FIELD REPORT

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MSc Part I

Applied Geology

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INDEX

Acknowledgement

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Introduction

Peninsular India is a collage of Archaean cratonic domains separated by Proterozoic mobile belts. A number of cratonic basins, known as “Purana basins” in the Indian literature, formed in different parts of the Indian Peninsula during extensional tectonic events, from Paleoproterozoic through Neoproterozoic times. In this contribution, we present a diversity of new geochronological data for different units within the Kaladgi and the Bhima basins, which overlie the western and eastern Dharwar cratons, respectively. The new geochronology data are discussed in terms of depositional history and provenance of these poorly understood Proterozoic intracratonic basins.

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

Regional Geology

For the Kaladgi Group, a U–Pb baddeleyite age of 1,861 ± 4 Ma obtained for a dolerite dyke intruding the Yendigere Formation is used to constrain the minimum age of deposition of the lower Kaladgi Group. This result demonstrates that this part of the succession is comparable in age to the Papaghni Group of the Cuddapah Basin, heralding onset of Purana sedimentation at ~1,900 Ma. The detrital zircon populations from the clastic rocks of the Kaladgi and Bhima basins show unique and distinct age patterns indicating different source of sediments for these two basins. Palaeocurrent analysis indicates a change in provenance from south or southeast to

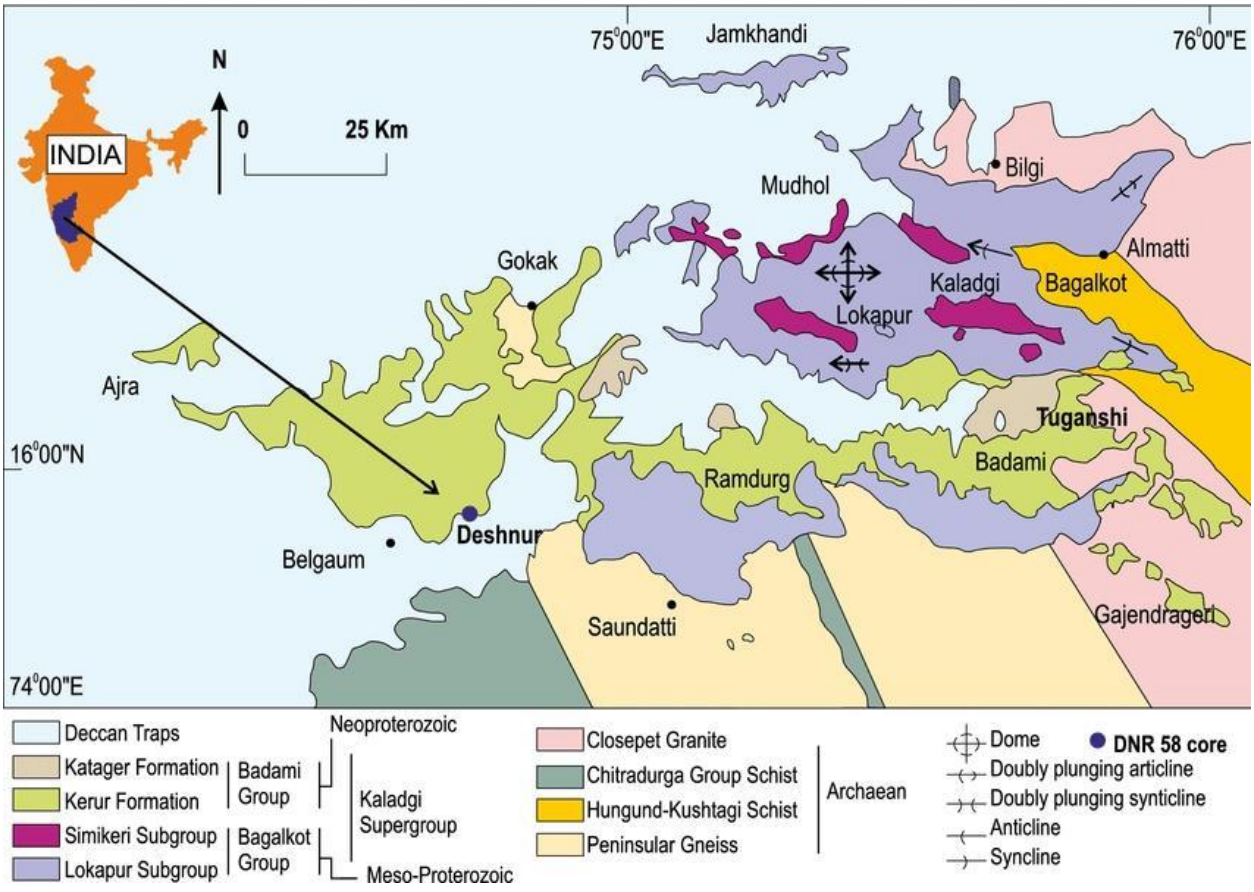
west or northwest between the Kaladgi and Bhima clastic sedimentation. New U–Th–Pb and Rb–Sr radiometric dates of limestones and glauconite-bearing sandstones of the Bhima Group (Bhima Basin) and the Badami Group (Kaladgi Basin) indicate deposition at around 800–900 Ma, suggesting contemporaneity for the two successions. Thus, the unconformity between the Kaladgi Group and the overlying Badami Group represents a time gap of up to 1,000 Myr. These new results demonstrate the complex multistage burial and unroofing history of the Archaean Dharwar Craton throughout the Proterozoic, with important implications for exploration of metal deposits and diamonds in Peninsular India.

