CHAPTER VI
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CONCLUSIONS

The high grade metamorphic rocks exposed around Bhavani is predominantly composed of charno-enderbitic granulites, retrogressed granulites, fissile biotite gneiss (Bhavani gneiss) with numerous dismembered, layered anorhostitic, two-pyroxene-plagioclase and garnet-two-pyroxene-plagioclase bearing basic granulites. The various meta-sedimentary rocks like biotite gneiss, garnet+kyanite/ sillimanite+ biotite gneiss, calc-silicates and quartzites are exposed in the area. The present study is aimed to understand the field relationship between various rock types, detailed petrological, micro-textural studies, P-T conditions of metamorphism and fluid inclusion studies, including geochemistry of rocks exposed around Bhavani in Tamil Nadu, southern India.

Based on field relationship, petrography and preliminary geochemical data, two types of charno-enderbitic granulites have been identified in the area viz., the Archaean (> 3.1 Ga) granulites around Mettur, forming part of the Biligiri Rangan Granulites (BRG) and the late Archaean to early Proterozoic (2.51 to 3.1?) Chennimalai granulites CG). The general N-S trending structures of the BRG are truncated by late N40°E to E-W trending, ductile to ductile/brittle structures in the Moyar-Bhavani shear zone (MBSZ). The present investigation has shown that the MBSZ represent a suture zones, separating the Archaean Dharwar craton in the north and the early Proterozoic Chennimalai granulite in the south. Structural studies have revealed that the southern block exposed around Bhavani has been upthrusted onto the N-S trending Biligiri Rangan granulites. Two more shear zone viz., Dharmapuri-Mettur Shear Zone (DMSZ) and Chennimalai Shear Zone (CSZ) have been mapped.

Presence of heterogeneous rock types with varying deformational styles characterise the rocks within the shear zone. The fissile biotite gneiss (Bhavani gneisses) in the Moyar-Bhavani shear zone (MBSZ) represent a suite of meta-sedimentary rocks belonging to Sathyamangalam Group. Careful field and petrographic study has helped to distinguish the
fissile biotite gneisses (Bhavani gneiss) from the bleby gneisses (retrogressed rocks of the Biligiri Rangan granulites) in the MBSZ.

The retrogressed epidote hornblende biotite gneiss, commonly occur in the DMSZ. This shear zone represents major deep seated fracture zones which are Earthquake prone areas in Tamil Nadu. The mineral isochron ages in the MBSZ and CSZ indicate Neoproterozoic to Pan African mineral growth (garnet 624-591Ma; muscovite 594Ma; biotite 604-540 Ma and biotite 488-485 Ma), synchronous with ductile shearing. There is no Pan African overprint recorded in the area around Mettur.

The MBSZ is a typical high pressure shear zone (upto 14 kbar) in southern India, exposing the deep seated mafic granulites. A tectonic regime with early collisional (IBC) followed by late extensional tectonics (ITD) is envisaged, based on P-T-t paths for the MBSZ. Granulites formed during collisional tectonic regime with emplacement of numerous basic igneous rocks (Bhavani layered igneous complex) probably during late Archaean/Palaeo Proterozoic times. Reworking of the early crust, migmatisation, magmatism and formation of pink to grey granites (Sankari-Tiruchengodu) took place during an extensional tectonic regime throughout Neoproterozoic to Pan-African times. Emplacements of many pegmatites and molybdenum-bearing quartz veins as well as barren quartz veins are associated with syn to post-tectonic granite melts.

In contrast, the CG block evolved along ITD path with innumerable pink granites (Udiyur granites) and syenites (Sivamalai), emplaced during an extensional tectonic regime.

The earliest, syn-metamorphic (M1, M2) CO₂ fluids are preserved in Grt I and Qtz I in the basic granulites within the MBSZ. However, most of the CO₂ fluids in granulites are post-peak metamorphic fluids with respect to M1 metamorphism. The CO₂ density data pass well below the mineral P-T box, providing evidence of fluid leakage. The CO₂ monophase inclusions appear to have been derived from the mantle source (Juvenile). This is further, supported by the occurrence of high density CO₂ inclusions in basic granulite in the MBSZ. This indicates extensive magmatic underplating below the crust which has produced voluminous CO₂ rich fluids in the area. Presence of large number of basic crust below the Moyar Bhavani shear zone (MBSZ). This interpretation is further supported by the Deep
Seismic Studies (DSS), where the reflection and refraction data indicate an average 45 km crustal thickness in this region. Further, the DSS data indicate that the crustal column south of MBSZ is generally denser (Reddy et al., 2000). This is supported by the presence of innumerable basic granulites within the MBSZ.

In high strain areas within the shear zones, the rocks are generally free from fluids. The Bhavani gneiss contain halite bearing inclusions (with salinity of upto 35 NaCl eq.wt.%).

The fluid regime changed from the early CO₂ rich fluid phase to late, moderate density CO₂, mixed CO₂-H₂O (with varying volume proportions of CO₂) and low salinity H₂O bearing fluids during Pan-African times, with the formation of Sankari and Tiruchengodu granites. These fluids are independent of fluids related to granulite facies metamorphism (M1). These granites may extend into deeper parts of the crust, forming large scale fluid rich granite reservoirs that create mid-crustal low velocity layer (LVL) in the Precambrian terrane.

Chamo-enderbitic granulites around Mettur show geochemical characteristic similar to the Biligiri Rangan granulites and are of tonalitic to trondhjemitic in composition. Whereas, chamo-enderbitic granulite of the Chennimalai are mainly granodioritic to quartz monzonitic in compositions. In Chennimalai both igneous and sedimentary protoliths for the granulite have been recorded in contrast to predominantly igneous protoliths around Mettur. Chamo-enderbitic rocks show calc-alkaline differentiation trend and the basic granulite exhibit tholeiitic to Fe-rich tholeiitic trend. No significant geochemical differences have been noticed when the charnockite was retrogressed to gneiss in shear zones. The geochemistry of Udiyur granite exposed in the Chennimalai area is comparable to Pan-African Sankari and Tiruchengodu granites.