Paper Number: 1702

Early history of Mediterranean-Atlantic exchange – new insights from IODP Expedition 339

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Mediterranean Outflow Water (MOW) is a considerable source of heat and salt for today's North Atlantic and contributes to maintaining the Atlantic meridional overturning circulation (AMOC). There is evidence that MOW intensity varied on glacial/interglacial and stadial/interstadial timescales in the past, and that phases of MOW intensification potentially preconditioned the thermohaline circulation for its interglacial mode in the late Pleistocene (Rogerson et al., 2011; Bahr et al, 2014). Until recently, however, efforts towards a better understanding of MOW behavior through time and potential climatic feedback mechanisms between MOW, the African Monsoon, AMOC, and eustatic sea-level fluctuations have been impeded by the limitation of available sample material largely to the uppermost Pleistocene and Holocene. In 2011/12, IODP Expedition 339 drilled several sites in the Gulf of Cadiz and off the western Iberian Margin, recovering a total of 4.5 km of Pliocene to Holocene contouritic deposits of MOW (Hernández-Molina et al. [1]).

In this paper, we present new findings on early MOW history from IODP Sites U1387 and U1389, specifically its onset after the Messinian Salinity Crisis and its behavior at the transition from the late Pliocene warmhouse to early Pleistocene icehouse climate. New micropalaeontological and geochemical records suggest that IODP Site U1387 is affected by Mediterranean water shortly after the opening of the Gibraltar Strait and before the onset of contourite drift deposition, representing the first signs of the Mediterranean-Atlantic exchange. At IODP Site U1389, cyclic patterns are recognized in the $CaCO_3$ and TOC contents as well as Ca/Ti- and Zr/Al-ratios of upper Pliocene and lower Pleistocene sediments. A preliminary cyclostratigraphic analysis of these records in well-recovered intervals suggests an interplay of obliquity and precessional forcing on the depositional environment. A significant change from deposits strongly influenced by terrestrial input to deposits strongly affected by MOW occurs at ~2.8-2.6 Myrs, coinciding with the onset of Northern Hemisphere Glaciation.

This study contributes to project P25831-N29 of the Austrian Science Fund (FWF) and is financially supported by grants of ECORD and the Max Kade Foundation

References:

[1] Hernández-Molina et al. (2014) Science 344 (6189): 1244–1250