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REPORT ON THE GEOLOGICAL MAPPING AND FIELD WORK STUDIES CARRIED OUT IN AND AROUND BAGALKOT

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Acknowledgement

I owe a very important dept to the authorities of Goa University for providing me an opportunity to get experience of geological field work in Bagalkot Karnataka.

I am grateful to Dean Dr Anthony Viegas, Professor Dr. Poornima Sawant, Dr. Nicole Siqueira and all other faculties of Earth Science department, Goa University for extending their continuous unfailing support without whom the field trip wouldn't have been possible. Besides, I would also like to acknowledge with much appreciation Ms. Heena, Department Laboratory assistant for providing essential equipment's required for field trip.

Finally, I would like to thank my parents and my colleagues and all those who have helped me to throughout this wonderful journey.

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Introduction

Overview

Our department of Applied Geology of Earth Science department had organised a geological field work. Geological field mapping and field work is an important part of Master's degree programme and provides good opportunity for students as a geologist to physically go out in field and record geological information from the rocks the outcrop and the surface, and this experience helps student to be great in field related work. For field work to be carried out in field we students were provided with geological equipment's like Toposheets which tells us about the location we are in on ground, Clinometer Compass and Brunton compass which is used in field to calculate strike and dip of geological features, hand lens is used for microscopic mineral identification, geological hammer and is used to break the rock sample.

The report focuses on area which we were studying as a Kaladgi basin. We basically visited several places took the structural data, and interpreted, like what is the lithology, where it should be placed on the stratigraphical column of Kaladgi basin, how it was formed, what lead to its current situation, what is the rock, what is the environment of deposition and so on. The aim of the field work was to use data gathered of stratigraphic sequence, structural data to reconstruct the geological evolution of the area during a certain time interval, and we have successfully gathered enough of information to know about, its depositional environment and can reconstruct the geological evolution of area.

Geology of Karnataka

Karnataka is the state that forms the part of peninsular India which is between north latitude 11°35'30" and 18°25'30" and east longitude 74°06'00" and 78°35'30". The rock formations in Karnataka as studied by geologist ranges in age from 3300 m.y. to 5 m.y. The Cambrian and recent part of rock formations are represented hardly but minor sediments which are tertiary and quaternary sediments are exposed along coastal margin to the west and this narrow coastal strip is about 5000 sq.Km. Substantial part of North of Karnataka region is covered by deccan traps in which deccan basalt covers an area of 31,250 sq. Km., presence of deccan traps in the area suggests phenomenal outburst of volcanic activity at dawn of Cenozoic era as researched by geologist who have worked on the area, the remaining area is dominated largely by two oldest eras Archean and Proterozoic rocks formation.

