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Amino acid epimerization dating of Quaternary coastal deformation in SE Iberian Peninsula: The region between Aguas and Antas Rivers' mouths

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ABSTRACT

The coastal area between the mouths of the Aguas and Antas Rivers presents a deformed system of raised marine deposits, some of which have been strongly affected by active tectonics. The use of amino acid epimerization dating of *Glycymeris* shells from raised coastal deposits allowed determining the age of these marine deposits, all of them linked to highstand sea levels in the Mediterranean realm, with ages between MIS 11 and MIS 1. These results allowed corroborating the age of some previously studied sites, and using new sampling sites, the general aminostratigraphy for the Quaternary raised marine deposits on the Mediterranean coast was confirmed. The main deformation event took place after MIS 11 and continued until MIS 5, and was linked to the activity of the Palomares Fault.

1. Introduction

Many studies have been focused on the age of Quaternary marine deposits of the Spanish Mediterranean coast based on faunal remains and radiometric ages (Causse et al., 1993; Dabrio et al., 2011; Goy et al., 1986; Hillaire-Marcel et al., 1986; Zazo, 1999; Zazo et al., 2003) and amino acid chronology (Hearty, 1986, 1987; Hearty et al., 1986; Ortiz et al., 2004; Torres et al., 2000, 2010).

Marine terraces along the Mediterranean coastline were previously sampled for building a regional aminostratigraphical framework (Torres et al., 2000, 2010). However, raised beach deposits around the Aguas and Antas Rivers mouths has not been examined in detail, and the lagoonal deposits that outcrop here were unknown until now and are reported here for the first time.

The study area, located in the Eastern onshore border of the Vera Basin (Fig. 1A), hosts a series of Pleistocene marine deposits along the active Palomares Fault. These could be interpreted as theoretically staircased raised beach deposits in a topostratigraphic order, which may easily be age-correlated (deposits of the same age should be located at the same elevation, with older deposits at higher elevations). However, there is evidence of deformations, i.e. of faults affecting cemented beach deposits at various elevations (Fig. 1B).

The topography of the village of Garrucha, located on a hill slope (Fig. 2A), which lies on quasi-azoic Pliocene delta sediments covered uncorformably by beach deposits, also reinforces the notion that the scenario is more complicated that initially thought. In fact, the western side of the village ends abruptly as a result of a vertical cliff, which falls on a flat, almost endorrheic depression — El Salar (Fig. 2B).

As a result of intensive building and active tectonics, outcrops from the same deposit may appear at various elevations and, in this case, amino acid racemization (AAR) dating can be a very useful tool for age-stratigraphic

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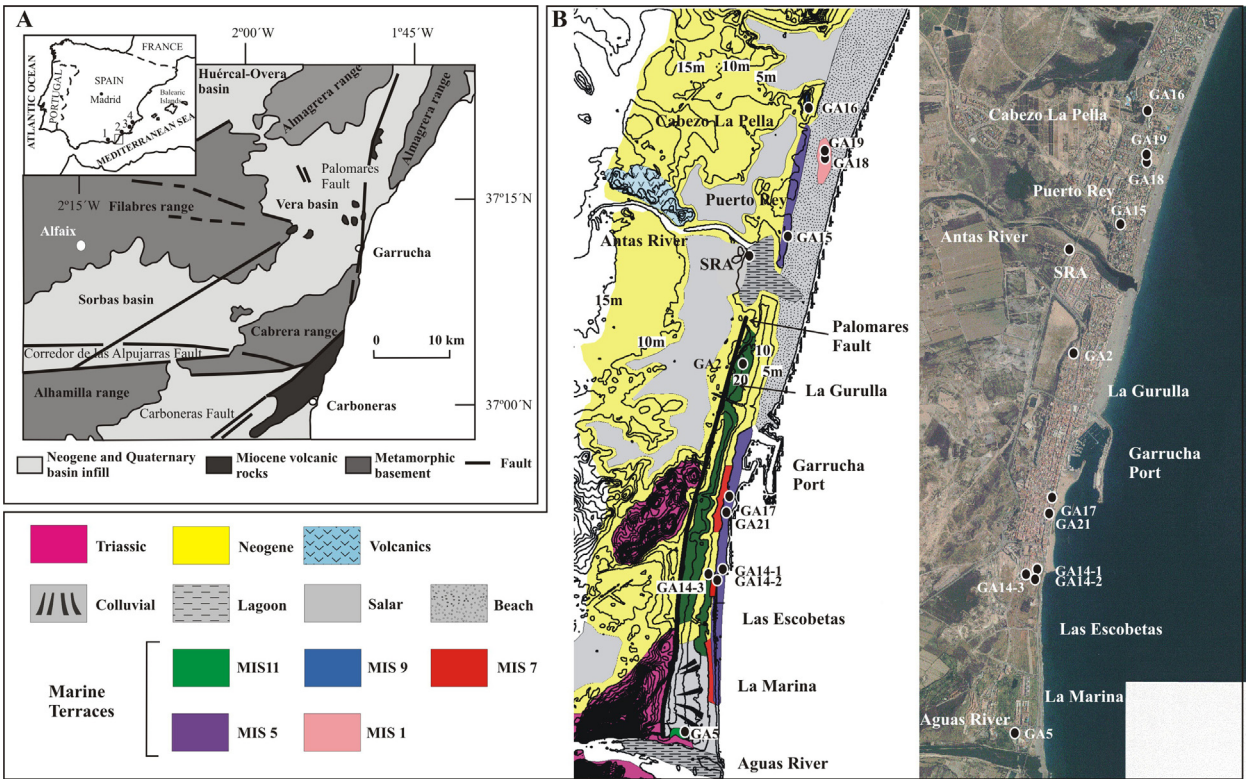

