



Bulletin of the Mineral Research and Exploration

<http://bulletin.mta.gov.tr>



First Mammuthus (Elephantidae) findings from Samsun district (Türkiye)

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Research Article

Keywords:

Elephantidae,
Mammuthus Meridionalis,
Mammuthus Trogontherii,
Quaternary, Samsun.

ABSTRACT

Located between Africa, Asia and Europe, Anatolia is a crossroads for the migration of many mammals such as elephantids. For this reason, important fossils belonging to different species of elephantids were found from various localities. In this study, mammoth molars found in Samsun-Ladik were examined. As a result of the examination, *M. meridionalis* and *M. trogontherii* were identified for the first time from this region. Although the number of fossils examined is very small, the results obtained are very important as *Mammuthus* was identified for the first time from Samsun. When considered together with the *Mammuthus* species identified from Anatolia so far, the results obtained from Samsun will provide information about the distribution of the *Mammuthus* genus in Anatolia and the changes it has undergone.

Received Date: 03.07.2022

Accepted Date: 13.10.2022

1. Introduction

Anatolia, paleogeographically, has a very important position during the migration of the Elephantidae (elephants) between Africa, Asia and Europe. The genus *Mammuthus* of the Elephantidae family, which is one of the most important mammal families of the Quaternary period, draws a lot of attention due to the important changes it has shown in a short time against the climate and environmental changes that took place in the Quaternary period. From approximately 3 million years ago until the end of the Pleistocene, mammoths found in Eurasia underwent very significant changes including shortening and heightening of the cranium and mandible, increase in molar hypsodonty (HI), increase in plate number (P), and thinning of dental enamel. Based on these changes, European mammoths have conventionally been divided into three chronospecies: Early Pleistocene *M. meridionalis*, Middle Pleistocene *M. trogontherii*,

and Late Pleistocene *M. primigenius* (Maglio, 1973; Lister, 1996; Lister et al., 2005). However, after some studies in recent years, there have been discussions about earlier primitive mammoth species (Lister and Van Essen, 2003; Markov, 2012; Albayrak, 2017; Rabinovich and Lister, 2017).

Various studies have been made on *Mammuthus* fossils found in Turkey to date (Falconer, 1857; Şenyürek, 1960, 1961; Becker-Platen and Sickenberg, 1968; Sickenberg et al., 1975; Adam, 1988; Dayan, 1989; Mayda, 2002; Albayrak and Lister, 2012; Boulbes et al., 2014). The first of these studies was done by Falconer (1857). He identified the molars found in Erzurum as a new species, *Elephas armeniacus*, and due to the morphological similarity of these molars to *M. trogontherii* found in Europe, Maglio (1973) considered them to be synonyms and renamed the material from Europe as *M. armeniacus*. However, the validity of *E. (Mammuthus) armeniacus* as a species is

Citation Info: Albayrak, E. 2023. First Mammuthus (Elephantidae) findings from Samsun district (Türkiye). Bulletin of the Mineral Research and Exploration 172, 141-148. <https://doi.org/10.19111/bulletinofmre.1188761>

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controversial. Adam (1988) revealed that the samples were insufficient and that these molars were similar to the molars of the Asian elephant (*E. maximus*). For this reason, the fossils from Erzurum that are accepted as *Mammuthus* by some researchers and *Elephas* by others will not be discussed in this study.

The fossils examined in this study are those found in different old coal mines in Samsun-Ladik and delivered to museums mostly by local people. Although the localities where the fossils were found are not known exactly, the fact that the data of *Mammuthus* were obtained for the first time around Samsun provides very important data for the Quaternary fauna of Anatolia.

2. Locality

The fossils in this study were found in various places in the Ladik district of Samsun. Ladik is located in the south of Samsun city center, close to the provincial border of Amasya (Figure 1). Since the fossils in the study were found incidentally from the coal mines in that region, there is little information

about the exact locality and stratigraphic level. Although there are various studies on the geology of the region (such as Öztürk, 1979; Aktimur et al., 1992; Gültekin et al., 2011), there is not enough study on the Quaternary.

