PHASE 2 INITIAL BOREHOLE DRILLING AND TESTING, SOUTH BRUCE

WP04G Data Report: Organic Geochemistry and Clay Mineralogy for SB_BH02

APM-REP-01332-0334 November 2023

Geofirma Engineering

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Phase 2 Initial Borehole Drilling and Testing, South Bruce

WP04G Data Report: Organic Geochemistry and Clay Mineralogy for SB_BH02

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Revision Tracking Table

Revision	Revision Release Date	Description of Modifications/Edits
R0	July 28, 2023	Release with NWMO comments addressed
R1	September 8, 2023	Re-release with updated Figure 2, Appendix, and more detail added to Section 3.2 and Section 4.2
R2	October 31, 2023	Re-release with minor changes to text for clarification and updated colours in figures 2-7.

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1 INTRODUCTION

Geofirma Engineering Ltd. (Geofirma) was retained by the Nuclear Waste Management Organization (NWMO) to complete a drilling and testing program for two deep bedrock boreholes (SB_BH01 & SB_BH02) as part of the NWMO's Phase 2 Geoscientific Preliminary Field Investigations. The full scope of the drilling and testing program for SB_BH02 is described in the Initial Borehole Characterization Plan.

Borehole SB_BH02 is located approximately 5.5 km northwest of the community of Teeswater, Ontario (see Figure 1) and was drilled to 900.57 m below ground surface (m BGS). SB_BH02 was drilled through the entire sedimentary bedrock sequence to approximately 14 m into the Precambrian basement. SB_BH02 is located approximately 2.5 km west of SB_BH01.

The purpose of this study is to provide geoscientific data that can be used to do a preliminary assessment of:

1) the quantity of organic matter present in core samples obtained from selected formations encountered by borehole SB_BH02; and

2) a preliminary assessment of the thermal maturity of the kerogen and clay mineralogy of several formations at the South Bruce Site.

Figure 1: Location of SB_BH02 (following page).

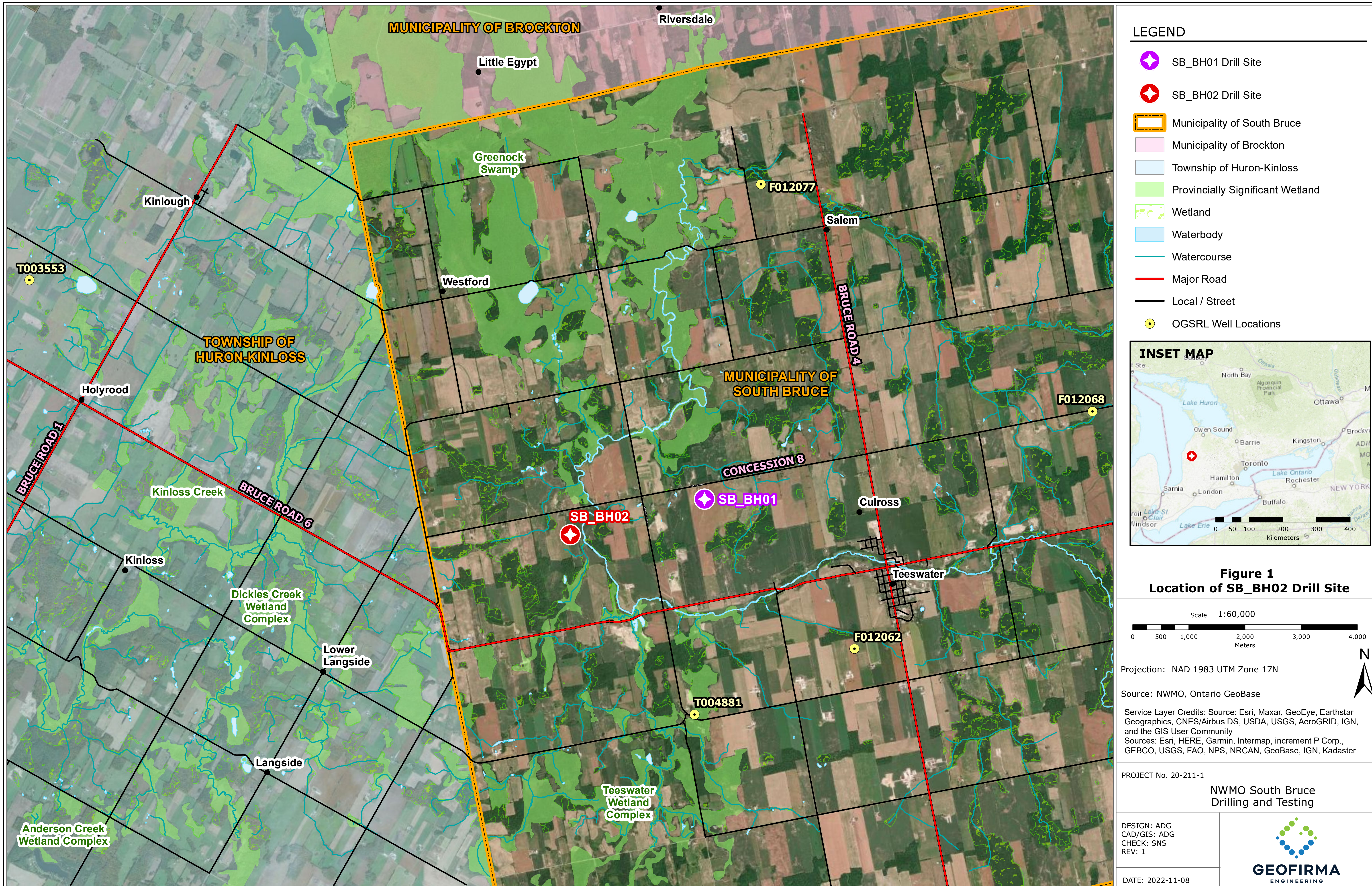

Figure 1
Location of SB_BH02 Drill Site

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2 BACKGROUND INFORMATION

2.1 Geologic Setting

The borehole SB_BH02 encountered a sequence of Paleozoic-aged strata that were deposited in the Michigan Basin northwest of the Algonquin Arch in Southwestern Ontario. The Michigan Basin is a circular-shaped cratonic basin that is composed primarily of shallow marine carbonates, evaporites, and shales that were deposited while eastern North America was in tropical latitudes during the Paleozoic Era (Armstrong and Carter, 2010). West of the Algonquin Arch, strata from the Michigan Basin tend to gradually dip westward into the Michigan Basin. Borehole SB_BH02 was drilled through the entire Paleozoic sequence to approximately 14 m into the Precambrian basement, which is composed of high-grade metamorphic rocks of the Grenville Province.

2.2 Technical Objectives

The objective of Work Package 04G (WP04G) is to determine the amount of organic matter and the preliminary quality of the kerogen content of selected formations in the South Bruce Site. This was accomplished through a preliminary assessment of geochemical parameters that characterize the thermal maturity of the sedimentary organic carbon or kerogen and clay mineralogy of several formations. Laboratory testing included total organic carbon (TOC) analysis, reservoir pyrolysis testing by Rock-Eval analysis, and combined whole rock mineral analysis with clay fraction analysis by X-ray diffraction (XRD).

2.3 Description of Testing Procedures

Core Laboratories Canada Ltd. conducted three tests on each of the samples to measure total organic content, hydrocarbon contents, and mineralogy to determine the hydrogen, oxygen, and production indices and kerogen types. Table 1 summarizes the completed tests, testing equipment and methods, and resultant test result parameters. Table 2 defines the acronyms for test and result parameters.

Table 1: Summary of Tests, Testing Equipment and Test Result Parameters

Test	Testing Equipment	Test Result Parameters
Total Organic Carbon	LECO-SC-632 Analyser	TOC in wt.%
Reservoir Pyrolysis	Rock-Eval 6 Instrumentation	S1, S2, S3 contents in mg/g Tmax in °C Calculated HI, OI and PI Kerogen type
Whole Rock and Clay Mineralogy by XRD	Scintag® Automated Powder Diffractometer	Whole Rock and Clay Fraction Mineralogy in %

Table 2: Summary of Measured and Calculated Parameters

Acronym	Definition
HI	Hydrogen Index: a parameter calculated from S2 and TOC that is used to characterize the origin of organic matter, reported in mg of hydrocarbons per gram of rock
OI	Oxygen Index: a parameter calculated from S3 and TOC that is correlated with the ratio of O to C, used to characterize the origin of organic matter, reported in mg of CO_2 per gram of rock
PI	Production Index: a unitless indicator of thermal maturity calculated using S1 and S2
S1	The amount of free/adsorbed hydrocarbons (gas and oil) in a sample, reported in milligrams of hydrocarbons per gram of rock
S2	The amount of hydrocarbons generated through thermal cracking of non-volatile organic matter, reported in milligrams of hydrocarbons per gram of rock
S3	The amount of CO_2 produced during pyrolysis of kerogen, reported in milligrams of CO_2 and CO per gram of rock
Tmax	The temperature at which the peak of S2 occurs, reported in degrees Celsius (°C)
TOC	Total organic carbon, reported in weight percentage (wt.%)

A total of 14 core samples, with a minimum core length of 10 cm, preserved with plastic film wrap within a vacuum-sealed polyethylene bag contained within a vacuum-sealed aluminum foil bag, were forwarded in coolers under chain of custody procedures to Core Laboratories in Calgary. Core sampling, preservation, handling, and shipment procedures for all core samples provided to Core Laboratories Canada Ltd. for use are fully described in WP03 Data Report: Geological and Geotechnical Core Logging, Photography, and Sampling for SB_BH02 (Geofirma Engineering Ltd., 2022).

A complete list of samples and their locations in SB_BH02 is presented in Figure 2 and Table 3. Lithologies listed herein are as logged at the time of sample collection during WP03 activities and it is possible that they do not reflect the lithology as indicated by XRD mineralogy results (see Section 3.2). Sample SB_BH02_OG016 of the Collingwood Formation was collected by the NWMO after WP03 completion. Samples SB_BH02_OG001, SB_BH02_OG003, SB_BH02_OG010, and SB_BH02_OG015 were collected from intervals for which the WP03 formation picks were revised during WP10: Data Integration. Table 3 provides the WP03 formation picks and lithologies as well as the WP10 revised formation picks for each sample. The data reported herein uses the final formation picks from WP10.

Table 3: Sample Locations and Formation Picks in SB_BH02 Core.

Sample ID	Top Depth (mBGS)	Bottom Depth (mBGS)	Formation (WP03)	Formation (WP10)	Lithology (WP03)
SB_BH02_OG001	96.28	96.32	Bois Blanc	Amherstburg	Limestone
SB_BH02_OG002	354.09	354.13	Salina A1 Carbonate	Salina A1 Unit Carbonate	Limestone
SB_BH02_OG003	407.99	408.03	Gasport	Goat Island	Limestone
SB_BH02_OG005	497.86	497.9	Queenston	Queenston	Shale
SB_BH02_OG008	587.76	587.8	Georgian Bay	Georgian Bay	Shale
SB_BH02_OG009	634.76	634.8	Blue Mountain	Blue Mountain	Shale
SB_BH02_OG010	668.83	668.87	Cobourg (Collingwood)	Blue Mountain	Shale
SB_BH02_OG016	670.81	670.82	Collected after WP03 completion	Cobourg (Collingwood)	Collected after WP03 completion
SB_BH02_OG006	689.98	690.02	Cobourg (Lower)	Cobourg (Lower)	Limestone
SB_BH02_OG011	748.61	748.65	Sherman Fall	Sherman Fall	Limestone
SB_BH02_OG012	780.26	780.3	Kirkfield	Kirkfield	Limestone
SB_BH02_OG013	814.54	814.58	Coboconk	Coboconk	Limestone
SB_BH02_OG014	844.99	845.03	Gull River	Gull River	Limestone
SB_BH02_OG015	880.09	880.13	Shadow Lake	Gull River	Shale

2.4 Test Apparatus and Procedures

2.4.1 Total Organic Carbon

The core was pulverized and passed through a 40-mesh sieve. Between 20 and 200 mg of pulverized rock was accurately weighed into a Pyrex beaker and reacted with concentrated 6N HCl to dissolve carbonate minerals. Once the reaction was complete, the sample was transferred to a microfiber filter paper using a Millipore filter apparatus and rinsed free of acid using distilled water with vacuum assist. The filter paper with the sample, was then transferred to a LECO crucible and dried. Accelerator was added and the sample was combusted in a LECO model SC-632 combustion furnace at ~1400 °C. CO_2 generated by the combustion of organic matter (OM) in the sample was then measured using an infrared detector.

2.4.2 Rock-Eval Pyrolysis

Samples were pulverized to ~100 µm size. The 60 to 100 mg samples of ground core were then placed into the Rock-Eval crucibles, which were then loaded within an auto sampler into the oven where they were purged. Each sample was then raised into a 150ºC oven for 10 minutes to elute free hydrocarbons (the S1 peak). The oven was then ramped at 25ºC/minute up to 600ºC to crack non-volatile organic matter (S2 peak). CO_2 issued from kerogen cracking was collected and quantified from 300ºC to 390ºC during cooling of the sample giving the S3 peak. S1, S2, and Tmax values are determined with a flame ionization detector (FID) while S3 was measured with a thermal conductivity detector (TCD).

More detailed descriptions of Rock-Eval pyrolysis testing are given by Carvajal-Ortiz and Gentzis (2015, 2018) and Lafargue et al. (1998).

2.4.3 Whole Rock and Clay Mineralogy by XRD

Whole rock X-ray diffraction (XRD) analysis was performed first to permit a reference for the subsequent clay fraction (<4 µm) analysis. The clay fractions were separated from the cores by milling the cores and soaking the resulting powders in purified water, sonicating and decanting the clay fraction after timed sedimentation. The decanted suspensions containing the clay fraction were then passed through a 0.4 µm filter. The suspension was then placed on a glass slide, allowed to dry at room temperature, placed in a desiccator with ethylene glycol, evacuated for 15-30 minutes, and left to saturate overnight. The samples were examined by XRD immediately after retrieving them from the desiccator. Finally, the glycolated samples were heated at 400 ºC and at 550 ºC for 1-2 hours and examined by XRD after each treatment.

XRD analyses of the samples were performed utilizing a Scintag® automated powder diffractometer equipped with a copper source (40kV, 40mA). The whole rock samples were analyzed over an angular range of 2-60 degrees 2θ at a scan rate of one degree per minute. The glycol-solvated clay-fraction mounts were analyzed over an angular range of 2-50 degrees 2θ at a rate of 1.5 degrees per minute.

2.5 Procedures for Analysis of Data

Some of the data collected through the testing procedures described above required further processing, which was done by Core Laboratories Canada Ltd.

2.5.1 Total Organic Carbon

Measured CO_2 (in wt.%) produced by the combustion of organic matter in a demineralized sample is taken as the total organic content of that sample.

2.5.2 Measured Rock-Eval Pyrolysis Parameters – S1, S2, S3 and Tmax

Rock-eval pyrolysis determines four parameters: the amount of free hydrocarbons (gas and oil) in a sample (S1), the amount of hydrocarbons generated through thermal cracking of non-volatile organic matter (S2), the amount of CO_2 and CO produced during pyrolysis of kerogen (S3), and the temperature at which the peak of S2 occurs (Tmax). S1 values greater than one (1) mg/g can be indicative of oil showings (Carvajal-Ortiz and Gentzis, 2015), S2 is a quantified indication of the potential of producing hydrocarbons through continued burial and maturation, and S3 is indicator of the amount of oxygen within the kerogen. These parameters are then used to determine hydrogen, oxygen, and production indices.

2.5.3 Calculated Indices: HI, OI, and PI

The Hydrogen Index (HI), the Oxygen Index (OI), and the Production Index (PI) are parameters calculated using the TOC (wt. %), S1 (mg HC/g), S2 (mg HC/g), and S3 (mg CO_2/g) values using the following respective formulas:

Hydrogen Index

$$HI = \frac{100 \times S2}{TOC}$$

Oxygen Index

$$OI = \frac{100 \times S3}{TOC}$$

Production Index

$$PI = \frac{S1}{S1 + S2}$$

2.5.4 Whole Rock and Clay Mineralogy

Semi-quantitative determinations of whole-rock and phyllosilicate mineral amounts were done using Core Laboratories proprietary reference intensity ratios developed by R.C. Reynolds. The total clay mineral (including mica) abundance of each sample was determined from the whole-rock XRD patterns using combined {00l} and {hkl} clay mineral reflections and suitable empirical RIR factors. Clay fraction analyzes focus on illite/smectite, illite and associated sheet silicates, kaolinite, and chlorite fraction determinations.

Determinations of mixed-layer clay ordering and expandability are done by comparing experimental diffraction data from the glycol-solvated clay mineral aggregates with simulated one-dimensional diffraction profiles generated using the program NEWMOD written by R.C. Reynolds of Core Laboratories.

3 LABORATORY RESULTS

All laboratory results for source rock analysis and mineralogy reported herein are provided by Core Laboratories Canada Ltd. Complete results provided by the lab, including data presented in tables and figures herein, are provided in the appendix.

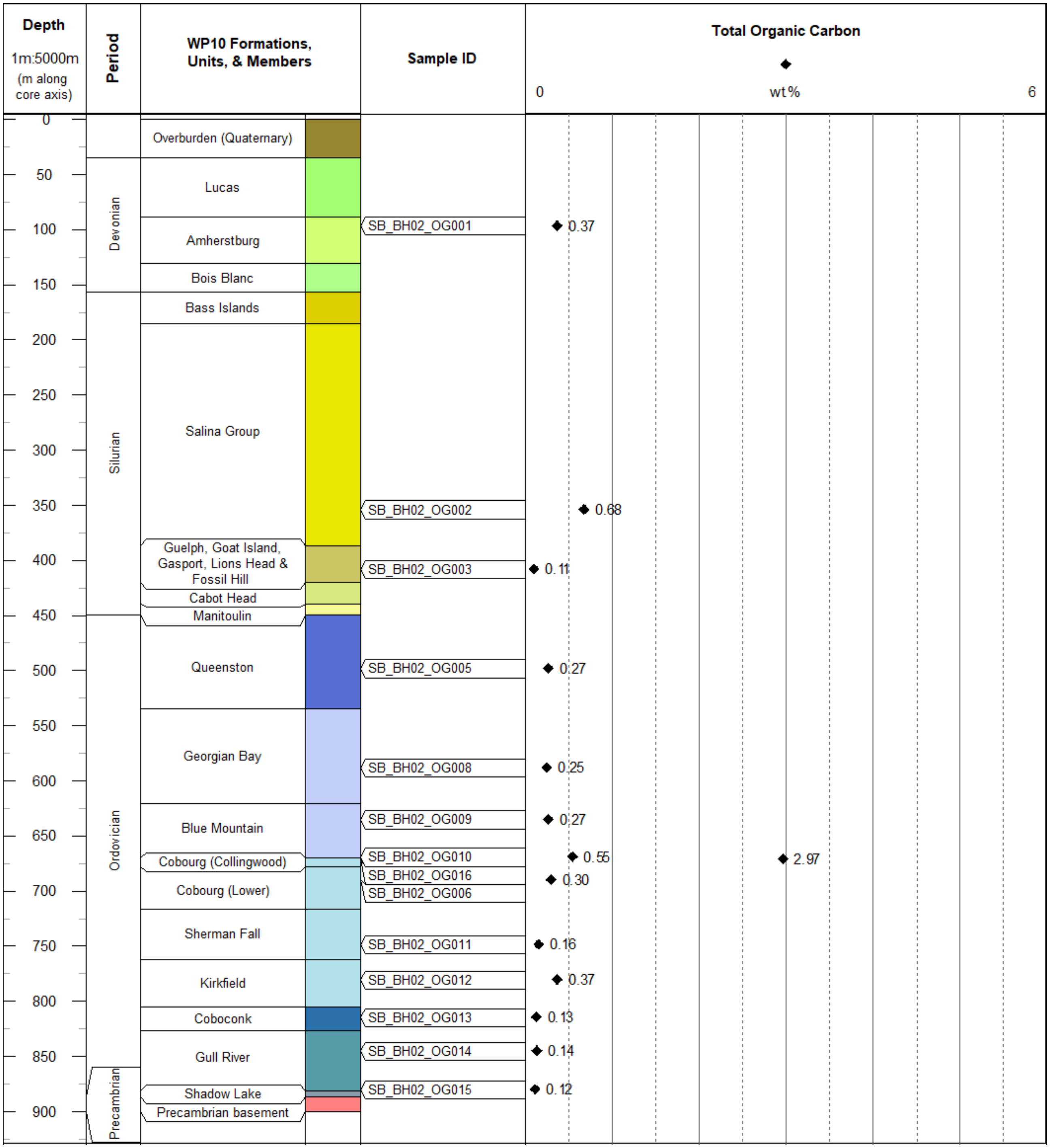

Figure 2: Logged Lithology and Total Organic Carbon Contents of SB_BH02 Core Samples.

3.1 Measured Total Organic Carbon and Rock-Eval Pyrolysis Parameters

All 14 samples yield total organic carbon (TOC) contents of less than three (3) weight percent (wt. %). The highest TOC was measured in one sample from the Cobourg Formation's Collingwood Member with a TOC content of 2.97%. All other samples yield TOC contents less than one (1) wt.%. TOC values for each sample are presented in Figure 2 and Table 4.

Table 4: Pyrolysis Results for SB_BH02 Core Samples.

Sample ID	Formation, lithology	TOC (wt. %)	S1 (mg HC/g)	S2 (mg HC/g)	S3 (mg CO_2/g)	S3 (mg CO/g)	Tmax (°C)
SB_BH02_OG001	Amherstburg, limestone	0.37	0.01	0.65	0.29	0.05	439
SB_BH02_OG002	Salina A1 Carbonate, limestone	0.68	0.61	1.79	0.33	0.01	428
SB_BH02_OG003	Goat Island, limestone	0.11	0.00	0.01	0.18	0.01	592
SB_BH02_OG005	Queenston, shale	0.27	0.00	0.05	1.00	0.01	431
SB_BH02_OG008	Georgian Bay, shale	0.25	0.03	0.25	0.38	0.01	432
SB_BH02_OG009	Blue Mountain, shale	0.27	0.16	1.06	0.33	0.01	441
SB_BH02_OG010	Blue Mountain, shale	0.55	0.07	0.60	0.36	0.01	445
SB_BH02_OG016	Cobourg (Collingwood)	2.97	1.37	15.84	0.34	0.10	445
SB_BH02_OG006	Cobourg (Lower), limestone	0.30	0.01	0.12	0.38	0.01	434
SB_BH02_OG011	Sherman Fall, limestone	0.16	0.01	0.07	0.43	0.01	431
SB_BH02_OG012	Kirkfield, limestone	0.37	0.09	0.62	0.69	0.01	445
SB_BH02_OG013	Coboconk, limestone	0.13	0.01	0.02	0.12	0.02	444
SB_BH02_OG014	Gull River, limestone	0.14	0.00	0.02	0.09	0.02	438
SB_BH02_OG015	Gull River, limestone	0.12	0.00	0.00	0.68	0.01	422

Note: Lithologies are as logged at the time of sample collection during WP03 activities. Sample SB_BH02_OG016 was collected after completion of WP03. HC = hydrocarbons.

Four primary parameters of source-rock evaluation were measured for all 14 samples: S1, S2, S3, and Tmax (see Table 4). Pyrograms (plots depicting the progression of pyrolysis) from which the parameters are derived for each sample are provided in the appendix. S1 and S2 values for all samples are proportional to the respective total organic carbon contents. The amount of free hydrocarbons (S1) is less than 1 mg/g for all samples except for SB_BH02_OG016 (Figure 3). The amount of hydrocarbons generated through thermal cracking (S2) is below 1 mg of hydrocarbons (HC) per g of rock for most samples. Salina A1 Carbonate sample OG_BH02_OG002 and Blue Mountain Formation sample SB_BH02_OG010 yield slightly higher values of 1.79 mg/g and 1.06 mg/g, respectively, and the Collingwood Member sample yields the highest S2 value of 15.84 mg/g. The amounts of CO_2 and CO produced during thermal cracking (S3) are all less than 1 mg/g. The temperature at which maximum hydrocarbon release occurs (Tmax; S2 peak) for each sample ranged from 422 to 592 °C.

Results from samples with low total organic carbon contents should be considered carefully since the contents of all samples are low and some near the detection limits of the testing equipment. The detection limit for the LECO device used herein, though variable, is commonly about 0.02 wt.% for shale samples. As low total organic contents near the detection limits of the equipment, the uncertainty of the measurement increases. Not only is the measure of organic carbon content less precise (i.e., greater associated uncertainty), but all measured products of pyrolysis (S1, S2, S3, and Tmax) will also have larger associated uncertainties. Specifically, the pyrograms (provided in the appendix) for samples with very low S2 (SB_BH02_OG003, SB_BH02_OG015) appear jagged and have the least well-defined peaks.

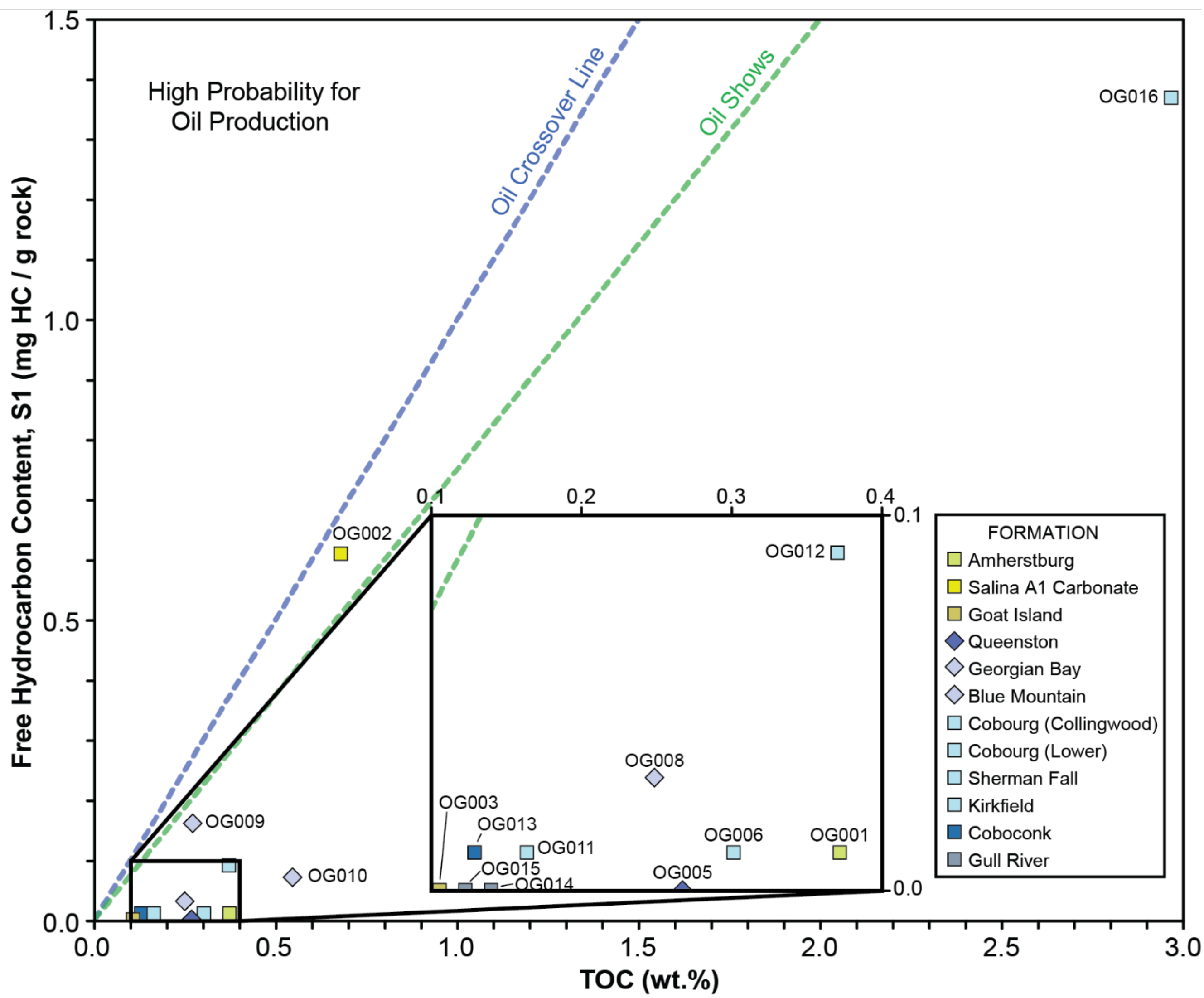

Figure 3: Oil and Gas Showings of SB_BH02 Core Samples.

3.1.1 Calculated Index Parameters

All calculated index parameters for SB_BH02 samples are provided in Table 5.Hydrogen Index

The Hydrogen Index (HI), a measure of the H to C ratio, was calculated for each sample from the S2 value determined through pyrolysis. Generally, organic matter derived from the remains of marine organisms and algae yield higher HI values than terrestrial plants (Carvajal-Ortiz and Gentzis, 2015).

This is attributed to the higher H to C ratios of their lipid and protein constituents compared to the carbohydrate-rich constituents of land plants. SB_BH02 core samples yield hydrogen indices between 0 and 533 mg of hydrocarbons per g of rock (see Table 5). Figures 3 and 5 are diagrams in which the hydrogen indices are used to infer the source of organic matter (kerogen type; see Section 3.1.2 for more details).

Table 5: Calculated Index Parameters for SB_BH02 Core Samples.

Sample ID	Formation, lithology	HI (mg HC / g rock)	OI (mg CO_2 / g rock)	PI
SB_BH02_OG001	Amherstburg, limestone	175	78	0.02
SB_BH02_OG002	Salina A1 Carbonate, limestone	263	49	0.25
SB_BH02_OG003	Goat Island, limestone	9	171	0.00
SB_BH02_OG005	Queenston, shale	19	374	0.00
SB_BH02_OG008	Georgian Bay, shale	101	153	0.11
SB_BH02_OG009	Blue Mountain, shale	392	122	0.13
SB_BH02_OG010	Blue Mountain, shale	110	66	0.10
SB_BH02_OG016	Cobourg (Collingwood)	533	11	0.08
SB_BH02_OG006	Cobourg (Lower), limestone	40	126	0.08
SB_BH02_OG011	Sherman Fall, limestone	43	263	0.13
SB_BH02_OG012	Kirkfield, limestone	167	186	0.13
SB_BH02_OG013	Coboconk, limestone	16	93	0.33
SB_BH02_OG014	Gull River, limestone	14	64	0.00
SB_BH02_OG015	Gull River, limestone	0	555	0.00

Note: Lithologies are as logged at the time of sample collection during WP03 activities. Sample SB_BH02_OG016 was collected after completion of WP03. HC = hydrocarbons.

Oxygen Index

The Oxygen Index (OI), which is calculated from the S3 value, correlates with the ratio of O to C. OI is important for assessing the origin and type of kerogen. Generally, ratios of O to C are higher for organic matter derived from terrestrial plants and residual organic matter (Carvajal-Ortiz and Gentzis, 2015). SB_BH02 core samples yield oxygen indices of 11 to 555 mg CO_2 per g of rock (see Table 5 and Figure 4).

Production Index

The Production Index (PI) is a unitless indicator of the extent to which kerogen has transformed into hydrocarbons (Table 5). This index, along with Tmax, is used to assess the maturity of source rocks (see Figure 6). SB_BH02 core samples yield PI values between 0.00 and 0.25. As PI is calculated from S1 and S2, it should be noted that S2 values are less than 1 mg of hydrocarbons per gram of rock for most samples, which is a source of uncertainty in interpreting PI results.

