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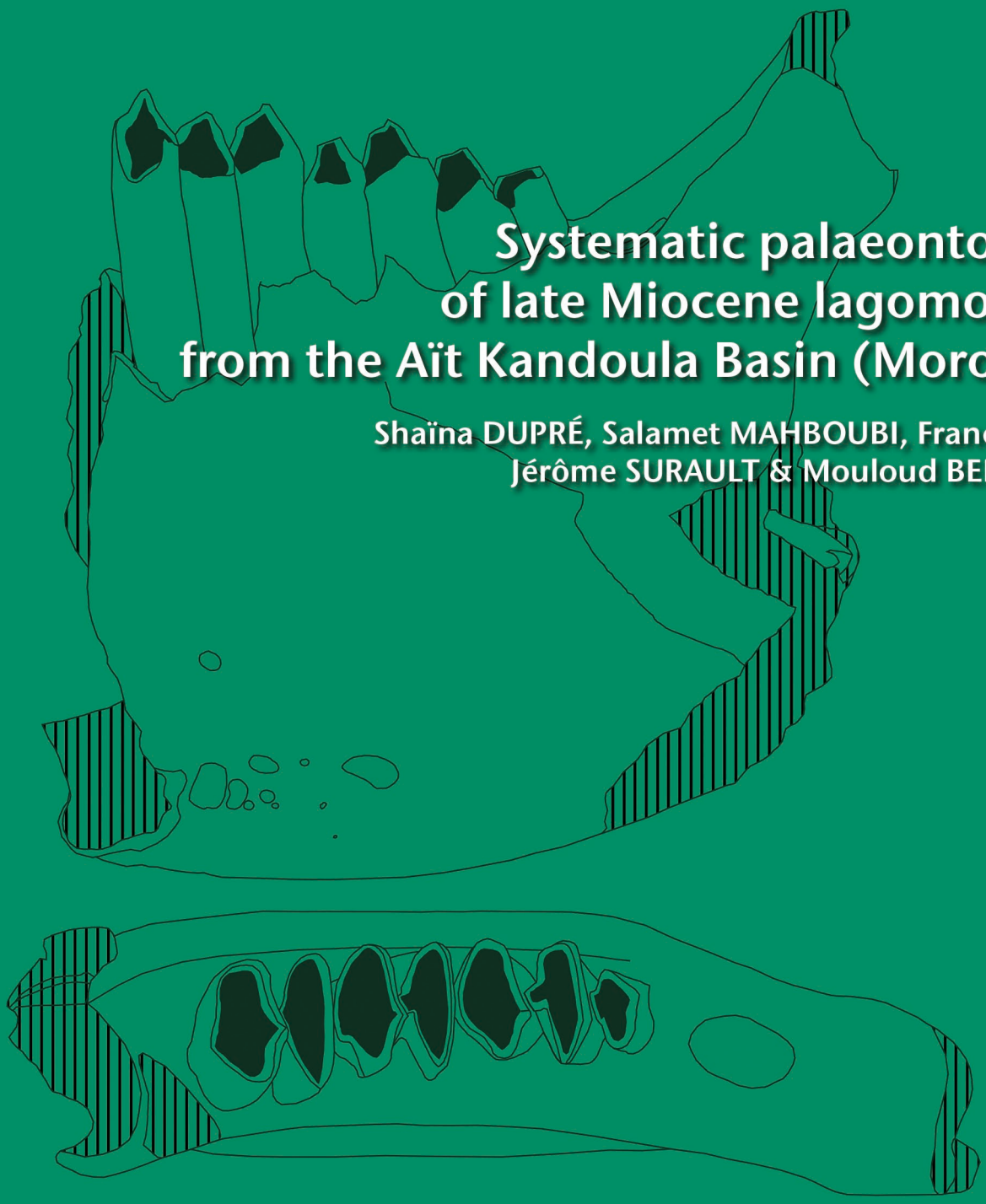

Systematic palaeontology of late Miocene lagomorphs from the Aït Kandoula Basin (Morocco)

Shaïna DUPRÉ, Salamet MAHBOUBI, Franck GUY, Jérôme SURAULT & Mouloud BENAMMI

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Systematic palaeontology of late Miocene lagomorphs from the Aït Kandoula Basin (Morocco)

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ABSTRACT
The occurrence of the genus *Prolagus* Pomel, 1853, in North Africa provides some of the strongest evidence for the existence of faunal exchanges between Europe and Africa. The oldest African *Prolagus* remains have been reported from the Messinian locality of Afoud in the Aït Kandoula Basin (6.2 Ma), identified during previous studies as the species *Prolagus michauxi* López-Martínez, 1975. Dental material already analyzed from the AF12-1 and AF12-2 levels and new material collected subsequently from the same levels form the basis of the current systematic study. This abundant material allows us to confirm the presence of a single *Prolagus* species in the Afoud locality, *P. michauxi.* However, this species' attribution to *P. michauxi* must be considered cautiously, given its evident morphological resemblance to *Prolagus sorbinii* Masini, 1989. These results are consistent with scenarios implying the migration of *P. michauxi* from Southern Europe to North Africa. In addition to the *Prolagus* remains, cheek teeth of Leporidae have been found and this is the oldest occurrence of this group in Morocco.

KEY WORDS
Ochotonidae, Leporidae, *Prolagus*, Morocco, Aït Kandoula basin, Messinian, faunal exchanges.

RÉSUMÉ

Paléontologie systématique des lagomorphes du Miocène supérieur du bassin d'Aït Kandoula (Maroc).
La présence du genre *Prolagus* Pomel, 1853 en Afrique du Nord est l'un des arguments les plus puissants démontrant l'existence d'échanges fauniques entre l'Europe et l'Afrique. Les plus vieux restes de *Prolagus* africains ont été trouvés dans la localité Messinienne d'Afoud, au sein du bassin d'Aït Kandoula (6,2 Ma), et ils ont été identifiés au cours de précédentes études comme appartenant à l'espèce *Prolagus michauxi* López-Martínez, 1975. Le matériel dentaire déjà analysé venant des niveaux AF12-1 et AF12-2, ainsi que le nouveau matériel collecté par la suite dans ces mêmes niveaux, constituent la base de la présente étude systématique. Cette abondance de matériel nous permet de confirmer la présence d'une unique espèce de *Prolagus* dans le site d'Afoud, *P. michauxi*. Cependant, l'attribution à *P. michauxi* doit être considérée avec prudence, étant donné la ressemblance morphologique évidente avec l'espèce *Prolagus sorbinii* Masini, 1989. Ces résultats sont en accord avec les scénarios impliquant la migration de l'espèce *P. michauxi* depuis le Sud de l'Europe vers l'Afrique du Nord. En plus des restes de *Prolagus*, des dents jugales de Leporidae ont été trouvées et cela constitue la plus vieille occurrence de ce groupe au Maroc.

MOTS CLÉS
Ochotonidae,
Leporidae,
Prolagus,
Maroc,
bassin d'Aït Kandoula,
Messinien,
échanges fauniques.

INTRODUCTION

The African lagomorph record includes few genera, particularly concerning the Ochotonidae. Although some genera of Leporidae have been described in North Africa (such as *Lepus* Linnaeus, 1758, *Serengetilagus* Dietricht, 1941, *Trischizolagus* Radulesco & Samson, 1967 and extant species), only three genera of Ochotonidae have been described in the whole African continent, all being extinct: *Alloptox* Dawson, 1961, *Kenyalagomys* MacInnes, 1953 (synonym of *Austrolagomys* Stromer, 1926) and *Prolagus* Pomel, 1853. The discovery of the genus *Prolagus* in North Africa (Fig. 1) has increased understanding of the faunal exchanges between Europe and Africa during the Messinian period. Indeed, it was previously believed to be endemic to Europe, except for some specimens of *Prolagus oeningensis* König, 1925 and *Prolagus sorbinii* Masini, 1989, which had been uncovered in Turkey, in the Miocene of Pasalar (Sen 1990) and the Pliocene of Develi (Sen *et al.* 1989), respectively. Moreover, in addition to the *Prolagus* genus, some European taxa such as the rodents *Castillomys* Michaux, 1969, *Stephanomys* Schaub, 1938, *Occitanomys* Michaux, 1969 and *Eliomys* Wagner, 1940 have been described in several African localities dated from the Messinian to the Pleistocene (Brandy & Jaeger 1980; Coiffait 1991; Benammi *et al.* 1996; Benammi 1997; Mahboubi 2014). On the other hand, some African taxa like the Camelidae *Paracamelus* Schlosser, 1903 or the rodents *Paraethomys* Petter, 1968, *Myocricetodon* Lavocat, 1952 and *Debruijnimys* Castillo & Agustí, 1996 have been identified in Europe during the same period (Jaeger *et al.* 1975; Minwer-Barakat *et al.* 2009; Agustí *et al.* 2011). It has been posited that these taxa migrated during the Messinian salinity crisis, due to the temporary closure of the Betic and Rifian corridors (López-Martínez 1974). However, the discovery of *Prolagus* remains in the AF1 level of the Afoud site, dated 6.1 Ma in Benammi *et al.* 1996, then 6.21 Ma in Gibert *et al.* 2013, indicates that the faunal exchanges between Europe and Africa began before the Messinian salinity crisis, which only started at 5.97 Ma (Benammi *et al.* 1996; Benammi 1997). Several phases of successive migration have been identified (Gibert *et al.* 2013) and with the exception of the migration of Hippopotamidae *Hexaprotodon* Falconer & Cautley, 1836 (about 6.3 Ma), whose transition from one continent to another was facilitated by its semi-aquatic lifestyle, the oldest migration phase occurred when the Betic Strait closed at around 6.2 Ma (Mahboubi 2014 states that this migration phase included *Prolagus*, *Castillomys*, *Stephanomys*, *Paracamelus* and *Paraethomys*). Later, this closure contributed to a perturbation of oceanic circulation involving the Messinian crisis (Pérez-Asencio *et al.* 2012; Pérez-Asencio *et al.* 2013).

In 2012, more *Prolagus* remains were identified along the Afoud section of the Aït Kandoula Basin in the southern High Atlas of Morocco (Fig. 2), described as part of Mahboubi (2014). The section had previously been described by Benammi *et al.* (1996) and Benammi (1997); it is mostly made up of a succession of clay layers interbedded with limestone, marl, or conglomerates (Fig. 3). A volcanic ash layer located in the upper part of the section has been dated at 5.9 ± 0.5 Ma, which allows us, along with biochronological and magnetostratigraphical data, to give a precise age for each fossiliferous layer (Benammi *et al.* 1996; Remy & Benammi 2006). Thus, the new fossiliferous levels Afoud 12-1 and Afoud 12-2 are dated to 6.12 Ma and 5.9 Ma, respectively. These levels reveal particularly abundant material, which distinguishes them from all other ochotonid sites in North Africa. The treated material has been assigned to the species *Prolagus michauxi* López-Martínez, 1975 in Mahboubi (2014). Attributions or at least close relations to this species have already been made in many localities from Western Europe and in some Mio-Pliocene North African sites associated with European affinity rodent remains, including for instance Argoub Kemellal-1 (Coiffait 1991) and Aghouri (Benammi 1997, with specimens identified as *Prolagus* cf. *michauxi*) in Morocco, or Aïn Guettara (Brandy & Jaeger 1980, with specimens identified as *Prolagus* aff. *michauxi*) in Algeria.

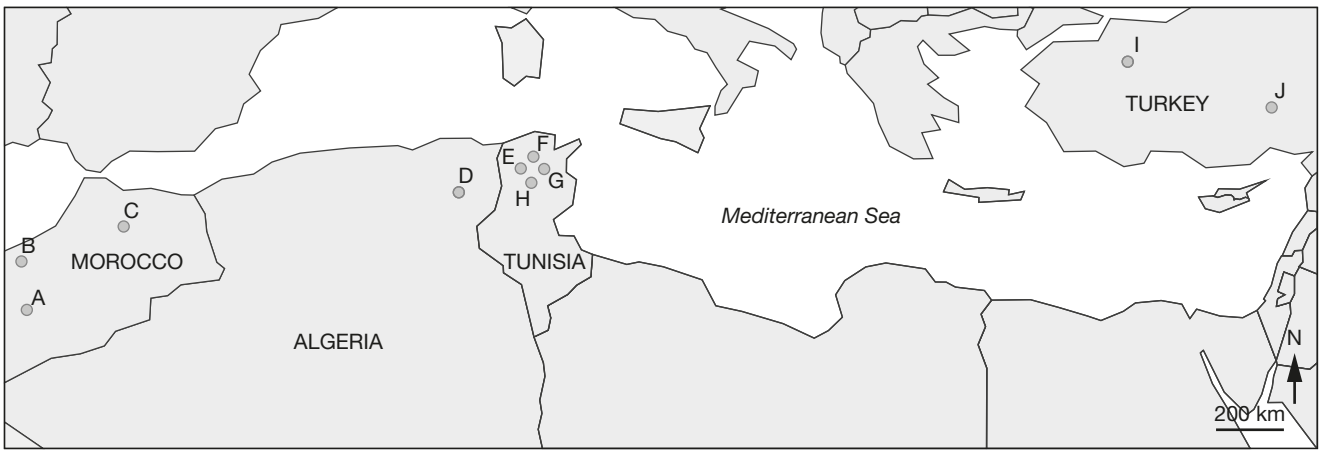

Fig. 1. — Localities yielding *Prolagus* Pomel, 1853 from sites outside Europe: **A**-**C**, Morocco: **A**, sites from the Aït Kandoula Basin (Afoud, Aghouri); **B**, Ahl al Oughlam; **C**, Aïn Guettara; **D**, Algeria, Argoub Kemellal 1; **E**-**H**, Tunisia: **E**, Oued Mellègue, Bulla Regia and Voie Ferré; **F**, Lac Ichkeul; **G**, Djebel Ressas; **H**, Testour; **I**, **J**, Turkey: **I**, Pasalar; **J**, Develi.

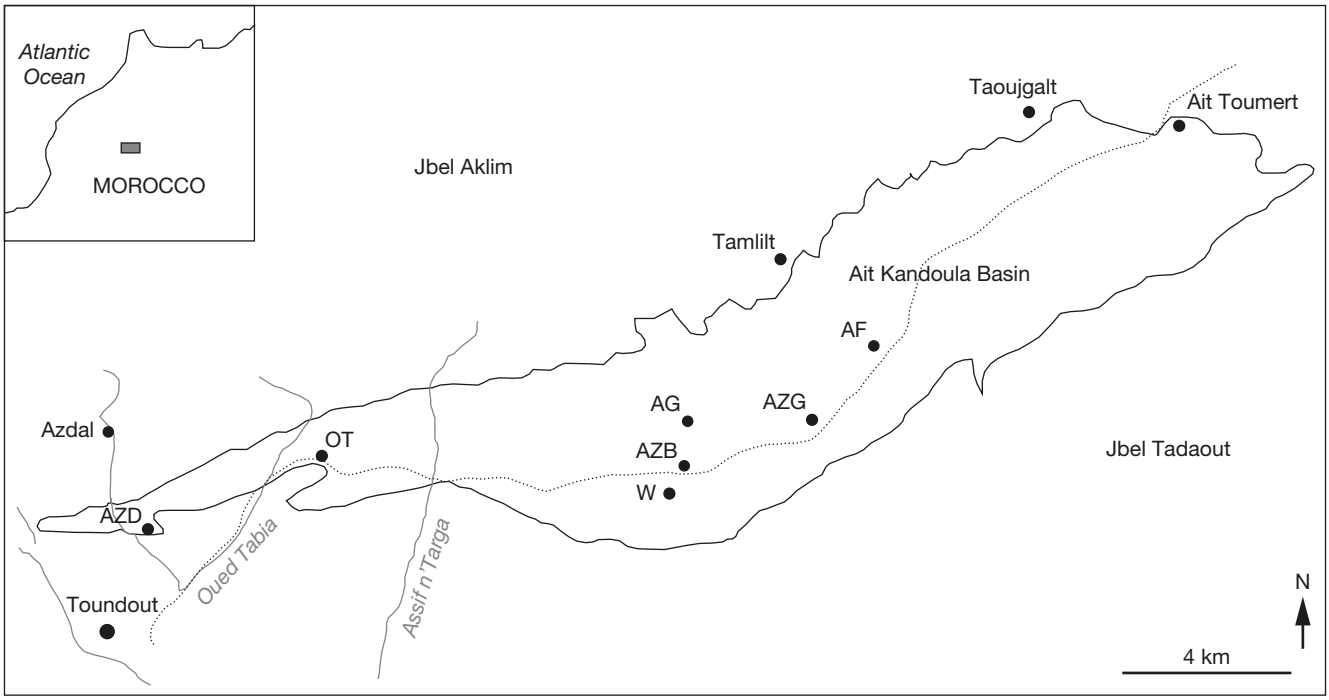

Fig. 2. — Schematic map of the Aït Kandoula Basin and localization of the fossiliferous sites. The **black dotted line** corresponds to a track. Abbreviations: **AF**, Afoud site; **AG**, Aghouri site; **AZB**, Azib site; **AZD**, Azdal site; **AZG**, Azaghar site; **OT**, Oued Tabia site; **W**, Wanou site. Based on Benammi 2006.

The present work consists of the description and taxonomic study of the lagomorphs from the AF12-1 and AF12-2 levels, collected in 2012 and subsequently. We hypothesize that only one species of lagomorph crossed the Mediterranean Sea during the Messinian period: *P. michauxi*. The considerable number of specimens of this taxonomic study allows us to test this hypothesis. A comparison of the material will also be performed with some specimens from other African localities, already attributed to *P. michauxi or P.* cf *michauxi*. This comparison will be made to confirm or disconfirm the taxonomic attribution of these other specimens, the material being scarce in these localities and incorrect attributions to *P. michauxi* or *P.* cf *michauxi* are commonplace even for European *Prolagus* (Angelone & Sesé 2009).

MATERIAL AND METHODS

The study is based on all the material collected in 2012 as part of the thesis of Mahboubi (2014) in addition to the material found during the subsequent missions in 2015 and 2016. In total, more than a thousand isolated teeth have been collected

TABLE 1. — Dimensions of the dental specimens of *Prolagus michauxi* López-Martínez, 1975 from Afoud (mm). Abbreviations: **AA**, partial width (Angelone & Sesé 2009); **L**, length; **Max**, maximum value; **Mean**, arithmetic mean; **Min**, minimum value; **N**, number of measured teeth; **PH**, hypoflexus depth (Angelone & Sesé 2009); **SD**, standard deviation; **TH**, distal hypercone length (Angelone & Sesé 2009); **W**, width. See Appendices 1 and 2 for detailed measurements of the individuals.

Level	Specimen	Measurement	N	Min	Mean	Max	SD
AF12-1	P2	L	3	0.97	1.09	1.24	0.14
		W	3	1.66	1.80	2.08	0.24
	P3	L	7	1.26	1.52	1.69	0.13
		W	3	2.37	2.66	3.01	0.33
	P4	L	9	1.03	1.25	1.35	0.11
		W	6	1.99	2.55	2.88	0.31
		AA	8	1.78	2.25	2.51	0.22
		PH	10	0.82	1.05	1.23	0.12
		TH	10	0.62	0.75	0.82	0.08
AF12-2	P2	L	105	0.88	1.09	1.36	0.10
		W	96	1.16	1.72	2.15	0.17
	P3	L	175	1.04	1.53	2.83	0.15
		W	137	1.68	2.48	3.13	0.27
	P4	L	144	0.88	1.26	1.48	0.12
		W	129	1.51	2.55	3.31	0.34
		AA	111	1.28	2.30	2.93	0.29
		PH	147	0.31	1.06	1.43	0.19
		TH	148	0.50	0.74	0.92	0.07
	p3	L	210	1.10	1.67	2.13	0.19
		W	252	1.00	1.68	2.19	0.20

in addition to rare fragmentary mandibles. The majority of the material comes from the AF12-2 level, while only around thirty teeth are from the AF12-1 level. The material is stored at the Université de Poitiers.

The percentages of occurrence of various characters were counted (not taking into account damaged specimens), while the length (L) and width (W) were measured in all teeth when ever possible along with the partial width (AA), hypoflexus depth (PH) and distal hypercone length (TH) for the P4 (measurements introduced in Angelone & Sesé 2009). These dimensions are displayed in Table 1; the detailed measurements and the character states for each specimen can be found in the Supplementary material (Appendices 1; 2). We applied a Shapiro-Wilk test to verify the normal distributions of our dental measurements. The L and W dimensions were exploited to draw some scatter plots that also include data from the literature. The reference measures used for the scatter plots, derived from the literature, are listed in Appendix 3 and pertain to the species *P. michauxi*, *P. sorbinii*, *Prolagus italicus* Angelone, 2008, *Prolagus latiuncinatus* Angelone & Cermák, 2015 and *Prolagus bilobus* Heller, 1936. The occurrences of characters were used in the morphological comparison with other species and in a multiple correspondence analysis (MCA). These three analyses helped us to determine the number of lagomorph species in the population from Afoud. Only the characters of the p3 were used for the MCA. For all statistical analyses performed, the illustrative variable "wear" was used to describe each tooth from our assemblage, in order to differentiate ontogenic variability and potential inter-specific variability. A tooth was labelled "unworn" if it had rounded and bulb-like cusps with a smooth aspect (sometimes with enamel covering the whole occlusal surface) and/or the absence of some connections between cusps.

The teeth were observed with a binocular magnifier and measurements were made with a Mitutoyo monocular measuroscope. Occlusal drawings of the specimens were made with a Leica binocular microscope. Statistical analyses were performed with R software version 4.0.0. The nomenclature used to describe the teeth is from López-Martínez (1974) (Fig. 4).

The morphology of the specimens from Afoud was compared with European specimens from the literature; these specimens are listed in Appendix 4. A morphological comparison between the material from Afoud and material from other African sites was also performed to try to confirm the attributions previously made at these sites based on very few specimens (see Appendix 5 for the list of African populations directly observed for this purpose).

ABBREVIATIONS

AA	partial width;
L	length;
MCA	multiple correspondence analysis;
PH	hypoflexus depth;
TH	distal hypercone length;
W	width.

SYSTEMATIC PALAEONTOLOGY

Order LAGOMORPHA Brandt, 1855
Family OCHOTONIDAE Thomas, 1897

Genus *Prolagus* Pomel, 1853

Prolagus Pomel, 1853: 43.

TYPE SPECIES. — *Prolagus sansaniensis* Lartet, 1851.

OCCURRENCE. — Neogene and Quaternary of Europe; upper Miocene of North Africa and Turkey.

EMENDED DIAGNOSIS. — Hordjik 2010: Tooth formula: (2, 0, 3, 2)/(1, 0, 2, 2). Ochotonids of small to large size. Adult teeth are

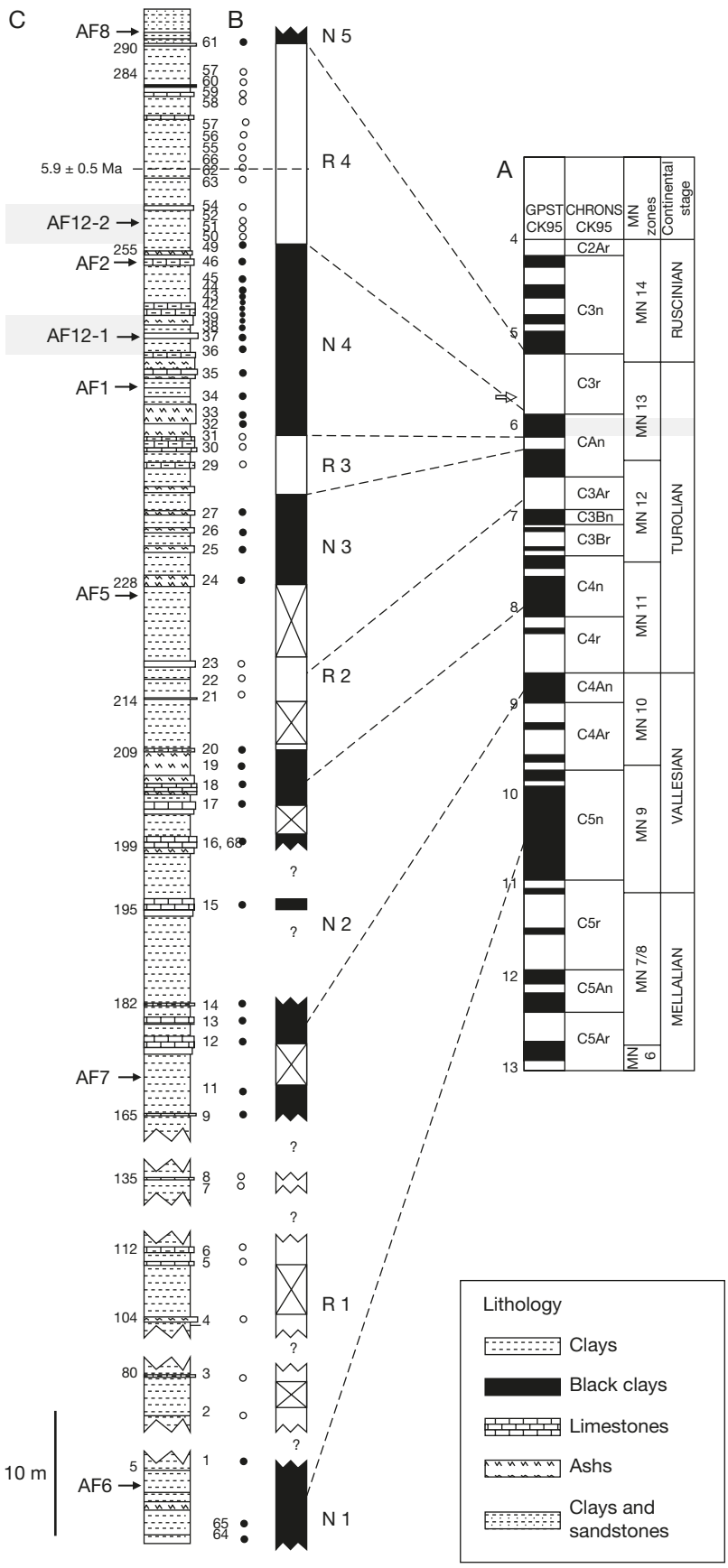

Fig. 3. — Stratigraphy of the Afoud site, in the Aït Kandoula Basin: **A**, stratigraphic scale; **B**, magnetic polarities of the Afoud site; **C**, lithology and position of the fossiliferous levels. The fossiliferous levels studied here are highlighted in grey. Based on Benammi *et al.* (1996).

