Controls on dissolved and truly dissolved REY in glacial-fed rivers in west Greenland

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Although global warming accelerates the retreat of glaciers and polar ice caps, and increases the meltwater input into the oceans, rather little is known about the distribution of Rare Earths and Yttrium (REY) in polar glacial meltwaters and glacial-fed rivers.

In this study, REY concentrations were determined in 200 nm-filtered glacial-fed river waters, in the respective filter residues (particulate fraction) and in ambient sediments (including a cryoconite sample from a meltwater pond on the surface of the Greenland Ice Sheet, GRIS) from the Kangerlussuaq area, West-Greenland. We also provide the first data for truly dissolved REY concentrations in polar glacial-fed rivers from a 10 KDa-ultrafiltered sample from the Watson River.

Shale-normalized ("$_{SN}$") REY patterns of the particulate fraction and ambient sediments (including cryoconite) show positive Eu_{SN} anomalies, which are similar to REY_{SN} patterns of local Archean basement gneisses. This rules out Asian dust as a possible source of these aluminosilicates, but suggests that local Archean basement is eroded and transported by ice, water and wind to the depositional sites in front of and onto the GRIS.

The 200 nm-filtered glacial-fed rivers show very unusual REY_{SN} patterns in comparison to tropical, temperate and boreal rivers, and are significant enriched in light REY relative to heavy REY. The truly dissolved 10 KDa-ultrafiltered sample from the Watson River shows much lower REY concentrations than the 200 nm-filtrate from the same river, suggesting that >99% of La and >78% of Yb are associated with nanoparticles and colloids.

Although the REY_{SN} patterns of the 200 nm-filtrates are rather similar to those of the respective particulate fraction and ambient sediments, they lack any Eu_{SN} anomalies, suggesting that in contrast to the particulate fraction and ambient sediments, the nanoparticles and colloids in the 200 nm-filtrates of the glacial-fed rivers are remobilized atmospheric dust from greater depth in the GRIS. Most of this dust originated from eastern Asia, shows REY distributions similar to Post-Archean upper continental crust, and as such lacks any Eu_{SN} anomalies.