

Kislangia gusii sp. nov., a new arvicolid (Rodentia) from the Late Pliocene of Spain

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This paper presents an analysis of the *Kislangia*-material from the localities of Almenara 1 (= Casablanca 1) and Galera 2 (Guadix-Baza Basin). This revision led to the recognition of a new species, *Kislangia gusii*, distinguished from the Central European *K. rex*, to which most of the Spanish populations were referred until now. Two different lineages of *Kislangia* existed during the late Villanyian in Europe, one leading to *K. gusii* and the other one leading to *K. rex*. *K. gusii* is compared with other samples, from French and Spanish localities.

Key words: Arvicolidae, Pliocene, Spain.

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Introduction

Among the various species originally described within the genus *Mimomys*, those ascribed to *Kislangia* belong to the best delimited lineages. The derived character allowing the recognition of this taxon is a typical broadening of the lingual triangles in the lower teeth.

The type-species of the genus is *Kislangia ondatrina* Kretzoi, 1954 from Kislang (Hungary). This species was later synonymized with *Mimomys rex* Kormos,

1934 from the late Villanyian of Villany 3 (Hungary). Other species assigned to *Kislangia* are: *K. cappelletti* (Michaux, 1971), *K. regulus* Rabeder, 1981, *K. praerex* Rabeder, 1981, *K. ischus* (Esteban & Martínez-Salanova, 1987), and *K. clairi* (Chaline, 1984).

Several Spanish populations from Upper Pliocene sites have also been referred to *Kislangia*, either as *Kislangia rex* or as *Kislangia* aff. *rex*: Valdeganga 3-4 (Mein et al., 1978), Galera 2 (Martín Suárez, 1988) and Almenara 1 (= Casablanca 1; Agustí & Galobart, 1986; Esteban Aenlle & López Martínez, 1987).

The site of Galera 2 (Guadix-Baza Basin, southern Spain) is located at the upper part of a palustrine gypsiferous sequence, ranging in age from Middle Pliocene (late Alfambrian) to Late Pliocene (late Villanyian, Agustí, 1986). This locality has yielded a diversified micromammal association, including *Kislangia gusii* sp. nov., *Mimomys medasensis*, *Stephanomys* cf. *thaleri*, *Apodemus dominans*, *Castillomys crusafonti*, *Eliomys intermedius*, *Galemys kormosi*, *Sorex prearaneus*, and *Crociodura kornfeldi*.

On the other hand, the Almenara (= Casablanca) karstic complex, in the Castellón province (E. Spain), is composed of more than five fossiliferous fissure-fillings, ranging from Late Miocene to Early Pleistocene (late Biharian; Agustí & Galobart, 1986). However, most of the fissure-fillings are dated as late Villanyian (Agustí & Galobart, op.cit.; Esteban Aenlle & López Martínez, 1987). The most characteristic locality of this age is Almenara 1 (= Casablanca 1). This is the only site in the complex, that shows a stratified sequence. The different levels within this sequence are rather similar. They contain more than 20 species: *Kislangia gusii* sp. nov., *Mimomys medasensis*, *M. tornensis*, *Stephanomys progressus*, *Castillomys crusafonti*, *Apodemus* aff. *mystacinus*, *Eliomys quercinus* ssp., Sciurinae indet., *Lynx* sp., *Felis* sp., *Vulpes alopecoides*, *Canis etruscus*, *Ursus etruscus*, *Pachycrocuta brevirostris*, *Equus stenonis stenonis*, *Gazellospira torticornis*, *Procamtoceras brivatense* (?), *Ovibovini* indet., *Dama nesti*, *Eucladoceros* sp., *Leptobos* sp., and abundant remains of amphibians, reptiles and birds.

Among the micromammal association, the big *Kislangia* from Galera 2 and Almenara 1, usually referred to as *K. rex*, shows in fact different ontogenetic dental trajectories as compared with the Central-European populations. Therefore, we propose its assignment to a new species, named *Kislangia gusii* sp. nov.

Acknowledgements

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Systematics

Family ARVICOLIDAE Gray, 1821

Genus *Kislangia* Kretzoi, 1954

Kislangia gusii sp. nov.
Pls 1-2, Fig. 8

Derivatio nominis — The species is dedicated to Francesc Gusi, Director of the Archaeological Survey of Castellón.

Type-locality — Almenara 1 (= Casablanca 1).

Holotype — An M_1 , IPS-ACB-1-NI-05, from level N-I of Almenara 1, and stored in the collections of the Institut de Paleontologia “Miquel Crusafont” (Sabadell, Spain).

Other localities with K. gusii — Galera 2 (Guadix-Baza Basin).

Diagnosis — Large *Kislangia* with persisting *Mimomys*-ridge in the M_1 , even in very advanced stages of abrasion.

Measurements — See Table 1.

Differential diagnosis — See ‘Comparison with other species’.

Dental terminology — See Figs. 1-2.

Description of the material from the type locality

M_1 — As in the M_1 of *Mimomys* species, this element is formed by a posterior lobe (PL), three alternating triangles (T1-T3) and an anteroconid complex (ACC). The alternating triangles display the characteristic broadening observed in *Kislangia*. The lingual re-entrant angles are deeper and present a more transversal position than the

Table 1. Length, width and hyposinulid height of the M_1 of four populations of *Kislangia*, measured as indicated in Fig. 3 (in mm).

