

PETROLOGY AND TECTONIC DEVELOPMENT OF SUPRA-CRUSTAL SEQUENCE OF KERALA KHONDALITE BELT, SOUTHERN INDIA.

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Granulite facies terrains are suitable models for the study of the deep crustal processes (1). The granulite terrain of southern India, of which the Kerala Khondalite belt (KKB) is a part, is unique in exposing crustal sections with arrested charnockite growth in different stages of transformation and in varied lithological association (2). The KKB with rocks of surficial origin and incipient charnockite development, poses several problems relating to the tectonics of burial of vast area and mechanisms involved in expelling initial H<sub>2</sub>O (causes of dryness) for granulite facies metamorphism.

The dominant lithologies in KKB are khondalite (garnet-plagioclase-K-feldspar-sillimanite-biotite-cordierite-graphite), calc-silicate, quartzite, graphite bearing garnetiferous charnockite ( $\pm$  cordierite), garnet-biotite gneiss and leptynite (garnetiferous quartzofeldspathic gneiss). Major lithologies are interlayered both on outcrop and map scale. Arrested conversion of garnet biotite gneiss to charnockite are seen throughout the KKB. The supracrustal sequence is terminated at their northern and southern margins by garnet free massif charnockites. The few available age data ranging from 540 to 3100 Ma (3,4,5) suggest polymetamorphic history of the KKB.

The parageneses of garnet-orthopyroxene-plagioclase-biotite-quartz; garnet-orthopyroxene-spinel-cordierite-biotite-plagioclase-quartz; garnet-cordierite-sillimanite-biotite-plagioclase-K-feldspar-quartz; orthopyroxene-clinopyroxene-plagioclase; and diopside-plagioclase-calcite-scapolite-quartz document strong impressions of granulite facies metamorphism. Several progressive mineral reactions like biotite and quartz reacting to produce orthopyroxene; development of cordierite + almandine assemblages; formation of meionite replacing calcite and plagioclase are recorded throughout the KKB. The pressure temperature conditions of metamorphism deduced from solid phase mineral chemistry indicate 4.5 to 6.5 Kbar pressure and 650 to 750°C temperature for the peak period of metamorphism (6). The P-T estimates are in consonant with the expected range from experimental phase equilibrium considerations and are fairly uniform over a large area.

The geochemistry of gneiss-charnockite-khondalites are comparable to arkose-pelite lithological association. The low Ni contents, lower ratios of MgO/FeO and Ni/V and typical LREE enriched nature with negative europium anomalies indicate a sialic source region. The massif charnockites, which bound the supracrustals, have predominantly sialic composition.

It is possible to infer the following sequence of events based on the field and laboratory studies: 1) derivation of protoliths of KKB from 'granitic' uplands and deposition in fault bounded basin (cratonic rift); 2) subhorizontal deep burial of sediments; 3) intense deformation of infra and supracrustal rocks; 4) early granulite facies metamorphism predating  $F_2$ -loss of primary structure in sediments and formation of charnockites from amphibole bearing gneisses and khondalites from pelites; 5) migmatization and deformation of metasediments and gneisses; 6) second event of charnockite formation probably aided by internal  $CO_2$  build up(7), these charnockites are coarse, foliation blurring patches cross cutting the compositional layering; 7) isothermal uplift, entrapment of late  $CO_2$  and mixed  $CO_2$ - $H_2O$  fluids, formation of second generation cordierites and cordierite symplectites.

#### References

1. Newton, R.C. and Hansen, E.C. (1986) J.Geol. Soc. London v.25, p.297-309.
2. Ravindra Kumar, G.R. and Chacko, T. (1986) Jour. Geol. Soc. India. v.28, p. 277-288.
3. Crawford, A.R. (1969) Jour. Geol. Soc. India v.10 p. 117-166.
4. Srikantappa, C., Raith, M. and Speiring, B. (1985) Jour. Geol. Soc. India. v.26, p. 849-872.
5. Chacko, T., Ravindra Kumar, G.R. and Newton, R.C. (1987) J.Geol. v.95, p. 343-358.
6. Chacko. T. (1987) Unpubl. PhD. thesis, University of North Carolina, 191pp.
7. Hansen, E.C., Janardhan, A.S., Newton. R.C., Pram, W.K.B.N. and Ravindra Kumar, G.R. (1987) Contrib. Mineral. Petrol. v.96, p. 225-244.