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Volume contents

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OSTRACODOPHILI

FROM NAPLES 1963 TO ROME 2013
A BRIEF REVIEW OF HOW THE INTERNATIONAL RESEARCH GROUP ON OSTRACODA (IRGO) DEVELOPED AS A SOCIAL COMMUNICATION SYSTEM

The first international symposium on Ostracoda was held in Italy 50 years ago (10-19 June 1963) at the Stazione Zoologica di Napoli. The event was organised by Dr. Harbans Puri, a confirmed ostracodologist from the Florida Geological Survey, Tallahassee, and the young geologist Dr. Gioacchino Bonaduce who was appointed at the Zoological Station to cooperate with H. Puri on the revision of the ecological distribution of the ostracods in the Bay of Naples. The ostracod fauna of the bay was taxonomically well documented through the monographic study of G. W. MÜLLER (1894) but its ecology was poorly known. At the symposium 28 specialists attended, from which 23 were ostracodologists coming from 11 countries. During the 10 days, aspects related to morphology, ecology and to the taxonomic system of Recent and fossil ostracods were discussed. The presentations were followed by in-depth discussions from which emerged a general consensus of the necessity to create an international research group on Ostracoda which should keep contact through active communication and effective scientific exchanges of material and ideas. A volume edited by H. PURI (1964) collected 20 presentations and the round-table discussions grouped into seven sessions. The philosophy of this symposium and the logical outcome, of what is now known as the IRGO was in line with the general atmosphere of the modern ecological and evolutionary research being done at the beginning of the 1960ies in North America and in Europe.

It is pointed out that a part of the important advances in ostracod research during the last 50 years is due to the social relationships developed by ostracod practitioners within the IRGO as well as on the social and economic situation of particular historical moments. The way ostracodology developed depending *inter alia* on sociological aspects was until now seldom discussed. Early reviews dealing with the advancement of general and/or special topics of ostracodology, like those presented in other ISO meetings, dealt mainly with the ostracod research within a utilitarian perspective and with documentation of conceptual aspects. We have particularly in mind the introductory lectures presented during the ISO-8 1982 in Houston and ISO-9 in Shizuoka 1985, published in the volumes edited by R. MADDOCKS (1983) and by T. HANAI *et al.* (1988) respectively.

For the present review of the advancement of ostracodology related to its sociological context, we divided the time elapsed between the 1st and the 17th ISO events into three periods, namely a first one from the Naples meeting to about 1982 – 1985, a second one up to about 2003 – 2005, and the last one until the present day, 2013.

We emphasize that the reciprocal empathy of the participants for cooperation led during the first period to the initiation of important activities, namely the organisation of ISO meetings at 2-3 years intervals. Those of Hull organised by J. Neale in 1967 and the Pau meeting (1970) of H. J. Oertli, remained memorable in the history of ostracodology. The production of the quarterly newsletter, *The Ostracodologist,* by E. Gerry certainly improved communication and contributed to what G. Bonaduce so nicely named, "the large family of ostracodologists" (dictum expressed during the ISO-5, Hamburg 1974). Further on, confirmed scientists and their young students profited from these emulative activities which led to long-term research projects and collaborations. These aspects will be substantiated through examples. The success of research activities during the 1965-1985 phase is related to applied research in the oil industry as well as to the large interest in the exploration of the world deep sea domain by zoologists and palaeontologists. Ostracodologists profited also from the research politics within national and international programmes. Some of the actors who met at the first three ISO symposia were strong and gifted personalities who offered opportunities of research in their laboratories to a whole new young generation of students. Our presentation offers examples from European and North American research groups who obtained impressive results studying both marine ostracods from the Mediterranean Sea and/or the Atlantic and Pacific oceans or from non-marine environments of various continents.

The next period between 1985 and the beginning of the new century saw the development of a completely new direction of research, namely the importance of ostracod research for the oil industry diminished whereas the interest for environmental research on large topics like the study of global events and the long-term climate change increased. New research teams emerged using other methods. While in the former period methods for biostratigraphical research using ostracods were at a premium, during the next years methods based on the measurement of trace elements and isotopes in the valves of ostracods became increasingly common. Some of the new methods were developed through collaborative research where geochemists were in tied contact with ostracod specialists trained for (palaeo)ecology and/or zoology and palaeontology. Ostracodology, at least in Europe, profited from the science politics of the European Community where funds were offered to international teams working on large projects and where participants were asked to visit (reciprocally) their colleagues in the other labs. Some of these projects dealt with general biologic problems like the study of sexual/asexual reproduction of ostracods, as compared to other invertebrate groups, or the protection of aquatic environments at both local and regional scales. A third generation of ostracodologists grew during this time-period which now forms the basis for present-day research dynamics. Besides inter-laboratories activities we show that the increase of ostracod meetings additionally to the international one at a tri-annual rhythm became a new social phenomenon within the IRGO. The establishment of regular symposia at the European level, the EOM-s, alternating with the ISO-s and with the annual national meetings increased the possibility to communicate directly between specialists and complemented other activities based on rapidly developing electronic media. The field excursions especially became attractive for many participants and the national ostracod meetings became truly international through their widening participation.

Another aspect which has to be pointed out is the trend of the researchers dealing with Palaeozoic ostracods who since the Saalfelden-ISO had their own discussion-group, IRGPO. Gradually the merging of this latter group with those dealing with post-Palaeozoic ostracods at various meetings improved the communication between specialists and enlarged the general perception of evolutionary aspects of selected groups.

We choose for the beginning of the last period the 2003-2005 year – a moment when communication and meeting possibilities increased again. Note for instance that in 2003 besides the EOM meeting in Cuenca during the summer another ostracod meeting was organised during the autumn in U.S.A. within the annual convention of the G.S.A., and two years latter we had an ISO meeting in Berlin. R. Matzke-Karasz, K. Martens and M. Schudack at the 15th ISO offered a comprehensive review of the main achievements of previous ostracod research upon which one could see where more intensive investigations should be done. We confirm largely their analysis and point out that the major topics and projects existing during the previous period continued during this recent one but with a stronger development of intercontinental cooperation. The integration within the IRGO structures of colleagues from South America and Asia is clearly visible but more can be done in the future. If this represents a major success, we see also during these last years a regression in the number of ostracodologists, in many countries, and/or the closure of research laboratories, especially those related to micropalaeontology, where earlier we had dynamic research teams. Moreover, we note the increased difficulties for young and gifted students to get access to research funds and/or to long-term research positions.

Amongst topics of research which now became more fashionable, we cite the reconstruction of palaeoclimate using transfer functions, the building of large datasets of ostracod distributions for regional and intercontinental studies, and the implementation of actions which should lead to taxonomic harmonisation. Within this context we stress out the growing importance of the development of effective data bases for the existing ostracod information. We recognise the services of E. Kempf data base and more recent ones, the NODE, NANODe and OMEGA. Projects within which molecular biological techniques are routinely used, combined with sophisticated morphological information, expanded in their importance during this last period.

As our conclusion we present one of the activities which developed stepwise during the whole 50 year period, namely the way to describe or illustrate ostracods and to use this information with data on the environment within which ostracods lived or are still living. It started with discussions and steering committees in Naples, continued during the second period with the advent of SEM techniques and the proposal of "The new Palaeontography" of P. Sylvester-Bradley, leading nowadays to computer tomography and confocal laser scanning microscopy being used for ostracods. This offers new possibilities for communication and exchange of material without museums being obliged to loan unique specimens of high value. Also, geometric morphometrics is another way to visualise and to illustrate ostracods which change in space and through time.

We show also that for the documentation of the environment as perceived by ostracods and/or ostracodologists we have nowadays new possibilities for characterising subtle changes at various spatial and temporal scales.

Finally, we should mention the comment of the current President of the IRGO, Renate Matzke-Karasz, who wrote in her Ostracodophili report: "despite our luck to work in this new world allowing information exchange on so many different levels, in virtual rooms, using a plethora of information technologies, none of them will ever surpass the quality of discussions led in real rooms, among real people. There is no replacement for the sparkling debates taking place during conferences, the eye-to-eye talks among colleagues, the personal exchange of knowledge and expertise during a workshop, the magic beginners' feel when first meeting the persons behind those names known only from literature."[1]

We dedicate this presentation to the memory of our colleagues who left us during this long period, but who during their life gave a chance to many creative students to become "Ostracodophili". We should do the same before we will leave the ostracodology scene.

REFERENCES

HANAI T., IKEYA N. & ISHIZAKI K. (Eds.), 1988. Evolutionary biology of Ostracoda, its fundamentals and applications. Proceedings of the Ninth International Symposium on Ostracoda. *Developments in Palaeontology and Stratigraphy*, 11: 3-1356.

MÜLLER G.W., 1894. Die Ostracoden des Golf von Neapel und der angrenzenden Meeres-Abschnitte. *Fauna und Flora des Golf von Neapel, Monographie*, 21: 1-404.

PURI H. (Ed.), 1964. Ostracods as ecological and palaeoecological indicators. *Pubblicazioni della Stazione Zoologica di Napoli*, 33(Suppl.): 1-612.

MADDOCKS R. (Ed.), 1983. Applications of Ostracoda. Proceedings of the Eighth International Symposium on Ostracoda. Department of Geosciences, University of Huston, Texas: 1-677.

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[1] The presentation is based beside the literature surveyed also on the notes produced by the various members of the Ostracodophili-group, *inter alia* several short MSS which are very informative and optimally complement the review. For the final MS we intend to publish these additional MSS as "Supplementary Material" to the Review. They should be used and/or quoted under the name of their original author.

[2] Ostracodophili is the virtual name under which 35 ostracodologists invited by D. L. D. agreed to contribute to this topic with reports or with photographic documentation. Their names and affiliations will be presented when delivering the lecture at the ISO-17, in Rome.

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JOSEP ANTONI AGUILAR-ALBEROLA & FRANCESC MESQUITA-JOANES

THE HATCHING PROCESS IN CYPRIDIDAE OSTRACODS: MORPHOLOGY AND FUNCTION OF THE A-9 STAGE

Due to its unpredictability, the emergence of juvenile ostracods when hatching from the egg is very difficult to observe and therefore remains a poorly understood process. Remarkably, ROESSLER (1998) described it in detail, including a description of a prenauplius A-9 stage involved in hatching events of Cyprididae ostracods. To facilitate studying this event, we used a hypochlorite treatment that allowed observation of the interior of *Heterocypris* eggs in the later phases of embryo development (AGUILAR-ALBEROLA & MESQUITA-JOANES, in press). Some of the more mature treated eggs suffered premature hatching, permitting observation of the process in more detail. Inside the egg, the poorly known stage A-9 develops. This prenauplius stage has two pairs of limbs on the anterior chamber; the first are the antennules, while the second corresponds to the fused group of the antennae and mandibles, observed by checking homology by formation. This is apparently the first time that such fusion of the second and third pairs of appendages during development is described in crustaceans. On the caudal part of the A-9 stage we found a folded structure, herein called the RPB (Roessler Protruding Bursa), separated by a membrane from the anterior chamber. Before hatching, the moulting process starts (apolysis) leading to the formation of instar A-8 inside the egg. After the egg membrane breaks, the juvenile instar A-8, still inside the A-9 exoskeleton, emerges from the egg helped by the swelling of the RPB (Fig. 1), demonstrating that it is a necessary structure for the hatching process and therefore the A-9 exoskeleton is not merely a protective cover for the A-8 instar.

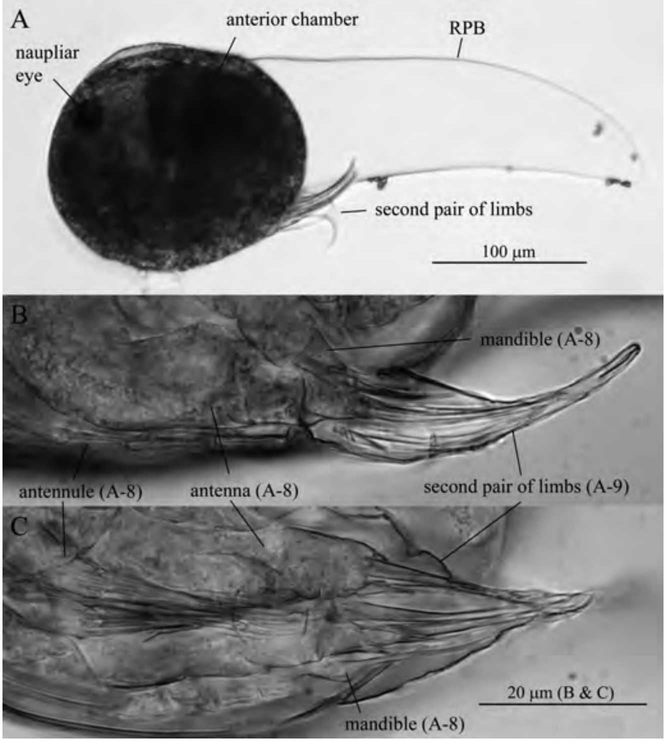

Fig. 1 — **A**, Lateral view of a *Heterocypris barbara* hatching stage, which corresponds to instar A-8 inside the anterior chamber of the A-9 stage, with the transparent Roessler Protruding Bursa (RPB) fully inflated. B-C, detail of the limbs of *Heterocypris bosniaca*, the outermost part corresponds to the cuticle of stage A-9, and inside the limbs of instar A-8 can be observed; **B**, lateral view; **C**, ventral view.

After a few minutes the moulting process finishes (ecdysis) through the emergence of a free A-8 instar from inside the A-9 remains.

REFERENCES

AGUILAR-ALBEROLA J.A. & MESQUITA-JOANES F., in press. Ontogeny of *Heterocypris bosniaca* (Ostracoda: Cyprididae): Description of postembryonic instars and rediscovery of the neglected A-9 stage. *J. Crust. Biol.*, 33.

ROESSLER E.W., 1998. On crucial developmental stages in podocopid ostracod ontogeny and their prenauplius as a missing link in crustacean phylogeny. *Arch. Hydrobiol. Spec. Issues Advanc. Limnol.*, 52: 535-547.

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GIUSEPPE AIELLO, DIANA BARRA & ROBERTA PARISI

VARIABILITY IN ORNAMENT AND SHAPE OF THE GENUS *UROCYTHEREIS* FROM A SOUTHERN ITALY BAY (IONIAN SEA)

High-degree variability in ostracod shell sculpture is a recurring problem experienced by authors dealing with studies of shallow marine assemblages. Seemingly well-distinct features occurring in some infralittoral ostracod taxa lead taxonomists either to propose a large number of specific names, which frequently have not stood the test of time, or to "lump" together very different forms.

During the study of the Recent ostracods of the La Strea Bay (AIELLO *et al.*, 2006) some hundreds of *Urocythereis* specimens were collected and assigned to three species: *U. margaritifera* (MÜLLER, 1894), *U. distinguenda* (NEVIANI, 1928) and *Urocythereis* sp. 1 (*sensu* BARRA, 1997). The presence of shells exhibiting transitional characters between the former two species (then included in *U. margaritifera*) indicated an unsolved taxonomic issue. The uncertain taxonomy of *Urocythereis* is due to the variability of the shell ornamentation and consequently species limits within the genus remain partly ambiguous.

To solve this problem, we have used two different methods of morphological analyses to assess how many species of *Urocythereis* inhabit the Recent bottom sediments of the La Strea Bay. One method is the comparison of ornament morphology, taking into special account the features of the reticulation. The other method is the morphometric analysis of the outline, by means of the computer program Morphomatica (LINHART *et al.*, 2006).

Analyses of reticulation patterns in Hemicytheridae and Trachyleberididae were originally undertaken by LIEBAU (1969, 1971) and BENSON (1971,

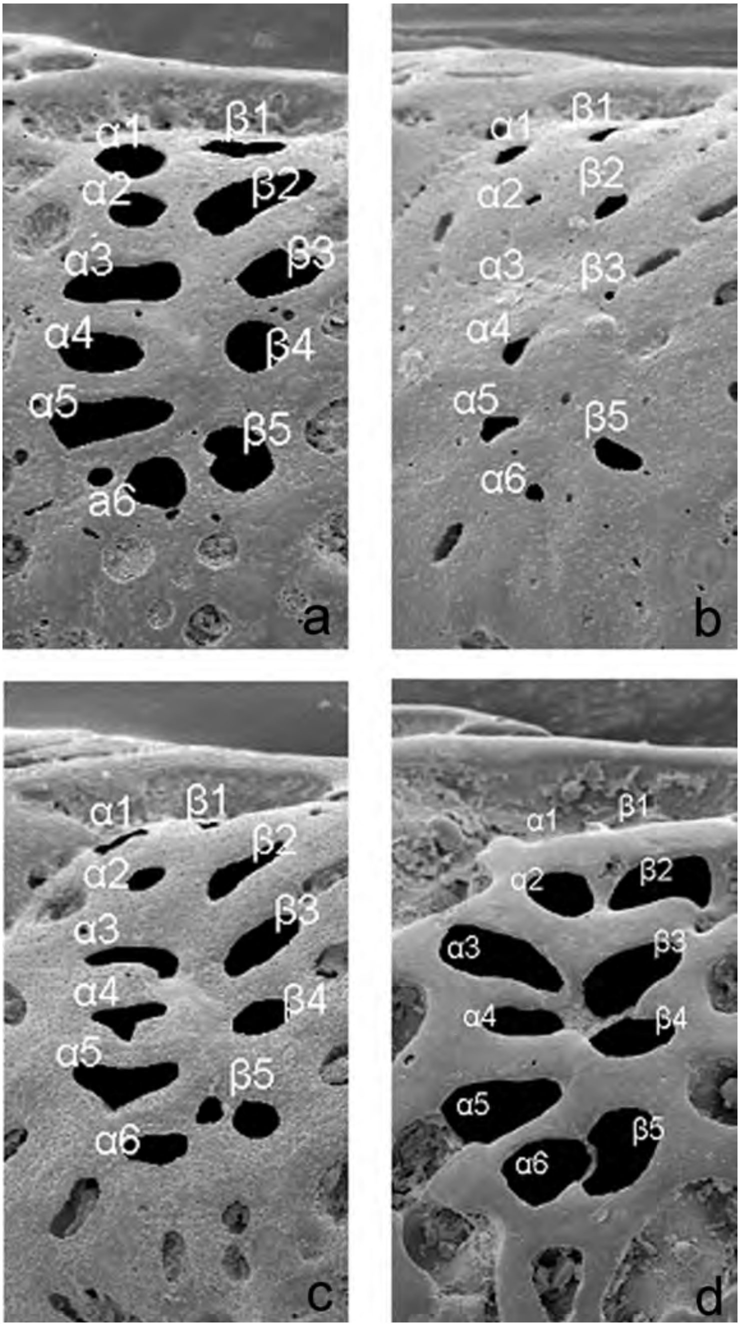

Fig. 1 — Dorsal median group of fossae in *U. margaritifera* (**a**), *U. distinguenda* (**b**), *U.? margaritifera* (**c**) e *Urocythereis* sp. 1 (**d**)

1972), evidencing the relevance of homologous structures for systematics and evolution studies. OKADA (1981, 1982) clarified the relationship between epidermal cells and reticulation meshes, and observed that in the specimens pertaining to the same species the structure of the fossae/muri system is steady.

In order to evaluate the variability range of the ornament features in *Urocythereis*, we have selected five areas where homologous fossae-muri can be recognized in the three forms ("species"). Such areas are: the pre-ocular area, the two concentric rows of fossae running parallel to the anterior margin, the antero-median group of three fossae just behind them, the dorsal median group (ATHERSUCH, 1977) situated between the post-ocular sinus and the sub-central area (Fig. 1) and the caudal group.

Some groups of fossae are relatively steady while others can vary in shape or in number of fossae (by subdivision). Celation, the development of an outer layer of calcite overlapping the reticulation (SYLVESTER-BRADLEY & BENSON, 1971) is a morphological disturbance able to hide some features, in part or completely.

Fossal pattern variations have been compared with shape analysis obtained through Morphomatica, an user-friendly computer programme designed for the morphometric analysis of the ostracod outline.

Results seem to indicate that the combined study of outline and ornament variability would be a useful tool for species discrimination.

REFERENCES

AIELLO G., BARRA D., COPPA M.G., VALENTE A & ZENI F., 2006. Recent infralittoral Foraminiferida and Ostracoda from the Porto Cesareo Lagoon (Ionian Sea, Mediterranean). *Boll. Soc. Paleont. It.*, 45 (1): 1-14.

ATHERSUCH J., 1977. The genus *Urocythereis* (Crustacea: Ostracoda) in Europe, with particular reference to Recent Mediterranean species. *Bull. Br. Mus. Nat. Hist. (Zoology)*, 32 (7): 247-283.

BARRA D., 1997. The shallow water marine ostracods of Tripoli (Lybia) and their geographical distribution in the Mediterranean. *Rev. Españ. Micropaleont.*, 29 (3): 71-106.

BENSON R.H., 1971. A new Cenozoic deep-sea genus, *Abyssocythere* (Crustacea: Ostracoda: Trachyleberididae), with descriptions of five new species. *Smithsonian contributions to paleobiology*, 7: 1-25.

BENSON R.H., 1972. The *Bradleya* Problem with descriptions of two new psychrospheric ostracode genera, *Agrenocythere* and *Poseidonamicus* (Ostracoda: Crustacea). *Smithsonian Contributions to Paleobiology*, 12: 1-138.

LIEBAU A., 1969. Homologisierende Korrelationen von Trachyleberididen-Ornamenten (Ostracoda, Cytheracea). *Neues Jahrb. Geol. Paleont.,* 7: 390–402.

LIEBAU A., 1971. Homologous Sculpture Patterns in Trachyleberididae and Related Ostracods. *Nolit Publ. House,* Belgrade, 92 pp.

LINHART J., BRAUNEIS W, NEUBAUER W. & DANIELOPOL D.L., 2006. Morphomatica, Computer Program Version 1.6. (http://palstrat.uni-graz.at/morphomatica/morphomatica_e.htm), Graz.

MÜLLER G.W., 1894. Die Ostracoden des Golfes von Neapel und der angrenzenden Meeres-Abschnitte. Fauna und Flora des Golfes von Neapel und der angrenzenden Meeres-Abschnitte. *Herausg. Zool. Station Neapel,* 21 (1-8): 1-404, pl. 40.

NEVIANI A., 1928. Ostracodi fossili d'Italia. 1: Vallebiaja (Calabriano). *Mem. Pont. Acc. Sci. Nuovi Lincei*, 81: 123-132.

OKADA Y., 1981. Development of Cell Arrangement in Ostracod Carapaces. *Paleobiology,* 7 (2): 276-280.

OKADA Y., 1982. Structure and cuticle formation of the reticulated carapace of the ostracode. *Bicornucythere bisanensis*. *Lethaia*, 15: 85- 101.

SYLVESTER-BRADLEY P.C. & BENSON R.H., 1971. Terminology for surface features in ornate ostracodes. *Lethaia*, 4: 249-286.

Authors' Addresses — G. AIELLO, D. BARRA, R. PARISI, Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse, University of Naples Federico II, L.go San Marcellino, 10 - 80138 Napoli (Italy); e-mail: ai64llo@hotmail.com; dibarra@unina.it; roberta.parisi@unina.it.

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DERYA AKDEMIR & OKAN KÜLKÖYLÜOĞLU

ON THE RELATIONSHIP BETWEEN CLIMATIC CHANGES AND ECOLOGY OF OSTRACODS IN HATAY REGION, TURKEY

This study was performed to determine distribution and ecological characteristics of recent freshwater ostracods from Hatay region which is located at the most southern part of Turkey. Samples were collected from 70 stations with 12 different habitat types (lake, dam, pond, pool, through, ditches, irrigation canal, creek, stream, river, waterfall and spring) from almost sea level 11m to 740 m of altitude during the summer of 2012. Totally, 19 recent freshwater ostracod species were found and 14 of them (*Darwinula stevensoni, Candona neglecta, Pseudocandona albicans, Cypridopsis vidua, Prionocypris zenkeri, Ilyocypris inermis, I. monstrifica, Herpetocypris intermedia, Psychrodromus olivaceus, P. fontinalis, Potamocypris fallax, P. variegata, Zonocypris costata, Limnocythere stationis*) were reported as new for the region. In order to assess the relation between species and environmental variables, a Canonical Correspondence Analysis (CCA) was performed. The second axis of CCA explained 79.7% of the cumulative variance of the relationship between 12 species and five environmental variables (elevation, pH, dissolved oxygen, electrical conductivity, and water temperature). Accordingly, water temperature ($p = 0.002$, $f = 4.327$) and electrical conductivity ($p = 0.014$, $f= 2.562$) were the most effective two factors on species ($p < 0.05$). Generally, ecological tolerance and optimum estimates of species with wide distribution were relatively higher than the mean of those species. Estimating optimum and tolerance values of species revealed that *Herpetocypris chevreuxi* displayed lowest tolerance value for water temperature while *Cypridopsis vidua* showed the highest value. If the studies showing air temperatures of southern regions of

Turkey have a tendency to increase as well as the scenarios forecasting increased air temperature in Mediterranean basin in future are considered, Hatay will be under the threat of such climatic changes since it is part of this region. Thus, under these circumstances, it is assumed that any change in ambient temperature will eventually cause alteration in water bodies. If current climatic scenarios are acceptable and correct, species with lower tolerance values will be critically affected from such changes. Future possibilities are discussed for those ostracod species.

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Lailah Gifty Akita, Peter Frenzel & Nicole Börner

THE RECENT OSTRACOD FAUNA OF THE TANGRA YUMCO LAKE SYSTEM, CENTRAL TIBETAN PLATEAU

The Tibetan Plateau is source area for most of the large southern and eastern Asian rivers providing water for a large part of the world's population. Water availability on the plateau is mainly driven by the Indian and South-East Asian monsoon systems. Understanding the processes influencing these systems is crucial for a sustainable water management on the background of climate change showing a serious impact onto the environmentally sensitive Tibetan Plateau. Reconstruction of past hydrological changes provides the data base for process understanding and climate modelling. One of the best geo-archives for this purpose are lake sediments. Beside sedimentological and geochemical proxies, microfossils are a powerful tool for palaeoenvironmental analysis because they are sensitive for a range of environmental factors and may integrate their effects. We are studying Ostracoda, the most important zoological microfossil group in lakes on the Tibetan Plateau.

One of our main study areas is the Tangra Yumco lake system consisting of Tangqun Co, Tangra Yumco and Xuru Co on the central Tibetan Plateau (N 31°6'; E 86°36') in altitudes of 4469 m, 4540 m and 4719 m asl. Tangra Yumco is one of the five largest lakes of the Tibetan Plateau covering 818 km^2. Xuru Co (152 km^2) and Tangqun Co (63 km^2) are considerably smaller. Tangra Yumco and Xuru Co are deep with 223 m respectively c. 210 m. Ancient shorelines and lake terraces indicate past lake levels more than 200 m higher than today. The remnant lake Tangqun Co has a salinity of about 100 ‰, and the larger lakes Tangra Yumco and Xuru Co have salinities of 8.3 ‰ and 3.2

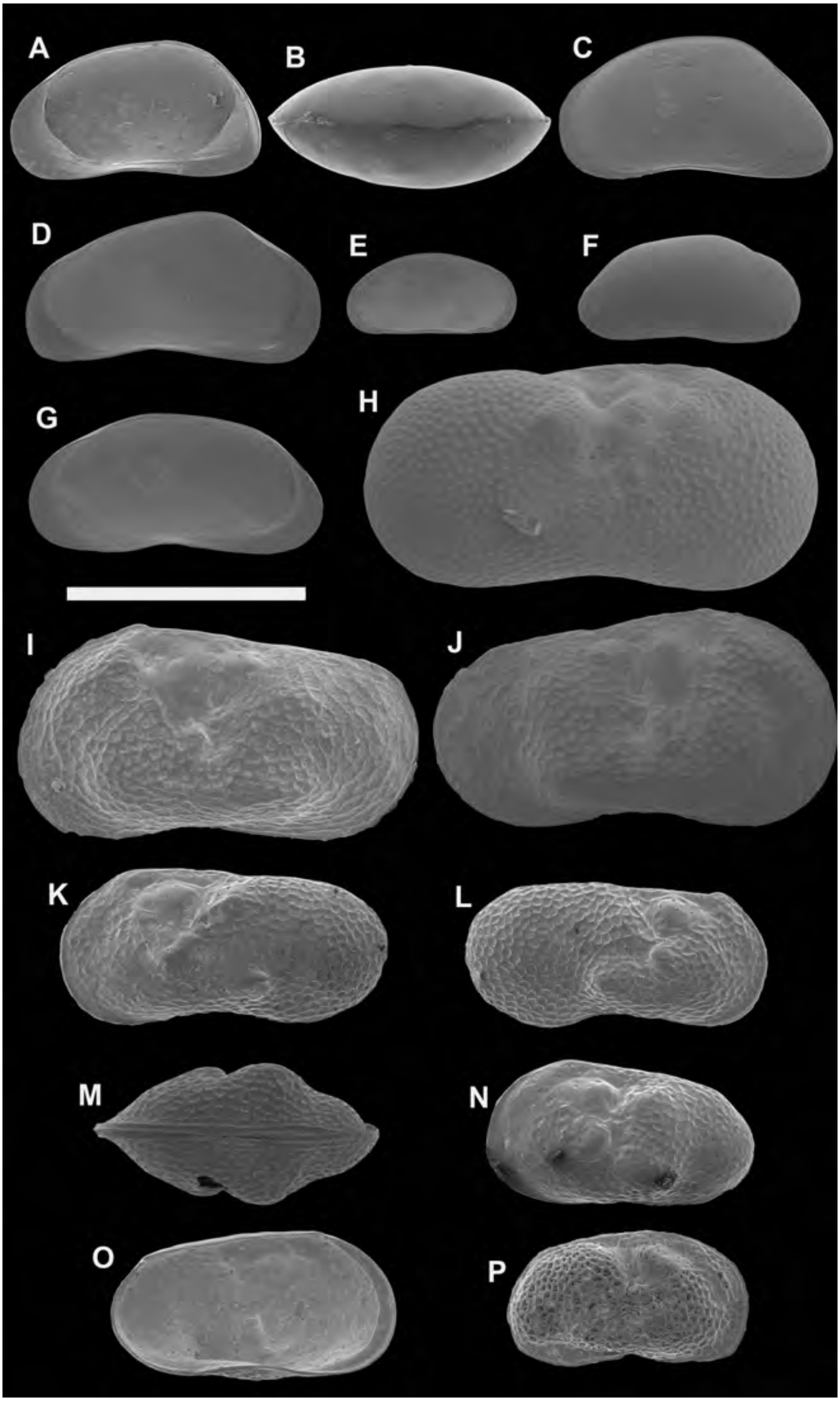
‰. The lakes represent a hydrologically closed basins. The water is characterised by a high alkalinity and a pH above 9.0.

As a base for later core and outcrop analyses providing data for the reconstruction of the evolution of the lake system, a survey of the Recent ostracod fauna was carried out in 2009 – 2012. For documenting species distribution and driving environmental factors, we collected sediment surface samples from c. 150 stations within the lakes and their catchment including rivers, ponds, wetlands and springs. The lake samples cover a water depth range of 0 to 223 m in Tangra Yumco. Lake samples were taken using a box corer and Ekman grab, and samples from smaller water bodies by using a hand-net. Samples were and preserved in 70% ethanol for distinguishing between living and dead individuals and for later soft-part analysis. The habitats were described and water parameters measured. Associated water sample was analysed for major cations and anions later in the lab. The sieve residue >200 m was picked and counted for living ostracods and empty shells separately. Multivariate statistics allow an evaluation of ostracod distribution and its driving environmental factors.

Except Tangqun Co, where ostracods are lacking because of a very high salinity, all lake sediments contain plenty of ostracods (Fig. 1). They are characterised by the dominating species *Leucocytherella sinensis, Leucocythere? dorsotuberosa* and *Limnocythere inopinata.* Rarer are *Fabaeformiscandona gyirongensis* and *Candona xizangensis*, despite reaching high dominances in some phytal habitats. Typical species of inflowing rivers and ponds are *Tonnacypris gyirongensis, Ilyocypris* cf. *I. mongolica* and *Candona candida. Ilyocypris.* cf. *I. mongolica* can be found relatively often but in small numbers as allochthonous component in lake sediments probably transported by inflow-

Fig. 1 — Key Recent ostracod species of the Tangra Yumco lake system. **A,** *Candona candida,* female RV (length: 1051 μm), external view, sample TiP11 75B; **B,** *Candona candida,* carapace (length: 1190 μm), dorsal view (anterior on the left side), sample TiP11 18; **C,** *Candona xizangensis* female RV (length: 1150 μm), internal view, sample TiP11 67C; **D,** *Fabaeformiscandona gyirongensis,* male RV (length: 1240 μm), external view, sample TiP11 67C; **E,** *Fabaeformiscandona gyirongensis* juvenile RV (length: 715 μm), internal view, sample TiP11 69; **F,** *Tonnacypris gyirongensis* RV (length: 933 μm) external view, sample TiP11 67C; **G,** *Tonnacypris gyirongensis* RV (length: 1237 μm), internal view, sample TiP11 29; **H,** *Ilyocypris* cf. *I. mongolica* RV (length: 953 μm), external view, sample TiP11 67C; **I,** *Leucocythere? dorsotuberosa,* LV (length: 839 μm), external view, sample TiP11 2; **J,** *Leucocythere? dorsotuberosa,* RV (length: 845 μm), external view, sample TiP11 67C; **K,** *Leucocytherella sinesis,* male LV (length: 687 μm), external view, sample TiP11 2; **L,** *Leucocytherella sinesis,* male RV (length: 636 μm), external view, sample TiP11 2; **M,** *Leucocytherella sinesis,* female carapace (length: 601 μm), ventral view, sample TiP11 25; **N,** *Leucocytherella sinesis,* female LV (length: 564 μm), external view, sample TiP11 4; **O,** *Leucocytherella sinesis,* female LV (length: 599 μm), internal view, sample TiP11 4; **P,** *Leucocytherella sinesis,* female RV (length: 509 μm), external view, sample TiP11 2. White bar corresponds to 1 mm for A.–G. and 0.5 mm for H.-P.

Fig. 1



ing river water superposing the lake water because of its lower density. *Tonnacypris gyirongensis* also frequently occurs in springs. *Limnocythere inopinata* is characteristic for the epilimnion of the lakes, whereas *L.? dorsotuberosa* prefers the profundal and *L. sinensis* seems to apparently an opportunistic species. Main driving environmental factor for the studied ostracod distribution is the type of water body and associated water chemistry. The sampling scheme along a water depth transect enables the set-up of an ostracod-based water depth transfer function to be used in lake level reconstructions of the recent past. Characteristic associations allow to distinguish habitat changes within the Late Quaternary.

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Cláudio Magalhães de Almeida & Dermeval Aparecido Do Carmo

TAXONOMY AND PALAEOENVIRONMENTAL EVOLUTION OF LATE CRETACEOUS OSTRACODES FROM OFFSHORE SANTOS BASIN, SOUTHERN CONTINENTAL MARGIN, BRAZIL

The Santos basin is an offshore basin located in São Paulo, Paraná and Santa Catarina states in the southern continental margin of Brazil. One hundred twenty cutting samples from three wells were analysed, two located on the shelf (1-SPS-5A and 1-SPS-9), and one on the slope (1-SCS-9A). A total of 35 species were identified. Of the 35 species, 21 are marine, six are limnic, and eight remain in open nomenclature. The marine species are *Protocosta struevae* Bertels, 1969, *Argilloecia tenuis* Ciampo, 1981, *Cythereis rionegrensis* Bertels, 1975, *Soudanella* sp. 1, *Soudanella* sp. 2, *Soudanella* sp. 3, *Soudanella* sp. 4, *Majungaella* sp. 1, *Majungaella* sp. 2, *Protocosta* sp., *Buntonia* sp., *Parakrite* sp., *Brachycythere* sp. ?*Parakrite* sp., *Neonesidea* sp. 1, *Neonesidea* sp. 2, *Neonesidea* sp. 3, *Neonesidea* sp. 4, *Cytherella* sp., *Rostrocytheridae* sp. and ?*Rostrocytheridea* sp. The limnic species are *Dolerocypris kinkoensis* Grekoff, 1960, *Allenocytheridea lobulata* Ballent, 1980, *Candona* sp., *Cetacella* sp., ?*Fabanella* sp. and ?*Vernoniella* sp. The species in open nomenclature are Gen. 1 sp., Gen. 2 sp., Gen. 3. sp., Gen. 4 sp., Gen. 5 sp., Gen. 6 sp., Gen. 7 sp. and Gen 8 sp.

In these wells 1-SPS-5A, 1-SPS-9 and 1-SCS-9A marine and limnetic depositional intervals are noted. These paleoenvironmental inferences are based on occurrences of species of Ostracoda and Carophytes. Based on occurrences of *Soudanella* sp. 1, sp 2, sp. 3 and sp. 4 and *Majungaella* sp. 1 and sp. 2 a deposition under marine conditions for the interval Coniaciano-Santonian for all the studied wells can be suppodes. In this cronostratigraphic interval only the well 1-SPS-9 presents occurrences of carophytes, so under limnetic conditions. The Campanian occurrences of Ostracoda species are restricted to well 1-SCS-9A. In this well, in the lower Campanian the occurence of *Soudanella* sp. 1, *S.* sp. 2, *S.* sp. 3, and *S.* sp. 4 and *Majungaella* sp. 2 indicates marine conditions. In the upper Campanian, *Candona* sp. indicates limnetic influence. The lower Maastrichtian occurrences of Ostracoda species are restricted to wells 1-SPS-5A and 1-SCS-9A. The limnic species *Alenocytheridea lobulata* is restricted to well 1-SPS-5A indicating limnetic influence in the base of this stratigraphic interval. *Dolerocypris kinkoensis* occurrs at both wells, at the top of this stratigraphic interval, indicating limnetic influences towards the upper part of interval, just after the last occurrences of *Brachycythere* sp. that is indicating marine conditions. The upper Maastrichtian occurrences of Ostracoda species are restricted to wells 1- SPS-5A and 1-SPS-9. In this interval, *Cythereis rionegrensis*, *Protocosta struveae*, *Buntonia* sp. and *Rostrocytheridea* sp. indicate deposition under essentially conditions marine. In perspective of work, there is the need for further studies of taxonomic and stratigraphic distribution with the goal establish a zonation based on ostracodes referred to the sections.

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Cláudio Magalhães de Almeida & Dermeval Aparecido Do Carmo

THE FIRST OSTRACOD SPECIES OF PERMIAN/?TRIASSIC FROM PARANÁ BASIN, CENTRAL BRAZIL

Taxonomic and relative dating investigations of Permian/Triassic strata in Brazil have traditionally been focused on macrofossils and palynomorphs recovered from Irati and Corumbataí formations, Paraná basin. Herein, eight species of Permian/?Lower Triassic from Irati and Corumbataí formations in Goiás State are identified: *Liuzhinia antalyaensis* Crasquin-Soleau, 2004, *Bairdiacypris* sp. 1, *Bairdiacypris* sp. 2, *Praepilatina* sp., *Basslerella* sp., *Roundyella*? sp., *Bairdia*? sp and Gen. A sp. The two new species are the first species recovered in Brazil formally described from the Permian/?Triassic boundary. Only *Bairdiacypris* sp. 2 occurs in both formations, the other seven species are restricted to the Corumbataí Formation. Based in the pattern of their occurrence, a marine palaeoenvironment is inferred for these portions of studied formations. The occurrence of *Liuzhinia antalyaensis*, a fossil-index for Lower Triassic, is restricted to Corumbataí Formation and suggests a Lower Triassic age at least for upper part of this formaion. Other palaeontological data corroborate this dating, e.g. the fish *Xenancanthus moorei* Woodward, 1889, and other, as palynomorphs fails. So this is a first biostratigraphic data based on Ostracoda and for the future new areas are planned to be studied in order to increase the knowledge of fauna and estimate the age.

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Carlos A. Alvarez Zarikian

OSTRACODA IN DEEP OCEAN CENOZOIC PALEOCEANOGRAPHY: FROM REGIONS OF DEEP WATER FORMATION TO ULTRAOLIGOTROPHIC ENVIRONMENTS

Ostracoda are, after benthic foraminifera, the second most abundant benthic calcareous microfossils found in deep sea sediments, yet their environmental preferences in bathyal to abyssal environs are less well known. Studies have shown that organic flux to the sea floor, bottom water chemistry and sediment characteristics strongly influence faunal densities, assemblage composition and diversity (e.g., Corrége, 1993; Ayress *et al.*, 1997; Mazzini, 2004; Yasuhara *et al.*, 2012). Epifaunal species require oxygen and labile food and some may prefer relatively oligotrophic environments, while some infaunal species can tolerate dysaerobic conditions and flourish in relatively eutrophic environments. Based on what is known about ostracod's ecological preferences, assemblage based studies have been applied successfully to reconstructions of past ocean conditions over millennial to orbital timescales and during major Cenozoic climatic and oceanic events (e.g., Benson *et al.*, 1984; Whatley & Coles, 1991; Cronin & Raymo, 1997; Cronin et al., 1999; Didié & Bauch, 2000; Majoran & Dingle, 2001a, 2001b; Didié *et al.*, 2002; Zhao, 2005; Yasuhara & Cronin, 2008; Alvarez Zarikian *et al.*, 2009; Yamaguchi & Norris, 2012; Yasuhara *et al.*, 2009, 2012). Here I present results from recent studies that use ostracoda to reconstruct deep water circulation patterns in the supolar North Atlantic during the late Quaternary (IODP Site U1314) and abyssal environmental conditions in the South Pacific Gyre (SPG) during the early Paleocene, Oligocene, and Miocene (IODP Sites U1367, U1368 and U1370).

North Atlantic Study: Site U1314 is located on the southern Gardar sediment drift at 2820 m water depth in the eastern flank of the Reykjanes Ridge south of Iceland. The sediment drift was formed by the interaction of Iceland-Scotland Overflow Water (ISOW) and local topography. Today, the location of Site U1314 is influenced mostly by ISOW with a minor component of Lower Deep Water (LDW). During the last glacial period, the site was bathed mainly by LDW (OPPO & LEHMAN, 1995; HODELL *et al.*, 2009), which is sourced from the Southern Ocean as reflected by its high silica content (MCCARTNEY, 1992). Its location, which is also close enough to the ice-rafted debris (IRD) belt, makes Site U1314 ideal for reconstructing North Atlantic Deep Water formation and monitoring ice sheet instability (CHANNELL *et al.*, 2010). Ostracods at Site U1314 are generally well preserved and range in abundance from 1 to >200 valves per 20 cm^3 sample. The overall assemblage includes >75 species. Species richness varies from 1 to 21 species per sample. The late Pleistocene record yielded the following major deep-sea genera: *Krithe* (dominant), *Rockallia*, *Cytheropteron, Henryhowella, Pennyella, Legitimocythere, Argilloecia, Echinocythereis* and *Pseudobosquetina*. Our results show that variability in ostracod preservation, population density, species richness and assemblage composition are coeval with glacial/interglacial-scale deep-water circulation changes. Moreover, individual ostracod taxa are associated with time intervals characterized by the influence of distinct deep water masses and prevailing climatic and oceanographic conditions. The genera *Pennyella, Argilloecia, Ambocythere, Pelecocythere, Echinocythereis* and *Bradleya* predominate during interglacials or interstadials, when the site was under the influence of NADW. *Rockallia* is nearly absent during full interglacial periods and most abundant during climate transitions. Likewise, *Cytheropteron* is strongly associated with deglaciations, while *Abyssocythere atlantica*, *Polycope* spp., *Dutoitella suhmi* and *Profundobythere bathytatos* are restricted to glacial and stadial intervals when the site was under the influence of LDW.

The South Pacific Gyre Study: The SPG is the largest of the ocean gyres. Its center is farther from continents and productive ocean regions than the center of any other gyre, and is considered Earth's largest oceanic desert. Sites U1367 (4289 m water depth) and U1368 (3740 m water depth) are located near the center of the SPG along ~26° S latitude, whereas Site U1370 (5074 m water depth) is located in the southwestern region of the SPG at 41° S latitude. These sites were chosen to study the nature of the ostracod assemblages in the most organic-poor sediment of the world ocean and to assess how these assemblages vary through time and with depth as the sites have moved from the ridge crest to the abyssal plain. Samples obtained from these sites have yielded rich ostracod assemblages. The Oligocene ostracod assemblage

(U1367) consists of a diverse fauna with a higher relative abundance of the genera *Krithe, Poseidonamicus, Argilloecia* and *Cytheropteron*. The overall ostracod assemblage suggests increased food supply to the ocean floor during the early Oligocene. The Miocene ostracod assemblage (U1368) is much less diverse. It is dominated by *Krithe* and characterized by significantly lower abundances of *Cytheropteron* and *Argilloecia*. The overall assemblage suggests more oligotrophic conditions and a fauna more adapted to the corrosive bottom waters. The Danian ostracod assemblage observed at Site U1370 is significantly different than those at the younger sediment records. Ostracod preservation and their stratigraphic distribution are affected by the position of each site with respect to the lysocline and the calcium carbonate compensation depth (CCD) at the time of deposition. Lithology shifts from carbonate ooze to metalliferous clay observed at the studied sites mark the time that the sites subsided beneath the South Pacific CCD as the underlying basement cooled with age. At Site U1370, the Danian carbonate ooze is most simply interpreted as resulting from the CCD diving to greater water depth than the water depth of this site during the early Paleocene interval of low planktonic carbonate production and low organic flux to the seafloor.

REFERENCES

Alvarez Zarikian C.A., Stepanova A.Y. & Grützner J., 2009. Glacial-interglacial variability in deep sea ostracod assemblage composition at IODP Site U1314 in the subpolar North Atlantic. *Marine Geology*, 258: 69-87, doi: 10.1016/j.margeo.2008.11.009.

Ayress M.A., Neil H., Passlow V. & Swanson K., 1997. Benthonic ostracods and deep water-masses: a qualitative comparison of Southwest Pacific, Southern and Atlantic Oceans. *Palaeogeography, Palaeoclimatology, Palaeoecology,* 131: 287-302.

Benson R.H., Chapman R.E. & Deck. L.T., 1984. Paleoceanographic events and deep-sea ostracodes. *Science*, 224: 1334-1336.

Channell, J.E.T., Sato, T., Kanamatsu, T., Stein, R., & Alvarez Zarikian, C.A., 2010. Expedition 303/306 synthesis: North Atlantic climate. In Channell J.E.T., Kanamatsu T., Sato T., Stein R., Alvarez Zarikian C.A., Malone M.J. & the Expedition 303/306 Scientists, Proc. IODP, 303/306: College Station, TX (Integrated Ocean Drilling Program Management International, Inc.). doi:10.2204/iodp.proc.303306.214.2010.

Corrége T., 1993. The relationship between water masses and benthic ostracod assemblages in the western Coral Sea, Southwest Pacific. *Palaeogeography, Palaeoclimatology, Palaeoecology,* 105: 245-266.

Cronin T.M., DeMartino D.M., Dwyer G.S. & Rodriguez-Lázaro, J., 1999. Deep-sea ostracode species diversity: response to late Quaternary climate change. *Marine Micropaleontology,* 37: 231-249.

Cronin T.M. & Raymo M.E., 1997. Orbital forcing of deep-sea benthic species diversity. *Nature,* 385: 624-627.

Didié C. & Bauch H.A., 2000. Species composition and glacialinterglacial variations in the ostracode fauna of the northeast Atlantic during the past 200,000 yr. *Marine Micropaleontology*, 40:105-129.

DIDIÉ C., BAUCH H.A. & HELMKE J.P., 2002. Late Quaternary deepsea ostracodes in the polar and subpolar North Atlantic: paleoecological and paleoenvironmental implications. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 184:195-212.

HODELL D.A., MINTH E.K., CURTIS, J.H., MCCAVE, I.N., HALL I.R., CHANNELL J.E.T. & XUAN C., 2009. Surface and deep-water hydrography on Gardar Drift (Iceland Basin) during the last interglacial period. *Earth and Planetary Science Letters,* 288: 10-19.

MAJORAN S. & DINGLE R.V., 2001a. Cenozoic deep-sea ostracods from southwestern South Atlantic (DSDP/ODP Sites 329, 513 and 699). *Revista Española de Micropaleontología*, 33:205-215.

MAJORAN S. & DINGLE R.V., 2001b. Palaeoceanographical changes recorded by Cenozoic deep-sea ostracod assemblages from the South Atlantic and the Southern Ocean (ODP Sites 1087 and 1088). *Lethaia*, 34:63-83.

MAZZINI I., 2004. Quaternary benthic Ostracoda from the Tasman Sea: distribution patterns within circumpolar deepwaters. *Bollettino della Societá Paleontologica Italiana,* 43: 217-224.

MCCARTNEY M.S., 1992. Recirculating components of the deep boundary current of the northern North Atlantic. *Progress in Oceanography,* 29: 283-383.

OPPO D.W. & LEHMAN S.J., 1995. Suborbital timescale variability of North Atlantic Deep Water during the past 200,000 years. *Paleoceanography,* 10 (5): 901-910.

WHATLEY R.C. & COLES G.P., 1991. Global change and the biostratigraphy of North Atlantic Cainozoic deep water Ostracoda. *Journal of Micropalaeontology*, 9: 119-132.

YAMAGUCHI T. & NORRIS R., 2012. Deep-sea ostracode turnovers through the Paleocene–Eocene thermal maximum in DSDP Site 401, Bay of Biscay, North Atlantic. *Marine Micropaleontology,* 86–87: 32-44.

YASUHARA M. & CRONIN T.M., 2008. Climatic influences on deep-sea ostracode (Crustacea) diversity for the last three million years. *Ecology*, 89: S52-S65.

YASUHARA M., CRONIN T.M., HUNT G. & HODELL D., 2009. Deep-sea ostracods from the South Atlantic sector of the Southern Ocean during the last 370,000 years. J*ournal of Paleontology*, 83(6): 2009, pp. 914-930.

YASUHARA M., HUNT G., VAN DIJKEN G., ARRIGO K.R., CRONIN T.M. & WOLLENBURG J.E., 2012. Patterns and controlling factors of species diversity in the Arctic Ocean. *Journal of Biogeography*, 39: 2081-2088.

ZHAO Q., 2005. Late Cainozoic ostracod faunas and paleoenvironmental changes at ODP Site 1148, South China Sea. *Marine Micropaleontology*, 54: 27-47.

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Lucas Antonietto, Anna Abrahão,
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TAXONOMIC, BIOSTRATIGRAPHIC AND PALAEOZOOGEOGRAPHIC ASPECTS OF *AMPHICYTHERURA* BUTLER & JONES, 1957 AND *ARACAJUIA* KRÖMMELBEIN, 1967
(*Cytheridae Schizocytherinae*)

The present work is based on a population of *Aracajuia benderi* Krömmelbein, 1967 isolated from the sample MP-291, collected at "Porto dos Barcos 3" outcrop (type-locality of the genus *Aracajuia* Krömmelbein, 1967) (Krömmelbein, 1967), Taquarí Member, Riachuelo Formation, Sergipe-Alagoas basin, northeastern Brazil. Our purpose is to reevaluate the taxonomic status of the genera *Amphicytherura* Butler & Jones, 1957, *Sondagella* Dingle, 1969 (originally a subgenus of *Amphicytherura*) and specially *Aracajuia*, along with its type-species, *Aracajuia benderi*. The authors also intend to review most of the palaeozoogeography and stratigraphic distribution of these genera, so as to infer migration pathway histories for their species.

Following the taxonomic review, the genera *Amphicytherura* and *Aracajuia* received new diagnoses. Some species currently assembled to *Amphicytherura* actually do not resemble its type-species, *Amphicytherura dubia* (Israelsky, 1929) (Butler & Jones, 1957); therefore, they should be placed in other existing genera, or possible new ones. *Sondagella*, due to its similarities to *Aracajuia*, and according to the principle of priority, was put into synonymy with the last.

Aracajuia benderi, which is the type-species of *Aracajuia* (Krömmelbein, 1967), was also re-diagnosed and re-described, based on SEM photography. Specimens attributed to this species had their height and length measured, and the results were used to analyse the ontogenetic development of the species. The occurrence of *Aracajuia benderi* is considered a stratigraphic marker of late Aptian–Albian sequences in the Sergipe-Alagoas basin

(VIVIERS *et al.*, 2000). A zone and a subzone were established based on this species, although both originally were named *Amphicytherura benderi*. The present authors propose a new combination to name these zones, *Aracajuia benderi* n. comb.

Although morphologically similar, *Amphicytherura* and *Aracajuia* present very distinct evolutionary histories. Occurrences of *Aracajuia* are mostly linked to the evolution of Gondwana, where it was observed in similar levels of diversity throughout tropical/arid and possibly warm temperate coasts of the palaeocontinent. Few exceptions were the occurrences in "paratropical" areas of ancient European portions of Laurasia. Its greatest diversity occurred during the Albian. The genus *Amphicytherura* is restricted to the Upper Cretacous and Paleocene. It was observed in warm temperate and possibly "paratropical" waters along the North Atlantic coasts of Europe and North America. The specific abundance of the genus peaked in the Maastrichtian, but *Amphicytherura* was still represented in the Paleocene–Eocene, when it ranged from Eastern Europe to Western Asia. Species currently placed in *Amphicytherura* which might belong to other genera or possible new ones were not considered in the present paleoecological analysis, and should be addressed properly elsewhere.

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REFERENCES

BUTLER E.A. & JONES D.E., 1957. Cretaceous ostracoda of Prothro and Rayburns Salt Domes, Bienville Parish, Louisiana. *Bulletin of the Louisiana Geological Survey*, 32: 1-65.

KRÖMMELBEIN K., 1967. Ostracoden aus der marinen "Küsten-Kreide" Brasiliens. 2: *Sergipella transatlantica* n. g., n. sp., und *Aracajuia benderi* n. g., n. sp., aus dem Ober Aptium/Albium. *Senckenbergiana lethaea*, 48: 525-533.

VIVIERS M.C., KOUTSOUKOS E.A.M., SILVA-TELLES JÚNIOR A.C. & BENGTSON P., 2000. Stratigraphy and biogeographic affinities of the late Aptian–Campanian ostracods of the Potiguar and Sergipe basins in northeastern Brazil. *Cretaceous Research*, 21: 407-455.

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ANGEL BALTANÁS & DAN L. DANIELOPOL

DISPARITY AND DIVERSITY IN THE CANDONINAE
(*Ostracoda Cypridoidea*)

Morphological disparity, like other components of biodiversity (e.g. species richness or ecological diversity), results from historical processes in which phylogenetic effects and ecophenotypic events interact in a complex way to produce currently observed patterns (MAGNIEZ-JANNIN *et al.*, 2000). Therefore, the analysis of morphological disparity and its relationships with other biodiversity features is expected to contribute significantly to our understanding of the evolution of any biological group: Does morphological disparity increase with increasing taxonomic diversity through the history of a clade? Does morphological divergence necessarily follow evolutionary innovation and adaptive radiation? Are (phylo)genetic and morphometric data so tightly correlated that lineages can be traced through geological time? At what spatial scales are environmental changes reflected in disparity patterns?

Within that conceptual framework we aim to explore disparity/diversity patterns in the subfamily Candoninae (Ostracoda, Cypridoidea), a group that includes one-fourth of global non-marine ostracod diversity and more than ninety percent of all recent species in the family Candonidae (MARTENS *et al.*, 2008). Along with its high taxonomic diversity (more than 500 species in 36 genera), some other features support the use of the Candoninae for such kind of analysis. The group is old with taxa known from mid-Jurassic onwards and widely, but not evenly, present-day distributed in all biogeographic regions (MARTENS *et al.*, 2008). Candoninae are ecologically diverse too; some taxa occur in mid-latitude areas whereas some others are restricted to tropical and subtropical regions. Carapace shape, as well as carapace size, is variable both within and between candonines groups; and shape similarity does not necessarily imply phyletic proximity (KARANOVIC, 2007). Their lifestyles are also quite diverse: many species have successfully colonised deep lakes, shallow temporary waters, the subterranean realm and even semi-terrestrial environments (DANIELOPOL, 1977; MEISCH, 2000). Indeed, most genera in the subfamily (30 out of 36) are either fully hypogean or include some hypogean species at least. Finally, the group displays very interesting radiations in ancient lakes, like lake Baikal where nearly 90 endemic species of that subfamily occur (MAZEPOVA, 1990).

Information concerning 483 extant Candoninae species - including taxonomy, carapace size, lifestyle and geographic distribution - was gathered from different published sources. A total of 304 valve outlines (representing 60% of all Recent species and the 36 extant genera in the subfamily) were recorded and submitted to geometric morphometric analysis in order to build a morphospace where shape diversity and shape relationships among members of the group can be estimated. The within-genus dispersion of carapace shapes was tested and its statistical significance evaluated under the null hypothesis of complete morphological randomness (i.e. assuming that the distribution of shapes within the morphospace is unrelated to taxonomy). If the null hypothesis is false, as we could *a priori* guess based on the supposed relatedness of the entities involved, then shape diversity within a given genus with *n* species is expected to be significantly lower than the average morphological similarity of collections of *n* species sampled at random from the whole subfamily. Quite unexpectedly, results showed that the similarity of outline carapace shape between species in 70% of the genera was not higher than expected by chance alone.

The next aim was to address the comparative analysis of the distribution of some traits (shape, size, diversity, disparity) in the group. Accordingly, a phylogenetic hypothesis of the group was needed given that observed values of those traits at the genus level do not conform a set of independent observations but are linked by ancestor-descendent relationships. Thus, we performed a cladistic analysis using an updated version of the character matrix developed by KARANOVIC (2007). Our results differ from the proposal of Karanovic at some point and support previously held contentions (e.g. the tribe Namibcypridini). But beyond that specific output, the phylogenetic hypothesis shows a low statistical support suggesting that the set of characters used, which are those widely recognised and commonly used in current taxonomic work, can hardly identify phylogenetic relationships among the groups considered.

With the phylogenetic hypothesis on hand, continuous traits of interest - size, shape, species richness and within-genus disparity - were analysed using phylogenetically based independent contrasts (FELSENSTEIN, 1985). Results showed the lack of statistical correlation in pairwise combinations of those traits except for disparity-shape, thus suggesting that carapace shape is weakly related to size; that species diversity within a genus is neither enhanced nor reduced by characteristic genus body size; and that within-genus disparity in genera with an ‘elongated’ shape is smaller than in genera with a more quadrangular/rounded outline.

The degree of disparity related to the ecological distribution of selected taxonomic groups is addressed for Candoninae living in hypogean aquatic media, in the long-lived Lake Baikal as compared to those occurring in other surface-water habitats. Our survey on the relative contribution of several groups from the former two environments to the overall disparity of Candoninae points out to the excess of “extreme shapes” existing in the Lake Baikal and/or in the aquatic subterranean domain. It is also shown that the disparity of several groups occurring exclusively in groundwater habitats (e.g. *Origocandona* and *Abcandonopsis* from subsurface aquatic habitats in Western Australia) displays values above those expected under a random distribution of shape among genera.

It is concluded that the analysis of disparity represents an excellent alternative to the species diversity studies in cases where taxonomic groups are poorly resolved. Hence, it is hoped that exploration of morphological diversity will bring, in the near future, new insights into still poorly understood aspects of the origin and evolution of the Candoninae.

REFERENCES

DANIELOPOL D.L., 1977. Ostracodes hypogés du sud de la France. 1. *Mixtocandona juberthieae* n.sp. *International Journal of Speleology,* 9: 235-249.

FELSENSTEIN J., 1985. Phylogenies and the comparative method. *The American Naturalist,* 125: 1-15.

KARANOVIC, I. 2007. Candoninae (Ostracoda) from the Pilbara region in Western Australia. *Crustaceana Monographs,* 7: 1-433.

MAGNIEZ-JANNIN F., DAVID B., DOMMERGUES J-L., SU Z-H., OKADA T. & OSAWA S., 2000. Analysing disparity by applying combined morphological and molecular approaches to French and Japanese carabid beetles. *Biological Journal of the Linnean Society,* 71: 343-358.

MARTENS K., SCHÖN I., MEISCH C. & HORNE D.J., 2008. Global diversity of ostracods (Ostracoda, Crustacea) in freshwater. *Hydrobiologia,* 595: 185-193.

MAZEPOVA G.F., 1990. Rakuschkovye ratschki (Ostracoda) Baikala [Ostracoda of Lake Baikal]. Nauk. Sib. Otdel. Akad. Nauk. SSSR, 471 pp.

MEISCH C., 2000. Freshwater Ostracoda of Western and Central Europe. *Spektrum Akademischer Verlag,* Heidelberg-Berlin, 522 pp.

Authors' Addresses — A. BALTANÁS, Department of Ecology (Fac. Sciences), Universidad Autonoma de Madrid, c/Darwin 2 - 28049 Madrid (Spain); e-mail: angel.baltanas@uam.es; D.L. DANIELOPOL, Institute of Earth Sciences (Depart. Geology & Palaeontology), University of Graz, Heinrichstr. 26, A-8010 Graz (Austria); e-mail: dan.danielopol@uni-graz.at.

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Ginny Benardout, David J. Horne, Joan Bunbury & Ian Boomer

TESTING THE MUTUAL OSTRACOD TEMPERATURE RANGE METHOD WITH A MULTI-PROXY APPROACH TO PALAEOTEMPERATURE ESTIMATION

Fossil assemblages are routinely used as biological proxies for inferring past climates through increasingly sophisticated methods, with a multi-proxy approach being adopted to provide a more robust and comprehensive understanding of palaeoclimates. In practice, however, multi-proxy approaches to quantitative palaeoclimatic reconstructions often fail to produce agreement between any two proxies. Where proxies disagree allows space for exploration of the possible causes of discrepancies, which could lead to subsequent improvements to the methods applied.

The Mutual Ostracod Temperature Range method (MOTR; Horne, 2007) works on the assumptions that (1) extant fossil specimens had the same climatic tolerances as their modern counterparts, (2) air temperature is at least a major control over non-marine ostracod distribution, and (3) we are able to define adequately the climatic tolerances of modern species.

Late-glacial to Holocene ostracod and chironomid assemblages from two lakes in Yukon Territory in northern Canada (Bunbury & Gajewski, 2012; Bunbury, 2012 *in press*) were analysed, using the MOTR method as well as transfer function methods and the modern analogue technique for both ostracods and chironomids, so as to compare the resulting climatic reconstructions. Stable isotope analyses (Oxygen and Carbon) of ostracod valves provided additional data for comparison.

The different geographical and climatic coverage of the training datasets are found to be a significant cause of discrepancies. For the MOTR reconstructions, the Canadian datasets used initially are shown to be inadequate for calibration of many living taxa as they do not capture the full temperature ranges of the species in question. Better reconstructions are obtained using combined North American and European datasets in OMEGA (Ostracod Metadatabase of Environmental and Geographical Attributes; Horne *et al.*, 2011), but in spite of its large size the combined data still falls short of complete coverage of cold-climate species, as is demonstrated by a comparison (Fig. 1) of calibrations with those obtained using the much smaller (but higher-latitude) Canadian dataset (Bunbury, 2012 *in press*). It is necessary, therefore, to carefully consider assumption (3) in any palaeoclimatic reconstruction using ostracods.

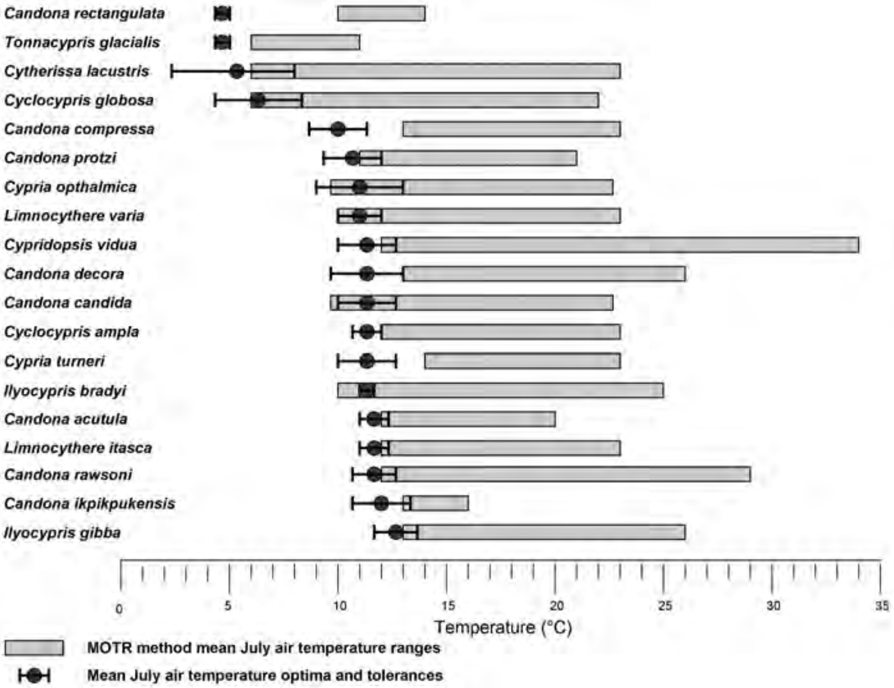

Fig. 1 — Comparison of calibrated July temperature ranges (using OMEGA) and July optima/tolerances (using a Canadian dataset) for ostracod species from Yukon lakes.

We present a critical evaluation of the ostracod and chironomid palaeoclimate methods and discuss its implications for proxy-based interpretations of the Late-glacial and Holocene climatic history of the Yukon.

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REFERENCES

BUNBURY J., 2012 in press. Distribution of freshwater ostracods in the Canadian North and implications for palaeoclimatic reconstructions. In: Horne, D.J., Holmes, J.A., Rodriguez-Lazaro, J. & Viehberg, F.A. (Eds.), Ostracoda as Proxies for Quaternary Climate Change. *Developments in Quaternary Science*, 17: 119-131. Elsevier.

BUNBURY J. & GAJEWSKI K., 2012. Temperatures of the past 2000 years inferred from lake sediments, southwest Yukon Territory, Canada. *Quaternary Research*, 77: 355-367.

HORNE D.J., 2007. A Mutual Ostracod Temperature Range method for Quaternary palaeoclimatic analysis using European nonmarine Ostracoda. *Quaternary Science Reviews*, 26: 1398-1415.

HORNE D.J., CURRY B.B., DELORME L.D., MARTENS K., SMITH A.J. & SMITH R.J. 2011. OMEGA: the Ostracod Metadatabase of Environmental and Geographical Attributes. *Joannea Geologie und Paläontologie*, 11: 80-84.

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CRISTIANINI TRESCASTRO BERGUE & GERSON FAUTH

PALEOENVIRONMENTAL ANALYSIS OF THE UPPER CRETACEOUS MARGINAL MARINE AND MARINE OSTRACODE ASSEMBLAGES OF SANTOS BASIN (SE BRAZIL)

The Santos Basin lies in the southeast portion of the Brazilian continental margin and its depositional history ranges from the Early Cretaceous to the Quaternary. The Santonian-Maastrichtian sequences studied correspond to the drift phase and are characterized by a progradational trend which culminated in the Maastrichtian (MOREIRA *et al.*, 2007). The main objective of this research is the study of the changes in richness and composition of the ostracode assemblages in response to environmental changes. The 2054 cutting samples used in this study were chosen from 14 offshore wells and their ages are based on unpublished palynological data. Micropaleontological analysis revealed the presence of both marine (neritic) and brackish-water assemblages in most wells. One hundred twenty-five ostracode species were recorded, 90 marine and 35 brackish. The assemblages differ according to the depositional environment, the brackish ones being characterized by high abundance and low richness. In the marine ones the richness is higher and the abundance is low, except for rare peaks of cytherellids and trachyleberids. *Fossocytheridea* is the genus with the most significative richness and abundance in the brackish-water assemblages. The most interesting ecologic characteristic of the genus is its adaptation to different ambiental contexts, the salinity being an important parameter controlling the species distribution. *Fossocytheridea* richness is higher in mesohaline environments (*sensu* BELT *et al.*, 2005), where occurs usually associated with *Perissocytheridea* spp., and lower in oligohaline environments, where it is represented usually by *F. posterodentata* BERGUE *et al.,* 2011. Some species of the genera *Cyprois*, *Ilyocypris* and *Cyprideis* are also recorded in the oligohaline intervals but they have not been identified at specific level. During the Santonian – Campanian the genera *Brachycythere*, *Cytherella* and *Paracypris* are the most abundant in the marine intervals whereas *Platycosta*, *Actinocythereis* and *Majungaella* characterize the Maastrichtian interval. These genera are typical of neritic assemblages and some of them (e.g. *Majungaella* and *Brachycythere*) are potentially good biostratigraphic markers due to the short temporal distribution of their species. Based on the assemblages composition it was possible to identify a succession of marine and marginal marine enviroments according to the presence of marine and mixohaline taxa, respectively. Only two marine species, *Majungaella santosensis* PIOVESAN *et al.*, 2012 and *Cytherelloidea spirocostata* BERTELS, 1973 have been identified. Most of the remaining taxa in open nomenclature are probably new ones and will be described in the continuity of this study. The well-defined chronostratigraphic distribution of some taxa both in marine and brackish water deposits allows the use of ostracodes to reconstruct paleoenvironmental changes (salinity changes, sedimentary input) in the different phases of the progradational trend which took place in Santos Basin during the Upper Cretaceous.

REFERENCES

BELT E.S., TIBERT N.E., CURRAN H.A., DIEMER J.A., HARTMAN J.H., KROEGER T.J. & HARWOOD D.M., 2005. Evidence for marine influence on a low gradient coastal plain: Ichnology and invertebrate paleontology of the lower Tongue River Member (Fort Union Formation, middle Paleocene), western Williston Basin, USA. *Rocky Mountain Geology*, 40(1): 1-24.

BERGUE C.T., FAUTH G., VIEIRA C.E.L., SANTOS A.S.& VIVIERS M.C., 2011. New species of *Fossocytheridea* Swain & Brown, 1964 (Ostracoda, Crustacea) in the Upper Cretaceous of Santos Basin, Brazil. *Revista Brasileira de Paleontologia*, 14: 149-156.

BERTELS A., 1973. Ostracodes of the typelocality of the Lower tertiary (Lower Danian) Rocanian Stage and Roca Formation of Argentina. *Micropaleontology*, 19(3): 308-340.

MOREIRA J.L.P., MADEIRA C.V., GIL J.A., MACHADO M.A.P., 2007. Bacia de Santos. *Boletim de Geociências da Petrobras*, 15: 531-549.

PIOVESAN E.K., BALLENT S. & FAUTH G., 2012. Cretaceous paleogeography of southern Gondwana from the distribution of the marine ostracod *Majungaella* Grekoff: New data and review. *Cretaceous Research*, 37: 122-147.

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Ian Boomer, David J. Horne, Alan Lord & Alison Smith

LATE PLEISTOCENE FRESHWATER OSTRACODA FROM NORTH EAST ENGLAND, WITH OBSERVATIONS ON THE STATUS OF *LIMNOCYTHERE SUESSENBORNENSIS* DIEBEL, 1968 AND *LIMNOCYTHERE FRIABILIS* BENSON & MACDONALD, 1963

Ostracoda recovered from a late Quaternary wetland site in NE England reveal a rather unusual assemblage for strata of this age and location. *Cytherissa lacustris* is not uncommon at this locality, suggesting relatively cool, stenothermal conditions, but the species is not common in contemporaneous wetland sites elsewhere in adjacent areas of northern England or southern Scotland. This species is rarely found in abundance in such shallow water settings except under relatively cool climatic conditions (e.g. northern Scotland today), the reason for its abundance here may lie in the local, groundwater-fed, hydrology.

Of greater interest is the additional occurrence of a small limnocytherid species which shows affinities with both *Limnocythere suessenbornensis* Diebel and *Limnocythere friabilis* Benson & MacDonald. The former species was described from mid-Pleistocene sediments in Germany and has only previously been recorded from sediments of Hoxnian age in the British Isles, from MIS 11 age sediments at West Stow, Suffolk. Late Pleistocene records suggest its geographical range may also extend into Siberia. The latter species (*L. friabilis*) is thought to range from the Plio-Pleistocene to Recent of the North American continent. Today it lives in relatively shallow water, interstitially in the Great Lakes where it is considered to be strongly associated with groundwater emergence, it also known sporadically from the Canadian Plains. We discuss the possibility that one or more of these biogeographical/ stratigraphical suppositions is incorrect and also discuss the possibility that the two taxa may ultimately be con-

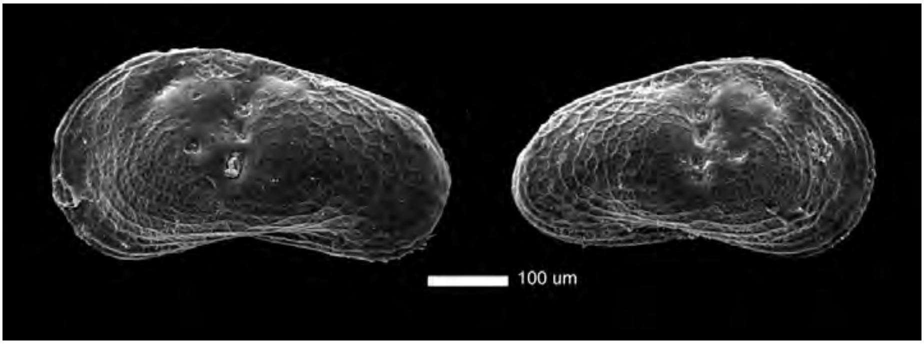

Fig. 1 — *Limnocythere* sp. Late Glacial, Bradford Kaims, Northumberland. This small limnocytherid shows affinities with both *L. friabilis* and *L. suessenbornensis*.

specific. The palaeoclimatic and palaeobiogeographic implications for the site in NE England are also discussed.

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NICOLE BÖRNER, BART DE BAERE, QICHAO YANG, KLAUS PETER JOCHUM,
PETER FRENZEL & ANTJE SCHWALB

THE FLOW-THROUGH TIME-RESOLVED ANALYSIS TECHNIQUE: A NEW METHOD IN TRACE ELEMENT DETERMINATION IN OSTRACODE SHELLS

Trace element analyses of ostracode shells are a vital tool for paleoenvironmental reconstructions. Conventional batch dissolution ICP-MS is the most common way for analyzing trace elements in ostracode shells. However, due to dissolution and/or secondary overgrowth the primary signal may be masked (BENNETT *et al.*, 2011; HOLMES & DE DECKKER, 2012; ITO *et al.*, 2003; KEATINGS *et al.*, 2002). Following deposition, ostracode shells are prone to selective dissolution as well as development of carbonate overgrowths altering the original chemical composition of the shell. Resulting variations in trace element composition have been identified to be in the order of a magnitude range. The extent to which significant alteration can be observed at low magnification is unclear, and the examination as well as the cleaning process is very time consuming. Therefore, the application of the newly developed flow-through technique will be assessed.

The flow-through analysis technique allows to chemically separate mineral phases of different solubility such as, in particular, original shell calcite from overgrowth calcite, and thus correct the measurements for the biogenic signal. The flow through leaching technique is a type of liquid chromatography. During a flow through experiment, eluent is continuously pumped through a sample column (typically a filter) in which a substrate (in this case microfossils) is loaded. As the eluent passes through the sample column, the substrate gradually dissolves. The dissolution of the substrate is controlled by a combination of eluent type, eluent temperature and eluent flow rate. The dissolved sample then flows directly to a mass spectrometer or fraction collector. The resulting data is a chromatograph, featuring – ideally – different mineral phases dissolving as time progresses. Hence, the flow through technique provides the user with a detailed geochemical fingerprint of the substrate and therefore additional data relative to conventional methods.

To calibrate the flow-through dissolution technique for the application to ostracodes we use living sampled ostracode shells from two Southern Tibetan Plateau lakes, Tangra YumCo and Taro Co, closed basin lake systems with no outlets, but several inlets. Both lakes feature an alkaline environment but show highly diverse conductivity and salinity, as well as hydrochemistry. Cleaned as well as uncleaned ostracode shells show similarity in their trace element signals and thus allow to do the measurements without prior cleaning of shells, allowing for more time-efficient sample throughput. Another advantage of the flow-through dissolution technique is that the measurements can be carried out on single ostracode shells, as not every single sediment sample contains enough adult intact specimens of all required genera making batch cleaning dissolution impossible.

The flow-through time-resolved analysis technique gives an accurate and high-resolution dataset. The trace elemental data for the living ostracodes compared to the hydrological data from each sampling site provides a calibration dataset for further hydrological and thus climatological reconstruction of a sediment core from Tangra YumCo. Mg/Ca and Sr/Ca ratios in ostracode shells will provide information about past water temperature and salinity resulting from changes in precipitation vs. evaporation ratios and monsoon activity. Further, we will exploit Mn/Ca, Fe/Ca and U/Ca ratios as redox indicators to reconstruct oxygenation cycles and Ba/Ca ratios to detect changes in productivity. This reconstruction should provide a more extensive insight in past climatic change, e.g. precipitation – evaporation balance, lake level and circulation changes, and thus will provide clues about monsoonal dynamics.

REFERENCES

BENNETT C.E., WILLIAMS M., LENG M.J., SIVETER D.J., DAVIES S.J., SLOANE H.J., WILKINSON I.P., 2011. Diagenesis of fossil ostracods: Implications for stable isotope based palaeoenvironmental reconstruction. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 305(1-4): 150-161.

HOLMES J., DE DECKKER P., 2012. The Chemical Composition of Ostracod Shells: Applications in Quaternary Palaeoclimatology. In: Horne, D., Holmes, J., Viehberg, F., Rodriguez-Lazaro, J. (Eds.), *Ostracoda as Proxies for Quaternary Climate Change*. Developments in Quaternary Science. Elsevier Science: 131-143.

ITO E., DE DECKKER P., EGGINS S.M., 2003. Ostracodes and their shell chemistry: Implications for paleohydrologic and paleoclimatologic applications, Bridging the Gap, Trends in the

Ostracode Biological and Geological Sciences. *The Paleontological Society Papers*. Paleontological Society, New Haven: 119-152.

KEATINGS K.W., HEATON T.H.E., HOLMES J.A., 2002. The effects of diagenesis on the trace element and stable isotope geochemistry of non-marine ostracod valves. *Journal of Paleolimnology*, 28(2): 245-252.

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SIMONE N. BRANDÃO

RECENT DEEP-SEA OSTRACODA BIOGEOGRAPHY REVISITED

The quantification of the spatial distribution of species in the deep sea is important for general community and macroecological theories that to date have been mostly based on terrestrial ecosystems. The objective of the present contribution is to study the biogeography of Recent deep-sea ostracods, through the analysis of a dataset of all previously published records of recent ostracods living deeper than 2000 meters.

In general, the deep-sea ostracod fauna have long been considered to be cosmopolitan at species and genus level (BENSON & SYLVESTER-BRADLEY, 1971, WHATLEY & AYRESS, 1988). This concept was introduced to ostracodology by Brady (1880), and also because information (and illustration) on the lectotypes of such 'cosmopolitan' species was very scarce, many authors seem to have avoided describing new species, instead they used Brady's name (Yasuhara, personal communication). As a consequence these 'cosmopolitan' species were recorded from many distant, deep-sea localities and the morphospecies definitions were further enlarged.

Although many publications gave support to the theory of the cosmopolitanism in the deep sea at species level, it was well known among ostracodologists that the taxonomy of the cosmopolitan species remained unclear and needed re-evaluation. As a consequence, some revisions have been published (e.g. BENSON, 1972; MADDOCKS, 1990; MAZZINI, 2005; JELLINEK *et al.*, 2006; BRANDÃO, 2013; BRANDÃO & YASUHARA, 2013). Prior to the analyses of the dataset mentioned above, the revised geographic distributions of such species were incorporated into the dataset.

Finally, the distribution of species and the degree of endemism of the Atlantic, Indian, Pacific and Southern Ocean were studied. Furthermore, since the "Global Open Oceans and Deep Seabed biogeographic classification (GOODS)" (UNESCO, 2009) was and should further be used by stakeholders in their decisions on the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction (UNESCO, 2009), the generality of this biogeographic classification was tested for the deep-sea ostracods.

REFERENCES

BENSON R.H., 1972. The *Bradleya* problem, with description of two new psychrospheric Ostracode genera, *Agrenocythere* and *Poseidonamicus* (Ostracoda : Crustacea). *Smithsonian Contributions to Paleobiology*, 12: 1-138.

BENSON R.H. & SYLVESTER-BRADLEY P.C., 1971. Deep-sea ostracodes and the transformation of ocean to sea in the Tethys. *Bulletin du Centre de Recherche Pau-SNPA*, 5: 63-91.

BRANDÃO S.N., 2013. Challenging cosmopolitanism in the deep sea: The case of "*Cythere acanthoderma* Brady, 1880" (Crustacea, Ostracoda). *Revue de Micropaléontologie*, 56: 2–19.

BRANDÃO S.N. & YASUHARA M., 2013. Challenging the deep-sea Cosmopolitanism – Revision of "*Cythere dasyderma* Brady, 1880" (Ostracoda, Trachyleberididae). *Journal of Micropalaeontology* (in press).

JELLINEK T., SWANSON K.M. & MAZZINI I., 2006. Is the cosmopolitan model still valid for deep-sea podocopid ostracods? With the discussion of two new species of the genus *Pseudobosquetina* Guernet & Moullade, 1994 and *Cytheropteron testudo* (Ostracoda) as case studies. *Senckenbergiana maritima*, 36: 29-50.

MADDOCKS R.F., 1990. Living and fossil Macrocyprididae (Ostracoda). *University of Kansas Paleontological Contributions Monograph No* 2: 1-285.

MAZZINI I., 2005. Taxonomy, biogeography and ecology of Quaternary benthic Ostracoda (Crustacea) from circumpolar deep water of the Emerald Basin (Southern Ocean) and the S Tasman Rise (Tasman Sea). *Senckenbergiana Maritima*, 35: 1-119.

UNESCO, 2009. Global Open Oceans and Deep Seabed (GOODS) biogeographic classification. *IOC Technical Series*, 84: 1-87.

WHATLEY R.C. & AYRESS M., 1988. Pandemic and endemic distribution patterns in Quaternary deep-sea Ostracoda. *Developments in Palaeontology and Stratigraphy*, 11: 739–755.

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Maria Cristina Cabral, Jean-Paul Colin, Ana Cristina Azerêdo,
Ricardo Silva & Luís Vítor Duarte

SINEMURIAN OSTRACOD ASSEMBLAGES FROM WESTERN PORTUGAL (PRAIA VELHA AND PRAIA DA CONCHA): PALAEOECOLOGICAL SIGNATURE AND PALAEOBIOGEOGRAPHICAL IMPLICATIONS

In S. Pedro de Moel region (W Portugal), the Jurassic cliffs of Praia Velha and Praia da Concha exhibit a fossiliferous carbonate succession with few marly intervals (Coimbra Formation), from which ostracods were studied. The lowest part of the succession yielded no age diagnostic fossils so far, but it is overlain by deposits bearing ammonite faunas (*Obtusum* Zone, earliest Late Sinemurian; e.g. Dommergues *et al.*, 2004); therefore, the age range of the succession is considered from the Early Sinemurian to the earliest Late Sinemurian. This sequence was divided by Azerêdo *et al.* (2010) into 4 units, from base to top: Unit A, dolostones /dolomitic limestones, skeletal limestones, marls, argillaceous limestones; Unit B, stromatolites; Units C and D, restricted marine fossiliferous /marly limestones, rarely marls. Units A-C and lowermost Unit D are regarded as possibly Lower Sinemurian, uppermost Unit D as Upper Sinemurian, though the boundary is uncertain.

Twelve samples from the marly levels were studied with regard to ostracods:

Unit A (3 samples): brackish, low diversity and badly preserved assemblage, mostly carapaces. Two brackish species were identified, one of them is new: *Phraterfabanella* nov. sp. Cabral & Colin and *Lutkevichinella hortonae* Ainsworth, 1989.

Unit B: no ostracods.

Unit C (1 sample): the ostracod assemblage differs dramatically: individuals are very abundant, diversity is low, valves>carapaces. This represents a somewhat restricted marine assemblage, with 2 main species: *Ektypho-*

cythere lacunosa (Ainsworth, 1989) is dominant, *Ljubimovella*? *frequens* Donze, 1968 is also abundant; the species from Unit A almost disappear, *Pseudomacrocypris subtriangularis* Michelsen, 1975 is rare and echinoid remains occur.

Unit D: several levels with ostracods, generally very abundant, with 2 distinct assemblages:

(i) the lower one (3 samples), with high diversity, valves>carapaces, persistence of echinoid remains, dominated by *L.*? *frequens* (sometimes>80% of the population), in association with several marine species, such as *Ektyphocythere sinemuriana* (Ainsworth, 1989), *E. retia* (Ainsworth, 1989), *Marslatourella* aff. *heitoufensis* Boutakiout, Donze & Oumalch, 1982, *Tropacythere*? *normaniae* (Donze, 1968), *Monoceratina*? sp. 1, *Donzocythere* cf. *convergens* (Donze, 1968) and *Micropneumatocythere* sp.; towards the upper part of this first assemblage of Unit D, *L.*? *frequens* is no longer dominant and frequency of the genus *Ektyphocythere* increases. Overall, it is a shallow marine assemblage.

(ii) the upper one (5 samples), with lower diversity, almost only carapaces, sometimes with echinoid fragments, where the brackish species *L. hortonae* is dominant (sometimes >70%), accompanied by *Phraterfabanella* nov. sp. Cabral & Colin (brackish), *P. subtriangularis*, *Klieana* nov. sp. Cabral & Colin (brackish), *Monoceratina*? sp. 1 and *Klinglerella* nov. sp. Cabral & Colin. These are brackish to restricted marine faunas; however, a more clearly brackish episode is identified by the absence of echinoids and the almost exclusive presence of brackish species (CABRAL *et al.,* 2009). Towards the terminal part, the assemblage becomes more marine, valves increase and the occurrence of *Ektyphocythere lotharingiae* (Donze, 1967) = *E. herrigi* (Ainsworth, 1989) stands out.

The studied fauna is very similar to those described in other European regions, in levels of same age or relatively close, namely in the Fastnet Basin, offshore SW Ireland (AINSWORTH, 1989) and the Paris Basin (DONZE, 1968, 1985; APOSTOLESCU, 1959), although exhibiting several new species. In the studied sections, the ostracods suggest variable environments, from shallow marine, usually restricted, to either more open or brackish.

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REFERENCES

AINSWORTH N., 1989. Rhaetian, Hettangian and Sinemurian Ostracoda from the Fastnet Basin, offshore Southwest Ireland. *Geol. Surv. Ire. Bull.*, Dublin, 4 (2): 107-150.

APOSTOLESCU V., 1959. Ostracodes du Lias du Bassin de Paris. *Rev. Inst. Français Pétrole*, Paris, 15 (6): 795-826.

AZERÊDO A.C., SILVA R.L., DUARTE L.V. & CABRAL M.C., 2010. Subtidal stromatolites from the Sinemurian of the Lusitanian Basin (Portugal). *Facies*, 56: 211-230.

CABRAL M.C., AZERÊDO A.C., COLIN J.-P., SILVA R.L. & DUARTE L.V., 2009. An unexpected oligohaline ostracod assemblage from the restricted-marine Sinemurian of W Portugal. *Program and Abstracts. 16th Int. Symp. Ostracoda, Brasília*: 50.

DOMMERGUES J.-L., MEISTER C., NEIGE P. & ROCHA R.B., 2004. Endemic Sinemurian (Early Jurassic) ammonites from the Lusitanian Basin (Portugal). *Rev. Paléobiol.*, 23 (2): 529-549.

DONZE P., 1968. Espèces nouvelles d'ostracodes du Lias inférieur normand. *Bull. Soc. Linn. Normandie*, 9: 78-87.

DONZE P., 1985. Lias inférieur et moyen. In: Atlas des ostracodes de France. OERTLI H.J. (edit). *Bull. Centres Rech. Explor. Prod. Elf-Aquitaine, Mém.* 9: 101-112.

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NEW FINDINGS OF NON-MARINE UPPER JURASSIC OSTRACODS FROM THE PORTUGUESE WESTERN COAST

Recent studies on an Upper Jurassic dinosaur fossil site in the Lusitanian Basin (W Portugal), allowed recognition of a rich non-marine ostracod assemblage represented by seven ostracod species, two of which are new. The ostracods come from a single sandy level located in the cliffs of Paimogo, in the western Portuguese coast (ca.76km NW of Lisbon, 14km S of Peniche). This level is the very base of the informal Sobral formation, represented by a sequence of marls, clays and sandstones, that correspond to continental fluvial sediments alternating with rare brackish ones and is attributed to the Late (or latest) Kimmeridgian-Early Tithonian (LEINFELDER, 1986; MANUPPELLA *et al.*,1999; SCHNEIDER *et al.*, 2009). This Sobral formation rests upon the traditional Alcobaça formation, both being equivalent to part of the also informal Lourinhã formation of HILL (1989). Stratigraphical constraint of these units is poor and their limits are mostly diachronic; the Alcobaça formation may range from ?Late Oxfordian to ?Early Tithonian, but is considered mostly Kimmeridgian in age (e.g. MANUPPELLA *et al.*,1999; SCHNEIDER *et al.*, 2009) and the Lourinhã formation spans the Kimmeridgian and Tithonian. Therefore, the most probable age for this level is either latest Upper Kimmeridgian or basal Tithonian.

The studied level contains relatively abundant charophytes and abundant ostracods, many of them belonging to *Cetacella armata* Martin, 1958, a species ranging from Oxfordian to Berriasian. The other species present in the sample are rare specimens of *Damonella ellipsoidea* (Wolburg, 1962) and *Alicenula* cf. *oblonga* (Roemer, 1839), abundant *Alicenula leguminella* (Forbes, 1855),

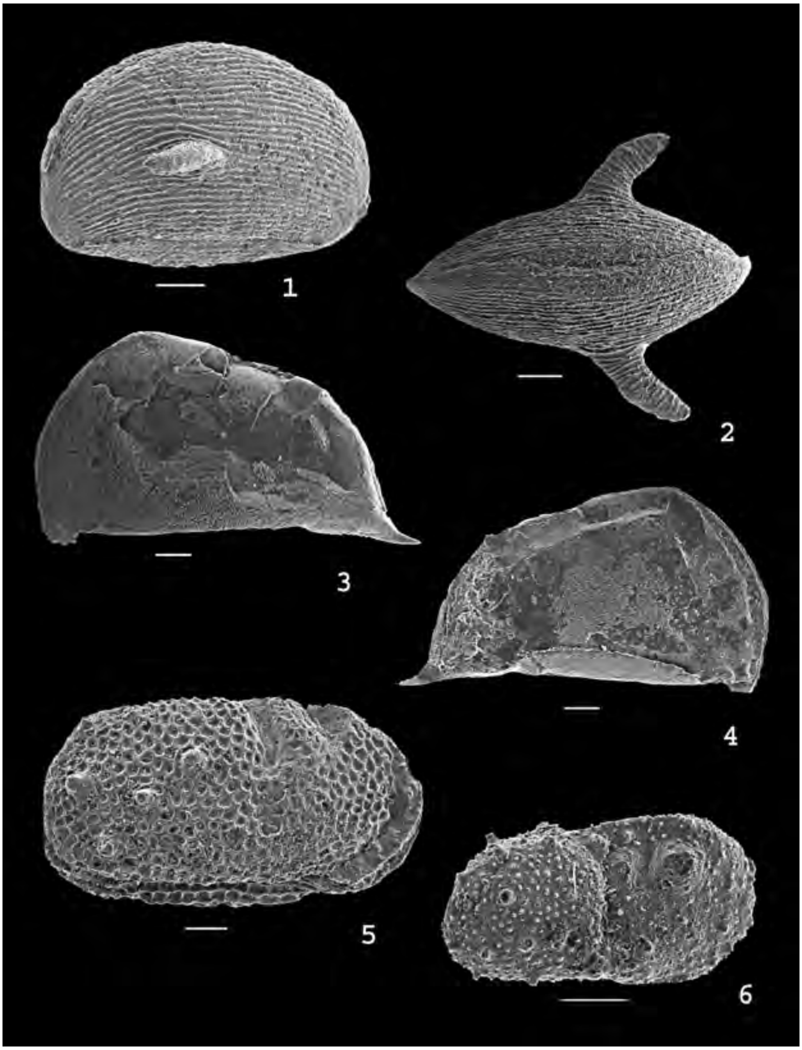

Fig. 1 — Ostracods of Paimogo, Portugal. **1-2**, *Cetacella armata* Martin, 1958, Paim 8, **1,** - C, right view, **2,** - C, dorsal view; **3-4** *Praecypridea* nov. sp. Cabral & Colin, Paim 8, **3** - C, left view, **4** - C, right view; **5**, *Theriosynoecum* nov. sp. Cabral & Colin, Paim 8, C, right view, male. **6**, *Rhinocypris jurassica* (Martin, 1940), Paim 8, C, right view; C – carapace; scale bar – 100 µm.

Rhinocypris jurassica (Martin, 1940), and the new species *Theriosynoecum* nov. sp. Cabral & Colin, previously identified as *Bisulcocypris* cf. *pahasapensis* (Roth, 1933) by HELMDACH (1974) and *Praecypridea* nov. sp. Cabral & Colin. This last species is closely related to the type-species *Praecypridea acuticyatha* (Schudack, 1998) described from the Morrison Formation of Kimmeridgian age of Oklahoma and Colorado (SCHUDACK, 1998; SAMES *et al.,* 2010). This assemblage is close to the one found and poorly described by HELMDACH (1971, 1974) in Porto Dinheiro and Porto das Barcas, some kms south of Paimogo, in presumably equivalent levels of the same formation, which is part of a regional synclinal structure. Sr isotope dating from the Sobral formation to the south of Porto das Barcas indicates a latest Kimmeridgian to middle Early Tithonian age (SCHNEIDER *et al.*, 2009), which fits into the time span assigned above.

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REFERENCES

HELMDACH F.F., 1971. Zur Gliederung limnisch-brackisher Sedimente der portugischen Oberjura (ob. Callovien-Kimmetridge) mit Hilfe von Ostracoden. *N. Jb. Geol. Palaöt. Mh.,* 11: 645-662.

HELMDACH F.F., 1974. A contribution to the stratigraphical subdivision of nonmarine sediments of the Portuguese Upper Jurassic. *Com. Serv. Geológicos de Portugal*, 57: 5-21.

HILL G., 1989. Distal alluvial fan sediments from the Upper Jurassic of Portugal: controls on their cyclicity and channel formation. *J. Geol. Soc. London*, 146: 539-555.

LEINFELDER R., 1986. Facies, stratigraphy and paleogeographic analysis of Upper? Kimmeridgian to Upper Portlandian sediments in the environs of Arruda dos Vinhos, Estremadura, Portugal. *Münchner Geowiss. Abh.*, 7: 216 pp.

MANUPPELLA G., ANTUNES M., PAIS J., RAMALHO M. & REY J., 1999. Notícia Explicativa da folha 30-A, Lourinhã, da carta Geoloógica de Portugal à escala 1:50.000. *Inst. Geol. e Mineiro,* 83 pp.

SAMES B., WHATLEY R. & SCHUDACK M.E., 2010. *Praecypridea*: a new non-marine ostracod genus from the Jurassic and Early Cretaceous of Europe, North and South America, and Africa. *Journal of Micropalaeontology*, London, 29: 163-176.

SCHNEIDER S., FÜRSICH F.T. & WERNER W., 2009. Sr-isotope stratigraphy of the Upper Jurassic of central Portugal (Lusitanian Basin) based on oyster shells. *Int J Earth Sci (Geol Rundsch)*, 98: 1949-1970.

SCHUDACK M.E., 1998. Appendix: The ostracodes and charophytes of the Morrison Formation. *In:* Schudack M.E., Turner C.E. & Peterson F. Biostratigraphy, paleoecology and biogeography of charophytes and ostracodes from the Upper Jurassic Morrison Formation, Western Interior, USA. *Modern Geology*, 22: 402-414.

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CONTRIBUTION TO THE KNOWLEDGE OF CONTINENTAL OSTRACOD FROM CHILE

Introduction

Our knowledge of continental ostracods in South America is still in its infancy with a total of only 260 species (Martens & Behen, 1994). Particularly in Chile, it is still scarce and scattered, with large voids in the taxonomy and distribution. In Chile, the first records were reported by Daday (1902), Brehm (1934) and Löffler (1961a, b). Later, Schwalb & Burns (1999) cited species of Limnocytheridae and Karanovic (2012) provided new records of Candonidae from Chile.

The main objective of this work is to provide a checklist of ostracods in Chile with updated distributional records.

Methodology

The checklist is based on literature review and recent sampling surveys from lakes of the Yali Complex (33°S, 71°W) and Cisnes Lake (47°S, 72°W) (Fig. 1). Samples in the Yali Complex were obtained with a 250 µm net and fixed in 70% alcohol. Samples in the Cisnes Lake were collected from a sediment core. Water temperature, pH and conductivity were measured during the surveys (Tab. 1).

Later, the samples were processed and individuals were identified up to species.

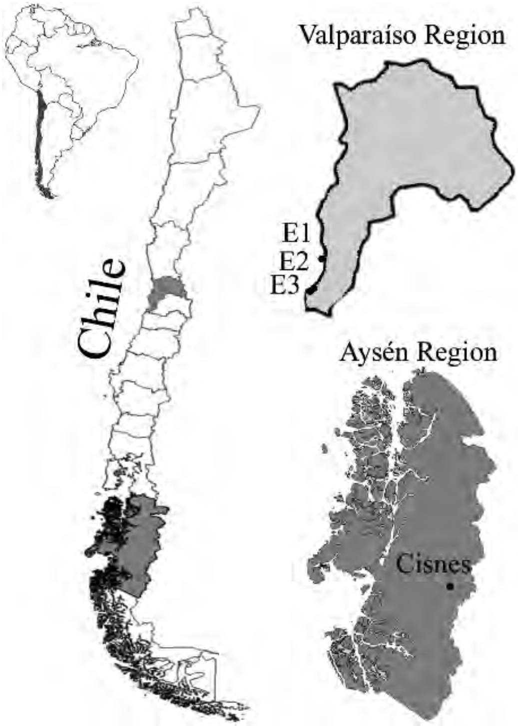

Fig. 1 — Location of **a**, Yali Complex, **b**, Lake Cisnes.

Table 1
Physico/Chemical parameters

Site	T (ºC)	pH	Conductivity (µS/cm)
L. Salinas E-1	13	9,4	667
L. Peral E-1	12	7,7	1288
L.Matanza E-2	12	7,5	1286
L.Colejuda E-3	11,6	8,4	52200
L. Cisnes	15,7	9,5	390

RESULTS

A total of 47 species, 24 genus and 7 families were recorded. Six of these species are new to Chile: a) *Eucypris virens*, b) *Cypris pubera*, c) *Heterocypris incongruens,* d) *Kapcypridopsis megapodus*, e) *Limnocythere patagonica*, f) *Penthesilenula incae* (Tab. 2, Fig. 2).

Table 2

Checklist of non-marine ostracods from Chile.

Phylum Crustacea Class Ostracoda Order Podocopida Family	**Genus**	**Species**	
Cyprididae	*Amphicypris*	*A. nobilis*	
	Chlamydotheca	*C. incisa*	
		C. symmetrica	
	Cypris	*C. pubera*	*C. pubera E1-E2**
		C. chilensis	*First record in S. America*
		C. bimaculata	
		C. ochracea	
		C. violacea	
		C. vidua	
	Cypridopsis	*C. pseudoparva*	
	Eucypris	*E. virens*	*E. virens E3 **
		E. noodti	
		E. trapezoides	
	Hemicypris	*H.salaria*	
	Heterocypris	*H.incongruens*	*H. incongruens E2-E3. First record in continental Chile*
		H.panningi	
		H.salina	
	Herpetocypris	*H.pectinata*	
		H.reptans	
	Ilyodromus	*I.verreauxi*	
	Kapcypridopsis	*K.megapodus*	*K. megapodus*: L. Cisnes*
	Isocypris	*I.beauchampi*	
	Neocypridopsis	*N.granulosa*	
		N. paradisea	
	Plesiocypridopsis	*P.silvestrii*	
	Sarscypridopsis	*S.aculeata*	
	Strandesia	*S.donnettii*	
		S.marina	
	Tanycypris	*T.marina*	
Notodromadidae	*Newnhamia*	*N.patagonica*	
Candonidae	*Candona*	*C.araucana*	
		C. albida	
		C.quasiincavum	
	Latinopsis	*L.patagonica*	
Ilyocyprididae	*Ilyocypris*	*I.bradyi*	
Darwinulidae	*Penthesilenula*	*P.araucana*	*P. incae* L. Cisnes*. Extended the distribution
		P. incae	
	Darwinula	*D. dicastrii*	
		D. sp	
Limnocytheridae	*Limnocythere*	*L. arthuri*	*L. patagonica* L. Cisnes*
		L. atacamae	
		L. inopinata	
		L. bradburyi	
		L.patagonica	
		L. sp	
	Cytheridella	*C. ilosvayi*	
Cytherideidae	*Cyprideis*	*C. beaconensis*	

* First record in Chile

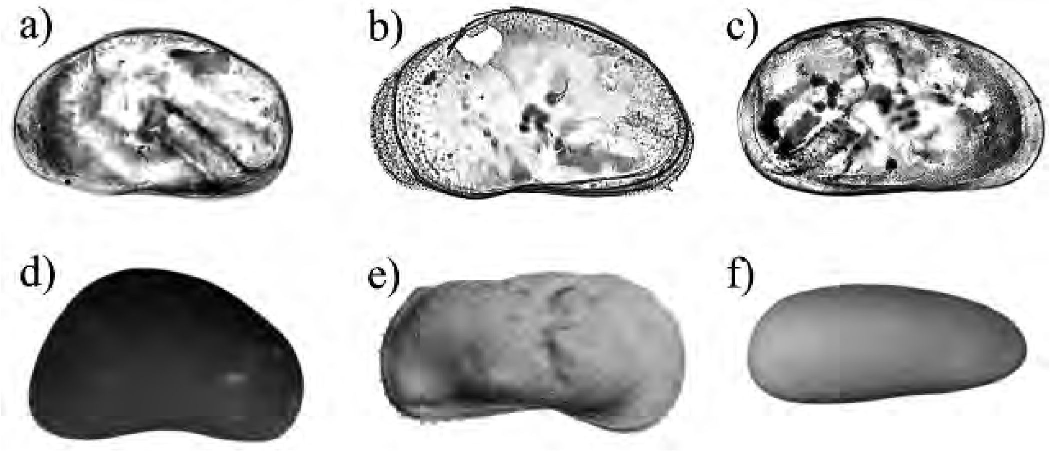

Fig. 2 — **a**, *Eucypris virens* (Jurine, 1820); **b**, *Cypris pubera* Müller, 1776; **c,** *Heterocypris incongruens* (Ramdohr, 1808), **d**, *Heterocypris salina* (Brady 1868); **e**, *Kapcypridopsis megapodus* Cusminsky and Whatley*,* 2005; **f**, *Limnocythere patagonica* Cusminsky and Whatley*,* 1996; **g**, *Penthesilenula incae* (Delachaux, 1928).

CONCLUSIONS

This work shows an updated checklist and new records of ostracods in Chile. Taxonomic and biogeographic knowledge of ostracods is a valuable tool for environmental studies and for the reconstruction of palaeoenvironments.

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REFERENCES

BREHM V., 1934. Über sudamerikanische Ostrakoden. *Zool. Anz.,*108: 74-85.

DADAY E., 1902. Mikroskopische Süswasserthiere aus Patagonien. *Természetrajzi fützetek.,* 25: 201-310.

KARANOVIC I., 2012. Recent freshwater ostracods of the world: Crustacea, Ostracoda, Podocopida. Springer Press, 604 pp.

LÖFFLER H., 1961a. Beiträge zur Kenntnis der iranischen Binnengewässer II. *Inter. Rev. Ges. Hydro,* 46: 309-406.

LÖFFLER H., 1961b. Zur Systematik und Ökologie der chilenischen Süß. *Beit. Neotr. Fauna* 2: 197-206.

MARTENS K. & BEHEN F., 1994. A checklist of the Recent non-marine ostracods from the Inland waters of South America. *Trav. Scientif. Mus. Nat. Hist. Natur.* 22: 84 pp.

Schwalb A. & Burns S.J.,1999. Holocene environments from stable isotope stratigraphy of ostracodes ans authigenic carbonates in Chilean Altiplano lakes. *Palaeogeogr. Palaeoclim. Palaeoecol.*, 148: 153-168.

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UPPER CRETACEOUS LIMNOCYTHERIDAE (*Ostracoda Crustacea*) FROM ARGENTINA

In the Upper Cretaceous of Argentina, although dominated by cypridoids, the limnocytherids are a common component of the ostracods associations. Several species were described from the Allen and Loncoche formations (late Campanian-early Maastrichtian, Neuquén Basin), recovered from sediments deposited under fresh to brackish water conditions. *Wolburgiopsis* sp. differs from *W. neocretacea* (Bertels) in its left valve that overlaps the right one in the posterior border, reticulated surface of broad *muri* and the smooth margins of the carapace. Both taxa presents spread sieve pores over the surface and are the most common limnocytherids in the associations. A related genus, *Looneyellopsis* KRÖMMELBEIN & WEBER, 1971 previously described from the Lower Cretaceous of Brazil and Argentina (MUSACCHIO, 1970), is represented in the uppermost Cretaceous of the Neuquén Basin by *Looneyellopsis* sp. This species presents the carapace surface strongly ornamented by tubercles, slender ribs and deep pits over the tubercles, resembling a honeycomb. Another component of the associations is *Paralimnocythere* Carbonnel, with two species characterized by a squarish posterior border, dorsal margin sloping backwards, and an alar expansion that modifies the carapace in dorsal view. Finally, the Timiraseviinae are represented by *Vecticypris* sp. 1, distinguishable by a swollen carapace with densely pitted surface (CARIGNANO & VARELA, 2011) and *Vecticypris* sp. 2, whose surface is covered by an irregular reticulum that becomes parallel to the margins of each valve.

In summary, during Campanian-Maastrichtian times the Limnocytherinae are represented by a group of small ostracods and become an important component of the assemblages, with the Timiriaseviinae remaining as a minor part. Probably, these taxa were better adapted to the changes in the environmental conditions, since several parts of Argentina were covered by a very shallow sea, with a flat coast and surrounded by lagoons with freshwater input.

On the other side, the limnocytherids described here show more affinities with those of the Adamantina Formation (Baurú Group, Brazil), considered by DIAS-BRITO *et al.* (2001) as Turonian-Santonian, rather than with the overlying Marília Formation (Maastrichtian). More studies in pre-Campanian sediments of the Neuquén Basin should be done to resolve this matter.

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REFERENCES

CARIGNANO A.P. & VARELA J.A., 2011. Ostrácodos (Crustacea) de la Formación Allen (Cretácico Tardío), Cuenca Neuquina, Argentina. *Revista Brasileira de Paleontologia,* 14: 169-178.

DIAS-BRITO D., MUSACCHIO E.A., CASTRO J.C., MARANHÃO M.S., SUÁREZ J. & RODRIGUES R., 2001 Grupo Bauru: uma unidade continental do Cretáceo no Brasil – concepções baseadas em dados micropaleontológicos, isotópicos e estratigráficos. *Revue de Paléobiologie*, 20: 245-304.

KRÖMMELBEIN K. & WEBER R., 1971. Ostracodes do Wealden do Nordeste Brasileiro. *Ciência Técnica Petróleo, Seção exploração de petróleo,* 16: 1-93.

MUSACCHIO E.A., 1970. Ostrácodos de las Superfamilias Cytheracea y Darwinulacea de la Formación La Amarga (Cretácico inferior) en la Provincia de Neuquén, República Argentina. *Ameghiniana*, 7: 301-316.

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OSTRACODS FROM SHALLOW LAKES IN CENTRAL SPAIN

The set of shallow lakes in the Biosphere Reserve of La Mancha Húmeda (Central Spain) is considered the main steppic wetland system of Western Europe (ALONSO, 1998). Located in the southern half of the Iberian central plateau, on the plains of Castilla-La Mancha (Spain), the lakes are characterized by an irregular hydrological regime, being relatively closed systems due to its deficient drainage with particular ecological conditions. The main factors influencing the biological communities are the temporality of the waters, the ionic composition and other stressing factors related with anthropogenic alterations (pollution, eutrophy, ephemerality) (ROCA *et al.,* 2000). This study is framed in a wide project about metacommunities of these lakes. Here, we present preliminary data on the distribution of ostracod species, abundance and assemblages from 30 shallow lakes, by analyzing surface sediment samples (n=61) obtained in different parts of the lakes from margin (littoral) to the centre (deepest part of the lake). Approximately 15 g of wet surface sediments were soaked in deionized water for about 12 h and were wet sieved with a 250 mesh sieve, to allow hand-pick ostracods under the binocular microscope. Only 34 of the 61 samples, corresponding to 18 lakes, contained ostracod remains. The lakes with highest numbers of valves per gram recorded were Pedro Muñoz, Miguel Esteban and Manjavacas. three endorheic lakes with high degree of deterioration (ROCA *et al.,* 2000). *Ilyocypris gibba* (Ramdohr, 1808) and *Heterocypris* showed the widest distribution, dominated by *Heterocypris barbara* (Gauthier & Brehm, 1928) (a typical halophilous species) and *Heterocypris salina* (Brady, 1868). Other abundant species were *Sarscypridop-*

sis aculeata (Costa, 1847), *Plesiocypridopsis newtoni* (Brady & Robertson, 1870) and *Potamocypris arcuata* (Sars, 1903). We also find other species poorly distributed, such as *Paralimnocythere psammophila* (Flössner, 1965), found in Navazuela, *Cypris bispinosa* (Lucas, 1849) and *Herpetocypris chevreuxi* (Sars, 1896) in Nava Grande de Malagón or *Eucypris mareotica* (Fischer, 1855), a typical inhabitant of high chloride waters (BALTANÁS *et al.*, 1990), which was reported in Manjavacas and Pedro Muñoz lakes. The lakes located in the Biosphere Reserve of La Mancha Húmeda represent unique ecosystems in the European context. This study will help us to understand these systems and use the acquired knowledge to better manage this interesting area.

REFERENCES

ALONSO M., 1998. Las lagunas de la España Peninsular. *Limnetica*, 15: 1-176.

BALTANÁS A., MONTES C. & MARTINO P., 1990. Distribution patterns of ostracods in iberian saline lakes. Influence of ecological factors. *Hydrobiologia*, 197: 207-220.

ROCA J.R., MEZQUITA F., RUEDA J., CAMACHO A. & MIRACLE M.R., 2000. Endorheic versus karstic lakes: patterns of ostracod distributions and lake typology in a Mediterranean landscape (Castilla-La Mancha, Spain). *Marine & Freshwater Research*, 51: 311-319.

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ANISONG CHITNARIN & SYLVIE CRASQUIN

PERMIAN OSTRACODS OF THE E-LERT FORMATION, NORTHEASTERN THAILAND

The siliciclastic strata of the E-lert Formation (CHAROENPRAVAT & WONGWANICH, 1976; CHAROENPRAVAT *et al.*, 1984) includes shales, siliceous shales and sandstones with rare bedded limestones and limestone blocks that outcrop west of Loei city, northeastern Thailand. The rocks are considered to represent turbidite deposits of probable Early Permian (Sakmarian-Artinskian) age, based mainly on ammonoid and radiolarian evidence (UENO & CHAROENTITIRAT, 2011).The presence of these open marine organisms permits an interpretion of a slope-to-basin depositional environment (FONTAINE *et al.*, 1999). In this study, limestone samples were collected from a single limestone bed within siliceous shales. Ostracods were separated from the rock by hot acetolysis technique (LETHIERS & CRASQUIN-SOLEAU, 1988; CRASQUIN-SOLEAU *et al.*, 2005), thereby yielding the first record of ostracods from the E-lert Formation. In addition, residues from conodont extraction yeilded many corroded ostracod specimens. More than fifteen genera have been identified; for example, *Bairdia, Liuzhinia, Baschkirina, Microcheilinella, Basslerella, Spinocypris*, *Bohemina*, *Paraberounella, Cyathus, Langdaia, Eukloedenella, Paraparchites, Samarella, Carinaknightina* and *Polycope.* Some of these genera are known to be deep water forms, others are shallow water components which are similar to the ostracods found in the nearby limestones (CHITNARIN *et al.*, 2012). The ostracod assemblages provide a paleoenvironmental interpretation of the E-lert Formation more precise than previous studies.

REFERENCES

CHAROENPRAVAT A., WONGWANICH T., TANTIWANIT W. & THEETIPARIVATA U., 1984. Geologic map of Changwat Loei (Sheet NE 47-12, scale 1: 250,000). Geological Survey Division, Department of Mineral Resources, Bangkok.

CHAROENPRAVAT A. & WONGWANICH T., 1976. Preliminary geology of Changwat Loei, (Map Sheet ND 47-12). Geological Survey Division, Department of Mineral Resources, Bangkok.

CHITNARIN A., CRASQUIN S., CHAROTITIRAT T., TEPNARONG P. & THANEE N., 2012 (in press). Ostracods (Crustacea) of the Early-Middle Permian from Central Thailand (Indochina block). Part I Order Palaeocopida. *Geodiversitas,* 34 (4).

CRASQUIN-SOLEAU S., VASLET D. & LE NINDRE Y.M., 2005. Ostracods from Permian-Triassic boundary in Saudi Arabia (Khuff Formation). *Palaeontology*, 48: 853-868.

FONTAINE H., SALYAPONGSE S. & VACHARD D., 1999. New carboniferous fossils found in Ban Bo Nam Area, Central Thailand. *In*: Khantaprab C. (ed.), Proceedings of the Symposium on Mineral, Energy, and Water Resources of Thailand: Towards the year 2000. Bangkok: 201-211.

LETHIERS F. & CRASQUIN-SOLEAU S., 1988. Comment extraire des microfossiles à tests calcitiques de roches calcaires dures. *Revue de Micropaléontologie*, 31: 56-61.

UENO K. & CHAROENTITIRAT T., 2011. Carboniferous and Permian. In: Ridd M.F., Barber, A.J. & Crow M.J. (eds.), The Geology of Thailand. *The Geological Society*, London, 626 pp.

