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A new discoglossid frog from the Upper Cretaceous (Santonian) of Hungary

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ABSTRACT

A new anuran genus and species is described from the Late Cretaceous (Santonian) Csehbánya Formation in the Bakony Mountains, northwestern Hungary. Based on its distinctive ilium, maxilla, angulosplenial and scapula, this new frog is identified as a member of the Laurasian Discoglossidae and represents the second group of anurans recorded from fluvio-terrestrial deposits of the Iharkút vertebrate locality. The diagnostic ilium exhibits a thickened and dorsolaterally low dorsal protuberance, a relatively high iliac crest and a ventrally reduced ilioischiadic junction. Based on the environmental constraints of Recent Discoglossidae, we suggest that the new species probably had a periaquatic life-style; potential habitats for this species could have been rivers and marshlands, and vegetated bordering zones. The palaeogeographic scene envisaged for the Iharkút region, which during the Late Cretaceous was part of the Adriatic microplate, is of a lissamphibian fauna consisting of two components: the primarily Laurasian albanerpetontids and discoglossids and a Gondwanan component, represented by a neobatrachian frog that arrived across the Mediterranean Sill before or during the Santonian Epoch.

1. Introduction

Long-term sea-level changes, largely controlled by tectonics (Miller, 2009), were important factors in the evolution and geographic distribution of Late Cretaceous frogs in Europe (Vullo and Néraudeau, 2008; Blain et al., 2010). The highest sea level was recorded globally throughout the Cenomanian–early Campanian (Golonka and Kiessling, 2002), which transformed the European continent into an archipelago. Because almost no continental deposits have been preserved from this interval (Smith et al., 2001), the record of mid–Late Cretaceous frogs in Europe is sparse and limited to isolated bones, with considerable gaps from the Cenomanian to the Santonian, but with moderately increasing rates from the Campanian to the Maastrichtian (Roček, 2000; Szentesi and Venczel, 2010). The only finds in the European Cenomanian–Santonian interval are known from the earliest Cenomanian deposits of Font-de-Benon, France (Vullo et al., 2011), and from the Santonian of Iharkút, Hungary (Szentesi and Venczel, 2010), which is in marked contrast to the almost continuous record of rich anuran assemblages in the North American Western Interior from the early Cenomanian to the late Maastrichtian (Estes and Sanchíz, 1982; Gardner, 2008; Roček et al., 2010).

The assemblage preserved in the Iharkút locality originates from fluvial and marshy terrestrial sediments, and contains a diversity of vertebrate fossils including fishes, amphibians, turtles, lizards, crocodilians, dinosaurs, pterosaurs and birds. Ősi and Rabi (2006) initially proposed that most of the vertebrate taxa known from the locality had Euramerican affinities. However, as additional fossils have been collected and taxa identified, it is now evident that some of the taxa also have Gondwanan affinities (e.g., neobatrachian frogs, bothremydid turtles, sebesuchian crocodilians, abelisaurids), whereas others may represent endemic forms (Szentesi and Venczel, 2010; Ősi et al., in press). The lissamphibians from Iharkút are generally rare and consist of isolated bones of frogs and albanerpetontids. So far, *Hungarobatrachus* is the only anuran described from the locality and putatively it is the geologically oldest neobatrachian yet described from Laurasia (Szentesi and Venczel, 2010).

Intensive screen-washing carried out at the Iharkút locality also has produced four isolated bones (maxilla, angulospenial, scapula and ilium) belonging to a new genus and species of Discoglossidae. Here we describe this new discoglossid frog and discuss its palaeoenvironmental and palaeobiogeographic implications.

Anatomical and taxonomic conventions. Throughout this paper we use standard terms for anatomical orientations of elements and,

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except for a few cases, common English terms for anatomical structures. The classification of frogs follows Sanchíz (1998).

Institutional abbreviations. FGGUB, Faculty of Geology and Geophysics, University of Bucharest, Bucharest, Romania; MNCN, Museo Nacional de Ciencias Naturales, Madrid, Spain; MTM, Hungarian Natural History Museum, Budapest, Hungary; NHM, Natural History Museum, London, UK.

2. Systematic palaeontology

Class Amphibia Linnaeus, 1758
Superorder Salientia Laurenti, 1768
Order Anura Fischer Von Waldheim, 1813
Family Discoglossidae Günther, 1859
Genus *Bakonybatrachus* gen. nov.

Type species. *Bakonybatrachus fedori* sp. nov.

Derivation of name. After Bakony Mountains in Hungary, where the Iharkút vertebrate locality is located, and *batrachos*, Greek, a frog.

Diagnosis. As for the type and only known species.

Bakonybatrachus fedori sp. nov.
Figs. 1 and 2.

Derivation of name. After László Fedor, classmate and friend of the first author.

Holotype. MTM V 2010.283.1. Incomplete right ilium (Fig. 1A–D), missing the posterodorsal part of the dorsal acetabular expansion, the anterior portion of the iliac shaft and the dorsal part of the iliac crest; the medial side of the ilioischiadic junction is also damaged.

Type locality. The Iharkút vertebrate locality occurs in an open pit bauxite mine about 3 km east to the village of Bakonyjákó and about 2 km north to the village of Németbánya, in the north Bakony Mountains of northwestern Hungary.