STRATIGRAPHY OF KALADGI SUPERGROUP

Supergroup	Group	Subgroup	Formation	Member	Thickness (m)	Sedimentary structures	Sedimentary environment
Kaladgi	Badami		Katageri	Konkankoppa Limestone	85	Profuse cross-bedding (tabular, trough and tangential), ripple marks, graded bedding, parting lineation, sandstone dykes and convolute lamination in Cave-Temple Arenite	Dominantly fluvial with subordinate lacustrine (Jayaprakash 2007; Mukhopadhyay *et al.* 2013)
				Halkurki Shale	67		
				Belikhindi Arenite	39		
			Kerur	Halgeri Shale	3		
				Cave-Temple Arenite	89		
				Kendur Conglomerate	3		
	---------- Angular unconformity ----------						
	Bagalkot	Simikeri	Hoskatti	Argillite	695	Cross-bedding (trough and tabular) and ripple marks (symmetrical and asymmetrical) in Muchkundi Quartzite	High-energy beach deposits grading upwards to tidal flats (Kale & Phansalkar 1991) with minor fluvial deposits (terrestrial fan; Jayaprakash 2007). Dominantly fluvial in the lower part of the Muchkundi Quartzite (Mukhopadhyay *et al.* 2013).
			Arlikatti	Lakshanhatti Dolomite	87		
				Kerkalmatti Ferruginous Member	42		
				Neralkeri Chert	39		
				Govindkoppa Argillite	80		
			Kundargi	Muchkundi Quartzite	182		
				Bevinmatti Conglomerate	15		
		---------- Disconformity ----------					
		Lokapur	Yadhalli	Argillite	58	Small- and large-scale cross-bedding (trough and tabular, at places herringbone type), symmetrical and asymmetrical ripple marks, mud and shrinkage cracks, graded bedding, crude parting lineation, rain prints and load casts in Saundatti Quartzite. Erosional parting surfaces and mud cracks in Manoli Argillite (Jayaprakash *et al.* 1987; George 1999; Jayaprakash 2007)	Transgressive beach and intertidal suite with minor fluvial deposits (terrestrial scree and fan deposits grading down slope into braided river sediments) at the base, grading upwards to cycles of alternating carbonate and muddy tidal flat deposits (Kale & Phansalkar 1991; Kale *et al.* 1996; Bose *et al.* 2008).
			Muddapur	Bamanbudni Dolomite	402		
				Petlur Limestone	121		
				Jalikatti Argillite	43		
			Yendigere	Nagnapur Dolomite	93		
				Chikkashellikere Limestone	883		
				Hebbal Argillite	166		
			Yargatti	Chitrabhanukot Dolomite	218		
				Muttalgeri Argillite	502		
			Malaprabha	Mahakut Chert	133		
				Manoli Argillite	61		
			Ramdurg	Saundatti Quartzite	383		
				Salgundi Conglomerate	31		
---------- Non-conformity ----------							
Archaean granitoids, gneisses and greenstone belt metavolcanic and metasedimentary rocks							

After Jayaprakash *et al.* (1987), Jayaprakash (2007).