3. Materials and Methods

The specimens studied in this study are the fossils found in Samsun-Ladik by citizens and delivered to museums. Specimens 55LAD01 and 55LAD02 were delivered to the MTA Natural History Museum and the others were delivered to the Samsun Museum.

Terminology follows Maglio (1973). Upper molars are indicated by upper-case letters, lowers by lower-case. The small lamella in the anterior and posterior of the tooth and does not extend to the root of the tooth, unlike the lamellae, and therefore merges with the lamella behind or in front of it, is called the talon in the upper tooth and the talonid in the lower tooth and is expressed with an x. The small posterior element of a last molar (M3/m3) when extending to the base of the crown and thus not technically a talon is termed



Figure 1- Geographic position of Samsun-Ladik (modified from Google Earth).

platelet and abbreviated p. All measurements were taken according to Aguirre (1969), Maglio (1973) and Lister (1996). The number of missing lamellae as a result of fracture or wear in the anterior part has been estimated according to the condition of the anterior roots (Sher and Garutt, 1987).

4. Systematic Paleontology

Ordo : Proboscidea Illiger, 1811.

Family : Elephantidae Gray, 1821.

Genus : *Mammuthus*, Brookes, 1828.

Type species : *Mammuthus meridionalis* (Nesti, 1825).

Age: Early Pleistocene.

Material: Right upper M3 (55LAD01) (Figure 2a, b).

Description: The tooth is broken anteriorly. Since the roots are not visible in this part, it is not clear how many lamellae are missing. There is a small deficiency in the posterior part, but the shape of the posterior part is similar to that of M3. The measurements are given in Table 1. The tooth has 7 lamellae and posterior talon. Cementum is quite thick (11 mm). The lamella frequency is low (LF: 4.67). The enamel has the characteristics of *M. meridionalis*; thick and very few wrinkles towards the edges of the lamellae, slightly more wrinkled in the middle, anterior and posterior expansions of the enamel in the middle of the enamel loop, and almost equal enamel rings. Although the height cannot be measured precisely because all the lamellae are worn, it is seen that the tooth has a low crown. When the measurements of the tooth and the enamel structure are examined in detail, it is identified as *M. meridionalis*.

Ordo : Proboscidea Illiger, 1811.

Family : Elephantidae Gray, 1821.

Genus : *Mammuthus*, Brookes, 1828.

Type species : *Mammuthus meridionalis* (Nesti, 1825).

Age: Early Pleistocene

Material: Left upper M2 (55LAD03) (Figure 2c, d)

Description: The tooth has 7 lamellae and posterior talonids. The measurements are given in Table 1. It is broken anteriorly, but according to the shape and root structure of the tooth, approximately 2 lamellae are missing from the anterior which makes the number of the plates 9. The lamella frequency is low (LF: 4.81). The height could not be measured precisely because all the lamellas were worn. However, it can be said that the tooth has a low crown. Enamel has typical *M. meridionalis* features; anterior and posterior expansions of the enamel in the middle part, less enamel wrinkles towards the edges, a few prominent and large enamel folds in the middle and enamel thickness. According to the measurements and enamel structure, this tooth is identified as *M. meridionalis*.

Ordo : Proboscidea Illiger, 1811.

Family : Elephantidae Gray, 1821.

Genus : *Mammuthus*, Brookes, 1828.

Type species : *Mammuthus trogontherii* Pohlig, 1885.

Age: Middle Pleistocene.

Material: Right upper M3 (55LAD02) (Figure 2e, f).

Description: The tooth is broken anteriorly. However, according to the first roots, it is clear that two lamellae are missing. In this case, the tooth has 20 lamellae and a platelet. The measurements are given in Table 1. Cement is thin (5 mm). The fact that the tooth has a high crown (HI: 1.74) and a high lamella count (P: 20) indicates that this tooth may be *M.*

Table 1- Measurements of the molars of *Mammuthus* specimens from Samsun-Ladik. Measurements in round brackets are considered not to present original values due to wear. Measurements in square brackets are estimates of original values. LAD is for Ladik.

