

Use of large multi-digest lithogeochemical datasets for mapping lithology and alteration in porphyry copper deposits

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During mineral exploration, it is common to collect large multielement lithogeochemical datasets from surface samples (e.g. soil or rock chips from outcrop) and drill holes (e.g. drill core or chips). Drill holes are typically sampled from “top to bottom” with continuous geochemical data collected at a resolution of 1 to 5 metres (depending on the deposit type) and geochemical data is most commonly collected using a 4-acid (4A) digestion method with ICPMS finish. This multielement data can be used to define economic mineralization and associated alteration, as well as identify lithological changes that are often challenging to visually distinguish in hydrothermally altered rocks (e.g. Halley, 2020). Four-acid ICPMS data has become a mineral industry-standard approach in the last decade; however, intrinsic limitations of the “near-total” nature of the method may not fully dissolve resistive minerals, which means that some elements (e.g. Ti, Zr, Nb, Ba) are underreported by 4A.

In this study, we compared 4A ICPMS data to portable X-ray fluorescence (pXRF) analyses of the same sample intervals from continuously sampled diamond drill holes in the Camp Creek Cu-Au-Ag-Mo porphyry target in the Thorn Project of northern British Columbia. Significant differences (up to 90%) occur between 4A and pXRF results for Ti, Zr, Ba and Nb. These differences have meaningful impacts on lithological interpretations that would be inferred from 4A data. Variations in Ti, Nb and Zr are controlled by lithology and hydrothermal alteration, likely related to the presence of rutile, which is resistant to 4A digestion. Variations in Ba between methods are attributed to barite formation during high-sulfidation alteration. While variations in 4A digestion of minerals are inherently problematic for downstream data interpretation, the integration with other digestion methods (e.g. whole rock pXRF, or other partial digestion methods such as aqua regia) yields variable results that provide valuable information on mineralogy (and mineral composition) which cannot be inferred from 4A data alone. Multi-digestion method comparison is a practical and relatively inexpensive tool that can help map mineralogy and mineral chemistry changes within mineral systems with utility for routine mineral exploration and geometallurgy applications.