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SHIVA ANALYTICALS INDIA PRIVATE LIMITED

Customer Name: Mr. K. Nageswara Rao.
Customer Address: Critical Minerals Trackers, Mineral Exploration and Geo Solution, #Concourse, No 406,7-1-58/CC/406, Opp Lal Bungalow, Greenland's, Hyderabad -500016 India.
Customer Ref : P27/LB/2025
Lab ID : G2296-12

Dates of Sample Analysis :05/09/2025
Date of Reporting :08/09/2025

MINERALOGY TEST REPORT

1.60 KW POWDER X RAY DIFRACTOMETER METHOD

INTRODUCTION: X-ray diffraction (XRD) and petrology studies are both valuable techniques used in geology and materials science for analysing minerals and rocks, but they serve different purposes and offer unique advantages. Here's how XRD is superior to petrology studies in certain aspects. XRD excels in identifying crystalline minerals present in a sample. It provides precise information about the crystal structure and lattice parameters of minerals, which can be challenging to ascertain solely through petrological observations. XRD allows for quantitative analysis of mineral phases present in a sample, providing accurate estimates of mineral composition based on peak intensities. Petrology studies, while descriptive, may not always provide quantitative data on mineral abundance. XRD is highly sensitive and can detect trace amounts of minerals present in a sample, even at concentrations as low as a few percent. Powder Diffraction (XRD) Database, contains a comprehensive collection of more than 6000 diffraction patterns for various materials. Researchers use this resource for identifying unknown substances, confirming crystal structures, and conducting material characterization. Shiva Analyticals team has decades of experience on XRD studies. Accurate chemical assay coupled with reliable mineralogy information is vital in resource characterisation.

Prepared by: Nagaraj Singh
Verified by: Satyanarayana

SHIVA ANALYTICALS (INDIA) PRIVATE LIMITED

Sample G2296-12 (P27/LB/2025)

Summary

Sample G2296-12: WDXRF (Bruker S8) bulk oxides and XRD (Bruker D8) major phases reconciled.
Reported XRD major phases: Kaolinite 40.06 wt%, Hematite 1.85 wt%, Goethite 24.1 wt%, M□silicate ~0.98 wt% (approx.).
Reported crystallinity = 67.0% → inferred amorphous fraction = 33.00% (note: user-stated amorphous 35% conflicts with crystallinity; we used 100−crystallinity).

WDXRF data

Oxide	Wt %
Al2O3	20.15
SiO2	23.14
Fe2O3	30.04
TiO2	9.11
CaO	0.90
MgO	0.69
P2O5	0.88
SO3	0.18
LOI	14.00

XRD major phases (preliminary)

Mineral phase	Wt % (sample)	Representative formula
Kaolinite	40.06	Al2Si2O5(OH)4
Hematite	1.85	Fe2O3
Goethite	24.10	FeO(OH)
M-silicate(MSiO3)	0.98	(Ca0.016Fe0.666Mg0.318)SiO3 (approx. MSiO3)

Stoichiometric conversions (mineral → oxide equivalents)

Mineral	Formula	Mol. mass (g/mol)	Major oxide wt% (per 100 g mineral)	Notes
Kaolinite	Al2Si2O5(OH)4	258.157	Al2O3: 39.50 ; SiO2: 46.55 ; H2O (LOI): 13.96	Typical clay; contributes Al2O3 & SiO2 and structural water.
Hematite	Fe2O3	159.687	Fe2O3: 100.00	Primary Fe-oxide;

				contributes Fe2O3.
Goethite	FeO(OH)	72.852	Fe2O3 (equiv): 109.60 ; H2O (LOI): -9.60	Hydroxy-iron oxide; will contribute Fe2O3 equivalent and LOI.
M-silicate (approx.)	(Ca0.016Fe0.666Mg0.318)SiO3	121.646	SiO2: 49.39 ; Fe2O3 equiv: 87.43 ; CaO: 0.74 ; MgO: 10.54	Minor indexed silicate — treated as MSiO3 for oxide accounting.

Predicted oxide contributions from crystalline phases

Oxide	Measured (WDXRF)	From Kaolinite	From Hematite	From Goethite	From M?silicate
Al2O3	20.15	15.82	0.00	0.00	0.00
SiO2	23.14	18.64	0.00	0.00	0.48
Fe2O3	30.04	0.00	1.85	26.41	0.86
TiO2	9.11	0.00	0.00	0.00	0.00
CaO	0.90	0.00	0.00	0.00	0.01
MgO	0.69	0.00	0.00	0.00	0.10
LOI	14.00	0.00	0.00	-2.31	0.00

Predicted totals, residuals and inferred amorphous composition

Oxide	Measured (wt%)	Predicted from crystalline (wt%)	Residual = Meas – Pred (wt%)
Al2O3	20.15	15.82	4.32
SiO2	23.14	19.13	4.01
Fe2O3	30.04	29.12	0.92
TiO2	9.11	0.00	9.11
CaO	0.90	0.01	0.89
MgO	0.69	0.10	0.59
LOI	14.00	3.28	10.72

Inferred amorphous fraction = 33.00 % of sample. Residual positive oxides are attributed primarily to this amorphous fraction. Below are residuals normalized to the amorphous mass (i.e., % of the 33.00% amorphous).

Oxide	Residual (wt% of sample)	Inferred % of amorphous (residual/33.0×100)
LOI	10.72	32.49
TiO2	9.11	27.60
Al2O3	4.33	13.12
SiO2	4.01	12.15
Fe2O3	0.92	2.79

CaO	0.89	2.71
P2O5	0.88	2.67
MgO	0.59	1.78
Na2O	0.28	0.85
BaO	0.23	0.70
SO3	0.18	0.55
SrO	0.12	0.36
Cr2O3	0.11	0.33
ZrO2	0.09	0.27
PbO	0.04	0.12
V2O5	0.02	0.06
NiO	0.02	0.06
K2O	0.01	0.03
MnO	0.01	0.03
ZnO	0.01	0.03

Interpretation, origin assessment & commercial implications

Interpretation:

- The sample is Al- and Fe-rich (Al_2O_3 20.15%, Fe_2O_3 30.04%) with substantial TiO_2 (9.11%) and SiO_2 (23.14%), and LOI 14%. The dominant minerals by XRD are kaolinite and Fe-oxides (goethite + hematite), summing ≈66.99% (=67%).
- The mineralogy and high Fe and Ti content strongly suggest a ferruginous lateritic / weathering profile or an iron-rich sediment with significant Ti-bearing heavy minerals (rutile/ilmenite or altered Ti-oxides). Kaolinite indicates advanced chemical weathering; goethite/hematite indicate Fe-oxide enrichment. The small M□silicate suggests minor detrital silicate relics.