Gelogical Map of Karnataka

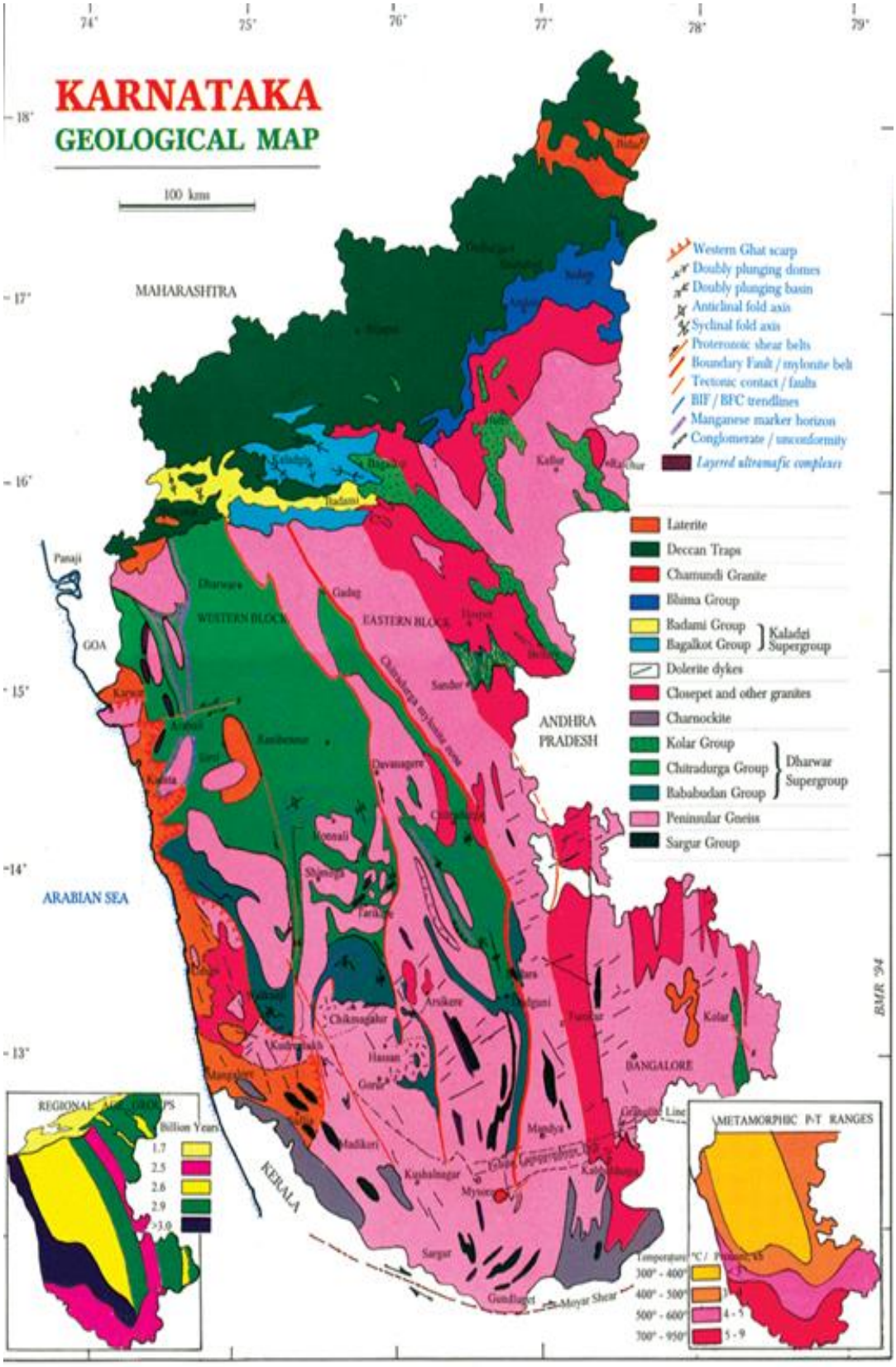

Figure 1 :Geological Map Of Karnataka

Regional Geology

The emphasis of our study mainly focuses on a supergroup of Meso- Neo Proterozoic which is about 1600-1000 ma in age which is the Kaladgi supergroup which is a part of Western Dharwar block found in northern Karnataka and adjoining Maharashtra state. The formation of Kaladgi supergroup is result of sedimentation into the basin. This basin has resulted due to consequence of crustal extension where present day Dharwar, Belgaum, Bijapur and Gulbarga districts were depressed below sea level creating such an extensive basin where deposition of sediments took place. The sediments deposited into the north east basin were recognised as the Kaladgi group of Proterozoic age. The name Kaladgi supergroup was given as the rock formation of this group was typically developed in the town of Kaladgi in Bijapur district of Karnataka. Kaladgi basin overlies the granitic basement of Eastern Dharwar Craton with profound unconformity and has faulted contact at many places. Kaladgi succession divided into two group the lower Bagalkot belongs to Mesoproterozoic and the upper Badami Neoproterozoic in age the two are separated by an angular unconformity. The lower Bagalkot group is further subdivided into subgroups lower lying above unconformable basement of Archean gneiss is the lokapur subgroup and above this lies the other subgroup which is separated by a disconformity called as simkeri group. Lokapur succession comprises of quarzitic sandstone and arkose at the base which grades upward into purple brown argillite's overlying these are cherty stromatolitic dolomites, associated with these are the siliceous ferruginous argillite's which are shallow water deposits, the result of chert breccia in basal part of formation is due to movement of faults that were generated, limestone and dolomite shale were deposited subsequently. Break in sedimentation is marked by disconformable conglomerate, the overlying simkeri subgroup succession consists of quartzite, chert breccia ferruginous shale and dolomites, towards the close of Bagalkot times, pegmatite quartz vein intruded the sediments. Separated

by unconformity overlying group Badami group consist of horizontally bedded multistorey sequence of arenite, shale and limestone in lesser amounts.

