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A multidisciplinary study on the crustal architecture and tectonic evolution of the Biligiri Rangan Block, southern India: Implications for Neoarchean plate tectonics

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Southern India is comprised of a collage of crustal blocks ranging in age from Archean to Neoproterozoic. Previous studies considered the Archean high-grade granulite terrain to the north of the Southern Granuilte Terrain (SGT) of southern India as the part of the Dharwar Craton and hence subdivided this craton into western, central and eastern provinces. This contribution presents my detailed examinations on the least studied Central Dharwar Province, comprising the Biligiri Rangan (BR) – Male Mahadeshwara (MM) Hills domain composed predominantly of charnockites. One of my recent study (Ratheesh-Kumar et al., 2016) for the first time provided necessary evidence for Neoarchean subduction-accretion-collision tectonic evolution of this domain as a separate crustal block which has been named as Biligiri Rangan Block (BRB) by using a multidisciplinary approach involving field investigation, petrography, mineral chemistry, thermodynamic modeling of metamorphic P-T evolution, and LA-ICPMS U-Pb and Lu-Hf analyses of zircons on representative rocks together with regional-scale crustal thickness model derived using isostatic gravimetric geophysical method. The important findings of this study are: (1) The BRB preserves the vestiges of a Mesoarchean primitive continental crust as indicated by the age (ca. 3207) and positive εHf value (+2.7) of quartzofeldspathic gneiss occurred in the central part of the block (2) The charnockites and associated mafic granulites and granites provide ages between ca. 2650 Ma and ca. 2498 Ma with large negative εHf values are suggestive of Neoarchean charnockitization and crustal remelting (3) New geochemical data of charnockites and mafic granulites from BRB are consistent with arc magmatic rocks generated through oceanic plate subduction (4) Delineation of a suture zone along the Kollegal structural lineament bounding the BRB and the Western Dharwar Craton surmised from the occurrences of quartzite-iron formation intercalations and also mafic-ultramafic lenses along this lineament with their evolution through a clockwise prograde and retrograde metamorphism in a subduction zone setting at a high-pressure of 18–19 kbar and temperature of $\sim$840°C (5) Spatial variation of crustal thickness data reveal high crustal thickness in the Biligiri Rangan and the Nilgiri Blocks, and are attributed to a more competently thickened crust resulted by the subduction and collision processes. Based on these results, this study proposes a new tectonic model for the evolution of the BRB that envisages eastward subduction of the Western Dharwar oceanic crust beneath the BRB along the Kollegal suture zone resulted in the arc magmatism during the Neoarchean. The relevance of this study relies on the fact that the proposed evolutionary model revises the existing debates on the tectonic framework and evolution of the Archean terranes of southern India.