SHAHID MATANGINI HAZRA GOVT. GENERAL DEGREE COLLEGE FOR WOMEN

DEPARTMENT OF GEOLOGY

FIELD REPORT

SUBMITTED BY

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GOVERNMENT OF WEST BENGAL

***SHAHID MATANGINI GOVT.* GENERAL DEGREE COLLEGE FOR WOMEN**
DEPARTMENT OF GEOLOGY
P.O.-CHAKSHRIKRISHNAPUR DIST.- PURBA MEDINIPUR

To Whom It May Concern

This is to certify that ----------, Roll

No- , has completed the field work under my supervision at "***Angul area, Orissa***" for the fulfillment of B. Sc (Hons.) 4th Semester in Geology. She is now allowed to submit her field report for final examination under Shahid Matangini Govt. College for women, Vidyasagar University.

Date:
Place: Chakshrikrishnapur

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CHAPTER 1

INTRODUCTION:

Geological Sciences is extended enough, not to be solely confined inside the classroom. The whole spectrum of this science can be easily understand if field works are mingled up with the class room studies.

We, the students of 4th semester, had undertaken a fieldwork in and around Angul area of Orissa. It is an excellent region with different Structural features. The field work carried out for 4 days duration from the 28th February to 2nd March., 2023.

1.1 Geographical Location and Topography

The district covers a geographical area of 6232 square kilometers and supports a population of about 11.40 lakhs. The altitude of the municipality is between 564-1187 m. Today Angul is a bustling and dynamic place. The locational advantages, abundant stock of manpower, raw materials has played an important role in the development of the district. The name Angul is said to be combination of Anugola, named after Anu, the last Khond Tribal Chief who was deposed by means of a gol, which literally means battle or plot. The town of Angul is situated on its left bank of the river/nulla, Nigira Nalla / Lingara which takes its rise in the hills, which forms the boundary of Athamallik and Angul Sub-Division and joins Brahmani at Khadagprasad near Meramandali Railway station of Dhenkanal district.

The physiography of this region (district) is marked by three major regions. The South and Western part comprises ranges of the Eastern ghat Super group and the Older Metamorphic Group. The Central portion is represented by sediments deposited in the Satpura- Mahanadi graven defined by pronounced NW-SE trending lineaments on a Precambrian plat form, almost separating the Eastern ghat Mobile Belt and Orissa craton. The northern boundaries of Talcher Basin are faulted. On a regional scale, Talcher basin takes the shape of a north westerly plunging syncline with closure in the east & the younger horizon outcropping progressively towards west. On the other hand, the beds dip northerly and number of coal seams increases in that direction indicating a possible homoclinal structure. The North and North East part is occupied by hill ranges of Iron Ore Super group. The elevation varies from 76 m. to 1186 m. The highest peak of the district is Malyagiri of Pallahara Sub-division which is 1186 meter above MSL. Banamadali peak in Angul Sub-division is 790 meter in height. In Athamallik Sub-division the main peaks are Panchadhara and Hingamandal hills.

1.2 Climate

The climatic condition of Angul is much varied. It has mainly 4 seasons. The summer season is from March to Mid June and the climatic condition of the district is generally hot with high humidity during this time. The monsoon generally breaks during the month of June and the period from Mid June to September is the Rainy season. The months October and November constitute the post monsoon season and winter is from December to February. The climate is generally cold during November and December.

(i) Rainfall: The average annual rainfall of the district is 1421 mm. However there is a great variation of rainfall from year to year. The rainfall in the district during the last 10 years varied between 896-1744 mm. There are 70 rainy days on an average in a year. The distribution of rainfall is also quite erratic causing wide spread drought year after year.

