

A PLIOCENE MASTODON AT BERBEȘTI (VÂLCEA DISTRICT)

VLAD AUREL CODREA

Babeș-Bolyai University of Cluj-Napoca, Laboratory of Paleotheriology and Quaternary Geology,
1 Kogălniceanu Street, 400084, Cluj-Napoca, Romania, e-mail: codrea_vlad@yahoo.fr

VENCZEL MÁRTON

Țării Crișurilor Museum, 1-3 Dacia Avenue, 410464, Oradea, Bihor, Romania;
Babeș Bolyai University, Department of Geology, 1 Mihail Kogălniceanu Street, 400084 Cluj-Napoca, Romania, e-mail: mvenczel@gmail.com

ABSTRACT. The Pliocene coal-bearing deposits from north-western Oltenia are mined since several decades, from the 20th century. These works are still continuing, but slower than once. An iconic mining area for such works is Berbești, located in Vâlcea County. The frequent fossils found there concern invertebrates, in dominance molluscs. Vertebrates were never mentioned from this locality. This paper deals with an upper tusk fragment originating from a mastodon found in the clay covering the coal seam V mined in Berbești open pit. These rocks are Parscovian (= middle Dacian, early Pliocene) in age. Although the fragment available for study is limited to the apical portion of the incisor, one may presume that the tusk was longer when it was found in the rock, the broken part being a fresh one. This fossil record is of special importance because the vertebrate remains of this age are rather rare in Oltenia. The environment where this mastodon lived was fluvial-deltaic.

Keywords: mastodon, early Pliocene, Carpathian Foredeep, Oltenia, Romania.

REZUMAT. Un Mastodon Pliocen la Berbești (județul Vâlcea). Depozitele purtătoare de cărbuni Pliocene din nord-vestul Olteniei sunt exploatate de câteva decenii, începând din secolul 20. Aceste lucrări continuă și în prezent, însă mult diminuate. O arie minieră emblematică pentru astfel de lucrări este Berbești, localizată în Județul Vâlcea. Fosilele frecvent descoperite acolo se referă la nevertebrate, predominant moluște. Vertebrate nu au fost niciodată semnalate din această localitate. Această lucrare se referă la un fragment de fildeș superior provenind de la un mastodont descoperit în argilele care acoperă stratul de cărbune V exploatat în cariera Berbești. Rocile sunt parscoviene (= Dacian mediu, Pliocen Inferior). Deși fragmentul aflat la dispoziție pentru studiu este limitat strict la terminația apicală a incisivului, se poate presupune că fildeșul aflat în strat a fost mai lung, spărtura mesială fiind proaspătă. Această semnalare a fosilei este de importanță deosebită, fiindcă resturile de vertebrate având această vechime sunt mai degrabă rare în Oltenia. Mediul în care acest mastodont a viețuit a fost unul fluvial-deltaic.

Cuvinte cheie: mastodont, Pliocen Inferior, Avanfosa Carpatică, Oltenia, România.

INTRODUCTION

In northern Oltenia (south-western Romania, western sector of the Dacian basin) between Olt and Jiu rivers, Pliocene exposures are largely spread as a belt-like area trended W-E. This area was and still is of economic interest, due to the coal seams interleaved in the Pliocene rocks. In the Pliocene sedimentary succession, both Lower and Upper Pliocene (= Dacian and Romanian) rocks can be observed.

In the basal most Dacian deposits sand is in prevalence, while towards the top of this succession the lithology is more diverse, with sand, silt clay and coal (lignite) seams being inter-bedded (Andreescu et al., 1985; Țicleanu & Pătruțoiu, 1987). In late Getian (= early Dacian) the coal occurs only on restricted areas and is devoid of mining interest. The Getian deposits are included in a distinct lithostratigraphic unit named the Berbești Formation (Andreescu et al., 1985). Later in the Dacian, the coal seams became thicker (locally reaching nearly to ten meters) and are mined in open pits, the lignite being burn in thermoelectric power plants. The participation of sand decreased, and silt, silt clay and clay prevail. Fossils are represented mainly by molluscs indicative for low brackish waters (Andreescu et al., 1985). The middle and late Dacian (= Parscovian and Siensian) deposits are included in the Motru-Jiu Formation.

