

Short Communication

No place for Pliocene tourists with Ockham's razor in the pocket: Comment on Crespo et al. (2023)

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Abstract

Crespo et al. (2023) have recently described a new genus and species called *Europotamogale melkarti*, purportedly an afrosoricid 'tourist genus' coming from central Africa to Spain during the Pliocene. The occurrence of this mysterious animal has been justified by means of a migration of thousands of kilometers leaving no other fossil evidence all along such an incredible journey. According to our analyses, this 'tourist genus' is surrounded by many inconsistent facts, which lead us to the conclusion that *Europotamogale* should not have been erected as a new taxon because its holotype (and only element yet known) belongs to a very different animal. We alternatively propose that this fossil is indeed a fragment of a tooth of a water-mole of the genus *Archaeodesmana*, which is a much more parsimonious hypothesis.

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1. Introduction

The fossil record is full of amazing treasures to be discovered. With every fossil find we get a better understanding of how life evolved in the past. As paleontologists, we are always excited to find out a new episode or animal never reported before. However, it is scientifically healthy not to overstimulate our imagination further away than the strict evidence. Likewise, it is advisable to keep our minds open to provide alternative hypotheses to our first impressions.

We found that in the recent publication by Crespo et al. (2023), the authors reported the unique find of a new

afrosoricid genus and species from a Pliocene locality in southern Spain. After a thorough reading of their paper, we found that the evidence provided to support the erection of a new taxon is too weak and the work includes many inconsistencies in several sections. In the forthcoming paragraphs we will summarize the most evident ones, which altogether lead us to the conclusion that the fossil element found in Moreda 3 is not a new taxon, but a mistake possibly brought about by wishful thinking.

2. No evidence of any other similar taxon in Spain or North Africa

The first and most surprising fact of a fossil Potamogalinae found in Spain is that there is no trace of any other similar form in thousands of kilometers around. The otter-shrews are endemic to sub-Saharan Africa, where

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only three living species exist nowadays, namely *Potamogale velox*, *Micropotamogale lamottei*, and *M. ruwenzorii*. Apparently, nothing is known about their evolutionary history based on fossil evidence. One can easily imagine that the absence of fossils in Central Africa could be due to insufficient sampling; however, if a stock of potamogaline populations had ever reached European lands, one would have expected fossils to have been found somewhere in their way. As it is, neither afrosoricids have ever been found in Spain, nor in North Africa.

The North of the African continent seems to have been an impassable natural boundary for otter-shrews. Anyone would expect that any successful population of potamogalines to arrive to Spanish lands in the Pliocene would have left some kind of fossil evidence in the extensively sampled sediments of the Neogene of Northwestern Africa, which is not the case (Stoetzel, 2013). Regarding the Spanish fossil record, such absence is even more notorious, because the small mammals from the Neogene period have been systematically studied since the 1960s, with extensive field campaigns leading to the recovery of huge collections of all kinds of mammal fossils (e.g., Daams and Freudenthal, 1988; Van Dam et al., 2006; Casanovas-Vilar et al., 2016). Therefore, the evolution of micromammal faunas in Spain through the Miocene and Pliocene is outstandingly well studied, especially in areas such as the Vallès-Penedès, Teruel, Cabriel, Fortuna, Granada or Guadix-Baza basins. Unlike in the case of some Paleozoic or Mesozoic time-intervals in Spain, which have a patchier fossil record or have only been explored in the last years (Furió et al., 2014), the chances to find a taxon in the Neogene much different to anything else found before are minimal. In fact, Peláez-Campomanes and Van der Meulen (2009) concluded that, unlike for the large mammals, the fossil record of small mammals at the time of publication was sufficiently complete in Europe to carry out palaeoecological studies based on the set of localities included in the NOW database (a database containing comprehensive information on Cenozoic land mammal localities and taxa, see Žliobaitė et al., 2023). In other words, there is little space for big surprises. The occurrence of an afrosoricid in the Pliocene of Spain unnoticed by several generations of paleontologists is therefore highly improbable. However, we are conscious that ‘the absence of evidence is not the evidence of absence’. So, the hypotheses proposed to explain the occurrence of this taxon in Spain deserve being checked.