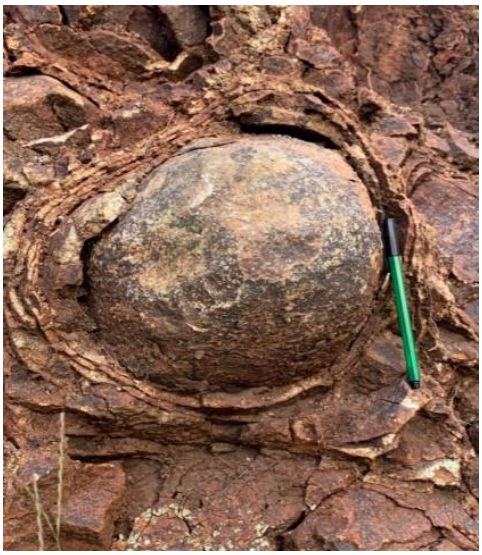
Map of Kaladgi basin



Day 1: 10 December 2022

Location 1: On the way to Bagalkot after crossing the Sambra Airport.
The rock is a conglomerate belonging to kundargi formation of simikeri subgroup.
The outcrop exposed was stretched at a height of around 8 metres from the road. This conglomerate is known as Bevinmatti Conglomerate.. The trend of the outcrop was 110(NW). As we traversed along the outcrop from base to the top the grain size ___
The clast to matrix ratio when determined we found that the matrix made up 60-70% of the rock.
We encountered siliceous matrix at the base of the outcrop and more ferruginous as we moved upward.

Location 2: 15°52'37.5"N 74°41'49"E
The outcrop was at roadcut section. Clasts of the rock are rudaceous in size and extremely weathered. The rock shows peroidal weathering in Deccan trap basalts with vesicles. The rock exposed can be around 66 million yrs old. defining a non conformity.



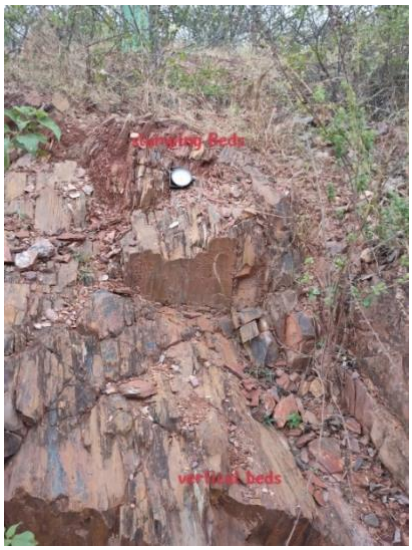
Day 2: 11 December 2022

Location 1: Ramthal

The basement here is made up of Hungund Schist belt which is made up of Metavolcanic sediments which are ultramafic in nature. Sediments are present with some acid volcanics, Greywackes with BIF. At this location there was also the deposition of CaCo3 along trenches.The basement is made up of BHQ Phyllite which were seen to be steeply dipping towards NE direction. They were striking in N163° in the NE direction which were dipping by 76° NE.Folding was present along the traverse. The BHQ present shows class 2 folds. (

Spot 2: caliche deposit

The rock consist of non crystalline deposit of caco3 could be ankerite. Smoky Quartz,amorohouse gympsum/calcite, epidote and chlorite. The rock is weathered and breaks in flakes. The thorny bushies present signifies dry and arid climatic conditions. Caco3 was confirmed with the help of HCl acid.



Spot 3:
The core of the anticline shows exposure of Banded Haematite Quartzite belonging to the older Hundgund-Kushtagi schist belt. They show metallic lusture and the non shiny part shows granulose texture,they exhibit Banded Iron Formations(BIF)..
There are layers of competent and incompetent beds with shallow plunge with the dip amount of 24°dipping inthe direction of N333°. Conglomerates with BIF's clasts were present. The clasts were 9 cm in length and 3.5 cm in width. The basal part of Badami has an unconformity. Microfolds were also present with a class of chevron folds. Sn is parallel to the axial plane and Sn+1 is the Intrafolial fabric which indicates that the 2 events of folding has taken place. The rocks are slumping at certain places.
Age: Archaean