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JEAN-PAUL COLIN

OSTRACODA IN THE PAST WORLDS, A CASE HISTORY: SOUTH ATLANTIC “PRE-SALT” PETROLEUM APPLICATIONS

Although the first mention of ostracodes in the Early Cretaceous of Brazil dates as far back as 1860 by JONES, the first paleontological evidences of continental drift were evoked by one of the pioneers of “industrial ostracodology”, GREKOFF as early as 1953. Working on Lower Cretaceous non-marine ostracodes from oil wells in Gabon, he remarked for the first time, the striking similarities between the Gabonese faunas and the Brazilian ones, tentatively correlating the Brazilian Aratú with the Gabonese Lower and Middle Cocobeach. He informed KRÖMMELBEIN who worked as consultant for the Brazilian national oil company and published the first paper on what is now known as “pre-salt” ostracodes, in 1961. At the beginning KRÖMMELBEIN was quite sceptical but was quickly convinced and in 1965-1966, published several papers demonstrating the great similarity of ostracode assemblages succession in the Gabonese Cocobeach series and the Brazilian, Bahia series of the Reconcavo-Tucano basins (KRÖMMELBEIN, 1965, 1966; KRÖMMELBEIN & WENGER, 1966). He was then followed by Petrobras ostracodologist, VIANA (1966) who divided the Bahia series of the Reconcavo/Tucano basins into 10 zones. GREKOFF & KRÖMMELBEIN (1967) finalized their collaboration in a reference publication comparing and illustrating ostracode faunas from the Cocobeach of Gabon and the Bahia Series of Brazil.

After this period, during many years, probably due to the “strong confidentiality”, very few papers has been published on this topic although many wells penetrating these productive non-marine series, have been drilled in Gabon, Congo, Cabinda and Brazil . We have to wait until 1972 for the work of MOURA, describing new species of ostracodes and the Reconcavo-Tucano basins. In 1988, the same author demonstrates the utility of ostracodes for the pre-salt stratigraphy in the Campos Basin. In west Africa, GROSDIDIER & BIGNOUNBA (1984), proved the invaluable value of ostracodes for the interpretation of the paleohydrological history of the Early Cretaceous lacustrine series of southern Gabon and gave correlations between the West African and Brazilian zonations. Finally, in 1996, GROSDIDIER *et al.* were allowed to release the ELF (now TOTAL) non-marine Lower Cretaceous biozonation of the Gabon and Congo Basins, in which they recognized 11 ostracode assemblage zones. This zonation is successfully applied by BATE *et al.* (2001) in the Kwanza Basin of Angola.

The renewal of interest for "pre-salt" Lower Cretaceous ostracodes in the South Atlantic is related with the recent enormous deep-water oil discoveries in the Aptian Alagoas, below the salt in the Santos basin, since 2006 (reserves estimated to more than 50 billion barrels). Equivalent prospects are expected to be found on the other side of the South Atlantic in Angola.

The implication of major oil companies in exploration focused on the "pre-salt" stimulate new research programs and this led to the publication of recent synthetic and taxonomic papers such as BATE (1999), who established a sequence-stratigraphic framework based on ostracodes in Angola, and recently POROPAT & COLIN (2012 a,b) who published two papers, a taxonomic reassesment of selected key genera and an exhaustive overview of the ostracod biostratigraphy of the Early Cretaceous of West Africa and Brazil.

REFERENCES

BATE R.H., 1999. Non-marine ostracod assemblages of the Pre-Salt rift basins of West Africa and their role in sequence stratigraphy, In: Cameron, N.R., Bate, R.H., Clure, V.S. (Eds.), The Oil and Gas Habitats of the South Atlantic: Geological Society Special Publication No. 153. *Geological Society*, London: 283-292.

BATE R.H., CAMERON N.R., BRANDÃO M.G.P., 2001. The Lower Cretaceous (Pre-Salt) lithostratigraphy of the Kwanza Basin, Angola. *Newsletters on Stratigraphy* 38: 117-127.

GREKOFF N., 1953. Sur l'utilisation des microfaunes d'ostracodes dans la stratigraphie précise du passage Jurassique-Crétacé (faciès continentaux). *Revue de l'Institut Français du Pétrole*, 8(7): 362-379.

GREKOFF N. & KRÖMMELBEIN K., 1967. Etude comparée des ostracodes mésozoïques continentaux des bassins atlantiques: série de Cocobeach, Gabon et série de Bahia, Brésil. *Revue de l' Institut Français du Pétrole,* 22 (9): 1304-1353.

GROSDIDIER E., BRACCINI E., DUPONT G. & MORO J.-M., 1996. Biozonation du Crétacé Inférieur non marin des bassins du Gabon et du Congo. In: Jardiné S., de Klasz I. & Debenay J.-P. (Edits.), Géologie de l'Afrique et de l'Atlantique Sud. *Bulletin des Centres de Recherche Exporation-Production Elf Aquitaine, Mémoire*, 16: 67-82.

GROSDIDIER E. & BIGNOUMBA J., 1984. Exemple de coupures écostratigraphiques basées sur un renouvellement des faunes d'ostracodes lacustres dans le Crétacé inférieur du rift atlantique au droit du Sud Gabon. *Géologie Méditeranéene*, 11: 87-95.

JONES T.R., 1860. Note of the fossil Entomostraca from Monserrate. In: ALLPORT, S. On the Discovery of some Fossil Remains near Bahia, in South America. *Quarterly Journal, Geological Society*, 16(1): 263-268.

KRÖMMELBEIN K., 1961. Stratigraphische Probleme in den wichtigsten Erdöl-Aufschlußgebieten Brasiliens. *Erdöl und Kohle*, 14: 893-900

KRÖMMELBEIN K. 1965. Neue, für Vergleiche mit West-Afrika wichtige Ostracoden-Arten der brasilianischen Bahia-Serie (Ober-Jura?) / Unter-Kreide in Wealden Fazies. *Senckenbergiana Lethaea*, 46: 177-213.

KRÖMMELBEIN K., 1966. On "Gondwana Wealden" ostracoda from NE Brazil and West Africa. In: van Hinte J.E. (Edit.), Proceedings of the 2nd West African Micropalaeontological Colloquium, Ibadan. E.J. Brill, Leiden: 113-119.

KRÖMMELBEIN K. & WENGER R., 1966. Sur quelques analogies remarquables dans les microfaunes crétacées du Gabon et du Brésil oriental (Bahia et Sergipe). In: Reyre D. (Edit.), Sedimentary Basins of the African Coasts. Part 1, Atlantic Coast. *Association of African Geological Surveys*: 193-196.

MOURA J.A., 1972. Algunas especies e subespecies nova de ostracodes da Bacia Reconcavo/Tucano. *Boletim Tecnico de Petrobras,* Rio de Janeiro, 15(3): 245-263.

POROPAT S. & COLIN J.-P., 2012a. Reassesment of the Early Cretaceous non-marine ostracod genera *Hourcqia* Krömmelbein, 1965 and *Pattersoncypris* Bate, 1972 with the description of a new genus, *Kroemmelbeincypris. Journal of Paleontology*, 86(4): 700-720.

POROPAT S. & COLIN J.-P., 2012b. Early Cretaceous ostracod biostratigraphy of eastern Brazil and western Africa: an overview. *Gondwana Research* doi: 10.1016/j.gr.2012.06.002

VIANA C.F., 1966. Correpondancia entre os ostracodes das series Cocobeach (Gabon) et Bahia (Brasil). *Boletim Técnico de Petrobras*, 9 (3/4): 111-135.

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DISTRIBUTION AND ECOLOGY OF FRESHWATER OSTRACODS FROM NORTHERN PATAGONIA: AN APPROACH

There are only a few studies about the ostracod faunal assemblages and their environmental requirements from Patagonia (e.g. Cusminsky *et al.*, 2011; Ramón Mercau *et al.*, 2012). Here we present the results of a survey of thirteen water bodies (streams, springs, temporary habitats) in Northern Patagonia (39° 52' – 41°50' S; 70°36' – 71°27' W) and their comparison with those of previous studies in the earstern Patagonia. The goal of this research is to enhance our understanding of the regional Patagonian ostracoda fauna and evaluate the relationship between ostracod species and physical and chemical (depth, temperature, pH, conductivity, dissolved oxygen concentration, seston and main ions) parameters of host waters along a W-E precipitation gradient (ranging from 1200 to 160mm/annually). To date, seven species were identified: *Amphicypris nobilis* Sars 1901*, Bradleystrandesia fuscata* (Jurine, 1820)*, Cypridopsis vidua* (O. F. Müller, 1776)*, Cypris pubera* O. F. Müller 1776, *Eucypris virens* (Jurine, 1820), *Heterocypris incongruens* (Ramdohr, 1808) and *Tonnacypris lutaria* (Koch, 1838). The more frequent species were *T. lutaria* and *E. virens*, while *A. nobilis* and *C. vidua* were only found in one site. Males of *A. nobilis* were found while the other species were represented only by females. The environment of this fauna is related to low conductivity and salinity in the water. Conversely, previous studies in the easternmost area of Patagonia have shown different fauna such us *Penthesinelula incae* (Delachaux, 1928), *Potamocypris smaradigma* (Vávra, 1891), *Ilyocypris ramirezi* Cusminsky and Whatley, 1996, *Limnocythere patagonica* Cusminsky and Whatley, 1996, *Eucypris fontana* (Graf, 1931), *Kapcypridopsis megapodus*

Cusminsky *et al.* 2005 and *Limnocythere rionegroensis,* Cusminsky and Whatley, 1996 living in comparatively higher conductivity (CUSMINSKY *et al.*, 2011). The latter suggest that the decreasing precipitation trend towards eastern Patagonia is reflected in the distribution of different ostracod fauna association. On the other hand, new distributions of cosmopolitan species are present, spreading out their geographical distribution to the Neotropical region (MARTENS *et al.*, 2008). Some of the species such us *C. pubera*, *E. virens* and *B. fuscata* have been also described in the Neartic region, suggesting that birds could be responsible to their dispersion. However, the mode of dispersion of *T. lutaria* in this region is still an open question.

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REFERENCES

CUSMINSKY G., SCHWALB A., PÉREZ A.P., PINEDA D., VIEHBERG F., WHATLEY R., MARKGRAF V., GILLI A., ARIZTEGUI D. & ANSELMETTI F.S., 2011. Late Quaternary environmental changes in patagonia as inferred from lacustrine fosil and extant ostracodes. *Biological Journal of the Linnean Society,* 103: 397-408.

MARTENS K., SCHÖN I., MEISCH C. & HORNE D.J., 2008. Global diversity of ostracods (Ostracoda, Crustacea) in freshwater. *Hydrobiologia*, 595(1):185-193.

RAMÓN MERCAU J., LAPRIDA C., MASAFERRO J., ROGORA M., TARTARI G. & MAIDANA N., 2012. Patagonian ostracods as indicators of climate related hydrological variables: implications for paleoenvironmental reconstructions in Southern South America. *Hydrobiologia*, 694(1): 235-251.

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SYLVIE CRASQUIN

OSTRACODS ON PERI-TETHYS MARGINS DURING PANGAEA TIMES (-360 TO -230MY): SOME HIGHLIGHTS

The evolution of Peri-Tethys margins is linked to the birth, the life and the disappearance of Tethys Ocean s.l. The whole period could be subdivided in three major intervals, that we might define as the Pangaea time, the Tethys time and the Alpine time. The Pangaea time includes the interval from the Early Carboniferous to the Late Triassic, the Tethys time the interval from latest Triassic to the Middle Cretaceous and the Alpine time to the more recent interval. In the talk, the focus will be done on Pangaea times. During this interval, from the Early Carboniferous (≈360My) to the end of Middle Triassic (≈230My), the Pangaea gathered. During this long time interval, ostracods permitted important progresses in our knowledge on Peri-Tethyan margins. This will be illustrated here by three highlights: the Early Carboniferous currentology in Europe, the evidence of palaeopsychrosphere during the Late Palaeozoic and the microbialite refuge after the Late Palaeozoic mass extinction

1. Early Carboniferous currentology in Europe

During the Tournaisian and the Visean, carbonated marine platforms extend on northern Europe. Analysis of Dinantian ostracod species allowed to establish palaeobiogeographic links between the different platforms surrounding the Variscan orogeny (CRASQUIN-SOLEAU & LETHIERS, 1993 and all references inside). The north-south fauna relationships between Armorican Massif and Ardenne, relatively close areas, are faint. On the contrary, those areas have a lot of common species with Russian platform and North Ameri-

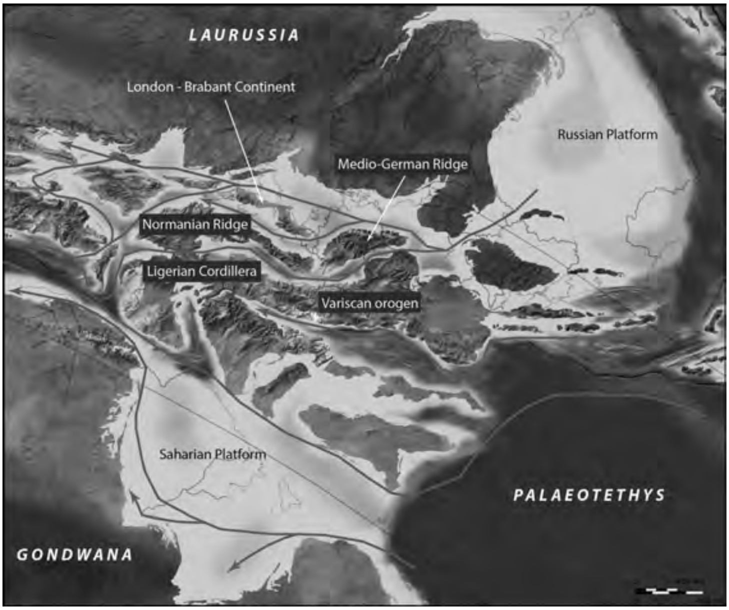

Fig. 1 — Reconstruction of palaeocurrents on European platforms during Early Carboniferous. Palinspastic map from Ron Blakey (http://cpgeosystems.com/paleomaps.html).

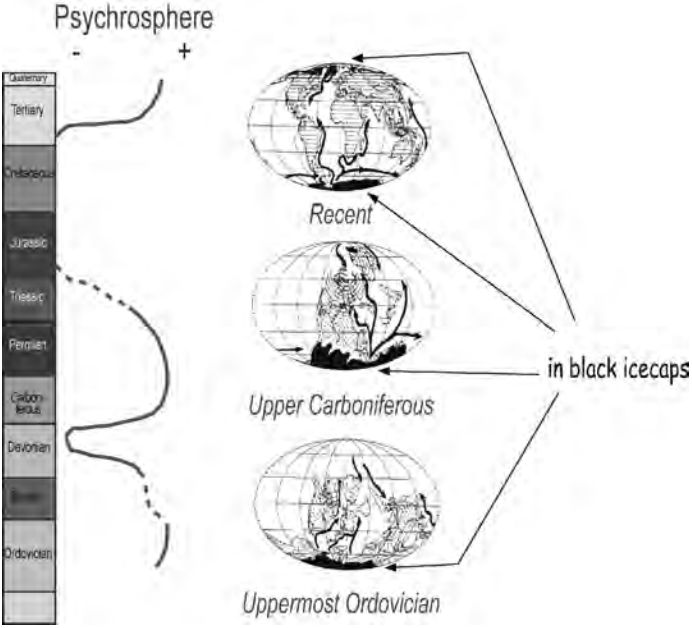

Fig. 2 — Psychrosphere through geological times (after Lethiers, 1998).

can platforms. Neither Normanian and medio-German ridges, nor a thermal barrier could explain this phenomenon. A currentological model was proposed to explain the Dinantian ostracod palaeobiogeography in Hercynian Europe. An east-west current, coming from Russian platform, favored faunal connections with Europe. A west-east counter current is also necessary. The current scheme in Europe was channeled, and probably emphasized, by a palaeogeography with long and narrow marine corridors.

2. Evidence of palaeopsychrosphere during the Late Palaeozoic-Early Triassic

The palaeopsychrospheric ostracods, indices of deep water environments, differ from contemporary neritic forms by their thin tests and/or the presence of very well developed spines. During the Late Devonian - Dinantian interval, such forms are associated with bathyal facies, in low energy cold water, and probably with low oxygen content (Lethiers & Crasquin, 1987; Crasquin-Soleau *et al.*, 1989; Lethiers & Feist, 1991). The palaeopsychrosphere existed twice before Present: during Late Ordovician and during Carboniferous – Permian. The palaeopsychrospheric ostracods are known from Late Ordovician to Early Triassic. This fauna is restricted to deep water environments, from 500 m to 5000 m deep, in connection with a global ocean

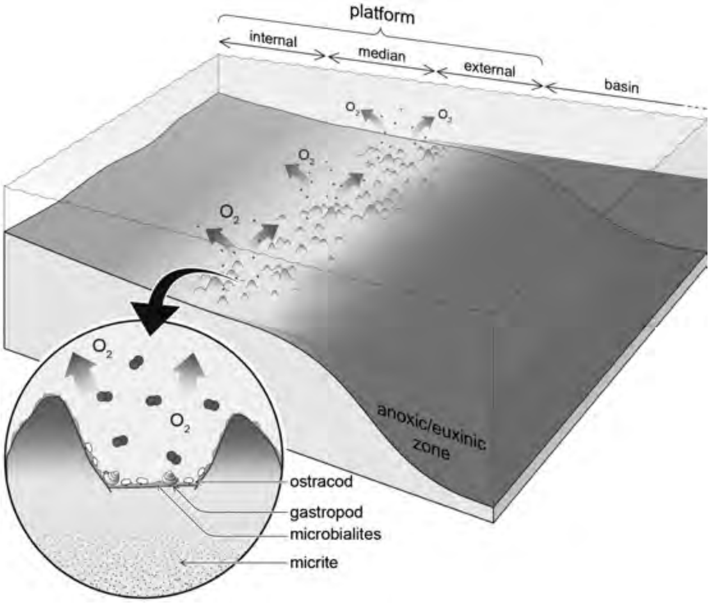

Fig. 3 — Schematic showing ecosystem functioning associated with Permian - Triassic boundary microbialites (in Forel *et al.,* 2012).

supplied with cold water by ice-caps. For the time being, we have no data outside of Palaeo-Tethys.

3. The microbialite refuge after the Late Palaeozoic mass extinction

Permian – Triassic boundary microbialites are thin carbonates formed after the end-Permian mass-extinction. They are abundant in low-latitude shallow-marine carbonates shelves of central Palaeo-Tethys continents but are rare in higher latitudes, liked inhibited by clastic supply on Pangaea margins (KERSHAW *et al.;* 2007, 2011, 2012). We studied in great detail the ostracods associated with microbial crusts in the aftermath of the most devastating extinction, the end-Permian extinction (EPE). These post-extinction microbialites dominated shallow shelf marine environments and were traditionally considered as devoid of any associated fauna. This dataset documents the proliferation of ostracods strictly associated with microbialites. Based on the diet of extant ostracods and uniformitarianism, we propose that the abundant microbes in the mats served as an unlimited food supply. Photosynthetic cyanobacteria may also have locally provided oxygen under low oxygen conditions interpreted by others (BOND & WIGNALL, 2010; CHEN *et al.*, 2010; LIAO *et al.,* 2010) for the microbialites. Microbialites provided a specialized environment that may have acted as refuge for ostracods in the immediate aftermath of the EPE. The surviving faunas may have been progenitors for the starting of the latter radiation (FOREL *et al.*, 2009, 2012; FOREL, 2012).

REFERENCES

BOND D.P.G. & WIGNALL P.B., 2010. Pyrite framboid study of marine Permian-Triassic boundary sections: A complex anoxic event and its relationship to contemporaneous mass extinction. *Geological Society of America Bulletin*, 122 (7/8): 1265-1279.

CHEN L., WANG Y., XIE S., KERSHAW S., DONG M., YANG H., LIU H., & ALGEO T.J., 2010. Molecular records of microbialites following the end-Permian mass extinction in Chongyang, Hubei Province, South China. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 308: 151-159.

CRASQUIN-SOLEAU S., AGUIRRE P. & PERRET M.-F., 1989. Premiers Ostracodes profonds du Carbonifère inférieur français (Pyrénées Occidentales). *Comptes Rendus de l'Académie des Sciences*, 309: 389-395.

CRASQUIN-SOLEAU S. & LETHIERS F., 1993. Distribution provinciale des ostracodes dinantiens: implications paléocourantologiques en Europe. *Bulletin Société Géologique de France*, 164 (2): 155-163.

FOREL M.-B., CRASQUIN KERSHAW S., FENG Q., & COLLIN P.Y., 2009. Ostracods (Crustacea) and water oxygenation on the earliest Triassic of South China: implications for oceanic events at the end-Permian mass extinction. *Australian Journal of Earth Sciences* 56: 815-823.

FOREL M.-B., CRASQUIN S., KERSHAW S., & COLLIN P.Y., 2012. In the aftermath of the end-Permian extinction: the microbialite refuge? *Terra Nova*. DOI:10.1111.ter.12017.

FOREL M.-B., 2012. Ostracods (Crustacea) associated with microbialites across the Permian-Triassic boundary in Dajiang (Guizhou Province, South China). *European Journal of Taxonomy*, 19: 1-34.

KERSHAW S., LI Y., CRASQUIN-SOLEAU S., FENG Q., MU X., COLLIN P.Y., REYNOLDS A. & GUO L., 2007. Earliest Triassic microbialites in the South China block and other areas: control on their growth and distribution. *Facies*, 53: 409-425.

KERSHAW S., CRASQUIN S., LI Y., COLLIN P.Y., FOREL M.-B., MU X., BAUD A., WANG Y., XIE S., MAURER F. & GUO L., 2012. Microbialites and global environmental change around the Permian-Triassic boundary: a synthesis. *Geobiology*, 10: 25-47.

KERSHAW S., CRASQUIN S., FOREL M.-B., RANDON C., COLLIN P.Y., KOSUN E., RICHOZ S., & BAUD A., 2011. Earliest Triassic microbialites in Çürük Dag, southern Turkey; composition, cyclicity and controls on formation. *Sedimentology*, 58 (3): 739-755.

LETHIERS, F. & CRASQUIN, S. 1987. Reconnaissance des milieux profonds de la Paléotéthys a l'aide des ostracodes. *Bulletin de la Société Géologique de France*, 8, 3(3): 415-423.

LETHIERS F. & FEIST R., 1991. Ostracodes, Stratigraphie et Bathymétrie du passage Dévonien-Carbonifère au Viséen inférieur en Montagne Noire (France). *Geobios*, 24 (1): 71-104.

LIAO W., WANG Y., KERSHAW S., WENG Z., & YANG H., 2010. Shallow-marine dysoxia across the Permian–Triassic boundary: Evidence from pyrite framboids in the microbialite in South China. *Sedimentary Geology* 232: 77-83.

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QUATERNARY OSTRACODA FROM THE ARCTIC OCEAN: SEA ICE AND OCEAN CIRCULATION VARIABILITY OVER ORBITAL TIMESCALES

The Arctic is experiencing major changes in sea-ice cover, ocean temperature and marine ecosystems that many hypothesize are caused by anthropogenic influence on polar climate. In order to understand the impacts of climatic change on the Arctic Ocean, it is instructive to examine past climate changes and their impacts. We analyzed ostracode assemblages from six piston cores from the Northwind and Mendeleev Ridges in the Amerasian Basin and the Lomonosov Ridge in the central Arctic to reconstruct paleoceanographic history during Quaternary glacial-interglacial cycles. These cores come from water depths ranging between 700 and 2000 meters and the sediments recovered represent glacial-interglacial cycles of the past ~700 ka (kiloannum) including the mid-Brunhes climatic transition (~ 700-300 ka). The most important ostracode taxa (and their paleoceanographic significance) include *Acetabulastoma arcticum* and *Pseudocythere caudata* (perennial sea ice), *Polycope* spp. (productivity and sea ice), *Krithe glacialis* and *Henryhowella asperrima* (partially sea-ice free conditions, deep water formation), *Pterygocythereis vannieuwenhuisei* (warm interglacial conditions). Results indicate a seasonally sea-ice free western Arctic during an exceptionally warm interglacial period ~ 400 ka (Marine Isotope Stage 11, MIS 11) and a major faunal turnover at approximately 300 ka when *P. vannieuenhuisei* became extinct. During this faunal and climatic transition, ostracode assemblages characteristic of interglacial and interstadial periods (MIS 9, 7, 5, 3, 1) first appeared in the Arctic. These changes signify the initial development of interglacial periods characterized by perennial sea ice, such as existed during the

late Holocene interglacial. In addition to orbital-scale paleoceanographic variability, ostracode assemblages vary over millennial timescales, which signify changes in ocean circulation during the glacial, deglacial and interglacial periods.

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TWO COASTAL SINKHOLE LAKES IN SW SICILY (ITALY) REVEAL LOW-SALINITY EXCURSION DURING GREEK AND ROMAN OCCUPATION

Disentangling the effects of the various paleoenvironmental vectors on proxy records from coastal lakes is challenging, especially in the Mediterranean region where the influence of effective moisture (climate) and its seasonality, local basin hydrogeology, humans, and sea level rise may all play a role in proxy response. Gorgo Basso (37.609°N, 12.655°) and Lago Preola (37.621°N, 12.638°W) (Trapani, Sicily), have yielded cores with published ca. 10,000 yr-long pollen and sedimentology records (Tinner *et al.*, 2009; Calò *et al.*, 2012). The lakes occur in endorheic basins formed by dissolution of gypsum. Although less than 1 km apart, the modern hydrochemistry of these two lakes is different. Gorgo Basso has low total dissolved solids (TDS) of about 40 mg/L and receives recharge from local shallow aquifers. The TDS of modern, ephemeral Lago Preola ranges from about 400 to 3000 mg/L; piper plots reveal that Lago Preola is a mixture of marine water, precipitation, and shallow groundwater (Cusimano *et al.*, 2006). The ecology of pre-modern ostracodes indicates Holocene Lago Preola was a permanent lake with a higher TDS than modern.

In spite of their contrasting hydrology, only *Cyprideis torosa* is unique to the Lago Preola record, and *Cypria ophtalmica, Cypris bispinosa*, and *Pseudocandona albicans* to the Gorgo Basso record. Both records include *Candona angulata*, *Heterocypris salina*, *Sarscypridopsis aculeata*, *Limnocythere inopinata*, *L. stationis*, *Darwinula stevensoni*, *Ilyocypris gibba* and *Cypridopsis vidua*. Transfer function reconstructions based on Mediterranean sites (Mezquita *et al.*, 2005) corroborates other lines of evidence that, over the past 10,000 years,

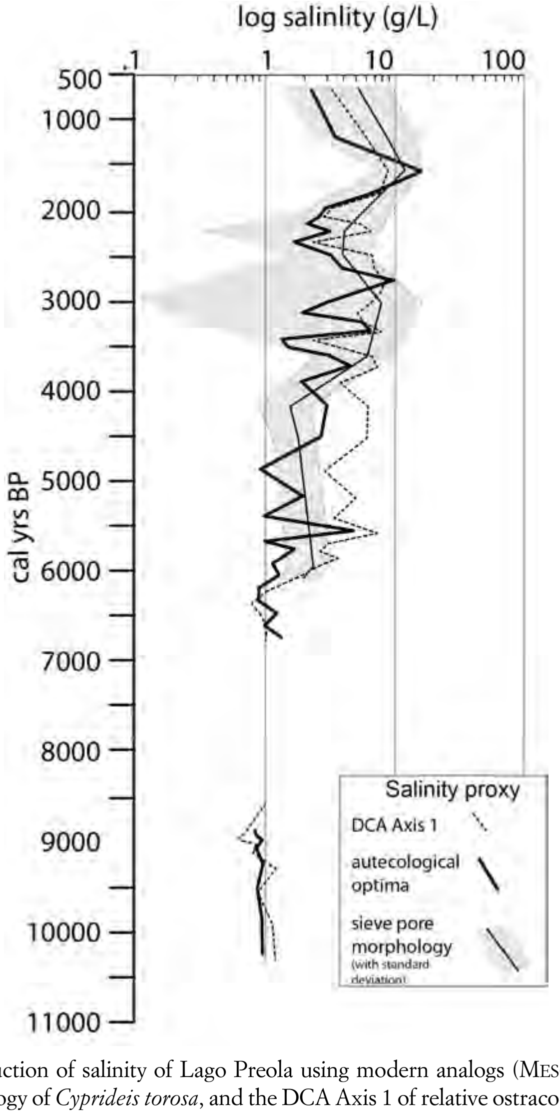

Fig. 1 — Reconstruction of salinity of Lago Preola using modern analogs (Mesquita *et al.*, 2005), sieve pore morphology of *Cyprideis torosa*, and the DCA Axis 1 of relative ostracode abundance data.

the TDS of Lago Preola has been about one order magnitude greater than that of Gorgo Basso (mean values of about 3,000 vs. 700 mg/L). This also is reflected in the higher valve concentration of Lago Preola compared to Gorgo Basso (29.5 vs. 3.0 valves/cm^3 dry sediment, respectively) and maximum sample interval concentration (168 vs. 14 valves/cm^3).

The most remarkable aspect of the Gorgo Basso record is the abrupt appearance of *C. ophtalmica* at 2,650 cal yr BP coincident with the establishment of Greek culture, and the proliferation of this species during the Roman period. *C. ophtalmica* thrives in low TDS environments with seasonal anoxia that is lethal to most other species (CURRY & FILIPPELLI, 2010). We attribute the abundant anoxia-tolerant ostracodes during these periods to anthropogenic addition of limiting nutrients to waters with relatively low TDS.

In addition to transfer function, other proxies have been explored at Lago Preola to reconstruct past salinity, including stable isotopes (C,O) and Sr/Ca for *Cyprideis torosa* and *Candona angulata*, and sieve pore analysis of *C. torosa* valves (Fig. 1). An intriguing trend observed in most proxy data is the short-lived period of lower salinity from seven samples dating at 2,640 to 1,970 cal yr BP (mean TDS ~3,000 mg/L) that are sandwiched between samples indicating very high salinity (2,780 cal yr BP = 11,100 mg/L TDS and 1,560 cal yr BP = 18,600 mg/L). Is this an indication of relatively high available moisture that helped to establish southwestern Sicily as an agricultural center, and facilitate the rise of Greek civilization? Likewise, did the dry conditions suggested by high salinity at 1,560 cal yr BP help destabilize the Roman Empire, at least in Sicily?

REFERENCES

CALÒ C., HENNE P.D., CURRY B., MAGNY M., VESCOVI E., LA MANTIA T., PASTA S., VANNIERE B. & TINNER W., 2012. Spatio-temporal patterns of Holocene vegetation change in southern Sicily. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 323-325: 110-122.

CURRY B.B. & FILIPPELLI G.M., 2010. Episodes of low dissolved oxygen indicated by ostracodes and sediment geochemistry at Crystal Lake, Illinois, USA. *Limnology and Oceanography*, 55(6): 2403–2423.

CUSIMANO G., HAUSER S. & VASSALLO M., 2006. Hydrogeochemistry of a wetland area of southwestern Sicily (Italy). E-Water (European Water Association), 13 pp.

MEZQUITA F., ROCA J.R., REED J.M. & WANSARD G., 2005. Quantifying species–environment relationships in non-marine Ostracoda for ecological and palaeoecological studies: Examples using Iberian data. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 225: 93-117.

TINNER W., VAN LEEUWEN J.F.N., COLOMBAROLI D., VESCOVI E., VAN DER KNAAP W.O., HENNE P.D., PASTA S., D'ANGELO S. & LA MANTIA T., 2009. Holocene environmental and climatic changes at Gorgo Basso, a coastal lake in southern Sicily, Italy. *Quaternary Science Reviews*, 28: 1498-1510.

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CAROLINA D'ARPA , ENRICO DI STEFANO & RODOLFO SPROVIERI

PALAEOECOLOGY OF EARLY PLEISTOCENE (SICILIAN SUBSTAGE) OSTRACODA FROM BELICE VALLEY, SOUTHWESTERN SICILY

This paper presents preliminary results from the on-going study on the Ostracods of the Casa Parrino section, in southwest Sicily, Italy (Fig. 1). The first report regarding Ostracoda from the Sicilian substage of the Belice Valley area was made by RUGGIERI, 1977, who listed "northern guests" from the Casa Catarinicchia section (not too distant from the Casa Parrino section).

The succession crops out to the right of the terminal part of the Belice river (Fig. 2); the study section is located in the upper part of a predominantly clayey monoclinal, tilted a few degrees south and referred to the Lower Pleistocene (upper Emilian, Sicilian).

The sediments of the Lower Pleistocene unconformably overlie the Pliocene Trubi Fm. (DI STEFANO et al., 1991); the sequence starts with 1.25 m of silty clay marls, passing into sands and topped off with a 0.90 cm thick layer of greyish biocalcarenites ; the section is closed by clays and yellow sands. The entire sequence is cut off by erosional phase which gave origin to the Great Upper Terrace (G.T.S).

The study of foraminifers and pteropods (DI STEFANO et al., 1991; BUCCHERI, 1985) allowed to analyze the environmental evolution of the succession referred to the lower part of the *Pseudoemiliania lacunose* Zone. An almost complete interglacial-glacial cycle was recognized, that gave rise to the biocalcarenite stratum rich in *Artica islandica* and *Limacina retroversa* (BUCCHERI, 1985), showing a great climatic instability in that time interval.

The biostratigraphic correlations made between the top of the biocalcarenite bed of Casa Parrino and the top of the Sicilian substage stratotype

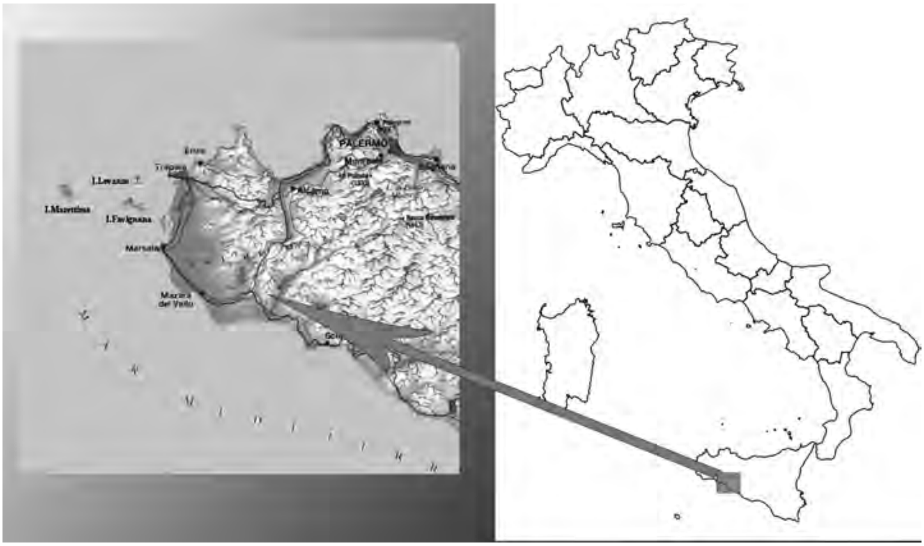

Fig. 1 — Location map of the study area in southwest Sicily, Italy.

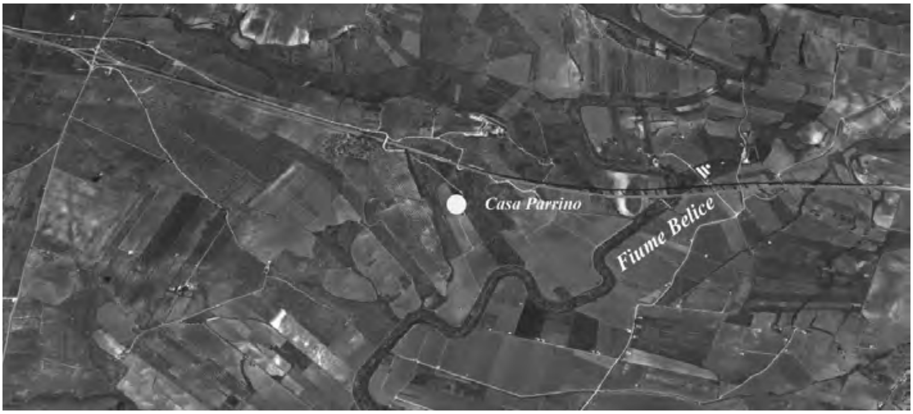

Fig. 2 — Location map of Casa Parrino section.

section of Ficarazzi (SPROVIERI, 1984; BUCCHERI, 1984; DI STEFANO & RIO, 1981) enable us to refer it to the top of the Sicilian substage.

For these reasons the Casa Parrino section might represent a valid succession to investigate and confirm the relationships between ostracod associations and palaeoclimatic/palaeoecological changes.

The goal of this research, is to detail the bathymetric and palaeoecological evolution of the whole Casa Parrino succession and to compare the obtained palaeo-ecological data with those of foraminifera and pteropods (well-known from literature: DI STEFANO et al., 1991; BUCCHERI, 1985).

Another aim of this study is to verify the presence of other "northern guests" in the Early Pleistocene (Sicilian) succession beyond those already reported by RUGGIERI, 1977 and FARANDA & GLIOZZI, 2011.

The same samples used for the biostratigraphic detailed study based on foraminifera and nannofossils (DI STEFANO et al., 1991) were kindly provided by the authors for the ostracods study. For this abstract, only the first 12 samples were picked and taxa were investigated to a generic level, although more detailed determinations are in progress.

Ostracods are fairly frequent in samples from 1 up to 6. They are generally well-preserved as loose valves; even delicate structures like the wing-like expansions of *Cytheropteron* are usually well-preserved. Many species are represented by both juvenile and adult specimens, which bear witness to all stages of ontogenetic development. From sample 7 a change in ostracod association is evident; they are often preserved as fragment and show lower frequencies that further decrease progressively upwards.

The assemblages of samples 1 and 2 include genera *Henryhowella, Cytherella, Cytheropteron*, and very rare *Semicytherura* and *Sagmatocythere*; *Henryhowella* is the most abundant. The association is typical of a circalittoral marine environment with depths of about 150 meters.

The gender *Henryhowella*, as well as *Cytheropteron*, is not very abundant in samples 3, 4 and 5. *Cytherella* becomes sporadic while *Cytherura*, *Semicytherura*, *Sagmatocythere, Bosquetina,* and *Paracytheridea* are numerous. The presence of *Semicytherura* and *Paracytheridea* seem to indicate a depth decrease.

From sample 7 to sample 11 a decrease in the ostracod frequencies is clearly evident and specimens are often preserved as fragments. The association consists of abundant *Semicytherura, Cytherura, Eucythere, Loxoconcha,* and *Phlyctocythere*; some representatives of the genus *Aurila* appear and *Henrhyowella* is always present. This association is typical of depths between 70 and 50 meters.

The on-going study shows systematic changes in faunal composition within each assemblage, which take place from the lowest to highest samples, corresponding to a decrease in depth and a lower sedimentation rate.

REFERENCES

BUCCHERI G., 1984. Pteropods as climate indicators in Quaternary sequences: a lower-middle Pleistocene sequences outcropping in Cava Puleo (Ficarazzi, Palermo, Italy). *Paleogeogr. Paleoclimat. Paleoecol.*, 45: 75-86.

BUCCHERI G. 1985. Osservazioni paleoclimatiche al limite Pleistocene inferiore-Pleistocene medio della foce del Belice (Sicilia sud-occidentale) mediante l'uso degli Pteropodi. *Boll. Soc. Geol. It.*, 104: 115-122.

DI STEFANO E., SPROVIERI R. & SCARANTINO S. 1991. Biostratigrafia e paleoecologia della sezione intrapleistocenica di Casa Parrino (Foce del Belice, Sicilia Sud-Occidentale). *Nat. Sic.,* XV:115-148.

DI STEFANO E. & RIO D., 1981. Biostratigrafia a nannofossili e biocronologia del Siciliano nella località tipo Ficarazzi (Palermo, Sicilia). *Ateneo Parmense Acta Naturalia*, 17: 97-111.

FARANDA C. & GLIOZZI E. 2011. A revision of the "northern guest" ostracoda (Crustacea) occurence in the quaternary of the mediterranean area. *Il Quaternario*, 24: 75-92.

SPROVIERI R., 1985. Paleoecological results from foraminiferal assemblage at the top of the Sicilian stratotype-section (Ficarazzi, Palermo, Italy). *Boll. Soc. Paleont. Ital.*, 24:3-11.

RUGGIERI G., 1977. Nuovi ostracodi nordici nel Pleistocene della Sicilia. *Boll. Soc. Paleont. It.*, 16: 81-85.

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LAURENT DECROUY, TORSTEN WALTER VENNEMANN,
THIERRY ADATTE & JEAN-LUC LOIZEAU

EVOLUTION OF OSTRACOD FOSSIL ASSEMBLAGE IN THE PETIT LAC (LAKE GENEVA, SWITZERLAND) TAPHONOMIC ISSUES OR MAJOR ENVIRONMENTAL CHANGE?

Ostracod fossil assemblages can be used to reconstruct changes in palaeo-environmental conditions. This can only be done if the species ecology is well known. In addition, the fossil assemblage should reflect as faithfully as possible the living fauna. Yet, biostratinomic processes such as post-mortem transport can substantially alter the ostracod fossil assemblage. Hence, silty sediments are generally preferred for sampling of ostracod because this grain size fraction generally corresponds to low energy environments where reworking of ostracod valves is minor. Studies of the age structure of the population, i.e. the variation in individual abundance for each instar of a given species, also allow the thanatocoenosis to be checked for size sorting and hence post-mortem transport. Interpretations of population structures are often not straightforward though, and other information is needed to discriminate changes due to biostratinomic processes from a real change in the ostracod fauna.

The present study examines a short sediment core dated by ^{137}Cs and ^{14}C taken at 58 m water depth in the Petit Lac (Lake Geneva, Switzerland). Sediments consist of fine silts and visual inspection suggests a continuous sequence without any perturbing events except an increase of organic matter content in the upper part of the core, which corresponds to the anthropogenic nutriment overload that affected Lake Geneva during the 19-20th century. The study of the ostracod fossil assemblage indicates that during the thousand years preceding the 19th century, the population was dominated by *Candona neglecta* and *Cypria lacustris* while *Limnocytherina sanctipatricii* and

Leucocythere mirabilis have had stable populations. Although the two last mentioned species disappeared at the beginning of the 19th century, the population of *C. neglecta* increased dramatically during the 19-20th century (tenfold increase). This increase coincides with the appearance of *Cytherissa lacustris* in the abyssal zones, a species that became dominating ever since. While this change in fossil assemblage is readily attributable to an increase of food resources in a well-oxygenated environment, the presence of numerous valves belonging to littoral species as well as a major change in the population structure point to important post-mortem transport. Additional analyses of sediment grain size, sieve residues and bulk sediment geochemistry support a complex combination between a control of bottom currents on sediment constituents, with a high proportion of within-habitat post-mortem transport of parautochthonous material (ostracod plus fine sediment) and little reworking of allochthonous ostracod valves (littoral species) and a real change in the autochthonous ostracod fauna. The comparison between the living ostracod fauna and the abundance of adults in core sediments supports the hypothesis that the increase in ostracod fossil abundance during the 19-20th century is, in part, due to an increase of the ostracod population. Besides, bottom currents in the Petit Lac are mainly induced by strong wind action. Hence, the change in bottom current strength and/or direction indicated by the change in the population structure provides additional information on changes in atmospheric conditions and, therefore, on climate.

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HUGO DELILE, ILARIA MAZZINI, JANNE BLICHERT-TOFT, JEAN-PHILIPPE GOIRAN,
FLORENT ARNAUD-GODET, FRANCIS ALBAREDE, SIMON KEAY

DEFINITION OF A NEW APPROACH IN ANCIENT HARBOR GEOARCHAEOLOGY: GEOCHEMISTRY AND OSTRACOD ANALYSES AT PORTUS (TIBER DELTA, CENTRAL ITALY)

Portus constituted the harbour complex of imperial Rome from the 1st century AD onward.

Located in a deltaic environment, the harbour was subject to influences of the Tyrrhenian marine environment and of the fluvial waters of the Tiber River. Such complex sedimentary processes registered also rapid environmental changes. Our research is based on the study of a sediment core (TR14) drilled in the access channel of the hexagonal basin of Trajan (Fig. 1). The goal of our study is the reconstruction the palaeo-environmental dynamics of the water column of the harbour according to a geochemical and an ostracodological approach.

The analysis of the ostracod assemblage has evidenced several palaeoenvironmental phases. These phases could be identified through the autoecological analysis of the 25 recognised taxa and their classification in four ecological groups (MAZZINI *et al.*, 2011). The results obtained present a succession of four environments, defined by variations in salinity and oxygenation.

From the bottom to a depth of 643 cm, the environment was a marine to brackish lagoon influenced by strong marine inputs as evidenced by the vicariance of *Cyprideis torosa* and *Pontocythere turbida*. *P. turbida* is a typical phytal ostracod often found together with *Posidonia oceanica* remains. From 600 to 454 cm the coastal marine environment becomes more stable. This could be linked to the establishment of the harbour activities and maintenance. The stability of the environment is still evident in the subsequent group, from 435 to 305 cm, characterised by the dominance of *C. torosa* and the lack of any fresh-

Fig. 1 — Location of the study area and of the TR14 core.

water influence. The increase in salinity could be related to evaporative effects on a closed body of water. From 300 cm the freshwater input becomes clear and constant although the influence of the close sea/brackish body of water is still noticeable. In the last metres a typical freshwater assemblage is represented, dominated by truly freshwater taxa (*Candona* sp. and *Pseudocandona marchica*), evidence for the occurrence of a freshwater marsh.

The geochemical results were analysed by Principal Components Analysis (PCA). The samples were assembled in several groups based on a Hierarchical Ascendant Classification (cluster analysis). Through PCA analysis, the geochemical and ostracological results of the "functional" harbour unit (800-300 cm) were combined. The different elements recorded in the geochemical analysis are distributed according to the main ostracod assemblages (from fresh water to brackish water and sea water). These elements have been grouped according to the model proposed by SAGEMAN & LYONS (2003). An evolution of these deposits in three stages is proposed. While the fluvial environments were quite well oxygenated, the harbour environment was more characterised by an increasing anoxia of the water column as it was observed by ELMALEH *et al.* (2012) in the harbor of Tyre. In a second phase, the variations in salinity distinguished the nature of the fluvial environments and the degree of openness to the sea of the harbour environment. The final phase is specific to a body of water completely isolated from fluviatile and marine influences and could be well representd by the fresco painted by Danti in 1582 in which the basin of Claudius is dried up, while Trajan's hexagonal basin and its access channel constitute a completely isolated marsh.

One of the objectives of this study was to determine the sedimentary sources of the different granulometric fractions, in order to evaluate their respective role in the sedimentation of the basin of Trajan. Comparison of the geochemical data and the granulometric data has led us to propose a fluvial origin for the fine particles (clays, silts, and very fine sands) and a marine origin for the sandy particles from the harbour of Claudius.

This multi-proxy study also provided the opportunity to identify the sedimentary sources of the fine and sandy particles of the harbour basin originating respectively from the fresh water of the Canale Traverso and the sea water of the port of Claudius.

REFERENCES

ELMALEH A., GALY A., ALLARD T., DAIRON R., DAY J. A., MICHEL F., MARRINER N., MORHANGE C. & COUFFIGNAL F., 2012. Anthropogenic accumulation of metals and metalloids in carbonate-rich sediments: Insights from the ancient harbor setting of Tyre (Lebanon). *Geochimica et Cosmeochimica Acta*, 82: 23-38.

MAZZINI I., FARANDA C., GIARDINI M., GIRAUDI C. & SADORI L., 2011. Late Holocene Palaeoenvironmental Evolution Of The Ancient Harbour Of Portus (Latium, Central Italy). *Journal of Palaeolimnology*, 46: 243-256.

SAGEMAN B.B. & LYONS T.W., 2003. Geochemistry of Fine-grained Sediments and Sedimentary Rocks, In *Treatise on Geochemistry* 7: 115-158.

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ANALÍA DÍAZ & ESTELA LOPRETTO

LIFE CYCLES OF TWO SPECIES OF *CHLAMYDOTHECA* (SARS, 1901) (*Crustacea Ostracoda*) REARED IN LABORATORY

The ontogenetic development of the order Podocopida-containing 8 postembryonic instars that are carried out successively up to the adult (KESLING, 1951)-is regular anamorphic (KAESTNER, 1970) with the presence of a larval nauplius preceded by a prenauplius that occurs within the egg (ROESSLER, 1982). As KESLING (1951) observed, the appearance, growth, and changes in the limbs throughout the different instars are closely related to those same changes in the carapace. Nevertheless, the fifth pair of appendages in the cyprididans appears after the third, rather than the second, molt (MEISCH, 2000). The early studies on the carapace and limb morphology of the postembryonic instars of the Cyprididae are summarized in KUBANÇ *et al.* (2007).

The genus *Chlamydotheca* is a typical representative of the Neotropical ostracod fauna that occupies lotic and lentic environments including temporary and permanent ponds. The adult of both species of the genus *Chlamydotheca* (Sars, 1901) has been described in previous publications about the distribution of the genus (DÍAZ & LOPRETTO, 2011). Postembryonic instars of two species of the non-marine ostracod *Chlamydotheca* (Sars, 1901) were reared in the laboratory from parthenogenetic females collected from Pampasic temporary ponds in Argentina. This is the first detailed postembryonic study of the carapace and limbs of the entire series of juvenile instars in this species.

Samples were obtained during October through December of 2007 and 2008 from temporary ponds in Pereyra Iraola Park (34° 50’ S – 58° 13’ W) in Buenos Aires province, Argentina. The genus *Chlamydotheca* was selected to study ostracod ontogeny because the species are large enough to permit each juvenile instar to be easily seen, handled, and dissected. Cultures were established in the laboratory. Culture media were prepared with the filtered and previously boiled water from the ostracods' ponds of origin and supplemented by the periodic addition of tiny proportions of commercial canned water-packed tuna. The aquaria were equipped with aerators. In order to follow the life cycle, the larvae and juveniles were individually placed in 24-well culture plates (2 ml), previously disinfected with 10% NaClO and rinsed with distilled water. The larvae and juveniles were dissected, their limb morphology studied from drawings made through the use of a camera lucida, and their valves and carapaces photographed by SEM. It was possible to study the subitaneous egg-case hatching by SEM in order to search for different ornamentation patterns.

Significant differences were observed in the morphology of the eggs, not only by the presence/absence of jelly-like substance, but also in the ornamentation of their covers. In *Chlamydotheca arcuata* Sars, 1901, the surface of eggs appeared covered with small, regularly spaced tubercles covered with a jelly-like substance. In *Chlamydotheca iheringi* Sars, 1901, eggs appear covered with small tubercles and the jelly-like substance kept them together in clusters.

The appearance of limbs in both species *Chlamydotheca arcuata*, and *C. iheringi* was not progressive. The time and number of eggs laying and hatching was different.

Chlamydotheca arcuata laid rapidly developing eggs 2–5 days after being isolated and each female laid 3–5 eggs, while females of *C. iheringi* laid up to three clusters of rapidly developing eggs 15–20 days after being isolated and each female laid a maximum of 50 (between 15-50). Neither of the species layed resistant eggs.

The nauplius larvae (instar A-8) of *Chlamydotheca arcuata* hatched 10–15 days after laying, while the larva nauplius (instar A-8) of *C. iheringi* hatched 7–10 days after laying.

Significant differences were found also in the sequence and morphology of setae and aesthetascs. In *Chlamydotheca arcuata*, the emergence of aesthetascs (Y, y_2) occurred in the first instars. A similar transition occurred when the juveniles (A-4) and (A-3) appeared and the number of sensory setae became increased. In. *C. iheringi* the aesthetascs appear in instar (A-8), and in both cases the number of sensory setae in the carapace increased in the course of development.

In both species the extensive growth of the mandibles and maxilles in the instars (A-7) was notable since usually only the *anlagen* of these limbs were present at that stage. The juvenile mortality was high from third / fourth stage of development.

The juvenile's behaviour differs from the nauplius onwards; in *C. arcuata* carapaces are ornamentated and it could be related with the slow movement of the juveniles while in *C. iheringi* carapaces are not so ornamentated and juveniles are active swimmers.

All changes in the ornamentation of the carapace could be related to the quite advanced swimming capability of the juveniles.

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REFERENCES

DÍAZ A.R. & LOPRETTO E.C., 2011. The genus *Chlamydotheca* Saussure (Crustacea: Ostracoda) in northeastern Argentina. *Nauplius*, 19(2): 97-107.

KAESTNER A., 1970. Invertebrate Zoology. Crustacea, Vol. 3. Interscience Publishers, New York, 523 pp.

KESLING R.V., 1951. The morphology of ostracods molt stages. *Illinois Biological Monographs*, 21(1-3): 1-324.

KUBANÇ N., ÖZULUĞ G. O. & KUBANÇ C., 2007. The ontogeny of appendages of *Heterocypris salina* (Brady, 1868) Ostracoda (Crustacea). *Hydrobiologia*, 585: 255-272.

MEISCH C., 2000. Freshwater Ostracoda of Western and Central Europe. Spektrum Akademischer Verlag, Heidelberg. 522 pp.

ROESSLER E.W., 1982. Estudios taxonómicos, ontogenéticos, ecológicos y etológicos sobre los ostrácodos de agua dulce en Colombia – III. El prenauplio y su papel en la eclosión del huevo en el género *Chlamydotheca* Saussure 1858 (Ostracoda, Podocopa, Cyprididae). *Caldasia* 13(64): 635-646.

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ANALÍA DÍAZ & KOEN MARTENS

A NEW GENUS AND SPECIES OF NON-MARINE OSTRACODS (*Crustacea Ostracoda*) FROM PATAGONIAN WETLANDS OF ARGENTINA

A new genus and species is described from a Patagonian lake in the province of Neuquen, Argentina. The genus and species clearly belong in the Eucypridini, and as such have a rather isolated biogeographical distribution in South America.

Samples were taken from Laguna Blanca, an Andean Patagonian lagoon situated in Neuquen Province, Argentina 39° 02' S, 70° 21' W ± 25-30 m; 1.230 masl. This permanent pond has a maximum depth of 11 m. The surface is covered by decaying organic matter, macrophytes and emergent vegetation. The conductivity in this lagoon was, at the sampling time of collecting, 1022 µm cm -1, the dissolved oxygen 9.5 (mg L-1) and pH 9.29. The material was collected on December 11, 2005 with a hand net with mesh size c 250 µm. The present description of a new species and genus confirms the validity of the 'c'-seta on the T1 as a good character to unite the Eucypridini (MARTENS, 1989). In addition, the presence of 'porenwarzen' the anterior part of the valves confirms this relatedness amongst the genera in this tribe. However, it is clear that there are three types of such structures present in this genus (1) the normal (small) external 'porenwarzen' which are quite common, (2) the large 'porenwarzen', present in fewer copies and (3) the enigmatic 'porenwarzen' on the inside of the (right) valve. Also of interest is the apparent relevance of the length ratio of setae d1 and d2 on T2, which can now in several groups be used to distinguish lineages at the generic level. Apart from the Eucypridini, this character is also successfully used in the Herpetocypridinae (MARTENS, 2001) and the Cypridinae (MARTENS, 1990; 1992) amongst others.

Rather surprising is the strongly curved shape of the attachment of the caudal ramus in this species/ genus. It is thus far unique in the Cyprididae, and again the functional reasons behind this peculiar morphology remain unknown.

The genus can be distinguished from other Eucypridini, based on both valve (large porenwarzen, anterior selvage and posterior outer list in RV) and soft part features (cylindrical shape of second Mx1-palp segment, length ratio setae d1 = c 3x d2 on T2, curved attachment of caudal ramus).

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REFERENCES

MARTENS K., 1989. On the systematic position of the Eucypris clavata – group, with a description of Trajancypris gen. nov. (Crustacea, Ostracoda). *Archiv für Hydrobiologie*, Supplements 83(2): 227-251.

MARTENS K., 1990. Taxonomic revision of African Cypridini. Part I. The genera Cypris O.F. MÜLLER, Pseudocypris DADAY and Globocypris KLIE. *Bulletin van het Koninklijk Belgisch Instituut voor Natuurwetenschappen, Biologie*, 60: 127-172.

MARTENS K., 1992. Taxonomic revision of African Cypridini. Part II. Description of Ramotha gen.nov. *Annals of the south African Museum*, 102(2): 91-130.

MARTENS K., 2001. Taxonomy of the Herpetocypridinae (Crustacea, Ostracoda). *Crustaceana*, 74(3): 295-308.

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Nastaran Ehsani, Iradj Yassini,
Nasser Mostafawi & Jahanbakhsh Daneshian

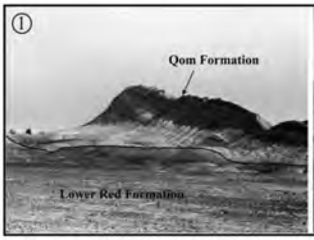
MIOCENE OSTRACODS FROM E-MEMBER OF QOM FORMATION AT KAMAR-KUH STRATIGRAPHIC SECTION, WEST OF QOM, CENTRAL IRAN

The marine deposits of Qom Formation in Central Iran correspond to the last sea level rise during late Oligocene and early Miocene (Dozy, 1944). Qom Formation is composed of marls, limestones, clastic deposits, evaporates and in some area volcanic rocks as well as pyroclastic elements. In the regional landscape, this Formation is easily distinguished from both underlaying and overlaying, Lower Red and Upper Red Formations, for its light grayish –green colour. According to Stratigraphic Lexicon of Iran (Stocklin & Setudehnia, 1991), Qom Formation in the type area is subdivided into nine lithological Members (a, b, c-1, c-2, c-3, c-4, d, e and f) with Oligocene to early Miocene in age. Within Qom Formation, c-4 and e-Members are dominantly composed of marl and contain a relatively rich and diversified ostracod fauna.

The thickness of the e-Member in Central Iran, varies between 80 to 650 meters (Aghanabati, 2004). The thickness of Qom Formation in the central portion of Kamr-Kuh anticline is around 1030 m (Emami, 1991). Here, Qom Formation is underlay with disconformity on the Lower Red Formation and is overlay Upper Red Formation (Figs. 1 & 2).

The e- Member of Qom Formation in Kamr-Kuh stratigraphic section is composed of an alternating sequence of marl, sandstone, coralline limestone and sandy limestone (Fig. 3).

Kamar-Kuh is a symmetrical anticline which extends over 10 Km in E-W direction and is located approximately 136 km to the south of Tehran and 10 Km to the west of Qom (Fig. 4).



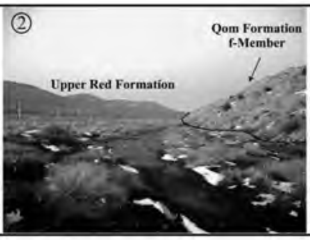


Fig. 1 — Southern view of disconformity between Lower Red Formation and Qom Formation in Kamar-kuh anticline.

Fig. 2 — Eastern view of disconformity between Qom Formation and Upper Red Formation in Kamar-Kuhr anticline.

Fig. 3 — Northern view of the e-Member in Kuh-Kamar anticling showing alternating layers of grayish-Green to yellow-green marls, sandstones and calcarenites.

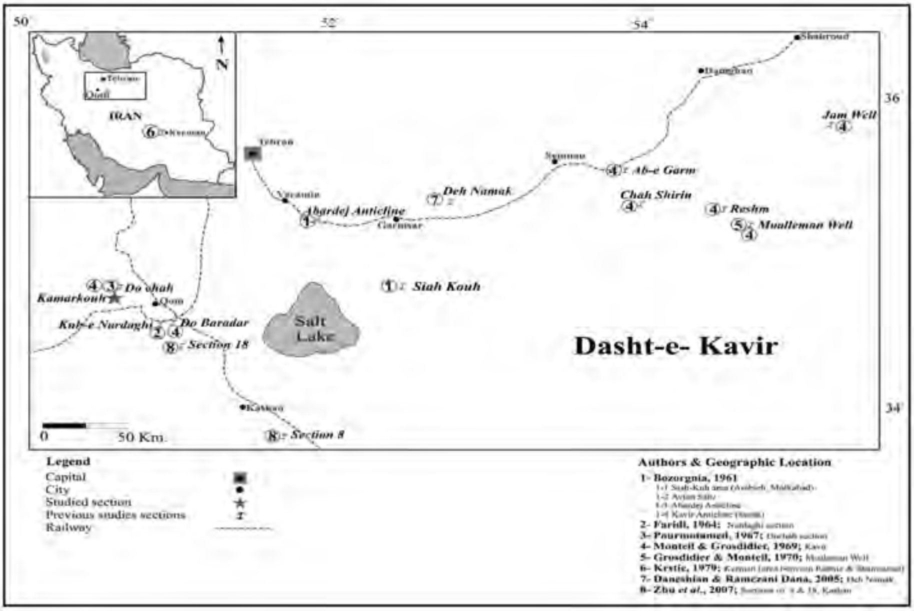


Fig. 4 — Location of the section described in this study and the sites of the previous studies on ostracods of Qom Formation in Central Iran.

For the purpose of the present study, the 112 m thick sequence of the e-Member on the northwestern flank of Kamar-Kuh anticline is measured and sampled, and the GPS coordinate of the top of the e-Member is 50° 40’ 28.7” E and 34° 38’ 22” N.

Majority of published works on Qom Formation microfauna were focused on foraminifera and non to little works were undertaken on ostra-

Table 1

Summarizes the previous studies on ostracods of Qom Formation in central Iran and Kerman region and list of ostracod genera and species that reported in this Formation.

Authors	Locations	Age
1. Bozorgnia, 1961	1-1 Siah- Kuh area (Arabieh)	
	1-2 Avian Sabz	Sannoisian- Helvetian
	1-3 Abardej anticline	
	1-4 Kavir anticline (Surak)	
2. Faridi, 1964	Nardaghi & Karvansarasangi stratigraphic sections	Chattian- Helvetian
3. Pourmotamed, 1967	Dochah stratigraphic section	Aquitanian- Helvetian
4. Monteil and Grosdidier, 1969	Dashte kavir (Dobaradar, Dochah, Bande Namak, Moaleman, Djam, Reshm, Chah Shirin, Ab-e Garm..,	Eocene - Miocene
5. Grosdidier and Monteil, 1970	Moalleman well, number 1	Aquitanian-Burdigalian
6. Krstic, 1979	Shams-Abad – Rahniz area Kerman	Aquitanian- Langhian
7. Daneshian & RamezaniDana, 2005	Deh namak stratigraphic section	Oligocene- Miocene
8. Zhu et al., 2007	Section 8 & 18, Kashan	Late Eocene

Species	1-1	1-2	1-3	1-4	2	3	4	5	6	7	8
Acratia spp.	●										
Actinocythereis spp.							●	●			
Actinocythereis tumefacentis									●		
Alocopocythere dhansariensis											●
Amphicytherura spp.	●										
Argilloecia spp.					●		●			●	
Asymmetricythere samalutensis											●
Aurila spp.	●	●	●	●	●		●	●			
Aurila punctata						●			●		
Bairdia spp.	●	●	●	●	●	●	●	●		●	
Bairdia sp. cf. *B. exoura*					●						
Bairdia montiformis											●
Bairdoppilata sp.					●						
Brachycythere spp.	●	●		●		●					
Bythocypris spp.	●						●	●			
Bythocythere spp.	●										
Buntonia spp.					●		●				
Callistocythere spp.	●										
Candona spp.	●	●		●			●				
Caudites sp.					●						
Chrysocythere sp.							●				
Cletocythereis sp.									●		
Costa spp.						●	●	●			
Costa edwardsii						●					
Cuneocythere sp.								●			
Cushmanidea sp.										●	
Cyamocytheridea spp.							●	●		●	
Cypria sp.										●	
Cyprideis spp.	●	●				●	●				
Cyprideis sp. cf. *C. floridana*					●						
Cythereis spp.	●	●	●	●	●						
Cythereis sp. aff. *C. dacyi*					●						
Cytherella spp.	●	●	●	●	●	●	●			●	
Cytherella hanai					●						
Cytherella jonesiana											●
Cytherella sp. cf. *C. truncate*					●						
Cytherelloidea spp.	●		●	●	●		●				
Cytherelloidea sp. aff. *C. costatruncata*									●		
Cytheretta spp.	●		●	●						●	
Cytheretta sp. cf. *C. karlana*					●						
Cytheretta sp. aff *C. plicata*					●						
Cytheretta virgulata											●
Cytheridea spp.	●				●		●	●		●	●
Cytheridea sp. cf. *C. autonoma*									●		
Cytheridea sp. cf. *C. bundensis*											●
Cytheridea sp. aff. *C. paracuminata*									●		
Cytheridea sp. cf. *C. scruposa*											●
Cytheromorpha spp.	●	●					●			●	
Cytheropteron spp.	●				●						
Cytherura spp.	●				●		●				

Table 1 – *Continued*

Species	1-1	1-2	1-3	1-4	2	3	4	5	6	7	8
Echinocythereis spp.					•		•		•	•	
Echinocythereis sp. cf. *E. fossularis*									•		
Echinocythereis ligula						•					
Eocytheropteron sp.					•						
Eopaijenborchella sp.											•
Eopaijenborchella berggreni									•		
Eucypris spp.							•				
Eucythere sp.	•						•				
Falunia sp.						•					
Flexus sp.									•	•	
Flexus sp. cf. *F. trifurcatus*									•		
Ghardaglaia kermani									•		
Haplocytheridea spp.	•	•	•	•	•					•	
Haplocytheridea helvetica						•					
Haplocytheridea sp. aff. *H. reversa*					•						
Hemicythere spp.	•				•	•				•	
Hemicytheria sp.					•						
Hemicytherura sp.					•						
Henryhowella ruggierii						•					
Hermanites spp.	•	•	•	•	•		•				
Hermanites sp. cf. *H. grawca*											•
Hermanites haidingeri						•					
Heterocythere sp.					•						
Ilyocypris spp.							•				
Kangarina sp.	•										
Krithe spp.	•	•	•	•	•	•	•	•	•	•	
Krithe sp. cf. *K. citae*						•					
Krithe sp. cf. *K. cubensis*					•						
Krithe sp. cf. *K. dolichoderina*					•						
Krithe oryza					•						•
Krithe sp. cf. *K. pernoides*					•						•
Leniocythere spp.							•				
Leguminocythereis spp.	•				•						
Limnocythere sp.							•				
Loxoconcha spp.	•	•	•	•	•	•	•	•		•	•
Loxoconcha sp. cf. *L. antoniettae*						•					
Loxoconcha sp. cf. *L.elliptica*						•					
Loxoconcha punctatella						•					
Loxoconcha subovata						•			•		
Macrocypris spp.	•				•						
Macrocypris sp. cf. *M. meridionalis*									•		
Macrocypris wrightii						•					
Manseyella sp.					•						
Miocyprideis iranica									•		
Monoceratina substriata						•					
Murrayina spp.					•		•				
Neocyprideis sp.							•				
Neocytherideis sp.						•					
Neomonoceratina spp					•		•	•	•		
Neomonoceratina sp. aff. *N. Kutchensis*									•		
Occultocythereis sp. cf. *O. bituberculata*						•					
Orionina sp.										•	
Paijenborchella spp.					•		•				
Paracypris spp.	•	•	•	•	•	•	•	•	•	•	•
Paracypris dotchahensis						•					
Paracytheridea sp.					•				•		
Paradoxostoma sp.							•				
Parakrithe sp.							•	•			
Pokorneyella spp.					•					•	
Pokornyella sp. aff. P. *chaasraensis*									•		
Pontocypris sp.							•				
Potamocypris sp.							•				
Propontocypris sp.											•
Propontocypris pirifera						•					
Propontocypris zongbuensis											•
Protocytheretta schoelleri						•					
Pterygocythere spp.	•				•						
Quadracythere spp.					•		•				
Rectotrachyleberis spp.	•										
Ruggieria spp.					•		•	•			
Ruggieria farchadi						•					
Ruggieria micheliniana					•	•					
Schizocythere spp.					•		•				
Schneiderella sp. aff. *S. oertlii*									•		
Schuleridea sp.							•			•	
Stigmatocythere sp.										•	
Thalmannia spp.							•	•			
Trachyleberidea spp.	•										
Trachyleberis spp.	•	•	•	•	•		•			•	
Trachyleberis sp. aff. *T. evax*					•						
Trachyleberis sp. cf. *T. hystrix*						•					
Uroleberis sp.										•	
Xestoleberis spp.	•	•	•	•	•	•	•	•	•	•	•
Xestoleberis fuscata						•					

cods. Previous reports on Qom Formation ostracods were without illustration and were restricted to numeral taxonomy of genera and species (Bozorgnia, 1961; Faridi, 1964; Pourmotamed, 1967). Monteil & Grosdidier (1969) from Elf –Aquitain Petroleum produced the first SEM illustration catalogue of various genera and species without any taxonomic clarification. Later Grosdidier & Monteil (1970) produced a second atlas with distribution range chart and tentative age determination of ostracod fauna from Moalleman well No 1, near Semnan region. In this work they also reported some ostracod species from Eocene age green tuff series, Lower Red and Upper Red Formations. Daneshian & Ramezani Dana (2005) reported some 23 species of ostracods in open nomenclature from Deh Namak stratigraphic section in east of Garmsar.

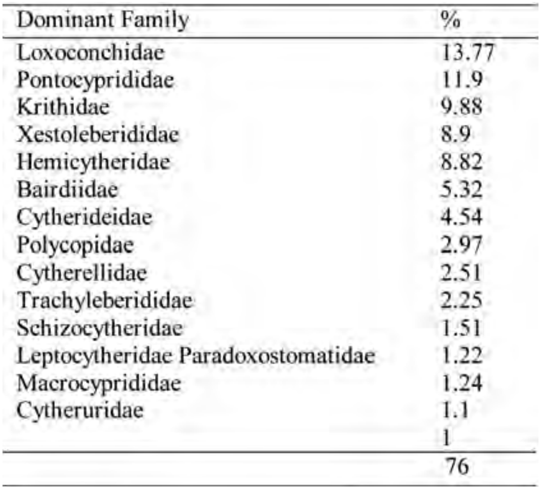
Table 1 summarizes the earlier works on Miocene ostracods of Qom Formation in central Iran and provide a list of species so far identified in this Formation.

A total of 68 samples (56 soft -12 hard) from e-Member at Kamar-Kuh section were investigated in the present study and a total of 3720 carapaces and 10 detached valves were recovered.

103 species belonging to 50 genera were recognised in this study and 27 species were identified to species level and the remaining left in open nomenclature. Table 2 summarized percentage of 15 dominant ostracod families identified in this study. Table 3 shows the total number of the dominant species and their frequencies in Kamr-Kuh e-Member samples. 96.2% of the

Table 2

Dominant Ostracod families in the kamar-kuh e-Member studied samples.



Dominant Family	%
Loxoconchidae	13.77
Pontocyprididae	11.9
Krithidae	9.88
Xestoleberididae	8.9
Hemicytheridae	8.82
Bairdiidae	5.32
Cytherideidae	4.54
Polycopidae	2.97
Cytherellidae	2.51
Trachyleberididae	2.25
Schizocytheridae	1.51
Leptocytheridae Paradoxostomatidae	1.22
Macrocyprididae	1.24
Cytheruridae	1.1
	1
	76

Table 3

Shows the total number of the dominant species and their frequencies in Kamr-kuh e-Member samples. The table includes those species with greater than 1 or 1 percent abundance.

Species	total number	%
Propontocypris sp. 2	403	10.8
Aurila sp.3	210	5.7
Krithe sp. 1	193	5.2
Neonesidea sp.2	154	4.16
Xestoleberis sp. 1	144	3.9
Loxoconcha aspidis	133	3.6
Xestoleberis glabrescens	118	3.2
Aurila sp.2	115	3.12
Polycope sp.	110	2.97
Loxoconcha sp.3	109	2.95
Parakrithe sp. 3	100	2.7
Cytherella sp.1	93	2.51
Ruggieria dorukae	84	2.25
Sagmatocythere raiai	75	2.03
Krithe sp. 2	73	1.98
Neomonaceratina Laskarevi	56	1.51
Xestoleberis sp. 2	52	1.4
Loxoconcha variesculpta	52	1.4
Loxocorniculum tuidum	49	1.32
Sagmatocythere sp. 2	51	1.37
Miocyprideis glabra asulcata	47	1.27
Cytheridea sp. 2	47	1.27
Paradoxostoma sp.	45	1.24
Callistocythere canaliculata	43	1.22
Bairdia sp.	41	1.16
Propontocypris sp. 4	41	1.1
Loxocorniculum sp. Cf. L. *hastata*	41	1.1
Macrocypris sp.	37	1
Cytheridea sp. 1	37	1
Miocyprideis sp.	37	1
Semicytherura sp. 1	37	1
	2831	75.1

ostracod fauna in the studied material belonged to Podocopida and 3.8% to Platicopida (Fig. 5).

Figure 6 shows the stratigraphic range of the ostracod species identified in the e-Member marl deposits, of Kamar-Kuh type area and also in various Neogene sedimentary basins of Tethys and Paratethys regions.

Majority of the identified species in the studied material show an extended stratigraphical distribution from Miocene to Pliocene epochs. Due to the

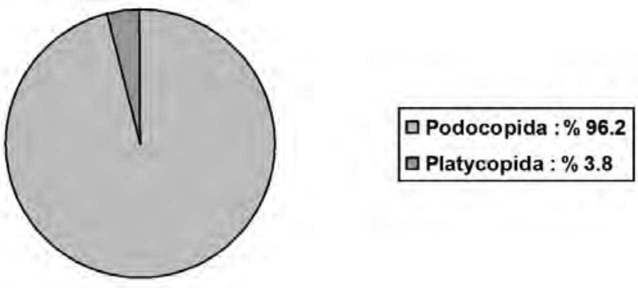


Fig. 5 — Pie chart of Podocopida and Platycopida ostracods in Kamar-kuh, e-Member deposits.

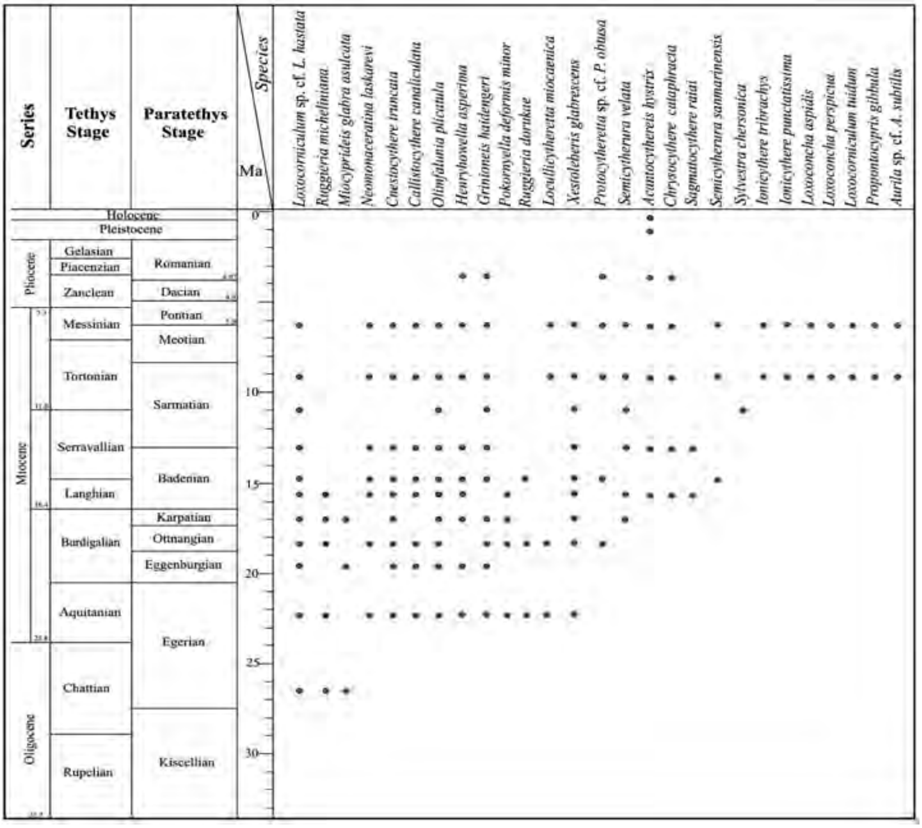


Fig. 6 — Stratigraphic range of the ostracode species identified in Kamar-kuh e-Member type area as reported in various Tethys Neogene sedimentary basins.

long range stratigraphical distribution of ostracods, it is difficult to provide a precise stratigraphic age to e-Member deposits.

However, according to foraminiferal biozone of *Borelis melocurdica* and *Lepidocyclina* (RAHAGHI, 1973) an early Miocene age and based on nanoplankton species (HADAVI *et al.*, 2009) an age of early to middle Miocene is given to this Member in Kamar-Kuh type area.

The presence of some species of Paratethys origin in e-Member's faunal assemblages, is a strong evidence that, during Miocene period, the Central Iran sedimentary basin was connected to Paratethys brackish environment to the North and to the deeper Tethys marine environment to the West.

Kamar-Kuh, e-Member lithological column, ostracod population density and species abundance are illustrated in Fig. 7.

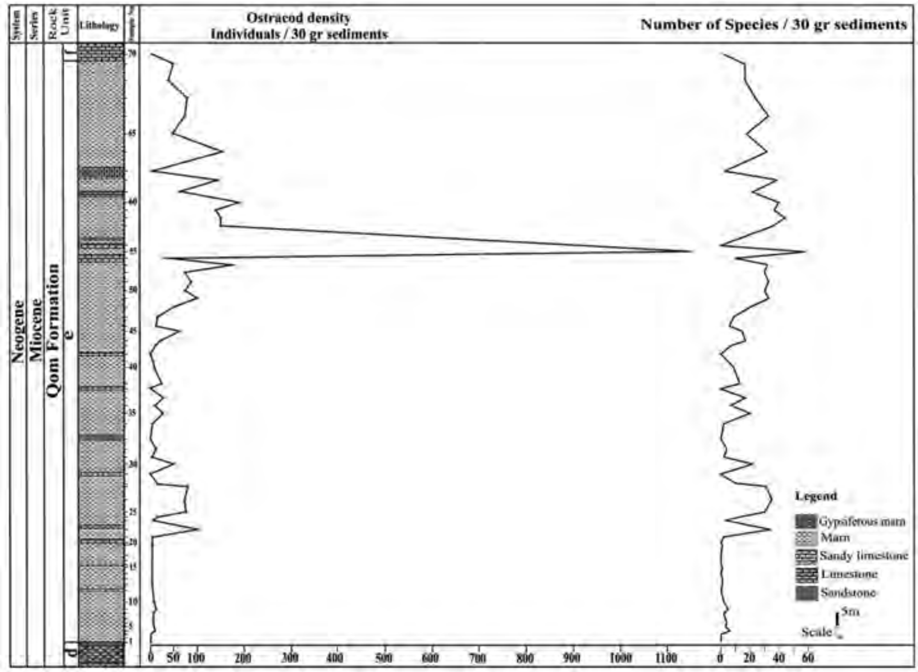


Fig. 7 — Kamar-kuh e-Member lithological column and fluctuation in ostracod population density and species number.

REFERENCES

AGHANABATI A., 2004. Geology of Iran. *Geological Survey of Iran*, p. 210.

BOZORGNIA F., 1961. Micropaleontological Investigation of Qom Formation in NW Central Iran. *National Iranian Oil Company*, Paleontological report, N. 79, 32 p.

DANESHIAN J. & RAMEZANI DANA L., 2005. Some Ostracoda from the Qom Formation of the North of Central Iran. – In: Kohring R. & Sames B. (Ed.), *15th International Symposium on Ostracoda*, Berlin, Program and Abstract, 24-27.

DOZY J., 1944. Comments on geological report no.1 by Thiebaud (on the Qum-Saveh area). *Geological Report* 308.

EMAMI M.H., 1991. Explanatory text of the Qom quadrangle map, scale 1:25000. *Geological Survey of Iran*, 101–108.

FARIDI Z., 1964. Investigation on ostracods of the Qum Formation of the Karvansarasang and the Nardaghi sections. *National Iranian Oil Company, Paleont.* Note No. 107/2, 24 pp.

GROSDIDIER E. & MONTEIL L., 1970. Sondage Moalleman n° 1 etude des ostracodes. *Entreprise de recherches et d'activités pétrolières Elf.* 03-D-31, n° 0/429 R, 2p.

HADAVI F., NOTGHI MOGHADDAM M. & MOUSAZADEH H., 2009. Burdigalian-Serravalian calcareous nannoplanktons from Qom Formation, North-Center Iran. *Arabian Journal of Geosciences*, 3, 133-139.

MONTEIL L. & GROSDIDIER E., 1969. Mission de terrain Iran–Dasht I Kavir etude des ostracodes. *Entreprise de recherches et d'activités pétrolières Elf.* D-31–B, n° 9/239 R, 23p.

POURMOTAMED F., 1967. Study of Ostracoda and Lithology of Qom Formation in Dochah area. *MS Thesis, University of Tehran.*

RAHAGHI A., 1973. Etude de quelques grands foraminiferes de la Formation de Qom (Iran Central). *Revue de Micropaleontology* 16 (1): 23-38.

STOCKLIN J. & SETUDEHNIA A., 1991. Stratigraphic Lexicon of Iran. *Geological Survey of Iran*, report. No. 18, third edition.

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Christian Laforsch

THE POTENTIAL ROLE OF FRESHWATER OSTRACODS IN CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEMS (CELSS)

Controlled Ecological Life Support Systems (CELSS) are an endeavor to create environments able to support and maintain human life by performing basic life support functions (e.g. food, water and oxygen supply). Based on cycle bioregenerative processes, such systems are preferably independent from material resupply and exclusively open with respect to energy. Therefore such systems will play an important role in manned future long-duration space missions like flights to Mars or explorations and life in extreme environments (Gitelson, 1992; MacElroy & Bredt, 1984). However, CELSS can be regarded as harsh, unfavorable and instable habitats with frequently changing environmental conditions. Since many freshwater ostracods are tolerant to a wide range of environmental factors and are capable to overcome unfavourable conditions with different strategies such as the production of resistant resting eggs, they are potential key organisms for aquatic based CELSS. Furthermore, many species are feeding on detritus, and transforming plant- and animal-derived decaying matter into biomass. On the other side, they serve as important food source for organisms of higher trophic levels such as fish (Meisch, 2000). Previous experiments with combined systems with ostracods, other invertebrates and plants on the MIR space station already showed that freshwater ostracods were the only crustaceans that did not develop deformations of their appendages, or die out completely; in contrast, they survived unharmed and even reproduced. However, they showed a characteristic behavior of disorientation, so called loop swimming (Ijiri *et al.* 1998; Ishikawa *et al.*, 1998). This behavior can also be seen in other ani-

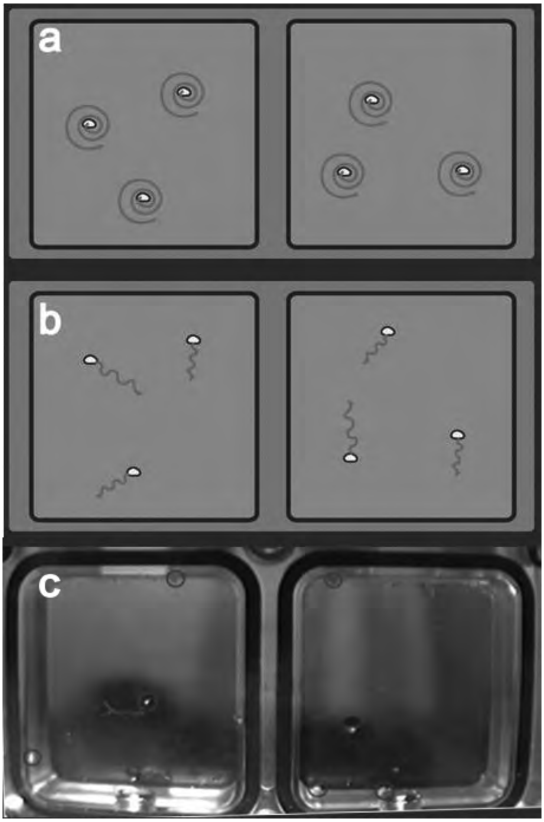

Fig. 1 — Swimming behaviour of **a**, *Heterocypris incongruens* and **b,** *Notodromas monacha* in microgravity; **c**, Ostracods in a video-monitored cuvette for parabolic flights.

mals exposed to microgravity (e.g. *Daphnia* sp. IJIRI *et al.*, 1998) and fish (ANKEN & HILBIG, 2004)) and is an indication for the relevance of gravity for orientation in their three-dimensional environment. Nevertheless, nothing is known about the mechanism of gravity perception in ostracods and if microgravity related behavioral changes interfere with their conventional life cycle (feeding, reproduction etc.). To analyze this, experiments have been conducted with two very common ostracod species, *Heterocypris incongruens* and *Notodromas monacha*. Specimens of these species, housed in sealed, video-monitored cuvettes, have been taken on parabolic flights, where an airplane follows the trajectory of a parabola. At the top part of the arc, the aircraft and its payload are in free fall, causing the sensation of weightlessness. The two species were chosen to cover differences in habitat use and the correlated morphological, physiological and behavioral differences. While *H.*

incongruens lives in the benthic and pelagic zone, *N. monacha* clings upside down to the water surface membrane to feed on particles or it crawls on plants. (MEISCH, 2000). Video analysis showed loop swimming of *H. incongruens* under microgravity conditions, while *N. monacha* showed no looping behavior. Those results suggest that if there is no long-term adaptation to microgravity, non-looping species like *N. monacha* are probably better qualified for CELSS compared to continuously looping ostracods, since they more likely exhibit a normal life cycle. It is furthermore supposable that the gravity sensing mechanisms in diverse species differ in their sensitivity. Hence, our main goal is to detect and analyze the specific gravity-sensing organ or mechanism in ostracods and to unravel its functional principle with further experiments. We plan using ground based facilities like klinostats and a droptower and we will continue experiments during parabolic flights. The outcome will not only add a robust and reliable species to future aquatic based live support systems but also foster our knowledge on the evolution of gravisensing mechanisms in zooplanktonic organisms.

REFERENCES

ANKEN R.H. & HILBIG R., 2004. A drop-tower experiment to determine the threshold of gravity for inducing motion sickness in fish. *Advances in Space Research*, 34(7): 1592-1597.

GITELSON J.I., 1992. Biological life-support systems for Mars mission. *Advances in Space Research*, 12(5): 167-192.

IJIRI K., MIZUMO R., NARITA T., OHMURA T., ISHIKAWA Y., YAMASHITA M., ANDERSON G., POYNTER J., MACCALLUM T., 1998. Behavior and reproduction of invertebrate animals during and after a long-term microgravity: space experiments using an Autonomous Biological System (ABS). *Biological Reviews of the Cambridge Philosophical Society*, 12(4): 377-388.

ISHIKAWA Y., KOBAYASHI K., SEKI K., MIZUTANI H., KAWASAKI Y., KOIKE J., IJIRI K., YAMASHITA M., SUGIURA K., POYNTER J., MACCALLUM T., ANDERSON G., 1998. Concluding remarks of autonomous biological systems (ABS) experiments. *Biological Sciences in Space*, 12(4): 394-399.

MACELROY R.D. & BREDT J., 1984. Current concepts and future directions of CELSS. *Advances in Space Research*, 4(12): 221-229.

MEISCH C., 2000. *Freshwater Ostracoda of western and central Europe*. J. Schwoerbel & P. Zwick, eds., Heidelberg, Berlin: Spektrum Akademischer Verlag.

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IMPACTS OF CLIMATE VARIABILITY AND MAYA SETTLEMENT ON LAGUNA TUSPÁN (PETÉN, GUATEMALA) AND ITS OSTRACOD FAUNA DURING THE PAST 5000 YEARS

Even though several studies (Curtis *et al.*, 1996; Haug *et al.*, 2003; Leyden *et al.*, 1998; Medina-Elizalde *et al.*, 2012) prove the occurrence of severe droughts between 800 and 900 AD, some studies have demonstrated that the reduction of rainfall was not the only cause of the collapse of Maya civilization at that time. There is some evidence that the Mayas caused deforestation (Galop *et al.*, 2004), which potentially changed the properties of soils (composition, sensitivity to erosion). In this case, human activities would have increased the vulnerability of their cultures to natural phenomena. Droughts, combined to a long-term decreasing productivity of fields, would have led the Mayas to migrate.

Here we present a multi-proxy study of lacustrine sediments from laguna Tuspan, near the Maya city of La Joyanca (Petén), designed to test the relative impact of climate variability and human activities on the environment.

Results on the clay composition and the ostracod fauna clearly show environmental changes in the drainage basin of the lake around 3000 BP (950 BC), when the La Joyanca plateau was first inhabited by the Mayas (Arnauld *et al.*, 2004). Before human settlement around the lake, the ostracod abundance decreased during humid periods. The percentage of the genus *Candonopsis* and the ^{13}C of *Cytheridella ilosvayi* valves decrease during such events, when high quantities of organic matter are brought to the lake. The variability of all proxies decreases in amplitude around 4000 BP, when the Caribbean zone gets drier (Haug *et al.*, 2003; Malaizé *et al.*, 2011). Halloysite is the main clay across the whole period preceding the arrival of the Mayas, which proves the formation of stable soils due to a dense forest cover (GALOP *et al.*, 2004).

After 3000 BP, none of our proxies follows the drying trend that is observed in the rest of the Caribbean zone (HODELL *et al.*, 1995). Interstratified smectite-chlorite is the main component of the clay fraction, which reveals increasing erosion of the substratum. Litter thickness and forest density are much reduced, which enhances the destabilization of soils under humid conditions. The lake received much more detritic particles than before, especially during the deposition of Maya clays. This study clearly indicates that the Mayas changed their environment even before they built cities.

REFERENCES

ARNAULD C., BREUIL-MARTINEZ V. & PONCIANO ALVARADO E., 2004. La Joyanca (La Libertad, Guatemala), antigua ciudad maya del noroeste del Petén, C. Arnauld, V. Breuil-Martinez et E. Ponciano A. (éds). CEMCA, CIRMA, Asociación Tikal, Guatemala, 145 pp.

CURTIS J.H., HODELL D.A. & BRENNER M., 1996. Climate variability on the Yucatan Peninsula (Mexico) during the past 3500 years, and implications for Maya cultural evolution. *Quaternary research*, 46: 37-47.

GALOP D., CAROZZA J.-M., LOPEZ-SAEZ J.A., VANNIERE B., BOSSUET G., VELIZ PEREZ M. & METAILIE J.-P., 2004. Historia del medio ambiente en la larga duración y ocupación del espacio en la región de La Joyanca, noroeste del Petén, Guatemala: primeros resultados. En *XVII Simposio de Investigaciones Arqueológicas en Guatemala, 2003* (editado por J.P. Laporte, B. Arroyo, H. Escobedo y H. Mejía): 530-542. Museo Nacional de Arqueología y Etnología, Guatemala.

HAUG G.H., DETLEF G., PETERSON L.C., SIGMAN D.M., HUGHEN K.A. & AESCHLIMANN B., 2003. Climate and the collapse of Maya civilization. *Science*, 299: 1731-1735.

HODELL D. A., CURTIS J. H. & BRENNER M., 1995. Possible role of climate in the collapse of Classic Maya civilization. *Nature*, 375: 391-394.

LEYDEN B.W., BRENNER M. & DAHLIN B.H., 1998. Cultural and climatic history of Coba, a lowland Maya city in Quintana Roo, Mexico. *Quaternary research*, 49: 111-122.

MALAIZÉ B., BERTRAN P., CARBONEL P., BONNISSENT D., CHARLIER K., GALOP D., IMBERT D., SERRAND N. & STOUVENOT CH., 2011. Hurricanes and climate in the Caribbean during the past 3700 years BP. *The Holocene*, 1-14.

MEDINA-ELIZALDE M. & ROHLING E. J., 2012. Collapse of Classic Maya civilization related to modest reduction in precipitation. *Science*, 335: 956-959.

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Alina Floroiu, Marius Stoica, Iuliana Vasiliev & Wout Krijgsman

PONTIAN OSTRACODS FROM SLANICUL DE BUZAU SECTION (EASTERN CARPATHIAN FOREDEEP)

Detailed micropaleontological, sedimentological and paleomagnetic sampling recently done in the Upper Miocene and Pliocene deposits from the Eastern Carpathians leaded us to establish a high-resolution ostracod biochronology for the Pontian stage.

The Lower Pontian (Odessian) deposits from Slanicul de Buzau Valley section developed into a pelitic facies represented by fine-bedded or massive marls with rare thin intercalations of silts and sandstones. The fresh-water ostracod faunas from the Late Maeotian were replaced by a more brackish one in the Early Pontian after the transgressive event at the Maeotian/Pontian boundary (6.04 Ma) (Krijgsman *et al.*, 2010; Stoica *et al.*, 2012). The Lower Pontian sediments were very rich in brackish mollusk and ostracod species. The most common ostracod species are represented by: *Candona (Caspiocypris) alta* (Zalányi), *C. (C.) pontica* Sokač, *C. (Camptocypria) ossoinaensis* Krstić, *C. (Zalanyiella) venusta* (Zalányi), *C. (Hastacandona) hysterica* Kristić & Stancheva, *C. (Fabeaformiscandona)* sp., *Pontoniella (Zalanyiella) acuminta* (Zalányi), *P. (Z.) quadrata* (Krsti), *P. (Z.) striata* (Mandelstam), *Cypria tocorjescui* Hanganu, *Bakunella dorsoarcuata* (Zalányi), *Cytherissa* sp., *Cyprideis pannonica* (Méhes), *Tyrrhenocythere pannonicum* Olteanu, *Amnicythere lata* Schneider, *A. andrusovi* (Livental), *A. palimpsesta* (Livental), *Euxinocythere* ex. gr. *costata* (Olteanu), *Leptocythere cymbula* (Livental), *Maetocythere bosqueti* (Livental), *Loxoconcha babazananica* Livental and *L. petasa* Livental.

The Middle Pontian (Portaferrian) represented a regressive moment when the base-level drop in the Dacian Basin and in all the Eastern Paratethyan basins possible as a consequence of the disconnection with the Mediterranean Sea during its desiccation moment (Messinian Salinity Crisis event). Several of the ostracod species from Paratethys migrated to the Mediterranean Sea during the "Lago Mare" event (GLIOZZI *et al.*, 2007). Predominantly basinal sequence of the Lower Pontian is replaced by a more proximal one developed in littoral and fluvial-deltaic environments. In the marginal zones of the basin, the intra-Pontian base-level drop had visible effects and the rich ostracod fauna from Lower Pontian was replaced by littoral, fluvial and lacustrine species: *Amplocypris dorsobrevis* Sokač, *Cyprideis pannonica* (Méhes), *C.* sp*., Tyrrhenocythere* ex. gr. *motasi* Olteanu, *Candoniella* sp*., Zonocypris membranae* (Livental).

The Late Pontian (Bosphorian) interval started with a new transgressive moment possible related to the reconnection of the Paratethys with the Mediterranean Sea due to the refilling of it during the Zanclean transgression at the Miocene/Pliocene boundary (5.33 Ma). We can recognize a "second Pontian bloom" of the ostracod fauna when most of the species from the Lower Pontian, that migrated to inner part of the basin during base-level drop, become dominant again together with several new taxa like *Tyrrhenocythere filipescui* (Hanganu), *T. taurica* Olteanu, *Cytherissa boghatschovi* Livental, *Scottia* sp., *Amplocypris* sp.

Some of the Late Pontian ostracod species will pass the boundary with the Lower Dacian (Getian; 4.70 Ma).

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REFERENCES

GLIOZZI E., CECI M. E., GROSSI F. & LIGIOS S., 2007. Paratethyan Ostracod immigrants in Italy during the Late Miocene. *Geobios*, 40: 325-337.

KRIJGSMAN W., STOICA M., VASILIEV I. & POPOV V., 2010. Rise and fall of the Paratethys Sea during the Messinian salinity crisis. *Earth and Planetary Science Letters*, 290, 183-191.

STOICA M., LAZAR I., KRIJGSMAN W., VASILIEV I., JIPA D. C. & FLOROIU A., 2012. Palaeoenvironmental evolution of the East Carpathian foredeep during the late Miocene – early Pliocene (Dacian Basin; Romania). *Global and Planetary Change*. http://dx.doi.org/10.1016/j.gloplacha.2012.04.004.

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Marie-Béatrice Forel, Sylvie Crasquin & Qinglai Feng

FIRST RECORD OF THE LILLIPUT OSTRACOD FAUNAS IN THE AFTERMATH OF THE END-PERMIAN EXTINCTION

Ostracods were strongly affected by the end-Permian extinction (EPE; ~ 252My ago), with species extinction rates ranging from 74 to 100% depending on locality (Crasquin & Forel, 2013). Ostracod recovery is assumed to be complete during the Ladinian, when they are well known in the Tethyan domain. During the earliest Triassic, survival in refuge areas of microbial origin has been recently described: microbial mats would have provided an unlimited food supply and O_2 to the supposedly anoxic environment following the EPE (Forel *et al.*, 2013; Forel, *in press*).

A Lilliput effect has been widely described for several fossil groups for the period in the aftermath of the EPE (e.g. brachiopods, He *et al.*, 2007; gastropods, Payne, 2005; foraminifera, Song *et al.*, 2011), but was until now unknown for ostracods. Considering Length (L) as a proxy to body size, we computed L_{max}, L_{min} and L_{mean} of ostracod assemblages through the EPE for places where they survived in refuges. In addition we analyzed the repartition of specimens among 13 classes of size, from 101 to 1400 m. It appears that:

(i) Maximal of L_{max}, L_{min} and L_{mean} are reached in Upper Permian assemblages whatever the locality.

(ii) The number of size classes' decreases from Permian to Triassic. Higher size classes disappear in the Earliest Triassic and small specimens dominate.

The observed patterns can be related to a Lilliput effect (real reduction of body size in all specimens) or to taphonomic process (apparent reduction due to preferential preservation of larvae, several ontogenic series being recognized from these localities (FOREL *et al.*, submitted). However:

(i) The disappearance of the largest forms cannot be considered as a disappearance of adult stages since it would lead to non-viable populations.

(ii) Among the few species crossing the EPE, within-larval stage size reduction is observed, Permian larvae being bigger than Triassic ones.

Consequently, they are interpreted as Lilliputian communities, based on 2 mechanisms: within-species size reduction and within-genera size reduction (appearance of small size species being most important). In the survival mechanism, they are not disaster nor opportunistic taxa but progenitors for the later radiation (FOREL *et al.*, 2013). This size reduction could be related to this seeding process in association with the relocation of energy from growth rates to reproduction, insuring survival in relatively inhospitable conditions.

REFERENCES

CRASQUIN S. & FOREL M.B., 2013. Ostracods (Crustacea) through Permian – Triassic events. *Earth-Sci. Rev, doi: 10.1016/j.earscirev.2013.01.006.*

FOREL M.B., CRASQUIN S., KERSHAW S. & COLLIN P.Y., 2013. In the aftermath of the end-Permian extinction: the microbialite refuge? *Terra Nova*, 25: 137-143.

FOREL M.B. in press. The Permian-Triassic mass extinction: ostracods (Crustacea) and microbialites. *C. R. Geosci*

FOREL M.B., CRASQUIN S., KERSHAW S., COLLIN P.Y., BAUD A. & FENG Q. submitted. Ostracods (Crustacea) from the earliest Triassic facies of Çürük Dağ section, southern Turkey: a high-resolution analysis of their palaeoenvironmental and palaeobiogeographical implications. *Fossil Record.*

HE W., SHI G.R., FENG Q., CAMPI M.J., GU S., BU J., PENG Y. & MENG Y., 2007. Brachiopod miniaturization and its possible causes during the Permian-Triassic crisis in deep water environments, South China. *Palaeogeogr., Palaeoclimatol., Palaeoecol.*, 252: 145-163.

PAYNE J.L., 2005. Evolutionary dynamics of gastropod size across the end-Permian extinction and through the Triassic recovery interval. *Paleobiology*, 31: 269-290.

SONG H., TONG J. & CHEN Z.Q., 2011. Evolutionary dynamics of the Permian–Triassic foraminifer size: Evidence for Lilliput effect in the end-Permian mass extinction and its aftermath. *Palaeogeogr., Palaeoclimatol., Palaeoecol.*, 308: 98-110.

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HOLOCENE LAKE LEVEL CHANGES OF TANGRA YUMCO (CENTRAL TIBETAN PLATEAU) AS INDICATED BY OSTRACODA AND OTHER PROXIES

The Tangra Yumco is one of the five largest lakes on the Tibetan Plateau. It covers an area of 818 km^2 within a catchment of 8220 km^2 and has a maximum depth of 223 m. Ancient shore lines more than 200 m above the present day level indicate remarkable climate changes during the Late Quaternary. Ostracods, beside other micropalaeontological, geochemical, mineralogical and sedimentological proxies, allow a reconstruction of the lake level evolution reflecting climatic changes.

We studied fossil ostracod associations from outcrops and lake cores for palaeoenvironmental reconstructions. Applicable methods are ecological tolerances and preferences of ostracod species, index assemblages, morphological variation (noding) of *Leucocytherella sinensis* Huang, 1982, ostracod-based transfer functions for water depth and salinity, ^{18}O and ^{13}C isotopes as well as Mg and Sr from ostracod shells.

The lake level of the Pleistocene-Holocene transitions was very low, probably distinctively lower than today. First exact estimations are possible for around 8 ka cal BP, when ostracods and palaeo-shore lines from ancient lake sediments indicate a lake level of approximately +180 m. Ostracod successions from several sections proof a continuously high lake level until approximately 2 ka cal BP, the last clear evidence for a lake level > +150 m. Then, a fast decline of lake level is documented by ostracods from a sediment profile close to the present day lake shore. At 0.7 ka cal BP, the lake level was already at +15 m. A distinctive rise of the lake level is recognisable during the last decades. Salinity changes documented by ostracod morphology and shell

chemistry indicate directions of these lake level fluctuations. Ostracod-based water depth reconstructions are useful only for lake system conditions, i.e. salinity or productivity, similar to the present one.

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Virgilio Frezza, M. Gabriella Carboni & Letizia Di Bella

DISTRIBUTION OF RECENT OSTRACODS NEAR THE OMBRONE RIVER MOUTH (NORTHERN TYRRHENIAN SEA, ITALY)

A preliminary study on the ostracods of the southern Tuscany marine sector was performed. The Ombrone River mouth is bordered to the north by the Piombino Promontory and the Elba Island and to the south by the Argentario Peninsula and the Giglio Island (Fig. 1). The Ombrone River is responsible for the natural processes of transport and the coastal evolution of the entire basin (approximately 3000 km^2). Its fine sediments are dispersed along a wide area between the Elba Island and the Argentario Promontory (Chiesi *et al.*, 1993).

Numerous grab-samples were collected during the “Maremma 1996” cruise, carried out by R/V Urania (November 15-29, 1996). Each sample consists of 50 cm^3 of undisturbed sediment, from the top 5-7 cm of seabed; in the laboratory, 127 samples (15-184 m water depth; Fig. 1) were wet-sieved through 125 m. A micropaleontological analysis was performed and the ostracods were collected, counted and classified. The species attribution was based mainly on publications concerning the Mediterranean area (e.g., Bonaduce *et al.*, 1976; Pugliese & Stanley, 1991; Montenegro & Pugliese, 1996; Arbulla *et al.*, 2000; Guernet *et al.*, 2003; Faranda & Gliozzi, 2008; Aiello & Barra, 2010). The distinction between autochthonous and allochthonous valves was made according to Pugliese & Stanley (1991). The species were considered autochthonous if:

- complete carapaces and/or valves of adults were found together with juveniles forms;
- young instars were absent but adult valves showed a good conservation status;

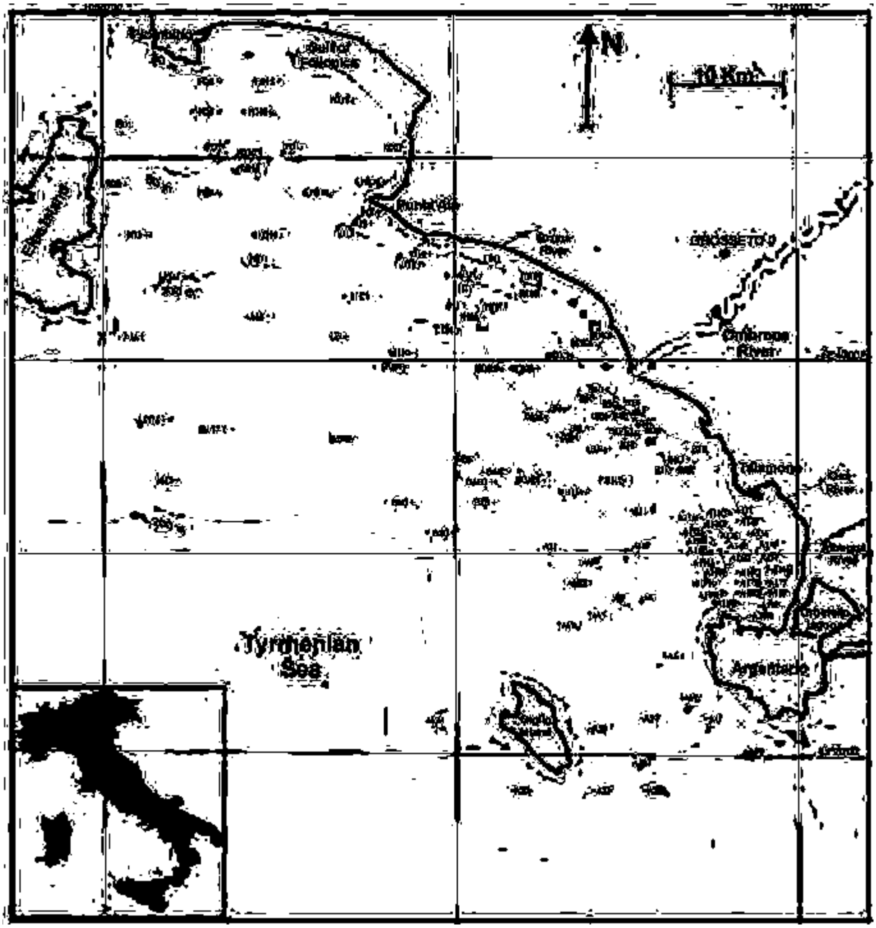

Fig. 1 — Geographic setting and location of sampling sites (from FREZZA & CARBONI, 2009).

— their features are consistent with the ecology and the stratigraphy.

In general, the ostracods are well preserved and are represented both by adult and young instars shells (carapaces or valves). A total of 62 species belonging to 36 genera was classified. Seven species have been left in open nomenclature. Three ostracod assemblages were recognised considering the 15 most common taxa:

— infralittoral assemblage with fluvial influence (15-60 m water depth), dominated by *Carinocythereis carinata*, *Leptocythere bacescoi*, *Leptocythere ramosa*, *Loxoconcha ovulata*, *Loxoconcha subrugosa*, *Palmoconcha turbida*, *Pontocythere turbida* and *Semicytherura incongruens*;

— infralittoral-circalittoral assemblage (30-79 m) with *Cytheridea neapolitana*, *Cytheropteron ruggierii* and *Sagmatocythere versicolor*;

— circalittoral assemblage (> 69 m), characterised by *Bosquetina dentata*, *Cytheropteron vespertilio*, *Henryhowella parthenopea* and *Krithe praetexta*.

The ostracod assemblages distribution is comparable with that of benthic foraminiferal assemblages recognised in this sector of the Tyrrhenian Sea (FREZZA & CARBONI, 2009).

REFERENCES

AIELLO G. & BARRA D., 2010. Crustacea, Ostracoda. *Biologia Marina Mediterranea*, 17: 401-419.

ARBULLA D., PUGLIESE N. & RUSSO A., 2000. Ostracodi del Golfo Saline (Sardegna nord-orientale). *Studi Trentini di Scienze Naturali - Acta Geologica*, 77: 25-35.

BONADUCE G., CIAMPO G. & MASOLI M., 1976. Distribution of Ostracoda in the Adriatic Sea. *Pubblicazioni della Stazione Zoologica di Napoli*, 40: 1-304.

CHIESI R., IMMORDINO F. & FORTI S., 1993. Composizione mineralogica e tessiturale dei sedimenti recenti dell'area del "Bacino Centrale" dell'Arcipelago Toscano (Tirreno Settentrionale). In: Furia S. (ed.), Arcipelago Toscano. Studio sedimentologico, geochimico e biologico. ENEA: 197–211.

FARANDA C. & GLIOZZI E., 2008. The ostracod fauna of the Plio-Pleistocene Monte Mario sucession (Roma, Italy). *Bollettino della Società Paleontologica Italiana*, 47: 215-267.

FREZZA V. & CARBONI M.G., 2009. Distribution of recent foraminiferal assemblages near the Ombrone River mouth (Northern Tyrrhenian Sea, Italy). *Revue de Micropaléontologie*, 52: 43-66.

GUERNET C., LEMEILLE F., SOREL D., BOURDILLON C., BERGE-THIERRY C. & MANAKOU M., 2003. Les Ostracodes et le Quaternaire d'Aigion (golfe de Corinthe, Grèce). *Revue de Micropaléontologie*, 46: 73-93.

MONTENEGRO M.E. & PUGLIESE N., 1996. Autecological remarks on the ostracod distribution in the Marano and Grado Lagoons (Northern Adriatic Sea, Italy). In: Cherchi A. (ed.), Autecology of selected fossil organisms: achievements and problems. *Bollettino della Società Paleontologica Italiana*, Special Volume 3: 123-132.

PUGLIESE N. & STANLEY D.J., 1991. Ostracoda, depositional environments and Late Quaternary evolution of the eastern Nile Delta, Egypt. *Il Quaternario*, 4: 275-302.

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PHENOTYPICAL VARIATION IN *LEUCOCYTHERELLA SINENSIS* HUANG, 1982 A NEW PROXY FOR PALAEOSALINITY IN TIBETAN LAKES

Ostracods are common proxies for palaeoenvironmental reconstructions due to their sensitivity for ecological conditions (e.g. MISCHKE *et al.*, 2007; FRENZEL *et al.*, 2011) and their carbonate valves which are used for geochemical analysis (e.g. SCHWALB, 2003). For freshwater taxa a high conductivity represents a stressing factor and is often associated with low diverse ostracod assemblages. Thus, palaeoecological analyses on the association alone may remain unsatisfying or defective.

Leucocytherella sinensis is an ubiquituous ostracod species endemic to the Tibetan Plateau where it is the most abundant species, sometimes up to more than 98 % of the ostracod association. A clue to it's palaeoecology may be environmentally driven phenotypic variation in *L. sinensis* which displays several morphological forms, characterised by different grades of node formation on their valves. This feature is so distinct that several junior synonyms were described from this species by different authors during the past 30 years (e.g. PANG *et al.*, 1985). This species is a member of the ostracod group of Cytheroidea known for node formation caused by water chemistry.

For the investigation of morphological variation in *L. sinensis* 21 Recent surface samples from twelve different lakes (Fig. 1) were analysed.

Morphological investigations and a non-metric MDS of the shape show that the species of *Leucocytherella* described from the Tibetan Plateau belong to one species: *Leucocytherella sinensis*. The analysis of the mean number of nodes on the valves of adult *L. sinensis* at a given conductivity and Ca^{2+} content shows a connection between noding and conductivity of the ambient

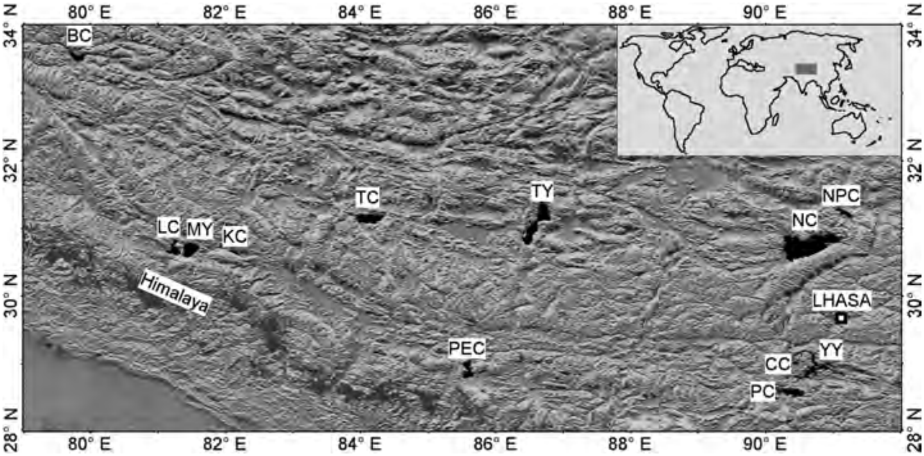

Fig. 1 — Morphological map of the Autonomous Region of Tibet and adjacent areas, based on freely available SRTM data (USGS, 2004) with position of analysed lakes: BC: Bangong Co; CC: Chen Co; KC: Kunggyu Co; LC: La'ang Co; MY: Mapam Yumco; NC: Nam Co; NPC: Npen Co; PC: Puma Yumco; PEC: Peiku Co; TC: Taro Co; TY: Tangra Yumco; YY: Yamdrok Yumco.

water with lower node number under higher salinity (Fig. 2). Suprisingly, nodes are not common in low conductivity populations but highest within the range between 0.5 and 3 ‰. However, high Ca^{2+} concentrations suggest a combined effect of salinity and Ca^{2+} ion concentration on the formation of

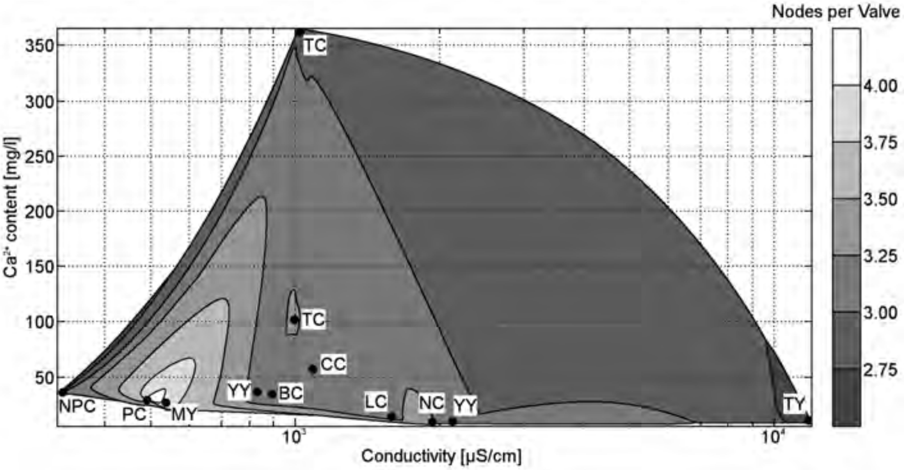

Fig. 2 — Noding per valve as a function of conductivity and Ca^{2+} content with black dots representing the position of analysed lakes: BC: Bangong Co; CC: Chen Co; LC: La'ang Co; MY: Mapam Yumco; NC: Nam Co; NPC: Npen Co; PC: Puma Yumco; TC: Taro Co; TY: Tangra Yumco; YY: Yamdrok Yumco.

nodes in *L. sinensis*. The number of nodes increases with decreasing salinity, but a high Ca^{2+} availability reduces the node formation.

