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Pliocene Large Mammals of Romania

Grandes Mamíferos del Plioceno de Rumania

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Abstract: A review of the Pliocene large mammals of the Dacic Basin and the Brasov Depression, Romania, is presented and the faunal associations of the most significant fossiliferous sites are indicated. Early Pliocene (Ruscinian, MN 14-15) and late Pliocene (middle/late Villafranchian, MN 17, MQ1) mammalian assemblages are well represented, whereas those of the middle Pliocene (early Villafranchian, MN 16) are still poorly known.
Key words: Pliocene, macrommamals, Dacic Dasin, Brasov Depression, Romania.

Resumen: Se presenta una revisión de los grandes mamíferos del Plioceno de la cuenca Dácica y la depresión Brasov, Rumania, y se indican las asociaciones faunísticas de los sitios fosilíferos más significativos. Las asociaciones de mamíferos del Plioceno inferior (Rusciniense, MN 14-15) y Plioceno superior (Villafranquiense medio/superior, MN17, MQ1) están bien representadas, mientras las del Plioceno medio (Villafranquiense inferior, MN 16) son aún poco conocidas.
Palabras clave: Plioceno, macromamíferos, Cuenca Dacica, Depresión Brasov, Rumania.

INTRODUCTION

Paleontological investigations carried out since 1960 on the Pliocene fluvio-lacustrine deposits of the Dacic Basin and of the Brasov Depression supplied rich and various remains of macromammals (Fig. 1). Fossiliferous sequences of deposits examined here span a time interval of about 2.5 million years (My) from more than 4 My for the Beresti fauna assigned to the late Dacian to about 1.8 My, the age of the association from Valea Graunceaunului belonging to the late Romanian. A review of the most significant Pliocene mammalian faunas of the Dacic Basin and equivalent faunas of the Brasov Depression will be presented below. Correlations between malacological faunas (NSM = Upper Neogene Mollusk zones; ANDREESCU, 1982) and mammalian faunas (MN = Mammal Neogene zones; MEIN, 1990) will also be proposed. The biostratigraphic framework provided by molluscan and mammalian index taxa is also supported by paleomagnetic studies (Fig. 2).

BIOSTRATIGRAPHY

DACIC BASIN

Southern Moldova

Beresti (Br) (early Pliocene, late Dacian, Parscovian NSM_9, MN 14 zone)

The Beresti fauna (SIMIONESCU, 1932) includes great amounts of leporids and ochotonids corresponding to the so-called "lagomorphic complex" of eastern and southeastern Europe (SCHEVTCHENKO, 1965). The large mammals include: *Dolichopithecus ruscinensis* DEPÉRET, *Agriotherium* sp., *Eucyon odessanus* (ODINTSOV), *Eomelivora* sp., *Baranogale* sp. Mustelidae indet. I, Suidae indet., *Paracamelus bessarabiensis* (KHOMENKO), *Procapreolus* sp., *Pliocervus* cf. *kutchurganicus* KOROTKEVICH, "*Parabos*" *athanasiui* (SIMIONESCU), *Gazella* sp., Bovidae indet. (cited as *Leptobos* in ALIMEN *et al*. 1968), *Stepha-norhinus leptorhinus* (CUVIER), *Hipparion malustenense* RADULESCU & SAMSON, "*Equus"* (*Hipparion*?) *simionescui* RADULESCU & SAMSON (Table 1).

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The Beresti faunal assemblage shows great affinities with the Ruscinian fauna of the Republic of Moldova and southwestern Ukraine on the one hand and with the fauna of the Aegean region on the other, particularly with the mammals from Megalo Emvolon (Karaburun) (Macedonia, Greece) which contains *Parabos macedoniae* ARAMBOURG & PIVETEAU (a big antelope very similar to "*P". athanasiui* from southern Moldova).

On the basis of mammals (association of *Parabos* with *Sus minor* DEPÉRET), Megalo Emvolon is situated within MN 15, although according to pollen data it seems to correspond to an older unit (probably MN 14, BENDA & MEULENKAMP, 1990). The Beresti mammalian association could antedate the Megalo Emvolon fauna, or it might correspond to the earliest of the three different fossiliferous levels which have been recognized at Megalo Emvolon (KOUFOS & al., 1994; KOUFOS & KOSTOPOULOS, 1997).

As a whole, the Beresti fauna including large mammals, many lagomorphs and a member of the *Cricetulus* group (*Moldavimus*), indicates a predominantly continental climate, in contrast to more humid conditions prevailing in the early Ruscinian (early MN 14).

Malusteni (Ml) (early Pliocene, early Romanian, Siensian NSM_{10}, MN 15a).