	Balaruc 2	Zújar 11	Galera 2	Almenara 1
L				
N	26	15	14	12
min.	3.28	3.43	3.69	3.96
mean	3.68	3.97	3.99	4.25
max.	4.03	4.35	4.36	4.71
W				
N	27	15	14	12
min.	1.30	1.45	1.58	1.68
mean	1.53	1.73	1.81	1.90
max.	1.71	1.95	2.02	2.16
Hpsld				
N	27	10	7	7
min.	0.20	0.99	3.34	3.26
mean	0.45	1.31	3.73	3.83
max.	0.98	1.66	4.13	4.27

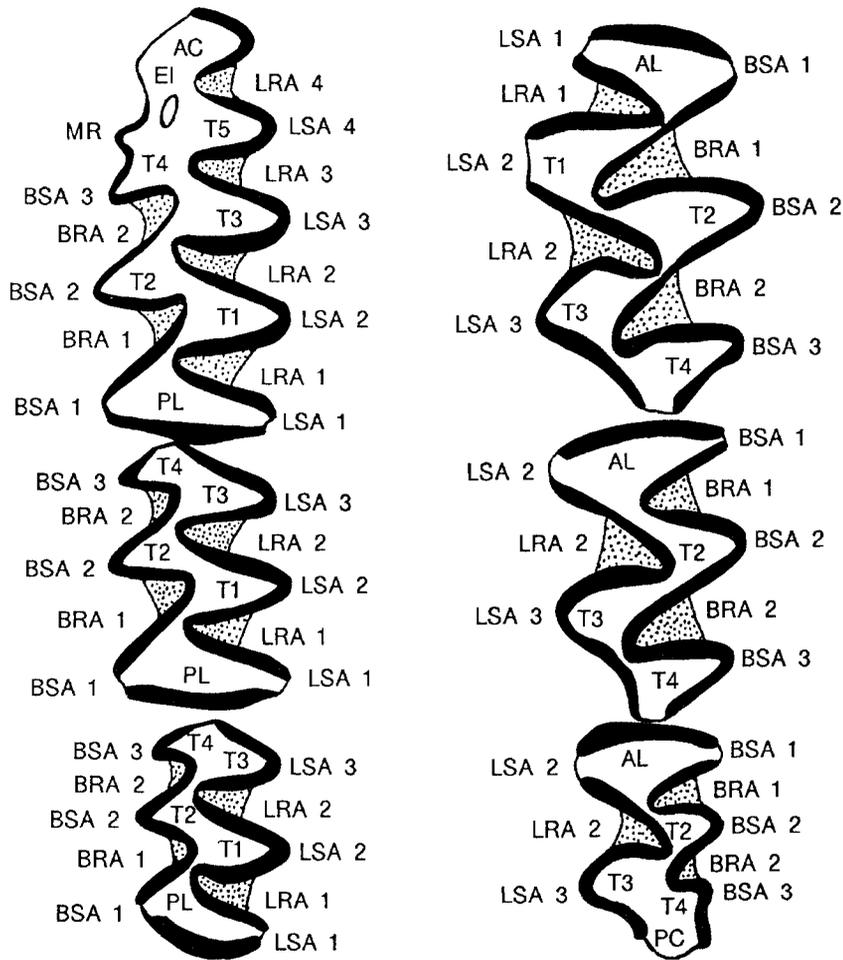


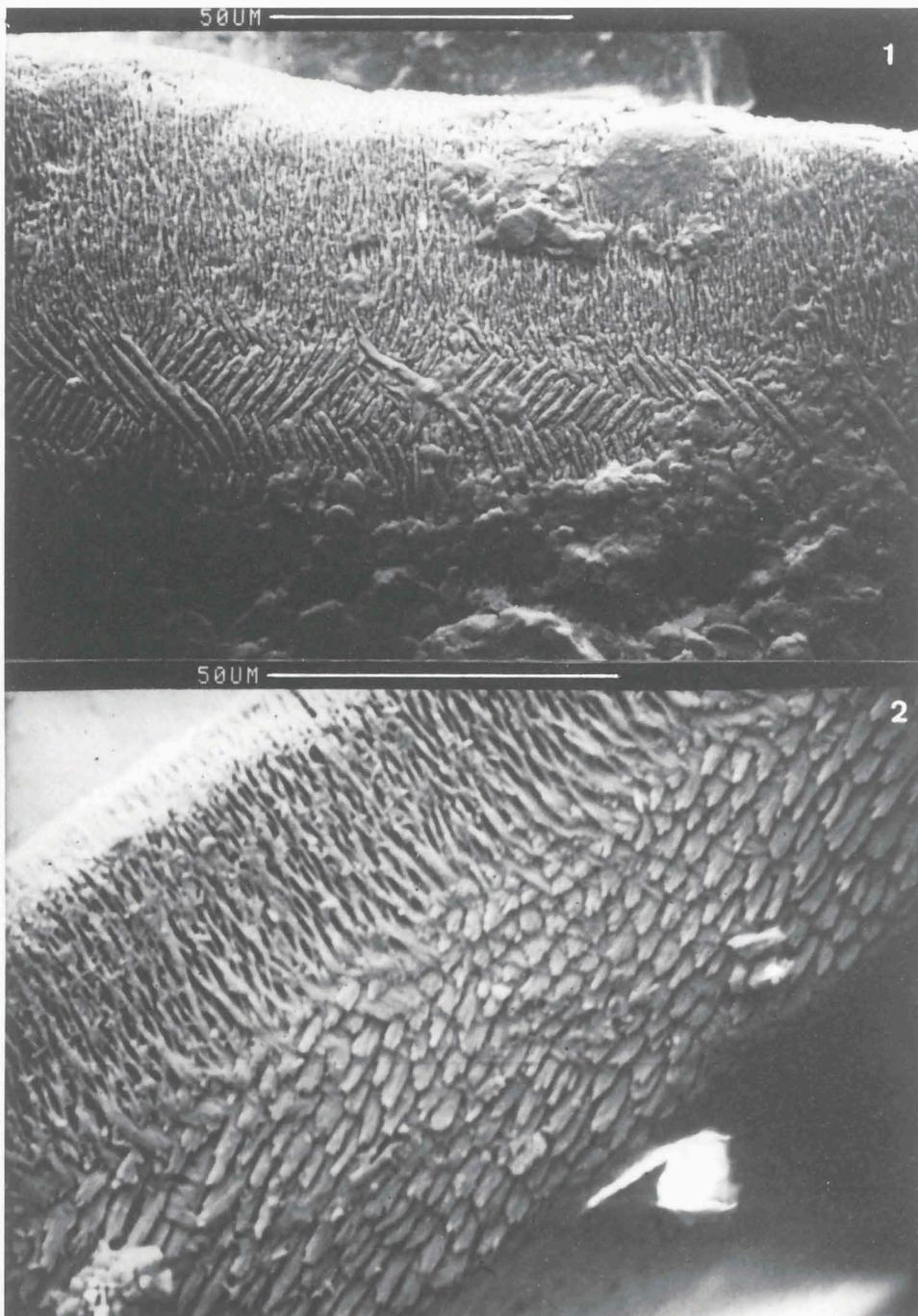
Fig. 1. Terminology used in the description of the molars of *Kislangia*. Left, lower molars; right, upper molars. AC: anterior cap; ACC: anteroconid complex; AL: anterior lobe; BRA: buccal re-entrant angle; BSA: buccal salient angle; EI: enamel islet; LRA: lingual re-entrant angle; LSA: lingual salient angle; MR: Mimomys-ridge; PC: posterior cap; PL: posterior lobe; T: enamel triangles (after van der Meulen, 1973).

