

## BADENIAN INSECTIVORES FROM BOZOVICI BASIN (SOUTHERN CARPATHIANS, CARAȘ-SEVERIN DISTRICT)

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**Abstract.** For the first time in our country, Middle Miocene insectivores belonging to *Galerix* and *Miosorex* genus are described. In the same assemblages, *Gliridae* indet. and small artiodactyls (*Lagomeryx* size) are also mentioned. The fossils were collected from core samples extracted from the borehole # 1266, located in the Bozovici Basin, one of the main post-tectogenetic basins which occurred in Southern Carpathians, after the Laramian tectogenesis. The filling of this basin consists on Miocene molassic deposits. For the Lăpușnicul Mare Formation, two new members are now introduced: Pârâul Lighidia and Valea Slătînicului. The former, consists on siliciclastic continental deposits, which could be Eggenburgian in age. The latter, includes swampy and lacustrine deposits, tuff intercalations and coal-bearing strata, where the insectivores have been found. The age of the fossils is Late Moravian-Early Wielician (most probably the uppermost part of the MN 5 unit). These mammals allow to interpret the paleoenvironment as a wooded area, in a subtropical climate, fairly humid, with open waters areas in the neighbourhood.

**Keywords :** Middle Miocene, Stratigraphy, Vertebrate paleontology, Insectivores; Bozovici Basin, MN 5, Southern Carpathians, Romania.

### INTRODUCTION

The discoveries of fossil mammals originating from the Middle Miocene formations in Romania are still rare. These fossils are best known in the Sarmatian deposits, but in older formations as the Badenian ones, only few such vertebrates have been described. They belong mainly to large mammals, as perissodactyls (Gheorghiu *et al.*, 1967; Codrea, 2000). Nothing is known concerning the micro-mammals. In such circumstances, each new discovery adds more details concerning these faunal assemblages.

### GEOLOGICAL SETTING

In the Southern Carpathians, the main tectonic units belonging to the southern Getides and Severinides, *i.e.* the Supragetic, Getic and Severin nappes, overthrust the Danubian Euxinides in the Laramian tectogenesis (Balintoni, 1997). After this main tectonic event, during the Cenozoic, several post-tectogenetic basins were generated. Among them, Bozovici Depression is one of the most representative, bordered by the Semenik Mountains to the North and Almaj Mountains to the South. In the older references, it was also named the "Valea Almajului Depression" (Figure 1).



Figure 1 – Location of Bozovici Basin.

The depression's outline resembles to a rounded ellipsoid directed NE-SW, 40 km long and 7-8 km in its largest section, between the localities Bozovici and Eftimie Murgu. This outline is in fact the heritage of the last Middle Miocene basin that evolved there.

If the rims of the basin are represented by the Getic Nappe's metamorphics or even Mesozoic sedimentary (Liassic?) formations, the filling deposits belong to the Miocene molasse. This kind of sediments kept the interest of a lot of geologists, due to their coal-bearing deposits. The first surveys, as well as the oldest tentative of extraction, runs long ago in time. The first mention of the coal-bearing

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strata is from the XVIII-th century and belongs to Grisellini (1780). He mentioned that in several sites in the Bozovici Basin, the bedrock of the gold-bearing alluvial sands consist of coal deposits.

The age of the coal-bearing formation was for a long time a subject of controversies. Iliescu *et al.* (1967) made a detailed description of the Miocene sedimentary succession and distinguished several stratigraphical units. Their data were used by other students, for monographic aims (ex. Todros, in: Petrescu *et al.*, 1987). From the base to the top, the following "horizons" were distinguished: i. the "lower" ("Lower Tortonian"), with two "sub horizons": a. "sandy, with gravels and conglomerate" and b. "marls and clays coal-bearing"; ii. "the Dalboșet beds" – conglomerate and sands and iii. "the Șopot beds" – variegated clays and marl clays (both "Upper Tortonian"); iv. the "upper" (possibly "Upper Tortonian or eventually Lower Sarmatian"), with gravels and sands.

Grigorescu (1985) described a M3 assigned to an anthracothere - *Brachyodus onoideus* (GERVAIS, 1852) -, found reworked in the recent alluvial sands and gravels of Minișului Valley, downstream from Bozovici town. The presumed sediments which yielded the tooth are siliciclastic, belonging to the base of the molassic succession. As the stratigraphical range of *B. onoideus* does not surpass the base of the Orleanian, the existence of Lower Miocene deposits were presumed in Bozovici Depression, at least for the base of the succession.

