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First record of non-marine ostracods from the Paleogene "hamadian deposits" of Méridja area, west of Bechar (southwestern Algeria)

Première découverte d'ostracodes non-marins dans les dépôts hamadiens paléogènes de la région de Méridja, Ouest de Bechar (sud-ouest algérien)

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ABSTRACT

A new non-marine ostracod fauna from the Paleogene "hamadian deposits" outcropping west of Bechar (southwestern Algeria) has been recovered from lacustrine to fluvial deposits of the Oued Méridja section and fluvial deposits on the southern edge of the Hamada de Méridja section. Recently, these sections have been dated as late Thanetian – early Ypresian (latest Paleocene to earliest Eocene) and Ypresian – earliest Lutetian (early to earliest middle Eocene), respectively, based on charophytes. The associated ostracod fauna recovered consists of relatively mostly moderately to badly preserved specimens and comprises 14 taxa, none of which could be identified to species level in view of its poor state of preservation; we have nevertheless been able to identify and describe the following taxa: *Herpetocypris* sp., *Cyprinotus?* sp., *Heterocypris?* sp. 1 and sp. 2, *Cypris?* sp., *Ilyocypris* sp., Cytheroidea indet. sp. 1 and sp. 2, Limnocytheridae indet. sp. 1, Cypridoidea indet. sp. 1, Cyprididae indet. sp. 1, and Ostracoda indet. sp. 1, 2 and 3. Only *Heterocypris* sp. 1 occurs in both sections. Although the fauna can as yet not be related to the few other contemporaneous faunas reported from the wider palaeogeographic area, it adds important new information to our poor knowledge on Eocene non-marine ostracods in North Africa and southern Europe. The Méridja sections and area are promising regarding the discovery of more, better preserved material and further studies, and one main limitation to the correlation of the fauna is the hitherto insufficient taxonomic knowledge on many faunal elements of Eocene non-marine ostracods to which our section contributes considerably.

Mots clés :
Ostracodes non-marins
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Oued Méridja
Hamada de Méridja
Bechar
Sud-ouest algérien

RÉSUMÉ

Cette étude décrit une nouvelle faune d'ostracodes non-marins du Paléogène de la région de Méridja, à l'ouest de Bechar (sud-ouest algérien), provenant des dépôts fluvio-lacustres de la coupe d'Oued Méridja et des dépôts fluviatiles de la coupe de la bordure sud de la Hamada de Méridja. Récemment, ces dépôts ont été respectivement bien datés du Thanétien supérieur à l'Yprésien inférieur (Paléocène terminal–Eocène basal) et de l'Yprésien inférieur–Lutétien basal (Eocène inférieur à Eocène moyen basal), grâce à l'étude de nouvelles associations de charophytes. Moins bien conservée, rare, mais assez diversifiée, la faune d'ostracodes associée a fourni 14 taxons. Le mauvais état de conservation des spécimens ne permet pas de poursuivre la classification jusqu'au rang des espèces ; nous avons pu néanmoins identifier et décrire les taxons suivants : *Herpetocypris* sp., *Cyprinotus?* sp., *Heterocypris?* sp. 1 and sp. 2, *Cypris?* sp., *Ilyocypris* sp., Cytheroidea indet. sp. 1 et sp. 2, Limnocytheridae indet. sp. 1, Cypridoidea indet. sp. 1, Cyprididae indet. sp. 1, et Ostracoda indet. sp. 1, 2 et 3 ; seule l'espèce *Heterocypris* sp. 1 est représentée dans les deux coupes. Bien que la faune ne puisse être liée aux quelques autres faunes contemporaines

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d'un contexte paléogéographique plus large, elle apporte néanmoins de nouvelles données importantes à notre connaissance limitée sur les ostracodes non-marins de l'Eocène en Afrique du Nord et au Sud de l'Europe. Les gisements découverts dans la région de Méridja semblent prometteurs ; le matériel recensé constitue donc un point de départ à d'autres études sur les ostracodes non-marins éocènes dans cette région.

1. Introduction

Ostracods are crustaceans of typically around 1 mm size that have a calcified bivalved shell (the carapace) and today inhabit virtually all aquatic environments, both marine and non-marine (equal to "continental" or "terrestrial" of other authors), including semi-terrestrial habitats. They have an excellent fossil record, the best of any arthropod group, and are known from the Ordovician to Recent. Owing to their small size, fossilization potential, morphological variability, ecology, and long geological history fossil ostracods are suitable for a wide array of applications including biostratigraphy, palaeoecology and palaeoenvironment, palaeoceanography and palaeolimnology, as well as palaeoclimate reconstructions. In the marine realm, ostracods often are outpaced by other microfossils in their utility. In non-marine settings, however, they are among the most common fossils at least since the Middle–Late Jurassic (e.g. Horne, 2003 and Sames and Horne, 2012). Mesozoic to recent non-marine ostracod faunas comprise taxa of the superfamilies Cypridoidea, Cytheroidea, and Darwinuloidea. Today's non-marine ostracod faunas are overwhelmingly dominated by representatives of the Cypridoidea in terms of diversity, different lineages of which invaded non-marine waters at different times (Martens et al., 1998; Horne, 2003).