At the present stage of knowledge, the list of large mammals includes: *Mammut borsoni* (HAYS), *Anancus arvenensis* CROIZET & JOBERT, *Tapirus arvernensis* DEVÈZE & BOUILLET, Rhinocerotidae indet., *Hipparion malustenense*, *Plesippus* (*Allohippus*) *euxinicus* SAMSON, *Propotamochoerus* cf. *provincialis* (GERVAIS), *Paracamelus alexeevi* HAVESSON, Cervidae indet. I-III, "*Parabos*" *athanasiui*, Bovidae indet., *Eucyon odessanus*, *Lynx* cf. *issiodorensis* CROIZET & JOBERT, *Eomelivora rumana* KRETZOI (="*Bessarabictis*"), *Baranogale* cf. *helbingii,* ?*Enhidrictis* sp., Mustelidae indet. I, "*Dolichopithecus*" cf. *arvernensis* DEPÉRET, ?*Mesopithecus monspessulanus* (GERVAIS), *Dolichopithecus ruscinensis* (Simionescu, 1930; Samson & Radulescu, 1973).

In the biostratigraphic scheme of the Dacic Basin, Ml is generally assigned to the beginning of the Romanian stage (Siensian) (ANDREESCU 1982, ALEXEEVA *et al*. 1983), however a somewhat older age should not be completely discarded (RADULESCU & SAMSON 1989), the presence of *P.* cf. *provincialis* suggests a correlation with the Montpellier fauna. The small mammal association from Malusteni is characterized by the first appearance of the primitive vole species *Mimomys moldavicus* KORMOS (MN 15a).

Sandy deposits containing the Ml fauna are equivalent to Carbolia Beds of fluvio-lacustrine origin from the Republic of Moldova (PEVZNER *et al*., 1996). On the basis of the presence of specimens of *M. moldavicus* showing a similar evolutionary stage, the Ml fauna is correlative with the Ciumesti horizon of the late Kimmerian of the Republic of Moldova (ALEXANDROVA, 1986). Paleomagnetic determinations indicated that the Ciumesti horizon is normally magnetized belonging to the Cochiti subchron (SADCHIKOVA *et al*. 1986). The Ml large mammal association antedates undoubtedly the well-known late Ruscinian fauna (Perpignan, Serrat d'en Vacquer) from France.

The climate was, very probably, more humid (Cervidae remains are more abundant than at Br).

Tulucesti (Tl) (middle Pliocene, middle Romanian, Pelendavian, NSM_{11}, MN 16a)

Mammalian remains are attributable to the following taxa (ATHANASIU, 1915; SAMSON & RADULESCU, 1973; SAMSON, 1976): *Mammuth borsoni, Anancus arvernensis, Archidiskodon* (*Mammuthus*) *rumanus* (STEFANESCU), *Paracamelus* cf. *kujalnensis* (KHOMENKO), *Cervus* cf. *perrieri* CROIZET & JOBERT, *Plesippus* (*Allohippus*) *euxinicus.*

The fossiliferous horizon with *A (M.) rumanus* at Tl is equivalent to the Skortselskian faunal complex (Skortselskian horizon of the late Poratian in NIKIFOROVA *et al*., 1986) of the Republic of Moldova (ALEXEEVA, 1977) which includes dental remains of a primitive elephant identified as *Archidiskodon* cf. *rumanus.*

Paleomagnetic data suggest a correlation of the Skortselskian horizon with the Middle Gauss normal subchron and the Kaena reversed event of the Gauss epoch (Fig. 2; NIKIFOROVA *et al*. 1986).

A correlation with the top of the MN 16a subzone (younger than the Csarnotian stage of Hungary) appears to be probable, taking into account the geological age of the equivalent assemblages of large mammals from the western Dacic Basin.

Oltenia

The Pliocene mammal-bearing deposits outcrop mainly along the valleys of the rivers Jiu and Olt and their tributaries. In this area, three lithostratigraphic