3.1.2 Inferred Kerogen Types

Calculated HI and OI values are used to infer kerogen types for each sample. These results are summarized in Table 6 and presented in Figures 4, 5, and 7. The majority of samples are inferred to be gas-prone Type III Kerogen and dry-gas prone Type IV Kerogen. Blue Mountain (SB_BH02_OG009) and

Collingwood (SB_BH02_OG016) samples yield oil-prone Type II results. The sample of Salina A1 Carbonate yields Mixed Type II and III oil and gas-prone results.

Table 6: Kerogen Types of SB_BH02 Core Samples.

Sample ID	Formation, lithology	Kerogen Type
SB_BH02_OG001	Amherstburg, limestone	Type III (perhydrous)
SB_BH02_OG002	Salina A1 Carbonate, limestone	Mixed Type II/III (oil and gas-prone)
SB_BH02_OG003	Goat Island, limestone	Type IV (dry gas-prone)
SB_BH02_OG005	Queenston, shale	Type IV (dry gas-prone)
SB_BH02_OG008	Georgian Bay, shale	Type III (gas-prone)
SB_BH02_OG009	Blue Mountain, shale	Type II (oil-prone)
SB_BH02_OG010	Blue Mountain, shale	Type III (gas-prone)
SB_BH02_OG016	Cobourg (Collingwood)	Type II (oil-prone)
SB_BH02_OG006	Cobourg (Lower), limestone	Type IV (dry gas-prone)
SB_BH02_OG011	Sherman Fall, limestone	Type IV (dry gas-prone)
SB_BH02_OG012	Kirkfield, limestone	Type III (perhydrous)
SB_BH02_OG013	Coboconk, limestone	Type IV (dry gas-prone)
SB_BH02_OG014	Gull River, limestone	Type IV (dry gas-prone)
SB_BH02_OG015	Gull River, limestone	Type IV (dry gas-prone)

Note: Lithologies are as logged at the time of sample collection during WP03 activities. Sample SB_BH02_OG016 was collected after completion of WP03.

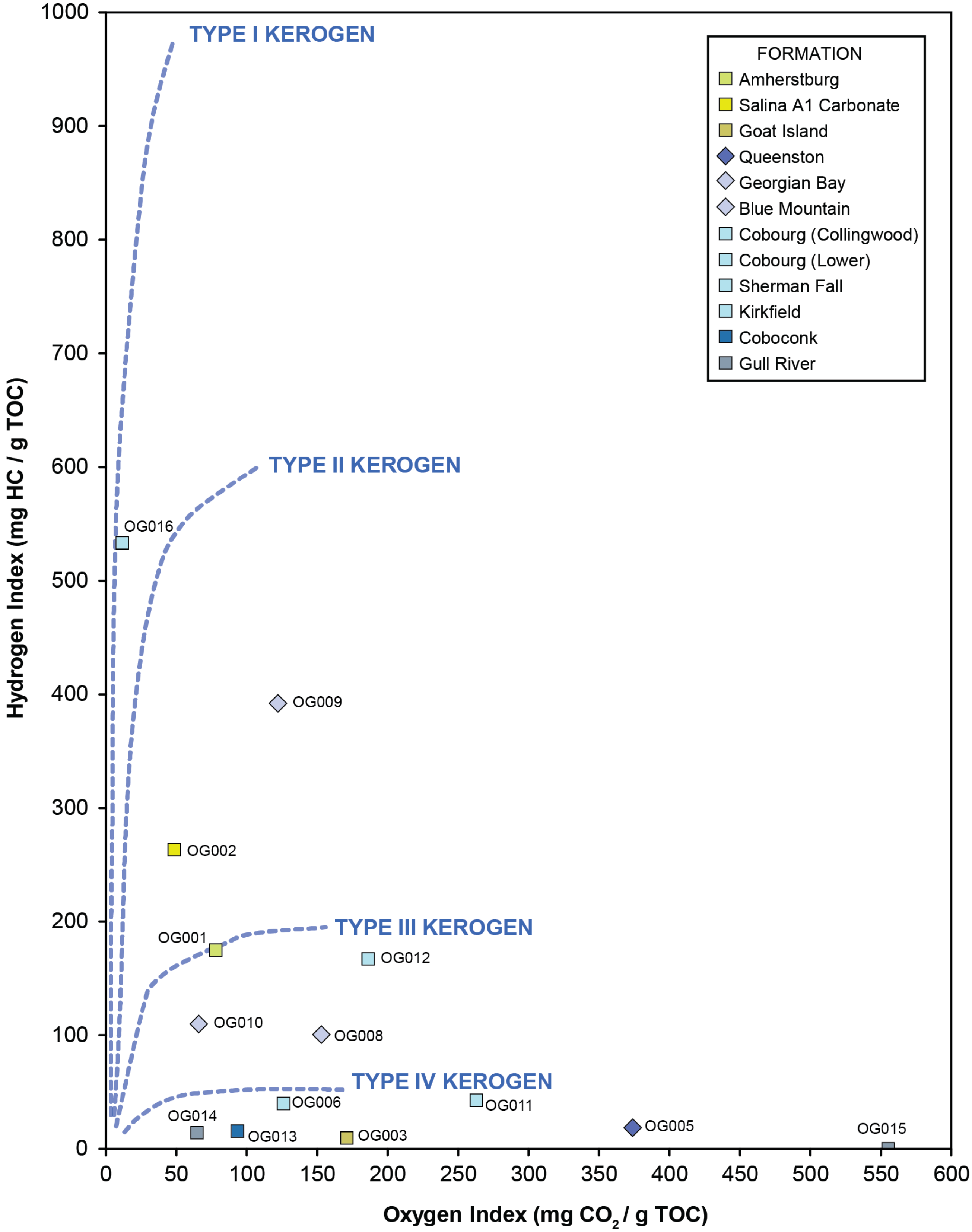

Figure 4: SB_BH02 Core Samples Plotted on a Pseudo–van Krevelen Diagram.

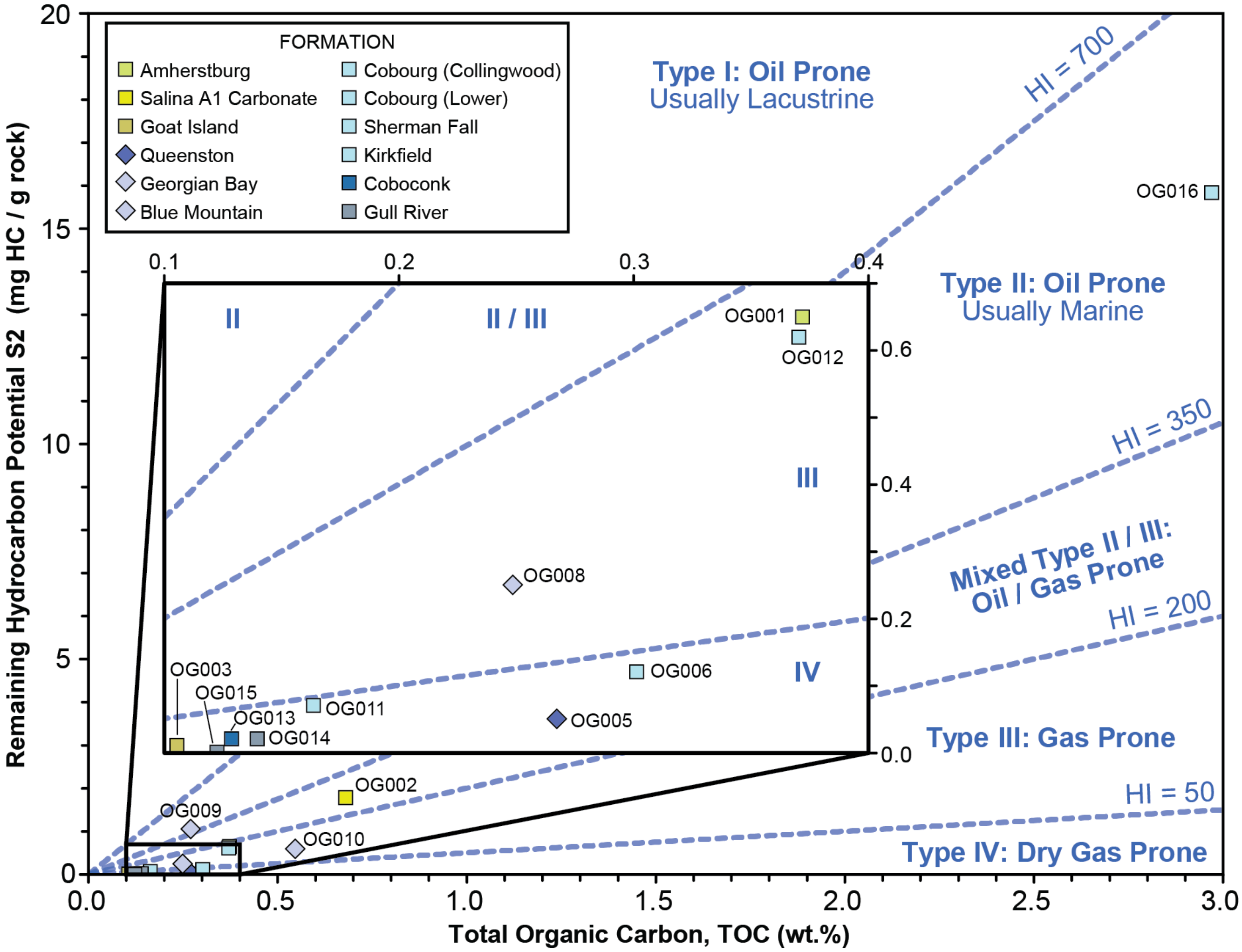

Figure 5: Kerogen Quality of SB_BH02 Core Samples.

3.1.3 Thermal Maturity of Source Rocks

Tmax, the temperature at which maximum hydrocarbon release occurs during pyrolysis, is an indicator of thermal maturity stage of the organic matter. Figures 6 and 7 present oil maturity inferences for SB_BH02 samples. Based on Tmax, Salina, Georgian Bay, Queenston, Cobourg (Lower), Sherman Fall, and Gull River (SB_BH02_OG015 only) samples are within the pre-oil window. Blue Mountain, Kirkfield, and Coboconk samples are within the oil window while Amherstburg, Cobourg (Collingwood), and Gull River (SB_BH02_OG014 only) samples yield low level conversion results. The Goat Island sample is in the dry gas zone.

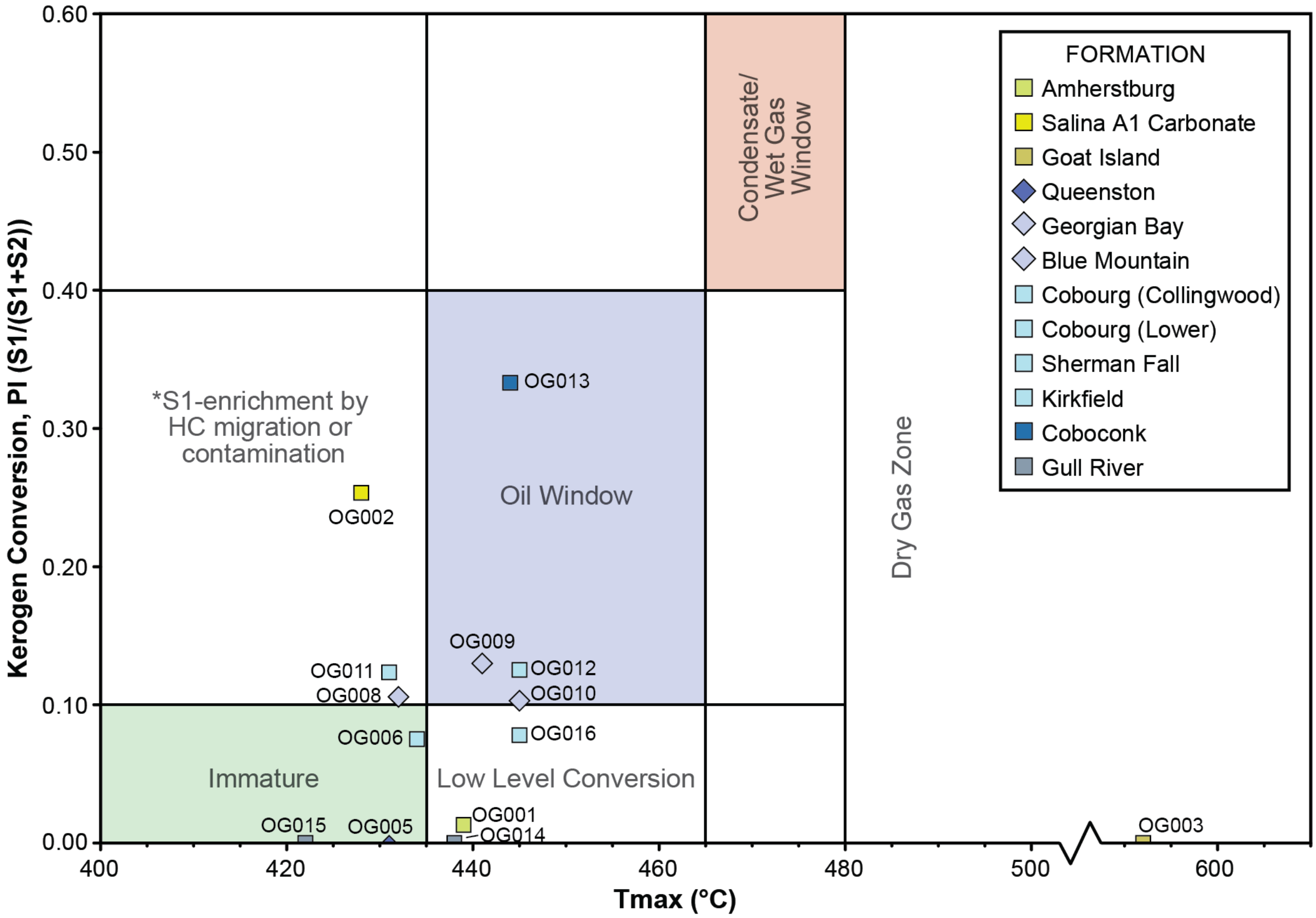

Figure 6: Kerogen Conversion (Production Index) and Maturity of SB_BH02 Core Samples.

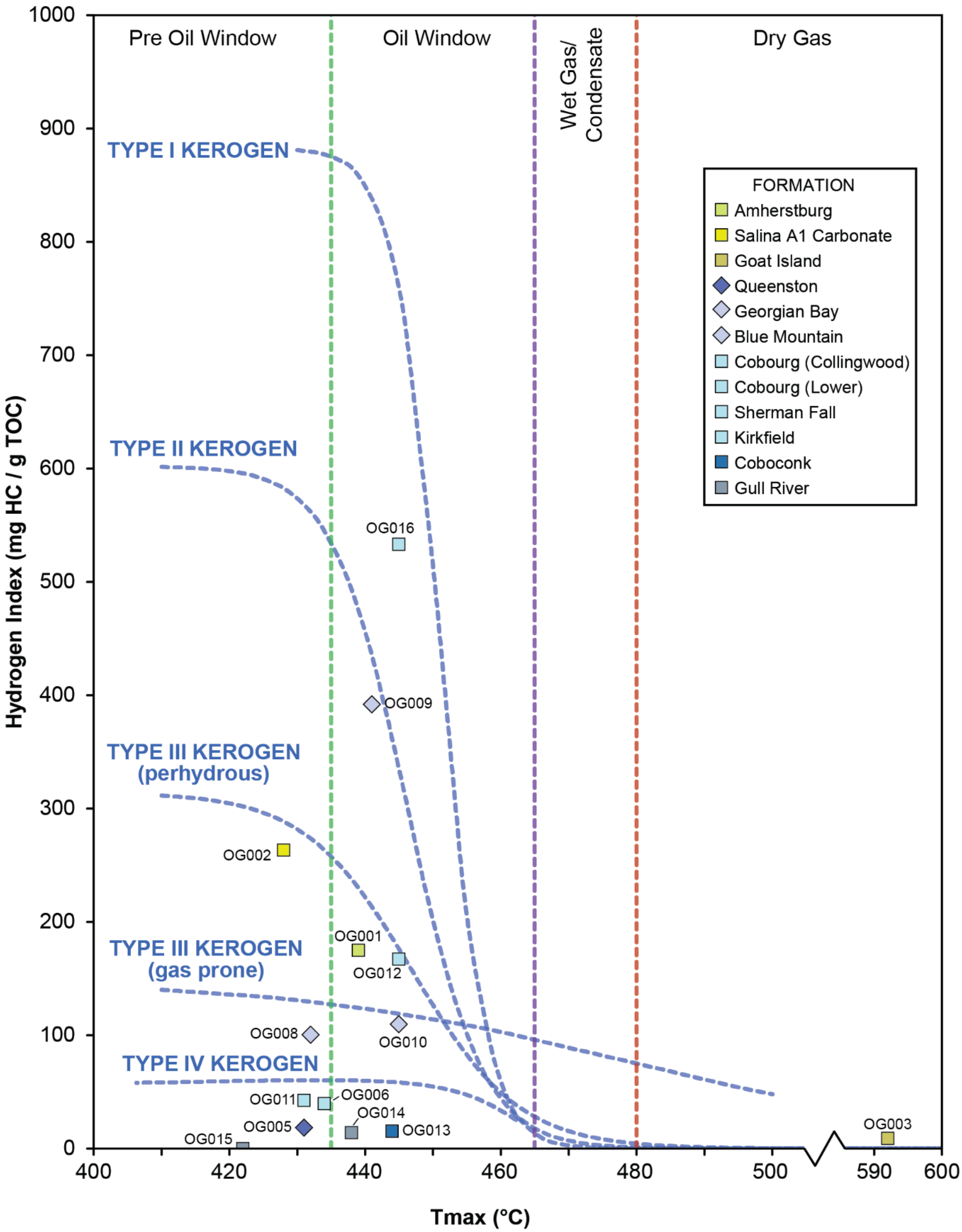

Figure 7: Kerogen Type and Maturity of SB_BH02 Core Samples.

Note: Parameters for organic matter type derived from Green River Shale (Type I), Liassic Shale (Type II), and Cambay Basin coals (Type III).

3.2 Whole Rock and Clay Mineralogy

A number of sheet silicates (phyllosilicates), commonly referred to as 'clay minerals', typically occur in the clay fraction (grains <4 µm in size) of sediments and sedimentary rocks. Non-sheet silicate minerals (e.g., quartz, felspar, calcite) may also be present within the clay-sized fraction and identified by XRD. Respectively, tables 7 and 8 present the XRD whole rock (including non-sheet silicates) and clay mineralogy results for SB_BH02. XRD diffractograms are provided in the appendix.

XRD detection limits are highly variable between minerals, depending on what other minerals are present in the matrix (clay-sized fraction) of the sample (Table 7). Detection limits are larger (less precise) for samples with mix-layered clay minerals, commonly shales, where a more abundant clay mineral may mask the presence of less abundant clay minerals. As such, mineral contents determined to be less than 0.20 wt.%, which is the estimated detection limit for clay-rich samples, are conservatively reported as having trace (Tr) content. Specific mineral contents are more precise for rock types that are not dominated by inter-layered clay minerals such as crystalline rocks and sandstones.

Table 7: XRD Whole Rock Mineralogy SB_BH02 Core Samples.

Sample ID	Sample Depth (mBGS)		Whole Rock Mineralogy (wt.%)							
	Top Depth	Bottom Depth	Quartz	K-Feldspar	Plagioclase	Calcite	Dolomite*	Pyrite	Halite	Total Clay
SB_BH02 OG001	96.28	96.32	9.4	0.7	0.0	38.3	49.8	0.0	0.2	1.6
SB_BH02 OG002	354.09	354.13	7.2	0.6	0.0	66.0	3.9	0.0	2.1	20.2
SB_BH02 OG003	407.99	408.03	2.8	0.8	0.0	64.7	21.3	0.0	3.4	7.1
SB_BH02 OG005	497.86	497.90	8.8	1.0	0.0	34.8	8.2	0.0	2.8	44.4
SB_BH02 OG008	587.76	587.80	21.5	1.8	1.0	1.4	3.0	2.2	1.0	68.1
SB_BH02 OG009	634.76	634.80	24.5	2.5	3.0	1.9	1.3	0.0	2.0	64.7
SB_BH02 OG010	668.83	668.87	21.5	2.2	2.3	2.3	1.1	0.0	2.0	68.5
SB_BH02_OG016	670.81	670.82	13.6	3.1	0.6	29.1	12.8	0.0	2.6	38.2
SB_BH02 OG006	689.98	690.02	4.4	1.1	0.0	75.7	7.5	0.0	0.5	10.7
SB_BH02 OG011	748.61	748.65	5.7	0.8	0.0	60.6	5.3	0.5	1.1	26.0
SB_BH02 OG012	780.26	780.30	9.6	2.6	0.0	49.5	1.4	0.0	2.5	34.5
SB_BH02 OG013	814.54	814.58	1.1	0.0	0.0	89.3	9.5	0.0	0.0	0.0
SB_BH02 OG014	844.99	845.03	5.9	0.0	0.0	70.9	23.1	0.0	0.0	Tr
SB_BH02 OG015	880.09	880.13	3.0	1.1	0.0	19.6	52.9	0.0	0.8	22.6

Note: Tr < 0.20 wt.%. Total clay is the sum of kaolinite, chlorite, illite and mica, and smectite/illite provided in Table 8. *Dolomite herein appears to be non-stoichiometric, most likely ferroan.

Whole rock mineralogy results for SB_BH02 are mostly consistent with the rock types logged during WP03. However, a few samples yield mineral contents that suggest they are of another lithology. SB_BH02_OG001 and SB_BH02_OG0015 are dominated by dolomite (approximately 50 wt.%), which indicates that their primary lithologies are dolostone. SB_BH02_OG005 is a calcareous shale with clay and calcite contents of 44% and 35%, respectively. All other samples have mineral contents consistent with their logged lithology—samples logged as limestone have calcite contents ≥50% and samples logged as shale have clay contents ≥50%.

Table 8: XRD Clay (Phyllosilicate) Mineralogy of SB_BH02 Core Samples.

Sample ID	Sample Depth (mBGS)		Formation, lithology	Clay Mineralogy (wt.%)				% Smectite in I/S
	Top Depth	Bottom Depth		Illite & Mica (I + M)	Kaolinite	Chlorite	Illite/ Smectite (I/S)	
SB_BH02 OG001	96.28	96.32	Amherstburg, limestone	100.0	0.0	0.0	0.0	-
SB_BH02 OG002	354.09	354.13	Salina A1 Carbonate, limestone	95.9	1.2	0.0	2.8	5-15
SB_BH02 OG003	407.99	408.03	Goat Island, limestone	94.4	0.7	0.3	4.6	5-15
SB_BH02 OG005	497.86	497.90	Queenston, shale	72.7	0.0	27.3	0.0	-
SB_BH02 OG008	587.76	587.80	Georgian Bay, shale	56.1	0.0	36.0	7.9	5-15
SB_BH02 OG009	634.76	634.80	Blue Mountain, shale	56.2	0.0	33.5	10.2	5-15
SB_BH02 OG010	668.83	668.87	Blue Mountain, shale	59.5	0.0	29.1	11.4	5-15
SB_BH02_OG016	670.81	670.82	Cobourg (Collingwood)	66.4	0.0	14.9	18.7	5-15
SB_BH02 OG006	689.98	690.02	Cobourg (Lower), limestone	78.8	0.0	9.4	11.8	5-15
SB_BH02 OG011	748.61	748.65	Sherman Fall, limestone	99.2	0.0	0.8	0.0	-
SB_BH02 OG012	780.26	780.30	Kirkfield, limestone	89.2	1.2	9.6	0.0	-
SB_BH02 OG013	814.54	814.58	Coboconk, limestone	0.0	0.0	0.0	0.0	-
SB_BH02 OG014	844.99	845.03	Gull River, limestone	100.0	0.0	0.0	0.0	-
SB_BH02 OG015	880.09	880.13	Gull River, limestone	96.4	0.0	3.6	0.0	-

Note: Lithologies are as logged at the time of sample collection during WP03 activities. Sample SB_BH02_OG016 was collected after completion of WP03.

Under the increased pressure and temperature conditions that lead to the conversion of organic matter into hydrocarbons, smectite undergoes diagenetic alteration and converts to illite (Héroux et al., 1979; Kübler et al., 1979). The disappearance of smectite has been directly correlated with the onset of hydrocarbon generation (Powell et al., 1978). As such, the presence or absence of smectite can be used as an indicator of thermal maturity of phyllosilicate-bearing source rocks. Seven of the 14 SB_BH02 samples total clay mineralogy results indicate the presence of smectite and/or illite (see Table 8). Of these samples, smectite is estimated to comprise 5-15% of the total smectite/illite content, suggesting that these samples are thermally immature. The other seven samples do not contain illite and/or smectite (0.0 wt.% I/S in Table 8) and their thermally maturity cannot be assessed using this indicator.

4 DATA QUALITY

Data quality conforms to standard laboratory practices in the oilfield services industry and in published literature. Results received from Core Laboratories Canada Ltd. were reviewed by Geofirma Engineering Ltd. for completeness, quality of testing, and reporting, by completing Data Quality Confirmation Forms which were accepted by NWMO subject matter experts. These forms were used to document that the data collection activities have been carried out in accordance with the quality requirements of the accepted WP04G Test Plan.

4.1 Calibration of Measurement and Test Equipment

Core Laboratories Canada Ltd. operates a Quality Management System (QMS) which complies with the requirements of ISO 9001:2015. As part of their QMS, Core Laboratories Canada Ltd. operates measurement and test equipment in accordance with manufacturer's specifications and calibration requirements including use of known standards for routine checking of equipment operation.

LECO SC-632 calibration standards are routinely used for TOC analyses (one in five samples).

The Rock-Eval instrument is routinely calibrated with standard samples. Standards are run every ten samples to check instrument calibration and status. Random reruns are also performed to check results.

The XRD equipment is calibrated every six months following manufacturers specifications and instructions.

4.2 Limitations of Sample Collection and Test Results

Samples were collected from pre-determined formations as specified in the test plan, including known hydrocarbon-bearing rocks in southwestern Ontario (Armstrong and Carter, 2010). Of these formations, the most apparently organic-rich portions of each formation were assessed based on core observations and targeted for sample collection. As single samples were collected for formations varying in thickness from 8 to 86 m, the samples do not provide insight into the distribution of hydrocarbons within formations nor a sense of hydrocarbon distribution over regular depth intervals. By targeting the most-organic rich portions of the borehole, sample collection herein likely provides an overestimate of the oil production potential. The presence of gas in SB_BH02 was assessed through collection of dissolved gas core samples (WP04C: Porewater Analysis) and fluid samples (WP07: Groundwater Sampling).

XRD detection limits are highly variable between minerals and contingent on the total mineral composition and lithology of the sample. Detection limits are relatively larger (i.e., less precise) for samples containing mix-layered clay minerals and smaller for clay-poor rocks.

5 CONCLUSIONS

The hydrocarbon production potential in SB_BH02 is low based on fourteen samples collected for organic geochemistry testing and source rock analysis. All samples yield low total organic carbon content (TOC) results of less than 3 wt.%, with most samples containing less than 0.5 wt.% TOC. Two samples from the Blue Mountain and Cobourg (Collingwood) formations contain inferred Type II Kerogen (oil prone) and the Salina A1 Carbonate sample contains Mixed Type II/III Kerogen. All other samples are inferred as Type III or IV gas-prone kerogen types. The thermal maturity (Tmax) and kerogen conversion (PI) of most samples suggest low-level conversion or maturity levels within the oil window with one thermally mature sample of the Goat Island formation in the dry gas zone. The presence of smectite in the seven illite/smectite-bearing samples from the Salina, Goat Island, Georgian Bay, Blue Mountain, and Cobourg formations indicates that they are thermally immature. Furthermore, free hydrocarbon (S1) and total organic carbon (TOC) content results yield a single oil showing in the Salina A1 Carbonate that is likely a result of enrichment through hydrocarbon migration. This suggests a low probability of oil production from all sampled formations.

6 REFERENCES

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Appendix

Core Laboratories Results and Supplemental Data

Source Rock Analysis

TOC, Kerogen Quality and Thermal Maturity Testing

Rock Eval 6

Version 4.09

LECO SC-632

Geofirma Engineering Ltd.