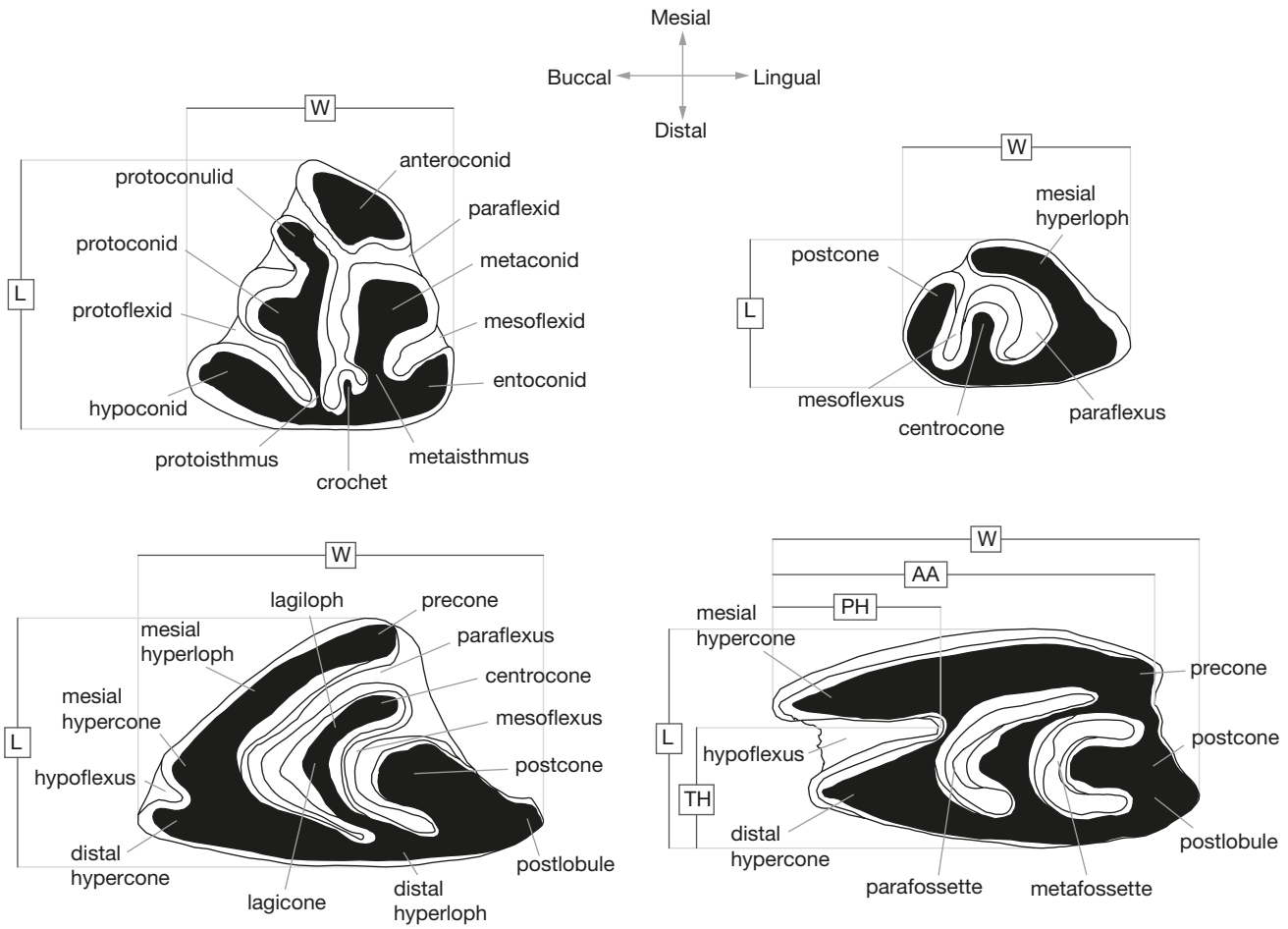

Fig. 4. — Nomenclature of the dental characters of *Prolagus* Pomel, 1853. From the upper left corner, then clockwise, left p3, left P2, left P4, left P3. Abbreviations: **AA**, partial width (Angelone & Sesé 2009); **L**, length; **PH**, hypoflexus depth (Angelone & Sesé 2009); **TH**, distal hypercone length (Angelone & Sesé 2009); **W**, width. Modified from López-Martínez (1974) and Angelone (2007).

hypsodont and rootless. The anteroconid in the p3 is isolated in the vast majority of specimens, but an occasional connection to the protoconid or metaconid is possible. A protoconulid may be absent, incipient or well-developed. The centroflexid in p3 can be absent, shallow or deep. The trigonid and talonid of the p4 and m1 form two lobes of similar width. A third lobe, the hypoconulid, is always and exclusively present in m2 and is partly or completely isolated from the hypoconid-entoconid lobe. The m3 is always absent. The P2 has a distinct meso- and paraflexus and the mesial hyperloph can be very short to well-developed. The P3 has a well-developed paraflexus and mesoflexus and a shallow and relatively narrow hypoflexus may be present. The P4 is molariform and usually includes one or more rudimentary enamel fossettes. Enamel fossettes in the M1-M2 may be present or absent and may reduce or become lost with wear. The reduction of fossettes in P4-M2 is more progressive towards the posterior, while the depth of the hypoflexus increases.

Prolagus michauxi López-Martínez, 1975 (Figs 5A-J, L-O; 6A-G)

Prolagus michauxi López-Martínez, 1975: 856.

Referred material. — Specimen from AF12-1: 4 isolated P2, 7 isolated P3, 10 isolated P4, 27 isolated M1 or M2, 2 isolated p3, 3 isolated p4 or m1, 28 upper molar fragments, 72 lower molar fragments, 1 isolated d3. Specimen from AF12-2: 8 incomplete mandibles, 133 isolated P2, 219 isolated P3, 158 isolated P4, 226 isolated upper molars, 337 isolated p3, 81 isolated p4 or m1, 22 upper molar fragments, 94 lower molar fragments, 9 isolated d3.

Measurements. — See Table 1.

Type locality. — Sète (France).

Occurrence. — Miocene and Pliocene of Spain, Portugal, Italy, Greece, France, Morocco, Algeria.

Original diagnosis. — López-Martínez & Thaler 1975 (here translated from French): *Prolagus* larger than *P. oeningensis* and smaller than *P. sardus*. Its maxillo-incisive canal is closed at the outside and its upper P2 is evolved like *P. sardus*, but the skull has a single incisive foramen and the upper molars have fossettes like *P. oeningensis*. The short muzzle, the very large premolar foramen, the diverging upper rows, the wide and protruding zygomatic arch and the wide lower p3 with frequent crochet and thick protoconulid, are new characters.

Description

P2 (Fig. 5G-J)

The mesial hyperloph is always present, usually reaching the centrocone without exceeding it, even though some specimens have a shorter (10% of the specimens) or longer (20%) hyperloph. Its shape is mostly curved and smooth (80%),

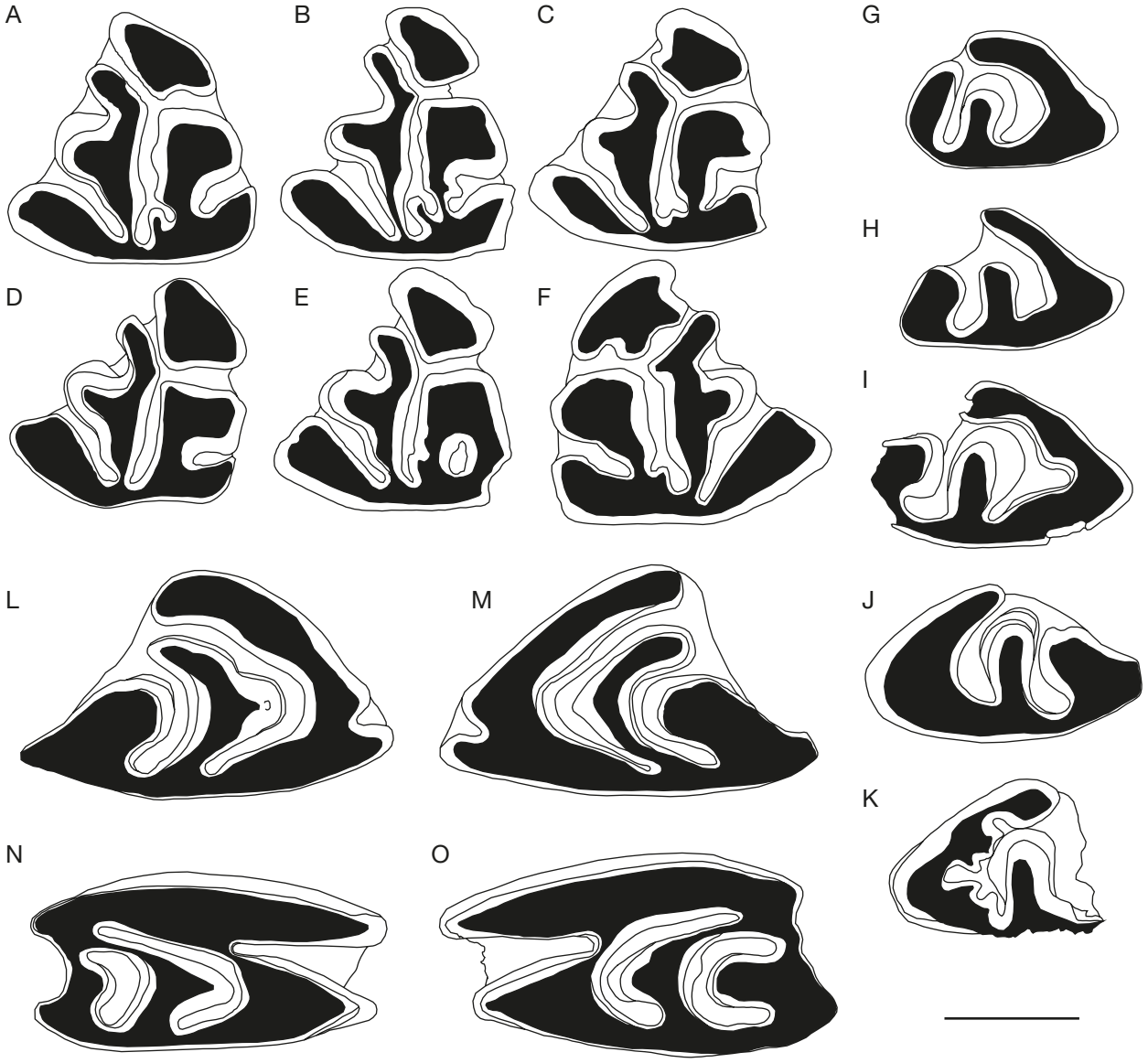

Fig. 5. — *Prolagus* Pomel, 1853 from the AF12-2 and AF12-1 levels (premolars): **A**-**J**, **L**-**O**, *Prolagus michauxi* López-Martínez, 1975: **A**-**E**, left p3 (AF12-2-L-72; AF12-2-L-45; AF12-2-L-62; AF12-2-L-14; AF12-2-L-82); **F**, right p3 (AF12-2-L-161); **G**-**I**, left P2 (AF12-2-L-338; AF12-2-L-361; AF12-2-L-379); **J**, right P2 (AF12-2-L-393); **L**, right P3 (AF12-2-L-629); **M**, left P3 (AF12-2-L-515); **N**, right P4 (AF12-2-L-764); **O**, left P4 (AF12-2-L-695); **K**, *Prolagus* sp., right P2 (AF12-2-L-453). Scale bar: 1 mm.

but sometimes relatively straight. A lingual fold, more or less marked, is present at the start of the hyperloph for 20% of the specimens. An enamel hiatus at the tip of the hyperloph can appear occasionally (10% of the non-damaged specimens) but is rarely visible in occlusal view. The paraflexus is often curved and sometimes widened at the distal tip (30% of the specimens). The mesoflexus can be curved (66%) or straight; over half of the specimens have a distally widened one. The mesoflexus is almost always longer than the paraflexus. One specimen has an isolated centrocone. The postcone is rarely indented (7% of the specimens).

P3 (Fig. 5L-M)

The lagiloph (the structure joining the lagicone to the centrocone) is usually long but rarely reaches the length of the mesial hyperloph. The hypoflexus depth is variable. Two teeth out of three have an enamel hiatus on the precone. The mesial tip of the postcone is rounded to flat and almost never indented.

P4 (Fig. 5N-O)

The distal lobe is longer than the mesial one; they are both of variable width. When they are not broken, the postolobule is generally longer than the precone. The parafossette is long and curved, while the metafossette is smaller and C-shaped. The hypoflexus accounts, on average, for 40% of the tooth.

Upper molars (Fig. 6C-G)

The upper molars are composed of two lobes separated by a deep hypoflexus. Fossettes are variable in size, shape and number: nearly 50% of upper molars do not have a fossette,

25% have only a small fossette, 8% have a long or large fossette and the remainder have two or three fossettes (17%).

p3 (Fig. 5A-F)
None of the p3 have a protolophid connecting the protoconid and the metaconid. The crochet is present in the vast majority of the specimens (about 80%); usually it is quite small. It is located in a central position or is displaced towards the metaconid. The anteroconid is more or less displaced lingually and its shape is variable, from triangular to rounded; more than half have a trapezoidal shape. The metaconid is usually rectangular (75%), otherwise it is fan-shaped or rounded (the latter shape is often found for the small-sized teeth that likely belong to young individuals). A slight indentation is sometimes observed on the anteroconid and on the buccal side of the metaconid. Quite rarely, the metaconid is indented distally (30% of the specimens), because of the growth of the mesoflexid. The metaconid is of the same size or slightly smaller than the anteroconid. The shape of the mesoflexid is variable, as it can be straight, curved, with mesial growth related to the indentation of the metaconid, sometimes with a lingually or buccaly widened apex and it is generally short to medium-size. Three specimens have a mesoflexid closed lingually. The protoconulid is generally of medium to reduced thickness with a variable length. An enamel hiatus is fairly often present on the entoconid (40% of the specimens). Around twenty teeth from AF12-2, probably fairly worn, have a connection between the anteroconid and the protoconulid. By contrast, some teeth of young appearance and often small in size do not have any connection between the protoconid and the hypoconid and/or between the metaconid and the entoconid.

p4 and lower molars (Fig. 6A, B)
The lobes of the p4 and m1 are kept together by cement. The m2 are three-lobed.

Comparisons
In addition to the primary shearing blade typical of lagomorphs, a secondary shearing blade is present on the posterior lobe of the upper molars, like all Ochotonidae (Von Koenigswald *et al.* 2010). The two shearing blades are also present on the lower molars and the anterior and posterior lobes on them do not have any lingual connection. The p3 has the characteristic morphology of the post-lower Miocene *Prolagus*. It is triangular with a centroflexid and there is no connection between the metaconid and the protoconulid. *Prolagus* also lacks an m3 and has a three-lobed m2; this morphology is unique among the Ochotonidae. The observation of the mandibles found in Afoud clearly shows these characteristics, confirming the attribution of these specimens to the genus *Prolagus*.

In the fossil record of *Prolagus*, the presence of a well-developed mesial hyperloph on the P2 is known to be found occasionally on specimens from the middle Miocene, with *Prolagus major* López-Martínez, 1977 (Hordijk 2010), but it only became very frequent at the beginning of the MN13 (Angelone 2007). Thus, most of the Messinian and post-Messinian species have a well-developed hyperloph on all of their specimens. The absence of the protolophid connecting the metaconid to the protoconulid in the p3 as well as the presence of a fairly well-developed hyperloph on all the P2 render the material from Afoud different from all Lower and middle Miocene species as well as from the more recent species *Prolagus crusafonti* López-Martínez, 1975, *Prolagus ibericus* López-Martínez, 1975 and *Prolagus pannonicus* Angelone & Cermák, 2015. The insular species *Prolagus apricenicus* Mazza, 1987, *Prolagus imperialis* Mazza, 1987, *Prolagus sardus* (Wagner, 1832) and to a lesser extent *Prolagus figaro* López-Martínez, 1975 have a strong indentation on the postcone of the P2 which is not present on the material from Afoud. *Prolagus figaro* also has a p3 with particularly crenulated enamel, distinguishing it even further from the Afoud specimens. *Prolagus caucasicus* Averianov & Tesakov, 1998 has a p3 that is much longer than it is broad and a P3 of much larger size than the Afoud specimens.

Prolagus calpensis Major, 1905 and *Prolagus depereti* López-Martínez, 1975 do not have any crochet on the p3 (or it is reduced), precluding the Afoud specimens from belonging to these species. The crochet of *P. michauxi* is frequent and of variable size. The crochet of *P. sorbinii* is often reduced, but it can be bigger or quite variable in some populations, like those from the Italian Messinian localities of Brisighella 25 and Ciabòt Cagna. The crochet of *P. italicus* is often present (50% at Montagnola Senese) and is of variable size. The crochet of *P. bilobus* of Gundersheim (Germany, MN15) and *P. latiuncinatus* of Polgárdi 2 (Hungary, MN13) is very well-developed. The fairly small size of the crochet of the specimens from Afoud 12-2 is clearly different from the size of the last two species. In addition, the crochet of *P. latiuncinatus* has a drop-like shape, which is nearly absent here.

The descriptions of *P. italicus* from the Italian localities Montagnola Senese (MN17) and Torre di Picchio (possibly MN17) indicate that the anteroconid and the metaconid sometimes have a very indented shape, whereas the cusps of p3 from Afoud are mostly non-indented. In the latter case the indentation is almost always less marked than in the Italian specimens. *Prolagus italicus* also has an anteroconid that is larger than the metaconid, which is rare in the Afoud specimens. *Prolagus latiuncinatus* can also have an anteroconid that is larger than the metaconid. In addition, these two species differ from the specimens from Afoud because of the morphology of their mesoflexid, which is not as variable as that of the Moroccan specimens. *Prolagus latiuncinatus*, *P. italicus* and *P. bilobus* do not have any enamel hiatus in the entoconid and in this regard differ even more from the Afoud specimens. The protoconulid of the Moroccan specimens is on average much smaller than those of *P. bilobus* or *P. italicus*. It also differs from that of *P. michauxi* of Sète (France, MN15) but resembles the one from Kessani (Greece, MN13/14).

Nearly half of the upper molars do not have fossettes (or are too damaged to allow observation of any). Those fossettes that do exist can be of very diverse size and shape (Fig. 6 C-G). About 10% of the upper molars observed

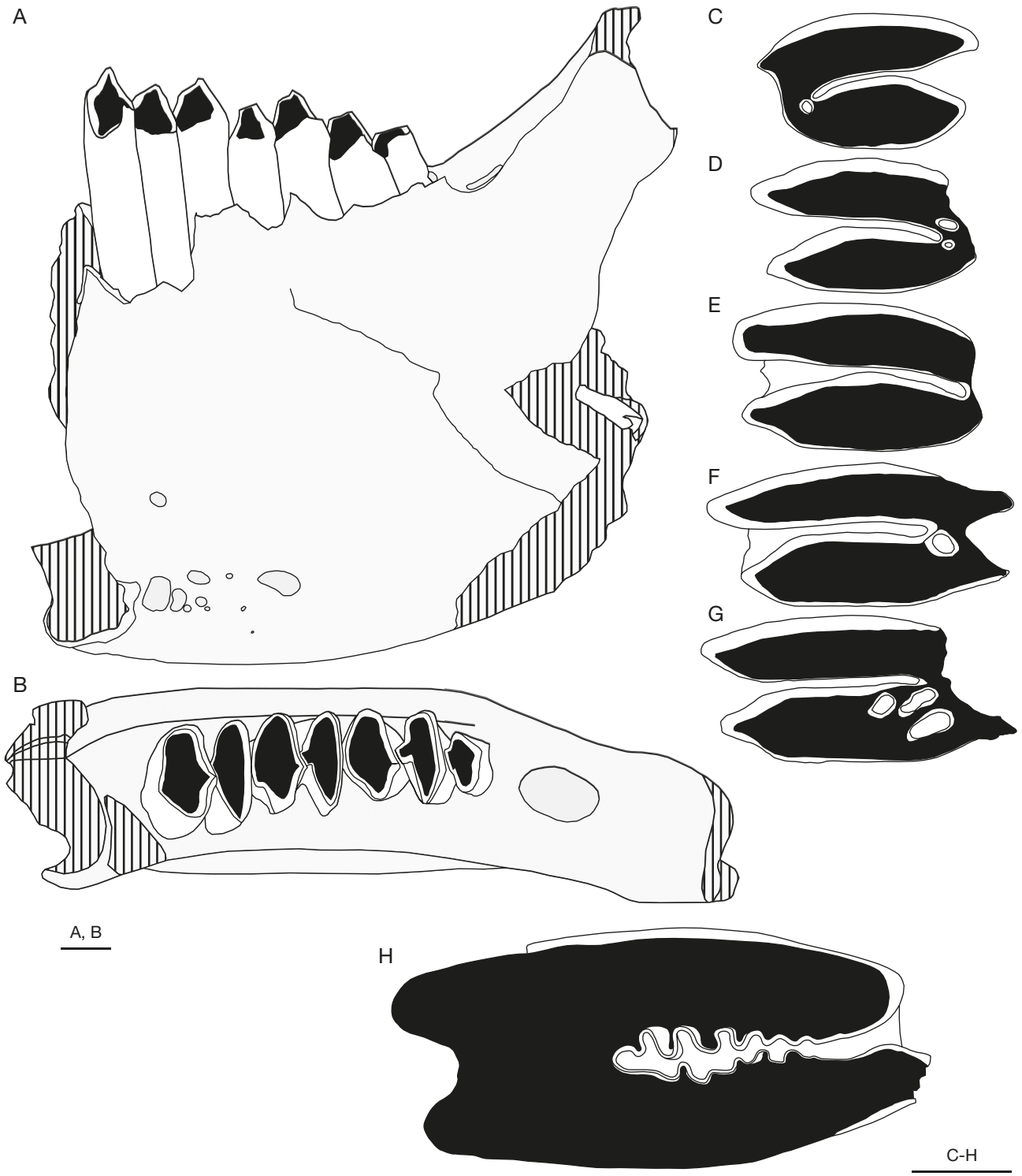

Fig. 6. — Lagomorphs from the AF12-2 and AF12-1 levels (molariform teeth): **A**-**G**, *Prolagus michauxi* López-Martínez, 1975: **A**, **B**, fragmented left hemi-mandible (AF12-2-L-1156), with p4, m1 and m2 (**A**, buccal view; **B**, occlusal view); **C**-**G**, upper molars: **C**, right M1 or M2 (AF12-2-L-910); **D**-**G**, left M1 or M2 (AF12-2-L-1074; AF12-1-L-1254; AF12-1-L-1250; AF12-2-L-848); **H**, Leporidae indet., right M1 or M2 (AF12-2-L-1280). Scale bars: 1 mm.

have at least two fossettes, with three of them (<2% of the upper molars) having three fossettes or more. The number, shape and size of these fossettes distinguish the specimens of Afoud 12 from all other known species, with the possible exception of *P. italicus*.

Figure 7 compares measurements of our material with data from the literature. The p3 (Fig. 7A) of *P. italicus* from Montagnola Senese, *P. bilobus* from Gundersheim, Raciszyn 1 and *P.* aff. *sorbinii* from Arcille are much larger than our specimens. The p3 of *P. italicus* from Torre di Picchio,

P. sorbinii from Monte Castellaro and *P.* aff. *sorbinii* from Case Inferno are slightly larger than our specimens. The other populations of *P. sorbinii* and *P.* cf. *sorbinii* (various localities), *P. bilobus* (Tanatary, Tatareshty), *P. michauxi* (Kessani) and *P. latiuncinatus* (Polgárdi 2) are, on the whole, included in the variation of the specimens from the present work. The P3 (Fig. 7C) of *P.* cf. *sorbinii* from Velona are clearly smaller than the Afoud specimens. The specimens from Monte Castellaro, Montagnola Senese and Kessani are slightly larger than our specimens.

The species *P. michauxi* and *P. sorbinii* seem to be the species with the closest morphologies and dimensions to the Afoud specimens. Due to the considerable intraspecific variability between the two former species, a population-level comparison is needed to assign our material to a species in order to discuss the possible Europe-Africa migration patterns.

Prolagus michauxi from Sète has a much larger crochet and protoconulid than is true of our specimens; furthermore, the enamel hiatus on the mesial hyperloph of the P2 is much more frequent at Sète. There is no information about the variability of the metaconid or the mesoflexid of the p3, but the mesoflexid illustrated in López-Martínez & Thaler (1975: fig. 4, pl. II) is much larger than that of our specimens. There is also no precision about the possible presence of a hiatus on the entoconid. The anteroconid has a triangular shape, which can also be found in Afoud without it being predominant.

Prolagus michauxi from Granada (Spain, Messinian) can be studied here only through a single illustration of the p3 (originally from López-Martínez 1989, appearing in Angelone 2008b: fig. 5, for example). However, the morphology of this p3 is very similar to that of our specimens. The crochet is present without being very large, the metaconid is rectangular, the mesoflexid has a medium size with a mesial growth and the protoconulid is not excessively thick. Nevertheless, the variability of its characters is not known because we did not have access to descriptions, so we cannot safely assign our specimens to the population of Granada.

Prolagus michauxi from Kessani has been described as having a p3 with a large, asymmetric and rectangular to oval-shaped metaconid, while the lagiloph of the P3 is long without reaching the outline of the tooth. There is no hiatus on the P2, which does not significantly differ from our specimens where the hiatus is rare. The mesoflexid of the p3 has been described as being long, but the representations from Vasileiadou *et al.* (2012: fig. 3f) show mesoflexids with a size that is included within the variation of our specimens. The P3 illustrated in the same study (Vasileiadou *et al.* 2012: fig. 3c) is quite similar to those from Afoud. However the p3 of this population differs from our material owing to its more rounded anteroconid; moreover, its crochet is at least "moderately long", which suggests that it is never absent or reduced; the length of the P3 is also greater at Kessani. The variability of the mesoflexid of the p3 is not mentioned. Vasileiadou *et al.* (2012) note that Syrides *et al.* (1997) also found material concerning *Prolagus* in Kessani, but attributed it to *P.* aff. *michauxi*. A drawing of a p3 from the latter study can be found in Angelone (2008a: fig. 1), which is very similar to some specimens assigned to *P. michauxi* from the same site.

Prolagus michauxi from Silata (Greece, MN13/14) has a rounded metaconid (in contrast to our specimens) and the entoconid is very thin. The hiatus on the P2 is also much more common than in the Afoud specimens. We can note the variability of the crochet and the anteroconid.

The specimens from Brisighella (Italy, Messinian) described as *P. sorbinii* have fairly varied morphologies, depending on the karst fissures from which they were extracted. The p3 from Brisighella 25 (Angelone 2008b: fig. 5) are very similar to the specimens from the Afoud locality, as they differ only in the size of the crochet, this being larger in Brisighella. On the other hand, the specimens from Brisighella 6 (Angelone 2007: fig. 4e) have a triangular metaconid and a much more slender shape, while their crochet is relatively small like on the Afoud specimens. Some specimens from Brisighella (Angelone 2007) have an indentation on the postcone of the P2, very rare in the Afoud specimens, but the fissure from where they came has not been specified.

Prolagus sorbinii from Monte Castellaro (Italy, MN13) has slightly larger p3, P2, P3 and P4 than our specimens (Fig. 7). The protoconulid on the p3 is extremely well-developed –especially in comparison with the very reduced protoconid– and the protoisthmus is often absent. The upper molars do not have any fossettes, or they are reduced.

