Residence Times of the Freshwater Lens in the Arctic "Switchyard" Region

Rebecca Chan[1], Peter Schlosser[2], Bill Smethie[2], Ronny Friedrich[2]
[1,2]Columbia College, Columbia University, [2]Lamont-Doherty Earth Observatory

Arctic change is an important indicator of changes in global climate, as the poles of the earth are affected earlier and more strongly by changing climate. One of the key components of Arctic Change with implications for global ocean circulation is the Arctic freshwater budget. Studying freshwater variability in the Arctic can give a clearer picture of sea ice formation and melting, addition of meteoric water including river runoff, flux of low-salinity Pacific Water and their interaction with global circulation. Using naturally occurring stable isotopes of water, nutrients, and transient tracers, the freshwater components and the mean residence time of the combined freshwater inventory can be determined. Tritium, high concentrations of which were introduced into the atmosphere during the nuclear weapons tests that occurred mainly during the early 1960s, serves as a transient tracer. If combined with its radioactive daughter, the tritium/^{3}He age can be calculated and used to determine the mean residence times of the upper waters in the Arctic "switchyard" region, the area north of Greenland, extending along the Lomonosov Ridge to the North Pole. Characteristic of the Arctic is a sharp halocline that prevents vertical mixing and leaves a layer of freshwater along the surface, or top 50-100 m of the water column. This "freshwater lens" was found to undergo rapid renewal, with mean residence times of 3-5 years. The underlying halocline and Atlantic Water layers showed significantly longer residence times of up to 40 years. Patterns in tritium and salinity indicated the presence of sea ice meltwater, a finding supported by δ^{18}O measurements.