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Surface Water and Mediterranean Outflow Water Variability During the Mid-Pleistocene Transition (Marine Isotope Stages 17-36) – the IODP Site U1387 record

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The Mediterranean Outflow Water (MOW) forms extensive contourite drift deposits along the Iberian margin, especially in the Gulf of Cadiz, and injects heat and salt into the intermediate depths of the North Atlantic that affect the overturning circulation. The sediments recovered during IODP Expedition 339 allow studying MOW's history throughout the Pleistocene and Pliocene and thus under varying climate forcing. Here we present centennial-to-millennial scale proxy records for surface water and MOW variations as recorded at IODP Site U1387 (558 m water depth), drilled into the Faro Drift, which is formed by the upper MOW core. We focus our study on the early to middle Pleistocene with special attention on the Mid-Pleistocene Transition (MPT) when the period of the dominant climate cycle changed from 41 kyr to 100 kyr.

Surface water and MOW proxy records show millennial-scale stadial/ interstadial oscillations on top of the glacial/ interglacial cycles. Changes in the planktonic and benthic oxygen isotope records are tightly coupled highlighting the constant exchange (entrainment) between the (sub)surface waters and the MOW. Alkenone-derived sea-surface temperatures (SST) increased abruptly at the beginning of an interglacial stage (with the exception of MIS 35) and reached maxima of 21-23°C. During the glacial stages, the SST record reveals abrupt drops down to 10-11°C that lasted approximately 1 kyr, respectively, and remind of the SST minima recorded on the western Iberian margin during Heinrich and Heinrich-type ice-rafting events of the middle to late Pleistocene (e.g., Rodrigues et al., 2011 in Paleoceanography). Low benthic carbon isotope values during deglacial and peak interglacial periods, coinciding with insolation maxima, reveal a poorly ventilated upper MOW core and point to a causal link between MOW ventilation and sapropel formation in the Mediterranean Sea. Better ventilation was recorded during glacial and stadial intervals, often in association with the formation of contourites (higher sand content; larger mean grain size) and thus higher bottom current velocity. During the warmer Marine Isotope Stages contourites, often more pronounced than their glacial counterparts, were formed during the stadial(s) following the peak interglacial period when northern hemisphere summer insolation was low. Thus, changes in the upper MOW core are tightly coupled to summer insolation with poor ventilation occurring during insolation maxima and higher current velocity marking insolation minima. This insolation forcing reveals a close link between MOW and Mediterranean Sea climate conditions, whereas the SST record reveals a tight link to surface water conditions in the open North Atlantic.