Porphyry deposits: genetic models using hyperspectral imagery data of drill core for exploration and mining applications

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Abstract

Mineral relationships, along with alteration mineral identification and their composition, can be successfully captured by hyperspectral drill core imaging and show wide range of spectral variation, relating to fundamental mineralization processes. Successful interpretation of hyperspectral drill core data, in combination with geological, geochemical and geophysical inputs, can lead to expansion of current mineral resources, optimisation of mine processes, as well as future delineation of new green-field districts. In a porphyry environment, alteration products that are genetically related to the chemistry of the mineralising fluids are easily detectable in the VIS-SWIR range. These include minerals such as the mica species, amphiboles, carbonates, chlorites, iron oxides, kaolinites, smectites, sulphates and tourmalines.

Mineralogical features such as chemical composition and structural order or crystallinity can be used as indicators of temperature of formation and pH gradients of hydrothermal systems and in turn these could be used as vectors to hidden porphyries. The spatial referencing allows for detailed comparison with downhole geological information such as geochemical assays. Geochemical assay data integrated with interpreted hyperspectral mineralogy and compositional variations effectively highlight a variety of important mineralization relationships. Hyperspectral imaging often assists in porphyry characterisation by illustrating and quantifying veining and other porphyritic textures. It may also allow for the identification and understanding of cross-cutting relationships and vein alteration envelopes that may not otherwise be apparent, as well as characterising alteration domains on drill hole or deposit scales. In certain case studies, these results can illuminate previously unknown mineralisation vectors and expose underutilised mineral compositions as applied to porphyries in exploration and mining.