

Investigating Vanadium Enrichment of the Duo Lake Formation at Howard's Pass, Yukon and Northwest Territories

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Black shales host significant vanadium (up to 2 wt % V₂O₅), nickel, and molybdenum, forming stratabound deposits with growing economic importance. While these deposits are traditionally thought to result from direct seawater precipitation, a potential hydrothermal influence remains underexplored. This study investigates vanadium-rich shales beneath Zn-Pb mineralization in the Duo Lake Formation at Howard's Pass, located in the Yukon and Northwest Territories. The goal is to assess the processes driving vanadium enrichment in this region and determine the factors influencing its accumulation.

To assess the geochemical controls on vanadium, this research integrates Fe speciation, Acid Volatile Sulfide (AVS) and Chromium Reducible Sulfide (CRS) experiments, and molybdenum and vanadium isotopic analyses. These methods provide insights into depositional redox conditions, fluid interactions, and metal transport mechanisms. Additionally, the spatial distribution of vanadium relative to zinc and lead is analyzed to assess co-mineralization potential. By comparing these findings to the Van Property of the Selwyn basin, located 60 km southeast in the same stratigraphic unit, this study evaluates whether the deposits share a genetic link and similar enrichment processes.

Understanding the mechanisms governing vanadium distribution is essential for improving exploration strategies and assessing its economic viability as a by-product of Zn-Pb mining. Beyond economic implications, this research also provides insights into sustainable mining strategies by clarifying the processes that concentrate vanadium in black shales. Given the increasing demand for vanadium in energy storage and steel production, refining geochemical models of its enrichment in sedimentary systems will aid in locating new deposits and support the development of more sustainable extraction methods, minimizing environmental impact while maximizing resource utilization.

This research contributes to a broader understanding of critical metal deposition in clastic-dominated Zn-Pb systems, with implications for future resource development in the Selwyn Basin and comparable metallogenic settings worldwide.