



## Quantitative X-Ray Diffraction by Rietveld Refinement

**Report Prepared for:** ARD-XRD/1619 MOTI Amec (Wood)  
3260 Production Way, Burnaby, Canada

**Project Number/ LIMS No.** Custom XRD/MI7015-SEP24

**Sample Receipt:** September 19, 2024

**Sample Analysis:** October 1, 2024

**Reporting Date:** November 13, 2024

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**Instrument:** Panalytical X'pert Pro Diffractometer

**Test Conditions:** Co radiation, 40 kV, 45 mA  
Regular Scanning: Step: 0.033°, Step time:0.15s, 2θ range: 5-80°

**Interpretations :** PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.

**Detection Limit :** 0.5-2%. Strongly dependent on crystallinity.

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## Method Summary

### ***Mineral Identification and Interpretation:***

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

### ***Quantitative Rietveld Analysis:***

Quantitative Rietveld Analysis is performed by using Diffrac Topas 7 (Bruker), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

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### Summary of Rietveld Quantitative Analysis X-Ray Diffraction Results

Mineral/Compound	HQ 1 SEP7015-1 (wt %)	HQ 2 SEP7015-2 (wt %)	HQ 3 SEP7015-3 (wt %)	HQ 4 SEP7015-4 (wt %)	HQ 5 SEP7015-5 (wt %)
Quartz	90.8	80.1	62.0	39.8	69.2
Pyrite	0.1	-	0.3	0.7	-
Albite	3.2	6.3	23.0	12.6	13.9
Microcline	0.4	2.5	3.4	1.8	10.7
Biotite	0.3	0.4	0.2	1.4	0.3
Muscovite	0.5	8.4	9.3	40.0	2.8
Chlorite	0.8	0.9	-	2.8	-
Maghemite	0.1	0.1	0.2	-	-
Ankerite	2.8	1.0	0.5	-	2.4
Fluorapatite	0.8	-	-	-	-
Calcite	0.2	0.3	1.2	-	0.5
Chalcopyrite	-	-	0.1	-	-
Szomolnokite	-	-	-	0.4	-
Ilmenite	-	-	-	0.5	0.2
<b>TOTAL</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

