

FIRST RECORD OF A FOSSIL BEETLE (COLEOPTERA, HALIPLIDAE) FROM THE BASAL PALEOCENE FLYSCH SEDIMENTS IN THE MAGURA UNIT (OUTER WESTERN CARPATHIANS, MORAVIA)

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Abstract: The first record of an insect (Coleoptera: Adephaga) from the base of Paleocene marine deposits in the Outer Flysch Carpathians of eastern Moravia (Czech Republic) is described. Its familial attribution to Gyrinidae or Haliplidae is critically discussed in comparison to fossil and recent representatives. The presence of a beetle elytron from hemipelagite in Early Paleocene deep-sea deposits is significant for taphonomy and suggests long wind transport from lagoonal to open marine environment and disarticulation by predators or scavengers in surface waters.

Key words: Paleocene, Outer Western Carpathians, taphonomy, Insecta, Coleoptera, Haliplidae, Gyrinidae.

Introduction

Archaic forms of Adephaga were possibly present in the Late Paleozoic beetle faunas, but this group is accurately known from the Mesozoic. Extinct Triaplidae or recent Trachypachidae were already present during the Triassic time (Ponomarenko 1977). During the Jurassic period, the number of Adephaga rapidly increased up to 10 % of the total diversity of Coleoptera, represented by the families Carabidae, Colymbethetidae, Coptoclavidae, Dytiscidae, Gyrinidae, Jurodidae, Liadytidae, Parahygrobiidae, Trachypachidae and Triaplidae (Ponomarenko 1995). The Early Cretaceous assemblages are similar to those from the Jurassic deposits with diverse Trachypachidae, while the Late Cretaceous beetle faunas are closer to those from the Cenozoic (Ponomarenko 1995).

The Gyrinidae and Haliplidae are regarded as the two most basal lineages of Adephaga (or Hydradephaga) (Beutel 1995), which implies a great antiquity for these families.

Fossil whirligig beetles (Gyrinidae) are known from the Upper Triassic until the present and they are the most common water beetles during the Late Cretaceous (Ponomarenko 1977, 1995). The Mesozoic diversity of Gyrinidae is higher than that of the Dytiscidae, which is the dominant group of aquatic beetles in many Cenozoic deposits. Another feature of the Mesozoic aquatic beetle fauna is the more frequent presence of brackish and lagoonal inhabitants with respect to the recent fauna. Correlation between continental and marine deposits using Mesozoic beetles is a possible future perspective (Ponomarenko et al. 1999). A sparse record of fossil crawling water beetles (Haliplidae) is first known from Lower to middle Cretaceous deposits (Dmitriev & Zherikhin 1988; Ren et al. 1995).

The further record of Haliplidae is still very poor. The genus *Haliplus* is recorded from the Miocene of Oeningen (Germa-

ny) (Schöberlin 1888; Guignot 1931–1933); Ponomarenko (1969) listed an isolated elytron from the late Lower Cretaceous of Labrador (Canada) that bears a strong resemblance to the haliplid “*Peltodytes*”, Ren et al. (1999) listed the family Haliplidae from the Late Mesozoic of Hebei Province, China; and Ren et al. (1995) described *Cretihaliplus chifengensis* and *Cretihaliplus sidaojingensis* from the Early Cretaceous of Inner Mongolia, China.

Geological setting

The single find of an insect was made during field research of the K/T boundary section near Uzgruň by one of the authors (M. Bubík). The Uzgruň K/T section is situated on the left bank of an unnamed creek NNE of the Uzgruň settlement near Velké Karlovice close to the Czech-Slovak border (Fig. 1). The sediments in the Uzgruň vicinity are part of the Rača Unit of the Magura Group of Nappes, Outer Flysch Carpathians. The insect bearing strata are assigned to the Solán Formation.

