

AVANCES DE LA GEOMORFOLOGÍA EN ESPAÑA 2010-2012

ACTAS DE LA
XII REUNIÓN NACIONAL DE GEOMORFOLOGÍA
Santander, 17-20 septiembre de 2012

Coordinador

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Universidad de Cantabria

Reunión Nacional de Geomorfología (12ª : 2012 : Santander)

Avances de la geomorfología en España 2010-2012 : actas de la XII Reunión Nacional de Geomorfología : Santander, 17-20 septiembre de 2012 / coordinador, A. González Díez ; editores, A. González Díez... [et al.]. — Santander : PubliCan, Ediciones de la Universidad de Cantabria, D.L. 2012.

xiv, 690 p. : il. ; 30 cm.

D.L. SA. 446-2012

ISBN 978-84-86116-54-5

1. Geomorfología — España — Congresos. I. González Díez, Alberto, ed. lit.

551.4(460)(063)

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Tlfno.-Fax: 942 201 087

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ISBN: 978-84-86116-54-5

D. L.: SA 446-2012

Impreso en España. *Printed in Spain*

Imprime: TGD

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GEOLOGICAL HERITAGE AND GEODIVERSITY: QUATERNARY DEPOSITS AS PALAEOENVIRONMENTAL RECORDS IN THE “SOUTHERN COAST” (GALICIA, NW SPAIN)

Patrimonio geológico y geodiversidad: depósitos cuaternarios como registros paleoambientales en la
“Costa Sur” (Galicia, NW España)

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Resumen: Durante la última década se ha desarrollado, a nivel mundial, una base de conocimiento relacionado con la geodiversidad y la caracterización, conservación y gestión del patrimonio geológico. El desarrollo metodológico en este campo, ha marcado pautas para su avance pero, la falta de conocimiento a nivel científico, por parte de la administración sobre “hitos de interés geológico” hace que sea complicado tener una normativa adecuada, debido a que no se puede proteger aquello que no es contemplado. Esta investigación centrada en Galicia, en la zona costera definida en el Plan de Ordenación Litoral (POL) como “Costa Sur”, tiene el objetivo de dar a conocer los depósitos sedimentarios antiguos, con el propósito de demostrar su importancia como archivos paleoambientales y geoformas con entidad propia, para que la “Costa Sur” de Galicia sea reconocida como Geositio, con dimensión de Área.

Key words: geosites, geological heritage, palaeoenvironmental record, Galicia-NW Spain.

Palabras clave: geosítios, patrimonio geológico, registro paleoambiental, Galicia-NW España.

1. INTRODUCTION

During 2007, important laws were passed by the Spanish Parliament explicitly mentioning geological heritage and geodiversity. This happened following the project previously started by the Geological Survey of Spain (IGME) to inventory national geosites. This inventory is not a closed list and may be subject to modification due to new incorporations. The lack of knowledge on a scientific level on the part of the administration regarding national, regional or local “sites of geological interest” makes it complicated to create appropriate legislation, as something which has not been contemplated cannot be protected.

This study concentrates on the coast of Galicia, established in the Planning Programme for the Coastline of Galicia (POL) as the “Southern Coast”, to analyse quaternary deposits. The variables that act on the coastal environment are more diverse than those prevailing on continent sites, thus

conferring particular characteristics on the coast and thereby producing geodiversity (Nieto, 2001; Gray, 2004; Carcavilla et al., 2011). Taking into account the scientific works and considering the current administrative context, the aim of this study is to demonstrate the importance of the quaternary sedimentary deposits as palaeoenvironmental records in the hope that this sector will be recognised as a Geosite with the level of Area.

2. REGIONAL SETTING

The area studied is located between the Ria of Vigo and the mouth of the Miño River, in the NW of the Iberian Peninsula (Fig. 1). This sector is characterised by the presence of coastal mountains that functioned as orographic barriers, providing suitable conditions for fluvio-nival and periglacial slope processes when the sea level was lower than it is today, in the middle and late Weichselian (Costa-Casais, 2001).

There are a significant number of scientific

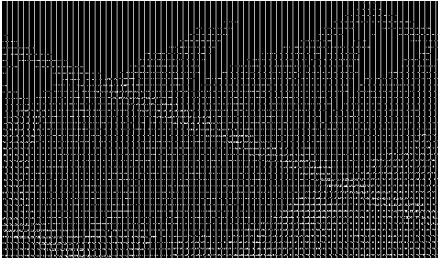


Fig. 1. Location of the study area

publications about these quaternary deposits: (a) classification and relation to the morphogenetic processes (Pérez Alberti et al., 1999); (b) physicochemical properties (Martínez-Cortizas and Costa-Casais, 1997); (c) colluvial deposits of nival origin (Costa-Casais et al., 2002), retreat of sedimentary cliffs (Blanco-Chao et al., 2002, 2003) and palaeoenvironmental reconstruction (Cano et al., 1997; Threnhaile et al., 1999); (d) Heinrich Events (Costa-Casais et al., 2008).

3. MATERIAL AND METHODS

3.1. Fieldwork and sampling

The fieldwork phase consisted of: differentiating the coastal forms, relating quaternary deposits with the coastal forms, and describing the sedimentary facies. Continuous samples, 5 cm in thickness, were collected in Oia Sur and Mougás deposits, except in the coarse material. The samples were air-dried and sieved to separate the fine earth (<2 mm) from coarser particles. Analytical determinations were performed on the fine earth fraction; and some analyses the samples were milled.

