

NEW MIDDLE MIOCENE VERTEBRATE LOCALITIES FROM SUBPIATRĂ (BIHOR DISTRICT, ROMANIA)

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Abstract – During 2004 two new Middle Miocene localities have been discovered near Subpiatră (Bihor District, W-Romania). In the localities Subpiatră 2/1R and 2/1L 15-20 cm thick sandy clay and silt deposit were intercalated in a series of clay and clay calcareous layers. Both localities yielded a diversified faunal assemblage: terrestrial mollusks, fish bones and otoliths, lissamphibians (*Triturus* sp., *Latonia gigantea*, *Rana* (*Pelophylax*) sp.), reptiles (cf. *Diplocynodon*, *Ophisaurus* sp., *Lacerta* sp., Varanidae indet., Colubrinae indet., *Vipera* sp.), still undetermined birds, large mammals (Suidae indet., Cervidae indet.), still undetermined insectivores, leporids (*Eurolagus fontannesii*) and rodents (*Muscardinus* aff. *sansaniensis*, *Myoglis meini*, *Megacricetodon* sp., *Democricetodon freisingensis*, *Democricetodon brevis*). The locality Subpiatră 2/2 yielded a number of lissamphibians (Salamandridae indet., *Latonia gigantea*, *Palaeobatrachus* sp., *Hyla* sp.), squamates (*Ophisaurus* sp., Colubrinae indet.), still undetermined insectivores, and rodents (Pteromyinae indet., *Blackia miocaenica*, *Spermophilinus bredai*, *Muscardinus* aff. *sansaniensis*, *Glirulus lissiensis*, *Paragilirulus werenfelsi*, *Myoglis meini*, *Megacricetodon germanicus*, *Democricetodon freisingensis*, and *Eumyarion medius*). Substantial difference is possible to presume in the biochronologic framework of the two fossil-bearing levels. Subpiatră 2/1 R can be related to MN 6 fauna, while Subpiatră 2/2 is probable younger: MN 7/8.

Keywords – Middle Miocene, lissamphibians, reptiles, mammals, biochronology, West Romania.

INTRODUCTION

Subpiatră (Bihor District, W-Romania) is a small village located in the northern range of Pădurea Craiului Mountains about 40 km east to Oradea. The presence of Middle Miocene freshwater sediments ("deltaic facies") in the area have been reported by Istocescu & Istocescu (1974). However, the age of these deposits were interpreted equivocal by different authors (e.g. Rusu 1988, Onac 2002).

In the summer of 2004 during a geological survey in the Rece Valley near Subpiatră, two fossil-bearing layers were identified by one of us (MV). The fossil bearing deposits are situated on the left slope of the Rece Valley (47°00' N and 22°18' E), 296 m above sea level. In order to differentiate these sites from the well-known Middle Pleistocene locality Subpiatră (= Subpiatră 1) the outcrops have been numbered as follows: Subpiatră 2/1 R (found in the right side of a small ravine), Subpiatră 2/1L (found in the left side of a small ravine) and Subpiatră 2/2 (situated about 25 m west from the locality Subpiatră 2/1R). In the localities Subpiatră 2/1R and 2/1L the microvertebrate remains and terrestrial mollusks were found into 15-20 cm thick sandy clay and silt deposit, interbedded in a series of clay and marl layers (the thickness of the exposed outcrops is about 11 m). In the locality Subpiatră 2/2 the vertebrate fossils were enclosed in a dark-brownish clay layer of about 15-20 cm thickness overlaid by a 60-70 cm thick yellow clay layer, both of which being extremely rich in planorbids.

MATERIAL AND METHODS

From the locality Subpiatră 2/1R about 600 kg, while from Subpiatră 2/2 about 1 ton of sediments have been processed for study by screening-washing. The samples were dried and washed using screens with mesh of 0.8 and 0.6 mm. All fossils collected belong to the Țării Crișurilor Museum in Oradea.

PALAEONTOLOGY

Amphibians and reptiles

At least thirteen different amphibian and reptile taxa have been recorded in the localities Subpiatră 2/1R and Subpiatră 2/2 (see Table 1).

Triturus sp.

Four small sized opisthocoelous trunk vertebrae were available for study. The centrum is relatively short with the neural arch moderately vaulted, provided with a relatively high neural spine. The latter has some lateral enlargement of its dorsal surface. The condyle is rounded, separated from the vertebral centrum by a constriction. The transverse processes are inserted distantly from each other with a relatively small rib articulating surface. In ventral view, there is a prominent subcentral keel delimited laterally by relatively large subcentral foramina. The above features point to the members of the subgenus *Palaeotriton* (Bolkay 1928).

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Table 1 - List of amphibians and reptiles from the Middle Miocene of Subpiatră

Taxon	Subpiatră 2/1R (min. no. of individuals)	Subpiatră 2/2 (min. no. of individuals)
<i>Triturus</i> sp.	1	-
Salamandridae indet.	1	3
<i>Latonia gigantea</i>	7	4
<i>Palaeobatrachus</i> sp.	-	1
<i>Hyla</i> sp.	-	1
<i>Rana</i> (<i>Pelophylax</i>) sp.	45	-
Emydidae indet.	2	-
cf. <i>Diplocynodon</i> sp.	2	-
<i>Ophisaurus</i> sp.	2	1
<i>Lacerta</i> sp.	3	-
Varanidae indet.	1	-
Colubrinae indet.	2	1
<i>Vipera</i> sp.	1	-

Salamandridae indet.

