Crustal Development in the Dharwar Craton of Southern India

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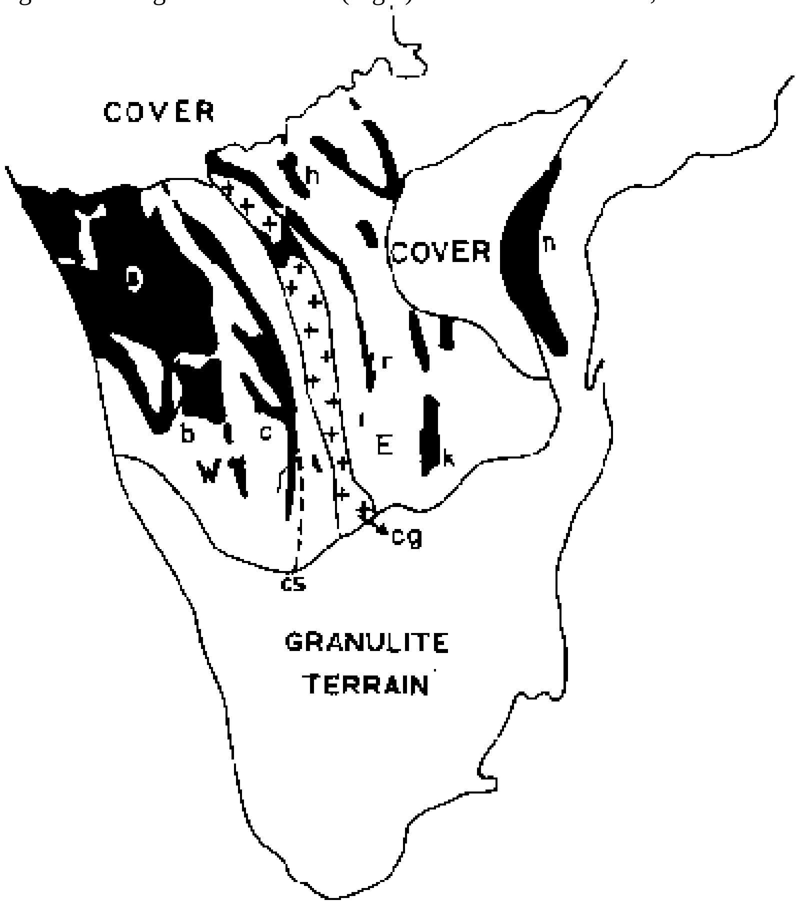
The Archaean Dharwar craton of southern India is divided into two prominent blocks viz.the Western and Eastern, separated by the steep, sinistral, N-S trending Chitradurga shear zone (Fig.1). The craton has witnessed two major periods of crustal stabilisation at 3000 Ma in the Western block and 2500 Ma in the Eastern block (Ramakrishnan, 1994; Chadwick et al. 1997).



Caption to Fig: W-Western block, E-Eastern block, S-Shimoga, C-Chitradurga, b-Bababudan, K-Kolar, r-Ramagiri, h-Hutti, n-Nellore, Cs-Chitradurga shear zone, Cg-Closepet granite

