Hydrothermal Attributes of the Union Bay Platinum Prospect

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At the Union Bay Alaskan-type zoned ultramafic complex (ZUC) PGE enrichment occurs within magnetite and not within chromitite, which is atypical of ZUCs. The zones of magnetite and PGE enrichment are restricted to pyroxene-rich parts of the complex. Field, petrographic, and analytical data strongly suggests that the PGE-related magnetite and PGEs are of hydrothermal origins, deposited at temperatures of ~ 700 to <400°C.

Platiniferous magnetite at Union Bay occurs in veins and irregular pods in both outcrop and thin section. Magnetite-rich veins cut across layering in ultramatfic rocks and commonly parallel diopside veins. The latter veins are compositionally distinct from the magmatic clinopyroxene and apparently represent an early stage of hydrothermal alteration in olivine-clinopyroxene rocks. PGM-rich zones are zones of abundant magnetite veins which can be traced along vein strike but cut across different ultramafic host rock types.

Temperature estimates from PGE bearing magnetite present in clinopyroxene rich rocks vary accordingly with changes in the alteration envelopes, and the amount of spinel and ilmenite exsolution. As the amount of exsolution in magnetite decreases so does the magnetite-ilmenite based temperature estimates. Alteration minerals surrounding magnetite change from hornblende to chlorite with decreasing temperature. Multiple PGMs have been identified in this magnetite and include Pt-Fe alloys, Erlichmanite (OsS_2), Hollingworthite (RhAsS), native Os, Os-Ir alloys, Ir-Pt alloys, Rh-Fe alloys, PtSb, and a possible PtIr sulfide. Microanalysis is being conducted on select samples to quantitatively identify the alloys and antimonides.

Hydrothermal pyroxene at Union Bay is nearly pure diopside, in contrast with the Fe-Al-bearing magmatic clinopyroxenes. Hydrothermal hornblende is richer in Na and Fe^{3+}, and poorer in Fe^{2+} than magmatic hornblende. Both Phlogopite and Hornblende associated with hydrothermal magnetite contain significant Cl^-, suggesting equilibrium with a moderately Cl^- rich fluid. Hydrothermal chlorite varies significantly in optical properties and composition. In particular chlorite associated with lower-temperature magnetite deposition has different Mg/Fe ratios than that which overprints alteration hornblende.

A likely scenario for deposition of magnetite and PGE at Union Bay involves a quartz-undersaturated fluid with moderately high Cl^- contents, a moderate pH, and a moderate fO_2. Reaction of such a fluid with olivine and clinopyroxene rich rocks would produce a reaction envelope of amphibole and (or) chlorite, depending on temperature. In either case, reaction with the magmatic silicates causes an increase in solution pH, which would cause both magnetite and PGE deposition from chloride complexes in solution. The origins of this fluid are unknown, but the absence of quartz deposition suggests ultimate derivation from a mafic-ultramafic source and most likely scavenging of metals from this source.

The Union Bay ZUC is atypical with respect to its PGE mineralization when compared with other ZUCs from around the globe. The lack of platiniferous chromitite and the presence of vein style mineralization set Union Bay apart from other ZUCs. Concentrations of PGE in the magnetite veins (a high of 18g/t Pt+Pd) are greater than the concentrations from chromitite in other ZUCs. These features could make Union Bay one of few economically viable PGE bearing ZUCs in the world.