SCHOOL OF EARTH, OCEAN AND ATMOSPHERIC SCIENCES

GOA UNIVERSITY

Exam: Roll No: 27

LABORATORY CERTIFICATE

This is to certify that Mr. /~~Ms.~~ Vishal T. Velip

has satisfactorily completed the course of practical for M.Sc in Applied Geology.

Experiments conducted are pertaining to paper GLC 122 Geological Field training

Practicals prescribed by the University for MSC Part II class, during the academic year 2022-2023

DEAN
SEOAS

Faculty member in-charge

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

Field report
of
Gujarat and Rajasthan
field visit

Name: Vishal T. Velip

Roll no.: 27

Acknowledgement

The field work is an important part of geology as we get field experience from that and this field work was made possible for us for which I am thankful and would like to acknowledge the efforts that were put in and and thank all the faculty members of the earth science department of Goa university.

I am grateful to Dr. Poornima Dhawaskar, Dr.Nicole Sequeira for the knowledge and guidance that they provided us. This field trip would not have been a success without the teachers who accompanied us namely Dr. Anthony Viegas (Vice dean), Dr. Niyati kalangutkar(programme director), Prof. Mahesh Mayekar and Prof. Pooja Ghadi. Their vast knowledge and interactive nature, humble attitude, care and guidance throughout the field trip. I would also like to appreciate the help received from the office and the laboratary assistant Ms. Heena for providing material required to carry for the field trip.

Introduction

Geology of Gujarat

Gujarat is a state located in western India and has a diverse geology that reflects its complex geological history. Here are some of the main geological features of Gujarat:Deccan Traps: The

Deccan Traps are a large volcanic province that covers much of western and central India, including parts of Gujarat. The Deccan Traps were formed by a series of massive volcanic eruptions that occurred about 65 million years ago during the Cretaceous-Paleogene extinction event.

Sedimentary Basins: Gujarat has several sedimentary basins, including the Cambay Basin, the Kutch Basin, and the Saurashtra Basin. These basins are composed of various sedimentary rocks, including sandstones, shales, and limestones, and contain significant hydrocarbon reserves.

Aravalli Range: The Aravalli Range is a range of mountains that runs through the northeastern part of Gujarat. The Aravalli Range is one of the oldest mountain ranges in India and is composed of metamorphic rocks such as granites, gneisses, and schists.

Coastal Plains: Gujarat has a long coastline along the Arabian Sea and has several coastal plains, including the Kathiawar Peninsula and the Gulf of Kutch. The coastal plains are composed of sedimentary rocks such as sandstones and shales and are also rich in marine fossils.

0Alluvial Plains: Gujarat has several rivers that flow through the state and have deposited alluvial sediments over time. The alluvial plains are composed of gravel, sand, silt, and clay and are found in the river valleys and floodplains.

Overall, the geology of Gujarat is diverse and provides a fascinating glimpse into the geological history of the region.

lithology of Gujarat

Gujarat is a state in western India that has a diverse range of lithologies due to its geological history. Here are some of the major lithologies found in Gujarat:

Deccan Traps: This is a large igneous province that covers a significant part of western and central India, including parts of Gujarat. The Deccan Traps are composed of basaltic lava flows, tuff, and other volcanic rocks that were formed during the Cretaceous-Paleogene extinction event.

Sedimentary Rocks: Gujarat has several sedimentary rock formations that were deposited during the Mesozoic and Cenozoic eras. These formations include the Bhuj Formation, Jaisalmer Formation, and Narmada Formation, among others. They consist of sandstones, shales, limestones, and other sedimentary rocks.

Alluvium: The state of Gujarat has several rivers that have deposited alluvial sediments over time. These alluvial deposits are made up of gravel, sand, silt, and clay and are found in the river valleys and floodplains.

Granites and Gneisses: These are metamorphic rocks that are found in the Aravalli Range, which is located in the northeastern part of Gujarat. They are composed of minerals such as quartz, feldspar, and mica and have a coarse-grained texture.

