
New Insights into Ore Genesis and Exploration Models from Multi-Element Geochemistry

Harry Brookes[1], Simon Griffiths[1], **Aidan Kitchener**[1]
[1]Third Planet Exploration Services Ltd., Bristol, United Kingdom

Geochemical data processing has resulted in enhancements in ore genesis and exploration models for massive sulphide, carbonate replacement and other sediment hosted deposits. These models are here applied to exploration for copper, zinc, gold and silver mineralisation.

Pyrite mineral chemistry reflects the process of formation, which might be diagenetic, hydrothermal, magmatic or metamorphic. Bulk chemical changes through the stratigraphic column are characteristic of individual sedimentary facies.

We use four-acid, multi-element exploration data from drill core to ascertain which samples contain pyrite and other sulphides. Sulphide bearing sample groups are then assessed using multivariate analysis, specifically Principal Component Analysis. Additionally, four-acid, multi-element exploration data were used to identify variations in RedOx Sensitive Trace Elements (ROSTEs) enrichment and covariance. Modelling and interpretation of these features has identified important controls on mineralisation.

We show that diagenetic and hydrothermal pyrite stages are distinguishable using trace element vectors from industry-standard drill core sampling data. This has enhanced alteration modelling, geochemical targeting and geometallurgical characterisation workflows that have been applied to exploration projects and mining operations at several pipeline stages.

Using a multivariate approach to assess how ROSTEs covary with one another and sulphidation, we generate a robust interpretation of oxidation state during deposition of sedimentary facies. This effective tool for identifying reduced sediment (reactive) horizons has been applied to several marine sediment hosted ore deposits. Often these units do not display clear textural or mineralogical differences and remain undifferentiated during core logging.

Our work demonstrates the adaptation of improvements in orebody knowledge to routinely collected exploration data. As such, we add value through more detailed geometallurgical models for both ore and waste material, shortening the time to discovery and development of mineral deposits.