

**Petrological study: Report of rock samples.**

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**PETROGRAPHIC STUDIES  
FOR  
NANHWARA KYMORE LIMESTONE AREA**

PREPARED BY:

**ENGEOTECH CONSULTANT**

1338, VIJAY NAGAR,  
JABALPUR, (M.P.) 482002



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### PETROGRAPHIC STUDY

| S. NO. | PARAMETER           | DESCRIPTION                                                                                                                                       |
|--------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.     | REPORT NO.          | ENGT/PS & MS/2026-27/03                                                                                                                           |
| 2.     | SAMPLE NO.          | BH-02 (13-14m)                                                                                                                                    |
| 3.     | LOCATION            | Nanhwara Kymore Limestone Block<br>Tehsil - Vijayraghgarh<br>District - Katni<br>Area - 22.52 Sq.KM.                                              |
| 4.     | PHYSICAL PROPERTIES | 1. Color - Light Grey<br>2. Form - Massive & micro-crystalline<br>3. Grain size - Fine Grain<br>4. Texture - Non-clastic<br>5. Hardness - 3 - 3.5 |
| 5.     | MINERAL COMPOSITION | 1. Calcite: 85 - 92%<br>2. Clay Mineral: 1-4%<br>3. Quartz: 2-3%<br>4. Opaque: < 1%                                                               |
| 6.     | TYPE OF ROCK        | Sedimentary Rock                                                                                                                                  |
| 7.     | NAME OF THE ROCK    | Grey Limestone                                                                                                                                    |
| 8.     | REMARKS             | This Limestone Section is belonging to<br>Rohtasgarh Formation of Semari Group of<br>Vindhyan Supergroup                                          |

  
INDRANEEL DAWANDE  
M.TECH APPLIED GEOLOGY

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### Sample No. BH-02 (Plane polarized light)

The following features observed:

Rock is Limestone (Limestone of Rohtasgarh Formation of Vindhyan Supergroup)

- **Texture** - Limestone exhibits a fine-grained micritic to microsparitic texture under Plane Polarized Light (PPL). The rock is composed predominantly of densely packed microcrystalline calcite forming a compact and homogeneous carbonate matrix. Recrystallization of the original carbonate mud is evident from the development of fine crystalline mosaic texture. The observed texture that the Rohtasgarh Limestone is a compact microcrystalline fabric is characteristic of Precambrian carbonate deposits of the Semri Group in the Vindhyan Basin.
- **Diagnostic feature:** fine-grained micritic to microsparitic limestone mainly composed of calcite with quartz, and opaque minerals. At places rock shows a compact recrystallized carbonate texture with calcite-filled microfractures and very low porosity, indicating shallow marine deposition followed by diagenetic alteration
- **Porosity:** very low primary porosity due to its dense micritic carbonate matrix and compact recrystallized texture. Minor secondary porosity is present locally along microfractures and calcite-filled veins developed during diagenetic activity.

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### Sample No. BH-02 (under crossed Nicol)

Rock thin section under crossed Nicol (XPL)

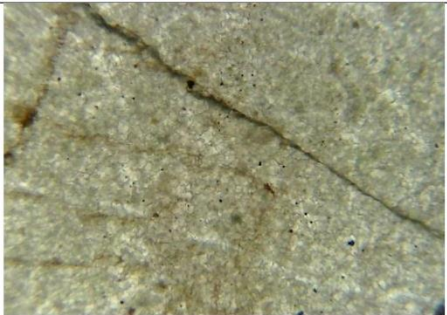
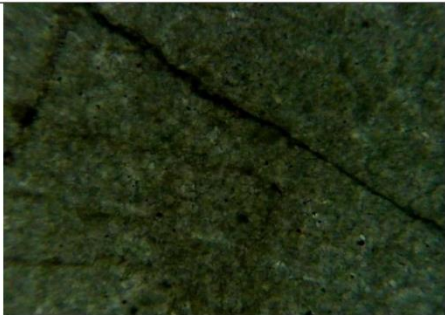
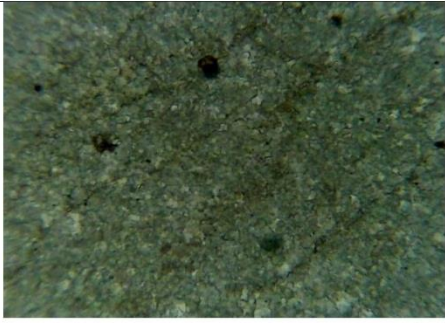
Thin section shows a carbonate – Dominated rock with predominance of calcite.

