

MASTODON TEETH IN CÂMPULUNG MUSCEL MUSEUM COLLECTIONS

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ABSTRACT. Two mastodon cheek teeth are hosted in the collection of Natural History of the Câmpulung Muscel Museum, documenting Pliocene species. The first is originating from Capu Piscului locality and concerns Auvergne mastodon (*Anancus arvernensis*). The fossil probably originates from Upper Pliocene (Dacian) deposits. The second documents the presence of the Borson's mastodont (*Mammuth borsoni*) and was collected decades ago from Aninoasa locality. According to the geology of the area, the deposits the fossil may have originated from are Lower Pliocene (Dacian). Both species are very characteristic for the Pliocene of the Dacian basin. Obviously, since the early Pliocene, large areas of the actual Argeș County were already emerged and fluvio-lacustrine environments allowed the development of these mastodon species. Although these fossils were found decades ago and their stratigraphy is not very detailed, their presence in the exhibition of the Câmpulung Muscel Museum is important for the large public, allowing a better understanding of the Pliocene evolution in this region.

Keywords: Dacian basin, Carpathian Foredeep, Pliocene, proboscidea, mastodons, Romania.

REZUMAT. Dinți de Mastodon din colecțiile Muzeului din Câmpulung Muscel. Doi molari de mastodont se găsesc în colecția de Istorie Naturală a Muzeului din Câmpulung Muscel, dovedind prezența a două specii pliocene. Prima provine din localitatea Capu Piscului și se referă la *Anancus arvernensis*. Fosila provine probabil din depozitele pliocene superioare (Romaniene). Cea de-a doua fosilă dovedește prezența speciei *Mammuth borsoni* și a fost colectată cu decenii în urmă din localitatea Aninoasa. Pe baza geologiei locale, depozitele de proveniență au putut reveni Pliocenului Inferior (Dacian). Ambele specii sunt foarte caracteristice Pliocenului din Bazinul Dacic. În mod clar, încă din Pliocenul timpuriu, suprafețe vaste ale actualului județ Argeș erau deja uscate pe care se găseau instalate paleomedii fluvio-lacustre care au permis existența acestor specii de mastodonți. Deși

aceste fosile au fost găsite cu decenii în urmă, iar stratigrafia lor este mai puțin exactă, prezența lor în expoziția Muzeului din Câmpulung Muscel este importantă pentru marele public, permițând o mai bună înțelegere a evoluției pliocene din regiunea argeșeană.

Cuvinte cheie: Bazinul Dacic, Avanfosa Carpatică, Pliocen, proboscideni, mastodonți, România.

INTRODUCTION

Pliocene-Pleistocene Proboscidean fossils are not rare in the Dacian basin. A large number of finds refers to the southern mammoth, *Mammuthus meridionalis* (NESTI, 1825), but the huge majority of finds concerns only isolate cheek teeth. Fragmentary skeletons are by far, rarer (as an exception, a rich sample of bones originates from the locality Leu, in Dolj County; Popescu, 2004, 2008, 2011).

The mastodon remains are common in the Pliocene deposits of the South Carpathians Foredeep. In the first volume of the yearbook of the Geological Institute of Romania, Athanasiu (1908) published an overview on the Pliocene Borson's mastodon *Mammuth borsoni* (HAYS, 1834; "*Mastodon Borsoni*" in Athanasiu) finds from the former Romanian Kingdom, soon followed (Athanasiu, 1909) by a similar approach on the Auvergne mastodon *Anancus arvernensis* (CROIZET & JOBERT, 1828; "*Mastodon arvernensis*" in Athanasiu). This couple of mastodon species is the most specific for the whole Pliocene of Romania, a rule also for the Pliocene of the whole Balkan region. Among Athanasiu's Pliocene finds, there are some from the sector of the Southern Carpathian Foredeep located in Argeș County.

In the paleontological collection of the Câmpulung Muscel Municipal Museum, Natural Sciences (hereinafter, abbreviated as CMNSC), there are hosted two mastodon cheek teeth, found in the Argeș County in the last century, several decades ago. As we think that each such find could bring a light to a better knowledge of the local geology, here we describe these fossils.

