Transferring Knowledge from Exploration to Minerals Processing: Innovative Use of Hyperspectral Imaging and Lithogeochemistry for Predictive Geometallurgy

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Ore characterization in exploration and mining is increasingly benefitting from hyperspectral imaging and multi-element geochemistry, with a promising potential to inform metallurgical process prediction across the mining value chain. However, identifying the valuable information within these large data sets is challenging, requiring the identification of quantitative geological proxies of performance distributed continuously across the orebody.

In this work, two techniques traditionally used in exploration were employed in a Copper-Gold Porphyry Deposit for comminution geometallurgical modelling. Lithogeochemistry was applied to recognize and quantify the relationship between hydrothermal alteration and comminution hardness. This helped to overcome the difficulties of recognizing and quantifying the alteration minerals which arise from subjectivity in the logging process and due to difficulties in accurately recording alteration through complex hydrothermal alteration, weathering and overprinting.

In the second approach, a workflow was developed to extract physicochemical information from the raw hyperspectral images collected with an automated core scanning system, avoiding the complexity of the conventional mineralogical interpretation process. While studies have been focused on the spectral absorption features associated with physicochemical conditions of mineral formation and proximity to ore zones, in this study, those were used to understand the links with comminution response.

Predictive models were developed using the outcomes of these approaches and the results of geometallurgical tests. They delivered strong predictors for comminution test results that outperform traditional mineralogical methods, such as automated mineralogy, X-Ray diffraction, and mineralogy interpreted from hyperspectral scanning systems.

Considering the availability and wide use of spectroscopy and geochemistry from the early stages of mining projects, this study presents an opportunity to use this information from the exploration stage for delineation of potential zones for geometallurgical sampling and process prediction.