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New genera and species of ostracods from the El Ma El Abiod Miocene Basin (Tébessa, NE Algeria)

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Abstract: Two new ostracod genera of the family Trachyleberididae SYLVESTER-BRADLEY, 1948, each based on a new species, are described and commented here. The specimens were collected in Tortonian sediments cropping out at El Hadjra Safra in the El Ma El Abiod basin (region of Tébessa, north-eastern Algeria).

Key-words:

- Ostracoda;
- Trachyleberididae;
- Tortonian;
- new taxa;
- Algeria

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Résumé : ***Nouveaux genres et espèces d'ostracodes du Bassin miocène d'El Ma El Abiod (Tébessa, NE de l'Algérie).-*** Deux nouveaux genres d'ostracodes de la famille Trachyleberididae SYLVESTER-BRADLEY, 1948, chacun fondé sur une espèce nouvelle, sont décrits et discutés dans cet article. Les spécimens proviennent de sédiments tortoniens affleurant à El Hadjra Safra dans le bassin d'El Ma El Abiod (région de Tébessa, nord-est de l'Algérie).

Mots-clefs :

- Ostracodes ;
- Trachyleberididae ;
- Tortonien ;
- nouveaux taxons ;
- Algérie

1. Introduction

Fossil ostracod fauna in Algeria is known only through few papers related to Tertiary (CARBONNEL & COURME-RAULT, 1995, 1997; COUTELLE & YASSINI, 1974; GUERNET *et al.*, 1984; BRACCINI & PEYPOUQUET, 1995) and Cretaceous (MAJORAN, 1989; VIVIÈRE, 1985). Therefore, the present paper represents a further small contribution to the knowledge of the Miocene ostracod fauna of this part of the North Africa. This study adds to the knowledge of Tortonian facies in the area south of the town of Tébessa, which has been studied little.

2. General setting, material and method

The El Ma El Abiod Miocene basin is located near the town of Tébessa, near the Tunisian border. It is geographically included in the Eastern Saharan Atlas (N Africa) (Fig. 1).

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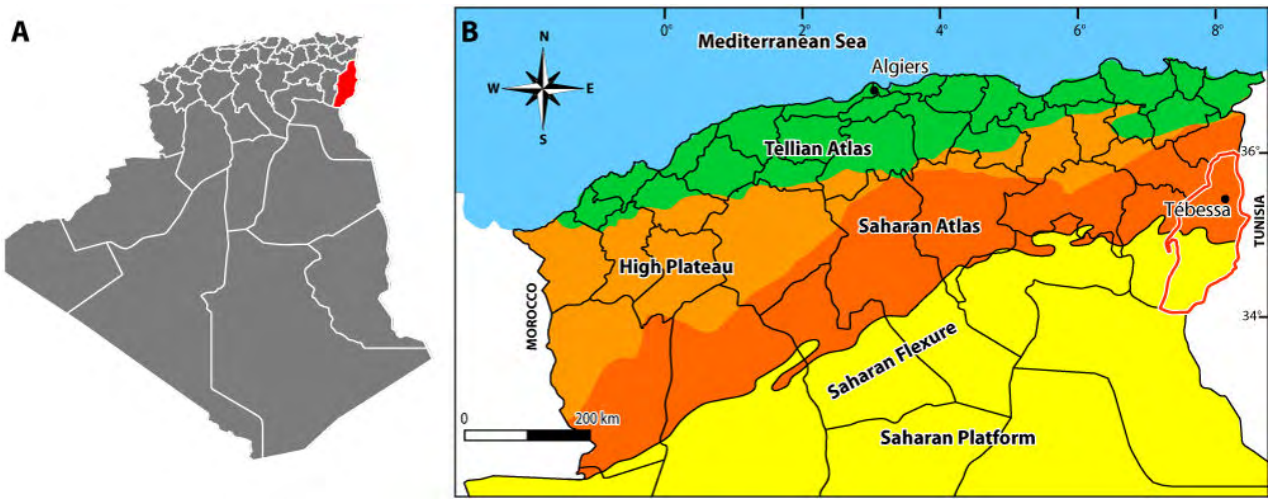

Figure 1: Morphostructural domains of the North Algeria (after many authors).

