Tectonics and crustal evolution of Shevaroy Block, Southern India: Insights from petrology, geochemistry and U-Pb zircon geochronology

*Sam Uthup[1], Tsunogae Toshiaki[1,2], Rajesh VJ[3], Tsutsumi Yukiyasu[4]

1. Graduate School of Life and Environmental Sciences, University of Tsukuba, Japan, 2. Department of Geology, University of Johannesburg, Auckland Park 2006, South Africa, 3. Department of Earth and Space Sciences, Indian Institute of Space Science and Technology, Trivandrum, India, 4. Department of Geology and Paleontology, National Museum of Nature and Science, Ibaraki 305-0005, Japan.

The amalgamation of arcs through parallel collision and subduction, and subsequent vertical growth and lateral accretion led to the episodic continental crustal growth on the planet Earth. The Southern Granulite Terrane (SGT) in peninsular India is composed of various crustal blocks ranging in age from Paleoarchean to late Neoproterozoic which are dissected by transcrustal suture zones (e.g., Drury et al., 1984; Santosh et al., 2013, 2015; Uthup et al., 2019). These crustal blocks inherit signatures of crustal growth processes which operated during Archean. The Shevaroy Block (SB) is bounded by the NE trending Mettur Suture Zone in the west, in the east by the NNE trending Nallamalai Suture Zone, and in the south by the E-W trending Salem-Attur Suture Zone. The Shevaroy Block is dominantly composed of charnockite and felsic orthogneiss, along with mafic granulite, metapyroxenite, syenite, and younger pegmatite intrusions. The SB is characterized by NNE-trending structures. The dominant mafic-ultramafic lithologies present in the SB are meta-pyroxenite (clinopyroxene + orthopyroxene + calcic amphibole + ilmenite + magnetite), garnet-bearing mafic granulite (garnet + clinopyroxene + orthopyroxene + quartz + actinolite + cummingtonite + ilmenite), and amphibolite (calcic amphibole + plagioclase ±clinopyroxene + ilmenite ±magnetite).

A garnet-bearing mafic granulite sample examined is composed of porphyritic garnet with clinopyroxene, plagioclase, ilmenite, and quartz inclusions. These inclusions within the porphyroblastic garnet are regarded as relicts of the prograde mineral assemblage (clinopyroxene + $plagioclase_0$ + ilmenite + quartz). While, the medium- to coarse-grained clinopyroxene + $garnet_1$ + $plagioclase_1$ + $orthopyroxene_1$ + quartz present in the matrix represents the peak metamorphic mineral assemblage. Application of conventional geothermobarometers on the peak assemblages yielded metamorphic temperatures and pressures of 840-910˚C and 10-11.5 kbar. Similar peak metamorphic conditions are reported from the adjacent crustal blocks as well as from adjacent suture zones. An early retrograde stage is marked by the $orthopyroxene_2$ + $plagioclase_2$ corona texture formed around the $garnet_1$, as the result of a reaction: $garnet_1$ + $clinopyroxene_1$ + quartz →$orthopyroxene_2$ + $plagioclase_2$. Subsequently, these $orthopyroxene_2$ and $plagioclase_2$ underwent retrograde hydration to form cummingtonite and actinolite. The peak metamorphic minerals are also mostly overprinted by the late-stage actinolite along their grain boundaries.

All the studied mafic-ultramafic rocks from the SB are basaltic in the total alkali vs SiO_2 diagram. In the primitive-mantle normalized trace elements diagram, all the mafic-ultramafic rocks show negative Nb, Ta, P, and Ti anomalies and relatively constant high field strength elements (e.g, Zr, Hf) except for the garnet-bearing mafic granulite. The metapyroxenites and amphibolites are also characterized by enrichment of large ion lithophile elements (LILE) (e.g., Ba, K) suggesting fractional crystallization. In the chondrite normalized REE diagram, metapyroxenites and amphibolites show enrichment of light rare earth elements (LREE) over heavy rare earth elements (HREE). However, the garnet-bearing mafic granulite display slightly depleted LREE pattern over HREE. These REE patterns and normalized trace element

diagram displayed by the garnet-bearing mafic granulite suggest a MORB source for its origin, while an arc-related origin for metapyroxenites and amphibolites. Different tectonic discrimination diagrams suggest volcanic arc setting for all the mafic rocks from the Shevaroy Block. The garnet-bearing mafic granulite, metapyroxenite, and amphibolite might have formed from an underplated mantle-derived magma. The geochemistry of these rocks from the SB suggests that the SB was formed dominantly by the arc magmatism in a convergent margin setting. The zircons from amphibolite displayed oscillatory zoned cores with thin bright CL rims. The magmatic core yielded U-Pb age of ca. 2.50-2.58 Ga, while the metamorphic overgrowth rims yielded an age of ca. 2.46 Ga. These magmatic ages also confirmed the crustal growth related to arc magmatism in a convergent tectonic setting, while the overgrowth ages are related to the high-grade granulite-facies metamorphism. Hence, the Shevaroy Block provides one of the best examples for understanding the continental growth and tectono-thermal history of southern India.

Keywords: Shevaroy Block, Geochemistry, Geothermobarometry, Crustal growth