#### **Mineralogical & optical features –**

- **Calcite (dominant):** Displays high order interference color (bright pastel shades typical of calcite). It occurs both micrite (both fine grained) and sparite (coarser crystalline calcite). At places dolomite occurs as a minor it shows slightly lower birefringence than calcite.
- **Opaque minerals:** Scattered black spots indicating minor opaques (possibly iron oxide).
- **Texture:** Predominantly micritic matrix with patches of sparry calcite cement.
- **Diagenetic feature:** Calcite cementation and recrystallisation mosaic texture are prominent. Twinned calcite indicates strain or diagenetic alteration. Minor voids or pores filled with sparite.
- **Interpretation:** The predominance of micritic carbonate matrix suggests deposition in a low-energy shallow marine environment, favorable for chemical and biochemical precipitation of carbonate mud. The compact nature and poor porosity indicate strong diagenetic cementation and recrystallization after deposition. The rock is fine to very fine grained essentially composed of micro anhedral calcite.

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|                                                                                                       |                                                                                      |
|-------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|                     |                                                                                      |
| <p>Hand Specimen<br/>(Core sample BH-02)</p>                                                          |                                                                                      |
|                      |    |
| <p>Under plane-polarized light (PPL) in showcases fine Micritic calcite &amp; secondary porosity.</p> | <p>At some places recrystallization notice.</p>                                      |
|                    |  |
| <p>At some places secondary porosity notice.</p>                                                      |                                                                                      |

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### PETROGRAPHIC STUDY

| S. NO. | PARAMETER           | DESCRIPTION                                                                                                                                        |
|--------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.     | REPORT NO.          | ENGT/PS & MS/2026-27/04                                                                                                                            |
| 2.     | SAMPLE NO.          | BH-04 (21-22m)                                                                                                                                     |
| 3.     | LOCATION            | Nanhwara Kymore Limestone Block<br>Tehsil - Vijayraghvarh<br>District - Katni<br>Area - 22.52 Sq.KM.                                               |
| 4.     | PHYSICAL PROPERTIES | 1. Color - Light Grey<br>2. Form - Massive & micro-crystalline<br>3. Grain size - Very Fine Grain<br>4. Texture - Non - clastic<br>5. Hardness - 3 |
| 5.     | MINERAL COMPOSITION | 1. Calcite: 83 - 92%<br>2. Clay Mineral: 1-4%<br>3. Quartz: 2-3%<br>4. Opaque: < 1%                                                                |
| 6.     | TYPE OF ROCK        | Sedimentary Rock                                                                                                                                   |
| 7.     | NAME OF THE ROCK    | Grey Limestone                                                                                                                                     |
| 8.     | REMARKS             | This Limestone Section is belonging to Rohtasgarh Formation of Semari Group of Vindhyan Supergroup                                                 |

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### Sample No. BH-04 (Plane polarized light)

Rock is Limestone (Limestone of Rohtasgarh Formation of Vindhyan Supergroup)

- **Texture** – Under plane-polarized light (PPL), the limestone exhibits a fine-grained micritic texture characterized by a dense and homogeneous microcrystalline carbonate matrix. The rock is predominantly composed of very fine calcite crystals forming a mud-supported fabric, with individual grains being difficult to distinguish due to their extremely small size. Minor dark patches and scattered opaque impurities are present within the matrix. Recrystallization of the original carbonate mud is evident from the development of fine crystalline mosaic texture. The observed texture that the Rohtasgarh Limestone is a compact microcrystalline fabric is characteristic of Precambrian carbonate deposits of the Semri Group in the Vindhyan Basin.
- **Diagnostic feature:** The limestone is characterized by a compact and homogeneous **micritic carbonate matrix** composed predominantly of microcrystalline calcite. The rock exhibits a **non-clastic, mud-supported texture** with very fine grain size. At places rock shows a compact recrystallized carbonate texture with calcite-filled microfractures and very low porosity, indicating shallow marine deposition followed by diagenetic alteration
- **Porosity:** very low primary porosity due to its dense micritic carbonate matrix and compact recrystallized texture. Minor secondary porosity is present locally along microfractures and calcite-filled veins developed during diagenetic activity.