Figure 2: Geologic-structural scheme of the Tébessa area (after DUROZOY, 1956). Aerial photos © 2021 IGN France.
Figure 3: El Hadjra Safra sampling station. Aerial photos © 2021 CNES/Airbus, Maxar technologies.

The Saharan Atlas extends in North Africa from the Atlantic to Algeria and the Pelagian Sea, north of the Saharan platform. It is considered an area of crustal weakness inherited from Triassic aborted rifting episodes associated to the opening of the Atlantic Ocean. During the late Lias, tectonics gave rise to the Atlasic trough, trending from Morocco to Tunisia. The Cretaceous–Eocene period was marked by the development of the worldwide "Mid-Cretaceous" transgression that proceeded both from the Atlantic and the Tethys. Since the Late Eocene, the entire Saharan Atlas was submitted to continental conditions. In the Algerian area, the Atlasic trough was filled and affected by transpressive deformation. Later, during the Cenozoic, as a consequence of the continental convergence between Africa and Europe, the region was subjected to tec-

tonics that led to the overlapping of ancient folds that uplifted the orogenic belt (*e.g.*, PIQUÉ *et al.*, 2002; ARBOLEYA *et al.*, 2004; BENAOUALI-MEBAREK *et al.*, 2006).

The El Ma El Abiod Miocene basin is located near the town of Tébessa, near the Tunisian border. It is geographically included in the Eastern Saharan Atlas (N Africa) (Fig. 1).

The Miocene was a period characterized by extensional tectonic phases that determined the formation of large sedimentary basins where sedimentary facies were deposited unconformably on the Meso-Cenozoic basement (BENAOUALI-MEBAREK *et al.*, 2006). Two wide Miocene sedimentary basins are in the Tébessa region: The El Aouinet-Meskiana Basin to the North and the El Ma El Abiod Basin to the South. In the latter, the samples that are the subject of this study were collected (Fig. 2).

The El Ma el Abiod Basin is located south of Tébessa (Fig. 2). Middle and Upper Miocene sediments fill this basin and they are divided into two different series, separated by a ferruginous crust: A lower series, occupying the eastern part of the basin, referable to the Middle Miocene, and an upper series, to the west, referable to Tortonian (KOWALSKI *et al.*, 1995a).

The Tortonian sediments that crop out unconformably over the Cretaceous- Eocene succession (Hamimed et al., 2015a, b; Defaflia et al., 2015) are referred to continental and/or transitional environments; however, locally, it is possible to find horizons rich in fragments of shells and micro-fauna referable to marine environments (present paper). These latter have already been verified in other Miocene outcrops in the Tébessa territory by KOWALSKI *et al.* (1995a, 1995b, 1996).

Within the El Ma el Abiod Basin, the marine sedimentary levels are particularly well exposed in El Hadjra Safra, few kilometres SE of the town of Tébessa, along the left side of the road southbound N16. The studied samples were found at this locality (Fig. 3).

Thirty-five samples, each one of 300-400 cm^3, along a 3.5 m succession of very fine-grained, whitish silty sands, were collected (Fig. 4.A-B). The sediments were routinely washed, dried and sieved; after that, ostracod specimens were picked from the > 63 µm fraction.

The specimens were examined and measured under a stereomicroscope and photographed by a LMU Tescan Vega II Scanning Electron Microscope at the Electronic Microscopy Laboratory of the Earth Science Section (University of Catania). The specimens are housed in the Palaeontological Museum of Catania University.

To classify ostracods, we consulted the systematics papers of MARTIN & DAVIS (2001), HORNE *et al.* (2001), and the website WoRMS (2021). To identify the taxa we consulted some of the key papers on Mediterranean Miocene ostracod fauna among which BONADUCE *et al.* (1988, 1992), BRACCINI & PEYPOUQUET (1995), CARBONNEL & COURME-RAULT (1995, 1997), CIAMPO (1980), COUTELLE & YASSINI (1974), GUERNET *et al.* (1984), RUGGIERI (1960), and RUSSO (1968).