The forming of nodes is not a taxonomic character but depends on salinity and the concentration of Ca^{2+} ions. If the proportion of Ca^{2+} ions stays constant, trends in salinity can be detected by counting the nodes on the valves of adult individuals.

The noding phenomenon in *L. sinensis* can be used as a new proxy for continuous palaeosalinity reconstruction in Quaternary sediments from lakes of the Tibetan Plateau. In connection with geochemistry, palaeoecology, or stable isotopes it can provide useful information on Holocene climate variability and changes in the monsoon system in Tibet.

REFERENCES

FRENZEL P., SCHULZE I., PINT A., BOOMER I. & FEIKE M., 2011. Salinity dependant morphological variation in *Cyprideis torosa*. *Joannea Geol. Paläont.*, 11: 59-61.

MISCHKE S., HERZSCHUH U., MASSMANN G. & ZHANG C., 2007. An ostracod-conductivity transfer function for Tibetan lakes. *Journal of Paleolimnology*, 38: 509-524.

PANG Q., ZHENG M. & LIU W., 1985. The late Cenozoic Ostracoda of the Siling lake and Bangkog lake district in the Xizang (Tibet) and its stratigraphic significance. Contribution to the Geology of the Qinghai-Xizang (Tibet) Plateau, 16: 260-266 [in Chinese with English abstract].

SCHWALB A., 2003. Lakustrine ostracodes as stable isotope recorders of late-glacial and Holocene environmental dynamics and climate. *Journal of Paleolimnology*, Kluwer Academic Publishers, 29: 265-351.

USGS, 2004. Shuttle Radar Topography Mission, 3 Arc Second scenes N28079 - N33E091, Unfilled Unfinished 2.0, Global Land Cover Facility, University of Maryland, College Park, Maryland, February 2000.

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CLIMATIC AND HYDROLOGICAL INSTABILITY IN EAST AFRICA DURING THE HOLOCENE: OSTRACOD EVIDENCE FROM LAKE CHAMO, SOUTH ETHIOPIA

Ostracod assemblages recovered from a 14.13 m long drill core from Lake Chamo, southern Ethiopia, together with XRF geochemical data, provide evidence for climatic and hydrological instability in southern Ethiopia during the Holocene. The change in ostracod assemblages are interpreted in terms of changing lake water salinity as a result of fluctuations in the evaporation-precipitation rate due to climate changes. During the wettest phase of the reconstructed paleoenvironment, the period between 8700 - 5200 cal yr BP, the lack of ostracod is probably caused by very poor calcite availability in the lake water. When the climate is changed in to arid periods, specifically from 5200 - 4200 cal yr BP, the lake was shallow, more open, and a more alkaline that the habitat was dominated by diverse ostracod taxa. *Gomphocythere angulata, Oncocypris omercooperi, Ilyocypris* cf. *I. decipiens, Humphcypris* cf. *H. brevisetosa, Sclerocypris* sp. and *Pseudocypris bouvieri* are restricted to this time interval. The ostracod assemblages represented a wide range of saline-tolerant species when the level of the lake was low. The dominance of *Heterocypris* cf. *H. giesbrechtii* following these assemblages is a good indication for the lake level fell to a minimum (MARTENS & TUDORANCEA, 1991). This shallower, alkaline-saline environment persisted until 2600 cal yr BP where members of *Limnocythere* are found together with other associated genera (ATNAFU & RUSSO, 2004). The climate shifted from warm-dry to warm-wet between 2600 and 2000 and from 1600 to 1000 cal yr B.P., and from relatively fresh water to shallow saline conditions, as shown by the dominance of ?*Darwinula stevensoni*. Finally, from 1000 cal yr B.P. to the present the climate was warmer as indicated by the predominance of *Limnocythere*. ?*Darwinula stevensoni* dominated again towards the upper most part of the core possibly due to an increase of littoral vegetation (MARTENS *et al.*,1997; MEISCH, 2000). The geochemical sediment data correlate well with the changes in ostracod communities during the past 8700 cal yr BP. The results of this study are compatible with other regional studies of Holocene lake level and palaeoclimate in East Africa (COHEN *et al.*, 1983).

REFERENCES

ATNAFU B. & RUSSO A., 2004. Late Quaternary lacustrine ostracoda of the Ziway-Shala Basin (Ethiopia) as paleoenvironmental indicators. *Bollettino della Società Paeontologica Italiana*, 43: 235-266.

COHEN A.S., DUSSINGER R. & RICHARDSON J., 1983. Lactstrine palaeochemical interpretations based on Eastern and Southern African Ostracods. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 43: 129-151.

MARTENS K. & TUDORANCEA C., 1991. Seasonality and spatial distribution of the ostracods of Lake Zwai, Ethiopia (Crustacea: Ostracoda). *Fresh water Biology,* 25: 233-241.

MARTENS, K., ROSSETTI, G. AND FUHRMANN, R., 1997. Pleistocene and recent species of the family Darwinulidae Brady and Norman, 1889 (Crustacea, Ostracoda) in Europe. *Hydrobiologia*, 357: 99-116.

MEISCH C., 2000. Freshwater Ostracoda of Western and Central Europe. In Schwoerbel, J. & P. Zwick (eds), Su¨swasserfauna von Mitteleuropa, vol. 8/3. Akademischer Verlag Spektrum, Heidelberg, 522 pp.

Authors' Addresses — T. GEBRU, University of Cologne; Seminar for Geography and Education; Gronewaldstrasse 2; 50931 Cologne (Germany); e-mail: tgebruka@uni-koeln.de; F.A. VIEHBERG, University of Cologne; Institute of Geology and Mineralogy; Zülpicher Str.49A; 50674 Cologne (Germany); e-mail: finn.viehberg@uni-koeln.de; V. FOERSTER, University of Cologne; Seminar for Geography and Education; Gronewaldstrasse 2; 50931 Cologne (Germany); e-mail: v.foerster@uni-koeln.de; A. ASRAT, Addis Ababa University, School of Earth Sciences; P. O. Box 1176, Addis Ababa (Ethiopia); e-mail: asfawossena@gmail.com; F. SCHÄBITZ, University of Cologne; Seminar for Geography and Education; Gronewaldstrasse 2; 50931 Cologne (Germany); e-mail: frank.schaebitz@uni-koeln.de.

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TAXONOMIC REVISION OF LIVENTAL'S SPECIES OF BRACKISH WATER OSTRACODA (*Crustacea*) AND DESIGNATION OF NEOTYPES

In the Late Serravallian (mid-Miocene), following the closure of the Palaeomediterranean-Paratethys connections, the Neo-Paratethys bio-province was created, characterised by endemic, brackish water mollusc and ostracod faunas that were distributed widely from the Pannonian Basin (central Paratethys) to the Caspian-Aral Basin (Eastern Paratethys) (OLTEANU & JIPA, 2006). Each Paratethyan basin [Styrian, Vienna, Pannonian, Dacian, Euxinic (former extent of the modern Black Sea basin), and Caspian-Aralic basins] was characterised both by endemic and common species, recording a complex palaeogeographical history of isolation and connection.

Some brackish water ostracods of the Neo-Paratethys were studied for the first time by REUSS (1850), who analysed the ostracods from the "Tertiary" (later ascribed to the Sarmatian-Pontian intervals) deposits of Austria and Hungary (Vienna Basin and Pannonian Basin) and MÉHES (1907, 1908) who studied the ostracod assemblages from Sopron, Budapest-Köbánia and Peremarton (Hungary, Pannonian Basin) at the time considered Pliocene in age but today revised to the lower Pannonian. In those papers several brackish water species were erected/described/figured? which were subsequently revised by later authors (see ZELENKA, 1989 for the Reuss' collection and ZALĂNYI, 1944 for some of Méhes' species – the Méhes collection is lost, L. Kordos, pers. comm. curator of the Geological Museum of the Geological Institute of Budapest). Those papers were followed by important contributions by ZALĂNYI (1929), again on the Pannonian Basin ostracods, and by LIVENTAL (1929) on the brackish water ostracods of the Caspian area. Both authors established several new species that were later shown to be widely distributed both stratigraphically and geographically across the Paratethys realm.

Unfortunately, older papers sometimes contain descriptions and illustrations that are not sufficient to correctly identify the species, thus in the eastern European literature many new species were erected and some of them probably represent junior synonyms. Moreover, as correctly noted by SCHORNIKOV (2011), several species were differentiated on minor details of their ornamentation, yet it is well known that, particularly in brackish water environments, tubercles may be more or less developed, or even absent, depending on environmental parameters, and it is clear that several species were erected on juveniles of already known taxa. The taxonomic confusion arising from all these factors limits our ability to correctly reconstruct the palaeogeographic relationships between the different Neogene Paratethyan basins and the evolutionary radiation of endemic lineages of ostracods that evolved in those basins.

The aim of this paper is to re-describe LIVENTAL's (1929) species through the SEM pictures of the specimens included in various historical collections deposited at the Micropaleontological Laboratory of the VNIGRI, St. Petersburg, Russia, since the original Livental's collection seems to be lost as well as the Azerbaijan collections by Agalarova (AGALAROVA, 1956, 1967; AGALAROVA *et al.*, 1940, 1961). In particular, the revision is based on the VNIGRI collection AZNII27 of L.N. Klein who studied the ostracods of the Azerbaijan area of Babazanan (KLEIN, 1960, the same area studied by LIVENTAL, 1929) and on several other collections from Turkmenistan, the Caucasus and Euxinic/Black Sea? Basin included both in historical collections (Mandelstam, Luebimova, Rozjeva, Stepanaitys) as well as on new findings from the Euxinic Basin. The discussion on each species is accompanied by its synonymy, and an updated geographical and stratigraphical distribution based on the new chronostratigraphical data of KRIJGSMAN *et al.* (2010) and VAN BAAK *et al.* (2013). In those few cases where the Livental's species are still living in the Caspian or Black Sea, the soft parts are described and the ecological parameters given.

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REFERENCES

AGALAROVA D.A., 1956. Microfauna of the productive bed of Aserbaijan and of the red coloured beds of Turkmenistan. *Akad. Nauk. Turkmenskoy, SSSR*: 1-192.

AGALAROVA D.A., 1967. Mikrofauna Ponticeskih otlojenii Azerbaydzhana i sopredelnyh raionov. *Izdvestia Nedra*: 1-124 (in Russian).

AGALAROVA D.A., DZHAFAROV D.I. & KHALILOV D.M., 1940. Spravochnik po mikrofaune tretichnykh otlozheniy apsheronskogo poluostrova. Baku: 1-135 (in Russian).

AGALAROVA D.A., KADYROVA Z.K. & KULIEVA S.A., 1961. Ostracoda from Pliocene and Post-Pliocene deposits of Azerbaijan. Baku: 1-420 (in Russian).

KLEIN L.N., 1960. Ob izmenenii sostava Ostrakod v Apscheronskom iaruse prikurinskoi nizmennosti. *Sbornik Naucno-Tekniceskoi informatsii voprosy geologii*, 1-8.

KRIJGSMAN W., STOICA M., VASILIEV I., POPOV V.V., 2010. Rise and fall of the Paratethys Sea during the Messinian Salinity Crisis. *Earth and Planetary Science Letters,* 290: 183-191.

LIVENTAL V.E., 1929. Ostrakody Akchagylskogo i Apsheronskogo yarusov po Babazananskomu razrezu. *Izdanie Izvestii Azerbaidjankogo Politeknieskogo Instituta*, Baku: 3-57.

MÉHES G., 1907. Beiträge zur kenntnis der Pliozänen Ostrakoden Ungarns. I. Die Cypridæn der unterpannonischen Stufe. *Suppl. Földtani Közlöny*, 37(12): 495-536.

MÉHES G., 1908. Beiträge zur kenntnis der Pliozänen Ostrakoden Ungarns. II. Die Darwinulidæn und Cytheridæn der unterpannonischen Stufe. *Suppl. Földtani Közlöny*, 38(7-10): 601-635.

OLTEANU R. & JIPA D.C., 2006. Dacian basin environmental evolution during Upper Neogene within the Paratethys domain. *Geo-Eco-Marina,* 12: 91-105.

REUSS A.E., 1850. Die fossilen Entomostraceen des Oesterreichischen Tertiarbeckens. *Naturwiss. Abh.*, 3(1): 41-92.

SCHORNIKOV E.I., 2011. Problems of studying Ostracoda of the Caspian basin. *Joannea Geologie und Paläontologie*, 11: 177-179.

VAN BAAK C.G.C., VASILIEV I., STOICA M., KUIPER K.F., FORTE A.M., ALIYEVA E. & KRIJGSMAN W., 2013. A magnetostratigraphic time frame for Plio-Pleistocene transgressions in the South Caspian Basin, Azerbaijan. *Global and Planetary Change*, 103: 119-134.

ZALĂNYI B., 1929. Morpho-systematische Studien über fossile Muschelkrebse. *Geologica Hungarica*, 5: 1-152.

ZALĂNYI B., 1944. Magyarorszăgi Neogén Ostracodăk. *Geologica Hungarica*, 21: 5-184.

ZELENKA J., 1989. A.E. Reuss' importance for research on Neogene Ostracoda from the Vienna Basin and the taxonomic revision of his determinations. *Cour. Forsch.-Inst. Senckenberg*, 113: 251-254.

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OSTRACODA COLLECTED OFF SOUTHERN ICELAND DURING THE ICEAGE PROJECT

The IceAGE Project (Icelandic marine Animals: Genetics and Ecology) aims to study the biodiversity (classical taxonomy, phylogeography and ecological modeling) in the climate sensitive region off Iceland (Brix *et al.*, 2012). The first IceAGE cruise was conducted in September 2011 and samples were collected from 241 stations in 31 working areas off Iceland (subpolar North Atlantic). Samples covered a depth range from the continental shelf to the bathyal zone.

Our objective is to analyse ostracods from Epibenthic Sledge (EBS) and Multicorer (MUC) samples collected from the stations following an increasing depth off Southern Iceland. We aim to compare the diversity of Ostracoda assemblage at different depths, as well as difference between samples obtained by EBS and MUC.

All specimens will be identified to species level and when necessary new species will be described. Furthermore, we will also compare environmental parameters with ostracod distribution pattern.

Preliminary results show that the faunal composition differs between the deep sea (Area 1) and shelf (Area 9) areas. EBS and MUC collected samples show different species composition. The smaller taxa (e.g. *Krithe*) were more abundant in the MUC samples, while the larger taxa (*Echinocythereis echinata*) are more abundant in the EBS samples.

This indicates that using both tools together provide a better picture of the ostracod species diversity.

REFERENCES

BRIX S., BAUERNFEIND W., BRENKE N., BLAZEWICZ M., BORGES V., BULDT K., CANNON J., DÍAZ AGRAS G., FIEGE D., FIORENTINO D., HARALDSDÓTTIR S., HOFFMANN S., HOLST S., HÜTTMANN F., JESKULKE K., JENNINGS R., KOCOT K., KHODAMI S., LUCAS RODRIGUEZ Y., MARTINEZ ARBIZU P., MEIßNER K., MIKKELSEN N., MILLER M., MURRAY A., NEUMANN H., OSTMANN A., RIEHL T., SCHNURR S., SAVAVARSSON J., YASUHARAET M., 2012 Overflow, Circulation and Biodiversity, Meteor-Berichte, Cruise No. 85, Leg 3: 1-41.

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CYPRIDEIS (*Ostracoda*) FROM WESTERN AMAZONIA'S NEOGENE (SOLIMÕES FORMATION, BRAZIL)

Ostracods and in particular the genus *Cyprideis* experienced an extensive radiation in western Amazonia during the Miocene. At that time a vast wetland ("Pebas system") shaped the landscape and its biota (e.g. HOORN *et al.*, 2010). Inter alia the frequent occurrence of the usually brackish water form *Cyprideis* motivated several authors to propose elevated salinities or sporadic marine transgressions. With the onset of the modern Amazon system the unique "Pebasian fauna" vanished during the Latest Miocene.

Here we document the microfauna of a 400.25 m deep drill hole (1AS-10-AM; S04°50'/W70°22'; 62 km SW Benjamin Constant). The core consists of sandy–pelitic alternations with dm-thick lignitic intercalations. Sediments below ~215 m depths are largely pedogenically altered (reddish paleosols) and yielded no or only very rare and badly preserved ostracod remains. Based on the biostratigraphic model of MUÑOZ-TORRES *et al.* (2006) the core interval above ~215 m comprises the *Cyprideis caraione* to *Cyprideis obliquosulcata* ostracod zones (possibly also the lower part of the *Cyprideis cyrtoma* zone). These zones correspond to a Middle–early Late Miocene age by applying the chronology of WESSELINGH & RAMOS (2010).

Cyprideis extremely dominates the faunas with more than 95 % of the found ostracods. Nine species belong to the "ornate" group sensu MUÑOZ-TORRES *et al.* (1998: *Cyprideis cyrtoma*, *C.* ?*graciosa*, *C. inversa*, *C. lacrimata*, *C.* ?*longispina*, *C. pebasae*, *C. sulcosigmoidalis*, *C.* aff. *C. tuber-*

culata, *Cyprideis* sp. 1) and at least seven to the "smooth" group (*C. amazonica*, *C.* aff. *C. amazonica*, *C. machadoi* s.l. (?4 species), *C. olivencai*, *C. schedogymnos*, *Cyprideis* sp. 2 and 3).

Among the "ornate" group, *C. sulcosigmoidalis* occurs throughout the productive sample interval (28.2–214.1 m depth). Considerable variations in size (between samples) as well as in ornamentation (within and between samples) are observed. Based on these results, the species *Cyprideis aulakos* is obviously closely related or even a junior synonym of *C. sulcosigmoidalis*. Because *C. aulakos* is assigned in the phylogenetic scheme of MUÑOZ-TORRES *et al.* (2006) to the "smooth" linage and its appearance defines the base of the *C. aulakos* zone, reconsiderations of the existing phylogenetic and biostratigraphic concept are required.

The smooth *C. machadoi* is supposed to be an extremely variable species in relation to shape and development of the anterior margin and MUÑOZ-TORRES *et al.* (1998) put several taxa in the synonymy of *C. machadoi*. However, four clearly differing morphotypes are found here, which necessitate a re-evaluation of the species concept around *C. machadoi*.

The Middle–early Late Miocene ostracod assemblages of core 1AS-10-AM differ with >95 % *Cyprideis* notably from the Late Miocene fauna of the Eirunepé region (250 km S B. Constant; GROSS *et al.*, 2012). There *Cyprideis* constitutes only ~1/3 of the ostracod fauna and is demonstrated to have adapted to pure freshwater settings during the fade out of the "Pebas system". Despite remarkable compositional differences between 1AS-10-AM and Eirunepé, no micropalaeontological evidences (e.g. foraminifers) for a marine influx were found throughout this core.

REFERENCES

GROSS M., RAMOS M.I., CAPORALETTI M. & PILLER W.E., 2012. Ostracods (Crustacea) and their palaeoenvironmental implication for the Solimões Formation (Late Miocene; Western Amazonia/Brazil). *Journal of South American Earth Sciences*, 40: 216-241.

HOORN C., WESSELINGH F.P., TER STEEGE H., BERMUDEZ M.A., MORA A., SEVINK J., SANMARTÍN I., SANCHEZ-MESEGUER A., ANDERSON C.L., FIGUEIREDO J.P., JARAMILLO C., RIFF D., NEGRI F.R., HOOGHIEMSTRA H., LUNDBERG J., STADLER T., SÄRKINEN T. & ANTONELLI A., 2010. Amazonia Through Time: Andean Uplift, Climate Change, Landscape Evolution, and Biodiversity. *Science*, 330: 927-931.

MUÑOZ-TORRES F., WHATLEY R.C. & VAN HARTEN D., 1998. The endemic non-marine Miocene ostracod fauna of the Upper Amazon Basin. *Revista Española de Micropaleontología*, 30: 89-105.

MUÑOZ-TORRES F.A., WHATLEY R.C. & VAN HARTEN D., 2006. Miocene ostracod (Crustacea) biostratigraphy of the upper Amazon Basin and evolution of the genus *Cyprideis*. *Journal of South American Earth Sciences*, 21: 75-86.

WESSELINGH F.P. & RAMOS M.I.F., 2010. Amazonian aquatic invertebrate faunas (Mollusca, Ostracoda) and their development over the past 30 million years. In: Hoorn C. & Wesselingh F.P. (eds.), Amazonia, Landscape and Species Evolution: A Look into the Past. *Wiley-Blackwell*, Oxford: 302-316.

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FRANCESCO GROSSI, ELSA GLIOZZI, PERE ANADÓN & FRANCESCA CASTORINA

IS *CYPRIDEIS AGRIGENTINA* DECIMA A GOOD PALAEOSALINOMETER FOR THE MESSINIAN SALINITY CRISIS? MORPHOMETRICAL AND GEOCHEMICAL ANALYSES FROM THE ERACLEA MINOA SECTION (SICILY)

Since the study of VESPER (1975) and ROSENFELD & VESPER (1977), it is known that the living anomalohaline species *Cyprideis torosa* (Jones) undergoes morphometrical variations in size, noding and sieve pore shape linked to the environmental salinity. Several studies (among others: CARBONEL, 1982; ALADIN, 1993; VAN HARTEN, 1996; KEYSER, 2005; BOOMER & FRENZEL, 2011; FRENZEL *et al.,* 2011, 2012) showed that salinity values around 8-9 psu represent the osmoregulation threshold and also the turning point between smaller and greater valve dimensions and prevailingly noded against un-noded valves. The variation of the percentage of round-, elongate- and irregular-shaped sieve pores on the valves has shown an empiric logarithmic correlation with the water salinity from 0 to 100 psu (ROSENFELD & VESPER, 1977). Due to this ecologically cued polymorphism, *Cyprideis torosa* represents an invaluable palaeosalinometer for Quaternary brackish basins.

Some authors (ROSENFELD, 1977; BONADUCE & SGARRELLA, 1999) applied the counting of different sieve pore shapes also to the fossil species *Cyprideis agrigentina* Decima, distributed in the Mediterranean during the post-evaporitic Messinian lago-mare phase.

In this paper we attempt to verify whether the ecophenotypical behaviour of *C. agrigentina* was comparable with that of *C. torosa*. To reach this goal three morphometrical characters have been analysed: 1) size variability; 2) noding; 3) variability of the percentage of the sieve pore shapes. The palaeoenvironmental interpretation was been made using synecological (GROSSI *et al.*, 2008) and geochemical approaches (trace elements, stable isotopes and Sr-isotopes). The morphometrical and geochemical analyses have been carried out on more than 3000 adult valves, and several thousand-juvenile valves were added for Sr-analyses. For this study, the 250 m-thick Messinian Lago-Mare succession of Eraclea Minoa (Agrigento, Sicily) was chosen. This section (Fig. 1), made by seven primary gypsum bodies alternated with terrigenous marls has been sampled about every metre.

Ostracods are discontinuously present in the lower 130 m (in the marls intercalated between the lowest six gypsum bodies) and become abundant in the upper portion, immediately below and above the seventh gypsum level). Assemblages show variable richness from 1 species (monotypic assemblages made only by *C. agrigentina*) up to 13 species mainly made by the typical lago-mare ostracod assemblages of Paratethyan origin. In the lowest portion *C. agrigentina* is scarce, and the rather diversified assemblages (*Loxoconcha mulleri*, *L. kocki*, *L. eichwaldi*, *Loxocorniculina djafarovi*, *Loxocauda limata*, *Camptocypria* sp. 1, *Tyrrhenocythere pontica*, *Euxinocythere* (*Maeotocythere*) *praebaquana*, *Amnicythere propinqua*, *A. subcaspia*, *A. multituberculata* and *A. accicularia*) shows a rather high equitability. They suggest salinities <10 psu. The monotypic assemblages have been recovered in the central portion of the Eraclea Minoa section, from 133 to 208 m and the collected valves are abundant and well preserved. In this interval, *C. agrigentina* is accompanied only by the euryhaline benthic foraminifer *Ammonia tepida* and, tentatively, a high salinity waterbody is interpreted. Finally, in the uppermost part of the section (from 208 to 256,5 m), *C. agrigentina* is again accompanied by the Paratethyan assemblage in which Loxoconchidae are less abundant, and two more leptocytherid species are included: *Amnicythere litica* and *A. costata*. This topmost interval seems again to be characterised by salinities <10 psu.

Fig. 1 — Panoramic view of the Eraclea Minoa section. In the foreground the gypsum bodies intercalated with fossiliferous marls; in the background the Messinian-Zanclean boundary (Arenazzolo Fm. – Trubi Fm).

The results of the morphometrical analyses shows that 1) no size variations have been observed on the measured valves along the section; 2) no noded specimens have been recovered along the section (nor have they ever been found in other Messinian lago-mare deposit in the Mediterranean area); 3) the analysis of the percentage of the sieve pore shape (carried out on samples from the middle and upper portion of the section points to different salinities (salinities have been calculated using the formula proposed by FRENZEL *et al.*, 2011 for *C. torosa*): 2.3 – 9.3 psu in the lower and upper portion, where *C. agrigentina* is associated with the Paratethyan contingent; 3.5 - 38.5 psu in the central portion of the succession, where monospecific assemblages made of *C. agrigentina* have been recognised, those last data are rather puzzling. Apart from a short interval between 179 and 186.5 m where the calculated salinities range from 24.1 to 38.5 psu, in which it is reasonable to think that the Paratethyan species cannot survive, the other salinities detected in this interval are very low (3.5 – 13.2 psu) in the range of the oligohaline to low mesohaline environment, and they are supposed to be totally included in the interval tolerated by the Paratethyan loxoconchids and leptocytherids. One possible explanation could be that this long interval deposited in a dysoxic environment (both *Cyprideis* and *Ammonia* are able to withstand reduced oxygen levels).

If this interpretation can be confirmed by the geochemical analyses (still in progress) it will be possible to conclude that the analysis of the percentages of sieve-pore shapes is a valuable palaeosalinometer even if applied on *C. agrigentina*, nothwithstanding the absence of other ecophenotypical variations such as noding and size.

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REFERENCES

ALADIN N.V., 1993. Salinity tolerance, morphology and physiology of the osmoregulation organs in Ostracoda with special reference to Ostracoda from the Aral Sea. In Jones, P. & McKenzie K. (Eds.), Ostracoda in Earth and Life Sciences, A.A. Balkema, Rotterdam: 387-404.

BONADUCE G. & SGARRELLA F., 1999. Paleoecological interpretation of the latest Messinian sediments from southern Sicily (Italy). *Mem. Soc. Geol. It.*, 54: 83-91.

CARBONEL P., 1982. Les Ostracodes, traceurs des variations hydrologiques dans des systèmes de transition eaux douces-eaux salées. *Mém. Soc. géol. Fr.,* 8 (144): 117-128.

BOOMER I. & FRENZEL P., 2011. Possible environmental and biological controls on carapace size in *Cyprideis torosa* (Jones, 1850). *Joannea Geol. Paläont.*, 11: 26-27.

FRENZEL P., SCHULZE I. & PINT A., 2011. Salinity dependant morphological variation in *Cyprideis torosa. Joannea Geol. Paläont.,* 11: 59-61.

Frenzel P., Schulze I. & Pint A., 2012. Noding of *Cyprideis torosa* valves (Ostracoda) – a proxy for salinity? New data from field observations and a long-term microcosm experiment. *Int. Rev. Hydrobiol.*, 97 (4): 314–329.

Grossi F., Cosentino D. & Gliozzi E., 2008. Palaeoenvironmental reconstruction of the late Messinian lago-mare successions in central and eastern Mediterranean using ostracod assemblages. *Boll. Soc. Paleont. Ital.*, 47 (2): 131-146.

Keyser D., 2005. Histological peculiarities of the nodin process in *Cyprideis torosa* (Jones) (Crustacea, Ostracoda). Hydrobiologia 538: 95-106.

Rosenfeld A., 1977. The Sieve Pores of *Cyprideis torosa* (Jones, 1850) from the Messinian Mavqi'im Formation in the Coastal Plain and Continental Shelf of Israel a san Indicator of Paleoenvironment. *Israel J. Earth-Sciences*, 26: 89-93.

Rosenfeld A. & Vesper B., 1977. The variability of the sieve-pores in recent and fossil species of *Cyprideis torosa* (Jones, 1850) as an indicator for salinity and paleosalinity. In: Löffler, H., Danielopol, D. (Eds.), Aspects of ecology and zoogeography of recent and fossil Ostracoda. Junk Publishers, The Hague: 55-67.

Van Harten D., 1996. *Cyprideis torosa* (Ostracoda) revisited. Of salinity, nodes and shell size. In: Keen, C. (Ed.), Proceedings of the second European Ostracodologists Meeting. *British Micropalaeont. Soc.*, London: 191–194.

Vesper B., 1975. To the problem of noding on *Cyprideis torosa* (Jones, 1850). In: Swain, F., Kornicker, L.S. & Lundin, R.F. (Eds.), Biology and Paleobiology of Ostracoda. *Bull. Amer. Paleontol.*, 65 (282): 205-216.

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RECENT OSTRACODA OF TARO CO (WESTERN TIBETAN PLATEAU)

Ostracoda is the major animal group preserved as microfossils in lake sediments on the Tibetan Plateau. They reach high abundances, a relatively high diversity and are well preserved in sediments of the predominantly brackish and alkaline lakes. Their ecological tolerances, as well as stable isotope and trace element signatures of their calcareous shells provide valuable information about hydrological and climatic changes of the past.

Because the knowledge about taxonomy, ecology and distribution of Recent ostracods on the Tibetan Plateau is very limited and such information is essential for analyzing sediment cores in order to understand the Late Quaternary history of changes of the Asian monsoon system, we carried out a first study on the Recent ostracod fauna of the lake Taro Co, situated on the western Tibetan Plateau (N 31.1°; E 84.1°) at an altitude of 4570 m asl. Its modern surface covers 489 km^2. The maximum depth is 123 m. The water is characterised by Ca-Mg-Cl-SO_4 and has a conductivity of 980 µS/cm, a pH between 9.0 and 9.5, and an alkalinity of 6.9 mmol/l. The thermocline lays in a water depth between 20 and 30 m. In the past, when its lake level was remarkably higher, Taro Co has had a connection with the present day hypersaline Zabuye lake about 20 km to the North.

For documenting species distribution and driving environmental factors, we collected surface sediment samples from 56 stations within the lake and its catchment (rivers, ponds and springs). From the lake, 35 short cores were taken using a gravity corer within a water depth interval of 0 to 123 m in 2012, bottom water samples were taken from the short core to analyse the major cations and anions and stable isotopes later in the laboratory. We extracted the surface sediment layer with a high water content using plastic straws and kept it in 70 % ethanol for later identification of living Ostracoda. In smaller water bodies, we used a hand-net and preserved the samples in ethanol also. The habitats were described and water parameters measured. The sieve residues >250 µm were picked and counted for living ostracods and the sieve residues > 200 µm for empty shells. An evaluation of Ostracod distribution and its driving environmental factors was done using multivariate statistical methods.

The lake is characterized by (in descending order of abundance) *Leucocytherella sinensis, ?Leucocythere dorsotuberosa, Candona xizangensis* and *Fabaeformiscandona gyirongensis*. Typical species of inflowing rivers and ponds are *Tonnacypris gyirongensis* and *Candona candida*. *Tonnacypris gyirongensis* is more abundant in springs together with *Potamocypris villosa*. *Bradleystrandesia reticulata*, *Heterocypris salina* and *H. incongruens* were found in large numbers in some ephemeral pond samples. *Limnocythere inopinata, Ilyocypris* sp. and two unidentified *Eucypris* species are rare only. The knowledge of the ecological preferences of the modern ostracods provides a reliable basis for the interpretation of Quaternary ostracod assemblages. Based on these data, we will establish a transfer function to explain the relationship between the water depth and the species assemblage which will be further applied to a 3 m long core to reconstruct the paleo-lake level of Taro Co.

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VALENTINA HAJEK-TADESSE

NONMARINE OSTRACOD FAUNA FROM THE EARLY MIOCENE LAKE (~17.000~16.000 Ma) IN CROATIA

In the present study, a synthesis of published and unpublished data on ostracod faunas from the Early Miocene nonmarine deposits of Croatia recovered in freshwater to brackish sediments of many outcrops, sections and boreholes is provided, which confirms the role of the Neogene Parathethyan basins in the development and evolution of endemic lineages of nonmarine ostracods.

The North Croatian Basin originated in the Early Miocene, probably in the Ottnangian (PAVELIĆ *et al.*, 1998; PAVELIĆ, 2001). Freshwater deposits cover a wider area. Barren alluvial sediments were overlain by Karpatian lacustrine freshwater to brackish deposits which provided abundant ostracod assemblages (HAJEK-TADESSE *et al.*, 2009; HAJEK-TADESSE, 2012). Ostracods were autochthonous and well preserved. Generally the population structure of the recovered assemblages indicates low water energy of the environments and low sedimentation rates.

Altogether, more than 20 genera (among which *Eucypris, Potamocypris, Amplocypris, Caspiolla, Typhlocypris, Heterocypris, Lineocypris, Fabaeformiscandona*) and 6 families (*Darwinulidae*, *Candonidae*, *Ilyocyprididae, Cyprididae*, *Limnocytheridae* and *Cytherideidae*) were identified. At the genus level Early Miocene lake ostracods show affinity with the nonmarine ostracods recovered in Central Paratethys, Lake Pannon, Pleistocene and recent faunas of the Black and Caspian seas.

According to HARZHAUSER & MANDIĆ (2008) the Paratethyan Neogene Lake Systems represented an unique laboratory for the evolution and many genera of mollusks displaied their FADs in those areas. This investigation, leades to the conclusion that many ostracod genera which characterise the Holocene and recent assemblages of the Ponto-Caspian area took origin from the oldest ostracod faunas of Early Miocene lake. Despite the drastic paleoecology changes (including marine transgressions), the ancestral ostracod nonmarine Miocene fauna of the Early Miocene lake succeeded to survive through time, migrating towards younger and newly formed nonmarine basins.

REFERENCES

HAJEK-TADESSE V., BELAK M., SREMAC J., VRSALJKO D. & WACHA L., 2009. Lower Miocene ostracods from the Sadovi section (Mt. Požeška gora, Croatia). *Geol. Carpathica*, 60 (3): 251-262.

HAJEK-TADESSE V., 2012. Nonmarine Early Miocene ostracods from Požega outcrop (Mt.Požeška gora, Croatia). In: Viehberg F.A. & Gromig R., (eds.), 14 th International German Ostracodologists Meeting,11-14, 2012. *Kölner Forum Geol. Paläont.*, 21: 25.

HARZHAUSER M. & MANDIĆ O., 2008. Neogene lake systems of Central and South-Eastern Europe: Faunal diversity, gradiens and interrelations. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 260: 417-434.

PAVELIĆ D., MIKNIĆ M. & SARKOTIĆ-ŠLAT M., 1998. Early to Middle miocene facies succession in lacustrine and marine environments on the southwestern margin of the Pannonian Basin System. *Geol. Carpathica*, 49 (6): 433-443.

PAVELIĆ D., 2001. Tectonostratigraphic model for the North Croatian and North Bosnian sector of the Miocene Pannonian Basin. System. *Basin Research*, 13: 359-376.

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JANET HIGUTI, KENNEDY FRANCIS ROCHE & KOEN MARTENS

A COMPARISON BETWEEN THE OSTRACOD (*Crustacea Ostracoda*) FAUNAS OF THE PANTANAL AND THE UPPER PARANÁ RIVER FLOODPLAINS (BRAZIL)

The ostracod fauna of South America is ill known (MARTENS & BEHEN, 1994), and Brazil is no exception to this (MARTENS *et al.*, 1998). Only recently was there a revival in research on the freshwater ecology and taxonomy of Brazilian floodplain ostracods (HIGUTI *et al.*, 2007, 2009a, b, 2010; MORMUL *et al.*, 2010; HIGUTI *et al.*, 2009c, 2013; HIGUTI & MARTENS, 2012). Floodplains associated with large rivers, such as the Pantanal and the Upper Paraná River floodplain, are excellent model systems to investigate potential drivers of biodiversity at a variety of spatial scales.

Here, we analyse the alpha (local), beta (change of faunal composition) and gamma (regional) diversity of ostracod species in two Brazilian floodplains, as well as compare the diversity between these floodplains. In addition, we assess the effect of the factor ‘environment’ on these levels of diversity. Ostracoda were collected from 28 lakes of Pantanal in 2003 and from 33 lakes of the Upper Paraná River floodplain in 2004. Ostracods were sampled using a rectangular net (mesh size c 160 µm) hauled close to sediment-water interface for littoral collections. Floating vegetation was hand collected, and roots were thoroughly washed in a bucket. The residues were washed in the same handnet. The material was preserved in 70% ethanol.

Both collections yielded 41 species together, 31 species were recorded in the Upper Paraná River floodplain and 26 in Pantanal. The rarefaction curves results showed that ostracod richness reached an asymptote in Upper Paraná River floodplain, while there still seems to be a slight tendency to increase the number of species in Pantanal. The higher species richness of ostracods in the

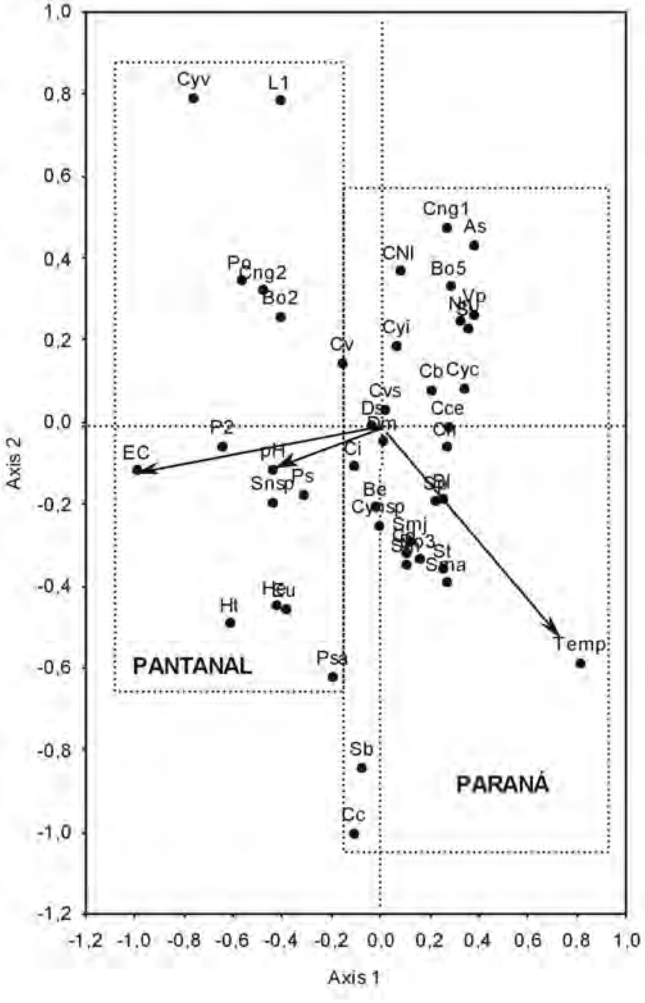

Fig. 1 — Distribution of scores of Canonical Correlation Analysis (CCA) derived from the composition and abundance of ostracods and environmental variables.

Upper Paraná River floodplain is mainly related to the variety of substrate types (different species of aquatic macrophytes) in this ecosystem. Aquatic macrophytes provide environmental heterogeneity and are thus important micro-habitats for aquatic communities. Beta diversity values were relatively low within the Pantanal (5%) and Upper Paraná River (4%) floodplains, meaning that there is a great similarity within environments. However, the beta diversity (32%) was higher between the floodplains. The Monte-Carlo permutation test evidenced that the analysis was significant ($p<0.05$) for the two axes of CCA, explaining 15% of the total variance. The most strongly influencing factor on the distribution of ostracods assemblage was electrical conductivity and water temperature. The results of the CCA showed a distinct separation according to composition and abundance of ostracods between the floodplains.

REFERENCES

Higuti J., Velho L.F.M., Lansac-Tôha F.A. & Martens K., 2007. Pleuston communities are buffered from regional flood pulses: the example of ostracods in the Paraná River floodplain, Brazil. *Freshwater Biology*, 52: 1930-1943.

Higuti J., Lansac-Tôha F.A., Velho L.F.M., Pinto R.L., Vieira L.C.G. & Martens K., 2009a. Composition and distribution of Darwinulidae (Crustacea, Ostracoda) in the alluvial valley of the Upper Paraná River, Brazil. *Brazilian Journal of Biology*, 69 (2): 253-262.

Higuti J., Velho L.F.M., Lansac-Tôha F.A. & Martens K., 2009b. Biodiversity of non-marine ostracods (Crustacea, Ostracoda) in the alluvial valley of the Upper Paraná River, Brazil. *Brazilian Journal of Biology*, 69 (suppl), 661-668.

Higuti J., Meisch C. & Martens K., 2009c. On *Paranacypris samambaiensis* n. gen. n. sp. (Crustacea, Ostracoda), the first South American psychrodromid, from the floodplain of the Upper Paraná River (Paraná, Brazil). *Journal of Natural History*, 43: 769-783.

Higuti J., De Clerck S., Lansac-Tôha F.A., Velho L.F.M. & Martens K., 2010. Variation in ostracod (Crustacea, Ostracoda) communities in the alluvial valley of the Upper Paraná River (Brazil) in relation to substrate. *Hydrobiologia*, 644: 261-278.

Higuti J. & Martens K., 2012. On a new cypridopsine genus (Crustacea, Ostracoda, Cyprididae) from the Upper Paraná River Floodplain (Brazil). *Zootaxa*, 3391: 23-28.

Higuti J., Schön I., Audenaert L. & Martens K., 2013. On the *Strandesia obtusata/elliptica* – lineage (Ostracoda, Cyprididae) in the alluvial valley of the Upper Paraná River (Brazil), with the description of three new species. *Crustaceana*, 86 (2): 182-211.

Martens K. & Behen F., 1994. A checklist of the non-marine ostracods (Crustacea, Ostracoda) from South-American inland waters and adjacent islands. *Travaux scientifiques du Musée d'Histoire naturelle de Luxembourg*, 22: 81 pp.

Martens K., Würdig N.L. & Behen F., 1998 Maxillopoda. Non-Marine Ostracoda: In: Young P.S. (ed.), Catalogue of Crustacea of Brazil. Rio de Janeiro: Museu Nacional, Série Livros 6: 45-65.

Mormul R.P., Thomaz S.M., Higuti J. & Martens K., 2010. Ostracod (Crustacea) colonization of a native and a non-native macrophyte species of Hydrocharitaceae in the Upper Paraná floodplain (Brazil): an experimental evaluation. *Hydrobiologia*, 644: 185-193.

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YUANYUAN HONG & MORIAKI YASUHARA

SHALLOW MARINE ECOLOGICAL DEGRADATION IN HONG KONG: A PALEOECOLOGICAL APPROACH USING OSTRACODS

Hong Kong is one of the largest and most rapidly developing cities in Asia. It is known that the marine ecosystems of Hong Kong have been seriously influenced by a variety of anthropogenic factors, including eutrophication, bottom trawling, coastal reclamation, pollution, etc. However, little is known about long-term history of such human-induced marine ecological degradation in Hong Kong. Here we use microfossil ostracod as a model system and compare among top-1-cm (representing live or recently dead assemblages) and whole (representing averaged state of assemblage for the past several decades) assemblages in grab samples and Holocene background assemblages in a long sediment core. Preliminary ostracod results showed that discrepancy between top-1-cm and whole assemblages is larger in urban sites and smaller in rural sites. Furthermore, species diversity of Holocene background assemblage was much higher than diversities in grab samples. Faunal composition of Holocene sample was also distinct from faunal assemblages of grab samples. These results clearly indicate serious ecological degradation during the past several decades, potentially reflecting recent human-induced eutrophication. Full results will be shown in the presentation.

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SEEING THROUGH THE WALLS: X-RAY MICROTOMOGRAPHY OF CLOSED NONMARINE OSTRACOD CARAPACES FROM THE LOWER CRETACEOUS OF THE ISLE OF WIGHT, UK.

Nonmarine ostracod assemblages recovered from the Early Cretaceous (Barremian) Wessex Formation of the Isle of Wight include species of *Cypridea*, *Pinnocypridea*, *Theriosynoecum*, and a new notodromadid genus. The ostracods occur in plant debris beds deposited by sheet floods on a low-relief flood plain occupied by rivers, lakes and ponds (Sweetman & Insole, 2010), with evidence of rapid burial in reducing conditions. Almost all of the ostracods are preserved as closed carapaces, typically infilled with secondary calcite and pyrite, making it impossible to observe internal features of the valves with conventional light microscopy or Scanning Electron Microscopy. We used X-ray microtomography to obtain images of the insides of carapaces and reconstruct diagnostic features such as the morphology of the calcified inner lamellae, additionally finding evidence of soft-part preservation in some specimens. Our latest findings will be presented and their implications for nonmarine ostracod phylogeny will be discussed.

REFERENCES

Sweetman S.C. & Insole A.N., 2010. The plant debris beds of the Early Cretaceous (Barremian) Wessex Formation of the Isle of Wight, southern England: their genesis and palaeontological significance. *Palaeogeography, Palaeoclimatology, Palaeoecology,* 292: 409-424.

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OSTRACODS FROM MICROBIALITES ACROSS THE PERMIAN-TRIASSIC BOUNDARY IN TUDIYA SECTION (CHONGQING MUNICIPALITY, SOUTH CHINA)

As the greatest mass extinction in the Phanerozoic, the Permian-Triassic (P-T) turnover is a hotspot in geological research. The post-extinction microbialites, built by microbial communities accompanied by metazoan such as ostracods, microgastropods and foraminifera, widely occur in the shallow shelf of the Tethys and give us a clue on the evolution of ostracods above the extinction horizon.

The studied section is located in Tudiya village, Beibei District, Chongqing Municipality, South China (N29°53.790' , E106°30.968' , H615m). The exposure is 2.92m in thickness and consists in ascending order of: the uppermost Permian Changxing Formation (0.5m), microbialites (2.3m), and the lowermost Triassic Feixianguan Formation (0.12m). The Changxing Formation is mainly composed of light grey limestones. The Feixianguan Formation consists of grey mudstones and marlstones. The index fossil for the P-T boundary (PTB), *Hindeodus parvus* (a conodont species), was found 0.3m below the top of the microbialites (Ezaki *et al.*, 2003).

Rather abundant well-preserved ostracod fossils have been retrieved by the hot acetolysis method from continuous sampling through the section. 12 genera and 19 species are recognized, which belong to the Podocopida and Palaeocopida. 3 genera and 3 species, namely ?*Mirabairdia minuta* Chen, 1982, *Acratia* sp., *Bairdia* sp. *sensu* Wang, 1978 were recognized from the Changxing Formation. The abundance and diversity are much higher in the microbialites and become lower again in the Feixianguan Formation. 5 specimens of *Hollinella* cf. *H. panxiensis* Wang, 1978 were found in the Feixianguan Formation, whose sizes are much larger than other species. Two species, *Paracypris badongensis* Guan, 1985 and *Callicythere postiangusta* Wei, 1981, cross the PTB in the section and were found in all levels sampled in this section.

The fauna in the microbialites is compared with those in the underlying Changxing Formation and overlying Feixianguan Formation, which indicates the paleoenvironmental change during the P-T. The abundant smooth podocopid assemblage corroborates the idea that microbialites may have acted as a refuge for ostracods in the aftermath of the PTB (Forel *et al.*, in press). Comparisons with contemporary microbialite faunas in South China such as the Laolongdong section in Chongqing Municipality (Crasquin-Soleau & Kershaw, 2005), Waili section in Guangxi Province (Crasquin-Soleau *et al.*, 2006), Dajiang section in Guizhou Province (Forel *et al.*, 2009; Forel, 2012), and Chongyang section in Hubei Province (Liu *et al.*, 2010) are performed. Some species are found to be in common with other areas, but most of them are endemic. This fact may indicate the variety of microbialites in different paleogeographic localities. More systematic work and analysis are still ongoing and further discussion and conclusion will come out in the near future.

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REFERENCES

Crasquin S., Forel M-B, Feng Q.L., Yuan A.H., Baudin F. & Collin P-Y, 2010. Ostracods (Crustacea) through Permian-Triassic boundary in South China: the Meishan stratotype (Zhejiang Province, South China). *Journal of Systematic Palaeontology*, 8(3): 331-370.

Crasquin-Soleau S., Galfetti B.H. & Brayard A., 2006. Palaeoecological changes after the end-Permian mass extinction: Early Triassic ostracods from Northwestern Guangxi Province, South China. *Rivista Italiana di Paleontologia e Stratigrafia*, 112(1): 55-75.

Crasquin-Soleau S. & Kershaw S., 2005. Ostracod fauna from the Permian–Triassic boundary interval of South China (Huaying Mountains, eastern Sichuan Province): palaeoenvironmental significance. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 217: 131-141.

Ezaki J., Liu J. & Adachi N., 2003. Earliest Triassic microbialite micro - to megastructures in the Huaying Mountains area of Sichuan Province, south China: implications for the nature of oceanic conditions after the end-Permian extinction. *Palaios*, 18: 388-402.

Forel M-B, 2012. Ostracods (Crustacea) associated with microbialites across the Permian-Triassic boundary in Dajiang (Guizhou Province, South China). *European Journal of Taxonomy*, 19: 1-34.

Forel M-B., Crasquin S., Kershaw S.& Collin P-Y., (in press). In the aftermath of the end-Permian extinction: the microbialite refuge? *Terra Nova.*

FOREL M-B., CRASQUIN S., KERSHAW S., FENG Q. L.& COLLIN P.Y., 2009. Ostracods (Crustacea) and water oxygenation in the earliest Triassic of South China: implications for oceanic events at the end-Permian mass extinction. *Australian Journal of Earth Sciences*, 56: 815-823.

LIU H., WANG Y.B., YUAN A.H., YANG H., SONG H.J.& ZHANG S.X., 2010. Ostracod fauna across the Permian-Triassic boundary at Chongyang, Hubei Province, and its implication for the process of the mass extinction. *Science China Earth Sciences*, doi: 10.1007/s11430-010-0045-8.

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GENE HUNT, CHRISTINE SOLON, ROWAN LOCKWOOD
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USING SEXUAL DIMORPHISM IN OSTRACODE CARAPACES TO STUDY SEXUAL SELECTION IN THE FOSSIL RECORD

Recent studies have suggested possible links between sexual selection and rates of species origination and extinction. Such processes can only be studied indirectly using extant species because it is very difficult to account for extinction without fossils. As a result, most studies use proxies for lineage extinction such as IUCN risk status or declines in population abundance. The sexual dimorphism of ostracodes, coupled with their rich fossil record together offer an opportunity to test the macroevolutionary role of sexual selection using true origination and extinction of lineages. Here we present work that takes a first step towards such an analysis by measuring and compiling patterns of sexual dimorphism in the marine ostracode fauna from the Late Cretaceous of the Gulf Coastal Plain of North America. We measure dimorphism by first fitting the digitized outlines of specimens to an ellipse and use the lengths of its major and minor axes as measures of valve length and height. Next, we fit to these measures a mixture model of two bivariate normal distributions, one for each sex. From the fitted model, we can compute the estimated sex ratio and the magnitude of sexual dimorphism as the Mahalanobis distance between males and females. To date, we have measured dimorphism in 34 different species with replicate samples within a few species. We find that our measure of dimorphism is quite repeatable; estimates of the same species from different samples are generally concordant. Although there is ~5-fold variation in the strength of dimorphism across species, related species tend to have similar patterns of dimorphism. For example, all species of *Veenia* and *Haplocytheridea* that we examined are all strongly dimorphic whereas species of *Brachycythere* and *Acuminobrachycythere* all have more modest differences between males and females. There are also differences in the nature of dimorphism across species. In some taxa, males and females are similar in overall size but males are rather more elongate, whereas in other taxa males are much bigger than females but only modestly more elongate. These two kinds of dimorphism may reflect a trade-off between pre-copulatory sexual selection (males are larger to gain access to females) and post-copulatory sexual selection (males are more elongate, representing investment in sperm production), which some studies have found to have different macroevolutionary effects. In this ostracode fauna, there is some indication that only strong shape dimorphism is associated with more female-skewed sex ratios.

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OSTRACODA AS PROXY FOR THE ENVIRONMENTAL MONITORING OF SHALLOW SUBSURFACE HABITAT IN A CONTAMINATED DETRITAL AQUIFER FROM CENTRAL SPAIN

Past and present human changes in the alluvial floodplain land-uses and the emission of contaminants in surface/groundwater have resulted in significant and profound impacts on surface/groundwater aquatic ecosystems. Consequently, the ecosystems services provided by groundwater i.e., water purification and the storage of high-quality waters on long term and in sufficient quantities were also impacted (BOULTON, 1998; HANCOCK, 2002; DANIELOPOL *et al.*, 2006; DOLE-OLIVIER *et al.*, 2009; IEPURE *et al.*, 2013). In the perspective of increasing human pressure and of growing groundwater demands over the last decades, short and long-term monitoring surveys are critical for placing the recent changes in groundwater quality into a wider context. Such actions will help assessing the sensitivity of distinct subsurface shallow habitats to anthropogenic forcing and consequently to reduce the negative impact upon the groundwater ecosystems.

The present survey aims to examine the use of groundwater ostracods assemblage as proxy for ecological assessment of the shallow aquifer ecosystem in the Jarama basin (Fig. 1). This region of central Spain is heavily affected by urban industrial effluents from the waste water treatment plants and agricultural practices. Another goal is to test whether the *intermediate disturbance hypothesis* (IDH) (WILKINSON, 1999), which suggests an intermediate level of pollution is associated with a peak in species diversity in a community, could be confirmed. The study was conducted at twenty-five hyporheic sites and thirty boreholes under distinctive local land-use and water resource protection: i) preserved forested natural sites at rivers headwaters where critical river ecosystem and alluvial plain processes are unaltered by human activities, and ii) lowland sites with different degree of subsurface water contamination resulted from anthropogenic activities (agriculture, urban industrial and mining) (Fig. 1). We analysed the relationship between environmental water conditions (quality status) (i.e. nutrients, Cu, Zn, Ni, Mn, Pb, Cd, volatile organic compounds, pesticides), land cover/uses in the alluvial floodplain, and ostracods assemblage structures. We predict that a severe subsurface water contamination and intensive or mixed land-uses in the alluvial floodplain would reduce species diversity and abundance and will control the distribution pattern of ostracods (stygobite vs. non-stygobite species).

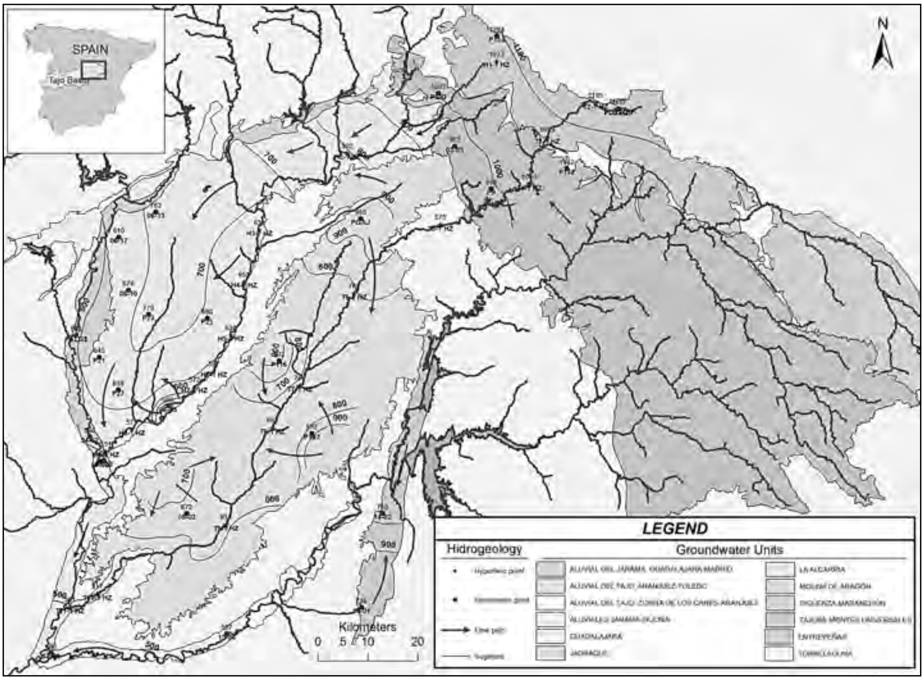

Fig. 1 — Map of the study area showing streams and location of the sampling sites (dots - hyporheic zone, star - boreholes) in the Jarama basin (central Spain).

Ostracod assemblages encompassed 19 species, the most abundant genera being *Pseudocandona* and *Herpetocypris* (Table 1). Most species peaked in abundance and diversity in carbonate waters with mesotrophic status. Canonical Analysis of Principal Coordinates (CAP) ordination technique using species abundance and environmental variable data, showed different groups of samples relate to ostracods abundance linked to particular habitat feature and water quality (Fig. 2a). The results of CAP analysis indicate that streams draining forested and/or sites with well-developed riparian zone are characterized by cold and oligotrophic pristine hyporheic waters, moderate ostracods diversity (2-3 species) and communities formed by hyporheic dwellers (*Cryptocandona vavrai, Pseudocandona albicans*, *Ps. compressa* gr.) and stygobites (*Darwinula stevensoni*) (Fig. 2b). The hyporheic waters and shallow aquifers from the lowland exposed to intensive agriculture practices and associated with an intermediate level of disturbance are rich in nutrients and attain the highest ostracods taxonomic diversity (4 species) with proliferation of *r*-strategists. SIMPER analysis indicate that *Fabaeformiscandona fabaeformis* and *Herpetocypris reptans* were primarily confined to sites governed by agriculture practices, whereas

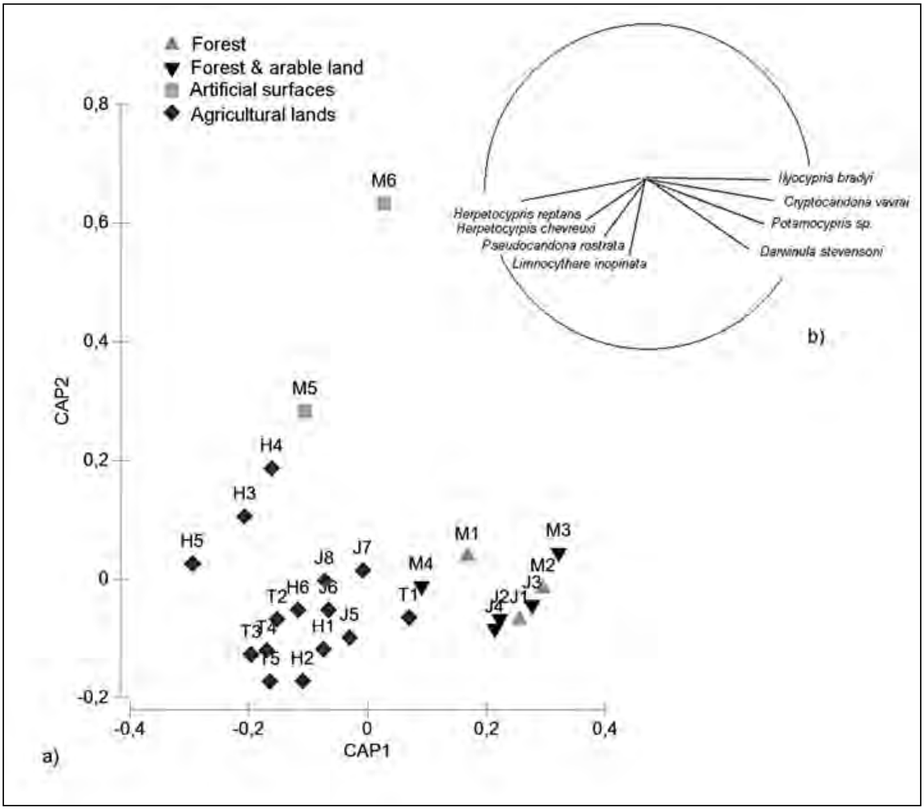

Fig. 2 — **a**, Canonical analysis of principal components (CAP) on Bray-Curtis similarities from log transformed ostracods species abundance data of the subsurface habitats (hyporheic zone) in the Jarama basin. **b**, the plot indicate overlaying vectors pointing the ostracoda species which had correlation > 0.4; c) (M – Manzanares River, J – Jarama River, T – Tajuña River, H – Henares River).

Limnocythere inopinata and *Cypris pubera* are mostly related to sites with mixed agricultural and artificial surfaces land uses. Ostracods decline or are completely absent from the most disturbed sites (with mixed industrial & urban development & agricultural practices) where nitrites, ammonia, trace metals and volatile organic compounds content are extremely high and dissolved oxygen decrease down to anoxia. The most sensitive species to high concentrations of Cr, Cu, and pesticides are *Pseudocandona albicans*, *Ps. compressa* gr. whereas *Cryptocandona vavrai* and *Pseudocandona eremita* are sensitive to volatile organic compounds.

The results obtained highlight the significance of recent ostracods as proxy in monitoring the health conditions of the subsurface ecosystems. They also provide forthcoming approaches to reconstruct the pollution history and environmental condition changes by investigating fossil ostracods recovered from sedimentary sequences in the Madrid basin.

Table 1
Ostracoda species found in subsurface habitats (hyporheic zone)
of the Jarama basin
(in bold: stygobite species)

OSTRACODA

***Pseudocandona* sp.** (species gr. *eremita*) (Vejdovský, 1882)
Darwinula stevensoni (Brady & Robertson, 1870)
Candona candida (O.F. Müller, 1776)
Candona neglecta Sars, 1887
Pseudocandona albicans (Brady, 1864)
Pseudocandona sp. 1 (species gr. *compressa*)
Pseudocandona sp. 2 (species gr. *rostrata*)
Cryptocandona vavrai (Kaufmann, 1900)
Cryptocandona sp. 1
Fabaeformiscandona fabaeformis (Fischer, 1851)
Cyclocypris laevis (Jurine, 1820)
Ilyocypris bradyi Sars, 1890
Prionocypris zenkeri (Chyzer and Toth, 1858)
Herpetocypris chevreuxi (Sars, 1896)
Herpetocypris reptans (Baird, 1835)
Potamocypris sp
Limnocythere inopinata (Baird, 1843)
Cyprideis torrosa (Jones, 1850)
Cypris pubera O.F. Müller, 1776
Candoninae

REFERENCES

BOULTON A.J., FINDLAY S., MARMONIER P., STANLEY E.H., VALETT H.M., 1998. The functional significance of the hyporheic zone in streams and rivers, *Annual Review of Ecology and Systematics,* 29: 59-81.

BOULTON A.J., FENWICK G.D., HANCOCK P.J. & HARVEY M.S., 2008. Biodiversity, functional roles and ecosystem services of groundwater invertebrates. *Invertebrate Systematics*, 22: 103-116.

BOULTON A.J., DATRY T., KASAHARA T., MUTZ M. & STANFORD J.A., 2010. Ecology and management of the hyporheic zone: stream-groundwater interactions. *Journal of Northern American Benthological Society*, 29: 26-40.

DANIELOPOL D.L., GUNATILAKA A., NOTENBOOM J., GRIEBLER C., GIBERT J., SKET B., HAHN H.J., MESSANA G., LÜDERS GRIFFIOEN T.G., LIEBICH J. & ALBRECHTSEN H.J., 2006. Groundwater ecology as a necessary link to the EU Water Framework Directive Umwelbundesamt European Groundwater Conference Proceedings, Vienna.

DOLE-OLIVIER M.J., MALARD F., MARTIN D., LEFÉBURE T. & GIBERT J., 2009. Relationships between environmental variables and groundwater biodiversity at the regional scale. *Freshwater Biology*, 54: 797-813.

IEPURE S., MARTINEZ V., HERERRA S., RASINES R. & BUSTAMANTE I., 2013. Response of microcrustacean communities from the surface – groundwater interface to water contamination in urban river system of the Jarama basin (central Spain). *Environmental Science and Pollution Research*, doi: 10.1007/s11356-013-1529-9.

WILKINSON D.M., 1999. The disturbing history of intermediate disturbance. *Oikos*, 84(1): 145–147.

HANCOCK P.J., 2002. Human impacts on the stream–groundwater exchange zone. *Environmental Management*, 29: 763–781.

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TEMPORAL VARIATIONS OF OSTRACODS, DIATOMS, AND ENVIRONMENTAL FACTORS OVER THE PAST SEVERAL HUNDRED YEARS IN THE SETO INLAND SEA, JAPAN - WITH RELATION TO ANTHROPOGENIC INFLUENCE

The Seto Inland Sea (SIS) is the largest enclosed sea in Japan, and has nine basins called “Nada” or “Wan”(bays) and three channels (Suido or Seto) (Fig. 1). During a period of strong economic growth from 1955 to 1973 (“economic miracle”), industrialization, reclamation, and sand collection for construction material intensified and a rapid increase in various effluents caused intensive

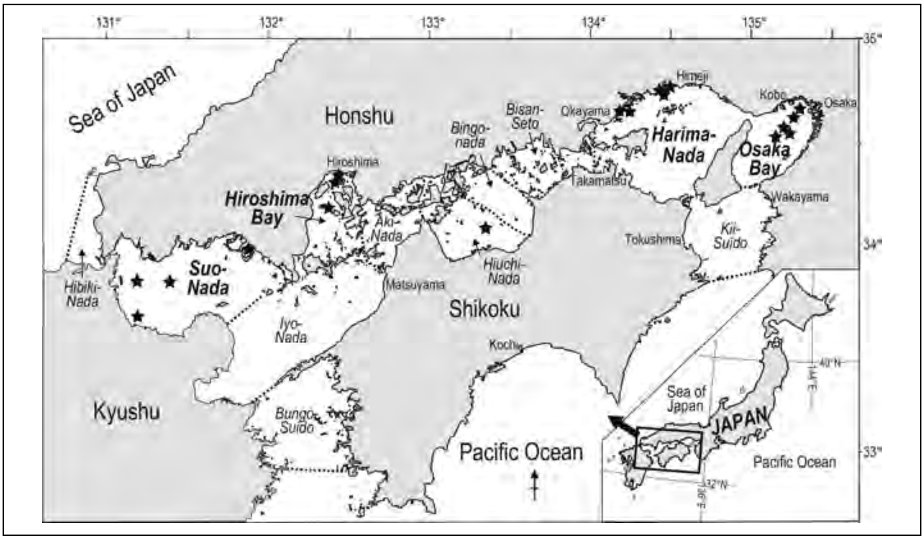

Fig. 1 — Index and locality maps of sediment core sites (black stars) in the Seto Inland Sea.

water pollution, red tides, and organic pollution in sediment. Since then effluents have been regulated in the SIS. Water quality has been measured widely in the SIS since the 1970s or 1980s. Temporal changes of ostracods and diatoms with relation to anthropogenic impacts in the SIS have been recently studied (e.g. YASUHARA *et al.*, 2003, 2007; HIROSE *et al.*, 2008; IRIZUKI *et al.*, 2011; YOSHIOKA *et al.*, 2012). We continue conducting such studies at many sites of the SIS. In this study we compiled these data and elucidated quantitatively the relations of ostracods to several environmental factors (e.g. TOC, TN, COD) and planktic and benthic diatoms, which seem to be one of foods for ostracods.

We used data from many core samples with age information based on ^{210}Pb and/or ^{137}Cs dating and surface sediment samples collected mainly from four basins (Osaka Bay, Harima-Nada, Hiroshima Bay, and Suo-Nada; Figure), which are enclosed bays in the SIS. Faunal changes of ostracods are found in most sites of four basins at the end of 19th century but there are no apparent changes in species composition and abundance of diatom assemblages and TOC content in the sediment. Drastic changes of ostracod and diatom assemblages occurred during the "economic miracle" in all basins.

Two ostracod bioassociations were recognized (KA and BC in IRIZUKI *et al.*, 2011). Species belonging to the KA association (mainly *Krithe* and *Ambtonia*) live in muddy bottoms with relatively low TOC and TN contents. They decreased during the "economic miracle" when red-tide diatoms rapidly increased anywhere in the SIS and have not recovered until recently. Decrease of the KA bioassociation started earlier in enclosed bay bordering areas of significant industrial and urban development such as the inner parts of Osaka, Harima, and Hiroshima bays. Thus, the KA bioassociation is sensitive to eutrophication suggested by the increase of diatom abundance, and organic pollution in sediment. Species belonging to the BC bioassociation (mainly *Bicornucythere* and *Cytheromorpha*) live even in muddy bottoms with relatively high TOC contents (approximately 2 wt%). Temporal profiles of COD content in water column are probably correlated to those of abundance of each species of the BC bioassociation, suggesting that these species are sensitive to organic matter saturated in water column. However, in coastal areas near large cities, where TOC in sediment is now more than 2 wt%, even the BC bioassociation has decreased and it became rare or absent by the 1960s.

REFERENCES

HIROSE K., YASUHARA M., TSUJIMOTO A., YAMAZAKI H. & YOSHIKAWA S., 2008. The succession of diatom assemblages and anthropogenically-induced environmental changes over the last 120 years, Osaka Bay, Japan. *The Quaternary Research*, 47: 287-296.

IRIZUKI T., TAKIMOTO A., SAKO M., NOMURA R., KAKUNO K., WANISHI A. & KAWANO S., 2011. The influences of various anthropogenic sources of deterioration on meiobenthos (Ostracoda) over the last 100 years in Suo-Nada in the Seto Inland Sea, southwest Japan. *Marine Pollution Bulletin*, 62: 2030-2041.

YASUHARA M., YAMAZAKI H., IRIZUKI T., YOSHIKAWA S., 2003. Temporal changes of ostracode assemblages and anthropogenic pollution during the last 100 years, in sediment cores from Hiroshima Bay, Japan. *The Holocene*, 13: 527-536.

YASUHARA M., YAMAZAKI H., TSUJIMOTO A., HIROSE K., 2007. The effect of long-term spatiotemporal variations in urbanization-induced eutrophication on a benthic ecosystem, Osaka Bay, Japan. *Limnology and Oceanography*, 52: 1633-1644.

YOSHIOKA K., HIROSE K., IRIZUKI T., KAWANO S., NOMURA R., GOTOMYO A., IWAI M., 2012. Spatiotemporal changes of diatom assemblages and marine environments over the past few hundred years in coastal areas of northern Harima-Nada, Hyogo Prefecture, southwestern Japan. *The Quaternary Research*, 51: 103-115.

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Annette Koenders, Isa Schön, Saskia Bode, Niels Bracke,
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INTEGRATIVE ANALYSES OF VALVE OUTLINES AND MOLECULAR DNA SEQUENCES IN *EUCYPRIS VIRENS* (*Crustacea Ostracoda*)

Eucypris virens is an ostracod with mixed reproduction, geographic parthenogenesis and Holarctic distribution. Bode *et al.* (2010) found that it actually forms a species complex with more than 35 cryptic species in Europe. Koenders *et al.* (2012) could meanwhile report that three of these cryptic species have also invaded Western Australia. We have analyzed valve outlines of about 100 European and 30 Australian specimens for which also mitochondrial COI sequences are available. Comparisons between molecular and morphological trees reveal very little similarity for the European *E. virens*. Also, grouping of valve outlines as compared to genetic clusters or geographic origins do not match. In *E. virens* from Australia, there is more congruence between geographic populations and their valve outlines but this could be due to reduced variability because of the relatively recent invasion. Our results indicate that the shape of ostracod valves is probably not genetically but environmentally determined.

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REFERENCES

Bode S.N.S., Lamatsch D.K., Martins M.J.F., Schmit O., Vandekerkhove J., Mezquita F., Namiotko T., Rossetti G., Schön I., Butlin R.K. & Martens K., 2010. Exceptional cryptic diversity and multiple origins of parthenogenesis in a freshwater ostracod. *Molecular Phylogenetics and Evolution*, 54: 542–552.

KOENDERS A., MARTENS K., HALSE S. & SCHÖN I., 2012. Cryptic species of the *Eucypris virens* species complex (Ostracoda, Crustacea) have invaded Western Australia. Biological. *Invasions*, 14: 2187-2201.

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EFFECT OF WATER LEVEL FLUCTUATION ON THE SPECIES DIVERSITY AND ECOLOGY OF OSTRACODA (*Crustacea*) IN LAKE ÇUBUK (BOLU, TURKEY)

To understand the effects of water level fluctuations on nonmarine ostracods, we collected monthly samplings for 26 months from 2008 to 2010 in Lake Çubuk (Bolu, Turkey). Seventeen ostracods (*Candona neglecta, C. candida, C. sanociensis, C. weltneri, Pseudocandona sucki, P. albicans, P. semicognita, P.* cf. *P. eremita, Fabaeformiscandona brevicornis, F.* cf. *F. subacuta, Physocypria kraepelini, Cypria ophthalmica, Cypridopsis vidua, Limnocythere inopinata, Ilyocypris gibba, Trajancypris serrata, Prionocypris zenkeri*) were identified from the lake. Both numbers of species and individuals were significantly reduced during the year 2010, corresponding to about 3m of water level increase. Numbers of individuals were found 2 or 4 times higher below 6 meters of depth. Among the species five species (*C. neglecta*, *C. ophthalmica*, *C. vidua*, *L. inopina*, *F.* cf. *subacuta*) showed seasonal occurrences when *P. kraepelini* was the only species encountered all year around. About 77.2% of variance between species and environment relationship was expressed by the first two axes of Canonical Correspondence analyses (CCA). Electrical conductivity and water temperature ($p = 0.002$) were the most influential variables on species. Spearman correlation analyses displayed significant negative correlation of seven species (*C. neglecta, P. semicognata, P.* cf. *P. eremita, F.* cf. *F. subacuta, C. ophthalmica, C. vidua, L. inopinata*) to conductivity. Of which, two (*F.* cf. *subacuta* and *C. vidua*) and one species (*C. candida*) showed a significant positive and negative correlation to water temperature ($p < 0.05$), respectively. *Candona neglecta* was the only species to show a positive correlation to dissolved oxygen. Tolerance levels of the most common species were

relatively higher than the mean of water temperature. It appears that cosmopolitan species seemed to be better adapted to seasonal changes and occur more frequently than the other species. The ratio of pseudorichness (1.13) was relatively higher than the other similar habitats.

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ACUTE TOXICITY AND BIOCONCENTRATION OF LEAD AND CADMIUM IN DIFFERENT STAGES OF *HETEROCYPRIS INCONGRUENS* RAMDHOR 1808 (*OSTRACODA*)

Over the last two decades various methods have been developed to evaluate sediment toxicity, including measuring contaminants effects on single "sentinel species" such as the cladoceran *Ceriodaphnia dubia* and the ostracod *Heterocypris incongruens* (HAVEL & TALBOTT, 1995; CHIAL & PERSOONE, 2002). However, little is known on the variation of responses (survival, bioaccumulation) to pollutants through ontogeny in crustaceans, and ostracods in particular. To fill this gap, acute toxicity tests (ATT) to 24-48-hours, exposed to ranged concentrations of Cd (0.0005-0.2 mg L^{-1}) and Pb (0.25-4.0 mg L^{-1}) were applied to stages A-8, A-7, A-1 and adults of the freshwater ostracod *Heterocypris incongruens*, and ostracod exuvia and bodies analysed by energy dispersive X-ray spectroscopy (EDS) and atomic absorption spectrophotometry (AAS) to find evidence of incorporation of Cd and Pb to the ostracod body.

Results of the ATT showed that the small instars A-8 and A-7 are more sensitive to Cd and Pb and bioconcentrate higher metal content, contrary to expected, than A-1 and adult individuals (Table 1). The present work highlights the importance to consider development stages, because values of lethal concentration (LC_{50}) and other ecotoxicological responses (LOEC-NOEC) change through development. Ecotoxicological risk evaluation, when using different juvenile instars and not only adults, can be more accurate as in this way we could avoid to underestimate detrimental impacts to younger individuals, as already observed in other crustaceans like gammarid amphipods (PASTORINHO *et al.* 2009)

Table 1

Acute Toxicity Tests (ATT) values (mg L^{-1}) for instars A8, A7, A1 and Adults of *H. incongruens* exposed to Pb and Cd for 24 hours. Three replicates (total of 30 individuals) used per instar and metal.

		Instar			
Metal	**ATT indicators**	**A-8**	**A-7**	**A-1**	**Adult**
Pb	**LC_{50}**	1.261	1.963	2.349	2.679
	NOEC [b]	0.5	0.50	2.0	2.5
	LOEC[a]	1.0	1.0	2.5	2.8
	Confidence limits 95%	(0.719-2.218)	(1.783-2.161)	(2.024-2.727)	(2.400-2.993)
	Determination coefficient r^2	0.594	0.850	0.856	0.937
	Range concentrations	0.50-2.5	0.25-2.2	1.5-3.5	1.5-4.0
Cd	**LC_{50}**	0.0081	0.0083	0.0538	0.0575
	NOEC [b]	0.001	0.002	0.04	0.100
	LOEC.[a]	0.002	0.0035	0.05	0.125
	Confidence limits 95%	(0.0037-0.0178)	(0.0044-0.0158)	(0.040-0.071)	(0.0213-0.155)
	Determination coefficient r^2	0.798	0.835	0.906	0.511
	Range concentrations	0.001-0.06	0.001-0.06	0.02-0.125	0.020-0.2

[a] LOEC: Lowest Observed Effect Concentration, respect of control group.
[b] NOEC: No Observed Effect Concentration

REFERENCES

Chial B. & Persoone G., 2002. Cyst-Based Toxicity Tests XIII–Development of a Short Chronic Sediment Toxicity Test with the Ostracod Crustacean *Heterocypris incongruens:* Methodology and Precision. *Environ. Toxicol.*, 17: 528–532.

Havel J.E. & Talbott B.L., 1995. Life history characteristics of the freshwater ostracod *Cyprinotus incongruens* and their application to toxicity testing. *Ecotoxicology*, 4(3): 206-218.

Pastorinho M.R., Telfer T.C. & Soares A.M.V.M., 2009. Amphipod susceptibility to metals: cautionary tales. *Chemosphere*, 75: 1423-1428.

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DEFINITION OF A TROPICAL ASSEMBLAGE OF SHALLOW-WATER OSTRACODA (PODOCOPIDA) FROM NORTHEASTERN AND EASTERN BRAZILIAN SHELVES

The present study deals with the Holocene ostracod assemblages from the Brazilian continental shelf between São Roque Cape (05°30'S) and Frio Cape (23ºS). The 104 studied samples were collected by either a Phillips or a Van Veen grab in water depths ranging from 12 to 110 m as part of the Legs 4 and 7 of the REMAC Project. The 131 species identified, some of them possibly new, were grouped into three assemblages: Tropical (here proposed), Temperate and Transitional one. In the study area, 36.5% of the species recorded are typical of temperate waters, 46.5% of warm waters, 4.0% are possibly eurytopic and 13% restricted to the Transitional Assemblage (Fig. 1). The new Tropical Assemblage is composed by 42 species, ranging from the extreme north of the northern region up to the south limit of the northeastern region. This assemblage is characterized by the absence of cold water species and by its restricted occurrence in carbonate sediments, except for the northeast portion of the northern region where sediments are more terrigenous due to the outflow of Amazonas river. The Temperate Assemblage has been identified in several studies on the Brazilian shelf (*e.g.*, Coimbra & Ornellas, 1989; Coimbra *et al.*, 1995; Ramos, 1996; Carmo & Sanguinetti, 1999; Machado & Drozinski, 2002; Ramos *et al.*, 2004, 2009). It is composed of species from the southern/southeastern regions, many of them ranging down to the Argentinian coast and characterized by the influence of temperate waters, terrigenous sediments and taxa typical of the South Brazilian Sub-province *sensu* Whatley *et al.* (1998). The Transitional Assemblage, composed of both warm and temperate water species, corresponds to the

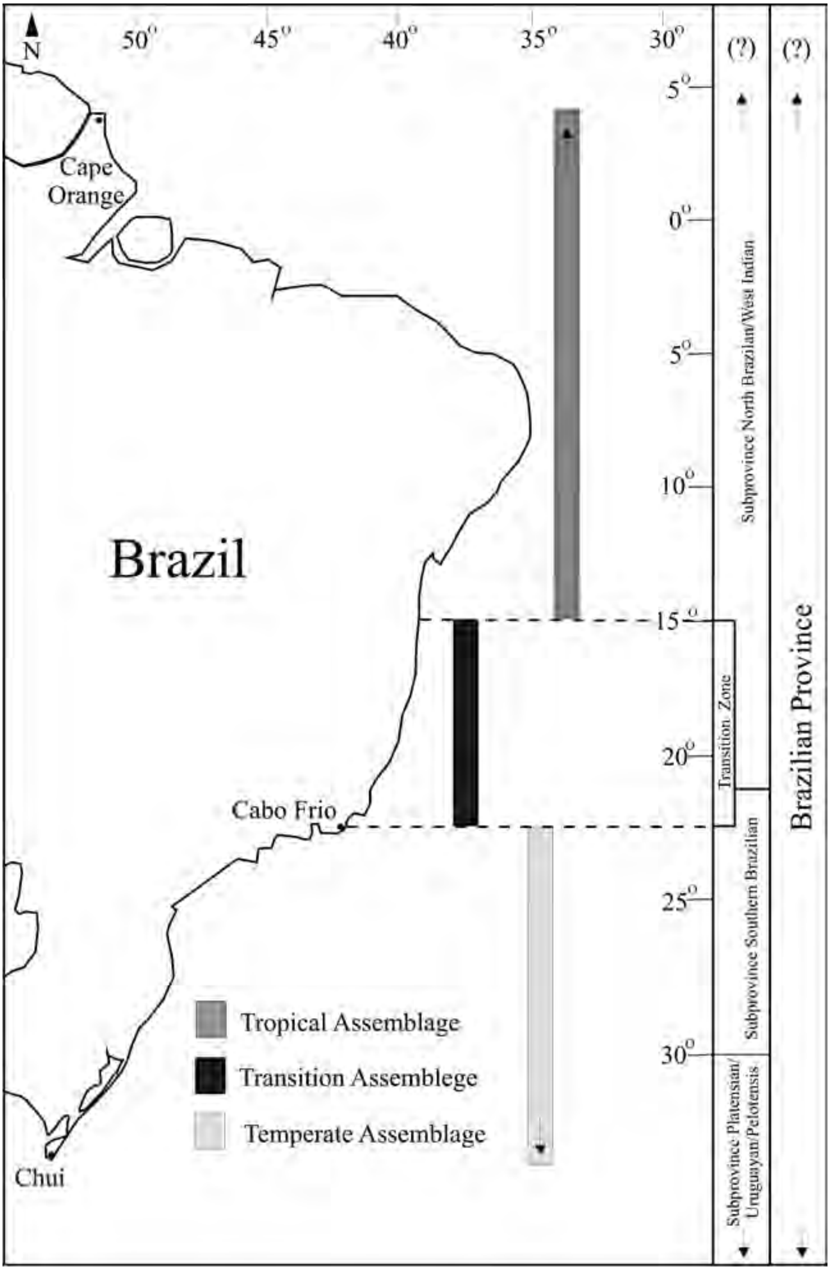

Fig. 1 — Geographical distribution of the ostracod assemblages on the Brazilian continental shelf (modified from MACHADO *et al.*, 2005 and WHATLEY *et al.*, 1998). The dotted horizontal lines at 15°S and 23°S indicate the north and the south limits of the Transition Zone of COIMBRA *et al.* (1995). The subdivision of the Brazilian Province in Sub-provinces is from WHATLEY *et al.* (1998). ?= north limit not yet defined.

ostracods from the Transitional Zone (15° - 23°S) proposed by COIMBRA & ORNELLAS (1989) and COIMBRA *et al.* (1995).

The Tropical Assemblage has strong affinities to the faunas from Caribbean, Gulf of Mexico and/or the northern part of South America. Among the studied species, 12% occur in the Caribbean and Mexican regions and 6% are cosmopolitan. Although previous studies along the Brazilian continental shelf have already identified warm water assemblages (e.g. AIELLO *et al.*, 2004; COIMBRA & ORNELLAS, 1989; COIMBRA *et al.*, 1995; COIMBRA & BERGUE, 2003; FAUTH& COIMBRA, 1998; MACHADO & DROZINSNKI, 2002; RAMOS, 1994, 1996), this is the first one in which the assemblage groups are well characterized and their southern boundary are established. The southern boundary of the Tropical Assemblage, defined by the disappearance of temperate species, has been located near 15°/16°S, while the northern boundary is still unclear due to the lack of data in the area between Guyana and French Guyana and the scarcity of data on marine ostracodes along the coasts of Venezuela and Colombia.

REFERENCES

AIELLO G., COIMBRA J.C. & BARRA D., 2004. *Ruggiericythere,* a new shallow marine ostracod genus from Brazil. *Boll. Soc. Paleontol. Ital.*, 43(1/2): 71-90.

CARMO D.A. & SANGUINETTI Y., 1999. Taxonomy and palaeoceanographical significance of the genus *Krithe* (Ostracoda) in the brazilian margin. *J. Micropaleontol.*, 18: 111-123.

COIMBRA J.C. & ORNELLAS L.P., 1989. Distribution and ecology of Sub-Recent Oriononinae (Ostracoda) in the brazilian continental shelf. *Rev. Bras. Geoci.*, 19(2): 177-186.

COIMBRA J.C., SANGUINETTI Y.T. & BITTENCOURT-CALCAGNO V.M., 1995. Taxonomy and distribution patterns of Recent species of *Callistocythere* Ruggieri, 1953 (Ostracoda) from the Brazilian continental shelf. *Rev. Esp. Micropaleontol*, 27(3): 117-136.

COIMBRA J.C. & BERGUE C.T., 2003. A new Recent marine Ostracoda species (Hemicytheridae) from Brazil. *Iheringia, Ser. Zool*, 93(3): 243-247.

FAUTH G. & COIMBRA J.C., 1998. Zoogeography of the ostracode genera *Auradilus* and *Radimella* (Ostracoda) along the brazilian continental shelf. *N. Jb. Geol. Paleontol. Mh.*, 8(8): 463-474.

MACHADO C.P. & DROZINSKI N.G.S., 2002. Taxonomia e distribuição de *Actinocythereis brasiliensis* sp. nov. (Podocopida, Trachyleberididade) na plataforma continental Brasileira. *Iheringia, Ser. Zool.*, 92(3): 1-112.

MACHADO C.P., COIMBRA J.C. & CARREÑO A.L., 2005. The ecological and zoogeographical significance of the sub-Recent Ostracoda off Cabo Frio, Rio de Janeiro State, Brazil. *Mar. Micropaleontol.*, 55(3/4): 235-253.

RAMOS M.I.F., 1994. The ostracod genus *Coquimba* Ohmert, 1968, form the brazilian continental shelf. *Rev. Esp. Micropaleontol.*, 26(3): 165-82.

RAMOS M.I.F., 1996. Taxonomy and zoogeography of the ostracod genera *Nanocoquimba* and *Cornucoquimba* Ohmert, 1968 form Recent sediments on the brazilian continental shelf. *Rev. Esp. Micropaleontol.*, 28(1): 105-128.

RAMOS M.I.F., WHATLEY R.C. & COIMBRA J.C., 2004. Sub-Recent marine Ostracoda (Pontocyprididae and Bairdiidae) from the southern brazilian continental shelf. *Rev. Bras. Paleontol.*, 7(3): 311-318.

RAMOS M.I.F., COIMBRA J.C. & WHATLEY R.C., 2009. The Family Thaerocytheridae Hazel, 1967 (ostracoda) the Southern Brazilian Continental Shelf. *Ameghiniana*, 46: 285-294.

WHATLEY R.C., RAMOS M.I.F., MOGUILEVSK A. & CHADWICK J., 1998. The provincial distribution of Recent littoral and shelf Ostracoda in the SW Atlantic. In: S. Crasquin-Soleau, E. Braccini & F. Lethiers (eds.), What About Ostracoda! *Bull. Centre Rech. Elf Explor. Prod.*, Paris-Bierville, 317-325.

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ECOMORPHS IN THE GIVETIAN SPECIES *CAVELLINA RHENANA* KRÖMMELBEIN, 1954 (MIDDLE DEVONIAN, ARDENNES)

Devonian deposits of the Ardennes set on a tropical carbonate platform located on the southern edge of the Old Red Sandstone continent. During the Givetian, this platform also includes the Boulonnais and the whole Rhenish Massif areas, forming a part of the northern margin of the RhenoHercynian Ocean.

Cavellina rhenana Krömmelbein, 1954 is a benthic neritic species reported only in the Upper Givetian in Eifel (Krömmelbein, 1954), Boulonnais (Milhau, 1988) and Ardennes (Milhau, 1983; Maillet, 2010). Because of its good stratigraphical value, a *C. rhenana* zone has been proposed in the Ardennes (Maillet, 2010), characterizing the base of the Fort Hulobiet Mb in the Fromelennes Fm. However, this zone is probably applicable in the entire RhenoHercynian area. In addition, a high dominance of *C. rhenana* in the ostracode assemblages and morphological variations of its carapace have been reported in Ardennes, but not explained (Milhau, 1983; Maillet, 2010). Indeed, morphology of the carapace could differ from the original description of Krömmelbein (1954), with varying characters as a whole ornamentation, a curved ventral margin, flattened anterior and posterior margins, a marked asymmetry of the valves with a strong overlapping or a sulcation. Aims of this work are to analyze these varying characters to define morphs, and to determine possible causes of these variations.

The studied material comes from three areas of Ardennes, representing proximal back-reef (Namur area), intermediate perireefal (Givet area) and distal fore-reef (Durbuy area) places on the Givetian carbonate platform. For the Namur area, the samples were collected in the Roux and the Presles Fms in the Aisemont section. For the Givet and Durbuy areas, the samples come from the Fort Hulobiet Mb, top of the Fromelennes Fm. The Cul d'Houille and the Flohimont sections were sampled for the Givet area, the Aisne quarry for the Durbuy area. More than 1,800 ostracodes were extracted from limestones by hot acetolysis (CRASQUIN *et al.*, 2005). The ostracode fauna, generally well preserved with both juveniles and adults instars and small and large species, seems rather native for all the samples.

To define morphs, 260 entire well preserved *C. rhenana* have been characterized: maximal height and length of each valve and width of the carapace were measured, and reticulation of the carapace, sulcation, asymmetry of the valves and overlapping, curvature of the ventral margin and flattening of the anterior and posterior margins were considered. Each varying character has been replaced on a height/length diagram: characters appear randomly in juveniles, females and males, signifying no relation with ontogeny or with the sexual dimorphism known in this species (COEN, 1985). To assess probable environmental-cued variations, lithology, associated macro- and micro- faunas, degree of dominance of *C. rhenana* and information on the ostracode assemblages were considered for each sample.

During the Upper Givetian, the carbonate platform of Ardennes is a ramp (BOULVAIN *et al.*, 2009). In the Givet area, from the base to the top of the Fort Hulobiet Mb, ostracodes assemblages are respectively representative of the Eifelian Assemblages I to III (MAILLET, 2010): it puts forwards a progressive deepening of the basin, in relation with the global Givetian-Frasnian transgressive episode (BOULVAIN *et al.*, 2009). Paleoenvironments changed from a semi-restricted lagoon, with an increasing influence of the open-sea, to a more stable open-marine environment (MAILLET, 2010).

Multivariate analyses indicated that types and quantity of morphs are correlated to the bed they come from. A high quantity of morphs and a high variation of morphology characterize the base of the series (semi-restricted lagoon), while a lower quantity of morphs and a low variation (*i.e.* specimens closer to the original description of KRÖMMELBEIN, 1954) characterize the top of the series (open-sea).

The Cavellinidae are close to the recent Cytherellidae (LETHIERS & WHATLEY, 1995), in which similar morphological variations are also known in lagoonal environment (BABINOT *et al.*, 1991). Thus, *C. rhenana* from the base of the series show a combined appearance of a sulcation, a whole reticulation, a high asymmetry of the valves, an incurved ventral margin and flattened anterior and posterior margins certainly reflecting salinity variations. A high availability of calcium in the water column could also explain a reinforcement of the reticulation (aggraded morphs, see PEYPOUQUET *et al.*, 1988). A high dominance (80 to

100 %) of *C. rhenana* at the base of the series could be related to salinity variations (low diversity and high abundance, see BENSON, 1973), or oligotrophy (Platycopid Signal Hypothesis, see HORNE *et al.*, 2011), or low oxygen levels (dominance of filter feeding, see LETHIERS & WHATLEY, 1995) or both.

REFERENCES

BABINOT J.-F., CARBONEL P., PEYPOUQUET J.-P., COLIN J.-P. & TAMBAREAU Y., 1991. Variations morphologiques et adaptations morphofonctionnelles chez les ostracodes: signification environnementale. *Geobios*, 13: 135-145.

BENSON R. H., 1973. An Ostracodal view of Messinian salinity crisis. In: DROOGER C.W. (ed), Messinian Events in the Mediterranean, Amsterdam, 235-242.

BOULVAIN F., MABILLE C., POULAIN G. & DA SILVA A.-C., 2009. Towards a palaeogeographical and sequential framework for the Givetian of Belgium. *Geologica Belgica*, 12(3-4): 161-178.

COEN M., 1985. Ostracodes givétiens de l'Ardenne. *Mémoire de l'Institut Géologique de l'Université de Louvain,* 32: 48 pp.

CRASQUIN-SOLEAU S., VASLET D. & LE NINDRE Y.-M., 2005. Ostracodes as markers of the Permian/Triassic boundary in the Khuff Formation of Saudi Arabia. *Palaeontology*, 48(4): 853-868.

HORNE D. J., NUNES BRANDÃO S. & SLIPPER I.J., 2011. The Platycopid Signal deciphered: Responses os ostracod taxa to environmental change during the Cenomanian-Turonian Boundary Event (Late Cretaceous) in SE England. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 308: 304-312.

KRÖMMELBEIN K., 1954. Eine Ostracoden-Fauna aus der Riff-Einlagerung im Plattenkalk der Paffrather Mulde (Givetium, Bergisches Land). *Senckenbergiana Lethaea*, 34: 247-258.

LETHIERS F. & WHATLEY R., 1995. Oxygénation des eaux et ostracodes filtreurs : application au Dévonien-Dinantien. *Geobios*, 28(2): 199-207.

MAILLET S., 2010. Les ostracodes du Givétien supérieur au bord sud du synclinorium de Dinant (Formation de Fromelennes, région de Givet, Ardennes): biostratigraphie, paléoécologie, recherche de bioévénements. *Unpublished Master thesis,* Université des Sciences et Technologies de Lille, 41 pp.

MILHAU B., 1983. Valeur biostratigraphique et paléoécologique des ostracodes du Givétien supérieur de la région-type (Ardenne). *Geobios,* 16(3): 347-359.

MILHAU B., 1988. Ostracodes du Givétien de Ferques (Dévonien moyen, Boulonnais – France). In: BRICE D. (ed.), Le Dévonien de Ferques, Bas Boulonnais (N. France). *Biostratigraphie du Paléozoïque,* 7: 479-491.

PEYPOUQUET J.-P., CARBONEL P., DUCASSE O., TOLDERER-FARMER M. & LETE C., 1988. Environmentally-cued polymorphism of ostracods. In: HANAI T., IKEYA N. & ISHIZAKI K. (eds), Evolutionary biology of ostracoda. *Developments in Palaeontology and Stratigraphy*, 11: 1003-1019.

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OSTRACOD ASSEMBLAGES FROM THE MIDDLE PLEISTOCENE SEQUENCE OF LAKE TRASIMENO (PERUGIA, ITALY) - PRELIMINARY RESULTS

Lake Trasimeno is a meso-eutrophic, shallow (<6 m deep) and large lake (~120km^2) located in central Italy, at 259 m above sea level (Fig. 1). As it is common in shallow-water ecosystems, climate change plays a funda-

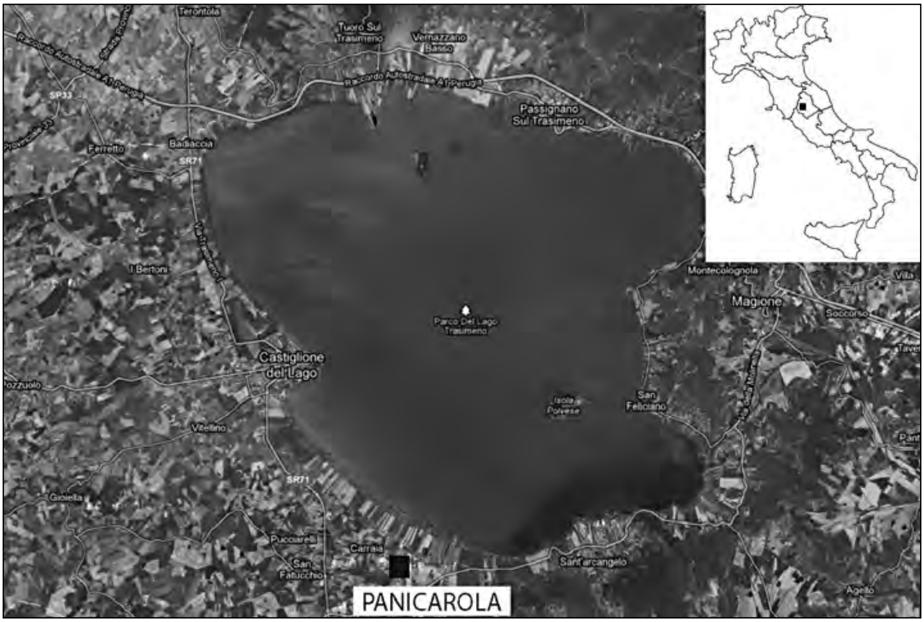

Fig. 1 — Study area and core localization (from GASPERINI *et al.*, 2010).

mental role in the Lake Trasimeno evolution and its history is signed by a strong dependence of the water balance on meteorological conditions (DRAGONI, 2004; LUDOVISI & GAINO, 2010). Recent geophysical data reveals that the Lake Trasimeno evolution was accompanied by a constant subsidence rate driven by normal faults. The extensional tectonic regime does not show substantial changes since the lake formation and it is probably responsible for its long-term preservation against sediment infill (GASPERINI *et al.*, 2010).

A 175 m long sedimentary core was retrieved by the Geological Survey of the Umbria Region along the present southern shore of the lake (north of Panicarola town). A multidisciplinary study of the core (i.e. palynology, geochemical analyses, magnetic susceptibility, paleomagnetism) is now in progress and a preliminary age model based on pollen data suggests that the record may be as old as Middle Pleistocene. A preliminary investigation of the first 30 meters of the Panicarola core revealed its great potential as archive of palaeoclimatic/palaeoenvironmental changes in the region.

As widely recognized, ostracod assemblages in lacustrine sediments represent a main tool for palaeoenvironmental reconstructions (VON GRAFENSTEIN, 2002; DECROUY *et al.*, 2012). The absence or presence of different species, their possible polymorphism, and the geochemical composition of the valves are strongly controlled by the prevailing environmental parameters (i.e. water and/or air temperature, oxygen content, isotopic composition of the host waters, water quality, water chemistry, salinity) during their moulds (HORNE *et al.*, 2012; VIEHBERG & MESQUITA-JOANES, 2012).

Although still in progress, the analysis of the ostracod assemblages recorded from the uppermost part (30 meters) of the Panicarola core reveals their constant presence along it. The uppermost portion of this interval, however, contains poor ostracod communities along with a decrease in TOC values and evidences of sediment alteration processes (oxidation?).

Preliminary species identifications suggest the presence of poorly diversified ostracod assemblages, mainly including *Ilyocypris gibba*, Candoninae instars and *Cyprideis torosa*. In particular the latter species indicate brackish water conditions probably with salinities above 7-8 psu, since it displays unnoded valves.

Further ostracod identifications as well as geochemical analyses on their valves will provide a more detailed reconstruction of the timing and magnitude of palaeoclimatechanges in the Lake Trasimeno area.

REFERENCES

DECROUY L., VENNEMANN T. & ARIZTEGUI D., 2012. Sediment penetration depths of epi- and infaunal ostracods from Lake Geneva (Switzerland). *Hydrobiologia*, 688 (1): 5-23.

DRAGONI W., 2004. Il Lago Trasimeno e le Variazioni Climatiche. Progetto informativo dell'assessorato all'Ambiente della Provincia di Perugia. *Servizio Gestione e Difesa Idraulica*, pp. 60.

GASPERINI L., BARCHI M.R., BELLUCCI L.G., BORTOLUZZI G., LIGI M. & PAUSELLI C., 2010. Tectonostratigraphy of Lake Trasimeno (Italy) and the geological evolution of the Northern Apennines. *Tectonophysics*, 492, 164-174.

HORNE D.J., HOLMES J.A., RODRIGUEZ-LAZARO J. & VIEHBERG F., 2012. Ostracoda as Proxies for Quaternary Climate Change. *Developments in Quaternary Sciences*, 17, 373 pp.

LUDOVISI A. & GAINO E., 2010. Meteorological and water quality changes in Lake Trasimeno (Umbria, Italy) during the last fifty years. *J. Limnol.*, 69 (1): 174-188.

VIEHBERG F.A. & MESQUITA-JOANES F. 2012. Quantitative Transfer Function Approaches in Palaeoclimatic Reconstruction Using Quaternary Ostracods. In: Horne, D.J., Holmes, J.A, Rodgriguez-Lazaro, J., Viehberg, F.A. (2012): Ostracoda, as Proxies for Quaternary Climate Change. *Developments in Quaternary Science*, 17: 47-64.

VON GRAFENSTEIN U., 2002. Oxygen-isotope studies of ostracods from deep lakes. In Holmes, J. A. & A. R. Chivas (eds.), The Ostracoda: Applications in Quaternary Research, American Geophysical Union, Vol.131: 249–266.

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RENATE MATZKE-KARASZ, ROBIN J. SMITH, JOHN V. NEIL, LIBOR MORKOVSKY,
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EARLY MIOCENE FRESHWATER OSTRACODS (*Crustacea*) WITH SOFT PART PRESERVATION FROM THE RIVERSLEIGH WORLD HERITAGE AREA; NW QUEENSLAND; AUSTRALIA

Ostracods sampled from the limestone and guano deposit of the Bitesantennary Site from the Riversleigh Station in Queensland, Australia, were first reported in 1989 (ARCHER *et al.*, 1989), but not investigated in detail until recently. A closer light- and scanning electron microscopic study of the fauna starting in 2009 revealed the presence of soft part preservation in 26 of about 800 specimens recovered.

The Riversleigh Station, which contains more than 300 fossil sites, was assigned World Heritage status in 1994. Many of its localities are famous for their exceptional Oligo-Miocene vertebrate fauna, especially that of marsupials. However, the only records of soft tissue preservation within the Riversleigh area are those of fungi, plants, insects and millipedes from the Upper Site and the Dunsinane Site (DUNCAN & BRIGGS, 1996; DUNCAN *et al.*, 1998; ARENA, 1997, 2008).

The Bitesantennary Site, which is within the early Miocene Riversleigh system B deposit, is known for its exceptionally preserved and diverse bat fauna (ARCHER *et al.*, 1994). The locality, only approximately 5m^2 in size, has been interpreted as a former cave area, with illuminated groundwater-fed rock pools inhabited by ostracods and other freshwater fauna and flora. Bats inhabiting the cave provided masses of guano, which promoted phosphatization of embedded microfaunas. The high diversity of fossils in this 0,7m thick deposit points to a long-term accumulation rather than to a mass mortality event (BASSAROVA, 2004).

The ostracods from the Bitesantennary Site show a wide range of different preservation modes and qualities. While some specimens are represented by valves only, with preserved, originally uncalcified inner lamellae, others show parts of appendages retained in their original position, with setae and setules present and with high detail in surface structure. A description of preservation modes and the taxonomical identification of the fauna can be found in MATZKE-KARASZ *et al.*, (in press).

To identify possible preservation of internal structures in ostracod specimens from this fauna, propagation phase contrast X-ray synchrotron microtomography has been recently undertaken at the European Synchrotron Radiation Facility in Grenoble. Sixty-seven specimens were tomographed at a 0.56 µm voxel size, with 29 specimens revealing preserved inner anatomical features. Due to its strong sclerotization in the living animal, the oesophagus is preserved in all these specimens.

REFERENCES

ARCHER M., GODTHELP H., HAND S.J. & MEGIRIAN D., 1989. Preliminary overview of mammalian diversity, biostratigraphy, correlation and environmental change evidenced by the fossil deposits of Riversleigh, northwestern Queensland, Australia. *Australian Zoologist*, 25: 29-64.

ARCHER M., HAND S.J. & GODTHELP H., 1994. Riversleigh: The Story of Animals in Ancient Rainforests of Inland Australia. *Reed Books*, Sydney, N.S.W. 264 pp.

ARENA D.A., 1997. The palaeontology and geology of the Dunsinane Site, Riversleigh, Australia. *Memoirs of the Queensland Museum*, 41(2): 171-179.

ARENA D.A., 2008. Exceptional preservation of plants and invertebrates by phosphatization, Riversleigh, Australia. *Palaios*, 23: 495-502.

BASSAROVA M., 2004. Taphonomy of Oligo-Miocene fossil sites of the Riversleigh World Heritage Area, Australia. *Ameghiniana* (Asociación Paleontologica Argentina), 41 (4): 627-640.

DUNCAN I.J., BRIGGS D.E.G. & ARCHER M., 1998. Three-dimensionally mineralised insects and millipedes from the Tertiary of Riversleigh, Queensland, Australia. *Palaeontology*, 41(5): 835-851.

DUNCAN I.J. & BRIGGS D.E.G., 1996. Three-dimensionally preserved insects. *Nature*, 381: 30-31.

MATZKE-KARASZ R., NEIL J.V., SMITH R.J., GODTHELP H., ARCHER M. & HAND S.J., in press. Ostracods (Crustacea) with soft part preservation from Miocene cave deposits of the Riversleigh World Heritage Area, NW Queensland, Australia. *Journal of Systematic Palaeontology.*

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Ilaria Mazzini, Faysal Bibi, Mathieu Schuster,
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THE "ELEPHANTS" AND THE OSTRACODS: A 7 MY OLD TALE FROM THE UNITED ARAB EMIRATES

Fossil trackways in the United Arab Emirates have been locally long known and related to dinosaurs and mythical giant men. Bibi *et al.* (2012) studying some of these trackways through kite aerial orthophotomosaic documented several fossil trackways. They were related to both a proboscidean herd and a solitary individual and led to the identification not only of their movements but also of their social behaviour and herd structure. The trackways were found in carbonate levels belonging to the Baynunah Formation. The fluvial sands and conglomerates from the lower part of the Baynunah Formation mainly outcrop in the NW area of the United Arab Emirates, in the Al Gharbia region. They have provided diverse fossil remains (vertebrates, invertebrates and plants) suggesting an age between 7.5 and 6.5 million years when animals such as hippopotamus, large giraffids, crocodile, sabre-tooth lions and proboscideans were living in a tropical fluvial environment where today is a hyperarid region (Bruijn & Whybrow, 1994; Whybrow & Hill, 1999). The upper part of the Baynunah Formation includes sands and clays alternating with thin to thick (≥2m) white carbonate and carbonate-rich beds. In at least 4 sites in the Mleisa area such carbonate layers are widely exposed forming a flat landscape were footprints are preserved. Nowadays, this area is located about 20 km inland. The finely laminated, silty to sandy carbonate levels display desiccation polygons and cracks on the bioturbated surface. In the carbonates, ostracod shells and gastropod moulds are preserved. The moulds seem to belong to the gastropod family Cerithidae, which mainly inhabits shallow marine waters (subtidal lagoons and intertidal habitats) and the seaward areas of estuaries (HEALY & WELLS, 1998).

Four samples from the carbonate level were studied for ostracod analyses (MLS1, MLS2, JB1, JB2) with the aim to determine the depositional environment of these carbonates: marine (shallow tidal algal zone) or freshwater-derived (highly evaporitic freshwater lake or shallow coastal lagune).

The ostracods are generally not very well preserved. This is due mainly to post-depositional processes, which have caused the chemical erosion of the calcitic valves. In some cases, the calcitic carapace completely dissolved and only the internal mould of the ostracods were preserved.

In all samples, *Cyprideis* gr. *torosa* is the dominant species, with un-noded forms. *C. torosa* is typical of brackish environments such as coastal lagoons, saline lakes, delta and estuaries. When occurring in un-noded forms it gives the indication that the salinity of the water must have been > 8-9 psu (FRENZEL *et al.*, 2012). *Heterocypris salina* is the second most common species, occurring in all samples except MLS1. *H. salina* is found in slightly salty coastal and inland water bodies, where it often occurs with other halophilic ostracods; however, it is also present in pure freshwater habitats (MEISCH, 2000). In sample MLS1 only, *Vestalenula cylindrica* and *Prolimnocythere* sp. occur. *V. cylindrica* has been recovered in sediments related to freshwater and brackish mesohaline environments, interstitial and spring habitats connected with fluvial, marshy and hypogean waters, (GROSS*,* 2004). *Prolimnocythere* sp. is represented by badly preserved scattered valves. In sample Jebel Barakah 1, a single valve of a juvenile of *Candona* sp. has been recovered. The ostracod assemblage confirms the Late Miocene age of the Baynunah Formation. In fact, *H. salina* appears during Late Miocene (MEISCH, 2000) and *V. cylindrica* is signalled since Middle to Late Miocene (LIGIOS *et al.,* 2009).

The study of the ostracod assemblage has provided relevant information about the depositional environment and excludes the hypothesis of a shallow tidal zone. Instead, the occurrence of *C.* gr. *torosa* together with *H. salina* point to a permanent calm to slowly flowing saline water body. The occurrence of *V. cylindrica* and *Prolimnocythere* sp. in sample MLS1 could indicate lower salinities and/or input from hypogean waters. Although *C.* gr. *torosa* is the dominant species, the co occurrence of taxa related to freshwater to slightly saline environments lead to a palaeoenvironmental reconstruction closer to a highly evaporitic freshwater lake or shallow coastal lagune/estuary. New multidisciplinary analysis will shed further light on the palaeoenvironmental reconstruction, depicting in detail the water body where these huge mammals left trace of their passage.

REFERENCES

BIBI F., KRAATZ B., CRAIG N., BEECH M., SCHUSTER M. & HILL A., 2012. Early evidence for complex social structure in Proboscidea from a late Miocene trackway site in the United Arab Emirates. *Biology Letters*, 8: 670-673.

BRUIJN H. DE & WHYBROW P.J., 1994. A Late Miocene Rodent Fauna From The Baynunah Formation, Emirate Of Abu Dhabi, United Arab Emirates. KNAW Proc. B 97: 407-422.

FRENZEL P., SCHULZE I. & PINT A., 2012. Noding of *Cyprideis torosa* valves (Ostracoda) – a proxy for salinity? New data from field observations and a long-term microcosm experiment. *International Review of Hydrobiology*, 97 (4): 314-329.

GROSS M., 2004. Zur Ostracodenfauna (Crustacea), Paläoökologie und Stratigrafie der Tongrube Mataschen (Unter-Pannonium, Steirisches Becken; Österreich). *Joannea Geologie und Paläontologie*, 5: 49-129.

HEALY J.M. & WELLS F.E., 1998. Superfamily Cerithioidea. *In*: P.L. Beesley, G.J.B. Ross and A. Wells (Eds), Mollusca: The Southern Synthesis. Fauna of Australia, 5: 707-733.

LIGIOS S., MINATI K., GLIOZZI E. & KRSTIC N., 2009. Occurrence of Vestalenula (Darwinuloidea, Ostracoda) in the Neogene of Italy, Crete and Serbia, with the description of three new species. *Journal of Micropalaeontology*, 28: 99-115.

MEISCH C., 2000. Freshwater Ostracoda of Western and Central Europe. In: Schwoerbel J. & Zwick P. (Eds). Süßwasserfauna von Mitteleuropa 8/3, Spektrum Akademischer Verlag, Heidelberg-Berlin: 1-522.

WHYBROW P.J. & HILL A., 1999. Fossil vertebrates of Arabia, with emphasis on the Late Miocene faunas, geology and palaeoenvironments of the Emirate Of Abu Dhabi, United Arab Emirates. New Haven, CT: Yale University Press: 1-523.

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THE CONTRIBUTION OF OSTRACODOLOGICAL STUDIES IN ARCHEOLOGICAL SETTINGS: A REVIEW AND A METHODOLOGICAL APPROACH

During the last years, geo-archaeology seems to live a revitalising moment and much effort has been made to combine geo-archaeological sciences such as, for instance, geomorphology, sedimentology, micropaleontology and geochemistry with the cultural archaeological approach. In 1976, Davidson & Shackley volume "Geo-archaeology: earth science and the past" provided the first definition of geo-archaeology as a tool to understand the context of the archaeological finds (Renfrew, 1976). In this perspective, ostracods can play a crucial role since they are valuable palaeoenvironmental indicators in all aquatic habitats, from freshwater to marine. Despite their potential, the integration of ostracods in archaeological studies was introduced much later and the first published paper with formal ostracod analyses dates 10 years later (Robinson, 1984). In the 90es, ostracod geo-archaeology seemed to finally take place with, among the others, studies about Maya agriculture (Bradbury *et al.*, 1990), neolithic human occurrence in Central Sahara (Carbonel, 1991), prehistoric human occupation in North America (Palacios-Fest, 1994) and also a systematic approach to ostracod studies in archaeological excavations (Griffiths, 1993). Since then, many geo-archaeological researches have included ostracod analyses. In particular, the methodological paper of Marriner *et al.* (2010) gave a new input to geo-archaeology applied to ancient harbours but it did not provide any standard methodology on ostracod analyses applied in such archaeological contests.

