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Silata, a new locality with micromammals from the Miocene/Pliocene boundary of the Chalkidiki peninsula, Macedonia, Greece

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A new locality with micromammals has been recovered, named Silata, in Chalkidiki, Northern Greece. The sediments of the locality belong to the Silata Member of the Gonia Formation. The fauna includes two Chiroptera, four Insectivora, nine Rodentia and three Lagomorpha and is correlated to the boundary of Miocene/Pliocene (MN13/14). During the deposition of the fossiliferous sediments, the environment was open and generally dry, with the presence of some water spots in the area.

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INTRODUCTION

The Neogene deposits in Chalkidiki peninsula outcrop in several areas, especially in its western part. During the 1980s, one of the authors (G.S.), working for his thesis in the area, found a level with micromammals near the village of Nea Silata (Fig. 1). At that time, he collected a poor sample and the fauna initially determined by Aguilar suggested an early Ruscinian age for the corresponding deposits (Syrides 1990). The detailed study of the fauna was assigned to the first author (K.V.), in 1998, as the subject of her master-thesis. The main purposes of the present study are: the brief presentation of the studied fauna, the determination of the age of the deposits and the definition of the local paleoenvironment. The few collected macromammals will also be mentioned.

GEOLOGICAL AND STRATIGRAPHICAL DATA

The Neogene deposits exposed in Western Chalkidiki represent mainly clastic sediments, deposited along the eastern margin of the Neogene palaeobasin of Axios-Thermaikos. The sediments reveal a general slight inclination towards SSE and their total thickness is about 700 m Syrides (1990) divided these sediments in six formations (Fig. 2).

Antonios Formation (Middle-Late Miocene) Unconsolidated, cross-stratified sands, alternated with lenses of rounded pebbles and cobbles, up to 100 m thick. They represent the first fluvial infilling of the paleobasin. A gradual transition towards the overlying red beds of the Triglia Formation is clear.

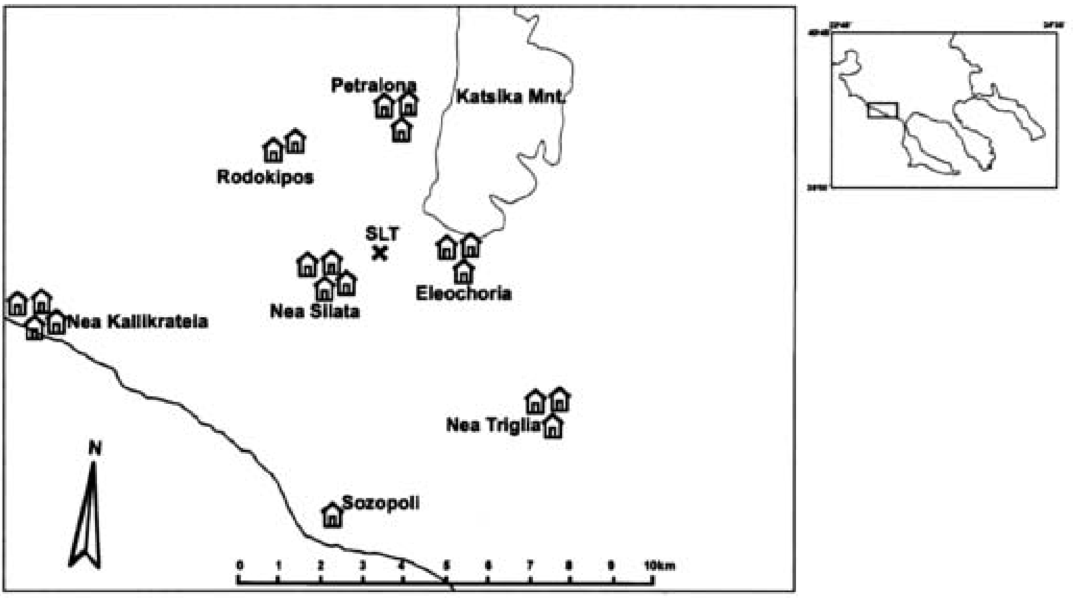


Figure 1 Sketch-map of the area of Chalkidiki and the locality of Silata.

Triglia Formation (Vallesian-Early Turolian) Coarse to fine-grained sands with red-brown silt and clay intermixed with angular pebbles. Their thickness varies from 20-60 m up to 100-200 m. They indicate a warm semi-arid savannah type of paleoenvironment.

Trilophos Formation (Latest Miocene = Pontian) Fossiliferous sands, clays, sandstones and limestones with numerous brackish mollusks of Paratethyan origin. These sediments are well stratified and have considerable lateral continuity. They overlay uncomformably the red beds of the Triglia Fm. and represent a Paratethyan transgression into the wider area of Northern Aegean.

Gonia Formation (Ruscinian) Alternations of lenses and lens-shaped beds of sands, clays, marls, sandstones, gravels and massive marly limestones, with frequent lateral passages and interchanging. Three beds of massive marly limestone reveal considerable lateral expansion and allow the separation of three members (Silata Mb., Rhodokipos Mb., Kallikratia Mb.). A total thickness of 100-150 m is possible. These sediments indicate a fluvial-lacustrine-marshy paleoenvironment. There is a gradual transition from the Trilophos Fm. to the Gonia Fm.

Moudania Formation (Late Pliocene-Early Pleistocene) Red beds deposited uncomformably above the Gonia Fm. The total thickness of the formation varies and reaches 200 m.

Eleochoria Formation (Late Pleistocene-Holocene) Tuffaceous limestones and travertines deposited diachronically around the southern margins of Katsika Mountain. Its thickness varies from 2 to 20 m.

