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Original article

Early Miocene Amphibians (Caudata, Salientia) from the Mokrá-Western Quarry (Czech Republic) with comments on the evolution of Early Miocene amphibian assemblages in Central Europe☆

Amphibiens (Caudata, Salientia) du Miocène inférieur de la carrière ouest de Mokrá (République Tchèque) et commentaires sur l'évolution des assemblages d'amphibiens du Miocène inférieur en Europe Centrale

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Abstract

The Mokrá-Western Quarry exhibits the rare occurrence of Early Miocene (MN 4) vertebrate fauna within the area of the eastern part of Central Europe. In addition to a rich fauna of reptiles and mammals, two fossiliferous karst joints (Mokrá-Western Quarry, 1/2001 Turtle Joint and Mokrá-Western Quarry, 2/2003 Reptile Joint) yielded a rich fauna of amphibians including 13 amphibian taxa: Salamandridae: *Mioproteus* sp., *Chelotriton* sp., type I, *Chelotriton* sp., type II, *Triturus* aff. *roehrsi*, *Triturus* cf. *marmoratus*, *Triturus* sp. (*T. cristatus* species group), *Chioglossa meini*, *Mertensiella mera*, Salamandridae gen. and sp. indet.; Pelobatidae: *Pelobates sanchizi*; Ranidae: *Rana* sp. (synklepton *Rana esculenta*); Bufonidae: *Bufo* sp. The first records of the West European species *Triturus* cf. *marmoratus* and *Chioglossa meini* are reported from the eastern part of Central Europe indicating the wide distribution of those taxa throughout the whole of Europe as early as MN 4. The oldest known record of *Pelobates sanchizi* documents the Early Miocene presence of representatives closely related to the extinct Late Oligocene representatives of *Pelobates*. The slow evolution of amphibian species is documented by the presence of *Triturus* cf. *marmoratus* and the oldest known occurrence of the extinct salamander *Mertensiella mera*.

Résumé

La carrière ouest de Mokrá contient une des rares occurrences de faune de vertébrés du Miocène inférieur (MN 4) de la partie Est d'Europe Centrale. En plus d'une riche faune de reptiles et de mammifères, deux joints karstiques fossilifères (carrière Ouest de Mokrá, 1/2001 « Turtle Joint » et carrière Ouest de Mokrá 2/2003 « Reptile Joint ») ont livré une faune diversifiée d'amphibiens comprenant 13 taxa : Salamandridae : *Mioproteus* sp., *Chelotriton* sp., type I, *Chelotriton* sp., type II, *Triturus* aff. *roehrsi*, *Triturus* cf. *marmoratus*, *Triturus* sp. (groupe *T. cristatus*), *Chioglossa meini*, *Mertensiella mera*, Salamandridae gen. et sp. indet. ; Pelobatidae : *Pelobates sanchizi* ; Ranidae ; *Rana* sp. (synklepton *Rana esculenta*) ; Bufonidae : *Bufo* sp. Les espèces ouest-européennes *Triturus* cf. *marmoratus* et *Chioglossa meini* sont enregistrées pour la première fois de la partie Est d'Europe Centrale ce qui démontre la distribution étendue de ces taxa en Europe déjà au MN 4. L'enregistrement le plus ancien de *Pelobates sanchizi* justifie la présence des représentantes du Miocène inférieur étroitement apparentés à représentantes éteintes de *Pelobates* de l'Oligocène supérieur. La lente évolution des espèces d'amphibiens est

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aussi mise en évidence par la présence de *Triturus* cf. *marmoratus* et par l'observation la plus ancienne de l'espèce éteinte de salamandre *Mertensiella mera*.

Keywords: Caudata; Salientia; Evolution of assemblages; Early Miocene; Central Europe

Mots clés : Caudata ; Salientia ; Évolution d'assemblages ; Miocène inférieur ; Europe Centrale

1. Introduction

Early Miocene herpetological assemblages are extremely rare in Central Europe east of Germany. Within this area the only Early Miocene herpetological localities are those of Merkur-North (MN 3a), Hrabák Mine (MN 3), Nástup Mine (MN 3), Skyřice (MN 3), Dolnice (MN 4), and Oberdorf (MN 4) sites (Szyndlar, 1987; Sanchíz, 1998b; Ivanov, 2002; Rage and Roček, 2003 - http://rocek.gli.cas.cz/Tertianura.pdf; Szyndlar and Rage, 2003). The recently discovered Mokrá-Western Quarry, in the Czech Republic, is an important locality (Fig. 1(1)) showing the diversified Early Miocene, MN 4 (Ivanov and Musil, 2004; Ivanov et al., 2006) herpetofauna situated in close proximity to the shores of Central Paratethys.

