# REPORT ON GEOLOGICAL FIELDWORK IN TIRUVANNAMALAI, UTHANGARAI, TIRUPATTUR, SALEM, PERAMBALUR, AND ARIYALLUR AREAS OF TAMIL NADU, INDIA


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**Field Support and Guidance**

1. Geological Survey of India
2. Tamil Nadu Mineral and Mines
3. Ponguru Magnesite Mines, Salem
4. Periyar University, Salem
5. Govt. Arts College (7-Arts), Salem
6. Ramco Cement

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# 1. Introduction

## 1.1 Geology of Tamil Nadu

The area is 80% covered by Archean to late Proterozoic crystalline rocks, while the remainder is covered by Phanerozoic sedimentary rocks, mainly along the coastal strip and in some inland river valleys. The hard rock terrain consists predominantly of charnockite and Khondalite groups and its migmatitic descendants, supracrustal sequences of the Sathyamangalam and Kolar Groups and the Peninsular Gneiss Complex (Bhavani Group) intruded by ultramafic complexes, basal dykes, granites and syenites. During the Archean and Proterozoic epochs, crystalline rocks were derived through a complex evolutionary history of multiple deformations, anatexis, intrusions, and multiphase metamorphic events. Carboniferous to Mio-Pliocene sedimentary rocks and coastal belts include fluvial, fluviomarine, marine sequences, and Quaternary sediments. Especially in the northern and central parts, the Pre-Cambrian terrane of Tamil Nadu is highly fractured and deeply faulted. Phanerozoic sediments are relatively unaffected and show well-preserved bedding planes with dips ranging from horizontal to 100°. On the other hand, the crystalline rocks had undergone multiphase deformation and metamorphism, resulting in well-developed foliation, i.e., S1, following the lithographic contacts in many places. Subsequent deformations have also induced the local development of new S-tissues. The NE regional structural trend is NNESSW, characterized by long linear canoe-shaped folds. Although the northwest is characterized by a regional structural trend near NS and multiphase folding has been recognized on-site, distinct regional structures have not been interpreted. In the central part, the regional structural trend EW often differs from ENE-WSW and WNW-ESE. South of the Tambaraparani River, i.e., the southernmost sector, shows pronounced NWSE structural granulation. Several shear zones were also recognized in the Precambrian. The terrain includes the Moyyar Shear Zone, Bhavani, Salem, Attur, Cauvery, Dharmapuri, Gangavalli and Achankovil.

## 1.2 Climate and Rainfall

The climate of Tamil Nadu is mainly tropical, i.e., it ranges from dry sub-humid to semi-arid and depends primarily on monsoon rains and hence is prone to drought when the monsoons fail. In May and June, which are the hottest months, daily maximum temperatures in Chennai rise on average around 100°F (38°C), while minimum temperatures drop on average around 80°F (20 °C). In December and January, the coldest months, temperatures generally rise by around 70°F (21°C) daily to mid-80s F (about 30°C). i.e., about 945 mm (37.2 in), of which 48% through the northeast monsoon and 32% through the southwest monsoon.

Therefore, the state has two distinct rainy periods: The southwest monsoon from June to September, with strong southwest winds; the Northeast monsoon from October to December, with prevailing winds from the northeast; Mountainous and hilly areas. The extreme western part of the state mainly receives the most precipitation, while the southern and lower southeast regions receive the least precipitation. As the state depends entirely on rainfall to replenish its water resources, monsoon failures

lead to severe water shortages and drought. Tamil Nadu is divided into seven agroclimatic zones: northeast, northwest, west, south, high rainfall, high altitude hills and the Cauveri delta, which is the most fertile agricultural zone.

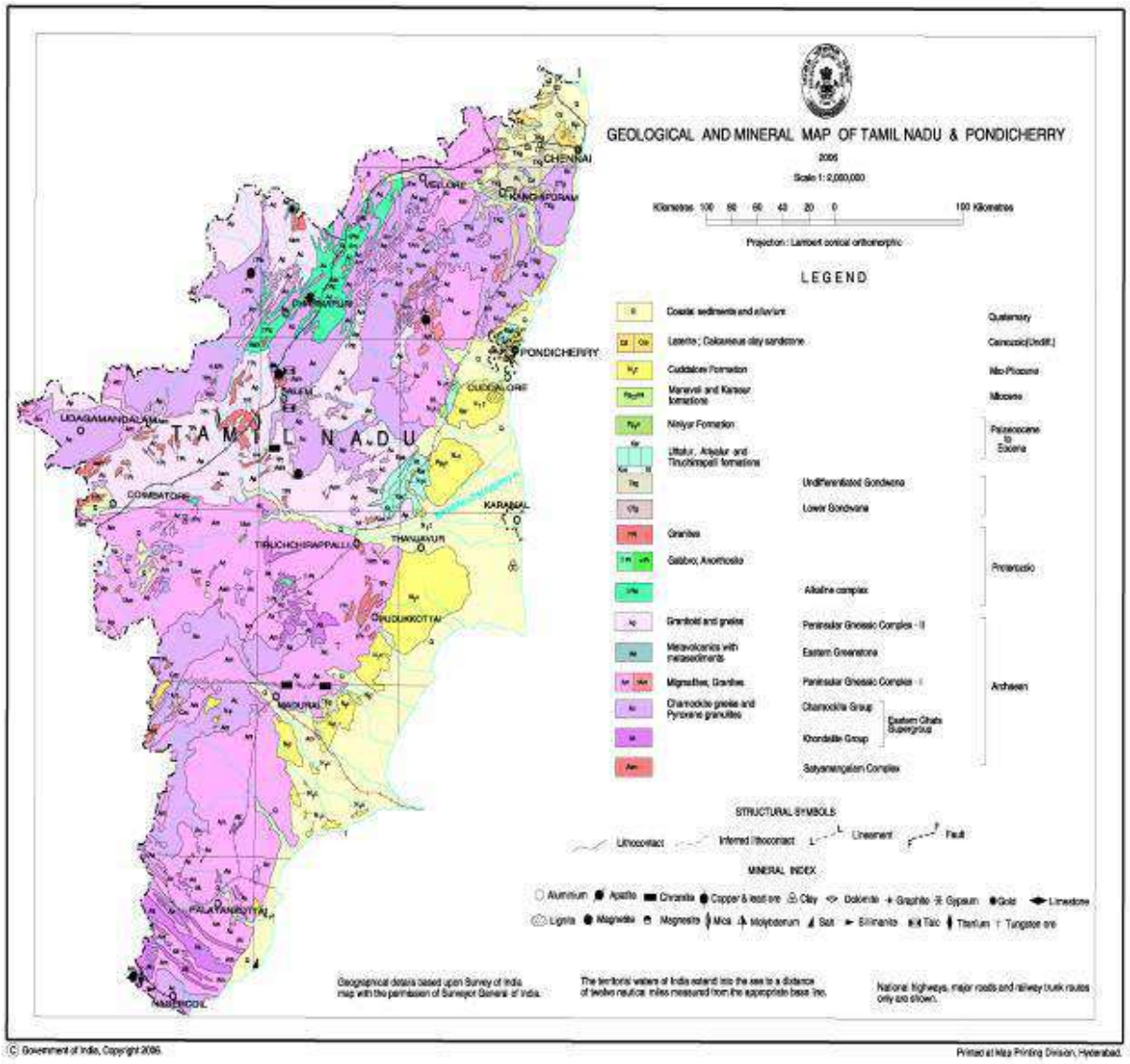


Figure 1 Geological Map of Tamil Nadu (Geological Survey of India, 2006)

## 1.3 Scope and purpose of the field visit

The main aim of the field visit is to gain geological field exposure to explorations, mining, and different lithology.

The objectives of the geological field visit are as follows:

- To study and understand the litho units mutual relationship, characters, and associates.
- To analyze the structures of the regions and their relationship to the regional tectonic settings.
- To collect samples of various litho-units for further petrographic studies and other analyses.
- To visit the real-time field survey and exploration sites.

- To visit the mining exploration, processing, grade classification and final product.
- To study the stratigraphic sequence of the investigated area with the regional geology.
- To prepare an overall geological perspective of the study area.

## 1.4 Method of Investigation

The following methodologies have been used during the fieldwork.

### 1.4.1 Measuring Attitude of Beds

While the exposure investigation was taken, the bed's strike, dip direction, and dip amount were measured using the Brunton compass and Clinometers.

### 1.4.2 Collecting Sample

Representative rock samples have been collected from all the study areas.

### 1.4.3 Identifying Mineral Constituents

The constituent minerals and grain length of rock specimens have been identified with the assistance of a lens.

### 1.4.4 Describing Lithology

The lithology of the exposures has been defined and accorded in the notebook.

### 1.4.5 Taking Photographs

Photographs of nicely uncovered geomorphic features, structures, vegetation and topography have been taken in every phase. All those records received using the above strategies from exposures have been cited in the notebook.

### 1.4.6 GPS

The global positioning system is a device which can determine the exact position of location of field investigation (as well as of the user) by signals from various satellites situated in space. The Latitude, Longitude and Elevation of its position can be known from it. It has some Expected Positional Error (EPE or accuracy) which tells accuracy of the data. In the area of no remarkable topography, it is an excellent way to find location instead of clinometers back bearing.

