

The first rodent from the Mariño Formation (Miocene) at Divisadero Largo (Mendoza, Argentina) and its biochronological implications

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ABSTRACT

A new significant mammal fossil from the Mariño Formation in the area of Divisadero Largo (Mendoza, Argentina) is described herein. The material consists of a mandibular fragment with the right series p4-m3 of the rodent *Scleromys* sp. It is compared with the Santacrucian species *S. osbornianus* Ameghino and *S. angustus* Ameghino, and with *S. quadrangulatus* Kramarz from the Pinturas Formation, all of them from the Santa Cruz Province. At the same time, the studied fossil presents a combination of characters that differ from those species: more transverse molars, with anterior wall slightly curved, lower degree of hypsodonty and smaller size. However, due to the great morphological variation within *Scleromys*, a specific determination is not provided based on a sole specimen. The presence of this genus, together with the previously studied mesotheriine, supports an early Miocene age for the middle member of the Mariño Formation.

Key words: Rodents, Mariño Formation, Early Miocene, Mendoza, Argentina.

RESUMEN

El primer roedor de la Formación Mariño (Mioceno) en Divisadero Largo (Mendoza, Argentina) y sus implicancias biocronológicas. Se describe un nuevo resto de mamífero procedente de la Formación Mariño en el área de Divisadero Largo (Mendoza, Argentina). Corresponde a un fragmento mandibular de roedor, con la serie p4-m3 derecha, identificado como *Scleromys* sp. Se lo compara con las especies santacrucenses, *S. osbornianus* Ameghino y *S. angustus* Ameghino de la Formación Santa Cruz y la *S. quadrangulatus* Kramarz de la Formación Pinturas, todas ellas de la Provincia de Santa Cruz. El ejemplar de Mendoza presenta una combinación de caracteres propia (molares más transversos, con la pared anterior ligeramente curva; menor desarrollo de la hipsodoncia; tamaño más pequeño) que lo diferencian de las especies anteriores. Sin embargo, debido a la gran variación morfológica observada en el género, se prefirió no hacer una determinación específica basada en un único ejemplar. La presencia de *Scleromys* sp., junto a la del mesoterino previamente descrito, apoya una edad miocena temprana para el miembro medio de la Formación Mariño.

Palabras claves: Roedores, Formación Mariño, Mioceno Temprano, Mendoza, Argentina.

INTRODUCTION

The Cenozoic outcrops of the Divisadero Largo area (Fig. 1), located 8 km west of the city of Mendoza (Mendoza Province, Argentina), provided a rich fauna in sediments of the Divisadero Largo Formation (Rusconi, 1946 a, b; Minoprio, 1947; Patterson, 1952; Simpson *et al.*, 1962; López, 2002), which gave place to the definition of the Divisaderan land mammal age, assigned to Late Eocene-Early Oligocene (Pascual *et al.*, 1965). The uniqueness of this mammal assemblage, however, is now under revision, since some data suggest a possible mixture of material from different stratigraphical origin (Cerdeño *et al.*, 2005; López and Manassero, 2006).

Recently, the finding of a mesotheriid (Notoungulata) tooth series and several vertebral remains in the overlying Mariño Formation has renewed the interest of this paleontological area, since they were the first mammal remains undoubtedly coming from this formation (Cerdeño *et al.*, 2006; Cerdeño,

in press). The Mariño Formation (Biondi, 1936¹; Roller and Criado Roque, 1970) has been ascribed to the Miocene, and is also known in other zones near the city of Mendoza, such as the Cacheuta-Potreros area, from where Rusconi (1949) described the freshwater bivalve *Corbicula elchaensis* Rusconi. Sepúlveda (1999) described some microfloras from Salagasta area (northern Mendoza), which allowed him to assign a Late Oligocene-Early Miocene age to the Mariño Formation. In addition, recent prospective studies in the Potrerillos area provided some paleobotanical remains and a series of undetermined ichnites (Zavattieri *et al.*, 2001)². Some ichnites have been also reported from fine sandy levels of Sierra de las Higueras, near Salagasta, in a unit correlated with the upper member of the Mariño Formation (Ahumada, 2004). They were preliminarily assigned to an ungulate mammal, but a detailed study is still lacking.

