REPORT ON THE GEOLOGICAL MAPPING AND FIELDWORK STUDIES CARRIED OUT IN AND AROUND BAGALKOT, KARNATAKA

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MSc PART 1

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Acknowledgment

I am grateful to Dr. Anthony Viegas, Dr. Poornima Sawant, Dr. Nicole Sequeira, and all other faculties of the Earth Science department, at Goa University. Because of them, this field trip could not be possible also I appreciate the help received from the laboratory assistant Ms. Heena for providing the material required for the field trip. I would like to express my gratitude towards my fellow classmates for helping me during these 10 days and giving me an update on what happening.

Introduction

Our department of applied geology, Goa university had organized 10 days of the field trip to Bagalkot, Karnataka. This field trip is a part of our master's program and is essential for a geology student to become great in field-related work. For this to happen we were meant to take various geological equipment which is a clinometer compass and Brunton compass to take structural data like strike direction, dip direction, dip amount, etc, a hand lens for mineral identification, and a toposheet to have an idea where we are, and hammer to break the rock sample.

The area which we were studying was the kaladgi basin. We basically visited several places took the structural data and started to interpret, like what is this lithology, where it should be placed on the stratigraphical column of the 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 goal of the work is to establish the stratigraphic sequence, dating formations, and recognize structures, with the help of field data that was gathered, we had enough information to know about, its depositional environment, contains the description of the stratigraphy, structures, and they are both used to reconstruct the geological evolution of the area during a certain time interval. we also had to face challenges like entering places where the area is filled with thorny plants, and cramped space, finding in situ rock beds, and climbing down along moderate to steep slopes.

Geology of Karnataka

Karnataka forming a part of the Indian Shield 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 Deccan basalts, the remaining area is dominated by Archaean-Proterozoic rocks. Mysore Plateau is geologically constituted of Dharwar Craton and comprises Greenstone Granite belts, Gneisses, and Granulites. Greenstone belts essentially consist of meta-volcano sedimentary sequences, surrounded and dissected by Peninsular Gneiss. At the southern end of the craton, these give way to a granulite suite of rocks. The craton preserves a billion-year orogenic history from 3400 m.a. to 2400 m.a. Epi-cratonic or intracratonic sedimentary basins called Purana Basins occupy the northern segment of the craton whose northern part, in turn, is concealed by Deccan basalts. Thus, the younging of litho-sequence from south to north is evident. Generalized regional lithostratigraphy worked out for Karnataka, is presented below, followed by a brief description of major groups. stratigraphy and lithology.

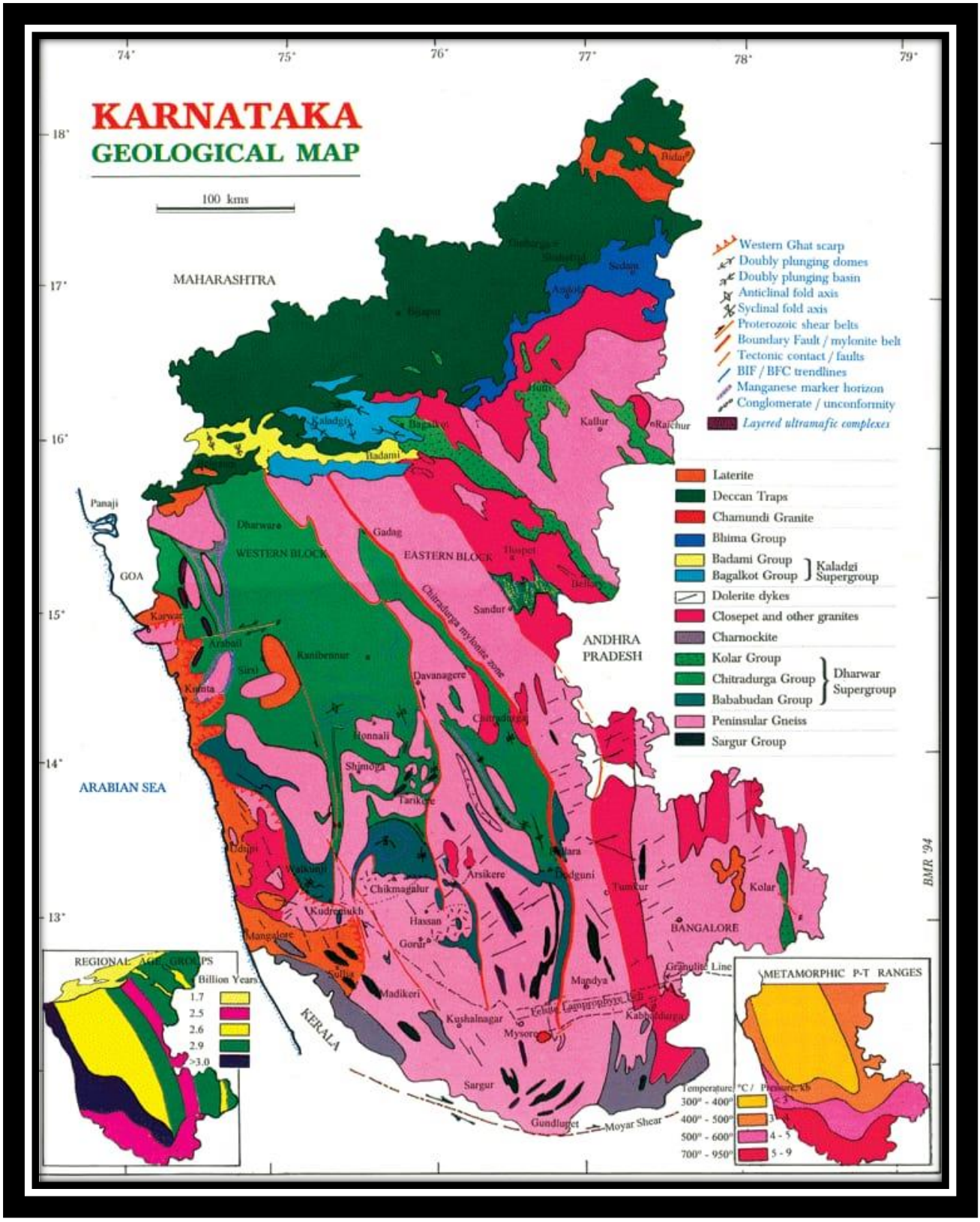

FIG NO. 1 GEOOGICAL MAP OF KARNATAKA

Physiography of Karnataka

Karnataka can be divided into three well-defined geomorphic regions viz., (1) the coastal plains on the west bordering the Arabian Sea, (2) the Malnad or mountainous region comprising the Western Ghat, and (3) the plateau region on the east. The coastline is straight and is about 400 km long. The coastal plains rarely exceed 30 km in width. To the east of the coastal plain, the Western Ghats forming the sub-continental water divide rise precipitously in a series of scarps and terraces towering more than 1000 m above MSL. within a short distance from the coastal plain. The Western Ghats trend NNW-SSE parallel to the west coast and have an average width of about 40 km. They are dotted with high peaks, viz., Kudremukh (1884 m) and Mulaingiri (1912 m) in the Bababudan hills. The Western Ghats grade into the plateau region towards the east. This plateau is the southern extension of the Deccan Plateau with an average elevation of about 650 m with a series of narrow, linear ridges and hill ranges of schistose rocks and bouldery granitoid hills. The state is drained by three major easterly flowing river systems. These are: (1) Manjira River of the Godavari basin in the north, (2) Krishna with its tributaries, Tungabhadra, Ghataprabha, Malaprabha, Bhima, and Vedavati draining the northern and central part, and (3) Cauvery with its tributaries, Kabini, Hemavathi, Simcha and Arkavati draining the southern part. Besides the easterly flowing river systems, there are several westerly flowing streams with short, straight and steep

courses. The most prominent of them are Kalindi, Sharavati, and Netravati.