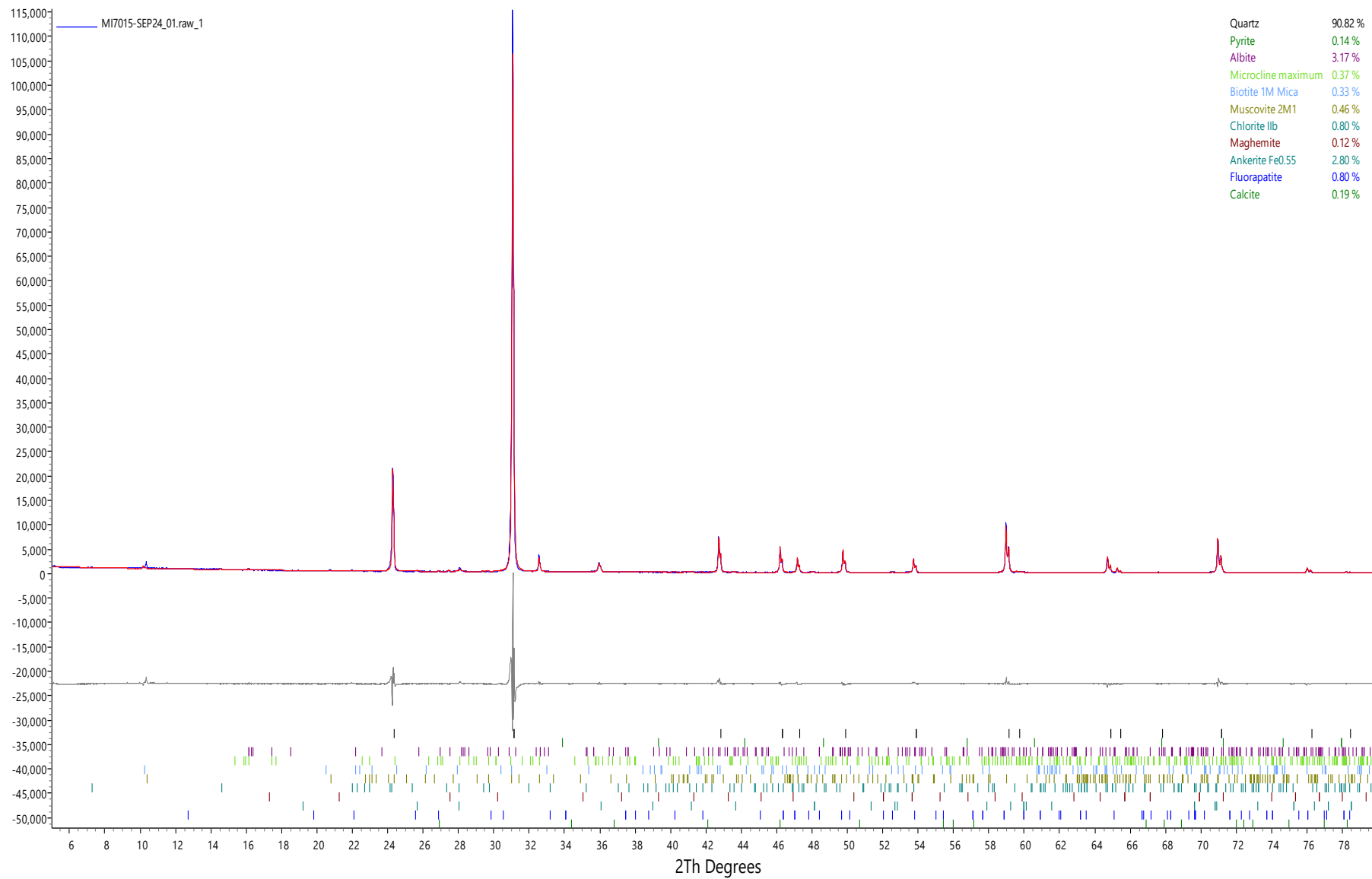
Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identified by the analyst and not included in the refinement calculation for the sample.

