2 Recent Advancements in Dharwar Geology and Tectonics

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Dharwar craton is bounded by the Eastern Ghats Mobile Belt in the east, East African Orogen in the west, Southern Granulite Terrain (Pandyan Mobile Belt) in the south and Proterozoic (Purana) platform basins in the north. Extensive geoscientific studies in recent years have created a wealth of new data that has led to a host of contemporary evolutionary models.

WDC & EDC

Revolutionary changes in stratigraphic framework of the craton have laid a firm foundation for the state-of-the-art laboratory studies and contemporary interpretation of data. An important change is that the Dharwar craton has been divided tectonically into Western Dharwar Craton (WDC) and Eastern Dharwar Craton (EDC) by Ramakrishnan et al (1976) and Swami Nath et al (1976). WDC is an ancient terrain distinguished by an older Sargur Orogeny involving the lithological assemblage of komatiite-tholeiite-BIF with minor quartzite-marble-pelite (Sargur Group, 3000-3300 Ma) enclosed in the TTG-type Peninsular Gneiss (3000-3400).The orogeny culminated in profuse invasion by trondhjemite-granodiorite plutons(3000 Ma), leading to the stabilization on the Mesoarchaean crust. This event was succeeded by the deposition of Dharwar Supergroup (2550-2800 Ma) on a peneplaned basement of Peninsular Gneiss (3000-3400 Ma) with Sargur Group. Angular unconformities over Peninsular Gneiss and Sargur Group, marked by basal oligomict conglomerate, quartz arenite-basalt cycles and Algoma-type BIF formed the lower Bababudan Group, overlain by polymict conglomerate-quartzite-carbonate-pelite-MnF and BIF, capped by basalt-rhyolite-greywacke-BIF association of the upper Chitradurga Group of Dharwar Supergroup. The Dharwar Supergroup and its basement gneiss is involved in Dharwar Orogeny which culminated in sporadic intrusion of ~ 2600 Ma potassic granites and final cratonization in end-Archaean. In contrast to these developments in WDC, the EDC bears only vestigial imprints of the older 3000 Ma orogeny marked by slivers of gneiss and basic xenoliths within a sea of granites, gneisses and greenstone belts. EDC is largely made of narrow greenstone belts of Kolar Group (2600-2700 Ma) that is equivalent of Chitradurga Group of WDC. The greenstone belts are engulfed by contemporaneous gneisses, and a large suite of younger granitoids (2550-2650 Ma) that are coeval with the top felsic volcanic suites of greenstone belts. Dharwar Orogeny encompassing both WDC and EDC closes around 2550 Ma. The gneisses and granitoids of EDC are described as forming the Dharwar Batholith by Chadwick et al (2000).

Transition Zone

Ever since the WDC and EDC were demarcated, their transitional contact was emphasized in many publications. Recently Jayananda et al (2013) have called this transition zone as Middle Dharwar Craton. The transition zone is distinguished by regional lithofacies change from Chitradurga Group of WDC to Kolar Group of EDC, the Sandur schist belt marking the transition. There is a corresponding change in schist-gneiss relationship from that of basement gneiss in WDC to intrusive gneiss and arc granitoids in EDC. A notional line of demarcation between WDC and EDC is drawn along the crustal scale Chitradurga shear zone (CSZ) as a convenient landmark for purposes of description.

Tectonic Evolution

Several plate tectonic models have been proposed for the evolution of Dharwar craton. Naqvi, Manikyamba and associates of NGRI (Naqvi, 2005) have proposed various models for individual greenstone belts involving subduction-accretion in an oceanic regime. Chadwick et al (2000) proposed a holistic model that describes WDC as a foreland to the accretionary arc of EDC represented by the Dharwar Batholith along with the enclosing intra-arc greenstone belts. NE-SW shortening resulting from WNW oblique convergence was visualized for the craton which was analogous to the Mesozoic-Cenozoic convergent settings. Chardon, Peucat, Jayananda and others (Jayananda et al 2013) proposed an ultrahot orogen involving two-stage accretion (2600-2700 Ma & 2520-2580 Ma) along west-dipping subduction zones in individual greenstone belts, with later development of plumes to explain extensive granite magmatism. Ramakrishnan (2008) proposed that WDC was formed by an earlier subduction-accretion orogeny involving Sargur Group greenstone belts and continental margin arcs denoted by Peninsular Gneiss during Sargur orogeny that closed at 3000 Ma. The attenuated continental crust to the east of Chitradurga Shear Zone (CSZ) formed part of the part of the composite Dharwar craton during Sargur orogeny. Dharwar Supergroup developed on this composite craton, with continental margin volcanic belts in WDC and arc volcanic belts with disrupted thin shelf assemblages at their western margin(Kolar Group) during 2600-2700 Ma. Accretion of arc volcanics and granitoids along many parallel west-dipping subduction zones in the EDC, with the continental margin association of WDC, along the CSZ at the time of Dharwar orogeny (culminating at 2550 Ma) resulted in the evolution of composite Dharwar craton.

Present Configuration

The present configuration of the Dharwar craton represents an oblique cross section of continental crust comparable to many well-studied cratons of the world. The craton was first tilted with moderate to steep gradient towards the west after the uplift of Eastern Ghats Mobile Belt (EGMB) and possibly after the emplacement of alkaline rock-carbonatite belt of Tamil Nadu around 750-800 Ma. The westerly steep tilt has caused the gradual narrowing of greenstone belts and progressive metamorphism from west to east towards the terrane boundary shear zone (Sileru Shear Zone of EGMB).The second episode of gentle tilting of the crust from south to north during post-Pan African times (500-550 Ma) exhumed the progressive regional metamorphic crust from greenschist in the north to granulite facies in the south, formed during Dharwar orogeny (2500-2600 Ma). This metamorphic event culminated in the development of E-W trending charnockite belt retaining the N-S trending cratonic structural fabrics. The disposition of charnockite belt orthogonal to the regional fabric is due to its parallelism with the regional metamorphic facies exposing deeper crustal levels as a consequence of gentle northerly tilt of the craton after Pan African orogeny (500-600 Ma) that affected the Southern Granulite Terrain. Significantly, the regional metamorphism during Dharwar orogeny is of kyanite-sillimanite (intermediate P/T) type in WDC, in contrast to the andalusite-sillimanite (high T/low P) type in the EDC, which is related to the profusion of younger granitoids in the EDC as against the relatively colder gneissic basement in WDC. The Dharwar craton that was stabilized at 2500 Ma as an Archaean accreted terrain was bounded by crustal scale shear zones (Sileru shear zone of EGMB and Palghat-Cauvery shear zone of SGT) formed during the Proterozoic collisional orogenies of Grenvillean EGMB and Pan-

African SGT. The general picture that emerges from the geoscientific synthesis of southern India is that Archaean cratons enclosing greenstone belts represent accretionary orogens that did not culminate in continent-continent collision, whereas the Proterozoic mobile belts that dissect and fringe the cratons represent the culmination of Wilson Cycle by continental collision. These mobile belts are zones of supercontinental assembly and dispersal during various orogenic episodes in Precambrian Earth history.

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