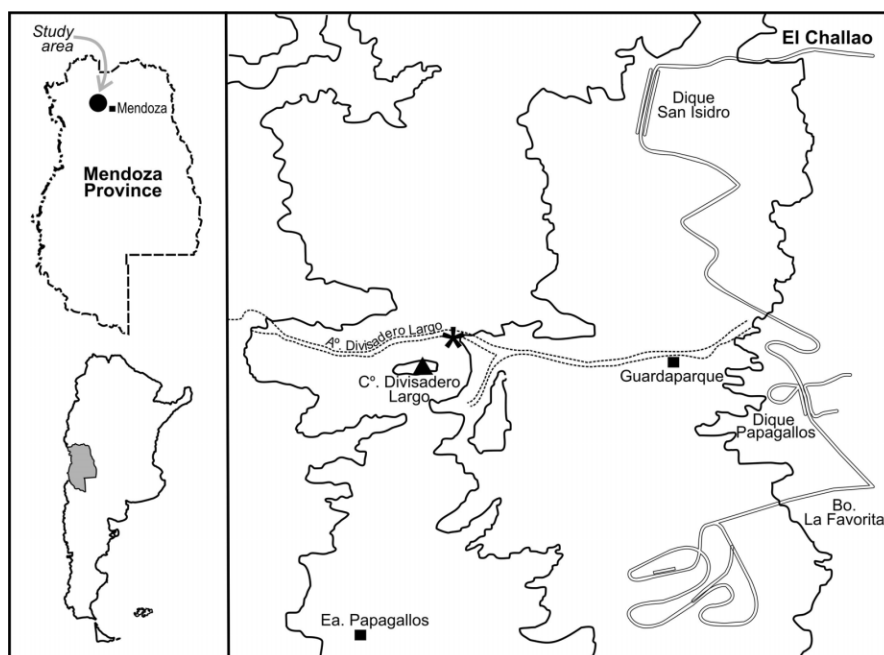


FIG. 1. Geographic location of the fossiliferous site (*) in the Mariño Formation, Divisadero Largo, Mendoza. **A°**- arroyo; **Bo**- barrio; **C°**- cerro; **Ea**- estancia.

¹ Biondi, J.L. 1936. Exploraciones geológicas en las inmediaciones del cerro Cacheuta. Unpublished report, Yacimientos Petrolíferos Fiscales, Buenos Aires.

² Zavattieri, A.M.; Cerdeño, E.; Bottero, R.; Londero, S. 2001. Estudio, prospección y propuesta de rescate y protección de yacimientos paleontológicos en el área de Potrerillos y zonas aledañas, Mendoza. Unpublished report, Ministerio de Ambiente y Obras Públicas de Mendoza: 133p.

As explained by Cerdeño *et al.* (2006), the only mention of a mammal specimen recovered from the Mariño Formation, before the new records, corresponds to a specimen of the Protheroheriidae *Licaphrium cf. floweri* Ameghino from the Estratos de Mariño in Cerro Cacheuta, probably Santacrucian (late early Miocene) in age (Rolleri, 1950³ in Yrigoyen, 1993). However, this specimen has never been described, localized, nor mentioned by later authors who have referred to the Cenozoic outcrops and faunas of Mendoza (Pascual and Odreman Rivas, 1973; Rolleri and Fernández Garrasino, 1979; Pascual and de la Fuente, 1993; Soria, 2001).

After the finding of the mesotheriid (Cerdeño *et al.*, 2006), several field seasons have been

developed. Although the thick sediments at Divisadero Largo are poor in fossils, we were successful in finding new fossil remains: some bony fragments too incomplete or insignificant for an accurate determination, an invertebrate trace (probable *Skolithos*; R. Melchor, personal communication, 2005), and, more importantly, a second significant specimen (Cerdeño and Vucetich, 2006), the fragmentary rodent mandible here described, which increases the incipient knowledge of the Mariño Formation mammal assemblage, and allows the refinement of the chronology of this formation. The material is stored at the Museo de Ciencias Naturales y Antropológicas 'J.C. Moyano' (MCNAM) in Mendoza.

GEOLOGICAL AND CHRONOSTRATIGRAPHICAL SETTING

The Mariño Formation, defined by Biondi (1936, *nom. subst.* Rolleri and Criado Roque 1970), is formed by three members: Conglomerados Violáceos at the bottom, Areniscas Entrecruzadas or Areniscas Inestratificadas in the middle of the section, and Estratos de Mariño or Serie del Higueral in the upper section (Chiotti, 1946).

From a paleoenvironmental point of view, the lower and upper members correspond to fluvial and alluvial levels, deposited under arid and semi-arid conditions, whereas the middle member is assigned to aeolian deposits (Irigoyen, 1997).

