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Rhaetian (Late Triassic) ostracods (Crustacea, Ostracoda) from the offshore prolongation of the North Dobrogean Orogen into the Romanian Black Sea shelf

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Abstract. The present study evaluates the significance of Triassic ostracods from the Romanian Black Sea shelf as part of a project for the understanding of the palaeoceanographical evolution of the offshore extension of the North Dobrogean Orogen. The drill core CM31, sampled from the borehole 817 Lebăda Vest drilled on the western Romanian portion of the Black Sea shelf, contains sediments of Rhaetian, Late Triassic age. The taxonomy of ostracods obtained is discussed and adds to the scientific understanding of marine ostracods during the Rhaetian stage. We document 72 species, of which seven are new: *Histriabairdia pontuseuxinusensis* Forel gen. et sp. nov., *Bairdiacypris argonautaii* Forel sp. nov., *Ceratobairdia*? *akhilleusi* Forel sp. nov., *Isobythocypris atalantella* Forel sp. nov., *Petasobairdia amazonella* Forel sp. nov., *Paracypris ovidi* Forel sp. nov. and *Pseudomacrocypris*? *kerabani* Forel sp. nov. *Histriabairdia* Forel gen. nov. is introduced to accommodate species of the Triassic–Jurassic interval previously attributed to the modern genus *Anchistrocheles*. These assemblages point to an outer shelf environmental with relatively normal marine oxygenation. The oldest occurrence of *Pokornyopsis*, found in this material, indicates that this forerunner of modern troglobitic ostracods may not have been troglobitic in the Triassic.

Keywords. Ostracods, Rhaetian, Late Triassic, Romanian Black Sea shelf.

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Introduction

Ostracods are millimetre-size crustaceans that are significant components of the meiofauna. Recent ostracods live in various aquatic environments, from temporary freshwater ponds to hydrothermal sources or cold methane seep sites (e.g., Horne *et al.* 2002; Maddocks 2005; Yasuhara *et al*. 2018), the deepest known living species occurring at a depth of 9307 m in the northwestern Pacific (Brandão *et al.* 2019). Some ostracods are commensal on diverse invertebrates or sea turtles (e.g., de Vos 1953; Maddocks 1968; Tanaka & Hayashi 2019). Ostracods were marine and benthic during the Early Palaeozoic (e.g., Salas *et al.* 2007; Siveter 2008), colonized the water column during the Silurian (e.g., Siveter 1984; Siveter & Vannier 1990; Siveter *et al.* 1991; Vannier & Abe 1992) and non-marine water bodies during the Carboniferous (e.g., Williams *et al.* 2006; Bennett 2008; Bennett *et al.* 2012). Marine ostracods greatly suffered during the most devastating mass extinction at the end of the Permian about 252 Ma (see Crasquin & Forel 2014 for a summary). Ostracods from the Permian–Triassic transition have been intensively investigated since the 1970's (e.g., Wang 1978; Shi & Chen 1987; Yi 2004; Forel *et al.* 2013a; Crasquin *et al.* 2017), allowing for the identification of several survival modes in the aftermath of the crisis (e.g., Forel *et al.* 2013b, 2020a; Gliwa *et al.* 2020). Following the high amplitude diversity fluctuations of the Early Triassic, the recovery of ostracods is considered as complete by the Anisian, Middle Triassic (e.g., Crasquin-Soleau *et al.* 2007; Crasquin & Forel 2014). This stage witnessed the acme of a high-diversity plateau that further developed until the brink of the end-Triassic extinction, as well as the radiation of numerous taxa, including Cytheruridae and typically Triassic ornate Bairdiidae (see Forel & Crasquin 2020 for a summary). The Triassic was also a turning point in the evolutionary history of ostracods with the replacement of the Palaeozoic evolutionary fauna by the Meso–Cenozoic one (e.g., McKenzie 1982; Crasquin-Soleau *et al.* 2007; Crasquin & Forel 2014). However, this period remains enigmatic due to the temporary dominance of Platycopida, the explosive radiation of ornate Bairdiidae (e.g., Kollmann 1960, 1963; Bolz 1971a, 1971b; Kristan-Tollmann 1978) and the residual occurrence of Palaeozoic taxa in deep waters up to the Carnian, Late Triassic (e.g., Forel *et al.* 2019a). In that sense, the Triassic ostracod fauna is transitional as it is neither Palaeozoic, nor truly Mesozoic. One of the major future challenges of ostracodology will be to reach a stable consensus on the classification of Bairdiidae, known from the Middle Ordovician (e.g., Becker 2001) up to today in all marine ecosystems, and to complete the 'morphological phylogeny' of Permian and Triassic ornate genera proposed by Forel & Crasquin (2020).

The Rhaetian, at the very end of the Late Triassic, witnessed the acme of several families, including Bairdiidae, Cytheruridae and Healdiidae, as well as the earliest known occurrences of Progonocytheridae and Cytheridae (Forel & Crasquin 2020). This stage precedes the end-Triassic extinction event, so the characterisation of assemblages during the Rhaetian is pivotal to providing a baseline to study this key interval. Rhaetian ostracods are known from localities in Alaska (Sohn 1987), Argentina (Ballent 1994; Riccardi *et al*. 2004), Australia (Kristan-Tollmann 1986a; Dépêche & Crasquin-Soleau 1992; Kristan-Tollmann & Gramann 1992), Austria (Kollmann 1960, 1963; Kristan-Tollmann 1970, 1971a, 1971b, 1972; Bolz 1969, 1971a, 1971b; Urlichs 1972; Kristan-Tollmann e*tal.* 1991a; Mette & Mohtat-Aghai 1999; Mette *et al*. 2012), Denmark (Christensen 1962), Germany (Dreyer 1967; Kozur 1968), India (Kristan-Tollmann & Gupta 1988), Iraq (Al-Khahab & Al-Halawachi 2018), Iran (Kristan-Tollmann *et al*. 1979, 1980), Ireland (Ainsworth & Horton 1986; Ainsworth 1989, 1990; Ainsworth *et al*. 1989; Rutherford & Ainsworth 1989), Italy (Belloni 1960; Crasquin-Soleau *et al.* 2000), UK (Jones 1894; Anderson 1964; Bate 1978; Boomer *et al.* 1999; Swift 2003) and Vietnam (Patte 1926). Here we report on the first known assemblage of marine ostracods of Rhaetian age from the Romanian Black Sea shelf. The taxonomy of the marine ostracod assemblages from CM31 drill core 817LV retrieved on the Romanian Black Sea shelf is discussed, adding to the scientific understanding of marine ostracods during the Rhaetian stage, Late Triassic. Their taxonomy is described and discussed, including the earliest known occurrences of *Pokornyopsis* Kozur, 1974 as well as the youngest known record of Rectonariidae. This new material allows us to introduce the new genus *Histriabairdia* gen. nov. to accommodate Triassic and Jurassic species previously attributed to the extended genus *Anchistrocheles* Brady & Norman, 1889.

Geological and stratigraphic framework (by Eugen Grădinaru)

Geological setting

The North Dobrogean Orogen apparently structurally extends eastwards into the Romanian sector of the western Black Sea shelf (Fig. 1). The Triassic rocks are widely represented in the onshore area of the North Dobrogean Orogen, with the largest areal extension and the complete stratigraphic development in the Tulcea Unit (Grădinaru 1995, 2000). However, the Triassic rocks have been found and sampled

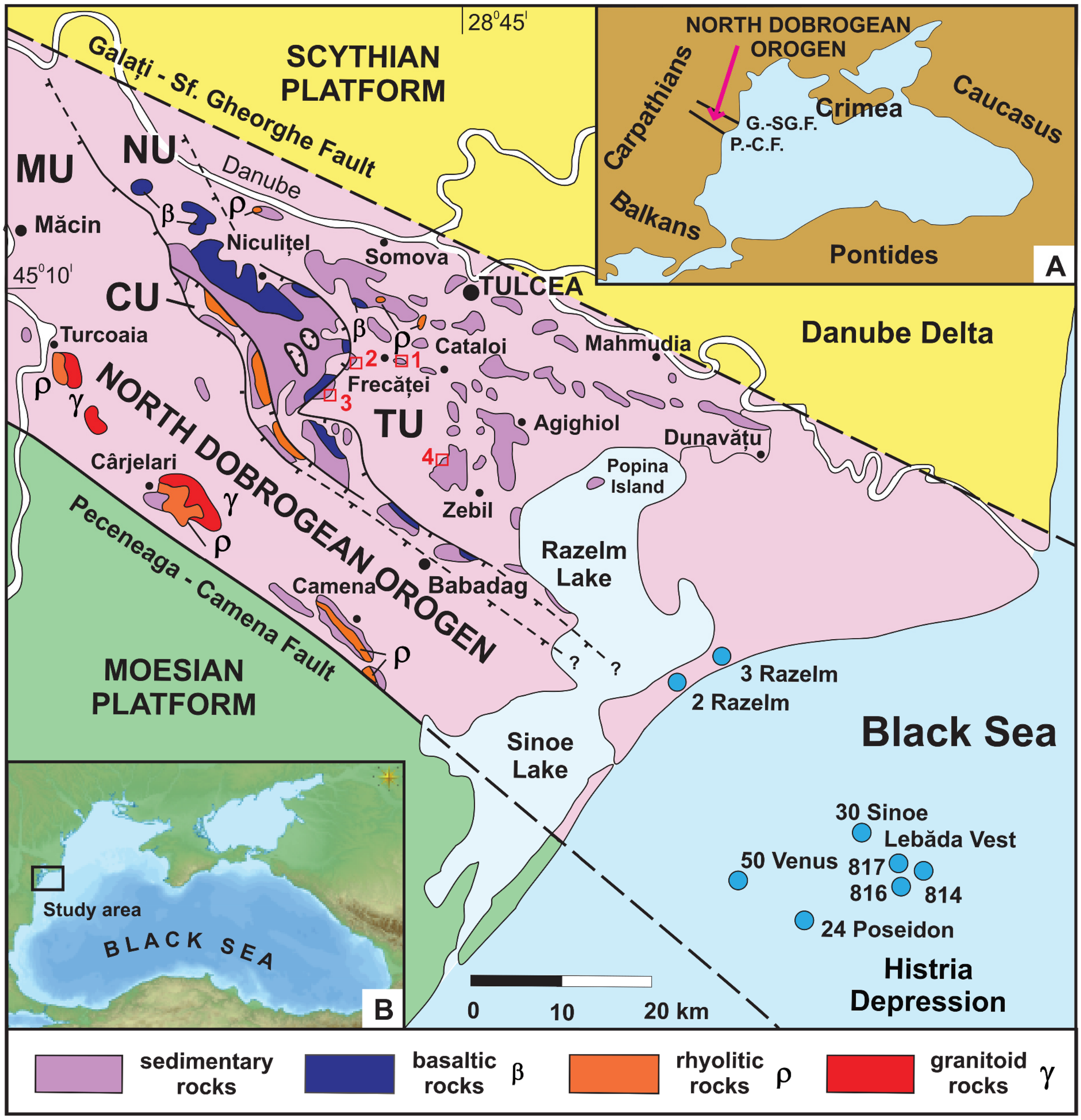


Fig. 1. Tectonostratigraphic map of the onshore North Dobrogean Orogen showing the distribution of Triassic rocks and the location of the boreholes on the western Black Sea shelf that drilled into the Triassic. MU = Măcin Unit; CU = Consul Unit; NU = Niculițel Unit; TU = Tulcea Unit (modified and completed after Grădinaru 2000). 1–4: onshore occurrences of the Rhaetian at Frecăței, Poșta, Izvoarele and Rândunica, respectively. Inset map A shows the location of the North Dobrogean Orogen. Inset map B shows the location of the study area on the western Black Sea shelf.

only in a few boreholes drilled on the Romanian Western Black Sea shelf. Grădinaru *et al*. (1989) provided the most complete report on the Triassic drilled in the Romanian Black Sea shelf based on the available data at that time.

The study of the Triassic rocks drilled on the Romanian Black Sea shelf is of key importance for any discussion concerning the offshore extension of the North Dobrogean Orogen. However, far too little attention has been paid in the published literature (e.g., Cătuneanu & Maftei 1994; Țambrea *et al.* 2002; Dinu *et al*. 2005) to its lithological development, microfacies features, biostratigraphy and fossil content, and to generate a well-constrained chronostratigraphic framework of the Triassic rocks drilled in the Romanian sector of the Black Sea western shelf.

The lithofacies of some Triassic rocks drilled on the Romanian western shelf of the Black Sea are comparable to those of some of the onshore North Dobrogean Triassic successions, such as those sampled in the boreholes 2 Razelm, 3 Razelm, 50 Venus or 24 Poseidon. In other cases, such as for the boreholes 814, 816 and 817 Lebăda Vest, and 30 Sinoe, the lithofacies of the sampled Triassic rocks do not match with any of the known onshore North Dobrogean Triassic successions. Apart from the two boreholes 2 Razelm and 3 Razelm, that were drilled on the shore of the Black Sea, all other boreholes are located in the area of the Histria Depression (e.g., Dinu *et al*. 1989, 2005).

In the present contribution, we focus on the Triassic rocks sampled in the borehole 817 Lebăda Vest (817 LV), which provides important data regarding their lithology, microfacies, and especially concerning the outstanding content of microfossils, ostracods (studied in the present paper), foraminifers (Luka Gale, pers. com.) and conodonts (Tea Kolar-Jurkovsek, pers. com.), relevant for the Rhaetian (Late Triassic) age. Macrofossils, especially brachiopods and rare bivalves, also constrain the Rhaetian age.

The borehole 817 LV was drilled into 5 m thick Triassic limestone, from 2620 to 2625 m, where it stopped (Fig. 2a). A 2 m thick drill core labelled CM31 (2623 to 2625 m) has been sampled and its ostracod content is scrutinized here. The limestone is light grey-cream in colour, compact and hard, with splintery cracking and thin veins of calcite or black clay. The last two meters of the higher core sample CM30 (2611 to 2618m) contain numerous limestone clasts, cm to dm in size, sub-angular to sub-rounded, together with clasts of volcanic origin, grey-greenish in colour, packed in slickensided Middle Jurassic black argillites.

There are several lines of evidence arguing that the Triassic drilled in the Lebada Vest field is allochthonous, being represented by exotic blocks of variable sizes, from centimeters (clasts) up to tens of meters (olistoliths) embedded in Middle Jurassic dark black argillites often slickensided. The microfacially homogenous 2 m thick limestone of the drill core CM31, which doesn't display any evident sedimentary structure, e.g., bedding, was drilled more or less along the bedding. This conclusion is also supported by the homogeneity of the ostracod assemblages retrieved from the different intervals of this drill core.

In the last decades, some authors have arbitrarily included the Romanian western Black Sea shelf in the so-called 'Odessa Shelf' (e.g., Okay & Tüysüz 1999; Kalvoda *et al.* 2002; Stephenson & Schellart 2010; Okay *et al*. 2015). The 'Odessa Shelf', in the meaning of the above-mentioned authors, is not only an incorrect geographical term but it is also not justified for both geological and geopolitical reasons. Intriguingly, the offshore extensions into the Black Sea shelf of the North Dobrogean Orogen and of the Moesian Platform, respectively, are assigned to the so-called 'Odessa Shelf'. However, the proper Odessa Shelf is underlain solely by the East European Platform at the north and by the Scythian Platform at the south (Starostenko *et al.* 2015: fig. 1), and it is fully located on the Ukraine Shelf.

There is a current tectonic model according to which the Istanbul Terrane/Zone allegedly rifted off from the Romanian/Ukrainian conjugate margin that is dubbed as the 'Odessa Shelf', and which was translated

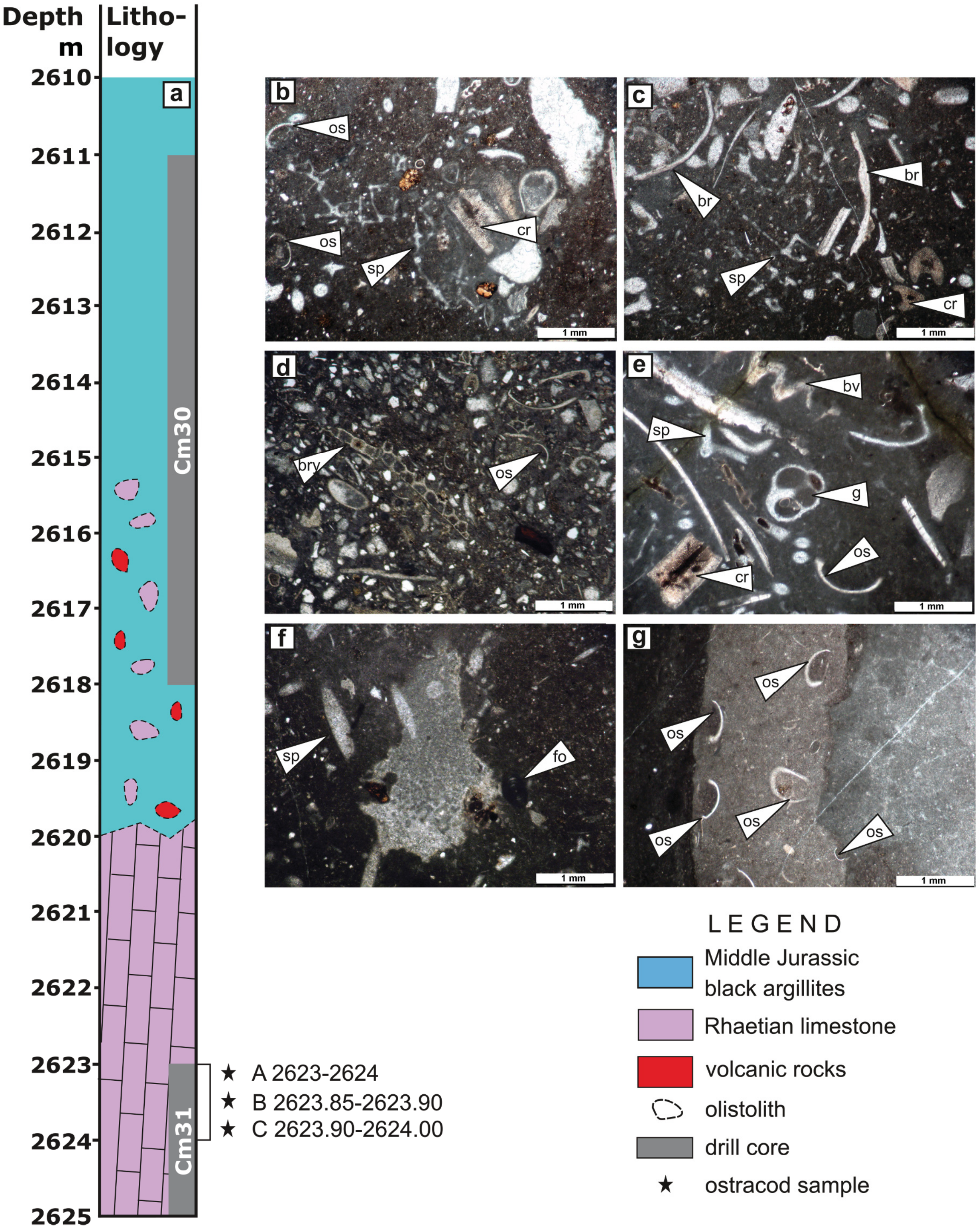


Fig. 2. Lithostratigraphic log of the lowest section in the borehole 817 LV [a], showing the depth level of drill core CM31 into the allochthonous Rhaetian limestone, Romanian Western Black Sea shelf, and the position of the samples (A, B and C) investigated for ostracods; [b–g] microfacies features in the brachiopod-bearing bioclastic wackestone: [b–e] skeletal grains of calcified sponge spicules and fragments of hexactinellid sponges (sp), echinoderm debris (cr), brachiopods (br), bivalves (bv), ostracods (os) and bryozoans (bry); [f] digitate cavity filled with micropeloidal sediment prior to the precipitation of the drusy cement – note the calcified sponge spicules (sp) and foraminifers (fo); [g] burrow infill with micrite containing ostracods (os).

southwards, opening the Western Black Sea basin during the Cretaceous (e.g., Okay *et al.* 1994, 2018; Okay & Tüysüz 1999; Okay & Görür 2007; Tari *et al.* 2015; Tüysüz 2018). The Triassic succesion of the Istanbul Terrane/Zone, as described by Yurttaş-Özdemir (1971), Assereto (1972), Fantini Sestini (1988), Okay *et al.* (2015) and Gaetani (2016), has no counterpart, neither by its lithology nor by its ammonoid and brachiopod faunas, in the Triassic successions of any of the geological units supposedly underlying the 'Odessa Shelf', i.e., in the Triassic successions of the Scythian and Moesian platforms and particularly in the Triassic successions of the North Dobrogean Orogen. Moreover, the Triassic successions drilled in the Histria Depression, located in the Romanian Western Black Sea shelf in the eastward offshore prolongation of the North Dobrogean Orogen (Grădinaru *et al.* 1989; Cătuneanu & Maftei 1994), are not to be found in the Istanbul Terrane/Zone.

The confusing term of the 'Odessa Shelf' ignores the highly differing geological structure and evolution of each of the tectonic units wrongly aggregated into it. In their suggested palaeotectonic reconstruction for the Triassic, Okay & Nikishin (2015: figs 6–7), to justify their assertion that the Istanbul Terrane/Zone was the counterpart Turkish margin of the 'Odessa Shelf', referred to their alleged 'Istanbul-Gebze and Dobrogea Triassic series', in which a fully unsuitable stratigraphic column is illustrated for the Triassic of North Dobrogea. On the contrary, for the Palaeozoic, Okay & Nikishin (2015: fig. 4) and Okay & Topuz (2017: fig. 4) considered that the Istanbul Terrane/Zone was the counterpart of Moesia, although the Palaeozoic successions underlying the Triassic in North Dobrogea are entirely different from the Palaeozoic sedimentary series underlying the Triassic of Moesia (e.g., Seghedi 2012: fig. 11 vs fig.18). So, amazingly, the Istanbul Terrane/Zone is considered akin either to the North Dobrogean Orogen for the Triassic or to Moesia for the Palaeozoic, although all of these geological units have nothing in common as regards their geological history and tectonic structure. The North Dobrogean Orogen and Moesia, which were coalesced into the actual tectonic configuration only during the Early Cretaceous, were not contiguous between them or with the Istanbul Terrane/Zone, neither in the puzzle of the Palaeozoic palaeogeography nor in that of the Triassic palaeogeography.

The dichotomy of the Triassic and Palaeozoic palaeotectonic reconstructions done by the above-mentioned authors just originates from the wrong term of the 'Odessa Shelf'as being the supposed conjugate margin of the Istanbul Terrane/Zone.

In conclusion, the tectonic model advocating that the Western Black Sea basin opened as a back-arc basin in the Late Cretaceous separating the Pontides from mainland Eurasia (Okay *et al.* 2020) is completely counterproductive in any attempts to palinspastically reconstruct the palaeogeographies of the Triassic and of the Palaeozoic, respectively, for the geological units surrounding the Western Black Sea basin, as it wholly ignores the kinematic evolution of the regions lying westwards of the Black Sea (Grădinaru & Gaetani 2019).

Microfacies and depositional environment

Microfacially, the brachiopod-bearing biomicritic limestone in the drill core of CM31 from borehole 817 LV is a burrowed bioclastic wackestone, locally a packstone. The micrite matrix, as seen in thin sections, contains predominantly skeletal grains of benthic organisms, such as sponges, echinoderm debris, brachiopods, bivalves, ostracods, foraminifers, bryozoans and rare juvenile gastropods. Skeletal particles change in frequency, but they are dominated by crinoids as well as echinoid plates and spines, to which calcified sponge spicules and fragments from the fine skeletal network of hexactinellid sponges are added. Foraminifera are represented by rare *Involutina*, *Ophthalmidium* and encrusting ?*Bullopora*. Some of the bioclasts are bioeroded, but there are abundant bioclasts that are not affected by bioerosion. The microfacies is characterized by common burrowing and some burrows contain ostracod shells (Fig. 2b–g). Rare radiolarians are present. The micrite contains very small skeletal debris forming a finely bioclastic matrix. Digitate cavities are filled with early intrusion of the micropeloidal sediment into cavities prior to the precipitation of drusy cement, creating normal and reverse grading and geopetal structures.

The depositional environment corresponds to a deep shelf environment that is indicated by the skeletal grains of benthic organisms. The sedimentation took place in a quiet-water, low-energy environment below the fair-weather base but within the reach of storm waves. Rare grains with ferruginous coatings indicate reworking. The diverse shelly fauna and the abundance of brachiopods and echinoderms indicate normal marine, stenohaline, well-oxygenated water conditions (cf. Flügel 2004).

Biostratigraphic data

A rich foraminiferal assemblage and rare conodonts have been obtained from residue obtained by cold acetolysis with buffered 5% acetic acid (Grădinaru *et al.* 1989) including *Ammobaculites tzankovi* (Trifonova, 1962), *Cyclogyra* cf. *pachygyra* (Gümbel, 1869), *Gaudryina triassica* Trifonova, 1962, *G. kelleri* Tappan, 1955, *Gaudryinella kotlensis* Trifonova, 1967, *Glomospira charoides* (Jones & Parker, 1860), *Jaculella* cf. *expansa* (Plummer, 1945), *Oberhauserella norica* Fuchs, 1968, Oberhauserellidae (diverse new species), *Plagioraphe tornata* Kristan-Tollmann, 1973, *Pseudobolivina tornata* Kristan-Tollmann, 1973, *Reophax rudis* Kristan-Tollmann, 1964, *Tetrataxis* sp., *Trochammina alpina* Kristan-Tollmann, 1964, *Norigondolella steinbergensis* (Mosher, 1968) and *Oncodella paucidentata* (Mostler, 1967). They are indicative of the *Steinbergensis* conodont biozone, base Rhaetian (Krystyn 1987).

Identified brachiopods are *Euxinella anatolica* (Bittner, 1891), *Fissirhynchia fissicostata* (Suess, 1854) and *Rhaetina pyriformis* (Suess, 1854). Specimens of the bivalve *Pteria*? aff. *gansingensis* (v. Alberti, 1864) have also been retrieved.

Onshore-offshore correlation of the Rhaetian

On the onshore area of the North Dobrogean Orogen, the Upper Triassic sedimentary deposits are present only in the Tulcea Unit (Grădinaru 1995, 2000). Due to the large coverage by the Quaternary loess, the occurrences of the Upper Triassic, including here both the Norian and the Rhaetian, are scanty and limited to only a few small areas. The Rhaetian deposits are biostratigraphically documented by the coquina calcareous siltstones with *Otapiria marshalli alpina* Zapfe, 1973 occurring one km eastwards of Frecăței village on the right side of the Telița valley (Grădinaru 1984; Mirăuță *et al.* 1993). Potentially, the Rhaetian also exists in the Movila Verde hill area, westwards of Poșta village, and in the Coasta lui Nicu area, northwards of Izvoarele village, respectively, both located in the innermost part of the Tulcea Unit which is tectonically overthrusted by the Niculițel Unit (Grădinaru 1984). The Rhaetian is represented in both areas by light-grey reddish limestones and grey claystones. Crumpled reddish biomicritic limestones with *Otapiria* occur south of Rândunica (Congaz) village, on the left side of the Telița valley, in the same region from where Mirăuță & Gheorghian (1975) described Norian conodonts and foraminifers.

