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Fossil micromammals of the early Pliocene locality of Almenara MB: biostratigraphical and palaeoecological implications

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ABSTRACT

In this work, we have studied the fossil rodent, insectivore and chiropteran faunas, of a new locality from the Almenara-Casablanca karstic complex, named ACB MB (Castellón, east Spain). We consider an early Ruscinian age for this site, close to the Miocene/Pliocene boundary, and infer warm and relatively humid conditions from the analysis of the micromammal assemblage. We remark the presence of two species of *Eliomys* in ACB MB, rare in localities of this age, and the lack of any gerbil remains, fossil markers of faunal interchanges between Africa and Europe in the context of the Messinian Salinity Crisis, recorded in the nearby late Miocene site of ACB M.

Keywords: Biostratigraphy, palaeoecology, Miocene/Pliocene boundary, micromammal, Spain.

RESUMEN

En este trabajo hemos estudiado los roedores, insectívoros y quirópteros fósiles de una nueva localidad del complejo kárstico de Almenara-Casablanca, denominada ACB MB (Castellón, Este de España). Consideramos que este yacimiento pertenece al Rusciniense temprano, cerca del límite Mio/Plioceno, e inferimos unas condiciones cálidas y relativamente húmedas a partir del análisis de su asociación de micromamíferos. Destacamos de la lista faunística de ACB MB la presencia poco frecuente de dos especies de *Eliomys* en yacimientos de esta edad, así como la ausencia de gerbílidos, marcadores del intercambio faunístico en el contexto de la Crisis de Salinidad Messiniense, y que se registran en el yacimiento cercano de ACB M (Mioceno tardío).

Palabras clave: Bioestratigrafía, paleoecología, límite Mioceno/Plioceno, micromamíferos, España.

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1. INTRODUCTION

The karstic complex of Almenara-Casablanca (ACB) is located in an abandoned quarry in the vicinity of the locality of Almenara (Castellón, Spain), in the eastern sector of the Iberian Range (Fig. 1). The fissure fillings containing vertebrate remains were discovered in the early 80s due to mining operations in the area, and in 1982 the Servei d'Investigacions Arqueològiques Provincials (SIAP) started a series of prospections, finding a great number of fossil remains (Furió *et al.*, 2005). Initially, the finding of what seemed to be flint flakes in a Pleistocene level led the researchers to consider an anthropic origin for these localities. However, these accumulations were better explained by natural processes, and from 1986 on the excavations focused mainly on micropaleontology (Gusi, 2003; Furió *et al.,* 2005).

Originally, the ACB complex comprised at least ten different sites, but some of them are buried under several meters of debris, since part of the area is now a dump (Gusi, 2003; Ruiz-Sánchez & Montoya, 2009). The remaining sites comprise ACB M (late Miocene), ACB 1 (earliest Pleistocene), ACB 3 (upper early Pleistocene) and ACB 4 (late Pliocene) (Agustí *et al.,* 2011).

In 2007, the group of vertebrate palaeontology of the Departament de Geologia of the Universitat de València started a new series of prospections to assess the degree of perturbation of the localities in this area, and to search for new fossiliferous levels (Ruiz-Sánchez & Montoya, 2009). As a result, a new locality, probably situated in the same fissure infilling where ACB M is located, and therefore named ACB MB, was discovered (Fig. 2). The fossil remains of rodents, insectivores and chiropterans from this level are studied in this work, providing new data about the biostratigraphical and palaeoecological context of this fissure infilling.

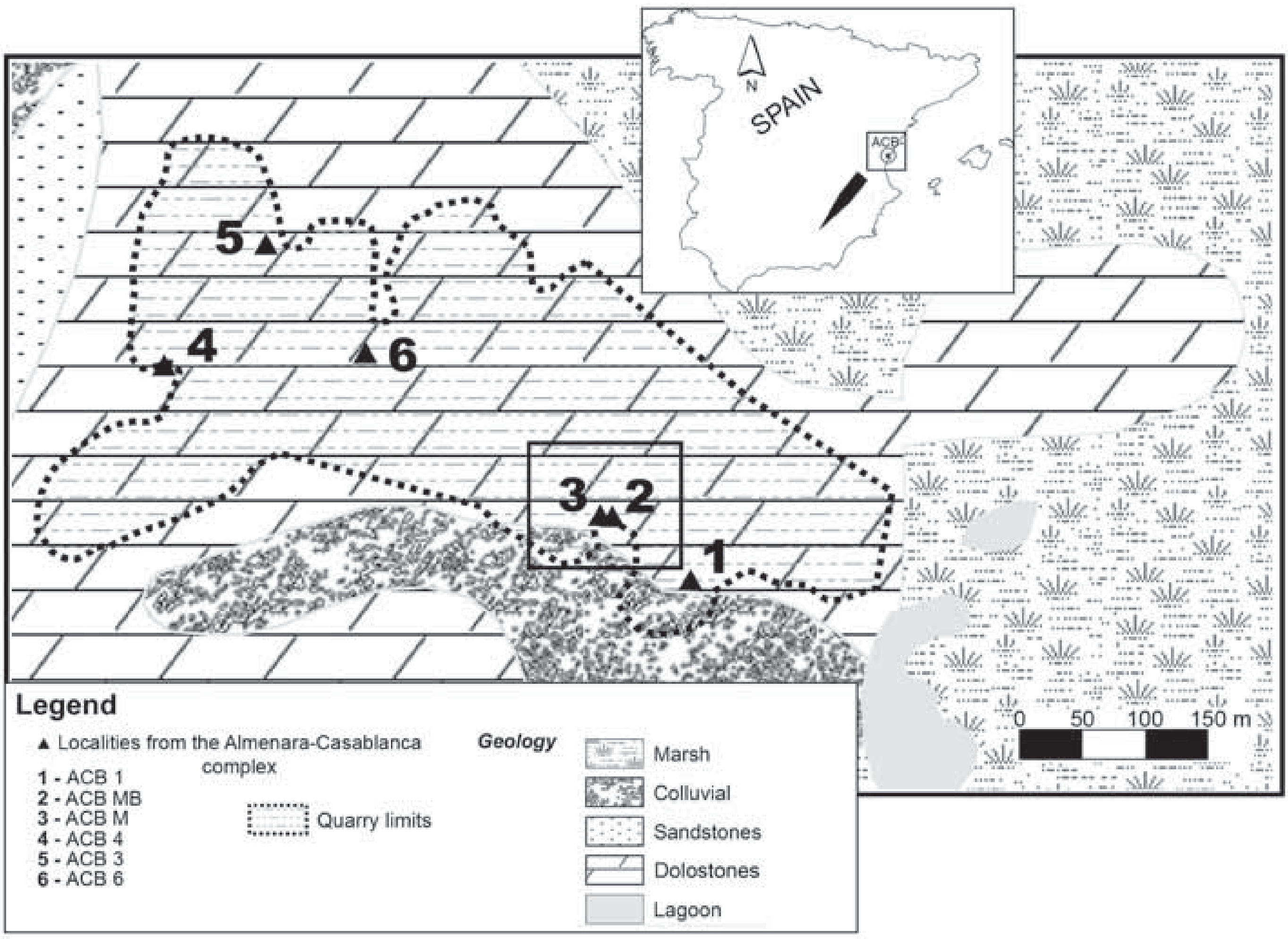

Figure 1. Geographical and geological setting of the Almenara-Casablanca complex, showing the location of the different sites found in the quarry.

