

**NEOGENE—QUATERNARY BOUNDARY IN THE CONTINENTAL  
SEDIMENTS OF THE GAUDIX-BAZA BASIN (SOUTHEASTERN SPAIN)**

by

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*Introduction.* The Guadix-Baza depression is an intramountainous basin situated in the Betic mountain range to the northeast of the province of Granada. The work under way in this basin permits the establishment of a continuous sequence from the Upper Miocene (Upper Turolian, MN13) to the Middle Pleistocene. The materials in this depression were studied by VERA (1970), who distinguished (disconformably over a basal deformed unit of Miocene age) three large formations with lateral changes:

A) *Guadix Formation.* This is formed of detritic materials belonging to a braided river system and fine meandering river deposits. They cover almost all the Western section and the margins of the Eastern section. The presence of *Hipparrion gromovae granatensis* near Abla (CUEVAS et al., 1984) indicates an Upper Miocene age (Upper Turolian, MN13) for the bottom of the formation.

B) *Gorafe Huélago Formation.* This is formed of chemical deposits (micritic limestone, marls, dolomites and gypsies) with lignitic intercalations, which are a lateral extension towards the centre of the basin of the fluvial deposits of the Guadix formation.

C) *Baza Formation.* This is richest formation in number of localities, especially within the Orce-Galera-Huéscar sector. In the centre of the formation, the dominant limestones and lutites change to gypsies. Three members can be differentiated in this formation. The lowermost, mainly composed of limestone with intercalations of lignitic clays, has suffered some deformation.

The Middle member (Red detrital member) lies unconformably on the above mentioned one. Its materials were deposited in an alluvial plain with a slightly stabilized fluvial system. Finally, the levels of the Upper member lie conformably on the above mentioned one. They are composed of locally evaporitic, yellowish-white lacustrine beds deposited in the context of a very shallow lake which received some detrital contributions from time to time from the adjoining fluvial systems.

***Trilophomys cf. castroi* zone**

In the Guadix-Baza basin, the Lower Pliocene is characterized by micromammal assemblages where the dominant elements are the Muridae. In the Gorafe-Huélagos formation the most characteristic locality belonging to this zone is Gorafe-4, which presents the following association: *Ruscinomys* sp., *Cricetus* cf. *barrierei*, *Trilophomys* cf. *castroi*, *Protatera* sp., *Stephanomys* cf. *margaritae*, *Paraethomys* *meini*, *Castillomys crusafonti*, *Apodemus dominans*, *Eliomys intermedius*, *Prolagus michauxi*, *Leporidae* indet., *Suinae* indet., *Gazella borbonica*.