Specimen	Number of plates	Width	Height	Hypsodonty index	Lamellar frequency	Enamel thickness
55LAD01 (M3)	-7p	113.4	(130.3)	(1.15)	4.67	3.68
55LAD02 (M3)	-18p [20p]	108.4	188.8	1.74	6.83	2.68
55LAD03 (M2)	-7x [10]	103.9	(122.0)	(1.18)	4.81	3.2

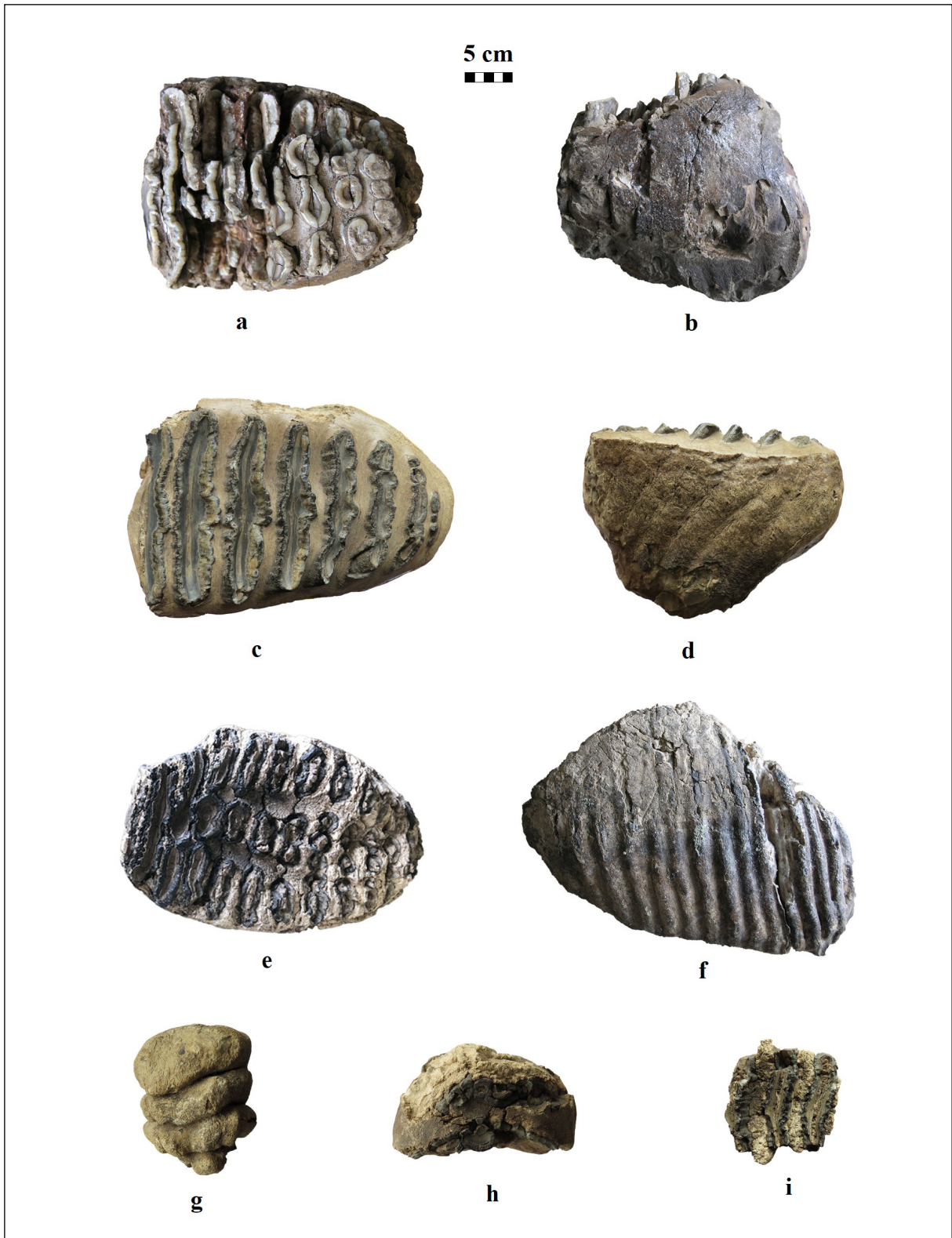


Figure 2- The molars examined in this study. 55LAD01, *Mammuthus meridionalis*, a) occlusal view, b) labial view (M3, right, MTA Natural History Museum); 55LAD03, *Mammuthus meridionalis*, c) occlusal view, d) labial view (M2, left, Samsun Museum); 55LAD02, *Mammuthus trogontherii*, e) occlusal view, f) lingual view, (M3, right, MTA Natural History Museum); 55LAD04, g) occlusal view (fragment of a molar, Samsun Museum); 55LAD05, h) occlusal view (fragment of a molar, Samsun Museum); 55LAD06, cf. *Mammuthus*, i) occlusal view (fragment of an upper molar, Samsun Museum).

trogontherii. The lamella frequency is high (LF: 6.83). The less worn lamellae have subequal enamel rings and anterior and posterior expansions in the middle part. The enamel is thinner and has more wrinkles in the middle of the lamellae, while there is less wrinkles towards the edges. Except for the wrinkles, there is no obvious fold in the middle. When the measurements and the structure of the enamel are examined, this tooth is identified as *M. trogontherii*.

Ordo : Proboscidea Illiger, 1811.

Family : Elephantidae Gray, 1821.

Material: Fragments of upper molars (55LAD04, 55LAD05).

Description: 55LAD04 (Figure 2g) has last 3 posterior lamellae and probably is the upper M1. No lamella has been worn, so the tooth is not sufficient for any diagnosis. 55LAD05 (Figure 2h), consisting of 2 posterior lamellae and posterior talon, probably belongs to the upper M1. Seen from the occlusal surface, the worn lamellae show several subequal enamel rings, generally seen in *Mammuthus*. However, it is not possible to make a diagnosis because there are very few lamellae of the tooth and their measurements could not be taken.

Ordo : Proboscidea Illiger, 1811.

Family : Elephantidae Gray, 1821.

Genus: cf. *Mammuthus*, Brookes, 1828.

