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Geobios 37 (2004) 749–753
GEOBIOS
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Article original

The first dinosaur remains from the Upper Cretaceous of Hungary (Csehbánya Formation, Bakony Mts)

Les premiers restes de dinosaures du Crétacé supérieur de Hongrie (formation Csehbánya, Monts Bakony)

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Received 18 June 2002; accepted 16 June 2003

Available online 28 October 2004

Abstract

The first dinosaur remains are described from the Upper Cretaceous (Santonian) Csehbánya Formation, Iharkút, Bakony Mts, Hungary. Eight teeth of herbivorous dinosaurs (Rhabdodontidae indet. Nodosauridae indet.) and four teeth belonging to Theropoda indet. are presented. There are also hundreds of fish, frog, turtle and crocodile bones and teeth embedded in fluvial sand of an alluvial plain. Palaeobiogeographic connections towards Provence, the eastern Alps, and southern Carpathians indicate that the Adriatic microplate bearing the fossiliferous succession was an island temporarily connected to the European continent during Late Cretaceous time.
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Résumé

Des restes de dinosaures sont décrits pour la première fois dans la formation Csehbánya du Crétacé supérieur (Santonien) ď'Iharkút dans les Monts Bakony, en Hongrie. Huit dents de dinosaures herbivores (Rhabdodontidae indét. et Nodosauridae indét.) et quatre dents appartenant au Theropoda indét. sont présentées. Des centaines d'os et de dents de poissons, de grenouilles, de tortues et de crocodiles ont également été découverts dans ce faciès de sables fluviatiles de plaine alluviale. Les relations paléobiogéographiques avec la Provence, les Alpes orientales et les Carpathes méridionales indiquent que la microplaque adriatique, comprenant la série fossilifère en question, était une île temporairement reliée au continent européen durant le Crétacé supérieur.
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Zusammenfassung

Die erste Körperfossilien von Dinosaurien wird aus dem Ober Kreide (Santonian) Csehbánya Formation aus Iharkút (Bakony Gebirge, Ungarn) geschrieben. Es wird drei Zähne von Rhabdodontidae indet., fünf Zähne von Nodosauridae indet. und vier Zähne von Theropoda indet. presentiert. Es wurde hunderte Fossilien von Fische, Frösche, Schildkröten, Krokodilien in einem fluvialen Sandstein Schicht gefunden. Wegen der grossen ähnlichkeit mit anderen Ökosystemen (in Muthmannsdorf, Ostösterreich oder in Südfrankreich) des europäischen Kontinents hatte die Fauna die Möglichkeit mit diesen Gebieten Europas in Verbindung zu sein.
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Keywords: Dinosaurs; Hungary; Santonian; Ornithopods; Nodosaurids; Theropods

Mots clés : Dinosaures ; Hongrie ; Santonien ; Ornithopoda ; Nodosauridae ; Theropoda

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doi:10.1016/j.geobios.2003.06.005

1. Introduction

György Wein discovered the first dinosaur remains in Hungary from the Early Jurassic of the Mecsek Mountains in 1966. These footprints were described by Kordos (1983). Dinosaur bones or teeth, however, were not found up to the present.

The first bones were discovered in 2000 in the Santonian (Upper Cretaceous) Csehbánya Formation at Iharkút, Bakony Mountains in western Hungary (Fig. 1). The fossiliferous bed yielded 410 bone fragments and teeth up to now. The outcrop is situated in the northeastern side of the Iharkút open-pit bauxite mine. The Csehbánya Formation consists of variegated clay and sandstone beds deposited in an alluvial plain. In the pit it has an average thickness of 50 m (Jocha-Edelényi and Császár, 1997). Palynological studies suggest a Santonian age (Knauer and Siegl-Farkas, 1992). It is conformable with the underlying Halimba Bauxite Formation and it is disconformably overlain by the Eocene Iharkút Conglomerate Formation (Haas et al., 1977; Mindszenty et al., 1984). The fauna is concentrated near the top of the outcrop in 20 cm thick sandy clay, sandstone bed. Hundreds of fish, frog, turtle, crocodile, and dinosaur bones and teeth fragment have been collected. These are buried in mud- and sand-filled channel deposits. Most of the fossils derive from 5 cm thick sandy clay layer below the sandstone. Other teeth and bones occur disordered on the surface of the sandstone bed and are covered with clay less than 1 cm thick. All of the material is housed in the Hungarian Natural History Museum (HNHM), Budapest.

