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Surface and Mediterranean Outflow Water Variability during the Mid-Pleistocene Transition – Evidence from IODP Site U1387 offshore southern Portugal

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The Mediterranean Outflow Water (MOW) forms contourite drift deposits along the Iberian margin, especially in the Gulf of Cadiz, and injects heat and salt into the North Atlantic affecting the overturning circulation. Drift sediments, such as the Faro Drift into which IODP Site U1387 was drilled during Exp. 339 – Mediterranean Outflow, allow studying MOW's response to climate oscillations at high resolution. Here we present centennial-to-millennial scale proxy records for surface and MOW variability during the 700 ky long interval spanning Marine Isotope Stage (MIS) 16 to 41 (630-1330 ka), encompassing the Mid-Pleistocene Transition. Surface water conditions are reconstructed using G. bulloides oxygen isotope and alkenone-based sea-surface temperature (SST) records, whereas bottom water/MOW conditions are deduced from benthic foraminifer stable isotope records as well as sedimentological indicators for contourite layers (wt% sand; XRF-derived Zr/Al).

Surface water conditions were relative stable during the interglacial periods with SST exceeding 21°C. Interglacial periods of MIS 31 to 41, i.e. during the 41 ky world, were, however, warmer (22-24°C) than those of MIS 17 to 29. Interglacial to glacial transitions as well as some of the glacial periods experienced millennial-scale stadial/interstadial oscillations, similar to those known from the late Pleistocene. Some of these stadials were associated with extreme cold events when SST dropped abruptly below 13°C indicating that the Polar Front was temporarily pushed further to the south than during most of the Heinrich events of the last glacial cycle. During glacial MIS 18 to 26, the cold events occurred at the end of the glacial period, whereas timing in the older glacials varied with events sometimes already occurring early on. Conditions in the upper MOW show no distinct change associated with the Mid-Pleistocene Transition. Throughout the whole interval MOW conditions are driven by insolation as the long-term driver and by MOW velocity increases in response to the millennial-scale stadial events. MOW's response to insolation changes was twofold. Insolation minima led to the formation of contourite layers (increased MOW velocity) during several interglacial periods (MIS 21, 25, 27, 31, 35, 37). Episodes of poor ventilation in the upper MOW core, on the other hand, followed insolation maxima and can clearly be linked to sapropel formation in the eastern Mediterranean Sea and the North African Monsoon system. Hydrographic conditions in the northern Gulf of Cadiz during the early to middle Pleistocene can thus be linked to high-latitude ice-ocean interactions in the North Atlantic as well as low-latitude monsoon variations and their impact on the Mediterranean Sea circulation.