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### Sample No. BH-04 (under crossed Nicol)

#### **Mineralogical & optical features –**

Under crossed polarized light (XPL), the limestone is composed predominantly of calcite, which exhibits characteristic low-order grey to whitish interference colours. The carbonate matrix displays a fine crystalline mosaic of micrite and microspar, indicating partial recrystallization of the original carbonate mud during diagenesis. Calcite crystals show moderate birefringence and irregular interlocking grain boundaries. The rock fabric is generally homogeneous, with no preferred crystal orientation. Minor opaque constituents remain extinct under crossed nicols and appear as dark patches within the carbonate matrix. The observed optical characteristics, together with the fine crystalline carbonate fabric, confirm the limestone to be a micritic limestone with localized microspar development resulting from mild diagenetic recrystallization.

- **Calcite (dominant):** Displays high order interference colour (bright pastel shades typical of calcite). It occurs both micrite (both fine grained) and sparite (coarser crystalline calcite). At places dolomite occurs as a minor it shows slightly lower birefringence than calcite. At places small calcite vein noticed the sparry calcite exhibits brighter interference colours and larger crystal sizes compared to the surrounding micrite. The crystals form an interlocking mosaic and display typical carbonate birefringence.
- **Opaque minerals:**

Opaque minerals are present in trace amounts (<1–2%) these minerals remain black and non-transmissive, indicating complete opacity to transmitted light. The opaque constituents are most likely represented by iron oxide minerals (possibly iron oxide).
- **Texture:** Predominantly micritic matrix with patches of sparry calcite cement.
- **Diagenetic feature:** The limestone shows evidence of mild diagenetic alteration, primarily in the form of recrystallization of micrite into microsparry calcite. Under the XPL, the original fine-grained carbonate mud has partially transformed into a mosaic of slightly

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coarser interlocking calcite crystals, while the overall micritic structure remains intact.

Calcite cementation and recrystallisation mosaic texture are prominent. Twinned calcite indicates strain or diagenetic alteration. Minor voids or pores filled with sparite.

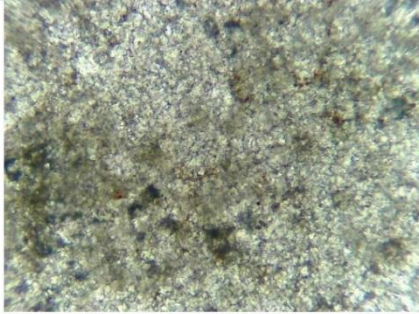
- **Interpretation:** The predominance of micritic carbonate matrix suggests deposition in a low-energy shallow marine environment, favourable for chemical and biochemical precipitation of carbonate mud. The compact nature and poor porosity indicate strong diagenetic cementation and recrystallization after deposition.

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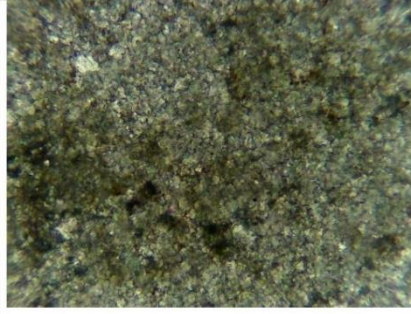
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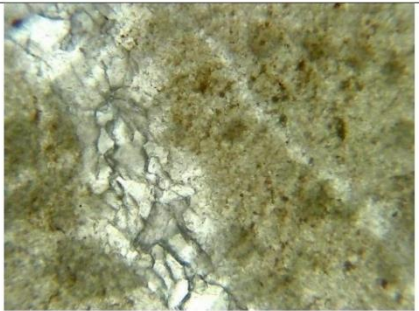
Hand Specimen  
(Core sample BH-04)