Later, Petrescu & Nicorici (1989) suggested that the coal-bearing intercalations and the underlying deposits could belong to the Early Miocene (Eggenburgian + Otthangian).

Recently, Marinescu *et al.* (1998) mentioned in the Bozovici Depression several formations, which accord generally well with the previous tentative: the Lăpușnicul Mare Formation in the base of the succession, followed by Dalboșet, Șopot and Vindinului Formations. According to their interpretation, except the latter, which is Sarmatian, the other are Late Badenian. Unfortunately, the descriptions of these formations are completely lacking.

In my opinion, the Lăpușnicul Mare Formation should be divided into two members, easy distinguishable, which are the following (Figure 2):

### 1. Pârâul Lighidia Member *nom. nov.*

**Definition:** succession of quartzitic sandstones with poligene microconglomerate interbeddings, lens-shaped, with red and green silt. These deposits belongs probably to

continental, alluvial plain facies. Its thickness is comprised between 2-19 m. Fossils are generally missing.

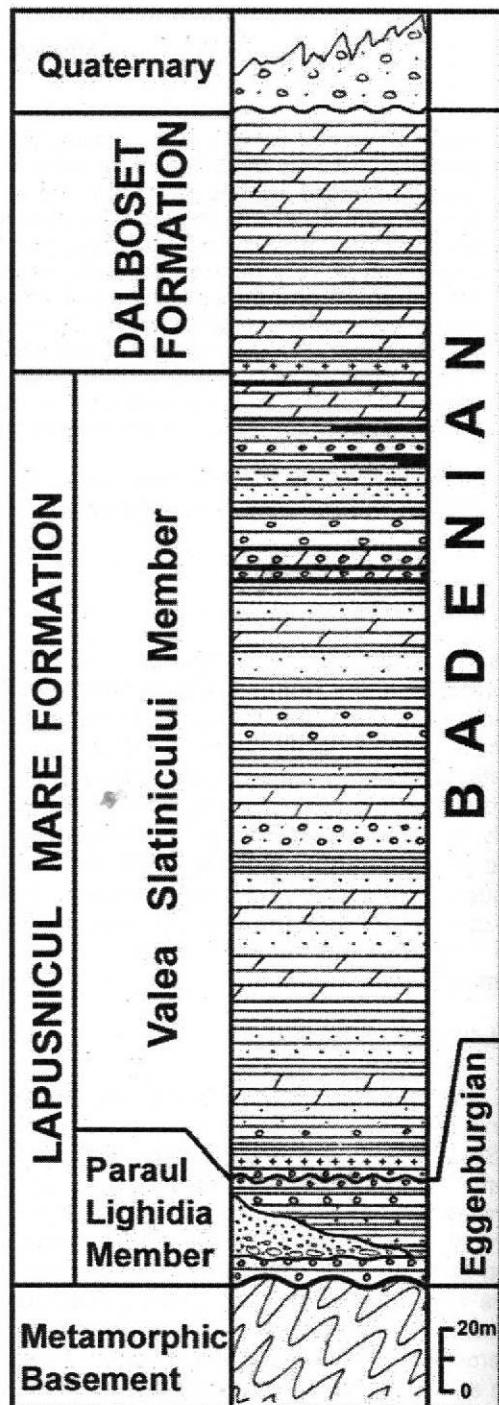


Figure 2 – Succession of the Miocene formations from Bozovici Basin.

**Lower boundary:** the unconformity between the molasse deposits and the old metamorphic and/or mesozoic sedimentary basement of the Bozovici Basin.