Chert: Chert is a hard, brittle sedimentary rock that is found in Gujarat. It is composed of microcrystalline quartz and forms as nodules in limestone or as layers in shale.

Overall, the lithology of Gujarat is varied and provides an interesting geological history of the region.

Stratigraphy of Gujarat

The state of Gujarat, located in western India, has a complex geological history that is reflected in its stratigraphy. Here are some of the main stratigraphic units found in Gujarat:

Deccan Traps: The Deccan Traps are a large igneous province that covers much of western and central India, including parts of Gujarat. The Deccan Traps were formed during the late Cretaceous period and are composed of basaltic lava flows, tuff, and other volcanic rocks.

Cambay Basin: The Cambay Basin is a sedimentary basin located in the western part of Gujarat. It is composed of various sedimentary rocks, including sandstones, shales, and limestones, and contains significant hydrocarbon reserves.

Kutch Basin: The Kutch Basin is a large sedimentary basin located in the northwestern part of Gujarat. It is composed of various sedimentary rocks, including sandstones, shales, and limestones, and contains marine fossils dating back to the Cretaceous period.

Saurashtra Basin: The Saurashtra Basin is a sedimentary basin located in the southwestern part of Gujarat. It is composed of various sedimentary rocks, including sandstones, shales, and limestones, and contains marine fossils dating back to the Cretaceous period.

Aravalli Range: The Aravalli Range is a range of mountains that runs through the northeastern part of Gujarat. It is composed of metamorphic rocks such as granites, gneisses, and schists.

Overall, the stratigraphy of Gujarat is complex and provides a glimpse into the geological history of the region. The various sedimentary basins and volcanic provinces found in Gujarat have significant economic importance due to their hydrocarbon reserves and mineral deposits.

Geology of Rajasthan

Rajasthan is a state located in the northwest region of India and has a rich geological history spanning millions of years. The state is known for its arid and semi-arid landscape, with the Thar Desert covering much of its territory.

The geological history of Rajasthan can be divided into four major periods: the Archean, the Proterozoic, the Paleozoic, and the Cenozoic.

During the Archean period, which lasted from about 4 billion to 2.5 billion years ago, the rocks in Rajasthan were formed through the process of volcanic activity and sedimentation. The most notable formations from this period are the Aravalli Range, which is one of the oldest mountain ranges in the world.

The Proterozoic period, which lasted from about 2.5 billion to 542 million years ago, saw the formation of several sedimentary basins in Rajasthan. These basins include the Delhi Supergroup, the Vindhyan Supergroup, and the Bhander Group. The sediments deposited during this time include sandstones, shales, and limestones.

The Paleozoic period, which lasted from about 542 million to 251 million years ago, saw the formation of several marine basins in Rajasthan. The sediments deposited during this time

include sandstones, shales, and limestones. Fossil records show the presence of trilobites, brachiopods, and other marine creatures in these sediments.

The Cenozoic period, which began about 66 million years ago and continues to the present day, saw the formation of the Thar Desert. This desert is made up of sand dunes and sandy plains, and is believed to have formed as a result of climatic changes and tectonic activity.

Overall, the geology of Rajasthan is characterized by a diverse range of rocks, including volcanic and sedimentary rocks, and a variety of geological features, including mountains, basins, and deserts. The state's geology has played an important role in shaping its landscape, natural resources, and cultural heritage.

Day 1

On day one we went to lothal.