3. Unsupported geological explanation (drift in Pliocene?)

The second point to be analyzed are the explanations to make reliable a migration of several thousands of kilometers from the core of Africa to the South of Spain. Crespo et al. (2023) provide two alternative hypotheses to justify the presence of an otter-shrew tooth in the Spanish fossil record. On the one hand, these authors invoke the Messinian Salinity Crisis (MSC) as a likely moment to take

over the Iberian Peninsula. The authors are right in that slightly before (~6.2 Ma) and during the Messinian Salinity Crisis (MSC, ~5.9–5.3 Ma), major faunal exchanges took place between the Iberian Peninsula and North Africa. However, these events were not only started by the “tourist taxa” pointed out by Crespo and colleagues (i.e., *Prolagus*, *Apodemus*, and two gerbillids). The European small mammals *Eliomys*, *Apodemus*, *Stephanomys*, *Castillomys*, *Occitanomys*, *Apocricetus*, *Ruscinomys* and *Prolagus* migrated to North Africa during this dispersal event as well (see a review in García-Alix et al., 2016). Micromammals of Iberian provenance are identified in Messinian and Early Pliocene localities from northeastern Tunisia to eastern Morocco (Jaeger, 1971; Brandy and Jaeger, 1980; Coiffait et al., 1985; Coiffait, 1991; Benammi et al., 1995, 1996; Geraads, 1998; Raynal et al., 1999; Gibert et al., 2013), and not only during the Pliocene in the Afro-Arabian coastline, as Crespo and colleagues suggested.

The opposite migratory route, from North Africa to the Iberian Peninsula, was followed by the rodents *Paraethomys*, *Myocricetodon* and *Debruijnimys*, as well as by large mammals such as *Paracamelus* and *Hexaprotodon* (Garcés et al., 1998, 2001; Agustí et al., 2006; Gibert et al., 2013; García-Alix et al., 2016; Minwer-Barakat et al., 2018), which are found in late Turolian and Ruscinian localities, frequently constrained by well-calibrated magnetostratigraphic sections (Garcés et al., 1998; Martín-Suárez et al., 2000; Gibert et al., 2013; Piñero et al., 2018). In other words, mammal migrations related with the MSC are well documented at the two sides of the Mediterranean by the frequent presence of the taxa during the late Turolian, sometimes extending to the early and even to the late Ruscinian. Other than suggested by Crespo and co-authors, these migrations are not comparable with the sudden and isolated appearance of an unknown immigrant taxon in southern Iberian Peninsula well into the Pliocene (latest Ruscinian, MN15), about two million years after the end of the MSC.

On the other hand, Crespo and colleagues suggest that this mysterious animal (or any of its ancestors) could have been already present in Andalusia before its connection with the rest of the Iberian Peninsula, as if it were synonym of the “Beached Viking Funeral Ship”. This idea is taken from Van Couvering and Delson (2020), who proposed this hypothesis in the context of the faunal exchanges between Iberia and North Africa during the MSC and their subsequent isolation due the reopening of the Gibraltar Strait. Hence, following Van Couvering and Delson (2020), this concept is not related to another type of dispersion event in the Iberian Peninsula, but to the very same hypothesis discussed above. In fact, the affirmations of Crespo and colleagues stating that “they [tenrecids] were already present in Andalusia before its connection with the rest of the Iberian Peninsula” and that “they arrived on the so-called ‘Beached Viking Funeral Ship’ (...), which could be applied to the part of Andalusia that went from being connected to

