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Applications of hyperspectral analysis to VMS and orogenic gold exploration in the Yilgarn Craton, Western Australia

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Abstract
Despite countless advances in recent years, exploration for volcanogenic massive sulphide (VMS) and orogenic gold deposits remains challenging. This is particularly the case in the Yilgarn Craton of Western Australia, where there is a paucity of outcrop, and weathering is deep and extensive. One of the most significant breakthroughs in recent years has been the accessibility of low-cost hyperspectral data to industry. Here were present the results of two exploration projects in the southern Kurnalpi Terrane, where large short-wave infrared datasets have been acquired.

The King Zn-(Cu-Au) VMS deposit occurs 140km east of Kalgoorlie as an overturned lens of massive sulfide mineralization in a basaltic to dacitic volcanic sequence. Chlorite and white-mica chemistry are strongly lithology dependant. Chlorite is dominated by mixed Fe-Mg compositions throughout the footwall stratigraphy, with localised zones of Fe- and Mg-rich compositions related to distinct lithologies and mineralization. Muscovitic white mica compositions predominantly occur in footwall basaltic rocks with more paragonitic compositions in dacitic rocks directly underlying massive sulfides. An increase in white mica abundance occurs towards the ore lens. Hanging-wall white mica is phengitic.

At the EO04 exploration target, orogenic Au mineralization is associated with the margins of a dolerite dyke cutting a mixed sequence of felsic to intermediate volcanic rocks. Anomalously high Te concentrations are restricted to west of the intrusion. Chlorite compositions are controlled by rock type, with Fe-rich chlorite in basaltic lithologies, and more mixed Fe-Mg compositions in andesitic and dacitic rocks. Mg-rich compositions are restricted to narrow zones within the latter, associated with anomalously high Te on the edge of current drilling. White mica compositions are dominantly muscovitic, with lesser phengite and occasional paragonite. Phengite occurs around zones of high grade Au mineralization at depth within the central zone of drilling, within both the andesitic volcanic rocks and crosscutting dolerite intrusion.