Certificate

This is to certify that the record of work done by Miss. Shavari Mahadev Surlikar of class MSc Applied Geology Part-1, year 2022-2023 contained in this report has been examined and signed and that the course of fieldwork in Geology prescribed by Department of Earth Science of Goa University has Been satisfactorily carried out.

Head of the department

Examiner's signature

Date:-

Dr. Anthony Vlegas
Vice Dean (Academic),
School of Earth, Ocean
& Atmospheric Sciences,
Goa University,
Goa - 403 206.

FIELDWORK STUDIES IN AND AROUND BAGALKOT

Shavari Mahadev Surlikar

MSc Part I

Semester I

Certificate

This is to certify that the record of work done by Miss. Shavari Mahadev Surlikar of class MSc Applied Geology Part-1, year 2022-2023 contained in this report has been examined and signed and that the course of fieldwork in Geology prescribed by Department of Earth Science of Goa University has Been satisfactorily carried out.

Head of the department Examiner's signature

Date:-

Acknowledgement

I would like to express my special thanks of gratitude to Dr. Anthony Viegas, Dr. Poornima Sawant , Dr. Nicole Sequeira and the other faculties of the Earth Science Department - Goa University for their assistance and guidance throughout the fieldwork days.

I would like to thank my friends who helped me during the fieldwork.

Geology of India

The geology of India is diverse. Different regions of India contain rocks belonging to different geologic periods, dating as far back as the Eoarchean Era. Some of the rocks are very deformed and altered. Other deposits include recently deposited alluvium that has yet to undergo diagenesis. Mineral deposits of great variety are found in the Indian subcontinent in huge quantity. Even India's fossil record is impressive in which stromatolites, invertebrates, vertebrates and plant fossils are included. India's geographical land area can be classified into the Deccan Traps, Gondwana and Vindhyan.

The Deccan Traps covers almost all of Maharashtra, a part of Gujarat, Karnataka, Madhya Pradesh and Andhra Pradesh marginally. During its journey northward after breaking off from the rest of Gondwana, the Indian Plate passed over a geologic hotspot, the Réunion hotspot, which caused extensive melting underneath the Indian Craton. The melting broke through the surface of the craton in a massive flood basalt event, creating the Deccan Traps. It is also thought that the Reunion hotspot caused the separation of Madagascar and India.

The Indian Craton was once part of the supercontinent of Pangaea. At that time, what is now India's southwest coast was attached to Madagascar and southern Africa, and what is now its east coast was attached to Australia. During the Jurassic Period about 160 Ma (ICS 2004), rifting caused Pangaea to break apart into two supercontinents, namely Gondwana (to the south) and Laurasia (to the north). The Indian Craton remained attached to Gondwana, until the supercontinent began to rift apart about in the early Cretaceous, about 125 million years ago (ICS 2004). The Indian Plate then drifted northward toward the Eurasian

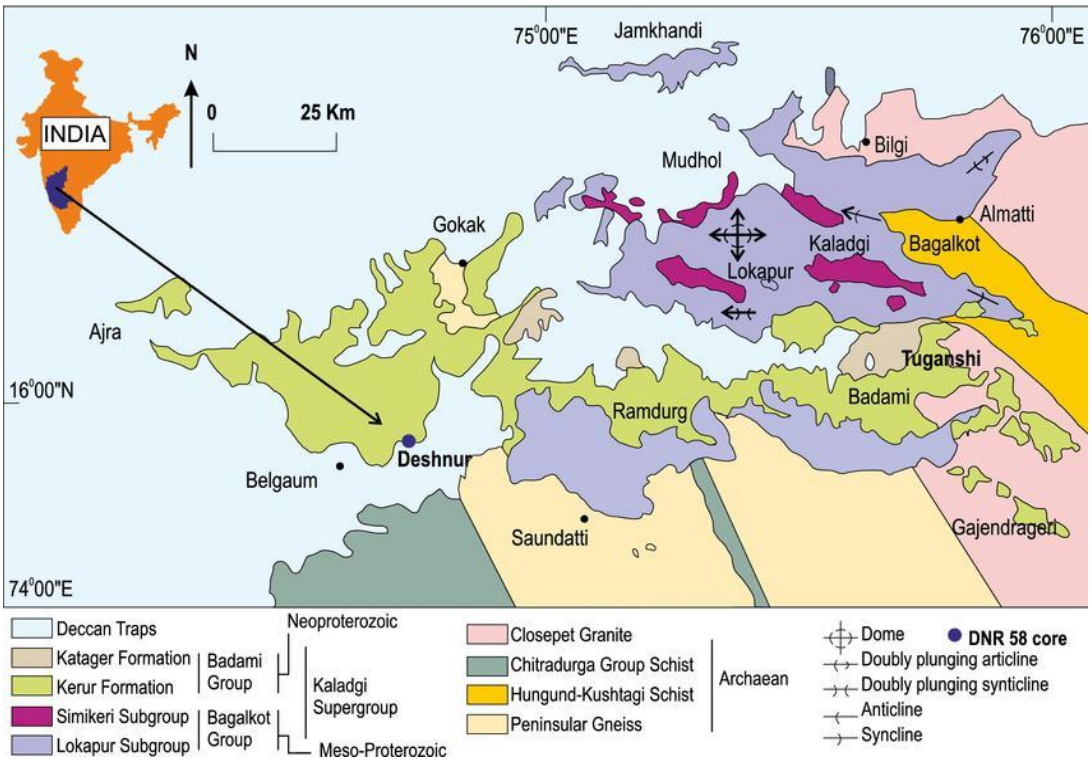
Plate, at a pace that is the fastest known movement of any plate. It is generally believed that the Indian Plate separated from Madagascar about 90 Million years ago (ICS 2004), however some biogeographical and geological evidence suggests that the connection between Madagascar and Africa was retained at the time when the Indian Plate collided with the Eurasian Plate about 50 Million years ago (ICS 2004). This orogeny, which is continuing today, is related to closure of the Tethys Ocean. The closure of this ocean which created the Alps in Europe, and the Caucasus range in western Asia, created the Himalaya Mountains and the Tibetan Plateau in South Asia. The current orogenic event is causing parts of the Asian continent to deform westward and eastward on either side of the orogen. Concurrently with this collision, the Indian Plate sutured on to the adjacent Australian Plate, forming a new larger plate, the Indo-Australian Plate.