This preliminary paper refers to the microfauna content of sample B3. It is a clayey-sandy silt from which only few ostracods and foraminifera have been extracted. Among the first, almost all the specimens found, both adults and immature, belong to two discrete taxa, which were considered new and, therefore, they are here described for the first time.

3. Systematic descriptions (F. SCIUTO)

Class Ostracoda LATREILLE, 1806
Order Podocopida SARS, 1866
Suborder Cytherocopina GRÜNDEL, 1967
Superfamily Cytheroidea BAIRD, 1850
Family Trachyleberididae SYLVESTER-BRADLEY, 1948
Subfamily Trachyleberidinae SYLVESTER-BRADLEY, 1948
Genus *Quasiagrenocythere* n.gen.

Etymology: Similar to *Agrenocythere* BENSON, 1972.

Type-species: *Quasiagrenocythere tevestaensis* n.gen. n.sp.

Diagnosis: Genus, at the present monospecific, considered belonging to the Subfamily Trachyleberidinae SYLVESTER-BRADLEY, 1948, characterized by a strong, large carapace, symmetric in dorsal view, reticulated, distinguishable from the Genus *Agrenocythere* BENSON, 1972, with which it shows some affinity, by the presence of an eye tubercle and the absence of the ventral carina.

Remarks: The new taxon here described shows some characters in common with other taxa: The Trachyleberidinae *Agrenocythere*, the Bradleyinae *Bradleya* HORNIBROOK, 1952, and *Poseidonamicus* BENSON, 1972.

Along with *Agrenocythere* the new taxon has in common the large size and the general shape of the carapace, the holamphydont hinge type, the polygonal ornamentation with well-marked large fossae and muri, the presence of something similar to the "castrum" described by BENSON (1972) and the pore conuli at the posterior end ("Terminus" in *Agrenocythere*). Conversely, the new taxon stands out by the presence of the eye tubercles, very few normal pores, the composite spines, a lower number of intramural pore conuli, and the absence of both the ventral carina and the "dorsal bullar series" defined by BENSON (1972: p. 20, fig. 8).

The new taxon has in common with the Genus *Bradleya* HORNIBROOK (1952): The "ocular ridge", the "posterodorsal" loop (BENSON, 1972: Fig. 9) and the hinge type; conversely, the ventral carina and the median ridge are absent, whereas it has a caudal process that is missing in *Bradleya*.

