

## New rodent faunas from Middle Miocene and Mio-Pliocene in the Cabriel Basin (Valencia, Spain)

Nuevas faunas de roedores del Mioceno medio y del Mio-Plioceno en la cuenca del Cabriel (Valencia, España)

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Received: 20/06/11 / Accepted: 19/10/11

### Abstract

Five new localities with micromammal remains have been located in the Cabriel Basin. These localities are situated in the eastern area of the Cabriel Basin, in the Juan Vich ravine, where the oldest deposits of this basin crop out. The localities JV2, JV3 and JV6 are of Middle Miocene age, JVTLI1 of Middle Miocene or Late Miocene age and JVTTS1 of Late Miocene or Early Pliocene age. The beginning of the sedimentary history of the basin was attributed to Late Turolian (Late Miocene). The new sedimentary record from the Juan Vich ravine and the mammalian findings extend the stratigraphic and paleontological knowledge of the Basin.

*Keywords:* Rodentia, Aragonian, Turolian-Ruscinian, Miocene-Pliocene, Cabriel Basin, Spain

### Resumen

Cinco nuevas localidades con restos de micromamíferos han sido localizadas en la cuenca del Cabriel. Estas localidades se sitúan en el sector este, en el conocido como barranco de Juan Vich, donde afloran los depósitos más antiguos de esta cuenca. Las localidades JV2, JV3 et JV6 son del Mioceno medio, del Mioceno medio o superior JVTLI1 y del Mioceno superior o Plioceno inferior JVTTS1. El inicio de la sedimentación en esta cuenca se había datado en el Turoliense. El registro sedimentario del barranco de Juan Vich y la fauna de mamíferos hallada en él, amplían el conocimiento estratigráfico y paleontológico de esta cuenca.

*Palabras clave:* Rodentia, Aragoniense, Turoliense-Rusciniense, Mioceno-Plioceno, cuenca del Cabriel, España

**1. Introduction**

The oldest sediments of the Cabriel basin crop out along the Juan Vich ravine (Fig. 1). The depositional environment of these deposits is continental. Two important localities of large mammals of Late Turolian age, Venta del Moro (Montoya *et al.*, 2006) and La Portera (Lacomba *et al.*, 1986) are known in the Cabriel valley area. Both localities are situated below the limestone Unit that forms the uppermost deposits from this basin. They contain a varied fossil assemblage, 39 species of mammals in Venta del Moro, many of which are immigrants of Asian or African origin (Montoya *et al.*, 2006).

The more extensive area of the Jucar-Cabriel valleys has yielded a rich set of fossil micromammal localities (Aguirre *et al.*, 1973; Alberdi *et al.*, 1982; Alberdi *et al.*, 1997; Benavent *et al.*, 2008; Freudenthal *et al.*, 1998; Lacomba *et al.*, 1986; López-Martínez, 1989; Mansino *et al.*, 2009; Martín-Suárez *et al.*, 1998; Martín-Suárez *et al.*, 2000; Mein *et al.*, 1978; Mein and Martín-Suárez, 1993; Montoya *et al.*, 2006; Morales, 1984; Opdyke *et al.*, 1990; Opdyke *et al.*, 1997; Robles *et al.*, 1974; Ruiz-Sánchez *et al.*, 1994). The age of these faunal assemblages covers a time span from Late Aragonian to Villafranchian (MN7/8 to MN17), or about 10 my of sedimentary record. Of this set, only one locality, JV-1 is of Middle Miocene age. The rest of the localities contain taxa from zones MN11 to MN17.

Five new localities with rodent remains have been located in the Juan Vich ravine (Table 1). Their stratigraphic position can be correlated with that of localities with large mammals of La Portera and Venta del Moro. The age of the new mammal localities comprises the interval between MN6 and MN13 or MN14. In this paper we describe the rodent faunas from the new localities and hypothesize on the bio- and chronostratigraphic implications.

*Abbreviations*

JV2: Juan Vich 2; JV3: Juan Vich 3; JV6: Juan Vich 6; JVTs1: Juan Vich upper section 1; JVTl1: Juan Vich lower lacustrine section 1; MN: European Neogene land mammal units; L, W: length and width, respectively. SC-SIE (UV): *Servei Central de Suport a la Investigació Experimental de la Universitat de València*.

**2. Material and methods**

Five levels of marls and mudstones in lacustrine and palustrine deposits in the Juan Vich ravine have been sampled during the field campaign of 1996. The resulting fossils are provisionally kept in the Department of Geology of the University of Valencia (UV) with the field labels JV2-, JV3-, JV6-, JVTl1- and JVTs1-. The nomenclature and measurement methods are that of Mein and Freudenthal (1971) (Cricetidae), Daams (1985) (Gliroidae) and Cuenca (1985) (Sciuridae). Measurements (L x