Lothal is an ancient Harappan port-town located in the modern-day state of Gujarat, India. It was discovered in 1954 by archaeologist S.R. Rao and is one of the most important sites of the Indus Valley Civilization. The archaeological remains of Lothal reveal a well-planned urban center with advanced features such as a dockyard, a warehouse, and a complex drainage system. The town is believed to have been inhabited from around 2400 BCE to 1900 BCE and was a major center of trade and commerce. The most significant feature of Lothal is its dockyard, which is one of the earliest known in the world. The dockyard was connected to the nearby river by a canal and was used for loading and unloading cargo ships. The warehouse was located nearby and was used to store goods such as cotton, timber, and ivory. The town also had a marketplace, residential areas, and a public bath, indicating a high level of urban planning and civic organization. The people of Lothal were skilled artisans and produced goods such as beads, pottery, and shell objects. Excavations at Lothal have revealed a number of artifacts, including seals, jewelry, and tools made of stone, copper, and bronze. The seals have inscriptions in the Indus script, which is still undeciphered, making it difficult to understand the full extent of the civilization. Overall, the remains of Lothal provide valuable insights into the social, economic, and technological advancements of the Harappan civilization, and its role in ancient maritime trade.

Fire place where the beads were

Market place

Channels for water transport

Well

Day 2

On the second day we visited the Physical research laboratory Gujarat

The Physical Research Laboratory (PRL) is a premier scientific research institution located in Ahmedabad, Gujarat, India. It was founded in 1947 by Dr. Vikram Sarabhai, a renowned Indian scientist and industrialist, with the aim of carrying out basic research in physics and space sciences. The main research areas of PRL include astronomy and astrophysics, earth sciences, atmospheric sciences, and planetary sciences. PRL is also involved in the development of instrumentation and technology for space research, as well as in the training of scientists and engineers in these fields. Some of the major research projects carried out at PRL include the study of cosmic rays and their effects on the Earth's atmosphere, the exploration of the Moon and Mars through remote sensing, and the development of high-resolution imaging systems for space applications. PRL has also played a significant role in India's space program, particularly in the development of satellite technology and space-based communications. In addition, PRL has collaborated with several international organizations and research institutions in the fields of space and astronomy. Overall, PRL is a leading research institution in India, with a strong focus on fundamental research in physical and space sciences, and a commitment to advancing knowledge and technology in these fields.

In the PRL the showed us instruments like IRMS and ICPOES. They explained use the working of the instruments.

IRMS

IRMS stands for Isotope Ratio Mass Spectrometry. It is a powerful analytical technique used to measure the isotopic composition of elements in a sample. Isotopes are variants of an element that have the same number of protons in their nucleus but differ in the number of neutrons. Isotopic analysis provides information on the sources and processes involved in the formation of a sample, and is widely used in fields such as geology, ecology, archaeology, and forensic science. The IRMS technique involves the use of a mass spectrometer to separate isotopes of an element based on their mass-to-charge ratio. The sample is first vaporized and ionized, and then introduced into the mass spectrometer. The ions are accelerated and passed through a magnetic field, which deflects them according to their mass-to-charge ratio. The resulting ion beam is detected and the isotopic composition of the sample is determined. IRMS can be used to analyze a wide range of elements, including carbon, nitrogen, oxygen, sulfur, and hydrogen. It has a high precision and sensitivity, and can detect very small differences in isotopic composition. IRMS is commonly used in environmental studies to track the movement of isotopes through food webs, ecosystems, and the atmosphere. It is also used in the study of historical and archaeological materials, such as bones and teeth, to reconstruct past diets and environmental conditions.

ICPOES

ICP-OES stands for Inductively Coupled Plasma Optical Emission Spectroscopy. It is an analytical technique used to determine the elemental composition of a sample. The ICP-OES technique involves the use of an inductively coupled plasma (ICP) to ionize atoms in the sample. The ionized atoms then emit light at specific wavelengths, which can be measured using an optical emission spectrometer. The intensity of the emitted light is proportional to the

concentration of the element in the sample. ICP-OES can be used to analyze a wide range of elements, including metals and non-metals. It has a high sensitivity and can detect trace amounts of elements in a sample. ICP-OES is commonly used in environmental and geochemical studies to determine the elemental composition of soils, sediments, and water samples. It is also used in industrial and quality control applications to ensure the purity and composition of products.