Plate 1

Enamel pattern of *Kislangia gusii* sp. nov. from Almenara 1.

Fig. 1. Leading edge. Above, radial enamel; below, lamellar enamel.

Fig. 2. Trailing edge. Above, radial enamel; below, tangential enamel.



labial ones; the labial re-entrant angles are oriented forwards. T1 and T2 are isolated, while a weak connection can be observed between T2 and T3. With respect to the anteroconid complex, the *Mimomys*-ridge persists even in senile specimens, after the disappearance by wear of the enamel islet. The LSA4 is very deep. The T5 is well developed and in highly worn specimens shows a morphology typical for *Kislangia*: the anterior and posterior walls of this triangle are parallel and at their lingual end form a semicircle, instead of the characteristic angle of other *Mimomys* species. This peculiar morphology is repeated in the anteroconid cap (AC 2), which displays a rounded lingual wall, not showing the incipient LSA5 found in other species from Almenara 1 (*Mimomys medasensis*). Anterosinuid, hyposinuid and hyposinulid are very high, tangential to the wear surface. This implies that the enamel interruptions appear in very early stages. The mimosinuid is less developed. The cement in the re-entrant angles is very abundant.

M_2 — Formed by a posterior lobe and four alternating triangles. T1 and T2 are connected. On the other hand, T2 and T3 appear isolated in most of the cases. The T4 is reduced to a small triangular lobe, broadly communicating with the T3. The enamel is interrupted anteriorly. The sinuous line shows three low enamel-free sinuids: anterosinuid, hyposinulid and hyposinuid.

M_3 — This tooth shows a morphology very similar to that of the M_2 , with a posterior lobe and three alternating triangles. However, the triangles are more straight than in the M_2 . The smallest width of the tooth is found at the level of the posterior lobe. As in the M_2 , a broad communication exists between T3 and T4. T1 and T2 are also communicated, while T2 and T3 appear isolated.

M^1 — Formed by an anterior lobe (= anterocone) and four alternating triangles. All triangles appear isolated, although a small communication can be observed between T1 and T2 and, at a lesser degree, between T3 and T4. The labial triangles are broader than the lingual ones. The largest width is found between T1 and T2. The T4 displays the largest chewing surface. Protosinus and anterosinus are highly developed, the enamel band being interrupted in the anterior lobe and in the T1 at very early stages. Labially, the anterosinulus and the distosinus are also highly developed.

M^2 — Formed by an anterior lobe, T2, T3, and T4. In a general way, this element follows the morphology of the M^1 , but the triangles remain connected in highly worn specimens. Labial and lingual triangles show similar-sized surfaces. There is a highly developed distosinus. The other sinuses are less developed than in M^1 .

M^3 — Formed by an anterior lobe, three alternating triangles (T2, T3, T4) and a

Plate 2

M_1 of *Kislangia gusii* sp. nov. from Almenara 1 (ACB-1) and Galera 2 (Ga-2).

Fig. 1. ACB-1-43.

Fig. 2. ACB-1-44.

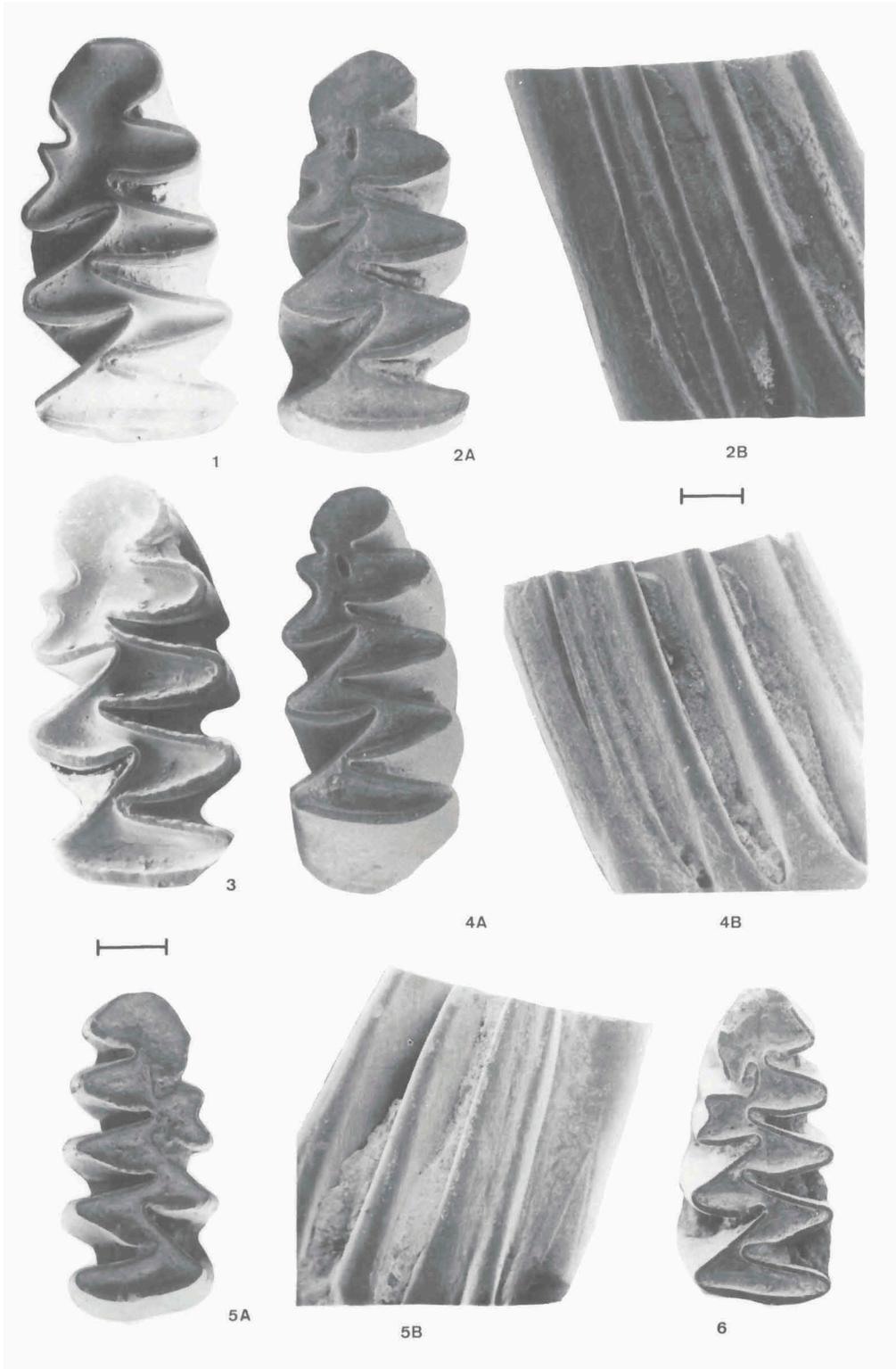
Fig. 3. ACB-1-45.

