ADDITIONAL PROBOSCIDEAN FOSSILS FROM MAVRODIN (TELEORMAN COUNTY, ROMANIA)

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Abstract. This paper describes proboscidean fossil remains (partial mandibles, isolated molars) recently discovered in the Pleistocene deposits from Mavrodin (Teleorman County). Based on dentition characters, the remains have been assigned to *Mammuthus meridionalis* and *M. trogontherii*, mammoth species previously reported from the same locality. The age of death of the animals has also been estimated, when the preservation state of the material allowed it. The microscopic study of the enamel is in agreement with the taxonomic assignment based on the morphological parameters, also allowing the assessment of more fragmentary material. The evolution stage of the specimens belonging to each species has been discussed preliminarily.

Keywords: Mammoths, Pleistocene, Southern Romania, *Mammuthus meridionalis*, *M. trogontherii*.

Rezumat. Noi resturi de proboscidieni de la Mavrodin (judeţul Teleorman, România). Această lucrare descrie resturile fosile de proboscidieni (mandibule parţiale, molari izolaţi) descoperite recent în depozitele pleistocene de la Mavrodin (judeţul Teleorman). Pe baza caracterelor dentiţiei, resturile au fost atribuite la *Mammuthus meridionalis* şi *M. trogontherii*, specii de mamuţi menţionate şi anterior din aceeaşi localitate. Vârsta morţii animalelor a fost de asemenea estimată, atunci când starea de conservare a materialului a permis-o. Studiul microscopic al emailului este în concordanţă cu determinarea taxonomică făcută pe baza parametrilor morfologici, permiţând şi determinarea materialului fragmentar. Stadiul evolutiv al specimenelor aparţinând fiecărei specii a fost discutat în mod preliminar.

Cuvinte cheie: mamuţi, Pleistocen, sudul României, *Mammuthus meridionalis*, *M. trogontherii*.

INTRODUCTION

The village of Mavrodin is located in the central area of Teleorman County, about 10 km northwest from Alexandria (44°01'43"N, 25°14'07"E). From the geomorphologic point of view, the locality belongs to the Găvanu-Burdea Plain, a subunit of the Romanian Plain, with a relatively flat relief in this sector, interrupted only by small creeks or by the terraces of a few rivers. The inhabited area of the village is crossed, from north to south by Câinelui Creek, which flows into the Vedea, the main river in this area, just south of the village. The area is covered by fertile soil, extensively used in agriculture, the only outcrops occurring along the two main valleys mentioned above, and along the banks of Tinoasa Creek, a small tributary of Câinelui Creek.

The sedimentary deposits covering the Moesian Platform are around 2,500 meters thick, and belong to four cycles (Permian-Triassic, Middle Jurassic-Barremian, Albian-"Senonian", Miocene-Holocene) (BANDRABUR *et al.*, 1967). The only deposits cropping out in Mavrodin area belong to the last cycle, namely to the Pleistocene. The Lower Pleistocene deposits consist of a basal subunit, the Cândeşti Formation, reported from boreholes from the northeastern part of the Moesian Platform, covered by the Frăteşti Formation, cropping out along the main valleys that cross the Romanian Plain (for the definition of the Cândeşti and Frăteşti Formations, as well as the Plio-Pleistocene stratigraphic units of the Dacian Basin, see ANDREESCU *et al.*, *in press*). The latter unit is represented by a succession of gravels covered by fine or coarse sand beds and it is better exposed further east, in Giurgiu County, where it has yielded numerous remains assigned by APOSTOL (1974) to "*Archidiskodon meridionalis"* (NESTI, 1825). In the interfluvial area between the Vedea and Teleorman rivers, the Lower Pleistocene Frăteşti Formation is 15-25 m thick, and is covered by a thinner Middle Pleistocene succession (1-4 meters of marls, clays and sands) capped by Middle-Upper Pleistocene loessoid deposits 10-20 m thick. The deposits presented above as forming the Pleistocene succession of the plain between the Vedea and the Teleorman have been cut by the Vedea River, whose terrace deposits accumulated during the Middle and Late Pleistocene and are represented by gravels and sands, capped by loess, the entire succession measuring from 9 to 12 meters (BANDRABUR *et al.*, 1967).

The only large mammal fossils described so far from Mavrodin have been found west of the inhabited area of the village, in the banks of Tinoasa Creek, near its junction with Câinelui Creek. The faunal assemblage described by APOSTOL & CACOVEANU (1980) included bovids, cervids, and the proboscideans "*A. meridionalis"* and "*Mammuthus chosaricus"* (DUBROVO, 1966). The two taxa will be referred to in this paper as belonging to the genus *Mammuthus*, following the chosen nomenclature mentioned below.