The Western block contains two large, parallel schist belts of Chitradurga and Shimoga which host the sediments and volcanics of Dharwar Supergroup (2500-2700 Ma). The supergroup consists of three sequences with a basal quartz pebble conglomerate resting unconformably on Peninsular Gneiss (3000 Ma with vestiges of 3400 Ma). The conglomerate is overlain by quartzite-basalt alternations. The basalts are tholeiites having geochemical signatures of marginal basin basalts, locally associated with felsic volcanics forming a bimodal association. Fine clastics and a major BIF complete the rifted continental margin association of Bababudan Group. The second sequence commences after a rapid uplift of Bababudan Group and its gneissic basement with a polymict conglomerate (Kaldurga, Talya). A quick succession of quartzites, pelites, polymict conglomerates, limestones and dolomites (locally stromatolitic), manganese formations and BIF in the proximal part and tholeiitic basalt, tuffs and fine clastics in the distal part (Ingaldhal and Jagar volcanics) complete the second sequence viz. lower part of Chitradurga Group, which is indicative of an unstable continental margin assemblage. The third sequence consists of polymict conglomerates, mafic to felsic volcanics and greywackes interbedded with BIF, comprising the upper part of Chitradurga Group. The lithological assemblage of Dharwar Supergaroup is described as a mixed mode, marginal basin set in a back arc environment by Chadwick, et al (1998), in contrast to the view that they are oceanic basins (Manikyamba and Naqvi, 1998) Deformation marked by upright to isoclinal folds of two phases (Mukhopadhyay, 1986) or a single phase of progressive deformation (Chadwick et al. 1989)is common with SW verging thrusts seen locally. The schist belts are deformed by NE-SW crustal shortening due to oblique convergence with N-S sinistral shear zone at their eastern margins. The regional metamorphism is of intermediate pressure,kyanite-sillimanite type and is progressive from N to S. The basement gneisses are deformed in shear zones and extensive fractures and are not extensively remobilized as visualized by some (Naha et al. 1986).

The older supracrustals of Sargur Group (3000-3200 Ma) occur as narrow linear belts and pervasive enclaves in Peninsular Gneiss. They consist of ultramafic complexes, peridotitic komatiites, amphibolites and BIF with quartzites, pelites, marbles and bedded barytes in some belts . These belts are extensively invaded by the TTG suite of Peninsualr Gneiss and underlie the Dharwar belts unconformably at Sigegudda, Bababudan, Ghatti Hosahalli and J.C.Pura (Ramakrishnan, 1994). These angular unconformities belie the view of "unity of structures" proposed by Naha et al (1986).

The Eastern block is characterised by four parallel narrow gold bearing greenstone belts viz.Sandur, Ramagiri, Kolar-Hutti and Raichur-Gadwal, with numerous slivers further east. These belts also show three sequences, the lower one consisting of enclaves of and screens of quartzites, limestones, pelites and Mn-Fe formations (Sakarsnahalli) at the western margin of greenstone belts. The next sequence is the most widely exposed mafic volcanics with some felsic volcaniclastics and BIF. These two sequences resemble that of the lower part of Chitradurga Group of Western block. The third sequence of widespread greywacke-BIF association of the Westrern block is absent here and in its place thin pelitic association occurs at the top.

The greenstones belts are engulfed by granites and gneisses on all sides, as a result of which no basement-cover relations are seen. The deformational pattern is similar to that of Western block. Metamorphism is of low pressure, andalusite-silimanite type attributed to younger granites occurring in several linear parallel belts. These granites and gneisses of this terrain are called as Dharwar batholith by Chadwick et al (1997).

Uniformitarian models of evolution of Dharwar craton (Drury, et al.1984; Newton, 1990; Krogstad et al. 1995) visualise northerly subduction and development of Andean margin. Non uniformitarian 'sagduction' models are proposed by the French school (Chardon et al. 1998). Recent structural and isotopic studies (Chadwick et al. 2000) suggest that the Western block may represent a continental foreland with back arc basins, while the Eastern block is an arc batholith with schist belts representing intra-arc basins. The tectonic evolution is visualised by them in terms of oblique convergence from SE to E towards NW and W. This model explains elegantly the presence of sinistral shear zones, SW verging thrusts, older and younger gneissic terrains and different types of baric metamorphism. The major difficulty is the lack of forearc accretionary prism, oceanic crust, ophiolitic melange and blue schist, especially when compared to the scale of development of the foreland and batholith. This clearly shows that strict application of uniformitarinism to Archaean is still not possible. Since the entire evolutionary scenario is anchored on continental crust, a model of several parallel rifts closed by collision from the east appears more likely with the higher thermal budget in the Eastern block resulting from basaltic underplating caused by mantle plumes. The exhumation of the terrain during the later evolution of mobile belts has exposed the granulite belt fringing the craton in the south, east and north.

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