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Surface and Deep Water Variations During MIS 11-15 at IODP Site U1313 in the Mid-Latitude North Atlantic: Insights Into Mid-Pleistocene Rapid Climate Change

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IODP site U1313, the recording of DSDP site 607, is nowadays located within the transitional waters between the subpolar and the subtropical fronts and influenced by the North Atlantic Drift (NAD). Studies on DSDP site 607 (e.g. Raymo et al., 1989) further revealed that the prevailing deep water mass changed from North Atlantic Deep Water (NADW) to Antarctic Bottom Water (AABW) on interglacial to glacial time scales, respectively. To contribute to the better understanding of past climate variability within interglacials and of rapid climate change during glacial inceptions and glacials we produced planktonic and benthic stable isotope and ice-rafted debris (IRD) records with a temporal resolution of 250 to 600 years for the interval from 355 to 640 ka. In addition to the glacial/ interglacial deep-water variations previously seen in the DSDP site 607 records, our high-resolution benthic isotope records reveal short-lasting excursions. Within glacial MIS 12 these excursions to lighter oxygen and heavier carbon isotope values are "bundled" into three intervals and are interpreted as a deepening of the NADW/ AABW interface and thus the presence of glacial NADW. During MIS 14 and the section of MIS 16 covered by our record such excursions are not revealed. MIS 15.4 to 15.1 and also the glacial inception of MIS 10 are, on the other hand, periods with higher variability again. During MIS 15 the benthic carbon isotope data reveals that the variations are linked to changes in the NADW composition. The changes within MIS 11, on the other hand, are caused by shoaling of the NADW/ AABW interface and thus incursions of AABW, like during the MIS 3 Heinrich ice- rafting events. In the surface water records higher variability is also observed during MIS 15 and 12. During MIS 12, three longer lasting periods with IRD deposition occurred with peak IRD deposition at the beginnings and ends of these intervals. Thermocline conditions as revealed by the G. inflata records, on the other hand, experienced 6 oscillations with 2-3 degree temperature changes and warmer conditions between the IRD events; again reminding of the MIS 3 stadial/ interstadial variability. Glacial MIS 14 is standing out as the "warmest" glacial in the studied interval and thermocline temperatures were not much colder than during MIS 13, which itself experienced colder temperatures than the other interglacial and interstadial periods. Peak interglacial values were similar during MIS 11 and 15 but thermocline nutrient levels were higher during MIS 15. During terminations nutrient levels gradually decreased and heaviest planktonic carbon isotope values at site U1313 were always reached during the second interglacial temperature rise observed during MIS 15.5, 13.3 and 11.3 in the EDC dD record. The onsets of the glacial inceptions were marked by IRD and cooling events. After the cold event, however, one or in the case of MIS 11 two warmings of thermocline waters are observed. These warmings lasted several thousand years and temperatures were nearly as warm as those recorded during the preceding interglacial (MIS 11.3) or interstadials (MIS 13.1, 15.1). Thus the modern flow path of the NAD persisted during the early phases of glacial inceptions allowing heat transport from the tropics to the mid-latitude North Atlantic and keeping conditions in the western basin much more stable and warmer than those observed along the eastern margin at ODP site 980 (McManus et al., 1999) or off Portugal.

4901 Abrupt/rapid climate change (1605)
4926 Glacial
4936 Interglacial
4962 Thermohaline
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