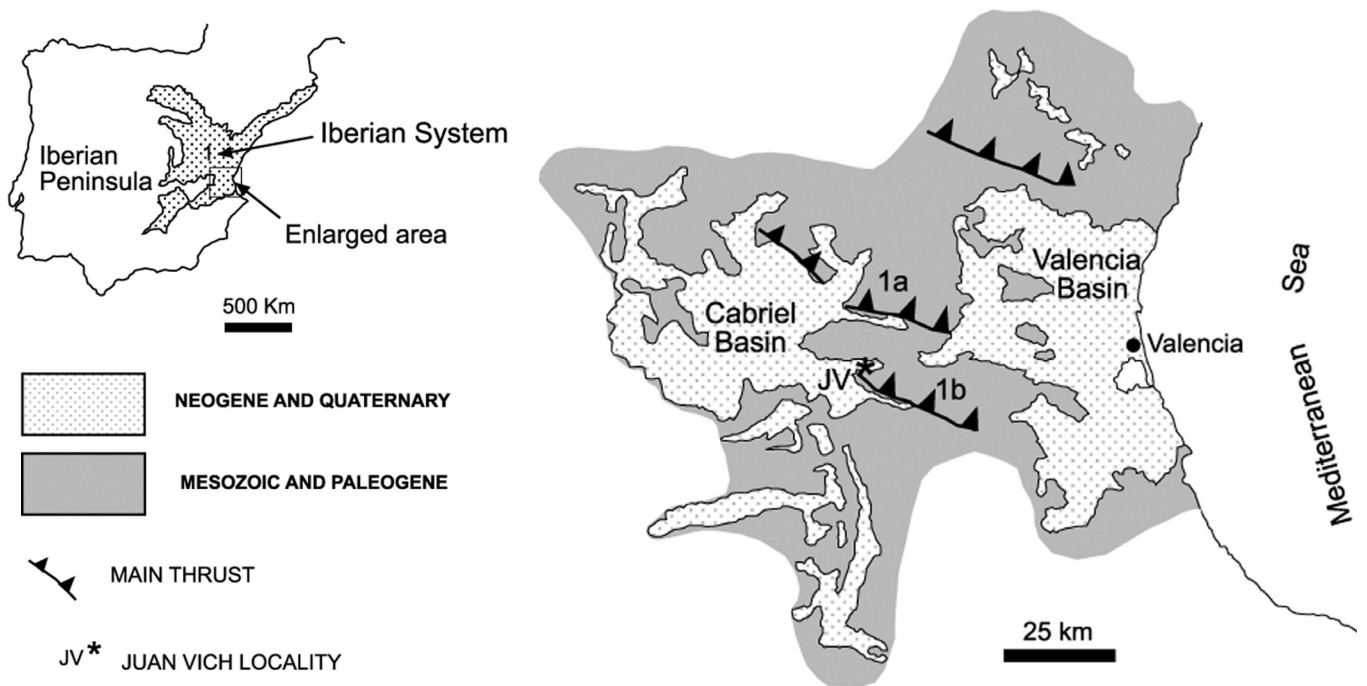


Fig. 1.- Geographic and geological setting of the Cabriel Basin, showing the location of the outcrops of the Juan Vich ravine (JV).  
 Fig. 1.- Esquema geográfico y geológico de la Cuenca del Cabriel, mostrando la localización de los afloramientos del barranco de Juan Vich (JV).

Species	Localities				
	JV2	JV3	JV6	JVTLI1	JVTS1
<i>Megacricetodon</i> cf. <i>crusafonti</i>	X(2)	X(2)	X(13)		
cf. <i>Fahlbuschia</i> or <i>Democricetodon</i> sp.		X(3)			
<i>Cricetodon</i> sp.		X(1)			
cf. <i>Megacricetodon</i> sp.				X(1)	
<i>Heteroxerus</i> sp.	X(1)			X(1)	
<i>Heteroxerus</i> grivensis		X(4)			
<i>Muscardinus</i> cf. <i>thaleri</i>	X(1)				
<i>Occitanomys</i> cf. <i>alcalai</i>					X(1)

Table 1. Faunal lists of JV2, JV3, JV6, JVTLI1 and JVTS1. In brackets, the number of studied specimens.

Tabla 1. Listas faunísticas de JV2, JV3, JV6, JVTLI1 y JVTS1. Entre paréntesis, el número de especímenes estudiados.

W) are in tenths of millimetres and were taken on a Leica MZ75 binocular microscope, by means of displacement of a mechanical stage, connected to a Sony Magnescale measuring equipment.

### 3. Geological setting

The Tertiary deposits of the Juan Vich ravine are located in the eastern sector of the Cabriel Basin, also denominated Requena Basin or Venta del Moro Basin (Robles, 1970). This basin is the biggest Neogene depression in the structural domain named Castilian-Valencian Branch of the Iberian System (Fig. 1).

The Iberian System is an intraplate alpine orogen placed in the eastern sector of the Iberian Peninsula. The structural domain of the Castilian-Valencian Branch of the Iberian System is formed by a group NW-SE overthrusts facing towards the SW, that affect both the paleozoic basement and the Mesozoic cover (Fig. 1).

The Cabriel basin is an intrachain basin, developed between two of these thrusts: Buñol-Utiel thrust (Sierras of Cabrera, Tejo and Utiel; Fig. 1.1a) and Dosaguas thrust (Sierras of Ave, Martés and Rubial; Fig. 1.1b). Their deposits constitute a postorogenic sedimentary sequence, formed between early Miocene and late Pliocene, that cover Mesozoic and Paleogene deformed materials.

The Tertiary continental sediments of the Cabriel basin were deposited during the buildup of the Southern Branch (Castilian - Valencian tectonic domain) of the Iberian chain. They are constituted by two series separated by an angular unconformity. The lower part is transitional with the marine Upper Cretaceous deposits. It is formed by Late Cretaceous (Villalba de la Sierra Formation) and Paleogene (up to Oligocene) deposits. Both were folded and fractured during the Alpine orogenesis. It contains a minimum of two megasequences with alluvial deposits, at the base, and lacustrine carbonates at the top, that have been related with the location of the Sieteaguas - Utiel thrust, in the northern margin of the Cabriel Basin (Santesteban and Ruiz-Sánchez, 2000) (Fig. 1.1a). No continental vertebrates have been found, except for remains of

dinosaurs in the latest Cretaceous deposits (Vilas *et al.*, 1982).

The Juan Vich sector belongs to the eastern margin of the Cabriel basin. The sedimentary record in this area consist of a 250 meters thick series, composed of lacustrine and alluvial deposits that overlap a substratum constituted by folded and fractured Jurassic and Cretaceous carbonates (Fig. 2). Until now, the lower deposits of this basin, located in the vicinities of Fuente Podrida spa, were considered of late Turolian age (Robles *et al.*, 1991); however, the materials that crop out in Juan Vich contain a micromammal association that dates the beginning of the sedimentary history of this basin as Middle Miocene (Late Aragonian, MN6).

The stratigraphy by Robles (1970) and Aguirre *et al.* (1973) reveals that the infill of the Cabriel basin is formed by two sequences, each one composed of clastic alluvial and fluvial materials, at the base, and fresh-water lacustrine carbonates at the top. Assens *et al.* (1973a, 1973b), have proposed an alternative subdivision in stratigraphic units, with more than two cycles culminating each one in lacustrine carbonates, ranging from Early Miocene up to Late Pliocene.

The stratigraphic units that crop out in the Juan Vich section, are physically correlatable with the ones of Robles (1970), although they represent an age interval similar to the one proposed by Assens (1973a, 1973b).