SB_BH02

Canada

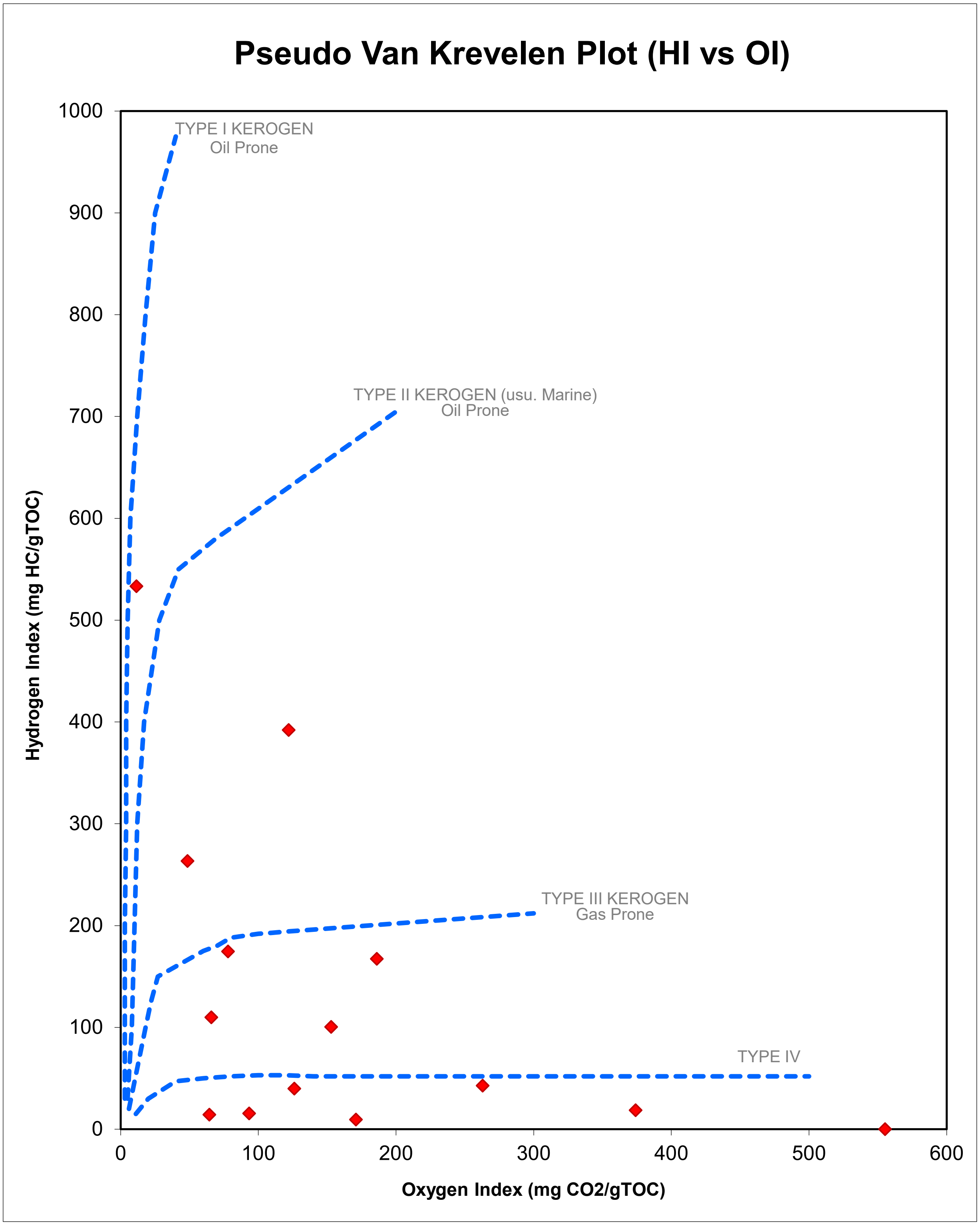
CoreLab ATC # 2201809

2023-06-16

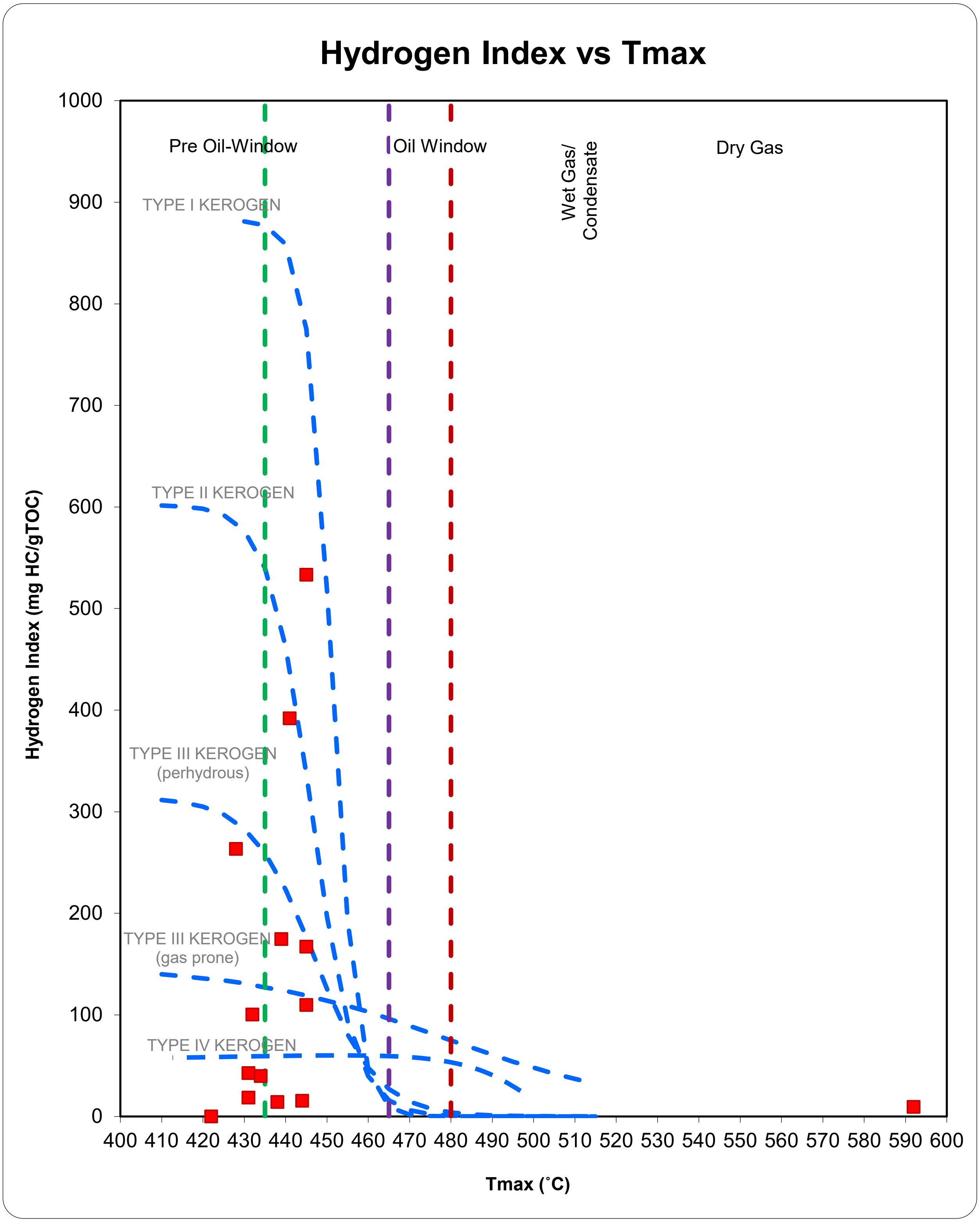
Core Laboratories
6316 Windfern Houston, TX 77040
713-328-2673

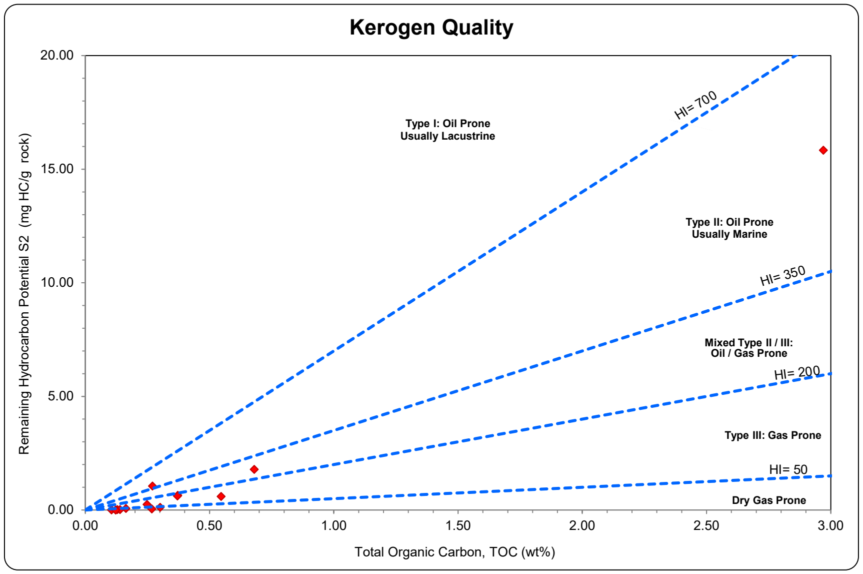
2201809

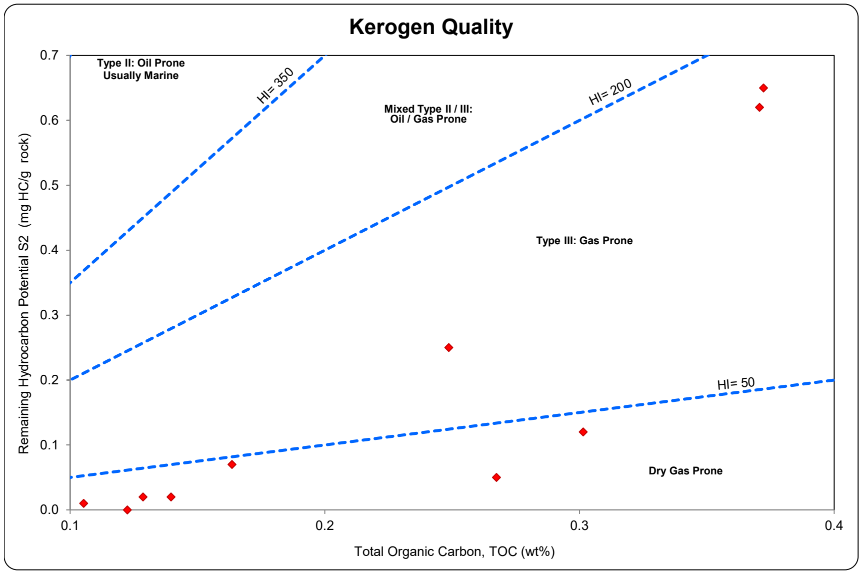
Sample	Upper Depth	Lower Depth	Median Depth	Sample Wt.	LECO TOC	S1	S2	S3 CO_2	S3 CO	Tmax	HI	OI	PI	OSI	Oil in Rock	VRo-Eq (%)	VRo-Eq (%)	VRo-Eq (%)	Remarks
ID	m	m	m	mg	wt%	mg HC/g	mg HC/g	mg CO2/g	mg CO/g	˚ C	S2x100/TOC	S3x100/TOC	S1/(S1+S2)	S1x100/TOC	bbl oil/ac-ft	Belle Fourche & Second White Specks Model	Duvernay Model	Barnett Model	Comments
SB_BH02_OG001	96.28	96.32	96.30	57	0.37	0.01	0.65	0.29	0.05	439	175	78	0.02	2.69	0.22	0.79	0.69	0.74	
SB_BH02_OG002	354.09	354.13	354.11	64.9	0.68	0.61	1.79	0.33	0.01	428	263	49	0.25	89.77	13.35	0.61	0.53	0.54	
SB_BH02_OG003	407.99	408.03	408.01	61.4	0.11	0.00	0.01	0.18	0.01	592	9	171	0.00	0.00	0.00	3.39	2.97	3.50	
SB_BH02_OG005	497.86	497.90	497.88	57.1	0.27	0.00	0.05	1.00	0.01	431	19	374	0.00	0.00	0.00	0.66	0.57	0.60	
SB_BH02_OG008	587.76	587.80	587.78	57.8	0.25	0.03	0.25	0.38	0.01	432	101	153	0.11	12.06	0.66	0.67	0.59	0.62	
SB_BH02_OG009	634.76	634.80	634.78	58.8	0.27	0.16	1.06	0.33	0.01	441	392	122	0.13	59.17	3.50	0.83	0.72	0.78	
SB_BH02_OG010	668.83	668.87	668.85	64.4	0.55	0.07	0.60	0.36	0.01	445	110	66	0.10	12.81	1.53	0.90	0.78	0.85	
SB_BH02_OG016	670.81	670.82	670.82	61.4	2.97	1.37	15.84	0.34	0.10	445	533	11	0.08	46.13	29.99	0.90	0.78	0.85	
SB_BH02_OG006	689.98	690.02	690.00	56.5	0.30	0.01	0.12	0.38	0.01	434	40	126	0.08	3.32	0.22	0.71	0.62	0.65	
SB_BH02_OG011	748.61	748.65	748.63	63.3	0.16	0.01	0.07	0.43	0.01	431	43	263	0.13	6.11	0.22	0.66	0.57	0.60	
SB_BH02_OG012	780.26	780.30	780.28	58.8	0.37	0.09	0.62	0.69	0.01	445	167	186	0.13	24.28	1.97	0.90	0.78	0.85	
SB_BH02_OG013	814.54	814.58	814.56	63.5	0.13	0.01	0.02	0.12	0.02	444	16	93	0.33	7.77	0.22	0.88	0.77	0.83	
SB_BH02_OG014	844.99	845.03	845.01	59.9	0.14	0.00	0.02	0.09	0.02	438	14	64	0.00	0.00	0.00	0.78	0.68	0.72	
SB_BH02_OG015	880.09	880.13	880.11	58.6	0.12	0.00	0.00	0.68	0.01	422	0	555	#DIV/0!	0.00	0.00	0.50	0.44	0.44	


Pseudo Van Krevelen Plot (HI vs OI)
TYPE I KEROGEN
Oil Prone
TYPE II KEROGEN (usu. Marine)
Oil Prone
TYPE III KEROGEN
Gas Prone
TYPE IV
Hydrogen Index (mg HC/gTOC)
Oxygen Index (mg CO2/gTOC)
0
100
200
300
400
500
600
700
800
900
1000

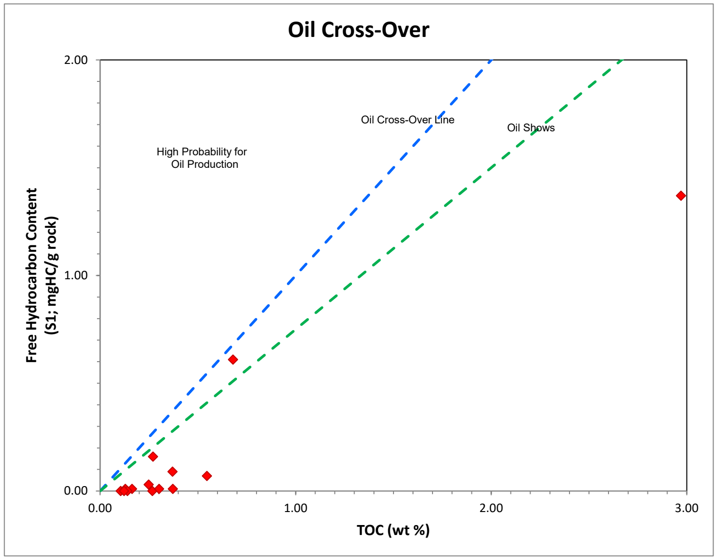
Job Number: CoreLab ATC # 2201809 Well Name: SB_BH02

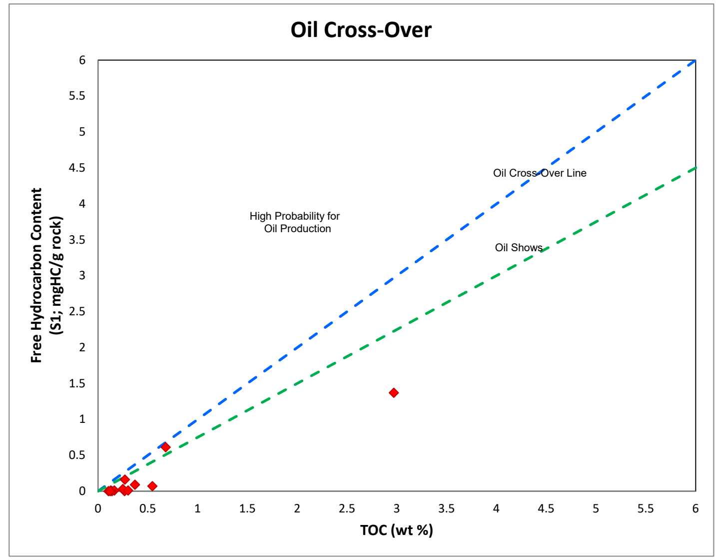



Kerogen Quality
Type I: Oil Prone
Usually Lacustrine
HI= 700
Type II: Oil Prone
Usually Marine
HI= 350
Mixed Type II / III:
Oil / Gas Prone
HI= 200
Type III: Gas Prone
HI= 50
Dry Gas Prone
Remaining Hydrocarbon Potential S2 (mg HC/g rock)
Total Organic Carbon, TOC (wt%)
0.00
5.00
10.00
15.00
20.00
0.50
1.00
1.50
2.00
2.50
3.00


Kerogen Quality
Type II: Oil Prone
Usually Marine
HI= 350
Mixed Type II / III:
Oil / Gas Prone
HI= 200
Type III: Gas Prone
HI= 50
Dry Gas Prone
Remaining Hydrocarbon Potential S2 (mg HC/g rock)
Total Organic Carbon, TOC (wt%)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7

Job Number: CoreLab ATC # 2201809 | Well Name: SB_BH02





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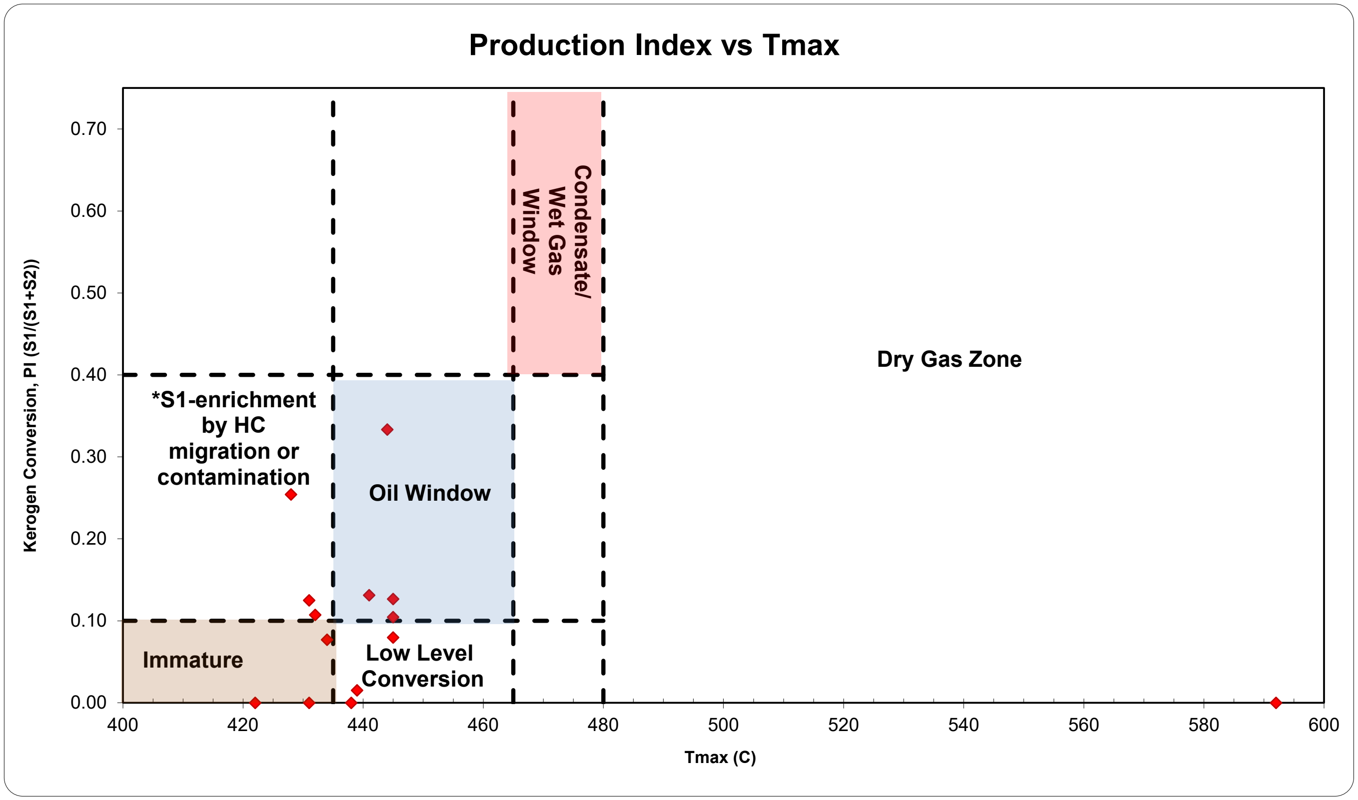
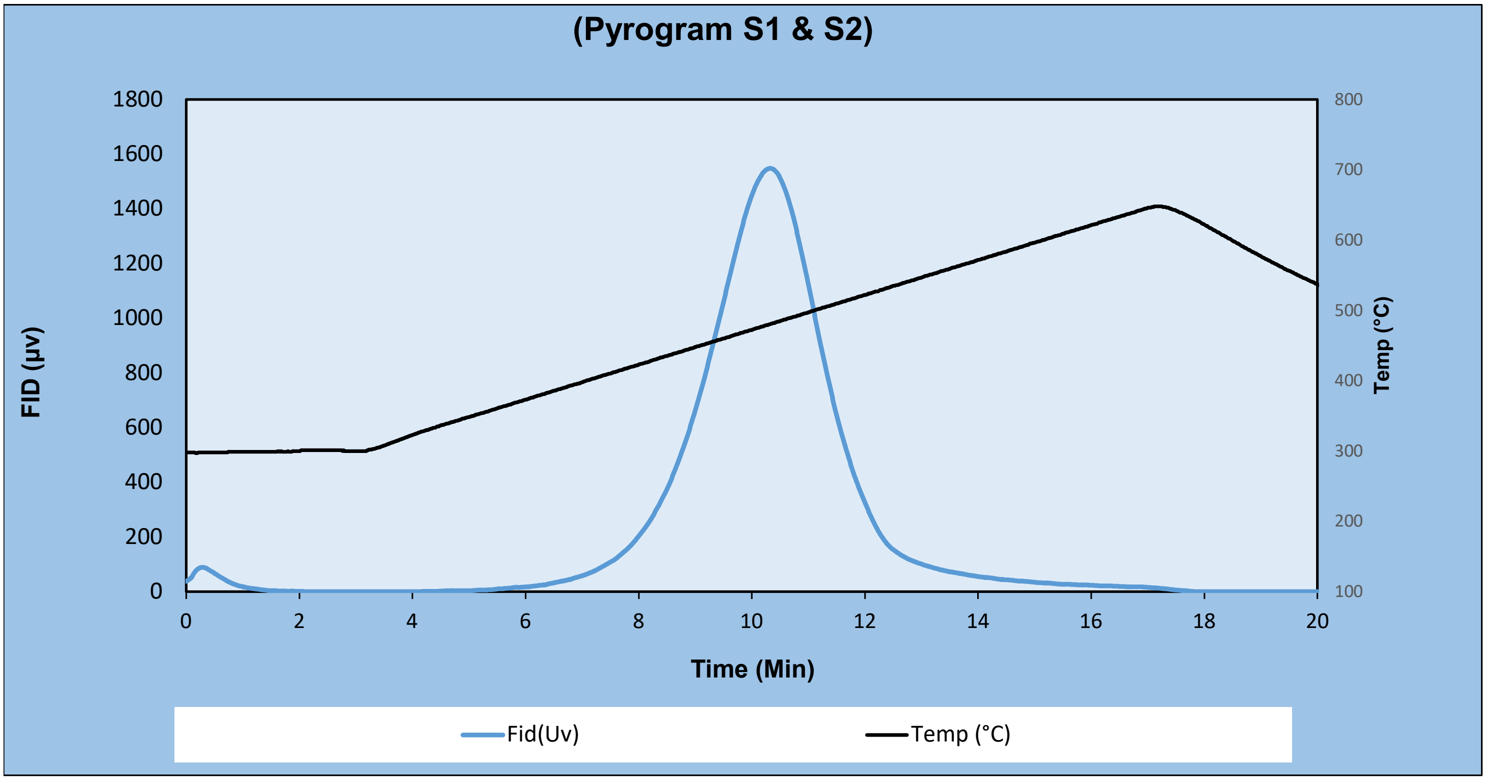
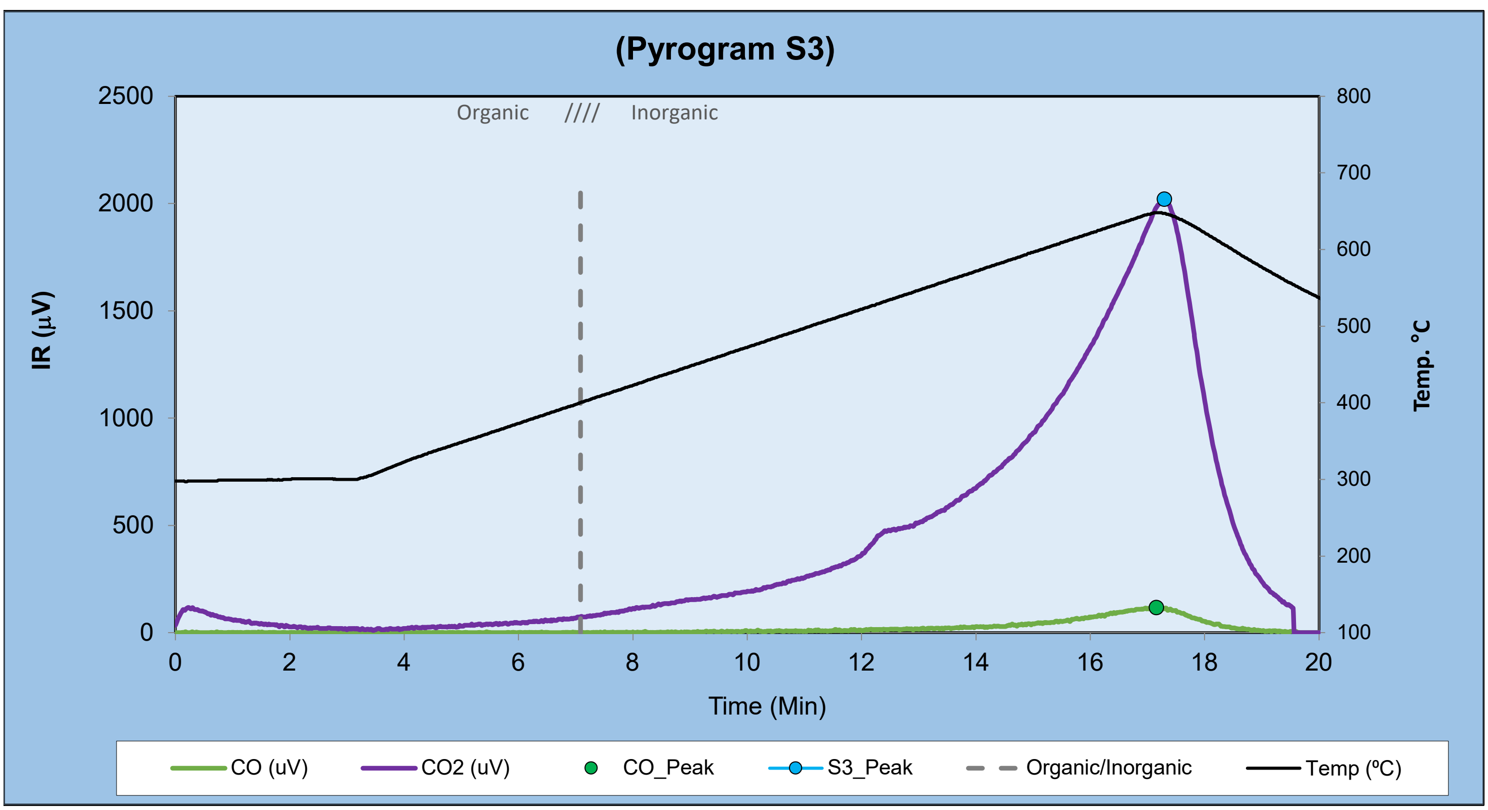


Source Pyrolysis

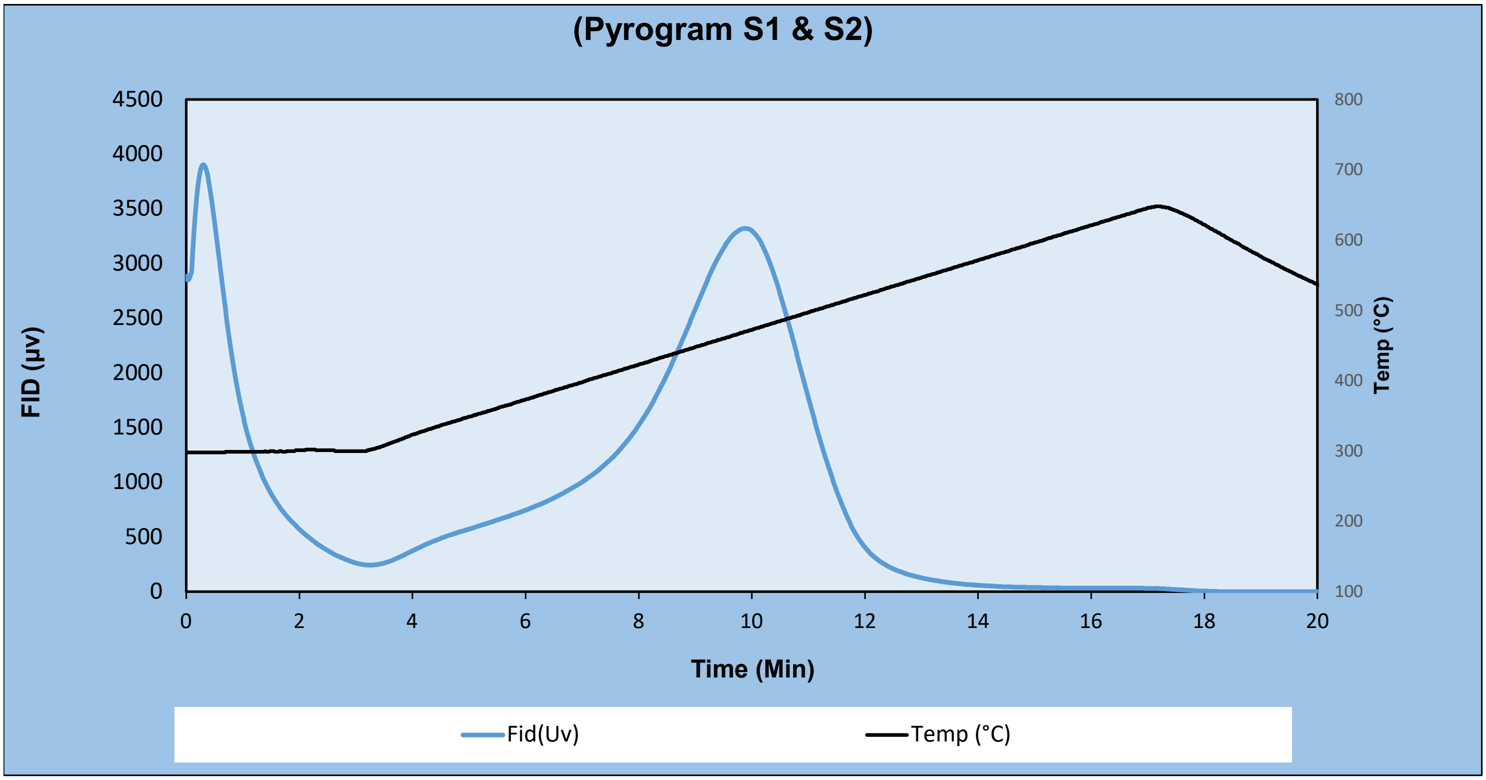
Company:	**Geofirma**	**ID:**	**SB_BH02_OG001**
Well:	**SB_BH02**	**Depth:**	**96.28**
Location:	**Canada**	**TOC:**	**0.37**
Formation:	**NA**	**Tmax:**	**439**