## 1.5 Schedule for the field visit

The field visit was initially planned for two weeks; however, due to the Covid-19 issue and research dissertation, the field visit was carried out for six days. The field visit started with the reconnaissance survey, sample collection, drilling operation, litho-log preparation, and ore estimation in the Uttangarai region with the support of the Geological Survey of India. In the following days, the field visit was carried out in the mica mines, Samalpatti carbonatite area, Sittampondi anorthosite complex, magnesite mine, Periyar University and Government Arts College of Salem, and Yercaud. The field visit ended with extensive work on the Gondwana and Cretaceous formations of Ariyalur and Perambalur Area with the support of GSI and Ramco Cement.

Table 1: Schedule of the Field Visit

| TIME / DATE | 4:30 AM | 11:00-11:30 AM | 11:00-4:30 PM | Evening |
|---|---|---|---|---|
| **14TH March** | Departure From CUTN | Arrival at Uttangarai GSI site | GSI Drilling Operation | Stay at Thirupattur |
| TIME / DATE | 8:00-10:00 AM | 10:00-12:00 PM | 12:00-3:00 PM | 3:30 PM |
| **15TH March** | Carbonatite Visit | Mica visit | Alkaline rock visit | Travelling to Salem |
| TIME / DATE | 07:30-10:00 AM | 10:30-01:30 PM | 1:30-4:00 PM | 4:30 PM |
| **16TH March** | Eclogite Garnet Visit | Anorthosite Visit | Chromite Visit | Vedha Lodge |
| TIME / DATE | 9:00-11:00 AM | 11:00-12:00 PM | 12:30-1:30 PM | |
| **17TH March** | Magnesite Mine | Periyar University | Govt. Arts and Science College, Salem | Perambalur |
| TIME / DATE | 7:30-8:30 PM | 8:30-5:30 PM | | |
| **18TH March** | GSI officials | Field Visit along GSI | | |
| TIME / DATE | 7:30 AM | 9:30-1:00 PM | 1:00-4:30 PM | 5:30 PM |
| **19TH March** | Departure from perambalur | RAMCO cements | Geological Field Vsit | To Cutn |

# 2. Detailed Filed Visit: DAY 1 (15/03/2022)

## 2.1 Area Name: Northern part of Southern Granulite Terrain, Harur-Uttangarai Molybdenum Belt

**Location 1 (sheared zone)**

Latitude: 12° 9' 51" Longitude: 78° 27' 23"

**Location 2 and 3 (Non-sheared zone)**

Latitude: 12° 9' 55" Longitude: 78° 27' 27"

The area is situated in the Dharmapuri and Krishnagiri districts of Tamil Nadu, bounded by the Uthangarai- Krishnagiri belt on the western side and the Madras belt on the eastern side. The NNE-SSW trending shear zone of 200 km long 50 km vast Mo province coincides with the Dharmapuri Rift Suture Zone (DRSZ)/ Dharmapuri Rift Zone (DRZ) bounded by Harur lineament in the east and Dharmapuri West lineament in the west.

Dharmapuri Alkaline Carbonatite Belt, between Dharmapuri and Krishnagiri district, Tamil Nadu, is 200 km long (strike) and 40 km wide. It is bounded on the eastern side by Charnockite, the western side by older granulite terrain and; the central part by gneissic high grade and metamorphic terrain. This shear zone falls under the southern granulite terrain with a toposheet number 57L/8. On the northern side, the area is abrupting the Palakkad zone, and on the south side is the Cauveri shear zone. This shear zone is a failure rift shear zone mainly due to rifting and is trending parallel to NNE-SSW. Moreover, the attitude of one of the outcrops shows a trend of N60°E/40°/SE, which is controlled by structural fabric like sigmoidal. Also, the fracture plane is dipping towards the south and has mainly two to three prominent cleavages. Also, the area is a core part of the belt that indicates a highly mineralized zone has a host rock of Epidote Horblende Gneiss. Because of various activities like chloritization of the host rock and action of fluid along with P/T condition at greater depth, Mylonite is formed in this area.

The area to the east is primarily composed of a charnokite cluster of fine to medium-grained rocks that are banded intermediate charnockite with linear bands of 2 pyroxene granulites, stone iron ore and pink quartzo-feldspathic granulite cut by little bodies of gabbro-norite-anorthosite-dunite-peridotite and younger basic dykes. Epidote amphibole gneiss rock with the variable composition of granodiorite to quartzdiorite is the characteristic rock sort that occupies most of the Mo province and is made by the gradual regression of charnockite. Enclaves of intermediate charnockite, pyroxene granulite, meta-pyroxenite, meta-gabbro, and conformable bands of quartzo-feldspathic gneiss occur at intervals epidote hornblende gneiss throughout the belt. Gabbro and dolerite embankments cross the terrain in WNW-ESE and NW-SE directions.

The Mo belt also characteristically includes the Neoproterozoic ultramafic carbonatite-alkaline plutons as oval-shaped complexes, namely Odugattur, Rasimalai, Elagiri, Koratti, Samalpatti and Pakkanadu.

The alkaline complexes show well-preserved planar igneous features. Nonconforming bodies of felsites, aplitic syenite, pegmatoidal syenite and quartz veining also occur in this belt. Younger quartz reefs intersect all of the above rock types along strike from NNE-SSW.

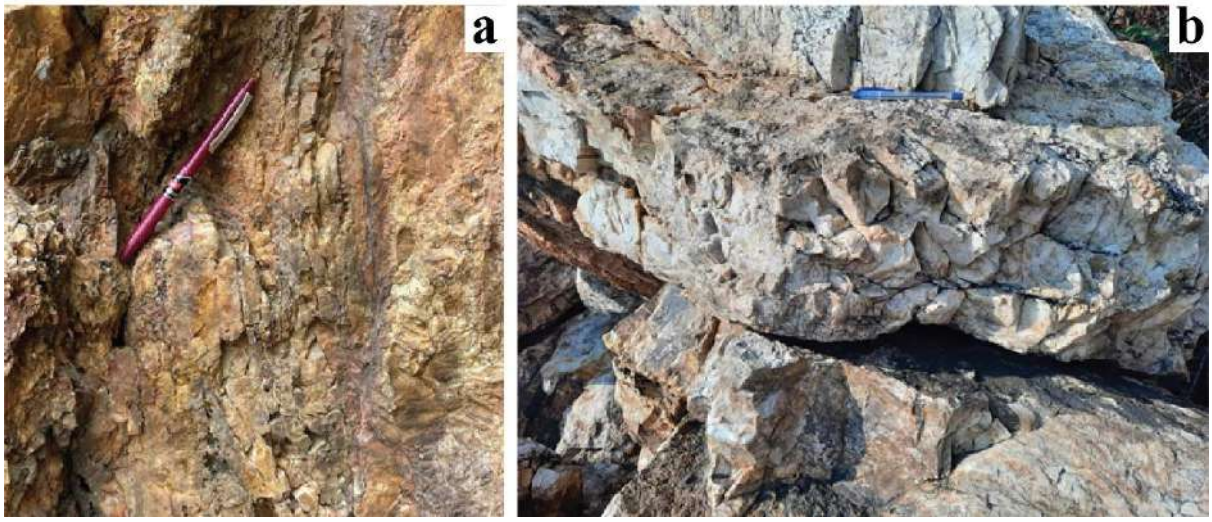


Figure 2 (a) Dharmapuri Rift Zone Shear Zone showing the Quartz Vein, (b) Molybdenum (green colour) Present in Hornblende Gneiss

The lithology of the terrain to the east is the Charnokite group of rock-pyroxene granulite, magnetite quartzite, anorthosite-dunite-peridotite bodies and younger basic dykes, and to the west, Peninsular Gneissic Complex of older supracrustal of Satyamangalam group. The Presence of Epidote-hornblende gneiss with composition granodiorite to quartz-diorite is the major rock type present in the middle of the terrain and occupies a significant part of deposits for Mo province. The landscape is formed by retrograde metamorphism with Continental tectonics, so the presence of Epidote-hornblende gneiss is formed due to the progressive continuing retrogression of Charnokites. The belt consists of an alkali complex that shows a well-preserved igneous planer feature with variations of different veins. And the younger quartz dyke cut the alkali complex along the NNE-SSW direction and developed parallel foliation with a steep dip towards NW. The Mo mineralization occurs in the structural fabric and shear fabric in the sericitized two types of gneiss such as quartz feldspathic gneiss and hornblende gneiss.

The shear zone is marked by the presence of homogeneous massive quartz with multiple shears with colour variation due to alteration because of the work of hydrothermal activity and can find some S-C fabrics. Towards the south side of the homogeneous massive quartz, the drilling was going on for Mo. The drilling is controlled by the Diamond drilling with an inclined dip of 45°.