Most of the river courses are principally aligned in two directions: (1) ENE-WSW to WNW-ESE, (ii) north-south to NNW-SSE and correspond to the major lineaments, faults, shear zones, and joints. Many of the major rivers, particularly the west-flowing rivers and some sections of all the east-flowing rivers have straight courses and sharp turns suggestive of strong structural control on the drainage pattern. There are a number of rapids, cascades, and waterfalls along the major rivers. The well-known among them, are the JogFalls on the Sharavati River and the Sivasamudram Falls on the Cauvery River. The state experiences humid Tropical to Semi-Arid climates for the most part of the year. The annual rainfall is about 300 to 500 cm in the coastal plains and the Western Ghats and about 80 cm on the eastern plateau. The Western Ghats are thickly forested. The plateau is generally devoid of dense forest.

Kaladgi basin

The Proterozoic Kaladgi–Badami and Bhima basins are intracratonic basins occurring over the Archaean Dharwar craton. The Kaladgi–Badami Basin contains arenites, shales, and carbonates with minor cherts and conglomerates deposited in continental, transitional, and shallow-marine environments presumably during the late Palaeoproterozoic/Mesoproterozoic to Neoproterozoic.

The lower part of the succession (Bagalkot Group) is deformed into east-west trending elongated doubly plunging synclines and anticlines. The upper part of the succession (Badami Group) is undeformed and unconformably overlies the lower part. The evolution of the Kaladgi–Badami Basin was controlled by movements along east–west-trending normal faults under an extensional stress regime. The Bhima Basin hosts mainly limestones with subordinate arenites and shales deposited in fluvial, deltaic, and tidal flat environments possibly during the Neoproterozoic. These sediments are undeformed except along faults with significant strike-slip components.

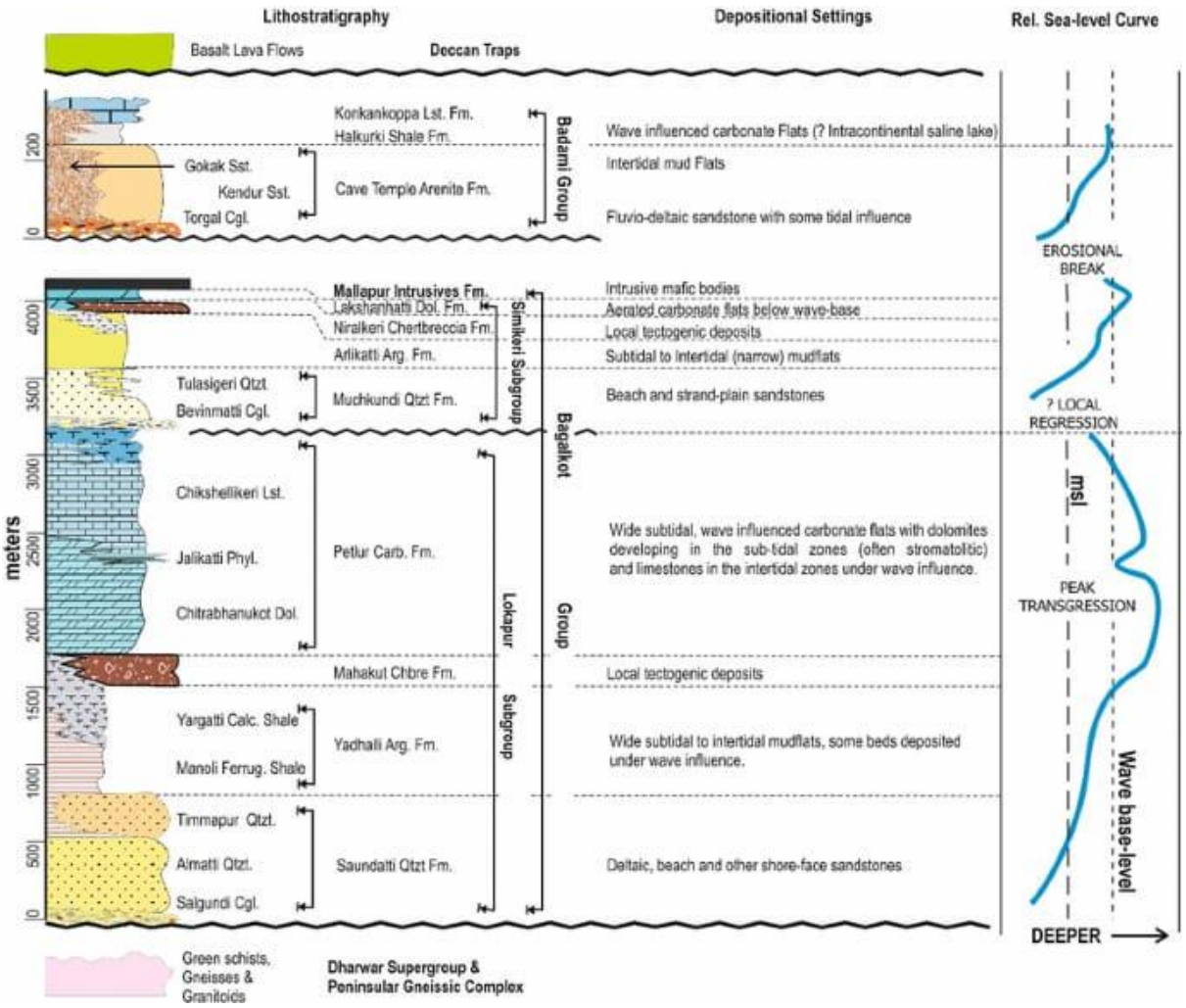

FIG NO. 2 STRATIGRAPHY OF KALADGI BASIN (Shilpa Patil Pillai, 2018)

Structural characters

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 have 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 them 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 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. (Awati and Kalaswad 1978; Nair and Raju 1987; Mukherjee et al. 2016)