Palaeobatrachus sp.
Pl. I, Figs. 1, 2

A humeral fragment from Subpiatră 2/1R and four others from Subpiatră 2/2 have their distal end moderately widened. The ectepicondyle is considerably larger than the entepicondyle, and the ventral cubital fossa is rather shallow. Based on size and morphology the specimens might have belonged to the genus *Triturus* too.

Latonia gigantea
Pl. II, Figs. 1, 2

The outer surface of several fragmentary frontoparietals and maxillae is covered with secondary sculpture formed by bony ridges and tubercles. The prearticular is medio-laterally compressed bearing a medially projecting coronoid process and a posteriorly situated paracoronoid process (Pl. II: Fig. 2). The latter structure has more or less a vertical orientation. The scapula is short and cleft with a relatively wide suprascapular part. In the only available specimen the distal section of the humerus is slightly shifted laterally. The humeral ball is broken off but the trace of the ventral cubital fossa is observed. The ilia belonged to specimens of various sizes. A large sized specimen is known from Subpiatră 2/2 (Pl. II: Fig. 1). The supraacetabular region in all the specimens is broken off, but there is a well-defined supraacetabular fossa; the preacetabular region is reduced. The dorsal protuberance (= *tuber superius*) is well defined, but sometimes is delimited indistinctly from the relatively high iliac crest. The junctura ilioischadica is distinctly widened ventrally and provided with a prominent interiliac tubercle.

The genus *Latonia* was rather common in the Middle Miocene deposits of Central Europe (Roček 1994, Rage & Roček 2003). This large bodied form with good swimming and jumping abilities probably inhabited various types of azonal ecosystems (Böhme 2002).

The posterior section of the frontoparietal table is wide and flat, delimited laterally and posteriorly by distinct ridges. In the mid section, the parasagittal ridges are salient and situated close to each other producing a narrow irregularly concave dorsal frontoparietal surface; the lateral wall is weakly slanting. In ventral view, there is an elongated depression outlined by sharp bony lamellae. The latter area covers the frontoparietal fenestra. The epicondylus medialis and the epicondylus lateralis on the distal part of the humerus are situated nearly symmetrical to each other. The lateral condyle is always larger than the medial one; the ventral cubital fossa is lacking.

The morphology of the frontoparietal strongly differ from that of *P. hiri*, known from the Middle Miocene localities of Mátraszőlős and Sámsonháza of Hungary (Venczel 2004) as well from that known from the Earliest Miocene of France (Hossini and Rage 2000).

Hyla sp.

From the single fragmentary ilium the larger part of the preacetabular region was broken off. The remnant of the latter structure is extremely thin edged. The dorsal prominence was presumably high and of oval shape, but its dorsolateral surface is partly eroded. After Holman (1992) and Bailon (2000) the shape of the dorsal protuberance is critical to distinguish the living *H. arborea* from *H. meridionalis*. Due to the above facts closer assignment of the above specimen is not possible.

Rana (*Pelophylax*) sp.
Pl. II, Figs. 3-6

The Meckel's groove of the prearticular is rather shallow. The coronoid process is well-developed displaying a wrinkled lingual margin (Pl. II: Fig. 3). A large number of ilia belonging to individuals of

various sizes have been found in Subpiatră 2/1R (Pl. II: 4-6). The acetabulum is circular; the supraacetabular and the preacetabular region (if preserved) are roughly of equal height. The supraacetabular fossa, situated anterodorsally to the acetabulum is deep; the iliac crest is thin and extremely high. The dorsal protuberance (= *tuber superius*) is of same height or sometimes higher than the iliac crest. In larger specimens the ventral margin of the dorsal protuberance is thickened and bears a distinct anteroventral overhang similar to specimens known from the Middle Miocene localities of Mátraszőlős 1 and 2 (Venczel 2004).

cf. *Diplocynodon* sp.
Pl. I, Figs. 3, 4

Fifteen isolated fragmentary teeth and three fragmentary osteoderms were recovered. The teeth are variable in size and morphology; the largest one approaches 9 mm in height. The tooth crown is finely striated with faint antero-posterior crests. The osteoderms display pitted dorsal surface and finely ornamented sutural margins. Based on the size of specimens and paleobiogeographic data the remains may be assigned with some doubts to *Diplocynodon*. The latter represents the last European crocodile which during MN 6 reached north of 37°N paleolatitude (Böhme 2002, 2003).

Ophisaurus sp.
Pl. II, Fig. 10

The available ten vertebrae and 75 osteoderms point to the genus *Ophisaurus*. The osteoderms are variable in size and morphology. Their dorsal surface displays a smaller smooth margin and a larger sculptured surface. The latter consist of from a prominent keel, bordered by a series of isolated or sometimes confluent tubercles.

Lacerta sp.
Pl. II, Fig. 7

Two fragmentary frontals, four fragmentary maxillae, four fragmentary dentaries have been assigned to this taxon. The tooth crown of the marginal teeth is provided with bicuspid tips.