#### 3.1. Stratigraphy and sedimentology

The sedimentary record of this basin has been assigned to the Venta del Moro-Villatoya formation, composed of three members (Robles, 1970): Fuente Podrida Mb., Los Isidros Mb. and Mirador Mb. The Fuente Podrida member is the lower one of the three and has a thickness of 60 meters. It is formed by gypsy marls at the base, and tufa limestones at the top. The Los Isidros member is a clastic unit. It is 200 m thick and it is formed by red or brown clays, sandstones and conglomerates. Locally, it presents intercalations of limestones, marls and gypsum. The Mirador member is the upper one of the three and has a thic-

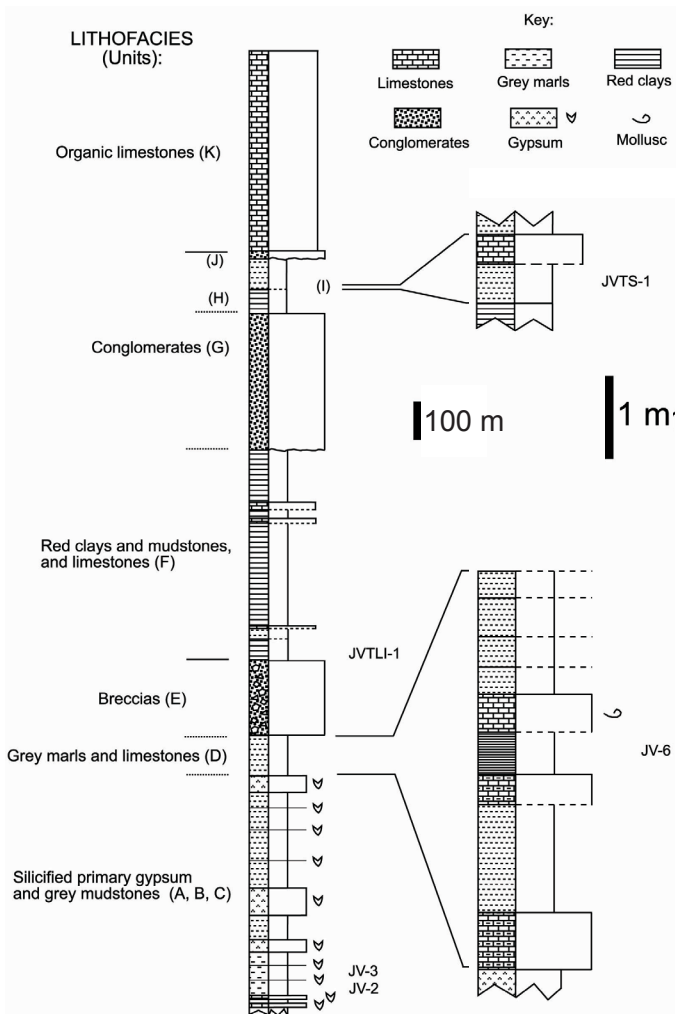


Fig. 2.- Stratigraphical position of the microvertebrate-bearing localities of the Juan Vich ravine (JV) (Units A, B, C, D, F and I).

Fig. 2.- Posición estratigráfica de los niveles con microvertebrados del barranco de Juan Vich (JV) (Unidades A, B, C, D, F e I).

kness of 30 meters. It is formed by grey tufa limestones that alternate with calcareous marls.

The studied sequence, has been measured throughout Juan Vich ravine, tributary of the Magro river (UTM base: 30S XJ 71484; UTM Top: 30S XJ 59800) This sequence (Fig. 2) is, from base to top:

A - 4 meters of intercalations of gray marls and white limestones with pseudomorphs of gypsum.

B - 4 meters of intercalations of red clays, gray marls and white limestones.

C - 52 meters of gray marls with thin beds of gypsum. It contains three layers, from 4 to 7 meters thick, formed by silica pseudomorphs of primary free-growth selenites, and lenticular gypsum of interstitial growth. These layers present moulds of dessication cracks.

D - 10 meters of intercalations of gray marls with organic matter and white calcareous marls. It presents moulds of dessication cracks.

E - 20 meters of breccias, with chaotic structure, formed by blocks and pebbles of Jurassic limestones and lower Cretaceous sandstones.

F - 55 metres of brown clays with three intercalations, of a thickness from 1 to 3 meters, of gray marls and limestones.

G - 36 meters of conglomerates with carbonate pebbles in a matrix of silicilastic sandstone, in amalgamated channeled bodies.

H - 6 metres of brown clays.

I - 8 meters of gray marls with an intercalation of palustrine limestones with root traces.

J - 2 meters of conglomerates composed of limestone pebbles.

K - 53 meters of gray limestones and marls.

The units F, G, H, I, and J belong to the Los Isidros member, while the upper limestones (unit K) represent the Mirador member.

From the sedimentological point of view the units A, B, C and D are palustrine and lacustrine deposits with alternations of saline and fresh-water stages. Unit E is a clastic deposit formed by gravitational mechanisms of mass transport of debris flow type. The units F, G, H, I, and J are deposits formed in an alluvial system. The carbonate unit K has been formed in a fresh-water lacustrine environment, dominated by organic production of sediment.

With the objective of characterizing the age of the materials of the Juan Vich sequence, we have sampled the palustrine and lacustrine deposits of the units A, B, C, D, F and I (Fig. 2). The sampling has allowed the location of five localities with micromammal remains: JV2, JV3, JV6, JVTLI1 and JVTS1.

#### 4. Systematic Palaeontology

Order: Rodentia Bodwich, 1821

Family: Cricetidae Fischer de Waldheim, 1817

Genus: *Megacricetodon* Fahlbusch, 1964

Species *Megacricetodon* cf. *crusafonti* (Freudenthal, 1963) (Fig. 3/1-2)

Locality: Juan Vich 2 (JV2)

Material: 2 M1 (JV2-1, JV2-2)

#### Description:

M1: (17.15 x 11.36; 17.40 x 12.06): Anterocone slightly subdivided. In front of the anterocone a small platform is present. Anterolophule connected to the middle of the anterocone. One specimen has a short spur that points obliquely backwards towards the anterior wall of the paracone. Longitudinal and short ectoloph on the paracone. Mesoloph short or of medium length. In one specimen the ectoloph is connected to the mesoloph. Metalophule

connected behind the hypocone. Posterosinus small.