The sedimentary succession across the K/T boundary near Uzgruň can be characterized as fine alternation of muddy turbidites and hemipelagites. Few thicker sandy turbidites (up to 40 cm thick) with missing fine part occur close to the K/T boundary. The majority of sandstones are up to a few cm thick and laterally they disappear over a short distance (Tc ripple sandstones). The most common turbidites comprise Te, Tde, and less frequently Tcde intervals of the Bouma classification. Across the K/T boundary a coarsening-upward trend was observed in both small and large scale (Bubík et al. 1999). The prevailing lithologies are grey-green, grey, and dark grey claystones intercalated by siltstones and fine- to medium-grained

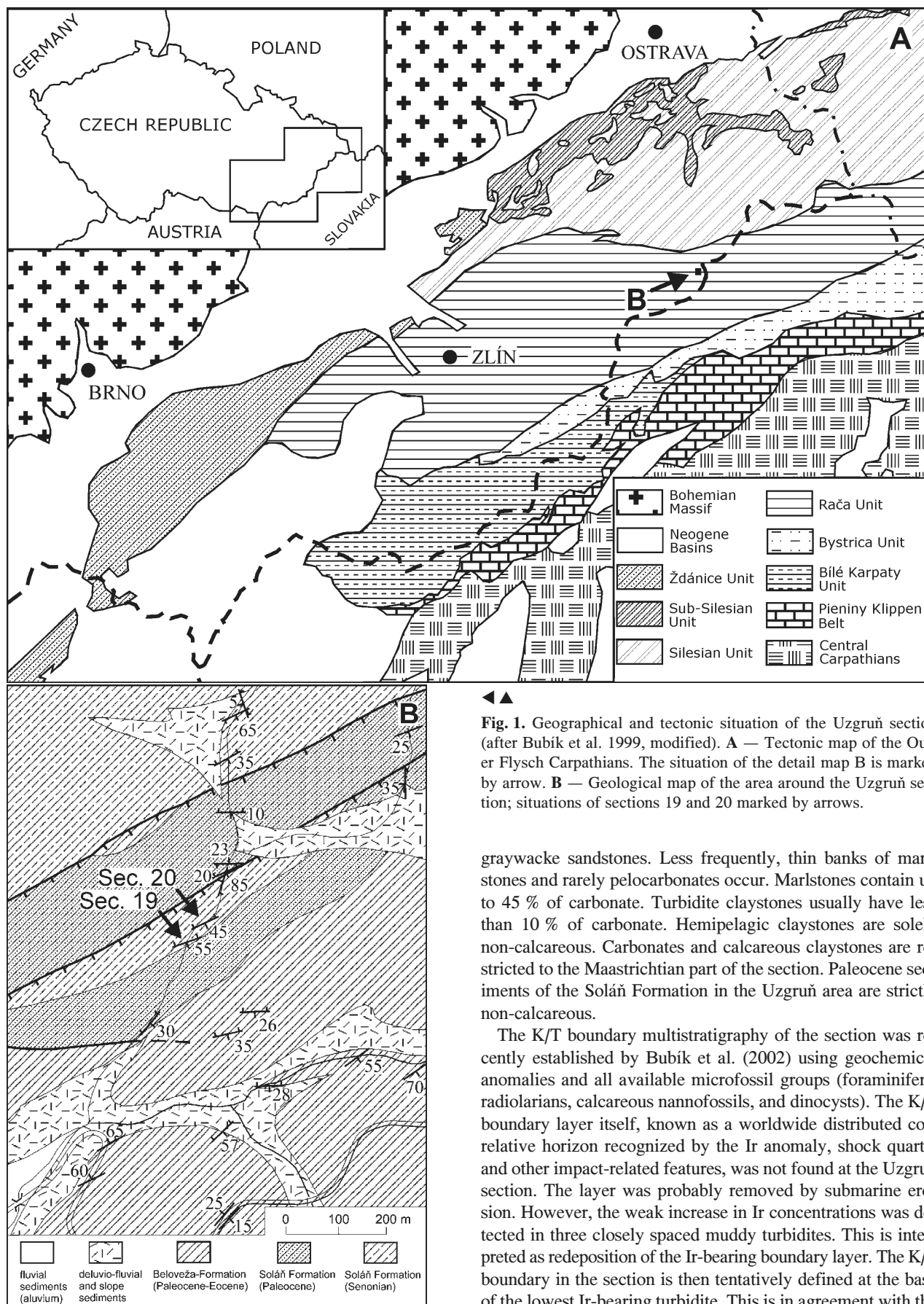


Fig. 1. Geographical and tectonic situation of the Uzgruň section (after Bubík et al. 1999, modified). **A** — Tectonic map of the Outer Flysch Carpathians. The situation of the detail map **B** is marked by arrow. **B** — Geological map of the area around the Uzgruň section; situations of sections 19 and 20 marked by arrows.

graywacke sandstones. Less frequently, thin banks of marlstones and rarely pelocarbonates occur. Marlstones contain up to 45 % of carbonate. Turbidite claystones usually have less than 10 % of carbonate. Hemipelagic claystones are solely non-calcareous. Carbonates and calcareous claystones are restricted to the Maastrichtian part of the section. Paleocene sediments of the Soláň Formation in the Uzgruň area are strictly non-calcareous.

The K/T boundary multistratigraphy of the section was recently established by Bubík et al. (2002) using geochemical anomalies and all available microfossil groups (foraminifers, radiolarians, calcareous nannofossils, and dinocysts). The K/T boundary layer itself, known as a worldwide distributed correlative horizon recognized by the Ir anomaly, shock quartz, and other impact-related features, was not found at the Uzgruň section. The layer was probably removed by submarine erosion. However, the weak increase in Ir concentrations was detected in three closely spaced muddy turbidites. This is interpreted as redeposition of the Ir-bearing boundary layer. The K/T boundary in the section is then tentatively defined at the base of the lowest Ir-bearing turbidite. This is in agreement with the

biostratigraphic data. The last occurrence of Maastrichtian nannofossils and planktonic foraminifer *Abathomphalus mayaroensis* was recorded 65 cm below this level and the Paleocene dinocyst index *Carpateella cornuta* (Dinophyceae) appears just 35 cm above.

