YUKON MICROPLASTICS IN FRESHWATER STATE OF SCIENCE REVIEW AND SAMPLING PROGRAM – PHASE 1

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EXECUTIVE SUMMARY

Microplastics (MP) in water and aquatic ecosystems are a growing concern for which there are little data, especially within freshwater systems. Currently, there are no standardized protocols for MP sampling (other than for microbeads) and quantification in Canada. Core Geoscience Services (CoreGeo) was retained by Yukon Government's Water Resource Branch (WRB) to conduct a literature review, and design and execute a pilot sampling program for MP in freshwater in winter, under ice.

Literature indicates that for surface water, techniques that allow for the collection of large volumes should be utilized, including volume reducing techniques such as filtration and sieving. The use of net trawls is not practical for all sampling scenarios and the standard mesh sizes used for these technique limits the detection of MP particles to the largest size range. Recommendations for mitigating cross contamination include using glass and metal equipment, avoiding the use of synthetic textile during sampling, cleaning surfaces with 70% ethanol and washing with acid followed by ultrapure water, filtering all working solutions, using procedural blanks and replicates to control for airborne contamination, keeping samples covered, and handling samples in a clean air environment when possible.

Based on the findings of the literature review, discussions with laboratories, and environmental conditions, a pilot study was designed to sample for MP in the Yukon River upstream of the Takhini River confluence. Samples were collected on March 24, 2021, using two different methods. Grab samples (total of 12) were obtained by pouring 100L of Yukon River water through a set of two sieves (8" brass 45µm and 500µm). Filter samples (total of 5) were obtained using a Geotech SS Geosub submersible pump and controller to pump 100L of Yukon River water through an in-line 0.45µm high-capacity groundwater filter. For both methods, QAQC samples (blanks and controls) were also collected. Four different laboratories and/or methods were used for sample analysis. Particle count was done though microscopy at the WRB laboratory and by ALS Laboratories (ALS). Particle size distribution was analyzed by ALS, University of British Columbia (UBC) and GR Petrology Consultants Inc. (GR Petrology) and elemental composition was conducted by GR Petrology.

Results show that MP are likely present in the Yukon River downstream of Whitehorse. Since sampling was conducted during winter conditions (under ice), atmospheric deposition is unlikely to be the main source of MP in the Yukon River. However, as indicated by QAQC samples results, it is extremely difficult to avoid contamination of the samples, or near impossible, and it is likely that atmospheric deposition has introduced contamination during sampling even though stringent measures were taken to avoid contamination, both in the field and in the lab. Both sampling methods tested presented some challenges, particularly for winter sampling. Apart from trying to prevent water from freezing in the sieves or filters, one of the biggest challenges is to prevent contamination as MP are omnipresent in the environment. MP were found in the blanks and in the control samples, despites numerous precautions to prevent contamination. Another challenge is with laboratory analyses and differentiating MP from other particles. There is currently no standard analytical method, and results from different labs are difficult to compare. The UBC low level particle size

analysis does not target MP specifically and can therefore not provide a count or density. Similarly, the particle size distribution and elemental breakdown provided by GR Petrology did not target MP and likely detected non-plastic particulates, meaning that MP presence can only be inferred, and a total MP count is not obtainable.

Given the challenges encountered using sieves and the pump and filters, and based on the particle count results obtained from ALS, it is recommended that 1L grab samples be used as the sampling technique in the next phase of the project to reduce potential contamination, and that a larger number of replicates is collected to compensate for the greater variability in smaller sample volumes. To better understand MP sources and fate in the environment, samples should be collected in additional locations including upstream and downstream of communities, storm sewers and water treatment plant discharge. Pristine lakes and dustfall samples should also be collected to understand background concentrations.

LIST OF ACRONYMS

°C	degrees Celsius
AS	Analytical Sensitivity
ATR	Attenuated Total Reflectance
BV	Bureau Veritas
CYFN	Council of Yukon First Nations
EDS	Elemental Spectroscopy
FTIR	Fourier-Transform Infrared Spectroscopy
GCMS	Gas Chromatography-Mass Spectrometry
HDPE	High Density Polyethylene
MP	Microplastic
MPP/L	Microplastic Particles per Liter
PE	Polyethylene
PET	Polyethylene Terephthalate
PP	Polypropylene
PPE	Personal Protective Equipment
PS	Polystyrene
PSD	Particle Size Distribution
PVC	Polyvinyl Chloride
SEM	Scanning Electron Microscope
TGA	Thermogravimetric Analyzer
UBC	University of British Columbia
UTM	Universal Transverse Mercator
WRB	Water Resources Branch (Yukon Government)
XRD	Crystalline Structure Determination
YG	Yukon Government

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1 INTRODUCTION

Core Geoscience Services (CoreGeo) was retained by Yukon Government's Water Resource Branch (WRB) to conduct a literature review, and design and execute a pilot sampling program for microplastics in freshwater.

1.1 BACKGROUND

Microplastics (MP) in water and aquatic ecosystems are a growing concern for which there are little data, especially within freshwater systems (Koelmans et al., 2019). Preliminary screening conducted by high school student, Bruce Porter, in collaboration with WRB indicated the presence of MP within the Yukon Territory's (Yukon) watercourses.

Currently, there are no standardized protocols for MP sampling (other than for microbeads) and quantification in Canada. The most common methods of sampling and analysis involve using various sizes of mesh to isolate MP from aquatic systems, and analysis with different spectroscopy techniques to quantify MP (Masura et al., 2015; Health Canada, 2018). Commercial and research laboratories develop their own MP sampling and analysis protocols based on project design and need. Lack of standardized sampling techniques and analytical methods limits evidence accrual and research conducted in this matter to date. These limitations restrict legal and scientific advances that can be made to study and mitigate this emergent environmental hazard.

1.2 OBJECTIVES

Objectives for this study are to:

- Review literature for current microplastics research, sampling programs and methods;
- Design a pilot study to test sampling methods in freshwater in Yukon and compare lab analysis techniques;
- Conduct sampling and sample analyses; and
- Provide recommendations for a sampling program for microplastics in Yukon.

2 LITERATURE REVIEW

Microplastics (MP), defined as any plastic polymer particle ranging in size from 50-5000µm (0.05-5mm) (World Health Organization, 2019), are quickly becoming one of the most ubiquitous forms of anthropogenic pollution present in almost every natural system on the planet (Smith and Rochman, 2021). Since the coining of the term "microplastics" in 2004, research has continuously increased our understanding of the truly omnipresent nature of these particles, leading the United Nations to declare microplastics one of the most ominous threats to the environment, second only to climate change (Smith and Rochman, 2021). Research is still needed to understand the full extent to which microplastics are polluting natural systems (marine, freshwater, groundwater, soil, air), as well as the impacts of microplastics on human health. The Government of Canada is set to invest $2.3 million in microplastic based research in Canada with a specific focus on assessing the impacts on human

health (Pawson 2020). This initiative comes as part of Canada's goals for zero plastic waste by 2030 (Pawson 2020).

To date, microplastic quantification in Yukon freshwater systems has been limited to the work conducted by Bruce Porter, a high school student from Whitehorse, YT. Bruce's novel study looked to assess the source and quantity of microplastic pollution in the Yukon River (Porter, 2019). Bruce determined that the dominant source of microplastics in the Yukon River is via atmospheric deposition, and that microplastics were predominantly classified as microfibers (Porter, 2019). This triggered further questions about presence, source and fate of MP in the environment, which can only be assessed reliably through standards protocols and methods. This forms the basis of the present study.

2.1 MICROPLASTIC OCCURRENCE IN FRESH WATER

The occurrence and distribution of MP in freshwater systems is poorly understood compared to marine systems, which have been more widely studied for MP pollutants (Duis and Coors 2016). Current information available suggests that MP concentration in fresh water is comparable to marine environments (Li et al. 2018). Variation in MP concentration in freshwater is a result of location, human activity, natural conditions, and sampling approach (Li et al. 2018). In general, MP are not evenly distributed vertically or horizontally in the water column and their abundance decrease at greater distances from the source of their introduction (Rios and Balcer 2019). MP will settle out of the water column at different rates depending on their density, potential for accumulating a biofilm, and the prevailing water currents (Rios and Balcer 2019). Surface water sampling generally had the lowest concentration of MP, likely because surface water studies generally only targeted larger particle sizes, whereas smaller particles are the most abundant (Koelmans et al. 2019). Wastewater treatment is a dominant source of MP in freshwater, followed by surface runoff, atmospheric deposition, and direct waste disposal (Li et al. 2018). A summary of results from studies of MP in freshwater systems in Canada can be found in the table below (Table 2-1).

Table 2-1: Summary of Microplastic Occurrence in Canadian Freshwater Systems

Source	Location	Sample Matrix	Plastic Occurrence	Notes/Methodology
Forest et al. 2019	Ottawa River, Ontario	Surface Water	0.02-0.41 particles/L	100µm sieve, 100L samples, Citizen Science samplers.
Vermaire et al. 2017.	Ottawa River, Ontario	Surface Water, Sediment	Grab sample: median 0.1 particles/L Manta trawl: mean 1.35 particles/m3 Sediment: mean 0.22 particle/g of sediment	100L grab samples, manta trawl, sediment samples.

Source	Location	Sample Matrix	Plastic Occurrence	Notes/Methodology
Crew at al. 2020	Upper St. Lawrence River, Quebec	Sediment and Surface Water	Sediment: 65-7561 particles/kg dry weight (avg. 832).	Ponar grab sediment samples and 250mL was analyzed. 4 L acid-washed plastic jugs were used to collect water at a depth of 0-5 cm a total of 25 times to filter 100 L of water through a new piece of 100 mm nylon mesh.
Hendrickson et al. 2018	Lake Superior, Canada	Surface Water	37 000 particles/km2	Highest concentrations on harbors and estuaries. Most common form of plastic was fibers.
Anderson et al. 2017	Lake Winnipeg, Manitoba, Canada	Surface Water	1.93x105 particles/km2	Collection cut off size 333µm.
Ballent et al. 2016	Lake Ontario, Canada	Nearshore Sediment	760 particles/kg sediment	Methodology Unknown.
Mason et al. 2016	Lake Michigan	Surface Water	~17,000 particles/km2	Manta Trawl. Dominated by particles <1mm
Eriksen et al. 2013	Laurentian Great Lakes	Surface Water	Average of 43,000 particles/km2	Manta trawl with 333µm mesh net.
Bujaczek et al. 2021	North Saskatchewan River, Alberta, Canada	Surface Water	Mean= 26.3 particles/m3 (4.6 to 88.3 particles/m3)	Plankton net with 53µm mesh

2.2 SAMPLING METHODS

Various methods have been used to sample MP in freshwater systems. Surface water sampling can be conducted via volume reducing sampling methods including the use of pump and filter, neuston/plankton/manta net trawls, or by non-volume reducing sampling via grab samples (Li et al., 2018, Koelmans et al., 2019). Abigail et al. (2017) found that between grab samples and neuston nets, grab samples collected more MP as well as a smaller size range and greater proportion of non-fibrous plastic that neuston nets. Neuston, plankton, drift and manta net trawls with mesh sizes ranging from 80 to 333 µm with attached flow meters are recommended if this method is chosen (Rios and Balcer 2019, Anderson et al. 2017). It is common practice to use 333µm neuston net or 335µm manta net for sampling MP in marine environments (Marine Debris Program, 2015, Anderson et al. 2017, Duis, K., & Coors, A., 2016). A grab method is typically used for sediment samples and for coastal sediments (Duis, K., & Coors, A., 2016); however, it is acknowledged that bulk sampling or increased number of samples is required to not underrepresent the distribution of microplastics in these mediums (Duis, K., & Coors, A., 2016). Pumps, steel or polycarbonate sampling tubes, or buckets have been used to collect bulk water samples from the surface or from different depths in lakes and rivers (Rios and

Balcer, 2019). While the volume of individual samples was generally small (0.3-25 L), the samples were filtered through very fine mesh (2.7-63 mm), thus each sample retained a fairly large number of very small MP particles, including thin fibers (Rios and Balcer, 2019).

The detection limit of MP particles generally benefits from larger sample volumes, as larger volumes equal a higher chance of detecting particles (Koelmans et al., 2019, Prata et al., 2019). The detection limit is also impacted by the size of particle being analyzed; i.e., larger particles (>300µm) have a higher likelihood of being detected than small particles (<100-300µm) (Koelmans et al., 2019). For example, the use of a neuston net is preferred when sampling large size MP that do require the use of a microscope to be observed, as a large volume of water can be sampled (Abigail et al., 2017). One article suggests using a 500 L minimum sample volume for surface water when looking for large particles, and more if smaller particles or sampling in remote locations (Koelmans et al., 2019).

2.3 LABORATORY PREPARATION AND ANALYSIS

A variety of methods and techniques have been employed for MP sample treatment prior to analysis. Some of these techniques will be discussed below in the context of sampling in freshwater systems. To separate microplastics from other particulates in samples, filtering, sieving, density separation, and digestion methods are commonly used (Duis, K., & Coors, A.,2016).

2.3.1 Filtration and Sieving

Filters and sieves can be used to process samples prior to analysis. Filters and sieves come in a large variety of pore sizes. Small pores can become clogged quickly with organic matter, requiring the use of multiple sieving events, with increasingly smaller pore sizes (Prata et al., 2019). In samples that have larger microplastics, tweezers were used to remove particles from the sieves, but this is known to increase the likelihood of bias when counting microplastics (Duis, K., & Coors, A., 2016). The use of sieves with small pore sizes is recommended as they capture more particles than simply using visual counting methods (Duis, K., & Coors, A., 2016).

