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Petrogenesis of Amphibolites from the Bhavani Shear Zone, South India

ABEENA PV AND PRATHEESH P

Central University of Kerala

Presenting Author: abhipv25@gmail.com

Southern Peninsular India comprises of an Archean accreted litho-units that have been deformed multiple times. These units were then dissected by Proterozoic shear systems, resulting in a diverse assemblage of varying metamorphic grades and tectonic histories. This makes the region an ideal location for studying Precambrian P-T (Pressure-Temperature) conditions and geodynamic evolution. The Bhavani shear zone (BSZ), a major crustal discontinuity in the South Indian Shield, is part of the Palghat-Cauvery shear system and trends NE-SW. Rocks with varying P-T conditions, including significant amphibolites, are exposed in the BSZ, with well-developed fabrics that parallel to the regional shear trend. The BSZ has undergone polyphase deformation and displays multiple reactivation domains of opposing shear senses at various scales. Detailed field and laboratory investigations have revealed a complete sequence of rocks ranging from relatively low-strained and coarse-grained amphibolites protolith outside the shear zone to highly strained and fine-grained ultramylonite in the center. Numerous magnesite and quartz veins are also observed in the area, indicating significant fluid migration during various metamorphic events. The study attempted quantitative SEM-EDX analyses of five different mineral phases from the amphibolites, which exhibit Fe-Mg melanosomes with Plagioclase/Quartz/Magnesite leucosome bands and a typical ortho-amphibolite paragenesis with Amphibole, Plagioclase, and Ilmenite. The microstructural studies of the amphibolites indicate that the BSZ has undergone extensive ductile shearing, accompanied by fluid-induced retrograde metamorphism. Geochemical studies also suggest that the rocks have ortho-amphibolite characteristics. Taken together, the field occurrence, petrography, and mineral chemistry of the BSZ amphibolites suggest that there may have been a post-rift collision and subsequent subduction-induced metasomatism in the present tectonic setting. The presence of magnesite veins suggests that a carbonation process was induced by the aqueous brine from the subducted oceanic slab.