The Nd isotopic composition in the Barents Sea, Nansen Basin and Fram Strait: Water mass exchange between the Arctic and Atlantic Ocean

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The principal exchange of Arctic Ocean water masses with the Nordic Seas (Norwegian, Greenland and Iceland Seas) occurs through the Barents Sea and Fram Strait. This exchange is crucial for the North Atlantic Deep Water formation. The Nd-isotopic composition, $\varepsilon_{Nd}(0)$, can be used as a water mass tracer for studies of large-scale oceanographic and paleoceanographic circulation. The $\varepsilon_{Nd}(0)$ of the Nordic Seas is well characterised but it is not clear how the signal is acquired and how it relates to the Arctic Ocean, which is due to the few studies of $\varepsilon_{Nd}(0)$ in waters from high latitudes above 77º N.

Here we present water $\varepsilon_{Nd}(0)$ in depth profiles from six locations extending from shelf stations in the Barents Sea east and north of Svalbard and into the deep Arctic Ocean Nansen Basin and from the eastern part of the Fram Strait. The sampling was carried out during the Swedish Arctic Ocean expeditions in 2001 and 2002.

On the Barents Sea shelf (0-250m depth) east of Svalbard both the Nd concentration, C_{Nd} ~16 pM, and the $\varepsilon_{Nd}(0)$ -10.8 is uniform and similar to that of North Atlantic waters. At shelf stations (0-100m depth) closer to Svalbard the C_{Nd} increases to ~30 pM and the $\varepsilon_{Nd}(0)$ becomes significantly lower, -11.8, which indicates that the Nd transported by Atlantic water is modified by exchange processes on the shelf in the Svalbard area. In deep waters the C_{Nd} drops from high values in the surface to ~17 pM below 100m, whereas the $\varepsilon_{Nd}(0)$ varies between -10 to -12. In the Nansen Basin both the C_{Nd} and $\varepsilon_{Nd}(0)$ is uniform with ~17 pM and -11.0 throughout the water column down to 3700m. Clearly the Nansen Basin is strongly influenced by the Atlantic-derived Nd. The Fram Strait profile shows a C_{Nd} distribution similar to the shelf close to Svalbard with high values, ~30 pM, in the surface water that decrease to ~17 pM below 100m. In contrast the $\varepsilon_{Nd}(0)$ is significantly more positive and homogeneous with values of about -9.5 down to 1275m. Clearly the Nd in the eastern part of the Fram Strait must include sources other than Atlantic- and Svalbard-derived Nd. The data show that several distinct water masses can be detected by $\varepsilon_{Nd}(0)$ in this oceanographically important area.