In the northern Oltenia sector of the Carpathian Foredeep, the Romanian was a time of transition from fluvial to alluvial depositional systems. The lithology of the deposits did not change to much compared to the Dacian ones, but the participation of gravel (more precisely, of coarser gravel), became more and more important to the top of the Pliocene sedimentary succession. Polycyclic sequences of coarse pebble, sands, silts and clay are in dominance. Coal seams still occur in Romanian too. For the northern margin of the Dacian basin, these Romanian deposits are included in the Căndești Formation (Andreescu et al., 2011, 2013 and references therein). Apart of various freshwater molluscs, mammal remains, mainly of large herbivores are recorded in several localities (Ibidem).

In reference to the coal seams, it is worth to mention that such beds were used on the whole territory of Oltenia as markers used for local or regional correlations. The coal seams were numbered either regionally or just locally (Petrescu et al., 1987). If the regional numbering refers to whole Oltenia region, there are also local numberings, as is the case of Jiu-Olt area (Țicleanu & Pătruțoiu, 1987). In our opinion, the local numbering caused confusion in interpreting of the regional charts and it may be useful strictly for local correlations, as the ones between different neighbouring coal open pits. The magnetostratigraphy is much more accurate that allowed better correlations of the coal seams (Andreescu et al., 1986, 1987). In the sector of our interest, the Dacian/Romanian boundary falls between the coal seams XIII and XIV (in the regional numbering of the coal seams; Ion Andreescu, written communication).

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Among the open pits mining the coal in northern Oltenia, Berbești is an iconic one. This locality is situated along Tărăia left affluent of Olteț River (Fig. 1).

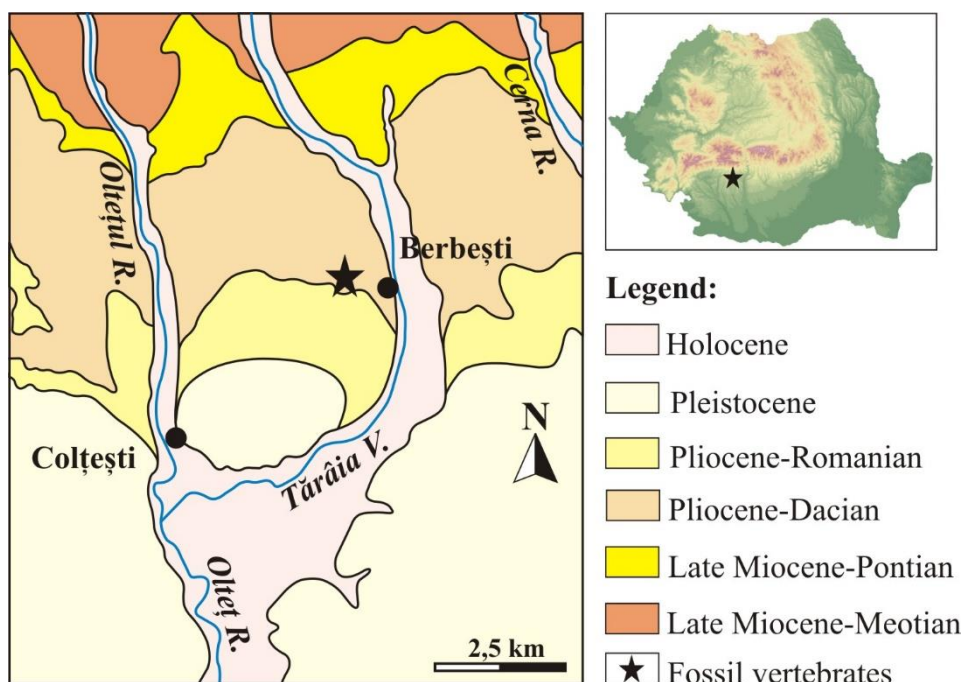


Figure 1 - Location of the locality Berbești on the geological map. Legend: Miocene: Po - Pontian; Pliocene: Dc - Dacian, Ro - Romanian; Quaternary: Pl - Pleistocene; Ho - Holocene. Star: vertebrate fossil.