Therefore, at the present state of knowledge, the light grey-cream biomicritic limestone of drill core CM31 from borehole 817 LV has no counterpart from a lithological point of view within the Rhaetian occurring in the onshore North Dobrogean Orogen.

It is of high relevance for palaeotectonic and palaeogeographic interpretations to highlight the close lithological and palaeobiological affinities of the allochthonous Rhaetian limestone drilled on the Romanian Black Sea shelf with the Rhaetian brachiopod-bearing biomicritic limestone within the Kichik-Sarman olistolith embedded in the Lower Eski-Orda Formation, located on the Alma-Bodrak interfluve, east of Bakhchisaray, in the Mountainous Crimea (Korchagin *et al.* 2003), and also within other Crimean exotic limestone blocks (Kotlyar *et al.* 1999). The brachiopod fauna of the allochthonous Rhaetian limestone in drill core CM31 contains similar species to that of the allochthonous Rhaetian limestone in the Mountainous Crimea as recorded by Dagys (1974). The close affinities of the allochthonous

Rhaetian limestone drilled on the Romanian western Black Sea shelf, in the eastwards prolongation of the North Dobrogea Orogen, with the Rhaetian limestone in the Crimean exotic blocks may open the way for constructive insights into the palaeotectonic and palaeogeographic relationships between the regions of North Dobrogea and Mountainous Crimea.

Material and methods

The studied material comes from the 2 m thick drill core CM31 (2623m to 2625m) of borehole 817 LV. Three limestone samples, labelled CM31A to CM31C (Fig. 2a), have been processed using the hot acetolysis technique (Lethiers & Crasquin-Soleau 1988; Crasquin-Soleau *et al.* 2005) for ostracod extraction.

In the present contribution, we follow the general classification of ostracods of Moore (1961), Becker (2002) and Horne *et al.* (2002). The taxonomy of Cytheroidea is based on the revision of Whatley & Boomer (2000) and that of Bythocytheridae follows Schornikov (1990).

Seventy-two species distributed across 30 genera and 13 families have been identified during this investigation of drill core CM31 (Table 1). As detailed above, several taxonomic issues are still pending regarding Triassic ostracods, so all species are illustrated to enable future comparisons (Figs 5–13); those left in open nomenclature or referred to already known species are only discussed when necessary. In our study, most of the specimens occur as complete carapaces, which hampers the observation of internal structures on the valves. Following Maddocks (2015), the degree of slope of the antero-dorsal and postero-dorsal margins were measured on external lateral views of the carapace/valves, with 0 being horizontal. As discussed for instance in Maddocks (1969), Bairdiidae are highly homeomorphic ostracods for which diagnostic features are complex to characterize and describe. To objectivize descriptions, characters are quantified as much as possible and the length convention of carapaces/valves is as follow: <0.40 very small, 0.40–0.50 small, 0.50–0.70 medium, 0.70–1.00 large, >1.0 very large.

In height/length diagrams (Figs 3–4), all right and left valves are distinguished, following for instance Urlichs (1971), Harloff (1993) and Forel *et al.* (2020b). The accurate delimitation of ontogenetic stages in the fossil record is often difficult because fossil assemblages represent time-averaging of populations from different environments or seasons (e.g., Morales-Ramirez & Jakob 2008) and because the smallest (i.e., youngest) specimens are only seldomly found for diverse reasons including fossilisation, picking and identification. To overcome this issue, the delineation of ontogenetic stages has been performed by producing Kernel density maps (Gaussian Kernel distribution, columns = 100, rows = 100, radius = 15 to 30) using PAST software (Hammer *et al.* 2001; Hammer & Harper 2005). For each species that counts at least 15 specimens (from this paper and the literature), Kernel density maps discriminate density patterns of individuals that correspond to different ontogenetical stages, with the hypothesis that the largest specimens are adults. Successive instars of ten species are recognized and described here (Figs 3–4).

Material repository

All type and figured specimens are deposited in the Micropalaeontology collections of the Muséum national d'histoire naturelle, Paris, France (MNHN) under catalogue numbers MNHN.F.F63181–MNHN.F.F63331.

Anatomical abbreviations

AB = anterior border
ADB = antero-dorsal border
AMS = adductor muscle scars
AVB = antero-ventral border

Table 1 (continued on next page). Taxonomic list of all ostracod species identified from drill core CM31, Black Sea, Romanian Continental Shelf, Rhaetian, Late Triassic.

Class OSTRACODA Latrielle, 1806
Subclass PODOCOPA Müller, 1894
Superfamily BAIRDIOIDEA Sars, 1887
Family BAIRDIIDAE Sars, 1887
    Acratia cf. *Acratia* sp. A in Bolz 1971 [Fig. 5A; CM31B–C]
    Acratia sp. 1 [Fig. 5B; CM31C]
    Acratia sp. 2 [Fig. 3C; CM31A]
    Bairdia sp. 7 in Mette & Mohtat-Aghai 1999 [Figs 5D–G; CM31 A–C]
    Bairdia cf. *parva* Ainsworth, 1987 [Fig. 3H–I; CM31 A–C]
    Bairdia sp. 3 [Fig. 5J–K; CM31 A–C]
    Bairdia sp. 4 [Fig. 5L–N; CM31 A–C]
    Bairdia sp. 5 [Fig. 5O–Q; CM31B–C]
    Bairdia sp. 6 [Fig. 5R; CM31C]
    Bairdia sp. 7 [Fig. 5S–T; CM31B]
    Bairdia sp. 8 [Figs 5U, 6A; CM31B]
    Bairdia sp. 9 [Fig. 6B–C; CM31C]
    Bairdiacypris multidentata Bolz, 1971 [Fig. 6D–E; CM31A–B]
    Bairdiacypris argonautaii Forel sp. nov. [Fig. 6F–O; CM31A–B]
    Bairdiacypris sp. in Forel *et al.* 2018 [Fig. 6P; CM31A]
    Bairdiacypris sp. 1 [Fig. 6Q; CM31A]
    Bairdiacypris sp. 2 [Fig. 6R; CM31C]
    Bairdiacypris sp. 3 [Fig. 6S; CM31B]
    Bairdiacypris? sp. 4 [Fig. 6T–U; CM31 A–C]
    Carinobairdia triassica triassica Kollmann, 1963 [Fig. 7A–B; CM31B–C]
    Carinobairdia alpina Kollmann, 1963 emend. Kristan-Tollmann, 1970 [Fig. 7C–F; CM31A–C]
    Ceratobairdia? *akhilleusi* Forel sp. nov. [Fig. 7G–S; CM31 A–C]
    Ceratobairdia sp. [Fig. 7T; CM31A]
    Fabalicypris cf. *triassica* Bolz, 1971 [Figs 7U, 8A; CM31A]
    Hiatobairdia sp. 1 [Fig. 8B; CM31B–C]
    Hiatobairdia sp. 2 [Fig. 8C–E; CM31B]
    Hiatobairdia sp. 3 [Fig. 8F; CM31B–C]
    Histriabairdia pontuseuxinusensis Forel gen. et sp. nov. [Fig. 8G–O; CM31 A–C]
    Histriabairdia gen. nov. sp. 1 [Fig. 8P–R; CM31C]
    Histriabairdia gen. nov. sp. 2 [Fig. 8S–U; CM31C]
    Isobythocypris sp. [Fig. 9A; CM31C]
    Isobythocypris atalantella Forel sp. nov. [Fig. 9B–I; CM31A–C]
    Lobobairdia salinaria Kollmann, 1963 [Fig. 9J–M; CM31A–C]
    Lobobairdia? sp. 1 [Fig. 9N; CM31B]
    Lobobairdia sp. 2 [Fig. 9O; CM31C]
    Mirabairdia sp. [Fig. 9P; CM31A]
    Petasobairdia amazonella Forel sp. nov. [Figs 9Q–U, 10A–D; CM31A–C]
Superfamily BAIRDIOCYPRIDOIDEA Shaver, 1961
Family RECTONARIIDAE Gründel, 1962
    Rectonariidae gen. 1 in Forel *et al*. 2019 [Fig. 10E; CM31C]
Superfamily CYPRIDOIDEA Baird, 1845
Family PARACYPRIDIDAE Sars, 1866
    "Aglaiocypris" sp. [Fig. 10F–G; CM31A–C]
    Paracypris ovidi Forel sp. nov. [Fig. 10H–N; CM31A–C]
    Paracypris cf. *Paracypris* sp. 1 in Lord & Lambourne 1991 [Fig. 10O; CM31A]
    Paracypris sp. 1 [Fig. 10P–Q; CM31A–C]
    Paracypris sp. 2 [Fig. 10R–U; CM31A–C]
    Paracypris sp. 3 [Fig. 11A; CM31A–B]

Table 1 (continued). Taxonomic list of all ostracod species identified from drill core CM31, Black Sea, Romanian Continental Shelf, Rhaetian, Late Triassic.

- Family PONTOCYPRIDIDAE Müller, 1894
  - *Pseudomacrocypris*? *kerabani* Forel sp. nov. [Fig. 11B–G; CM31A–C]
  - *Pseudomacrocypris*? sp. [Fig. 11H; CM31B–C]
- Superfamily CYTHEROIDEA Baird, 1850
- Family BYTHOCYTHERIDAE Sars, 1866
  - *Praebythoceratina* sp. [Fig. 11I–J; CM31B–C]
  - *Triassocythere* sp. [Fig. 11K; CM31C]
- Family CYTHERURIDAE Müller, 1894
- Subfamily CYTHERURINAE Müller, 1894
  - *Judahella andrusovi* Kozur & Bolz in Bunza & Kozur, 1971 [Fig. 11L–M; CM31A–C]
  - Cytheruridae gen. et sp. indet. [Fig. 11N–P; CM31B–C]
- Superfamily MACROCYPRIDOIDEA Müller, 1912
- Family MACROCYPRIDIDAE Sars, 1866
  - *Praemacrocypris* sp. [Fig. 11Q; CM31B]
- Superfamily SIGILLIOIDEA Mandelstam, 1960
- Family SIGILLIIDAE Mandelstam, 1960
  - *Cardobairdia* sp. 1 [Fig. 11R–S; CM31A–B]
  - *Cardobairdia* sp. 2 [Figs 11T–U, 12A-C; CM31A–C]
  - *Cardobairdia* sp. 3 [Fig. 12D–F; CM31A, C]
  - *Cardobairdia* sp. 4 [Fig. 12G–K; CM31A–B]
  - *Cardobairdia* sp. 5 [Fig. 12L; CM31C]
  - *Cardobairdia*? sp. 6 [Fig. 12M; CM31B]
- Suborder METACOPINA Sylvester-Bradley, 1961
- Superfamily HEALDIOIDEA Harlton, 1933
- Family HEALDIIDAE Harlton, 1933
  - *Hungarella koessenensis* (Mette & Mohtat-Aghai, 1999) [Fig. 12N–Q; CM31A–C]
  - *Hungarella* sp. 1 [Fig. 12R; CM31B]
  - *Hungarella*? sp. 2 [Fig. 12S; CM31C]
- Order PLATYCOPIDA Sars, 1866
- Suborder PLATYCOPINA Sars, 1866
- Superfamily CYTHERELLOIDEA Sars, 1866
- Family CYTHERELLIDAE Sars, 1866
  - *Cytherelloidea* cf. *modesta* Apostolescu, 1959 [Fig. 12T; CM31B–C]
  - *Cytherelloidea?* sp. [Fig. 12U; CM31A]
  - *Leviella* sp. [Fig. 13A; CM31C]
- Subclass MYODOCOPA Sars, 1866
- Order HALOCYPRIDA Dana, 1853
- Suborder HALOCYPRIDINA Dana, 1853
- Superfamily THAUMATOCYPRIDOIDEA Müller, 1906
- Family THAUMATOCYPRIDIDAE Müller, 1906
  - *Pokornyopsis* sp. 1 [Fig. 13B–C; CM31B]
  - *Pokornyopsis*? sp. 2 [Fig. 13D–E; CM31A]
  - *Pokornyopsis* sp. 3 [Fig. 13F; CM31A]
- Order MYODOCOPIDA Sars, 1866
- Suborder MYODOCOPINA Sars, 1866
- Superfamily CYLINDROLEBERIDOIDEA Müller, 1906
- Family CYLINDROLEBERIDIDAE Müller, 1906
  - *Hungaroleberis* sp. 1 [Fig. 13G–I; CM31A–C]
  - *Hungaroleberis* sp. 2 [Fig. 13J–L; CM31A]
- Superfamily POLYCOPOIDEA Sars, 1866
- Family POLYCOPIDAE Sars, 1866
  - *Polycope* sp. 1 [Fig. 13M; CM31A–C]
  - *Polycope* sp. 2 [Fig. 13N; CM31A–C]
  - *Polycope* sp. 3 [Fig. 13O; CM31A–B]
  - *Polycope* sp. 4 [Fig. 13P; CM31C]

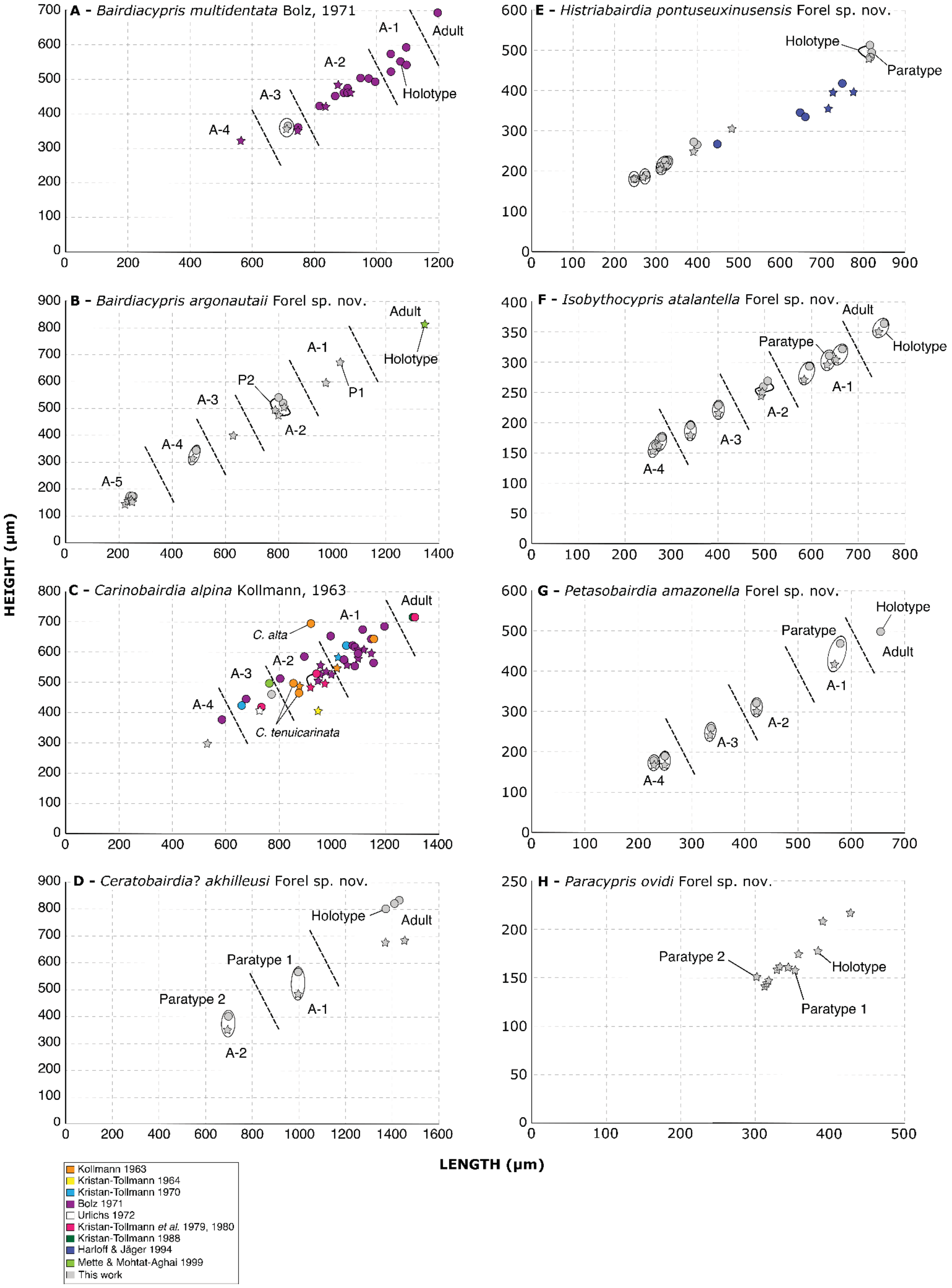


Fig. 3. Height/length scatter plots of species from borehole 817 Lebăda Vest, drill core CM31, western portion of Black Sea shelf, Rhaetian, Late Triassic. In all diagrams, the dimensions of right (stars) and left (circles) valves of complete carapaces are shown separately and circled or linked. P1 = paratype 1; P2 = paratype 2. **A**. *Bairdiacypris multidentata* Bolz, 1971. **B**. *Bairdiacypris argonautaii* Forel sp. nov. **C**. *Carinobairdia alpina* Kollmann, 1963. **D**. *Ceratobairdia*? *akhilleusi* Forel sp. nov. **E**. *Histriabairdia pontuseuxinusensis* Forel gen. et sp. nov. **F**. *Isobythocypris atalantella* Forel sp. nov. **G**. *Petasobairdia amazonella* Forel sp. nov. **H**. *Paracypris ovidi* Forel sp. nov.

DB = dorsal border
H = height
L = length
LV = left valve
PB = posterior border
PDB = postero-dorsal border
PVB = postero-ventral border
RV = right valve
VB = ventral border
W = width

Results

Systematic palaeontology (by Marie-Béatrice Forel)

Class Ostracoda Latreille, 1806
Subclass Podocopa Müller, 1894
Superfamily Bairdioidea Sars, 1887

Family **Bairdiidae** Sars, 1887

Subfamilial and generic discussions

Taxonomy of Bairdiidae: state of the art and consensus

Bairdiidae have been components of marine ostracod assemblages from the Ordovician (e.g., Moore 1961; Salas 2007) to present days (e.g., Brady 1880, 1890; Maddocks 1969, 1975; Titterton & Whatley 1988; Brandão 2008). Their generally simple and smooth carapaces make it complex to accurately discriminate taxa and describe their diagnostic characters. This homeomorphy led to the unreliability of their taxonomy, as has often been discussed in the literature (e.g., Maddocks 1969; Malz 1988). Intense efforts have partly clarified the taxonomy of modern representatives of the '*Bairdia* dynasty' (Malz 1988) with the establishment and/or revision of *Neonesidea* Maddocks, 1969, *Paranesidea* Maddocks, 1969, *Bairdoppilata* Coryell *et al.*, 1935 and *Triebelina* van den Bold, 1946 (e.g., Maddocks

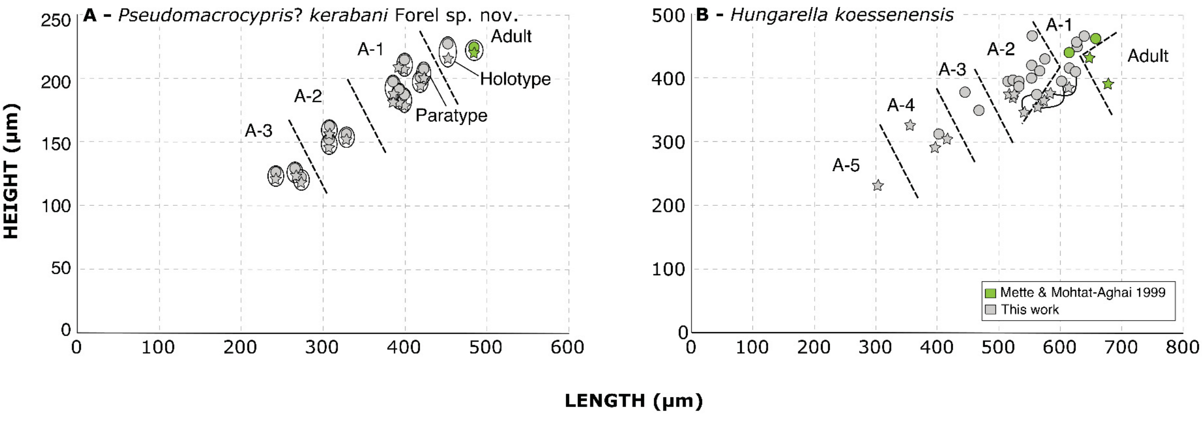


Fig. 4. Height/length scatter plots of species from borehole 817 Lebăda Vest, drill core CM31, western portion of Black Sea shelf, Rhaetian, Late Triassic. In all diagrams, the dimensions of right (stars) and left (circles) valves of complete carapaces are shown separately and circled or linked. **A**. *Pseudomacrocypris*? *kerabani* Forel sp. nov. **B**. *Hungarella koessenensis* (Mette & Mohtat-Aghai, 1999).

1969, 2013, 2015). The diagnostic features of these genera are found in soft parts as well as carapaces, and recently the taxonomic potential of their chewing apparatus has been discussed (Maddocks 2013, 2018). Conversely, the classification of fossil Bairdiidae has not improved much since the 1960's, when Sohn (1960) and Kollmann (1960, 1963) clarified the classification of Palaeozoic and Triassic taxa, respectively. Although the taxonomic conclusions of these papers are disputed, it is agreed that *Bairdia* s. str. is restricted to the Palaeozoic and that "to include other forms under this name violates its morphologic and quite possibly its phyletic homogeneity" (Maddocks 1969: 1). Maddocks (1969) and all subsequent contributions deconstructed the widespread idea, termed 'heresy', that "the 'key' to relationships among Recent ostracod species is to be found in the soft parts, and that the carapace alone provides insufficient evidence for distinction of 'biologic' or 'natural' taxa". In the long evolutionary history of Bairdiidae, the Triassic period has been a turning point in recording the explosive diversification of ornate forms (e.g., Kollmann 1960, 1963; Kristan-Tollmann 1970, 1971a; Bolz 1971a, 1971b; Kozur 1971a, 1971b) that are still present in modern marine ecosystems, although less abundant and diverse (e.g., Brady 1870; Cabioch *et al*. 1986; Malz & Lord 1988; Titterton & Whatley 1988; Jellinek 1989; Maddocks & Wouters 1990; M.-B. Forel, pers. obs. and work in progress). The classification of fossil and recent ornate Bairdiidae, defined as "small to medium-sized, thick-shelled, heavily ornamented forms, largely but not entirely restricted to reefal habitats" (Maddocks & Wouters 1990: 173), has been debated since their descriptions, as was summarized for instance in Bolz (1971a, 1971b). Notwithstanding the problems we have encountered, we consider that it is beyond the scope and intention of this paper and its material to attempt a revision of the Bairdiidae at the subfamilial and generic levels. An attempt to introduce a phylogeny for Permian and Triassic genera has recently been proposed, describing two lineages (*Ceratobairdia* lineage and *Abrobairdia* lineage), both derived from *Petasobairdia* in the early Permian (Forel & Crasquin 2020). Until this model is improved, we follow the generic scheme of Kollmann (1963) in considering primary ornamentation as a relevant generic character, considering that ornamentation is widely used as a generic marker, *mutatis mutandis*, for other families (e.g., Trachyleberididae: Moore 1961; Warne & Whatley 2016) and often corresponds to morphologic features with diverse functions, some of which are genetically controlled (e.g., Liebau 1977; Keyser 1995). We furthermore follow the subfamilial scheme proposed by Maddocks (1969) in which most of the Triassic subfamilies created in the successive contributions of Kollmann and Kristan-Tollmann are downgraded to the tribe level. We consider this inclusive scheme as the most reasonable to avoid artificial over-splitting.

Taxonomic consensus on *Bairdiacypris* / *Fabalicypris* / *Isobythocypris*

The original description of *Fabalicypris* Cooper, 1946 states that it is morphologically close to other bairdiids but differs from *Bairdia* McCoy, 1844 and *Bairdiacypris* Bradfield, 1935 in lacking a pronounced postero-dorsal slope and highly arched dorsal border. It is further differentiated from *Bairdia* by the lack of an acuminate posterior end. *Fabalicypris* also differs from *Bairdiacypris* in being more tumid and by the presence of a pronounced offset of the antero-ventral overlap (Cooper 1946). These elements are problematic, as they imply that *Bairdia* and *Bairdiacypris* should also differ by the presence of an antero-ventral overlap in *Bairdia*, which is not the case. In subsequent years, the validity of *Fabalicypris* has been discussed, leading to different schools of thought. The first one considers that the characters differentiating *Bairdiacypris* and *Fabalicypris* are highly variable and that *Fabalicypris* is a junior synonym of *Bairdiacypris* (e.g., Sohn 1983; Hoare *et al.* 1999). The second school of thought considers *Fabalicypris* as a subgenus of *Bairdiacypris*, described as "with overall carapace morphology of *Bairdiacypris*, but bairdiid shape more or less obscured; ventral overlap decreasing abruptly in anterior third to form offset or step-like process" (Becker 2001). Conversely, *Bairdiacypris* is described as "elongate bairdiid outline; dorsal margin tripartite, sometimes barely discernible; posterior end rounded" (Becker 2001). Here, we follow the first school of thought to avoid complicating the taxonomic situation of bairdiids until a complete revision of these ostracods. We therefore use the following diagnostic summaries provided by Ainsworth (1990):

Table 2. Classification consensus for *Bairdiacypris* Bradfield, 1935, *Fabalicypris* Cooper, 1946 and *Isobythocypris* Apostolescu, 1959.

	Lateral outline	Dorsal margin	Ventral offset
Bairdiacypris	subovate-subtriangular	tripartite	absent
Fabalicypris	elongate subovate-elongate subtriangular	arched	present
Isobythocypris	subrectangular-elongate subrectangular	arched	absent

Bairdiacypris: "Carapace of medium to large size, subovate to subtriangular, laterally compressed in dorsal view. Anterior margin asymmetrically rounded, lower margin convex, upper margin straight. Posterior margin broadly rounded. Dorsal margin near straight to strongly arched. Ventral margin often with a well formed oral concavity in right valve. Hinge adont, short. Inner lamella moderately wide, with both anterior and posterior vestibules. Muscle scar pattern of several discrete spots" (Ainsworth 1990: 179).

Fabalicypris: "Carapace of medium to large size, elongate subovate to elongate subtriangular in lateral view. Anterior margin rounded. Posterior margin strongly asymmetrically rounded, near subtriangular. Dorsal margin generally evenly arched. Ventral margin straight, with a prominent oral concavity in right valve. Inner lamella moderately wide. Hinge adont" (Ainsworth 1990: 179).

Confusion may also arise for the distinction of *Isobythocypris* Apostolescu, 1959 from other bairdiids. The diagnosis of *Isobythocypris* is as follows: "Un genre de Bairdiidae caractérisé par sa carapace subréniforme et par sa charnière. Dans la valve droite, le système de fermeture consiste en deux proéminences de forme elliptique; dans la valve gauche, un sillon étroit et lisse, terminé à chaque extrémité par un alvéole" (Apostolescu 1959 : 807), which translates as "a genus of Bairdiidae characterized by its subreniform carapace and its hinge. In the right valve, the closing system consists of two elliptical protuberances; in the left valve, a narrow and smooth ridge, terminated by an alveole at each extremity". Ainsworth (1989, 1990) clarified the diagnosis of *Isobythocypris* as follows: "Carapace of medium to large size, subrectangular to elongate subrectangular. Inner lamella broad, especially anteriorly. Anterior and posterior vestibules moderately wide. Hinge lophodont" (Ainsworth 1989: 126, 1990: 179). In the present investigation, most of the specimens are present as complete carapaces or as valves with poorly preserved inner surface so that hingement was not accessible. The outer characters used here to distinguish *Bairdiacypris*, *Fabalicypris* and *Isobythocypris* are summarized in Table 2.