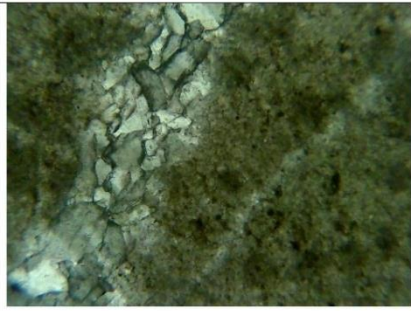
Under plane-polarized light (PPL) in showcases fine  
Micritic calcite



At some places recrystallization notice. (XPL)



At some places small calcite vein are notice. (PPL)



Under Crossed Nicol calcite vein are notice.

**PETROGRAPHIC STUDIES**  
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### PETROGRAPHIC STUDY

| S. NO. | PARAMETER           | DESCRIPTION                                                                                                                                   |
|--------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 1.     | REPORT NO.          | ENGT/PS & MS/2026-27/05                                                                                                                       |
| 2.     | SAMPLE NO.          | BH-05 (23-24m)                                                                                                                                |
| 3.     | LOCATION            | Nanhwara Kymore Limestone Block<br>Tehsil - Vijayraghgarh<br>District - Katni<br>Area - 22.52 Sq.KM.                                          |
| 4.     | PHYSICAL PROPERTIES | 1. Color - Light Gray to Purple Color<br>2. Form - Massive<br>3. Grain size - Fine Grain<br>4. Texture - Non-clastic<br>5. Hardness - 3 - 3.5 |
| 5.     | MINERAL COMPOSITION | 1. Calcite: 90 - 95%<br>2. Clay Mineral: 2 - 4%<br>3. Quartz: 1 - 2%<br>4. Opaque: 0.50 - 1%                                                  |
| 6.     | TYPE OF ROCK        | Sedimentary Rock                                                                                                                              |
| 7.     | NAME OF THE ROCK    | Grey Limestone                                                                                                                                |
| 8.     | REMARKS             | This Limestone Section is belonging to Rohtasgarh Formation of Semari Group of Vindhyan Supergroup                                            |

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### Sample No. BH-05 (PPL)

The Limestone under thin section, under PPL (Plane polarized light).

#### **The following features observed:**

Rock is Limestone (Limestone of Rohtasgarh Formation of Vindhyan Supergroup)

- **Texture** – Microcrystalline to sparry texture. Poor to moderate sorting grain supported to partially matrix supported fabric mineralogical composition dominantly calcite. Presence of micrite (microcrystalline calcite as matrix). Sparry Calcite cement in voids/fracture. Calcite crystals show an interlocking mosaic pattern. The observed texture that the Rohtasgarh Limestone is a compact microcrystalline fabric is characteristic of Precambrian carbonate deposits of the Semri Group in the Vindhyan Basin. The limestone exhibits a fine crystalline micritic to microsparitic texture. The rock is predominantly composed of very fine-grained calcite forming a compact and dense mosaic fabric. Calcite crystals are closely packed and show an interlocking relationship, producing a homogeneous appearance throughout the thin section.
- **Diagnostic feature:** fine-grained micritic limestone deposited under low-energy shallow marine conditions and subsequently subjected to mild diagenetic recrystallization. At places slight compaction effects possible pressure solution feature (irregular boundaries).
- **Porosity:** Very low primary porosity and secondary porosity partly intermixed shale with calcite cement. Other observation cloudy appearance due to micrite and patchy distribution of sparry calcite. No strong colour variation in PPL (typical of calcite). limestone is characterized by a dense and compact texture with poor effective porosity, indicating strong diagenetic compaction and cementation

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### Sample No. BH-05 (XPL)

Rock thin section under crossed Nicol (XPL)

Thin section shows a carbonate – Dominated rock with predominance of calcite.

