Native Metals and Alloys in Arc-Related Ultramafic Rocks: Crustal Metamorphic Phenomenon?

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We report an occurrence of native metals and alloys in arc-related ultramafic rocks emplaced along the southern margin of the Siberian craton during Mesozoic (232-140 Ma) subduction. Ultramafic rocks underwent serpentinization followed by amphibolite metamorphism and contain a diverse suite (Figure 1) of native metals (W, Fe, Ni, Cu, Sn, Zn, Pt, Au, Ag) and alloys (Pt-Fe, Rh-Pd, Co-Cu, Ni-Cu-Au-Ag, Fe-Sn-Cu) associated with Cl-Br-I salts or included in halogen-bearing minerals (Cl-F-apatite, Cl-bearing amphibole, biotite, chlorite, serpentine). Refractory metals (W and Pt) possibly

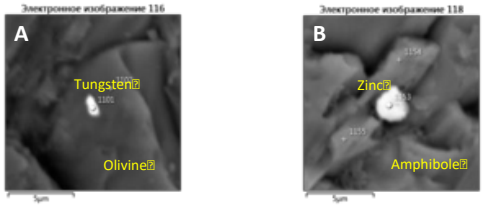

Figure 1. Inclusions of tungsten in olivine (A) and zinc in pargasitic amphibole (B).

reflect intrinsic mantle heterogeneity in respect to redox conditions. Other native metals (Fe, Ni and Cu) are texturally associated with serpentinization and appear to have been formed through reduction of relevant magmatic sulfides in presence of H_2 and CH_4. Refractory metal alloys with low-melting-point metals (Sn, Pb, Zn, Sb) associated with halides suggest involvement of halogen-rich, aqueous fluids. Previous studies indicate that fine-scale redox heterogeneity in otherwise oxidized subduction zone environments may be created by either percolation of sub-lithospheric C-O-H fluids [1] or by carbonate reduction under low oxygen fugacity [2]. Native metals and alloys in arc ultramafic rocks suggest that local metamorphic gradients played an important role in the formation of extreme redox variations in subduction-related lithosphere.

[1] Griffin *et al.* (2018) *Mineral. Petrol.* **112**, 101-114. [2] Tao *et al.* (2018) *Geochim. Cosmochim. Acta* **239**, 390-408.

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