Sediment facies from Alboran contourite drifts (SW Mediterranean): sedimentary models and palaeo-hydrodynamic scenarios for the last 26 ka

Belen Alonso (1), Gemma Ercilla (1), Isabel Cacho (2), David Casas (3), Nieves López-González (4), Francisco Javier Rodríguez-Tovar (5), Javier Dorador (6), Carmen Juan (1), Guillermo Frances (7), Thomas Vandorpe (8), Juan-Tomás Vázquez (4)

(1) Instituto de Ciencias del Mar CSIC, (2) University of Barcelona/Fac. de Ciencias de la Tierra, (3) Instituto Geologico y Minero de España, (4) Instituto Español de Oceanografía, (5) University of Granada/Dep. Estratigrafia, (6) Royal Holloway University of London/Dep. of Earth Sciences, (7) Universidad de Vigo, Facultad de Ciencias del Mar, (8) Vlaams Instituut Voor De Zee (VLIZ)

The occurrence of extensive Plio-Quaternary contourite drifts in the Alboran region has recently been well documented, principally using geophysical methods. However, the sedimentological characteristics are not yet well documented, in spite of the fact that they provide a record of palaeoceanographic/climate changes. In this study, the sedimentary and geochemical characteristics of the contourite drifts formed by the Western Mediterranean Deep Water (WMDW) are examined in a core transect represented by three cores at 631 m, 712 m, and 914 m water depth. Three facies (1 to 3) are defined based on a combination of sedimentological and Zr/Al ratio. Facies 1 is the most dominant and consists of silty-clay, representing the finest-grained sediments; Facies 2 is composed of bioturbated clayey-silt with a remarkable Zr/Al peak, deposited during the Younger Dryas; Facies 3 consists of the coarsest sediments (sand), deposited during Heinrich event 2. The latter two facies present a remarkable Zr/Al peak. The mainly fine-grained contourites allow the Alboran contourite drifts to be classified as “muddy contourites”. The vertical succession of these three facies permits the definition of two bi-gradational sequence types. Sequence A, represented by the vertical succession of facies 1, 2, 3, 2, 1, corresponds to the standard contourite sequence model, while Sequence B is composed of a vertical succession of facies 1, 2, 1, and corresponds to partial contourite sequences. Both sequences, A and B, are linked to shifts in the strength of the bottom currents, from weak to strong and then back to weak, corresponding to acceleration/deceleration periods. To decode the contourite facies successions in terms of bottom current speed, a comparison between two binary plots has been made: magnitude changes in mean sortable silt (meanss in μm) and changes in WMDW flow speed (in cm/s) versus four periods of acceleration of bottom currents (a: 23.4-19 ka, b: 17.8-16.2 ka; c:15.0-12.5 ka; d: 9.8-8.0 ka). The regional Alboran palaeo-WMDW flow speed has been assessed using a similar record (meanss) from another contourite drift in the NW Mediterranean at 2391 m wd, close to the formation zone of the water mass. This comparison reveals that the Alboran contourite drifts were affected by low (~1.5-5.5 cm/s) and moderate flow speeds (~8-13 cm/s). These palaeo-speeds are in the same range as modern oceanographic data, indicating that the WMDW flow operated on the construction of those drifts in two hydrodynamic scenarios: Scenario 1 corresponded to low bottom current speeds (< 5.5 cm/s) for the period b; Scenario 2 was defined by higher bottom current speeds (up to ~12.8 cm/s), during the periods a, c, and d. This research represents a prime example of bottom current effect on the construction of contourite drifts and how to apply fine-grained, mainly muddy contourites in sedimentological and palaeoceanographic studies, despite the strong bioturbation. The core transect provides a regional perspective of bottom current flow, from close to its formation area along its pathway, which is governed by topographic restrictions (e.g., seamounts and submarine canyons). Contribution from Project FAUCES CTM2015-65461-C2-R (MINECO/FEDER)