#### **Mineralogical & optical features –**

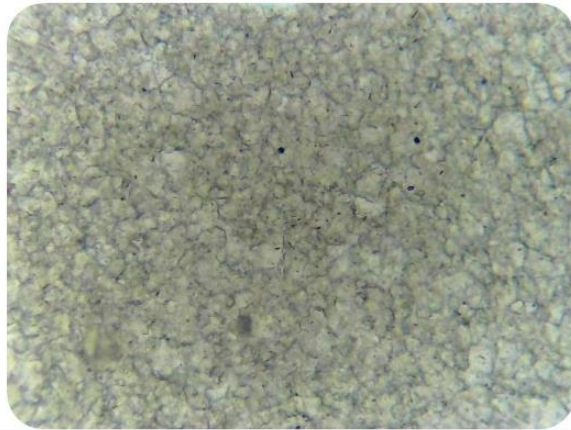
- **Calcite (dominant):** Displays high order interference colour (bright pastel shades typical of calcite). It occurs both micrite (both fine grained) and sparite (coarser crystalline calcite). At places dolomite occurs as a minor it shows slightly lower birefringence than calcite.
- **Opaque minerals:** Scattered black spots indicating minor opaques (possibly iron oxide).
- **Texture:** Predominantly micritic matrix with patches of sparry calcite cement.
- **Diagenetic feature:** Calcite cementation and recrystallisation mosaic texture are prominent. Twinned calcite indicates strain or diagenetic alteration. Minor voids or pores filled with sparite.
- **Interpretation:** The predominance of micritic to microsparitic limestone deposited in a low-energy shallow marine carbonate environment. Subsequent diagenesis resulted in recrystallization of the original carbonate mud into a fine crystalline calcite mosaic, producing a compact, low-porosity limestone characteristic of the Rohtasgarh Limestone Formation (Semri Group) exposed in the Nanhwara–Vijayraghavgarh area of Katni District.

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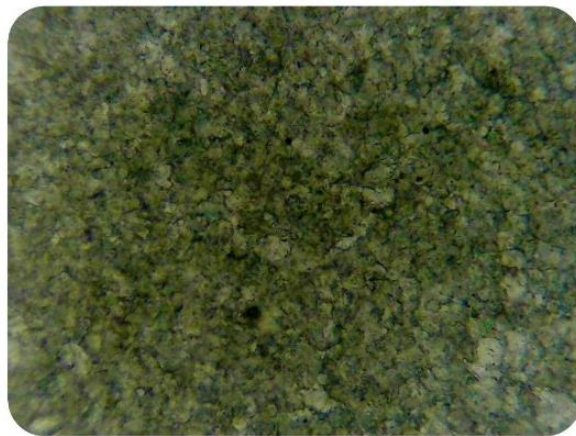
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Hand Specimen  
(Core sample BH-05)



At this places micritic to micro-sparitic texture  
noticed in Plane polarized light.



At some places recrystallization notice under crossed  
Nicol

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|--------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 1.     | REPORT NO.          | ENGT/PS & MS/2026-27/06                                                                                                                       |
| 2.     | SAMPLE NO.          | BH-08 (09-10m)                                                                                                                                |
| 3.     | LOCATION            | Nanhwara Kymore Limestone Block<br>Tehsil - Vijayraghvarh<br>District - Katni<br>Area - 22.52 Sq.KM.                                          |
| 4.     | PHYSICAL PROPERTIES | 1. Color - Light Gray to Purple Color<br>2. Form - Massive<br>3. Grain size - Fine Grain<br>4. Texture - Non-clastic<br>5. Hardness - 3 - 3.5 |
| 5.     | MINERAL COMPOSITION | 1. Calcite: 90 - 95%<br>2. Clay Mineral: 2 - 4%<br>3. Quartz: 1 - 2%<br>4. Opaque: 0.50 - 1%                                                  |
| 6.     | TYPE OF ROCK        | Sedimentary Rock                                                                                                                              |
| 7.     | NAME OF THE ROCK    | Grey Limestone                                                                                                                                |
| 8.     | REMARKS             | This Limestone Section is belonging to<br>Rohtasgarh Formation of Semari Group of<br>Vindhyan Supergroup                                      |

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### Sample No. BH-08 (PPL)

The Limestone under thin section, under PPL (Plane polarized light).

