



# Biostratigraphy and biochronology of the Monte Hermoso Formation (early Pliocene) at its type locality, Buenos Aires Province, Argentina



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## ABSTRACT

The Monte Hermoso Formation, cropping out at its type locality of Farola Monte Hermoso (Buenos Aires Province), is a classical fossiliferous unit of the South American Neogene, highlighted by the abundance and diversity of its vertebrate remains. However, its biostratigraphy and age have been largely debated, and numerous discrepancies and controversies have been stated. In this regard, the result of the analysis of new materials recovered from the different levels of this formation, following a strict control of stratigraphic provenance, is here reported. As well, the provenance of specimens of previous collections has been evaluated. The studied assemblage consists of Osteichthyes, Amphibia, Reptilia, Aves and Mammalia. These latter are the most numerous and belong to the Didelphimorphia, Polydolopimorphia, Rodentia, Notoungulata, Litopterna and Xenarthra. The recorded taxa suggest no important faunistic variations among the different levels of the Monte Hermoso Formation that would imply significant chronological differences, and hence, justify the recognition of two biostratigraphic units. The analysis of the first and last records as well as the taxa considered as exclusive, does not support the validity of the biozones of *Trigodon gaudryi* and *Neocavia depressidens* previously proposed. On this basis, a new scheme for the Monte Hermoso Formation at its type locality is proposed, including a new single biostratigraphic unit. This unit is the *Eumysops laeviplicatus* Range Zone, which represents the biostratigraphic base for the Montehermosan Stage/Age of the early Pliocene.

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## 1. Introduction

The biostratigraphic units of the late Cenozoic of South America are mainly based on the taxonomic content and distribution of the fossil mammal assemblages (Cione and Tonni, 2005; Cione et al., 2007; Deschamps et al., 2012). In this regard, numerous deposits including levels bearing a rich vertebrate fauna, especially mammals, of the late Miocene–Holocene are exposed at the Pampean Region (Argentina). These deposits, which sometimes include the type sections of the biostratigraphic units of the late Cenozoic, are among the most complete sequences in the continent (Zárate, 2005; Cione et al., 2007).

Farola Monte Hermoso, located at the south-west of the Buenos Aires Province (Pampean Region, Argentina; Fig. 1), is the type locality of the Monte Hermoso Formation, formally defined by Zavala

(1993), and one of the most important fossiliferous sites of the South American Neogene. Over time, numerous and varied designations have been used for this locality, including "Monte Hermoso" (Darwin, 1846; Ameghino, 1887; Vignati, 1925; Bonaparte, 1960), "barrancas de Monte Hermoso" (Monte Hermoso cliffs; Leanza, 1948; Fidalgo and Tonni, 1982), "barrancas de la costa atlántica situadas a unos 17 km al sudoeste de Pehuén co" (cliffs of the Atlantic coast some 17 km SW from Pehuén co; Tonni, 1974), "barrancas de la costa atlántica, aproximadamente a 60 km al este de Bahía Blanca" (cliffs of the Atlantic coast near 60 km east from Bahía Blanca; Reig, 1978) or "acantilados marinos cercanos a Bahía Blanca" (marine cliffs near Bahía Blanca; Cione and Báez, 2007).

The deposits currently included in the Monte Hermoso Formation (sensu Zavala, 1993) were mentioned by several authors (e.g. Darwin, 1846; Ameghino, 1887; Kraglievich, 1946; Bonaparte, 1960), who highlighted the abundance and diversity of vertebrate remains. Ameghino (1887: p. 332) noted that these deposits were "... atestados de fósiles. En todas partes se ven asomar puntas de huesos...aquí una mandíbula, allí un cráneo, más allá una pierna,

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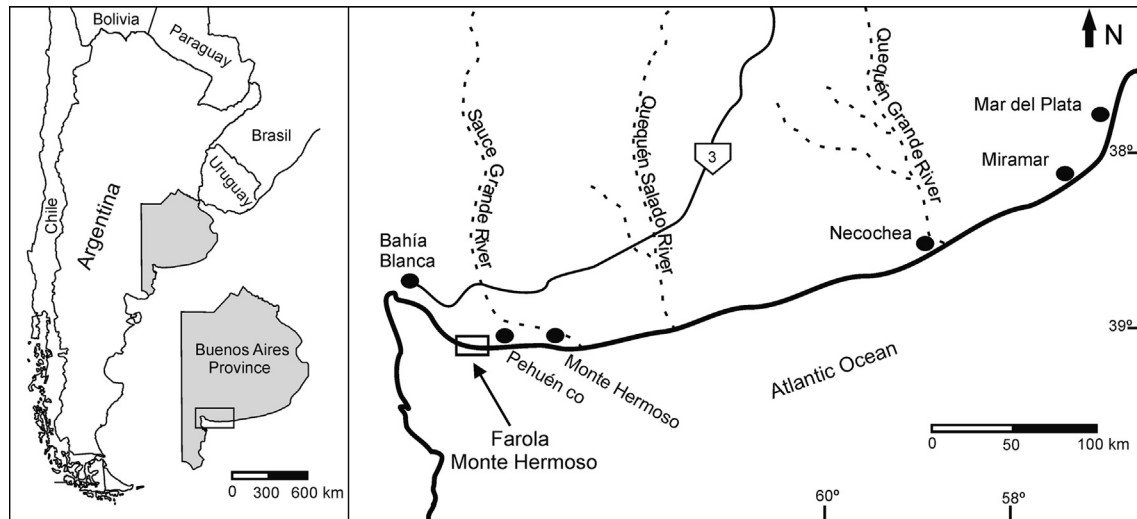


