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New Pliocene localities with micromammals from the Czech Republic: a preliminary report

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With 5 figures and 2 tables

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Abstract

The first well defined Pliocene mammalian faunas in the Czech Republic – found at localities Měňany 3 and Vitošov – are reported herein. Pilot samples from the localities have yielded an assemblage of at least 23 taxa of small mammals (Lipotyphla, Chiroptera, Lagomorpha, and Rodentia). The key taxa *Mimomys hassiacus*, *M*. cf. *gracilis* (an advanced form), *Baranomys*, and *Germanomys* in the assemblage suggest age of the fauna is Pliocene, possibly near the Ruscinian – Villanyian (MN15b – MN16a) boundary.

Schlüsselwörter: Kleinsäugetiere, Pliozän, Ruscinium, Villanyium, Tschechische Republik.

Zusammenfassung

Die ersten gut definierten Säugetierfaunen des Pliozäns – aus Měňany 3 und Vitošov – werden hier zum erstenmal untersucht. Die ersten Proben lieferten eine Fauna von 23 Säugetiertaxa der Ordnungen Lipotyphla, Chiroptera, Lagomorpha und Rodentia. Die biochronologisch wichtigen Formen *Mimomys hassiacus*, *M*. cf. *gracilis* (eine fortschrittliche Form), *Baranomys* und *Germanomys* unterstützen die Alterseinstufung der Fauna an der Grenze des Ruscinium – Villanyium (MN15b – MN16a).

Introduction

In the past, several late Cenozoic faunas were described from the Czech Republic (Fejfar & Horáček 1983). However, no Late Ruscinian (MN15b), or Early Villanyian (MN16a) faunal assemblage were known from that area until now. Two new localities, Měňany 3 (Central Bohemia) and Vitošov (Northern Moravia) fill this gap in the fossil record in the Czech Republic and yield new information about this rare level in Central Europe.

The following localities have been described as Late Ruscinian (MN15b) from Central Europe: Csarnóta 1–3 in Hungary (Kretzoi 1959, 1962; Jánossy 1986); Ivanovce 1 and 2 in Slovakia (Fejfar 1961a, 1961b, 1970); Węże 1 and 2 in Poland (Samsonowicz 1934; Sulimski 1959, 1962, 1964; Kowalski 1960); Gundersheim (Findling) (Fejfar & Storch

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1990), Gundersheim 4 (Tobien et al. in press), and Wölfersheim (Fejfar & Repenning 1998; Dahlmann 2001) – all three from Germany. Changes in the composition among these faunal assemblages were identified in S-N and E-W directions (Fejfar & Storch 1990). Slightly younger MN16a faunas are less common in this region with only a few localities known: Beremend 1–3 and 5 in Hungary (Jánossy 1986); Hajnáčka in Slovakia (Fejfar 1964; Fejfar et al. 1990; Lindsay et al. 1997; Sabol 2004a); Hambach (Mörs et al. 1998) and partly Gundersheim in Germany (Heller 1936; Fejfar & Storch 1990). Also an important sequence of Pliocene faunas was introduced from Deutsch-Altenburg in Austria (Rabeder 1981).

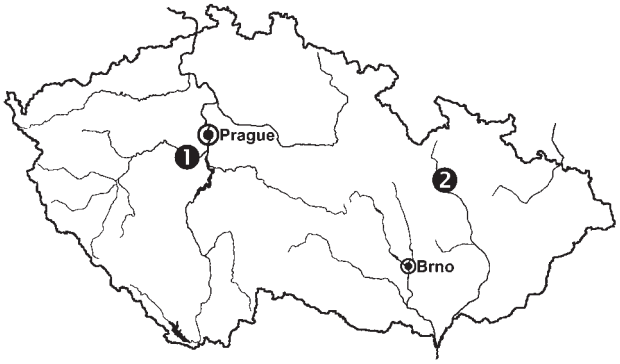

Fig 1. The geographical position of the localities under study. **1** – Měňany 3; **2** – Vitošov.

Material and methods

The fossil fauna described in this paper comes from preliminary researches of the above mentioned localities. Pilot samples of sediment (about 10 kg from Měňany 3 and about 15 kg from Vitošov) were processed following conventional screen-washing procedure to recover small mammals. For purposes of this paper only taxonomically important specimens were identified (see Tables 1 and 2 for details). Measurements and drawings were made with the aid of binocular microscope. All measurements, given in millimeters, were taken on the maximum dimensions length (L) and width (W) of the occlusal surface of the teeth.

The following abbreviations were used in the text and tables: c/C = lower/upper canine, i/I = lower/upper incisor, p/P = lower/upper premolar, m/M = lower/upper molar, N = sample size. The dental terminology of Arvicolidae follows Rabeder (1981). The fossil material is currently held by the authors and will later be deposited in the collections of the National Museum in Prague.

