

### **Detailed Petrographical / Petrological Report**

**1. Sample No.: RP-01 (Surface Sample)**

**Rock Type: Fine-grained Siltstone with vein filling**

**a. Megascopic Description**

The rock is greyish to light brown in colour, fine to very fine grained, compact, and hard in nature. The surface shows thin linear streaks and minor cracks. No foliation or metamorphic banding is observed.

**b. Microscopic Description**



- Under the microscope, the rock exhibits a very **fine granular clastic texture** characteristic of sedimentary origin. The grains are very fine, closely packed, and sub-angular to sub-rounded, forming a **massive, non-foliated fabric**.
- Thin fractures and hairline cracks are present, locally filled with secondary mineral matter forming **irregular, discontinuous vein-like fillings**, indicating post-depositional fracturing.
- The fine, compact matrix binds the clastic grains, with **minor brownish ferruginous staining** along fractures and grain boundaries. No preferred mineral orientation or recrystallized texture is observed.

**c. Approximate Mineral / Component Composition**

- **Quartz:** ~55–60%  
Present as very fine sub-angular to sub-rounded detrital grains.
- **Feldspar:** ~15–20%  
Occurs as fine detrital grains, partly altered.
- **Clay minerals / fine matrix:** ~10–15%  
Present as fine binding material between grains.
- **Ferruginous matter:** ~3–5%  
Seen as brownish stains along fractures and grain contacts.
- **Secondary vein material (Quartz / Calcite):** ~3–5%  
Filling thin cracks and micro-fractures.
- **Opaque minerals:** ~1–2%  
Present as scattered fine black grains.

**d. Cement and Porosity**

- The rock is compact and cemented mainly by siliceous to minor calcareous material.
- Primary porosity is low, further reduced due to cementation and compaction.

**e. Interpretation**

The fine clastic texture, absence of foliation, and presence of detrital quartz and feldspar grains indicate a **sedimentary origin**. The thin vein fillings represent **post-depositional fracturing followed by secondary mineral infilling**. Minor ferruginous staining suggests limited secondary alteration.

**f. Result**

Based on microphotograph interpretation, the specimen is identified as a **fine-grained Siltstone rock** with **secondary vein filling**.

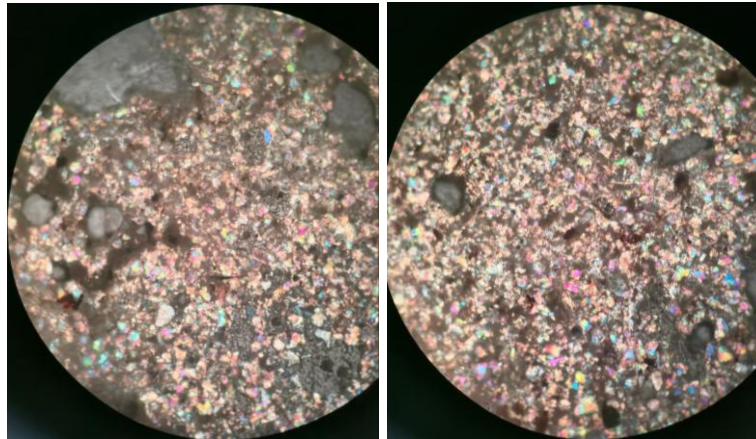
**2. Sample No.: RP-02 (Surface Sample)**

**Rock Type: Shale / Silty Shale**

**a. Megascopic Description**

The rock is **buff grey in colour**, **very fine to medium grained**, compact, and massive in nature.

**b. Microscopic Description**



Under the microscope, the rock is **very fine grained and matrix-dominated**. It shows a **clastic texture** and is **poorly sorted**. Most grains are embedded in a fine clay-rich groundmass. A weak preferred orientation of platy minerals is observed, which is typical of shale to silty shale.

**c. Approximate Mineral Composition**

- **Clay minerals (mainly illite):** ~55–60%  
Occur as very fine flaky aggregates forming the main matrix.
- **Quartz:** ~25–30%  
Present as very fine silt-sized grains, sub-angular to sub-rounded in shape.
- **Ferruginous matter:** ~8–10%  
Occurs as brownish to reddish patches and stains within the matrix and along grain contacts.
- **Opaque minerals:** ~2–3%  
Present as fine black grains and streaky fillings.

**d. Cement and Porosity**

- The cement is mainly **clay and minor ferruginous material**.
- **Porosity is very low**, as pore spaces are filled by clay and iron oxides.