Karnataka forms a part of the Indian Shield that is constituted of rock formations ranging in age from 3300 m.y. to 5 m.y. Barring a narrow coastal strip of about 5000 sq.km of Tertiary and Quaternary sediments and another 31,250 sq.km of Craton comprises of greenstone-granite belts, gneisses and granulites. Greenstones essentially consist of meta-volcano-sedimentary sequences, surrounded and dissected by Peninsular Gneiss. At the southern end of the craton these give way to granulite suite of rocks. The craton preserves a billion years orogenic history from 3400 m.a to 2400 m.a. Epicratonic or intracratonic sedimentary basins called Purana Basins occupy the northern segment of the craton whose northern part in turn is concealed by Deccan Basalt.

Kaladgi Basin

Kaladgi basin is an E-W trending irregular basin underlain by the basement granitoids (Penninsular Gneiss and Dharwar Batholith) of the Dharwar craton in the south and east and overlain by the Deccan Trap in the north. The basin covers an area of 8300 sq. km is made of an older Kaladgi sequence and younger Badami sequence occurring is separate sub-basinal areas, like the older Cuddapah and younger Kurnool sequences in Cuddapah basin. Unlike the other Purana basins, Kaladgi basin is not marginally deformed, as it is not spatially associated either with mobile belt or with terrane boundaries.

Instead, the deformation is concentrated in the centre of the basin with the periphery remaining unaffected. The basin consists of three quartzite-shale-limestone cycles with an aggregate thickness of 4500 m.



Kaladgi basin hosts vast resources of limestone and dolomite, as well as building and ornamental stones, besides minor iron ore.

The basin contains arenites, shale, carbonate, and conglomerate. The depositional environment is continental, transitional and shallow marine. The lower group is the bagalkot group which is highly deformed and the Badami group is the upper part which is undeformed.

	Group	Subgroup	Formation	Member
	Deccan traps			
	Angular and erosional unconformity			
KALADGI SUPERGROUP	**Neo-Proterozoic** BADAMI		⇒ Konkankoppa Limestone ⇒ Halkurki Shale ⇒ Cave Temple Arenite	• Gokak Sandstone • Kendur Sandstone • Torgal Conglomerate
	Angular unconformity			
	Meso-Proterozoic BAGALKOT	SIMIKERI	⇒ Lakshanhatti Dolomite ⇒ Niralkeri Chertbreccia ⇒ Arlikatti Argillite ⇒ Muchkundi Quartzite	• Tulasigeri Quartzite • Bevinmatti Conglomerate
		Disconformity		
		LOKAPUR	⇒ Petlur Carbonates ⇒ Mahakut Chertbreccia ⇒ Yadhalli Argillite ⇒ Saundatti Quartzite	• Chikshellikeri Limestone • Chitrabhanukot Dolomite • Yargatti Calc. Shale • Jalikatti Phyllite • Manoli Ferrug. Shale • Timmapur Quartzite • Almatti Quartzite • Salgundi Conglomerate
	Angular and erosional unconformity			
	PRECAMBRIAN BASEMENT COMPLEX (PBC) Granitoids, Gneisses & Metasediments			