Fig. 1. Location map showing Farola Monte Hermoso, Buenos Aires Province, Argentina.

por otro lado un caparazón monstruo; se camina de sorpresa en sorpresa" (... full of fossils. Tips of bones are exposed everywhere... here a mandible, there a skull, a leg farther, or a monstrous carapace; we walk from surprise to surprise). In turn, this author was first to assign a precise age to these exposures, for which he defined the "Piso Hermosico" (Ameghino, 1889) or "Horizonte Hermosense" (Ameghino, 1908), of the upper Miocene.

Several authors (e.g. Willis, 1912; Wichmann, 1916; Kantor, 1922) recognized two levels in these deposits, different in color and separated by an important erosive discontinuity. Since these studies, the lower level was defined as "Hermosense típico" (Vignati, 1925) and the upper one was assigned to the "Piso Chapadmalense" (Vignati, 1948) or to a transitional horizon between the "Hermosense" and the classical "Chapadmalense" of the area of Mar del Plata–Miramar (Kraglievich, 1946; Parodi and Kraglievich, 1948; Fig. 1). Based on faunistic differences recorded between both levels, a biostratigraphic and biochronologic scheme was proposed for the Monte Hermoso Formation, which included two biozones chronologically successive (Tonni et al., 1992; Cione and Tonni, 1995, 1996, 2001, 2005). The fauna from the lower level, the "Hermosense típico", was assigned to the *Trigodon gaudryi* Biozone, as the biostratigraphic base of the Montehermosan Stage/Age (late Miocene–early Pliocene), whereas that of the upper level, related to the "Piso Chapadmalense" was included in the *Neocavia depressidens* Biozone, as the biostratigraphic base for the lower Chapadmalalan Stage/Age (early Pliocene).

Other authors (e.g., Frenguelli, 1928; Bonaparte, 1960; Deschamps et al., 2012; Olivares et al., 2012; Tomassini, 2012; Tomassini and Montalvo, 2013) noted that the geological and paleontological differences recorded within the Monte Hermoso Formation were minimal, so that it was impossible to define with certainty the existence of two levels of different age.

The different interpretations both from the litho and biostratigraphic point of view and the chronological aspects arise mainly in the different denominations of the site, and in the interpretations of the fossil-bearing levels, as well as in the use of controversial taxa. This latter because of dubious taxonomic assignment or dubious or unknown provenances, at least at the time when the schemes were proposed (Tonni et al., 1992; Tomassini, 2012).

Bearing this in mind, the aim of the present paper is to report a new assemblage recovered from the different levels of the Monte Hermoso Formation with precise stratigraphic provenance. The

faunistic list is updated, and the validity of the biostratigraphic scheme previously proposed is discussed on the basis of new records and the analysis of specimens from previous collections. Finally, a new biostratigraphic unit is proposed for this formation.

## 2. Geographic and stratigraphic setting

The fossiliferous site Farola Monte Hermoso (S 38°58'01", W 61°41'43") is located on the Atlantic coast, at the south-west of the Buenos Aires Province (Pampean Region, Argentina), approximately 53 km of Bahía Blanca city and 12 km of Pehuén co Beach (Fig. 1). The deposits are represented by NW–SE coastal cliffs exposed along three km, with variable heights that reach 15 m maximum.

This site is the type locality of the Monte Hermoso, Puerto Belgrano and Punta Tejada formations, corresponding to the early Pliocene, late Pleistocene and late Pleistocene–early Holocene respectively (sensu Zavala, 1993). In the first unit, the biozones of *T. gaudryi* and *N. depressidens*, belonging to the Montehermosan and lower Chapadmalalan stages/ages respectively, were defined by Cione and Tonni (2005). These authors assigned the first one to the late Miocene–early Pliocene and the second to the early Pliocene.

According to Zavala (1993), the Monte Hermoso Formation crops out at the lower and middle sector of the cliff along its entire exposure, with 6 m of maximum thickness, and base covered (Fig. 2). Zavala and Navarro (1993) recognized architectural elements of channel, overbank deposits and lateral accretion deposits. In turn, they interpreted that the Monte Hermoso Formation was deposited through a fluvial dynamic of high-sinuosity rivers similar to those proposed by Miall (1985) as "muddy fine-grained rivers".

The overbank deposits display a wide lateral extension in the abrasion platform and the lower part of the cliff; and include the Fl and Fm facies. These levels are equivalent to the "Hermosense típico" of Vignati (1925) and Bonaparte (1960), the "Unidad A" of Fidalgo et al. (1975), and "Unidad Litoestratigráfica I" of Fidalgo and Tonni (1982) (Fig. 3).

The Fl facies is composed mainly of silty mudstones, ranging from reddish brown to yellowish brown; though reddish brown sandy siltstones and silty sandstones are also present. These deposits show a very fine lamination in the lower sector, while in the middle-upper one they are massive (Fig. 2). Besides abundant fossil

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