

Petrogenesis of charnockites in India and Sri Lanka

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Charnockites in India and Sri Lanka are now recognised to be of two categories: (1) regional masses which cover extensive areas in the absence of intimately associated precursor lithologies, and (2) locally developed incipient pods and veins within upper amphibolite facies gneisses through structurally controlled dehydration. Understanding the petrogenesis of both the charnockite types is not only important in tracing the geologic history of individual terrains, but also fundamental to the understanding of deep crustal processes in general.

The regional charnockites represent products of the highest grade metamorphic event, as well as the oldest, in each terrain. Incipient charnockite formation, on the other hand, occurred repeatedly in different periods during the geologic history. Thus, it is possible to recognize at least three chronologic groups, namely, at *ca.* 2500 Ma (e.g. Kabbaldurga in Karnataka, India), *ca.* 1000 Ma (Orissa, India) and *ca.* 500 Ma (Kerala, Tamil Nadu and Sri Lanka). In all these instances, the incipient charnockites cut across regional penetrative structures and post-date the older regional metamorphism and its subsequent retrogression (Pichamuthu 1953; Yoshida and Santosh 1990). Field occurrences, petrology, mineral chemistry and fluid-inclusion characteristics of the incipient charnockites indicate that they were formed in a brittle structural regime, under relatively lower temperature and pressure conditions as compared to the regional granulites, aided by the influx of externally derived CO₂-rich fluids along shears and fractures, which buffered the water activity to low values.

Models of the petrogenesis of regional charnockites are diverse, ranging from magmatic to metasomatic and metamorphic. However, various studies in India and Antarctica converge on to models involving metamorphic and metasomatic processes of precursor lithologies in the *in situ* generation of regional charnockites (e.g. Yoshida 1978). Recent fluid-inclusion studies

(Santosh 1991) indicate that regional charnockites in India, Sri Lanka and Antarctica preserve evidence for a CO₂-buffered petrogenetic history.

A synthesis of field and laboratory data suggests that the incipient charnockites formed subsequent to the high-grade metamorphism and retrogression in regional granulite terrains. Their formation coincided with uplift, enhanced by the flushing of CO₂-rich fluids along structural controlled pathways. Regional charnockite genesis is best explained by the mechanism of carbonic metamorphism at the base of the crust (Newton *et al.* 1980) where CO₂ streaming has been more widespread and homogeneous.