The *Prolagus* from Ciaòt Cagna (Italy, MN13) were first described in Cavallo *et al.* (1993) and more information was subsequently provided by Angelone (2007). However, Angelone & Cavallo (2010) have deemed this description valid for the "radical" side of the tooth rather than the occlusal one, which is broken. Thus, these specimens, first classified as *P. michauxi* and then *P. sorbinii* after the revision, cannot be assigned to the Moroccan specimens.

The p3 of *P. sorbinii* from Verduno (Italy, Messinian) illustrated in Colombero *et al.* (2014: fig. 12.1) does not seem very different from our specimens, except that the global shape is quite slender and the metaconid is considered triangular. There is no information about the variability of the characters.

The illustrated specimens of *P. sorbinii* from Develi (Turkey, MN14) in Sen *et al.* (1989: figs m-q) include a P2 with a very large and protruding centrocone (very different from the Afoud specimens) and a p3 with a rounded anteroconid and metaconid.

The p3 of *P. sorbinii* from Grebeniki 2 and Novaya Andriyashevka (Ukraine and Moldova, MN14) have a rounded anteroconid and a short mesoflexid and their crochet is often absent, while the P3 seems more variable than our specimens.

Prolagus aff. *sorbinii* from Arcille (Italy, MN16a) has a very well-developed protoconulid and a buccal indentation on the anteroconid. In addition, the paraflexus and the mesoflexus of the P2 have the same size and shape; they are straight and thin, in contrast to our specimens. An enamel hiatus on the hyperloph is present, but the frequency has not been specified. Conversely, there is no hiatus on the entoconid

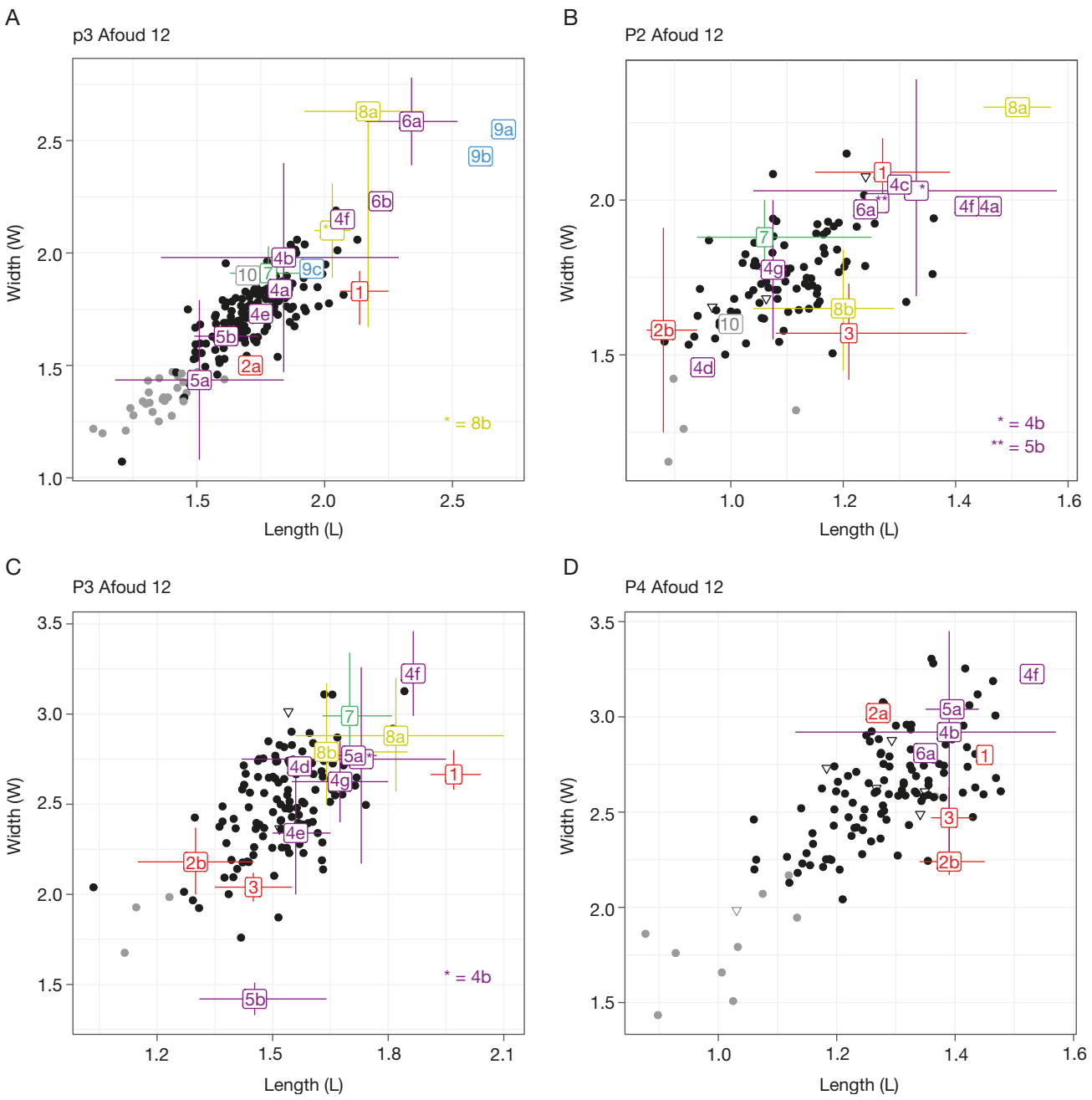

Fig. 7. — Representation of the dimensions of the dental material of the Ochotonidae from AF12-1 and AF12-2 and comparison with specimens from the literature: **A**, dimensions of p3; **B**, dimensions of P2; **C**, dimensions of P3; **D**, dimensions of P4. **Rounded points** correspond to specimens from AF12-2, **triangular points** correspond to specimens from AF12-1, while **grey points** correspond to unworn teeth. **Solid coloured lines** correspond to the range of the values measured on complete specimens, taken from the literature for the different species; **dotted coloured lines** correspond to the range of all the measured values for each species from the literature, including the values of partially broken specimens. Localities taken from the literature, for each species: *Prolagus michauxi* López-Martínez, 1975: **1**, Kessani; **2a**, Afoud 2; **2b**, Afoud 8; *P. cf. michauxi*: **3**, Aghouri; *Prolagus sorbinii* Masini, 1989: **4a**, Brisighella 6; **4b**, Brisighella 25; **4c**, Ciaboˀt Cagna; **4d**, Develi; **4e**, Grebeniki 2; **4f**, Monte Castellaro; **4g**, Novaya Andriyashevka; *P.* cf. *sorbinii*: **5a**, Borro Strolla; **5b**, Velona; *P.* aff. *sorbinii*: **6a**, Arcille; **6b**, Case Inferno; *Prolagus latiuncinatus* Angelone & Cermák, 2015: **7**, Polgárdi 2; *Prolagus italicus* Angelone, 2008: **8a**, Montagnola Senese; **8b**, Torre di Picchio; *Prolagus bilobus* Heller, 1936: **9a**, Gundersheim; **9b**, Raciszyn 1; **9c**, Tatareshty; *Prolagus* sp.: **10**, Voie Ferrée site. See Appendix 3 for details about these localities and Appendices 1 and 2 for the detailed measurements of the specimens from Afoud.

of the p3. The crochet has neither been mentioned nor illustrated, while the centroflexid is undulated and curved towards the protoconid, in contrast to the crochet in the Afoud specimens, which is displaced towards the metaconid. The metaconid's variability has not been mentioned, althrough the one illustrated in Angelone & Rook (2012: fig. 3o) is fan-shaped. The size of the p3 is distinctly larger than those of Afoud. Similarly, *P.* aff. *sorbinii* from Case Inferno (Italy, Pleistocene) also has a well-developed protoconulid, a buccally indented anteroconid, an entoconid lacking a hiatus and a centroflexid curved towards the buccal side, in addition to having a fairly large p3 (Fig. 7A).

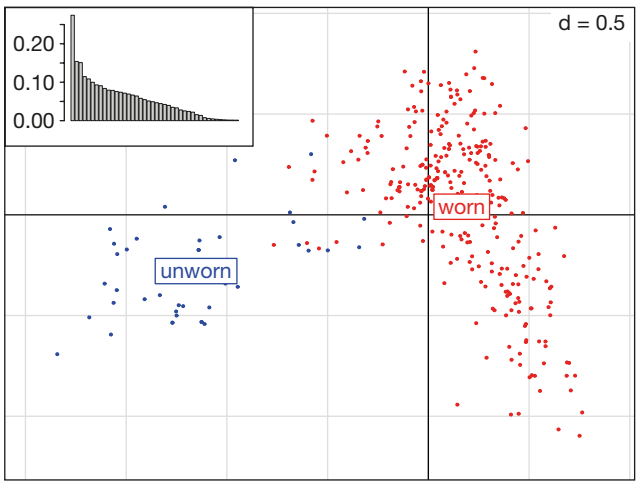

Fig. 8. — Distribution of the individuals on the morphological space according to the first two factorial axes, as part of the multiple correspondence analysis (MCA) realized on the p3. The eigenvalues of the factorial axes are illustrated in the bar plot. The illustrative variable "wear" classifies individuals into two distinct groups, the first including unworn teeth (**blue**) and the second including all other specimens (**red**). See Appendix 2 for details regarding the character states of the individuals used in the MCA.

Prolagus cf. *sorbinii* from Velona (Italy, Messinian), in addition to having a much smaller P3 than the specimens from Afoud (Fig. 7C), has a p3 with a triangular metaconid, an entoconid without a hiatus and a distal and lateral indentation of the anteroconid more frequent than our specimen. The mesial hyperloph of the P2 is very long and is thinner than our specimens, while the paraflexus and the mesoflexus are verticalized, relatively straight and thin.

The illustrations of *P.* cf. *sorbinii* from Maramena (Greece, MN13/14), originally from De Bruijn (1995) and appearing also in Angelone (2007: fig. 4f-h), for example, show a p3 with a triangular yet quite rounded metaconid. The illustrated P2 has a particularly straight and thin mesial hyperloph, paraflexus and mesoflexus. These are very different from the specimens from Afoud.

Prolagus cf. *sobinii* from Borro Strolla (Italy, Mio-Pliocene boundary) has a metaconid that is very different from the rectangular one from Afoud and the representation in Angelone & Rook (2012: fig. 3e-f) shows a very long protoconulid; the shape of the p3 seems more slender than in Afoud. The variability of the mesoflexid has not been mentioned; the only morphology evoked is a large and V-shaped one. The lagiloph on the P3 is shorter than those of our specimens.

Therefore, the populations that are closest to our specimens are *P. michauxi* from Granada and Kessani and *P. sorbinii* from Brisighella 25 as well as maybe Verduno. Brisighella 25 is only one of the many karst fissures from the Brisighella locality corresponding to the Monticino Quarry. The specimens from this fissure are very different from those of many other karst fissures, even though they have been described as the same species. The filling of these fissures can be of different ages, so it is necessary to study them independently; as a result, the difference between *P. sorbinii* from Brisighella 25 and those from the other fissures do not provide a sufficient argument to exclude the specimens from Brisighella 25 from our reasoning. However, the large size of the crochet, which is their only clear difference from our material, cannot be observed in the p3 from Granada, this tooth in fact manifesting no difference from the p3 from Afoud. *Prolagus michauxi* from Granada looks more like our specimens than *P. sorbinii* from Brisighella 25, but the fact that the tooth from Granada is only studied here through a unique representation, without description, does not allow us to come to an immediate conclusion, given that we do not know the variability of the population. The population from Verduno has a slender p3 and a triangular metaconid, while the one from Kessani has a slightly rounded anteroconid and a fairly large crochet in addition to a quite long P3. However, the variability of the metaconids found within the Afoud population has only been described in the specimens from Kessani.

The great resemblance between the tooth from Granada and our material, combined with the variability of the metaconid in the population from Kessani, ultimately allows us to assign the specimens from the Afoud locality to the species *P. michauxi*.

Prolagus michauxi and *P. sorbinii* are dentally very similar; in fact, a morphometric (complex discrete fourier transform, CDFT) analysis performed by Angelone (2008a) was unable to distinguish these two species. In this study, it even turned out that the specimen assigned to *P.* aff. *michauxi* in the locality of Kessani, used for the comparison of our material, was closer to *P. italicus* than *P. michauxi*, despite the resemblance between *P.* aff. *michauxi* and the *P. michauxi* from Kessani. However, these species can still be distinguished using the morphology of their skull. Indeed, in the emended diagnosis of *P. sorbinii,* Angelone (2007) stated that the premolar foramen of *P. sorbinii* is larger than that of *P. michauxi*, that the incisive foramen is divided in two by a narrowing of the premaxillary bone in *P. sorbinii* (which is not the case in *P. michauxi*) and that the muzzle is longer for *P. sorbinii*. Thus, the attributions realized in the current work must be considered cautiously until some more complete cranial material is found in the Aït Kandoula Basin. Until then, the specimens from Afoud are still attributed to the species *P. michauxi*.

The measures performed on the p3, P2 and P4 from AF12-1 and AF12-2 (Fig. 7A-B, D; Table 1) encompass the measures of both African and European *P. michauxi* and *P.* cf. *michauxi* from the literature (the African specimens often being smaller than their European counterparts), which is a further argument concerning the assignment of the previous Moroccan specimens (from Aghouri, Afoud 2 and 8) to the species *P. michauxi* or *P.* cf. *michauxi*. *Prolagus* sp. from the Voie Ferrée site is included within the variation of the Afoud specimens (Fig. 7A-B) and may be assignable to the species *P. michauxi*, but direct study of its morphology is needed first.

The presence of a single *Prolagus* species from Afoud (excluding the P2 mentioned below) is confirmed by the MCA, where the distribution of individuals in morphological space (Fig. 8) reflects the presence of worn and unworn teeth. It is probable that unworn teeth are recently erupted and are therefore likely to belong to rather young individuals.

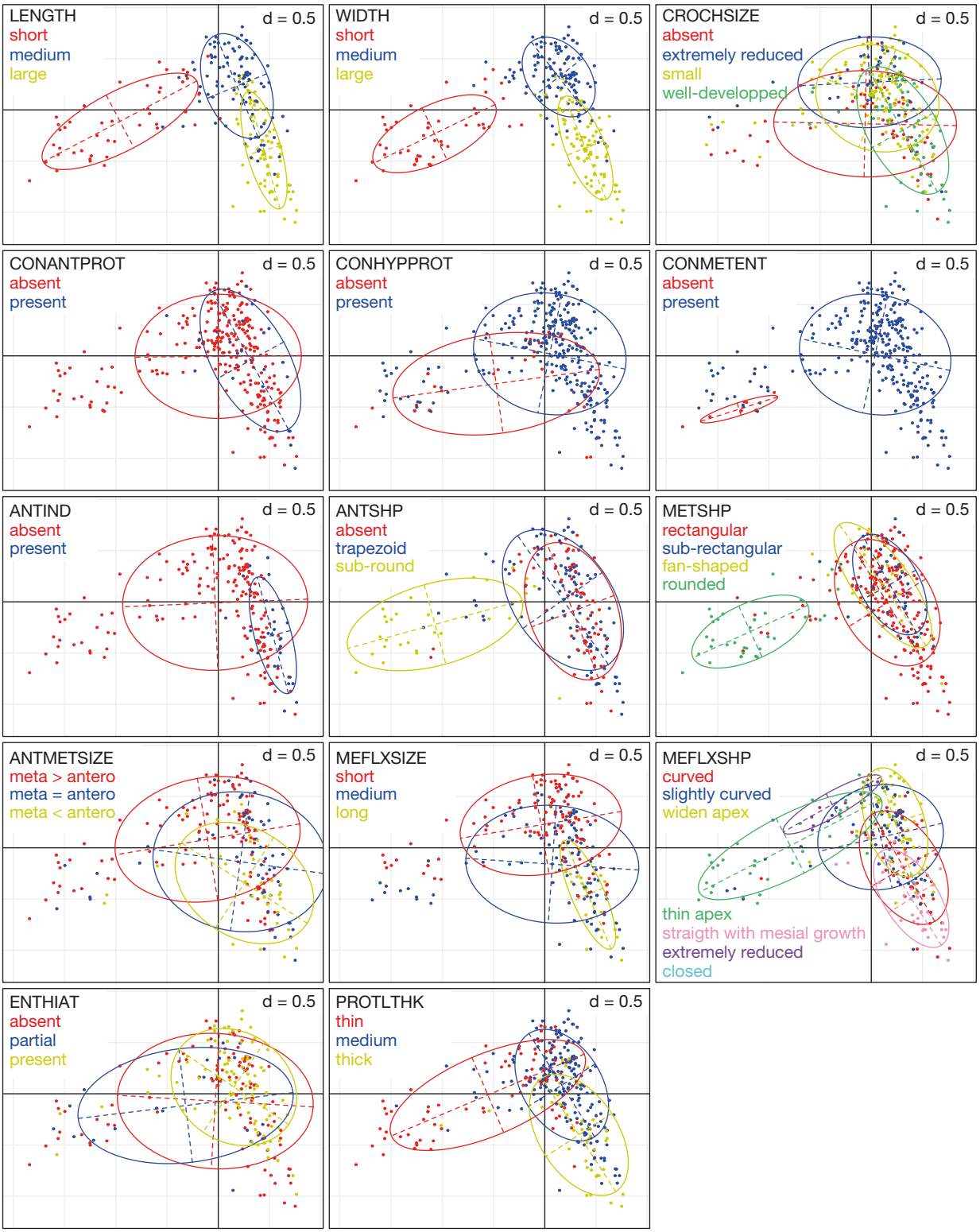

Fig. 9. — Distribution of the individuals on the morphological space according to the first two factorial axes, as part of the multiple correspondence analysis (MCA) realized on the p3. Quantitative characters (**LENGTH** and **WIDTH**) have been converted into qualitative, with the use of the Jenks natural breaks classification method. The resulting classes for the LENGTH are [1.095; 1.519[(short), [1.519; 1.765[(medium) and [1.765; 2.128] (large); the resulting classes for the WIDTH are [1,004; 1,494[(short), [1.494; 1.766[(medium) and [1.766; 2,189] (large). Abbreviations of characters: **ANTIND**, presence of indentation in the anteroconid; **ANTMETSIZE**, size of the anteroconid compared to that of the metaconid; **ANTSHP**, anteroconid shape; **CONANTPROT**, presence of the anteroconid-protoconulid connection; **CONHYPPROT**, presence of the hypoconid-protoconid connection; **CONMETENT**, presence of the metaconid-entoconid connection; **CROCHSIZE**, crochet size; **ENTHIAT**, presence of an enamel hiatus on the entoconid; **MEFLXSHP**, mesoflexid shape; **MEFLXSIZE**, mesoflexid size; **METSHP**, metaconid shape; **PROTLTHK**, protoconulid thickness. Other abbreviations: **antero**, anteroconid; **meta**, metaconid. See Appendix 2 for details regarding the character states of the individuals used in the MCA.

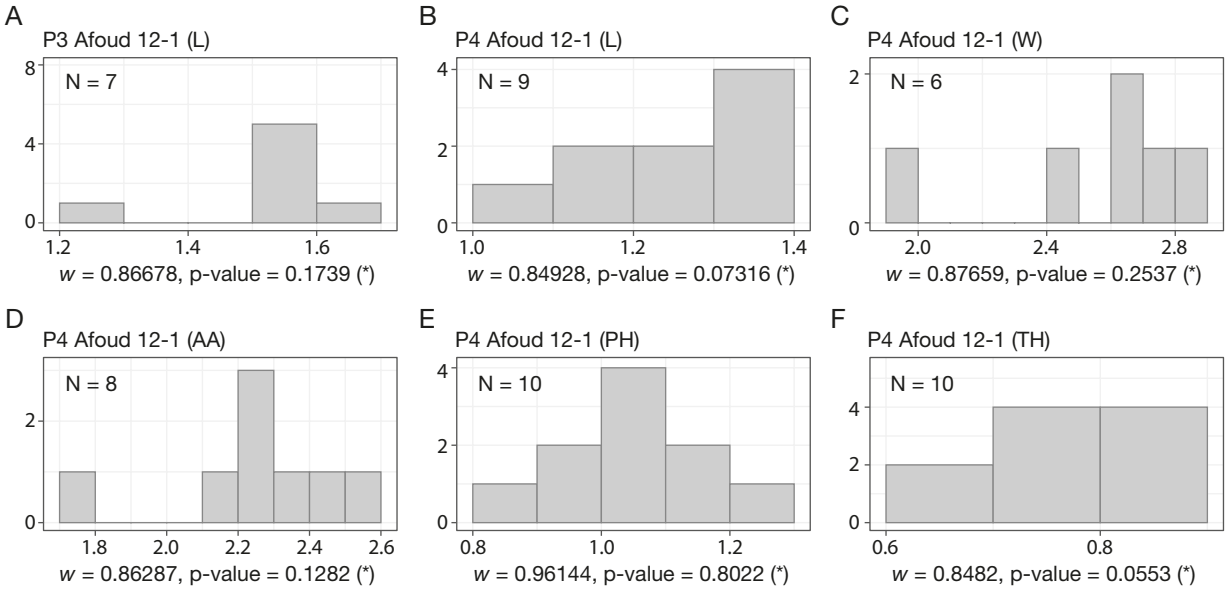

Fig. 10. — Distribution of measurements (mm) of *Prolagus* Pomel, 1853 teeth from AF12-1. Histograms with a headcount of three or fewer were not included. The Y-axis corresponds to the frequency of the classes. The results of the Shapiro-Wilk normality tests are displayed below each histogram. A measurement follows a normal distribution if its p-value is greater than 0.05 (*). Abbreviations: **AA**, partial width (Angelone & Sesé 2009); **L**, length; **N**, number of measured teeth; **PH**, hypoflexus depth (Angelone & Sesé 2009); **TH**, distal hypercone length (Angelone & Sesé 2009); ***w***, statistic of Shapiro-Wilk; **W**, width.

The fact that these unworn teeth have a relatively small size (while some of them are not necessarily different in size from the smaller fully adult specimens) is an element in support of their labelling as juvenile. Figure 9 confirms this fact: indeed, the character states causing a separation within the morphological space are the short LENGTH, short WIDTH, absent CONMETENT, sub-round ANTSHP, rounded METSHP and to a lesser extent the absent CONHYPPROT, thin apex MEFLXSHP and thin PROTLTHK. The absence of some connections, the rounding and also the small size are characters typical of rather young individuals, their permanent teeth being present but probably not worn. Given that the separation along the first factorial axis –horizontal– is caused by characters related to ontogeny, this factorial axis should thus represent the ontogeny. The bar plot in Figure 8 highlights the fact that this first factorial axis has an eigenvalue much higher than the others (0.2741, representing 11.60% of the information), even without being extremely high itself, showing that this horizontal separation in the morphological space is the only efficient way of making groups with these individuals. In fact, the other factorial axes did not allow us to identify several groups. Therefore, it is likely that the only differences observed from one individual to another are related to wear and to the phenotypic variation within a species, so it is quite unlikely that several species of *Prolagus* can be present in this assemblage.

Histograms (Figs 10; 11) do not point to the presence of several species in AF12-1 and AF12-2. All histograms with a sufficiently high headcount for the results to be significant display a unimodal distribution. Some dimensions are normally distributed when AF12-1 and AF12-2 are treated separately; in AF12-2 (Fig. 11), this is the case for the length of P2 (w of Shapiro-Wilk = 0.98735, p-value = 0.426) and the widths of P2 (w = 0.97705, p-value = 0.0902) and P3 (w = 0.98637, p-value = 0.2055). All other dimensions from AF12-2 do not follow a normal distribution; but their distribution is still unimodal, so it does not contradict the statement of a single species. It is possible that ontogeny, as highlighted previously, can explain this type of distribution. The cessation or slowing down of growth at sexual maturity can explain the shift of the peak towards the right of the histograms: all sexually mature individuals of this species may have a quite similar and large size (with little variability among individuals), no matter whether they are young adults or very old individuals. Conversely, juvenile individuals of different ages are likely to have very different sizes, which may explain the spread of the lower values. The gradual increase in these dimensions during their lifetime can explain why we do not see two different age groups in the histograms.

The morphometric (Fig. 7) and morphological variability of the dental characters of the AF12-1 level is included in the variability of the AF12-2 variation. In addition, when a dimension follows a normal distribution both in AF12-1 and AF12-2 (as is the case of the length of P2 and the width of P2 and P3), the distribution remains normal when we combine the measurement of the two levels (Fig. 12). This implies that the specimen of the two levels can be assimilated to the same population. The specimens from these two levels are thus assigned to the same species.

The morphology of the specimens from Aghouri and Afoud 2 and 8 (Benammi 1997) is not particularly different from that of the specimens from AF12-1 and AF12-2, hence confirming their attribution as *P. michauxi* and *P.* cf. *michauxi*. Conversely, the *Prolagus* sp. specimens from the Plio-Pleistocene locality of Ahl al Oughlam differ from our specimens (Sen & Geraads pers. com. 2017).

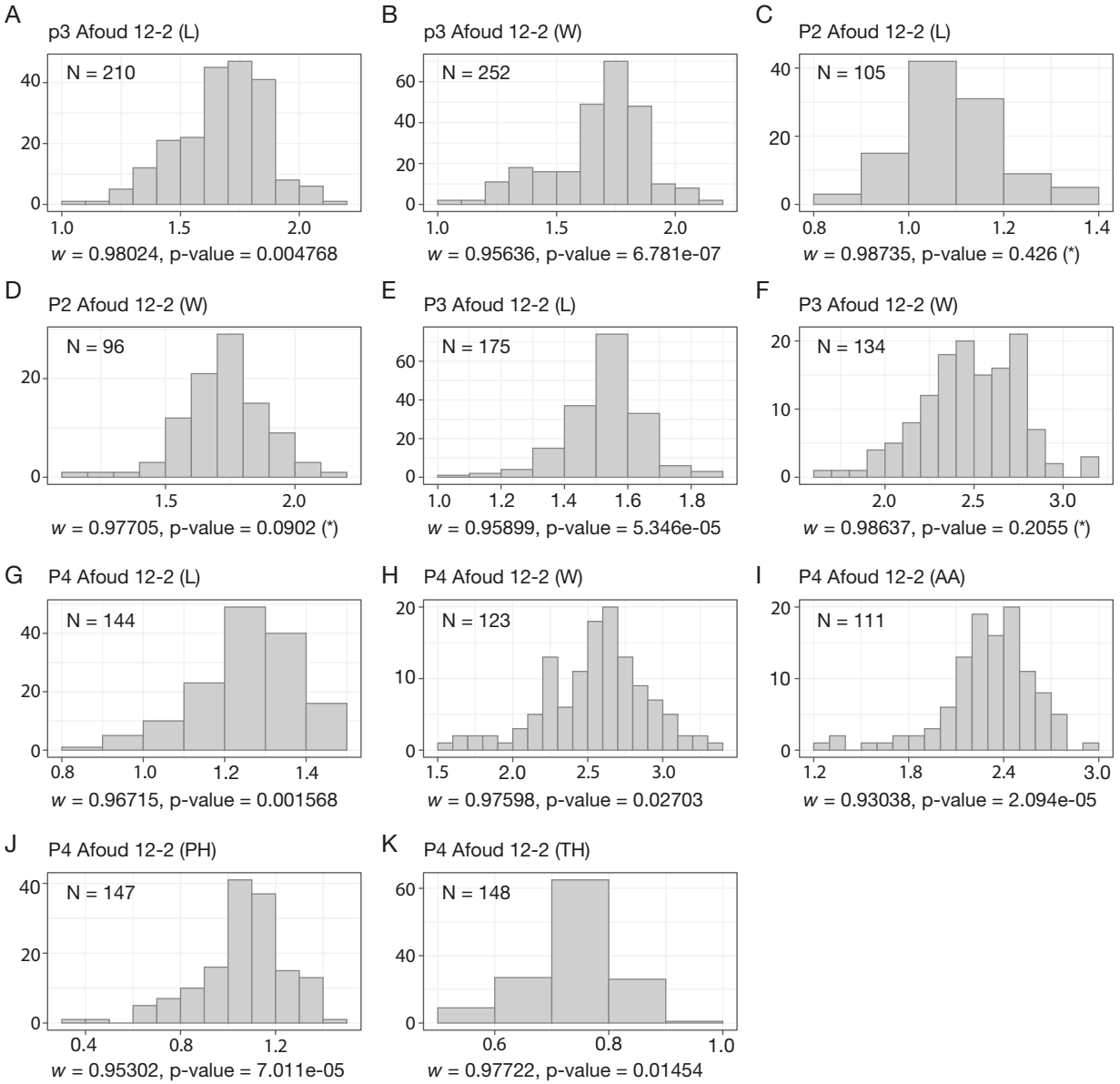

Fig. 11. — Distribution of measurements (mm) of *Prolagus* Pomel, 1853 teeth from AF12-2. The Y-axis corresponds to the frequency of the classes. The results of the Shapiro-Wilk normality tests are displayed below each histogram. A measurement follows a normal distribution if its p-value is greater than 0.05 (*). Abbreviations: **AA**, partial width (Angelone & Sesé 2009); **L**, length; **N**, number of measured teeth; **PH**, hypoflexus depth (Angelone & Sesé 2009); **TH**, distal hypercone length (Angelone & Sesé 2009); ***w***, statistic of Shapiro-Wilk; **W**, width.

