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Vectoring in Metamorphosed VMS Deposit: Insights from Chlorite, White Mica, and Garnet

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Most ancient volcanogenic massive sulphide (VMS) deposits have been subjected to metamorphism particularly those Archean in age. Despite countless advances in recent years, exploration for (VMS) 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. Recent significant breakthroughs in the accessibility of low-cost hyperspectral data to industry offer a great opportunity as an exploration tool in geologically complex terranes. In this study, we investigate the King Zn deposit using detailed mineralogical and hyperspectral analysis of both the orebody and host rocks. Mineralogical and geochemical data suggested that the footwall stratigraphy consists of several basaltic volcanic rocks that have been metamorphosed into garnet amphibolite and various types of felsic-intermediate schists. The immediate hanging-wall stratigraphy consists of metaexhalite and argillaceous metasedimentary rocks.

The chemistry of chlorite and white mica is strongly controlled by lithology. 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, whereas the hanging-wall white mica is phengitic. Fluorine and manganese concentrations in chlorite increase systematically towards the ore horizon before dropping sharply in the hanging-wall strata. Similarly, fluorine concentrations in white mica increase systematically through the footwall stratigraphy. Garnet composition is dominated by almandine end member, with increasing manganese content towards the ore proximity. Integrating mineral chemistry and hyperspectral data offers a rapid and cost-effective method for identifying potential ore horizons during the initial exploration phase. These findings have significant implications for enhancing exploration strategies in geologically complex regions.