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A basal oxyteline rove beetle (Coleoptera: Staphylinidae) from the Early Cretaceous of China: Oldest record for the tribe Euphaniini

*Un nouveau staphylin basal remarquable du Crétacé inférieur de Chine: le plus ancien représentant de la tribu Euphaniini*Chen-yang Cai^a, Margaret K. Thayer^b, Di-ying Huang^{a,*}, Xiang-dong Wang^c, Alfred F. Newton^b^a State Key Laboratory of Palaeobiology and Stratigraphy; Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, 210008 Nanjing, PR China^b Department of Zoology; Field Museum of Natural History, Chicago IL 60605, USA^c No. 7 Xinghuo Road, Fengtai District, 100086 Beijing, China

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ABSTRACT

A remarkable new rove beetle, *Protodeleaster glaber* gen. et sp. nov, is described and illustrated based on two well-preserved specimens from the Lower Cretaceous Yixian Formation of Liaoning Province, China. The new genus is placed in the extant staphylinid subfamily Oxytelinae, and recent tribe Euphaniini, based on several characteristic features (e.g. a single pair of wide paratergites on abdominal segments; open procoxal fissures; contiguous mesocoxae; abdominal sternite II short and poorly sclerotized). This find from the Early Cretaceous documents the oldest fossil representative of the tribe Euphaniini. Morphologically, it resembles most closely the recent genus *Platydeleaster* Schülke, 2003, an unusual member of the extant Oxytelinae. According to the currently accepted hypothesis of the phylogenetic position of Euphaniini and the prior discovery of other taxa from the Late Jurassic, we suggest the tribe might have first appeared at least as early as the Late Jurassic.

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R É S U M É

Protodeleaster glaber gen. et sp. nov, un nouveau staphylin remarquable, est décrit et illustré sur la base de deux spécimens très bien préservés de la formation Yixian (Crétacé inférieur, province du Liaoning, Chine). Le nouveau genre appartient à la sous-famille Oxytelinae et à la tribu moderne des Euphaniini, sur la base de plusieurs structures caractéristiques (par exemple, une seule paire de grands paratergites sur les segments abdominaux, des fissures procoxales ouvertes, mesocoxae contiguës, sternite II court et faiblement sclérifié). Cette découverte dans le début du Crétacé représente le plus ancien représentant fossile de la tribu Euphaniini. Morphologiquement, il ressemble étroitement au genre récent *Platydeleaster* Schülke, 2003, un membre inhabituel chez les Oxytelinae. D'après l'hypothèse couramment acceptée sur la position phylogénétique des Euphaniini et les découvertes antérieures de taxons du Jurassique supérieur, nous suggérons que cette tribu a pu apparaître au moins à cette dernière époque.

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1. Introduction

The staphylinid subfamily Oxytelinae, with 2056 extant and extinct species placed in 46 genera (Newton, unpublished data, January 2013), is one of the more ancient groups of Staphylinidae. Oxytelinae, as a well-defined monophyletic group of staphylinids, are readily distinguished from all other staphylinid subfamilies by the unique presence of paired secretory openings of non-reversible abdominal defensive glands on tergum IX, which is divided by tergum X or nearly so (Czarniawski and Staniec, 1997; Dettner, 1993; Dettner et al., 1985; Hansen, 1997; Herman, 1970; Newton, 1982; Newton et al., 2000; Thayer, 2005), and the presence in most taxa of a fully developed sternite II (in more derived taxa; some have sternite II reduced, such as *Oxypius peckorum* Newton, 1982, for details see Newton, 1982). The subfamily currently comprises five valid tribes: Blediini Ádám, 2001, Coprophilini Heer, 1839, Euphaniini Reitter, 1909, Oxytelini Fleming, 1821 and Planeustomini Jacquelin du Val, 1857 (Bouchard et al., 2011). A new tribal classification of Oxytelinae, with four additional tribes, has just been proposed by Khachikov (2012), but since it is based on a limited morphological character set (adult abdominal apex) and includes no phylogenetic analysis, we refrain from adopting it here pending more thorough study. Among the five current tribes, Euphaniini Reitter, 1909 (=Deleasterini Reitter, 1909) is thought to be a basal lineage on the basis of a revised cladistic analysis presented by Newton (Newton, 1982). This tribe, characterized by having only one pair of relatively wide paratergites on abdominal segments III to VI, is now composed of six peculiar extant genera: *Syntomium* Curtis, 1828; *Deleaster* Erichson, 1839; *Euphanias* Fairmaire and Laboulbène, 1856; *Mitosynum* Campbell, 1982; *Oxypius* Newton, 1982 and *Platydeleaster* Schülke, 2003 (Makranczy, 2006; Schülke, 2003). The recently described genus *Platydeleaster*, discovered in the Sikhote Aline mountain range in the Russian Far East, has been suggested to be sister taxon to all of the other Euphaniini (Schülke, 2003). It was found to be the sister taxon to all other included Oxytelinae in the most recent phylogenetic analysis of the subfamily (Makranczy, 2006), although that analysis included only *Deleaster* and *Platydeleaster* as representatives of Euphaniini.