Judging on the size and morphology of maxillae and dentaries at least two, relatively small sized forms were present in the deposit.

Varanidae indet.
Pl. II, Fig. 8, 9

Two isolated fragmentary teeth were available for study. The specimens are slightly curved and labiolingually compressed. The tooth base is striated and the posterior tooth margin bears a finely striated crest.

Colubrinae indet.
Pl. II, Fig. 11, 12

At least two different forms were present in the locality 2/1R. The centrum length of the largest vertebra is 5 mm, while its centrum width is 3.34 mm (CL/CW = 1.49). The neural arch is moderately vaulted and the anterior margin of the zygosphenes is crenate. The haemal keel is flattened and spatulate shaped. The paradiapophyses are diminutive with the diapophyseal and parapophyseal portion of roughly equal length.

Vipera sp.

Two fragmentary trunk vertebrae and one venom fang were found in the locality Subpiatră 2/1R. The centrum length of the largest vertebra is 4.24 mm, while its centrum width is 2.92 mm (CL/CW = 1.45). The tip of the hypapophysis is broken off, but its base is directed posteroventrally. The zygosphenes, preserved in the smaller specimen only is provided with a protruding central lobe. The size and morphology of the above vertebrae is reminiscent of the *Vipera aspis* complex of the genus *Vipera* (Szyndlar & Rage 2002).

The rodents

In the locality Subpiatră 2/1R the hamsters are nearly exclusive (see Table 2), while the glirids are the dominant family in the sample from the Subpiatră 2/2, where is a diverse sciurid material too (see Table 3).

Sciuridae
Sciurinae

Spermophilinus bredai (Von Meyer, 1848)

Seven molars can be related to this frequent ground squirrel species. The most important markers are the smooth enamel, the rounded lingual contour of the occlusal surfaces of the lower molars devoid of entoconid.

Pteromyinae
Pteromyinae gen. et sp. indet. I – II.

Two fragmentary m3 were found in Su 2/2. The larger one has hummocky sculptured enamel into the talonid basin; the middle sized specimen has wrinkled enamel (similar to the ornamentation of *Blackia*).

Blackia miocaenica Mein, 1970

The small sized flying squirrel is represented by two molars.

Table 2 - List of rodents from the Middle Miocene of Subpiatră

Taxon	Subpiatră 2/1R (No. of intact molars)	Subpiatră 2/2 (No. of intact molars)
<i>Eurolagus fontannesi</i>	1	-
<i>Petauristidae</i> indet.	-	2
<i>Blackia miocaenica</i>	-	2
<i>Spermophilinus bredai</i>	-	8
<i>Muscardinus sansaniensis</i>	3	-
<i>Muscardinus</i> aff. <i>sansaniensis</i>	-	2
<i>Glirulus lissiensis</i>	-	2
<i>Paraglrulus werenfelsi</i>	-	2
<i>Myoglis meini</i>	2	24
<i>Megacricetodon</i> sp.	89	-
<i>Megacricetodon germanicus</i>	-	12
<i>Democricetodon freisingensis</i>	-	7
<i>Democricetodon brevis</i>	3	-
<i>Eumyarion medius</i>	-	3
Total =	98	64

Table 3 - The composition of rodent families from the Middle Miocene of Subpiatră

Family	Subpiatră 2/1R	Subpiatră 2/2
Pteromyinae	-	7%
Sciurinae	-	13%
Gliridae	5%	45%
Cricetidae	95%	35%
Total =	120 molars	62 molars

Gliridae

Muscardinus aff. *sansaniensis*

Pl. III, Figs. 4, 5

Five molars were found in Su 2/1 and two molars were collected from Su 2/2. The morphology of the available 3 M1 is characterized by five main ridges. The development of the secondary ridges is variable. The shape of the flat occlusal surfaces of the M1 is not elongated and the anterior width is not narrower than the posterior one. The sizes are relatively small: M1 no. 107: 1.12 x 1.02 mm, M1 no. 47: 1.08 x 1.08 mm, M1 no. 42: 1.18 x 1.20 mm.

The presence of the species *Muscardinus vallesiensis* Hartenberger 1966, *M. hispanicus* de Bruijn 1966, and *M. topachevskii* Nesin & Kowalski 1997 is not probable in these localities.

Myoglis meini (de Bruijn, 1966)

Pl. III, Figs. 1, 2

One molar is known from Su 2/1 and 25 molars were found in Su 2/2. The most important markers of the flat occlusal surface of the M1 and M2 are the four main ridges (anteroloph, protoloph, metaloph, posteroloph) and a well developed anterior centroloph. In the lower m1–m2 the four main ridges (anterolophid, metalophid, mesolophid, posterolophid) and the well developed anterior extra ridge are the constant elements. The development of the secondary ridges is variable

but on the whole those are less developed than the corresponding ridges of the *M. meini* population in Felsőtárkány 3/2 (MN 7/8) (Hír 2004).

Confusion with the early Miocene species *Myoglis antecessens* Mayr 1979 is improbable because of the relatively large measurements values of the Subpiatră teeth: M1 no. 25: 1.81 x 1.82 mm, M1 no. 27: 1.83 x 1.89, M1 no. 31: 1.81 x 1.89. The species *Myoglis ucrainicus* Nesin & Kowalski (1997) is possible to rule out also because in the upper molars of this species the protoloph, metaloph and posteroloph ridges are not strictly merged in the protocone.