The beetle elytron was found in green-gray hemipelagite claystone 25 to 30 cm above the K/T boundary in the basal Paleocene. Diversified flysch-type agglutinated foraminiferal fauna, dinocysts dominated by oceanic forms, and radiolarians in this sediment characterize the paleoenvironment as deep-sea open marine and persistently below the CCD. Besides the turbidite currents, the bottom was disturbed by bottom currents as indicated by silty intercalations without sharp base and with negative gradation. The paleoenvironment was furthermore influenced by an oxygen minimum zone in the water column and possible weak upwelling (Bubík et al. 2002). The oxygenated bottom conditions persisted across the K/T boundary as shown by the benthic foraminiferal fauna and paleoichnological record (Bubík et al. 2002).

Systematical paleontology

Suborder: **Adephaga** Emery, 1886

Family: **Haliplidae** Thomson, 1860

Haliplidae gen. et sp. indet.
(Fig. 2A–B)

Description: Elytron 4.9 mm long, 2.6 mm wide, ratio length to greatest width 1.88, ratio of length to basal elytral width 3.1; six distinct rows of large irregular punctures, each row with maximally 17 punctures; no visible polygonal pattern but micropunctures present on entire surface; sutural stria not present and elytral suture not deflected near apex; lateral edge of elytron weakly sinuate distally; epipleuron not recognizable.

Material: Specimen T02729 (National Museum Prague coll.), imprint and counter-imprint of elytron with well-preserved structure and visible six puncture rows in dorsal view.

Age and layer: Paleocene, Solán Formation, Uzgruň, Czech Republic.

Discussion: The present specimen has some characteristics of both the families Gyrinidae and Haliplidae in the structure and shape of the elytron. These are the presence of six distinct rows of irregular punctures; lateral edge of elytron weakly sinuate distally and ratio (3.1) of elytral length to the basal elytral width *sensu* Lawrence & Newton (1995). It is extremely difficult to determine the family affinities of a Coleoptera on the sole basis of the elytral structures. But, after Khalav (1980), the Haliplidae have no polygonal pattern on the surface of the elytron, unlike the Gyrinidae. This character suggests that our fossil belongs to the Haliplidae rather than the Gyrinidae, which is also supported by the elytron size.