2.3.2 Digestion

The use of a digestion step is recommended for sample preparation when sampling surface and wastewater to digest and remove any organics, separating them from inorganic (plastic) particles (Koelamans et al., 2019). Potassium hydroxide (KOH) or enzymes have been demonstrated to be acceptable methods (Koelamans et al., 2019). Another common method used is wet peroxide oxidation (WPO) in the presence of Fe(II) catalyst to digest organics (Marine Debris Program, 2015). In general, digestion protocols should have the least impact (i.e., degradation) on plastic polymers (Prata et al., 2019). Some polymers have low resistance to acids used in digestion and may be degraded (Prata et al., 2019).

Digestion using alkali substances may damage colour and leave oily residue (Prata et al., 2019). KOH (10% at 60°C overnight) is a good choice for digestions; however, KOH can still cause discolouration

and degradation of some plastic polymers (Prata et al. 2019). Hard parts (bone) and fats do not fully digest with Alkali digestion (Prata et al. 2019).

The use of oxidizing agents such as hydrogen peroxide (H_2O_2) are a good choice that tends to have less impact on the degradation of plastic but can still cause some discolouration (Prata et al., 2019). The use of high temperatures can help H_2O_2 digestion occur faster and is more effective in the removal of organic matter (Prata et al., 2019).

2.3.3 Spectroscopy and Polymer Identification

A variety of high-power spectroscopy techniques such as FTIR (Fourier-transform Infrared Spectroscopy), Raman spectroscopy, pyrolysis-GCMS (gas chromatography mass spectrometry) or TGA-GCMS (thermogravimetric analyzers- gas chromatography mass spectrometry), ATR-mFT-IT (attenuated total reflectance with micro-Fourier transform infrared), and Scanning electron microscope (SEM) techniques are recommended for MP analysis and polymer identification (Koelmans et al., 2019, Rios and Balcer, 2019, Prata et al., 2019). These spectroscopy techniques are powerful but laborious, leading to a need for subsampling of MP for identification. Subsampling should be avoided, if possible, but the practicality of sampling must be considered (Koelmans et al., 2019). The practice of manual sorting and counting MP particles has considerable bias compared to FTIR or Raman microscopy and is therefore discouraged when analyzing particles <300um (Koelmans et al.2019). ATR-mFT-IT is one of the most reliable methods of polymer ID that does not need chemical preparation (Rios and Balcer, 2019). Focal place array with FT-IR can be used but requires chemical preparation; mRAMAN spectroscopy is also recommended but can lead to interference from pigment spectra (Rios and Balcer 2019). Scanning electron microscope (SEM) is an alternative to qualitatively to assess MP presence (Rios and Balcer 2019). It is recommended that, coupled with visual inspection, 10% of MP 10-5000µm and all MP 20-100 µm should be assessed with FTIR or Raman methods (Prata et al. 2019).

2.3.4 Sample Preparation and Quality Assurance and Quality Control

2.3.4.1 Work Conditions and Clean Air Control

General working conditions and the use of clean air control are important considerations when sampling MP to reduce contamination from external sources. Airborne fibers are the most common source of contamination during the processing of samples in the lab and can result in an overestimation of MP abundance (Rios and Balcer, 2019). It is recommended that all sample handling following collections (i.e., during laboratory analysis) be done in a clean air cabinet or laminar flow cabinet (Koelmans et al., 2019, Prata et al., 2021). The use of a laminar air hood is preferred over the use of a fume hood, as laminar flow actively creates a clean air environment (Prata et al., 2021). When working with open sample bottles in the field and lab, the use of aluminum foil or glass lids covering samples can help in reducing air contamination to some extent (Prata et al., 2021). With the need for widespread MP sampling, the use of citizen science efforts has been suggested as a useful method for sample acquisition. The use of citizen science to support MP studies has not been validated and has

the possibility of creating considerable error and contamination to be introduced (Koelmans et al., 2019).

2.3.4.2 Materials and Equipment

Consideration for the type and treatment of all equipment used in MP sampling is also important for reducing the likelihood of external contamination. Bottles and all lab equipment used in sampling procedures should be properly rinsed (x3 rinses) prior to use, using filtered or distilled water (Koelmans et al., 2019, Prata et al., 2021). Beyond rinsing with distilled water, washing glassware overnight with a mild acid (or ethanol for metals) can be helpful in removing MP contamination (Prata et al., 2021).

Measures should be taken to avoid the use or exposure of synthetic clothing to samples. It is highly recommended that cotton lab coats or similar natural fiber clothing be worn when sampling and processing MP (Koelmans et al., 2019, Prata et al., 2021). It should be noted that cotton clothing can still release fibers that look very similar to MP fibers that can contaminate samples; if no polymer identification is conducted on fibrous particles, cotton particles may be mistaken for MP (Prata et al., 2021). For potential sources of contamination (gloves, lab coats, paper towel) the use of products with highly distinguishable colors is recommended (i.e., bright orange cotton fabrics), to help differentiate plastic and non-plastic materials (Prata et al., 2021). Some studies avoided the use of plastic or nitrile gloves while others still used them (Prata et al., 2021). For analysis using harsh chemicals, gloves and other PPE should always be used (Prata et al., 2021). Finally, sampling methods involving nets that utilize plastic mesh led to contamination issues, especially when thoroughly cleaning the nets (vigorous washing releases particles from the mesh) (Prata et al., 2021).

2.3.4.3 Contamination of Solutions and Filters

Solutions used for cleaning sampling materials can still be a source of contamination, even when using filtered or ultra-clean water, acids, and other detergents (Prata et al., 2021). This contamination can occur from contact with equipment, deposition from the air, or directly from origin or the solution (Prata et al., 2021). Filtration of these solutions prior to use can help prevent contamination (Prata et al., 2021). Glass filters are recommended to filter solutions but can still be contaminated due to an unclean working environment (Prata et al., 2021). This can be mitigated through heat treatment to clean glass filters at 450°C for 3 hours (Prata et al., 2021). When filters were not cleaned, MP quantities were overestimated (Prata et al., 2021).

2.3.4.4 Field, procedural and Clean Air Blanks/Controls

The use of control samples is highly recommended when conducting MP sampling. It is recommended that a minimum of three procedural blanks be used to develop a correction factor for sample results (Koelmans et al., 2019). Procedural blanks should follow the same procedure as samples and are only

useful in yielding results if the smallest size range of MP is analyzed (Prata et al., 2021). Laboratory blanks are also recommended where uncovered samples are left open in the lab environment to capture plastic deposition from the air (Prata et al., 2021).

2.3.4.5 Positive Control

The loss of MP particles from samples may occur during various steps of the sampling process, it is therefore recommended that losses be quantified using positive control samples (Koelmans et al., 2019). Positive control samples are "spiked" with known quantities of MP particles to assess the recovery rate of MP during sample analysis (Koelmans et al., 2019). These positive control samples should undergo the same sample analysis as all other samples to verify sufficiently high recovery rates of particles and develop a correction factor for MP loss during sample processing (Koelmans et al., 2019). If recoveries are low yet reproducible, the reported counts should be corrected for this incomplete recovery (Koelmans et al., 2019). The use of positive control samples is demonstrated in a study by Bujaczek et al. (2021), where samples were spiked with a variety of fluorescent microbeads of know sizes and quantities. Recovery of the spiked particles was then used to help determine the recovery rate of MP particles in the samples and correct for losses (Bujaczek et al., 2021).

2.4 SUMMARY OF FINDINGS, RECOMMENDATIONS AND BEST PRACTICES

The detection limit of MP particles generally benefits from larger sample volumes as more particles are captured and detected (Koelmans et al., 2019, Prata et al., 2019). It is recommended that the largest feasible sample volume be collected. For sampling surface water, sampling techniques that allow for large sample volumes to be collected are recommended, including volume reducing techniques such as filtration and sieving, or large volume grab sampling when feasible. Net trawls are not practical for all sampling scenarios and the standard mesh sizes used for these techniques limit the detection of MP particle to the largest size range.

Areas for improvement and innovation when conducting MP sampling include sample treatment, polymer identification, clean air conditions and the use of positive control samples (Koelmans et al., 2019). Recommendations for mitigating cross contamination include using glass and metal equipment, avoiding the use of synthetic textile during sampling, cleaning surface with 70% ethanol and washing with acid followed by ultrapure water, filtering all working solutions, using procedural blanks and replicates to control for airborne contamination, keeping samples covered as much as possible, and handling samples in a clean air environment when possible (Prata et al., 2019, Scopetani et al., 2020, Prata et al., 2021).

3 PILOT SAMPLING PROGRAM

Based on the findings of the literature review, discussions with laboratories and environmental conditions, a pilot study was designed to sample for microplastics in the Yukon River.

3.1 METHODS

3.1.1 Sample Collection

Field work was conducted on March 23rd and 24th, 2021 by a team consisting of Bruce Porter, WRB employee Devon O'Connor, Council of Yukon First Nations (CYFN) representative Neil Hawkes, and CoreGeo staff Sruthee Govindaraj, David Krug and Catherine Henry. Samples were collected from the Yukon River, just upstream of the Takhini River confluence at UTM coordinates 08V 490208 6744916 (see Figure 3-1; Photo 3-1). This location is regularly sampled by WRB for general chemistry but had yet to be sampled for MP.

The site was accessed by foot from the Takhini bridge boat launch. Gear was transported by snowmobile. Methods were tested on March 23rd during a 'dry run' and samples were collected on March 24th. Sampling was conducted under a mix of sun and clouds, calm to light winds and air temperature ranging from -14°C to -2°C. Snow was cleared from the sampling area and a hole was drilled through the ice using a battery powered ice auger (see Photo 3-2). The ice thickness was 44cm.

Figure 3-1: Sampling Location

Photo 3-1: Sampling Location on the Yukon River, seen from the confluence of the Takhini River

Photo 3-2: Hole in the Ice for Sampling

In-situ parameters were collected using a YSI Professional Plus multi-meter calibrated before the trip. Data are presented in Table 3-1.

Table 3-1: In-situ Parameters, Yukon River upstream of Takhini River Confluence, March 24, 2021

Time	10:50
Temperature (°C)	0.0
pH (pH units)	8.11
Specific Conductance (µS/cm)	79.7
Dissolved Oxygen (%)	84.4
Dissolved Oxygen (mg/L)	12.38
Oxidation-Reduction Potential (mV)	79.9

3.1.1.1 Grab Samples

A 15L graduated metal bucket was used to measure and pour 100L of Yukon River water through a set of two sieves (8" brass 45µm and 500µm). The 500µm sieve was placed on top of the 45µm sieve to capture larger debris such as organic matter and ice (Photo 3-3). Deionized water, warmed using a camping stove, was used to melt the slush and ice that built up in the sieves by pouring through the sieve. The sieves were rinsed with warm deionized water, by holding the sieve at an angle and washing all particulate matter to one side. Particulate was then washed and collected into a high-density polyethylene (HDPE) bottles provided by the labs (Photo 3-4). A total of 12 samples were collected using this method: three destined for Bureau Veritas GR Petrology lab, three for Bureau Veritas University of British Columbia subcontracted lab, three for ALS Laboratory (ALS) and three for Bruce Porter for analysis. All bottles had approximately 10-20mL of water and particulate sample. Samples submitted to BV laboratory, due to lab protocols, were topped up with additional deionized water for a total volume of 1L in each bottle.

Photo 3-3: Pouring Yukon River Water through Sieves

Photo 3-4: Washing Sieves with Deionized Water

3.1.1.2 Filter Samples

A Geotech SS Geosub submersible pump and controller were used to pump Yukon River water through an in-line 0.45µm high-capacity groundwater filter (Photos 3-5 and 3-6). Teflon tubing was used to minimize risks of plastic contamination from regular tubing. The pump was operated using a generator, which was placed downwind and well away from the sampling location. The pump head was placed 30 cm below the ice surface, the head screen size is not known but was estimated to be in the 150 to 200 µm range. For each sample, a total of 100L of Yukon River water was pumped through the filter. Pumping rates ranged from 122 Hz to 74 Hz; the pumping rate was adjusted down during sampling to prevent excessive pressure building in the system due to freezing. Once the 100L passed through the filters, the filters were capped and placed in a glass jar for submission to the laboratory. A total of five Yukon River samples were collected using this method. All filter samples were sent to BV GR Petrology lab for analysis as it is the only lab that accepts filters for analysis.

Photo 3-5: Pump and Filter Setup

Photo 3-6: In-line Filter

3.1.1.3 Snow Samples

Snow samples were collected from disturbed and undisturbed areas in the vicinity of the water sampling site. Disturbed areas were areas used by the field crew to work, walk, or where snowmobile tracks were found. Samples were melted using a camping stove and metal pot and transferred into 1L sampling HDPE bottles provided by the laboratories. Two 1L samples were collected from each area (disturbed and undisturbed) and manually counted in WRB's lab by Bruce Porter.