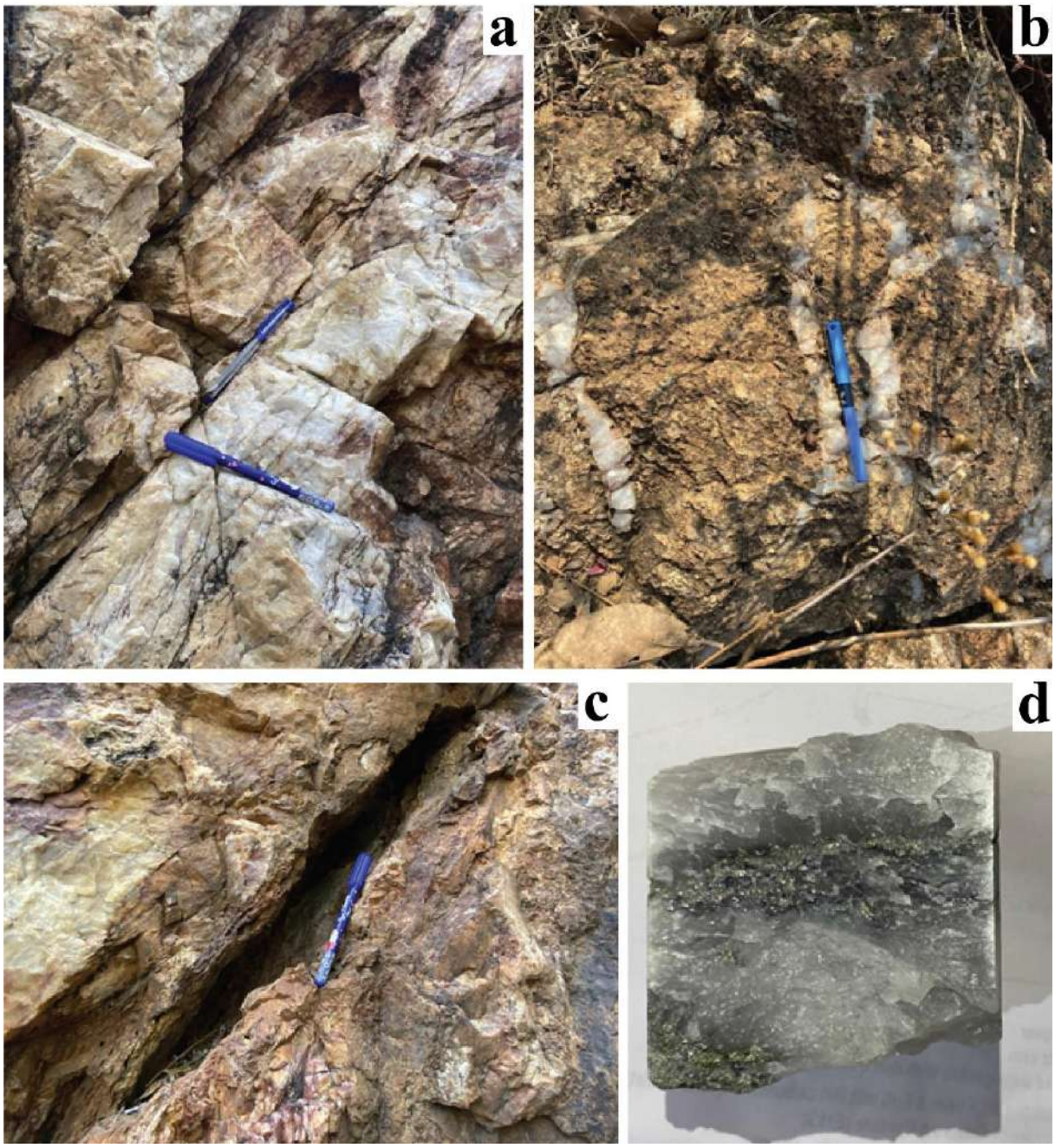


Figure 3 (a) Two sets of prominent foliation plane, (b) Quartz veins (Fractured body filled with quartz within a rock), (c) Cavity Filling (Hydrothermal type of deposit where the deposition of minerals takes place within the cavity), (d) Molybdenum with trace amounts of Pyrite (Mo is a strategic mineral)

### 2.1.1 Economic Importance

In this shear zone, mainly Molybdenum (Mo) exploration is done with the help of the G2 stage of the investigation. This zone is characterized by well-developed quartz veins and sericitised gneiss, on the other hand. We know Mo is of fine flake-like granular aggregates with disseminated grains and is found in the fractures of quartz veins, so the significant concentration of Mo is located in the contact zones of quartz chains and the hydrothermally altered rocks within the veins. Thus these veins act as a carrier pattern for fluids, and the quartz vein type of deposit is the main type of deposit in this

zone. Also, Pyrite is seen as a secondary mineral due to sulphidisation.

## 2.2 Visit to GSI Drilling Site

The Harur Uttangarai Belt has been divided into 20 blocks, each 1.65 km long, for ease of operation. The blocks (1 to 11) are in the south of the Ponnaiyar River and are under the Harur Sector, and the blocks (12 to 20) are in the north of the Ponnaiyar River and are under the Uttangarai Sector. After detailed mapping and trenching, the continuity of the MSZ (Moyar Shear Zone) strike was established and then the underground exploration began by drilling that too in inclined holes for about 45°. The first level holes were drilled to intersect the MSZ at 50m vertical depth. Generally, four stages of exploration are carried out, such as the G1, G2, G3 and G4 phases, of which G4 is the basic level. The G3 stage reduces the drilling interval by increasing the level. The G1 stage is the final level of exploration where the main part of the drilling is carried out, and less than 40° is generally avoided. Also, we have interpreted some data from one of the core samples to gain knowledge of how a sample is evaluated after collecting or extraction.


Figure 4 (a) Diamond drill bit with the casing, (b) Core Sample in a box pattern, (c) Drilling site for Molybdenum, (d) Mylonitized Epidotite Hornblende Gneiss.

### *2.2.1* Economics Important

The primary ore deposits of the area are Mo with a base metal of Pb, Zn, Au, Co and Ni. The grade-

wise Mo can be explored up to a maximum of 4000 ppm-5000 ppm. The crustal abundance of Mo is 1.5 ppm.

## 2.3 Area Name: Mylonite Rock

**Location 1**

Latitude: 12° 12' 41" Longitude: 78° 28' 52"

The area is the core part of the Harur-Uttangarai Molybdenum Belt, which indicates the highly mineralized zone having Epidote Hornblende Gneiss host rock. Due to fluid activity and chloritization of the host rock with temperature variation at deeper depth, it changed to Mylonite. Hence, the rock type is called Mylonitized Epidotite Hornblende Gneiss.

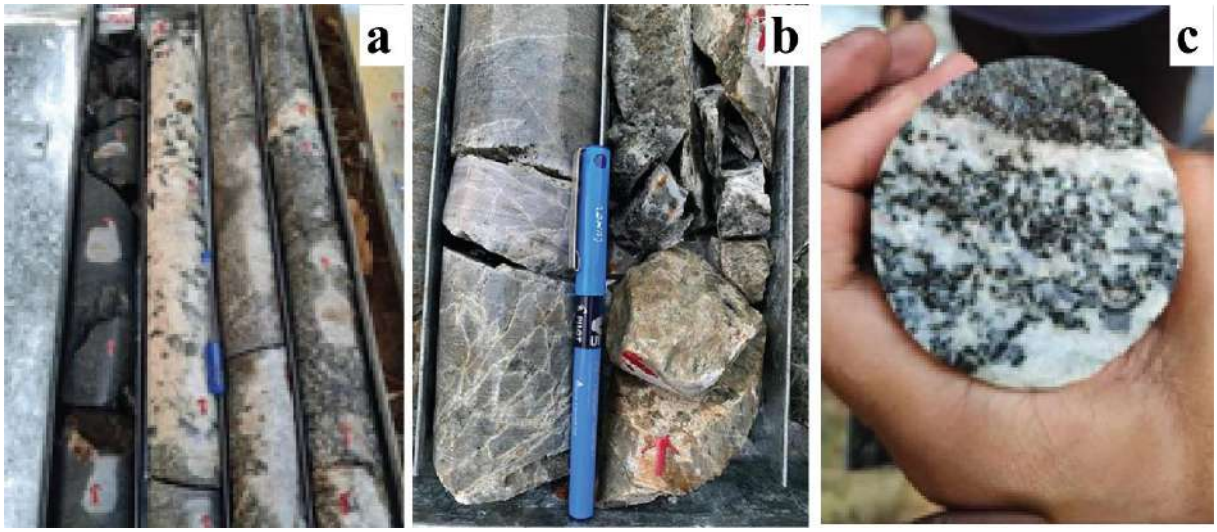


Figure 5 (a) & (b) Core samples after drilling kept in a book pattern at GSI camp, Uttangarai, (c) visible gneissose structure.

## 2.4 Area Name: GSI Camp Site

The area is the GSI campsite. Here the collection of core samples was there. The Harur-Uttangarai Molybdenum Belt was mapped by a Geochemical and Pedogeochemical survey. There are four stages of exploration cum drilling G1, G2, G3 and G4. The stages are called grades. The volume will reduce, the grade will increase closer to the ore body, and complexity will resolve in the highest exploration stage. The exploration is done up to G1. After that, mining will start. The core samples followed the book pattern for ease of calculation of core recovery, which was found to be 35%. The core sample is of the same composition as they have collected from the Harur- Uttangarai Molybdenum Belt.

# 3. DAY 2 (16/3/2022)

## 3.1 Area Name: TAMIN Vermiculite Mines and Exploration Plant Tamil Nadu Minerals and Mine Corporation, Sebathur.

**Location 1**

Latitude: 12° 25' 12" Longitude: 78° 31' 36"

**General Information**

**Total Area:** 23.71 Hector **Recovery:** 9%

**Name of Mica:** Vermiculite Mica **Per day production**: Approximately 5 tons

**Direction:** NE-SW **Grade**: 3,4,5

**Geological Reserves:** 1895875 tons

**Working Principle**

- Step-1: Collection of raw material by plucking method- Grade1 and 2
- Step-2: Separate the material based on size
- Step-3: Fry/roast the material with oil at the temperature of 6000 °C

### 3.1.1 General Geology

This mica mine is located in the village named Sebathur and has a total extension area of about 23.71 hectares. The direction of formation of the mineral deposit is NE-SW. The lithology of the mine area is Kankar, Carbonatite, Pyroxene, Calc Granulite, Syenite, Gneisses, and Vermiculite.