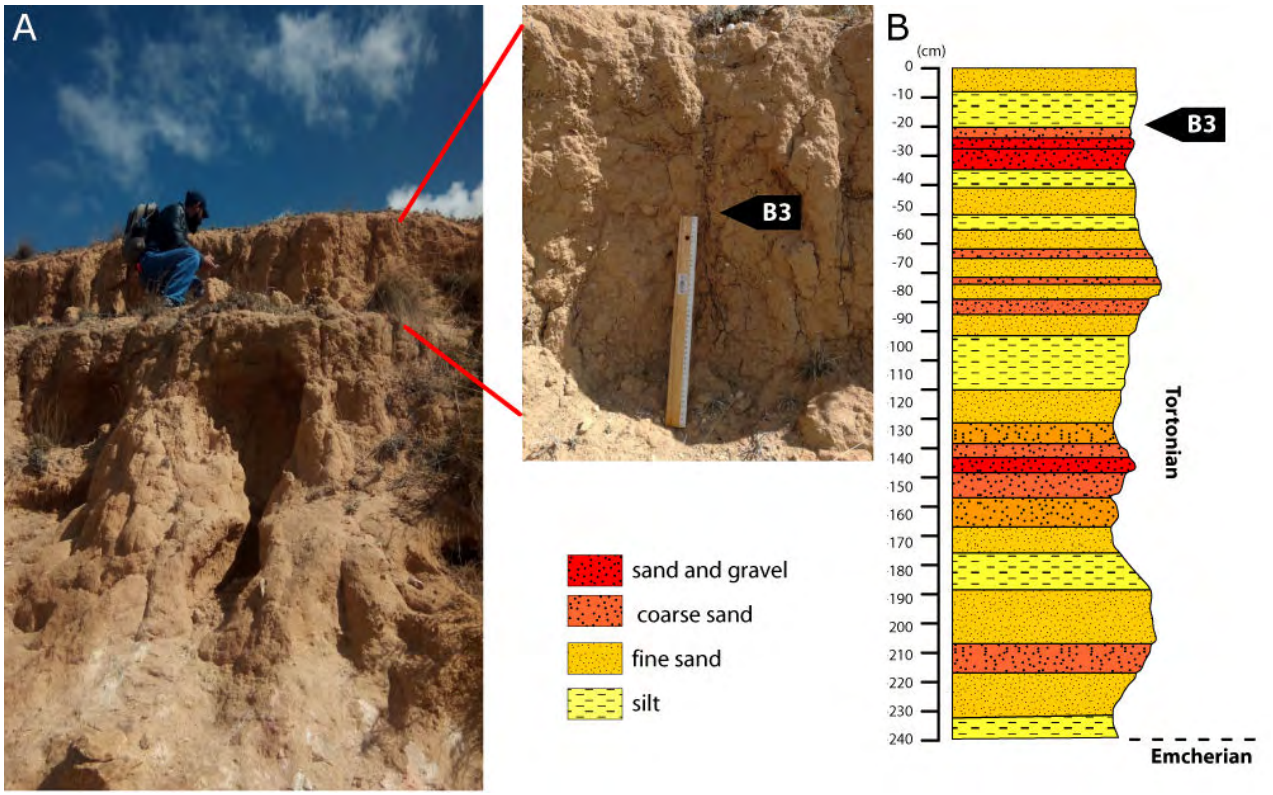

Figure 4: A) The sedimentary outcrops at El Hadjra Safra; B) corresponding lithological log.

Also *Poseidonamicus* shows the general carapace shape similar to that of the new genus, which is clearly distinguished by the presence of the ventral carina and the subvertical fossae arrangement in central part of the carapace.

Quasiagrenocythere n.gen. shows some morphological affinity also with the specimen figured in Russo (1968: Tav. 2, Fig. 6a) and belonging, according to the author, to the Hemicytheridae Genus *Hemicytheria* Pokorny, 1955. Nevertheless, although in disagreement with the author's identification, the different distribution of fossae on the carapace and the different position of the caudal processes distinguishes Russo's genus from the new genus.

***Quasiagrenocythere tevestaensis* n.gen. n.sp.**

(Pl. 1, figs. 1-6)

Etymology: From "Tevesta" the roman name of the city of Tébessa near the type locality.

Holotype: One complete carapace (PMC.O89 h 06.03.2021).

Paratypes: One complete carapace and four valves (PMC.O195 p 06.03.2021).

Other materials: Some immature specimens.

Type locality: El Hadjra Safra (south side of the P. Romain Mount, GPS 35°19'42"N 8°11' 31.8"E), along the road N16 southbound, in very fine-grained, whitish silty sands.

Stratigraphic range: Tortonian, identified by the first common occurrence (FCO) of *Neoglobocuadrina acostaensis* (Blow, 1959) (samples 8 to 10).

Diagnosis: Large-sized species with typical "trachyleberidinae" shape, with large reticulated ornamentation, prominent eye tubercle and acute caudal processes hooked upwards.

Description: Carapace large, elongated, sub rectangular in lateral external view. Anterior margin regularly arched and marked by numerous composite spines, dorsal margin straight and curved upwards at the eye tubercle; posterior margin with a caudal process slightly acute and hooked upwards with numerous composite spines in the lower part; ventral margin straight with shallow oral concavity. Symmetrical valves in dorsal view with anterior and posterior ends thick and flattened, central part of the carapace swollen with a slight central groove. Outer surface of the carapace ornamented by a polygonal grid with large fossae and strong muri. Fossae are irregularly arranged on the surface of the carapace except those in the anterior area where they are regularly aligned parallel to the anterior margin, and in the antero-central area, where the fossae are arranged almost concentrically to form what resembles the "castrum" (Pl. 1, fig. 4) of Benson (1972). The muri in the central part and along a centre line of the carapace are densely pitted (Pl. 1, figs. 4-5). Composite spines are present along the anterior and posterior margin, two "intramural pore conuli", the first positioned approximately in the middle of the dorsal border, the second at the end of the upper side of the caudal process. Few normal pore canals and few tubercles in the dorsal area. Eye tubercles well marked.