3.1.1.4 Quality Assurance and Quality Control

To minimize the risk of contamination from clothing fibers, the field crew wore 100% cotton coveralls during sampling. To minimize the risk of contamination through atmospheric deposition, open buckets and containers were covered with aluminum foil when not is use. Finally, to reduce the risk of contamination from sampling equipment, metal or glass containers and instruments were used where possible. Where plastic containers or instruments had to be used, they were triple rinsed with deionized water prior to use.

Blanks were prepared in WRB's lab with deionized water and HDPE sampling bottles provided by the analytical laboratories and brought out in the field on sampling day. Three unopened 1L bottles and three opened bottles were left at the sampling location during the sampling activities. The unopened bottles will help detect potential contamination from the bottles themselves or in the deionized water, while the open bottles could provide insight into atmospheric deposition. Upon return to WRB's lab, 100L of deionized water was passed through the sieves and collected in three 1L sampling bottles (sieve control). This control is aimed at detecting possible contamination from the sieves. One of each type of blank and control samples was sent to each lab.

For the pump and filter method, 100L of deionized water were pumped through the system using a new filter, and the filter was sent to the lab for analysis (Photo 3-7). The control was done in the WRB's lab. This will allow detection of contamination that may originate from the pump system. In addition, one blank filter was also sent for analysis to detect potential contamination form the filter itself or from handling it.

Photo 3-7: Filter Blank Processing with 100L Deionized Water in WRB's Laboratory

Once the filters were received at GR Petrology lab, the lab determined that they were unable to safely remove the filters from the plastic casing to analyze the membrane without risks of contamination; therefore, the filters were returned to CoreGeo to be opened. CoreGeo used a hot blade from a wood burning kit to melt the plastic and extract the filter membrane (Photo 3-8). This was done under the fume hood in the WRB's lab to minimize risks of contamination. Surfaces were wiped clean and

orange cotton suits were worn to further decrease the risk of contamination. Filter membranes were then individually wrapped in aluminum foil and sent back to GR Petrology lab for analysis. Because it is unknown if this method of opening the filter had the potential to introduce microplastics particles in the filter membrane, an additional unused filter was opened using the same method and sent for analysis, as quality control.

For samples that were processed in WRB's lab by Bruce Porter (see Section 3.1.2.3), two coffee filters were placed in petri dishes and left with the lid off in the lab for five hours while samples were processed. These were then observed for MP contamination, and none was found.

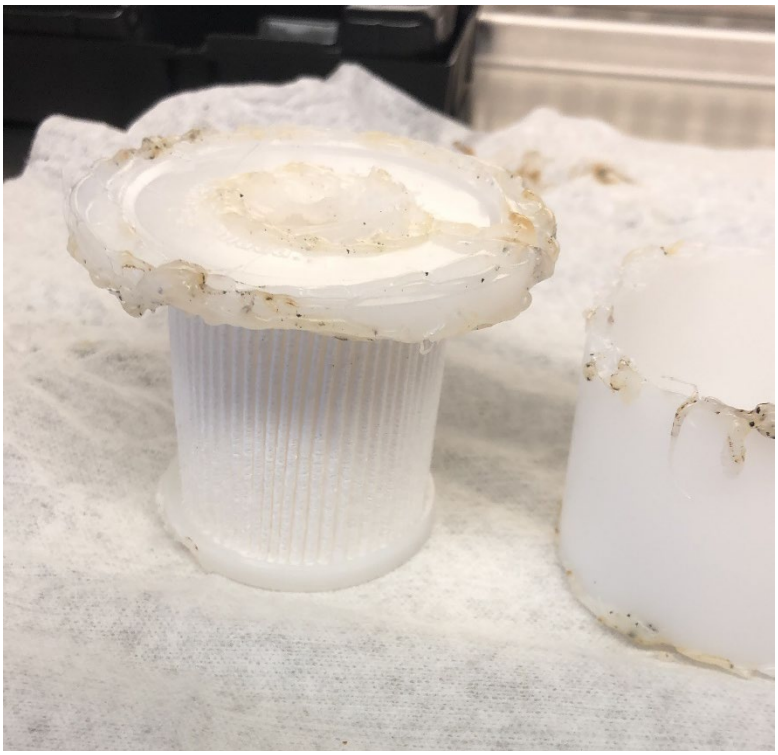


Photo 3-8: Filter Removed from Plastic Casing using Hot Blade

Spiked samples (positive controls) were prepared in WRB's lab using fluorescent microbeads obtained from Dr. Matthew Ross from MacEwan University, Edmonton, Alberta. Bruce Porter counted four colours of microbeads using a dissecting microscope at 10x magnification, and petri dish with a filter paper in it for each lab sample (See Table 3-2). There are variations in the number of coloured beads due to restraints of hand counting the beads under the microscope. The beads were washed into three 1L bottles of deionized water. One spiked sample bottle was sent to each of the three labs.

Table 3-2: Number of beads per 1L deionized water bottle sample for each laboratory.

Bead Color	Size Range (µm)	# of beads/1L sample		
		BV (GR Petrology)	BV (UBC)	ALS
Yellow	600-710	14	10	11
Red	250-300	13	12	23
Green	250-300	23	13	12
Purple	125-150	9	15	19
Total		59	50	65

3.1.2 Sample Analysis

Four different laboratories and/or methods were used for sample analysis.

3.1.2.1 Microscopy Particle Count

This method is available through ALS laboratories and is conducted at ALS Cincinnati. Samples are analyzed according to ALS SOP Micro-Fluor-001 for the detection of micro plastic particles using fluorescent tagging and static image analysis. With this method, fluorescent dye is added to the samples. After activation time, samples are filtered, and filters are viewed under the microscope. The fluorescent dye targets polymers like polyethylene, polypropylene, polystyrene and nylon though it cannot differentiate between them. Analytical Sensitivity (AS), ie the smallest amount of substance in a sample that can accurately be measured, is reported by ALS for each sample and is based on the volume and clarity of the sample. Particle sizing is performed using static image analysis of representative calibrated two-dimensional photomicrographs.

Manual count under a 10x magnification dissecting microscope was also conducted by Bruce Porter (Porter, 2019) using WRB's lab and repeated during this study for comparison. A total of three water samples and four snow samples were manually counted for MP under the microscope by Bruce Porter. Criteria used to identify MP were as follows (Marine & Environmental Research Institute, 2017):

- Small size (largest dimension ≤5mm);
- No cellular or organic structures visible;
- Fibers should be equally thick throughout their entire length; and
- Particles should exhibit clear and homogeneous color throughout.

The hot needle test can be used when unsure if a particle is plastic. To perform this, a small needle is heated until red, then touched to the particle. If the particle warps of shrivels, it is assumed to be plastic.

3.1.2.2 Low Level Particle Size Analysis

Low level particle size analysis is available at the University of British Columbia (UBC), through a BV subcontract. This analysis is done using a Elzone II 5390 instrument from Micromeritics, Inc. where a particle passes through an orifice and interrupts a small current; the size of the interruption is proportional to the size of the particle. This method does not specifically target plastics but provides a count of the very small particles that are suspended as a surrogate. This analysis is non-quantitative for the total amount of MP present.

3.1.2.3 XRD/EDS/Microscopy/PSD

This analysis is available through BV. For water samples, the sample is filtered using a 0.45 µm filter upon arrival to BV lab and the particulate on the filter paper are forwarded to a petrology lab (GR Petrology Consultants Inc.) for X-ray diffraction (XRD; crystalline structure determination), EDS (elemental spectroscopy), PSD (particle size distribution) and scanning electron microscopy (SEM). Filter samples are directly forwarded to the petrology lab (GR Petrology). These analyses are non-quantitative for the total amount of MP present.

3.2 FINDINGS

3.2.1 Sampling Methodology

Both methodologies tested presented some advantages and challenges, summarized in Table 3-3. Additional challenges related to winter conditions were experienced with both methods. For grab samples, water freezing in the sieves was mitigated by pre-heating deionized water for rinsing. For filter samples, flow rates had to be reduced during sampling to counteract pressure created by water freezing in the filter and prevent filters from cracking. Should sampling be carried out at colder temperatures, it would be advisable to set up a heated shelter (such as an ice fishing shelter) to prevent freezing. Doing so would however require controls to determine if MP can originate from the shelter itself. Also of note, another sampling method was identified from the literature but was not retained for this pilot study due to its impracticality during winter conditions: plankton nets are commonly used for MP sampling, either dragged behind a boat or left in flowing water for a given duration. This method could be tested in summer conditions, however, should a standard sampling method be developed, it should be viable year-round for comparability of results.

Table 3-3: Advantages and Challenges of the two Sampling Methods Tested

Method	Advantages	Challenges
Grab Samples	• Requires less equipment • Equipment is more affordable • Easier to standardize and to deploy in remote locations • Samples can be analyzed by several labs • Quantitative analyses can be done • Some lab analyses are more affordable • Can be used for any volume of sample • Can target different particle sizes by using sieves with different mesh size	• Higher risk of contamination due to exposure to atmosphere during sieving process • Need to bring larger amounts of deionized water in the field (proportional to number of samples being collected) • Need warm deionized water during winter sampling • Complete rinsing of sieves and buckets may be challenging
Filter Samples	• Closed system – minimal risk of contamination • Less manipulation and associated risk for error • Less physically labour intensive	• Requires the use of a generator. • Pump and controller are expensive • Only one lab can analyze filters at this time and analysis is more expensive • Analysis is non-quantitative • Opening the filter casing can introduce contamination. • Filters can fault in colder conditions. • Particle size limited by pump screen size

3.2.2 Laboratory Results

Complete laboratory reports are available in Appendix A, while results are summarized below.

3.2.2.1 Particle Count

Microscopy particle count was conducted by Bruce Porter in the WRB lab and by ALS. Table 3-4 summarizes results in number of MP particle per litre (MPP/L). ALS reported results as MMP/L based on the sample size they received (10-75 mL), while the actual concentration is much less, given that 100L of Yukon River water was passed through the sieve, prior to transferring the samples into bottles. Results in Table 3-4 are therefore converted to account for the actual sample volume of 100 litres.

Table 3-4: Microscopy Particle Count Results

	Sample Volume (L.)	Bruce Porter (MPP/L)	ALS (MPP/L)
Trip Blank (unopened)	1	-	6.69
Trip Blank (opened)	1	-	17.39
Sieve Control	100	-	2.77
Spike Sample (65 MPP/L)	1	-	270
Yukon River Sample BP1	100	0.13	-
Yukon River Sample BP2	100	0.06	-
Yukon River Sample BP3	100	0.04	-

	Sample Volume (L.)	Bruce Porter (MPP/L)	ALS (MPP/L)
Yukon River Sample ALS1	100	-	7.09
Yukon River Sample ALS2	100	-	16.95
Yukon River Sample ALS3	100	-	36.93
Fresh Snow Sample S1	Melted to 1 litre	1	-
Disturbed Snow Sample S2	Melted to 1 litre	5	-
Fresh Snow Sample S3	Melted to 1 litre	1	-
Disturbed Snow Sample S4	Melted to 1 litre	6	-

Microplastics were found in all samples, by both microscopy methods reported by ALS and by Bruce Porter, including in river water, melted snow and in trip blanks. Results are generally higher from ALS laboratories than with the WRB microscope, indicating that the ability to detect microplastic particle maybe higher using fluorescent tagging. Analytical sensitivity reported by ALS, once converted back to the actual 100 litres sample volume is 0.0134 MPP/L All measurements reported by ALS were above the analytical sensitivity. The use of fluorescent tagging and static image analysis by ALS likely contributes to increased detection power. Photos 3-9 and 3-10 show examples of microplastics particles detected using WRB's dissecting microscope at 10x magnification while Photo 3-11 shows examples of fluorescing particles observed at ALS lab.

Based on ALS results, Yukon River samples contained 7.09 to 36.93 MPP/L (average 20.32 MPP/L), while the unopened trip blank contained 6.69 MPP/L, similar to the Yukon River sample with the lowest count. This indicates that MP particles were either present in the deionized water, in the air in the lab while preparing or analyzing the trip blanks or originated from the sampling bottle. The trip blank that was left open while sampling returned 17.39 MPP/L indicating the potential for atmospheric deposition during the sampling event. The sieve control sample returned a relatively low MP count (2.77 MPP/L) which suggests minimal contamination from the sieves themselves. 270 MPP were detected in the spike sample, compared to 65 MPP that were added (see Table 3-2), further indicating potential contamination in the deionized water, from the air in the lab or from the bottle.

The snow samples analyzed by Bruce Porter returned higher counts of MP in samples collected from disturbed areas versus undisturbed snow, suggesting MP may originate from clothing or equipment more than from atmospheric deposition. However, the small number of samples and of MP in each does not support robust conclusions and should be taken as preliminary observations.