**e. Chemical Reaction**

The rock does **not react with dilute acids**, but shows **weak reaction with strong (hard) acids**.

**f. Interpretation**

The very fine grain size, dominance of clay minerals, and matrix-supported fabric indicate deposition in a **low-energy environment**, such as a **quiet marine or lacustrine setting**. The mineral assemblage suggests **moderate burial and diagenesis**.

**g. Result**

Based on megascopic and microscopic characteristics, the specimen is identified as **Shale to silty shale**.

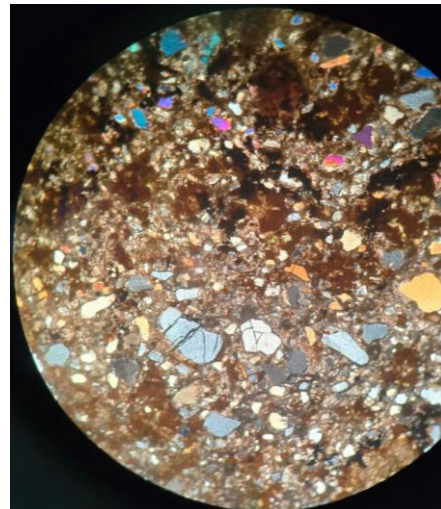
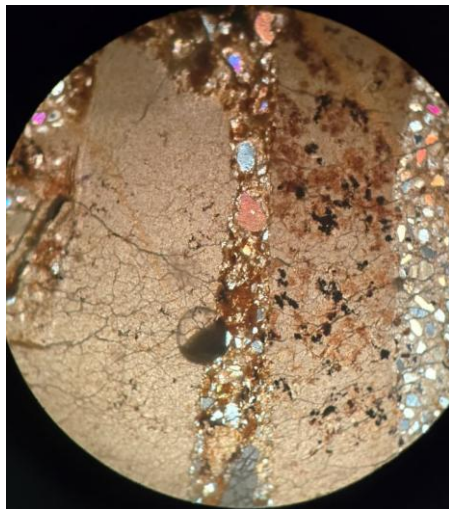
**3. Sample No.: RP-03 (Surface Sample)**

**Rock Type: Phosphate-bearing Sandstone (Sandstone with Collophane)**

**a. Megascopic Description**

The rock is **light buff to brown** in colour, **fine grained**, and shows a **granular texture**.

**b. Microscopic Description**



Under the microscope, the rock shows a **clastic, granular texture**. The grains are **fine to medium sized** and are **sub-rounded to sub-angular** in shape. The framework grains are floating in a **mixed clay–collophane–ferruginous matrix**.

**c. Approximate Mineral Composition**

- **Quartz:** ~40–45%  
Present as fine to medium-grained sub-rounded to sub-angular clasts forming the main framework.
- **Clay minerals:** ~20–25%  
Occur as very fine flaky aggregates in the matrix.
- **Collophane (phosphate mineral):** ~15–20%  
Present as **brownish amorphous aggregates and patches**, commonly mixed with clay and ferruginous material.
- **Ferruginous matter:** ~10–12%  
Occurs as reddish-brown patches, stains, and coatings along grain boundaries.
- **Rock fragments & Feldspar:** ~3–5%  
Present in minor amounts as detrital grains.
- **Biotite (accessory):** ~1–2%  
Occurs as very fine brown flaky grains.

**d. Cement and Porosity**

- The cement is mainly **clay, collophane, and ferruginous material**.



- **Porosity is low to moderate**, partly reduced due to clay and phosphate filling the pore spaces.

**e. Chemical Reaction**

The rock **reacts with strong (hard) acids**, indicating the presence of phosphate and associated calcareous material.

**f. Interpretation**

The presence of quartz framework grains with a clay–collophane matrix indicates deposition in a **sedimentary environment with phosphate enrichment**. The collophane suggests **phosphatic input**, possibly under **marine or marginal-marine conditions**. Ferruginous staining indicates post-depositional iron enrichment.

**g. Result**

Based on megascopic features, thin-section study, and mineral composition, the given specimen is identified as a **phosphate-bearing sandstone (sandstone with collophane)**.

