

SPATIAL EVOLUTION AND ARCHAEOLOGICAL CONTEXTUALIZATION THROUGH HOLOCENE EDAPHO-SEDIMENTARY DEPOSITS: AREOSO ISLAND (NW SPAIN)

EVOLUCIÓN ESPACIAL Y CONTEXTUALIZACIÓN ARQUEOLÓGICA A TRAVÉS DE DEPÓSITOS EDAPOSEDIMENTARIOS HOLOCENOS: ISLA AREOSO (NW ESPAÑA)

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Abstract

Areoso Island is located in the inner part of the Ría de Arousa, located on the Atlantic coast of northwestern Spain. With an area of 8 ha, it has a high density of Neolithic burial mounds. The island has a varied geomorphological heritage, highlighting the granite geoforms or the presence of edapho-sedimentary deposits. These coastal deposits are quaternary formations made up of unconsolidated material, which appear discontinuously throughout the Galician coastline. The analysis of its facies allows to detect past environmental changes, the study of which is of great interest in the field of Earth Sciences and of great use for other disciplines such as Archeology. The island has a high archaeological interest, highlighting the documented presence of five Neolithic funerary tumuli. At present, these constructions are threatened by marine erosion, derived from unique morphodynamic conditions.

The deposits were sampled in different sectors and environments of the island, obtaining an almost continuous chronological sequence of the edapho-sedimentary formation during the last 6000 years. This allowed reconstructing the palaeoenvironmental evolution, differentiating several stages, where the Holocene transgression played a fundamental role in its formation. 6000 years ago, with a sea level lower than today, the emerged surface was much higher than in the present, and could even be connected to the continent. These facts are relevant to archaeological interpretation, as they suggest that the burial mounds were not built in a coastal setting. The study of the ancient deposits of Areoso allows obtaining different proxies (sedimentary, geochemical, biological, archaeological), which are of great help to interpret the archaeological context, since anthropic activities are reflected in the resulting deposits. The high scientific and didactic interest of the ancient edapho-sedimentary formations makes it necessary to put them in value. This palaeoenvironmental information means that they should be considered natural heritage. In the current context of rising sea levels, many of them are seriously threatened, so it is necessary to promote their management and geoconservation, to the extent that natural processes allow. The objective of this work is to value them and proclaim their importance as environmental records.

Keywords: Edapho-sedimentary deposits, Archaeological sites, Holocene transgression, Natural heritage, Areoso Island (NW Spain)

Resumen

El islote Areoso se encuentra en la parte interna de la Ría de Arousa, situada en la costa atlántica del noroeste de España. Con una superficie de 8 ha, tiene una alta densidad de túmulos funerarios neolíticos. La isla tiene un patrimonio geomorfológico variado, destacando las geoformas graníticas o la presencia de depósitos edafo-sedimentarios. Estos depósitos costeros son formaciones cuaternarias conformadas por material no consolidado, que aparecen de forma discontinua por todo el litoral gallego. El análisis de sus facies permite detectar los cambios ambientales pasados, cuyo estudio es de gran interés en el campo de las Ciencias de la Tierra y de gran utilidad para otras disciplinas como la Arqueología. Este islote tiene un elevado interés arqueológico, destacando la presencia documentada de cinco túmulos funerarios neolíticos. En la actualidad, estas construcciones se encuentran amenazadas por la erosión marina, derivada de unas condiciones morfodinámicas singulares.

Los depósitos fueron muestreados en diferentes sectores y ambientes de la isla, obteniendo una secuencia cronológica casi continua de la formación edafo-sedimentaria durante los últimos 6000 años. Esto permitió reconstruir la evolución paleoambiental, diferenciando varias etapas, donde la transgresión del Holoceno ha jugado un papel fundamental en su formación. Hace 6000 años, con un nivel del mar más bajo que el actual, la superficie emergida era mucho más alta que la actual, e incluso podría estar conectada al continente. Estos hechos son relevantes para la interpretación arqueológica, ya que sugieren que los montículos funerarios no fueron construidos en un entorno costero. El estudio de los depósitos antiguos de Areoso permite obtener diferentes proxies (sedimentarios, geoquímicos, biológicos, arqueológicos), que son de gran ayuda para interpretar el contexto arqueológico, pues las actividades antrópicas se reflejan en los depósitos resultantes. El alto interés científico y didáctico de las formaciones edafo-sedimentarias antiguas hace necesario ponerlas en valor. Esta información paleoambiental hace que se deban considerar patrimonio natural. En el contexto actual de subida del nivel del mar, muchos de ellos se encuentran seriamente amenazados, por lo que es necesario promover su gestión y geoconservación, en la medida que los procesos naturales lo permitan. El objetivo de este trabajo es ponerlos en valor y proclamar su importancia como registros ambientales.