Prolagus sp.
(Fig. 5K)

Description and comparisons

A unique P2 (AF12-2-L-453) has an extremely marked crenulation in the mesial hyperloph. Although a slight indentation has been observed in some *Prolagus* species, especially insular, this type of extreme crenulation has not been seen in any known taxon. It is represented in this assemblage by only one specimen, without any intermediate form between the smooth hyperloph of *P. michauxi* and the crenulated hyperloph of this P2 (some specimens assigned to *P. michauxi* do have a very slight indentation, but not marked enough to be related to this P2). It is still possible that it is an aberrant individual of the species *P. michauxi*, but the lack of documentation about anomalies in Ochotonidae impels us to describe this tooth as *Prolagus* sp.

Family Leporidae Fischer von Waldheim, 1817

Leporidae gen. et sp. indet.
(Fig. 6H)

Referred material. — Specimens from AF12-2: 2 P4 or M1, 1 M1 or M2.

Measurements. — AF12-2-L-1279: L = 2.56 mm; W = 3.24 mm (broken); AF12-2-L-1280: L = 2.56 mm; W = 4.53 mm; AF12-2-L-1281: L = 2.12 mm; W = 3.92 mm.

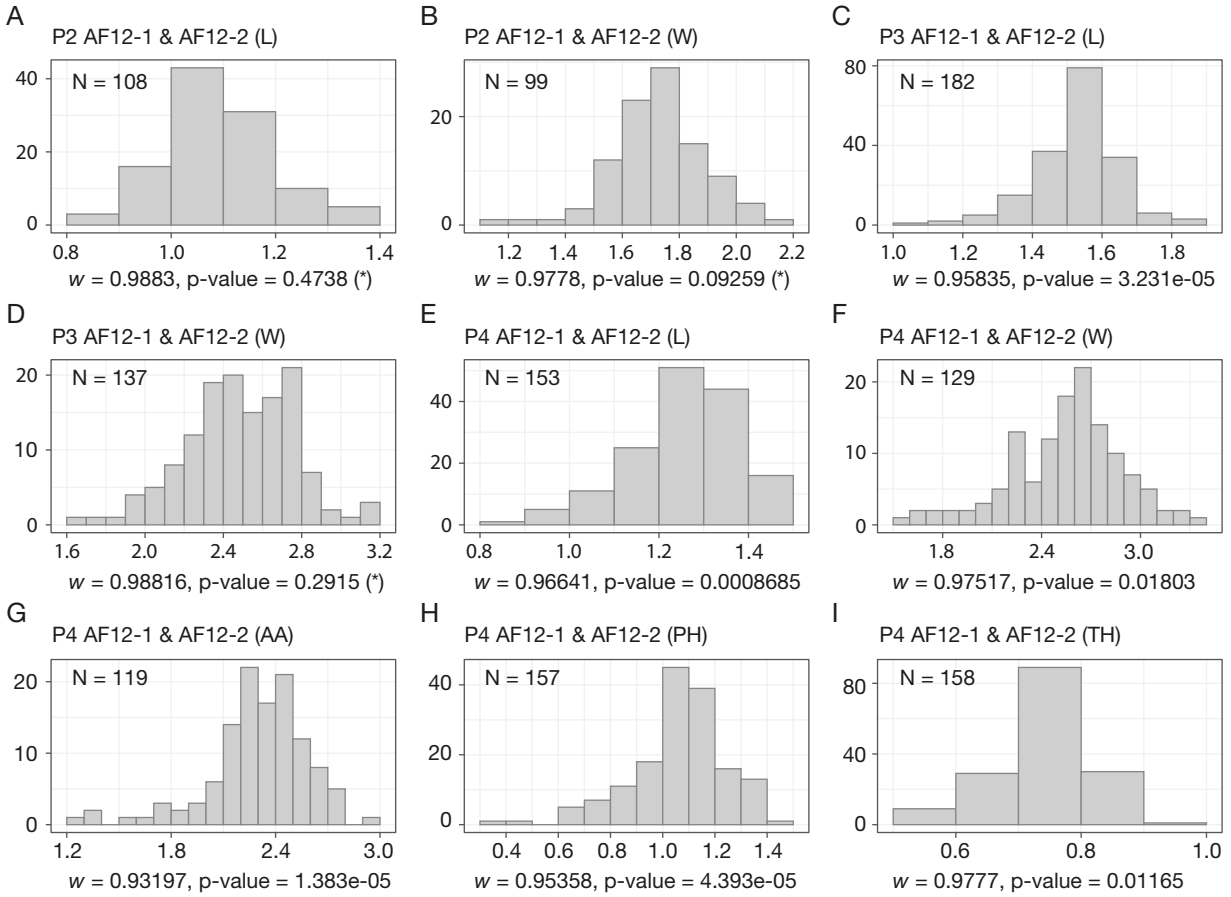

Fig. 12. — Combination of the distribution of measurements (mm) of *Prolagus* Pomel, 1853 teeth from AF12-1 and AF12-2. Histograms of p3 are identical to Figure 11, so they were not included. The Y-axis corresponds to the frequency of the classes. The results of the Shapiro-Wilk normality tests are displayed below each histogram. A measurement follows a normal distribution if its p-value is greater than 0.05 (*). Abbreviations: **AA**, partial width (Angelone & Sesé 2009); **L**, length; **N**, number of measured teeth; **PH**, hypoflexus depth (Angelone & Sesé 2009); **TH**, distal hypercone length (Angelone & Sesé 2009); ***w***, statistic of Shapiro-Wilk; **W**, width.

Description and comparisons

In addition to the thousand teeth assigned to Ochotonidae, three upper molariform teeth, clearly typical of the Leporidae, were unearthed. For each of them, the hypoflexus is strongly crenulated and the general size of the tooth is much larger than that of the other Afoud specimens. We did not perform any extensive analysis on these specimens, so we were unable to assign these teeth to a precise genus or species. Examples of Leporidae to which these teeth may be affiliated, with regard only to their palaeogeographical setting, include *Trischizolagus*, found in some Plio-Pleistocene sites of Morocco (Geraads 1994, 2006), *Serengetilagus*, present in Chad during the late Miocene (López-Martínez *et al.* 2007), and *Alilepus* Dice, 1931, present in the late Miocene of Southern Europe (Angelone & Rook 2011) and which may have had the opportunity to migrate with *Prolagus*.

DISCUSSION

Messinian faunal exchanges

The current study has enabled us to confirm the presence of the species *P. michauxi*, already identified in many Messinian localities from Western Europe as well as in some Mio-Pliocene sites from North Africa, in the AF12-1 and AF12-2 levels. In these levels, Mahboubi (2014) found this species to be associated with rodents such as Muridae (genus *Arvicanthis* Lesson, 1942, *Castillomys*, *Mus* Linnaeus, 1758, *Occitanomys* Michaux, 1969, *Paraethomys* and *Stephanomys*), Gliridae (*Eliomys*), Sciuridae (*Atlantoxerus* Major, 1893), Gerbillidae (*Protatera* Jaeger, 1977 and *Myocricetodon*) and Ctenodactylidae (*Irhoudia* Jaeger, 1971) and with Lipotyphla such as Erinaceidae (*Parasorex* Von Meyer, 1865) and Soricidae (Soricidae indet.). A large number of these genera have some affinities with European species (*Castillomys*, *Stephanomys*, *Occitanomys, Eliomys* and *Prolagus*). In addition to these Rodentia and Lipotyphla, it appears that the lagomorph species that was able to migrate from Europe to Africa was indeed *P. michauxi*. In North Africa, Afoud is the oldest site yielding *Prolagus* remains, with the AF1 level dated 6.2 Ma. The Europe-Africa faunal dispersal including *P. michauxi* is still maintained near 6.2 Ma, a little while before the beginning of the Messinian salinity crisis.

Palaeoenvironmental implications

A palaeoenvironmental analysis was previously performed in the AF12-2 level by Mahboubi (2014), following the method of Martín-Suárez (1988) (also used in Martín-Suárez *et al.*

2001, Minwer-Barakat 2005 and Garcia-Alix *et al.* 2008). Here we will reuse what was stated in this previous study.

It has already been demonstrated that the mammal remains from this level were not subject to post-mortem displacement, according to the absence of polishing traces and the presence of some articulated elements of large mammals. Moreover, we assume that small mammals are very closely related to specific environments, as they are likely to respond very quickly to environmental changes (be it on an ecological timescale or, even more so, on a geological one; the same assumption was made in Van Dam & Weltje 1999, for example). Therefore, the analysis of the Glires and Lipotyphla assemblages from AF12-2 allows the vegetation type and climate relating to this level to be inferred.

Among the micro-mammals from AF12-2 studied in Mahboubi (2014), Ochotonidae (*Prolagus*) and Muridae are comfortably the predominant groups. *Paraethomys* represents the largest part of the Muridae, constituting more than 90% of this group. The relative abundances of the Gliridae, Ctenodactylidae, Erinaceidae and Soricidae are fairly low, as they each account for about 1% of the material. Gerbilidae (*Protatera, Myocricetodon*) and Sciuridae (*Atlantoxerus*) are a little more present, without being that abundant.

The ecological preferences of *Prolagus* are not yet well-known. Some species from the late Miocene or the Pliocene were able to live in moist and wooded environments, whereas others lived in more arid, open environments but with significant seasonal precipitation (López-Martínez 2001; Angelone 2008b).

Paraethomys and especially the species *Paraethomys meini* (Michaux, 1969) is a warm and semi-arid climate indicator (Renaud *et al.* 1999; Martín-Suárez *et al.* 2001). *Protatera*, *Atlantoxerus* and *Myocricetodon* are also associated with relatively open, dry and warm environments (Jaeger 1977; Ameur-Chehbeur 1988; De Bruijn 1999). The substantial presence of these species thus indicates a mostly open, warm and at least semi-arid environment. According to isotopic analyses and to the occasional presence of taxa associated with humid environments like *Eliomys* (Van Dam & Weltje 1999), the environment should be like a savannah composed of C3 plants, with some small wooded patches (Benammi 1997; Mahboubi 2014).

CONCLUSIONS

This study of the dental material from the AF12-1 and AF12-2 levels of the Afoud locality in the Ait Kandoula Basin has confirmed the presence of the species *P. michauxi* in this site, even if additional cranial material is needed to definitively exclude its belonging to the species *P. sorbinii*, which has a very similar dental morphology. It is the only known ochotonid to have crossed the Mediterranean Sea during the late Miocene.

The presence of Leporidae at this site, alongside Ochotonidae, is interesting, given that they have not previously been reported in Morocco before the Pliocene. We hope for the discovery of new material to determine the species to which this Leporidae belong.

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REFERENCES

Agustí J., Santos-Cubedo A., Furio M., De Marfa R., Blain H. A., Oms O. & Sevilla P. 2011. — The late Neogene-early Quaternary small vertebrate succession from the Almenara-Casablanca karst complex (Castellón, Eastern Spain): chronologic and paleoclimatic context. *Quaternary International* 243 (1): 183-191. https://doi.org/10.1016/j.quaint.2010.11.016

Ameur-Chehbeur R. 1988. — *Biochronologie des formations continentales du Néogène et du Quaternaire de l'Oranie: contribution des micromammifères*. PhD thesis, Université des Sciences et de la Technologie d'Oran, Oran, 432 p.

Angelone C. 2007. — Messinian *Prolagus* (Ochotonidae, Lagomorpha) of Italy. *Geobios* 40 (3): 407-421. https://doi.org/10.1016/j.geobios.2006.04.004

Angelone C. 2008a. — Contribution of complex discrete Fourier transform (CDFT) analysis to the systematics of the genus *Prolagus* (Ochotonidae, Lagomorpha, Mammalia). *Neues Jahrbuch für Geologie und Paläontologie-Abhandlungen* 249 (2): 129-138. https://doi.org/10.1127/0077-7749/2008/0249-0129

Angelone C. 2008b. — *Prolagus italicus* n. sp. (Ochotonidae, Lagomorpha), a new Pliocene species of peninsular Italy. *Geobios* 41 (4): 445-453. https://doi.org/10.1016/j.geobios.2007.12.001

Angelone C. & Sesé C. 2009. — New characters for species discrimination within the genus *Prolagus* (Ochotonidae, Lagomorpha, Mammalia). *Journal of Paleontology* 83 (1): 80-88. https://doi.org/10.1666/07-067R2.1

Angelone C. & Cavallo O. 2010. — A new look to *Prolagus* (Ochotonidae, Lagomorpha) from the late Messinian of Ciaòt Cagna (Piedmont, NW Italy). *Rivista Italiana di Paleontologia e Stratigrafia* 116 (2): 267-270. https://doi.org/10.13130/2039-4942/5954

Angelone C. & Rook L. 2011. — *Alilepus meini* nov. sp. (Leporidae, Lagomorpha) from the early Messinian of Tuscany (central-western Italy). *Geobios* 44 (2-3): 151-156. https://doi.org/10.1016/j.geobios.2010.11.003

Angelone C. & Rook L. 2012. — Late Neogene and Quaternary lagomorphs from Tuscany: a revision based on specimens in Basel Naturhistorisches Museum and Florence University collection. *Swiss Journal of Palaeontology* 131: 127-145. https://doi.org/10.1007/s13358-011-0035-2

Angelone C. & Cermák S. 2015. — Two new species of *Prolagus* (Lagomorpha, Mammalia) from the Late Miocene of Hungary: taxonomy, biochronology and palaeobiogeography. *Paläontologische Zeitchrift* 89: 1023-1038. https://doi.org/10.1007/s12542-014-0247-z

Benammi M. 1997. — *Étude biochronologique et magnétostratigraphique des bassins continentaux Néogènes du Maroc (Bassin d'Aït Kandoula et Formation du Jebel Rhassoul).* PhD thesis, Université de Montpellier II, Montpellier, 350 p.

Benammi M. 2006. — Nouveaux gisements à rongeurs dans le Miocène moyen continental du bassin d'Aït Kandoula (Maroc). *Geobios* 39 (5): 589-598. https://doi.org/10.1016/j.geobios.2004.09.005

Benammi M., Calvo M., Prévot M. & Jaeger J. J. 1996. — Magnetostratigraphy and paleontology of Aït Kandoula basin (High Atlas, Morocco) and the African-European late Miocene terrestrial faunal exchanges. *Earth and Planetary Science Letters* 145 (1-4): 15-29. https://doi.org/10.1016/S0012-821X(96)00183-5

Brandy L. D. & Jaeger J. J. 1980. — Les échanges de faunes terrestres entre l'Europe et l'Afrique au Messinien. *Comptes Rendus de l'Académie des Sciences de Paris* 291: 465-468.

Cavallo O., Sen S., Rage J. C. & Gaudant J. 1993. — Vertébrés Messiniens du faciès à congéries de Ciabot Cagna, Corneliano d'Alba (Piémont, Italie). *Rivista Piemontese di Storia Naturale* 14: 3-22.

Čermák S. & Angelone C. 2013. — Revision of the type material of the Pliocene species *Prolagus bilobus* Heller, 1936 (Mammalia, Lagomorpha) with comments on the taxonomic validity of *P. osmolskae* Fostowicz-Frelik, 2010. *Bulletin of Geosciences* 88 (1): 45-50. https://doi.org/10.3140/bull.geosc.1369

Coiffait B. 1991. — *Contribution des rongeurs du Néogène d'Afrique à la biostratigraphie d'Afrique du Nord Occidentale.* PhD thesis, Université de Nancy I, Nancy, 389 p.

Colombero S., Angelone C., Boneli E., Carnevale G., Cavallo O., Delfino M., Giuntelli P., Mazza P., Pavia G. & Repetto G. 2014. — The upper Messinian assemblages of fossils vertebrate remains of Verduno (NW Italy): another brick for a latest Miocene bridge across the Mediterranean. *Neues Jahrbuch für Geologie und Paläontologie-Abhandlungen* 272 (3): 287-324. https://doi.org/10.1127/0077-7749/2014/0408

De Bruijn H. 1995. — Lagomorpha (Mammalia), *in* Schmidt-Kittler N. (ed.), The vertebrate locality Maramena (Macedonia, Greece) at the Turolian-Ruscinian boundary (Neogene). *Münchner Geowissenschaftliche Abhandlungen A* 28. Dr. Friedrich Pfeil, München: 133-136.

De Bruijn H. 1999. — Superfamilly Sciuroidea, *in* Rössner G. E. & Heissig K. (eds), *The Miocene land mammals of Europe.* Dr. Friedrich Pfeil, München: 271-280.

Fostowicz-Frelik L. 2010. — A new species of Pliocene *Prolagus* (Lagomorpha: Ochotonidae) from Poland is the northernmost record of the genus. *Journal of Vertebrate Paleontology* 30 (2): 609-612. https://doi.org/10.1080/02724631003621789

Garcia-Alix A., Minwer-Barakat R., Martín-Suárez E., Freudenthal M. & Martin J. M. 2008. — Late Miocene–Early Pliocene climatic evolution of the Granada Basin (southern Spain) deduced from the paleoecology of the micromammal associations. Palaeogeography, Palaeoclimatology, Palaeoecology 265 (3-4): 214-225. https://doi.org/10.1016/j.palaeo.2008.04.005

Geraads D. 1994. — Rongeurs et lagomorphes du Pléistocène moyen de la "Grotte des Rhinocéros", Carrière Oulad Hamida 1 à Casablanca, Maroc. *Neues Jahrbuch für Geologie und Paläontologie-Abhandlungen* 191: 147-172.

Geraads D. 2006. — The Late Pliocene locality of Ahl al Oughlam, Morocco: vertebrate fauna and interpretation. *Transactions of the Royal Society of South Africa* 61 (2): 97-101. https://doi.org/10.1080/00359190609519958

Gibert L., Scott G.R., Montoya P., Ruiz-Sánchez F.J., Morales J., Luque L., Abella J. & Lería M. 2013. — Evidence for an African-Iberian mammal dispersal during the pre-evaporitic Messinian. *Geology* 41 (6): 691-694. https://doi.org/10.1130/G34164.1

Heller F. 1936. — Eine oberpliocäne Wirbeltierfauna aus Rheinhessen. *Neues Jahrbuch für Mineralogie, Geologie und Paläontologie* 76: 99-160. https://doi.org/10.1007/BF03042849

Hordijk K. 2010. — *Perseverance of pikas in the Miocene: Interplay of climate and competition in the evolution of Spanish Ochotonidae (Lagomorpha, Mammalia).* PhD thesis, Universiteit Utrecht, Utrecht, 232 p.

Jaeger J. J. 1977. — Les rongeurs du Miocene moyen et supérieurs du Maghreb. *Palaeovertebrata* 8: 1-166.

Jaeger J. J., Michaux J. & Thaler L. 1975. — Présence d'un rongeur muridé nouveau, *Paraethomys miocaenicus* n. sp., dans le Turolien supérieur du Maroc et d'Espagne. Implications paléogéographiques. *Comptes Rendus de l'Académie des Sciences de Paris* 280: 1673-1675.

López-Martínez N. 1974. — *Évolution de la lignée Piezodus-Prolagus (Lagomorpha, Ochotonidae) dans le Cénozoïque d'Europe sud-occidentale.* PhD thesis, Université de Montpellier II, Montpellier, 153 p.

López-Martínez N. 1989. — Revisión sistemática y biostratigráfica de los Lagomorpha (Mammalia) del Terciario y Cuaternario de España. *Memorias del Museo Paleontológico de la Universidad de Zaragoza* 3: 1-342.

López-Martínez N. 2001. — Paleobiogeographical history of *Prolagus*, an European ochotonid (Lagomorpha). *Lynx* 32: 215-231.

López-Martínez N. & Thaler L. 1975. — Biogéographie, évolution et compléments à la systématique du groupe d'ochotonides *Piezodus-Prolagus* (Mammalia, Lagomorpha). *Bulletin de la Société Géologique de France* 17 (5): 850-866. https://doi.org/10.2113/gssgfbull.S7-XVII.5.850

López-Martínez N., Likius A., Mackaye H. T., Vignaud P. & Brunet M. 2007. — A new lagomorph from the Late Miocene of Chad (Central Africa). *Revista Española de Paleontología* 22 (1): 1-20. https://doi.org/10.7203/sjp.22.1.20384

Mahboubi S. 2014. — *Les rongeurs du Miocène supérieur et terminal d'Afrique nord-occidentale: biochronologie, magnétostratigraphie, biogéographie et paléoenvironnements.* PhD thesis, Université de Poitiers, Poitiers, 253 p.

Martín-Suárez E. 1988. — *Sucesiones de micromamíferos en la depresión Guadix-Baza.* PhD thesis, Universidad de Granada, Granada, 241 p.

Martín-Suárez E., Freudenthal M. & Civis J. 2001. — Rodent palaeoecology of the continental Upper Miocene of Crevillente (Alicante, SE Spain). *Palaeogeography, Palaeoclimatology, Palaeoecology* 165 (3-4): 349-359. https://doi.org/10.1016/S0031-0182(00)00170-X

Minwer-Barakat R. 2005. — *Roedores e insectívoros del Turoliense superior y el Plioceno del sector central de la cuenca de Guadix.* PhD thesis, Universidad de Granada, Granada, 535 p.

Minwer-Barakat R., Garcia-Alix A., Agustí J., Martín-Suárez E. & Freudenthal M. 2009. — The micromammal fauna from Negratín-1 (Guadix Basin, Southern Spain): new evidence of African-Iberian mammal exchanges during the Late Miocene. Journal of Paleontology 83 (6): 854-879. https://doi.org/10.1666/09-009.1

Pérez-Asencio J. N., Aguirre J., Schmiedl G. & Civis J. 2012. — Impact of restriction of the Atlantic-Mediterranean gateway on the Mediterranean Outflow Water and eastern Atlantic circulation during the Messinian. *Paleoceanography* 27 (3), 14 p. https://doi.org/10.1029/2012PA002309

Pérez-Asencio J. N., Aguirre J., Jiménez-Moreno G., Schmiedl G. & Civis J. 2013. — Glacioeustatic control on the origin and cessation of the Messinian salinity crisis. *Global and Planetary Change* 111: 1-8. https://doi.org/10.1016/j.gloplacha.2013.08.008

Pomel A. 1853. — *Catalogue méthodique et descriptif des vertébrés fossiles : découverts dans le bassin hydrographique supérieur de la Loire, et surtout dans la vallée de son affluent principal, l'Allier.* J.-B. Baillière, Paris : 1-193.

Remy J. A. & Benammi M. 2006. — Presence of a Gomphotheriidae indet. (Proboscidea, Mammalia) in the Vallesian fauna of Afoud AF6 (Aït Kandoula Basin, Morocco), inferred from the enamel microstructure of a molar chip. *Geobios* 39 (4): 555-562. https://doi.org/10.1016/j.geobios.2005.03.004

Renaud S., Benammi M. & Jaeger J. J. 1999. — Morphological evolution of the Murinae rodent *Paraethomys* in response to climatic variations (Mio-Pleistocene of North Africa). *Paleobiology* 25 (3): 369-382. https://doi.org/10.1017/S0094837300021333

Robinson P., Black C. C., Krishtalka L. & Dawson M. R. 1982. — Fossil small mammals from the Kechabta Formation, northwestern Tunisia. *Annals of Carnegie Museum* 51: 231-249. https://doi.org/10.5962/p.214567

Sen S. 1990. — Middle Miocene lagomorphs from Pasalar, Turkey. *Journal of Human Evolution* 19 (4-5): 455-461. https://doi.org/10.1016/0047-2484(90)90056-H

Sen S., Jaeger J. J., Dalfes N., Mazin J. M. & Bocherens H. 1989. — Découverte d'une faune de petits mammifères Pliocènes en Anatolie occidentale. *Comptes Rendus de l'Académie des Sciences de Paris* 309: 1729-1734.

Syrides G. E., Koliadimou K. K. & Koufos G. D. 1997. — New Neogene molluscan and mammalian sites from Thrace, Greece. *Comptes Rendus de l'Académie des Sciences de Paris* 324: 427-433.

Tesakov A. & Averianov A. O. 2002. — *Prolagus* (Lagomorpha, Prolagidae) from the Pliocene of Moldova and Ukraine. *Paleontological Journal* 36: 80-86.

Van Dam J. A. & Weltje G. J. 1999. — Reconstruction of the Late Miocene climate of Spain using rodent paleocommunity successions: an application of end-member modelling. *Palaeogeography, Palaeoclimatology, Palaeoecology* 151 (4): 267-305. https://doi.org/10.1016/S0031-0182(99)00015-2

Vasileiadou K. V., Koufos G. D. & Syrides G. E. 2003. — Silata, a new locality with micrommals from the Miocene/Pliocene boundary of the Chalkidiki peninsula, Macedonia, Greece, *in* Reumer J. W. F. & Wessels W. (eds), *Distribution and migration of Tertiary mammals in Eurasia. A volume in honor of Hans de Bruijn*. *Deinsea* 10. Natuurmuseum Rotterdam, Rotterdam: 549-562.

