



## Earthen mound formation in the Uruguayan lowlands (South America): micromorphological analyses of the Pago Lindo archaeological complex

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### ABSTRACT

The stratigraphic excavation of the Pago Lindo archaeological complex, in central-eastern Uruguay (La Plata basin), helped to propose an alternative model for mound formation that expresses the intrinsic complexity of prehistoric earthen architecture. This model, known as the spatial–temporal discontinuous model, sees mound complexes as multi-functional areas, with diverse earth works occupied and abandoned intermittently. Since earthen mound sediments are homogeneous, resemble natural soils and show evidences of intense bioturbation, soil micromorphology was used to confirm, refute and further investigate issues raised during field work, related with the prime material used for mound construction, detection of major episodes of mound building, identification of activity areas and taphonomic processes. In this paper, we present the results of the micromorphological analyses of two different earth works from the Pago Lindo archaeological complex (a mound and a micro-relief). Analyses proved the recurrent use of surface horizons for mound and micro-relief building throughout the entire period of site occupation. It also demonstrated the difficulty in identifying discrete depositional episodes and occupation surfaces, because of the intense bioturbation. Two activity areas were recognized: a domestic hut built over a platform, ca. 1600 yrs. BP; and an area of plant residue accumulation over a platform, raised almost 800 hundred year after the domestic hut. The practice of cleaning the occupation surfaces was interpreted from the complete absence of bioarchaeological remains (bones and micro-charcoal). The use of micromorphology as a complementary tool in the stratigraphic excavation of Pago Lindo unraveled evidences that corroborate a newly proposed model for mound growth.

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### 1. Introduction

The South American lowlands comprise a broad region of the continent whose pre-Columbian populations have traditionally been viewed as mobile groups of hunter–gatherers (Steward, 1944). In some specific areas of the lowlands, such as the Amazon basin, llanos de Moxos, Pantanal and Paraná delta, recent archaeological research has proved that intense social changes took place at around 1000 AD which include: rising of complex societies; growth of densely populated villages; technological specialization; earthen architecture; slash and burn agriculture; and plant management (Balée and Erickson, 2006; Barreto, 2006; Bonomo et al., 2011; Erickson, 2008; Heckenberger et al., 2003; Neves and

Petersen, 2006; Roosevelt, 1999; Schaan, 2008; Wüst and Barreto, 1999). In this paper, we will focus on the Uruguayan lowlands, located in the south-east of the continent. The region has the earliest evidences of cultivars and village systems of South America, which date back to the mid-Holocene (around 4000 yrs. BP) (Iriarte et al., 2004). These innovations developed independently from the Amazonian cultural complexes and belong to the earthen mound culture of the La Plata basin, which appears from 5000 BP, in the east of Uruguay and south of Brazil, associated to permanent and semi-permanent wetlands, prairies with palm trees and lagoons.

The first earthen mounds in Uruguay, locally known as *cerritos*, appear around ca. 5000–4800 years BP in the south eastern wetlands (Bracco, 2006; Bracco et al., 2000a; Lopez Mazz, 2001). These are artificial mounds of 20–40 m in diameter and 0.5–7 m high, of diverse shape and function whose construction may have taken hundreds to thousands of years (Lopez Mazz, 2001). Mound complexes are formed by circular, elliptical and horse-shoe arrangements of earthen structures, frequently with a central

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plaza. The high density of mounds, the contemporaneous growth of many of them and the regularities detected in their spatial arrangement lead to the interpretation of an architectural planning for the development of mound complexes (Gianotti, 2005; Iriarte et al., 2004; Iriarte, 2006; Lopez Mazz, 2001). Earthen mounds are only one of many earth works that exist in the Uruguayan lowlands, which include micro-reliefs (mounds of less than 1 m high), platforms, elongated rises, borrow pits (Bracco et al., 2000a; Femenías et al., 1990; Lopez Mazz and Gianotti, 1998; Iriarte, 2006; Lopez Mazz, 2001), anthropic lagoons and channels (Gianotti et al., 2009).

In the 1990s researchers proposed that mounds were built by complex hunter–gatherers (Lopez Mazz, 2001; Lopez Mazz and Bracco, 1994). Later research identified village systems with horticulture (Iriarte et al., 2004; Iriarte, 2006), ceremonial platforms (Bracco et al., 2000a; Gianotti, 2005; Lopez Mazz, 2001; Lopez Mazz and Gianotti, 1998) and burial mounds with evidences of different mortuary practices, such as single craniums and bodies with violence marks (Gianotti and Lopez Mazz, 2009; Pintos and Bracco, 1999). These evidences lead researchers to propose that mound builders point to an incipient Formative period in the region (Iriarte et al., 2004; Lopez Mazz, 2001). Some researchers also proposed a local periodization for mound construction that includes two basic stages: the preceramic mound period (ca. 4500–3000 BP), characterized by mixed economies (Iriarte, 2006), with high residence mobility, bifacial lithic technology (Lopez Mazz, 2001) and domestic earthen mounds (Gianotti, 2005); and the ceramic mound period (ca. 3000– until contact with Spanish colonizers), characterized by increased sedentism, demographic growth, ceramic technology (Lopez Mazz, 2001) and burial mounds (Lopez Mazz and Gianotti, 1998; Gianotti and Lopez Mazz, 2009).