Origin assessment:

- Most consistent with intense tropical/subtropical weathering (laterite/bauxite-lateritic profile) or an iron□rich residual/regolith derived from mafic/ultramafic or volcanic parent rocks.

Commercial implications:

- Iron: Fe_2O_3 ~30% — material could be of interest as an industrial iron-bearing product for pigments or specialized iron products, but grade and form (oxides) are not directly suitable for blast□furnace iron without concentration.
- TiO_2 ~9% is significant — if Ti is present as discrete ilmenite/rutile with liberable grains, beneficiation could yield Ti feedstock for pigment or Ti metal production.
- Kaolinite: 40% kaolinite indicates potential use for ceramics, paper filler, and other industrial mineral applications, subject to Ti/Fe impurity levels which may limit high□brightness uses.
- Overall: the sample looks more suited to industrial mineral applications (ceramics, pigments, fillers) or as a target for heavy□mineral (Ti) concentration, rather than immediate metallurgical Fe ore.

Minor / secondary phases likely present (not listed as majors)

- Rutile/ilmenite or leucoxene (source of TiO_2)
- Amorphous silica/opaline silica or microcrystalline quartz (contributing residual SiO_2)

- Allophane/smectite (poorly crystalline aluminosilicates in amorphous fraction)
- Apatite/fluorapatite (minor P_2O_5 = 0.88%)
- Sulfates or gypsum (trace SO_3 = 0.18%)
- Accessory zircon, chromite traces (ZrO_2, Cr_2O_3 present)

Concise final results

- XRD major phases (wt%): Kaolinite 40.06, Goethite 24.10, Hematite 1.85, M-silicate ~0.98 (sum ≈ 67.0%). Amorphous ≈ 33.00%.
- Bulk WDXRF (wt%): Al_2O_3 20.15, Fe_2O_3 30.04, TiO_2 9.11, SiO_2 23.14, LOI 14.00.
- Interpretation: Ferruginous, highly weathered material (lateritic / iron-rich regolith) with potential for Ti concentration and industrial mineral uses; not meteoritic.

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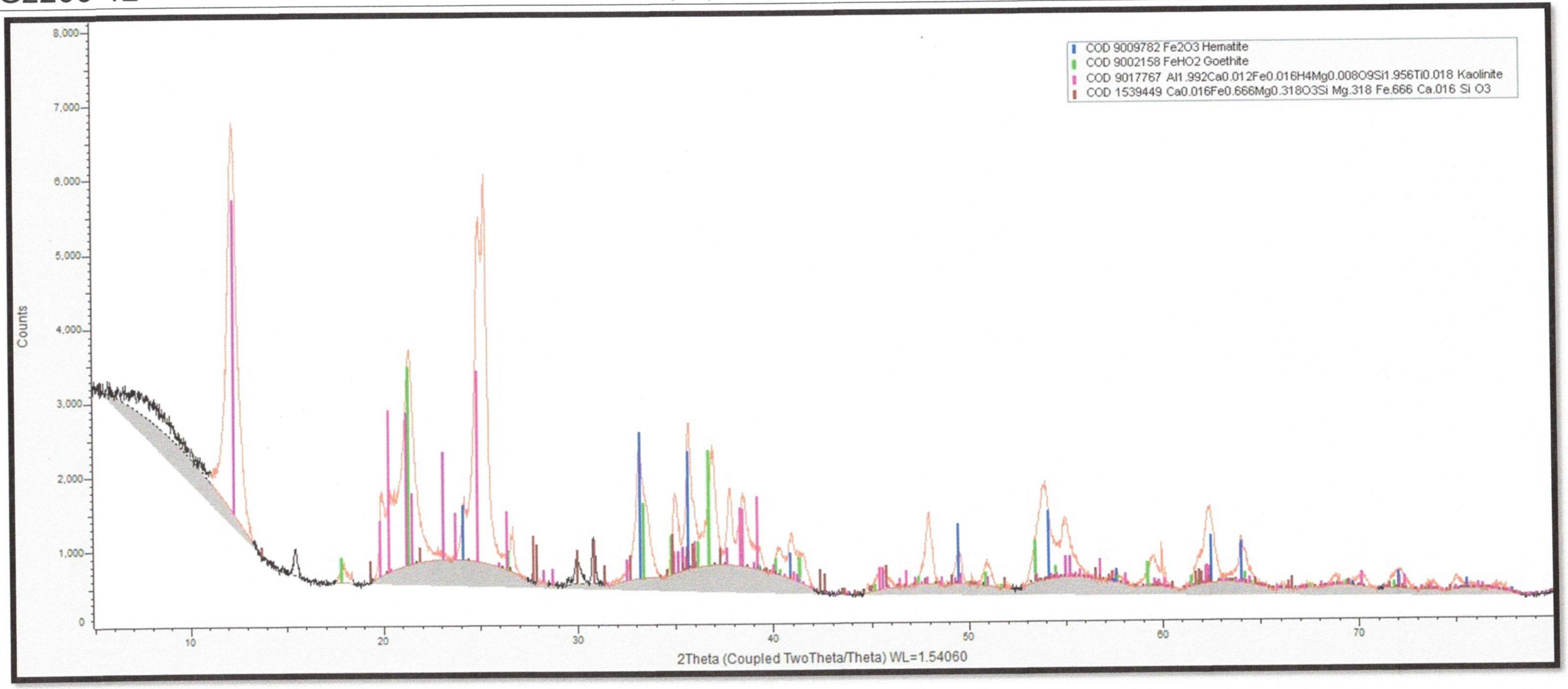
BRUKER D8 ADVANE XRD TEST DATA