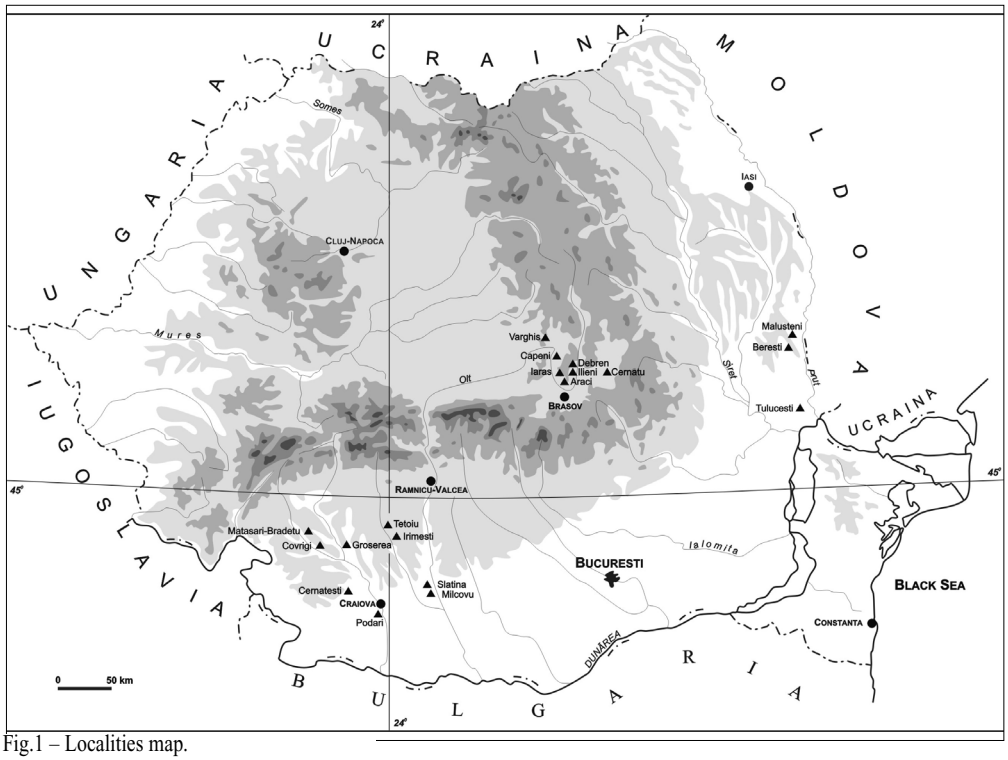

Fig.1 – Localities map.
Fig. 1 - Mapa de localidades.

units (the Berbesti formation, Jiu-Motru formation and the Candesti formation) including up to 22 coal layers were distinguished (ANDREESCU *et al*., 1985).

Covrigi (Cv) (middle Pliocene, middle Romanian, Pelendavian, NSM_{11}, MN 16a).

The Candesti formation consisting predominantly of sands and gravels begins above coal bed XII of the local stratigraphy. These deposits are well exposed at Covrigi where remains of large mammals were collected (Feru *et al*., 1965, 1983): *Mammuth borsoni, Anancus arvernensis, Stephanorhinus* cf. *elatus* (CROIZET & JOBERT), *Metacervocerus* cf. *pardinensis* (CROIZET & JOBERT).

Matasari-Bradetu (MtB) (middle Pliocene, middle Romanian, Pelendavian, NSM_{11}, MN 16a).

The fauna of this locality coming from sediments above coal bed XIII contains: *Anancus arvenensis*, *Stephanorhinus* cf. *etruscus* (FALCONER).

Groserea (Grs) (middle Pliocene, middle Romanian, Pelendavian, NSM_{11}, MN 16a).

The fauna comes from sediments between coal beds XII and XV. The stratigraphic exposures are characterized by the discontinuous occurrence or even the absence of coal beds XIII-XIV. Fauna: *Mammut borsoni, Anancus arvenensis, Stephanorhinus elatus, Equus* sp., *Metacervocerus pardinensis, Cervus* cf. *perrieri*.

Compared with the Ruscinian mammalian assemblage from Moldova, the Cv fauna has yielded a different type of rhinoceros identified as *S. elatus.* A further step is realized by the first appearance in this area (MtB above coal bed XIII) of a rhinoceros belonging to the *S. etruscus* group. During the MN 16a the Cervidae are dominant.

Sediments including coal beds XII to XIV are normally magnetized and can be placed within the Early Gauss subchron (ANDREESCU *et al*., 1986). The Cv mammalian association is broadly equivalent to the Villafranchian (sensu stricto) faunas of Italy (RADULESCU & SAMSON, 1995) and to Vialette fauna of France.

The Cv fauna from sandy sediments can be situated within MN 16a subzone (FERU *et al*., 1965). The occurrence of a smaller rhinoceros at MtB above coal bed XIII indicates the first appearance of the *S. etruscus* group in southeastern Europe (MN 16a). Dur-

ing the same time interval (3.1-2.9 My), *S. etruscus* is mentioned from Las Higueruelas (Ciudad Real, Spain) (MAZO, 1996).

The Grs faunal assemblage although corresponding to a greater time interval, is not basically different from the two previous faunas. It must be pointed out, however, that the Grs faunal assemblage includes a monodactyl horse (described as *Equus* cf. *simionescui* in SAMSON, 1976) that seems to be absent in the Cv and MtB faunas. Judging from the faunal evidence, the Grs mammalian assemblage is also attributable to the early Villafranchian.