The first tooth is an isolate lower molar of the Auvergne mastodon (*A. arvernensis*), labeled as CMNSC 979. In the museum repertory, there are not too many details about this find. It is simply mentioned that it was found in 1970 in the locality Capu Piscului, situated ca. 12 km SW from Câmpulung Muscel, on Bughea River. On the geological map of the Geological Institute of Romania, scale 1:200,000, folio 34 Pitești (L-35-XXV, Murgeanu et al., 1967), in this area there are exposed both Lower (Dacian) and Upper (Romanian) Pliocene deposits (Fig. 1). It is difficult to know after so many years from which level the tooth originated from, in absence of any additional detail in the museum's documents. The bearing rock for this tooth was a microconglomerate, as the rock matrix still fixed on the tooth documents. If considering the location of Capu Piscului near the Dacian/Romanian boundary and as in Romanian the sand and sandstone increase in prevalence (Mărgărit, 1987), one may think that this fossil could originate from the basal portion of the Upper Pliocene (Romanian) succession.

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The second mastodon tooth refers also to an isolate molar assigned to Borson's mastodon (*M. borsoni*). In the repertory of the museum (CMNSC 119) for this tooth we had on hand some richer data: it originates from Aninoasa locality (Argeş County) and it was found by Mr. Costică Constantinescu, in Valea Romilor. In this case, on the same mentioned geological map (Fig. 1), in the whole area only Lower Pliocene (Dacian) deposits are exposed, with sand, marl, clay, and coal (lignite) seams inter-beddings. The matrix fixed on the tooth concerns microconglomerate and sandstone. Therefore, in this situation it is clear an origin from Lower Pliocene rocks.

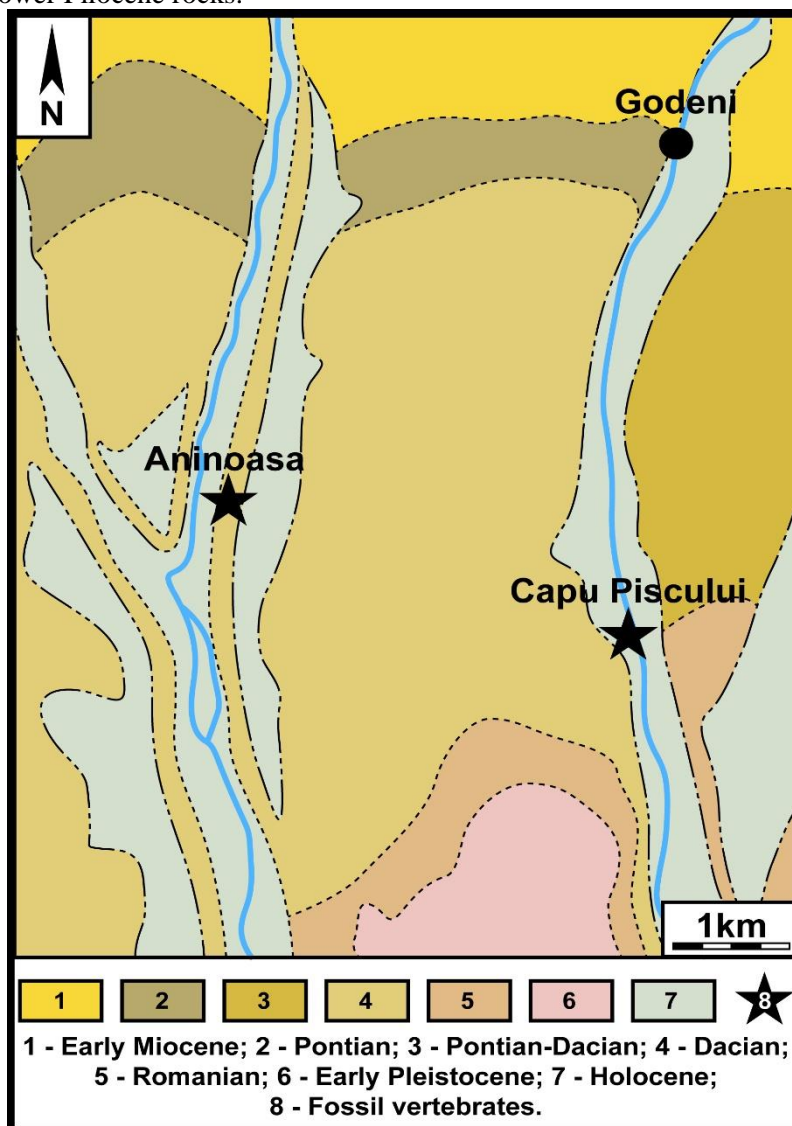


Figure 1 - Location of the mastodon localities on the geological map.