3.2. Physical chemical analysis and radiocarbon age dating

The sample characterisation includes physical properties (LOI, particle size, morphometry, weathering degree, colour, structure, consistency and charcoal quantification) and geochemical properties (pH, C, N and inorganic phase elemental composition).

The samples for radiocarbon dating were selected according to: changes in total

carbon content, relationship with erosive discontinuities and the base of the palaeosol.

3.3. Methodological proposal for the preparation of an inventory of Sites of Geological Interest (SGIs)

We followed the guidelines of the “Methodological Document for the Drawing Up of the Spanish Inventory of Sites of Geological Interest” of the Spanish Geological Survey (IGME) (García-Cortés and Carcavilla, 2009). Despite the fact that “Southern Coast” is fossilised by deposits, for the purposes of this study Oia has been selected as representative of the study area.

4. RESULTS AND DISCUSSION

4.1. Colluvial layers of coarse material and edaphic dynamics

The colluvial layers of coarse material are interspersed with palaeosols of fine material (Fig. 2). The most significant processes in the creation of the deposits are those relating to nival and periglacial activity. The representative formations are the gelifluidal and solifluidal facies of head type. According to Van Vliet-Lanöe and Valadas (1983), these formations can be used as palaeoclimatic indicators. The sands reveal the existence of deep seasonal ice with a high degree of humidity and the coarse material proves the existence of permafrost, which occurred in a cold and dry atmosphere. The soils are indicative of the predominance of stability on slopes under cold conditions in which the contribution of humidity was one of the most important factors in their development. Radiocarbon dates indicate that the oldest sediments were deposited 40,000 years ago (Costa-Casais, 2001).

The colluvial material, which fossilised the palaeosols, either slowed down or stopped the edaphogenetic processes. Their properties respond to all the dominant environmental factors as they occupied the land surface (Martínez-Cortizas and Moares Domínguez, 1995).

The organic matter has an irregular

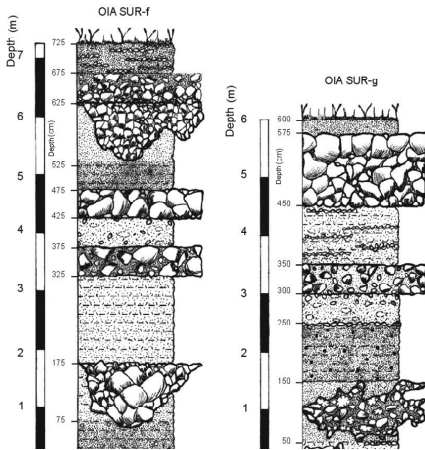


Fig. 2. Sedimentological and stratigraphic schemes of two profiles in Oia Sur deposit.

distribution in depth and there is low content in the subsurface, concentrated in buried A horizons. The bromine (Br) has a similar concentration profile to C. The main source is the ocean and it is incorporated into soils by wet deposition, which is why it can be used as an indicator of precipitation. The low level of concentration of Br in the colluvial accumulations is indicative of a low total precipitation (Costa-Casais et al., 2008).

4.2. Chronological context and Heinrich Events

Documenting and relating the variability of the sedimentary facies of coarse material of colluvial origin, generated under cold processes, permitted a relation to Heinrich Events (HE) to be identified (Duplessy et al., 1981; Heinrich, 1988). With the support of radiocarbon dating, the HE can be contextualised within the chronological framework of the Late Pleistocene. The most ancient ages were obtained at the base of the deposits (43,000-38,000 years BP). The chronological gaps would correspond to the 2a (23,500 BP) and 1a (16,000 BP) HE, which are possibly represented by colluvial layers rich in coarse material which are unable to be dated by radiocarbon methods.

4.3. Proposal for the assessment of the Protection Priority of the Oia deposit

The scores obtained for the specific figures of protection (PPc, PPd and PPt) in Oia (Table 1), prove that specific protection status is necessary for scientific, didactic, touristic and recreational use in the medium term. The status of global protection (PPG) reached the score of 530. A value in excess of 500 points indicates that urgent protection is necessary.

Table 1. Evaluation of protection priority (PP).
After García-Cortés and Carcavilla (2009).

5. CONCLUSIONS

The proposal made in this study is to bring to light the quaternary deposits, from a scientific point of view, in order to encourage a conservation strategy with the aim that they are valued by administrations, which have the power to protect them. This leads to the proposal that the “Southern Coast” as a whole be declared a Geosite with the dimension of Area. The quaternary deposits are an important Geological Heritage, as they are environmental archives of the past and thus, scientific knowledge of them is of great help when attempting to understand the evolution of the Galician coast.

Acknowledgements

Manuela Costa-Casais is supported by the Research Programme "Isidro Parga Pondal" Xunta Galicia. This research was partially funded by Project 09SEC015606PR (2009-

2012), Xunta de Galicia, and by Portuguese National Funds through the FCT (Fundação para a Ciência e a Tecnologia) under the project PESt-OE/CTE/UI0039/2011". The authors are deeply grateful to the reviewers for their helpful comments and contributions on the manuscript.

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Julio, 2012