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Unusual scaled preservation samples on freshwater decapods (Crustacea, Decapoda) from the Pleistocene (Late Cenozoic) of Turkey and Kazakistan

Abstract - We report two rare examples of preservation by calcareous incrustation of two specimens of decapod crustaceans, discovered in continental carbonate deposits from the Pleistocene (Late Cenozoic) of SW Turkey (W Anatolia) and S Kazakistan (“Caucasian Area”) respectively. The specimen from Turkey is assigned to *Potamon* Savigny, 1816 (Potamidae) while the specimen from Kazakistan is assigned to *Austropotamobius* Skorikov, 1907 (Astacidae).

Key words: incrustation, Crustacea, Decapoda, Pleistocene, Anatolia, Caucasian Area.

Riassunto - Esempi di inusuale conservazione per incrostazione in decapodi di acqua dolce (Crustacea, Decapoda) del Pleistocene (Cenozoico superiore) dell’Anatolia e del Kazakistan.

Vengono descritti due rari esempi di conservazione per incrostazione calcarea in due campioni di crostacei decapodi provenienti rispettivamente da depositi carbonatici continentali del Pleistocene (Cenozoico superiore) della Turchia asiatica (Anatolia occidentale) e del Kazakistan meridionale (“Area Caucasicca”). L’esemplare della Turchia è attribuito a *Potamon* Savigny, 1816 (Potamidae) mentre quello del Kazakistan è attribuito a *Austropotamobius* Skorikov, 1907 (Astacidae).

Parole chiave: incrostazione, Decapodi, Pleistocene, Anatolia, Area Caucasicca.

Material and discussion

The subject of this short paper is to report the unusual scaled preservation of two decapods crustaceans, rarely documented in the fossil record of this group of arthropods. We give only a brief indication in regard their systematic position because of their most important diagnostic characters are completely obscured or too incomplete to arrive at their species assignation. The studied sample comprises two specimens, housed in the paleontological collections of the Museo di Storia Naturale di Milano (MSNM). One specimen, ascribed to *Potamon* Savigny, 1816 (Potamidae), comes from continental freshwater deposits of the Denizli basin, loca-

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ted in SW Turkey (W Anatolia). The second specimen, assigned to *Austropotamobius* Skorikov, 1907 (Astacidae), comes from the Almaty Region in the S Kazakistan Republic, in the so called “Caucasian Area”.

Turkish specimen

A single nearly complete, partially articulated crab (carapace 27 x 22 mm) totally coated and preserved as a three-dimensional outer cast within a straight natural cavernous cavity of a white travertine matrix. It is covered by an inorganic film of calcium carbonate (2 mm thick) (MSNM i27475) (Fig. 1). The specimen was discovered in an outcrop of the Denizli Basin (SW Turkey), well known especially for its famous white travertine terraces and falls at Pamukkale (World Heritage Site), located a few kilometers north of the town of Denizli. Here the travertine deposition has been in progress for about the last 400,000 years. As reported by Altunel & Hancock (1993) it originates from a heavy emission of hot geothermal waters that emerge at 35°-56° C, “very rich in hydrogen carbonate and calcium precipitation by calcium carbonates”. The graben is probably a Plio-Quaternary structure (Bozkurt, 2001), but the precise origin and age of these travertine formations is still debated (Vengosh *et al.*, 2002). Recently Erten *et al.* (2005) reported some Quaternary fossil mammal remains (e. g. *Equus* aff. *suessenbornensis*, *Dama* sp.,



Fig. 1 – General view of the specimen MSNM i27475. / Visione d’insieme dell’esemplare MSN i27475 (x 2.5).

Bos sp.) from the travertine deposits of the basin, indicating a middle Pleistocene age consistent with the thermoluminescence data of the carbonate matrix. These reports were possible as a result of the quarrying of the marble industries around the area. The formation of the cavernous travertine preceded inhabitation and fossilization of the specimen. The lack of stratigraphic data and geological analysis makes it necessary to assign the studied specimen to the Pleistocene (Late Cenozoic) in generic terms. The scaled preservation of the specimen MSNM i27475 was the consequence of high temperatures of the thermal waters present in the outcrop, with rapid calcareous deposition around the exoskeleton. The behavior of these decapods that live in excavated holes or inhabit natural cavities along or around inland freshwaters (Fig. 2) makes this occurrence possible. The disarticulation of the pereiopods and part of the body makes it possible to suppose that the specimen may have died before fossilization process or, simply, it represents an exuvia. This kind of preservation does not allow observation of the diagnostic characters of the carapace and ornamentation. However the general outline of the subrectangular carapace, the bilobate front with large orbits, the convex anterolateral margins, the posterolateral margins converging posteriorly, the heterochely with the more strongly developed right chela, the flattened transverse section of the pereiopods and, finally, the true inland freshwater paleoenvironment, supports assignment of the specimen to *Potamon* Savigny, 1816 (Potamidae) as an indeterminate species. Recently Fraaije *et al.* (2010) also reported some specimens from the same outcrop, preliminarily identified as close to *Potamon* (*Potamon*) *potamios* (Olivier, 1804). Among the extant epigeal freshwater crabs, Özbek & Ustaoglu (2006) reported a complete and updated check list of Turkish inland brachyurans including nine total species all belonging to Potamidae Ortmann 1896. Within these only two are endemic taxa, *Potamon bileki* Pretzmann, 1971, and *P. hueceste* Pretzmann, 1962.



