

# The Pan-African thermal event in East Gondwana: evidence and implications

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Results from recent geochronologic investigations in the high-grade terrains of southern India, Sri Lanka and East Antarctica suggest a prominent resetting of the stable isotope distribution in rocks and minerals during the 500-700 Ma timespan. This is either in the scale of a few centimetres, as in incipient charnockites, or pervasive, covering large segments, as in eastern Antarctica. Evidence for this is provided by the Sm-Nd mineral isochron ages from decompression-related cordierite-bearing granulites (Santosh *et al.* 1991) from southern India ( $539 \pm 20$  Ma) and Sri Lanka ( $490 \pm 16$  Ma), and from incipient charnockites (524 Ma from Kurunegala, Burton and O'Nions 1990; 560 Ma from Ponmudi, Chaudhary *et al.* 1991). Ion microprobe dating of zircons from Sri Lanka (Kröner *et al.* 1987) has also brought out events at ca. 750 and 550 Ma. Charnockitic rocks from the Sor Rondane Mountains of East Antarctica define an Sm-Nd mineral isochron age of  $624 \pm 20$  Ma (Shiraishi and Kagami 1989). Several metamorphic ages in the 500-700 Ma timespan are now emerging from these terrains, which converge to indicate a critical thermal event in the East Gondwana during the Pan-African.

The manifestation of this thermal event is best illustrated by the structurally controlled granulite formation in southern India and Sri Lanka, where amphibolite facies gneisses transform to charnockites along deep crustal fluid pathways. The microstructural and mineral phase equilibria characteristics in such localities dictate that nearly isothermal uplift conditions prevailed and that charnockite formation post-dated regional metamorphism and penetrative deformational fabrics. Fluid inclusion studies show that externally influxed CO<sub>2</sub>, which advected through faults and shears, was the major non-aqueous dilutant which effected the transformation and stabilized the anhydrous mineral assemblage.

The 500-700 Ma timespan also evidenced extensive fault-controlled alkali granite and syenite magmatism in the East Gondwanian fragments (Santosh and Drury 1988). Models based on geochemical and isotopic characteristics suggest that the magmatism was triggered by deep-seated extension and volatile-induced melting in the lower crust.

The Pan-African in East Gondwana is thus marked by a critical thermal perturbation which effected alkaline magmatism as well as structurally controlled granulite metamorphism, both in a distensional tectonic regime. We propose that lithospheric attenuation in response to deep-seated extension, triggering the release of large fluxes of CO<sub>2</sub> from the mantle, was central to the tectonics which operated in the East Gondwanan crustal fragments during 500-700 Ma ago.