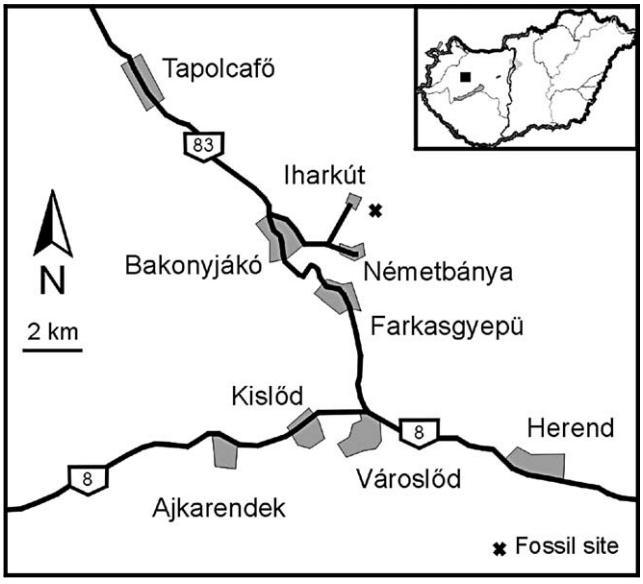

Fig. 1. Location of the fossil site.
Fig. 1. Position géographique du site fossilifère.

2. Systematic paleontology

Order ORNITHISCHIA Seeley, 1887
Suborder ORNITHOPODA Marsh, 1881, 1986
Family RHABDODONTIDAE Weishampel et al.,
RHABDODONTIDAE indet.
Fig. 2(1–3)

Material: HNHM V.2000.01, V.2000.32, V.2000.33.

Description: Three teeth of Rhabdodontidae indet. were found. V.2000.01 is a 19 mm long dentary tooth, the crown is 6.5 mm wide, leaf shaped, not worn. The crown has a strong, primary medial ridge on the lingual side, which divides two U-shaped surfaces. One of these surfaces bears a thin secondary ridge. Secondary ridges parallel with the primary ridge are characteristic for the dentary teeth of *Rhabdodon* (Seeley, 1881; Nopcsa, 1902; Jianu, 1994). V.2000.32 and V.2000.33 are probably maxillary teeth of a rhabdodontid ornithopod. V.2000.32 is 6 mm wide, the root is broken and the buccal surface bears eight slighter, nearly parallel ribs. One of the middle ribs is a little bit stronger than the others. V.2000.33 is broken in the midline of the tooth and the buccal surface were three, small parallel ribs, and has a significant cingulum. The top of the maxillary tooth crowns are worn.

Discussion: Nopcsa (1902) reported that he could distinguish between the first dentary tooth of a juvenile animal and other (posterior) dentary tooth of an adult animal, because the former one does not possess secondary ribs in contrast to the latter. Compared with the tooth from Muthmannsdorf (Campanian, Eastern Austria; Bunzel, 1871; Seeley, 1881) and teeth from the Hateg basin (Maastrichtian, Romania) (Nopcsa, 1902; Jianu personal communication) V.2000.01 is a first dentary tooth of a juvenile rhabdodontid ornithopod. These are the oldest remains of the rhabdodontid ornithopods.

Remains of *Rhabdodon* are known from Southern France Early Campanian of Villeveyrac Basin (Buffetaut et al., 1996), Maastrichtian of Provence (Matheron, 1869a, 1869b; Lapparent, 1947; Buffetaut and Le Loeuff, 1991), and in Campanian–Maastrichtian, northern Spain e.g. southern Montsec (Llompart and Krauss, 1982; Pereda-Suberbiola and Sanz, 1999).

