भारत सरकार
GOVERNMENT OF INDIA
खान मंत्रालय
MINISTRY OF MINES

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भारतीय भूवैशलनक सवेक्षण / Geological Survey of India
दतक्षण क्षेत्र / Southern Region
बैंडलागुडा / Bandlaguda
हैदराबाद / Hyderabad-500068

No. 2611/TCS/GSI/Pet/EPMA/SR/2025 Date: 26/11/2025

Petrographic report

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Sender details

K. Nageswar Rao, Director (G), PR & Corordination,
Critical mineralTrackers,
Hyderabad

Madam,

Please find the attached petrographic report on submitted samples (4 nos.) for your perusal.

Thanking you,

Yours sincere

K. Basak

(Dr. KRISHNAPRIYA BASAK)

/ KRISHNAPRIYA BASAK
Director
Geological Survey of India

1. Sample code: RB/TS/P20

Microscopic observations:

Microscopic study reveals that the rock shows iron oxide minerals dominate these photomicrographs, imparting a pervasive reddish-brown to yellowish hue throughout the rock. Hematite and goethite (Gth) are visible, with goethite showing its characteristic yellow-brown pleochroism and earthy appearance (Fig. 1A-1B). These iron oxides and hydroxides are major constituents of lateritic profiles, forming from the intense chemical weathering of source rocks. Calcite (Cal) is also present as secondary mineralization in discrete patches and vein-like fillings, distinguishable under cross-polarized light by its strong birefringence (Fig. 1C-1D).

The groundmass of the laterite shows a very fine-grained, earthy texture—characteristic of secondary iron oxide/hydroxide accumulation products. The granular to cryptocrystalline appearance of the matrix points to extensive chemical alteration and re-precipitation. Iron oxides display variable grain sizes and aggregate textures, with some areas showing massive accumulations and others more disseminated forms. Calcite infills pore spaces and fractures, indicating later-stage carbonate precipitation likely linked to groundwater movement.

The dominance of goethite and iron oxides marks advanced weathering in a tropical or sub-tropical climate, where leaching removes silica, alkalis, and bases, leaving behind iron and aluminum oxides. Calcite's presence as a late-stage cement or vein-filling suggests diagenetic alterations postdating primary iron oxide formation, possibly due to changes in groundwater pH levels.

Overall, a highly weathered regolith composed mainly of iron oxides/goethite with secondary re-precipitated calcite. The microtextures and diagenetic features—such as matrix-supported iron oxides and calcite veins—point to complex weathering, leaching, and secondary mineralization processes under oxidizing and seasonally wet climate conditions. This mineralogical assemblage and fabric are diagnostic for laterite profiles developed in well-drained, iron-rich weathering environments.

Rock/Mineral Name: Based on the mineral and textural characteristics, it is a Laterite.

Fig. 1C. Photomicrograph showing presence of iron oxide and Calcite (Cal) under transmitted light XPL (10X).

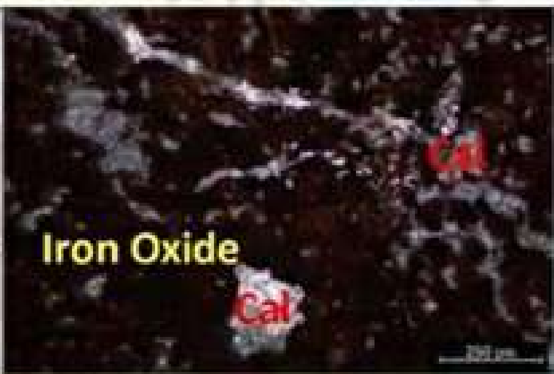


Fig. 1D. Photomicrograph showing presence of iron oxide and Calcite (Cal) under transmitted light XPL (10X).

Fig. 1A. Photomicrograph showing presence of iron oxide under transmitted light XPL (2X).

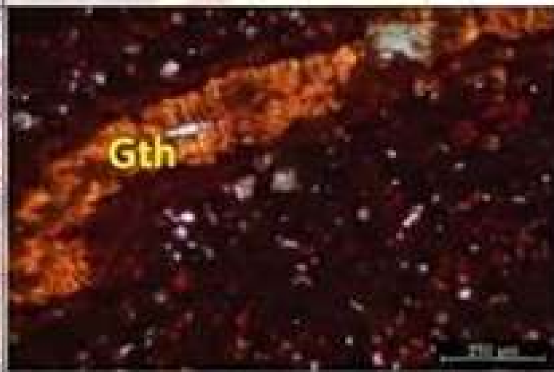


Fig. 1B. Photomicrograph showing presence Goethite (Gth) under transmitted light XPL (10X).