Field Observations

Day 1 :- Location 1 – Karadigudda

Latitude- 15° 52' 55" N

Longitude- 74° 41' 42" E

Spot 1- Bevinmatti Conglomerate

It is a part of simikeri sub-group of bagalkot group of kaladgi supergroup. The trend is N280°. The matrix in the conglomerate is ferruginous and this conglomerate is clast supported. The clast is of quartz , feldspar, jasper.We observed graded bedding form due to change in velocity and alignment that helps to find out direction of flow. As we walk up the hill the clast size decreases and the rock becomes matrix supported, and walk further up we got to see quartzite as the grains were fuse together. Clast size is 1.7cm. Conglomerate marks the unconformity between simikeri and lokapur.

Spot 2- Deccan basalt

Latitude -15° 52' 37.5"N

Longitude - 74° 41' 49" E

Exposed along a sharp turn along the road side.

The outcrop consists of rudaceous sized boulders. Grey colour, melanocratic, fractures and vesicles were present.

The rock was exfoliated. Spheroidal weathering can be observed as a result of chemical weathering of dolorite, basalt.

Day 2:- Location 1 – Ramthal

Latlong- 16° 6' 36"N 75° 92' 45" E

The name of the village is kamatii it was just after crossing bridge

The area seemed gentle hill at the base of which there were banded rocks showing layering and they were folded and shattered on a large scale.

These are Archean rocks , the rock is BIF.

Bands of iron Quartzite & also jasper can be observed. BHQ were also seen where the base bands of Quartz were seen.

SD: N143°

Dip: 76° towards NE

This are the basement rock of archean age which are highly deformed. Named as Hundgun shist belt of Dharwad.

Location 2

Data on upright fold

(Folded BHQ)

Spot 1: SD: N161°

Dip: 38° towards SW

Spot 2: SD: N133°

Dip: 76° towards SW

Close to the hinge

1) SD: N155°

Dip: 40° towards SW

2) SD: N148°

Dip: 20° towards NE

Data on phyllite

1) SD: N334°

Dip: 76° towards NE

2) SD: N325°

Dip: 65° towards NE

Location 3

Here there was an outcrop of Caliche deposits. The minerals present were smoky quartz (vitreous lustre) & amorphous variety of calcite. This kind of deposits forms in the dry conditions. The presence of $CaCO_3$ was confirmed with HCl on mineral surface gave effervescence on coming in contact with it.

Location 4

Latlong: 16°4’53” N 75°52’29”E

The prominent lithology observed is of alternating bands of phyllite and BHQ.

Reading along the section observed along roadside towards N.

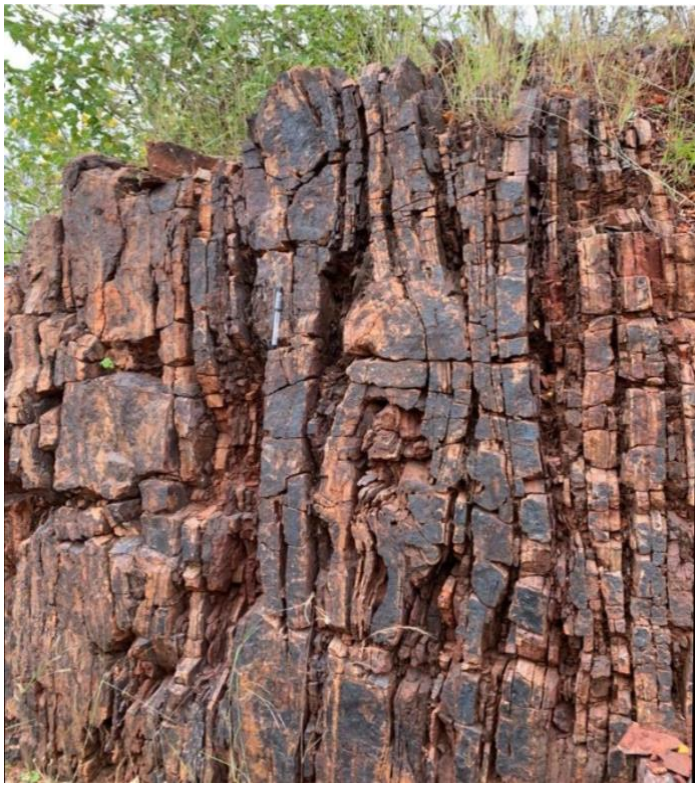
SD: N355° Dip: 62° towards SW

There is warping in the layers of fold. An intrafolial fold is enclosed by steep fold layers in either sides with well exposed hinges.

