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Early to Middle Pleistocene Climate Records off Southern Iberia Reveal two Types of Interglacial Climate Evolution

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The Gulf of Cadiz off southern Iberia is an ideal place to study the interaction between North Atlantic and Mediterranean Sea climate variations with surface waters reflecting subtropical gyre conditions and the intermediate-depth Mediterranean Outflow Water (MOW) combining Mediterranean Sea and North Atlantic signals. Using centennial-scale records from IODP Site U1387 (36.8°N, 7.7°W; 559 m w.d.) we evaluate interglacial surface-water and MOW conditions during the interval from Marine Isotope Stage (MIS) 16 to 48 (630-1470 ka). Surface-water changes are deduced from alkenone-derived sea-surface temperature (SST) and G. bulloides stable isotope records and MOW conditions from the benthic foraminifer stable isotope data and the wt% sand.

The surface water records clearly allow distinguishing two groups of interglacial climate evolution that can be defined by the shape of the deglaciation and the timing of the interglacial SST maximum. An abrupt glacial/interglacial transition and maximum SST at the beginning of the respective interglacial period are recorded for MIS 17 to MIS 27 and for MIS 47, whereas MIS 29 to MIS 45 exhibit a more gradual transition and a SST maximum later on during the interglacial period. The change in interglacial climate evolution roughly coincides with the Mid-Pleistocene Transition, during which the step to a higher, glacial ice-volume occurred in MIS 22. The shift to cooler interglacial SST occurred already earlier, i.e. between MIS 31 and MIS 29. MIS 29 and younger interglacials experienced SSTs around 22°C (exception is MIS 23 with 19.5°C), whereas MIS 31 and older show values of 23-23.5°C, even reaching 24.5-25°C during MIS 37 and MIS 41. All glacial periods experienced millennial-scale oscillations and extreme cold events during glacial periods happened throughout the record. In contrast, the interglacial MOW shows no major shifts at either MIS 25 or MIS 31. Interglacial MOW conditions are strongly linked to the insolation maxima and the related, African monsoon induced changes in Mediterranean Sea hydrology (e.g., sapropel formation). Thus, the interglacial MOW is a poorly ventilated, sluggish current (with poorest ventilation during MIS 23, 25 and 27), similar to the late Pleistocene interglacials (Bahr et al., 2015; Geology). Consequently, in the Gulf of Cadiz, understanding interglacial climate variability during the Pleistocene depends on the water depth/ water mass studied.