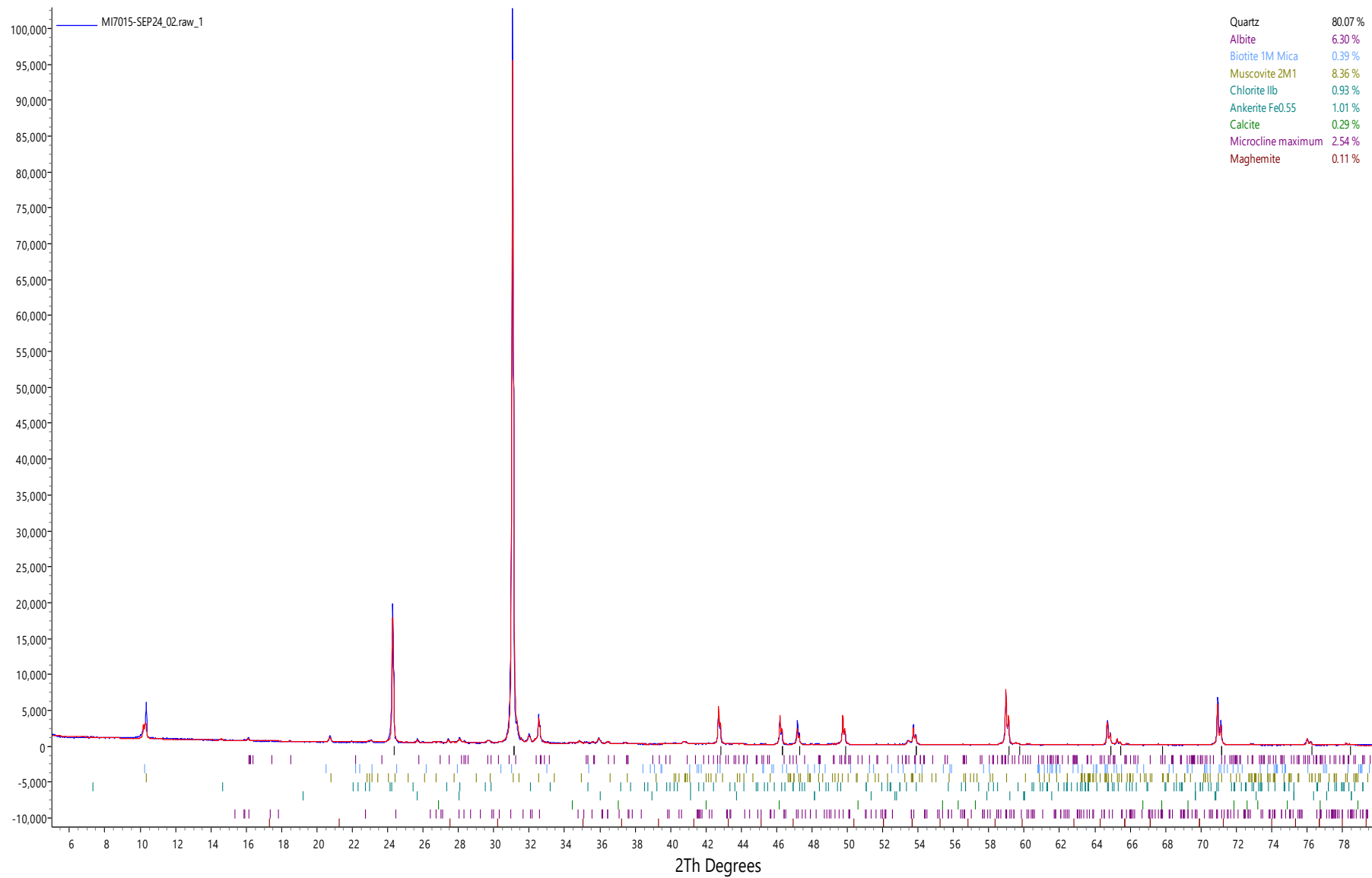
The weight percent quantities indicated have been normalized to a sum of 100%. The quantity of amorphous material has not been determined.

Mineral/Compound	Formula
Quartz	SiO <sub>2</sub>
Pyrite	FeS <sub>2</sub>
Albite	NaAlSi <sub>3</sub> O <sub>8</sub>
Microcline	KAlSi <sub>3</sub> O <sub>8</sub>
Biotite	K(Mg,Fe) <sub>3</sub> (AlSi <sub>3</sub> O <sub>10</sub> )(OH) <sub>2</sub>
Muscovite	KAl <sub>2</sub> (AlSi <sub>3</sub> O <sub>10</sub> )(OH) <sub>2</sub>
Chlorite	(Fe,(Mg,Mn) <sub>5</sub> ,Al)(Si <sub>3</sub> Al)O <sub>10</sub> (OH) <sub>8</sub>
Maghemite	γ-Fe <sub>2</sub> O <sub>3</sub>
Ankerite	CaFe(CO <sub>3</sub> ) <sub>2</sub>
Fluorapatite	Ca <sub>5</sub> (PO <sub>4</sub> ) <sub>3</sub> F
Calcite	CaCO <sub>3</sub>
Chalcopyrite	CuFeS <sub>2</sub>
Szomolnokite	FeSO <sub>4</sub> ·H <sub>2</sub> O
Ilmenite	FeTiO <sub>3</sub>