G2296-12 **T23/RB/2025/01** XRD Scan Report_1 of 2



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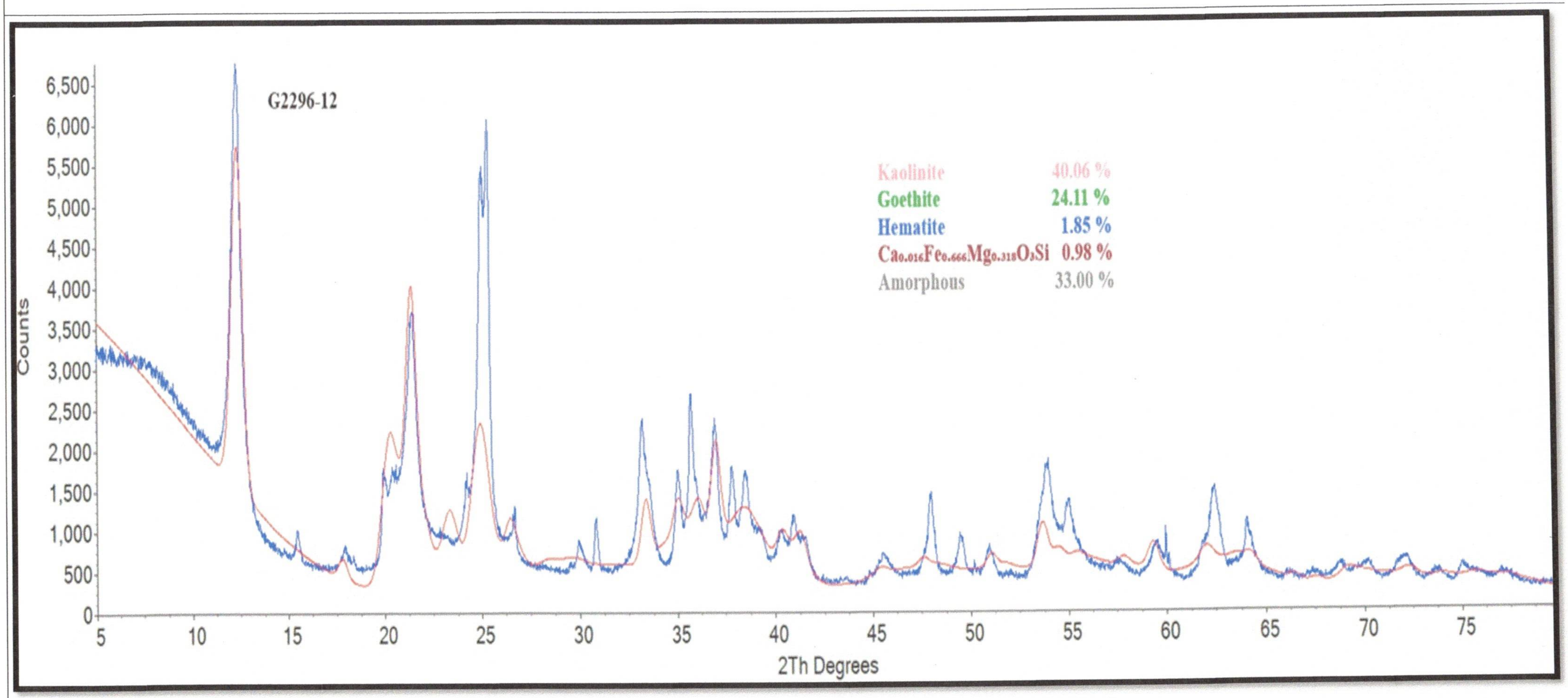
BRUKER D8 ADVANE XRD TEST DATA

G2296-12	P27/LB/2025	XRD Scan Report_2 of 2



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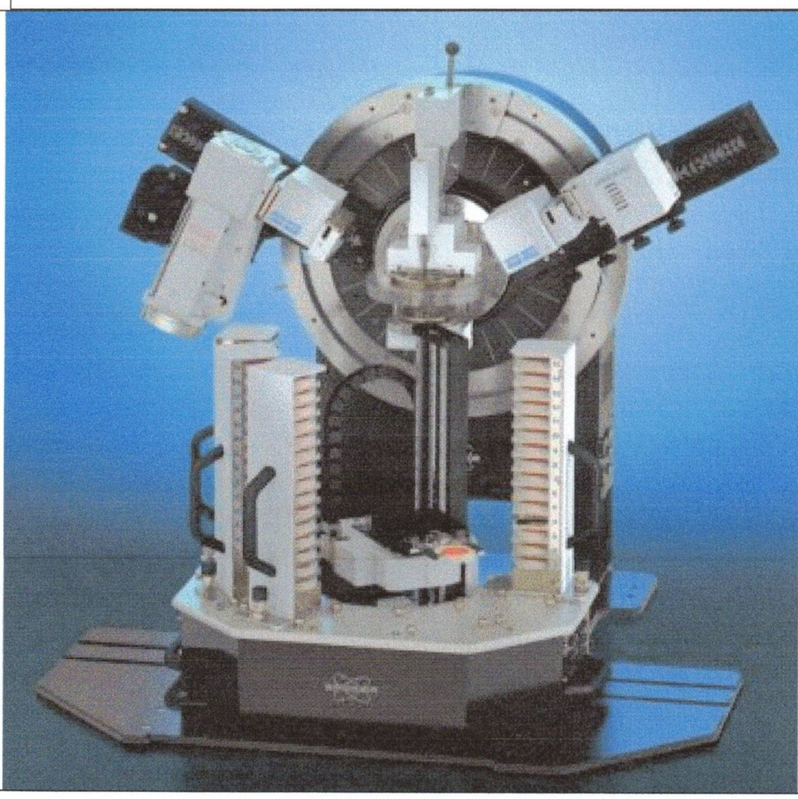
Customer Ref : T13/LB/2025/03
Lab ID : G2296-15