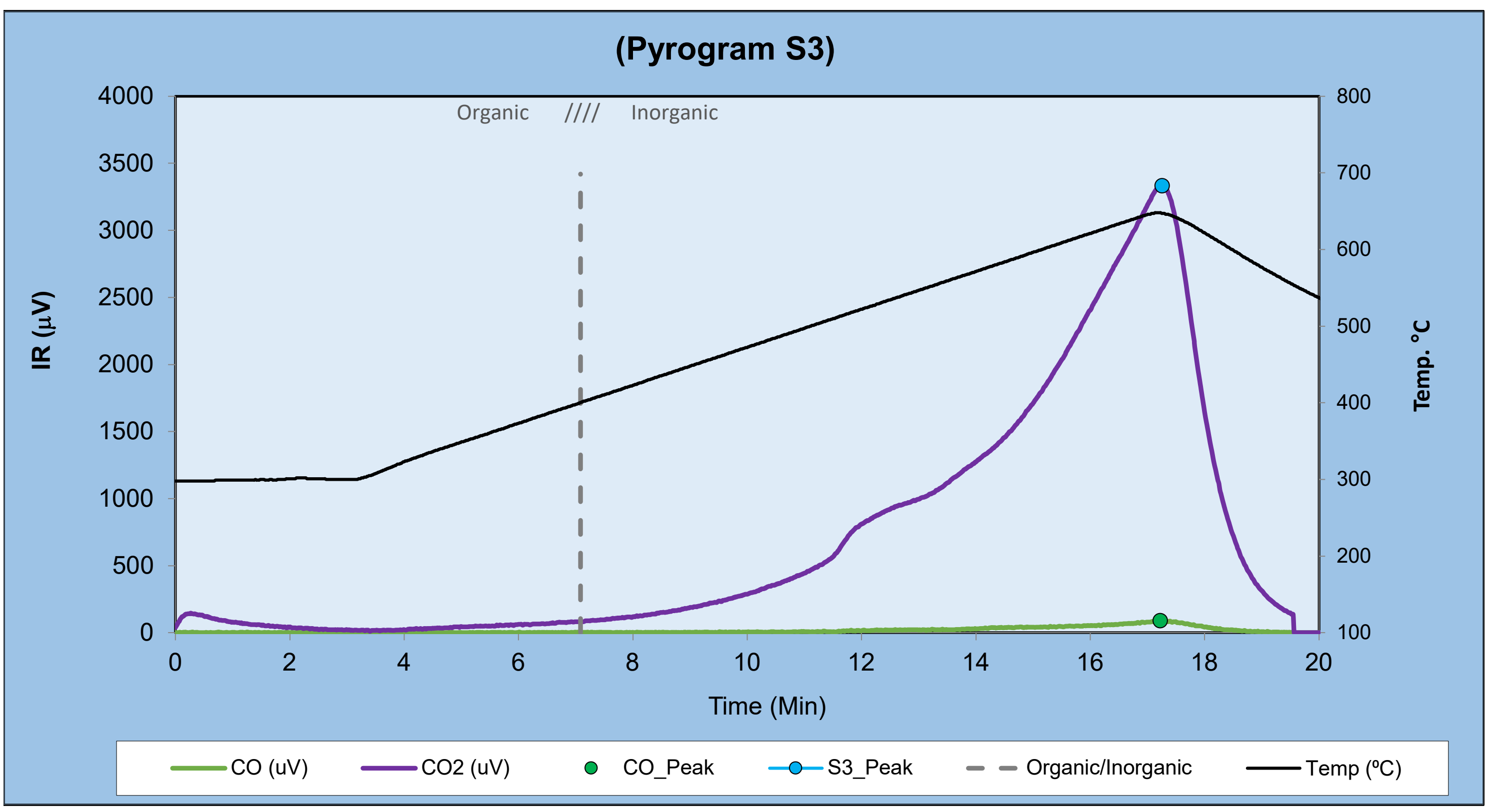




Source Pyrolysis

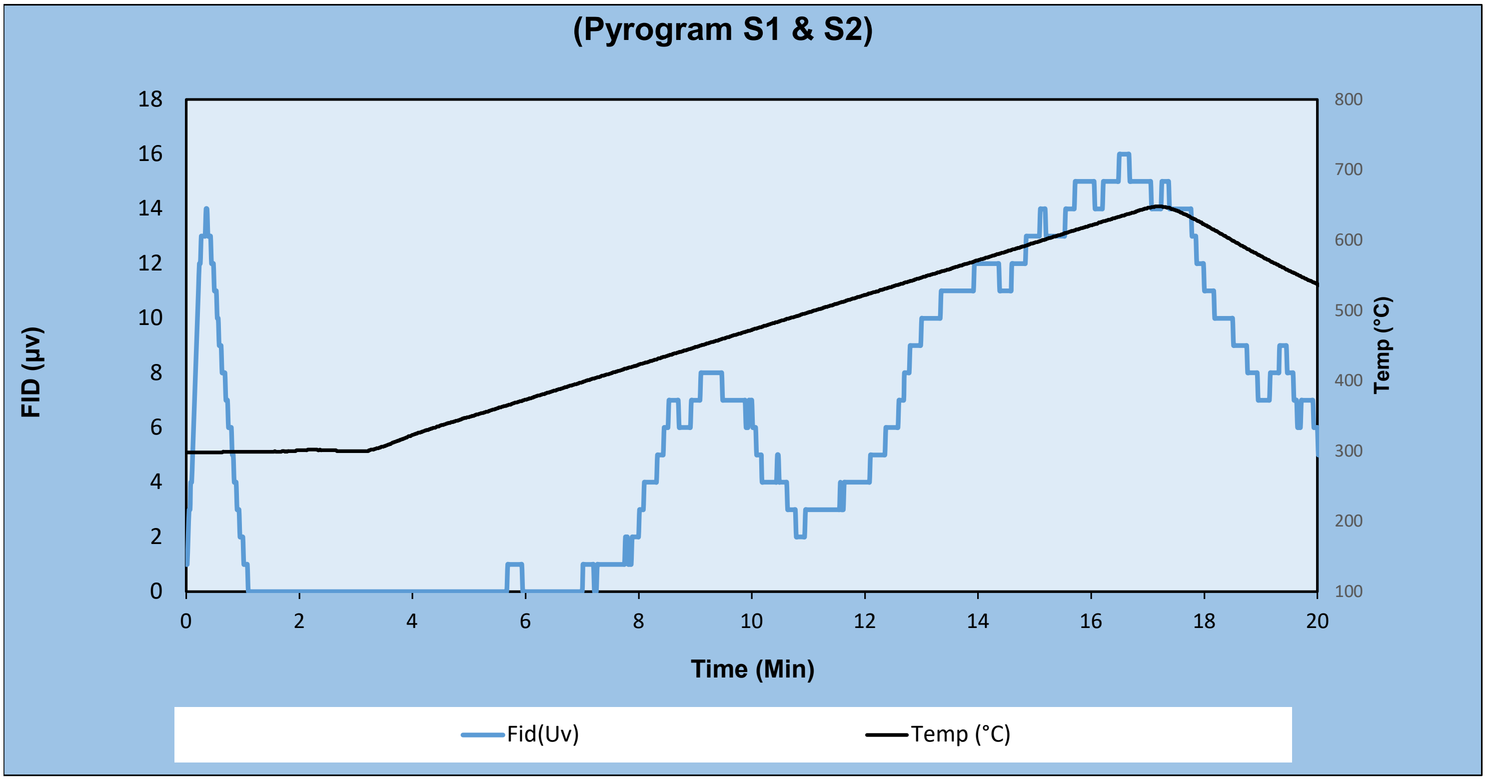
Company:	**Geofirma**	**ID:**	**SB_BH02_OG002**
Well:	**SB_BH02**	**Depth:**	**354.09**
Location:	**Canada**	**TOC:**	**0.68**
Formation:	**NA**	**Tmax:**	**428**

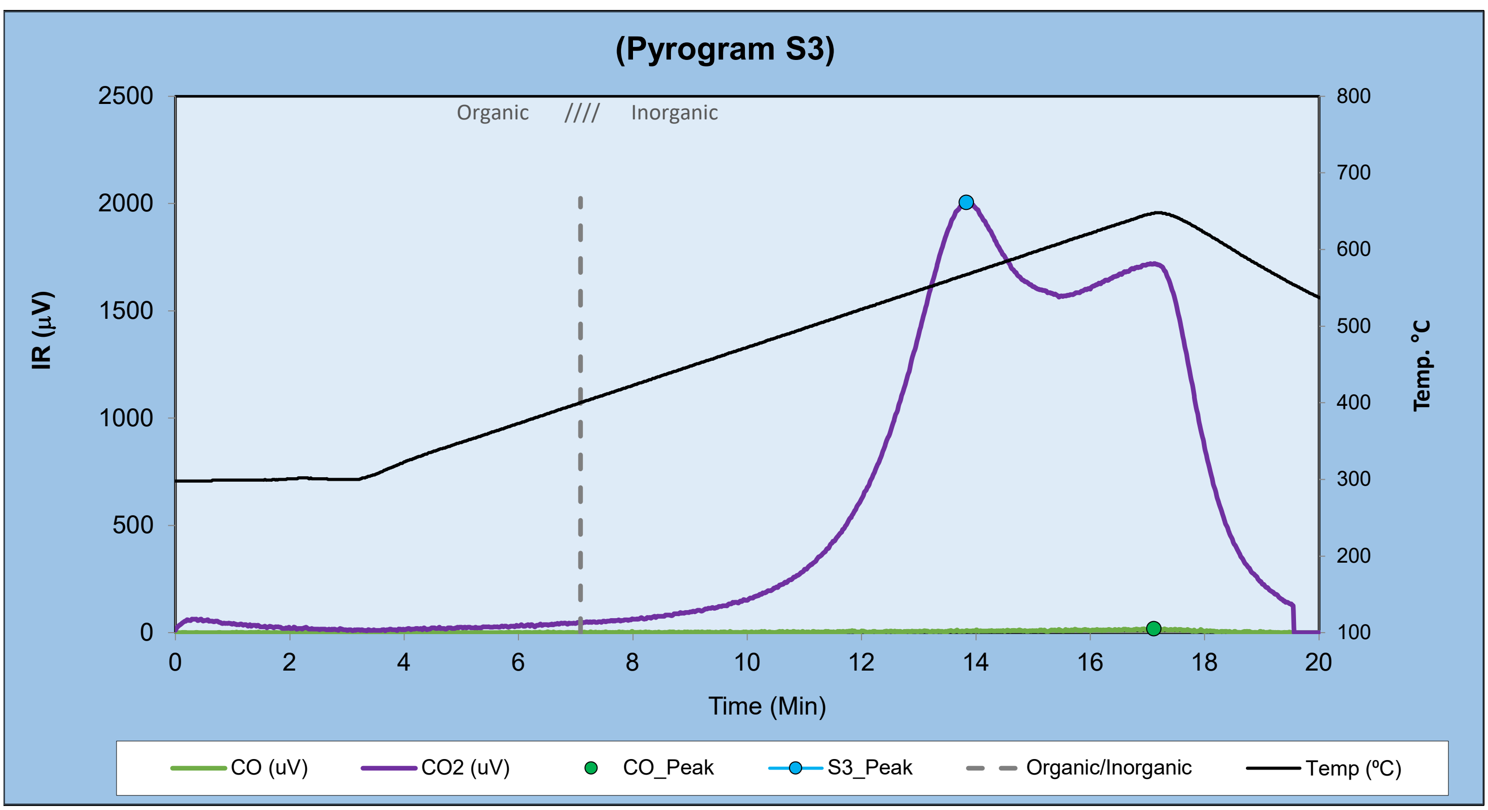




Source Pyrolysis

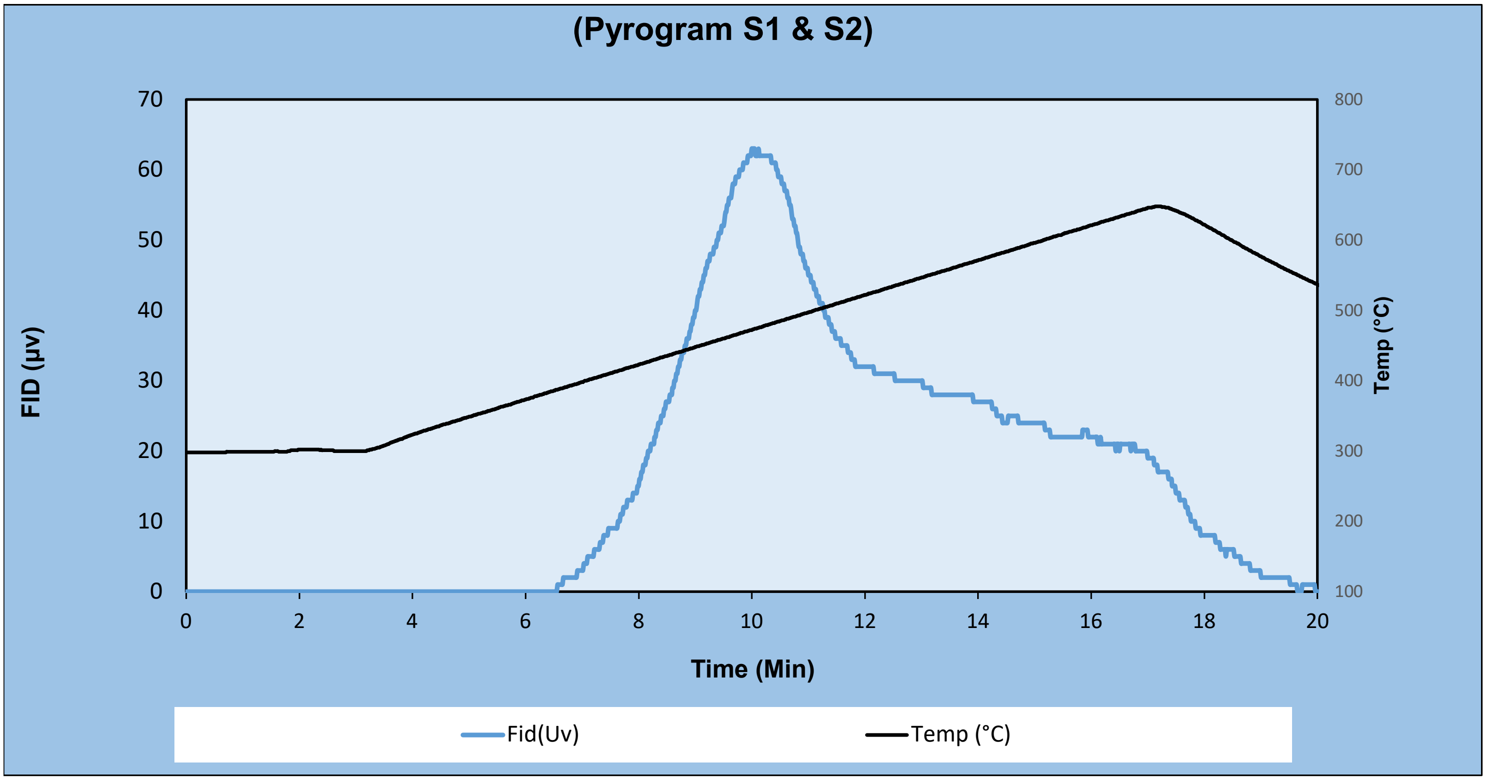
Company:	**Geofirma**	**ID:**	**SB_BH02_OG003**
Well:	**SB_BH02**	**Depth:**	**407.99**
Location:	**Canada**	**TOC:**	**0.11**
Formation:	**NA**	**Tmax:**	**592**

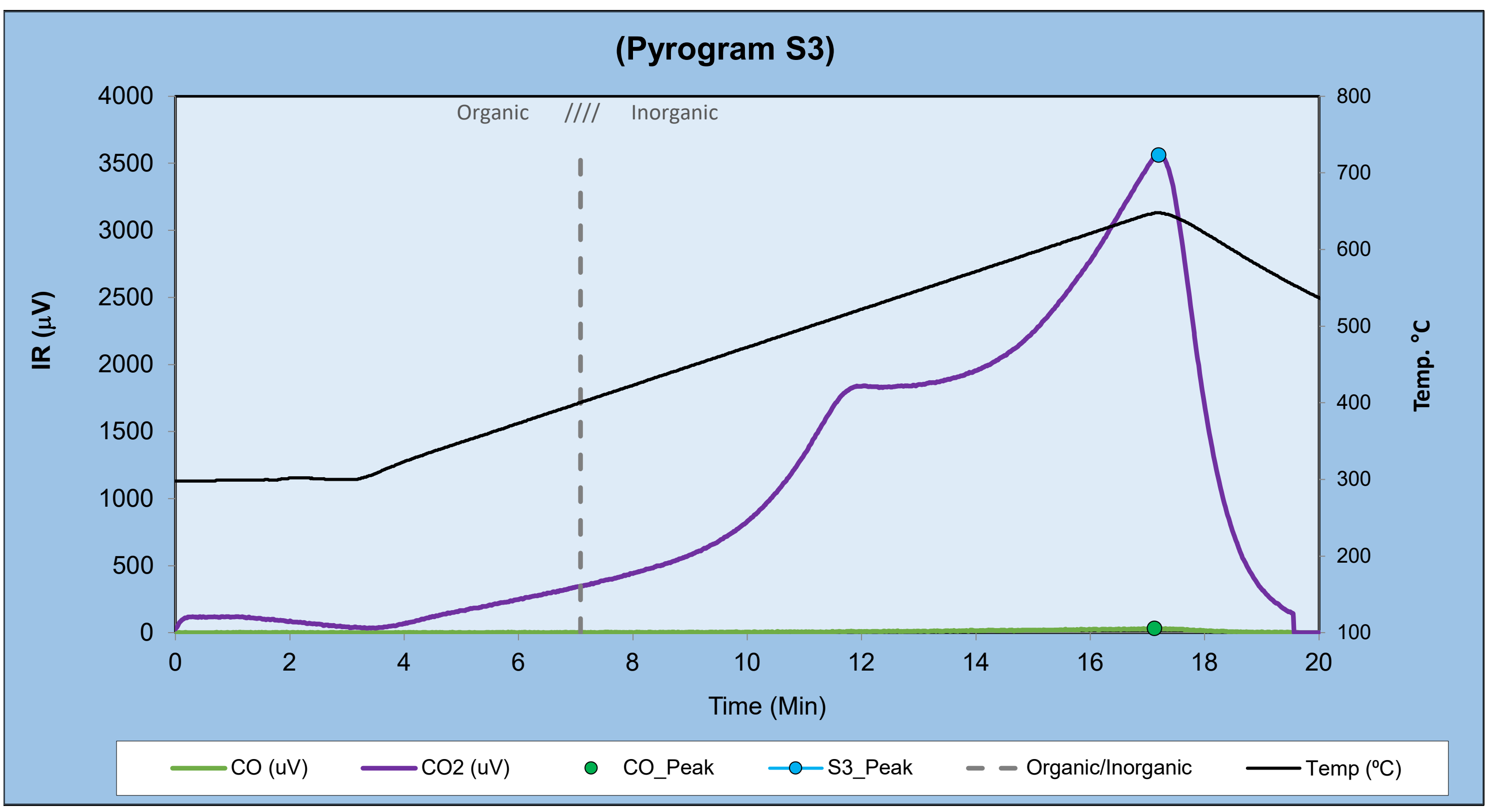




Source Pyrolysis

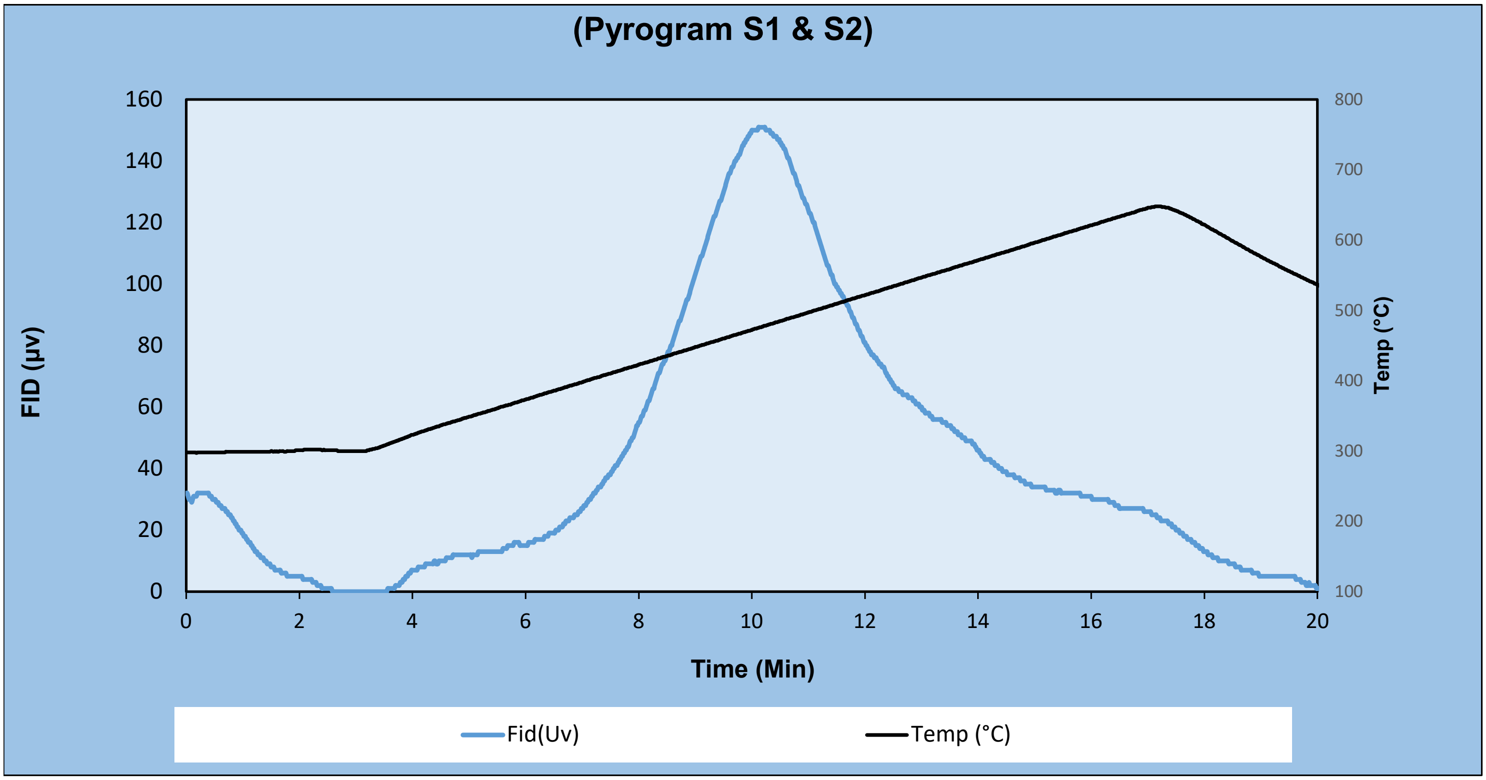
Company:	**Geofirma**	**ID:**	**SB_BH02_OG005**
Well:	**SB_BH02**	**Depth:**	**497.86**
Location:	**Canada**	**TOC:**	**0.27**
Formation:	**NA**	**Tmax:**	**431**

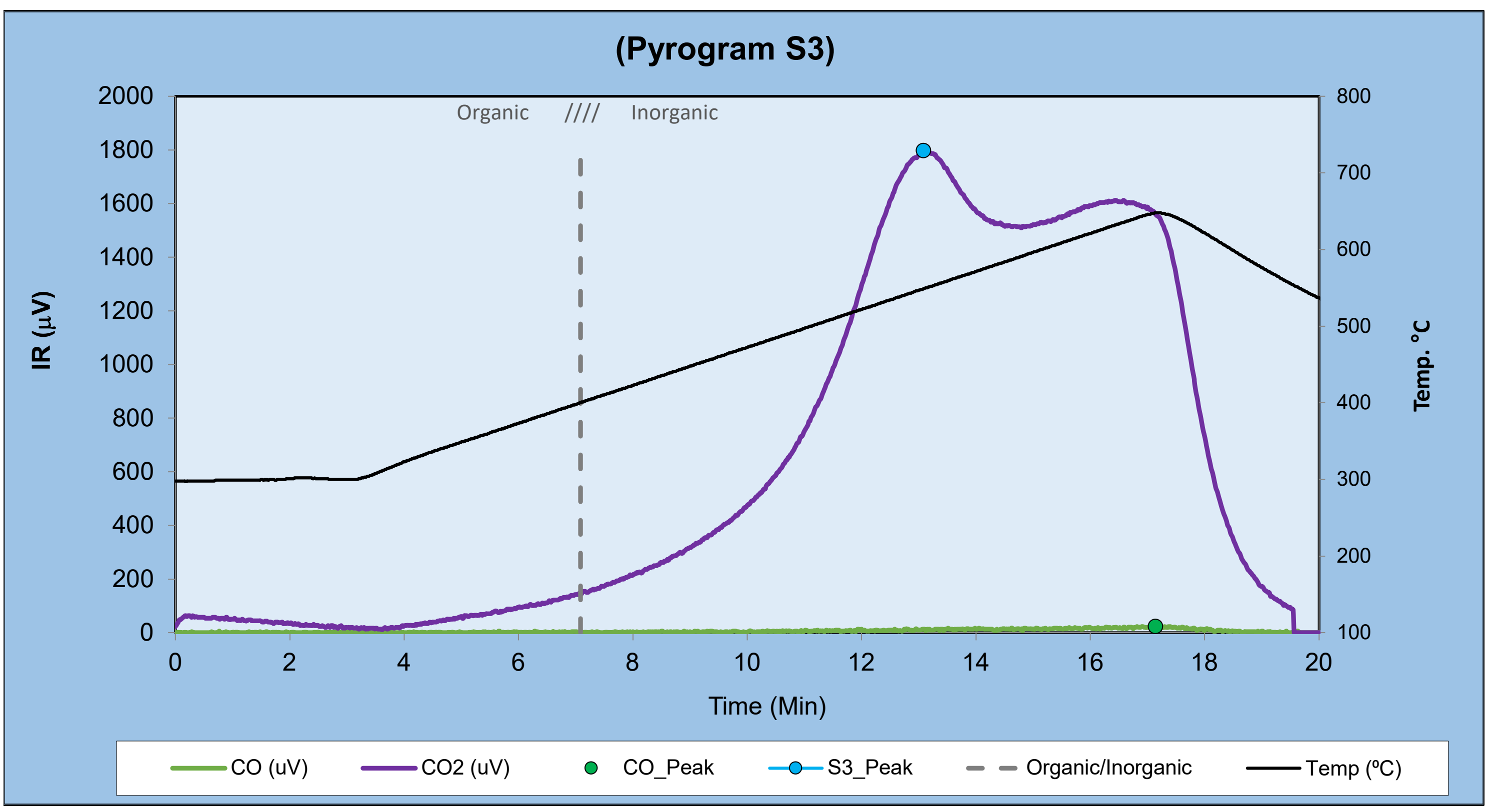




Source Pyrolysis

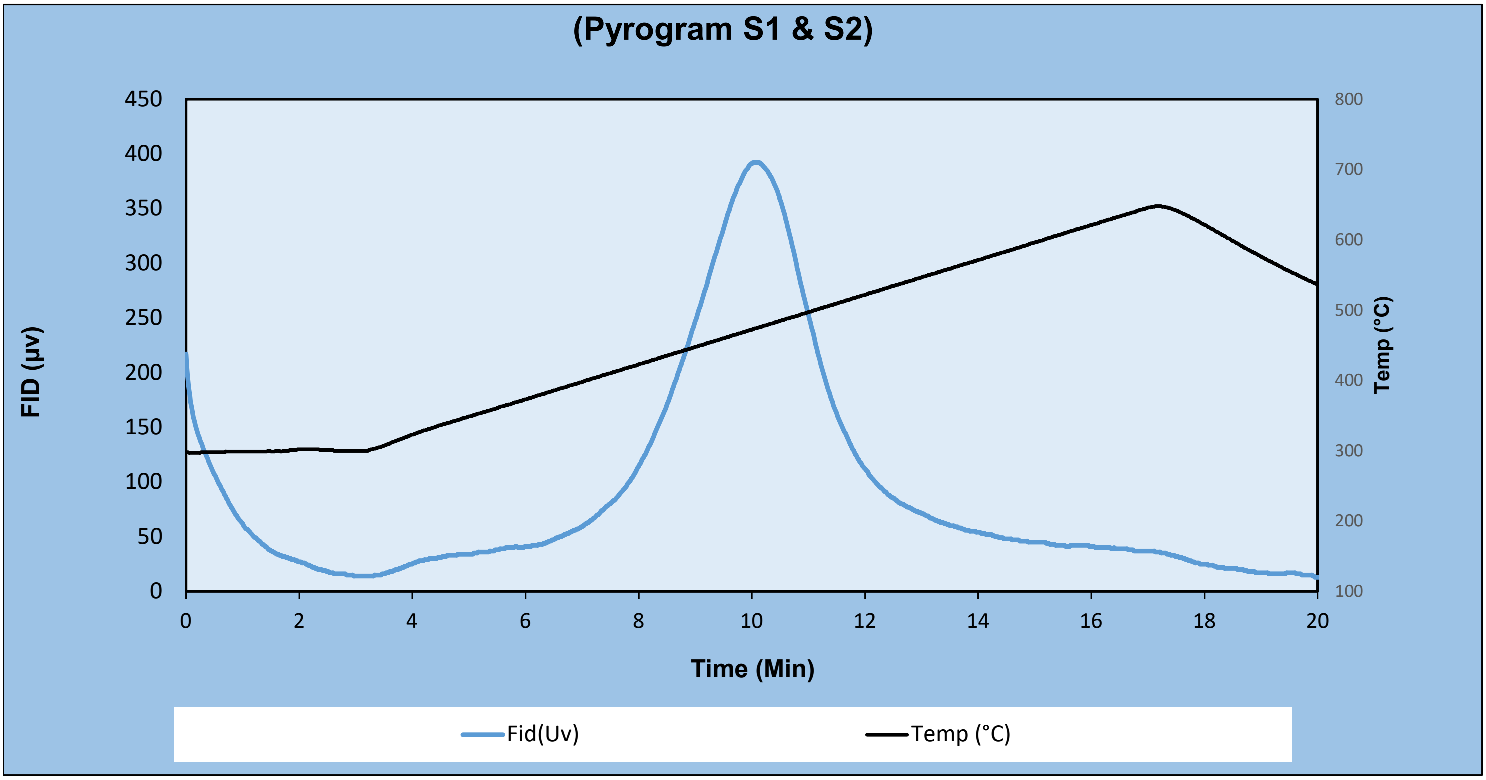
Company:	**Geofirma**	**ID:**	**SB_BH02_OG008**
Well:	**SB_BH02**	**Depth:**	**587.76**
Location:	**Canada**	**TOC:**	**0.30**
Formation:	**NA**	**Tmax:**	**434**