Stratigraphic horizon and age. The Iharkút locality is in the Upper Cretaceous Csehbánya Formation. This formation is about 50–60 m thick at Iharkút, where it is partially overlain by middle Eocene sediments of the Iharkút Conglomerate Formation and by Oligocene–Miocene sediments of the Csatka Formation (Jocha-Edelényi and Császár, 1997). The Csehbánya Formation consists of variegated clays, palaeosols and dark silt filled with amber grains, and silt with sand and sandstone layers deposited by a braided river system with wide channels and floodplains; the sediments containing vertebrate remains were embedded in fossiliferous pockets (Ősi et al., 2003). Hitherto, the quarry has yielded a moderately diverse assemblage of fishes, albanerpetontids, frogs, turtles, lizards, crocodilians, dinosaurs, pterosaurs and birds (Kocsis et al., 2009). The palynological studies of Knauer and Siegl-Farkas (1992) and palaeomagnetic investigations of Mártonné (pers. com.) indicate a Santonian age for the formation.

Referred specimens. One fragmentary maxilla (MTM V 2009.34.1.), one fragmentary angulosplenial (MTM V 2008.31.1.) and one fragmentary scapula (MTM V 2008.30.1.) (Fig. 2).

Diagnosis. A small anuran, with estimated snout–vent length of 25–30 mm. It differs from gobiatine, bombinatorine, alytine frogs and *Callobatrachus*, as well as from the incertae sedis anurans *Hatzegobatrachus* and *Yizhoubatrachus* by the presence of a well-developed iliac crest. It differs from discoglossine frogs, with the exception of some members of *Discoglossus*, by its dorsal protuberance being lower than that of the iliac crest and provided with a thickened and flattened dorsolateral surface circumscribed by a shallow groove. It differs also from *Discoglossus*, *Latonia*, *Paradiscoglossus* and *Paralatonia* by its more robustly built dorsal acetabular expansion and by its smaller ventral acetabular expansion.

Description of holotype. In lateral view (Fig. 1A), the acetabular fossa of the ilium is deep and almost hemispherical, and is delimited anteroventrally by a prominent acetabular rim. A relatively shallow supraacetabular fossa is present. The dorsal acetabular expansion (=pars ascendens) is relatively large and oriented posterodorsally; its posterior end is damaged, but in the living animal it probably projected well beyond the posterior margin of the acetabulum. The ventral edge of the ventral acetabular expansion (=pars descendens) is slightly damaged, but seemingly it was much smaller than the dorsal acetabular expansion. The preacetabular fossa is deep and almost circular. The dorsal protuberance (=tuber superius) is elongate and low, with a thickened, flattened and slightly concave dorsolateral surface, and its base is circumscribed by a shallow groove. The angle between the dorsal acetabular expansion and the dorsal protuberance is wide (about 130°). Anteriorly from the dorsal protuberance, a small remnant of the iliac crest is preserved; enough of the crest remains to indicate that it was more elevated than the dorsal protuberance and that the lateral surface of the crest is relatively smooth. The fossula tuberis superioris is pierced by few small foramina (see also Roček, 1994: fig. 18).

In medial view (Fig. 1B), the acetabular and supraacetabular areas are separated by a shallow groove extending anteroposteriorly. The medial surface of the interiliac tubercle is damaged to some extent, but there is no sign of iliac synchondrosis. The iliac shaft appears cylindrical in cross section, extends anteriorly in a dorsally convex arc, and is separated from the iliac crest by a longitudinal trough. The dorsal margin of the iliac crest is mostly broken off, but the preserved part is about 1.5 times higher than the iliac shaft.

In dorsal view (Fig. 1C), the acetabular region is moderately robust and the iliac shaft is shallowly curved medially. The fractured surface of the iliac crest exposes a rather thin mediolateral wall. The dorsal part of the iliac crest is slightly inclined medially and bears a relatively large insertion surface for the iliacus externus muscle.

In posterior view (Fig. 1D) the outline of the ilioischiadic junction, with its upper part distinctly shifted laterally, closely resembles that of other discoglossid frogs. Because there is some damage to the medial margin of the ilioischiadic junction, the lower part of the junction appears narrower than it would have been when the ilium was intact.

Remarks. A combination of features seen in the holotype ilium (e.g., large dorsal acetabular expansion, small ventral acetabular expansion, well-developed iliac crest), supports membership within Discoglossinae (sensu Sanchíz, 1998). Although these structures are typical of Cretaceous Discoglossinae (i.e., *Paradiscoglossus*, *Paralatonia* and *Wealdenbatrachus*), *Latonia* and *Discoglossus*, the dorsal acetabular expansion in these taxa appears less robust and the ventral acetabular expansion significantly larger. In addition *Paradiscoglossus* possesses an extremely deep supraacetabular fossa (Estes and Sanchíz, 1982, figs. 1B, 2B), which is more reduced in other discoglossine frogs. In alytine frogs (sensu Sanchíz, 1998), the ilium has a strong dorsal acetabular expansion that overgrows the dorsal limit of the ischium (Evans and Manabe, 1998, fig. 4B, C), but it lacks an iliac crest. In Bombinatorinae (i.e.,