Inconsistencies between Fram Strait Water Mass Budget Assessments based on Radiogenic Neodymium Isotopes and Nutrients

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Arctic-derived freshwaters exported through the western Fram Strait via the East Greenland Current (EGC) can reach the North Atlantic with the potential to influence deep convection and circulation of the subpolar gyre, thus altering the meridional overturning circulation. To date, however, the exact sources, mixing and variability of these exported waters are poorly constrained.

Here we use data from GEOTRACES cruise GN05 to compare two different approaches to identify and quantify Arctic water mass components in the western Fram Strait and on the NE Greenland (NEG) Shelf. These approaches are based on 1) radiogenic neodymium (Nd) isotopes and 2) different macronutrient relationships. The marked contrasts seen in dissolved Nd isotope signatures (expressed as ε_{Nd}) between Arctic-sourced Polar Water ($\varepsilon_{Nd} \approx -9$) forming the core of the EGC and locally formed NEG Shelf Shallow Water ($-18 > \varepsilon_{Nd} > -10$) are not mirrored in the dissolved N/P ratios or the P concentration corrected for mineralization with O. Instead, calculations based on these parameters indicate very high fractions of Pacific Water in a confined area close to the Greenland coast, which at the same time is dominated by advection of NEG Shelf Shallow Water as evidenced by pronouncedly negative ε_{Nd} signals. These high N/P-based Pacific fractions by far exceed even those estimated for the EGC core based on Nd isotopes.

We discuss possible causes for the inconsistencies observed between these two methods by investigating endmember uncertainties, biogeochemical processes altering the water column distributions and by comparing our results to the local and regional circulation patterns.