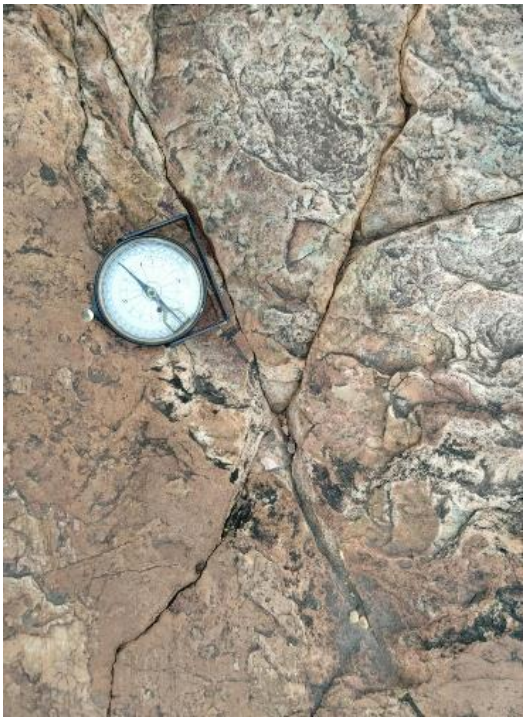
Day 3: 12 December 2022

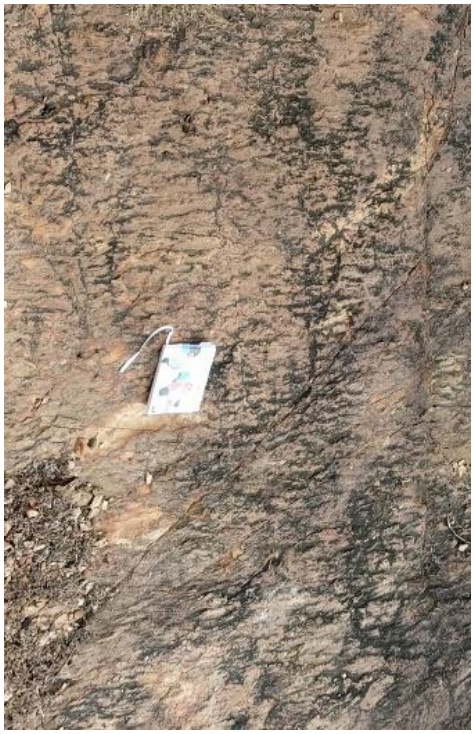
Location 1: 15°44'23"N 75°22'28"E
The rocks under study area are folliated. The exposed section shows variation in the structural data when measured from east to west direction. Rocks to the east has a strike of N152 dipping in SW direction with an amount of 79. Rocks to its left (when viewed from facing the outcrop) has a strike of N150 dipping sw with an amount 76, next reading taken to the first of the second readings has strike varying to N160.
The foliation readings compare with the readings from the day 1 location at Ramthal.

There is warping observed in the outcrop along with quartz veins that are parallel to the foliation observed thus it can be inferred that they can be synchronous with the deformation or it can be formed during the formation of rock itself. (3A)
A small scale shear zone is also observed which runs horizontal to the inclined foliation exposed downward. Three generations of folliation are observed which are Sn, SN+1 and Sn-1. SN fabric is the one showing prominent primary folliation, Sn-1 is the fabric which is obliterated and can't be seen at all places. Sn+1 is the spaced fabric which is not penetrative.

Location 2: Nargund (Windmill)
:16°04'52.6"N 75°52'30.3"E

The outcrop is located at the height of around 600m above MSL.
The rock exposed are of quartzite which are fused together and are very fine. The grains are siliceous. Rock shows joints sets belonging to orthogonal
and conjugate types which makes 90° and 30-60° angles respectively.
The trend of joints are
Ripple marks, Haringbone structures are also observed in the rock exposed suggesting the geological history of the area.





Day 4: 13 December 2022

Aihole

Spot 1 :16°0'49"N 75°53'5"E

The outcrop is at around km distance from the heritage temple. To the north of we can see horizontally exposed badami rocks where as to the south of the same road there are rocks which are dipping moderately.

The outcrop to the south of the road is an expansive outcrop made up of quartzite which is reddish in color, it has well defined bedding planes. The bedding plane are dipping and not horizontal. The beds are dipping towards the SSW with moderate dip of around 45.Within the bedding junction we can see cross bedding structure that are well preserved it appears as alternate bands of red and white color. There are intraformational conglomerate beds parallel to the bedding junction which is 10cm wide. The conglomerate have clasts that are of feldspar, quartz and Jasper which are varying in size from 1-10 cm.