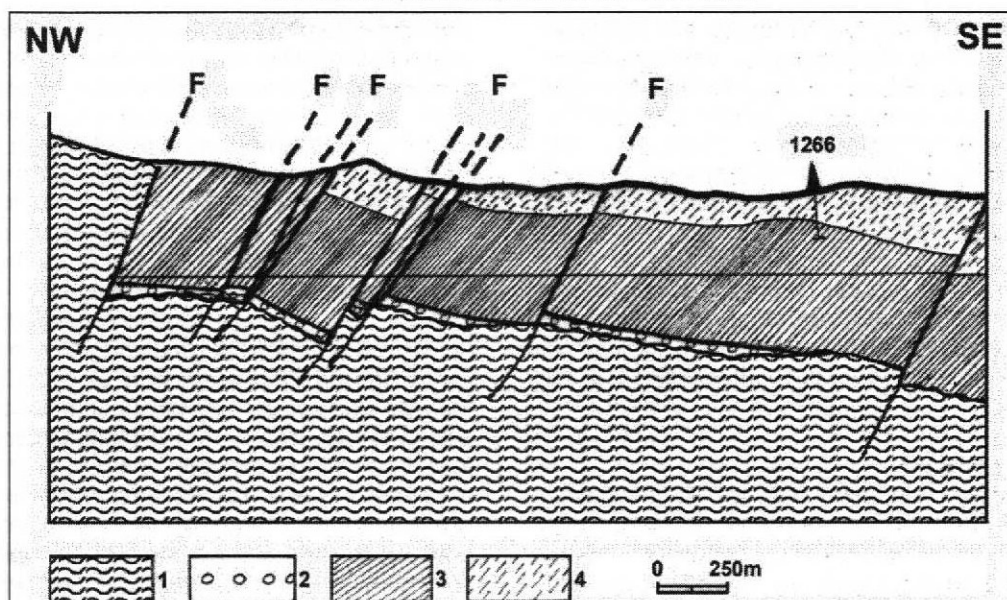


Figure 3 – Section on the northern rim of Bozovici Basin, with the location of the borehole # 1266:  
 1 – pre-Miocene basement; 2 – Pârâul Lighidia Member; 3 – Valea Slătanicului Member;  
 4 – Dalboșeț Formation.

**Upper boundary:** the sequence which ends just under the first tuff intercalation known as the "Slătinic Tuff". It probably corresponds to an unconformity produced by an erosional event.

**Age:** ?Early Miocene(? Eggenburgian).

**Comments.** These deposits are usually devoid of fossils and one can presume any age comprised between the Late Maastrichtian and pre-Badenian. As one can suppose that the anthracothere tooth originated from, the Eggenburgian age could be credible, without excluding other stratigraphical terms.

## 2. Valea Slătanicului Member *nom. nov.*

**Definition:** succession of silty sandstones and clays, micro conglomerates, marls, clays and tuff intercalations. Toward the top, coal intercalations occur (at least eleven lignite beds). The thickness of this member is very variable, usually between 50-150 m. The thickness of the coal-beds is also variable: at "Cracu cu Tufă" the maximum thick reached 11 m, but S and SE from Nera River, these strata can completely disappear.

**Lower boundary:** The first tuff intercalation, overlaying the Pârâul Lighidia Member. Between these members, an erosional discontinuity should exist.

**Upper boundary:** The contact with the base of Dalboșeț Formation.

**Age:** Upper part of Moravian, possibly the base of Wfelician too. Probably the uppermost part of MN 5.

**Comments.** The main part of this

succession belongs to coal-generating, swampy and lacustrine facies. Several fresh-water levels, documented by mollusks like *Unio* or *Planorbis*, as well as some short marine episodes, documented by nannoplankton species, were identified too.

In the last decades, a lot of drillings were made for prospecting the coal-bearing deposits. The samples collected from the boreholes allowed detailed studies of the flora, invertebrate and vertebrate Middle Miocene assemblages.

The borehole # 1266, drilled on the western bank of Agrijului Valley, between the town of Bozovici and the village Lăpușnicul Mare, is of special interest, for several vertebrate fossils collected from its cores (Figure 3).

## THE INSECTIVORES FROM BOZOVICI

Family Erinaceidae BONAPARTE, 1838  
 Subfamily Echinorocinae CABRERA, 1925  
 Tribe Galericiini POMEL, 1848  
 Genus *Galerix* POMEL, 1848

*Galerix* aff. *symeonidisi* DOUKAS, 1983

**Locality:** Bozovici (Caraș-Severin district), from the borehole # 1266. The core was extracted between 154.70-155.15 m in depth, from Valea Slătanicului Member's deposits.