The known record of *non-marine* (also termed continental or terrestrial by other authors) Paleocene to Eocene ostracods from Europe and Africa is relatively sparse (e.g. Colin and Antunes, 2003 – Portugal; Mebrouk et al., 2011, 2013 – central Saharian Atlas, Algeria), which is related to the palaeogeography and availability of records and studies. Among these, however, are examples of exceptional preservation, such as preservation in Eocene Baltic amber (Keyser and Weitschat, 2005, western Russia). Extensive records come from Asia (for China see synoptic atlases of Hou et al., 2002, Hou and Gou, 2007 and references therein), for example, and also North America (e.g. Swain, 1990, 1999, and references therein). Against the background of the facts that:

many non-marine ostracod groups are not restricted to individual water bodies or smaller geographical regions in their distribution and dispersal;

as today, whole living specimens or eggs of non-marine ostracods are considered to have been able to be transported passively by larger animals or wind over long distances, crossing migration barriers, since at least the Late Jurassic (see Sames and Horne, 2012), the general potential of a palaeogeographically wider distribution and dispersal of (Eocene) non-marine ostracod needs to be considered. Our current knowledge is strongly limited by the few documented records and dated taxonomy. Many non-marine Eocene taxa, particularly those of the superfamily Cypridoidea with smooth carapaces are in need of taxonomic revision based on internal carapace features and in the wider palaeogeographic context.

Here, we present the first record and study of a latest Paleocene (late Thanetian) to early Eocene (Ypresian) non-marine, fluvial to lacustrine ostracod fauna from southwestern Algeria that is entirely composed of taxa of the Cypridoidea. These derive from newly discovered ostracod-bearing layers from "hamadian deposits' of the Méridja area, located west of the large Oued (Wadi) Guir, at the eastern and the southern extremities of the Hamada de Méridja; about 70 km west of Bechar (southwestern Algeria, northwestern Sahara) (Fig. 1), from two localities of which the charophytes have been reported recently (Adaci et al., 2005; Hammouda et al., 2016b, 2017).

2. Geological setting

A large proportion of the desert areas in the northwestern corner of the Algerian Sahara is constituted by stony plateaus ("plateaux") largely devoid of sand which are known as "hamadas". Ages previously given for the "hamadian deposits" of the northwestern Sahara range from Eocene to Pliocene. These mainly detrital formations have a long and controversial chronostratigraphic history, as palaeontological arguments are sparse. A variety of ages was suggested for these deposits, including Senonian (i.e. Coniacian to Maastrichtian, Menchikoff, 1946; Lavocat, 1954), Eocene–Oligocene or Miocene–Pliocene (Deleau, 1952).

The hamadas west of Bechar (see Fig. 1) – including the large Hamada of Guir that runs almost north–south and is Neogene in age, as well as two other hamadas of Paleogene age, the Hamada de Oum es Sebaa and the Hamada de Méridja – unconformably overlie the marine Cretaceous deposits (Adaci et al., 2005).

The Hamada de Oum es Sebaa, a vast plateau that runs almost east-northeast to west-southwest, stretches from Bechar westward to the eastern bank of the Oued Guir. The early studies carried out on respective "hamadian deposits" east of the Méridja locality, north of the Bechar-Kenadsa-Méridja axis, had yielded only very few fossils, such as the gastropod *Pseudoceratodes* Wenz and encrusting algae. The *Pseudoceratodes*-bearing lacustrine limestones (Clariond, 1939) allowed Jodot (1953a) to suggest an early Eocene age for these beds, based on the species *Pseudoceratodes clariondi* Jodot, 1953.

The Hamada de Méridja covers a large area between Oued Guir east of Méridja and the Hamada de Boudenib in Morocco. It includes two quite distinct stony plateaus, the plateau of Méridja to the East and that of Dermchane to the West, the latter of which is the lateral continuation of the Hamada de Boudenib in Morocco. Like the Hamada of Boudenib in eastern Morocco, the Hamada de Méridja had been considered as Oligocene (e.g., geological survey sheets "Hamada of Guir" [Choubert, 1950] and "Morocco–west Algeria' [Anonymous, 1952]) (Fig. 2). Being rich in terrestrial gastropods identified as *Clavator* v. Martens at the time, these continental deposits were informally referred to as "*Clavator* Hamada' by Jodot (1953b), who hypothesized an early Miocene (Aquitanian) age of deposition for them. Since those earlier works, the "hamadian deposits' of the Boudenib area were assigned to the middle–upper Eocene after a tentative revised classification of the gastropod fauna they were found to contain (Truc et al., 1987; El Youssi, 1993). New biostratigraphic age estimates

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