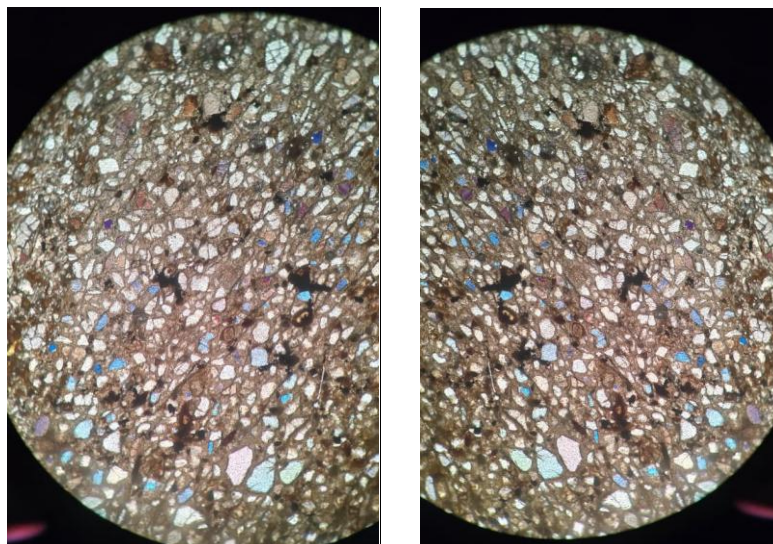
**4. Sample No.: RP-04 (Core Sample)**

**Rock Type: Shale**

**a. Megascopic Description**

The rock is **buff grey** in colour, **very fine grained**, laminated, compact, and massive in appearance.

**b. Microscopic Description (Thin Section Study)**



Under the microscope, the rock shows a **very fine-grained clastic texture**. It is **matrix-supported**, poorly sorted, and made up mainly of clay-sized to fine silt-sized particles. The platy minerals show a **parallel arrangement**, which gives the rock its typical **shaly nature**.

**c. Approximate Mineral Composition**

- **Illite:** ~45–50%  
Present as very fine platy flakes forming the main groundmass. The flakes are aligned parallel to each other.
- **Quartz:** ~25–30%  
Occurs as very fine silt-sized grains, mostly sub-angular to sub-rounded, scattered within the clay matrix.
- **Ferruginous matter:** ~7–10%  
Appears as reddish-brown patches, streaks, and fine fillings between grains.
- **Opaque minerals:** ~5–7%  
Present as small black grains and fine streaks, often associated with iron-rich material.
- **Biotite:** ~1–2%  
Occurs as very fine brownish flakes in minor amounts.

**d. Cement and Porosity**

- The cement is mainly **clay and ferruginous material**.
- **Porosity is very low**, as pore spaces are filled by clay and iron oxides.

**e. Interpretation**

The very fine grain size, dominance of clay minerals, and aligned texture indicate that the rock was deposited in a **low-energy environment**, such as a **quiet marine or lacustrine setting**. The presence of illite suggests **moderate burial and diagenesis**.

**f. Result**

Based on microscopic features and mineral composition, the specimen is identified as a **Shale**.

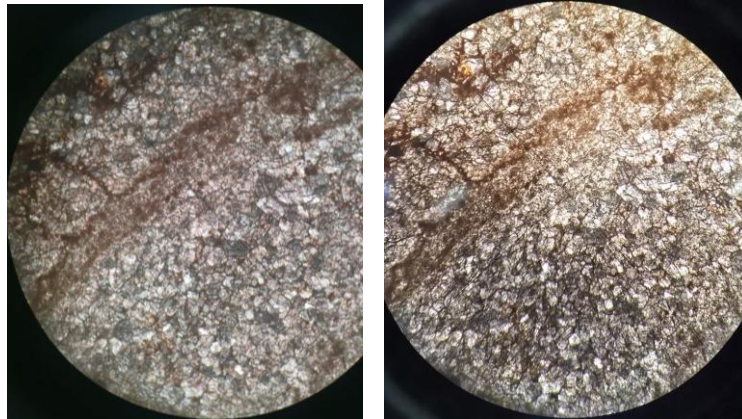
**5. Sample No.: RP-05 Surface Sample**

**Rock Type:** Stromatolitic Limestone (Biogenic Carbonate Sedimentary Rock)

**a. Megascopic Description**

The rock is light grey to brownish grey in colour, fine grained, compact, and hard. Faint wavy banding and irregular lamination are visible on the surface, suggestive of stromatolitic structures. The rock is massive overall, with localized brownish staining along bands and fractures.

**b. Microscopic Description (Thin Section / Microphotograph Interpretation)**



- Under the microscope, the rock exhibits a **fine to very fine crystalline carbonate texture**, laminated to wavy banded predominantly composed of calcite. The calcite grains are closely packed, mostly anhedral to subhedral, forming a dense crystalline mosaic.
- Distinct **stromatolitic lamination** is observed, represented by alternating light and dark bands. The lighter bands are rich in microcrystalline calcite, while the darker bands contain higher concentrations of **ferruginous material, organic matter, and fine impurities**, giving a brownish appearance. These laminae are irregular, wavy, and discontinuous, typical of microbial mat-induced sedimentary structures.