Subfamily Bairdiinae Sars, 1923

Genus *Acratia* Delo, 1930

Type species

Acratia typica Delo, 1930, by original designation.

Acratia cf. *Acratia* sp. A in Bolz 1971
Fig. 5A

Material examined

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63181 • 1 LV; same locality as for preceding but sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63341.

Table 3. Dimensions of all specimens of *Acratia* cf. *Acratia* sp. A in Bolz 1971 (this paper).

	Length (µm)	Height (µm)	H/L	Reference
***A.* sp. A** (LV)	1590	610	0.38	Bolz (1971b)
***A.* sp. A** (LV)	1110	450	0.40	Bolz (1971b)
***A.* sp. A** (RV)	1380	550	0.40	Bolz (1971b)
***A.* cf. *A.* sp. A** (LV of carapace)	828	291	0.35	This paper
***A.* cf. *A.* sp. A** (RV of carapace)	828	280	0.34	This paper

Dimensions

Bolz (1971b) provided measurements for two carapaces and a RV. Here we equate the measurements of carapaces with those of the larger LV to allow for comparisons (Table 3).

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Late Triassic (this paper).

Remarks

This species differs from *Acratia* sp. A in Bolz 1971b from the Norian–Rhaetian of the Northern Calcareous Alps (Bolz 1971b) in being slightly more elongate, having a more pronounced ventral concavity, a more angulate dorsal margin at LV and a rostrum located higher. The two species are nevertheless close morphologically as shown by the antero-dorsal offset of LV over RV. The complete carapace recovered here is slightly smaller than the specimens reported from Austria (Table 3) and could represent an immature juvenile. We cannot exclude that the observed differences relate to ontogeny, the antero-dorsal offset being a diagnostic character of the species. *Acratia* cf. *Acratia* sp. A in Bolz 1971 is also close to *A. goemoeryi* Kozur, 1970 from the Middle Triassic of Hungary (Kozur 1970). Forel *et al.* (2019a) plotted the H/L diagram of all known specimens of *A. goemoeryi*, in which the present specimen could correspond to a relatively young juvenile stage. Several isolated valves or poorly preserved carapaces of *A. goemoeryi* have been documented from the Middle Triassic and early Late Triassic, which do not allow for the observation of the possible dorsal offset visible in *Acratia* sp. A in Bolz 1971 and *Acratia* cf. *Acratia* sp. A in Bolz 1971. Furthermore, the ADB of RV is arched in *A. goemoeryi* while it is concave in the present material.

Acratia sp. 1
Fig. 5B

Material examined

ROMANIA • 1 RV; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63182.

Dimensions

L = 343 µm; H = 147 µm; H/L = 0.43.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

The small dimensions of this specimen indicate that it may be an immature stage. However, its very rounded anterior margin and downward pointing posterior extremity preclude it from being attributed to any of the co-occurring species of *Acratia*. *Acratia* sp. 1 is close to *Paracypris* sp. 1 in Lord & Lambourne 1991 from the Early Jurassic of Turkey (Lord & Lambourne 1991) and to *Paracypris* cf. *Paracypris* sp. 1 in Lord & Lambourne 1991 in the present paper (Fig. 10O). However, the small antero-ventral concavity of the present specimen relates it to the genus *Acratia*. *Acratia* sp. 1 is also related to *A. kollmanni* Forel in Forel *et al.*, 2019 from the Carnian, Late Triassic, of Turkey (Forel *et al.* 2019a) as shown by its anterior and posterior extremities being located very low, with a uniformly rounded dorsal margin. However, *A. kollmanni* is shorter and higher and has a more incised antero-ventral concavity.

Genus ***Bairdia*** McCoy, 1844

Type species

Bairdia curta McCoy, 1844, subsequently designated by Ulrich & Bassler (1923).

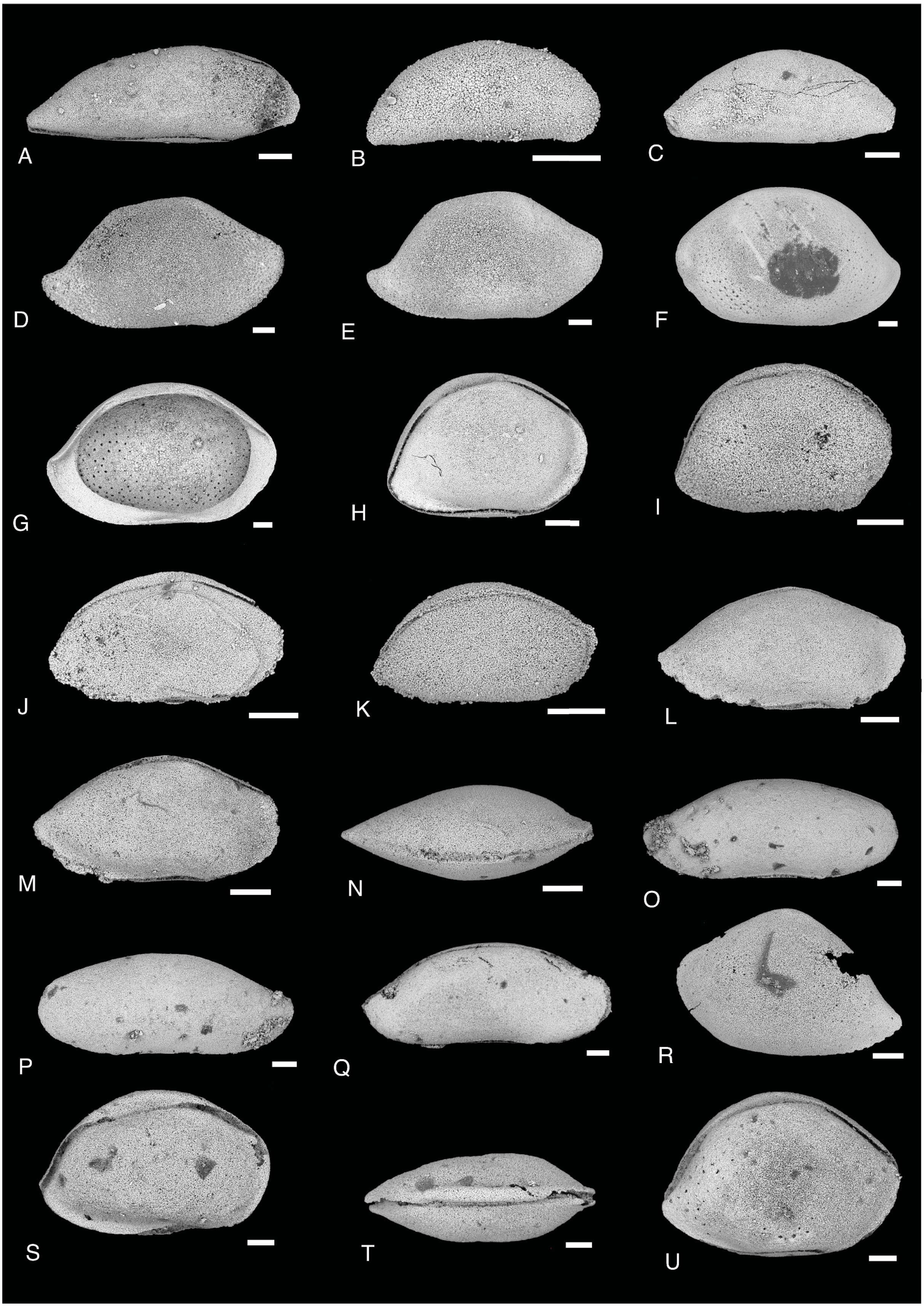
Bairdia sp. 7 in Mette & Mohtat-Aghai 1999
Fig. 5D–G

Bairdia sp. 7 – Mette & Mohtat-Aghai 1999: pl. 4, figs 4–5.

Material examined

ROMANIA • 1 RV; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63184 • 1 RV; same locality as for preceding but sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63185 • 1 LV; same locality as for preceding but sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63186 • 2 complete carapaces, 5 RV, 4 LV; same locality as for preceding but samples CM31A, CM31B and CM31C; Rhaetian, Upper Triassic; MNHN.F.F63342.

Fig. 5 (opposite page). SEM micrographs of ostracods from borehole 817 Lebăda Vest, drill core CM31, western portion of Black Sea shelf, Rhaetian, Late Triassic. All specimens are housed in the collections of the Muséum national d'histoire naturelle, Paris, France (MNHN). **A**. *Acratia* cf. *Acratia* sp. A in Bolz 1971, right lateral view of a carapace, sample CM31B (MNHN.F.F63181). **B**. *Acratia* sp. 1, external view of a right valve, sample CM31C (MNHN.F.F63182). **C**. *Acratia* sp. 2, right lateral view of a carapace, sample CM31A (MNHN.F.F63183). **D–G**. *Bairdia* sp. 7 in Mette & Mohtat-Aghai 1999. **D**. External view of a right valve, sample CM31B (MNHN.F.F63184). **E**. External view of a right valve, sample CM31A (MNHN.F.F63185). **F**. External view of a left valve, sample CM31B (MNHN.F.F63186). **G**. Same specimen, inner view. **H–I**. *Bairdia* cf. *parva* Ainsworth, 1987. **H**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63187). **I**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63188). **J–K**. *Bairdia* sp. 3. **J**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63189). **K**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63190). **L–N**. *Bairdia* sp. 4. **L**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63191). **M**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63192). **N**. Same specimen, dorsal view. **O–Q**. *Bairdia* sp. 5. **O**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63193). **P**. Same specimen, dorsal view. **Q**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63194). **R**. *Bairdia* sp. 6, external view of a left valve, sample CM31C (MNHN.F.F63195). **S–T**. *Bairdia* sp. 7. **S**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63196). **T**. Same specimen, dorsal view. **U**. *Bairdia* sp. 8, right lateral view of a carapace, sample CM31B (MNHN.F.F63197). Scale bars: 100 µm.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Dimensions (this paper)

RV: L = 372–1138 µm; H = 200–603 µm; H/L = 0.53–0.56.
LV: L = 372–1212 µm; H = 205–768 µm; H/L = 0.55–0.63.

Occurrence

Kössen Formation, Northern Calcareous Alps, Tyrol, Austria, Rhaetian, Upper Triassic (Mette & Mohtat-Aghai 1999); Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Bairdia sp. 7 in Mette & Mohtat-Aghai 1999 was first recorded from the Kössen Formation outcropping in the Northern Calcareous Alps (Mette & Mohtat-Aghai 1999). This species is higher and slightly shorter than *B. cassiana* (Reuss, 1869), which is largely documented from the Early Anisian–Late Carnian interval of Europe (Reuss 1869; Gümbel 1869; Styk 1958; Urlichs 1972; Kristan-Tollmann 1978; Kristan-Tollmann *et al.* 1991b; Monostori 1995; Crasquin-Soleau & Grădinaru 1996; Monostori & Tóth 2013, 2014; Mette *et al.* 2015; Crasquin *et al*. 2018; Forel *et al.* 2020). It also shares morphological proximity with *B. jiangyouensis* Xie in Wei *et al.*, 1983 from the Carnian–Norian interval of Sichuan Province, South China (Wei *et al.* 1983; Forel *et al*. 2019b), from which it differs by a larger and slightly less caudate posterior end and an anterior maximum of convexity located lower. *Bairdia jiangyouensis* is also characterized by having LV overlapping RV all around: the nature of the overlap cannot be completely characterized for the present species as only juvenile carapaces have been found, with an interrupted overlap along AVB and AB. *Bairdia* sp. 7 in Mette & Mohtat-Aghai 1999 also differs from *Bairdia* sp. A in Bolz 1971 from the Zlambach Formation, Norian–Rhaetian, of the Northern Calcareous Alps (Bolz 1971a: pl. 7, figs 82–83) in having a tripartite dorsal margin on RV, while it is uniformly convex in *Bairdia* sp. A. It also differs from *Bairdia* sp. B in Bolz 1971 (Bolz 1971a: pl. 7, figs 82–83) by having its DB inclined posteriorly, PB larger and less caudate and AVB less convex and anteriorly projected. It is also close to *Bairdia* sp. in Kristan-Tollmann 1979 from the Rhaetian of Iran (Kristan-Tollmann *et al*. 1979), but the RV of the Iranian species has a shorter posterior end, a pronounced concavity at the ADB and a slight concavity at the base of the AVB. Crasquin *et al.* (2018) recently considered that *Bairdia* sp. 3 from the Carnian, Late Triassic, of Sicily (Crasquin *et al.* 2018: fig. 6u) might be conspecific with *Bairdia* sp. 7 *in* Mette & Mohtat-Aghai 1999. However, the specimen shown in Crasquin *et al.* (2018) has a longer and more caudate posterior border, with AVB and PVB slightly compressed laterally in their median extremity. For this reason, we do not consider these taxa to be conspecific. *Bairdia* sp. 7 in Mette & Mohtat-Aghai 1999 is undeniably new to science, but it is kept in open nomenclature until complete carapaces are discovered to fully describe the overlap of the LV over RV. The description of the ontogeny of the species listed above will allow the clarification of their possible conspecificities, but until now most of them are only know from a few specimens.

Genus ***Bairdiacypris*** Bradfield, 1935

Type species

Bairdiacypris deloi Bradfield, 1935, by original designation.

Bairdiacypris multidentata Bolz, 1971
Fig. 6D–E

Bairdiacypris multidentata Bolz, 1971b: 230–231, pl. 8, figs 98–100.

Bairdiacypris multidentata – Mette *et al.* 2012: 70.

Material examined

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63199 • 1 complete carapace; same locality as for preceding but sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63200 • 1 broken carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63343.

Dimensions

See Fig. 3A.

Occurrence

Northern Calcareous Alps, Tyrol, Austria, Norian–Rhaetian, Upper Triassic (Bolz 1971b; Mette *et al*. 2012); Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Bairdiacypris cf. *multidentata* Bolz, 1971 has been reported from the Eiberg Member, Kössen Formation, outcropping at the Eiberg section in the Northern Calcareous Alps (Mette *et al*. 2012: 70), but no illustration and no discussion were provided to further discuss this attribution. Bolz (1971b) provided dimensions of complete carapaces, LV and RV: owing to the overlap of LV over RV in *B. multidentata,* the dimensions of carapaces are here treated as those of LV and all dimensions are plotted in Fig. 3A. Bolz (1971b) illustrated three specimens and stated that the material was not sufficient for an investigation of the ontogeny (Bolz 1971b: 231). Although the lack of illustrated specimens doesn't allow a discussion of the morphological changes in *B. multidentata* through its development, the large dispersion of the H/L scatter plot of all specimens points to a mixture of ontogenetic stages, at least corresponding to five ontogenetic stages (A-4 to adult). The holotype appears to be an immature stage. The only measurable carapace found during the present analysis (Fig. 6E) is the smallest known carapace of *B. multidentata* and corresponds to a very young juvenile in the A-4 stage (Fig. 3A).

Bairdiacypris argonautaii Forel sp. nov.

urn:lsid:zoobank.org:act:4AF32BE0-8E7A-4ABD-BCC8-42D2F99F451F
Fig. 6F–O

Bairdiacypris? aff. *Bairdiacypris* sp. A Bolz – Mette & Mohtat-Aghai 1999: pl. 3, fig. 7.

Diagnosis

A new species ovoid in shape, with overlap interrupted at AVB and PVB, RV preplete and LV amplete to postplete.

Etymology

From the ancient Greek Αργοναῦται, Argonautai, referring to the mythological heroes, the argonauts, who travelled the Black Sea searching for the golden fleece.

Material examined

Holotype

AUSTRIA • 1 RV; Northern Calcareous Alps, Tyrol; Kössen Formation, Rhaetian, Upper Triassic (Mette & Mohtat-Aghai 1999: pl. 3, fig. 7); University of Innsbruck, Austria.

Paratypes

ROMANIA • 1 RV; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63201 • 1 complete carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63202.

Other material

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63203 • 1 complete carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63204 • 1 complete carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63206 • 1 complete carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63207 • 1 complete carapace; same locality as for preceding but sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63205 • 1 complete carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63208.

Dimensions

See Fig. 3B.

Description

Carapace. Very large, massive, ovoid in lateral view with L_{max} below mid-H at both valves; LV larger than RV, overlapping it all along dorsal margin with maximum at DB, and along VB, overlap interrupted along AVB and PVB; biconvex in dorsal view with W_{max} behind L_{max}, overlapping area seemingly flat; surface smooth.

RV. Subrectangular with H_{max} at antero-dorsal angulation; dorsal margin tripartite with dulled angulations; PDB straight to slightly convex in young instars, short (12–21% of L_{max}) and steeply sloping to PB (60–70°); DB straight, moderately sloping to postero-dorsal angulation (10–20°) with length increasing through ontogeny; ADB straight, long, with relatively constant length through ontogeny (37–45% of L), sloping toward AB with an angle ranging from 20° to 40°; AB large, relatively bairdiid in shape, with maximum of curvature at or slightly below mid-H; ventral margin long and sinuous; AVB steeply raised

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Fig. 6 (opposite page). SEM micrographs of ostracods from borehole 817 Lebăda Vest, drill core CM31, western portion of Black Sea shelf, Rhaetian, Late Triassic. All specimens are housed in the collections of the Muséum national d'histoire naturelle, Paris, France (MNHN). **A**. *Bairdia* sp. 8, same specimen as in Fig. 5U, dorsal view. **B–C**. *Bairdia* sp. 9. **B**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63198). **C**. Same specimen, dorsal view. **D–E**. *Bairdiacypris multidentata* Bolz, 1971. **D**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63199). **E**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63200). **F–O**. *Bairdiacypris argonautaii* Forel sp. nov. **F**. Paratype 2, right lateral view of a carapace, sample CM31A (MNHN.F.F63201). **G**. Paratype 1, external view of a right valve, sample CM31B (MNHN.F.F63202). **H**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63203). **I**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63204). **J**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63205). **K**. Same specimen, dorsal view. **L**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63206). **M**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63207). **N**. Same specimen, dorsal view. **O**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63208). **P**. *Bairdiacypris* sp. in Forel *et al*. 2018, external view of a right valve, sample CM31A (MNHN.F.F63209). **Q**. *Bairdiacypris* sp. 1, external view of a right valve, sample CM31A (MNHN.F.F63210). **R**. *Bairdiacypris* sp. 2, external view of a right valve, sample CM31C (MNHN.F.F63211). **S**. *Bairdiacypris* sp. 3, external view of a right valve, sample CM31B (MNHN.F.F63212). **T–U**. *Bairdiacypris*? sp. 4. **T**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63213). **U**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63214). Scale bars: 100 µm.


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to AB and largely convex to close to vertical in young instars; VB with tenuous oral concavity mid-L; PVB short, convex, only slightly raised to PB; PB at lower ¼ of H_{max}, relatively narrow, gently rounded to only slightly bairdiid in shape.

LV. Ovoid with H_{max} behind mid-H in large forms, at antero-dorsal angulation in younger instars; dorsal margin gently rounded with dulled angulations in young instars that are unrecognizable in larger instars and adults; ventral margin long and straight to gently convex.

Occurrence

Kössen Formation, Northern Calcareous Alps, Tyrol, Austria, Rhaetian, Upper Triassic (Mette & Mohtat-Aghai 1999); Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Bairdiacypris argonautaii sp. nov. is higher and shorter than “*Bairdia*” *raetica* Bolz, 1971 from the Rhaetian interval, Late Triassic, of Tyrol (Bolz 1971b); it also differs by the antero-ventral and postero-ventral interruption of the overlap, dorsal margin tripartite with pronounced antero-dorsal and postero-dorsal angulations and anterior margin larger. *Bairdiacypris argonautaii* sp. nov. is also close to *Bairdiacypris* sp. in Kristan-Tollmann *et al.* 1979 from the Rhaetian, Late Triassic, of Iran (Kristan-Tollmann *et al*. 1979) but the only illustrated Iranian specimen shows a continuous overlap along AVB and PVB and a posterior maximum of convexity located higher resulting in subsymmetric anterior and posterior borders. *Bairdiacypris argonautaii* sp. nov. is also morphologically close to *Bairdia* cf. *peneovoidea* Bolz, 1971 from the Rhaetian, Late Triassic, of Iran (Kristan-Tollmann *et al*. 1979) but has a more rounded AVB and a larger PB. The dimensions of all specimens attributed to *B. argonautaii* sp. nov. are plotted in Fig. 3B. The largest specimen known to date is a right valve from the Rhaetian of Tyrol (Mette & Mohtat-Aghai 1999). All specimens found in the present investigation are distributed across at least six successive ontogenetic stages, all smaller than the specimen from Mette & Mohtat-Aghai (1999). The ontogenetic development of *B. argonautaii* sp. nov. is mainly marked by an enlargement of the posterior end of the carapace.

Bairdiacypris sp. in Forel *et al.* 2018
Fig. 6P

Bairdiacypris sp. – Forel *et al.* 2018: fig. 4/16.

Material examined

ROMANIA • 1 RV; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63209.

Dimensions

RV in Forel *et al*. (2018): L = 774 µm; H = 320 µm; H/L = 0.41.
RV in this paper: L = 766 µm; H = 331 µm; H/L = 0.43.

Occurrence

Killik Formation, Tavusçayiri Block, Sorgun Ophiolitic Mélange, southern Turkey, Huğlu Tuffite, *Spongotortilispinus moixi* radiolarian Zone, lower Tuvalian, Upper Carnian, Upper Triassic (Forel *et al*. 2018); Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Bairdiacypris sp. in Forel *et al.* 2018 is related to *Bairdiacypris anisica* Kozur, 1971 from the Anisian, Middle Triassic, of Hungary (Kozur 1971c). However, only one valve has been found here; since bairdiids are very homoplastic ostracods, it is most reasonable to avoid artificially extending the stratigraphic range of *Bairdiacypris anisica* Kozur, 1971, from the Middle Triassic to the end of the Rhaetian, until more material is available to clarify this possibility. *Bairdiacypris* sp. in Forel *et al.* 2018 is also morphologically close to *Bairdiacypris* sp. in Forel *et al*. 2019 from the Carnian, Late Triassic, of the Kilek section in Turkey (Forel *et al*. 2019a), but the anterior border is more raised in the present material. In the present analysis, *Bairdiacypris* sp. in Forel *et al.* 2018 is primarily related to *Bairdiacypris* sp. 1, from which it differs mainly by the morphology of the posterior extremity and the position of the oral concavity in front of H_{max}, while it is at mid-L in *Bairdiacypris* sp. 1.

Bairdiacypris sp. 1

Fig. 6Q

Material examined

ROMANIA • 1 RV; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63210.

Dimensions

L = 821 µm; H = 311 µm; H/L = 0.38.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Bairdiacypris sp. 1 differs from *Bairdiacypris* sp. in Forel *et al.* 2018 in being more elongate in lateral view with a more elongate posterior end, PB located higher and PDB concave, while it is uniformly convex in *Bairdiacypris* sp. in Forel *et al.* 2018. *Bairdiacypris* sp. 1 is also close to *Fabalicypris triassica* Bolz, 1971 from the Norian–Rhaetian of the Northern Calcareous Alps (Bolz 1971b), but it differs by its higher posterior end and straight DB. In spite of the lack of a complete carapace to observe the nature of its ventral overlap, *Bairdiacypris* sp. 1 has a clear tripartite dorsal margin, which precludes the attribution to *Fabalicypris*.

Bairdiacypris sp. 3

Fig. 6S

Material examined

ROMANIA • 1 RV; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63212 • 1 complete carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63344.

Dimensions

L = 1060 µm; H = 481 µm; H/L = 0.45.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Bairdiacypris sp. 3 is close to *Fabalicypris* n. sp. in Kristan-Tollmann *et al.* 1980 from the Rhaetian of Iran (Kristan-Tollmann *et al.* 1980), but the present species has a tripartite dorsal margin at RV with longer DB and lacks the *Fabalicypris* offset of the ventral overlap. *Bairdiacypris* sp. 3 is also close to *Bairdiacypris*? sp. 2 in Lord & Lambourne 1991 from the Pliensbachian, Early Jurassic, of Turkey (Lord & Lambourne 1991), from which it differs in being larger with a less elongate posterior end. *Bairdiacypris* sp. 3 shares a strong similarity with *Bairdiacypris* sp. B in Bolz 1971 from the Rhaetian interval of the Northern Calcareous Alps (Bolz 1971b), which is only shown as inner views. However, *Bairdiacypris* sp. 3 has a shorter DB and a larger PB with maximum of convexity located higher. *Bairdiacypris* sp. 3 is also larger than *Bairdiacypris* sp. B in Bolz 1971 (L = 690–950 µm; H = 320–500 µm; H/L = 0.44–0.55), with a similar H/L ratio; this characteristic could relate to ontogeny. It is nevertheless worth noting that the H/L ratio of *Bairdiacypris* sp. B in Bolz 1971 mainly ranges from 0.44 to 0.48 (Bolz 1971b: 231). The dimensions provided for the specimen illustrated in Bolz (1971b: pl 8, fig. 104) are L = 900 µm and H = 500 µm, leading to an H/L ratio of 0.55.

Bairdiacypris? sp. 4
Fig. 6T–U

Material examined

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63213 • 1 complete carapace; same locality as for preceding but sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63214 • 5 complete carapaces; same locality as for preceding but samples CM31A, CM31B and CM31C; Rhaetian, Upper Triassic; MNHN.F.F63345.

Dimensions

RV: L = 327–809 µm; H = 157–326 µm; H/L = 0.38–0.48.
LV: L = 327–809 µm; H = 167–348 µm; H/L = 0.41–0.51.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

The absence of an antero-ventral offset of the overlap leads to the generic attribution to *Bairdiacypris* rather than *Fabalicypris*. However, in the absence of angulations at the dorsal margin, this identification is still tentative. *Bairdiacypris*? sp. 4 is closely related to *Fabalicypris*? *praelonga* Donze, 1966 from the *Plicatulus* Horizon, Hettangian, Early Jurassic, of Le Sartre, Ardèche, France (Donze 1966). However, *Bairdiacypris*? sp. 4 differs by having a more bairdiid AB with a maximum of curvature located higher and the AVB more raised dorsally. It is worth noting that the doubt in the generic attribution of *Fabalicypris*? *praelonga* is related to Donze's inability to observe the inner structures (Donze 1966).

Genus ***Carinobairdia*** Kollmann, 1963

Type species

Carinobairdia triassica triassica Kollmann, 1963 by original designation.

Remarks

Carinobairdia triassica triassica Kollmann, 1963 and *C. alpina* Kollmann, 1963 emend. Kristan-Tollmann 1970 are both typical for the Rhaetian, Late Triassic, of the western Tethys and Iran as shown by the occurrences lists. Until recently, *Carinobairdia* was restricted to the Rhaetian of the western area of the Tethys, but the discovery of a Carnian species traced the roots of this genus to the eastern Tethys (Forel *et al*. 2019b).