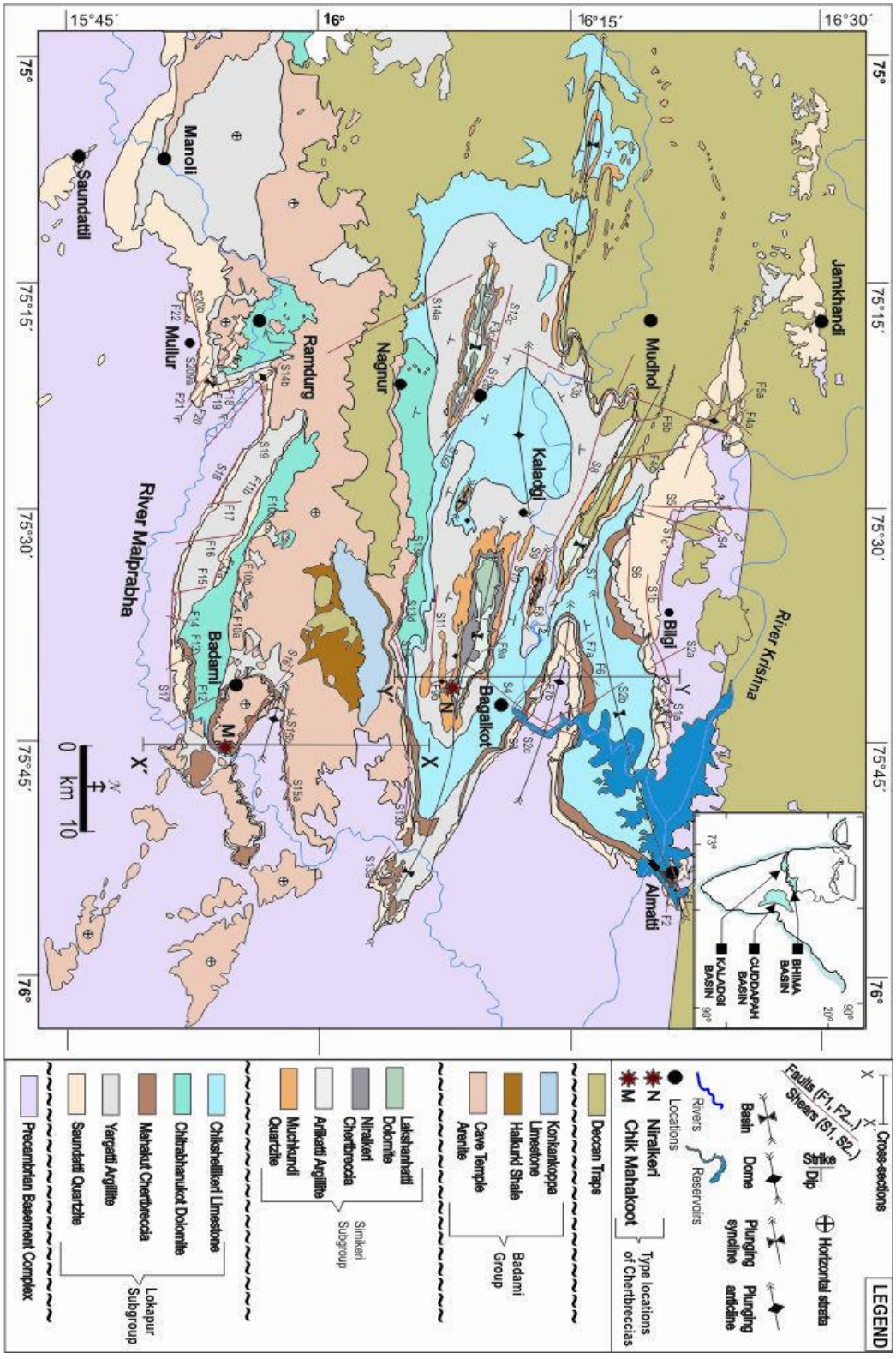

FIG NO. 3 GEOLOGICAL MAP OF KALADGI BASIN

Field Observations

DAY 01

DATE: 10/12/22

SPOT NO. 01

LOCATION NAME: KARADUGDDI

LATITUDE: 15˚52’55” N

LONGITUDE: 75˚41’41” E

DESCRIPTION: This spot was a hill located near the road site and the nearest landmark was Samra Airport. The slope of the hill was moderate with a height of 820m. The rock has a pebble-sized clast that is held together by a matrix. The rock was a Conglomerate which was ridge trending in N110˚W. The clast was of feldspar (that shows vitreous lustre, translucent, hardness of 6, cleavages can be seen), quartz (vitreous lustre’ hardness 7, no cleavage, conchoidal fracture,) and at some parts, there was jasper present (red colour). The size of clasts was 1.5cm in general. The pebbles were deposited in such a way that they resemble graded bedding which is a term that is used when clast is sorted wherein coarser heavier clast is settled at the bottom and finer small clast is settled at the top due to gravity. Looking at the class size one can depict that the velocity of the water/stream was very high, it was so high that bigger pebbles can be easily moved by the flow of water. Also, the clast that was below 1cm was subangular and subrounded while the clast which was bigger than 1 cm was substantially rounder which means that the source is not near but the

smaller clast's source is nearby or else those were the result of breaking bigger clast. The agent of transport is fluvial which can be a river. The rock also showed bedding seen in Sandstone beds in the North which was 1cm thick. The Conglomerate bed was inclined with a strike of N140 dipping NE.

Additionally, the size of the class is decreasing while moving up. With this quartzite starts to be more prominent above the conglomerate. This means marine regression has taken place which slowed down the stream of water that made the rivers carry only small clast. We can also observe that there were exfoliation and root wedging erosional processes were in action. This conglomerate is deposited like imbricated bedding like a shingled structure in a deposit of flattened or disk-shaped pebbles or cobbles. That is to say, elongated and commonly flattened pebbles and cobbles in gravelly sediment are deposited so that they overlap one another like roofing shingles. The bed was concluded to be of Bavinmatti conglomerate and the quartzite was muchkundi quartzite of Kundargi formation which lies in the Simikeri subgroup and in the Bagalkot group of the Kaladgi basin.

FIG NO. 1.1 SHOWING CLASTS OF BEVINMATTI CONGLOMERATE

FIG NO. 1.2 INCLINED BED OF MUCHKUNDI QUARTZITE

FIG NO. 1.3 GRADED BEDDING IN SANDSTONE

FIG NO. 1.4 EXPOSURE OF MUCHKUNDI QUARTZITE

SPOT NO. 2

LATITUDE: 15°52'37.5"N

LONGITUDE: 74°42'49"E

DESCRIPTION: After travelling for 10-20m ahead we got to a place which was a road cut outcrop showing spheroidal weathering. This weathering is a form of chemical weathering that affects jointed bedrock and results in the formation of concentric or spherical layers of highly decayed rock within weathered bedrock that is known as saprolite. When saprolite is exposed to physical erosion, these concentric layer peel (spall) off as concentric shells much like the layers of a peeled onion. Further plant's roots were adding to its weathering. The rock fine-grained, melanocratic, mafic minerals can be observed which had a small number of vesicles present that were filled with the secondary mineral called zeolite making it an amygdaloidal, some things to be noted that not all vesicles were filled. There were some fracture sets. This particular rock is an outlier because the younger formation is surrounded by an older formation. The rock is identified as a basalt which is derived from the Deccan traps about 64-65 Ma, which is a Mesozoic and Cenozoic boundary.

FIG NO. 1.5 SPHEROIDAL WEATHERING IN DECCAN TRAPS

DAY 02

DATE: 11/2/22

LOCATION NAME: RAMTHAL

LATITUDE: 16°3'49"N

LONGITUDE:75°55'28"E

SPOT NO. 1

DESCRIPTION: We got to this place by crossing kamatgri village. This spot was beside a road and the outcrop was exposed on a hill which had a moderate slope, wherein we encountered our first basement rock of the Kaladgi basin. The first rock which we came across were BIFs i.e BHQ and BHJ in

which we saw some chevron folds, micro faults, and class 1B and Class 2 folds. The rock was reddish in colour and had banded layering.

FIG NO. 2.1 MICROFAULTS IN BIF

FIG NO. 2.2 BROKEN ISOLATED OF BHQ

FIG NO. 2.3 CHEVRON FOLD IN BIF

FIG NO. 2.4 ISOLATED BROKEN SAMPLE OF BHJ

SPOT NO. 2

DESCRIPTION: The rock exposed at this spot was a metapellite i.e Phyllite which had a slaty cleavage and plunging fold. The fold was asymmetric and the rock was breaking into chips. The structural data for the plunging fold

Axial plane : striking N166 and dipping towards NE with an amount of 67°

Data on limbs:

left limb= striking N163° and dipping towards NE with an amount of 76°

Right limbs= striking N143° and dipping towards SW with an amount of 40°

Shallow dipping right limb= striking 168° and dipping towards SW with an amount of 4°

Hinge of plunging fold= Striking N129° and dipping towards SW with an amount of 40°

FIG NO. 2.5 PHYLLITE BREAKING IN THE FORM OF CHIPS

FIG NO. 2.6 PHYLLITE SHOWING FOLDS

SPOT NO. 3

DESCRIPTION: As we move towards the higher elevation we encountered a folded BHQ sample with a spaced fabric which had class 1B fold and its axial plane was parallel to the intrafolial plane. Further, we also encountered imbrication on salgundi conglomerate which had a clast of elongated BIQ and BHJ of 5-10cm in length. However, we couldn't make out the direction of flow because it was not an in-situ rock. At a height of 600m for MSL we come across a contact which was an unconformity between saundatti quartzite and salgundi conglomerate, wherein the quartzite was showing crossbedding.