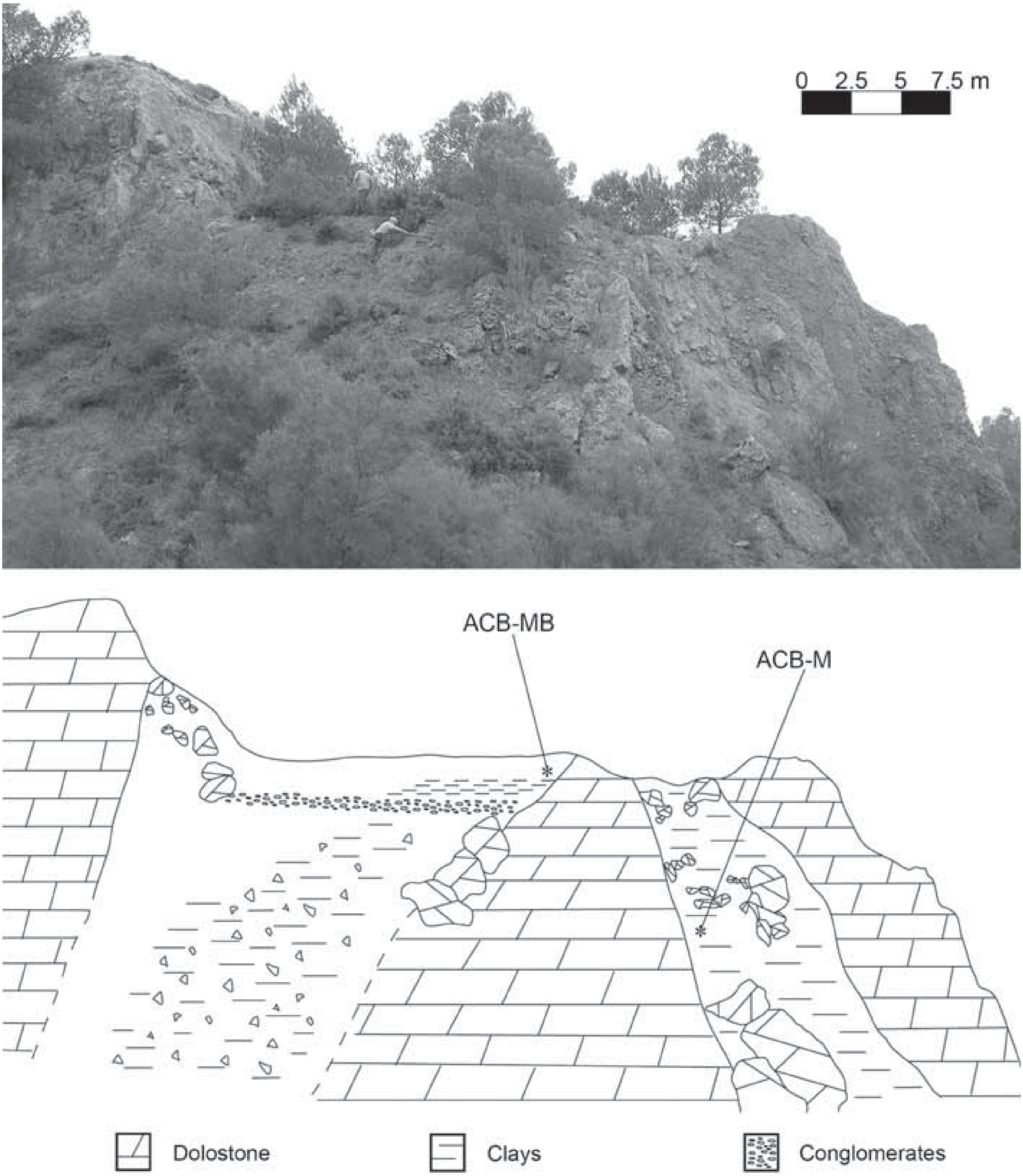

Figure 2. Detailed geological sketch of the fissure fillings containing the localities of ACB M (late Turolian) and ACB MB (early Ruscinian), showing their relative stratigraphic position.

2. MATERIALS AND METHODS

In 2015, we extracted 250 kg of sediment from the locality ACB MB. The study of this relatively small sample resulted in a micromammal collection comprising 93 identifiable remains, stored at the Museu de Geologia de la Universitat de València (MGUV) with the acronym ACBMB-.

The nomenclature and measurement methods are those from Martín-Suárez & Freudenthal (1993) for the family Muridae, Mein & Freudenthal (1971) for the Cricetidae, Daams (1981) and Freudenthal (2004) for the Gliridae, Sevilla (1988) for the Chiroptera, and Reumer (1984) for the insectivores. Measurements are in millimetres and were taken on a Leica MZ75 binocular microscope, by means of displacement of a mechanical stage, connected to a Sony Magnescale measuring equipment.

Abbreviations. AC, Alcoi Cristian; **ACB**, Almenara Casablanca; **AL2**, Alcoi 2; **AW**, anterior width; **BL**, buccal length; **I**, upper incisive; **c**, lower canine; **C**, upper canine; **p**, lower premolar; **P**, upper premolar; **m**, lower molar; **M**, upper molar; **H**, height; **L**, length; **LL**, lingual length; **LT**, length of the talon; **PE**, posterior emargination; **PW**, posterior width; **Taw**, talonid width; **Trw**, trigonid width.

3. SYSTEMATIC PALAEONTOLOGY

Order RODENTIA Bowdich, 1821
Family **Muridae** Illiger, 1811
Genus *Occitanomys* Michaux, 1969
Type species *Occitanomys brailloni* Michaux, 1969

Occitanomys alcalai Adrover *et al*., 1988
(Figs 3a-b)

Material. 2 m1 (ACBMB-105, ACBMB-110), 3 m2 (ACBMB-29, ACBMB-30, ACBMB-103), 3 m3 (ACBMB-38, ACBMB-39, ACBMB-108), 1 M1 (ACBMB-99), 1 M2 (ACBMB-102), 3 M3 (ACBMB-20, ACBMB-26, ACBMB-104).

Measurements. Table 1.

Description.

m1. Both specimens are broken and poorly preserved. One of the molars has a reduced longitudinal spur. The other specimen shows a well-developed c1 and two accessory cuspids. The posterior heel is large, oval and lingually displaced. Roots are not preserved.

m2. Large and isolated anterolabial cuspid. One specimen (Fig. 3a) has a hint of distal spur. The labial cingulum is wide, but there is neither c1 nor accessory cuspids. The posterior heel is small and oval. There are two roots.

Table 1. Measurements in millimetres of the teeth of *Occitanomys alcalai* from ACB MB. m1 = first lower molar; m2 = second lower molar; m3 = third lower molar; M1 = first upper molar; M2 = second upper molar; M3 = third upper molar.

Element	Parameter	Nº of elements	minimum	mean	maximum
m2	Length	3	1.20	1.28	1.33
	Width	2	1.12	1.15	1.18
m3	Length	3	1.03	1.10	1.19
	Width	1	0.93	1.02	1.13
M1	Width	1	-	1.33	-
M2	Length	1	-	1.32	-
M3	Length	1	-	1.01	-
	Width	1	0.97	1.00	1.03

m3. The anterolabial cuspid is small in one specimen and absent in the other two. One molar has a weak connection between the posterior complex and the protoconid-metaconid pair, which is absent in the others. Roots are not preserved.

M1. The molar is broken anteriorly. The t1-t5 connection is high. There is a well-developed t1 bis. There is a distal spur on t3. Roots are not preserved.

M2. The specimen is broken anterolabially and much worn. There is a large t1 bis. The t1 is basally connected to the t5. The t3 is reduced. Roots are not preserved.

M3. The t1 is isolated. The t3 is absent. The t4, t5 and t6 are connected, and in one specimen both t4 and t6 are connected to t8. Roots are not preserved.

Remarks. The relatively high crown, well-developed t1 bis in M1, absence of isolated cusps in the upper molars and lack of complete longitudinal crests in the lower molars are typical traits of *Occitanomys alcalai*. The size of these specimens is similar to that of *O. alcalai* from its type locality, Peralejos E (Adrover *et al*., 1988), and other localities from the Teruel Basin such as La Gloria 4 and 5, Celadas 9, Valdecebro 3 and 6 and Villastar (Adrover *et al*., 1993), as well as the localities from the Granada (García-Alix *et al*., 2008a) and Guadix basins (Minwer-Barakat *et al*., 2009a, 2009b).

The teeth from ACB MB are slightly smaller, have less developed connections in the lower molars and more developed connections in the upper molars than *Occitanomys adroveri* (Thaler, 1966). These specimens are much smaller and with less developed spurs and crests in the upper molars than *O. brailloni* Michaux, 1969. Our material is also larger and show a greater development of the t1 bis and less developed longitudinal crests in the lower molars than *O. sondaari* van de Weerd, 1976.

Genus *Paraethomys* Petter, 1968
Type species *Paraethomys filfilae* Petter, 1968

Paraethomys meini (Michaux, 1969)
(Figs 3c-d)

Material. 2 m2 (ACBMB-33, ACBMB-35), 3 m3 (ACBMB-40, ACBMB-42, ACBMB-107), 5 M1 (ACBMB-1, ACBMB-2, ACBMB-7, ACBMB-12, ACBMB-14), 1 M2 (ACBMB-17), 1 M3 (ACBMB-21).

Measurements. Table 2.