Structural Formation

The Bagalkot Group displays variable deformation in The Bagalkot Group displays variable deformation in different sectors of the basin. Along the basin-fringes (along the Saundatti–Ramdurg–Badami tract in the south and the Jamkhandi–Bilgi sector in the north), gentle monoclinal folding and local deformation along faults has been recorded. These margins have suffered homogeneous strain-flattening, probably under the influence of gravity-related subsidence of the basin floor. Boundary-parallel normal faults (essentially trending E–W) that can be traced to the basement of the sediments, suggest a causal linkage between hem and the growth of the basin. In the central parts, particularly north of the Shirur Shear, the sediments display tight isoclinal (often doubly plunging and locally recumbent or overturned) folds around Yadwad, Lokapur and Bagalkot (Awati and Kalaswad 13 1978; Nair and Raju 1987; Mukherjee et al. 2016). The sub-vertical axial planes trend in the WNW–ESE direction; coaxial with a series of WNW–ESE trending shear zones/faults fferent sectors of the basin. Along the basin-fringes (along the Saundatti–Ramdurg–Badami tract in the south and the Jamkhandi–Bilgi sector in the north), gentle monoclinal folding and local deformation along faults has been recorded. These margins have suffered homogeneous strain-flattening, probably under the influence of gravity-related subsidence of the basin floor. Boundary-parallel normal faults (essentially trending E–W) that can be traced to the basement of the sediments, suggest a causal linkage between hem and the growth of the basin. In the central parts, particularly north of the Shirur Shear, the sediments display tight isoclinal (often doubly plunging and locally recumbent or overturned) folds around Yadwad, Lokapur and Bagalkot (Awati and Kalaswad 13 1978; Nair and Raju 1987; Mukherjee et al. 2016). The sub-vertical axial planes trend in the

