Molecular and hydrogen isotope evidence of Holocene climate and cryosphere variability: results from a sediment core from the Adélie coast, Antarctica (IODP Expedition 318)

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The Southern Ocean remains the least studied region on Earth with respect to Holocene climate variability. The few Antarctic proximal marine sedimentary records available tend to be short, low resolution, and discontinuous. However, sediments recently recovered from the Adélie drift during IODP Expedition 318 present a new opportunity to study East Antarctic Holocene climatic evolution, at a resolution that facilitates direct comparison with ice-cores. Expedition 318 recovered 171m of Holocene laminated diatom ooze from site U1357B. The sediments represent continuous Holocene accumulation up to the present day (based on 89 AMS ^{14}C dates) and are characterised by 2-6cm thick, light/dark laminae couplets, interpreted as seasonal biogenic production and accumulation events.

We present the results of initial biomarker analyses: fatty acid δD and TEX_{86} measurements on lipid extracts from paired light/dark laminae throughout the Holocene. The C_{18} fatty acid is assumed to represent an integrated signal from the algal precursors and thus surface water conditions. The $\delta D_{C18\text{-}FA}$ values show no consistent offset between the light and dark laminae, and values become isotopically heavier on average through the Holocene (ca. -220 to 140‰), in line with declining insolation at 65°S. Superimposed on this trend are millennial scale isotopic excursions of ca. 20 to 60‰, including a clear excursion coeval with the late Holocene climate 'optimum' between 6 and 3 kyr, inferred from East Antarctic ice-cores (Masson et al., 2000). $\delta D_{C18\text{-}FA}$ shows no clear relationship with TEX_{86}^{L} sea-surface temperature estimates, which display pronounced early variability and relative warmth from 11.2 to 10.4 ka (0 to 6.5 °C, average ca. 3.5 °C), but almost no change after 10.4 ka, as cold, stable SSTs (average ca. 2 °C) persist through the rest of the Holocene. We explore the potential controls on the $\delta D_{C18\text{-}FA}$ record and suggest the influence of isotopically depleted meltwater from the proximal ice-sheet (additive to a salinity effect) and/or upwelling can account for the millennial scale variability.

References

V. F. Masson *et al.*, *Quaternary Research* **54**, 348 (2000).