Table 2. Measurements in millimetres of the teeth of *Paraethomys meini* from ACB MB. m1 = first lower molar; m2 = second lower molar; m3 = third lower molar; M1 = first upper molar; M2 = second upper molar; M3 = third upper molar.

Element	Parameter	Nº of elements	minimum	mean	maximum
m2	Length	2	1.47	1.53	1.59
	Width	2	1.40	1.42	1.43
m3	Length	3	1.17	1.22	1.26
	Width	3	1.10	1.12	1.14
M1	Length	2	2.13	2.22	2.31
	Width	5	1.41	1.50	1.60
M2	Length	1	-	1.69	-
	Width	1	-	1.55	-
M3	Length	1	-	1.08	-
	Width	1	-	1.18	-

Description.

m2. The anterolabial cuspid is large and isolated. There is no longitudinal crest. The labial cingulum is moderate, bearing a large c1 but no accessory cuspids. Medium-sized oval posterior heel. There are two roots.

m3. The anterolabial cuspid is absent in one specimen and small in the other two. There is no longitudinal connection. There is neither c1 nor accessory cusps. Roots are not preserved.

M1. The t1-t2 connection is low. There are reduced spurs on t1 in three out of five specimens. There is no trace of spur on the t3 in two molars, a hint of spur in another two (Fig. 3c), and more developed spurs in the remaining two specimens. The connection between t4 and t8 is low. There is a small t12. Roots are not preserved.

M2. The t1 and t3 are isolated. The t9 is reduced to a thickening of the enamel (Fig. 3d). There is no t12. Roots are not preserved.

M3. The t1 is isolated. The t4, t5, t6 and t8 are connected. Roots are not preserved.

Remarks. The specimens from ACB MB show some of the typical traits of *Paraethomys*: moderate or reduced labial cingulum in the lower molars, reduced or absent anterolabial cusp in m3 and reduced or absent t9 in M2 (Fig. 3d).

The molars from ACB MB are clearly smaller than the Pliocene *Paraethomys* such as *P. jaegeri* Montenat & de Bruijn, 1976, *P. abaigari* Adrover *et al*. 1988 and *P.* aff. *abaigari*, and consistent in size with other populations of *P. meini* such as Crevillente 6 (de Bruijn *et al.*, 1975), Peralejos E (Adrover *et al.*, 1988), the localities from the Granada Basin (García-Alix *et al.*, 2008a) and Venta del Moro (Mansino, personal observation). However, the two larger M1 from ACB MB show spurs on both t1 and t3. These spurs are usually more developed in the Pliocene species of the genus, and the width of these specimens, the only measurement that we were able to make, is close to that of the smaller M1 of *Paraethomys* aff. *abaigari*, such as some molars from AC-0 (Mansino *et al*., 2015a) and La Gloria 4 (Adrover *et al*., 1993). In this regard, the sample from ACB MB resembles some *Paraethomys* populations close in age to the Mio/Pliocene boundary, in which a great biometrical variability has been described, although the presence of two distinct *Paraethomys* species in these assemblages is unlikely (García-Alix *et al.*, 2008a; Mansino *et al.*, in press).

Genus *Stephanomys* Schaub, 1938
Type species *Mus donnezani* Depéret, 1890

Stephanomys dubari Aguilar *et al*., 1991
(Figs 3e-g)

Material. 3 m1 (ACBMB-27, ACBMB-28, ACBMB-100), 4 m2 (ACBMB-31, ACBMB-32, ACBMB-34, ACBMB-36), 3 m3 (ACBMB-41, ACBMB-106, ACBMB-109), 10 M1 (ACBMB-3 to ACBMB-6, ACBMB-8 to ACBMB-11, ACBMB-13, ACBMB-15), 6 M2 (ACBMB-16, ACBMB-18, ACBMB-19, ACBMB-37, ACBMB-101, ACBMB-111), 4 M3 (ACBMB-22 to ACBMB-25).

Measurements. Table 3

Description.

m1. The anteroconid is connected to the protoconid-metaconid pair. There is a well-developed longitudinal crest. The labial cingulum is moderate. There is a medium-sized c1, but no accessory cuspids. The posterior heel is oval. Roots are not preserved.

m2. The anterolabial cuspid is large and isolated. The anterior complex is connected to the metaconid or to the protoconid-metaconid junction by a longitudinal crest. The c1 is small or absent. The posterior heel is oval. There are two roots.

m3. The anterolabial cuspid is large. The longitudinal crest is low in two specimens, and another one has a spur. These longitudinal connections arise from the metaconid. A small c1 is present in one specimen. There are two roots.

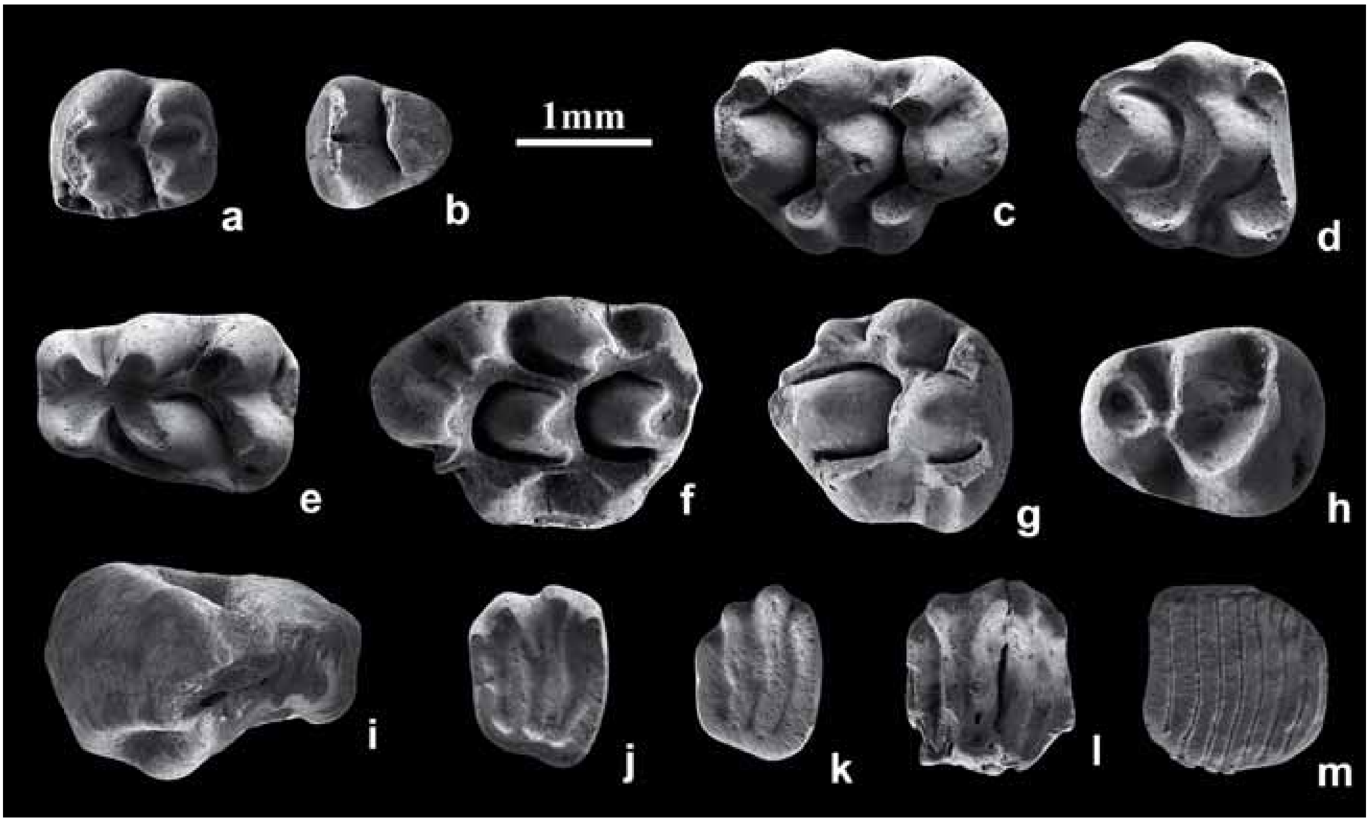

Figure 3. Rodents from ACB MB. *Occitanomys alcalai*, **a)** left m2, ACBMB-29; **b)** left m3, ACBMB-38. *Paraethomys meini*, **c)** right M1, ACBMB-7; **d)** right M2, ACBMB-17. *Stephanomys dubari*, **e)** left m1, ACBMB-27; **f)** left M1, ACBMB-3; **g)** right M2, ACBMB-16. *Apocricetus* sp., **h)** right M3, ACBMB-43. *Ruscinomys* cf. schaubi, **i)** left m3, ACBMB-44. *Eliomys truci*, **j)** right m2, ACBMB-50. **k)** right M1, M2, ACBMB-47; *Eliomys* sp., **l)** right M3, ACBMB-48. *Muscardinus* cf. *vireti*, **m)** right M1, M2, ACBMB-49. Scale bar 1 mm.