Day 3

Site 1

On day 3 we went to village named Bori Dhumri. The outcro[p was exposed near the Bhim Bhumeda Mahadev temple. The exposed outcrop were the Tors of the Godhra Granite

Godhra Granite

Godhra granite is a type of granite that is quarried from the Godhra region in the Indian state of Gujarat. It is known for its strength, durability, and aesthetic appeal, making it a popular choice for various construction and decorative purposes. Godhra granite has a uniform texture and is composed of minerals such as quartz, feldspar, and mica. It typically comes in shades of grey, pink, and white, with variations in patterns and speckles. Due to its durability and resistance to wear and tear, Godhra granite is commonly used for flooring, cladding, countertops, monuments, and memorials. It is also popular for landscaping and outdoor applications such as paving, steps, and retaining walls. Overall, Godhra granite is a high-quality natural stone that adds value and beauty to any project it is used in.

Godhra granite from here are said to be 925-940 million years old. Neoproterozoic to middle mesozoic. The formations in this area broadly divided into three categaries, the younger lametas under which are bey belt and the oldest are himatnagar. Godra granites are from the lametas. The lithology can be also divided into three, the oldest are the conglomerate above which are the sandstones and the youngest are the limestones. The sandstones found here contain bones and clusters of dinosaur eggs were found in the limestones.

In the outcrop the granite was coarse grained showing Tors topography. Segregations of biotites were visible and porphyroblasts were off feldsphars.

Tors of ganite

porphyroblasts

Site 2

Dinosaur fossil park rayoli

The Dinosaur Fossil Park in Rayoli (also known as Raiyoli) is located in Balasinor, Gujarat, India. The park covers an area of about 10 square kilometers and is home to a number of dinosaur fossil sites. The fossils found in the park belong to the Mesozoic Era, which is also known as the "Age of Dinosaurs." The park has a large number of dinosaur eggs, bones, and footprints that have been preserved in the rocks. The fossils date back to the late Cretaceous period, which was about 65 million years ago. The dinosaur fossils found in the park are believed to belong to several species, including the Titanosaurus, which was a herbivorous dinosaur. The Dinosaur Fossil Park in Rayoli is open to visitors who can explore the park and see the dinosaur fossils on display. The park also has a museum with exhibits that provide information about the dinosaurs that once roamed the area. Visitors can learn about the various species of dinosaurs that lived in the region, their habitats, and behavior. Overall, the Dinosaur Fossil Park in Rayoli is an important site for paleontology in India and a popular destination for tourists and dinosaur enthusiasts alike.

In this parks we were able to see the eggs of dinosaurs and their bones .

Bones of Dinosaurs

Dinosaurs Eggs

Bones of Dinosaurs

Rayoli Dinosaur museum

Rayoli Dinosaur Museum" located in Balasinor, Gujarat, India. The museum is also known as the Raiyoli Dinosaur Fossil Park and is situated near the village of Raiyoli. The Rayoli Dinosaur Museum is a popular tourist attraction and is home to a collection of dinosaur fossils and eggs that were discovered in the nearby area. The fossils date back to the Mesozoic Era, which is known as the "Age of Dinosaurs." Visitors to the museum can view the fossils on display and learn about the different species of dinosaurs that once roamed the region. The museum also features interactive exhibits, a 3D movie, and a virtual reality tour that allows visitors to experience the dinosaurs up close. Overall, the Rayoli Dinosaur Museum is a fascinating destination for dinosaur enthusiasts and anyone interested in the history of life on Earth.

Dinosaur models

Day 4

On day 4 we visited ONGC Motera Ahmedabad

ONGC (Oil and Natural Gas Corporation) has an office in Motera, Ahmedabad, Gujarat, India. However, the office in Motera does not involve any exploration, production, or drilling activities related to oil and gas. It primarily serves as an administrative and support office for ONGC operations in the region. The Motera office of ONGC is responsible for providing various support services to the Ahmedabad Asset, which is responsible for exploring and producing oil and gas from the Cambay Basin in Gujarat. The office provides administrative and logistical support, including human resources, finance, and procurement. ONGC also has a major production installation in Ahmedabad, located in the Ankleshwar field. The Ankleshwar field produces crude oil, natural gas, and associated petroleum products and is one of the major oil and gas producing fields in Gujarat. The Ahmedabad Asset of ONGC is responsible for the production and management of the Ankleshwar field, which is located approximately 50 kilometers from the ONGC office in Motera. Overall, the ONGC office in Motera serves as an important support center for the company's operations in Gujarat, but does not involve any direct activities related to oil and gas exploration or production.