FIG NO. 2.7 AXIAL PLANE OF CLASS 1B FOLD IS PARALLEL TO Sn+1 FABRIC

FIG NO. 2.8 FOLDS FOUND IN BHQ

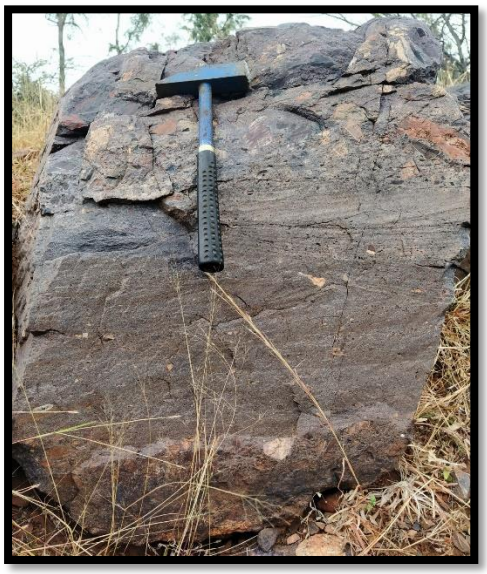

FIG NO. 2.9 CONTACT BETWEEN SAUNDATTI QUARTZITE AND SALGUNDI CONGLOMERATE

FIG NO. 2.91 IMBRICATION IN SALGUNDI CONGLOMERATE

SPOT NO. 4

DESCRIPTION: At this spot, the rock exposed was inclined quartzite whose continuation could be seen on other side of

the road. The quartzite had a flesh colour and was showing crossbedding. Its inclined nature is suggested that it is part of a Bagalkot group. The inclined quartzite bed had a strike of N285 and dip direction NE with a dip amount of 36°.

FIG NO. 2.92 INCLINED SANDSTONE BED WHICH WERE SHOWING CROSSBEDDING

FIG NO. 2.93 SAMPLE OF SANDSTONE

SPOT NO. 5

DESCRIPTION: The area was surrounded by thorny bushes indicating an arid region. This site was exposed due to excavation, it was white in appearance, and when the rock was tested against acid it gave effervescence suggesting it was a calcium carbonate deposit known as the Caliche deposit. Due to leaching all the carbonate deposits had concentrated downwards which was in the amorphous form of $CaCO_3$. However, it had some minerals which were weathered but could be identified as smoky quartz, chlorite, iron and epidote turning to feldspar.

FIG NO. 2.94 CALICHE DEPOSIT

SPOT NO. 6

LATITUDE: 16°4'50"N

LONGITUDE:75°52'11"E

DESCRIPTION: At this spot, we came across Ferruginous Phyllite and BHQ alternating bands. The road section had a vertical intrafolial fold which was showing woping at the center of the fold. The structural data for the fold is given below:

Hinge data- strike =N40°, dip direction=NW, dip amount= 34°

Limb data - strike =N320°, dip direction= NE, dip amount= 74°

FIG NO. 2.5 ROADCUT SECTION OF INTRAFOLIAL FOLD IN PHYLLITE

DAY 03

DATE: 12/12/22

SPOT NO. 1

LOCATION NAME: NARGUND

LATITUDE: 15°44'23"N

LONGITUDE: 75°22'27"E

DESCRIPTION: The rock exposed here was Phyllite intercalated with Ferruginous BIF. Whole outcrop was highly deformed with fractures. It had an intrafolial fold plus there was a woping of foliation towards the west indicating small-scale horizontal shear zone. The exposure had Quartz veins parallel to foliation. Due to leaching all the carbonate deposits had concentrated downwards which gave effervescence after

testing it against acid. We can make out the exposure had undergone 3 stages of deformation. Due to woping of foliation, we got varying strike direction data as given below:

Strike direction - N148 Dip direction - SW Dip amount- 70°

Strike direction - N168 Dip direction - SW Dip amount -70°

FIG NO. 3.1 WOPING OF FOLIATION SEEN IN PHYLLITE INTERCALATED WITH BIF

FIG NO. 3.2 INTRAFOLIAL FOLD IN PHYLLITE INTERCALATED WITH BIF

SPOT NO. 2

DESCRIPTION: After moving in the East direction for 5m we came across an Angular unconformity wherein the bottom rocks were inclined BIF and on top of that were loose sediments of recent deposits which had pebbles and cobbles. Due to erosion and slumping the Quartz veins were sharply inclined i.e 45°. However, some Phyllites were folded. The top recent deposit showed reverse grading wherein there was a

sharp contact between the pebble and soil. The structural data for the inclined foliation are as given below:

Strike direction - N150° Dip direction - SW Dip Amount -84°

Strike direction - N145° Dip direction - SW Dip amount - 65°

Strike direction - N150° Dip direction - SW Dip direction - 46°

FIG NO. 3.3 ANGULAR UNCONFORMITY IN RECENT DEPOSIT AND PHYLLITE INTERCLATED WITH BIF WHICH ARE FOLDED

SPOT NO. 3

LOCATION NAME: NARGUND HILL

LATITUDE: 15°44'23"N

LONGITUDE: 75°22'25"E

DESCRIPTION: The area was surrounded by huge windmills and we were at a height of about 800m above MSL. The rock exposed here was a pinkish quartzite which was highly jointed

and fractured. There were 2 joint sets which were trending in N297 and N235. The rock displayed some sedimentary structures like herringbone bedding and ripple marks indicating a shallow marine environment of deposition. Further, the rock exposure indicated an outlier wherein the younger rocks were surrounded by older rocks.

FIG NO. 3.4 HERRINGBONE STRUCTURE IN SANDSTONE

FIG NO. 3.5 RIPPLE MARKS IN SANDSTONE

DAY 04

DATE: 13/12/22

SPOT NO. 1

LOCATION NAME: AIHOLE

LATITUDE: 16°1'47"N

LONGITUDE: 75°53'4"E

DESCRIPTION: At this spot, we came across an unconformity i.e angular unconformity wherein the Bagalkot group rocks were inclined and Badami group rocks were horizontal. On the

south side, there were inclined beds of ferruginous quartzite with intraformational conglomerate and breccia with 10-15cm width. It has been that there were many layers of the intraformational conglomerate in which the coarser clasts were angular and finer clasts were rounded. The grain size of quartzite was medium-grained, arenaceous, and the matrix was of siliceous. The conglomerate contains clasts of milky quartz, Jasper, Agate, BIF and chert with variations of 6-7cm in length and 3.5-5cm in width. There were some randomly oriented Quartz veins which have a thickness of 1cm. The rock exposure showed cross-bedding in quartzites with were shown by alternate light and dark-coloured bands. This is a Hoskatti formation.

The structural data for the inclined beds are given below:

Strike direction - N125° Dip direction - SSW Dip amount - 38°

Strike direction - N118° Dip direction - SSW Dip amount - 37°

Strike direction - N124° Dip direction - SSW Dip amount - 35°

FIG NO. 4.1 CROSSBEDDING SEEN IN QUARTZITE WITH CLASTS OF VARYING SIZES

SPOT NO. 2

LATITUDE: 16°0'50"N

LONGITUDE: 75°53'7"E

DESCRIPTION: This rock was exposed towards the north side. The rock exposed was a weathered Arenite sandstone which was horizontal to subhorizontal. At the top, the sandstone beds were horizontal with decreasing elevation the beds were slightly subhorizontal. The rock was fine-grained and had a siliceous matrix. This is the new Kerul formation.