METHODS

The teeth were not cleaned of their entire rock matrix, as all the details concerning the morphology were clear enough. Photographs of the teeth were captured with a D700 Nikon camera and a 105 mm Sigma lens, using a professional tripod. The measurements are done using professional calipers.

For both mastodons we follow the systematic of Shoshany and Tassy (1997). For *Anancus* we follow the dental terminology of Tobien (1973, 1986), Tassy (1997), Göhlich (1998); for *Mammut* we follow Tobien (1997).

Institutional abbreviations: **CMNSC**, Câmpulung Muscel Municipal Museum, Natural Sciences; **MTC**, Țării Crișurilor Museum, Oradea.

RESULTS

Systematic paleontology

Order Proboscidea ILLIGER, 1811

Family Gomphotheriidae HAY, 1922

Anancus AYMARD, 1855

Anancus arvernensis (CROIZET & JOBERT, 1828) (Fig. 2. 1-3)

Locality: Capu Piscului, CMNSC 979.

Geological age: ? Late Pliocene (Romanian).

Measurements (mm). In table 1.

Description. An isolated right m2 documents this species. It originated from an adult specimen, still young. Only the crown is preserved. The roots are broken, result of the strong action of hydrotaphonomy: the water streams carried the tooth probably on a rather long distance before its definitive burial into the sediment. The molar outline in crown view is rectangular elongate, slightly arched outward in the mesial portion, typical for its position in the lower tooth row. It has four transverse lophids. As the cheek tooth has a typical anancoid pattern, with the posttrite cusps advanced forward in relation to the pretrite ones, the transverse lophids are directly influenced by this pattern. This degree of anancoidy is indicating an advanced bunodont mastodon (Tobien, 1973). The attrition acted heavily on all tubercles and erased them nearly to their bases, but the most advanced wear refers to the area of the protoconid and metaconid. According this wearing, obviously the tooth was ejected from the tooth row during the mastodon lifetime. Pressure marks can be noticed both mesial and distal. Cingulums can be observed on the buccal side and only as weak portions on the lingual one.

Discussion. This species is largely spread (Athanasiu, 1909; Barbu, 1930; Apostol, 1968; Macarovici, 1978; Simionescu, 1990; Feru et al., 1983; Rădulescu et al., 2003; Codrea & Diaconu, 2011) in the Pliocene deposits of the Dacian basin (Andreescu et al., 2011, 2013). In the Dacian locality Mălușteni (MN 15a, Late Dacian) from southern Moldavia (eastern region of the basin), *A. arvernensis* was recorded together with *M. borsoni* (Rădulescu et al., 2003). On the western side of the basin, the same situation can be noticed in Oltenia, in the Late Pliocene

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(Romanian) localities Covrigi or Groșerea (both, in MN 16a). In Cernătești (MN 16a), both mastodons share the same mammalian assemblage with the oldest European mammoth *Mammuthus rumanus* (ȘTEFĂNESCU, 1924). After the mammalian zone MN 16a, both mastodons went extinct in the Dacian basin, only mammoth being recorded.