The oldest known Oxytelinae are from the Late Jurassic of Karatau in Kazakhstan (Tikhomirova, 1968). So far, 26 extinct oxyteline species are known (Newton, unpublished data), of which nine species within five genera are from several Mesozoic deposits of Eurasia. These are: *Mesoxytelus* Tikhomirova, 1968 from the Upper Jurassic Karabastau Formation of Karatau, Kazakhstan (Tikhomirova, 1968); *Turgaphloeus* Ryvkin, 1990 from the Lower Cretaceous Turga Formation of Russia; *Morda* Ryvkin, 1990 from the Upper Jurassic Daya Formation of Russia (Ryvkin, 1990); *Sinoxytelus* Yue, Zhao and Ren, 2010 from the Late Jurassic to Early Cretaceous of Liaoning Province, China, and the Urey locality of Transbaikalia, Russia (Cai et al., 2013; Yue et al., 2010); and *Anotylus archaicus* Yue, Makranczy and Ren, 2012 from the Early Cretaceous of Liaoning Province, China. All of the hitherto-described Mesozoic species, however, appear to represent more derived

oxyteline lineages, and none of them shows similarities to the basal lineage Euphaniini. Little is known about the ancient members of the tribe Euphaniini. The only fossil record, *Deleaster grandiceps* Wickham, 1912, is from the Eocene of Florissant, USA (Wickham, 1912). The material from the Mesozoic is, therefore, promising for understanding the early evolution of this tribe. The recently found exquisitely preserved staphylinid impression fossils from the locality near Huangbanjigou Village of Beipiao City, Liaoning Province, northeastern China (Yixian Formation) are of great significance for the exploration of the early evolution of Euphaniini.

The Yixian Formation has long been famous for yielding a number of feathered dinosaurs, mammals, beaked birds, angiosperm plants, and numerous insects (Chang, 2003). Its precise geological age is suggested as Early Cretaceous, ca. 125 Ma (Swisher et al., 1999).

2. Systematic palaeontology

Order: Coleoptera Linnaeus, 1758
 Family: Staphylinidae Latreille, 1802
 Subfamily: Oxytelinae Fleming, 1821
 Tribe: Euphaniini Reitter, 1909
 Genus ***Protodeleaster*** gen. nov

Type species. *Protodeleaster glaber* sp. nov, designated here.

Etymology. The generic name is a combination of the Latinized prefix *proto-*, meaning giving rise to, and *Deleaster*, the most common Recent genus of the tribe Euphaniini; it is of masculine gender.

Diagnosis. The genus can be separated from all other extinct and extant Oxytelinae by the following combination of characters: body relatively large and elongate, glabrous, impunctate; antenna filiform to moniliform, with apical five antennomeres slightly dilated; gular sutures very narrowly separated at middle of head; epistomal suture present, straight and entire; pronotum well margined laterally, transverse; exposed part of procoxae small and rounded, procoxal cavities open, procoxal fissure probably open; mesocoxal cavities contiguous; mesoscutellum relatively large and exposed; meso- and metatibiae armed with one or two distinct ridges; abdominal segment II relatively short, poorly sclerotized; abdominal segments III–VII each with a single pair of wide paratergites; and tergites without basolateral ridges.

