Petrographic And Geochemical Characteristics Of Mafic / Ultramafic Bodies Of Odhimalai And Thenkalmalai Segments, Late Archean Bhavani Layered Complex, Mettupalayam, South India.

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The significant landmark in the Late Archean tectonic history of Cauvery Shear Zone (CSZ) is continental – continental collision event and associated layered anorthosite complexes such as Sitampundi and Bhavani layered complexes. Both complexes show contemporaneous magmatic intrusive characteristics except omission and predominance of certain lithologies in the latter complex. The Archaean high grade Bhavani complex is composed predominantly of metagabbro and meta-anorthositic gabbros, along with pyroxenites and amphibolites. The Pyroxenite has been subdivided into the following zones, from base to top: 1. Websterite with opaque minerals, 2. Pyroxenite and 3. Plagioclase bearing Pyroxenite. The boundaries between the zones are transitional. Distinctive cumulus textures and the modal mineralogy varying systematically with stratigraphic positions. The Pyroxenites are stratigraphically grading into the Gabbroic rocks. Based on the grain size and plagioclase content, the Gabbro has been subdivided into the following zones, from base to top: 1. Gabbro and 2. Meta gabbro norite. Petrographic data generated for the dismembered segments of Odhimalai and Thenkalmalai mafic-ultramafic bodies divulges the evolutionary history suggesting the sequential settling in the magmatic chamber as cumulates.

Both clinopyroxene and plagioclase minerals associated with Gabbroic rocks exhibit a graded layering. Coarse grained layer occurring at the bottom of the sequence has shown stacking of finer grained layer confirming a gradational character. The Gabbroic rocks are cumulates composed of a framework of touching minerals concentrated through fractional crystallization. The relatively unzoned nature of the cumulus phases and their granular interlocking textures suggest the amount of postcumulus material is small. The large interstitial but homogeneous clinopyroxene grains found in many of the gabbros appear to have grown in equilibrium with the coexisting, largely unzoned plagioclase and pyroxene and do not represent intercumulus crystallization.

The silica content of the gabbro and Pyroxenite rocks varies from 49.04 - 56.05 % and 49.03 – 56.02 % respectively. In TAS diagram, total alkalis vs. silica values plotted for Odhimalai and Thenkalmalai rocks falls within boundaries demarked for the Gabbro and Tholeiitic rock fields suggesting their derivation either from mantle fractionates or pre collision plates. MgO and FeO decrease with increasing SiO_2, consistent with fractionation / accumulation. Pyroxenite samples show strong negative correlation with MgO and FeO whereas the Gabbro samples show weak correlation with them. CaO increase with increasing SiO_2, consistent with fractionation/ accumulation of clinopyroxene and plagioclase. As these lithologies represent dismembered units of Bhavani Anorthosite complex, the early formed fractionated ultramafic rocks such as chromatite and dunite bodies are located elsewhere in these area suggesting part of the magmatic chamber where these rocks were formed during magmatic fractionation. Both ultramafic and two-pyroxene-bearing rocks were emplaced nearly simultaneously, as partly crystallized magmas and magmatic crystal mushes that had similar temperature. In all the rocks the structures are dominantly magmatic and were produced by sorting and orientation of crystals by magmatic flow. The structural and chemical relations within the mafic complex suggest that all the rocks are derived from a single magma by crystal fractionation, with the ultramafic rocks formed by mechanical accumulation of early crystallized mafic minerals, and the two pyroxene-bearing granodiorite crystallized from a felsic differentiate.
Key words : cumulates, magmatic fractionation, continental collision