Table 3. Measurements in millimetres of the teeth of *Stephanomys dubari* from ACB MB. m1 = first lower molar; m2 = second lower molar; m3 = third lower molar; M1 = first upper molar; M2 = second upper molar; M3 = third upper molar.

Element	Parameter	Nº of elements	minimum	mean	maximum
m1	Length	2	2.05	2.13	2.21
	Width	2	1.27	1.34	1.45
m2	Length	3	1.54	1.61	1.69
	Width	3	1.54	1.57	1.59
m3	Length	3	1.34	1.35	1.36
	Width	3	1.20	1.22	1.23
M1	Length	8	2.33	2.40	2.50
	Width	8	1.65	1.72	1.78
M2	Length	4	1.64	1.70	1.78
	Width	4	1.65	1.70	1.77
M3	Length	1	1.17	1.22	1.25
	Width	1	1.13	1.16	1.19

M1. The t1 is displaced slightly backwards with respect to the t3. The t1 bis is well developed, while the t2 bis is smaller. The t1 and t3 are connected to the t5 by longitudinal crests, being the labial crest usually higher. The t4-t5-t6-t8-t9 are connected by high crests. There is a small t12. There are three roots.

M2. The t1 is large, and a small t1 bis is attached to its posterior side. The connection between t1 and t5 is very low (Fig. 3g). The t3 is isolated, although in one there is a very low crest connecting t3 and t5. The t4, t5, t6 and t9 are connected by high crests. There is a much-reduced t12. There are three roots.

M3. The t1, t4, t5 and t6 are connected. There is no t3. In three specimens, a spur arises from the t8 directed towards the t6, and in another one these cusps are connected by a crest. There are two roots.

Remarks. The height of the crown, development of longitudinal crests in the lower molars and distal crests or spurs on the t1 and t3 of the upper molars suggest that these specimens belong to the genus *Stephanomys*. These molars are smaller, less hypsodont and with a less pronounced stephanodonty than the *Stephanomys* identified in the Pliocene and Pleistocene (see Minwer-Barakat *et al*., 2011, and references therein).

Stephanomys dubari belongs to the anagenetic lineage *Occitanomys adroveri-Stephanomys ramblensis* van de Weerd 1976-*Stephanomys dubari-Stephanomys cordii* Ruiz-Bustos, 1986, in which there is a progressive increase in size and stephanodonty along time (García-Alix *et al*., 2008a). The specimens from ACB MB are larger, more hypsodont and with a more pronounced stephanodonty than *S. ramblensis*, in which the longitudinal crest of the m1 is sometimes directed to the protoconid, and the t1 and t3 of the M1 and M2 rarely develop full longitudinal crests (García-Alix, 2006; García-Alix *et al*., 2008a). These molars are smaller and have less developed longitudinal connections in M1 and M2 than *S. cordii* from AL2-C and AL2-D (Mansino *et al*., 2013) and *Stephanomys* aff. *cordii* from AC-0 (Mansino *et al*., 2015a). The longitudinal connection of m3 usually arises from the metaconid in *S. dubari*, as in the specimens from ACB MB, while in *S. cordii* this crest arises from the protoconid (Cordy, 1976).

In *Stephanomys dubari* the t1 is displaced slightly more backwards than in *S. cordii*. However, in the specimens from ACB MB this cusp is close to the position of the t3 except in three molars. Despite this, because of their size and development of the longitudinal connections, we ascribe the material from ACB MB to *S. dubari*.

Family **Cricetidae** Fischer, 1817
Subfamily Cricetodontinae Stehlin & Schaub, 1951
Genus *Apocricetus* Freudenthal *et al.*, 1998
Type species *Cricetus angustidens* Depéret, 1890

Apocricetus sp.
(Fig. 3h)

Material. 1 M3 (ACBMB-43).

Measurements. M3: L=1.75 x W=1.44.

Description. Moderately developed lingual anteroloph. The protocone is not separated from the lingual border. The labial anteroloph is long and connected to the paracone. The anterior protolophule, posterior protolophule and anterior metalophule are complete, but the anterior protolophule is lower than these other two crests (Fig. 3h). The posterolingual corner is rounded. The posterosinus is reduced. Roots are not preserved.

Remarks. Traditionally, size has been the main criterion to distinguish between the different species of the genus *Apocricetus* (Freudenthal *et al.*, 1998), although it is indeed the quantification of the morphological characters the best way to discern between them (Mansino *et al.*, 2014; Ruiz-Sánchez *et al.*, 2014). The size of the only M3 from ACB MB is consistent with the largest specimens of *A. plinii* (Freudenthal *et al.*, 1991) and *A. alberti* Freudenthal *et al.* 1998, and with the smallest M3 of *A. barrierei* (Mein & Michaux, 1970). This molar is larger than *Apocricetus* aff. *plinii*, and much smaller than *A. angustidens* (Depéret, 1890) (Freudenthal *et al.*, 1998; García-Alix *et al.*, 2008b; Mansino *et al.*, 2014; Ruiz-Sánchez *et al.*, 2014).

In the M3 of *Apocricetus*, the most diagnostic character is the proportion of presence/absence of the anterior protolophule. This crest is more frequent in *A. plinii* and *A. alberti* than in *A. barrierei*, but it is also relatively common in this latter species (Mansino *et al*., 2014; Ruiz-Sánchez *et al.*, 2014). The presence of just one specimen precludes assigning it to any particular species until more material becomes available. Thus, we assign this molar to *Apocricetus* sp.

Genus *Ruscinomys* Depéret, 1890
Type species *Ruscinomys europaeus* Depéret, 1890

Ruscinomys cf. *schaubi* Villalta & Crusafont Pairó, 1956
(Fig. 3i)

Material. 1 M3 (ACBMB-44).

Measurements. M3: L=2.28 x W=1.63 x H: 2.67.

Description. The molar has two lobes, delimited by sinus and mesosinus, being the anterior lobe larger. Roots are not preserved.

Remarks. The general morphology and great hypsodonty of the specimen suggest that it belongs to the genus *Ruscinomys*. However, the M3 lack most of the diagnostic features that allow distinguishing between the different species of the genus.

The size of the molar agrees with the largest specimens of *R. schaubi* from Los Mansuetos (Adrover, 1969) and Aljezar B (Adrover, 1986), being larger than *R. lasallei* Adrover, 1969, from Alcoy, and smaller than *R. europaeus* Depéret, 1890 from Nîmes (Adrover, 1969). The M3 of *R. schaubi* is less reduced and more similar to the M2 than in *R. lasallei* (Adrover, 1969). Since the posterior lobe of the specimen from ACB MB is well developed, we ascribe this specimen to *Ruscinomys* cf. *schaubi*.

Family **Gliridae** Muirhead, 1819
Subfamily Dryomyinae de Bruijn, 1967
Genus *Eliomys* Wagner, 1840
Type species *Eliomys melanurus* Wagner, 1840

Eliomys truci Mein & Michaux, 1970
(Figs 3j-k)

Material. 1 p4 (ACBMB-45), 1 m1 (ACBMB-46), 1 M1/2 (ACBMB-47), 1 M3 (ACBMB-48).

Measurements. p4: L=1.20 x W=1.06; m1: L=1.26 x W=1.29; M1/2: L=1.05 x W=1.32; M3: L=0.98 x W=1.25.

Description.

p4. Subtriangular outline. The protoconid and the large anterolophid create a high, triangular anterior complex, which is separated from the metaconid by a narrow furrow. There is a long centrolophid, which almost reaches the protoconid. The mesoconid and entoconid are connected by the mesolophid, and separated from the anterior complex by a deep valley. The mesoconid and hypoconid are separated. There is a discontinuous posterotropid. The posterolophid is high and curved. Roots are not preserved.

m1. Rectangular outline. The anterolophid is connected to the protoconid. Metalophid and metaconid are connected basally. The centrolophid is long and not connected to the metalophid. There is a long posterotropid. The hypoconid is large. Roots are not preserved.