*Discussion:*

The size of this material is bigger than in the populations of *Megacricetodon primitivus* and *Megacricetodon collongensis* from the lower and middle Aragonian, and very similar to that of *Megacricetodon crusafonti* from the upper Aragonian of the Calatayud-Teruel basin (Daams and Freudenthal, 1988b) and Cazuma 1, a locality in the nearby basin of Quesa-Bicorp, where *Megacricetodon crusafonti* is also recorded (Ruiz-Sánchez et al., 2005). The morphology of *Megacricetodon* from JV2 is very similar to the populations of these last localities from the upper Aragonian. The presence of a slightly subdivided anterocone and of short and medium mesoloph and longitudinal ectoloph, connected or not to the mesoloph, is a common feature in *Megacricetodon* of this age (Daams and Freudenthal, 1988b).

Based on these features and until more material becomes available, we consider the assemblage from JV2 as belonging to a form related with *M. crusafonti*.

Species *Megacricetodon* cf. *crusafonti* (Freudenthal, 1963) (Fig. 3/5-6)

Locality: Juan Vich 3 (JV3)

Material: 1 m3 (JV3-2) and 1 M1 (JV3-1)

*Description:*

*m3*: (10.90 x 8.14): Anterosinusid absent. Protosinusid narrow. Sinusid transverse and well-developed. Mesolophid absent. Posterosinusid of medium size.

*M1*: (17.73 x 10.80): Anterocone slightly subdivided. In front of the anterocone a platform of medium size is present. Anterolophule very short and connected to the middle part of the anterocone. From the anterolophule a short spur points obliquely backwards towards the anterior wall of the paracone. Ectoloph on the paracone very short. Mesoloph short. Ectoloph and mesoloph are not connected. Metalophule simple and connected behind the hypocone. Posterosinus very small.

*Discussion:*

The presence of a slightly subdivided anterocone in the M1 from JV3 is a characteristic feature of the genus *Megacricetodon* (Daams and Freudenthal, 1988b). The M1 from JV3 is very similar in size and morphology to that of *Megacricetodon* cf. *crusafonti* from JV2. The anterior platform in front of the anterocone, the short spur on the anterolophule and similar development of ectoloph and mesoloph in M1 are features that match in both assemblages. The size values of m3 and M1 from JV3 match those of *Megacricetodon* species from the

Late Aragonian of the Calatayud-Teruel basin (Daams and Freudenthal, 1988b).

Species *Megacricetodon* cf. *crusafonti* (Fig. 3/13-18)

Locality: Juan Vich 6 (JV6)

Material: 3 m1 (JV6-1, JV6-2, JV6-9), 2 m2 (JV6-4, JV6-5), 3 m3 (JV6-6, JV6-7, JV6-8), 2 M1 (JV6-10, JV6-11), 1 M2 (JV6-13) and 2 M3 (JV6-14, JV6-15)

*Description:*

*m1*: (16.44 x 10.62; 17.39 x 10.39): Anteroconid deeply split (2) or 8-shaped (1). Long labial spur of the anterolophulid in 2 out of 3 specimens. Mesolophid very short, nearly absent. Sinusid long and deep.

*m2*: ( x 10.31; x 9.71): Lingual anterolophid short. Mesolophid very short.

*m3*: (11.18 x 8.58; 11.04 x 8.68): Lingual anterolophid short or of medium size. Metalophulid short or absent. Mesolophid and ectomesolophid absent. Hypolophulid short and transverse. Posterosinusid small.

*M1*: (16.86 x 10.44; 15.37 x 10.52): Anterocone deeply split without anterior platform or with anterior platform. Labial spur on the anterolophule absent. Ectoloph on the paracone short. Mesoloph short or of medium size and connected to the metacone. Ectoloph not connected to the mesoloph. Posterosinus small.

*M2*: (13.19 x 10.60): The protolophule is simple and points obliquely forward, connecting to the anterolophule in front of the protocone. Ectoloph on the paracone and mesoloph of medium size and not connected. Sinus transverse. Metalophule double, with the anterior branch interrupted. Posterosinus small and narrow.

*M3*: (8.65 x 9.58): Teeth of subrectangular shape. Protolophule transverse and complete, connected to the protocone. Sinus narrow. Neo-entoloph high and narrow or low and interrupted. Mesosinus open to the labial border. Centrocone strongly developed and connected to the hypocone. Axioloph interrupted (1) or well developed (1).

*Discussion:*

The size of *Megacricetodon* from JV6 matches the values of *M. crusafonti* from the Upper Aragonian and *M. ibericus* from the Upper Aragonian and Lower Vallesian of the Calatayud-Teruel basin (Daams and Freudenthal, 1988b). The M1 from JV6 is a bit smaller than the Vallesian form. The morphology of the m1 from JV6 is very different from *M. ibericus*, being the anteroconid of the m1 from JV6 not as deeply split as in *M. ibericus*. On the other hand, the presence of a double metalophule in the M2 is a very rare morphological feature in *M. ibericus* (1 out of 16 specimens in Nombrevilla) and

