

Amphibole as a New Vectoring Tool in Metamorphosed VMS Deposits

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Traditional exploration of VMS deposits is generally straightforward, relying on well-established mineralogical, geochemical, and isotopic halos. However, in high-grade metamorphic terranes these alteration assemblages are often overprinted and obscured by metamorphism, which complicates exploration efforts. As a result, the development of robust exploration tools is essential for improving discovery rates in these challenging geological settings. In this study we present systematic amphibole major and trace element data from several well-characterized VMS deposits from the Archean Yilgarn Craton of Western Australia (King, Talling, Wheatley deposits), NW Scotland (Kerry Road) and Norwegian Caledonides (Sullitjelma) which have been metamorphosed to amphibolite-granulite facies. The amphibole mineralogy in our samples generally can be divided into three main types: (i) prograde hornblende; (ii) prograde grunerite; and (iii) retrograde actinolite. Hornblende and actinolite are abundant in mafic metavolcanic units while grunerite is associated with metaexhalite units. Our preliminary results shows that the prograde hornblende typically shows manganese enrichment around the massive sulfide lenses. Prograde hornblende and grunerite also consistently show positive europium anomalies, compared to regional metamorphic amphibole which are typically absent or show negative europium anomalies. These Mn enrichment and positive europium anomalies are also observed in co-existing garnet in the studied samples which are indicative of a hydrothermal fluid influence, retained in these metamorphic minerals. Our results suggest that the presence of positive Eu anomalies in amphibole coupled with Mn enrichment can be used a new vectoring tool in metamorphosed VMS deposits for both deposit-scale exploration and regional prospecting.