Neoarchean arc magmatism in Bhavani suture zone, South India: Insights from geochemistry and zircon U-Pb geochronology

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The Archean crust holds an important key in understanding the crustal origin, growth and evolution. The Archean continents grew by vertical and lateral accretions in arc-arc, arc-continent and continent-continent collisions (e.g., Xiao and Santosh 2014). The peninsular India is composed of several crustal blocks (e.g., Nilgiri, Coorg, Salem, Madurai and Trivandrum blocks) ranging in age from Paleoarchean to Neoproterozoic-Cambrian making them an ideal study area to provide more insights into the evolutionary history of continental crust during early earth. The crustal blocks in Southern Granulite Terrane (SGT) are separated by major suture zones (e.g., Collins et al., 2014). The Palghat-Carvery suture zone (PCSZ) which trends E-W is dividing the SGT into two domains with Proterozoic granulite blocks to south and Paleo- to Neoarchean granulite blocks to north. The PCSZ is the late Neoproterozoic collisional suture, which carries the remnants of Mozambique ocean that got closed during the final collisional suturing at 550-530 Ma (Santosh et al., 2009). Recent studies in the SGT reported several arc magmatism and suprasubduction complexes formed by multiple subduction and accretion regime ranging in age from Paleoarchean to Neoproterozoic.

The Bhavani suture zone (BSZ) trends NW-SE in western region and changes to NE-SW in the eastern region. The Mettupalayam mafic-ultramafic complex which falls in the eastern part of the BSZ is characterised by amphibolites, metagabbros, metadiorites and mafic granulites that are intruded by younger granites, dolerite dykes and pegmatites. The dominant lithologies of the complex are amphibolite (amphibole + plagioclase ± orthopyroxene ± ilmenite ± magnetite), metagabbros (clinopyroxene + amphibole + plagioclase ± ilmenite ± rutile ± magnetite), garnet-bearing metagabbros (garnet ± clinopyroxene + plagioclase + amphibole ± ilmenite ± rutile ± biotite), metadiorite (plagioclase + amphibole + clinopyroxene ± epidote ± ilmenite) and mafic granulite (orthopyroxene + clinopyroxene + amphibole ± ilmenite ± magnetite).

Major and trace element chemistry of mafic-ultramafic rock suites suggests that these are tholeiitic in nature. The rock samples are characterised by marked enrichment in LREE and LILE with relative depletion of HFSE suggesting a typical subduction-related arc magmatic environment. The U-Pb zircon geochronology of Mettupalayam samples shows Neoarchean magmatic crystallization age with Paleoproterozoic metamorphic overgrowth. These age data from Mettupalayam mafic-ultramafic complexes are in accordance with the previous studies suggesting periodic magmatic events from Paleoarchean to Neoarchean from this region. Thus, our data also supports the model which suggests the occurrence of multiple arc magmatisms, and the magmatic arcs accreted onto the Nilgiri block and Coorg block along the BSZ and Moyar suture zone, respectively (e.g., Yano et al., 2016). Neoarchean magmatisms are also reported from other parts of the earth (e.g., Tsunogae et al., 2014), making Neoarchean a crucial time for crustal growth during earth's evolutionary history.

References

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