

Neolithic occupation and mid-Holocene soil formation at Encosta de Sant'Ana (Lisbon, Portugal): a geoarchaeological approach

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Abstract

Excavations at the archaeological site of Encosta de Sant'Ana (Lisbon, Portugal) uncovered a mid-Holocene buried alluvial soil associated with early Neolithic occupation layers. Routine laboratory analyses and micromorphological observations were undertaken on the soil material. Humic acids from its Ab horizon, as well as Neolithic ecofacts, were radiocarbon dated. The dates obtained indicate that soil was formed between c. 8.0 and 6.0 cal ka BP and that the pedological evidence fits the record of the North Atlantic Holocene IRD events ("Bond events") and the so-called "Holocene climate optimum". The geoarchaeological record reveals that Neolithic inhabitants settled upon a stable surface, still affected by soil formation that was suddenly interrupted by slope wasting, probably in correspondence to Bond event 4, at c. 6.0 cal ka BP. © 2006 Published by Elsevier Ltd.

Keywords: Neolithic; Mid Holocene; Radiocarbon dating; Humic acids; Soil formation; Holocene IRD events

1. Introduction

The archaeological site of Encosta de Sant'Ana (from now onwards: ESA) is located in downtown Lisbon, Portugal, along a slope crossed by the 14th century town wall. Its coordinates are 38°43'02" N and 09°08'02" W (European Datum); its altitude ranges from 15 to 20 m (Fig. 1).

Salvage excavation at the site began in 2002 and, after a short interruption, was recommenced in 2004. Fieldwork uncovered an impressive archaeological succession that includes Neolithic and Bronze Age dwellings, part of the Roman town's cemetery, Islamic layers and features, medieval houses, and the rubble of the 1531 and 1755 earthquakes, which strongly affected this part of Lisbon (Angelucci, submitted; Angelucci et al., 2004; Muralha et al., 2002).

The oldest human traces observed at ESA are the Neolithic accumulations of shells in stratigraphic unit SU 5, which are embedded in a buried Ab horizon, and the occupation floor of SU 4, which rest on top of the same horizon. Charcoal fragments from SU 4 were dated to 5420 ± 45 BP (Sac-1893) and 5140 ± 140 BP (Sac-1894; see Table 1 and Angelucci et al., 2004). The Ab horizon is part of a buried alluvial soil profile. Here we present the radiocarbon dates obtained on the shell fragments of SU 5 and on the humic acids of the Ab horizon. These new dates are relevant for reconstructing the chronology of the process of Neolithization of the Lisbon region and the development of the environment in mid-Holocene times.

2. Site presentation

Lisbon is on the northern shore of the River Tagus' estuary, at a short distance from its opening into the Atlantic Ocean, in the Portuguese Estremadura region. Downtown Lisbon—the so-called *Baixa Pombalina*—occupies a small alluvial plain