Fig. 4. Ga-2-01.

M_1 of *Kislangia cappettai* from Balaruc 2 (BAL-2).

Fig. 5. BAL-2-07.

Fig. 6. BAL-2-08; A: occlusal view; B: labial view.



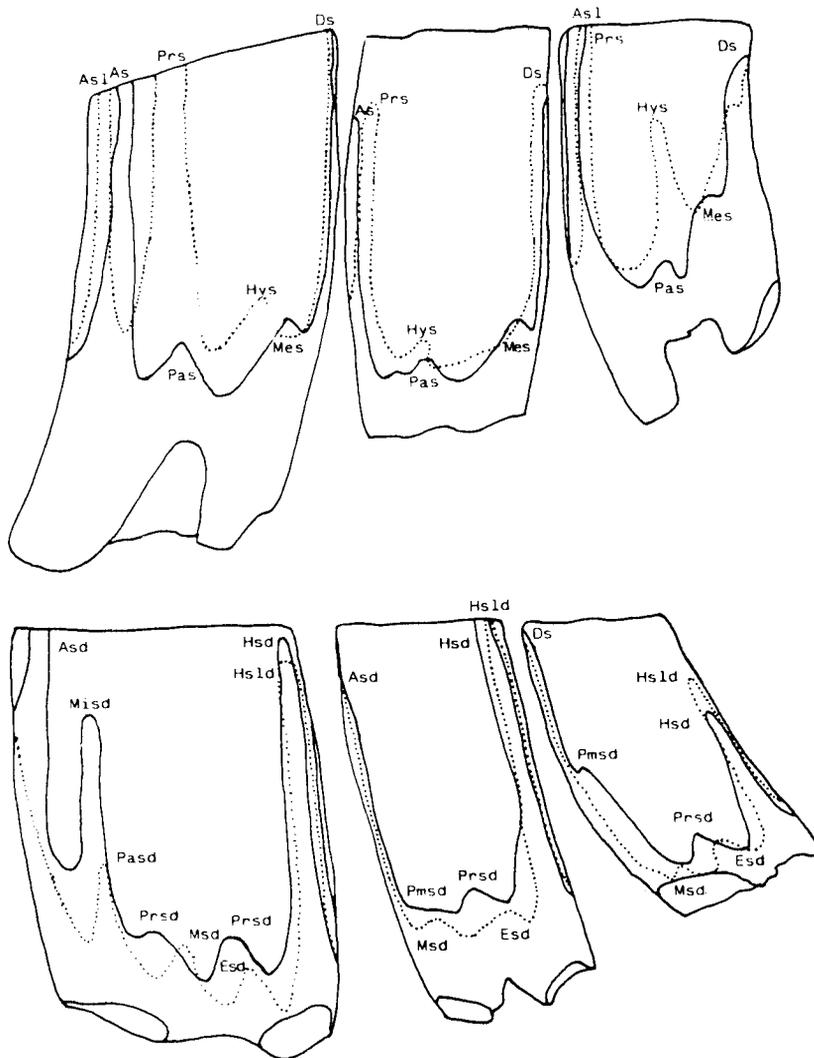


Fig. 2. Terminology of the linea sinuosa. Below, lower molars; above, upper molars. As: anterosinus; Asl: anterosinulus; Ds: distosinus; Hys: hyposinus; Mes: metasinus; Pas: parasinus; Prs: protosinus; Ad: anterosinuid; Esd: entosinuid; Hsd: hyposinuid; Hsld: hyposinulid; Misd: mimosinuid; Msd: metasinuid; Pasd: parasinuid; Pmsd: prismosinuid; Prsd: protosinuid (after Rabeder, 1981).

posterior cap. The anterior lobe and the T2 communicate. A narrower communication can be observed between T2 and T3. The posterior cap is rounded, with well-developed LRA-3 and BRA-3 filled with cement. The enamel islet is present, very narrow and with a subrectangular shape. It starts in the communication field between T2 and T3 and ends close to the wall of the BRA-3, almost closing the T3. This enamel islet persists even in highly worn specimens. In all cases, protosinus, hyposinus and distosinus are highly developed.

DISCUSSION ON *K. GUSII*

Kislangia gusii from Galera 2 presents the same general features as the material from Almenara 1; some minor differences between the two samples can be observed. Thus, in contrast with the M_1 of the type-population, T1 and T2 are broadly connected. Moreover, T2-T3 and T3-T4 show a weak connection in most of the cases. There is also some variation in the shape and position of the enamel islet. In Almenara 1 the oval enamel islet is longitudinal between the LRA-4 and the anterior side of the BSA-3, the Mimomys-ridge being placed backwards. On the other hand, in Galera 2, the enamel islet is placed in a more posterior position, between the T5 and the Mimomys-ridge, directed towards the anterior part of the BSA-3. In some specimens from Galera 2 the enamel islet is fused with the BSA-3, the latter becoming a very straight angle directed backwards. This morphotype is not found in the population from Almenara 1. With respect to the M^3 , the posterior cap in Galera 2 shows a less-developed LRA-3 and BRA-3, and a more prominent LRA-4. The enamel islet of this tooth is placed in a more transversal position with respect to the border of the tooth than in Almenara 1. In one case, it is lingually open, thus delimiting a very deep LRA-3.

