THE GEOLOGY AND PETROGENESIS OF THE SOUTHERN CLOSEPET GRANITE

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The Archaean Closepet Granite (~ 2500 Ma) is a Polyphase body intruding the Peninsular Gneiss Complex and the associated supracrustal rocks. The granite out-crop runs for nearly 500 km with an approximate width of 20-25 km and cut across the regional metamorphic structure passing from granulite facies in the South and green schist facies in the north. In the amphibolite-granulite facies transition zone the granite is intimatly mixed with migmatites and charnockite. Field observations suggests that anatexis of Peninsular gneisses led to the formation of granite melt, and there is a space relationship between migmatite formation, charnockite development and production and emplacement of granite magma.

Based on texture and cross cutting relationships four major granite phases are recognised. Relationships are not consistant from quarry to quarry, however, there is a general evolutionary trend ranging from an early granodiorite to late granite. The chronological sequence of emplacement of major granite phases are as follows

1. Pyroxene bearing dark grey granite
2. Porphyritec granite
3. Equigranular grey granite
4. Equigranular pink granite

Additionally there are small areas of 'K' and 'Na' rich rocks such as brick red rocks (9.7% K_2O) and albitite (11.6% Na_2O). Field and geochemical features suggests that they could only have arisen by extensive metasomatism.

The granite is medium to coarse grained and exhibit hypidiomorphic granular to porphyritic texture. The modal composition varies from granite granodiorite to quartz monzonite. Where the order of crystallization is deduced, biotite generally forms an early phase in the melt followed by plagioclase and quartz or quartz followed by plagioclase. Though K-feldspar generally a late phase begin to crystallize, still there was sufficient space for it to crystallize as subhedral phenocrysts. Amphibole is also an important mafic phase which is quite unstable breaking down in to biotite symplectites. Textural evidence suggests that part of the amphibole crystallized from the melt

Clinopyroxene occurs only in dark grey granite, where it is interstitial to late phase and textural evidence supports primary igneous origin. The accessories such as zircon may be derived and apatite, allanite and sphene are the early phases in the melt.

Geochemical variation of the granite suite is consistant with either fractional crystallization or partial melting, but in both the cases biotite + feldspar must be involved as fractionating or residual phases during melting to account trace element chemistry. The trace element data has been plotted on discriminant diagrams, where majority of samples plot in volconic arc and within plate, tectonic environments. However, field observations suggest a within plate environment likely to have prevailed during the evolution of the granite. When the calculated mesonormative minerologies (qtz-plag-k-feld) are plotted on phase diagrams, they suggest the derivation of granite by equilibrium fusion (batch melting) of the Peninsular gneisses. A quantitative trace element modelling has been tested. The trace element modelling suggests that partial melting to certain extent fractional crystallization were in operation during the evolution of the granite suite.

The granite show distinct REE patterns with variable total REE content. Textural evidence argues that large fraction of REE resides in accessory phases such as zircon, apatite, allanite and sphene. The REE abundances observed indicate no evidence for progressively more fractionated REE patterns from granodiorite to granite. The dark grey granite contains high total REE and show coherent patterns without any significant Eu anomalies. The Porphyritic pink granite exhibits variable total REE and fractionated patterns without any significant Eu anomalies. The porphyritic grey and equigranular grey granite with variable total REE show HREE enrichment, and negative Eu anomalies. The equigranular pink granite with variable total REE show slight LREE enrichment and negligible Eu anomalies. The REE patterns and overall abundances suggests that the granite suite represents a product of partial melting of crustal source in which fractional crystallization operated in a limited number of cases.