LOCALITY

The new fossiliferous locality named Silata (SLT) is situated 1.5 km NE of the Nea Silata village. In a small ravine with steep sides, successive layers of sands, silts, clays, marls and marly limestone outcrop (Fig. 3). The sediments belong to the Silata Mb of Gonia Fm. The micromammals originate from two

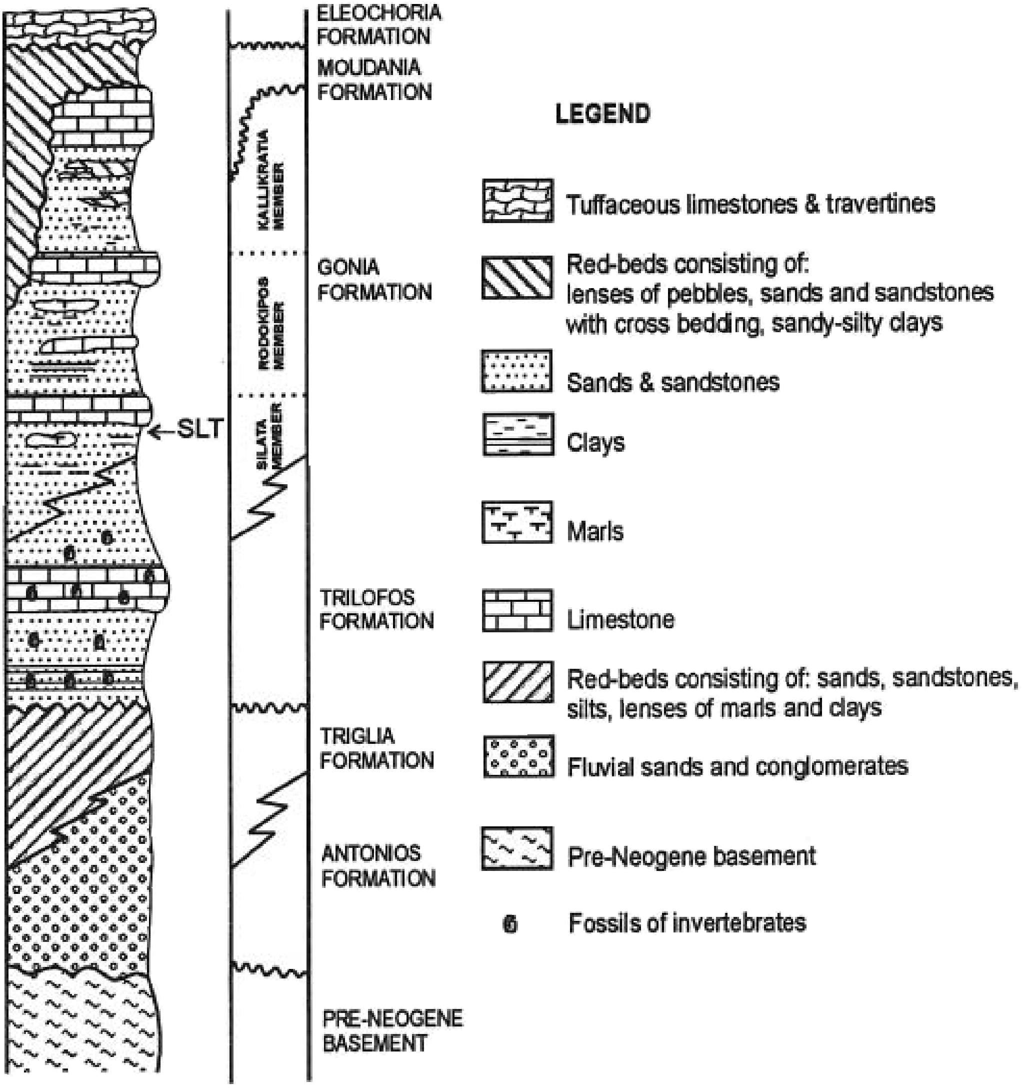


Figure 2 Lithostratigraphy of West Chalkidiki, with the fossiliferous level (data from Syrides 1990).

horizons, bed 2 (silts-clays) and bed 3 (clayey-marly sands). Both horizons contain, except for the micromammals, fragments of teeth and bones from large mammals, reptiles (Testudo fragments), a lot of fresh-water mollusks and opercula of Gastropods. It is worth mentioning that the fossiliferous level 2 includes also high percentage of lignitic elements.

THE FAUNA FROM SILATA

The micromammalian assemblage collected from Silata was thoroughly measured, described and compared with known taxa.