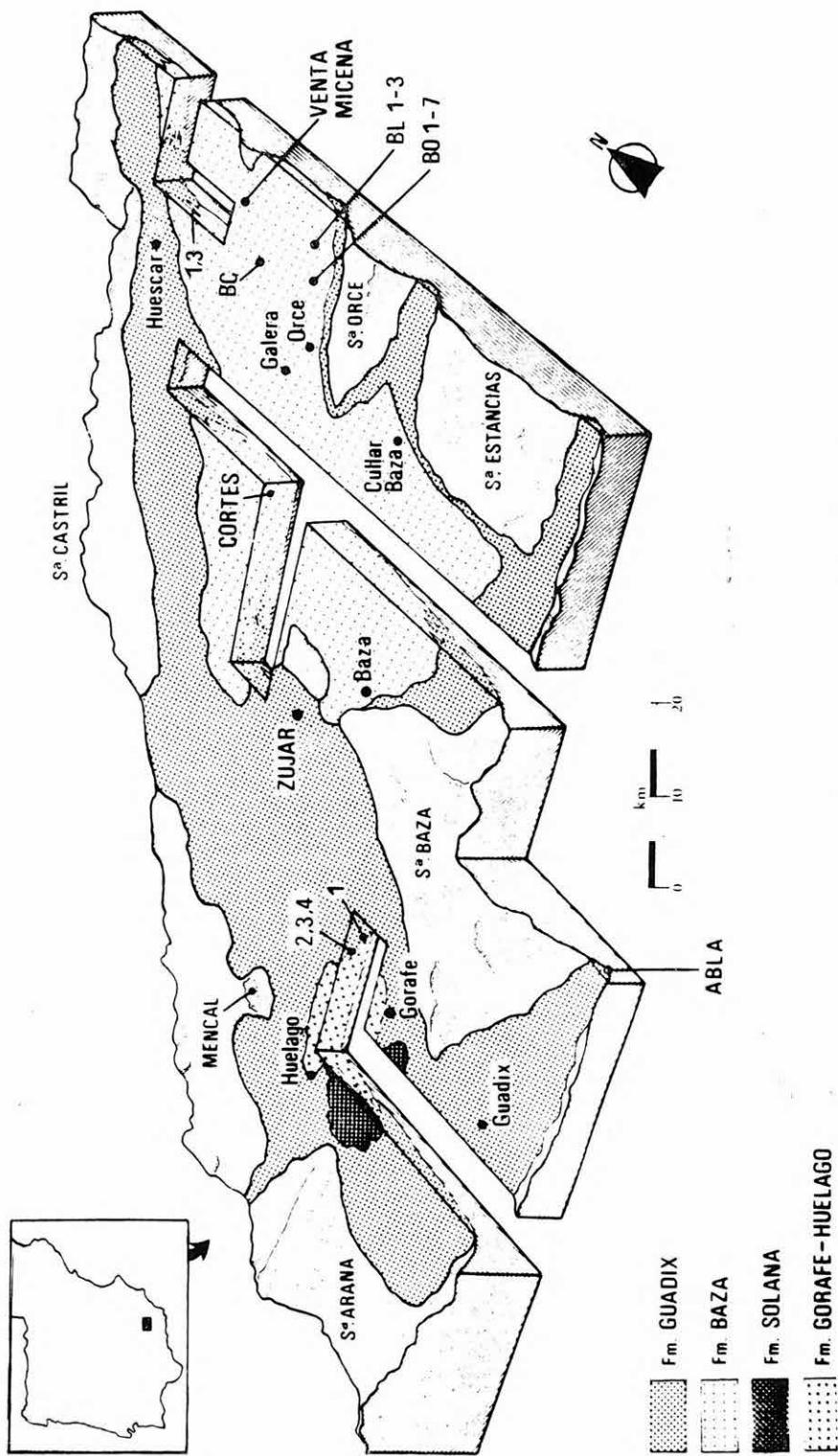


Fig. 1. Formations and paleontological sites of the Guadix-Baza basin (SE of Spain)

Some notable features of this fauna are:

- As stayed above, the Murids are the dominant element of the association, both from a quantitative and qualitative point of view.
- Among the Cricetids, two species (*Ruscinomys* sp. and *Cricetus* cf. *barrierei*) are of clear European origin, while *Trilophomys* cf. *castroi* is probably of Asiatic origin.
- A member of the Gerbillidae family is present in the association (*Protatera* sp.).
- No truly arvicolid species has been found in Gorafe-4.

*Protatera* sp. is present in other localities in the Guadix-Baza basin (Gorafe-1 in the Gorafe-Huélagos formation; Botardo-C in the Baza formation). In Spain, this form appears at the top of the Turolian (MN13) and persists until the base of the Ruscinian. *Protatera* sp. is probably of African origin but an eastern one cannot be excluded.

Besides Gorafe-1, -3 and -4, in the Gorafe-Huélagos formation, the localities of the Botardo section (Botardo B, C, 2 and 3, in the Baza formation) also belong to the *Trilophomys* cf. *castroi* zone. This zone may be correlated with the MN14.

