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Geological mapping around mohana, ganjam district, Odisha

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Abstract
Geology is not a subject to be taught within the four walls of a classroom. In fact, it is a field science; without the field knowledge, the study is incomplete. A proper field training program is very essential as it will enable the student to have a better understanding as to how the different land form, how formed by different geological agents, how minerals, rocks etc occur in the nature. Topo sheet No. 74 A/3 and 74 A/7 of 1: 50, 000 scale was used for geological mapping. Field work has been carried out by taking traverse across the general strike to get acquainted with the rock types. General procedure of back bearing method has been adopted to locate the different rock types on the topo sheet. GPS is used to locate the exact position of the outcrop in the topographic maps. Major portion of the study area is covered by granite-gneiss. Spheroidal weathering is a common phenomenon in the granitic gneissic rocks. different structural features are Joints, Faulting/shearing, Foliation and Lineation. The study area has potentiality of producing building material. Since joint sets have affect the granite gneiss. This cannot be used for dimension stones.

Keywords: foliation, lineation, granulite, granoblastic, khondalite

1. Introduction
Geology is not a subject to be taught with in the four walls of a classroom. In fact, it is a field science; with out the field knowledge, the study is incomplete [1-2]. To attain a through idea about geology, a proper field training programme is very essential as it will enable the student to have a better understanding as to how the different land form, how formed by different geological agents, how minerals, rocks etc occur in the nature; how the rock units become deforms due to different forces causing folding/faulting/jointing etc. A mere glimpse of the nature will be more illustrative than the diasporas/picture of a textbook. Similarly measuring the altitudes of various litho units in the field will impart a better result than a simple classroom teaching of measuring altitudes of litho units. So considering all these facts, a geological field training program had been conducted which includes a study of the physiography & mapping of a nearby area. The high lands/ridges/hills are present as distinguish patches encircling Mohana. These have developed over both Granitic gneisses & khondalite suite of rocks.

Study Area
The study area covers an area of 4.0 Sq. miles near Mohana (19° N.Lat - 84° E Long.) in the Gajapati District and forms a part of the survey of India Topo sheet No. 74 A/3 and 74 A/7. The area is 67 kms away from Berhampur town and is on the Berhampur – Rayagada route (State highway No. 17). After Taptapani (19° 28’ 07” E. Long) onwards the ghat begins for which the roads have a serpentine look. Buses ply frequently in this route. The region experiences humid subtropical climate and belongs to the Aw type of climate of Koppen [7]. The maximum land and minimum temperature of this area are 50°c (in the Summer) and 11°c (in the winter) respectively. In the plain area (intermontane valley), the important crops are mostly paddy, rag and variety of vegetables. Whereas in the hilly area pulses, turmeric are very common. The forest species include sal, (Shoree Robust), Asan (Terminialia tomentosa), Kendu (Diesporues melaxlon), Mahula (Basia latifolia), Khaira (Acacia Catechu), Aonla (Amblica officineli), Bamboo (Bambusa arundinoca), Jack fruit (Artocarpus heterophyllus), Banyan (Ficus bengalensis) besides the exotic species like Acacia and many varieties of bushes and oueepers/ climbers. Owing to the presence of forest on the hilly tracts, bear (Melurses ursinus), Jackal (Conisqureh indices), Monkey (Senoopithecus entellus), Elephants (Elophas-masimus) and a variety of reptiles (including snake) are common in the study area.

2. Methodology
The Topo sheet No. 74 A/3 and 74 A/7 of 1: 50, 000 scale was used for geological mapping. The important topographic features have been recorded in these topo sheets. Field work has been carried out by taking traverse across the general strike to get acquainted with the rock types. General procedure of back bearing method has been adopted to locate the different rock types on the topo sheet. GPS is used to locate the exact position of the outcrop in the topographic maps. The attitude of planner and linear structures have been recorded with the help of Brunton Compass. About 50 rocks samples of suitable sizes have been collected for petrographic studies in the laboratory. Petrographical and mineralogical studies has been carried out using 20 thin sections and 10 polished sections. Field photographs are taken.

3. Geomorphology
Geo-morphologically the study area can be divided into three

distinct region:
1. High lands, ridges and hills.
2. Intermountain valley.
3. Flood plains.

The high lands/ridges/hills are present as distinguish patches encircling Mohana. These have developed over both Granitic gneisses & khondalite suite of rocks and can be designated as denudation hills and residual hills[3].The highest peak. In the study area is of 2556 ft high. The intermountain valley is the Mohana valley and is drained by three rivers normally the Haribanga, the Durabankatu and the Badagada and a number of small nalas. Accordingly this geomorphic unit is covered by thick alluvium and thick vegetation. The Mohana Township situated at a height of 1605' from MSL.The third geomorphic unit is the flood plain. In fact narrow flood plains of 10 – 30 feet width have developed along all the three river valleys. Within the flood plain as well as along the course of the river, at a number of places rock exposures are present. Where ever rocky bed is present along the river course at many place, pot-holder are present. Through all the three Rivers are meandering in nature, still a good number of meanders are present along the river Haribhanga. Channel bar deposits are a common feature.The study area is drained by three major rivers and a number of nalas.