**Geological age:** Middle Miocene, probably the uppermost part of the MN 5 zone (Badenian).

**Referred material:** All fossils are curate at the Museum of Paleontology - Stratigraphy of the University Babeş - Bolyai, in Cluj - Napoca (abbreviated: MPSUBB). p2 - right (MPSUBB V 173/1) and left (MPSUBB V 173/2); p4 - left (fragment, MPSUBB V 173/3); m2 - left (MPSUBB V 173/4); m3 - left (MPSUBB V 173/5); P3 - lingual fragments, right (MPSUBB V 173/6) and left (MPSUBB V 173/7); P4 - right (MPSUBB V 173/8) and left (MPSUBB V 173/9); M1 - fragments, right (MPSUBB V 173/10) and left (MPSUBB V 173/11); M2 - right (MPSUBB V 173/12) and left (MPSUBB V 173/13).

### Description

Washing the sandy marls from the core, several upper and lower teeth, probably belonging to the same individual, were collected. As the sample was initially processed for forams or other micro invertebrates, the sediment was boiled, and the teeth were unfortunately severely damaged.

p2 - Both right and left teeth are preserved, the left one together with a little fragment of the jaw. The p1 alveoli can be also observed, indicating that this tooth was single-rooted. The right p2 has only its crown, slightly broken on its mesial margin.

This premolar has a quite simple pattern. Its shape, on occlusal view is similar to a rounded trapezoid. The tubercles are distributed on a mesio-distal direction. The canine-like protoconid is very prominent, located centrally, between two weak stylids, which positions are near the lingual border. The anterior stylid is very weak and is higher compared to the distal one. From lateral view, the area comprised between the cone-shape protoconid and the posterior stylid is fairly concave. This tooth has two parallel roots.

p4 - A fragment, representing the trigonid is available for study. It belongs to the left tooth. One can observe the protoconid, the metaconid and the paraconid. The protoconid is the highest cusp, connected by a low ridge with the paraconid. The metaconid is located forward, compared to the protoconid. No cingulum can be observed. All the tubercles are worn on their posterior sides.

m2 - It is slightly damaged on the anterolingual margin, on the paralophid area. All the tubercles are worn by abrasion. The metaconid is the strongest cusp. The protoconid and the entoconid are nearly equally in height. The talonid is well closed on the labial side, by the oblique cristid which runs just on the posterior side of the protoconid. On the lingual side, the narrow ridge connecting the entoconid with the metaconid is very low. In this manner, on this

side the talonid is not very well closed. The trigonid is nearly equal in length with the talonid. A well-developed cingulum can be noted on the lingual margin. It ends just after the protoconid, where the oblique cristid reach this cusp. The posterior cingulum is present, strong developed mainly on the labial half of this side. There are two roots: the anterior one is vertical; the posterior one is fairly inclined compared to the base of the crown.

m3 - The general pattern is similar with m2, but here the trigonid is clearly larger compared to the talonid. The metaconid is the highest, tubercle. The ridge connecting the entoconid with the metaconid is well expressed, compared to m2. The hypoconid is located in a more anterior position in respect with the entoconid. The difference in height between the hypoconid and entoconid is obvious: the former is very low compared to the last. The labial and posterior cingulums are lacking, but an anterior one is present. The roots are similar with m2.

P3 - Two lingual fragments, originating from the left and right rows, is available for study. Both have two lingual cusps, the protocone and the hypocone. The protocone is much higher as the hypocone. The anterior cingulum ends before the protocone. The posterior one is stronger, and it runs until the posterior side of the hypocone. On the straight lingual side, the cingulum is missing.

The most important feature is the presence of two cusps on the lingual size. Doukas (1986), as well as other students like Ziegler & Fahlbusch (1986) or De Jong (1988), observed that there are two groups of *Galerix*, distinguishable by different patterns of this premolar:

*G. exilis* group, with only one lingual cusp and

*G. socialis* group, which *G. symeonidisi* belongs to, with two cusps. To this pattern, the Bozovici *Galerix*, also belongs.

P4 - Both the left and right premolars are well preserved, excepting the small areas located at the posterior labial terminations. The strongest and highest cusp is the paracone. A straight ridge connects this cusp with the parastyle. The anterior margin is concave. The anterior and posterior cingulums are similar with P3.

M1 - There are two fragments belonging to this molar: a right lingual and a left labial. The labial fragment includes the paracone, the metacone and the very extended metastyle. The metacone is more voluminous and higher than the paracone. Anterior, posterior and labial cingulums can be noticed. The lingual fragment preserves only the protocone, the hypocone and a part of the metaconule. There is neither

connection between the protocone and the metaconule, nor between the hypocone and metaconule. The protocone and the hypocone are connected. The metaconule is big, "V" shaped. The anterior cingulum ends at the base of the protocone. The posterior one also didn't reach the lingual side, ending before. No lingual cingulum can be noticed.