Survey of Měňany 3

A limestone quarry in Plešivec Hill (= Nový Homolák Hill) contains several karstic fissures, three of which yielded vertebrate remains. Two of the fissures (Měňany 1 and 2) are Late Villanyian – Early Biharian age. They were discovered (between 2002 and 2004) by the geologist Dr. Žák. On his advice, this quarry was visited during the fall of 2005 by several paleontologists. At that time a third fossiliferous fissure was discovered by S. Čermák and I. Horáček, and independently by C. Diedrich. Fauna from this third fissure is presented in this paper.

The site with GPS coordinates 49°54′23″ N, 14°5′27″ E is located in the Bohemian Karst (Beroun District, Central Bohemia) 1.8 km W of the small village Měňany, within an abandoned limestone quarry in the Plešivec hill (Fig. 1).

The fossil remains are well preserved, usually whitish coloured, and, in some cases the surface of bones is covered by secondary manganese. All remains come from non-cemented terra rossa-like sediment (with secondary manganese concretions) located in the upper part of the exposure.

The age of the fauna is near the Late Ruscinian (MN15b) – Early Villanyian (MN16a) boundary (see Table 1 and "Discussion and Results" for details).

Table 1
List of identified taxa from Měňany 3 (see "Material and methods" for explanation of abbreviations).

Taxa	Material examined	Figures
Lipotyphla Haeckel, 1866		
Talpa sp. (a large form)	1 humerus	
Beremendia cf. *fissidens* (Petényi, 1864)	1 i, 1 m1	3 A, C
Blarinoides cf. *mariae* Sulimsky, 1959	1 i	3 B
Lagomorpha Brandt, 1855		
Hypolagus sp.	2 I1, 1 i1, 2 M2, 1 distal part of humerus, 1 fragment of pelvis, 1 metatarsal, 6 phalangeal bones	
Rodentia Bowdich, 1821		
Prospalax cf. *priscus* Méhely, 1908	1 M1, L × W = 2.00 × 1.72	2 I
Baranomys longidens (Kowalski, 1960)	1 m1, L × W = 1.68 × 0.88	2 H
Germanomys weileri Heller, 1936	1 m1, L × W = 2.20 × 1.12	2 G, g
Mimomys cf. *gracilis* (Kretzoi, 1962)	3 m1, mean L × W = 2.51 × 1.08;	2 D–F, d–f
(an advanced form)	3 M3, mean L × W = 1.61 × 0.89	4 F, f, G, g
Mimomys hassiacus Heller, 1936	3 m1, mean L × W = 3.03 × 1.32	2 A–C, a–c
	5 M3, mean L × W = 2.04 × 1.12	
Synaptomys seu *Lemmus* sp.	1 M1	