We are not able to attribute this fossil to a recent genus because of the lack of the characters currently used in the taxonomy and phylogeny of the family (Chandler 1943; Beutel & Ruhnu 1990). Nevertheless, our fossil has an ornamentation of the elytra similar to *Peltodytes* Régimbart, 1878, that is a

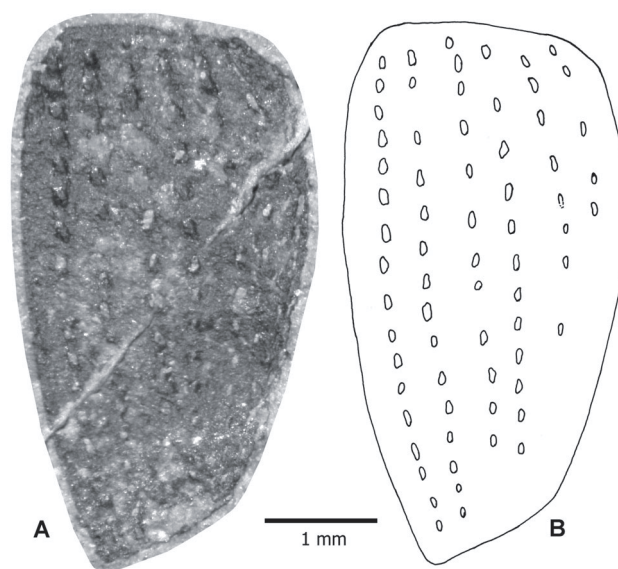


Fig. 2. Halipidae gen. et sp. indet., Paleocene, Solán Formation, Uzgruň, right elytron — ventral view (T02729, National Museum Prague coll.). **A** — photograph. **B** — line-drawing.

pronounced outer anterior angle and with 6–7 rows of punctures. But this similarity could be due to a convergence, and it is not sufficient to attribute this Paleocene fossil to the recent genus.

The fossil *Cretihaliplus chifengensis* has strong continuous striae on the upper surface of its elytra, unlike our fossil.

However, there is no fossil or recent Gyrinidae with a pattern of irregular rows of large punctures on elytra. Also, nearly all the recent Gyrinidae have elytra more or less posteriorly truncate, but not all of them (*Dineutes politus* Mac Leay, 1825, see Régimbart 1902: Fig. 1). Therefore affinities with the Gyrinidae can reasonably be excluded, but a comparison with the described species is added.

Eleven fossil genera of Gyrinidae have been described until now. Seven of them are known from the Mesozoic (Ponomarenko 1985; Nel 1989; Carpenter 1992). The Lower Jurassic monotypic *Anagyrius* Handlirsch, 1906, with *A. atavus* (Heer, 1865), is a little-known genus from the European deposits (Germany and Switzerland). Its elytra are without sculptures except for a marginal line that is different from our specimen. The Middle Jurassic monotypic *Angarogyris* Ponomarenko, 1977, with *A. minimus* Ponomarenko, 1977 from Iya (Cis-Baikal, Irkutsk area in Asian Russia), differs from our specimen in its smooth and apically rounded elytra. The Lower Cretaceous monotypic genus *Avitortor* Ponomarenko, 1977, with *A. primitivus* Ponomarenko, 1977 from Baissa (Transbaikalia, Russia), differs in the presence of fine grooves unlike the irregular puncture rows of our specimen. The other Lower Cretaceous monotypic *Baissogyris* Ponomarenko, 1973, with *B. saviolovi* Ponomarenko, 1973, is known from eastern Russia. It is based on a ventral part of the body. Thus, it is not possible to compare with our specimen. The type species *C. zherichini* Ponomarenko, 1973 of the Upper Creta-