Chiroptera

Vespertilionidae

The Vespertilionidae that were found belong

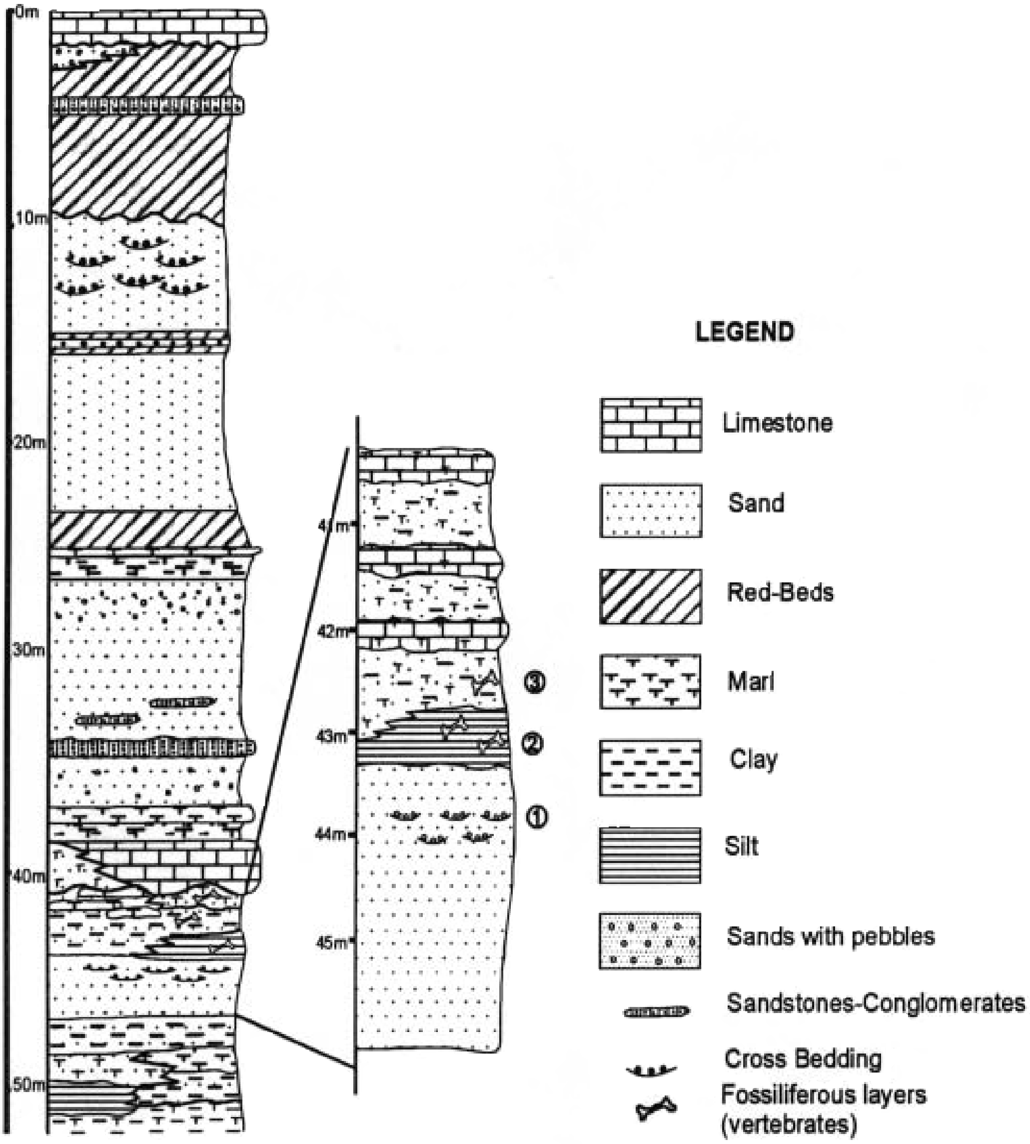


Figure 3 Lithostratigraphy of the area of Silata, with the stratigraphical column of the fossiliferous locality Silata and the fossiliferous horizons (data of the left column from Syrides 1990).

to two distinct groups, based on the difference in their size (Fig. 4a,b). Unfortunately, the material of both forms is not enough and they cannot be determined to generic level.

Insectivora
Erinaceidae
Erinaceus

The material classified in *Erinaceus* is also scarce and cannot be determined in specific level. It is, thus, referred to as *Erinaceus* sp.

Soricidae
Amblycoptus

Amblycoptus from Silata is characterized by a strong posterolabial cingulum and a strongly emarginated posterolabial margin on the I sup. (Fig. 4c), one incipient cuspid on the occlusal surface of the I inf. (Fig. 4d) and distinct and separated entostylid and endoconid on the m1. These morphological features, as well as the size of the teeth, fit quite well with those of *Amblycoptus jessiae*. Due to the few and fragmentary material, the Amblycoptus from Silata is determined as *Amblycoptus* cf. *jessiae*.

Asoriculus

The fissident I sup. (Fig. 4e), the very small anterior cuspid on the occlusal surface of the bicuspulate I inf. (Fig. 4f) and the low endoconid crest and buccal re-entrant valley that opens in small distance from the labial cingulum on the m1 of the *Asoriculus* from Silata, as well as the size of the teeth, allow the determination of the material to *Asoriculus gibberodon*.

Deinsdorfia

Deinsdorfia from Silata has the following morphological features: the talon is small and the postero-buccal cingulum is wide on the I sup. (Fig. 4g), the parastyle is placed anteriorly and the hypoconal flange is wide on the P4, the posterior margin is slightly emarginated on the M1 and M2 and the third cuspid on the occlusal surface of the I inf. is very small (Fig. 4h). These features lead to the determination of the material as *Deinsdorfia kerkhoffi*.

Rodentia
Muridae
Occitanomys

Occitanomys from Silata is characterized by the following features: the t1 is connected with the t5 and not with the t2, the t1bis is well-developed and the t4-t8 connection is rather high on the M1 (Fig. 4 i), the labial cingulum is weak with one or two accessory cuspids on the m1 (Fig. 4 j) and the labial cingulum is very weak to absent with none or one cuspids on the m2. Based on these features and the size of the molars, the material is attributed to *Occitanomys brailloni*.

Apodemus

Apodemus from Silata was separated in two species, based on the size of the molars. The small species is characterized by a large t7, mostly separated from the t4, and connected enamel of the t6 and the t9 on the M1 (Fig. 4k) and an antero-central cuspid separated from the anterior chevron on the m1 (Fig. 4l). These features lead to its determination as *Apodemus dominans*. The large *Apodemus* from Silata has the following features: the t6 and the t9 are separated on the one and connected on the second M2 (Fig. 4m), the antero-central cuspid is always present and isolated on the m1 (Fig. 4n), while the labial cingulum is strong with one or two large accessory cuspids on the m2. Based on these features and the size of the molars, the material is determined as *Apodemus gorafensis*.