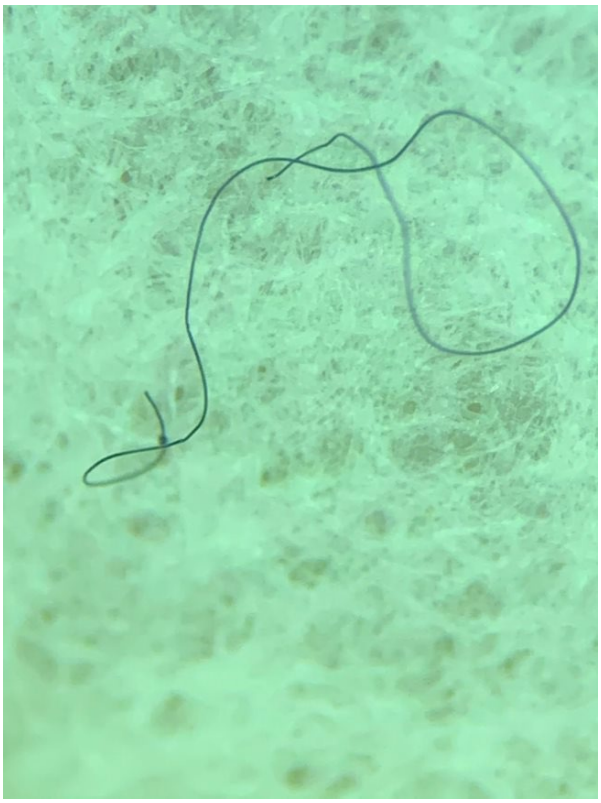


Photo 3-9: Microplastic Filament observed under WRB's Microscope.

Photo 3-10: Microplastic Particle observed under WRB's Microscope.

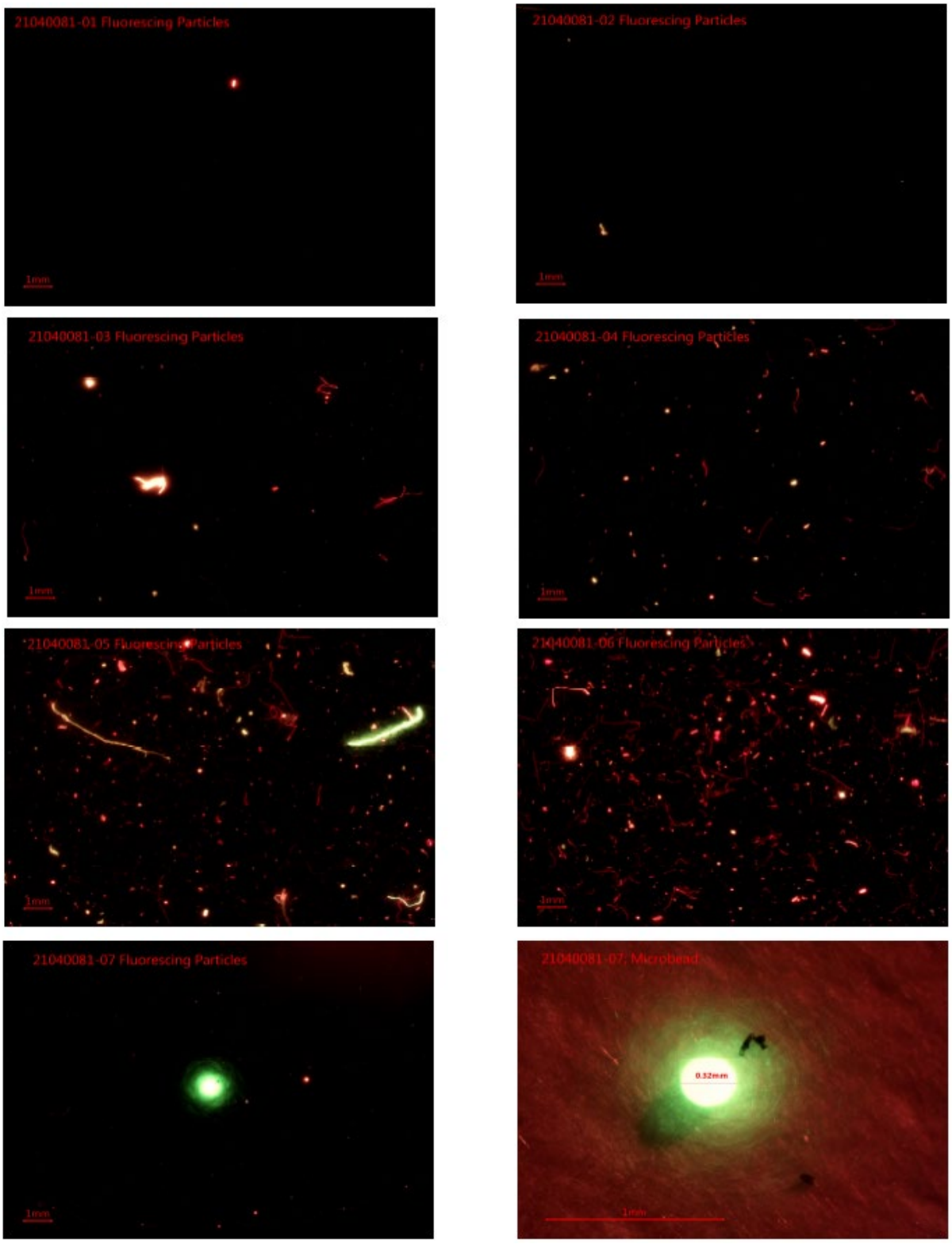


Photo 3-11: Fluorescing Particles Observed at ALS Laboratory

3.2.2.2 Particle Size

Particle size data was reported differently by the different labs. Table 3-5 to Table 3-8 below summarize comparable metrics where possible, while complete results are included in Appendix A.

Table 3-5: Particle Size Data, ALS

	Field Blank Closed	Field Blank Open	Sieve Control	Sieve Sample 1	Sieve Sample 2	Sieve Sample 3	Spike Sample
>6.5<10µm (%)	80.0	23.1	2.4	1.7	0.8	1.2	3.3
>10<100µm (%)	0.0	69.2	85.5	84.0	84.2	89.7	91.8
>100<500µm (%)	20.0	7.7	11.1	13.8	14.4	8.6	3.3
>500µm<1mm (%)	0.0	0.0	1.0	0.6	0.6	0.4	0.0
>1<5mm (%)	0.0	0.0	0.0	0.0	0.0	0.1	1.5

Table 3-6: Particle Size Data, BV – UBC

	Field Blank Closed 2	Field Blank Open 2	Sieve Control 2	Sieve Sample 4	Sieve Sample 5	Sieve Sample 6	Spike Sample 2
<10µm (%)	* Sample is too clean to close background solutions. No report for this sample.	* Sample is too clean to close background solutions. No report for this sample.	9.0	11.2	8.1	0.3	* Sample is too clean to close background solutions. No report for this sample.
>10<100µm (%)			83.0	78.5	82.7	58.8	
>100µm (%)			8.0	10.3	9.2	40.9	
Mean (µm)			64.62	65.38	66.78	89.48	
Median (µm)			64.4	65.78	65.03	89.21	
Minimum (µm)			0.1	0.1	0.1	0.1	
Maximum (µm)			200.98	196.85	200.98	170.2	

Table 3-7: Particle Size Data, Sieve Samples, BV - GR Petrology

	Field Blank Closed 1	Field Blank Open 1	Sieve Control 1	Sieve Sample 1	Sieve Sample 2	Sieve Sample 3	Spike Sample 1
<8µm (%)	98.4	99.4	92.0	83.4	89.4	84.6	99.2
>8<128µm (%)	2.6	0.6	7.4	16.4	10.2	14.8	0.8
>128µm (%)	0.0	0.0	0.6	0.2	0.4	0.6	0.0
Maximum (µm)	32.52	19.52	196.48	182	276.34	204.42	30.29
Quartile 3 (µm)	0.79	0.42	0.85	4.48	2.55	4.42	0.71
Mean (µm)	0.85	0.47	3.05	6.42	4.84	6.6	0.68
Median (µm)	0.36	0.19	0.34	0.61	0.83	1.12	0.25
Quartile 1 (µm)	0.08	0.06	0.09	0.14	0.33	0.37	0.06
Minimum (µm)	0.01	0.07	0.01	0.01	0.01	0.02	0.01
Standard Deviation (µm)	2.22	1.35	13.5	16.37	17.24	18.89	1.86

Table 3-8: Particle Size Data, Filter Samples, BV - GR Petrology

	F1 - Yukon River	F2 - Yukon River	F3 - Yukon River	F4 - Yukon River	F5 - Yukon River	F6 - Blank Filter	F7 - Filter Control
<8µm (%)	89.0	87.6	86.8	75.0	91.8	98.6	93.8
>8<128µm (%)	11.0	12.2	13.2	24.6	8.2	1.4	6.2
>128µm (%)	0.0	0.2	0.0	0.4	0.0	0.0	0.0
Maximum (µm)	66.61	338.01	92.58	274.26	90.53	27.85	62.54
Quartile 3 (µm)	3.72	4.63	4.73	8.01	3.03	0.71	2.11
Mean (µm)	3.14	4.92	4.15	7.86	2.93	0.86	2.11
Median (µm)	1	2.37	2.07	2.61	1.14	0.28	0.71
Quartile 1 (µm)	0.22	1.19	0.73	0.86	0.36	0.13	0.29
Minimum (µm)	0.02	0.06	0.05	0.03	0.02	0.01	0.03
Standard Deviation (µm)	5.74	16.28	7.19	19.69	6.35	2.49	4.5

Particle size distribution from both ALS and UBC indicates that most of the particles are in the 10µm to 100µm range for all samples, except for the closed field blank, which mostly contained smaller particles (6.5µm - 10µm). UBC was not able to qualitatively detect and report particle distribution for the sample spiked with fluorescent microbeads obtained from Dr. Matthew Ross from MacEwan University, Edmonton, Alberta. This result indicates that the UBC lab may not be able to report on microplastic particulate appropriately. GR Petrology did not report particle size distribution for the same size categories, but overall indicate that most particles detected are of a much smaller size (<8µm). Summary statistics indicate a size range of 0.01µm to 338µm with mean values 2.93µm to 7.86µm for Yukon River samples. In comparison, Yukon River samples analysed by UBC had mean sizes of 65µm, 67µm and 89µm. The large difference between reported mean sizes from the two labs could be due to differences in analytical techniques, where the technique used by GR Petrology was able to detect a larger proportion of the smallest size of particles (microplastics) in the samples. Given the sieves mesh size used during sampling in the Yukon River, the expected particle size in the samples should range between 45µm and 500µm. Similarly for filter samples, the expected range is 0.45µm (filter size) to ~200µm (estimated mesh size on pump head). Smaller particles could potentially originate from air deposition; this is supported by the fact that particles found in blanks tend to be smaller. It is also interesting to note that particle sizes observed in the spike samples tend to be much smaller than the beads used to prepare the spikes (125µm to 710µm), indicating the presence of particles from other origins.

3.2.2.3 Elemental Composition

The GR Petrology report (2021) indicates that "XRD analysis only detects elements in crystalline compounds because only crystalline components of the sample diffract X-rays. […] It must be emphasized that each element identified by X-ray diffraction analysis should also be detected by EDS; however, the reverse is not necessarily true." As such, EDS is considered more appropriate for the detection of microplastics, which are typically non crystalline structures.

As shown in Table 3-9 reproduced from the GR Petrology lab report (see Appendix A), all sieve samples are dominated by oxygen, followed by carbon and nitrogen, which is representative of the filter paper used by the lab. Plastic particles are carbon based, and can be connected to hydrogen, oxygen, nitrogen, chlorine, or sulfur (American Chemistry Council, 2021). Most samples did not contain hydrogen or chlorine, while sulphur was present in small amounts. **This indicates that the majority of the particles found are likely not plastic (mineral or paper)**.

Table 3-10 presents elemental composition results for the filter samples. For all samples, carbon and oxygen dominate the elemental spectrograph, some of which represent the filter paper. Again, there is little hydrogen or chlorine, and minimal nitrogen. Sulphur is detected in all samples at higher % weight than in the sieve samples. Non-crystalline carbon and sulphur-bearing compounds could represent plastic particles.

Comments from the lab indicated that analyses were conducted on 2 cm^2 sections of each filter that had some visible particulate, and that most particles were found to be mineral or inorganic material such as quartz and clays, as well as some diatoms. “Coloured material, fibres or other irregular material was not present. […] The EDS data does suggest the presence of trace non-crystalline Carbon, Nitrogen and Oxygen compounds. This C, N, O data is most consistent with contributions from the disc and cassette filters analyzed. The EDS data collected does not suggest the presence of C, N or O containing material that is discernable from the filters used in sample collection.” (BV, pers.comm. 2021). Examples of particles observed by GR Petrology are provided in Photo 3-1. Overall, this method did not appear to be suitable to detect MP.

