Tracing the Sources of Lead in the Canadian Arctic from the Atmosphere to the Ocean

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Trace metals play important roles in various biogeochemical processes in the Arctic, and the changing climate of the Arctic is expected to impact the distribution and cycling of many trace metals. A major pathway for trace metals to get to the Arctic and potentially become dissolved in seawater is through atmospheric deposition of aerosols. In this study, we measured lead (Pb) and its isotopes in aerosols and seawater samples collected in the Canadian Arctic. Lead isotopes are useful particulate source tracers and can be used to understand particulate inputs and oceanic circulation. From measurements of aerosol samples collected at Alert, Canada between April and July of 2013 and 2014 and during the Canadian Arctic Geotraces cruises between July and October 2015, we show that anthropogenic aerosols from Europe and Russia dominate during the Arctic Haze period (winter–spring) and that summer-fall aerosols come from more mixed sources including North America. The aerosol trace metal loads also indicate that particulate pollution levels have been relatively stable in the Arctic since the 2000s.

Dissolved Pb isotopes from the Canada Basin (CB), Canadian Arctic Archipelago (CAA) and Baffin Bay (BB) were also measured to identify the sources of Pb in the water column. Although Pb is present at low concentrations, anthropogenic Pb dominates the CB including the deepest and oldest water. It also contributes significantly to the BB and CAA. Furthermore, water masses in the CB, CAA and BB with elevated concentrations of Pb have distinctly low 206Pb/207Pb ratios (~1.13–1.15), which is likely from historic Eurasian Pb aerosol input. It is likely that previously deposited aerosols are released and remobilized to the interior parts through sea ice melting and shelf-related processes such as coastal erosion, sediment resuspension and brine injection.

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