Contrasting halogen geochemistry of barren and mineralized breccias of the Sudbury Igneous Complex, Ontario

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The potential for the halogen elements (Cl, Br, I) to be used as geochemical indicators for contact-style Ni-Cu-PGE mineralization along the lower contact of the Sudbury Igneous Complex (SIC) has been investigated. Two environments - one barren, and the other containing economic magmatic sulphide ore systems - were compared. The studied host rocks to these deposits are polymict igneous-textured breccias, formed by partial melting of the Archean country rocks (gneisses).

No significant differences in bulk major and trace element geochemistry of rocks between the environments aside from the halogen elements were observed. Two major differences in halogen geochemistry were recognized:

First, mineralized breccias show marked enrichment in I. This is thought to have resulted from the leaching of I from brecciated sulphides by hydrothermal fluids released during contact metamorphism and partial melting of the country rocks, and is unique to those breccias that host sulfides. The anomalous I can be detected for distances of up to several 100 metres from mineralized samples. This observation is consistent with experimental studies which show that I is the most compatible halogen in sulfide liquids [1] leading to I enrichment in environments where sulfide liquids crystallize.

Second, analysis of the soluble fraction (from fluid inclusions) of the halogens reveal that two distinct fluid end-members were trapped in the matrix of the breccias during their crystallization (as mixtures in primary fluid inclusions): a high Cl^-/Br^- fluid phase of probable magmatic origin (exsolved from the SIC), and a low Cl^-/Br^- fluid phase derived from fluid released during dehydration of hydrous minerals in the country rocks. Mineralized breccias contain a much higher proportion of the non-magmatic fluid end-member. This would suggest that footwall partial melting was a critical component to deposit development, possibly promoting sulfide saturation in this local environment or the transportation of ore metals in high salinity fluids of non-magmatic origin (e.g. groundwater, metamorphic fluid).

[1] Mungall & Brenan (2003) *Can. Min.* **41**, 207–220.

Sources and input mechanisms of hafnium and neodymium in surface waters of the Atlantic sector of the Southern Ocean

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The first combined dissolved hafnium (Hf) and neodymium (Nd) isotope and concentration data from surface waters of the Atlantic sector of the Southern Ocean are presented here. The samples were collected along the Zero Meridian (ZM), in the Weddell Sea (WS) and in the Drake Passage (DP) during RV Polarstern expedition ANTXXIV/3 and ANTXXIII/3 in the frame of the International Polar Year (IPY) and the GEOTRACES program. The distribution of Hf and Nd concentrations is overall similar. However, at the northernmost station located 200 km southwest of Cape Town a pronounced increase of the Nd concentration is observed, whereas the Hf concentration at the same time is at its minimum indicating lower amounts of Hf than of Nd released by weathering of the Archean cratonic rocks of South Africa. From the southern part of the Subtropical Front (STF) to the Polar Front (PF) Hf and Nd show the lowest concentrations (<0.12 pmol/kg and 10 pmol/kg, respectively), most probably due to the low terrigenous flux in this area and scavenging of Hf and Nd by biogenic opal. In the vicinity of landmasses the Hf and Nd isotope composition is clearly labelled by terrigenous inputs. Near South Africa Nd isotope values as low as $\varepsilon_{Nd} = -18.9$ indicate unradiogenic inputs supplied via the Agulhas Current. To the south the Nd isotope compositions are relatively radiogenic ($\varepsilon_{Nd} \sim -8$ to -8.5) towards the STF, within the Antarctic Circumpolar Current, in the Weddell Gyre and the Drake Pasage. Near the volcanic Antarctic Peninsula the isotopic data show significant increases to $\varepsilon_{Hf} = 6.1$ and $\varepsilon_{Nd} = -4.0$. implying an enhanced release of Nd and Hf. The Hf isotope compositions in the study area only show a small range between $\varepsilon_{Hf} = 6.1$ and 2.8. The new data show that Hf can be a sensitive tracer for prevailing physical weathering conditions, which is not the case for Nd. Neodymium isotopes show a factor of five larger range than Hf isotopes, which confirms Nd isotopes to be a sensitive tracer for the provenance of weathering inputs to surface waters of the Southern Ocean.