GLC122

REPORT
ON
GEOLOGICAL FIELD TRAINING CARRIED OUT IN RAJASTHAN AND GUJARAT

SUBMITTED BT
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CONTENT

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I Would like to thank the administrative staff, SEAOS, Goa University for being cooperative and providing necessary facilities needed so as to complete the field studies. I would also like to thank my classmates for being caring and supportive throughout the field work

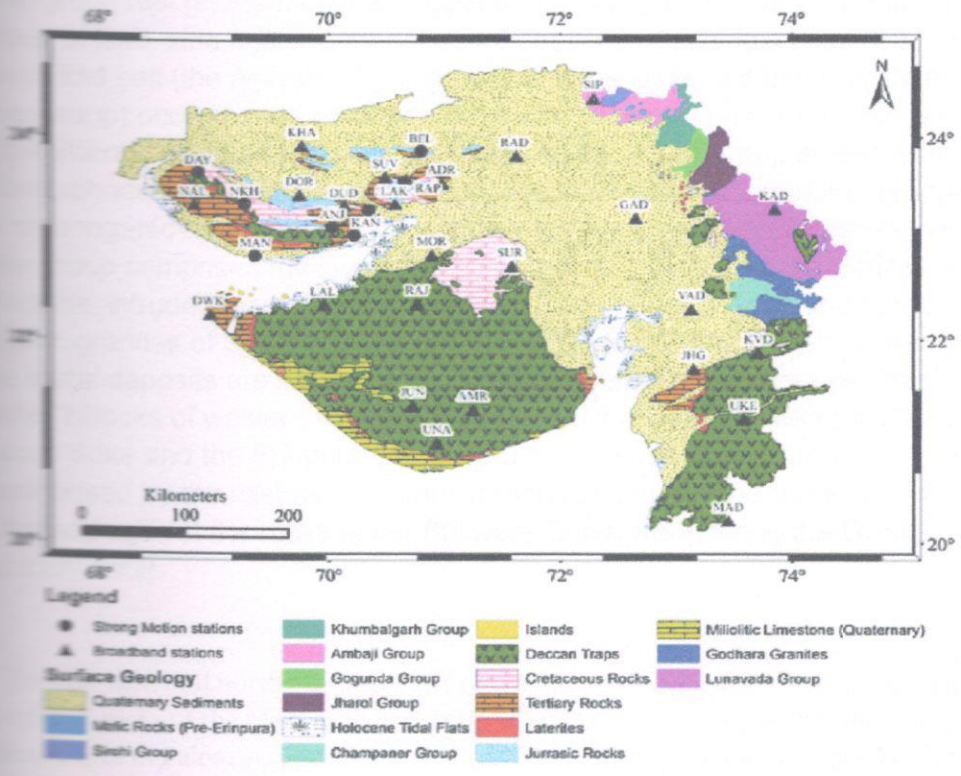
GEOLOGY OF GUJRAT

Geomorphologically, the State can be divided into three distinct divisions, viz.:
a) Gujarat-Mainland.
b) Saurashtra-Kathiawar Peninsula, and
c) Kutch Peninsula.

a) Gujarat-Mainland.
The wellknown agriculturally rich alluvial basin of Gujarat rises from the estuarine tracts between Narmada and Tapi rivers and extends 250 miles (402 km) northwards merging into the desert plains of Rajasthan and the Rann of Kutch. It is roughly 75 miles (121 km) wide. The eastern border of the basin is bounded by Aravali, Vindhya, Satpura, and Sahyadri hill ranges. The topography of the land is obviously controlled by the geological formations. The eastern part of the south Gujarat bordering the alluvial tract has a typical Deccan trap scenery up to Narmada valley. The hills are formed by circumdenudation leaving wide plateau at top, and a step like feature because of horizontal lava-flows and their differential weathering.
b) Saurashtra-Kathiawar Peninsula: The Saurashtra is bounded by Gujarat plains in the East and NE, by gulf of Kutch and Little Rann on the north, and on the SE by the Gulf of Cambay. The Arabian Sea borders the entire southern seaboard. The Central part of the region forms an elevated table land, from where most of the rivers rise and flow radially. The terrain generally slopes gently towards the peninsular margin to merge into the coastal plains and the great alluvial tract stretches to NE and east. The sedimentary rocks along the coast form almost a low flat country.
c) Kutch Peninsula The mainland of Kutch is isolated by the Great Rann of the north and east, Little Rann on the SE, Gulf of Kutch on the south and rest by the Arabian sea. The central portion of Kutch 7 forms a table-land sloping on all sides, the shape of the region is like a tortoise and hence the name. In general, there are three hill ranges, trending almost east-west. North-flowing rivers disappear in the Rann; others join the sea. The Banni is formed by sediments deposited by northern border of the main land and is composed of fairly good soil. The Rann is a dry bed of the remnant of an arm of the sea, which formally connected the Narmada rift with Sind and separated Kutch from the mainland

