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Is the Tennant Creek Mineral Field an IOCG Province? Insights from Chlorite Chemistry

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Recent studies in mineral geochemistry have shown that chlorite can delineate distal and proximal zones in porphyry Cu deposits. However, it is not known whether chlorite from other mineral deposit types exhibits the same characteristics. The Proterozoic Tennant Creek mineral field (TCMF), Northern Territory, Australia, has produced over 200 t gold and 350,000 t copper since 1932. Although the deposits are classified as iron oxide-copper-gold (IOCG) type, the Tennant Creek deposits differ from typical IOCG systems in that they have spatially restricted chlorite-rich hydrothermal alteration haloes and are enriched in Bi. Laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) analyses have been carried out on chlorite associated with several deposits from the TCMF and compiled with chlorite data from different ore deposit types (such as porphyry, IOCG, and volcanic massive sulfide deposits).

Results from univariate and multivariate analyses show distinct mineral chemistry domains of IOCG, porphyry, and VMS chlorite. The Tennant Creek population overlaps with other Australian IOCG deposits, highlighting the strong potential of chlorite geochemistry for explorers and researchers to help recognise ore deposit types. Compositional variations in chlorite chemistry proximal to known deposits in Tennant Creek permit it to be used as a geochemical vector towards mineralisation. Preliminary results show different trace element content between chlorite from barren and mineralized ironstones, enabling a distinction that is not possible with traditional exploration methods. Moreover, strong Fe and Co content in some chlorite could allow workers to explore the potential for critical metal mineralisation in the TCMF. These advances confirm that chlorite geochemistry is a powerful tool that could improve exploration models and lead to future world-class discoveries in Tennant Creek and other IOCG deposits.