Two open pits are mining the coal in Berbești: a first one is located ca. 3 km westward (Berbești open pit), and a second eastern one (Panga open pit), at ca. 3 km distance from the locality. In Berbești open pit, during the coal mining works over a decade ago, an upper mastodon tusk fragment (I2) has been unearthed in the clay covering the coal seam V (in the regional numbering, II in the local one; Fig. 2). Probably the tusk preserved within the rock was longer, but the careless extraction of the fossil by miners damaged a large part. Therefore, only this fragment is now available for study.

MATERIAL AND METHODS

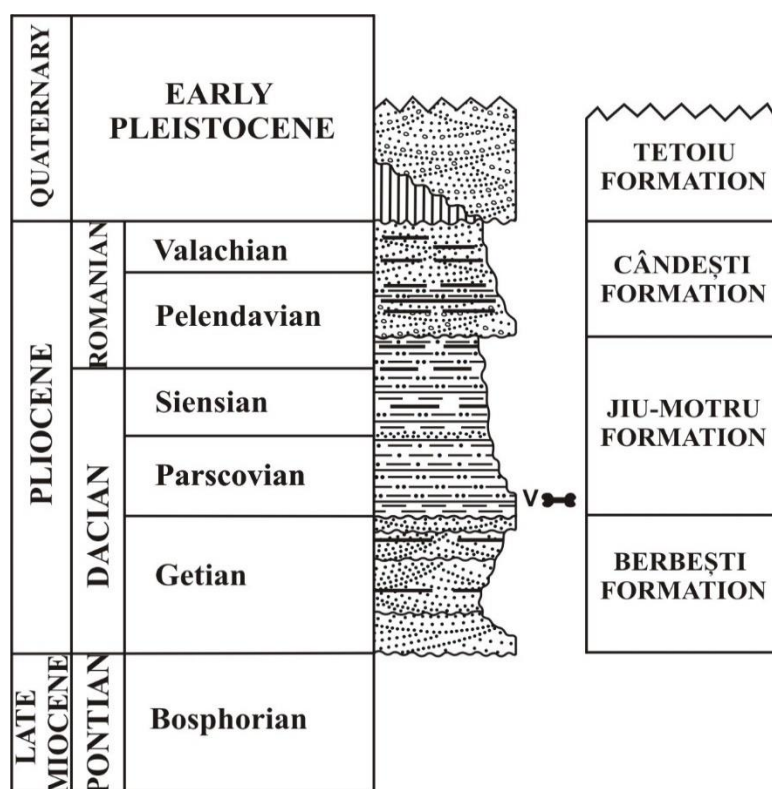
The tusk fragment did not need special preparation. Its state of preservation was fair. However, as it was broken into three parts, they were glued with a professional polymer.

The tusk fragment was compared with the ones of the "Stoina mastodon" (Demetrescu & Nicolaescu-Plopșor, 1929) hosted in the Olteniei Museum Natural Sciences Branch in Craiova (inventory number 1466) and with the fossil illustrate

by Athanasiu (1908) from Adj. For *Mammut borsoni* (HAYS, 1834), comparisons were based on references of the *Milia mastodon* specimens (Greece; Tsoukala & Mol, 2016).

Photographs were captured with Sony® DSC-RX100M5 with lens ZeissVario-Sonnar T* 1.8-2.8/8.8-25.7, then processed in Adobe®Photoshop® CS2 Version 9 in order to sharpen some details.

Systematic follows Shoshani & Tassy (1997).



Legend:

	Cross-stratified pebbles		Clay
	Sedimentary gap		Sand
	Cross-stratified sands		Coal
	Sandy clay		Disconformity
	Silt		Mastodon tusk

Figure 2 - Pliocene lithostratigraphy between Jiu and Olt rivers. In legend, V indicates the level where the mastodon tusk originated from.

RESULTS

Systematic palaeontology

Order Proboscidea ILLIGER, 1811

Suborder Elephantiformes TASSY, 1988

Superfamily Elephantoidae GRAY, 1821 sensu TASSY, 1988

Family Mammutidae HAY, 1922, *Mammut* BLUMENBACH, 1799, probably *M. borsoni* (HAYS, 1834) or,

Plesion *Anancus* AYMARD, 1855, probably *A. arvernensis* (CROIZET & JOBERT), 1828 (Fig. 3).