The aim of our study is to present an overview of the most recent ostracod research in geo-archaeology and, mostly, to propose a standard methodological approach that could be used in the different palaeoenvironments where ostracod analyses are commonly performed. Such environments are coastal harbours in the Mediterranean area such as Alexandria in Egypt (GOIRAN *et al.*, 2000), Marseille in France (MORHANGE *et al.*, 2003), Luna and Portus in Italy (BINI *et al.*, 2012; MAZZINI *et al.*, 2011; GOIRAN *et al.*, 2010), the ancient Tyre in Lebanon (MARRINER *et al.*, 2008), Kytion in Cyprus (MORHANGE *et al.*, 2000); alluvial areas in Portugal (LORD *et al.*, 2011), conti-

Table 1
Comparison about the different methodologies applied in the cited literature for ostracod analyses in geo-archaeological research

Reference	**Locality**	**Typology**	**Methodology**		
			Sample weight (g)	Sieve mesh (μm)	Picked ostracods (n)
Bini *et al.* 2012	Luna (Italy)	core	100 g	125	total
Mazzini *et al.* 2010	Portus (Italy)	core	–	63	300
Lord *et al.* 2011	Rio Sizandro (Portugal)	core	–	63	total
Griffiths 1998	Lough Boora (Ireland)	core	(2 mm slices)	–	100-300
Sarti *et al.* 2013	Magdala (Israel)	outcrop	100 (dry)	63	–
Goiran *et al.* 2010	Alexandria (Egypt)	core	no description		
Morhange *et al.* 2003	Marseille (France)	core			
Goiran *et al.* 2010	Portus (Italy)	core			
Morhange *et al.* 2000	Kytion (Cyprus)	core			
Marriner *et al.* 2006	Tyre (Lebanon)	core			
Holmes *et al.* 2010	Boxgrove (UK)	outcrop			
Le Tensorer *et al.* 2007	Hummal (Syria)	outcrop			

nental settings in England (Holmes *et al.*, 2010) and Syria (Le Tensorer *et al.*, 2007), lakes in Ireland (Griffiths, 1999) and in Israel (Sarti *et al.*, 2013). Most of these studies were performed on sediment cores, some on stratigraphic sections but all of them used a multiproxy approach, combining the ostracodological analyses with other paleontological proxies such as pollen or mollusc analyses and sedimentological, geochemical and geochronological data. Most of the methods described for these are similar but not for ostracod analyses, making the comparison of different records almost impossible as summarised in table 1 where some of the most recent papers on the topic are compared. Clearly, the methodological approach depends from the available amount of sediment sampled from a core or from an outcrop. In the first case, the most controlling limit is the scarce quantity of sediment together with the need to spare enough material for a series of parallel analyses. When the methodology about the treatment of ostracod samples is extensively explained (Tab. 1), the main data provided are: the weight of the sample, the sieve mesh used and the number of ostracods picked. The best suggested practice is an average weight of 100 g of dry sediment when possible, a sieve with a mesh size of 63 μm and the total picking of the sample, ie the extraction of all ostracod valves from the sediment (adult and juveniles). The interpretation of the ostracod assemblage depends of course from the studied palaeoenvironment and from the focus of the research. Ostracods could be used, for instance, to reconstruct palaeoclimate s.l., variations in sea/lake levels and in salinity, to detect fluvial flood events or opening of artificial channels or even to disentangle the human impact from the environmental signal.

REFERENCES

Bini M., Bruckner H., Chelli A., Da Prato S. & Gervasini L., 2012. Palaeogeographies of the Magra Valley coastal plain to costrain the location of the Roman harbour of Luna (NW Italy). *Palaeogeography, Palaeoclimatology, Palaeoecology,* 337-338: 37-51.

Bradbury J.P., Forester R.M., Bryant W.A. & Covich A.P., 1990. Paleolimnology of Laguna de Cocos, Albion Island, Rio Hondo, Belize In: POHL M.D. (ed), Ancient Maya wetland agriculture. Excavations on Albion Island, Northern Belize. Boulder:Westview Press, 119-154.

Carbonel P., 1991. Les ostracodes du paleolac Haijad. In: N. Petit-Maire (Ed.) *Paleoenvironnements du Sahara. Lacs holocènes à Taoudenni, Mali.* Editions du CNRS : 91-102.

Goiran J.-P., Morhange C., Bourcier M., Carbonel P. & Morigi C., 2000. Evolution holocène des littoraux d'Alexandrie. *Méditerranée*, 1-2: 83-90.

Goiran J.-P., Tronchère H., Salomon F., Carbonel P., Djerbi H. & Ognard C., 2010. Palaeoenvironmental reconstruction of the ancient harbors of Rome: Claudius and Trajan's marine harbors on the Tiber delta. *Quaternary International*, 216: 3-13.

Griffiths H. I, 1999. Freshwater Ostracoda from the Mesolithic Lake Site at Lough Boora, Co. Offaly, Ireland. *Irish Journal of Earth Sciences*, 17: 39-49.

GRIFFITHS H.I., ROUSE A., & EVANS J.G., 1993. Processing freshwater ostracods from archaeological deposits, with a key to the valves of the major British genera. *Circaea*, 10: 53-62.

HOLMES J.A., ATKINSON T., DARBYSHIRE D.P.F., HORNE D.J., JOORDENS J., ROBERTS M.B., SINKA K.J. & WHITTAKER J.E., 2010. Middle Pleistocene climate and hydrological environment at the Boxgrove hominin site (West Sussex, UK) from ostracod records. *Quaternary Science Review*, 29: 1515–1527.

LE TENSORER J.-M., JAGHER R., RENTZEL P., HAUCK T., ISMAIL-MEYER K., PUMPIN C. & WOJTCZAK D., 2007. Long-term site formation processes at the natural springs Nadaouiyeh and Hummal in the El Kowm Oasis, Central Syria. *Geoarchaeology*, 22(6): 621 -640.

LORD A., CABRAL M.C., DAMBECK R. & KUNST M., 2011. Ostracod evidence for the neolithic environment of Rioz Sizandro, Portugal. Palaeobiodiversity and Palaeoenvironments, 91: 215-228.

MAZZINI I., FARANDA C., GIARDINI M., GIRAUDI C. & SADORI L., 2011. Late Holocene palaeoenvironmental evolution of the Roman harbour of Portus, Italy. *Journal of Paleolimnology*, 46: 243-256.

MARRINER N., MORHANGE C. & CARAYON N., 2008. Ancient Tyre and its harbours: 5000 years of human-environment interactions. *Journal of Archaeological Science*, 35: 1281-1310.

MARRINER N., MORHANGE C. & GOIRAN J.P., 2010. Coastal and ancient harbour geoarchaeology. *Geology Today*, 26: 21-27.

MORHANGE C., GOIRAN J.-P., BOURCIER M., CARBONEL P., LE CAMPION J., ROUCHY J.-M. & YON M., 2000. Recent Holocene paleo-environmental evolution and coastline changes of Kition, Larnaca, Cyprus, Mediterranean Sea. *Marine Geology*, 26: 205-230.

MORHANGE C., BLANC F., SCHMITT-MERCURY S., BOURCIER M., CARBONEL P., OBERLIN C., PRONE A., VIVENT D. & HESNARD A., 2003. Stratigraphy of late-Holocene deposits of the ancient harbour of Marseilles, southern France. *The Holocene*, 13 (4): 593-604.

PALACIOS-FEST M.R., 1994. Non-marine Ostracod shell chemistry from Hohkam irrigation canals in Central Arizona: a paleohydrochemical tool for the interpretation of prehistoric human occupation in the North American Southwest. *Geoarcheology*, 9: 1-29.

RENFREW C., 1976. Archaeology and the earth sciences. In: DAVIDSON D.A. & SHACKLEY M.L. (eds), Geoarchaeology: Earth Science and the Past, Duckworth, London, 1-5.

ROBINSON E ., 1984. 'Ostracods' In: STRAKER, V, ROBINSON, M, AND ROBINSON, E. 'Biological investigations of waterlogged deposits in the Roman Fortress ditch at Exeter'. *Proceedings of Devon Archaeological Society*, 42: 59-69.

SARTI G., ROSSI V., AMOROSI A., DE LUCA S., LENA A., MORHANGE C., RIBOLINI A., SAMMARTINO I., BERTONI D. & ZANCHETTA G., in press. Magdala harbour sedimentation (Sea of Galilee, Israel), from natural to anthropogenic control. *Quaternary International* (2013), http://dx.doi.org/10.1016/j.quaint.2013.01.032

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OSTRACOD COMMUNITIES ASSOCIATED TO AQUATIC MACROPHYTES IN AN URBAN PARK: THE EXAMPLE OF THE CAFFARELLA VALLEY (PARK OF THE APPIA ANTICA, ROME, ITALY)

Urban parks are important areas for the conservation of biodiversity within cities, although their fauna and flora is affected by a number of anthropogenic stressors. When such parks are located in a city as ancient as Rome, landscape alterations can be dated back to as far as historical times. On the other hand, irrigation channels, fountains and ponds can act as important reservoirs of freshwater biodiversity. Our research focuses on the area of the Caffarella Valley Park (SE sector of Rome) a portion of the Appia Antica Regional Park (Fig. 1), protected since 1988. In the park, the semi-natural landscape of the "Campagna Romana" (Roman countryside) and its typical agricultural activities are still preserved. Indeed, it is a stretch of countryside within the city dotted with archaeological remains, ponds, ditches, channels and many springs. In particular, the Caffarella Valley Park is crossed by the Almone River and flanked on both sides by two irrigation channels (left and right marrana).

The aim of our research was to study the ostracod fauna in this urban park and to investigate the relationship between ostracod and macrophyte communities. Sampling sites were selected to represent different types of freshwater habitat and fruition: (1) springs and surrounding areas (left marrana) where fruition is free or regulated, (2) shallow waters of channels (right marrana) where fruition is free and agricultural activities are allowed, (3) shallow waters of a pond created in 2004 and inaccessible to the public. Ostracod and macrophyte samples were collected at 11sites together with a suite of physical and chemical variables. Ostracod sampling was repeated

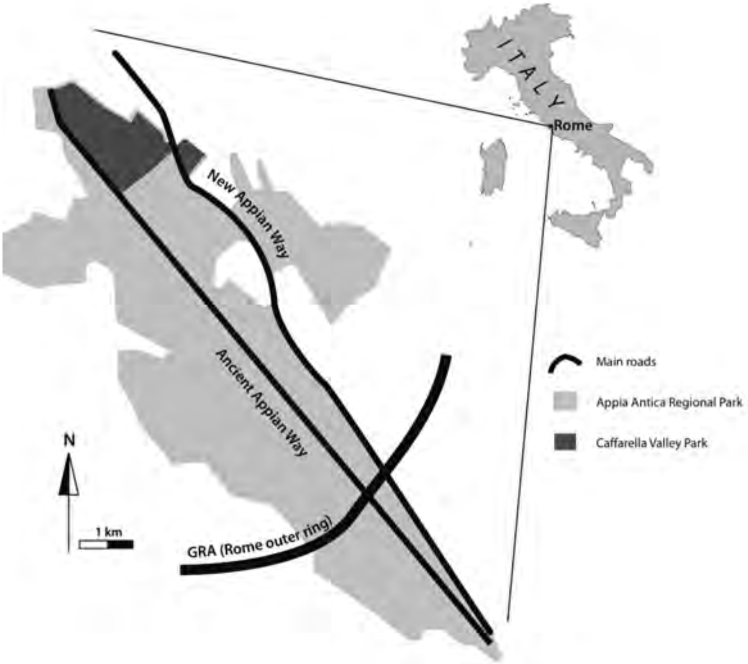

Fig. 1 — Location of the study area.

each season for a year whereas sampling of macrophytes took place during spring and summer. Ostracod samples were collected sweeping the surface sediment with a hand-net (120 μm-mesh size) over an area of about 1m^2. When floating vegetation was present, surface samples were collected also. Thirteen ostracod species were identified following Meisch (2000). Macrophyte surveys were carried out using the phytosociological method (Braun-Blanquet, 1964). During each survey, we listed all aquatic macrophytes (macro-algae, bryophytes, angiosperms), recording their percentage coverage value. Different collection methods were used: floating masses of filamentous algae were collected by means of a 25 μm-mesh plankton net; bryophytes from substrate by scalpel and hands; angiosperms by direct observation in field. Taxonomical determination was based on specific literature with regard to algae (John *et al.*, 2002), bryophytes (Cortini Pedrotti, 2001), and angiosperms (Pignatti, 1982). Water temperature, dissolved oxygen content, conductivity, total dissolved solids and pH were measured in situ using a hand-held multi-parameter instrument (Hydrolab Minisonde 4a), whereas concentrations of phosphate, ammonia, nitrate, and chemical oxygen demand were determined through spectrophotometric analysis (WTW Photometer MPM 3000). Sediment grain size was analysed in the laboratory following the sieving technique.

Statistical analyses were performed on both biological and environmental data using the software PAST (HAMMER *et al.*, 2001). Firstly, all data were processed by cluster analysis, using the Ward's method and Euclidean distance algorithm, in order to group the samples on a similarity ratio. Principal Component Analysis (PCA) was used for the estimation of the influence of environmental variables on ostracod and macrophyte assemblage. Non-metric multidimensional scaling (NMDS) based on the Horn similarity index was used to compare the composition of the assemblages in the different macrophyte habitats.

The statistical analyses outlined the relationship between ostracods, macrophytes and some environmental parameters within the three different habitats. In the left marrana, fed only by isolated springs, *Cypria ophtalmica* and floating macrophytes (e.g. *Lemna minor*, *L. minuta*) (Fig. 2) were strictly linked to the dissolved oxygen percent saturation. The right marrana, fed by linear springs and characterised by different aquatic habitats and agricultural activities, hosted a variety of ostracod and macrophyte taxa, among which the most common associations were: *Cypridopsis vidua* and *Sparganium erectum*, *Candona neglecta* and *Apium nodiflorum* and *Veronica anagallis-aquatica*. These species assemblages seem to be mainly linked to depth and temperature. Finally, the pond showed a different situation, being an artificial and renaturalised lake fed by rainwaters and by the waters from the right marrana.

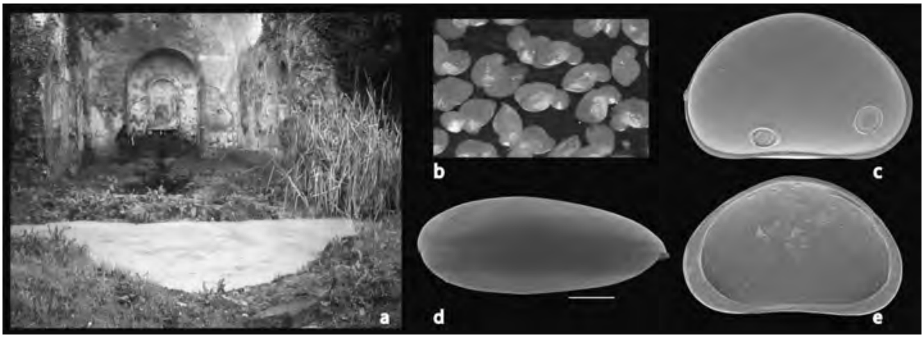

Fig. 2 — The Nynphaeum of Egeria station, left marrana: **a**, panoramic view of the archaeological structure: the spring water comes out from the large central niche and feeds the deep pool in front covered by *L. minuta*; **b**, detail of *L. minuta* (one leaf has an average length of 2.5 mm and width of 1.5mm); **c**, *Cypria ophtalmica*, carapace, right lateral view; **d**, *C. ophtalmica*, carapace, dorsal view; **e**, *C. ophtalmica*, left valve, internal view. Scale bars 100 m.

Here the ostracod community was dominated by *Fabaeformiscandona fabaeformis* and by the macrophytes *Typha latifolia* and *Phragmites australis*.

As a matter of fact, the three investigated situations mirror different ostracod/macrophytes communities, which seem to be determined by land use issues more than by public fruition pressure. In the left marrana, the two species of *Lemna* form a continuous layer across the water surface. Ostracods live exclusively within these floating mats, since they are used as shelter and suitable substrate, and beneath them low dissolved oxygen content has been measured, probably due to limited light penetration and consequent reduction in phytoplankton productivity. In the pond, the ostracod fauna is scarce whereas the macrophytes community is quite diverse. This could be linked to the coarse substrate and the recent creation of the pond itself. Finally, the right marrana represents a sequence of patchy environments, each one characterised by peculiar ostracod and macrophyte communities.

REFERENCES

BRAUN-BLANQUET J., 1964. Pflanzensoziologie. Grundzuge der Vegetationskunde. Springer, Wien-New York. 865 pp.

CORTINI PEDROTTI C., 2001. Flora dei muschi d'Italia. *Sphagnopsida*, *Andreaeopsida*, *Bryopsida* (I parte). Roma, Antonio Delfino Editore.

HAMMER Ø., HARPER D.A.T., RYAN P.D., 2001. PAST: Paleontological statistics software package for education and data analysis. *Palaeontologia Electronica* 4(1): 1-9.

JOHN. D.M., WHITTON. B.A., BROOK. A.J., 2002. The Freshwater Algal Flora of the British Isles. Cambridge University Press, Cambridge. 702 pp.

MEISCH C., 2000. Freshwater Ostracoda of Western and Central Europe. In: Schwoerbel J. & Zwick P. (Eds). Süßwasserfauna von Mitteleuropa 8/3, Spektrum Akademischer Verlag, Heidelberg-Berlin: 522 pp.

PIGNATTI S., 1982. Flora d'Italia. 3 Vol. Bologna: Edagricole.

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Ilaria Mazzini, Elsa Gliozzi, Rexhep Koci, Ingeborg SouliÉ-Märsche, Giovanni Zanchetta, Ilaria Baneschi, Laura Sadori, Marco Giardini, Aurelien Van Welden & Salvatore Bushati

A 4500-YEAR OSTRACOD RECORD FROM LAKE SHKODRA (ALBANIA): PALAEOENVIRONMENTAL AND PALAEOCLIMATIC RECONSTRUCTION USING A MULTI PROXY APPROACH

During September 2003 several cores were drilled from the Albanian side of Lake Shkodra. Among them, a 7,8 m long composite core (SK13), drilled at a lake bottom depth of 7 m in the central southern part of the lake (42°6'11.65"N, 19°25'18.96"E) has been selected for multidisciplinary analysis. Ostracods, characeae, pollen, $CaCO_3$ content and stable isotopes were studied with the aim to reconstruct the palaeoenvironmental and palaeoclimatic changes occurred during the Late Holocene. The chronological framework of SK13 was established through the recognition of four well-dated tephra layers and four ^{14}C accelerator mass spectrometry measurements; the sedimentation rate has been calculated as spanning between 1.1 and 3.0 mm/yr in the different portions of the composite sediment core (Sulpizio *et al.*, 2010, Van Welden *et al.*, 2008).

Ostracods have been recovered from 337 samples of $2cm^3$ in volume, collected almost continuously along the core. They are abundant and well preserved in all samples, represented by adults and juveniles. On the whole, 13 species have been recovered with different frequencies. Some of them were already known as living in the Montenegro portion of the Lake (Petkovski, 1961), such as the endemic *Candona montenigrina*, and *Limnocythere scutariens* or were originally considered endemic of Lake Dojran as *Candona paionica.* The widespread *Darwinula stevensoni*, *Cypria ophtalmica*, *Ilyocypris gibba,* and *Cypridopsis vidua* are commonly found in the core sediments. Other species are recorded for the first time in the Lake Shkodra, but were known from other Balcanic lakes (*Paralimnocythere georgevitschi* in

Lake Ohrid, *Candona "angulata" meridionalis* in Lake Dojran) (PETKOVSKI, 1958, 1960; GRIFFITHS *et al.*, 2002). The remaining taxa (*Pseudocandona marchica*, *Metacypris cordata, Cyclocypris* sp. and *Zonocypris* sp.) are widely distributed in central and southern Europe, but signalled for the first time in the Holocene of Shkodra and Albania.

The faunal composition is quite homogeneous, with the percentages of the different species varying along the sediment core (Fig. 1). The main change occurs at about 1200 cal yr BP, where 8 ostracod species disappear and the frequency of the remaining 5 species dramatically increases. This major change reflects the $CaCO_3$ trend with its major peak around 1200 cal yr BP. Moreover, considering the percentage frequency of three different *I. gibba* morphotypes (smooth, tuberculate, spinous), the age of about 1200 cal yr BP corresponds to the threshold between the spinous valves, which occur only in the lower part of the borehole, and the smooth valves, which are recovered only from this moment upwards. The Characeae display an opposite behaviour, occurring continuously from the base of the core until about 1200 cal yr BP, when they disappear as well.

The $\delta^{18}O_c$ record shows values between ca. -8.7‰ and - 6.4‰, with frequent and large fluctuations from 4500 to ca. 1200 cal yr BP; such fluctuations decrease after ca. 1200 cal yr BP and at ca. 800 cal yr BP the values attain close to ca. -7.2 ‰. The $\delta^{13}C_c$ record displays value ranges between ca. -5.1‰ and -3.1‰, the highest values are recorded between 4500 and 3000 cal yr BP and the lowest peak is reached at about 1200 cal yr BP following which there is an increasing trend reaching stability around -3.7‰ from 700 cal yr BP (ZANCHETTA *et al.*, 2012).

The pollen record is quite homogeneous, however since ca. 1100 cal yr BP the percentage of arboreal pollen decreases together with the pollen concentrations (SADORI *et al.*, 2011).

The drastic change recorded by all proxies at around 1200 cal yr BP could be related to favourable climatic conditions linked to the Medieval Warm Period as recorded in other Mediterranean lakes (BRADLEY *et al.*, 2003). These conditions could have induced a rise of the water table, causing the environmental change from shallow lacustrine or palustrine conditions to a true lacustrine, deeper lake. But a more local signal could have been the trigger for the sudden increase in ostracod frequencies: the disappearance of charophytes and the progressive magnitude reduction of the $\delta^{18}O_c$ excursions recorded after 1200 cal yr BP could be also linked to a change in land use due to human activities (ZANCHETTA *et al.*, 2012).

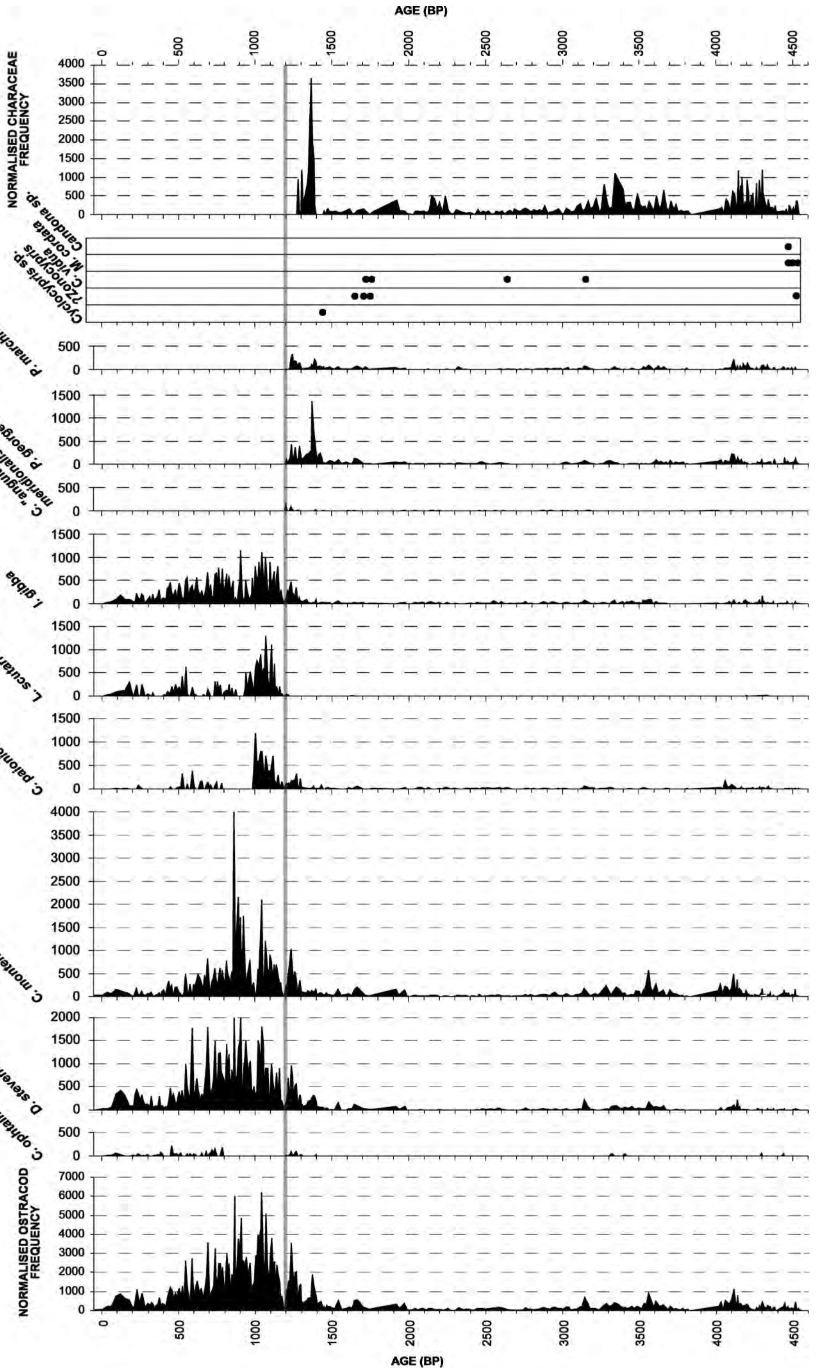

Fig. 1 — Frequency diagrams of Ostracoda and Characeae along the SK 13 composite cores.

REFERENCES

Bradley R.S., Hughes M.K. & Diaz H.F., 2003. Climate in Medieval time. Science 302: 404-405.

Griffiths H.I., Reed J.M., Leng M.J., Ryan S. & Petkovski S., 2002. The recent palaeoecology and conservation status of Balkan Lake Dojran. *Biological Conservation* 104: 35-49.

Petkovski T.K., 1958. Zwei neue Ostracoden aus dem Dojransee. *Bioloski Glasnik*, 11: 27-34.

Petkovski T.K., 1960. Zwei neue Ostracoden aus dem Ohrid – und Prespasee. *Izdanija Institut de Pisciculture de la R.P. Macedonie*, 3(2): 57-66.

Petkovski T.K., 1961. Zur kenntnis der Crustaceen des Skadar- (Scutari-) Sees. *Musei Macedonici Scientiarum Naturalium*, 8(2): 29-52.

Sadori L., Zanchetta G., Van Welden A., Baneschi I., Drysdale R., Giardini M., Gliozzi E., Mazzini I. & Roberts N., 2011. Climate changes at Lake Shkodra (Albania): the last 4500 years. *Rend. Online Soc. Geol. It.*, 18(2012): 35-38.

Sulpizio R., van Welden A., Caron B. & Zanchetta G., 2010. The Holocene tephrostratigraphic record of Lake Shkodra (Albania and Montenegro). *Journal of Quaternary Science*, 25: 633-650.

Van Welden A., Beck C., Reyss J.L., Bushati S., Koci R., Jouanne F. & Mugnier J.L., 2008. The last 500 year of sedimentation in Shkodra Lake (Albania/Montenegro): paleoenvironmental evolution and potential for paleosismicity studies. *Journal of Paleolimnology*, 40: 619-633.

Zanchetta G., Van Welden A., Baneschi I., Drysdale R., Sadori L., Roberts N., Giardini M., Beck C., Pascucci V. & Sulpizio R., 2012. Multiproxy record for the last 4500 years from Lake Shkodra (Albania/Montenegro). *Journal of Quaternary Science*, 27(8): 780-789.

Authors' Addresses — I. Mazzini, E. Gliozzi, Dipartimento di Scienze, Università Roma Tre, Largo S. Leonardo Murialdo, 1, Rome (Italy); e-mail: ilaria.mazzini@gmail.com; elsa.gliozzi@uniroma3.it; R. Koci, Institute of Sismology, Tirana (Albania); e-mail: rexhep.koci@yahoo.com; I. Soulié-Märsche, Institut des Sciences de l'evolution (UMR 5554/CNRS) – Paleoenvironments, Universitè Montpellier 2, C.P. 061, Place E. Bataillon, F34095 Montpellier-Cedex (France); e-mail: ingeborg.soulie-marsche@univ-montp2.fr; G. Zanchetta, Dipartimento di Scienze della Terra, University of Pisa, Via S. Maria, 53, 56126 Pisa (Italy) and INGV sez. Pisa, Pisa (Italy) and IGG-CNR sez. Pisa, Pisa (Italy); e-mail:zanchetta@dst.unipi.it; I. Baneschi, IGG-CNR sez. Pisa, Pisa (Italy); e-mail: i.baneschi@igg.cnr.it; L. Sadori, M. Giardini, Dipartimento di Biologia Ambientale, Università 'La Sapienza', P.le A. Moro, 5, 00185 Rome (Italy); e-mail: laura.sadori@uniroma1.it; marco.giardini@uniroma1.it; A. Van Welden, G & G Scientist i CGGVeritas Multi-Client & New Ventures; e-mail:aurelien.vanwelden@gmail.com; S. Bushati, Academy of Sciences, Sheshi Fan S. Noli , Nr. 4, Tirana (Albania); e-mail: sbushati@akad.edu.al.

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ILARIA MAZZINI, ELSA GLIOZZI, GIAMPAOLO ROSSETTI & VALENTINA PIERI

A MULTIDISCIPLINARY CONTRIBUTION TO THE *ILYOCYPRIS* PUZZLE

Ilyocypris Brady & Norman, 1889 is a widespread freshwater ostracod genus that includes many living and fossil species (34 living species according to MARTENS & SAVATENALINTON, 2011; 28 living species according to KARANOVIC & LEE, 2013; around 190 fossil species according to KEMPF, 1980; 1997). The identification of *Ilyocypris* species is based on the soft parts and the valves characteristics of adult specimens (MEISCH, 2000). VAN HARTEN (1979: p.72) was the first to recognise the diagnostic value of the "marginal ripplets" located on the postero-ventral internal marginal zone of left valves. Such features, when preserved, have been regarded as a taxonomic species-specific character useful particularly to palaeontologists for the distinction of the most common *Ilyocypris* species, (JANZ, 1994). Another diagnostic feature of the carapace is the presence/absence of tubercles and spines in some species. Non-tuberculated and tuberculated specimens of *I. bradyi* and *I. gibba* and many transitional forms between these end members are often found in shells of *I. gibba* (VAN HARTEN, 1979; MEISCH, 1988, 2000; YANG *et al.*, 2002). Although the occurrence of tubercles has been supposed to be environmentally cued (ANADÓN *et al.*, 1986; YANG *et al.*, 2002), ornamentation is still considered an important character for species identification (MEISCH, 2000; SYLVESTER BRADLEY & KEMPF, 1979). In studies about Quaternary lacustrine and fluvio-lacustrine deposits, the marginal ripplets and the surface ornamentation have sometimes been successfully used to distinguish between different *Ilyocypris* species (WROZYNA *et al.*, 2009; MISCHKE & ZHANG, 2010; LORD *et al.*, 2011; MISCHKE *et al.,* 2012). In some cases, however, the simultaneous use of the two diagnostic criteria led to controversial species attribution and eventually to a supra-specific identification (Gliozzi & Mazzini, 1998; Anadón *et al.*, 2012; Van der Meeren *et al.*, 2012).

Our research aims to test the taxonomic significance of the carapace characteristics through the examination of specimens unambiguously identified on the basis of their soft part morphology according to Meisch (2000), in order to provide useful keys for the identification of *Ilyocypris* shells in fossil assemblages. We analysed adult valves of living *Ilyocypris* species collected in Italy, namely: *Ilyocypris bradyi* (18 carapaces), *I. decipiens* (c. 7), *I. gibba* (c. 17), *I. inermis* (c. 14) and *I. monstrifica* (c. 8). The valves were photographed under the Scanning Electron Microscopy in external, internal and dorsal views; additionally, the geometric morphometric analysis of the outline of the female left valves of each species was performed. In this respect, we followed the approach proposed by Baltanás & Danielopol (2011) using the B-splines analysis adapted by Linhard (Neubauer & Linhart, 2008) and the software Morphomatica (Linhart *et al.*, 2006).

Shape: the geometric morphometric analysis showed that *I. inermis* and *I. monstrifica* are clearly recognizable from their outline shape (Fig. 1). *I. decipiens*, *I. gibba* and *I. bradyi* displayed highly overlapping outlines, although with *I. bradyi* slightly more elongated and *I. decipiens* clearly separable for its larger size.

Ornamentation: *I. decipiens* showed no tubercles; only one specimen displays 6-7 posterior marginal spinules. The specimens of *I. inermis* showed no tubercles, but all showed tiny anterior and posterior marginal spinules. All the *I. bradyi* valves displayed no tubercles and more or less prominent marginal spinules. *I. gibba* valves spanned from smooth (without tubercles) specimens to forms with a blunt antero-dorsal tubercle; anterior and posterior marginal spinules were more or less prominent, but

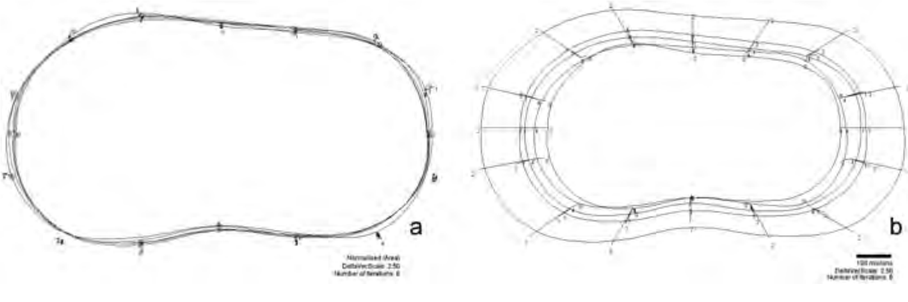

Fig. 1 — Results of the geometric morphometric analysis performed on the mean outlines of different *Ilyocypris* species in “normalised for area” (**a**) and “not normalised for area” (**b**) modes: 0. *I. monstrifica*; 1. *I. bradyi*; 2. *I. decipiens*; 3. *I. gibba*; 4. *I. inermis*.

always present. The valves of *I. monstrifica* were characterised by a variable ornamentation, from the typical form with 5 tubercles (of which the more prominent is the postero-dorsal one, spinous and curved backwards), to forms with postero-dorsal spine protruding laterally, or to tuberculated forms with only 2-3 blunt tubercles; the marginal spines were always present, pronounced and arranged in multiple rows parallel to the anterior and posterior margins.

Marginal ripplets: *I. bradyi* displayed three to five radial ripplets near the outer shell margin and an adjoining smooth list above them; *I. decipiens* showed in the same position a band of numerous, inconspicuously small ripplets or five to twelve radial ripplets more similar to those observed on the I. *bradyi* specimens; *I. gibba* displayed a double row of ripplets: near the outer shell margin a band of numerous, inconspicuously small ripplets, a row of 4 to 7 radial ripplets in the adjoining list above; *I. inermis* showed an inconspicuous, short row of ripplets shifted toward the ventral side or a row of 3 ripplets in the same position; *I. monstrifica* displayed a row of tiny ripplets in a more inward position. Both *I. monstrifica* and *I. gibba* can display a row of thin ripplets near the anterior inner shell margin.

Comparing our results with the data available in the literature, it is evident that both marginal ripplets and ornamentation are non-conservative characters displaying a variability that could lead to inaccurate identifications. We agree with the statement of KARANOVIC & LEE (2013) that the genus needs a revision based on a thorough morphological description, which, from a palaeontological point of view, includes the accurate description of the shape, the ornamentation and the marginal ripplets and, in this paper we propose the revision of the extant Italian *Ilyocypris* species.

REFERENCES

ANADÓN P., DEDECKKER P. & JULIÁ R., 1986. The Pleistocene lake deposits of the NE Baza Basin (Spain): salinity variations and Ostracod succession. *Hydrobiologia,*143: 199-208.

ANADÓN P., GLIOZZI E. & MAZZINI I., 2012. Geochemical and palaeoecological analyses on Mid Pleistocene to Holocene ostracod assemblages from Valle di Castiglione (Italy): palaeoenvironmental and palaeoclimatic assessment. In: Horne D. et al. (Eds.)“Ostracoda as proxies for Quaternary climate change”. *Developments in Quaternary Science*, 17: 217-240.

BALTANÁS A. & DANIELOPOL D.L., 2011. Geometric morphometrics and its use in ostracod research: a short guide. *Joannea Geologie und Paläontologie*, 11: 235-272.

GLIOZZI E. & MAZZINI I., 1998. Palaeoenvironmental analysis of the 250,000-year Quaternary sediment core of Valle di Castiglione (Latium, Italy) using ostracods. In: Crasquin Soleau, S., Braccini, E., Lethiers, F. (Eds). What about Ostracoda! Actes du 3e Congrès Européen des Ostracodologistes, 1996. *Bulletin du Centre de Recherches Elf Exploration Production, Pau, Mémoires,* 20: 69-82.

JANZ, H., 1994. Zur Bedeutung des Schalenmerkmals 'Marginalrippen' der Gattung *Ilyocypris* (Ostracoda, Crustacea). *Stuttgarter Beitr äge zur Naturkunde, Series* B 206: 1-19.

KARANOVIC I. & LEE W., 2013. On the ostracod genus *Ilyocypris* with description of one new species from Korea and the first report of males of *I. bradyi* (Crustacea: Ostracoda: Podocopida). *Proceedings of the biological society of Washington*, 126(1): 39-71.

KEMPF E.G., 1980. Index and bibliography of nonmarine ostracoda 1. Index A. Geologisches Institut der Universität zu Koeln Sonderveroeffenlichungen, 35: 1-188.

KEMPF E.G., 1997. Index and bibliography of nonmarine ostracoda 6. Index A, Supplement 1. Geologisches Institut der Universität zu Koeln Sonderveroeffenlichungen, 109: 1-148.

LINHART J., BRAUNEIS W. & NEUBAUER W., 2006. Morphomatica (Version 1.6.0.1) – http://palstrat.uni-graz.at/methods in ostracodology/methods in ostracodology d.htm.

LORD A., CABRAL M.C., DAMBECK R. & KUNST M., 2011. Ostracod evidence for the Neolithic environment of Rio Sizandro, Portugal. *Palaeobiodiversity and Palaeoenvironments*, 91: 215-228.

MARTENS K. & SAVATENALINTON S., 2011. A subjective checklist of the Recent, free-living, nonmarine Ostracoda (Crustacea). *Zootaxa*. 2855: 1-79.

MEISCH C., 1988. Ostracodes récoltés à Paris. Avec une clef pour la détermination des espèces européennes du genre *Ilyocypris* (Crustacea, Ostracoda). *Bulletin de la Société des Naturalistes Luxembourgeois*, 88: 145-163.

MEISCH C., 2000. Freshwater Ostracoda of Western and Central Europe. In: Schwoerbel J. & Zwick P. (Eds). Süßwasserfauna von Mitteleuropa 8/3, Spektrum Akademischer Verlag, Heidelberg-Berlin: 1-522.

MISCHKE S. & ZHANG C., 2010. Ostracod distribution in Ulungur Lake (Xinjiang, China) and a reassessed Holocene record. *Ecological Research*, 26: 133-145.

MISCHKE S., GINAT H., AL-SAQARAT B. & ALMOGI-LABIN A., 2012. Ostracods from water bodies in hyperarid Israel and Jordan as habitat and water chemistry indicators. *Ecological Indicators*, 14: 87-99.

NEUBAUER W. & LINHART J., 2008. Approximating and distinguishing Ostracoda by the use of B-Splines. In: Danielopol D.L., Gross M. & Piller W.E. (Eds.), Contribution to geometric morphometrics. *Berichte des Institutes für Endiwissenschaften. Karl-Franzens Universität, Graz*, 13: 21-42.

SYLVESTER-BRADLEY P.C. & KEMPF E.K., 1973. *On Ilyocypris monstrificata* (Norman). *Stereo-Atlas of Ostracod Shells*, 1(28): 149-152.

YANG F., SUN Z., ZHANG Y. & QIAO Z., 2002. Taxonomic significance of nodal ornamentation of Quaternary genus *Ilyocypris* (Ostracoda) from Qaidam basin, Qinghai province. *Acta Micropalaeontol Sinica*, 19: 15-32.

VAN DER MEEREN T., MISCHKE S., SUNJIDMAA N., HERZSCHUH U., ITO E., MARTENS K. & VERSCHUREN D., 2012. Subfossil ostracode assemblages from Mongolia – Quantifying response for paleolimnological applications. *Ecological Indicators*, 14: 138-151.

WROZYNA C., FRENZEL P., SCHWALB A., STEEB P. & ZHU L.P., 2009. Water depth related assemblage composition of recent ostracoda in Lake Nam Co, southern Tibetan Plateau. *Revista Espanola de Micropaleontologıa,* 41: 1-20.

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Tõnu Meidla, Vincent Perrier, Oive Tinn & Karin Truuver

A SURVIVAL GAME - DOUBLE EXTINCTION OF OSTRACODA IN THE LATEST ORDOVICIAN

The latest Ordovician Hirnantian glaciation caused extensive rearrangements in all major fossil groups via a double extinction event (Brenchley, 2004). The succession of events in the ostracod record is well documented from numerous sections in the Baltoscandian Palaeobasin, which was located at low latitudes outside the direct influence of glaciation (Meidla, 1996; Truuver *et al.*, 2012).

Rapid cooling, formation of ice caps and an associated drop in sea level caused the first extinction event. This level is marked by a nearly complete turnover in the ostracod succession and a remarkable change in the structure of assemblages. Species richness decreased and diversity of the suborder *Palaeocopa* also decreased markedly (Meidla, 1996). Members of the *Binodicopa*, representing immigrant genera from higher latitudes (Meidla, 2007), occupied an important position in a survival assemblage of moderately high diversity.

A return to pre-glacial conditions and a related rapid sea level rise led to the second extinction event, which resulted in a nearly complete faunal turnover at the species level though higher taxa were less affected. The faunas above the extinction level are of low diversity and comprise predominantly representatives of *Metacopa*. Appearance of the characteristic Silurian families of *Beyrichiocopa* was delayed, likely for several million years.

The major losers in this survival game were members of the oldest known ostracod group, the Palaeocopa, representatives of which are first known in the Tremadoc (Tinn & Meidla, 2004). Palaeocopes are characterized by having a long straight dorsal margin, distinct vertically aligned lobes/sulci and well developed, often dimorphic adventral structures. A high level of ostracod provincialism in the Ordovician (MEIDLA *et al.*, in press) suggests that palaeocopes had limited migration potential and this could be a possible factor that caused widespread extinction in this group.

REFERENCES

BRENCHLEY P. J., 2004. End Ordovician glaciation. In B.D. Webby, F. Paris, M.L. Droser & I.G. Percival (eds.), The Great Ordovician Biodiversification Event. Columbia University Press, New York: 81-83.

MEIDLA T., 1996. Late Ordovician ostracodes of Estonia. *Fossilia Baltica*, vol. 2: 222 pp.

MEIDLA T., 2007. Ostracods from the Upper Ordovician Borenshult fauna, Sweden. *GFF*, 129: 123-132.

MEIDLA T., TINN O., SALAS M.J., WILLIAMS M., SIVETER D., VANDENBROUCKE T. & SABBE K., (in press). Biogeographical patterns of Ordovician ostracods. In: Harper, D & Servais, T. (eds), Early Palaeozoic Palaeobiogeography and Palaeogeography (x). Geological Society.

TINN O. & MEIDLA T., 2004. Phylogenetic relationships of Early-middle Ordovician ostracods of Baltoscandia. *Palaeontology*, 47: 199-221.

TRUUVER K., MEIDLA T., AINSAAR L., BERGSTRÖM J. & TINN O., 2012. Stratigraphy of the Ordovician-Silurian boundary interval in Östergötland, Sweden, based on ostracod distribution and stable carbon isotopic data. *GFF*, vol. 134, 4.

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FROM THE PAST TO THE FUTURE: OSTRACODS AS INDICATORS OF HUMAN IMPACTS AND THEIR ROLE IN PLANNING THE ECOLOGICAL RESTORATION OF AQUATIC ECOSYSTEMS

Different authors have discussed the potential of ostracods as indicators of water quality and human impact. However, their use as such has never been implemented in standardised water policy and management protocols, unlike other groups like diatoms, macroinvertebrates or fishes. Identification complexities, restricted species distributions, and relatively low diversity and abundance (e.g. in running waters) might be some of the reasons why water quality managers have not paid more attention to this group as sentinels of environmental impacts. Yet ostracods, as with other organisms with durable remains, offer the opportunity to compare between present and past community compositions. Thus, they provide a tool to assess the intensity and direction of changes that a water body undergoes and, most importantly, to discover the original environmental framework prior to these changes. By way of example, the lake Albufera in Valencia (Eastern Iberian Peninsula), presently in a highly polluted, hypertrophic state, used to be very rich in ostracod species typical of freshwater macrophyte meadows decades ago, and was dominated by brackish ostracod assemblages a few centuries ago (POQUET *et al.*, 2008; MARCO-BARBA *et al.,* in press). Another shallow Iberian lake, Estany d'Ivars, has been recently restored after a dry period induced by humans for agriculture. Based on some historic documents, a restoration programme was set up to establish a permanent freshwater lake (ALONSO *et al.,* 2007). However, ostracod remains tell the long story of a saline temporary playa system that was far from the present restored conditions. Environmental managers can make full use of ostracod-based reconstructions to evaluate the original, pristine conditions of disturbed lakes. Then they can decide whether or not it is worth attempting to restore habitats as closely as possible to previous natural settings.

REFERENCES

ALONSO N., ARMENGOL J., COLET A., CURRAS A., ESCALA O., JUNYENT E., JULIÀ R., LÓPEZ-SÁEZ J.A., MARQUÉS M.A., MARTÍNEZ ELCACHO A., MEZQUITA F., REED J., RIERA S. & ZAMORA L., 2007. Primers resultats del projecte paleoecològic i historicoarqueològic "4.000 anys de l'estany d'Ivars i Vila-sana i la seva gent". In: Patrimoni natural i històric de l'estany d'Ivars i Vila-sana. *Consorci d'Estany d'Ivars i Vila-sana,* Mollerussa: 61-78.

MARCO-BARBA J., MEZQUITA F. & MIRACLE M.R. (in press). Ostracod palaeolimnological analysis reveals drastic historical changes in salinity, eutrophication and biodiversity loss in a coastal Mediterranean lake. *The Holocene*. DOI: 10.1177/0959683612466752.

POQUET J.M., MESQUITA-JOANES F., RUEDA J. & MIRACLE M.R., 2008. Loss of Ostracoda biodiversity in Western Mediterranean wetlands. *Aquatic Conservation: Marine and Freshwater Ecosystems,* 18: 280-296.

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MENNO SOES & FRANCESC MESQUITA-JOANES

CRAYFISHES HOSTING ENTOCYTHERID OSTRACODS IN EUROPE

Organisms such as parasites, commensals or mutualists that colonize new areas using the invasive capacity of their hosts are an interesting component of the invasion process. The effects of filters involved in such processes may result in only a selection of the potential biota associated with an invasive organism becoming established in the new populations of the invasive host (TORCHIN *et al.*, 2003). The Entocytheridae is a family composed by 220 species of ostracods epicommensal on other crustaceans, mainly crayfishes. The two most speciose subfamilies of this family, the Entocytherinae (with 183 species) and the Notocytherinae (26 species) inhabit mostly crayfishes of North and Central America (Cambaridae and Astacidae) and Oceania (Parastacidae), respectively. In addition, there are some other entocytherid species native to Europe and America living on stygobitic isopods (HART & HART, 1974), which mostly belong to the family Sphaeromicolinae. European native crayfishes of the family Astacidae are endangered, mainly because of the introduction of exotic invasive American crayfishes to Europe during the last 50 years that carried the aphanomycosis plague and, in addition, are better competitors (HOLDICH, 2002). Recently, two American entocytherids were found outside of their areas of origin. *Ankylocythere sinuosa*, was found associated with the American red swamp crayfish *Procambarus clarkii* in the Eastern Iberian Peninsula (AGUILAR-ALBEROLA *et al.*, 2012), and *Uncinocythere occidentalis* was found associated with the signal crayfish *Paci-*

fastacus leniusculus in Japan and Germany (SMITH & KAMIYA, 2001; GRABOW & MARTENS, 2009). In the present survey, we carried out extensive checks of the native and exotic European crayfishes for the presence of entocytherid ostracods, by examining individuals preserved in alcohol collections, or using a specific methodology for entocytherid removal from live crayfish (MESTRE *et al.*, 2011). This included sampling more than 90 European locations (within Spain, France, Germany, The Netherlands, Czech Republic, Croatia, Ukraine, Turkey and U.K.), from which we recovered 4 native and 8 exotic crayfish species. According to our results, there are two American entocytherid species widely established in Europe: *Ankylocythere sinuosa* was found at 39 widely distributed locations on the Iberian Peninsula, plus a location on Mallorca Island and a petshop in the Czech Republic, in all cases, associated with *Procambarus clarkii*; *Uncinocythere occidentalis* was found at 10 localities with a wide latitudinal range from the centre of the Iberian Peninsula to Southern England, with some localities in France, the Netherlands and Germany, associated with *Pacifastacus leniusculus*, with the exception of a locality where it was found living on *P. clarkii*, cohabiting with *A. sinuosa* on the same crayfish. We did not find entocytherids on the other 5 exotic crayfishes nor on the native crayfishes sampled. The fact that only two exotic entocytherid species were widely established in Europe, and only in populations of two exotic crayfish species, is evidence that there are factors limiting the invasive success of the Entocytheridae to a smaller proportion of the potential set of species. The absence of native entocytherids on European native crayfishes might be related to the evolutionary history of the group; in this work, we propose the hypothesis that the jump to crayfish hosts was via stygobitic crayfishes cohabiting with other crustaceans (probably isopods) hosting entocytherids, after the tectonic separation of Europe and America. According to this hypothesis, the absence of native stygobitic crayfish species in Europe precluded this phenomenon in this continent.

REFERENCES

AGUILAR-ALBEROLA J.A., MESQUITA-JOANES F., LÓPEZ S., MESTRE A., CASANOVA J.C., RUEDA J. & RIBAS A., 2012. An invaded invader: infection of the red swamp crayfish *Procambarus clarkii* (Girard, 1852) by entocytherid ostracods in the Iberian Peninsula. *Hydrobiologia* 688: 63-73.

GRABOW K. & MARTENS A., 2009. Neozoische Aufsitzer auf in Deutschland eingeschleppten Signalkrebsen. *4. Internationales Flußkrebsforum 07.-10.Mai 2009 Gersfeld/Rhön, Deutschland:* 38-42.

HART D.G. & HART C.W., 1974. The Ostracod Family Entocytheridae. *Fulton Press Inc.*, Lancaster, 239 pp.

HOLDICH D.M., 2002. Distribution of crayfish in Europe and some adjoining countries. *Bull. Fr. Pêche Piscic.,* 367: 611-650.

Mestre A., Monrós J.S. & Mesquita-Joanes F., 2011. Comparison of two chemicals for removing an entocytherid (Ostracoda: Crustacea) species from its host crayfish (Cambaridae: Crustacea). *Internat. Rev. Hydrobiol.*, 96: 347-355.

Smith R.J. & Kamiya T., 2001. The first record of an entocytherid ostracod from Japan. *Benth. Res.,* 56: 57-61.

Torchin M.E., Lafferty K.D., Dobson A.P., McKenzie V.J. & Kuris A.M., 2003. Introduced species and their missing parasites. *Nature*, 421: 628-630.

Authors' Addresses — A. Mestre, J.A. Aguilar-Alberola, J.A. Gil-Delgado, J. Monrós, J. Rueda, F. Mesquita-Joanes, Department of Microbiology and Ecology and ICBiBE, University of Valencia (Spain); e-mail: alexandre.mestre@uv.es; heterocypris@hotmail.com; gild@uv.es; monros@uv.es; juan.rueda@uv.es; mezquita@uv.es; D. Baldry, Cessy Angling Association (France); e.mail: balindat@orange.fr; H. Balkis, A. Mülayim, Faculty of Science, Department of Biology, Istanbul University, 34134 Vezneciler, Istanbul (Turkey); e-mail: aysegulm@istanbul.edu.tr; A. Ellis, North-East Thames, Apollo Court, 2 Bishops Square, St Albans Rd West, Hatfield, Herts, AL10 9EX (UK); e-mail: adamgrahamellis@yahoo.co.uk; G.I.V. Klobučar, I. Maguire, Department of Zoology, Faculty of Science, University of Zagreb (Croatia); email: imaguire@biol.pmf.hr; Antonin Kouba, University of South Bohemia in Ceske Budejovice, South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses, Zatisi 728/II, 389 25 Vodnany (Czech Republic); e-mail: antonin.kouba@seznam.cz; K. Grabow, A. Martens, Institut für Biologie, Pädagogische Hochschule Karlsruhe, Bismarckstraße 10, 76133 Karlsruhe (Germany); e-mail: grabow@ph-karlsruhe.de; martens@ph-karlsruhe.de; B. Sharf, Ellhornstr. 21, D-28195, Bremen (Germany); e-mail: burkhard.w.scharf@t-online.de; M. Soes, NCB Naturalis, P.O. Box 9517, NL-2300 RA Leiden, The Netherlands & Bureau Waardenburg P.O. Box 365, NL-4100 AJ Culemborg (The Netherlands); e-mail: menno.soes@gmail.com.

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HEALDIID OSTRACOD ASSEMBLAGES FROM ORGANIC-RICH BASINAL DEPOSITS IN THE UPPER TRIASSIC (RHAETIAN) OF THE NORTHERN CALCAREOUS ALPS (AUSTRIA)

According to previous research the taxonomic diversity and composition of ostracod assemblages, particularly the relative abundance of Platycopida and Metacopida can be helpful in identifying periods of oxygen-poor conditions. Ostracod assemblages from Mid-Cretaceous pelagic sediments show a strong decline in species diversity and high percentage of Platycopida during the Oceanic Anoxic Event in the Cenomanian-Turonian boundary interval (JARVIS *et al*., 1988). High percentages of Platycopida were also recorded from other sedimentary successions, which were considered to be deposited under oxygen-poor conditions (e.g. BOOMER & WHATLEY, 1992; CRASQUIN & KERSHAW, 2005; WHATLEY *et al*., 2003). WHATLEY (1990, 1991, 1995) interpreted the high abundance of Platycopida by the fact that the Platycopida are more efficient than Podocopida in circulating water due to their filter-feeding technique and were thus also more efficient in respiration. BRANDAO & HORNE (2009) however noted that previous calibrations of platycopid abundances against past oxygen levels are not justified by the ostracod depth distribution in the modern Oxygen Minimum Zone. LETHIERS & WHATLEY (1994, 1995) postulated that several Palaeozoic ostracod groups such as the Metacopida and many Palaeocopida (Kloedenelloidea, Paraparchitoidea) were also filter-feeders because of their carapace morphology and their relative abundance could be used as palaeo-oxygenation reconstruction tool.

Palaeoecologic and sedimentologic results from the Rhaetian Kössen Formation in the Northern Calcareous Alps suggest that certain species of the Healdiidae can be indicative of oxygen deficiency and possibly related ecologic factors (e.g. food avaibility, substrate conditions). The data were obtained from the Eiberg section (Fig. 1) which is located in the central part of the Eiberg Basin, an intraplatform basin in the northwestern part of the Tethyan shelf. Palaeoecologic and stable istope data suggest a depth-related oxygen gradient in the Eiberg Basin due to diminished deep-water circulation (METTE *et al*., 2012). According to sedimentologic and biofacies criteria the maximum water depth (150-200m) of the Eiberg Basin is recorded in the upper Kössen Formation (upper Eiberg Member).

The transgressive part of a transgressive-regressive cycle in the upper Kössen Formation (Fig. 2) consists of bituminous shales which yielded low diverse ostracod assemblages dominated by *Pseudohealdia* spp. In these transgressive deposits, oxygen deficiency is indicated by a high abundance of framboidal pyrite, small pyritized burrows, amorphous organic matter and well-preserved palynomorphs (HOLSTEIN, 2004). Abundant casts of tiny bivalves, pointing to episodic mass mortalities, also prove adverse environmental conditions. Additional indications of low oxygenation levels were obtained from the size range and morphologies of benthic calcareous foraminifera. The foraminifera assemblages (*Frondicularia*, *Dentalina*) associated with *Pseudohealdia* show low diversity and small test size. Studies on Mesozoic, Cenozoic and Holocene foraminifera (e.g. GOVEAN, 1980; DOUGLAS, 1981; BERNHARD, 1986) have demonstrated that assemblages from anaerobic organic-rich deposits are dominated by thin-shelled forms of small size and with flattened morphology. Assemblages from sediments representing oxygenated depositional settings contain specimens of greater size and with variable morphologies. A close relationship between test size and morphology of benthic foraminifera and oxygen concentration at the seafloor was also reported from Cretaceous and modern assemblages (e.g. KOUTSOUKOS *et al*., 1990; KALHO, 1994).

The regressive part of the T/R-cycle in the upper Kössen Formation yielded macrobenthic assemblages (brachiopods, bivalves) and more diverse microbenthic assemblages including Healdiidae, Bairdioidae, Cytheroidae and large-sized Nodosariid and Vaginulinid foraminifera.

REFERENCES

BERNHARD J.M., 1986. Characteristic assemblages and morphologies of benthic foraminifera from anoxic, organic-rich deposits: Jurassic through Holocene. *Journal of Foraminiferal Research,* 16 (3): 207-215.

BOOMER I. & WHATLEY R., 1992. Ostracoda and dysaerobia in the Lower Jurassic of Wales: the reconstruction of past oxygen levels. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 99: 373-379.

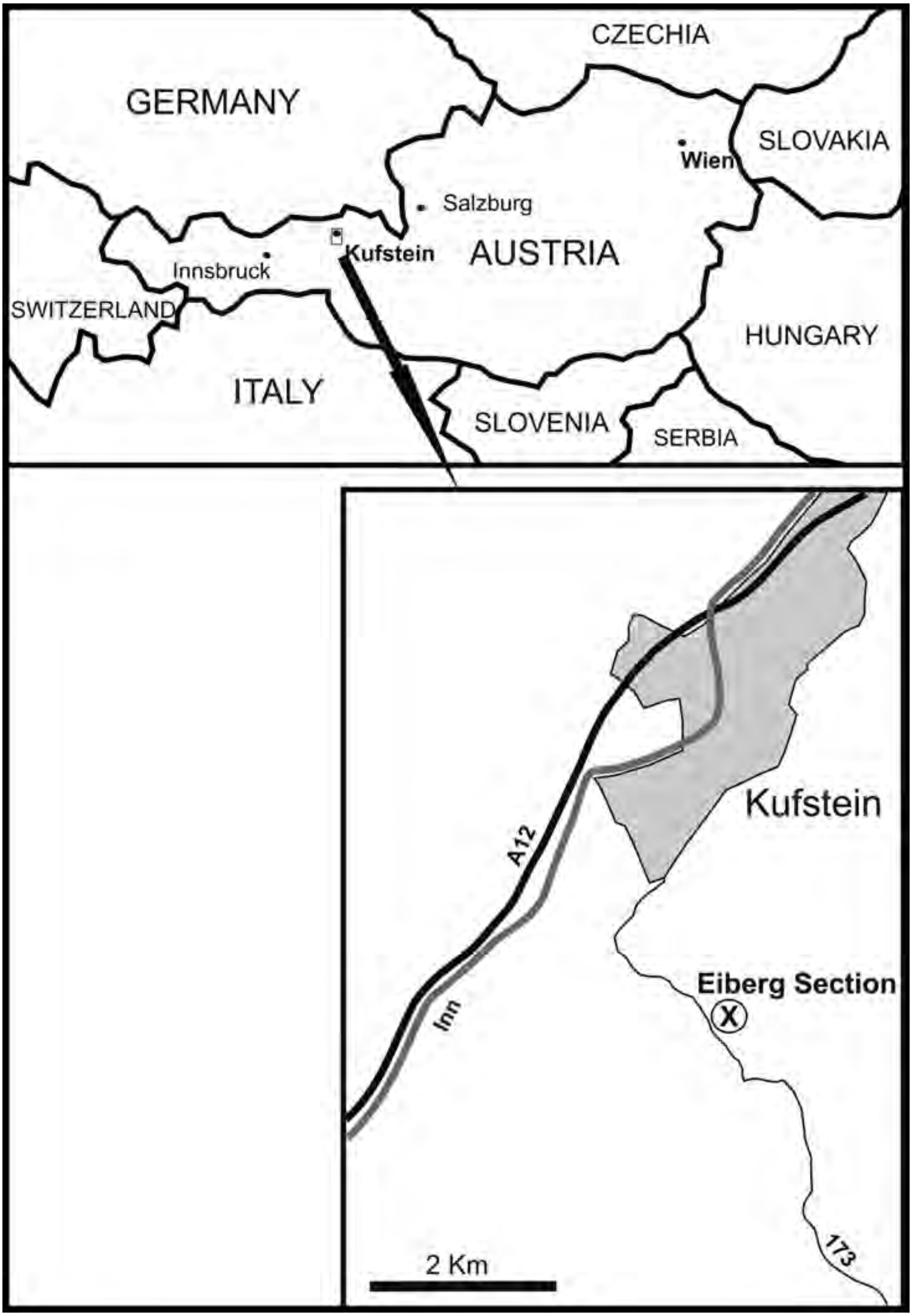

Fig. 1 — Locality map of the Eiberg section.

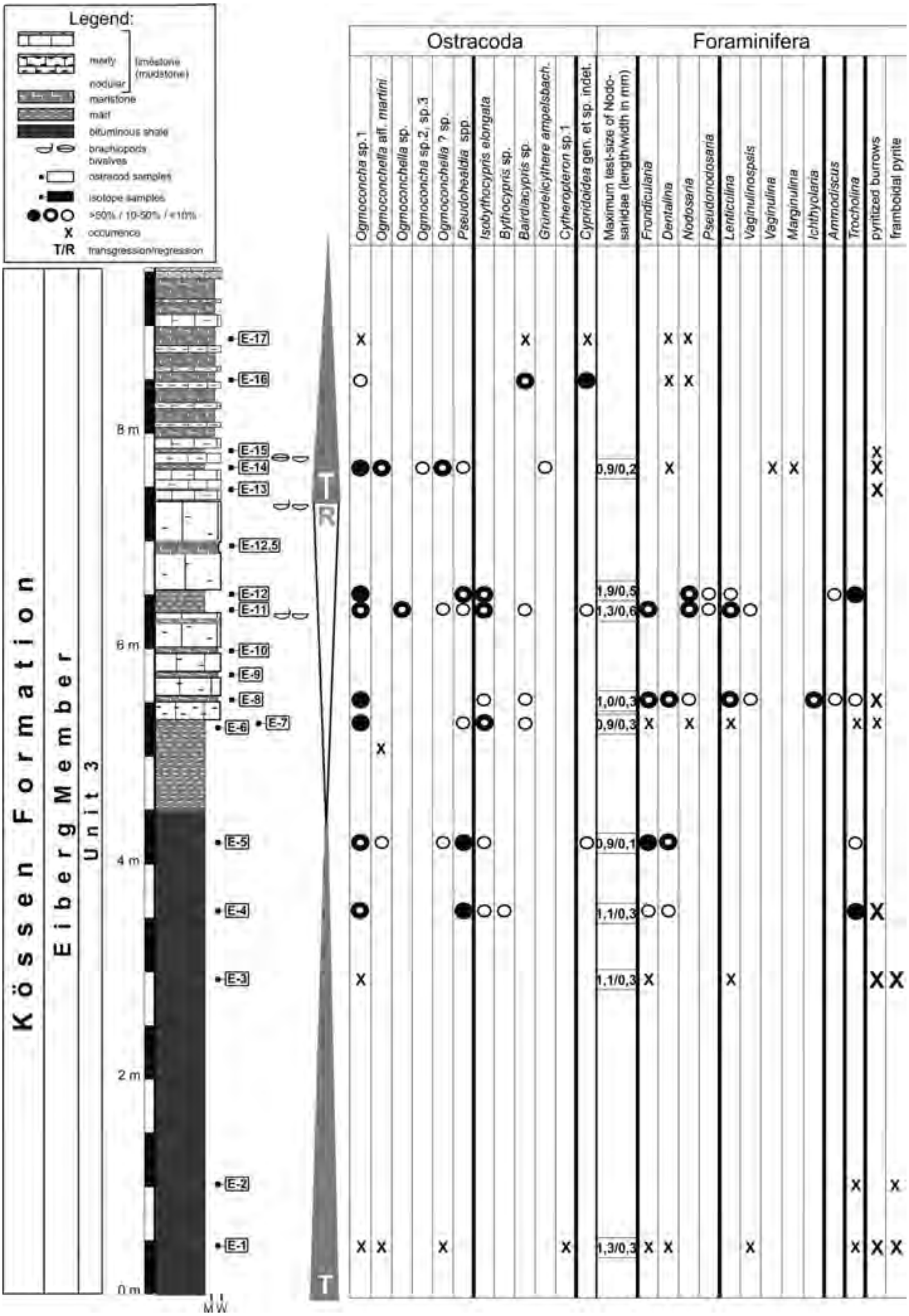

Fig. 2 — Lithofacies, transgressive-regressive cyclicity and microbenthic faunas in the upper Kössen Formation (Upper Rhaetian) at Eiberg section.

BRANDÃO S.N. & HORNE D.J., 2009. The platycopid signal of oxygen depletion in the ocean: A critical evaluation of the evidence from modern ostracod biology, ecology and depths distribution. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 283: 126-133.

CRASQUIN-SOLEAU S. & KERSHAW S., 2005. Ostracod fauna from the Permian-Triassic boundary interval of South China (Hyang Mountains, eastern Sichuan Province): palaeoenvironmental significance. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 217: 131-141.

DOUGLAS R.G., 1981. Paleoecology of continental margin basins: A mordern case history from the borderland of southern California. In: Douglas, R.G., Colburn, I.P., Gorsline, D.S. (eds.), Depositional systems of active continental margin basins; *Short Course Notes. Society of Economic Paleontologists and Mineralogists*, *Pacific Section*, San Francisco, 121-156.

GOVEAN F.G., 1980. Some paleoecologic aspects of the Monterey Formation, California. Ph.D. Dissertation, University of California.

HOLSTEIN B., 2004. Palynologische Untersuchungen der Kössener Schichten (Rhät, Alpine Obertrias). *Jahrbuch der Geologischen Bundesanstalt*, 144 (3-4): 261-365.

JARVIS I., CARSON G.A., COOPER M.K.A., HART M.B., LEARY P.N., TOCHER B.A., HORNE D.J. & ROSENFELD A., 1988. Microfossil assemblages and the Cenomanian-Turonian (Late Cretaceous) oceanic anoxic event. *Cretaceous Research*, 9 (1): 3-103.

KALHO K., 1994. Benthic foraminiferal dissolved-oxygen index and dissolved-oxygen levels in the modern ocean. *Geology*, 22: 719-722.

KOUTSOUKOS E.A.M., LEARY P.N. & HART M.B., 1990. Latest Cenomanian-earliest Turonian low-oxygen tolerant benthonic foraminifera: a case study from the Sergipe basin (N.E. Brazil) and the western Anglo-Paris basin (southern England). *Palaeogeography, Palaeoclimatology, Palaeoecology*, 77: 145-177.

LETHIERS F. & WHATLEY R., 1994. The use of Ostracoda to reconstruct the oxygen levels of Late Palaeozoic oceans. *Marine Micropaleontology*, 24: 57-69.

LETHIERS F. & WHATLEY R., 1995. Oxygenation des eaux et Ostracods filtreurs: Application au Devonien-Dinantien. *Geobios*, 28 (2): 199-207.

METTE W., ELSLER A. & KORTE C. 2012. Palaeoenvironmental changes in the Late Triassic (Rhaetian) of the Northern Calcareous Alps: clues from stable isotopes and microfossils. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 350-352: 62-72.

WHATLEY R.C., 1990. Ostracoda and global events. - In: Whatley, R.C. & Maybury, R. (eds.), Ostracoda and global events. *Chapman & Hall*, London, 3-24.

WHATLEY R.C., 1991. The platycopid signal: a means of detecting kenoxic events using Ostracoda. *Journal of Micropalaeontology*, 10 (2): 181-183.

WHATLEY R.C., 1995. Ostracoda and oceanic palaeoxygen levels. *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut*, 92: 337-353.

WHATLEY R.C., PYNE R.S. & WILKINSON I.P., 2003. Ostracoda and palaeo-oxygen levels, with particular reference to the Upper Cretaceous of East Anglia. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 194: 355-386.

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OSTRACODS FROM THE ACHEULIAN GESHER BENOT YA'AQOV SITE IN THE UPPER JORDAN VALLEY

The archaeological Gesher Benot Ya'aqov (GBY) site in the upper Jordan Valley represents a key location for studies of hominin occupation and the early-mid Pleistocene environmental conditions in the Levant (ALPERSON-AFIL *et al.*, 2009). The Brunhes-Matuyama boundary of 0.78 Ma was identified in the sequence of fluvio-lacustrine sediments, which were accumulated in the Hula paleolake and near its southern shore (GOREN-INBAR *et al.*, 2000; BELITZKY, 2002).

Ostracod shells from the lake and near-shore deposits belong to 26 species. Shells of *Candona neglecta*, *Candona angulata*, *Darwinula stevensoni*, *Humphcypris subterranea*, *Physocypria kraepelini*, *Ilyocypris* cf. *bradyi* and *Gomphocythere ortali* are the most abundant ostracod remains at GBY. Shells of the typical brackish-water dweller *Cyprideis torosa* or brackish-water tolerant species such as *Heterocypris salina* are rare. Thus, the Hula paleolake was probably filled by freshwater with ion concentrations lower than the slightly oligohaline waters of the modern Lake Kinneret (Sea of Galilee) 13 km downstream of GBY where *Cyprideis torosa* dominates the modern ostracod fauna. The relatively high number of recorded species at GBY supports the earlier inferences of mostly near-shore depositional environments, which include various types of micro-habitats. Comparisons of the GBY ostracod assemblage data with those of modern water bodies in the region provide further insights into the specific environmental setting of the early-mid Pleistocene hominin occupation of the Hula paleolake shore.

REFERENCES

ALPERSON-AFIL N., SHARON G., ZOHAR I., BITON R., MELAMED Y., KISLEV M.E., ASHKENAZI S., RABINOVICH R., WERKER E., HARTMAN G. & GOREN-INBAR N., 2009. Spatial organization of hominins activities at Gesher Benot Ya'aqov, Israel. *Science*, 326: 1677-1680.

BELITZKY S., 2002. The structure and morphotectonics of the Gesher Benot Ya'aqov area, Northern Dead Sea Rift, Israel. *Quaternary Research,* 58: 372-380.

GOREN-INBAR N., FEIBEL C.S., VEROSUB K.L., MELAMED Y., KISLEV M.E., TCHERNOV E. & SARAGUSTI I., 2000. Pleistocene Milestones on the Out-of-Africa Corridor at Gesher Benot Ya'aqov, Israel. *Science*, 289: 944-974.

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PALEOENVIRONMENTAL CHANGES DURING THE LATE PLIOCENE AND EARLY PLEISTOCENE: AN ANALYSIS OF FOSSIL OSTRACOD ASSEMBLAGES FROM THE SHELF CORE U1353, U1354 AND U1351 (IODP EXP. 317) IN CANTERBURY BASIN, OFF NEW ZEALAND

High-resolution analysis of fossil ostracod assemblages was examined to clarify detailed paleoenvironmental changes in Pliocene-Pleistocene sections of IODP (Intergrated Ocean Drilling Program) sites U1353 (85 m water depth), U1354 (113 m) and U1351 (122 m), which are located on the continental shelf of Canterbury Basin, off New Zealand. Forty, eighty and nineteen samples from Plio-Pleistocene strata of U1353, U1354 and U1351 were chosen respectively. In addition, the samples from near sea bottom of each shelf site and a slope site (344 m water depth) were also used to reveal recent ostracode assemblages in the study area.

At least, 178 ostracode species belonging to 70 genera were identified, and many of them are living in the continental shelf around New Zealand (e.g. Swanson, 1979). We examined 103 samples containing more than 40 ostracode specimens and 78 taxa which occupy more than 3.5% of total relative abundance in any samples for Q-mode factor analysis. As a result, first six varimax factors explained 69.3% of total variance and indicate paleoenvironments spanning the entire range of lagoon/estuary to outer shelf (100-200 m). Ostracode taxa showing high factor score in first to fifth varimax factors inhabit in the recent sea around the study area where is located under the Subtropical Water (STW). They suggest that first to fifth factors show the shelf bottoms influenced by the STW. On the other hands, *Pellucistoma coombsi* having high factor score in sixth varimax factor inhabits only in outer shelf (621-769 m) off Westland coast where is influenced by the Antarctic Intermediate Water (AAIW). Thus, sixth varimax factor shows the influences of the AAIW or colder water.

Vertical paleobathymetric shifts were reconstructed based on Q-mode

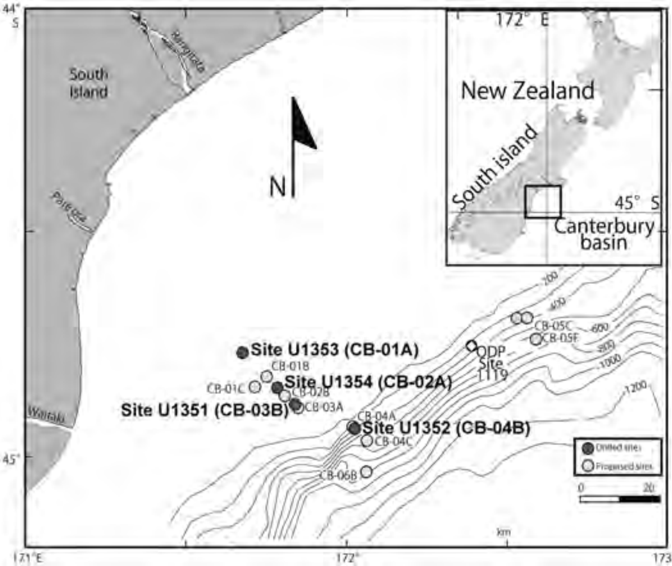

Fig. 1 — Index maps of study area. Modified from EXPEDITION 317 SCIENTISTS (2010).

factor analysis and lithofacies. At least, seven, fourteen and three transgressive-regressive cycles in the range between land (0 m) and outer shelf (100-200 m) were recognized in U1353, U1354 and U1351, respectively. These paleobathymetric changes can be correlated with the benthic ^{18}O stack curve (LISIECKI & RAYMO, 2005) based on the frequency of cycles, the datums of trustworthy microfossil bioevents and unconformities. Thus, some high-stand and low-stand periods might coincide with MIS M2, G10, G10-7, G6-4, G3, G2, G1, 104, 103, 102, 101, 100, 99, 63, 62, 61, 60, 59, 43, 42, 41 and 40. The influence of the AAIW or colder water was found in the high-stand intervals corresponding to the MIS 99 and 59.

REFERENCES

EXPEDITION 317 SCIENTISTS, 2010. Canterbury Basin Sea Level, Global and local controls on continental margin stratigraphy. IODP Prel. Rept., 317

LISIECKI L.E. & RAYMO M.E., 2005. A Pliocene-Pleistocene stack of 57 globally distributed benthic $^{18}\delta$O records. *Paleoceanography*, 20, PA1003

SWANSON K.M., 1979. The Marine Fauna of New Zealand: Ostracods of the Otago Shelf. New Zealand Oceanographic Institute Memoir, 78, 56 pp.

Authors' Addresses — M. NAKAMURA, S. KUSUNOKI, Graduate School of Science and Technology, Shinshu University, Asahi 3-1-1, Matsumoto Nagano 390-8621 (Japan); e-mail: 12sm413g@shinshu-u.ac.jp; K. YAMADA, K. HOYANAGI, Department of Geology, Faculty of Science, Shinshu University, Asahi 3-1-1, Matsumoto Nagano 390-8621 (Japan).

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PALAEOECOLOGY OF OSTRACODS FROM DEEP-LAKE MONDSEE (AUSTRIA) AS A SOURCE OF IDEAS FOR NEW (PALAEO-) BIOLOGICAL RESEARCH

Within the multi-disciplinary project DecLakes (Decadal Holocene and Lateglacial variability of the oxygen isotopic composition in precipitation over Europe reconstructed from deep-lake sediments), funded by the ESF Eurocores Programme EuroCLIMATE (2005-2008), we analysed the sequential distribution of ostracods in a 14.8-m-long sediment core recovered from pre-Alpine lake Mondsee (Upper Austria) at 62 m water depth. Ostracod valves, obtained from high-resolution sediment sampling (valves extracted semi-quantitatively from 0.5-cm-thick sediment slices), were used mainly for oxygen and carbon stable isotopes analysis (Lauterbach *et al.*, 2011). Ostracods were also analysed palaeoecologically from several sections representing windows on the depositional succession of the lake sediments during the last 15,000 yrs. We investigated ostracods in more detail from the Pleniglacial (Pl), Allerød (Al) at ~13,600 yrs BP, Younger Dryas (YD) at ~12,100 yrs BP, Early Holocene (EH) from 11,000 to 8,030 yrs BP, encompassing also the 8.2 ka BP cold event, Late Holocene (LH) from ~1,300 to ~970 yrs BP and Sub-Recent (SR) from ~70 to ~20 yrs BP.

The following ostracod species found in the sediments offer potential for palaeoecological studies: *Candona neglecta* Sars, *C. candida* (Müller), *Fabaeformiscandona tricicatricosa* (Diebel & Pietrzeniuk), *F. harmsworthi* (Scott), *F. protzi* (Hartwig), *Cypria ophtalmica* (Jurine), *Cytherissa lacustris* (Sars), *Limnocytherina sanctipatricii* (Brady & Robertson) and *Leucocythere mirabilis* Kaufmann. An analysis of their succession based on the relative abundance throughout the sediment core allowed distinguishing two major palaeoassemblages. The first one represented by *Candona candida, Fabaeformiscandona harmsworthi*, *F. tricicatricosa*, *Cytherissa lacustris*, *Limnocytherina sanctipatricii* and *Leucocythere mirabilis* had high frequency in the lower part of the core (sections Pl, Al, YD, EH). These species either completely disappeared or occurred sporadically (and at low abundances) during the rest of the Holocene (i.e. in the LH and SR periods). The second assemblage of species, represented by *Candona neglecta* and *Cypria ophtalmica*, occurred in the LH and SR sections with both high constancy and high relative abundance.

Because water temperature in the deepest part of the lake (below 60 m) remains rather constant (it ranges 4-6 °C at 10 cm above the lake bottom: GEIGER, 1990), we hypothesize that the productivity of the lake, which increased from Late Glacial to Late Holocene, must be the factor behind the observed ostracod succession. If our hypothesis is correct, the period when both the 'old' and the 'new' ostracod assemblages overlap (the former declining and the latter expanding) should denote a major shift in the trophic status of lake Mondsee, from oligotrophic condition to more nutrients enriched. However, ecological requirements in the lacustrine profundal zone for most of the recorded species are poorly known and, consequently, it is highly problematic to find support for that hypothesis from available, published records. Alternatively, we will offer an agenda of potential questions that should form the core of future research projects.

As a spinoff of the DecLakes project we present new aspects on the type of palaeoecological information, which can be extracted from the morphological variability of ostracod valves – the case story of the juvenile A-3 stage of *Candona neglecta* from the above mentioned sediment profile. Valves of the A-3 stage are specially suited for such studies because they do not display sexual dimorphism, no large difference exist between the opposite valves, they are well calcified, remain often preserved in large numbers in the sediment and can also be easily picked up from samples. We show that the percentage of valves with traces of degradation of their outer lamella in the lower part of the core (Al and YD age), when annual sedimentation rates were very low, was higher than that in the LH core section, when sedimentation was about five times higher than in the previous section. This taphonomic aspect merits detailed studies in order to understand the way bacteria attack the valves deposited on the bottom of the lake upon the death of animals; it is also of interest for further palaeoecological studies.

The variability of the valve shape of A-3 juveniles of *C. neglecta* in the lower part of the core up to the 8.2 ka BP cold event (i.e. during the Al, YD and EH) is significantly lower than in the upper part of the core, i.e. in several selected levels of the LH. This aspect was tackled using a geometric-morphometric analysis and comparing statistically disparity in shape at different time periods by the PERMDISP test (permutational analysis of multivariate dispersions) implemented in the PRIMER 6 & PERMANOVA+ statistical package (ANDERSON *et al.*, 2008).

It is hypothesised that the shape variability of the A-3 juvenile valves of *C. neglecta* is also related to the lake productivity. We propose for a better understanding of this aspect to start studies on the biological requirements of juveniles during their post-embryonic development. Geometric morphometrics offers an excellent method for the analysis of this aspect of the developmental trajectory of *C. neglecta*. Additionally, laboratory cultures of this species using different organically enriched sediments and variable oxygen and pH concentrations could provide new information for the observations we presented here.

REFERENCES

ANDERSON M, GORLEY R.N. & CLARKE K.R., 2008. Permanova+ for Primer: Guide to software and statistical methods. *Primer-E Ltd.*, Plymouth, 214 pp.

GEIGER W., 1990. The role of oxygen in the disturbance and recovery of the *Cytherissa lacustris* population in Mondsee. In: Danielopol D.L., Carbonel P. & Colin J.P. (eds.), *Cytherissa* (Ostracoda) – The *Drosophila* of Paleolimnology. *Bull. Inst. Geol. Bassin d'Aquitaine*, Bordeaux, 47-48: 167-190.

LAUTERBACH S., BRAUER A., ANDERSEN N., DANIELOPOL D.L., DULSKI P., HÜLS M., MILECKA K., NAMIOTKO T., OBREMSKA M., VON GRAFENSTEIN U. & DECLAKES PARTICIPANTS, 2011. Environmental responses to Lateglacial climatic fluctuations recorded in the sediments of pre-Alpine Lake Mondsee (northeastern Alps). *J. Quaternary Sci.*, 26: 253-267.

Authors' Addresses — T. NAMIOTKO, Univ. Gdańsk, Fac. Biology, Dept. Genetics, Lab. Limnozoology, Wita Stwosza 59, 80-308 Gdańsk (Poland); e-mail: tadeusz.namiotko@biol.ug.edu.pl; D.L. DANIELOPOL, Univ. Graz, Inst. Earth Sciences (Geology & Palaeontology), Heinrichstr. 26, A-8010 Graz (Austria); U. VON GRAFENSTEIN, Lab. Sciences du Climat et de l'Environement, UMR, CEA-CNRS, Orme des Merissiers, 91191 Gif-sur-Yvette (France); S. LAUTERBACH, A. BRAUER, GFZ German Research Centre for Geosciences, Section 5.2 – Climate Dynamics and Landscape Evolution, Telegrafenberg, 14473 Potsdam (Germany); N. ANDERSEN, M. HÜLS, Christian Albrechts Univ., Leibniz Lab. for Radiometric Dating and Stable Isotope Research, Max-Eyth Str. 11-13, 24118 Kiel (Germany); K. MILECKA, Adam Mickiewicz Univ., Fac. Geographical and Geological Sci., Dept. Biogeography and Palaeoecology, Dzięgielowa 27, 61-680 Poznań (Poland); A. BALTANÁS, Univ. Autonoma de Madrid, Fac. Sciences, Dept. Ecology, 28049 Madrid (Spain); W. GEIGER, Budinskygasse 16/18, 1190 Vienna (Austria); DECLAKES PARTICIPANTS: Soumaya Belmecheri (LSCE, Gif-sur-Yvette, now at Pennsylvania State Univ.), Marc Desmet (ISTO, Univ. F. Rabelais, Tours), Helmut Erlenkeuser (Leibniz Lab., Kiel), Jérôme Nomade (Lab. Géodynamique des Chaines Alpines, Grenoble).

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Atike Nazİk, Demet Ongan & Emine Şeker

MEDITERRANEAN AND BLACK SEA OSTRACOD ASSEMBLAGES OF THE HOLOCENE SEDIMENTS FROM THE SOUTHWEST BLACK SEA SHELF

Oceanographic and paleooceanographic features of Black Sea are affected by (1) water-exchange having distinct physical, chemical and biological characteristic between Mediterranean and Black Sea and (2) closure and opening of water-way with the Bosphorus and Marmara Sea. Ostracod fauna of gravity cores between the exit of the Bosphorus and neada from SW shelf of the Black Sea were analysed and in this study from the Neoeuxinian (Late Glacial) to present (Fig. 1). The aim of study is to understand the changing environmental conditions according to ostracod content and their distribution in the cores after the inflow of saline Mediterranean water until the present day.

Cores from the surroundings of the Bosphorus and outer shelf indicate coarse grained sediments and abundant shells. Fine-grained sediments were found in the mid-shelf and inner shelf cores. The oldest age (11.8 ky BP) obtained from the base of core 10 as the lacustrine Neoeuxinic period of Black Sea (Ongan *et al.*, 2009).

Euxinocythere (*Maeotocythere*) *lopatici*, *Amnicythere olivia, Loxoconcha lepida, Loxoconcha immodulata, Loxoconcha* sp. 1 Boomer 2010, *Tyrrenocythere amnicola, Tyrrenocythere flipescui, Candona (Caspiolla) liventalina, Candona (Pontoniella) srebarnensis, Candona (Typhlocypris)* sp., *Candona (Metacandona)* sp. are especially found in outher shelf cores as fresh-brackish condition of the Neoeuxinian basin. A range of 7.3 and 7.9 ky BP obtained from the base of near-channel (WB7), inner shelf (7) and mid-shelf (5) cores. *Bythocythere minima, Callistocythere pallida, Carinocythereis carinata, Costa edwardsii, Palmoconcha agilis, Hiltermannicythere rubra* from ostracods of Mediterranean origin

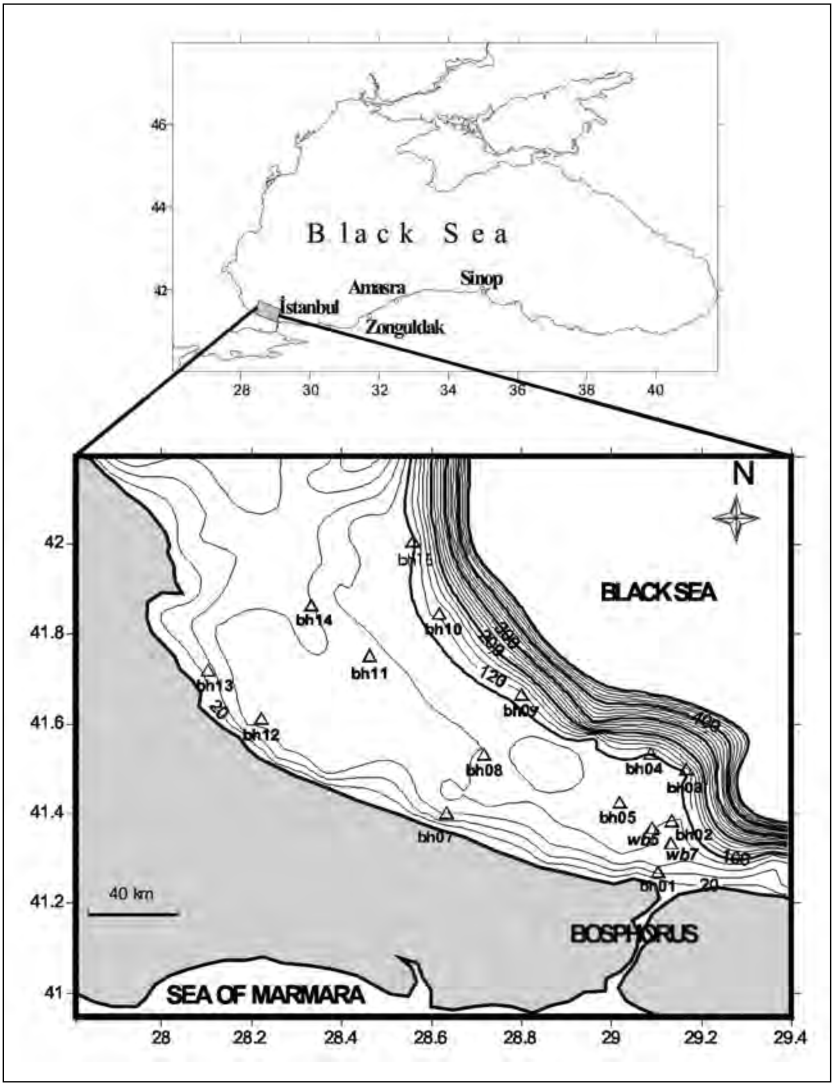

Fig. 1 — Location map of the Bosphorus boreholes.

are observed in inner shelf cores between İğneada and Bosphorus. Previous works (LANE-SERFF *et al.*, 1997; ALGAN *et al.*, 2002; AKSU *et al.*, 2002a,b; RYAN *et al.*, 2003; KWIECIEN *et al.*, 2008) indicate between Mediterranean and Black Sea connection before ~8.3 ky BP. The mixed fauna is recognized in the sediments later 7.9 ky BP in this study. This finding supports previously published data of Mediterranean water intrusion into the Black Sea.

REFERENCES

ALGAN O., GOKAŞAN E., GAZIOĞLU C., YÜCEL Z., ALPAR B., GÜNEYSU C., KIRCI E., DEMIREL S., SARI E. & ONGAN D., 2002. A high-resolution seismic study in Sakarya Delta and Submarine Canyon, southern Black Sea shelf. *Continental Shelf Research*, 22: 1511-1527.

AKSU A.E., HISCOTT R.N., YAŞAR D., İŞLER F.İ. & MARSH S., 2002a. Seismic stratigraphy of Late Quaternary deposits from the southwestern Black Sea shelf: evidence for non-catastrophic variations in sea-level during the last 10.000 yr. *Marine Geology*, 190: 61-94.

AKSU A.E., HISCOTT R.N., KAMINSKI M.A., MUDIE P.J., GILLESPIE H., ABRAJANO T. & YAŞAR D., 2002b. Last glacial-Holocene paleoceanography of the Black Sea and Marmara Sea: stable isotopic, foraminiferal and coccolith evidence. *Marine Geology*, 190: 119-149.

BOOMER I., GUICHARD F.& LERICOLAIS G., 2010. Late Pleistocene to Recent ostracod assemblages from the western Black Sea. *Journal of Micropalaeontology*, 29: 119-133.

KWIECIEN O., ARZ H.W., LAMY F., WULF S., BAHR A., RÖHL U. & HAUG G., 2008. Estimated reservoir ages of the Black Sea since the last Glacial. *Radiocarbon*, 50: 99-118.

LANE-SERFF G.F., ROHLING E.J., BRYDEN H.L. & CHARNHOCK H., 1997. Postglacial connection of the Black Sea to the Mediterranean and its relation to the timing of sapropel formation. *Paleoceanography,* 12: 169-174.

ONGAN D., ALGAN O., KAPAN-YEŞILYURT S., NAZİK A, ERGIN M. & EASTOE C., 2009. Benthic Faunal Assemblages of the Holocene Sediments from the Southwest Black Sea Shelf. *Turkish J. Earth Sci.*, 18: 239-297.

RYAN W.B.F., MAJOR C.O., LERICOLAIS G. & GOLDSTEIN S.L., 2003. Catastrophic flooding of the Black Sea. *Annual Review of Earth and Planetary Sciences*, 31: 525-554.

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ANNA ANDRESSA EVANGELISTA NOGUEIRA & MARIA INÊS FEIJÓ RAMOS

COSTA VARIABILOCOSTATA RECTICOSTATA? BOLD, 1970 IN THE NEOGENE FROM THE PIRABAS FORMATION, EASTERN AMAZONIA, BRAZIL

The Miocene Pirabas Formation (MAURY, 1925) is one of the most important fossiliferous units of the Cenozoic of brazilian Amazonia. Paleontological and stratigraphic studies have interpreted this formation as deposited in coastal to marine environment (ROSSETTI & GÓES, 2004). Microfossils are abundant in Pirabas deposits and ostracods were studied firstly by MACEDO (1970, 1985), and recently by NOGUEIRA *et al.* (2011), who gave more detailed taxonomic information of the ostracods collected in Capanema region, Pará state, northern Brazil. In this latter paper some ostracods taxa were recorded and the abundance of the genus *Haplocytheridea* was stressed.

In this work we reviewed and integrated the informations related to the species *Costa variabilocostata* and its subspecific variations Bold, 1970, showing its distributions along the carbonate succession exposed in the Aricuru, Capanema and Primavera quarries (Fig. 1).

Forty-eight samples were processed according to the standard methods for microfossils at Museu de Pesquisa Emílio Goeldi (MPEG) and Federal University of Pará laboratories. Sampling was carried out on the different facies recognized along the 12m-thick high carbonate sucession (Fig. 2). Six grams of each sample were hand-picked using a Zeiss stereo Microscope, and micrographic images were taken using SEM (Scanning Electron Microscope). The taxonomy were based in the MOORE (1961) and classical literature (BOLD, 1957, 1966, 1968, 1970, 1972).

The species *Costa variabilocostata* was previously recorded in the Pirabas Formation by TÁVORA (1994).This species has subspecific variations in the

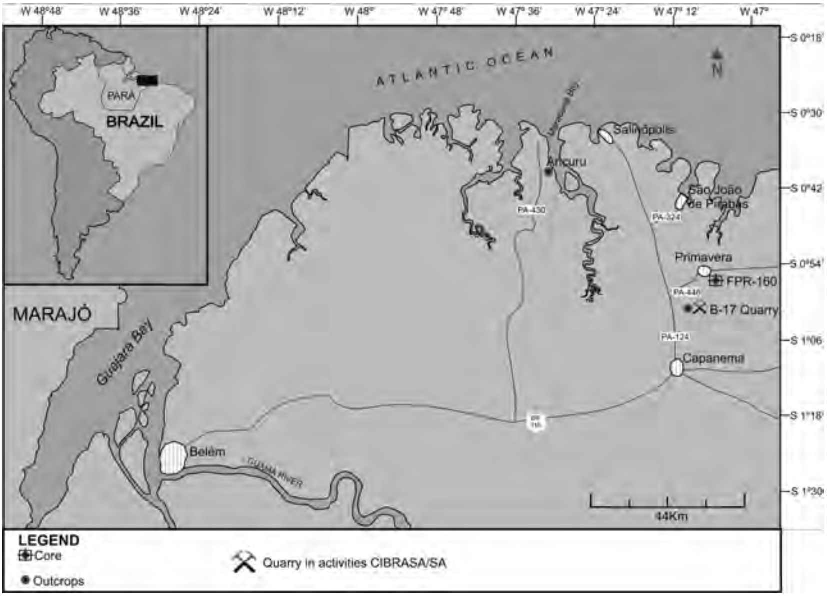

Fig. 1 — Location map of the study area (Modified from Google Earth 2012).

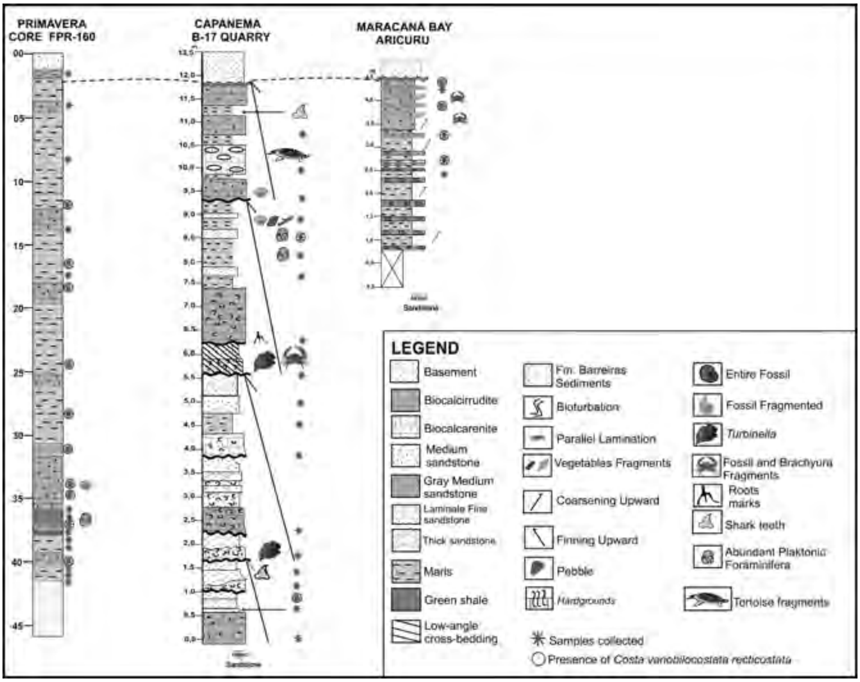

Fig. 2 — Measured sections of the studied localities.

fossil record. The subspecies *C. variabilicostata recticostata*? is preliminarily identified in the studied material and its is very similar to *C. variabilicostata variabilicosta*. However an accurate taxonomical analyses is in progress and its identification needs a comparison with types specimens from museums collections. In the studied material its species is rare and exhibits a pronounced sexual dimorphism (Fig. 3). In the present paper, 44 specimens of the subspecies *C. variabilocostata recticostata?* were recorded for the first time in 16 samples: from Aricuru (4 samples, 11 specimens), Primavera (10 samples, 17 specimens), and B-17 quarry localities (2 samples, 21 specimens). The stratigraphical distribution of the subspecies spans from the Late Miocene to Recent (BOLD, 1970).

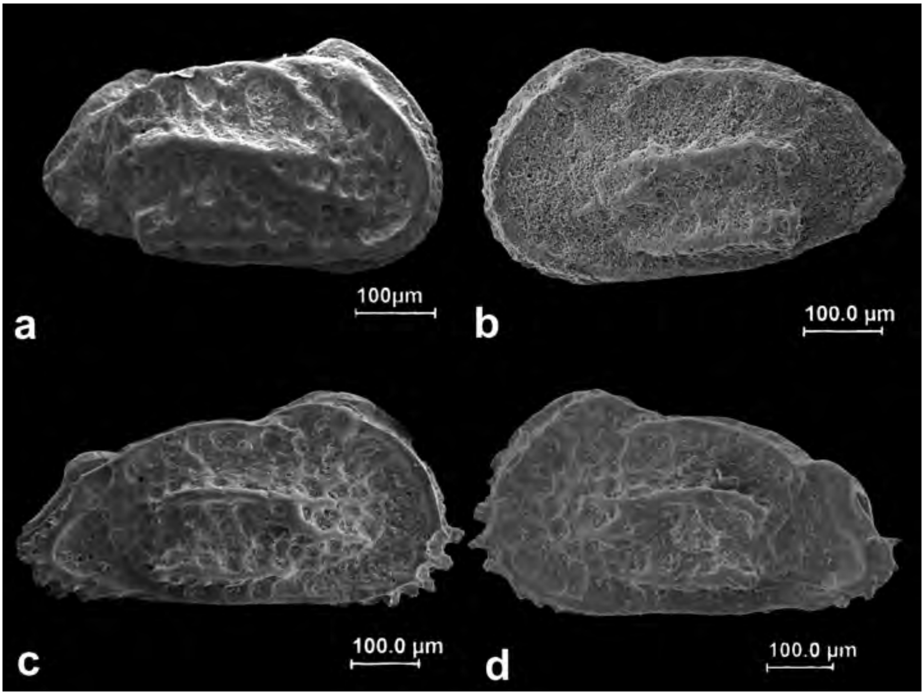

Fig. 3 — Subspecies *Costa variabilocostata recticostata* Bold, 1970: **a**, female, right valve; **b**, female, left valve; **c**, male, right valve; **d**, male, left valve.

The presence of *Costa variabilocostata recticostata?* in the Pirabas Formation points to extend its paleobiogeographic distribution to the northern South America, although this information depends of a more accurate taxonomic studies. The Miocene fossil assemblage associated with *Costa variabilocostata* gr. indicates that the Pirabas succession deposited in a typical shallow water paleoenvironment. The data provided by this work confirm the hypothesis of BOLD (1970), that hypotesized the large diffusion of this group towards South America.

REFERENCES

BOLD W.A. VAN DEN, 1957. Oligo-Miocene Ostracoda from southern Trinidad. *Micropaleontology*, 3 (3): 231–254.

BOLD W.A. VAN DEN, 1966. Ostracoda Of The Pozón Section, Falcón, Venezuela. *Journal of Paleontology*, 40 (1): 177-185.

BOLD W.A. VAN DEN, 1968. Ostracoda of the Yaague Group (Neogene) of the northern Dominican Republic. *Bulletins of American Paleontology*, 54 (239): 1–106.

BOLD W.A. VAN DEN, 1970. The genus Costa (Ostracoda) in the Upper Cenozoic of the Caribbean Region. *Micropaleontology*, 16 (1): 61–75.

BOLD W.A. VAN DEN, 1972. Ostrácodos del Post-Eoceno de Venezuela y regiones vecinas. IV Cong. Geol. Venez., Pub. Esp 7, 2: 999-1072.

MACEDO A.C.M., 1970. Sobre a distribuição de Ostracoda no Mioceno caribeano com um estudo especial sobre os ostracodes da Formação Pirabas, Pará, Brasil. Rio de Janeiro. Dissertação (Mestrado em Geologia). Programa de Pós-Graduação em Geologia, Universidade Federal do Rio de Janeiro, 62 pp.

MACEDO A.C.M., 1985. Comentários sobre Ostracodes da fácies Castelo, Formação Pirabas, Estado do Pará. *Anais da Academia Brasileira de Ciências*, 57: 140.

MAURY C. J., 1925. Fósseis Terciários do Brasil com descrição de novas formas Cretáceas. Monografia. Serviço Geológico e Mineiro do Brasil, Rio de Janeiro, 4: 1-705.

MOORE R.C. (ed.), 1961. Treatise on invertebrate paleontology, pt. Q [Arthropoda 3: Crustacea Ostracoda]. Geol. Soc. Amer./Univ. Kan., New York/Lawrence, Kans., 465 pp.

NOGUEIRA A.E., RAMOS M.I.F. & PUCKETT T.M., 2011. The genera *Haplocytheridea* Stephenson, 1936 and *Cytheridea* Bosquet, 1852 (Subphylum Crustacea, Class Ostracoda) from the Early Miocene Pirabas Formation, Brazil. *Revue de Micropaléontologie*, v. 54: 215-235.

ROSSETTI D.F. & GÓES A.M., 2004. O Neógeno da Amazônia Oriental. Coleção Friedrich Katzer, Museu Paraense Emílio Goeldi Press, 225 pp.

TÁVORA V.A., 1994. Hemicytheridae, Loxoconchidae, Paradoxostomatidae, Pectocytheridae e Trachyleberididae (Crustacea- Ostracoda) na Formação Pirabas (Eomioceno)- Estado do Pará. *Boletim Museu Paraense Emílio Goeldi*, 6: 65-90.

Authors' Addresses — A. NOGUEIRA, Programa de Pós-Graduação em Geologia e Geoquímica, Instituto de Geociêcias, Universidade Federal do Pará, Avenida Perimetral, State of Pará (Brazil); email: bioanna@gmail.com; M.I.F. RAMOS, Museu Paraense Emílio Goeldi, Campus de Pesquisa, Coordenação de Ciências da Terra e Ecologia, State of Pará (Brazil); email: mramos@museu-goeldi.br.

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EWA OLEMPSKA

PLANKTONIC MYODOCOPE OSTRACOD FAUNA FROM THE SILURIAN OF THE HOLY CROSS MOUNTAINS, POLAND

The detailed investigation of the myodocope ostracods from the Silurian section of Widełki, near Łagów, in the Holy Cross Mountains was carried out. This monotonous succession of shales and shales with mudstone intercalations is well dated by graptolites as middle-late Ludlow. This approximately 8-10 m thick sequence rests on the Niewachlów graywackes (STUPNICKA *et al.*, 1991).

The ostracods described herein belong to the families Bolbozoidae Bouček, 1936, Cypridinidae BAIRD, 1850 and Entomozoidae Přibyl, 1949.

Myodocope assemblage from Widełki contains 7 species of the genera *Bolbozoe* (*B. anomala* Barrande, 1872), *Parabolbozoe* (*P. bohemica* (Barrande, 1872), *P.* sp.), *Silurocypridina* (*S. calva* PERRIER *et al.*, 2011), *Richteria* (*R. migrans* (Barrande, 1872), *R.* sp.) and *Rhomboentomozoe* (*R.? rhomboidea* (Barrande, 1872)).

The Silurian (Wenlock-Pridoli) myodocope ostracods are known from the Czech Republic (Prague Basin), Britain, France (Armorican Massif, Montagne Noire), Italy (Sardinia). *Parabolbozoe bohemica* appeared in the late Wenlock and got extinct by the mid Ludlow. *Richteria migrans* is known from the mid Ludlow (PERRIER *et al.*, 2007, 2011).

The myodocope ostracods are very diverse and abundant in various marine environments. However, they are very rare in the fossil record even in the young, sub-recent samples, mostly due to their weakly mineralized carapace. Unlike those of most fossil ostracods, myodocopid shells very rarely survive as calcareous objects. They occur most commonly as internal and external moulds in shales. The external moulds of the myodocopes from the Widełki were casted using latex.

REFERENCES

PERRIER V., VANNIER J. & SIVETER D.J., 2007. The Silurian pelagic myodocope ostracod. *Richteria migrans*. *Transactions of the Royal Society of Edinburgh* 98: 151-163.

PERRIER V., VANNIER J. & SIVETER D.J., 2011. Silurian bolbozoids and cypridinids (Myodocopida) from Europe: pioneer pelagic ostracods. *Palaeontology* 54: 1361-1391.

STUPNICKA E., PRZYBYŁOWICZ T. & ŻBIKOWSKA B., 1991. Wiek szarogłazów niewachlowskich i łupków z Widełek k. Barda (Góry Świętokrzyskie). *Przegląd Geologiczny* 9: 389-393.

Author's Address — E. OLEMPSKA, Institute of Paleobiology, Polish Academy of Sciences, Twarda 51/55, 00-818-Warszawa (Poland); e-mail: olempska@twarda.pan.pl.

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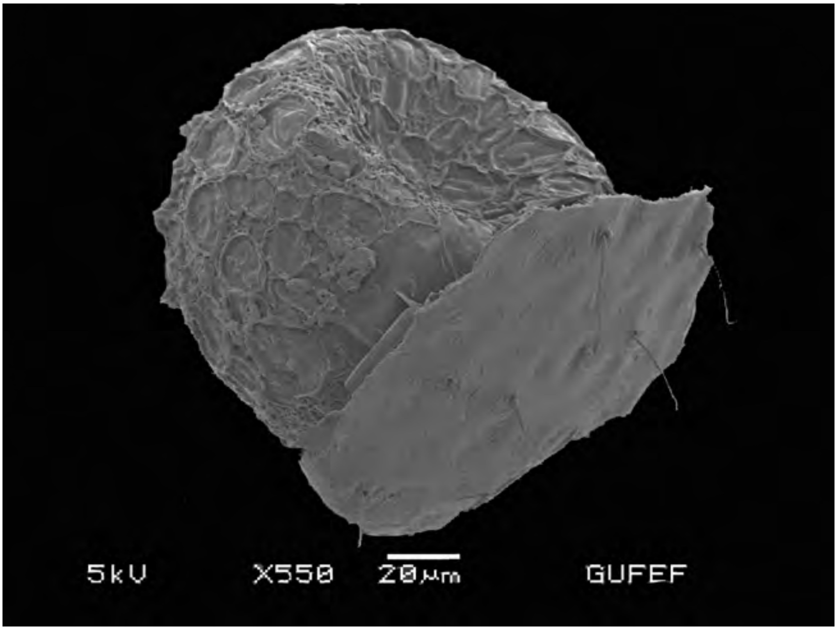
OYA ÖZULUĞ & ZEKIYE SULUDERE

TWO TYPES OF EGGS THAT HAVE EVOLVED FOR SURVIVAL AND DISTRIBUTIONS IN TERRESTRIAL AREAS

Ostracods can be found in marine and non-marine habitats. Members of non-marine ostracods, particularly Cypridoidea show highest diversity in the Palaearctic region. The adaptation and distribution ability is closely related to some biological features such as brooding, desiccation-resistant eggs and parthenogenesis (HORN & MARTENS, 1998; MARTENS *et al.*, 2008). Desiccation-resistant eggs are not specific features of the Ostracoda; the resting eggs can also be seen in some Anostraca species (Crustacea: Branchiopoda) that inhabit inland waters which are periodically drying up (GILCHRIST, 1978). It can be said that desiccation-resistant eggs are an important evolutional gain that is a key factor for the survival and distribution success of non-marine ostracods. Especially the eggs of the most common Cypridean species *Heterocypris incongruens* are investigated and the detailed structural features of desiccation-resistant eggs are known (ÖZULUĞ & SULUDERE, 2012). In addition, *H. incongruens*, eggs of *Cypris pubera* and *Herpetocypris reptans* are investigated by Scanning Electron Microscope (SEM).

As a result of SEM investigation, two types of eggs are observed. One of them has orderly surface ornamentation; the other does not have orderly surface ornamentation. Both of them belong to *Cypris pubera*. Short and long period eggs have been estimated and mentioned in some publications (ANGEL & HANCOCK, 1989; ROSSI *et al.*, 1996; SPENCER & BLAUSTEIN, 2001) but until now they have not been exhibited visually. With this study, the egg that has evolved for survival in extreme ecological conditions (Fig. 1a) and the egg



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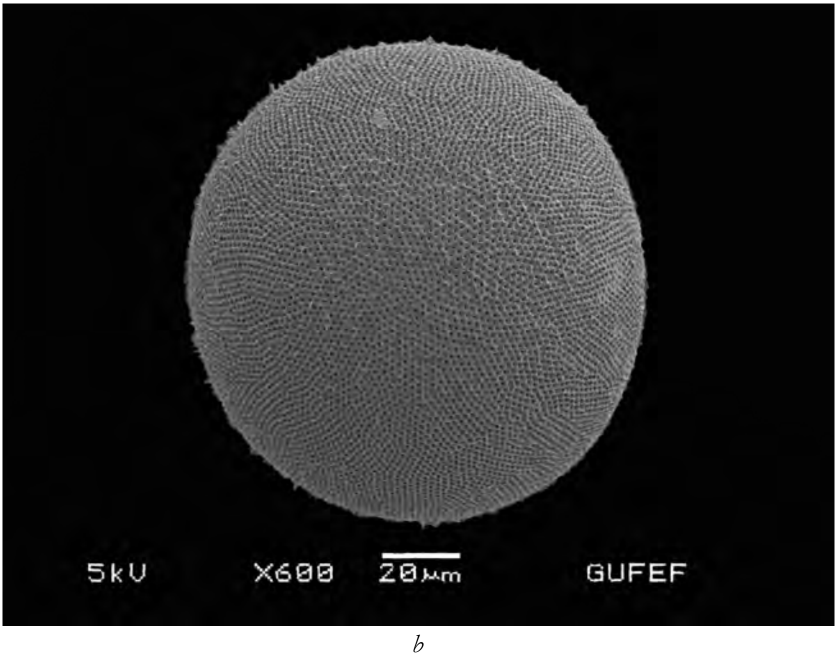

b

Fig. 1 — Two types of eggs of *Cypris pubera* which were laid by a single specimen. **a**, Long, **b**, Short period eggs.

growth in a short period (Fig. 1b) of time that must be used for increasing the numbers of population members are introduced with SEM figures.

Two types of egg in the culture indicate that Cypridean ostracods are ready for both wet and dry periods.

REFERENCES

ANGELL R.W. & HANCOCK J.W., 1989. Response of eggs of *Heterocypris incongruens* (Ostracoda) to experimental stress. *J. Crustacean Biol.* 9, 381-386.

GILCHRIST B.M., 1978. Scanning electron microscope studies of the egg shell in some Anostraca (Crustacea: Branchiopoda). *Cell Tiss. Res.*, 193: 337-351.

HORNE D.J. & MARTENS K., 1998. An assessment of the importance of resting eggs for the evolutionary success of Mesozoic non-marine Cypridoidean Ostracoda (Crustacea). *Arch. Hydrobiol.* Special Issue Advanced Limnology, 52: 549-561.

MARTENS K., SCHÖN I., MEISCH C. & HORN D.J., 2008. Global diversity of ostracods (Ostracoda, Crustacea) in freshwater. *Hydrobiologia*, 589: 185-193

ÖZULUĞ O. & SULUDERE Z., 2012. Morphology of dry- resistant eggs in parthenogenetik *Heterocypris incongruens* (Ramdohr, 1808) (Ostracoda, Crustacea). *Acta Biol Hung,* 63(2): 333-341.

ROSSI V., GANDOLFI A. & MENOZZI P., 1996. Egg diapouse and clonal structure in parthenogenetic populations of *Heterocypris incongruens* (Ostracoda). *Hydrobiologia. 320*, 45-54.

SPENCER M. & BLAUSTEIN L., 2001. Risk of Predation and Hatching of Resting Eggs in the Ostracod *Heterocypris incongruens*. *J. Crustacean Biol.* 21: 575-581.

Authors' Addresses — O. ÖZULUĞ, Istanbul University Science Faculty Department of Biology 34134 Vezneciler – İstanbul (Turkey); e-mail: oozulu@istanbul.edu.tr; Z. SULUDERE, Gazi University, Faculty of Science, Department of Biology 06500 Teknikokullar, Ankara (Turkey); e-mail: zekiyes@gazi.edu.tr.

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PING PENG, LIPING ZHU & PETER FRENZEL

OSTRACOD-INFERRED CONDUCTIVITY TRANSFER FUNCTION FROM NATURAL AQUATIC HABITATS OF THE TIBETAN PLATEAU

Ostracods, bivalved micro-crustaceans living in all kinds of natural water bodies, provide significant information of habitat conditions and are used as sensitive monitoring tools in palaeo-environmental change research. Ostracod transfer functions based on dataset of ostracods and environmental variables are rapidly developing as quantitative approaches in palaeolimnology. The Tibetan Plateau, which is known as “the third pole”, provides a natural lab condition for the study of global climate changes. A high number of lakes scattered on the plateau could supply sediments for multiproxy analyses in past climate change research. This study aims at analysing samples (Fig. 1) of modern ostracods and their habitat conditions to produce a dataset including species of modern ostracods and environmental variables (Table 1) such as temperature, electric conductivity and dissolved oxygen. A transfer function will be set up based on this dataset and multivariable gradient analyses using canonical correspondence analysis (CCA), partial canonical correspondence analysis (PCCA) and dentrended correspondence analysis (DCA). The best taxon optima and response model, evaluated by indexes (root mean squared error of prediction and coefficient of estimated and measured values etc.), will be selected as a final transfer function model. Input fossil or sub-fossil ostracod data of core sediments to the final model will produce reconstructed data for revealing past environmental change. This ostracod transfer function will be used for environment reconstruction of lake Pumayum Co (located in southern Tibet) past climate change from mid to late Holocene.

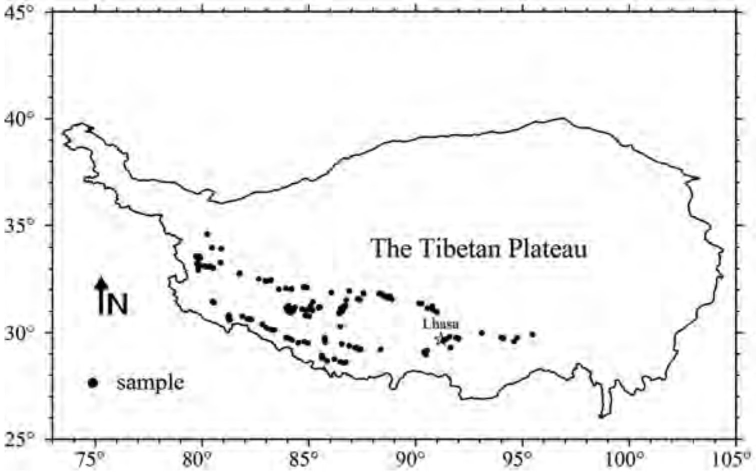

Fig. 1 — Samples analysed in 2011 and 2012 on the Tibetan Plateau for building an ostracod-conductivity transfer function.