The rocks to the north of the road are almost horizontal, dipping with an amount of 7-8° They belong to the badami group of rocks. The rocks are mostly sandstone. It is more of siliceous rock but we can see some parts as ferruginous. Weathering of the rock has taken place,there are alternate bands of siliceous and ferruginous material seen. The rock is also folliated at some places which makes the rock easier to break.

Spot2:16°5'31"N. 75°46'59"E

The outcrop is next to the temple at sirur. Its an expansive outcrop made up of quartzite. We can observe a fault plane that is indicated by striations. No offset marker or shear sense indicator is observed. There are surface lineatiions present on the fault plane and in some places we can see slickenslides where precipitation of secondary mineral has taken place.
The fault plane is a shallow dipping plane.Using Anderson's theory of faulting we can conclude that the observed fault is reverse fault (30° shallow dipping)
The presence of joint sets on the bedding place are indicative of Brittle deformation. The observed joint sets are conjugate joints.

Day5: 14 December 2022

Location 1 : Amingad :
:16°3'22"N. 75°57'7"E
The location had boulders of pink granite which were identified by the presence of orthoclase, quartz and accesorry of pyroxene. The same boulder when seen on the either side on the Steps on the way up to the mountain is found weathered and has more biotite minerals present as accesories.
The granite found is the closepet granite which makes up the basement of Kaladgi. Xenoliths are found in the rock which are of accidental type. Xenolith have more of biotite and hornblende with less amount of quartz.
As we climb up we can locate the contact between the two sequences which is marked by a intercalated conglomerate.


contact

Location 2:
This was a type area near the school, the area is a part of the hungund schist belt. We can observe BHQ and phyllites. The phyllitic beds were striking 125 dipping NNE with an amount of 56.
Intrafollial folds are preserved the younger rocks.

Day 6: 15 December 2022

Spot 1 :16°11'17"N. 75°37'43"E
The location shows exposure of closepet granite which is overlain by the badami rocks. The mineralogy of the rock is feldspar, quartz and biotite as accesorry. The granite is recrystallised since we cannot make out the clasts.
The outcrop is traversed by around 5-6 veins which are of mostly pegmatite. Their width varies to 10 cm. They are coarse grained.
We can make out a fault passing through the vein which shows dextral shear sense. The pegmatite also shows jointing at certain places.

Various kinds of xenoliths are observed on the outcrop having plagioclase z hornblende and quartz in their mineralogy. They are of mostly restite type (light grey)and also accidental kind(more grey).
By observing the mentioned things we can colvide the geological history of the area as follows, the grey granite must have formed first which then underwent recrystallisation due to change to P,T conditions, the pegmatitic veins intruded after a certain time followed by jointing.

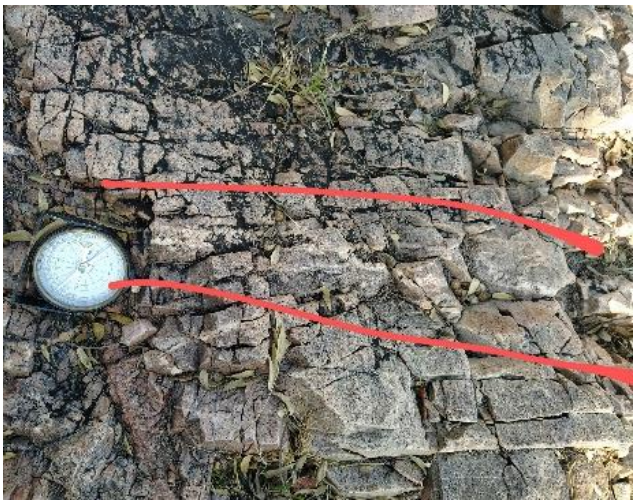
Spot 2: 16°20'14.1"N. 75°36'43.8"E
At Bilgi,the area seems to be a quarry at some time in the past. The outcrop of quartzitic sandstone exposed is nearly horizontal similar to badami rocks. There is jointing seen in the area. The outcrop is of quartzite which shows recrystallisation of minerals. There are signs of leaching seen because of chemical weathering that has taken place.

Spot 3: 16°20'29"N. 75°36'59" E
The outcrop is reddish in color almost shallow dipping and shows intraformational conglomerate. The conglomerate is oligomictic. The rocks have undergone cyclic deposition. There are syndepositional primary structures identified. Graded bedding is preserved in the rock.