Data along the roadside

SD: N306° Dip: 40° towards NE

SD: N320° Dip:74° towards NE



Day 3:- Location 1- Nargund

Latlong: 15°44’23”N 75°22’28”E

There is an broad warp in the foliation. Therefore strike is changing and dip varying. Quartz veins are present which shows a parallel relationship to the foliation. The intrusion is synchronous with the deformation of rocks. Phyllite is intercalated with BIF.

SD: N168° Dip: 85° towards SW

SD: N160° Dip:76° towards SW

SD: N152° Dip: 79° towards SW

There is a small scale horizontal shear zone which could be one of the possible reason for the variation at strike data. There are three deformation fabric.

Sn-1 (present in few places, near obliterated)

Sn (penetrative)

Sn+1 (spaced fabric, couple of meters scale)

Location 2 - slightly ahead

The rocks present at this location are associated with Caliche deposits. There is an unconformity present is of recent age.

Horizontal layers of soil below the stress foliation is the Angular Unconformity.

A layers of pebbles , cobbles sized clasts are part of recent formation. The quartz veins that appears to be vertical.

SD: N150° Dip: 84° towards SW

SD: N145° Dip: 65° towards SW

SD: N153° Dip: 85° towards SW

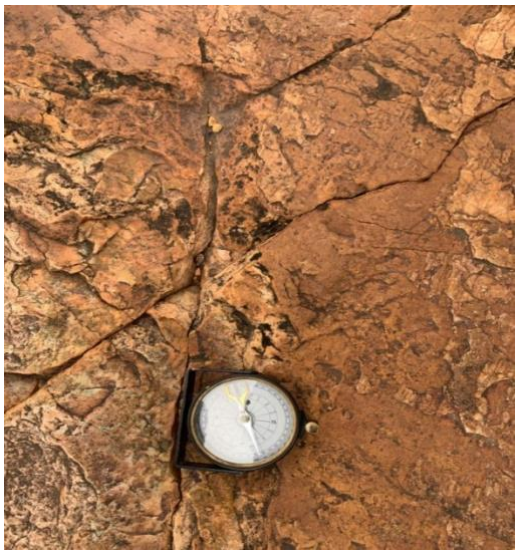
Location 3- Nargund near Bhoruka power plant corporation Ltd

Latlong:

Power plant produces power of 8MW. The outcrop exposed near power plant consists of numerous set of joints (orthogonal), fractures, ripples marks. The rock is Quartzite(ferrogenous).

SD: N133°

Dip: 11° towards SW



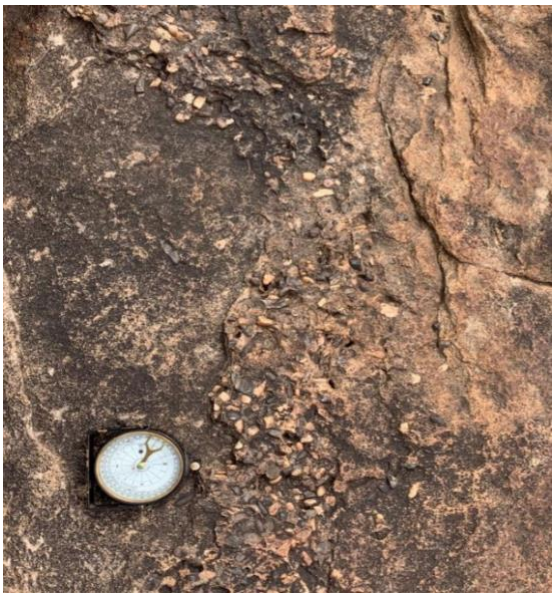
Joint sets data

N60°	N225°
N105°	N252°
N155°	N149°
N150°	N153°

Day 4:- Location 1 -Aihole (1.5km away from heritage temple) & Location 2 (opposite side of the road)

Latlong: 16°0’48” N 75°53’5” E

On the North side of the road exposure is very expansive with horizontal beds. On the south side of the road rocks are inclined. The rocks could be termed as Quartzite where the grains of sand size particle have fused with no distinguishable grain boundaries and one can call it a sandstone where grain boundaries are visible. The outcrop possess intraformational conglomerate within the beds consisting clasts made up of quartz,agate, chert and BIFs which are generally elongated.



On the southern side of the road Quartzite have a well defined bedding junction. They also have well defined cross bedding that have alternate bands of white and red colour.

On Northern side of the road huge outcrop is exposed. The rocks seen here were reddish pink sandstone which have horizontal beds. This is the upper part of the unconformity.