Group	System	Rock Type	Localities	Age in millions of years
Quaternary	Recent and subrecent	Alluvium, Blown sand, Silts of Rann and Banni, Tidal flats and raised beaches.	Alluvial plains of Gujarat, Rann, Banni & Coastal deposits.	0.01
	Pleistocene	Miliolites	(i) Saurashtra coast from Gopnath northwards extending beyond Porbandar. (ii) Kutch area.	1
Tertiary or Kainozoic	Pliocene	Dwarka beds, Manchhar beds, Gypsiferous clays and sandy foraminiferal limestones.	Dwarka, Okha, Piram Island, Kutch.	12
	Miocene	Gaj beds-Highly fossiliferous clays and limestones. Agate bearing conglomerates. Kand formations.	Saurashtra coast, Kutch.	25
	Oligocene	Tarkeshwar clays.	Tarkeshwar (District:Surat) and Kutch.	40
	Eocene	Nummulitic limestones and clays.	Tarkeshwar area and Kutch.	60
	Paleocene	Madh series-Supratrapean.	Kutch.	
Secondary or Mesozoic.	Cretaceous Eocene	Deccan traps with inter trappeans.	Parts of Sabarkantha, Panchmahals, Baroda, Broach, Surat and major part of Bulsar and Dangs Districts. Major part of Saurashtra and small part of Kutch.	
	Cretaceous	Himatnagar sand-stones, Lameta (lime-stones). Bagh beds	Himatnagar, Kapadvanj, Balasinor, Parabia, Dohad, Gabat, Narmada valley,	110

		(sand-stones, Lime-stones and shales). Songir sandstones, Nimar sandstones,Wadhavan sandstone (Infratrappeans), Bhuj and Umia series sandstones	Gora, Surpan Vanji, etc. Songir.Near pavagadh. Wadhavan,Dhrangadhra,Bhuj etc.	
	Jurassic	Katrol series, Chari series, Patcham series (sand-stones, shales and lime-stones).	Kutch.	150
	Purana (Algonkian & Part of Cambrian)	Erinpura granite (Post-Delhi).	Palanpur, Danta, Idar, Modasa, Taranga, Dharoi, Virpur, Wanakbori, Godhra, etc.	1500
		Delhi System-Alwar quartzites, schists, and calc-gneisses, calc-schists of Ajabgarh series.	Parts of Sabarkantha and Banaskantha, and Mehsana Districts.	
Archaean or Azoic		Aravali System-Mica-schists, Phyllites, quartzites, etc.	Sabarkantha, Panchmahals, Baroda, Banaskantha.	4000
		Banded gneissic complex.	Baroda District.	