Material: Fragment of upper molar (55LAD06) (Figure 2i).

Description: It consists of 3 lamellae from the middle part of probably the upper molar. The lingual and labial parts are worn. The way the enamel is wrinkled and worn resembles that of *Mammuthus*. While the enamel wrinkle is less at the lingual and

labial sides, it increases towards the middle, and there is an anterior and posterior expansion in the middle of the enamel loop, and there are few enamel folds where this expansion occurs. Necessary measurements could not be taken because most of the tooth is missing. Therefore, a definitive diagnosis has not been made, but according to the enamel structure, it is thought to be *Mammuthus* sp.

5. Discussion

In this study, mammoth molars found in old coal mines were examined. Although there are few fossils, some of which consist of only tooth fragments, it is very important because it is the first data from the Quaternary period from Samsun.

M. meridionalis has been identified from several localities in Anatolia so far (Table 2). Among them, *M. meridionalis* identified from Eskişehir-Yukarısöğütönü has primitive features. Especially the lamella number (x11p) and lamella frequency (3.93) of m3 (no: 1853) is quite low for typical *M. meridionalis*. Therefore, these fossils were identified as primitive *M. meridionalis*, morphologically between *M. rumanus* and *M. meridionalis*, as an early mammoth (Albayrak and Lister, 2012; Albayrak, 2017). According to the revised biochronological zonation of the continental Neogene of Europe and Western Asia, the faunal composition at Yukarısöğütönü is Villanyian, MN17, approximately 2.2-1.8 Ma. (De Bruijn et al., 1992). M2 (2221B), identified from Konya-Zengen, has typical *M. meridionalis* features. However, the other two incomplete m3s have low lamella frequency and lamella number, similar to the Yukarısöğütönü fossils (Albayrak and Lister, 2012). Although the number of fossils found in Zengen is low, *M. meridionalis* specimens from Zengen can be considered at a close evolutionary level with those from Yukarısöğütönü.