(ii) Temperature: There is a meteorological observatory in the district. The hot season commences by beginning of March. May is the hottest month with a mean daily maximum temperature at 44 degree Celsius. With the onset of monsoon, early in June day temperature drops appreciably. After withdrawal of monsoon by the 1st week of October both day and night temperature began to diminish steadily. December is usually coldest month of a year with a mean daily minimum temperature of 120 degree Celsius. In association with the passage of western disturbances across north India during winter months short spells of cold occur and the minimum temperature drops down to 10 degree Celsius. The highest maximum temperature recorded at Angul was 46.9 degree Celsius on dt.30.05.98. The lowest minimum temperature was 6.0 degree Celsius on 16.01.03 in Angul. The angul municipal area and the neighborhood are hottest part of the district and have lower rainfall. The summer temperature has shown as increasing trend in recent past.

(iii)Humidity, Cloudiness and Winds: The humidity of the air is generally high, especially in the South West monsoon and post monsoon months. In other months, the afternoons are

comparatively drier. In the summer afternoons the relative humidity varies between 25 and 40 percent. During the South-West monsoon season the sky is generally heavily clouded. In the summer and the post monsoon months there is moderate cloud. Winds are generally light to moderate with some increase in force in the summer and southwest monsoon seasons. Winds usually blow from southwest and northwest directions in the monsoon. In the post monsoon and cold season's winds blow between the west and north.