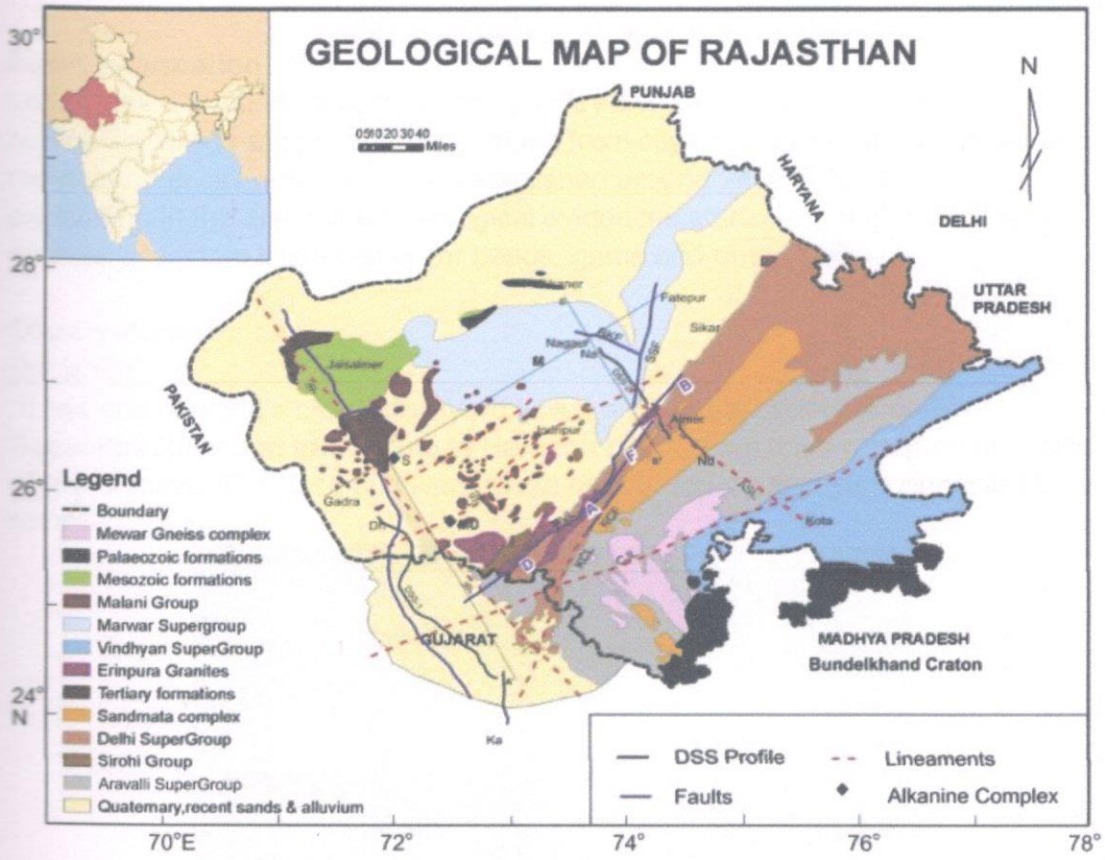
Geology Of Rajasthan

The rajasthan is north western part of Indian shield . The state exposes varity of lithological tectonic events ranging from Archean to Recent times.
Rajasthan is endowed with a continuous geological sequence of rocks from the oldest Archaean Metamorphic, represented by Bhilwara Supergroup (>2500 m. y.) to sub-recent alluvium & wind blown sand. The geological sequence of the state is highly varied and complex, revealing the co-existence of the most ancient rocks of the Pre-Cambrian age and the most recent alluvium as well as windblown sand.

The basement rocks – the Sandmata Complex, Mangalwar Complex and Hindoli Group of Bhilwara Super group – occupy central and south-eastern plains. They are Archaean in age and comprise in general, granulite-gneiss; amphibolites, metapelite, paragneiss, calc-silicate rocks and greywacke (the older granite greenstone belt) and metavolcanic, met greywacke (the younger granite greenstone belt) respectively. The Lower Proterozoic supracrustal rocks of the Jahajpur, Rajpura-Dariba, Pur Banera and Sawar Groups of Bhilwara Super-group rest on the basement rocks of the Mangalwar Complex and host a number of lead, zinc and copper deposits. The Proterozoic fold belts, viz., the Aravalli fold belt (the Aravalli Super-group) and the Delhi fold belt (the Delhi Super-group) occupies the southern and south eastern, and south-western and north-eastern Rajasthan respectively. The Aravalli Super-group is represented by metamorphosed and complexly folded clastic sediments with minor chemogenic and organogenic assemblages with interlay red basic volcanic, whereas the Delhi Super group comprises mainly carbonates, metavolcanics, metasammites and metapelite, intruded by magmatic rock of Phulad Ophiolite Suite and syn-orogenic granites of Sendra- Ambaji, Baraith, Dadikar, Harsora, etc. A number of base metal deposits are located in these belts as also other minerals. The isolated hillocks of western Rajasthan constitute the Upper Proterozoic Malani Igneous Suite and the Erinpura Granite pluton. Eastern Rajasthan is characterised by the vast sedimentary stretch constituting the Vindhyan, which is juxtaposed against the rocks of the Bhilwara Supergroup along the Great Boundary Fault.