SD: N120° Dip: 38° towards SSW

SD: N117° Dip: 41° towards SSW

SD: N 115° Dip: 38° towards SSW

SD: N112° Dip: 34° towards SSW

SD: N122° Dip: 36° towards SSW

Then we have visited Aihole temples.

Location 3 - Sirur

Latlong: 16° 5’34” N 75° 46’59” E

The outcrop exposed next to the temple is an expansive outcrop entirely made up of Quartzite. We observed a fault plane that is indicated by presence of striations, number of secondary minerals formed along striations. It is a plane not zone. No shear sense indicator or offset marker is observed. We could observe lineation on fault plane which are called as surface lineation & some plane there is slickensides are observed where there is precipitation of secondary minerals. Fault plane is shallow dipping & not steep.

By using Anderson’s Theory of faulting we can conclude that the observed fault is reverse fault. The presence of joint sets on the bedding plane are indicative of brittle deformation. The observed joint set are orthogonal joints.

SD:N111° Dip: 60° towards NE

Day 5:- Location 1 – Amingad

Latlong- 16°03’22” N 75° 56’43” E

We were standing at the basement of kaladgi basin (Clospet Granite, age 2.5 B.a). The outcrop observed is a granitic outcrop which is pinkish in colour having coarse grained size and has minerals such as feldspars and quartz. Feldspars are pink in colour (K- feld). Feldspars formed the clasts. The rock has not deformed. There is no foliation in rock. The outcrop of granite towards NW is not weathered whereas towards NE it has undergone extensive weathering with development of joint sets and fractures indicative of presence of shear zones.

SD: N174° Dip: 72° towards EW

Presence of xenoliths of pyroxene & xenoliths are of restitic type. The size of xenoliths varies from 7-12cm and they are in sub rounded patches form.

Location 2- slightly ahead

Conglomerate is intercalated with BIF. Clasts are rich in BIF.

Location 3

The rock exposed here was sandstone.

SD: N116° Dip: 21° towards NNE

SD: N120° Dip: 21° towards NNE

SD: N125° Dip: 25° towards NNE

Location 4- Hundgun Schist Belt

(Behind Adarsha Mahavidyalaya School)

Latlong- 16°04’8” N 76°03’33”

Hundgun Schist Belt contains much more iron concentration than the BIFs at previous locations. There is cross vein which is younger than rock.

SD: N125° Dip: 55° towards NNE

There is intrafolial fold present in the rock. Shear lenses will preserve the fabric without taking part in deformation.

Data on axial plane of intrafolial fold

SD: N143° Dip: 85° towards NNE

Day 6:- Location 1- Bilagi

Latlong- 16°20’25” N 75° 36’41”E

The outcrop shows the exposure of basement Granite overlain by the more of Badami rocks. The essential minerals present in rock are the quartz and feldspar with accessory minerals such as hornblende and biotite. The granite exposed is greyish in colour hence could be termed as grey granite. The granite rocks is intruded by six pegmatitic veins.

Trend data on joint	Trend of pegmatitic veins
N 80°E	N62° N129° N55°
N 64°E	N50° N62° N55°

Pegmatite veins consists of essential minerals such as quartz and feldspar (orthoclase). The grains are very coarse. The pegmatites are jointed. Fault is observed in the vein. Offset is seen and it shows dextral sense of shear. The rock is undergone weathering. The grey granite here is having Na rich feldspar. Anorthite is grey in colour.

All the xenoliths are not elongated. They are more or less aligned. The other xenolith is having less mafic composition (restitic xenolith) There was a xenolith within xenolith present. (N105°)

Trend of xenoliths

N72°

N110°

N105°

Location 2 – 200m away from 1st location

Latlong- 16° 20’14” N 75° 36’43” E

The study area is a quarry of quartzite and shows a sharp contact between sandstones and quartzites. Different types of colour banding can be seen. There is layering of ferrogenous and siliceous material in the Quartzite.

SD: N30° Dip: 5°towards SSE

SD: N60° Dip: 2° towards SSE

SD: N40° Dip:6° towards SSE

Location 3

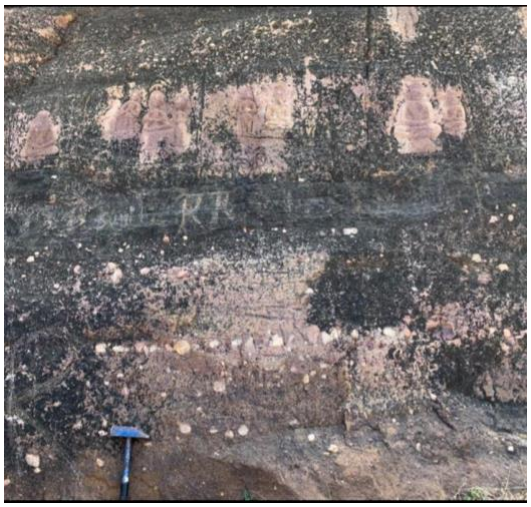
Latlong- 16°20’29” N 75°36’59” E

The rock we observed here is conglomerate.i It is intraformational conglomerate not a basal Conglomerate. It has graded bedding. The rock have undergone cyclic deposition.

