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Oxide and sulphide isograds along a late Archean, deep-crustal profile in Tamil Nadu, south India

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Oxide-sulphide-Fe-Mg-silicate and titanite-ilmenite textures as well as their 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. Titanite is limited to the amphibolite-facies terrain where it rims ilmenite or occurs as independent grains. Pyrite is widespread throughout the traverse increasing in abundance with increasing metamorphic grade. Pyrrhotite is confined to the highest-grade granulites. Ilmenite is widespread throughout the traverse increasing in abundance with increasing metamorphic grade and occurring primarily as hemo-ilmenite in the highest-grade granulite-facies rocks. Magnetite is widespread through out the traverse and is commonly associated with ilmenite. It decreases in abundance with increasing metamorphic grade. In the granulite-facies zone, reaction rims of magnetite + quartz occur along Fe-Mg silicate grain boundaries. Magnetite also commonly rims or is associated with pyrite. Both types of reaction rims represent an oxidation effect resulting from the partial subsolidus reduction of the hematite component in ilmenite to magnetite. This is confirmed by the presence of composite 3-oxide grains consisting of hematite, magnetite, and ilmenite. Magnetite and magnetite-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. Oxygen fugacities estimated from the orthopyroxene-magnetite-quartz, orthopyroxene-hematite-quartz, and magnetite-hematite buffers average 2.5 log units above QFM. It is proposed that the trends in mineral assemblages, textures, and composition across the traverse could be explained by an external, infiltrating concentrated brine containing an oxidising component such

as $CaSO_4$ during high-grade metamorphism later acted upon by prograde and retrograde mineral reactions that do not involve an externally derived fluid phase.