Cernatesti (Cr) (middle Pliocene, middle Romanian, Pelendavian, late NSM_{11}, MN 16a).

South of Cv area, the upper part of the psammopsephitic sequence between coal beds XII-XV outcrops at Cr and Podari. A sand quarry located in "Dealul Calului" has yielded the following species: *Mammuth borsoni, Anancus arvernensis, Archidiskodon* (*Mammuthus*) *rumanus, Stephanorhinus elatus, S. etruscus* group, *Metacervocerus pardinensis.*

The Cr fauna is characterized by the first appearance in the Dacic Basin of a very primitive elephant. Evidence drawn from dental morphology suggests many similarities between *A (M.) rumanus* and *Elaphas africanavus* ARAMBOURG of North Africa. The relationships between these two species are, however, still poorly understood.

Slatina-2 (Sl-2) (late Pliocene, late Romanian, Wallachian, NSM_{12d}, MN 17).

On the left bank of the Olt River, between Slatina in the north and Milcovu din Vale in the south over a distance of about 3 km, there are several important exposures, 45 m thick, including deposits of the late Romanian and early Pleistocene. This sequence of deposits underlies the middle Pleistocene 45 m terrace of the Olt river.

The late Romanian deposits include (from bottom to top) three fossiliferous levels (Slatina-1, Slatina-2, Slatina-3) with small mammals and molluscan faunas. Sl-2 supplied a few remains of large mammals: *Mammuthus gromovi* ALEXEEVA & GARUTT, *Eucladoceros* sp. The sandy deposits containing the Sl-2 fauna are reversely magnetized and belong to the early Matuyama subchron, prior to the Olduvai normal event (ANDREESCU *et al*., 1985).

Tetoiu-Bugiulesti (T) (late Pliocene, late Romanian, late Vallachian, MN 17-MQ1).

The sequence of late Pliocene deposits containing several fossiliferous horizons rich in larger mammals is located at Tetoiu in the middle valley of the Oltet, a tributary of the Olt river.

In this area, three successive mammalian fossiliferous horizons correspond to the late Pliocene (lower faunal horizon, T-1) and to the early Pleistocene (middle T-1 and upper T-3 faunal horizons) (SAMSON & RADULESCU 1963, 1966, 1973; FERU *et al*., 1983, RADULESCU & SAMSON 1990, 2001).

The fossil localities belonging to T-1 have yielded the following mammalian associations (in ascending stratigraphic order):

Valea Roscai (VRc) (late Pliocene, late Romanian, late Wallachian, MN 17).

This site is located in a small gully cut into the northern flank of the Dealul Tetesului in the southern extremity of Tetoiu. The fauna includes: *Mammuthus* (*Archidiskodon*) *meridionalis* (archaic form), *Trogontherium dacicum.*

La Pietris (P) (late Pliocene, late Romanian, late Vallachian, MN 17/MQ1).

This site, rich in mammalian remains, is situated some 3 km north of VRc; a sequence of sandy sediments supplied: *Mammuthus* (*Archidiskodon*) *meridionalis*, *Stephanorhinus etruscus, Plesippus* (*Allohippus*) *athanasiui* SAMSON, *Eucladoceros* sp., *Pliotragus ardeus* (DEPÉRET), *Nyctereutes megamastoides* (POMEL), *Vulpes alopecoides* MAJOR, *Lynx issiodorensis.*

Valea Graunceanului (VGr) (late Pliocene, late Romanian, late Vallachian, MN 17/MQ1).

This site has yielded the richest and most varied mammalian fauna; the list of mammal is constituted as follows: *Mammuthus* (*Archidiskodon*) *meridionalis*, *Stephanorhinus* sp. (large size), *Plesippus* (*Allohippus*) *athanasiui* (type locality), *Eucladoceros* sp., *Cervus rhenanus/philisi* group, *Pliotragus ardeus, Gazellospira torticornis* (AYMARD), *Mitilanotherium inexpectatum* SAMSON & RADULESCU, *Nyctereutes megamastoides*, *Ursus etruscus* CUVIER, *Pliocrocuta perrieri* (CROIZET & JOBERT), *Homotherium crenatidens* (FABRINI), *Megantereon megantereon* (CROIZET & JOBERT), *Lynx issiodorensis, Manis* cf. *hungarica* KORMOS, *Paradolichopithecus*

