

## Geochemistry and Sr-Nd isotopic systematics of Archaean and Neoproterozoic charnockites from the Southern Granulite Terrain, South India: Magma genesis and tectonics

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The Southern Granulite Terrain (SGT), South India presents a mosaic of Archaean and Neoproterozoic regional granulite terrains with peak-metamorphism dated at ~2.5 Ga and ~0.55 Ga respectively. The temporally distinct terrains lie across a crustal-scale shear zone system, well known as the Palghat-Cauvery Shear Zone. In recent Gondwana supercontinent models, the Neoproterozoic granulite terrains of the SGT are part of an extensive zone of reworked ancient crust within the Pan-African (0.75-0.55 Ga) East African Orogen. Charnockitic ortho-gneisses are widespread in both the Archaean and Neoproterozoic terrains and provide a rare opportunity to evaluate magma genesis in contrasting tectonic regimes.

Based on a new data set of major-trace element compositions and Sr-Nd isotopic systematics of 130 charnockite samples, we infer contrasting source compositions and genetic environments for the protoliths of the Archaean and Proterozoic charnockites. The former show near-chondritic  $\epsilon\text{Nd}_0$  and initial- $^{87}\text{Sr}/^{86}\text{Sr}$  at ca. 2.5 Ga. Their rare earth element and other incompatible trace element distributions are suggestive of derivation of the Archaean magmas by hydrous partial melting of amphibolitic crust with residual garnet and hornblende. Their source could be *either* dominated by a mantle component produced by subduction process during the latest Archaean, with variable extent of incorporation of mid-Archaean (upto 3.5 Ga) crustal components *or* may have involved an Archaean granulitic lower crust typically with low-initial  $^{87}\text{Sr}/^{86}\text{Sr}$ . On the contrary, the sources of Proterozoic charnockites involved greater recycling of older (upto 3.2 Ga) crustal components. Modeled at ca. 1.8 Ga, 0.8 Ga and 0.55 Ga, the genesis of the Proterozoic charnockites is consistent with significant intracrustal melting processes within a thickened crust. In a restricted segment of the Neoproterozoic domain there is also evidence for charnockites derived from juvenile protoliths with affinities to syn-collisional or arc magmas. A review of correlation between the South Indian and Sri Lankan high-grade terrains is also considered.

## Sea-floor weathering of hydrothermal chimney sulfides at the East Pacific Rise 9°N: Chemical speciation and isotopic signature of Iron using X-ray absorption spectroscopy and laser-ablation MC-ICP-MS

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A new laser-ablation MC-ICP-MS analytical method was used with spatially-resolved elemental and mineralogical data (synchrotron-radiation XRF, XRD, and XAS) to provide constraints on: (1) the complex interactions between hydrothermal fluids, seawater, and sulfide minerals over a wide range of temperature and redox conditions, and (2) potential biosignatures of Fe-oxidizing and Fe-S-reducing bacteria in chimney environments at the East Pacific Rise 9°N. Iron mineralogy, chemical speciation, and isotopic ratios were determined for several inactive chimneys and massive sulfides with contrasted extents of seafloor weathering. We collected two-dimensional elemental maps – Fe, K, S, and Si – at the micron scale within chimney cross-sections. With the XRF maps as a guide, we examined the mineral structure (XAS and XRD) and Fe isotopic signature (laser ablation MC-ICP-MS) of Fe oxide and sulfide minerals. Fe oxide minerals were essentially present: (1) as coatings on sulfide minerals, and (2) in close association with Si-rich materials. XAS results reveal the presence of a suite of Fe oxide minerals representing a continuum of crystallinity from less ordered than ferrihydrite to well crystallized goethite. We interpret the Fe-isotope signatures of goethite and ferrihydrite as reflecting different Fe oxidizing environments related to: (1) direct oxidation from Fe from pyrite in massive sulfide under oxygenated seawater conditions, yielding  $\delta^{57}\text{Fe}$  values similar to those of pyrite and (2) Fe oxidation from late stage Fe-Si-rich hydrothermal fluids in chimney environments, yielding variable  $\delta^{57}\text{Fe}$  values, both lower and higher than  $\delta^{57}\text{Fe}$  values of associated pyrite.