#### *Mimomys occitanus* zone

The main difference between the levels of Gorafe-1, 3-4 and Botardo those belonging to this biozone is the appearance in the basin of the first true arvicolid, *Mimomys occitanus*. In the Gorafe-Huélagos formation, this species is documented in the localities of Gorafe-2 and Gorafe-5. The latter has yielded the following microfauna:

*Ruscinomys* sp., "Cricetus" cf. *angustidens*, *Mimomys occitanus*, *Apodemus dominans*, *Occitanomys* sp., *Stephanomys* cf. *thaleri*, *Castillomys crusafonti crusafonti*, *Paraethomys meini*, *Eliomys intermedius*.

The absence of *Protatera* and *Trilophomys* should be noted. Nevertheless, the remainder of the microfauna strongly resembles that of the previous biozone (e.g. Gorafe-4).

In the Baza formation, a number of localities are also referable to this zone: Galera-1, Cañada del Castaño-1, Huéscar-1. This the microfauna from Huéscar-1 shows the following composition: *Mimomys occitanus*, *Apodemus dominans*, *Castillomys crusafonti crusafonti*, *Stephanomys* cf. *thaleri*. The level of Cañada del Castaño-1 has yielded somewhat different association with *Apodemus dominans*, *Castillomys crusafonti crusafonti*, *Paraethomys meini*, *Stephanomys* cf. *thaleri* and *Muscardinus pliocaenicus*. The presence of the latter taxon indicates wetter conditions than the previous levels. Curiously, all the localities in the Baza formation lack the cricetid "Cricetus" *angustidens*, an ever present species in the Gorafe section. Whether this absence is significant from a biostratigraphic point of view or is due to environmental factore is something to dilucidate in further fieldwork.

#### *Mimomys cappetai* zone

This zone is characterized by the presence the arvicolid *Mimomys* (*Kislanguia*) *cappetai*. A number of taxa persist from the former zone: *Apodemus dominans*, *Castillomys crusafonti crusafonti*, *Stephanomys* cf. *thaleri* and *Eliomys intermedius*

## Biozones and Mammal associations in the Guadix-Baza basin

Table 1

Mammal stages	Biozones	Localities	Faunal associations
Upper Biharian	A. cantiana	Cúllar de Baza I, II	<i>Arvicola cantiana</i> , <i>Microtus brecciensis</i> , <i>Allocricetus bursee duranciensis</i> , <i>Apodemus aff. sylvaticus</i> , <i>Eliomys quercinus</i>
	P. arvalidens zone	Cúllar de Baza-A, -B, -C	<i>Pitymys cf. arvalidens</i> , <i>Castillomys crusafonti</i> , <i>Eliomys quercinus</i> , <i>Oryctolagus cf. lacosti</i> , <i>Insectivora indet.</i> , <i>Carnivora indet.</i>
Middle Biharian	M. savini zone	Lome Quemada-1 Húescar-2, -3 Puerto Lobo-1, -4	<i>Mimomys savini</i> , <i>Allophaiomys cf. nutiensis</i> , <i>Apodemus aff. sylvaticus</i> , <i>Equus stenonis</i> , <i>Archidiskodon meridionalis</i> , <i>Dicerorhinus etruscus</i> , <i>Hippopotamus incognitus</i> , <i>Cervidae indet.</i>
Lower Biharian	Allophaiomys pliocaenicus zone	Cañada de Murcia-1, -2 Venta Micena-1, -2 Fuentenueva-2 Orce-6, -7 Barranco Leon-1, -2, -3 Fuentenueva-C Orce-4, -5, P Cañada de Balmaez? Camino Yeseras?	<i>Allophaiomys pliocaenicus</i> , <i>Castillomys crusafonti</i> , <i>Apodemus aff. sylvaticus</i> , <i>A. aff. mystacinus</i> , <i>Eliomys intermedius</i> , <i>Hystrix primigenia</i> , <i>Oryctolagus cf. lacosti</i> , <i>Desmana sp.</i> , <i>Soricidae indet.</i> , <i>Canis etruscus</i> , <i>Pachycrocuta brevirostris</i> , <i>Homotherium crenatidens</i> , <i>Ursus aff. etruscus</i> , <i>Archidiskodon meridionalis</i> , <i>Equus stenosis</i> , <i>Dicerorhinus etruscus</i> , <i>Hippopotamus incognitus</i> , <i>Megacerini indet.</i> , <i>Cervidae indet.</i> , "Cervus" elaphoides, <i>Praevibos n. sp.</i> , <i>Hemitragus n. sp.</i> , <i>Ovis sp.</i> , <i>Bison sp.</i> , <i>Bovidae indet.</i>
	Mimomys ostramosensis zone	Fuentecilla-5 Cementerio de Orce-B Cortijo D. Alfonso Cortijo D. Diego Barranco los Conejos Orce-1, -2 Orce-D	<i>Mimomys ostramosensis</i> , <i>M. cf. pusillus</i> , <i>Apodemus aff. sylvaticus</i> , <i>Castillomys crusafonti</i> , <i>Eliomys aff. quercinus</i> , <i>Equus stenonis</i> , <i>Leptobos etruscus</i> , <i>Dicerorhinus etruscus</i> , <i>Archidiskodon meridionalis</i>
Upper Villanyian	Mimomys cf. neidi zone MN 17	Orce C Fuentenueva-1 Alqueria Fuentecilla-2? Cortes de Baza-3?	<i>Mimomys cf. reidi</i> , <i>Apodemus aff. dominans</i> , <i>Castillomys crusafonti</i> , <i>Eliomys intermedius</i> , <i>Equus stenonis vireti</i> , <i>Gazella borbonica</i> , <i>Cervidae indet.</i> , <i>Carnivora indet.</i> , <i>Leporidae indet.</i>
Lower Villanyian	M. cappetai zone MN 16	Cañada de Murcia-3 Galera-2 Zujar	<i>Kislangia cappetai</i> , <i>Stephanomys cf. tahleri</i> , <i>Apodemus aff. dominans</i> , <i>Castillomys crusafonti</i> , <i>Eliomys intermedius</i>