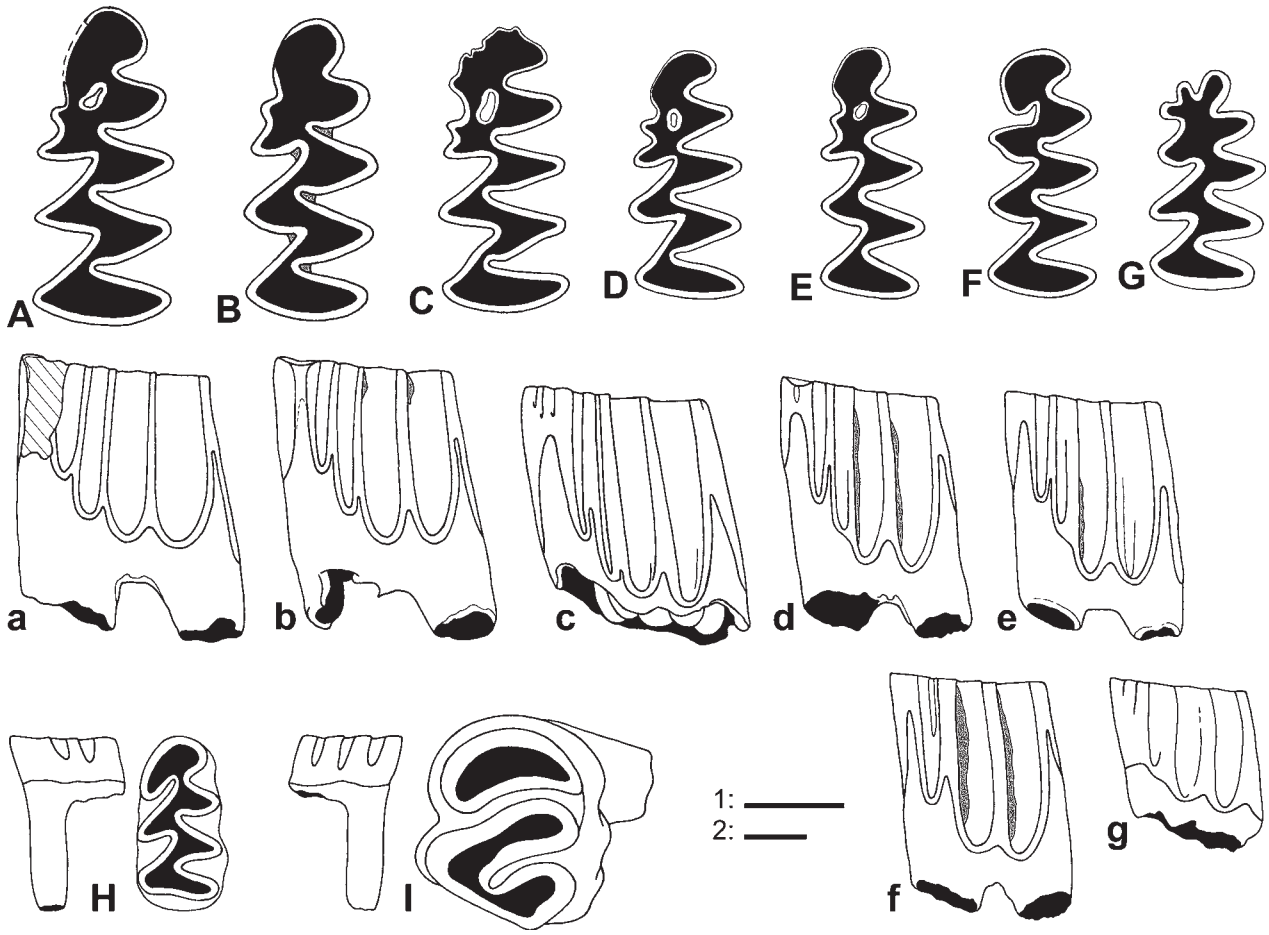

Fig. 2. Fossil remains from Měňany 3. **A**–**C**, **a**–**c** – *Mimomys hassiacus* Heller, 1936; **A**, **B**, **a**, **b** – m1 dex (reversed); **C**, **c** – m1 sin; **D**–**F**, **d**–**f** – *Mimomys* cf. *gracilis* Kretzoi, 1962 (an advanced form), m1 dex (reversed); **G**, **g** – *Germanomys weileri* Heller, 1936, m1 dex (reversed); **H** – *Baranomys longidens* Kowalski, 1960, m1 dex (reversed); **I** – *Prospalax* cf. *priscus* Méhely, 1908, M1 dex (reversed). **A**–**G**, **I** – occlusal views; **a**–**g** – buccal views; **H** – buccal, occlusal, and lingual view, respectively. Scale bars represent 1 mm, **1** – for occlusal view, **2** – for buccal and lingual view.

Discussion of the fauna

The cricetid remains are described in more detail since they provide the most important evidence for the age of the locality. A large and a small form of *Mimomys* is presented in the faunal assemblage from Měňany 3. The enamel thickness of the *Mimomys* teeth is not differentiated. The crown is moderately high but the crown base (linea sinuosa) is relatively low (particularly the Mimo-, Primo-, and Protosinuid). There is very thin and irregular crown-cementum in the synclines of some m1 (Fig. 2b, d–f). The shape of the occlusal surface of these teeth is variable, however it bears a "*Mimomys*"-morphotype (e.g., *Mimomys*-ridge, enamel islet, etc.); one m1 shows "*Dolomys*"-morphotype with an open fold (Fig. 2F), but with cementum in the synclines. The larger arvicoline specimens can be referred to *Mimomys hassiacus*, and the smaller one is tentatively referred to an advanced form of *Mimomys gracilis* (see "Discussion and Results" for details).

Germanomys is another significant member of this Late Ruscinian – Early Villanyian assemblage. This taxon represents a conservative branch of the Arvicolinae which does not show significant changes in its primitive morphology during this time interval. The m1 from Měňany 3 has a low hypsodont (mesodont) crown with slight undulation of the basal enamel margin. The synclines lack cementum and the alternation of synclines is less complete. Occlusal shape of the anteroconid complex is three-lobed, the lingual lobe is longer than the buccal ones. The dimensions of m1 allow assignment of the specimen from Měňany 3 to *Germanomys weileri*. There are several insignificant differences (particularly in morphology of the anteroconid complex) among *Germanomys* remains from Gundersheim (type locality), Hajnáčka, Ivanovce, Ostramos 7, Rębielice Królewskie, Węże, and Wölfersheim that are probably the result of intraspecific and ontogenetic variability.