MATERIAL AND METHODS

The fossil material described here was collected along Câinelui Creek between 2005 and 2011 either by the authors, who found it scattered along the creek bed, or by the locals, when excavating for sand and gravel to use locally in construction. Even if some of the specimens accidentally discovered by the locals were found *in situ*, their precise stratigraphical position was not noted.

The deposits cropping out along the banks of Câinelui Creek consist of gravels and sands that show parallel, oblique and crossed bedding and are interrupted by thin layers of brown clay. The precise age of these deposits remains uncertain, but some other vertebrate remains belonging to equids, cervids and bovids (other than those mentioned above as being described by APOSTOL & CACOVEANU, 1980), found *in situ*, might offer more useful information in this respect, after their taxonomical assessment will be complete.

The proboscidean fossils are housed in Bucharest, at the University of Bucharest Laboratory of Paleontology (provisional working numbers preceded by MV) and at the Primary School no. 156 "The Great Martyr Saint George" (provisional numbers beginning with Sc.156).

Morphometric parameters have been measured according to MAGLIO (1973) – for the grinding teeth – and according to MASCHENKO (2002) – for the mandibles – using a digital calliper, and the measuring tape for the larger specimens.

The systematics and nomenclature follow LISTER (1996), emended by LISTER & VAN ESSEN (2003) and LISTER *et al*. (2005) by the separation of *M. rumanus* (ŞTEFĂNESCU, 1924) as the basalmost Eurasian representative of the *Mammuthus* phylogenetic line.

The nomenclature of grinding teeth follows SHOSHANI (1996) in naming deciduous premolars (dP) distinctly from the molars (M). For an alternative opinion see, for example, LAWS (1966). The upper teeth have their position written as superscript (e.g. M^{1-3}) and the lower teeth as subscript (e. g. dP_4, M_3).

The evolution of the three main layers of the molar enamel in the case of the Eurasian mammoth lineage could represent a useful diagnostic character for intrageneric systematics. During the transition from *M. rumanus* to *M. primigenius*, the relative thickness of the middle enamel layer increased, while the inner and outer layers were thinned (FERRETTI, 2003). Thin sections were prepared in order to analyze the microstructure of the specimens from Mavrodin with the following method: detached molar plates were sectioned horizontally (perpendicular to the occlusal-basal axis) with a circular diamond saw. The samples were then embedded in a low-viscosity two-component epoxy adhesive system (Araldit AY 103 with Hardener HY 956) diluted with one drop of ethanol for every 10 ml of the mixture to prevent further fragmentation. The samples were polished with wet aluminium oxide powder from coarser to finer (grit numbers 400, 800, and 1000) and then the polished surfaces were glued on glass slides using the above mentioned two component epoxy glue. The samples were thinned further to achieve the optimal expression of examined features. Photomicrographs of the sections were taken with a Nikon Eclipse E600 microscope using ×2 to ×40 objective lenses with trans-illumination. Glycerol was used between the objective and the section when viewed under magnifications above ×20.

Thickness measurements of the enamel layers were taken along a line perpendicular to the enamel-dentine junction (i.e. the boundary plane between dentine and enamel). As the thickness may vary locally along the enamel section, a minimum of 10 measurements was taken at different sites on each section, and then a mean value was calculated for each specimen.

The difference map shown on figure 3 d was made with a layer-based image-editing software (Adobe Photoshop).

RESULTS AND DISCUSSIONS

Class Mammalia LINNAEUS, 1758
Order Proboscidea ILLIGER, 1811
Family Elephantidae GRAY, 1821
Subfamily Elephantinae GRAY, 1821
Genus *Mammuthus* BROOKES, 1828
M. meridionalis NESTI, 1825

The material assigned to *M. meridionalis* consists in one juvenile partial mandible and two isolated partial molars.