Table 3-9: Elemental Composition of Sieve Samples, BV - GR Petrology

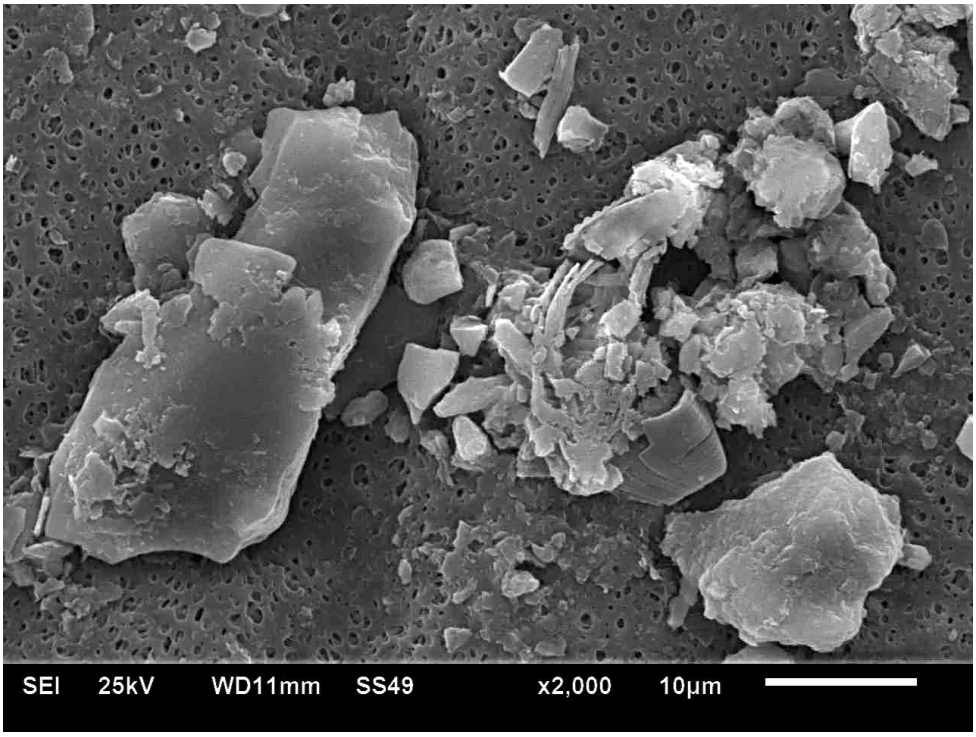
GR Sample #	Sample ID	H	C	N	O	Na	Mg	Al	Si	P	S	Cl	K	Ca	Fe	Ni	Cu
GR-001	ZN6708-Field Blank Closed	-	26.42	8.48	64.85	-	-	0.14	0.02	-	0.03	-	-	-	0.02	-	0.04
		-	-	-	tr	-	-	-	tr	-	-	-	-	-	-	-	-
GR-002	ZN6709-Field Blank Open	-	25.67	15.95	58.08	-	0.02	0.07	0.02	-	0.09	-	-	0.03	-	-	0.05
		-	-	-	tr	-	-	-	tr	-	-	-	-	-	-	-	-
GR-003	ZN6710-Sieve Control 1	-	27.38	8.18	64.17	-	-	0.10	0.02	-	0.10	0.01	-	-	-	-	0.04
		-	-	-	tr	-	-	-	tr	-	-	-	-	-	-	-	-
GR-004	ZN6711-Sieve Sample 1	-	27.79	6.62	64.93	0.06	0.04	0.12	0.22	-	0.10	-	0.01	0.03	0.04	-	0.06
		0.41	-	-	48.92	2.17	0.99	10.79	32.00	-	-	-	2.43	-	2.28	-	-
GR-005	ZN6712-Sieve Sample 2	-	25.82	9.01	64.52	0.07	0.05	0.13	0.28	-	0.06	-	0.01	0.02	0.04	0.04	0.03
		0.53	-	-	49.89	2.16	0.65	12.18	30.39	-	-	-	2.71	-	1.49	-	-
GR-006	ZN6713-Sieve Sample 3	-	28.27	5.70	65.43	0.08	0.06	0.09	0.21	-	0.11	-	0.12	0.03	0.04	-	0.05
		0.47	-	-	50.12	0.67	0.84	10.02	33.32	-	-	-	2.61	-	1.93	-	-
GR-007	ZN6714-Spike Sample 1	-	28.21	6.05	65.55	-	-	0.08	0.02	-	0.03	-	-	0.01	0.01	-	0.03
		-	-	-	tr	-	-	-	tr	-	-	-	-	-	-	-	-

H - Hydrogen	Mg - Magnesium	Cl - Chlorine	Cu - Copper
C - Carbon	Al - Aluminum	K - Potassium	
N - Nitrogen	Si - Silicon	Ca - Calcium	tr - trace
O - Oxygen	P - Phosphorus	Fe - Iron	Black - EDS Analysis
Na - Sodium	S - Sulphur	Ni - Nickel	Red - Calculated from XRD

Table 3-10: Elemental Composition of Filter Samples, BV - GR Petrology

GR Sample #	Sample ID	H	C	N	O	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	Cr	Fe	Ni	Cu
GR-001	ZN6701-F1	-	33.00	11.44	51.72	0.33	0.33	0.76	1.37	0.02	0.91	-	0.03	0.02	-	-	0.01	-	0.05
		0.68	-	-	46.72	1.17	2.18	15.40	26.21	-	-	-	2.64	-	-	-	5.01	-	-
GR-002	ZN6702-F2	-	45.73	-	44.44	0.47	0.34	1.05	1.93	-	5.50	-	0.10	0.10	-	-	0.24	0.03	0.07
		0.71	-	-	45.72	0.49	2.79	15.63	25.99	-	-	-	2.28	-	-	-	6.40	-	-
GR-003	ZN6703-F3	-	50.00	-	40.68	-	0.19	0.64	1.55	0.09	6.46	-	0.08	0.05	-	-	0.22	-	0.04
		0.66	-	-	46.38	1.15	2.32	15.42	26.15	-	-	-	2.60	-	-	-	5.33	-	-
GR-004	ZN6704-F4	-	29.87	-	52.59	0.90	0.70	2.28	6.65	0.10	5.41	0.04	0.31	0.29	0.06	-	0.74	-	0.06
		0.62	-	-	44.01	1.38	3.08	16.28	24.62	-	-	-	2.95	-	-	-	7.07	-	-
GR-005	ZN6705-F5	-	42.36	-	41.23	0.34	0.18	0.68	1.72	0.16	12.80	-	0.09	0.08	-	-	0.28	-	0.08
		tr	-	-	tr	tr	tr	tr	tr	-	-	-	tr	-	-	-	tr	-	-
GR-006	ZN6706-F6	-	50.39	-	33.12	-	-	-	-	-	16.18	0.19	-	-	-	-	-	-	0.12
		NON-CHRYSTALLINE																	
GR-007	ZN6707-F7	-	70.29	-	25.09	-	0.14	2.37	0.08	-	1.55	0.04	-	0.02	-	0.04	0.15	0.10	0.12
		-	-	-	tr	-	-	-	tr	-	-	-	-	-	-	-	-	-	-

H - Hydrogen	Al - Aluminum	Ca - Calcium	Sn - Tin
C - Carbon	Si - Silicon	Ti - Titanium	
N - Nitrogen	P - Phosphorus	Cr - Chromium	
O - Oxygen	S - Sulphur	Fe - Iron	tr - trace
Na - Sodium	Cl - Chlorine	Ni - Nickel	Black - EDS Analysis
Mg - Magnesium	K - Potassium	Cu - Copper	Red - Calculated from XRD



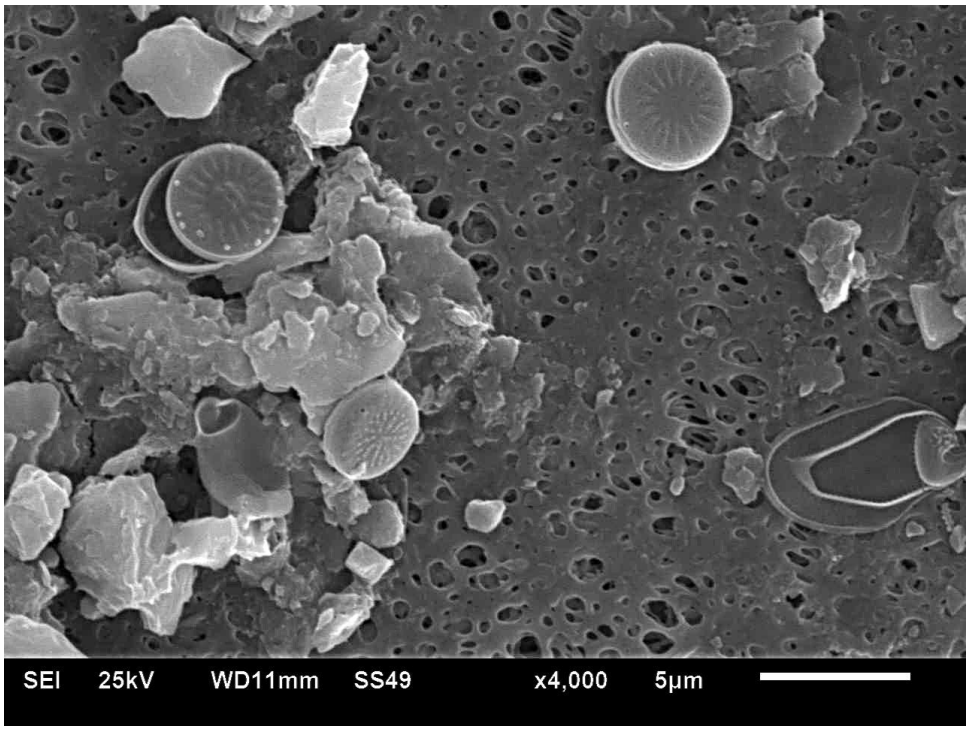


Photo 3-12: Examples of particles observed by GR Petrology, showing crystalline structure and diatoms

4 DISCUSSION

Results show that MP are likely present in the Yukon River downstream of Whitehorse. Since sampling was conducted during winter conditions (under ice), atmospheric deposition is unlikely to be the main source of MP in the Yukon River. However, as indicated by QAQC samples results, it is likely that atmospheric deposition introduced contamination during sampling. Atmospheric deposition could also contribute to MP presence in the Yukon River through summer deposition and spring snow melt.

Both sampling methods tested presented challenges, particularly for winter sampling. Apart from trying to prevent water from freezing in the sieves or filters, one of the biggest challenges is to prevent contamination as MP are omnipresent in the environment. As shown in Table 3-4, MP were found in the blanks and in the control samples, despites numerous precautions to prevent contamination.

Another challenge encountered is the interpretation of laboratory analysis results and differentiating MP from other particles. There is currently no standard analytical method for MP, making comparison of results from different labs difficult. The analytical method used by UBC does not target microplastics specifically and can therefore not provide a MP count or density. Similarly, the particle size distribution and elemental breakdown via XRD and EDS provided by GR Petrology includes all particles in the sample and it can only be inferred whether MP are present or not. Overall, the XRD/EDS methods did not appear to be suitable to detect MP. Microscopy appears to be the most suitable laboratory technique to obtain MP-specific particle count and size distribution. Fluorescent tagging conducted by ALS lab appears to have a higher detection power than the sole use of a 10x dissecting microscope at WRB lab.

5 RECOMMENDATIONS AND CONCLUSION

Given the challenges encountered using the sieve and pump and filter methods, and based on the particle count results obtained from ALS, it is recommended that 1L grab samples be used as the sampling technique in the next phase of the project. Based on recommendations from the literature review, and feasibility of winter sampling, a100L sample volume was chosen for this project, as it was believed that MP concentrations in the natural environment would be too low to detect in smaller sample volumes (1L). The MPP/L counts reported by ALS in river water samples ranged from 7 to 270 (100L) while the sensitivity is reported to be 0.0134 MPP/L in clean samples, indicating it is likely to have enough plastic particulates in 1L to be detected and reported in a smaller sample volumes (1L). Yet, it possible that a 1L sample would not contain any MP, however, a larger number of replicates could compensate for the greater variability in smaller sample volumes. Collecting simple grab samples in a single bottle would reduce the risk of contamination as there is less manipulation involved (through volume reducing techniques sur as sieves or filters) and eliminate the challenges associated with winter sampling conditions where water freezes in the filters of sieves. Microscopy particle count method using fluorescent tagging proposed by ALS seems to be the only quantitative laboratory analysis available commercially at this time that is suitable for detecting MP and is therefore recommended for future sample analyses.

To better understand MP prevalence, sources and fate in the environment, samples should be collected over time, upstream and downstream of communities located on major waterways (Yukon

River), and near potential sources such as storm sewers and water treatment plant discharge. Pristine lakes and rivers away from potential sources, as well as dust fall samples should also be collected to start characterizing baseline and background concentrations of microplastics in watersheds.

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APPENDIX A

LABORATORY CERTIFICATES OF ANALYSIS

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **WR2100270**	Page	: 1 of 3
Client	: **Core Geoscience Services Inc.**	Laboratory	: Whitehorse - Environmental
Contact	: Sruthee Govindaraj	Account Manager	: Heather McKenzie
Address	: 11 Dolly Varden Drive Whitehorse YT Canada Y1A 6A1	Address	: #12 151 Industrial Road Whitehorse YT Canada Y1A 2V3
Telephone	: ----	Telephone	: +1 867 668 6689
Project	: ----	Date Samples Received	: 26-Mar-2021 17:20
PO	: ----	Date Analysis Commenced	: 14-Apr-2021
C-O-C number	: 17-773553	Issue Date	: 14-Apr-2021 16:54
Sampler	: ----		
Site	: ----		
Quote number	: VA21-CGSI100-02		
No. of samples received	: 7		
No. of samples analysed	: 7		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Kaitlyn Gardner	Account Manager Assistant	Internal Subcontracting, Cincinnati, Ohio

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

Unit	*Description*
-	No Unit

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical Results

Sub-Matrix: **Water** (Matrix: **Water**)					Client sample ID	**Field Blank Closed**	**Field Blank Open**	**Sieve Control**	**Sieve Sample 1**	**Sieve Sample 2**
					Client sampling date / time	24-Mar-2021 11:15	24-Mar-2021 11:15	24-Mar-2021 16:58	24-Mar-2021 11:54	24-Mar-2021 12:09
Analyte	*CAS Number*	*Method*	*LOR*	*Unit*		**WR2100270-001**	**WR2100270-002**	**WR2100270-003**	**WR2100270-004**	**WR2100270-005**
						Result	Result	Result	Result	Result
Physical Tests										
microplastic particles	n/a	MicroPlastics	-	-		See attached	See attached	See attached	See attached	See attached

Please refer to the General Comments section for an explanation of any qualifiers detected.