The northern and north-western parts of the State exhibit Upper Proterozoic-Early Cambrian rocks of the Marwar Super group which are overlain by sedimentary rocks of different ages of Paleozoic and Mesozoic Era. Many industrial mineral deposits are found in these rocks. The Deccan Traps are restricted to the south eastern part of the State in

Chittorgarh- Banswara area. The Cenozoic rocks are manifested in Barmer and Jaisalmer basins in the west and GanganagarPalana shelf in the north. The Quaternary sediments of Aeolian and fluvial origin constitute the Thar Desert of Rajasthan.



FIELD OBSERVATION

DAY 1
22/01/23

LOCATION 1
LOTHAL – LATTITUDE - 22°52'27"
LONGITUDE – 72°24'93"

Basic information

Lothal was a remnant of ancient Indus valley civilization which located on saragwala village at approximately 78 km from city of Ahmadabad In Gujarat by roadway. The city was said to be established around 2400 BCE. The first excavation in the area for archeological evidences started in 1955. Lothal was once an important trade center for beads, gems and ornaments.

Observations

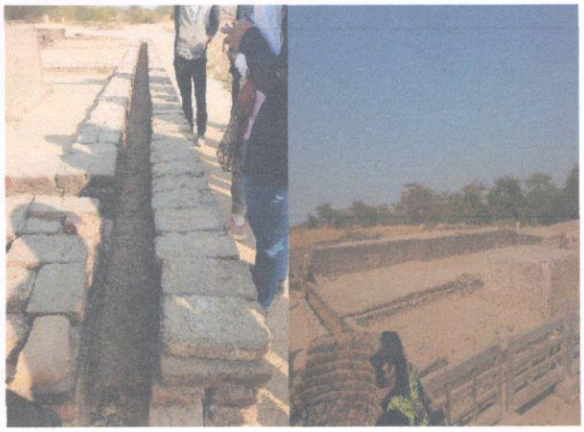
Dockyard:

It has one of world's oldest dockyard which explain the course of earlier Sabarmati River and trade route to Harappa Civilization. It is located on east side of city of lothal. The dock and warehouse near to city central was connected by a ramp

Warehouse and Upper Town:

Warehouse built on a mud brick podium of 3.5m height which is used for storage facilities for dockyard. The structure was on a higher ground than dockyard connected by ramp towards western part of the dock close to upper town. Upper town consist of mud brick platform which as well established drainage system, well's and common bathing area found like in Harappa. Citedal is found here

Ware house



Upper town

Factory:

This was an area which is used for making beads and gemstone cutting. Amethyst and onyx is said to be major gemstone used here. Agate is also used for making beads. Steatite is also used for seal making.It have dump and kiln connected by stock holes

LOWN AND MARKET

Arou eters away from beads factory market place is seen and p er town is also present. The market is built in straight row o ide of the streets which has residencies, shops and workp

DAY 2
23/1/23

LOCATION 1: AMRITAVISHANI VAV

Located 500 m away from Ahmadabad railway station Panchkuva, literally *five wells*, area derived its name the five wells in the area. Amritavanshini vav was completed in 1723 as per Devanagari and Persian inscription in the stepwell. It was built by Raghunathdas, diwan to Haidar Quli Khan, who was the governor of Gujarat

LOCATION 2:
PHYSICAL RESEARCH LABORATORY
LATTITUDE: 23°02'08"N LONGITUDE: 72°32'33"E

Basic Information:

The physical research laboratory was founded on 11 November 1947 by Dr. Vikram Sarabhai. This is an institution developed for research in astronomy, astrophysics, atmospheric sciences, planetary and Geo sciences. It is located 6.3 km from Ahmadabad railway station. The current director of the PRL is Dr. Anil Bhardwaj

Observation and Studies:

The physical research laboratory is one of the best institution in India which use the latest technologies and advance methods in Geo science exploration and studies. Their achievements in marine and planetary science is unconditional. Their developments in solid earth research, paleoclimate researches and ocean

Bio chemistry is exceptional. Some of the technologies explained by the researchers were:

MC-ICPMS:

Multicollector Inductively Coupled Plasma-Mass Spectrometer is an equipment used to determine low concentration and ultra-low concentration isotopic analysis of elements. Argon plasma is used to convert sample into ion as the ICPMS It is used in variety of industries including environmental monitoring, geo chemical analysis, pharmaceutical and clinical researches and more

Processing method:

- Peristaltic pump- the sample solution is introduced into the PERISTALIC PUMP which pump the liquid into nebulizer
- Nebulizer and Spray chamber – the liquid is converted into aerosol using argon gas in nebulizer and larger droplets removed in spray chamber later and moved into plasma torch
- Plasma Torch - In Plasma at extreme temperature atomization and ionization of the aerosol occur
- Further the ions moved into mass spectrometer
- Sampler cone : free ions are transmitted into a temperature and pressure compared to a compartment at room temperature on high vacuum
- Metal rods separate ions
- Detector which enhance the signals from ions so that a measurable pulse is detected
- Electronically represent the data acquired from the mass spectrometer

TIMS:

Thermal ionization mass spectrometer that is magnetic sector capable of making very precise measurement of isotropic ratios that are used in geochemistry, geochronology, and Cosmo chemistry. Radioactive decay elements in a system is used for analysis. It gives near 100% transmission of ions from source to collector. Even though not all elements are easily ionized, which restricts applications to elements with low ionization potentials

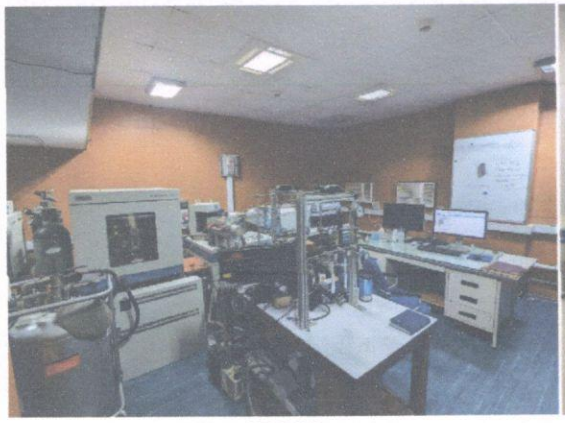
Processing method:

1) ion source, the region in which ions are produced, accelerated, and focused;
2) analyzer, the region in which the beam is separated based on mass/charge ratios
3) collector, a region in which the ion beams are measured simultaneously .

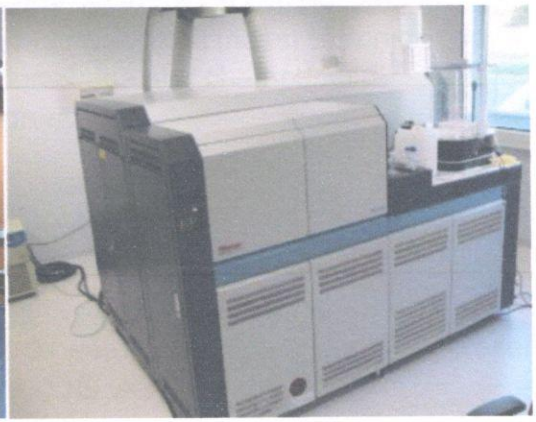
The electronics of these instruments must operate to very close tolerances in order to produce isotope ratios that are precise

IRMS:

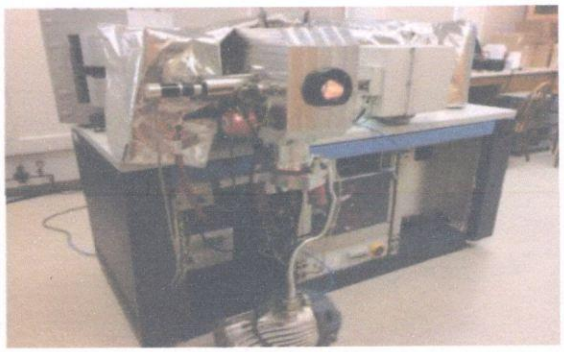
Isotope Ratio Mass Spectrometry (IRMS) is a specialized technique used to provide information about the geographic, chemical, and biological origins of substances. The ability to determine the source of an organic substance stems from the relative isotopic abundances of the elements which comprise the material. Samples are converted in gases such as H 2, CO 2, N 2, and CO depending on their chemical composition through interaction with the electron beam in the ion source



IRMS



MS-ICPMS



TIMS

DAY 3
24/1/23

LOCATION 1: Balasinoor
LATTITUDE :22 97'07" N
LONGITUDE:73 34'64" E

BASIC INFORMATION

The southern Aravalli fold belt represent a geologically complex terrain consisting of migmatites ,gneiss, low grade meta sediments and intrusive granite. The area consist of **GODHRA GRANITE** which is one of the granitic intrusion took place in Neoproterozoic era (950ma-925ma). The granitic intrusion can be seen in southern margin of Aravalli mountain belt near to central Indian tectonic zone (CITZ). The Godhra granite intruded into lunawada and champanar metasedimentary rocks of Aravalli super group.