The mandible (Sc.156/3, Figs. 1 a - c) preserves the mandibular body almost entirely. The anterior process of the symphysis is broken off, as are the lingual walls, posterior to the two grinding teeth. Both ascending rami are broken off. Both left and right deciduous teeth (dP_4) are in place. In buccal view (Fig. 1 a), the lower border of the corpus is concave, just posterior to the downward-pointing symphysis. The anterior border is almost vertical, with a slight concavity in its middle part. In anterior view (Fig 1 b), the mandible outline is V-shaped, showing a wide symphysis and a high pre-alveolar depth. In occlusal view (Fig. 1 c), the mandible appears to be wide and antero-posteriorly short. The dP_3 alveoli are not entirely resorbed. The dP_4 are in use, their entire occlusal surface, counting 8 plates each, being equally worn. Posterior to them, the lingual part of the corpus is broken, but the inner side of the buccal wall shows plate impressions from the M_1, which was fairly developed, yet not in use. The left dP_4 detaches from its socket, so all its parameters could be measured (Table 2). Measurements of the mandible are listed in Table 1.

The co-occurrence of dP_3 sockets anterior to dP_4s in full use and signs of a well developed yet not erupted M_1 is comparable to a state between age groups VI and VII described by LAWS (1966) for the extant African bush elephant, which gives an approximate age at death of 4-6 African elephant years for the juvenile mammoth whose mandible is described above. JACHMANN (1985, 1988) showed that LAWS' (1966) estimation of age based on the progression of teeth is not entirely precise, overestimating the age of young individuals distributed to age groups IX-XVIII. Since our specimen shows tooth progression outside this age group interval, the estimation based on LAWS (1966) remains plausible and does not fall under the age interval rightfully criticized by JACHMANN (1985, 1988). ROTH & SHOSHANI's (1988) evaluation of Indian elephant age based on the type of grinding teeth in use and the degree of wear, gives an approximate age at death of 5-6 Indian elephant years for the present juvenile mammoth.

The broken symphyseal process does not allow a gender determination of this individual using the data from AVERIANOV (1996) employed below for the more complete MV01, and, even for the fragmentary MV02.

A fragmentary molar (MV31) preserves the posteriormost four plates and one platelet (Figs. 2 a - b) of an M^3. The fragment is damaged, showing obvious signs of transport: the interplate cement is mostly eroded, and parts of enamel are broken off from the occlusal and lateral sides.

Sc.156/2 designates a partial left M_2 that preserves the posteriormost six plates and talon (Figs. 2 c - d). The plates are widely spaced by cement-filled intervals, and show advanced wear. The enamel forms a continuous loop for each of the anteriormost two plates preserved, dividing into three or four islets. Enamel is thicker on the posterior side of each plate (2.17-2.38 mm posteriorly compared to 2.3-3.3 mm anteriorly; see Table 2 for an average of all measurements). The cement intervals are 4-5 mm lower than the level of the plates.

M. meridionalis is a common occurrence in the Pleistocene deposits from the Romanian area located between the Carpathians and the Danube (e.g. APOSTOL, 1968, 1974b), reports from outside this area being rare and based on doubtful material (e. g. JURCSÁK, 1973; CZIER, 2002).

