Gold and PGE mobility during serpentinization

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The mobility of precious metals during serpentinization has implications for the source to ore pathways at ultramafic-hosted Au deposits and for deep element cycling during subduction. However, the behaviour of Au and platinum group elements (PGE) at the onset of serpentinization is not well understood because early-stage features are typically obliterated during successive stages of mineral hydration. New geochemical results will be described for a suite of sulphide (pentlandite, pyrrhotite, chalcopyrite) native metals (Cu and Fe) and Ni-Fe alloys (awaruite) from variably serpentinized harzburgite, dunite, and pyroxenite from the Cache Creek terrane (Atlin, British Columbia, Canada). Native Fe- and awaruite-bearing mineral assemblages require super-reducing conditions that were likely generated during the conversion of olivine to serpentine and magnetite. Serpentinization decoupled precious metals at the micro-scale, partitioning Au, Ag, Pt and Pd within awaruite and native metals (Cu and Fe) at concentrations up to 100s of ppm. Other PGE (Os and Ir) acted as conservative elements within pentlandite and pyrrhotite (0.1–100 ppm), which we interpret as relict, low-temperature equilibrated mantle sulphide phases. Whole-rock mass balance calculations suggest that precious metal remobilization was limited to the micro-scale, which, in the case of Au, is consistent with its low solubility within such super-reduced fluids. Ultramafic-hosted Au deposits, however, are characterized by pyritized veins and wall rocks. Progressive serpentinization and olivine exhaustion likely de-stabilized the super-reduced mineral assemblage, liberating and transporting Au present as alloys and ultrafine native metals within more oxidized, S-bearing fluids. We suggest that native metals and alloys pre-enriched in Au, Ag, Pt and Pd may also occur within partially serpentinized oceanic slabs and contribute to the deep cycling of these elements during subduction.