#### **The following features observed:**

Rock is Limestone (Limestone of Rohtasgarh Formation of Vindhyan Supergroup)

- **Texture** – The sample exhibits a microcrystalline fabric, dominated by uniform, interlocking grains. The crystals are primarily micritic to microsparitic in size, indicating a very fine-grained texture. The distribution of grains appears relatively homogeneous across the field of view. The presence of a crystalline mosaic in XPL suggests a texture that has undergone diagenetic stabilization or partial recrystallization. The observed texture that the Rohtasgarh Limestone is a compact microcrystalline fabric is characteristic of Precambrian carbonate deposits of the Semri Group in the Vindhyan Basin. The limestone exhibits a fine crystalline micritic to microsparitic texture. The rock is predominantly composed of very fine-grained calcite forming a compact and dense mosaic fabric. Calcite crystals are closely packed and show an interlocking relationship, producing a homogeneous appearance throughout the thin section.
- **Grain size:** Very fine grained (micrite dominant) occasional slightly coarser re-crystallized patches.
- **Diagnostic feature:** fine-grained micritic limestone deposited under low-energy shallow marine conditions and subsequently subjected to mild diagenetic recrystallization. At places slight compaction effects possible pressure solution feature (irregular boundaries).
- **Porosity:** Very low primary porosity and secondary porosity partly intermixed shale with calcite cement. Other observation cloudy appearance due to micrite and patchy distribution of sparry calcite. No strong colour variation in PPL (typical of calcite). Limestone is characterized by a dense and compact texture with poor effective porosity, indicating strong diagenetic compaction and cementation

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### Sample No. BH-8 (XPL)

Rock thin section under crossed Nicol (XPL)

Thin section shows a carbonate – Dominated rock with predominance of calcite.

#### **Mineralogical & optical features –**

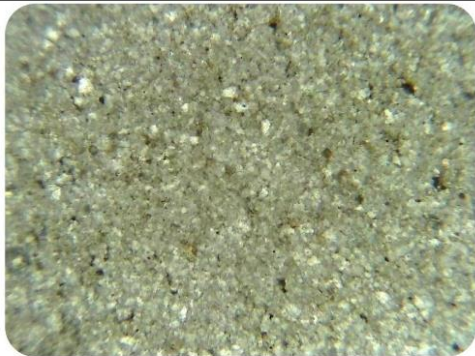
- **Calcite (dominant):** Displays high order interference colour (bright pastel shades typical of calcite). It occurs both micrite (both fine grained) and sparite (coarser crystalline calcite). At places dolomite occurs as a minor it shows slightly lower birefringence than calcite.
- **Opaque minerals:** Scattered black spots indicating minor opaques (possibly iron oxide).
- **Texture:** The rock shows a micritic to microsparitic texture with patches of recrystallization forming sparry calcite. Grain size is very fine to fine. The texture is mostly homogeneous through locally patchy due to diagenetic effect. The fabric is massive and non-oriented, typical of carbonate rock. No preferred alignment of grains is observed.
- **Optical properties (XPL):** Calcite grains exhibit high order interference colour (bright pastel shades), though somewhat subdued due to fine grain size. Twinning in calcite faintly visible in coarse sparry patches. Micrite appears relatively dull under XPL compared to sparry calcite. Quartz grains (minor) show low order grey interference color.
- **Diagenetic feature:** Calcite cementation and recrystallisation mosaic texture are prominent. Twinned calcite indicates strain or diagenetic alteration. Minor voids or pores filled with sparite.
- **Interpretation:** The predominance of micritic to microsparitic limestone deposited in a low-energy shallow marine carbonate environment. Subsequent diagenesis resulted in recrystallization of the original carbonate mud into a fine crystalline calcite mosaic, producing a compact, low-porosity limestone characteristic of the Rohtasgarh Limestone Formation (Semri Group) exposed in the Nanhwara–Vijayraghavgarh area of Katni District.