Protodeleaster glaber sp. nov (Figs. 1–2)

Description. Female, body robust, glabrous; elytra and abdomen distinctly wider than head and prothorax.

Head: moderate in size, distinctly narrower than pronotum; widest across eyes; base of head slightly constricted to form a broad neck. Eyes moderate in size, convex. Antenna long, 11-segmented, apical five antennomeres slightly dilated; basal antennomere long; antennomere 2 shorter and narrower; 3 distinctly longer than 2; antennomeres 4–7 more or less elongate, each slightly longer than wide; antennomeres 8–10 each wider than long; antennomere 11 large, elongate oval in outline. Epistomal

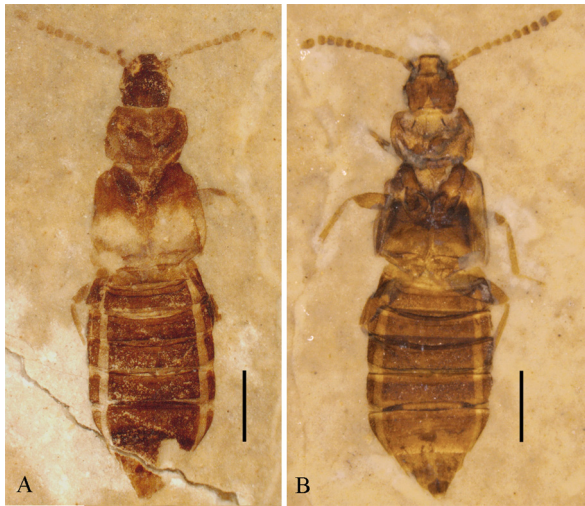


Fig. 1. *Protodeleaster glaber* gen. et sp. nov, from the Lower Cretaceous Yixian Fm., holotype, habitus. A. NIGP 152503a, part. B. NIGP 152503b, counterpart. Scale bars: 1 mm.

Fig. 1. *Protodeleaster glaber* gen. et sp. nov. de la formation Yixian, Crétacé inférieur, holotype, habitus. A. NIGP 152503a, empreinte. B. NIGP 152503b, contre-empreinte. Barres d'échelle : 1 mm.

suture distinctly present, straight and entire. Gular sutures very narrowly separated, subparallel at middle of head, strongly divergent toward base and apex. Clypeus well developed, broad. Maxillary palpi 4-segmented, elongate; apical three palpomeres thick, subequal to each other in width; palpomere 2 elongate, oblique apically, 3 shorter than 2, apical palpomere 4 elongate, acuminate apically.

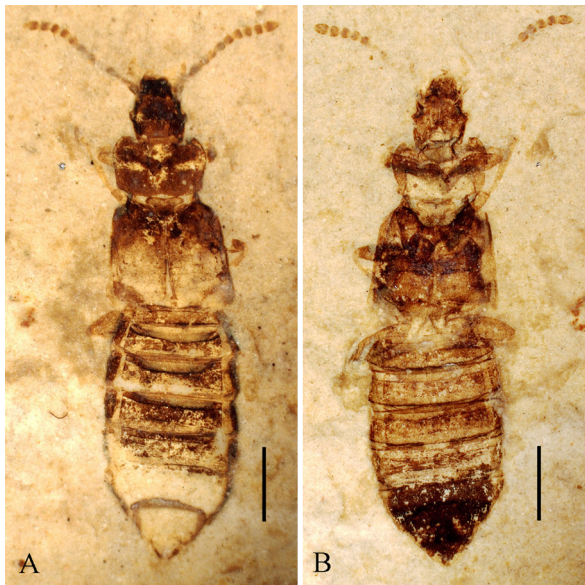


Fig. 2. *Protodeleaster glaber* from the Lower Cretaceous Yixian Fm., paratype. A. NIGP 152504a, part. B. NIGP 152504b, counterpart. Scale bars: 1 mm.