The structural data for the subhorizontal beds is given below:

Strike direction - N90° Dip direction- S Dip amount - 3°

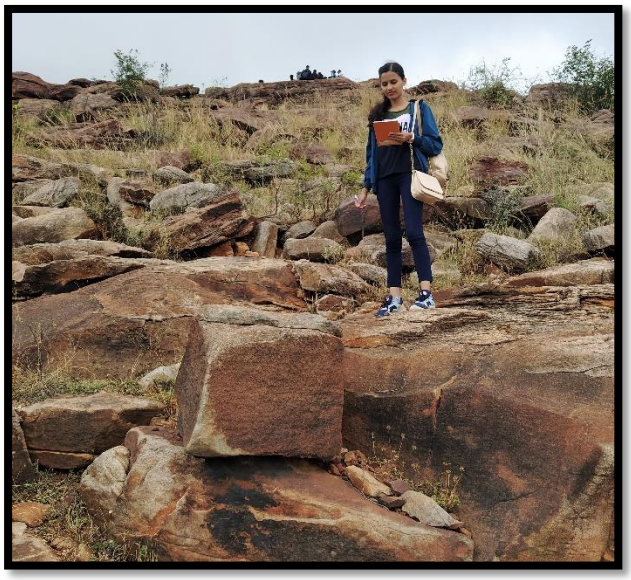

FIG NO. 4.2 HORIZONTAL TO SUBHORIZONTAL ARENITE SANDSTONE BEDS OF BADAMI GROUP

SPOT NO. 3

LOCATION NAME: SHIRUR

LATITUDE: 16°5'34"N

LONGITUDE: 75°46'57"E

DESCRIPTION: The rock encountered here was a quartzite which was from the saundatti quartzite of the Bagalkot group. There was a fault plane in the field area which was suggested by the presence of slickensides. We could feel that the striations were smooth from one side and rough from the another. The fault plane was shallow dipping and as per Anderson's theory of faulting it was a reversed fault. There was another fault plane which was vertical and had lineation. The structural data for this fault plane is given below:

Strike direction - 111°N Dip direction - NE Dip amount- 60°

The angle between the Strike line and the lineation line was 88°.The rock had many joint sets which were trending in N148° and N125°. The area had some intraformational conglomerate beds of 1-3cm thickness, which had fragments of quartz and feldspar that are subrounded to sub-angular and had clast size of 2 to 3cm.

FIG NO. 4.2 INTRAFORMATIONAL CONGLOMERATE

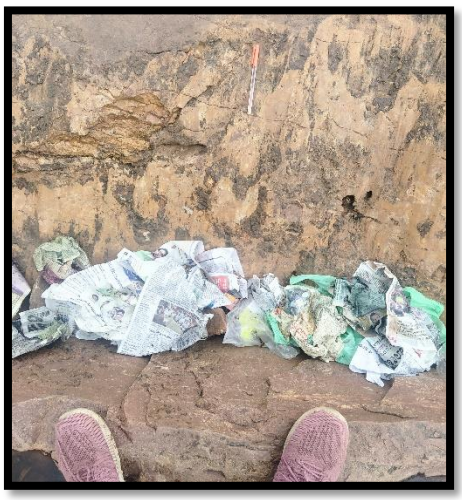

FIG NO. 4.3 SLICKENSIDES

FIG NO. 4.4 LINEATIONS ON FAULT PLANE

DAY 05

DATE: 14/12/22

SPOT NO. 1

LOCATION NAME: AMINGAD

LATITUDE: 16°3'22"N

LONGITUDE: 75°56'43"E

DESCRIPTION: The rocks we encountered here were on a hill with a moderate slope. At the base of the hill on the left side, we found granite boulders which were in the form of tors. The rock was pinkish in colour having k-feldspar, quartz, hornblende and biotite. In addition to this, we encountered an accidental mafic xenolith with 10.5cm in length and 7cm in width. However, on the right side, we found pink granite which was highly fractured and joints indicating it to be a shear zone. The shear plane was striking in N201 with a dip direction in ESE and a dip amount of 33°.

As we move towards higher elevation we came across a contact wherein the conglomerate was intercalated with the

quartzite with class rich in BIF and had a 700 million age gap between conglomerate and quartzite. Later, we found inclined beds of quartzite which had a strike direction of N129° with a dip direction in NE and a dip amount of 16°. At the highest elevation of the hill, we found Mahakut chert breccia.

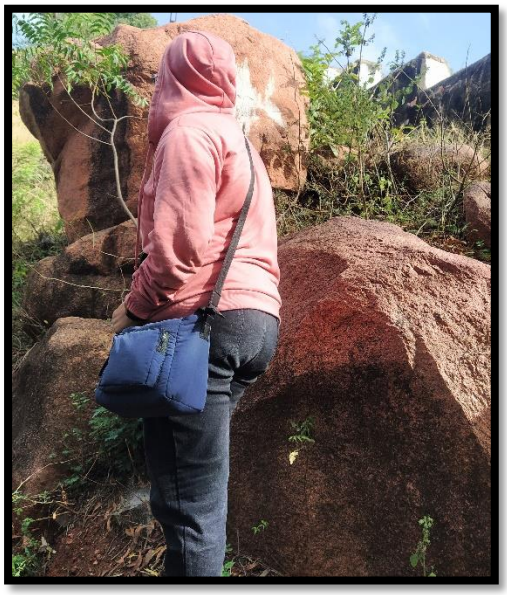

FIG NO. 5.1 PINK GRANITE TORS

SPOT NO. 2

LOCATION NAME: HUNGUND

LATITUDE:16°4'8"N

LONGITUDE:76°3'3"E

DESCRIPTION: At this spot, the rock exposed was the Hungund Schist belt which is one of the basements of the Kaladgi basin. At the bottom, there was BIF rich layer and overlying that there was phyllite. A quartz vein was crosscutting the entire outcrop which was inclined indicating that the quartz veins are younger than the schist belt. There was a shear lens of BIF which was preserving the structure of basement. There were

some intrafolial folds in Phyllite. The joints sets were perpendicular to the schist belt. Further, it had a small-scale shear zone wherein there was displacement. The planes of schist belt were getting vertical as we take readings in North direction.