Paraglrulus werenfelsi Engesser, 1972

Pl. III, Fig. 3

In Su 2/2 3 molars belong to this species: m1 no. 45: 1.34 x 1.22 mm, m2 no. 46: 1.30 x 1.30 mm, m3 no. 47: 1.20 x 1.15 mm. The occlusal surface of the molars is concave. There are five main ridges (anterolophid, metalophid, centrolophid, mesolophid and posterolophid). The centrolophid and the mesolophid are connected on the buccal side. There are four extra ridges.

Glirulus lissiensis (Hugueney & Mein, 1965)

Pl. III, Fig. 6

The species is represented by only one M2 in Su 2/2 (no. 48): 0.87 x 1.01 mm. The occlusal surface is concave, the lingual surface is

ornamented. The anterior width of the rectangular molar is larger than the posterior one. The endoloph is complete. There are five main transversal ridges of the occlusal surface (anteroloph, protoloph, posterior centroloph, metaloph, posteroloph). All of them are connected to the endoloph. The anterior centroloph has a connection to the paracone as well. The posterior centroloph is interrupted and neither connected to the endoloph, nor to the metacone. There are three extra ridges.

Cricetidae

Democricetodon freisingensis Fahlbusch, 1964
Pl. III, Figs. 8, 10

There are one M1 (no. 59: 1.85 x 1.15 mm) and two m1 (no. 1: 1.61 x 1.15, no. 2: 1.75 x 1.19) from Su. 2/2. The anterocone of the M1 is divided by a short and very shallow notch on the anterior surface. The lingual cingulum of the anterocone reaches the antero-lingual base of the protocone. The anterolophule has a well developed labial spur (= anteromesoloph) which reaches a strong parastyle at the labial margin of the occlusal surface. The protolophule I is not developed. The mesoloph is long and reaches the labial margin. The short protolophule and metalophule are directed postero-lingually. The posterosinus is labially closed.

The anteroconid of the m1 is simple, subtriangular. A labial cingulum of the anteroconid reaches the antero-labial base of the protoconid. The anterolophulid is connected to the metaconid. There is a narrow notch between the anterolophulid and the protoconid. The mesolophid is long and reaches the lingual margin of the occlusal surface. The ectomesolophid is developed but in the figured specimen the lingual end of this ridge does not reach the mesoconid.

The slightly similar *Democricetodon zarandicus* Rădulescu & Samson, 1988 can be excluded because the anterocone in the M1 of this species is divided, the anteroconid is clearly connected to the protoconid and there is no ectomesolophid in the m1.

Democricetodon brevis (Schaub, 1925)
Pl. III, Fig. 9

Two M1 were found in Su 2/1 (no. 8: 1.75 x 1.16, no. 9: 1.85 x 1.30). The anterocone of the molars is simple. Notch is not developed on the anterior surface. The anterocone has a lingual and a labial cingulum as well. The later reaches the anterior base of the protocone and the metacone. The labial spur of the anterolophule is variable in length: it is short in the figured specimen, while it is rather long in the other one reaching the labial cingulum of the anterocone. The mesoloph is long but does not reach the labial margin. The posterosinus is labially closed.

Megacricetodon germanicus Aguilar, 1980
Pl. III, Figs. 14, 18, 19

One M1 (no. 61: 1.83 x 1.13 mm) and two m1 (no. 3: 1.64 x 0.98, no. 4: 1.67 x 0.98) originate from Su 2/2. The anterocone of the M1 is divided. The lingual cuscula of the anterocone is connected to the protocone. There is a lingual cingulum of the anterocone reaching the antero-lingual basis of the protocone.

The protolophule I is connected to the antero-lingual basis of the paracone. The posterior spur of the paracone is very short. The mesoloph is middle developed. The anteroconid of the m1 is unicuspid. There are cingulums on the lingual and the labial side of the anteroconid. The anterolophulid has a buccal spur which is connected to the antero-labial cingulum. The mesolophid is short.

The species is frequent in the Swiss – Bavarian molass (Bolliger 1994) but it is rather rare in the Carpathian Basin. Up to the present *M. germanicus* is known from Tășad (Hír et al. 2002) and from Felsőtárkány–Felnémet (Hír, unpublished). Only one molar were found in both localities.

Megacricetodon sp.
Pl. III, Figs. 11, 12, 13, 15, 16, 17

Twenty M1 and 18 m1 were collected in Su 2/1. The anterocone in the M1 is divided. The protolophule I is found in 14 molars but it is missing in 6 specimens. The posterior spur of the paracone is short.

A well developed entomesoloph is found in five M1 and in six m1. This element is weak but visible (the lingual part is developed only). Among the 23 m2 well developed entomesoloph is found in four cases, while weakly developed one is found in seven specimens. The occurrence of this enamel ridge is not mentioned in the descriptions of other *Megacricetodon* populations (e.g. Fahlbusch 1964, Daams & Freudenthal 1988, Aguilar 1995).

The morphological feature of the m1 are the long lingual and labial spurs of the anterolophulid (in eight molars). However, only labial spur is found in eight specimens. *Megacricetodon minor*, the generally most frequent species of the Middle Miocene faunas of the Carpathian Basin is missing in Subpiatră.