Carinobairdia triassica triassica Kollmann, 1963
Fig. 7A–B

Carinobairdia triassica Kollmann, 1963: 191–192, pl. 3, figs 5–9, pl. 11, fig. 1.

Carinobairdia triassica – Bolz 1969: 413, pl. 1, figs 1–6, pls 2–5. — Kristan-Tollmann 1969: 86, pl. 4. — Bolz 1971a: pl. 2, fig. 5. — Hillebrandt *et al.* 2007: fig. 14. — Zorn 2010: 273, pl. 5, figs 15–16, pl. 8, fig. 5.
Carinobairdia triassica triassica – Kristan-Tollmann 1970: 297, pl. 5, figs 1–2, pl. 35, fig. 6; 1988: fig. 6/4. — Kristan-Tollmann *et al.* 1980: 4–5, pl. 7, figs 1–6.
Lobobairdia triassica – Urlichs 1972: 229, pl. 1, fig. 3. — Mette & Mohtat-Aghai 1999: pl. 5, figs 6–7. — Hillebrandt *et al.* 2013: 176, pl. 5, figs 15–16, pl. 8, fig. 5.

Material examined

ROMANIA • 1 RV; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63215 • 1 RV; same locality as for preceding but sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63216 • 1 RV, 2 LV; same locality as for preceding but samples CM31B and CM31C; Rhaetian, Upper Triassic; MNHN.F.F63346.

Dimensions

RV (sample CM31C, Fig. 7B): L = 703 µm; H = 390 µm; H/L = 0.55.
RV (sample CM31B, Fig. 7A): L = 576 µm; H = 334 µm; H/L = 0.58.

Occurrence

Zlambach Formation, Plackleswiese, W Plackles, Hohe Wand, NW Wiener Neustadt, Lower Austria, Austria, Rhaetian, Upper Triassic (Kollmann 1963; Zorn 2010); Zlambach Formation, Höllgraben, Krautgartenalm, Grünbachgraben, Austria, Rhaetian, Upper Triassic (Bolz 1969, 1971a; Kristan-Tollmann 1969, 1970); Kössen Formation, Weissloferbach, Kössen, Austria, Rhaetian, Upper Triassic (Urlichs 1972); Kössen Formation, Northern Calcareous Alps, Tyrol, Austria, Rhaetian, Upper Triassic (Mette & Mohtat-Aghai 1999); Kössen Formation, Eiberg Member, Kuhjoch, Karwendel Mountains, Northern Calcareous Alps, Tyrol, Austria, *marshi* Zone, Rhaetian, Upper Triassic (Hillebrandt *et al.* 2007, 2013); Kössen, Austria, Rhaetian, Upper Triassic (Urlichs 1972); Nayband Formation, Wali-Abad, Iran, Rhaetian, Upper Triassic (Kristan-Tollmann *et al.* 1980; Kristan-Tollmann 1988); Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Opinions on the validity of the genus *Carinobairdia* and the species *C. triassica* have varied through time and among authors. The taxonomic scheme established by Kollmann (1963) was accepted and followed by Kristan-Tollmann (1969, 1970, 1988) and Kristan-Tollmann *et al.* (1979, 1980). Kristan-Tollmann (1970) additionally created the subspecies *C. triassica interrupta* from the Rhaetian of Austria, which led to the re-qualification of *C. triassica* as *C. triassica triassica*. The opinion of Bolz (1971a, 1971b) differed in drastic ways: he re-attributed *C. triassica* and *C. umbonata* to the genus *Lobobairdia* and furthermore considered *Carinobairdia* as a synonym of both *Lobobairdia* and *Triebelina* (*Nodobairdia*). Conversely, Urlichs (1972) first followed the re-attributions of Bolz (1971a, 1971b), later came back to the original scheme by using the genus *Carinobairdia* (in Hillebrandt *et al.* 2007) and again used the Bolz (1971a, 1971b) scheme (in Hillebrandt *et al.* 2013). It is out of the scope of the present paper to discuss these schemes in detail: the above summary clearly shows the volatility of the positions adopted through time and the non-robustness of characters and discussions on their significance. The status of the generic classification of Bairdiidae is in need of a detailed and thorough analysis with phylogenetic tools and cladistics. Such an analysis is currently in progress. However, to stop complicating the taxonomic situation of sculptured Bairdiidae, we choose to go on using the original scheme until an analysis of the phylogeny of these ostracods and of the significance of ornamentation if performed.

Bolz (1969) measured and discussed more than 200 specimens of *Carinobairdia triassica triassica* Kollmann, 1963. According to the H and L ranges provided in that paper, the RV found in the present investigation are juveniles: A-2 stage for the RV obtained from sample CM31C (Fig. 7B), A-3 from the valve obtained from sample CM31B (Fig. 7A).

Carinobairdia alpina Kollmann, 1963 emend. Kristan-Tollmann 1970

Fig. 7C–F

Carinobairdia alpina Kollmann, 1963: 194–195, pl. 3, figs 3–4, pl. 11, figs 9–12.
Carinobairdia alta Kollmann, 1963: 195, pl. 11, figs 2–4.
Carinobairdia tenuicarinata Kollmann, 1963: 196, pl. 11, figs 5–8.

Carinobairdia alpina – Kristan-Tollmann 1964: 71, pl. 3, fig. 8; 1970: 297, pl. 5, figs 5–7; 1988: fig. 6/5. — Bolz 1971a: pl. 2, fig. 6. — Kristan-Tollmann *et al.* 1979: 150, pl. 6, fig. 5; 1980: 183–184, pl. 7, figs 7–10.
Triebelina (*Nodobairdia*) *alpina* – Bolz 1971b: 218–221, pl. 16, figs 233–243. — Urlichs 1972: 676, pl. 1, fig. 2.
Nodobyirdia alpina [sic] – Mette & Mohtat-Aghai 1999: pl. 5, fig. 5.
Nodobairdia alpina – Urlichs & Krystyn 2016: 20. — Hillebrandt *et al*. 2013: 175.

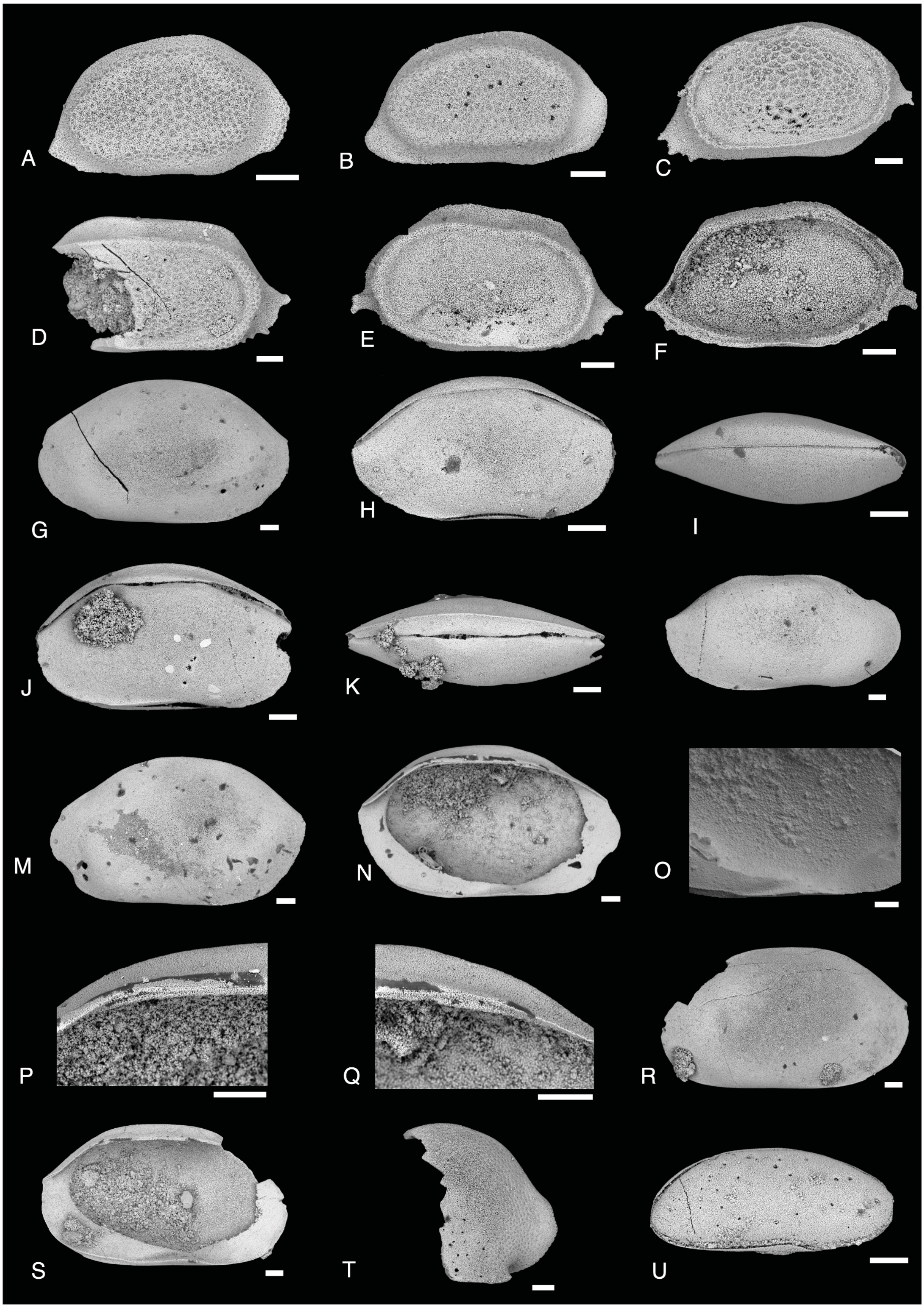
Material examined

ROMANIA • 1 RV; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63217 • 1 broken LV; same locality as for preceding but sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63218 • 1 LV; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63219.

Dimensions

See Fig. 3C.

Fig. 7 (opposite page). SEM micrographs of ostracods from borehole 817 Lebăda Vest, drill core CM31, western portion of Black Sea shelf, Rhaetian, Late Triassic. All specimens are housed in the collections of the Muséum national d'histoire naturelle, Paris, France (MNHN). **A–B**. *Carinobairdia triassica triassica* Kollmann, 1963. **A**. External view of a right valve, sample CM31B (MNHN.F.F63215). **B**. External view of a right valve, sample CM31C (MNHN.F.F63216). **C–F**. *Carinobairdia alpina* Kollmann, 1963 emend. Kristan-Tollmann 1970. **C**. External view of a right valve, sample CM31C (MNHN.F.F63217). **D**. External view of a broken left valve, sample CM31B (MNHN.F.F63218). **E**. External view of a left valve, sample CM31B (MNHN.F.F63219). **F**. Same specimen, inner view. **G–S**. *Ceratobairdia*? *akhilleusi* Forel sp. nov. **G**. External view of a left valve, sample CM31C (MNHN.F.F63220). **H**. Paratype 2, right lateral view of a carapace, sample CM31A (MNHN.F.F63221). **I**. Same specimen, dorsal view. **J**. Paratype 1, right lateral view of a carapace, sample CM31C (MNHN.F.F63222). **K**. Same specimen, dorsal view. **L**. External view of a right valve, sample CM31A (MNHN.F.F63223). **M**. Holotype, external view of a left valve, sample CM31B (MNHN.F.F63224). **N**. Same specimen, inner view. **O**. Detail of the muscle scar field area (topography mode). **P**. Detail of the posterior end of hingement. **Q**. Detail of the anterior end of hingement. **R**. External view of a left valve, sample CM31A (MNHN.F.F63225). **S**. Same specimen, inner view. **T**. *Ceratobairdia* sp., external view of a broken left valve, sample CM31A (MNHN.F.F63226). **U**. *Fabalicypris* cf. *triassica* Bolz, 1971, right lateral view of a carapace, sample CM31A (MNHN.F.F63227). Scale bars: 100 µm.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Occurrence

Zlambach Formation, Backhaus Member, Elisabeth Member, Josef Member, Grünbachgraben and Mergel, Dolomitenhütte and Plackles, Austria, Rhaetian, Upper Triassic (Kollmann 1963); Kössen Formation, Northern Calcareous Alps, Tyrol, Austria, Rhaetian, Upper Triassic (Kristan-Tollmann 1964; Mette & Mohtat-Aghai 1999); Zlambach Formation, Höllgraben, Krautgartenalm, Grünbachgraben, Austria, Rhaetian, Upper Triassic (Kristan-Tollmann 1969, 1970); Zlambach Formation, Fischerwiese, Aussee, Salzkammergut, Austria, Rhaetian, Upper Triassic (Kristan-Tollman*,* 1970); Zlambach beds, Grünbachgraben, Northern Calcareous Alps, Rhaetian, Upper Triassic (Bolz 1971a, 1971b); Kössen Formation, Weissloferbach, Kössen, Austria, Rhaetian, Upper Triassic (Urlichs 1972); Kössen Formation, Eiberg section, Northern Calcareous Alps, Rhaetian, Upper Triassic (Mette *et al*. 2012; Hillebrandt *et al*. 2013); Steinbergkogel, Austria, uppermost Hallstatt Limestone Formation and lowermost Zlambach Formation, *Paracochloceras suessi* Zone, *Vandaites stuerzenbaumi* Zone, *Choristoceras marshi* Zone, Early Rhaetian, Upper Triassic (Urlichs & Krystyn 2016); Waliabad, Abadeh, Iran, Rhaetian, Upper Triassic (Kristan-Tollmann *et al*. 1979); Nayband Formation, Wali-Abad, Iran, Rhaetian, Upper Triassic (Kristan-Tollmann *et al.* 1980; Kristan-Tollmann 1988); Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

This species was alternatively attributed to *Triebelina* (*Nodobairdia*) by Bolz (1971b) and to the newly erected *Bolzibairdia* by Kozur (1985). As discussed for *Carinobairdia triassica triassica*, we follow the original generic scheme introduced by Kollmann (1960, 1963). However, we follow Bolz (1971a, 1971b) in considering that *C. alta* Kollmann, 1963 (erected on LV only) and *C. tenuicarinata* Kollmann, 1963 (considered as juveniles) are synonyms of *C. alpina* Kollmann, 1963. *Carinobairdia alpina* is typical for the Rhaetian, Late Triassic, of western Tethys and Iran as shown by the occurrences list.

The height and length of all specimens of *Carinobairdia alpina* are plotted in Fig. 3C, which document their distribution in five ontogenetic stages from A-4 to adult. The only carapace known for this species, from the Rhaetian of Iran (Kristan-Tollmann *et al.* 1980), documents an already important overlap of LV on RV in the A-2. The smallest known specimen is an RV obtained from sample CM31C of the present paper (L = 535 µm; H = 292 µm; H/L = 0.55). The smallest LV is recorded from the Rhaetian of the Northern Calcareous Alps (Bolz 1971b: L = 590 µm; H = 370 µm; H/L = 0.63). The Black Sea specimens are small compared to other records and represent immature stages.

Genus ***Ceratobairdia*** Sohn, 1954

Type species

Ceratobairdia dorsospinosa Sohn, 1954 by original designation.

Ceratobairdia*? *akhilleusi Forel sp. nov.

urn:lsid:zoobank.org:act:94F7B0AC-8359-4EEF-B620-8334E6DAB902

Fig. 7G–S

Diagnosis

A species with rectangular carapace, dorsal overlap of left valve on right valve laterally compressed and postero-ventral border of right valve underlined by a ridge.

Etymology

From the ancient Greek Ἀχιλλεύς/Akhilleús referring to the legendary hero Achilles who has been long revered around the Black Sea.

Material examined

Holotype

ROMANIA • 1 LV; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63224.

Paratypes

ROMANIA • 1 complete carapace; same locality as for holotype but sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63222 • 1 complete carapace; same locality as for holotype but sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63221.

Other material

ROMANIA • 1 LV; same locality as for holotype but sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63220 • 1 RV; same locality as for holotype but sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63223 • 1 LV; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63225 • 1 carapace, 2 LV, 1 RV; same locality as for holotype but samples CM31A, CM31B and CM31C; Rhaetian, Upper Triassic; MNHN.F.F63347.

Dimensions

See Fig. 3D.

Description

CARAPACE. Large, rectangular in lateral view, with H_{max} at mid-L, L_{max} above mid-H; position of W_{max} variable through ontogeny, posterior to mid-L in LV and anterior to mid-L in RV of immature specimens (Fig. 7I) and around mid-L at both valves in large specimens (Fig. 7K); LV larger that RV, overlapping it along VB and overreaching its dorsal margin with maximum at DB, overreach laterally compressed; surface smooth.

RV. Rectangular in lateral view, with H_{max} along DB in large specimens (Fig. 7L) and at antero-dorsal angulation in immature ones (Fig. 7H); dorsal margin divided into subequal ADB, DB and PDB, with concave end of PDB more expressed in mature specimens, straight ADB and DB; dorsal angulations salient and compressed laterally; AB large, more truncate ventrally in mature specimens, with maximum located above mid-H; PB close to vertical in mature specimens, with maximum of convexity located above mid-H; ventral margin sinuous with oral concavity slightly in front of mid-L.

LV. Subtriangular in lateral view with H_{max} at mid-L; dorsal margin evenly convex and laterally compressed, slightly tapered posteriorly in immature specimens (Fig. 7H); outlines of AVB and PVB similar to those of RV, VB straight; in inner view, PVB bordered by a shallow groove; calcified inner lamella from mid-ADB to mid-PDB, largest along AVB and PVB; vestibulum wide along AVB and PVB, nearly non-existent in oral area; selvage moderately expressed; hinge bar long, straight, apparently smooth, with conspicuous anterior and posterior triangular lists; AMS field only partly visible and shows a curved and compact posterior row of four scars and two subcentral scars (Fig. 7O).

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Ceratobairdia? *akhilleusi* sp. nov. is attributed with doubt to *Ceratobairdia* because the postero-ventral ridge is only visible on RV and not well expressed in all specimens (e.g., Fig. 7L). The laterally compressed overlap of *Ceratobairdia*? *akhilleusi* sp. nov. is reminiscent of that in *Petasobairdia* Chen in Chen &

Shi, 1982 described from the Late Permian of South China (Chen & Shi 1982) and whose taxonomy and stratigraphical as well as geographical distributions are examined in the discussion chapter of this paper. However, the presence of a relatively flat posterior venter with regard to the lateral extension underlined by a ridge leads us to favour attribution to *Ceratobairdia*. *Ceratobairdia*? *akhilleusi* sp. nov. is close to *Bairdiacypris*? form G in Harloff & Jäger 1994 from the Sinemurian, Early Jurassic, of the Calcareous Alps (Harloff & Jäger 1994), from which it differs by having a less upturned PB, a thicker and laterally compressed overlap along the dorsal margin and the presence of a ridge underlining the PVB at RV. The new species is also close to *Bairdia michelseni michelseni* Herrig, 1979 from the Late Sinemurian, Early Jurassic, of Thüringen (Herrig 1979a), but the German species has a longer and more caudate PB at RV, an anterior maximum of curvature located higher, a pitted surface and lacks the laterally compressed overlap and the ridge along PVB of RV. It can also be compared to *Bairdia michelseni arcuatocaudata* Monostori, 1996 from the Pliensbachian, Early Jurassic of Hungary (Monostori 1996), but this species also lacks the laterally compressed dorsal overlap and the postero-ventral ridge, which is replaced by a thin lateral compression. *Ceratobairdia*? *akhilleusi* sp. nov. can finally be compared with *Bairdia* cf. *michelseni* in Honigstein *et al.* 2014 from the Early Jurassic of Austria (Honigstein *et al.* 2014), but this species also lacks the distinctive laterally compressed overlap, has a lower PB with a more pronounced PDB concavity and lacks the angulation between DB and ADB on LV. The H/L diagram of measurable specimens (Fig. 3D) shows that the holotype is a sub-mature specimen. The largest specimen of the study, interpreted as an adult, is the second paratype. The ontogeny of *Ceratobairdia*? *akhilleusi* sp. nov. is marked by an enlargement of the valves and an accentuation of the PV ridge and dorsal lamella.

Genus ***Hiatobairdia*** Kristan-Tollmann, 1970

Type species

Hiatobairdia subsymmetrica Kristan-Tollmann, 1970 by original designation.

Remarks

All species of *Hiatobairdia* occurring in the sediments of borehole 817LV are closely related to species already described in the literature, but the paucity of specimens forces us to keep them in open nomenclature until further material can be observed.

Hiatobairdia sp. 1
Fig. 8B

Material examined

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63229 • 2 LV; same locality as for preceding but samples CM31B and CM31C; Rhaetian, Upper Triassic; MNHN.F.F63348.

Dimensions

RV: L = 973 µm; H = 554 µm; H/L = 0.57.
LV: L = 710–973 µm; H = 500–608 µm; H/L = 0.62–0.7.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Hiatobairdia sp. 1 is distinguished from other species known from the literature and from the present assemblages by its relatively poorly expressed lateral compressions along AVB and PVB, large AB with a maximum of curvature below mid-height and a posterior maximum of curvature located very low.

Hiatobairdia **sp. 2**

Fig. 8C–E

Material examined

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63230 • 1 LV; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63231 • 2 LV; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63349.

Dimensions

RV: L = 1068 µm; H = 644 µm; H/L = 0.6.
LV: L = 838–1068 µm; H = 520–695 µm; H/L = 0.62–0.63.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Late Triassic (this paper).

Remarks

Hiatobairdia sp. 2 is characterized by its very high and nearly symmetrical AB and PB, which clearly relates it to *Hiatobairdia arcuata* Kristan-Tollmann in Kristan-Tollmann *et al.*, 1980 from the Rhaetian of Iran (Kristan-Tollmann *et al.* 1980). However, *Hiatobairdia* sp. 2 is differentiated from it by having the lateral surface not overhanging the ventral margin, absence of postero-ventral thickening and less pronounced antero-dorsal and postero-dorsal concavities. *Hiatobairdia* sp. 2 is undeniably a new species, but we lack enough material to define its diagnostic characters.

Hiatobairdia **sp. 3**

Fig. 8F

Material examined

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63232 • 1 RV; same locality as for preceding but sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63350.

Dimensions

RV: L = 1152 µm; H = 678 µm; H/L = 0.59.
LV: L = 1152 µm; H = 627 µm; H/L = 0.54.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Hiatobairdia sp. 3 is very close to several species already known from the literature, but the conspecificity of our material with these species is impossible to ascertain because the RV of cthe omplete carapace is broken posteriorly. *Hiatobairdia* sp. 3 is relatively close to *Hiatobairdia subsymmetrica* Kristan-Tollmann in Kristan-Tollmann *et al.*, 1980 from the Rhaetian of Iran (Kristan-Tollmann *et al.* 1980), but the presence of the diagnostic ridge underlying the ventral margin is not verifiable here and our specimens have a relatively shorter and larger AB, as well as a shorter and less pointed PB. The slight indentation visible at the PVB of the RV could relate *Hiatobairdia* sp. 3 to *Hiatobairdia labrifera* Kristan-Tollmann in Kristan-Tollmann *et al.*, 1980 from the Rhaetian of Iran (Kristan-Tollmann *et al.* 1980), but it is difficult to ascertain that the observed indentation is not related to preservation bias. For these reasons, and until additional material can be observed, the present species is kept in open nomenclature.

Genus ***Histriabairdia*** Forel gen. nov.
urn:lsid:zoobank.org:act:E3BC5C1B-2B5E-4A14-AF20-94748EC55F14

Type species

Histriabairdia pontuseuxinusensis Forel gen. et sp. nov.

Diagnosis

A moderately calcified bairdiid genus, subrectangular, with antero-ventral and postero-ventral margins laterally compressed and bordered by marginal denticles at both valves; anterior margin large; surface smooth, reticulate to spinose.

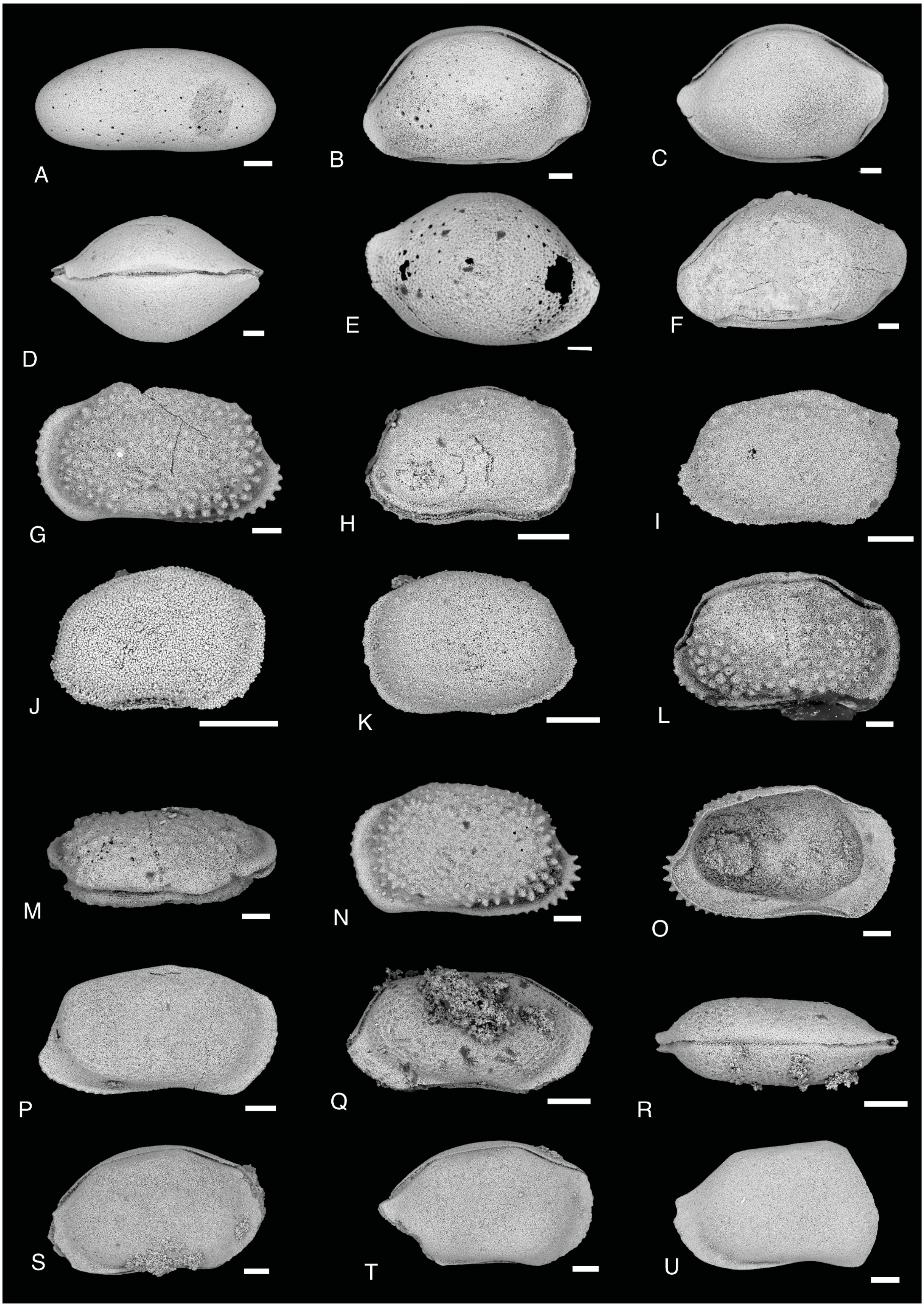
Etymology

This genus is named after the Histria Depression, where the studied borehole was drilled.

