Tracking the Parental Melt of Chromite Using Trace Elements from LA-ICP-MS: an Effective Tool for Chromite Provenance

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Chromite is one of the first phases to crystallize in ultramafic - mafic silicate melts, and can thus be used to study early magmatic processes in volcanic and plutonic environments. A better understanding of chromite crystallization is also of economic interest, since it constitutes the only source of primary Cr, and massive chromitites can host important Platinum-Group Element (PGE) concentrations (e.g. UG2, Bushveld Complex).

In our ongoing work, we are studying the composition of chromites, obtained by EMPA and LA-ICP-MS, to i) constrain it's role in the fractionation of certain elements (e.g. Os, Ir, Ru, Sc, Ga, Ni, Co, …) during early magmatic processes (i.e. fractionation of Ru by komatiitic chromite [2, 3]) and ii) investigate the nature of the parental melt involved in the formation of chromitite in both oceanic and continental settings. Using this approach, we have shown a clear similarity between the geochemical signature of chromite from ophiolitic podiform chromitites and chromite from the primitive boninites [1]. This study aims to constrain the nature of the primitive melt involved in the formation of the Stillwater Complex chromitites which have a distinctive geochemical signature compared to chromites from various primitive ultramafic - mafic melts (Fig. 1) suggesting that none of these primitive magmas are involved in their formation. Also, these dissimilarities between the geochemical signature of chromite from the various lavas and from the Stillwater Complex chromitites can be used to discriminate them from one another and thus be used as a provenance mineral.

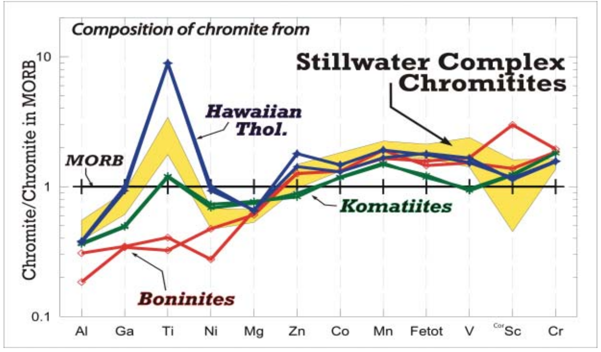

Figure 1: Composition of chromites from the Stillwater Complex chromitites compared to chromite from ultramafic-mafic volcanic rocks, including komatiite, boninite, and Hawaiian tholeiite, all of which have been normalised to the composition of the chromite from the MORB [1].

[1] Pagé & Barnes (2009) *Economic Geology* **104**, 997-1018.
[2] Pagé, Barnes, Bédard & Zientek (in press) *Chemical Geology*, 10.1016/j.chemgeo.2011.06.006.
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Neodymium isotopic composition of South Pacific bottom water

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Neodymium isotope ratios in seawater are a useful tracer of water masses and marine biogeochemical processes, but our current knowledge of the distribution of Nd isotopes in the ocean is limited by the number of available data. Large areas, particularly in the Southern Ocean, remain unstudied. The international effort of the GEOTRACES program to map the global distributions of trace elements and isotopes in the ocean [1] is improving the basis for the use of Nd isotopes as tracers of present and past processes and changes.

Here we present water column and surface sediment Nd isotope ratios (^{143}Nd/^{144}Nd, expressed in ε_{Nd} notation) from the Pacific sector of the Southern Ocean collected during *R/V Polarstern* expedition ANTXXVI-2. Deep and bottom waters in the southwest Pacific within the Antarctic Circumpolar Current (ACC) have an isotopic composition of $\varepsilon_{Nd} = -9$, the characteristic isotope signature of the ACC in the South Pacific and Atlantic [2, 3]. At a station south of the ACC and just north of the Ross Sea (69°S), bottom waters with the temperature-salinity properties of Antarctic Bottom Water formed in the Ross Sea (RSBW), are more radiogenic ($\varepsilon_{Nd} = -7$). These values are consistent with the Nd isotopic composition of sediments and tills in the Ross Sea [4-6]), suggesting an imprint of the Ross Sea signal on RSBW.

We find similar ε_{Nd} values in the authigenic ferromanganese oxide fraction of surface sediments in the southeast Pacific at depths bathed by RSBW, suggesting the northward transport of the Ross Sea ε_{Nd} signal into the southeast Pacific. Our results show a clear contribution of Antarctic Nd sources on the isotopic composition of South Pacific bottom water and suggest that ε_{Nd} can be used to trace the northward flow of RSBW into the southeast Pacific.

[1] GEOTRACES Science Plan (2006) *SCOR*. [2] Stichel et al. (2012) *Earth Planet. Sci. Lett.* **317-318**, 282-294. [3] Carter *et al.* (2012) *Geochim. Cosmochim. Acta* **79**, 41-59. [4] Farmer *et al.* (2006) *Earth Planet. Sci. Lett.* **249**, 90-107. [5] van de Flierdt *et al.* (2007) *Earth Planet. Sci. Lett.* **259**, 432-441. [6] Roy *et al.* (2007) *Chem. Geol*. **244**, 507-519.