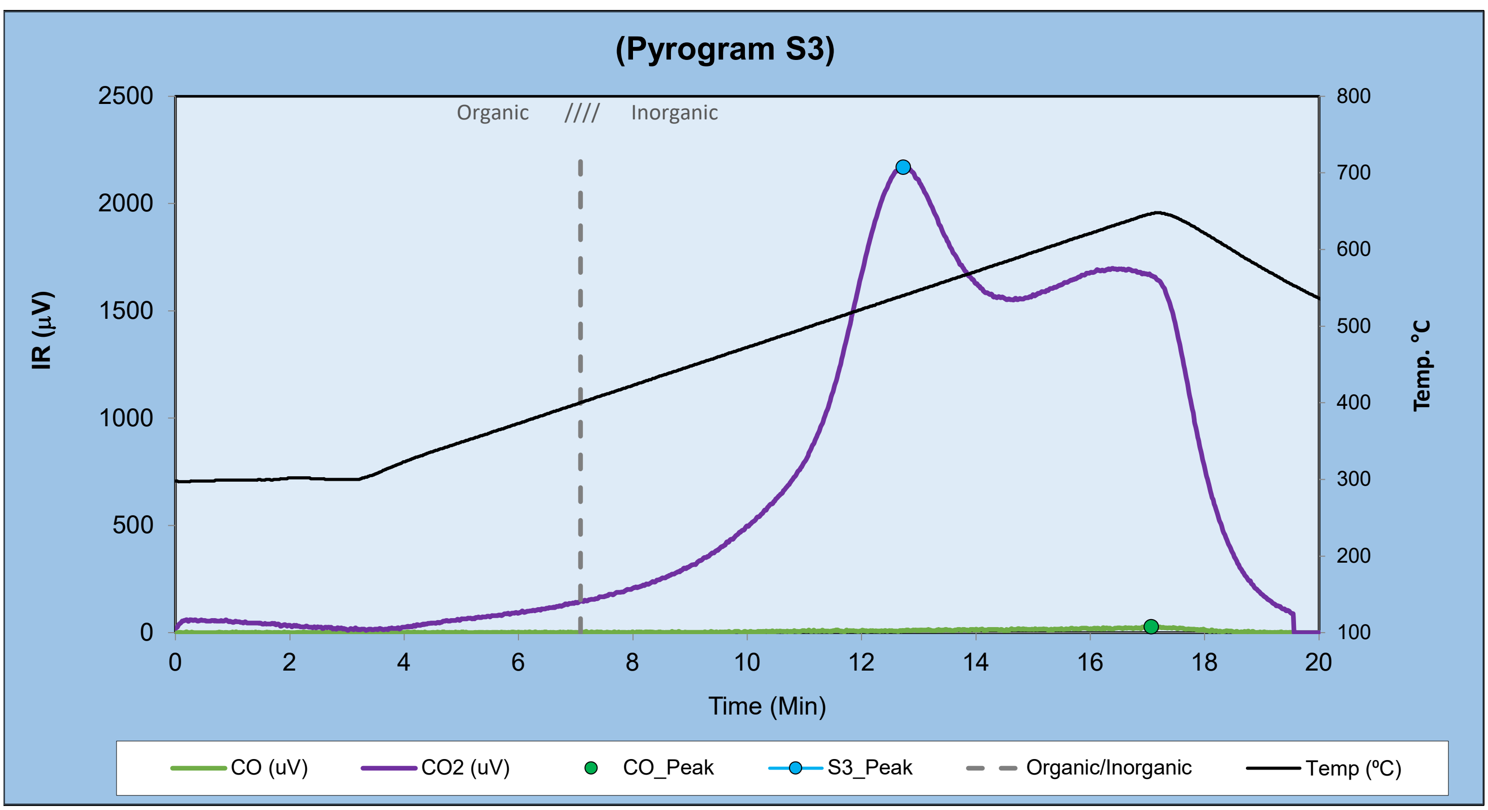




Source Pyrolysis

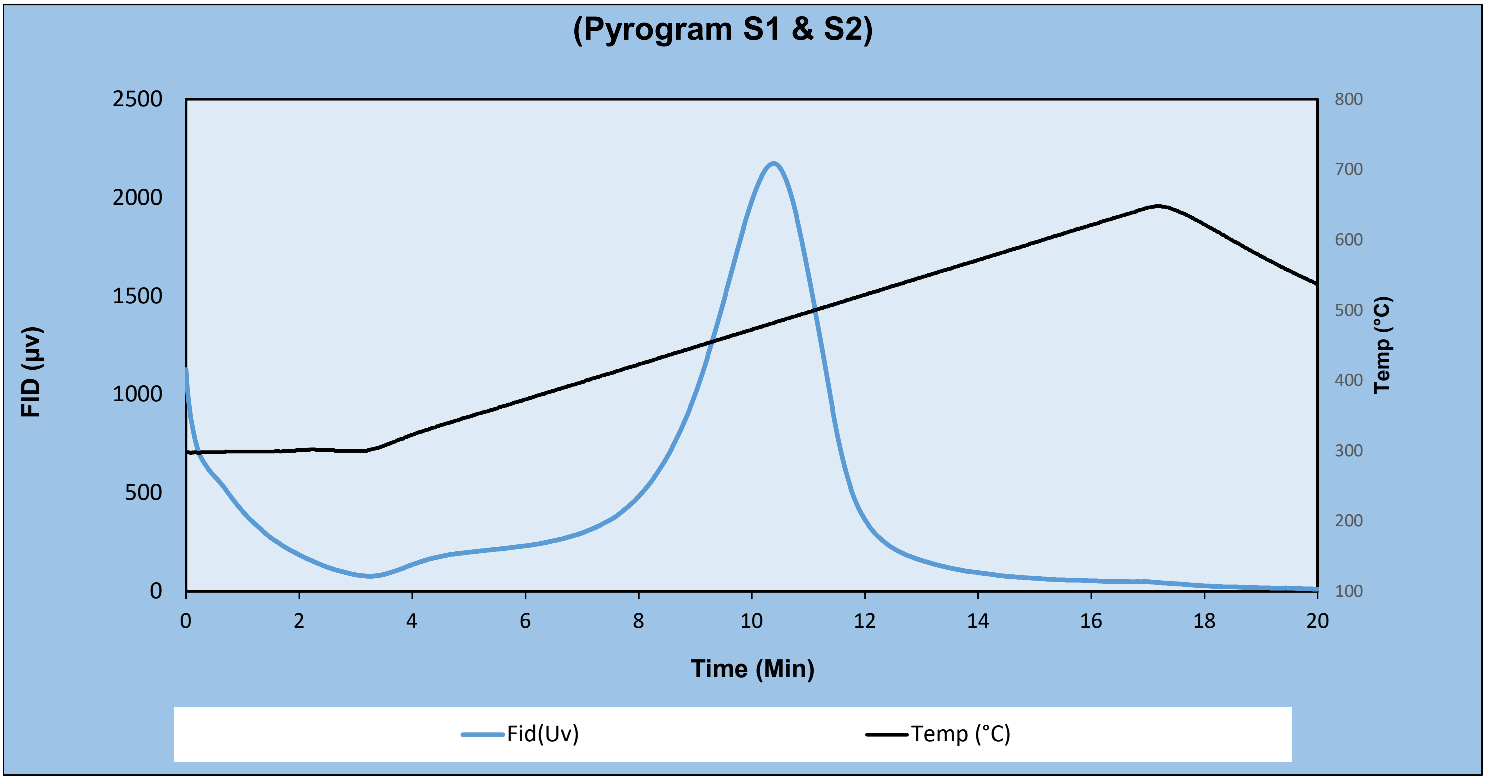
Company:	**Geofirma**	**ID:**	**SB_BH02_OG009**
Well:	**SB_BH02**	**Depth:**	**634.76**
Location:	**Canada**	**TOC:**	**0.25**
Formation:	**NA**	**Tmax:**	**432**

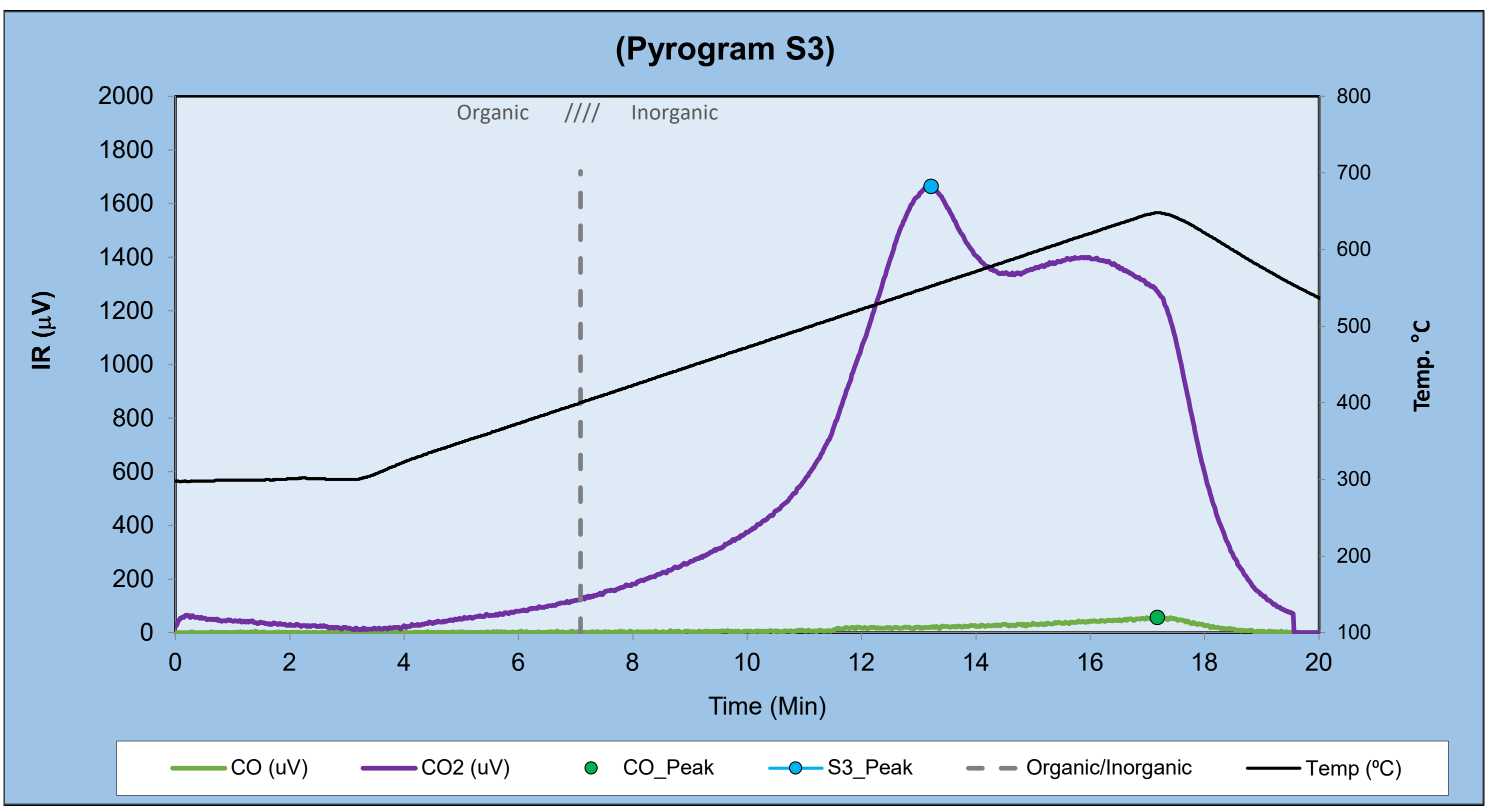




Source Pyrolysis

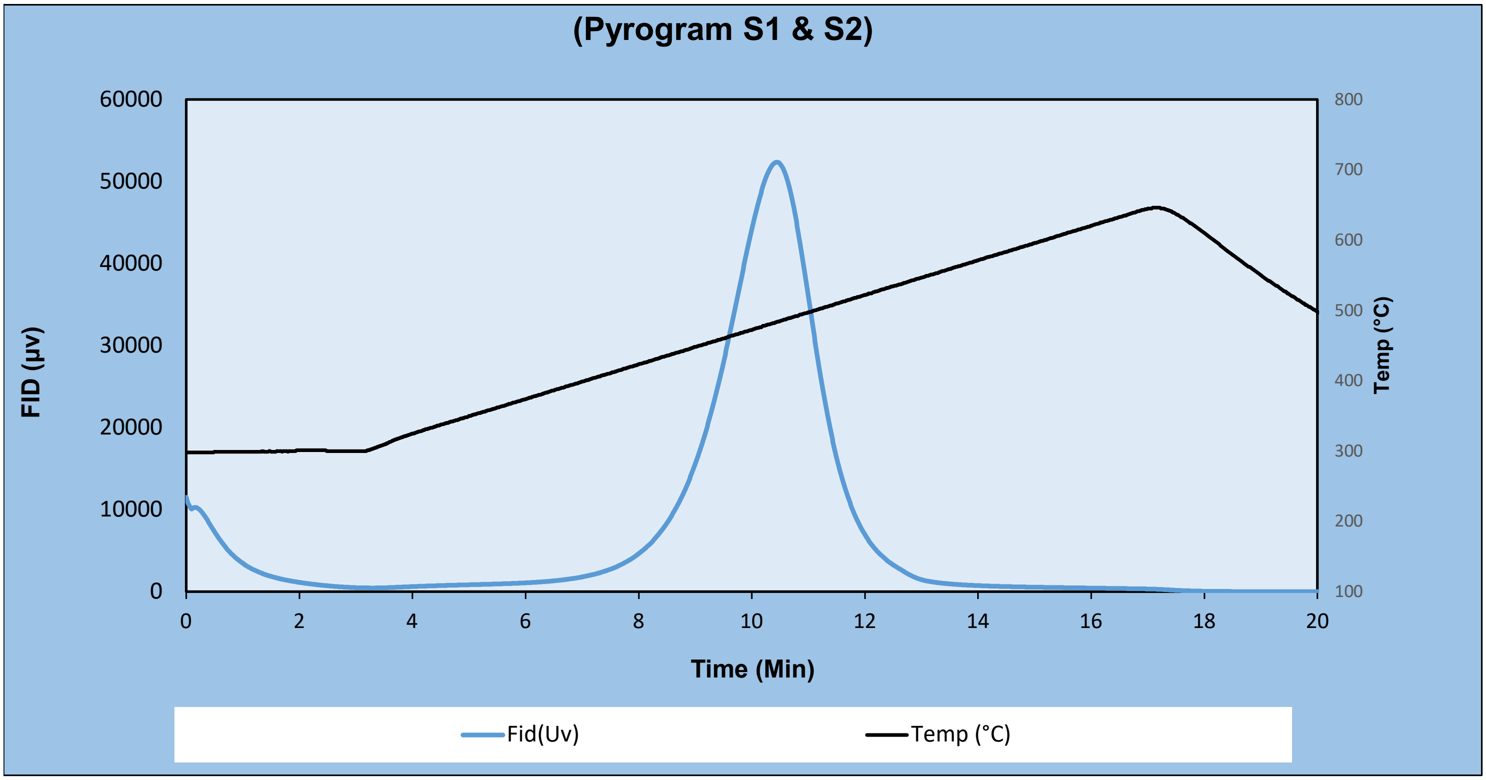
Company:	**Geofirma**	**ID:**	**SB_BH02_OG010**
Well:	**SB_BH02**	**Depth:**	**668.83**
Location:	**Canada**	**TOC:**	**0.27**
Formation:	**NA**	**Tmax:**	**441**

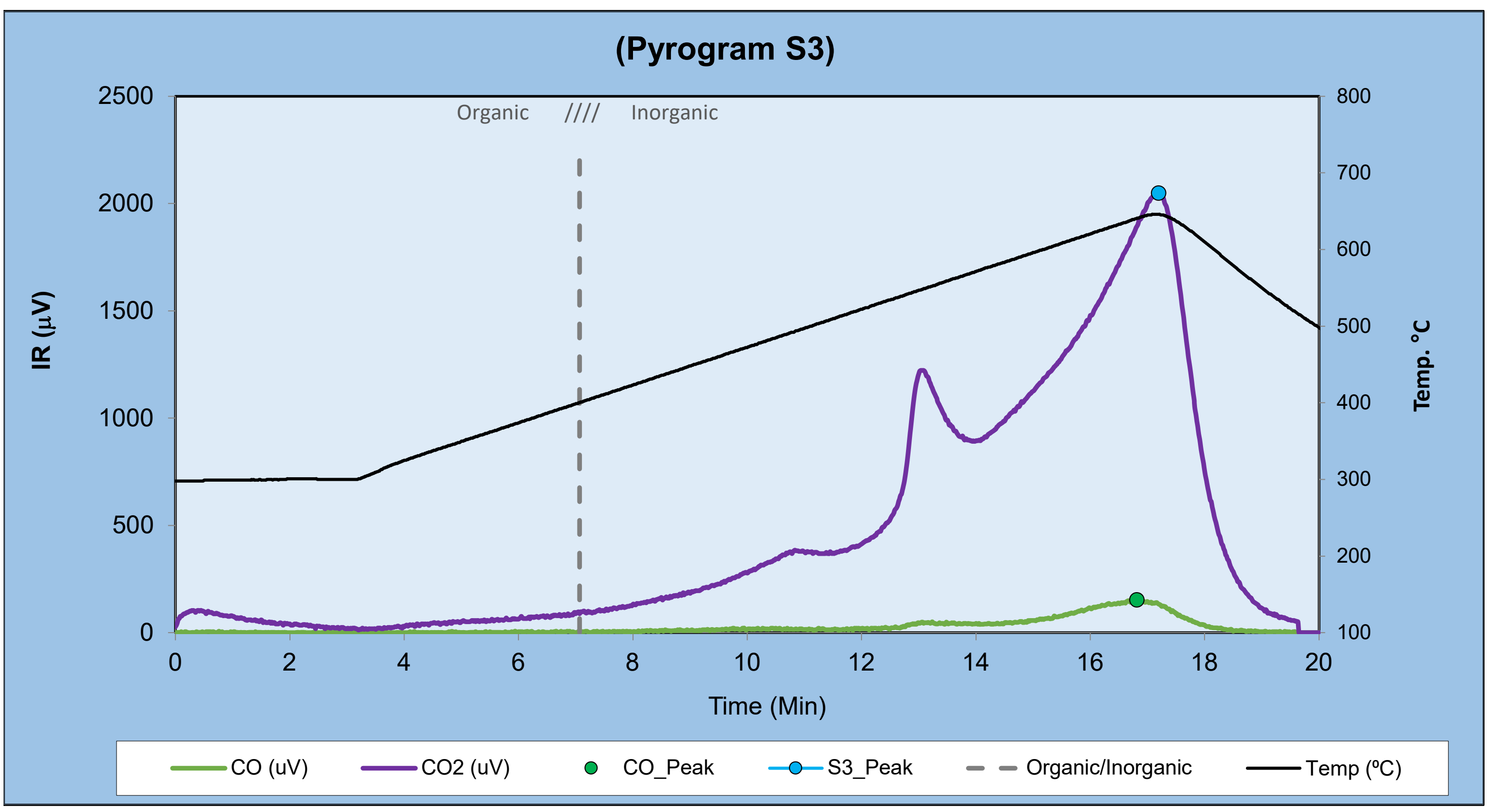




Source Pyrolysis

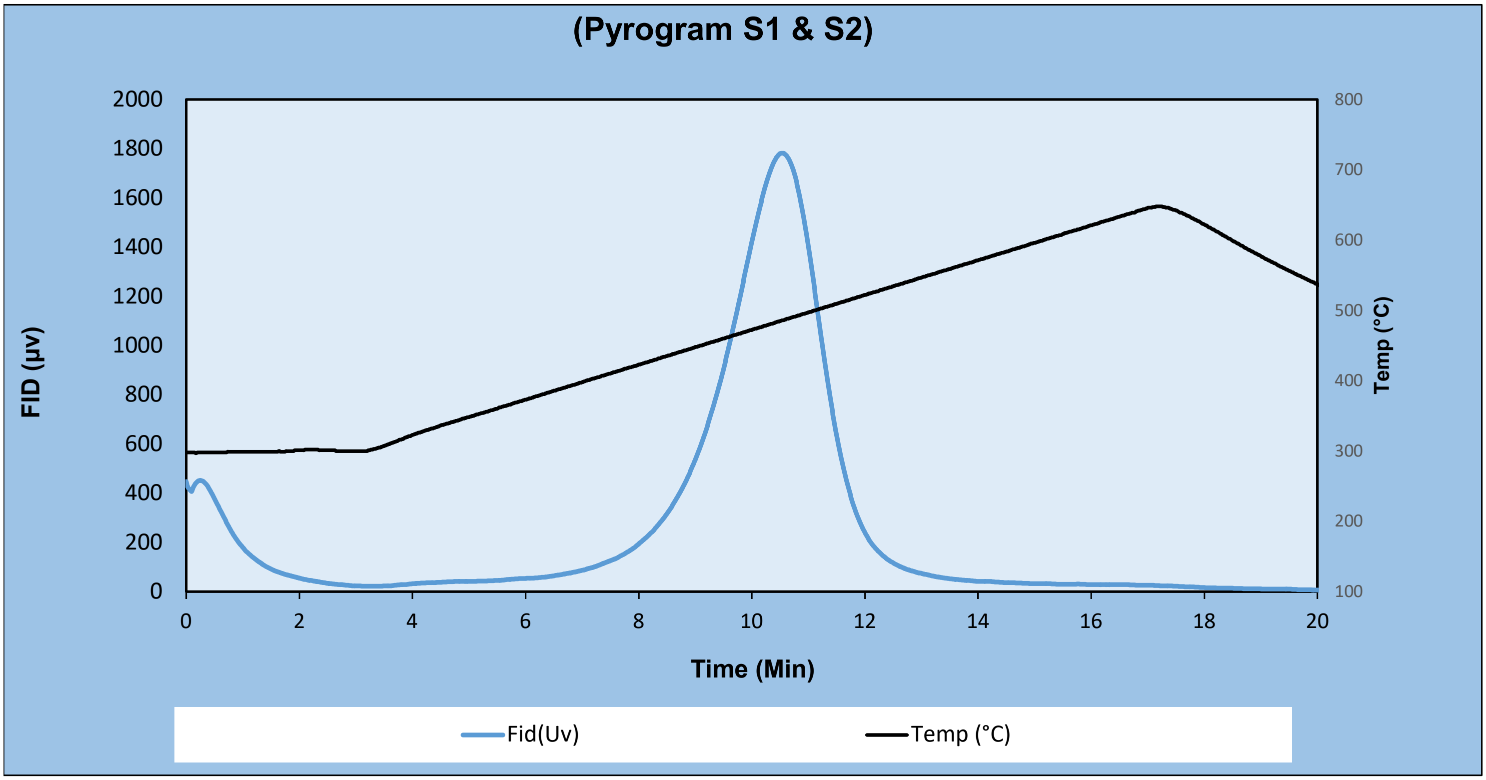
Company:	Geofirma	**ID:**	SB_BH02_OG016
Well:	SB_BH03	**Depth:**	670.81
Location:	Canada	**TOC:**	2.97
Formation:	NA	**Tmax:**	445

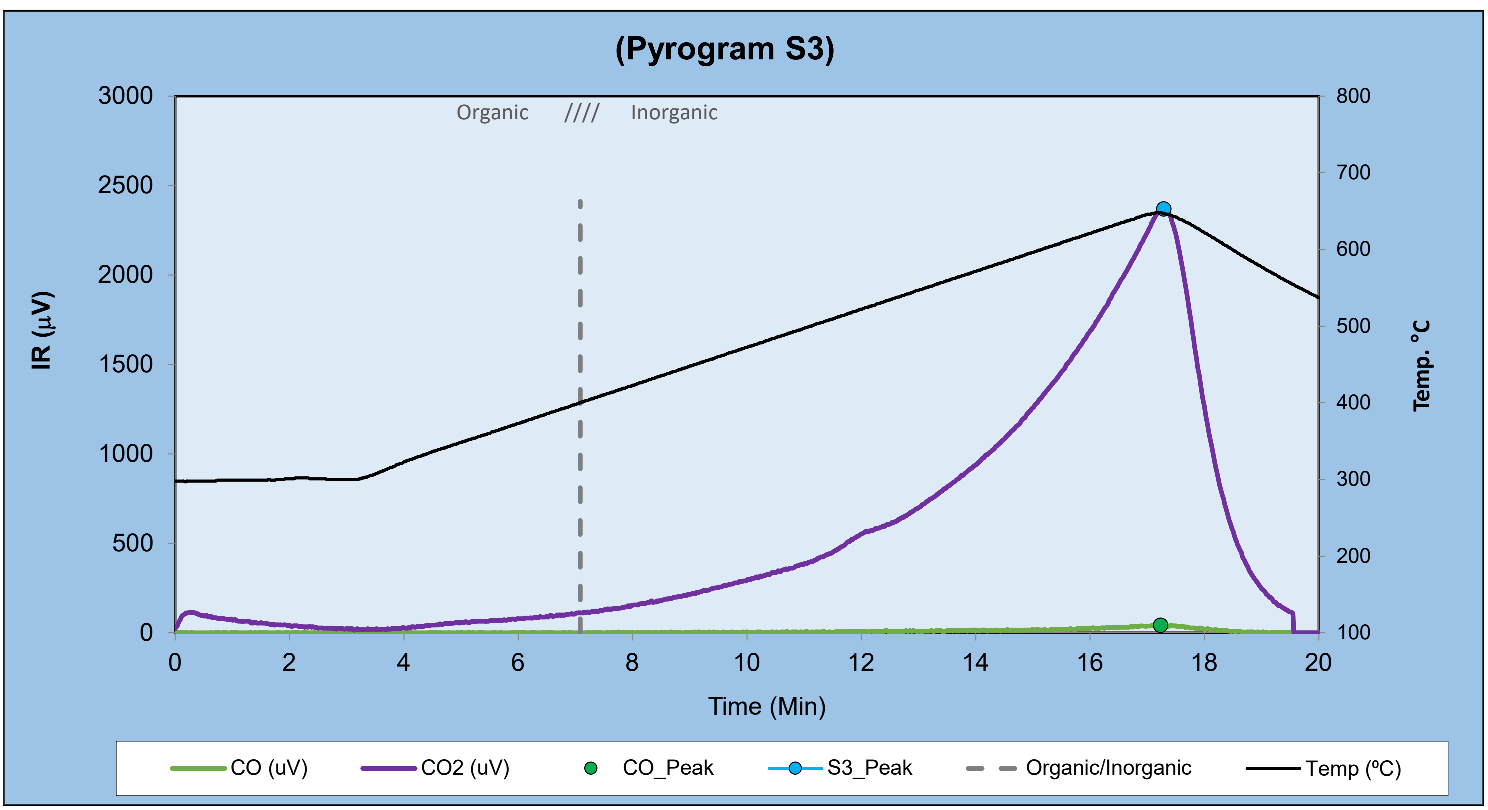




Source Pyrolysis

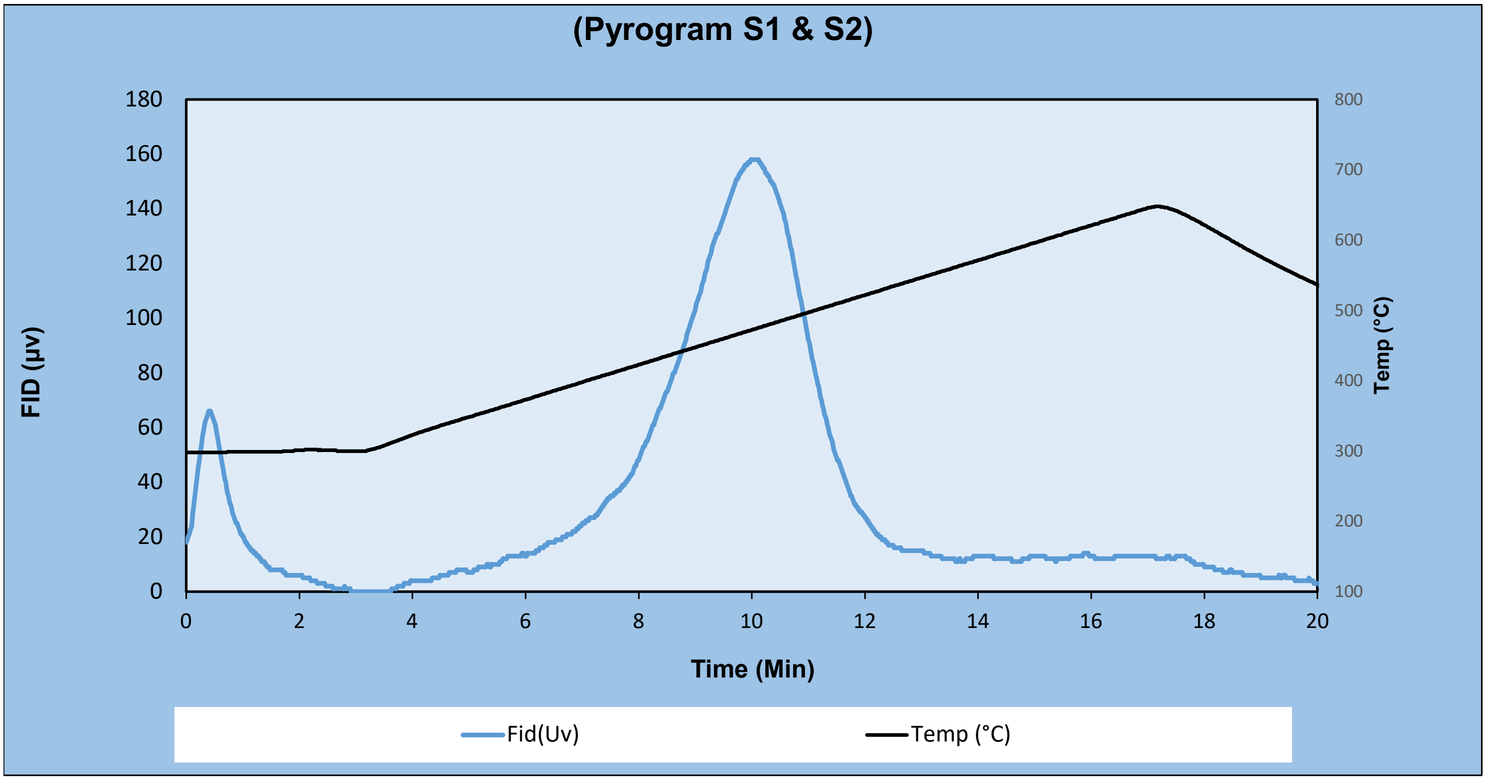
Company:	**Geofirma**	**ID:**	**SB_BH02_OG006**
Well:	**SB_BH02**	**Depth:**	**689.98**
Location:	**Canada**	**TOC:**	**0.55**
Formation:	**NA**	**Tmax:**	**445**