The single remain documenting the presence of mastodons in the Parscovian deposits of Berbești is an apical fragment of an upper tusk (I2), most likely the right one. The tusk is break at its tip, as well as in the mesial extremity. The tusk is devoid of any enamel band and the dentine is polished in the tip area. The colour of dentine is greenish-gray. The size of the tusk is pronouncedly increasing from the tip towards the skull: on only 40 cm length, the largest diameter increases from 36 mm at the tip torn zone, to 84 mm in the mesial cross section. The cross sections are different, from oval (Fig. 3, 1 a) to the tip, to a quasi-circular one in the mesial area (Fig. 3, 1 c). In the mesial torn area, the inner dentine has a blackish colour. The Schreger lines angles (Fig. 3, 3) exceed 90° near the tusk surface, and decreases towards its longitudinal axe, where the angle is sharp. This tendency is noted also in other proboscideans, as the woolly mammoth (Ábelová, 2008).

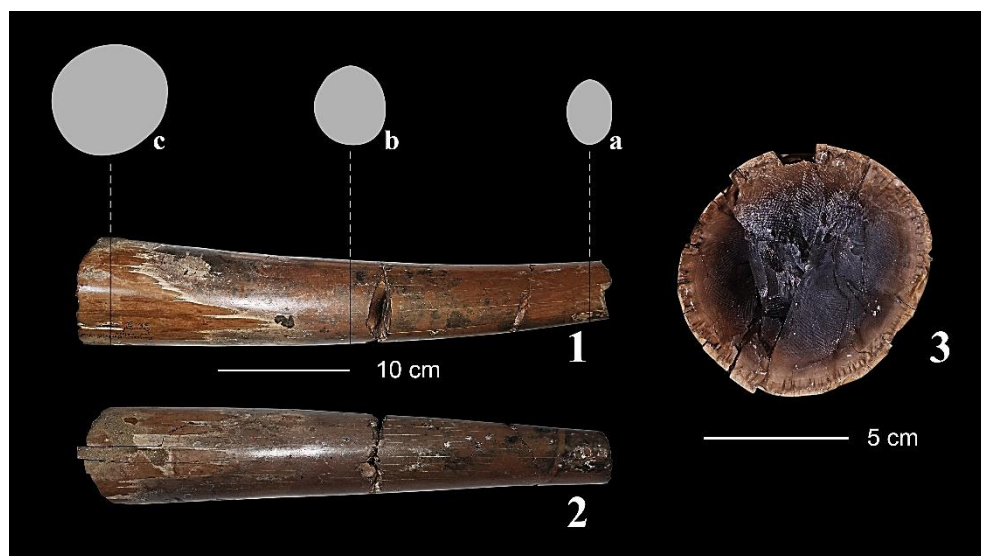


Figure 3 - Mastodon tusk fragment from Berbești: 1. Outer view with successive cross sections (marked a, b, c from distal to mesial portions); 2. Ventral view; 3. Mesial cross section with Schreger lines.

DISCUSSIONS

In Romania, as in many other regions of Europe, in the Pliocene there are only two mastodon species: the gomphotheriid *Anancus arvernensis* (CROIZET & JOBERT, 1828) and the mammutid *Mammut borsoni* (HAYS, 1834).

The fossil record of *Mammut praetypicum* (SCHLEZINGER, 1919), a third species that could be eventually present in Pliocene, is still a subject of debate, as outlined among others by Lungu & Obadă (2001) and Codrea et al. (2005). The finds originating from Păgaia (Bihor County) that yielded fossils for the last mentioned species were not enriched by new ones in the last years; therefore it is hard to resume a new discussion based on richer samples. There are no new geological studies on Păgaia area that could lead to a clearer stratigraphy. Therefore, the possible Pliocene age of this locality should be based on stronger arguments, still missing. Anyhow, *M. praetypicum* was never mentioned in the Dacian basin.

In these circumstances we have to refer only to the couple of mastodon species firstly mentioned above. Both are reported from various early and late Pliocene localities from Oltenia. What is less clear in this region is the stratigraphy of several localities where these fossils originated from. But, it is obviously clear that both mastodon species were at last for a time span in the Pliocene contemporaneous, each one adapted to a specific food.