Eumyarion medius (Lartet, 1851)
Pl. III, Fig. 7

Two m2 were found in Su 2/2, no. 15: 1.62x 1.39 mm, no. 16: 1.57x 1.43 mm. The most important markers are the weakly developed antero-lingual cingulum, the lingually merged posterior spur of the protoconid with the mesolophid. A central enamel ring is surrounded by these ridges.

CONCLUSIONS

The microvertebrate faunas of Subpiatră are worth for further investigations. We have to solve the following problems: the systematic status of *Megacricetodon* sp. having special morphological markers; the paleoecologic background of the

strongly different composition of Su 2/1 and Su 2/2 assemblages; the biochronological differences between these two faunas.

In the present state of the study we can give an approaching estimation of the biochronologic position of the faunas after the stratigraphic ranges of some studied species (Table 4).

Table 4 – Stratigraphic range of selected rodent taxa from the Middle Miocene of Subpiatră [according Bolliger (1994), Kálin et al. (2001), Nemetschek & Mörs (2003), Daxner-Höck (2005)].

Taxa	FOD	LOD
<i>Muscardinus</i> aff. <i>sansaniensis</i>	MN 6	MN 7/8
<i>Myoglis meini</i>	MN 5	MN 10
<i>Paragilirulus werenfelsi</i>	MN 5	MN 10
<i>Glirulus lissiensis</i>	MN 4	MN 13
<i>Democricetodon freisingensis</i>	MN 6	Mn 7/8
<i>Democricetodon brevis</i>	MN 6	MN 7/8
<i>Megacricetodon germanicus</i>	MN 6	MN 7/8
<i>Eumyarion medius</i>	MN 6	Mn 7/8

Substantial difference is possible to presume in the biochronologic position of the two fossiliferous levels. Su 2/1 R can be classified as a MN 6 fauna. Su 2/2 is probable younger: MN 7/8. According the fauna of Subpiatră 2/2, a forested paleoenvironment can be concluded because the higher represented Sciuridae and Gliridae. The composition of the fauna from Subpiatră 2/1 suggests a dry scrub milieu.

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REFERENCES

- Aguilar, J., 1995: Evolution de la lignée *Megacricetodon collongensis* – *Megacricetodon roussillonensis* (Cricetidae, Rodentia, Mammalia) au cours du Miocene inférieur et moyen dans le Sud de la France, *Palaeovertebrata*, 24(1-2), p. 1-45.
- Aguilar, J., 1980: Nouvelle interprétation de l'évolution du genre *Megacricetodon* au cours du Miocène. *Palaeovertebrata*, Mém. Jubilaire R. Lavocat. p. 355-364. Montpellier.
- Bailon S., 2000: Amphibiens et reptiles du Pliocène terminal d'Ahl al Oughlam (Casablanca, Maroc). *Geodiversitas* 22(4), p. 539-558.

- Bolliger, T., 1994: Die Obere Süßwasser-molasse in Bayern und der Ostschweiz: bio- und lithostratigraphische Korrelationen. *Mitteilungen der Bayerischen Staats-sammlung für Paläontologie und historische Geologie*, 34, p. 109-144.
- Bolkay, S.J., 1928: Die Schädel der Salamandrinen, mit besonderer Rücksicht auf ihre systematische Bedeutung. *Zeitschrift Anatomie Entwicklungsgeschichte* (Abteilung I: Gesamte Anatomie), 86, p. 259-319.
- Böhme, M., 2002: Lower vertebrates (Teleostei, Amphibia, Sauria) from the Karpathian of the Korneuburg Basin – palaeoecological, environmental and palaeoclimatical implications. *Beiträge Paläontologie*, 27, p. 339-353.
- Böhme, M., 2003: The Miocene Climatic Optimum: evidence from ectothermic vertebrates of Central Europe. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 195 (2003), p. 389-401.
- Bruijn, H. de, 1966: On the Mammalian fauna of the *Hipparion*-beds in the Calatayud –Teruel Basin (Prov. Zaragoza, Spain). *Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen, Series B*, 69(3), p. 1-21.
- Daams, R. & Freudenthal M., 1988: Cricetidae (Rodentia) from the type -Aragonian; the genus *Megacricetodon*. – In: Freudenthal, M. (ed.) *Biostratigraphy and paleoecology of the Neogene micromammalian faunas from the Calatayud – Teruel Basin (Spain)*. *Scripta Geologica, Special Issue*, 1, p. 39-132.
- Daxner-Höck, G., 2005: Eomyidae and Gliridae from Rudabánya. *Manuscript*, p. 1-27. Wien.
- Fahlbusch, V., 1964: Die Cricetiden (Mammalia) der Oberen Süßwasser-Molasse Bayerns. *Bayerische Akademie der Wissenschaften, mathematisch-naturwissenschaftliche Klasse, Abhandlungen, Neue Folge*, 118, p. 1-136.
- Engesser, B., 1972: Die obermiozäne Säugetierfauna von Anwil (Baselland). *Tätigkeitsbericht der*