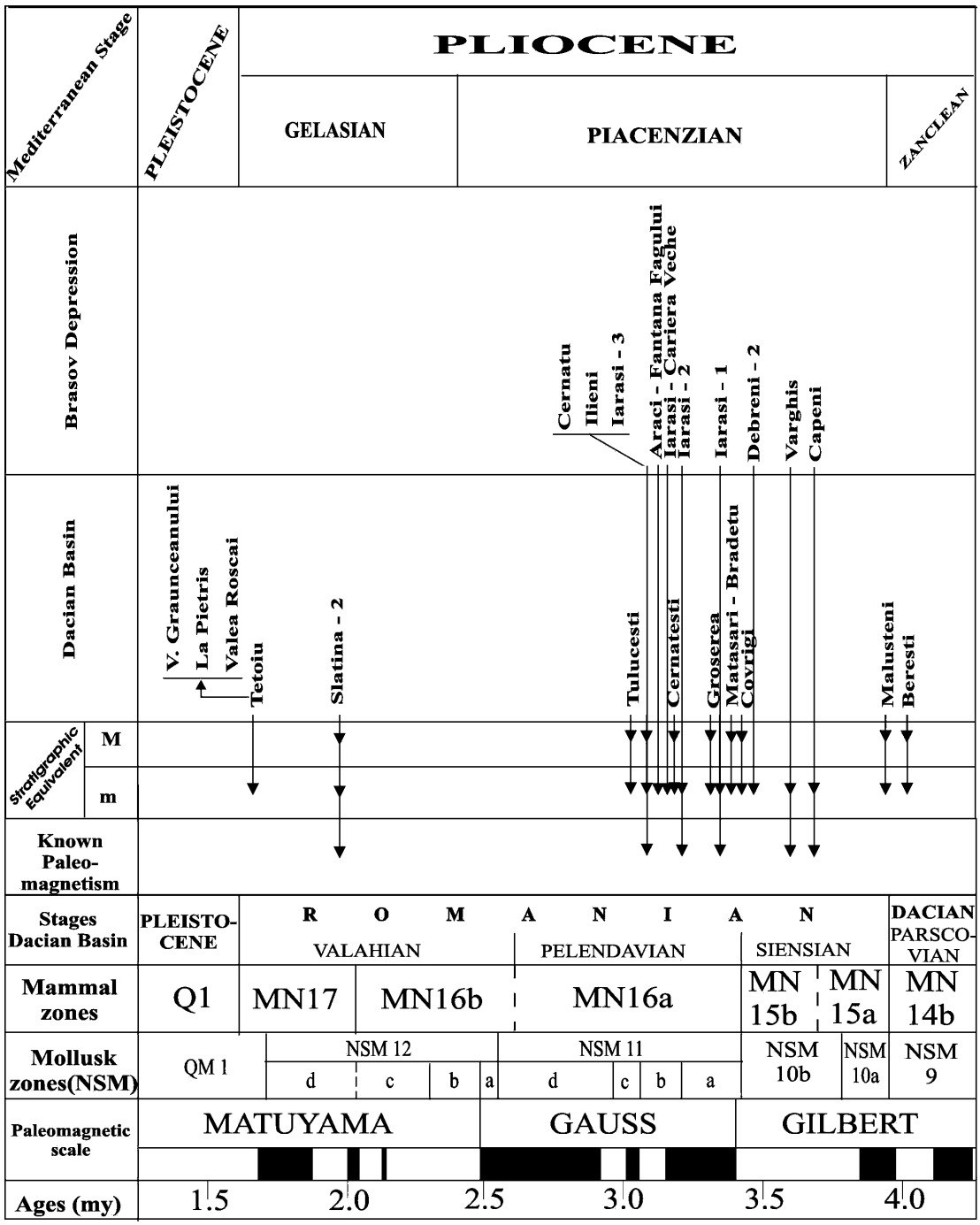

Fig. 2 – Correlation table (m = mollusk, M = mammals). Paleomagnetic determination after Ghenea et al., 1981, Andreescu *et al*., 1981.
Fig. 2 - Tabla de correlación (m = moluscos, M = mamíferos). Las determinaciones paleomagnéticas según Ghenea et al., 1981, Andreescu et al.*, 1981.*

arvernensis geticus NECRASOV, SAMSON & RADULESCU (type locality).

The three late Pliocene sites of VRc, P and VGr, which form the lower faunal horizon of Tetoiu (T-1) are characterized by the presence of *M. meridionalis* and the absence of mastodons. P containing predominantly Equids indicates a more continental climate, whereas VGr including especially Cervidae corresponds to a more humid and warmer environment.

In comparison with the older fauna from P, the site VGr supplied an association including new types of animals: the cercopithecid primate *Paradolichopitecus,* the antilope *Gazellospira*, the giraffid *Mitilanotherium* and the pangolin *Manis*; a large-sized rhinoceros, documented only by few limbs bones is also present.

In a previous paper we suggested that T-1 is, very probably, equivalent to portions of the Tiglian; VGr corresponding seemingly to the warmer Tiglian C5 of the chronostratigraphic scheme of the Netherlands (RADULESCU & SAMSON, 1990).