Fig. 2. *Protodeleaster glaber* de la formation Yixian, Crétacé inférieur, paratype. A. NIGP 152504a, empreinte. B. NIGP 152504b, contre-empreinte. Barres d'échelle : 1 mm.

Thorax: pronotum transverse, about 1.4 times as wide as long, distinctly margined, widest at anterior third; lateral margin broadly sinuate; anterior and posterior margins truncate. Surface probably with impressions. Hypomeron broad and strongly deflexed. Mesoscutellum relatively large, subtriangular, with longitudinal impressed line in anterior part, posterior part exposed behind pronotum. Mesoventral process short, extending between mesocoxae nearly to middle. Metaventral process absent. Elytra bicolored, anterior part of each darker, posterior part lighter; elytra relatively short, not covering segment II, each elytron 1.8 times as long as wide, laterally slightly widened to apex; apex truncate. Elytral epipleural ridge present. Surface of elytra glabrous, impunctate, without distinct longitudinal striae.

Legs: exposed medial part of procoxae small, rounded and contiguous; procoxal cavities open posteriorly, procoxal fissure seemingly open; protrochanters distinct; profemora fusiform, robust; protibiae not preserved. Mesocoxae relatively small, somewhat rounded, contiguous; mesotrochanters tear-like, elongate; mesofemora robust, similar to profemora; mesotibiae thin, each with two longitudinal ridges. Middle tarsi partly preserved, apparently 5-segmented, basal four tarsomeres each relatively short, apical tarsomere elongate. Metacoxae subtriangular, contiguous, reaching posterolateral corners of metaventrite; metafemora very stout, fusiform; metatibiae thin, each with one longitudinal ridge visible.

Abdomen: relatively broad, with seven sterna visible; gradually widened towards apex, segment VII widest, VII and VIII strongly tapered to apex. Sternite II slightly narrower than III and relatively poorly sclerotized. Sternites II and III without basal midlongitudinal carina. Segments II to VII each with one pair of wide paratergites, tergites without basolateral ridges.

Female genital segment very small; a pair of distal gonocoxites present, gonocoxites subtriangular, apparently lacking styli.

Dimensions (in mm). Holotype, female, NIGP 152503a–b: body length (from anterior margin of head to apex of abdomen): 6.20; head length: 0.78, width: 0.76; pronotum length: 0.81, width: 1.15; Elytra length: 1.48. Paratype, female, NIGP 152504a–b: body length: 6.60; head length: 0.83, width: 0.81; pronotum length: 0.86, width: 1.22; Elytra length: 1.58.

Material. Holotype 152503a–b (Fig. 1). Paratype 152504a–b (Fig. 2); both are imprints, preserved as part and counterpart. The type specimens of the new species are deposited at the Nanjing Institute of Geology and Palaeontology, Nanjing, China.

Etymology. Derived from the Latin adjective *glaber*, meaning smooth (without setae).

Age and locality. Lower Cretaceous, Yixian Formation; Huangbanjigou Village, Shangyuan Township, Beipiao City, Liaoning Province, China.

3. Discussion

The family Staphylinidae, one of the most diverse families of Animalia, has at least 59,304 species (Newton, unpublished data, January 2013) grouped into one extinct



Fig. 3. The extant species *Platydeleaster bimaculatus*, dorsal habitus. Scale bar: 1 mm.

Fig. 3. Espèce vivante encore *Platydeleaster bimaculatus*, habitus dorsal. Barre d'échelle : 1 mm.

and 32 extant subfamilies (Herman, 2001; Bouchard et al., 2011). Among the 32 recent subfamilies of rove beetles, Oxytelinae are the only ones with secretory openings on the basal margin of tergum IX (which is usually divided into two parts by tergum X, see Newton, 1982). However, the characteristic gland openings, which are generally hidden within segment VIII, are not easy to see even in extant beetles, and the normal retracted position of the genital segment (IX–X) in the fossils makes it impossible to ascertain their presence. Sternite II of this newly discovered species is, however, relatively well developed and distinctive, suggesting that the new genus can be attributed to Oxytelinae and more specifically the recent tribe Euphaniini Reitter, 1909 (Bouchard et al., 2011) on the basis of the following combination of characters: abdominal segments III to VII with only one pair of very broad paratergites per segment; procoxal cavities open; mesocoxae small and contiguous; and sternite II distinctly developed, but comparatively short and poorly sclerotized (Newton et al., 2000).