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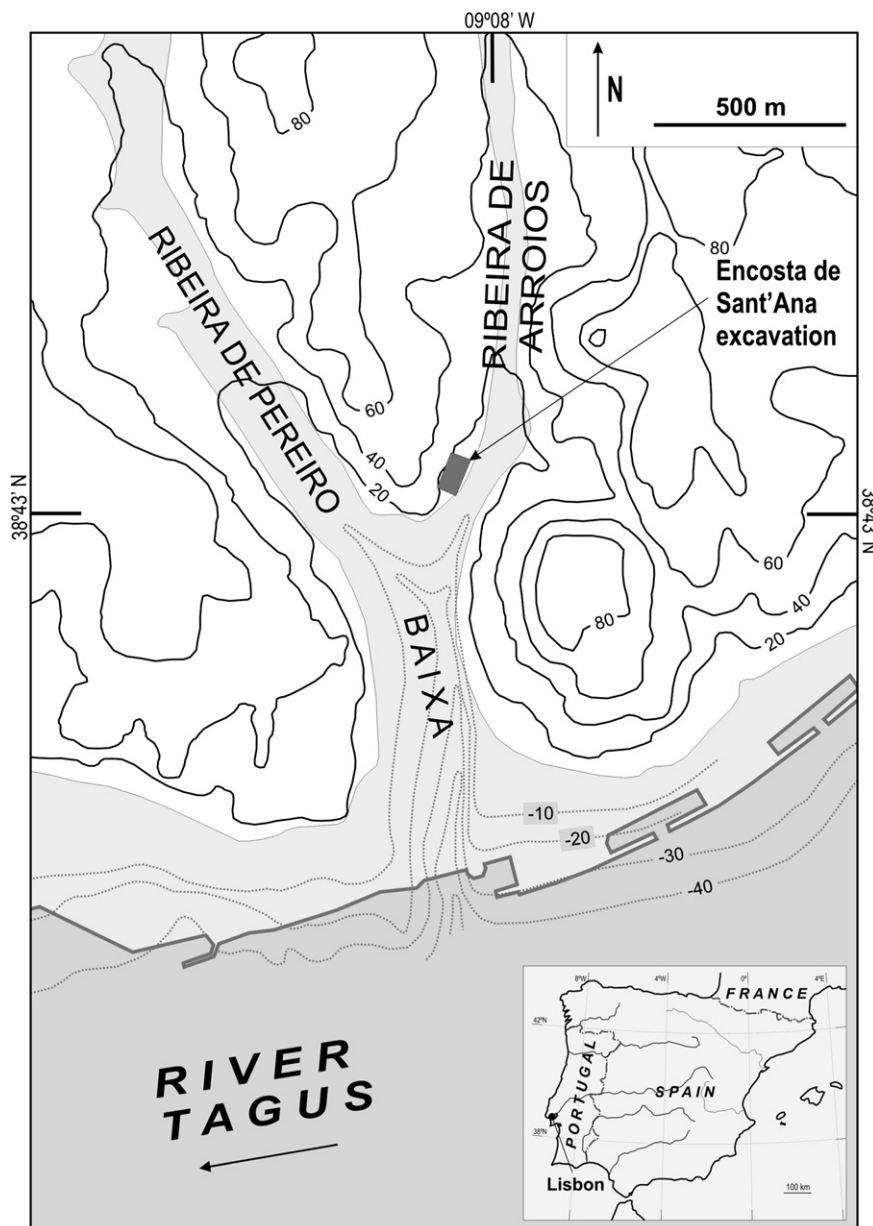


Fig. 1. Topography of present-day downtown Lisbon. Countour line intervals are 20 m; the shaded area represents the extension of Quaternary sediments; dotted lines correspond to the depth of the boundary between Quaternary sediments and pre-Quaternary (Miocene) bedrock (partly after Almeida, 1986).

derived from the late glacial and Holocene infilling of an inlet of the Tagus' estuary (Almeida, 1986). Two valleys—the *Ribeira de Pereiro* and the *Ribeira de Arroios*—today corresponding to major urban axes of Lisbon, converge into the *Baixa* plain. ESA is situated at the outlet of the *Ribeira de Arroios*, on its right slope, facing SE (Fig. 1).

The bedrock of the ESA's slope is composed of an alternation of sands, silty sands and sandstones with intercalations of limestone and marl. They all belong to the “*Areolas de Estefânia*” geological formation, a part of the “Lisbon Miocene Series”, which includes continental, coastal and marine sediments (Almeida, 1986). At the foot of the slope and towards the valley centre (present-day *Martim Moniz* square) the Miocene bedrock sinks under the alluvial sediments on which the buried soil developed.

This soil represents the base of the thick archaeological succession that spans the Neolithic to the present and comprises three main stratigraphic complexes (Angelucci et al., 2004; Muralha et al., 2002): (a) the Neolithic layers and structures (SU 5 and SU 4); (b) a lower slope waste complex (SU 3), featuring a layer with Bronze Age occupations (SU 2); (c) an upper slope waste complex (SU 1), containing Roman, Islamic and Medieval layers, covered by the rubble of the post-medieval earthquakes.

Neolithic layers and archaeological features were detected both along the slope and at its base (Angelucci et al., 2004). The Neolithic assemblages stratigraphically related to the buried soil are well-defined by both their ceramic and lithic content and refer to two different phases of the Portuguese Estremadura early Neolithic cultural complex—an ancient

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