ONGC Motera Ahmedabad

Day 5

On day 5 we went to the Jhamar Kotra mine

The Jhamar kotra Mine is a large open-pit mine located in the Udaipur district of Rajasthan, India. The mine is one of the largest phosphate deposits in India and is owned by the Rajasthan State Mines and Minerals Limited (RSMML). The Jhamarkotra Mine is a low-grade deposit, with the phosphate content ranging from 16-20%, which makes it one of the most economical phosphate mines in India. The mine produces around 1.3 million tons of phosphate rock annually, which is used primarily in the production of fertilizers. The Jhamarkotra Mine is an important source of employment in the region, providing jobs to thousands of people. The mine also has a significant impact on the local economy, with several industries such as transportation, logistics, and manufacturing depending on it. The mining operations at Jhamarkotra Mine are carried out in an environmentally sustainable manner. The mine has implemented several measures to minimize its impact on the environment, including the use of rainwater harvesting systems, dust suppression techniques, and the restoration of mined-out areas. Overall, the Jhamarkotra Mine plays an important role in the production of phosphate-based fertilizers in India and is an important contributor to the local economy.

Noting

Mine started in 1960. it is divided into 4 units. Phosphate mining is done in mine. The Jaisalmer unit mines marble, gypsum and phosphate, this phosphate is used in fertilizer industries. The main source are the rock phosphates. This mine is the major phosphate mine in India. 90% of the phosphate comes from this mine. The strike length of the mine is 16 km and the rock is found in

zig zag shape. The strike is EW. The mine is divided into different blocks like A,B,C,D,E,F and G. the rock phosphate occurs as stromatolites formed due to metabolic activities of blue green algae. Different types of stromatolites are found in this area. This is an open cast mine. The depth is 80 m. two types of ores are found low grade and high grade.above 45% B2O5 content is considered as high grade. This two grade are then mixed and blended as per the requirements.

The total mine reserve is 31 million tonnes but about 18 million tonnes is mineable. Out of which 6 million tonne is high grade and remaining is low grade. The ore to overburden ratio is 1:16. then they showed us different blocks in their mine what word is carried out in those blocks.

Ore mixing plant

High grade ore

Phosphate in Rocks

Day 6

Site 1

We went to see the outcrop along the river Behrach. The outcrop exposed in the that area was Suket Shale which was showing slaty cleavage. We saw two set of folds in this area. The strike data was taken from two location along that outcrop. The first set of strike data are

Strike = N400

Dip = 500

Dip Amount = 1300

Strike = N500

Dip = N1450

Dip Amount = 600

Strike = N40 0

Dip = N1320

Dip Amount = 510

Strike = N420

Dip = N1360

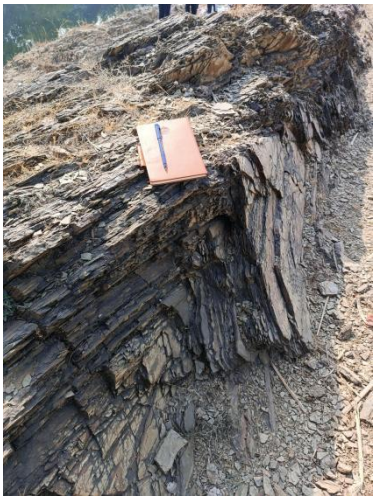
Dip Amount = 440

Strike = N570

Each person in this picture is sitting on the location where the reading were taken

Dip = N1530

Dip Amount = 410



folds

Two sets of fold can be observed in this picture

The second set of data are

Strike = N380

Dip = N1300

Dip Amount = 48=0

Strike = NN530

Dip = N1410

Dip Amount = 360

Strike = N360

Dip = N1280

Dip Amount = 520

Strike = N2050

Dip = N2950

Dip Amount = 640

The folds are asymmetrical.