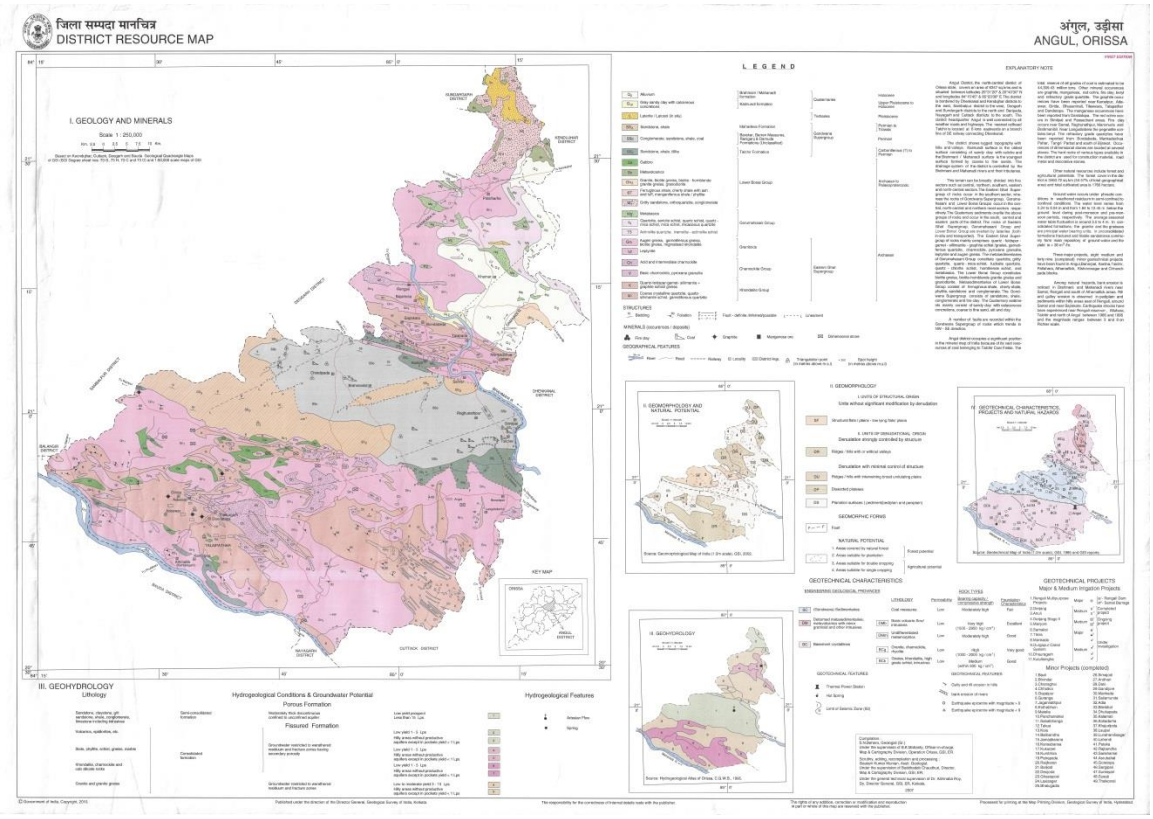
1.3 Connectivity

The city is well connected by road and rail network. It is an important railhead on the East Coast railway line. The district headquarters is about 150 kilometers from the state capital Bhubaneswar. It is situated on the National Highway No. 42, making it well accessible from all parts of the state. However, the road system of this district in ancient and medieval times was under developed. During the medieval period prosperous towns like Bajrakote, Yamagartta (modern Yamagadia near Angul) and Anugulaka Pattana (Modern Purunagarh) thrived in this region and these were connected with good roads. But all these were local roads and no extra-territorial route is known to have passed through this part of Orissa during that period.

1.4 Drainage

The western and southern hilly regions form the watershed between rivers Mahanadi and Brahmani. The eastern part of the area slopes towards west and all the rivers and rivulets originating in this area converge into river Brahmani. The eastern hill ranges divide the catchments of river Brahmani and river Ramiala (a tributary of river Brahmani). There are two large water reservoirs on the river Brahmani at Rengali and Samal. In the south of the area canals are being used for irrigation purposes. The Rengali multi-purpose project and Rengali Irrigation project (Stage-2) are the major irrigation projects and Aunli irrigation project and Derjang irrigation project are the two medium irrigation projects in the area. Brahmani and its tributaries

drain the major portion of the area. The Brahmani River flows in a general SE direction, broadly parallel to the general strike trends of the prevalent rock formations, but locally guided by major joints and faults. The major tributaries of Brahmani are Tikra jhor, Singhra jhor, Samakoi, Nandira jhor, Gambharia, Nigra, Bade jhor etc. and show a general right angle pattern while joining with the river Brahmani.



Map no. 1.District Resource Map of Angul District (Quadrangle map of Angul 2005) .

1.5 OBJECTIVE OF STUDY:

- Identification of litho units and litho-boundaries.
- Study of the development of various structural features and their relative ages.
- Study of relationship between different planer and linear structure.
- Recognition and measurement of the different kinds of structural elements.
- Preparation of lithological Map.

CHAPTER 2

GENERAL GEOLOGICAL SETTING OF EASTERN GHAT MOBILE BELT

According to Ramakrishnan et al. 1988 Eastern Ghats belt is subdivided into four longitudinal lithotectonic domains – viz. the western and eastern khondalite zones, central migmatite zone and a western charnockite zone . Rickers et al.(2001) first pointed out that the EGB of different isotopic domains with different protolith ages and contrasting styles of tectonometamorphic evolution. These isotopic domains were numbered as **1A,1B, 2,3 and 4** (Dasgupta et al.2013).

Dobmeier &Raith (2003) proposed that the EGB is several provinces and domains. They identified four provinces **Eastern Ghats, Rangali, Jeypore and Krishna.** The Eastern Ghats province (EGB) comprises the isotopic Domains 2 and 3 of Rickers et al.(2001), The Rangali and Joypora provinces are identical to isotopic domains 4 and 1B of Rickers et al.(2001). The Krishna province, identified one domain (the Ongole Domain) , while the Ongole Domain is the same as isotopic Domain 1A of Rickers et al.(2001) (Fig.2).

Our study are belongs to Angul domain of Eastern Ghats Province (EGP). The norther boundary of the EGP is mostly buried under Gondwana sediments and commonly known as Kerajang Fault Zone. The southern boundary of our study area is bounded by Mahanadi shear zone.

