Geochemistry and Tectonic Significance of Chromites in Ophiolitic Mantle

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Chrome spinel [$(Mg,Fe^{II})(Cr,Al,Fe^{III})_2O_4$] is an alteration-resistant accessory phase which carries geochemical information on the petrogenesis and tectonic evolution of mantle peridotites in ophiolite complexes. Because the divalent (X) site has its closure temperature well below the mantle solidus, the trivalent (Y) site carries the more useful information, which may be obtained by micro-analysis using a combination of EMA and LA-ICPMS. Of the major elements in the Y site, the proportion of Cr (the Cr#), is sensitive to melting history, while Fe^{III} can be used to calculate oxygen fugacity. The plot of oxygen fugacity (fO_2) against Cr# is thus one of the most effective tectonic setting discriminants, separating variable fO_2, low Cr# ocean-continent transition zone (OCT) peridotites from low fO_2, moderate Cr# abyssal peridotites, low fO_2, high Cr# plume-related peridotites and high fO_2, moderate-high Cr# Supra-Subduction Zone (SSZ) peridotites. Of the analysable minor elements in the Y site, Ti and Ga are particularly useful: the incompatibility of Ti makes it particularly sensitive to the identification of melt-rock interactions, while Ga has the ionic radius of ferric iron but no redox dependency, so providing a way of correcting for the effects of magmatic differentiation on Fe^{III}. V is significant mainly because of its anomalously low values in most podiform chromitites, a feature likely related to redox conditions and/or olivine replacement associated with chromitite genesis. Sc and Yttrium are detectable only using other instrumentation, and their significance is presently unclear because of limited data. In this presentation, I compare and contrast the Y-site geochemical signatures in a range of ophiolitic chromites in order to compare and contrast their tectonic histories, with the aim of testing the various hypotheses for the presence of deep, recycled materials in many chromitite deposits.

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