Micromys

The material of *Micromys* consists of only one m1 and one m2. The m1 has a very small antero-central cuspid, a big terminal heel and

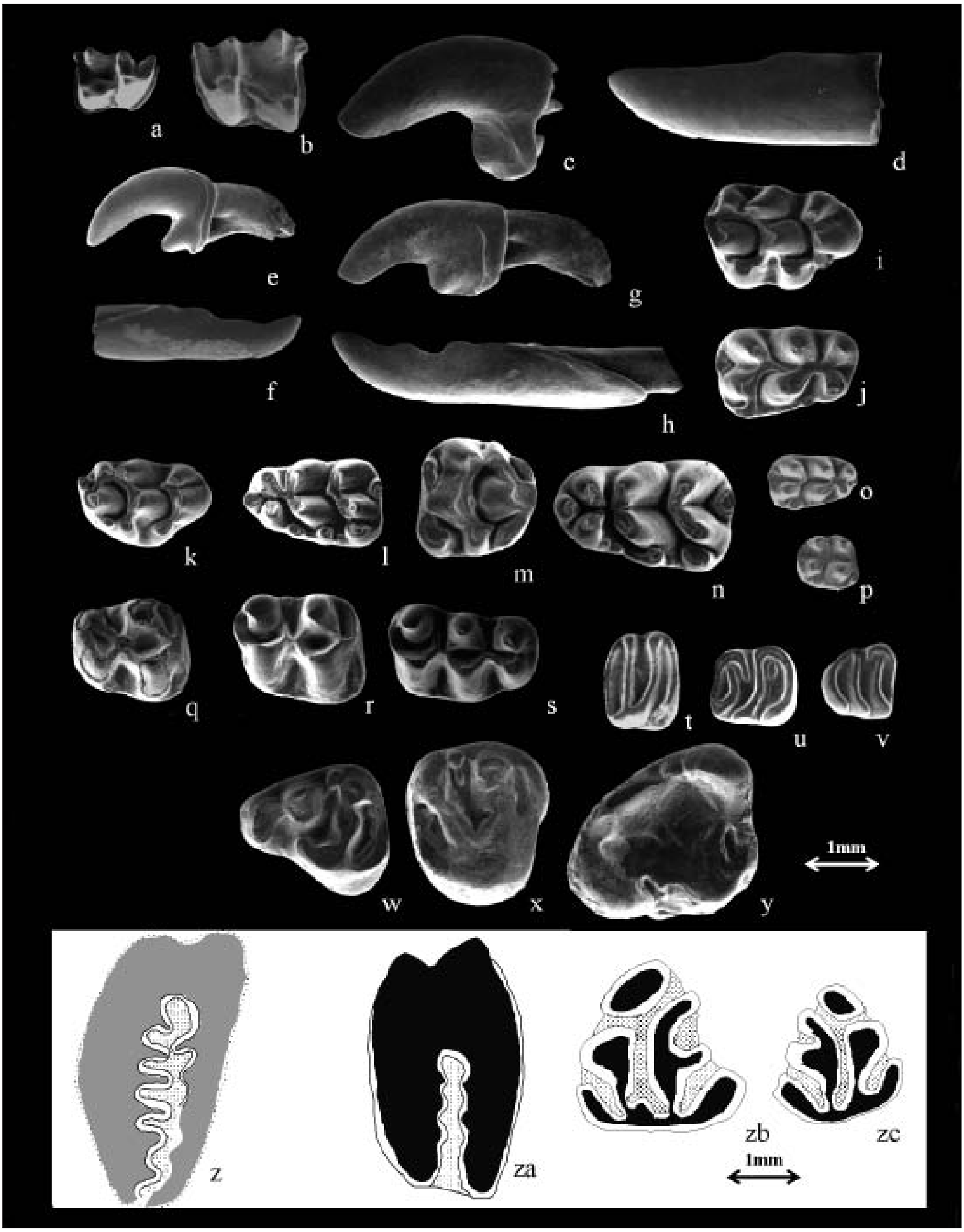


Figure 4 The micromammals from Silata. Vespertilionidae, **4a**: sp.1 right m1; **4b**: sp.2 left m1; *Amblycoptus* cf. *jessiae*, **4c**: left I sup., **4d**: left I inf.; *Asoriculus gibberodon*: **4e**: left I sup., **4f**: right I inf.; *Deinsdorfia kerkhoffi*, **4g**: left I sup., **4h**: left I inf.; *Occitanomys brailloni*, **4i:** right M1, **4j**: right m1; *Apodemus dominans*, **4k**: right M1, **4l**: left m1; *Apodemus gorafensis*, **4m**: left M2, **4n**: left m1; *Micromys* cf. *paricioi*:, **4o**: right m1, **4p**: right m2; *Mesocricetus primitivus*, **4q**: right M3, **4r**: right M2, **4s**: right m2; *Myomimus maritsensis*, **4t**: right M1/2, **4u**: left m1, **4v**: right m3; *Spermophilinus* cf. *turoliensis*, **4w**: left D4, **4x**: left P4, **4y**: right m3; Leporidae indet., **4z** & **4za**:
molarized upper teeth; *Prolagus michaux*, **4zb**; right p3, **4zc**: left p3. Bar = 1mm.

a weak labial cingulum (Fig. 4o). The m2 has a small, elongated antero-labial cuspid (Fig. 4p). These features and the size of the molars fit best with the features of *Micromys paricioi*. However, the material is scanty and, thus, determined as *Micromy*s cf. *paricioi*.

