

## Oceanographic processes and products around the Iberia continental margin: a new multi-disciplinary approach?

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**Abstract:** *Our understanding of the physical oceanographic processes that affect sedimentation and erosion, e.g. overflows, tide, deep sea storms, vortices, internal waves and tsunamis, is improving. However, the results of such processes on the depositional and erosional features in the ocean are still less extensively studied. In the present compilation an overview of some key physical oceanographic processes and their sedimentary products around the Iberia margin is presented. The oceanographic processes are affecting the shape and evolution of the Iberian continental margin and adjacent oceanic basins, but have nonetheless been somewhat overlooked historically. A better understanding on the effect of the oceanographic processes on e.g. contourite sea-floor features, their spatial and temporal evolution, and the near-bottom flows that form them is needed in order to understand how the Iberian continental margin functions. It is proposed that more intensive collaboration studies between specialist from Geology, Oceanography and Benthic Biology in multi-disciplinary approach should be prioritized in the near future combining oceanographic data, sea-floor morphology, sediment and seismic characterization and benthic biologic mapping. This will be essential to improve our knowledge of the permanent and intermittent processes around Iberia and evaluate their conceptual and regional role in the margin evolution over time and space.*

**Key words:** *Iberian margin, oceanographic processes; bottom current; sedimentary products*

### INTRODUCTION

Bottom currents are often a persistent process with a net flow *along-slope* (or following the local bathymetry), but can also be variable in direction and velocity on short time scales. They are affected by a number of persistent processes, such as overflows, tides and internal tides but also intermittent processes such as giant (vertical) eddies, deep sea storms, (horizontal) vortices, internal waves and solitons, tsunamis, rogue and cyclonic waves. An overview can be found in Rebesco et al. (2014). The various forcing mechanisms modulates the bottom current speed and direction, and serve to develop local and regional hydrodynamic signatures (*cores, branches, filaments, eddies, vortices, local turbulence, internal waves, helicoidal flows, vertical columns*, etc.) that control the sedimentary and erosional processes and associated sedimentary facies. Most of those oceanographic deep-water processes are rarely observed but believed to be capable of generating depositional and erosional features in many contexts, at both short and long term scales.

We present here a compilation where we describe persistent and intermittent oceanographic processes associated with the bottom-current circulation along the Iberian continental margin and adjacent oceanic basins, including some examples and their potential role in the sedimentary processes. This compilation has allowed us to present some suggestions for future deep-water sedimentation studies and related applied research. Importance of these processes is highlighted and its research and applied implication discussed.

### A MULTI-DISCIPLINARY APPROACH IS NECESSARY

Bottom current-controlled depositional and erosional features have been shown by e.g. Hernández-Molina et al. (2011) to be common along the Iberian continental margin. The bottom-current circulation around the Iberian is affected by a number of permanent and intermittent oceanographic processes (Fig. 1), which are not fully understood, but they appear to be important in

controlling the sedimentary facies and shaping the seafloor.

Based on these results it is suggested that a better understanding of the oceanographic processes related to bottom currents and its associated products are required. The hitherto underestimated pervasiveness role of these oceanographic processes in the sedimentary stacking pattern on continental margins in long-term has to be also seriously reconsidered in future decades. The only way to achieve that along the Iberian margin is through a more intensive collaboration between specialists from Marine Geology, Oceanography and Benthic Biology. Further, long-term multi-disciplinary measurement programs are needed in order to understand the evolution of the continental margin and predict its future and stability. Such collaboration represent a major challenge since the disciplines have separate short-term objectives, focus areas and terminology.

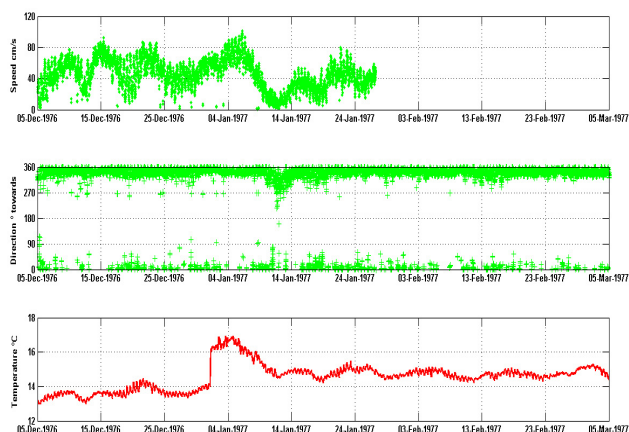


FIGURE 1. Time series observations of the near-bottom current (78 m above the seafloor) at the Eastern Gulf of Cadiz (554m water depth) showing a strongly directional MOW towards the NNW with speeds up to  $1 \text{ m.s}^{-1}$ . A clear semi-diurnal tidal periodicity with a spring-neap tidal cycle is observed, which also modulates the near-bottom temperature. The jump in the temperature record is presumable due to the mooring turnaround operation and the sampling of a slightly different water parcel.

In addition, as in many marine sciences, the future perspectives depend on the technological development, allowing more accurate and detailed studies of the water column, seafloor, and on samples retrieved from the contourite deposits (Rebesco et al., 2014). For example, exciting new developments in the field of seismic oceanography will allow to couple these in-situ observations to a 2D (or even 3D) insight in the oceanographic processes. An integrated acoustic approach coupled with oceanographic data such as CTD or (L)ADCP and moorings should be considered. A better characterisation of the contourite products will soon be fully linked to advances in marine geophysics, making high-resolution 3D seismics, multibeam and backscatter data more readily available for academic purposes as well as even more detailed observations of seafloor morphology and benthic communities from Automated Underwater Vehicles (AUV) and ROVs. These evolving methodologies will likely be essential for mapping oceanographic processes associated to the bottom-current

circulation and correlate them with seafloor contourite morphologic features and benthic communities.

## AN APPLIED RESEARCH?

Multi-disciplinary studies for understanding of oceanographic processes associated to the near bottom-current circulation have important implications in applied research. For example, economic interest of sandy contourites can be explored and evaluated. Sandy contourites differ from deep-water turbidite sands that currently dominate the deep-water oil and gas plays. There exists a potential economic interest that can be explored and evaluated in the near future. A better evaluation of the potential of sandy contourite systems as reservoirs for oil and gas, as well as the potential of muddy contourites both as source rocks for hydrocarbons and as unconventional reservoirs are other potential focus areas. These new findings could herald a paradigm shift in exploration targets in deep-water settings.

Moreover, the frequent association of contourite deposits, both sandy and muddy, with cold-water coral mounds may also be regarded as an interesting unconventional reservoir. Therefore, it is also important to better elucidate the role of oceanographic processes associated to the bottom-current circulation and its variability due to climate on the ecological health status of deep-water ecosystems, such as reefs. An emerging field that requires more insight in deep bottom water circulation is the renewed exploration phase for metalliferous resources, which also have been also identified along the Iberian margin. More knowledge about their formation with respect to bottom currents and seafloor morphology is required in order to perform predictive mapping of these marine resources.

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