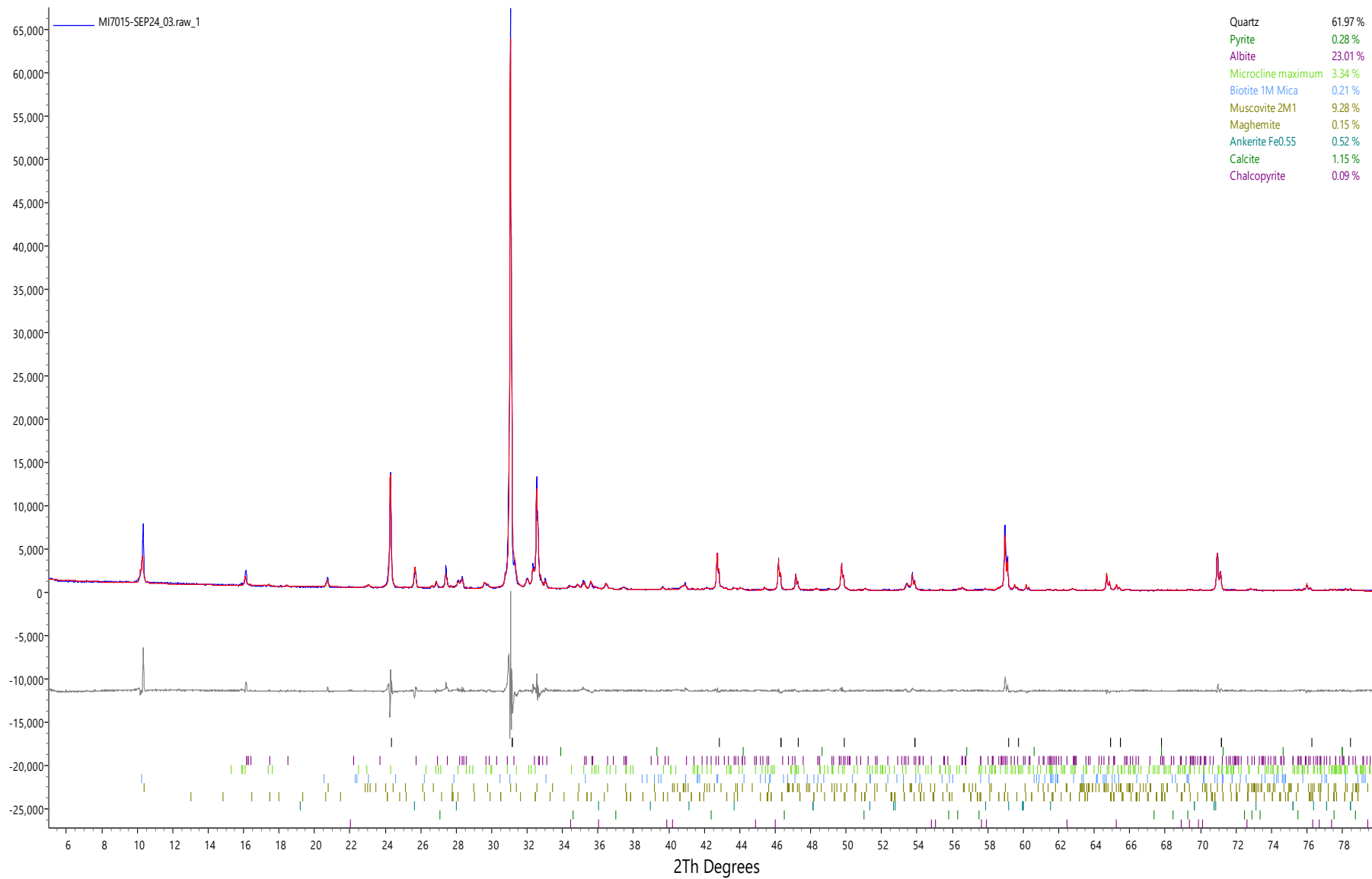
HQ 1