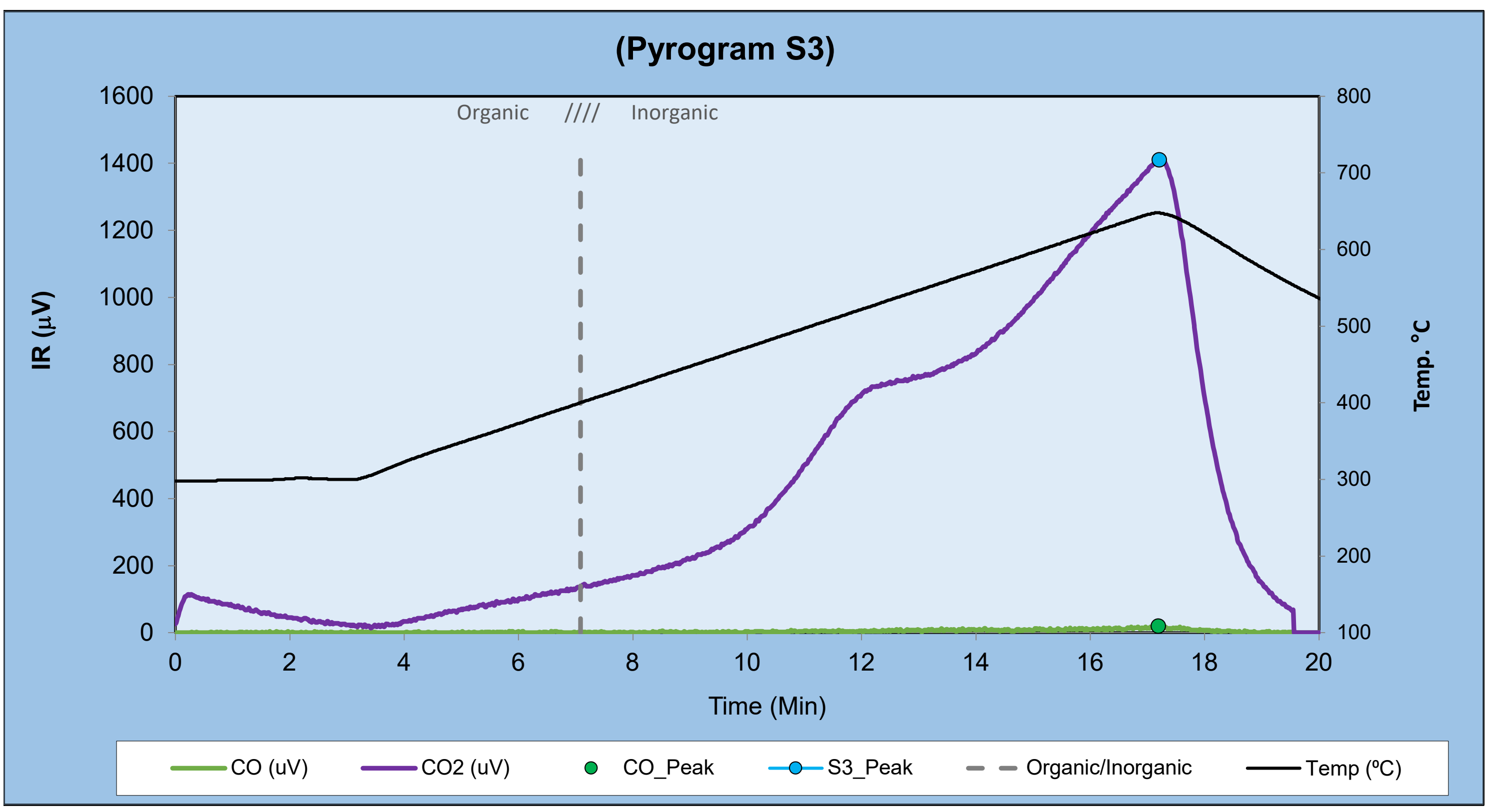




Source Pyrolysis

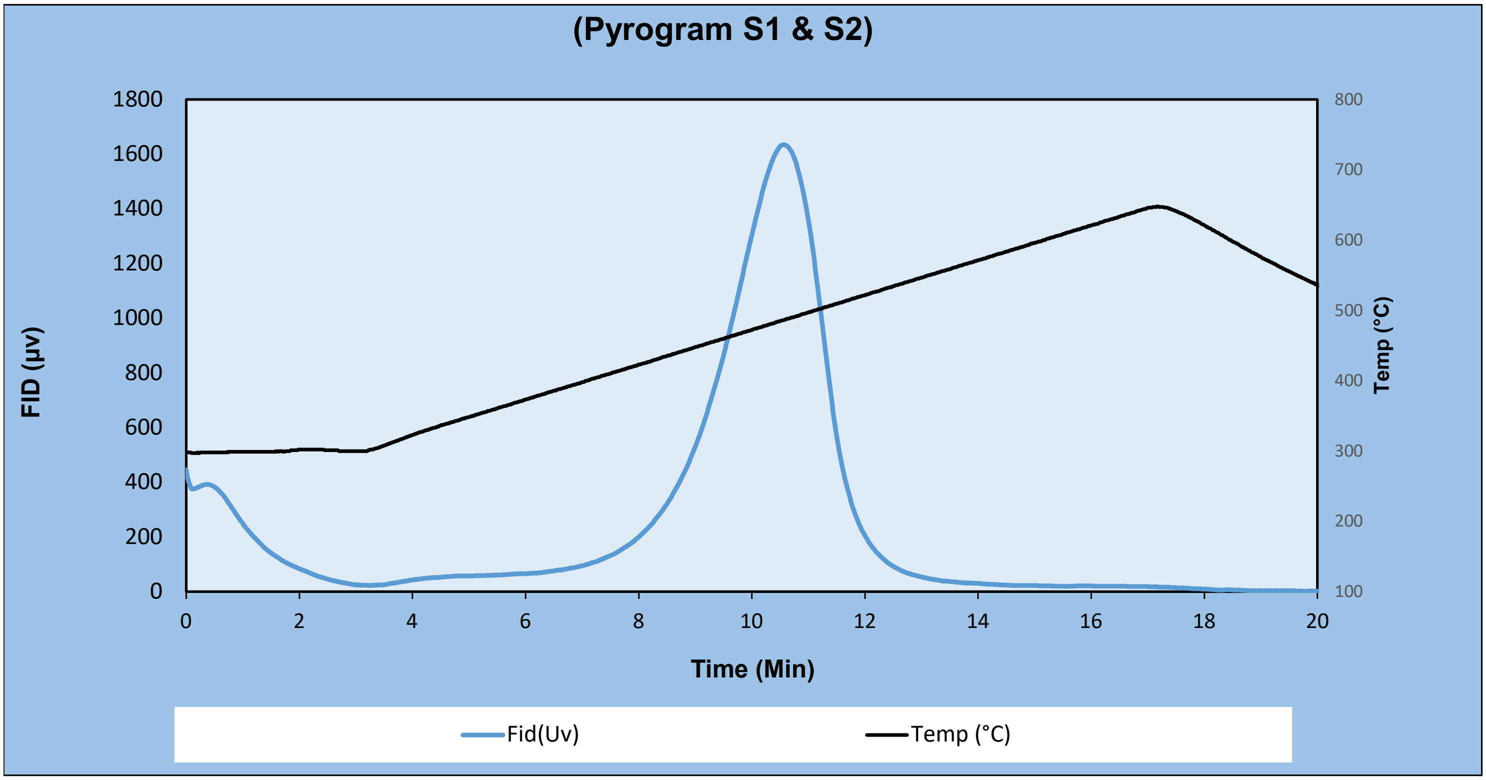
Company:	**Geofirma**	**ID:**	**SB_BH02_OG011**
Well:	**SB_BH02**	**Depth:**	**748.61**
Location:	**Canada**	**TOC:**	**0.16**
Formation:	**NA**	**Tmax:**	**431**

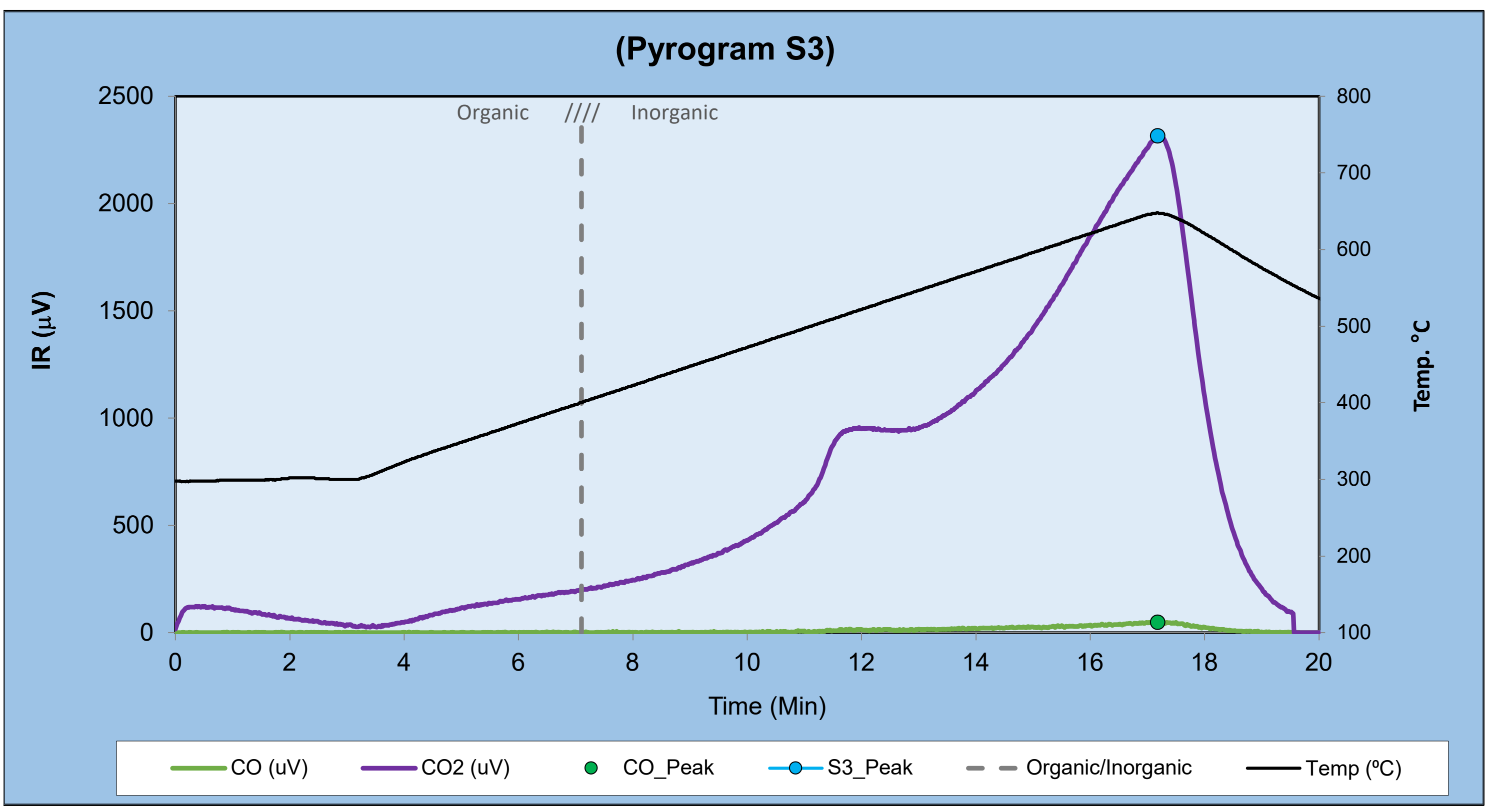




Source Pyrolysis

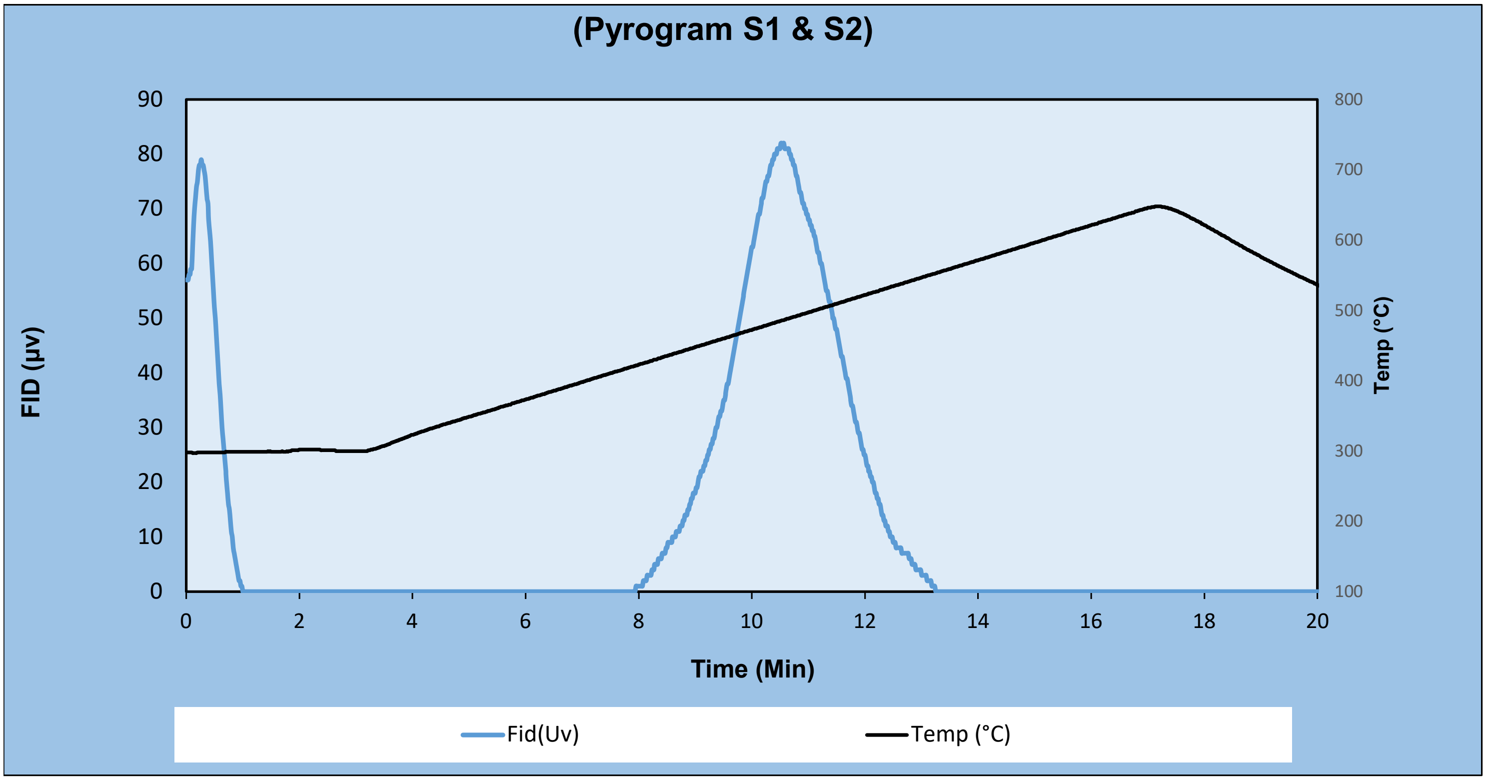
Company:	**Geofirma**	**ID:**	**SB_BH02_OG012**
Well:	**SB_BH02**	**Depth:**	**780.26**
Location:	**Canada**	**TOC:**	**0.37**
Formation:	**NA**	**Tmax:**	**445**

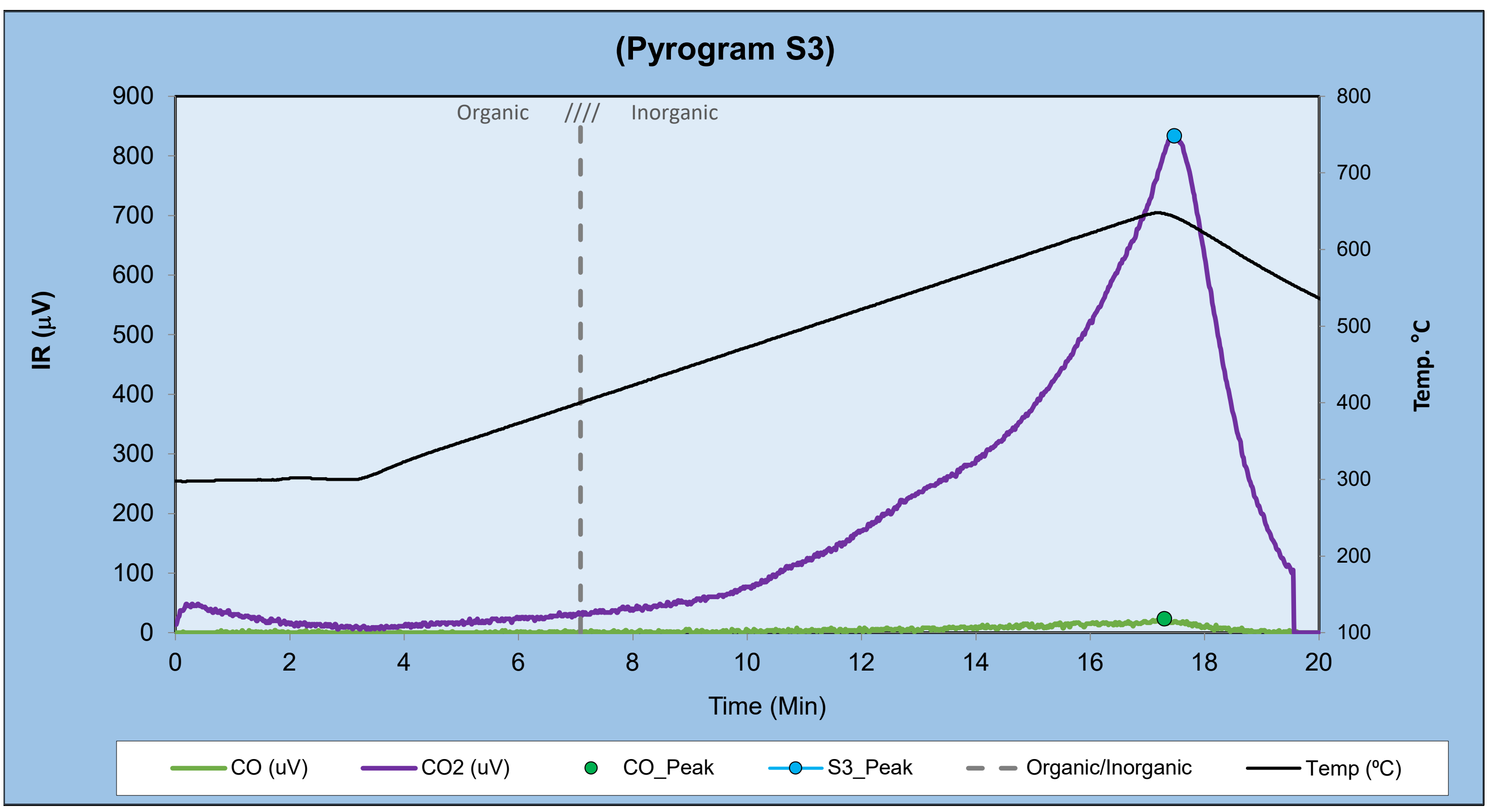




Source Pyrolysis

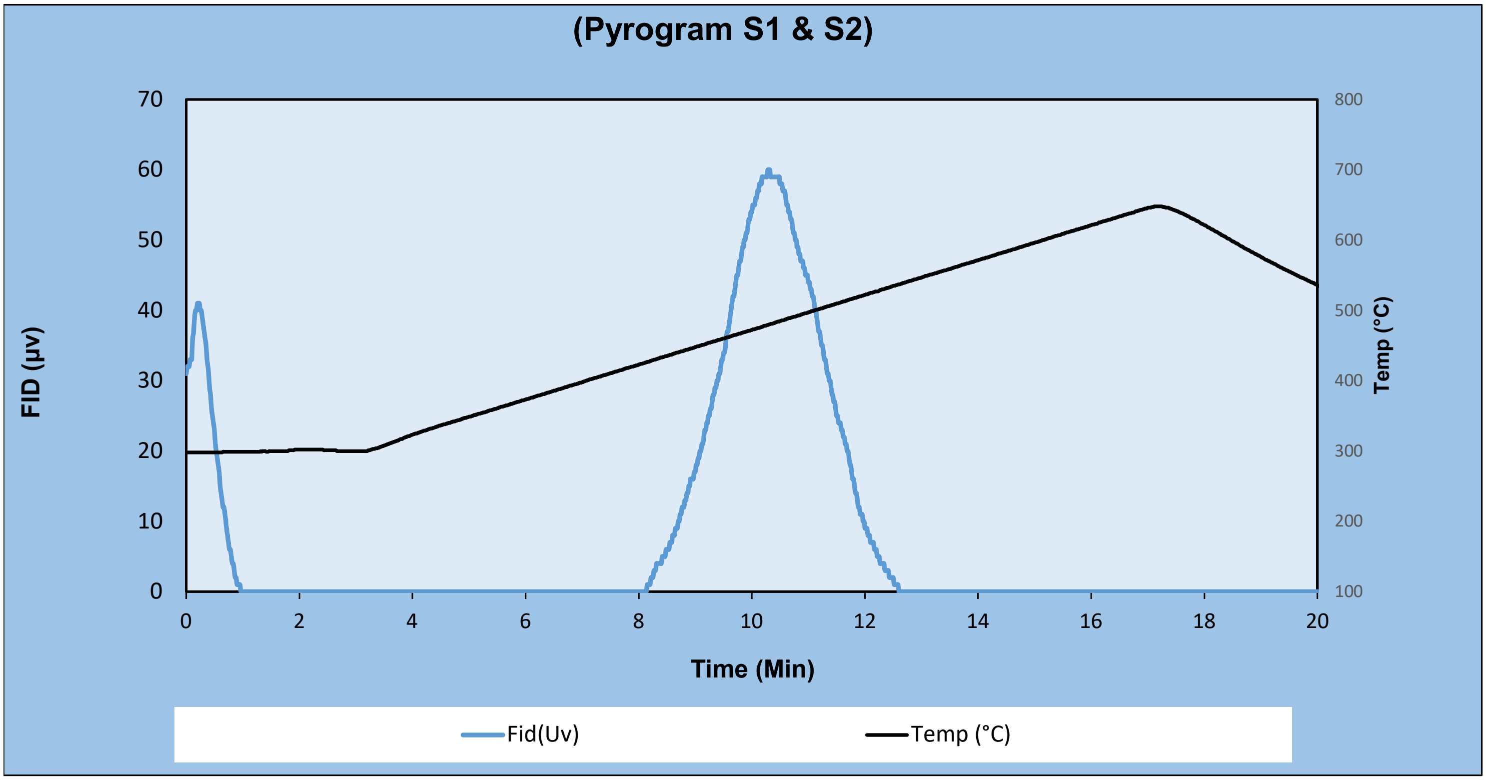
Company:	**Geofirma**	**ID:**	**SB_BH02_OG013**
Well:	**SB_BH02**	**Depth:**	**814.54**
Location:	**Canada**	**TOC:**	**0.13**
Formation:	**NA**	**Tmax:**	**444**

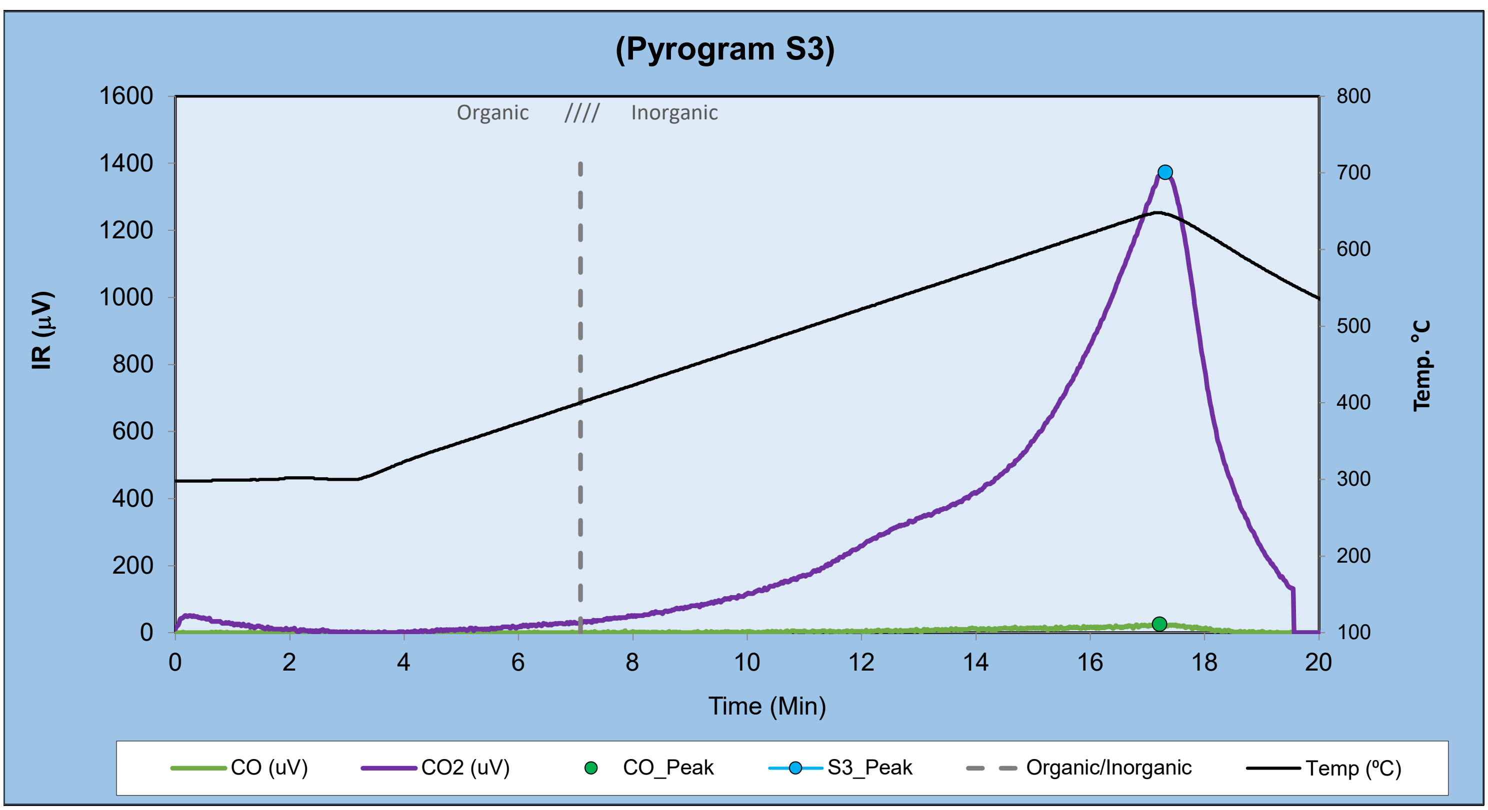




Source Pyrolysis

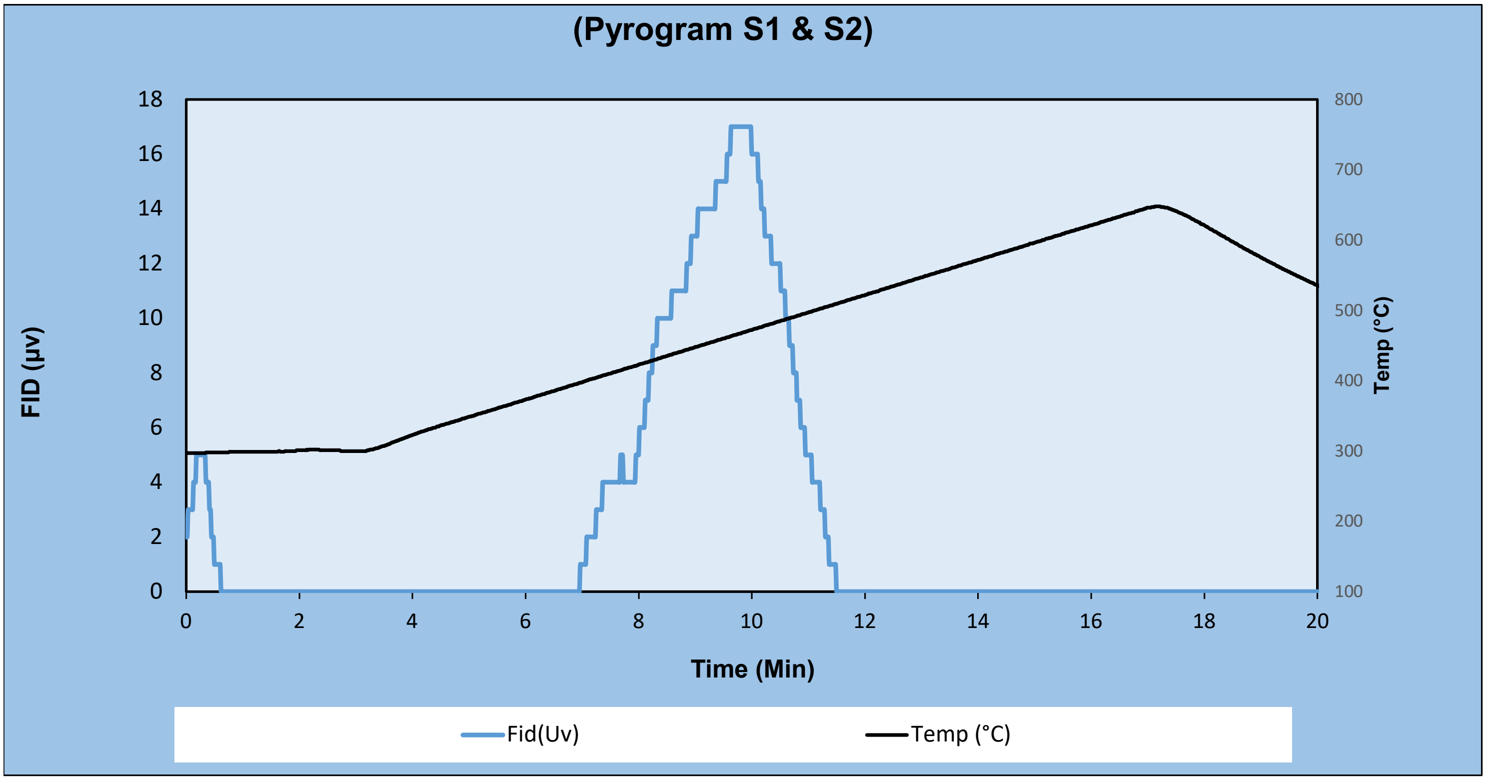
Company:	**Geofirma**	**ID:**	**SB_BH02_OG014**
Well:	**SB_BH02**	**Depth:**	**844.99**
Location:	**Canada**	**TOC:**	**0.14**
Formation:	**NA**	**Tmax:**	**438**

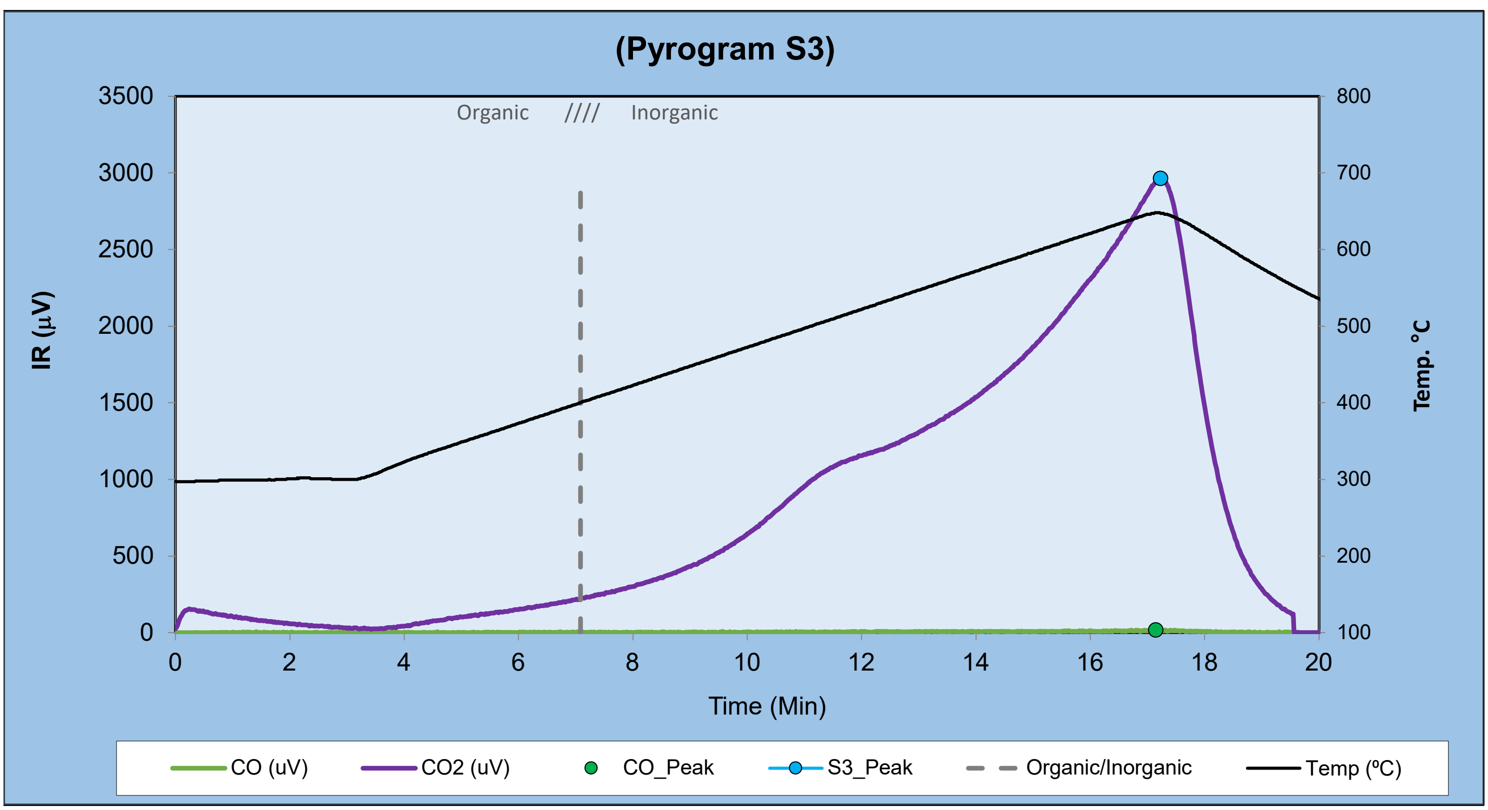




Source Pyrolysis

Company:	**Geofirma**	**ID:**	**SB_BH02_OG015**
Well:	**SB_BH02**	**Depth:**	**880.09**
Location:	**Canada**	**TOC:**	**0.12**
Formation:	**NA**	**Tmax:**	**422**