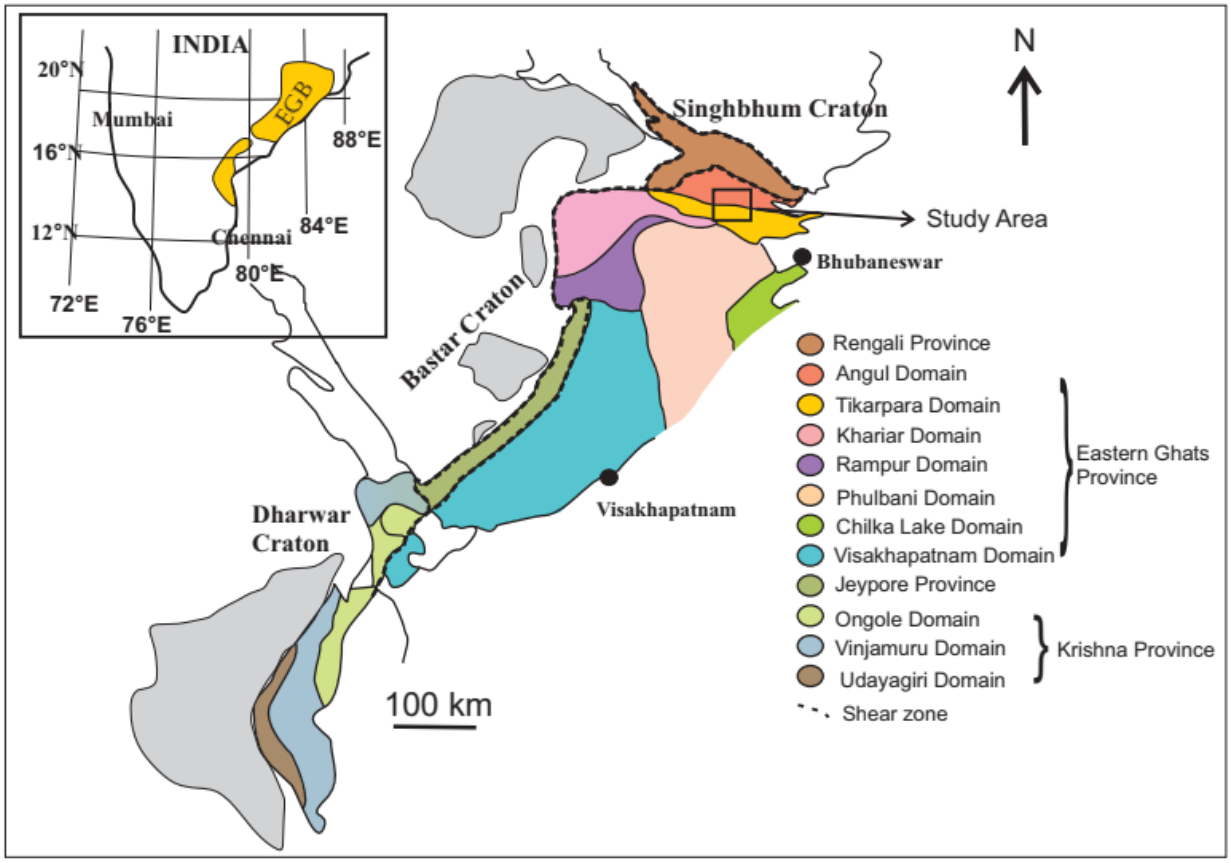


Figure.1 Geological map of the Eastern Ghats Belt (Modified after Dobmeier and Raith, 2003) showing the present study area.

CHAPTER 3

LITHOLOGY OF THE AREA

In our field area we can identify different types of high grade metamorphic rocks which are basically belong to Eastern ghats province. We encountered meta-sedimentary and meta-igneous rocks in our field area in Barakera and Ogi area of Angul district.

The dominant litho-units of our study area are felsic gneiss, mafic granulite, olivine-bearing metanorite, gabbro and fine-grained charnockite. Felsic gneiss occurs as dominant unit in this area and occasionally intercalated with fine-grained charnockite. Khondalite, typically occurred as hilly range. Sporadic occurrences of olivine-bearing metanorite and gabbro are also noteworthy.

Felsic gneiss: The gneissic foliation of the felsic gneiss is demarcated by the alternate mafic and felsic banding. This rock is occurred as dominant litho unit of this area. This rock locally shows migmatitic character.