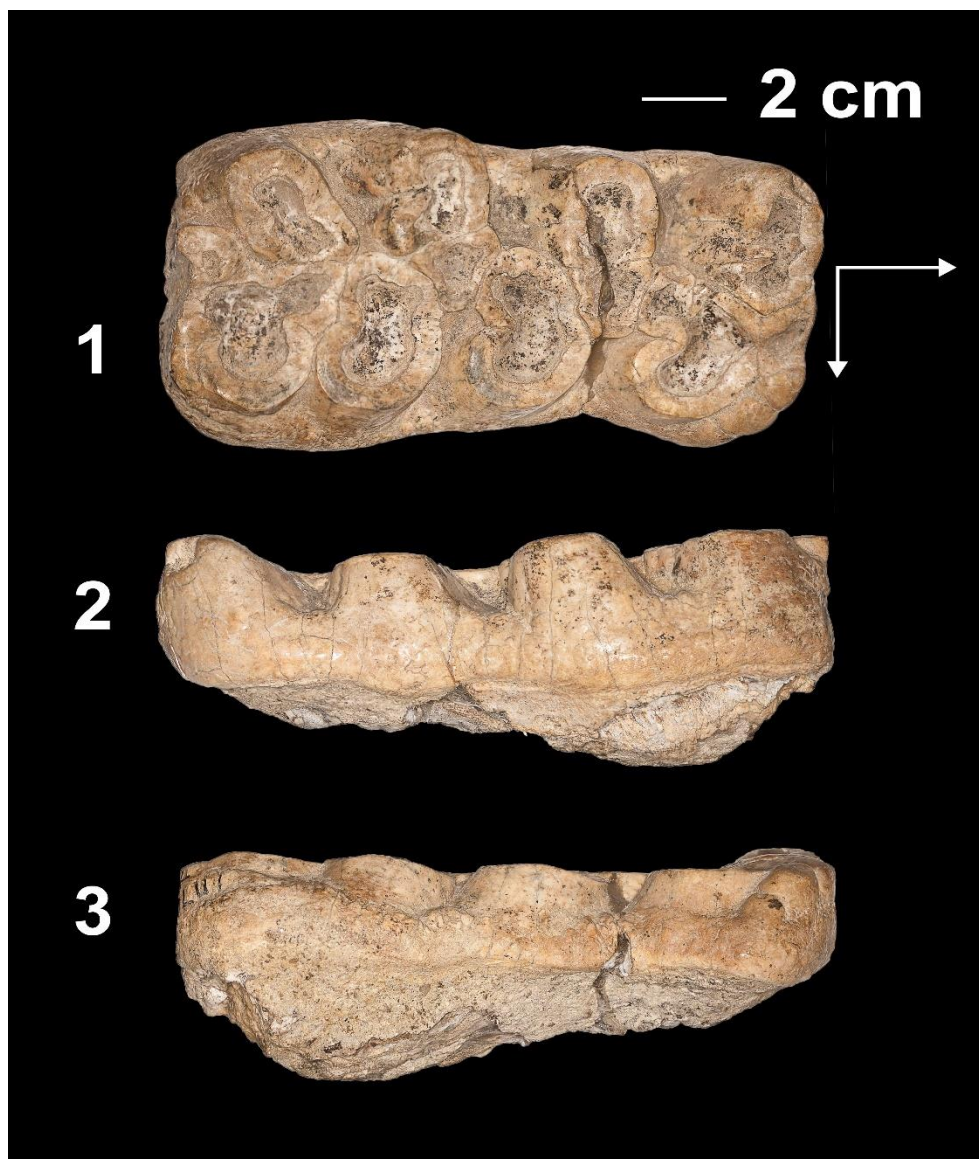


Figure 2 - *Anancus arvernenis*, Romanian, Capu Piscului, Argeș, CMNSC 979, right m2. 1- Crown view; 2 - Lingual view; 3 - Buccal view. Arrows indicate the mesial and buccal sides.

Table 1 - Comparative measurements (mm) of the mastodon tooth from Capu Piscului and some other comparable finds in Romania.

<i>Anancus arvernensis</i> m2 dext.	Capu Piscului, Argeş	Huta Păgaia, Bihor ¹	Oradea, Dealul Viilor, Bihor ²	Ceptura, Prahova ^{3*}	Zăvelceşti, Gorj ⁴	Hurezani, Gorj ^{5**}	Tigveni, Argeş ⁶	Ghidfalău, Covasna ⁷	Brădeţu, Gorj ⁸	Fântâna Domnească, Mehedinţi ⁹
Crown length	149	136	140	163	146	141	-	142.5	ca. 140	-
Width of the first transverse ridge	80.7	-	-	-	-	-	-	81	-	-
Width of the second transverse ridge	81	77	80	54	70	65	-	-	-	-
Width of the third transverse ridge	70	-	-	-	-	-	-	-	ca. 73	70.5
Width of the fourth transverse ridge	75	-	-	67	78	70	70	-	-	70

Legend: 1. Jurcsák & Popa, 1977, Pannonian *s.l.*; 2. Jurcsák, 1973, "Villafranchian"; 3. Athanasiu, 1909, "middle Pliocene", i. e. Dacian, * - measured at the crown base, the crown was missing; 4. Ibidem, Pliocene, "from levantine beds or from *Vivipara bifarcinata* beds from the upper part of the Dacian"; former Pojaru de Sus locality; 5. Ibidem, "Orezaui de Jos", in fact on the road connecting Vladimir and Hurezani; probably Romanian; 6. Ibidem, devoid of sharp stratigraphy; 7. Radulesco et al., 1965, "Villafranchien"; 8. Feru et al., 1965, on Sănişlăva Creek, Motru-Jiu Formation, early Romanian ("under the XIII coal seam"); 9. Codrea & Diaconu, 2011; Romanian.

