The E&L Magmatic Ni-Cu-(PGE) Deposit, Northwestern British Columbia: Preliminary Sulfide Petrology, Platinum-Group Element Mineralogy and Lead Isotope Systematics

By

Eric Douglas James Vandenburg

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Abstract

The olivine gabbro-hosted E&L magmatic Ni-Cu-(PGE) sulfide deposit is located in the Jurassic Eskay Rift back-arc basin within the Stikine Terrane of northwestern British Columbia and is one of only two known high-grade magmatic Ni-Cu-(PGE) massive sulfide deposits in the Canadian Cordillera. The E&L intrusion is hosted in the 180.7 Ma Nickel Mountain Gabbro Complex and by Upper Hazelton Group pyritic black shales and mudstones. The petrology of sulfide and platinum group minerals and the lead (Pb) isotopic compositions of ore minerals were investigated to provide constraints on mineralization mechanisms and the source of metals in the deposit. The textures of pyrrhotite-pentlandite-chalcopyrite-magnetite are typical of magmatic ore deposits and platinum group minerals are predominantly tellurides and bismuthotellurides. Unusual sieve-textured magnetite in the semi-net-textured sulfides of the Lower Chamber and "pseudo-cuneiform" magnetite in the massive sulfides of the Lower Discovery Zone are interpreted to be the result of disequilibrium-induced resorption. The Pb isotopic compositions of sulfide minerals analyzed directly in thin section by laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) are variable with many of the results overlapping within analytical uncertainty. Some of the higher temperature sulfides (e.g., pyrrhotite) have relatively unradiogenic Pb isotope compositions, whereas lower temperature minerals (e.g., chalcopyrite) have compositions indicating the effects of crustal contaminant and of secondary hydrothermal alteration. Isotope mixing models suggest that variable degrees of contamination occurred at depth of a mantle-derived magma by the Triassic-Jurassic island-arc basement of Stikinia and at shallower depths by Upper Hazelton Group strata. The similarities in Pb isotopic ratios between E&L sulfides and sulfides from other deposit types in the region highlight the relative isotopic homogeneity of the Stikinia crust during the Early-Middle Jurassic. Combined, trace element and Pb isotopic geochemical variations from the E&L intrusion and deposit are consistent with post-collisional decompression melting of a metasomatized mantle source during the transtensional development of the Eskay Rift, with no genetic relationship to the Nickel Mountain Gabbro Complex. Given the inferred ascent path of the parent magmas along areas of high structural permeability and the lack of upper age constraints on mineralization, there may be a close tectonic relationship between mineralization at the E&L deposit and the nearby Eskay Creek and Anyox volcanogenic massive sulfide (VMS) deposits.