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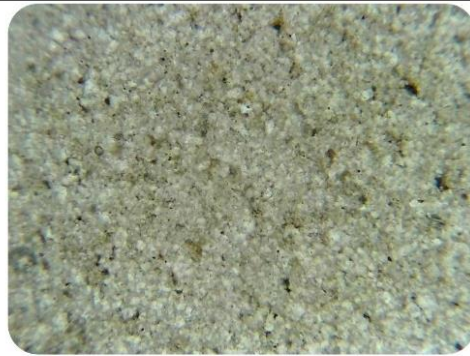
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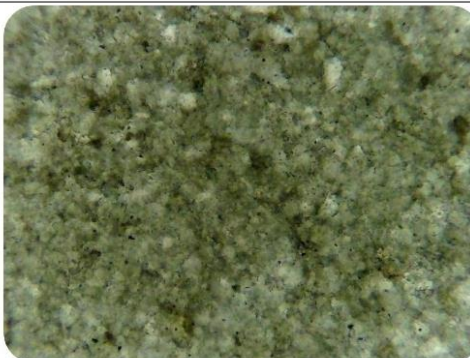
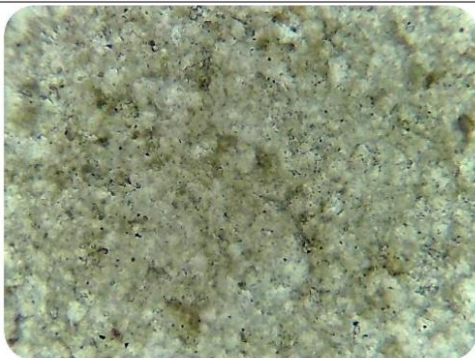
Hand Specimen  
(Core sample BH-08)



At this places micritic to micro-sparitic texture noticed in Plane polarized light.



At some places recrystallization notice under crossed Nicol



**PETROGRAPHIC STUDIES**  
**FOR**  
**NANHWARA KYMORE LIMESTONE AREA**

PREPARED BY:

**ENGEOTECH CONSULTANT**  
1338, VIJAY NAGAR,  
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### PETROGRAPHIC STUDY

| S. NO. | PARAMETER           | DESCRIPTION                                                                                                                  |
|--------|---------------------|------------------------------------------------------------------------------------------------------------------------------|
| 1.     | REPORT NO.          | ENGT/PS & MS/2026-27/02                                                                                                      |
| 2.     | SAMPLE NO.          | Bed Rock Sample - 39                                                                                                         |
| 3.     | LOCATION            | Nanhwara Kymore Limestone Block<br>Tehsil - Vijayraghgarh<br>District - Katni<br>Area - 22.52 Sq.KM.                         |
| 4.     | PHYSICAL PROPERTIES | 1. Color - Light Gray<br>2. Form - Massive<br>3. Grain size - Very Fine Grain<br>4. Texture - non-clastic<br>5. Hardness - 3 |
| 5.     | MINERAL COMPOSITION | 1. Calcite: 90 - 94%<br>2. Clay Mineral: 2 - 4%<br>3. Quartz: 1 - 2%<br>4. Opaque: 0.50 - 1%                                 |
| 6.     | TYPE OF ROCK        | Sedimentary Rock                                                                                                             |
| 7.     | NAME OF THE ROCK    | Grey Limestone                                                                                                               |
| 8.     | REMARKS             | This Limestone Section is belonging to<br>Rohtasgarh Formation of Semari Group of<br>Vindhyan Supergroup                     |

INDRANEEL DAWANDE  
M.TECH APPLIED GEOLOGY

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### BRS Sample -39 (plane polarized light)

The limestone thin section study reveals that under PPL (plane polarized light, Limestone) it shows light grade colored carbonate shale dominated by fine grained constituent. The texture appears uniform with occasional darker patches and faint liner features.

**Mineralogical composition:** Calcite is the dominant mineral constituent and forms a fine-grained to microcrystalline (micritic) matrix throughout the thin section. Under PPL, calcite appears colorless, transparent, and exhibits low relief. Clay minerals occur as dark brown to grey, irregular streaks and patches, particularly along the prominent dark seam. Quartz is present in trace to very minor amounts as fine, colorless, anhedral grains dispersed within the carbonate matrix. Opaque minerals occur as minute black specks scattered throughout the thin section. Under Plane Polarized Light, the thin section is composed predominantly of colorless microcrystalline calcite (90–94%), forming a dense micritic matrix. Minor argillaceous material occurs as dark streaks and patches, locally concentrated along pressure-solution seams. Quartz is present in trace amounts as fine colorless grains, while opaque minerals occur as sparse black disseminations.