The faunal association containing *Mitilanotherium* at VGr has many affinities with some fossil localities of Macedonia (northern Greece) such as Dafnero (Grevena Basin) and Volaks (Drama basin) which were assigned to the Middle Villafranchian or MN 17 (Saint Vallier), zone on the side (KOSTOPOULOS & KOUFOS, 1994; KOUFOS & KOSTOPOULOS, 1997). The presence of *Paradolichopithecus* at VGr suggests a broad equivalence between this locality and Senèze (France) where the fauna includes a similar form. The occurrence of a pangolin at VGr is indicative of a correlation with Villany-3 (Hungary).

Traces of human activity

It is of greatest interest to mention the discovery on the northern slope of Dealul Mijlociu Hill (DM), in a sequence with sands and gravels we found some artifacts man-made from pebbles (SAMSON & RADULESCU, 1963; RADULESCU & SAMSON, 1990; RADULESCU *et al*., 1998). Stratigraphically, the level that yielded the artifacts occupies an intermediate position between the P fossil level and that of VGr.

BRASOV DEPRESSION

The Brasov Depression is situated in the bend zone of the eastern Carpathians (southeastern Transylvania). The depression consists of several smaller basins (Baraolt, Sfantu-Gheorghe, Targu-Secuiesc, Vladeni, Barsa and Ilieni) which can be seen as gulfs penetrating into the orogen along drained valleys. Several lithostratigraphic complexes, based especially on studies carried out in the Baraolt Basin, have been individualized (from bottom to top): the Coal complex, the Marly complex and the Iaras sands formation, which is a littoral equivalent of the upper part of the Marly complex.

Baraolt Basin

Capeni (C) (late early Pliocene, MN 15b).

The mammal remains coming from the productive coal bed III include: *Mammuth borsoni, Anancus arvernensis, Tapirus arvernensis, Stephanorhinus leptorhinus*, *Hipparion* sp., *Allohippus* cf. *athanasiui* (*Macrohippus sylvarum* KRETZOI, *nomen nudum*), *Sus minor, Metacervocerus* cf. *pardinensis, Procapreolus* sp., "*Parabos*" *athanasiui,* Bovidae indet., *Canis* sp., *Protarctos boeckhi* (SCHLOSSER), *Parailurus anglicus* (DAWKINS), *Lynx* sp., Machairodontinae indet., (?) *Mesopithecus monspesulanus*, *Dolichopithecus ruscinensis* (SCHLOSSER, 1899; MOTTL, 1939; KRETZOI, 1954; RADULESCU *et al*., 1965; ALIMEN *et al*., 1968; SAMSON & RADULESCU, 1973; RADULESCU & SAMSON, 1985, 2001).

Varghis (V) (late early Pliocene, MN 15b).

Mammals from coal bed III: *Mammuth borsoni, Anancus arvernensis, Tapirus arvernensis, Sus minor, Metacervocerus* cf. *pardinensis*, "*Parabos*" *athanasiui, Bovidae* indet., *Dolichopithecus ruscinensis.*

The mammalian assemblages at C and V are characterized by the presence of the two species of mastodons, *Sus minor* and a large antelope; the first appearance of *Parailurus anglicus*, a Pliocene species otherwise known from the Red Crag of England also represents a peculiarity of this fauna.

The associations of mammals from C and V appear to postdate the Malusteni fauna, which contains a larger suid form attributable to *Propotamochoerus provincialis.* In addition, *Metacervocerus* was never found at Malusteni. The two fossil localities of the Baraolt Basin can be placed in a young time interval within the MN 15 zone (MN 15b).

Iaras (I) (middle Pliocene, MN 16)

In the Iaras area, the coal bed III and Marly Complex (reversely magnetized) underlies the Iaras Sands Formation at Cariera Noua (New Quarry) (ALIMEN *et al*. 1968, SAMSON & RADULESCU 1973, GHENEA *et al*.