The last important cricetid member of the assemblage belongs to *Baranomys*, a form with the "microtoid (sensu Schaub 1934)" low prismatic structure of molars. The m1 from Měňany 3 is small, two-rooted, with a low crown, and almost straight basal enamel margin; the enamel is thick and less

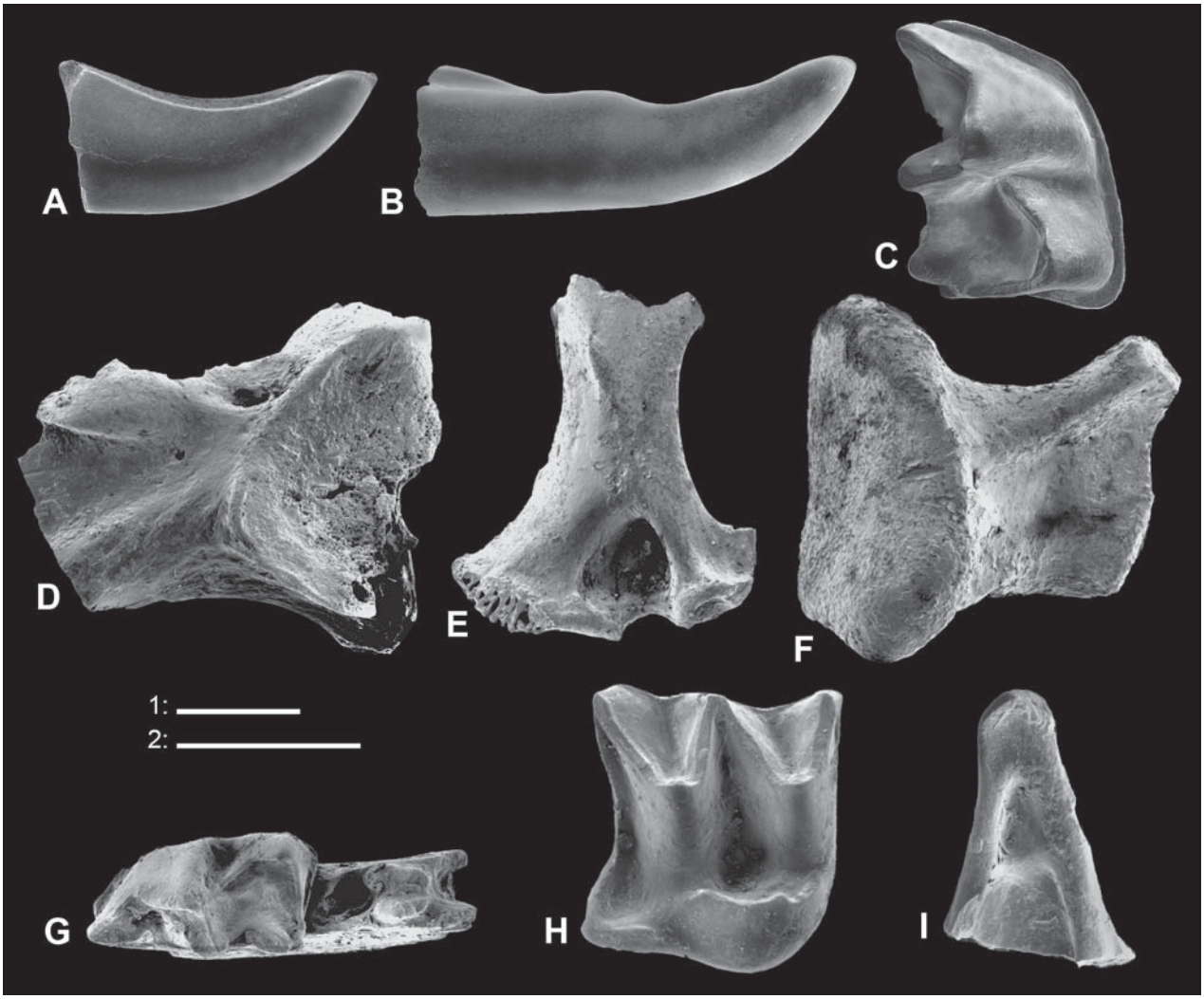

Fig. 3. Fossil remains from Měňany 3 (**A**–**C**) and Vitošov (**D**–**I**). **A**, **C** – *Beremendia* cf. *fissidens* Petényi, 1864; **A** – i dex; **C** – m1 dex; **B** – *Blarinoides* cf. *mariae* Sulimsky, 1959, i dex; **D** – *Rana* sp. fragment of left illium; **E** – *Desmanella* sp., humerus; **F** – *Talpa* cf. *minor* Freudenberg, 1914, clavicula; **G**, **H** – *Blarinella* (*Adelloblarinella*) cf. *europaea* Reumer, 1984; **G** – m1 dex, **H** – M2 dex; **I** – cf. *Sorex bor* Reumer, 1984, or *Paenelimnoecus pannonicus* Kormos, 1934, right processus coronoideus. Scale bars represent 1 mm, **1** – for **A**–**F**, **2** – for **G**–**I**.

differentiated; the occlusal surface is simple, consisting of rounded anteroconid and three alternating triangles. The anteroconid of m1 lacks an enamel islet and its labial fold is elongated; there are no dentine tracks in the synclines of the triangles. Based on the dimensions and morphology of the m1, this specimen is referred to *Baranomys longidens*, known also from the localities Gundersheim 4, Gundersheim (Findling), Węże, and Wölfersheim.

