Nutrients fluxes from Tr/He tracer ages:

In 2005 Icebreaker Oden occupied 42 hydrographic stations between Barrow, Alaska, and the Barents Sea. Nutrients, stable isotopes, and transient tracers were collected, along with CTD traces of salinity, temperature, fluorosence and transmissivity. Here we combine tritium/helium ages with nutrient concentrations to estimate rates of nutrient regeneration below the mixed layer, in the Arctic Halocline.

Nutrients fluxes from Tr/He tracer ages:

Freshwater from river runoff and ice melt are drawn to the Canadian Basin by anti-cyclonic wind patterns. Centered at about 350 meters depth is the “Atlantic” layer of relatively warm, salty water. The Atlantic and surface waters are separated by a strong halocline. The Upper Halocline, above the 33.1 salinity isoline, is distinguished by high nutrient concentrations and is strongly influenced by North Pacific water defensing from the Chukchi shelf. The Lower Halocline, between about 33.1 and 34.5 psu, is a mixture of waters with their origins in the North Atlantic and on the Arctic shelves. We analyzed respiration and regeneration rates separately in the upper and lower haloclines and calculated water column averages. The result is basin-scale estimates of the export productivity.

Nutrient fluxes from Tr/He tracer ages:

Nutrient – Tr/He Age Relationships

Plots above show changes in O2, NO3 and PO4 concentration with age in the Upper and Lower Halocline layers. (Mixed layer samples were excluded from correlation calculations.) Respiration rates are roughly twice as high in the Upper Halocline. The NO3/PO4 anomalies are Chukchi Shelf water.

Nutrients fluxes from Tr/He tracer ages:

Using oxygen isotope ratios, salinity, and nutrient concentrations one can decompose the freshwater anomaly into Atlantic, Pacific, Sea-ice Melt and Meteoric components. Between 1994 and 2005 the upper waters of the Makarov Basin, where the two AOS cruises overlap, freshened significantly by an average of 3.5 m in total column freshwater inventory. The shift between Atlantic and Pacific derived ocean waters did not contribute to this freshening. 1 meter came from increased sea-ice melt (or decreased net sea-ice formation) and the major fraction, 2.5 meters, came from increased meteoric water: river runoff plus local precipitation.

Nutrients fluxes from Tr/He tracer ages:

The Arctic growing season lengthens, chlorophyll concentrations increases over the continental shelf and the southern Canadian Basin. With higher surface productivity, export is likely to rise and the nutrient asymptote should increase. Hydrographic and tracer cruises can track changes as integrated along isopycnals.

Nutrients fluxes from Tr/He tracer ages:

Nitrate/phosphate relationships are used in the Arctic to identify waters that have a significant fraction of North Pacific water. Centered along the low-phosphate line are waters of mainly Atlantic origin; those near the high-phosphate line are heavily influenced by Pacific/Arctic Shelf water. Water moved along either of the black lines in the phosphate/nitrate ratio space is evidence of isopycnal mixing. The strong gradients between the two high-nutrient ends of the lines are in the Lower Halocline. These between the lines at the low-nutrient end are the Shelf Water. The gradient in the source regions over the shelves are smoothed by isopycnal mixing over the deep Canadian and Eurasian Basins, giving Arctic-wide averages.

Nutrients fluxes from Tr/He tracer ages:

Nutrient regeneration rates are estimated from the correlation between nutrient concentrations and the “Tritium-Helium” age. This radioactive tracer age, is a biased estimator, systematically but non-linearly underestimating the mean time since last surface contact. Data from the Atlantic boundary current in the Canadian Basin indicates that the Tr/He age may be as low as half the mean age. Uncertainty in the true age and the variance in the nutrient regeneration ratios are the main source of uncertainty.

Nutrients fluxes from Tr/He tracer ages:

Calculation of export production in grams of Carbon per square meter is based on:
• Polar mixed layer 20 meters thick.
• Average depth of the base of the Upper Halocline: 93 meters
• Average depth of the base of the Lower Halocline: 180 meters.
• Average Regenerated C/NO3 ratio: 0.9
• Standard (global average) Redfield ratios (106C : 16N : 1P)

Average Regenerated C/NO3 ratio: 0.9.
Average depth of the base of the Upper Halocline: 93 meters
Average depth of the base of the Lower Halocline: 180 meters.
Standard (global average) Redfield ratios (106C : 16N : 1P)

Nutrients fluxes from Tr/He tracer ages:

Using oxygen isotope ratios, salinity, and nutrient concentrations one can decompose the freshwater anomaly into Atlantic, Pacific, Sea-ice Melt and Meteoric components. Between 1994 and 2005 the upper waters of the Makarov Basin, where the two AOS cruises overlap, freshened significantly by an average of 3.5 m in total column freshwater inventory. The shift between Atlantic and Pacific derived ocean waters did not contribute to this freshening. 1 meter came from increased sea-ice melt (or decreased net sea-ice formation) and the major fraction, 2.5 meters, came from increased meteoric water: river runoff plus local precipitation.