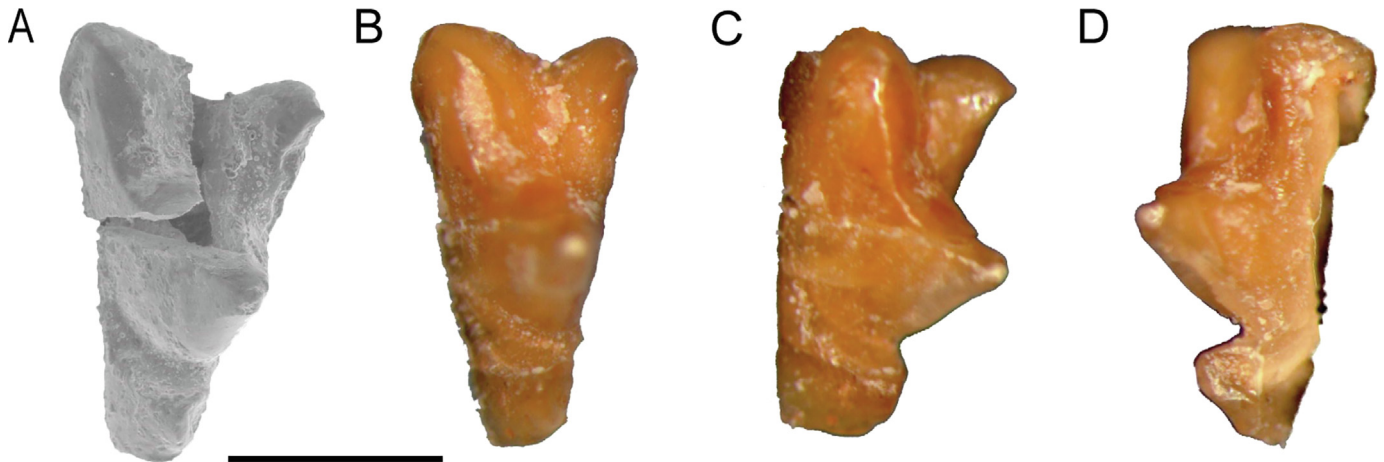


Fig. 1. Specimen MO3-A2-A3-1 from Moreda-3, described by Crespo et al. (2023) as the holotype of the purported new genus and species *Europotamogale melkarti*. (A) and (B) show the specimen in occlusal view; (C) and (D) correspond to posterior and anterior views, respectively, according to Crespo et al. (2023). Following our alternative hypothesis, (C) would correspond to an anterior view if the specimen were an anterolabial fragment of a left M2 or M3, but a posterior view in case it would be the posterolabial fragment of a right M2. Similarly, (D) would correspond to a posterior view if the specimen were an anterolabial fragment of a left M2 or M3, but an anterior view if the specimen is the posterolabial fragment of a right M2. Scale bar equals 1 mm. Reproduced from Crespo et al. (2023), with permission of the publisher (license number: 5682580838936).