A similar situation may be noticed in Bârsei basin (southeastern Transylvania), but there is no locality documenting the coexistence of mastodons with the archaic mammoth. It is interesting to note that a damaged tooth was found in the locality Ghidfalău (Covasna County; Radulesco et al., 1965; Macarovici, 1978), but visibly this discovery remained as an isolated one, since no other subsequent reference resumed this find. According these paleontologists, the age of the rocks the tooth originated from is "Villafranchian". In later references (e.g. Rădulescu & Samson, 1985), Ghidfalău became a reference locality (Ghidfalău-1 and Ghidfalău-2) in the Sfântu Gheorghe sub-basin of Bârsei basin, but for Mindel/Elster age. In this context, in order to avoid any confusion, the mastodon find should be regarded just as an isolate record there, from older deposits than the Mindel/Elster glacial.

Apart these regions *A. arvernensis* was noticed in several localities situated westward from the Apuseni Mountains (Jurcsák, 1973; Codrea & Iuga, 2006), but in the majority of situations the finds refer only to isolate teeth and bones. Exceptions concern two fragmentary skeletons found in Oradea (Bihor County;

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Jurcsák, 1973) or Huta (Bihor County; Jurcsák & Popa, 1977), both in a bad state of preservation. However, in both localities m2 are available and allowed direct comparisons with the tooth from Capu Piscului (Tab. 1, Fig. 3). The most valuable find from stratigraphical viewpoint originates from Derșida (Sălaj County, Șimleu sub-basin of the Pannonian basin). The mastodon remains from this locality document an uppermost Late Miocene (Pontian) representative, from the unit MN 13 (Jurcsák, 1973, 1983; Codrea et al., 2002).

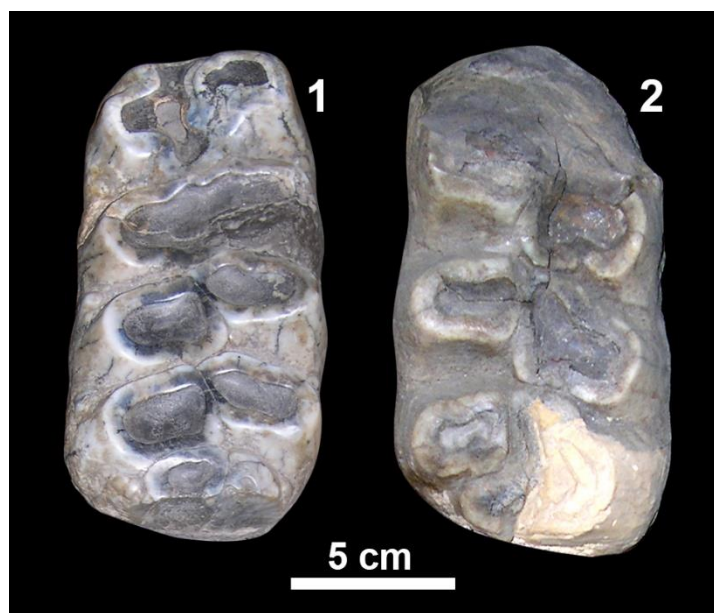


Figure 3 - *Anancus arvernensis*, Pliocene, m2. 1 - Huta Bihor, MTC 8927; 2 - Oradea Bihor, MTC 5290. Crown views.

For instance, in none region of Romania there were not coined evolutionary stages for these both mastodon species, i.e. diagnostic morphologic characters allowing clear assignations to archaic or evolved forms. However, the data available allow some observations concerning the anancoidy of m2 as marker of evolutionary stages of *A. arvernensis* in Romania. In Derșida on Peșterii Creek (Jurcsák, 1973), the m2 is missing in the repertory of discoveries, therefore we cannot make any direct comparison, although a such one would be interesting and useful, as long as it concerns an uppermost Miocene representative. The tooth form Capu Piscului exposes similar degree of anancoidy with the mastodon from Huta, but seems to be more evolved compared with the one from Oradea. This last one is damaged mostly in the mesial portion of the tooth rendering an incomplete anterior transverse ridge, but offers better details on the second and third ridges. The stratigraphy of Huta locality is poor, but Jurcsák & Popa (1977) estimates that the mastodon unearthed there would refers to "an evolved form of *Anancus* (*Mastodon*) *arvernensis* (CROIZET & JOBERT, 1828) from a female specimen, with

