Smarter Use of Geochemistry and Machine Learning to Support Geological Domaining and Geometallurgical Modelling of Porphyry Cu Deposits

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Consistent definition of geological domains is essential for geological modelling. The traditional methods for geological model construction are typically reliant upon subjective visual geological logging or a limited geochemical assay suite. This results in models that poorly represent the true characteristics of the rocks.

Whole rock multi-element geochemistry provides a fingerprint of the elemental composition of drillhole samples that is objective and amenable to powerful data science techniques. Applying dimension reduction and grouping analysis to process high-dimensional data can generate practical solutions for domaining and guide robust sample selection for orebody knowledge studies, for example, metallurgical, geotechnical or environmental.

Grouping materials with similar characteristics using these techniques results in better geological interpretations and improved understanding of geological processes and controls on mineralization. Groups of samples with like geochemical characteristics are defined using a combination of grouping algorithms and geological information and these groups are then interpreted spatially in two and three dimensions. Since they are based on high-quality assay data, these groups provide a higher level of consistency and repeatability than visual logs alone.

To convert a geological model into a geometallurgical model requires the integration of the drillhole database with metallurgical test work. Selecting representative metallurgical samples is critical for establishing relationships between the composition of the rocks and mineral processing response, such as metal recovery and concentrate grade. Machine learning techniques facilitate modelling of predictive relationships between metallurgical test results and the geochemical characteristics of the ore. This enables the results of a limited number of metallurgical tests to be leveraged against the larger drillhole database to provide predictions of ore processing response that can be deployed into every block in a resource block model.

We will present examples of this approach to improve interpretation, support sample selection and build geometallurgical models in porphyry Cu deposits.