

INVESTIGATING THE INFLUENCES OF RAPID CLIMATE CHANGE ON THE MOROCCAN ATLANTIC SLOPE DURING MARINE ISOTOPE STAGE 3

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Introduction

The sediment core MD08-3227 was collected during the R/V Marion Dufresne 169 Microsystems cruise in 2008. The core is located off-shore Morocco in the southern part of the Gulf of Cádiz (Fig. 1) and is an important site for further IODP investigations. Earlier studies in the northern part of this region already demonstrate the variability of the ocean currents during the last 50 ka related to the paleoclimatological changes. These changes are attributed to Heinrich events (HE) and Dansgaard/Oeschger (D/O) oscillations [1]. In the southern part, paleoceanographic studies are rare, creating a knowledge gap for the spatial and temporal evolution of oceanic drivers for cold-water coral ecosystems.

Complex current regime

Many different currents occurring in the Gulf of Cádiz complicate the reconstruction of the hydrographical network. The major process controlling the water mass distribution of the basin is the exchange between Mediterranean and Atlantic water masses (Fig. 2) through the Strait of Gibraltar [2]. The Mediterranean Outflow Water (MOW) is composed of different water masses mainly formed during winter cooling of the surface water:

- Western Mediterranean Deep Water (WMDW)
- Levantine Intermediate Water (LIW)
- Winter Intermediate Water (WIW)
- Tyrrhenian Deep Water (TDW)

The depositional setting and the mean grain size of the sediment in the Gulf of Cádiz is influenced by the MOW. However, this is not the only water mass of the basin. Two meddies and a deep cyclone will mix the Eastern North Atlantic Central Water (ENACW) with MOW (Fig. 2). A meddy is an anticyclonic lens of intermediate water controlled by the topography [3]. Other water masses influencing the hydrography are:

- Antarctic Intermediate Water (AAIW)
- North Atlantic Deep Water (NADW)
- Surface Water

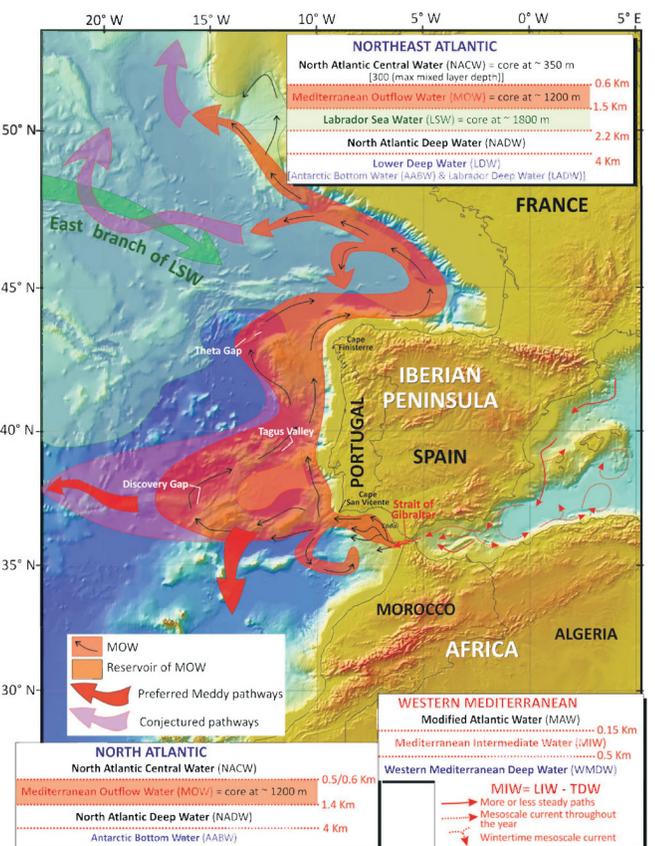


Figure 2: Schematic representation of the prevailing currents in the Gulf of Cádiz and adjacent regions [12].