The geological context and the stratigraphic profile of the Mariño Formation in the Divisadero Largo area are fully detailed in Cerdeño *et al.* (2006). The new fossil material comes from about 45 m higher in the section than the mesotheriid remains, which come from the so-called level FM1 cited by those authors. The new fossiliferous point, FM3, is placed at 32° 52.684'S and 68° 56.453'W, at 1,081 m altitude, and presents the same characteristics as FM1, brown-grey sandstones of homogeneous texture, with massive stratification.

The age of the Mariño Formation has been differently interpreted. Although firstly was thought to be Oligocene in age (Groeber, 1951), most

authors have considered it as Miocene and correlated it with the Agua de la Piedra Formation, cropping out in Malargüe (south of Mendoza), and originally considered Late Oligocene-Early Miocene in age (Rolleri and Criado Roque, 1968; Gorroño *et al.*, 1979; Yrigoyen, 1993) and more recently Middle Miocene (Combina *et al.*, 1997; Combina and Nullo, 1999). Sepúlveda (1999), based on palinologic data, also suggested a Late Oligocene-Early Miocene age for the upper member of the formation (Estratos de Mariño). On the other hand, Irigoyen (1997) and Irigoyen *et al.* (2000, 2002) obtained an isotopic age of 12.03±0.45 Ma for the uppermost part of the Mariño Formation, and established a range of 15.7-12.2 Ma for the whole formation based on paleomagnetic correlations; this time span corresponds to the Middle Miocene, Colloncuran and Laventan ages (Flynn *et al.*, 2002; Pascual *et al.*, 2002). Moreover, the mesotheriid from the Mariño Formation is very similar to a species from the Chucal Formation (Chile) (Cerdeño, in press), ascribed to the Santacrucian age, of the late Early Miocene (Croft *et al.*, 2004). The rodent here described supplies new data concerning the age of the fossil-bearing levels.

³Rolleri, E.O. 1950. Informe Geológico de la Hoja 23c, Mendoza. Unpublished report, Dirección General de Yacimientos Petrolíferos Fiscales: 146 p.

SYSTEMATIC DESCRIPTIONS

Order Rodentia Bowdich, 1821
 Suborder Hystricognathi Tulberg, 1899
 Superfamily Chinchilloidea Kraglievich, 1940
 Family Dinomyidae Peters, 1873
 Genus *Scleromys* Ameghino, 1887

Type species: *Scleromys angustus* Ameghino, 1887. Patagonia, Pinturas and Santa Cruz formations, late Early Miocene.

***Scleromys* sp.**

Fig. 2, A-D

Material: MCNAM-PV 3655, right mandibular fragment with p4-m3 of a young adult individual.

Geographic and stratigraphic provenance: Divisadero Largo, Mendoza; Middle Member of the Mariño Formation (Fig. 1).

Description: The p4 is somewhat longer than wide (Table 1), with the talonid slightly wider than the trigonid. The occlusal surface is clearly S-shaped because only hypo- and metaflexid are still open. The anterior wall is straight. The metalophid is very curved and there is a small anterofossettid at the antero-lingual angle.

The m1 and m2 are similar in shape, but m2 is larger and more transverse. The mesoflexid is closed in m1, but still open in m2, and there is no anterofossettid in either of them.

The m3 is the smallest cheek tooth (Table 1). It is little worn and thus the posterior lamina is isolated. A remnant of the metalophid is still distinguishable, but in this degree of wear it does not form an anterofossettid.

Mandible: The notch for the tendon of the *M. masseter medialis pars anterior* (Woods and Howland, 1979) is shallow, and the mental foramen is round and placed slightly ahead of p4. The alveolus of i1 extends backward to a point below the anterior portion of m3.

Comparisons: *Scleromys* sp. differs from the Santacrucian species, *S. osbornianus* Ameghino and *S. angustus* Ameghino, in its smaller size, particularly from the latter, the largest species of the genus (Table 1), and lesser degree of hypsodonty. Molars of both Santacrucian species are slightly longer than wide or subquadrangular in shape,