Vasileiadou K. V., Konidaris G. & Koufos G. D. 2012. — New data on the micromammalian locality of Kessani (Thrace, Greece) at the Mio-Pliocene boundary. *Palaeobiodiversity and Palaeoenvironments* 92: 211-237. https://doi.org/10.1007/s12549-012-0075-7

Von Koenigswald W., Anders U., Engels S., Schultz J. A. & Ruf I. 2010. — Tooth morphology in fossil and extant Lagomorpha (Mammalia) reflects different mastication patterns. *Journal of Mammalian Evolution* 17: 275-299. https://doi.org/10.1007/s10914-010-9140-z

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APPENDICES

Appendix 1. — Detailed dimensions of the P2, P3 and P4 of *Prolagus michauxi* López-Martínez, 1975 from Afoud (mm). Abbreviations: **L**, length; **W**, width; **AA**, partial width (Angelone & Sesé 2009); **PH**, hypoflexus depth (Angelone & Sesé 2009); **TH**, distal hypercone length (Angelone & Sesé 2009).

Level	Position	Specimen.number	L	W	AA	PH	TH
AF12-1	P2	AF12-1-L-1226	1.24	2.076	NA	NA	NA
AF12-1	P2	AF12-1-L-1227	1.063	1.682	NA	NA	NA
AF12-1	P2	AF12-1-L-1228	0.967	1.655	NA	NA	NA
AF12-1	P2	AF12-1-L-1229	NA	NA	NA	NA	NA
AF12-1	P3	AF12-1-L-1230	1.257	NA	NA	NA	NA
AF12-1	P3	AF12-1-L-1231	1.588	NA	NA	NA	NA
AF12-1	P3	AF12-1-L-1232	1.527	NA	NA	NA	NA
AF12-1	P3	AF12-1-L-1233	1.541	3.014	NA	NA	NA
AF12-1	P3	AF12-1-L-1234	1.518	2.365	NA	NA	NA
AF12-1	P3	AF12-1-L-1235	1.693	2.606	NA	NA	NA
AF12-1	P3	AF12-1-L-1236	1.502	NA	NA	NA	NA
AF12-1	P4	AF12-1-L-1237	1.349	2.608	2.416	1.119	0.813
AF12-1	P4	AF12-1-L-1238	1.267	2.626	2.506	1.233	0.746
AF12-1	P4	AF12-1-L-1239	1.183	2.731	2.223	0.993	0.629
AF12-1	P4	AF12-1-L-1240	1.293	2.877	2.342	1.067	0.719
AF12-1	P4	AF12-1-L-1241	1.031	1.985	1.781	0.815	0.624
AF12-1	P4	AF12-1-L-1242	1.341	2.489	2.25	1.085	0.82
AF12-1	P4	AF12-1-L-1243	1.322	NA	2.27	1.021	0.791
AF12-1	P4	AF12-1-L-1244	1.321	NA	2.197	1.137	0.807
AF12-1	P4	AF12-1-L-1245	1.171	NA	NA	1.088	0.724
AF12-1	P4	AF12-1-L-1246	NA	NA	NA	0.906	0.821
AF12-2	P2	AF12-2-L-338	0.99	1.501	NA	NA	NA
AF12-2	P2	AF12-2-L-339	1.158	1.673	NA	NA	NA
AF12-2	P2	AF12-2-L-340	1.154	1.662	NA	NA	NA
AF12-2	P2	AF12-2-L-341	1.167	1.827	NA	NA	NA
AF12-2	P2	AF12-2-L-342	1.256	1.924	NA	NA	NA
AF12-2	P2	AF12-2-L-343	0.98	1.595	NA	NA	NA
AF12-2	P2	AF12-2-L-344	1.152	1.892	NA	NA	NA
AF12-2	P2	AF12-2-L-346	1.041	1.789	NA	NA	NA
AF12-2	P2	AF12-2-L-348	1.058	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-350	1.096	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-351	1.359	1.761	NA	NA	NA
AF12-2	P2	AF12-2-L-352	1.097	1.737	NA	NA	NA
AF12-2	P2	AF12-2-L-353	1.261	2.072	NA	NA	NA
AF12-2	P2	AF12-2-L-354	1.021	1.797	NA	NA	NA
AF12-2	P2	AF12-2-L-355	0.882	1.543	NA	NA	NA
AF12-2	P2	AF12-2-L-356	1.067	1.717	NA	NA	NA
AF12-2	P2	AF12-2-L-357	1.094	1.578	NA	NA	NA
AF12-2	P2	AF12-2-L-359	1.165	1.889	NA	NA	NA
AF12-2	P2	AF12-2-L-360	1.042	1.862	NA	NA	NA
AF12-2	P2	AF12-2-L-361	0.935	1.559	NA	NA	NA
AF12-2	P2	AF12-2-L-362	0.974	1.644	NA	NA	NA
AF12-2	P2	AF12-2-L-363	1.173	1.93	NA	NA	NA
AF12-2	P2	AF12-2-L-364	0.925	1.533	NA	NA	NA
AF12-2	P2	AF12-2-L-365	1.1	1.778	NA	NA	NA
AF12-2	P2	AF12-2-L-366	1.156	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-367	1.102	1.639	NA	NA	NA
AF12-2	P2	AF12-2-L-368		1.64	NA	NA	NA
AF12-2	P2	AF12-2-L-369	1.312	1.671	NA	NA	NA
AF12-2	P2	AF12-2-L-370	1.099	1.764	NA	NA	NA
AF12-2	P2	AF12-2-L-371	1.027	1.537	NA	NA	NA
AF12-2	P2	AF12-2-L-372	1.032	1.693	NA	NA	NA
AF12-2	P2	AF12-2-L-373	0.945	1.713	NA	NA	NA
AF12-2	P2	AF12-2-L-374	1.083	1.71	NA	NA	NA
AF12-2	P2	AF12-2-L-376	0.941	1.626	NA	NA	NA
AF12-2	P2	AF12-2-L-377	1.04	1.709	NA	NA	NA
AF12-2	P2	AF12-2-L-378	1.086	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-379	1.189	1.84	NA	NA	NA
AF12-2	P2	AF12-2-L-380	1.212	1.832	NA	NA	NA
AF12-2	P2	AF12-2-L-381	1.043	1.803	NA	NA	NA
AF12-2	P2	AF12-2-L-383	NA	1.652	NA	NA	NA
AF12-2	P2	AF12-2-L-384	1.059	1.617	NA	NA	NA
AF12-2	P2	AF12-2-L-385	0.914	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-391	NA	1.567	NA	NA	NA
AF12-2	P2	AF12-2-L-392	NA	NA	NA	NA	NA

Appendix 1. — Continuation.

Level	Position	Specimen.number	L	W	AA	PH	TH
AF12-2	P2	AF12-2-L-393	1.075	2.084	NA	NA	NA
AF12-2	P2	AF12-2-L-394	1.132	1.73	NA	NA	NA
AF12-2	P2	AF12-2-L-395	NA	1.648	NA	NA	NA
AF12-2	P2	AF12-2-L-396	1.183	1.915	NA	NA	NA
AF12-2	P2	AF12-2-L-397	1.143	1.747	NA	NA	NA
AF12-2	P2	AF12-2-L-398	1.154	1.922	NA	NA	NA
AF12-2	P2	AF12-2-L-399	1.237	2.016	NA	NA	NA
AF12-2	P2	AF12-2-L-400	1.224	1.914	NA	NA	NA
AF12-2	P2	AF12-2-L-401	1.026	1.825	NA	NA	NA
AF12-2	P2	AF12-2-L-402	1.138	1.722	NA	NA	NA
AF12-2	P2	AF12-2-L-403	1.156	1.803	NA	NA	NA
AF12-2	P2	AF12-2-L-404	1.135	1.749	NA	NA	NA
AF12-2	P2	AF12-2-L-405	1.121	1.645	NA	NA	NA
AF12-2	P2	AF12-2-L-406	1.046	1.788	NA	NA	NA
AF12-2	P2	AF12-2-L-407	1.117	1.714	NA	NA	NA
AF12-2	P2	AF12-2-L-408	1.095	1.854	NA	NA	NA
AF12-2	P2	AF12-2-L-409	1.079	1.71	NA	NA	NA
AF12-2	P2	AF12-2-L-410	1.011	1.637	NA	NA	NA
AF12-2	P2	AF12-2-L-411	1.055	1.619	NA	NA	NA
AF12-2	P2	AF12-2-L-412	1.083	1.681	NA	NA	NA
AF12-2	P2	AF12-2-L-413	1.139	1.649	NA	NA	NA
AF12-2	P2	AF12-2-L-414	1.054	1.729	NA	NA	NA
AF12-2	P2	AF12-2-L-415	1.051	1.668	NA	NA	NA
AF12-2	P2	AF12-2-L-416	1.171	1.899	NA	NA	NA
AF12-2	P2	AF12-2-L-417	1.181	1.505	NA	NA	NA
AF12-2	P2	AF12-2-L-419	NA	1.64	NA	NA	NA
AF12-2	P2	AF12-2-L-420	1.192	1.767	NA	NA	NA
AF12-2	P2	AF12-2-L-421	1.13	1.784	NA	NA	NA
AF12-2	P2	AF12-2-L-422	1.206	1.801	NA	NA	NA
AF12-2	P2	AF12-2-L-423	1.086	1.542	NA	NA	NA
AF12-2	P2	AF12-2-L-424	NA	1.535	NA	NA	NA
AF12-2	P2	AF12-2-L-425	0.932	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-426	0.889	1.155	NA	NA	NA
AF12-2	P2	AF12-2-L-427	0.898	1.423	NA	NA	NA
AF12-2	P2	AF12-2-L-428	0.916	1.261	NA	NA	NA
AF12-2	P2	AF12-2-L-429	0.941	1.476	NA	NA	NA
AF12-2	P2	AF12-2-L-430	1.116	1.321	NA	NA	NA
AF12-2	P2	AF12-2-L-431	0.972	1.553	NA	NA	NA
AF12-2	P2	AF12-2-L-432	1.206	2.15	NA	NA	NA
AF12-2	P2	AF12-2-L-433	1.153	1.697	NA	NA	NA
AF12-2	P2	AF12-2-L-434	NA	1.788	NA	NA	NA
AF12-2	P2	AF12-2-L-435	1.075	1.94	NA	NA	NA
AF12-2	P2	AF12-2-L-436	1.043	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-437	1.145	1.725	NA	NA	NA
AF12-2	P2	AF12-2-L-438	1.074	1.83	NA	NA	NA
AF12-2	P2	AF12-2-L-439	1.03	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-440	1.063	1.737	NA	NA	NA
AF12-2	P2	AF12-2-L-442	1.055	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-443	1.116	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-444	1.011	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-445	1.301	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-450	1.154	1.715	NA	NA	NA
AF12-2	P2	AF12-2-L-452	1.024	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-454	1.361	1.941	NA	NA	NA
AF12-2	P2	AF12-2-L-455	1.202	1.785	NA	NA	NA
AF12-2	P2	AF12-2-L-456	1.088	1.757	NA	NA	NA
AF12-2	P2	AF12-2-L-457	1.239	1.787	NA	NA	NA
AF12-2	P2	AF12-2-L-458	1.081	1.932	NA	NA	NA
AF12-2	P2	AF12-2-L-459	1.05	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-461	1.077	1.779	NA	NA	NA
AF12-2	P2	AF12-2-L-462	1.006	1.681	NA	NA	NA
AF12-2	P2	AF12-2-L-463	0.961	1.87	NA	NA	NA
AF12-2	P2	AF12-2-L-464	1.106	1.779	NA	NA	NA
AF12-2	P2	AF12-2-L-465	1.144	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-466	1.192	1.927	NA	NA	NA
AF12-2	P2	AF12-2-L-467	1.305	NA	NA	NA	NA
AF12-2	P2	AF12-2-L-468	NA	1.498	NA	NA	NA
AF12-2	P2	AF12-2-L-469	0.98	1.605	NA	NA	NA
AF12-2	P2	AF12-2-L-470	1.076	1.883	NA	NA	NA
AF12-2	P3	AF12-2-L-471	1.434	2.182	NA	NA	NA

Appendix 1. — Continuation.

Level	Position	Specimen.number	L	W	AA	PH	TH
AF12-2	P3	AF12-2-L-472	1.611	2.58	NA	NA	NA
AF12-2	P3	AF12-2-L-473	1.544	2.474	NA	NA	NA
AF12-2	P3	AF12-2-L-474	1.458	2.396	NA	NA	NA
AF12-2	P3	AF12-2-L-475	1.553	2.748	NA	NA	NA
AF12-2	P3	AF12-2-L-476	1.393	2.191	NA	NA	NA
AF12-2	P3	AF12-2-L-477	1.602	2.728	NA	NA	NA
AF12-2	P3	AF12-2-L-478	1.507	2.769	NA	NA	NA
AF12-2	P3	AF12-2-L-479	1.404	2.366	NA	NA	NA
AF12-2	P3	AF12-2-L-480	1.441	2.564	NA	NA	NA
AF12-2	P3	AF12-2-L-481	1.576	2.361	NA	NA	NA
AF12-2	P3	AF12-2-L-482	1.37	2.488	NA	NA	NA
AF12-2	P3	AF12-2-L-483	1.489	2.849	NA	NA	NA
AF12-2	P3	AF12-2-L-484	1.507	2.642	NA	NA	NA
AF12-2	P3	AF12-2-L-485	1.454	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-487	1.53	2.817	NA	NA	NA
AF12-2	P3	AF12-2-L-488	1.55	2.828	NA	NA	NA
AF12-2	P3	AF12-2-L-489	1.399	2.419	NA	NA	NA
AF12-2	P3	AF12-2-L-490	1.521	2.408	NA	NA	NA
AF12-2	P3	AF12-2-L-491	1.49	2.647	NA	NA	NA
AF12-2	P3	AF12-2-L-492	1.509	2.736	NA	NA	NA
AF12-2	P3	AF12-2-L-493	1.829	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-494	1.6	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-495	1.501	2.652	NA	NA	NA
AF12-2	P3	AF12-2-L-496	1.629	2.761	NA	NA	NA
AF12-2	P3	AF12-2-L-497	1.591	2.702	NA	NA	NA
AF12-2	P3	AF12-2-L-498	1.398	2.095	NA	NA	NA
AF12-2	P3	AF12-2-L-499	1.57	2.279	NA	NA	NA
AF12-2	P3	AF12-2-L-500	1.584	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-501	1.55	2.429	NA	NA	NA
AF12-2	P3	AF12-2-L-502	1.583	2.386	NA	NA	NA
AF12-2	P3	AF12-2-L-503	1.604	2.402	NA	NA	NA
AF12-2	P3	AF12-2-L-506	1.668	2.87	NA	NA	NA
AF12-2	P3	AF12-2-L-507	1.566	2.743	NA	NA	NA
AF12-2	P3	AF12-2-L-508	1.538	2.551	NA	NA	NA
AF12-2	P3	AF12-2-L-509	1.425	2.715	NA	NA	NA
AF12-2	P3	AF12-2-L-510	1.496	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-511	1.486	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-512	1.629	2.288	NA	NA	NA
AF12-2	P3	AF12-2-L-513	1.521	2.499	NA	NA	NA
AF12-2	P3	AF12-2-L-514	1.501	2.456	NA	NA	NA
AF12-2	P3	AF12-2-L-515	1.626	2.776	NA	NA	NA
AF12-2	P3	AF12-2-L-516	1.498	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-517	1.63	2.652	NA	NA	NA
AF12-2	P3	AF12-2-L-518	1.375	2.093	NA	NA	NA
AF12-2	P3	AF12-2-L-519	1.524	2.26	NA	NA	NA
AF12-2	P3	AF12-2-L-520	1.709	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-521	NA	2.342	NA	NA	NA
AF12-2	P3	AF12-2-L-522	1.54	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-523	1.681	2.554	NA	NA	NA
AF12-2	P3	AF12-2-L-524	1.656	2.726	NA	NA	NA
AF12-2	P3	AF12-2-L-525	1.466	2.387	NA	NA	NA
AF12-2	P3	AF12-2-L-526	1.51	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-527	1.582	2.505	NA	NA	NA
AF12-2	P3	AF12-2-L-528	1.693	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-529	1.537	2.258	NA	NA	NA
AF12-2	P3	AF12-2-L-530	NA	2.354	NA	NA	NA
AF12-2	P3	AF12-2-L-531	1.452	2.262	NA	NA	NA
AF12-2	P3	AF12-2-L-532	1.812	2.919	NA	NA	NA
AF12-2	P3	AF12-2-L-533	1.563	2.48	NA	NA	NA
AF12-2	P3	AF12-2-L-534	1.475	2.322	NA	NA	NA
AF12-2	P3	AF12-2-L-535	NA	2.292	NA	NA	NA
AF12-2	P3	AF12-2-L-536	1.628	2.189	NA	NA	NA
AF12-2	P3	AF12-2-L-537	1.496	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-538	1.035	2.039	NA	NA	NA
AF12-2	P3	AF12-2-L-539	1.27	2.014	NA	NA	NA
AF12-2	P3	AF12-2-L-540	1.293	1.967	NA	NA	NA
AF12-2	P3	AF12-2-L-542	1.482	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-544	1.386	2.001	NA	NA	NA
AF12-2	P3	AF12-2-L-547	1.562	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-548	1.617	2.34	NA	NA	NA

Appendix 1. — Continuation.

Level	Position	Specimen.number	L	W	AA	PH	TH
AF12-2	P3	AF12-2-L-549	1.515	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-551	1.522	2.363	NA	NA	NA
AF12-2	P3	AF12-2-L-555	1.545	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-556	1.498	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-557	1.304	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-558	1.563	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-560	1.509	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-561	1.514	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-562	1.438	2.179	NA	NA	NA
AF12-2	P3	AF12-2-L-563	1.45	2.218	NA	NA	NA
AF12-2	P3	AF12-2-L-564	1.518	2.828	NA	NA	NA
AF12-2	P3	AF12-2-L-565	1.649	2.513	NA	NA	NA
AF12-2	P3	AF12-2-L-566	1.594	2.73	NA	NA	NA
AF12-2	P3	AF12-2-L-567	1.512	2.738	NA	NA	NA
AF12-2	P3	AF12-2-L-568	1.575	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-569	1.577	2.514	NA	NA	NA
AF12-2	P3	AF12-2-L-570	1.627	2.683	NA	NA	NA
AF12-2	P3	AF12-2-L-571	1.586	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-572	1.462	2.74	NA	NA	NA
AF12-2	P3	AF12-2-L-573	1.576	2.388	NA	NA	NA
AF12-2	P3	AF12-2-L-574	1.541	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-575	1.54	2.336	NA	NA	NA
AF12-2	P3	AF12-2-L-576	NA	2.499	NA	NA	NA
AF12-2	P3	AF12-2-L-577	1.532	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-579	1.456	2.363	NA	NA	NA
AF12-2	P3	AF12-2-L-580	1.429	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-582	1.519	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-583	1.488	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-584	1.592	2.395	NA	NA	NA
AF12-2	P3	AF12-2-L-585	1.438	2.483	NA	NA	NA
AF12-2	P3	AF12-2-L-586	1.574	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-587	1.388	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-588	1.559	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-591	1.606	2.667	NA	NA	NA
AF12-2	P3	AF12-2-L-592	1.476	2.754	NA	NA	NA
AF12-2	P3	AF12-2-L-593	1.478	2.562	NA	NA	NA
AF12-2	P3	AF12-2-L-594	1.604	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-595	1.65	2.639	NA	NA	NA
AF12-2	P3	AF12-2-L-596	1.613	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-597	1.662	2.549	NA	NA	NA
AF12-2	P3	AF12-2-L-598	1.37	2.404	NA	NA	NA
AF12-2	P3	AF12-2-L-599	1.605	2.839	NA	NA	NA
AF12-2	P3	AF12-2-L-600	1.53	2.64	NA	NA	NA
AF12-2	P3	AF12-2-L-601	1.633	2.74	NA	NA	NA
AF12-2	P3	AF12-2-L-602	1.568	2.441	NA	NA	NA
AF12-2	P3	AF12-2-L-603	1.478	2.368	NA	NA	NA
AF12-2	P3	AF12-2-L-604	1.58	2.229	NA	NA	NA
AF12-2	P3	AF12-2-L-605	1.718	2.648	NA	NA	NA
AF12-2	P3	AF12-2-L-606	1.511	2.527	NA	NA	NA
AF12-2	P3	AF12-2-L-607	1.543	2.229	NA	NA	NA
AF12-2	P3	AF12-2-L-608	1.742	2.496	NA	NA	NA
AF12-2	P3	AF12-2-L-609	1.566	2.396	NA	NA	NA
AF12-2	P3	AF12-2-L-610	1.541	2.741	NA	NA	NA
AF12-2	P3	AF12-2-L-611	1.655	3.108	NA	NA	NA
AF12-2	P3	AF12-2-L-612	1.637	2.793	NA	NA	NA
AF12-2	P3	AF12-2-L-613	1.421	2.582	NA	NA	NA
AF12-2	P3	AF12-2-L-614	1.842	3.127	NA	NA	NA
AF12-2	P3	AF12-2-L-615	1.714	2.603	NA	NA	NA
AF12-2	P3	AF12-2-L-616	1.738	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-617	NA	2.447	NA	NA	NA
AF12-2	P3	AF12-2-L-619	1.54	2.579	NA	NA	NA
AF12-2	P3	AF12-2-L-620	1.51	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-622	1.362	2.375	NA	NA	NA
AF12-2	P3	AF12-2-L-624	1.544	2.727	NA	NA	NA
AF12-2	P3	AF12-2-L-625	1.422	2.177	NA	NA	NA
AF12-2	P3	AF12-2-L-626	1.462	2.651	NA	NA	NA
AF12-2	P3	AF12-2-L-627	1.408	2.141	NA	NA	NA
AF12-2	P3	AF12-2-L-628	1.309	1.924	NA	NA	NA
AF12-2	P3	AF12-2-L-629	1.561	2.666	NA	NA	NA
AF12-2	P3	AF12-2-L-630	1.465	2.751	NA	NA	NA

Appendix 1. — Continuation.

Level	Position	Specimen.number	L	W	AA	PH	TH
AF12-2	P3	AF12-2-L-631	NA	2.381	NA	NA	NA
AF12-2	P3	AF12-2-L-632	1.402	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-633	1.38	2.284	NA	NA	NA
AF12-2	P3	AF12-2-L-634	1.531	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-636	1.426	2.608	NA	NA	NA
AF12-2	P3	AF12-2-L-637	1.43	2.669	NA	NA	NA
AF12-2	P3	AF12-2-L-638	1.577	2.793	NA	NA	NA
AF12-2	P3	AF12-2-L-640	1.522	2.412	NA	NA	NA
AF12-2	P3	AF12-2-L-641	1.146	1.928	NA	NA	NA
AF12-2	P3	AF12-2-L-642	1.566	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-644	1.604	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-645	1.499	2.258	NA	NA	NA
AF12-2	P3	AF12-2-L-652	1.615	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-653	1.298	2.426	NA	NA	NA
AF12-2	P3	AF12-2-L-658	1.515	1.872	NA	NA	NA
AF12-2	P3	AF12-2-L-659	1.116	1.676	NA	NA	NA
AF12-2	P3	AF12-2-L-660	1.515	2.62	NA	NA	NA
AF12-2	P3	AF12-2-L-661	1.543	2.485	NA	NA	NA
AF12-2	P3	AF12-2-L-662	1.324	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-665	1.631	2.138	NA	NA	NA
AF12-2	P3	AF12-2-L-666	1.418	1.76	NA	NA	NA
AF12-2	P3	AF12-2-L-667	1.606	2.465	NA	NA	NA
AF12-2	P3	AF12-2-L-668	1.504	2.103	NA	NA	NA
AF12-2	P3	AF12-2-L-669	1.654	2.58	NA	NA	NA
AF12-2	P3	AF12-2-L-670	1.52	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-671	NA	2.284	NA	NA	NA
AF12-2	P3	AF12-2-L-672	1.232	1.985	NA	NA	NA
AF12-2	P3	AF12-2-L-673	1.308	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-674	1.634	3.109	NA	NA	NA
AF12-2	P3	AF12-2-L-675	1.656	2.588	NA	NA	NA
AF12-2	P3	AF12-2-L-676	1.666	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-677	1.707	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-678	1.533	2.477	NA	NA	NA
AF12-2	P3	AF12-2-L-679	1.53	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-680	1.323	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-681	1.515	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-682	1.586	NA	NA	NA	NA
AF12-2	P3	AF12-2-L-685	1.544	2.515	NA	NA	NA
AF12-2	P3	AF12-2-L-686	NA	2.657	NA	NA	NA
AF12-2	P3	AF12-2-L-687	1.684	2.715	NA	NA	NA
AF12-2	P3	AF12-2-L-688	1.596	2.895	NA	NA	NA
AF12-2	P3	AF12-2-L-689	1.549	2.902	NA	NA	NA
AF12-2	P4	AF12-2-L-690	1.363	2.776	2.538	1.069	0.797
AF12-2	P4	AF12-2-L-691	1.448	2.593	2.517	1.169	0.833
AF12-2	P4	AF12-2-L-692	1.355	2.59	2.366	1.112	0.791
AF12-2	P4	AF12-2-L-693	1.256	2.871	2.45	1.114	0.711
AF12-2	P4	AF12-2-L-694	1.278	2.535	2.299	1.045	0.73
AF12-2	P4	AF12-2-L-695	1.384	2.855	2.567	1.174	0.729
AF12-2	P4	AF12-2-L-696	1.28	2.507	NA	1.372	0.776
AF12-2	P4	AF12-2-L-697	1.343	2.558	2.152	1.043	0.775
AF12-2	P4	AF12-2-L-698	1.322	2.432	2.145	1.047	0.728
AF12-2	P4	AF12-2-L-700	1.199	2.609	2.286	1.01	0.652
AF12-2	P4	AF12-2-L-701	1.468	3.007	2.769	0.964	0.728
AF12-2	P4	AF12-2-L-702	1.188	NA	NA	1.081	0.774
AF12-2	P4	AF12-2-L-703	1.21	2.042	NA	0.876	0.763
AF12-2	P4	AF12-2-L-704	1.332	2.608	2.401	1.125	0.773
AF12-2	P4	AF12-2-L-705	1.233	2.711	2.483	1.116	0.74
AF12-2	P4	AF12-2-L-706	1.381	2.744	2.575	1.36	0.845
AF12-2	P4	AF12-2-L-707	1.334	2.689	2.548	1.25	0.763
AF12-2	P4	AF12-2-L-708	1.414	2.954	2.736	1.22	0.803
AF12-2	P4	AF12-2-L-709	1.274	2.804	2.41	1.05	0.724
AF12-2	P4	AF12-2-L-710	1.347	2.744	2.491	1.218	0.824
AF12-2	P4	AF12-2-L-711	1.373	2.753	2.409	1.017	0.818
AF12-2	P4	AF12-2-L-712	1.363	3.281	2.925	1.333	0.806
AF12-2	P4	AF12-2-L-713	1.133	1.946	1.784	0.785	0.766
AF12-2	P4	AF12-2-L-714	1.191	2.249	2.043	1.094	0.696
AF12-2	P4	AF12-2-L-715	0.998	NA	NA	NA	0.592
AF12-2	P4	AF12-2-L-716	1.087	NA	2.119	0.882	0.638
AF12-2	P4	AF12-2-L-717	1.177	2.212	1.98	1.048	0.715
AF12-2	P4	AF12-2-L-718	1.267	NA	NA	1.354	0.783

Appendix 1. — Continuation.