Day 7: 16 December 2022

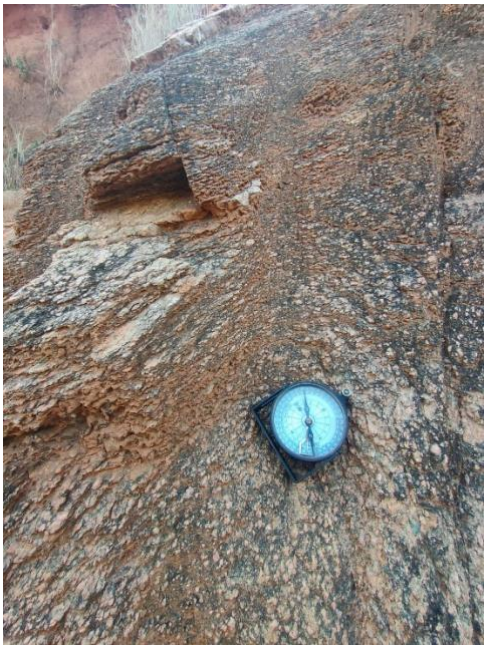
Location 1 : 16°5'47"N 75°48'7" E

The outcrop is of quartzite characterised by feldspar and quartz. The rocks are fractured and jointed, there are varying dips for the joint set. Some joints continue throughout the set where as others discontinue. Veins are also observed on the outcrop some are calcite veins while others are quartz. They are 2.5-3 cm wide. The cross cutting veins observed are orthogonal veins that forms parallel to the vein sets(quartz vein).
Other veins have elongated minerals and is coarse grained. Due to extension Gash veins which show comb structure. The trend of this vein is N45/N235.
It's width 5 cm. Veins are important because they precipitate economic deposits.




Offset

Spot 2:
The rocks exposed is of granite. It has undergone weathering. The rock also shows folliation. There are veins present which show Cross cutting relationship. It is difficult to interpret age of the veins. As we take a traverse along the path we find a(second)pink granite including grey color. The grey rock shows schistosity while the intruded granite doesn't. The granite encountered at a distance from the second shows more k feldspar content and less biotite.



Spot 3:
The outcrop is not continuous but are in the form of rocks which are spread over a large extent. There are intraformational conglomerate and jointing In the rock. Outcrop is of siliceous quartzite(saundatti quartzite of badami formation) with clast of BHQ and Jasper.
The rock shows cross bedding, Haringbone structure and joints of orthogonal and conjugate type. Leaching is seen which give red or brown color to the rocks.

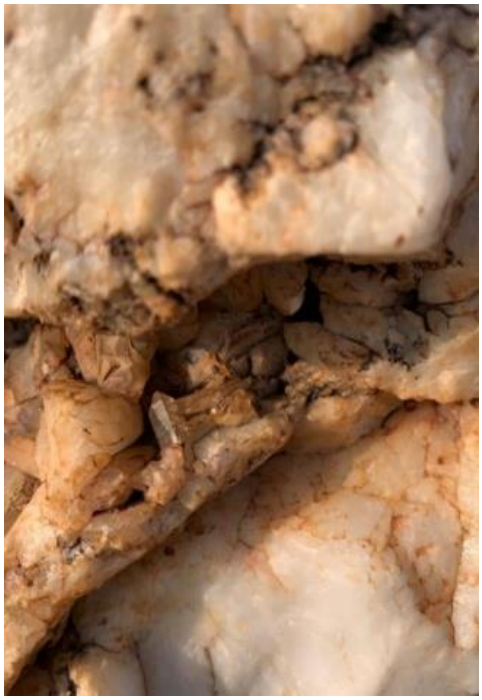
Spot 4: Niralkeri

The outcrop is of phyllite which is folliated and display well defined folds. Readings on these folds were taken and plotted on the stereonet. The fold is an upright fold with its axial plane trending in the E-W direction.

Day 8: 17 December 2022

Location 1: Kagalkom
Spot 1: 16°7'29" N 75°35'46"E

The rocks exposed are quartz, white in color (Milky quartz)suggesting the presence of impurities. Rocks show conchoidal fracture.
Radial jointing due to blasting is observed at many locations(8A). The body of quartz has a width
of almost 40-50m. Perfect Hexagonal crystals of quartz are found. Extensional and contractional
cracks are also observed which took place because of stress acting on them due to blasting.



