

ARCTIC GEOTRACES

Letter of Intent

Circulation and mean residence times of the upper waters and its freshwater components in the Arctic Ocean studied by stable isotopes of water ($\text{H}_2^{18}\text{O}/\text{H}_2^{16}\text{O}$ ratio and $^2\text{H}/\text{H}$ ratio), tritium/ ^3He , CFCs, and SF_6

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Proposed Measurements

Distributions of transient tracers such as tritium/ ^3He , CFCs, and SF_6 are widely used to study circulation patterns, water mass formation processes and rates, and mean residence times of waters formed during the past ca. 50 years (mainly upper waters). We propose to measure a combination of tritium/ ^3He , CFCs, and SF_6 during the Arctic GEOTRACES cruise and to use these data, together with hydrographic data including nutrients, to characterize the dynamics of the upper waters including advective transport, mixing, and water mass transformation. This information is essential for separating physical and biogeochemical processes that determine the distributions of chemical variables, TEI's and carbon. We have applied these methods in the Arctic Ocean in the past and demonstrated that they contribute to our understanding of a variety of physical and chemical processes.

A unique feature of the Arctic Ocean is the freshwater lens capping the water column and the related strong haline stratification of the upper water column. Buoyancy gradients due to the freshwater distribution dominate both the stability of the water column and the prominent surface currents in the Arctic. Stable isotopes can be used to determine the provenance of freshwater, and thus are critical in understanding the dynamics underlying circulation patterns and material transports. Stable isotope data will also be important in estimating provenance of dissolved and suspended TEIs that enter the Arctic Ocean with river runoff and Pacific water inflow and are impacted by formation and melting of sea ice. We propose to measure stable isotopes of water ($\text{H}_2^{18}\text{O}/\text{H}_2^{16}\text{O}$ ratio and $^2\text{H}/\text{H}$ ratio) and use these data, together with measurements of salinity, nutrients (nitrate and phosphate), and dissolved oxygen), to separate the individual freshwater components that contribute to the overall freshwater inventory of the Arctic Ocean (Pacific Water, Meteoric Water, and Sea Ice Meltwater).

Logistics

Samples will be collected in glass bottles, syringes, or copper tubes. Some samples (CFC and SF_6) will be measured on board, others (tritium/ ^3He) will be shipped back to the lab for analysis. The $\text{H}_2^{18}\text{O}/\text{H}_2^{16}\text{O}$ ratio and $^2\text{H}/\text{H}$ ratio can be measured on board if it is desirable to have the data in close to real time to aid in planning sampling strategy or samples can be returned to the laboratory for measurement. We need 2 to 3 berths to conduct the proposed sample collection/measurement program.