Species included

- *Anchistrocheles* sp. A in Bolz 1971 from the Rhaetian of Austria (Bolz 1971a, 1971b)
- *Anchistrocheles*? *spinosa* Sheppard in Brand, 1990 from the Bathonian, Middle Jurassic, of France (Brand 1990)
- *Anchistrocheles* sp. A from the Bathonian, Middle Jurassic, of India (Khosla & Jakhar 1999; Khosla *et al*. 2009)
- *Anchistrocheles*? *tuningensis* Beher, 2004 from the Sinemurian, Early Jurassic, of Germany and Switzerland (Beher 2004)
- *Anchistrocheles* sp. B from the Bajocian–Bathonian, Middle Jurassic, of India (Khosla *et al.* 2006, 2009)

Fig. 8 (opposite page). SEM micrographs of ostracods from borehole 817 Lebăda Vest, drill core CM31, western portion of Black Sea shelf, Rhaetian, Late Triassic. All specimens are housed in the collections of the Muséum national d'histoire naturelle, Paris, France (MNHN). **A**. *Fabalicypris* cf. *triassica* Bolz, 1971, external view of a left valve, sample CM31A (MNHN.F.F63228). **B**. *Hiatobairdia* sp. 1, right lateral view of a carapace, sample CM31B (MNHN.F.F63229). **C–E**. *Hiatobairdia* sp. 2. **C**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63230). **D**. Same specimen, dorsal view. **E**. External view of a left valve, sample CM31B (MNHN.F.F63231). **F**. *Hiatobairdia* sp. 3, right lateral view of a carapace, sample CM31B (MNHN.F.F63232). **G–O**. *Histriabairdia pontuseuxinusensis* Forel gen. et sp. nov. **G**. External view of a left valve, sample CM31C (MNHN.F.F63233). **H**. Right lateral view of a complete carapace, sample CM31C (MNHN.F.F63234). **I**. External view of a right valve, sample CM31C (MNHN.F.F63235). **J**. Right lateral view of a complete carapace, sample CM31C (MNHN.F.F63236). **K**. External view of a left valve, sample CM31C (MNHN.F.F63237). **L**. Holotype, right lateral view of a complete carapace, sample CM31B (MNHN.F.F63238). **M**. Same specimen, dorsal view. **N**. Paratype, external view of a left valve, sample CM31B (MNHN.F.F63239). **O**. Same specimen, inner view. **P–R**. *Histriabairdia* gen nov. sp. 1. **P**. External view of a right valve, sample CM31C (MNHN.F.F63240). **Q**. Right lateral view of a complete carapace, sample CM31C (MNHN.F.F63241). **R**. Same specimen, dorsal view. **S–U**. *Histriabairdia* gen. nov. sp. 2. **S**. Right lateral view of a carapace broken anteriorly and posteriorly, sample CM31C (MNHN.F.F63242). **T**. Right lateral view of a carapace broken anteriorly and posteriorly, sample CM31C (MNHN.F.F63243). **U**. External view of a broken right valve, sample CM31C (MNHN.F.F63244). Scale bars: 100 µm.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- "*Anchistrocheles*" *gemmellaroi* Crasquin in Crasquin *et al.*, 2018 from the Carnian of Sicily (Crasquin *et al.* 2018)
- *Histriabairdia pontuseuxinusensis* Forel gen. et sp. nov. from the Rhaetian of the Black Sea (this paper)
- *Histriabairdia* gen. nov. sp. 1 from the Rhaetian of the Romanian Black Sea shelf (this paper)
- *Histriabairdia* gen. nov. sp. 2 from the Rhaetian of the Romanian Black Sea shelf (this paper)

Questionable species

- *Pustulobairdia subparalella* Kristan-Tollmann, 1970 from the Ladinian, Middle Triassic, of the Dolomites (Kristan-Tollmann 1970): the general outline of this species is in line with the diagnositic features of *Histriabairdia* gen. nov. but the antero-ventral and postero-ventral compressions are not mentioned in its description and not visible on the drawings provided by Kristan-Tollmann (1970)
- *Anchistrocheles*? sp. in Beher 2004 from the Sinemurian, Early Jurassic, of Germany and Switzerland (Beher 2004) is questionably included because this species is only shown in inner view
- *Anchistrocheles* sp. 1 in Forel *et al.* 2019 from the Carnian of Turkey (Forel *et al.* 2019a): antero-ventral and postero-ventral compressions are lacking, but the overall morphology is reminiscent of that of *Histriabairdia* gen. nov.; the size of the unique LV (L = 463 µm; H = 275 µm, excluding marginal spines) and the very narrow calcified inner lamella indicate that it might be an immature instar, which could explain the absence of a lateral compression as seen in the taxa described in the present contribution.

Remarks

All species from the literature re-attributed to *Histriabairdia* gen. nov. were originally attributed, tentatively or not, to *Anchistrocheles* Brady & Norman, 1889 emend. Maddocks 1976 (type species *Anchistrocheles fumata* Brady & Norman, 1889 subsequently designated by Brady 1890). Recent species of *Anchistrocheles* are known for instance from the North Sea, Irish Sea and English Channel (Brady & Norman 1889), Madagascar (e.g., Brady 1890; Maddocks 1969), Bermuda (Maddocks 1976), Mozambique (Maddocks 1969) and the Mediterranean Sea (e.g., Breman 1975; Aiello *et al.* 1996). Fossil species are for instance known from the Neogene of Hawaii (Brady 1890), the Plio–Pleistocene of the Mediterranean Basin (Aiello *et al.* 1996; Sciuto & Pugliese 2013), the Pleistocene of Italy (e.g., Colalongo 1965; Greco *et al*. 1974; Sciuto 2012, 2015), Rhodes (Mostafawi 1989) and Japan (Yajima 1987), the Miocene of Australia (Whatley & Downing 1984; Warne 1990), the Eocene of the USA (Swain 2000) and the Late Cretaceous of Poland (Herrig 1992). Older species from the Triassic–Jurassic time interval have been tentatively attributed to the genus *Anchistrocheles* in the Bathonian, Middle Jurassic, of France (Brand 1990) and India (Khosla & Jakhar 1999; Khosla *et al*. 2009), the Bathonian-Bajocian, Middle Jurassic, of India (Khosla *et al.* 2006, 2009), the Sinemurian, Early Jurassic, of Germany and Switzerland (Beher *et al.* 2001; Beher 2004), the Rhaetian, Late Triassic, of Austria (Bolz 1971a, 1971b), and the Carnian, Late Triassic, of Sicily (Crasquin *et al.* 2018) and Turkey (Forel *et al.* 2019a). The carapace of *Anchistrocheles* is small, delicate, mirror-smooth, laterally compressed, streamlined, reniform in outline, with extremely compressed margins, but this genus is mainly diagnosed by characters of the inner part of their valves (broad fused marginal zone, abundant straight radial pore canals, bythocyprid adductor muscle-scar pattern) and appendages (Maddocks 1969; Maddocks & Illife 1991). *Anchistrocheles* has an overall juvenile aspect as compared with Bairdiinae (Maddocks 1969). Warne (1990) furthermore considered *Anchistrocheles* s. str. as including forms with a reniform to subreniform outline, narrow compression along the anterior, posterior and ventral margins, and a very broad inner lamella except in the middle portion of the dorsal margin. Inner structures are only partly accessible for *Histriabairdia* gen. nov., but the type species displays an inner lamella that does not extend as far dorsally as in the conception of Warne (1990), excluding it from *Anchistrocheles*. *Histriabairdia spinosa* (Sheppard in Brand, 1990) gen. et comb. nov. from the Bathonian, Middle Jurassic, of France (Brand 1990) has muscle scars described has "typical bythocyprid-type with anterior row of 3 horizontal oval scars and 1 posteroventral scar". The inner structures of these Triassic–Jurassic forms are visible in Beher (2004), but their preservation is poor and only the extension of the inner lamella is visible.

The subfamilial position of *Anchistrocheles* has been unstable and it is now placed in the Pussellinae: they are medium to small-size Bairdiidae with a smooth or weakly punctate, elongate, laterally compressed, thin-walled carapace, conspicuous ventral indentation and anteroventral angle, normal pores funnel-shaped or with low, flat wall, width of fused zone and number of distinct radial pore canals proportional to size of carapace, bythocyprid muscle-scar pattern (5 scars, adductor scars arranged in an anterior row of three horizontal scars plus one posteroventral scar, all scars may be divided but not separated; Maddocks 1969) and an adont hinge (Danielopol in Maddocks 1976). Pussellinae are adapted to phytal, interstitial and possibly cryptic habitats, mostly in tropical reefs, as shown by the morphological adaptations of their antennae, posterior legs and the laterally compressed, streamlined, mirror-smooth, fragile carapace with broadened marginal zone of concrescence (Maddocks 1976; Maddocks & Illife 1991). Conversely, the Bairdiinae are ovate to subhexagonal in lateral view, with LV larger than RV and overlapping it dorsally and ventrally, usually of different shapes; the RV hinge is a simple bar with a dorsal groove and the LV hinge is an incised groove with a dorsal shelf and ventro-terminal triangular sloping platforms; the adductor muscle-scar pattern is characteristically composed of 8–10 scars arranged in three anterior plus one postero-ventral rows of 2–3 scars each (Maddocks 1969). According to the emended diagnoses of the Pussellinae Danielopol in Maddocks, 1976 and of *Anchistrocheles* (Maddocks 1976), they are characterized by a smooth or weakly punctate carapace. This character clearly excludes most of the present species from the actual genus *Anchistrocheles* and from the Pussellinae. The spinose antero-ventral and postero-ventral margins are reminiscent of recent Bairdiidae (e.g., Maddocks 1969).

Histriabairdia gen. nov. differs from *Bairdia* McCoy, 1844 by its conspicuous AV and PV lateral compressions on both valves, overall rectangular outline of the carapace and surface ornamentation ranging from smooth to reticulate and spinose. *Pustulobairdia* Sohn, 1960 differs from *Bairdia* by having its surface covered with pustules. However, *Pustulobairdia* also lacks the AV and PV lateral compressions and rows of spines that are characteristic of *Histriabairdia* gen. nov. Furthermore, the visible pustules expressed at the surface of the type species are specific characters, contrary to the interpretation of Sohn (1960) for *Pustulobairdia*. *Lobobairdia* Kollmann, 1963 is diagnosed as having AV and PV laterally compressed into deep furrows. However, *Lobobairdia* has a highly convex dorsal margin with a much lower anterior margin.

Histriabairdia pontuseuxinusensis Forel gen. et sp. nov.
urn:lsid:zoobank.org:act:2A9EE0A7-227E-41AC-840C-3F3F93A26790
Fig. 8G–O

Pustulobairdia subparallela – Harloff & Jäger 1994: pl. 2, figs 7–8. [not Kristan-Tollmann, 1970]

Diagnosis

Dorsal margin tripartite and lateral surface spinose except on the smooth, laterally compressed antero-ventral and postero-ventral surfaces, anterior margin subvertical.

Etymology

From *Pontus Euxinus*, one of the Latin names for the Black Sea, where borehole 817LV was drilled.

Material examined

Holotype

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63238.

Paratype

ROMANIA • 1 LV; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63239.

Other material

ROMANIA • 1 LV; same locality as for holotype but sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63233 • 1 LV; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63237 • 1 complete carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63234 • 1 complete carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63236 • 1 RV; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63235 • 5 complete carapaces; same locality as for preceding but samples CM31A, CM31B and CM31C; Rhaetian, Upper Triassic; MNHN.F.F63351.

Dimensions

See Fig. 3E.

Description

Carapace subrectangular, large, inflated laterally except along compressed antero-ventral and postero-ventral margins; carapace preplete with H_{max} located at antero-dorsal angulation; L_{max} located below mid-height; dorsal margin long and tripartite at both valves; LV larger than RV, overlapping it along dorsal margin with maximum along DB and ventral margin with maximum at oral concavity; DB long (43–55 % of L_{max}), straight at RV and straight to slightly convex at LV, slightly inclined posteriorly (between 20° in small specimens and 5° in largest forms); ADB shorter (34–43 % of L_{max}), concave at both valves, more strongly in adults that in younger instars; PDB short (8–20 % of L_{max}), steeply bent posteriorly (from 60° to close to vertical in smallest instars) with terminal concavity more clearly expressed in adults; antero-dorsal and postero-dorsal angulations rounded; AB large and subvertical, with apex located in upper third of H_{max}; AVB underlined by series of marginal denticles on both valves and bordered by a laterally compressed area; PB narrower, with maximum of convexity in lower third of H_{max} on both valves, underlined by a narrow laterally compressed zone; 9 to 10 marginal denticles aligned along PVB, one located above PB; ventral margin long and sinuous with oral concavity located in front of mid-L, bordered by a laterally compressed zone that extends from anterior maximum of convexity to posterior one, attenuated at oral concavity; laterally inflated surface covered with spinose pustules arranged concentrically parallel to free margins except on smooth compressed zones along antero-ventral and postero-ventral margins; antero-ventral and postero-ventral margins bordered by row of sharp spines, length of which decreases ventrally, their number increasing through ontogeny; in inner view, calcified lamella large along anterior and posterior margins, weaker along oral concavity, vestibulum large; central muscle scar not visible; hinge not visible and bairdoppilate auxiliary structure absent.

Occurrence

Tyrol, Austria, Hettangian, Early Jurassic (Harloff & Jäger 1994); Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

The short spines across the lateral surface of *Histriabairdia pontuseuxinusensis* gen. et sp. nov. are reminiscent of those in the Palaeozoic genus *Pustulobairdia* Sohn, 1960. *Pustulobairdia subparallella* Kristan-Tollmann, 1970 was described from the Ladinian, Middle Triassic, of the Dolomites, Italy (Kristan-Tollmann 1970) but lacks AD angulation, so that the DB and ADB are in line. On the contrary, specimens attributed to *P. subparallella* from the Hettangian, Early Jurassic, of Tyrol (Harloff & Jäger 1994) have a well-expressed AD angulation on both valves, also expressed at young stages, similarly to in the Black Sea material. Therefore, this Jurassic material is not conspecific with *P. subparallella*,which is restricted to the Ladinian of the Dolomites. Conversely, specimens from the Hettangian are attributed to *Histriabairdia pontuseuxinusensis* gen. et sp. nov. The surface ornamentation of *H. pontuseuxinusensis* gen. et sp. nov. is reminiscent of that in *Anchistrocheles* sp. 1 from the Carnian of Turkey (Forel *et al.* 2019a), but this Carnian species is significantly smaller (L = 463 µm, H = 275 µm) and shorter (H/L = 0.6), with smaller and more abundant pustules covering the entire lateral surface. The very narrow calcified inner lamella of the only valve (LV) from the Carnian of Turkey implies that the specimen is a relatively young instar. *Histriabairdia spinosa* (Sheppard in Brand, 1990) gen. et comb. nov. from the Bathonian, Middle Jurassic, of France (Brand 1990) is also defined by its pustulose surface, but it differs from *H. pontuseuxinusensis* gen. et sp. nov. by having much smaller spines.

The large distribution of the H and L scatter plot indicates the co-occurrence of several ontogenetic stages for *Histriabairdia pontuseuxinusensis* gen. et sp. nov. (Fig. 3E). However, the rarity of specimens of intermediate dimensions does not reasonably allow a discrimination of the stages. The holotype (Fig. 8L–M) and the paratype (Fig. 8N–O) are among the largest specimens and are thus considered as adults. The ontogenetic development of *H. pontuseuxinusensis* gen. et sp. nov. is marked by the progressive strengthening of the lateral spines, densification of the surface coverage, widening of the lateral compressions along AVB and PVB, an increase in the number of marginal spines and an upward migration of the PB. Jurassic specimens have a slightly higher H/L ratio for both valves (Fig. 3E), which may relate to distinct environmental conditions.

Histriabairdia gen. nov. sp. 1

Fig. 8P–R

Material examined

ROMANIA • 1 RV; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63240 • 1 complete carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63241.

Dimensions

RV: L = 570–800 µm; H = 275–570 µm; H/L = 0.48–0.54.
LV: L = 575 µm; H = 292 µm; H/L = 0.51.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

The two specimens of *Histriabairdia* gen. nov. sp. 1 have different dimensions and correspond to distinct ontogenetic stages. This species is characterized by its relatively slender carapace, long and straight to convex ADB and reticulate surface. The reticulate surface of *Histriabairdia* gen. nov. sp. 1 is reminiscent of that of *Histriabairdia gemmellaroi* (Crasquin in Crasquin *et al.*, 2018) gen. et comb. nov. from the Late Carnian of Sicily (Crasquin *et al.* 2018). However, *Histriabairdia gemmellaroi* gen. et comb. nov. is comparatively shorter (H/L = 0.61) with ADB shorter and concave, postero-dorsal angulation less expressed at both valves and small tubercles developed in the antero-dorsal and dorsal areas of the surface. *Histriabairdia* gen. nov. sp. 1 is very close to *Histriabairdia tuningensis* (Beher, 2004) gen. et comb. nov. from the Sinemurian, Early Jurassic, of Germany and Switzerland (Beher 2004), as shown by its similar elongation and long, straight ADB. However, the marginal compressions along AVB and PVB are narrower, anterior maximum of curvature is located lower and the surface is punctate rather than reticulate.

Histriabairdia gen. nov. sp. 2
Fig. 8S–U

Material examined

ROMANIA • 1 broken carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63242 • 1 broken carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63243 • 1 broken RV; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63244 • 2 RV; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63352.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

No complete specimen of *Histriabairdia* gen. nov. sp. 2 has been found, so no dimensions are provided. *Histriabairdia* gen. nov. sp. 2 is close to *Anchistrocheles* sp. B in Khosla *et al.* 2006 (here considered a member of *Histriabairdia* gen. nov.) from the Bajocian–Bathonian interval, Middle Jurassic, of India (Khosla *et al*. 2006), from which it differs by having a more elongate and caudate posterior extremity, a more rounded AVB and by lacking the median vertical 'sulcus'.

Genus ***Isobythocypris*** Apostolescu, 1959

Type species

Isobythocypris unispinata Apostolescu, 1959 by original designation.

Isobythocypris sp.
Fig. 9A

Material examined

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63245 • 1 complete carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63353.

Dimensions

RV: L = 470–780 µm; H = 268–427 µm; H/L = 0.55–0.57.
LV: L = 480–798 µm; H = 275–466 µm; H/L = 0.58.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Isobythocypris Apostolescu, 1959 is mainly distinguished from other bairdiid genera by its lophodont hinge (Apostolescu 1959). More recently, Ainsworth (1990) clarified that *Isobythocypris* has a subrectangular to elongate subrectangular lateral outline. Only complete carapaces have been retrieved from the CM31 sample so it is impossible to characterize the nature of the hinge in the present material. However, because of its sub-rectangular outline it is attributed to *Isobythocypris*. *Isobythocypris* sp. resembles *I. dorsoconvexa* Ainsworth, 1987 and *I. pliensbachensis* Ainsworth, 1987 both from the Pliensbachian, Early Jurassic, of the Fastnet Basin, offshore Southwest Ireland (Ainsworth 1987), from which it differs by its shorter oral concavity, less pronounced lateral compression along AVB and its visible, although poorly expressed, dorsal angulations. *Isobythocypris* sp. is also close to *Bairdiacypris triassica postera* Herrig, 1979 from the Upper Sinemurian, Early Jurassic, of Thüringen, Germany (Herrig 1979b), but it differs in being more massive and less elongate, with a longer posterior end and a more tapered anterior end.

Isobythocypris atalantella Forel sp. nov.
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Fig. 9B–I

Diagnosis

A new species of *Isobythocypris* with long and slightly arched dorsal margin, relatively large posterior border.

Etymology

From Ἀταλάντη / Átalántê, the only Augonaut woman.

Material examined

Holotype

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63246.

Paratype

ROMANIA • 1 complete carapace; same collection data as for holotype; Rhaetian, Upper Triassic; MNHN.F.F63247.

Other material

ROMANIA • 1 complete carapace; same collection data as for holotype; Rhaetian, Upper Triassic; MNHN.F.F63248 • 1 complete carapace; same collection data as for holotype; Rhaetian, Upper Triassic; MNHN.F.F63249 • 1 complete carapace; same collection data as for holotype; Rhaetian, Upper Triassic; MNHN.F.F63251 • 1 complete carapace; same locality as for preceding but sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63250 • 9 complete carapaces; same locality as for preceding but samples CM31A, CM31B and CM31C; Rhaetian, Upper Triassic; MNHN.F.F63354.

Dimensions

See Fig. 3F.

Description

Carapace of medium size, ovoid in lateral view, with H_{max} around mid-L, L_{max} slightly below mid-H, W_{max} slightly posterior to mid-L; LV larger than RV, overlapping along dorsal margin and oral concavity, with interruption at AVB and PVB. Dorsal margin long and slightly convex, lacking angulations at LV, with weak angulations at RV resulting from tight folds of overlapping LV; antero-dorsal slope gentle in large specimens (±10°), slightly steeper in smaller ones (±20°); DB straight, somewhat sloping posteriorly (±25–35°); postero-dorsal slope short, steep, often poorly differentiated; anterior margin large, only slightly tapered ventrally, with poorly expressed bairdiid morphology and maximum of curvature at mid-H; ventral margin long and sinuous, with median oral concavity expressed on both valves, only slightly more in RV; AVB only slightly raised, PVB horizontal; posterior end narrowly rounded. Inner structures not observed. Surface smooth.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Isobythocypris atalantella sp. nov. is relatively close to the species of *Bythocypris* illustrated in Bolz (1971b). Of them, *Bythocypris* sp. A is only shown as inner views (Bolz 1971b: pl. 8, figs 118–119), which makes a comparison difficult. However, *Isobythocypris atalantella* sp. nov. differs from *Bythocypris* sp. A and *Bythocypris* sp. B from the Rhaetian of the Northern Calcareous Alps (Bolz 1971b) by its narrower and uniformly convex posterior margin, which is close to vertical in both species of *Bythocypris*. *Isobythocypris atalantella* sp. nov. also differs from *Bythocypris ubiquefrequens* Bolz, 1971 from the Rhaetian of the Northern Calcareous Alps (Bolz 1971b) in having a longer and less curved dorsal margin, a less marked bairdiid anterior margin and a larger posterior maximum of curvature. *Isobythocypris atalantella* sp. nov. is morphologically close to *Isobythocypris*? sp. in Dreyer 1967 from the Early Domerian, Early Jurassic, of Germany (Dreyer 1967) but the PB of *Isobythocypris*? sp. is nearly vertical, with the maximum of curvature narrower and located more ventrally. It also differs from *Isobythocypris elongata* (Blake, 1876) from the Early Jurassic of Yorkshire (Blake 1876) by having a larger and not angulate posterior border. *Isobythocypris atalantella* sp. nov. also differs from *Bythocypris faba* Knitter, 1983 from the Toarcian, Early Jurassic, of Southern Germany (Knitter 1983) by its more homogeneous convex dorsal margin, anterior maximum of convexity located higher and posterior border located lower and less bairdiid.

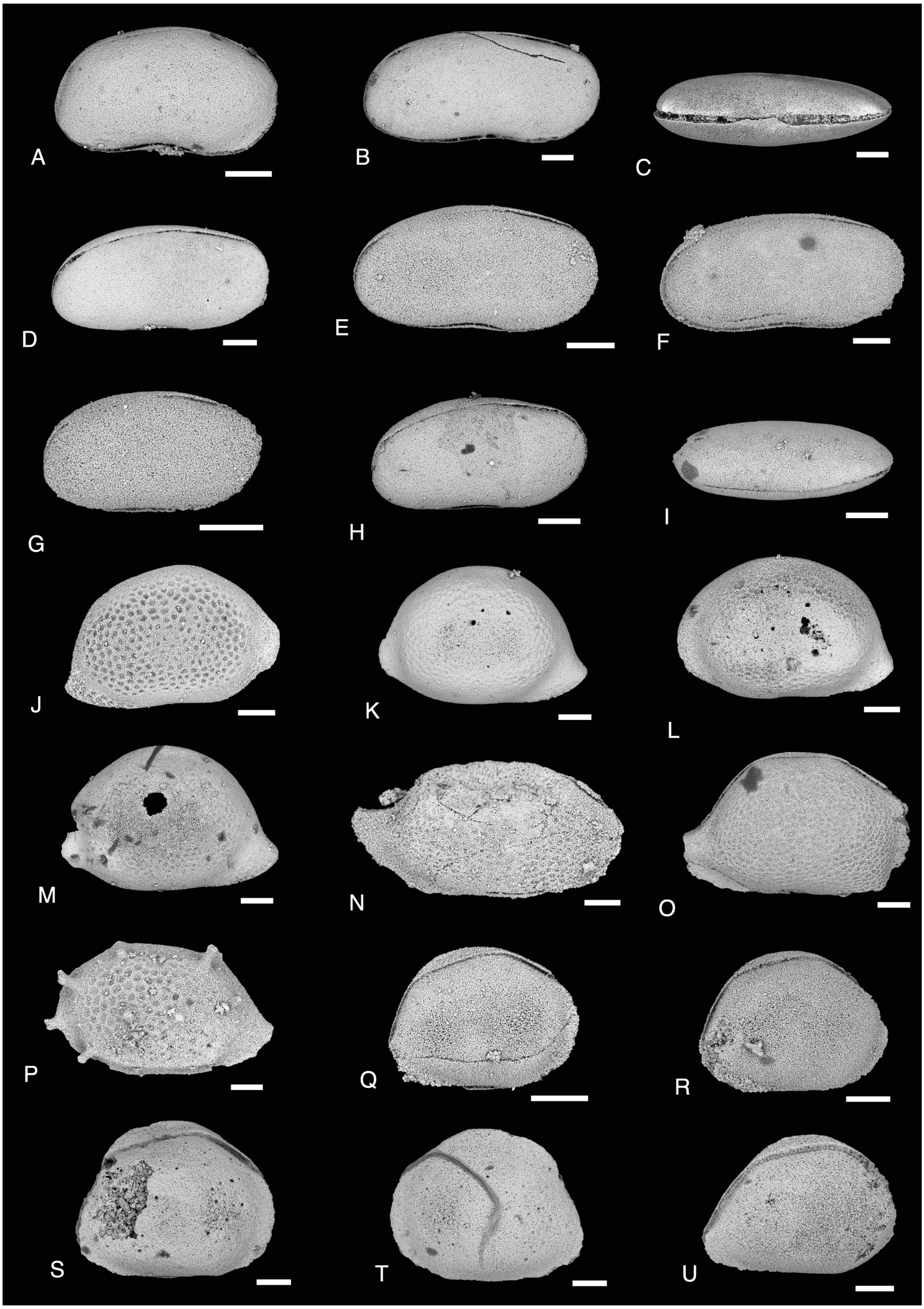
The H/L scatter plot of all measurable specimens of *Isobythocypris atalantella* sp. nov. (Fig. 3F) documents the occurrence of at least five ontogenetic stages, from A-4 to adult. The holotype (Fig. 9B–C) is the largest known adult. Conversely, the paratype (Fig. 9D) may correspond to an A-1 stage. The ontogeny of *Isobythocypris atalantella* sp. nov. is marked by the overall elongation of the carapace, narrowing of the PB and accentuation of the median oral concavity on both valves.