Suborder THYREOPHORA Nopcsa, 1915
Infra-order ANKYLOSAURIA Osborn, 1923
Family NODOSAURIDAE Marsh, 1890
NODOSAURIDAE indet.
Fig. 2(4)

Material: HNHM V.2000.37, V.2000.38, V.2000.39 V.2000.40, V.2000.41.

Description: The crowns are labio-lingually compressed. There are six secondary cusps anterior and posterior to the apical cusp. The flutes between the marginal cusps are continued on the flanks of the teeth. The cingulum is ornamented, apically arched on the non-occlusal face of the crown and perpendicular on the occlusal face. The roots are missing.

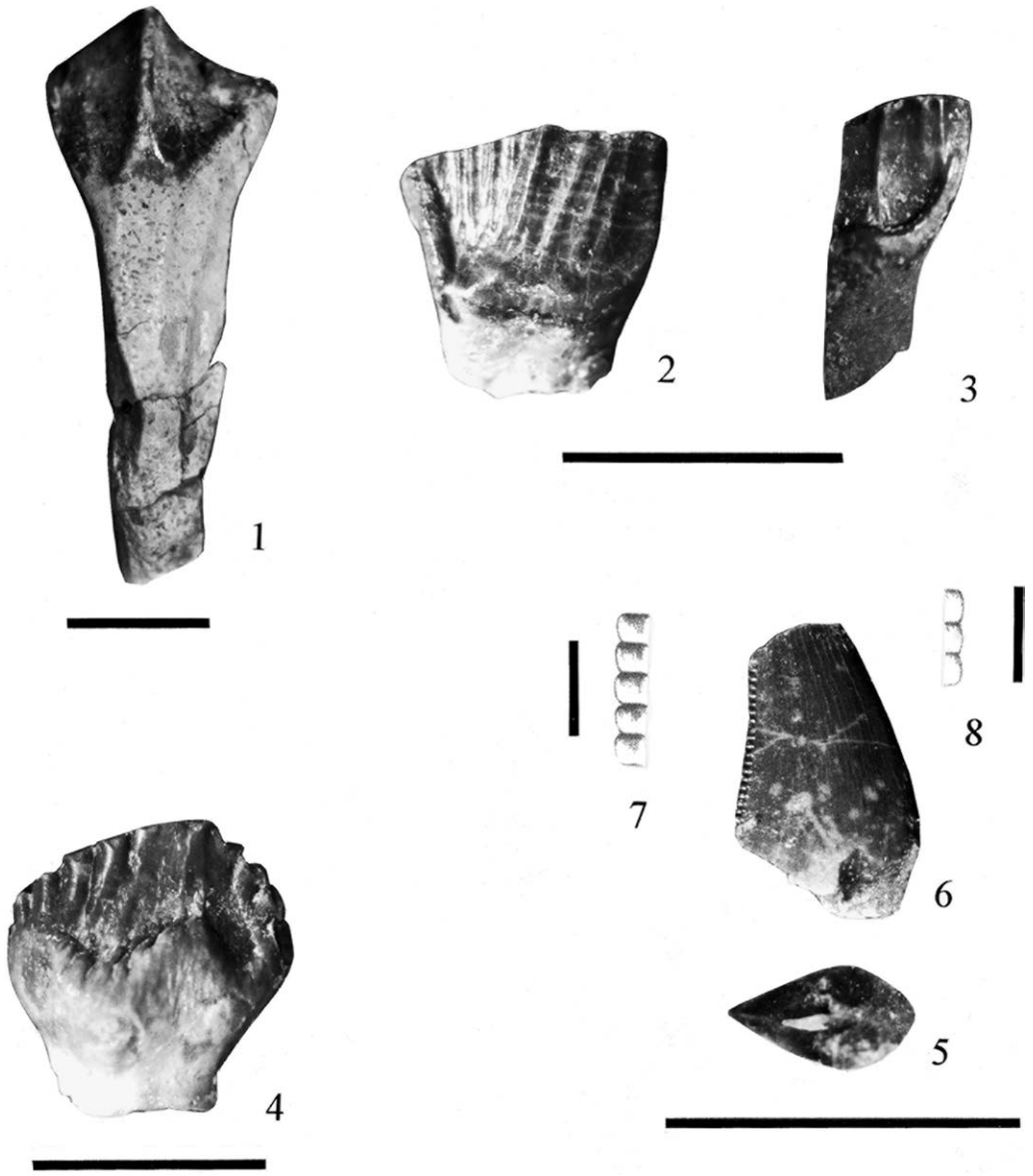

Fig. 2. (1) Dentary tooth of Rhabdodontidae indet. V.2000.01. (2) Maxillary tooth of Rhabdodontidae indet.V.2000.32. (3) Maxillary tooth of Rhabdodontidae indet. V.2000.33. (4) Tooth of Nodosauridae indet.V.2000.37. (5) Tooth of Theropoda indet. V.2000.02. (6) Cross-section of the base of V.2000.02. 7. Posterior denticles of V.2000.02. (8) Anterior denticles of V.2000.02. Scale bars 5 mm for 1–6 and 0.3 mm for 7 and 8.
Fig. 2. (1) Dent mandibulaire de Rhabdodontidae indét. V.2000,01. (2) Dent maxillaire de Rhabdodontidae indét.V.2000,32. (3) Dent maxillaire de Rhabdodontidae indét.V.2000,33. (4) Dent d'un Nodosauridae indét. V.2000,37. (5) Dent de Theropoda indét. V.2000,02. (6) Section transverse de la base de V.2000,02. (7) Denticules postérieurs de V.2000,02. (8) Denticules antérieurs de V.2000,02. Barre d'échelle : 5 mm pour 1–6 et 0,3 mm pour 7 (7) et 8.

Discussion: The ankylosaurs have a very simple and primitive tooth morphology (Coombs, 1990), so a more detailed taxonomical determination is impossible.

Order SAURISCHIA Seeley, 1887