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Lithostratigraphy

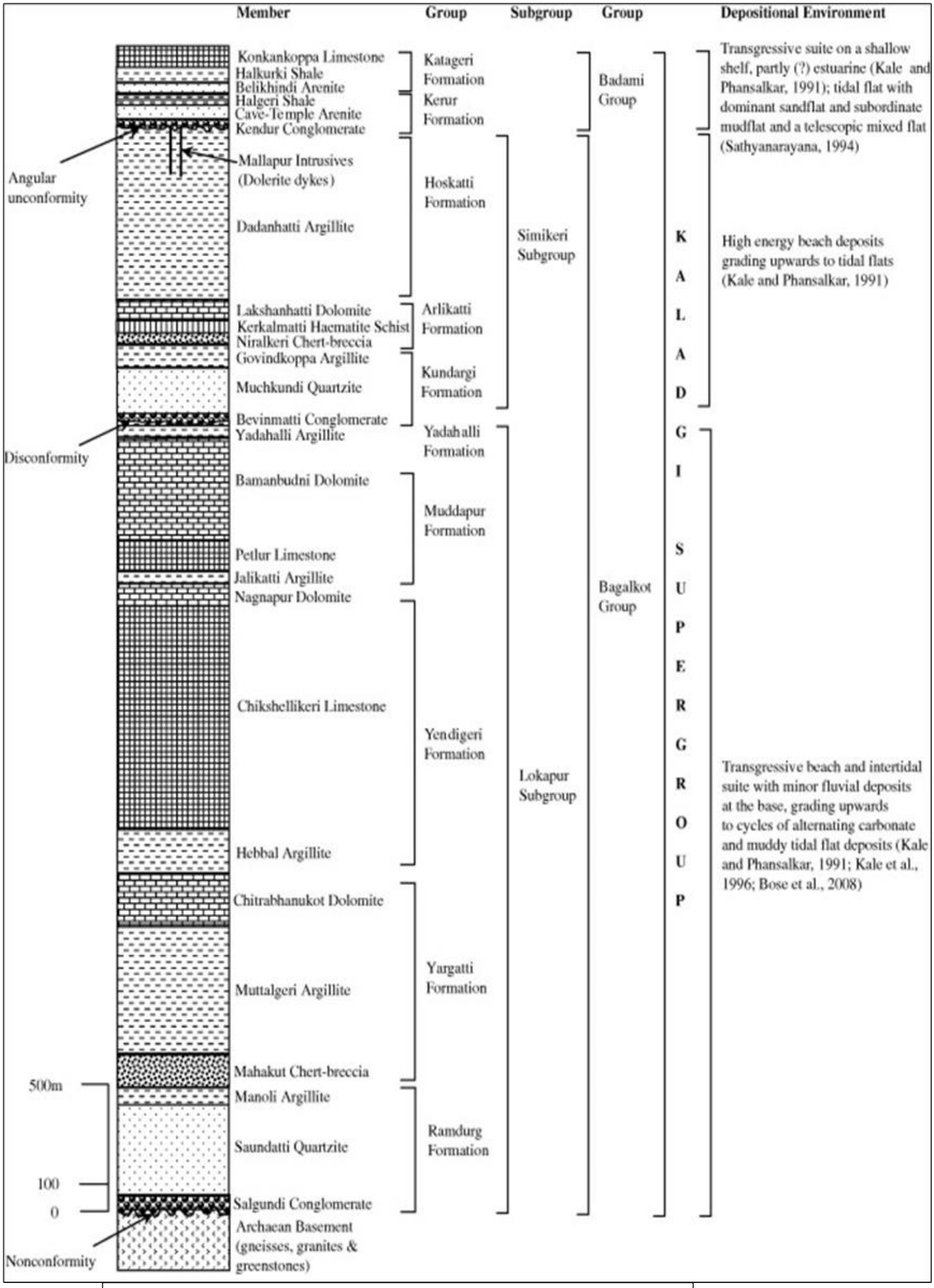

Figure 2: Lithostratigraphy of the area

Field Observations

Day 1 Date: 10th December 2022

Site 1

Location: $15^0 52' 51.5'' N$, $74^0 41' 41.6''$ E

Karadigudda Village in Karnataka

Spot 1:

Figure 3: Bevinmatti

The location visited is an outcrop that is located on the hill which is along the roadside, the slope of the hill is moderate. The rock outcrop exposed on base of hill has pebble size clast that are held together by matrix. And this rock is Bevinmatti conglomerate this rock formation is part of Simkeri subgroup of Bagalkot. In the rock there were more of pebble size clast then the amount of matrix present which indicated that the rock is clast supported at the base of hill. The clast was of quartz (which was of vitreous lustre, hardness 7, no cleavage, conchoidal fracture) and of feldspar (which is of vitreous, translucent, hardness of 6, cleavages can be seen) both of the grains are subrounded and the matrix was

siliceous matrix. As we move up the from base of hill to the top of hill there is variation seen in clast size of the rock from at the base clast size was of about approximately 2cm which was reduced to less than 1 cm scale which indicated that as we moved up the hill the rock become more matrix supported then clast supported. And at the rock shows more of ferruginous matrix.

Spot 2: 16 km away.

Location :$15^0 52' 37.5'' N$, Longitude : $74^0 41' 49.0'' E$

Figure 4: Deccan Trap Basalt (Spheroidal Weathering

The next outcrop few km away from spot 1 exposure was a road cut outcrop showed a bulbous structure present, is indicative of prominent spheroidal weathering, this weathering is a form of chemical weathering in which concentric spherical shells of decayed rock are loosened and separated from a block of rock body by water penetrating the bounding joints or other fractures attacking the block from all sides. This spheroidal weathering has weathered a fine-grained

rock, melanocratic, mafic mineral is observed which has small number of vesicles present filled with secondary mineral called zeolite making it amygdaloidal, thing to be notes not all vesicles were filled. The following layer is outlier because the younger formation is surrounded by older formation. The rock is identified as basalt derived from deccan traps about 64-65 Ma, that is Mesozoic Cenozoic Boundary. The outcrop consisted of Rudaceous sized boulders of the clast size of 24.5 cm. The conglomerate present in this section showed clast size more than 15 cm.