Dates of Sample Analysis :05/09/2025
Date of Reporting :08/09/2025

MINERALOGY TEST REPORT

1.60 KW POWDER X RAY DIFRACTOMETER METHOD



INTRODUCTION: X-ray diffraction (XRD) and petrology studies are both valuable techniques used in geology and materials science for analysing minerals and rocks, but they serve different purposes and offer unique advantages. Here's how XRD is superior to petrology studies in certain aspects. XRD excels in identifying crystalline minerals present in a sample. It provides precise information about the crystal structure and lattice parameters of minerals, which can be challenging to ascertain solely through petrological observations. XRD allows for quantitative analysis of mineral phases present in a sample, providing accurate estimates of mineral composition based on peak intensities. Petrology studies, while descriptive, may not always provide quantitative data on mineral abundance. XRD is highly sensitive and can detect trace amounts of minerals present in a sample, even at concentrations as low as a few percent. Powder Diffraction (XRD) Database, contains a comprehensive collection of more than 6000 diffraction patterns for various materials. Researchers use this resource for identifying unknown substances, confirming crystal structures, and conducting material characterization. Shiva Analyticals team has decades of experience on XRD studies. Accurate chemical assay coupled with reliable mineralogy information is vital in resource characterisation.

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Sample G2296-15 (T13/LB/2025/03)

Summary

Sample G2296-15: WDXRF bulk oxides (Bruker S8 Tiger 4 kW) and XRD (Bruker D8 Advance) major phases reconciled. XRD phases (crystalline fraction): Gibbsite 51.49 %, Kaolinite 45.71 %, Ilmenite 2.8 % with crystallinity = 77.4% and amorphous fraction = 22.6% of the whole sample.
Below we show stoichiometric conversions, predicted oxide contributions from the crystalline phases (expressed as wt% of the whole sample), residuals (measured − predicted) and an inferred composition of the amorphous fraction.

WDXRF data

Oxide	Wt % (measured)
Al2O3	44.29
SiO2	25.33
Fe2O3	2.31
TiO2	3.98
CaO	0.39
MgO	0.21
P2O5	0.11
SO3	0.94
LOI	21.87

XRD phases

The absolute phase weight percent in the whole sample = (phase% of crystalline) × (crystallinity/100).

Mineral (reported % of crystalline)	Absolute wt% of sample (calculated)	Representative formula
Kaolinite (45.71% of crystalline)	35.37	Al2Si2O5(OH)4
Gibbsite (51.49% of crystalline)	39.85	Al(OH)3
Ilmenite (2.80% of crystalline)	2.16	FeTiO3 (Ilmenite)

Stoichiometric conversions (mineral → oxide equivalents)

Mineral	Formula	Mol. mass (g/mol)	Major oxide wt% (per 100 g mineral)	Notes
Kaolinite	$Al_2Si_2O_5(OH)_4$	258.15	Al_2O_3: 39.495 ; SiO_2: 46.548 ; H_2O (LOI): 13.957	Expressed as $Al_2O_3 + 2SiO_2 + 2H_2O$.
Gibbsite	$Al(OH)_3$	78.00	Al_2O_3: 65.357 ; H_2O (LOI): 34.643	2 $Al(OH)_3$ = Al_2O_3 + 3 H_2O (used for oxide accounting).
Ilmenite	$FeTiO_3$	151.70	FeO (as Fe): 47.356 (converted to Fe_2O_3 equiv); TiO_2: 52.644	Fe present as Fe^{2+} in ilmenite -> converted to Fe_2O_3 equivalent for comparison with XRF.

Predicted oxide contributions from crystalline phases (wt% of whole sample)

Oxide	Measured (WDXRF, wt%)	From Kaolinite (wt%)	From Gibbsite (wt%)	From Ilmenite (wt%)	Total predicted (wt%)
Al_2O_3	44.29	13.97	26.05	0.00	40.02
SiO_2	25.33	16.47	0.00	0.00	16.47
Fe_2O_3	2.31	0.00	0.00	2.28	2.28
TiO_2	3.98	0.00	0.00	1.14	1.14
LOI	21.87	0.00	0.00	0.00	0.00
CaO	0.39	0.00	0.00	0.00	0.00
MgO	0.21	0.00	0.00	0.00	0.00

Predicted totals, residuals and inferred amorphous composition

Oxide	Measured (wt%)	Predicted crystalline (wt%)	Residual (Meas – Pred, wt%)
Al_2O_3	44.29	40.02	4.27
SiO_2	25.33	16.47	8.86
Fe_2O_3	2.31	2.28	0.03
TiO_2	3.98	1.14	2.84
LOI	21.87	18.74	3.13
CaO	0.39	0.00	0.39

MgO	0.21	0.00	0.21

Inferred amorphous fraction = 22.60 % of sample. Positive residuals are allocated to the amorphous fraction. Residuals normalized to the amorphous mass (i.e., percent of the 22.60% amorphous) are shown below.

Oxide	Residual (wt% of sample)	Inferred % of amorphous (residual/22.6×100)
SiO2	8.86	39.21
Al2O3	4.27	18.89
LOI	3.13	13.83
TiO2	2.84	12.56
SO3	0.94	4.16
CaO	0.39	1.73
K2O	0.21	0.93
MgO	0.21	0.93
Na2O	0.13	0.58
P2O5	0.11	0.49
Cr2O3	0.08	0.35
ZrO2	0.05	0.22
SrO	0.04	0.18
PbO	0.03	0.13
Fe2O3	0.03	0.13
MnO	0.01	0.04
V2O5	0.01	0.04
CuO	0.01	0.04
NiO	0.01	0.04

Interpretation, origin assessment & commercial implications

Interpretation:

• The sample is strongly Al⍰enriched (Al2O3 = 44.29 wt%), with significant structural water (LOI = 21.87 wt%) and moderate SiO2 (25.33 wt%). XRD indicates the crystalline Al⍰bearing minerals are kaolinite and gibbsite, which together account for most of the crystalline mass (absolute: Kaolinite 35.38 wt%, Gibbsite 39.85 wt%). Ilmenite is a minor heavy⍰mineral (≈ 2.17 wt%).

Origin assessment:

• This assemblage (high Al2O3, large gibbsite fraction, large LOI) strongly supports intense chemical weathering and residual concentration — typical of bauxitic/lateritic profiles developed in tropical/subtropical climates. Gibbsite dominance (high Al(OH)3) commonly forms under sustained leaching and low silica activity (bauxitic conditions). Presence of minor ilmenite suggests a mafic/igneous detrital source for Ti.