Suborder THEROPODA Marsh, 1881
THEROPODA indet.

Morphotype 1
Fig. 2(5–8)
Material: HNHM V.2000.02, V.2000.03, V.2000.04, V.2000.35.

Description: The crown of the teeth of morphotype 1 are labio-lingually compressed and anteroposteriorly sharply curved. The fore-aft basal length (FABL) of V.2000.35 is as much as double of the basal width (BW). Both carinae of the teeth of morphotype 1 are serrated and situated in the midline of the tooth. Anterior denticles tend to start closer to the base of the crown.

Discussion: Fiorillo and Currie (1994) pointed out in the case of *Richardoestesia gilmorei* that "the most readily identifiable characteristics of these teeth are the very small height and length of the denticles." This corresponds to the teeth of morphotype 1. Maximum number of denticles on both carinae is 8.5–10.5 per millimeter (Fig. 3). Posterior denticles curve very slightly distally towards the apex of the crown. The teeth are similar to those of Velociraptorinae but differ in

Theropoda indet	Specimen Number	Length (L)	FABL	BW	L/FABL	ant. serr. per mm	pos. serr. per mm	DSDI
Morphotype 1	V.2000.02	4 ?(6)	—	—	—	9	9	1
	V.2000.03	4 ?(6)	—	—	—	9.5	9	1.05
	V.2000.04	3,5	2.5	—	1.4	10	9	1.11
	V.2000.35	4	3	1,1	1,3	10,5	9.5	1,1
Morphotype 2	V.2000.05	2.6	2,1	0.8	1.23	—	7.5	—
Morphotype 3	V.2000.06	9,5	—	—	—	7.5	7	1.07

Fig. 3. Measurements of theropod teeth from Iharkút. All measurements are given in mm. DSDI: denticle size difference index. BW: basal width. FABL: fore-aft basal length. Ant. serr.: anterior serration. Pos. serr.: posterior serration. (Terminology after Currie, 1987; Currie et al., 1990; Rauhut and Werner, 1995; Csiki and Grigorescu, 1998).