Day 2: Ramthal

Date: 11 December

Site: 1

Latitude: 16º05’07’’ N

Longitude: 75º52’31’’E

Spot 1

Figure 5 : BHJ with quartz vein

The next outcrop exposed is of Ramthal village before Ramthal which was besides a road and the outcrop was situated on the hill having a moderate slope.

The rock exposed on the hill included reddish colour, texture was banded layering was seen and was folded to some extent the banded layer had cherry red streak on it of hematite hence the rock can be concluded as banded hematite quartzite. Also, red colour mineral was present later identified as jasper. And another layer is of quartzite. Fractures was present which has a trend of N135 and N195. so, there are BHQ and BHJ present. The bed has strike direction of N210, dip direction of N310, and dip amount of 39 degrees.

Spot 2

Figure 6 Brittle deformation in metapellites

The second spot consisted of metapellite layers which were folded. The major fold contains microfolds along with crenulation hinge lineation. There are class 3 folds of a ferruginous layer seen in a quartzite. The folds form class 1B folds. There were also Sn and Sn+1 foliations which was seen in the rock. The rock contains competent as well as incompetent layers and the quartzite being the competent layer is very resistant to folding.

Spot 3: The outcrop exposed consisted of phyllitic rocks whose dip is very steep. These phyllites were striking in N165 direction and were dipping towards SW, having a dip amount of 76º

Spot 4:

Figure 7: BHQ

The outcrop consisted of the rock beds of BHQ which were folded, and these folded beds were striking in N220 direction and were dipping towards NW, having a dip amount of 60º on one of the limbs and were striking in N112 direction and were dipping towards NE, having a dip amount of 55º on the other limb of the fold which contained intrafolial folds**.** This rock exhibits folding which are of class 1c. this rock layer is the basement rock for Kaladgi basin. The matrix here is ferruginous. Above this layer there is conglomerate present and mixture of quartzite and conglomerate can be observed wherein the conglomerate are present as lenses. There is also a big vein of quartz which has quartzite clast in it, the layer was about 1- 2 m thick. this layer is

While travelling upwards one can see quartzite rock beds, strike direction is N270, dip direction of N360 and dip amount of 37 degree. This quartzite is called saundatti quartzite and beside this there is a bank of river malaprabha.

Manoli argillite are fine graine and younger than quartzite.

Spot 5:

There were conglomerates with clast size varying from 10- 15 cm in length and approximately 9cm in width having clasts of BHQ and jasper. These conglomerates showed imbrications indicated by grain boundaries of clasts in contact with each other and showing a particular orientation

Figure 8: Salgundi

Spot 6:

Figure 9: Caliche

This site was exposed due to excavation, and was white in appearance, when acid test was done on this rock it strongly reacted and showed effervescence and it thus gave us an idea that it is a carbonate mineral, which has been settled down due to leaching effect and these sediments has then concentrated downwards. It is called caliche. Some mineral found in this caliche rock are feldspar is seen to be in converting stage to epidote, amorphous $CaCo_3$, gypsum.

Day 3 (12th December 2022)

