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# Structural Analysis of The Quartzarenites Exposed On Southcentral Margin Of Kaladgi Basin, Karnataka

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***Abstract*— The Proterozoic rocks of Kaladgi Group comprise of quartzarenites, argillites, limestones and dolomites as its major litho-units. The quartzarenites with variegated colors exposed in the southern border of main Kaladgi basin have a general trend of E-W, dipping gently towards north. These are resting over the Archean gneisses of Dharwar Super Group with a profound angular unconformity, separated by a conglomeratic horizon. This litho-unit bear the signature of deformative forces enacted upon it, in the form of numerous rupture structures. The eastern and western extent of the study area is marked by Basidoni and Malaprabha dam site (Naviluteerth) in Saundatti taluk Belgaum district Karnataka state, stretching for 24kms. This stretch formulates the southern margin or periphery of the Kaladgi basin ruptured by numerous parallel faults with short extent. Since these parallel faults dislocated the margin or the periphery of the basin, they are classified as "marginal or peripheral faults". The detailed geological investigations carried out in the area signify the existence of nearly 25 minor and major faults along the periphery. The present study reveals the occurrence of several peripheral faults, their disposition and displacement generated due to the upliftment of basin and tectonic deformation.**

***Keywords- Proterozoic, Kaladgi basin, Quartzarenites, marginal and peripheral fault, Deformation***

## I. INTRODUCTION

The area under study formulates south central part of Kaladgi basin on its southern border. The area comprises quartzarenites with variegated colors such as dark grey, red, pink, pink with purple bands and white colors. The cardinal co-ordinates of the area studied are 75˚ 06' 36" and 75˚ 15' 00" E longitude, and 15˚ 47' 40" and 15˚ 54' 00" N latitude. The quartzarenites exposed here are in the form of ridges with dip slope and escarpment scenery, stretching between Basidoni on the east and Malaprabha dam site (Naviluteerth) on the west for nearly 24 km. The Litho-units are having a general E-W strike with a gentle dip towards north and resting over Archean basement of granitic gneisses of Dharwar Super Group with a profound angular unconformity marked by a conglomeratic bed (Fig.3.a). The Archean gneisses are seen to be traversed by basic igneous intrusions. Based on the disposition of the primary sedimentary features like current bedding, ripple marks and graded bedding, the beds are observed to be in the "right-side-up" position. The maximum height attained in the region under study is 784 meters, which is located west of Huli village and is right on the southern border of the study area. The lowest elevation is 580 meters near Manoli. The difference in altitude has exposed the rocks over a thickness of about 200 meters and thus creates an opportunity for detailed geological investigations. The broad linear structures are delineated with the help of satellite imagery and the field evidences are collected to decipher the ground truth. However, the study has revealed that wherever valleys have been formed, these are invariably along sheared and ruptured Quartzarenitic rocks. The present position of these brittle rocks in the form of ruptured ridges trending E-W might have formed due to upliftment of basin during end of Proterozoic Era. The deformative forces or the tectonic pressure might be one of the causative factors in the upliftment of southern border of the Kaladgi basin which resulted into innumerable parallel faults or dislocations in quartzarenites forming peripheral or marginal faults.

## II. GEOMORPHOLOGY AND GEOLOGICAL SETTING

The area under description is probably the best example for control of geomorphology by lithology and structures. Hillocks wherever developed, these display the characteristic dip slope and escarpment scenery, owing to

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the presence of hard Quartzarenitic rocks at the top. The gneisses and other rocks have not given rise to such hills, but are seen to develop moderate slopes. All along the southern border of the area, a prominent cliff like structure is seen to extend right from the western most boundaries, towards Basidoni village in the east. This cliff marks the escarpment face and the northern slope is found to be gentle. This latter gentle slope is due to the rocks also dipping towards north, with a low inclination of 8˚ to 12˚. Hills are mostly composed of the hard Quartzarenitic rocks while the flat ground and depressions are normally due to the presence of argillites. However, the study has revealed that wherever valleys have been formed, these are invariably along sheared and ruptured Quartzarenitic rocks. The Malaprabha River, as it flows over the quartzarenites, argillites and other rocks belonging to the Kaladgi formation, has incised a gorge which is about 60 meters deep, notwithstanding the resistance offered by the hard rocks in the form of quartzarenites. The said gorge incised by the river is decidedly along a weak structural plane, like a fault. This has been described by the earlier workers as a "Peacock Gorge" (Foote, op.cit). (Fig.3.c). Based on the field relations between the rocks exposed in the area under description, the following order of superposition has been arrived at:

| | |
|---|---|
| | Soils (recent) |
| | Argillites (variegated colors) |
| KALADGIS | Grits and Breccia |
| | Quartzarenites (grey, purple, |
| | pink, White and red varieties) |
| | Conglomerates |

~~~~~~~~~~PROFOUND ANGULAR UNCONFORMITY ~~~~~~~~~~

Dharwars- Granitic Gneiss (pink and grey) with basic dykes

## III. RUPTURE STRUCTURES

The action of deformative forces on competent and resistant rocks brings about their rupturing or fracturing. Several terms are used, like, rupture, fracture, shear, shatter and joints. It is therefore necessary to distinguish between these different varieties. It is suggested that the rupture or the fracture planes are numerous and trending in multitudinous directions, but are short lived as far as their extension in the three directions (two horizontal and one vertical) is concerned. The rock gets cut up into irregularly sized small and big blocks, simulating an appearance of a breccia. These may be described as 'ruptures' (Fig.3.b) Likewise the term 'shatter' also can be used if the rock is broken irregularly .When the directions of ruptures are reduced and the space between two fracture planes gets increased, it is customary to describe such fractures as joint planes. It may be appreciated that whereas fracture planes are small in dimensions and the joint planes are relatively bigger. Many times the fracture planes are reduced to one, two or three, and displacement along such fracture planes may take place. These fractures are then described as 'faults'. Further, the joint planes extend to a greater extent at depth. When the fracture planes are parallel to one another, more in number and very closely spaced, such structures are designated by the term 'shears'. It is quite obvious that the shearing may be restricted in certain parts of the rocks, and then these are described as 'shear zones'.

### Faults

This formulates one of the major structures which is invariably studied in the field by the geoscientists. The Quartzarenitic rocks constituting the area under study are quite suitable for the development of faults as the rocks are competent ones. Further the area being devoid of vegetation (scanty), presence of several quarries together with the presence of many non-perennial streams has rendered it possible to identify numerous faults in the field.

### Recognition of faults

Recognition of faults in the field is achieved by considering several field features such as:

a.) Development of slickenside surfaces., b.) Displacement of bed or key horizons., c.) Sudden change in the direction of strike or that of amount of dip, in case the rocks are bedded formations., d.) Development of gouge and mylonite., e.) Development of breccia and pseudotachylyte., f.) Development of gorge and escarpment., g.) Initiation of a narrow straight cut valley.

## IV. MARGINAL AND PERIPHERAL FAULTS

The competent and resistant Quartzarenitic rocks on the southern border of south central Kaladgi basin have been sliced due to innumerable faults occurred during the upliftment of Kaladgi basin by deformative forces enacted upon them, during the end of Proterozoic Era. These faults are almost parallel in nature dissecting across the southern border of the basin as the rungs of ladder and designated as "peripheral or marginal faults" (Billings) (Fig.1). These faults are short lived trending in different directions and recognize by detachment, dextral and sinistral movement, change in the horizontality of the beds, straight cut narrow valleys, gorges, key bed displacement, shear zones, shatter zones, brecciation, development of pseudotachylyte, scarp surfaces, slickenside surfaces, etc. The E-W trending quartzarenites exposed in the form of ridge on the southernmost border of basin stretching for 24kms from Malaprabha dam side (Naviluteerth) on western edge and up to Basidoni in the eastern part, have incised by as many as 25 minor and major peripheral or marginal faults. These marginal faults are ascertained by their appearance on

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satellite imagery and as well as on the field relations along with the recognizing feature associated with the displacements enumerated as above. Out of 25 faults, 1 fault is trending in N-S direction, 1 faults In the E-W direction, 10 in NW-SE direction and 13 in the NE-SW direction.