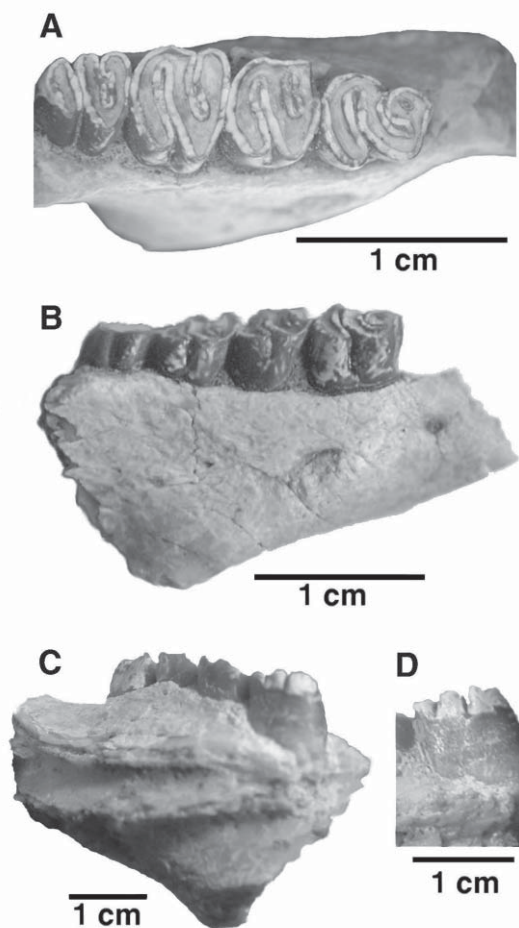


FIG. 2. Right mandibular fragment with p4-m3 of *Scleromys* sp. from the Mariño Formation, Mendoza. A- occlusal view; B- labial view; C- lingual, oblique view; D- detail of m3.

with convex walls; the m1 in particular is almost subcircular when highly worn. In *Scleromys* sp. the molars are more transverse, specially the m2, and the anterior walls are straighter. The notch for the tendon of the *M. masseter medialis pars anterior* and the mental foramen are less conspicuous and

proportionally smaller than in *S. osbornianus* (these characters are not known in *S. angustus*). *S. quadrangulatus* Kramarz from the Pinturas Formation (Early Miocene, Santa Cruz Province; Fleagle *et al.*, 1995; Kramarz, 2001, 2006; Kramarz and Bellosi, 2005) differs from *Scleromys* sp. in its somewhat larger size and less transverse cheek teeth with

almost straight anterior wall, but has a similar degree of hypsodonty, as attested by x-ray studies and comparisons between isolated and partially encased molars, as well as size and disposition of the notch for the tendon of the *M. masseter medialis pars anterior* and the mental foramen.

TABLE 1. MEASUREMENTS (IN MM) OF *SCLEROMYS* SP. FROM THE MARIÑO FORMATION COMPARED WITH OTHER SPECIES OF THE GENUS.

	Mariño Fm. <i>Scleromys</i> sp.	Pinturas Fm. <i>Scleromys</i> <i>quadrangulatus</i>	Santa Cruz Fm. <i>S. osbornianus</i>				Santa Cruz Fm. <i>S. angustus</i>	
	MCNAM-PV 3655	MLP 82-VI-3-2	MLP 15-386	MLP 15-280	MLP 15-369	MLP 15-286	MLP 15-204	MACN 1681-82
p4 APD	4.91	4.85	6.27	5.25	6.03			
AW	3.48	2.72	3.95	3.52	4.12			
PW	4.47	4.00	4.54	4.64	5.02			
m1 APD	4.54	4.58	4.54	4.82	4.21	4.90	5.19	
AW	4.73	4.75	3.84	4.57	4.57	5.02	5.77	
PW	4.56	4.55	3.86	4.72	4.39	4.80	5.83	
m2 APD	4.65	4.83	4.84	5.26	5.07	5.25	6.10	
AW	5.41	4.28	4.75	5.06	4.80	4.57	6.02	
PW	5.10	4.54	4.58	5.07	4.52	4.50	5.93	
m3 APD	4.12	4.11	5.31	4.99		4.86		6.42
AW	3.12	3.54	4.40	4.68		4.85		5.38
PW	3.11	3.00	3.80	3.97		4.08		5.43
p4-m3	18.25	19.68	20.23	20.28			25.36	

Abbreviations. A) Dental measurements: antero-posterior diameter: **APD**; anterior transverse width: **AW**; posterior transverse width: **PW**. Tooth nomenclature is based on Patterson and Wood (1982); B) Institutional: **MACN**: Museo Argentino de Ciencias Naturales 'Bernardino Rivadavia', Buenos Aires; **MCNAM**: Museo de Ciencias Naturales y Antropológicas 'J. C. Moyano', Mendoza; **MLP**: Museo de La Plata.

