Petrological, geochemical and geochronological insights to the stature of Mercara Suture Zone in the Southern Peninsular India and its role in Gondwana

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Southern India was the leading vertex of India as it collided with the other Gondwana continents in Ediacaran-Cambrian times. The south Indian shield which preserves early formed crust (prior to 2500 Ma) has been divided into the Dharvar Craton (DC) and the Southern Granulite Terrain (SGT) by Fermor (1936), is a transition between the charnockitic and non-charnockitic terrains (Fig. 1a). The Mercara Shear Zone is sandwiched between the Western Dharwar craton and the Coorg block in the northern periphery of the SGT (Fig. 1b). The shear zone is marked by steep gravity gradients reflecting the presence of under plated high-density material, along with the electrical anomalies suggestive for vertical conductive structure extending from the lower crust into the upper mantle coinciding with this geologically marked transition zone.

Previous studies correlated the trace of this zone to Mesoproterozoic Rodinian suture, in which the Betsimisaraka suture from the Madagascar cross over to the Indian sub-continent at the Karwar Kumta region (Karwar–Kumta suture zone), as well as the northernmost part of Dharwar Craton. Even though it was structurally and geochronologicaly challenged by other workers they accept the correlation between the Mercara Shear Zone and the ca. 2.4 Ga Betsimisaraka Suture Zone in east-central Madagascar.

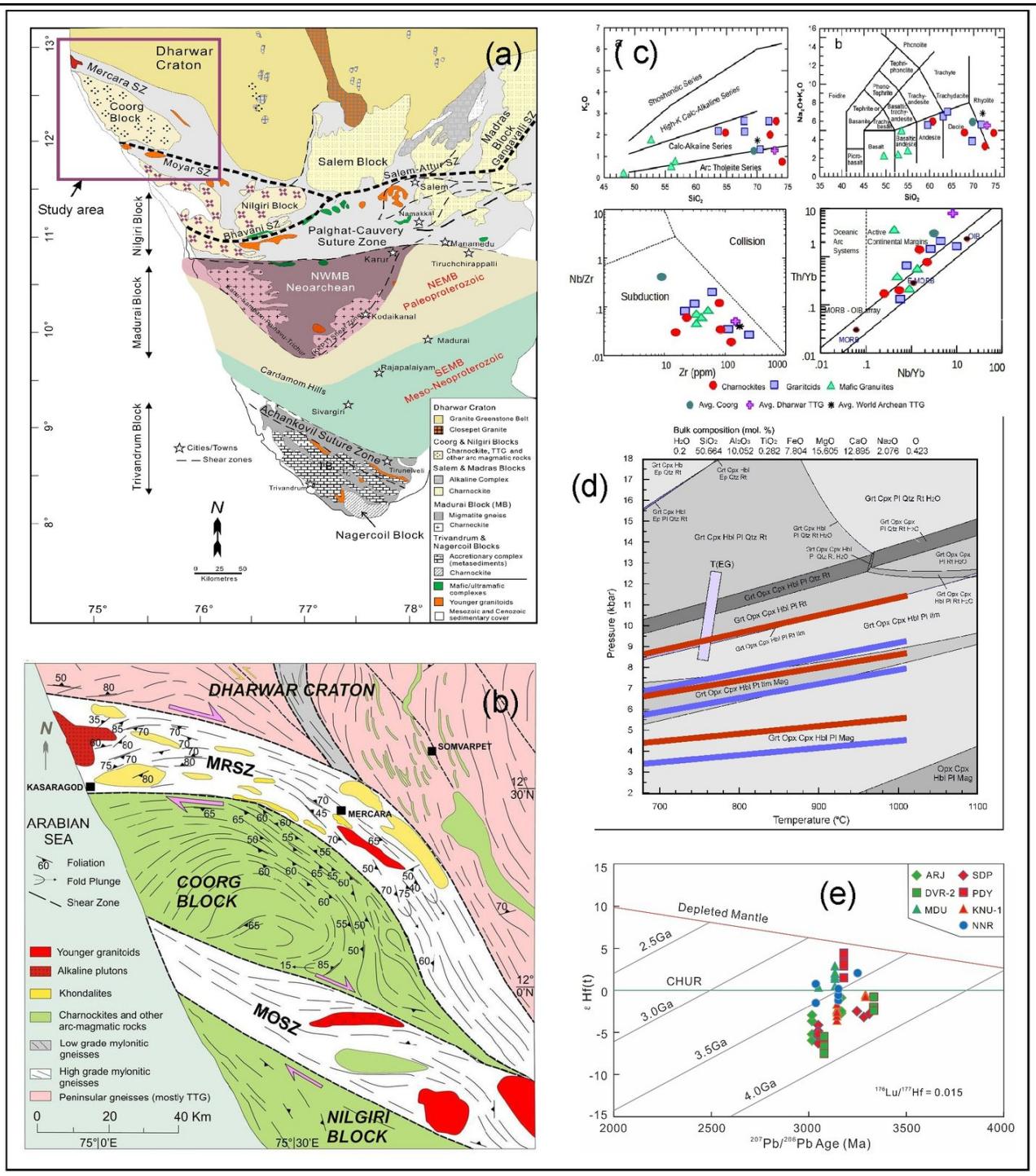
In this context our study try to elucidate the geological, petrological, geochemical, geochronological and genetical aspects from a suite of metaigneous (TTG-related gneisses, charnockite, metagabbro, mafic granulite) and metasedimentary (quartz mica schist, khondalite, garnet biotite gneiss, kyanite-sillimanite bearing metapelite) rocks from Mercara Shear Zone.

