GEOTRACES Arctic Section: Shipboard determination of key trace elements

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Bioactive metals, especially Fe, are essential components for biological activities in the surface ocean. The high-resolution distribution of dissolved Fe along with other metals such as Al and Mn helps us to understand the mechanisms responsible for their distributions within the ocean. During the US Arctic GEOTRACES expedition from August 9th to October 12th, 2015, dissolved Al, Fe, Mn were determined shipboard on seawater samples collected throughout the water column from 60˚N to 90˚N along 170˚W-180˚E (Northbound) and from 90˚N to 65˚N along 150˚W (Southbound) in the Arctic Ocean. Samples were collected using the dedicated GEOTRACES trace element rosette with Teflon-coated, GO-FLO bottles, and samples were filtered using a 0.2µm AcroPak filter. In addition, water samples were collected at nominal depths of 1, 5 and 20m from under the sea ice, using a portable pumping system. At these same stations, samples of melted snow, sea-ice, and where available melt ponds, were also obtained. These latter samples were also filtered through the 0.2µm AcroPak filter. A total of 411 trace metal samples were collected at 28 GEOTRACES water column and 6 sea-ice stations, and dissolved trace metals were determined using shipboard Flow Injection Analysis. In general, across the Arctic Ocean the greatest Fe enrichments (5-10nM) were seen in the shelf waters of the Chukchi Sea as a result of remineralisation processes. This shelf water also shows the greatest Mn enrichments (18-54nM). At the shelf edge, the halocline spreading out from the shelf between 100-200m showed enriched nutrient concentrations (silicate and phosphate) as well as advection of the Fe (~2nM), Mn (~7nM) enriched shelf waters. Lower transmissometer signals at the shelf edge correspond to Mn enrichments, suggesting that this signal is probably associated with coastal reducing sediments that have been resuspended and advected offshore. Small Al enrichments (2-5nM) are seen on the shelf, but no maxima within the halocline waters at the shelf edge (~2nM). However high Al values (4-8nM) and Mn (1-7nM) are seen in the bottom water at the shelf break corresponding to a strong transmissometer signal. Surface water Fe values over much of the cruise track are generally ~1nM but a region of elevated values (2-7nM) are seen north of 85˚N on both the northbound and southbound tracks, coincident with the presence of ice cover.