Fig.3 Felsic gneiss

Mafic granulite: In our study area mafic granulites occurred as enclave within felsic gneiss. Mafic granulites are lens shaped and also present as dismembered band within felsic gneiss. This rock is mainly composed of orthopyroxene, clinopyroxene and plagioclase feldspar.

Fig.4 Mafic granulite enclave within felsic gneiss

Khondalite: Khondalite is second dominated rock type in study area. It is mainly composed of garnet, sillimanite, k-feldspar, plagioclase feldspar and quartz. Khondalite is also occurred as enclave within felsic gneiss.

Fig.5 Enclave of Khondalite within felsic gneiss

Fine-grained charnockite: These litho-units are intercalated with felsic gneiss and also occurred as enclave within felsic gneiss. This rock is composed of orthopyroxene, plagioclase feldspar, garnet and quartz.

Fig.6 Fine-grained charnockite intercalated with felsic gneiss.

CHAPTER 4

TOOLS USED FOR STRUCTURAL STUDIES

The tools used for structural studies are clinometer compass, Brunton compass, diagonal scale, stereo net, toposheet of the area to be studied and cellophane sheet.

4.1. Use of clinometers for the determination of planar and linear elements:

Attitudes of linear and planar structures of a rock can be directly measured in the field by an instrument called clinometer compass. It possesses a pivoted magnetic needle with a mark on North point. The peripheral part of the compass is graduated by a circular scale (0-360°). N-S and E-W line of the compass coincide with 0°-180° and 90°-270° angles and the north point of the scale 0/360° is marked by a crown. Besides this outer scale which is used to determine the directional alignment of a line or plane, there is also an inner circular scale, which is divided into four quadrants, each is marked from 0°-90°. This scale is used for measuring inclination of a line or plane. A brass pendulum hangs from the centre which will swing freely in a true vertical position of the compass. There is a bridge, movable in a semi-circular manner. This bridge helps to orient the compass as necessary.

Fig . 4.1 Clinometer – Compass

For measuring the angle of inclination of a plane (dip), we have to put the clinometer along with its bridge in a vertical position on the inclined planconcerned. In this position, the pendulum also lies vertically. In order to find out the true direction of inclination of the plane, the upper end of the bridge is kept fixed, while the lower end is moved in a circular way on the surface of the

plane. At one position, the pendulum of the compass is found to oscillate freely. This indicates the direction of maximum inclination. At this position, dip of the plane will be indicated by the angle between 0-0 line and the pendulum indicator.

To find the trend of a linear structure, the clinometer is kept horizontally and the line is made parallel to N-S line of the outer scale of the clinometer. At this position, clinometer magnetic needle (or magnetic N-S direction) will make some angle with the line. This angle is the trend of the linear element. In order to measure the plunge direction of a line, same procedure should be followed with a slight alteration. We have to keep the N-S line of the clinometer parallel to the line, with the crown of the outer scale of clinometer pointing towards a particular direction. The angle of this direction with the north point of the magnetic needle would be the required direction.

4.2 Use of toposheet:

The outcrop pattern of different rock units are represented on a base map, which is generally a topographic map. Topographic maps are prepared by surveyors, commonly by ***Plane table survey***. On this map, points denoting different elevations are plotted and lines drawn connecting the points of equal elevations which are called contour lines. There may be a wide choice of contour interval and scale of the map. By observing the pattern of contour lines we can locate river, nalas, hilly tracts, valleys, peaks and all other notable physiographic features of the area. Besides, topographic maps also show location of villages, railway-lines and rail stations, metalled and non-metalled roads, foot tracks, market places, ponds, temples, hospital, post-office and many other features.

4.3. Use of stereo net:

Stereographic projection is an essential tool of structural geology. It is used to represent the orientation of planar and linear structures and find the angular relations between them. In actual practice the plotting of planar and linear structures is done with the help of a **STEREOGRAPHIC NET** or a **WULFF NET**.