Table 2- Comparative measurements for M3 of *M. meridionalis* from Turkey and Maglio (1973). a) Mayda, 2002, b) Albayrak and Lister, 2012, c) Boulbes et al., 2014. The measurements given by Maglio (1973) are the average of the measurements of M3s found from various localities belonging to *M. meridionalis*. Measurements in round brackets are considered not to present original values due to wear.

Specimen	Number of plates	Width	Height	Hypsodonty index	Lamellar frequency	Enamel thickness
55LAD01 (M3)	-7p	113.4	(130.3)	(1.15)	4.67	3.68
2306 (M3) ^a	x12p	119.5	134.1	1.2	3.93	3.67
MTA2 ^b	-8.5x	96.5	(117.0)	(1.21)	5.0	3.3
PV-1469 ^c	-9	(107.0)	-	-	4.5	3.8
Maglio (1973)	12.8	104.8	122.7	1.25	4.9	3.3

Mayda (2002) identified the molar tooth found from Aşağıçobanisa (west of Turkey) (Early-Middle Pleistocene, MNQ 19-20) as *M. meridionalis*. This specimen has a higher lamellar frequency and thinner enamel than the Yukarısöğütözü and Zengen specimens (Table 2, MTA2). Boulbes et al. (2014) suggested that the large mammal assemblage, including *Archidiskodon meridionalis meridionalis*, identified in the Denizli Basin (southwest of Turkey), is similar to the Southern and Western European Late Villafranchian and may be older than 1.2 Ma. *M. meridionalis* identified here has typical *meridionalis* features (Table 2, PV-1469).

The number of plates, hypsodonty index, lamella frequency and enamel thickness of 55LAD01 examined in this study were similar to those found in localities other than Yukarısöğütözü. It is also consistent with the measurements given by Maglio (1973) for the typical *meridionalis*.

55LAD03 has slightly more primitive features than *M. meridionalis* M2 (2221B) found from Konya-Zengen and typical *M. meridionalis* for which Maglio (1973) gives the average of its measurements (Table 3). Although the number of plates is not very low, the lamellar frequency is slightly lower and the enamel is a little thicker. With such a small number of specimens, Early Pleistocene can be considered for the age of *M. meridionalis* specimens found in Ladik.

M. trogontherii has been identified from three localities in Anatolia so far: Erzurum-Pasinler, Amasya-Suluova and Konya-Dursunlu. Since M3 is not among the specimens from Pasinler, it was not used for comparison in this study. M3 identified from Suluova, with its high crown (HI: 1.68), high lamella count (x19p) (Table 4) and enamel wear pattern on the

occlusal face fall within the limits of *M. trogontherii*. The tooth from the Eski Çeltik Coal Mine in Suluova was found from the Pleistocene layer overlying the Eocene aged layer. According to the latest studies in this region, the age of *M. trogontherii* found in Suluova is dated to approximately 1 mya (Erturaç et al., 2019).

Dursunlu, another locality where *M. trogontherii* was identified, is an interesting locality with its *Mammuthus* specimens. According to palaeomagnetic analysis, the minimum age is 780.000 years. Studies on micromammals indicate, from the presence of *Allophaiomys nutiensis*, that the fauna of Dursunlu can be correlated with Lower Biharian faunas of Les Valerots (France) and Monte Peglia (Italy) which are considered to be about 900.000 years old (Güleç, 1996; Güleç et al., 1997). Transitional populations between *M. meridionalis* and *M. trogontherii* are seen between 1.0-0.7 Ma in many localities in Europe (Lister et al., 2005; Lister and Stuart, 2010). M3 (42-DUR-1-41) (Table 4) and m3 (42-DUR-1-40) found in Dursunlu were identified as *M. trogontherii*. On the other hand, dp4 (42-DUR-1-29) is similar to *M. meridionalis* (Albayrak and Lister, 2012). For this reason, it can be thought that the Dursunlu mammoths show transitional group characteristics, similar to localities in the same age range in Europe.