numerous pathologic deformations” (p. 92), avoiding to specify a clear geological age for the sedimentary deposits where the fossil originated from. In Oradea, the paleontological finds from Dealul Viilor (Tóth, 1895) could be more indicative, as long as Kretzoi (1982) mentioned some fossil vertebrate older finds including: *Hipparion* sp., *Procapreolus* sp., *Procapra* sp., Tragocerinae indet., Muntiacinae indet. Assigned to ”Baltávarium, probably bértaltavárium”, i.e. uppermost Pannonian *s.l.* or lowermost Pliocene (”lower Levant” ”*Unio wetzleri*”; Kretzoi, 1982, p. 387). This fauna resembles closely the one from Derşida, where *Hipparion* is well represented beside *Procapreolus* sp. (Codrea et al., 2002). A level with ”*Unio wetzleri*” is also known from this locality (Maxim & Ghiurcă, 1960, 1963, 1964). Therefore, if the sands from Oradea would be rather coeval with the deposits from Derşida (where apart the mastodon, the large sized deinother *Deinotherium proavum* EICHWALD, 1831; Codrea et al., 2016, was discovered too, as argument for an uppermost Miocene age of those rocks), one may consider the specimen as belonging to a basal representative and the difference in anancoidy degree would be logical. In such circumstances, the mastodons from Huta and Capu Piscului could represent more evolved forms compared with the ones from Oradea, the Romanian age for the rocks from Capu Piscului being credible.

Although, we mention that there is no mounted skeleton in Romania of any of these two mentioned mastodon species. The most complete find concerns the so-called ”Racoş mastodon”, a nearly complete *A. arvernensis* skeleton from Baraolt sub-basin (Toth et al., 2010; Codrea et al., 2018).

Family Mammutidae HAY, 1922

Genus *Mammut* BLUMENBACH, 1799

Mammut borsoni HAYS, 1834 (Fig. 4. 1-3)

Locality: Aninoasa, CMNSC 119.

Geological age: Early Pliocene (Dacian).

Measurements (mm). In table 2.

Description. A single isolate right M2 was found in the microconglomerates and sandstone from Aninoasa. This upper cheek tooth shares a lot of common features with the one described by Codrea & Diaconu (2007) from Husnicioara, in the westernmost sector of the Dacian basin. But in Aninoasa, the attrition wearing is by far, much advanced. The preservation is fair, but in the mesial-lingual portion the last inner half ridge, as well as the distal cingulum are damaged, with the enamel broken.

The tooth has three transverse ridges. As the median sulcus is not obstructed by any cusp, it runs on the whole length of the crown, on mesial-distal direction. In this manner, each transverse ridge is divided into a couple of distinct half-ridges. The attrition acted on all the cusps, the more advanced wear being in the first transverse ridge, on protocone and paracone areas, decreasing distally both on the pretrite and posttrite portions. In this manner, several details cannot be observed, as the conelets. On the pretrite part, the attrition wear united the protocone, the antecrescentoid, the postcrescentoid and the conelets. Same stage

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concerns the hypocone and metacone on the second transverse ridge, and is similar on the third ridge too. A strong pressure mark is on the anterior cingulum; on the distal cingulum it is less evident as this part is damaged. Lateral cingulums are present, both buccally and lingually. One can conclude that this tooth was ejected from the buccal cavity of the mastodon during its lifetime, at mature stage.

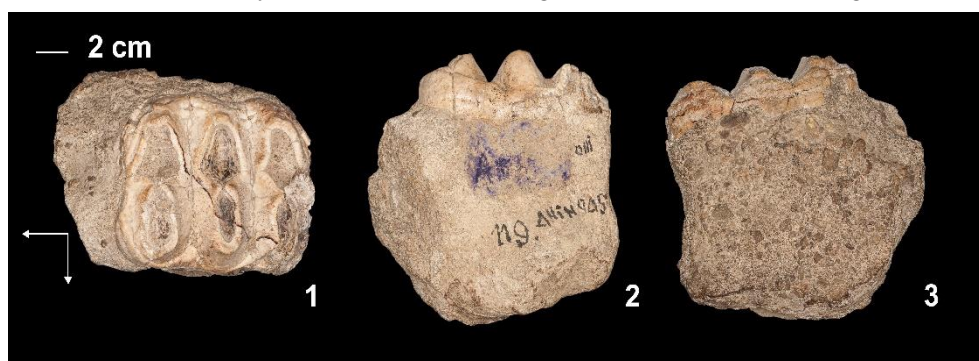


Figure 4 - *Mammut borsoni*, Dacian, Aninoasa, Argeș, CMNSC 119, right M2. 1 - Crown view; 2 - Buccal view; 3 - Lingual view. Arrows indicate the mesial and buccal sides.