Among the six genera of the tribe Euphaniini (*Deleaster*, *Euphantias*, *Mitosynum*, *Oxypius*, *Platydeleaster*, and *Syntomium*), the new genus displays the most morphological resemblances to the recent genus *Platydeleaster* Schülke, 2003 (Fig. 3), which has been suggested to be a relatively basal member of the subfamily Oxytelinae (Schülke, 2003). This similarity includes general habitus (superficially Omaliinae-like), relatively large body size, antennal morphology (with a slight 5-segmented club), well-defined

straight epistomal suture, well-margined pronotum, bicolored elytra, and slender legs. However, the new genus can be readily distinguished from *Platydeleaster* by the absence of distinct impressed rows of punctures on the elytra and the presence of a much broader pronotum and shorter elytra. It is noteworthy that the meso- and metatibiae of the new genus are distinctly armed with one or two longitudinal ridges, which is very rare among the subfamily Oxytelinae and the extant fauna of the whole family.

Among all Mesozoic fossil staphylinids, the new genus displays more features resembling some Jurassic fossil taxa originally attributed to the subfamily Omaliinae than those assigned to subfamily Oxytelinae. Specifically, this new genus most resembles *Eophyllodrepa* Ryvkin, 1985 and *Porrhodromus* Tikhomirova, 1968, two Mesozoic genera discovered from the Early or Middle Jurassic of Russia and Late Jurassic of Karatau, Kazakhstan, respectively (Ryvkin, 1985; Tikhomirova, 1968). Compared to *Eophyllodrepa* (based on the original description), the new genus possesses a more elongate head, more slender antennae, shorter elytra and a broader abdominal segment VII. The new genus is also superficially similar to the Omaliine genus *Porrhodromus* (based on the original description), but can be easily separated from the latter by three features:

- 1) the antenna of *Protodeleaster* is relatively long with the apical five antennomeres distinctly dilated, whereas only the apical antennomere of *Porrhodromus* is strongly enlarged;
- 2) the posterior elytral margins of *Protodeleaster* are truncate, with the inner angle of each elytron a right angle, but those of *Porrhodromus* are obviously oblique, with the inner angles acute and;
- 3) the mesocoxae are relatively small and round in *Protodeleaster*, but distinctly oblique and subconical in *Porrhodromus*.

Compared to *Deleaster grandiceps*, the much younger but only known fossil species of Euphaniini, *Protodeleaster* can be easily separated by having a wider pronotum and the antennae with the five apical antennomeres dilated.

Phylogenetically, Euphaniini was suggested to be a basal, well-isolated group of Oxytelinae, sister to all remaining oxytelines (Newton, 1982). The oldest known oxyteline genus, *Mesoxytelus* Tikhomirova, 1968, from the Late Jurassic of Karatau, Kazakhstan, possesses several characteristic features of the tribes Thinobiini (general shape of forebody, strongly rounded elytral apex, reminiscent of *Thinobius* Kiesenwetter, 1844 and *Bledius* Samouelle, 1819) and Oxytelini (three longitudinal ridges on pronotum, characteristic of most *Oxytelus* Gravenhorst, 1802 and *Anotylus* Thomson, 1859) (Makranczy, 2006), as well as apparently two pairs of paratergites on segments III–VII, like members of those tribes but unlike Euphaniini and *Protodeleaster*. Therefore, the proposed phylogenetic position of Euphaniini and the discovery of the more derived *Mesoxytelus* from the Late Jurassic together imply that the tribe Euphaniini is a very old lineage, probably having appeared at least as far back as the Late Jurassic.

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