Drainage

In general, the drainage pattern of the area can be described as dendritic [8]. Besides at places rectangular patterns is also present. Particularly where the course of rivers are controlled by joint sets. Both the rivers Durabankatu and the initial Haribanga (before the confluence with Badagada) run almost parallel for a channel length of 2 miles. This parallelism can be ascribed as sub-parallel pattern. In the study area a number of perennial springs are also present.

Weathering

Spheroidal weathering is a common phenomenon in the granitic gneissic rocks and produces boulders of varying size both at the top and foothill region. But the weathering pattern is different in Khondalitic rocks producing thick veneer of Detritus at the foot hill region. Differential weathering is very common in khondalite and Calc-granulite grooves and ridges. The grooves are produced due to the removal of less resistant feldspar grains. In some granite gneisses the garnet grains have protruded and are of very large size. The protrusion of garnets are due to differential weathering. Bio-Physical weathering is a very common in the study area. The plants that grow within the fractures of the rock exerts pressure due to their growth. This pressure widens the fracture, which in turn accelerates the mechanical disintegration process of weathering. Besides, gully erosion is very common.

4. Lithology

In the study area, a number of litho units have identified and mapped separately. The different litho units are: -

- Granite-gneiss.
- Khondalite.
- Calc-granulite.
- Charnockite.
- Leptynite.
- Pegmatite.
- Basic intrusives.
- Alluvium.

Granite-Gneiss

Major portion of the study area is covered by granite-gneiss and are present as hills. These are light grey to grey in color and consist of quartz, feldspar and garnet. As the name implies these Gneissose structure and Granoblastic texture. At places porphyroblastic texture is quiet prominent (Figure 1). In the field, a variety of such gneiss have recognized whose categorization is mainly based on the shape of the feldspar grains. In the streaky gneiss variety, the constituents (mainly feldspars) are streak like. In the porphyroblast variety, the feldspars grains (porphyroblast) are rectangular or elongated in shape and vary in size from 2cm to 4cm. With in the granite gneiss, at number of places remnants of the parent rock are seen as islands which are dark in colour. This speaks of the conversion of parent rock in to granite gneiss and the process of conversion is known as granitisation. The presence of islands of parent rock indicates the younger nature of granite gneisses. The foliations in granite gneiss have developed along two direction out of which the 335°-155° is the most dominant. The other foliation is along 290°-110°. The dip of the former is 83° towards South West where as the later has almost vertical dip.

Fig 1: Porphyroblastic Texture in Rock

Khondalite

Next to granite gneiss, khondalites are the prominent litho units and are exposed in the North Western and South Eastern part of the study area as elongated ridges. These are reddish brown to dark brown colored rocks and shows gneissose structure, granoblastic tester. Quartz, feldspar, garnet, sillimanite are the main constituents the Khondalities are banded in nature. The bands differ in color and width of bands vary from a fraction of cm to few cms. The foliation strikes along 335°-155° with 83° dip towards South West.

Calc-Granulite

With granoblasitc texture and granulose structure,these are light grey to white colored rocks (Fig. 2) Quartz, feldspar and calcium bearing minerals like diopside, calcite, sphene, wollastonite, garnet, etc. are the chief constituents. These are

present in the Western side of Dhanupanka village and their occurrence is restricted to low mounts. The strike of the foliation plane is 295°-155° with almost vertical dip.

Fig 2: Granulitic rock of the study area

Leptynite
The occurrence of leptynite is restricted and in the study area these are exposed at the base of the hill (2556feet) with in an area of 30-40 sqmts near Ladrima village. These are light color fine grained rocks with quartz feldspar garnet and subordinate amount of sillimanite. The texture is granoblastic and structure is granulose.

Charnockite
These are dark colored rocks with quartz feldspar and hypersthene. In the study area, their occurrence is very restricted and are found as isolated patches with in the granite gneiss. This speaks their older nature in comparison to granite gneiss. Though the texture is granoblastic and the structure is granulose, at places weak foliation has been developed. The trend of the foliation is 05°-185°.

Pegmatite
These are intrusive in nature and are found as veins with in other rock bodies. This speaks of their younger nature. In the study area two old workings have been reported by Geological Survey of India. The pegmatite consist of giant crystals of quartz and muscovite. Besides quartz veins are also present with in other rock bodies.