The structural data for the inclined hungund schist belt is as given below:

Strike direction - N130° Dip direction - NE Dip amount - 65°

Strike direction - N125° Dip direction - NE Dip amount - 56°

Strike direction - N331° Dip direction - NE Dip amount - 59°

Strike direction - N310° Dip direction - NE Dip amount - 90°

Axial plane of intrafolial fold

Strike direction - 140° Dip direction - NE Dip amount- 85°

FIG NO. 5.2 HUNGUND SCHIST

FIG NO. 5.3 INTRAFOLIAL FOLD IN BHQ LENS

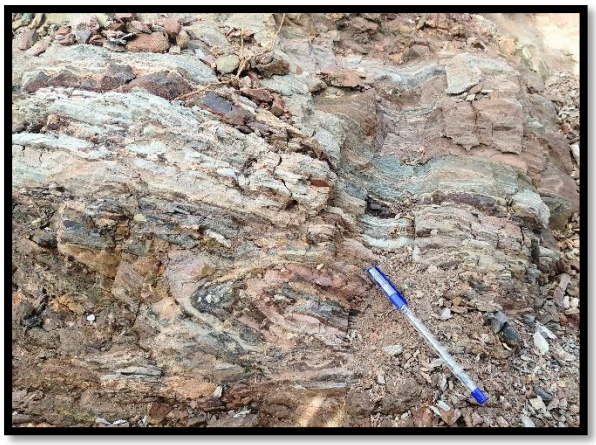

FIG NO.5.4 INTRAFOLIAL FOLD IN PHYLLITE

DAY 06

DATE: 15/12/22

SPOT NO. 1

LOCATION NAME: BILGI

LATITUDE:16°20'26"N

LONGITUDE:75°36'41"E

LONGITUDE:75°36'41"E

DESCRIPTION: The rock exposed at this spot was a basement of Kaladgi basin namely closepet granite of Dharwar Craton of age 2500-2600 Ma. It was an extensive outcrop showing exfoliation. The rock was grey granite with mineral composition of Quartz, Plagioclase, K-feldspar and biotite. There were 5 pegmatite veins cross cutting the outcrop with a trend of N62°E and N55°E. The pegmatite veins were pink and had quartz, biotite and orthoclase with an average thickness of veins of 15cm. There was fault plane which showing it to be a dextral fault with a strike direction of N48° and dip amount

55° towards North. Some potholes were present if 10-15cm length.

The outcrop was jointed with a trend of N80°E and N64°E. The outcrop also had 3 types of xenoliths entrapped in it namely accidental, restitic and double xenolith. The xenolith varied in size i e 32-39cm in length and 14.5-17cm in width. The accidental xenolith was mafic in nature and a circular shape. The restitic xenolith was elongated with a trend of N72°E and was mafic in nature but had a white layer formed due to reaction with mafic xenolith. The double xenolith had mafic xenolith inside that there was a felsic xenolith.

FIG NO. 6.1 EXFOLIATION IN GREY GRANITE

FIG NO. 6.2 GREY GRANITE SAMPLE

FIG NO. 6.3 RESTITIC XENOLITH WHEREIN THERE IS WHITE COLOUR MINERAL RIM

FIG NO. 6.3 DOUBLE XENOLITH

SPOT NO. 2

LATITUDE: 16°20'14"N

LONGITUDE: 75°36'43.8"E

DESCRIPTION: This spot was a quartzite quarry where slightly inclined with a strike direction of 76°N and a dip amount of 6° towards SSE. The outcrop was jointed and had undergone chemical weathering and as a result of leaching, there was the appearance of folds on the walls of the rock.

FIG NO. 6.4 CHEMICAL WEATHERING GIVING AN ILLUSION OF FOLDS

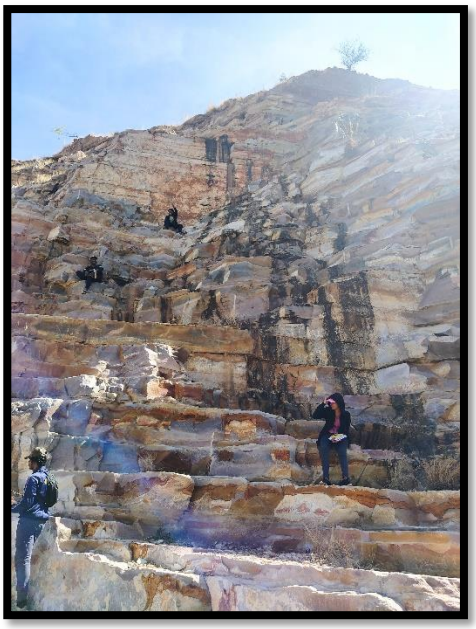

FIG NO. 6.5 QUARTZITE QUARRY

SPOT NO. 3

LATITUDE: 16°20'29"N

LONGITUDE:75°36'59"E

LOCATION NAME: BEHIND HIGH GRADE SCHOOL

DESCRIPTION: The exposed rock was an Oligomictic conglomerate which had quartz clast with varying thicknessES between 2-3 and lengths between 3-7cm. It was showing syndepositional structures like current bedding, crossbedding and graded bedding indicating cyclic deposition. The outcrop was weathered and had fractures. There were inclined sandstone beds whose structural data is given below:

Strike direction - N114° Dip direction - SSW Dip amount - 11°

Strike direction - N90° Dip direction - S Dip amount - 22°

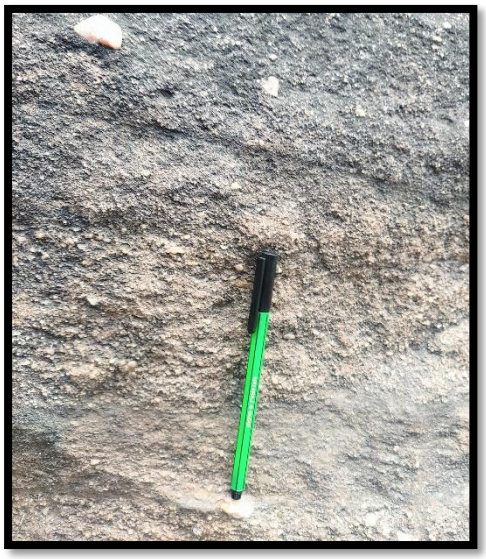

FIG NO. 6.6 REVERSE GRADED BEDDING IN CONGLOMERATE

DAY 07

DATE: 16/12/22

SPOT NO. 1

LOCATION NAME: BUDANAGAD

LATITUDE: 16°5'22"N

LONGITUDE: 75°48'21"E

DESCRIPTION: This spot was a continuation of Shirur fault zone. It was a road side exposure containing fractures and joints. The rock exposed was quartzite. There were 3 joint sets which were trending in N36°, N57° and N262°. There were intrusion of few quartz veins with varying thickness. Further there was a small scale fault in the veins with 12cm displacement. Due to rock extension there were development

of gash veins. In addition to that, the outcrop had orthogonal quartz veins. Comb structure was also exposed in the quartz indicating it to be a fault zone which was in EW direction, wherein the grains were elongated and they were perpendicular to the wall of vein.

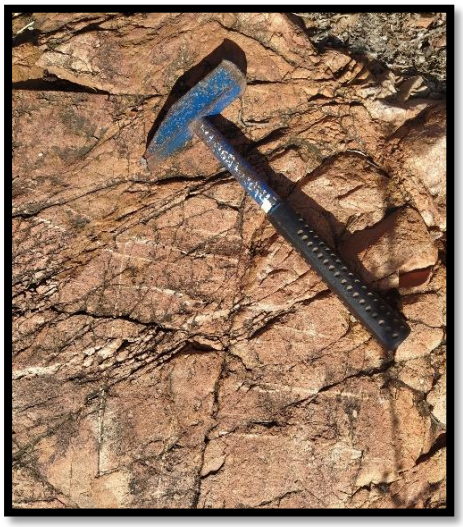

FIG NO. 7.1 OFFSETS IN 3 VEINLETS

FIG NO. 7.2 COMB STRUCTURE IN QUARTZ

SPOT NO. 2

LATITUDE: 16°5'7"N

LONGITUDE: 75°48'47"E

DESCRIPTION: The rock exposed here was a granite which was highly deformed and foliation. It had many cross cutting veins varying in thickness between 1.5-8 cm. The outcrop even had some curved veins and orthogonal veins. The veins were formed in single generation. The outcrop even showed some crenelations. One of the joint set was trending in N40°.

