Arctic Ocean Nd isotope compositions, water mass distributions, and freshwater inputs

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The Arctic Ocean is a restricted basin, with broad continental shelves and several deep sub-basins. The principal exchange of seawater is with the Atlantic Ocean, with some input from the Pacific as well. Freshwater inputs are from a number of Siberian and Canadian Rivers. Each of these inputs has distinct Nd isotope compositions, from the relatively radiogenic Pacific waters, the unradiogenic Atlantic, to the rivers draining varioius continental terrains. Another dominant hydrological feature is the sea ice cover, which affects biological activity, particle fluxes, and salinity distributions.

Here we present the first vertical profiles of Nd isotope data for the Arctic Ocean. Samples were collected from depth profiles at three locations extending from the Alaskan coast into the Canadian Basin during a cruise in 2000 with the USCGC Polar Star. Samples from depth profiles in the Makarov and Admundsen Basins were collected during the Swedish Arctic Ocean 2001 expedition.

The Arctic Nd concentration profiles at most locations are characterized as strongly decreasing with depth, in contrast to the common oceanic pattern of increasing concentration with depth. Near surface waters also have exceptionally high concentrations. In the Canada Basin, values of up to 26pM were found down to 85m. In the Makarov Basin, values of up to 49pM were found near the surface, and similarly high values were measured in the Amundsen Basin. Deep waters were generally around 17pM in each basin.

The Nd isotope compositions reflect the distribution of the inputs from various sources and transport between basins. In the Canada Basin, the highest values of ε_{Nd} of -6.4 were found at 50-85m. Near-surface waters in the Canada Basin, with values down to -8.7, reflect inputs from a MacKenzie River component with a concentration that has been modified by estuarine processes. Values of -11.0 were found in the deepest waters. In contrast, the Makarov profile is relatively uniform, with most values around -10.5. The Amundsen Basin demonstrates greater variability, with the lowest value of -12.3 at 3900m, and incursions of up to -8.8 above 100m. While variations in the upper water column are attributable to contributions from Siberian Rivers, their influence on Nd in the central basin is controlled by losses during transit across the shelves.