Survey of Vitošov

This site was discovered by Dr. Morávek in March 2002, when he found a vertical cave with curious pisolithic speleothemes with a small dislocated block of cemented terra near the entrance. He noted presence of fossils in the sample and invited us to inspect the quarry. We found the fossiliferous level during our visit in June 2002 when we obtained about 50 kg of the sediment.

The site with GPS coordinates 49°51′53″ N, 16°56′44″ E is located 5 km SE of the town Zábřeh (Šumperk District, Northern Moravia) within a limestone quarry near the limekiln of Vitošov (Fig. 1).

The cemented debris with terra rossa infill yielded white colored fossil remains. The content of fossils was rather poor and the material very fragmented.

The age of the fauna is near the Late Ruscinian (MN15b) – Early Villanyian (MN16a) boundary (see Table 2 and "Discussion and Results" for details).

Discussion of the fauna

Chiroptera, Gliridae, and Muridae form a dominant element of the Vitošov faunal assemblage. The presence of *Desmanella* sp. or *Blarinella* cf.

Table 2
List of identified taxa from site of Vitošov (see "Material and methods" for explanation of abbreviations).

Taxa	Material examined	Figures
Amphibia		
Rana sp.	1 ilium with vexillum partim, 2 scapulae, 1 humerus	3 D
Lipotyphla Haeckel, 1866		
Talpa cf. *minor* Freudenberg, 1914	1 humerus, 1 clavicula	3 F
Desmanella sp. (Urotrichini)	1 humerus	3 E
Beremendia fissidens (Petényi, 1864)	2 i1, 1 m1	
Blarinella (Adelloblarinella) cf. *europaea* Reumer, 1984	1 M1, 1 M2, 1 m1	3 G, H
cf. *Sorex bor* Reumer, 1984 seu *Paenelimnoecus pannonicus* (Kormos, 1934)	1 processus coronoideus	3 I
Chiroptera Blumenbach, 1779		
Rhinolophus cf. *kowalskii* Topál, 1979	2 cochleae, 1 c, 1 P4, 1 m1 partim	5 D
Rhinolophus cf. *lissiensis* Mein, 1964	1 m1	5 E
Myotis cf. *gundersheimensis* Heller, 1936	6 C, 5 c, 6 mandibular fragments, 1 M1, 1 m2	5 F, G
Myotis cf. *danutae* Kowalski, 1956	2 P4–M1, 1 M1, 1 m	5 C
Myotis aff. *daubentonii* (Kuhl, 1817) (cf. *paradaubentonii* Topál, 1983)	1 M1	5 B
Myotis sp. (a small form)	1 mandible with m3	
"*Kerivoula*" sp. (a very small form)	1 m1	5 A
Rodentia Bowdich, 1821		
Glis minor Kowalski, 1956	1 P4, L × W = 1.12 × 1.28; 1 M1, L × W = 1.71 × 1.79; 1 m1, 1 m2	5 L, M
Apodemus cf. *atavus* Heller, 1936	4 M1, 4 m1, 1 m2, 1 m3	5 H–K
Baranomys sp.	1 M1, L × W = 1.60 × 0.90	4 I
Germanomys sp.	1 m3, L × W = 1.32 × 0.90	4 H
Mimomys cf. *gracilis* (Kretzoi, 1962) (an advanced form)	1 fragment of right mandible with m1–m2 (m1: L × W = 2.88 × 1.3); 1 m1 (without posterior loop), W = 1.16; 2 M3, mean L × W = 1.83 × 1.07	4 A, a, B, b, D, d, E, e
Mimomys hassiacus Heller, 1936	1 m1 (with incomplete anteroconid complex), W = 1.44	4 C, c