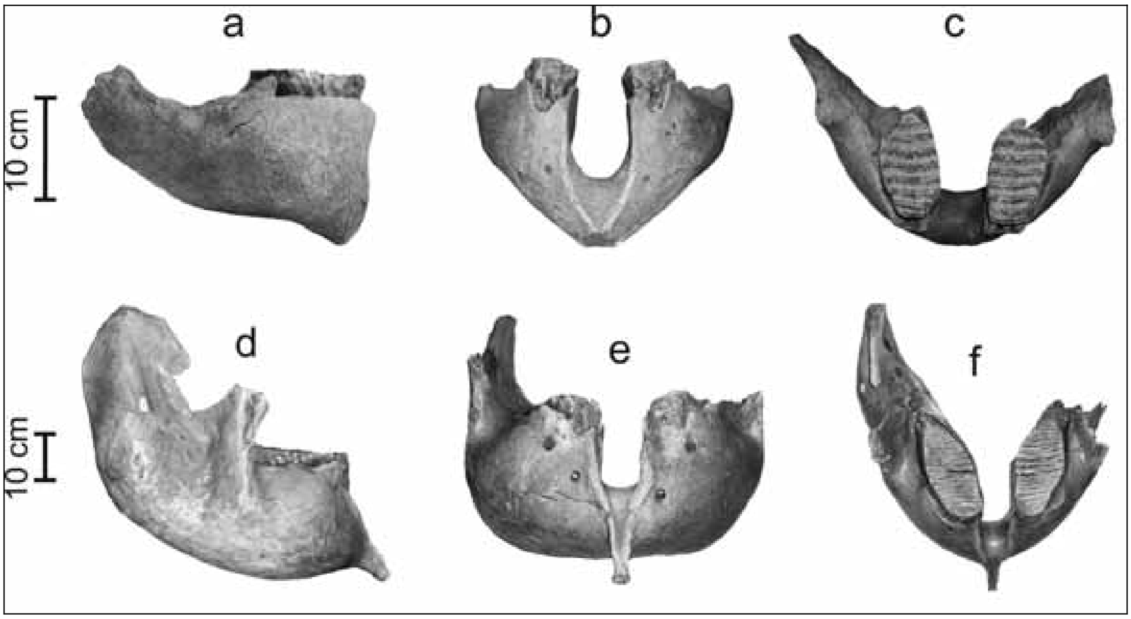

Figure 1. Proboscidean partial mandibles from Mavrodin. a - c. *M. meridionalis*, Sc.156/3, in right buccal, anterior, and occlusal views; d-f. *M. trogontherii*, MV01, in right buccal, anterior, and occlusal views.
Figura 1. Mandibule parţiale de proboscidieni de la Mavrodin. a - c. *M. meridionalis*, Sc.156/3, în vedere bucală dreaptă, anterioară şi oclusală; d - f. *M. trogontherii*, MV01, în vedere bucală dreaptă, anterioară şi oclusală.

Table 1. Dimensions of mandibles (in mm) / Tabel 1. Dimensiunile mandibulelor (în mm).

Inventory number	Sc.156/3	MV01	MV02
Greatest length of the lower jaw	+230	+490	-
Height of the horizontal branch under a functional tooth	101	260	-
Length of interalveolar crest	-	220	+245
Greatest width of horizontal branches	+288	667	-
Symphysis length	76	166	195
Greatest symphysis width	55	56	68
Distance between the horizontal branches at the level of anterior edge of alveoli of functional teeth	88	130	-
Distance between the horizontal branches at the level of anterior edge of alveoli of functional teeth	112	265	-

MAGLIO (1973) tentatively splits the *M. meridionalis* recorded from western and southern Europe into three stages of evolution, from the more primitive state (with less plates, thicker enamel and lower lamellar frequency of M3s) assigned to the "Laiatico Stage"; to the typical *M. meridionalis* as described by NESTI (1825), assigned to the "Montevarchi Stage" (originally misspelled "Montavarchi" by MAGLIO, 1973); and ending with the more evolved state, the transitional form to *M. trogontherii* (with more plates, thinner enamel and higher lamellar frequency of M3s), assigned to the "Bacton Stage". A similar distinction between different stages of evolution of *M. meridionalis* has been proposed based on the material found and described from Eastern Europe. Different subspecies of "*Archidiskodon*" *meridionalis* have been designated to describe up to four stages of evolution of the genus: "*A. m. rumanus*", "*A. m. gromovi*", "*A. m. meridionalis*" and "*A. m. tamanensis*" (for a review see BAYGUSHEVA & TITOV, 2001; or DUBROVO, 1977 for a different opinion). Clarifying the validity of different genera or subspecies is beyond the purpose of this paper. Although the preferred nomenclature (use of *Mammuthus* over *Archidiskodon*) was stated in the previous section, and although we consider the separation of subspecies not fully supported yet, reference to subspecies of "*A. meridionalis*" is made in the present text in order to facilitate comparison with Eastern European material, whereby the terms used by researchers of this area are employed. The separation of *M. meridionalis* into stages of evolution is mostly based on the morphometric analysis of M3 parameters. Therefore the only specimens from Mavrodin that can be analysed in this respect are the fragmentary M^3 (MV31) described above, and the M^3 described by APOSTOL & CACOVEANU (1980). Compared to the data sets and graphs plotted by DUBROVO (1977), LISTER (1996), and BAYGUSHEVA & TITOV (2012), the two molars fall within the limits of the typical *M. meridionalis* ("Montevarchi Stage"), the fragmentary M^3 (MV31) showing affinities towards the more basal form ("*A. m. gromovi*"). This assignment is, however, only tentative, given the low number of available samples, the fragmentary character of MV31, or the fact that the specimen from APOSTOL & CACOVEANU (1980) has only been analysed based on indirect measurements, its whereabouts being so far unknown to the authors.

Mammuthus trogontherii POHLIG, 1888

One partial mandible, one broken symphysis, and two partial isolated molars have been assigned to *M. trogontherii*.

The best preserved specimen recovered so far from Mavrodin is represented by an almost complete mandible (MV01, Fig. 1. d.-f.), which only misses the left ramus and the condylar part of the right one. The thin rostral part of the right ramus is also partially broken, in the area of the masseteric fossa.