Cricetidae
Mesocricetus

The M2-3 of *Mesocricetus* found in Silata have a lingual anteroloph and mesostyle (Fig. 4q,r), the m1 has a slightly divided anteroconid and the m2 has a long mesolophid (Fig. 4s). Based on these morphological features and the size of the molars, the material is determined as *Mesocricetus primitivus*.

Petauristidae
Pliopetaurista

The fragment of the upper molar of *Pliopetaurista* from Silata bears strong comma-shaped posterior spurs of the metacone and metaconule that end on the posteroloph. These specialized characteristic, together with the size of the molar, lead to its determination as *Pliopetaurista dehneli*.

Sciuridae
Spermophilinus

The species of *Spermophilinus* are usually separated based on their size. The material from Silata has the size of *Spermophilinus turolensis*. Its only difference from this species is the strong mesostyle on the D4 and P4 (Fig. 4w,x). Thus, the material is determined as *Spermophilinus* cf. *turolensis*.

Gliridae
Myomimus

Myomimus from Silata has a rather simple morphology. The M1 and M2 have either none (40%) or one (60%) centroloph (Fig. 4t). On the m1 and m2, the centrolophid runs along either the 1/3 (37,5%) or the 1/2 (62,5%) of the total width of the molar and the posterior extra ridge is absent (37,5%) or has the shape of a small cuspid (25%) or of a small ridge (37,5%) (Fig. 4u). On the m3, there is a small centrolophid, but there is no posterior extra ridge (Fig. 4v). Based on these characteristics and the size of the teeth, the material is determined as *Myomimus maritsensis*.

Spalacidae
Pliospalax

A few specimens of *Pliospalax* were found in Silata. The M1 does not bear a mesoloph and the postero-labial sinus is very shallow. The M3 bears a labial sinus that closes soon with wear. The m1 (unworn) has a long mesolophid that turns towards the anterior part of the molar, which appears isolated. The morphology and the size of the molars resemble those of the species *Pliospalax macoveii*. However, the material is scanty and it can only be determined as *Pliospalax* cf. *macoveii*.

Lagomorpha
Leporidae

The three molarized teeth of Leporidae that were found in Silata are attributed to two species, based on the enamel plication in the hyposinus. Two of the teeth have a low enamel plication (Fig. 4za) and one has strong enamel plication (Fig. 4z). However, the characteristic teeth (p3, P2) are absent and, thus, the material is referred to as Leporidae indet.

