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Geology of the Western Dharwar Craton

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Abstract : *The Peninsular Gneissic complex is one the most ancient stable part of the Peninsular shield. It forms the basement for the younger Dharwar Supergroup which unconformably overlies them. Rocks that make up the Supergroup are one of the oldest rocks of the earth. The PGC has been rejuvenated so many times that it now appears to be younger than the overlying craton. The Supergroup has been divided into the Eastern Dharwar craton and the Western Dharwar craton. This paper deals with interpretation of the geochemical and petrographical data gathered from the samples collected around Dharwad city area.*

Keywords – *Archaeans, Dharwar craton, Geochemistry,Greenstones, Greywackes.*

I. Introduction

Petrography and geochemistry of clastic metasedimentary rocks of the Archaean supracrustal belts have provided reliable clues regarding the nature of the upper continental crustal rocks, exposed for weathering, thereby providing information on physical conditions of exogenic processes, geodynamic settings and crustal evolution. In many instances, the provenance regions get destroyed but their record still lies in the sediments derived from them. Among clastic sediments, greywackes are the hallmark of the Archaean sedimentation, and are the most widely studied clastic sediments all over the world. The Dharwar Craton of south India, which hosts several Archaean volcano-sedimentary supracrustal belts within Peninsular Gneissic complex, is one of the ideal terrains in the world for understanding the nature of the Archaean upper continental crust, which probably served as major provenance that shed the detritus for the Archaean sedimentary basins of the craton.

The Dharwar Craton has been divided into Eastern Dharwar Craton (EDC) and Western Dharwar Craton (WDC), based on the nature and abundance of supracrustal belts, crustal thickness, lithological assemblage, grade of regional metamorphism and degree of melting (Swaminath et al, 1976; Gupta et al, 2003; Jayananda et al, 2006; Chardon et al, 2008). Further, these schist belts of the craton have been divided into three stratigraphic groups based on the stratigraphy, age and litho assemblage (Swaminath et al, 1976; Swaminath and Ramakrishnan, 1981). In the WDC, the schist belts of Sargur Group (3.1 to 3.3 by) are deformed with Peninsular Gneisses and are unconformably overlain by the younger moderately deformed schist belts of Dharwar Supergroup (2.6 to 2.8 BY) (Peucat et al, 1995; Nutman et al, 1996, Trendal et al, 1997). The Dharwar Supergroup unconformably overlies Peninsular Gneiss and Sargur Group rocks, and is divided into lower Bababudhan Group and an upper Chitradurga Group (Swaminath and Ramakrishnan, 1981). While the schist belts of the Kolar Group from the EDC are coeval with the schist belts of Bababudhan Group (Walker et al, 1990; Nutman et al, 1996; Balakrishnan et al, 1987). The metagreywackes are totally absent in the Sargur Group and Bababudhan Group; they are either absent or present in minor abundance in Kolar Group, while they constitute the most dominant lithounits in the Chitradurga Group, especially in Gadag-Chitradurga and Dharwar-Shimoga Schist belts (Swaminath and Ramakrishnan, 1981; Naqvi et al, 1988; Srinivasan and Naha, 1993). The metagreywackes under study belong to the Ranibennur Formation of the Chitradurga Group of Dharwar-Shimoga belt. The present dissertation work deals with the petrography and geochemistry of metagreywackes around Dharwad area of the Bruce Foote’s type area of the Dharwars that forms the northern part of the Dharwar-Shimoga greenstone belt in the WDC, to understand the sediment maturity, paleoclimatic conditions, provenance, and plate tectonic setting of study area.

II. Objectives

1) To take traverses around Dharwad area to understand Lithology.
2) Collection of representative samples of greywackes, which are the most dominant litho units in the area.

3) Interpretation of geological data to understand sediment maturity, palaeoclimatic conditions, provenance and plate tectonic setting of study area.
4) Conclusions.

III. Geology Of The Western Dharwar Craton

The Dharwar craton in south India is one of the best geologically documented terrains with voluminous gneisses, granitoids and several volcano sedimentary supracrustal belts for understanding the nature of the Archaean geology, tectonics, crustal evolution and metallogeny (Fig. 1). The craton has been divided into two distinct tectonic regions, the Western Dharwar Craton (WDC) and the Eastern Dharwar Craton (EDC), separated by the Chitradurga Shear Zone, close to the linear Closepet Granite. The contact between WDC and EDC is not sharp, and there is a transition zone between the Chitradurga Shear Zone and Closepet Granite. The grey gneissic complex covering the entire craton was formerly known by the term the "Peninsular Gneiss". However, in age, composition, mutual relation with the associated supracrustal rocks and geographic distribution in separate tectonic blocks, the term "Peninsular Gneiss" (>3000 M.a.) is proposed to be restricted to the gneisses of WDC, while the granites and gneissic terrain of EDC is collectively called as the "Dharwar Batholith" of 2.7 to 2.5 M.a age (Ramakrishnan, 1994; Chadwick et al, 2000).