Table 1: Presence or absence of some important morphological characters in *Quasiagrenocythere*, *Agrenocythere*, *Bradleya* and *Poseidonamicus* useful for distinguishing the genera.

	Quasiagrenocythere	*Agrenocythere*	*Oblitacythereis*	*Bradleya*	*Poseidonamicus*
holamphidont type hinge	x	x	x	x	x
eye tubercles	x				
castrum	x	x			
posterior pore conul ("terminus")	x	x			
dorsal bullar series		x			
composite spines	x				
intramural pore conuli	very few	many			
ocular ridge				x	
posterodorsal loop/dorsal carina	x		x	x	x
ventral carina		x	x	x	x
median ridge			x	x	
caudal process	x	x			x

Inner lamella: Anteriorly and postero-ventrally wide. Holamphidont hinge type. Muscle scars typical of the Trachyleberidinae.

Sexual dimorphism clear: Female more inflated posteriorly than male one.

Okadaleberis (?) *benzartiae* n.sp. described and figured in SCIUTO *et al.*, 2021, p. 9, Fig. 4.4, now, on the basis of these characters, can be referred to this new genus.

Genus *Pseudomutilus* n.gen.

Type-species: *Pseudomutilus benkheddai* n.gen. n.sp.

Etymology: From the Greek word ψευδής = sham + *Mutilus*

Diagnosis: Genus belonging to Subfamily Trachyleberidinae SYLVESTER-BRADLEY, 1948, characterized by medium-sized carapace, ornamented by strong, acute crests that intersect forming very wide polygonal fossae.

Remarks: The carapace of the new genus has some morphological affinity with the Hemicytheridae genera *Procythereis* SKOGSBERG, 1928, *Arutella* BONADUCE *et al.*, 1987, and *Mutilus* NEVIANI, 1928. In the first case the robust rib simulating a wing typical of the Genus Procythereis (POKORNY, 1955) is evident in dorsal and ventral views. However, the hinge type, the ornamentation, the absence of pits (other characteristics present in *Procythereis*), the high position of the caudal process, the strong eye tubercle are all characters that allow the distinction between *Pseudomutilus* n. gen. and *Procythereis*. In the case of *Arutella*, the similarity simply concerns the general shape of the carapace; the different hinge type, the caudal process position, the different type of fossae without any type of tegmination differentiate the two genera. The new genus is distinguished from *Mutilus* by the absence of the ridge crossing the eye tubercle and the so-called "butterfly" of BONADUCE *et al.* (1987: p. 252, Fig. 1).

Pseudomutilus benkheddai n.gen. n.sp.

(Pl. 1, figs. 7-10)

Etymology: From the father's name of the second author: "Benkhedda".

Holotype: One complete carapace (PMC.O90 h 06.03.2021).

Paratypes: Two complete carapaces and two valves (PMC.O196-197p 06.03.2021).

Type locality: El Hadjra Safra (south side of the P. Romain Mount, GPS 35°19'42"N 8°11' 31.8"E), along the road N16 southbound, in very fine-grained, whitish silty sands.

Stratigraphic range: Tortonian identified by the first common occurrence (FCO) of *Neogloboquadrina acostaensis* (BLOW, 1959) (samples 8 to 10).

Diagnosis: Carapace "*Mutilus*-shaped" but without the crest crossing the eye tubercle and without the so-called "butterfly" of BONADUCE *et al.* (1987).