ENAMEL STRUCTURE

As in other species of *Mimomys*, *Kislangia gusii* displays an evolved enamel structure, with three kinds of enamel bands: radial, tangential and lamellar. Tangential enamel is well developed on the external side of the trailing edge of the triangles, while the internal side is occupied by radial enamel. The leading edge of the triangles is composed of an external band with radial enamel and an internal one with lamellar enamel. The latter band is well developed and reaches the labial end of the lingual triangles and the lingual end of the labial triangles. This enamel structure is more evolved than the one observed in *Kislangia cappettai* from Balaruc 2 (with less-developed lamellar enamel). It is comparable to that of Late Pliocene *Mimomys* species like *M. polonicus* (see von Koenigswald & Martin, 1984).

Comparison with other species

Unfortunately, most of the described species of *Kislangia* are based on very scarce, badly preserved material. *K. regulus* Rabeder, 1981 and *K. praerex* Rabeder, 1981 were based on a few fragmentary teeth from the fissure-fillings of Stranzendorf D and G. *Mimomys clairi* Chaline, 1984 is based on five fragmentary M_1 and some other teeth. In the case of *K. ischus* (Esteban & Martínez-Salanova, 1987) the material from the type-locality includes three M_1 and eleven other teeth. In Spain, *K. ischus* is also present in the section of Zújar (level of Zújar 11), in the Guadix-Baza Basin. We have used this sample for comparison with the species from Almenara 1 and Galera 2. So, *K. gusii* sp. nov. has been compared with populations of *K. cappettai* (Michaux, 1971) from Balaruc 2 and Moreda 1B, and with *K. ischus* from Zújar 11. An indirect comparison has been made with *K. praerex*, *K. regulus* and *K. clairi*. The analysis has been based on the general dimensions (Figs. 3-4), hypsodonty (Figs. 5-6) and ontogenetic trajectory of the

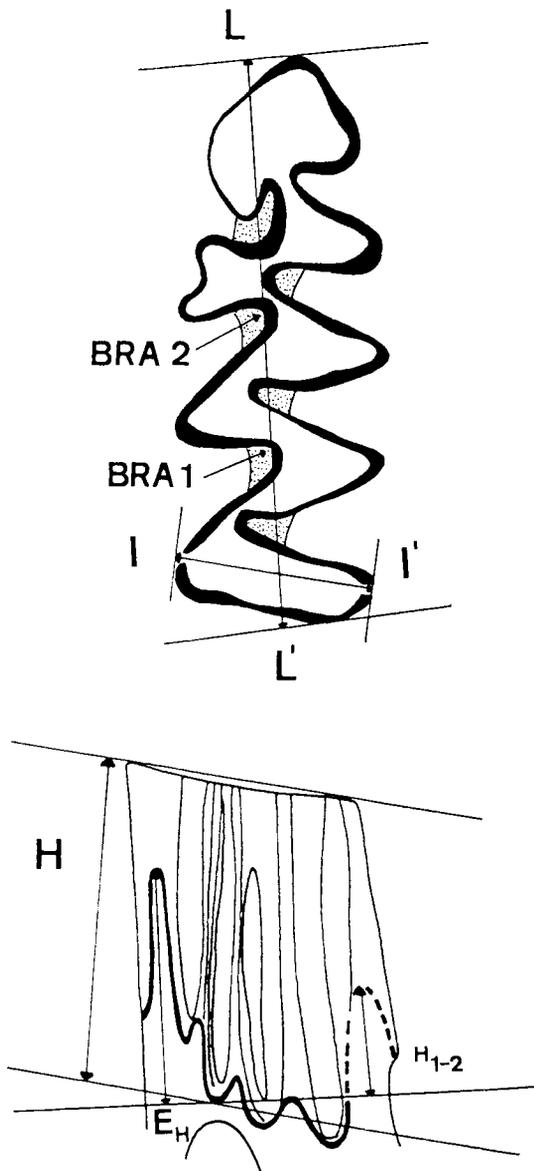


Fig. 3. Occlusal surface and lateral view of a left M_1 of *Kislangia* illustrating the parameters measured in this paper. L-L': length; I-I': width; H: height of the crown; H 2: height of the hyposinulid.

M_1 (Fig. 7). The definition of length and width is given in Fig. 3. The length is measured in a similar way as proposed by van der Meulen (1973) and Rabeder (1981), except for the fact that the length is taken as the line defined by the lingual extremes of the BRA-1 and BRA-2. The width has been measured as defined by Rabeder (1981). Taking into