Palabras clave: Depósitos edafosedimentarios, Yacimientos arqueológicos, Transgresión holocena, Patrimonio natural, Islote Areoso (NO de España)

1. Introduction

The increasing scientific advance in recent times is mainly based on the constant development and implementation of technological innovations. However, the multidisciplinary approach of science has allowed the creation of synergies between different disciplines, optimizing the multiple approaches and the results obtained. An example of this collaboration is Geoarchaeology, which represents the collaboration between Geosciences and Archaeology. In this sense, Siart, Forbriger & Bubbenzer (2018) suggest that the application of geosciences has become an indispensable part of archaeological investigations, especially with regard to the geographical approach and field methods (e.g., analysis and dating of sediments and soils, geomorphological interpretation or geophysical surveys). The collaboration of Earth sciences can be very useful in archaeological contexts, helping in the interpretation of stratigraphy, the formation and conservation of the archaeological site, the evolution of the surrounding landscape and the potential influence of environmental conditions on the behaviour of prehistoric societies.

In the case of NW Spain, there are numerous examples of collaboration between Earth Sciences and Archeology, especially in relation to the study of the edapho-sedimentary deposits located next to archaeological sites. In the NW of Spain there are a number these types of deposits along the present

coastline, formed during the Late Pleistocene and the Early Holocene. These deposits have been studied in coastal (Costa-Casais et al., 2012a; Tallón-Armada et al., 2018; Cajade-Pascual et al., 2019; Mañana-Borrazás et al., 2020) and continental environments (Ameijenda Iglesias et al., 2010; Costa-Casais et al., 2012b; 2016; Fábregas Valcarce, 2003; Kaal et al., 2013; Barbeito Pose et al., 2015). The NW peninsular coast has a great density of these formations, which appear spared along the entire coast. The rarity of this high presence on the coast, gives these formations a high interest for the interpretation of environmental changes from the late Pleistocene to the middle Holocene (Costa-Casais et al., 2008; Costa-Casais & Caetano Alves, 2016). This uniqueness, together with the fact that they are formations threatened by erosion and anthropic activity, makes it necessary for them to be considered natural heritage and therefore, their protection and conservation must be implemented. (Costa-Casais & Domínguez-Almansa, 2018; Domínguez-Almansa et al., 2019, 2021)

2. Study area

The island of Areoso is located in the central part of Ría de Arousa, in NW Spain (Figure 1). The island is 8 ha in surface area, and is divided into two different sectors. The north sector is basically a lobe of sandy sediment with dunes partially phytostabilized, while the south is a granitic substrate covered by an aeolian mantle. Due to the topography of the area, the sediment that we find has a strictly local origin, since there are no nearby sources that can make new contributions of matter, except for material of biogenic origin. Areoso contains numerous traces of prehistoric activity, including five cataloged Neolithic funerary tumuli. The island also has an important and varied geomorphological heritage, highlighting the presence of edapho-sedimentary deposits and granite exhumation geofoms (gnammas, castle-kopje, balancing rock, tafoni, etc.). However, this natural and cultural heritage is threatened by high erosion rates, which particularly affect the western sector. Despite the fact that the island is in an area with low wave energy, since the 1980s, the dune front has receded by about 60 meters. This erosive dynamic is a consequence of the unique morphodynamics of Areoso, characterized by a process of rotation of the northern sandy lobe (Blanco-Chao et al., 2020). In recent years, erosive rates have decreased, but remain being important.

The dune sector contains some endemic plant species from NW Iberia (e.g., *Alyssum loiseleurii* subsp. *Gallaecicum*, *Angelica pachycarpa*). In addition, it is a dune habitat that acts as a breeding place for different species of seabirds. The island is uninhabited, but it is not free of anthropic pressure, as it is an excellent tourist place that is highly visited in the summer season. The arrival of large number of visitors makes it difficult to preserve the natural and cultural heritage, and is one of the factors in the destabilization of the dune front.