Description: Carapace medium-sized, sub rectangular, strong; anterior margin arched, slightly inclined down and marked by a sharp crest, which continues on the straight dorsal margin; ventral margin slightly curved with a weak oral convexity; at two thirds of its length it slopes steeply upwards reaching an obtuse upward hooked caudal process. Oval-shaped carapace in dorsal and ventral view with symmetrical valves strongly overlapping. Outer surface of the carapace ornamented by strong acute crests that cross irregularly to form a large polygonal grid. Four main crests have a greater longitudinal development than the others; the first extends along the anterior, dorsal and ventral margin; the second is present in anteroventral position; the third begins in an anteroventral position, it joins the posterior ventral border simulating a wing, then bends suddenly upwards and ends in the posterodorsal position; the fourth crest starts in the middle of the anterior margin, extends towards the centre up to the first third of

the carapace, then folds towards the dorsal caudal area in an anterocentral position. Eye tubercle well marked. Inner lamella: anteriorly and postero-ventrally wide. Hinge: amphidont type.

4. Conclusion

The description of these two new taxa contributes to the knowledge of the Algerian Miocene ostracofauna. At the present time, the genera described are monospecific, only found in the fossil record and associated with an extremely scarce microfauna; therefore, it is not possible to formulate any hypothesis on their autoecology and/or synecology. The analogies of *Quasiagrenocythere* n.gen. and *Pseudomutilus* n.gen. with the different genera with which they were compared, could confirm, in the first case, an aptitude for deep water or relatively deep-water environments, and, in the second case, a tendency to more superficial environments. Further research may provide new data that will allow a more detailed paleoecological result.

