

Sulphide and oxide isograds along a late Archean, deep-crustal profile, Tamil Nadu, south India

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Oxide-sulphide textures and mineral compositions have been studied in felsic and intermediate orthogneisses across an amphibolite- (north) to granulite-facies (south) traverse of lower Archean crust, Tamil Nadu, south India. Pyrite is widespread throughout the traverse increasing in abundance with increasing metamorphic grade. Pyrrhotite is confined to the highest-grade granulites in the extreme south. Ilm is widespread throughout the traverse increasing in abundance with increasing metamorphic grade and occurring primarily as Hm-Ilm in the granulite-facies rocks. Mt is widespread throughout the traverse and is commonly associated with Ilm. It decreases in abundance with increasing metamorphic grade. In the granulite-facies zone, reaction rims of Mt + Qtz occur along Fe-Mg silicate grain boundaries. Mt also commonly rims or is associated with Pyrite. In the highest grade section of the granulite-facies zone Pyrrhotite is absent in the most oxidized samples ($\text{IlmX}_{\text{Hm}} > 0.4$) and Pyrite commonly has Mt reaction rims. Pyrrhotite-Pyrite-Mt associations are commonly found in moderately oxidized samples ($0.1 < \text{IlmX}_{\text{Hm}} < 0.4$). The most reduced samples in this section have Pyrrhotite as the dominant sulphide with little or no Pyrite and no Mt. Reduced samples are absent in the lower-grade granulite-facies and transitional zones to the north. Oxygen fugacities estimated from the Opx-Mt-Qtz, Opx-Hm-Qtz, and Mt-Hm buffers average 2.5 log units above QFM throughout the granulite-facies terrane. Extensive Mt-Pyrite reaction rims and vein networks associated with Opx, Cpx, and Amph, give evidence for a pervasive, highly oxidizing fluid phase resulting from the partial subsolidus reduction of the Hm component in Ilm to Mt. This is confirmed by the presence of composite three oxide (Hm, Mt, and Ilm) grains. In general Mt and Mt-Pyrite micro-veins along silicate grain boundaries formed over a wide range of post-peak metamorphic temperatures and pressures ranging from high-grade SO_2 - to lower-grade H_2S -dominated conditions. Trends in mineral assemblages, textures, and composition are postulated to be the result of an external, infiltrating concentrated brine containing an oxidising component, probably CaSO_4 , during high-grade metamorphism. These rocks were then later acted upon by prograde and retrograde mineral reactions during post peak metamorphic uplift and cooling.