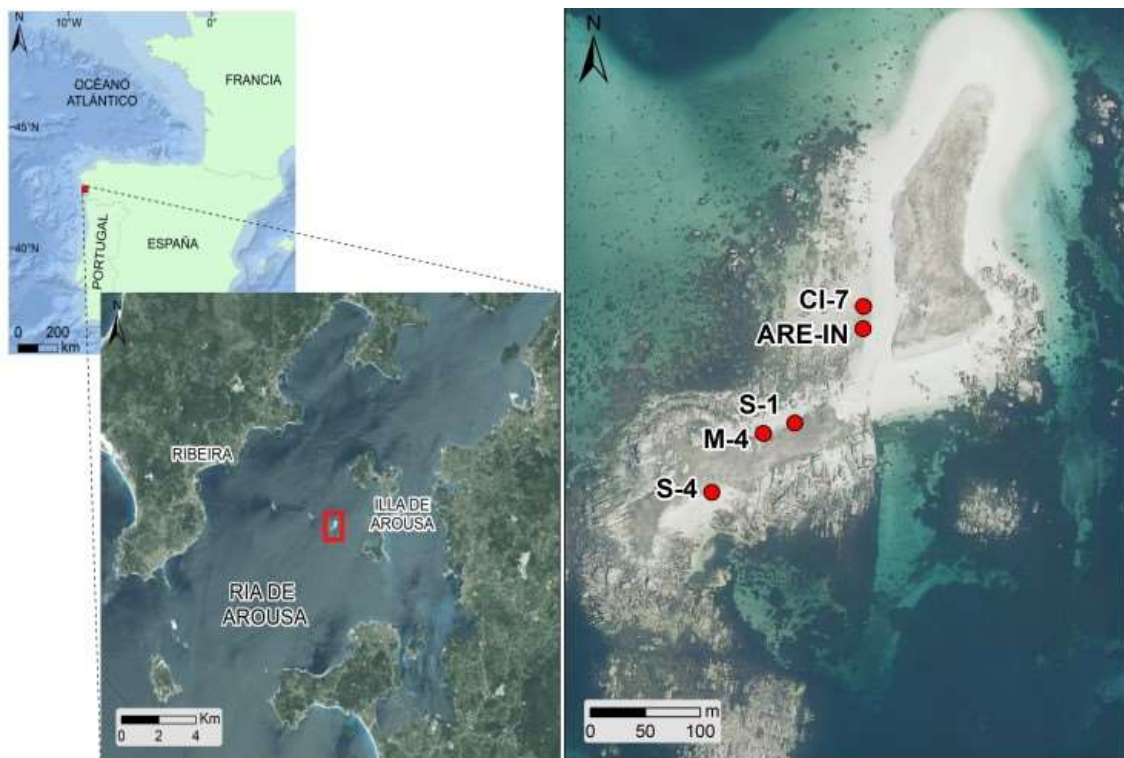


Figure 1 – Location of Areoso island and sampling positions (Sequences: S-1, S-4, M-4, ARE-IN, CI-7).

3. Material and methods

For the study of the edapho-sedimentary levels present on the island, five sampling points have been selected (Figure 1). The S-4 and S-1 sequences have been obtained below the current level of the beach, but on different flanks of the southern sector. Both sequences present a basal level of coarse material and a fine matrix with a high content of organic matter, and a lighter upper level composed of sand-sized sediment. The M-4 sequence was obtained during the excavation of one of the funerary tumuli, and ranges from the basal level to the current dune surface (Figure 2). The CI-7 and ARE-IN sequences were taken at the intertidal level that outcrops in the central sector. They present sandy levels and other more cohesive ones. In CI-7 we find a level of accumulation of biogenic material. In all sequences, samples have been taken every 5 cm of depth and a description was made in the field.

In the laboratory, different procedures have been carried out (granulometric and morphometric study, biogenic carbonate content, content of organic matter by Loss on Ignition (LOI), pH, elemental analysis and radiocarbon dating) to obtain the necessary data for the interpretation of the different physical and chemical properties of the sedimentary facies.



Figure 2 – Sequence sampling on Areoso Island. *Left*: sequence S-1; *Right*: sequence M-4.

4. Areoso: a threatened archaeological context

Despite its small size, Areoso is an important prehistoric site buried by sand in which, until now, five megalithic funerary monuments from the Late Neolithic (≈ 6000 BP) have been documented. There is also evidence of later occupations, during the Bronze Age and the Iron Age. The archaeological studies (López-Romero et al., 2015, 2017; Mañana-Borrazás et al., 2020) have defined Areoso as an exceptional archaeological site since it is not usual to find prehistoric funerary monuments from the Neolithic and Bronze Age in the low-lying coastal areas of northwestern Iberia. The special sedimentation conditions have facilitated better conservation of the complex until the last decades, but the erosive dynamics have led to the destruction of part of the prehistoric structures and seriously threaten those that are still preserved (Figure 3).

The imminent threat of destruction by marine erosion, led to Tumulus 4 being excavated between 2016 and 2017. The removal of the aeolian material that buried the tumular structure was used to take the M-4 sequence and to study the stratigraphy levels developed since the construction of the mound to the present. The tumulus was built on a basal level, formed by coarse-grained angular material in a fine matrix with abundant organic matter. It is a material resulting from the weathering of the granitic rock substrate and with evidence of having undergone edafization processes. This fact suggests that the construction of the tumulus took place directly on a continental surface of little thickness.