Composition Determined by X-ray Diffraction and TOC Analyses

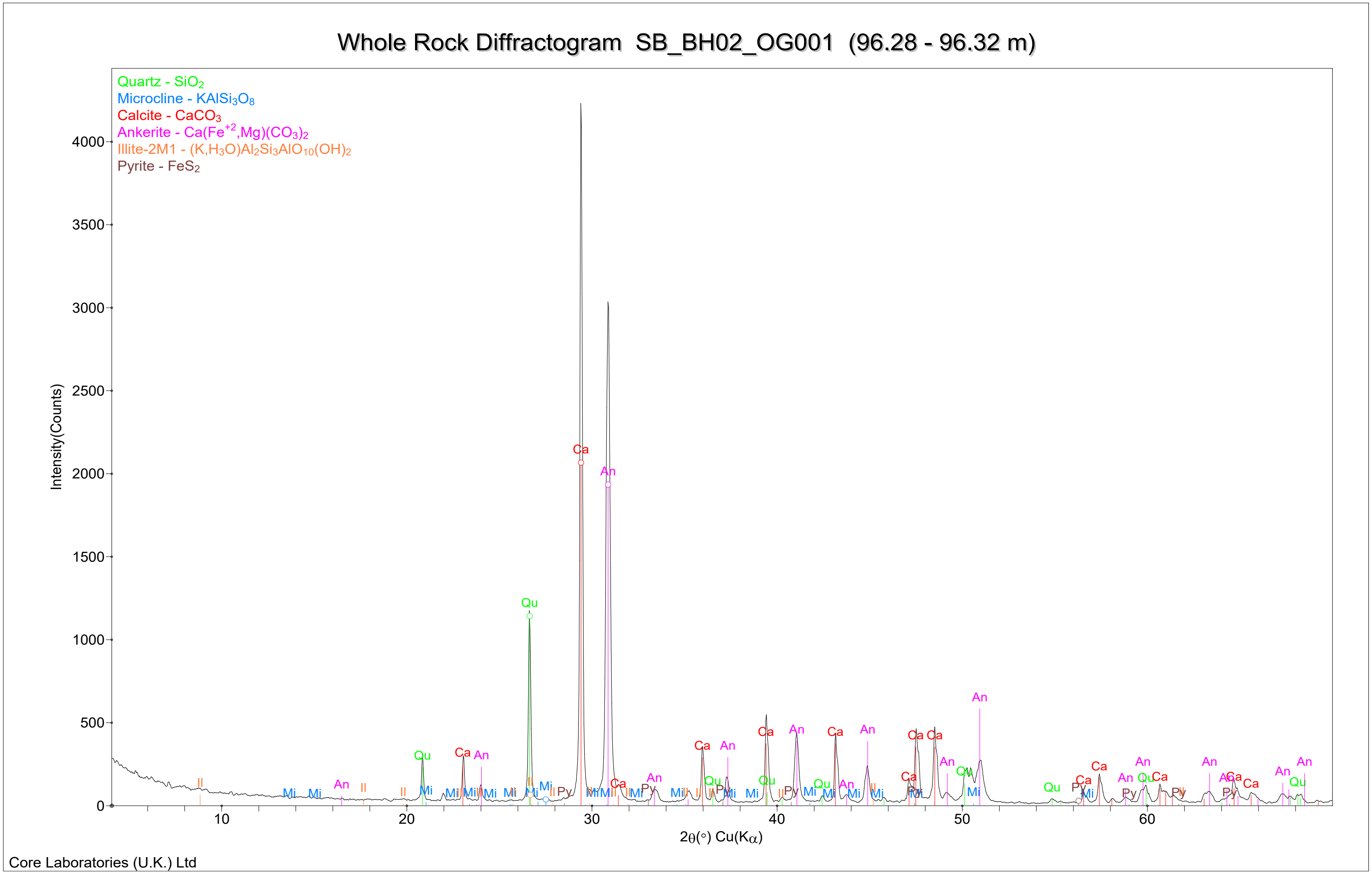
Company: GEOFIRMA
Well: SB BH02
Job File: 202201809

Sample No	**#1**	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**	**#8**	**#14**	**#9**	**#10**	**#11**	**#12**	**#13**
Sample ID	**SB_BH02 OG001**	**SB_BH02 OG002**	**SB_BH02 OG003**	**SB_BH02 OG005**	**SB_BH02 OG006**	**SB_BH02 OG008**	**SB_BH02 OG009**	**SB_BH02 OG010**	**SB_BH02_OG016**	**SB_BH02 OG011**	**SB_BH02 OG012**	**SB_BH02 OG013**	**SB_BH02 OG014**	**SB_BH02 OG015**
Top Depth (m)	**96.28**	**354.09**	**407.99**	**497.86**	**689.98**	**587.76**	**634.76**	**668.83**	**670.81**	**748.61**	**780.26**	**814.54**	**844.99**	**880.09**
Bottom Depth (m)	**96.32**	**354.13**	**408.03**	**497.9**	**690.02**	**587.8**	**634.8**	**668.87**	**670.82**	**748.65**	**780.3**	**814.58**	**845.03**	**880.13**
TOC wt%	**0.37**	**0.68**	**0.11**	**0.27**	**0.30**	**0.25**	**0.27**	**0.55**	**2.97**	**0.16**	**0.37**	**0.13**	**0.14**	**0.12**
Weight % Mineralogy														
(without TOC)														
Quartz	9.4	7.2	2.8	8.8	4.4	21.5	24.5	21.5	13.6	5.7	9.6	1.1	5.9	3.0
K-Feldspar	0.7	0.6	0.8	1.0	1.1	1.8	2.5	2.2	3.1	0.8	2.6	0.0	0.0	1.1
Plagioclase	0.0	0.0	0.0	0.0	0.0	1.0	3.0	2.3	0.6	0.0	0.0	0.0	0.0	0.0
Calcite	38.3	66.0	64.7	34.8	75.7	1.4	1.9	2.3	29.1	60.6	49.5	89.3	70.9	19.6
Dolomite (ferroan?)	49.8	3.9	21.3	8.2	7.5	3.0	1.3	1.1	12.8	5.3	1.4	9.5	23.1	52.9
Halite	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
Pyrite	0.2	2.1	3.4	2.8	0.5	1.0	2.0	2.0	2.6	1.1	2.5	0.0	0.0	0.8
Total Clay	1.6	20.2	7.1	44.4	10.7	68.1	64.7	68.5	38.2	26.0	34.5	0.0	Tr	22.6
Relative Clay %														
Illite/Smectite (I/S)	0.0	2.8	4.6	0.0	11.8	7.9	10.2	11.4	18.7	0.0	0.0	0.0	0.0	0.0
Illite & Mica	100.0	95.9	94.4	72.7	78.8	56.1	56.2	59.5	66.4	99.2	89.2	0.0	100.0	96.4
Kaolinite	0.0	1.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0
Chlorite	0.0	0.0	0.3	27.3	9.4	36.0	33.5	29.1	14.9	0.8	9.6	0.0	0.0	3.6
% Smectite in I/S	-	5-15%	5-15%	-	5-15%	5-15%	5-15%	5-15%	5-15%	-	-	-	-	-
Sum Bulk	100.0	100.0	100.1	100.0	99.9	100.0	99.9	99.9	100.0	100.0	100.1	99.9	99.9	100.0
Sum Clay	100.0	99.9	100.0	100.0	100.0	100.0	99.9	100.0	100.0	100.0	100.0	0.0	100.0	100.0
Volume % Mineralogy														
(includes TOC as kerogen)														
Quartz	9.8	7.3	2.9	9.1	4.5	22.1	25.2	21.9	13.0	5.9	9.8	1.2	6.1	3.1
K-Feldspar	0.8	0.6	0.9	1.0	1.2	1.9	2.7	2.3	3.0	0.8	2.7	0.0	0.0	1.2
Plagioclase	0.0	0.0	0.0	0.0	0.0	1.0	3.1	2.4	0.6	0.0	0.0	0.0	0.0	0.0
Calcite	38.9	65.4	66.2	35.2	75.4	1.4	1.9	2.3	27.2	60.5	49.3	89.5	71.5	20.1
Dolomite (ferroan?)	47.7	3.7	20.5	7.8	7.1	2.9	1.3	1.0	11.3	5.0	1.3	9.0	22.0	51.2
Halite	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
Pyrite	Tr	1.1	1.9	1.5	0.3	0.5	1.1	1.1	1.3	0.6	1.3	0.0	0.0	0.5
Illite/Smectite	0.0	0.6	0.3	0.0	1.3	5.5	6.8	7.9	6.8	0.0	0.0	0.0	0.0	0.0
Illite & Mica	1.6	19.2	6.9	33.1	8.5	38.9	37.0	41.1	24.0	26.1	31.1	0.0	Tr	22.8
Kaolinite	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0
Chlorite	0.0	0.0	0.0	11.4	0.9	23.0	20.3	18.5	5.0	0.2	3.1	0.0	0.0	0.8
Kerogen	**1.0**	**1.8**	**0.3**	**0.7**	**0.8**	**0.7**	**0.7**	**1.5**	**7.8**	**0.4**	**1.0**	**0.4**	**0.4**	**0.3**
Total	99.8	100.0	100.0	99.8	100.0	100.0	100.1	100.0	100.0	100.0	100.0	100.1	100.0	100.0
Vclay	**1.6**	**20.1**	**7.3**	**44.5**	**10.7**	**67.4**	**64.1**	**67.5**	**35.8**	**26.3**	**34.6**	**0.0**	**0.1**	**23.6**
Calc. G.D. (g/cc)	**2.769**	**2.710**	**2.780**	**2.750**	**2.710**	**2.731**	**2.726**	**2.712**	**2.633**	**2.712**	**2.712**	**2.719**	**2.737**	**2.790**

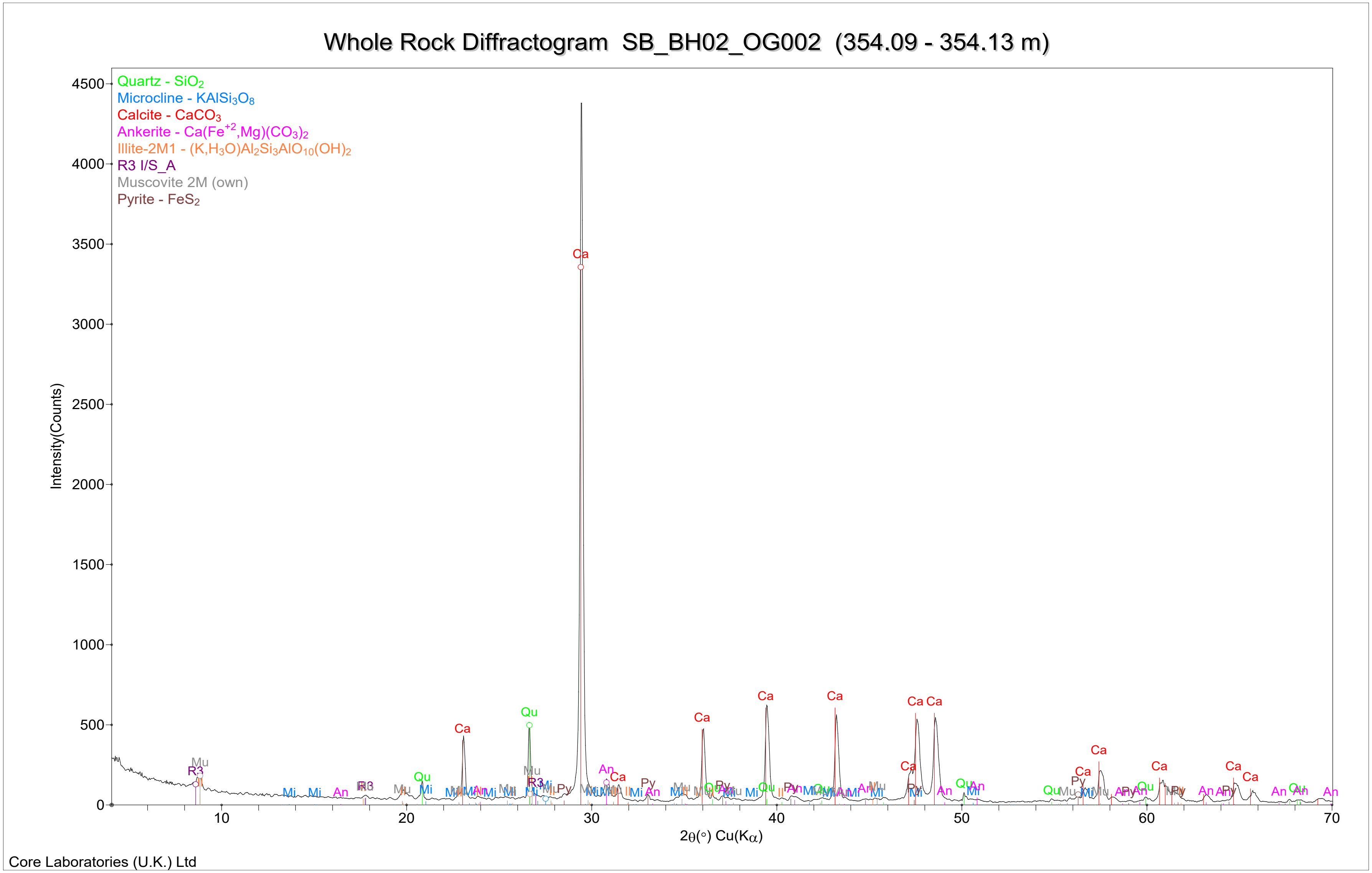
(Note: Due to 'rounding issues values for 'Totals' (both bulks and clays) might differ from 100.0 by +/-0.2 %)

Dolomite observed here appears to be non-stoichiometric, most likely ferroan.

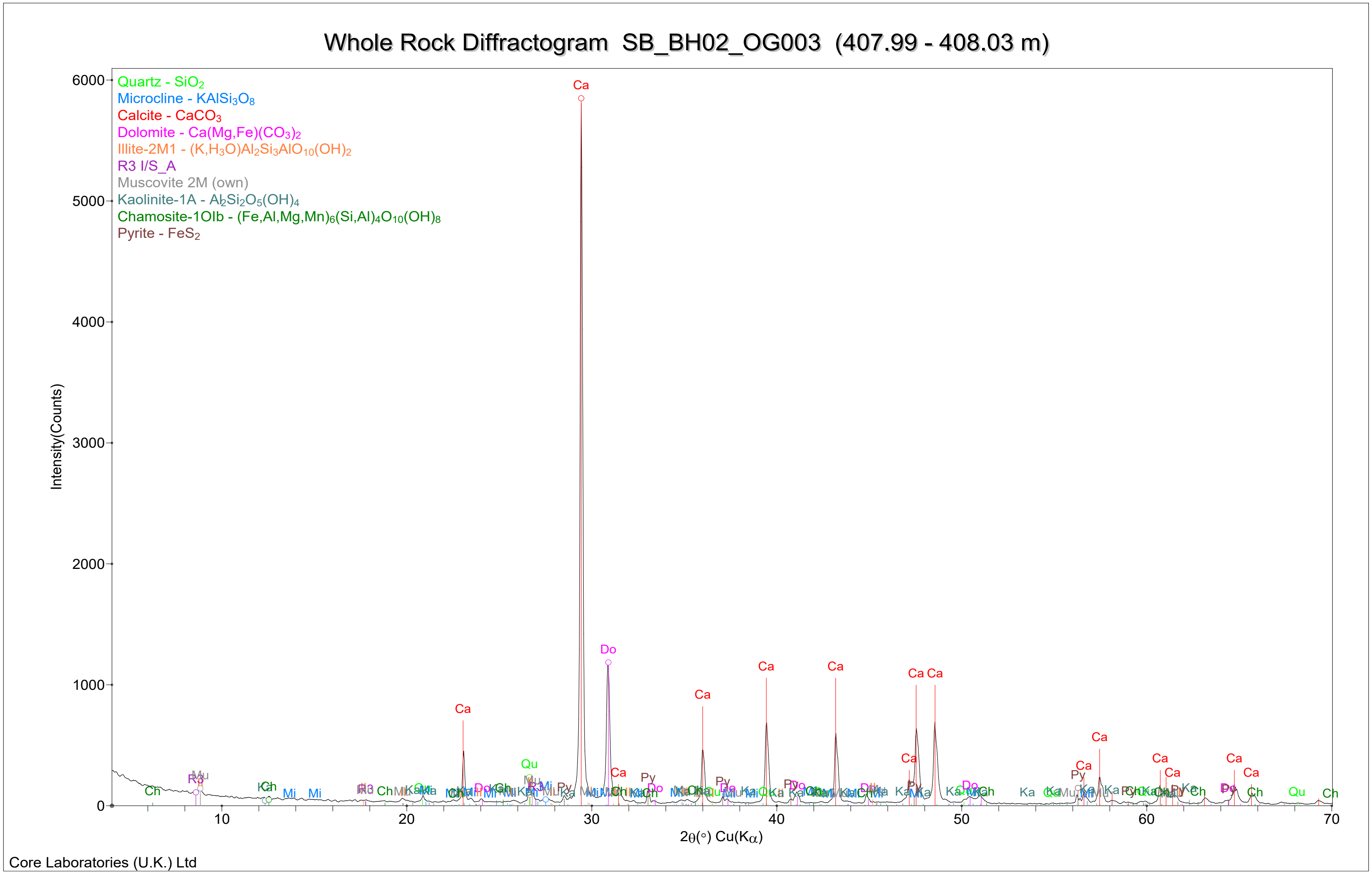
Tr < 0.2wt%

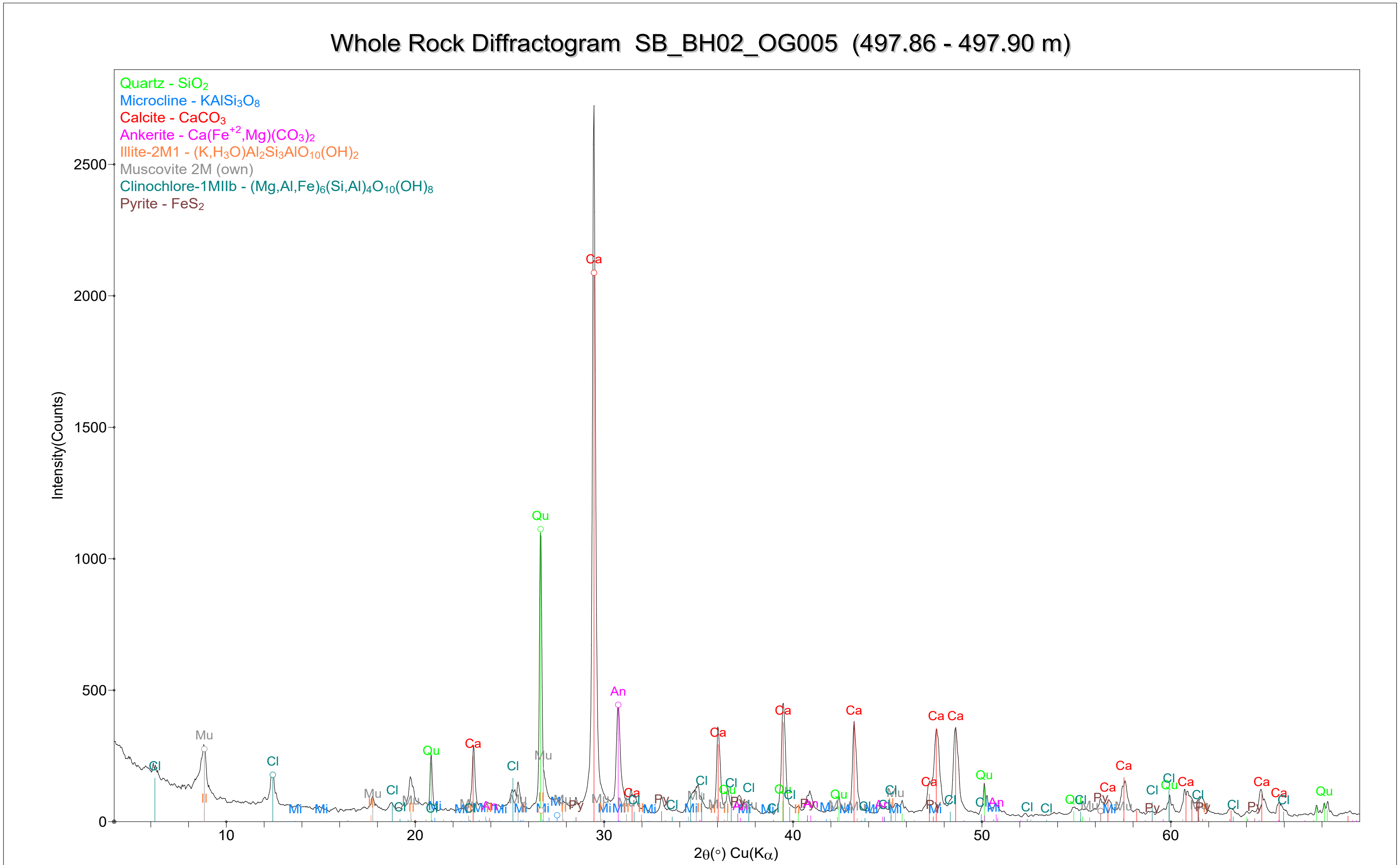


Whole Rock Diffractogram SB_BH02_OG001 (96.28 - 96.32 m)
Quartz - SiO_2
Microcline - $KAlSi_3O_8$
Calcite - $CaCO_3$
Ankerite - $Ca(Fe^{+2},Mg)(CO_3)_2$
Illite-2M1 - $(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$
Pyrite - FeS_2
Intensity(Counts)
2θ(°) Cu(Kα)
Core Laboratories (U.K.) Ltd

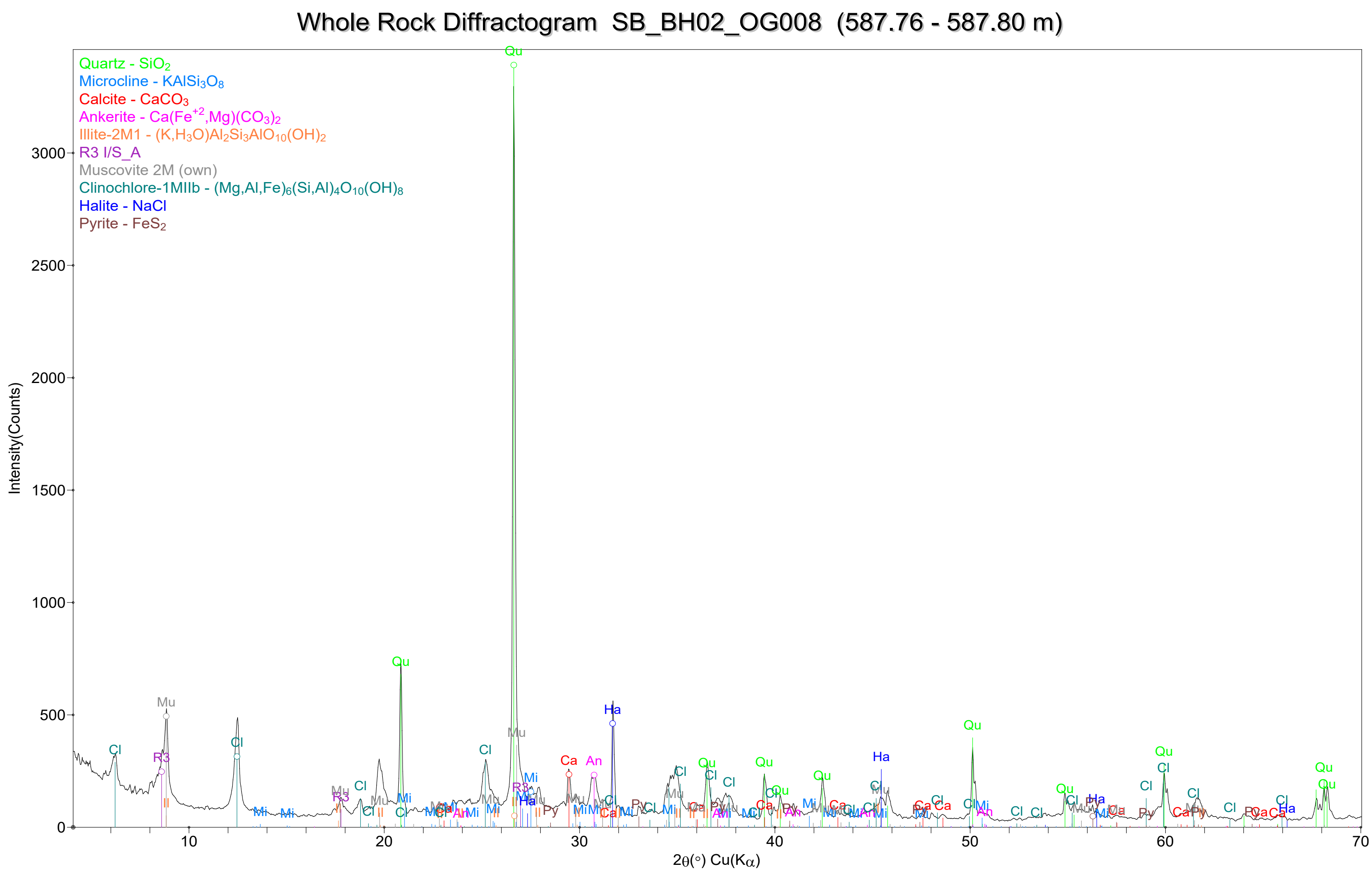


Whole Rock Diffractogram SB_BH02_OG002 (354.09 - 354.13 m)
Quartz - SiO_2
Microcline - $KAlSi_3O_8$
Calcite - $CaCO_3$
Ankerite - $Ca(Fe^{+2},Mg)(CO_3)_2$
Illite-2M1 - $(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$
R3 I/S_A
Muscovite 2M (own)
Pyrite - FeS_2
Intensity(Counts)
2θ(°) Cu(Kα)
Core Laboratories (U.K.) Ltd

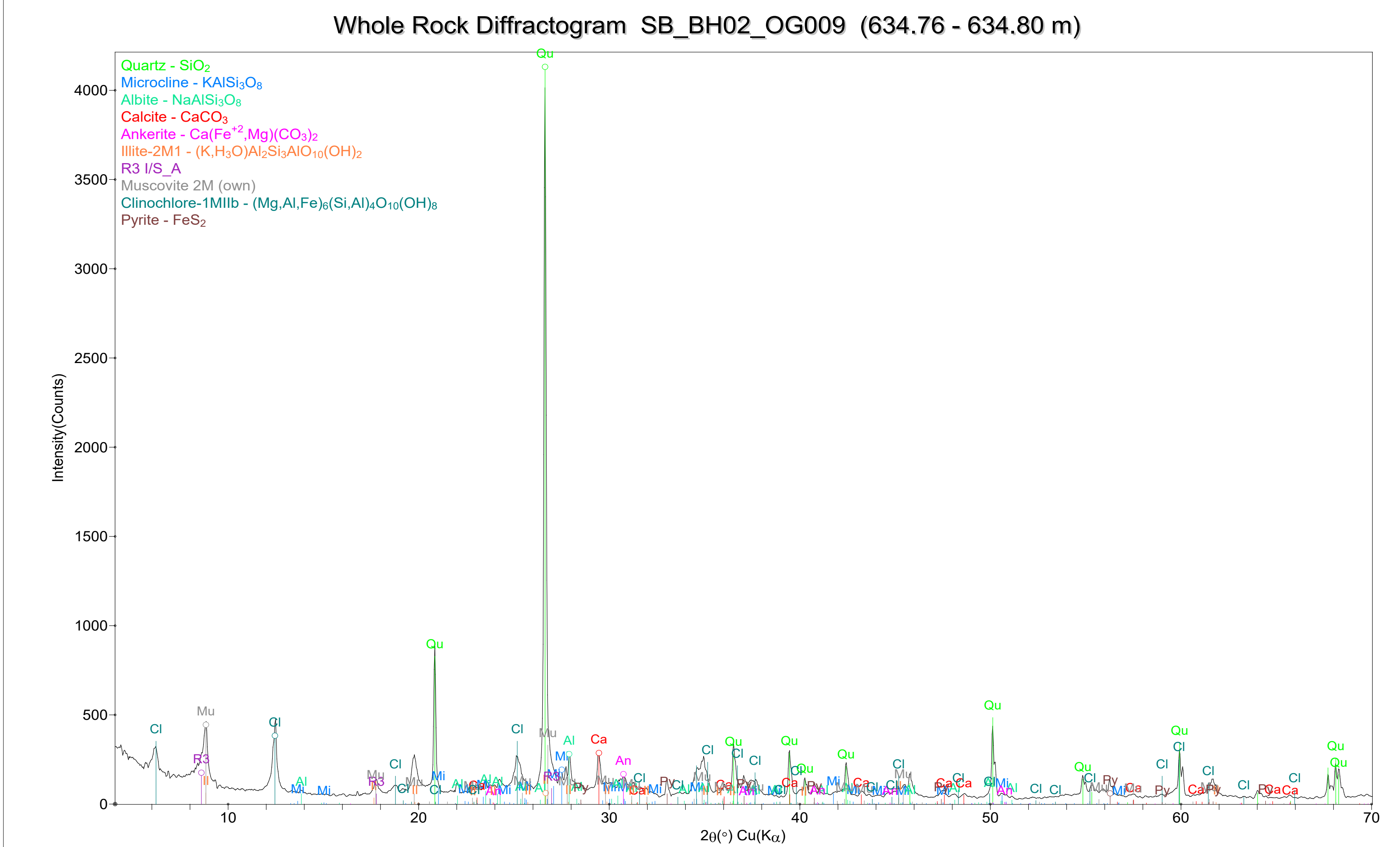

Whole Rock Diffractogram SB_BH02_OG003 (407.99 - 408.03 m)
Quartz - SiO_2
Microcline - $KAlSi_3O_8$
Calcite - $CaCO_3$
Dolomite - $Ca(Mg,Fe)(CO_3)_2$
Illite-2M1 - $(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$
R3 I/S_A
Muscovite 2M (own)
Kaolinite-1A - $Al_2Si_2O_5(OH)_4$
Chamosite-1OIb - $(Fe,Al,Mg,Mn)_6(Si,Al)_4O_{10}(OH)_8$
Pyrite - FeS_2
Intensity(Counts)
2θ(°) Cu(Kα)
Core Laboratories (U.K.) Ltd