Table 1
Sample patterns and data range for our ostracod study on the Tibetan Plateau

Sample Amount	170 samples from small water bodies; 90 samples from 36 lakes
Conductivity Range	11-11033μS/cm
Water Temperature Range	8.2-30.2℃
Distribution Range	79.8-95.5°E，28.6-33.6°N
Elevation Range	2634-4913m

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Vincent Perrier, Tõnu Meidla, Oive Tinn & Leho Ainsaar

BIOTIC RESPONSE TO EXPLOSIVE VOLCANISM IN THE PALAEOZOIC - OSTRACOD RECOVERY AFTER ORDOVICIAN ASH-FALLS

The impact of two Ordovician ash-falls of different intensities was studied (Perrier *et al.*, 2012) in order to determine the recovery patterns of benthic ostracods (palaeocopes and 'non palaeocopes'). The studied sections are both of Sandbian age and located in NW Estonia: Põõsaspea, Kinnekulle K-bentonite (~40 cm, derived from a major volcanic event in the Palaeozoic) and Ristna, Grimstorp bentonite (~6 cm).

In Põõsaspea, important faunal changes are observed: the five pre-crisis dominant species disappear above the bentonite and at least one species gets completely extinct. The post-crisis ecosystem shows strong perturbations in terms of abundance and diversity for about ten thousand years. In Ristna the impact of the ash-fall is less dramatic: all the dominant pre-crisis species survive, although some disturbance in abundance and diversity are observed for approximately five thousand years.

These results show that thicker and more geographically widespread ash-falls will lead to strong rearrangement of assemblages and extinction of some taxa while less prominent volcanic episodes only result in temporary changes in the assemblage structure. In both cases, the recovery follows several distinct steps:

– Post-event ecosystem with 'survival faunas' (very low abundance; low diversity); one/two species (opportunistic taxa?) dominates the assemblage.

– Early stages of recolonization with 'recovery faunas' (increasing abundance and diversity; recolonization by pre-event and new species).

– Return to 'climax assemblages' with specialized taxa (high abundance; high diversity).

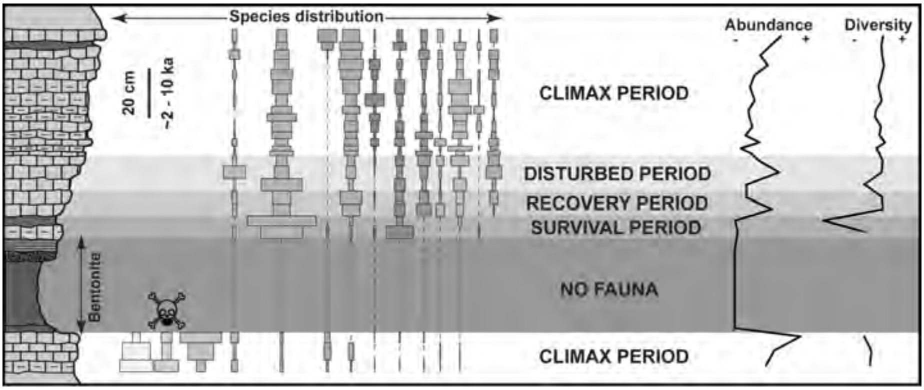

Fig. 1 — Lithology, species distribution, fauna succession, abundance and diversity of the 14 most abundant ostracods species across the Kinnekulle bentonite in the Põõsaspea section (after PERRIER *et al.*, 2012).

Although the assemblages recovered rapidly after the crises, the recovery periods after the ash falls were still much longer than observed in Recent foraminiferal assemblages. Causal links between the volcanic events and subsequent diversifications could not be demonstrated.

REFERENCES

PERRIER V., MEIDLA T., TINN O. & AISNAAR L., 2012. Biotic response to explosive volcanism – ostracod recovery after Ordovician ash-falls. *Palaeogeography, Palaeoclimatology, Palaeoecology,* 365: 166-183.

Authors' Addresses — V. PERRIER, University of Leicester, Department of Geology, University Road, Leicester, LE1 7RH (UK); email: vp110@leicester.ac.uk; T. MEIDLA, O. TINN, L. AINSAAR, University of Tartu, Institute of Ecology and Earth Sciences, Department of Geology, Ravila 14A, 50411 Tartu (Estonia); e-mails: tonu.meidla@ut.ee; oive.tinn@ut.ee, leho.ainsaar@ut.ee.

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VINCENT PERRIER, DAVID J. SIVETER, MARK WILLIAMS & PHILIP LANE

AN EARLY SILURIAN 'HEREFORDSHIRE' OSTRACOD FROM GREENLAND

The Silurian has relatively few exceptionally preserved biotas compared to other periods of Earth history. The mid-Silurian (Wenlock Series) Herefordshire Lagerstätte, known from a single locality and horizon, has yielded unrivalled anatomical data in a diversity of 3-D preserved invertebrates, including brachiopods, a polychaete worm, molluscs, an asteroid and a range of arthropods including four (myodocope) ostracod species. The latter have revolutionized our knowledge of the palaeobiology of Palaeozoic ostracods. None of the exceptionally preserved invertebrate taxa of the Herefordshire Lagerstätte was known outside the type locality in the Welsh Borderland until now. Here we record the occurrence of a new species of the Herefordshire ostracod genus *Pauline* (SIVETER *et al.*, in press) from the early Silurian (Telychian Series) of Greenland.

The new species was recovered from a biosparite boulder collected south of Kap Schuchert, Washington Land, North Greenland. The ostracod-bearing rock is derived from a high energy reef complex of the Pentamerus Bjerg Formation, uppermost Llandovery (*Monograptus spiralis* Biozone) age. Reefal associates include stromatoporoids, crinoids, trilobites (HUGHES & THOMAS, 2011).

Like the type species *Pauline avibella*, the new form from Greenland is very large (for an ostracod) with a 1 cm long carapace, and similarly has a well-developed adductorial sulcus, eye tubercle and alar projection. It is reasonable to transpose the palaeobiology known from *P. avibella* - body, limbs including swimming antennae, lateral eyes, gills and alimentary system - into

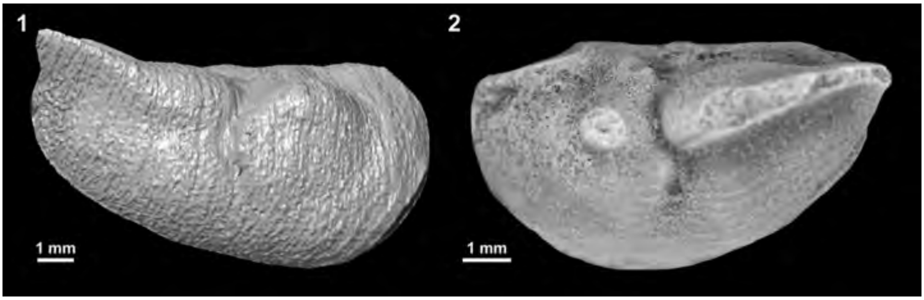

Fig. 1 — Comparison between *Pauline avibella* (1), Wenlock Series, Herefordshire Lagerstätte, UK and *Pauline* n. sp. (2), Llandovery Series, Kap Schuchert, North Greenland.

the shell of the Greenland species, which represents the oldest cylindroleberidid myodocopid and almost the oldest known myodocope.

Morphological, facies and faunal evidence suggest that the Greenland species was nektobenthic. This is compatible with the notion that ostracods (specifically myodocopids) did not invade the water column until the late Wenlock Series (Silurian). *Pauline* is an Early Silurian link between 'Baltic-British' and North Laurentian ostracod faunas, endorsing the idea that UK and Greenland were in close geographical proximity, near a remnant Iapetus Ocean, during the Late Llandovery.

REFERENCES

HUGHES H.E. & THOMAS A.T., 2011. Trilobite associations, taphonomy, lithofacies and environments of the Silurian reefs of North Greenland. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 302 (3-4): 142-155.

SIVETER D. J., BRIGGS D.E.G., SIVETER D.J., SUTTON M.D. & JOOMUN S.C., in press. A Silurian myodocope with preserved soft-parts: cautioning the interpretation of the shell-based ostracod record. *Proceedings of the Royal Society B.*

Authors' Addresses — V. PERRIER, D.J. SIVETER, M. WILLIAMS, University of Leicester, Department of Geology, University Road, Leicester, LE1 7RH (UK); email: vp110@le.ac.uk, djs@le.ac.uk, mri@le.ac.uk; P. LANE, Keele University, School of Earth Sciences and Geography, William Smith Building, Staffs ST5 5BG (UK); email: p.d.lane@keele.ac.uk.

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Valentina Pieri, Koen Martens & Isa Schön

FIRST RESULTS ON CRYPTIC DIVERSITY OF THE *CYTHERISSA* FLOCK (*Crustacea Ostracoda*) FROM LAKE BAIKAL (SIBERIA)

Ancient lakes are freshwater habitats that have long been recognized as natural evolutionary laboratories and hot spots of endemic biodiversity; speciation processes, that have led to the formation of many endemic ancient lake taxa, have received much attention in evolutionary research (Martens*,* 1994, 1997). Ancient lakes thus act as engines generating novel diversity in- and outside of the lake. For non-marine ostracods (Crustacea), ancient lakes are especially important as they hold at least one quarter of the currently known 2000 morpho-species worldwide (Martens *et al.,* 2008) The discovery of so-called cryptic diversity, being defined by two or more genetic species that cannot be distinguished morphologically, has been of great importance for providing real (and much higher) levels of biodiversity and for adapting future conservation management. Genetic studies have detected cryptic diversity in many animal taxa including ostracods (Crustacea) (e.g. Bode *et al.*, 2010; Schön *et al.*, 2012), with the general implication that there are many more species than were previously recognised (Scheffers *et al.,* 2012).

In the present research, we assessed the importance of cryptic ostracod species for biodiversity estimates and conservation of ancient lakes and investigated the underlying evolutionary and ecological processes that may have led to the high diversity in explosive lacustrine radiations.

Here, we presented the first results of our research project on cryptic species in the Baikalian *Cytherissa* species flock.

The *Cytherissa*-radiation from Lake Baikal (Siberia), the largest and the deepest of all extant ancient lakes, was used as model system because it is one of the most species-rich ostracod flocks and contains 47 morphological (sub) species (MAZEPOVA, 1990).

The morphology of *Cytherissa* from Lake Baikal was investigated in detail by Scanning Electronic Microscopy (SEM) of the carapace, hemipenis and chaetotaxy, thus greatly advancing reliable species identification of Baikalian *Cytherissa*, which was so far limited to a single scientific publication (MAZEPOVA, 1990) based on valve characters only.

Furthermore, DNA was extracted from individual ostracod specimens and used for PCR amplification and sequencing of different molecular markers. Sequence data were used to construct phylogenies and test for the presence of cryptic species.

We indeed identified cryptic species in different *Cytherissa* morphospecies. These results illustrate not only that diversity of ostracods from ancient lakes is much higher than previously assumed but also that these higher levels of diversity increase the importance of the ancient lakes as reservoirs and engines for generating freshwater diversity even further.

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REFERENCES

BODE S.N.S., ADOLFSSON S., LAMATSCH D., MARTINS M.J.F., SCHMIT O., VANDEKERKHOVE J., MEZQUITA F., NAMIOTKO T., ROSSETTI G., SCHÖN I., BUTLIN R.K. & MARTENS K., 2010. Exceptional cryptic diversity and multiple origins of parthenogenesis in a freshwater ostracod. *Molecular Phylogenetics and Evolution*, 54: 542-552.

MARTENS K., 1994. Ostracod speciation in ancient lakes: a review. In: MARTENS K., GODDEERIS B., COULTER G. (eds.), Speciation in ancient lakes. *Advances in Limnology*, Vol. 44: 203-222.

MARTENS K., 1997. Speciation in ancient lakes. *Trends in Ecology & Evolution,* 12: 177-182.

MARTENS K., SCHÖN I., MEISCH C. & HORNE D., 2008. Global diversity of ostracods (Ostracoda, Crustacea) in freshwater. *Hydrobiologia,* 595: 185-193.

MAZEPOVA G.F., 1990. Rakoeshkovieje Ratshkie (Ostracoda) Baikala. Novosibirsk: Naoeka Sibirskov Atdjelenieje. (in het Russisch), 472 pp.

SCHEFFERS B.R., JOPPA L.P., PIMM S.L. & LAURENCE W.F., 2012. What we know and don't know about Earth's missing biodiversity. *Trends in Ecology and Evolution*, doi: 10.1016/j.tree.2012.05.008.

SCHÖN I., PINTO R., HALSE S., SMITH A., MARTENS K. & BIRKY C.W. JR, 2012. Cryptic diversity in putative ancient asexual darwinulids (Crustacea: Ostracoda). *PLoS ONE* 7, e39844.

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VALENTINA PIERI, KOEN MARTENS, CLAUDE MEISCH & GIAMPAOLO ROSSETTI

AN UPDATED CHECKLIST OF THE RECENT NON-MARINE OSTRACODS (*Crustacea Ostracoda*) FROM ITALY

The main goal of this research was to update the Italian checklist of non-marine ostracods published by Ghetti & McKenzie in 1981. Data were obtained from the literature and new collections carried out in 14 Italian regions (Abruzzo, Calabria, Emilia Romagna, Friuli Venezia Giulia, Lazio, Lombardia, Piemonte, Puglia, Sardegna, Sicilia, Trentino Alto Adige, Toscana, Valle d'Aosta and Veneto). Altogether, 1623 ostracod samples were gathered from 1205 sites visited between 1981 and 2013 (Fig. 1). Distribution data for several restricted geographic areas have recently been published by STOCH *et al.*, 2009, 2011; BOTTAZZI *et al.*, 2008, 2011; PIERI *et al.*, 2006, 2007, 2009; ROSSETTI *et al.*, 2005, 2006).

Sites were selected to encompass the most common types of freshwater aquatic habitats (i.e., pools, ponds, peat bogs, springs and streams) and subjected to different anthropogenic impacts. These analyses led to the identification of 87 ostracod species. Fifty additional taxa remained at the generic level because only few (juvenile) individuals were available or the material was damaged. Of particular interest is the occurrence of nine species new to Italy: *Candonopsis scourfieldi, Cyclocypris globosa, C. mediosetosa, Eucypris elongata, Fabaeformiscandona breuili, F. wegelini, Microdarwinula zimmeri, Penthesilenula brasiliensis* and *Pseudocandona semicognita.* In addition, three putative new species (*Pseudolimnocythere* sp., *Candona* sp. 1 and *Eucypris* sp. 1) were left in open nomenclature.

After synonymising several species and removing invalid taxa reported by GHETTI & MCKENZIE (1981) or found in the more recent literature, the

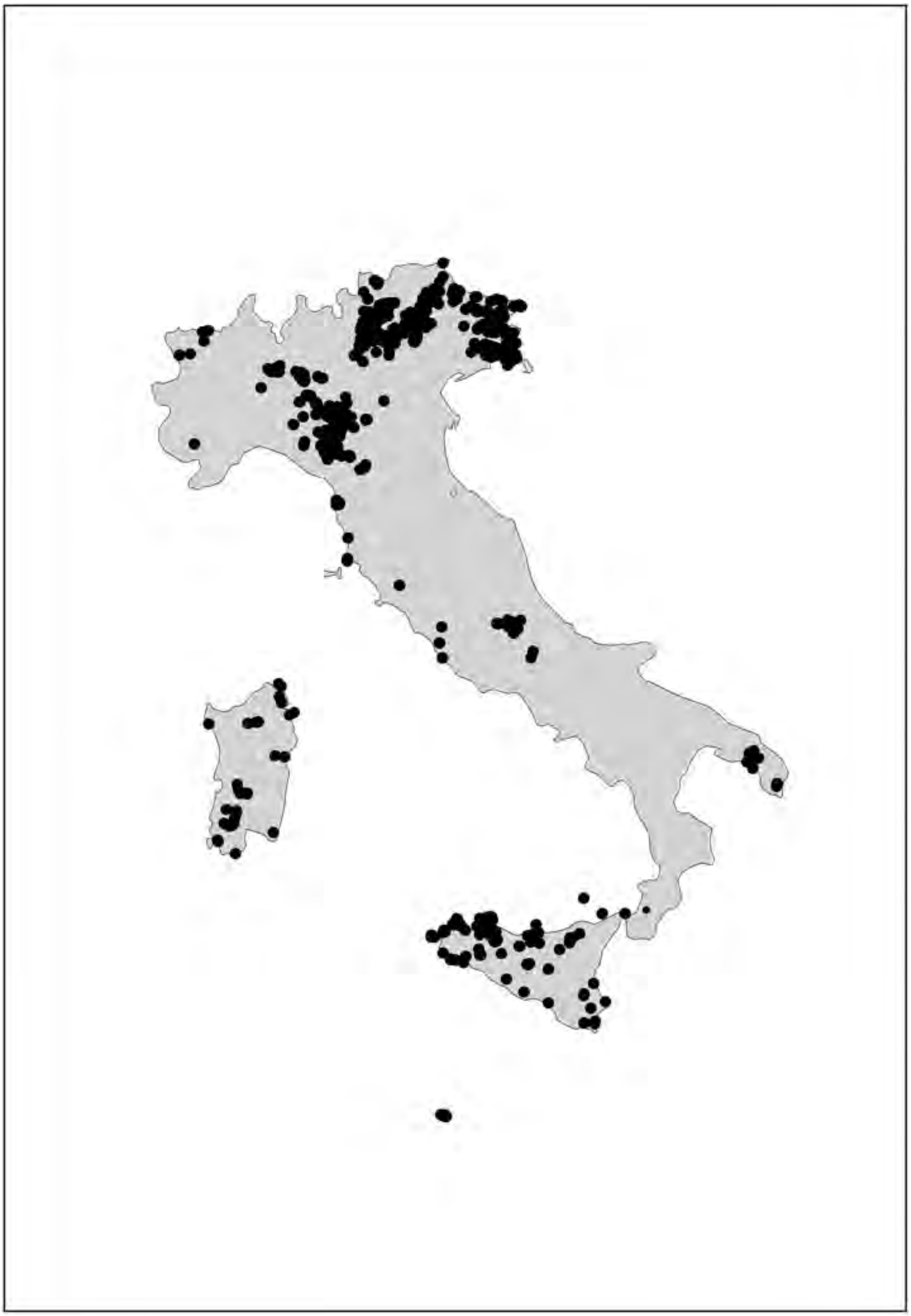

Fig. 1 — Map of Italy showing the sampling sites. Some nearby sampling sites are indicated with a single spot.

updated checklist of the Italian ostracod fauna now includes 151 species and 60 taxa identified at supraspecific level, belonging to 10 families (Darwinulidae, Candonidae, Ilyocyprididae, Notodromadidae, Cyprididae, Limnocytheridae, Cytherididae, Loxochonchidae, Leptocytheridae and Xestoleberididae). Thus, from this study, it can be concluded that the Italian non-marine ostracod fauna is the most diverse in Europe (Tab.1).

Table 1
Total number of species of Recent non-marine ostracods recorded in European countries (Baltanàs et al., 1996; Meisch, 2000; Mori & Meisch, 2012)

Country	**Number of species**
Italy (present study)	151
Germany	126
Great Britain	90
Iberian Peninsula, Balearic Isles and Canary Isles	86
Austria	81
Belgium	71
Czech Republic	70
Slovenia	61
Netherlands	59
Switzerland	52
Luxembourg	51
Ireland	50

REFERENCES

Baltanàs A., Beroiz B. & Lopez A., 1996. Lista faunística y bibliográfica de los ostrácodos no-marinos (Crustacea, Ostracoda) de la Península Ibérica, Islas Baleares e Islas Canarias. Listas de la Flora y Fauna de las Aguas Continentales de la Península Ibérica. N° 12. *Asociación Española de Limnología*. 71 pp.

Bottazzi E., Bruno M.C., Pieri V., Sabatino A., Silveri L., Carolli M. & Rossetti G., 2011. Spatial and seasonal distribution of invertebrates in Northern Apenninic rheocrene springs. In: Cantonati M., R. Gerecke, I. Jüttner, E.J. Cox (Eds), Springs: neglected key habitats for biodiversity conservation. *Journal of Limnology,* 70 (Suppl. 1): 77-92.

Bottazzi E., Bruno M.C., Mazzini M., Pieri V. & Rossetti G., 2008. First report on Copepoda and Ostracoda (Crustacea) from northern Apennine springs: a faunal and biogeographic account. *Journal of Limnology*, 67 (1): 56-63.

Ghetti P.F. & McKenzie K.G., 1981. Ostracodi (Crustacea, Ostracoda). Guide per il riconoscimento delle specie animali delle acque interne italiane. *Consiglio Nazionale delle Ricerche*, 83 pp.

Meisch C., 2000. Freshwater Ostracoda of Western and Central Europe. *Spektrum Academischer Verlag GmbH* – Heidelberg, Berlin, 522 pp.

Mori N. & Meisch C., 2012. Contribution to the knowledge on the distribution of Recent free-living freshwater ostracods (Podocopida, Ostracoda, Crustacea) in Slovenia. *Natura Sloveniae*, 14(2): 5-22.

PIERI V., CASERINI C., GOMARASCA S., MARTENS K. & ROSSETTI G., 2007. Water quality and diversity of the Recent ostracod fauna in lowland springs from Lombardy (northern Italy). *Hydrobiologia,* 585: 79-87.

PIERI V., MARTENS K., NASELLI FLORES L., MARRONE F. & ROSSETTI G., 2006. Distribution of Recent ostracods in inland waters of Sicily (Southern Italy). *Journal of Limnology,* 65 (1): 1-8.

PIERI V., MARTENS K., STOCH F. & ROSSETTI G., 2009. Distribution and ecology of non-marine ostracods (Crustacea, Ostracoda) from Friuli Venezia Giulia (NE Italy). *Journal of Limnology*, 68 (1): 1-15.

ROSSETTI G., MARTENS K., MEISCH C., TAVERNELLI S. & PIERI V., 2006. Small is beautiful: diversity and distributional patterns of ostracods (Crustacea, Ostracoda) in marginal freshwater habitats of the province of Parma (northern Italy). *Journal of Limnology*, 65 (2): 121-131.

ROSSETTI G., PIERI V. & MARTENS K., 2005. Recent Ostracods (Crustacea, Ostracoda) found in lawland springs of the provinces of Piacenza and Parma (Northern Italy), 2005. *Hydrobiologia,* 542: 287-296.

STOCH F., GERECKE R., PIERI V., ROSSETTI G. & SAMBUGAR B., 2011. Exploring species distribution of spring meiofauna (Annelida, Acari, Crustacea) in the south-eastern Alps. In: Cantonati M., R. Gerecke, I. Jüttner, E.J. Cox (Eds), Springs: neglected key habitats for biodiversity conservation. *Journal of Limnology,* 70 (Suppl. 1): 65-76.

STOCH F., PIERI V., SAMBUGAR B. & ZULLINI A., 2009. La fauna delle acque sotterranee dell'Alta Val Secchia (Appennino Reggiano). Il progetto Trias. *Memorie dell'Istituto Italiano di Speleologia*, s. II, 22:143-160.

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ANNA PINT, SANDRA MELZER, PETER FRENZEL,
MAX ENGEL & HELMUT BRÜCKNER

MONOSPECIFIC OCCURRENCE OF *CYPRIDEIS TOROSA* ASSOCIATED WITH MICRO- AND MACROFAUNA OF MARINE ORIGIN IN SABKHA SEDIMENTS OF THE NORTHERN ARABIAN PENINSULA

The oasis Tayma in northwestern Saudi Arabia (27°38'N, 38°33'E) is well known for its rich archaeological heritage. Its history starts with neolithic artefacts and reports a large fortified city on an important trading route from the late Bronze Age.

The palaeontologically investigated material comes from two 5.5 m long sediment cores taken in the northeastern and central part of the sabkha and two outcrops close to the former shoreline north eastern and south western of a large lake. Microfossil-rich layers have an age of about 10 – 4 ka BP. The sandy and silty carbonate dominated sediments contain autochthonous balanids, the gastropods *Melanoides tuberculata* and hydrobiids as well as the foraminifers *Ammonia tepida* (Cushman, 1926), *Quinqueloculina seminula* (Linnaeus, 1758), and *Flintionoides labiosa* (d'Orbigny, 1839). This brackish water association is completed by partially mass-occurrence of *Cyprideis torosa* (Jones, 1850), an euryhaline and generally widely tolerant ostracod species. Only the smooth shelled morphotype *littoralis* occurs. The association indicates a large brackish water lake with temporary freshwater inflows. All species documented originate in the marginal marine environment of the Red or Mediterranean Sea within the intertidal zone and hence they are adapted for strong environmental changes. In a thin horizon near the base of the core from the central part of the sabkha, four species of freshwater ostracods (*Ilyocypris* sp., *Herpetocypris* sp., *Cryptocandona*? sp. and an unidentified darwinulid species) occur in small numbers probably due to a subaquatic spring providing freshwater into this generally brackish lake. We assume

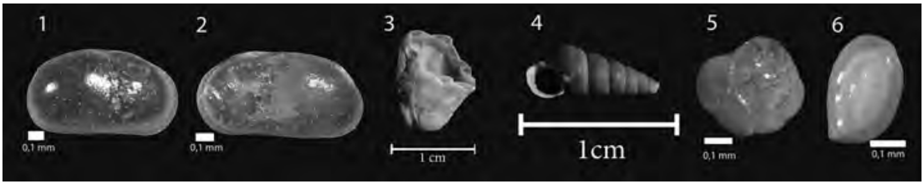

Fig. 1 — Marine or brackish water originated micro-and macrofossils of the sabkha sediments of the oasis of Tayma: **1**: *Cyprideis torosa* (female), **2**: *Cyprideis torosa* (male), **3**: *Balanus* sp., **4**: *Melanoides tuberculata*, **5**: *Ammonia tepida*, **6**: *Quinqueloculina seminula.*

negative water balance under arid climatic conditions as cause for the high salinity of this athalassic lake. Sieve-pore analyses and shell chemistry suppose a trend of increasing salinity towards the top of the studied microfossil-bearing sections. This pattern is confirmed by increasing test malformation ratios of foraminifers.

The marine origin of the fauna is surprising in this area 250 km away from the sea in an altitude about 800 m a.s.l. We assume an avian-mediated transport of eggs, larvae or even adult animals to this site. The brackish water character of the lake enabled a permanent settling of marginal marine foraminifers, ostracods and even macrofauna as gastropods and balanids.

The studied microfauna, morphological and shell chemistry analyses reveal the athalassic but saline character of the palaeo-lake and indicate a wet climate phase in the early Holocene of northwestern Saudi Arabia. Furthermore, the increasing salinity at the younger part of the sections confirms a climatic shift to drier conditions towards the mid Holocene.

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ANNA PINT, VOLKER WENNRICH, PETER FRENZEL & BURKHARD SCHARF

EVOLUTION OF THE HOLOCENE MANSFELDER LAKE AREA IN CENTRAL GERMANY BASED ON AN OSTRACOD RECORD

The Mansfelder Lake area in Central Germany is characterized by three old lakes: the still existing lake Süsser See and the former lakes Fauler See and Salziger See. The latter had been drained in the medieval times, and finally 1895, due to mining activity, disappeared except a few ponds and small relict-lakes like Bindersee and Kernersee. Investigations of sections from Salziger See and Süsser See produced a detailed multiproxy dataset used for palaeoenvironmental and palaeoclimatic reconstruction of the "Mansfelder Land" during the Holocene (WENNRICH, 2005). Ostracod analysis and new data from a section of the Bindersee complete the dataset and enable new hydrological and climatological interpretations.

The finely laminated and diatom rich sediments of the three studied sections contain a divers freshwater ostracod fauna. The increasing dominance of *Cyprideis torosa* (Jones, 1850) indicates a raised salinity for the first time in the early Holocene in all sections. In large parts of the sections, *C. torosa* is dominating. Another typical marginal marine brackish water ostracod is *Cytheromorpha fuscata* (Brady, 1869), however, occurring in small numbers only. Other abundant ostracod species are *Candona neglecta* Sars, 1887*, Darwinula stevensoni* (Brady & Robertson, 1870)*, Eucypris inflata* (Sars, 1903)*, Heterocypris salina* (Brady, 1868), *Limnocythere inopinata* (Baird, 1850) and *Sarscypridopsis aculeata* (Costa, 1847). In the uppermost Atlanticum, the occurrence of marginal marine foraminifers (*Ammonia* sp. and *Miliammina fusca* (Brady, 1870)) support high salinity estimations. Subsequently the distribution of the ostracod species slightly diverges in the separated lake basins,

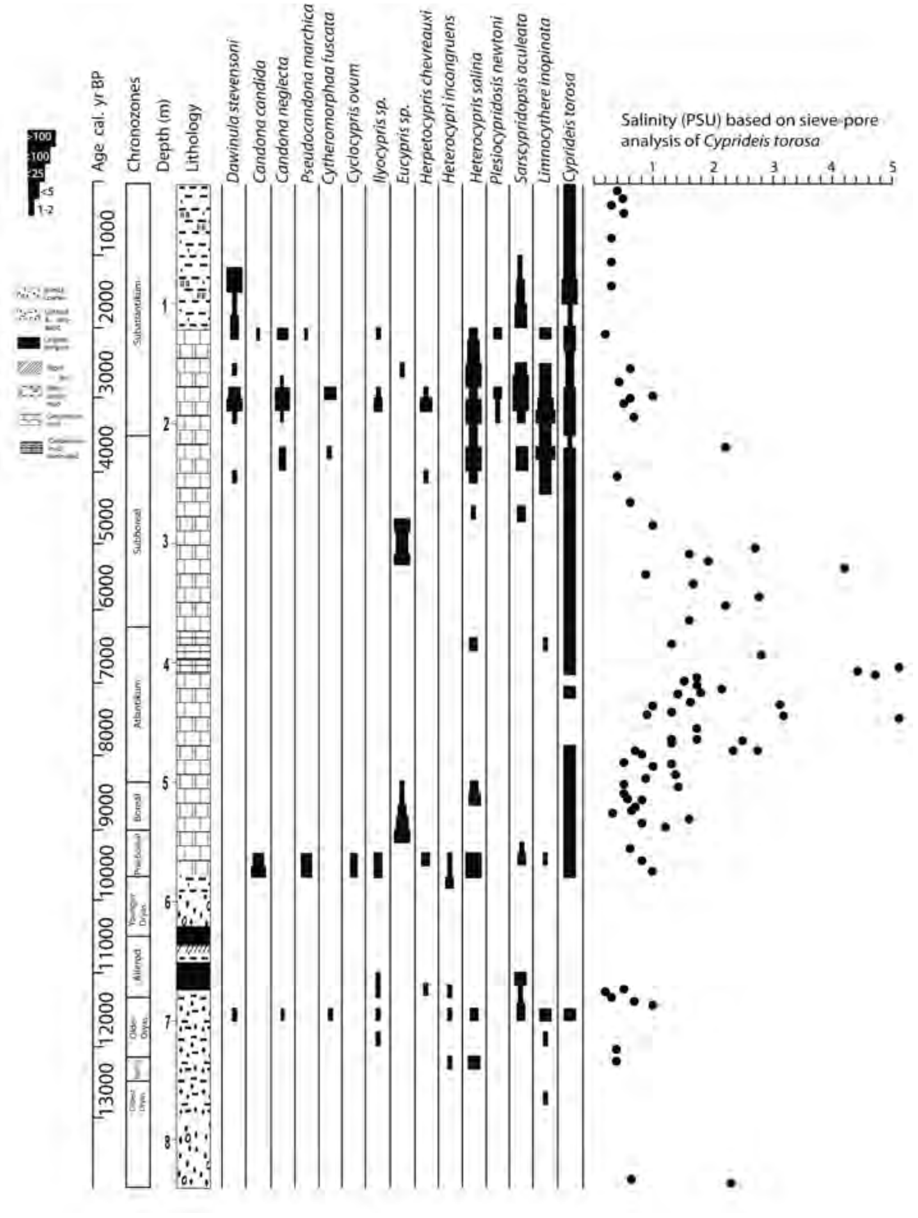

Fig. 1 — Ostracod distribution of a section of the “Salziger See” and the estimated salinity based on sieve-pore analysis of *Cyprideis torosa*.

probable caused by different ecological conditions. Variations in shell morphology, like nodes and sieve-pore shapes of valves of *C. torosa* provide detailed evidence of Holocene salinity trends reflecting climate changes and subrosion processes.

REFERENCES

WENNRICH V., 2005. Die spätweichselglaziale und holozäne Klima und Umweltgeschichte des Mansfelder Landes/Sachsen-Anhalt, abgeleitet aus Seesedimenten des ehemaligen Salzigen Sees. *PhD thesis*, University of Leipzig, 112 pp. [unpublished]

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RICARDO L. PINTO

OSTRACODA FROM AN EXTREME HIGH-ALTITUDE VOLCANIC LAKE IN SOUTH AMERICA

High altitude lakes in the Andes can present several physico-chemical peculiarities such as increased salinity as a result of low precipitation and/or high evaporation, low temperature and oxygen content, high UV radiation, among other (DE SMET & GIBSON, 2009). These characteristics have attracted scientific interest to the area, as in the case of "The High Lakes Project", which consists of a multidisciplinary astrobiological investigation trying to understand environmental conditions and life in extreme water-bodies on Earth, as an analogy to paleolakes on Mars (CABROL *et al.*, 2009). The study sites investigated by The High Lakes Project include one of the highest lakes on Earth: the lake at the summit of Licancabur volcano, located on the border of Chile and Bolivia (22°50'07"S 67°53'07"W) at 6000 m a.s.l. (CABROL *et al.*, 2009). Here, a report is presented on the ostracods from zooplankton samples obtained at the Licancabur summit lake by The High Lakes Project team.

Two ostracod species were found to be living in the lake: the cypridid *Amphicypris* sp. 1 and the limnocytherid Gen. 1 sp. 1 gen. et sp. nov.

The only adult female available of *Amphicypris* sp. 1 has 3,2 mm in length and 1,5 mm in height. In terms of body size and valve outline, *Amphicypris* sp. 1 resembles *A. argentinensis*, described by FONTANA & BALLENT (2005) and thus far known only from its type locality. Small differences were observed between *Amphicypris* sp. 1 and *A. argentinensis*, however, since a single adult female (and 5 juveniles) of *Amphicypris* sp. 1 was recovered, identification remains inconclusive until more specimens are available.

DELACHAUX (1928) described a series of ostracod species from high altitude areas in Peru, most of which belonged to the subfamily Limnocytherinae. The second ostracod species here reported from Licancabur, based on 1 adult male and 5 adult females, also belongs to this subfamily, but is new to science both at the generic and specific level. This new genus is most likely related to the genera *Paracythereis* and *Neolimnocythere*, described by DELACHAUX (1928), which are characterised by a large caudal ramus on the hemipenis, possibly forming a lineage within the Limnocytherinae that colonised and diversified in the high altitude areas of South America. Gen.1 sp.1 gen. et sp. nov. is a medium sized ostracod, with adult females being 0,81 mm in length and 0,37 mm in height while adult males have a length of 1,01 mm and height of 0,48 mm. The anatomy of appendages and morphology of valves of this species are congruent to the general Limnocytherinae type. Several morphological aspects allow the allocation of this species into a separate genus, in particular the structure of reproductive organs of both males and females, including unique appendage like projections in the female anatomy. Further studies with species of this lineage could allow a comparison with the additional appendages described for *Liocypris grandis* by MARTENS (2003).

The two ostracod species reported here were collected among a moderately diverse planktonic community, composed of copepods, cladocerans, amphipods, chironomids, trichopterans, nematodes and rotifers (CABROL *et al.*, 2009). It is important to notice that neither of the two ostracod species is truly planktonic, so their occurrence in zooplankton samples is incidental.

In terms of ecology, it is possible that *Amphicypris* sp.1 represents one of the top predators of this lake food web. The stomach content of the one adult specimen studied included articulated appendages, probably from copepods and/or cladocerans. Besides this, the species has a relatively large size in comparison to the other organisms found in the lake. An alternative explanation is that this species is a scavenger of dead animals on the lake bottom.

The last eruption that formed the cone of the Licancabur volcano occurred about 11 ka and the summit lake most likely formed due to the small amount of rain and snow that collects in the cone (FLEMING & PRUFERT-BEBOUT, 2010). Therefore, colonisation and establishments of communities must have occurred from the beginning of the Holocene onwards. Studies of other altitude freshwater environments in the Andes could help elucidate the history of these ostracod lineages and allow biogeographic studies of the region.

REFERENCES

CABROL N.A., GRIN E.A., CHONG G., MINKLEY E., HOCK A.N., YU Y., BEBOUT L., FLEMING E., HÄDER D.P., DEMERGASSO C., GIBSON J., ESCUDERO L., DORADOR C., LIM D., WOOSLEY C., MORRIS R.L., TAMBLEY C., GAETE V., GALVEZ M.E., SMITH E., USKIN-

Peate I., Salazar C., Dawidowicz G. & Majerowicz J., 2009. The High-Lakes Project, *J. Geophys. Res.*, 114, G00D06, doi:10.1029/2008JG000818.

Delachaux T., 1928. Faune invertébrée d'eau douce des hauts plateaux du Pérou (Région de Huancavelica, département de Junin), récoltée en 1915 par feu E. Godet, ing. (Calanides, Ostracodes, Rotateurs noveaux). *Bull. Soc. Neuchatel. Sci. Nat.*, 1: 45-77.

De Smet W.H. & Gibson J.A.E., 2009. On a New Species of Euglyphid Testate Amoeba, *Scutiglypha cabrolae*, from the Licancabur Caldera Lake, Central Andes. *Acta Protozool.,* 48: 119-126.

Fleming E.D. & Prufert-Bebout, L. 2010. Characterization of cyanobacterial communities from high-elevation lakes in the Bolivian Andes. *J. Geophys. Res.*, 115, G00D07, doi:10.1029/2008JG000817.

Fontana S.L. & Ballent S., 2005. A new giant cypridid ostracod (Crustacea) from southern Buenos Aires Province, Argentina. *Hydrobiologia*, 533: 187-197.

Martens K., 2003. On a remarkable South African giant ostracod (Crustacea, Ostracoda, Cyprididae) from temporary pools, with additional appendages. *Hydrobiologia*, 500: 115-130.

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ENELISE KATIA PIOVESAN, GERSON FAUTH
& CRISTIANINI TRESCASTRO BERGUE

OSTRACODS AND SEQUENCE STRATIGRAPHY IN THE TURONIAN-SANTONIAN OF THE POTIGUAR BASIN, NORTHEAST BRAZIL

The ostracods are very reliable indicators of depositional processes due to their sensitivity to environmental parameters, contributing to the recognition of sequences and their limits. Sequences deposition record fluctuations of various parameters such as relative sea level and sedimentation rate, which are critical factors in the distribution and preservation of organisms. The Potiguar Basin is located in the extreme east of the Brazilian Continental Margin, covering an area of approximately 48,000 km^2 (PESSOA NETO *et al.*, 2007). The Jandaíra Formation, aged Turonian–Campanian, results from the first large marine ingression from the north. This lithostratigraphic unit consists predominantly of bioclastic limestones deposited in a tidal flat of a shallow shelf. Besides this environment, the studied well records also a thick section of carbonates deposited in a lagoon and bioclastic bars. The ostracod fauna of this basin was studied previously by VIVIERS (1995), DELICIO *et al.* (2000) and VIVIERS *et al.* (2000). The main objective of this study is the identification of species and their distribution in different depositional sequences. Ninety-two species have been identified, distributed in 38 genera and 13 families. For the same interval CÓRDOBA (2001) proposed five depositional sequences (Fig. 1), being the sequence A (lower–middle Turonian) representative of the highstand system tract (HST). Its upper portion, is marked by intense dolomitization, with rainwater input and influx of siliciclastic sediments. The fauna of this interval is marked by low richness (11 species), low abundance and poor preservation. The non-marine fauna is represented by *Candona* sp.1. The marine assemblages dominate at the base, with a progres-

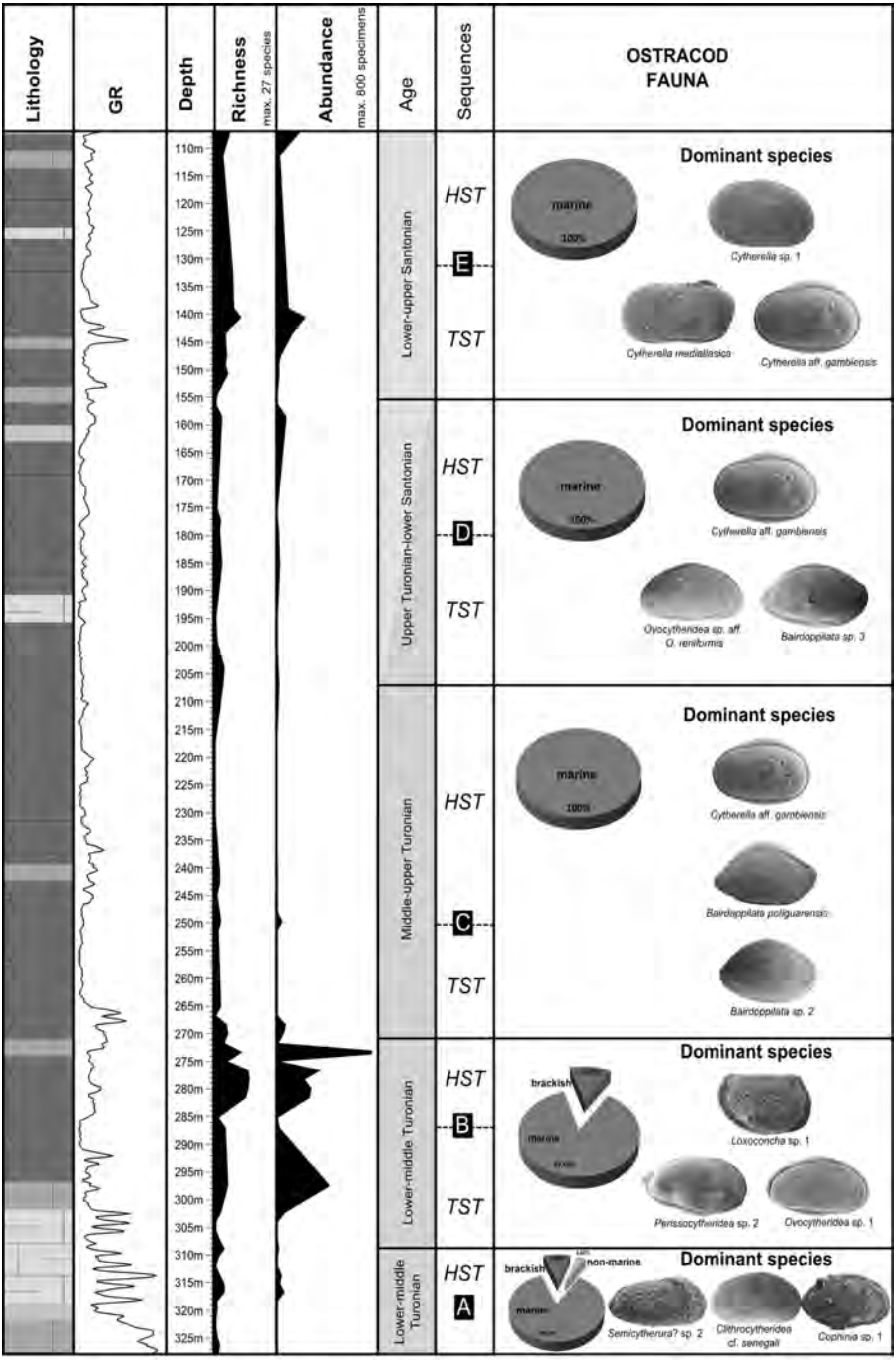

Fig. 1 — Richness and abundance in the sequences of a well from Jandaíra Formation, Potiguar Basin.

sive faunal turnover characterized by the enrichment of brackish species towards the top, represented specially by *Perissocytheridea* sp. 1. In the sequence B (lower–middle Turonian), there is a decrease in the input of siliciclastic sediments and an increase in the richness (60 species) and abundance. In the transgressive system tract (TST) species from the brackish genus *Perissocytheridea* occurs in abundance. Above the maximum flooding surface (MFS), with the establishment of HST, the marine species richness increases, with the dominance of *Loxoconcha* sp. 1. The sequence C (middle–upper Turonian) is marked by abrupt facies changes, being those formely represented in previous sequences, by tidal flat giving way to bar facies. The assemblage is exclusively marine and very poorly preserved, with only nine species recorded. The sequence D (upper Turonian–lower Santonian) has also only marine species, with low richness (nine species) and abundance, including the HST and the TST. In the sequence E (lower–upper Santonian) the fauna has high levels of richness (31 spp.) and abundance being all marine, dominated by the genus *Cytherella.* A clear relationship between the fauna of ostracods and depositional sequences was observed. The sequences C, D and E have an exclusively marine fauna, reinforcing the transgressive trend of the Jandaíra Formation.

REFERENCES

CÓRDOBA V.C., 2001. A evolução da plataforma carbonática Jandaíra durante ao Neocretáceo na Bacia Potiguar: análise paleoambiental, diagenética e estratigráfica. *PhD Thesis,* Instituto de Geociências e Ciências Exatas, Rio Claro, 239 pp.

DELICIO M.P., COIMBRA J.C. & CARREÑO A.L., 2000. Cretaceous marine Ostracoda from the Potiguar basin, Northeastern Brazil. *Neues Jahrbuch für Geologie und Paläontologie Abhandlungen*, 215: 321-345.

PESSOA NETO O.C., SOARES U.M., SILVA J.G.F., ROESNER E.H., FLORENCIO C.P. & SOUZA C.A.V., 2007. Bacia Potiguar. *Boletim de Geociências da* Petrobras, 15: 357-387.

VIVIERS M.C., 1995. Ostracodes marinhos na Bacia Potiguar: aplicação nos estudos bioestratigráficos do Cretáceo. *Anais da Academia Brasileira de Ciências*, 67: 392-393.

VIVIERS M.C., KOUTSOUKOS E.A.M., SILVA-TELLES A.C. & BENGTSON P., 2000. Stratigraphy and biogeographic affinities of the late Aptian-Campanian ostracods of the Potiguar and Sergipe basins in northeastern Brazil. *Cretaceous Research*, 21: 407-455.

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RADOVAN PIPÍK, DUŠAN STAREK, MICHAL SEKO & MARTINA SÝKOROVÁ

OSTRACODS OF THE LATE MIOCENE LONG LIVED LAKE PANNON

The palaeogeographic changes that affected the Central Paratethys between the Middle and Late Miocene led to a drastic reduction of the marine water body, drop of salinity and emergence of the brackish Lake Pannon at about 11.6 Ma. The rise of Lake Pannon was a challenge for the Middle Miocene polymorphic brackish ostracods (*Cyprideis, Hemicytheria, Euxinocythere, Amnicythere, Loxoconcha*), which adapted to empty ecological niches dominated by sandy deltaic and clayey offshore sedimentation with relatively stable brackish salinity. The ostracods of freshwater origin, with affinity to extant holarctic and cosmopolitan fauna (*Candona s.s., Fabaeformiscandona, Cryptocandona, Notodromas, Cyclocypris, Ilyocypris, Heterocypris*, *Paralimnocythere*, Darwinulidae) (Fig. 1), occupied the marshes, oxbows, estuaries, and ephemeral lakes at the lake margin and we suppose they have never entered the lake. *Cypria* seems the only exception among the freshwater genera because it is frequently observed in brackish ostracod associations.

Less than 0.5 Ma after the establishment of Lake Pannon a lacustrine regression resulted in the deposition of thick sandy sedimentary bodies and in the disappearance of littoral populations. Nonetheless, around 11.04 to 9.78 Ma, Lake Pannon reached its maximum extent due to the increased basin subsidence (Zone "E" sensu PAPP, 1951; Chron C5n; MAGYAR *et al.*, 2007). The onset of a new transgressive cycle created the space for neoendemic littoral taxa, which showed a limited morphometric similarity to their ancestors and contemporaneous sublittoral relatives. Benthic, bathymetrically clearly differentiated taxa lived and flourished in muddy, fully oxic and still brackish environments. Locally, riverine discharge and anoxic events affected the bottom meiofauna (Cziczer *et al.*, 2009; Starek *et al.*, 2010). Candoninae, represented by several morphologically particular genera (trapezoidal, elongated rectangular, and triangular) (Fig. 1), and Leptocytheridae dominated the littoral and sublittoral faunae. Cyprididae (*Amplocypris*), settled and successfully adapted in brackish limnic environment, on the contrary to what happens in the extant long lived lakes. Brackish Hemicytheridae, Loxoconchidae and Cyprididae (*Amplocypris, Herpetocyprella*) were minor families, but locally dominated the associations.

After 9.78 Ma, a sudden retreat of the Lake Pannon led to the development of extensive alluvial lowlands as well as ephemeral lakes and swamps. The endemic brackish fauna became extinct (almost all *Cyprideis, Amplocypris,* and *Hemicytheria*) or shifted to the southern part of the Lake Pannon and to the Eastern Paratethys (*Amnicythere multituberculata* (Livental, 1929), *A. cornutocostata* (Schweyer, 1949), *Bakunella dorsoarcuata* (Zalanyi, 1929), *Camptocypria praebalcanica* (Zalanyi, 1929), *C. lobata* Zalanyi, 1929, *Euxinocythere naca* (Mehes, 1908). Occasionally, some of them migrated into the Mediterranean during the lagomare event (*Euxinocythere prebaquana* (Livental, 1929), *Loxoconcha* aff. *L. schweyeri* Suzin, 1956, *Zalanyiella venusta* (Zalanyi, 1929), and *Loxocorniculina djafarovi* (Schneider, 1956) (Pipík, 2007; Cziczer *et al.,* 2009) (Fig. 1). The progressive freshening of the lake resulted in the evolution of the new freshwater species at the time of the deposition of the Pliocene Paludinian Beds.

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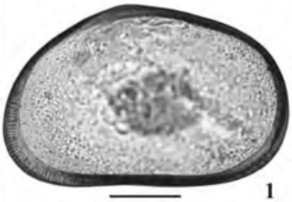
Fig. 1 — **1-4**. Freshwater ostracods from the marginal lake facies of the Lake Pannon with affinity to extant holarctic and cosmopolitan fauna. Scale bar 0.25 mm; LV – left valve; RV – right valve. **1**. *Heterocypris* sp., LV, late Middle Miocene, Sankt Margarethen; **2**. *Notodromas* sp., LV, late Middle Miocene, Sankt Margarethen; **3**. *Paralimnocythere* sp., RV, Late Miocene, Studienka; **4**. *Cryptocandona* sp., LV, Late Miocene, drilling PID-1 Orešany. **5-14**. Brackish Lake Pannon littoral and sublittoral ostracods. **5**. *Amplocypris recta* (Reuss, 1850), LV, Late Miocene, Studienka; **6**. *Cyprideis pannonica* (Méhes, 1908), LV, late Middle Miocene, Skalica; **7**. *Caspiocypris fahrioni* (Turnovsky 1954), LV, Late Miocene; Gbely; **8**. *Serbiella* aff. *truncata* (Sokać, 1972), LV, Late Miocene; Tata; **9**. *Camptocypria praebalcanica* (Krsti , 1972), RV, Late Miocene; **10**. *Lineocypris reticulata* (Méhes, 1907), LV, Late Miocene, Tata; **11**. *Euxinocythere lacunosa* (Reuss, 1850), RV, Late Miocene, Gbely; **12**. *Loxocorniculina djaffarovi* (Schneider, 1956), RV, Late Miocene, Tata; **13**. *Amnicythere cornutocostata* (Schweyer, 1949), LV, Late Miocene, Tata; **14**. *Tyrhenocythere pezinokensis* (Jiříček, 1985), LV, Late Miocene, Pezinok.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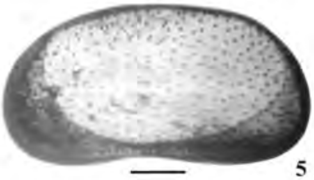
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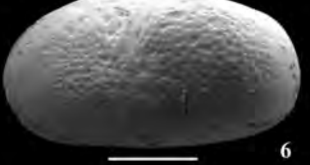
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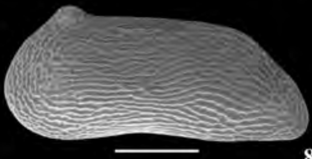
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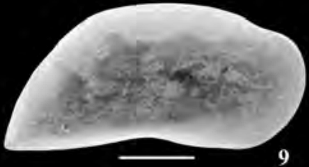
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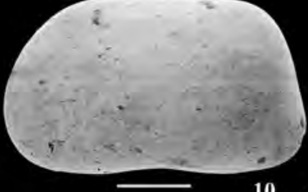
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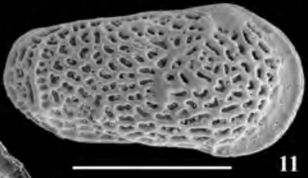
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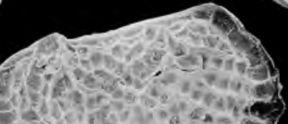
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REFERENCES

Cziczer I., Magyar I., Pipík R., Böhme M., Ćorić S., Bakra K., Süt -Szentai M., Lantos M., Babinszki E. & Müller P., 2009. Life in the sublittoral zone of Lake Pannon: paleontological analysis of the Upper Miocene Szák Formation, Hungary. *International Journal of Earth Sciences*, 98: 1741-1766.

Magyar I., Lantos M., Ujszaszi K. & Kordos L., 2007. Magnetostratigraphic, seismic and biostratigraphic correlations of the Upper Miocene sediments in the northwestern Pannonian Basin System. *Geologica Carpathica*, 58: 277-290.

Papp A., 1951. Das Pannon des Wiener Beckens. Mitteilungen der Geologischen Gesellschaft in Wien 1946: 39-41 and 1948: 99-193.

Pipík R., 2007. Phylogeny, palaeoecology, and invasion of non-marine waters by the late Miocene hemicytherid ostracod *Tyrrhenocythere* from Lake Pannon. *Acta Palaeontologica Polonica*, 52: 351-368.

Starek D., Pipík R. & Hagarová I., 2010. Meiofauna, trace metals, TOC, sedimentology and oxygen availability in the Upper Miocene sublittoral deposits of the Lake Pannon. *Facies*, 56: 369-384.

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RADOVAN PIPÍK, MARTINA SÝKOROVÁ, DUŠAN STAREK & MICHAL SEKO

OSTRACODS OF TRAVERTINE SPRINGS AND LAKES IN SLOVAKIA - PRELIMINARY RESULTS

Ostracods are very frequent fossils in the travertine, but we know little about their biodiversity, space distribution and ecological preferences in the extant travertine springs and lakes. To improve their application in Quaternary paleoecologic and paleoclimatic studies, we studied travertine springs and lakes (*sensu* PENTECOST, 2005) of different physical characteristics (cold <25°C and hot water >25°C) and chemical composition (carbonate, sulfate, Fe) in Slovakia.

The samplings were performed in summer 2012 at 14 localities measuring a temperature of the water, pH, ORP, DO (%), DO (ppm), EC, resistivity, TDS and salinity by multimeter HANNA HI 9828. Sampled material was partially washed at the sampling place and preserved in 90% alcohol. The habitats sampled at the travertine dome comprised 1) the area, where the travertine groundwater reaches the surface (seep, including lake), 2) the sites of chemical sedimentation (canals, cascades, terraces, and dams) where $CaCO_3$ precipitates and incrusts moos, leaves, and other plant and animal remnants, and 3) biotopes in front of travertine dome (marshes, bogs).

Twenty-four ostracod species were observed in the travertine springs, lakes and their surroundings. Three species represented by juveniles were left in the open nomenclature. Our preliminary results do not allow to make definite conclusions about the physical and chemical parameters that affect the presence and the distribution of ostracods in particular travertine habitats. However, our findings provide interesting information on ostracod biodiversity in these environments.

Thirteen species were collected in the seeps. *Candona candida, Pseudocandona* sp. juv.*, C. neglecta, Fabaeformiscandona brevicornis, Fabaeformiscan-*

dona sp. 1, *Cryptocandona* sp. juv*., Cypria ophtalmica, Cyclocypris ovum, Cavernocypris subterranea, Potamocypris fallax, P. zschokkei, Psychrodromus fontinalis* inhabited cold carbonate water while seeps with SO_4^{2-} emanation and salinity between 1.0 and 3.4 ‰ were colonized only by *Heterocypris incongruens*. No species have been observed in thermal waters with a temperature 48°C.

The sites of chemical sedimentation hosted 10 species. Empty valves of seeps species have been frequently found here. In dams, cascades and terraces of sulphatic waters only *H. incongruens* was found, whilst in cold carbonate water were present *Pseudocandona albicans, Fabaeformiscandona brevicornis, Cyclocypris ovum, Microdarwinula zimmeri, Cypridopsis vidua, Scottia pseudobrowniana, Psychrodromus olivaceus, Potamocypris fallax, P. zschokkei.*

The highest species diversity was observed in front of the travertine dome (21 taxa, namely *Candona candida, Candona neglecta, C.* sp. juv., *Pseudocandona marchica, Ps. albicans, Fabaeformiscandona fabaeformis, F.* sp.1*, Cryptocandona vavrai, Cyclocypris ovum, Ilyocypris bradyi, Vestalenula danielopoli, Microdarwinula zimmeri, Notodromas monacha, Heterocypris salina, Eucypris pigra, Potamocypris villosa, P. zschokkei, P. fallax, Limnocytherinae* sp. indet*, Psychrodromus olivaceus, Scottia pseudobrowniana*). Most of these species (11) were found in a bog with carbonate sedimentation and water vegetation. Marshes with intensive SO_4^{2-} emanation was settled by *Heterocypris incongruens* and *H. salina.*

In the springs with Fe-ochre at the bottom and in their cascades no ostracods were found, although in the bogs in front of these springs were present *Fabaeformiscandona fabaeformis, Fabaeformiscandona* sp.1*, Pseudocandona albicans, Limnocytherinae* sp. indet. The Fe concentration in the water therefore seems to potentially influence the ostracod occurrence. The lakes used for recreational purposes (e.g. as swimming pools) did not yield ostracod fauna, differently from similar lakes in near pristine conditions, thus suggesting a potential negative impact of human activities.

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REFERENCES

Pentecost A., 2005. Travertine. Springer, Berlin-Heidelberg, 429 pp.

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HYDROLOGICAL CHANGES IN A SMALL LAKE AT THE PAMPEAN REGION OF THE SOUTH AMERICAN CENTRAL PLAINS (ARGENTINA) DURING THE LAST CENTURIES

Paleolimnology studies are extremely useful in the argentine Pampas because they represent the main source of hydrometeorological reconstructions in this mid-latitude South American temperate plain. The upper 30 cm of a short sediment core (81,5 cm) obtained from Laguna La Barrancosa (37°19'S / 60°06'W) were studied for estimating hydro-ecological variations based on fossil ostracod assemblages. These results were considered jointly with variations in fossil pigments content (total carotenoids -TC- and chlorophyll derivatives-CD) and grain-size sediment distribution. A preliminary age model was established based on stratigraphic correlation with dated cores from nearby Pampean small lakes (*lagunas*).

The core, which spans approximately 300 years, shows centimeter scale lamination and frequent textural variations. Consideration of statistically significant ostracod zones determined by numerical zonation of the assemblages allows recognition of five stages in the hydrological evolution of the studied *laguna*. Zone A (30-26cm) is characterized by low abundance of ostracods - *Potamocypris villosa* and *Limnocythere ?solum*, high index CD/TC, low water content and predominance of sand and silt. These features are consistent with sedimentation in a small seasonal stream with abundant allochthonous organic matter. Zone B (25-23cm) is characterized by a rise in ostracod abundance and the appearance of *Heterocypris incongruens*, as well as an increase in water content, TOC (Total Organic Carbon), TC and CD. In this phase, the system would have evolved to a grassy stream which periodically drained shallow seasonal pools, which would indicate a positive precipitation/evaporation balance. In Zone C (22-18cm), *Cypridopsis vidua* appears and *H. incongruens* is replaced by *Eucypris* sp., while both CD and the CD/TC ratio increase notably. These variations allow inferring the establishment of a shallow temporary pool stream in the early 1800's. In Zone D (18-15cm) *P. villosa* disappears, pointing to the establishment of a shallow temporary pond. The increase in the CD/TC ratio indicates a productive water body and authochtonous origin of organic matter. Zone E (15cm-top) is characterized by the total replacement of *L. solum* by *Limnocythere* sp. nov. RAMÓN MERCAU *et al.* (this volume) and *Eucypris* sp., pointing to the establishment of an oligohaline permanent shallow pond around 1870 AD. The marked increment both in the absolute amount of pigments and the CD/TC ratio in the top core would reflect enhanced anthropic activity in the area.

To sum up, the sedimentary record of La Barrancosa traces the gradual establishment of a permanent pond at the coring site, indicating an amelioration of the hydrological balance in the Pampean region since the end of the Little Ice Age, around the mid-1800s. Besides this long term trend, certain decadal-scale events can be tracked in the record as well. In particular, at 7-8 cm depth the occurrence of macrophytes remains, a peak in CD and in the index CD/TC, and an impoverishment in ostracod absolute abundance seem to indicate retraction of the water body, which according to the preliminary age model could be coincident with the 1930's-1940's megadrought.

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REFERENCES

RAMÓN MERCAU J., PLASTANI M.S. & LAPRIDA C., this volume. A new Limnocythere species in the Pampean region (Buenos Aires, Argentina).

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THE CONTRIBUTION OF OSTRACOD ANALYSIS TO GEOARCHAEOLOGY: THE EXEMPLE OF THE ANCIENT RIVER MOUTH HARBOUR OF OSTIA (ITALY)

In the northwest of the ancient city of Ostia, the analysis of a core revealed a stratigraphic sequence, which we interpret as the filling of a harbour basin. Indeed, many attempts have been carried out to locate the river mouth harbour of Ostia. Geomagnetic surveys conducted in the 2000s (Heinzelmann & Martin, 2002) have corroborated the hypothesis of the basin localisation in the north of the city, west of the so-called Palazzo Imperiale, which was advanced by Italian archaeologists in the 19th century. In order to definitely validate or refute this hypothesis, a 12m core (PO2) was mechanically drilled to the north of this area, near the present day Tiber River.

The study of PO2 allowed identifying a discontinuity in the core stratigraphy, also confirmed by the chronology. Such a discontinuity can be interpreted as the digging of a harbour basin. The basin, dated between the 4th and 2nd century BC, was contemporary with Ostia and presented a 6m-depth, which allowed heavy tonnage ship to access it (Goiran *et al.*, 2012).

In this study, ostracods were used to help identifying marine and river influence phases. Indeed, they are valuable palaeoenvironmental indicators in marginal marine environments. The ostracod assemblages were separated in five ecological groups: marine, phytal marine, coastal phytal, brackish lagoonal and freshwater (Mazzini *et al.*, 2011).

Based on the stratigraphy and dating, the core PO2 can be divided into three major units: a pre-harbour environment unit, a sequence showing a typical harbour environment, and finally a post-harbour state. The pre-harbour environment unit (9th - 8th century BC), prior to the foundation of

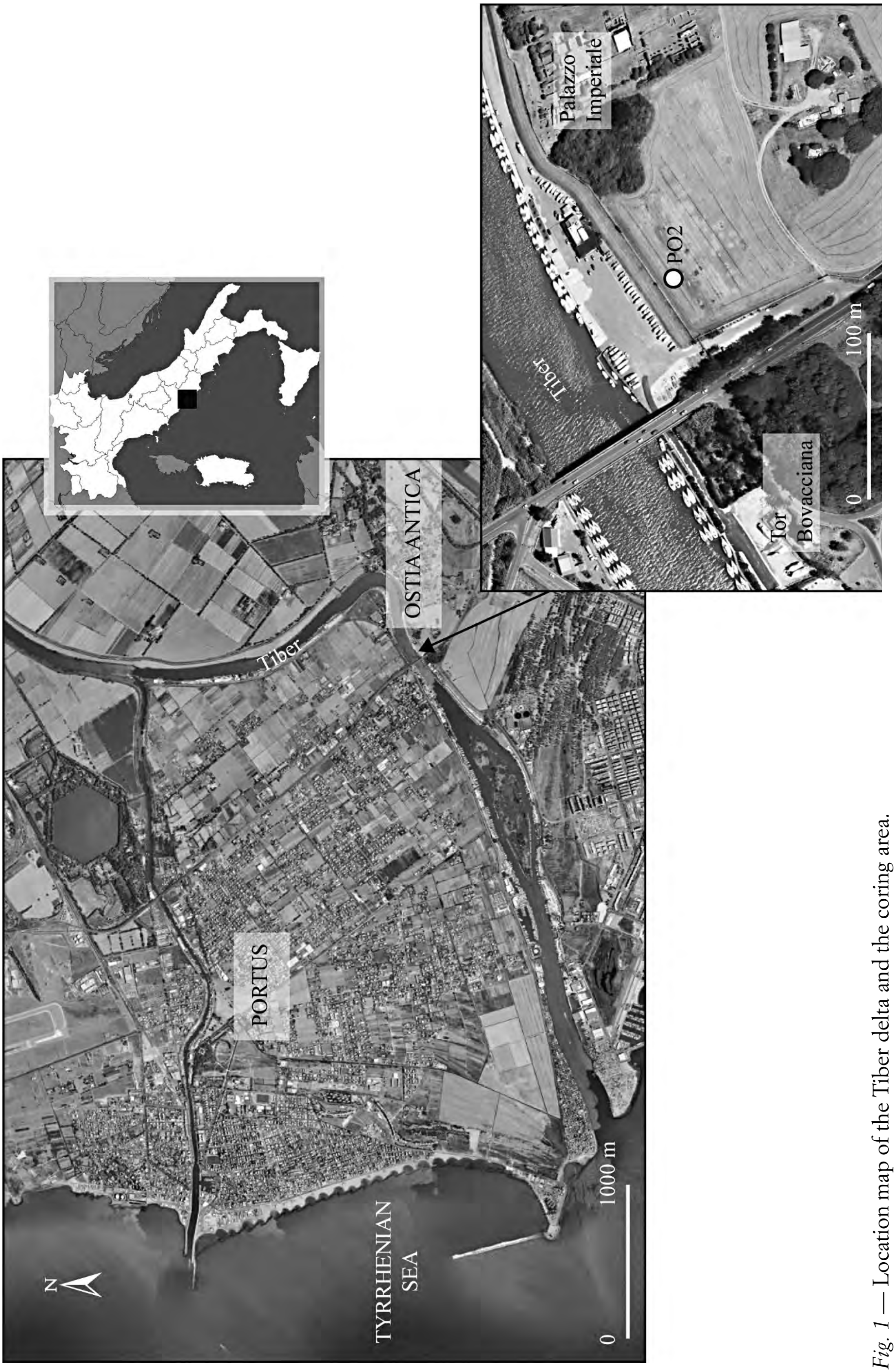

Fig. 1 — Location map of the Tiber delta and the coring area.

Ostia, is characterized by an alternation of marine and fluvial influences, which suggests a coastal mobility of an estuarine river mouth. The laminated grey sands present at the base of this subunit (9.52 to 9.57m) are extremely rich in ostracod fauna (672 valves per gram of dry sediment). It shows coastal brackish sediments well sorted, which were subjected to freshwater inflows, evidenced by the occurrence of the ostracod *Ilyocypris bradyi*. The ostracod assemblage is dominated by brackish lagoonal (*Palmoconcha turbida*) and phytal marine and coastal taxa (*Semicytherura* spp. and *Pontocythere turbida*). The remaining part of this basal subunit is an alternate deposit either barren of ostracods or characterized by brackish lagoonal to coastal assemblages.

After the 9th and 8th centuries BC, the fluvial influence becomes weaker, the ostracod fauna is often absent or limited to a few numbers of valves typical of a brackish lagoon environment type, and occasional marine incursions are recorded (occurrence of *Aurila convexa*, *Costa batei*, *Leptocythere ramosa*, *Neocytherideis subulata*, *Palmoconcha turbida*, *Pontocythere turbida*).

Then a discontinuity is observed in the stratigraphy: sediments change from a grey coarse sandy texture (estuarine context) to a dark grey fine texture, which is deposited in a quiet environment with fluvial influence. This sequence, typical harbour environment, can be divided into two subunits. The first (from 6.75 to 3.31m) consists of dark grey clays, related to an environment which remained largely under the influence of river water. From 6.75 to 4.24m, ostracods are represented by some valves of *I. gibba* and *Candona* sp juv. and thus reflect the presence of freshwater, subjected to low currents. Occasional traces of salty water contributions are observed, probably related to marine incursions during storms. From 4.03 to 3.31m, they are characterized by oligohaline freshwater assemblage influenced by marine inputs as represented by *Xestoleberis communis*, a marine phytal ostracod, whose occurrence in such an environment may be linked to storms. The occurrence of scattered valves of open marine species such as *Henryhowella asperrima* that could have been displaced during sea storms could confirm this theory. The second subunit (from 3.3 to 1.17m) is composed of alternating facies of sands and sands rich in organic and plant material. This subunit reveals clearly high fluvial influence and yielded no ostracod fauna. The chronostratigraphical gap suggests dredging operations in the basin that caused the loss of sedimentary archives. Gradually, silty clay sediments from the Tiber River and its watershed filled in the basin and signed the abandonment of the harbour in favour of the Portus harbour, no later than the beginning of the 1st century BC.

The study of the ostracod fauna, combined with geo-archaeological observations, helped to reconstruct the different palaeoenvironmental phases of the stratigraphic sequence in the depression, which we can now interpret as a river mouth harbour basin. All these changes in the ecosystem seem more to be attributed to human activity than to nature.

REFERENCES

GOIRAN J.-PH., SALOMON F., PLEUGER E., VITTORI C., MAZZINI I., BOETTO G., ARNAUD P. & PELLEGRINO A., 2012. Port antique d'Ostie, Chronique des activités archéologiques de l'École française de Rome [En ligne], Italie centrale, mis en ligne le 19 décembre 2012. URL: http://cefr.revues.org/299

HEINZELMANN M. & MARTIN A., 2002. River port, navalia, and harbour temple at Ostia : new results of a DAI-AAR Project. *Journal of roman archaeology* 15, 5-19.

MAZZINI I., FARANDA C., GIARDINI M., GIRAUDI C. & SADORI L., 2011. Late Holocene Palaeoenvironmental Evolution Of The Ancient Harbour Of Portus (Latium, Central Italy). *Journal of Palaeolimnology* , 46: 243-256.

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ITALIAN BRACKISH AND MARINE OSTRACOD FAUNA

In the literature, there are many studies concerning ostracods in the Italian seas. Among the most relevant are the evergreen monograph of Müller (1894) about the ostracods from the Gulf of Naples, the publications of Bonaduce *et al.*, 1976 and Breman,1976 about the Adriatic Sea, Puri *et al.*, 1964, again about the Gulf of Naples and Bonaduce *et al.*, 1977 about the southern Tyrrhenian Sea. In addition, different authors centered their research in smaller areas of the Italian coasts (Montenegro *et al.*, 1998; Sciuto & Rosso, 2002; Arbulla *et al.*, 2004; Sciuto, in progress;) proposed a synthesis of the most abundant and more easily identifiable ostracods from the Italian shelves, linking their occurrence to some environmental factors such as bathymetry and substrate. Ten different ostracod assemblages were observed in relation to the type of substrate, and nine bathymetric assemblages were detected. Evident changes of the autochthonous ostracod fauna were recorded at 50-60 m, 90-100 m and 125-150 m, corresponding to the infralittoral-circalittoral, inner-middle circalittoral and middle-outer circalittoral boundaries respectively.

More recently, Aiello & Barra (2010) have published a checklist of the Italian marine ostracods, reporting 377 ostracod species from the screening of 84 papers.

In this contribution, we present an updated database of the ostracod species pertaining to the infralittoral and circalittoral zones, together with those occurring in lagoon, intertidal, submarine cave and deep water settings. Furthermore, we intend to highlight the links between the ostracod assemblages recorded all along the coasts of the Italian peninsula, Sicily and Sardinia, and some environmental parameters. The main issue is the heterogeneous geographic distribution of the data; we have used the most updated literature, including unpublished data collections as well as reports about ostracod occurrence in natural parks, reserves or SCI (Sites of Community Importance).

Such research intends to realize a synthesis of these data, which could be used as an integrative support, focused on the Mediterranean Sea, to the already existing available databases of the European Marine Biodiversity Research Site and the Global Biodiversity Information Facility.

The aim of this work is to propose a straightforward database containing taxonomic, including possible synonymies, ecological and geographical information. We also think that this database might be a starting point for the achievement of a more complete database covering the whole Mediterranean area.

REFERENCES

AIELLO G. & BARRA D., 2010. Crustacea Ostracoda. *Biol. Mar. Mediterr.*, 17 (suppl. 1): 401-419.

ARBULLA D., PUGLIESE N. & RUSSO A., 2004. Ostracods from the National Park of La Maddalena Archipelago (Sardinia, Italy). *Boll. Soc. Paleont. Ital.*, 43 (1-2): 91- 99.

BONADUCE G., CIAMPO G. & MASOLI M., 1976. Distribution of Ostracoda in the Adriatic Sea. *Pubbl. Staz. Zool. Napoli*, 40, suppl. 1: 1-304.

BONADUCE G., MASOLI M. & PUGLIESE N., 1977. Ostracodi bentonici dell'alto Tirreno. *Studi Trentini Sc. Nat., Biol.*, 54: 243-261.

BREMAN E., 1976. The distribution of ostracodes in the bottom sediments of the Adriatic Sea. *Acad. Proefschr. Vrije Univ. Amsterdam*: 1-165.

MONTENEGRO M.E., PUGLIESE N. & BONADUCE G., 1998. Shelf ostracods distribution in the Italian seas. - In: What about Ostracoda Actes 3° Congr. Europ. Ostracod. *Bull. Centre Rech. Elf Explor. Prod., Mém.*, 20: 91-101.

MÜLLER G.W., 1894. Die Ostracoden des Golfes von Neapel und der angrenzenden Meeres-Abschnitte: Fauna und Flora. *Herausg. Zool. Sta. Neapel*, 21 (1-8): 1-404.

PURI H.S., BONADUCE G. & MALLOY J., 1964. Ecology of the Gulf of Naples. *Pubbl. Staz. Zool. Napoli*, 33, Suppl.: 87-199.

SCIUTO F. & ROSSO A., 2002. Contributo alla conoscenza di tanatocenosi ad ostracodi di fondi circalitorali al largo di Aci Trezza (Sicilia orientale). *Boll. Acc. Gioenia di Sc. Naturali*, 35 (361): 293-390.

SCIUTO F., in progress. Recent ostracods from Messina Straits (southern Ionian Sea, north-east Sicily).

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HAIYING QU, XIAOQIAO WAN & DANGPENG XI

NON-MARINE OSTRACOD, UPPER CRETACEOUS-EARLY TERTIARY BIOSTRATIGRAPHY OF THE SK1 (N) BOREHOLE, SONGLIAO BASIN, NORTHEAST CHINA

High-resolution biostratigraphy has been established by fossil ostracods from the Cretaceous Continental Scientific Drilling borehole-Songke 1 (north) (SK1 (n)) in the Songliao Basin, northeast China. More than 40 species belonging to 20 genera were identified and 8 ostracod assemblage zones have been recognized. The assemblage zones in ascending order are: *Cypridea gunsulinensis* - *Cypridea gunsulinensis* var. *carinata* assemblage spanning the upper part of the Member 1 of the Nenjiang Formation to the lower part of the Member 2 of the Nenjiang Formation; the *Mongolocypris magna* assemblage embraces the lower-middle part of the Member 2 of the Nenjiang Formation; the *Cypridea liaukhenensis* - *Ilyocyprimorpha* - *Limnocypridea sunliaonensis* assemblage occurs in the lower-middle part of the Member 2 of the Nenjiang Formation; the *Periacanthella* - *Cypridea spongvosa* assemblage is from the upper part of the Member 2 of the Nenjiang Formation to the lower part of the Member 3 of the Nenjiang Formation; the *Strumosia inandita* assemblage spans the Member 3 and lower part of the Member 4 of the Nenjiang Formation; the *Talicypridea amoena* - *Eucypris cuneata* assemblage ranges from the Sifangtai Formation to the lower part of the Mingshui Formation; the *Metacypris kaitunensis* – *Ziziphocypris simakovi* assemblage locates in the lower part of the Member 1 of the Mingshui Formation to the uppermost Mingshui Formation; *Ilyocypris* assemblage locates in the upper part of the Mingshui Formation. During the deposition of the Member 4 and Member 5 of the Nenjiang Formation, ostracod are poorly preserved. It is mostly due to the change of the sedimentary environment. The zonal fossil

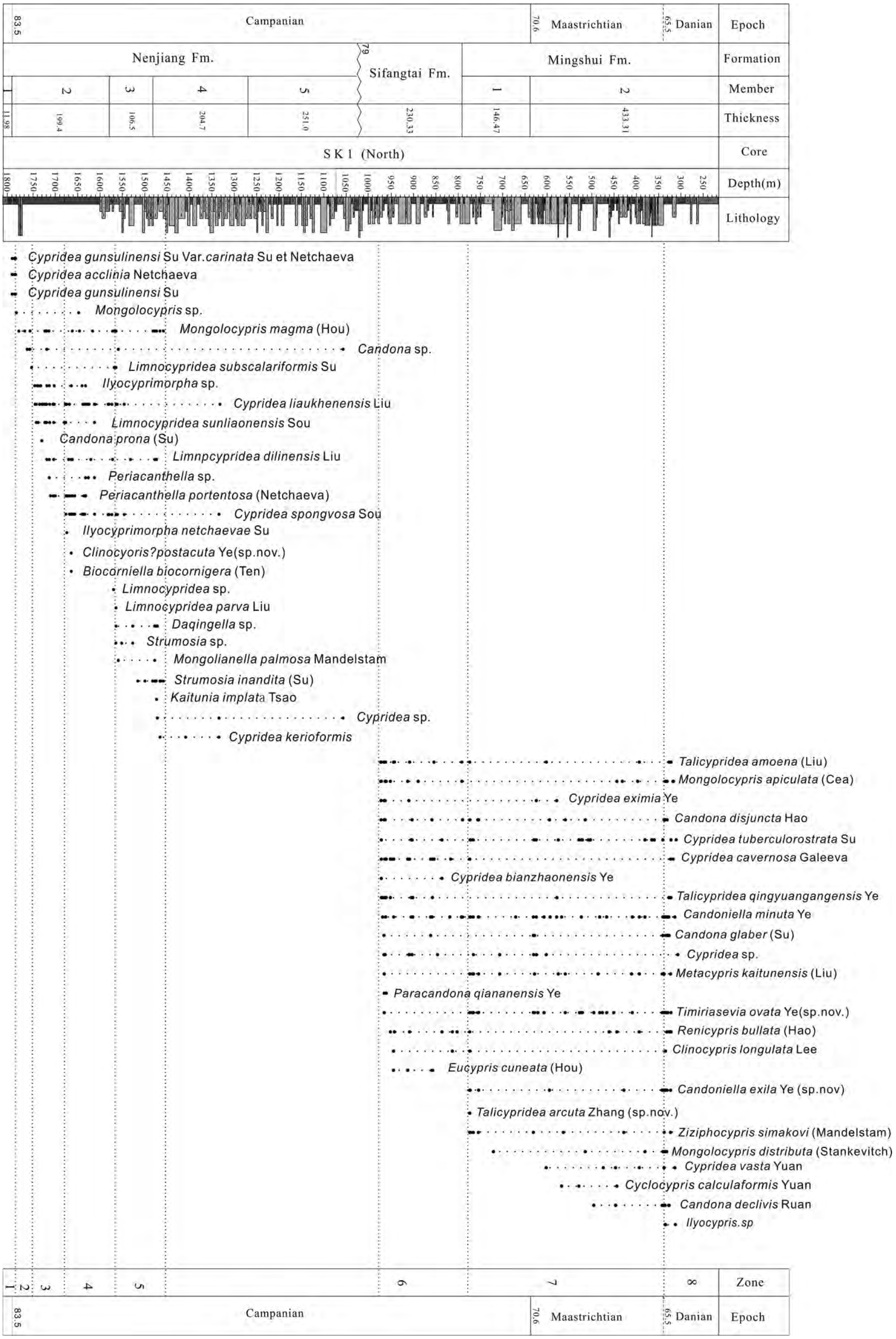

Fig. 1 — Ostracod assemblages zones of the SK1 (N)

Ilyocypris of Zone 8 reported previously from the Paleocene (Ye *et al.*, 2002) was found for the first time in the upper Mingshui Fomation in the Songliao Basin. Furthermore, some typical Paleocene charophyte like *Neochara* and *Grovesicahra* coexist with *Ilyocypris.* It is suggested that the age of the *Ilyocypris* assemblage zone is Paleocene. By integrated data of charophytes (Li *et al.*, 2013), spores and pollen (Li *et al.*, 2010) and magnetostratigraphy (Deng *et al.*, 2012), the present work attributes the boundary between the *Metacypris kaitunensis – Ziziphocypris simakovi* assemblage and *Ilyocypris* assemblage to the Cretacous-Paleogene boundary. This is a potential type section for the terrestrial K/Pg boundary in China.

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REFERENCES

Deng C.L., He H.Y., Pan Y.X. & Zhu R.X., 2012. Chronology of the terrestrial Upper Cretaceous in the Songliao Basin, northeast Asia. *Palaeogeography, Palaeoclimatology, Palaeoecology*. Doi: org/1 0.1016/j.palaeo.2012.07.028.

Li J.G., Batten D.J. & Zhang Y.Y., 2010. Palynological record from a composite core through Late Cretaceous-early Paleocene deposits in the Songliao Basin, Northeast China and its biostratigraphic implications. *Cretaceous Research*, 32 (1): 1-12.

Li S., Gao Q.Q., Zhang Y.Y. *et al.*, 2013. Late Cretaceous-early Paleogene charophytes from Songliao Basin, North China: SK1(N) Core. *Acta Micropalaeontological Sinica* (in press).

Ye D.Q., Huang Q.H., Zhang Y. & Chen C.R., 2002. Cretaceous ostracoda biostratigraphy in Songliao basin. *The Petroleum Industry Press*, Beijing: 11-144 (in Chinese).

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NOT AS RARE AS WE THOUGHT: THE SALTMARSH OSTRACOD *LOXOCONCHA MALCOMSONI* HORNE & ROBINSON, 1985

The ostracod *Loxoconcha malcomsoni* Horne & Robinson, 1985 was formerly thought to be an extinct Pleistocene species. It was originally described as *Loxoconcha cuneiformis* Malcomson, 1886 (the species name being preoccupied by *L. cuneiformis* Terquem, 1885) on the basis of a single Recent specimen from the coast of Ireland which was subsequently considered to be probably reworked from a Quaternary deposit. However, living populations were found in the mid-1990s on English saltmarshes on the Isle of Wight and in Norfolk (HORNE & BOOMER, 2000). A newly-discovered saltmarsh population of this species near Tollesbury in Essex (SE England) suggests that it is may not be as rare as was previously thought.

Loxoconcha malcomsoni appears to be restricted to marine or near-marine saltmarsh habitats and, as such, may be a valuable palaeoenvironmental and sea-level indicator in Pleistocene and Holocene assemblages. British saltmarsh ostracod species belong exclusively to the Superfamily Cytheroidea; out of more than 100 British coastal marine and brackish water species, only about 10 are commonly associated with saltmarshes (ATHERSUCH *et al.*, 1989; HORNE & BOOMER, 2000). They can survive in this intertidal environment by closing up their shells tightly to withstand the short periods of emergence and potential desiccation while the tide is out.

Seasonal sampling in 2012 and 2013 has yielded new information about the ecology and life cycle of *L. malcomsoni* on the Tollesbury saltmarsh. The saltmarsh can be divided into high, mid and low zones with characteristic plant species. On the high marsh (*Elytrigia atherica*), agglutinated foraminifera are abundant, but no ostracods live there. Only in the mid (*Atriplex portulacoides*) and low marsh (*Salicornia europaea* and creek rims) are ostracods found living, including *L. malcomsoni*. Associated species include *Leptocythere baltica* Klie, 1929 and *Leptocythere porcellanea* (Brady, 1869), as well as a population of *Terrestricythere* sp. found crawling on leaves and roots of *Aster tripolium*. The adult population of *Loxoconcha malcomsoni* peaks between February and April and it appears to have a life cycle of one generation per year. Further studies will seek to ascertain how widely distributed this species is on British saltmarshes and whether or not it is truly endemic to the British Isles.

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REFERENCES

ATHERSUCH J., HORNE D.J. & WHITTAKER J.E., 1989. Marine and brackish water ostracods. – Synopses of the British Faune (New Series). E.J. Brill (Ed.) for the Linnean Society of London & the Estuarine and Brackish Water Sciences Association. 43 + 343 pp.

HORNE D.J. & BOOMER I., 2000. The role of Ostracoda in saltmarsh meiofauna communities. In: Sherwood, B.R. 2000 British saltmarshes. Linnean Society of London: 181-202.

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JOSEFINA RAMÓN MERCAU, MARÍA SOFÍA PLASTANI & CECILIA LAPRIDA

A NEW *LIMNOCYTHERE* SPECIES IN THE PAMPEAN REGION (BUENOS AIRES, ARGENTINA)

Multiproxy paleolimnological research which includes the use of ostracods is in progress in several small lakes (lagunas) in the central plains of Buenos Aires province. Despite the great potential of ostracod-based reconstructions of past hydrological variations, such studies are still scarce. At least two syngamic species of *Limnocythere* have recently been recovered from Pampean Holocene lacustrine sedimentary cores. Correct identification of these species is of critical importance for the paleoenvironmental interpretation of the ostracod assemblages; however, the taxonomic status of the limocytherids reported from Holocene sediments in the area is far from clear.

BERTELS & MARTÍNEZ (1990) mentioned two species of *Limnocythere* left in open nomenclature from Pampean sediments. CUSMINSKY & WHATLEY (1996) described some new species, including *L. rionegroensis*, from Patagonia and synonymized *L.* aff. *L. bradburyi* figured by BERTELS & MARTÍNEZ (1990) with this new species. FERRERO (1996) reported *L. staplini* from marginal marine deposits from Buenos Aires. BERTELS & MARTÍNEZ (1997) published a paper including the same two taxa of their previous work, without changes in their identification. CUSMINSKY *et al.* (2005) assigned *L.* aff. *L. bradburyi* of BERTELS & MARTÍNEZ (1990, 1997) to *L. rionegroensis*. LAPRIDA (2006) reported two extant limnocytherids, *Limnocythere* sp. and *L.* aff. *L. staplini*, and subsequently found them in sedimentary cores from Pampean lagunas (LAPRIDA & VALERO-GARCÉS, 2009). This account attests to the need of taxonomic revision of this genus in the area.

In order to clarify its taxonomic status, we present the valve and soft parts description of *L.* aff. *L. staplini* (*sensu* LAPRIDA, 2006) based on individuals newly collected from Arroyo Chico stream (37° 23'S- 57° 9'W). Lateral view: carapace fairly symmetrical; maximum length (ML) ~ 0.67 mm; maximum height ~ 0.28 – 0.30 mm, occurring at ~1/3 ML. Dorsal view: anterior end beak shaped, posterior end rounded with left valve (LV) overlapping right valve (RV). Valve external ornamentation weak, presenting light reticulation over the whole surface. A sulcus and two or three poorly developed tubercles occur slightly anteriorly of mid-length. Internal view: lophodont hinge of LV consisting of anterior and posterior teeth sockets flanking a central smooth bar; RV with corresponding smooth teeth and central groove. Marginal denticles absent. Marginal zone more developed anteriorly, with few straight, unbranched marginal pore canals. The four anteriormost appendages as for the genus; A2 lacks flagellated claws. Two setae on anterodistal edge of basal segment of the first walking leg (T1), one seta in the corresponding position of second and third walking legs (T2 and T3). Sexual dimorphism pronounced. Female: Dorsal margin rounded. Terminal claw of T1 about ¼ shorter than those of T2 and T3 (with T2 ≈ T3). Male: More elongated than female, carapace reniform, dorsal margin straight. T1 ≈ T2 in length, terminal claw of T3 ≈ 2.5 as long as terminal claws of T2 and T3.

This species differs from *L. staplini* and *L. bradburyi* in the hinge (smooth vs crenulated elements); from both and *L. rionegroensis* in the slope of the valve dorsal margin of the female and valve shape of the male; and from *L. staplini* further in the sexual dimorphism in thoracopod size vs thoracopod size equal for both sexes (DELORME, 1971). The above combination of features is unique to this taxon, thus warranting the erection of a new species, *Limnocythere* sp. nov.

REFERENCES

BERTELS A. & MARTÍNEZ D.E., 1990. Quaternary ostracodes of continental and transitional littoral-shallow marine environments. *Courier Forschunginstitut Senckenberg*, 123: 141-159.

BERTELS A. & MARTÍNEZ D.E., 1997. Ostrácodos holocenos de la desembocadura del Arroyo Napostá Grande, sur de la provincia de Buenos Aires, Argentina. *Revista Española de Micropaleontología*, 29: 29-69.

CUSMINSKY G.C. & WHATLEY R., 1996. Quaternary non-marine ostracodes from lake beds in northern Patagonia. *Revista Española de Paleontología*, 11: 143-154.

CUSMINSKY G.C., PÉREZ P.A., SCHWALB A. & WHATLEY R.C., 2005. Modern lacustrine ostracods from Patagonia, Argentina.. *Revista Española de Micropaleontología*, 37: 431–450.

DELORME L.D., 1971. Freshwater ostracods of Canada. Part 5. Families Limnocytheridae, Loxoconchidae. *Canadian Journal of Zoology*, 49: 43-64.

FERRERO L., 1996. Paleoecología de ostrácodos holocenos del estuario del río Quequén Grande (Provincia de Buenos Aires). *Ameghiniana*, 33 (2): 209-222.

LAPRIDA C., 2006. Ostrácodos recientes de la llanura pampeana, Buenos Aires, Argentina: ecología e implicancias paleolimnológicas. *Ameghiniana*, Buenos Aires, 43: 181-204.

LAPRIDA C. & VALERO-GARCÉS B., 2009. Cambios ambientales de épocas históricas en la pampa bonaerense en base a ostrácodos: historia hidrológica de la laguna de Chascomús. *Ameghiniana*, 46(1): 95-111.

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Julio Rodriguez-Lazaro, Pere Anadón, Eduardo Barron,
Maite Martin, Rosa Utrilla & Antonio Vazquez

MIOCENE OSTRACODS FROM THE EBRO BASIN (AZUARA SUBBASIN, N SPAIN): FAUNAL AND BIOGEOCHEMICAL APPROACHES

Neogene non-marine ostracods in Spain have been listed into Recent (87 spp.), Quaternary (69 spp.), Pliocene (32 spp.) and Miocene (87 spp.) stocks (Gliozzi *et al.*, 2005; Rodriguez-Lazaro & Martin-Rubio, 2005). The occurrence of marine-like fauna (with foraminifers, ostracods and molluscs) in several levels of the Middle-Upper Miocene of the Ebro Basin (N Spain) challenges the palaeogeographic models of that time where no sea-connections are envisaged since the Late Eocene (Anadón, 1992; Anadón *et al.*, 2003).

In an ongoing research on the environmental reconstruction of some Miocene lacustrine systems, we studied the ostracods and molluscs to characterize the palaeoenvironmental and palaeoclimatic features of the athalassic Miocene saline lake system with marine-like fauna of the Ebro Basin (Azuara area). For the saline marine-like fauna of the Ebro Basin, the lacustrine setting is feasible on the basis of trace element (Mg, Sr) and isotope (C, O, Sr) analyses of shell carbonates, but the geochemical data are not conclusive yet. The lacustrine option is also in conflict with some faunal features. A silled estuary could resolve some of the contradictory evidence but poses problems in localizing the marine connection. On the other hand, the ostracod fauna has some Paratethyan influence, which supports the hypothesis that this fauna is linked to the central European Paratethys.

The environmental-climate generated reconstruction may be integrated into the framework of the Miocene global climate change. The ostracod assemblages of the Miocene Azuara subbasin are composed by 29 genera some of them characteristic of diluted waters (*Candona, Candonopsis, Cyclocypris, Cypridopsis, Darwinula, Herpetocypris, Ilyocypris, Kovalevskiella, Limnocythere, Leucocythere, Metacypris, Paralimnocythere, Penthesilenula, Pseudocandona*), or more saline waters (*Amnicythere, Chartocythere, Cyprideis, Cytheromorpha, Euxinocythere, Hemicyprideis, Heterocypris, Leptocythere, Mediocytherideis, Miocyprideis*). The distribution of these ecologic assemblages depicts the lacustrine/perilacustrine bodies in the basin, while the detailed correlation among faunal diversity and isotopic/geochemical values depicts environmental variations inside the general palaeoclimatic-induced trends in the Ebro basin.

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REFERENCES

Anadón P., 1992. Composition of inland waters with marine-like fauna and inferences for a Miocene lake in Spain. *Palaeogeography, Palaeoclimatololy, Palaeoecology*, 99: 1-8.

Anadón P., Rodriguez-Lazaro J., Pérez A. & Martin-Rubio M., 2003. Middle-Upper Miocene ostracod-rich deposits of Fuendetodos (South-Central Ebro Basin, Spain). In: Rodriguez-Lazaro J. & Baltanás A. (eds.), Fifth European Ostracodologists Meeting EOM-V, Cuenca 2003. *Servicio Editorial UPV/EHU*, Bilbao, Excursion Guidebook: 99-117.

Gliozzi E., Rodriguez-Lazaro J., Nachite D., Martin-Rubio M. & Bekkali R., 2005. An overview of Neogene brackish leptocytherids from Italy and Spain: Biochronological and palaeogeographical implications. *Palaeogeography, Palaeoclimatololy, Palaeoecology*, 225: 283-301.

Rodriguez-Lazaro J. & Martin-Rubio M., 2005. Neogene records of nonmarine ostracods from Spain. In: Kohring R. & Sames B. (eds.), Proc., ISO 15, Intern. Symposium on Ostracoda, Berlin. *Berliner Paläobiologische Abh.*, 6: 101-102.

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JULIO RODRIGUEZ-LAZARO, BLANCA MARTINEZ & ANA PASCUAL

THE "NORTHERN GUESTS" AND OTHER PALAEOCLIMATIC OSTRACOD PROXIES IN THE LATE QUATERNARY OF THE BASQUE BASIN (S BAY OF BISCAY)

Results from our current research on the chronology, isotopic geochemistry and faunal distributions of foraminifers and ostracods (PASCUAL *et al.*, 2008; RODRIGUEZ-LAZARO *et al.*, 2009; 2011) are used to describe the palaeoenvironmental evolution of the southern region of the Bay of Biscay during the late Quaternary. We present the results of palaeoceanographic and palaeoclimatic reconstructions from the MIS3 to Holocene time interval in the Basque basin based on ostracods as paleo-indicators. The distribution of modern ostracod assemblages in this basin (151 species) is regulated by the sediment type, amount of organic matter, oxygen content and depth. Assemblages are predominated by *Costa edwardsii* (Roemer), *Pterygocythereis jonesii* (Baird), *Palmoconcha guttata* (Norman), *Carinocythereis carinata* (Roemer) and *Cytheropteron nodosum* (Brady). On muddy sediment *P. guttata* dominates in shallow water area (<100 mwd, meters water depth) and *P. jonesii* on the outer shelf. On the inner shelf it is common to also find estuarine species indicative of the important river influence on the shelf.

Based on a comparative study of modern and fossil ostracod assemblages (together with faunal distributions and isotopic analyses of the foraminifers) we can reconstruct the environmental changes of the last 57 ka. We compare our results with the standard palaeoceanographic curve of ^{18}O of *Globigerina bulloides* d'Orbigny of the North Atlantic (SHACKLETON, 2001) and place them into a general climatic scale (ice core GISP2). Palaeoenvironmental study is based on data from six cores ranging from the shelf (114 mwd) to the upper slope (483 mwd). The MIS3-MIS2 interval is clearly differentiated from the Holocene based upon ^{18}O of *G. bulloides* (2-2.8/0.2-0.8 per mil PDB, respectively) and the characteristic assemblages of ostracods (*Krithe* spp., *Cytherella lata* Brady*, Celtia quadridentata* (Baird) for the MIS3-MIS2 and *C. edwardsii, Cytheropteron punctatum* Brady*, P. guttata,* for the Holocene).

MIS3 is characterized by cold climate with several Heinrich events. HE5 and HE4 are not accompanied by significant ostracod assemblage changes, but HE3 is very clearly detected as a cold pulse by the sudden increase of *Krithe* spp. and *Acanthocythereis dunelmensis* (Norman) (together with planktonic foraminifer *Neogloboquadrina pachyderma* (Ehrenberg) sin., a good indicator of polar waters). These data support the entrance of North Atlantic water masses in this basin during the HE3. MIS2 is characterized by *Krithe* spp. and *C. lata,* but also *Cytheropteron testudo* Sars was introduced during the Last Glacial Maximum, while findings of *A. dunelmensis* are only recorded during stadials HE2, HE1.

In the early Holocene, a warm interval (Hypsithermal, 11.5-6.9 ka cal BP) is evidenced by ^{18}O *G. bulloides* (0.3-0.8 per mil PDB) and "interstadial" species of foraminifers and ostracods, the latter are dominated by *C. edwardsii* and *C. punctatum*. The "neoglacial" interval of the Holocene (6.9-4.6 ka cal BP) is detected on the western shelf by the occurrence of *Krithe* spp., *C. lata*, *Trachyleberis* sp., *A. dunelmensis* and *Argilloecia acuminata* G.W. Müller. In the eastern area of the shelf there is a clear association of the cold-water indicators ("northern guests", *A. dunelmensis, C. testudo, Krithe* spp.) with cooler intervals in the Holocene (Holocene Cooling Events, HCE6 to HCE2).

Our results evidence the influence of major Atlantic water masses in this region of the Bay of Biscay. The ostracod assemblages of the Basque basin contain species typical of cold waters during the MIS3 and the neoglacial Holocene interval. *A. dunelmensis* is a good proxy of northern cold water inflow during the HE3, HE2, HE1, and together with *C. testudo* they indicate the cooler intervals of the Holocene HCE5, HCE4, HCE3 and HCE2. These species reached the Basque basin following upwelling currents through the Capbreton and San Sebastian canyons.

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REFERENCES

Pascual A., Rodriguez-Lazaro J., Martin M., Jouanneau J.M. & Weber O., 2008. A survey of the benthic microfauna (Foraminifera, Ostracoda) on the Basque Shelf (Southern Bay of Biscay). *Journal of Marine Systems,* 72: 35-63.

RODRIGUEZ-LAZARO J., MARTIN-RUBIO M., PASCUAL A. & MARTINEZ B., 2009. Ostracods as tracers of late Quaternary climatic oscillations in the southern Bay of Biscay. *16th Intern. Symp. on Ostracoda ISO16, Brasilia (Brasil), July 20-30, 2009. Abst., 066.*

RODRIGUEZ-LAZARO J., MARTINEZ GARCIA B., PASCUAL A., 2011. Late Quaternary (60 ka) paleoclimatic record of the Basque Basin (S Bay of Biscay). Climate changes, bioevents and geochronology in the Atlantic and Mediterranean over the last 23 Myr. RCANS and RCMNS, Salamanca 21-23 sept., 2011, 1 p.

SHACKLETON N.J., 2001. ^{18}O (planktic foraminifera) of sediment core MD95-2042. *PANGAEA*, doi: 10.1594/PANGAEA.58210.

Authors' Addresses — J. RODRIGUEZ-LAZARO, B. MARTINEZ, A. PASCUAL, Department of Stratigraphy and Palaeontology, University of the Basque Country UPV/EHU, Apartado 644, E48080 Bilbao (Spain); e-mail: julio.rodriguez@ehu.es; blancamaria.martinez@ehu.es; ana.pascual@ehu.es.

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MELISSA ROSATI, MARCO CANTONATI,
RAUL PRIMICERIO & GIAMPAOLO ROSSETTI

ECOLOGICAL DRIVERS AND MULTI-SCALE SPATIAL PATTERNS OF OSTRACOD DIVERSITY IN COLD SPRINGS OF WESTERN PALEARCTIC

Springs are multiple ecotones between aquatic (ground, surface and interstitial waters) and terrestrial ecosystems (SCARSBROOK, 2007). The "mosaic" ecotonal structure results in a number of microhabitats that sustain high species richness, and therefore these environments can be considered as hotspots of aquatic biodiversity (CANTONATI *et al.*, 2012). The fragmented nature of springs makes them ecological islands, where the among-spring dispersal is expected to be limited, although with marked differences between taxa (STUTZ *et al.*, 2010). Most permanent freshwater springs and associated aquifers have a great physical and chemical stability (GLAZIER, 1991; WILLIAMS, 1991) and have persisted over geological times through significant climate fluctuations, acting as refugia for aquatic fauna and potential speciation sites. In spite of their ecological relevance, relatively few investigations have dealt with the anthropic impacts on springs and their biota, both at local (water abstraction, nutrient enrichment, trampling cattle, sediment input and damage or removal of the surrounding vegetation) and global (e.g. predicted reduction and increasing irregularity of precipitation due to climate change) scales (CANTONATI *et al.*, 2006, 2007; ILMONEN *et al.*, 2012).

Ostracods are common component of springs (FORESTER, 1991). Previous investigations aimed at analyzing the relationships between ecology and ostracod composition in different types of springs have been performed at various spatial scales and in different biogeographic areas (e.g., MEZQUITA *et al.*, 1999; KÜLKÖYLÜOĞLU & VINYARD, 2000; BOTTAZZI *et al.*, 2008). In this study we review the current knowledge on diversity and distribution of ostra-

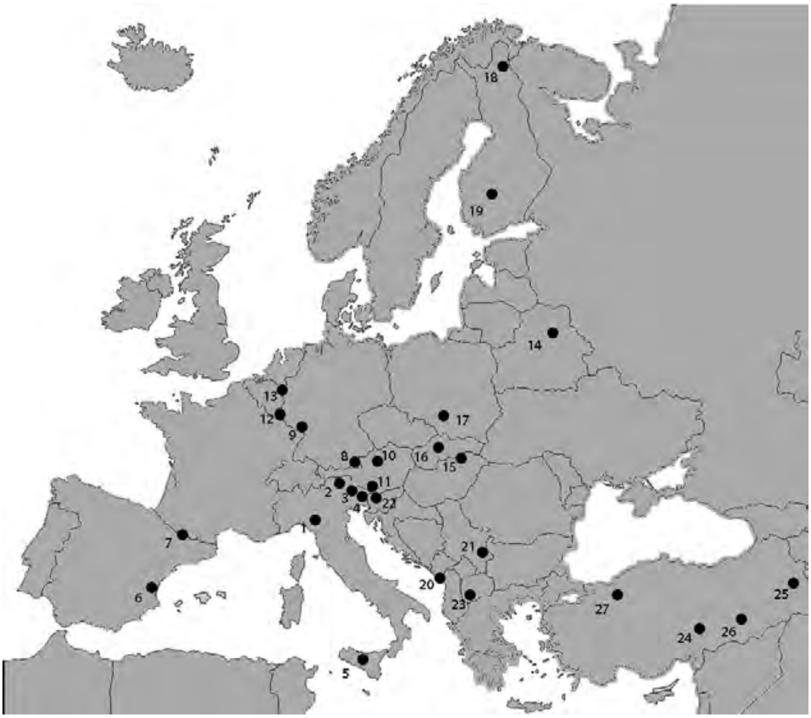

Fig. 1 — Map of the spring areas considered in this study. **1**: Lombardia and Emilia Romagna (Italy). **2**: Trentino Alto Adige (Italy). **3**: Dolomiti Bellunesi (Italy). **4**: Friuli Venezia Giulia (Italy). **5**: Sicily (Italy). **6**: Pyrenees (Spain). **7**: Eastern Spain. **8**: Berchtesgaden National Park (Germany). **9**: Pfälzerwald Mountains (Germany). **10**: Kalkalpen National Park (Austria). **11**: Schütt (Austria). **12**: Luxemburg. **13**: Central Plateau (Netherland). **14**: Minsk and Vitebsk areas (Belarus). **15**: Northern Hungary. **16**: Východná and Bojnice (Slovakia). **17**: Cracow–Czêstochowa Upland (Poland). **18**: Inari Lapland (Finland). **19**: Southern Finland. **20**: Skadar Valley (Montenegro). **21**: Stara Planina Mountains (Serbia). **22**: Slovenia. **23**: Pelister Mountains (Macedonia). **24**: Kahramanmara Province (Turkey). **25**: Northeastern Van (Turkey). **26**: Diyarbakır (Turkey). **27**: Bolu (Turkey).

cod faunas associated with cold springs and on the ecological factors that have been reported to affect their occurrence. More than 50 papers have been considered for this purpose, allowing to gather information on c. 100 ostracod taxa belonging to 30 genera. An analysis of spatial variations in community structure from landscape to continental scales, integrating multivariate models (BORCARD *et al.*, 2011) and null models of community assembly (GOTELLI & ULRICH, 2012), allows to assess the driving ecological processes responsible for shaping spring communities and to reveal biogeographic patterns. We further consider the influence of local, regional and historical factors on taxonomic and phylogenetic diversity in springs of the Palearctic region, with a special focus on mountain areas of Northern Italy.

REFERENCES

BORCARD D., GILLET F. & LEGENDRE P., 2011. Numerical Ecology with R. *Springer*, New York, 319 pp.

BOTTAZZI E., BRUNO M.C., MAZZINI M., PIERI V. & ROSSETTI G., 2008. First report on Copepoda and Ostracoda (Crustacea) from northern Apenninic springs (N. Italy): a faunal and biogeographical account. *Journal of Limnology*, 67(1): 56-63.

CANTONATI M., GERECKE R. & BERTUZZI E., 2006. Springs of the Alps. Sensitive Ecosystems to Environmental Change: From Biodiversity Assessments to Long-term Studies. *Hydrobiologia*, 562(1): 59-96.

CANTONATI M., MORESCHINI R., BERTUZZI E. & OSS CAZZADOR P., 2007. Detailed spring inventory of two areas of special interest for nature conservation within the Adamello-Brenta Natural Park (south-eastern Alps, Trentino, Italy). *Monografie del Museo Tridentino di Scienze Naturali*, 4: 327-334.

CANTONATI M., FÜREDER L., GERECKE R., JÜTTNER I. & COX E.J., 2012. Crenic habitats, hotspots for freshwater biodiversity conservation: toward an understanding of their ecology. *Freshwater Science*, 31: 463-480.

FORESTER R.M., 1991. Ostracode assemblages from springs in the western United States: Implications for paleohydrology. *Memoirs of the Entomological Society of Canada*, 155: 181-201.

GLAZIER D.S., 1991. The fauna of North America temperate cold springs: patterns and hypotheses. *Freshwater Biology*, 26: 527-542.

GOTELLI N. J. & ULRICH W., 2012. Statistical challenges in null model analysis. *Oikos*, 121: 171-180.

ILMONEN J., MYKRÄ H., VIRTANEN R., PAASIVIRTA L. & MUOTKA T., 2012. Responses of spring macroinvertebrate and bryophyte communities to habitat modification: community composition, species richness, and red-listed species. *Freshwater Science*, 31(2): 657-667.

KÜLKÖYLÜOĞLU O. & VINYARD G.L., 2000. Distribution and ecology of freshwater Ostracoda (Crustacea) collected from springs of Nevada, Idaho, and Oregon: a preliminary study. *Western North American Naturalist*, 60(3): 291-303.

MEZQUITA F., TAPIA G. & ROCA J.R., 1999. Ostracoda from springs on the eastern Iberian Peninsula: ecology, biogeography and palaeolimnological implications. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 148(1-3): 65-85.

SCARSBROOK M., BARQUIN J. & GRAY D., 2007. New Zealand coldwater springs and their biodiversity. *Science for Conservation*, 278: 72 pp.

STUTZ H.L., SHIOZAWA D.K. & EVANS R.P., 2010. Inferring dispersal of aquatic invertebrates from genetic variation: a comparative study of an amphipod and mayfly in Great Basin springs. *Journal of the North American Benthological Society*, 29(3): 1132-1147.

WILLIAMS D.D., 1991. Life history traits of aquatic arthropods in springs. *Memories of the Entomological Society of Canada*, 155: 63-87.

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VALERIA ROSSI, DANIA ALBINI, GIORGIO BENASSI & PAOLO MENOZZI

HATCHING PHENOLOGY OF *HETEROCYPRIS INCONGRUENS* EGGS: ENVIRONMENTAL AND MATERNAL EFFECTS

Colonisation of ephemeral ponds requires adaptations in life history parameters: organisms have to take advantage of ponds filling and "hedge their bets" for the possibility of completing their life cycle and produce resting stages that ensure that the population will not go extinct. The timing of many phenological events (e.g. egg hatching, beginning of reproduction and production of resting eggs) is the result of a complex interplay among organism genotype, environmental factors (e.g. temperature, photoperiod, hydroperiod predictability) and maternal effects. The ability of resting eggs to survive periods of drying and hydroperiod shorter than their life cycle duration affects a species' persistence in temporary waters. We previously described the formation of an egg bank by a clonal lineage of *Heterocypris incongruens* (Clone W) typical of Northern Italy vernal pools and reported an estimation of resting egg density in the pond ($65x10^4$ eggs m^{-2}) (ROSSI *et al.,* 2011). The lack of genetic variation expected among clonal organisms make them ideal material for investigating phenotypic plasticity as well as maternal effects (e.g. mother presence, the environment the mother experienced, maternal age at deposition, egg size).

By laboratory experiments, we measured the hatching phenology of clonal resting eggs and egg bank depletion during four successive inundations (followed by dry periods) without reproduction (ROSSI *et al.,* 2012). On a total of 7133 hatchings recorded, about 80% were observed in the first inundation while the rest in three subsequent inundations. Egg aging and photoperiod had no effect on hatching phenology while metabolites produced by adult females in conditioned water had a negative effect on hatching percentage (ROSSI *et al.,* 2012). Short inundation did not affect hatching percentages and, hence, resting egg survivorship. Hatching in successive inundations did not depend on genetic differences among eggs and the process may be considered a stochastic switching of a single genotype among different phenotypes. Such a hatching phenology represents a risk spreading response, advantageous in highly stochastic environments to prevent the population extinction in the case of hydroperiod shorter than life cycle and/or for at least four subsequent generations of failed reproduction.

Maternal age at egg deposition and egg size are considered important maternal effects. The relationship between egg size and development time is known and it is generally accepted that larger eggs take longer to develop than smaller ones. The production of eggs with variable size may represent a strategy by which a mother spreads the risks connected with life in a temporary habitat. In laboratory experiments we evaluated the effect of different photoperiods experienced by mothers (12:12 L:D photoperiod, chosen as a proxy of favourable but unpredictable late winter-spring conditions, and 16:8 L:D photoperiod, proxy of incoming a dry predictably unfavourable season inducing resting egg production) and of maternal age on egg size and on development time of non resting eggs of W clonal lineage (ROSSI *et al.,* 2013). Egg diameter at deposition did not affect the highly variable (2 to 100 days) hatching time of non resting eggs and did vary significantly with photoperiod experience by the mother (at 16:8 L:D mean diameter = 129.9 µm, sd = 7.69, at 12:12 L:D mean diameter = 133.1 µm, sd = 8.46). During our observation time, egg diameter of both resting and non-resting eggs increased (1.09-1.14 times) following an asymptotic model. Size increment was larger and slower in eggs produced at 16:8 L:D than in eggs produced at 12:12 L:D and was linked to the embryo developmental process that occurred within 0-3 days from deposition both in resting and non resting eggs. Final diameter of both resting and non-resting eggs did not show a threshold size and its variability might be linked to hatching asynchrony observed both in resting and non-resting eggs.

REFERENCES

ROSSI V., BENASSI G., BELLETTI F. & MENOZZI P., 2011. Colonization, population dynamics, predatory behaviour and cannibalism in *Heterocypris incongruens* (Crustacea: Ostracoda). *J. Limnol.*, 70: 102-108.

ROSSI V., ALBINI D., BENASSI G. & MENOZZI P., 2012. To rest in hydration: hatching phenology of resting eggs of *Heterocypris incongruens* (Crustacea: Ostracoda). *Fundam. Appl. Limnol.*, 181: 49-58.

Rossi V., Zatorri M., Perotti A. & Menozzi P., 2013 (in press). What does egg size tell us about hatching phenology in *Heterocypris incongruens*? *Fundam. Appl. Limnol.*, 182: 253-270.

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ENVIRONMENTAL CHANGES IN THE LACUSTRINE ANCIENT HARBOUR OF MAGDALA (KINNERET LAKE, ISRAEL) INFERRED FROM OSTRACOD, GEOCHEMICAL AND SEDIMENTOLOGICAL ANALYSES

Ancient harbour areas represent a peculiar context where the cooperation between geosciences and archaeology may provide useful information about the mutual interactions involving natural settings and human society. Several multidisciplinary studies have recently focused on the evolution of Mediterranean seaports, furnishing a wide literature about the past bio-sedimentary response to harbour activities (Marriner *et al.*, 2010). In contrast, few geoarchaeological-palaeoecological data are available on strictly lacustrine harbours. In these areas, the importance of ostracods as bio-indicators is enhanced by the lack of other organisms as foraminifers. As a part of the “Magdala Project” and in the framework of the late Hellenistic-Roman (167 BC-350 AD) sedimentary history reconstructed by Sarti *et al.* (in press) for the Magdala harbour area (Kinneret Lake, north Israel), quantitative ostracod analyses were performed on 28 samples collected from two key stratigraphic sections excavated in front of the Roman harbour structures (docks and a flight of stairs).

Along the sections, already described in detail in terms of sedimentological and archaeological features (Lena, 2012; Sarti *et al.*, in press), the abundant and well-preserved ostracod fauna shows consistent changes in composition. Despite the oligotypic character of the ostracod community, strongly dominated by the opportunistic, true euryhaline species *Cyprideis torosa*, two different associations were distinguished. Similar to the present-day lake conditions at ca. 5 m water depth (Mischke *et al.*, 2010), the lacustrine beach sands at the bottom of the sections, barren in anthropogenic (pre-harbour unit), show a comparable proportion of smooth and noded valves of *C. torosa*. At the boundary with the overlying bay silty sands, which contain an abundance of late Hellenistic archaeological, a sharp increase of noded *C. torosa* (up to 87% of the total fauna) is recorded, along with the occurrence of other species preferring fine-grained substrates and high-organic stagnant waters, as *Pseudocandona albicans*. This vertical change in ostracod composition is paralleled by a sharp increase in concentration of selected metals (Pb, Zn and Cu), up to six times greater than background values. Increased metal values suggest the establishment of an anthropogenically forced semi-protected basin with high levels of heavy-metal pollution during the late Hellenistic period (sin-harbour unit).

