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TECTONIC EVOLUTION OF GREENSTONE-GNEISS ASSOCIATION IN DHARWAR CRATON, SOUTH INDIA: PROBLEMS AND PERSPECTIVES FOR FUTURE RESEARCH

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The two fold stratigraphic subdivision of the Archean-Proterozoic greenstone-gneiss association of Dharwar craton into an older "Sargur group" (older than 2.9 Ga.) and a younger "Dharwar Supergroup" (1) serves as an apriori stratigraphic model. The concordannt greenstone (schist)-gneiss (Peninsular gneiss) relationships, ambiguities in stratigraphic correlations of the schist belts assigned to Sargur group and difficulties in deciphering the older gneiss units can be best appreciated if the Sargur group be regarded as a trimodal association of: (i) ultrabasic-mafic metavolcanics (including komatiites), (ii) clastic and nonclastic metasediments and paragneisses and (iii) mainly tonalite/trondhjemite gneisses and migmatites of diverse ages (2) which could be as old as c. 3.4 Ga. or even older. The extensive occurrence of this greenstone-gneiss complex is evident from recent mapping in many areas of central and southern Karnataka State.

The Dharwar Supergroup is deposited unconformably over an ensialic basement comprising the older trimodal association and is further divisible into a lower Bababudan and an upper Chitradurga groups. The volcanic and sedimentary rocks in the Dharwar schist belts display highly variable compositions, lithofacies and stratigraphic thicknesses. The available data is compatible with their deposition in a variably subsiding and progressively evolving basin(s) in an intracratonic or continental margin setting. The Bababudan group is dominated by sediments characteristic of the nearshore intratidal to shallow marine environments and subaerial toshallow marine volcanics (3, 4). The sediment thickness and way-up criteria are suggestive of progressive subsidence of the basin from south to north and concomitant accumulation of sediments derived from both intrabasinal and exterior sources which culminated in the deposition of thick (over 5 kms) sequence of polymict conglomerates and alluvial fan deposits in the rapidly subsiding Kaldurga basin (4). Subsequent sedimentation and volcanism proceeded in essentially deep marine environment as evident from rocks in the interiors of Shimoga and Chitradurga belts. The volcanic character evolved from predominantly tholeiitic (with minor komatiitic occurrences) in the lower units of Bababudan group to calc-alkalic affinities in the upper units of the Dharwar Supergroup. The overall major and trace element compositions of the Dharwar metavolcanics are comparable to Phanerozoic volcanics from continental margin or back-arc settings. While both light REE depleted and enriched types are noted often within the same volcanic formation, an important feature of the metavolcanics is their high Zr/Y character compared to most other Archean volcanic suites in the southern hemisphere suggesting possible trace element heterogeneities in the source regions of Dharwar volcanic rocks (5, 6).

The greenstone and gneiss formations throughout the craton show evidences of two or three phases of deformation with superposed folding resulting often in complex interference patterns. Both pre-Dharwar and Dharwar formations display broadly similar deformation styles and a remarkable parallelism in their tectonic fabrics differing in the intensities of deformation and grade of regional metamorphism (4, 7). The older sequences show superposition of tight upright or overturned isoclinal and/or recumbent folds of the first and second generations (F1 and F2) and a set of open folds (F3) and metamorphosed to amphibolite or granulite facies while the Dharwar rocks are generally in greenschist facies with large scale recumbent and tight isoclinal folds being uncommon (4). The structural history of the craton is complicated by repeated syn or late tectonic diapirism and intense shearing, strike-oblique slip movements and thrusting particularly along several of the N-S trending regional shear systems (8).

Apart from the general problems concerning the conceptual approaches to early Archean tectonics and crustal evolution, the stages of the tectonic evolution in the Dharwar craton are poorly constrained by lack of information on many crucial aspects of the geology such as; chrono-stratigraphy of schist belts, timing of the major thermal and tectonic events, schist-gneiss relationships and their relative antiquities in the (older) trimodal association, the nature and evolution of the low grade-high grade transitions in the craton. Thus, while the evolution of the pre-Dharwar greenstone-gneiss association is largely enigmatic, the Dharwar Supergroup appears to be a consequence of wide-spread heating of the continental crust around c. 3.0 Ga., tectonic instability resulting in rifting probably along reactivated pre-existing lineaments, formation of broad basin(s), volcanism and sedimentation concomitant with variable rates of subsidence of the basin(s) in response to basement instability and differential upliftment of the surrounding basement highs (horsts?) across the boundary faults (4). The tectonic evolution of the pre-Dharwar crust and the relative importance of the "thick skin" vis-a-vis "thin skin" tectonics (4, 8) to the Archean/Proterozoic history of the Dharwar craton can be assessed only after more detailed structural data on a regional scale become available in conjunction with precise and reliable data on the primary and metamorphic ages of the schists and gneisses in the craton.

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