In buccal view, the corpus appears as massive, especially in its rostral part (Fig. 1. d). The ventral border of the corpus is dorsally curved and forms a rounded mandibular angle. The ramus is anteroposteriorly wide, thicker caudally but thinning rostrally in the area of the wide and shallow masseteric fossa. The angle between the mandibular corpus and ramus is acute. In anterior view the ventral and lateral borders of the mandible give it a wide U-shaped outline (Fig. 1. e). The symphyseal process (rostrum) is well developed. In occlusal view, the two very well preserved M_3s can be seen in place (Fig. 1. f). No remaining sockets of previous teeth can be seen in front of the molars. The occlusal surface is moderately worn, the cement between the plates being worn only to a slightly lower level than that of the enamel crests, except for the area around mid-length, where the cement is extremely worn, especially on the lingual sides, where it was reduced to a level 15-20 mm below the enamel crest. The mesial and distal ends of the grinding surface are higher than the mid-length area, and give the occlusal surface a slightly concave outline, when seen in lateral view. On the left M_3 the grinding surface comprises 14 plates and the anterior talonid, while 16 plates and the talonid appear on its right counterpart. The mandibular body is broken posterior to the left M_3, so that five more plates and the posterior talon are exposed, none of which is in use. The parameters that could be measured on the molars (given their implanted state) are given in table 2. Mandible parameters are listed in table 1.

The sole presence of the M_3s, as well as their wear stage corresponds to age stage XXV as described by LAWS (1966), allowing the age of death to be estimated at around 47 African elephant years, outside the interval which according to JACHMANN (1985, 1988) presents significant errors. When compared to the scheme presented by ROTH & SHOSHANI (1988), the wear stage of the M_3s show that the steppe mammoth whose mandible is described here died around the age of 50 Indian elephant years. These estimations are supported by the data presented by ATHANASSIOU (2012), who estimated the age at death of the Loussiká mammoth to around 45 years, based not only on dental wear stage, but also on the stage of epiphyseal synostosis. Since the Loussiká *M. trogontherii* still had the posterior parts of its M_2s with the remaining three plates in wear, the mammoth described here was most probably older; hence the age of 47-50 years is considered a good approximation for the time of its death. A broken symphysis that entirely preserves the rostrum, has been tentatively assigned to *M. trogontherii* because its resemblance to the same portion of MV01. The size of the rostrum, as well as the greatest width of the symphysis, is significantly larger than in MV01. The data presented by AVERIANOV (1996) shows that a well developed symphyseal process is usually associated with the remains of male mammoths. Both MV01 and MV02 have a well developed rostrum and probably belonged to males. The larger size in MV02 accounts for a larger and probably older individual, given that male elephants (both living and fossil) are known to be larger than females, and to grow slowly through their entire life (AVERIANOV, 1996; HAYNES, 1993). The gender assessment based on the relative size of the rostrum is, however, doubtful, a thorough statistical analysis of the morphometric parameters of woolly mammoth mandibles giving inconclusive results when it comes to sexual dimorphism (ÁLVAREZ-LAO & MÉNDEZ, 2011).

MV55 designates an extremely high, hence upper molar that probably represents a left M^3 (Fig. 2 e-f). The grinding surface counts 15 plates, all in use, the posterior convergence of the lateral edges and the presence of enamel islets on the posteriormost preserved plate suggest that the molar only lacks two or three more plates. It is however possible that such wear figures, albeit more elongated, also occurred on the next four posterior preserved plates, but the buccal thirds of these plates are broken. The measured parameters (e.g. the lamellar frequency, enamel thickness) fall within the interval corresponding to the overlap between *M. trogontherii* and *M. primigenius*. The specimen has been assigned to *M. trogontherii* mostly based on the large size of the tooth. It is, however, not definitive that this specimen represents a highly evolved *M. trogontherii* or a primitive *M. primigenius*.

Another partial upper molar assigned to *M. trogontherii* (Sc.156/1) only preserves eight plates and the basal halves of two more plates, all from the posterior part of the possible right M_3 (Fig. 2. g-h). Only the anterior two of the complete plates show wear figures, and the posteriormost plates barely show initial wear.

Remains of the steppe mammoth in Romania are rare both inside (see CODREA, 2008 for a review) and outside (e.g. APOSTOL 1968, 1971, 1974a; SIMIONESCU, 1930) the Carpathian arch.