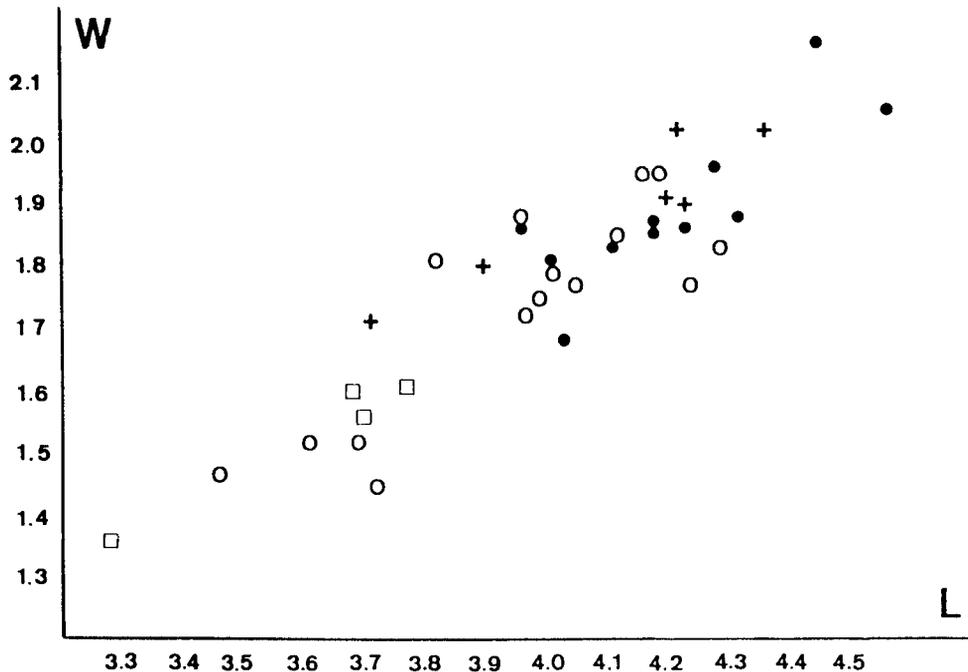


Fig. 4. Length-Width scatter diagram for the M_1 of four populations of *Kislangia*: *K. cappettai* from Balaruc 2 (squares), *K. ischus* from Zújar 11 (circles), *K. gusii* from Galera 2 (crosses), and *K. gusii* from Almenara 2 (dots).

account the high degree of hypsodonty of *K. gusii*, this character has been measured on the hypsinulid (H2, see Fig. 3). Finally, several ontogenetic stages have been defined for the M_1 , based on the closure of the roots and the closure and posterior wear of the enamel-islet. The following stages have been defined for these features:

Roots: R1: Open crown. R2: Beginning of the closure of the base of the crown, roots still absent. R3: Closure of the crown by the development of roots.

Enamel-islet: P1: Open enamel-islet, directly communicating with the BRA-3. P2: Closed enamel-islet. P3: Enamel-islet absent through wear.

The combination of these two characters enables us to establish five ontogenetic stages in the development of M_1 : P1R1-P1R2-P2R2-P2R3-P3R3 (Figs. 6-7).

Kislangia cappettai (Michaux, 1971) — *K. gusii* is clearly larger and more hypsodont than *K. cappettai* (Figs. 4-5). The ontogenetic trajectory is also less progressive: the primitive morphotype P1R1 is retained in relatively worn specimens (at 1.2 mm crown height, see Fig. 7).

Kislangia ischus (Esteban & Martínez-Salanova, 1987) — *K. gusii* is somewhat larger than *K. ischus*. But the most obvious difference between the two species is the considerably greater hypsodonty of the former species, with respect to the latter one. The ontogenetic trajectory of *K. gusii* is also more progressive than that of *K. ischus*: although there is not a great difference in the aged specimens, the younger individuals retain the primitive condition P1R2.

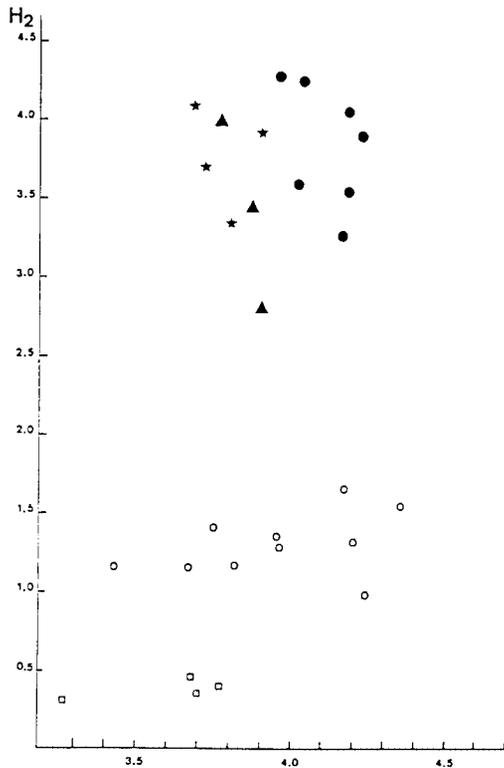


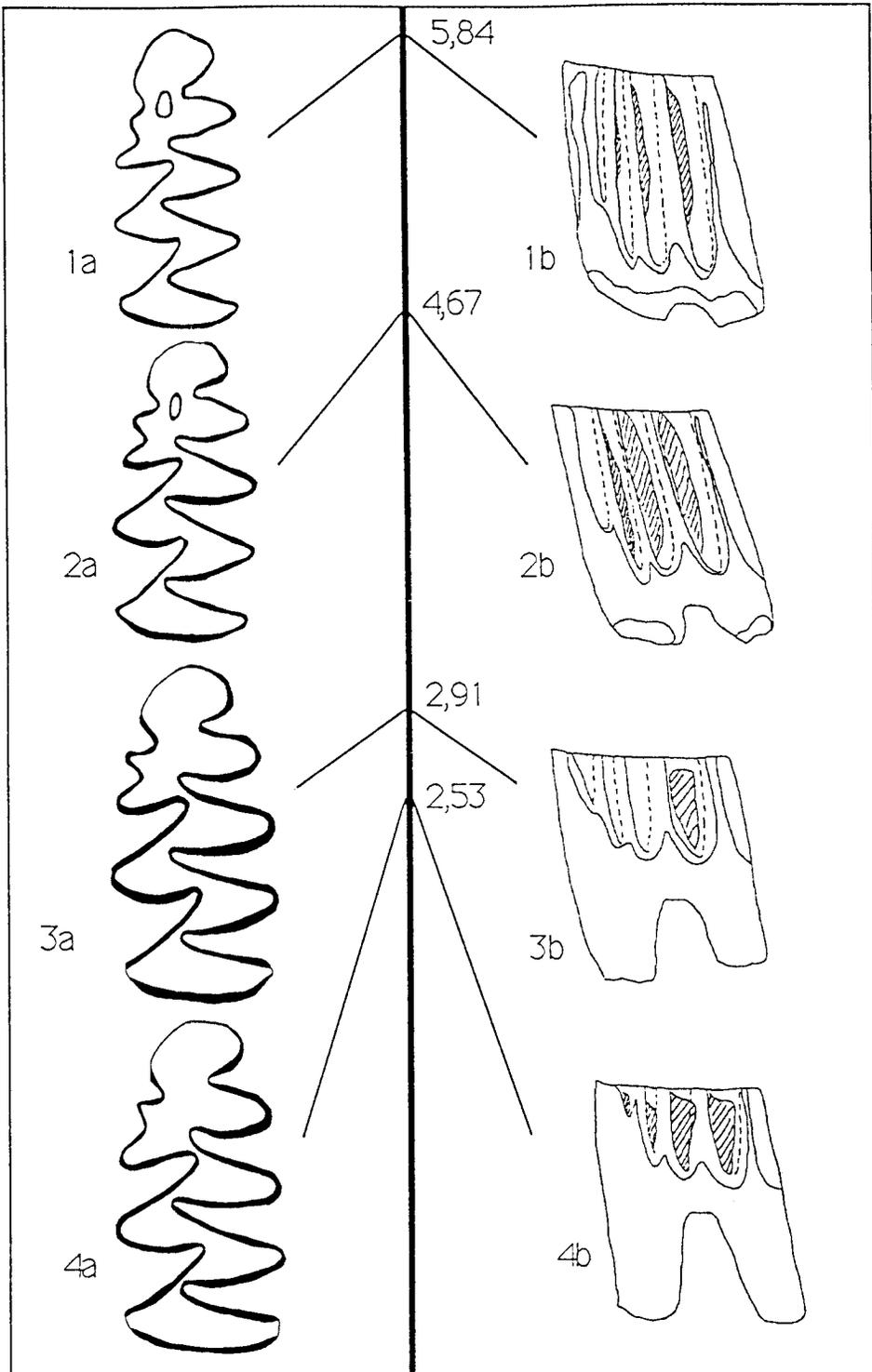
Fig. 5. Relation between the length and the height of the crown (hypsodonty, measured as the height of the hyposinulid) in five populations of *Kislangia*: *K. cappettai* from Balaruc 2 (squares), *K. ischus* from Zújar 11 (circles), *K. gusii* from Galera 2 (asterisks), *K. gusii* from Zújar 14 (triangles), and *K. gusii* from Casablanca 2 (dots).