Spot 2: few meters from spot 1e
The rocks observed here are dolomites. The rocks are brown in color with well developed planes of foliation. The rocks are dipping with an amount of 44° due SW.

Spot 3: Konkantappa

:16°03’19” 75°38’45”E

The rock is of limestone which are almost horizontal striking 120°N dipping with an amount varying 3°-7°.The rocks are exposed near water body . They’re grey in color and shows folliaiton.

Spot 4:

:16°01’14” N. 75°38’48”E.

The outcrop is of Halkurki Shale/argillite made up of clay minerals size 1/256mm. Clay minerals can be identified using XRD The presence of Shale suggest deepwater environment. The outcrop is striking 125N with an amount of 3°.

The age of this Sedimentary rock is Neoproterozoic. The country rock is dolomite.

Day 9: 18 December 2022

: 16°10'4"N 75°21'31"E

The outcrop is Sedimentary rock of Marl along with slate. The outcrop is covered with stromatolites which are deformed. The rock and stromatolite must have formed with episodic layering. Nodular structure are also observed. The stromatolite ls are used to date the rocks belonging to the Kaladgi sequence.

Location 2:

The location was at a quarry of limestone. We saw perfect crystal of calcite which displayed perfect cleavage sets and which were exposed on the surface because of blasting and quarrying taking place.

Day 10: 19 December 2022

Location 1:

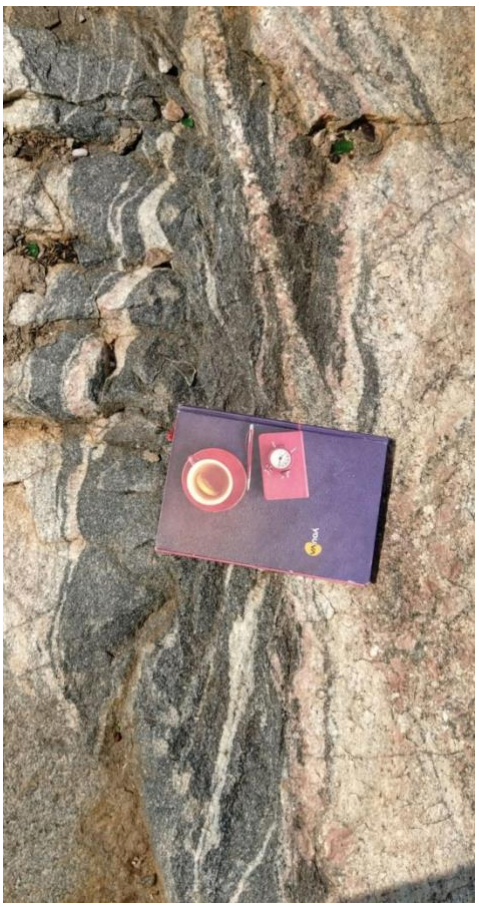
The Lal Bahadur Shastri Dam is also known as Almatti Dam is a hydroelectric project on the Krishna River[1] in North Karnataka, India which was completed in July 2005. The target annual electric output of the dam is 560 MU (or GWh).

The visit to the Almatti dam was very informative. The dam is built to direct the water from the 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. During the initial stages of the project, estimated costs were projected as Rs.14.70 billion, but following the transfer of project's management to the Karnataka Power Corporation Limited (KPCL), the estimated cost was reduced by over fifty percent to Rs. 6.74 billion. KPCL eventually completed the project at an even lower cost of Rs. 5.20 billion.[citation needed] The entire dam was finished in less than forty months, with construction ending in July 2005. The dam is located on the edge of Bijapur and Bagalkot districts.

Location 2: 16°20'28"N 75°55'34"E

The outcrop exposed is of migmatite which is approximately of 3.3 -3.6 age of rock. The outcrop consists of more than one type of rock namely the white granite, handed gneiss, grey granite, pegmatitie (vein).

Order of formation-The white granite cuts across the bands of gneiss and in some places it follows it, hence we can say that it is either syntectonic or pretectonic to the bands. The grey granite cuts across all the folds, white granite and gneissic banding hence it must have formed after the formation of the two. The pegmatite looks to be the youngest in the outcrop because it cross cutting the pink granite which overlies the grey granite.



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