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PETROLOGY AND PHYSICAL CONDITIONS OF METAMORPHISM OF CALC-SILICATE ROCKS FROM LOW- TO HIGH-GRADE TRANSITION AREA, DHARMAPURI DISTRICT, TAMIL NADU; **B.L.Narayana, R. Natarajan and P.K.Govil,** National Geophysical Research Institute, Hyderabad-500 007 India

Calc-silicate rocks comprising quartz, plagioclase, diopside, sphene, scapolite, grossularite-andradite and wollastonite occur as lensoid enclaves within the greasy migmatitic and charnockitic gneisses of the Archaean amphibolite- to granulite-facies transition zone in Dharmapuri district, Tamil Nadu. They are associated with magnetite-quartzites and corundum- sillimanite-bearing metapelite bands in which segregation of leucosomes containing garnet and K-feldspar are present. The calc-silicate rocks are characterized by the absence of K-feldspar and primary calcite, presence of large modal quartz and plagioclase and formation of secondary garnet and zoisite rims around scapolite and wollastonite.

The mineral distributions suggest compositional layering. Late retrograde rim garnet at the interfaces of plagioclase and wollastonite is grossular-rich ($Gross_{72}$) while the other garnet is comparatively low in graossular content indicating variation in the bulk composition of different layers. Microprobe analyses of the constituent minerals in three calc-silicate rocks have shown that calcic-rich plagioclase (An_{88-89}) is associated with scapolite of lower equivalent anorthite content (eq. An_{67-73}) while less calcic plagioclase (An_{55}) is associated with scapolite of higher equivalent anorthite content (eq. An_{64}) indicating the control of bulk composition. The chemical composition and mineralogy of the calc-silicate rocks indicate that they were derived from impure silica-rich calcareous sediments whose composition is similar to that of pelite-limestone mixtures.

From the mineral assemblages the temperature, pressure and fluid composition during metamorphism have been estimated. The partitioning of Na and Ca between scapolite and plagioclase yield temperatures greater than 660°C[1] while the scapolite composition indicates a minimum temperature of less than 750°C. The garnet-clinopyroxene-plagioclase-quartz geobarometer[2] and clinopyroxene-plagioclase-quartz geobarometer[3] give pressures of about 6 kbars.

The observed mineral reaction sequences require a range of X_{CO2} values (from about 0.4 to 0.12) demonstrating that an initially CO_2-rich metamorphic fluid evolved with time towards considerably more H_2O-rich compositions. These variations in fluid composition suggest that there were sources of water-rich fluids external to the calc-silicate rocks and that mixing of these fluids with those of calc-silicate rocks was important in controlling fluid composition in calc-silicate rocks and some adjacent rock types as well. Probably the calc-silicate rocks behaved as an open system for a short time only, and the reactions resulting from rehydration proceeded more rapidly, and never completed.

Hydration causing formation of garnet and zoisite rims in calc-silicate rocks is related to secondary biotite in the associated charnockitic gneisses. The occurrence of leucosome segregations with garnet and K-feldspar in metapelites indicates melting and absorption of H_2O into anatectic melts and this dehydration has aided the granulite-facies metamorphism of the South Indian shield in addition to streaming of CO_2-rich fluids[4] proposed for the metamorphism.

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