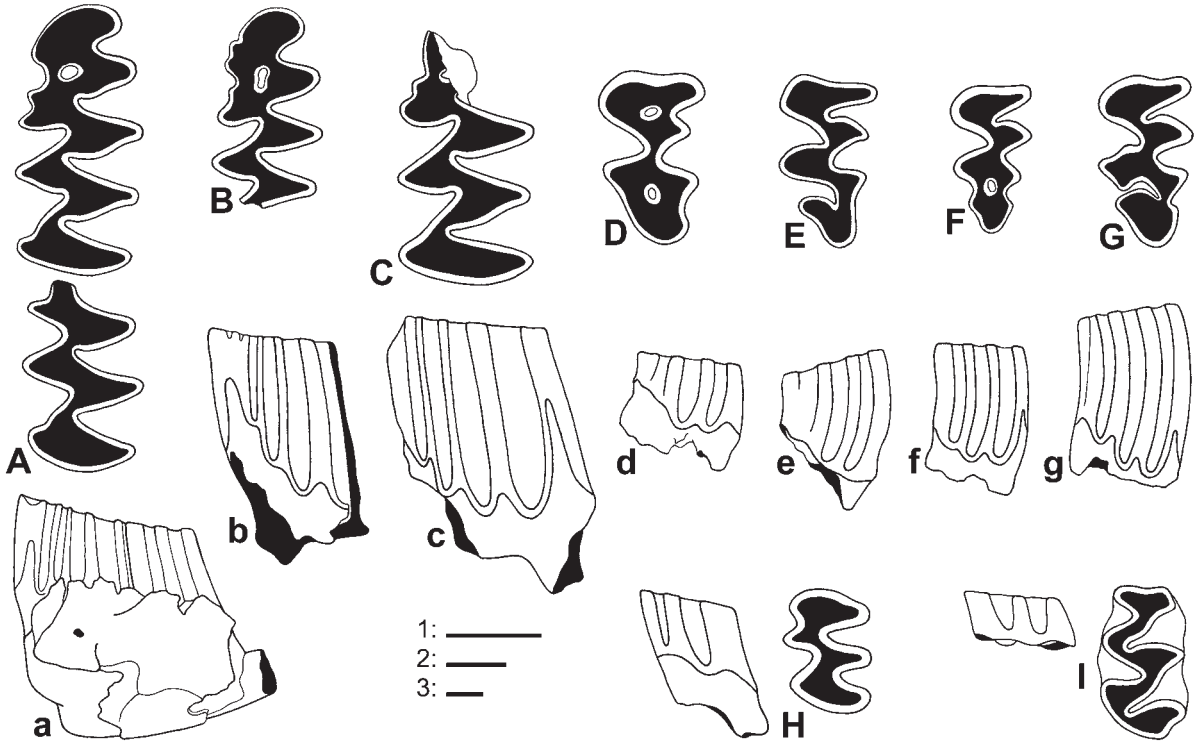

Fig. 4. Fossil remains from Vitošov (**A**–**E**, **a**–**e**, **H**, **I**) and Měňany 3 (**F**, **G**, **f**, **g**). **A**, **B**, **D**, **E**, **a**, **b**, **d**, **e** – *Mimomys* cf. *gracilis* Kretzoi, 1962 (an advanced form); **A**, **a** – fragment of right mandible with m1–m2 (reversed); **B**, **b** – m1 dex (reversed); **D**, **E**, **d**, **e** – M3 sin; **C**, **c** – *Mimomys hassiacus* Heller, 1936, m1 dex (reversed); **H** – *Germanomys* sp. m3 sin; **I** – *Baranomys* sp. M1 dex (reversed); **F**, **G**, **f**, **g** – *Mimomys* cf. *gracilis* Kretzoi, 1962 (an advanced form); **F**, **f** – M3 dex (reversed); **G**, **g** – M3 sin. **A**– **G** – occlusal views; **a**–**g** – buccal views; **H**, **I** – buccal and occlusal view. Scale bars represent 1 mm, **1** – for occlusal view, **2** – for buccal view, **3** – for buccal view of mandible.