M1/2. Trapezoidal outline. The anteroloph is connected to the protocone. The paracone and metacone are high and separated. Straight protoloph and metaloph. The precentroloph is absent, but there is a short postcentroloph (Fig. 3j). The posteroloph is discontinuous, and connected to the endoloph. Roots are not preserved.

M3. Trapezoidal outline. The anteroloph is connected to the protocone. The paracone and metacone are high and separated. The protoloph and metaloph are slightly sinuous (Fig. 3k). Both centrolophs are absent. There is a continuous endoloph. Roots are not preserved.

Remarks. The molars from ACB MB agree in size with *E. truci* and the smaller specimens of *E. yevesi* Mansino *et al.*, 2014, being larger than the other Miocene representatives of the genus: *E. lafarguei* Aguilar *et al.*, 2007, *E. assimilis* Mayr, 1979 and *E. reductus* Mayr, 1979. The teeth from ACB MB are clearly smaller than those of the Pliocene form *E. intermedius* Friant, 1953, and those of the Pleistocene and extant *E. quercinus* (Linnaeus, 1766) (see Mansino *et al.*, 2015b).

The presence of a long centrolophid and a long posterotropid in the lower molars and absent or reduced centrolophs in the upper molars also agrees with *Eliomys truci*. The shape of these teeth is more quadrangular than those of *E. reductus* and *E. assimilis*; they further differ from *E. assimilis* by the absence of accessory crests in the upper molars, and from *E. reductus* by the presence of posterotropid and a discontinuous endolophid. The specimens from ACB MB have a longer centrolophid than *E. lafarguei*, which also has a continuous endolophid, and less developed centrolophs in the upper molars than *E. yevesi*, *E. intermedius* and *E. quercinus*.

Eliomys sp
(Fig. 3l)

Material. 1 M1/2 (ACBMB-49).

Measurements. M1/2: L=1.26.

Description. Molar broken lingually. The anteroloph is separated from the paracone and protoloph. The paracone and metacone are high and separated. The protoloph and metaloph are continuous and slightly sinuous. There is a well-developed precentroloph (Fig. 3l), connected to the metacone.

Remarks. This specimen is clearly larger, more concave and has a longer precentroloph than the other molars of *Eliomys* from ACB MB (see Figs 3j-k, 3l). Its size is consistent with the smaller specimens of *E. intermedius* and the larger ones of *E. yevesi* (Mansino *et al.*, 2015b), and the long precentroloph is more common in these species than in *E. truci* (Adrover, 1986; García-Alix *et al.*, 2008b; Mansino *et al.*, 2015b). However, this molar is smaller than the specimens of *Eliomys* aff. *intermedius* from ACB 4 (Gil & Sesé, 1985).

Mansino *et al.* (2015b) defined the lineage *E. truci–E. yevesi–E. intermedius–E. quercinus*, in which there is a trend towards the development of centrolophs in the upper molars, and a reduction of the accessory crests in the lower molars. These authors explained the presence of two different species of *Eliomys* in a number of Pliocene localities such a Villalba Alta, Séte, Orrios 3 (Adrover, 1986), La Gloria 4 (Adrover *et al.,* 1988) and TCH-13 (García-Alix *et al.,* 2008b), by a process of cladogenesis near the Mio/Pliocene boundary, following the previous works by Adrover (1986) and García-Alix *et al*. (2008b). These localities have yielded material of a small *Eliomys*, *E. truci*, and a much larger one, *E. intermedius*. However, the scarce material available of the larger form in ACB MB does not allow a specific ascription, since its size and morphology fall within the variability of both *E. yevesi* and *E. intermedius*.

Subfamily Glirinae Thomas, 1897
Genus *Muscardinu*s Kaup, 1829
Type species *Mus avellanarius* Linnaeus, 1758

Muscardinus cf. *vireti* Hugueney & Mein, 1965
(Fig. 3m)

Material. 1 M2 (ACBMB-50).

Measurements. M2: L>1.32 x W>1.36.

Description. Digested specimen; it lacks the enamel of the lingual and posterior sides. The outline is subquadrangular. There are eight low ridges, slightly concave towards the posterior side of the molar except the first one, which is straight. Both the sixth and the seventh ridges bifurcate near the labial border, creating two small extra ridges (Fig. 3m). Roots are not preserved.

Remarks. The extremely flat occlusal outline and high number of ridges are characteristic of *Muscardinus*. There are six species of *Muscardinus* that have eight ridges in the M2: *M. sansaniensis* (Lartet, 1851), *M.* aff. *sansaniensis, M. vallesiensis* Hartenberger, 1967, *M. vireti* Hugueney & Mein, 1965*, M. helleri* Fejfar & Storch, 1990 and *M. meridionalis* García-Alix *et al*., 2008c.

The size of the specimen is consistent with *M. meridionalis* and *M. vireti*, being smaller than *M. vallesiensis* and *M. helleri*, and larger than *M. sansaniensis* (data from García-Alix *et al.*, 2008c). The presence of extra ridges in M2 differs from *M. helleri* and *M. meridionalis* (García-Alix *et al.*, 2008c; Colombero *et al.*, 2014). Therefore, we assign the M2 from ACB MB to *Muscardinus* cf. *vireti*.

Family **Sciuridae** Fischer, 1817
Subfamily Pteromyinae Brandt, 1855
Genus *Heteroxerus* Stehlin & Schaub, 1951
Type species *Xerus grivensis* Forsyth Major, 1893

Heteroxerus sp.

Material. 1 m2 (ACBMB-51).

Description. The specimen is broken lingually. There is a well-developed anterior cingulum, which bears a double anteroconulid. The protoconid and hypoconid are large and high, and connected to the mesoconid by low crests. Roots are not preserved.

Remarks. The small size and well-developed labial cingulum of the specimen are typical traits of *Heteroxerus*, differing from the genus *Atlantoxerus* (Cuenca-Bescós, 1988). However, the scarcity and poor state of preservation of this molar prevents us from reaching a specific ascription.

Order CHIROPTERA Blumenbach, 1779
Suborder Microchiroptera Dobson, 1875
Family **Vespertilionidae** Gray, 1821
Genus *Myotis* Kaup, 1829
Type species *Vespertilio myotis* Borkhausen, 1797

Myotis sp.
(Figs 4a-d)

Material. 1 c (ACBMB-77), 1 m1 (ACBMB-61), 1 m2 (ACBMB-85), 1 C (ACBMB 73), 1 M1 (ACBMB-62), 1 M2 (ACBMB-63).

Measurements. c: L=1.13 x W=0.99; m1: Trw=1.38; C: L=1.20 x W=1.05; M2: L=1.71 x W=1.92.

Description.

c. Subelliptical tooth. There is a narrow lingual cingulum and a wide labial cingulum that reaches the posterior side of the molar (Fig. 4a). The cingulum bears a small cuspid on its posterolabial side, which encloses a small valley. Roots are not preserved.

m1. This molar is broken labially. There is a 'V' shaped paralophid. The protoconid is the highest cusp of the trigonid. The paraconid, the metaconid and the entoconid are aligned in occlusal view. The entocristid is convex on its anterior side, and concave on its posterior side. The labial cingulum is broken posteriorly. The lingual cingulum is absent. Roots are not preserved.

m2. The trigonid is the only cusp preserved. The morphology is similar to that of the m1, but this element is narrower. Roots are not preserved.

C. Teeth rounded in cross section. The cingulum borders the main cusp (Fig. 4b). The labial side of this cingulum is wide. There is one well-developed root.

M1. Subquadrangular tooth. The parastyle is broken. The anterior cingulum is narrow and connected to the protocone. Another cingulum is present on the anterior side of the protocone. The labial cingulum of the paraflex is small and the labial cingulum of the metaflex is better developed. The metacone is slightly higher than the paracone. The ectoloph is very symmetric. The mesostyle is narrow. The paraloph, metaloph and paraconule are small. There is a short postprotocrista. Both the talon and hypocone are absent. The cingulum of the talon is wide (Fig. 4c). The distal cingulum is labially connected to the metastyle. Roots are not preserved.

M2. The M2 is similar to the M1, but the parastyle is more developed (Fig. 4d). The anterior cingulum of the protocone is wider than in the M1. The labial cingulum of the paraflex is smaller. The ectoloph is less asymmetric than in the M1. The paraloph is absent, and the distal cingulum is not connected to the metastyle on the labial side. Roots are not preserved.