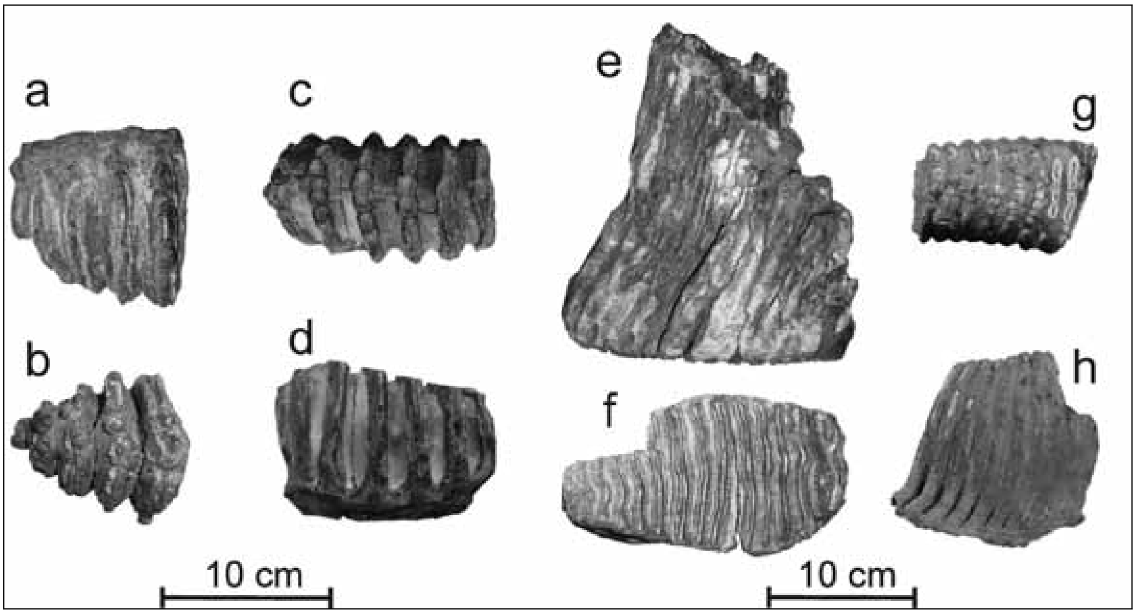

Figure 2. Isolated proboscidean molars from Mavrodin. *M. meridionalis*: a - b. MV31, M^3, in lateral and occlusal views; c - d. Sc.156/2, M_2 sin, in occlusal and lingual views. *M. trogontherii*: e - f. MV55, M^3 sin, in lingual and occlusal views; g - h. Sc.156/1, M_3 dex, in occlusal and buccal views. Posterior is to the left – images b and g have been flipped horizontally to fit this arrangement.
Figura 2. Molari izolaţi de proboscidieni de la Mavrodin. *M. meridionalis*: a - b. MV31, M^3, în vedere laterală şi oclusală; c - d. Sc.156/2, M_2 sin, în vedere oclusală şi linguală. *M. trogontherii*: e - f. MV55, M^3 sin, în vedere linguală şi oclusală; g - h. Sc.156/1, M_3 dex, în vedere oclusală şi bucală. Partea posterioară spre stânga imaginii - b şi g reprezintă imaginile în oglindă ale vederilor respective, pentru a se potrivi acestui aranjament.

Table 2. Dimensions of proboscidean teeth from Mavrodin / Tabel 2. Dimensiunile dinţilor de proboscidieni de la Mavrodin.

Taxon	Tooth type	Inventory number	L (mm)	H (mm)	W (mm)	HI (H/W)	P	LF (10P/L)	ET (mm)
M. meridionalis	dP_4 sin	Sc.156/3	104.33	62.14	56.46	1.1	8	7.66	1.46
	dP_4 dex	Sc.156/3	98.34	-	55.57	-	8	8.13	1.43
	M_2 sin	Sc.156/2	+127.84	92.5	79	1.17	+6, x	4.69	2.5
	M^3	MV31	+106.1	110.6	98	1.12	+4, x	4.69	3.9
	M^3 sin*	-*	257*	125*	120*	1.04*	14*	4-5*	3*
M. trogontherii	M_3 sin	MV01	320	-	105.07	-	19, x	6.46	2.31
	M_3 dex	MV01	+241.88	-	107.8	-	17+	7.03	2.91
	M^3 sin	MV55	+185	215	93.6	2.29	15+	8.1	1.9
	M_3 dex	Sc.156/1	+131	158	89	1.77	+10	7.63	2.28
	M^3 dex*	-*	243*	160*	100*	1.6*	18*	7*	3-4*

Legend: L – maximum length; H – maximum height; W – maximum width; HI – hypsodonty index; P – plate number; LF – lamellar frequency; ET – enamel thickness; + designates incomplete teeth; x – talonid or platelet. * - data taken from APOSTOL & CACOVEANU (1980).
Legendă: L – lungimea maximă; H – înălţimea maximă; W – lăţimea maximă; HI – indicele de hypsodontie; P – numărul de lofe; LF – frecvenţa lamelară; ET – grosimea emailului; + indică un dinte incomplet; x – talonid sau lofidă. * - date preluate din APOSTOL & CACOVEANU (1980).