There are syndepositional sedimentary structure. The conglomerate is oligomyctic. The clasts of conglomerate varies from 1 to 8cm. Some layer are pink and buff colored indicating cross bedding.

SD: N129° Dip: 14° towards SSW

SD: N135° Dip: 14° towards SSW



Day 7:- Location 1 – Boudangadda

Latlong- 16°5’47” N 75°48’07” E

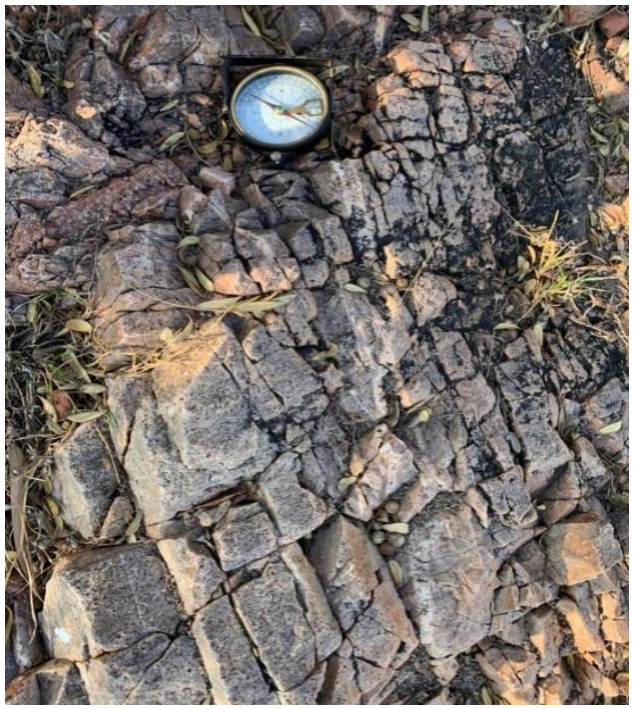
The outcrop exposed is light pink in color consist of numerous joint sets. The rock exposed is Quartzite and is ferrogenous.

2 prominent joint sets are observed. One is parallel to bedding and other is perpendicular to plane. There is orthogonal as well as conjugate joint sets. Rock is highly fractured. Joints sets are not continuous.

SD: N57° Dip: 67° towards SE

Data of joint set

SD: N65° Dip: 45° towards SE



Veins are parallel to joint sets. Several veins varying sizes from 0.7cm to 4 cm. Vein consist of quartz we can call it quartz vein. Trend of vein is N55°. Some veins are cross cutting is each other.

We have also observed Gash vein(comb like structure). It is very coarse grain vein. The minerals are elongated in nature. They look like a teeth. Within these vein we get secondary minerals. The elongation is perpendicular to vein wall. Trend of gash vein N44° but it varies between 30°- 40°. The width of the shear zone is 27m. Veins are important because they precipitate economic deposits.

This outcrop was continuation of Sirur fault.

Location 2 – 500m away from 1st location

Latlong- 16°05’11”N 75°48’47” E

The outcrop is granite. The grain size is medium to coarse. Rock consists of quartz, feldspar and biotite.

Location 3- slightly ahead

Latlong- 16° 5’17” N Dip: 75°48’29” E

It is an outcrop of weathered granitic rock. The rock consists of quartz, feldspar and biotite. It shows foliation which is prominent. The rock traversed by vein that cross cuts each other. There is displacement in vein. Trend of vein N189°. Two sets of vein. One is parallel to foliation and other is perpendicular to foliation.

SD: N160° Dip: 60° towards NE

SD: N140°. Dip: 55° towards NE

Data on foliation plane

SD: N280° Dip: 79° towards NNE

SD: N270° Dip: 42° towards NNE

Location 4 - 200m away from location 3

Latlong- 16°05’09” N 75°48’45”E

Rock exposed over large area with lot of vegetation around. Pink granite intruding grey color. Grey colour rock shows schistosity. The intrusion of granite does not shows schistosity.

Location 5

Latlong- 16° 05’05”N 75°48’50”E

The rock exposed is at roadside. There are exposure on both the sides of road. The rock exposed here is granite but with less mafic content.