M2 - I had on my disposal the teeth originating on both dental rows, more (the right) or less (the left) damaged.

This molar has a similar pattern with M1. The mesostyle is shorter compared to the M1. This tooth has consequently a rectangular outline. The anterior arm of the protoconule does not touch the anterior cingulum. The posterior arm of the metaconule remains far from the posterior cingulum. There is a connection between the protocone and the hypocone, but no connections of these cusps with the metaconule can be observed.

In his study concerning *Galerix exilis* (DE BLAINVILLE, 1839) and *G. socialis* (VON WEYER, 1865) from Calatayud-Teruel Basin, De Jong (1988; Figure 4) figured two fundamental morphotypes and two intermediary ones for M2. The pattern of the Bozovici insectivore is similar with the intermediary De Jong's form # 1. In *G. symeonidis* from Aliveri (Doukas, 1986) there are connections between the metaconule with the protocone, or both with the protocone and the hypocone. This feature seems to be however, very variable. In the *G. symeonidis* or *G. aff. symeonidis* specimens figured from different sites, like Forsthart or Rimbach (Ziegler & Fahlbusch, 1986), there is no connection between the metaconule and the lingual cusps.

A cingulum can be noticed on each labial, anterior and posterior side.

**Measurements** (in mm; after Doukas' method, 1986)

	Length	Width
p2	1.90	1.02
m2	2.50*	1.80
m3	2.07	1.27
P4	2.15*	1.97
M1	2.70	-
M2	2.12*	2.77

- incomplete

**Comments.** Doukas (1986) described *G. symeonidis* from Aliveri (Greece) as a small species of the genus. Compared to Doukas' data, the Bozovici's *Galerix* can be distinguished by the following details: the p2 is wider, the m2 is longer, the m3 is longer, but less wide, the P4 is less wide, M1 is much

longer and the M2 longer and wider. However, Doukas' number of specimens available for study was not very high.

A richer *G. symeonidis* sample, originating from different localities from Southern Germany, was published by Ziegler & Fahlbusch (1986). The Bozovici's *Galerix* dimensions agree with these sizes especially for the upper teeth. The lower ones are rather large.

In these circumstances, I interpret this specimen as an evolved form of *G. symeonidis*, which dimensions were close to the next representative of the lineage, *G. exilis* (DE BLAINVILLE, 1839).

Family Soricidae GRAY, 1821

Subfamily Crocidosoricinae REUMER, 1987

Genus *Miosorex* KRETZOI, 1959

*Miosorex* sp.

**Locality:** Bozovici (Caraş-Severin district), from the borehole # 1266. The core was extracted between 158.33-159.00 m in depth, from Valea Slătinicului Member's deposits.

**Geological age:** Middle Miocene, probably the uppermost part of the MN 5 zone (Badenian).

**Referred material:** M3 - right (MPSUBB V 174/1).

**Description.** This tooth shows typical features for this genus. Unfortunately, it is the only element documenting this kind of insectivore at Bozovici.

**Measurements** (mm): Length - 0.90 ; Width - 1.47

#### Stratigraphy and ecology

Although this is the first mention of the genus in Romania, however *Galerix* is not rare in the Middle or Upper Miocene faunal assemblages from this part of Europe. At Engesser's (1980) map, showing the geographic distribution of *Galerix* and *Schizogalerix* ENGESSER, 1980 sites, some new localities can be added:

-Hungary: Budapest XII ker., Széchenyi-hegy (*G. cf. socialis*, "*Sümegium*" i.e. Pontian s.str.), Felsőtárkány (*G. ehiki* KRETZOI, Early Pannonian s.str.), Sümeg (*G. socialis*, "*Sümegium*", i.e. Pontian s.str.; Kretzoi, 1982);

-Serbia: Sibnica (a mandible fragment, with p4 and m2, assigned to *G. exilis*; Late Badenian-Early Sarmatian; Petronijević, 1967);

-Moldova: Bujor (p3-m3 and P3-M3, belonging to "*G. sarmaticum* LUNGU, 1981; Middle Sarmatian - Bessarabian; Lungu, 1981).

Among these sites, the nearest similarities seem to exist with the fossil originating from Serbia, which dimensions are very close.