Fig. 1. A. Geographical setting Garrucha (other localities cited in the paper are also shown: 1, Roquetas de Mar; 2, Pozo del Esparto; 3, La Marina–Santa Pola; 4, Cabo de Huertas). B. Geological setting with the position of the localities. Contour lines with 5-m equidistance.

correlation (Belluomini et al., 1986; Demarchi et al., 2015; Hearty, 1986, 1987; Hearty et al., 1986; Miller et al., 1986; Torres et al., 2000, 2006, 2010; Wehmiller, 1982). AAR was used here:

- to establish a reliable chronological framework for the coastal deposits around the mouths of the Aguas and Antas rivers. For this purpose, we used shells from the bivalve *Glycymeris*, which are abundant in Mediterranean raised deposits;
- the paleogeographical reconstruction was completed by comparison of AAR ages from the lagoonal deposits near the mouth of Antas River (Figs. 1B and 2B) drilled in 2009 for geotechnical purposes (SRA borehole);
- in addition, we discuss the influence of tectonic activity, very important during the Quaternary, according to previous works (Booth-Rea et al., 2004; Martínez-Díaz and Hernández-Enrile, 2004; Silva et al., 2003; Stokes, 2008).

2. Geological setting

2.1. Tectonic framework

A series of studies have been devoted to the active tectonics-controlled evolution of the Neogene basins of the Betic realm (Mather, 1991; Sanz de Galdeano and Vera, 1992; Silva et al., 1993; Stokes, 1997; Stokes and Mather, 2003; Viseras, 1991). Adjacent to the study area, in the Huércal-Overa Basin (Fig. 1A), intense Plio-Pleistocene tectonic activity linked to faults has been described (García-Meléndez, 1993; García-Meléndez et al., 2003), which decreased during Middle Pleistocene times.

One of these basins with an intense tectonic control is the Vera Basin, where the study area is located. The Vera Basin developed within the Internal Zone of the Betic Cordillera (Sanz de Galdeano and Vera, 1992).

The basin infill consists of marls, siltstones, sandstones, and conglomerates of Miocene–Pliocene age. Völk and Rondeel (1964) established the first Pliocene–Pleistocene stratigraphy of the basin and an extensive review of the Vera Basin evolution was provided by Stokes (2008). During Pliocene–Early Pleistocene times, the basin was inverted (Stokes, 2008) and functioned as a continental basin, sedimentation being controlled by coalescent alluvial fans that fed a playa lake.

From a geodynamical point of view, the Vera Basin is placed along the Eastern Betic Shear Zone (Silva et al., 1993) or the Trans-Alboran Shear Zone (De Larouzière et al., 1988), next to three important active faults (Fig. 1A): Carboneras Fault, Palomares Fault and Corredor de las Alpujarras Fault (Bousquet, 1979; Gràcia et al., 2006). The activity of these faults explains the current seismicity of the zone (Instituto Geográfico Nacional, 2001; Marín-Lechado et al., 2005; Masana et al., 2004), the Palomares Fault being responsible for the earthquake of 1518.