Level	Position	Specimen.number	L	W	AA	PH	TH
AF12-2	P4	AF12-2-L-719	1.149	2.284	2.156	0.774	0.737
AF12-2	P4	AF12-2-L-720	1.28	2.667	2.464	1.118	0.708
AF12-2	P4	AF12-2-L-721	1.395	2.882	2.236	1.187	0.831
AF12-2	P4	AF12-2-L-722	1.417	3.254	2.716	1.398	0.843
AF12-2	P4	AF12-2-L-723	1.38	2.576	2.404	1.185	0.858
AF12-2	P4	AF12-2-L-724	1.313	2.646	2.202	1.127	0.804
AF12-2	P4	AF12-2-L-725	1.244	2.405	2.201	1.066	0.691
AF12-2	P4	AF12-2-L-726	1.064	2.25	1.917	0.739	0.58
AF12-2	P4	AF12-2-L-727	1.116	2.265	2.139	1.151	0.598
AF12-2	P4	AF12-2-L-728	1.327	2.722	2.495	1.098	0.76
AF12-2	P4	AF12-2-L-729	1.438	3.118	2.647	1.156	0.818
AF12-2	P4	AF12-2-L-730	1.277	NA	NA	0.993	0.687
AF12-2	P4	AF12-2-L-731	1.342	NA	NA	NA	0.839
AF12-2	P4	AF12-2-L-732	1.313	2.656	2.465	1.254	0.774
AF12-2	P4	AF12-2-L-733	1.242	NA	NA	1.047	0.714
AF12-2	P4	AF12-2-L-734	0.877	1.861	1.681	0.766	0.5
AF12-2	P4	AF12-2-L-735	1.075	2.071	1.707	0.768	0.618
AF12-2	P4	AF12-2-L-736	0.992	NA	NA	0.664	0.564
AF12-2	P4	AF12-2-L-737	1.006	1.658	1.351	0.627	0.601
AF12-2	P4	AF12-2-L-738	NA	2.379	NA	1.068	NA
AF12-2	P4	AF12-2-L-739	NA	2.642	NA	NA	NA
AF12-2	P4	AF12-2-L-742	NA	NA	NA	0.858	0.765
AF12-2	P4	AF12-2-L-743	NA	1.889	NA	0.763	0.704
AF12-2	P4	AF12-2-L-744	NA	2.217	NA	NA	NA
AF12-2	P4	AF12-2-L-745	1.305	NA	2.619	1.154	0.765
AF12-2	P4	AF12-2-L-746	1.056	NA	NA	0.675	0.669
AF12-2	P4	AF12-2-L-747	1.366	2.582	2.426	1.244	0.73
AF12-2	P4	AF12-2-L-748	1.31	2.615	2.25	0.897	0.726
AF12-2	P4	AF12-2-L-749	1.289	2.739	NA	1.277	0.75
AF12-2	P4	AF12-2-L-750	1.434	2.805	2.609	1.315	0.879
AF12-2	P4	AF12-2-L-751	1.326	2.959	2.484	1.12	0.742
AF12-2	P4	AF12-2-L-752	1.271	2.883	2.426	1.14	0.765
AF12-2	P4	AF12-2-L-753	1.159	2.389	2.118	1.006	0.708
AF12-2	P4	AF12-2-L-754	1.477	2.609	2.431	1.177	0.881
AF12-2	P4	AF12-2-L-755	1.275	2.811	2.359	1.101	0.71
AF12-2	P4	AF12-2-L-756	1.202	2.659	2.331	0.938	0.701
AF12-2	P4	AF12-2-L-757	1.355	2.666	NA	1.289	0.864
AF12-2	P4	AF12-2-L-758	1.403	NA	NA	1.24	0.816
AF12-2	P4	AF12-2-L-759	1.434	2.629	2.279	1.06	0.838
AF12-2	P4	AF12-2-L-760	1.381	2.706	2.396	1.118	0.794
AF12-2	P4	AF12-2-L-761	1.247	2.514	NA	1.127	0.718
AF12-2	P4	AF12-2-L-762	1.424	3.061	2.578	1.157	0.779
AF12-2	P4	AF12-2-L-763	1.3	2.954	2.481	1.149	0.741
AF12-2	P4	AF12-2-L-764	1.22	2.473	2.22	1.112	0.744
AF12-2	P4	AF12-2-L-765	1.355	2.642	2.438	1.139	0.769
AF12-2	P4	AF12-2-L-766	1.205	2.198	NA	1.364	0.843
AF12-2	P4	AF12-2-L-767	1.254	2.652	2.372	1.088	0.698
AF12-2	P4	AF12-2-L-768	1.245	2.471	NA	1.033	0.694
AF12-2	P4	AF12-2-L-769	1.234	2.42	2.259	1.081	0.703
AF12-2	P4	AF12-2-L-770	1.289	2.792	2.398	1.353	0.823
AF12-2	P4	AF12-2-L-771	1.284	2.46	2.121	1.158	0.73
AF12-2	P4	AF12-2-L-772	1.068	NA	NA	0.805	0.664
AF12-2	P4	AF12-2-L-773	1.354	2.244	2.188	1.102	0.846
AF12-2	P4	AF12-2-L-774	1.119	2.168	NA	0.943	0.688
AF12-2	P4	AF12-2-L-775	1.033	1.792	NA	0.72	0.612
AF12-2	P4	AF12-2-L-776	1.325	NA	2.411	1.053	0.746
AF12-2	P4	AF12-2-L-777	1.217	NA	NA	1.203	0.748
AF12-2	P4	AF12-2-L-778	1.304	2.586	2.23		0.775
AF12-2	P4	AF12-2-L-779	1.347	2.582	2.375	1.143	0.802
AF12-2	P4	AF12-2-L-780	1.396	3.032	2.732	1.383	0.806
AF12-2	P4	AF12-2-L-781	1.318	2.959	2.614	1.17	0.757
AF12-2	P4	AF12-2-L-782	1.142	2.23	2.035	0.892	0.692
AF12-2	P4	AF12-2-L-783	1.274	2.361	2.171	1.046	0.751
AF12-2	P4	AF12-2-L-784	1.243	2.279	2.149	1.308	0.742
AF12-2	P4	AF12-2-L-785	1.303	2.272	NA	1.023	0.778
AF12-2	P4	AF12-2-L-786	1.364	2.578	2.303	1.167	0.775
AF12-2	P4	AF12-2-L-787	1.155	2.221	2.003	0.939	0.717
AF12-2	P4	AF12-2-L-789	1.2	NA	NA	0.978	0.747
AF12-2	P4	AF12-2-L-790	1.288	2.594	2.393	1.154	0.759
AF12-2	P4	AF12-2-L-791	1.214	2.597	2.266	0.997	0.66

Appendix 1. — Continuation.

Level	Position	Specimen.number	L	W	AA	PH	TH
AF12-2	P4	AF12-2-L-792	1.421	2.738	2.517	1.137	0.815
AF12-2	P4	AF12-2-L-793	1.25	2.903	2.623	1.085	0.738
AF12-2	P4	AF12-2-L-794	1.025	1.508	1.284	0.314	0.649
AF12-2	P4	AF12-2-L-795	1.219	2.69	2.296	1.013	0.682
AF12-2	P4	AF12-2-L-796	1.325	2.934	2.7	1.271	0.792
AF12-2	P4	AF12-2-L-797	1.28	3.069	2.563	1.277	0.77
AF12-2	P4	AF12-2-L-798	1.283	NA	2.144	1.102	0.771
AF12-2	P4	AF12-2-L-799	NA	NA	NA	1.087	0.835
AF12-2	P4	AF12-2-L-800	NA	2.06	1.843	0.841	0.676
AF12-2	P4	AF12-2-L-801	1.413	2.602	2.363	1.009	0.789
AF12-2	P4	AF12-2-L-802	1.469	2.679	2.441	1.114	0.916
AF12-2	P4	AF12-2-L-803	1.188	2.253	2.021	0.972	0.727
AF12-2	P4	AF12-2-L-804	1.25	NA	NA	0.984	0.706
AF12-2	P4	AF12-2-L-805	1.176	NA	NA	1.082	0.74
AF12-2	P4	AF12-2-L-806	1.382	NA	NA	1.142	0.792
AF12-2	P4	AF12-2-L-807	1.43	2.474	2.232	1.211	0.756
AF12-2	P4	AF12-2-L-808	1.277	NA	NA	1.303	0.731
AF12-2	P4	AF12-2-L-809	1.12	2.129	2.047	0.939	0.675
AF12-2	P4	AF12-2-L-810	1.175	2.624	2.442	0.604	0.55
AF12-2	P4	AF12-2-L-814	1.258	2.346	2.149	1.042	0.748
AF12-2	P4	AF12-2-L-815	1.14	2.52	2.295	0.921	0.611
AF12-2	P4	AF12-2-L-816	1.208	NA	NA	1.103	0.75
AF12-2	P4	AF12-2-L-817	1.278	3.077	2.56	1.233	0.706
AF12-2	P4	AF12-2-L-818	1.134	2.181	1.895	0.824	0.656
AF12-2	P4	AF12-2-L-819	1.061	2.199	1.986	0.873	0.628
AF12-2	P4	AF12-2-L-820	1.316	2.587	2.381	1.011	0.754
AF12-2	P4	AF12-2-L-821	1.36	3.305	2.71	1.205	0.747
AF12-2	P4	AF12-2-L-822	1.23	2.417	NA	0.971	0.728
AF12-2	P4	AF12-2-L-823	0.928	1.76	1.596	0.616	0.545
AF12-2	P4	AF12-2-L-824	1.182	2.252	2.063	1.007	0.717
AF12-2	P4	AF12-2-L-825	1.264	2.601	2.345	1.012	0.734
AF12-2	P4	AF12-2-L-826	1.325	2.829	2.593	1.144	0.741
AF12-2	P4	AF12-2-L-827	1.279	2.753	NA	1.139	0.781
AF12-2	P4	AF12-2-L-828	1.195	2.429	2.271	1.088	0.718
AF12-2	P4	AF12-2-L-829	1.224	NA	NA	1.046	0.638
AF12-2	P4	AF12-2-L-830	0.951	NA	NA	0.818	0.594
AF12-2	P4	AF12-2-L-831	1.225	2.375	2.212	0.966	0.666
AF12-2	P4	AF12-2-L-832	1.21	NA	NA	1.004	0.742
AF12-2	P4	AF12-2-L-833	1.335	2.599	2.393	1.096	0.781
AF12-2	P4	AF12-2-L-834	1.16	2.333	2.212	1.074	0.671
AF12-2	P4	AF12-2-L-835	1.354	NA	NA	1.2	0.817
AF12-2	P4	AF12-2-L-836	1.245	NA	NA	0.909	0.637
AF12-2	P4	AF12-2-L-837	1.42	2.841	2.529	1.4	0.854
AF12-2	P4	AF12-2-L-838	1.275	2.491	2.259	1.229	0.736
AF12-2	P4	AF12-2-L-839	1.196	2.74	2.375	1.045	0.742
AF12-2	P4	AF12-2-L-840	1.06	2.461	2.124	1.009	0.645
AF12-2	P4	AF12-2-L-841	0.963	1.601	1.333	0.472	0.561
AF12-2	P4	AF12-2-L-842	1.324	2.744	2.343	0.969	0.724
AF12-2	P4	AF12-2-L-843	1.196	2.514	2.401	1.433	0.751
AF12-2	P4	AF12-2-L-844	1.464	3.188	2.644	1.099	0.792
AF12-2	P4	AF12-2-L-845	1.259	2.924	2.648	1.323	0.76
AF12-2	P4	AF12-2-L-846	1.268	2.609	2.228	1.059	0.72
AF12-2	P4	AF12-2-L-847	1.227	2.549	2.347	1.022	0.719

Appendix 2. — Detailed dimensions and character states (used for the MCA) of the p3 of *Prolagus michauxi* López-Martínez, 1975 from Afoud (mm). Abbreviations: **L**, length; **W**, width. Illustrative variable: **Wear**, presence of very roundish and bulb-like cusps and/or unusual absence of connections between cusps. Characters studied for the MCA: **ANTIND**, presence of indentation in the anteroconid; **ANTMETSIZE**, size of the anteroconid compared to that of the metaconid; **ANTSHP**, anteroconid shape; **CONANTPROT**, presence of the anteroconid-protoconulid connection; **CONHYPPROT**, presence of the hypoconid-protoconid connection; **CONMETENT**, presence of the metaconid-entoconid connection; **CROCHSIZE**, crochet size; **ENTHIAT**, presence of an enamel hiatus on the entoconid; **LENGTH**, qualitative characterization of the length, based on the Jenks natural breaks classification method ([1.095; 1.519[are labelled short; [1.519; 1.765[are labelled medium; [1.765; 2.128] are labelled large); **MEFLXSIZE**, mesoflexid size; **MEFLXSHP**, mesoflexid shape; **METSHP**, metaconid shape; **PROTLTHK**, protoconulid thickness; **WIDTH**, qualitative characterization of the width, based on the Jenks natural breaks classification method ([1,004; 1,494[are labelled short, [1.494; 1.766[are labelled medium; [1.766 ; 2,189] are labelled large).

Level	Position	Specimen number	L	W	LENGTH	WIDTH	Wear	CROCHSIZE	CONANTPROT	CONHYPPROT	CONMETENT	ANTIND	ANTSHP	METSHP	ANTMETSIZE	MEFLXSIZE	MEFLXSHP	ENTHIAT	PROTLTHK
AF12-1	p3	AF12-1-L-1224	NA	NA	NA	NA	worn	absent	absent	present	present	absent	trapezoid	rectangular	metaconid smaller than anteroconid	long	slightly curved	NA	medium
AF12-1	p3	AF12-1-L-1225	NA	NA	NA	NA	worn	absent	absent	present	present	NA	NA	rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-1	1.849	2.007	larg	larg	worn	well-developped	present	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	long	straigth with mesial growth	absent	medium
AF12-2	p3	AF12-2-L-10	1.681	1.65	med	med	worn	extremely reduced	absent	present	present	absent	triangular	rectangular	metaconid equal anteroconid	short	widen apex	present	medium
AF12-2	p3	AF12-2-L-100	NA	NA	NA	NA	worn	well-developped	NA	present	present	NA	NA	rectangular	NA	NA	NA	NA	NA
AF12-2	p3	AF12-2-L-101	NA	NA	NA	NA	worn	well-developped	NA	present	present	NA	NA	sub-rectangular	NA	NA	NA	NA	thick
AF12-2	p3	AF12-2-L-102	NA	NA	NA	NA	worn	small	NA	present	present	NA	NA	rectangular	NA	short	extremely reduced	NA	thin
AF12-2	p3	AF12-2-L-103	NA	NA	NA	NA	worn	small	NA	present	present	NA	NA	rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-104	NA	NA	NA	NA	worn	small	NA	present	present	NA	NA	rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-105	NA	1.771	NA	larg	worn	extremely reduced	NA	present	present	NA	NA	rectangular	NA	NA	NA	present	medium
AF12-2	p3	AF12-2-L-106	NA	NA	NA	NA	worn	absent	NA	present	present	NA	NA	NA	NA	NA	NA	NA	NA
AF12-2	p3	AF12-2-L-107	NA	NA	NA	NA	worn	small	NA	present	NA	NA	NA	NA	NA	NA	NA	present	NA
AF12-2	p3	AF12-2-L-108	NA	1.67	NA	med	worn	extremely reduced	NA	present	present	NA	NA	rectangular	NA	short	slightly curved	present	medium
AF12-2	p3	AF12-2-L-109	NA	1.966	NA	larg	worn	absent	NA	present	present	NA	NA	sub-rectangular	NA	long	curved	present	medium
AF12-2	p3	AF12-2-L-11	1.571	1.716	med	med	worn	absent	absent	present	present	absent	triangular	sub-rectangular	metaconid equal anteroconid	medium	straigth with mesial growth	absent	medium
AF12-2	p3	AF12-2-L-110	NA	NA	NA	NA	worn	extremely reduced	NA	present	present	NA	NA	rectangular	NA	NA	NA	present	medium
AF12-2	p3	AF12-2-L-111	NA	1.685	NA	med	worn	small	NA	present	present	NA	NA	rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-112	NA	1.668	NA	med	worn	small	NA	present	present	NA	NA	rectangular	NA	short	widen apex	NA	thick
AF12-2	p3	AF12-2-L-113	NA	1.524	NA	med	worn	absent	NA	present	present	NA	NA	rectangular	NA	short	widen apex	NA	thin
AF12-2	p3	AF12-2-L-114	NA	1.602	NA	med	worn	well-developped	NA	present	present	NA	NA	rectangular	NA	short	curved	absent	thin
AF12-2	p3	AF12-2-L-115	NA	1.772	NA	larg	worn	small	present	present	present	NA	NA	rectangular	NA	medium	curved	NA	thin
AF12-2	p3	AF12-2-L-116	NA	1.835	NA	larg	worn	small	NA	present	present	NA	NA	rectangular	NA	short	slightly curved	present	thin
AF12-2	p3	AF12-2-L-117	NA	1.766	NA	larg	worn	small	NA	present	present	NA	NA	rectangular	NA	long	straigth with mesial growth	NA	thick
AF12-2	p3	AF12-2-L-118	NA	1.647	NA	med	worn	extremely reduced	present	present	present	NA	NA	rectangular	NA	short	slightly curved	present	thick
AF12-2	p3	AF12-2-L-119	NA	1.754	NA	med	worn	small	present	present	present	NA	NA	rectangular	NA	medium	curved	present	thin
AF12-2	p3	AF12-2-L-12	1.751	1.822	med	larg	worn	absent	absent	present	present	absent	triangular	fan-shaped	metaconid bigger than anteroconid	long	straigth with mesial growth	absent	medium
AF12-2	p3	AF12-2-L-120	NA	1.481	NA	shrt	worn	small	NA	present	present	NA	NA	fan-shaped	NA	short	slightly curved	NA	thin

Appendix 2. — Continuation.

Level	Position	Specimen number	L	W	LENGTH	WIDTH	Wear	CROCHSIZE	CONANTPROT	CONHYPPROT	CONMETENT	ANTIND	ANTSHP	METSHP	ANTMETSIZE	MEFLXSIZE	MEFLXSHP	ENTHIAT	PROTLTHK
AF12-2	p3	AF12-2-L-121	NA	1.758	NA	med	worn	absent	NA	present	present	NA	NA	rectangular	NA	long	slightly curved	absent	thick
AF12-2	p3	AF12-2-L-122	NA	1.865	NA	larg	worn	small	NA	present	present	NA	NA	rectangular	NA	long	slightly curved	present	thick
AF12-2	p3	AF12-2-L-123	1.207	1.072	shrt	shrt	worn	well-developped	NA	present	present	NA	NA	NA	NA	short	extremely reduced	present	NA
AF12-2	p3	AF12-2-L-124	NA	1.6	NA	med	worn	small	NA	present	present	NA	NA	rectangular	NA	NA	NA	NA	NA
AF12-2	p3	AF12-2-L-125	NA	1.79	NA	larg	worn	small	NA	present	present	NA	NA	rectangular	NA	NA	NA	present	NA
AF12-2	p3	AF12-2-L-126	NA	1.948	NA	larg	worn	small	NA	present	present	NA	NA	rectangular	NA	medium	thin apex	NA	medium
AF12-2	p3	AF12-2-L-127	NA	NA	NA	NA	worn	absent	NA	present	present	NA	NA	rectangular	NA	long	curved	NA	medium
AF12-2	p3	AF12-2-L-128	NA	NA	NA	NA	worn	small	NA	present	present	NA	NA	rectangular	NA	medium	curved	NA	medium
AF12-2	p3	AF12-2-L-129	NA	1.72	NA	med	worn	small	NA	present	present	NA	NA	rectangular	NA	short	widen apex	NA	medium
AF12-2	p3	AF12-2-L-13	1.739	1.714	med	med	worn	absent	absent	present	present	absent	sub-round	rectangular	metaconid bigger than anteroconid	medium	slightly curved	NA	medium
AF12-2	p3	AF12-2-L-130	1.636	1.692	med	med	worn	small	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	NA	NA	present	thin
AF12-2	p3	AF12-2-L-131	1.611	1.762	med	med	worn	small	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	NA	NA	partial	thin
AF12-2	p3	AF12-2-L-132	1.889		larg	larg	worn	small	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	medium	curved	present	thick
AF12-2	p3	AF12-2-L-133	1.864	1.693	larg	med	worn	well-developped	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	medium	slightly curved	present	medium
AF12-2	p3	AF12-2-L-134	1.847	1.856	larg	larg	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid smaller than anteroconid	medium	curved	present	medium
AF12-2	p3	AF12-2-L-135	1.494	1.56	shrt	med	worn	small	absent	present	present	absent	trapezoid	fan-shaped	metaconid bigger than anteroconid	short	thin apex	NA	thin
AF12-2	p3	AF12-2-L-136	1.69	1.828	med	larg	worn	well-developped	absent	present	present	absent	triangular	NA	NA	NA	NA	present	thick
AF12-2	p3	AF12-2-L-137	1.991	1.907	larg	larg	worn	small	absent	present	present	absent	triangular	rectangular	NA	medium	slightly curved	NA	thick
AF12-2	p3	AF12-2-L-138	NA	1.213	NA	shrt	unworn	NA	NA	absent	present	NA	NA	rounded	NA	short	thin apex	NA	thin
AF12-2	p3	AF12-2-L-139	NA	NA	NA	NA	worn	NA	NA	absent	present	NA	NA	rectangular	NA	short	widen apex	partial	medium
AF12-2	p3	AF12-2-L-14	1.765	1.652	larg	med	worn	absent	absent	present	present	absent	triangular	rectangular	metaconid smaller than anteroconid	short	widen apex	present	medium
AF12-2	p3	AF12-2-L-140	1.836	1.811	larg	larg	worn	well-developped	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	short	widen apex	absent	thin
AF12-2	p3	AF12-2-L-141	1.719	1.702	med	med	worn	small	present	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	short	widen apex	NA	medium
AF12-2	p3	AF12-2-L-142	1.719	1.734	med	med	worn	small	present	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	short	slightly curved	present	medium
AF12-2	p3	AF12-2-L-143	1.451	1.357	shrt	shrt	worn	small	present	present	present	absent	trapezoid	sub-rectangular	metaconid bigger than anteroconid	short	extremely reduced	absent	medium
AF12-2	p3	AF12-2-L-144	1.635	1.656	med	med	worn	small	present	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	short	curved	present	medium
AF12-2	p3	AF12-2-L-145	1.8	1.802	larg	larg	worn	well-developped	present	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	short	slightly curved	partial	medium

Appendix 2. — Continuation.

Level	Position	Specimen number	L	W	LENGTH	WIDTH	Wear	CROCHSIZE	CONANTPROT	CONHYPPROT	CONMETENT	ANTIND	ANTSHP	METSHP	ANTMETSIZE	MEFLXSIZE	MEFLXSHP	ENTHIAT	PROTLTHK
AF12-2	p3	AF12-2-L-146	1.761	1.721	med	med	worn	well-developped	present	present	present	present	trapezoid	rectangular	metaconid equal anteroconid	medium	straigth with mesial growth	present	medium
AF12-2	p3	AF12-2-L-147	1.817	1.725	larg	med	worn	absent	absent	present	present	present	triangular	rectangular	metaconid smaller than anteroconid	medium	slightly curved	present	medium
AF12-2	p3	AF12-2-L-148	1.922	2.038	larg	larg	worn	absent	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	medium	curved	present	medium
AF12-2	p3	AF12-2-L-149	1.575	1.685	med	med	worn	absent	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	short	extremely reduced	present	medium
AF12-2	p3	AF12-2-L-15	1.706	1.804	med	larg	worn	absent	absent	present	present	absent	triangular	fan-shaped	metaconid bigger than anteroconid	medium	slightly curved	present	medium
AF12-2	p3	AF12-2-L-150	1.972	1.848	larg	larg	worn	extremely reduced	absent	present	present	absent	triangular	rectangular	metaconid equal anteroconid	short	widen apex	NA	medium
AF12-2	p3	AF12-2-L-151	1.811	1.847	larg	larg	worn	absent	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	medium	widen apex	absent	medium
AF12-2	p3	AF12-2-L-152	1.926	1.741	larg	med	worn	absent	absent	present	present	absent	trapezoid	rectangular	metaconid smaller than anteroconid	short	widen apex	absent	medium
AF12-2	p3	AF12-2-L-153	1.788	1.794	larg	larg	worn	absent	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	long	straigth with mesial growth	NA	medium
AF12-2	p3	AF12-2-L-154	1.601	1.79	med	larg	worn	absent	absent	present	present	absent	subround	rectangular	metaconid bigger than anteroconid	short	widen apex	NA	medium
AF12-2	p3	AF12-2-L-155	2.003	1.949	larg	larg	worn	absent	absent	present	present	absent	triangular	rectangular	metaconid equal anteroconid	long	straigth with mesial growth	absent	medium
AF12-2	p3	AF12-2-L-156	1.741	1.705	med	med	worn	absent	absent	present	present	present	triangular	rectangular	metaconid equal anteroconid	long	curved	absent	medium
AF12-2	p3	AF12-2-L-157	2.074	1.814	larg	larg	worn	absent	absent	present	present	present	triangular	rectangular	metaconid smaller than anteroconid	short	curved	NA	medium
AF12-2	p3	AF12-2-L-158	1.882	1.674	larg	med	worn	NA	absent	absent	present	absent	triangular	sub-rectangular	NA	short	widen apex	NA	medium
AF12-2	p3	AF12-2-L-159	NA	NA	NA	NA	worn	NA	NA	absent	present	NA	NA	rounded	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-16	1.725	1.613	med	med	worn	extremely reduced	absent	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	short	widen apex	present	thin
AF12-2	p3	AF12-2-L-160	1.351	1.251	shrt	shrt	unworn	NA	absent	absent	present	absent	subround	rounded	metaconid bigger than anteroconid	medium	thin apex	absent	thin
AF12-2	p3	AF12-2-L-161	1.852	1.898	larg	larg	worn	extremely reduced	absent	present	present	present	trapezoid	fan-shaped	metaconid smaller than anteroconid	long	straigth with mesial growth	absent	medium
AF12-2	p3	AF12-2-L-162	1.835	1.874	larg	larg	worn	extremely reduced	absent	present	present	present	triangular	rectangular	metaconid equal anteroconid	short	widen apex	NA	thick
AF12-2	p3	AF12-2-L-163	1.748	1.722	med	med	worn	small	absent	present	present	absent	trapezoid	sub-rectangular	metaconid equal anteroconid	short	widen apex	NA	medium
AF12-2	p3	AF12-2-L-164	1.739	1.626	med	med	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	medium	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-165	1.781	1.916	larg	larg	worn	NA	absent	present	NA	absent	trapezoid	rectangular	metaconid bigger than anteroconid	medium	straigth with mesial growth	NA	thick
AF12-2	p3	AF12-2-L-166	1.804	1.737	larg	med	worn	small	absent	present	present	absent	trapezoid	sub-rectangular	metaconid bigger than anteroconid	medium	straigth with mesial growth	absent	medium
AF12-2	p3	AF12-2-L-167	1.469	1.421	shrt	shrt	worn	well-developped	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	medium	widen apex	partial	thin

Appendix 2. — Continuation.

