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Olivine Andesite Contemporaneous with Mineralization at the Hishikari Deposit

Catherine Suclan¹, Keiko Hattori¹, Yashushi Watanabe¹

¹Department of Earth and Environmental Sciences, University of Ottawa, Ottawa, Canada

The Hishikari epithermal gold deposit is one of the highest-grade gold deposits in the world (409t Au) among currently mined. The Cretaceous Shimanto metasedimentary rocks form the basement and are overlain by the Hishikari Lower Andesites (1.62-0.84 Ma), Hishikari Middle Andesites (~0.78Ma), Shishimano Dacites (1.1-0.66 Ma), Hannyaji Rhyodacites (0.7-0.6Ma) and Hishikari Upper Andesites (0.58-0.51Ma). The Hishikari Lower Andesite is Mg-rich (MgO \geq ~ 3.0 wt%) compared to other volcanic rocks. It contains olivine-bearing pyroclastic rock and two pyroxene lava. The two pyroxene lava contains phenocrysts of plagioclase (~An64), augite (Mg #64), hypersthene (Mg#60, En61, 1.42wt% CaO), magnetite (~12.0 wt% TiO₂, 28.1% ulvospinel component), ilmenite (13.6 % hematite component) and apatite. Ratios of Mg and Mn in oxides show that magnetite and ilmenite are in equilibrium, yielding ~ 820 °C. The data suggests slow cooling of the lava. The oxidation conditions, FMQ+1.1, are lower than fO₂ values of ~ FMQ+2, obtained for younger units in the area, such as Hannyaji Rhyodacite. The olivine bearing pyroclastic unit is dark grey, fine to medium grained containing Mg-rich olivine (Fo76, 0.05wt% Ni, 0.13wt% CaO, ~0.35wt% Mn), plagioclase (~An60), augite (Mg#77), hypersthene (Mg#67, En65, 0.96wt% CaO), magnetite (9.64wt% TiO₂, 27.8 % ulvospinel component) and apatite phenocrysts in a groundmass of glass, plagioclase laths, and two pyroxenes. The Fe²⁺/Mg ratio of a melt in equilibrium with olivine (Fo76) is 1.0. The Fe²⁺/Mg ratio of the bulk rock composition is 0.98 using the fraction of Fe²⁺ as 90%, suggesting that olivine is a phenocryst crystallized in the magma. Inclusions of Cr-magnetite (1.58 %Cr₂O₃, 4.3wt% TiO₂, 7.1wt% Al₂O₃) in olivine and high Mg in olivine suggest an injection of a high temperature, mantle-derived parental magma during mineralization.