Spot 1: Nargund

Lat: 15º44’23’’ N

Lon: 75º22’27’’ E

Spot 1: Somapur Nargund village

Figure10: Phyllite

The exposed rock is a foliated rock that has been subjected to low level of heat pressure and chemical activity. It consists of flake shaped minerals which have aligned and arranged themselves well. The alignment of mineral is of mica grain which shows parallel alignment. The alignment of mineral allows the rock easily to split in sheets and slabs. Alignment of grain of mica distinguish it from rock slate so the rock is concluded to be phyllite. It is a metapellitic protolith/ parent rock, a sedimentary rock which has undergone regional metamorphism it might indicate past environment where in the sedimentary rock got buried and mildly got altered due to heat and direct pressure. The brown tan on rock seen might be due to weathering of rock. The phyllite rock is intercalated with Banded Iron formation. There is broad whop seen in foliation. Therefore, strike is seen to be varying by $< 10^0$. The foliation present is penetrative in nature. There is a vein present which shows parallel relationship with foliation and it is intrusive at the same time. The rock is phyllite hence the grade of metamorphism is not high and has not undergone above more than the greenschist facies of metamorphism and as foliation are planes of weakness the quartz vein has easily intruded into the weakly metamorphic rock. The intrusions synchronous with deformation of the rock.

Spot 2: Markundi

Latitude: 15º44’23’’ N

Longitude: 74º22’25’’ E

Location: Bhuruka Powerplant Corporation

Figure 11: Quartzite

This outcrop was present near, at Markundi, on a hill where there were 9 wind mills present. The rocky outcrop which was exposed on top of the hill consists of the rock quartzite which contained numerous fractures and joint sets. The joint set readings are N297 and N235. In some places the rock showed herring bone structure. This rock is an outlier where the younger rock formation isolated among older rocks.

Day 4: Aihole

Latitude: 16º00’49’’ N

Longitude: 75º53’05’’E

Spot 1

Figure 12: Sandstone

Figure 13: Badami Sandstone

The outcrop is exposed 1 and half km from the heritage temple. The outcrop is exposed 1 and half km from the heritage temple. The outcrop exposed has two sides the north and the south side. The north side of outcrop shows an exposure of horizontal to sub horizontal layer of bed of Badami group. The south side shows rocks that are inclined. The rock exposure on south side of the road shows rock which have undergone complete metamorphism and have experienced greenschist facies metamorphism hence the grain boundaries are still visible. . The rock is composed of sand sized grains and at some places the sand sized grains are fused together whereas at other places the grain boundaries are still visible. The rocks where the sand sized grains are fused together are called quartzites and the rocks where the sand sized grains are still visible are that of sandstone. Intraformational breccias are also present with clast consisting of quartz. There are clast of breccia also found they appear to be banded. Clast in breccia are not basal and show variation in clast grain size ranging from 1-3cm at top and 0.5- 2 cm seen at the bottom way down The structural data from the site is strike direction was N310, dip direction is N225 and dip amount is 39.

Randomly oriented quartz veins which has a thickness of 1cm and are very rarely seen in these rocks. This formation is called the Hoskatti formation of the Bagalkot Group of rocks

Day 5: Amingad

Spot 1

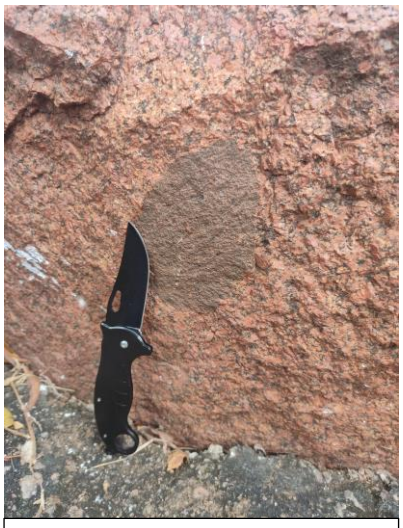

Figure 14 :Pink Granite

Outcrop exposed has massive boulders of granite of pink variety. Mineral identified is orthoclase feldspar, quartz in association with dark coloured minerals which could be hornblende or biotite. The same exposure of this granite towards the NW has not weathered whereas the granites on the NE has undergone extensive weathering with development of joint sets and fractures which are indicative of the presence of shear zones.. There are also dark coloured are restitic xenoliths seen in the rock which are mafic and are composed of pyroxenes and these xenoliths are of type. The contact between the basement and the formation above is separated by conglomerate which is intercalated with BIF. The structural data from the plan view of sandstone is strike direction was N120, which dips 21 towards NNE direction. The structural data from the granite is strike direction was N174 dipping 72 towards SW

Day 6 (15th December 2022)