On the westernmost part of the study area a 60 m deep narrow gorge is carved in the weaker planes of hard and compact quartzarenites incised by the River Malaprabha at the entrance of Kaladgi basin. This gorge named as "peacock gorge" runs for nearly 1.5 kms in N15°E direction which formulates a typical marginal fault F1-F1 (Fig.1.),(Fig.2.) At this juncture, where the River Malaprabha flows in a narrow gorge at the entrance of Kaladgi basin, a dam is constructed across the river to irrigate the land of surrounding area and also for drinking water purpose. This dam is known as Malaprabha dam site or locally as Indira Gandhi Anekattu (Fig.3.c.). As we move towards the east from Malaprabha dam site, there are nearly 9 peripheral faults almost parallel to the fault F1- F1. The fault F3-F3, a typical marginal fault is recognized on the basis of displacement of a conglomeratic bend or a key horizon in the homogeneous pink quartzarenites exposed near Vatnal on the road leading to Malaprabha dam site. This intra-formational pebbly bend is of 20-30 cm thickness showing the distinct dislocation along northwest direction alongwith the smooth slickenside surfaces on the fault plain (Fig.3.e) In the immediate northern vicinity of Goravanakolla village there are three narrow straight cut valleys with scarp and slickenside surfaces trending in N25°-30°E direction mark the peripheral or the marginal faults (Fig.3.f and Fig.3.g) further several peripheral faults have been delineated by gathering the field evidences (Fig.3.h)

As the eastern edge is approached, in the vicinity of Hooli, Manikatti, Hulikatti and Basidoni villages , the attitude of the quartzarenites is changed and become trending N70°E-S70°W, dipping 25°-35° due N20°W (Fig.1.). This might be due to differential upliftment of the Kaladgi basin on its south central part. On this eastern border the displacement are in totally different directions. The marginal or peripheral faults in this area trend either in E-W direction or NW-SE direction owing to the differential upliftment. In this area the marginal or peripheral faults have been recognized by multifarious field evidences such as straight cut valleys, shear and shatter zones, presence of pseudotachylyte, slickenside surfaces, brecciation etc. The line of join or the suture line of this differential upliftment is demarcated by a long E-W running fault (F23-F23) (Fig.1).

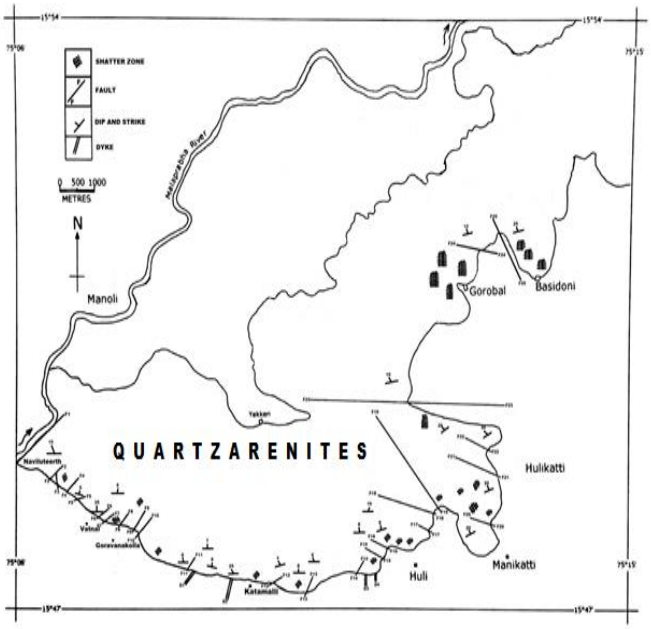


**Fig. 1. Marginal or peripheral faults on the southern margin of south central Kaladgi basin.**

HOOLI

**Fig. 2. Satellite image of the study area.**


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**Fig. 6.) a.) Angular Unconformity. (b) Rupture structures. (c) Malaprabha dam site (Naviluteerth). (d) Development of gorge near Naviluteerth dam. (e) Initiation of valley.**

## V. CONCLUSION

The detailed geological investigations carried out on the southernmost border of south central part of Kaladgi basin reveal the presence of ridges exposing the dissected pink quartzarenites extending from Malaprabha dam site on the west and Basidoni on the east stretching for 24 kms. Within this small stretch there are as many as 25 faults with different directions dissecting the edge of the basin in the form of "marginal or peripheral faults". These rupture structures are associated with shear zones and shatter zones alongwith other field evidences. The causative factor for the development of enumerable marginal or peripheral faults on the southernmost border of south central Kaladgi basin might be the differential upliftment of the Kaladgi basin during the end of Proterozoic Era. This differential upliftment caused by the deformative forces enacted upon the Kaladgi basin itself, brought in the multifarious rupture structures, change in attitude of the rocks and also exposing the quartzarenites in the form of dissected ridges. The satellite imagery of the study area from Google earth is also in accordance with the field evidences carried out to decipher the rungs of ladder in the form of marginal or peripheral faults in the pink Quartzarenites and also support the differential upliftment of the south central Kaladgi Basin.

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