Table 2 - Comparative measurements (mm) of the mastodon tooth from Aninoasa and some other comparable finds in Romania.

<i>Mammut borsoni</i>	Aninoasa, Argeș	Husnicioara, Mehedinți ¹	Budești, Vâlcea ²	Sălcuța, Dolj ³
Length	116.5	118.5	114	120
Width 1 st transverse ridge	90.2	87	82	-
Width 2 nd transverse ridge	91	91	85	90
Width 3 rd transverse ridge	87	93	83	-

Legend: 1. Codrea & Diaconu, 2007, Dacian; 2. Athanasu (1908), on Simnicu Creek, in the Upper "Pontian"; 3. Ibidem, in "Levantine beds".

Discussion. *Mammut* is a genus occurred since the late Miocene (MN 12), as the discoveries from Northern China document. The basal most representatives of this genus seem to share common features with Choerolophodontidae, having therefore a common ancient ancestor among the basal Elephantida (Wang et al., 2017).

Since the discovery of the mastodon tooth from Husnicioara, very few data can be added in Romania about the Borson's mastodon (Codrea & Diaconu, 2007 and references therein). A tooth was also reported in Hurducești (Mehedinți County) by Codrea & Diaconu (2010), but as it concerns an old find, it brings nearly nothing new about the stratigraphy of the Pliocene in the Dacian basin. The find refers to a tooth reworked into the actual alluvia of the Hușnița Valley, a river incising various Pliocene and Pleistocene rocks. In such circumstances, it is hard to coin in our country evolutionary tendencies for this species.

A comparison between sizes, shows that the tooth from Aninoasa share nearly the same ones with the tooth from Husnicioara, probably because of the same geological age of the specimens, both Dacian. The Table 2 illustrates that the metric data for M2 in Romania are still too scarce. However, if the locality Budești is really a Pontian locality (but in our opinion based on the data issued on the geological map 1:200,000, folio 34 Pitești (Murgeanu et al., 1967), this age could be difficult to support in this area) and Sălcuța a Romanian one, one may think about an increasing size trend of this species, from older geological ages to the younger ones, at least for the time span Dacian-Pontian. But, there are extremely few data either about the early representatives of this lineage (see data about *M. praetypicum* (SCHLEZINGER, 1919) from Păgaia in Codrea et al., 2005), or the extinction of this species in Romania, and other details could be added only if late representatives originating from localities well dated from stratigraphical viewpoint will be discovered.

In such circumstances, the stratigraphy of this species in Romania do not break the rule already coined in the whole Central and Eastern Europe regions, this mastodon being a rather common presence in the mammalian communities since the uppermost Miocene, until the early Pleistocene (Göhlich, 1999).

CONCLUDING REMARKS

The mastodon teeth from Câmpulung Museum collection are, like in numerous other collections in our country just isolate finds, happened decades ago. In such situations it is difficult, even impossible to recover data on the exact stratigraphic level of provenance and implicitly, on taphonomy or sedimentology of the deposits of origin. The rock matrix still adherent to the teeth we described can offer some indications, but not very rich. In these circumstances, the mastodon remains from this collection can just enlarge the list of localities in our country where these species originated from. We want underline the remarkable potential of Argeș County for such discoveries, pointing out that all are important for a better knowledge about the vertebrate paleontology in our country. If such a new find will occurs, it is essential that professional paleontologists know as soon as possible about it and weigh in with their knowledge. Otherwise, as time is running, the scientific value of these finds is lowering and a lot of data are lost.

Last but not least, the value of these specimens for the local museums like the one of Câmpulung remains is important: people interested about Earth evolution can find in such evidence a key for better understanding the Earth history, in this case about the geological time that preceded the Ice Age, as well as for the regional geology.

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