Level	Position	Specimen number	L	W	LENGTH	WIDTH	Wear	CROCHSIZE	CONANTPROT	CONHYPPROT	CONMETENT	ANTIND	ANTSHP	METSHP	ANTMETSIZE	MEFLXSIZE	MEFLXSHP	ENTHIAT	PROTLTHK
AF12-2	p3	AF12-2-L-168	1.636	1.742	med	med	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	short	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-169	1.821	1.786	larg	larg	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	medium	straigth with mesial growth	absent	thick
AF12-2	p3	AF12-2-L-17	NA	1.726	NA	med	worn	absent	NA	present	present	NA	NA	rectangular	NA	long	straigth with mesial growth	present	thin
AF12-2	p3	AF12-2-L-170	1.711	1.774	med	larg	worn	extremely reduced	absent	present	present	absent	triangular	rectangular	metaconid equal anteroconid	medium	widen apex	absent	medium
AF12-2	p3	AF12-2-L-171	1.327	1.293	shrt	shrt	unworn	small	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	medium	thin apex	absent	medium
AF12-2	p3	AF12-2-L-172	1.448	1.34	shrt	shrt	unworn	absent	absent	present	present	absent	subround	rectangular	metaconid bigger than anteroconid	short	thin apex	absent	thick
AF12-2	p3	AF12-2-L-173	1.58	1.459	med	shrt	worn	small	absent	present	present	absent	subround	rectangular	metaconid bigger than anteroconid	NA	NA	partial	thick
AF12-2	p3	AF12-2-L-174	1.424	1.4	shrt	shrt	unworn	small	absent	present	present	absent	subround	rounded	metaconid bigger than anteroconid	medium	thin apex	partial	thin
AF12-2	p3	AF12-2-L-175	1.608	1.438	med	shrt	unworn	small	absent	present	present	absent	subround	rectangular	metaconid bigger than anteroconid	medium	straigth with mesial growth	present	medium
AF12-2	p3	AF12-2-L-176	1.402	1.276	shrt	shrt	unworn	absent	absent	present	present	absent	trapezoid	rounded	metaconid equal anteroconid	short	thin apex	absent	thin
AF12-2	p3	AF12-2-L-177	1.252	1.278	shrt	shrt	unworn	absent	absent	present	present	absent	subround	rounded	metaconid bigger than anteroconid	medium	slightly curved	partial	thin
AF12-2	p3	AF12-2-L-178	1.441	1.464	shrt	shrt	unworn	small	absent	present	present	absent	subround	rounded	metaconid bigger than anteroconid	short	thin apex	partial	medium
AF12-2	p3	AF12-2-L-179	NA	1.71	NA	med	worn	small	absent	present	present	NA	NA	rectangular	metaconid bigger than anteroconid	short	widen apex	present	medium
AF12-2	p3	AF12-2-L-18	1.374	1.342	shrt	shrt	unworn	absent	absent	present	present	absent	subround	rounded	metaconid bigger than anteroconid	short	thin apex	present	thin
AF12-2	p3	AF12-2-L-180	1.597	1.644	med	med	worn	small	absent	present	present	absent	trapezoid	fan-shaped	metaconid bigger than anteroconid	medium	slightly curved	absent	thick
AF12-2	p3	AF12-2-L-181	1.843	1.813	larg	larg	worn	small	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	medium	curved	absent	medium
AF12-2	p3	AF12-2-L-182	1.711	1.818	med	larg	worn	well-developped	absent	present	present	absent	triangular	rectangular	metaconid equal anteroconid	medium	slightly curved	NA	medium
AF12-2	p3	AF12-2-L-183	1.513	1.598	shrt	med	worn	small	absent	present	present	absent	trapezoid	sub-rectangular	metaconid bigger than anteroconid	medium	thin apex	present	medium
AF12-2	p3	AF12-2-L-184	1.731	1.842	med	larg	worn	extremely reduced	absent	present	present	absent	triangular	rectangular	metaconid equal anteroconid	medium	slightly curved	present	medium
AF12-2	p3	AF12-2-L-185	1.733	1.72	med	med	worn	well-developped	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	medium	slightly curved	NA	medium
AF12-2	p3	AF12-2-L-186	1.725	1.705	med	med	worn	absent	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	medium	straigth with mesial growth	NA	medium
AF12-2	p3	AF12-2-L-187	1.519	1.555	med	med	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	short	widen apex	NA	thin
AF12-2	p3	AF12-2-L-188	1.845	1.799	larg	larg	worn	well-developped	absent	present	present	absent	triangular	rectangular	metaconid smaller than anteroconid	short	curved	NA	thick
AF12-2	p3	AF12-2-L-189	1.84	1.828	larg	larg	worn	well-developped	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	medium	straigth with mesial growth	NA	thick

Appendix 2. — Continuation.

Level	Position	Specimen number	L	W	LENGTH	WIDTH	Wear	CROCHSIZE	CONANTPROT	CONHYPPROT	CONMETENT	ANTIND	ANTSHP	METSHP	ANTMETSIZE	MEFLXSIZE	MEFLXSHP	ENTHIAT	PROTLTHK
AF12-2	p3	AF12-2-L-19	1.46	1.378	shrt	shrt	unworn	absent	absent	present	present	absent	trapezoid	rounded	metaconid bigger than anteroconid	short	slightly curved	absent	thin
AF12-2	p3	AF12-2-L-190	1.679	1.639	med	med	worn	well-developped	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	medium	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-191	1.859	1.817	larg	larg	worn	well-developped	absent	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	medium	straigth with mesial growth	present	medium
AF12-2	p3	AF12-2-L-192	1.716	1.747	med	med	worn	well-developped	absent	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	short	widen apex	present	thick
AF12-2	p3	AF12-2-L-193	1.726	1.758	med	med	worn	well-developped	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	medium	curved	NA	medium
AF12-2	p3	AF12-2-L-194	1.849	1.841	larg	larg	worn	well-developped	absent	present	present	absent	subround	rectangular	metaconid smaller than anteroconid	medium	straigth with mesial growth	partial	medium
AF12-2	p3	AF12-2-L-195	1.73	1.845	med	larg	worn	well-developped	absent	present	present	absent	triangular	sub-rectangular	metaconid bigger than anteroconid	medium	curved	NA	thick
AF12-2	p3	AF12-2-L-196	1.572	1.569	med	med	worn	extremely reduced	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	medium	slightly curved	present	medium
AF12-2	p3	AF12-2-L-197	1.633	1.717	med	med	worn	small	absent	present	present	present	triangular	rectangular	metaconid bigger than anteroconid	medium	straigth with mesial growth	present	medium
AF12-2	p3	AF12-2-L-198	1.816	1.538	larg	med	worn	well-developped	absent	present	present	absent	triangular	rectangular	metaconid equal anteroconid	medium	slightly curved	present	medium
AF12-2	p3	AF12-2-L-199	1.68	1.757	med	med	worn	extremely reduced	absent	present	present	absent	triangular	rectangular	metaconid equal anteroconid	medium	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-2	2.128	2.059	larg	larg	worn	well-developped	present	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	long	curved	absent	medium
AF12-2	p3	AF12-2-L-20	1.289	1.34	shrt	shrt	unworn	extremely reduced	absent	present	present	absent	subround	rounded	metaconid bigger than anteroconid	short	thin apex	absent	thin
AF12-2	p3	AF12-2-L-202	NA	NA	NA	NA	unworn	NA	absent	absent	present	NA	NA	rounded	NA	NA	NA	NA	NA
AF12-2	p3	AF12-2-L-203	NA	1.357	NA	shrt	unworn	NA	absent	absent	absent	NA	NA	rounded	NA	NA	NA	NA	NA
AF12-2	p3	AF12-2-L-204	NA	1.004	NA	shrt	unworn	NA	absent	absent	absent	NA	NA	rounded	NA	NA	NA	NA	NA
AF12-2	p3	AF12-2-L-205	NA	1.369	NA	shrt	unworn	NA	absent	present	present	NA	NA	rounded	NA	NA	NA	NA	NA
AF12-2	p3	AF12-2-L-206	1.309	1.432	shrt	shrt	unworn	NA	absent	present	absent	NA	NA	rounded	NA	NA	NA	NA	NA
AF12-2	p3	AF12-2-L-207	1.465	1.749	shrt	med	worn	well-developped	absent	present	present	absent	triangular	rectangular	metaconid smaller than anteroconid	NA	NA	present	NA
AF12-2	p3	AF12-2-L-208	NA	NA	NA	NA	worn	small	absent	absent	NA	NA	NA	rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-209	NA	NA	NA	NA	worn	extremely reduced	absent	present	present	NA	NA	rectangular	NA	NA	NA	present	thin
AF12-2	p3	AF12-2-L-21	1.387	1.358	shrt	shrt	unworn	absent	absent	present	present	absent	subround	rounded	metaconid equal anteroconid	medium	slightly curved	absent	thin
AF12-2	p3	AF12-2-L-210	NA	NA	NA	NA	worn	absent	absent	present	present	NA	NA	rectangular	NA	medium	curved	NA	medium
AF12-2	p3	AF12-2-L-211	NA	NA	NA	NA	worn	small	absent	present	present	NA	NA	rectangular	NA	medium	straigth with mesial growth	NA	medium
AF12-2	p3	AF12-2-L-212	NA	NA	NA	NA	worn	well-developped	absent	present	present	NA	NA	rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-213	NA	1.769	NA	larg	worn	absent	absent	present	present	NA	NA	rectangular	NA	medium	slightly curved	present	medium
AF12-2	p3	AF12-2-L-214	NA	1.72	NA	med	worn	absent	absent	present	present	NA	NA	rectangular	NA	medium	slightly curved	present	medium

Appendix 2. — Continuation.

Level	Position	Specimen number	L	W	LENGTH	WIDTH	Wear	CROCHSIZE	CONANTPROT	CONHYPPROT	CONMETENT	ANTIND	ANTSHP	METSHP	ANTMETSIZE	MEFLXSIZE	MEFLXSHP	ENTHIAT	PROTLTHK
AF12-2	p3	AF12-2-L-215	NA	1.803	NA	larg	worn	absent	absent	present	present	NA	NA	rectangular	NA	medium	curved	NA	medium
AF12-2	p3	AF12-2-L-216	NA	1.777	NA	larg	worn	extremely reduced	absent	present	present	NA	NA	rectangular	NA	short	widen apex	NA	medium
AF12-2	p3	AF12-2-L-217	NA	NA	NA	NA	worn	extremely reduced	absent	present	present	NA	NA	rectangular	NA	short	widen apex	NA	medium
AF12-2	p3	AF12-2-L-218	NA	1.492	NA	shrt	worn	extremely reduced	absent	present	present	NA	NA	rectangular	NA	medium	thin apex	present	medium
AF12-2	p3	AF12-2-L-219	NA	1.707	NA	med	worn	extremely reduced	absent	present	present	NA	NA	rectangular	metaconid bigger than anteroconid	medium	straigth with mesial growth	NA	thin
AF12-2	p3	AF12-2-L-22	1.599	1.654	med	med	worn	NA	absent	absent	present	absent	triangular	rectangular	metaconid bigger than anteroconid	NA	NA	absent	thin
AF12-2	p3	AF12-2-L-220	NA	1.781	NA	larg	worn	well-developped	absent	present	present	NA	NA	sub-rectangular	NA	long	curved	absent	medium
AF12-2	p3	AF12-2-L-221	NA	1.864	NA	larg	worn	well-developped	absent	present	present	NA	NA	sub-rectangular	NA	short	curved	present	medium
AF12-2	p3	AF12-2-L-222	NA	1.778	NA	larg	worn	small	absent	present	present	NA	NA	rectangular	NA	medium	straigth with mesial growth	NA	thin
AF12-2	p3	AF12-2-L-223	NA	1.618	NA	med	worn	small	absent	present	present	NA	NA	rectangular	NA	short	slightly curved	NA	thin
AF12-2	p3	AF12-2-L-224	NA	NA	NA	NA	worn	small	absent	present	present	NA	NA	rectangular	NA	NA	NA	NA	thin
AF12-2	p3	AF12-2-L-225	NA	1.802	NA	larg	worn	small	absent	present	present	NA	NA	fan-shaped	NA	medium	straigth with mesial growth	present	medium
AF12-2	p3	AF12-2-L-226	1.673	1.765	med	med	worn	well-developped	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-227	NA	NA	NA	NA	worn	well-developped	present	present	present	absent	trapezoid	NA	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-228	1.866	1.751	larg	med	worn	well-developped	absent	present	present	present	trapezoid	rectangular	metaconid smaller than anteroconid	medium	curved	absent	medium
AF12-2	p3	AF12-2-L-229	1.77	1.795	larg	larg	worn	small	absent	present	present	present	triangular	sub-rectangular	metaconid bigger than anteroconid	medium	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-23	1.689	1.601	med	med	worn	NA	absent	absent	present	absent	trapezoid	rectangular	metaconid equal anteroconid	short	curved	absent	thin
AF12-2	p3	AF12-2-L-230	NA	1.714	NA	med	worn	small	absent	present	present	NA	NA	rectangular	NA	short	widen apex	partial	medium
AF12-2	p3	AF12-2-L-231	NA	1.645	NA	med	worn	extremely reduced	absent	present	present	NA	NA	rectangular	NA	short	slightly curved	present	medium
AF12-2	p3	AF12-2-L-232	NA	NA	NA	NA	worn	extremely reduced	absent	present	present	NA	NA	rectangular	NA	short	widen apex	absent	medium
AF12-2	p3	AF12-2-L-233	NA	1.639	NA	med	worn	small	absent	present	present	NA	NA	sub-rectangular	NA	short	curved	absent	medium
AF12-2	p3	AF12-2-L-234	1.495	1.532	shrt	med	worn	extremely reduced	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	short	slightly curved	present	medium
AF12-2	p3	AF12-2-L-235	1.645	1.618	med	med	worn	small	absent	present	present	absent	triangular	rectangular	metaconid equal anteroconid	short	widen apex	partial	medium
AF12-2	p3	AF12-2-L-236	1.693	1.711	med	med	worn	absent	absent	present	present	absent	trapezoid	fan-shaped	metaconid bigger than anteroconid	short	extremely reduced	absent	medium
AF12-2	p3	AF12-2-L-237	NA	1.71	NA	med	worn	extremely reduced	absent	present	present	NA	NA	rectangular	NA	short	widen apex	NA	medium
AF12-2	p3	AF12-2-L-238	NA	1.78	NA	larg	worn	extremely reduced	absent	present	present	NA	NA	rectangular	NA	medium	curved	present	medium
AF12-2	p3	AF12-2-L-239	1.772	NA	larg	NA	worn	well-developped	absent	present	present	absent	triangular	sub-rectangular	metaconid bigger than anteroconid	short	widen apex	present	medium
AF12-2	p3	AF12-2-L-24	1.405	1.471	shrt	shrt	unworn	NA	absent	absent	present	absent	sub-round	rectangular	metaconid equal anteroconid	medium	thin apex	absent	thin

Appendix 2. — Continuation.

Level	Position	Specimen number	L	W	LENGTH	WIDTH	Wear	CROCHSIZE	CONANTPROT	CONHYPPROT	CONMETENT	ANTIND	ANTSHP	METSHP	ANTMETSIZE	MEFLXSIZE	MEFLXSHP	ENTHIAT	PROTLTHK
AF12-2	p3	AF12-2-L-240	1.805	1.813	larg	larg	worn	small	absent	present	present	absent	triangular	rectangular	metaconid equal anteroconid	medium	widen apex	present	medium
AF12-2	p3	AF12-2-L-241	1.888	1.716	larg	med	worn	absent	absent	present	present	absent	trapezoid	rectangular	metaconid smaller than anteroconid	short	curved	NA	medium
AF12-2	p3	AF12-2-L-242	1.686	1.62	med	med	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	short	widen apex	present	medium
AF12-2	p3	AF12-2-L-243	1.663	1.686	med	med	worn	extremely reduced	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	medium	curved	present	medium
AF12-2	p3	AF12-2-L-244	NA	NA	NA	NA	worn	small	absent	present	present	NA	NA	rectangular	NA	medium	thin apex	NA	medium
AF12-2	p3	AF12-2-L-245	1.976	1.763	larg	med	worn	small	absent	present	present	absent	triangular	sub-rectangular	metaconid bigger than anteroconid	short	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-246	NA	NA	NA	NA	worn	small	absent	present	present	NA	NA	sub-rectangular	NA	NA	NA	present	medium
AF12-2	p3	AF12-2-L-247	NA	1.706	NA	med	worn	well-developped	absent	present	present	NA	NA	sub-rectangular	NA	short	widen apex	absent	medium
AF12-2	p3	AF12-2-L-248	NA	1.699	NA	med	worn	absent	absent	present	present	NA	NA	NA	NA	short	slightly curved	present	medium
AF12-2	p3	AF12-2-L-249	NA	1.815	NA	larg	worn	small	absent	present	present	NA	NA	rectangular	NA	short	widen apex	present	medium
AF12-2	p3	AF12-2-L-25	1.24	1.31	shrt	shrt	unworn	NA	absent	absent	present	absent	subround	rectangular	metaconid bigger than anteroconid	short	curved	absent	thin
AF12-2	p3	AF12-2-L-250	1.796	1.743	larg	med	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	short	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-251	NA	NA	NA	NA	worn	extremely reduced	absent	present	present	NA	NA	rounded	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-252	NA	1.274	NA	shrt	unworn	NA	absent	present	absent	NA	NA	rounded	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-253	NA	NA	NA	NA	worn	NA	absent	present	NA	absent	trapezoid	rectangular	NA	short	widen apex	NA	medium
AF12-2	p3	AF12-2-L-254	1.88	NA	larg	NA	worn	well-developped	absent	present	present	absent	triangular	rectangular	metaconid smaller than anteroconid	long	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-255	NA	NA	NA	NA	worn	small	absent	present	present	NA	NA	NA	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-256	NA	NA	NA	NA	worn	small	NA	present	present	NA	NA	NA	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-257	NA	NA	NA	NA	worn	NA	absent	absent	present	NA	NA	rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-258	NA	NA	NA	NA	worn	small	absent	NA	present	NA	NA	rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-259	NA	NA	NA	NA	worn	extremely reduced	absent	NA	NA	NA	NA	NA	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-26	1.66	1.698	med	med	worn	NA	absent	absent	present	present	trapezoid	rectangular	metaconid smaller than anteroconid	medium	slightly curved	absent	thin
AF12-2	p3	AF12-2-L-260	NA	NA	NA	NA	worn	small	absent	NA	present	NA	NA	rectangular	NA	NA	NA	absent	medium
AF12-2	p3	AF12-2-L-261	NA	NA	NA	NA	worn	small	absent	NA	present	NA	NA	NA	NA	NA	NA	absent	medium
AF12-2	p3	AF12-2-L-262	NA	NA	NA	NA	worn	NA	absent	present	NA	NA	NA	NA	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-263	NA	NA	NA	NA	worn	NA	absent	NA	NA	NA	NA	NA	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-264	NA	NA	NA	NA	worn	small	absent	NA	present	NA	NA	rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-265	1.864	NA	larg	NA	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	short	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-266	NA	NA	NA	NA	worn	extremely reduced	absent	absent	present	NA	NA	NA	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-267	NA	NA	NA	NA	worn	extremely reduced	absent	NA	present	NA	NA	NA	NA	NA	NA	NA	medium

Appendix 2. — Continuation.

Level	Position	Specimen number	L	W	LENGTH	WIDTH	Wear	CROCHSIZE	CONANTPROT	CONHYPPROT	CONMETENT	ANTIND	ANTSHP	METSHP	ANTMETSIZE	MEFLXSIZE	MEFLXSHP	ENTHIAT	PROTLTHK
AF12-2	p3	AF12-2-L-268	NA	NA	NA	NA	worn	NA	absent	NA	NA	NA	NA	NA	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-269	NA	NA	NA	NA	worn	well-developped	absent	NA	present	NA	NA	NA	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-27	NA	1.206	NA	shrt	unworn	NA	NA	absent	absent	NA	NA	rounded	NA	NA	NA	NA	thin
AF12-2	p3	AF12-2-L-270	NA	NA	NA	NA	worn	extremely reduced	absent	NA	present	NA	NA	NA	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-271	NA	NA	NA	NA	worn	small	absent	NA	present	NA	NA	NA	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-272	NA	NA	NA	NA	worn	extremely reduced	absent	NA	present	NA	NA	rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-273	NA	NA	NA	NA	worn	absent	absent	NA	present	NA	NA	NA	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-274	NA	NA	NA	NA	worn	absent	absent	NA	present	NA	NA	rectangular	NA	medium	slightly curved	NA	medium
AF12-2	p3	AF12-2-L-275	2.017	1.776	larg	larg	worn	small	present	present	present	present	trapezoid	rectangular	metaconid equal anteroconid	medium	straigth with mesial growth	absent	medium
AF12-2	p3	AF12-2-L-276	1.918	1.889	larg	larg	worn	well-developped	absent	present	present	present	trapezoid	fan-shaped	metaconid smaller than anteroconid	short	widen apex	absent	medium
AF12-2	p3	AF12-2-L-277	1.638	1.784	med	larg	worn	small	absent	present	present	absent	triangular	rectangular	metaconid smaller than anteroconid	long	slightly curved	absent	thin
AF12-2	p3	AF12-2-L-278	1.587	NA	med	NA	worn	absent	absent	present	present	absent	sub-round	fan-shaped	metaconid equal anteroconid	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-279	1.315	1.334	shrt	shrt	unworn	small	absent	present	present	absent	triangular	rounded	metaconid smaller than anteroconid	medium	thin apex	absent	thin
AF12-2	p3	AF12-2-L-28	1.426	1.453	shrt	shrt	unworn	NA	absent	present	absent	absent	sub-round	rounded	metaconid equal anteroconid	NA	NA	present	thin
AF12-2	p3	AF12-2-L-280	1.608	1.529	med	med	worn	small	absent	present	present	absent	sub-round	sub-rectangular	metaconid smaller than anteroconid	short	thin apex	absent	medium
AF12-2	p3	AF12-2-L-281	1.626	1.637	med	med	worn	extremely reduced	absent	present	present	absent	trapezoid	fan-shaped	metaconid smaller than anteroconid	medium	slightly curved	partial	medium
AF12-2	p3	AF12-2-L-282	1.867	2.037	larg	larg	worn	absent	absent	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	medium	straigth with mesial growth	present	medium
AF12-2	p3	AF12-2-L-283	1.661	1.681	med	med	worn	absent	absent	present	present	absent	triangular	fan-shaped	metaconid smaller than anteroconid	short	thin apex	absent	medium
AF12-2	p3	AF12-2-L-284	1.095	1.218	shrt	shrt	unworn	absent	absent	present	present	absent	triangular	rounded	metaconid smaller than anteroconid	medium	thin apex	NA	thin
AF12-2	p3	AF12-2-L-285	NA	NA	NA	NA	worn	small	present	present	present	NA	NA	sub-rectangular	NA	medium	curved	absent	medium
AF12-2	p3	AF12-2-L-286	1.803	1.76	larg	med	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	short	widen apex	absent	medium
AF12-2	p3	AF12-2-L-287	1.885	2.015	larg	larg	worn	NA	absent	absent	present	absent	triangular	rectangular	metaconid smaller than anteroconid	long	slightly curved	absent	thick
AF12-2	p3	AF12-2-L-288	1.462	NA	shrt	NA	worn	well-developped	absent	present	present	absent	sub-round	rectangular	metaconid bigger than anteroconid	short	extremely reduced	NA	medium
AF12-2	p3	AF12-2-L-289	2.04	2.151	larg	larg	worn	NA	absent	absent	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	medium	widen apex	absent	thick
AF12-2	p3	AF12-2-L-29	NA	1.199	NA	shrt	unworn	NA	NA	present	absent	NA	NA	rounded	NA	NA	NA	partial	thin
AF12-2	p3	AF12-2-L-290	1.841	2.002	larg	larg	worn	extremely reduced	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	NA	closed	present	thick
AF12-2	p3	AF12-2-L-291	1.503	1.471	shrt	shrt	unworn	extremely reduced	absent	present	present	absent	trapezoid	rounded	metaconid bigger than anteroconid	short	extremely reduced	absent	medium

Appendix 2. — Continuation.