DISCUSSION AND CONCLUSIONS

The rodents of the genus *Scleromys* are here included in the Family Dinomyidae, which in turn is assigned to the Superfamily Chinchilloidea according to Horovitz *et al.* (2006). *Scleromys* is known from the different levels of the Pinturas Formation (Kramarz and Bellosi, 2005; Kramarz, 2006) and the Santacrucian levels of Patagonia. Two species of *Scleromys* were recognized for the Laventan (Middle Miocene, Colombia; Fields, 1957), but this generic assignment has been repeatedly challenged (Patterson and Wood, 1982; Walton, 1997; Kramarz, 2001).

The species of *Scleromys* are protohypsodont with a great amount of dental morphological change with ontogeny, basically due to flexi/ids closure,

fossette/ids disappearance, and change in molar (specially m1) size and outline. This makes an accurate determination difficult when dealing with only one specimen. For this reason, the new material is not determined at specific level.

The Santacrucian species *S. osbornianus* Ameghino and *S. angustus* Ameghino are more derived than the one represented by the new material from Mendoza in their greater degree of hypsodonty. In contrast, this lesser hypsodonty is similar to that displayed by *S. quadrangulatus* Kramarz from the Pinturas Formation, suggesting they may represent a similar evolutionary stage, and that they could be similar in age. In fact, the above mentioned differences in dental morphology

between *Scleromys* sp. and *S. quadrangulatus* (specially very transverse molars and moderately straight anterior wall) might be due to the different degree of wear displayed by the known specimens, and eventually both taxa might prove to pertain to the same species.

Scleromys quadrangulatus comes from the lower and middle sequences of the Pinturas Formation, and it is replaced in the upper member by the Santacrucian species *S. osbornianus* (Kramarz and Bellosi, 2005; Kramarz, 2006). Lower and middle sequences bear the typical Pinturan fauna ('faune Astrapothericuléen'), considered by Ameghino (1906) older than the Santacrucian faunas, and informally recognized by some authors as Pinturan assemblage, mainly based on rodents (Kramarz and Bellosi, 2005). Contrarily, the upper member of the Pinturas Formation has been assigned to the Santacrucian based on its hystriognath rodent assemblage (Kramarz and Bellosi, 2005). These authors stated that the Pinturan rodents are more primitive than those from the Santacrucian, the lesser degree of hypsodonty being one of the most conspicuous differences, such as the one seen between *S. quadrangulatus* and *S. osbornianus*.

On the other hand, the previously known mesotheriid (Cerdeño, in press) is very similar if not identical to one species from the Chucal Formation (Chile), which has been assigned to the Santacrucian age (Croft *et al.*, 2004), constrained between 17.4 and 18.79 or 21.7 Ma (based on different isotopic data).

Croft *et al.* (2004) stated that the time interval of the Chucal fauna overlaps or slightly pre-dates the Santacrucian age, but they did not consider the Pinturan fauna as a different mammal association. However, the radioisotopic data allow some

equivalence with the Pinturas Formation and, in addition, other taxa establish differences (*e.g.*, mesotheriid diversity, absence of interatheriids) with respect to the well known Santacrucian samples in Argentina and southern Chile, attributed by Croft *et al.* (2004) to ecological and/or biogeographic factors. In the uppermost part of the Sarmiento Formation at Gran Barranca (Chubut), there is a faunal assemblage similar to the Pinturan fauna, ranging between 18.28 and 18.78 Ma (Madden *et al.*, 2005; Vucetich *et al.*, 2005; Carlini *et al.*, 2005). Therefore, the Pinturan assemblage could range from 18.78 to 16.5 Ma; the Chucal Formation would be included in this temporal range.

The Mariño Formation specimens support a preliminary biostratigraphic correlation between the middle member of that formation and the Chucal fauna, on one hand, and the Pinturan fauna on the other, although the scanty material from Mariño Formation precludes a finer analysis. Since the fossils of the Mariño Formation indicate an Early Miocene age, this implies a longer temporal extension than that supposed by Irigoyen (1997) and Irigoyen *et al.* (2000, 2002).

A detailed comparison between the Chucal and Pinturan faunas is needed, but it is beyond the aim of this paper. Future findings in the Mariño Formation, as well as a better understanding of mammals other than rodents from the Pinturas Formation and the description of mammals other than notoungulates from Chucal, will help to elucidate more precisely the biostratigraphic and biogeographic relationships among these three Early Miocene faunal assemblages. The geographic location of the Mariño Formation, intermediate between Chucal and Patagonian areas, will eventually permit a better understanding of the biogeographic history of the Miocene South American faunas.

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