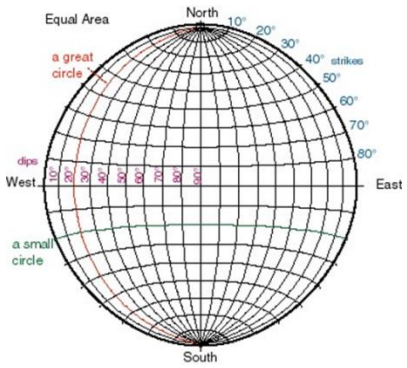


Fig 4.2. Stereo net

Any plane or line with any attitude can be projected on stereographic net. Equal area stereographic net has been used. The periphery of a stereo net is called ***primitive circle***. Two diameters of this primitive circle have been drawn cutting each other at 90° indicating N-S and E-W directions.The North and South directions are specially marked as two poles of a geographic globe.

From East to West, a number of arcs are drawn just like longitudinal lines of geographic globe. These are called ***great circles***. The two diameters through N-S and E-W are also two great circles (like meridian and equator of a globe). There are some smaller arcs centering North and South Pole just like latitudinal lines of the globe. They are called ***small circles***. Each great circle on the stereo net represents the horizontal projection of any plane inclined towards East, West, North or South. The two diameters are also projections of two vertical planes, while the primitive circle of the net represents the projection of a horizontal plane. The angular measurements on the net are done from the small circles, as each point of intersection of small circle and great circle is situated at a definite angle from the north or South Pole. The dip/plunge is measured from the intersection of small circles and N-S/E-W line (each point representing 2°). On the other hand, intersection points of small circles with the primitive give measurement of directional angle (0°-360°).

4.4. Geological Mapping in toposheet and plain paper:

For any type of geological field work on a toposheet, we have to locate ourselves on the map. For this we have to orient the toposheet according to the N-S direction of the area (that can be found by clinometer compass) with N-S direction of toposheet (given on the map). After orientation of the map, we have to identify at least 2 spots in that area which are also given on

the map. With the help of the clinometer, we have to find out our positions with respectto these two points. To determine our position we have to take back bearing value. The intersection points of these two lines would be our position on the map. Then we measure the planar and other structural elements of rocks exposed at that locality and plot them on the topo-sheet.

The 3-D form of the large scale structures can be constructed only if the outcrop pattern of the large scale folds can be obtained by mapping the lithological units or the form surface on a plain paper. For that purpose a suitable scale (1:100) was chosen. The geographical North direction was marked on the map .After that, starting from an initial location, traverses were taken for short distance and new locations are marked on the plain paper. At each location all data related to S_1, S_2, S_3 and F_1, F_2, F_3 were measured. The different structural elements were represented by different notations. Measurements were taken by measuring tape and clinometer compass.

CHAPTER 5

STRUCTURAL FEATURES:

In our field area we can see such structure that are produced due to deformation of rocks. These are the secondary structures and are highly deformed structures.

- **Planer Structures:**
- FOLIATION:It can be defined as a general term used for any planar feature that occurs penetratively in a rock body. In our field we see two types of foliation surface:
  - GNEISSOSITY: Gneissosity is a secondary planar fabric, define by the alternative mafic & felsic layers in a coarse grained rock. It is produced under high grade metamorphic condition. It can be documented Felsic Gneiss.
- LINEATION: Lineation is a descriptive and non genetic term for any linear feature that may be penetrative or non penetrative in a rock body.