The greenstone belts/schist belts of the Dharwar Craton are divided into three groups on the basis of their stratigraphy and age (Swaminath et al, 1976; Swaminath and Ramakrishnan, 1981). In the WDC, the greenstone belts of 3.1 to 3.3 M.a. of Sargur Group are deformed together with the Peninsular Gneiss and are unconformably overlaid by the younger (2.6-2.8 M.a), moderately deformed greenstone belts of Dharwad Supergroup (Peucat et al, 1995; Nutman et al, 1996; Trendal et al, 1997). Greenstone belts of the Kolar Group from the EDC are coeval with the greenstone belts of the Dharwad Supergroup (Walker et al, 1990; Nutman et al, 1996; Balakrishnan et al, 1999). In the Dharwad Supergroup, two main divisions are recognized (Swaminatha and Ramakrishnan, 1981). The older of the two, that is mainly igneous in character, is named as the Bababudhan Group and hosts the main iron formations. Overlying this is a more extensive group of schistose rocks, largely sedimentary in character for which the name, the Chitradurga Group has been given. There is no unconformity as such between Bababudhan and Chitradurga Groups. The salient features of Sargur, Bababudhan and Chitradurga Groups are described below.

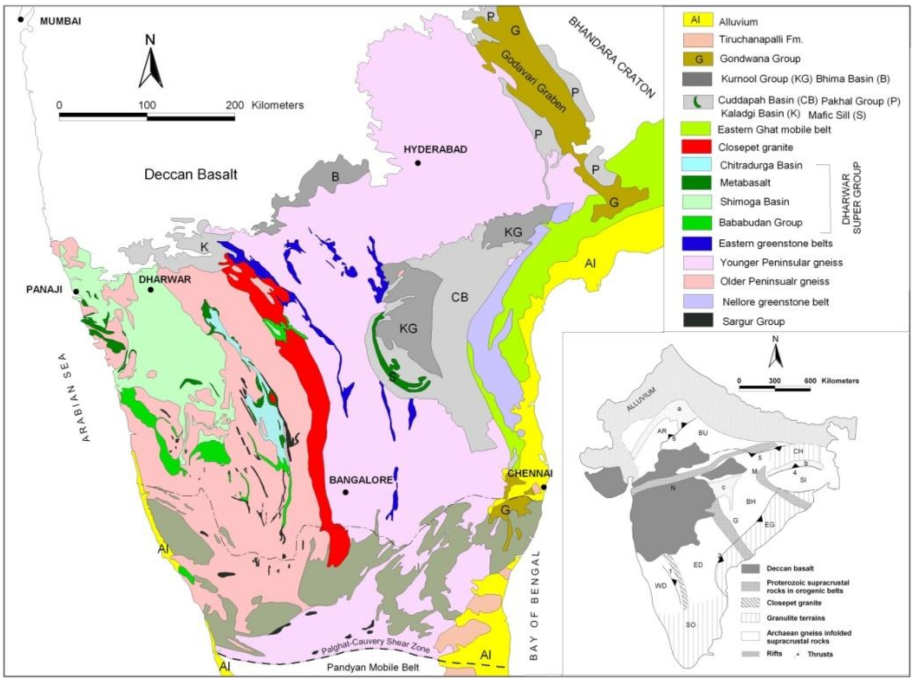

Fig. 1. Geological map of Dharwar Craton (adapted from project Vasundhara map of GSI, 1994) Inset: Generalized geological map of India showing cratons and regional structures (after Rogers, 1990). a-Delhi Supergroup; b-Singhbhum orogenic belt and c-Granulite terrains. CH-Chotanagpur; EG-Eastern Ghats and SO-

Southern granulite terrains. Archaean gneissic terrains with Supracrustal belts: AR-Aravalli; BU-Bundelkhand; SI-Singhbhum; BH-Bhandara; ED-Eastern Dharwar; WD-Western Dharwar. Rift valleys: N-Narmada; S-Son; M-Mahanadi and G-Godawari. Major thrusts: 1-Chitradurga thrust in Western Dharwar Craton; 2-Eastern Ghats front; 3-Sukinda; 4-Singhbhum (copper belt); 5-thrust south of Son valley and 6-Great Boundary fault.