**Texture:** Micritic texture very fine-grained carbonate matrix, locally shows recrystallization of micro-spar overall homogeneous with minor heterogeneity.

**Grain size:** Very fine grained (micrite dominant) occasional slightly coarser re-crystallized patches.

**Fabric structure:** Massive appearance presence of thin veins/ fracture (seen on earlier features) likely filled with iron-stained calcite or impurities. weakly developed patches modelling due to diagenetic alteration. There is no fossil fragments visible in the section.

Micritization dominant recrystallization to micro-spar in patches. Vein formation (possibly calcite filled fractures) minor iron staining along the fracture noticed.

**Porosity:** Very low to negligible primary porosity largely obtained by cementation.

**Interpretation:** The rock represents a micritic limestone deposited in a low energy marine environment subsequent diagenesis led to recrystallization and fractures filling.

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### BRS Sample -39 (under crossed Nicol)

#### Mineralogical & optical features:

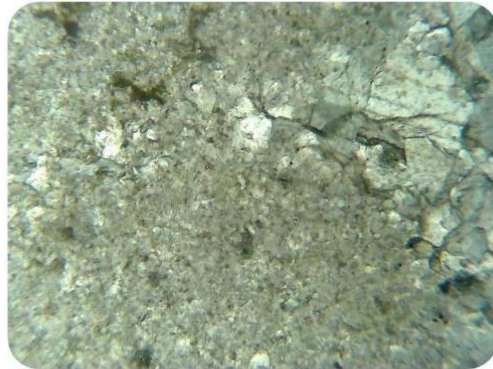
- **Calcite (dominant):** Calcite is the dominant mineral and occurs as a fine-grained micritic to microsparitic mosaic. Under crossed nicols, the carbonate matrix displays low- to high-order interference colors (predominantly grey, white, and locally bright pastel colors) characteristic of calcite. In some areas, recrystallization has produced slightly coarser calcite crystals showing clearer crystal boundaries and mosaic texture.
- **Opaque minerals:** Scattered black spots indicating minor opaques (possibly iron oxide).
- **Texture:** The rock shows a micritic to microsparitic texture with patches of recrystallization forming sparry calcite. Grain size is very fine to fine. The texture is mostly homogeneous through locally patchy due to diagenetic effect. The fabric is massive and non-oriented, typical of carbonate rock. No preferred alignment of grains is observed.
- **Optical properties (XPL):** Moderate to high-order interference colors, appearing as grey, High, characteristic of calcite. Twinning has not distinctly observed in the present field due to fine crystal size, but may occur in recrystallized calcite grains. Form of Crystal Predominantly anhedral microcrystalline to microsparitic crystals. Micrite appears relatively dull under XPL compared to sparry calcite. Quartz grains (minor) show low order grey interference color.
- **Diagenetic feature:** Calcite cementation and recrystallisation mosaic texture are prominent. Twinned calcite indicates strain or diagenetic alteration. Minor voids or pores filled with sparry calcite.
- **Interpretation:** The predominance of micritic to microsparitic limestone deposited in a low-energy shallow marine carbonate environment. Subsequent diagenesis resulted in recrystallization of the original carbonate mud into a fine crystalline calcite mosaic, producing a compact, low-porosity limestone characteristic of the Rohtasgarh Limestone Formation (Semri Group) exposed in the Nanhwara-Vijayraghavgarh area of Katni District.



Hand Specimen  
(BRS Sample 39)



At this place massive appearance presence of thin veins/ fracture (seen on earlier features on left side) likely filled with iron-stained calcite or impurities.



Cleavage is indistinct within the fine-grained carbonate groundmass. Locally, larger calcite crystals exhibit weak to moderate rhombohedral cleavage traces characteristic of calcite.