Fig. 3. Mesures des dents de théropodes d'Iharkút. Toutes les dimensions sont données en mm. DSDI : indice de différence de mesure de denticule. BW : largeur basale. FABL : longueur basale antéro-postérieure. Ant. serr.: crénelure antérieure. Pos. serr.: crénelure postérieure. (Terminologie d'après Currie, 1987; Currie et al., 1990; Rauhut and Werner, 1995; Csiki and Grigorescu, 1998).

having differently shaped, smaller denticles and smaller curvature of the crown (Currie et al., 1990). Description and measurements of the teeth of *Richardoestesia* cf. *gilmorei* in Sankey (2001) correspond to the characters of the Hungarian specimens. Teeth of *Richardoestesia isosceles* Sankey, 2001 differ in having isosceles triangle shape.

Morphotype 2

Material: V.2000.05.

Description: The shape of the denticles of morphotype 2 are similar to those morphotype 1. V.2000.05 is laterally compressed and bears a well-developed anteroposterior curvature. The absence of anterior serration and the relationship between total length, and FABL are differences compared with morphotype 1 (Fig. 3). The strong curvature and the number of posterior denticles of the tooth are similar to that of *Saurornitholestes* from the Judith River Formation (TMP 82,24.16 Currie et al. 1990: p. 111, Fig. 8,2B) but the strong curvature and the small height of the crown are characteristic to *Richardoestesia gilmorei* too (Currie et al., 1990).

Morphotype 3

Material: V.2000.06.

The third morphotype is less compressed laterally. The distance between the anterior and the posterior carinae is twice the width of the tooth in cross-section. Both carinae are serrated, the tooth has a slight curvature making the posterior carina almost straight.

3. Conclusions

Based on 12 teeth, three family of dinosaurs (Rhabdodontidae, Nodosauridae, Dromaeosauridae) represent the new Hungarian fauna. These families are present in the Campanian and Maastrichtian faunas of Europe too. In addition to these families, titanosaurid sauropods and hadrosaurs are also present in the main European localities (Le Loeuff, 1993; Buffetaut and Le Loeuff, 1991), which, however, have not been found in the Hungarian fauna till now.

The newly discovered dinosaur fossil site, the Iharkút area was a low-relief plain during the Late Cretaceous (Santonian) formed by fine-grained alluvial sediments derived from eroding areas to the east-northeast (Jocha Edelényi, 1988). Most of the European continent was covered by sea until the Late Cretaceous, but many ecosystems developed on the continent (e.g. in southern France and northern Spain, Buffetaut and Le Loeuff, 1991) and on some supposed islands (e.g. eastern Austria, Hateg Basin, Iharkút area). There is no evidence for direct connection between Iharkút and any other parts of Europe during the Santonian.

The newly discovered vertebrate fossil assemblage with the first dinosaur remains from Hungary, which represents a periodically isolated ecosystem, gives a newer chance of comparison between faunas of small terranes and communities that lived on large continents during the Late Cretaceous.

Acknowledgments

The author thanks András Torma, Ferenc Szőke, László Kocsis, and István Főzy for help in collecting and Ágnes Görög and Roland Wernli (Genf) for help in photography and translation. I am very grateful to Coralia Maria Jianu (Deva) for her assistance in the study of the fossils. The author would like to thank André Poisson (Paris) and Coralia Maria Jianu for sending some literature. Miklós Kázmér, David Weishampel, and László Kordos read previous versions of the manuscript. I thanks Emőke Jocha-Edelényi and Andrea Mindszenty for consulting the Bauxite Ltd. during fieldwork in the mine and I also thank the Bauxite Ltd. especially Attila Pataki, Tamás Böröczky, and Géza Fodor for permission to collect and logistical help.

I am grateful to the reviewers, especially Jean Le Loeuff for their useful comments.

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