Site 2

Site two was opposite side of the river and on that location the outcrop was same. But on the top at some places we saw an unconsolidated sedimentary rock. With rounded to sub rounded grains.

Site 3

Site 3 was few kilometers away from the river Behrach to the river Gamberi. Along this river there were exposure of Nimbara limestone. Strike is N1800, N2700 and the dip amount was 420.

limestone

Day 7

On day 7 we went to place named Rajsamand. Here we visited a marble quarry. The outcrop at this place showed three layers. One layer was dark it can be schist with dark greenish minerals. It can be mica , chlorite schist. The bottom layer was a marble layer, it showed setroidal texture, elongated asicular elements, they can be tremolite ,actinolite, we also saw greenish part which can be serpentine and the rock can be serpentine marble. The outcrop might be a part of a larger anticular fold.

Rajsamand Marble Characteristics

Rajsamand marble is a type of white marble found in the Rajsamand district of Rajasthan, India. It is known for its beautiful texture, high quality, and durability, making it a popular choice for various construction and decorative purposes. Rajsamand marble is extracted from the mines in the Rajsamand district, which is located in the Aravalli Range. The marble is formed from limestone that has been subjected to high temperatures and pressure over millions of years, resulting in its unique texture and appearance. The marble is characterized by its white color, with occasional streaks of Grey and black. It is highly sought after for its uniformity, which makes it ideal for large-scale projects. Rajsamand marble is commonly used in flooring, cladding, sculptures, and other decorative purposes. Rajsamand marble has a high level of purity, with minimal impurities and veins. This makes it easier to work with and produces a smoother finish. It is also highly resistant to weathering and wear, which makes it a popular choice for outdoor

applications as well. Overall, Rajsamand marble is a premium quality marble that is highly valued for its beauty, durability, and versatility.

Rajsamand marble

Three layers of rocks

Reference

- Gupta BC, Mukherjee PN (1938) Geology of Gujarat and southern Rajputna. Rec Geol Surv Ind Vol 73).
- Gupta SN, Arora YK, Mathur RK (1980) Lithostratigraphic map of Aravalli region, southern Rajasthan and northeastern Gujrat. Rec Geol Surv India.
- Biswal TK (1988) Polyphase deformation in Delhi rocks, south- east Amirgarh, Banaskantha district, Gujarat. Mem Geol Soc India 7: 267-277.
- Biswal TK, Gyani KC, Parthasarathy R, Pant DR (1998) Tectonic Implication of Geochemistry of Gabbro-Norite Basic Granulite Suite in The Proterozoic Delhi Supergroup, Rajasthan India. J Geol. Soc India 52: 721- 732.
- Choudhury AK, Gopalan K, Gupta SNP, B, Sastry CA, et al. (1981) Rb-Sr chronology of Untala and other granites from the BCG, Rajasthan. Three decades of developments in Petrology, Mineralogy and Petrochemistry in India. Jaipur Abstract
- Mukul, S.S. and Vimal Kumar, 1984. Detailed geological mapping and exploration for base metals in Udaipur district, Rajathan (F.S. 1979-80).
- Munshi, R.L., 1982. Geology of parts of Bundi and Bhilwara districts, Rajasthan (F.S. 1973-74).
- Munshi, R.L , 1976. An interim report on the drilling investigation for bentonite in Bisu Kalan area, Barmer district, Rajasthan (F.S. 1975-76).
- Munshi, R.L , 1977. Report on the elucidation of solid geology of alluvium covered area in parts of Bikaner and Ganganagar districts, Rajasthan (F.S. 1976-77).
- https://www.prl.res.in/prl-eng/