- Naturforschenden Gesellschaft Baselland, 28, p. 37-363.
- Fahlbusch, V., 1964: Die Cricetiden (Mammalia) der Oberen Süsswasser-Molasse Bayerns. Bayerische Akademie der Wissenschaften, mathematisch – naturwissenschaftliche Klasse, Abhandlungen, Neue Folge, 118, p. 1-136.
- Hartenberger, J., 1966: Les Rongeurs du Vallésien (Miocène supérieur) de Can Llobateres (Sabadell, Espagne): Gliridae et Eomyidae. Bulletin de la Société géologique de France, 7, p. 596-604.
- Hír, J., 2004: The Middle Miocene (Late Astaracian, MN 7-8) Rodent Fauna of Felsőtárkány 3/2 (Hungary). Acta Palaeontologica Romaniae 4, p. 125-136.
- Hír, J., Kókay, J. & Venczel, M., 2002: Middle Miocene molluscs and microvertebrata from Tășad (Bihor District, Romania). Acta Paleontologica Romaniae, 3, p. 161-172.
- Holman, J. A., 1992: *Hyla meridionalis* from the late Pleistocene (last interglacial age: Ipswichian) of Britain. British Herpetological Society Bulletin, 41, p. 12-14.
- Hossini, S. & Rage, J.C., 2000: Palaeobatrachid frogs from the earliest Miocene (Agenian) of France, with description of a new species. Geobios 33, p. 223-231.
- Hugueney, M. & Mein, P., 1965: Lagomorphes et rongeurs du Neogène de Lissieu (Rhône). Trav. Lab. Géol. Univ. Lyon, NS 12, p. 109-123.
- Istocescu, D. & Istocescu, F., 1974. – Considerații geologice asupra depozitelor neogene ale Bazinului Crișurilor. Studii și cercetări geologice, geofizice, geografice 19, p. 115-127.
- Kálin, D., Weidmann, M., Engesser, B. & Berger, J., 2001: Paléontologie et âge de la Molasse d' eau douce supérieure (OSM) du Jura neuchâtelois. Schweizerische Paläontologische Abhandlungen, 121, p. 65-99.
- Lartet, E., 1851: Notice sur la colline de Sansan. Portes, Auch p. 1-47.
- Mayr, H., 1979: Gebiðmorphologische Untersuchungen an miozänen Gliriden (Mammalia, Rodentia) Süddeutschlands. Inauguraldissertation, p. 1-380. München.
- Mein, P., 1970: Les Sciuroptères (Mammalia, Rodentia) néogènes d' Europe Occidentale. Geobios, 3(3), p. 7-77.
- Meyer, H. von, 1848: Mittheilungen an Professor Bronn gerichtet. Neues Jahrb. Min. Geol. Pal.: 465-473.
- Nemetschek, A. & Mörs, T., 2003: *Myoglis meini* (De Bruijn, 1965 [1966] (Mammalia: Gliridae) aus dem Miozän von Hambach 6C (NM-Deutschland). Paläontologische Zeitschrift, 77(2), p. 401-416.
- Nesin, V. & Kowalski, K., 1997: Miocene Gliridae (Mammalia: Rodentia) from Grytsiv (Ukraine). Acta Zoologica Cracoviensia, 40(2), p. 209-222.
- Onac, B., 2002: Exocarstul, In: Racoviță G., Moldovan O. & B. Onac (eds.) Monografia carstului din Munții Pădurea Craiului, p. 18-34. Presa Universitară Clujeană, Cluj-Napoca.
- Rădulescu, C. & Samson P., 1988: Les Cricétidés (Rodentia, Mammalia) du Miocène (Astaracien supérieure) de Roumanie. Travaux Institute Spéologie „Emile Racovitza”, 27, p. 67-78.
- Rage, J. C. & Roček, Z., 2003: Evolution of anuran assemblages in the Tertiary and Quaternary of Europe, in the context of palaeoclimate and palaeogeography. - Amphibia-Reptilia 24, p. 133-167.
- Roček Z., 1994: Taxonomy and distribution of Tertiary discoglossids (Anura) of the genus *Latonia* v. Meyer, 1843. - Geobios, 27(6), p. 717-751.
- Rusu, T., 1988: Carstul din Munții Pădurea Craiului, Dacia, Cluj-Napoca, p. 1-254.
- Schaub, S., 1925: Die hamsterartigen Nagetiere des Tertiärs und ihre lebenden Verwandten. Abhandlungen der Schweizerischen Paläontologischen Gesellschaft. 45, p. 1-114.
- Szyndlar, Z. & Rage, J. C., 2002: Fossil record of true vipers, In: Schuett et al. (eds), Biology of the Vipers. Eagle Mountain Publishing, Eagle Mountain (Utah, USA).
- Venczel, M., 2004: Middle Miocene anurans from the Carpathian Basin. Palaeontographica abt. A, 271(5-6), p. 151-174

PLATE CAPTIONS

PLATE I: *Palaeobatrachus* and cf. *Diplocynodon* remains from the Middle Miocene of Subpiatră. Fig. 1, 2: frontoparietal of *Palaeobatrachus* sp. from Su 2/2 in dorsal (1) and ventral (2) views; Fig. 3: osteoderm of cf. *Diplocynodon* sp. from Su 2/1R; Fig. 4: isolated tooth of cf. *Diplocynodon* sp. from Su 2/1R. Scale bar: 1 mm.