Conventional geothermobarometry and pseudosection computations indicate that the metapelites and mafic granulites from the Mercara Suture Zone have undergone high grade metamorphism at granulite facies conditions, possibly associated with a collisional event. Geochemical data on the magmatic suite suggests formation through subduction-related arc magmatism, whereas the metasediments represent volcano-sedimentary trench sequences (Fig. 1c). The fluid inclusion microthermometry of inclusions in quartz and garnet reporting high-density carbonic (1.15 g/cm^3) fluids from the charnockites and mafic granulites. The fluid inclusion data extracted from these granulites is in conjunction with the mineral thermobarometry of the terrain and suggest deep subduction and subsequent exhumation (Fig. 1d).

The zircon U-Pb age data from the magmatic rocks indicate crystallization ages between 3.1 Ga. to 3.2 Ga Ma whereas the detrital zircons from the sedimentary sequences provide an age range of 3.1 Ga to 3.5 Ga. The tightly defined ages of 3.1 to 3.2 Ga from igneous zircons in the magmatic suite suggest prominent Mesoarchean convergent margin magmatism. Hf isotope features suggest magma derivation mostly from juvenile sources and the Lu–Hf model ages indicate that the crust building might have also involved partial recycling of basement rocks as old as ca. 3.8 Ga (Fig. 1e).

The zircon data in our study clearly show metamorphic overgrowth at ca. 3.0 Ga suggesting collisional suturing in the Mesoarchean, rather than Neoarchean or Mesoproterozoic. It is possible that the younger events recorded in the other studies represent reactivation of a Mesoarchean suture. Future studies focusing on the timing of metamorphism of the rocks along this suture might provide further insights into this intriguing problem and the debate over the age and reactivation history of the Mercara Suture Zone. Our study defines the Mercara Shear Zone as a terrane boundary, and possible Mesoarchean suture along which the Coorg Block was accreted to the Western Dharwar Craton.

Keywords: Petrology and Geochemistry, Fluid Inclusion, Zircon Geochronology, Mercara Suture Zone, southern India



Figs. 1(a) Generalised tectonic framework of Southern India
(b) Detailed Geology map of Study area (c) Geochemical differentiation diagrams
(d) Combined mineral phase diagram with Co2 isochores
(e) εHf (t) versus 207Pb/206Pb age diagram of zircons