In order to increase the quality of our palaeoenvironmental reconstructions and provide insights into the harbour water chemistry derived from human activities, ostracod geochemistry analyses are in progress on *C. torosa* valves recovered from the pre-harbour and sin-harbour units. By comparing element concentrations with the frequency of noded forms and plotting shell chemistry of smooth *versus* noded valves, we (i) provide new information about ostracods, including *C. torosa* ecophenotypical features, as bioindicators of high pollution levels within ancient lacustrine harbours, and (ii) address the issue of the potential use of integrated palaeontological and geochemical analyses to detect polluted conditions in past environments. This methodological approach may also improve our knowledge of the "factor X" (VAN HARTEN, 2000), which contributes to the development of phenotypic nodes on *C. torosa* within freshwater-oligohaline settings.

REFERENCES

MARRINER N., MORHANGE C. & GOIRAN J.-P., 2010. Coastal and ancient harbour geoarchaeology. *Geology Today*, 26: 21-27.

LENA A., 2012. Il porto di Magdala/Tarichea sul Lago di Galilea. PhD Thesis in Archeology (unpublished): East-West Relations, PhD Program in Intercultural Studies, Università di Napoli L'Orientale, 247 pp.

MISCHKE S., ALMOGI-LABIN A., ORTAL R., ROSENFELD A., SCHWAB M.J. & BOOMER I., 2010. Quantitative reconstruction of lake conductivity in the Quaternary of the Near East (Israel) using ostracods. *Journal of Paleolimnology,* 43: 667-688.

SARTI G., ROSSI V., AMOROSI A., DE LUCA S., LENA A., MORHANGE C., RIBOLINI A., SAMMARTINO I., BERTONI D. & ZANCHETTA G., in press. Magdala harbour sedimentation (Sea of Galilee, Israel), from natural to anthropogenic control. *Quaternary International.*

VAN HARTEN D., 2000. Variable noding in *Cyprideis torosa* (Ostracoda, Crustacea): an overview, experimental results and a model from Catastrophe Theory. *Hydrobiologia,* 419: 131-139.

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OSTRACOD ASSOCIATIONS AND DEPOSITIONAL ENVIRONMENTS OF EOCENE SECTIONS IN THE CENTRAL SAKARYA REGION (NW ANATOLIA)

In the present investigation, the ostracod faunas of five Middle to Late Eocene sections in the Central Sakarya Region were studied. We valuate palaeoenvironmental changes based on the found ostracod assemblages. Further, we propose stratigraphical correlations to other Central Anatolian basins as well as a regional palaeogeographic scenario. The following taxa were determined in our sections as follows,: Cytherellidae including *Cytherella triestina* Kollmann, *C. montensis* Marliere, *C. münsteri* (Roemer), *C. transversa* Speyer, *Cytherelloidea jonesiana* (Bosquet), *C. damariacensis* (Apostolescu), Bairdiidae including *Bairdia cymbula* Deltel, *B. crebra* Deltel, *B. subdeltoidea* (Muenster), *Bairdioppilata gliberti* Keij, Cytherideidae including *Neocyprideis williamsoniana* (Bosquet), *Cuneocythere* (*Monsmirabilia*) *triebeli* (Keij), *Paleomonsmirabilia nodulosa* Duru, *Schuleridea perforata* (Roemer), *Mosmirabilia* sp., Leptocytheridae including *Leptocythere* sp., Limnocytheridae including *Cyamocytheridea* sp., Krithidae including *Krithe parvula* Deltel, *K. angusta* Deltel, *K. caudata* Van Den Bold, *K. rutoti* Keij, *Parakrithe* sp., Trachyleberididae including *Trachyleberis aculeata modesta* Van Hinte, *Costa* sp., *Pterygocythereis aquitanica* Ducasse, *Nucleolina multicostata* (Deltel), *Leguminocythereis genappensis* Keij, *L. magna* Ducasse, *L. tenuistriata* (Apostolescu), Hemicytheridae including *Grinioneis alata* Ducasse, *G paijenborchiana* (Keij), *Quadracythere persica* Tambareau, *Caudites orientalis* Sönmez-Gökçen, Loxoconchidae including *Loxoconcha subovata* (Muenster), Cytheruridae *Cytheropteron* sp., Xestoleberididae including *Uroleberis globosa* Ducasse, Bythocytheridae including *Monoceratina striata* Deltel, Macrocyprididae including *Macrocypris* sp., Candonidae including *Paracypris contracta* (Jones), *P. trosliensis* Apostolescu, Cyprididae including *Cyprinotus* sp., *Heterocypris* sp.

Within this ostracod association, *Cyprinotus* and *Heterocypris* represent lacustrine environments; *Neocyprideis*, *Loxoconcha* indicate lagoonal settings; *Leptocythere*, *Cyamocytheridea* would represent both lagoonal and littoral environments; *Grinioneis* , *Quadracythere*, *Uroleberis* hint to epineritic environments, while, *Paleomonsmirabilia*, *Schuleridea*, *Costa* and *Caudites* would indicate environments from epineritic to infraneritic. *Paracypris* represents infraneritic settings. *Cytherella*, *Bairdia* as well as *Cytheropteron* refer to epineritic to bathyal environments. Lastly, *Krithe* and *Macrocypris* indicates infraneritic to bathyal settings.

Based on this the change from lacustrine to deep marine settings during the Middle to the Late Eocene *Cyprinotus* sp., *Heterocypris* sp., *Neocyprideis williamsoniana* (Bosquet), *Loxoconcha subovata* (Muenster), *Leptocythere* sp., *Cyamocytheridea* sp., *Grinioneis alata* Ducasse, *G paijenborchiana* (Keij), *Quadracythere persica* Tambareau, *Uroleberis globosa* Ducasse *Cuneocythere* (*Monsmirabilia*) *triebeli* (Keij), *Paleomonsmirabilia nodulosa* Duru, *Schuleridea perforata* (Roemer), *Costa* sp., *Caudites orientalis* Sönmez-Gökçen, *Paracypris contracta* (Jones), *P. trosliensis* Apostolescu, *Cytheropteron* sp., *Krithe parvula* Deltel, *K. angusta* Deltel, *K. caudata* Van Den Bold, *K. rutoti* Keij, *Macrocypris* sp.were determined.

The study was carried out within southern units of basin developed in rising at the Middle Sakarya Basin (NW Anatolia / Turkey).The research is firstly characterised by ostracoda fauna and their stratigraphical types of ostracodes and aged as Middle-Late Eocene as a result of correlation of Middle Europe and Turkey works.

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GIANGUIDO SALVI

OSTRACOD FAUNA FROM THE SEDIMENTS OF LAGO DI BORDAGLIA (FRIULI VENEZIA GIULIA - NE ITALY)

Research on recent freshwater ostracods of Friuli Venezia Giulia region has not been carried out on a regular basis and available data mostly rely on occasional investigations (COLIZZA *et al.*, 1987; 1990). However, detailed accounts on taxonomy, ecology and geographic distribution of ostracods in Friuli Venezia Giulia have recently been published (PIERI *et al.*, 2009; STOCH, 2003; 2004). In this study, we analyzed 55 bottom sediments collected in Lago di Bordaglia, a small glacial lake located in the northernmost sector of the Carnic Alps at altitudes of 1750 m a.s.l., during three different summer surveys (1991,1992 and 2012). Bathymetry, physical and hydrochemical variables were measured (pH, Oxygen, Carbonates), sedimentological (textural) analysis was also carried out.

Three ostracod species (*Cypria ophthalmica, Cypridopsis vidua and Candona candida*) were identified in sediment samples collected during 1991 and 1992 summer surveys. The most abundant species was *Cypria ophtalmica* recorded in 30 samples followed by *Cypridopsis vidua*. *Cypridopsis vidua* was not found in the samples collected in 2012. From a first analysis of the data, the presence of ostracods seems to be linked to high values of carbonate and pH in sediments with high percentages of silt component, while oxygen does not seem to indicate specific trends. In fact, the presence of carbonates and pH values are all factors that influence the composition of ostracod carapaces.

Moreover, biocoenosis and thanatocoenosis indicate a preferential distribution (diffusion) in the southern part of the lake characterized by very shallow waters.

Finally, particular attention should be drawn to the broad tolerance of freshwater ostracods in terms of the environmental and ecological variables combined with a high resilience to extreme environments, such as high mountain lakes.

REFERENCES

COLIZZA E., FANZUTTI G.P. & PUGLIESE N., 1987. The diffusion of ostracode fauna in Lake Ragogna (Friuli, Italy). *Biogeography,* 13: 529-537.

COLIZZA E., FANZUTTI G.P., MELIS R., POLANO S. & PUGLIESE N., 1990. Primi risultati sui sedimenti e sulle ostracofaune del lago di Cavazzo o dei Tre Comuni (Udine). Atti tavola rotonda "Ecologia e Paleontologia", *Quaderno del Museo Geologico e Paleontologico di Monfalcone*: 53-77.

PIERI V., MARTENS K., STOCH F. & ROSSETTI G., 2009. Distribution and ecology of non-marine ostracods (Crustacea, Ostracoda) from Friuli Venezia Giulia (NE Italy). *J. Limnol.*, 68: 1-15.

STOCH F., 2003. Indagini ecologiche e faunistiche sulla meiofauna (Acari e Crostacei) di alcune sorgenti del Parco Naturale delle Prealpi Giulie (Italia nord-orientale). *Gortania, Atti Mus. Friul. St. Nat.*, 25: 239-250.

STOCH F., 2004. Prime osservazioni sulla fauna delle acque carsiche sotterranee delle Alpi Carniche. *Mem. Ist. It. Spel.*, s. II, 15:87-95.

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GIANGUIDO SALVI, CARLA BUOSI, SANDRO DE MURO, DEBORAH ARBULLA,
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OSTRACODA AND FORAMINIFERA RESPONSE TO A SEVERELY CONTAMINATED ENVIRONMENT: THE CASE OF THE EX MILITARY ARSENAL OF THE MADDALENA HARBOUR (SARDINIA, ITALY)

Benthic ostracod and foraminifer faunas have recently been used as environmental bio-indicators, especially in polluted environments where their sensitivity to pollutants may be expressed in particular with a modification in the assemblage (BERGIN *et al.*, 2006; RUIZ, 2012). Disappearance, replacement or appearance of specific species, the occurrence of morphological anomalies, or the alteration of population dynamics could well be the evidence of stressed environments related to anthropogenic impacts (CHERCHI *et al.*, 2009; FRONTALINI *et al.*, 2009).

Comparing thanatocoenosis and biocoenosis in polluted and clean water areas, it is possible to determine the degree of destruction of the so-called primary complexes under the effects of anthropogenic pressure. Besides this, they resettle areas subject to repeated pollution much slower than many other organisms. It has also been found that pollution reduces species diversity and causes changes in community structure and, finally, the total extinction of ostracods (RUIZ, 2005; ZENINA, 2009).

Benthic foraminifer assemblages are useful as bio-indicator proxies for a valuable characterization of specific environments in coastal systems, because foraminifers have short life and reproductive cycles, they react quite quickly to both short and long-term changes in marine and transitional-marine environments on both global and local levels. Changes in benthic foraminifers abundance, species composition and variation in test morphology provide evidence of fluctuation in several environmental factors and can therefore be used as an efficient method for determining the ecosystems conditions. These bio-indicators are considered to be a basic way of monitoring ecological factors and anthropogenic pressure (e.g. Alve, 1995; Coccioni *et al.*, 2003; Schönfeld, 2012).

Here we present the first micropaleontological data obtained through the analysis of ten top core sediments collected in the Ex-military arsenal of the La Maddalena harbour located on the southern-eastern coast of La Maddalena island (Sardinia, Italy). In this context, the study performed in a military harbour, where a naval arsenal worked for nearly one century with heavy impact on the coastal zone, is an important example of environmental characterization finalized to the restoration of a polluted marine area.

Preliminary data on Ostracods have evidenced low species diversity with a low number of genera and specimens. A total of 14 genera of benthic ostracods have been recognized. Biocoenoses are not present in significant numbers. Juvenile specimens with left, right or complete adult valves represent the autochthonous thanatocoenosis. The more common species are mainly represented by *Bairdia mediterranea*, *Loxoconcha affinis* and *Xestoleberis* spp. These species represent the most opportunistic species with the greater number of specimens. The relative abundance of individual species varies from station to station even if a significant decrease of genera and specimens is evident in the samples collected in the outer area of La Maddalena harbour.

Previous analysis of La Maddalena archipelago (Arbulla, 2002) highlighted an abundant ostracod fauna well represented from a qualitative and quantitative point of view with a total of 150 species belonging to 56 genera. The samples collected near La Maddalena harbour showed a degradation of environmental conditions with low numbers of species and specimens.

The living benthic foraminifer faunas from La Maddalena harbour are very poor with a low number of species and specimens. A total of 9 genera and 16 benthic foraminifera species are recognized. The biotic indices (Species richness, Foraminiferal Density, Dominance, Shannon–Weaver, Fisher-) show a degradation of environmental conditions, mainly evidenced by the almost total disappearance of the biocoenosis and by the low value of the foraminifer density and species richness. The biocoenosis of La Maddalena are largely formed by bolivinids, elphidiids and peneroplids. The thanatocoenosis is rather well-diversified and rich. This consists of 128 species belonging to 51 genera. The relative abundance of individual species varies from station to station, with only 14 species showing abundances >5% in at least one sample. The thanatocoenosis is slightly dominated by *Peneroplis pertusus* (8.10%), *Elphidium macellum* (6.38%) and *Miliolinella subrotunda* (6.25%).

The investigated benthic foraminifer assemblages show a degraded depositional environment, since the biocoenosis is nearly absent, while the thanatocoenosis is diversified and consists of a high number of individuals and species. Ostracods confirm a degraded depositional environment since the biocoenosis is nearly absent, while the thanatocoenosis consists of a low number of species with high number of individuals. In addition, the biotic indices of foraminifer thanatocoenosis do not vary appreciably from sample to sample, indicating similar environmental conditions in almost all the analyzed area. Future analysis in particular on ostracods and foraminifera shells will led to a better identification of the anthropogenic effects and, consequently, to assess the need for remediation measures.

REFERENCES

ALVE E., 1995. Benthic foraminiferal responses to estuarine pollution: a review. *J. Foramin. Res.*, 25: 190-203.

ARBULLA. D., 2002. Ostracofauna del Parco Nazionale dell'Arcipelago di La Maddalena (Sardegna): sistematica, ecologia, biogeografia. *Unpublished Ph.D thesis*: 150 pp.

BERGIN F., KUCUKSEZGIN F., ULUTURHAN E., BARUT I.F., MERIC E., AVSAR N. & NAZIK A., 2006 The response of benthic foraminifera and ostracoda to heavy metal pollution in Gulf of Izmir (Eastern Aegean Sea). *Estuarine, Coastal and Shelf Science*, 66:368-386.

CHERCHI A., DA PELO S., IBBA A., MANA D., BUOSI C. & FLORIS N., 2009. Benthic foraminifera response and geochemical characterization of the coastal environment surrounding the polluted industrial area of Portovesme (South-Western Sardinia, Italy). *Marine Pollution Bulletin*, 59: 281-296.

COCCIONI R., MARSILI A. & VENTURATI A., 2003. Foraminiferi e stress ambientale. In: Coccioni, R. (ed.), Verso la gestione integrata della costa del Monte San Bartolo: risultati di un progetto pilota. *Quaderni del Centro di Geobiologia dell'Università degli Studi di Urbino*, Urbino, Vol. 1: 99-118.

FRONTALINI F., BUOSI C., DA PELO S., COCCIONI R., CHERCHI A. & BUCCI C., 2009. Benthic Foraminifera as bio-indicators of trace element pollution in the heavily contaminated Santa Gilla lagoon (Cagliari, Italy). *Marine Pollution Bulletin*, 58: 858-877.

RUIZ F., ABAD M., BODERGAT A.M., CARBONEL P., RODRIGUEZ-LAZARO J. & YASUHARA M., 2005. Marine and brackish-water ostracods as sentinels of anthropogenic impacts. *Earth-Science Reviews*, 72: 89-111.

RUIZ F., GONZÁLEZ-REGALADO M.L., GALÁN E., GONZÁLEZ M.I., PRUDENCIO M.I., DIAS M.I., ABAD M., TOSCANO A., PRENDA J. & MARA GARCÍA E.X., 2012. Benthic foraminifera as bioindicators of anthropogenic impacts in two north African lagoons: a comparison with ostracod assemblages. *Revista Mexicana de Ciencias Geológicas,* 29, 3: 527-533.

SCHÖNFELD J., 2012. History and development of methods in Recent benthic foraminiferal studies. *Journal of Micropalaeontology*, 31: 53-72.

ZENINA M.A., 2009. Influence of Anthropogenic Pollution on Ostracod Assemblages of Amurskii Bay, Sea of Japan. *Russian Journal of Marine Biology*, 35, 4: 305-312.

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RECONSTRUCTION OF THE LATE QUATERNARY CLIMATIC VARIATIONS BASED ON OSTRACOD ASSEMBLAGES FROM THE NORTH WESTERN BASIN (ROSS SEA, ANTARCTICA)

Within the National Program on Antarctic Research (PNRA), studies of ostracods assemblages from seven sediment cores (ANTA91 c9, ANTA 98 c25, ANTA02 NW1, NW2, NW5, NW6, NW12) sampled in the north western sector of the Ross Sea continental shelf showed some interesting micropaleontological results, which are very useful for the reconstruction of the climatic history of the area.

This sector of the Ross Sea presents a wide zone characterized by a rich carbonate deposition which occurred during the late Pleistocene and was likely contemporaneous with basal till and glacial-marine deposition on almost the whole continental shelf. The radiometric age measured on these deposits revealed that the sedimentation took place simultaneously with the late Quaternary glacial phases and subsequently during the phases of withdrawal of the West Antarctic Ice Sheet (WAIS) (Taviani *et al.*, 1993). The carbonate deposits located along the western margins of banks on the NW Ross Sea Shelf yielded the ostracod population analyzed in this work.

In the Southern Ocean, the ostracod research has mainly concerned recent ostracods up to now, i.e. those realized by Hartmann (1993; 1994; 1997), Whatley *et al.*, 1998, Dingle (2002; 2003), Majewski & Olempska (2005), Yasuhara *et al.*, 2007 and Brandão & Horne (2009). These studies have largely improved our knowledge of the ostracods from the Antarctic area. On the contrary, investigations on ostracods in past records (sediment cores) of the Antarctic seas are rare, in consequence to the poor preservation of the fossil ostracod's valves (Brambati *et al.*, 1999; Cai, 1996; Rathburn *et al.*, 1997).

In this research on fossil ostracods, the preliminary results from three of the seven cores, showed strong qualitative and quantitative variations on the ostracod populations. The species almost constantly present throughout the cores are: *Cativella bensoni, Cytheropteron antarcticum*, *Echinocythereis* sp., *Loxoreticulatum fallax*, *Krithe* sp., *Pseudocythere* cf. *P. caudata*. Some levels of the log are characterized by high terrigenous inputs and show an evident decrease of the number of ostracods, mainly on *Echinocythereis* sp., *Loxoreticulatum fallax and Australicythere sp.* The first results provide information which confirms that these analyses, based on the ostracofauna of the Ross Sea, will help to improve our understanding of the carbonate deposition in polar settings and will be an excellent instrument to obtain a sharper interpretation of the palaeoenvironmental and climatic changes that affected the Ross Sea area during the last glacial events.

REFERENCES

BRANDAO S.N. & HORNE D.V., 2009. The Platycopid Signal of oxygen depletion in the ocean: a critical evaluation of the evidence from modern ostracod biology, ecology and depth distribution. *Paleogeography, Paleoclimatology, Paleoecology*, 283: 126-133.

BRAMBATI A., FANZUTTI G.P., FINOCCHIARO F., MELIS R., PUGLIESE N., SALVI G. & FARANDA C., 1999. Some paleoecological remarks on the Ross Sea Shelf, Antarctica. Faranda F., Guglielmo E., Ianora A. Ross Sea Ecology: Italiantartide Expeditions (1987-1995). *Berlin . Sringer-Verlag*: 51-61.

CAI H.M., 1996. Holocene Ostracoda and sedimentary environment implication in the core NG931-1 from the Great Wall Bay, Antarctica. *Antarctic Research*, 7(2): 141-149.

DINGLE R.V., 2002. Insular endemism in Recent Southern Ocean benthic Ostracoda from Marion Island: paleozoogeographical and evolutionary implications. *Revista Española de Micropaleontologia*, 34 (2): 215-233.

DINGLE R.V., 2003. Recent Subantarctic benthic ostracod faunas from the Marion and Prince Edward Islands Archipelago, Southern Ocean. *Revista Española de Micropaleontologia*, 35 (1): 119-155.

HARTMANN G., 1993. Antarktische benthische Ostracoden IX. Ostracoden von der Antarktischen Halbinsel und von der Isla de los Estados (Feuerland/Argentinien). Auswertung der "Polarstern" Reise PS ANT/X/1b. *Mitteilungen aus dem Hamburgischen zoologischen Museum und Institut*, 90: 227-237.

HARTMANN G., 1994. Antarktische benthische Ostracoden X. Bemerkungen zur Gattung Krithe mit Beschreibung einer neuen Untergattung Austrokrithe. *Mitteilungen aus dem Hamburgischen zoologischen Museum und Institut*, 91: 77-79.

HARTMANN G., 1997. Antarktische und Subantarktische Podocopa (Ostracoda). In: J.W. Wagele and J. Sieg (eds) Synopses of the Antarctic Benthos, vol. 7. *Koeltz Scientific Books, Koenigstein*: 355 pp.

MAJEWSKI W. & OLEMPSKA E., 2005. Recent ostracods from Admiralty Bay, King George Island, West Antarctica. *Polish Polar Research*, 26(1): 13-36

YASUHARA M., KATO M., IKEYA N. & SETO K., 2007. Modern benthic ostracodes from Lutzow-Holm Bay, East Antarctica: paleoceanographic, paleobiogeographic, and evolutionary significance. *Micropaleontology*, 53(6): 469-496.

RATHBURN A.E., PICHON J.J., AYRESS M.A. & DE DECKKER P., 1997. Microfossil and stable-isotope evidence for changes in Late Holocene palaeoproductivity and palaeoceanographic conditions in the Prydz Bay region of Antarctica. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 131: 485-510.

TAVIANI M., REID D. & ANDERSON J.B., 1993. Skeletal an isotopic composition and paleoclimatic significance of late pleistocene carbonates, Ross Sea Antarctica. *Journal of Sedimentary Petrology* 63(1): 84-90.

WHATLEY R.C., MOGUILEVSKY A., RAMOS M.I.F. & COXILL D.J., 1998. Recent deep and shallow water Ostracoda from the Antarctic Peninsula and the Scotia Sea. *Revista Española de Micropaleontologia*, 30 (3): 111–135.

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SUKONTHIP SAVATENALINTON

AN UPDATED CHECKLIST OF RECENT NON-MARINE OSTRACODS (*Crustacea*) FROM THAILAND

A total of 75 recent non-marine ostracod species belonging to 35 genera (Table 1) have been recorded from Thailand (VAVRA, 1906; SAVATENALINTON, 2009; SAVATENALINTON, 2010a, b; SAVATENALINTON, 2011; MARTENS & SAVATENALINTON, 2011; SAVATENALINTON & MARTENS, 2013). Twenty-five of these are considered endemic to the Oriental region and 14 species were

Table 1
Number of species in each genus found in Thailand

Genera	**N. of species**	**Genera**	**N. of species**
Alicenula	2	*Limnocythere*	1
Astenocypris	1	*Notodromas*	1
Bradleycypris	1	*Oncocypris*	1
Bradleystrandesia	1	*Physocypria*	5
Bradleytriebella	3	*Plesiocypridopsis*	1
Callistocypris	1	*Potamocypris*	1
Candona	2	*Pseudocypretta*	1
Candonopsis	1	*Pseudostrandesia*	7
Chrissia	3	*Sanyuania*	1
Cypretta	3	*Sarcypridopsis*	1
Cypridopsis	4	*Sclerocypris*	1
Cyprinotus	1	*Stenocypris*	5
Cypris	1	*Strandesia*	7
Dolerocypris	3	*Tanycypris*	1
Fabaeformiscandona	1	*Thaicythere*	1
Hemicypris	4	*Vestalenula*	2
Hungarocypris	1	*Zonocypris*	1
Ilyocypris	4	TOTAL	75

encountered and described as new for Thailand. - The most diverse genera were *Strandesia* Stuhlmann, 1888 (7 species); *Pseudostrandesia* Savatenalinton & Martens, 2009 (7 species); *Stenocypris* Sars, 1889 (5 species) and *Physocypria* Vávra, 1897 (5 species). Other enigmatic groups and new taxa occur in the checklist, but these need to be described elsewhere in the future. For example, several species of Cypridopsinae, Cyclocypridinae, Candoninae and other groups await description. Most of the records were reported from the northern and northeastern parts of Thailand, some from the central part. Sampled habitat types range from ponds, (oxbow) lakes, swamps, reservoirs, springs, canals, rivers, rice fields, waterfalls, and to damp leaf litter.

REFERENCES

MARTENS K. & SAVATENALINTON S., 2011. A subjective checklist of the Recent, free-living, non-marine Ostracoda (Crustacea). *Zootaxa*, 2855: 1-79.

SAVATENALINTON S., 2009. Taxonomy and distribution of non-marine ostracods (Crustacea, Ostracoda) in Thailand. *Thesis*, University of Ghent, Belgium, 258 pp.

SAVATENALINTON S., 2010a. Species diversity of ostracods (Crustacea, Ostracoda) in floodplain of the Chi River Basin, Mahasarakham Province. Research report, Mahasarakham University, Thailand, 28 pp. (in Thai with English abstract).

SAVATENALINTON S., 2010b. Species diversity and distribution of non-marine ostracods (Ostracoda: Crustacea) in Mahasarakham and Roi-et provinces, Thailand. Research report, Mahasarakham University, Thailand, 29 pp. (in Thai with English abstract).

SAVATENALINTON S., 2011. Diversity and distribution of non-marine ostracods (Ostracoda, Crustacea) in Udon Thani, Nong Bua lam Phu, Loei and Nong Khai provinces, Thailand. Research report, Mahasarakham University, Thailand, 26 pp. (in Thai with English abstract).

SAVATENALINTON S. & MARTENS K., 2013 (in press). On *Callistocypris thailandensis* sp. nov. (Ostracoda, Crustacea) from Thailand. *Zootaxa*.

VAVRA W., 1906. Ostracoden von Sumatra, Java, Siam, den Sandwich-Inseln und Japan. *Zoologische Jahrbücher*, 23: 413-438.

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ISA SCHÖN & KOEN MARTENS

MOLECULAR SPECIES DEFINITIONS AND PHYLOGEOGRAPHIC PATTERNS IN NON-MARINE OSTRACODS

The application of molecular tools like PCR amplification and automatic DNA sequencing of mitochondrial or nuclear regions has revolutionized existing estimates of species diversity, because many so-called cryptic species have been discovered. Furthermore, this kind of molecular data can be used to unravel phylogeographic patterns and investigate the processes that have led to the current species diversity. Here, we will present an overview on applying these techniques to non-marine ostracods with asexual, mixed and sexual reproduction.

The diversity of six morphospecies of putative ancient asexual darwinulids has been investigated with DNA sequence data of mitochondrial CO1. While two *Vestalenula* species from Western Australia show no cryptic diversity at all (SCHÖN *et al.*, 2010), three other morphospecies, *Penthesilenula aotearoa, Darwinula stevensoni* and *P. brasiliensis*, can be characterized by 2; 6-7 en 8 cryptic species, respectively (SCHÖN *et al.*, 2012). The ostracod *Eucypris virens* with mixed reproduction and geographic parthenogenesis actually forms a species complex with more than 35 cryptic species in Europe and Northern Africa (BODE *et al.*, 2010), the highest number reported for a freshwater invertebrate. Western Australian *Bennelongia* species, on the one hand, with mixed reproduction have no or limited amounts of cryptic diversity (MARTENS *et al.*, 2012), while sexual *Romecytheridea* ostracods from Lake Tanganyika display large cryptic diversity (Schön *et al.* submitted).

In some ostracods, cryptic diversity goes together with disjunctive distributions and clear phylogeographic patterns, as for example in the asexual *D.*

stevensoni, and sexual *Romecytheridea*. In contrast, no phylogeographic patterns at all can be found among the cryptic *E. virens* species with mixed reproduction, while some investigated *Penthesilenula* species display patterns of geographic separation and others do not. Obviously, the reproductive mode is not the only factor shaping relationships between cryptic diversity and phylogeography, which is why other possible mechanisms will also be discussed.

REFERENCES

BODE S.N.S., LAMATSCH D.K., MARTINS M.J.F., SCHMIT O., VANDEKERKHOVE J., MEZQUITA F., NAMIOTKO T., ROSSETTI G., SCHÖN I., BUTLIN R.K. & MARTENS K., 2010. Exceptional cryptic diversity and multiple origins of parthenogenesis in a freshwater ostracod. *Molecular Phylogenetics and Evolution*, 54: 542-552.

MARTENS K., HALSE S. & SCHÖN I., 2012. Nine new species of *Bennelongia* DeDeckker & McKenzie, 1981 (Crustacea, Ostracoda) from Western Australia, with the description of one new subfamily. *European Journal of Taxonomy*, 8: 1-56.

SCHÖN I., POUX C., VERHEYEN E. & MARTENS K. (in revision). High cryptic diversity and persistent lineage segregation in endemic *Romecytheridea* (Crustacea, Ostracoda) from the ancient Lake Tangayika (East Africa). Submitted to *Hydrobiologia*.

SCHÖN I., MARTENS K. & HALSE S., 2010. Genetic diversity in Australian ancient asexual *Vestalenula* (Ostracoda, Darwinulidae) – little variability down-under. *Hydrobiologia*, 641: 59-70.

SCHÖN I., PINTO R., HALSE S., SMITH A., MARTENS K. & BIRKY C.W. JR, 2012. Cryptic diversity in putative ancient asexual darwinulids (Crustacea: Ostracoda). PLoS ONE 7: e39844.

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Isa Schön & Koen Martens

PHYLOGENETIC ANALYSES OF ENDEMIC OSTRACODS FROM ANCIENT LAKES - EXAMPLES FROM LAKE TANGANYIKA AND LAKE BAIKAL

Ancient lakes are natural laboratories for evolutionary research, where species can be studied in the cradle where they originated (Martens, 1997). We investigated two endemic ostracod species flocks from the two oldest lakes in the world, Lake Baikal (c. 28 myr) and Lake Tanganyika (c. 12 myr), the *Cytherissa* and the *Cyprideis* flock, respectively, with DNA sequence data (Schön & Martens, 2012). While most phylogenetic relationships of the Tanganyika flock were resolved with mitochondrial COI data, the Baikalian tree contained non-resolved multifurcations of up to seven different clades. The latter pattern can most likely be explained by explosive speciation events during its earlier history. Nuclear ITS1 was not sufficiently variable to resolve the phylogeny of both flocks at all. The Tanganyikan *Cyprideis* flock shows higher genetic variability of COI, which fits with its higher morphological variability.

We also found evidence that the rate of molecular evolution between the two flocks is quite different, which could possibly be attributed to different generation times. Applying a molecular clock for COI (Wilke *et al.*, 2009) and using the wide fossil appearance of *Cytherissa* in the Holarctic 8 myr ago (Danielopol *et al.*, 1990) to calibrate the tree gave similar results – an estimated age for ancestral *Cytherissa* of 5 to 8 myr, around the time when the cold, oxygenated abyss was formed in Lake Baikal. The Tanganyikan *Cyprideis* flock is with c. 15 myr almost twice as old as the Baikalian *Cytherissa* flock, and possibly older than Lake Tanganyika itself. This means that the *Cyprideis* flock must have survived drastic lake level changes and the resulting drastic changes in salinity during its whole history.

REFERENCES

DANIELOPOL D.L., OLTEANU R., LÖFFLER H. & CARBONEL P., 1990. Present and past geographical and ecological distribution of *Cytherissa* (Ostracoda, Cytherideidae). In: Danielopol D.L., Carbonel P. & Colin J.P. (eds.) *Cytherissa* (Ostracoda) – the *Drosophila* of Palaeolimnology. *Bulletin de l'institut de géologie du bassin d'acquitaine*, 47-48: 97-116.

MARTENS K., 1997. Speciation in ancient lakes. *Trends in Ecology and Evolution*, 12: 177-182.

SCHÖN I. & MARTENS K., 2012. Molecular analyses of ostracod flocks from Lake Baikal and Lake Tanganyika. *Hydrobiologia*, 682: 91-110.

WILKE T., SCHULTHEIß R. & ALBRECHT C., 2009. As time goes by: A simple fool's guide to molecular clock approaches in invertebrates. *American Malacological Bulletin*, 27: 25-45.

Authors' Addresses — I. SCHÖN, K. MARTENS, Royal Belgian Institute of Natural Sciences, Freshwater Biology, Vautierstraat 29, B-1000 Brussels (Belgium); e-mail: isa.schoen@naturalsciences.be; koen.martens@naturalsciences.be.

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ISA SCHÖN, STUART HALSE & KOEN MARTENS

A REVISION OF WESTERN AUSTRALIAN *BENNELONGIA* (*Crustacea Ostracoda Cyprididae*) - THE COMPLEMENTARITY OF MOLECULAR AND MORPHOLOGICAL STUDIES

We will report on our ongoing revision of the genus *Bennelongia* De Deckker & McKenzie, 1981; endemic to Australia and New Zealand. Originally, only two morphospecies of this genus were described from temporary pools in Western Australia but we meanwhile identified and described 9 new species (MARTENS *et al.*, 2012). By applying DNA sequencing and the Evolutionary Genetic Species concept (PONS *et al.*, 2006; BIRKY *et al.*, 2010), we confirmed species status for six of these new species genetically. Subsequent, more detailed morphological studies based on new and micro characters, such as position and shape of the label on the right ostracod valve, supported the genetic species boundaries. We are currently reviewing additional material, from which we expect to describe another 10 to 20 new species. We will also present phylogeographic analyses of these species to test whether they occur sym – or allopatric.

Our study emphasizes the need of geneticist and taxonomists to work closely together to unravel cryptic diversities and develop adequate measures for the protection of our biodiversity.

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REFERENCES

BIRKY C.W., ADAMS J., GEMMEL M. & PERRY J., 2010. Using population genetic theory and DNA sequences for species identification in asexual organisms. *PLoS ONE*, 5:e10609.

MARTENS K., HALSE S. & SCHÖN I., 2012. Nine new species of *Bennelongia* DeDeckker & McKenzie, 1981 (Crustacea, Ostracoda) from Western Australia, with the description of one new subfamily. European. *Journal of Taxonomy*, 8: 1-56.

PONS J., BARRACLOUGH T., GOMEZ-ZURITA J., CARDOSO A., DURAN D., HAZELL S., KAMOUN S., SUMLIN W. & VOGLER A., 2006. Sequence-based species delimitation for the DNA taxonomy of undescribed insects. *Systematic Biology*, 55: 595-609.

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Michael Schudack, Ulla Schudack & Daniel Marty

KIMMERIDGIAN (UPPER JURASSIC) OSTRACODS FROM THE TRANSJURANE HIGHWAY (CANTON JURA, NW SWITZERLAND): TAXONOMY, STRATIGRAPHY AND PALAEOECOLOGY

Since the year 2000, road works for the future Transjurane highway (Canton Jura, Switzerland) revealed over 4000 dinosaur footprints including 280 trackways of Kimmeridgian age (Marty *et al.*, 2007). Here, we describe the ostracods from this succession, and their biostratigraphical and palaeoecological implications. With a few exceptions (Oertli, 1959, 1963), the ostracod faunas from the Upper Jurassic of the Swiss Jura were not studied in detail (partly due to the abundance of stratigraphically useful ammonites).

Here, we present 21 ostracod species belonging to 13 genera, from five sections, all from the middle part of the Reuchenette Formation. In principal, the biostratigrapy is largely known from the study of ammonites (summarized by Marty *et al.*, 2007), but the ostracods presented in this paper have been studied in order to support and – if and where possible – enhance these relative datations. With respect to the boreal ammonite zones (Ogg & Hinnov, 2012) used in this study, the ostracod-bearing parts of the sections (only the Kimmeridgian part considered here) represent the uppermost part of the *Cymodoce* zone (Banné Member = uppermost Lower Kimmeridgian), the *Mutabilis* zone (Courtedoux Member = lower part of the Upper Kimmeridgian) and the lowermost part of the *Eudoxus* zone (lower *Virgula* marls = base of the middle part of the Upper Kimmeridigan).

Four (out of the 21) ostracod species are exclusive to the uppermost *Cymodoce* zone, whereas three species range from the *Cymodoce* into the *Mutabilis* zone and five long-ranging species even into the lowermost

Eudoxus zone. Nine species are exclusive to the *Mutabilis* and lower *Eudoxus* ammonite zones, and three of them only to the lower *Eudoxus* zone.

In no case, known stratigraphical ranges of the ostracod species contradict the ammonite biozonation of the sections under study, but – unfortunately - they don´t contribute to more refined stratigraphical subdivisions. Nevertheless, we can observe the trend that several species providing geologically older FADs and LADs preferably occur in lower levels of the sections (at least statistically), and vice versa. This fact confirms of the principal usability of these ostracods for biostratigraphical purposes, though not as accurate as it is possible with ammonites.

On the basis of ostracods alone, and without the available stratigraphic information from ammonites, the Banné Member would have been correlated with the upper *Cymodoce* and/or *Mutabilis* ammonite zones, the Courtedoux Member with the *Mutabilis* zone, and the lower *Virgula* marls with the *Mutabilis* and/or lower *Eudoxus* zone. Thus, the stratigraphical succession within the Kimmeridgian is as clearly visible as the limitation of the whole sequence under discussion to the upper *Cymodoce*, *Mutabilis*, and lower *Eudoxus* ammonite zones.

Ostracods are also useful indicators for palaeoecology of the sections under study (here: salinity). Based upon estimations and calculations of several authors (see WEISS, 1995, for a summary and more publications on this subject), ranges of salinity tolerances of many late Jurassic genera are well established. We have calculated the “average salinities” for each of the ostracod-bearing layers in the five sections, derived from all genera existing in a sample.

According to these calculations (only applying to the ostracod-bearing layers), the lowermost part of the sequence (Banné Member, 1 section) provides the highest salinity (average salinities between 23 and 28‰, reflecting brachyhaline waters). The member becomes more brackish in its upper part, which correlates with an increasing number of ammonites.

Most of the samples from the lower part of the Courtedoux Member (1 section) have yielded only few ostracods, but clearly pointing to an average salinity of around 16-18‰ (highly pliohaline, and thus a little more brackish than the underlying Banné Member).

The intermediate and upper levels of the Courtedoux Member and the lower Virgula marls (3 sections) have produced a large number of ostracod-bearing samples, all pointing to somewhat higher salinities. A slight trend leads from average salinities around 20-25‰ in the basal part of these sections (intermediate level of Courtedoux M.) to higher (nearly euhaline) average salinities of 25-30‰ in its upper part (upper level of Courtedoux M. and lower Virgula marls). Again, this trend of slightly increasing salinities is paralleled by the inset of ammonite occurrences.

REFERENCES

MARTY D., AYER J., BECKER D., BERGER J.-P., BILLON-BRUYAT J.-P., BRAILLARD L., HUG W.A. & MEYER C.A., 2007. Late Jurassic dinosaur tracksites of the Transjurane highway (Canton Jura, NW Switzerland): overview and measures for their protection and valorization. *Bulletin for Applied Geology,* 12: 75-89.

OERTLI H.J., 1959. Malm-Ostrakoden aus dem schweizerischen Juragebirge. *Denkschriften der Schweizerischen Naturforschenden Gesellschaft.,* 83: 44 pp.

OERTLI H.J., 1963. Ostracodes du "Purbeckien" du Bassin Parisien. *Revue de l'Institut Francais du Pétrole*, 18: 5-38.

OGG J. & HINNOV L.A., 2012. Jurassic. In: Gradstein F., Ogg J., Schmitz M. & Ogg G. (eds.), The geologic time scale 2012. *Elsevier*: 731-792.

WEISS M., 1995. Stratigraphie und Microfauna im Kimmeridge SE-Niedersachsens unter besonderer Berücksichtigung der Ostracoden. *Ph.D. dissertation*, Technische Universität Clausthal, Clausthal, Germany, 359 pp.

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Oana-Gabriela Sebe, Sylvie Crasquin & Eugen Grădinaru

OSTRACOD BIOSTRATIGRAPHY IN THE DEŞLI CAIRA SECTION (ROMANIA): A GSSP CANDIDATE FOR THE OLENEKIAN-ANISIAN BOUNDARY

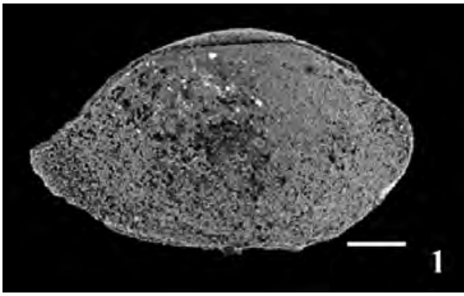
After the most drastic biological crisis of Phanerozoic times, 252 My ago, the Lower Triassic is marked by a long recovery period. Whereas the Upper Triassic ostracods are quite well known, particularly in the Tethyan domain, ostracod faunas of the Lower and Middle Triassic interval stay poorly documented.

In the North Dobrogean Orogen, the Triassic deposits crop out over large areas and are present in all its tectonostratigraphic units: Măcin Unit, Consul Unit, Niculiţel Unit and Tulcea Unit. The Triassic is most completely developed in the Tulcea Unit, where many sections are well calibrated by ammonoid and conodont biostratigraphy (Grădinaru, 2000).

At the Deşli Caira section (Agighiol Hills, Tulcea Unit), which is a candidate for the Global Stratotype Section and Point (GSSP) of the Olenekian-Anisian stage boundary, i.e. the Lower-Middle Triassic series boundary, the classic Agighiol lithofacies (fossiliferous limestone in Hallstatt-type facies) is exposed. It shows an impressive occurrence of macrofaunas (ammonoids) and microfaunas (ostracods and conodonts) in the Olenekian-Anisian boundary interval.

This study includes a systematic study of the ostracods from the Lower and Middle Triassic deposits of the Deşli Caira section and their stratigraphic range at the Olenekian-Anisian (Lower-Middle Triassic) boundary.

The ostracods were extracted by the hot acetolysis method (Lethiers & Crasquin-Soleau, 1988) Most of the ostracod assemblages are very well preserved and over 25 species have been identified. They belong to the



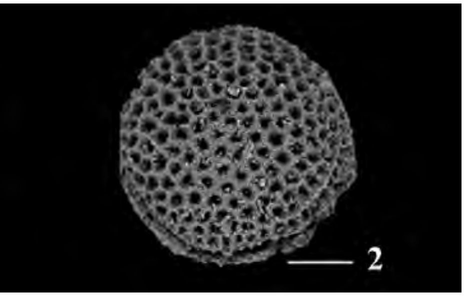


Fig. 1 — Ptychobairdia *cf.* kuepperi *Kollmann, 1963.*
Fig. 2 — Discoidella *cf.* suprapermiana *Kozur, 1985.*

Podocopida (Bairdiidae) including *Bairdia* sp. 2, sp. 3, sp. 4, sp. 5, sp. 6, sp. 7, sp. 9, sp. 10, sp. 24, *Bairdiacypris* cf. *anisica* Kozur, 1971, *Ptychobairdia* cf. *kuepperi* Kollmann, 1963, *Ptychobairdia* sp., *Lobobairdia salinaria* Kollmann, 1963, and the Myodocopida (Polycopidae) including *Polycope* sp. 1, sp. 3, *Discoidella* cf. *suprapermiana* Kozur, 1985.

The Olenekian-Anisian (Lower-Middle Triassic) boundary is marked by a major change in the ostracod fauna. At base of the Anisian the ostracod fauna assemblage is largely dominated by smooth species of *Bairdia* which are indicative of an open-marine environment. The ostracod biostratigraphy in the Deşli Caira section is supported by ammonoids, nautiloids and conodont faunas (GRĂDINARU *et al.*, 2006; GRĂDINARU & SOBOLEV, 2006; ORCHARD *et al.*, 2007).

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REFERENCES

GRĂDINARU E., 2000. Introduction to the Triassic geology of North Dobrogea Orogene – An overview of the Triassic System in the Tulcea Unit and the ammonoid biostratigraphy. In: Grădinaru E. (Ed.), Workshop on the Lower-Middle Triassic (Olenekian-Anisian) boundary, 7-10 June 2000, Tulcea, Romania, Field Trip Section, 5-18, Bucharest.

GRĂDINARU E., KOZUR H.W., NICORA A. & ORCHARD M.J., 2006. The *Chiosella timorensis* lineage and correlation of the ammonoids and conodonts around the base of the Anisian in the GSSP candidates at Deşli Caira (North Dobrogea, Romania). *Albertiana*, 34: 34-38.

GRĂDINARU E. & SOBOLEV E.S., 2006. Ammonoid and nautiloid biostratigraphy around the Olenekian-Anisian boundary in the Tethyan Triassic of North Dobrogea (Romania): correlation with the Boreal Triassic. In: NAKREM H. A. & MORK A. (Eds), Boreal Triassic 2006, Longyearbyen, Svalbard, 16-19 August 2006, NGF. *Abstracts and Proceedings of the Geological Society of Norway*, 3: 56-58.

LETHIERS F. & CRASQUIN-SOLEAU S., 1988. Comment extraire des microfossiles à tests calcitiques de roches calcaires dures. *Revue de Micropaléontologie* 31 (1): 56-61.

ORCHARD M.J., GRĂDINARU E. & NICORA A., 2007. A summary of the conodont succession around the Olenekian-Anisian boundary at De li Caira, North Dobrogea, Romania. In: Lucas S.G. & Spielmann J. A. (Eds), The Global Triassic, *New Mexico Museum of natural History and Science Bulletin*, 41: 341-346.

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A NEOGENE LARGE AND SHALLOW BRACKISH WATER LAKE IN THE ILI BASIN, KAZAKHSTAN (EASTERN PARATETHYS) AND ITS OSTRACOD FAUNA

The present study covers Miocene to Pliocene sediments from the Ili Basin in southeastern Kazakhstan. These continental sediments were deposited during the uplift of mountain ranges of the Tienschan. Especially Miocene deposits show a great variety of lacustrine facies, which interfinger with alluvial fans, mud flats and river channels. Varying colour and composition of the sedimentary succession as well as fluctuating contents of salt and gypsum in the mudstones point to major climatic changes reflected by lake level oscillation, probably partly in cyclic patterns.

We investigated twenty samples from presumable aquatic deposits (marls and sands). They belong to the Miocene Santash Formation and the Pliocene Ili Formation. Except one, all contain aquatic microfossils, especially a rich ostracod fauna. The state of fossil preservation ranges between good and poor with crystal enlargement and sometimes signs of dissolution or with fragmentation and deformation of valves. We cannot exclude that parts of the poorly preserved associations are reworked, however, most alterations seem to be diagenetic. There are no indications for river sediments and associated transport before the Ili formation.

In total, 21 ostracod taxa could be identified relying mostly on BODINA (1961). The most frequent taxa are *Ilyocypris gibba*, *Cyprideis torosa*, *Cyprinotus baturini*, *Paracandona euplectella* and an unknown *Eucypris* species (compare list of taxa below). The ostracods indicate a Miocene to early Pliocene age of the studied samples (Santash and Ili formations). The differentiation between both investigated formations is defined by facies and a stratigraphical subdivision based on ostracods is still problematical. Most of the Santash formation is characterised by lake taxa (e.g. *Cyprideis torosa*, limnocytherids), whereas its upper part and the Ili formation contain associations reflecting more unstable environmental conditions of small and temporary waters (e.g. *Paracandona euplectella*, *Cyprinotus* spp., darwinulids) as well as rivers. Other microfossils are abundant gyrogonites and stems of charophytes, gastropodes and bivalve fragments as well as fish bones and scales.

Also, the wide distribution of lacustrine sediments indicates a large lake during the Santash formation. Characteristic is the brackish water ostracod *Cyprideis torosa,* which does not have dry-resistent eggs and needs therefore permanent water bodies with an elevated salt content (HEIP, 1976; PINT *et al.*, 2012). This index species (GRAMANN, 2000) is not present in all samples indicating fluctuating lake levels and salinities. The water was generally shallow and the phytal zone well developed. The shore line is assumed to be situated close to the study area in the North. Despite strong fluctuations, there is anup-section tendency to higher salinity shown by monospecific mass occurrence of smooth shelled *C. torosa* in the upper part of the Santash Formation pointing to dry climatic conditions. Cyclic sedimentation patterns and fluctuation of shore lines and salinity indicate climatically driven lake level changes during the deposition of the Santash Formation. The following associations of the Ili Formation are characterised by freshwater taxa, the lack of *C. torosa* and more and more forms preferring temporary and smaller waters. They indicate a perishing of the former lake. The depositional system was charceterisedby smaller temporary water bodies on the flood-plain of a major river system in the early Pliocene.

Systematic List

Higher systematics according to HORNE *et al.* (2002).

Class Ostracoda Latreille, 1806
  Suborder Darwinulocopina Sohn, 1988
    Superfamily Darwinulidea Brady & Norman, 1889
      Darwinula kenderlykensis Bodina, 1961
  Suborder Cypridocopina Sohn, 1988
    Superfamily Cypridoidea Baird, 1845
Family Candonidae Kaufmann, 1900
      Candoniella? marcida Mandelstam, 1961
      Paracandona euplectella (Robertson, 1889)
      Pseudocandona kirgizica (Mandelstam, 1961)
    Family Ilyocyprididae Kaufmann, 1900
      Ilyocypris gibba (Ramdohr, 1808)
    Family Cyprididae Baird, 1845
      Cypridopsis vassoevitschi Schneider 1961
      Cypridopsis sp.

Cyprinotus baturini Schneider 1961
Cyprinotus espinicus Bodina 1961
Cyprinotus vialovi Schneider 1961
Eucypris kovalevskyi Schneider, 1961
Eucypris sp.
Potamocypris sp.
Prionocypris sp. sensu Bodina 1961
Prionocypris vitrea Bodina 1961
Virgatocypris sp.
SuborderCytherocopina
Superfamily Cytheroidea
Family Limnocytheridae Klie, 1938
Limnocythere prasolowi Bodina 1961
Family Cytherideidae Sars, 1925
Cyprideis torosa (Jones, 1850)

gen. et sp. inc.

REFERENCES

[BODINA, L.E.] БОДИНА Л.Е., 1961. Остракоды третичных отложений Зайсанской и Илийскй депрессий [Ostracoda from Tertiary deposits of the Saysan and Ili Basin]. In: [Microfauna of the USSR] Микрофауна СССР, XII (фораминиферы и остракоды меловых и третичных отложений Западной Сибири, Восточного Казахстана и Дальнего Востока [Foraminifera and Ostracoda from Cretaceous and Tertiary sediments of Western Sibiria, Eastern Kasakhstan and the Far East of the USSR]): 43-139, 14 plates; VNIGRI, Leningrad.

GRAMANN F., 2000. Ostrakoden der Art *Cyprideis torosa* als Indikatoren für Salzgehalt und Klima – Nachweis eines Binnensalinars im Pleistozän Nordostniedersachsens. *Zeitschrift für Angewandte Geologie*, 46(1): 49-58.

HORNE D.J., COHEN A. & MARTENS K., 2002. Taxonomy, morphology and biology of Quaternary and living Ostracoda. In: K.A. HOLMES, A.R. CHIVAS (Eds.), The Ostracoda, Application in Quaternary Research. Geophysical Monographs 131, American Geophysical Union, Washington, DC (2002), pp. 5-36.

HEIP C., 1976. The life-cycle of *Cyprideis torosa* (Crustacea, Ostracoda). *Oecologia*, 24: 229-245.

PINT A., FRENZEL P., FUHRMANN R., SCHARF B. & WENNRICH V., 2012. Distribution of *Cyprideis torosa* (Ostracoda) in Quaternary athalassic sediments in Germany and its application for palaeoecological reconstructions. *International Review of Hydrobiology*, 4: 330-355.

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RYLAN SHEARN, STUART HALSE, KOEN MARTENS,
ANNETTE KOENDERS & ISA SCHÖN

DECIPHERING RADIATION PATTERNS IN AUSTRALIAN *BENNELONGIA* DE DECKKER & MCKENZIE, 1981 (*Crustacea Ostracoda*)

Throughout the world, invertebrate communities lay idle in sediments during drought periods and arise upon inundation events in temporary pools, using a range of adaptations that enable drought resistance and a tolerance to the highly variable conditions after inundation (HUMPHRIES & BALDWIN, 2003; SÁNCHEZ & ANGELER, 2007). Some geographic regions of the world show a higher diversity and endemicity of these taxa than others (KING *et al.*, 1996). However, this is rarely explained by hypotheses that draw from phylogeography and evolutionary history.

In Australia for example, a higher diversity and endemism of some drought resistant invertebrates has been documented in the continent's western region, compared to the eastern region (FREY, 1998; REMIGIO *et al.*, 2001; TIMMS, 2002). The proposed explanations for this are firstly the long period of tectonic inactivity in Australia, which has left temporary pools unaltered for long evolutionary timescales (DE DECKKER, 1983; HALSE *et al.*, 2003), thus enabling the radiation of these taxa over time. However, this does not explain why these taxa have not dispersed throughout the remainder of the continent. This problem is explained by a second hypothesis that describes barriers to dispersal, formed either by the arid climatic conditions of central Australia (ARCHER & CLAYTON, 1984; FREY, 1998), or the presence of an inland sea during the Cretaceous (REMIGIO *et al.*, 2001), or a combination of the two. Current biological evidence for these hypotheses is based on examples of high documented diversity in the western region (FREY, 1998; BOXSHALL & DEFAYE, 2008; REMIGIO *et al.*, 2001; TIMMS, 2002) that lack comparison of the similarity between east and west regions. Ideally, genetic comparisons between regions would enable a better understanding of whether (or to what extent) these barriers to dispersal are present.

Recent taxonomic studies on *Bennelongia* (Ostracoda, Cyprididae) have revealed this genus to be yet another exemplar for the aforementioned hypotheses, with a high diversity in the western region (MARTENS *et al.*, 2012), but comparatively low diversity in the eastern region (SHEARN *et al.*, 2012). In this study, the degree of genetic variability throughout Australia was analysed by extracting DNA from representative *Bennelongia* species throughout eastern and western regions, then sequencing the mitochondrial COI gene and determining the genetic variability between regions using computational phylogenetic approaches.

Analysis of the genetic variability within and between these regions has revealed different patterns between lineages within this genus. For some lineages, a higher degree of similarity between regions was observed, while for others the opposite pattern was evident. These results suggest that the movement of some lineages between regions was not impeded by the hypothesised dispersal barrier, either because of spatial or temporal breaks in the barrier (for example during periodic retractions of the arid zone (BOWLER, 1982)), or through recent, highly efficient dispersal. For lineages that do show isolation, the use of molecular clocks to estimate divergence times will be useful in showing evidence for the location and timing of barriers that may have impeded dispersal. More widely, these results suggest that isolated eastern and western radiations are not a universal feature of temporary pool microfauna in Australia.

REFERENCES

ARCHER M. & CLAYTON G., 1984. Vertebrate Zoogeography and Evolution in Australasia (Animals in space and time). *Hesperian Press*: Marrickville NSW.

BOWLER J.M., 1982. Aridity in the late Tertiary and Quarternary of Australia. In: W. R. Barker & P. J. Greenslade (eds.), Evolution of the flora and fauna of arid Australia. *Peacock Publications*, Frewville.

BOXSHALL G. & DEFAYE D., 2008. Global diversity of copepods (Crustacea: Copepoda) in freshwater. *Hydrobiologia,* 595: 195-207.

DE DECKKER P., 1983. Australian salt lakes: their history, chemistry and biota – a review. *Hydrobiologia,* 105: 231-244.

FREY D., 1998. Expanded description of Leberis aenigmatosa Smirnov (Anomopoda: Chydoridae): a further indication of the biological isolation between western and eastern Australia. *Hydrobiologia,* 367: 31-42.

HALSE S.A., RUPRECHT J.K. & PINDER A.M., 2003. Salinisation and prospects for biodiversity in rivers and wetlands of south-west Western Australia. *Australian Journal of Botany,* 51: 673-688.

HUMPHRIES P. & BALDWIN D.S., 2003. Drought and aquatic ecosystems: an introduction. *Freshwater Biology*, 48: 1141-1146.

KING J.L., SIMOVICH M.A. & BRUSCA R.C., 1996. Species richness, endemism and ecology of crustacean assemblages in northern California vernal pools. *Hydrobiologia,* 328: 85-116.

MARTENS K., HALSE S. & SCHÖN I., 2012. Nine new species of *Bennelongia* De Deckker & McKenzie, 1981 (Crustacea, Ostracoda) from Western Australia, with the description of a new subfamily. *European Journal of Taxonomy,* 8: 1-56.

REMIGIO E.A., HEBERT P.D.N. & SAVAGE A., 2001. Phylogenetic relationships and remarkable radiation in *Parartemia* (Crustacea: Anostraca), the endemic brine shrimp of Australia: evidence from mitochondrial DNA sequences. *Biological Journal of the Linnean Society,* 74: 59-71.

SÁNCHEZ B. & ANGELER D.G., 2007. Can fairy shrimps (Crustacea: Anostraca) structure zooplankton communities in temporary ponds? *Marine and Freshwater Research,* 58: 827-834.

SHEARN R., KOENDERS A., HALSE S., SCHÖN I. & MARTENS K., 2012. A review of *Bennelongia* De Deckker & McKenzie, 1981 (Crustacea, Ostracoda) species from eastern Australia with the description of three new species. *European Journal of Taxonomy,* 25: 1-35.

TIMMS B.V., 2002. The fairy shrimp genus *Branchinella* Sayce (Crustacea: Anostraca: Thamnocephalidae) in Western Australia, including a description of four new species. *Hydrobiologia,* 486: 71-89.

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RYLAN SHEARN, ISA SCHÖN, ANNETTE KOENDERS,
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GEOGRAPHIC PARTHENOGENESIS IN AUSTRALIAN *ILYODROMUS* SARS, 1894 (*Crustacea Ostracoda*)

Most multicellular organisms reproduce sexually at some point in their life cycle (BELL, 1982). This prevalence and persistence of sex has been described as paradoxical, because with the two-fold cost of sex (MAYNARD-SMITH, 1978) one would expect the world to be dominated by asexual organisms (DAGG, 2000). This has since been partially explained with ideas based on the early exintion of asexual lineages, such as their inability to adapt to rapidly changing selection conditions (known as the Red Queen hypothesis: BIRDSELL & WILLS, 2003; HAMILTON, 1980; MAYNARD-SMITH, 1980) or their accumulation of deleterious mutations (KONDRASHOV, 1988; MULLER, 1932). However, asexual lineages continue to persist throughout wide distributions, in vastly different habitats (BELL, 1982; SCHÖN *et al.*, 2009; SUOMALAINEN *et al.*, 1987), and in some cases for long evolutionary timescales (SCHÖN *et al.*, 1998; WELCH & MESELSON, 2000). Furthermore the growing number of incompatible explanatory hypotheses suggests that the paradox of sex is far from solved.

One area of research showing great promise in highlighting ecological factors that may explain the prevalence of sexual reproduction is the study of the differential geographic distribution of sexuals and asexuals (known as Geographic Parthenogenesis: VANDEL, 1928). Organisms that display this phenomenon tend to have asexual lineages distributed in more marginal habitats than sexual lineages of either the same or closely related species (VANDEL, 1928; 1940). Trends in Geographic Parthenogenesis are perhaps best documented in Europe, where asexual lineages tend to occur everywhere while sexual lineages are limited to the Mediterranean region (VANDEL, 1928). It is generally believed that this may be a reflection of the short term colonisation ability of asexual lineages since the last glaciation eliminated populations that occurred in the north. In contrast, sexual colonisers need to find a mate in temporally and spatially diluted environments. More recently, a finer scale trend was observed; polyploid asexuals were shown to be more generalist and to have a wider distribution than diploid asexuals (ADOLFSSON *et al.*, 2009; MANIATSI *et al.*, 2011; STENBERG *et al.*, 2003). This suggests that, at least in Europe, a higher selective advantage (KEARNEY, 2003) through increased potential gene combinations (OTTO & WHITTON, 2000) could govern the success of asexual lineages in marginal environments.

A similar pattern has been observed in Australia. However the hypothesised underlying mechanisms are slightly different. Parthenogenetic and polyploid lineages have been shown to occur in more arid habitats, and sexuals in higher rainfall areas (KEARNEY, 2003; KEARNEY *et al.*, 2006; VORBURGER, 2006). The explanation offered is that the increased colonisation and reproductive efficiency of parthenogenetic organisms is an advantageous attribute in Australian arid environments, where population densities are often low (KEARNEY, 2003). Furthermore, sexuals in the high rainfall areas of Australia are hypothesised to undergo inter-species hybridisation, resulting in rapid production of asexuals with new phenotypes adapted to the empty niches left from prolonged drought in nearby arid regions (KEARNEY, 2003). However, unlike Europe, a trend has not been successfully documented in aquatic taxa. Although attempts have been made, outcomes did not show Geographic Parthenogenesis due to the use of fully sexual models (FINSTON, 2002 for example). As they are aquatic and have a mixed reproductive mode, cypridid ostracod taxa are the best candidates to test if this Australian pattern is caused by more complex processes than rainfall alone (for example habitat stability or water chemistry). *Ilyodromus* Sars, 1894 is a non-marine cypridid ostracod genus that is known to have both sexual and parthenogenetic populations distributed throughout Australia (Stuart Halse, unpublished data). As these species occur across a range of climates (Stuart Halse, unpublished data), their mixed reproductive strategy makes them an ideal model to investigate the relationship between aridity, habitat stability and reproductive mode in Australia. We intend to implement this investigation, by firstly establishing a taxonomic framework for the genus that will enable the study of species and the differential distribution of their reproductive mode, then using a number of traditional and molecular approaches to define patterns of Geographic Parthenogenesis and/or ploidy level distribution.

REFERENCES

ADOLFSSON S., MICHALAKIS Y., PACZESNIAK D., BODE S.N.S., BUTLIN R.K., LAMATSCH D.K., MARTINS M.J.F., SCHMIT O., VANDEKERKHOVE J. & JOKELA J., 2009. Evaluation Of Elevated Ploidy And Asexual Reproduction As Alternative Explanations For Geographic Parthenogenesis In Eucypris Virens Ostracods. *Evolution,* 64: 986-997.

BELL G., 1982. The Masterpiece of Nature: the Evolution and Genetics of Sexuality. *Croom Helm*: London.

BIRDSELL J.A. & WILLS C., 2003. The evolutionary origin and maintenance of sexual recombination: a review of contemporary models. *Evolutionary Biology,* 33.

DAGG J.L., 2000. Why sex? A parody on the paradox. *Oikos,* 89.

FINSTON T.L., 2002. Geographic patterns of population genetic structure in *Mytilocypris* (Ostracoda: Cyprididae): interpreting breeding systems, gene flow and history in species with differing distributions. *Molecular Ecology,* 11: 1931-1946.

HAMILTON W.D., 1980. Sex vs. non-sex vs parasite. *Oikos,* 35: 282-290.

KEARNEY M.R., 2003. Why is sex so unpopular in the Australian desert? *Trends in Ecology and Evolution,* 18: 605-607.

KEARNEY M.R., BLACKET M.J., STRASBURG J.L. & MORITZ C., 2006. Waves of parthenogenesis in the desert: evidence for the parallel loss of sex in a grasshopper and a gecko from Australia. *Molecular Ecology,* 15: 1743-1748.

KONDRASHOV A.S., 1988. Deleterious mutations and the evolution of sexual reproduction. *Nature,* 336.

MANIATSI S., BAXEVANIS A.D., KAPPAS I., DELIGIANNIDIS P., TRIANTAFYLLIDIS A., PAPAKOSTAS S., BOUGIOUKLIS D. & ABATZOPOULOS T.J., 2011. Is polyploidy a persevering accident or an adaptive evolutionary pattern? The case of the brine shrimp Artemia. *Molecular Phylogenetics and Evolution,* 58: 353-364.

MAYNARD-SMITH J., 1978. The Evolution of Sex. *Cambridge University Press*: Cambridge.

MAYNARD-SMITH J., 1980. Selection for recombination in a polygenic model. *Genet Res,* 35.

MULLER H.J., 1932 Some genetic aspects of sex. *American Naturalist,* 66: 118-138.

OTTO S.P. & WHITTON J., 2000. Polyploid Incidence and Evolution. *Annual Review of Genetics,* 2000: 401-437.

SCHÖN I., BUTLIN R.K., GRIFFITHS H.I. & MARTENS K., 1998. Slow molecular evolution in an ancient asexual ostracod. *Proceedings of the Royal Society of London,* 265: 235-242.

SCHÖN I., MARTENS K. & DIJK P. V., 2009. Lost Sex, The Evolutionary Biology of Parthenogenesis. *Springer*: Dordrecht, Heidelberg, London, New York.

STENBERG P., LUNDMARK M., KNUTELSKI S. & SAURA A., 2003. Evolution of Clonality and Polyploidy in a Weevil System. *Molecular Biology and Evolution,*20: 1626-1632.

SUOMALAINEN E., SAURA A. & LOKKI J., 1987. Cytology and evolution in parthenogenesis. *CRC Press*: Boca Raton.

VANDEL A., 1928. La parthénogénèse géographique contribution a l`étude biologique et cytologique de la parthénogénèse naturelle. *Bull Biol France Belg* 62: 164-281.

VANDEL A., 1940. La parthénogénèse géographique. IV. Polyploidie et distribution géographique. *Bull Biol France Belg,* 74.

VORBURGER C., 2006. Geographic Parthenogenesis. *Current Biology,* 15: 641-643.

WELCH D.M., & MESELSON M., 2000. Evidence for the Evolution of Bdelloid Rotifers Without Sexual Reproduction or Genetic Exchange. *Science,* 288: 1211-1215.

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DAVID J. SIVETER

ORIGIN & EARLY HISTORY OF OSTRACODS

There is general agreement that the Cambrian witnessed the origin of the major morphological novelties within the Arthropoda and there is consensus regarding the general pattern of arthropod phylogeny. However, certain details remain unresolved; for example, within the Mandibulata, what is the relationship between Crustacea and Hexapoda? The case for ostracod monophly based on morphological analysis is supported by recent molecular studies. The Bradoriida and Phosphaticopina, traditionally regarded as the representatives of Ostracoda in the Cambrian, are now generally accepted as stem crustaceans, but both fossil and molecular evidence argue in favour of a Cambrian ostracod record. The earliest supposed ostracods based on fossil shell evidence are of early Ordovician age. Rare Silurian Myodocopa and Devonian Podocopa with soft-part preservation confirm the presence of both groups in the Palaeozoic. In the absence of knowledge of soft anatomy the true systematic affinity and integrity of the Palaeocopida, known from some 500 Palaeozoic genera, remains problematic, especially as features of the shell morphology of Silurian myodocopid myodocopes recall halocyprid myodocopes and palaeocopes and thereby encourage caution in classifying ostracods based on the carapace alone and query the interpretation of their shell-based fossil record. Although having multilayered shells, other shell features of the Eridostracina (Ordovician-Carboniferous) suggest an ostracod affinity, but the ostracod affiliation of the leperditicopids (Ordovician-Devonian) remains conjecture.

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ARIANY DE JESUS E SOUSA & LUCIO RIOGI TOKUTAKE

VARIATIONS OF THE GENERA *KRITHE*, *HENRYHOWELLA* AND *POSEIDONAMICUS* IN UPPER QUATERNARY SEDIMENTS OF THE CAMPOS BASIN (SOUTHEASTERN BRAZIL): PALAEOCLIMATOLOGY AND PALEOCEANOGRAPHY

The marine ostracods are an excellent tool for interpreting climatic and oceanographic changes (DINGLE & LORD, 1990; AYRESS *et al.*, 1997). This study is based on samples from the piston core GL-451 that penetrated the lower slope of the Campos Basin (southeastern Brazil), at a water depth of 1500 m. The carbonate-rich sediments recovered from this core were dated as Late Pleistocene/Holocene based on planktonic foraminifera (zones W, X, Y, and Z; SOUSA *et al.*, 2011) and marine isotopic stages (MIS), from oxygen and carbon isotopes (MIS 1-6; TOKUTAKE, 2005).

The recovery of ostracods along the GL-451 proved to be irregular. The greater ostracod abundance is coincident with periods of cooling, as evidenced by the $\delta^{18}O$ curve (Figs. 1 - 2). The association of ostracods proved to be diversified through the core, and included several typical bathyal genera. The three genera selected for this study, *Krithe*, *Henryhowella,* and *Poseidonamicus*, are particulary abundant through the core, and are known to characterize different water masses in the South Atlantic (DINGLE & LORD, 1990).

Krithe is the most diversified genera, being represented by the species *Krithe morkhoveni morkhoveni*, *K. reversa, K. dolichodeira, K. trinidadensis*, and four other species that remain in open nomenclature. *Henryhowella* and *Poseidonamicus* are poorly diversified; the first is represented by one species in open nomenclature (*Henryhowella* sp. 1) and the second, mainly by *Poseidonamicus pintoi*. Other genera with notable abundance are *Australoecia*, *Macropyxis* and *Argilloecia*.

Figure 1 shows the relative abundances of *Krithe*, *Henryhowella* and

Poseidonamicus together with the total abundance of ostracods curve, δ^{18}O curve, sedimentological, and biostratigraphic data. Among these ostracods, *Krithe* is most abundant, reaching 100% of the association in the W2-W1 subzonal transition; in the subzone X2; in the middle of subzone X1; and through the Y4-Y3 transition.

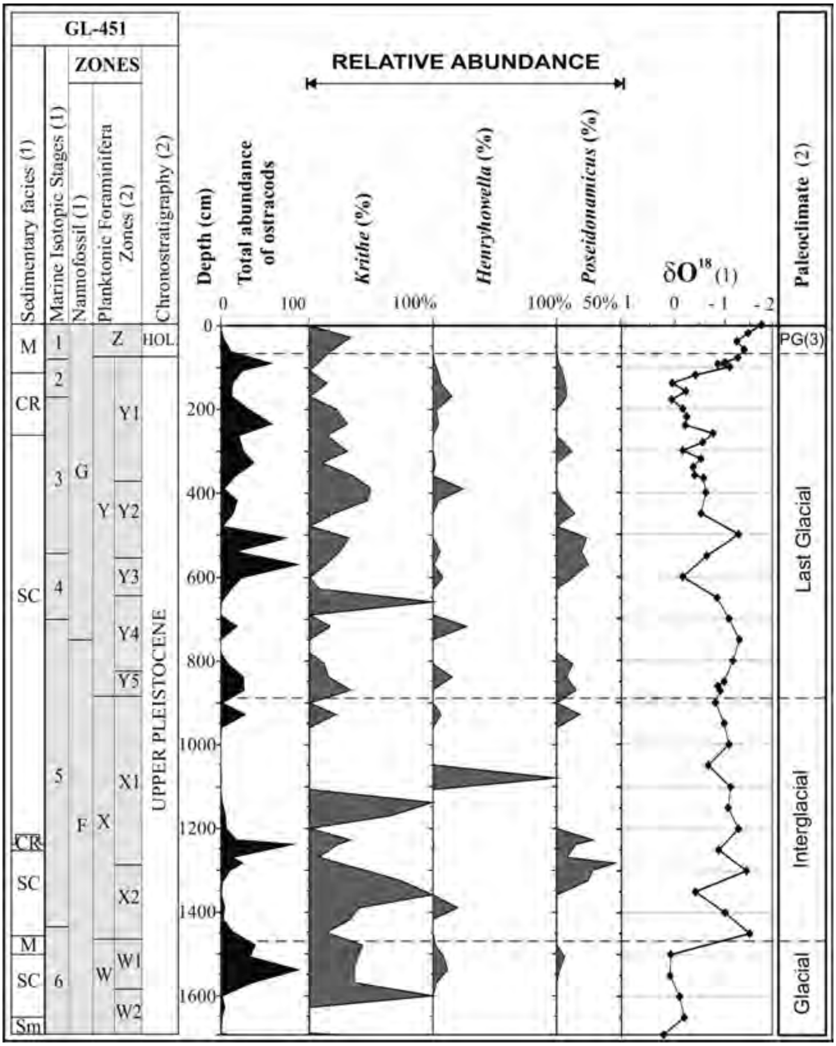

Fig. 1 — Relative abundances of *Krithe*, *Henryhowella,* and *Poseidonamicus* and δ^{18}O curve plotted against to the zones of planktonic foraminifera and calcareous nannofossils, marine isotope stages, and sedimentary facies of piston core GL-451. Note: (1) Tokutake (2005), (2) Sousa *et al.* (2011), (3) Postglacial; M – marl (30-60% $CaCO_3$), CR – calcareous rich mud (15-30% $CaCO_3$), SC – slightly calcareous mud (5-15% $CaCO_3$), Sm – siliciclastic muddy sand (<5% $CaCO_3$).

Poseidonamicus is less abundant than *Krithe*. Its maximum value (27%) is within the Interglacial Stage in the X2-X1 subzonal transition (in an inverse relationship with the values of *Krithe*) and in the Last Glacial Stage (subzones Y3 and Y2). A fauna comprised only *Henryhowella* is recorded in the Interglacial Stage (subzone X1) preceded by total fauna dominance by *Krithe*. *Henryhowella*, though not particularly abundant, becomes more common in samples within the Last Glacial Stage.

The three genera clearly show different responses to the paleoenvironmental and paleoclimatic fluctuations that occurred in the Campos Basin, as evidenced by planktonic foraminifera and the $\delta^{18}O$ curve. Periods of warming and cooling are considered as the prime controlling factors in the distribution of the ostracods.

REFERENCES

AYRESS M., NEIL H., PASSLOW V. & SWANSON K., 1997. Benthonic ostracods and deep watermasses: A qualitative comparison of southwest Pacific, Southern and Atlantic oceans. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 131: 287-302.

DINGLE R.V. & LORD A.R., 1990. Benthic ostracods and deep water-masses in the Atlantic Ocean. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 80: 213-235.

SOUSA A.J., SANJINES A.E.S., TOKUTAKE L.R., QUEIROZ-NETO J.V., MARINS G.M. & FERREIRA E.P., 2011. Bioeventos de Ostracodes Marinhos Relacionados a Foraminíferos e Isótopos de Oxigênio, Quaternário, Bacia de Campos, Brasil. In: Carvalho I. S., Srivastava N. K., Strohschoen Jr. O., Lana C. C. (eds.), Paleontologia: Cenários da Vida. *Editora Interciência*, Vol. III: 143-151.

TOKUTAKE L.R., 2005. Bioestratigrafia de nanofósseis calcários e estratigrafia de isótopos (C e O) do talude médio, Quaternário, porção N da Bacia de Campos, ES. Masters thesis. *Universidade Federal do Rio Grande do Sul, Porto Alegre*, 96 pp.

Authors' Addresses — A.J. SOUSA, Petrobras, Centro de Pesquisa e Desenvolvimento Leopoldo Américo Miguez de Mello, Gerência de Bioestratigrafia e Paleoecologia Aplicada, Rua Horácio Macedo, nº 950, p. 20 sl. 1102, Cidade Universitária, Ilha do Fundão, Rio de Janeiro, RJ (Brazil), 21941915, email: aryani@petrobras.com.br; L.R. TOKUTAKE, Petrobras, Unidade Operacional do Espírito Santo, Gerência de Sedimentologia e Estratigrafia, Av. Nossa Senhora da Penha, nº 1688, Vitória, ES (Brazil), 29057-550, email: tokutake@petrobras.com.br.

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DEEP-SEA OSTRACODA FROM THE EASTERN EQUATORIAL PACIFIC AND GLACIAL-INTERGLACIAL VARIATIONS FROM THE ODP SITE 1238 OVER THE LAST 460 KA

Surface (mudline) and core catcher samples from 2 IODP and 6 ODP sites were investigated for ostracod assemblage composition: Sites U1337 and U1338 are located at abyssal depths of 4200-4463 m, and ODP sites 1237, 1238, 1239, 1240, 1241 and 1242 cover a depth range of 1400-3200 m. Abyssal sites U1337 and U1338 are almost devoid of Ostracoda, while other sites exhibit similar taxonomic composition with predominance of *Krithe* spp. Site 1238 had the highest total abundance and was selected for the downcore assemblage study of glacial-interglacial variations over the last 460 ka. ODP Site 1238 is located ~200 km west of Ecuador at a water depth of 2203 m.

Ages for Site 1238 were estimated by correlating the Site 1238 carbonate profile to those from nearby cores V19-28 and V19-29 using benthic oxygen isotope stratigraphy (Shackleton, 1987). The oxygen isotopes on these cores were correlated to the Lisiecki & Raymo (2005) oxygen isotope stack to estimate ages. The Site 1238 $CaCO_3$ profile was estimated by XRF-scanning on the splice section. There are no published oxygen isotope data for Site 1238. For the 25-28 mcd interval of the core 1238 age was obtained by linear interpolation using a tie-point of 460 ka at 27.44 mcd.

A total of three different assemblages were distinguished: glacial, interglacial and background. The glacial assemblage is characterized by higher total ostracod abundance, ostracod valve accumulation rates, and species diversity. The typical glacial taxa are *Krithe* spp., *Legitimocythere castanea*, *Bradleya mesembrina*, *Cytheropteron* spp. and *Apatihowella (Fallacihowella) sol*. Interglacial intervals are characterized by low abundance and diversity and the characteristic taxa are *Pseudobosquetina mucronalata*, *Bradleya* sp.1, *Agrenocythere hazelae*, *Poseidonamicus major*. A background assemblage is found throughout the entire record and consists of *Krithe* spp., *Parakrithe* sp., *Ambocythere* cf. *sturgio* and *Rugocythereis* sp.

The taxonomic composition of the glacial assemblage suggests a deep-sea environment with stronger influence of cold water from Antarctica (Circumpolar Deep Water) and higher oxygen content. Higher C_{org} Mass Accumulation Rates during glacials result in overall higher total abundance levels.

The interglacial assemblage appears to correspond to dissolution intervals. Although the characteristic taxa are not restricted to corrosive bottom waters, it is possible that they can grow and reproduce in bottom waters undersaturated with respect to calcite. In the Equatorial Pacific interglacials are typically associated with increased dissolution and corrosiveness of bottom water. Consequently, the low abundance low diversity interglacial assemblage of ostracods at Site 1238 reflects the interglacial conditions and bottom water calcite undersaturation.

The background assemblage is not linked to oceanographic and climate changes and possibly represents an opportunistic group of taxa, tolerant to changes in oxygen level and food availability.

REFERENCES

LISIECKI L.E. & RAYMO M.E., 2005. A Pliocene-Pleistocene stack of 57 globally distributed benthic $\delta^{18}O$ records. *Paleoceanography*, 20, PA1003.

SHACKLETON N.J., 1987. Oxygen isotopes, ice volume and sea level. *Quaternary Science Reviews*, 6: 183-190.

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POSTGLACIAL ENVIRONMENTAL CHANGES AT THE EASTERN LAPTEV SEA CONTINENTAL MARGIN BASED ON OSTRACOD ASSEMBLAGE STUDY

Sediment core PS2458 from 983 m water depth is located at the Eastern Laptev Sea continental margin in front of the position of the former Lena and Yana river mouths on the shelf break (SPIELHAGEN *et al.*, 2005). It is well-dated (AMS ^{14}C) from 201 cm down to 625 cm, this sediment interval corresponds in time to 8.9-14.6 cal.ka (SPIELHAGEN *et al.*, 2005). The upper 100 cm of sediments are likely to be a result of slow sediment accumulation during a long time period of several thousand years in the Holocene. Most part of the core (~330-625 cm) was deposited during the last deglaciation.

Four intervals characterized by different ostracod assemblages were distinguished. The oldest interval corresponds to 645-515 cm depth in the core and warm Bølling-Allerød period. Ostracod assemblage has low total abundance and is taxonomically poor, characterized by the following taxa, commonly found on the Arctic continental slopes: *Rabilimis mirabilis* (Brady, 1868), *Swainocythere* sp. and *Cytheropteron* spp. Low diversity and abundance indicate harsh environments for ostracods.

The second interval covers the interval of 515-390 cm and can be subdivided into 2 phases. The first interval of 515-490 cm corresponding to the Younger Dryas and the 13 cal.ka fresh water event is characterized by slightly higher abundance of *R. mirabilis* and presence of shallow water taxa, such as *Cytheromorpha macchesneyi* (Brady and Crosskey, 1871), *Paracyprideis pseudopunctillata* Swain, 1963 and *Cytheropteron sulense* Lev, 1972. Presence of shallow water shelf taxa probably indicate strong freshwater influence particularly at shallower depths, when shallow water ostracod valves could be replaced down the slope. This is very similar to the changes observed on the western upper continental slope (TALDENKOVA *et al.*, 2012) and indicate such environmental changes as the development of freshened shelf water mass due to the outer shelf flooding and resulting diminished influence of Atlantic derived water masses on the Laptev Sea continental slope. The interval of 520-503 cm is characterized by the presence of vivianite concretions, that could form under conditions of strong water stratification due to meltwater input together with heavy sea-ice cover could create the anoxic bottom water environment. Thus, together with absence of foraminifera, it additionally confirms that the ostracods we find here were brought from shallower locations. The interval of 490-390 cm contains very poor ostracod assemblage and some samples are devoid of ostracods.

The third interval of 390-225 cm corresponds to the Early Holocene time period and contains the highest diversity and abundance ostracod assemblage. The major taxa are: *R. mirabilis*, *Cluthia cluthae* (Brady, Crosskey and Robertson, 1874), *Krithe glacialis* Brady, Crosskey and Robertson, 1874, *Cytheropteron tumefactum* Lev, 1972, *C. arcuatum* Brady, Crosskey and Robertson, 1874, *Argilloecia* spp., *Swainocythere* sp. and *Polycope* spp., all of these taxa are typical taxa found at the continental slope depths in the studied area, and indicating Atlantic-derived water masses influence. Thus, this interval corresponds to gradual establishment of modern-like environment in terms of water depth, the distance from the coast and decreasing fluvial influence. High abundance points to sufficient food supply for ostracods.

The fourth interval of 225-90 cm (largely Mid Holocene) can be subdivided into two phases 225-115 and 115-90. The first one is mainly characterized by *K. glacialis* with minor admixture of other outer-shelf upper slope ostracod taxa. The interval of 115-90 cm is mainly characterized by the genus *Cytheropteron*. Both intervals contain modern-like assemblage; presence and predominance of *Krithe* in the older interval may indicate colder water vs warmer Atlantic-derived waters in the younger interval with *Cytheropteron*.

REFERENCES

SPIELHAGEN R.F., ERLENKEUSER H. & SIEGERT C., 2005. History of freshwater runoff across the Laptev Sea (Arctic) during the Last deglaciaion. *Global and Planetary Change,* 48 (1-3): 187-207.

TALDENKOVA E., BAUCH H.A., STEPANOVA A., OVSEPYAN Y., POGODINA I., KLYUVITKINA T. & NIKO-

LAEV S., 2012. Benthic and planktic community changes at the North Siberian margin in response to Atlantic water mass variability since last deglacial times. *Marine Micropaleontology*, 96-97: 13-28.

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Marius Stoica

THE *CYPRIDEA* GENUS IN PURBECKIAN SEDIMENTS FROM SOUTH DOBROGEA (ROMANIA)

Recent studies on Lower Cretaceous sediments from the southern part of Dobrogea provided a very rich and well-preserved association of non-marine ostracods. The material comes from an up to 50 m thick clay unit, which was intercepted in more than 20 geotechnical drillings. Approximately fifty ostracod species are described from these sediments (Stoica, 2007). The observed ostracod assemblages correlate to the first two ostracod zones of the Purbeck and Wealden beds of southern England, *Cypridea dunkeri* Zone and *Cypridea granulosa* Zone (Anderson, 1985), or to the first two subzones of the *Theriosynoecum forbesi* Zone of the revised zonation by Horne (1995). This proves that the Lower Purbeck and the first part of the Middle Purbeck are present in the Jurassic/Cretaceous boundary sediments of south Dobrogea.

The extinct non-marine ostracod genus *Cypridea* Bosquet, 1852, emblematic for the Late Jurassic-Early Cretaceous interval, developed in Purbeckian-Wealdian facies. A recent revision of the genus *Cypridea* was realized by Sames, 2011. This genus, with a characteristic 'beak-like' modification of the anteroventral valve margin, achieved high diversity and global distribution and, therefore, has a great utility in biostratigraphy, palaeoecology and correlation of Purbeck and Wealden beds (Horne, 2002). In the investigated samples we identified about 10 species of *Cypridea*: *Cypridea dunkeri dunkeri* Jones, *Cypridea dunkeri carinata* Martin, *Cypridea setina* Anderson ssp. 1 and ssp. 2, *Cypridea tumescens praecursor* Oertli, *Cypridea tumescens tumescens* (Anderson), *Cypridea* sp.1- sp.3. The *Cypridea* species are associated with other Purbeckian taxa of genera

Rhinocypris, *Damonella*, *Darwinula*, *Klieana*, *Fabanella*, *Mantelliana, Mongolianella*, *Paracypris*, *Pontocyprella*, *Scabriculocypris*, *Stenestroemia*, *Stenocypris*, *Theriosynoecum*, *Timiriasevia Virgatocypris* and *Wolburgia.*

The high degree of preservation of the ostracod valves from Dobrogea allows detailed morphological analyses. Regarding the *Cypridea* species, it appears that (at least) *Cypridea dunkeri carinata* Jones shows sexual dimorphism (Fig. 1). This sheds a new light on the reproduction modes of *Cypridea*,

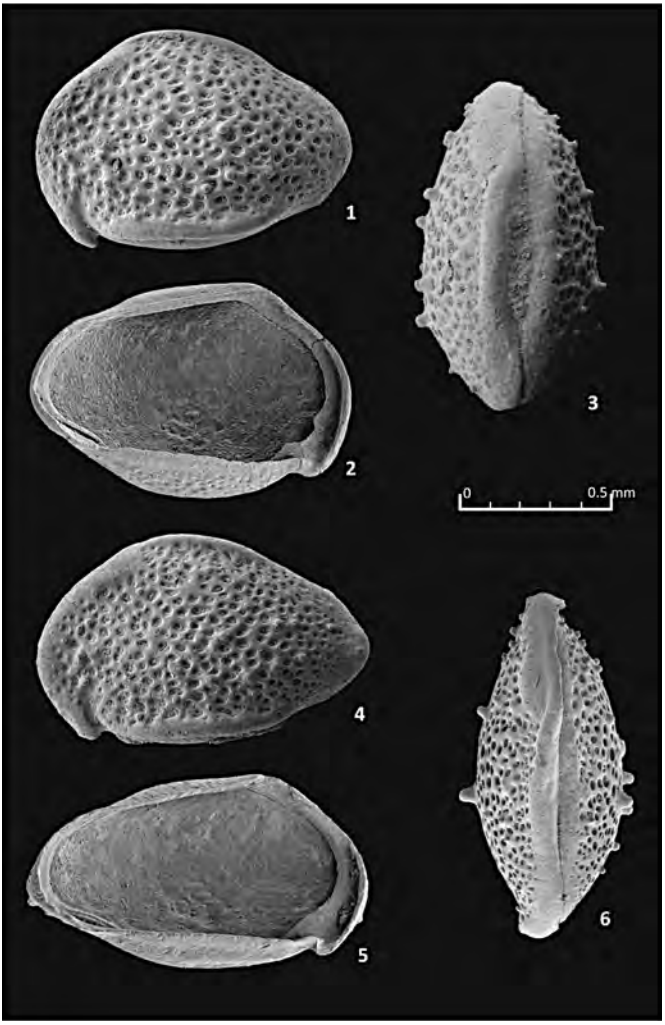

Fig. 1 — **1-6.** *Cypridea dunkeri carinata* Martin, 1940. **1-3**. female individuals; 1, left valve, external lateral view; 2, left valve, internal view; 3, carapace, dorsal view; **4-6**. male individuals; 4, left valve, external lateral view; 5, left valve, internal view; 6, carapace, dorsal view.

as *Cypridea dunkeri carinata* Jones was commonly considered to have reproduced asexually. The high diversity and speciation rates of *Cypridea* are, however, very hard to explain by an exclusively parthenogenetic lineage and therefore a mixed reproduction is the most likely reproductive mode of this extinct genus (HORNE & MARTENS, 1998; MARTENS *et al.*, 1998; SAMES, 2011).

REFERENCES

ANDERSON F.W., 1985. Ostracod faunas in the Purbeck and Wealden of England. *J. Micropalaeontol.* 4 (2): 1-68.

HORNE D.J., 1995. A revised ostracod biostratigraphy for the PurbeckeWealden of England. *Cretaceous Res.*, 16: 639-663.

HORNE D.J., 2002. Ostracod biostratigraphy and palaeoecology of the Purbeck Limestone Group in southern England. In: Milner, A.R., Batten, D.J. (Eds.), Life and Environments in Purbeck Times. *Special Papers in Palaeontology*, 68: 53-70.

HORNE D.J. & MARTENS K., 1998. An assessment of the importance of resting eggs for the evolutionary success of Mesozoic non-marine cypridoidean Ostracoda (Crustacea). In: Brendonck L., Meester de L., Hairston N. (Eds.), Evolutionary and Ecological Aspects of Crustacean Diapause. *Advances in Limnology,* 52: 549-561.

MARTENS K., HORNE D.J. & GRIFFITHS H.I., 1998. Age and diversity of non-marine ostracods. In: Martens K., (ed.) *Sex and Parthenogenesis. Evolutionary Ecology of Reproductive Modes in Non-Marine Ostracods.* Backhuys Publishers, Leiden: 37-55.

SAMES B., 2011a. Early Cretaceous Cypridea Bosquet 1852 in North America and Europe. In: Sames B. (ed.), Taxonomic Studies in Early Cretaceous Nonmarine Ostracoda of North America and Europe. *Micropaleontology*, 57: 345-431.

STOICA M., 2007. Purbeckian ostracods from South Dobrogea (in romanian). 218 p., 53 pl. *Ed. Ars Docendi*, Bucharest, 218 pp., 53 pl.

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Marius Stoica, Alina Floroiu, Wout Krijgsman & Iuliana Vasiliev

UPPER MIOCENE OSTRACODS FROM THE BLACK SEA (TAMAN PENINSULA; RUSSIA)

The Taman peninsula comprises one of the best-exposed Neogene sedimentary successions of the Black Sea basin. Biostratigraphic analyses of the classic Zheleznyi Rog and Panagia sections provided a rich and well-preserved ostracod faunal record. We identified more than 40 ostracod species in these sections that comprise the regional Paratethys stages Khersonian, Maeotian and Pontian. All these ostracod species, most of them already described and figured before using hand drawings (Livental, 1929; Svejer, 1949; Suzin, 1956; Mandelstam & Schneider, 1963; Agalarova, 1967; Vekua, 1975) are now displayed using high-resolution SEM pictures. This is an important step ahead for better taxonomical identification of the Paratethyan ostracods and avoiding future confusions.

In this study we focus on ostracods from the Zheleznyi Rog section that excellently exposes Maeotian, Pontian and Kimmerian sediments. Some ostracod species from this section where already presented in the recent paper by Rostovtseva & Tesakova, 2009. The stratigraphical distribution of the studied ostracod fauna is now fully integrated with magnetostratigraphy and radio-isotope dating (Vasiliev *et al.*, 2011). Ostracods reflect very accurately all changes in palaeoenvironments, water chemistry and basin connections and therefore can be used for reconstructions of Paratethys evolution during Late Miocene-Pliocene.

The Lower Maeotian ostracod assemblages indicate relatively (for Maeotian) higher salinities, as the ostracod fauna is dominated by *Leptocytheridae* as the number of individuals even the diversity is not very high. The

Leptocytheridae species are associated with rare species of *Loxoconcha*, *Mediocythereis*, *Xestoleberis*. In this interval, ostracods are frequently associated with foraminifers (species of *Quinqueloculina*, *Triloculina*, *Ammonia*, *Porosononion*, *Elphidium*). Towards the Upper Maeotian, fresher water conditions are dominant and the ostracod fauna is largely dominated by *Candonidae* (species of *Candona*, *Caspiolla*, *Caspiocypris*, *Pontoniella*). The *Cyprideis* genus is present in all associations by *Cyprideis torosa* species with smooth or nodded shells.

At the Maeotian / Pontian boundary, an important transgressive event took place in all Paratethys (KRIJGSMAN *et al*., 2010, STOICA *et al*., 2013). For a short moment, the reconnection of Paratethys with the open seas (Mediterranean Sea, or alternatively Indian Ocean) allowed marine waters to invade the brackish or freshwater Paratethyan basins. This resulted in the deposition of a thin layer rich in foraminifers, including the enigmatic genus *Streptochilus*, as well the bivalve species *Congeria* (*Andrusoviconca*) *amygdaloides novorossica*. After this short event, the Lower Pontian ostracod fauna became more diverse, probably because of migration of endemic species from the Pannonian and Aegean basins towards the Eastern Paratethys. In the studied section (but also in other sections), the Pontian starts with a level rich in pyritized ostracod shells, especially *Candonidae* like *Caspiocypris pontica*, *C. alta*, *C. labiata*, *Pontoniella lotzi*, *P. acuminata*, *P. acuminata striata*, *Hastacandona hysterica*, *Caspiolla venusta*, *C. balcanica*. Following upwards other taxa enrich the ostracod assemblage, at least up to the "Red Level" rich in iron oxides, considered as Kimmerian in Russian literature, but (partly) synchronous with the Middle Pontian (Portaferrian) of the Dacian Basin. Most common ostracods representing the Pontian of Taman are: *Leptocyderidae* species like *Amnicythere andrusovi*, *A. cornutocostata, A. cymbula, A. palimpsesta, A. lata*, *A. naca, A. subcaspia, Maetocythere bosqueti, M. praebaquana, Maeotocythere* sp., as well frequent individuals of *Bacunella dorsoarquata*, *Bacunella* sp., *Cytherissa bogatschovi*, *C.* sp., *Loxoconcha djaffarovi, L. eichwaldi, L. granifera, L. petasa, L. pontica, L. schweyeri, L. babazananica , Mediocythereis apatoica, Pontoleberis pontica.* Surprisingly, the *Tyrrhenocythere* and *Amplocypris* genera have no representatives in this section.

Magnetostratigraphic correlations show that these Pontian ostracods from the Black Sea basin correspond to the time interval during which the Mediterranean experienced its Messinian Salinity Crisis (MSC). More specifically, the Taman succession is considered to be the time-equivalent of the widespread Primary Lower Gypsum deposits of the Mediterranean (KRIJGSMAN *et al*., 2010). The "Red Level" was interpreted to correspond to the peak MSC lowstand of the Mediterranean. Some Paratethyan ostracods are well-known to have migrated into the Mediterranean Basin during this phase, as shown from many of the so-called "Lago Mare" successions in Italy (GLIOZZI *et al.*, 2007).

REFERENCES

AGALAROVA D.A., 1967. Microfauna of the Pontian Deposits of Azerbaijan and Adjacent Regions. Nedra, Leningrad (in Russian).

GLIOZZI E., CECI M.E., GROSSI F. & LIGIOS S., 2007. Paratethyan ostracod immigrants in Italy during the Late Miocene. *Geobios*, 40: 325-337.

KRIJGSMAN W., STOICA M., VASILIEV I. & POPOV V., 2010. Rise and fall of the Paratethys Sea during the Messinian salinity crisis. *Earth and Planetary Science Letters*, 290: 183-191.

LIVENTAL V.E., 1929. Ostracoda Akciagilscogo i Apsheronscogo Iarusov: Iz. Iz. Azerb. Polit. Inst., Bacu.

MANDELSTAM M.I. & SCHNEIDER G.F., 1963. Iskopaemye ostracody SSSR. Semejstvo *Cyprididae*: Trudy VNIGRI, Leningrad

ROSTOVTSEVA Y.V. & TESAKOVA E.M. 2009. Late Miocene Ostracodes (Ostracoda, Crustacea) from the Enikal Strait (Eastern Paratethys) as Indicators of Salinity Changes. *Paleontological Journal*, 43(2): 170-177.

STOICA M., LAZAR I., KRIJGSMAN W., VASILIEV I., JIPA D.C. & FLOROIU A., 2013. Palaeoenvironmental evolution of the East Carpathian foredeep during the late Miocene – early Pliocene (Dacian Basin; Romania). *Global and Planetary Change*, 103: 135-148.

SUZIN A.V., 1956. Ostracodes in the Tertiary Deposits of Northern Ciscaucasia. *Gostoptekhizdat*, Moscow, (in Russian).

SVEJER A.V., 1949. Osnovi morfologii i sistematiki pliocenovih i postpliocenovih Ostracod. Trudy VNIGRI, n. ser. 30, *Gostoptehizdat*, Leningrad-Moskva.

VASILIEV I., IOSIFIDI A.G., KHRAMOV A.N., KRIJGSMAN W., KUIPER, K.F., LANGEREIS C.G., POPOV V.V., STOICA M., TOMSHA V.A. AND YUDIN S.V. (2011). Magnetostratigraphy and radiometric dating of upper Miocene – lower Pliocene sedimentary successions of the Black Sea Basin (Taman Peninsula, Russia), *Palaeogeogr. Palaeoclimatol. Palaeoecol.*, 310, 163-175.

VEKUA M.I, 1975. Ostracodes from the Kimmerian and Kualnijkian deposits of Abkasia and their stratigraphic importance. *Academie Nauk Gorjistan SSR*. 136 pp. (in Russian).

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Shin-Ichi Nomura & David Siveter

EXCEPTIONALLY PRESERVED HOLOCENE FOSSIL OSTRACODS IN TSUNAMIGENIC SEDIMENTS

Chitin is the most ubiquitous chemical component in marine arthropods, which are abundant mostly as 'hard-parts' from the Early Cambrian onward. Even in exceptionally preserved fossils original chitin is altered or lost during fossilisation. Some remains of chitin have been documented from terrestrial arthropods (insects) from the Tertiary (Gupta *et al.*, 2006), but hitherto there are no reports of original chitin preserved in fossil marine arthropods, which are much more abundant than terrestrial representatives.

Here we report exceptionally preserved original chitin in a marine podocopid ostracod, *Parakrithella pseudadonta* (Hanai, 1959), from tsunamigenic sediment of the Holocene Numa Formation, Boso Peninsula, cental Japan. The tsunamigenic sediment contains many fossilised molluscs, including *Dosinella penicillata*, *Fulvia mutica*, *Cryptoma busoensis*, *Ostrea denselamelosa*, *Saidomus purpuratus* and pectinid bivalves, which inhabited the muddy bottom of an inner bay or rocky shore 6300 – 6000 yrs BP (Fujiwara *et al.*, 1996). The ostracod assemblage from this horizon is characterized by *Loxoconcha kattoi* Ishizaki, 1968, *Xestoleberis hanaii* Ishizaki, 1968, *Loxoconcha viva* Ishizaki, 1968, and *P. pseudadonta* which lived in an estimated water depth of 38 m (Tanaka *et al.*, 2012). Several specimens have some soft parts preserved, mainly parts of antennules and antenna. *P. pseudadonta* has a transparent carapace and was selected to investigate the relative degree of fossilization of soft parts. One in 17 specimens of *P. pseudadonta* had preserved soft parts. From about 10 kg of sediment analysed we recovered 470 individuals of *P. pseudadonta*, of which 5% had only the shell preserved, 68% had shell and membraneous layers preserved, and 27% showed parts of limbs preserved.

Some of the specimens with preserved soft parts contains framboidal pyrites and octahedral pyrites and others preserved an original chitinous colour. Analysis by pyrolysis-gas chromatography-nitrogen phosphorus detection revealed that the fossil *P. pseudadonta* had 12 - 13% original chitin preserved compared with Recent conspecific specimens.

REFERENCES

FUJIWARA O., MASUDA F., SAKAI T., FUSE K. & SAITO A., 1996. Tsunami deposits in Holocene bay-floor muds and uplift history of the Boso and Miura Peninsulas. *Quart. Res*, 36: 73-86.

GUPTA N. S., MICHELS R., BRIGGS D.E.G., EVERSHED R.P., GVERSHED R.P. & PANCOST R.D., 2006. The organic preservation of fossil arthropods: an experimental study. *Proc. R. Soc. Lond. B*, 273: 2777-2783.

HANAI T., 1959. Studies on the Ostracoda from Japan: 4. Family Cytherideidae Sars 1925. *J. Fac. Sci., Univ. Tokyo, Sec. 2*, 11: 291-308.

ISHIZAKI K., 1968. Ostracodes from Uranouchi Bay, Kochi Prefecture, Japan. *Sci. Rep. Tohoku Univ., Sendai, Second Ser. Geol.*, 40: 1-45.

TANAKA G., KANEKO M., AOKI T. & PARTICIPANTS OF 2011 SPP CLASS I OTA GIRLS' HIGH SCHOOL, 2012. Ostracods from the Holocene Numa Formation, Chiba Prefecture, central Japan. *Bull. Gunma Mus. Nat. Hist.*, 16: 111-118.

Authors' Addresses — G. TANAKA, Gunma Museum of Natural History, 1674-1, Kamikuroiwa, Tomioka, Gunma, 370-2345 (Japan); e-mail: tanaka@gmnh.pref.gunma.jp; H. OHTANI, K. KATO, Nagoya Institute of Technology, Gokiso-cho, Showa-ku, Nagoya, Aichi, 466-8555 (Japan); e-mail: ohtani.hajime@nitech.ac.jp; S. NOMURA, Amawa Highschool, 229, Kazuma, Tomitsu, Chiba, 299-1606 (Japan); e-mail: snom@kyi.biglobe.ne.jp; D. SIVETER, Department of Geology, University of Leicester, University Road, Leicester, LE1 7RH (UK); e-mail: djs@leicester.ac.uk.

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Ekaterina Tesakova

OSTRACODA, GENUS *PALAEOCYTHERIDEA* MANDELSTAM, 1947 FROM THE MIDDLE AND UPPER JURRASSIC OF EUROPE: REVISION, STRATIGRAPHY, PALEOBIOGEOGRAPHY

Species of the ostracod genus *Palaeocytheridea*, common both in the Boreal and Tethyan regions in Europe were used to distinguish a number of sequences that can be correlated, making this genus important for stratigraphy.

However, the inaccuracy in the description of the hinge of *Palaeocytheridea*, made by M.I. Mandelstam (1947) when describing the type species *P. bakirovi* Mandelstam, 1947, and the replacement of the type species with *Eucythere denticulata* Sharapova, 1937 made later by P.S. Lubimova (1955), led to a confusion in the understanding of the extent of the genus *Palaeocytheridea* and attributing to it some of the forms not only from other genera but also from other families.

93 forms of *Palaeocytheridea* were revised, and 11 species were determined as valid, out of which one species is new. Based on shell outline, either elongated-subrectangular or elongated-oval, members of this genus can be clearly subdivided into two subgenera – *Palaeocytheridea* s. str. and *Malzevia* Tesakova, 2013. To the subgenus *Palaeocytheridea,* we refer the following species: *P.* (*P.*) *bakirovi* Mandelstam, 1947, *P.* (*P.*) *carinilia* (Sylvester-Bradley, 1948), *P.* (*P.*) *pavlovi* (Lubimova, 1955), *P.* (*P.*) *kalandadzei* Tesakova, 2013; and to subgenus *Malzevia* – *P.* (*M.*) *parabakirovi* Malz, 1962, *P.* (*M.*) *rara* Permjakova, 1974, *P.* (*M.*) *priva* Permjakova, 1974, *P.* (*M.*) *subtilis* Permjakova, 1974, *P.* (*M.*) *laevis* Permjakova, 1974, *P.* (*M.*) *groissi* Schudack, 1997, *P.* (*M.*) *blaszykina* Franz, Tesakova, Beher, 2009.

Subgenus *Palaeocytheridea* is known in the geological history since the end of late Bajocian, while *Malzevia* is known from older strata – early Bajocian (Fig. 1). This allows the assumption that *Palaeocytheridea* descended from *Malzevia*. Another fact supporting this hypothesis is that all *Malzevia* ontogenetic stages had a carapace of solely elongated-oval outlines while in *Palaeocytheridea* only early and middle moult stages had elongated-oval outlines. During growth, the carapace became rounded-subrectangular in outline.

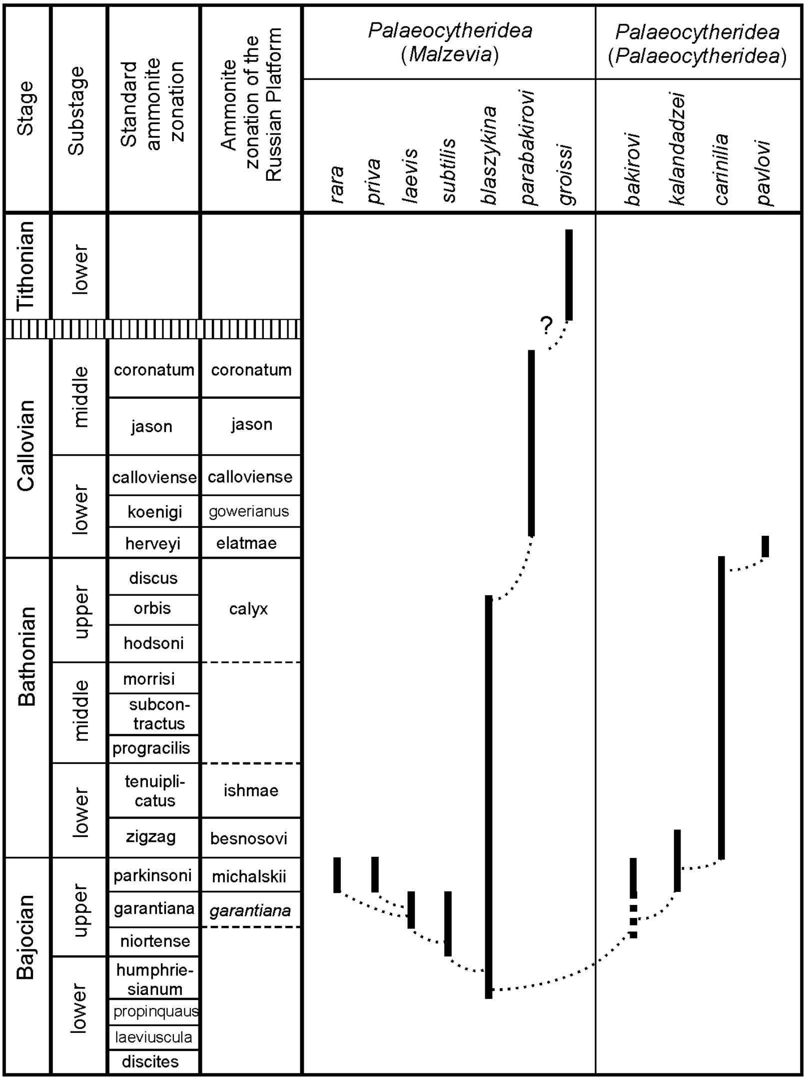

Fig. 1 — Phylogenetic scheme of members of the subgenera *Palaeocytheridea* and *Malzevia*.

Based on the distribution of endemic and cosmopolitan forms of *Palaeocytheridea* it was shown that the Tethyan and Boreal-Atlantic regions in Western and Eastern Europe were isolated during Bajocian and Bathonian times, and the connection between these two parts of the European paleobasin is indicated starting from the middle part of the Early Callovian (Fig. 2). Ostracod zones based on the stratigraphic distribution of species of the genus *Palaeocytheridea* were suggested for the Middle Jurassic in Western and Eastern Europe and Ukraine.

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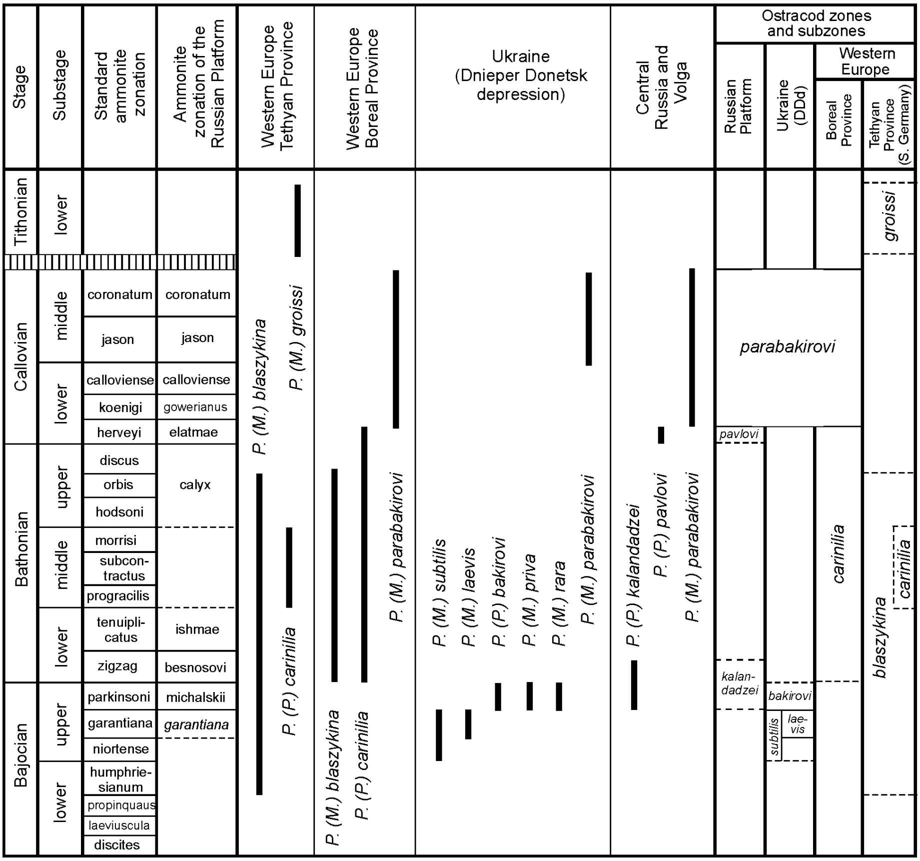

Fig. 2 — Stratigraphic distribution of *Palaeocytheridea* in the Middle-Upper Jurassic of Europe.

REFERENCES

Lubimova P.S., 1955. Ostracods of the Mesozoic Deposits of the Central Volga Region and the Obshchii Syrt. In: Trudy Vsesoyusnogo Nauchno-Issled. Inst. Nefti Geol. Razved. Nov. Ser. *Gostoptekhizdat*, Leningrad, issue 84: 3-190.

MANDELSTAM M.I., 1947. Ostracods from the middle Jurassic Deposits of the Mangyshlak Peninsula. In: Microfauna neftyanykh mestorozhdenii Kavkaza, Emby I Srednei Azii (Microfauna of the Oil Fields of the Caucasus, Emba, and Central Asia). *Gostoptekhizdat*, Leningrad: 239-256.

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JULIANA TIEMI MATSUDA, ROGER PAULO MORMUL,
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HABITAT COMPLEXITY AND THE OSTRACODA (*Crustacea*) COMMUNITY IN A TROPICAL FLOODPLAIN

Aquatic macrophytes provide heterogeneity to the environment and are important micro-habitats for aquatic communities (CYR & DOWNING, 1988; PADIAL *et al.*, 2009; DECLERCK *et al.*, 2011; SUEIRO *et al.*, 2011). Several studies have shown the importance of structural complexity of aquatic macrophytes on richness distribution and invertebrate abundance (TANIGUCHI *et al.*, 2003; TANIGUCHI & TOKESHI, 2004; MOORE & HOVEL, 2010), but thus far they did not quantify the fractal complexity of aquatic macrophytes.

Here, we analyse the ostracod communities associated with aquatic macrophytes with different structural complexities, measured by fractal dimension. We test the hypothesis that more complex plants are inhabited by higher richness and abundance of ostracods.

Sampling was performed in July 2012, in 29 environments in the Upper Paraná River floodplain, Brazil. Eleven species of aquatic macrophytes were used with different fractal dimension values, which ranged of 1.49 to 1.94. Ostracods associated to macrophytes were hand-collected and plants were thoroughly washed in a bucket. The residues were washed in the net (mesh size c 160 µm). The material was preserved in 70% ethanol. The present survey recorded 34 species of ostracods in the Upper Paraná River floodplain. The results showed a positive correlation ($r=0.46$; $p<0.05$) between the richness of ostracods and fractal dimension, confirming one of the hypotheses of this study. However, the fractal dimension does not affect the density of ostracods. A DCA was performed to determine the difference in ostracod community composition in macrophytes of different complexities. This result showed a separation in the axis 1 in relation to the fractal complexity of plants, where the more complex plants support smaller ostracod species, such as *Cypretta costata* G.W. Müller, 1898, *Penthe-*

silenula brasiliensis (Pinto & Kotzian, 1961) and *Alicenula serricaudata* (Klie, 1935). On the other hand, *Diaphanocypris meridana* (Furtos, 1936) and *Cypricercus centrura* (Klie, 1940) were more common in less complex plant species.

The correlation fractal dimension with the richness was expected, since more complex habitats can provide a greater amount of micro-habitats, allowing the occurrence of a higher number of species (BELL *et al.*, 1991). Regarding the composition of the community of Ostracoda, the relationship of smaller species and non-swimmers with more complex species, could be because these plants are able to retain more sedimentary material in their roots or leaves, providing a substrate where these (normally benthic) species of ostracods can establish their populations. However, swimming species can move more easily and can settle in less complex plants. Thus, we conclude that the complexity of macrophytes is important, not only for the richness of ostracods, but also for the species composition of the communities.

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REFERENCES

BELL S.S., MCCOY E.D. & MUSHINSKI H.R. (Eds.), 1991. Habitat Structure: the physical arrangement of objects in space, New York: Chapman and Hall.

CYR H. & DOWNING J.A., 1988. The abundance of phytophilous invertebrates on different species of submerged macrophytes. *Freshwater Biology*, 20: 365-374.