IV. Geology of The Study Area

The area under investigation forms the northern part of the well-known Dharwar-Shimoga greenstone belt (Fig. 2) in the western Dharwar Craton. The reconnaissance field investigation in this area by Hanagodimath et al. (1999) has indicated that the area comprises volcano-sedimentary sequence of basaltic lavas together with chemical as well as detrital sediments. The banded iron formations occupy ridges of hills with general NNW-SSE trend. They are intensely deformed and brecciated. Banded iron formations are underlain by shales. The shales appear to be the in situ reworked and weathered/alteration products of precursor greywackes and banded iron formations. The metavolcanics and clastic metasediments are co-folded with BIF's. Metavolcanics occur as pillowed basalts and flows and thick bands of pyroclastic volcanic, which are on the northern part of study area. Metagreywackes are the most dominant lithounits of study area and exhibit schistosity/foliation dipping 70^0-75^0 west with NNW-SSE strike (Fig. 3). Veins of quartz and calcite frequently traverse the metagreywackes. The sills and dykes of dolerite composition cut across these lithounits (see Fig. 4).

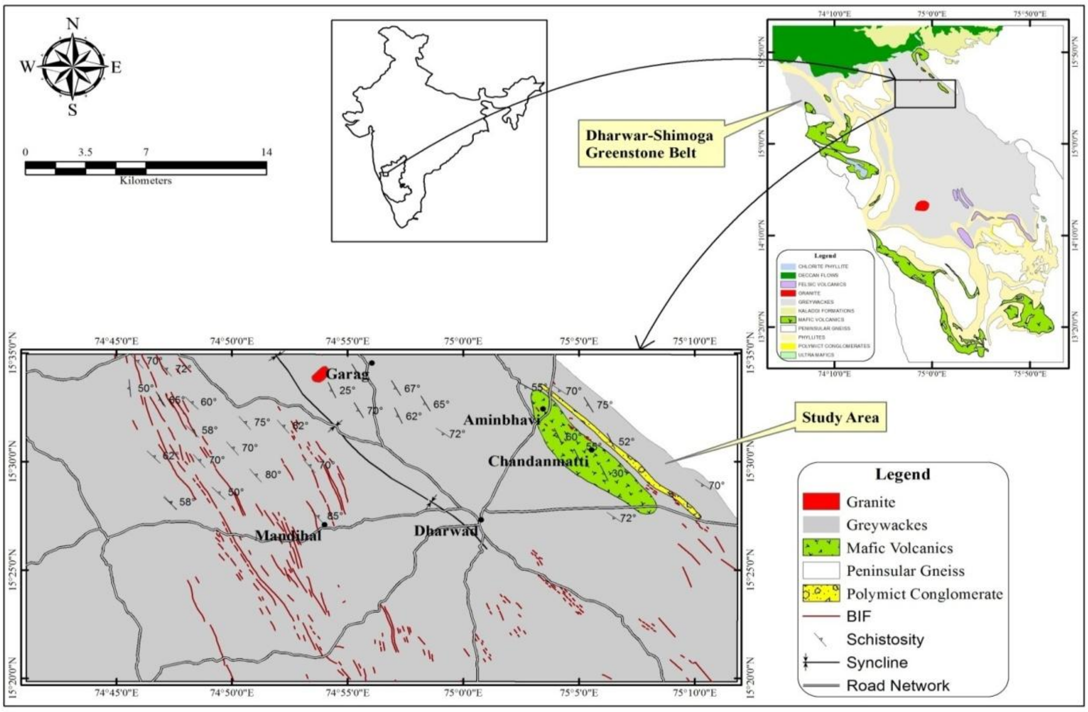

Fig. 2: Detailed Geological Map of the Study Area

Fig. 3: Field photograph of metagreywacke, near Someshwar quarry, showing sub-vertical to vertical schistocity/foliation. Also note permeations of quartz veins along joints and schistosity planes

Fig. 4: Field photograph of metagreywacke intruded by dolerite dyke

V. Conclusions

Greywackes are the most dominant lithounits in the study area, which are metamorphosed and can be called as metagreywackes. The shales are the insitu weathered, oblique, altered product of these greywackes veins of quartz and dykes cut across greywackes.

Petrographically greywackes indicate that they are made up of subrounded, subangular to angular clasts of quartz, feldspar (plagioclase feldspar dominates) and lithic fragments of volcanics (mafic and felsic), chert and quartzites.

The clasts are set in matrix of chlorite, sericite, plagioclase, quartz and calcite whose percentage varies from 20-30%.

The greywackes with matrix of 20 to 30%, of which clay size fraction is more than 5%, the clasts are bimodal, poorly sorted and are angular to sub-angular grains with fresh feldspars and lithic fragments, which indicate textural immaturity. These greywackes indicate moderate, chemical weathering, less transportation and rapid sedimentation suggesting arid palaeoclimatic conditions.

Petrographic and geochemical characteristic suggest that these greywackes were derived from the mixed mafic to felsic source rock. Petrographic and geochemical characteristics of these greywackes indicate that a subduction related continental island arc, plate tectonic setting seems to be appropriate for the deposition of these rocks.

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