

Significance of mafic-ultramafic rocks in Bhavani Shear Zone, South India: implications for Archaean crust-mantle interaction processes

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The mafic-ultramafic rocks formed in diverse tectonics environments are of great significance to understand the mantle geodynamics and crust-mantle interaction processes. It is generally recognized that there is mafic-ultramafic constituents in our crust and mantle. Mafic-ultramafic rocks are also present in younger and older ophiolite complexes/dismembered ophiolite fragments, formed in various petrogenetic and tectonic environments emplaced within continental masses. The geodynamic processes of mafic-ultramafic rocks have similarly been applied in many instances for the reconstruction of continental landmasses. The Southern Granulite Terrain (SGT) in South India occupies an important position in various Gondwana reconstruction models. Recent multi-disciplinary geological studies on various crustal blocks and suture zones within the SGT have substantiated the Neoproterozoic subduction of the Mozambique Ocean lithosphere followed by final collisional suturing and incorporation of the crustal blocks within the Gondwana supercontinent. The multiple subduction and accretion regimes during Neoproterozoic in the southern part of Peninsular India have been further confirmed from detailed investigations on suprasubduction zone complexes and arc magmas from this region. The main crustal blocks in the SGT include Madras, Salem, Coorg, Nilgiri, Madurai and Trivandrum blocks. The Nilgiri arc, Salem arc, Madras arc and Coorg arc are the major tectono-magmatic arcs proposed in the SGT. The suture/shear zones within the SGT are characterized by the occurrence of ultramafic-mafic suite of rocks.

The Moyar-Bhavani suture/shear zone is a major crustal divide between Archean Dharwar craton in the north and the Proterozoic blocks in the south. The Moyar-Bhavani shear/suture zone extends to the Salem Attur shear zone. The Bhavani shear zone which is interpreted as a transcrustal suture system has a NW–SE trend in western region and shifts to NE–SW in the eastern region. Mafic-ultramafic rocks ranging in composition from dunite, peridotite, pyroxinites, websterites garnetiferous gabbro, gabbroic anorthosite to anorthosite are exposed along this suture zone. The minerals in these rocks have the potential to preserve chemical evidences for igneous processes and subsequent metamorphism. We aim to study extensive geochemistry and mineral chemistry of the various mantle and lower crustal rocks in order to have a better understanding on phase stability and pressure-temperature conditions of mantle-crust window. Our isotopic studies (like, δO^{18} , ϵNd^{144} , Sm/Nd) will provide information on petrogenetic environment and processes such as mantle magmatism, crustal component involvement, signatures of subduction components etc. The presence of fluid inclusions such as CO_2 , H_2O , etc., were observed in the primary minerals such as olivine and pyroxene indicate the role of mantle volatiles in the genesis of these rocks and can provide significant information on the thermochemical behavior of upper mantle.

The mafic- ultramafic rocks in this region are closely associated with subduction zone/arc magmatic rocks indicating their genesis as related to subduction processes in the terrain. The subduction of oceanic crust plays a key role in the exchange of mass and energy between the mantle and the crust, which leads to the mantle heterogeneity. The geochemistry of these rocks formed will give insights into the magma generation and post melting metasomatism of mantle in the subduction zone and role of slab dehydrated fluids in the subduction zone processes. Therefore, a comprehensive multidimensional petrological, isotopic studies, geochronology and fluid inclusion of ultramafic-mafic complexes in various arc segments within the SGT will provide us more insight into the crust-mantle interaction processes, the post melting metasomatism of lithospheric mantle in the suprasubduction zone and role of fluids and silicate in the above mentioned process.