### 3.1.2 Mineralogical Characteristics

Mica is one of a group of hydrated potassium aluminium silicate minerals. It is a layered silicate species with a two-dimensional sheet or layered structure. Among the essential rock-forming minerals, mica is found in all three major rock types. Out of 28 known Mica groups, Vermiculite is predominantly found in this mica mine.

### 3.1.3 Economic Importance

This mine mainly consists of Vermiculite mica, of which the total geological reserve is about 18 lakhs 95 thousand 875 tonnes. The per day recovery percentage is 9% from the raw material. Per tonne, mica is about 21 thousand, including GST, and per day production is exfoliated as 5 tonnes (approx.) The mica is refined into different grades, i.e. based on the size as per the customer's requirement. Basically, there are three grades, such as Grade 3, 4, and 5, depending on the size, i.e. Grade 5 is the finest of all.


Figure 6 (a) Mica Mine, (b) Control Machine, Air Compressors

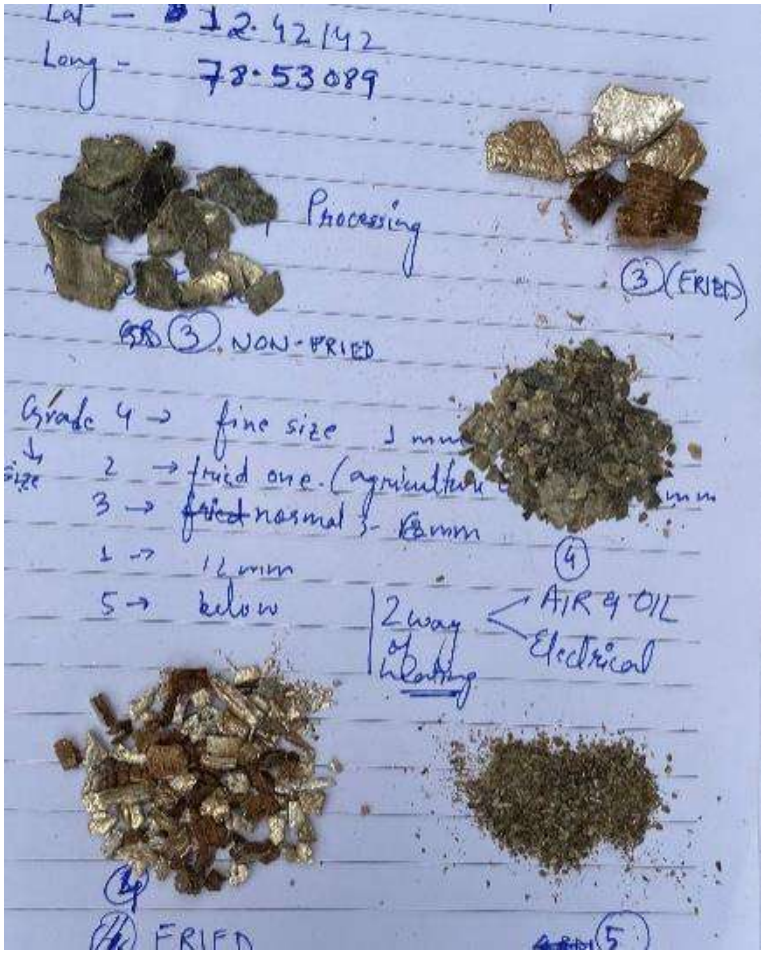


Figure 7 Mica of Grade 3, 4 and 5

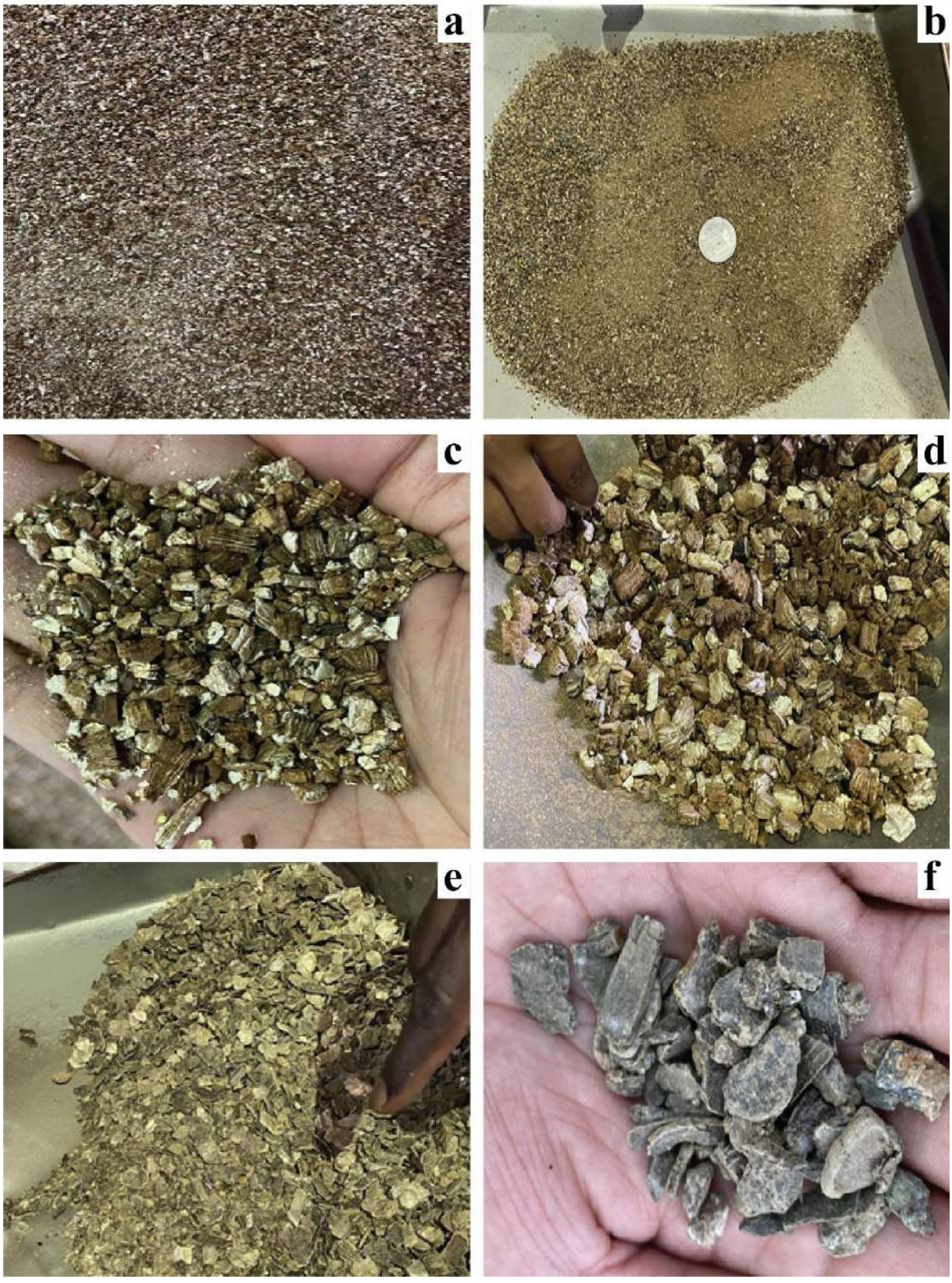


Figure 8 (a) Grade 5 (Refined), (b) Grade 5 (Raw), (c) Grade 4 (Refined), (d) Grade 3 (Refined), (e) Grade 3 (Raw), (f) Waste Material

Table 2 Different Grade Sizes

| | |
|---|---|
| Grade-1 | Above 12 mm |
| Grade-2 | 6 mm-12 mm |
| Grade-3 | 3 mm-6 mm |
| Grade-4 | 1 mm-3 mm |
| Grade-5 | Below 1 mm |

## 3.2 Area Name: Ultramafic Pyroxenite/Syenite Suite (Location 2), Core Syenite / Ultramafic Alkaline Suite (Location 3), Kanjanur (Location 4)

**Location 2**

Latitude: 12° 20' 55" Longitude: 78° 31' 12"

**Location 3**

Latitude: 12° 17' 39" Longitude: 78° 25' 32"

**Location 2**

Latitude: 12° 15' 56" Longitude: 78° 28' 03"

### 3.2.1 General Geology

This area is mainly bounded with syenite and is trending towards NNE-SSW (L2). It is characterized by a Trachytic structure where plagioclase minerals seem like floating, i.e. plagioclase is of bigger grain size present in a fine grain matrix. Because of the shear zone activity, the veins of deposition are present in the area.

### 3.2.2 Mineralogical Characteristics

In Locations 2 and 3, within the syenite rock, there is a presence of Carbonatite in a few places. Carbonatites are mainly of two types i.e Fe-rich and Mg-rich, i.e., they are composed of ferromagnesian minerals and alkali feldspar. A particular group of alkali syenites is characterized by the presence of a feldspathoid mineral such as nepheline, leucite, and sodalite. In location 4, the hill was moderately covered with weathered Dunite Rock exhibiting a Crocodile weathering pattern.

### 3.2.3 Economic Importance

Mainly syenite is used for construction purposes such as flooring, interior decoration, building stone, etc.

