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Paleoenvironmental reconstruction of central-western Argentina from analysis of Late-Pleistocene mammal droppings

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ABSTRACT

Plant macrofossils studied in coprolites from small-sized, medium-sized and large mammals, dated by ^{14}C to ca. 30.8–24 and 9 kybp, allowed to record changes in local vegetation and its relation with geomorphological units. Paleobotanical samples were determined using microhistological analysis. We found that plant associations and the vegetation–geomorphology relation were similar in the two periods analyzed. According to this study, the Monte plant formation would reflect certain stability during the analyzed period in arid central-western Argentina, although this does not imply the absence of variations in plant structure.

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1. Introduction

Reconstruction of the paleoclimate of southern South America for the last glacial cycle provides valuable information related to global climate change. The analysis of faunal feces is a fruitful means for the reconstruction of environmental conditions in the past. Small and medium-sized mammals are important components of the faunal communities in South America; however their fossil record is still scarce. In America, paleoenvironmental studies of feces and contents of caves of small mammals (rodents) have been conducted in desert areas of the United States and northern Chile (Betancourt et al., 1990; Latorre et al., 2001, 2002, 2006) including the last 40 ^{14}C kybp. Microhistological and DNA studies were made on feces from large mammals from different places in the USA (Phillips, 1984; Poinar et al., 1998; Thompson et al., 1980). In South America, instead, paleoenvironmental reconstructions for the Pleistocene have mostly focused on pollen (Heusser, 1983; Markgraf et al., 1992; Páez et al., 2008; Zárate and Páez, 2002) and glacier studies (Porter, 1981; Rabassa and Clapperton, 1990). The present knowledge of Late Quaternary environmental change in subtropical central-western Argentina is fragmentary, particularly because dated records from feces are scarce, pollen analyses are mostly restricted to the Holocene, and a general model of Pleistocene glacial advances is not yet available.

The paleoecological record obtained from recent stratigraphic excavations at the site Gruta del Indio (Mendoza), central-western Argentina, reveals the presence of coprolites from small, medium-sized and large mammals, this record being unique in South America. Analyzing this record represents the first contribution to the reconstruction of paleoenvironmental conditions of the late Pleistocene in the area around 34° S, based on microhistological studies (García and Martínez Carretero, 2010; Martínez Carretero et al., 2009). The archaeological material from Gruta del Indio's first excavations was examined by Lagiglia (1956, 1977; Semper and Lagiglia, 1968), while D'Antoni (1976) and D'Antoni and Markgraf (1977) made paleoclimatic considerations from pollen analyses. New excavations carried out since 1997, within the dripline of the cave, at the limit between squares R8 and R9, provided a stratigraphic profile that is basically coincident with the one proposed by Lagiglia (1977). Plant samples obtained provide information about paleoenvironmental and biogeographical evolution in the area for the period 30.8–9 ^{14}C kybp.

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2. Study area, stratigraphy and chronology

The site Gruta del Indio is located in the area known as Rincón del Atuel at 34° 45′S–68° 22′W, in central-southern Mendoza, Argentina. The area around the site is constituted by a basaltic outcrop next to the Atuel River, located 20 m above the alluvial plain. Under the outcrop, water erosion formed a cave which was later filled with gravel, sand and slime, dominant elements in the profile (Semper and Lagiglia, 1968), and with finer illuviated materials.

Vegetation of the studied area corresponds mostly to the Monte and Cardonal phytogeographic provinces (Martínez Carretero, 2004; Roig et al., 1995) (Fig. 1). Based on the present work, plant communities in the study area were classified as: a) Monte communities (*Larrea divaricata–Larrea cuneifolia*, Roig, 1989); b) Monte riparian communities (*Senecio–Proustia cuneifolia*, Roig, 1989); and c) Communities on xeric rocky slopes of the Cardonal (*Dolichlasium lagascae*, Roig and Martinez Carretero, 1998). In the comparative table (Table 2) species were arranged according to these plant communities.