Location 6 – Muradi

Latlong- 16°02’06” N 75°45’26” E

The outcrop is not continuous but are in the form of rocks which are spread over a large extent. The rock exposed is Quartzite. There are intraformational conglomerate and jointings in rock.

Clast of Jasper is also seen. The rocks are of Saundatti Quartzite of Badami formation. It shows cross bedding, current bedding and having herring bone structure. Trend of conjugate joint N114° , N263°. Mainly leaching is seen which gives red or brown color to the rock.

Location 7- Keralmatti

Latlong- 16°4’28” N 75°42’10” E

The rock exposed is phyllite (ferroginous).

SD: N95° Dip: 26° towards S

SD: N81° Dip: 26° towards NNW

SD: N145° Dip: 23° towards S

SD: N91° Dip: 23° towards N

SD: N85° Dip: 20° towards NNW

Niralkeri mine

Day 8 :- Location 1 – Kalgalkom

Latlong-16°06’52”N 75°38’24”E

A huge body of Quartz towards the N of the road nearly 40- 50m width is exposed at this location. The outcrop is trending is E- W. The quartz appears milky white indicating the presence of impurities. Highly fractured rock. Joints were observed. Few well developed hexagonal crystal faces in quartz were observed.

There are radiating pattern formed by quartz. Quartz vein is present. Trend of this vein is N69° with approximate thickness of 1cm. Overall entire outcrop is undergone deformation. There was a ridge on which this Quartz were depositing. The ridge is trending in E- W (N103°).

Location 2 – Kagalkom

Latlong- 16° 6’ 45” N 75°38’ 21”E

In the vicinity of roadside towards N are inclined beds of Dolomite. At the the foothills besides road. Colour white with pale green, fine grain , non clastic chemically precipitated rock. Gives effervescence on pouring of HCL on it.

SD: N105° Dip: 40° towards SSW

SD: N108° Dip: 40° towards SSW

SD: N107° Dip: 46° towards SSW

SD: N106° Dip: 36° towards SSW

Location 3- Sulikeri mine

Latlong- 16° 6’ 52”N 75°38’ 25” E

This was mining area that we visited. Grey in colour , non clastic chemically precipitated rock. High mg content.The rock is Limestone.

Location 4 – Kokankappa

Latlong-16°03’19” N 75°38’45”E

The rock is Limestone. White colour, non clastic chemically precipitated rock, composed of calcium carbonate. Limestone shows thin siliceous bands. Rock belong to badami group.

SD: N95° Dip: 4° towards SW

SD: N94° Dip: 3° towards SW

SD: N92° Dip: 4° towards SW

SD: N94° Dip: 4° towards SW

Location 5 – Halkurki

Latlong-16°1’14” N 75°38’58” E

The rock exposed here is Halkurki shale. Off-white red in color, fine grained clastic sedimentary rock. Showed thin alternate layers of dark color and light color. The dark color bands were of calcareous material and the dark color bands were of ferruginous material. The rock shows slaty cleavage. Slaty cleavage will be developed in slate at an angle. The type of clay is identified by XRD and not by field observation. Bragg's law basic principle of XRD. The age of this sedimentary structure is Neoproterozoic. Shale is also called as argillite.

SD: N140° Dip: 4° towards SSE

SD: N154° Dip: 4° towards SSE

SD: N125° Dip: 4° towards SSE

Location 6- B hotel badami court behind HP petrol pump

Latlong-15°56'18"N 75°40'35"E

The outcrop at this location is if sandstone with quartz, orthoclase feldspar and white cementing material. There are ferroginous and silicious bands present. Cross bedding is observed. Joints are developed parallel to the bedding plane. Name of the rock is Arenites.

Visit to Badami cave temples.

Day 9:- location 1 – Lokapur (Nagnapur)

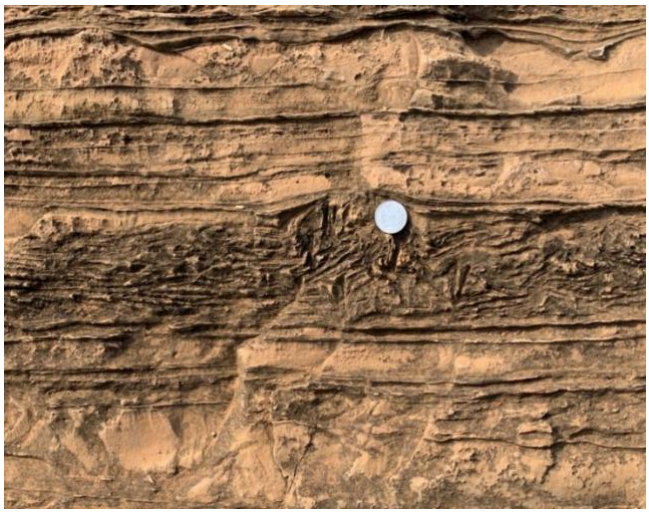
Latlong- 16°10’04”N 75°21’31” E

The rock exposed here is Limestone. The outcrop is exposed to the south of road. They are intercalated rocks.