Commercial implications:

• Al2O3 ~44.3% and high gibbsite content suggest potential as a bauxite precursor for alumina production (Bayer process). However, the silica (SiO2 ~25.3%) and LOI need assessment for Bayer⍰suitability — high reactive silica is detrimental. • Kaolinite/gibbsite-rich materials are also used in ceramics, refractories, filler applications, and as feedstock for metakaolin (after calcination).

• Ilmenite (~2.2 wt% absolute) and TiO2 ~3.98% indicate low Ti potential unless heavy mineral concentrations increase with simple gravity concentration.

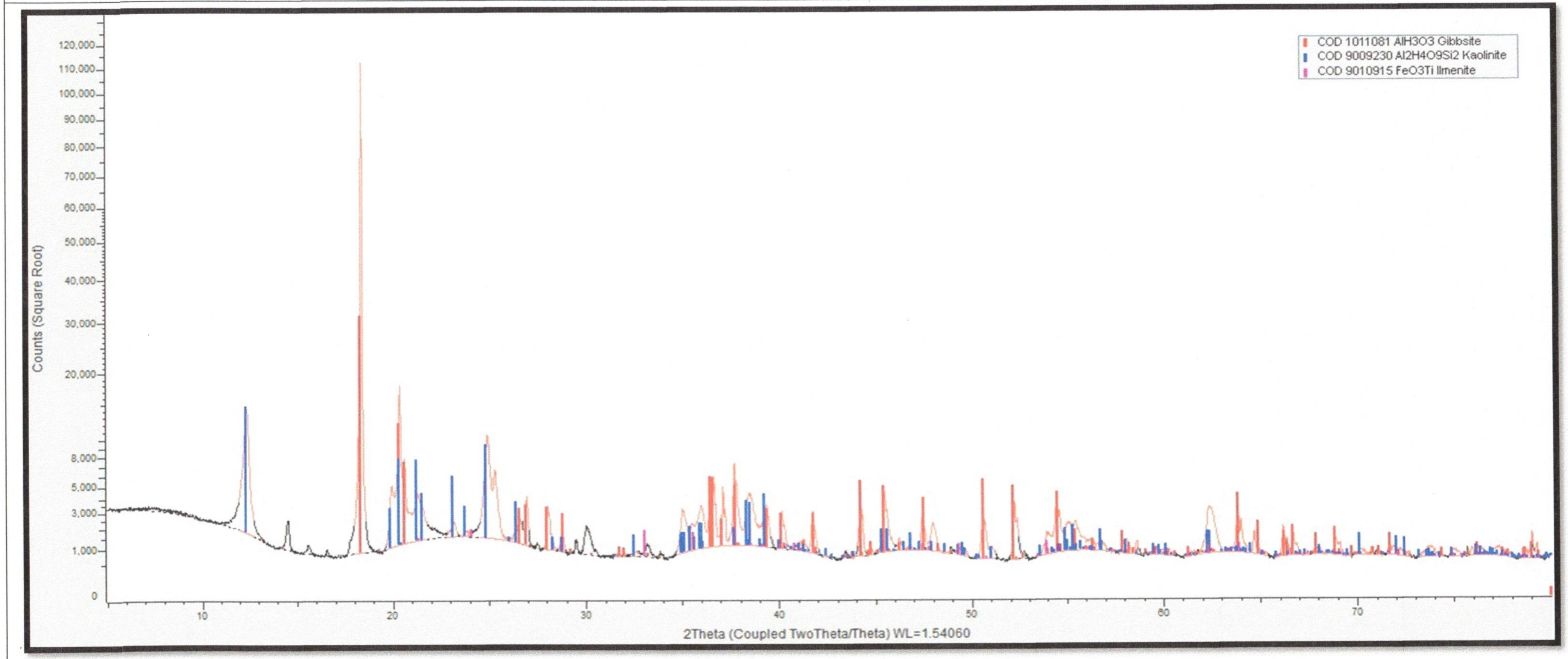
Minor / secondary phases likely present

- Amorphous/allophanic aluminosilicates (allophane, imogolite) in the amorphous fraction
- Poorly crystalline silica (opal/opal-CT) or microcrystalline quartz (contributes residual SiO_2)
- Iron oxides present in low abundance (hematite/goethite) as coatings — consistent with low Fe_2O_3 (2.31 wt%)
- Anatase/rutile or altered ilmenite as Ti-bearing fine phases
- Trace apatite (P_2O_5 = 0.11%) or adsorbed phosphates

Final concise results

• XRD major phases (absolute wt% of sample): Kaolinite 35.38 wt%, Gibbsite 39.85 wt%, Ilmenite 2.17 wt%. Crystallinity = 77.4%, Amorphous = 22.6%.
• Bulk WDXRF (wt%): Al_2O_3 44.29, SiO_2 25.33, TiO_2 3.98, Fe_2O_3 2.31, LOI 21.87.
• Interpretation: Strongly lateritic/bauxitic material with high gibbsite content — promising for alumina after appropriate beneficiation and silica control; low Ti and Fe metallurgical potential unless concentrated.