"*G. sarmaticum*" is a very different form, which could be related rather to *Schizogalerix* ENGESSER, 1980 than to *Galerix*. The ridge connecting the paracone and the metacone is completely missing in M1 and M2 (Lungu, 1981; Table 1, Figure 4a).

The stratigraphical range of *G. symeonidisi* in Central Europe includes the time interval comprised between the mammalian units MN 4a and MN 5 (Engesser & Ziegler, 1996;). In the uppermost MN 5, and immediately after in MN 6, *G. symeonidisi* was replaced by *G. exilis*. Transitional forms are known from several sites from South Germany, as Niederaichbach (MN 5, Schötz, 1988; Ziegler, 1999).

The rather large dimensions, as well as the P 3 pattern, indicate that the *Galerix* from Bozovici could be interpreted as an evolved form belonging to *G. symeonidisi*/*G. exilis* lineage.

The *Miosorex* genus is still too poor documented at Bozovici for allowing a detailed interpretation.

From the marl intercalations belonging to the coaly member, a nannoplakton assemblage with *Sphenolithus heteromorphus* DEFLANDRE, 1953 and *Braarudosphaera bigelowii* (GRAN & BRAARUD, 1935) was found (N. Mészáros, written communication).

In such circumstances, I appreciate that the coal deposits from Bozovici Depression could be Badenian, more precisely belonging to the uppermost Langhian, i.e. the top of Moravian and/or the base of the Wielician in Central

Paratethys. Obviously, in the Carpathian area *S. heteromorphus* range ends at the base of the MNN 6a sub zone (Măruntănu *et al.*, 1999).

For reconstructing the ancient environments, this kind of insectivores is not very diagnostic. Apart the insectivores, in the same borehole, between 158.33-150.00 m in depth, some other vertebrate remains were found: an upper molar belonging to *Gliroidae* THOMAS, 1897 indet. (MPSUBB V 175/1) and a naviculo-cuboid of a small artiodactyle (*Lagomeryx* size; MPSUBB V 176/1). All these elements allow an interpretation of the paleoenvironment as a wooded area, in a warm and still enough humid climate (subtropical type). The open water surfaces were surely present in the neighborhood and the coals suggest even swampy tendencies.

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I express my deep gratitude to my former student, **Emil Moricz**, who provided the material from Bozovici, as well as for some geological information about this area. I am also fully indebted to Dr. **Manfred Schötz** (Lichtenhaag.) and to Dr. **Mary R. Dawson** (The Carnegie Museum of Natural History, Pittsburgh, USA), for their valuable bibliographic help. The SEM photographs are due to **Christiane Chancogne** (Muséum National d'Histoire Naturelle Paris, France). My colleagues from Babeş-Bolyai University, Reader Dr. **Sorin Filipescu**, Assist. Dr. **Emanoil Săsăran** and Dr. **Paul Dica**, helped me a lot in revising the English version on the text and in processing the figures and plates.

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PLATE

Bozovici, borehole # 1266, Lăpușnicul Mare Formation, Badenian:

*Galerix* aff. *symeonidisi* DOUKAS, 1983

- Figure 1 – p2 left, inner view (MPSUBB V 173/2)
  - Figure 2 – p2 right, inner view (MPSUBB V 173/1)
  - Figure 3 – p4 left, trigonid fragment, crown view (MPSUBB V 173/3)
  - Figure 4 – m2 left, crown view (MPSUBB V 173/4)
  - Figure 5 – m3 left, crown view (MPSUBB V 173/5)
  - Figure 6 – P3 right, lingual fragment, crown view (MPSUBB V 173/6)
  - Figure 7 – P3 left, lingual fragment, crown view (MPSUBB V 173/7)
  - Figure 8 – P4 right, crown view (MPSUBB V 173/8)
  - Figure 9 – P4 left, crown view (MPSUBB V 173/9)
  - Figure 10 – M1 right, lingual fragment (MPSUBB V 173/10)
  - Figure 11 – M1 left, labial fragment (MPSUBB V 173/11)
  - Figure 12 – M2 right, crown view (MPSUBB V, 173/12)
  - Figure 13 – M2 left, crown view (MPSUBB V 173/13)
- Gliridae* indet.
- Figure 14 – upper tooth (MPSUBB V 175/1)

Bar length – 1.0 mm