Without any intention to redact an exhaustive list of localities where these Pliocene mastodons were reported from, we will discuss some of the localities from Oltenia. A first problem to be solved concerning not only the local stratigraphy but the whole Dacian basin is to reassess the regional geological maps, consequence of relocation of the Pliocene/Pleistocene boundary at ca. 2.58 Ma. instead the former limit of ca. 1.8 Ma (e.g. Van Couvering, 2004; <http://www.stratigraphy.org/ICSchart/ChronostratChart2018-08.pdf>). The geological maps on scale 1:200,000 made by the Geological Institute of Romania are rather old, the folios being published in the years '60-'70 of the 20th century. In the specific case of the Berbești locality, the Tg. Jiu folio L-34-XXX (Codarcea et al., 1967) issued when the Pliocene/Pleistocene boundary was younger than nowadays. More recent maps on scale 1:50,000 for this area are missing. In such circumstances, the Pliocene/Pleistocene limits on the geological map 1:200,000 should be redrawn. Obviously, a part of the former deposits of the Valachian (= late Romanian) have to be now considered as Pleistocene.

The same concerns several Pliocene vertebrate localities reported from Oltenia by Rădulescu & Samson (2001) and Rădulescu et al. (2003) that should be stratigraphically reassessed: Slatina 2 and Tetoiu-Bugiulești area with the sites Valea Roșcăi, La Pietriș or Valea Greuceanului are considered now Pleistocene and not Upper Pliocene, as once (a chart of reassessed Pliocene and Pleistocene mammalian localities from the Dacian Basin specifying also the paleomagnetically investigated sites in Andreescu et al., 2011, 2013). But all these above mentioned localities are devoid of interest for mastodons, as long as in the mammal unit MN

17 the only proboscideans ever reported belong to *Mammuthus*, mastodons being already extinct in this region. In the older MN 16a subunit (Romanian, late Pliocene) Cernătești is an outstanding locality, where *Anancus arvernensis* and *Mammuth borsoni* were coeval with *Mammuthus rumanus* (ȘTEFĂNESCU, 1924), the earliest known European mammoth (Ștefănescu, 1924; Listner & van Essen, 2003; Markov, 2012). In the other localities of the same subunit as Groșerea or Covrigi only mastodons are reported, and in Mătășari-Brădețu only *A. arvernensis* is mentioned (possibly due to the scarcity of vertebrate fossils in this locality: apart the mastodon, only the rhinoceros *Stephanorhinus* cf. *etruscus* is present; Rădulescu et al., 2003).

The tentative of comparison of this portion of tusk to the similar ones of *A. arvernensis* from Stoina (Gorj District; Demetrescu & Nicolaescu-Plopșor, 1929) and Adjud (Athanasie, 1908) or *M. borsoni* from Milia (Greece; Tsoukala & Mol, 2014, 2016) reveals nothing but the impossibility to separate these two species based on this fragment. Neither the internal structure, nor the dimensions and cross-section geometry are not useful for such discrimination. The single reasonable conclusion to be done based on this fossil is that mastodons were present in the Lower Pliocene coal bearing deposits of the South Carpathian Foredeep, in this specific case at Berbești. Other finds are supporting the same evidence, as the one from Husnicioara (Mehedinți County) coal open pit, where a left upper second molar of *M. borsoni* was unearthed during the coal mining works from the rocks covering the coal bed IV (Codrea & Diaconu, 2007). It is clear that in the Dacian the mastodon remains are not frequent at all, possibly due to the specific taphonomy in deltaic environments, sometimes with some increased fluvial plain influences, specific since the Berbești Formation deposition (between the whole region comprised between Danube and Olt River; Ion Andreescu, written communication).

As it concerns an old find, there is scarce data about the taphonomy. The fossil was collected by a coal miner that gave it to the geologist. In Berbești quarries, as in the majority of coal open pits in Oltenia, only large sized excavators are used for coal extraction (Fig. 4). The underground mining once working (the mines Alunu, Berbești and Copăcenii) ceased still long time ago and manual extraction in the open pits was never used. In these circumstances, even a whole skeleton of a large herbivore like a mastodon could have gone unnoticed. In the mesial portion, the tusk broken area has a fresh aspect, which let us to presume that at least another of its part was present into the rock. The mastodon upper tusks can be very hardly moved before their definitive burial, as they are nearly always very long (in Milia, the *M. borsoni* tusks exceeds five meters; Tsoukala & Mol, 2014, 2016). In such circumstances, we may think that probably the whole tusk was in the rock bed, and even the mastodon skeleton, complete or fragmentary was nearby.