**c. Mineral / Component Composition (Approximate)**

- **Calcite ( $\text{CaCO}_3$ ): ~80–85%**  
Present as microcrystalline to fine crystalline carbonate forming stromatolitic laminae and matrix.
- **Ferruginous material / organic matter: ~5–8%**  
Concentrated along darker stromatolitic bands and micro-fractures.
- **Siliceous material (Quartz / Chert): ~5–7%**  
Occurs as very fine disseminated grains within the carbonate matrix.
- **Clay minerals: ~2–4%**  
Present as fine impurities associated with darker laminae.
- **Opaque minerals: ~1–2%**  
Occur as minor scattered grains.

**d. Cementation and Diagenesis**

The rock is strongly cemented by **calcite cement**, resulting in a dense and compact nature. Diagenetic features include minor recrystallization of micritic carbonate into fine sparry calcite and localized ferruginous staining along laminae and fractures.

**e. Chemical Reaction**

The sample shows a **strong effervescence with dilute hydrochloric acid**, confirming its calcareous composition.

#### **f. Interpretation**

The presence of well-developed stromatolitic lamination indicates formation through **microbial activity**, where cyanobacterial mats trapped and bound carbonate sediments. The sedimentological and petrographic features suggest deposition in a **shallow marine to intertidal environment**, under low-energy conditions with periodic exposure and limited siliciclastic input.

#### **g. Result**

Based on detailed petrographical characteristics, the specimen is identified as **Stromatolitic limestone**, a biogenic carbonate sedimentary rock formed in a shallow marine environment.

### **6. Sample No.: RP-06 Surface Sample**

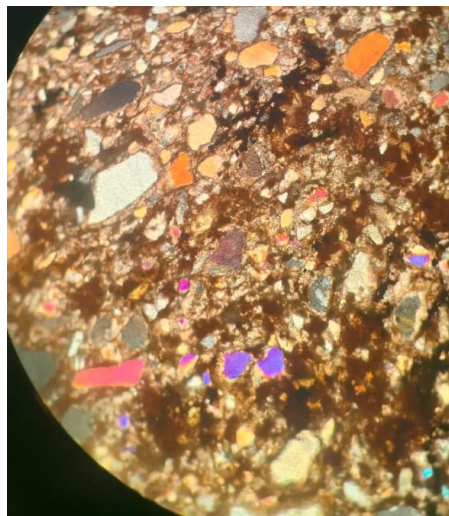
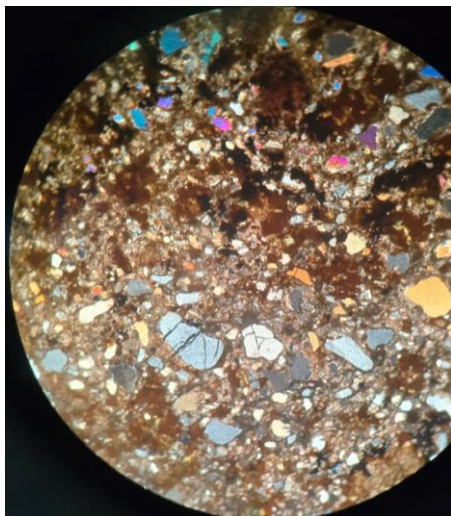
**Rock Type: Ferruginous Lithic Sandstone / Gritty Sandstone**

#### **a. Megascopic Description**

The rock is brown to dark brown in colour, medium to coarse grained, compact, and hard. It shows a gritty feel on fresh surface with visible clastic grains of varying size embedded in a brownish matrix.

#### **b. Microscopic Description**

- Under the Microscope, the rock exhibits a **clastic, poorly to moderately sorted texture**. The grains are **fine to coarse sand-sized**, sub-angular to sub-rounded, and show wide variation in size, indicating immature sedimentation.





- The framework is dominated by **quartz and lithic fragments**, embedded in a **brown ferruginous matrix**. Quartz grains show low to moderate interference colours under crossed polars and occur as monocrystalline and polycrystalline varieties. Lithic fragments of varying composition are common and contribute to the heterogeneous appearance.
- The matrix is abundant and rich in **iron oxide material**, imparting the brown colour to the rock. Grain-to-grain contacts are mostly point to long contacts, suggesting moderate compaction. No foliation or metamorphic fabric is observed.