As in *M. meridionalis*, and indeed, in all European species of *Mammuthus*, the transition from *M. trogontherii* to *M. primigenius* seems to have followed the same pattern, supposedly in steps, with the more advanced types evolving in the Oriental part of Eurasia (either China or Siberia), subsequently migrating westward to Europe, where it gradually replaced the more primitive forms (LISTER & SHER, 2001; LISTER *et al*., 2005). DUBROVO (1966) assigned the more advanced molars to a separate species, *M. chosaricus*, because of their smaller size, the increase in the number of plates and, hence, of the lamellar frequency, along with a decrease in enamel thickness. Subsequently, she considered that the differences between *M. trogontherii* and "*M. chosaricus*" are not that significant, and cannot sustain the separation of the later taxon as a different species, but rather as a subspecies, and names two *M. trogontherii* subspecies: the more primitive "*M. t. trogontherii*" and the more evolved "*M. t. chosaricus*" (DUBROVO, 1977). It is to this latter taxon that APOSTOL & CACOVEANU (1980, Fig. 16) assign one of the molars found along Tinoasa Creek. Other isolated molars from Romania have been assigned to this taxon, mainly based on their small size (GARRUT *fide* APOSTOL, 1968).

Comparing the measurements of the "*M. chosaricus*" from Mavrodin to the data presented by DUBROVO (1977), one can indeed consider that the size of the M^3 corresponds to that of the more evolved form, "*M. t. chosaricus*", but this conclusion is premature, since the number of plates, the lamellar frequency and the enamel thickness are well outside the limits of that form, fitting well within the limits of the typical "*M. t. trogontherii*". The M_3s from the MV01 mandible also seem to fit within the limits of the measurement interval of the typical *M. trogontherii*, even if they are close, in some respects (lamellar frequency, enamel thickness) to "*M. t. chosaricus*". The MV55 M^3 is, in its measured parameters, the closest to *M. primigenius*, to such degree that it might very well have belonged to a primitive representative of this species. The number of specimens is again two small to draw firm conclusions in respect to the primitive or evolved state of the *M. trogontherii* coming from Mavrodin, but the affinities towards a more evolved "*M. t. chosaricus*" stage are present.

According to FERRETTI (2003), the optic fibre effect of the enamel prisms (bundles of apatite crystallites) allows the rapid and coarse identification of the relatively large enamel portions under light microscopy. The innermost layer of the enamel adjacent to the enamel-dentine junction (EDJ) is irregular. The middle layer makes up almost 50-60 percent of the total enamel thickness. The outermost layer is marked by a sudden flattening of the inclination of the enamel prisms which become parallel to the occlusal plane. The latter change causes a slight difference in the optical properties of the aforementioned layer when viewed under crossed nicols. An additional thin prismless enamel layer is often visible near the outer enamel surface. The boundary plane between the enamel and cement (ECJ = enamel-cement junction) is wrinkled. The enamel can be seen to bulge along the ECJ.

