Using Apatite Chemistry to Identify Proximity to Copper at the Nifty Sediment-Hosted Cu Deposit, Western Australia

Jennifer Porter[1,2], David E Kelsey[2], Fawna J Korhonen[2]
[1]University of South Australia, Adelaide, Australia, [2]Geological Survey of Western Australia, Perth, Australia

The Neoproterozoic Paterson Orogen of Western Australia is the setting of several known copper deposits and recent discoveries (e.g. Winu) have highlighted the importance of this area as a future source of copper. To improve targeting of difficult to detect undercover mineralisation, there has been a focus on re-evaluating the formation histories of known copper deposits, including the sediment-hosted Nifty Cu deposit. Apatite, which forms together with copper ore at Nifty, provides a useful geochemical fingerprint for exploring undercover as it retains chemistry related to the processes of mineralisation. Understanding apatite chemistry in a deposit and how it changes across the footprint of a mineralising system is important to evaluating how this chemical fingerprint can be used to vector to new mineralisation when exploring undercover.

In this study, 25 thick section samples were taken from drillcore across the Nifty mine area from several lithologies including carbonaceous and calcareous shales, pyritic shales, carbonate and silica alteration, and the main Cu mineralisation. Apatite trace element chemistry was obtained using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS), and principal component analysis with unsupervised clustering was performed on 37 elements to identify chemically distinct apatite groups within each of the lithologies.

Eight distinct apatite chemistries, including two directly associated with the main Cu mineralisation were identified. These distinct chemistries distinguish apatite with different morphologies and mineral associations, including those associated with oxidised, uranium-bearing fluids from apatite associated with reduced Sn-associated Cu-bearing fluids. The apatite chemistries were also able to predict which apatite is associated with carbonate and silica alteration and which is not directly associated with mineralising fluids. These distinct apatite chemistries support concurrent research suggesting Nifty Cu was formed from more than one mineralising fluid and highlights the utility of apatite when vectoring to ore during sediment-hosted Cu deposit exploration.