Sampling and analyses

The marine sediment core MD08-3227 with a length of 33 m is taken into the Plio-Pleistocene sediment drift. Previous XRF Ca scanning results indicated a long time frame up to 30ka. It is assumed that the terrigenous input increases during dry periods, while it decreases during humid periods. This variation should be represented in the grain size distribution (Fig. 4) and would as a consequence be a good indicator for the paleoclimatological changes. Sampling of the core will be performed at regular intervals covering the Marine Isotope Stage 3 (last full glacial period) and will shed more light on the impact of HE and D/O oscillations on bottom current circulation. The collected sediment samples will be sieved in wet conditions with distilled water separating the different fractions. Sortable silt fraction will be analysed with the Sedigraph (Fig. 5) providing a high resolution grain size distribution (mean grain size, sorting, kurtosis and skewness).

References

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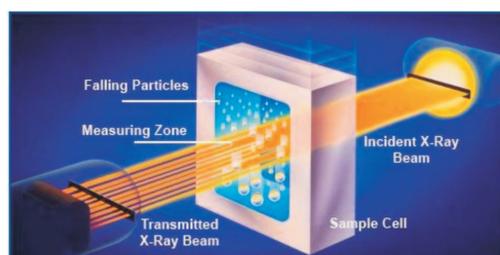


Figure 5: Schematic representation of the grain size measurement with the Sedigraph. The sediment in suspension is introduced in the sample cell where it is bombarded by X-ray. Part of the transmitted beam will scatter and reflect on the sediment particles while the rest hit the detector behind the cell.

Geology

The region is geodynamically characterized by a slow, oblique NW-SE convergence of the African and European plate acting since the Late Miocene [4], resulting in a compressive regime that affects the sedimentary deposits [5]. The formation and the tectonic evolution of the Gulf of Cádiz is characterized by three distinctive phases:

- 1) Passive margin associated to a half-graben extension system from the Mesozoic to Early Cenozoic [6].
- 2) Plate convergence between Africa and Iberia from Late Eocene to Early Miocene with the emplacement of an olistostrome body [6].
- 3) Accelerated subsidence, coinciding with the final phase of olistostrome emplacement, associated to passive margins [7].

During the Middle Miocene, an accretionary wedge was formed by the westward motion of the Gibraltar Arc front [8]. As a consequence of increased subsidence, large olistostrome complexes, forming allochthonous nappes, were emplaced during the Tortonian. Above the olistostrome unit a 0.2 to 2 km thick Neogene sedimentary cover was established. This cover is pierced by mud volcanoes, salt diapirs and fluid escape features showing evidence of strike-slip and compressional deformation [9]. This also has led to the formation of slope-traversing ridges such as the Renard Ridge with steep Pen Duick Escarpment (Fig. 3.) in the El Arraiche mud volcano province. On top of this escarpment, dormant cold-water coral mounds were discovered [10].

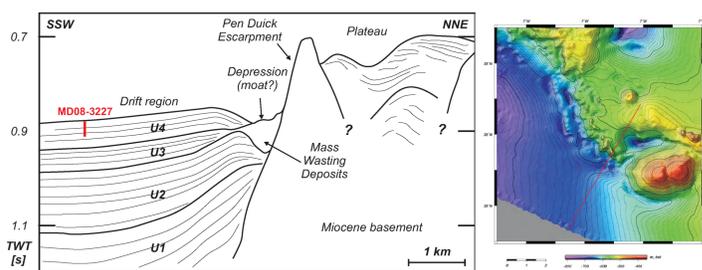


Figure 3: a) Seismic data collected during the Marion Dufresne 169 Microsystems cruise perpendicular to the Pen Duick Escarpment. U1 and U2 are deformed by tectonics, U3 covers the slump and U4 is the last deposit of the drift. The mass wasting deposits are probably formed by drift and tectonics [10]. b) Bathymetric map with indication of the seismic profile [10].

Objectives

The aim of the project is to identify the HE and the D/O oscillations in the MIS 3 time interval based on the sedimentological properties. This collected information will be interpreted in function of the paleocurrents to determine the influence of MOW during the last glacial period in the southern part of the Gulf of Cadiz. A comparison with the more studied northern part of the Gulf of Cadiz could possibly show a marked difference.