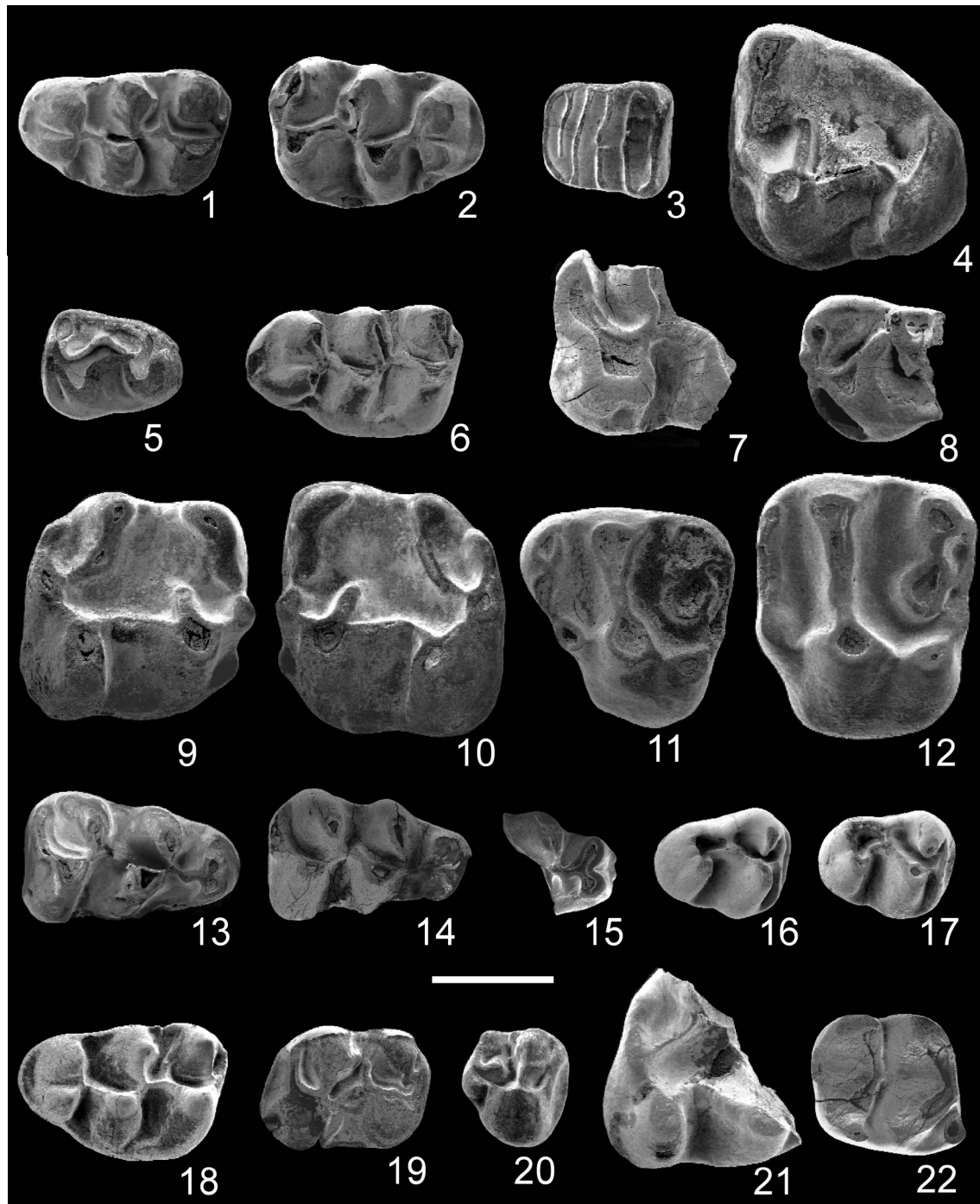


Fig. 3.- Rodent faunas from Juan Vich ravine (Cabriel Basin, Spain). *Megacricetodon* cf. *crusafonti* from JV2. 1, left M1, JV2-1; 2, right M1, JV2-2. *Muscardinus* cf. *thaleri* from JV2. 3, left m1, JV2-3. *Heteroxerus* sp. from JV2. 4, left m3, JV2-4. *Megacricetodon* cf. *crusafonti* from JV3. 5, left m3, JV3-2; 6, left M1, JV3-1. *Cricetodon* sp. from JV3. 7, right m2, JV3-4. cf. *Fahlbuschia* or *Democricetodon* sp. from JV3. 8, left m3, JV3-6. *Heteroxerus grivensis* from JV3. 9, right m1, JV3-8; 10, left m2, JV3-9; 11, right D4, JV3-10; 12, left M1,2, JV3-11. *Megacricetodon* cf. *crusafonti* from JV6. 13, right m1, JV6-2; 14, right m1, JV6-1; 15, right m1, JV6-9; 16, right m3, JV6-6; 17, right m3, JV6-7; 18, left M1, JV6-10; 19, left M2, JV6-13; 20, right M3, JV6-14. *Heteroxerus* sp. from JV6. 21, right m1,2, JVTLS1-2. *Occitanomys* cf. *alcalai* from JVTLS1. 22, right m2, JVTLS1-1. Scale=1mm.

Fig. 3.- Roedores del barranco de Juan Vich (Cuenca del Cabriel, España). *Megacricetodon* cf. *crusafonti* de JV2. 1, M1 izquierdo, JV2-1; 2, M1 derecho, JV2-2. *Muscardinus* cf. *thaleri* de JV2. 3, m1 izquierdo, JV2-3. *Heteroxerus* sp. de JV2. 4, m3 izquierdo, JV2-4. *Megacricetodon* cf. *crusafonti* de JV3. 5, m3 izquierdo, JV3-2; 6, M1 izquierdo, JV3-1. *Cricetodon* sp. de JV3. 7, m2 derecho, JV3-4. cf. *Fahlbuschia* ou *Democricetodon* sp. de JV3. 8, m3 izquierdo, JV3-6. *Heteroxerus grivensis* de JV3. 9, m1 derecho, JV3-8; 10, m2 izquierdo, JV3-9; 11, D4 derecho, JV3-10; 12, M1,2 izquierdo, JV3-11. *Megacricetodon* cf. *crusafonti* de JV6. 13, m1 derecho, JV6-2; 14, m1 derecho, JV6-1; 15, m1 derecho, JV6-9; 16, m3 derecho, JV6-6; 17, m3 derecho, JV6-7; 18, M1 izquierdo, JV6-10; 19, M2 izquierdo, JV6-13; 20, M3 derecho, JV6-14. *Heteroxerus* sp. de JV6. 21, m1,2 derecho, JVTLS1-2. *Occitanomys* cf. *alcalai* de JVTLS1. 22, m2 derecho, JVTLS1-1. Escala=1mm.

more frequent (39 out of 98 specimens in Solera) in *M. crusafonti-ibericus* from the localities of zone G3 (Daams and Freudenthal, 1988b). In JV6 the only M2 shows a double metalophule.