### 1.1. Traditional models for mound growth

Two models have been proposed for mound growth, which result in substantial interpretations on the cultural dynamics of the populations responsible for the formation of earthen mound complexes: 1) the “layer-by-layer growth model” (LBL) refers to the intentional digging of soil as prime material for construction of domestic, ceremonial and funerary platforms through organized labor, within a frame of emerging complexity among hunter–gatherers, seen as social systems with and incipient hierarchy and semi-sedentary settlement patterns (Cabrera, 2000; Gianotti, 2005; Iriarte et al., 2004; Lopez Mazz, 2000, 2001; Pintos, 1999); 2) the “continuous growth model” (CG), which states that living in the same place caused the accumulation of sediments in a mound-shaped structure, thus questioning the intentionality behind mound formation, refusing the deliberate construction of platforms and denying the social complexity associated with the supposedly earthen architecture (Bracco, 2006; Bracco and Ures, 1999).

New strategies for the excavation and analyses of earthen mounds, proposed by Gianotti et al. (2009), are being used to test the two models and unravel the architecture and social dynamics involved in mound formation. This novel approach involved the meticulous excavation of earthen mounds from the Pago Lindo archaeological complex, in north eastern Uruguay, where occupation spans from 3000 to 700 yrs. BP. The archaeological complex is formed by tens of mounds of different shapes and sizes, some of them reaching 300 m long and 30 m wide, with almost 4 m high. The whole complex has a semi-circular arrangement that follows a meander from an affluent stream of the Caraguatá River (Fig. 1A). Most structures are placed over the bar deposit. Two possibly anthropic lagoons were identified in the site, one that is currently active and located in the center of a group of mounds, and a second

silted lagoon located to the south east of the mound complex (Fig. 1B).

The excavation of Pago Lindo is based on the hypothesis that earthen mounds grew from overlapping domestic occupations of seasonal and/or semi-permanent settlements, as has been proposed for other regions of the country (see Iriarte, 2006). To test this hypothesis, wide areas of the site have been studied following the method of stratigraphic excavation proposed by Carandini (1997) and Harris (1991). This led to the proposal of a third model for mound formation, named by Gianotti et al. (2009) as the “spatial–temporal discontinuous model” (STD).

The model states that earthen mound formation does not follow a unidirectional sequence of accumulating sediments in the same place, whether intentionally or not. Since mounds are located within archaeological complexes formed by a diversity of earth works, mound building would be a compound process that involves the domestic occupation of one area with simultaneous platform building in another, relocation of habitation areas through time within the same space and seasonal abandonment of the site with re-occupation and shifts in site function. The stratigraphic excavation of Pago Lindo revealed the spatial complexity in mound formation that contradicts the first-sight simple stratigraphy of Uruguayan earthen mounds. It unveiled evidences that confirm the STD model, such as: borrow pits within the mound complex; clear construction events that increase mound height; platforms and foundation layers for domestic occupation; occupation floors circumscribed by post molds; and differential concentration of stone and ceramic artifacts in specific areas of the mound complex.

To confirm or refute field observations made during the stratigraphic excavation of the site, such as identification of discrete episodes of mound construction, activity areas, occupation floors and post-depositional processes affecting the integrity of the archaeological record, micromorphological analyses were done for the first time in Uruguayan archaeology. Soil micromorphology is the microscopic study of undisturbed soil and sediment samples to interpret the depositional and post-depositional processes involved in their genesis. In archaeology, it is widely used for site formation studies and identification of activity areas (Courty et al., 1989; Courty, 2001).

Micromorphological studies on earthen mounds have been made in urban tells (Ge et al., 1993; Matthews, 2010; Matthews et al., 1997; Milek, 2012), medieval artificial hills (Gebhardt and Langohr, 1999) and monumental structures from the North American Late Archaic and Formative periods (Sherwood and Kidder, 2011). In these sites, complex stratigraphies are already visible at the macroscopic scale and micromorphology is used to refine field observations on living floors, trampling, spatial distribution of activity areas, site function (ritual and domestic spaces), cultivation practices, cattle enclosures etc. Few micromorphological studies have been made in earthen mounds made of homogeneous deposits that resemble natural soils (see Arroyo-Kalin, 2008; Cromeens, 2005), such as the Uruguayan earthen mounds, where the macroscopic indicators of stages in mound formation (e.g. sharp boundaries between layers) and activity areas (e.g. trampled surfaces) are less evident. In these contexts, the microscopic differences and particularities of stratigraphic units, mostly erased by pedogenic processes, must be searched in subtle changes in texture, microstructure, c:f ratio, composition of the micromass and pedofeatures.

In this paper, we will focus on the micromorphological analyses of one earthen mound and a micro-relief in the Pago Lindo archaeological complex. The aims of this work can be summarized as: 1) investigate the sources of the sedimentary material used for mound building; 2) define the similarities and differences between stratigraphic units from diverse features within the archaeological

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