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# Depositional Redox Conditions of the Stratigraphy Hosting the Howard's Pass Zn-Pb and V Mineralization

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The Howard's Pass district, of the Selwyn basin, spans the Yukon-Northwest Territories border and contains an estimated 400.7Mt of mineralization grading at 4.5% Zn and 1.5% Pb, which accounts for over 30% of global Zn and Pb resources. Mineralization is hosted in the Ordovician to Silurian Duo Lake Formation, which consists of carbonaceous and siliceous mudstone. There are multiple proposed genetic models of a modified exhalative environment including Zn-Pb-rich brines permeating sulfidic muds by downward percolation of the metalliferous brine into unconsolidated sediments, or selective replacement of reactive strata during early diagenesis. Therefore, redox conditions at the time of sedimentation may play an important role in controlling mineralization. A recent study suggests that global Ordovician through Early Devonian anoxic marine waters were commonly ferruginous. Previous workers have used whole rock multi-element geochemical proxies to show that at Howard's Pass the redox conditions during host sediment deposition fluctuated from suboxic to sulfidic, but the occurrence of ferruginous conditions has not been fully investigated. Disorganized to partially organized packing of framboidal pyrite, with the majority averaging 5.0 microns in diameter, was observed across 17 samples from two drill cores. This suggests possible periods of euxinia or anoxic conditions with episodic periods of $H_2S$. Normalized against Al and relative to average shale values, enrichment factors of V, U, Mo, and Zn were found to be 397, 297, 1273, and 199, respectively. This study also employs Fe-speciation sequential extractions to test for ferruginous conditions in the strata hosting Zn-Pb mineralization at Howards Pass. Sequential leach analyses will quantify different forms of iron hosted in hosted in the carbonaceous and siliceous mudstones and determine ferrous-ferric oxide phases. This study aims to address knowledge gaps in sediment-hosted massive sulfide deposits by interpreting the relationship between redox environments and mineralization processes. The geochemical analyses will elucidate how redox fluctuations impact metal concentration and preservation in sediment, potentially offering broader implications for sediment-hosted ore-deposit exploration. Further, this study will provide empirical data to assess the effects of hydrothermal systems on Fe-speciation analyses.