

Geochemical fingerprints of mineralization in the gold deposits of the Klondike district, Yukon

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The Klondike district in west-central Yukon hosts several orogenic Au occurrences. Despite the importance of these occurrences as exploration targets, their fundamental geochemical signatures remain unconstrained. This is not only fundamental for efficient exploration in the district, but also for understanding the genesis of these occurrences, including potential metal sources. To address this, here we combine petrographic observation, whole-rock geochemical data and pyrite LA-ICP-MS and S-SIMS analyses to reveal the fundamental geochemical fingerprints of mineralization of gold deposits in the Klondike.

Whole-rock composition data reveal that Au concentrations are correlated with other elements following one of two main geochemical associations, (1) Au-Ag-Te or (2) Au-As. Gold occurrences in west Klondike (Lone Star, Nugget-Buckland, Gay Gulch) have a Au-Ag-Te signature, while those in central and east Klondike (Dominion and Gold Run) show a Au-As signature. Pyrite geochemistry provides useful constraints to interpret these whole-rock associations, since it is spatially associated with Au-bearing veins.

Pyrite in central-east Klondike has higher median As concentrations (>1,000 ppm) compared to pyrite in west Klondike occurrences (<100 ppm), excepting Nugget pyrite which is relatively As-rich. We interpret that the whole-rock Au-As association in central-east Klondike is partially linked to the spatial association of arsenian pyrite and Au alloy. In Dominion, arsenopyrite likely contributes to this geochemical signature.

At Lone Star, pyrite Au and Te concentrations increase from the host rock towards the veins. Pyrite compositional maps reveal that these variations are related to Au-Te-bearing grains in pyrite, which matches previous studies reporting the occurrence of Au-Ag-bearing tellurides in paragenesis with Au alloy in Lone Star. Hence, it is suggested that the Au-As-Te association in whole-rock in west Klondike is mineralogically linked to the occurrence of Au-bearing tellurides.

Pyrite S-isotope data also show differences between west Klondike and central-east Klondike. In Lone Star, vein pyrite $\delta^{34}\text{S}$ values range from -2.8 to $+3.3\text{‰}$, while in Gold Run range from $+7.6$ to $+8.6\text{‰}$. The underlying controls driving these geochemical signatures in whole-rock and pyrite are currently being investigated. The results of this research are expected to aid in exploration efforts in the Klondike and elsewhere in Yukon.