The Mokrá open-cast mine is located about 12 km ENE of the city of Brno on the Mokrá Plateau (420–450 m a.s.l.), itself situated in the southern part of the Drahany Upland (Moravia, Czech Republic). The Mokrá Plateau is situated in the SE part of the Moravian Karst. It is made up predominantly of Devonian carbonates passing into Lower Carboniferous flyschs facies. The western part of the Mokrá Plateau is intensively karstificated. The Mokrá open-cast mine consists of three separate quarries: the western, the central, and the eastern (Fig. 1(2)). The karst predominates only in the Western Quarry (Vít et al., 2001). The geological setting of the Mokrá Plateau is discussed in detail by Ivanov et al. (2006).

The vertical fossiliferous joints, Mokrá-Western Quarry, 1/2001 Turtle Joint (49°13′58,16″ N, 16°45′6,07″ E, floor 380 m a.s.l.) and Mokrá-Western Quarry, 2/2003 Reptile Joint (49°13′57,81″ N, 16°45′5,09″ E, floor 380 m a.s.l.) in Devonian limestone are of particular importance. They consist of fine, sandy clays of lacustrine origin with mammal Zone MN 4 (Ottnangian-Karpatian) fauna including *Democricetodon*, *Megacricetodon*, and *Melissiodon* (Fig. 2). Both lacustrine clays and faunal assemblage indicate proximity to a freshwater basin with sandy shores and dense vegetation in rather warm and humid conditions (Ivanov and Musil, 2004; Ivanov et al., 2006). Amphibian fauna discovered in both joints is accompanied by abundant fauna of squamate reptiles, turtles, and mammals (Ivanov and Musil, 2004; Ivanov et al., 2006). Further to the north-west, numerous joints are filled with reworked terra rossa soil, with limestone fragments and rare Early Biharian fauna of small mammals (Fejfar and Horáček, 1983).

The material is held in the collections of the Moravian Museum, Brno.

Abbreviations: MMB-Ge: Department of Geology and Palaeontology, Moravian Museum, Brno. ZFMK: Zoologische Forschungsinstitut und Museum Alexander von Koenig. NMP: National Museum Prague. DP FNSP: Department of Palaeontology, Faculty of Sciences, Charles University, Prague.

Terminology used in Systematic part: Terminology for cranial osteology of Caudata is based on Bolkay (1928), Francis (1934), Duellman and Trueb (1986), and Trueb (1993). Anuran cranial terminology is based on Bolkay (1919), Roček (1981, 1994a), and Sanchíz (1998a). Terminology for postcranial skeleton of Caudata is based on Teege (1957), Bailon (1991), and Rage and Hossini (2000). Postcranial terminology for Anura comes from Roček (1994a) and Sanchíz (1998a). The classification of fossil material is based on the systems published by Estes (1981), Sanchíz (1998a), and Roček (2002).

2. Systematic palaeontology

Class AMPHIBIA Linnaeus, 1758
Infraclass CAUDATA Scopoli, 1777
Order PROTEOIDEA (Noble, 1931) emend. Edwards, 1876
Family PROTEIDAE Hogg, 1838
Genus ***Mioproteus*** Estes and Darevsky, 1977

Species typica: *Mioproteus caucasicus* Estes and Darevsky, 1977: 164–169. – Estes, 1981: 27, Fig. 5E. Middle Miocene of Germany, Caucasus, and east Kazakhstan.

Mioproteus sp.

Locality: Mokrá-Western Quarry, 2/2003 Reptile Joint.
Material: Two precaudal vertebrae (MMB-Ge29628/1-2).

Precaudal vertebrae (Fig. 3(1–4)): A more completely preserved vertebra is typically amphicoelous. In lateral view, the neural spine was most probably relatively high with the base of its cranial margin posteriorly inclined. The anterior zygapophyseal crest is clearly sharp, forming the dorsal border of the deep depression in front of the broken off rib-bearer. The cranial margin of the neural arch is tilted dorsally. In dorsal view, the only preserved right prezygapophyseal articular facet is widely oval. The neural spine extends as far as the anterior margin of the neural arch. The ventral surface is perforated with numerous foramina indicating damage to the bone surface structure rather than the presence of subcentral foramina.

Comments: Assignment to the genus *Mioproteus* is based on the following features: (1), amphicoelous centrum; (2), cranial margin of the neural arch is tilted dorsally; (3), there is a distinct wide depression at the anterior base of the rib-bearer. Both fragmentary vertebrae do not differ from the *Mioproteus wezei* Młynarski, Szyndlar, Estes and Sanchíz, 1984 reported from the Middle Pliocene and questionably from the Early