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Plate

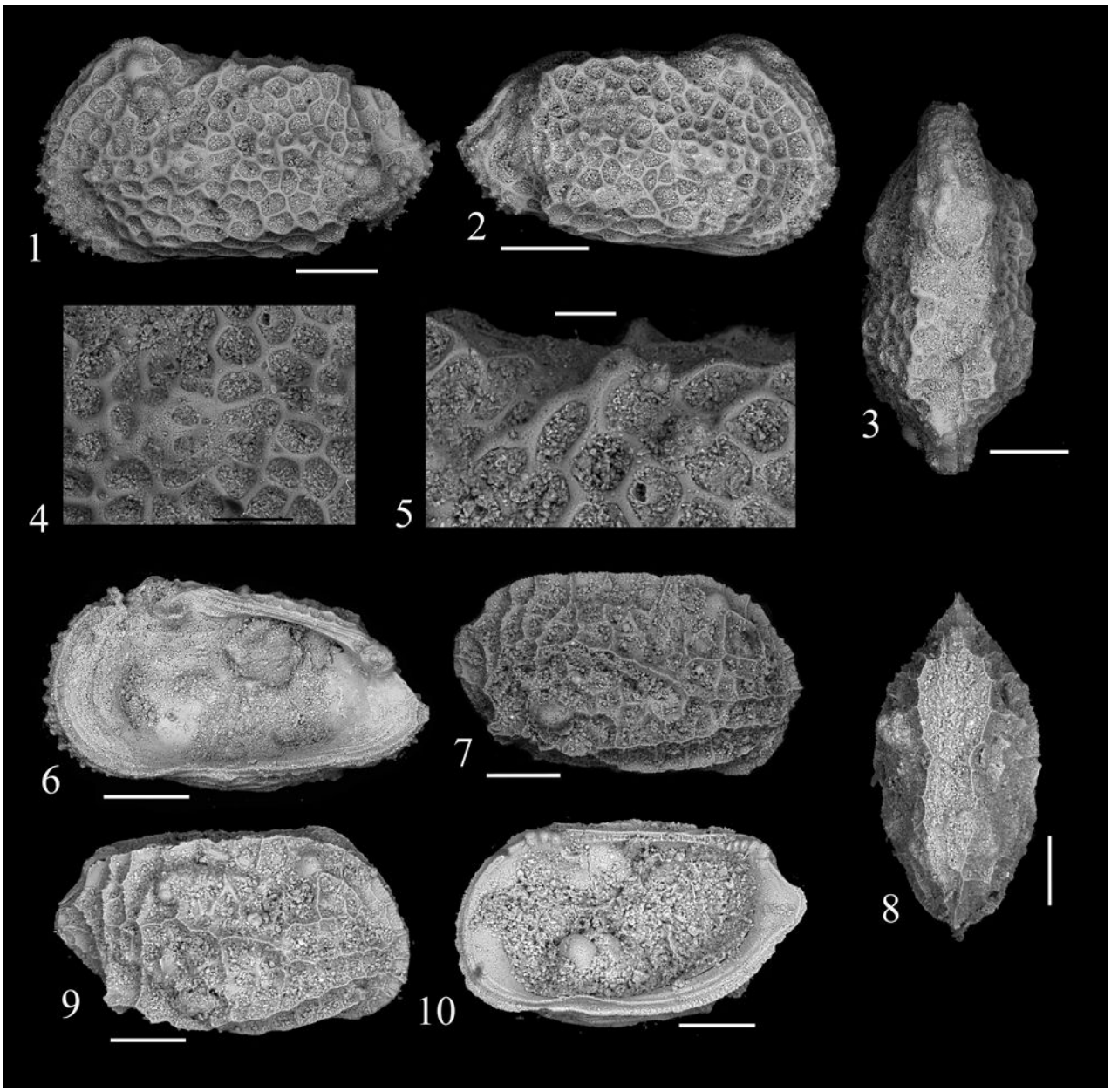

Plate 1: Figs. 1-6 *Quasiagrenocythere tevestaensis* n.gen. n.sp.; figs. 7-10 *Pseudomutilus benkheddai* n.gen. n.sp.
1- *Quasiagrenocythere tevestaensis* n.gen. n.sp. Paratype. Left valve external lateral view, male, scale bar 200 µm.
2- *Quasiagrenocythere tevestaensis* n.gen. n.sp. Paratype. Right valve external lateral view, female, scale bar 200 µm.
3- *Quasiagrenocythere tevestaensis* n.gen. n.sp. Holotype, dorsal view, scale bar 200 µm.
4- The "*castrum*" in *Quasiagrenocythere tevestaensis* n.gen. n.sp., scale bar 100 µm.
5- Pore-conul in *Quasiagrenocythere tevestaensis* n.gen. n.sp., scale bar 100 µm.
6- *Quasiagrenocythere tevestaensis* n.gen. n.sp. Internal view, scale bar 200 µm.
7- *Pseudomutilus benkheddai* n.gen. n.sp. Paratype, right valve external lateral view, scale bar 100 µm.
8- *Pseudomutilus benkheddai* n.gen. n.sp. Holotype, ventral view, scale bar 100 µm.
9- *Pseudomutilus benkheddai* n.gen. n.sp. Paratype, right valve external lateral view, scale bar 100 µm.
10- *Pseudomutilus benkheddai* n.gen. n.sp. Paratype, right valve internal view, scale bar 100 µm.

Nomenclatural note:
Life Sciences Identifier (LSID)
http://zoobank.org/References/1A4D4181-9A67-4F65-BE54-9EB31219D02B

Genus Group

• *Quasiagrenocythere* SCIUTO *in* SCIUTO & BENKHEDDA, 2021

http://zoobank.org/NomenclaturalActs/60e0bc17-2b4b-47f0-a4a8-bc457ec4bade

• *Pseudomutilus* SCIUTO *in* SCIUTO & BENKHEDDA, 2021, 2021

http://zoobank.org/NomenclaturalActs/54f74234-9c81-4f81-b754-4c4048a95950

Species Group

• *Quasiagrenocythere tevestaensis* SCIUTO *in* SCIUTO & BENKHEDDA, 2021

http://zoobank.org/NomenclaturalActs/e5e5acbe-ae43-4157-88a7-cec669445243

• *Pseudomutilus benkheddai* SCIUTO *in* SCIUTO & BENKHEDDA, 2021

http://zoobank.org/NomenclaturalActs/45b992cf-a038-48b0-9c7d-3d5a4123b887