The presence of a long labial spur of the anterolophulid in 2 out of 3 m1 from JV6 is an uncommon feature in *M. crusafonti*, and it is not known in *M. crusafonti-ibericus* and *M. ibericus*. This character is not mentioned in *M. crusafonti* in Daams and Freudenthal (1988b), but Freudenthal (1963) reported a frequency of 20% in *M. crusafonti* from Manchones. This character is also present in some specimens of *M. primitivus* (5% in Valtorres and 14% in Vargas 1A) (MN4 and lower part of MN5), *M. collongensis* (3% in Casetón 1A and 10% in Valdemoros 3B) (MN5) and *M. debruijini* (2% in Pedregueras 2C and 17% in Pedregueras 2A) (upper part of MN9) from localities of the Calatayud-Teruel basin (Daams and Freudenthal, 1988b), but not in the same proportion as in JV6.

Outside the Iberian Peninsula this situation repeats. Whereas in *M. aunayi* from the French karstic locality of Blanquatière 1 (MN4-MN5) 21% of the m1 have a labial spur on the anterolophulid (Lazzari and Aguilar, 2007), in *M. aff. bavaricus* from Estruguettes 5 (MN7-8) 2 out of 2 m1 have this character too (Aguilar et al., 1999; Fig. 6a). In *M. bavaricus* from Langenmoosen (MN5), Fahlbusch (1964) cites that most of the m1 also show this character. The size and dental pattern of the *Megacricetodon* from JV6 agree well with those of *M. bavaricus* from Langenmoosen and *M. aff. bavaricus* from Estruguettes 5.

Based on these features and until more material becomes available, we consider the assemblage from JV6 as belonging to a form related with *M. crusafonti*.

Species cf. *Megacricetodon* sp.

Locality: (JVTLI1)

Material: 1 M1 (JVTLI1-1)

*Description:*

*M1:* Worn tooth. Protosinus and sinus open to lingual border.

*Discussion:*

The tooth is strongly deteriorated, the enamel is partially lost. The general configuration of this specimen resembles *Megacricetodon*. In the anterior end, something like a split anterocone is present. Based on these facts, it is determined as cf. *Megacricetodon* sp.

Genus: *Fahlbuschia* Freudenthal, 1971

or *Democricetodon* Fahlbusch, 1964

Species *Fahlbuschia* or *Democricetodon* sp. (Fig. 3/8)

Locality: Juan Vich 3 (JV3)

Material: 1 m3 (JV3-6), 1 M1,2 (JV3-5) and 1 M3 (JV3-7)

*Description:*

*m3:* (x 12.60): The posterior side is broken. Anterosinusid very small. Mesolophid absent. Hypolophulid very short.

*M1,2:* Only the posterolingual side is preserved. Sinus narrow and open to lingual border.

*M3:* Sinus small. Neo-entoloph high and complete. Posterosinus divided in two small portions by a short and longitudinal ridge.

*Discussion:*

The status of several cricetids from the Miocene (*Fahlbuschia*, *Democricetodon*, *Pseudofahlbuschia* and *Renzimys*) is still under discussion (Freudenthal 2006; Van der Meulen et al., 2004). The new classification suggested by Van der Meulen et al. (2004) was rejected by Freudenthal (2006). For the moment we use the classification of Freudenthal and Daams (1988).

The medium-sized m3 from JV3 matches the values of *F. freudenthali* and *F. darocensis* from the Aragonian type area, it is larger than *Pseudofahlbuschia jordensi* and somewhat smaller than *F. crusafonti* and any form of the genus *Renzimys* (Freudenthal and Daams, 1988). The presence of small and narrow sinuses in the upper molars, a neo-entoloph in the M3, a small anterosinusid and a short hypolophulid in the m3 from JV3 match the morphology of a form of *Fahlbuschia* or *Democricetodon* (Freudenthal and Daams, 1988). Based on these features, we determine this material as *Fahlbuschia* or *Democricetodon* sp.

Genus: *Cricetodon* Freudenthal, 1971

Species *Cricetodon* sp. (Fig. 3/7)

Locality: Juan Vich 3 (JV3)

Material: 1 m1,2 (JV3-4)

*Description:*

*m1,2:* The specimen is the posterior part of a m1,2. Tooth moderately hypsodont with a size over 2 mm long. The enamel is wrinkled. Sinusid and posterosinusid relatively narrow.

*Discussion:*

The wrinkled enamel, big size of the specimen and moderate hypsodonty are clear features of the tribus *Crice-*  
*todontini* Schaub, 1925. The degree of hypsodonty is not as strong as in *Hispanomys* and *Ruscinomys*, the other *Cricetodontini* genera registered in the Miocene of SW Europe, and very similar to *Cricetodon* (Mein and Freudenthal, 1971). The material of this *Cricetodontini* from

JV3 is very scarce, limited to a fragmentary specimen. Nevertheless, based on the size and the general morphology it is determined as *Cricetodon* sp.

Family: Gliridae Muirhead, 1819

Subfamily: Glirinae Thomas, 1897

Genus: *Muscardinus* Kaup, 1829

Species *Muscardinus* cf. *thaleri* de Bruijn, 1966 (Fig. 3/3)

Locality: Juan Vich 2 (JV2)

Material: 1 m1 (JV2-3)

*Description:*

*m1*: (10.16 x 9.59): Tooth with six ridges. In the labial border, the first and third ridges are low connected. The second ridge is long and not connected to another ridge. The fourth ridge is divided into two parts. The fifth ridge is long too and it has three small tubercles. The fifth and sixth ridges are connected at the labial border.

*Discussion:*

Daams (1985; Fig. 7) distinguishes three morphotypes in the m1 of *Muscardinus* from the Aragonian. The first morphotype has seven ridges, while the second and third have six. In the third morphotype, the second ridge reaches the labial border, whereas in the second morphotype it does not. These morphological differences allow distinguishing the two *Muscardinus* species from the Aragonian. Whereas *M. thaleri* has an m1 with first and second morphotype, *M. hispanicus* only has m1 with the second ridge long and connected to first ridge. According to the scheme proposed, the material of *Muscardinus* from JV2 is determined as *M. cf. thaleri*.

Family: Sciuridae Gray, 1821

Genus: *Heteroxerus* Stehlin and Schaub, 1951

Species *Heteroxerus* sp. (Fig. 3/4)

Locality: Juan Vich 2 (JV2)

Material: 1 m3 (JV2-4)

*Description:*

*m3*: (19.84 x 18.61): Protoconid, metaconid, hypoconid, anteroconulid and hypoconulid well developed. Anterior wall vertical. Anterolophid low and complete, connected to the protoconid. Metalophid transverse and of medium size. Entolophid absent. Posterolophid continuous, developed from hypoconid to metaconid.

