# SEG 2024 Conference: Sustainable Mineral Exploration and Development

## Using Geochemical and Petrophysical Properties to Target Sediment-Hosted Copper Deposits

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Airborne geophysical surveys, such as airborne magnetics and gravity, are important techniques employed in mineral exploration, particularly for unexposed, inaccessible regions under cover. Characterising the petrophysical and chemical properties of the rock types that occur within and near a deposit can improve geophysical models and identify targets based on relevant anomalies. These data can be utilised to prioritise geophysical surveying programs in order to improve exploration efficiency and costs.

The Neoproterozoic Yeneena Basin in the Paterson Province of Western Australia contains several known Cu deposits, including the Nifty Cu deposit. Nifty is a base metal (Cu ±Zn ±Pb) deposit hosted primarily in carbonaceous shale with lesser carbonate beds in stratiform lenses within a syncline structure. Nifty has been well studied and thus provides an opportunity to characterise the mineralised host rock and related alteration zones in order to define the stratigraphy using only petrophysical and chemical properties.

Whole-rock geochemistry and petrophysical measurements were taken at ~10-m intervals in seven diamond drill cores across the Nifty deposit. Using principal component analysis and machine learning techniques, five units with distinctive chemical and physical properties were identified, including those identifying the main Cu orebody, silicic alteration, carbonate alteration, pyrite-rich shales, and less-altered black shales. These units are laterally extensive across the mine site mineralisation and provide targets for further site-scale geophysical surveying. Based on these classified lithological groups, an induced polarisation/resistivity survey would identify the conductive Cu ore, surrounding resistive silica-rich alteration and the overlying, chargeable pyrite-rich shale layer. This technique could be used to trace these layers across the extent of the mineralisation footprint and could be further applied to areas of less well-explored sediment-hosted Cu prospects.