Analytical Results

Sub-Matrix: **Water** (Matrix: **Water**)					Client sample ID	**Sieve Sample 3**	**Spike Sample**	**----**	**----**	**----**
					Client sampling date / time	24-Mar-2021 16:15	24-Mar-2021 10:30	----	----	----
Analyte	*CAS Number*	*Method*	*LOR*	*Unit*		**WR2100270-006**	**WR2100270-007**	**--------**	**--------**	**--------**
						Result	Result	----	----	----
Physical Tests										
microplastic particles	n/a	MicroPlastics	-	-		See attached	See attached	----	----	----

Please refer to the General Comments section for an explanation of any qualifiers detected.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WR2100270**	Page	: 1 of 6
Client	: **Core Geoscience Services Inc.**	Laboratory	: Whitehorse - Environmental
Contact	: Sruthee Govindaraj	Account Manager	: Heather McKenzie
Address	: 11 Dolly Varden Drive Whitehorse YT Canada Y1A 6A1	Address	: #12 151 Industrial Road Whitehorse, Yukon Canada Y1A 2V3
Telephone	: ----	Telephone	: +1 867 668 6689
Project	: ----	Date Samples Received	: 26-Mar-2021 17:20
PO	: ----	Issue Date	: 14-Apr-2021 16:54
C-O-C number	: 17-773553		
Sampler	: ----		
Site	: ----		
Quote number	: VA21-CGSI100-02		
No. of samples received	: 7		
No. of samples analysed	: 7		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 15:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 15:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Physical Tests : Microplastic Particles by Microscopy										
HDPE										
Field Blank Closed	MicroPlastics	24-Mar-2021	----	----	----		14-Apr-2021	----	----	
Physical Tests : Microplastic Particles by Microscopy										
HDPE										
Field Blank Open	MicroPlastics	24-Mar-2021	----	----	----		14-Apr-2021	----	----	
Physical Tests : Microplastic Particles by Microscopy										
HDPE										
Sieve Control	MicroPlastics	24-Mar-2021	----	----	----		14-Apr-2021	----	----	
Physical Tests : Microplastic Particles by Microscopy										
HDPE										
Sieve Sample 1	MicroPlastics	24-Mar-2021	----	----	----		14-Apr-2021	----	----	
Physical Tests : Microplastic Particles by Microscopy										
HDPE										
Sieve Sample 2	MicroPlastics	24-Mar-2021	----	----	----		14-Apr-2021	----	----	
Physical Tests : Microplastic Particles by Microscopy										
HDPE										
Sieve Sample 3	MicroPlastics	24-Mar-2021	----	----	----		14-Apr-2021	----	----	
Physical Tests : Microplastic Particles by Microscopy										
HDPE										
Spike Sample	MicroPlastics	24-Mar-2021	----	----	----		14-Apr-2021	----	----	

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

- **No Quality Control data available for this section.**

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by “mod”).

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Microplastic Particles by Microscopy	MicroPlastics Cincinnati - Environmental - 4388 Glendale-Milford Road Cincinnati Ohio United States 45242	Water	See attached.	See attached report.

QUALITY CONTROL REPORT

Work Order	: **WR2100270**	Page	: 1 of 2
Client	: Core Geoscience Services Inc.	Laboratory	: Whitehorse - Environmental
Contact	: Sruthee Govindaraj	Account Manager	: Heather McKenzie
Address	: 11 Dolly Varden Drive Whitehorse YT Canada Y1A 6A1	Address	: #12 151 Industrial Road Whitehorse, Yukon Canada Y1A 2V3
Telephone	: ----	Telephone	: +1 867 668 6689
Project	: ----	Date Samples Received	: 26-Mar-2021 17:20
PO	: ----	Date Analysis Commenced	: 14-Apr-2021
C-O-C number	: 17-773553	Issue Date	: 14-Apr-2021 16:54
Sampler	: ----		
Site	: ----		
Quote number	: VA21-CGSI100-02		
No. of samples received	: 7		
No. of samples analysed	: 7		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits
- Reference Material (RM) Report; Recovery and Acceptance Limits
- Method Blank (MB) Report; Recovery and Acceptance Limits
- Laboratory Control Sample (LCS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Kaitlyn Gardner	Account Manager Assistant	Internal Subcontracting, Cincinnati, Ohio

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Services number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percentage Difference
# = Indicates a QC result that did not meet the ALS DQO.

Contact: Heather McKenzie
Company: ALS Whitehorse
Address: 12-151 Industrial Rd,
Whitehorse, YT, Y1A2V3

Project / Location: WR2100270
PO Number: WR2100270
ALS Work Order: 21040081

NARRATIVE: This method was based on the study, "Synthetic Polymer Contamination in Bottled Water" conducted at the State University of New York at Fredonia which found an average of 325 MPP/L in bottled water brands from around the globe. The efficacy of this method for the detection of MPP in non-potable waters or other matrices has not been determined. Samples were analyzed according to ALS SOP Micro-Fluor-001 for the detection of micro plastic particles (MPP) using fluorescent tagging and static image analysis. This method has been shown to be sufficient for the rapid detection of polymerics including polyethylene, polypropylene, polystyrene and nylon 6 though it cannot differentiate between them.

Particle sizing is performed using static image analysis of representative calibrated two dimensional photomicrographs. The minimum caliper is the shortest distance between any 2 points along a single particle boundary and represents the approximate width/diameter of the particle/fiber. The maximum caliper is the longest distance between any 2 points along a single particle boundary and represents the length of the particle/fiber. The smallest single particle dimension confidently resolved by this method at the lowest available magnification has been determined to be approximately 6.5µm. Additionally, particles whose largest single dimension is greater than 5mm fall outside the generally accepted definition of MPP. Therefore, the total MPP concentration reported includes only fluorescing particles >6.5µm<5mm.

The dimension of interest (DOI) is selected based on observation of dominant particle morphology and determines the particle dimensions reported herein. Samples observed to contain primarily fibrous MPP exhibiting a length to width aspect ratio of 3:1 or greater are categorized according to maximum caliper (length). Samples observed to contain primarily non-fibrous MPP are categorized according to minimum caliper (diameter or width). Samples observed to contain an approximately equal mixture of both fibrous and non-fibrous MPP are categorized according to total area in square µm or mm.

The analytical sensitivity (AS) for this method is based on the detection of one particle in the total area analyzed. When possible sufficient sample is analyzed to yield an AS<10 MPP/L. However, the volume of sample that can be analyzed is dependent upon clarity. Therefore, samples containing significant concentrations of interferences may not attain the desired AS. Interferences such as opaque suspended solids may result in a negative bias and lipid-rich interferences such as fats, waxes, and oils may result in a positive bias.

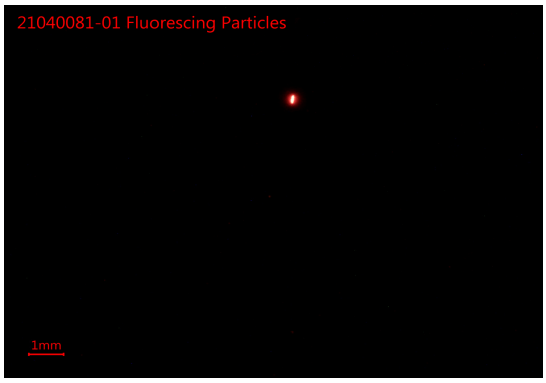
All sample collection is performed outside ALS and is the sole responsibility of the client. Filtered samples are archived for 60 days prior to disposal. Results apply only to portions analyzed. Microscopy is not suitable for the examination of all types of materials. Additional testing may be required.

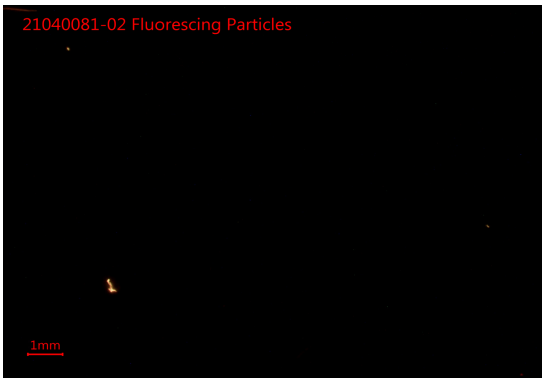
IDENTIFICATION					
	WR2100270-001	WR2100270-002	WR2100270-003	WR2100270-004	WR2100270-005
Client Sample ID:					
ALS Sample ID:	21040081-01	21040081-02	21040081-03	21040081-04	21040081-05
Collection Date:	3/24/2021	3/24/2021	3/24/2021	3/24/2021	3/24/2021
Collection Time:	14:15	14:15	19:58	14:54	15:09
ANALYSIS					
Analyst:	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar	Pamela Hizar
Date:	4/7/2021	4/7/2021	4/7/2021	4/7/2021	4/7/2021
Filtered Volume (mL):	1000	1000	15	10	55
AS (MPP/L):	1.34	1.34	89.18	133.77	24.32
DOI:	DIAMETER	DIAMETER	DIAMETER	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)					
>6.5≤10µm:	5.35	4.01	446	1,204	243
>10≤100µm:	0.00	12.04	15,785	59,527	25,951
>100≤500µm:	1.34	1.34	2,051	9,765	4,451
>500µm≤1mm:	0.00	0.00	178	401	170
>1≤5mm:	0.00	0.00	0.00	0.00	0.00
TOTAL:	**6.69**	**17.39**	**18,460**	**70,897**	**30,815**

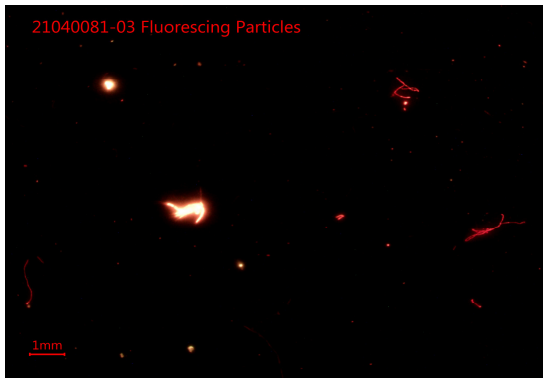
IDENTIFICATION		
	WR2100270-006	WR2100270-007
Client Sample ID:		
ALS Sample ID:	21040081-06	21040081-07
Collection Date:	3/24/2021	3/24/2021
Collection Time:	19:15	13:30
ANALYSIS		
Analyst:	Pamela Hizar	Pamela Hizar
Date:	4/7/2021	4/7/2021
Filtered Volume (mL):	75	1000
AS (MPP/L):	17.84	1.34
DOI:	DIAMETER	DIAMETER
CONCENTRATION (MPP/L)		
>6.5≤10µm:	589	9
>10≤100µm:	44,161	247
>100≤500µm:	4,245	9
>500µm≤1mm:	214	0
>1≤5mm:	36	4
TOTAL:	**49,245**	**270**

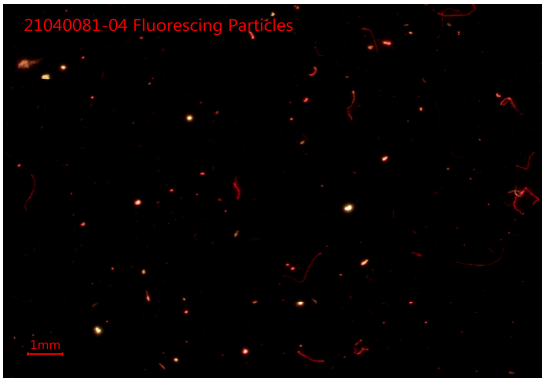
PHOTOMICROGRAPHS

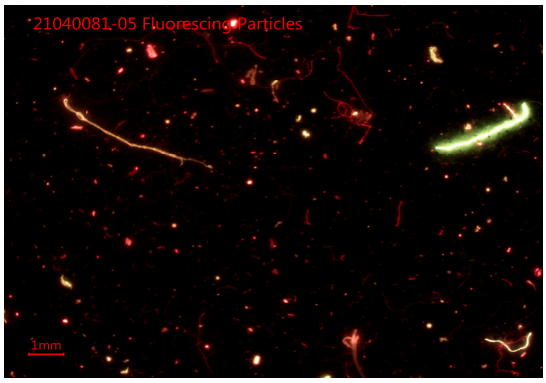
Collected using OMAX Toupeview Calibrated Digital Imaging System