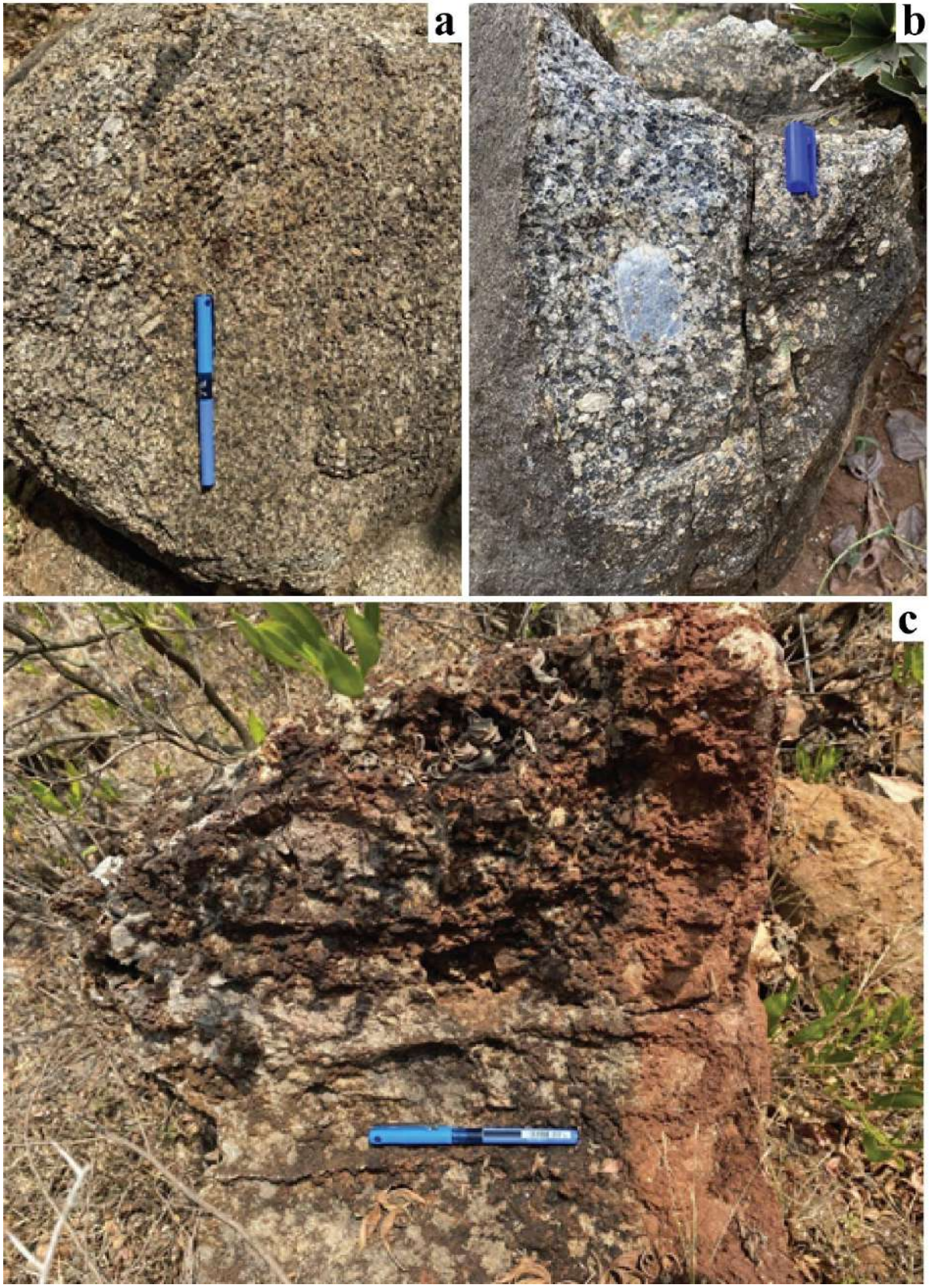


Figure 9 (a) Syenite (Coarse-grained intrusive igneous rock similar to granite but is deficient in quartz), (b) Syenite (Coarse-grained intrusive igneous rock similar to granite but is deficient in quartz), (c) Crocodile weathering (Occurs in partially serpentinized rocks)


Figure 10 (a) Syenite boundary rock for the Ultramafic Syenite suite, (b) Syenite rock of core area in Ultramafic Syenite suite

# 4. DAY 3 (17/3/2022)

## 4.1 Area Name: Sangakari Granite, Tuthipalayam

### Location 1

Latitude: 11° 28' 37" Longitude: 77° 59' 12"

### 4.1.1 General Geology

The Sangakari granite is in the form of a batholith which may be extended more than 100 km. It is a large body of igneous rock formed beneath the Earth's surface due to the intrusion and solidification of magma. It is mainly composed of coarse-grained rocks such as granite (in this area) or granodiorite with a surface exposure of 100 $km^2$ or more. It is formed when a number of plutons converge together to form a massive expanse of granitic rock.

The Sangakari granite, also called Sankari – Tiruchengode (ST) granite, covering an area of about 520 $km^2$ is emplaced at the intersection of the NE-SW trending Mettur lineament with the E-W trending Moyar-Bhavani-Attur Lineament. This area is formed by a deep crustal fault resulting from the surface to the upper mantle. It is geologically younger as it is derived from the Sangagiri batholith. The age of the Sangagiri batholith is more or less similar in age, i.e. 2.8 billion years as Pakkanadu pegmatite. This granite is generally massive, and no planar fabric is developed even at the contact. The rock is composed of mineral hornblende, orthoclase, biotite and mica.

Figure 11 Granite with hornblende and mica minerals

### 4.1.2 Mineralogical Characteristics

Granite is a coarse-medium-grained intrusive igneous rock rich in quartz and feldspar. It is a common plutonic rock of the Earth's crust formed by the cooling of magma at great depths. In the area, we observed hornblende and biotite mica grains, giving us an idea of the rock being an Amphibolite.

### 4.1.3 Economic Importance

Granite is mainly used for construction purposes.

## 4.2 Area Name: Near Water Treatment Plant, Tidumal (Opp to Dhasampalam, TNWB)

**Location 2**

Latitude: 11° 13' 8" Longitude: 77° 56' 13"

### 4.2.1 General Geology

The area is mostly covered with exposures of high- grade metamorphic rocks, dominantly Eclogite Garnet. The general trend of the outcrops falls around 234°/77°/161° towards SE.

Figure 12 Eclogite Garnet (Metamorphic rock hosted in the matrix of sodium-rich pyroxene)

### 4.2.2 Mineral Characteristics

It is a high P/T metamorphic rock that is essentially composed of more than 75% of garnet, mainly pyrope or Mg-rich almandine and omphacite or Na-Ca-Al-Mg clinopyroxene. Also, Rutile, kyanite,

and quartz are typically present. Thus, they are found primarily on blueschist facies.

### 4.2.3 Economic Importance

In medical industries and geological simulations.

## 4.3 Area Name: Sittampundi

**Location 3**

Latitude: 11° 13' 10" Longitude: 77° 56' 05"

### 4.3.1 General Geology

The Anorthosite complex in southern India formed around 2.5 Ga, implying lower crustal stabilization of the Dharwar Craton. The parental magma of Anorthosite was contaminated by ancient mafic lower crust.

Figure 13 Anorthosite (Rock composed predominantly calcium-rich plagioclase feldspar)

### 4.3.2 Mineralogical Characteristics

Anorthosite is mainly a light- coloured, coarse-grained plutonic rock primarily composed of plagioclase, usually labradorite or bytownite, often with trace amounts of pyroxene. Other minerals like Olivine, amphibole, ilmenite, magnetite, and spinel are also found.

### 4.3.3 Economic Importance

This particular complex is essential for its corundum deposits excavated as Ruby for the gemstone industries.

## 4.4 Area Name: Thotiyanthotam

**Location 4**

Latitude: 11° 14' 29" Longitude: 77° 57' 39"

### 4.4.1 General Geology

Presence of Chromite.

### 4.4.2 Mineral Characteristics

It is an oxide mineral of the spinel group which contains Mg, Fe, Al and Cr in different proportions.

Figure 14 Structural Mapping in Anorthosite Complex

Figure 15 Hands-on experience with Structural Mapping

Figure 16 Chromite Deposit

## 4.5 Area Name: Nallur

**Location 5**

Latitude: 11° 55' 31" Longitude: 77° 56' 54"

This area comes under the migmatite complex. Migmatite is considered to both igneous as well as metamorphic origins. The rock types may be quartzo-feldspathic gneiss, garnetiferous granite gneiss, garnet biotite gneiss with associated migmatites, hornblende gneiss, hornblende-biotite and quartz mica gneiss, biotite gneiss and epidote-chlorite biotite gneiss are grouped under migmatites and gneisses.

### 4.5.1 General Geology

It is a Migmatitic Complex formed by multiple deformations because of repeated metamorphism. The complex is formed as dykes, sills and ultramafic bodies. The rock type consists of feldspar and quartz-like igneous minerals and gneiss. The exposure had many folded patterns caused during lava flow along with some boudinage structures. Also, it was an old river bed interpreted from numerous potholes.

### 4.5.2 Mineralization Characteristics

The rock is mainly composed of alternating layers of quartz, feldspar and biotite and is a type of high-grade metamorphic rock formed under extreme P/T conditions.

### 4.5.3 Economic Importance

As a building stone and sometimes as a polished ornament.