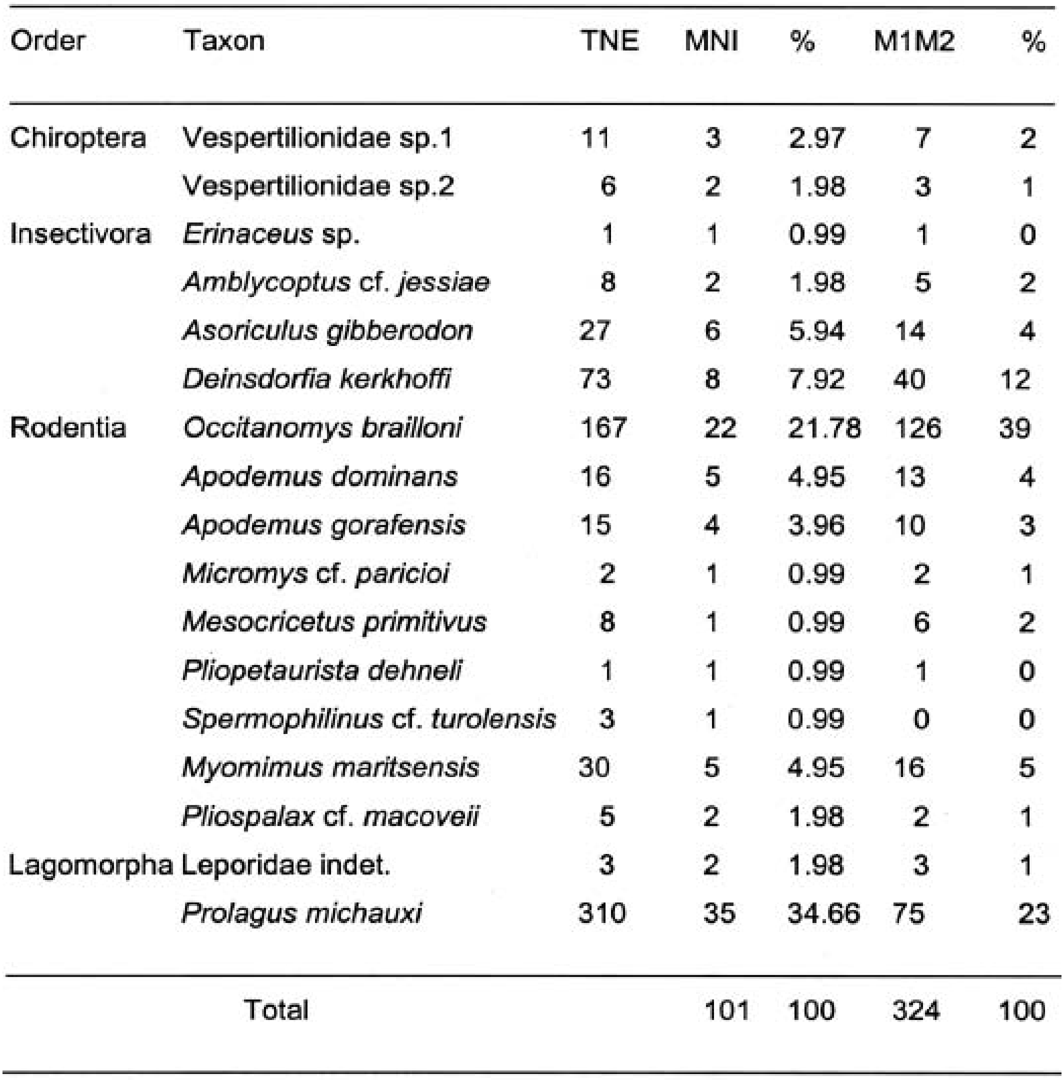
Ochotonidae
Prolagus

The tooth that helps most with the identification of the *Prolagus* species is p3. The p3 of the Silata *Prolagus* has a large, elongated anteroconid, oblique to the longitudinal axis of the tooth. The protoconulid is more narrow and longer than the protoconid. The metaconid is large and round, while the endoconid and hypoconid are large and elongated. The crochet is absent (32,6%), small (55,8%) or large (11.6%) (Fig. 4zb,zc). The morphology of the p3, as well as of the other teeth, lead to the determination of the material as *Prolagus michauxi*.

All the determined taxa of the micromammals are listed in Table 1. In the same table, the minimum number of individuals (MNI) and its percentage in the total MNI of the fauna for each one of the taxa are given. Furthermore, the number of upper and lower first and second molars (M1M2) and its percentage in the total M1M2 for each micromammalian taxon is given.

The large mammals in the Silata fauna are represented by few and fragmentary fossils.

Table 1 The faunal list of the "Silata" locality, the total number of elements (**TNE**), the minimum number of individuals (**MNI**) and its percentage in the total MNI (%), the total number of upper and lower first and second molars (**M1M2**) (for *Prolagus michauxi* M1M2=M1+M2+p4+m1+m2) and its percentage in the total M1M2 (%) for each micromammalian taxon.



Order	Taxon	TNE	MNI	%	M1M2	%
Chiroptera	Vespertilionidae sp.1	11	3	2.97	7	2
	Vespertilionidae sp.2	6	2	1.98	3	1
Insectivora	*Erinaceus* sp.	1	1	0.99	1	0
	Amblycoptus cf. *jessiae*	8	2	1.98	5	2
	Asoriculus gibberodon	27	6	5.94	14	4
	Deinsdorfia kerkhoffi	73	8	7.92	40	12
Rodentia	*Occitanomys brailloni*	167	22	21.78	126	39
	Apodemus dominans	16	5	4.95	13	4
	Apodemus gorafensis	15	4	3.96	10	3
	Micromys cf. *paricioi*	2	1	0.99	2	1
	Mesocricetus primitivus	8	1	0.99	6	2
	Pliopetaurista dehneli	1	1	0.99	1	0
	Spermophilinus cf. *turolensis*	3	1	0.99	0	0
	Myomimus maritsensis	30	5	4.95	16	5
	Pliospalax cf. *macoveii*	5	2	1.98	2	1
Lagomorpha	Leporidae indet.	3	2	1.98	3	1
	Prolagus michauxi	310	35	34.66	75	23
	Total		101	100	324	100

Among them, there are two isolated teeth of *Hipparion*, indicating a middle-sized form. A m2 of a suid was also found. The morphology and the dimensions (27.6x19.0 mm) of the tooth suggest that it belongs to *Microstonyx major*. The size of the m2 for *M. major* varies between (26.9-28.2)x(20.1-22) for Pikermi, (29.1-31.7)x(26.3-27.0) for Dytiko and (27.1-27.7)x(23.1-24) for Vathylakkos (de Bonis & Bouvrain 1996). An upper canine of a machairodont was found; it is relatively small and weak, slightly curved posteriorly, the labial surface is convex, while the lingual one is flattened. There is a crest across its anterior border. The posterior border indicates a small crenulation. The dimensions at the base are 15.5x8.6 mm. These morphological characters and dimensions are close to those of *Paramachairodus orientalis*, a form well known from Pikermi, Maragha, Eppelsheim and Spain. Finally, a distal part of a giraffid metapodial was present in the Silata fauna, which size suggests similarities to *Helladotherium*.

BIOCHRONOLOGY

The Silata fauna includes some faunal elements that can help to identify its age. The stratigraphic range of the determined species is given in Figure 5 (based on data from de Bruijn et al. 1992, van der Meulen & van Kolfschoten 1986, Schmidt-Kittler *et al*. 1995, Sen 1997). The genus Deinsdorfia and the species Asoriculus gibberodon and Pliopetaurista dehneli first occurred in the fauna of Maramena (Serres basin, Greece), dated to the Miocene/Pliocene boundary (Schmidt-Kittler *et al*. 1995). The studied material belonging to these taxa is very similar to that from Maramena, indicating also age similarities. Two elements of the Silata fauna, *Amblycoptus jessiae* and *Deinsdorfia kerkhoffi* are only known from Maramena, confirming the above mentioned age similarity. Moreover, the last occurrence of *Spermophilinus turolensis* is reported from the locality of Maramena. Its presence in the Silata fauna does not contradict a similar age for the two faunas. All these data suggest that a Latest Turolian/Earliest Ruscinian age is very possible for the fauna from Silata.

The absence of arvicolids from the fauna is also an evidence for this age. In the initial faunal list given by Aguilar (Syrides 1990) a single tooth of the arvicolid *Promimomys* was reported. Until now, in our collection, no representatives of this genus have been found. The first arvicolids in the area of North Greece are reported from the earliest Ruscinian locality of Spilia 0 (de Bruijn 1989). Even if we accept that *Promimomys* is present in the Silata fauna, the age is not different than that we have already proposed. Some of the large mammals can also give an indication for the age of the fauna. *Paramachairodus orientalis* and *Microstonyx*

Figure 5 Biostratigraphical range of the taxa found in Silata and comparison of the age of the locality with the age of other Upper Miocene and Low Pliocene European and Greek localities (data from de Bruijn *et al*. 1992, van der Meulen & van Kolfschoten 1986, Schmidt-Kittler *et al*. 1995, Sen 1997).

major have a great stratigraphic range, but both disappeared from the Eastern Mediterranean area at the end of Miocene. Thus, their presence in the studied fauna doesn't contradict the Latest Miocene/Earliest Pliocene age determined based on the small mammals.