**a. Mineral / Component Composition (Approximate)**

- **Quartz:** ~40–45%  
Present as sub-angular to sub-rounded detrital grains.
- **Lithic fragments:** ~20–25%  
Includes fine rock fragments of sedimentary origin.
- **Feldspar:** ~10–15%  
Occurs as sub-angular grains, partly altered.
- **Ferruginous matrix / cement:** ~15–20%  
Acts as the primary binding material, giving the rock its brown colour.
- **Opaque minerals:** ~2–3%  
Present as scattered fine grains.

**b. Cementation and Porosity**

The rock is cemented mainly by **ferruginous material**, with minor siliceous cement. Primary porosity is **low**, reduced significantly due to matrix abundance and cementation.

**c. Interpretation**

The poor sorting, abundance of lithic fragments, and ferruginous matrix indicate deposition in a **high-energy sedimentary environment**, such as fluvial channels or proximal alluvial settings. The sediment shows limited transport and rapid deposition, leading to textural immaturity.

**d. Result**

Based on petrographical characteristics, the specimen is identified as a **ferruginous lithic sandstone to gritty sandstone**, a clastic sedimentary rock.

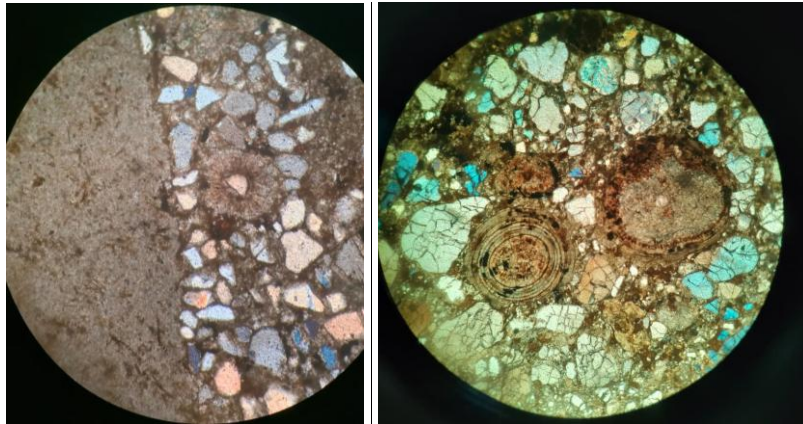
**7. Sample No.: RP-07 Core sample**

**Rock Type: Phosphatic Limestone / Calcareous Rock with Collophane**

**a. Megascopic Description**

The rock is light buff to brown in colour, very fine grained, and exhibits a tabular structure, with smooth granular texture, compact and massive in nature.

## **b. Microscopic Description (Thin Section Study)**



Under the microscope, the rock shows a **clastic to allochemical texture** dominated by **carbonate material**. Rounded to sub-rounded calcareous grains are present, some of which show **concentric layering (ooids/oncoids)**. The grains are embedded in a fine carbonate matrix with minor clay content.

In some thin sections, **collophane is clearly observed**, while in others it is absent, indicating **patchy distribution** of phosphate material.

## **c. Approximate Mineral / Component Composition**

- **Calcite (carbonate material):** ~60–65%  
Occurs as ooids/oncoids, micritic matrix, and sparry cement.
- **Collophane (phosphate mineral):** ~10–15%  
Present as **brownish amorphous aggregates and pore-filling material**, locally associated with carbonate grains.
- **Quartz:** ~10–15%  
Occurs as fine sub-angular to sub-rounded detrital grains.
- **Clay minerals:** ~5–8%  
Present as very fine material mixed with the carbonate matrix.
- **Ferruginous matter:** ~3–5%  
Occurs as brownish stains and patches along grain boundaries.
- **Opaque minerals:** ~1–2%  
Present as minor black grains.

## **d. Cement and Porosity**

- The rock is cemented mainly by **carbonate (calcite) cement**, with local filling by collophane and clay.
- **Porosity is low to moderate**, partly reduced due to cementation.

## **e. Interpretation**

The presence of ooids/oncoids indicates deposition in a **shallow, warm, and moderately agitated marine environment**. The **localized presence of collophane** suggests **phosphate enrichment during or after sedimentation**, possibly linked to marine chemical precipitation and early diagenesis.

## **f. Result**

Based on megascopic features, thin-section study, and mineral composition, the specimen is identified as **Phosphatic Limestone (Limestone with localized collophane)**.