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Global variation in chromite trace element compositions

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Chromite [(Mg, Fe^{2+})(Cr, Al, Fe^{3+})$_2$$O_4$] is an early crystallizing phase in mafic-ultramafic magmas and a refractory phase during partial melting of the mantle. Systematic changes in chromite chemistry during these processes make it a useful petrogenetic indicator, and the major element composition of chromite is widely used to constrain the petrogenesis and original tectonic setting of their host rocks. However, there is considerable overlap in the major element composition of chromite from different tectonic settings. Furthermore, its major element composition, especially of divalent elements like Mg and Fe, is subject to change during alteration and metamorphism.

Trace elements in chromite can potentially provide additional information about the petrogenesis and tectonic setting of their host rocks, and might give clues about primary processes in cases where the major element composition has been altered. We present major and trace elements from ~4000 chromite samples compiled from published literature. Chromites are first broadly grouped based on their host rock: ophiolite mantle, mantle xenoliths, layered intrusions and lavas. The data show distinct differences between chromites from these groups but also significant differences within the groups, for example between MORB, komatiite and boninite lavas.

The trace element pattern of lavas (especially picrites and komatiites) is similar to layered intrusions. However, layered intrusions often have lower Ni and Sc concentrations. This is interpreted to reflect slow cooling of layered intrusions and extended interaction between chromite and inter-cumulus liquid in equilibrium with olivine and pyroxene. Ophiolite mantle is dominated by trace element patterns similar to chromite from boninites although compositions range between chromite from boninites and MORB. Chromite from mantle xenoliths tend to be high in Al, Ga and low in Sc reflecting their origin from mantle that is relatively fertile compared to ophiolite mantle. These differences can help reconstruct the nature of mafic-ultramafic magmatism based on the chemistry of chromite of uncertain origin.