2. Sample code: RB/TS/T3

Microscopic observations:

Microscopic study reveals that the rock shows iron oxides are abundant and form the fundamental matrix of the sample, visible throughout as a reddish-brown, microcrystalline groundmass. These likely represent goethite, hematite, or a mixture of both, which develop under intense chemical weathering conditions typical of tropical lateritic profiles (Fig. 2A-2B). Calcite (Cal), shown in bright birefringence under polarized light, appears as secondary infilling material along fractures and pore spaces (Fig. 2C-2D).

Fine-grained aggregates of iron oxide are apparent, often surrounding or enclosing isolated patches of calcite. The calcite crystals are typically granular to subhedral and occupy interconnected pore spaces or appear as veins, suggesting that lateritic porosity was partially occluded by carbonate precipitation after initial iron oxide formation.

The iron oxide framework reflects extreme leaching and removal of silica, bases, and alkalis, while retaining and reprecipitating iron from precursor minerals. The presence of calcite as a cementing and pore-filling phase points to at least one subsequent episode of geochemical change, such as groundwater influx with dissolved carbonate, resulting in localized calcite precipitation. These processes highlight the multi-stage evolution of laterite, progressing from ferruginous enrichment to partial carbonate cementation.

This rock confirms the classic characteristics of laterite—an iron oxide-rich regolith showing intense weathering, high porosity (partly reduced by later carbonate infilling), and a lack of significant primary silicate minerals. The petrographic evidence demonstrates a highly evolved weathering profile, consistent with tropical soil-forming processes, periodically influenced by groundwater-driven diagenetic developments. Such features are diagnostic for mature laterites, commonly developed over mafic or felsic rocks in warm, humid climates with episodic hydrological changes.

Rock/Mineral Name: Based on the mineral and textural characteristics, it is a Laterite.

Fig. 2A. Photomicrograph showing presence of iron oxide under transmitted light XPL (2X).

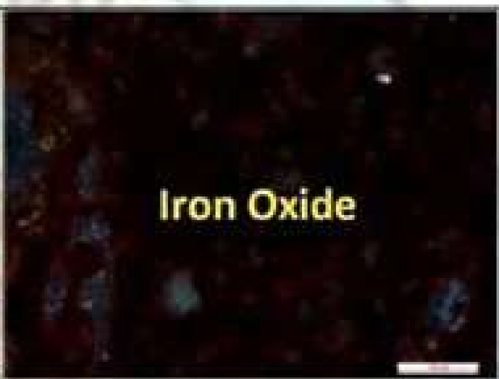


Fig. 2B. Photomicrograph showing presence of iron oxide under transmitted light XPL (5X).

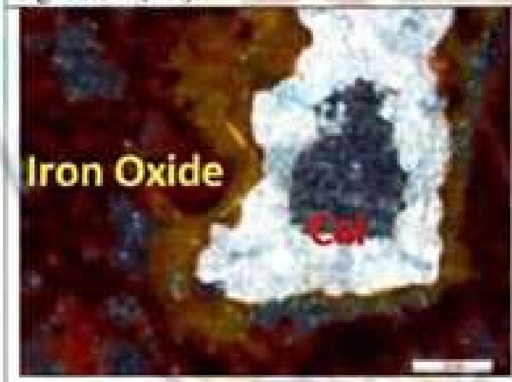


Fig. 2C. Photomicrograph showing presence of iron oxide and Calcite (Cal) under transmitted light XPL (10X).

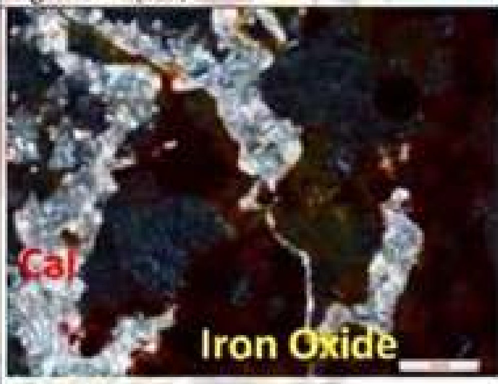


Fig. 2D. Photomicrograph showing presence of iron oxide and Calcite (Cal) under transmitted light XPL (10X).