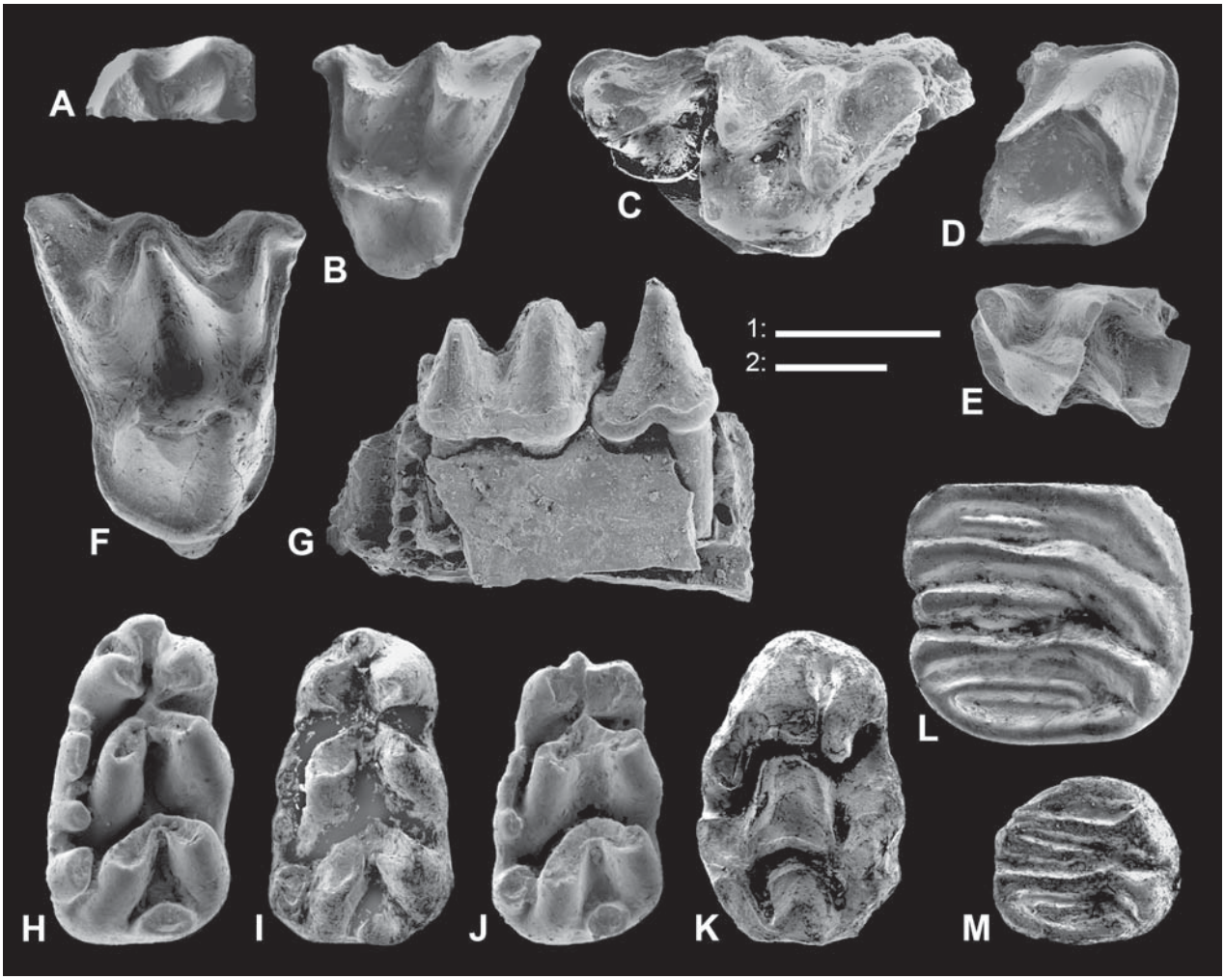

Fig. 5. Fossil remains from Vitošov. **A** – "*Kerivoula*" sp. m1 dex; **B** – *Myotis* aff. *daubentonii* Kuhl, 1817, M1 sin; **C** – *Myotis* cf. *danutae* Kowalski, 1956, P4–M1 sin; **D** – *Rhinolophus* cf. *kowalskii* Topál, 1979, m1 dex; **E** – *Rhinolophus* cf. *lissiensis* Mein, 1964, m1 sin; **F**, **G** – *Myotis* cf. *gundersheimensis* Heller, 1936; **F** – m2 dex; **G** – p4–m1 dex; **H**–**K** – *Apodemus* cf. *atavus* Heller, 1936; **H**–**J** – m1 sin; **K** – M1 sin; **L**, **M** – *Glis minor* Kowalski, 1956; **L** – M1 dex; **M** – P4 dex. Scale bars represent 1 mm, **1** – for **A**–**F**, **H**–**M**, **2** – for **G**.

europaea as well as a relatively high percentage of shrews in the sample support Ruscinian age for the deposit (compare Reumer 1984, 1985). A small sized myodont bat provisionally denoted "*Kerivoula*" resembles the material reported from MN16/17 site Javoříčko (Horáček 1988). *Rhinolophus lissiensis*, a gracile, medium sized horseshoe bat is reported from Lissieu (Mein 1964), Osztramos 10 (Topál 1974), Osztramos 9/1 (Jánossy & Kordos 1977), Koněprusy – Nová propast (Horáček 1980), and a form with similar features is also present in the Gundersheim fauna (Heller 1936).

Cricetid remains are rare at Vitošov although a few specimens of *Mimomys*, *Baranomys*, and *Germanomys* are preserved. There are five taxonomically significant teeth which can be assigned to *Mimomys* species. Three m1 (two of them incomplete), including both a small and a large species, correspond morphologically with the m1s from Měňany 3. Two small M3 obtained from Vitošov differ in structure of the crown; in the first one the buccal and lingual dentine fields are almost confluent and there are two enamel islets on the occlusal surface; in contrast, the other M3 has only an open isle fold on the posterior loop (as in *Dolomys* species) and the synclines are transversely longer with more complete alternation. The enamel crown base in both upper molars is low, slightly undulated. The large molar is assigned to *Mimomys hassiacus*, the small molars are tentatively assigned to an advanced *Mimomys gracilis*. The following taxa are represented by teeth with generic features: m3 with thick enamel and slightly undulated basal enamel margin is asigned to *Germanomys* sp.; a low prismatic M1 with almost straight basal enamel margin is assigned to *Baranomys* sp.