Core Laboratories (U.K.) Ltd



Core Laboratories (U.K.) Ltd



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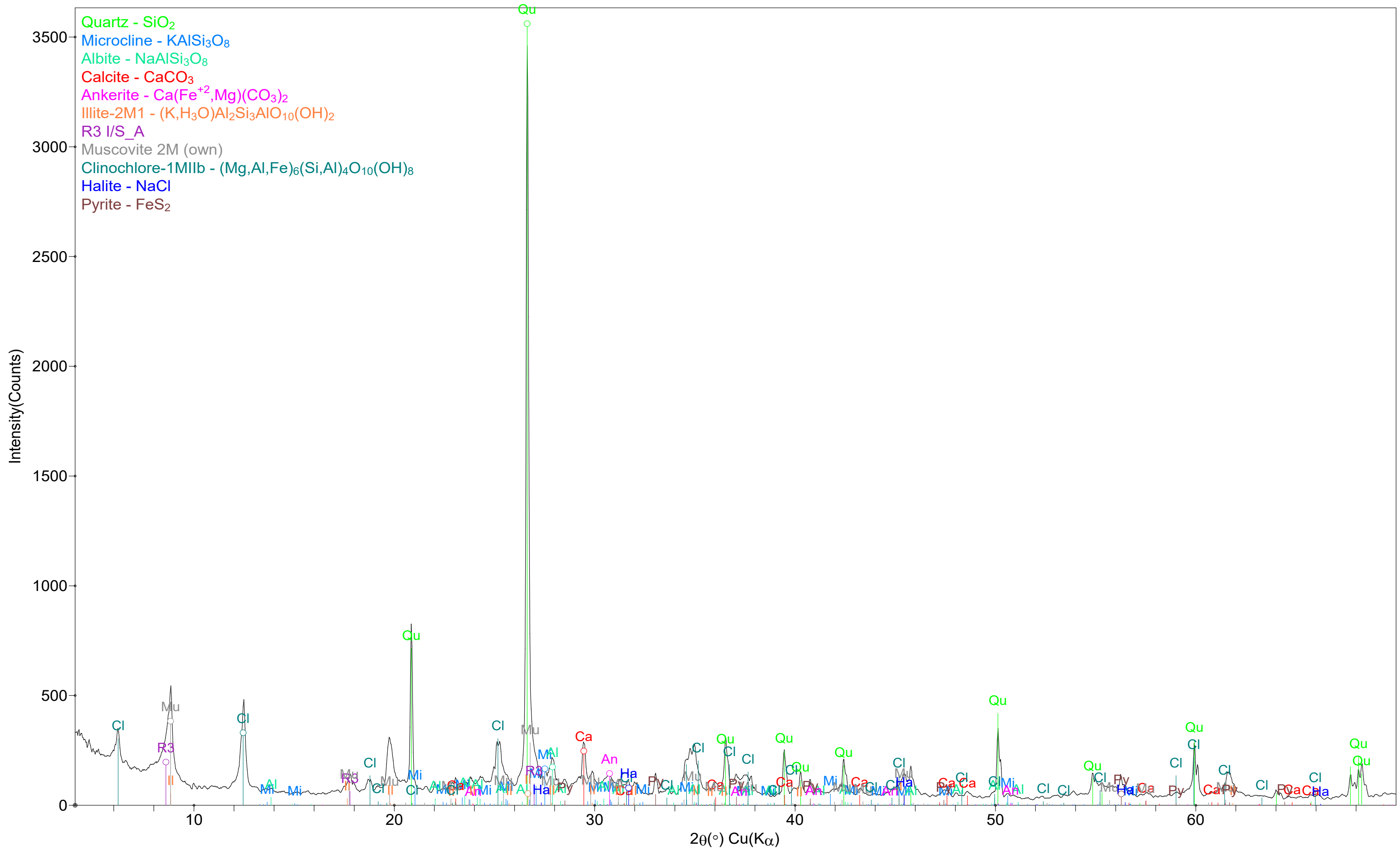
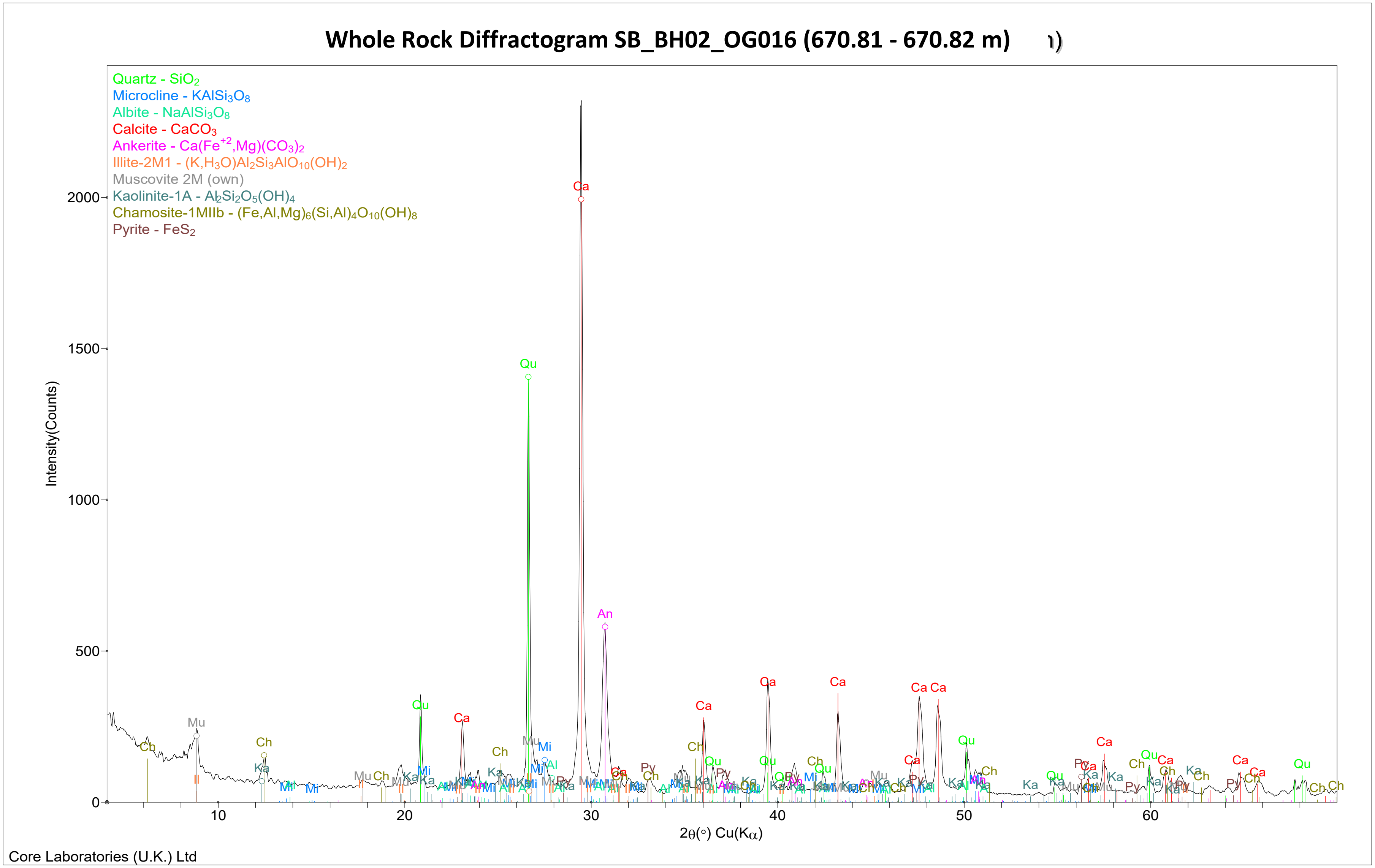
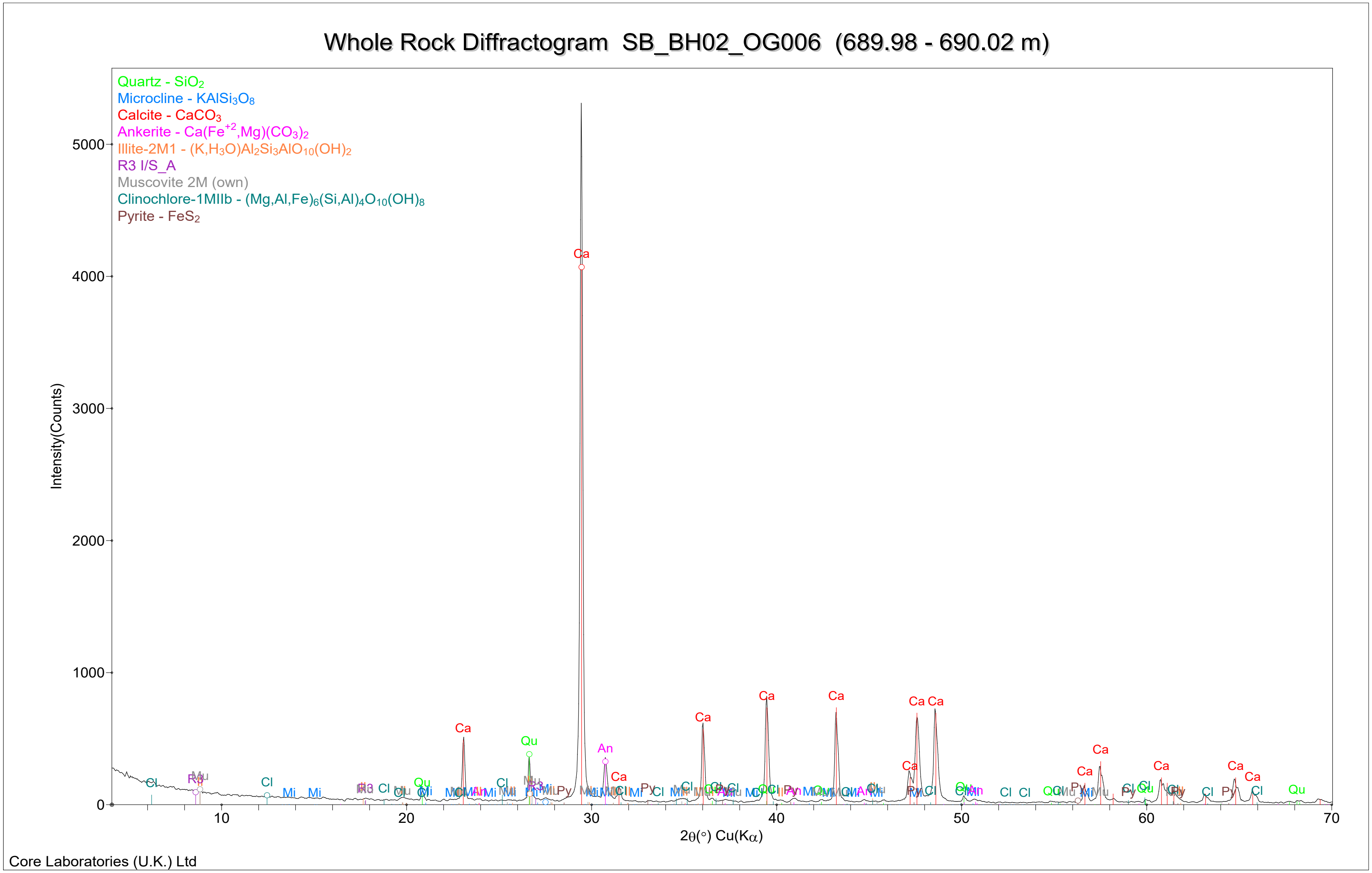
Whole Rock Diffractogram SB_BH02_OG010 (668.83 - 668.87 m)



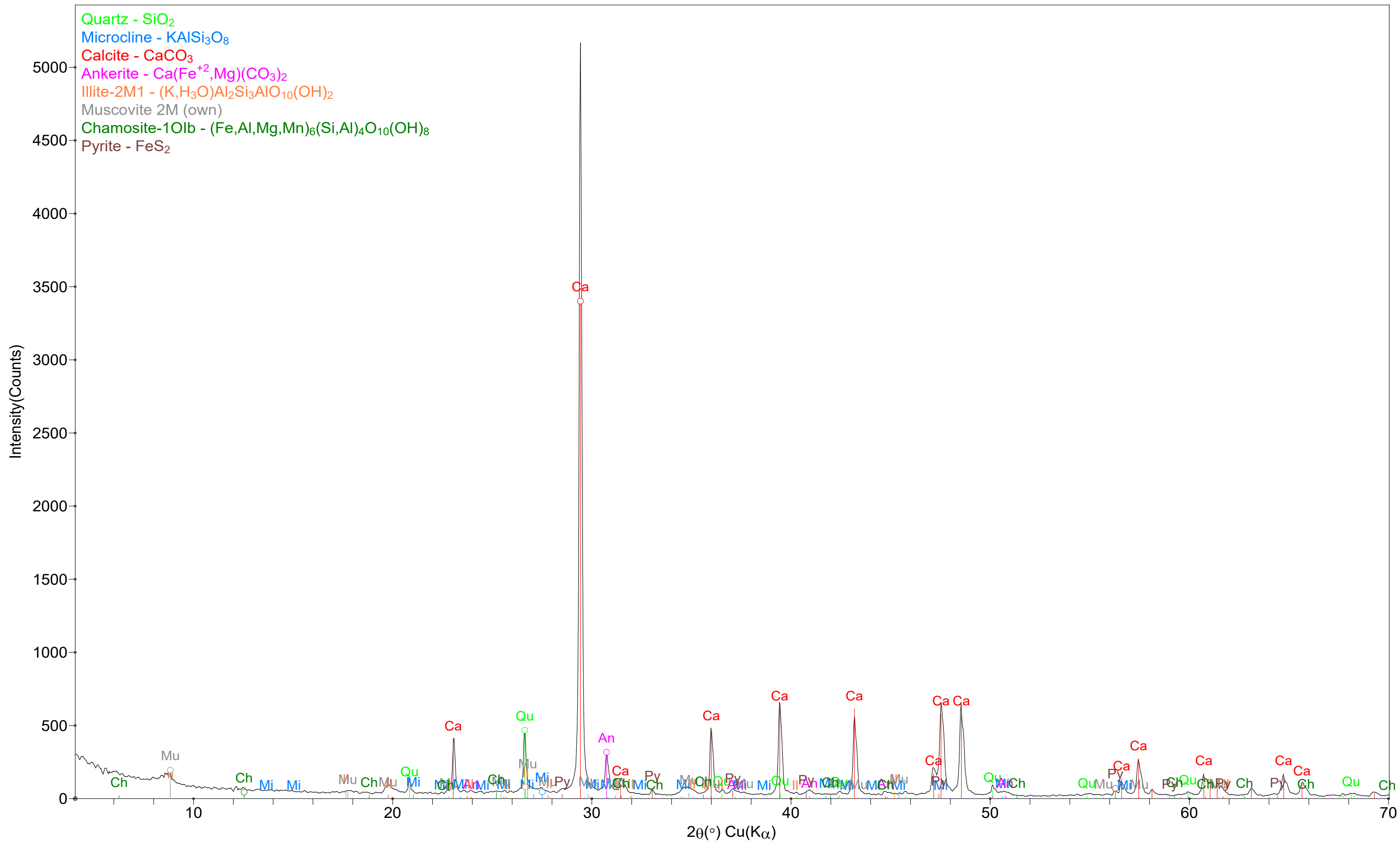
Core Laboratories (U.K.) Ltd



Whole Rock Diffractogram SB_BH02_OG016 (670.81 - 670.82 m)
Quartz - SiO2
Microcline - KAlSi3O8
Albite - NaAlSi3O8
Calcite - CaCO3
Ankerite - Ca(Fe+2,Mg)(CO3)2
Illite-2M1 - (K,H3O)Al2Si3AlO10(OH)2
Muscovite 2M (own)
Kaolinite-1A - Al2Si2O5(OH)4
Chamosite-1MIIb - (Fe,Al,Mg)6(Si,Al)4O10(OH)8
Pyrite - FeS2
Intensity(Counts)
2θ(°) Cu(Kα)
Core Laboratories (U.K.) Ltd


Whole Rock Diffractogram SB_BH02_OG006 (689.98 - 690.02 m)
Quartz - SiO2
Microcline - KAlSi3O8
Calcite - CaCO3
Ankerite - Ca(Fe+2,Mg)(CO3)2
Illite-2M1 - (K,H3O)Al2Si3AlO10(OH)2
R3 I/S_A
Muscovite 2M (own)
Clinochlore-1MIIb - (Mg,Al,Fe)6(Si,Al)4O10(OH)8
Pyrite - FeS2
Intensity(Counts)
2θ(°) Cu(Kα)
Core Laboratories (U.K.) Ltd

Whole Rock Diffractogram SB_BH02_OG011 (748.61 - 748.65 m)



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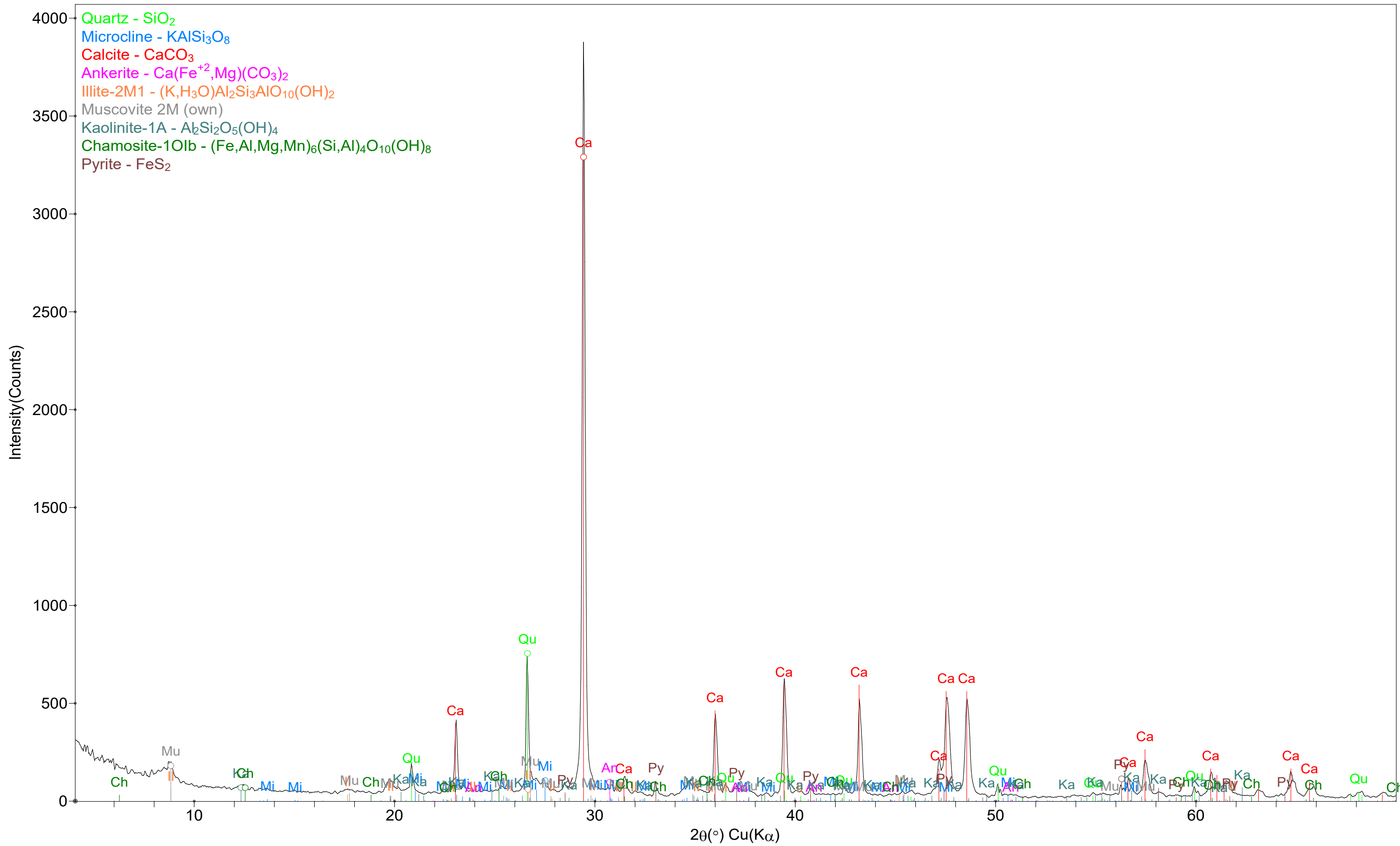
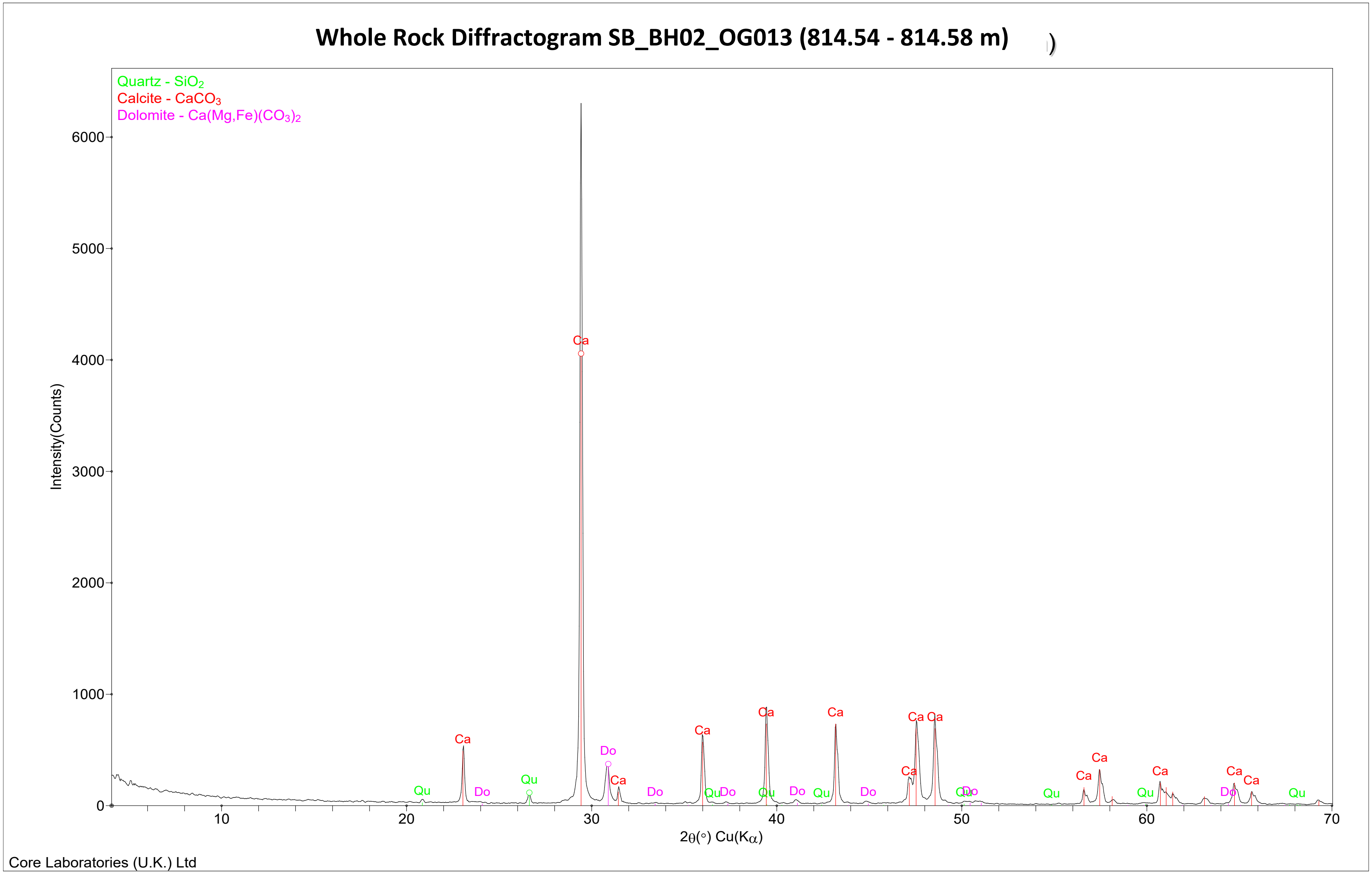
Whole Rock Diffractogram SB_BH02_OG012 (780.26 - 780.30 m)

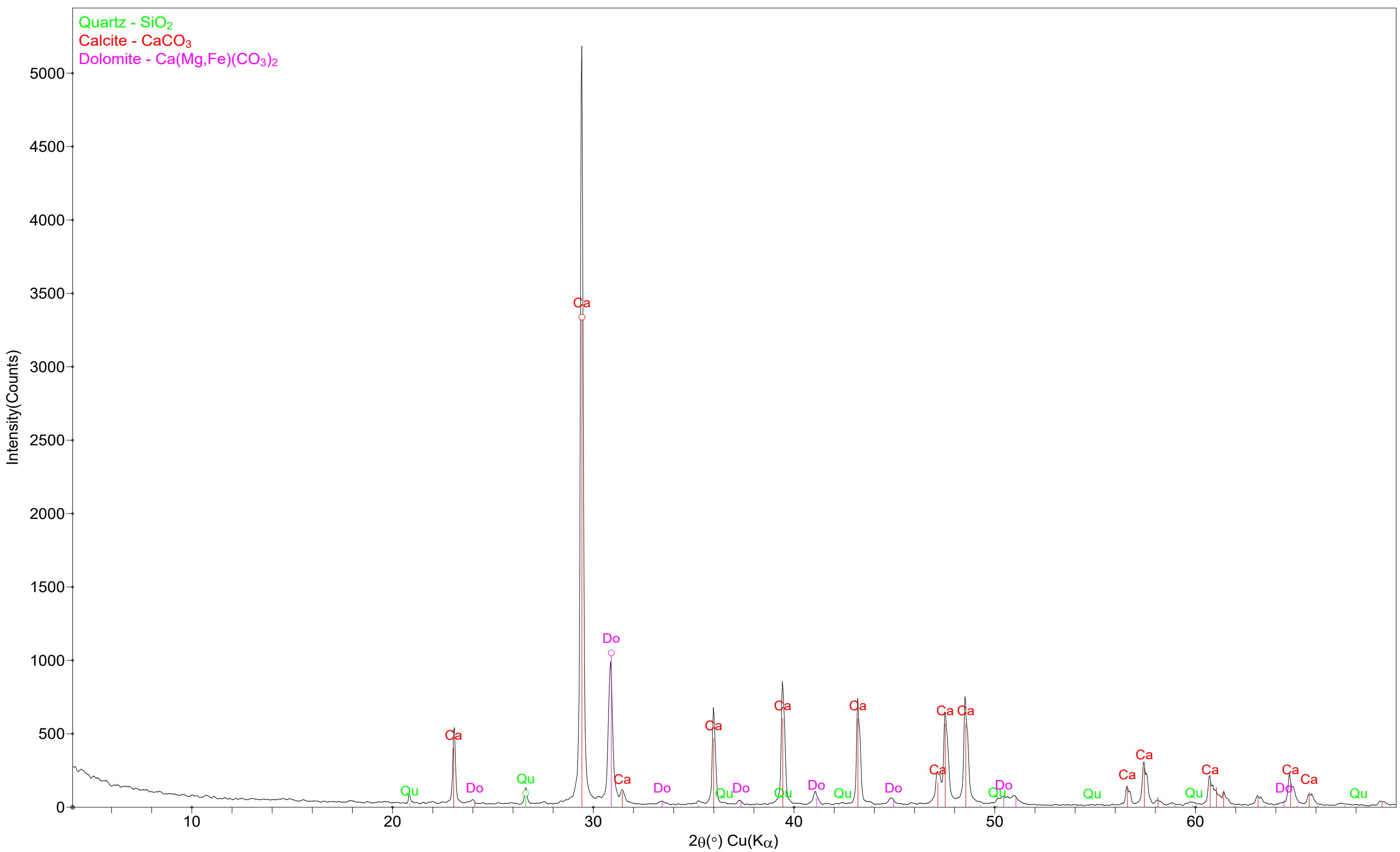


Core Laboratories (U.K.) Ltd



Whole Rock Diffractogram SB_BH02_OG013 (814.54 - 814.58 m)
Quartz - SiO2
Calcite - CaCO3
Dolomite - Ca(Mg,Fe)(CO3)2
Intensity(Counts)
2θ(°) Cu(Kα)
Core Laboratories (U.K.) Ltd

Whole Rock Diffractogram SB_BH02_OG014 (844.99 - 845.03 m)



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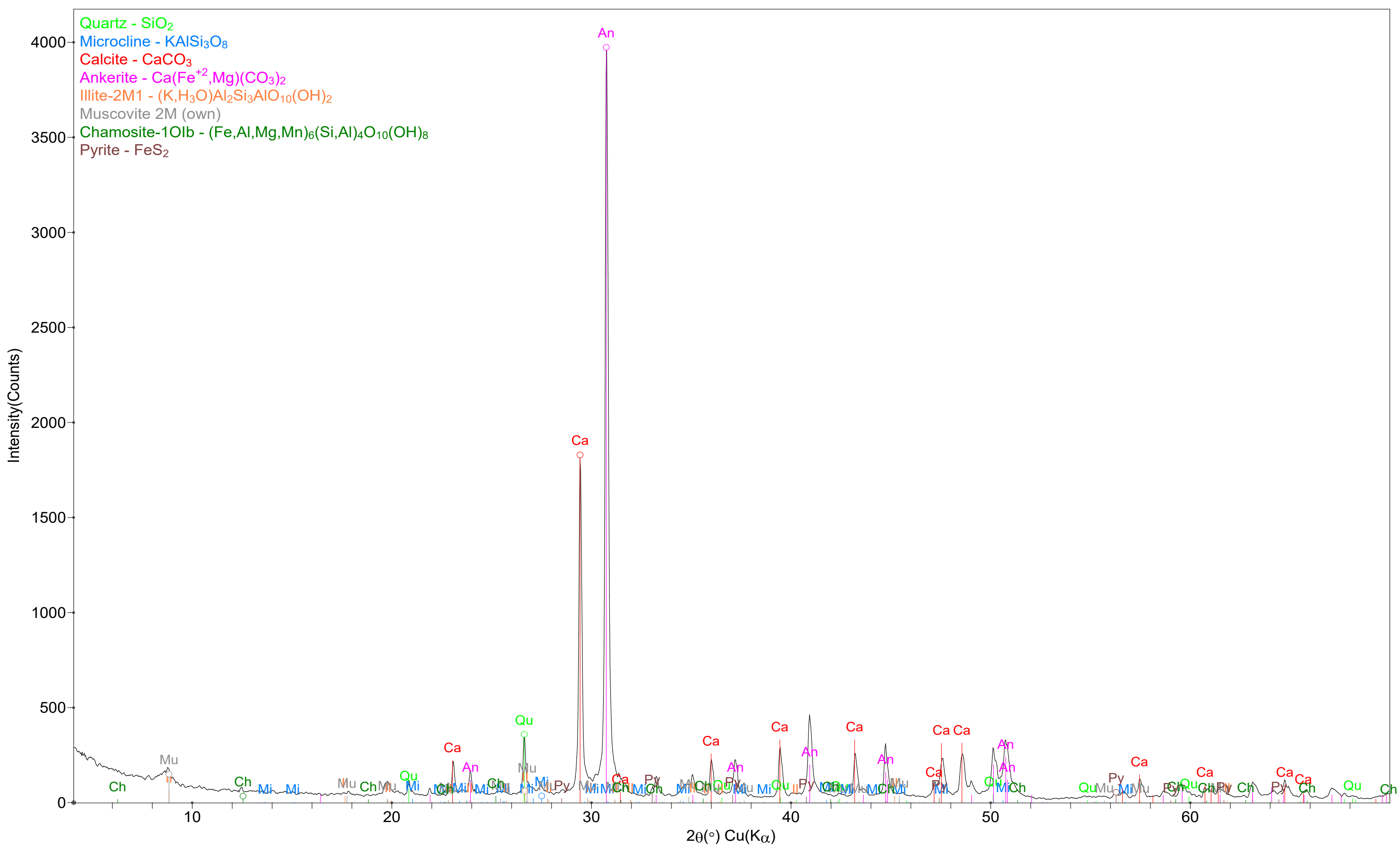
Whole Rock Diffractogram SB_BH02_OG015 (880.09 - 880.13 m)



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