Figure 17 (a) Pot hole (Depressions formed due to Eddy currents), (b) Ptygmatic Fold (Irregular gold found where particular competent layers are enclosed in a matrix), (c) Boudinage (Structure formed by extension and is cylindrical or lens like in shape)

# 5. DAY 4 (18/3/2022)

## 5.1 Area Name: Ponguru Magnesite Mine

**Location 1**

Latitude: 11° 41' 52" Longitude: 78° 07' 19"

- Name of Mines- Sri Ponguru Magnesite Mines
- Mineral- Magnesite associate with dunite
- Area- 77.5Hector
- Types of deposit- vein type deposit
- Method of mining- Open cast mining
- Rate of recovery- 6%
- Drilling types- Two types of Jack Hammer drilling and Rotary cum Percussive drilling
- Explosive – $NH_4NH_3$ Uses

➢ Used as refractory material

➢ Use as a catalyst and filler in the production of rubber

➢ Also used as fertilizers

### 5.1.1 General Geology

This mine was established in 1963 in Jagir, Ammapalyan Salem Taluk district, where Magnesite deposits are found in an area of 200 acres. The method of mining that is operated is Open cast Drilling. The height of a particular bench of 6 m is maintained along with the width. Mainly in this mine, the chemical explosive component is used, and here it has a heat capacity of about 1500°C. Mainly two types of drilling occur, i.e. Jack and hammer and Wagon drill. Also, other drilling like Rotary drilling, Percussive and Rotary-Percussive is being performed. Segregation by hand plucking is also seen inside the mine after blasting in a potential area.

The country rock of the mine is dunite, i.e. the deposit occurs in an Ultrabasic Rock. Generally, magnesite is found in banded iron formations and sedimentary rocks and the abundance we observed the occurrence of magnesite mainly in a vein type of deposit. It is a magnesium carbonate mineral that usually forms during the alteration of Mg-rich rocks or carbonate rocks by chemical weathering. It is found in the Calcite group of minerals.

### 5.1.2 Economic Importance

The recovery percentage of the mine is only 6%, and if the deposit has less than 3% of silica, then only it is considered a high-grade deposit. Also, the dump should not be more than 30 m to have a substantial deposit. Thus, it is mainly used in steel furnaces and Ceramics.

Figure 18 Mine visit and general insight of the Ponguru Magnesite Mine

## 5.2 Department of Geology, Periyar University

At Periyar University, we interacted well with Dr. S Anbazhagan, an expert in Remote Sensing and GIS Applications, Planetary Remote Sensing, Natural Disaster Management and mitigation. During the discussion, he explained the Lunar Soil Simulant for Chandrayan II mission programme, where the Geology Department of Periyar University plays a significant role by contributing to the National Planetary Exploration Programme. A rover schedules the southern side of the Lunar highland; based on this; a satellite image has been created by IRS P6, which is then compared with the Anorthosite Complex of the Sittampundi area. He shared his work experience and involvement with that project and how he collected samples and prepared the patent. Also, samples of Anorthosite have been shown to us, which have been collected for the ongoing research work.


Figure 19 Different grades of Anorthosite Sample

Figure 20 Discussion with Prof. S. Anbazhagan, Geology Department, Periyar University

### 5.3 Area Name: Government Arts College, Salem-7

We had a good discussion with Dr. M. Jayabalan (Associate Professor and Head) and Dr. V. Thirukumaran (Associate Professor). Dr. Jayabalan and Dr. Thirukumaran have shared the work experience of their field visit and explained the geological features like structure, fossils content and lithology of Salem district and nearby areas such as Sittampundi Anorthite Complex, Samalpatti carbonatite and different mines present over Salem such as Yercaud Bauxite mine and Ponguru Magnesite Mines. They showed their collection of different megascopic rock samples and fossils from other states.

Figure 21 Interaction with the Department of Geology, Government Arts College Salem-7

## 5.4 Area Name: Yercaud, Sevarayan

**Location 2**

Latitude: 11° 48' 53" Longitude: 78° 13' 12"

Bauxite is formed as a residual deposit; it is found in Shevaroy of Yercaud. Here we can find that the parent rock is charnockite and granulite; these rocks are formed at the lower crust and then uplifted because of their low density. The entire Yercaud hill is made up of these rocks.

The pink colour in the bauxite is due to the Iron content in the rock; high the iron, the more the colour. The bauxite formed here is due to weathering. Both chemical and physical weathering work in the formation of bauxite from charnockite.

### 5.4.1 General Geology

The deposit mainly takes place at a certain height as it is temperature appropriate and is studied in a paleoclimatic condition. Mostly the structure of the rock is oolitic. Other structures like Rain prints and mud cracks are observed in the area.

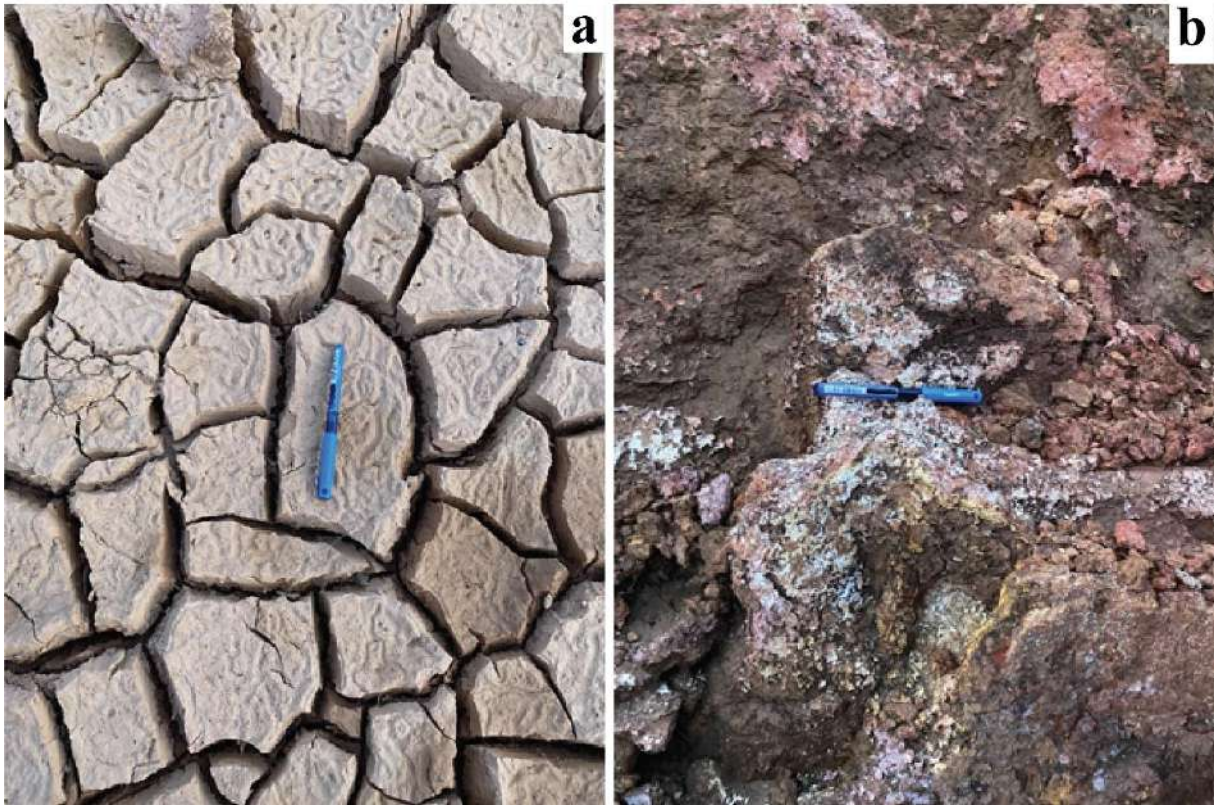


Figure 22 (a) Rain print and Mud Crack (Sedimentary Structures), (b) Weathered Bauxite (Bauxite is a residual rock which high content of aluminium and here it is a low-grade bauxite deposit)

### 5.4.2 Mineral Characteristics

Low-grade bauxite is found in the area with the parent rock of Charnockite and Granulite. From Laterite, primarily Geothite is formed, and finally, it gives rise to bauxite, a residual rock, i.e., it forms when laterite soils are severely leached of silica and other soluble materials in a wet tropical

or subtropical climate. It is a mixture of hydrous aluminium oxides, aluminium hydroxides, clay minerals, and insoluble materials such as quartz, hematite, magnetite, siderite, and goethite. The aluminium minerals in bauxite can include gibbsite $Al(OH)_3$, boehmite AlO(OH), and diaspore, AlO(OH).

Figure 23 Yercaud Bauxite mines

# 6. DAY 5 (18/3/2022)

## 6.1 Area Name: Uttatur Terrain, Cauvery Basin (Location 1), Karai Formation (Location 2), Sathanur Petrified Wood (Location 3), Alathur-Ariyalur (Location 4)

**Location 1**

Latitude: 11° 04' 20" Longitude: 78° 52' 09"

**Location 2**

Latitude: 11° 07' 29" Longitude: 78° 54' 26"

**Location 3**

Latitude: 11° 09' 40" Longitude: 78° 58' 35"

**Location 4**

Latitude: 11° 07' 18" Longitude: 78° 56' 02"

### 6.1.1 Geology

It is Precambrian Basement in the southern granulite terrain. Mainly this area is Karai formation of Uttatur Group where major transgression has occurred below 150 m water depth and ranges from Lower Cretaceous to Upper Cretaceous. It falls under the Cauvery Basin, a sedimentary basin and sub-divided into Pondicherry, Tiruchirapalli and Ariyalur sub-basins. The trend of one of the outcrops that we measured in the area is N40E/N130/SE. In the area, we observed two types of terrains, i.e. hard rock and soft rock and the presence of soft rock, mostly clay, indicates that the area was filled with water or is used as a water reservoir. In location 2, we mainly observed badland topography which is calcic rich and plays a critical role because there cannot be any activity. Also, we observed some sand dykes that usually form late than the mudstone. In Location 3, we observed petrified wood about 90my old, formed in a shallow marine to fluvial interphase. In Location 4, we observed contact zones, i.e. the formation of contact between Karai and Kollokantham sandstone. We know there are four unconformities, and in the area we mainly observed only disconformity, which is an unconformity between parallel layers of sedimentary rocks representing a period of erosion or non-deposition.