The structural data for the foliation plane:

Strike direction - N270° Dip direction - NNE Dip amount - 43°

FIG NO. 7.3 FOLIATED DEFORMED GRANITE

SPOT NO. 3

LATITUDE: 16°5'8"N

LONGITUDE: 75°48'48"E

DESCRIPTION: As we move towards a higher elevation we came across a granite and quartzite contact. Further 3m away we found granite intruding in the mafic rock which was black, foliated and showed schistosity. The foliation of the mafic enclave was striking in N305 direction and was dipping in NE with an amount of 42°, which was same as hungund schist. After walking for 10m higher on the hill we came across a granite which same as the granite at spot 2 but it was not weathered and foliated.

FIG NO. 7.4 CONTACT BETWEEN GRANITE AND QUARTZITE

FIG NO. 7.5 INTRUSION OF GRANITE IN MAFIC ROCK

FIG NO. 7.6 FOLIATED MAFIC ROCK

SPOT NO. 4

LOCATION NAME: MURUDI

LATITUDE: 16°2'6"N

LONGITUDE: 75°45'26"E

DESCRIPTION: There were some conglomerates containing clasts of BIF, Jasper and Quartz. After spreading out different directions we found pure white sandstone of Badami group. The sandstone beds shows cross bedding and herringbone structure. It also showed curved joints formed due to weathering processes. The outcrop even had some joints which were trending in N90°, N70° and N80°.

FIG NO. 7.7 CROSS-BEDDING IN PURE SANDSTONE

FIG NO. 7.8 CONGLOMERATE

SPOT NO. 5

LOCATION NAME: KELAWADI

LATITUDE: 16°4'28"N

LONGITUDE: 75°42'9"E

DESCRIPTION: It was a roadside exposure of folded ferruginous phyllite. It was 5km away from spot 5. The phyllite was showing schistosity and was breaking in the form of chips. It was reddish in colour with no shine. The folds were almost

symmetrical in nature wherein the left limb was dipping towards south and right limb towards north.

The structural data for the folded ferruginous phyllite :

Strike direction - N68° Dip direction - SSE Dip amount - 33°

Strike direction - N64° Dip direction - NW. Dip amount - 6°

Strike direction - N109° Dip direction - NE Dip amount - 6°

Strike direction - N82° Dip direction - NW Dip amount - 12°

FIG NO. 7.9 ROADSIDE FOLDED FERRUGINOUS PHYLLITE

DAY 08

DATE: 17/12/22

SPOT NO. 1

LOCATION NAME: KAGAL KOMB

LATITUDE: 16°7'29"N

LONGITUDE: 75°35'46"E

DESCRIPTION: This place was 10-12km away from Bagalkot. This spot was present at a higher elevation. Once upon a time this place was glass industry. The quartz mineral was identified by its properties like vitreous lustre, conchoidal fracture, white colour and it had no cleavage indicating it to be a milky quartz. Due to blasting, the quartz had developed radiating joints. Some extensional and tensional joints were also seen along which there was secondary mineral crystallization happening. In some cavities there were development of hexagonal quartz crystal which were milky white to transparent in nature. The whole outcrop was about 40-50m in length. The rock was jointed and scissor joints. The trend of few joints are N54°, N96° and N34°. In the field, we also came across some quartz veins which were earlier fractures which got filled later on. It had an average width ranging between 1- 4.5cm. A 1cm vein was trending in N69°.

FIG NO. 8.1 HEXAGONAL CRYSTALS OF QUARTZ

FIG NO. 8.2 RADIATING JOINTS IN QUARTZ

FIG NO. 8.3 TENSIONAL JOINTS MILKY QUARTZ

SPOT NO. 2

DESCRIPTION: This spot was present at the bottom of the hill. The rock exposed was inclined dolomite. The beds were striking in N105° and dipping in SSW with an amount of 44°. The rock had layering and was highly weathered.

FIG NO. 8.4 FOLIATED DOLOMITE INCLINED BEDS

SPOT NO. 3

LOCATION NAME: SULKERI DOLOMITE MINE

LATITUDE: 16°6'23"N

LONGITUDE: 75°39'3"E

DESCRIPTION: It was a dolomite mine and it was in vicinity of spot 2. Mining of dolomite was commercial where there was various machinery to mine the rocks and to grade the rock by their sizes. This mine was active and it has reached a point where they have to pump out the groundwater to another location. The trend of the lake was N102°. This mine is an open pit mine. The faces of the pit were steep and the benches were broad so that two vehicles can pass simultaneously.

FIG NO. 8.5 DOLOMITE MINE

SPOT NO. 4

LOCATION NAME: KOKANKAPPA

LATITUDE: 16°3'9"N

LONGITUDE: 75°38'45"E

DESCRIPTION: The rock exposed was a Kokankappa limestone. It was greyish in colour and after testing the rock against HCl it gave effervescence confirming presence of carbonate minerals. The rock was jointed with a trend of N194°. There was some potholes present indicating erosion and weathering. The beds were inclined but were having gentle dip indicating that the rock was belonging to Badami group. We were on the continental shelf at this spot.

The structural data for the inclined beds:

Strike direction- N96° Dip direction - SSW Dip amount - 1°

Strike direction- N90° Dip direction - SSW Dip amount - 4°

Strike direction- N110° Dip direction - SSW Dip amount - 5°

FIG NO. 8.6 SLIGHTLY INCLINED LIMESTONE BELT

SPOT NO. 5

LOCATION NAME: HALKURKI

LATITUDE: 16°1'14"N

LONGITUDE: 75°38'58"E

DESCRIPTION: The rock exposed was argillite which was made up of clay minerals. This was a Halkurki shale of neoproterozoic Badami group. We were now on abyssal plains and towards the south there would be paleoocean. The rock was reddish in colour indicating it to be a ferruginous shale. The ferruginous shale had lamination of dark and colour layers and the laminations were parallel to the bedding planes. The shale beds were slightly inclined at the base with strike direction N154°, dipping in SSE direction with an amount of 6°. Because of weathering and erosion, some beds were also showing strike direction as N121°, dip in SSE direction with an amount of 35°.

FIG NO. 8.7 HALKURKI SHALE

SPOT NO. 6

LOCATION NAME: BADAMI, OPPOSITE TO HOTEL BADAMI COURT

LATITUDE: 15°56'16.8"N

LONGITUDE: 75°40'37"E

DESCRIPTION: The rock exposed was a Sandstone. It is the oldest in the Badami group. The minerals identified were quartz and feldspar and it was classified as Arenite sandstone. It had ferruginous and siliceous matrix. There was huge boulder of Sandstone which were jointed and highly inclined. The beds were horizontal and along the bedding planes algal and lichens growth was booming. The outcrop was fractures and weathered giving it colours like brown, grey and white. They were showing crossbedding structures. These are the same type of rocks as Cave Temple Arenites.

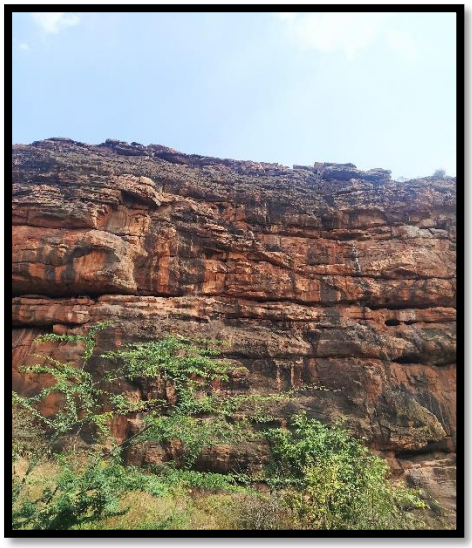

FIG NO. 8.8 BADAMI SANDSTONE ARENITE

SPOT NO. 7

LOCATION NAME: BADAMI CAVE TEMPLES

LATITUDE: 15°55'4"N

LONGITUDE: 75°41'24"E

DESCRIPTION: This place was a tourist area where we saw many monkeys which were very friendly. The caves had statues of gods and goddesses. The cave was made up of Arenite sandstone. It has a thickness of about 89 m, they are composed of sand-sized grains, and a matrix of ferrugineous material some parts were also siliceous. Here cross bedding is seen everywhere on the lithology stating that it has deposited due to a shallow marine environment, and while it was deposited the ground was sinking so there was a constant supply of sand and this made the rock's framework naming it as sandstone.