However, *Pliospalax* cf. *macoveii* is also present and it could suggest a younger age for the studied fauna. *Pliospalax macoveii* has only been found, until now, in localities of MN15 age in Turkey, Romania and Ukraine. Several faunas in Southeastern Europe and Turkey have yielded *Pliospalax*, but as the material is usually very poor, it is often described just as *Pliospalax* sp. It is also possible that *Pliospalax sotirisi*, determined from the locality of Maritsa (Greece; de Bruijn *et al*. 1970), is a junior synonym for *P. macoveii*, although in the last revision of the family Spalacidae (Ünay 1999) it is referred to as a separate species. Thus, the real stratigraphical range of *Pliospalax macoveii* is unknown and its presence in the studied fauna from Silata cannot give clear information about the age of the fauna.

ENVIRONMENTAL CHARACTERS OF THE MICROMAMMALIAN TAXA

The representatives of the family Vespertilionidae live today in a great variety of climates and environments. The reconstruction of the environment of an area using the presence of fossil Chiroptera is dangerous, as the presence of Chiroptera usually depends on factors different than the climate (Storch 1999). Thus, the presence of Chiroptera in the fauna from Silata does not give information about the paleoenvironmental conditions of the area. The two recent European *Erinaceus* species live in deciduous forests or in humid meadows (Macdonald & Barrett 1993). In Asia and Africa, there are several recent species that live in open and more arid environments (Koliadimou 1996). Hence, it can be assumed that the extinct *Erinaceus* species used to live in a variety of climates and environments.

The genus *Amblycoptus* was probably living in forested and humid environments, like its recent relative, *Anourosorex squamipes* (Reumer 1984). *Asoriculus* probably preferred humid environments or areas with open water, like its living descendant, *Episoriculus* (Reumer 1984). *Deinsdorfia* indicates the presence of water in the area or humid environment, due to its exoedaenodont teeth that is the result of a diet consisting of mollusks (Reumer 1984). The presence of these three soricids in the studied fauna indicates the high humidity and the possible presence of water spots in the area.

The molars of *Occitanomys* are characterized by high level of stephanodonty, high value of the width to length ratio and wide valleys in the longitudinal direction. These characteristics point out to a diet rich in fibers. Thus, *Occitanomys* was living in open and dry environments, with high amount of low and hard vegetation (Van Dam & Weltje 1999). Its presence in the Silata fauna in a high percentage (21.78%) indicates that the environment around the locality was rather open and dry. All the recent species of *Apodemus* are adjusted to a broad variety of environments. They feed on fruits and seeds or they are omnivorous, but they never feed on grass. It is quite probable that the fossil species of *Apodemus* were also adjusted in a variety of environments, as well (Van Dam & Weltje 1999). Thus, its presence in the studied fauna cannot be an indication for the environment of the area. The recent species of *Micromys* live in humid areas, but not in areas with open water (Macdonald & Barrett 1993). The fossil species seem to be absent from faunas that come from dry areas (Van de Weerd 1979). The presence of Micromys in the studied fauna confirms the rather high humidity.

The genus *Mesocricetus* is known today in the area of Balkans, Ukraine, Turkey and Middle East. It inhabits dry areas with a low amount of vegetation and probably the fossil representatives used to live in analogous environments (Tchernov 1968, Theocharopoulos 1991). Hence, the appearance of the genus in the Silata fauna confirms the assumption that the environment in the area surrounding the locality was dry and open. The recent petauristids are diversified and abundant in the tropical forests of Southeastern Asia. The flying squirrels found only as fossils, like *Pliopetaurista*, must be also adjusted to close, forested environments (Van Dam & Weltje 1999). The Silata *Pliopetaurista* indicates the presence of thick vegetation around the lake that was present in the area. Unlike the other tribes of ground squirrels, the tribe Tamiini lives today in close, relatively humid environments. *Spermophilinus* is abundant in fossil faunas coming from very humid areas, like the fauna from Dorn-Dürkheim (Germany, MN11), while it is rare or absent in faunas from dry areas (Van Dam & Weltje 1999). The *Spermophilinus* found in the Silata fauna apparently lived around the lake, where the conditions were more humid.

The recent species of *Myomimus* live in open areas in Bulgaria and semi-desert areas of Iran. Probably, the extinct species were living in similar conditions (Van Dam & Weltje 1999). The *Myomimus* is the second more abundant species of rodents in the Silata fauna, after *Occitanomys*. This abundance indicates that the environment of the wider area was open and dry.

All the extant representatives of Spalacidae are well known for their fossorial mode of living, in underground tunnels. They prefer open areas, with soft soil, usually not completely dry, but not very wet either. Usually, *Pliospalax* is used as an indicator of open and arid environment (Van de Weerd 1979, de Bruijn 1989, Ünay 1999). Thus, its presence in the studied fauna shows the dry and open character of the environment in the surrounding area.

The recent Leporidae usually live in open areas with bushes, a few trees and low humidity. However, they can very easily adjust to different environmental conditions and they can also be found in forests or meadows. Therefore, conclusions about the environmental preference of the extant or the extinct leporids cannot be made (Macdonald & Barrett 1993, Koliadimou 1996). Thus, their presence in the Silata fauna cannot provide data about the environment of the area. Species of the genus *Prolagus* were spread all over Europe in the previous times. This great geographical distribution of the genus in the past can only mean that the species could easily adjust to any kind of environment (Lopez Martinez & Thaler 1975). Therefore, its presence in the studied fauna cannot indicate the environmental conditions of the area.