Remarks. The presence of metaloph in the upper molars and a paraloph and a small paraconule in M1 are characteristic of the genus *Myotis*. These teeth differ from the similar genus *Leuconoe* by not having a well-developed paraconule (Ziegler, 2000, 2003).

The presence of both metaloph and paraloph in the specimens from ACB MB differs from *Myotis myotis* (Borkhausen, 1797)*, Myotis blythi* (Tomes, 1857), *Myotis nattereri* (Kuhl, 1817), *Myotis intermedius* Ziegler, 2000 and *Myotis darelbeidensis* Gunnell *et al*., 2011 (Ziegler, 2000; Gunnell *et al.*, 2011). *Myotis elegans* Baudelot, 1972 differs from our specimens by its high and more anterior protocone, while in *Myotis boyeri* Mein, 1965 the postprotocrista joins the posterior cingulum (Sevilla & Chaline, 2004).

The teeth of *Myotis minor* Ziegler, 2000 is smaller than our material, and has well-developed metaloph and paraloph in the M2 and a complete lingual cingulum (Ziegler, 2000). Meanwhile, *Myotis korotkevichae* Rosina & Semenov, 2012 differs from the teeth from ACB MB by its M2 with hyperdeveloped metaloph and paraloph (Rosina & Semenov, 2012).

Although the metaloph is poorly developed and the paraloph resembles *Myotis bavaricus* Ziegler, 2003, the absence of the paraconule in this species differs from our specimens. The presence of a paraconule in the M1 from ACB MB disagrees with *Myotis mystacinus* (Kuhl, 1817) (Galán *et al.*, in press). *Myotis reductus* Ziegler 2003 differs from our material since the metaloph, paraloph, metaconule and paraconule, are missing, and thus showing a complete lingual cingulum. The upper molars of *Myotis bechsteini* (Kuhl, 1817) have weak traces of paralophes but no metalophes (Rosina & Kruskop, 2011). Finally, *Myotis emarginatus* (Geoffroy, 1806) differs from the studied specimens by having a metaconule, which is well developed in the M2 (Popov, 2004).

The remains from ACB MB are morphologically similar to the extant *Myotis daubentonii* (Kuhl, 1817) and *Myotis brandtii* (Eversmann, 1845), although they differ from these species by the presence of a small paraloph, metaloph and paraconule (Sevilla & Chaline 2004). These authors designate *Myotis delicatus* Heller, 1936 as a probably Plio/Pleistocene ancestor of both species, but Ziegler (2003) placed this species in the genus *Leuconoe*. Another similar species is the Pliocene *Myotis podlesicensis* Kowalski, 1956, because it has both metaloph and paraloph (Rosina & Kruskop, 2011). The lack of more diagnostic characters prevents a specific ascription, but we consider the specimens from ACB MB to be related to the extant species *M. daubentonii* and *M. brandti*, and to the Pliocene species *M. podlesicensis*.

Genus *Miniopterus* Bonaparte, 1837
Type species *Vespertilio schreibersii* Kuhl, 1817

Miniopterus fossilis Zapfe, 1950
(Figs 4e-i)

Material. 1 p3 (ACBMB-83), 1 m1 (ACBMB-52), 1 m2 (ACBMB-53), 1 M1 (ACBMB-55), 1 M3 (ACBMB-54).

Measurements. p3: L=0.96 x W=0.84; m1: L=1.43 x Trw=0.87 x Taw=0.91; m2: L=1.37 x Trw=0.96 x Taw=0.95; M3=1.37 x 1.69.

Description.

p3. Rectangular shape. Two edges are present in the cusp, the lingual edge more developed than the labial one, and three facets. The labial side is more developed. The posterior part of the tooth is wider than anterior one. The cingulum is well developed, and irregular on its lingual side. A small cuspule is present in both the anterolingual and the posterolingual sides. There are two roots (Fig. 4e).

m1. Nyctalodont tooth, with a 'V' shaped paralophid. The protoconid is the highest cusp of the trigonid. The paraconid, the metaconid and the entoconid are aligned in occlusal view. The hypoconulid is labially displaced respect the entoconid. The entocristid is concave. The distal base of the trigonid, in the centre of the talonid, has a small spur (Fig. 4f). The lingual cingulum is small. The labial cingulum is wide and connects the base of the paraconid to the hypoconulid. Roots are not preserved.

m2. The tooth is similar to m1 (Fig. 4g), but the spur arising from the trigonid is more developed. Roots are not preserved.

M1. Subquadrangular tooth. The parastyle is broken. The anterior cingulum is wide and connected to the protocone. An independent cingulum is present on the anterior side of the protocone. The labial cingulum of the paraflex and the metaflex are small. The height of the metacone and paracone is similar. The mesostyle is narrow. The metaloph and paraloph are well developed. There is a short postprotocrista. The hypocone is small and connected to the protocone. The talon is small (Fig. 4h). The cingulum of the talon is wide. The distal cingulum is connected to the cingulum of the talon on the lingual side, and not connected to the metastyle on the labial side. Roots are not preserved.

M3. Subtriangular tooth (Fig. 4i). The parastyle is inflated. The anterior cingulum is wide and connected to the protocone, but not to the parastyle. An independent anterior cingulum is present in the protocone. The metacone is reduced. Both the metastyle and the postmetacrista are absent. The paraloph is well developed. The postprotocresta is short and connected to small metaconule. The talon is reduced to a small cingulum. Roots are not preserved.

Remarks. The remains from ACB MB present many of the typical features of *Miniopterus*, such as a two-rooted p3, nyctalodont lower molars and a well-developed talon in the M1 (Popov, 2004). The specimens of *M. fossilis* from Petersbuch 18 (Ziegler, 2003) are similar to our material in size and morphology, presenting a lingual cingulum of the trigonid, a complete labial cingulum (although wider in ACB MB molars), and a small spur in the posterior side of the trigonid.

Order EULIPOTYPHLA Waddell, Okada & Hasegawa, 1999
Suborder Soricomorpha Gregory, 1910
Family **Soricidae** Fischer, 1814
Tribe Nectogalini Anderson, 1879