Kislangia rex (Kormos, 1934) — *K. rex* is similar in size to *K. gusii*. This is why the latter has often been referred to as *K. aff. rex*. Nevertheless, the study of the type-material from Villany 3 shows a basic difference in the structure of M_1 : the Mimomys-ridge is still present in the populations from Almenara 1 and Galera 2, even in highly worn specimens, in which the enamel-islet is already absent. On the other hand, in *K. rex* from Villany, the enamel-islet is still present in specimens, in which the Mimomys-ridge is absent or has disappeared. This basically different pattern of development of the M_1 indicates that at least these two populations (Iberian and Central-European) are specifically different.

Kislangia regulus and *K. praerex* Rabeder, 1981 — Unfortunately, as indicated above, these two species have been defined on the basis of poorly preserved, scarce material. Nevertheless, after the descriptions and figures by Rabeder (1981), both species seem less evolved than *K. gusii*: more primitive *linea sinuosa*, lower hypsodonty and smaller dimensions. In fact, it is a matter of discussion whether or not these species belong to the *Kislangia* lineage.

Kislangia clairi Chaline, 1984 — The type material of this species is also very scarce. Although Chaline (1984) does not give any measurements of the specimens, he refers to this species as a medium-sized form, therefore smaller than *K. gusii*. But the most differentiating feature, as in *K. rex*, is the pattern of tooth development. As shown by the figures in this paper, the latest stages in the M_1 are characterized by the loss of the

Fig. 6. Wear sequence of the M_1 in *Kislangia gusii* from Almenara 1.