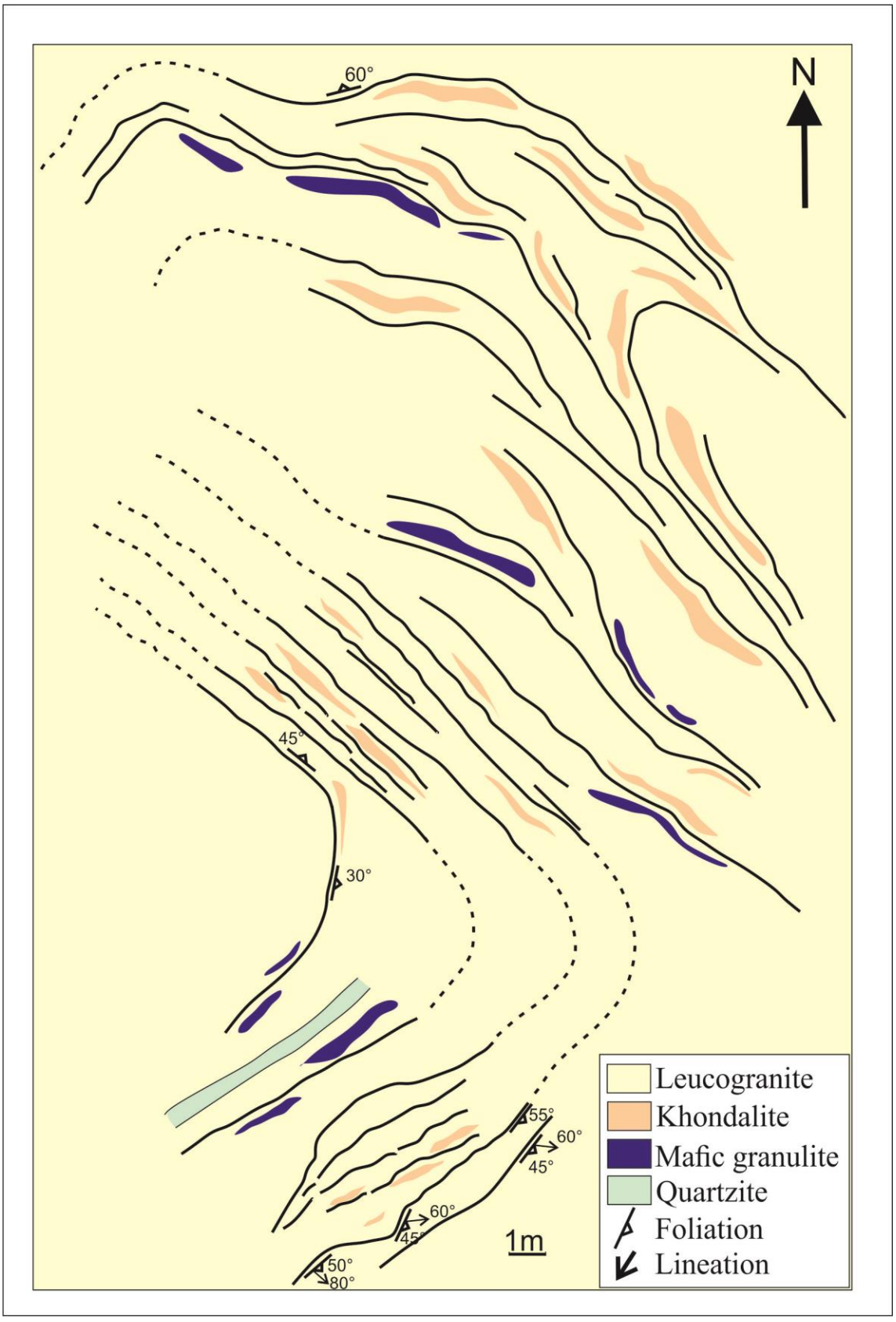
Fold axis lineation: This type of lineation developed along the fold axis of the regional folding. In our study area this type of lineation observed in felsic gneiss.

Fig 5.2 Fold axis lineation in granite gneiss

FOLD:

Fold is a curved surface whose curvature increases from the initial stage due to deformation.Folds are developed in the Felsic gneiss and in khondalitic rock when the region is subjected to severe stress.

