Hydrothermal alteration recorded in chromite deposit: implications for mobility of platinum group elements

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Both spinel and chromite are relatively resistant to fluid-driven alteration relative to associated silicate minerals and thus may preserve original magmatic features. However, post-magmatic alteration of chrome-spinel can produce Fe-rich chromite, as shown in the Sartohay chromitite where intense metamorphism leads to major changes in chrome-spinel chemistry and to the growth of secondary phases (Fig. 1). After serpentinization, spinel was progressively replaced by Fe-rich chromite rim by a dissolution-recrystallization process. The Fe-rich chromite rims surrounding chrome-spinels probably formed during serpentinization of ultramafic rocks. The Fe^{3+}/Fe^{2+} ratios (0.14–0.34) of the Fe-rich chromite are highly variable and are mostly lower than that for chrome-spinel cores.

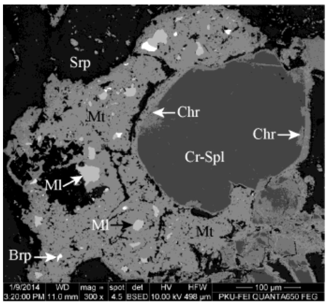

Fig. 1. BSE image showing Cr-spinel (Cr-Spl) surrounded by chromitite (Chr) rim was replaced by breithauptite (Brp) -magnetite (Mt) -millerite (Ml).

Sulfides, arsenides, and platinum group mineral (PGM) were observed mostly in the Fe-rich chromite, magnetite, and chloritite surrounding chrome-spinel porphyroblasts in the Sartohay chromitites. This and the fact that none of such minerals have been found occurring as inclusions in chrome-spinel suggest their secondary origin. Crystallization of these minerals must be associated with hydrothermal process, which formed a systematic change from magnetite- pentlandite, pentlandite-heazlewoodite-maucherite, millerite-breithauptite, to millerite-godlevskite-PGM assemblage. Enrichments of Os, Ir, Sb, and As in disseminated irarsite, breithauptite, and Fe-Ni-As-S minerals reflect the mobility of Os, Ir, Sb, and As during low-temperature hydrothermal processes overprinting the chromitites in the Sartohay region.