Figure 3 – Effects of marine erosion on archaeological elements. *Right*: State of Tumulus 4 before the archaeological intervention. *Left*: Destruction of tumulus 5 by the sea.

Source: (Mañana-Borrazás et al., 2020)

During the Bronze Age (≈ 4000 BP), the inhabitants of this territory altered the monument and accumulated a large amount of shell remains (*Ostrea*, *Mytilus*, *Patella* etc.) on one side of the tumulus (Mañana-Borrazás et al., 2020). Evidence of a later occupation in the Iron Age was also found. Around 2000 years ago, the formation of the dunes began to cover the burials, facilitating their conservation, until the action of the sea has left them exposed again.

5. Edapho-Sedimentary deposits as archives of the past

The study of the five edapho-sedimentary sequences analyzed in Areoso has made it possible to establish different stages in the configuration of the island (Cajade-Pascual et al., 2019). The oldest levels dated (≈ 6500 BP) correspond to continental facies, formed by weathering of granitic bedrock. The Neolithic burial mounds are built on this material and it was used to cover the outer structure in the case of tumulus 4. This continental level was truncated, and beach facies develop over it (4000-3500 BP), indicating a change in the nature of sedimentation with a sea level close to the present one. Around 2000 BP aeolian sedimentation begins, which will eventually form the dunes that fossilize the tumulus (Figure 4).

The information obtained indicates that the current island would have been different at the time of prehistoric occupation. Around 6000 years ago, during the construction of the tumulus, the island had a much larger area and could have been connected to the mainland, or be very easily accessible to Neolithic

inhabitants. The continental characteristics of the sediment on which is located the funerary mound and the existing bibliography in relation to sea level during the Holocene (Alonso & Pagés, 2010; González-Villanueva et al., 2015), suggest it was not built in a shore environment. The archaeological site would have been located on the top of a small hill, much more separated from the sea than the present (Cajade-Pascual et al., 2019; Mañana-Borrazás et al., 2020)



Figure 4 – Edapho-sedimentary deposit opened during the archaeological excavation of Tumulus 4 (2016-2017) Changes are observed from the basal levels (with remains of the stone breastplate from the tumulus) and the dune levels that cover them.

The palaeoenvironmental information obtained from the coastal deposits allows a better interpretation of the past environmental changes. These quaternary forms of sedimentary accumulation, which fossilise a large part of the Galician Atlantic Coast offer valuable information in terms of geomorphological, stratigraphical, sedimentological and pedological characteristics. Although in the case of Areoso we only have a record from the middle Holocene, in other deposits on the Galician coast they offer a more extensive chronological record. They are environmental archives of the past and therefore contain scientific information that is of great assistance in attempting to understand the evolution of the coast and archaeological sites (Costa-Casais & Caetano Alves, 2013; 2016) as in the case of Areoso.

It should be emphasised that the Galician Atlantic coast is unique on a national level due to the scientific and educational value offered by these landforms. They are one of the best exponents of the environmental changes that have occurred in the past, and therefore can help to interpret future changes.

However, marine erosion in a global context of rising sea levels, together with anthropic impacts, put its conservation at risk. The destruction of these geomorphs means losing their scientific and educational values, which should be preserved for future generations. (Costa-Casais & Domínguez-Almansa, 2018; Domínguez-Almansa et al., 2021). For this reason, its value as a natural heritage must be the first step to guarantee its conservation and protection.

6. Conclusions

Areoso is a small island located on the Atlantic coast of Galicia (NW of Spain), which has a great density of archaeological records, highlighting the Neolithic tumuli. Today, this site is threatened by marine erosion, which has led to an urgent need for its study, from multiple disciplines and from an interdisciplinary perspective. The edapho-sedimentary deposits offer valuable information to interpret the environmental changes in the territory. In addition, this information can be very useful for the study and contextualization of archaeological sites. In the case of Areoso, it allows us to interpret how the environmental conditions were in the Late Neolithic (6000 years ago). The island would have a much larger size, and the tumuli would have been built on a small elevation on the ground, far from the sea. These facts are relevant for archaeological interpretation, as they suggest that the funerary mounds were not built in a shore environment.

Their importance as environmental records, together with their scientific and educational interest, urges the enhancement of these sedimentary formations, which are threatened by the current context of sea levels rising. The destruction of these quaternary formations means the loss of the environmental archive that they offer which provides valuable information to interpret the evolution of the territory and the landscape, the climatic variations or even to contextualize an archaeological site. For these reasons, it is necessary to promote their management and geoconservation, to the extent that natural processes allow.

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