Basic Intrusive
With in the granite gneiss, basic intrusives have been reported from a number of places-particularly with in the granite gneiss just North of the confluence of the Badagada river and the Haibanga river. Here the intrusives have a parallel relationship with the foliation. The trend of the intrusive is along 290°-110°. These intrusives are also present with in calc-granulites and have parallel relationship. Mineralogically these units consist of some dark colored minerals (may be pyrobols, biotite etc.). Because of very fine grain size, individual minerals cannot be identified megascopically.

Alluvium
These consist of very fine grain sand to coarse grained sand and are present along the course of the major rivers.

Fig 3: Jointed Quartzite in the study area

5. Structure
In the study area the rocks are not so disturbed. How ever the different structural features are:

- Joints
- Faulting/shearing.
- Foliation
- Lineation

Joints
Almost all the litho units are highly jointed (Figure 3). Particularly in the granite gneiss, three sets of joints are quite prominent which are responsible for the formation of large boulders. Out of the three sets, one set joint is along the foliation of the granite gneiss (335° to 155°) and has vertical dip; the second set is across the foliation (290°-110°) with almost vertical dip (photo1.8). The third set is horizontal. Besides these three sets the fourth set is along 30° to 210° with 65° dip towards South East. The effect of jointing is quite prominent on the drainage pattern. At a number of places the initial Haribanga river and the integrated Haribanga river follow straight path owing to the presence of the 110°-290° joint set. This joint set with another joint set (335°-155°) almost control the course of the integrated Haribangi river producing rectangular pattern. The effect of the fourth joint set (30°-210°) is distinguishable from the course of the Badagada River.

Faulting\Shearing
Though no clear evidence of faulting is present in the study area, shearing is quite prominent in the granite gneiss. Along the shear plane, pseudo-tachylite is present. dominant foliation present in all the litho units is along 335°-155°. The other foliation is along 290°-110°. Lineation is present in form of striations in almost all litho units.

From the disposition of different litho units some of the field relationship can be established as follows.

a. Along the foliation planes of other litho units quartzo-feldspathic materials are seen as veins which can be inferred as the conversion of older rocks in to granite gneiss. Thus granite gneiss are of intrusive in nature and younger than the other litho units like Khondalite, Calc-Granulite.
b. Remnants of charnockite are seen as islands with in the granite gneiss. So definitely the charnockites are older than granite gneiss and were on the process of conversion to gneiss.

c. Though no direct relationship is observed between Khondalite and Calc-Granulite, in the study area, calc-granulites can be placed safely above the Khondalites. Because according to order of cyclothem at the bottom arenaceous sediments will be deposited followed by argillaceous and calcareous. These upon metamorphism will give rise to quartzite, Khondalite and Calc-Granulite. In the absence of quartzite (the quartzite that are present are vein quartz) the Khondalite can be considered older than the Calc-granulite.
d. During such a short field training programe, exact field relation could not be established with charnockites so far as Khondalite and or Calc-granulites are concerned. However from earlier literature [4-6]. It is found to be younger than the Khondalite.
e. The granite gneiss are intruded (Cut) by basic intrusives which show the basic intrusive are younger than the gneiss (Figure 4).
f. The time and mode of occurrence of Pegmatite indicate that these are the youngest unit. According to old literature, all the above litho units belong to Eastern Ghat Super group.
g. The alluvium that are present are of quaternary age.

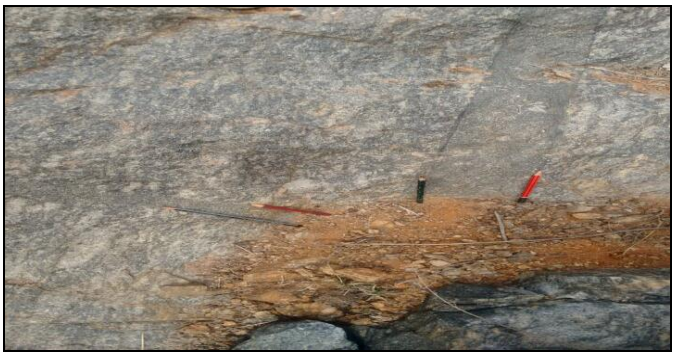

Fig 4: Intrusive in rock of the study area

From the above field relationship the statigraphy area can be established as follows-

Quaternary: (Alluvium (Sand)
Eastern Ghats Super Group: Pegmatite and quartz vein.
Basic Intrusives
Granite Gneiss
Charnockite
Calc-granulite
Khondalite
Basement not known

6. Conclusions

The study area has potentiality of producing building material. Since joint sets have affect the granite gneiss. This cannot be used for dimension stone. On the other hand, can be used for foundary stone, road material and even chips. In the intermountain valley, areas drained by river channels can be used for double cropping. Since a number of small nalas are present check dams can be constructed across such nala. This will check the speed of the sheet wash and can recharge the ground water. Jhum (shifting) cultivation is also practiced in this area which should be discouraged and more and more plantation should be done in the deforested area.

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