Observations and studies :

- The granite is mainly composed of plagioclase and quartz.phenocryst of muscovite and biotite are also seen with size varying from 1 to 5 cm. due to the co-genetic mixing of magma MME's were also seen.
- Xenolith of (biotite +/- hornblende was seen) mafic nature was present
- Joints with reading of N290 ,N300,N9 were also present
- Shear zone passing through the foliation was also seen

Strike direction 150 N
Dip amount 75 NE

Xenolith

Godhra granite

Location 2: Rhyoli Fossil Park and Museum
Latitude :23 05'62"N
Longitude:73 34'35"E

BASIC INFORMATION:

The Rhyoli dinosaur fossil park is located about 78 km from Ahmadabad and covers an area of 72 acres in rhayoli village of balasinor. The museum covers an area of more than 25,000 square feet. It was one of the worlds largest dinosaur egg hatching spot. There are about 13 species of dinosaur's fossils and egg hatching spot can be observed here and estimated to be thrived 65million years ago.It has over 10000 dinosaur fossils. The place become a dinosaur fossil excavation spot since 1980 . The most common fossil observed in here is of RAJASAURES(carnivores tyrannosaurs) .

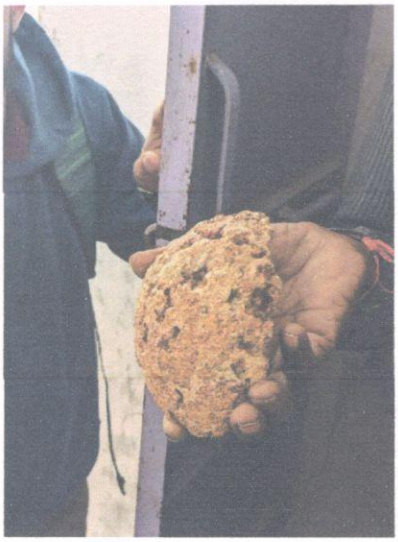
The remains of *Rajasaurus* were found in this fossil-rich limestone bed to which GSI geologist Suresh Srivastava was assigned to excavate on two separate trips from 1982–1983 and 1983–1984. In 2001, teams from the American Institute of Indian Studies and the National Geographic Society, with the support of the Panjab University, joined the study in order to reconstruct the excavated remains

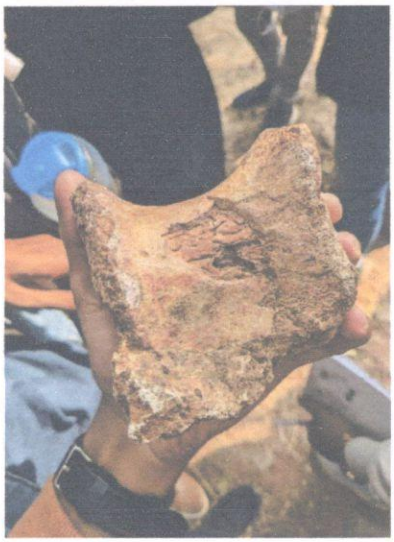
There are also plains of the river Narmada that extended from its basin proved an ideal breeding ground for the Indian Titanosaurid Sauropods and Abelisaurid Theropods

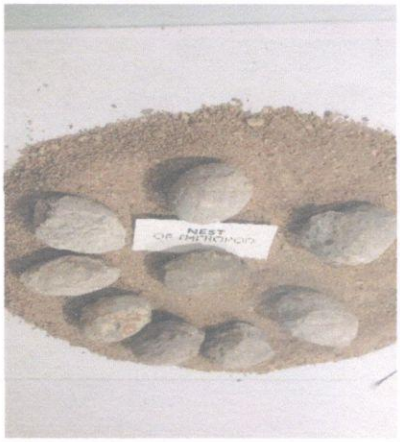
The fossil museum is to be established around same time the fossil is discovered. It consist of many eggs and bones in the display . There many classes which explain about geological evolution and histories

Observation and studies:

The area consist of fossils from different species present in the area. The main fossil observed are body parts such as femur,backbone parts,eggs and nesting spot. Most of the fossil are from rajasaures