Fig. 2 – Close up of the natural cavity across the travertine matrix. MSNM i27475. / Chiusura della cavità naturale della matrice di travertino.

Kazakistan specimen

The specimen consist in an articulated and complete (total length 90 mm) coated (about 0.9 mm thick) three-dimensional outer cast of an astacidean crayfish very well preserved in an impressive “life position” on a small fragmentary calcareous slab with a layered appearance (MSNM i12621) (Figs. 3, 4). The specimen comes from the Almaty Region (S Kazakistan), located at the northern base of the Tien

Shan Mountains, rich in freshwater environments. Unfortunately, no precise locality or geological data are available for this old specimen, collected by a Russian mineralogist as a curiosity in the first years of the last Century. The specimen is three-dimensionally preserved, complete with chelipeds and part of the pereopods, and is preserved slightly coated in a yellow-brown carbonate deposit. It is exposed stretched out and tilted on a small calcareous slab, cut along the borders. Where it is observable, the overlapped succession of different colours and thickness of the following rhythmic deposits appear as in a stromatolitic structure (Fig. 3). On the



Fig. 3 – Cross section of the overlapped scaled calcareous deposits. MSNM i12621. / Sezione trasversale dell'incrostazione del deposito calcareo.

interior of the inorganic deposit the original integument of the body is still preserved. The carapace has a large irregular hole on the left side of the branchial region, possibly a result of predation. This kind of sedimentation, similar to a stalagmite formation occurs, out of natural karstic caves, in environments where calm waters rich in carbonate solution occurs with slow deposition at different times (or temperatures) and only during certain seasons. This kind of soft incrustation is also present on the exoskeleton of some specimens of the extant European *Austropotamobius pallipes* (Astacidae), when it inhabits calm calcareous freshwaters with slow precipitation by calcium carbonates (Pasini pers. obs., 2010). Lacking paleontological and stratigraphic data and due to the thickness of the scale deposit, we propose a possible uppermost Pleistocene to Holocene age for the specimen. The thickness of the calcareous outer layer permits observing some morphologic characters, such as the slightly down-turned short rostrum with two very small proximal teeth, and a median, weakly developed smooth ridge, one postorbital ridge, and irregular occlusal margins of dactylus and index, with some strong randomly-arranged teeth. As reported by Hobbs (1974), at present two families including Northern Hemisphere freshwater crayfishes, Astacidae and Cambaridae are known. Among the extant and fossil genera known to date, only *Austropotamobius* Skorikov, 1907, bears the above-mentioned characters since the other genera usually have a longer or wider rostrum with or without more or less developed lateral teeth, a carapace with a couple of postorbital ridges, and chelipeds with more or less elongate chelae with regular, usually smooth occlusal margins. Even though it is difficult to assign the studied specimen to one of the three extant species known to date, *A. pallipes* (Lereboullet, 1858), *A. berndhauseri* Bott, 1972, and *A. torrentium* (Schrank, 1803), we can suppose that it could belong to *A. torrentium*, a widespread species in central-eastern Europe. At present, the only published fossil crayfish from Europe is *A. llopsi* (Via, 1971) from the Early Cretaceous (Barremian) of Las Hoyas (Spain).



Fig. 4 – General view of the specimen MSNM i12621. / Visione d'insieme dell' esemplare MSN i12621 (natural size).

Conclusion

Coated preservation in arthropods is uncommon in the fossil record and is generally associated with peculiar non marine rocks from the Late Cenozoic (e. g. natural caves, travertine deposits, hypercalcareous waters, boric-fumarole of extant formations). More frequently vegetable and mammalian vertebrate remains are preserved in this way. Freshwater fossil land crabs are poorly documented due the unfavorable environment for their preservation; encrustation is here reported as a valid but very unusual condition for fossilization. The true freshwater potamonid crabs record ranged from the Oligocene (Feldmann *et al.*, 2007) to the Quaternary while the scarce record of astacid crayfish ranges from the Early Cretaceous (Barremian) to the Quaternary (Garassino, 1997). This new report enlarges the distribution and knowledge of the fossil specimens in the central Asian area during the Late Cenozoic, involving peculiar unreported taphonomic events in freshwater decapods.

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