Fig 5.3 Fold in felsic gneiss


N
60°
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30°
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50°
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Khondalite
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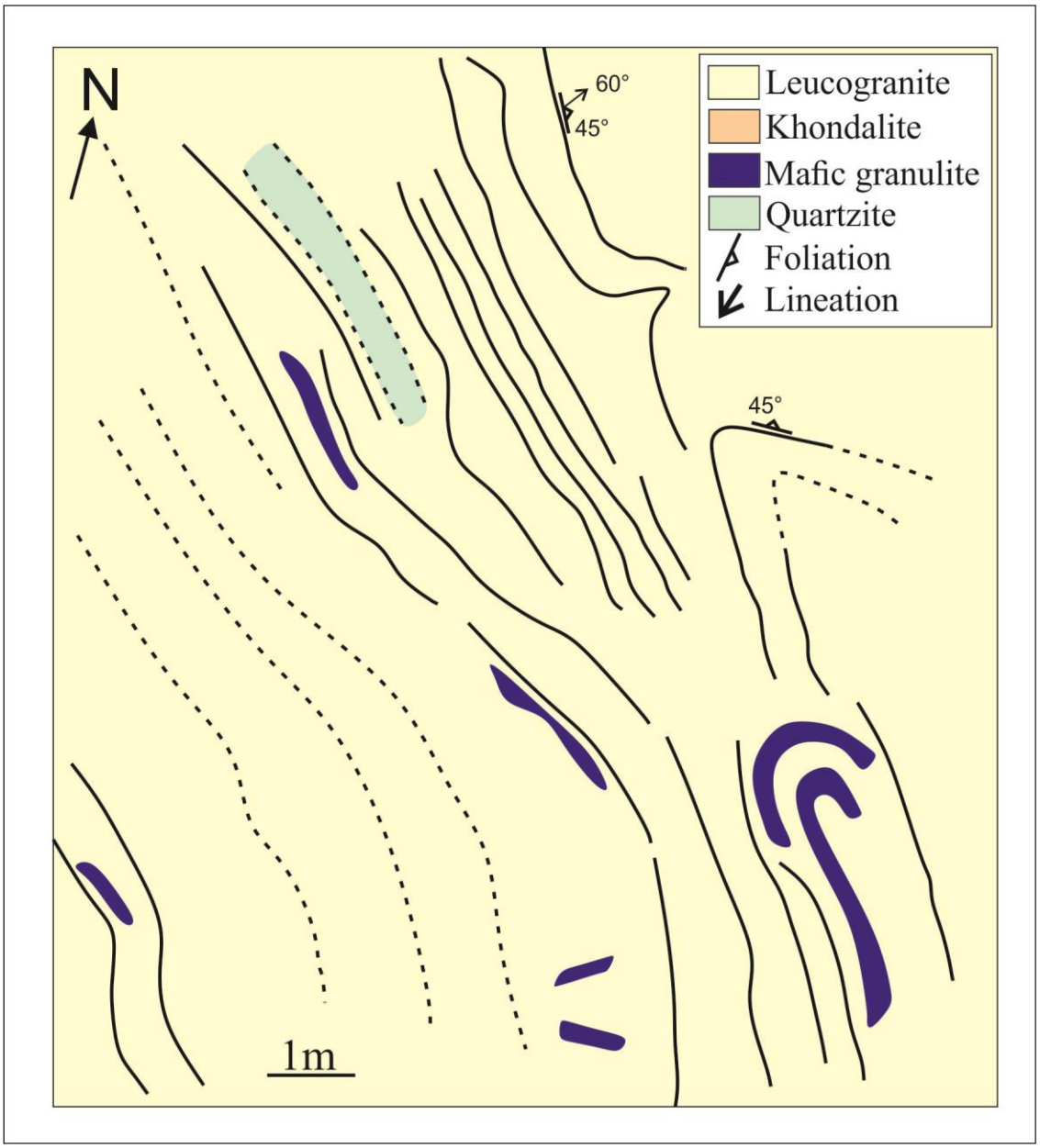
Quartzite
Foliation
Lineation


N
60°
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Foliation
Lineation
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They taught us, scolded us, when we made mistakes, but they always stuck to their guns and never got tired of our endless questions. They taught us to survive through a tough fieldwork and made us realize our own potential and for this, we shall be extremely thankful to them.