The species composition and even the structure of the fauna recorded in Vitošov closely resembles the situation described from the MN15b site Gundersheim (Findling) (Fejfar & Storch 1990; Dahlmann & Storch 1996).

Discussion and Results

Biochronological position of the sites under study

Most of the small mammalian taxa from Měňany 3 and Vitošov, e. g., *Beremendia*, *Blarinoides*, *Talpa*, *Hypolagus*, cover broader time ranges; however, some taxa of cricetids allow more precise correlation. For instance, *Baranomys* is restricted to MN14–17 zones and *Germanomys* is restricted to MN15b–17 (Fejfar & Heinrich 1990; Dahlmann 2001); so these conservative cricetids suggest an age younger than MN15a zone of the Pliocene.

The most precise biochronologic correlation is possible on the base of evolutionary stages of *Mimomys* species. The available teeth of large sized *Mimomys* from Měňany 3 and Vitošov, referred to *M. hassiacus*, correspond very closely, particularly in its linea sinuosa, to finds of *M. hassiacus* known from Gundersheim (Findling), Wölfersheim, Hambach, Beremend 3, and Hajnáčka. The material under study is almost identical with these remains and falls clearly within known species variation. In both localities described here, a small *Mimomys* shows the same evolutionary level of linea sinuosa of m1, however based on the morphology linea sinuosa of M3, the finds from Měňany 3 seems slightly more advanced than from Vitošov (Fig. 4d–g). Taking into account the small samples, it is difficult to evaluate comparison precisely with the other known Central European sites. Nevertheless, the small *Mimomys* under study is slightly more advanced in the level of linea sinuosa compared with *Mimomys gracilis* from Csarnóta 2, Wölfersheim, Ivanovce A, and Węże; simultaneously, it seems more primitive than *Mimomys stehlini* from Hajnáčka and Osztramos 7. Hence, this stage of *Mimomys* falls within the *Mimomys gracilis-stehlini* lineage; most probably it belongs to an advanced form of *M. gracilis.*

Thus, we think that the stratigraphical position of the faunas of Měňany 3 and Vitošov based primarily on the arvicolids represent transitional assemblages between MN15b – MN16a, or possibly the earliest representatives of MN16a zone, younger than Csarnóta 2, but a little older than known Middle European MN16a faunas like Hajnáčka. That is apparent especially on the evolutionary stage of the smaller *Mimomys*-species, that is more advanced than typical *M. gracilis* (e.g., in the type locality Csarnóta 2), but without reaching the evolutionary level of *M. stehlini* from Hajnáčka. However, the paucity of the material currently available from Měňany 3 and Vitošov does not allow a precise age assignment.

A note on the Pliocene chronology

Concerning the exact chronologic position of studied faunas within the standard European time scale, several problems are noted. The two Pliocene European land mammal ages, Ruscinian and Villanyian, are defined as having a concurrent range of genera *Trilophomys-Ruscinomys* and *Borsodia-Villanyia*, respectively (Fejfar & Heinrich 1983, 1990; Fejfar & Horáček 1990; Fejfar et al. 1998). But in fact the Ruscinian – Villanyian boundary is for the time being less precisely definable/recognizable in the Middle European area for the following reasons: 1) in the latest faunas from the Ruscinian mammal zone (MN15b) no *Ruscinomys* is present; 2) the genera *Villanyia* and *Borsodia* are not currently recorded in the earliest Villanyian faunas (Hajnáčka – see Fejfar et al. 1990; Sabol 2004b; Hambach – see Mörs et al. 1998; Beremend 1–3 and 5 – see Jánossy 1986), however both of these genera are recorded in eastern Europe in the pre-Villanyian faunas (Fejfar & Heinrich 1981). From the Middle European perspective, the boundary between MN15a and MN15b zones seems more precisely definable than that between MN15b and MN16a. While the MN15a – MN15b boundary is strictly characterized in the Middle Europe faunas by immigration of several new microtid genera, like *Dolomys* (but is sometimes, Fejfar et al. 1998, referred from MN15a), *Germanomys*, *Stachomys*, *Ungaromys* (Fejfar & Heinrich 1981, 1990) and species, like *Mimomys hassiacus* and *Dolomys occitanus* (e.g. in Wölfersheim, see Fejfar & Repenning 1998; Dahlmann 2001). No important changes are characterized for the MN15b – MN16a boundary, that is all genera of arvicolids exceed this boundary and no new genera occurred in the oldest Villanyian faunas (Fejfar & Heinrich 1990; Dahlmann 2001).

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