DECLERCK S.A.J., BAKKER E.S., LITH B., KERSBERGEN A. & DONK E., 2011. Effects of nutrients additions and macrophyte composition on invertebrate community assembly and diversity in experimental ponds. *Basic and Applied Ecology*, 12: 466-475.

MOORE E.C. & HOVEL K.A., 2010. Relative influence of habitat complexity and proximity to patch edges on seagrass epifaunal communities. *Oikos*, 119: 1299-1311.

PADIAL A.A., THOMAZ S.M. & AGOSTINHO A.A., 2009. Effects of structural heterogeneity provided by the floating macrophyte *Eichhornia azurea* on the predation efficiency and habitat use of the small Neotropical fish *Moenkhausia sanctaefilomenae*. *Hydrobiologia*, 624: 161-170.

SUEIRO M.C., BORTOLUS A. & SCHWINDT E., 2011. Habitat complexity and community composition: relationships between different ecosystem engineers and the associated macroinvertebrate assemblages. *Helgoland Marine Research*, 65: 467-477.

TANIGUCHI H., TAKANO S. & TOKESHI M., 2003. Influences of habitat complexity on the diversity and abundance of epiphytic invertebrates on plants. *Freshwater Biology*, 48: 718-728.

TANIGUCHI H. & TOKESHI M., 2004. Effects of habitat complexity on benthic assemblages in a variable environment. *Freshwater Biology*, 49: 1164-1178.

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THEODORA TSOUROU, HARA DRINIA & GEORGE ANASTASAKIS

OSTRACOD ASSEMBLAGES FROM HOLOCENE MIDDLE SHELF DEPOSITS OF SOUTHERN EVOIKOS GULF (CENTRAL AEGEAN SEA, GREECE) AND THEIR PALAEOENVIRONMENTAL IMPLICATIONS

The purpose of this study is to collect micropalaeontological evidence concerning the palaeoenvironmental changes that took place at Southern Evoikos Gulf during the Holocene.

The Southern Evoikos Gulf (Fig. 1) is a shallow epicontinental basin, slightly deformed with formation of a tectonic graben trending WNW-ESE to NW-SE in the back-arc area at the northern prolongation of the Cycladic Platform (PAPANIKOLAOU *et al.*, 1988). The gulf separates Attica from Southern Evia and it is divided into two sub-basins: a northern shallow one where water depths range from 20 to 70 m and a southern deeper basin with a maximum depth of 160 m (PAPANIKOLAOU *et al.*, 1988; KARAGEORGIS *et al.*, 2000).

The study area of the present research is located at the northern part of Southern Evoikos gulf. Two cores, DEH 1 and DEH 5, yielded a sedimentary record that covers the last 13910 cal. yr B.P., they were recovered from 70 m and 75.5 m water depth respectively (Fig. 1). A detailed quantitative and qualitative ostracod study was undertaken on 74 samples of DEH 5 and 52 samples of DEH 1, in order to reconstruct palaeoenvironmental conditions.

Sediment core DEH 5 demonstrated the following ostracod assemblages: At the lower part of the core, *Cyprideis torosa* (noded and smooth forms) is the most abundant species, and it is accompanied mainly by *Leptocythere lagunae*, *Limnocythere inopinata* and *Candona* species. The synthesis of this fauna indicates a shallow oligohaline environment (CLAVE *et al.*, 2001; RUIZ *et al.*, 2006). At the middle part of the core, *C. torosa* is dominant, accompanied by *L. lagunae*, *Xestoleberis* spp. and *Candona neglecta*. Towards

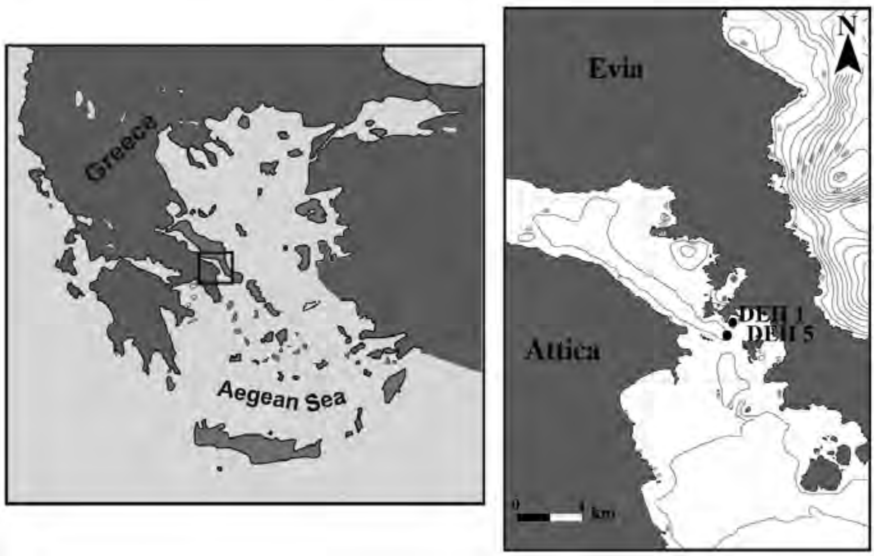

Fig. 1 — Location map and the position of the studied sediment cores.

the top of the core, *C. torosa*, *L. lagunae* and *Xestoleberis* spp. are still present, but the character of the ostracod assemblages presents more marine features as indicated by the presence of *Callistocythere crispata*, *C. intricatoides*, *Leptocythere ramosa*, *L. rara*, *Loxoconcha* spp. The uppermost part of the core presents an ostracod assemblage which corresponds to an environment similar to the present one, which is a shallow (less than 70 m water depth) open marine environment (RUIZ *et al.*, 2006, 2008). The ostracod assemblage consists mainly of *C. crispata*, *C. intricatoides*, *Cytherella* spp., *Xestoleberis* spp., *Acanthocythereis hystrix*, *Semicytherura* spp. and *C. edwardsii*.

Concerning sediment core DEH 1, three main ostracod assemblages were distinguished from the bottom to the top of the sediment core indicating a marine coastal environment with a gradual transition from a circalittoral to an infralittoral restricted one (RUIZ *et al.*, 2006, 2008; TSOUROU, 2012): At the lower part of the core assemblage consists mainly of *Costa edwardsii*, *Cytheridea neapolitana*, *Callistocythere* spp., *Pterygocythereis jonesii* and *Leptocythere* spp. At the middle part, *C. edwardsii* is the dominant species. At the upper part ostracod fauna consists mainly of *C. edwardsii*, *Loxoconcha* spp., *Xestoleberis* spp. and *C. torosa*. This part of the core corresponds to the time interval that DEH 5 represents an oligohaline lagoon.

Ostracod analysis of DEH 5 indicates that the northern basin of southern Evoikos gulf was an oligohaline closed lagoon for the largest part of Holocene, while DEH 1 represents a shallow coastal environment at the edge of this basin. The faunal pattern may provide the key to unlocking the broader question as to whether the depositional pattern within the South Evoikos gulf were driven by tectonic or climatic (eustatic) change.

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REFERENCES

CLAVE B., MASSE L., CARBONEL P. & TASTET J.P., 2001. Holocene coastal changes and infilling of the La Perroche marsh (French Atlantic coast). *Oceanological Acta*, 24: 377-389.

KARAGEORGIS A., ANAGNOSTOU CH., SIOULAS A., ELEFTHERIADIS G. & TSIRAMBIDES A., 2000. Distribution of surficial sediments in the Southern Evoikos and Petalioi Gulfs, Greece. *Mediterranean Marine Science*, 1(1): 111-121.

PAPANIKOLAOU D., LYKOUSIS V., CHRONIS G. & PAVLAKIS P., 1988. A comparative study of neotectonic basins across the Hellenic arc: the Messiniakos, Argolikos, Saronikos and Southern Evoikos. *Gulfs Basin Research*, 1: 167-1 76

RUIZ F., ABAD M., OLIAS M., GALAN E., GONZALEZ I., AGUILA E., HAMOUMI N., PULIDOD I. & CANTANO M., 2006. The present environmental scenario of the Nador Lagoon (Morocco). *Environmental Research*, 102: 215-229.

RUIZ F., GONZÁLEZ-REGALADO M.L., ABAD M., CIVIS J., GONZÁLEZ DELGADO J.Á., GARCÍA E.X.M., PRUDÊNCIO M.I. & DIAS M.I., 2008. Pliocene ostracods of Southwestern Europe. *Geobios*, 41: 845-859.

TSOUROU T., 2012. Composition and Distribution of Recent Marine Ostracod Assemblages in the Bottom Sediments of Central Aegean Sea (SE Andros Island, Greece). *International Review of Hydrobiolog.*, 97(4): 276-300.

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THEODORA TSOUROU, KOSMAS P. PAVLOPOULOS,
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PALAEOENVIRONMENTAL EVOLUTION OF PIRAEUS (ATTICA, GREECE) DURING THE HOLOCENE BASED ON OSTRACOD ASSEMBLAGES

The aim of this study is to present the environmental history of Piraeus port since 8700 yr B.P., as it is recorded by the ostracod assemblages. The study area is located in SW Attica (Fig. 1) where recently, GOIRAN *et al.* (2011) conducted an interdisciplinary geoarchaeological research combining cartographic, topographic and historic data, radiocarbon datings, sedimentological and micropalaeontological analysis. As a result, they verified Greek geographer Strabo, who wrote, in the first century AD, that Piraeus was formerly an island.

Three well-dated sediment cores were selected (Fig. 1) of the 10 rotational boreholes, which were drilled for the aim of the above mentioned geoarchaeological research, and a detailed quantitative and qualitative ostracodological analysis of about 200 samples was performed.

The distribution patterns of the identified ostracod assemblages combined with the sedimentary facies recognised in the boreholes reflect different depositional environments that alternate along the cores.

In particular, five lithostratigraphical units were determined. The lowermost unit (A) was deposited between 8700 and 7500 cal. yr B.P., it consists of clay with silty sand layers and it was recorded in all three boreholes. The euryhaline species *Cyprideis torosa* is the dominant ostracod taxa, accompanied mainly by freshwater to oligohaline species such as *Ilyocypris bradyi* and *Limnocythere inopinata* at the lower part of the unit, while at the upper part of the unit *C. torosa* is accompanied mainly by mesohaline-polyhaline species such as *Loxoconcha elliptica*, *Leptocythere lagunae, Aurila arborescens* and *Xestole-*

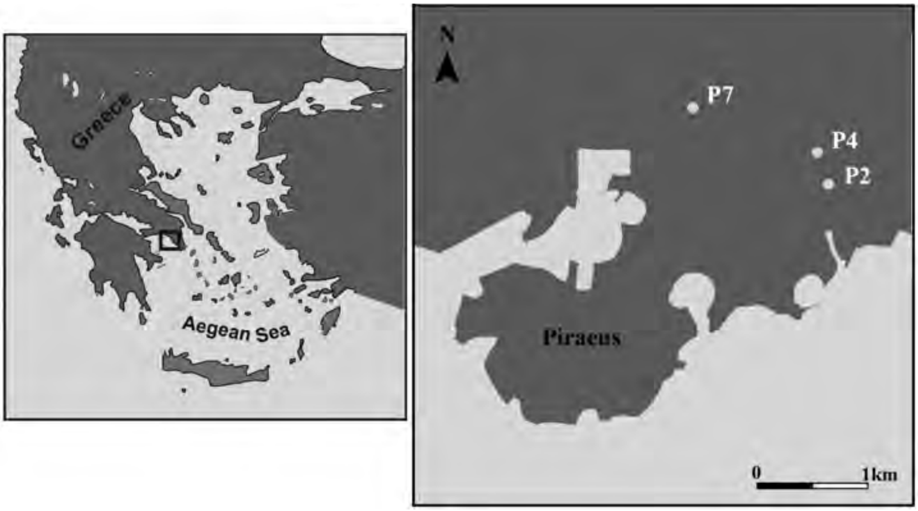

Fig. 1 — Location map and the position of the studied boreholes.

beris communis. The alternation of these faunas indicates a lagoonal environment with progressively increasing marine influence (e.g. RUIZ *et al.*, 2006; TRIANTAPHYLLOU *et al.*, 2010).

Unit B consists of shelly silty sand and it was recorded in all three boreholes. This unit is dated between 6800 and 5400 cal. yr B.P.. The brackish mesohaline ostracod assemblage is replaced towards the upper part of this unit by a shallow marine assemblage (mainly *Aurila convexa*, *Semicytherura incogruens*, *Loxoconcha affinis*, *Xestoleberis* spp.) demonstrating the establishment of a shallow coastal marine environment (e.g. RUIZ *et al.*, 2006; TSOUROU, 2012).

Unit C is present in boreholes P4 and P7 and it is dated between 4800 and 3500 cal. yr B.P. It consists of clay with sand and pebbles. The lowermost part of the unit still represents a shallow coastal marine environment with *Xestoleberis* spp. and *A. convexa*. This fauna is replaced by an assemblage characterised by the dominance of *C. torosa* and the presence of oligohaline to freshwater species reflecting the transition to a closed lagoonal environment.

Unit D, consists of clay and silt, it is present in boreholes P4 and P7 and is dated younger than 2800 cal. yr B.P.. Oligohaline to freshwater species gradually predominate in this unit, mainly *I. bradyi* and *Cyprinotus salinus,* indicating the formation of a shallow marsh (e.g. TRIANTAPHYLLOU *et al.*, 2010).

Unit E represents the lateral transition of units C and D and it is present in borehole P2. It consists of medium to coarse sand and it is dated between 3400 and 2500 cal. yr B.P.. Lithology and the scarce presence of ostracods, indicate a coastal environment of high energy in the supralittoral zone.

REFERENCES

GOIRAN J.-P., PAVLOPOULOS K.P., FOUACHE E., TRIANTAPHYLLOU M. & ETIENNE R., 2011. Piraeus, the ancient island of Athens: Evidence from Holocene sediments and historical archives. *Geology*, 39(6): 531-534.

RUIZ F., ABAD M., OLIAS M., GALAN E., GONZALEZ I., AGUILA E., HAMOUMI N., PULIDOD I. & CANTANO M., 2006. The present environmental scenario of the Nador Lagoon (Morocco). *Environmental Research*, 102: 215-229.

TRIANTAPHYLLOU M.V., KOULI K., TSOUROU T., KOUKOUSIOURA O., PAVLOPOULOS K. & DERMITZAKIS M.D., 2010. Paleoenvironmental changes since 3000 BC in the coastal marsh of Vravron (Attica, SE Greece). *Quaternary International*, 216: 14-22.

TSOUROU T., 2012. Composition and Distribution of Recent Marine Ostracod Assemblages in the Bottom Sediments of Central Aegean Sea (SE Andros Island, Greece). *International Review of Hydrobiology*, 97(4): 276-300.

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Alaettİn Tuncer, Cemal Tunoglu, Ökmen Sümer & Ugur Inci

EARLY PLEISTOCENE OSTRACODA ASSEMBLAGE AND PALEOENVIRONMENTAL CHARACTERISTICS OF THE FEVZIPASA FORMATION, SÖKE, WESTERN TURKEY

The study area is located about 40 km west of Aydın district in western Turkey. This area includes Neogene to Quaternary sediments. The Fevzipasa Formation unconformably overlies the Miocene rock units. It includes conglomerates, sandstones, mudstones, marls, limestones and tuff layers and unconformably overlain by recent deposits of the Söke – Milet Basin (Sümer *et al.*, 2013a). The lower part of the Fevzipasa formation is represented by coarse clastics and lacustrine carbonates. This lower part is overlain by mollusca shells-bearing fine to coarse-grained sandstones. Prominent tuff layers (lower and upper tuff layers) of this dominantly sandstone succession were radiometrically dated between roughly 2 and 1 Ma (Sümer *et al.*, 2013b). Based on small mammal fauna (Ünay *et al.*, 1995; Ünay & Goktas, 1999; Sarica, 2000) the age of the upper part is Early to Late Pleistocene age.

To investigate the palaeoenvironmental evolution of the succession, forty-two samples were collected along two stratigraphic sections. Ostracoda assemblages together with Chara flora, Gastropoda and Bivalvia faunas and fish remains were recovered from only twenty-nine samples. Ostracod assemblages include *Candona neglecta*, *C. parallela pannonica*, *Pseudocandona* sp., *Cyclocypris ovum*, *Ilyocypris gibba*, *I. bradyi*, *Heterocypris salina* and *Scottia pseudobrowniana*. In addition to these, fish remains belonging the Cyprinidae family (*Tinca* sp., *Leuciscus* sp., *Leuciscus etilius)* and Characeae gyrogonites referable to *Nitellopsis obtusa*, *Chara* sp., *C. aspera*, *C. globularis*, *C. hispida*, *C. vulgaris, Lychnothamnus* sp. and *Sphaerochara* sp. occurred in the samples.

Overall the ostracod, fish and gyrogonites records indicate that the

Fevzipasa Formation was deposited in a palaeoenvironmental setting characterized by permanent and shallow water bodies. According to determined ostracoda fauna assemblage, age of the investigated levels of this formation is Pleistocene (MEISCH, 2000). By combining all these data, it can be suggested that the age of the upper part of the Fevzipasa Formation is Pleistocene.

REFERENCES

MEISCH C., 2000. Freshwater Ostracoda of Western and Central Europe. Süß wasserfauna von Mitteleuropa 8/3. Spektrum Akad Vlg, Gustav Fischer, Heidelberg, Berlin: 522 pp.

ÜNAY F., GÖKTAS F., HAKYEMEZ H.Y., AVSAR M. & SAN Ö., 1995. Dating of the exposed at the northern part of the Büyük Menderes Graben (Turkey) on the basis of Arvicolidae (Rodentia, Mammalia). *Geological Bulletin of Turkey.,* Volume 38 (2): 75-80.

ÜNAY F. & GÖKTAS F., 1999. Late Early Miocene and Quaternary small mammals in the surrounding of Söke (Aydın): Preliminary results. *Geological Bulletin of Turkey,* 42 (2): 99-113.

SARICA N., 2000. The Plio – Pleistocene age of Büyük Menderes and Gediz grabens and their tectonic significance on N-S extensional tectonics in West Anatolia: mammalian evidence from the continental deposits. *Geological Journal,* 35: 1-24.

SÜMER Ö., İNCI U. & SÖZBILIR H., 2013a. Tectonic evolution of the Söke Basin: Extension-dominated transtensional basin formation in western part of the Büyük Menderes Graben, Western Anatolia. *Journal of Geodynamics*, 65: 148-175.

SÜMER Ö., İNCI U. & SÖZBILIR H., 2013b. Under review. First report of sedimentary evidence for sea level change in Pleistocene shallow marine fan-deltaic successions of the Fevzipaşa Formation, Western Anatolia Turkey. *Journal of Quaternary Science.*

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Cemal Tunoğlu, Alaettin Tuncer, Nazire Özgen & Özgen Kangal

OLIGOCENE OSTRACODA FROM THE SIVAS BASIN (CENTRAL ANATOLIA, TURKEY)

The Sivas Tertiary Basin is located east of Central Anatolia and is represented by many Paleogene-Quaternary sedimentary units. In this study, Oligocene ostracoda have been investigated, and their biostratigraphic position and environmental interpretation has been stated. Twenty-four samples from five measured stratigraphic sections have been analyzed. Amoung them, the ostracoda from the Pınarca and Eğribucak sections have been evaluated by a stratigraphic, biostratigraphic and chronostratigraphic point of view. Totally, a number of twenty-four ostracod taxa which related to twelve genera (*Cytherella, Krithe, Haplocytheridea, Monoceratina, Loxoconcha, Xestoleberis, ?Cyprideis, Aurila, Eucythere, Hemicyprideis, Neomonoceratina, Paracypris*) have been identified. Of these, eleven species were identified *(Cytherella beyrichi* (Reuss), *Krithe rutoti* Keij, *Krithe bartonensis* (Jones), *Krithe strangulata* Deltel, *Haplocytheridea helvetica* Lieenklaus, *Loxoconcha delemontensis* Oertli, *Loxoconcha favata, Xestoleberis obtusa* Lienenklaus, *Neomonoceratina helvetica, Hemicyprideis oubenasensis* Apostelescu and *Pokornyella limbata* (Bosquet). Thirteen species were left open nomenclature (*Monoceratina* sp., *Cytherella* sp.1, *Cytherella* sp.2, *Cytherella* sp.3, *Paracypris* sp., *Krithe* sp., *Haplocytheridea* sp., *Loxoconcha* sp., *Hiltermannicythere* sp., *Hemicyprideis* sp., *Eucythere* sp*., Aurila* sp. and *?Cyprideis* sp.). Three taxa were regarded as *incertae saedis* (*incerta saedis* 1, *incertae saedis* 2, *incertae saedis* 3). When considering the identified taxa for paleoenvironmental reconstruction, it is known that some of them (*Krithe*, *Cytherella*, *Paracypris*) live in bathyal and infraneritic conditions, whereas others *(?Cyprideis, Xestoleberis, Pokornyella,*

Aurila, Loxoconcha) live in epineritic, littoral and brackish conditions. The chronostratigraphic age determination of the identified ostracoda species indicates to a large extent Oligocene. A compatible age determination has been inferred through the analysis of benthic foraminifera, gastropoda, pelecypoda, spore and pollen which have been recovered in the study area. It can be said that, in the light of stable isotope values ($d^{18/16}O$, $d^{13/12}C$) of some levels, the environment reflects marine, tidal lagoon and tide over the planes of evaporites (sabkha).

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LATE MIOCENE OSTRACODA FROM BIZELJSKO SECTION (EASTERN SLOVENIA)

Late Miocene sediments of the Pannonian basin are extensive in the eastern and north-eastern parts of Slovenia. The Bizeljsko section (Krška kotlina) measures around 950 m in thickness, spamming »Banatica beds«, »Abichi beds« and »Rhomboidea beds«.

The ostracod assemblages, preservation and abundance of ostracod valves from the Bizeljsko section depend on salinity changes of lake water and the rate of terrigenous input.

The oldest Pannonian (D zone sensu Papp, 1951) fossiliferous marls were deposited in the deeper part of the lake. Determined ostracods indicate oligohaline to mesohaline environment. The most abundant are: *Herpetocyprella hyeroglyphica* (Méhes), *Herpetocyprella* cf. *marginata* (Zalányi), *Amplocypris* cf. *abscissa* (Reuss), *Amplocypris* cf. *angulata* (Zalányi), *Loxoconcha porosa* (Mehés), *Pontoniella acuminata* (Zalányi), and *Lineocypris hodonensis* (Pokorný).

Succeeding the Pannonian (E, F, G zones sensu Papp, 1951) turbidite deposits mark continuous deposition of clastic material, which resulted from river floods or re-sedimentation processes. Sand- marl intercalations deposited in the proximal prodelta setting. No microfauna was found in sands, whereas marls are rich in ostracods. Re-sedimented bentic and planktonic foraminifers can also be found.

The ostracods record the increase of lake salinity to the mesohalinic regime. The typical species is *Cyprideis macrostigma spinosa* (Soka), *Bacunella* cf. *dorsoarcuata* (Zalányi), *Hemicytheria marginata* (Soka), *Hemicytheria* cf.

croatica (Sokač), *Candona* (*Lineocypris*) *trapezoidea* (Zalányi), *Leptocythere naca* (Méhes) and *Leptocythere* cf. *bosqueti* (Livental) are abundant.

The youngest Pannonian deposits of the Bizeljsko section record a decline in salinity due to the progressive infiling of basin with sediments and change from brackish lake conditions to fresh water lakes and river sistem. Sands and sandstones resulting from extensive river floods dominate in this part of the section. Interbeds of silty marls are dominated by *Camptocypria* and *Caspiolla* genera. *Hastacandona lotzyi* (Zalányi) and *Hastacandona histerica* (Krstić) are present in this part only.

REFERENCES

PAPP A., 1951. Das Pannon des Wiener Beckens. *Mitteilungen der Geologischen Gesellschaft in Wien*, 39-41: 99-193.

Authors' Addresses — M. VESEL-LUKIĆ, Geological Survey of Slovenia, Dimičeva ul. 14, SI-1000 Ljubljana (Slovenia); e-mail: marina.vesel-lukic@geo-zs.si; V. HAJEK-TADESSE, Croatian Geological Survey, Sachsova 2, HR-10000 Zagreb (Croatia); e-mail: valentina.tadesse@hgi-cgs.hr; M. POLJAK, Geological Survey of Slovenia, Dimičeva ul. 14, SI-1000 Ljubljana (Slovenia); e-mail: marijan.poljak@geo-zs.si.

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A MULTI-PROXY APPROACH BASED ON A LATE PLEISTOCENE/HOLOCENE OSTRACOD RECORD FROM LAKE IZNIK (TURKEY)

Multi-proxy studies are in favour to decipher past environmental conditions and climate patterns from sedimentological records. Here we focus on sediment cores from Lake Iznik (Turkey) covering the past 36 ka cal BP, which were analysed by means of sedimentological, geochemical and palaeontological methods (Roeser *et al.*, 2012; Viehberg *et al.*, in press). Modern studies conclude that Lake Iznik is a warm-monomictic eutrophic lake with anoxic conditions during thermo-stratification and high alkalinity of the lake water is caused by increased sodium carbonate concentrations (Viehberg *et al.*, 2012). However, ostracods represent a key feature throughout the core, as many proxies derive from their remains to reconstruct the palaeoenvironmental setting. The freshwater ostracod fauna assemblages reflect non-marine, but slight saline conditions in the Late Pleistocene shifting rapidly to high alkaline water during the Early Holocene (i.e. monospecific *Limnocythere inopinata*). Morphological changes of *L. inopinata* valves are also indicating this dramatic change in hydrology. The shape analysis reveals a significant morphological difference to modern reference material of extant *L. inopinata* from Anatolia. The stable oxygen isotopes of the ostracod valves hint to severe changes in precipitation patterns in the East Mediterranean during the Pleistocene-Holocene transition. Initial increase in precipitation during the Allerød event and at the onset of the Holocene might have caused erosional processes in the carbonate rich catchment area that led to high lake level stands and high alkalinity in the lake water simultaneously.

REFERENCES

ROESER P.A., FRANZ S.O., LITT T., ÜLGEN U.B., HILGERS A., WULF S., WENNRICH V., ÖN AKÇER S., VIEHBERG F.A., ÇAĞATAY M.N. & MELLES M., 2012. Lithostratigraphic and geochronological framework for the paleoenvironmental reconstruction of the last ~36ka cal BP from a sediment record from Lake Iznik (NW Turkey). *Quaternary International,* 274: 73-87.

VIEHBERG F.A., ÜLGEN U.B., DAMCI E., FRANZ S.O., ÖN AKÇER S., ROESER P.A., ÇAĞATAY M.N., LITT T. & MELLES M., 2012. Seasonal hydrochemical changes and spatial sedimentological variations in Lake Iznik (NW Turkey). *Quaternary International*, 274, 102-111.

VIEHBERG F.A., DAMCI E., ÜLGEN U.B., FRANZ S.O., ROESER P.A., WULF S., ÇAĞATAY M.N., LITT T. & MELLES M., in press. Palaeoenvironmental multi-site study in Lake Iznik (NW Turkey) during late Pleistocene and Holocene. *Journal of Paleolimnology*.

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NEWS FROM THE ENDEMIC OSTRACOD FAUNA FROM LAKES PRESPA AND OHRID (ALBANIA, GREECE, MACEDONIA)

One biodiversity hotspot for ostracods in the Balkans is the Dessarete lake system with its extant members Lakes Prespa and Ohrid, which yield over 40 extant species most of them endemic to the region (LORENSCHAT *et al.*, 2011; NAMIOTKO *et al.*, 2012; PETKOVSKI, 1960). The Holocene and/or Late Pleistocene fossil record has been evaluated in recent studies investigating past climate and environmental changes (AUFGEBAUER *et al.*, 2012; BELMECHERI *et al.*, 2009, 2010; HOFMANN *et al.*, 2012; WAGNER *et al.*, 2009). However, a critical checklist of extant ostracod species is still pending for this remarkable fauna, as it is needed to define species ecology and to test suggested hypothesis for the basins origin, which is supposed to be at least 2 to 5 Ma old (ALBRECHT & WILKE, 2008). We collected Recent material between 2011 and 2012 and compiled a checklist for all species known from this area with their biogeographical range, in order to harmonize the regional taxonomy. In addition, we evaluated the morphological variability also through time from core material from Lake Prespa spanning back to MIS5 (AUFGEBAUER *et al.*, 2012) and present a first comparative study of faunal elements within the Dessarete lake system and adjacent freshwater systems in the Balkan.

REFERENCES

ALBRECHT C. & WILKE T., 2008. Ancient Lake Ohrid: biodiversity and evolution. *Hydrobiologia*, 615: 103-140.

AUFGEBAUER A., PANAGIOTOPOULOS K., WAGNER B., SCHAEBITZ F., VIEHBERG F.A., VOGEL H., ZANCHETTA G., SULPIZIO R., LENG M.J. & DAMASCHKE M., 2012. Climate and environmental change in the Balkans over the last 17 ka recorded in sediments from Lake Prespa (Albania/F.Y.R. of Macedonia/Greece). *Quaternary International*, 274: 122-135.

BELMECHERI S., NAMIOTKO T., ROBERT C., VON GRAFENSTEIN U. & DANIELOPOL D.L., 2009. Climate controlled ostracod preservation in Lake Ohrid (Albania, Macedonia). *Palaeogeography, Palaeoclimatology, Palaeoecology*, 277: 236-245.

BELMECHERI S., VON GRAFENSTEIN U., ANDERSEN N., EYMARD-BORDON A., RÉGNIER D., GRENIER C. & LÉZINE A.-M., 2010. Ostracod-based isotope record from Lake Ohrid (Balkan Peninsula) over the last 140 ka. *Quaternary Science Reviews*, 29: 3894-3904.

HOFFMANN N., REICHERTER K., GRÜTZNER C., HÜRTGEN J., RUDERSDORF A., VIEHBERG F. & WESSELS M., 2012. Quaternary coastline evolution of Lake Ohrid (Macedonia/Albania). *Central European Journal of Geosciences*, 4: 94-110.

LORENSCHAT J., SCHARF B.W., PETKOVSKI T.K., VIEHBERG F.A. & SCHWALB A., 2011. Scientific Collaboration On Past Speciation Conditions in Ohrid (SCOPSCO): Recent and fossil Ostracods from Lake Ohrid as indicators of past environments: A coupled ecological and molecular genetic approach with deep-time perspective. *Joannea Geologie und Paläontologie*, 11: 113-115.

NAMIOTKO T., DANIELOPOL D.L., BELMECHERI S., GROSS M. & VON GRAFENSTEIN U., 2012. On the Leptocytheridae Ostracods of the Long-Lived Lake Ohrid: A Reappraisal of their Taxonomic Assignment and Biogeographic Origin. *International Review of Hydrobiology*, 97: 356-374.

PETKOVSKI T.K., 1960. Zur Kenntnis der Crustaceen des Prespasees. *Fragmenta Balcanica Musei Macedonici Scientiarum Naturalium*, 3 (15/74): 117-131.

WAGNER B., LOTTER A.F., NOWACZYK N., REED J.M., SCHWALB A., SULPIZIO R., VALSECCHI V., WESSELS M. & ZANCHETTA G., 2009. A 40,000-year record of environmental change from ancient Lake Ohrid (Albania and Macedonia). *Journal of Paleolimnology*, 41: 407-430.

Authors' Addresses — F.A. VIEHBERG, A. HASBERG, N. ROHN, Institute of Geology and Mineralogy, University of Cologne, Zülpicher Str. 49A, D-50674 Cologne (Germany); e-mail: finn.viehberg@uni-koeln.de; S. TRAJANOVSKI, Hydrobiological Institute Ohrid, Naum Ohridski 50, 6000 Ohrid (Former Yugoslav Republic of Macedonia); e-mail: trajsa@hio.edu.mk.

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OSTRACODOLOGY AND PALAEOENVIRONMENT IN ANTHROPIC CONTEXT: THE *OSTIA* PALAEO-LAGOON CASE

This study is part of a wider research dealing with the recent dynamics of the Tiber's delta and its palaeoenvironmental evolution (Goiran *et al.*, 2010; Mazzini *et al.*, 2011). Here, the preliminary results of the analysis of a core that traces the entire stratigraphy of the *Ostia* palaeo-lagoon, located on the left bank of the Tiber, are presented. The proximity of the ancient city of *Ostia* makes this site an especially anthropized environment since the antiquity. The aim of this preliminary study is to trace the palaeoenvironmental evolution of this area, which remains still poorly understood.

Ostracods are a valuable tool for our study because they are good palaeoenvironmental indicators in marginal marine environments, due to their high abundance and diversity in oligohaline and mesohaline environments (Boomer & Eisenhauer, 2002). Despite the low diversity recorded in the *Ostia* palaeo-lagoon - only 12 taxa of ostracods determined in the core- the autoecological analysis revealed the succession of four major periods.

Post to 6800 BP, the reduction in the sea level rising rate led to the formation of a prograding delta and induced the formation of a barrier that isolated the *Ostia* lagoon (Bellotti *et al.*, 2007), visible in the stratigraphy from 11.8 m. Initially, it was an environment relatively open to the sea as evidenced by the presence of marine taxa (*Aurila speyeri*, *Paradoxostoma augustum*, *Leptocythere rara* and *Callistocythere* sp.) associated with opportunistic euryhaline (*Palmoconcha turbida* and *Leptocythere lagunae*) and brackish (*Cyprideis torosa*) taxa. During this period, the lagoon environ-

Fig. 1 — Location map of the Tiber delta and the sediment core.

ment displayed its largest specific diversity (average 6 taxa) and indicates an environment that was not yet fully confined. The occasional occurrence of freshwater taxa (*Candona* sp. and *Darwinula stevensoni*) confirms the freshwater influx into the lagoon.

At about 10.3 m, the lagoon is evolving towards a confined environment, characterized by a very low specific diversity (average 2 taxa). This period is marked by the presence of alternating environments subjected to marine influence, characterized by the association of opportunistic euryhaline (*P. turbida* or *Xestoleberis* sp.), brackish (*C. torosa*) and freshwater taxa (*Candona* sp.). These data provide two important insights into the nature of the lagoon: (1) the presence of *Candona* sp. can imply a direct connection with a freshwater body, which could mean that a palaeo-channel of the Tiber had to flow into the *Ostia* palaeo-lagoon, (2) the absence of any trace of hydrodynamic change, even punctual, in the sedimentary sequence suggests the dominant role of the barrier beaches opening and closing in these variations.

Between 8.2 and 5.8 m four peat levels can be related to the generalized peat formation in the north of the lagoon, which took place from 1880/1530 BC (Bellotti *et al.*, 2011). It is in these inter-peat deposits that we can find the latest manifestation of freshwater influx, marked by the presence of *Can-*

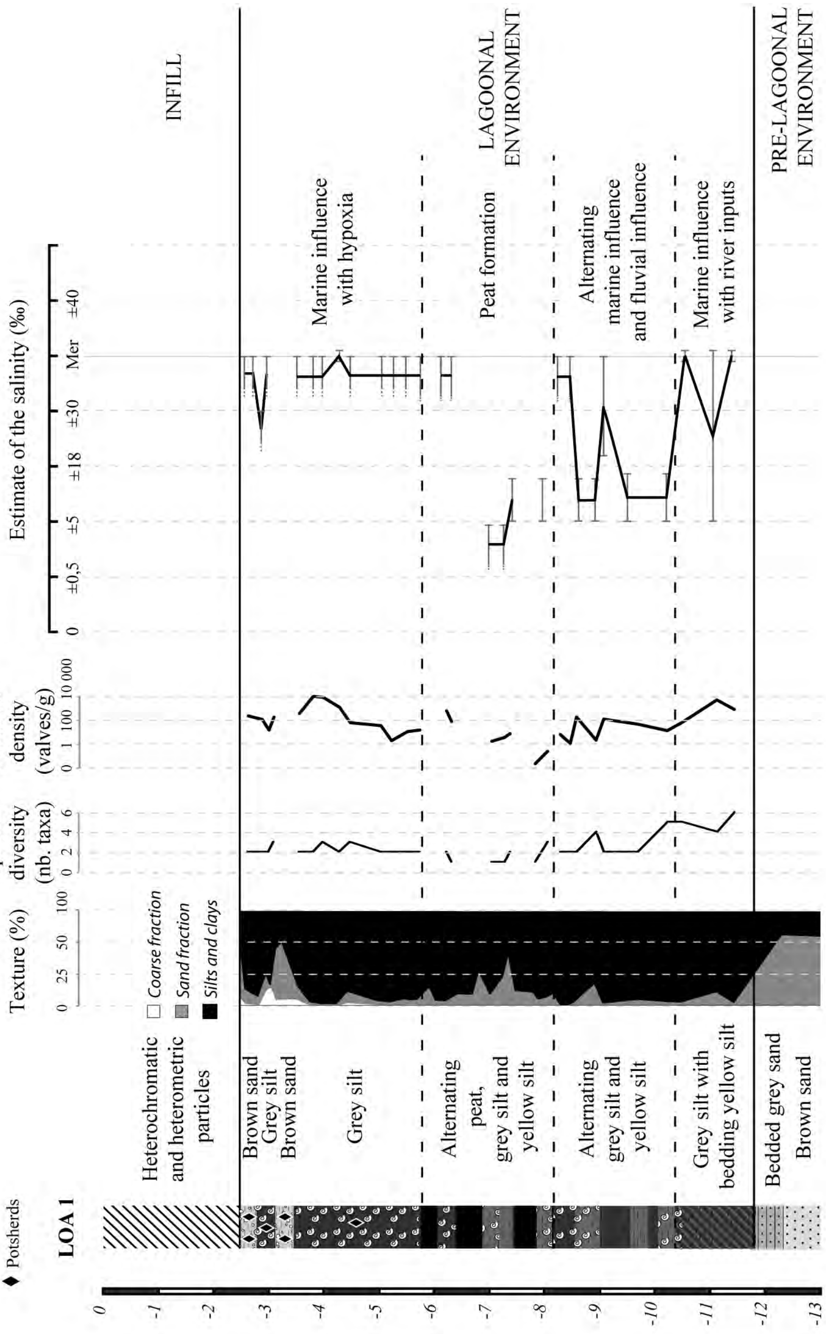

Fig. 2 — Ostracodologic log of core LOA1: specific diversity, faunistic density and estimate of the salinity based on the autoecological data.

dona sp., *C. torosa* with tubercles (salinity <5 ‰) and freshwater gastropod *Bythinia tentaculata*, suggesting that the formation of the peat is related to the progressive movement of the palaeo-channel that previously flowed into the palaeo-lagoon.

After this episode, we can see that the last peat sequence is interrupted by a marine intrusion. It starts up as a very confined euryhaline environment, characterized by an increased faunal density and an opportunistic taxa assemblage, such as the ostracods *C. torosa* and *P. turbida*, the bivalve *Cerastoderma glaucum* and the gastropod *Hydrobia ventrosa*, all supporting hypoxic conditions. The resilience of this environment is to be linked on one hand to the disconnection of the palaeo-channel of the Tiber and on the other hand to the stabilization of the barrier beaches, which might be starting to get caught in the delta progradation deposits.

It was during this period that the first signs of human presence appear in the lagoon, with some potsherds. Over time, the anthropogenic pressure is increasingly visible, with the increase of exogenous factors (potsherds, mortar, pozzolan, sand) until the palaeo-lagoon is filled.

The outstanding results of this preliminary study highlighted by analyzing the auto-ecology of the faunal assemblages are the following: (1) the newly obtained stratigraphy indicates for the first time a direct contact between the *Ostia* palaeo-lagoon and a palaeo-channel of the Tiber, whose chronology will be more defined thanks to datings expected in June 2013 (2) the lagoon environment seems to have been permanent since the establishment of the city of *Ostia*, despite ever more intense anthropic pressure.

REFERENCES

BELLOTTI P., CALDERONI G., CARBONI M.G., BELLA L.D., TORTORA P., VALERI P. & ZERNITSKAYA V., 2007. Late Quaternary landscape evolution of the Tiber River delta plain (Central Italy): new evidence from pollen data, biostratigraphy and 14C dating. *Zeitschrift für Geomorphologie*, 51: 505-534.

BELLOTTI P., CALDERONI G., RITA F.D., D'OREFICE M., D'AMICO C., ESU D., MAGRI D., MARTINEZ M.P., TORTORA P. & VALERI P., 2011. The Tiber River Delta Plain (Central Italy): Coastal evolution and implications for the Ancient Ostia roman settlement. *The Holocene*, 21: 1105-1116.

BOOMER I. & EISENHAUER G., 2002. Ostracod faunas as palaeoenvironmental indicators in marginal marine environments. In: Holmes, A.H., Chivas, A.R. (Eds.), The ostracoda: applications to Quaternary research: 135-149.

GOIRAN J.P., TRONCHÈRE H., SALOMON F., CARBONEL P., DJERBI H. & OGNARD C., 2010. Palaeoenvironmental reconstruction of the ancient harbors of Rome: Claudius and Trajan's marine harbors on the Tiber delta. *Quaternary International*, 216: 3-13.

MAZZINI I., FARANDA C., GIARDINI M., GIRAUDI C. & SADORI L., 2011. Late Holocene Palaeoenvironmental Evolution Of The Ancient Harbour Of Portus (Latium, Central Italy). *Journal of Palaeolimnology*, 46: 243-256.

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YAQIONG WANG

EARLY CRETACEOUS NONMARINE OSTRACOD BIOSTRATIGRAPHY OF THE WESTERN LIAONING AREA, NE CHINA

Nonmarine ostracod faunas of the western Liaoning had been studied since 1950s (HOU, 1958; ZHANG & ZHANG, 1982; ZHANG, 1985; ZHANG *et al.*, 1985; CAO, 1999; WANG *et al.*, 2004), but the species diversity has been greatly exaggerated by previous authors, because the species and subspecies described have been based on an inadequate number of specimens. The present paper is based on a large number of fossils and descriptions of taxonomic features that are more precise than those presented previously. All of the published species from the Yixian, Jiufotang, Fuxin, Sunjiawan formations of western Liaoning are revised and listed (Figs. 1-2).

The nonmarine ostracod fauna of the Barremian to Albian strata of western Liaoning can be subdivided into six successive ostracod assemblages. They are in ascending order:

1. *Cypridea liaoningensis-Damonella circulate* assemblage (mainly in the lower part of the Yixian Formation)

2. *Cypridea deflecta-Cypridea jinganshanensis-Lycopterocypris infantilis* assemblage (mainly in the upper part of the Yixian Formation and the lower part of the Jiufotang Formation)

3. *Limnocypridea grammi-Scabriculocypris pingquanensis-Cypridea delnovi* assemblage (mainly in the upper part of the Jiufotang Formation)

4. *Mongolocypris kleinbergi-Mongolianella palmosa-Cypridea tumidiusula* assemblage (mainly in the lower part of the Fuxin Formation)

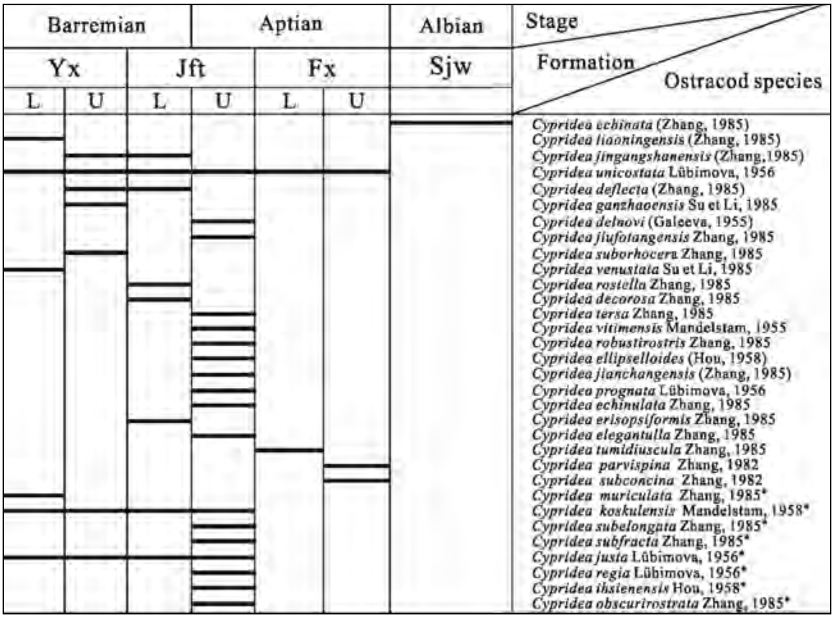

Fig. 1 — Stratigraphical ranges of the cypridean species from western Liaoning of Northeastern China in detail (* (star) indicates the *Cypridea* species with RV>LV).

5. *Mongolocypris globra-Candona*? *dongliangensis* assemblage (mainly in the upper part of the Fuxin Formation)

6. *Cypridea echinata-Bisulcocypridea edentula* (Sunjiawan Formation)

The cypridean specimens encountered in the Yixian Formation (Barremian age) of the Beipiao-Yixian Basin are the earliest record of this genus in China (CAO, 1999; GUAN *et al.*, 2001). But the earliest representatives of (true) *Cypridea* were documented by SCHUDACK & SCHUDACK (2002) from Kimmeridgian of the Middle Saurian Member of the Tendaguru Formation, East Africa. The timing of the earliest appearance and evolution and dispersal of species of *Cypridea* in China heavily depends on the age assignments and correlation of the concerning strata, which is still controversial.

REFERENCES

CAO M.Z., 1999. Nonmarine ostracods of the lower part of the Yixian Formation in Sihetun area, western Liaoning, China. *Palaeoworld*, 11: 131-144 (in Chinese, English abstract).

GUAN S.Z., PANG Q.Q. & XIAO Z.Z., 2001. Discussion on the lowest horizon of *Cypridea* (Ostracoda) in China. *Geology of Chemical Minerals*, 23: 65-74 (in Chinese, English abstract).

HOU Y.T., 1958. Jurassic and Cretaceous nonmarine ostracods of the subfamily Cypridenae from

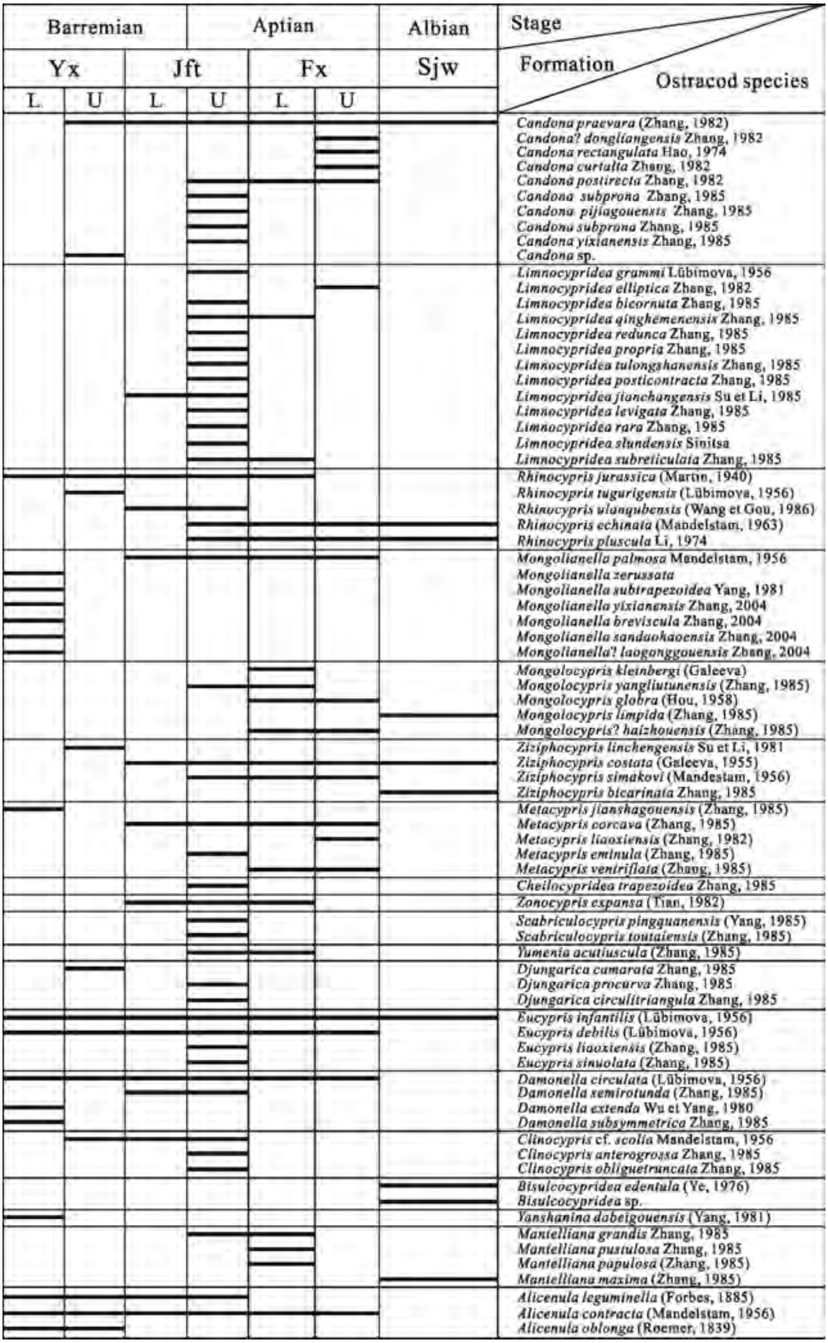

Fig. 2 — Stratigraphical ranges of the non-cypridean species from western Liaoning of Northeastern China in detail.

north-western and north-eastern regions of China. *Memoirs of Nanjing Institute of Geology and Palaeontology Academia Sinica*, 1: 33-103.

SCHUDACK M.E. & SCHUDACK U., 2002. Ostracods from the Middle Dinosaur Member of the Tendaguru Formation (Upper Jurassic of Tanzania). *Neues Jahrbuch für Geologie und Paläontologie, Monatshefte*, 6: 321-336.

WANG W.L., ZHANG H., ZHANG L.J., ZHENG S.L., YANG F.L., LI Z.T., ZHENG Y.J. & DING Q.H., 2004. Standard sections of Tuchengzi stage and Yixian Stage and their stratigraphy, palaeontology and tectonic-volcanic actions. *Geological Publishing House*: 175-190 (in Chinese).

ZHANG L.J. & ZHANG Y.J., 1982. Ostracodes from the Fuxin Formation (Lower Cretaceous) in the Fuxin Basin, Liaoning. *Acta Palaeontologica Sinica*, 21 (3): 362-369 (in Chinese, English abstract).

ZHANG L.J., 1985. The freshwater ostracodes from the lower Cretaceous Jiufotang and Shahai Formation in the Western Liaoning. *Selected paper on Micropalaeontology of China*: 137-149 (in Chinese).

ZHANG L.J., PU R.G. & WU H.Z., 1985. Mesozoic stratigraphy and palaeontology of Western Liaoning (Vol. 2). *Geological Publishing House*, 1-120 pp. (in Chinese).

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CLAUDIA SEYFERT, PETER FRENZEL & THOMAS VOIGT

A NEOGENE LARGE AND SHALLOW BRACKISH WATER LAKE IN THE ILI BASIN, KAZAKHSTAN (EASTERN PARATETHYS) AND ITS OSTRACOD FAUNA

The present study covers Miocene to Pliocene sediments from the Ili Basin in southeastern Kazakhstan. These continental sediments were deposited during the uplift of mountain ranges of the Tienschan. Especially Miocene deposits show a great variety of lacustrine facies, which interfinger with alluvial fans, mud flats and river channels. Varying colour and composition of the sedimentary succession as well as fluctuating contents of salt and gypsum in the mudstones point to major climatic changes reflected by lake level oscillation, probably partly in cyclic patterns.

We investigated twenty samples from presumable aquatic deposits (marls and sands). They belong to the Miocene Santash Formation and the Pliocene Ili Formation. Except one, all contain aquatic microfossils, especially a rich ostracod fauna. The state of fossil preservation ranges between good and poor with crystal enlargement and sometimes signs of dissolution or with fragmentation and deformation of valves. We cannot exclude that parts of the poorly preserved associations are reworked, however, most alterations seem to be diagenetic. There are no indications for river sediments and associated transport before the Ili formation.

In total, 21 ostracod taxa could be identified relying mostly on BODINA (1961). The most frequent taxa are *Ilyocypris gibba*, *Cyprideis torosa*, *Cyprinotus baturini*, *Paracandona euplectella* and an unknown *Eucypris* species (compare list of taxa below). The ostracods indicate a Miocene to early Pliocene age of the studied samples (Santash and Ili formations). The differentiation between both investigated formations is defined by facies and a stratigraphical subdivision based on ostracods is still problematical. Most of the Santash formation is characterised by lake taxa (e.g. *Cyprideis torosa*, limnocytherids), whereas its upper part and the Ili formation contain associations reflecting more unstable environmental conditions of small and temporary waters (e.g. *Paracandona euplectella*, *Cyprinotus* spp., darwinulids) as well as rivers. Other microfossils are abundant gyrogonites and stems of charophytes, gastropodes and bivalve fragments as well as fish bones and scales.

Also, the wide distribution of lacustrine sediments indicates a large lake during the Santash formation. Characteristic is the brackish water ostracod *Cyprideis torosa,* which does not have dry-resistent eggs and needs therefore permanent water bodies with an elevated salt content (HEIP, 1976; PINT *et al.*, 2012). This index species (GRAMANN, 2000) is not present in all samples indicating fluctuating lake levels and salinities. The water was generally shallow and the phytal zone well developed. The shore line is assumed to be situated close to the study area in the North. Despite strong fluctuations, there is anup-section tendency to higher salinity shown by monospecific mass occurrence of smooth shelled *C. torosa* in the upper part of the Santash Formation pointing to dry climatic conditions. Cyclic sedimentation patterns and fluctuation of shore lines and salinity indicate climatically driven lake level changes during the deposition of the Santash Formation. The following associations of the Ili Formation are characterised by freshwater taxa, the lack of *C. torosa* and more and more forms preferring temporary and smaller waters. They indicate a perishing of the former lake. The depositional system was charceterisedby smaller temporary water bodies on the flood-plain of a major river system in the early Pliocene.

Systematic List

Higher systematics according to HORNE *et al.* (2002).

Class Ostracoda Latreille, 1806
  Suborder Darwinulocopina Sohn, 1988
    Superfamily Darwinulidea Brady & Norman, 1889
      Darwinula kenderlykensis Bodina, 1961
  Suborder Cypridocopina Sohn, 1988
    Superfamily Cypridoidea Baird, 1845
Family Candonidae Kaufmann, 1900
      Candoniella? *marcida* Mandelstam, 1961
      Paracandona euplectella (Robertson, 1889)
      Pseudocandona kirgizica (Mandelstam, 1961)
    Family Ilyocyprididae Kaufmann, 1900
      Ilyocypris gibba (Ramdohr, 1808)
    Family Cyprididae Baird, 1845
      Cypridopsis vassoevitschi Schneider 1961
      Cypridopsis sp.

Cyprinotus baturini Schneider 1961
Cyprinotus espinicus Bodina 1961
Cyprinotus vialovi Schneider 1961
Eucypris kovalevskyi Schneider, 1961
Eucypris sp.
Potamocypris sp.
Prionocypris sp. sensu Bodina 1961
Prionocypris vitrea Bodina 1961
Virgatocypris sp.
SuborderCytherocopina
Superfamily Cytheroidea
Family Limnocytheridae Klie, 1938
Limnocythere prasolowi Bodina 1961
Family Cytherideidae Sars, 1925
Cyprideis torosa (Jones, 1850)

gen. et sp. inc.

REFERENCES

[Bodina, L.E.] Бодина Л.Е., 1961. Остракоды третичных отложений Зайсанской и Илйскй депрессий [Ostracoda from Tertiary deposits of the Saysan and Ili Basin]. In: [Microfauna of the USSR] Микрофауна СССР, XII (фораминиферы и остракоды меловых и третичных отложений Западной Сибири, Восточного Казахстана и Дальнего Востока [Foraminifera and Ostracoda from Cretaceous and Tertiary sediments of Western Sibiria, Eastern Kasakhstan and the Far East of the USSR]): 43-139, 14 plates; VNIGRI, Leningrad.

Gramann F., 2000. Ostrakoden der Art *Cyprideis torosa* als Indikatoren für Salzgehalt und Klima – Nachweis eines Binnensalinars im Pleistozän Nordostniedersachsens. *Zeitschrift für Angewandte Geologie*, 46(1): 49-58.

Horne D.J., Cohen A. & Martens K., 2002. Taxonomy, morphology and biology of Quaternary and living Ostracoda. In: K.A. Holmes, A.R. Chivas (Eds.), The Ostracoda, Application in Quaternary Research. Geophysical Monographs 131, American Geophysical Union, Washington, DC (2002), pp. 5-36.

Heip C., 1976. The life-cycle of *Cyprideis torosa* (Crustacea, Ostracoda). *Oecologia*, 24: 229-245.

Pint A., Frenzel P., Fuhrmann R., Scharf B. & Wennrich V., 2012. Distribution of *Cyprideis torosa* (Ostracoda) in Quaternary athalassic sediments in Germany and its application for palaeoecological reconstructions. *International Review of Hydrobiology*, 4: 330-355.

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RYLAN SHEARN, STUART HALSE, KOEN MARTENS,
ANNETTE KOENDERS & ISA SCHÖN

DECIPHERING RADIATION PATTERNS IN AUSTRALIAN *BENNELONGIA* DE DECKKER & MCKENZIE, 1981 (*Crustacea Ostracoda*)

Throughout the world, invertebrate communities lay idle in sediments during drought periods and arise upon inundation events in temporary pools, using a range of adaptations that enable drought resistance and a tolerance to the highly variable conditions after inundation (HUMPHRIES & BALDWIN, 2003; SÁNCHEZ & ANGELER, 2007). Some geographic regions of the world show a higher diversity and endemicity of these taxa than others (KING *et al.*, 1996). However, this is rarely explained by hypotheses that draw from phylogeography and evolutionary history.

In Australia for example, a higher diversity and endemism of some drought resistant invertebrates has been documented in the continent's western region, compared to the eastern region (FREY, 1998; REMIGIO *et al.*, 2001; TIMMS, 2002). The proposed explanations for this are firstly the long period of tectonic inactivity in Australia, which has left temporary pools unaltered for long evolutionary timescales (DE DECKKER, 1983; HALSE *et al.*, 2003), thus enabling the radiation of these taxa over time. However, this does not explain why these taxa have not dispersed throughout the remainder of the continent. This problem is explained by a second hypothesis that describes barriers to dispersal, formed either by the arid climatic conditions of central Australia (ARCHER & CLAYTON, 1984; FREY, 1998), or the presence of an inland sea during the Cretaceous (REMIGIO *et al.*, 2001), or a combination of the two. Current biological evidence for these hypotheses is based on examples of high documented diversity in the western region (FREY, 1998; BOXSHALL & DEFAYE, 2008; REMIGIO *et al.*, 2001; TIMMS, 2002) that lack comparison of the similarity between east and west regions. Ideally, genetic comparisons between regions would enable a better understanding of whether (or to what extent) these barriers to dispersal are present.

Recent taxonomic studies on *Bennelongia* (Ostracoda, Cyprididae) have revealed this genus to be yet another exemplar for the aforementioned hypotheses, with a high diversity in the western region (MARTENS *et al.*, 2012), but comparatively low diversity in the eastern region (SHEARN *et al.*, 2012). In this study, the degree of genetic variability throughout Australia was analysed by extracting DNA from representative *Bennelongia* species throughout eastern and western regions, then sequencing the mitochondrial COI gene and determining the genetic variability between regions using computational phylogenetic approaches.

Analysis of the genetic variability within and between these regions has revealed different patterns between lineages within this genus. For some lineages, a higher degree of similarity between regions was observed, while for others the opposite pattern was evident. These results suggest that the movement of some lineages between regions was not impeded by the hypothesised dispersal barrier, either because of spatial or temporal breaks in the barrier (for example during periodic retractions of the arid zone (BOWLER, 1982)), or through recent, highly efficient dispersal. For lineages that do show isolation, the use of molecular clocks to estimate divergence times will be useful in showing evidence for the location and timing of barriers that may have impeded dispersal. More widely, these results suggest that isolated eastern and western radiations are not a universal feature of temporary pool microfauna in Australia.

REFERENCES

ARCHER M. & CLAYTON G., 1984. Vertebrate Zoogeography and Evolution in Australasia (Animals in space and time). *Hesperian Press*: Marrickville NSW.

BOWLER J.M., 1982. Aridity in the late Tertiary and Quarternary of Australia. In: W. R. Barker & P. J. Greenslade (eds.), Evolution of the flora and fauna of arid Australia. *Peacock Publications*, Frewville.

BOXSHALL G. & DEFAYE D., 2008. Global diversity of copepods (Crustacea: Copepoda) in freshwater. *Hydrobiologia,* 595: 195-207.

DE DECKKER P., 1983. Australian salt lakes: their history, chemistry and biota – a review. *Hydrobiologia,* 105: 231-244.

FREY D., 1998. Expanded description of Leberis aenigmatosa Smirnov (Anomopoda: Chydoridae): a further indication of the biological isolation between western and eastern Australia. *Hydrobiologia,* 367: 31-42.

HALSE S.A., RUPRECHT J.K. & PINDER A.M., 2003. Salinisation and prospects for biodiversity in rivers and wetlands of south-west Western Australia. *Australian Journal of Botany,* 51: 673-688.

HUMPHRIES P. & BALDWIN D.S., 2003. Drought and aquatic ecosystems: an introduction. *Freshwater Biology*, 48: 1141-1146.

KING J.L., SIMOVICH M.A. & BRUSCA R.C., 1996. Species richness, endemism and ecology of crustacean assemblages in northern California vernal pools. *Hydrobiologia,* 328: 85-116.

MARTENS K., HALSE S. & SCHÖN I., 2012. Nine new species of *Bennelongia* De Deckker & McKenzie, 1981 (Crustacea, Ostracoda) from Western Australia, with the description of a new subfamily. *European Journal of Taxonomy,* 8: 1-56.

REMIGIO E.A., HEBERT P.D.N. & SAVAGE A., 2001. Phylogenetic relationships and remarkable radiation in *Parartemia* (Crustacea: Anostraca), the endemic brine shrimp of Australia: evidence from mitochondrial DNA sequences. *Biological Journal of the Linnean Society,* 74: 59-71.

SÁNCHEZ B. & ANGELER D.G., 2007. Can fairy shrimps (Crustacea: Anostraca) structure zooplankton communities in temporary ponds? *Marine and Freshwater Research,* 58: 827-834.

SHEARN R., KOENDERS A., HALSE S., SCHÖN I. & MARTENS K., 2012. A review of *Bennelongia* De Deckker & McKenzie, 1981 (Crustacea, Ostracoda) species from eastern Australia with the description of three new species. *European Journal of Taxonomy,* 25: 1-35.

TIMMS B.V., 2002. The fairy shrimp genus *Branchinella* Sayce (Crustacea: Anostraca: Thamnocephalidae) in Western Australia, including a description of four new species. *Hydrobiologia,* 486: 71-89.

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RYLAN SHEARN, ISA SCHÖN, ANNETTE KOENDERS,
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GEOGRAPHIC PARTHENOGENESIS IN AUSTRALIAN *ILYODROMUS* SARS, 1894 (*Crustacea Ostracoda*)

Most multicellular organisms reproduce sexually at some point in their life cycle (BELL, 1982). This prevalence and persistence of sex has been described as paradoxical, because with the two-fold cost of sex (MAYNARD-SMITH, 1978) one would expect the world to be dominated by asexual organisms (DAGG, 2000). This has since been partially explained with ideas based on the early exintion of asexual lineages, such as their inability to adapt to rapidly changing selection conditions (known as the Red Queen hypothesis: BIRDSELL & WILLS, 2003; HAMILTON, 1980; MAYNARD-SMITH, 1980) or their accumulation of deleterious mutations (KONDRASHOV, 1988; MULLER, 1932). However, asexual lineages continue to persist throughout wide distributions, in vastly different habitats (BELL, 1982; SCHÖN *et al.*, 2009; SUOMALAINEN *et al.*, 1987), and in some cases for long evolutionary timescales (SCHÖN *et al.*, 1998; WELCH & MESELSON, 2000). Furthermore the growing number of incompatible explanatory hypotheses suggests that the paradox of sex is far from solved.

One area of research showing great promise in highlighting ecological factors that may explain the prevalence of sexual reproduction is the study of the differential geographic distribution of sexuals and asexuals (known as Geographic Parthenogenesis: VANDEL, 1928). Organisms that display this phenomenon tend to have asexual lineages distributed in more marginal habitats than sexual lineages of either the same or closely related species (VANDEL, 1928; 1940). Trends in Geographic Parthenogenesis are perhaps best documented in Europe, where asexual lineages tend to occur everywhere while sexual lineages are limited to the Mediterranean region (VANDEL, 1928). It is generally believed that this may be a reflection of the short term colonisation ability of asexual lineages since the last glaciation eliminated populations that occurred in the north. In contrast, sexual colonisers need to find a mate in temporally and spatially diluted environments. More recently, a finer scale trend was observed; polyploid asexuals were shown to be more generalist and to have a wider distribution than diploid asexuals (ADOLFSSON *et al.*, 2009; MANIATSI *et al.*, 2011; STENBERG *et al.*, 2003). This suggests that, at least in Europe, a higher selective advantage (KEARNEY, 2003) through increased potential gene combinations (OTTO & WHITTON, 2000) could govern the success of asexual lineages in marginal environments.

A similar pattern has been observed in Australia. However the hypothesised underlying mechanisms are slightly different. Parthenogenetic and polyploid lineages have been shown to occur in more arid habitats, and sexuals in higher rainfall areas (KEARNEY, 2003; KEARNEY *et al.*, 2006; VORBURGER, 2006). The explanation offered is that the increased colonisation and reproductive efficiency of parthenogenetic organisms is an advantageous attribute in Australian arid environments, where population densities are often low (KEARNEY, 2003). Furthermore, sexuals in the high rainfall areas of Australia are hypothesised to undergo inter-species hybridisation, resulting in rapid production of asexuals with new phenotypes adapted to the empty niches left from prolonged drought in nearby arid regions (KEARNEY, 2003). However, unlike Europe, a trend has not been successfully documented in aquatic taxa. Although attempts have been made, outcomes did not show Geographic Parthenogenesis due to the use of fully sexual models (FINSTON, 2002 for example). As they are aquatic and have a mixed reproductive mode, cypridid ostracod taxa are the best candidates to test if this Australian pattern is caused by more complex processes than rainfall alone (for example habitat stability or water chemistry). *Ilyodromus* Sars, 1894 is a non-marine cypridid ostracod genus that is known to have both sexual and parthenogenetic populations distributed throughout Australia (Stuart Halse, unpublished data). As these species occur across a range of climates (Stuart Halse, unpublished data), their mixed reproductive strategy makes them an ideal model to investigate the relationship between aridity, habitat stability and reproductive mode in Australia. We intend to implement this investigation, by firstly establishing a taxonomic framework for the genus that will enable the study of species and the differential distribution of their reproductive mode, then using a number of traditional and molecular approaches to define patterns of Geographic Parthenogenesis and/or ploidy level distribution.

REFERENCES

ADOLFSSON S., MICHALAKIS Y., PACZESNIAK D., BODE S.N.S., BUTLIN R.K., LAMATSCH D.K., MARTINS M.J.F., SCHMIT O., VANDEKERKHOVE J. & JOKELA J., 2009. Evaluation Of Elevated Ploidy And Asexual Reproduction As Alternative Explanations For Geographic Parthenogenesis In Eucypris Virens Ostracods. *Evolution,* 64: 986-997.

BELL G., 1982. The Masterpiece of Nature: the Evolution and Genetics of Sexuality. *Croom Helm*: London.

BIRDSELL J.A. & WILLS C., 2003. The evolutionary origin and maintenance of sexual recombination: a review of contemporary models. *Evolutionary Biology,* 33.

DAGG J.L., 2000. Why sex? A parody on the paradox. *Oikos,* 89.

FINSTON T.L., 2002. Geographic patterns of population genetic structure in *Mytilocypris* (Ostracoda: Cyprididae): interpreting breeding systems, gene flow and history in species with differing distributions. *Molecular Ecology,* 11: 1931-1946.

HAMILTON W.D., 1980. Sex vs. non-sex vs parasite. *Oikos,* 35: 282-290.

KEARNEY M.R., 2003. Why is sex so unpopular in the Australian desert? *Trends in Ecology and Evolution,* 18: 605-607.

KEARNEY M.R., BLACKET M.J., STRASBURG J.L. & MORITZ C., 2006. Waves of parthenogenesis in the desert: evidence for the parallel loss of sex in a grasshopper and a gecko from Australia. *Molecular Ecology,* 15: 1743-1748.

KONDRASHOV A.S., 1988. Deleterious mutations and the evolution of sexual reproduction. *Nature,* 336.

MANIATSI S., BAXEVANIS A.D., KAPPAS I., DELIGIANNIDIS P., TRIANTAFYLLIDIS A., PAPAKOSTAS S., BOUGIOUKLIS D. & ABATZOPOULOS T.J., 2011. Is polyploidy a persevering accident or an adaptive evolutionary pattern? The case of the brine shrimp Artemia. *Molecular Phylogenetics and Evolution,* 58: 353-364.

MAYNARD-SMITH J., 1978. The Evolution of Sex. *Cambridge University Press*: Cambridge.

MAYNARD-SMITH J., 1980. Selection for recombination in a polygenic model. *Genet Res,* 35.

MULLER H.J., 1932 Some genetic aspects of sex. *American Naturalist,* 66: 118-138.

OTTO S.P. & WHITTON J., 2000. Polyploid Incidence and Evolution. *Annual Review of Genetics,* 2000: 401-437.

SCHÖN I., BUTLIN R.K., GRIFFITHS H.I. & MARTENS K., 1998. Slow molecular evolution in an ancient asexual ostracod. *Proceedings of the Royal Society of London,* 265: 235-242.

SCHÖN I., MARTENS K. & DIJK P. V., 2009. Lost Sex, The Evolutionary Biology of Parthenogenesis. *Springer*: Dordrecht, Heidelberg, London, New York.

STENBERG P., LUNDMARK M., KNUTELSKI S. & SAURA A., 2003. Evolution of Clonality and Polyploidy in a Weevil System. *Molecular Biology and Evolution,*20: 1626-1632.

SUOMALAINEN E., SAURA A. & LOKKI J., 1987. Cytology and evolution in parthenogenesis. *CRC Press*: Boca Raton.

VANDEL A., 1928. La parthénogénèse géographique contribution a l`étude biologique et cytologique de la parthénogénèse naturelle. *Bull Biol France Belg* 62: 164-281.

VANDEL A., 1940. La parthénogénèse géographique. IV. Polyploidie et distribution géographique. *Bull Biol France Belg,* 74.

VORBURGER C., 2006. Geographic Parthenogenesis. *Current Biology,* 15: 641-643.

WELCH D.M., & MESELSON M., 2000. Evidence for the Evolution of Bdelloid Rotifers Without Sexual Reproduction or Genetic Exchange. *Science,* 288: 1211-1215.

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DAVID J. SIVETER

ORIGIN & EARLY HISTORY OF OSTRACODS

There is general agreement that the Cambrian witnessed the origin of the major morphological novelties within the Arthropoda and there is consensus regarding the general pattern of arthropod phylogeny. However, certain details remain unresolved; for example, within the Mandibulata, what is the relationship between Crustacea and Hexapoda? The case for ostracod monophly based on morphological analysis is supported by recent molecular studies. The Bradoriida and Phosphaticopina, traditionally regarded as the representatives of Ostracoda in the Cambrian, are now generally accepted as stem crustaceans, but both fossil and molecular evidence argue in favour of a Cambrian ostracod record. The earliest supposed ostracods based on fossil shell evidence are of early Ordovician age. Rare Silurian Myodocopa and Devonian Podocopa with soft-part preservation confirm the presence of both groups in the Palaeozoic. In the absence of knowledge of soft anatomy the true systematic affinity and integrity of the Palaeocopida, known from some 500 Palaeozoic genera, remains problematic, especially as features of the shell morphology of Silurian myodocopid myodocopes recall halocyprid myodocopes and palaeocopes and thereby encourage caution in classifying ostracods based on the carapace alone and query the interpretation of their shell-based fossil record. Although having multilayered shells, other shell features of the Eridostracina (Ordovician-Carboniferous) suggest an ostracod affinity, but the ostracod affiliation of the leperditicopids (Ordovician-Devonian) remains conjecture.

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ARIANY DE JESUS E SOUSA & LUCIO RIOGI TOKUTAKE

VARIATIONS OF THE GENERA *KRITHE*, *HENRYHOWELLA* AND *POSEIDONAMICUS* IN UPPER QUATERNARY SEDIMENTS OF THE CAMPOS BASIN (SOUTHEASTERN BRAZIL): PALAEOCLIMATOLOGY AND PALEOCEANOGRAPHY

The marine ostracods are an excellent tool for interpreting climatic and oceanographic changes (DINGLE & LORD, 1990; AYRESS *et al.*, 1997). This study is based on samples from the piston core GL-451 that penetrated the lower slope of the Campos Basin (southeastern Brazil), at a water depth of 1500 m. The carbonate-rich sediments recovered from this core were dated as Late Pleistocene/Holocene based on planktonic foraminifera (zones W, X, Y, and Z; SOUSA *et al.*, 2011) and marine isotopic stages (MIS), from oxygen and carbon isotopes (MIS 1-6; TOKUTAKE, 2005).

The recovery of ostracods along the GL-451 proved to be irregular. The greater ostracod abundance is coincident with periods of cooling, as evidenced by the $\delta^{18}O$ curve (Figs. 1 - 2). The association of ostracods proved to be diversified through the core, and included several typical bathyal genera. The three genera selected for this study, *Krithe*, *Henryhowella,* and *Poseidonamicus*, are particulary abundant through the core, and are known to characterize different water masses in the South Atlantic (DINGLE & LORD, 1990).

Krithe is the most diversified genera, being represented by the species *Krithe morkhoveni morkhoveni*, *K. reversa, K. dolichodeira, K. trinidadensis*, and four other species that remain in open nomenclature. *Henryhowella* and *Poseidonamicus* are poorly diversified; the first is represented by one species in open nomenclature (*Henryhowella* sp. 1) and the second, mainly by *Poseidonamicus pintoi*. Other genera with notable abundance are *Australoecia*, *Macropyxis* and *Argilloecia*.

Figure 1 shows the relative abundances of *Krithe*, *Henryhowella* and

Poseidonamicus together with the total abundance of ostracods curve, $\delta^{18}O$ curve, sedimentological, and biostratigraphic data. Among these ostracods, *Krithe* is most abundant, reaching 100% of the association in the W2-W1 subzonal transition; in the subzone X2; in the middle of subzone X1; and through the Y4-Y3 transition.

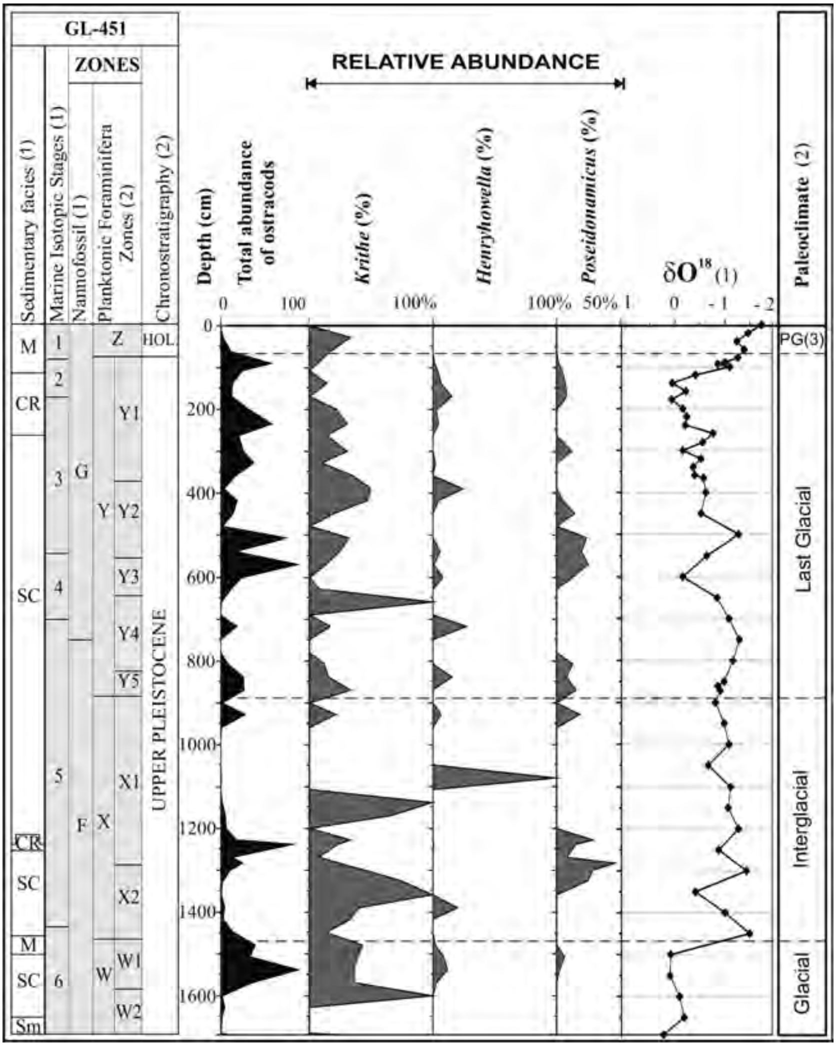

Fig. 1 — Relative abundances of *Krithe*, *Henryhowella,* and *Poseidonamicus* and $\delta^{18}O$ curve plotted against to the zones of planktonic foraminifera and calcareous nannofossils, marine isotope stages, and sedimentary facies of piston core GL-451. Note: (1) Tokutake (2005), (2) Sousa *et al.* (2011), (3) Postglacial; M – marl (30-60% $CaCO_3$), CR – calcareous rich mud (15-30% $CaCO_3$), SC – slightly calcareous mud (5-15% $CaCO_3$), Sm – siliciclastic muddy sand (<5% $CaCO_3$).

Poseidonamicus is less abundant than *Krithe*. Its maximum value (27%) is within the Interglacial Stage in the X2-X1 subzonal transition (in an inverse relationship with the values of *Krithe*) and in the Last Glacial Stage (subzones Y3 and Y2). A fauna comprised only *Henryhowella* is recorded in the Interglacial Stage (subzone X1) preceded by total fauna dominance by *Krithe*. *Henryhowella*, though not particularly abundant, becomes more common in samples within the Last Glacial Stage.

The three genera clearly show different responses to the paleoenvironmental and paleoclimatic fluctuations that occurred in the Campos Basin, as evidenced by planktonic foraminifera and the $\delta^{18}O$ curve. Periods of warming and cooling are considered as the prime controlling factors in the distribution of the ostracods.

REFERENCES

AYRESS M., NEIL H., PASSLOW V. & SWANSON K., 1997. Benthonic ostracods and deep watermasses: A qualitative comparison of southwest Pacific, Southern and Atlantic oceans. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 131: 287-302.

DINGLE R.V. & LORD A.R., 1990. Benthic ostracods and deep water-masses in the Atlantic Ocean. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 80: 213-235.

SOUSA A.J., SANJINES A.E.S., TOKUTAKE L.R., QUEIROZ-NETO J.V., MARINS G.M. & FERREIRA E.P., 2011. Bioeventos de Ostracodes Marinhos Relacionados a Foraminíferos e Isótopos de Oxigênio, Quaternário, Bacia de Campos, Brasil. In: Carvalho I. S., Srivastava N. K., Strohschoen Jr. O., Lana C. C. (eds.), Paleontologia: Cenários da Vida. *Editora Interciência*, Vol. III: 143-151.

TOKUTAKE L.R., 2005. Bioestratigrafia de nanofósseis calcários e estratigrafia de isótopos (C e O) do talude médio, Quaternário, porção N da Bacia de Campos, ES. Masters thesis. *Universidade Federal do Rio Grande do Sul, Porto Alegre*, 96 pp.

Authors' Addresses — A.J. SOUSA, Petrobras, Centro de Pesquisa e Desenvolvimento Leopoldo Américo Miguez de Mello, Gerência de Bioestratigrafia e Paleoecologia Aplicada, Rua Horácio Macedo, nº 950, p. 20 sl. 1102, Cidade Universitária, Ilha do Fundão, Rio de Janeiro, RJ (Brazil), 21941915, email: aryani@petrobras.com.br; L.R. TOKUTAKE, Petrobras, Unidade Operacional do Espírito Santo, Gerência de Sedimentologia e Estratigrafia, Av. Nossa Senhora da Penha, nº 1688, Vitória, ES (Brazil), 29057-550, email: tokutake@petrobras.com.br.

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ANNA STEPANOVA & MITCHELL W. LYLE

DEEP-SEA OSTRACODA FROM THE EASTERN EQUATORIAL PACIFIC AND GLACIAL-INTERGLACIAL VARIATIONS FROM THE ODP SITE 1238 OVER THE LAST 460 KA

Surface (mudline) and core catcher samples from 2 IODP and 6 ODP sites were investigated for ostracod assemblage composition: Sites U1337 and U1338 are located at abyssal depths of 4200-4463 m, and ODP sites 1237, 1238, 1239, 1240, 1241 and 1242 cover a depth range of 1400-3200 m. Abyssal sites U1337 and U1338 are almost devoid of Ostracoda, while other sites exhibit similar taxonomic composition with predominance of *Krithe* spp. Site 1238 had the highest total abundance and was selected for the downcore assemblage study of glacial-interglacial variations over the last 460 ka. ODP Site 1238 is located ~200 km west of Ecuador at a water depth of 2203 m.

Ages for Site 1238 were estimated by correlating the Site 1238 carbonate profile to those from nearby cores V19-28 and V19-29 using benthic oxygen isotope stratigraphy (SHACKLETON, 1987). The oxygen isotopes on these cores were correlated to the LISIECKI & RAYMO (2005) oxygen isotope stack to estimate ages. The Site 1238 $CaCO_3$ profile was estimated by XRF-scanning on the splice section. There are no published oxygen isotope data for Site 1238. For the 25-28 mcd interval of the core 1238 age was obtained by linear interpolation using a tie-point of 460 ka at 27.44 mcd.

A total of three different assemblages were distinguished: glacial, interglacial and background. The glacial assemblage is characterized by higher total ostracod abundance, ostracod valve accumulation rates, and species diversity. The typical glacial taxa are *Krithe* spp., *Legitimocythere castanea*, *Bradleya mesembrina*, *Cytheropteron* spp. and *Apatihowella (Fallacihowella) sol*. Interglacial intervals are characterized by low abundance and diversity and the characteristic taxa are *Pseudobosquetina mucronalata*, *Bradleya* sp.1, *Agrenocythere hazelae*, *Poseidonamicus major*. A background assemblage is found throughout the entire record and consists of *Krithe* spp., *Parakrithe* sp., *Ambocythere* cf. *sturgio* and *Rugocythereis* sp.

The taxonomic composition of the glacial assemblage suggests a deep-sea environment with stronger influence of cold water from Antarctica (Circumpolar Deep Water) and higher oxygen content. Higher C_{org} Mass Accumulation Rates during glacials result in overall higher total abundance levels.

The interglacial assemblage appears to correspond to dissolution intervals. Although the characteristic taxa are not restricted to corrosive bottom waters, it is possible that they can grow and reproduce in bottom waters undersaturated with respect to calcite. In the Equatorial Pacific interglacials are typically associated with increased dissolution and corrosiveness of bottom water. Consequently, the low abundance low diversity interglacial assemblage of ostracods at Site 1238 reflects the interglacial conditions and bottom water calcite undersaturation.

The background assemblage is not linked to oceanographic and climate changes and possibly represents an opportunistic group of taxa, tolerant to changes in oxygen level and food availability.

REFERENCES

LISIECKI L.E. & RAYMO M.E., 2005. A Pliocene-Pleistocene stack of 57 globally distributed benthic $\delta^{18}O$ records. *Paleoceanography*, 20, PA1003.

SHACKLETON N.J., 1987. Oxygen isotopes, ice volume and sea level. *Quaternary Science Reviews*, 6: 183-190.

Authors' Addresses — A. STEPANOVA, Texas A&M University, Department of Oceanography, College Station, Texas, 77843 (USA); Borisyak Paleontological Institute of Russian Academy of Sciences, Moscow, 117997 (Russia); e-mail: a.yu.stepanova@gmail.com; M.W. LYLE, Texas A&M University, Department of Oceanography, College Station, Texas, 77843 (USA); e-mail: mlyle@ocean.tamu.edu.

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ANNA STEPANOVA, EKATERINA TALDENKOVA & ROBERT F. SPIELHAGEN

POSTGLACIAL ENVIRONMENTAL CHANGES AT THE EASTERN LAPTEV SEA CONTINENTAL MARGIN BASED ON OSTRACOD ASSEMBLAGE STUDY

Sediment core PS2458 from 983 m water depth is located at the Eastern Laptev Sea continental margin in front of the position of the former Lena and Yana river mouths on the shelf break (SPIELHAGEN *et al.*, 2005). It is well-dated (AMS ^{14}C) from 201 cm down to 625 cm, this sediment interval corresponds in time to 8.9-14.6 cal.ka (SPIELHAGEN *et al.*, 2005). The upper 100 cm of sediments are likely to be a result of slow sediment accumulation during a long time period of several thousand years in the Holocene. Most part of the core (~330-625 cm) was deposited during the last deglaciation.

Four intervals characterized by different ostracod assemblages were distinguished. The oldest interval corresponds to 645-515 cm depth in the core and warm Bølling-Allerød period. Ostracod assemblage has low total abundance and is taxonomically poor, characterized by the following taxa, commonly found on the Arctic continental slopes: *Rabilimis mirabilis* (Brady, 1868), *Swainocythere* sp. and *Cytheropteron* spp. Low diversity and abundance indicate harsh environments for ostracods.

The second interval covers the interval of 515-390 cm and can be subdivided into 2 phases. The first interval of 515-490 cm corresponding to the Younger Dryas and the 13 cal.ka fresh water event is characterized by slightly higher abundance of *R. mirabilis* and presence of shallow water taxa, such as *Cytheromorpha macchesneyi* (Brady and Crosskey, 1871), *Paracyprideis pseudopunctillata* Swain, 1963 and *Cytheropteron sulense* Lev, 1972. Presence of shallow water shelf taxa probably indicate strong freshwater influence particularly at shallower depths, when shallow water ostracod valves could be replaced down the slope. This is very similar to the changes observed on the western upper continental slope (TALDENKOVA *et al.*, 2012) and indicate such environmental changes as the development of freshened shelf water mass due to the outer shelf flooding and resulting diminished influence of Atlantic derived water masses on the Laptev Sea continental slope. The interval of 520-503 cm is characterized by the presence of vivianite concretions, that could form under conditions of strong water stratification due to meltwater input together with heavy sea-ice cover could create the anoxic bottom water environment. Thus, together with absence of foraminifera, it additionally confirms that the ostracods we find here were brought from shallower locations. The interval of 490-390 cm contains very poor ostracod assemblage and some samples are devoid of ostracods.

The third interval of 390-225 cm corresponds to the Early Holocene time period and contains the highest diversity and abundance ostracod assemblage. The major taxa are: *R. mirabilis*, *Cluthia cluthae* (Brady, Crosskey and Robertson, 1874), *Krithe glacialis* Brady, Crosskey and Robertson, 1874, *Cytheropteron tumefactum* Lev, 1972, *C. arcuatum* Brady, Crosskey and Robertson, 1874, *Argilloecia* spp., *Swainocythere* sp. and *Polycope* spp., all of these taxa are typical taxa found at the continental slope depths in the studied area, and indicating Atlantic-derived water masses influence. Thus, this interval corresponds to gradual establishment of modern-like environment in terms of water depth, the distance from the coast and decreasing fluvial influence. High abundance points to sufficient food supply for ostracods.

The fourth interval of 225-90 cm (largely Mid Holocene) can be subdivided into two phases 225-115 and 115-90. The first one is mainly characterized by *K. glacialis* with minor admixture of other outer-shelf upper slope ostracod taxa. The interval of 115-90 cm is mainly characterized by the genus *Cytheropteron*. Both intervals contain modern-like assemblage; presence and predominance of *Krithe* in the older interval may indicate colder water vs warmer Atlantic-derived waters in the younger interval with *Cytheropteron*.

REFERENCES

SPIELHAGEN R.F., ERLENKEUSER H. & SIEGERT C., 2005. History of freshwater runoff across the Laptev Sea (Arctic) during the Last deglaciaion. *Global and Planetary Change,* 48 (1-3): 187-207.

TALDENKOVA E., BAUCH H.A., STEPANOVA A., OVSEPYAN Y., POGODINA I., KLYUVITKINA T. & NIKO-

LAEV S., 2012. Benthic and planktic community changes at the North Siberian margin in response to Atlantic water mass variability since last deglacial times. *Marine Micropaleontology*, 96-97: 13-28.

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Marius Stoica

THE *CYPRIDEA* GENUS IN PURBECKIAN SEDIMENTS FROM SOUTH DOBROGEA (ROMANIA)

Recent studies on Lower Cretaceous sediments from the southern part of Dobrogea provided a very rich and well-preserved association of non-marine ostracods. The material comes from an up to 50 m thick clay unit, which was intercepted in more than 20 geotechnical drillings. Approximately fifty ostracod species are described from these sediments (Stoica, 2007). The observed ostracod assemblages correlate to the first two ostracod zones of the Purbeck and Wealden beds of southern England, *Cypridea dunkeri* Zone and *Cypridea granulosa* Zone (Anderson, 1985), or to the first two subzones of the *Theriosynoecum forbesi* Zone of the revised zonation by Horne (1995). This proves that the Lower Purbeck and the first part of the Middle Purbeck are present in the Jurassic/Cretaceous boundary sediments of south Dobrogea.

The extinct non-marine ostracod genus *Cypridea* Bosquet, 1852, emblematic for the Late Jurassic-Early Cretaceous interval, developed in Purbeckian-Wealdian facies. A recent revision of the genus *Cypridea* was realized by Sames, 2011. This genus, with a characteristic 'beak-like' modification of the anteroventral valve margin, achieved high diversity and global distribution and, therefore, has a great utility in biostratigraphy, palaeoecology and correlation of Purbeck and Wealden beds (Horne, 2002). In the investigated samples we identified about 10 species of *Cypridea*: *Cypridea dunkeri dunkeri* Jones, *Cypridea dunkeri carinata* Martin, *Cypridea setina* Anderson ssp. 1 and ssp. 2, *Cypridea tumescens praecursor* Oertli, *Cypridea tumescens tumescens* (Anderson), *Cypridea* sp.1- sp.3. The *Cypridea* species are associated with other Purbeckian taxa of genera

Rhinocypris, *Damonella*, *Darwinula*, *Klieana*, *Fabanella*, *Mantelliana, Mongolianella*, *Paracypris*, *Pontocyprella*, *Scabriculocypris*, *Stenestroemia*, *Stenocypris*, *Theriosynoecum*, *Timiriasevia Virgatocypris* and *Wolburgia.*

The high degree of preservation of the ostracod valves from Dobrogea allows detailed morphological analyses. Regarding the *Cypridea* species, it appears that (at least) *Cypridea dunkeri carinata* Jones shows sexual dimorphism (Fig. 1). This sheds a new light on the reproduction modes of *Cypridea*,

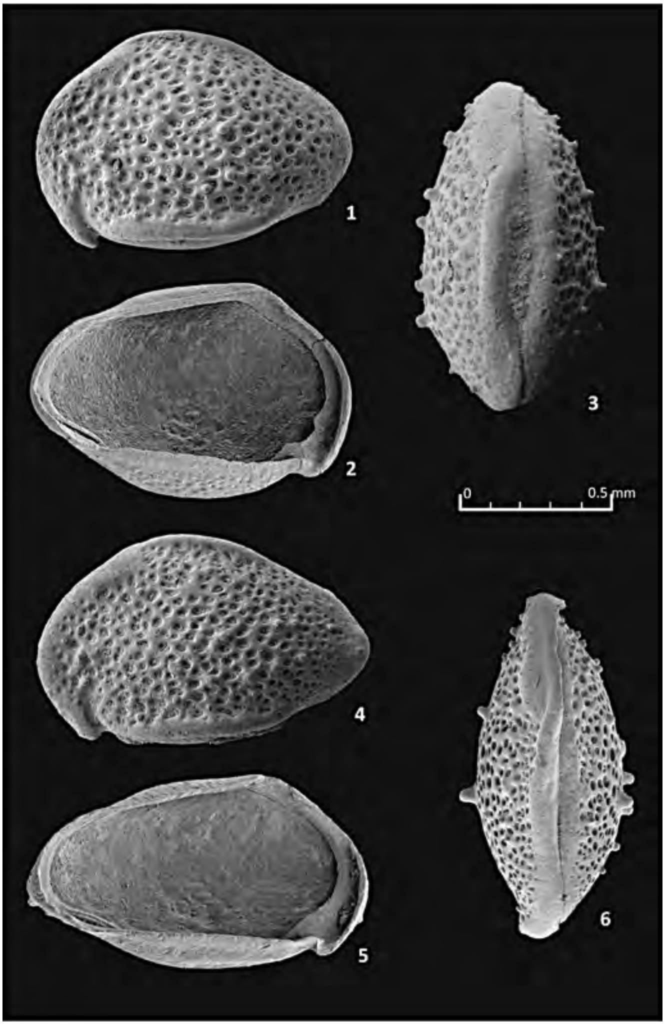

Fig. 1 — **1-6.** *Cypridea dunkeri carinata* Martin, 1940. **1-3**. female individuals; 1, left valve, external lateral view; 2, left valve, internal view; 3, carapace, dorsal view; **4-6**. male individuals; 4, left valve, external lateral view; 5, left valve, internal view; 6, carapace, dorsal view.

as *Cypridea dunkeri carinata* Jones was commonly considered to have reproduced asexually. The high diversity and speciation rates of *Cypridea* are, however, very hard to explain by an exclusively parthenogenetic lineage and therefore a mixed reproduction is the most likely reproductive mode of this extinct genus (HORNE & MARTENS, 1998; MARTENS *et al.*, 1998; SAMES, 2011).

REFERENCES

ANDERSON F.W., 1985. Ostracod faunas in the Purbeck and Wealden of England. *J. Micropalaeontol.* 4 (2): 1-68.

HORNE D.J., 1995. A revised ostracod biostratigraphy for the PurbeckeWealden of England. *Cretaceous Res.*, 16: 639-663.

HORNE D.J., 2002. Ostracod biostratigraphy and palaeoecology of the Purbeck Limestone Group in southern England. In: Milner, A.R., Batten, D.J. (Eds.), Life and Environments in Purbeck Times. *Special Papers in Palaeontology*, 68: 53-70.

HORNE D.J. & MARTENS K., 1998. An assessment of the importance of resting eggs for the evolutionary success of Mesozoic non-marine cypridoidean Ostracoda (Crustacea). In: Brendonck L., Meester de L., Hairston N. (Eds.), Evolutionary and Ecological Aspects of Crustacean Diapause. *Advances in Limnology,* 52: 549-561.

MARTENS K., HORNE D.J. & GRIFFITHS H.I., 1998. Age and diversity of non-marine ostracods. In: Martens K., (ed.) *Sex and Parthenogenesis. Evolutionary Ecology of Reproductive Modes in Non-Marine Ostracods.* Backhuys Publishers, Leiden: 37-55.

SAMES B., 2011a. Early Cretaceous Cypridea Bosquet 1852 in North America and Europe. In: Sames B. (ed.), Taxonomic Studies in Early Cretaceous Nonmarine Ostracoda of North America and Europe. *Micropaleontology*, 57: 345-431.

STOICA M., 2007. Purbeckian ostracods from South Dobrogea (in romanian). 218 p., 53 pl. *Ed. Ars Docendi*, Bucharest, 218 pp., 53 pl.

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MARIUS STOICA, ALINA FLOROIU, WOUT KRIJGSMAN & IULIANA VASILIEV

UPPER MIOCENE OSTRACODS FROM THE BLACK SEA (TAMAN PENINSULA; RUSSIA)

The Taman peninsula comprises one of the best-exposed Neogene sedimentary successions of the Black Sea basin. Biostratigraphic analyses of the classic Zheleznyi Rog and Panagia sections provided a rich and well-preserved ostracod faunal record. We identified more than 40 ostracod species in these sections that comprise the regional Paratethys stages Khersonian, Maeotian and Pontian. All these ostracod species, most of them already described and figured before using hand drawings (LIVENTAL, 1929; SVEJER, 1949; SUZIN, 1956; MANDELSTAM & SCHNEIDER, 1963; AGALAROVA, 1967; VEKUA, 1975) are now displayed using high-resolution SEM pictures. This is an important step ahead for better taxonomical identification of the Paratethyan ostracods and avoiding future confusions.

In this study we focus on ostracods from the Zheleznyi Rog section that excellently exposes Maeotian, Pontian and Kimmerian sediments. Some ostracod species from this section where already presented in the recent paper by ROSTOVTSEVA & TESAKOVA, 2009. The stratigraphical distribution of the studied ostracod fauna is now fully integrated with magnetostratigraphy and radio-isotope dating (VASILIEV *et al.*, 2011). Ostracods reflect very accurately all changes in palaeoenvironments, water chemistry and basin connections and therefore can be used for reconstructions of Paratethys evolution during Late Miocene-Pliocene.

The Lower Maeotian ostracod assemblages indicate relatively (for Maeotian) higher salinities, as the ostracod fauna is dominated by *Leptocytheridae* as the number of individuals even the diversity is not very high. The

Leptocytheridae species are associated with rare species of *Loxoconcha*, *Mediocythereis*, *Xestoleberis*. In this interval, ostracods are frequently associated with foraminifers (species of *Quinqueloculina*, *Triloculina*, *Ammonia*, *Porosononion*, *Elphidium*). Towards the Upper Maeotian, fresher water conditions are dominant and the ostracod fauna is largely dominated by *Candonidae* (species of *Candona*, *Caspiolla*, *Caspiocypris*, *Pontoniella*). The *Cyprideis* genus is present in all associations by *Cyprideis torosa* species with smooth or nodded shells.

At the Maeotian / Pontian boundary, an important transgressive event took place in all Paratethys (KRIJGSMAN *et al.*, 2010, STOICA *et al.*, 2013). For a short moment, the reconnection of Paratethys with the open seas (Mediterranean Sea, or alternatively Indian Ocean) allowed marine waters to invade the brackish or freshwater Paratethyan basins. This resulted in the deposition of a thin layer rich in foraminifers, including the enigmatic genus *Streptochilus*, as well the bivalve species *Congeria* (*Andrusoviconca*) *amygdaloides novorossica*. After this short event, the Lower Pontian ostracod fauna became more diverse, probably because of migration of endemic species from the Pannonian and Aegean basins towards the Eastern Paratethys. In the studied section (but also in other sections), the Pontian starts with a level rich in pyritized ostracod shells, especially *Candonidae* like *Caspiocypris pontica*, *C. alta*, *C. labiata*, *Pontoniella lotzi*, *P. acuminata*, *P. acuminata striata*, *Hastacandona hysterica*, *Caspiolla venusta*, *C. balcanica*. Following upwards other taxa enrich the ostracod assemblage, at least up to the "Red Level" rich in iron oxides, considered as Kimmerian in Russian literature, but (partly) synchronous with the Middle Pontian (Portaferrian) of the Dacian Basin. Most common ostracods representing the Pontian of Taman are: *Leptocyderidae* species like *Amnicythere andrusovi*, *A. cornutocostata, A. cymbula, A. palimpsesta, A. lata*, *A. naca, A. subcaspia, Maetocythere bosqueti, M. praebaquana, Maeotocythere* sp., as well frequent individuals of *Bacunella dorsoarquata*, *Bacunella* sp., *Cytherissa bogatschovi*, *C.* sp., *Loxoconcha djaffarovi, L. eichwaldi, L. granifera, L. petasa, L. pontica, L. schweyeri, L. babazananica , Mediocythereis apatoica, Pontoleberis pontica.* Surprisingly, the *Tyrrhenocythere* and *Amplocypris* genera have no representatives in this section.

Magnetostratigraphic correlations show that these Pontian ostracods from the Black Sea basin correspond to the time interval during which the Mediterranean experienced its Messinian Salinity Crisis (MSC). More specifically, the Taman succession is considered to be the time-equivalent of the widespread Primary Lower Gypsum deposits of the Mediterranean (KRIJGSMAN *et al.*, 2010). The "Red Level" was interpreted to correspond to the peak MSC lowstand of the Mediterranean. Some Paratethyan ostracods are well-known to have migrated into the Mediterranean Basin during this phase, as shown from many of the so-called "Lago Mare" successions in Italy (GLIOZZi *et al.*, 2007).

REFERENCES

AGALAROVA D.A., 1967. Microfauna of the Pontian Deposits of Azerbaijan and Adjacent Regions. Nedra, Leningrad (in Russian).

GLIOZZI E., CECI M.E., GROSSI F. & LIGIOS S., 2007. Paratethyan ostracod immigrants in Italy during the Late Miocene. *Geobios*, 40: 325-337.

KRIJGSMAN W., STOICA M., VASILIEV I. & POPOV V., 2010. Rise and fall of the Paratethys Sea during the Messinian salinity crisis. *Earth and Planetary Science Letters*, 290: 183-191.

LIVENTAL V.E., 1929. Ostracoda Akciagilscogo i Apsheronscogo Iarusov: Iz. Iz. Azerb. Polit. Inst., Bacu.

MANDELSTAM M.I. & SCHNEIDER G.F., 1963. Iskopaemye ostracody SSSR. Semejstvo *Cyprididae*: Trudy VNIGRI, Leningrad

ROSTOVTSEVA Y.V. & TESAKOVA E.M. 2009. Late Miocene Ostracodes (Ostracoda, Crustacea) from the Enikal Strait (Eastern Paratethys) as Indicators of Salinity Changes. *Paleontological Journal*, 43(2): 170-177.

STOICA M., LAZAR I., KRIJGSMAN W., VASILIEV I., JIPA D.C. & FLOROIU A., 2013. Palaeoenvironmental evolution of the East Carpathian foredeep during the late Miocene – early Pliocene (Dacian Basin; Romania). *Global and Planetary Change*, 103: 135-148.

SUZIN A.V., 1956. Ostracodes in the Tertiary Deposits of Northern Ciscaucasia. *Gostoptekhizdat*, Moscow, (in Russian).

SVEJER A.V., 1949. Osnovi morfologii i sistematiki pliocenovih i postpliocenovih Ostracod. Trudy VNIGRI, n. ser. 30, *Gostoptehizdat*, Leningrad-Moskva.

VASILIEV I., IOSIFIDI A.G., KHRAMOV A.N., KRIJGSMAN W., KUIPER, K.F., LANGEREIS C.G., POPOV V.V., STOICA M., TOMSHA V.A. AND YUDIN S.V. (2011). Magnetostratigraphy and radiometric dating of upper Miocene – lower Pliocene sedimentary successions of the Black Sea Basin (Taman Peninsula, Russia), *Palaeogeogr. Palaeoclimatol. Palaeoecol.*, 310, 163-175.

VEKUA M.I, 1975. Ostracodes from the Kimmerian and Kualnijkian deposits of Abkasia and their stratigraphic importance. *Academie Nauk Gorjistan SSR*. 136 pp. (in Russian).

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GENGO TANAKA, HAJIME OHTANI, KAHO KATO,
SHIN-ICHI NOMURA & DAVID SIVETER

EXCEPTIONALLY PRESERVED HOLOCENE FOSSIL OSTRACODS IN TSUNAMIGENIC SEDIMENTS

Chitin is the most ubiquitous chemical component in marine arthropods, which are abundant mostly as ‘hard-parts’ from the Early Cambrian onward. Even in exceptionally preserved fossils original chitin is altered or lost during fossilisation. Some remains of chitin have been documented from terrestrial arthropods (insects) from the Tertiary (GUPTA *et al.*, 2006), but hitherto there are no reports of original chitin preserved in fossil marine arthropods, which are much more abundant than terrestrial representatives.

Here we report exceptionally preserved original chitin in a marine podocopid ostracod, *Parakrithella pseudadonta* (Hanai, 1959), from tsunamigenic sediment of the Holocene Numa Formation, Boso Peninsula, cental Japan. The tsunamigenic sediment contains many fossilised molluscs, including *Dosinella penicillata*, *Fulvia mutica*, *Cryptoma busoensis*, *Ostrea denselamelosa*, *Saidomus purpuratus* and pectinid bivalves, which inhabited the muddy bottom of an inner bay or rocky shore 6300 – 6000 yrs BP (FUJIWARA *et al.*, 1996). The ostracod assemblage from this horizon is characterized by *Loxoconcha kattoi* ISHIZAKI, 1968, *Xestoleberis hanaii* ISHIZAKI, 1968, *Loxoconcha viva* ISHIZAKI, 1968, and *P. pseudadonta* which lived in an estimated water depth of 38 m (TANAKA *et al.*, 2012). Several specimens have some soft parts preserved, mainly parts of antennules and antenna. *P. pseudadonta* has a transparent carapace and was selected to investigate the relative degree of fossilization of soft parts. One in 17 specimens of *P. pseudadonta* had preserved soft parts. From about 10 kg of sediment analysed we recovered 470 individuals of *P. pseudadonta*, of which 5% had only the shell preserved, 68% had shell and membraneous layers preserved, and 27% showed parts of limbs preserved.

Some of the specimens with preserved soft parts contains framboidal pyrites and octahedral pyrites and others preserved an original chitinous colour. Analysis by pyrolysis-gas chromatography-nitrogen phosphorus detection revealed that the fossil *P. pseudadonta* had 12 - 13% original chitin preserved compared with Recent conspecific specimens.

REFERENCES

FUJIWARA O., MASUDA F., SAKAI T., FUSE K. & SAITO A., 1996. Tsunami deposits in Holocene bay-floor muds and uplift history of the Boso and Miura Peninsulas. *Quart. Res*, 36: 73-86.

GUPTA N. S., MICHELS R., BRIGGS D.E.G., EVERSHED R.P., GVERSHED R.P. & PANCOST R.D., 2006. The organic preservation of fossil arthropods: an experimental study. *Proc. R. Soc. Lond. B*, 273: 2777-2783.

HANAI T., 1959. Studies on the Ostracoda from Japan: 4. Family Cytherideidae Sars 1925. *J. Fac. Sci., Univ. Tokyo, Sec. 2*, 11: 291-308.

ISHIZAKI K., 1968. Ostracodes from Uranouchi Bay, Kochi Prefecture, Japan. *Sci. Rep. Tohoku Univ., Sendai, Second Ser. Geol.*, 40: 1-45.

TANAKA G., KANEKO M., AOKI T. & PARTICIPANTS OF 2011 SPP CLASS I OTA GIRLS' HIGH SCHOOL, 2012. Ostracods from the Holocene Numa Formation, Chiba Prefecture, central Japan. *Bull. Gunma Mus. Nat. Hist.*, 16: 111-118.

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EKATERINA TESAKOVA

OSTRACODA, GENUS *PALAEOCYTHERIDEA* MANDELSTAM, 1947 FROM THE MIDDLE AND UPPER JURRASSIC OF EUROPE: REVISION, STRATIGRAPHY, PALEOBIOGEOGRAPHY

Species of the ostracod genus *Palaeocytheridea*, common both in the Boreal and Tethyan regions in Europe were used to distinguish a number of sequences that can be correlated, making this genus important for stratigraphy.

However, the inaccuracy in the description of the hinge of *Palaeocytheridea*, made by M.I. MANDELSTAM (1947) when describing the type species *P. bakirovi* MANDELSTAM, 1947, and the replacement of the type species with *Eucythere denticulata* Sharapova, 1937 made later by P.S. LUBIMOVA (1955), led to a confusion in the understanding of the extent of the genus *Palaeocytheridea* and attributing to it some of the forms not only from other genera but also from other families.

93 forms of *Palaeocytheridea* were revised, and 11 species were determined as valid, out of which one species is new. Based on shell outline, either elongated-subrectangular or elongated-oval, members of this genus can be clearly subdivided into two subgenera – *Palaeocytheridea* s. str. and *Malzevia* Tesakova, 2013. To the subgenus *Palaeocytheridea,* we refer the following species: *P.* (*P.*) *bakirovi* Mandelstam, 1947, *P.* (*P.*) *carinilia* (Sylvester-Bradley, 1948), *P.* (*P.*) *pavlovi* (LUBIMOVA, 1955), *P.* (*P.*) *kalandadzei* Tesakova, 2013; and to subgenus *Malzevia* – *P.* (*M.*) *parabakirovi* Malz, 1962, *P.* (*M.*) *rara* Permjakova, 1974, *P.* (*M.*) *priva* Permjakova, 1974, *P.* (*M.*) *subtilis* Permjakova, 1974, *P.* (*M.*) *laevis* Permjakova, 1974, *P.* (*M.*) *groissi* Schudack, 1997, *P.* (*M.*) *blaszykina* Franz, Tesakova, Beher, 2009.

Subgenus *Palaeocytheridea* is known in the geological history since the end of late Bajocian, while *Malzevia* is known from older strata – early Bajocian (Fig. 1). This allows the assumption that *Palaeocytheridea* descended from *Malzevia*. Another fact supporting this hypothesis is that all *Malzevia* ontogenetic stages had a carapace of solely elongated-oval outlines while in *Palaeocytheridea* only early and middle moult stages had elongated-oval outlines. During growth, the carapace became rounded-subrectangular in outline.

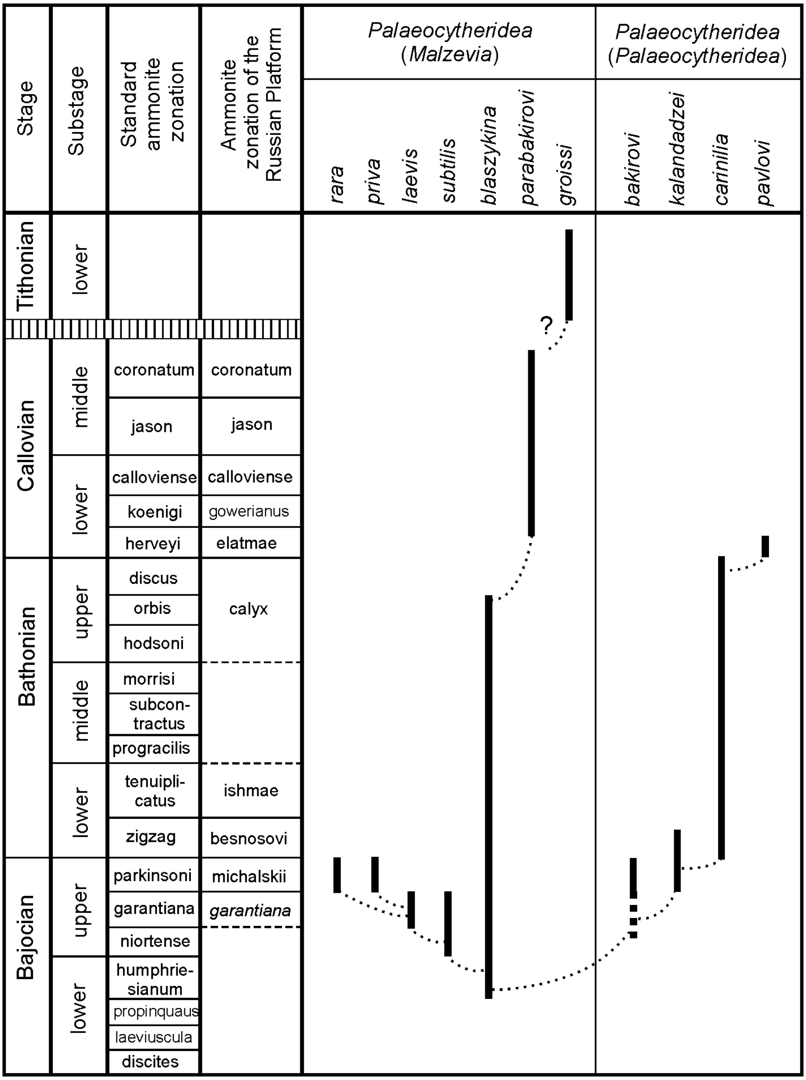

Fig. 1 — Phylogenetic scheme of members of the subgenera *Palaeocytheridea* and *Malzevia*.

Based on the distribution of endemic and cosmopolitan forms of *Palaeocytheridea* it was shown that the Tethyan and Boreal-Atlantic regions in Western and Eastern Europe were isolated during Bajocian and Bathonian times, and the connection between these two parts of the European paleobasin is indicated starting from the middle part of the Early Callovian (Fig. 2). Ostracod zones based on the stratigraphic distribution of species of the genus *Palaeocytheridea* were suggested for the Middle Jurassic in Western and Eastern Europe and Ukraine.

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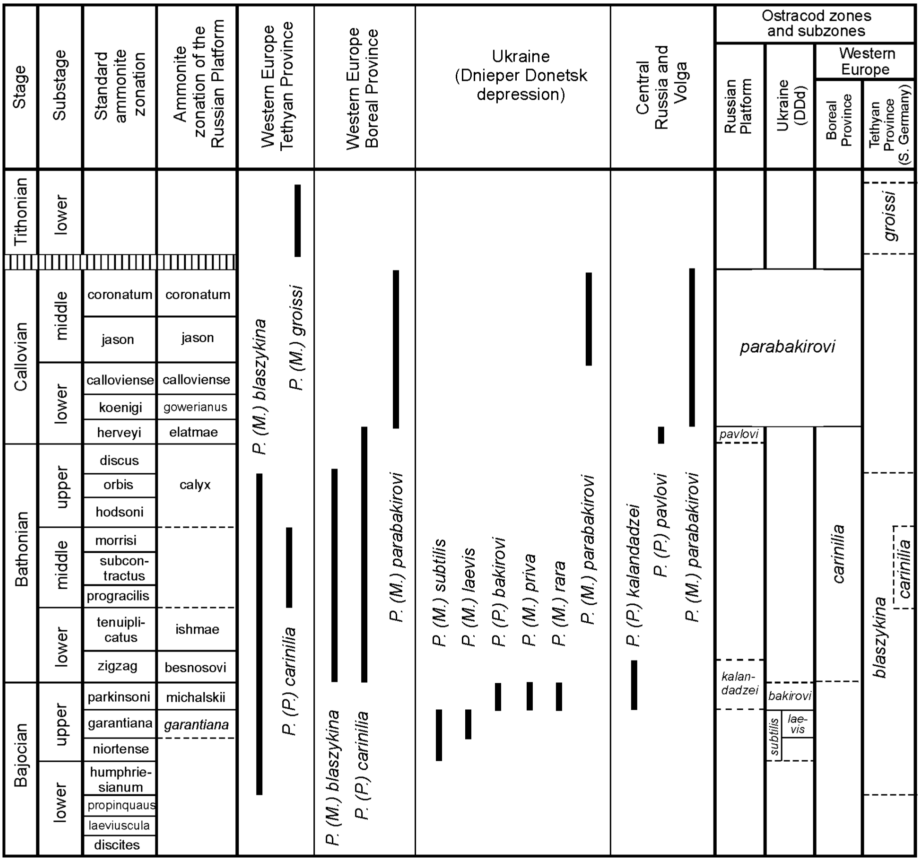

Fig. 2 — Stratigraphic distribution of *Palaeocytheridea* in the Middle-Upper Jurassic of Europe.