3. Sample no: RB/TS/L-170

Mineral assemblage: Framework and matrix mineral: Quartz

Cement: Chert

Texture: It is a medium grained clastic sedimentary rock consisting only of quartz as framework as well as matrix mineral. Sub angular to subrounded clasts of quartz form the framework of the rock. The polymodal grain size distribution of quartz grains is recorded. Fine grained angular quartz grains were deposited within the interstitial spaces forming matrix. The framework and matrix mineral is cemented by chert. Few quartz grains show undulose extinction and deformation bands.

The rock is mineralogically mature indicating second cycle of deposition and the provenance must be a sandstone dominated rock. The textural immaturity is evidenced from angularity of grains, poor sorting, polymodal grain size distribution, grain size variation indicating less transportation and nearby provenance.

Name of the rock: Sandstone

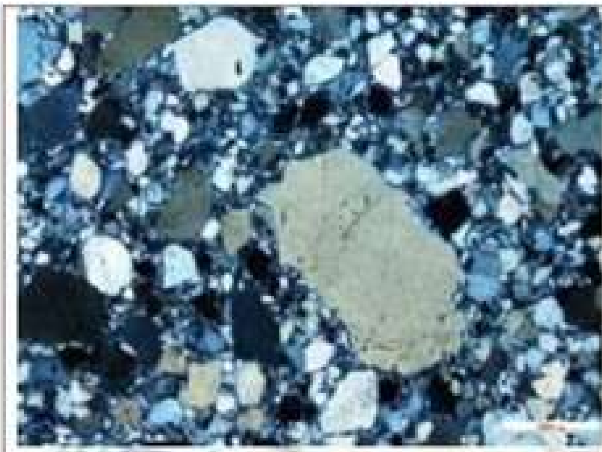


Fig.3.1 Angular to subrounded frameworking grains of quartz in cherty cement and fine grained matrix of quartz; note the polymodal grain size distribution indicating textural immaturity.

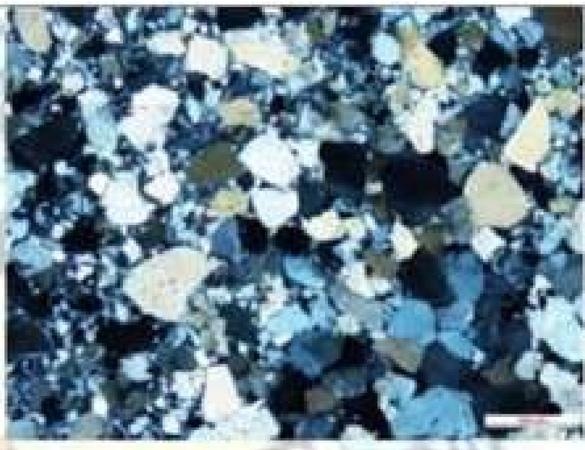


Fig.3.2 Angular to subrounded frameworking grains of quartz in cherty cement and fine grained matrix of quartz; frameworking grains dominated sandstone

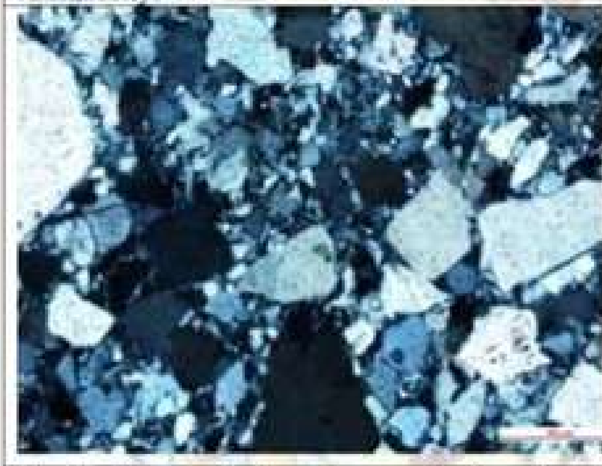


Fig. 3.3 Texturally immature grains showing angular frameworking quartz indicating very less transportation