When 55LAD02 is compared with Suluova and Dursunlu *M. trogontherii* specimens, similar to them it is seen to have a high hypsodonty index and lamella frequency and a thin enamel. Although the lamella frequency is higher than the other samples, it would not be appropriate to make a more detailed comparison with a single molar. Therefore, the age of *M. trogontherii* from Ladik, can be considered as approximately 1.0-0.5 years old.

Table 3- Comparative measurements for M2 of *M. meridionalis* from Turkey and Maglio (1973). a) Albayrak and Lister, 2012. The measurements given by Maglio (1973) are the average of the measurements of M2s found from various localities belonging to *M. meridionalis*. Measurements in round brackets are considered not to present original values due to wear. Measurements in square brackets are estimates of original values.

Specimen	Number of plates	Width	Height	Hypsodonty index	Lamellar frequency	Enamel thickness
55LAD03 (M2)	-7x [10]	103.9	(122.0)	(1.18)	4.81	3.2
2221B (M2) ^a	x8x	87.8	(107.1)	(1.22)	5.27	2.97
Maglio (1973)	9.7	86.8	113.9	1.31	5.1	2.9

Table 4- Comparative measurements for M3s of *M. trogontherii* from Turkey and Maglio (1973). a) Albayrak and Lister, 2012. The measurements given by Maglio (1973) are the average of the measurements of M3s found from various localities belonging to *M. trogontherii*. Measurements in round brackets are considered not to present original values due to wear. Measurements in square brackets are estimates of original values. DUR is for Dursunlu, SUL is for Suluova.

Specimen	Number of plates	Width	Height	Hypsodonty index	Lamellar frequency	Enamel thickness
55LAD02 (M3)	-18p [20p]	108.4	188.8	1.74	6.83	2.68
42-DUR-1-41 (M3) ^a	x18p	109.0	(165.4)	(1.52)	6.13	2.79
05SUL01 (M3) ^a	x19p	108.2	181.8	1.68	6.41	2.73
Maglio (1973)	18.6	85.2	162.5	1.99	6.5	2.2

6. Results

With this study, *Mammuthus* was identified for the first time in Samsun. Although the exact localities of the fossils are not known and the number of fossils is low, the results are very important since there is no record of Quaternary large mammals from Samsun until today. *M. rumanus*, the earliest representative of mammoths in Europe, one of the most important animal groups of the Quaternary period, probably appeared in Africa about 3.5 mya and then spread to Southern Europe via the Levant (Markov and Spassov, 2003; Markov, 2012). Due to its location, Anatolia has been a very important transition point during the dispersal of the *Mammuthus* genus from Africa to Europe and Asia. Mammoth fossils of different ages have been identified from different localities in Anatolia with the studies carried out to date. The presence of Early Pleistocene aged *M. meridionalis* and Middle Pleistocene aged *M. trogontherii* in Samsun shows that this region is very important for Elephantids and Quaternary fauna. Suluova, a locality where *M. trogontherii* was previously found, is located very close to Ladik (Figure 1). Although the fossils found in both localities are few in number, this region seems to have a potential for the Quaternary mammal fauna and distribution of the genus *Mammuthus*. For this reason, it is thought that much more detailed and important data will be obtained about the Anatolian Quaternary mammal fauna, which has not yet been revealed in detail, with detailed geological and paleontological studies to be carried out in this region in the future. And also, this study demonstrates that the coal-mines in this region must include Early and early Middle Pleistocene sediments.

Acknowledgements

I am deeply grateful to the people who found the fossils studied in this study and delivered them to

museums and made this work possible. I would like to thank the Samsun Museum Directorate and the museum staff for giving me the opportunity to study the fossils in their museum and for their help during the study. Adrian LISTER, the editor of the journal and anonymous reviewer helped to improve the manuscript.

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