G2296-15 **T13/LB/2025/03** XRD Scan Report_1 of 2



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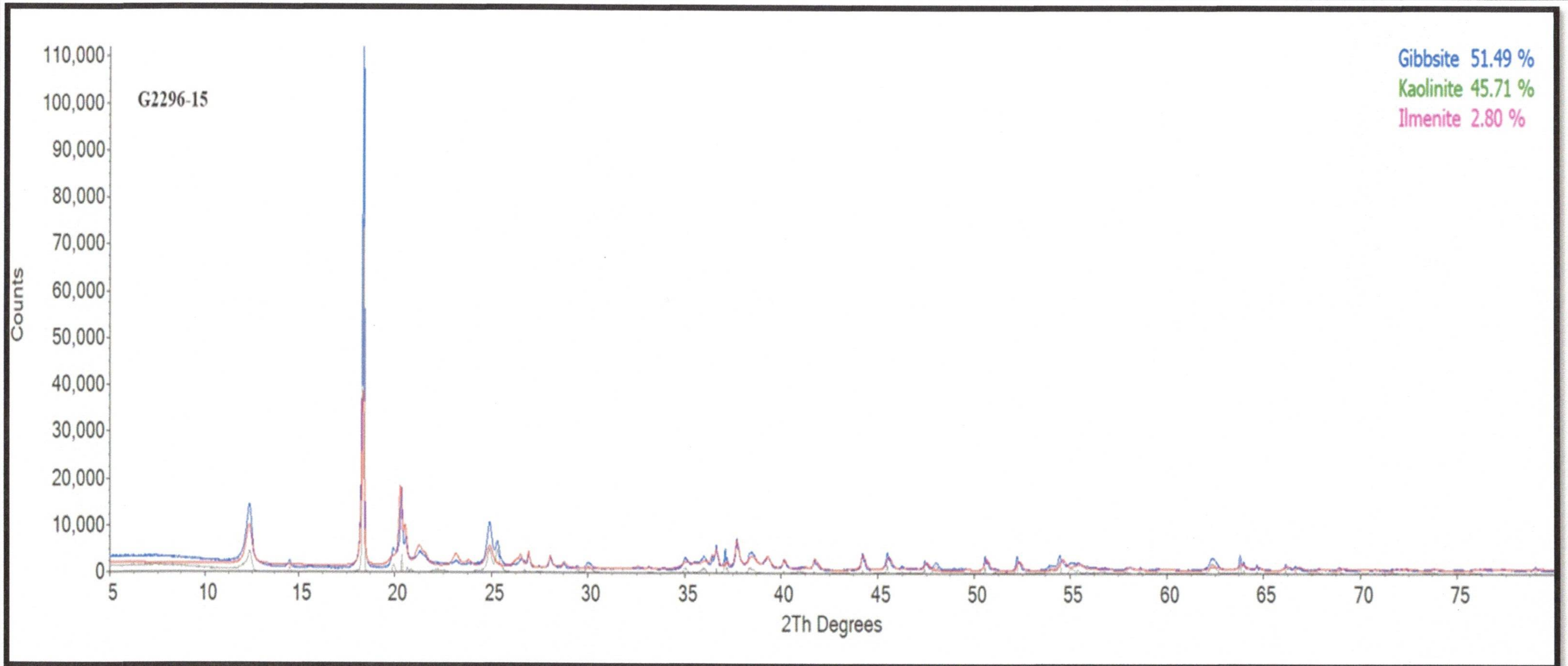
G2296-15 **T13/LB/2025/03** XRD Scan Report_2 of 2



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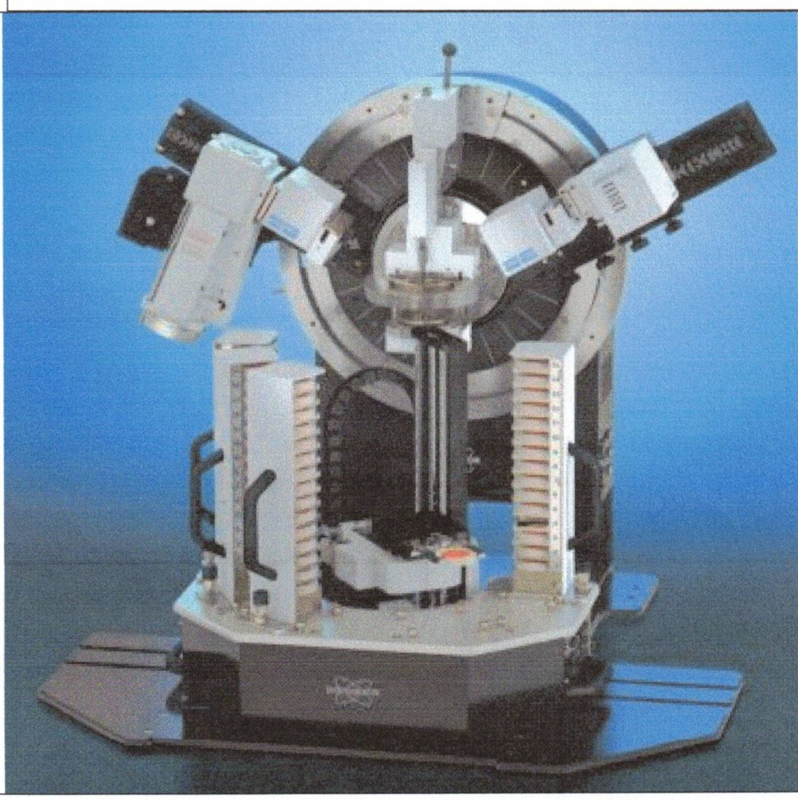
Customer Ref : T14/LB/2025/05
Lab ID : G2296-16

Dates of Sample Analysis :05/09/2025
Date of Reporting :08/09/2025

MINERALOGY TEST REPORT

1.60 KW POWDER X RAY DIFRACTOMETER METHOD



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SHIVA ANALYTICALS (INDIA) PRIVATE LIMITED

Sample G2296-16 (T14/LB/2025/05)

Sample G2296-16

Summary

Sample G2296-16: WDXRF bulk oxides (Bruker S8 Tiger 4 kW) and XRD (Bruker D8 Advance) major phases reconciled with crystallinity = 70.10 % and amorphous = 29.90 %.

WDXRF Data

Oxide	Wt % (measured)
Al2O3	19.59
SiO2	29.96
Fe2O3	22.37
TiO2	7.63
CaO	4.37
MgO	0.34
P2O5	0.87
SO3	0.06
LOI	14.19

XRD major phases (scaled to crystallinity)

Mineral phase	Wt % (sample, scaled)	Representative formula
Kaolinite	31.05	$Al_2Si_2O5(OH)_4$
Goethite	21.69	FeO(OH)
Hematite	5.91	Fe_2O_3
Calcite	5.53	$CaCO_3$
Quartz	2.95	SiO_2 (quartz)
Cristobalite	2.94	SiO_2 (cristobalite)

Stoichiometric conversions (mineral → oxide equivalents)

Mineral	Formula	Mol. mass (g/mol)	Major oxide wt% (per 100 g mineral)	Notes
Kaolinite	Al2Si2O5(OH)4	258.157	Al2O3: 39.495 ; SiO2: 46.548 ; H2O: 13.957	Contributes Al2O3, SiO2 and structural H2O (LOI).
Goethite	FeO(OH)	88.851	Fe2O3 (equiv): 89.862 ; H2O (LOI): 10.138	Hydroxy-iron oxide; contributes Fe2O3 equivalent and LOI.
Hematite	Fe2O3	159.687	Fe2O3: 100.00	Primary iron oxide.