Genus ***Lobobairdia*** Kollmann, 1963

Type species

Lobobairdia salinaria Kollmann, 1963 by original designation.

Fig. 9 (opposite page). SEM micrographs of ostracods from borehole 817 Lebăda Vest, drill core CM31, western portion of Black Sea shelf, Rhaetian, Late Triassic. All specimens are housed in the collections of the Muséum national d'histoire naturelle, Paris, France (MNHN). **A**. *Isobythocypris* sp., right lateral view of a carapace, sample CM31C (MNHN.F.F63245). **B–I**. *Isobythocypris atalantella* Forel sp. nov. **B**. Holotype, right lateral view of a carapace, sample CM31B (MNHN.F.F63246). **C**. Same specimen, ventral view. **D**. Paratype, right lateral view of a carapace, sample CM31B (MNHN.F.F63247). **E**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63248). **F**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63249). **G**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63250). **H**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63251). **I**. Same specimen, dorsal view. **J–M**. *Lobobairdia salinara* Kollmann, 1963. **J**. External view of a right valve, sample CM31B (MNHN.F.F63252). **K**. External view of a left valve, sample CM31B (MNHN.F.F63253). **L**. External view of a left valve, sample CM31B (MNHN.F.F63254). **M**. External view of a left valve, sample CM31C (MNHN.F.F63255). **N**. *Lobobairdia*? sp. 1, right lateral view of a carapace, sample CM31B (MNHN.F.F63256). **O**. *Lobobairdia* sp. 2, right lateral view of a carapace, sample CM31C (MNHN.F.F63257). **P**. *Mirabairdia* sp., external view of a left valve, sample CM31A (MNHN.F.F63258). **Q–U**. *Petasobairdia amazonella* Forel sp. nov. **Q**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63259). **R**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63260). **S**. Paratype, right lateral view of a carapace, sample CM31B (MNHN.F.F63261). **T**. Same specimen, dorsal view. **U**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63262). Scale bars: 100 µm.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Lobobairdia salinaria Kollmann, 1963
Fig. 9J–M

Lobobairdia salinaria Kollmann 1963: 169, pl. 6, figs 9–12.

Ptychobairdia? sp. – Kollmann 1960: 102, pl. 27, figs 5–8.
Lobobairdia salinaria – Bolz 1969: 419, pl. 1, fig. 7–10. — Urlichs 1972: 675, pl. 1, fig. 1. — Mette & Mohtat-Aghai 1999: pl. 5, figs 9–10. — Zorn 2010: 271, pl. 7, figs 1–4.

non *Lobobairdia salinaria* – Sebe *et al.* 2013: 358.

Material examined

ROMANIA • 1 RV; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63252 • 1 LV; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63253 • 1 LV; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63254 • 1 LV; same locality as for preceding but sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63255 • 1 broken RV, 5 broken LV; same locality as for preceding but samples CM31A, CM13B and CM31C; Rhaetian, Upper Triassic; MNHN.F.F63355.

Dimensions

RV: L = 584 µm; H = 373 µm; H/L = 0.64.
LV: L = 615–678 µm; H = 405–454 µm; H/L = 0.66–0.67.

Occurrence

Rhaetian, Late Triassic, Zlambach Formation, Hallstatt, Salzberg, Upper Austria, Austria (Kollmann 1960, 1963; Bolz 1969; Zorn 2010); Austria, Rhaetian, Upper Triassic (Urlichs 1972); Kössen Formation, Northern Calcareous Alps, Tyrol, Austria, Rhaetian, Upper Triassic (Mette & Mohtat-Aghai 1999); Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

The present record is the first known occurrence of *Lobobairdia salinaria* outside of Austria. This species appears to be typical for the Rhaetian of Western Europe. It is mentioned as part of the Aegean, Lower Anisian, Middle Triassic assemblage of the North Dobrogean Orogen (Sebe *et al.* 2013). However, such an early occurrence prescribes extreme care as it would extend the range of this species to more than 40 Ma. Because this specimen was not illustrated, we consider this Middle Triassic occurrence as invalid.

Bolz (1969) plotted the dimensions of 169 specimens of *Lobobairdia salinaria* and identified five ontogenetic stages, from A-4 to adult. The only complete RV obtained from the present analysis corresponds to an A-1 stage based on the ranges provided by Bolz (1969). Conversely, the three LV correspond to the A-2 stage as defined by Bolz (1969). The largest LV shown in Fig. 9M bears a drill hole, which is described in the discussion chapter.

Genus ***Mirabairdia*** Kollmann, 1963

Type species

Mirabairdia pernodosa Kollmann, 1963 by original designation.

Mirabairdia sp.
Fig. 9P

Material examined

ROMANIA • 1 LV; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63258.

Dimensions

L = 687 μm; H = 419 μm; H/L = 0.61.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Only one LV of the present species was found, in sample CM31A, which hampers its attribution to any known species. It is close to *Triebelina* sp. F in Bolz 1971 from the Rhaetian, Late Triassic of Tyrol (Bolz 1971a), later re-attributed to the newly erected *Triebelina* (*Nodobairdia*) *nodata* Bolz, 1971 (Bolz 1971b). However, our specimen is significantly smaller than the specimens illustrated in Bolz (1971a, 1971b), which all exceed 1 mm in length; it also differs by having a weaker marginal ridge only expressed along the ventral margin and thorns instead of knots marking the marginal ridge, some possibly being bifid (the lack of spines on the medio-lateral surface may relate to preservation). These differences may be related to ontogeny, *Mirabairdia* sp. possibly being a young instar of *T.* (*Nodobairdia*) *nodata* Bolz, 1971 as shown by its size. Although the ontogeny of *T.* (*Nodobairdia*) *nodata* Bolz, 1971 was not discussed in detail, this hypothesis might be substantiated by the precision made by Bolz (1971b: 224) that the marginal ridge is only expressed along the ventral margin on small specimens, where it is short and narrow; this corresponds to the type of ridge visible in *Mirabairdia* sp. Similarly, Bolz (1971b) indicates that in small specimens, the thorns are already strong and long, which is the case in *Mirabairdia* sp. However, the seemingly bifid nature of some thorns in *Mirabairdia* sp., as well as the specimen being slightly higher than specimens of the same length listed in Bolz (1971b), lead us to keep this species in open nomenclature until more material can resolve this doubt. *Mirabairdia* sp. can also be compared to *M. longispinosa* Kristan-Tollmann, 1978 from the Cordevolian, Early Carnian, Late Triassic of the Cassian Formation (Kristan-Tollmann 1978) by its much thinner lateral spines.

Genus ***Petasobairdia*** Chen in Chen & Shi, 1982

Praelobobairdia Kozur, 1985: 66.

Type species

Petasobairdia bicornuta Chen in Chen & Shi, 1982 by original designation.

Petasobairdia amazonella Forel sp. nov.

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Figs 9Q–U, 10A–D

Diagnosis

A new species of *Petasobairdia*, short for the genus, triangular in outline with high anterior border.

Etymology

From Ἀμαζόνες/Amazónes, the legendary tribe of warrior women who, according to tradition, used to live along the Black Sea shore.

Material examined

Holotype

ROMANIA • 1 LV; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63264.

Paratype

ROMANIA • 1 complete carapace; same locality as for holotype but sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63261.

Other material

ROMANIA • 1 complete carapace; same collection data as for holotype; Rhaetian, Upper Triassic; MNHN.F.F63259 • 1 complete carapace; same locality as for preceding but sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63260 • 1 complete carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63263 • 1 complete carapace; same locality as for preceding but sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63262 • 4 complete carapaces, 1 RV, 1 LV; same locality as for preceding but samples CM31A, CM31B and CM31C; Rhaetian, Upper Triassic; MNHN.F.F63356.

Dimensions

See Fig. 3G.

Description

Carapace of medium size, sub-square in lateral view, with H_{max} at antero-dorsal angulation and L_{max} below mid-L; LV larger than RV, overlapping it slightly ventrally at ventral concavity and along dorsal margin with laterally compressed overreach along DB; dorsal margin tripartite with rounded angulations at both valves; PDB straight, steep (from 60° in largest specimens to 80° in smallest ones) and short (from 5% of L_{max} in smallest specimens to 20% in larger forms); ADB and DB straight and approximately of same L (40–45% of L_{max}); ADB slope of ±30–40°; DB sloping posteriorly from 10° to 15°; AB large, only poorly tapered ventrally, laterally compressed ventrally, with maximum of curvature slightly below mid-H; ventral margin long and straight with median concavity visible on some specimens; PB narrow, laterally compressed ventrally, with maximum of curvature located in lower ¼ of H_{max}; surface smooth; calcified inner lamella from mid-ADB to mid-PDB, relatively wide along AVB and PVB; large vestibulum along AVB and PVB, narrow in oral area; hinge bar seemingly smooth with anterior and posterior enlarged platforms; AMS field relatively compact, somewhat hastate, located below mid-H and around mid-L, composed of anteriorly incurved row of 3 individual scars and 2 to 3 scars aligned in a short posterior row (Fig. 10D).

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

The laterally compressed overlap of *Petasobairdia amazonella* sp. nov. relates it to the Permian species *P. silenitiformis* (Kozur, 1985), *P. nantongensis* Chen, 1982 and *P. subnantongensis* Chen in Shi & Chen, 1987, for instance, but its shortness, with the posterior maximum of convexity located ventrally, providing it with a sub-square outline in lateral view, differ from conditions in all known species. Although poorly preserved, the AMS pattern on the inner surface of the paratype (Fig. 10D) only differs from that of *P. silenitiformis*, which is to our knowledge the only observation of AMS for *Petasobairdia*, in being more compact and less rounded. In general terms, the outline of *P. amazonella* sp. nov. is reminiscent of that in *Bairdia donzei* Herrig, 1979 from the Domerian, Early Jurassic, of Germany (Herrig 1979a), but this Jurassic species has a longer posterior extremity and its LV is more rounded in outline and lacks the laterally compressed DB. The H/L scatter plot of all specimens of *P. amazonella* sp. nov. (Fig. 3G) records the occurrence of several ontogenetic stages, from A-4 to adult. The holotype (Fig. 9S–T) and paratype (Fig. 10B–D) are the largest known specimens, but owing to the size difference between the paratype and the LV of the holotype, we consider that the holotype is a submature stage. The development of *P. amazonella* sp. nov. is marked by the increasing height of the overlap as well as the elongation of the PDB, from 5% of L_{max} in the smallest instar to 27% in the paratype, the largest known specimen to date (Fig. 3G).

Superfamily Bairdiocypridoidea Shaver, 1961

Family **Rectonariidae** Gründel, 1962

Remarks

A unique isolated valve of Rectonariidae was encountered in our material. Because most of this family is characterized by asymmetrically ornamented valves, it is kept in open nomenclature. It is, however, of pivotal importance since it is the youngest report of Rectonariidae, which were abundant in deep-water environments during the Devonian–Carboniferous (e.g., Gründel 1962) with a previously last documented occurrence in the Carnian, Late Triassic, of Turkey (Forel *et al*. 2019a).

Rectonariidae gen. 1 in Forel *et al*. 2019
Fig. 10E

Rectonariidae gen. 1 – Forel *et al.* 2019a: 22, fig. 14c.

Material examined

ROMANIA • 1 RV; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63265.

Dimensions

L = 448 µm; H = 302 µm (RV in this paper).
L = 423 µm; H = 262 µm (LV in Forel *et al*. 2019a).

Occurrence

Kilek section, Tavusçayiri Block, Sorgun Ophiolitic Mélange, southern Turkey, Huğlu Tuffite, *Tetraporobrachia haeckeli* radiolarian Zone, Julian, Middle Carnian, Upper Triassic (Forel *et al*. 2019a); Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Forel *et al*. (2019a) noted the morphological proximity of this taxon to *Siciliella* Crasquin *et al.*, 2008 from the Lower–Middle Permian of Sicily (Crasquin *et al.* 2008), characterized by its subquadrangular outline, the occurrence of a single spine on each valve and LV overlapping RV all around. The unique LV discovered from the Carnian, Late Triassic, of Turkey was kept in open nomenclature because of the impossibility of confirming the nature of the overlap and the occurrence of a spine on each valve (Forel *et al*. 2019a). The present RV confirms the presence of a spine on the RV, also positioned in the postero-ventral area of the valve, oriented backwards and downwards. However, until a complete carapace allows a description of the relationship between the two valves, it seems unreasonable to artificially extend the stratigraphical range of *Siciliella* from the Middle–Late Permian up to the Rhaetian, Late Triassic. Nevertheless, although kept in open nomenclature, Rectonariidae gen. 1 in Forel *et al*. 2019 confirms the occurrence of Rectonariidae during the Late Triassic that was first recorded in the Carnian of Turkey (Forel *et al*. 2019a). It further extends the range of Rectonariidae to the Rhaetian.

Suborder Cypridocopina Jones, 1901
Superfamily Cypridoidea Baird, 1845
Family Paracyprididae Sars, 1923

Genus ***Aglaiocypris*** Sylvester-Bradley, 1947 *sensu* Kozur in Kozur *et al.* 1974

Type species

Aglaia pulchella Brady, 1868 subsequently designated by Sylvester-Bradley (1947).

Remarks

Aglaiocypris Sylvester-Bradley, 1947 is a recent genus and for this reason and because internal structures cannot be observed, we refer to this genus as "*Aglaiocypris*". Following Kozur *et al.* (1974), we consider that this genus may be new to science but material is still lacking to fully describe its diagnostic characters.

"***Aglaiocypris***" sp.
Fig. 10F–G

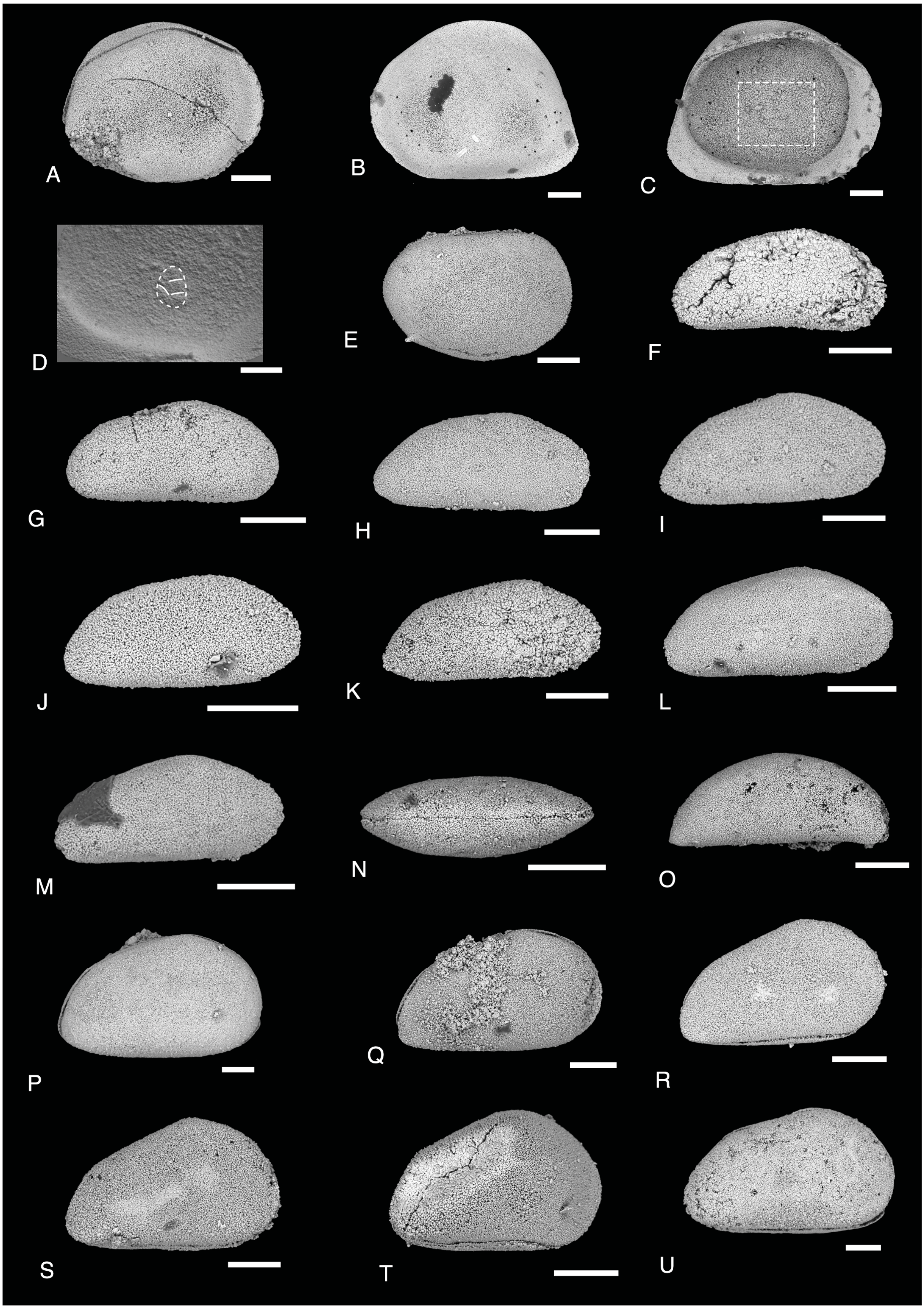
Material examined

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63266 • 1 complete carapace; same locality as for preceding but sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63267 • 2 complete carapaces; same locality as for preceding but sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63357.

Dimensions

RV: L = 333–482 µm; H = 162–243 µm; H/L = 0.46–0.49.
LV: L = 333–482 µm; H = 162–243 µm; H/L = 0.48–0.5.

Fig. 10 (opposite page). SEM micrographs of ostracods from borehole 817 Lebăda Vest, drill core CM31, western portion of Black Sea shelf, Rhaetian, Late Triassic. All specimens are housed in the collections of the Muséum national d'histoire naturelle, Paris, France (MNHN). **A–D**. *Petasobairdia amazonella* Forel sp. nov. **A**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63263). **B**. Holotype, external view of a left valve, sample CM31C (MNHN.F.F63264). **C**. Same specimen, inner view, square indicates the area enlarged in D. **D**. Line drawing of the adductor muscle scar field of the paratype marked in C. **E**. Rectonariidae gen. 1 in Forel *et al*. 2019, external view of a right valve, sample CM31C (MNHN.F.F63265). **F–G**. "*Aglaiocypris*" sp. **F**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63266). **G**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63267). **H–N**. *Paracypris ovidi* Forel sp. nov. **H**. Holotype, right lateral view of a carapace, sample CM31B (MNHN.F.F63268). **I**. Paratype 2, right lateral view of a carapace, sample CM31B (MNHN.F.F63269). **J**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63270). **K**. Paratype 1, right lateral view of a carapace, sample CM31B (MNHN.F.F63271). **L**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63272). **M**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63273). **N**. Same specimen, dorsal view. **O**. *Paracypris* cf. *Paracypris* sp. 1 in Lord & Lambourne 1991, right lateral view of a carapace, sample CM31A (MNHN.F.F63274). **P–Q**. *Paracypris* sp. 1. **P**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63275). **Q**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63276). **R–U**. *Paracypris* sp. 2. **R**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63277). **S**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63278). **T**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63279). **U**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63280). Scale bars: 100 µm.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Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

The present species is close to *Aglaiocypris*? sp. from the Ladinian, Middle Triassic, of Spain (Kozur *et al.* 1974). This species is morphologically similar to *Fabalicypris*? sp. A in Ainsworth 1990 from the Hettangian, Early Jurassic, from Ireland (Ainsworth 1990), but the carapace of the present species is thinner, with H_{max} located more anteriorly, shorter and more rounded ADB, and AB more rounded and less bairdiid. These characters are closer to those of *Aglaiocypris* as described in Kozur *et al.* (1974).

Genus ***Paracypris*** Sars, 1866

Type species

Paracypris polita Sars, 1866 by original designation.

Paracypris ovidi Forel sp. nov.

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Fig. 10H–N

Diagnosis

A small ear-shaped species with conspicuous dorsal angulations and anterior maximum of curvature slightly below mid-height.

Etymology

In reference to the Latin poet Ovid (Publius Ovidius Naso) who died in exile on the Black Sea shore in Tomis, present-day Constanţa (Romania).

Material examined

Holotype

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63268.

Paratypes

ROMANIA • 1 complete carapace; same collection data as for holotype; Rhaetian, Upper Triassic; MNHN.F.F63271 • 1 complete carapace; same collection data as for holotype; Rhaetian, Upper Triassic; MNHN.F.F63269.

Other material

ROMANIA • 1 complete carapace; same collection data as for holotype; Rhaetian, Upper Triassic; MNHN.F.F63270 • 1 complete carapace; same collection data as for holotype; Rhaetian, Upper Triassic; MNHN.F.F63364 • 1 complete carapace; same locality as for preceding but sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63272 • 1 complete carapace; same locality as for preceding but sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63273 • 11 complete carapaces, 2 broken carapaces; same locality as for preceding but samples CM31A, CM31B and CM31C; Rhaetian, Upper Triassic; MNHN.F.F63358.

Dimensions

See Fig. 3H.

Description

Carapace small, ear-shaped, tapered posteriorly in lateral view, with H_{max} at antero-dorsal angulation, L_{max} slightly below mid-H and W_{max} at mid-L; LV overlaps RV very thinly along DB, PDB and VB; dorsal margin distinctly tripartite with conspicuous angulations, more uniformly arched in small specimens; ADB, DB and PDB straight, PDB sometimes slightly convex; ADB and DB of similar length (± 80% of L_{max}), respectively gently sloping to AB and antero-dorsal angulation; PB short (± 20% of L_{max}), inclined posteriorly with an angle of 45–55°; AB relatively large, with largely rounded AVB and maximum of convexity located slightly below mid-H; PB narrowly rounded, with maximum of curvature slightly above ventral margin; surface smooth; inner structures not visible.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Paracypris ovidi sp. nov. is closely related to *Pseudomacrocypris*? *kerabani* sp. nov. described below, from which it differs by having dorsal angulations more acute and AB angulation located slightly higher. *Paracypris ovidi* sp. nov. also displays a normal overlap of LV around RV, which excludes it from *Pseudomacrocypris* and relates it to *Paracypris*. *Paracypris ovidi* sp. nov. also differs from the widespread Jurassic *P. redcarensis* (Blake, 1876) (e.g., Harloff & Jäger 1994; Boomer *et al.* 1998; Ainsworth & Boomer 2001; Honigstein *et al.* 2014) in being less tapered posteriorly, with a less rounded anterior margin and a less pronounced overlap.

The H/L diagram shown in Fig. 3H documents the occurrence of several ontogenetic stages, the delimitation of which is complicated. The holotype (Fig. 10H) and one of the paratypes (Fig. 10I) are among the largest specimens recorded. The ontogenetic development of *Paracypris ovidi* sp. nov. mainly consists in size increase and accentuation of dorsal angulations.

Paracypris cf. *Paracypris* sp. 1 in Lord & Lambourne 1991

Fig. 10O

Material examined

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63274.

Dimensions

L = 404 µm; H = 135 µm; H/L = 0.41.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

The present species shares very close morphological proximity with *Paracypris* sp. 1 in Lord & Lambourne 1991 from the Pliensbachian, Early Jurassic, of the Western Pontides, Turkey (Lord & Lambourne 1991): similar H/L ratio (0.41), low anterior maximum of curvature pointing downward, pointed PB at venter, oral concavity long, poorly expressed, located in anterior half of L_{max}. The two specimens might be conspecific, but the Rhaetian specimen is smaller than the Jurassic one (L = 700 µm;

H = 289 µm) and might represent an immature stage. These two hypotheses can only be tested by more sampling in the two areas.

Family Pontocyprididae Müller, 1894

Genus ***Pseudomacrocypris*** Michelsen, 1975

Type species

Pseudomacrocypris subtriangularis Michelsen, 1975 by original designation.

Remarks

Pseudomacrocypris Michelsen, 1975 was described from the Jurassic of Denmark (Michelsen 1975). Michelsen (1975) referred to the tripartite hinge of *Pseudomacrocypris* as "markedly dentate" and therefore referred this genus to the Macrocyprididae Sars, 1866. However, Maddocks (1991) showed that the hinge structure is convergent with that of Macrocyprididae while other features are typical of Pontocyprididae Sars, 1866. We here follow this revision and consider *Pseudomacrocypris* as part of the Pontocyprididae.

Pseudomacrocypris*? *kerabani Forel sp. nov.

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Fig. 11B–G

Pontocypris? sp. pars – Kristan-Tollmann *et al.* 1991a: 165, pl. 2, fig. 11.
Pontocypris? sp. – Mette & Mohtat-Aghai 1999: 53, pl. 2, fig. 8.

non *Pontocypris*? sp. – Kristan-Tollmann *et al.* 1991a: 165, pl. 7, fig. 5.

Diagnosis

A species with truncate subtriangular outline, with low anterior and posterior maximum of curvature and offset overlap along dorsal and ventral borders.

Etymology

From the novel *Kéraban-le-Têtu*, by Jules Verne, that describes the adventures of a Turkish tobacco seller, Kéraban, around the Black Sea.

Material examined

Holotype

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63283.

Paratype

ROMANIA • 1 complete carapace; same collection data as for holotype; Rhaetian, Upper Triassic; MNHN.F.F63282.

Other material

ROMANIA • 1 complete carapace; same collection data as for holotype; Rhaetian, Upper Triassic; MNHN.F.F63284 • 1 complete carapace; same collection data as for holotype; Rhaetian, Upper Triassic; MNHN.F.F63285 • 1 complete carapace; same collection data as for holotype; Rhaetian, Upper Triassic; MNHN.F.F63287 • 1 complete carapace; same locality as for preceding but sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63286 • 9 complete carapaces, 2 broken carapaces; same locality as for preceding but samples CM31A, CM31B and CM31C; Rhaetian, Upper Triassic; MNHN.F.F63359.

Dimensions

Fig. 4A.

Description

Carapace of medium size, dorsally-truncate subtriangular in lateral view, with H_{max} at antero-dorsal angulation, L_{max} around lower ¼ of H_{max}; offset overlap characterized by LV overlaping RV along DB (e.g., Fig. 11B) and RV overlaping LV along VB (Fig. 11E); dorsal margin divided into three parts of similar length, with blunt antero-dorsal and postero-dorsal angulations, the latter poorly expressed in smooth juveniles; ADB gently arched inclined anteriorly with an angle of 30–35°, DB straight, slightly inclined toward PD angulation, thinly overlapped by LV at RV, PDB straight to very tenuously convex in small specimens, bent posteriorly with an angle of ±40°; AB at the same level or slightly above PB, uniformly rounded, with relatively narrow curvature; PB narrow, rounded to bluntly angulate, with maximum close to ventral margin; ventral margin long and gently convex, with thin overlap of RV on LV in center and shallow concavity anteriorly in some specimens (e.g., Fig. 11C, G); surface smooth; inner structures not visible.

