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Fluid Inclusion studies of high grade granulite terrain of Sivasamudram - Satnur area, Southern Karnataka, India

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The high grade granulite terrain of Sivasamudram-Satnur area in the southern Karnataka form a part of amphibolite-granulite facies transformation zone in the southern part of the Dharwar craton and indicates protolith age of ~2.9 Ga, which is a magmatic event followed by 2.5 Ga granulite facies metamorphism. The major lithologies of the area are massive to banded/foliated charnockite with the enclaves of basic granulites and metasediments (banded magnetite quartzite, quartzite and peltite). All these lithologies show a prominent N-S trend, which is a major trend prevalent during the Archean-Proterozoic period, marked by linear N-S trending Closepet granite. Based on the field and petrographic studies the terrain has revealed evidences of strong deformation and high-grade metamorphic events. The banded/foliated charnockites are medium to coarse grained consist of quartz, potash feldspar, plagioclase, orthopyroxene, clinopyroxene, hornblende and biotite with accessories of zircon, rutile and opaques. These rocks have undergone intense mylonite deformation indicated by feldspar porphyrodast and development of recovery and recrystallization (R-R) fabric and plagioclase is generally antiperthitic with bent twin lamellae indicating progressive deformation indicate the prograde metamorphism and development of symplectite of hornblende by replacing early orthopyroxene indicates retrograde metamorphic event in the area.

Geochemical, these charnockite are of wide variation of SiO_2 content from 48.77% to 76.65%. Na_2O is greater than K_2O, Na_2O/ K_2O ratio varies from 0.47 to 10.25. In normative diagram of O'Connor (1965) these charnockites fall on tonalitic to granodioritic fields. Rb and Sr ratio (Rb/Sr = 0.085) reveals that their magmatic protoliths originated from upper mantle to lower crust. PT conditions of charnockites were estimated using Fe-Mg exchange for equilibrium between different mineral pairs of garnet-clinopyroxene, garnet-orthopyroxene and orthopyroxene-clinopyroxene thermometry and garnet-orthopyroxene-plagioclase-quartz barometry. It reveals temperature of 720°C to 737°C and pressures 6.65 to 6.95 Kbars at near-peak metamorphism.

Two types of primary fluid inclusions are noticed in the quartz and plagioclase minerals in charnockitic rock. They are carbonic (CO_2) inclusions and aqueous carbonic (H_2O+ NaCl+CO_2(L)+ CO_2(V) ±CH4) inclusions. The carbonic inclusions show the melting temperature in the range of -57.0° to -56.3° C, suggesting a dominantly pure CO_2 with minor traces of the CH_4 and other gases. The carbonic inclusions homogenize in to liquid phase (Th_{CO2}) at temperature ranging from -26.1°C to -8.1°C, indicates high density (0.909 to 1.059 g/cm^3) carbonic fluids. These fluids are also confirmed by Raman spectroscopy studies due to shift in the CO_2 peak (1281 cm^{-1}) and the aqueous carbonic inclusions indicate the salinity of 1.48 to 8.91 wt% NaCl equivalent.

The estimated CO_2 isochore for primary inclusions in quartz and plagioclase minerals intersects with peak P-T condition of the granulites derived form mineral phase equilibria and it infers that CO_2 was the dominant fluid species that was trapped at or near peak metamorphic conditions in the area and imply synmetamorphic origin of lower continental crust derived fluids. These fluids were the dominant agents for granulite facies transformation on a regional scale and it might be responsible for the formation of regional charnockites.