Mammal stages	Biozones	Localities	Faunal associations
Upper Ruscinian	Occitanus zone MN 15	Huéscar-1 Cañada del Castaño Galera-1 Baza? Gorafe-2, -3, -5	<i>Mimomys</i> cf. <i>occitanus</i> , <i>Paraethomys</i> <i>meini</i> , <i>Stephanomys</i> cf. <i>thaleri</i> , <i>Occitanomys</i> <i>brailloni</i> , <i>Castillomys crusafonti</i> , <i>Apodemus</i> aff. <i>dominans</i> , <i>Muscardinus</i> <i>plioecaenicus</i> , <i>Anancus arvernensis</i>  <i>Cricetus</i> cf. <i>angustidens</i> , <i>Trilophomys</i> cf. <i>castroi</i> , <i>Mimomys</i> cf. <i>occitanus</i> , <i>Paraethomys</i> <i>meini</i> , <i>Stephanomys</i> cf. <i>margaritae</i> , <i>Castillomys crusafonti</i> , <i>Apodemus</i> aff. <i>dominans</i> , <i>Eliomys intermedius</i> , <i>Prolagus michauchi</i> , <i>Leporidae</i> indet., <i>Soricidae</i> indet.
Lower Ruscinian	<i>Trilophomys</i> <i>castroi</i> zone MN 14	Gorafe-1, -4	<i>Ruscinomys</i> sp., <i>Cricetus</i> cf. <i>barrierei</i> , <i>Protatera</i> sp., <i>Trilophomys</i> cf. <i>castroi</i> , <i>Paraethomys</i> <i>meini</i> , <i>Stephanomys</i> cf. <i>medius</i> , <i>Occitanomys</i> sp., <i>Castillomys crusafonti</i> , <i>Apodemus</i> cf. <i>dominans</i> , <i>Eliomys intermedius</i> , <i>Atalantoxerus adroveri</i> , <i>Prolagus michauchi</i> , <i>Desmana</i> sp., <i>Microtonix</i> sp., <i>Trischizolagus maritsae</i> , <i>Gazella borbonica</i> , <i>Sinuinae</i> indet.