Lat: 16º33’97’’ N

Lon: 75º61’28’’E

Bilgi Village

Spot 1:

Figure 15 :Grey Granite

The rock outcrop exposed is a few m away along from the roadside. Exposed on a very gentle slope, the rock exposed is leucocratic medium grained rock, with mineral composition of alkali feldspar and quartz the clast size of mineral in rock is of 1 to 2 cm. Since mineral quartz content is 10 to 20% and Sodium rich alkaline feldspar is more 10 to 50 percent with accessory mineral biotite, the rock is identified to be anorthositic in composition the rock is grey granite. Further this granite is seen to be deformed undergoing recrystallisation giving rise to an intruded vein, and along with this jointing and faulting is seen in the rock which indicates the deformed state. Along with this in some portions of this granitic rock restricted xenolith is seen it is because the mineral in granite might have melted to produce this rock. The Xenolith exposed shows elongation in some part of exposures.

Spot 3 Rudra Guda Patil Govt First Grade college

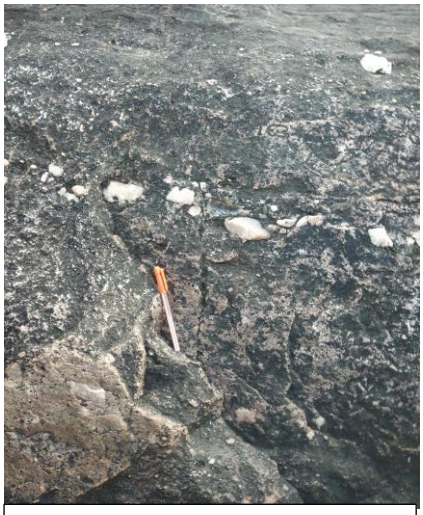

Figure 16: Conglomerate

The outcrop is of intraformational conglomerate, the rocks have undergone cyclic decomposition, and show primary Syndepositional structure that curves into a shallow bed, some layers of beds are pink and some are buff coloured indicating presence of cross bedding structure. And there normal graded bedding seen at some places and at some places current bedding. Places where graded bedding is seen in conglomerate such conglomerates are called as oligomictic conglomerate.

Day 7 - (16th December 2022)

Spot 1: Bundanagad

Lat: 16º05’22’’ N

Lon: 75º48’21’’E

Figure 17: Quartzites with joints and fractures

The rock outcrop exposed is that of quartzite which are found to be jointed and fractured having joint sets perpendicular to bedding planes. The joint sets are seen to be striking the bedding plane at N220 and N226 directions. There are multiple veins seen in the rock trending whose directions were taken from different spots N49, N131, N136 directions; some of the veins are orthogonal to each other while other veins cross cut each other at an angle. The size of the veins varies between 8cm to 15cm. The veins are coarse, elongated and some veins have a comb structure which happens when the minerals grow perpendicular to the walls of the veins. The veins form as a result due to extension of and minerals fill into the gaps created; such veins are called Gash veins which are seen in the outcrop.

Day 8

Kagalcomb 10to 12km away from Bagalkot.

Latitude: N $16^0$7’29”

Longitude: E $75^0$35’46”

Spot 1:

F igure 18: Quartz mineral

A huge body of quartz was seen towards north of the road nearly 40 to 50m width exposed at this location. The rock appears milky white in colour indicating impurities. Very few of the quartz found have hexagonal well-developed faces. At few places deformation is seen to have been taken place in rock shown which undergone bending mechanisms which are seen have resulted in extensional cracks on outer core. And tensional cracks are seen perpendicular to the extension. The radiating patterns of quartz the veins are seen trending in N 69^0 with approximate 1 cm thickness. The secondary mineral crystallisation is seen along the crack's development. Overall, the entire exposure has undergone deformation event. The joint sets are seen trending in E- W direction N 102^0.

Spot 2

Figure 19:Dolomite

In vicinity of the roadside towards the N are inclined dolomite beds. Dataset of dolomite (country rock) bed obtained shows them pointing towards north. The trend obtained are as follows N 92^0 dipping 41^0SSW, second trend obtained is N105^0 dipping 44^0 SSW.