Basin	Dacic Basin											Brasov Depression						
Localities	**Br**	**Ml**	**Tl**	**Cv**	**MtB**	**Grs**	**Cr**	**Sl2**	**VRc**	**P**	**VGr**	**C**	**V**	**I**	**AFF**	**Db2**	**Il**	**CR**
Ord. Primates																		
Dolichopithecus ruscinensis	+	+										+	+					
"Dolichopithecus" cf. *arvernensis*		+																
?*Mesopithecus monspessulanus*		+										+						
Paradolichopithecus arvernensis geticus											+							
Ord. Pholidota																		
Manis cf. *hungarica*											+							
Supraord. Carnivora (Ord. Fissipeda)																		
Agriotherium sp.	+																	
Lynx issiodorensis		+								+	+	+						
Vulpes allopecoides										+								
Canis sp.												+						+
Nyctereutes megamastoides										+	+							
Eucyon odessanus	+	+																
Eomelivora sp.	+																	
Eomelivora rumana (="*Bassarabictis rumana*")		+																
Baranogale sp	+																	
Baranogale cf. *helbingii*		+																
Mustelidae indet. I	+	+																
?*Enhidrictis* sp.		+																
Parsailurus anglicus												+						
Protarctos bockhi												+						
Ursus etruscus											+							
Ursus minimis																	+	
Pliocrocuta perrieri											+							
Machairodontinae indet.												+						
Homotherium crenatidens											+							
Megantereon megantereon											+							
Ord. Proboscidea																		
Mammuth borsoni		+	+	+		+	+					+	+	+	+			
Anancus arvernensis		+	+	+	+	+	+					+	+	+	+	+	+	
Archidiskodon rumanus (="*Mammuthus rumanus"*)			+				+											
Mammuthus gromovi								+										
Mammuthus (*Archidiskodon*) *meridionalis*									+	+	+			+				
Ord. Perissodactyla																		
Tapirus arvernensis		+										+	+	+	+		+	
Rhinocerotidae g. et sp. indet.		+																
Stephanorhinus elatus				+		+	+							+	+		+	+
Stephanorhinus sp. (*S. leptorhinus*)	+										+			+		+		
Stephanorhinus etruscus					+		+			+				+				
Dicerorhinus cf. *leptorhinus*	+											+						
Equus sp.(*Hipparion*) *simionescui*	+																	
Equus sp.						+						+						
Hipparion malustenense	+	+												+				
Plesippus (*Allohippus?*) *euxinicus*		+	+															
Plesippus (*Allohipus*) *athanasiui*										+	+	+						
Allohippus stenonis mitilanensis														+				
Ord. Artiodactyla																		
Sus sp./ *S. minor*												+	+					
Propotamochoerus provincialis		+																
Paracamelus bessarabiensis	+																	
Paracamelus alexeevi		+																
Paracamelus cf. *kujalnensis*			+															
Procapreolus sp	+											+						
Cervidae indet (IIII)		+									+						+	+
Metacervocerus pardinensis				+		+	+					+	+		+			
Cervus cf. *perrieri*			+			+								+				
Pliocervus cf. *kutchurganicus*	+																	
Eucladoceros sp.								+		+	+			+				
Mitilanotherium inespectatum											+							
Pliotragus ardeus											+							
"Parabos" athanasiui	+	+										+	+	+				
Gazella sp.	+																+	
Bovidae g. et sp. indet.	+	+				+												

Table 1 – Distribution of the large mammals in the mentioned localities (localities abbreviations see in text).
Tabla 1. - Distribución de los grandes mamíferos en las localidades mencionadas (abreviatura de las localidades en el texto).

1981). The sequence of deposits includes normally polarized, ferruginous sands at the base, followed by predominantly white sands. Periglacial phenomena (ice wedge, small cryoclastic pebbles, plications) occur at the middle part of these white sands; the zone disturbed by frost phenomena underlies in turn horizontally bedded white sands with small-sized gravel intercalations. The sequence of white sands (normally magnetized) is overlain by upper marly deposits displaying reversed polarity.

The Iaras Sands Formation supplied mammalian remains at various levels; in ascending order these fossil horizons are as follows:

Iaras - 1 (ICN - 1)

The lower fossil horizon, consisting of ferruginous sands supplied the following species: *Mammut borsoni, Anancus arvernensis, Tapirus arvernensis, Stephanorhinus leptorhinus* (a more hypsodont form), *Hipparion* cf. *malustenensis, "Parabos" athanasiui.*

Iaras - 2 (ICN - 2)

The sequence of white sands supplied some remains coming from the horizon above the level disturbed by cryoclastic phenomena: *Stephanorhinus* cf. *elatus.*

Iaras - Cariera Veche (Old Quarry) (ICV - 2)

In the nearby "Cariera Veche", now disused, the upper part of the sequence of white sands is still available for examination. Some remains of mammals were identified at ICV (Radulescu et. al. 1965): *Stephanorhinus* cf. *etruscus*, Cervidae cf. *Arvernoceros ardei* (CROIZET & JOBERT)/*Cervus perrieri* (CROIZET & JOBERT).

Iaras - 3 (ICN - 3)

The upper marly beds at Iaras New Quarry yielded some molars belonging to: *Anancus arvernensis*.

Morphological studies showed that ICN -1 fauna including representatives of the genera *Hipparion* and *"Parabos"*, has still Ruscinian affinities. The large-sized *Stephanorhinus*, which possesses more hypsodont molars in comparison with *S. leptorhinus* from C and V, is similar to the rhinoceros from Wolfersheim (Germany) (GUÉRIN, 1980).