(Zújar, Galera-2, Cañada de Murcia-3, Cañada del Castaño-2). Most of the cricetid and murid species disappear: *Ruscinomys* sp., *Cricetus* cf. *angustidens*, *Occitanomys* cf. *brailloni*, *Paraethomys* *meini*. Thus, in contrast with the *M. occitanus* zone, the arvicolids (in this case, *M. cappetai*) become quantitatively dominant in the associations.

#### *Mimomys* cf. *reidi* zone

This zone marks an important change with respect to the previous one since, among the Rodents, only *Apodemus dominans*, *Castillomys crusafonti* and *Eliomys intermedius* persist. The *Mimomys* (*Kislanguia*) and *Stephanomys* species disappear in younger levels. This is a surprising event, since both lineages persisted in other sites in the Iberian Peninsula and their remains are found in karst deposits.

The most characteristic element of the biozone is a small to medium sized hypodont *Mimomys* with cement which maintains its mimomyan structures ("Mimomys"-ridge, enamel ring, etc). Nevertheless, this species (here provisionally called *M. cf. reidi*) is larger than the other European representatives of *Mimomys reidi*.

Besides *M. cf. reidi*, the locality of Fuentenueva-1 is illustrative of the associated fauna: *Apodemus dominans*, *Castillomys crusafonti*, *Leporidae* indet., *Carnivora* indet., *Cervidae* indet., *Gazella borbonica* and *Equus stenonis vireti*. Other sites in the Baza formation belonging to this zone are Alquería and Orce-C.

The *Mimomys* cf. *reidi* zone can be partially correlated with the MN17 zone (Upper Villanyian). All the localities in this part of the Baza formation are situated at the top of the deformed Lower Calcareous Member. The beds of the overlaying member (Red Detrital Member) were deposited unconformably over above mentioned. Nevertheless, the supposed gap seems not to be of great importance since the fossiliferous levels deposited immediately over this Red Detrital Member also belong to the Upper Villanyian.

#### *Mimomys pliocaenicus ostramosensis* zone

All the fossiliferous beds after the *Mimomys* cf. *reidi* zone are situated in the Upper Calcareous Member. The youngest levels before those with *Allophaiomys pliocaenicus* are characterized by the presence of up to three different lineages of *Mimomys*.

In the oldest locality of the Upper Calcareous Member, Orce-D, a form close to *M. pliocaenicus* is associated with a small-sized *Mimomys* lacking the mimomyian structures (*Mimomys* cf. *pusillus*). In younger localities (Orce-1, Cementerio Orce A and B, Cortijo D. Diego, Cortijo D. Alfonso, Fuentecilla-5), the first species increases in size and hypsodonty (giving *M. pliocaenicus ostramosensis*) but the rest of the association remains the same.

In the level of Orce-2, a new immigrant appears among the Rodents. Its generic attribution is doubtful, since this form lacks roots and mimomyian structures and has abundant cement. Nevertheless, its enamel is undifferentiated or of a *Mimomys*-kind. Its size is larger than any *Allophaiomys* species and it seems not to be related to *A. decuationis*. Besides the three arvicolid species, (*Mimomys p. ostramosensis*, *Mimomys* cf. *pusillus*, *Allophaiomys* sp.), the remainder of the Mammal fauna from Orce-2. is typical of the Upper Villanyian: *Apodemus dominans*, *Castillomys crusafonti* ssp., *Eliomys quercinus*, *Leptobos etruscus* and *Equus stenonis*. In the level of Barranco de los Conejos there still appear *Mimomys ostramosensis*, *Mimomys* cf. *pusillus* (as in Orce-D and Orce-2, but without roots) and *Allophaiomys* sp., but they were already associated with the cold-quaternary immigrant *Praeovibus* sp.. In the upper levels of the Orce Section, the preceding arvicolid species are substituted by *Mimomys* cf. *savini* and *Allophaiomys pliocaenicus*.