Calcite	CaCO3	100.086	CaO: 56.029 ; CO2 (LOI): 43.971	Contributes CaO and CO2 (as LOI).
Quartz / Cristobalite	SiO2	60.084	SiO2: 100.00	Silica polymorphs; contribute SiO2.

Predicted oxide contributions from crystalline phases (wt% of whole sample)

Oxide	Measured (WDXRF)	From Kaolinite	From Fe-oxides (Goethite+Hematite)	From Carbonate (Calcite)	From Quartz/Cristobalite
Al2O3	19.59	12.27	0.00	0.00	0.00
SiO2	29.96	14.46	0.00	0.00	20.36
Fe2O3	22.37	0.00	25.41	0.00	0.00
CaO	4.37	0.00	0.00	3.10	0.00
LOI	14.19	0.00	2.20	2.43	0.00
TiO2	7.63	0.00	0.00	0.00	0.00

Predicted totals, residuals and inferred amorphous composition

Oxide	Measured (wt%)	Predicted crystalline (wt%)	Residual (Meas – Pred, wt%)
Al2O3	19.59	12.27	7.32
SiO2	29.96	20.36	9.60
Fe2O3	22.37	25.41	-3.04
CaO	4.37	3.10	1.27
LOI	14.19	8.97	5.22
TiO2	7.63	0.00	7.63

Inferred amorphous fraction = 29.90 % of sample. Residual positive oxides are primarily attributed to this amorphous fraction. Residuals normalized to the amorphous mass (i.e., % of the 29.90% amorphous) are shown below.

Oxide	Residual (wt% of sample)	Inferred % of amorphous (residual/29.9×100)
SiO2	9.60	32.10
TiO2	7.63	25.52
Al2O3	7.32	24.49
LOI	5.22	17.47
CaO	1.27	4.25
P2O5	0.87	2.91
MgO	0.34	1.14
Cr2O3	0.16	0.54
BaO	0.12	0.40
SrO	0.09	0.30
ZrO2	0.08	0.27
Na2O	0.07	0.23
SO3	0.06	0.20
PbO	0.04	0.13

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Oxide	Residual (wt% of sample)	Inferred % of amorphous (residual/29.9×100)
V2O5	0.03	0.10
K2O	0.02	0.07
MnO	0.01	0.03
NiO	0.01	0.03
ZnO	0.01	0.03
Fe2O3	-3.03	-3.03

Interpretation & expert justification

• The identified crystalline phases account for most measured Al2O3, Fe2O3 and part of SiO2 and CaO. Measured LOI (14.19 wt%) exceeds predicted crystalline LOI, indicating additional structural water or carbonates/organic matter in the amorphous fraction.

• Residual TiO2 (~7.63 wt%) suggests Ti is present largely in fine or amorphous Ti⍰oxide phases (anatase/rutile/leucoxene) not resolved by XRD at detection limits.

• The assemblage indicates intense weathering (lateritic/ferruginous profile) potentially derived from mafic/volcanic parent materials, with some carbonate influence (calcite). Meteoritic origin is unlikely.

Minor / secondary phases likely present

- Anatase/rutile/ilmenite (source of TiO2)
- Amorphous silica (opal/opal-CT) or microcrystalline quartz
- Poorly crystalline allophane/imogolite-type aluminosilicates
- Ferrihydrite and coated iron oxyhydroxides
- Smectite or mixed-layer clays as minor components
- Apatite/other phosphate phases (P2O5 = 0.87%)

Commercial significance & recommendations

• Commercial uses: kaolinite for ceramics/fillers, Fe-oxides for pigments/specialty uses, Ti-oxide concentration for pigment/metal feedstock if economically recoverable. Calcite as minor filler/soil amendment.
• Recommendations: Rietveld with internal standard, TGA/DSC, SEM-EDS/QEMSCAN, heavy/mineral separation and magnetic separation tests to evaluate Ti/Fe recoverability, and reactive silica tests if Al recovery is of interest.

Final concise results

• Scaled XRD major phases (wt% of sample): Kaolinite 31.06%, Goethite 21.69%, Hematite 5.92%, Calcite 5.53%, Quartz 2.96%, Cristobalite 2.95% (sum = 70.10%). Crystallinity = 70.10%, Amorphous = 29.90%.
• Bulk WDXRF (wt%): Al2O3 19.59, SiO2 29.96, Fe2O3 22.37, TiO2 7.63, LOI 14.19.
• Interpretation: Lateritic/ferruginous regolith; industrial mineral potential and candidate for Ti enrichment with further testing.