Beds are steeply dipping. There were deformed stromatolites. Stromatolites is used to date the rock. Kaladgi basin is dated based on types of stromatolites.(Based on morphology). Rock is having MgO silica and it is high grade limestone. The rock were showing foliation.

SD: N120° Dip: 66° towards SW

SD: N121° Dip: 75° towards SW



Location 2- Lokapur Limestone mine (Jalikatti 1km away from lokapur town)

Latlong- 16°09’58” N 75°23’31”E

The min. we observed is calcite.

Day 10 : Location 1 –

1) visit to Almatti Dam

The dam was built on river Krishna. The dam meets around 60% watee needs of the state. The capacity of the dam is 123TMC. The dam is a mix type of dam. Nearly 180 villages submerged which are now shifted to a newly built colony called as navanagar.

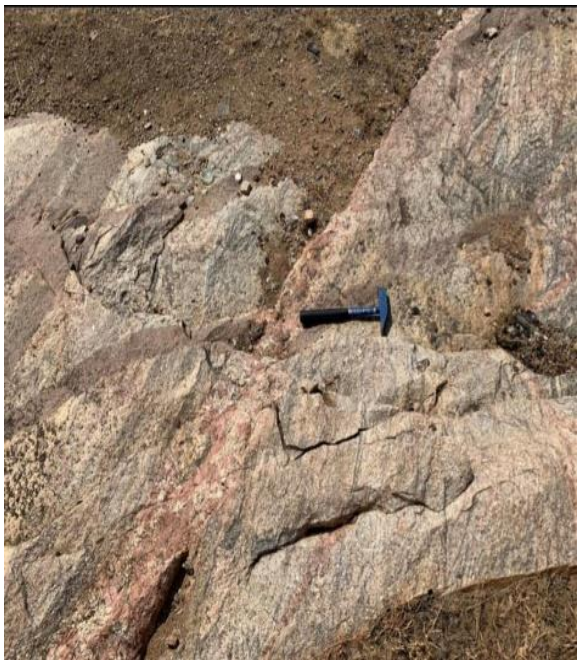
2) Visit to rock garden

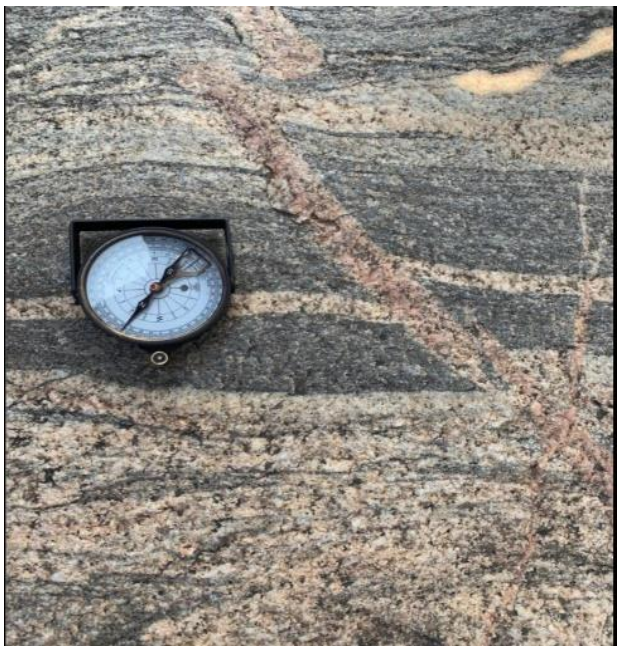
Location 2- Kashinakunti

Latlong- 16°20’38”N 75°55’34”E

It is an expansive outcrop which has undergone weathering. This rock is possibly 3.6 B.a years old. The melting of TTG gneisses. Extensively exposed because of partial melting. This rock is

basement of Migmatite. The outcrop has undergone several episodes of melting producing different granites. Pegmatite veins were observed. Xenoliths and faults were observed. Dark colour rock, banded granite, pink Granite , grey granite rocks were present. Dark colour rock is oldest(xenolith). Mafic xenoliths and gneissic rocks has folds on bands. White granite intruding into gneiss. Pegmatite vein is younger than pink granite.





References

Lithostrtigraphy of Kaladgi and Badami Groups, Karnataka by Vishwanathiah M.N (1979)