*Discussion:*

The shape is very similar to what is described for the genus *Heteroxerus* from the localities of Aragonian age of the Calatayud-Teruel basin (Cuenca, 1988). The size is bigger than those of *H. rubricati*, except those from

localities Ramblar 7, Villafeliche 2A, Olmo Redondo 9, Valdemoros 1A, Valdemoros 3A, Regajo 2 and Valalto 2C. The size of the specimen from JV2 matches the maximum values of *H. rubricati* from these last localities. Apart from its size, it resembles *Heteroxerus*, in the absence of an entolophid in m3. Based on these facts, it is determined as *Heteroxerus* sp.

Species *Heteroxerus grivensis* (Forsyth Major, 1893) (Fig. 3/9-12)

Locality: Juan Vich 3 (JV3)

Material: 1 m1 (JV3-8), 1 m2 (JV3-9), 1 D4 (JV3-10) and 1 M1,2 (JV3-11)

*Description:*

*m1*: (19.48 x 18.43): Tooth of subquadrangular shape. Protoconid, metaconid, hypoconid, entoconid, anteroconulid and hypoconulid well developed. The metaconid is the highest cusp. Anterolophid short and connected to the protoconid. Metalophid short and attached to the metaconid base. Entolophid complete and connected to the hypoconulid. Posterolophid continuous and not connected to the entoconid.

*m2*: (19.14 x 20.45): Tooth of subrectangular shape. Protoconid, metaconid, hypoconid, entoconid, anteroconulid and hypoconulid well developed. The metaconid is the highest cusp. Anterolophid very small, as a fold in the anterior wall. Metalophid of medium size and obliquely directed backward. Entolophid complete and connected to the hypoconulid. Posterolophid continuous and not connected to the entoconid.

*D4*: (17.78 x 18.79): Tooth of subtriangular shape. The cusps are big and rounded and the ridges short. Four main cusps: protocone, paracone, metacone and hypocone and three conules: anteroconule, metaconule and hypoconule. The ridges are continuous and well developed.

*M1,2*: (18.14 x 21.51): Tooth of subrectangular shape. The cusps are big and rounded, and the ridges short. Four main cusps: protocone, paracone, metacone and hypocone and three conules: anteroconule, metaconule and hypoconule. The ridges are continuous and well developed. A short parastyle and a little mesostyl are present. Metacone and a large metaconule are connected by the metaloph. The metaconule is in close contact with the hypoconule. Posteroloph low, connecting hypoconule and metacone.

*Discussion:*

The shape and the size are within the range of *H. grivensis* from the localities of Aragonian age of the Calatayud-Teruel basin (Cuenca, 1988). The size of teeth is almost always bigger than *H. rubricati*. It resembles *H. grivensis*



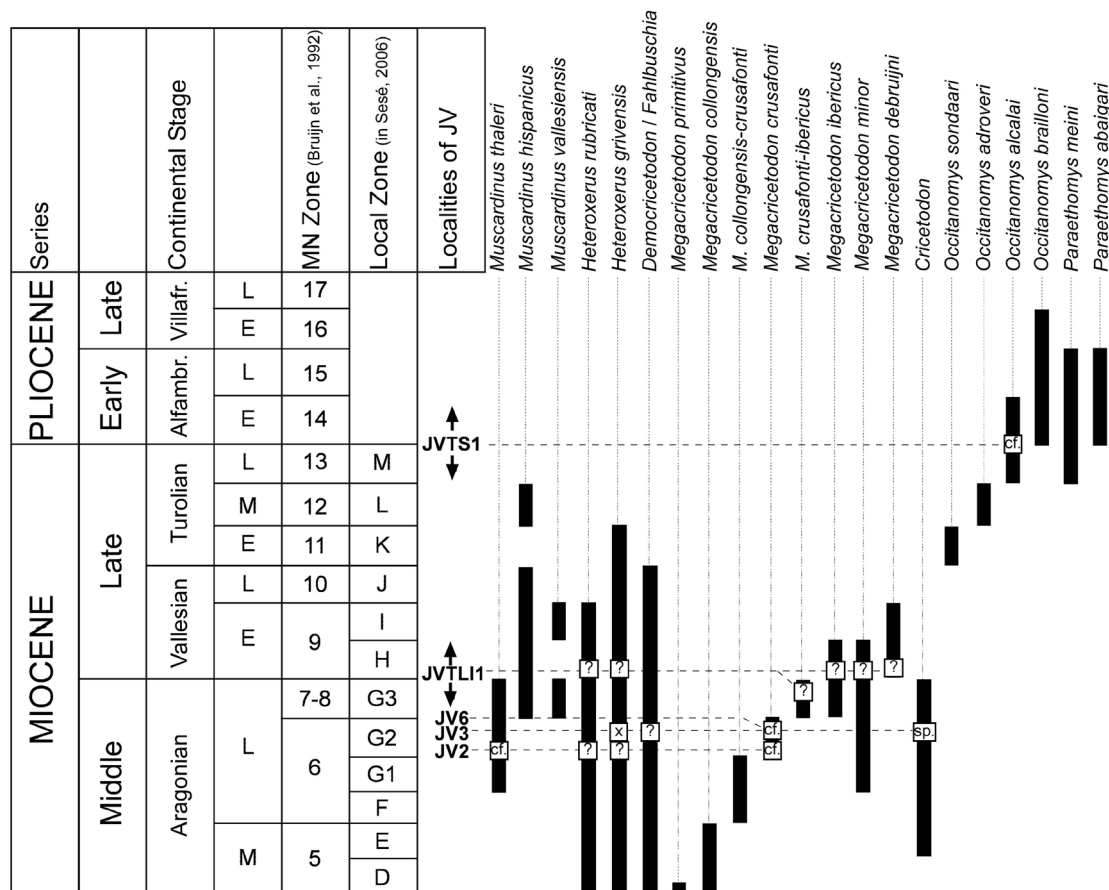


Fig. 4. Distribution chart of the rodents species studied in this paper and of other species of similar age. X= Confirmed presence of this taxon; ?= Possible species of the genus recorded in the locality.