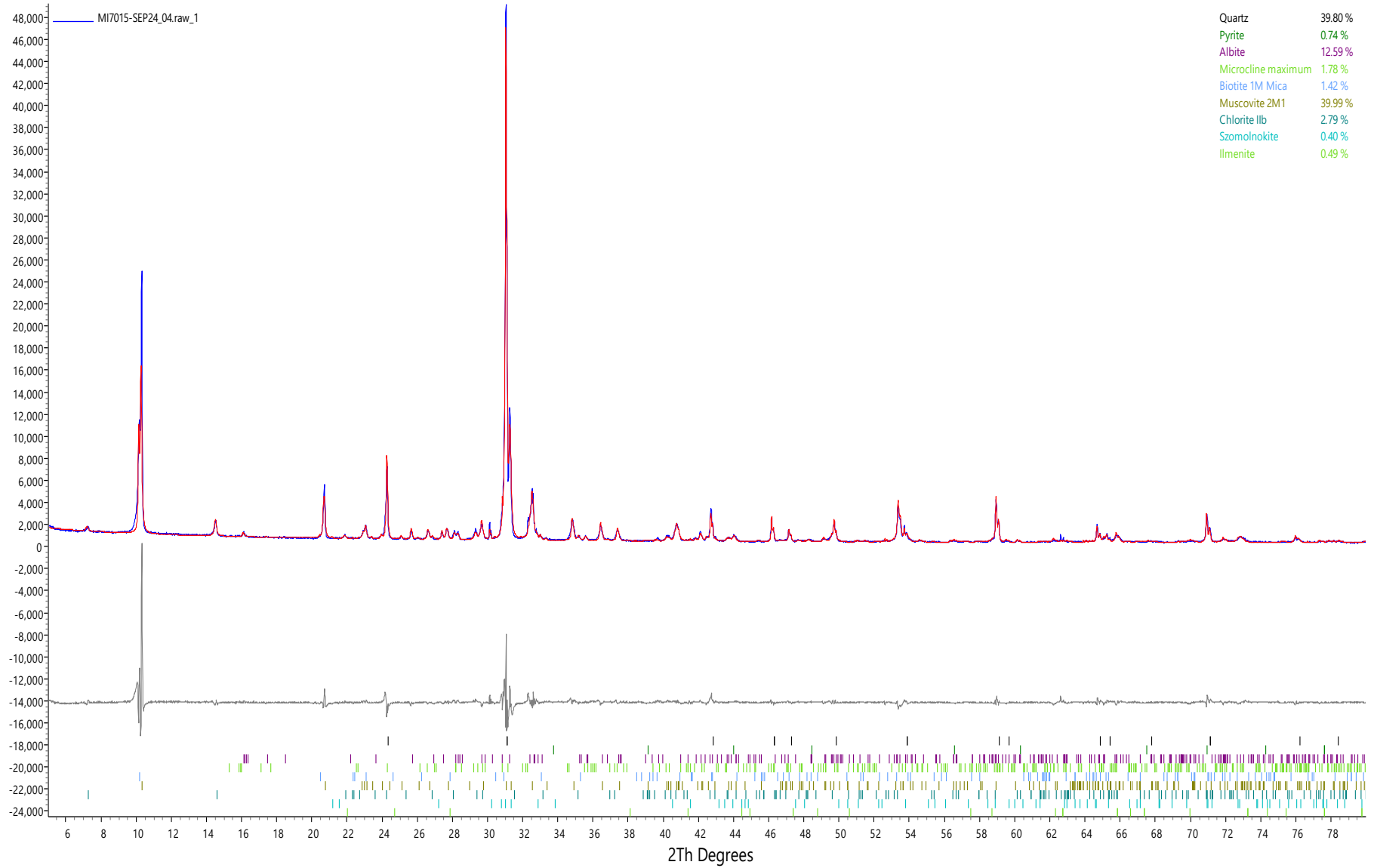
HQ 2



HQ 3



HQ 4



HQ 5