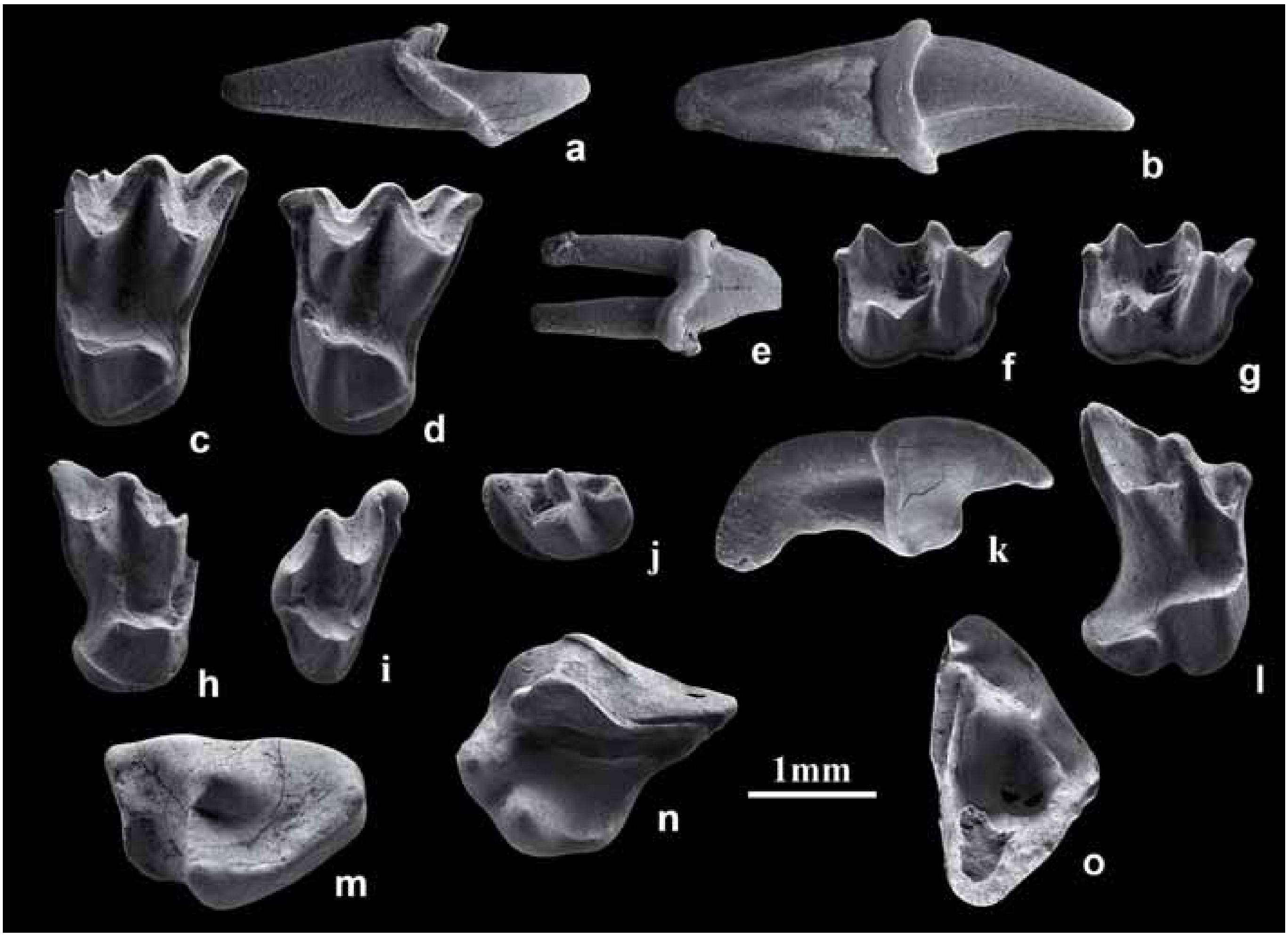

Figure 4. Insectivores and chiropterans from ACBMB. *Myotis* sp., **a)** right c, ACBMB-77; **b)**, right C, ACBMB-73; **c)**, left M1, ACBMB-62; **d)**, left M2, ACBMB-63; *Miniopterus* cf. *fossilis*, **e)**, left p3, ACBMB-83; **f)**, right m1, ACBMB-52; **g)**, right m2, ACBMB-53; **h)**, left M3, ACBMB-54; **i)** right M1, ACBMB-55. *Asoriculus gibberodon*, **j)**, right I1, ACBMB-69; **k)**, left m3, ACBMB-84; **l)** right M1, ACBMB-68. *Parasorex* cf. *ibericus*, **m)**, right p4, ACBMB-80; **n)**, right P3, ACBMB-66; **o)**, right P3, ACBMB-67. Scale bar 1 mm.

Genus *Asoriculus* Kretzoi, 1959
Type species *Crocidura gibberodon* Petényi, 1854

Asoriculus gibberodon (Petényi, 1854)
(Figs 4 j-l)

Material. 1 m1/2 (ACBMB-81), 2 m3 (ACBMB-82, ACBMB-84), 1 I1 (ACBMB-69), 3 M1 (ACBMB-64, ACBMB-65, ACBMB-68).

Measurements. m3: L=1.17 x W=0.64; L=1.21 x W=0.67; I1: L=1.43 x LT=0.65 x H=1.13; M1: PE=1.13 x AW=1.61 x PE=1.16 x LL=1.41 x AW=1.65 x BL=1.40 x PE=1.06 x LL=1.35 x AW=1.67 x PW=2.11.

Description.
m1/2. The trigonid is the only part preserved. The paralophid and metalophid are 'V' shaped. The metaconid and the paraconid have similar height. There is a wide labial cingulum. Roots are not preserved.

m3. The talonid is reduced (Fig. 4j). There are both hypoconid and entoconid. The oblique crest and entocristid are close to contact at the base of the trigonid. The height of the metaconid and paraconid is similar. Paralophid and metalophid are 'V' shaped. The depression of the trigonid is open and 'V' shaped. The protoconid is the highest cusp. The basal cingulum is complete, and wider on the labial side. Roots are not preserved.

I1. The single principal cusp is curved. A well-developed cingulum borders the base of the crown (Fig. 4k). Two cusps are present in the ventral side of the cingulum. Roots are not preserved.

M1. The metaloph does not reach the hypocone. There is a well-developed hypoconal flange and a pronounced posterior emargination. The hypocone is high and conical in one specimen and high and elongated in another one

(Fig. 4l). The basal connection between the hypocone and posteroloph is developed. The preprotocrista is in contact with the paracone. The parastyle and mesostyle are rounded. The paracrest is the shortest crest in the ectoloph. The paramesocrest is longer than the postmesocrest. The metastyle is long. The metacone is higher than the paracone. The ectoloph is very asymmetric. Roots are not preserved.

Remarks. *Asoriculus gibberodon* is characterized by the presence of a small basin in the talonid of the m3 (Reumer, 1984), more reduced than in the genus *Neomys* (Furió, 2007). Moreover, the lower molars have a complete basal cingulum (Furió, 2007). Reumer (1984) described two different morphologies for the connection between hypocone and posteroloph (A, with isolated and well-developed hypocone; B, with a connected hypocone and posteroloph). The specimens from ACBM MB agree with morphotype B, but one of them has a well-developed hypocone, similar to morphotype A. This morphological variability is typical of *A. gibberodon* (Reumer, 1984), but our material is smaller than the Plio/Pleistocene populations of this species from Fuente Nueva 3 and Barranco León (Furió, 2007).

Asoriculus gibberodon is common during the Pliocene of Europe (Furió & Angelone, 2010), but the oldest remains come from the MN12 of Tardosbanya (Mészáros, 1998), and it has been described in the MN13 sites of Polgárdi (Mészáros, 1999), Brisighella (Rofes & Cuenca-Bescós, 2006) and near the Mio/Pliocene boundary in Maramena (Doukas *et al*., 1995). Therefore, it is possible to ascribe the specimens from ACB MB to *Asoriculus gibberodon.*

Family **Erinaceidae** Fischer, 1814
Subfamily Galericinae Pomel, 1848
Tribe Galericini Pomel, 1848
Genus *Parasorex* von Meyer, 1865
Type species *Parasorex socialis,* von Meyer, 1865

Parasorex cf. *ibericus* (Mein & Martín-Suárez, 1994)
(Figs 4 m-o)

Material. 1 i2 (ACBMB-78), 2 p1 (ACBMB-75, ACBMB-76), 1 p3 (ACBMB-71), 1 p4 (ACBMB-80), 2 I2 (ACBMB-74, ACBMB-79), 1 P1 (ACBMB-72), 1 P2 (ACBMB-70), 1 P3 (ACBMB-66), 1 M3 (ACBMB-67).

Measurements. i2: L=0.58 x W=0.87; p1: L=1.25 x W=0.64; L=1.11 x W=0.68; p3: L=1.53 x W=0.90; p4: L=2.15 x W=1.28; I2: L=0.88 x W=0.66; P1: L=1.42 x W=0.81; P2: L=1.39 x W=0.78; P3: L=2.23 x W=1.76; M3: L=1.37 x W=2.25.

Description.

i2. The tooth is thickened, with a principal flat cuspid and an accessory cuspule. There is one large root.

p1. The tooth has an elliptical shape. There is a principal cuspid, a well-developed anterior cuspule and a smaller posterior one. There is one large root.

p3. The tooth has a subtriangular shape. Irregular posterior side. There are two roots.

p4. Subrectangular tooth. The paraconid is high, being connected to the paralophid without a clear differentiation between them. The paralophid is straight. The trigonid depression is small. The protoconid is better developed than the metaconid (Fig. 4m). The posterior cingulum is well developed, and it bears a small cuspule near to the lingual side. There are two roots.

I2. The tooth has a tear-like shape. The principal cusp is rounded in cross section, and slightly curved. A small cuspule is present in its posterior side. There is one root.

P1. The tooth has a tear-like shape in occlusal view. There is a cuspule in the posterior part. There are two roots

P2. The tooth has a subtriangular shape, rounded on its anterior side. There is a small cuspule. There are two roots.

P3. Subquadrangular tooth, without enamel on its labial side. The parastyle is absent. The paracone is the largest cusp (Fig. 4n). The protocone is higher than the hypocone, and isolated from this latter cusp. There is a short paramesocrista. The posterior cingulum is wide. Roots are not preserved.

M3. The tooth is triangular. The parastyle is well developed. The anterior cingulum is wide and connected to the parastyle. The paracone is connected to the parastyle. The depression of the trigonid is closed. The protocone is the largest cusp. The posterior cingulum is absent (Fig. 4o). Roots are not preserved.