REFERENCES

Lubimova P.S., 1955. Ostracods of the Mesozoic Deposits of the Central Volga Region and the Obshchii Syrt. In: Trudy Vsesoyusnogo Nauchno-Issled. Inst. Nefti Geol. Razved. Nov. Ser. *Gostoptekhizdat*, Leningrad, issue 84: 3-190.

MANDELSTAM M.I., 1947. Ostracods from the middle Jurassic Deposits of the Mangyshlak Peninsula. In: Microfauna neftyanykh mestorozhdenii Kavkaza, Emby I Srednei Azii (Microfauna of the Oil Fields of the Caucasus, Emba, and Central Asia). *Gostoptekhizdat*, Leningrad: 239-256.

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HABITAT COMPLEXITY AND THE OSTRACODA (*Crustacea*) COMMUNITY IN A TROPICAL FLOODPLAIN

Aquatic macrophytes provide heterogeneity to the environment and are important micro-habitats for aquatic communities (Cyr & Downing, 1988; Padial *et al.*, 2009; Declerck *et al.*, 2011; Sueiro *et al.*, 2011). Several studies have shown the importance of structural complexity of aquatic macrophytes on richness distribution and invertebrate abundance (Taniguchi *et al.*, 2003; Taniguchi & Tokeshi, 2004; Moore & Hovel, 2010), but thus far they did not quantify the fractal complexity of aquatic macrophytes.

Here, we analyse the ostracod communities associated with aquatic macrophytes with different structural complexities, measured by fractal dimension. We test the hypothesis that more complex plants are inhabited by higher richness and abundance of ostracods.

Sampling was performed in July 2012, in 29 environments in the Upper Paraná River floodplain, Brazil. Eleven species of aquatic macrophytes were used with different fractal dimension values, which ranged of 1.49 to 1.94. Ostracods associated to macrophytes were hand-collected and plants were thoroughly washed in a bucket. The residues were washed in the net (mesh size c 160 µm). The material was preserved in 70% ethanol. The present survey recorded 34 species of ostracods in the Upper Paraná River floodplain. The results showed a positive correlation ($r=0.46$; $p<0.05$) between the richness of ostracods and fractal dimension, confirming one of the hypotheses of this study. However, the fractal dimension does not affect the density of ostracods. A DCA was performed to determine the difference in ostracod community composition in macrophytes of different complexities. This result showed a separation in the axis 1 in relation to the fractal complexity of plants, where the more complex plants support smaller ostracod species, such as *Cypretta costata* G.W. Müller, 1898, *Penthe-*

silenula brasiliensis (Pinto & Kotzian, 1961) and *Alicenula serricaudata* (Klie, 1935). On the other hand, *Diaphanocypris meridana* (Furtos, 1936) and *Cypricercus centrura* (Klie, 1940) were more common in less complex plant species.

The correlation fractal dimension with the richness was expected, since more complex habitats can provide a greater amount of micro-habitats, allowing the occurrence of a higher number of species (BELL *et al.*, 1991). Regarding the composition of the community of Ostracoda, the relationship of smaller species and non-swimmers with more complex species, could be because these plants are able to retain more sedimentary material in their roots or leaves, providing a substrate where these (normally benthic) species of ostracods can establish their populations. However, swimming species can move more easily and can settle in less complex plants. Thus, we conclude that the complexity of macrophytes is important, not only for the richness of ostracods, but also for the species composition of the communities.

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REFERENCES

BELL S.S., MCCOY E.D. & MUSHINSKI H.R. (Eds.), 1991. Habitat Structure: the physical arrangement of objects in space, New York: Chapman and Hall.

CYR H. & DOWNING J.A., 1988. The abundance of phytophilous invertebrates on different species of submerged macrophytes. *Freshwater Biology*, 20: 365-374.

DECLERCK S.A.J., BAKKER E.S., LITH B., KERSBERGEN A. & DONK E., 2011. Effects of nutrients additions and macrophyte composition on invertebrate community assembly and diversity in experimental ponds. *Basic and Applied Ecology*, 12: 466-475.

MOORE E.C. & HOVEL K.A., 2010. Relative influence of habitat complexity and proximity to patch edges on seagrass epifaunal communities. *Oikos*, 119: 1299-1311.

PADIAL A.A., THOMAZ S.M. & AGOSTINHO A.A., 2009. Effects of structural heterogeneity provided by the floating macrophyte *Eichhornia azurea* on the predation efficiency and habitat use of the small Neotropical fish *Moenkhausia sanctaefilomenae*. *Hydrobiologia*, 624: 161-170.

SUEIRO M.C., BORTOLUS A. & SCHWINDT E., 2011. Habitat complexity and community composition: relationships between different ecosystem engineers and the associated macroinvertebrate assemblages. *Helgoland Marine Research*, 65: 467-477.

TANIGUCHI H., TAKANO S. & TOKESHI M., 2003. Influences of habitat complexity on the diversity and abundance of epiphytic invertebrates on plants. *Freshwater Biology*, 48: 718-728.

TANIGUCHI H. & TOKESHI M., 2004. Effects of habitat complexity on benthic assemblages in a variable environment. *Freshwater Biology*, 49: 1164-1178.

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OSTRACOD ASSEMBLAGES FROM HOLOCENE MIDDLE SHELF DEPOSITS OF SOUTHERN EVOIKOS GULF (CENTRAL AEGEAN SEA, GREECE) AND THEIR PALAEOENVIRONMENTAL IMPLICATIONS

The purpose of this study is to collect micropalaeontological evidence concerning the palaeoenvironmental changes that took place at Southern Evoikos Gulf during the Holocene.

The Southern Evoikos Gulf (Fig. 1) is a shallow epicontinental basin, slightly deformed with formation of a tectonic graben trending WNW-ESE to NW-SE in the back-arc area at the northern prolongation of the Cycladic Platform (Papanikolaou *et al.*, 1988). The gulf separates Attica from Southern Evia and it is divided into two sub-basins: a northern shallow one where water depths range from 20 to 70 m and a southern deeper basin with a maximum depth of 160 m (Papanikolaou *et al.*, 1988; Karageorgis *et al.*, 2000).

The study area of the present research is located at the northern part of Southern Evoikos gulf. Two cores, DEH 1 and DEH 5, yielded a sedimentary record that covers the last 13910 cal. yr B.P., they were recovered from 70 m and 75.5 m water depth respectively (Fig. 1). A detailed quantitative and qualitative ostracod study was undertaken on 74 samples of DEH 5 and 52 samples of DEH 1, in order to reconstruct palaeoenvironmental conditions.

Sediment core DEH 5 demonstrated the following ostracod assemblages: At the lower part of the core*, Cyprideis torosa* (noded and smooth forms) is the most abundant species, and it is accompanied mainly by *Leptocythere lagunae*, *Limnocythere inopinata* and *Candona* species. The synthesis of this fauna indicates a shallow oligohaline environment (Clave *et al.*, 2001; Ruiz *et al.*, 2006). At the middle part of the core, *C. torosa* is dominant, accompanied by *L. lagunae*, *Xestoleberis* spp. and *Candona neglecta*. Towards

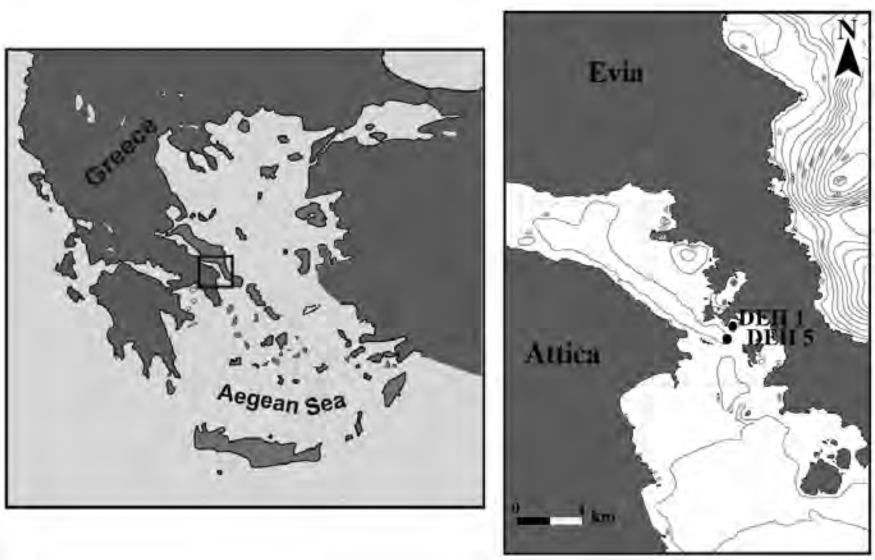

Fig. 1 — Location map and the position of the studied sediment cores.

the top of the core, *C. torosa*, *L. lagunae* and *Xestoleberis* spp. are still present, but the character of the ostracod assemblages presents more marine features as indicated by the presence of *Callistocythere crispata*, *C. intricatoides*, *Leptocythere ramosa*, *L. rara*, *Loxoconcha* spp. The uppermost part of the core presents an ostracod assemblage which corresponds to an environment similar to the present one, which is a shallow (less than 70 m water depth) open marine environment (RUIZ *et al.*, 2006, 2008). The ostracod assemblage consists mainly of *C. crispata*, *C. intricatoides*, *Cytherella* spp., *Xestoleberis* spp., *Acanthocythereis hystrix*, *Semicytherura* spp. and *C. edwardsii*.

Concerning sediment core DEH 1, three main ostracod assemblages were distinguished from the bottom to the top of the sediment core indicating a marine coastal environment with a gradual transition from a circalittoral to an infralittoral restricted one (RUIZ *et al.*, 2006, 2008; TSOUROU, 2012): At the lower part of the core assemblage consists mainly of *Costa edwardsii*, *Cytheridea neapolitana*, *Callistocythere* spp., *Pterygocythereis jonesii* and *Leptocythere* spp. At the middle part, *C. edwardsii* is the dominant species. At the upper part ostracod fauna consists mainly of *C. edwardsii*, *Loxoconcha* spp., *Xestoleberis* spp. and *C. torosa*. This part of the core corresponds to the time interval that DEH 5 represents an oligohaline lagoon.

Ostracod analysis of DEH 5 indicates that the northern basin of southern Evoikos gulf was an oligohaline closed lagoon for the largest part of Holocene, while DEH 1 represents a shallow coastal environment at the edge of this basin. The faunal pattern may provide the key to unlocking the broader question as to whether the depositional pattern within the South Evoikos gulf were driven by tectonic or climatic (eustatic) change.

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REFERENCES

CLAVE B., MASSE L., CARBONEL P. & TASTET J.P., 2001. Holocene coastal changes and infilling of the La Perroche marsh (French Atlantic coast). *Oceanological Acta*, 24: 377-389.

KARAGEORGIS A., ANAGNOSTOU CH., SIOULAS A., ELEFTHERIADIS G. & TSIRAMBIDES A., 2000. Distribution of surficial sediments in the Southern Evoikos and Petalioi Gulfs, Greece. *Mediterranean Marine Science*, 1(1): 111-121.

PAPANIKOLAOU D., LYKOUSIS V., CHRONIS G. & PAVLAKIS P., 1988. A comparative study of neotectonic basins across the Hellenic arc: the Messiniakos, Argolikos, Saronikos and Southern Evoikos. *Gulfs Basin Research*, 1: 167-1 76

RUIZ F., ABAD M., OLIAS M., GALAN E., GONZALEZ I., AGUILA E., HAMOUMI N., PULIDOD I. & CANTANO M., 2006. The present environmental scenario of the Nador Lagoon (Morocco). *Environmental Research*, 102: 215-229.

RUIZ F., GONZÁLEZ-REGALADO M.L., ABAD M., CIVIS J., GONZÁLEZ DELGADO J.Á., GARCÍA E.X.M., PRUDÊNCIO M.I. & DIAS M.I., 2008. Pliocene ostracods of Southwestern Europe. *Geobios*, 41: 845-859.

TSOUROU T., 2012. Composition and Distribution of Recent Marine Ostracod Assemblages in the Bottom Sediments of Central Aegean Sea (SE Andros Island, Greece). *International Review of Hydrobiolog.*, 97(4): 276-300.

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THEODORA TSOUROU, KOSMAS P. PAVLOPOULOS,
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PALAEOENVIRONMENTAL EVOLUTION OF PIRAEUS (ATTICA, GREECE) DURING THE HOLOCENE BASED ON OSTRACOD ASSEMBLAGES

The aim of this study is to present the environmental history of Piraeus port since 8700 yr B.P., as it is recorded by the ostracod assemblages. The study area is located in SW Attica (Fig. 1) where recently, GOIRAN *et al.* (2011) conducted an interdisciplinary geoarchaeological research combining cartographic, topographic and historic data, radiocarbon datings, sedimentological and micropalaeontological analysis. As a result, they verified Greek geographer Strabo, who wrote, in the first century AD, that Piraeus was formerly an island.

Three well-dated sediment cores were selected (Fig. 1) of the 10 rotational boreholes, which were drilled for the aim of the above mentioned geoarchaeological research, and a detailed quantitative and qualitative ostracodological analysis of about 200 samples was performed.

The distribution patterns of the identified ostracod assemblages combined with the sedimentary facies recognised in the boreholes reflect different depositional environments that alternate along the cores.

In particular, five lithostratigraphical units were determined. The lowermost unit (A) was deposited between 8700 and 7500 cal. yr B.P., it consists of clay with silty sand layers and it was recorded in all three boreholes. The euryhaline species *Cyprideis torosa* is the dominant ostracod taxa, accompanied mainly by freshwater to oligohaline species such as *Ilyocypris bradyi* and *Limnocythere inopinata* at the lower part of the unit, while at the upper part of the unit *C. torosa* is accompanied mainly by mesohaline-polyhaline species such as *Loxoconcha elliptica*, *Leptocythere lagunae, Aurila arborescens* and *Xestole-*

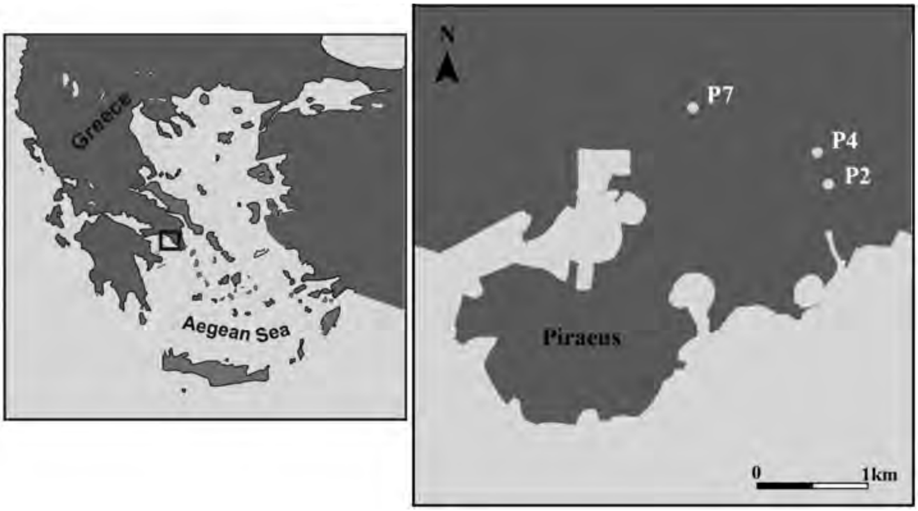

Fig. 1 — Location map and the position of the studied boreholes.

beris communis. The alternation of these faunas indicates a lagoonal environment with progressively increasing marine influence (e.g. RUIZ *et al.*, 2006; TRIANTAPHYLLOU *et al.*, 2010).

Unit B consists of shelly silty sand and it was recorded in all three boreholes. This unit is dated between 6800 and 5400 cal. yr B.P.. The brackish mesohaline ostracod assemblage is replaced towards the upper part of this unit by a shallow marine assemblage (mainly *Aurila convexa*, *Semicytherura incogruens*, *Loxoconcha affinis*, *Xestoleberis* spp.) demonstrating the establishment of a shallow coastal marine environment (e.g. RUIZ *et al.*, 2006; TSOUROU, 2012).

Unit C is present in boreholes P4 and P7 and it is dated between 4800 and 3500 cal. yr B.P. It consists of clay with sand and pebbles. The lowermost part of the unit still represents a shallow coastal marine environment with *Xestoleberis* spp. and *A. convexa*. This fauna is replaced by an assemblage characterised by the dominance of *C. torosa* and the presence of oligohaline to freshwater species reflecting the transition to a closed lagoonal environment.

Unit D, consists of clay and silt, it is present in boreholes P4 and P7 and is dated younger than 2800 cal. yr B.P.. Oligohaline to freshwater species gradually predominate in this unit, mainly *I. bradyi* and *Cyprinotus salinus,* indicating the formation of a shallow marsh (e.g. TRIANTAPHYLLOU *et al.*, 2010).

Unit E represents the lateral transition of units C and D and it is present in borehole P2. It consists of medium to coarse sand and it is dated between 3400 and 2500 cal. yr B.P.. Lithology and the scarce presence of ostracods, indicate a coastal environment of high energy in the supralittoral zone.

REFERENCES

GOIRAN J.-P., PAVLOPOULOS K.P., FOUACHE E., TRIANTAPHYLLOU M. & ETIENNE R., 2011. Piraeus, the ancient island of Athens: Evidence from Holocene sediments and historical archives. *Geology*, 39(6): 531-534.

RUIZ F., ABAD M., OLIAS M., GALAN E., GONZALEZ I., AGUILA E., HAMOUMI N., PULIDOD I. & CANTANO M., 2006. The present environmental scenario of the Nador Lagoon (Morocco). *Environmental Research*, 102: 215-229.

TRIANTAPHYLLOU M.V., KOULI K., TSOUROU T., KOUKOUSIOURA O., PAVLOPOULOS K. & DERMITZAKIS M.D., 2010. Paleoenvironmental changes since 3000 BC in the coastal marsh of Vravron (Attica, SE Greece). *Quaternary International*, 216: 14-22.

TSOUROU T., 2012. Composition and Distribution of Recent Marine Ostracod Assemblages in the Bottom Sediments of Central Aegean Sea (SE Andros Island, Greece). *International Review of Hydrobiology*, 97(4): 276-300.

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ALAETTİN TUNCER, CEMAL TUNOGLU, ÖKMEN SÜMER & UGUR INCI

EARLY PLEISTOCENE OSTRACODA ASSEMBLAGE AND PALEOENVIRONMENTAL CHARACTERISTICS OF THE FEVZIPASA FORMATION, SÖKE, WESTERN TURKEY

The study area is located about 40 km west of Aydın district in western Turkey. This area includes Neogene to Quaternary sediments. The Fevzipasa Formation unconformably overlies the Miocene rock units. It includes conglomerates, sandstones, mudstones, marls, limestones and tuff layers and unconformably overlain by recent deposits of the Söke – Milet Basin (SÜMER *et al.*, 2013a). The lower part of the Fevzipasa formation is represented by coarse clastics and lacustrine carbonates. This lower part is overlain by mollusca shells-bearing fine to coarse-grained sandstones. Prominent tuff layers (lower and upper tuff layers) of this dominantly sandstone succession were radiometrically dated between roughly 2 and 1 Ma (SÜMER *et al.*, 2013b). Based on small mammal fauna (ÜNAY *et al.*, 1995; ÜNAY & GOKTAS, 1999; SARICA, 2000) the age of the upper part is Early to Late Pleistocene age.

To investigate the palaeoenvironmental evolution of the succession, forty-two samples were collected along two stratigraphic sections. Ostracoda assemblages together with Chara flora, Gastropoda and Bivalvia faunas and fish remains were recovered from only twenty-nine samples. Ostracod assemblages include *Candona neglecta*, *C. parallela pannonica*, *Pseudocandona* sp., *Cyclocypris ovum*, *Ilyocypris gibba*, *I. bradyi*, *Heterocypris salina* and *Scottia pseudobrowniana*. In addition to these, fish remains belonging the Cyprinidae family (*Tinca* sp., *Leuciscus* sp., *Leuciscus etilius)* and Characeae gyrogonites referable to *Nitellopsis obtusa*, *Chara* sp., *C. aspera*, *C. globularis*, *C. hispida*, *C. vulgaris, Lychnothamnus* sp. and *Sphaerochara* sp. occurred in the samples.

Overall the ostracod, fish and gyrogonites records indicate that the

Fevzipasa Formation was deposited in a palaeoenvironmental setting characterized by permanent and shallow water bodies. According to determined ostracoda fauna assemblage, age of the investigated levels of this formation is Pleistocene (MEISCH, 2000). By combining all these data, it can be suggested that the age of the upper part of the Fevzipasa Formation is Pleistocene.

REFERENCES

MEISCH C., 2000. Freshwater Ostracoda of Western and Central Europe. Süßwasserfauna von Mitteleuropa 8/3. Spektrum Akad Vlg, Gustav Fischer, Heidelberg, Berlin: 522 pp.

ÜNAY F., GÖKTAS F., HAKYEMEZ H.Y., AVSAR M. & SAN Ö., 1995. Dating of the exposed at the northern part of the Büyük Menderes Graben (Turkey) on the basis of Arvicolidae (Rodentia, Mammalia). *Geological Bulletin of Turkey.,* Volume 38 (2): 75-80.

ÜNAY F. & GÖKTAS F., 1999. Late Early Miocene and Quaternary small mammals in the surrounding of Söke (Aydın): Preliminary results. *Geological Bulletin of Turkey,* 42 (2): 99-113.

SARICA N., 2000. The Plio – Pleistocene age of Büyük Menderes and Gediz grabens and their tectonic significance on N-S extensional tectonics in West Anatolia: mammalian evidence from the continental deposits. *Geological Journal,* 35: 1-24.

SÜMER Ö., İNCI U. & SÖZBILIR H., 2013a. Tectonic evolution of the Söke Basin: Extension-dominated transtensional basin formation in western part of the Büyük Menderes Graben, Western Anatolia. *Journal of Geodynamics*, 65: 148-175.

SÜMER Ö., İNCI U. & SÖZBILIR H., 2013b. Under review. First report of sedimentary evidence for sea level change in Pleistocene shallow marine fan-deltaic successions of the Fevzipaşa Formation, Western Anatolia Turkey. *Journal of Quaternary Science*.

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OLIGOCENE OSTRACODA FROM THE SIVAS BASIN
(CENTRAL ANATOLIA, TURKEY)

The Sivas Tertiary Basin is located east of Central Anatolia and is represented by many Paleogene-Quaternary sedimentary units. In this study, Oligocene ostracoda have been investigated, and their biostratigraphic position and environmental interpretation has been stated. Twenty-four samples from five measured stratigraphic sections have been analyzed. Amoung them, the ostracoda from the Pınarca and Eğribucak sections have been evaluated by a stratigraphic, biostratigraphic and chronostratigraphic point of view. Totally, a number of twenty-four ostracod taxa which related to twelve genera (*Cytherella, Krithe, Haplocytheridea, Monoceratina, Loxoconcha, Xestoleberis, ?Cyprideis, Aurila, Eucythere, Hemicyprideis, Neomonoceratina, Paracypris*) have been identified. Of these, eleven species were identified *(Cytherella beyrichi* (Reuss), *Krithe rutoti* Keij, *Krithe bartonensis* (Jones), *Krithe strangulata* Deltel, *Haplocytheridea helvetica* Lieenklaus, *Loxoconcha delemontensis* Oertli, *Loxoconcha favata, Xestoleberis obtusa* Lienenklaus, *Neomonoceratina helvetica, Hemicyprideis oubenasensis* Apostelescu and *Pokornyella limbata* (Bosquet). Thirteen species were left open nomenclature (*Monoceratina* sp., *Cytherella* sp.1, *Cytherella* sp.2, *Cytherella* sp.3, *Paracypris* sp., *Krithe* sp., *Haplocytheridea* sp., *Loxoconcha* sp., *Hiltermannicythere* sp., *Hemicyprideis* sp., *Eucythere* sp.*, Aurila* sp. and *?Cyprideis* sp.). Three taxa were regarded as *incertae saedis* (*incerta saedis* 1, *incertae saedis* 2, *incertae saedis* 3). When considering the identified taxa for paleoenvironmental reconstruction, it is known that some of them (*Krithe*, *Cytherella*, *Paracypris*) live in bathyal and infraneritic conditions, whereas others *(?Cyprideis, Xestoleberis, Pokornyella,*

Aurila, Loxoconcha) live in epineritic, littoral and brackish conditions. The chronostratigraphic age determination of the identified ostracoda species indicates to a large extent Oligocene. A compatible age determination has been inferred through the analysis of benthic foraminifera, gastropoda, pelecypoda, spore and pollen which have been recovered in the study area. It can be said that, in the light of stable isotope values ($d^{18/16}O$, $d^{13/12}C$) of some levels, the environment reflects marine, tidal lagoon and tide over the planes of evaporites (sabkha).

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Marina Vesel-Lukić, Valentina Hajek-Tadesse & Marijan Poljak

LATE MIOCENE OSTRACODA FROM BIZELJSKO SECTION (EASTERN SLOVENIA)

Late Miocene sediments of the Pannonian basin are extensive in the eastern and north-eastern parts of Slovenia. The Bizeljsko section (Krška kotlina) measures around 950 m in thickness, spamming »Banatica beds«, »Abichi beds« and »Rhomboidea beds«.

The ostracod assemblages, preservation and abundance of ostracod valves from the Bizeljsko section depend on salinity changes of lake water and the rate of terrigenous input.

The oldest Pannonian (D zone sensu Papp, 1951) fossiliferous marls were deposited in the deeper part of the lake. Determined ostracods indicate oligohaline to mesohaline environment. The most abundant are: *Herpetocyprella hyeroglyphica* (Méhes), *Herpetocyprella* cf. *marginata* (Zalányi), *Amplocypris* cf. *abscissa* (Reuss), *Amplocypris* cf. *angulata* (Zalányi), *Loxoconcha porosa* (Mehés), *Pontoniella acuminata* (Zalányi), and *Lineocypris hodonensis* (Pokorný).

Succeeding the Pannonian (E, F, G zones sensu Papp, 1951) turbidite deposits mark continuous deposition of clastic material, which resulted from river floods or re-sedimentation processes. Sand- marl intercalations deposited in the proximal prodelta setting. No microfauna was found in sands, whereas marls are rich in ostracods. Re-sedimented bentic and planktonic foraminifers can also be found.

The ostracods record the increase of lake salinity to the mesohalinic regime. The typical species is *Cyprideis macrostigma spinosa* (Soka), *Bacunella* cf. *dorsoarcuata* (Zalányi), *Hemicytheria marginata* (Soka), *Hemicytheria* cf.

croatica (Sokač), *Candona* (*Lineocypris*) *trapezoidea* (Zalányi), *Leptocythere naca* (Méhes) and *Leptocythere* cf. *bosqueti* (Livental) are abundant.

The youngest Pannonian deposits of the Bizeljsko section record a decline in salinity due to the progressive infiling of basin with sediments and change from brackish lake conditions to fresh water lakes and river sistem. Sands and sandstones resulting from extensive river floods dominate in this part of the section. Interbeds of silty marls are dominated by *Camptocypria* and *Caspiolla* genera. *Hastacandona lotzyi* (Zalányi) and *Hastacandona histerica* (Krstić) are present in this part only.

REFERENCES

PAPP A., 1951. Das Pannon des Wiener Beckens. *Mitteilungen der Geologischen Gesellschaft in Wien*, 39-41: 99-193.

Authors' Addresses — M. VESEL-LUKIĆ, Geological Survey of Slovenia, Dimičeva ul. 14, SI-1000 Ljubljana (Slovenia); e-mail: marina.vesel-lukic@geo-zs.si; V. HAJEK-TADESSE, Croatian Geological Survey, Sachsova 2, HR-10000 Zagreb (Croatia); e-mail: valentina.tadesse@hgi-cgs.hr; M. POLJAK, Geological Survey of Slovenia, Dimičeva ul. 14, SI-1000 Ljubljana (Slovenia); e-mail: marijan.poljak@geo-zs.si.

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A MULTI-PROXY APPROACH BASED ON A LATE PLEISTOCENE/HOLOCENE OSTRACOD RECORD FROM LAKE IZNIK (TURKEY)

Multi-proxy studies are in favour to decipher past environmental conditions and climate patterns from sedimentological records. Here we focus on sediment cores from Lake Iznik (Turkey) covering the past 36 ka cal BP, which were analysed by means of sedimentological, geochemical and palaeontological methods (Roeser *et al.*, 2012; Viehberg *et al.*, in press). Modern studies conclude that Lake Iznik is a warm-monomictic eutrophic lake with anoxic conditions during thermo-stratification and high alkalinity of the lake water is caused by increased sodium carbonate concentrations (Viehberg *et al.*, 2012). However, ostracods represent a key feature throughout the core, as many proxies derive from their remains to reconstruct the palaeoenvironmental setting. The freshwater ostracod fauna assemblages reflect non-marine, but slight saline conditions in the Late Pleistocene shifting rapidly to high alkaline water during the Early Holocene (i.e. monospecific *Limnocythere inopinata*). Morphological changes of *L. inopinata* valves are also indicating this dramatic change in hydrology. The shape analysis reveals a significant morphological difference to modern reference material of extant *L. inopinata* from Anatolia. The stable oxygen isotopes of the ostracod valves hint to severe changes in precipitation patterns in the East Mediterranean during the Pleistocene-Holocene transition. Initial increase in precipitation during the Allerød event and at the onset of the Holocene might have caused erosional processes in the carbonate rich catchment area that led to high lake level stands and high alkalinity in the lake water simultaneously.

REFERENCES

ROESER P.A., FRANZ S.O., LITT T., ÜLGEN U.B., HILGERS A., WULF S., WENNRICH V., ÖN AKÇER S., VIEHBERG F.A., ÇAĞATAY M.N. & MELLES M., 2012. Lithostratigraphic and geochronological framework for the paleoenvironmental reconstruction of the last ~36ka cal BP from a sediment record from Lake Iznik (NW Turkey). *Quaternary International,* 274: 73-87.

VIEHBERG F.A., ÜLGEN U.B., DAMCI E., FRANZ S.O., ÖN AKÇER S., ROESER P.A., ÇAĞATAY M.N., LITT T. & MELLES M., 2012. Seasonal hydrochemical changes and spatial sedimentological variations in Lake Iznik (NW Turkey). *Quaternary International*, 274, 102-111.

VIEHBERG F.A., DAMCI E., ÜLGEN U.B., FRANZ S.O., ROESER P.A., WULF S., ÇAĞATAY M.N., LITT T. & MELLES M., in press. Palaeoenvironmental multi-site study in Lake Iznik (NW Turkey) during late Pleistocene and Holocene. *Journal of Paleolimnology*.

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NEWS FROM THE ENDEMIC OSTRACOD FAUNA FROM LAKES PRESPA AND OHRID (ALBANIA, GREECE, MACEDONIA)

One biodiversity hotspot for ostracods in the Balkans is the Dessarete lake system with its extant members Lakes Prespa and Ohrid, which yield over 40 extant species most of them endemic to the region (LORENSCHAT *et al.*, 2011; NAMIOTKO *et al.*, 2012; PETKOVSKI, 1960). The Holocene and/or Late Pleistocene fossil record has been evaluated in recent studies investigating past climate and environmental changes (AUFGEBAUER *et al.*, 2012; BELMECHERI *et al.*, 2009, 2010; HOFMANN *et al.*, 2012; WAGNER *et al.*, 2009). However, a critical checklist of extant ostracod species is still pending for this remarkable fauna, as it is needed to define species ecology and to test suggested hypothesis for the basins origin, which is supposed to be at least 2 to 5 Ma old (ALBRECHT & WILKE, 2008). We collected Recent material between 2011 and 2012 and compiled a checklist for all species known from this area with their biogeographical range, in order to harmonize the regional taxonomy. In addition, we evaluated the morphological variability also through time from core material from Lake Prespa spanning back to MIS5 (AUFGEBAUER *et al.*, 2012) and present a first comparative study of faunal elements within the Dessarete lake system and adjacent freshwater systems in the Balkan.

REFERENCES

ALBRECHT C. & WILKE T., 2008. Ancient Lake Ohrid: biodiversity and evolution. *Hydrobiologia*, 615: 103-140.

AUFGEBAUER A., PANAGIOTOPOULOS K., WAGNER B., SCHAEBITZ F., VIEHBERG F.A., VOGEL H., ZANCHETTA G., SULPIZIO R., LENG M.J. & DAMASCHKE M., 2012. Climate and environmental change in the Balkans over the last 17 ka recorded in sediments from Lake Prespa (Albania/F.Y.R. of Macedonia/Greece). *Quaternary International*, 274: 122-135.

BELMECHERI S., NAMIOTKO T., ROBERT C., VON GRAFENSTEIN U. & DANIELOPOL D.L., 2009. Climate controlled ostracod preservation in Lake Ohrid (Albania, Macedonia). *Palaeogeography, Palaeoclimatology, Palaeoecology*, 277: 236-245.

BELMECHERI S., VON GRAFENSTEIN U., ANDERSEN N., EYMARD-BORDON A., RÉGNIER D., GRENIER C. & LÉZINE A.-M., 2010. Ostracod-based isotope record from Lake Ohrid (Balkan Peninsula) over the last 140 ka. *Quaternary Science Reviews*, 29: 3894-3904.

HOFFMANN N., REICHERTER K., GRÜTZNER C., HÜRTGEN J., RUDERSDORF A., VIEHBERG F. & WESSELS M., 2012. Quaternary coastline evolution of Lake Ohrid (Macedonia/Albania). *Central European Journal of Geosciences*, 4: 94-110.

LORENSCHAT J., SCHARF B.W., PETKOVSKI T.K., VIEHBERG F.A. & SCHWALB A., 2011. Scientific Collaboration On Past Speciation Conditions in Ohrid (SCOPSCO): Recent and fossil Ostracods from Lake Ohrid as indicators of past environments: A coupled ecological and molecular genetic approach with deep-time perspective. *Joannea Geologie und Paläontologie*, 11: 113-115.

NAMIOTKO T., DANIELOPOL D.L., BELMECHERI S., GROSS M. & VON GRAFENSTEIN U., 2012. On the Leptocytheridae Ostracods of the Long-Lived Lake Ohrid: A Reappraisal of their Taxonomic Assignment and Biogeographic Origin. *International Review of Hydrobiology*, 97: 356-374.

PETKOVSKI T.K., 1960. Zur Kenntnis der Crustaceen des Prespasees. *Fragmenta Balcanica Musei Macedonici Scientiarum Naturalium*, 3 (15/74): 117-131.

WAGNER B., LOTTER A.F., NOWACZYK N., REED J.M., SCHWALB A., SULPIZIO R., VALSECCHI V., WESSELS M. & ZANCHETTA G., 2009. A 40,000-year record of environmental change from ancient Lake Ohrid (Albania and Macedonia). *Journal of Paleolimnology*, 41: 407-430.

Authors' Addresses — F.A. VIEHBERG, A. HASBERG, N. ROHN, Institute of Geology and Mineralogy, University of Cologne, Zülpicher Str. 49A, D-50674 Cologne (Germany); e-mail: finn.viehberg@uni-koeln.de; S. TRAJANOVSKI, Hydrobiological Institute Ohrid, Naum Ohridski 50, 6000 Ohrid (Former Yugoslav Republic of Macedonia); e-mail: trajsa@hio.edu.mk.

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OSTRACODOLOGY AND PALAEOENVIRONMENT IN ANTHROPIC CONTEXT: THE *OSTIA* PALAEO-LAGOON CASE

This study is part of a wider research dealing with the recent dynamics of the Tiber's delta and its palaeoenvironmental evolution (GOIRAN *et al.*, 2010; MAZZINI *et al.*, 2011). Here, the preliminary results of the analysis of a core that traces the entire stratigraphy of the *Ostia* palaeo-lagoon, located on the left bank of the Tiber, are presented. The proximity of the ancient city of *Ostia* makes this site an especially anthropized environment since the antiquity. The aim of this preliminary study is to trace the palaeoenvironmental evolution of this area, which remains still poorly understood.

Ostracods are a valuable tool for our study because they are good palaeoenvironmental indicators in marginal marine environments, due to their high abundance and diversity in oligohaline and mesohaline environments (BOOMER & EISENHAUER, 2002). Despite the low diversity recorded in the *Ostia* palaeo-lagoon - only 12 taxa of ostracods determined in the core- the autoecological analysis revealed the succession of four major periods.

Post to 6800 BP, the reduction in the sea level rising rate led to the formation of a prograding delta and induced the formation of a barrier that isolated the *Ostia* lagoon (BELLOTTI *et al.*, 2007), visible in the stratigraphy from 11.8 m. Initially, it was an environment relatively open to the sea as evidenced by the presence of marine taxa (*Aurila speyeri*, *Paradoxostoma augustum*, *Leptocythere rara* and *Callistocythere* sp.) associated with opportunistic euryhaline (*Palmoconcha turbida* and *Leptocythere lagunae*) and brackish (*Cyprideis torosa*) taxa. During this period, the lagoon environ-

Fig. 1 — Location map of the Tiber delta and the sediment core.

ment displayed its largest specific diversity (average 6 taxa) and indicates an environment that was not yet fully confined. The occasional occurrence of freshwater taxa (*Candona* sp. and *Darwinula stevensoni*) confirms the freshwater influx into the lagoon.

At about 10.3 m, the lagoon is evolving towards a confined environment, characterized by a very low specific diversity (average 2 taxa). This period is marked by the presence of alternating environments subjected to marine influence, characterized by the association of opportunistic euryhaline (*P. turbida* or *Xestoleberis* sp.), brackish (*C. torosa*) and freshwater taxa (*Candona* sp.). These data provide two important insights into the nature of the lagoon: (1) the presence of *Candona* sp. can imply a direct connection with a freshwater body, which could mean that a palaeo-channel of the Tiber had to flow into the *Ostia* palaeo-lagoon, (2) the absence of any trace of hydrodynamic change, even punctual, in the sedimentary sequence suggests the dominant role of the barrier beaches opening and closing in these variations.

Between 8.2 and 5.8 m four peat levels can be related to the generalized peat formation in the north of the lagoon, which took place from 1880/1530 BC (BELLOTTI *et al.*, 2011). It is in these inter-peat deposits that we can find the latest manifestation of freshwater influx, marked by the presence of *Can-*

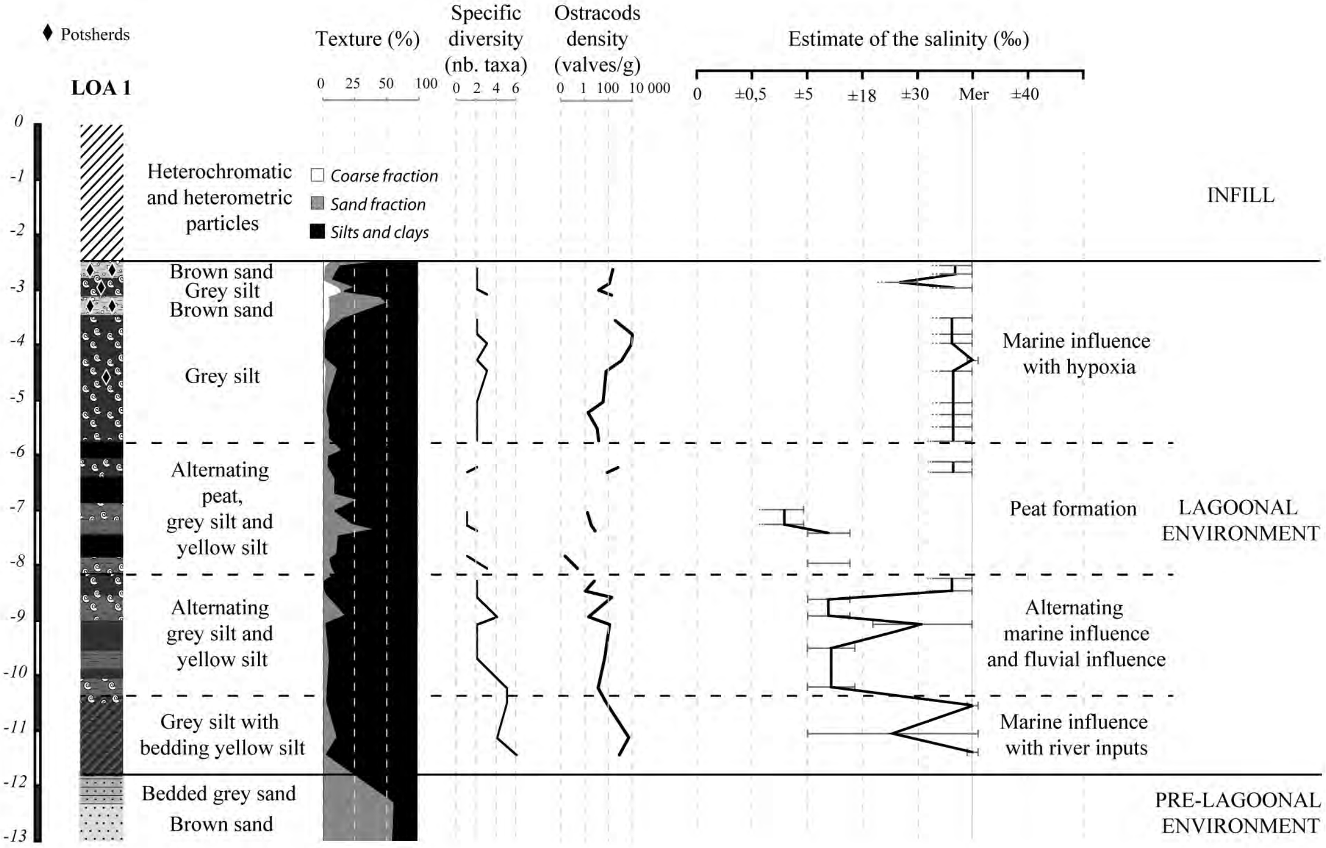

Fig. 2 — Ostracodologic log of core LOA1: specific diversity, faunistic density and estimate of the salinity based on the autoecological data.

dona sp., *C. torosa* with tubercles (salinity <5 ‰) and freshwater gastropod *Bythinia tentaculata*, suggesting that the formation of the peat is related to the progressive movement of the palaeo-channel that previously flowed into the palaeo-lagoon.

After this episode, we can see that the last peat sequence is interrupted by a marine intrusion. It starts up as a very confined euryhaline environment, characterized by an increased faunal density and an opportunistic taxa assemblage, such as the ostracods *C. torosa* and *P. turbida*, the bivalve *Cerastoderma glaucum* and the gastropod *Hydrobia ventrosa*, all supporting hypoxic conditions. The resilience of this environment is to be linked on one hand to the disconnection of the palaeo-channel of the Tiber and on the other hand to the stabilization of the barrier beaches, which might be starting to get caught in the delta progradation deposits.

It was during this period that the first signs of human presence appear in the lagoon, with some potsherds. Over time, the anthropogenic pressure is increasingly visible, with the increase of exogenous factors (potsherds, mortar, pozzolan, sand) until the palaeo-lagoon is filled.

The outstanding results of this preliminary study highlighted by analyzing the auto-ecology of the faunal assemblages are the following: (1) the newly obtained stratigraphy indicates for the first time a direct contact between the *Ostia* palaeo-lagoon and a palaeo-channel of the Tiber, whose chronology will be more defined thanks to datings expected in June 2013 (2) the lagoon environment seems to have been permanent since the establishment of the city of *Ostia*, despite ever more intense anthropic pressure.

REFERENCES

BELLOTTI P., CALDERONI G., CARBONI M.G., BELLA L.D., TORTORA P., VALERI P. & ZERNITSKAYA V., 2007. Late Quaternary landscape evolution of the Tiber River delta plain (Central Italy): new evidence from pollen data, biostratigraphy and 14C dating. *Zeitschrift für Geomorphologie*, 51: 505-534.

BELLOTTI P., CALDERONI G., RITA F.D., D'OREFICE M., D'AMICO C., ESU D., MAGRI D., MARTINEZ M.P., TORTORA P. & VALERI P., 2011. The Tiber River Delta Plain (Central Italy): Coastal evolution and implications for the Ancient Ostia roman settlement. *The Holocene*, 21: 1105-1116.

BOOMER I. & EISENHAUER G., 2002. Ostracod faunas as palaeoenvironmental indicators in marginal marine environments. In: Holmes, A.H., Chivas, A.R. (Eds.), The ostracoda: applications to Quaternary research: 135-149.

GOIRAN J.P., TRONCHÈRE H., SALOMON F., CARBONEL P., DJERBI H. & OGNARD C., 2010. Palaeoenvironmental reconstruction of the ancient harbors of Rome: Claudius and Trajan's marine harbors on the Tiber delta. *Quaternary International*, 216: 3-13.

Mazzini I., Faranda C., Giardini M., Giraudi C. & Sadori L., 2011. Late Holocene Palaeoenvironmental Evolution Of The Ancient Harbour Of Portus (Latium, Central Italy). *Journal of Palaeolimnology*, 46: 243-256.

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YAQIONG WANG

EARLY CRETACEOUS NONMARINE OSTRACOD BIOSTRATIGRAPHY OF THE WESTERN LIAONING AREA, NE CHINA

Nonmarine ostracod faunas of the western Liaoning had been studied since 1950s (HOU, 1958; ZHANG & ZHANG, 1982; ZHANG, 1985; ZHANG *et al.*, 1985; CAO, 1999; WANG *et al.*, 2004), but the species diversity has been greatly exaggerated by previous authors, because the species and subspecies described have been based on an inadequate number of specimens. The present paper is based on a large number of fossils and descriptions of taxonomic features that are more precise than those presented previously. All of the published species from the Yixian, Jiufotang, Fuxin, Sunjiawan formations of western Liaoning are revised and listed (Figs. 1-2).

The nonmarine ostracod fauna of the Barremian to Albian strata of western Liaoning can be subdivided into six successive ostracod assemblages. They are in ascending order:

1. *Cypridea liaoningensis-Damonella circulate* assemblage (mainly in the lower part of the Yixian Formation)

2. *Cypridea deflecta-Cypridea jinganshanensis-Lycopterocypris infantilis* assemblage (mainly in the upper part of the Yixian Formation and the lower part of the Jiufotang Formation)

3. *Limnocypridea grammi-Scabriculocypris pingquanensis-Cypridea delnovi* assemblage (mainly in the upper part of the Jiufotang Formation)

4. *Mongolocypris kleinbergi-Mongolianella palmosa-Cypridea tumidiusula* assemblage (mainly in the lower part of the Fuxin Formation)

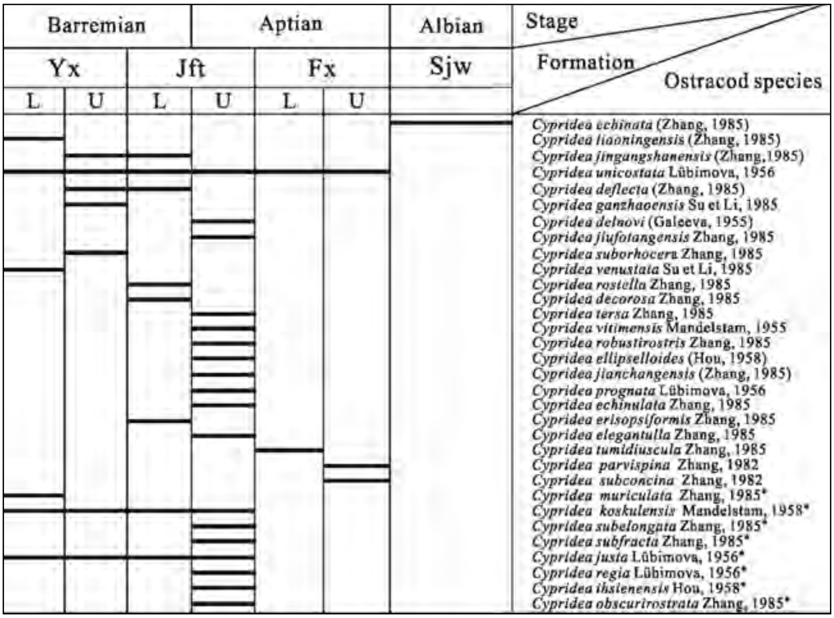

Fig. 1 — Stratigraphical ranges of the cypridean species from western Liaoning of Northeastern China in detail (* (star) indicates the *Cypridea* species with RV>LV).

5. *Mongolocypris globra-Candona*? *dongliangensis* assemblage (mainly in the upper part of the Fuxin Formation)

6. *Cypridea echinata-Bisulcocypridea edentula* (Sunjiawan Formation)

The cypridean specimens encountered in the Yixian Formation (Barremian age) of the Beipiao-Yixian Basin are the earliest record of this genus in China (CAO, 1999; GUAN *et al.*, 2001). But the earliest representatives of (true) *Cypridea* were documented by SCHUDACK & SCHUDACK (2002) from Kimmeridgian of the Middle Saurian Member of the Tendaguru Formation, East Africa. The timing of the earliest appearance and evolution and dispersal of species of *Cypridea* in China heavily depends on the age assignments and correlation of the concerning strata, which is still controversial.

REFERENCES

CAO M.Z., 1999. Nonmarine ostracods of the lower part of the Yixian Formation in Sihetun area, western Liaoning, China. *Palaeoworld*, 11: 131-144 (in Chinese, English abstract).

GUAN S.Z., PANG Q.Q. & XIAO Z.Z., 2001. Discussion on the lowest horizon of *Cypridea* (Ostracoda) in China. *Geology of Chemical Minerals*, 23: 65-74 (in Chinese, English abstract).

HOU Y.T., 1958. Jurassic and Cretaceous nonmarine ostracods of the subfamily Cypridenae from

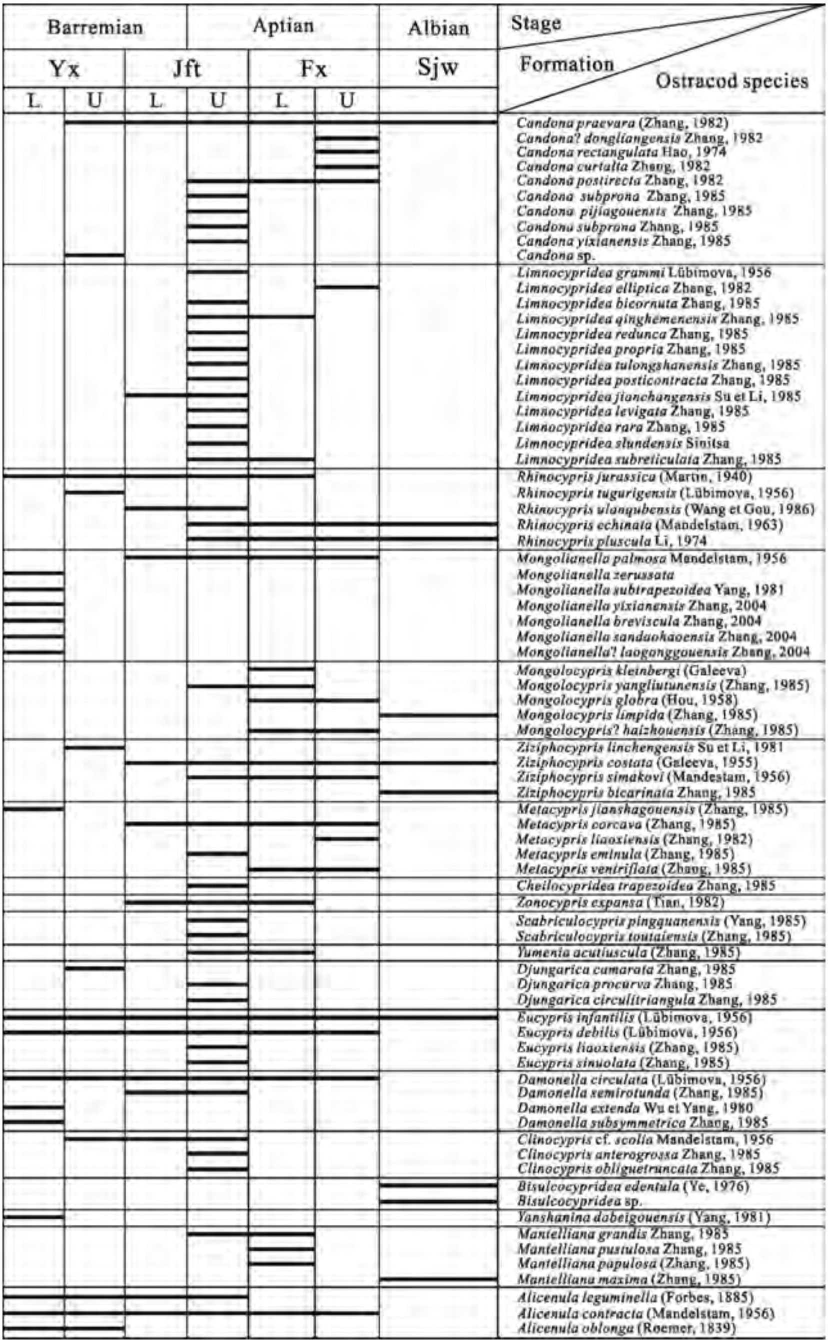

Fig. 2 — Stratigraphical ranges of the non-cypridean species from western Liaoning of Northeastern China in detail.

north-western and north-eastern regions of China. *Memoirs of Nanjing Institute of Geology and Palaeontology Academia Sinica*, 1: 33-103.

SCHUDACK M.E. & SCHUDACK U., 2002. Ostracods from the Middle Dinosaur Member of the Tendaguru Formation (Upper Jurassic of Tanzania). *Neues Jahrbuch für Geologie und Paläontologie, Monatshefte*, 6: 321-336.

WANG W.L., ZHANG H., ZHANG L.J., ZHENG S.L., YANG F.L., LI Z.T., ZHENG Y.J. & DING Q.H., 2004. Standard sections of Tuchengzi stage and Yixian Stage and their stratigraphy, palaeontology and tectonic-volcanic actions. *Geological Publishing House*: 175-190 (in Chinese).

ZHANG L.J. & ZHANG Y.J., 1982. Ostracodes from the Fuxin Formation (Lower Cretaceous) in the Fuxin Basin, Liaoning. *Acta Palaeontologica Sinica*, 21 (3): 362-369 (in Chinese, English abstract).

ZHANG L.J., 1985. The freshwater ostracodes from the lower Cretaceous Jiufotang and Shahai Formation in the Western Liaoning. *Selected paper on Micropalaeontology of China*: 137-149 (in Chinese).

ZHANG L.J., PU R.G. & WU H.Z., 1985. Mesozoic stratigraphy and palaeontology of Western Liaoning (Vol. 2). *Geological Publishing House*, 1-120 pp. (in Chinese).

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YAQIONG WANG & JINGENG SHA

NONMARINE CRETACEOUS OSTRACOD ASSEMBLAGES OF CHINA

Ostracods range from Early Ordovician to Recent (e.g. Horne, 2004; Williams et al., 2008). These small, bivalved arthropods occur in aquatic environments, e.g. small, temporary ponds, rivers, lakes, and oceans. Their calcite carapaces show an excellent fossilization potential, which is demonstrated by the fossil record. Thus, fossil ostracods have a wide application in biostratigraphy, palaeoecology and paleogeography. Nonmarine Cretaceous rocks bearing abundant coal and oil resources are widely distributed in China. These sediments contain variously abundant and diverse ostracod faunas, ranging from Hauterivian to Maastrichtian in age.

On the basis of the characteristic taxa and composition in nonmarine Cretaceous strata of China, 7 ostracod assemblages have previously been established: 1) the Hauterivian–Barremian *Jingguella–Minheella–Pinnocypridea* assemblage in northwestern and southwestern China; 2) the Barremian *Cypridea–Latonia–Darwinula* assemblage in northwestern and southwestern China; 3) the Aptian–Albian, *Cypridea* (Morinina) *–Bisulcocypridea–Mongolocypris* assemblage; 4) the mainly Hauterivian–Barremian *Cypridea–Mongolianella–Darwinula* assemblage in northeastern, central, and eastern China; 5) the Barremian–Aptian *Cypridea (Cypridea)–Cypridea (Ulwellia) –Limnocypridea* assemblage in northeastern, central, and eastern China; 6) the Cenomanian–Santonian *Cypridea–Triangulicypris–Sunliavia–Lycopterocypris* assemblage; 7) the Campanian–Maastrichtian *Talicypridea–Cypridea–Quadracypris–Candona* assemblage. Seventy-three ostracod-bearing formations/groups in 22 regions of China are analyzed and correlated

(Wang et al., 2012). Particularly, the *Cypridea–Mongolianella–Darwinula* and *Cypridea (Cypridea)–Cypridea (Ulwellia)–Limnocypridea* assemblages are mainly found in the famous Jehol Group (Yixian and Jiufotang formations).

On the basis of new radiometric dates as well as marine and nonmarine correlations, new age constraints are assigned to these assemblages. However, several problems remain since most of the assemblages have a long historiestratigraphic (temporal) range, and none of these assemblages are recorded in all of China, but are more or less restricted to some regions of China. Moreover, we have to take the misclassification of ostracods and the environmental factors – including the geographic, climatic, sedimentary and water chemistry changes – into consideration, which could highly influence our results.

REFERENCES

HORNE D.J., 2004. Ostracoda. In: Selley R.C., Cooks R.M. & Plimer, I.R. (eds.), *Encyclopedia of Geology*. Elsevier, Oxford, Vol. 3: 453-463 pp.

WANG Y.Q., SHA J.G., PAN Y.H., ZHANG X.L. & RAO X., 2012. Non-marine Cretaceous ostracod assemblages in China: a preliminary review. *Journal of Stratigraphy*, 36: 290-300.

WILLIAMS M., SIVETER D.J., SALAS M.J., VANNIER J., POPOV L.E. & GHOUBADI F.M., 2008. The earliest ostracods: the geological evidence. *Senckenbergiana Lethaea*, 88: 11-21.

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MARK T. WARNE

THE HOLOCENE CLIMATIC OPTIMUM AND COASTAL OSTRACOD FAUNAS OF SOUTHEASTERN AUSTRALIA

The mid Holocene was a period when sea levels were higher and climates warmer than the present day. This study utilises ostracod proxy data to evaluate mid Holocene coastal palaeomorphology, coastal palaeoclimates and relative sea levels within southeastern Australia. The lowland regions between Warrnambool and Nelson in southwest Victoria possess a thin but spatially widespread veneer of late Quaternary coastal wetland sediments, which include the mid Holocene Pertobe Coquina (GILL, 1967). The Pertobe Coquina is a black shelly mud or grey shelly sand with a relative elevation near present day sea level.

For this study, samples of the Pertobe Couqina were collected from several cores taken in the Warrnambool, Port Fairy and Nelson districts of southwest Victoria. Radiocarbon dates for these samples range from ca 5000 BP to ca 7400 BP. These samples yielded abundant and diverse coastal lagoon and estuarine fossil ostracod faunas often dominated by the species *Osticythere baragwanathi* (Chapman & Crespin)*, Leptocythere hartmanni* (McKenzie)*, Leptocythere lacustris* De Deckker*, Xestoleberis cedunaensis* Hartmann*, Paracytheroma sudaustralis* (McKenzie) and *Paracypria maryboroughensis* Hartmann. Pertobe Coquina ostracod faunas indicate two broad palaeoenvironmental phases during the mid Holocene.

PHASE 1 (> 7000 BP)

Pertobe Coquina sediments older than 7000 BP from inland of the Port Fairy coastline contain a diverse polyhaline coastal lagoon ostracod fauna including both abundant thalassic (marine derived) and athalassic (non-marine derived) species. The high abundance and diversity of normal shallow marine species indicates a dominant marine influence and sub-tidal water depths of a few metres, suggesting that sea levels were slightly higher than in the present day. These relatively old Pertobe Coquina sediments also include fossils of “warm water” marginal marine ostracod species (e.g. *Cyprideis torosa australiensis* Hartmann) that are not found in present day southern Victorian or Tasmanian estuaries and coastal lagoons - but which do occur in more western and northern modern coastal marine habitats of Australia. “Warm water” marginal marine ostracod species are only found in this older depositional phase of the Pertobe Coquina.

PHASE 2 (5000 BP – 7000 BP)

Pertobe Coquina sediments younger than 7000 BP occur adjacent to the southwest Victorian coastline from Warrnambool in the east to Nelson in the west. Ostracod faunas indicate the presence of polyhaline coastal lagoon, mesohaline estuarine and oligohaline coastal lake palaeoenvironments. There is no evidence of fossil ostracod species from warmer coastal maritime climes than that prevailing in this region in the present day. Faunas most commonly suggest mesohaline estuarine conditions, with normal marine faunal elements being far less prevalent than in phase 1 Pertobe Coquina deposits. This suggests that sea levels were lower than during phase 1 deposition. Under the Glenelg River estuary at Nelson, ca 5000 BP Pertobe Coquina sediments contain numerous athalassic (lacustrine) ostracod species (e.g. *Mytilocypris* sp., *Alboa* sp.) that indicate the presence of an oligohaline (slightly brackish) to perhaps almost freshwater coastal palaeo-lake. This suggests substantial freshwater discharge into a coastal lagoon setting via the palaeo-Glenelg River system.

CORRELATIONS

The marginal marine palaeoenvironments of the Pertobe Coquina, coupled with its distribution along a narrow belt parallel to the southwest Victorian coastline, suggest the presence of a large mid Holocene coastal lagoon complex similar to the present day “Coorong” coastal lagoon of southeast South Australia. The initial development of this palaeo-coastal lagoon complex in southwest Victoria broadly correlates with the onset of relatively high Holocene sea levels in coastal New South Wales (ca 7500 BP; SLOSS *et al.,* 2010), relatively high inland lake levels in western Victoria (KEMP *et al.*, 2012), and relatively high rainfall regimes in western South Australia (QUIGLEY *et al.,* 2010). These relatively high sea level and wet climatic conditions caused marine flooding and high river discharges across the southwest Victorian coastal lowlands during the mid Holocene, accounting for the formation of a large palaeo-coastal lagoon complex in this region.

REFERENCES

GILL E.D., 1967. Evolution of the Warrnambool– Port Fairy Coast and the Tower Hill Eruption, Western Victoria. In: Jennings J.N. & Mabbutt, J.A. (eds.), Landform Studies from Australia and New Guinea. *Australian National University Press,* Canberra: 341-364.

KEMP J., RADKE L.C., OLLEY J., JUGGINS S. & DE DECKKER P., 2012. Holocene lake salinity changes in the Wimmera, southeastern Australia, provide evidence for millennial-scale climate variability. *Quaternary Research*, 77: 65-76.

QUIGLEY M.C., HORTON T., HELLSTROM J.C., CUPPER M.L. & SANDIFORD M., 2010. Holocene climate change in arid Australia from speleothem and alluvial records. *The Holocene*, 20 (7):1093-1104.

SLOSS C.R., JONES B.G., SWITZER A.D., NICHOL S., CLEMENT J.H. & NICHOLAS A.W., 2010. The Holocene infill of Lake Conjola, a narrow incised valley system on the southeast coast of Australia. *Quaternary International,* 221: 23-35.

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IAN WILKINSON, MARK WILLIAMS, JEREMY TAYLOR, IAN WHITBREAD,
IAN BOOMER, REBECCA STAMP & EMMA YATES

OSTRACODS AND THE PROVENANCE OF IRON AGE ARTEFACTS

Ancient trade routes and cultural connections can be demonstrated archaeologically by the distribution of high value items such as coins, jewelry and weapons, but the sources of everyday objects in peoples' lives such as cooking pots, or the materials used in earthworks, wattle and daub houses and other building materials are more problematic. Microfossils (foraminifera and ostracods) have proved to be of great value in provenancing these archaeological artefacts in the UK, particularly where only small samples are available for analysis. Examples include tesserae from Roman Mosaics at Silchester (WILKINSON *et al.*, 2008), the Isle of Wight (TASKER *et al.*, 2011) and Leicester (TASKER *et al.*, in press); a putative English Civil War gun emplacement at Wallingford (WILKINSON *et al.*, 2010); and Medieval mud bricks from Chearsley and building stone from the 12th-15th century Mary Magdalene Church, Upper Wichendon (unpublished data).

The Iron Age Fort at Burrough Hill, Leicestershire, eastern England, lies in a lowland landscape of Mesozoic sedimentary rocks comprising mainly mudstones, but with thin limestones, sandstones and ironstones, which are blanketed by Pleistocene till. During the Late Iron Age, the hill fort was a tribal centre of the Corieltauvi people; permanent occupation probably began in late Bronze Age or early Iron Age times (*circa* 800-600 BC) and continued into Roman times (*circa* AD 400). A variety of archaeological artifacts have been recovered, including pottery of La Tène and Scored ceramic styles, daub from roundhouses, clay mortar from walls of the gatehouse, and clay linings of storage pits and hearths. Microfossils are recoverable from many settings at Burrough Hill, and coupled with a detailed study of the local geology, provide a clear indication of the sourcing of materials for pottery and buildings at the site. Microfossils recovered from the clay mortar, daub and the clay linings of storage pits include early to late Jurassic ostracods, such as *Ogmoconcha hagenowi* (Late Hettangian to early Sinemurian), *Ogmoconchella aequalis* (Lower Pliensbachian), *Praeschuleridea pseudokinkelinella* (Lower Toarcian) *Glypterocythere polita* (Bajocian) and *Neurocythere bradiana (*Bathonian to lower Callovian), together with Jurassic and Late Cretaceous foraminifera. It appears, ostensibly, that clays were transported some distance and from a number of sources, an enigmatic situation considering the large amount of mudstones in the surrounding neighborhood. However, microfaunal analyses of the Pleistocene till near the fort proved essentially similar assemblages, so that we conclude that this was the source of the clay.

Finally, ceramics have been examined in thin section, and although foraminifera are present, including early Jurassic and rare late Cretaceous species, ostracods are relatively rare and indeterminate.

REFERENCES

TASKER A., WILKINSON I.P., FULFORD M.G. & WILLIAMS M., 2011. Provenance of chalk tesserae from Brading Roman Villa, Isle of Wight, UK. *Proceedings of the Geologists' Association*, London, 122: 933-937.

TASKER A., WILKINSON I.P., WILLIAMS M., MORRIS M., COOPER N. & FULFORD M.G., in press. Provenance of Chalk Tesserae from a Roman Town House in Vine Street, Leicester. *Britannia*.

WILKINSON I.P., WILLIAMS M., YOUNG J.R., COOK S.R., FULFORD M.G. & LOTT G.K., 2008. The application of microfossils in assessing the provenance of chalk used in the manufacture of Roman mosaics at Silchester. *Journal of Archaeological Science,* 35: 2415-2422.

WILKINSON I.P., TASKER A., GOULDWELL A., WILLIAMS M., EDGEWORTH M., ZALASIEWICZ J. & CHRISTIE N., 2010. Micropalaeontology reveals the source of building materials for a defensive earthwork (English Civil War?) at Wallingford Castle, Oxfordshire. *Journal of Micropalaeontology*, 29: 1-6.

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MARK WILLIAMS

OSTRACODS: THE ULTIMATE SURVIVORS

Analysis of the fossil record identifies five Phanerozoic mass extinctions and we may be approaching a sixth phase of major extinction driven by human activities (BARNOSKY *et al.*, 2011). While many groups of organisms have been exterminated during mass extinction events, some have prevailed to become the most successful in their particular niches: an outstanding example is the ostracod. Small, robust and very resilient, ostracods have survived 500 million years of Earth history. Here I evaluate the evidence for ostracods acquiring many of the physiological, anatomical and behavioral features that promote their survival early in their evolution. And, the survival characteristics of ostracods provide a baseline for understanding the causes of extinction in other organism groups, particularly bivalved arthropods such as Bradoriida and Phosphatocopida that became extinct in the late Cambrian - early Ordovician.

REFERENCES

BARNOSKY A.D., MATZKE N., TOMIYA S., WOGAN G., SWARTZ B., QUENTAL T., MARSHALL C., MCGUIRE J.L., LINDSEY E.L., MAGUIRE K.C., MERSEY B. & FERRER E.A., 2011. Has the Earth's sixth mass extinction already arrived? *Nature*, 471: 51-57.

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CLAUDIA WROZYNA, WERNER E. PILLER & MARTIN GROSS

MORPHO-ECOLOGICAL ANALYSES OF NEOTROPICAL *CYTHERIDELLA* (*Ostracoda Crustacea*)

Interrelationships between geographical distribution, environmental conditions, phenotypic variability and reproductive modes are poorly understood for most ostracod species.

Moreover, there is only limited knowledge about intraspecific morphological variability of soft and hard parts.

We have investigated the intraspecific limb and shell variability of the neotropical freshwater ostracod species *Cytheridella ilosvayi* which has been known so far to reproduce only sexually. Limb variability of adult and juvenile individuals (down to A-3) is generally low. Highest variation is shown by podomere proportions of the antennas, while thoracopods and setae provide minor influence on the variability. Based on discriminant analyses, some morphometric parameters of the shell (i.e., shell length, position of the transversal sulcus) have proved to be more significant than limb ratios for the differentiation of the *C. ilosvayi* morphotypes. Adult females exhibit a large size range in which two clearly separated morphotypes exist. According to the correspondences in limb ratios between smaller females and males they are interpreted as being sexual. Consequently, the large females are assumed to be parthenogenetic.

Based on these results, we will analyse *Cytheridella* spp. populations through their whole geographical range, focussing on the intraspecific morphological variability in relation to ecological parameters (e.g., habitat type, solute composition, and temperature) in order to identify possible biogeographical patterns of morphological disparity and the link with ecological conditions and the reproductive mode.

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KATSURA YAMADA, TOSHIAKI IRIZUKI & TAKASHI GOTO

PALAEO-TEMPERATURE SHIFTS AND GRADIENTS OF INTERMEDIATE AND SHALLOW WATERS IN THE SEA OF JAPAN DURING THE LATE PLIOCENE ESTIMATED BY Mg/Ca RATIO OF OSTRACOD VALVES

Previous study of fossil ostracods from the upper Pliocene Kuwae Formation, central Japan, clarified that temperate intermediate waters (TIW) had existed in the Sea of Japan during several interglacial periods between 3.5 and 2.8 Ma and palaeo-temperature of the TIW was roughly estimated on the basis of factor analysis of fossil ostracode assemblages (IRIZUKI *et al.*, 2007). In the present study, Mg/Ca analysis of valves of genera *Krithe* (intermediate water dweller) and *Cytheropteron* (shallow water dweller) from the Kuwae Formation was conducted to determine more accurately palaeo-temperatures of intermediate and shallow waters during the late Pliocene in the Sea of Japan.

More than 60 sandy mudstone samples were collected from the Tainai and Sakai sections where the Kuwae Formation is well exposed. Two to six whole adult ostracode valves per sample were analyzed by ICP-AES in the Kochi Core Center, Japan. The regression lines established in the previous studies (e.g. DWYER *et al.*, 2002) were used for *Krithe*. For *Cytheropteron*, the partition coefficient between water temperature and Mg/Ca ratio of ostracode shells was newly established based on the analysis of recent ostracode shells collected from the Sea of Japan. We used annual water temperature dataset disclosed in the web site of the Japan Oceanographic Data Center as a recent bottom water temperature in each study site. Mg/Ca ratio of *Cytheropteron* and temperature data correlated positively, though the number of Mg/Ca records was not enough for accurate calculation. The regression line was preliminarily established as the following equation:

Water temperature (°C) = 0.58*Mg/Ca ostracode (mmol/mol) – 0.86 (R^2=0.79)

Mg/Ca ratio was measured using samples from the successive intervals in the Tainai section deposited during the periods of the MIS G19 to G17 and MIS G14 to G13 (approximately 3.1 to 2.8 Ma). Calculated bottom water temperatures located below intermediate waters ranged from 0.5 to 15°C based on Mg/Ca ratio of valves of *Krithe*. Their temperature intervals in each sample ranged from 2.0 to 7.5°C based on seven different regression lines. The intermediate water temperature shifted largely and abruptly within the range of 0.5–12.5°C in the interglacial periods, whereas it changed within the range between 2 and 8°C in the glacial periods. During the MIS G17, lowest temperature (0.5–3°C) was estimated in the interglacial maximum. Moreover, two peaks of higher temperature (6–10°C) were found in the horizons just below and above the interglacial maximum, which correspond to the transitional periods. Therefore bottom water temperatures in the study site increased in the transitional period from glacial to interglacial maximum due to the inflow of the TIW though water depth became deeper. Then, the study site was influenced by cold deep waters lying under the TIW because of sea-level rise at the interglacial maximum. Increase and decrease of intermediate water temperatures during the transitional period from interglacial to glacial maximum indicate that the study site was located below the TIW again and then was affected by cool intermediate waters after the disappearance of the TIW. Shallow water temperature calculated by Mg/Ca ratio of valves of *Cytheropteron* ranged between 7 and 14 °C in the Tainai section. Relatively higher values (10–15°C) were estimated in the horizons containing many specimens of shallow and temperate taxa, whereas lower values (7–9°C) were found in the horizons containing many cold and temperate taxa and were within the range of intermediate water temperatures except for one horizon. Palaeo-temperature gradient between shallow and intermediate waters were reconstructed based on our calculated temperatures of Mg/Ca records in the periods of the MIS G19 to G17 and G14 to G13 in the Sea of Japan. The estimated values of intermediate water in the MIS G17 and G13 were within the temperature that *Krithe* can inhabit abundantly in the recent sea around Japan. They are approximately 4–6 °C warmer than those at water depths of 150–200 m off the study site today.

REFERENCES

IRIZUKI T., KUSUMOTO M., ISHIDA K. & TANAKA Y., 2007. Sea-level changes and water structures between 3.5 and 2.8 Ma in the central part of the Japan Sea Borderland: Analyses of fossil Ostracoda from the Pliocene Kuwae Formation, central Japan. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 245:421-443.

DWYER G., CRONIN T. & BAKER P., 2002. Trace elements in marine ostracodes. In: Holmes, J. and

Chivas, A. (eds.), The Ostracoda. *Geophysical Monograph*, 131, American Geophysical Union, Washington, DC, 205-226.

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TATSUHIKO YAMAGUCHI & RICHARD D. NORRIS

OSTRACODE FAUNAL CHANGES THROUGH THE PALEOCENE-EOCENE THERMAL MAXIMUM AT OCEAN DRILLING PROGRAM SITE 865, EQUATORIAL PACIFIC

The Paleocene-Eocene thermal maximum (PETM) is a notable global warming event at ~56 Ma. Sea surface and deep water temperature increased ~5°C in a few thousand years. The warming event was associated with a shoaling of the carbonate compensation depth, ocean acidification, and changes in primary productivity (e.g. BAINS *et al.*, 2000; ZACHOS *et al.*, 2005). In the deep sea, ~30–50% of cosmopolitan taxa of benthic foraminifers went extinct (THOMAS & SHACKLETON, 1996). Ostracode faunal changes through the PETM are still unclear. YAMAGUCHI & NORRIS (2012) revealed ostracode faunal changes during the PETM at Deep Sea Drilling Project Site 401, in the northeastern Atlantic, and discovered an extinction event that was coincident with the benthic foraminifer extinction. However, except for this study, few other records indicate an ostracode extinction at the PETM (SPEIJER *et al.*, 2012). Here we present the response of ostracode faunas through the PETM at Ocean Drilling Program Site 865, in the equatorial Pacific. Near the onset of the PETM (~55.8 Ma), five of nine species present disappeared. Only one, *Pariceratina ubiquita* BOOMER, 1994, is found through the PETM. The other three taxa are Lazarus taxa. The extinction event is accompanied by diversity loss in the ostracode assemblage. The assemblage recovered its taxonomic diversity at ~53.6 Ma. Our data strongly suggest a global extinction event of deep-sea ostracodes at the PETM. Ostracode faunal changes in the equatorial Pacific site differ from the northeastern Atlantic site in that in the equatorial Pacific, the recovery of ostracode diversity occurs later than in the northeastern Atlantic. The difference is probably caused by geomorphologic and paleoceanographic settings.

REFERENCES

BAINS S., NORRIS R., CORFIELD R. & FAUL K., 2000. Termination of global warmth at the Palaeocene/Eocene boundary through productivity feedback. *Nature*, 407: 171-174.

BOOMER I., 1994. On *Pariceratina ubiquita* Boomer sp. nov. *Stereo-Atlas of Ostracod Shells*, 21: 79-86.

SPEIJER R.P., SCHEIBNER C., STASSEN P. & MORSI A.-M.M., 2012. Response of marine ecosystems to deep-time global warming: a synthesis of biotic patterns across the Paleocene-Eocene thermal maximum (PETM). *Austrian Journal of Earth Sciences*, 105: 6-16.

THOMAS E. & SHACKLETON N.J., 1996. The Paleocene-Eocene benthic foraminiferal extinction and stable isotope anomalies, In: Knox R.W.O.B., Corfield R. M. & Dunay R. E. (eds.), Correlation of the Early Paleogene in Northwest Europe. *Geological Society of London*, London: 401-441.

YAMAGUCHI T. & NORRIS R.D., 2012. Deep-sea ostracode turnovers through the Paleocene–Eocene thermal maximum in DSDP Site 401, Bay of Biscay, North Atlantic. *Marine Micropaleontology*, 86-87: 32-44.

ZACHOS J.C., ROHL U., SCHELLENBERG S.A., SLUIJS A., HODELL D.A., KELLY D.C., THOMAS E., NICOLO M., RAFFI I., LOURENS L.J., MCCARREN H. & KROON D., 2005. Rapid acidification of the ocean during the Paleocene-Eocene thermal maximum. *Science*, 308: 1611-1615.

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TATSUHIKO YAMAGUCHI, RICHARD D. NORRIS & DAVID T. DOCKERY III

AN OSTRACODE TURNOVER DURING THE EOCENE-OLIGOCENE CLIMATE TRANSITION IN MISSISSIPPI, THE GULF COAST PLAIN, USA

The Eocene-Oligocene climate transition (EOT) is the largest global cooling event of the Cenozoic (~34 Ma). It was associated with a major eustatic sea level fall, sea surface cooling, change in ocean stratification, and enhanced seasonality (e.g. KATZ *et al.*, 2008). During the period, terrestrial and marine biota turned over (e.g. PROTHERO *et al.*, 2003). Previously HAZEL (1990) and YAMAGUCHI & KAMIYA (2007) studied changes in ostracode faunas during the EOT in the Gulf Coastal of Mexico in the United States and southern Japan. Details of the faunal changes have not yet been revealed. Here we present changes in ostracode faunas from shelf deposits in the Gulf Coast of Mexico through the late Eocene to early Oligocene in ~10,000 year interval, analyzing biostratigraphy and paleoecology of ostracodes from the Jacksonian Yazoo Formation in the Mossy Grove Core, Mississippi. In our finding, Mossy Grove ostracode faunas suffered gradual extinction and diversity loss between 33.93 to 33.80 Ma. During the turnover, ten of 21 species disappeared. Five of the ten vanishing species became extinct, while others are Lazarus taxa that later re-appear in the Vicksburgian (~33.7 Ma). The vanishing species contain all platycopid ostracodes, filter feeders, found in deep shelf communities. The turnover was coincident with a decrease in Gulf Coast sea-water temperature and the global extinction of planktonic foraminifers (WADE & PEARSON, 2008; WADE *et al.*, 2012). We propose that decrease in the sea surface temperature, increase in surface ocean seasonality and increased stratification of coastal waters caused the ostracode turnover. Decreased temperatures during the winter (e.g. IVANY *et al.,* 2000; KOBASHI *et al.*, 2004) may have had particular impact on shallow coastal species accustomed to warm inner shelf conditions whereas the increase in stratification may have affected food supply to filter feeding taxa. The changes in taxonomic diversity and composition of feeding-type indicate that the Eocene–Oligocene transition caused changes in the foodweb of the coastal benthic ecosystem.

REFERENCES

HAZEL J.E., 1990. Major changes in Eocene and Oligocene Gulf Coast ostracod assemblages: relationship to global events, In: Whatley, R., Maybury, C. (eds.), Ostracoda and Global Events. Chapman and Hall, London: 113-121.

IVANY L.C., PATTERSON W.P. & LOHMANN K.C., 2000. Cooler winters as a possible cause of mass extinctions at the Eocene-Oligocene boundary. *Nature*, 407: 887–890.

KATZ M.E., MILLER K.G., WRIGHT J.D., WADE B.S., BROWNING J.V., CRAMER B.S. & ROSENTHAL Y., 2008. Stepwise transition from the Eocene greenhouse to the Oligocene icehouse. *Nature Geoscience*, 1: 329-334.

KOBASHI T., GROSSMAN E.L., DOCKERY D.T.III & IVANY L.C., 2004. Water mass stability reconstructions from greenhouse (Eocene) to icehouse (Oligocene) for the northern Gulf Coast continental shelf (USA). *Paleoceanography*, 19: PA1022.

PROTHERO D.R., IVANY L.C. & NESBITT E.A., 2003. From the greenhouse to icehouse: the marine Oligocene–Eocene transition. Columbia University Press, New York.

WADE B.S. & PEARSON P.N., 2008. Planktonic foraminiferal turnover, diversity fluctuations and geochemical signals across the Eocene/Oligocene boundary in Tanzania. *Marine Micropaleontology*, 68: 244-255.

WADE B.S., HOUBEN A.J.P., QUAIJTAAL W., SCHOUTEN S., ROSENTHAL Y., MILLER K.G., KATZ M.E., WRIGHT J.D. & BRINKHUIS H., 2012. Multiproxy record of abrupt sea-surface cooling across the Eocene-Oligocene transition in the Gulf of Mexico. *Geology*, 40: 159-162.

YAMAGUCHI T. & KAMIYA T., 2007. Shallow-marine ostracode faunas around the Eocene/Oligocene boundary in the northwestern Kyushu, southwestern Japan. *Lethaia*, 40: 293-303.

Authors' Addresses — T. YAMAGUCHI, R.D. NORRIS, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA92093-0244 (U.S.A.); e-mail: tyamaguchi@mail.ucsd.edu; tyamaguch@mac.com; rnorris@ucsd.edu; D.T. DOCKERY III, Office of Geology, P. O. Box 2279, Mississippi Department of Environmental Quality, Jackson, MS39225 (U.S.A.).

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HUMAN-INDUCED MARINE ECOLOGICAL DEGRADATION: MICROPALEONTOLOGICAL PERSPECTIVES

We analyzed published downcore microfossil (including ostracods, foraminifera, diatoms, dinoflagellates, and coccolithophores) records from 150 studies and reinterpreted them from an ecological degradation perspective to address the following critical but still imperfectly answered questions: (1) How is the timing of human-induced degradation of marine ecosystems different among regions? (2) What are the dominant causes of human-induced marine ecological degradation? (3) How can we better document natural variability and thereby avoid the problem of shifting baselines of comparison as degradation progresses over time? The results indicated that: (1) ecological degradation in marine systems began significantly earlier in Europe and North America (~1800s) compared with Asia (post-1900) due to earlier industrialization in European and North American countries, (2) ecological degradation accelerated globally in the late 20th century due to post-World War II economic growth, (3) recovery from the degraded state in late 20th century following various restoration efforts and environmental regulations occurred only in limited localities. Although complex in detail, typical signs of ecological degradation were diversity decline, dramatic changes in total abundance, decrease in benthic and/or sensitive species, and increase in planktic, resistant, toxic, and/or introduced species. The predominant cause of degradation detected in these microfossil records was nutrient enrichment and the resulting symptoms of eutrophication, including hypoxia. Other causes also played considerable roles in some areas, including severe metal pollution around mining sites, water acidification by acidic wastewater, and salinity changes from construction of causeways, dikes, and channels, deforestation, and land clearance. Microfossils enable reconstruction of the ecological history of the past 10^2–10^3 years or even more, and, in conjunction with statistical modeling approaches using independent proxy records of climate and human-induced environmental changes, future research will enable workers to better address Shifting Baseline Syndrome and separate anthropogenic impacts from background natural variability.

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Mehmet Yavuzatmaca, Okan Külköylüoğlu & Ozan Yilmaz

FRESHWATER OSTRACODA (CRUSTACEA) FROM ADIYAMAN PROVINCE (TURKEY) BY APPLICATION OF POISSON DISTRIBUTION

To understand the distribution and ecological characteristics of nonmarine ostracods, total of 41 ostracod taxa (26 recent and 15 sub-recent forms) were identified from 111 of 120 different aquatic bodies of Adıyaman which covers about 7614 km^2 of surface area. As long as we know, this is the first comprehensive study in this province where all taxa we found are new reports with this work. *Schellencandona insueta* is also new report for Turkey. The null hypothesis "Ostracods are randomly distributed in Adıyaman province" was tested by application of Poisson method along with Chi-square test at 0.05 significant level. Then after distribution of species was determined by comparing the ratio between variance (S^2) and the mean (μ) of the population (Ludwig & Reynolds, 1988). The results of Poisson was not significant ($X^2_{(3, 120, 0.05)} = 7.81 > 5.33$ & $S^2/\mu=1.06$), supporting random distribution of ostracods among the sampling sites. Generally, species with cosmopolitan characteristics (*Candona neglecta*, *Heterocypris incongruens*, *Ilyocypris bradyi* and *Psychrodromus olivaceus*) tend to have higher levels of optima and tolerance values than the mean levels for four environmental variables used. This may explain extensive geographical distribution of these species in variety of ecological conditions, implying preferences of some species for certain kinds of habitats. Both first and the second axes of Canonical Correspondence Analysis (CCA) were able to explain ca. 77.4 % of the relationship between 11 most common species and five environmental variables (water temperature, pH, electrical conductivity, elevation and dissolved oxygen). Our results did not show any significant effect of elevation on species but it may be assumed that elevation can play a primary (MEZQUITA *et al.*, 1999) or secondary (KÜLKÖYLÜOĞLU *et al.*, 2012) role due to its close relationships to the changes on water temperature, depth and salinity (REEVES *et al.*, 2007). Indeed, elevation was not significant ($p < 0.05$) on the numbers of species from 550 m to 1156 m of elevational range. Accordingly, species number declined above 1156 m but this correspond reduction in the numbers of sampling sites. Thus, our results suggest that species – especially cosmopolitans – can have successive distribution in all different aquatic bodies as long as conditions are suitable for them. The question “what is suitable condition for ostracods?” should however be taken under consideration for future studies.

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REFERENCES

KÜLKÖYLÜOĞLU O., SARI N. & AKDEMIR D., 2012. Distribution and ecological requirements of Ostracods (Crustacea) at high altitudinal ranges in Northeastern Van (Turkey). *Annales de limnologie - International journal of limnology,* 48: 39-51.

LUDWIG J.A. & REYNOLDS J.F., 1988. Statistical Ecology – A primer on methods and computing. *John Wiley & Sons*, New York, 337 pp.

MEZQUITA F., GRIFFITHS H.I., SANZ S., SORIA J.M. & PINON A., 1999. Ecology and distribution of ostracods associated with flowing waters in the eastern Iberian peninsula. *Journal of Crustaecan Biology,* 19: 344-354.

REEVES J.M., DE DECKKER P. & HALSE S.A., 2007. Groundwater ostracods from the arid Pilbara region of northwestern Australia: distribution and water chemistry. *Hydrobiologia,,* 585: 99-118.

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Ozan Yilmaz, Dilan Polat, Serpil Taşkin,
Merve Eğribel & Okan Külköylüoğlu

SEASONAL CHANGES OF OSTRACODS IN TROUGHS (BOLU, TURKEY)

In order to understand seasonal occurrences of trough ostracods, five troughs located at about same elevation (ca. 795m a.s.l.) in two villages (Yumrukaya and Hamidiye) in Bolu were visited four seasons between 07 October 2011 and 12 July 2012. The water provided to the troughs are coming from underground by the aid of pipes but the depth is not known. A total of six taxa (*Ilyocypris bradyi, Heterocypris incongruens, Prionocypris zenkeri, Psychrodromus olivaceus*, *Pseudocandona* sp., *Heterocypris* sp.) was found. When *I. bradyi* was encountered in all seasons, *P. olivaceus* and *P. zenkeri* were found in fall and winter seasons. Other taxa were only reported from fall season. Generally, except *Pseudocandona* sp. and *Heterocypris* sp., other species display cosmopolitan distribution. Comparing the age of the troughs, the oldest (established in 1957) two species while the youngest (established in 1991) had four species. Except some previous reports from troughs (Fryer,1997; Meisch, 2000; Külköylüoğlu, *et al.*, in press), there is no similar seasonal study on trough ostracods. Moreover, it is clear that the number of taxa differed among troughs which were mostly dominated by cosmopolitans. Thus, results may imply that species with cosmopolitan characteristics are probably the first invaders of such newly established habitats. However, due to lack of physicochemical data, our results cannot be comparable and cannot be generalized at the moment. Future studies are required to understand seasonal occurrences of species and their correlation to different types of environmental variables.

REFERENCES

FRYER G., 1997. The horse-trough ostracod *Heterocypris incongruens*. *Naturalist*, 122: 121-135.

KÜLKÖYLÜOĞLU O., AKDEMIR D., SARI N., YAVUZATMACA M., ORAL C. & BAŞAK E., (in press). Distribution and ecology of Ostracoda (Crustacea) from troughs in Turkey. *Turkish Journal of Zoology*, DOI: 10.3906/zoo-1205-17.

MEISCH C., 2000. Freshwater Ostracoda of Western and Central Europe. Susswasserfauna von Mitteleuropa 8/3. *Spektrum Akademischer Verlag*, Heidelberg, Berlin, 522 pp.

Authors' Addresses — O. YILMAZ, D. POLAT, S. TAŞKIN, M. EĞRIBEL & O. KÜLKÖYLÜOĞLU, Abant İzzet Baysal University, Faculty of Arts and Science, Department of Biology, 14280 Bolu (Turkey); e-mail: ozan84yilmaz@gmail.com; dilanpolat500@gmail.com; serpiltaskin1@gmail.com; merveegribel@hotmail.com; kulkoyluoglu_o@ibu.edu.tr.

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DISTRIBUTION AND ECOLOGY OF NONMARINE OSTRACODA (CRUSTACEA) FROM KARABÜK REGION OF TURKEY

We collected 36 taxa (22 living and 14 sub-recent) with 4155 individuals from 54 of 81 sites in Karabük region (4,145 km^2) during the summer 2012. All taxa are new reports for the region. Second axis of Canonical Correspondence Analysis (CCA) displayed 73.4 % of the total inertia (6.245) of the relationship between species and environmental variables. Accordingly moist ($p=0.008$, $F=2.317$) and water temperature ($p = 0.03$, $F=1.896$) was more effective variables on species than the others (dissolved oxygen, pH, elevation, redox potential, total dissolved solids). Among the species, *Heterocypris incongruens*, *H. salina*, *Ilyocypris bradyi* and *Psychrodromus olivaceus* were found as the most frequently occurring species. When *H. incongruens* showed relatively higher optimum and tolerance values more than the mean values of 14 species analyzed, others showed species-specific tolerance and optimum levels to the variables. Indeed, *Limnocythere inopinata* showed the highest optimum and tolerance levels to electrical conductivity. Our sampling sites included a range from 11 m to 740 m of elevation. None of the species examined revealed a clear correlation to elevation. This does not mean to ignore the effect of elevation which may play secondary role on the species distribution and diversity (Külköylüoğlu *et al.* 2012). Majority of species were mostly found from 50 troughs followed by stream, ditch, springs, ponds, lake and cave water. Results suggest that although artificial, troughs can provide suitable habitats for ostracods. However, converting natural water sources to troughs will eventually lower the species quality and diversity.

REFERENCES

KÜLKÖYLÜOĞLU O., YAVUZATMACA M., AKDEMİR D. & SARI N., 2012. Distribution and Local Species Diversity of Freshwater Ostracoda in Relation to Habitat in the Kahramanmaras Province of Turkey. *Internat. Rev. Hydrobiol.*, 97(4): 247–261.

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SINDBAD ZAZZALI & SYLVIE CRASQUIN

OSTRACODS AND THE BIOLOGICAL CRISIS OF MIDDLE - UPPER PERMIAN BOUNDARY

The evolution of the biosphere during geological times has not been continuous and regular. Indeed, its history has been interspersed by biological crises of various magnitudes leading to brutal extinctions, by opposition with radiation and stability phases. Among these events, five major crises with global and fatal implications have been identified. The most important of these cataclysms defines the limit between Palaeozoic and Mesozoic eras and is dated to about 252 million years (Permian-Triassic Boundary, PTB).

In the second half of the 90's, STANLEY & YANG (1994) and JIN *et al.* (1994) studies, based on the observations of marine invertebrate groups (fusulinids, corals, bivalves …), present important taxonomic modifications near the Middle Permian-Upper Permian boundary (Guadalupian-Lopingian boundary, GLB).

During the last two decades, different studies (e.g. LAI *et al.*, 2008; WIGNALL *et al.,* 2009) suggest that the GLB could have been marked by a great biological crisis recorded in the last stage of Middle Permian (Capitanian). Some recent studies seem to date this event more precisely from the middle of the Capitanian (ISOZAKI *et al.,* 2007a; WIGNALL *et al.,* 2009). The mass extinction, identified about 10My before the PTB, is considered by some authors to be the first step of end-Permian biodiversity drop (YIN *et al.*, 2007).

Several mechanisms have been proposed in order to explain the causes of this crisis, but none of these has attained a consensus status.

The Permian is characterized by an overall warming climatic trend leading to a total loss of continental icecaps in the Upper Permian (LETHIERS, 1998). During this general trend, VEIZER *et al.* (2000) and ISOZAKI *et al.* (2007b) evoke a global cooling episode during the Capitanian. This cooling interval, called "Kamura cooling event", is presented as synchronous in some sections with the biological crisis event, and so, is thought to be linked with extinction losses.

The Middle Permian also corresponds to a global sea level fall (ROSS & ROSS, 1995). Moreover, the Upper Capitanian records one of the lowest marine levels in the Palaeozoic (HAQ & SCHUTTER, 2008), that should have impacted the marine biosphere.

Furthermore, a volcanic episode, related to the Emeishan igneous province (South China), has been identified by some authors (i.e. ZHANG *et al.*, 2008; SUN *et al.*, 2010) in different sections around the GLB and was also described as a potential cause of the end-Guadalupian extinctions.

Ostracods are not known in the Guadalupian – Lopingian boundary interval. A detailed analysis of the ostracods assemblages is undertaken to document the evolution of the group. Several sections were sampled in South China, particularly the Chao Tian section in Sichuan Province and the Maoershan section in Hubei Province. The goal of this analysis is to explore biodiversity evolution: to confirm or not the existence of a biological crisis for the ostracod class and, if it is confirmed, to describe extinction patterns and recovery processes.

Furthermore, ostracods are efficient tools for characterization of past environments. Study of ostracod association variations, on both sides of the GLB, will lead to an improvement of the knowledge on global and/or local palaeoenvironmental settings. These data will permit to test the different hypotheses proposed during the last two decades.

REFERENCES

HAQ B.U. & SCHUTTER S.R., 2008. A chronology of Paleozoic sea-level changes. *Science*, 322: 64-68.

ISOZAKI Y., SHIMIZU N., YAO J., JI Z. & MATSUDA T., 2007a. End-Permian extinction and volcanism-induced environmental stress: The Permian-Triassic boundary interval of lower-slope facies at Chaotian, South China. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 252: 218-238.

ISOZAKI Y., KAWAHATA H. & MINOSHIMA K., 2007b. The Capitanian (Permian) Kamura cooling event: the beginning of the Paleozoic–Mesozoic transition. *Paleoworld*, 16: 16-30.

JIN Y. G., ZHANG J. & SHANG Q., 1994. Two phases of the end-Permian mass extinction. In: Pangea: global environements and ressources. *Canadian Society of Petroleum. Memoir*, 17: 813-822.

LAI X., WANG W., WIGNALL P.B., BOND D.P.G., JIANG H.S., ALI J.R., JOHN E.H. & SUN Y., 2008. Palaeoenvironmental change during the end-Guadalupian (Permian) mass extinction in Sichuan, China. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 269: 78-93.

LETHIERS F., 1998. Évolution de la biosphère et événements géologiques. Gordon and Breach Science Publishers, 321 pp.

ROSS C.A. & ROSS J.R.P., 1995. Foraminiferal zonation of late Paleozoic depositional sequences. *Marine Micropaleontology*, 26 (1-4): 469-478.

STANLEY D.J. & YANG X., 1994. Double mass-extinction at the end of the Paleozoic era. *Science*, 266: 1340-1344.

SUN Y., LAI X., WIGNALL P.B., WIDDOWSON M., ALI J.R., JIANG H., WANG W., YAN C., BOND D.P.G. & VÉDRINE S., 2010. Dating the onset and nature of the Middle Permian Emeishan large igneous province eruptions in SW China using conodont biostratigraphy and its bearing on mantle plume uplift models. *Lithos*, 119: 20-33.

VEIZER J., GODDERIS Y. & FRANCOIS L.M., 2000. Evidence for decoupling of atmospheric CO2 and global climate during the Phanerozoic eon. *Nature*, 408: 698-701.

WIGNALL P.B., VÉDRINE S., BOND D.P.G., WANG W., LAI L.X., ALI J.R. & JIANG H.S., 2009. Facies analysis and sea-level change at the Guadalupian – Lopingian Global Stratotype (Laibin, South China), and its bearing on the end-Guadalupian mass extinction. *Journal of the Geological Society*, 166: 655-666.

YIN H.F., FENG Q., LAI X., BAUD A. & TONG J., 2007. The protracted Permo-Triassic crisis and multi-episode extinction around the Permian-Triassic boundary. *Global and Planetary Change*, 55: 1-20.

ZHANG L.-L., ZHANG N. & XIA W.–C., 2008. Conodont succession in the Guadalupian–Lopingian boundary interval (upper Permian) of the Maoershan section, Hubei Province, China. *Micropaleontology*, 53: 433-446.

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THE HOLOCENE OSTRACODS FROM THE NORTHEASTERN BLACK SEA SHELF AS INDICATORS OF ENVIRONMENTAL CHANGES

Ostracods are a remarkable group of organisms largely used as indicators of water ecosystem conditions as they are quite abundant, inhabit all possible biotopes, forming specific species assemblages and are extremely sensitive to environmental changes. This work is aimed at reconstructing the Holocene environmental changes on the northeastern (Caucasian) Black Sea shelf based on quantitative ostracod data.

We studied the ostracod assemblages in three sediment cores: Ak 497 (44° 32.43 N, 37°57.31 E, water depth 55 m) collected from the middle shelf and Ash-8 (44°32,454 N, 38°01,235 E, water depth 32 m) from the inner shelf, both off the town of Gelenzhik, and Ak 2575 (44°13.46 N, 38°38.03 E, water depth 99 m) retrieved on the outer shelf off the Arkhipo–Osipovka village. In total, more than fifty ostracod species have been identified, and the relative abundance (%) of each species was estimated. The stratigraphy of the cores Ak 497 (Ivanova *et al.*, 2007) and Ak 2575 is based on the AMS-^{14}C dates whereas the recent sediments from the core Ash-8 (Ivanova *et al.*, 2012) are dated by radionuclides, ^{210}Pb and ^{137}Cs.

The fauna of the most interesting core Ak 2575 recovering the early-to-late Holocene sediments, contains 28 ostracod species. Among them, 12 species are of Mediterranean origin while the other 16 species are considered to have originated from the Caspian Sea. Three major assemblages are identified in the core record. Assemblage I from the lower part of the core is characterized by the presence of 16 oligohaline ostracod species of the Caspian origin. Among them *Loxocaspia lepida* (Stepanaitys, 1962), *Loxocaspia sub-*

lepida (Stancheva, 1989), *Amnicythere postbissinuata* (Negadaev, 1955), *Graviacypris elongata* (Schweyer, 1949) are the most abundant. Assemblage II from the middle part of the core can be considered as transitional from the Caspian to the Mediterranean fauna. It consists of the three oligohaline Caspian species: *L. lepida*, *L. sublepida*, *G. elongata* and the first Mediterranean immigrants represented mainly by *Hiltermannicythere rubra* (Müller, 1894), *Leptocythere multipunctata* (Seguenza,1884) and *Sagmatocythere rennata* (Schornikov, 1965). Assemblage II is further subdivided into three subassemblages depending on the total ratio of the Mediterranean and Caspian species. Assemblage III from the upper part of the core is represented by impoverished ostracod fauna of Mediterranean origin typical for depth more than 50 m. The most common species are *H. rubra*, *Palmoconcha agilis* (Ruggieri, 1967) and *Xestoleberis cornelii* Caraion, 1963. The core Ak 497 contains very rich assemblages of the late Holocene studied in detail. In core Ash-8, adult/juvenile ratio is also estimated along with the species percentages. The succession of the Holocene ostracod assemblages from core Ak 2575, as well as from the other cores, is interpreted in terms of changes in the bottom environments including salinity, substrate and other conditions favorable or unfavorable for the different species. These environmental changes result from the overprint of complicate local dynamics on the global natural and anthropogenic changes, and on water exchange between the Black and Mediterranean seas during the Holocene.

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REFERENCES

IVANOVA E.V., MURDMAA I.O., CHEPALYGA A.L., CRONIN T.M., PASECHNIK I.V., LEVCHENKO O.V., HOWE S.S., MANUSHKINA A.V. & PLATONOVA E.A., 2007. Holocene sea-level oscillations and environmental changes on the Eastern Black Sea shelf. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 246: 228-259.

IVANOVA E., MURDMAA I., SCHORNIKOV E., ALIEV R., MARRET F., CHEPALYGA A., BRADLEY L., ZENINA M., KRAVTSOV V. & ALEKHINA G., 2012. Decadal-to-millennial scale environmental changes on the northeastern Black sea shelf during the late Holocene and 20th century. In: At the edge of the sea: sediments, geomorphology, tectonics and stratigraphy in Quaternary studies. *INQUA SEQS Meeting*, Programme and abstract, Sassari, Italy: 43-44.

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DAYOU ZHAI & JULE XIAO

ON A NEW SPECIES OF THE GENUS *ILYOCYPRIS* BRADY & NORMAN 1889 FROM HULUN LAKE, CHINA

A new species of the genus *Ilyocypris* is described with type specimens from Hulun Lake of China.

Family Ilyocyprididae Kaufmann 1900
Genus *Ilyocypris* Brady and Norman 1889

Ilyocypris innermongolica n. sp.

Diagnosis. Carapace small for the genus. Posterior margin of LV with 11-14 ripplets. A1 α seta reaching beyond ya. A2 swimming setae reaching beyond distal claws with c. 1/2 of their length. L6 penultimate segment divided. L7 penultimate segment with setae f and g, and distally with thin, curved setules. Lobe h of Hp slender, not inflated at the outer corner. Zenker organ with 17-21 spinuous rings.

Type locality. Southeastern part of Hulun Lake, China, 49°1' N, 117°42' E.

Type material. Sampled in Aug 2009 by authors, kept in Institute of Geology and Geophysics, CAS. Holotype, male (dyzoc8); Allotype, female (dyzoc7). Both from type locality. Paratypes, 4 males (dyzoc5, 93, 100, 114) from various sites of the lake.

Etymology. Named from the province where it was sampled.

Brief description (Figs. 1-3). Carapace outline typical of the genus. Posterior margin of LV with 11-14 short marginal ripplets, anterior margin with 6-8 short ripplets. All type specimens node-free, but juveniles

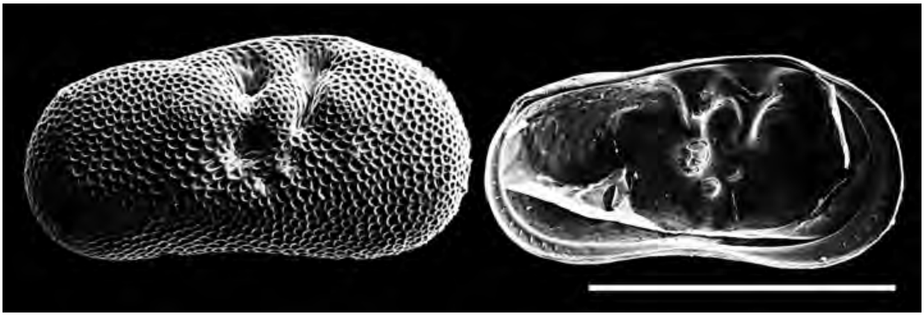

Fig. 1 — *I. innermongolica* n. sp., male. Left: RV, ext. (dyzoc5). Right: LV, int. (dyzoc8, holotype), 0.69×0.36 mm. Scale=0.5 mm

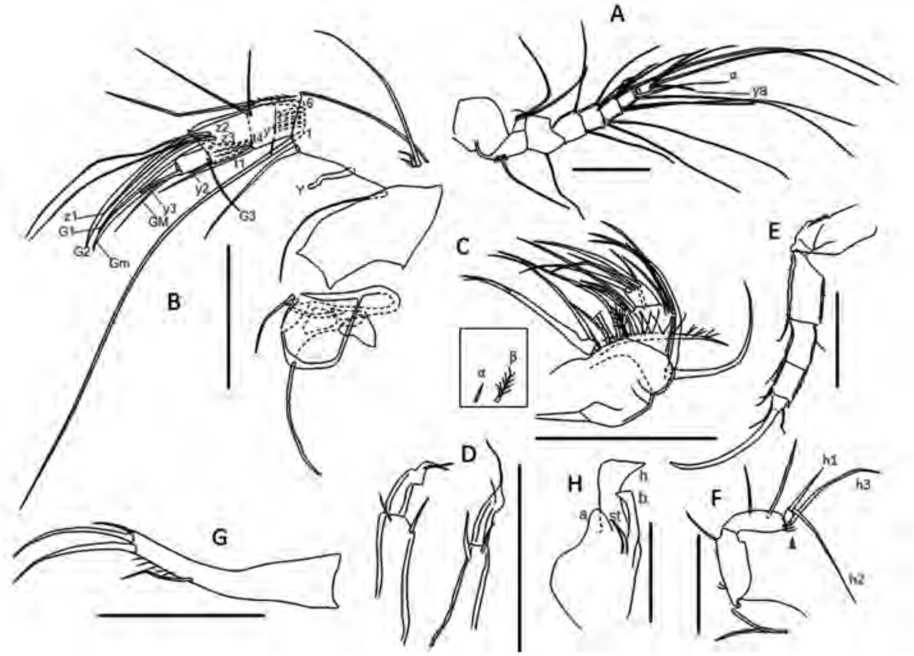

Fig. 2 — *I. innermongolica* n. sp., male. A, A1; B, A2, C, palp of Md; D, L5 palps; E, L6; F, L7; G, Ur, H, Hp. A-G, dyzoc8 (holotype); H, dyzoc5. Scales=0.1 mm

often with nodes. Size male 0.69-0.74 mm (n=5). Female 0.76 mm (n=1). **A1** α seta very long, reaching beyond ya. Ventro-apical seta of 8th segment claw-like. **A2** swimming setae reaching beyond distal claws with c. 1/2 of their length. The 6th seta reaching middle of claws. t1 reaching beyond

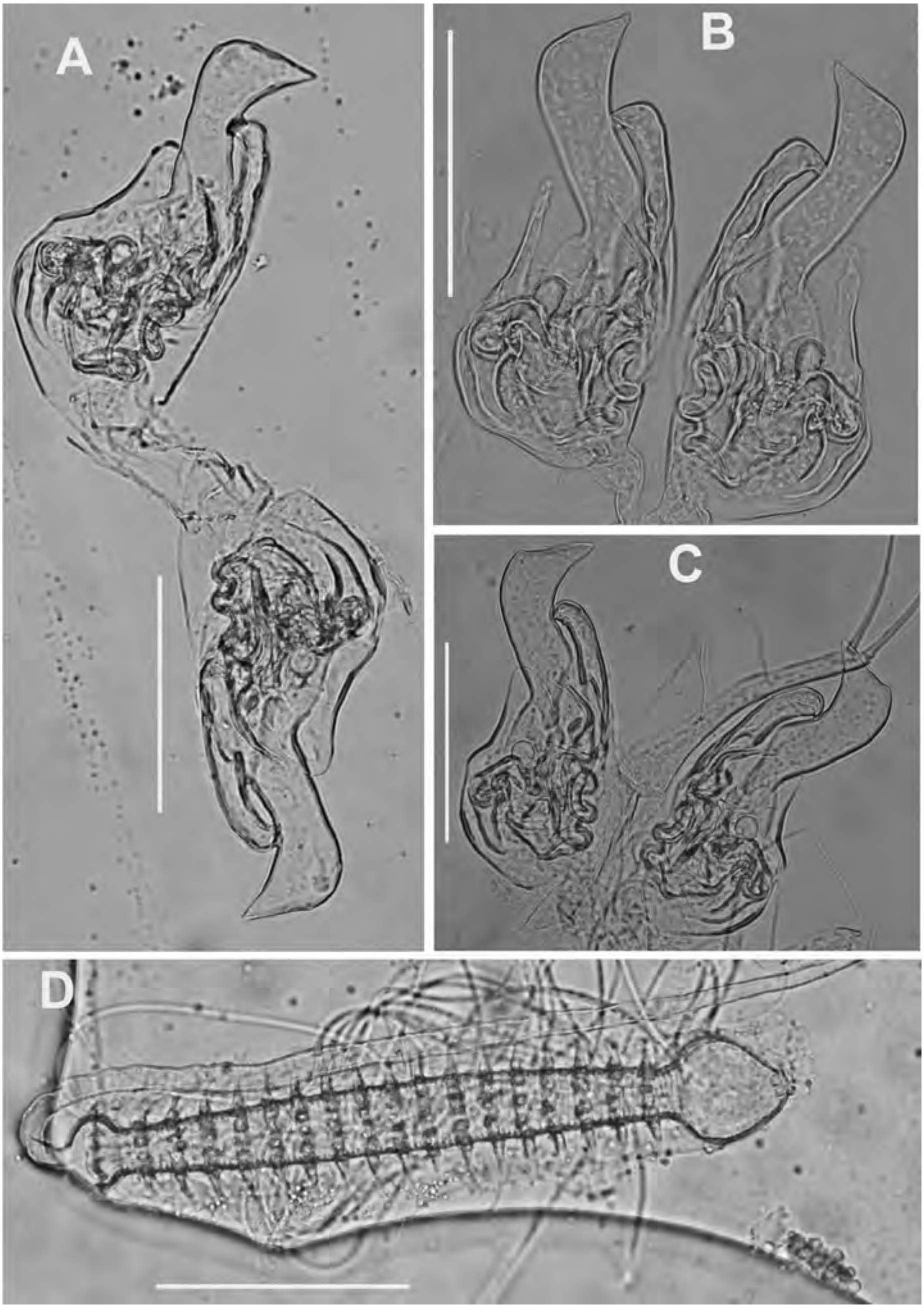

Fig. 3 — *I. innermongolica* n. sp., male. A, penes (dyzoc5); B, penes (dyzoc100); C, penes (dyzoc114); D, Zenker organ (dyzoc5). Scales=0.1 mm

terminal segment, t2-4 short, subequal. Claws smooth. **Md** typical of the genus. Coxa with 7 short teeth. Palp with very small, smooth α seta and short, plumose β seta. Terminal segment with 2 long and 2 short claws. **Mx** typical of the genus, without special features. Male **L5** palps subequal. Trunk elongate with two setae. Finger slender, subapically swollen, carrying two setae. Female L5 palp 3-segmented. **L6** penultimate segment divided. d1 short. e, f and g subequal in length. h1 slightly longer than h3. h2 claw smooth. **L7** d1 seta strong. Penultimate segment with f and g setae. Distal end of penultimate segment bearing c. 5 thin, somewhat curved setules. h2 slightly shorter than h3. **Ur** ramus arched with slightly swollen base. Sp situated at distal c. 1/3 of the ramus, reaching base of claws. Ga subequally long with Gp, both smooth. Sa shorter than Sp. Distal half of ramus hairy. **Hp** with 4 distal lobes. Lobe h quite slender, distally with a rounded outer end and a pointed inner end. Lobe b slender, reaching mid-way of h, with a pointed outer end and a rounded inner end. Lobe a short, distally rounded. Stylus very slim, pointed. **Zenker organ** with 17-21 rings each carrying c. 7-8 spines. Both ends spherically enlarged but distal end larger.

Differential diagnosis. 1) *I. australiensis*, *I. brehmi*, *I. dentifera*, *I. fallax*, *I. gibba*, *I. lacustris* and *I. nipponica* have undivided L6 penultimate segment (MEISCH, 2000; OKUBO, 2004; KARANOVIC, 2012). 2) The new species can be distinguished from those with much shorter A2 swimming setae: *I. bradyi*, *I. decipiens*, *I. getica*, *I. hartmanni*, *I. inermis*, *I. nitida* and *I. salebrosa* (MARTENS & DUMONT, 1984; MEISCH, 2000). 3) *I. nagamalaiensis* has no seta on L7 penultimate segment. *I. haterumensis* has only one. 4) *I. alta*, *I. echinata* and *I. propinqua* have very different valve outlines. 5) Nodes are always present in *I. monstrifica.* 6) *I. divisa* and *I. botniensis* have short Ur Sp. 7) Female *I. carinata* has rounded posterior extensions in dorsal view. 8) *I. mongolica* has no marginal ripplets (our observation), L7 hook-like setules are stronger, and Hp lobe h is triangular-shaped (MARTENS, 1991).

REFERENCES

KARANOVIC I., 2012. Recent Freshwater Ostracods of the World. *Springer-Verlag*, Berlin, 608 pp.

MARTENS K., 1991. On a small collection of non-marine ostracods from Mongolia, with the description of a new species (Crustacea, Ostracoda). *Miscellanea Zoologica Hungarica*, 6: 53-60.

MARTENS K. & DUMONT H.J., 1984. The ostracod fauna (Crustacea, Ostracoda) of Lake Donk (Flanders): a comparison between two surveys 20 years apart. *Biological Journal of Dodonaea*, 52: 95-111.

MEISCH C., 2000. Freshwater Ostracoda of western and central Europe. In: Schwoerbel J. & Zwick

P. (eds.), Süßwasserfauna von Mitteleuropa 8/3. *Spektrum Akademischer Verlag*, Heidelberg, 522 pp.

OKUBO I., 2004. Nihon tansui san kaimijinko rui ni tsuite. *Kabushikigaisha Sanmon Insatsusho*, Okayama, 72 pp.

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