

Evolution of the Sado estuary limit over the last 8400 years: implications for the Mesolithic communities

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ABSTRACT

In this work we present preliminary results of the palaeoenvironmental reconstruction of the Sado valley over the last 8400 years. The reconstruction relies upon environmental proxies in sediments taken from six cores collected between Arapouco and Laxique (Alcácer do Sal), near the Mesolithic shellmiddens found in the area. Additionally, electric resistivity profiles were used to characterize the subsurface Sado valley configuration. Results suggest a more or less extensive brackish environment since, at least, 8400 cal BP in the studied area, i.e. there is evidence for the influence of marine water in the vicinity of the area occupied by the Mesolithic groups.

RESUMO

Neste trabalho são apresentados os resultados preliminares da reconstrução paleoambiental do vale do Sado nos últimos 8400 anos. As interpretações fundamentam-se na análise de indicadores ambientais de sedimentos obtidos em 6 sondagens recolhidas entre Arapouco e Laxique (Alcácer do Sal), localizadas na proximidade da área ocupada pelos caçadores – recolectores do Mesolítico Final. Adicionalmente, foram executados perfis de resistividade eléctrica com o objectivo de compreender a configuração subsuperficial do vale. A interpretação dos resultados aponta para a presença de água salgada nas proximidades da área ocupada por estes grupos de caçadores-recolectores no Mesolítico.

INTRODUCTION

Since the Last Glacial Maximum (LGM) several environmental and landscape changes occurred in response to a major climatic re-organisation. Those changes are particularly visible in coastal areas that, due to the sea-level rise induced by global warming, were flooded or led to the formation of “new” boundary spaces at the interface between land and sea.

The surroundings of estuarine areas shaped contemporaneously to the maximum reach of marine influence of the Holocene transgression, particularly on the Tagus and Sado rivers, were occupied and exploited by Late Mesolithic hunter-gatherer communities between c.8400 and 7000 cal BP (e.g. Arnaud, 1989, Diniz and Arias, 2012). These groups are known to have exploited high quantities of marine resources and recent data reveals large asymmetries concerning marine resources consumption within Sado shell middens that remain to be explained (e.g. Peyroteo-Stjerna, 2016). However the maximum extension of marine invasion in the Sado river has never been studied since it was predicted (e.g. Arnaud, 1989) that the shell middens area should be similar to Tagus paleoestuary environment.

In this work we present preliminary results of multiproxy analysis combined with a detailed ¹⁴C dating program performed in six sediment cores collected upstream the present-day limit of the Sado estuary, between Arapouco and Laxique (Alcácer do Sal; Figure 1-A and -B). The palaeoenvironmental reconstruction is also supported by several electric resistivity profiles performed in the Sado alluvial plain (Figure 1-C).

METHODS

Sediment cores were measured for magnetic susceptibility (MS; Bartington equipment) and then open, described, weighted and freeze-dried. Sub-samples were analysed for grain-size (Malvern laser equipment), calcium carbonate (CaCO₃; Eijkelkamp calcimeter), organic matter (OM; method adapted from Kristensen (1990)) and organic carbon (C_{org}; ThermoFinnigan elemental analyser) contents, and for diatoms identification. Electrical resistivity profiles were performed with an ABEM 4000 resistivity meter with Lund system.

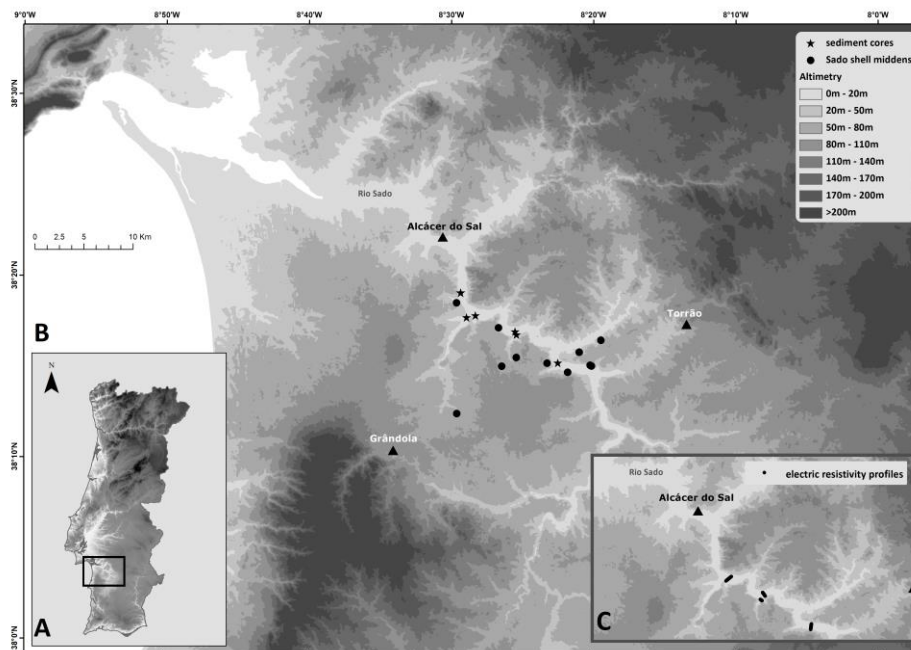


Figure 1. A- Location of the Sado Valley in Portugal; B – Location of the sediment cores analysed in this work and the Mesolithic archaeological sites from Sado estuary; C – Location of the electric resistivity profiles.

RESULTS, DISCUSSION AND CONCLUSIONS

The interpretation of the electric resistivity profiles allows recognising a deeply incised valley (~40m) in the main Sado channel in opposition to less deeper valleys in the tributaries. The ^{14}C dates obtained for the base of each sediment core indicate higher sedimentation rates at the Sado main stream than in the tributaries. The analysed proxies, particularly MS, MO and diatom assemblages, reflect the marine influence upstream the present-day estuary and within the Sado river, reaching at least the westernmost area occupied by Late Mesolithic groups. The results of the organic carbon in sediment reflect a mixed source between terrestrial and marine components with exception of the topmost section of the cores where the terrestrial/fluvial component increases in importance. Major differences in the results (MS, MO and diatoms) occur at a depth similar to the present mean sea level, pointing to higher fluvial influence and to the aggradation of the alluvial plain. Pulses in the sea level rise rate (ca. 3600 cal BP) may have promoted higher sedimentation rate, at least, at Arapouco.

In conclusion, our data points to an estuarine environment between Arapouco and Laxique during the Late Mesolithic occupation, with favourable conditions for the local exploitation of marine/estuarine resources. The definition of the maximum estuarine environment area it still in course of analysis.

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