PLATE II: Anurans and Squamates from the Middle Miocene of Subpiatră. Fig. 1: right Ilium of *Latonia gigantea* from Su 2/2 in lateral view; Fig. 2: left prearticular of *Latonia gigantea* from Su 2/1R in dorso-lateral view; Fig. 3: left prearticular of *Rana (Pelophylax)* sp. from Su 2/1R in dorso-lateral view; Fig. 4,5,6: ilia of *Rana (Pelophylax)* sp. from Su 2/1R in lateral views. Fig. 7: left dentary fragment of *Lacerta* sp. from Su 2/1R in lingual view; Fig. 8, 9: isolated teeth of Varanidae indet., from Su 2/1R; Fig. 10: osteoderm of *Ophisaurus* sp. from Su 2/1R; Fig. 11, 12: trunk vertebra of Colubrinae indet., in dorsal (7) and ventral (8) views. Scale bar 1 mm.

PLATE III: Occlusal surfaces of some Rodent molars from Subpiatră. Fig.1: *Myoglis meini* M1 from Su 2/2, no. 25; Fig. 2: *Myoglis meini* m1 from Su 2/2, no. 37; Fig. 3: *Paraglitirulus werenfelsi* m1 from Su 2/2, no. 45; Fig. 4: *Muscardinus* aff. *sansaniensis* M1 from Su 2/1R; Fig. 5: *Muscardinus* aff. *sansaniensis* M1 from Su 2/1R; Fig. 6: *Glirulus lissiensis* M2 from Su 2/2, no. 48; Fig. 7: *Eumyarion medius* m2 from Su 2/2, no. 15; Fig. 8: *Democricetodon freisingensis* M1 from Su 2/2, no. 59; Fig. 9: *Democricetodon brevis* M1 from Su 2/1R, no. 8; Fig. 10: *Democricetodon freisingensis* m1 from Su 2/2, no. 1; Figure 11: *Megacricetodon* sp. m1 from Su 2/1R, no. 29; Fig. 12: *Megacricetodon* sp. M1 from Su 2/1R, no. 1; Fig. 13: *Megacricetodon* sp. M1 from Su 2/1R, no. 110; Fig. 14: *Megacricetodon germanicus* M1 from Su 2/2, no. 61; Fig. 15: *Megacricetodon* sp. m1 from Su 2/1R, no. 28; Fig. 16: *Megacricetodon* sp. M2 from Su 2/1R, no. 112; Fig. 17: *Megacricetodon* sp. M2 from Su 2/1R, no. 66; Fig. 18: *Megacricetodon germanicus* M2 from Su 2/2, no. 50; Fig. 19: *Megacricetodon germanicus* m1 from Su 2/2, no. 3.