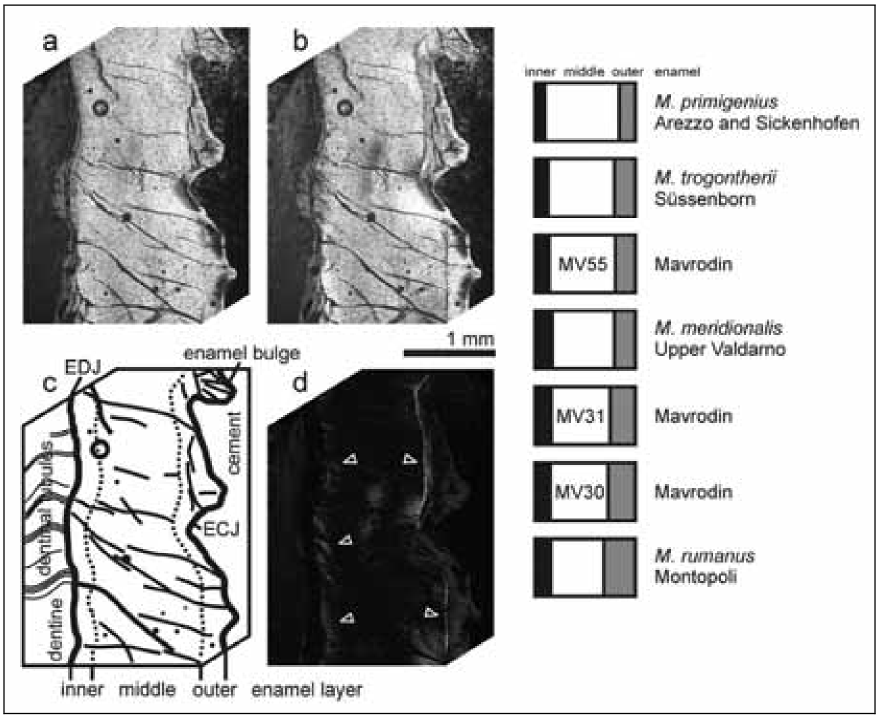

Figure 3. Horizontal section of the MV55 molar enamel (a: without crossed nicols, b: with crossed nicols) and the schematic representation of the depicted slice (c). Lighter tones on image d represent greater differences between image a and b. Abbreviations: EDJ = enamel-dentin junction, ECJ = enamel-cement junction. To the right: the enamel properties of the Mavrodin mammoths related to taxa from other localities. Data in addition are from FERRETTI (2003).

Figura 3. Secţiune orizontală prin emailul molarului MV55 (a: cu un singur nicol, b: cu nicoli încrucişaţi) şi reprezentarea schematic a secţiunii figurate (c). Tonurile mai deschise din imaginea d reprezintă diferenţe mai accentuate între imaginile a şi b. Abrevieri: EDJ = joncţiunea email-dentină. ECJ = joncţiunea email-ciment. În partea dreaptă: proprietăţile emailului mamuţior de la Mavrodin alături de taxoni din alte localităţi. Datele suplimentare din FERRETTI (2003).

Table 3. The enamel properties of the Mavrodin mammoths/ Tabelul 3.Proprietăţile emailului mamuţilor de la Mavrodin.

Specimen	Relative enamel thickness			ET (mm)
	inner enamel	middle enamel	outer enamel	
MV30	15	58	27	4.0
MV31	16	59	25	3.9
MV55	14	66	20	1.9

The above-mentioned layers are distinguishable in the case of the samples from the MV30, MV31 and MV55 specimens, although the enamel was poorly preserved and fragmented in the first two cases. The results are shown on figure 3 and summarized in Table 3. On the basis of the mean percentage thickness of the main layers relative to the whole enamel thickness, MV30 and MV31 belong to primitive *M. meridionalis*, while MV55 is most plausibly referable to *M. trogontherii*.

CONCLUSIONS

The morphometric parameters have shown that the proboscidean fossil remains from Mavrodin belong to two species: *M. meridionalis* and *M. trogontherii*. The abundant sample adds to the previously described one (APOSTOL & CACOVEANU, 1980), but the precise age of the fossil-bearing deposits is not thoroughly documented, so it is not clear if the two types of mammoth were contemporaneous.

Observations of the worn teeth present in the two partial mandibles, as well as their wear stages, allowed an estimation of the time of death for the two individuals, and documented the presence of a *M. meridionalis* juvenile and a fully grown, mature *M. trogontherii*. The features of the mandibles further suggest that two of the remains come from male steppe mammoths.

The preliminary data shows that the *M. meridionalis* M3s belong to the typical or even basal stage in the evolution of the species, whereas the *M. trogontherii* remains show an evolved stage, which dismisses the possibility that the fossil record samples a mixed population of the two species. It is not clear if *M. meridionalis* remains were reworked in the Middle Pleistocene, or if both *M. meridionalis* and *M. trogontherii* remains were reworked and re-deposited in the Upper Pleistocene terrace deposits. Further research (land mammal assemblage, palynology, freshwater mollusc assemblage, etc.) is needed in order to assess what stratigraphical levels have yielded the proboscidean remains. An increase of the sample, by the addition of more new material, as well as a revision of the material housed in the local museums (from Alexandria and Roşiorii de Vede), will make assessments of the evolutionary stages of the two species found at Mavrodin much more reliable and will show whether or not they occurred in this area simultaneously.

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