PALEOENVIRONMENTAL RECONSTRUCTION

Unfortunately, the remains of the large mammals yielded from the locality under study are only scarce and fragmentary. As a result, typical methods for paleoenvironmental reconstruction (such as cenograms and multivariate analysis) cannot be used. The few *Hipparion* teeth have low enamel plication, with small plication in the upper molar, while the lower one has no plication or crenulation in the flexids. These characters indicate adaptation to open environment. The presence of

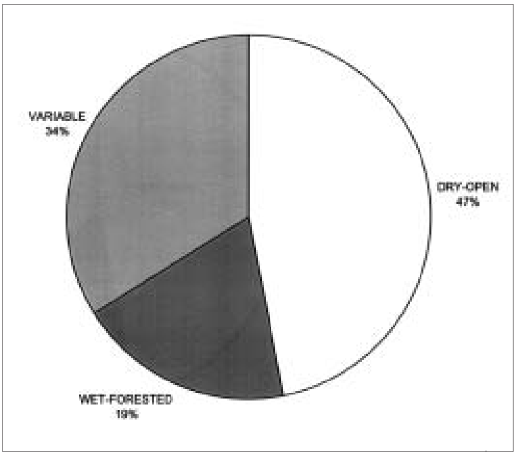


Figure 6 Pie-diagram showing the three ecological groups that the taxa from Silata belong to, based on their environmental preferences and on the number of upper and lower first and second molars (M1M2) for each group, as they result from Table 1.

the giraffid also suggests a similar environment. The pie-diagram of Figure 6 is based on the environmental preferences of the micromammalian taxa of the Silata fauna given in the previous paragraph and on the number of upper and lower first and second molars (M1M2) for each taxon given in Table 1. The taxa of the fauna were separated in three groups. The first group includes Vespertilionidae sp. 1, Vespertilionidae sp. 2, *Erinaceus* sp., *Apodemus dominans*, *Apodemus gorafensis*, Leporidae indet. and *Prolagus michauxi* and indicates a wide variety of environmental conditions. The second group consists of *Occitanomys brailloni*, *Mesocricetus primitivus*, *Myomimus maritsensis* and *Pliospalax* cf. *macoveii* and indicates an open and relatively dry environment. The third group includes *Amblycoptus* cf. *jessiae*, *Asoriculus gibberodon*, *Deinsdorfia kerkhoffi*, *Micromys* cf. *paricioi*, *Pliopetaurista* dehneli and *Spermophilinus* cf. *turolensis* and indicates an environment with high humidity, maybe closed, even forested. The percentage of the first group (in terms of M1M2) is 34%, of the second group 47% and of the third group 19% (Fig. 6). These values indicate that the environment of the area around the locality was dry and open rather than humid and closed, as the percentage of the second group is higher than that of the third group.

The low number of Soricidae species in the fauna suggests a relatively dry environment for the area of Silata. The soricids are more successful and diversified in humid climates (Rzebik-Kowalska 1995). In the studied fauna, only three species of Soricidae were found, while in contemporaneous faunas coming from humid areas more species of Soricidae are usually found. For example, five species of Soricidae were found in the fauna from Maramena (Greece, MN13/14) (Doukas *et al*. 1995). The locality of Maramena is considered to represent a lake with relatively high humidity, high amount of vegetation and big trees, while some drier and more open areas were present around the lake (Schmidt-Kittler *et al*. 1995). It is also worth mentioning that typically (semi)-aquatic insectivores, like Desmaninae, are absent from the fauna of Silata, while they have three representatives in the fauna from Maramena.

Another evidence of the relatively dry conditions in the area of Silata is the low species diversity that the fauna reflects. The total number of species belonging to the four orders found in Silata (Chiroptera, Insectivora, Rodentia and Lagomorpha) is only 17, while the contemporaneous locality Maramena has yielded at least 33 species (the exact number of the Chiroptera species is not known) (Schmidt-Kittler *et al*. 1995). On the other hand, the type of the fossiliferous sediments (silts and clays) and the abundance of fresh-water mollusks and opercula indicate the existence of a lake in the area of the fossiliferous locality. Furthermore, the presence of *Pliopetaurista dehneli* proves the presence of trees, probably around the lake. Finally, the high percentage of lignitic elements in the fossiliferous level 2 is another evidence for the presence of a swamp or lake.

CONCLUSIONS

The rich micromammalian fauna includes several species. The species *Amblycoptus* cf. *jessiae* and *Deinsdorfia kerkhoffi* are only present, until now, in the Maramena fauna, correlated to the Miocene/Pliocene boundary. The close resemblance of the Silata fauna with that of Maramena suggests similarities in the age of the two faunas. Thus, the age of the Silata fauna must be Latest Turolian/Earliest Ruscinian (MN13/14).

The ecological adaptation of each taxon, the composition of the fauna, the lithology of the fossiliferous beds, the presence of the non-micromammalian fossils and the lignite elements suggest an open and dry environment, with water spots (lakes, swamps, springs) in the wider area. Such environmental conditions are also mentioned for the latest Turolian fauna of Dytiko, in Axios valley, Greece (de Bonis *et al*. 1992). The Silata fauna fits well with a fauna found around a water spot. It includes taxa living in humid and wet conditions, or taxa living on the trees surrounding the water spot, or taxa coming to the water spot from the wider dry area in order to find water or food. The presence of the suid and machairodont is another evidence that there was water in this area. Usually, the big carnivores live around the water spots, where it is easier for them to hunt the animals going there for water.

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