Remarks. The presence of a triangular M3 is characteristic of the subfamily Galericinae (Lopatin, 2006), and having a metaconid in p3 is a typical trait of the genus *Parasorex* (Hoek Ostende, 2001). The absence or reduced posterior cingulum in the M3 is a typical feature of *P. ibericus* (Mein & Martín-Suárez, 1994). Therefore, we ascribe this material to *Parasorex* cf. *ibericus*.

4. BIOSTRATIGRAPHY

The faunal list of ACB MB is shown in table 4. The co-occurrence of *Occitanomys alcalai*, *Paraethomys meini* and *Stephanomys dubari* is typical of the late Turolian/earliest Ruscinian (García-Alix *et al*., 2008a, 2008d).

Muscardinus vireti is present in the late Turolian localities of Lissieu and Junqueras 2B, being replaced by its descendant, *M. meridionalis* near the Mio/Pliocene boundary (García-Alix *et al*., 2008c). The specimen from ACB MB belongs to the lineage *M. meridionalis-M. vireti*, but its ascription is uncertain because of the scarcity of the material.

Table 4. Faunal list of the locality ACB MB.

Muridae	Cricetidae	Gliridae	Sciuridae	Soricidae	Erinaceidae	Vespertilionidae
Occitanomys alcalai	*Apocricetus* sp.	*Eliomys truci*	*Heteroxerus* sp.	*Asoriculus gibberodon*	*Parasorex* cf. *ibericus*	*Myotis* sp.
Paraethomys meini	*Ruscinomys* cf. *schaubi*	*Eliomys* sp.				*Miniopterus fossilis*
Stephanomys dubari		*Muscardinus* cf. *vireti*				

Nevertheless, the presence of some remains of *Paraethomys* close in size to the Pliocene *Paraethomys* aff. *abaigari* and two species of *Eliomys*, which hitherto had only been described in Pliocene localities (Adrover, 1986; Castillo, 1990; Mein *et al*., 1990; García-Alix *et al*., 2008b), suggests that the age of ACB MB may be indeed early Ruscinian. This age makes ACB MB probably the oldest locality with two different *Eliomys* species, since the only other locality from the MN14 with two *Eliomys* is La Gloria 4 (Mein *et al*., 1990), and the other known localities are assigned to MN15/MN16 (Mein *et al*., 1990; García-Alix *et al*., 2008b). This supports the hypothesis of a late Miocene cladogenetic speciation process of *Eliomys*, giving rise to the lines of *E. truci* and *E. yevesi*-*E. intermedius* near the Mio/Pliocene boundary (García-Alix *et al*., 2008b; Mansino *et al*., 2015b). Furthermore, this dating makes of *Miniopterus fossilis* from ACB MB the youngest record of this species, which until now was the MN13 site of Salobreña (Aguilar *et al*., 1984).

An early Pliocene age makes ACB MB one of the oldest localities from the Almenara-Casablanca complex, being only younger than nearby late Turolian site of ACB M (Agustí *et al*., 2011) (Figs 1-2). In this locality, Agustí *et al.* (2011) described an assemblage typical of the MN13, clearly older than ACB MB by the presence of *Stephanomys ramblensis*, *Occitanomys adroveri*, *Apodemus gudrunae* and *Apocricetus alberti*. Furthermore, ACB M has yielded a number of taxa with African and Asian affinities, such as the gerbils *Debruijnimys almenarensis* and *Pseudomeriones abbreviatus* and the myocricetodontines *Myocricetodon jaegeri* and *Calomyscus* sp. (Agustí *et al*., 2011), which are absent in ACB MB.

5. PALAEOECOLOGY

The analysis of the proportions of the micromammal species has been extensively used in palaeoclimatic reconstructions. The minimum sample size has been placed in 100 specimens by some authors (Daams *et al.*, 1999; García-Alix *et al.*, 2008e), while others considered samples over 50 diagnostic elements to be acceptable (Casanovas-Vilar & Agustí, 2007). Since ACB MB has yielded 93 identifiable remains (Table 5), we consider proper to perform a palaeoecological analysis of this locality.

In this work, we have followed the ecological affinities proposed by García-Alix *et al.* (2008e) and Freudenthal *et al.* (2014) in order to attempt a palaeoclimatic reconstruction of ACB MB. These affinities are summarized in Table 5.

Eurytopic taxa are the most numerous in the three environmental categories considered (temperature, humidity and habitat, Table 5). However, the relative abundance of warm indicators (42.36 %, Table 5) and the higher proportion of wet indicators respect dry indicators (23.54 *versus* 18.82 %, Table 5) would point to a warm and relatively humid environment, and the presence of forest taxa suggest some degree of vegetation cover (Table 5). This scenario is more humid than the conditions inferred for ACB M by Agustí *et al*. (2011), which are regarded as dry and sub-desertic.

The analysis of fossil micromammal communities shows a moderate increase in humidity from the latest Messinian towards the Early Pliocene in the Granada Basin (García-Alix *et al.*, 2008e; García-Alix, 2015), and a marked reduction of dry indicators from the Miocene/Pliocene boundary to the early Pliocene in the Alcoy Basin (Mansino *et al.*, in press). Under this frame, the apparent lack of gerbils in ACB MB, which are considered typical of desertic environments, may be a consequence of a shift towards wetter conditions in the early Pliocene. However, more intense sampling must be performed before discarding the presence of these taxa in ACB MB, and for the moment these considerations are just speculative.

6. CONCLUSIONS

The new site of ACB MB has yielded remains of *Occitanomys alcalai*, *Paraethomys meini*, *Stephanomys dubari*, *Eliomys truci*, *Eliomys* sp., *Muscardinus* cf. *vireti*, *Apocricetus* sp., *Ruscinomys* cf. *schaubi*, *Heteroxerus* sp., *Myotis* sp., *Miniopterus fossilis*, *Asoriculus gibberodon* and *Parasorex* cf. *ibericus*. This faunal assemblage suggests an earliest Ruscinian age, close to the Mio/Pliocene boundary, for this locality.

Table 5. Palaeoecological affinities of the taxa from ACB MB. The relative abundance (RA) of each taxon is calculated following Martín-Suárez (1988), dividing the number of specimens (N) by the number of diagnostic elements (DE) of each group.

	N	DE	N/DE	RA (%)	Temperature	Humidity	Habitat
Occitanomys alcalai	13	12	1.08	17.79	Warm	Humid	Eurytopic
Paraethomys meini	12	12	1.00	16.42	Warm	Dry	Eurytopic
Stephanomys dubari	30	12	2.50	41.06	Eurytopic	Eurytopic	Eurytopic
Eliomys	5	16	0.31	5.13	Eurytopic	Eurytopic	Eurytopic
Muscardinus	1	16	0.06	1.03	Eurytopic	Eurytopic	Forest
Apocricetus	1	12	0.08	1.37	Warm	Eurytopic	Open
Ruscinomys	1	12	0.08	1.37	Cold	Dry	Open
Heteroxerus	1	16	0.06	1.03	Warm	Dry	Open
Myotis	6	38	0.16	2.59	Unknown	Unknown	Unknown
Miniopterus fossilis	5	38	0.13	2.16	Unknown	Unknown	Unknown
Asoriculus gibberodon	7	20	0.35	5.75	Warm	Humid	Forest
Parasorex ibericus	11	42	0.26	4.30	Eurytopic	Eurytopic	Eurytopic
Total	93		6.09				
					Warm 42.36 % **Cold** 1.37 % **Eurytopic** 51.52 % **Unknown** 4.75 %	**Humid** 18.82 % **Dry** 23.54 % **Eurytopic** 52.89 % **Unknown** 4.75 %	**Open** 3.76 % **Forest** 6.77 % **Eurytopic** 84.71 % **Unknown** 4.75 %

The palaeecological analysis of the micromammal assemblage from ACB MB points to a warm and relatively humid environment, with some vegetation cover. These results contrast with those from the nearby locality of ACB M, in which the presence of gerbils suggests a sub-desertic environment. Since a trend towards more humid conditions from the latest Turolian to the earliest Ruscinian has been recorded in some Iberian basins such as the Granada and Alcoy basins, we hypothesize that a shift in the environmental conditions may affect the distribution of gerbils in the Iberian Peninsula.

In addition, the presence of two *Eliomys* species in ACB MB, a small form identified as *E. truci*, and a larger form belonging to the line *E. yevesi*-*E. intermedius*, represents the oldest record of two species of this genus in the same locality, supporting the hypothesis of a cladogenetic process of speciation during Late Miocene.

Finally, the remains of *Miniopterus fossilis* constitute the youngest record of this species, which until now was the MN13 site of Salobreña.

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