Level	Position	Specimen number	L	W	LENGTH	WIDTH	Wear	CROCHSIZE	CONANTPROT	CONHYPPROT	CONMETENT	ANTIND	ANTSHP	METSHP	ANTMETSIZE	MEFLXSIZE	MEFLXSHP	ENTHIAT	PROTLTHK
AF12-2	p3	AF12-2-L-292	1.809	1.896	larg	larg	worn	small	absent	present	present	absent	trapezoid	sub-rectangular	metaconid bigger than anteroconid	medium	slightly curved	partial	thick
AF12-2	p3	AF12-2-L-293	1.755	1.732	med	med	worn	small	absent	present	present	absent	trapezoid	sub-rectangular	metaconid bigger than anteroconid	short	widen apex	present	medium
AF12-2	p3	AF12-2-L-294	1.827	1.835	larg	larg	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	short	thin apex	present	medium
AF12-2	p3	AF12-2-L-295	NA	NA	NA	NA	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	medium	slightly curved	NA	medium
AF12-2	p3	AF12-2-L-296	1.619	1.643	med	med	worn	small	absent	present	present	absent	trapezoid	sub-rectangular	metaconid bigger than anteroconid	long	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-297	1.516	1.439	shrt	shrt	worn	small	present	present	present	absent	trapezoid	sub-rectangular	metaconid bigger than anteroconid	medium	straigth with mesial growth	present	medium
AF12-2	p3	AF12-2-L-298	1.771	1.838	larg	larg	worn	small	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	medium	straigth with mesial growth	absent	thick
AF12-2	p3	AF12-2-L-299	1.768	1.714	larg	med	worn	small	absent	present	present	absent	trapezoid	sub-rectangular	metaconid equal anteroconid	short	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-3	1.613	1.954	med	larg	worn	small	present	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	medium	straigth with mesial growth	present	medium
AF12-2	p3	AF12-2-L-30	1.131	1.198	shrt	shrt	unworn	NA	absent	absent	absent	absent	sub-round	rounded	metaconid bigger than anteroconid	NA	NA	absent	thin
AF12-2	p3	AF12-2-L-300	1.652	1.8	med	larg	worn	absent	absent	present	present	present	triangular	rectangular	metaconid bigger than anteroconid	long	straigth with mesial growth	absent	medium
AF12-2	p3	AF12-2-L-301	NA	NA	NA	NA	worn	small	absent	present	present	NA	NA	rectangular	NA	NA	NA	present	medium
AF12-2	p3	AF12-2-L-302	NA	NA	NA	NA	worn	small	absent	present	present	NA	NA	rectangular	NA	NA	NA	present	thick
AF12-2	p3	AF12-2-L-303	NA	NA	NA	NA	worn	small	absent	present	present	NA	NA	rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-304	NA	NA	NA	NA	worn	absent	absent	present	present	NA	NA	NA	NA	short	slightly curved	absent	NA
AF12-2	p3	AF12-2-L-305	NA	NA	NA	NA	worn	NA	absent	present	NA	NA	NA	NA	NA	NA	NA	NA	thin
AF12-2	p3	AF12-2-L-306	1.874	1.864	larg	larg	worn	small	absent	present	present	present	trapezoid	rectangular	metaconid equal anteroconid	short	widen apex	absent	medium
AF12-2	p3	AF12-2-L-307	1.658	NA	med	NA	worn	small	present	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	NA	NA	absent	thin
AF12-2	p3	AF12-2-L-308	2.05	2.012	larg	larg	worn	well-developped	present	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	long	straigth with mesial growth	absent	thick
AF12-2	p3	AF12-2-L-309	1.806	1.902	larg	larg	worn	absent	absent	present	present	present	triangular	rectangular	metaconid smaller than anteroconid	medium	curved	absent	thick
AF12-2	p3	AF12-2-L-31	NA	1.208	NA	shrt	unworn	NA	NA	absent	absent	NA	NA	rounded	NA	NA	NA	NA	thin
AF12-2	p3	AF12-2-L-310	1.536	1.597	med	med	worn	extremely reduced	absent	present	present	absent	trapezoid	rounded	metaconid bigger than anteroconid	medium	slightly curved	absent	thin
AF12-2	p3	AF12-2-L-311	1.312	1.38	shrt	shrt	unworn	absent	absent	present	present	absent	sub-round	rounded	metaconid bigger than anteroconid	medium	slightly curved	absent	thin
AF12-2	p3	AF12-2-L-312	1.571	NA	med	NA	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	NA	NA	NA	thick
AF12-2	p3	AF12-2-L-313	1.664	1.69	med	med	worn	small	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	short	widen apex	absent	medium
AF12-2	p3	AF12-2-L-314	1.737	1.886	med	larg	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	medium	slightly curved	absent	medium

Appendix 2. — Continuation.

Level	Position	Specimen number	L	W	LENGTH	WIDTH	Wear	CROCHSIZE	CONANTPROT	CONHYPPROT	CONMETENT	ANTIND	ANTSHP	METSHP	ANTMETSIZE	MEFLXSIZE	MEFLXSHP	ENTHIAT	PROTLTHK
AF12-2	p3	AF12-2-L-315	1.659	NA	med	NA	worn	extremely reduced	absent	present	present	absent	trapezoid	rectangular	metaconid smaller than anteroconid	short	widen apex	NA	medium
AF12-2	p3	AF12-2-L-316	1.675	1.654	med	med	worn	extremely reduced	absent	present	present	absent	trapezoid	sub-rectangular	metaconid bigger than anteroconid	medium	thin apex	absent	medium
AF12-2	p3	AF12-2-L-317	1.775	1.673	larg	med	worn	well-developped	absent	present	present	absent	trapezoid	sub-rectangular	metaconid bigger than anteroconid	short	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-318	NA	NA	NA	NA	worn	small	absent	present	present	NA	NA	rectangular	NA	short	widen apex	partial	medium
AF12-2	p3	AF12-2-L-319	NA	NA	NA	NA	worn	well-developped	absent	present	present	NA	NA	rectangular	NA	short	curved	NA	medium
AF12-2	p3	AF12-2-L-32	NA	1.255	NA	shrt	unworn	NA	NA	absent	present	NA	NA	rounded	NA	short	thin apex	NA	thin
AF12-2	p3	AF12-2-L-320	NA	NA	NA	NA	worn	small	absent	present	present	NA	NA	rectangular	NA	short	curved	absent	medium
AF12-2	p3	AF12-2-L-321	NA	1.852	NA	larg	worn	well-developped	absent	present	present	NA	NA	NA	NA	short	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-322	NA	NA	NA	NA	worn	small	absent	present	NA	NA	NA	rectangular	NA	NA	NA	absent	thick
AF12-2	p3	AF12-2-L-323	NA	NA	NA	NA	worn	NA	absent	NA	NA	NA	NA	rectangular	NA	NA	NA	absent	medium
AF12-2	p3	AF12-2-L-324	1.651	1.652	med	med	worn	NA	absent	absent	present	NA	NA	rectangular	NA	short	curved	absent	medium
AF12-2	p3	AF12-2-L-325	1.447	1.426	shrt	shrt	unworn	small	absent	present	present	absent	trapezoid	rounded	metaconid equal anteroconid	short	slightly curved	present	medium
AF12-2	p3	AF12-2-L-326	1.606	1.689	med	med	worn	well-developped	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	short	curved	NA	medium
AF12-2	p3	AF12-2-L-327	1.579	1.622	med	med	worn	small	absent	present	present	absent	trapezoid	sub-rectangular	metaconid bigger than anteroconid	short	thin apex	absent	medium
AF12-2	p3	AF12-2-L-328	1.589	1.511	med	med	worn	extremely reduced	absent	present	present	absent	trapezoid	fan-shaped	metaconid bigger than anteroconid	short	thin apex	absent	medium
AF12-2	p3	AF12-2-L-329	NA	1.632	NA	med	worn	small	NA	present	present	NA	NA	fan-shaped	NA	medium	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-33	NA	1.303	NA	shrt	unworn	NA	NA	absent	present	NA	NA	rounded	NA	NA	NA	partial	thin
AF12-2	p3	AF12-2-L-330	1.671	1.623	med	med	worn	extremely reduced	absent	present	present	absent	triangular	rectangular	metaconid equal anteroconid	short	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-331	1.735	1.844	med	larg	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid smaller than anteroconid	medium	straigth with mesial growth	NA	medium
AF12-2	p3	AF12-2-L-332	NA	1.389	NA	shrt	unworn	small	NA	present	present	NA	NA	NA	NA	short	extremely reduced	absent	thin
AF12-2	p3	AF12-2-L-333	NA	1.607	NA	med	worn	absent	NA	present	present	NA	NA	rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-334	NA	1.766	NA	larg	worn	small	NA	present	present	NA	NA	rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-335	1.826	NA	larg	NA	worn	small	absent	present	present	absent	triangular	rectangular	metaconid smaller than anteroconid	medium	straigth with mesial growth	present	medium
AF12-2	p3	AF12-2-L-336	1.759	1.833	med	larg	worn	NA	absent	absent	present	present	triangular	rectangular	metaconid bigger than anteroconid	medium	straigth with mesial growth	present	medium
AF12-2	p3	AF12-2-L-337	1.892	2.059	larg	larg	worn	small	absent	present	present	absent	triangular	sub-rectangular	metaconid bigger than anteroconid	short	widen apex	absent	medium
AF12-2	p3	AF12-2-L-34	1.222	1.21	shrt	shrt	unworn	NA	absent	present	present	absent	sub-round	rounded	metaconid bigger than anteroconid	medium	thin apex	absent	thin
AF12-2	p3	AF12-2-L-35	1.732	1.818	med	larg	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	short	slightly curved	present	thin

Appendix 2. — Continuation.

Level	Position	Specimen number	L	W	LENGTH	WIDTH	Wear	CROCHSIZE	CONANTPROT	CONHYPPROT	CONMETENT	ANTIND	ANTSHP	METSHP	ANTMETSIZE	MEFLXSIZE	MEFLXSHP	ENTHIAT	PROTLTHK
AF12-2	p3	AF12-2-L-36	1.301	1.329	shrt	shrt	unworn	small	absent	present	present	absent	sub-round	rounded	metaconid bigger than anteroconid	short	thin apex	absent	thin
AF12-2	p3	AF12-2-L-37	1.366	1.349	shrt	shrt	unworn	extremely reduced	absent	present	present	absent	sub-round	rectan-gular	metaconid bigger than anteroconid	short	thin apex	partial	thin
AF12-2	p3	AF12-2-L-38	1.37	1.358	shrt	shrt	unworn	small	absent	present	present	absent	sub-round	rectan-gular	metaconid bigger than anteroconid	medium	thin apex	present	thin
AF12-2	p3	AF12-2-L-39	1.353	1.443	shrt	shrt	unworn	absent	absent	present	present	absent	sub-round	rounded	metaconid bigger than anteroconid	medium	thin apex	absent	thin
AF12-2	p3	AF12-2-L-4	1.498	NA	shrt	NA	worn	small	present	present	present	absent	trape-zoid	rectan-gular	metaconid bigger than anteroconid	short	curved	present	thin
AF12-2	p3	AF12-2-L-40	1.4	NA	shrt	NA	unworn	well-devel-opped	absent	present	present	absent	trape-zoid	rectan-gular	metaconid bigger than anteroconid	NA	NA	NA	thin
AF12-2	p3	AF12-2-L-41	1.513	1.682	shrt	med	worn	small	absent	present	present	absent	trape-zoid	rectan-gular	metaconid bigger than anteroconid	NA	NA	NA	thin
AF12-2	p3	AF12-2-L-42	1.605	1.577	med	med	worn	small	absent	present	present	absent	trian-gular	rectan-gular	metaconid bigger than anteroconid	short	thin apex	absent	thin
AF12-2	p3	AF12-2-L-43	1.419	1.469	shrt	shrt	worn	small	absent	present	present	absent	trape-zoid	rectan-gular	metaco-nid equal anteroconid	medium	thin apex	NA	thin
AF12-2	p3	AF12-2-L-44	1.577	1.615	med	med	worn	extremely reduced	absent	present	present	absent	trian-gular	rectan-gular	metaconid bigger than anteroconid	medium	thin apex	NA	thin
AF12-2	p3	AF12-2-L-45	1.81	1.782	larg	larg	worn	well-devel-opped	absent	present	present	absent	trian-gular	rectan-gular	metaconid bigger than anteroconid	medium	straigth with mesial growth	absent	thin
AF12-2	p3	AF12-2-L-46	1.776	1.842	larg	larg	worn	well-devel-opped	absent	present	present	absent	trape-zoid	rectan-gular	metaconid bigger than anteroconid	short	widen apex	present	thick
AF12-2	p3	AF12-2-L-47	1.841	1.826	larg	larg	worn	well-devel-opped	absent	present	present	absent	trape-zoid	rectan-gular	metaco-nid equal anteroconid	short	widen apex	partial	thick
AF12-2	p3	AF12-2-L-48	1.876	1.761	larg	med	worn	small	absent	present	present	absent	trape-zoid	rectan-gular	metaconid bigger than anteroconid	medium	slightly curved	present	medium
AF12-2	p3	AF12-2-L-49	1.696	1.655	med	med	worn	extremely reduced	absent	present	present	absent	trape-zoid	rectan-gular	metaconid bigger than anteroconid	medium	thin apex	present	medium
AF12-2	p3	AF12-2-L-5	1.676	1.734	med	med	worn	extremely reduced	present	present	present	pre-sent	trape-zoid	rectan-gular	metaco-nid equal anteroconid	short	curved	absent	medium
AF12-2	p3	AF12-2-L-50	1.574	1.725	med	med	worn	extremely reduced	absent	present	present	absent	trape-zoid	sub-rectan-gular	metaconid bigger than anteroconid	medium	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-51	1.797	1.89	larg	larg	worn	NA	absent	absent	present	absent	trape-zoid	rectan-gular	metaconid smaller than anteroconid	short	curved	present	medium
AF12-2	p3	AF12-2-L-52	1.695	1.543	med	med	worn	small	absent	present	present	absent	trape-zoid	rectan-gular	metaco-nid equal anteroconid	short	extremely reduced	present	thin
AF12-2	p3	AF12-2-L-53	1.494	1.668	shrt	med	worn	small	absent	present	present	absent	trape-zoid	rectan-gular	metaconid bigger than anteroconid	short	slightly curved	absent	thin
AF12-2	p3	AF12-2-L-54	1.852	1.762	larg	med	worn	small	absent	present	present	absent	trian-gular	rectan-gular	metaconid bigger than anteroconid	short	widen apex	absent	thick
AF12-2	p3	AF12-2-L-55	1.92	1.756	larg	med	worn	well-devel-opped	absent	present	present	absent	trape-zoid	rectan-gular	metaco-nid equal anteroconid	long	curved	present	medium
AF12-2	p3	AF12-2-L-56	1.836	1.859	larg	larg	worn	well-devel-opped	absent	present	present	absent	trape-zoid	fan-shaped	metaco-nid equal anteroconid	medium	curved	NA	medium
AF12-2	p3	AF12-2-L-57	1.862	1.84	larg	larg	worn	small	absent	present	present	pre-sent	trape-zoid	sub-rec-tangular	metaconid smaller than anteroconid	short	widen apex	absent	thick

Appendix 2. — Continuation.

Level	Position	Specimen number	L	W	LENGTH	WIDTH	Wear	CROCHSIZE	CONANTPROT	CONHYPPROT	CONMETENT	ANTIND	ANTSHP	METSHP	ANTMETSIZE	MEFLXSIZE	MEFLXSHP	ENTHIAT	PROTLTHK
AF12-2	p3	AF12-2-L-58	1.699	1.762	med	med	worn	small	absent	present	present	present	trapezoid	fan-shaped	metaconid bigger than anteroconid	medium	slightly curved	absent	medium
AF12-2	p3	AF12-2-L-59	1.722	1.625	med	med	worn	small	absent	present	present	absent	trapezoid	fan-shaped	metaconid bigger than anteroconid	medium	thin apex	absent	medium
AF12-2	p3	AF12-2-L-6	1.739	1.782	med	larg	worn	small	present	present	present	present	trapezoid	rectangular	metaconid equal anteroconid	short	curved	present	medium
AF12-2	p3	AF12-2-L-60	1.616	1.689	med	med	worn	small	absent	present	present	absent	trapezoid	fan-shaped	metaconid bigger than anteroconid	NA	NA	NA	thin
AF12-2	p3	AF12-2-L-61	1.67	1.701	med	med	worn	small	absent	present	present	present	triangular	rectangular	metaconid equal anteroconid	short	widen apex	present	medium
AF12-2	p3	AF12-2-L-62	1.644	1.626	med	med	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	short	widen apex	NA	medium
AF12-2	p3	AF12-2-L-63	1.801	1.863	larg	larg	worn	well-developped	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	medium	straigth with mesial growth	NA	medium
AF12-2	p3	AF12-2-L-64	1.775	1.962	larg	larg	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	medium	curved	absent	medium
AF12-2	p3	AF12-2-L-65	1.781	1.815	larg	larg	worn	well-developped	absent	present	present	present	trapezoid	rectangular	metaconid equal anteroconid	medium	straigth with mesial growth	present	medium
AF12-2	p3	AF12-2-L-66	1.918	1.849	larg	larg	worn	well-developped	absent	present	present	present	trapezoid	rectangular	metaconid smaller than anteroconid	medium	curved	present	thick
AF12-2	p3	AF12-2-L-67	1.587	1.637	med	med	worn	well-developped	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	short	widen apex	NA	medium
AF12-2	p3	AF12-2-L-68	1.686	1.676	med	med	worn	well-developped	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	short	widen apex	NA	thin
AF12-2	p3	AF12-2-L-69	1.724	1.917	med	larg	worn	well-developped	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	long	curved	partial	medium
AF12-2	p3	AF12-2-L-7	1.723	1.742	med	med	worn	small	present	present	present	absent	trapezoid	rectangular	metaconid equal anteroconid	medium	curved	present	medium
AF12-2	p3	AF12-2-L-70	1.587	1.528	med	med	worn	small	absent	present	present	NA	NA	rectangular	metaconid bigger than anteroconid	short	slightly curved	present	thin
AF12-2	p3	AF12-2-L-71	2.044	2.189	larg	larg	worn	well-developped	absent	absent	present	absent	triangular	rectangular	metaconid equal anteroconid	medium	curved	absent	thick
AF12-2	p3	AF12-2-L-72	1.718	1.89	med	larg	worn	small	absent	present	present	present	triangular	sub-rectangular	metaconid equal anteroconid	short	curved	absent	medium
AF12-2	p3	AF12-2-L-73	1.746	1.811	med	larg	worn	small	absent	present	present	present	triangular	rectangular	metaconid smaller than anteroconid	medium	slightly curved	present	thick
AF12-2	p3	AF12-2-L-74	1.616	1.78	med	larg	worn	small	absent	present	present	present	triangular	rectangular	metaconid bigger than anteroconid	long	slightly curved	absent	thin
AF12-2	p3	AF12-2-L-75	1.725	1.837	med	larg	worn	small	absent	present	present	absent	triangular	sub-rectangular	metaconid bigger than anteroconid	short	slightly curved	present	thin
AF12-2	p3	AF12-2-L-76	1.856	1.868	larg	larg	worn	small	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	long	straigth with mesial growth	NA	thick
AF12-2	p3	AF12-2-L-77	1.486	1.459	shrt	shrt	unworn	extremely reduced	absent	present	present	absent	sub-round	rounded	metaconid equal anteroconid	short	thin apex	absent	thin
AF12-2	p3	AF12-2-L-78	1.446	1.354	shrt	shrt	unworn	absent	absent	present	present	absent	trapezoid	rectangular	metaconid smaller than anteroconid	short	slightly curved	absent	thin
AF12-2	p3	AF12-2-L-79	1.69	1.729	med	med	worn	small	absent	present	present	present	trapezoid	rectangular	metaconid bigger than anteroconid	medium	slightly curved	partial	medium

Appendix 2. — Continuation.

Level	Position	Specimen number	L	W	LENGTH	WIDTH	Wear	CROCHSIZE	CONANTPROT	CONHYPPROT	CONMETENT	ANTIND	ANTSHP	METSHP	ANTMETSIZE	MEFLXSIZE	MEFLXSHP	ENTHIAT	PROTLTHK
AF12-2	p3	AF12-2-L-8	1.74	1.833	med	larg	worn	absent	absent	present	present	absent	triangular	rectangular	metaconid equal anteroconid	medium	straigth with mesial growth	partial	medium
AF12-2	p3	AF12-2-L-80	1.733	1.603	med	med	worn	well-developped	absent	present	present	absent	trapezoid	rectangular	metaconid bigger than anteroconid	medium	slightly curved	present	medium
AF12-2	p3	AF12-2-L-81	1.495	1.594	shrt	med	worn	absent	absent	present	present	absent	subround	rectangular	metaconid bigger than anteroconid	short	thin apex	present	medium
AF12-2	p3	AF12-2-L-82	1.677	1.796	med	larg	worn	absent	absent	present	present	absent	triangular	rectangular	metaconid equal anteroconid	NA	closed	NA	medium
AF12-2	p3	AF12-2-L-83	1.533	1.494	med	med	worn	extremely reduced	absent	present	present	absent	trapezoid	fan-shaped	metaconid bigger than anteroconid	long	slightly curved	NA	thin
AF12-2	p3	AF12-2-L-84	1.488	1.528	shrt	med	worn	extremely reduced	absent	present	present	absent	triangular	rectangular	metaconid bigger than anteroconid	medium	thin apex	present	medium
AF12-2	p3	AF12-2-L-85	NA	NA	NA	NA	worn	small	NA	present	present	NA	NA	rectangular	NA	NA	NA	NA	thin
AF12-2	p3	AF12-2-L-86	NA	NA	NA	NA	worn	well-developped	NA	present	present	NA	NA	rectangular	NA	medium	curved	present	NA
AF12-2	p3	AF12-2-L-88	NA	NA	NA	NA	worn	absent	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	thin
AF12-2	p3	AF12-2-L-89	NA	NA	NA	NA	worn	NA	NA	present	NA	NA	NA	rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-9	1.561	1.628	med	med	worn	absent	absent	present	present	absent	triangular	rectangular	metaconid smaller than anteroconid	medium	slightly curved	present	medium
AF12-2	p3	AF12-2-L-92	NA	NA	NA	NA	worn	small	NA	present	present	NA	NA	rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-93	NA	NA	NA	NA	worn	NA	NA	absent	present	NA	NA	NA	NA	NA	NA	NA	NA
AF12-2	p3	AF12-2-L-94	1.753	NA	med	NA	worn	NA	absent	absent	NA	NA	NA	rectangular	NA	NA	NA	NA	thick
AF12-2	p3	AF12-2-L-95	NA	NA	NA	NA	worn	absent	NA	present	NA	NA	NA	sub-rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-96	NA	NA	NA	NA	worn	small	absent	present	present	NA	NA	rectangular	NA	NA	NA	present	medium
AF12-2	p3	AF12-2-L-97	1.602	NA	med	NA	worn	extremely reduced	absent	present	present	NA	NA	sub-rectangular	metaconid bigger than anteroconid	NA	NA	present	medium
AF12-2	p3	AF12-2-L-98	NA	NA	NA	NA	worn	small	NA	present	present	NA	NA	sub-rectangular	NA	NA	NA	NA	medium
AF12-2	p3	AF12-2-L-99	NA	NA	NA	NA	worn	small	NA	present	present	NA	NA	rectangular	NA	NA	NA	NA	thin

Appendix 3. — List of measurements of *Prolagus* Pomel, 1853 taken from the literature, used for the construction of the scatter plots.

Species	Locality	Country	Epoch	MN Zones	Sources	Comments
P. michauxi	Afoud 2	Morocco	Late Miocene (Messinian)	MN13	Benammi 1997	–
	Afoud 8	Morocco	Pliocene	MN13	Benammi 1997	–
	Kessani	Greece	Mio-Pliocene boundary	MN13/14	Vasileiadou *et al.* 2012	–
P. cf. *michauxi*	Aghouri	Morocco	Pliocene	–	Benammi 1997	–
P. sorbinii	Brisighella 6	Italy	Late Miocene (Messinian)	–	Angelone 2007	–
	Brisighella 25	Italy	Late Miocene (Messinian)	–	Angelone 2007	–
	Ciaboˀt Cagna	Italy	Late Miocene (Messinian)	MN13	Angelone & Cavallo 2010	–
	Develi	Turkey	Early Pliocene	MN14	Sen *et al.* 1989	Described as *P. michauxi*
	Grebeniki 2	Ukraine	Pliocene	MN14	Tesakov & Averianov 2002	–
	Monte Castellaro	Italy	Late Miocene (Messinian)	MN13	Angelone 2007	–
	Novaya Andriyashevka	Moldova	Pliocene	MN14	Tesakov & Averianov 2002	–
P. aff. *sorbinii*	Arcille	Italy	Late Pliocene	MN16a	Angelone & Rook 2012	–
	Case Inferno	Italy	Pleistocene	–	Angelone & Rook 2012	–
P. cf. *sorbinii*	Borro Strolla	Italy	Mio-Pliocene boundary	–	Angelone & Rook 2012	–
	Velona	Italy	Late Miocene (Messinian)	–	Angelone 2007; Angelone & Rook 2012	–
P. italicus	Montagnola Senese	Italy	Pliocene	MN17	Angelone 2008b	–
	Torre di Picchio	Italy	Plio-Pleistocene	? MN17	Angelone 2008b	–
P. latiuncinatus	Polgárdi 2	Hungary	Late Miocene	MN13	Angelone & Cermák 2015	–
P. bilobus	Gundersheim	Germany	Pliocene	MN15	Heller 1936	–
	Raciszyn 1	Poland	Pliocene	MN15b	Fostowicz-Frelik 2010	Described as *Prolagus osmolskae* Fostowicz-Frelik, 2010
	Tatareshty	Moldova	Pliocene	MN15	Tesakov & Averianov 2002	–
Prolagus sp.	Voie Ferrée	Tunisia	Late Miocene	–	Robinson *et al.* 1982	–

Appendix 4. — List of populations of *Prolagus* Pomel, 1853 whose morphological informations were taken from the literature, for the population morphological comparison.

Species	Locality	Country	Epoch	MN Zones	Sources	Comments
P. michauxi	Granada	Spain	Late Miocene (Messinian)	–	Angelone 2008b: fig. 5	Figure originally from López-Martinez 1989
	Kessani	Greece	Mio-Pliocene boundary	MN13/14	Vasileiadou *et al.* 2012	–
	Sète	France	Pliocene	MN15	López-Martinez & Thaler 1975	–
	Silata	Greece	Mio-Pliocene boundary	MN13/14	Vasileiadou *et al.* 2003	–
P. aff. *michauxi*	Kessani	Greece	Mio-Pliocene boundary	MN13/14	Angelone 2008a: fig. 1	Figure originally from Syrides *et al.* 1997
P. sorbinii	Brisighella 6	Italy	Late Miocene (Messinian)	–	Angelone 2007: fig. 4e	–
	Brisighella 25	Italy	Late Miocene (Messinian)	–	Angelone 2008b: fig. 5	–
	Monte Castellaro	Italy	Late Miocene (Messinian)	MN13	Angelone 2007	–
	Ciabòt Cagna	Italy	Late Miocene (Messinian)	MN13	Cavallo *et al.* 1993; Angelone 2007 Angelone & Cavallo 2010	First described as *P. michauxi*
	Develi	Turkey	Early Pliocene	MN14	Sen *et al.* 1989	Described as *P. michauxi*
	Grebeniki 2	Ukraine	Pliocene	MN14	Tesakov & Averianov 2002	–
	Novaya Andriyashevka	Moldova	Pliocene	MN14	Tesakov & Averianov 2002	–
	Verduno	Italy	Late Miocene (Messinian)	–	Colombero *et al.* 2014	–
P. aff. *sorbinii*	Arcille	Italy	Late Pliocene	MN16a	Angelone & Rook 2012	–
	Case Inferno	Italy	Pleistocene	–	Angelone & Rook 2012	–
P. cf. *sorbinii*	Borro Strolla	Italy	Mio-Pliocene boundary	–	Angelone & Rook 2012	–
	Maramena	Greece	Mio-Pliocene boundary	MN13/14	Angelone 2007: fig. 4f-h	Figure originally from De Bruijn 1995
	Velona	Italy	Late Miocene (Messinian)	–	Angelone 2007; Angelone & Rook 2012	–
P. italicus	Montagnola Senese	Italy	Pliocene	MN17	Angelone 2008b	–
	Torre di Picchio	Italy	Plio-Pleistocene	? MN17	Angelone 2008b	–
P. latiuncinatus	Polgárdi 2	Hungary	Late Miocene	MN13	Angelone & Cermák 2015	–
P. bilobus	Gundersheim	Germany	Pliocene	MN15	Cermák & Angelone 2013	–

Appendix 5. — List of populations of *Prolagus* Pomel, 1853 directly observed by the authors, for the populational morphologic comparison. See Benammi 1997 for complementary information about these specimens.

Species	Locality	Country	Epoch	MN Zones
P. michauxi	Afoud 2	Morocco	Late Miocene (Messinian)	MN13
	Afoud 8	Morocco	Pliocene	MN13
P. cf. *michauxi*	Aghouri	Morocco	Pliocene	–