

Significance of the occurrence of incipient charnockites within the granulite-facies zone of south India

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Most of the known charnockites were formed in late Archaean time when the temperature and pressure conditions were of the order of 700-800⁰C and 7-9 kbars, respectively (Bohlen 1987; Newton 1987). Transformation of calc-alkaline, grey, amphibole-bearing gneisses to charnockites and development of large tracts of the granulite belt of south India were achieved largely during this metamorphism. Several occurrences of pockets of patchy charnockites in the transitional metamorphic zones (e.g., Kabbaldurga) were noted by few as the arrested initial steps in the development of the massive charnockite belt (Condie *et al.* 1982; Hansen *et al.* 1984). Patchy charnockites were recently recorded in garnet-biotite bearing paragneisses of the Khondalite belt of southern Kerala (Ravindra Kumar *et al.* 1985). These occurrences have been ascribed to a conducive orthopyroxene-forming metamorphic reaction achieved later (*ca.* 550 m.y.) through biotite breakdown in the presence of quartz (Srikantappa *et al.* 1985; Ravindra Kumar & Chacko 1986). Occurrence of incipient charnockites within the dominantly granulite facies region were considered to be absent, as all the rocks, barring late dykes and granites, have witnessed prolonged granulite facies metamorphism and the metamorphism is expected to be complete. Aspects of occurrences of patchy charnockite growth within the granulite facies zone and their implications for the development of the granulite belt of south India are presented.

The Palghat 'gap' region in central Kerala is situated in the heart of the south Indian granulite-facies belt. Highly migmatized gneisses, forming the dominant rock type, preserve a complex tectono-metamorphic history. Pyroxene granulites and amphibolites occur as deformed, broken, boudinaged and rotated relics within these gneisses. At least two deformations have been witnessed by these rocks, during which time granulite-facies metamorphism was prevalent. P-T conditions of metamorphism were in excess of 8 kbars and 800⁰C (estimates based on gar-opx/cpx-plag-qz and gar-plag-sill-qz assemblages geothermobarometry). This initial granulite-facies metamorphism helped in the development of orthopyroxene in early amphibole-bearing gneisses, sillimanite in pelites, recrystallisation, and imposition of granulitic textures on early basic dykes. Partial melting,

synchronous with large-scale emplacement of pink granites, occurred subsequent to this metamorphism; it resulted in retrogression of early massive charnockites, breaking up of basic materials into layers, and development of composite gneisses. Charnockite-forming metamorphism was reimposed on the terrain, either through a rejuvenated metamorphism which had gone dormant or by a second event of granulite facies metamorphism. These charnockites occur in hinges of second-generation folds; in boudin necks of the highly migmatitic grey gneisses; along weak fractures as charnockite veins; in chemically modified zones (resulting from the action of migrating melts) adjacent to basic enclaves (like pyroxene granulite and amphibolite); alongside alkaline biotite-rich dykes (biotite + clinopyroxene + hornblende + feldspars + allanite) and pegmatites; and in thin veins rich in sulphide minerals. The common features of all these incipient charnockites are coarse grain size, absence of foliation, discordancy to the general structural fabric, occurrences only in grey hornblende-biotite gneisses (modified paleosomes) or leucosomes, and absence of any discernible late retrogression.

The pervasive charnockitisation in certain areas and patchy nature in certain other areas are not just the result of the amount of CO₂ available for dehydration. They are the result of a combination of geological and geochemical processes which modified the mineralogical and chemical make-up of the precursor rock and controlled the fluid-rock interaction prior to the metamorphism. The rocks and zones, indisposible to initial charnockite formations were modified by subsequent deformation and migmatitisation; within these zones suitable areas were the locales for pathy charnockite development. Dehydration may have been followed by internal buffering of fluid compositions or by CO₂ influx from an external source. Incipient charnockitisation was a late and, quite probably, an independant event characteristic of the region and not linked to a specific evolutionary time frame of the south Indian granulite belt.

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