Occurrence

Kössen Formation, Northern Calcareous Alps, Tyrol, Austria, Rhaetian, Upper Triassic (Kristan-Tollmann *et al.* 1991a; Mette & Mohtat-Aghai 1999); Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Pseudomacrocypris? *kerabani* sp. nov. has previously been pictured from the Kössen Formation outcropping in Tyrol (Kristan-Tollmann *et al.* 1991a; Mette & Mohtat-Aghai 1999), where it was attributed with doubt to the genus *Pontocypris* Sars, 1866. One of the two specimens from the Rhaetian of Austria shown in Kristan-Tollmann *et al.* (1991a; pl. 7, fig. 5) is excluded because of its lateral outline and much larger dimensions. *Pseudomacrocypris* Michelsen, 1975 is characterized by a right over left valve overlap and a central adductorial muscle field of rosette shape made of 5–6 spots (Michelsen 1975; Kaye 1965; Maddocks 1991). Although the dentate and tripartite hinge of *Pseudomacrocypris* is unusual for Pontocyprididae (Maddocks 1991), the muscle-scar pattern as well as the nature of the overlap led Maddocks (1991) to consider that *Pseudomacrocypris* and *Propontocypris* might be synonymous, and re-attributed *Pseudomacrocypris* to the family Pontocyprididae. Maddocks (1991: 41) summarized the common characters between *Pseudomacrocypris* and *Propontocypris* as follows: laterally compressed carapace, subtriangular to subovate in lateral view, tiny size ($L = 0.41$ mm), smooth exterior with numerous tiny normal pore canals, right valve overlap, straight dorsal valve-contact line and deep vestibules. However, *Pseudomacrocypris* is kept as a separate genus because of its unusual hinge and age (Early Jurassic to Early Cretaceous in Maddocks 1991). Only complete carapaces have been found in the present analysis, which unfortunately precludes the close observation of hinge and AMS patterns. However, the offset overlap of RV over LV along the ventral margin and LV over RV along DB is unusual for both genera, but *Pseudomacrocypris* is preferred here because of the age and presence of right over left valve overlap, although partial. *Pseudomacrocypris*? *kerabani* sp. nov. differs from *P.* cf. *subtriangularis* Michelsen, 1975 in Kristan-Tollmann *et al.* 1991 from the Rhaetian of Tyrol (Kristan-Tollmann *et al.* 1991a) in being more slender, with narrower AB, less pointed PB and RV overlapping LV only along VB. It also differs from *Pseudomacrocypris* sp. from the same level by having a less rounded ADB and narrower AB with the maximum of curvature located more ventrally. *Pseudomacrocypris*? *kerabani* sp. nov. also differs from the widespread Jurassic *P. subtriangularis* (e.g., Sivhed 1980; Harloff & Jäger 1994; Boomer *et al.* 1998; Cabral *et al.* 2013) by having its AB located more ventrally and LV overlapping RV along DB.

The H/L diagram of all specimens shown in Fig. 4A documents the occurrence of at least 4 ontogenetic stages, from A-3 to adult. It is noteworthy that the specimen shown in Kristan-Tollmann *et al.* (1991a) is much larger than all others, including those from the same locality reported by Mette & Mohtat-Aghai (1999). The holotype may be an adult (Fig. 11C), with a quite large dispersal of size in adult specimens, while the paratype (Fig. 11B) is an A-1 instar. The lateral morphology of *Pseudomacrocypris*? *kerabani* sp. nov. is very conservative through its development, only marked by a slight enlargement of the posterior maximum of convexity and an accentuation of the tripartite division of the dorsal margin.

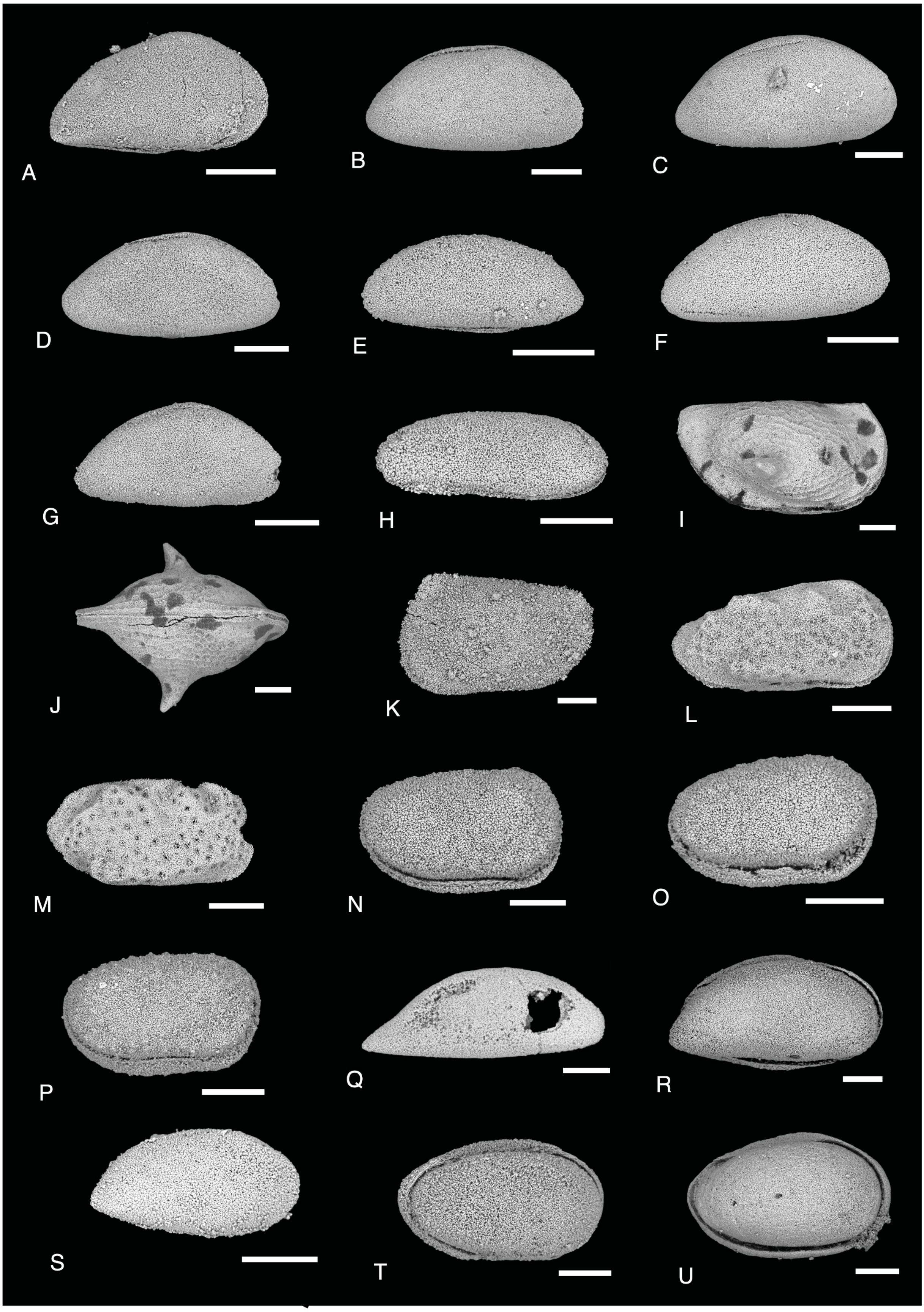
Suborder Cytherocopina Gründel, 1967
Superfamily Cytheroidea Baird, 1850

Family **Cytheruridae** Müller, 1894

Remarks

The classification of Triassic and Early Jurassic Cytheruridae was revised by Whatley & Boomer (2000), who considered that they are distributed in two subfamilies: Cytheropterinae Hanai, 1957 and Cytherurinae Müller, 1894. Conversely, Maddocks & Steineck (1987) and Mazzini & Gliozzi (2000) proposed a three subfamily arrangement for the Cytheruridae: Cytheropterinae Hanai, 1957, Cytherurinae Müller, 1894 and Eucytherurinae Puri, 1974 (emend. Maddocks & Steineck 1987). The recent phylogenetic analysis carried on the living Eucytherurinae *Xylocythere sarrazinae* Tanaka & Hayashi, 2019 from a hydrothermal vent field in the northeastern Pacific Ocean, supports the three subfamily scheme (Tanaka & Hayashi 2019). This molecular analysis furthermore highlights the basal position of *Xylocythere sarrazinae*, supporting the hypothesis of an ancient origin of Eucytherurinae. In their revision, Whatley & Boomer (2000) considered a number of Early Mesozoic Cytheruridae as junior synonyms of the extant genus *Eucytherura* Müller, 1894 and classified this genus within the Cytherurinae, in line with contributions on extent Cytheruridae (e.g., Ayress *et al*. 1995; Ballent & Whatley 2009).

Fig. 11 (opposite page). SEM micrographs of ostracods from borehole 817 Lebăda Vest, drill core CM31, western portion of Black Sea shelf, Rhaetian, Late Triassic. All specimens are housed in the collections of the Muséum national d'histoire naturelle, Paris, France (MNHN). **A**. *Paracypris* sp. 3, right lateral view of a carapace, sample CM31A (MNHN.F.F63281). **B–G**. *Pseudomacrocypris*? *kerabani* Forel sp. nov. **B**. Paratype, right lateral view of a carapace, sample CM31C (MNHN.F.F63282). **C**. Holotype, right lateral view of a carapace, sample CM31C (MNHN.F.F63283). **D**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63284). **E**. Left lateral view of a carapace, sample CM31C (MNHN.F.F63285). **F**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63286). **G**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63287). **H**. *Pseudomacrocypris*? sp., left lateral view of a carapace, sample CM31B (MNHN.F.F63288). **I–J**. *Praebythoceratina* sp. **I**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63289). **J**. Same specimen, dorsal view. **K**. *Triassocythere* sp., external view of a left valve, sample CM31C (MNHN.F.F63290). **L–M**. *Judahella andrusovi* Kozur & Bolz in Bunza & Kozur, 1971. **L**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63291). **M**. External view of a right valve, sample CM31A (MNHN.F.F63292). **N–P**. Cytheruridae gen. et sp. indet. **N**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63293). **O**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63294). **P**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63295). **Q**. *Praemacrocypris* sp., external view of a right valve, sample CM31B (MNHN.F.F63296). **R–S**. *Cardobairdia* sp. 1. **R**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63297). **S**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63298). **T–U**. *Cardobairdia* sp. 2. **T**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63299). **U**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63300). Scale bars: 100 µm.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Subfamily Cytherurinae Müller, 1894

Genus ***Judahella*** Sohn, 1968

Type species

Judahella tsorfatia Sohn, 1968 by original designation.

Judahella andrusovi Kozur & Bolz in Bunza & Kozur, 1971

Fig. 11L–M

Judahella andrusovi Kozur & Bolz in Bunza & Kozur 1971: 25, pl. 14, figs 14, 16–22.

Judahella andrusovi – Kozur 1972: pl. 2, fig. 9. — Urlichs 1972: 679, pl. 1, fig. 15. — Kristan-Tollmann *et al.* 1991a: 202, pl. 2, fig. 8, pl. 5, figs 1–7; 1991b: pl. 3, figs 10–11. — Mette *et al.* 2012: 70. — Forel *et al*. 2019a: 26–27, fig. 18e–h.

Judahella (*Judahella*) *andrusovi* – Kristan-Tollmann *et al.* 1980: 189, pl. 11, figs 9–10. — Kristan-Tollmann 1983: 151, pl. 9, figs 5–9; 1988: figs 6, 12.

Material examined

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63291 • 1 RV; same locality as for preceding but sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63292 • 1 complete carapace, 1 RV; same locality as for preceding but samples CM31B and CM31C; Rhaetian, Upper Triassic; MNHN.F.F63360.

Dimensions

Females (only RV; Fig. 11M): L = 371–468 µm; H = 196–264 µm.

Males (one carapace measured; Fig 11L): LV: L = 508 µm; H = 251 µm. RV: L = 502 µm; H = 244 µm.

Occurrence

Leidapo section, South China, upper Anisian, Middle Triassic (Kristan-Tollmann 1983); Transdanubian Central Range, Hungary, Carnian, Upper Triassic (Kristan-Tollmann *et al.* 1991b); Hungary, upper Norian, Upper Triassic (Kozur 1972); Ampelsbach, Austria, upper Norian, Upper Triassic (Bunza & Kozur 1971); Saltspring section, Bagerabad, Iran, Rhaetian, Upper Triassic (Kristan-Tollmann *et al.* 1980; Kristan-Tollmann 1988); Austria, Rhaetian, Upper Triassic (Urlichs 1972; Kristan-Tollmann *et al.* 1991b; Mette *et al.* 2012); Kilek section, Mersin Mélange, southern Turkey, Huğlu Tuffite, Julian, middle Carnian, Upper Triassic (Forel *et al.* 2019a); Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Cytheruridae gen. et sp. indet.

Fig. 11N–P

Material examined

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63293 • 1 complete carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63294 • 1 complete carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63295 • 1 complete carapace; same locality as for preceding but sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63361.

Dimensions

RV: L = 256–319 µm; H = 170–197 µm; H/L = 0.6–0.63.
LV: L = 271–301 µm; H = 145–172 µm; H/L = 0.57.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

These very small specimens are characterized by a strong overlap of LV around the free margin of RV, lateral surface of both valves entirely tuberculate, lack of marginal compression, and a lack of caudal process, sulcus or lateral extensions. They may correspond to a new genus but the material is still too scant to confirm this hypothesis and fully appreciate the diagnostic characters of this possibly new genus.

Superfamily Sigillioidea Mandelstam, 1960
Family Sigilliidae Mandelstam, 1960

Genus ***Cardobairdia*** van den Bold, 1960 emend. McKenzie 1967

Type species

Cardobairdia ovata van den Bold, 1960 by original designation.

Cardobairdia sp. 3

Fig. 12D–F

Material examined

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31C; Rhaetian, Upper Triassic; MNHN.F.F63302 • 1 RV; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63362 • 1 complete carapace; same locality as for preceding but sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63303.

Dimensions

RV: L = 275–354 µm; H = 143–203 µm; H/L = 0.59–0.64.
LV: L = 283–299 µm; H = 168–192 µm; H/L = 0.52–0.59.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Cardobairdia sp. 3 is very close to *Cardobairdia* cf. *liassica* (Drexler, 1958) in Monostori 2008 from the Pliensbachian of Hungary (Monostori 2008: pl. 1, fig. 8). *Cardobairdia* has been attributed to the Sigilliidae, which are merodont hinge ostracods (e.g., Tabuki & Hanai 1999; Olempska 2001). *Cardobairdia* shows a crenulate posterior tooth, which might correspond to a merodont hingement. However, the ventral bar is not visible, so it is not possible to assess with certainty that it is crenulate or whether the lobes occur before and after the anterior and posterior teeth.

Suborder Metacopina Sylvester-Bradley, 1961
Superfamily Healdioidea Harlton, 1933
Family Healdiidae Harlton, 1933

Genus ***Hungarella*** Méhes, 1911

Type species

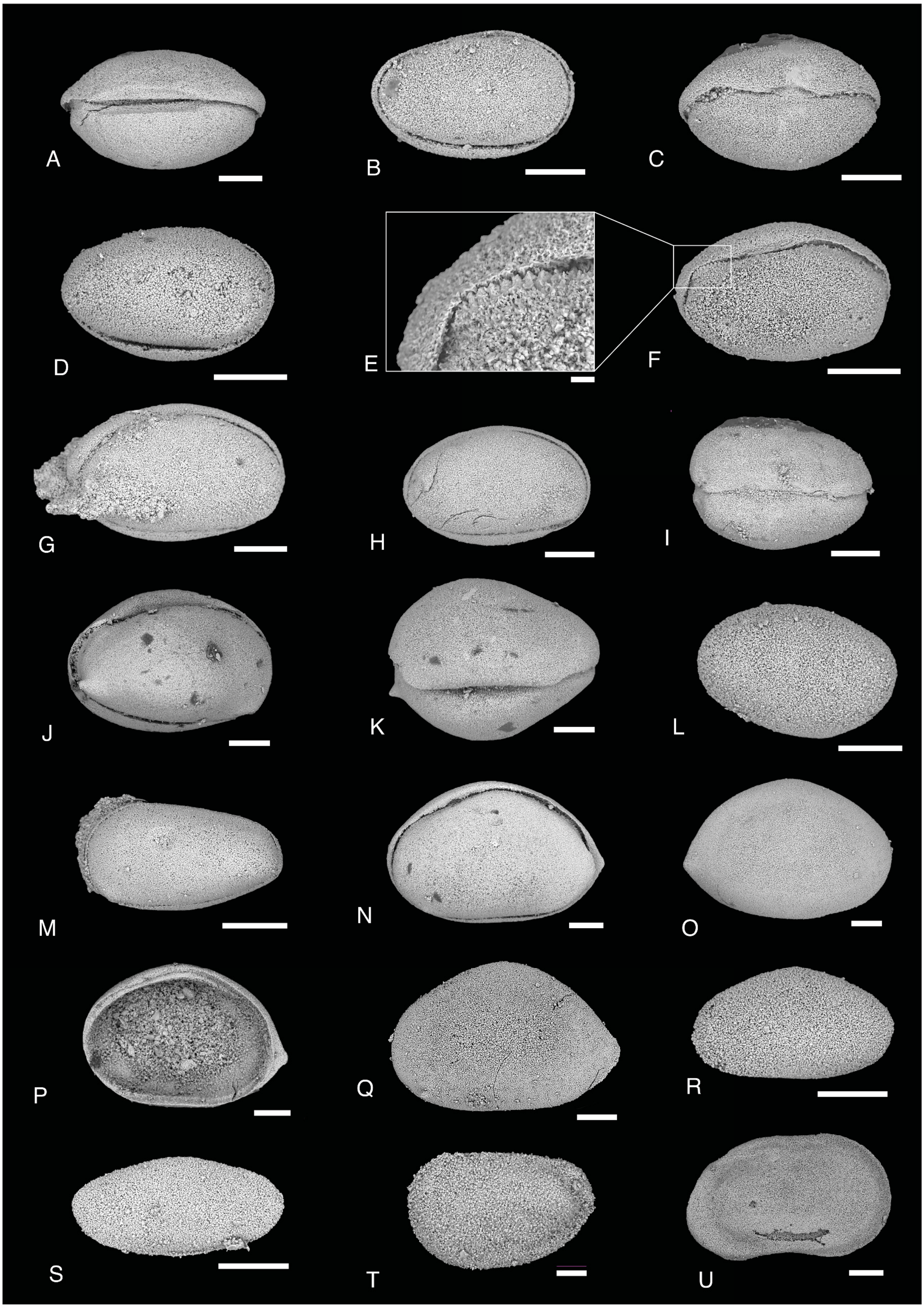
Hungarella problematica Méhes, 1911 by original designation.

Remarks

The possible synonymy of *Ogmoconcha*, described from the Lias δ of Germany (Triebel 1941), and *Hungarella*, described from the Triassic of Hungary (Méhes 1911), has long been debated but material from the type locality of *Hungarella* has yet to be observed to clarify this issue (e.g., Lord 1972, 1982). Here we agree with the position of Lord who stated that "it is preferable to call Lower Jurassic species which are congeneric with *Ogmoconcha contractula* Triebel, 1941 (type species of *Ogmoconcha*) by the generic name *Ogmoconcha* rather than *Hungarella* since the synonymy of the two genera is unproved" (Lord 1972: 332), and consider that the corollary position should be applied by restricting the use of *Hungarella* to Triassic species. Until the relationship of *Ogmoconcha* and *Hungarella* is clarified, we choose to only use *Hungarella* for Triassic species to avoid artificially rooting *Ogmoconcha* down to the Triassic and biasing our understanding of the diversity dynamics at the end of the Triassic (Forel & Crasquin 2020). We thus follow Kristan-Tollmann (1977a, 1977b) and Lord (1982) in considering that:

- the valves of *Hungarella* are asymmetrical contrary to those of *Ogmoconcha*
- the anterior margin of the RV of *Hungarella* may display a rim or a spine but numerous marginal spines are diagnostic of *Ogmoconcha*

Fig. 12 (opposite page). SEM micrographs of ostracods from borehole 817 Lebăda Vest, drill core CM31, western portion of Black Sea shelf, Rhaetian, Late Triassic. All specimens are housed in the collections of the Muséum national d'histoire naturelle, Paris, France (MNHN). **A–C**. *Cardobairdia* sp. 2. **A**. Same specimen as in Fig. 11U (MNHN.F.F63300), dorsal view. **B**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63301). **C**. Same specimen, dorsal view. **D–F**. *Cardobairdia* sp. 3. **D**. Right lateral view of a carapace, sample CM31C (MNHN.F.F63302). **E**. Details of posterior end of hingement of specimen shown in F. **F**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63303). **G–K**. *Cardobairdia* sp. 4. **G**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63304). **H**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63305). **I**. Same specimen, dorsal view. **J**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63306). **K**. Same specimen, dorsal view. **L**. *Cardobairdia* sp. 5, external view of a left valve, sample CM31C (MNHN.F.F63307). **M**. *Cardobairdia*? sp. 6, right lateral view of a carapace, sample CM31B (MNHN.F.F63308). **N–Q**. *Hungarella koessenensis* (Mette & Mohtat-Aghai, 1999). **N**. Right lateral view of a carapace, sample CM31B (MNHN.F.F63309). **O**. External view of a left valve, sample CM31B (MNHN.F.F63310). **P**. Inner view of a left valve, sample CM31B (MNHN.F.F63311). **Q**. External view of a right valve, sample CM31B (MNHN.F.F63312). **R**. *Hungarella* sp. 1, external view of a right valve, sample CM31B (MNHN.F.F63313). **S**. *Hungarella*? sp. 2, right lateral view of a carapace, sample CM31C (MNHN.F.F63314). **T**. *Cytherelloidea* cf. *modesta* Apostolescu, 1959, external view of a left valve, sample CM31B (MNHN.F.F63315). **U**. *Cytherelloidea*? sp., external view of a right valve, sample CM31A (MNHN.F.F63316). Scale bars: 100 µm.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Hungarella koessenensis (Mette & Mohtat-Aghai, 1999)

Fig. 12N–Q

Ogmoconcha koessenensis Mette & Mohtat-Aghai, 1999: 52–53, pl. 2, figs 1–4.

? *Ogmoconcha* sp. – Sohn 1987: C18, pl. 10, figs 12–14, pl. 11, figs 13–16, 20–24.

Material examined

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63309 • 1 LV; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63310 • 1 LV; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63311 • 1 RV; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63312 • 3 complete carapaces, 14 LV, 8 RV; same locality as for preceding but samples CM31A, CM31B and CM31C; Rhaetian, Upper Triassic; MNHN.F.F63363.

Occurrence

Eiberg Member, upper Kössen Formation, Waidringer Setinplatte, Northern Calcareous Alps, Tyrol, Austria, upper Rhaetian, Upper Triassic (Mette & Mohtat-Aghai 1999); Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Dimensions

Fig. 4B.

Remarks

This species was ascribed to *Ogmoconcha* Triebel, 1941 by Mette & Mohtat-Aghai (1999) and it is here re-attributed to *Hungarella* as explained above. Mette & Mohtat-Aghai (1999) noted the closeness of *H. koessenensis* to *Hungarella* sp. from the Carnian of Hungary (identified as *Ogmoconcha* sp. in Sohn 1987) but could not confirm their conspecificity because of low preservation and low abundance of their material. In spite of the relatively good preservation of the present material, apart from the inner structures, the illustrations of *Ogmoconcha* sp. in Sohn 1987 do not allow us to ascertain the conspecificity of the specimens.

The dimensions of all known valves and carapaces are shown in Fig. 4B, where LV and RV are distinguished. The delimitation of successive ontogenetic stages is here hardened by the relatively important overlap of LV over RV, resulting in the overlap of their distributions on the H/L diagram (Fig. 4B). The three carapaces known (e.g., Fig. 12N) serve as anchor-points and appear to document a relative increase in the thickness of the overlap through the ontogeny of *Hungarella koessenensis*. The H/L diagram furthermore documents two distinct groups of valves that are not visible in the smallest specimens: a first group of small valves and a second group of larger valves, the three carapaces belonging to the first one. These two groups may represent sexually dimorphic specimens, the larger ones being wider posteriorly, with PB close to vertical, and possibly related to females. Such a pattern of size and morphology has also been observed for *H. subtera* Zheng, 1976 from the Carnian of South China (Forel *et al*. 2019b). Owing to these observations, we consider that six ontogenetic stages, A-5 to adult, occur for *H. koessenensis* (Fig. 4B). A-5 is represented by a unique RV while A-3 is represented by only two LV. The ontogeny of this species appear to be mainly related to size increase and the apparition of sexual dimorphism in A-3.

Subclass Myodocopa Sars, 1866
Order Halocyprida Dana, 1853
Suborder Halocypridina Dana, 1853
Superfamily Thaumatocypridoidea Müller, 1906
Family Thaumatocyprididae Müller, 1906

Genus ***Pokornyopsis*** Kozur, 1974

Type species

Thaumatocypris feifeli Triebel, 1941 subsequently designated by Kozur (1974).

Pokornyopsis sp. 1
Fig. 13B–C

Material examined

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31B; Rhaetian, Upper Triassic; MNHN.F.F63318.

Dimensions

L = 618 µm; H = 494 µm.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Pokornyopsis feifeli (Triebel, 1941) from the Early to Late Jurassic (see Tóth & Cséfán 2018 for a summary) is characterized by having strongly reticulate valves with parallel ribs surrounded by 3 concentric marginal ribs. *Pokornyopsis* sp. 1 has less numerous and more spaced parallel ribs on the lateral surface. The three marginal ribs of *P. feifeli* are here lacking, a strong thin ridge runs parallel to the free margin, the rostrum is more pronounced, and the incisure is deeper and narrower.

Pokornyopsis? sp. 2
Fig. 13D–E

Material examined

ROMANIA • 1 complete carapace; Black Sea, Romanian Continental Shelf, borehole 817LV, sample CM31A; Rhaetian, Upper Triassic; MNHN.F.F63319 • 1 complete carapace; same collection data as for preceding; Rhaetian, Upper Triassic; MNHN.F.F63320.

Dimensions

LV (Fig. 13D): L = 289 µm; H = 258 µm.
RV (Fig. 13E): L = 228 µm; H = 203 µm.

Occurrence

Romanian Continental Shelf, Black Sea, Rhaetian, Upper Triassic (this paper).

Remarks

Pokornyopsis? sp. 2 is close to *Polycope*? or *Thaumatocypris*? sp. from the Jurassic of Tethys (Oertli 1972: pl. 3, figs 39–42) in having a sharp and pointed outline of the rostrum. However, the ornamentation of the present specimen is much stronger than in the Jurassic material. Furthermore, a postero-dorsal nodule is apparently present and relates the present specimen to the genus *Pokornyopsis*, which is not reported in Oertli (1972).