The sedimentary profile exposed by the excavation shows four layers. Upper Layers 1 and 2 consist of yellowish brown, fine slimy sediment, differing only in the grade of cohesion (Fig. 2). Layer 3 is the only one having fecal pellets of extinct Pleistocene mammals, along with feces of extant species, such as those of *Lagidium viscacia*. Pleistocene megafauna bones, wood fragments and a few small chalcedony flakes (supposed to correspond to Layer 2 or upper part of Layer 3) are also present. Layer 3 is composed of brown (10 YR 5/3) fine sediment with small fragments of basaltic rock fallen from the ceiling of the cave. Both color and composition of sediments are homogenous throughout the layer, showing no signs of alteration by post-depositional agents (such as burrowing rodents, ants, and geological displacements). The presumably vertical movement of the small flakes (García and Lagiglia, 1999) suggests that alteration processes occurred in the excavation area, although they must have been quite restricted, as shown by the integrity of megafauna feces and by the absence of both inclination in rock and wood fragments and intrusion of sediments different from those of Layer 3. Feces are isolated, not forming a midden, generally in horizontal position and showing high level of integrity. This integrity, however, decreases from the upper to the bottom part of Layer 3. Lagiglia previously (1956) indicated the presence on the site of remains of large mammals attributed to *Megatherium* sp. and *Mylodon listai*, including some big feces now exhibited in the Museum of Natural History of San Rafael. The mammal pellets analyzed in this study are smaller (Fig. 3), and similar to those of *Hippidion* sp. found in Gruta Los Morrillos (Gambier, 1995). Taking also into account that bones of *Hippidion* have been identified in the record of Gruta del Indio (García, 2003), we assigned our dung samples to this taxon. Finally, Layer 4 presents a dark sand deposit with neither cultural nor faunal remains.

Several ^{14}C dates were obtained through analyses of megafauna feces from R8/R9 performed by the Tritium and Radiocarbon Laboratory (Latyr) of La Plata University. Each sample consisted of a single pellet or two adjacent megafauna excrements. The absolute stratigraphic coherence of coprolite dates (Garcia and Lagiglia, 1999) minimizes eventual differences related to the high standard deviations obtained. Table 1 shows the occurrence of two periods of sediment and pellet deposition for Layer 3. The radiocarbon dates indicate that the record of the oldest period in R8-R9 begins at least

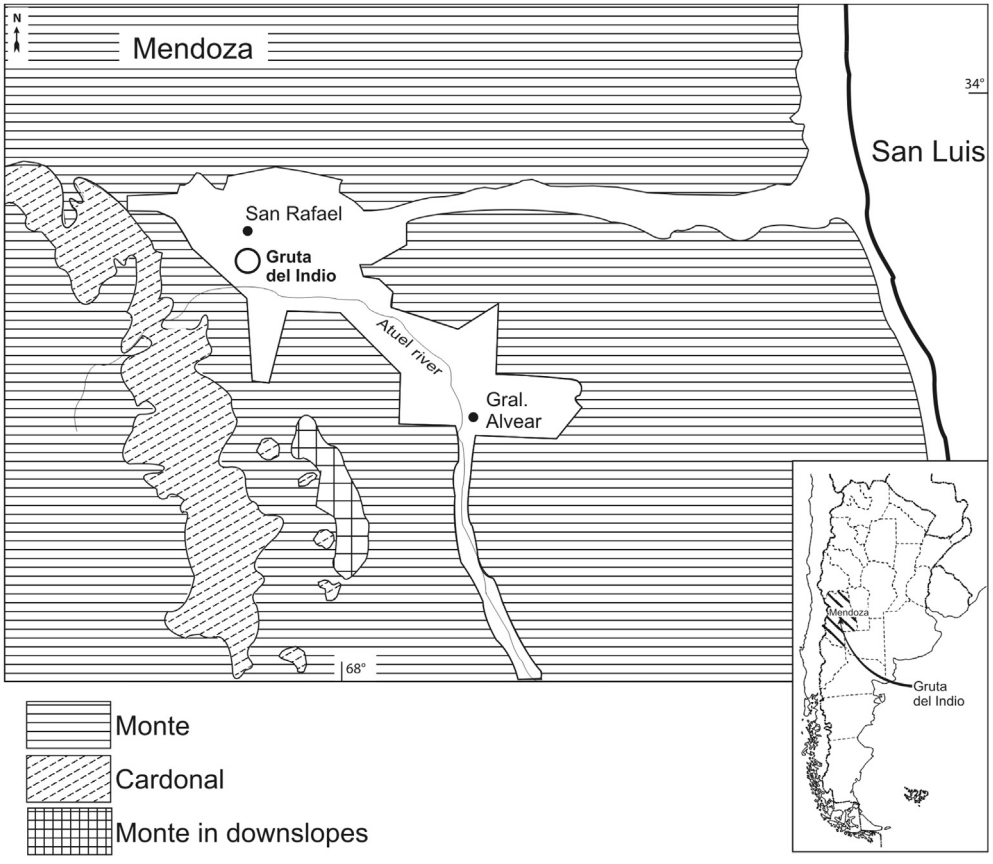

Fig. 1. Vegetation map of Gruta del Indio area.

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