### 6.1.2 Mineralogical Characteristics:

Karai Formation is predominantly composed of clay. The parent rock in the area is Charnockite which has quartz, feldspar and pyroxene. Especially in Location 2, we observed that it has mudstone with intercalation of siltstone. The area was filled with phosphatic nodules or commonly known as Uttatur Potato, along with the presence of gypsum.

### 6.1.3 Economic Importance:

The area is abundantly filled with fossils, mainly belemnites, indicating the area to be a marine environment. It is an important food source for many marine creatures and played an important role in restructuring marine ecosystems after the Triassic–Jurassic extinction event. The presence of phosphatic nodules, spherical in shape, contains fossils in it, supplies nutrients, is highly organic and is upwelling

in nature.

The Mesozoic rocks of southern India are exposed mainly in the Cauvery Basin, divided into three sub-basin, and Ariyalur is one of them. The importance of these Cretaceous deposits lies in the development of their diverse lithofacies, abundance and variety of fossils and wide geographical distribution in the region. The Cauvery basin cover 1/3$^{rd}$ part of the landmass and 2/3$^{rd}$ of the offshore. The main structural framework of the Cauvery basin is of the horst and graben type. The area is located at Uttattur in the Perambalur district. The Uttattur Group is divisible into Lower Arogyapuram Formation (Albian), Middle Maruvattur Formation (Late Albian) made up of limestone, mud and clay and Upper Karai Formation (Late Albian – early Turonian) consisting of gypseous clay and sandstone with lenses of limestone. The presence of alternative shale, limestone and clay are due to sea level changes in 110ma with many transgression and regression. The area is dominant in Non-conformity.

Badlands are dry terrain, where softer sedimentary rocks are clay-rich soils that have been extensively Eroded by wind and water. They are characterized by steep slopes, minimum human habituation, minimum vegetation and high drainage density. The general dip of the area is toward NE at a low angle. The terrain highlands are due to their highly eroding nature. This area belongs to a past enclosed bay and experienced a huge deposition of salt evaporation. It is a highly eroded area, and a greater number of gullies are formed, joining the mainstream, or these sediments are rich in gypsum; the region is favourable for cotton cultivation. Here, abundantly found phosphatic nodules known as 'Uttatur potatoes' with an outer shell of chalk and inner phosphate forming a potato-like structure.


Figure 24 (a) Dr. Kumarvel, GSI explaining the Badland Topography, its mechanism of formation (b) Disconformity between Karai shale and Kolakanatham sandstone, (c) Dr. Kumarvel, GSI eplaining the idea of mapping and usage of toposheet during field study.

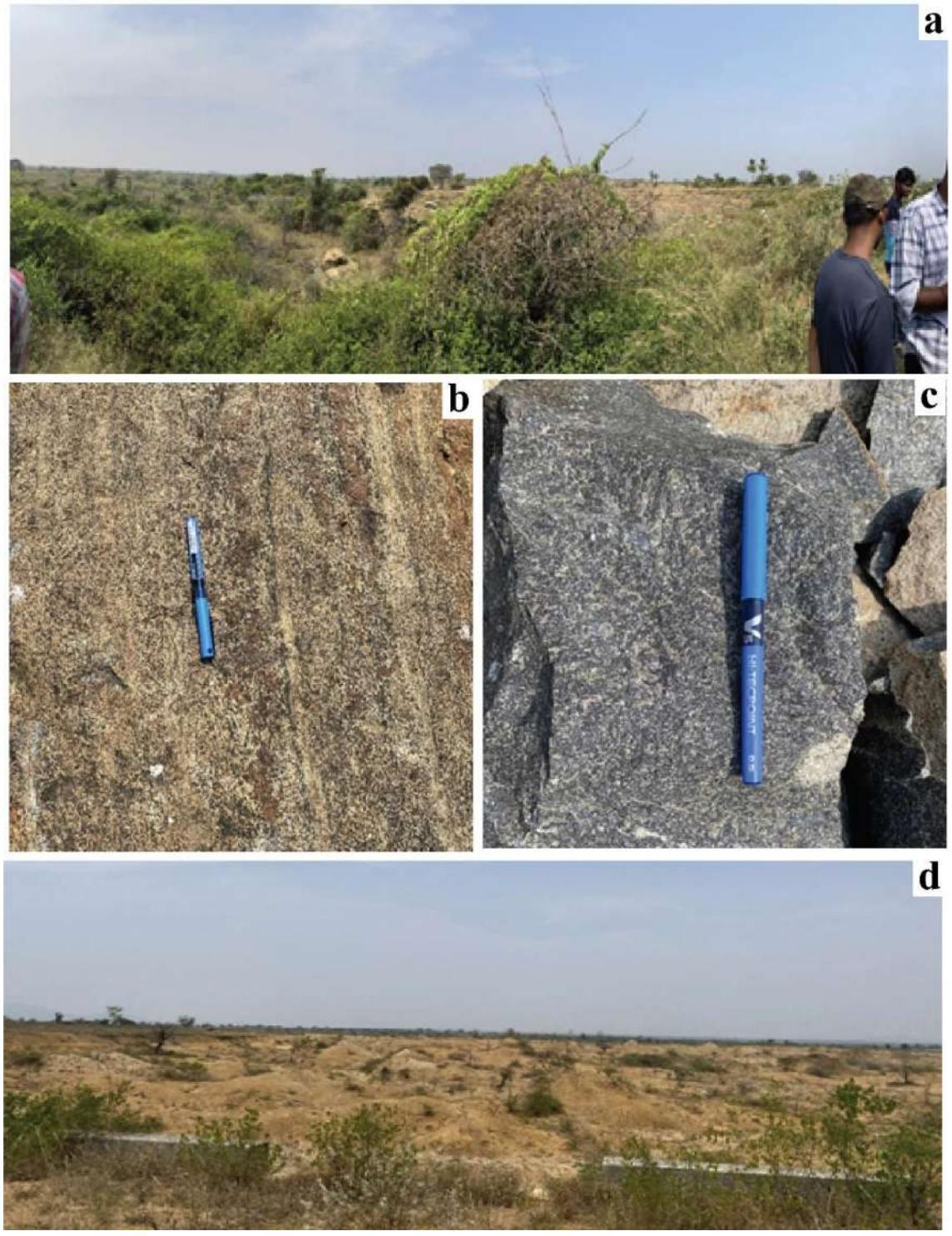


Figure 25 (a) Karai Formation (mostly clay dominated), (b) Charnockite (Metamorphic rock which mainly consists of orthopyroxene-bearing quartz-feldspar formed at high P/T condition and is found in granulite facies), (c) Charnockite (Metamorphic rock which mainly consists of orthopyroxene-bearing quartz-feldspar formed at high P/T condition and is found in granulite facies), (d) Badland Topography (Dry terrain where different agents extensively erode soft terrain

These marine sediments belong to the Uttatur formation. The Uttatur beds consist of fine silts, calcareous shales and sandy Clays containing ferruginous, phosphatic and calcareous nodules. The clay

is often streaked with yellow and brown ferruginous stains. Phosphatic minerals first cover the area, and then the area is reached by lime. The area is called Badlands topography. Sand dyke is found in the area.