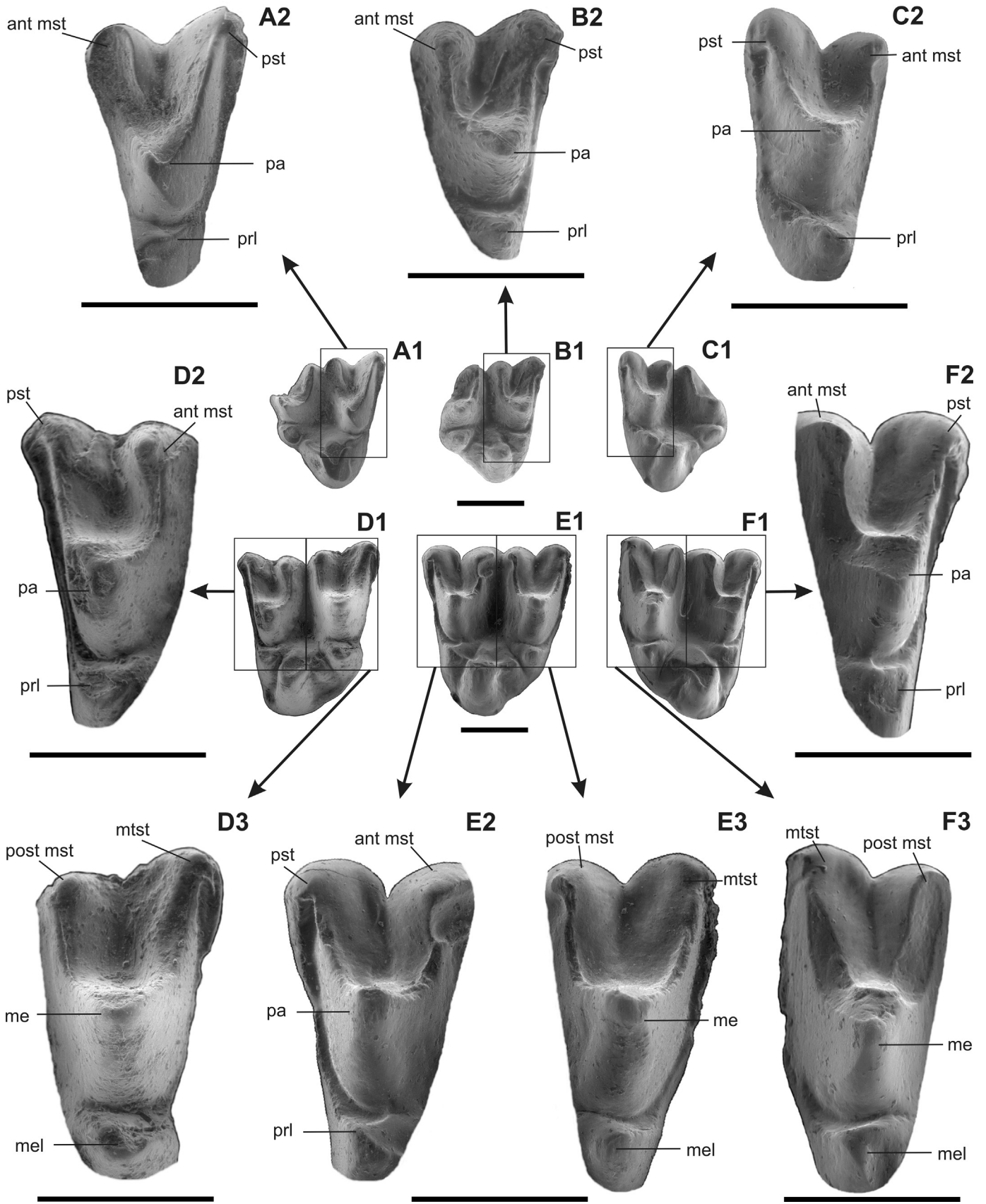
Africa to being connected to Europe” are not in line with the geodynamic evolution of the Betic-Rif system in the western Mediterranean area. Crespo and co-authors did not clarify when and how this phenomenon is supposed to have occurred, but the geological materials that nowadays are found in Andalusia were not connected in origin to Africa and relocated to Europe during the Neogene (Quesada and Oliveira, 2019). Anyway, the two hypotheses proposed by Crespo et al. (2023) would imply that tenrecid specimens would have arrived to the Betic area in the Miocene and “stay hidden” for several million years until they appeared in Moreda 3 fossil site in the Pliocene (MN15), which is extremely unlikely.

4. Dubious provenance of the fossil

A third controversial point is the origin of the material. The exact provenance of the holotype of *Europotamogale melkarti* is not clear enough. Crespo et al. (2023) allude to a karstic site named Moreda 3, but no reference to previous works describing this infilling is provided. According to them, the fauna from Moreda 3, not determined in detail, includes *Trilophomys* cf. *vandeweerdii*, an unidentified arvicolid, probable remains of *Blancomys*, a species belonging to the genus *Castillomys* and unidentified lagomorphs. In such a short and imprecise faunal list, some absences are worth of mention. Apparently, the murid *Stephanomys* is absent. This is surprising, because this genus is always the most abundant one in all the levels of the Moreda karstic complex known hitherto (Castillo Ruiz, 1990) and the best represented in many other Pliocene and Early Pleistocene karstic localities from the Iberian Peninsula (e.g., Cordy, 1976; Aguilar et al., 1993; Agustí et al., 2011; Piñero et al., 2023). Thus, it must be deduced that the fau-

