Dissolved Ga distribution in the 2015 US Arctic GEOTRACES Section

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The Arctic Ocean has a direct influence on global ocean circulation and heat transport. However, because of variability in atmopheric conditions controlling surface circulation, the difficulty of accessing the Arctic, and a shortage of data, we lack a solid understanding of how waters are transported through and within the basins. Previous studies have indicated that gallium (Ga) may be a useful tracer for distinguishing water with sources in the Atlantic and Pacific oceans [1]. If this is the case, [Ga] could alleviate the need to use quasi-conservative nutrient relationships to deconvolve water masses.

Our study describes distributions of Ga in the Bering/Chukchi shelf seas, the Makarov Basin, and the Canada Basin using samples from the 2015 US GEOTRACES Arctic Section (GN01). Our results agree with McAlister and Orians'[1] supposition that Ga could be a useful tracer in the Arctic. Pacific-derived waters, between 24 and 27 σ, have low Ga concentrations (5 − 10 pmol/kg-sw), which increase to approximately 30 pmol/kg-sw in Atlantic-derived waters (> 27.6 σ). This contrast, in addition to Ga's low reactivity relative to the residence times of shallow waters in the Arctic, is what drives Ga's potential as a tracer.

Here, we present the first full section Ga data in two Arctic Ocean basins and assess the utililty of Ga as a tracer for Pacific and Atlantic water by employing a linear end-member mixing model [2]. Data from shelf-influenced waters show no impact of shelf processes on the Ga distribution. Likewise, comparison with the distributions of particle-reactive trace elements suggests minimal particle scavenging of Ga. Results for the Ga mixing model are compared to those previously generated using the nitrate-phosphate relationship as constraints for Pacific and Atlantic waters.

[1] McAlister and Orians (2015), Marine Chemistry 177, 101-109. [2] Newton et al. (2013), J. Geophys. Res. Oceans, 118, 2133–2154.