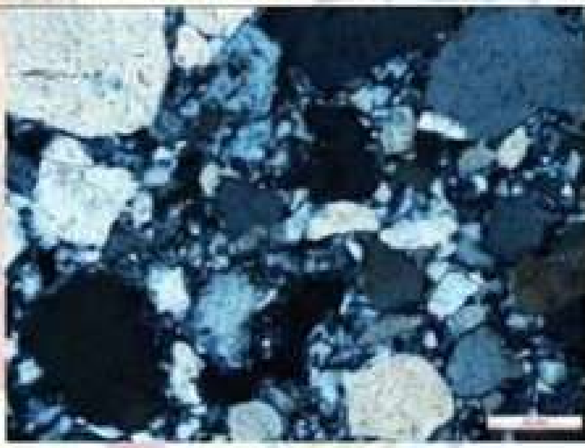
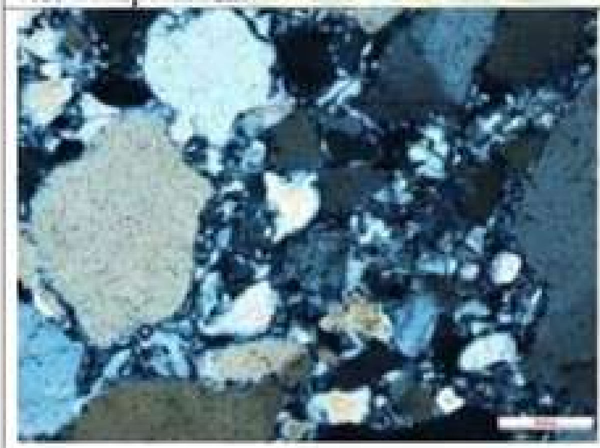
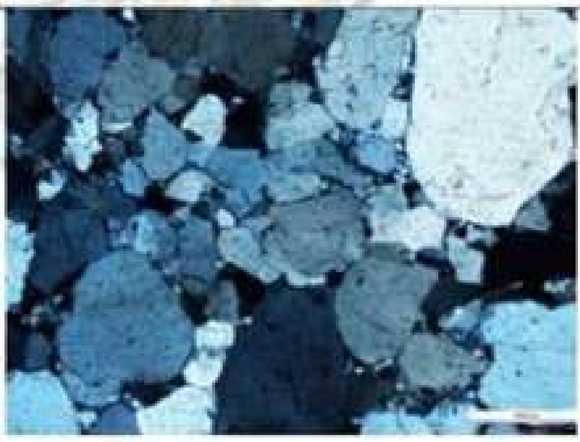


Fig. 3.4 Subrounded large grains in matrix and cement of fine grained quartz





4. Sample no: RB/TS/L-28

Mineral assemblages: Phenocrysts phase: Plagioclase

Matrix phases: Plagioclase microlites + Clinopyroxene + Devitrified glass + Zeolite + Magnetite

Texture: It is a very fine grained basaltic rock containing haphazardly oriented plagioclase microlites, very fine magnetite grains and clinopyroxene in matrix. Brown coloured, non-pleochroic and isotropic volcanic glass with very thin crystals indicate devitrified nature of glass. Few euhedral shaped, coarse plagioclase grains occur as phenocrysts within the fine grained matrix. Yellow coloured zeolite also present within the matrix.

Name of the Rock: **Basalt**

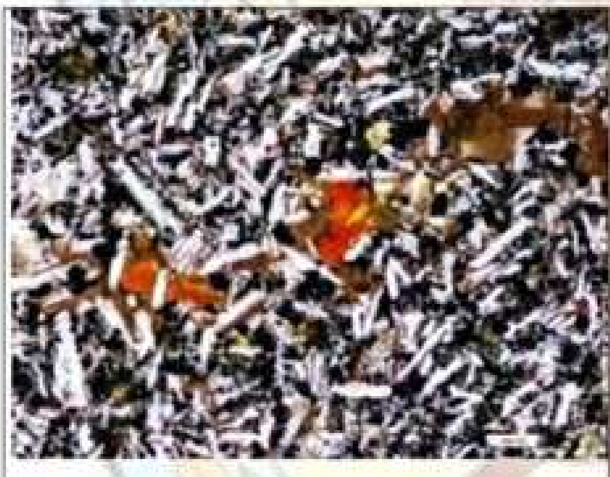


Fig..4.1 Brown and orange brown coloured glass in the interstitial spaces	Fig.4.2 Tiny magnetites disseminated in the basaltic matrix

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Name of the Rock: **Basalt**

Fig. 3.1 Brown and orange brown coloured glass in the interstitial spaces

Fig.4.7 Fine grained matrix consisting of plagioclase microlite, glass and magnetite

Fig.4.8 Brown coloured glass with devitrification; note the very fine needles and relatively coarser pyroxene grains within glass