nal list is based on a partial sample from the site. However, the authors do not hesitate in assigning the Moreda 3 level to MN15, justifying that (Crespo et al., 2023, p. 369) “this faunal association is similar to that from the Tollo de Chiclana 1B site in the Guadix-Baza Basin and Moreda 1A (Minwer-Barakat et al., 2012)”. This statement is not accurate because the real biostratigraphic markers identified in Tollo de Chiclana-1B (i.e., the arvicolid *Mimomys hassiacus* and the murid *Stephanomys donnezani*, Minwer-Barakat et al., 2004, 2005, 2008a) have not been found in Moreda 3 by Crespo and colleagues.

Alternatively, the site could have been already studied and dated in some previous work. However, Moreda 3 is not included among the different infillings described in detail in the PhD thesis of Castillo Ruiz (1990), the most comprehensive study of the Moreda fossil site. There is only a brief mention to a fissure infilling named Moreda 3 in a previous work (Agustí et al., 1986), which in the above-mentioned thesis is renamed as Rambla Seca-A and divided into several levels (Castillo Ruiz, 1990, p. 17). Searching for more information about the nature of this fossil site, we checked the collections from the Moreda karstic complex stored at the Universidad de Granada. Indeed, we found that many specimens in these collections labelled as ‘Moreda 3’ were figured in the mentioned thesis as recovered from a site named ‘Rambla Seca-A’, which is very closely located to the main fissure of Moreda 1 (Castillo Ruiz, 1990). Hence, we assume that much likely the site was preliminarily named as ‘Moreda 3’, but the infilling was finally published under the name of ‘Rambla Seca-A’. As we will develop later, this is of great importance, because the fossil assemblage of Rambla Seca-A includes some interesting faunal elements not listed in the preliminary identification carried out by Crespo and colleagues.



5. How complete is the holotype of *Europotamogale melkarti*?

A fourth point to be considered is related with the completeness of the only tooth found by Crespo et al. (2023). A thorough analysis of the photographs depicted in their fig. 3 (reproduced in Fig. 1 in the present paper) provides an interesting detail of this isolated dental element, which was apparently unnoticed by the authors. According to their fig. 2, the outline of the specimen MO3-A2-A3-1 is smooth and regular. However, when checked in the photographs, the margins of the holotype turn to be not that regular and smooth, but rather pixelate (Fig. 1). There is also a change in the tonality and brightness between different parts of the tooth in the purported anterior view (Fig. 1D), most likely evidencing some surfaces with broken enamel. Thus, the possibility of this element to be missing a part is open. In fact, the alleged tooth of an afrosoricid could only represent a fragment of a larger tooth of another animal. Obviously, the original diagnosis of *E. melkarti* stating: “*Zalambdodont molars with two cingula in an anteroposterior position which are connected with the styles and the protocone; this latter cusp is small*” and its differential diagnosis saying “*Europotamogale differs from nearly all members of Eulipotyphla and Chiroptera on account of the dilambdodonty of these groups and in that the M3 of the anterior groups of the latter lack metacone, because the tooth is nearly symmetrical anteroposteriorly, and the posterior side is not reduced*” would be inappropriate if it is confirmed that the only tooth available is not complete.