ceous genus *Cretotortor* Ponomarenko, 1973 (Kzyl-dzhar-Karatau, southern Kazakhstan), based on an elytron with 9 prominent furrows and a sutural margin, is different from our specimen. The same genus comprises *C. archarensis* Ponomarenko, 1977 from Arkhara in Russia. Its elytron differs from our specimen in the sutural margin, distinct transversal rugae and relatively dense punctuation. From the same Late Cretaceous locality Arkhara also comes the monotypic *Mesodineutes* Ponomarenko, 1977, with *M. amurensis* Ponomarenko, 1977, characterized by almost smooth elytra with dense ventral punctuation, and distinct margin along the suture. The Mesozoic *Mesogyrus* Ponomarenko, 1973, with *M. antiquus* Ponomarenko, 1973 known from the Late Jurassic of Kazakhstan, has 8–9 distinct furrows and a sutural margin. Other Cretaceous species of this genus are *M. sibiricus* Ponomarenko, 1985 and *M. striatus* Ponomarenko, 1973 from the Asian part of Russia, which have similar structure of elytra (Ponomarenko 1973).

There are several Tertiary gyrid genera described (see list in Nel 1989). *Gyrionides* Motschulsky, 1856, with *G. limbatulus* Motschulsky, 1856 from the Early Oligocene Baltic amber, is similar to the recent genus *Gyrinus* Linnaeus, 1767, differing mainly in the absence of striae. It is the smallest known fossil Gyrinidae (Hatch 1927). *Miodineutes* Hatch, 1927, with *M. oeningensis* Hatch, 1927 from the Upper Miocene of Oeningen (Baden, Germany), is similar to the recent *Enhydrus* Laporte de Castelnau, 1834. The elytra of this species are without sculpture except for the marginal line. *Orectochilus* sp. from the Paleocene of Menat (Puy-de-Dôme, France), lacks similar elytra punctuation. Fourth, *Gyrinus aquisextanea* Nel, 1989, described from the Upper Oligocene of Aix-en-Provence (France), is attributed to a recent genus. This species has no distinct punctuation, unlike our elytron.

Finally, one Quaternary monotypic *Protogyrinus* Hatch, 1927, with *P. confines* (Scudder, 1900) from the Pleistocene of Ontario (Canada), is also similar to the recent *Gyrinus* but differ by presence of rows of punctures and elytral striae extending independently to the apex (Hatch 1927).

Conclusion

In spite of the fact that we have only a single elytron without strict autapomorphies with Gyrinidae or Haliplidae, we propose to attribute this specimen to the Haliplidae because of the unique character of six irregular rows of large punctures similarly present in recent genus *Peltodytes* Régimbart, 1878 (6–7 rows of punctures). This character is not present in any fossil or recent species of Gyrinidae worldwide. In this family, different kinds of punctures are present in superficial striae, usually much less pronounced than in this fossil and Haliplidae. However, any of these characters cannot be used to make more precise determination or establish a new taxon, so we propose to leave this specimen in open nomenclature. Further findings of a complete body could help to solve the systematic position of this enigmatic beetle.

Although the systematic position of this elytron is uncertain, the discovery has undoubted taphonomical significance. It is probably the first insect record from the Magura Flysch of

the Carpathian Orogen at all. This is not surprising when considering the paleoenvironment of Magura Flysch sediments: bathyal to abyssal oceanic basin with oxic bottom conditions. Although terrigenous phytodetritus is a relatively common component of turbidites of many Cretaceous to Paleogene formations in the Magura Flysch, phytodetrit accumulations have revealed no insect remains yet. Repeated transport and deposition in the marginal marine to deep-sea environments is probably rather harsh processes for preservation of insect exoskeletons. The described beetle elytron was found in hemipelagite sediment deposited in the lower bathyal to abyssal zone. This rather excludes the transport by turbidite current and suggests probably long wind transport from lagoonal to open marine environment and disarticulation by predators or scavengers in surface waters. The presence of an oxygen minimum zone and relatively rapid sedimentation in a turbidite fan system probably served as favourable conditions for preservation.

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