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Petrogenesis and evolution of charnockites formed at the Archaean-Proterozoic boundary

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The Archaean-Proterozoic transition was accompanied by major changes in global geodynamics, and in both crust and mantle geochemistry. The shift to modern petrogenetic and tectonic processes did not happen at one specific point in time, however, but over a period that spanned about 500 million years (c. 3.0–2.5 Ga).

The Southern Granulite Terrane (SGT) in India is a natural laboratory where processes that operated late in the transition period can be studied. However, the petrogenesis and tectonic significance of the predominant rock type in the SGT, enormous bodies of relatively homogeneous Opx-bearing granite (charnockite), remain a matter of much debate.

Zircon dating of garnet-bearing foliated charnockite, garnet-absent massive charnockite and associated gabbro from the Kolli Hills records emplacement at c. 2.5 Ga, closely followed by metamorphism at c. 2.4 Ga. Moderate to high density monophase fluid inclusions in the charnockite quartz and garnet indicate granulite-grade. The charnockite εHf reflects minor magma mixing with crustal rocks and yields a $T_{(DM)}$ model age of c. 2.7 Ga. The εHf values of the associated gabbro are positive, yielding a lower $T_{(DM)}$ model age of c. 2.6 Ga.

Whole-rock major and trace element compositions, and zircon REE, provide evidence for the source and origin of these rocks and their petrogenetic evolution, contributing hard data to the debate over whether the charnockites in the SGT are igneous or metamorphic.