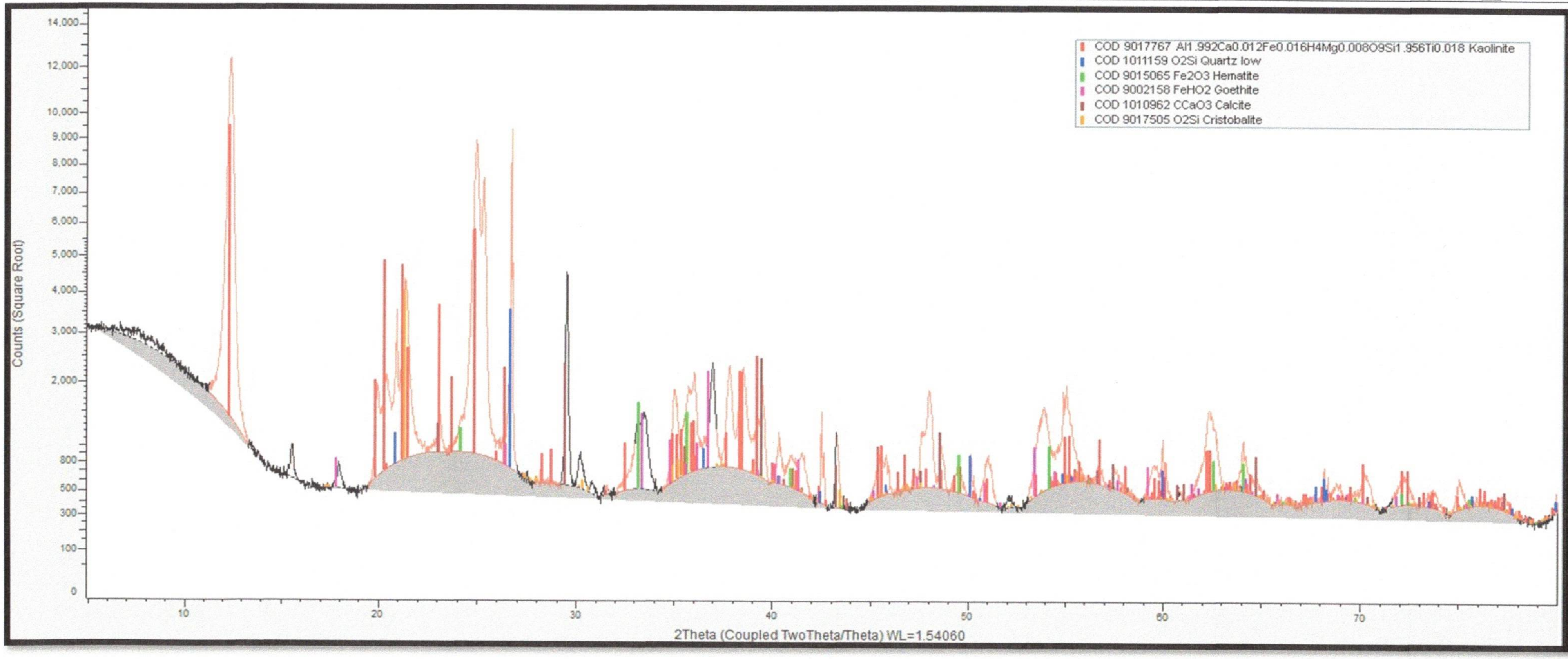
SHIVA ANALYTICALS INDIA PRIVATE LIMITED

BRUKER D8 ADVANE XRD TEST DATA

G2296-16

T14/LB/2025/05

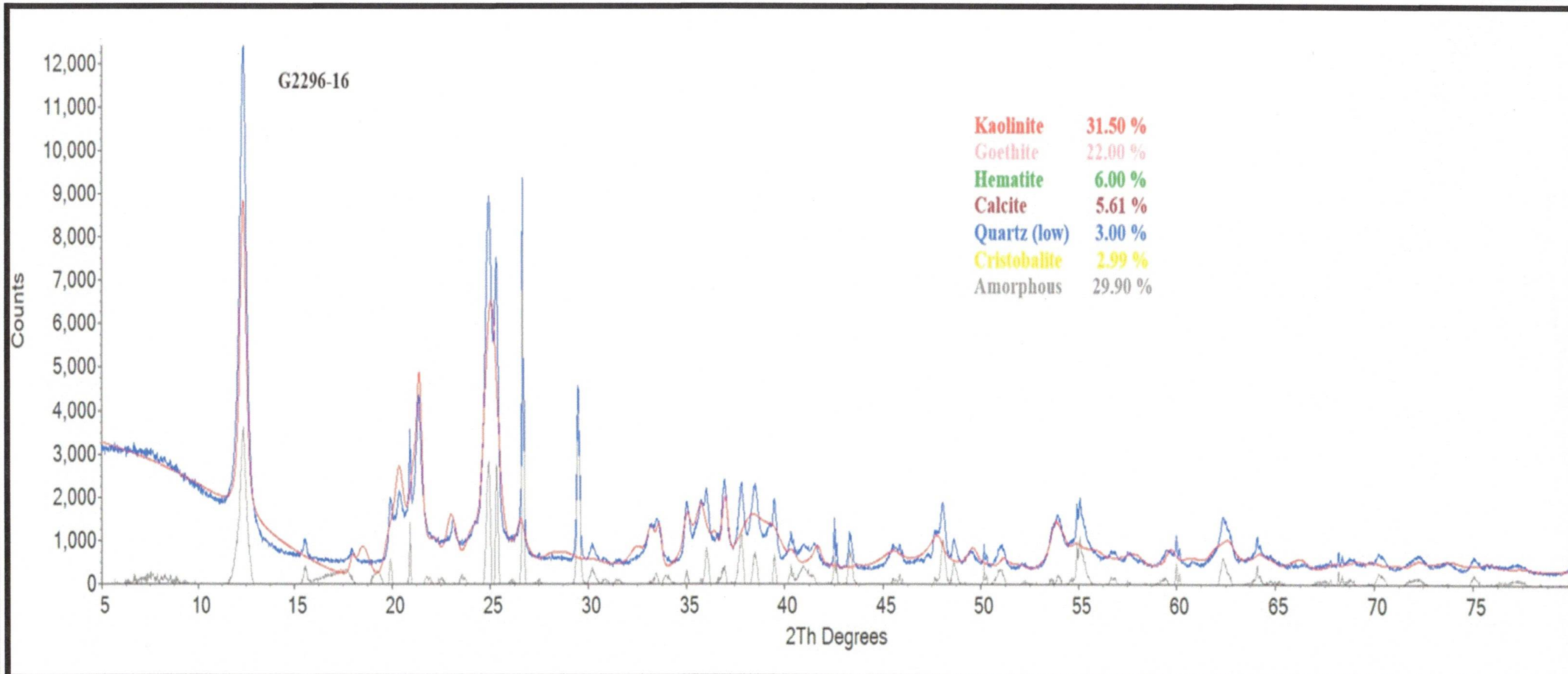
XRD Scan Report_1 of 2



Prepared by: Nagaraj Singh

Verified by: Satyanarayana

G2296-16	**T14/LB/2025/05**	XRD Scan Report_2 of 2



Prepared by: Nagaraj Singh

Verified by: Satyanarayana