EGGS

BONES

DAY 4
25/1/23
Location: ONGC Ahmedabad Asset GGS-Motera
Latitude:23 11'31"N
Longitude:72 59'79"E

Basic information

The ONGC CGS Motera is gas gathering station under ONGC(Oil and Natural Gas corporation).This facilities of ONGC separate the natural gas from crude oil and water which come from oil fields. They station is highly protected by its safety measures and maintenance. They use advance technologies here for separation, transmit and maintenance of crude oil.There were 59 wells in near by area connected by pipelines

Observation and Studies:

Some of the machineries used for this process are

- water injection plant : It is used in process of sepration of mixture by injecting liquid into carrier gas

- booster gas compress plant: it is used to increase the air pressure coming from an existing compression system. It can the pressure by 80-150 psig to as much as 2000 psig
- Main process plant: connect the gas through pipeline to separator and move it to the compressor. Around 45000ltr of oil is passing through the separator. It separates the gas and crude on basis of gravitation method. -corrosion inhibitor: used to stop corrosion in the separation tank. Imidazoline and quaternary amine compounds are best inhibitor
- Bath heater : it is used to mitigate the crude . by increasing the temperature mobility of crude also increase
- Monitor office : which is used to live time maintenance of pressure, temperature , productivity data, other equipment functioning and fire and safety check

DAY 5:
27/1/23

Location: Jhamarkotra Phosphate Mine, Rajasthan
Latitude:23 58'25" N
Longitude:73 51'71"E

Basic information:
Jhamarkotra phosphate mine is a open cast mine of phosphate deposit in Udaipur . It is the largest mine beside coal and steel in India. These mines are started excavation around 1968 under Bikaner Gypsum Limited . It is under control of Rajasthan State Mines and Minerals limited (RSMML) which is one of the leading and progressive undertaking of the Government of Rajasthan.There are 4 units of mine owned by RSMML. This is the only indigenous phosphate deposit in India. The ore body trending in an E- W direction with strike length of 16 km and dip of 55 . The ore to over burden ratio of the mine is 1:16.

- **Formation**: The deposition in the region is formed due to presence of blue green algae. phosphorites of the Udaipur area were deposited in shallow waters where luxuriant growth of Stromatolite algae helped in trapping and precipitating phosphorus from the basin waters 2000 million years ago. It lies over complex gneissic rock

- **Production:** The open pit mining method is being followed at Jhamarkotra Mine for exploitation of the mineral. The working levels are kept dry by continuous pumping of ground water through tube-wells constructed on periphery of the pit limit. About 98% of rock phosphate production of India is from jhamarkotra with an annual rock excavation of about 20 million tones.

- **Grade of ore:** At Jhamarkotra deposit, generally a Bi-modal grade distribution pattern viz.+30 % (37- 38%) P2O5 designated as High-Grade Ore (HGO) and 16 to 22 % P2O5 designated as Low-Grade Ore (LGO) could be deciphered. However, at places near the contacts of the above grade of phosphate bed, some transitional zones exist which are designated as Mixed / Medium Grade Ore (MGO). The marketable grade

of ore is 31.5% & 30% P2O5, but a large resource of low-grade ore also occurs in the area. Looking at great demand of phosphate fertilizer and reduce its import, the low-grade ore is being upgraded through froth flotation in beneficiation plant

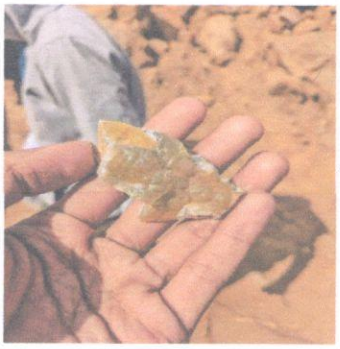
Mining Method: The working levels are kept dry by continuous pumping of ground water through tube-wells constructed on periphery of the pit limit. The bench height in this extent of mine is given at 7m followed by a face of 10 m

Benification Method: The plant produces Beneficiated Rock Phosphate Concentrate (Avg. 31.5% and 34% P2O5 on demand for SSP & DAP Manufacturing Units) Original Capacity is1500 TPD and Expanded Capacity upto 3000 TPD .