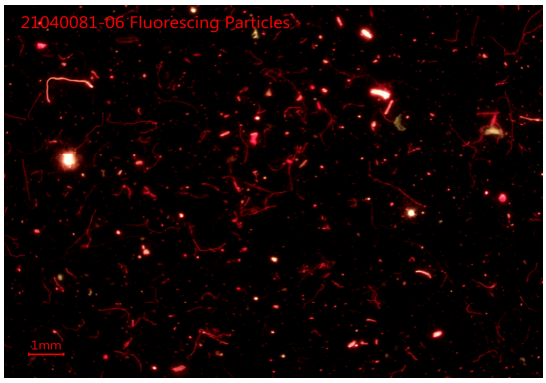


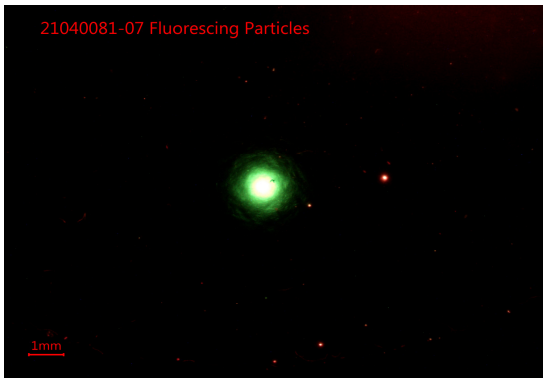


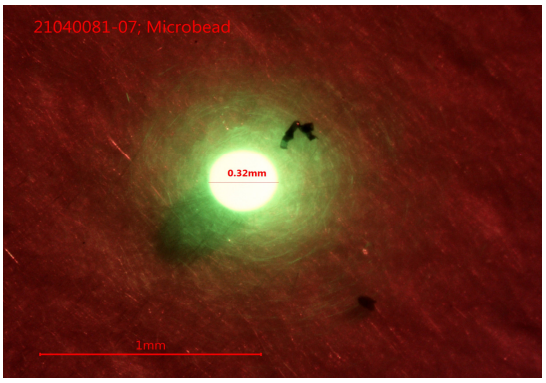












ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 17 - 773553

Page 1 of 1

Environmental Division Whitehorse

Work Order Reference WR2100270

Telephone : +1 867 668 6689

Report To	Contact and company name below will appear on the final report
Company:	Core Geoscience Services
Contact:	Sruthee Govindaraj
Phone:	867 633 4041
Company address below will appear on the final report	
Street:	11 Dally Varden Dr.
City/Province:	Whitehorse YT
Postal Code:	Y1A 6A1
Invoice To	Same as Report To [X] YES [ ] NO
	Copy of Invoice with Report [X] YES [ ] NO
Company:	
Contact:	

Report Format / Distribution	
Select Report Format:	[X] PDF [X] EXCEL [ ] EDD (DIGITAL)
Quality Control (QC) Report with Report	[X] YES [ ] NO
[ ] Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	[X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	sruthee@coregeo.ca
Email 2	catherine@coregeo.ca
Email 3	

Invoice Distribution	
Select Invoice Distribution:	[X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	admin@coregeo.ca
Email 2	

Select Service Level Below - Contact your

Regular [R] [X] Standard TAT if received

PRIORITY (Business Days): 4 day [P4-20%] [ ] | 3 day [P3-25%] [ ] | 2 day [P2-50%] [ ]

EMERGENCY: 1 Busi | Same D (Labor

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level s

Anal

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	VA21-CGS1100-02	AFE/Cost Center:	PO#
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact:	Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS: Microplastics	Indicate Filtered (F), Preserved (P) or	SAMPLES ON H	SUSPECTED HAZARD (see Special Instructions)
	Field Blank Closed	24-Mar-21	11:15	water	1	X		
	Field Blank Open	24-Mar-21	11:15	water	1	X		
	Sieve Control	24-Mar-21	16:58	water	1	X		
	Sieve Sample 1	24-Mar-21	11:54	water	1	X		
	Sieve Sample 2	24-Mar-21	12:09	water	1	X		
	Sieve Sample 3	24-Mar-21	16:15	water	1	X		
	Spike Sample	25-Mar-21	10:30	water	1	X		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

[ ] YES [X] NO

Are samples for human consumption/ use?

[ ] YES [X] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] SIF Observations Yes [ ] No [ ]

Ice Packs [ ] Ice Cubes [ ] Custody seal intact Yes [ ] No [ ]

Cooling Initiated [ ]

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
13							

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
Catherine Hunt	26-Mar-21	15:45		26 MAR	4:20			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2018 FRONT

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

Affix ALS barcode label here (lab use only)

COC Number: 17 - 773553

Page 1 of 1

Environmental Division Whitehorse

Work Order Reference WR2100270

Telephone : +1 867 668 6689

Report To	Contact and company name below will appear on the final report
Company:	Core Geoscience Services
Contact:	Sruthee Govindaraj
Phone:	867 633 4041
	Company address below will appear on the final report
Street:	11 Dalty Varden Dr -
City/Province:	Whitehorse YT
Postal Code:	Y1A 6A1

Report Format / Distribution	
Select Report Format:	[X] PDF [X] EXCEL [ ] EDD (DIGITAL)
Quality Control (QC) Report with Report	[X] YES [ ] NO
[ ] Compare Results to Criteria on Report - provide details below if box checked	
Select Distribution:	[X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	Sruthee@coregeo.ca
Email 2	Catherine@coregeo.ca
Email 3	

Select Service Level Below - Contact your

Regular [R] [X] Standard TAT if received b

PRIORITY (Business Days): 4 day [P4-20%] [ ] | 3 day [P3-25%] [ ] | 2 day [P2-50%] [ ]

EMERGENCY: 1 Busi [ ] | Same D (Labor [ ]

Date and Time Required for all E&P TATs:

For tests that can not be performed according to the service level s

Anal

Invoice To		
	Same as Report To	[X] YES [ ] NO
	Copy of Invoice with Report	[X] YES [ ] NO
Company:		
Contact:		

Invoice Distribution	
Select Invoice Distribution:	[X] EMAIL [ ] MAIL [ ] FAX
Email 1 or Fax	admin@coregeo.ca
Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	VA21-GGS1100-02	AFE/Cost Center:	PO#:
Job #:		Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	

ALS Lab Work Order # (lab use only):

ALS Contact:

Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Microplastics	SAMPLES ON H	SUSPECTED HAZARD (see Special Instructions)
	Field Blank Closed	24-Mar-21	11:15	water	1	X		
	Field Blank Open	24-Mar-21	11:15	water	1	X		
	Sieve Control	24-Mar-21	16:58	water	1	X		
	Sieve Sample 1	24-Mar-21	11:54	water	1	X		
	Sieve sample 2	24-Mar-21	12:09	water	1	X		
	Sieve sample 3	24-Mar-21	16:15	water	1	X		
	Spike sample	25-Mar-21	10:30	water	1	X		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System?

[ ] YES [X] NO

Are samples for human consumption/ use?

[ ] YES [X] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] SIF Observations Yes [ ] No [ ]

Ice Packs [ ] Ice Cubes [ ] Custody seal intact Yes [ ] No [ ]

Cooling Initiated [ ]

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
13				2			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
Catherine Hynes	26-Mar-21	15:45		MAR 26	1420	ice pack JC	MAR 31 2021	1230

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2020 FRONT

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Your Project #: MP - QA/QC
Site Location: CITY OF WHITEHORSE

Attention: Ethan Allen

Core Geoscience Services (Coregeo)
11 Dolly Varden Drive
Whitehorse, YT
CANADA Y1A6A1

Your C.O.C. #: 632793-01-01, 632793-02-01, 632793-03-01

Report Date: 2021/05/13
Report #: R3020087
Version: 2 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C119656
Received: 2021/03/26, 16:00

Sample Matrix: Water
Samples Received: 22

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Particle Size Distribution (1)	7	N/A	2021/04/27		
Particle Size Distribution (1)	8	N/A	2021/05/12		
Particle Size Distribution Subcontract (2)	7	N/A	2021/04/28		

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Sub Vancouver to GR Petrology
(2) This test was performed by Sub Vancouver to U of BC

Your Project #: MP - QA/QC
Site Location: CITY OF WHITEHORSE

Attention: Ethan Allen

Core Geoscience Services (Coregeo)
11 Dolly Varden Drive
Whitehorse, YT
CANADA Y1A6A1

Your C.O.C. #: 632793-01-01, 632793-02-01, 632793-03-01

Report Date: 2021/05/13
Report #: R3020087
Version: 2 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C119656
Received: 2021/03/26, 16:00

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Customer Solutions, Western Canada Customer Experience Team
Email: customersolutionswest@bureauveritas.com
Phone# (604) 734 7276

==========

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C119656
Report Date: 2021/05/13

Core Geoscience Services (Coregeo)
Client Project #: MP - QA/QC
Site Location: CITY OF WHITEHORSE

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		ZN6701	ZN6702	ZN6703	ZN6704	ZN6705	ZN6706	
Sampling Date		2021/03/24 11:50	2021/03/24 12:27	2021/03/24 13:01	2021/03/24 13:30	2021/03/24 14:02	2021/03/24 15:43	
COC Number		632793-01-01	632793-01-01	632793-01-01	632793-01-01	632793-01-01	632793-01-01	
	UNITS	F1	F2	F3	F4	F5	F6	QC Batch
Parameter								
Subcontract Parameter	N/A	ATTACHED	ATTACHED	ATTACHED	ATTACHED	ATTACHED	ATTACHED	A223989

BV Labs ID		ZN6707		ZN6708	ZN6709	ZN6710	
Sampling Date		2021/03/25 10:50		2021/03/24 11:15	2021/03/24 11:15	2021/03/24 16:57	
COC Number		632793-01-01		632793-01-01	632793-01-01	632793-01-01	
	UNITS	F7	QC Batch	FIELD BLANK CLOSED	FIELD BLANK OPEN	SIEVE CONTROL 1	QC Batch
Parameter							
Subcontract Parameter	N/A	ATTACHED	A223989	ATTACHED	ATTACHED	ATTACHED	A210234

BV Labs ID		ZN6711	ZN6712	ZN6713	ZN6714	
Sampling Date		2021/03/24 11:57	2021/03/24 12:08	2021/03/24 12:41	2021/03/25 10:28	
COC Number		632793-02-01	632793-02-01	632793-02-01	632793-02-01	
	UNITS	SIEVE SAMPLE 1	SIEVE SAMPLE 2	SIEVE SAMPLE 3	SPIKE SAMPLE 1	QC Batch
Parameter						
Subcontract Parameter	N/A	ATTACHED	ATTACHED	ATTACHED	ATTACHED	A210234

BV Labs ID		ZN6715	ZN6716	ZN6717	ZN6718	ZN6719	
Sampling Date		2021/03/24 11:15	2021/03/24 11:15	2021/03/24 12:41	2021/03/24 12:53	2021/03/24 16:23	
COC Number		632793-02-01	632793-02-01	632793-02-01	632793-02-01	632793-02-01	
	UNITS	FIELD BLANK CLOSED 2	FIELD BLANK OPEN 2	SIEVE SAMPEL 4	SIEVE SAMPLE 5	SIEVE SAMPLE 6	QC Batch
Parameter							
Subcontract Parameter	N/A	ATTACHED	ATTACHED	ATTACHED	ATTACHED	ATTACHED	A210877

BV Labs ID		ZN6720	ZN6721		ZR0439	
Sampling Date		2021/03/24 16:59	2021/03/25 10:25		2021/03/25 10:25	
COC Number		632793-02-01	632793-03-01		632793-03-01	
	UNITS	SIEVE CONTROL 2	SPIKE SAMPLE 2	QC Batch	F8	QC Batch
Parameter						
Subcontract Parameter	N/A	ATTACHED	ATTACHED	A210877	ATTACHED	A223989

GENERAL COMMENTS

Sample ZN6701 [F1] : Please see attachment for Particle Size Distribution results.

Sample ZN6702 [F2] : Please see attachment for Particle Size Distribution results.

Sample ZN6703 [F3] : Please see attachment for Particle Size Distribution results.

Sample ZN6704 [F4] : Please see attachment for Particle Size Distribution results.

Sample ZN6705 [F5] : Please see attachment for Particle Size Distribution results.

Sample ZN6706 [F6] : Please see attachment for Particle Size Distribution results.

Sample ZN6707 [F7] : Please see attachment for Particle Size Distribution results.

Sample ZN6708 [FIELD BLANK CLOSED] : Please see attachment for Particle Size Distribution results.

Sample ZN6709 [FIELD BLANK OPEN] : Please see attachment for Particle Size Distribution results.

Sample ZN6710 [SIEVE CONTROL 1] : Please see attachment for Particle Size Distribution results.

Sample ZN6711 [SIEVE SAMPLE 1] : Please see attachment for Particle Size Distribution results.

Sample ZN6712 [SIEVE SAMPLE 2] : Please see attachment for Particle Size Distribution results.

Sample ZN6713 [SIEVE SAMPLE 3] : Please see attachment for Particle Size Distribution results.

Sample ZN6714 [SPIKE SAMPLE 1] : Please see attachment for Particle Size Distribution results.

Sample ZR0439 [F8] : Please see attachment for Particle Size Distribution results.

Results relate only to the items tested.

