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Using Mg-Carbonates, Kyanite, and Immobile Elements as Pathfinders for Technology Metals in the Central African Copperbelt

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Fluids are an important component of a mineralizing system, leaching, transporting and concentrating the metals that ultimately make up an ore deposit. The extensive geochemical and mineralogical footprint of a fluid is often used to vector towards potential localized mineralization. The Central African Copperbelt (CACB) records a >250-m.y. history of basin extension and inversion in addition to ~500 m.y. of potential supergene fluid interaction, where multiple generations of fluids have altered the surrounding rocks, changing their geochemical signatures. Owing to the longevity and pervasiveness of fluid flow in the basin, alteration footprints can be difficult to unravel, and potential links to mineralization may remain cryptic. Nevertheless, alteration footprints contain a wealth of information relating to the physiochemistry of the fluids that passed through the district's rock packages. Information such as pressure, temperature, salinity, oxygen fugacity, and sulfur fugacity may be recorded in the mineralogy of the alteration footprints which, if deciphered, can provide important clues as to the location of prospective fluid flow pathways.

For example, hydrothermal kyanite-bearing assemblages have been locally observed to relate to Mg metasomatism, which appears to be a basin-wide occurrence. These assemblages act as an indicator for extremely saline (>30 wt %) fluids that have increased capacity to transport metals such as Co, Cu and Ni, as well as traditionally immobile elements such as Al, Ti, and rare earth elements (REEs). The footprint of kyanite alteration is smaller than the pervasive Mg alteration, but broader than that resulting from sulfide mineralization, providing a potentially useful pathfinder mineral for a mineralizing system.

By leveraging the totality of information recorded in the minerals preserved in the basin, we will begin to construct a spatial and temporal picture of alteration and mineralization within such systems improving both our understanding and potentially exploration success.