6. A more parsimonious hypothesis

The claims in Crespo et al. (2023) lead to a biogeographic scenario that is considered improbable. For our most plausible explanation about the actual identity of specimen MO3-A2-A3-1, we appeal to a different mammal group, phylogenetically very distant from afrosoricids but, as it will be shown below, displaying a dental morphology suspiciously similar to the purported tenrecid tooth from Moreda. They are the commonly known as ‘water-moles’ (subfamily Desmaninae sensu Motokawa, 2004; tribe Desmanini sensu Hutterer, 2005), which have been reported in nearly all Late Miocene, Pliocene and Pleistocene fossil sites in the Iberian Peninsula (Furió et al., 2018). The group

is well known especially after the masterful work by Rümke (1985), who analyzed vast fossil collections and described several new species, mostly based on material from Spain. Notably, water-moles were frequent during the Late Miocene and Pliocene in southern Spain, and they have been the object of recent studies in the Granada Basin, even including description of two new species (Martín-Suárez et al., 2001; Minwer-Barakat et al., 2020). In the neighboring Guadix-Baza Basin, where the Moreda fossil site is located, Desmaninae are not recorded in the oldest continental levels of latest Turolian age due to particularly dry conditions (Minwer-Barakat et al., 2009; García-Alix et al., 2011), but they appear in the earliest Pliocene levels of Botardo (Martín-Suárez, 1988; Piñero et al., 2018) and they stand among the most common inhabitants of this basin throughout the Pliocene and Pleistocene (Rümke, 1985; Martín-Suárez, 1988; Furió, 2007; Minwer-Barakat et al., 2008b, 2012; Furió et al., 2018; Piñero et al., 2018).

In fact, desmanines were already known from the Pliocene site of Moreda since the 1980s. While it is true that water-moles are not particularly abundant in karstic infillings (as these sites are originated by accumulation of owl pellets and desmanines are not among these bird’s common prey), some teeth from Moreda were already described by Rümke (1985) and attributed to the genus *Dibolia* (now included in *Archaeodesmana*, see Hutterer, 1995). Notably, the most exhaustive study of the fossil site of Moreda is by Castillo Ruiz (1990), one of the authors who described the “tenrecid” specimen, where the occurrence of *Archaeodesmana* is reported in the main infillings of the locality, the so-called Moreda 1-A and 1-B (Castillo Ruiz, 1990, p. 34), even though the specimens found in these levels were not described in detail.

The record of *Archaeodesmana* from Moreda has been further discussed in later works (Minwer-Barakat et al., 2008b, 2020), so references to the presence of desmanines in that site can be easily found in recent literature. Apart from this, our own scrutiny of the collections from Moreda curated in the Universidad de Granada confirms the presence of some dental remains of *Archaeodesmana* in level Moreda 1-B. To this material, we must add some other teeth of the same genus also from Moreda 1-B recently found in the collections of the Université Claude Bernard Lyon I and currently under study. Within the collections of the Universidad de Granada, we have also identified

Fig. 2. Second and third upper molars of several species of *Archaeodesmana* from different southern Iberian Pliocene sites (A1–F1), and selected anterolabial (A2–F2) and posterolabial (D3–F3) parts of these teeth that resemble the morphology of the holotype of *Europotamogale melkarti* from Moreda 3. All the figured specimens are curated in the Departamento de Estratigrafía y Paleontología, Universidad de Granada. (A) Right M3 of *Archaeodesmana* sp. from Moreda Bloque 1 (Mo Bloq-1 1). (B) Right M3 of *Archaeodesmana elvirae* from Tollo de Chiclana-1 (TCH-1 237). (C) Left M3 of *Archaeodesmana brailloni* from Tollo de Chiclana-1B (TCH-1B 698). (D) Left M2 of *Archaeodesmana elvirae* from Tollo de Chiclana-1 (TCH-1 219). (E) Left M2 of *Archaeodesmana brailloni* from Tollo de Chiclana-1B (TCH-1B 693). (F) Right M2 of *Archaeodesmana brailloni* from Tollo de Chiclana-1B (TCH-1B 695). Abbreviations: ant mst, anterior mesostyle; me, metacone; mel, metaconule; mtst, metastyle; pa, paracone; post mst, posterior mesostyle; prl, protoconule; pst, parastyle. Scale bars equal 1 mm.

some teeth attributable to *Archaeodesmana* labelled as Moreda 3-A1 and Moreda 3-A4 (which correspond to the levels named as “Rambla Seca-A1” and “Rambla Seca-A4” by Castillo Ruiz, 1990), thus evidencing the presence of desman remains in the same fissure infilling from which the putative afrosoricid was recovered. Furthermore, our team recovered a small sample from a dropped block found just at the base of the main fissure of Moreda 1 and, after screen-washing, also identified remains of *Archaeodesmana*, including the upper third molar shown in Fig. 2A.