Fig. 4. Cuadro de distribución de las especies de roedores estudiados en este trabajo y de otras especies de similar edad. X= Presencia confirmada del taxon; ?= Posible especie del género registrada en el yacimiento.

by the presence of a mesostyle and the close contact of metaloph (metaconule) and posteroloph in the upper molars. Therefore, it is determined as *H. grivensis*.

Species *Heteroxerus* sp. (Fig. 3/19)

Locality: Juan Vich lower lacustrine section 1 (JVTLI1)

Material: 1 m1,2 (JVTLI1-2)

#### Description:

*m1,2*: Anterior side of the tooth broken. A small part of an anterior cingulum is visible. Ectolophid short and curved. Entolophid long and connected to entoconid and hypoconulid. Posterolophid long and connected to the base of the entoconid.

#### Discussion:

The presence of a trace of an anterior cingulum, a long entolophid connected the entoconid and a hypoconulid are characteristic features of *Heteroxerus* (Cuenca, 1988). The scarce material does not allow a more detailed determination. Therefore it is classified as *Heteroxerus* sp.

Family: Muridae Illiger, 1811

Genus: *Occitanomys* Michaux, 1969

Species *Occitanomys* cf. *alcalai* Adrover, Mein and Moissenet, 1993 (Fig. 3/20)

Locality: Juan Vich upper sector (JVTS1)

Material: 1 m2 (JVTS1-1)

#### Description:

*m2*: (12.77 x 11.16): The posterior part of the tooth is narrower than the anterior part. Anterolabial cusp well developed, not connected to the protoconid. Between protoconid-metaconid and hypoconid-entoconid a small and low longitudinal spur is present. The labial cingulum is continuous, with a small c1 and a c2 attached to the labial wall of the protoconid. Hypoconid placed backward with respect to the entoconid. Posterior heel oval. There are two roots.

#### Discussion:

The tooth is brachyodont. There is a trace of a low longitudinal connection between the anterior and posterior cusp pair and a labial cingulum with a small c1. This

morphology matches very well with those described in *Occitanomys* assemblages of Miocene age and resembles also *Paraethomys* (García-Alix, 2006). The size of the m2 from JVTS1 matches *O. alcalai*, and is clearly smaller than the rest of *Occitanomys* species and much smaller than any species of *Paraethomys* (García-Alix, 2006). Based on these facts and the scarce material, it is determined as *Occitanomys cf. alcalai*.

## 5. Discussion

The upper series of the Cabriel Basin is of Neogene age and represents the post-orogenic infill of the Cabriel basin. Until present it had been attributed to Upper Miocene and Pliocene (Robles, 1970). The lower part of the series of Juan Vich contains, at the base, lacustrine breccias associated to the synsedimentary activity of normal faults in the Mesozoic substratum. The materials of the upper part of this series are horizontal and without tectonic deformation.

A biostratigraphic chart, modified after Sesé (2006), is given in Figure 4. Biostratigraphically, the most important element in the first set of localities of Juan Vich ravine is the genus *Megacricetodon*. This genus usually is the most abundant taxon in the localities between MN4 and the lower part of MN9 (Daams and Freudenthal, 1988a-b; Daams et al., 1999). One form of this genus is present in the Juan Vich localities: *Megacricetodon crusafonti* (as *M. cf. crusafonti*). In the localities of the Calatayud-Teruel basin, *M. crusafonti* is characteristic of the Middle Miocene zone G2 (Daams and Freudenthal, 1988b). The rest of the taxa registered in the Juan Vich localities (*Muscardinus*, *Heteroxerus*, *Cricetodon* and *Fahlbuschia* or *Democricetodon*) are recorded in this time span too. The higher stratigraphic position of JVTLI1 with respect to JV2, JV3 and JV6 and the presence in the former locality of *Megacricetodon* sp. and *Heteroxerus* sp., allow dating this locality as Aragonian or Vallesian.

The locality JVTS1 contains the only murid recovered in Juan Vich. The first Muridae in Europe appear in the Lower Vallesian (MN9, Late Miocene) registers. From the Late Miocene onward and during a large part of the Pliocene murids are the dominant rodents in Europe (Freudenthal and Martín-Suárez, 1999). The specimen found in JVTS1 has been assigned to *Occitanomys cf. alcalai*. The stratigraphic range of *O. alcalai* is restricted to Late Miocene and Early Pliocene (Freudenthal and Martín-Suárez, 1999; García-Alix, 2006) (Fig. 4). Therefore we assign this locality to Late Turolian or Early Ruscinian (MN13 or MN14).

The microfauna found in the Juan Vich ravine indicates that the upper series of the Cabriel Basin dates from middle Miocene until the Pliocene. The lower part of the series of Juan Vich is Middle Miocene in age.

## 6. Conclusions

In the Juan Vich ravine the oldest sediments of the upper sequence of materials of the Cabriel basin crop out. This sequence represents the infill of one of the biggest post-orogenic basins in the southern branch of the Iberian system. The paleontological data provided by the new localities found in the Juan Vich ravine allow the first detailed dating of the stratigraphic units defined in the Juan Vich sector and that summarize the Tertiary deposits of the Cabriel basin.

New data on pre-Turolian faunas from the Cabriel basin are here presented. Five new localities of ages comprised between Middle Miocene to Late Miocene-Early Pliocene have been discovered in the Juan Vich ravine section. The oldest localities (JV2, JV3 and JV6) have an Aragonian age, the intermediate one (JVTLI1) is Aragonian or Vallesian and the youngest (JVTS1) is of Turolian or Alfambrian age.

The presence of the glirid *Muscardinus*, the cricetid *Cricetodon* and the murid *Occitanomys* represent the first records of these rodent genera in the Levantine sector of the Iberian Cordillera.

## Acknowledgements

We thank to P. Gómez and E. Navarro (SCSIE, UV) for capable laboratory assistance, and Dr. Jorge Morales and an anonymous reviewer for their comments and criticism. Likewise, we thank the efficient work of editors, José López Gómez and Javier Martín Chivelet. This study was supported by the project CGL2008-06533-CO3-03/BTE.

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