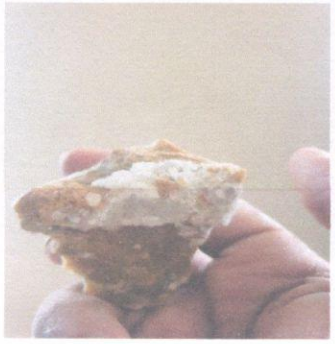
Observations :

- Different grade of ore of phosphate is observed and studied
- Phosphate with apatite crystals are formed in some secondry grade excavations
- Stromatolite formations are found

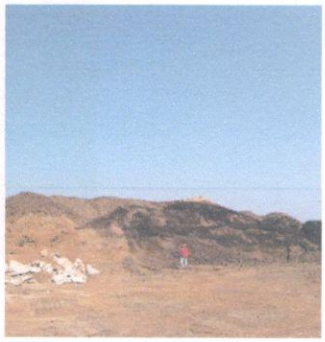
Jhamarkotra Open cast mine



Phosphate



Apatite crystal



grade of phosphate ore

stromatolite

Spot 2 – Jhameshwar Mahadev Temple, Jhamarkotra

Observations :

Scaletites are observed inside the cave in this area . It is formed due to Leakage from the canal may over plate the sheath creating downward grow from dipping walls and ceilings

DAY 6:
28/01/23

LOCATION 1: Chittor
Latitude : 24 47 40 N
Longitude : 73 51 71 E

Basic information :

The area is part of **suket shale – phyllite** the uppermost member of Semri group of south eastern Rajasthan. The Study area is located on the banks of Ghambiri river in Chittorgarh district . An average age of the shale is said to be 1400 million years ago.

Observations and studies :

The area is highly folded and tightly packed rocks are present. These phyllites haves been folded into large- scale low plunging folds trending parallel to the GBF. The shale soft ,fragile and fissile. They vary in colour from grey to reddish brown to yellowish in colour. Foliations are present in the rock. The area consist of 2 sets of joints. Slicken sides are observed, which indicates the presence of fault and quartz veins are also present which may be either syngenetic or post genetic. Tight folds are also present.

It showing varying structural data along the bedding plane

Strike	Dip amount	Dip Direction
N48E	48	N135
N40E	60	150

Structural Data of fold

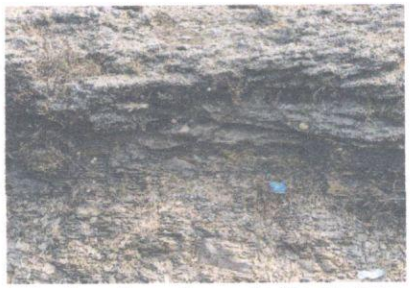
	Strike Direction	Dip Amount with Direction
Hinge Plane	192	20N
Limb 1	195	36E
Limb 2	125	54W

Structural Data of joints:

	Strike Direction
Joint Set 1	145° N
Joint Set 2	100° N

The are is overlined by weathered conglomerate in eastern side of the river

folded Suket shale



Weathered conglomerate lies of shale

LOCATION 2 : Nimbara Limestone

Nimbara Limestone is a type of sedimentary rock that is primarily composed of calcium carbonate. It is commonly found in the Nimbara region of Rajasthan, India, and is a popular building material due to its durability, strength, and natural beauty

This limestone is typically light gray in color and contains fossilized marine organisms, including shells and corals, which are visible on its surface. It is formed through the accumulation of calcium carbonate-rich sediment that has been compressed over millions of years, often in marine environments. We had the opportunity to take the readings of the Nimbara Limestone near Chittorgarh Fort and here are some readings

	Strike Direction	Dip Amount with Direction
Spot 1	N	40° W
Spot 2	N	64° W

DAY 7
29/01/23

LOCATION : Nathwara Limestone/Marble
LATTITUDE : 25 05' 76" N,
LONGITUDE: 73 85 08" E

Basic information:
Nathwara lime stone is located in the Udaipur district of Rajasthan . lime stone is one of the most excavation in this region .

Observations and studies:
Inclined bed of marble and limestone was present. The presence of recrystallized silica grains in the marble suggest that place undergone contact metamorphisem. The marble bed which was inclined has some miner folding

Some schist in this area show asicular structure in some area . Presence of tremolite and chlorite is also seen .

Marble	Strike Direction	Dip Amount with Direction
Spot 1	130 N	32 SW
Spot 2	125 N	36 E

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