Fate of mercury entering lakes and ponds in the Canadian High Arctic: Role of biological and geochemical drivers

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Mercury is a contaminant of concern in the High Arctic because of intense atmospheric deposition events in spring and elevated levels in some top predator organisms. We investigated the influence of geochemical and biological factors on the methylmercury (MeHg) content of aquatic invertebrates (chironomids and zooplankton) in 22 lakes and ponds in the Canadian Arctic Archipelago. Total mercury (THg) is delivered to fresh waters primarily by snowmelt, and we tested the role of mercury supply by sampling water bodies with a range in drainage basin size. We found that THg concentrations in sediment (after correcting for organic matter content) increased with drainage basin size, suggesting our study sites represented a gradient in mercury loading. MeHg concentrations in sediment and water were low and generally similar despite a gradient in THg supply. We suggest that bacterial production of MeHg in High Arctic lakes is weakly coupled to the supply of inorganic mercury because of poor environmental conditions for methylation. Biological processes were key drivers of invertebrate MeHg content while environmental mercury levels, drainage basin size and habitat characteristics were secondary explanatory variables. *Daphnia*, an efficient filter feeder, had elevated MeHg content compared to other zooplankton species in the water column, and its abundance best explained mercury levels in this invertebrate community. *Daphnia* densities in High Arctic lakes were related to aquatic producitivity, and we suggest that climate warming may increase the presence of these mercury-rich zooplankton. For bottom-dwelling invertebrates, specifically chirononomids, metamorphosis concentrated MeHg in adults up to 3 times more than in immature stages. Landlocked Arctic char inhabiting our study lakes primarily consume chironomids, and differential consumption of immature and adult stages may affect MeHg uptake by fish. We conclude that biological and food web processes play a greater role in MeHg transfer to fish than atmospheric mercury deposition in the extreme environment of High Arctic fresh waters.

Isotopic data (Sr-Nd-Hf-O) of intrusive rocks from the Kerguelen Islands (Indian Ocean)

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The Kerguelen Archipelago (Indian Ocean) is the emergent part of the northern Kerguelen oceanic Plateau. When the Kerguelen Mantle Plume started to build the Kerguelen Islands about 30 million years ago, it was situated near the South East Indian Ridge that then moved away, leaving the Plateau in its present intraplate setting. The early magmatism was transitional-tholeiitic and changes to alkaline to highly alkaline over time [1, 2] with some underplating [3] to create thickened oceanic lithosphere (15-20 km thick). The nature of the intrusive rocks and related cumulate ultramafic-mafic xenoliths is unravelling the different stages of lithospheric differentiation in this unusual thickened oceanic crust.

Studied samples (phenocrystic basalts, dolerites and ultramafic-mafic cumulates) mainly consist of the minerals plagioclase and clinopyroxene. Accessory minerals are oxides, alkali feldspars, sulfides and apatites. Results show that several types of gabbroic (intrusive and cumulates) rocks can be distinguished on the basis of the rare earth element (REE) composition of their clinopyroxene. Isotopic data (Hf-Sr-Nd) show that the gabbroic rocks mostly have the same range of isotopic signatures as the basalts and that they mostly vary between two end-members corresponding from the inferred sources for the Kerguelen plume and oceanic basalts. The $\delta^{18}0_{cpx}$ values for gabbroic samples are relatively homogeneous (5.0-6.0‰SMOW) and show equilibrium at high temperature in mantle conditions. However the $\delta^{18}O_{WR}$ values indicate that subsolidus interactions with crustal fluids have taken place.

[1] Gautier *et al*. (1990) *Earth and Planetary Science Letters* **100**, 59-76. [2] Weis *et al*. (1993) *Earth and Planetary Science Letters* **118**, 101-119. [3] Grégoire *et al*. (2001) *Contrib. Mineral Petrol*. **142**, 244-259.