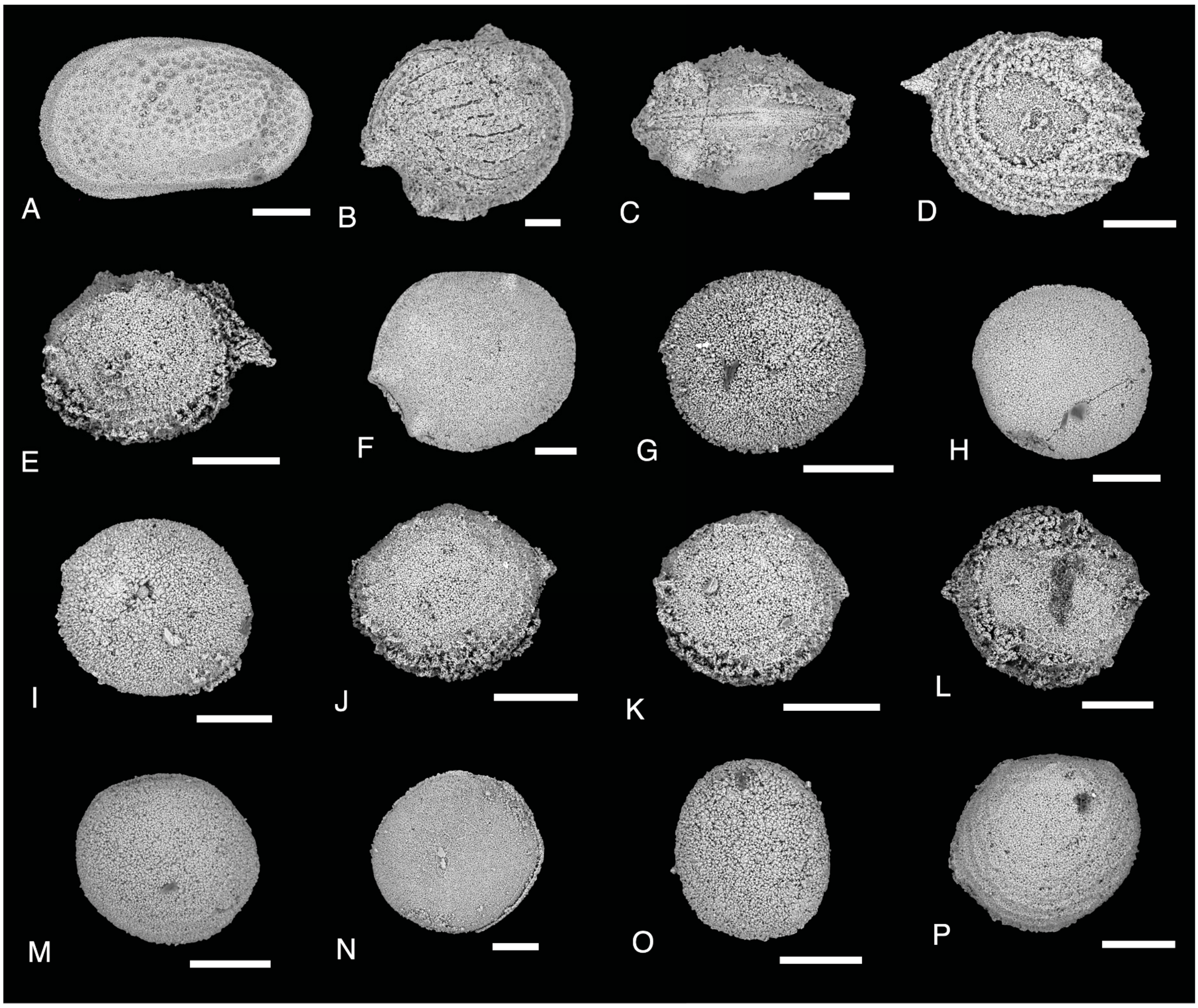

Fig. 13. SEM micrographs of ostracods from borehole 817 Lebăda Vest, drill core CM31, western portion of Black Sea shelf, Rhaetian, Late Triassic. All specimens are housed in the collections of the Muséum national d'histoire naturelle, Paris, France (MNHN). **A**. *Leviella* sp., external view of a left valve, sample CM31C (MNHN.F.F63317). **B**–**C**. *Pokornyopsis* sp. 1. **B**. Left lateral view of a carapace, sample CM31B (MNHN.F.F63318). **C**. Same specimen, dorsal view. **D**–**E**. *Pokornyopsis*? sp. 2. **D**. Left lateral view of a carapace, sample CM31A (MNHN.F.F63319). **E**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63320). **F**. *Pokornyopsis* sp. 3, left lateral view of a carapace, sample CM31A (MNHN.F.F63321). **G**–**I**. *Hungaroleberis* sp. 1. **G**. Left lateral view of a carapace, sample CM31B (MNHN.F.F63322). **H**. Left lateral view of a carapace, sample CM31C (MNHN.F.F63323). **I**. Left lateral view of a carapace, sample CM31A (MNHN.F.F63324). **J**–**L**. *Hungaroleberis* sp. 2. **J**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63325). **K**. Right lateral view of a carapace, sample CM31A (MNHN.F.F63326). **L**. Left lateral view of a carapace, sample CM31A (MNHN.F.F63327). **M**. *Polycope* sp. 1, lateral view of a carapace, sample CM31A (MNHN.F.F63328). **N**. *Polycope* sp. 2, lateral view of a carapace, sample CM31B (MNHN.F.F63329). **O**. *Polycope* sp. 3, lateral view of a carapace, sample CM31A (MNHN.F.F63330). **P**. *Polycope* sp. 4, lateral view of a carapace, sample CM31C (MNHN.F.F63331). Scale bars: 100 µm.

Discussion

Diversity and taxonomic composition of ostracod assemblages

Each of the three samples collected from the Rhaetian sediments of the CM31 drill core 817LV performed on the Romanian Black Sea shelf yielded identifiable ostracods. In total, 72 species have been identified, belonging to 29 genera and 13 families. The genus *Histriabairdia* gen. nov. is newly described. Six species were previously known from the Triassic, seven are new (*Bairdiacypris argonautaii* sp. nov., *Ceratobairdia*? *akhilleusi* sp. nov., *Histriabairdia pontuseuxinusensis* gen. et sp. nov., *Isobythocypris atalantella* sp. nov., *Petasobairdia amazonella* sp. nov., *Paracypris ovidi* sp. nov. and *Pseudomacrocypris*? *kerabani* sp. nov.) and 59 are kept in open nomenclature due to poor preservation and/or paucity of material (including *Bairdia* sp. 7 in Mette & Mohtat-Aghai 1999 and *Bairdiacypris* sp. in Forel *et al.* 2018, which are known from other localities from the Late Triassic). Table 1 provides a complete taxonomic list of the three assemblages from the Rhaetian of the Romanian Black Sea shelf. The composition of the ostracod assemblages retrieved from the studied samples is rather homogeneous, yet some variations in the distribution of species within the 13 families are visible, as shown in Fig. 14. The highest diversity in terms of species and genera occurs in samples CM31B and CM31C, with 46 species each and 23 and 24 genera, respectively. The assemblage from sample CM31A yielded 40 species distributed in 22 genera.

The three studied assemblages are very similar in terms of taxonomic composition and only differ by accessory genera. They are first characterized by the overall massive dominance of Bairdiidae, which constitutes 48% of the species in CM31A (19 species; genera *Acratia*, *Bairdia*, *Bairdiacypris*, *Carinobairdia*, *Ceratobairdia*, *Fabalicypris*, *Histriabairdia* gen. nov., *Isobythocypris*, *Lobobairdia*, *Mirabairdia* and *Petasobairdia*), 50% in CM31B (23 species; genera *Acratia*, *Bairdia*, *Bairdiacypris*, *Carinobairdia*, *Ceratobairdia*, *Hiatobairdia*, *Histriabairdia* gen. nov., *Isobythocypris*, *Lobobairdia* and *Petasobairdia*) and 52% in CM31C (24 species; genera *Acratia*, *Bairdia*, *Bairdiacypris*, *Carinobairdia*, *Ceratobairdia*, *Hiatobairdia*, *Histriabairdia* gen. nov., *Isobythocypris*, *Lobobairdia* and *Petasobairdia*). Paracyprididae are second in terms of species proportions: 15% in CM31A (6 species), 11% in CM31B (5 species) and 11% in CM31B (4 species), represented by "*Aglaiocypris*" and *Paracypris* in all three assemblages. The third most important component of these assemblages are Sigilliidae, only represented by the genus *Cardobairdia*: 10% in CM31A, 9% in CM31B and 7% in CM31C. Polycopidae are fourth in terms of importance, only represented by the genus *Polycope*, and are 8% of the species in CM31A, and 7% in CM31B and CM31C. Cylindroleberididae (genus *Hungaroleberis*), Cytherellidae (genera *Cytherelloidea*, *Leviella*), Healdiidae (genus *Hungarella*), Cytheruridae (genera *Judahella*, gen. indet.) and Pontocyprididae (genus *Pseudomacrocypris*) are accessory components of all assemblages. Thaumathocyprididae (genus *Pokornyopsis*) only occur in CM31A and CM31B. Bythocytheridae are only found in CM31B and CM31C. Macrocyprididae and Rectonariidae only occur in CM31B and CM31C, respectively.

Palaeoenvironmental implications

The autochthonous or allochthonous nature of ostracod assemblages is generally discussed by the proportion of complete carapaces vs isolated valves, as well as the demographic structure of populations (e.g., Oertli 1971; Boomer *et al*. 2003). In the studied assemblages from the Rhaetian deposits of the Romanian Black Sea shelf, isolated valves occur but they are not dominant and thus indicate that some transportation might have occurred. However, ten of the species are composed of adults and successive ontogenetic stages (Figs 3–4): if transportation occurred, it may have been very limited.

A first important feature for palaeoenvironmental conditions is here the overall dominance of Bairdiidae, which is a good indicator of open marine conditions throughout the investigated interval. The low diversity and abundance of Cytheruridae, with the absence of *Eucytherura* Müller, 1894, is worth noting in the

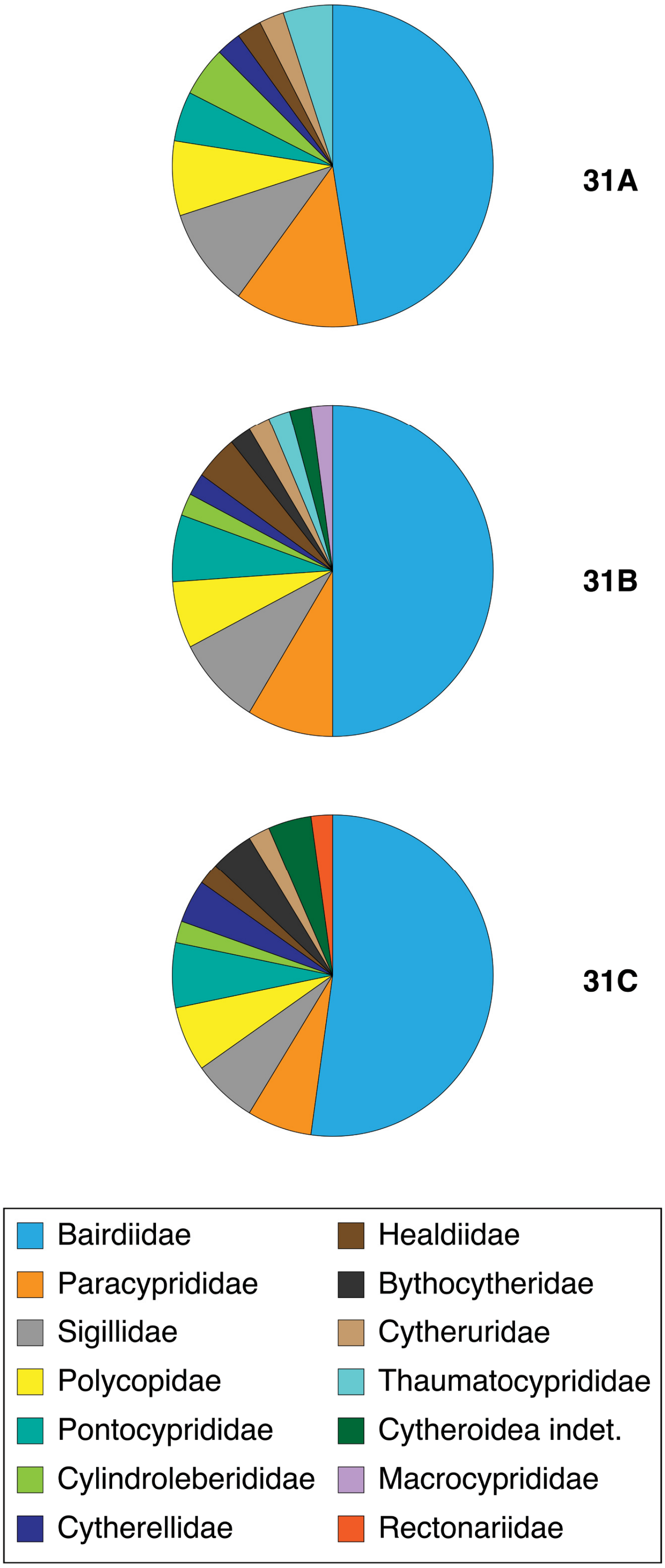

Fig. 14. Circular diagrams of faunal composition of ostracod assemblages by number of species in each group from drill core CM31, Black Sea, Romanian Continental Shelf, Rhaetian, Late Triassic.

present assemblages from the Rhaetian deposits of the Romanian Black Sea shelf. During the Mesozoic, cytherurids were restricted to shelf depths, including marginal marine habitats: they are crawlers that dwell on and in soft, relatively fine-grained substrates (silt and fine sand) and generally indicate shallow marine conditions with clear and well-oxygenated waters (e.g., Ballent & Whaltey 2000, 2009). In line with this observation is the limited occurrence of Cytherellidae, which are generally significant in warm water littoral environments (e.g., Sohn 1962; Kornicker 1963; Urlichs 1972; Whatley *et al*. 1995) and absent from shallow cold waters in the Mesozoic (Whatley 1988). For instance, Cytheruridae occurred on the outer platform-upper slope zone offshore of Turkey during the Carnian, Late Triassic (Forel *et al*. 2019a), but their absence from Early Jurassic deposits of Turkey (Lord & Lambourne 1991) and Austria (Honigestein *et al*. 2014) has been considered as indicative of bathyal and outer neritic-upper continental slope conditions, respectively. Consequently, the low diversity and abundance of both platycopids and cytherurids seem to point to relatively deep conditions.

Accessory components of each assemblage document slight environmental differences. Bythocytheridae found in Middle and Late Triassic deep-sea deposits (e.g., Crasquin-Soleau & Grădinaru 1996; Kozur *et al*. 2000; Sebe *et al.* 2013; Forel *et al.* 2019a) are rare but present in CM31B and CM31C, possibly demonstrating a relatively deeper position for these two assemblages compared to CM31A. Rectonariidae, which were typical Palaeozoic deep-sea taxa, occur in CM31C. Similarly, the thaumathocypridid *Pokornyopsis* is benthic and its maximum distribution depth is 200 m (Aubrecht & Kozur 1995). These Thaumathocyprididae only occur in CM31A and CM31B, which may indicate that CM31A was deposited under a slightly shallower water column. To sum up, the ostracod assemblages collected from the Rhaetian deposits of the borehole 817LV drilled on the Romanian Black Sea shelf indicate open marine conditions. They furthermore document an increase in water depth from CM31A, deposited in the deep subtidal zone, to CM31C, which may correspond to the outer shelf area in normal marine oxygenation.

A point on the genus *Petasobairdia* Chen, 1982

Petasobairdia amazonella sp. nov., newly described here from the Rhaetian deposits of the Romanian Black Sea shelf calls for a necessary clarification of the concept of *Petasobairdia*. *Petasobairdia* Chen, 1982 was erected to accommodate bairdiids with laterally compressed antero-ventral and postero-ventral margins, with the dorsal margin of the LV bearing a ridge, nodes, denticulation or horny spines (Chen & Shi 1982). This genus was described from the Late Permian of South China and is said to occur from the Devonian to the Triassic (Chen & Shi 1982). The Devonian occurrences were, however, not discussed or detailed by Chen & Shi (1982), a fact that was also underlined by Becker (2001). Kozur (1985) provided a range extension from the Early Carboniferous to the Late Permian for *Petasobairdia* and created two tribes within the newly erected subfamily Ceratobairdiinae: Ceratobairdiini and Petasobairdiini. In this concept, Ceratobairdiini (Early Permian–Recent) contains *Ceratobairdia* Sohn, 1954 and *Havanardia* Pokorny, 1968, and have a strongly inflated or winged ventrolateral area with the flattened ventral surface delimited by a ventral strip, the dorsal margin of LV strongly convex, smooth or with small numerous or one or two large spines, and the lateral surface smooth to reticulate (Kozur 1985). Conversely, Petasobairdiini (Late Permian-Rhaetian) contains *Petasobairdia* and *Alatobairdia* Kristan-Tollmann, 1971, and have one or two long spines on the dorsal margin of the LV, with the lateral surface smooth to reticulate (Kozur 1985). In the same paper, *Praelobobairdia* Kozur, 1985 was erected (subfamily Carinobairdiinae), differing from *Petasobairdia* by the laterally compressed dorsal overlap of LV over RV, while it bears horns or spines in *Petasobairdia*. On this new basis, Kozur (1985) re-attributed the Permian species *Petasobairdia nantongensis* Chen, 1982, *Petasobairdia* sp. in Chen & Shi 1982 and *P. subnantongensis* Chen in Shi & Chen, 1987 to *Praelobairdia*.

However, the taxonomic status of *Praelobobairdia* and *Petasobairdia*, should they be synonyms or not, has been unstable and unclear, highlighting the confusion between these genera. This taxonomic re-attribution has indeed never been followed in subsequent papers scrutinizing assemblages from the Permian–Triassic interval worldwide, referring for instance to *Petasobairdia nantongensis* (e.g., Shi & Chen 1987; Yi 2004; Crasquin-Soleau *et al*. 2004; Crasquin *et al*. 2010; Forel & Crasquin 2011; Forel *et al*. 2015; Chitnarin *et al*. 2017), which implies that most authors implicitly consider *Praelobairdia* as a junior synonym of *Petasobairdia*. The only contributions that consider these two genera as distinct deal with the Late Permian assemblages from Israel (Gerry *et al*. 1987; Honigstein *et al.* 2005) and the Middle Permian of Thailand (Chitnarin *et al*. 2008), this last example illustrating the instability of authors regarding their concept of these genera. *Praelobobairdia* has been considered as a possible synonym of *Petasobairdia* (Becker 2001: 286). Here, this view is followed and two morphs are discriminated: the spinose/horny forms and the laterally compressed forms. This choice might be debatable, as it relies on the still unresolved issue of how to integrate the ornamentation features of Bairdiidae in their classification. However, considering the two morphological groups as distinct genera or as morphs within a unique genus is only a matter of semantics, which does not impair the scientific clustering of these species. The only necessity is thus to maintain a stability of taxonomic concepts until new analyses can be carried out on the significance of outer ornaments in bairdiids and of the phylogeny of Permian and Triassic ornate forms that have been proposed to be rooted in the Early Permian *Petasobairdia* (Forel & Crasquin 2020). Here we follow Kozur (1985) in re-attributing *Ceratobairdia gombasekensis* Kozur, 1971 from the Ladinian, Middle Triassic, of Slovakia (Kozur 1971b) to *Petasobairdia* as its ventral margin is not winged. Conversely, *Praeloboairdia* cf. *silenitiformis* Kozur, 1985 from the Middle Permian of Thailand (Chitnarin *et al*. 2008) is not here re-attributed to *Petasobairdia*, because the dorsal margin on the LV is hardly visible. *Praelobobairdia* sp. from the Early–Middle Triassic of Israel (Honigstein & Crasquin 2011) cannot be confirmed, as the illustrated specimens are heavily covered with sediment.

Stratigraphic and geographical distributions: updates and discussion

Research on Late Triassic marine ostracods worldwide sheds new light to the pivotal mechanisms underlying the Palaeozoic–Mesozoic turnover, i.e., the residual occurrence of Palaeozoic taxa up to the Late Triassic (e.g., Kozur *et al.* 2000; Forel *et al.* 2019a) and the early roots of typical Triassic and Jurassic taxa (e.g., Kristan-Tollmann 1983, 1993; Forel *et al.* 2019b). As summarized in Forel & Moix (2020), three major hypotheses have been proposed for the area of origin of Mesozoic tethyan ostracods: western America (Kristan-Tollmann & Tollmann 1981, 1982; Kristan-Tollmann 1986a, 1986b, 1988), western Tethys (Bate 1977; Lord 1988) and eastern Tethys (Bate 1977; Lord 1988; Kristan-Tollmann 1983, 1993; Ketmuangmoon *et al.* 2018; Forel *et al.* 2019b). An analysis performed at the generic and species levels documented the complexity of these issues and the intricate mixture of westward migration of genera (e.g., *Nodobairdia* as shown in Ketmuangmoon *et al.* 2018; *Carinobairdia* as shown in Forel *et al.* 2019b) and eastward migration of species (e.g., *Nodobairdia mammilata*; Forel & Moix 2020). Our understanding of the radiative explosion of ornate Bairdiidae characterizing the Triassic has recently been renewed by the introduction of a new phylogenetic model for their radiation and evolution through the Permian and the Triassic (Forel & Crasquin 2020). In reaching the general aim of unravelling the Palaeozoic–Mesozoic transition, new occurrences and spatial distribution are major tools, at all taxonomic levels.

Cardobairdia was described from the Middle Eocene of Trinidad (van den Bold 1960). It has since turned out to be typical of Jurassic layers of western Tethys (e.g., Apostolescu 1959; Szczechura & Blaszyk 1968; Harloff & Jäger 1994; Monostori 1996; Boomer *et al.* 1998; Ainsworth & Boomer 2001; Olempska & Blaszyk 2001; Beher 2004). The large geographical distribution of its oldest records in the Early Jurassic of England, Ireland (Lord & Boomer 1988; Ainsworth 1986, 1987) and Australia (Lord *et al.* 1993) documented that *Cardobairdia* may have radiated earlier in the Triassic. The earliest roots of *Cardobairdia* have recently been identified in the Carnian of Slovenia (Forel *et al.* 2020b) and the present assemblages display the highest Triassic diversity for this genus which is, at the time of writing, not known from anywhere else during the Rhaetian. At this time, the early history of this important Jurassic taxon is purely western-tethyan, from its Carnian roots to the present record of a major diversification in the Rhaetian.

In terms of species, *Judahella andrusovi* Kozur & Bolz in Bunza & Kozur, 1971 (Fig. 11L–M) is a long lasting species known from the Late Anisian (Kristan-Tollmann 1983) to the Rhaetian (Urlichs 1972; Kristan-Tollmann *et al.* 1980, 1991a; Kristan-Tollmann 1988; Mette *et al.* 2012; this paper). This species was described from the Norian, Late Triassic, of Austria (Bunza & Kozur 1971), but it radiated from the south Chinese shores on the eastern side of Tethys in the Anisian, Middle Triassic. The spatio-temporal distribution of this species is a new indicator of the importance of the easternmost Tethys (South China Block and Indochina Block) for the radiation and subsequent dispersal of taxa that later became typical for the Triassic or Jurassic of the western tethyan area (e.g., Kristan-Tollmann 1983; Ketmuangmoon *et al*. 2018; Forel *et al*. 2019b).

The Triassic myodocopid fossil record from the North Dobrogea is rich compared to that of contemporaneous assemblages (e.g., Crasquin-Soleau & Grădinaru 1996; Sebe *et al.* 2013; Forel & Grădinaru 2018). Until the present record, the thaumatocyprid *Pokornyopsis* was only known from the Jurassic (e.g., Triebel 1941; Bartenstein 1949; Aubrecht & Kozur 1995; Tóth & Cséfán 2018). Kozur (1974) and Aubrecht & Kozur (1995) mentioned the occurrence of specimens of *Pokornyopsis* in the late Triassic, but these were not further discussed or illustrated and Tóth & Csefan (2018) revealed that the specimens were lost. The present analysis of Rhaetian deposits from the Romanian Black Sea shelf therefore reports the first verified record of *Pokornyopsis* in the Triassic. *Pokornyopsis* is considered as the forerunner of recent anchialine and submarine cave ostracod taxa, including *Danielopolina* Kornicker & Sohn, 1976. In the Jurassic, *Pokornyopsis* occurs in submarine neptunian dykes and crevices and it is assumed that this stock may have “survived in the stable, old crevicular habitat from the Mesozoic Tethys” with “extremely small changes within this stock since the Triassic” (Aubrecht & Kozur 1995: 8). However, the sediments observed from the Romanian Black Sea shelf show no indication of crevicular deposition. Similarly, a project currently in progress by the present two authors on ostracods from Late Triassic neptunian dykes lack any trace of *Pokornyopsis*. This would rather indicate that *Pokornyopsis* did not colonize crevicular systems in the Triassic. *Hungaroleberis* has been reported from the Wordian, Middle Permian, of Greece (Crasquin-Soleau & Baud 1998) to the Bajocian, Middle Jurassic, of Hungary (Tóth & Cséfán 2018), and the species reported in this paper (Fig. 13G–L) correspond to its first known occurrence in the Triassic worldwide.

Data documenting the residual survivorship of Palaeozoic taxa in the Triassic have considerably increased in the recent years and have shown the importance of deep-water areas. Of them, Palaeocopida, which were among the chief components of the Palaeozoic fauna, have been traced up to the Carnian, Late Triassic, documenting their last presence in deep waters (Forel *et al*. 2019a). Palaeozoic deep-sea taxa such as Beecherellidae have also been increasingly documented up to the Middle Triassic (Kozur 1970; Crasquin-Soleau & Grădinaru 1996; Sebe *et al.* 2013) and even to the Carnian, Late Triassic (Forel *et al*. 2019a). These taxa can now be considered as representative of deep waters of the tethyan Triassic and are irreplaceable proxies to trace deep-water conditions during this interval. Similar recognition is difficult in the Jurassic because of the absence of these distinctive facies-ostracods and deep-water assemblages are recognized by their dissimilarity with known coeval material (e.g., Lord & Lambourne 1991; Honigstein *et al*. 2014). Rectonariidae were also important Palaeozoic deep-water taxa (e.g., Gründel 1962; Blumenstengel 1979; Kozur 1991) and they were considered as victims of the end-Permian/Triassic event until their discovery in Carnian deep-water sediments of Turkey (Forel *et al*. 2019a). The present record of Rectonariidae gen. 1 in Forel *et al*. 2019 (Fig. 10E) is important for several reasons: 1) it represents the latest known occurrence of unquestionable facies-type ostracods related to the deep-sea, 2) it extends the record of Rectonariidae to the brink of the end-Triassic extinction after its Lazarus record from the Changhsingian to the Carnian and 3) it documents a maintained radiation in the deep sea, as this genus is new to science and restricted to the Triassic, ranging from the Carnian to the Rhaetian.

Conclusions

Ostracods of Rhaetian, Late Triassic, age have been extracted from drill core CM31, sampled from borehole 817 Lebăda Vest, drilled on the western Romanian portion of Black Sea shelf. The ostracod assemblage is composed of 72 species, which represent 29 genera and 13 families. The genus *Histriabairdia* gen. nov. is newly described to accommodate species from the Triassic–Jurassic interval that were previously attributed to the extent genus *Anchistrocheles*. Seven new species are described: *Bairdiacypris argonautaii* sp. nov., *Ceratobairdia*? *akhilleusi* sp. nov., *Histriabairdia pontuseuxinusensis* gen. et sp. nov., *Isobythocypris atalantella* sp. nov., *Petasobairdia amazonella* sp. nov., *Paracypris ovidi* sp. nov. and *Pseudomacrocypris*? *kerabani* sp. nov. The environmental affinities of the recovered taxa suggest an outer shelf environment with relatively normal marine oxygenation. We discuss the record of the genus *Petasobairdia* in the Permian–Triassic interval, and its synonymy with *Praelobobairdia*. The present material further provides the youngest record of Rectonariidae as well as the oldest verified occurrence of *Pokornyopsis*, the forerunner of recent anchialine and submarine cave ostracod taxa. However, contrary to previous claims, the Rhaetian material analysed here shows that *Pokornyopsis* may not have been troglobytic in the Triassic.

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