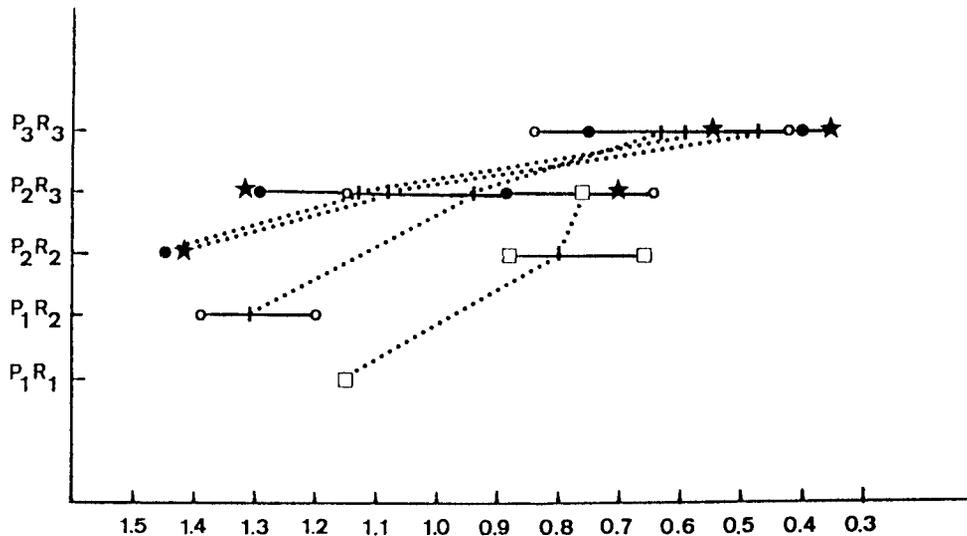


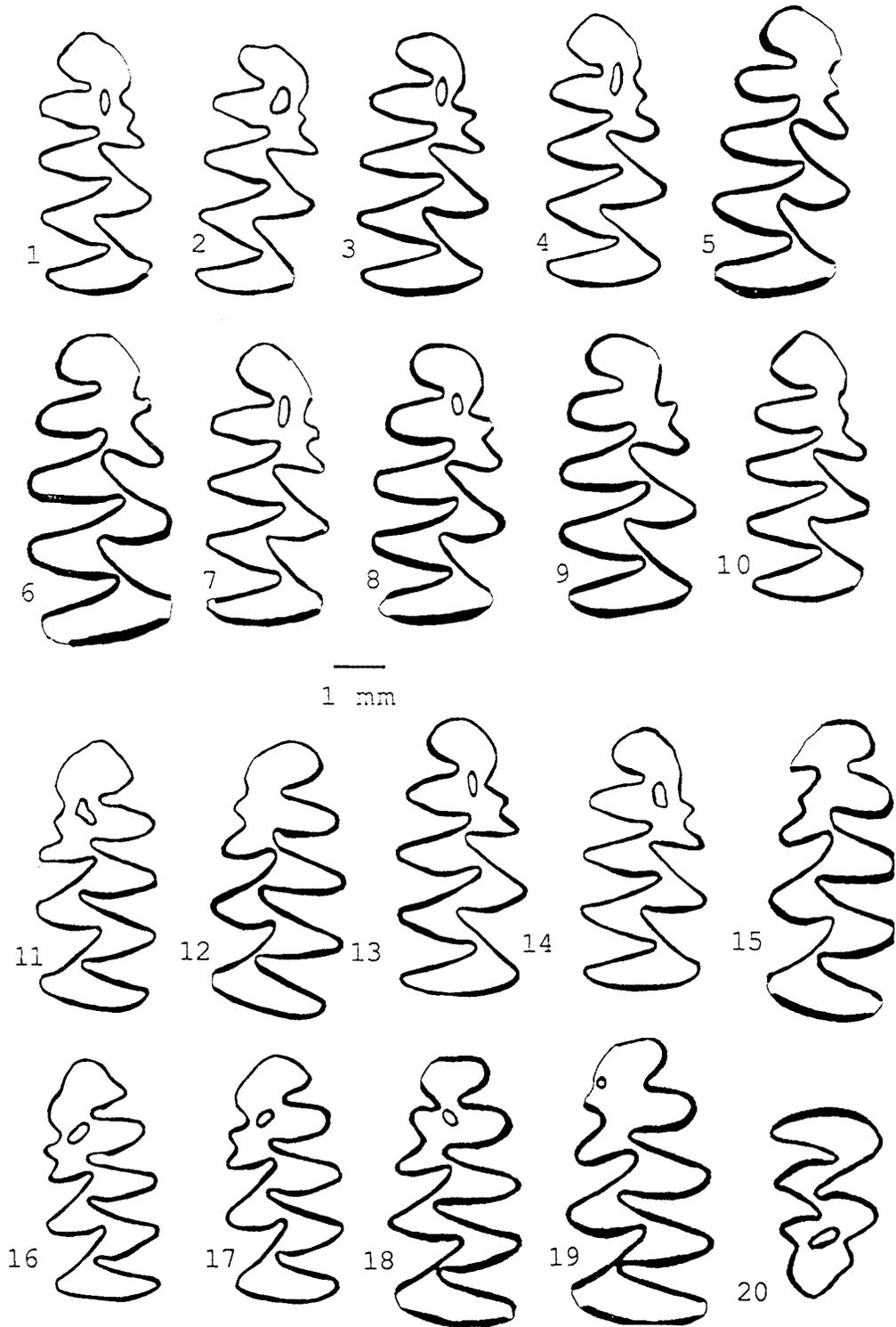
Fig. 7. Ontogenetic trajectories of the first M_1 in four populations of *Kislangia*: *K. cappettai* from Balaruc 2 (squares), *K. ischus* from Zújar 11 (circles), *K. gusii* from Galera 2 (asterisks), and *K. gusii* from Almenara 1 (dots). Each ontogenetic trajectory is represented as a function of size and shape. In this case, the relative age is not represented by size, but by the height of the crown (= degree of abrasion). The mean value, as well as the limits of variability, are represented for each stage. Mean values for each stage are connected by dotted lines.

Mimomys-ridge. In fact, in *K. clairi*, this character gets lost almost simultaneously with the enamel islet, while *K. gusii* retains the Mimomys-ridge even in the most-worn specimens.

Conclusions

The data obtained from the populations from Almenara 1 and Galera 2 strongly support the idea that the evolution of *Kislangia* has not been as simple as initially thought (a succession of ancestor-descendant populations ranging from Central Europe to Southern Spain). The existence of *K. gusii* indicates that at least two different groups of *Kislangia* were differentiated in Europe in the late Villanyian. A first group of species including *K. ischus* and *K. gusii* has an almost exclusively Iberian distribution. The evolution of this lineage is characterized by two different phases. In a first step, during the early Villanyian (from Balaruc 2 to Zújar 11), there is a clear increase in size. In a second phase, during the late Villanyian (from Zújar 11 to

Fig. 8. *Kislangia gusii* sp. nov. from Almenara 1 (ACB-1) and Galera 2 (Ga-2) and *K. cappettai* from Balaruc 2 (BAL-2). 1-19: M_1 ; 20: M^3 . 1: ACB-1-06; 2: ACB-1-07; 3: ACB-1-39; 4: ACB-1-10; 5: ACB-1-12; 6: ACB-1-14; 7: ACB-1-15; 8: ACB-1-35; 9: ACB-1-38; 10: ACB-1-41; 11: ACB-1-11; 12: ACB-1-09; 13: ACB-1-36; 14: ACB-1-08; 15: ACB-1-13; 16: BAL-2-02; 17: BAL-2-03; 18: Ga-2-49; 19: Ga-2-50; 20: Ga-2-51 (M^3). Crown cementum not drawn.



Galera 2 and Almenara 1), there is a slight increase in size associated with a much greater hypsodonty. The last populations of *Kislangia gusii* are characterized by very large size and hypsodonty, but the M_1 still retain the *Miomys*-ridge even in the most-worn specimens. On the other hand, a second lineage of *Kislangia* presents a more gradual evolution, with a progressive increase in size and hypsodonty (*K. cappettai* - *K. clairi*, perhaps including *K. praecursor* and *K. praerex*). The last evolutionary stages in this lineage are characterized by the loss in the adults of all *miomysian* characters, including the *Miomys*-ridge (*K. rex*).

The analysis of the ontogenetic trajectories in the M_1 of the *Kislangia cappettai* - *K. gusii* lineage shows, that during most of its evolution the features of the adult ancestor tend to appear as juvenile features in the descendant populations. This seems particularly clear in the transition from *K. cappettai* to *K. ischus* and, to a lesser degree, in the transition from *K. ischus* to *K. gusii*. In the first case, we are clearly dealing with an acceleration process. In the second case, the same kind of heterochrony is combined with the opposite effect in later phases. Such a combination of heterochronic processes has also been observed in the *Miomys occitanus* - *M. savini* lineage (Chaline & Sevilla, 1990).

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