#### *Allophaiomys pliocaenicus* zone

This is the best represented biozone in the Guadix-Baza basin (Orce 3-7, Barranco León-1-3, Fuentenueva C and -2, Venta Micena-1 and -2, Cañada de Murcia-1, etc.). *Allophaiomys pliocaenicus* appears in some levels associated with a *Mimomys* species close to *M. savini* but it usually constitutes the only arvicolid present. The most representative locality in this zone Venta Micena-2, which presents the following association (Moyà-Solà et al., 1981): *Desmana* sp., *Allophaiomys pliocaenicus*, *Castillomys crusafonti* ssp., *Apodemus* aff. *sylvaticus*, *Hystrix* sp., *Eliomys intermedius*, *Lepus* sp., *Ursus etruscus*, *Canis etruscus*, *Pachycrocuta brevirostris*, *Panthera* sp., cf. *Panthera gomgaszogensis*, *Homotherium* cf. *latidens*, *Megantereon* sp., *Vulpes praeglacialis*, *Lynx* cf. *spelaea*, *Mustelidae* indet., *Archidiskodon meridionalis*, *Equus stenonis*, *Dicerorhinus etruscus*, *Hippopotamus incognitus*, *Megaceros* aff. *verticornis*, *Cervus* (?) *elaphoides*, *Praeovibus* sp., *Capra* sp., *Caprini* indet., *Bison* sp., *Soergelia* sp., *Testudo* indet., *Lacerta* indet., *Amphibia* indet.

The *Allophaiomys* specimens from Venta Micena—2 show the typical morphotypes for *A. pliocaenicus*. Nevertheless, there is a certain tendency in some of them to develop an incipient BSA—4 in the lower M1. The remaining Rodent fauna (*Hystrix* excepted) is composed of elements from the previous biozones.

#### *Mimomys savini* zone

The most representative locality in this zone is Loma Quemada—1 with a microfauna which includes *Mimomys savini*, *Allophaiomys nutiensis*, *Apodemus* aff. *sylvaticus* and *Castillomys crusafonti* ssp. In the localities of Puerto Lobo—1 and Huéscar—2, *Mimomys savini* is associated with *Equus stenonis*, *Dicerorhinus etruscus* (large form), *Archidiskodon meridionalis*, *Hippopotamus incognitus*, *Cervidae* indet.

The main differences with this biozone in the *A. pliocaenicus* relation are the following:

- *Mimomys*, represented by *M. savini*, reappear, becoming the dominant arvicolid in the association.
- *Allophaiomys* is represented by two different species: *A. nutiensis* and *A. aff. burgondiae*. *A. aff. burgondiae* is the descendant in place of *A. pliocaenicus* from the previous biozone.

#### *Pitymys cf. arvalidens* zone

This zone is characterized by the appearance of the first arvicolae with *Pitymy* morphotypes (*Pitymys cf. arvalidens* in Cúllar de Baza—C). In the levels situated immediately below this locality (Cúllar de Baza—B) we still found *Castillomys crusafonti* (the last record in the basin).

Over these beds we found the site of Cúllar de Baza—I (RUIZ and MICHAUX, 1976) with a typical cromerian fauna including *Arvicola cantiana*, *Microtus breccensis*, *Allocricetus bursae duranciensis*, *Apodemus* aff. *sylvaticus*, *Eliomys cuernicus*, etc.

This paper takes part of the project 1929/82 of the C.A.I.C.Y.T.

#### REFERENCES

- CUEVAS F., MARTIN-PENELA A., RODRIGUEZ-FERNANDEZ J., SANZ DE GALDEANO C. y VERA J. A. 1984: "Premier datation du Turolien à la base du la Formation du Guadix. (Secteur d'Abla, Espagne)". — Geobios. 17.:355—361.
- MOYÀ-SOLÀ S., AGUSTÍ J., GIBERT J. y PONS-MOYÀ J. 1981: "El yacimiento cuaternario de Venta Micena (España) y su importancia dentro de las asociaciones faunísticas del Pleistoceno inferior europeo". — Paleont. i Evol. 16.:39—53.
- VERA J. A. 1970: "Estudio estratigráfico de la Depresión Guadix-Baza". — Bol. Geol. Min. 81.:429—462.

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