PLATE I

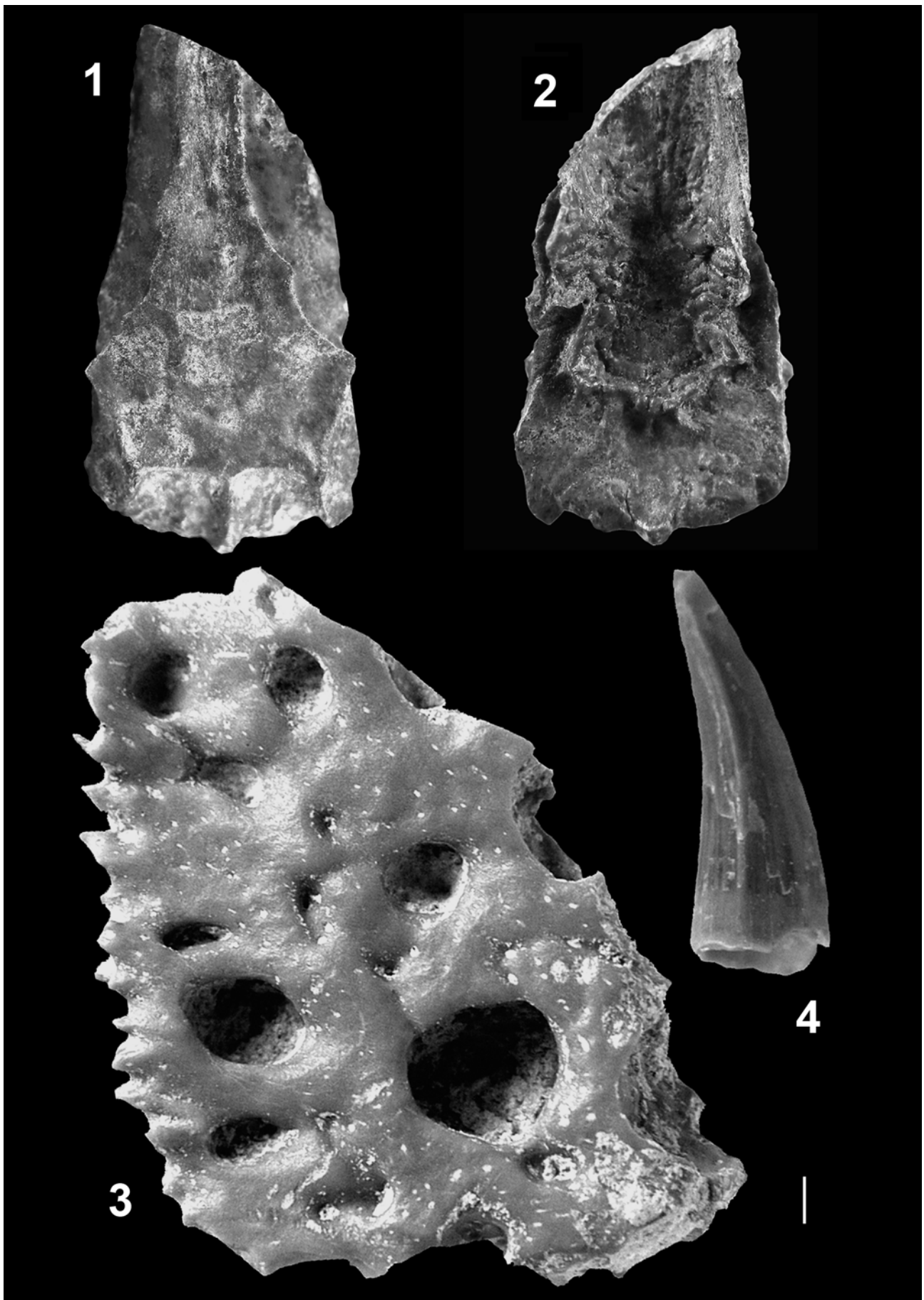


PLATE II

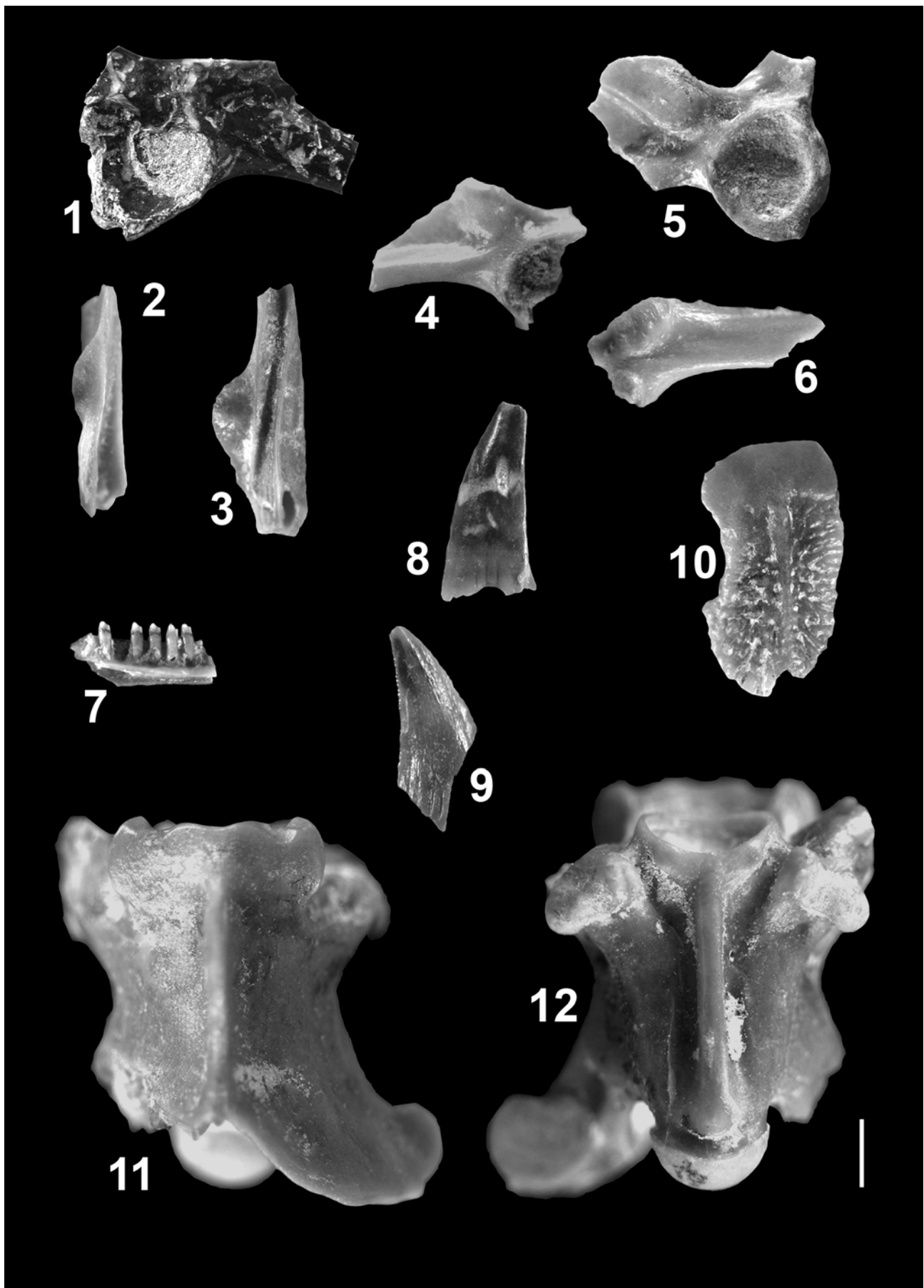


PLATE III