The frequent occurrence of this genus is important because the specimen MO3-A2-A3-1, a putative ‘M2 of a potamogalinae’, suspiciously resembles a portion of the labial region of a water-mole upper molar. The M1s of Desmaninae are rather asymmetrical on its labial region, usually with prominent parastyles and always displaying a metacone much more developed than the paracone, with a very elongated posterior arm. However, the supposed afrosoricid molar from Moreda 3 perfectly matches the morphology and size of a labial fragment of either an M2 or an M3 of a Desmaninae (Fig. 2). Water-mole’s M2s are symmetrical on its labial region, with paracone and metacone equally developed, parastyle and metastyle not very prominent and anterior and posterior mesostyles of similar dimensions (Fig. 2D–F). Towards the lingual region, protoconule and metaconule (according to the nomenclature proposed by Rümke, 1985) also resemble to each other in size, and the distance that separates these conules from the paracone and metacone, respectively, is also similar. This way, the element attributed to a complete M2 of *Europotamogale* can in fact correspond to either an anterolabial or to a posterolabial fragment of a desmanine M2.

Alternatively, the assumed tenrecid specimen could also correspond to the anterolabial portion of a desmanine M3 (the posterolabial region of the third molar can be ruled out, since the metacone only bears the anterior arm, Fig. 2A–C). In the case that this specimen corresponds to the anterolabial part of either an M2 (Fig. 2D2, E2, F2) or an M3 (Fig. 2A2, B2, C2), the supposed metastyle would be the parastyle, the purported parastyle would correspond to the anterior mesostyle, the paracone would indeed be the paracone, while the hypothetical protocone would be the protoconule. If the specimen corresponds to a posterolabial fragment of an M2 (Fig. 2D3, E3, F3), then the supposed metastyle, parastyle, paracone and protocone illustrated by Crespo et al. (2023) in their fig. 2 would correspond to the metastyle, posterior mesostyle, metacone and metaconule, respectively.

The similarity between Desmaninae M2 and M3, together with the bad preservation of the specimen in question and the poor quality of the published images, preclude a firm conclusion regarding the attribution of this fossil to either a second or a third molar fragment of a water-mole. We are prone to the option that it corresponds to a M3 fragment, because in this molar the styles and the conules

are less developed than in the M2 and thus resemble more the questioned fossil from Moreda 3. Nevertheless, the possibility of being a M2 fragment cannot be discarded either. In any case, the find of a fragment of an *Archaeodesmana* tooth, a genus widely documented in dozens of Pliocene vertebrate-bearing sites from Spain (including the karstic complex of Moreda), does make much more sense than the occurrence of a taxon with no other systematic equivalent in time and space like Potamogalinae.

7. Conclusions

As Carl Sagan once stated, “extraordinary claims require extraordinary evidence”. The evidence provided by Crespo et al. (2023) from the Spanish locality of Moreda 3 (= Rambla Seca-A) is too weak to support such an amazing (and unlikely) theory of an afrosoricid living out of Africa. We find much stronger evidence that the purported otter shrew tooth is instead a fragment of the labial part of a M2 or M3 of *Archaeodesmana*. This is a much easier, plausible, and parsimonious explanation to the nature of the fossil MO3-A2-A3-1, because water-moles are frequent elements of the fossil faunal assemblages in Pliocene sites from Spain. In other words, we regret communicating that *Europotamogale melkarti*, the purported ‘otter-shrew’ presented by Crespo and colleagues as a ‘tourist taxon’, brings an Ockham’s razor hidden in the pocket that is too sharp to allow it taking a ‘Pliocene flight’ from Central Africa to Spain.

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