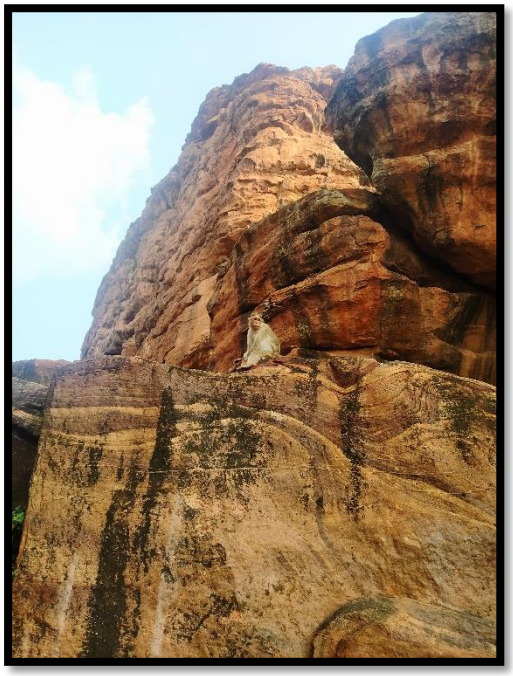

FIG NO. 8.9 CUURRENT BEDDING IN BADAMI CAVE ARENITES

DAY 09

DATE: 18/12/22

LOCATION NAME: NAGANAPURA, LOKAPUR

SPOT NO. 1

LATITUDE: 16°10'04"N

LONGITUDE: 75°21'32"E

DESCRIPTION: The outcrop is exposed to the south of the roadside. There is high deformation with penetrative foliation. It is similar to dolomite of kagal komb and the beds are inclined. There were some deformed stromatolites fossils in the limestone beds.

The structural data for the inclined beds:

Strike direction - N121° Dip direction - SSW Dip amount - 75°

Strike direction - N125° Dip direction - SSW Dip amount - 71°

FIG NO. 9.1 DEFORMED STROMATOLITES IN LIMESTONE BEDS

SPOT NO. 2

LOCATION NAME: LOKAPUR LIMESTONE MINE

LATITUDE: 16°9'58"N

LONGITUDE: 75°23'31"E

DESCRIPTION: This place was 10m away from Lokapur town. At this mine, Jalikatti limestones were being mined. It was an active open cast mine wherein benches and faces had a gentle slopes. At this spot, we also found some calcite deposits which could be identified by properties like 3 sets of cleavage, white in colour, vitreous lustre, hardness 3 and breaking in cubes.

FIG NO. 9.2 CALCITE DEPOSITS IN LIMESTONE MINE

DAY 10

DATE: 19/12/22

SPOT NO. 1

LOCATION NAME: ALMANTI DAM

LATITUDE: 16°19’51.6”N

LONGITUDE: 75°53’16.8”E

DESCRIPTION: The Lal Bahadur Shastri Dam is also known as Almatti Dam is a hydroelectric project on the Krishna River in North Karnataka, India which was completed in July 2005.The dam is located on the edge of Bijapur and Bagalkot districts. The target annual electric output of the dam is 560 MU. It is a mixed dam. It was started in 1964 and inaugrated in 2006 by Abdul Kalam. To build this dam 180 villages of Bagalkot got submerged and 2 lakh families got rehabilitated. It took 30 years to complete this dam. The entire budget of dam was 50000 Crores. The dam has 6 turbines in total out of which 5 turbines are 55 MW generators and one turbine is of 50 MW generator. It has a height of 524.26ft and a length of 1565.15 ft. It has a total capacity of 124 TMC. The dam has a catchment area of about 33,375 sq. km and a surface area of 24,230 hectares. Water is released into the Narayanpur reservoir after using for power generation to serve the downstream irrigation needs. The backwaters of the dam host several migratory birds during summer.

SPOT NO. 2

LOCATION NAME: KASHINAKUNTI

LATITUDE: 16°20'38"N

LONGITUDE: 75°55'34"E

DESCRIPTION: The rock exposed at this spot was Migmatite which is one of the basement rock and it is 3 billion years. This rock is formed because of the partial melting of TTG rock which is the basement of Dharwar Craton which have an age of 3.2-3.5 billion years. There are 6 magma generations at this spot. There are many cross-cutting veins and joint sets. Some of the joint sets trend in N145° and N215°. There are fractures in the outcrop which are filled by Pegmatite veins. There is a fault in the pegmatite vein which has a 5cm displacement and it is a dextral fault. There are 6 generations of magmas. The youngest to oldest magma generations are Pegmatite vein, pink granite, grey granite, white granite, gneiss and mafic rock. We have come to this order of superposition by paying attention to the cross-cutting nature of the veins. The pegmatite vein is the youngest because it cross-cutting all the other rocks.

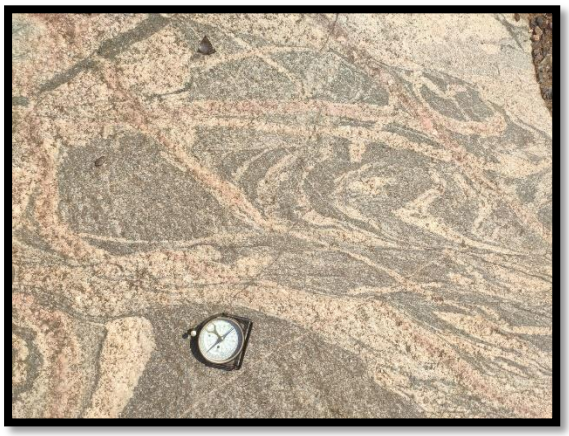

FIG NO.10.1 FOLDS IN GRANITE

FIG NO. 10.2 OFFSET IN PEGMATITE VEIN

CONCLUSION

The Kaladgi basin comprises of mafic rocks and shallow marine deposits which indicates that it all happened during Pangea times when India was not together like in present. It consists of sedimentary rocks like Sandstones, Limestones, Dolomites, shales and conglomerates of polymictic to oligomictic. Spheroidal weathering was seen in Deccan Trap Basalts which overlies the kaladgi basin. The Bagalkot group rocks are of Mesoproterozoic age and the Badami group rocks are of Neoproterozoic age.

The basement is made up of Precambrian rocks like Gneiss in kashinakunti, Closepet granite in Bilgi, metasediments in Ramthal, Hungund schist in Hungund and migmatites in Kashinakunti. On top of this, there is an angular unconformity. We saw contact between salgundi conglomerate and saundatti quartzite at Ramthal at a higher elevation of 600m approx. This is the lokapur subgroup of the Bagalkot group. At top Amingad hill we saw Mahakut Chert breccia. And in lokapur, we encountered some dolomites and limestones. Then in Karidaguddi, we encountered Bevinmatti conglomerate and muchkundi quartzite wherein we saw clasts of muchkundi quartzite which indicates a disconformity. These rocks are from the simikeri group.

These sedimentary rocks are from Bagalkot group which are inclined and thus form an angular unconformity with the overlying strata. From here Badami group starts, these are horizontal to subhorizontal rocks; first, there is cave temple arenite followed to that there is halkurki shale and konkankappa limestone. On the Kaladgi basin, there are Deccan trap flows.

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