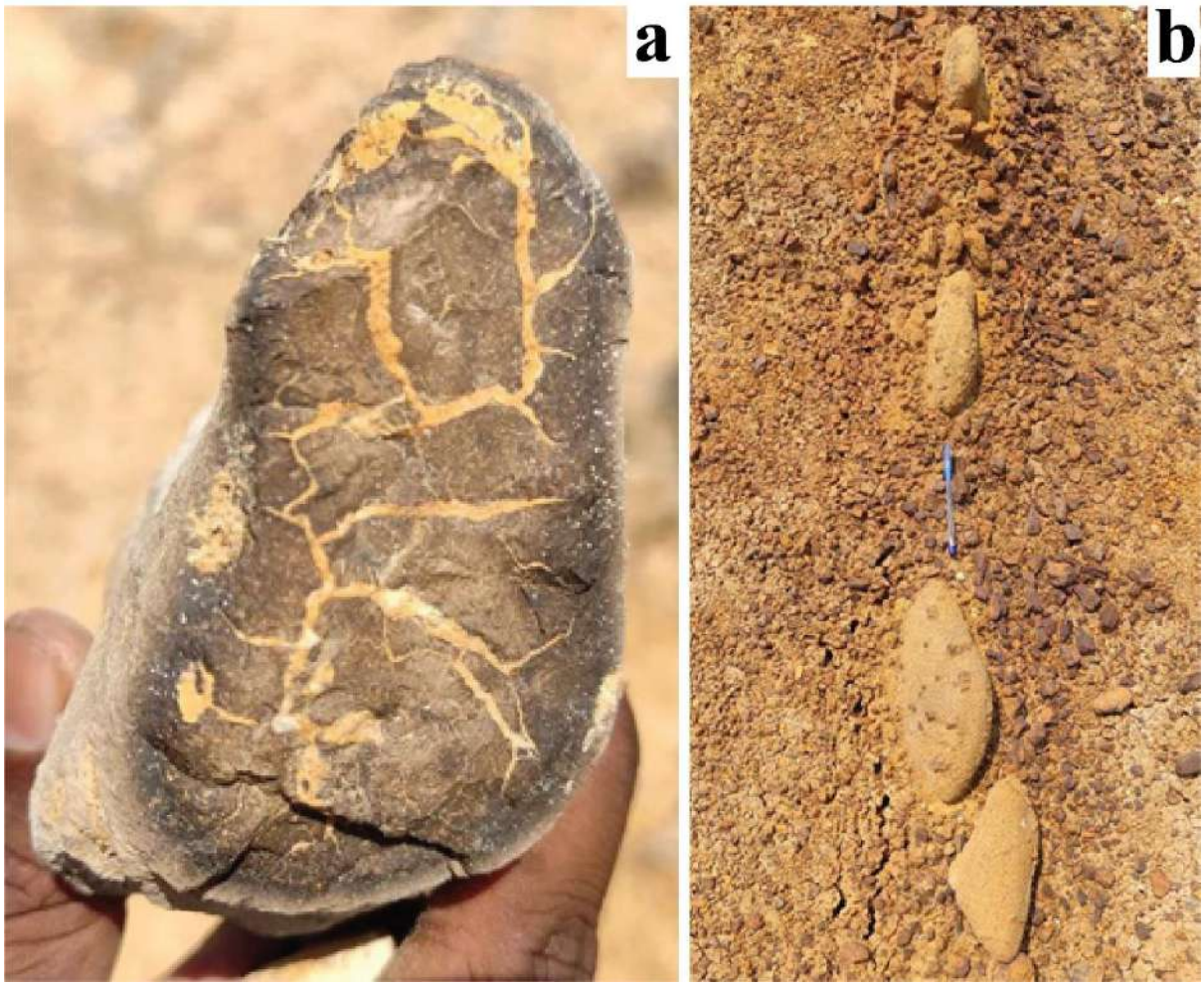


Figure 26 (a) Phosphatic Uttatur potatoes, (b) Sand dyke in Badland topography

## 6.2 Area Name: National Fossil Park, Sathanur

**Location**

Latitude: 11° 09' 49" Longitude: 78° 58' 08"

Sathanur is a National Geo-heritage monument of India located at Sathanur in Perambalur district, Tamil Nadu. The petrified tree trunk is believed to be over 120 million years old, and it was found by M.S. Krishnan in 1940. It is considered to be evidence of the presence of a sea during the cretaceous period in this area. This fossil is of a conifer and measures around 18 metres long. The sand deposition is preserved, and the tree's tissue is removed and replaced by silica materials, but the cell structure is still sustained and now formed as a rock. This fossil tree is a rare National asset collection of specimens. Two fossil woods of 20ma are also present in that park, collected from Thriuvakkarai of Villupuram district.


Figure 27 (a) Petrified Tree Trunk, (b) Petrified wood of Villupuram district

## 6.3 Area Name: Disconformity between Karai shale and Kolakanatham sandstone

**Location**

Latitude: 11° 07' 18" Longitude: 78° 56' 02"

An exposure showed the abrupt contact zone between **Karai- shale** and **Kolakanatham- sandstone**. The exposure was so clear that we could recognize the shale and sandstone contact zone; in other words, it was a disconformity.

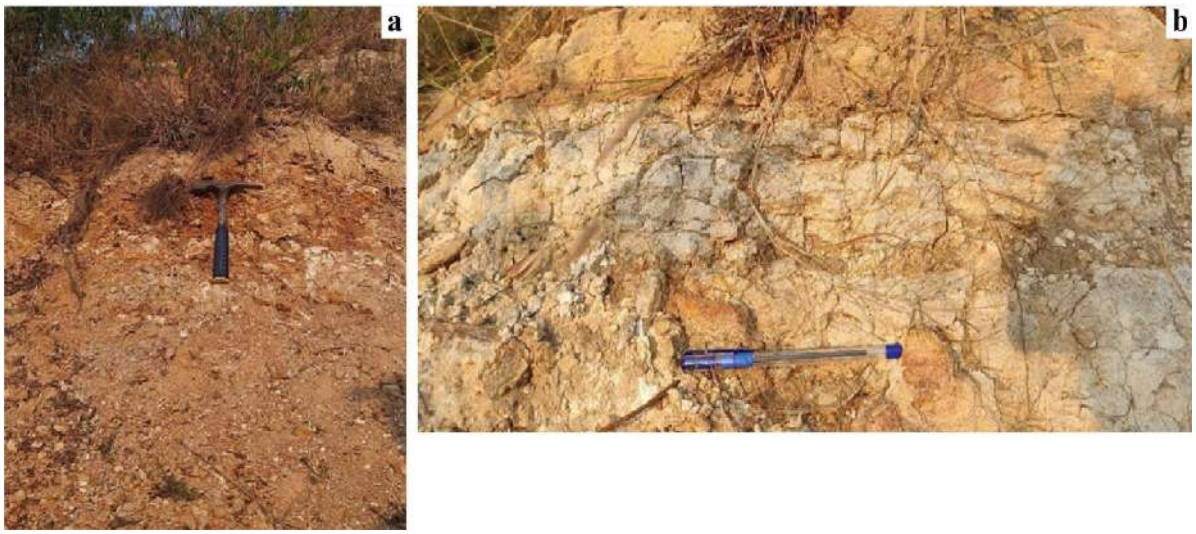


Figure 28 Disconformity between Karai shale and Kolakanatham sandstone indicates alternative transgression and regression.

# 7. DAY 6 (19/3/2022)

## 7.1 Area Name: The Ramco Cements Limited (Office) (Location 1), Cement Mine (Location 2), Karambiyam (Location 4), Factory (Location 4)

**Location 1**

Latitude: 11° 07' 12" Longitude: 79° 08' 51"

**Location 2**

Latitude: 11° 09' 31" Longitude: 79° 10' 45"

**Location 3**

Latitude: 11° 10' 34" Longitude: 79° 05' 49"

**Location 4**

Latitude: 11° 10' 25" Longitude: 79° 05' 42"

The area is a part of Ramco Cement limited; it is an open-cast mine of limestone associated with fossils deposit. The Ariyalur Ramco cement factory is of sedimentary hosted in the case of Virudhunagar and Thoothukudi of meta sediment deposits. The lithology of the area is Limestone, ferruginous Limestone, Calc Sandstone and Conglomerate. The primary fossil contents are Ammonite, Gryphaea, Stigmatophygus, and Pecten. The major composition for Cement is limestone $CaCo_3$(96%), Iron ore $Fe_2O_3$(2%), $Al_2O_3$ (2%) and 1% of burning material.

### 7.1.1 General Geology:

The Ramco Cement has 6-7 plants, of which three are present in the state of Tamil Nadu itself, and this mine, i.e. situated in Ariyalur, is of sedimentary type. The Ariyalu Ramco Cement has two areas, i.e. Virudhanagar, which is sedimentary hosted, and Thoothukudi, which is meta sediment hosted. The area is a metasedimentary basin, part of Ramco Cement limited, and is associated with many fossils. The major type of mining in this area is open cast mining.

Location 3, the Karambiyam area belongs to the Tiruchirapalli group and is a protected area where we observed prominent ammonite fossils.

### 7.1.2 Mineralogical Characteristics:

This area mainly consists of limestone and calcite; the parent rock is mostly Pyroxene Garnet. It is of the upper Cretaceous period with a lithology of Limestone, Ferruginous Limestone, Calc Sandstone, and Conglomerate.

The Cement composition is mostly limestone of about 96%, Iron Ore of 2%, Aluminium oxide of 2% and burning material of 1%.

### 7.1.3 Economic Importance:

Many fossils, mainly of the Cretaceous period, are found in the area, such as Ammonite, Gryphaea, Pecten, and Stigmatophygus, which help in excellent stratigraphy and indicate the presence of marine sedimentary rock.

Figure 29 Ammonite with dendritic pattern (Shelled cephalopods belonging to the phylum Mollusca with some imprints of leaves)


Figure 30 Interaction with the Geologist, Ramco Cement, Ariyalur

# 8. Conclusion

Geological fieldwork is an integral part of the curriculum, which helps in enhancing theoretical knowledge in the practical world.

Our field was mainly based in geological domain areas of Tamil Nadu, where we visited some of the mines, such as Mica Mines and Magnesite Mines. We also observed various rock types, with few primary and secondary structures, along with some economically essential minerals and fossils. We also visited Periyar University and Arts and Science College, Salem, where we were introduced to various new ideas and learned the importance of the field area.

Although Geologists are not perfect, as there is a saying that each one of the Geologist has got their fault but we the budding Geologist, still tried our best to complete the fieldwork successfully in time with much enthusiasm and fill ourselves with much knowledge and holding a belief of learning more in the near future.

# Acknowledgement

Firstly, we would like to thank God, who gave me this opportunity to participate and perform on such a promising trip. This fieldwork was conducted from 14$^{th}$ to 19$^{th}$ March 2022. We would like to express our gratitude to the authorities of the Central University of Tamil Nadu for permitting us to conduct the Geological Field Work in and around different districts of Tamil Nadu. Our utmost thanks to Dr.Guru Balamurugan, Head of the Department of Geology and Dr. Bankim Chandra Mahanta, Assistant Professor, Department of Geology, for making all the necessary arrangements for the field study.

We express our earnest gratitude to the Geological Survey of India (GSI), Periyar University and Government College of Arts and Science, Ramco Cements, Ariyalur, Ponguru Magnesite, Salem, Sevattur Mica Mine for giving us their valuable time and guidance throughout the fieldwork and providing us the knowledge and helping us in understanding all the necessary terms related to the fieldwork.

At last, we would like to thank all the faculty members of the Department of Geology, CUTN, for their continuous support.