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Plio-Pleistocene evolution of water mass exchange and erosional input in the Fram Strait

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We determined the isotopic composition of neodymium (Nd) and lead (Pb) of past seawater to reconstruct water mass exchange and erosional input between the Arctic Ocean and the Norwegian-Greenland Seas over the past 5 Ma. For this purpose, sediments of ODP site 911 (leg 151) located at 900 m water depth on the Yermak Plateau in the Fram Strait were used. The paleo-seawater variability of Nd and Pb isotopes was extracted from the sea water-derived metal oxide coatings on the sediment particles following the leaching method of Gutjahr et al. (2007). All radiogenic isotope data were acquired by Multi-Collector (MC) ICP-MS. The site 911 stratigraphy of Knies et al. (2009) was applied.

Surface sediment Sr and Nd isotope data, as well as downcore Sr isotope data obtained on the same leaches are close to seawater and confirm the seawater origin of the Nd and Pb isotope signatures. The deep water Nd isotope time series extracted from site 911 was in general more radiogenic ($\epsilon_{\text{Nd}} = -7.5$ to -10) than present day deep water ($\epsilon_{\text{Nd}} = -9.8$ to -11.8) in the area of the Fram Strait (Andersson et al., 2008) and does not show a systematic trend with time. In contrast, the radiogenic isotope composition of Pb evolved from $^{206}\text{Pb}/^{204}\text{Pb}$ ratios around 18.7 to more radiogenic values around 19.2 between 2 Ma and today.

The data indicate that mixing of water masses from the Arctic Ocean and the Norwegian-Greenland Seas has controlled the Nd isotope signatures of deep waters on the Yermak Plateau over the past 5 Ma. Prior to 1.7 Ma the Nd isotope signatures on the Yermak Plateau were less radiogenic than waters from the same depth in the central Arctic Ocean (Haley et al., 2008) pointing to a greater influence from the Norwegian-Greenland Seas. After 1.7 Ma the central Arctic and Yermak Plateau data have varied around similar values indicating water mass mixing overall similar to today.

In contrast, the Pb isotope composition of deep waters in the Fram Strait appears to have been dominated by weathering inputs from glacially weathering old continental landmasses, such as Greenland or parts of Svalbard since 2 Ma. A similar control over the Pb isotope evolution of seawater since the onset of Northern Hemisphere Glaciation was recorded by ferromanganese crusts that grew from North Atlantic Deep Water in the western North Atlantic.

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