Figure 4 - Coal mining in Panga open pit with large size excavator.

CONCLUSIONS

Mastodons were a common presence in the early and late Pliocene, leaving fossil evidence in numerous localities of the Dacian basin. *A. arvernensis* and *M. borsoni* were coeval since the Dacian and continued until the early Romanian (subzone MN16a), when they lived besides the first European mammoth, *M. rumanus*. After that, *M. borsoni* became rarer, while the frequency of *A. arvernensis* increased. The explanation should be found in the changes occurred in the Pliocene environments of the Dacian basin, the deltaic ones being gradually replaced mostly on the western and northern sides by fluvial and alluvial environments (Andreescu et al., 2011, 2013). These changes, certainly had influences in the vegetal communities as noticed by Petrescu et al. (1989 a, b) and Codrea et al. (2006). These authors made even a reconstruction of the Pliocene environments (Figs. 5, 6), that Codrea (1997) resumed. The different diets of the two mastodon taxa were probably a strong control factor that could explain the different stratigraphic frequencies above mentioned.

This is the first fossil record of a mastodon in Berbești, a new locality for the Pliocene vertebrates in the Dacian basin. The mastodon tusk was found in the basal portion of the Jiu-Motru Formation, in Dacian deposits.

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Figure 5 - Reconstruction of the lower Pliocene (Dacian) environment in the Dacian basin; in front, *M. borsoni*. Oil on canvas by painter V. Svințiu, scientific supervision of I. Petrescu (plants) and V. Codrea (mastodon).

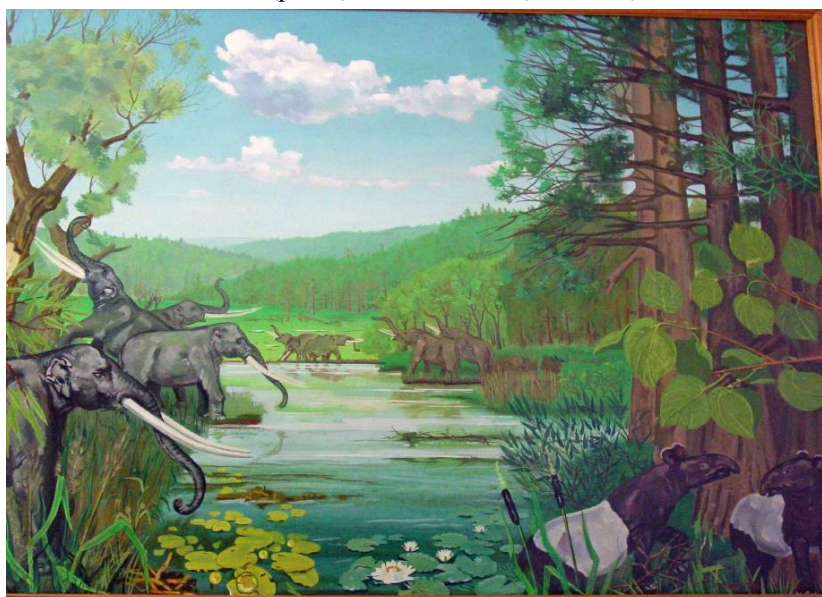


Figure 6 - Reconstruction of the upper Pliocene (Romanian) environment in the Dacian basin; in front, *A. arvernensis* and the tapir *Tapirus arvernensis* CROIZET & JOBERT, 1828. This last one was never found in Oltenia, but it was added based on the discoveries from Baraolt basin and South Moldova (Mălușteni), considered at that time as Romanian ones (now, reassessed as Dacian). Oil on canvas by painter V. Svințiu, scientific supervision of I. Petrescu (plants) and V. Codrea (mastodon).

Probably, the vertebrate fossils unearthed during the coal mining were by far more numerous, but they were lost. The potential of these deposits for vertebrate remains is considerable, and a systematic scientific survey would be desirable.

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