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New stable isotope records from the Atlantic Ocean for the Paleocene to Eocene interval (DSDP Site 401): What do they tell us?

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The early Paleogene is characterized by a greenhouse climate mode, which is punctuated by at least two short-termed hyperthermal events (duration <200 ky) and the longer lasting Early Eocene Climatic Optimum (EECO, ~52-54 Ma). These hyperthermals cover the Paleocene– Eocene Thermal Maximum (PETM; ~55.5 Ma) and the more recently discovered Elmo event, which took place about 1.8 Myrs after the PETM. The EECO is followed by a gradual long-term cooling finally leading to the Oligocene icehouse as indicated by benthic foraminiferal oxygen isotope records (Zachos et al., 2008, Nature).

DSDP Site 401 is situated on the North Biscay margin and represents thereby - besides DSDP Site 550 - one of the most northern scientific drill sites, which provide pelagic carbonates of Paleocene to middle Eocene age. A 100-m-thick sedimentary succession covering the study interval has been investigated with respect to the oxygen and carbon isotopic composition of unfilled, planktic (mostly Accarinina, Hantkenina, Morozovella, Morozovelloides and Subbotina) and benthic foraminiferal tests (mostly Cibicidoides and Nuttallides truempyi). A fairly good core recovery, well preserved foraminiferal calcite and the fact that no detailed long-term record from this stratigraphic interval has been published from the North Atlantic, yet, makes this site suitable for correlations and comparison with other long term records from the Pacific Ocean (Allison-Guyot, Shatsky Rise) and elsewhere.

According to the calcareous nannofossil biostratigraphy all biozones are present, suggesting that the succession at DSDP Site 401 is mostly complete (apart from recovery gaps), although the lower Eocene/middle Eocene transition is somewhat condensed. The latter is also apparent in the oxygen isotope record of the benthics which shows an abrupt increase in oxygen isotopes marking the end of the EECO at Site 401. However, this increase is less apparent in the surface waters compared to the deep-sea. The planktic foraminiferal long-term record from Site 401 is largely similar to those reported from the Pacific Ocean. Oxygen and carbon isotope data display the typical gradient between the surface dwelling morozovellids and acarininids, the subsurface/thermocline dwelling taxa like subbotinids and hantkeninids, and the benthics. The gradient is more pronounced during the Paleocene and the middle Eocene, suggesting an attenuation of water-column stratification during the early Eocene. High-resolution sampling of the biozone NP11 shows a well developed cyclicity in sediment color, which is also reflected in the CaCO3 contents. Darker, less carbonate-rich horizons are also characterized by four bulk-rock and benthic foraminiferal negative isotope excursions of both carbon and oxygen. The stratigraphic position of these shifts within NP11 suggest that one of these excursions may represent the Elmo event (for more information see also abstract by D'haenens et al., EGU2010-10446).