An experimental study of the effect of water on chromite saturation in komatiite

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Chromite ($FeCr_2O_4$) is an oxide mineral and common accessory phase in ultramafic rocks. More unusually, chromite occurs in concentrated strata or lenses within layered mafic intrusions. The komatiite-hosted Blackbird Chromite deposit, located near McFaulds Lake in the James Bay Lowlands, Ontario, is one of five known chromite deposits within the Ring of Fire intrusive complex, and is the subject of this study. Chromite is the only chromium ore, and such deposits have great economic importance. Despite this, the conditions of formation of large chromite deposits are poorly constrained. The purpose of this investigation is to characterize the influence of magmatic water on the mineral phase relationships in komatiitic magmas. Water is hypothesized to promote chromite crystallization by suppressing the growth of silicate phases that might otherwise compete for chromium in the melt. It is known from studies of more felsic melt compositions that, while magmatic water inhibits crystallization of most silicate phases, it has a relatively lesser impact on oxide stability. Orthopyroxene, an important constituent in komatiites, readily accepts chromium into its structure, such that early-crystallizing pyroxene can prevent chromite from precipitating. Preliminary data from this study suggest that olivine may be a heretofore overlooked competitor for chromium. Experiments using synthetic komatiite (~2100 ppm Cr) with up to 4 wt% added H_2O have been equilibrated at temperatures ranging from 1350–1450°C. To accommodate water, experimental charges are sealed in graphite-lined platinum capsules and pressurized to 1 GPa in a piston-cylinder apparatus. In addition to phase characterization by electron microprobe analysis, we will analyse for chromium and trace element partitioning between mineral phases and melt using laser-ablation inductively coupled plasma mass spectrometry. If trace element partitioning is sensitive to water content, and water content affects the chromite formation capacity of a melt, then such a fingerprint may have applications in characterization of natural komatiites with respect to their economic potential. Experiments are underway to measure the chromite liquidus in magmas of different water contents, as well as to verify the liquidus phase assemblages.

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