ICN - 1 normally magnetized corresponds to the transition from the MN 15 to MN 16 and can be placed at the beginning of the Gauss epoch.

ICV faunas, where the first appearance of the *Stephanorhinus* cf. *etruscus* in the Brasov Depression is recorded, appears to correlate with Matasari - Bradetu of the Dacic Basin. With regard to the ICN - 2 fauna, the presence of *S. elatus* strongly suggests temporal equivalence to the early Villafranchian Covrigi fauna of the Dacic Basin containing the same species. The lowering of temperature indicated by frost phenomena at Iaras - New Quarry may be situated towards the end of Early Gauss subchron. The occurrence of *S.* cf. *etruscus* is very probably connected with an increase of continentality.

ICN - 3 belongs to a reversed polarity zone which may be correlatable with Mammoth or Kaena event of the Gauss epoch (RADULESCU & SAMSON, 1995).

Araci - Fântâna Fagului Quarry (AFF) (middle Pliocene, MN 16a)

This sand quarry (now abandoned) is situated near the locality of Araci in the southern part of the Baraolt Basin. A basal level consisting of normally magnetized white sands, very similar to those at ICN -2, have yielded mammalian remains belonging to the following species: *Mammuth borsoni, Anancus arvernensis, Tapirus arvernensis, Stephanorhinus elatus* (a skull with nasal septum), *Metacervocerus pardinensis.*

This associations is without any doubt equivalent to both ICN - 2 and Covrigi faunas. AFF fauna can be therefore, placed within the Early Gauss subchron (MN 16a).

Sfantu-Gheorghe Basin

Debren - 2 (Db - 2) (early Pliocene, MN 15b)

A sequence of sands intercalated with gravel lenses located in the Debren valley near the town of Sfantu - Gheorghe, yielded the following mammalian species: *Anancus arvernensis, Stephanorhinus leptorhinus* (skull fragment without nasal septum), *Muntiacus polonicus* CZYZEWSKA.

The presence of *M. polonicus* suggests an equivalence to Weze faunal level of Poland (MN 15b).

Ilieni Basin (Il) (middle Pliocene, MN 16).

Coal beds in this small basin yielded the following taxa: *Anancus arvenensis, Tapirus arvenensis, Stephanorhinus* cf. *elatus, Cervidae* indet., *Gazella* sp., *Ursus minimus* DEVÈZE & BOUILLET.

The fossil horizon at Ilieni is characterized by the first appearance of a new ursid species (*U. minimus*),

more evolved in comparison with *P. boeckhi* from Capeni. The chronostratigraphic position of this site among the Middle Pliocene localities discussed above is still questionable.

Targu-Secuiesc Basin

Cernatu (CR) (middle Pliocene, MN 16).

The Robert sand Quarry located near Cernatu supplied some mammalian remains attributable to the following species: *Stephanorhinus elatus, Arvernoceros ardei,* Canidae indet.

The chronostratigraphic position of this site is not exactly known. Its fauna suggests, however, an early Villafranchian age.

In summary, the mammalian remains collected from the coal bed III (Productive Formation) and from the Iaras Sands Formation and its stratigraphic equivalents strongly suggest that mammalian bearing deposits can be situated within the late Gilbert subchron (coal bed III, lower part of the Marly Complex, Db-2) on the one hand and within the early Gauss subchron (Iaras Sands Formation, AFF, I1, CR) on the other.

CONCLUSIONS

Although the macromammalian faunas are unequally studied in the Romanian Pliocene sites, an important faunistic renewal happened in this period, in terms of FAD and LAD of taxa.

The main faunistic periods are the followings, using the Mediterranean chronostratigraphy with three Pliocene subdivision (Lower Pliocene = Zanclean, Middle Pliocene = Piacenzian and Upper Pliocene = Gelazian) (Cita *et al*., 1996).

- the faunal associations from the last half of the lower Pliocene is recorded in Beresti and Malusteni. The first sites present a strong affinity with the so called "lagomorphic complex" from E and SE Europe and the Aegean fauna.
- although with some gaps, the middle Pliocene is characterized by first apparition of the Elephant in Europe (*Archidiskodon* (*Mammuthus*) *rumanus*) in association with *Mamuth borsoni, Anancus arvernensis, Paracamelus, Cervus* cf. *perrieri* and *Plesippus (Allohippus) euxinicus.*
- the upper Pliocene is characterized by the several climatic oscillations, going from a relatively more humid period to a more dry one, as indicated by the steppe markers *Borsodia* and *Allactaga* among micromammals and *Mammuthus gromovi* and *Eucladoceros* among macromammals.

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