Spot 3

Figure 19 : a)Limestone

Figure 19 b)Limestone showing two Joint sets

Konkan Kappa village the outcrop exposed shows effervescence and is the Konkan Kappa limestone.

Structural data taken of outcrop: The beds of limestone have a strike direction of N 96^0 dipping in Southwest direction with dip amount of 4^0. At some places joint sets are seen trending in 194 ^{0}N. Some pothole structures also are seen to exposed this structure is a form of result due to weathering.

Spot 4:

Figure 20:Halkurki Shale

This area is exposed having a latitude of $16^0$1’14” N and longitude of E 75^0 35’38”. The exposure consists of clay minerals which are too fine to be identified in field the clay size is < 1/ 256mm. The rock may be made up clay minerals present kaolinite, bentonite, montmorinoli, illite, spessartite. The type of clay minerals can be identified with help of XRD not by field observation. Braggs law basic principle of XRD. The age of the rock is Neoproterozoic. Formation of the shale shows deep water sedimentary rocks from the edge of the basin we come towards the center. This is a shale which is also called as Hal- kukri shale also called as agrellite. Shale is having lamination plane. The strike direction of the shale bed is strike is in direction of N 210^0 dipping in SSW with dip amount of 50^0 SE. And mud cracks are also found to be seen nearby this exposure.

Spot 5

Latitude$15^0$56’18”

Longitude :$75^0$40’45”

Location: Hotel Badami court behind hotel Phattepur

The Outcrop exposed at location is of sandstone with quartz, orthoclase, feldspar and white cementing material. There are ferruginous and siliceous band present. Prominent cross bedding is observed. There is extensive weathering of surface

exposed gives the surface various colours. Along with algal and licheans growth. Joint is developed parallel to the bedding plane.

Day 9 Lokapur

Latitude:$16^0 10' 4''$ N

Longitude: 75^0 21'32" E

The outcrop exposed on the south of the roadside. There is a high deformation that was seen with penetrative foliation. The rock exposed is dolomite with steeply dipping beds.

Based on structural data obtained the beds are having a strike direction of 121N dipping in 55 W and dip amount is 75 degrees.

Day 10 - (19th December 2022)

Spot 1: Near Almatti Dam area

Lat: 16ºY'Z'' N

Lon: 75ºY'Z''E

The rock outcrop exposed in the area is that of Migmatite which is a basement rock formed around 3.6 billion years by melting of the Dharwar TTG gneisses. There were several generations of melts, granites and pegmatites produced which gave rise to rocks like coarse grained pegmatite, fine grained pink granite, fine grained grey granite, white colored granite, Banded gneiss and a dark colored rock which is the oldest rock in the area. There were also veins of pegmatite seen in the outcrop which are parallel to each other and were trending in the NW-SE direction. There are also joint sets which are seen in the rock having a strike of N144, N292, N302, and N215. Some of the joints are found to be filled with pegmatite veins.

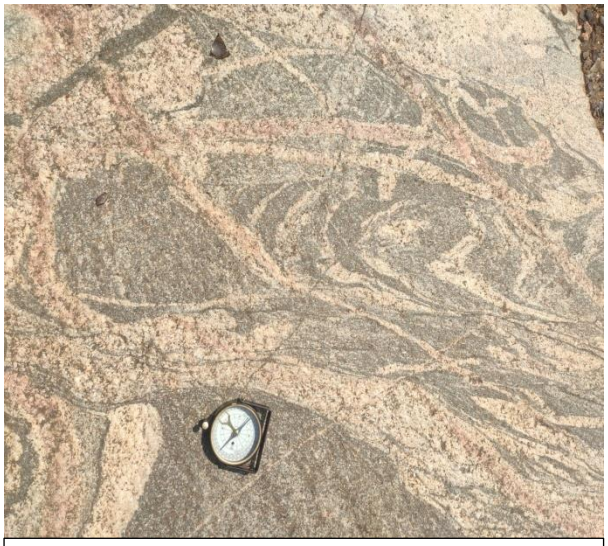

Figure 21: Migmatite

Conclusion

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