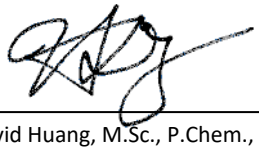
Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

BV Labs Job #: C119656
Report Date: 2021/05/13

Core Geoscience Services (Coregeo)
Client Project #: MP - QA/QC
Site Location: CITY OF WHITEHORSE

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



David Huang, M.Sc., P.Chem., QP, Scientific Services Manager

Jennifer Villocero, Project Solutions Representative

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Bureau Veritas Laboratories
4000 19st N.E, Calgary, Alberta Canada T2E 6P8 Tel:(403) 291-3077 Toll-free:800-563-6266 Fax:(403) 291-9468 www.bvlabs.com

C119656_COC

Bottle Order #: 632793

INVOICE TO:		Report Information		Project Information		Chain Of Custody Record	Project Manager
Company Name	#12319 Core Geoscience Services (Coregeo)	Company Name	CoreGeo	Quotation #	C01254	C#632793-01-01	Customer Solutions
Contact Name	Sruthee Govindaraj	Contact Name		P.O. #			
Address	11 Dolly Varden Drive Whitehorse YT Y1A6A1	Address		Project #	MP - QA/QC		
Phone	(867) 633-4011 Fax:	Phone	Fax:	Project Name			
Email	sruthee@coregeo.ca	Email		Site #			
				Sampled By			

Regulatory Criteria

Special Instructions

Note: For regulated drinking water samples - please use the Drinking Water Chain of Custody Form

Samples must be kept cool (< 10°C) from time of sampling until delivery to BV Labs

Turnaround Time (TAT) Required

Please provide advance notice for rush projects

Regular (Standard) TAT ☑
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: Time Required:
Rush Confirmation Number: (call lab for #)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Regulated Drinking Water ? (Y/N)	Metals Field Filtered ? (Y/N)	Microplastics - Filtration, XRD/EDS/Microscopy/PSD	Particle Size Distribution Subcontract	# of Bottles	Comments
1		F1	24-Mar-21	11:50	filter			X			
2		F2	24-Mar-21	12:27	filter			X			
3		F3	24-Mar-21	13:01	filter			X			
4		F4	24-Mar-21	13:30	filter			X			
5		F5	24-Mar-21	14:02	filter			X			
6		F6	24-Mar-21	15:43	filter			X			
7		F7	25-Mar-21	10:50	filter			X			
8		Field Blank Closed	24-Mar-21	11:15	water			X			
9		Field Blank Open	24-Mar-21	11:15	water			X			
10		Sieve Control 1	24-Mar-21	16:57	water			X			

RECEIVED IN WHITEHORSE
BY: MDuncan @ 1600
2021-03-26
TEMP: 16 / 18 / 16
client 18 18 18
added cooling media
just prior to arrival

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Lab Use Only: Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
Catherine Henry	26-Mar-21	15:45	PEDRO TAOE	2021/03/27	14:47		☐	4, 3, 3	☒ Yes ☐ No
Catherine Henry								3, 2, 4	

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.
* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: BV Labs Yellow: Client

Bureau Veritas Laboratories
4000 19st N.E, Calgary, Alberta Canada T2E 6P8 Tel: (403) 291-3077 Toll-free 800-563-6266 Fax (403) 291-9468 www.bvlabs.com

C119656_COC

Bottle Order #: 632793

INVOICE TO:		Report Information		Project Information	
Company Name	#12319 Core Geoscience Services (Coregeo)	Company Name	Core Geo	Quotation #	C01254
Contact Name	Sruthee Govindaraj	Contact Name		P.O. #	
Address	11 Dolly Varden Drive Whitehorse YT Y1A6A1	Address		Project #	MP - QA/QC
Phone	(867) 633-4011 Fax:	Phone	Fax:	Project Name	
Email	sruthee@coregeo.ca	Email		Site #	
				Sampled By	

Chain Of Custody Record: C#632793-02-01

Project Manager: Customer Solutions

Regulatory Criteria

Special Instructions

Note: For regulated drinking water samples - please use the Drinking Water Chain of Custody Form

Samples must be kept cool (< 10°C) from time of sampling until delivery to BV Labs

Turnaround Time (TAT) Required

Please provide advance notice for rush projects

Regular (Standard) TAT
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: Time Required:
Rush Confirmation Number: (call lab for #)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Regulated Drinking Water ? (Y/N)	Metals Field Filtered ? (Y/N)	Microplastics - Filtration, XRD/EDS/Microscopy/PSD	Particle Size Distribution Subcontract	# of Bottles	Comments
1		Sieve Sample 1	24-Mar-21	11:57	water			X			
2		Sieve sample 2	24-Mar-21	12:08	water			X			
3		Sieve Sample 3	24-Mar-21	12:41	water			X			
4		Spike Sample 1	25-Mar-21	10:28	water			X			
5		Field Blank Closed 2	24-Mar-21	11:15	water				X		
6		Field Blank Open 2	24-Mar-21	11:15	water				X		
7		Sieve Sample 4	24-Mar-21	12:41	water				X		
8		Sieve sample 5	24-Mar-21	12:53	water				X		
9		Sieve sample 6	24-Mar-21	16:23	water				X		
10		Sieve Control 2	24-Mar-21	16:59	water				X		

RECEIVED IN WHITEHORSE
BY: YMDumCon @1600
2021-03-26
TEMP: 16 / 18 / 16
client 18 18 18
added cooling media just prior to arrival

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Lab Use Only: Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
Catherine Henry Catherine Henry	26-Mar-21	15:45	LUPEORO TAOC	2021/03/29	14:47			4,3,3 3,2,4	Yes / No

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.
* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: BV Labs Yellow: Client

Bureau Veritas Canada (2019) Inc.

Bureau Veritas Laboratories
4000 19st N.E, Calgary, Alberta Canada T2E 6P8 Tel:(403) 291-3077 Toll-free:800-563-6266 Fax:(403) 291-9468 www.bvlabs.com

C119656_COC

Lab Only — Bottle Order #: 632793

INVOICE TO:		Report Information		Project Information	
Company Name	#12319 Core Geoscience Services (Coregeo)	Company Name	Core Geo	Quotation #	C01254
Contact Name	Sruthee Govindaraj	Contact Name		P.O. #	
Address	11 Dolly Varden Drive Whitehorse YT Y1A6A1	Address		Project #	MP - QA/QC
Phone	(867) 633-4011 Fax:	Phone	Fax:	Project Name	
Email	sruthee@coregeo.ca	Email		Site #	
				Sampled By	

Chain Of Custody Record: C#632793-03-01

Project Manager: Customer Solutions

Regulatory Criteria

Special Instructions

Note: For regulated drinking water samples - please use the Drinking Water Chain of Custody Form

Samples must be kept cool (< 10°C) from time of sampling until delivery to BV Labs

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Regulated Drinking Water ? (Y/N)	Metals Field Filtered ? (Y/N)	Microplastics - Filtration, XRD/EDS/Microscopy/PSD	Particle Size Distribution Subcontract	# of Bottles	Comments
1		Spike sample 2	25-Mar-21	10:25	water				X		
2											
3											
4											
5											
6											
7											
8											
9											
10											

Turnaround Time (TAT) Required

Please provide advance notice for rush projects

Regular (Standard) TAT ☑

(will be applied if Rush TAT is not specified)

Standard TAT = 5-7 Working days for most tests.

Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission) ☐

Date Required: Time Required:

Rush Confirmation Number: (call lab for #)

RECEIVED IN WHITEHORSE
BY: MDuncan @ 1600
2021-03-26
TEMP: 16 / 18 / 16
client 18 19 18
added cooling media
just prior to arrival

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Catherine Henry Catherine Henry	26-Mar-21	15:45	PEDRO TACE	2021/03/27	14:47	

Lab Use Only: Time Sensitive ☐ | Temperature (°C) on Receipt: 4,3,3 / 3,2,4 | Custody Seal Intact on Cooler? ☒ Yes ☐ No

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: BV Labs Yellow: Client

Bureau Veritas Laboratories
4000 19st N.E. Calgary, Alberta Canada T2E 6P8 Tel: (403) 291-3077 Toll-free 800-563-6266 Fax (403) 291-9468 www.bvlabs.com

Page of

C119656_COC

Only

Bottle Order #: 632793

Project Manager

Customer Solutions

C#632793-02-01

INVOICE TO:		Report Information		Project Information	
Company Name	#12319 Core Geoscience Services (Coregeo)	Company Name	Core Geoscience Services.	Quotation #	C01254
Contact Name	Sruthee Govindaraj	Contact Name	Sruthee Govindaraj	P.O. #	
Address	11 Dolly Varden Drive Whitehorse YT Y1A6A1	Address	11 Dolly Varden Dr. Whitehorse YT Y1A 6A1	Project #	MP - QA/QC
Phone	(867) 633-4011 Fax:	Phone	867 332 8261 Fax:	Project Name	
Email	sruthee@coregeo.ca	Email	Sruthee@coregeo.ca.	Site #	
				Sampled By	

Regulatory Criteria

Special Instructions

Note: For regulated drinking water samples - please use the Drinking Water Chain of Custody Form

Samples must be kept cool (< 10°C) from time of sampling until delivery to BV Labs

Analysis Requested

Turnaround Time (TAT) Required

Please provide advance notice for rush projects

Regular (Standard) TAT ✓
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: Time Required:
Rush Confirmation Number: (call lab for #)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Regulated Drinking Water ? (Y/N)	Metals Field Filtered ? (Y/N)	Microplastics - Filtration, XRD/EDS/Microscopy/PSD	Particle Size Distribution Subcontract	# of Bottles	Comments
1		F8	Apr21/21	1145		N	N		✓		
2											
3											
4											
5											
6											
7											
8											
9											
10											

RECEIVED IN WHITEHORSE
BY: mDuncan @ 1400
2021-04-22
TEMP:

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted	Lab Use Only: Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
Sruthee Govindaraj	2021/04/22	1400	[illegible] TACE	2021/04/23	10:50		☐	14,15,14	☒ Yes ☐ No

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

White: BV Labs Yellow: Client

ICE = NOT PRESENT

Bureau Veritas Canada (2019) Inc.

BUREAU VERITAS 1828

Sent To: **GR Petrology Consultants Inc.**
1323 44 Auenue NE
Calgary, AB, T2E 6L5
Tel: (403) 291-3420

CHAIN OF CUSTODY RECORD FOR SUBCONTRACTED WORK

33445

COC # C119656-VGRP-01-01

REPORT INFORMATION

Company:	Bureau Veritas Laboratories
Address:	4606 Canada Way, Burnaby, British Columbia, V5G 1K5
Contact Name:	Customer Solutions
Email:	customersolutionswest@bureauveritas.com, customerservice@bvlabs.com
Phone:	
BV Labs Project #:	C119656

ANALYSIS REQUESTED

#	SAMPLE ID	MATRIX	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	SAMPLER INITIALS	# CONT.	Microplastics - Filtration, XRD/EDS/Microscopy/PSD									ADDITIONAL SAMPLE INFORMATION
1	ZN6701-F1	WATER	2021/03/24	11:50		1	X									(P: 01)
2	ZN6702-F2	WATER	2021/03/24	12:27		1	X									(P: 01)
3	ZN6703-F3	WATER	2021/03/24	13:01		1	X									(P: 01)
4	ZN6704-F4	WATER	2021/03/24	13:30		1	X									(P: 01)
5	ZN6705-F5	WATER	2021/03/24	14:02		1	X									(P: 01)
6	ZN6706-F6	WATER	2021/03/24	15:43		1	X									(P: 01)
7	ZN6707-F7	WATER	2021/03/25	10:50		1	X									(P: 01)
8	ZN6708-FIELD BLANK CLOSED	WATER	2021/03/24	11:15		1	X									(P: 01)
9	ZN6709-FIELD BLANK OPEN	WATER	2021/03/24	11:15		1	X									(P: 01)
10	ZN6710-SIEVE CONTROL 1	WATER	2021/03/24	16:57		1	X									(P: 01)

REGULATORY CRITERIA

SPECIAL INSTRUCTIONS

Please inform BV Labs immediately if you are not accredited for the requested test(s).
Please return a copy of this form with the report.
Full-scale analysis (EDS, XRD, Microscopy) + particle size

TURNAROUND TIME

☐ Rush Required

2021/04/26

Date Required

Please inform us if rush charges will be incurred.

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

RELINQUISHED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
1.Kevin Chong	2021/04/23	15:00	1. MA. MELBA HABLADO	2021/04/26	8:57
2.			2.		

BUREAU VERITAS

Sent To: GR Petrology Consultants Inc.
1323 44 Auenue NE
Calgary, AB, T2E 6L5
Tel: (403) 291-3420

CHAIN OF CUSTODY RECORD FOR SUBCONTRACTED WORK

33445

COC # C119656-VGRP-02-01

REPORT INFORMATION	
Company:	Bureau Veritas Laboratories
Address:	4606 Canada Way, Burnaby, British Columbia, V5G 1K5
Contact Name:	Customer Solutions
Email:	customersolutionswest@bureauveritas.com, customerservice@bvlabs.com
Phone:	
BV Labs Project #:	C119656

ANALYSIS REQUESTED

#	SAMPLE ID	MATRIX	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	SAMPLER INITIALS	# CONT.	Microplastics - Filtration, XRD/EDS/Microscopy/PSD										ADDITIONAL SAMPLE INFORMATION
1	ZN6711-SIEVE SAMPLE 1	WATER	2021/03/24	11:57		1	X										(P: 01)
2	ZN6712-SIEVE SAMPLE 2	WATER	2021/03/24	12:08		1	X										(P: 01)
3	ZN6713-SIEVE SAMPLE 3	WATER	2021/03/24	12:41		1	X										(P: 01)
4	ZN6714-SPIKE SAMPLE 1	WATER	2021/03/25	10:28		1	X										(P: 01)
5	ZR0439-F8	WATER	2021/03/25	10:25		1	X										(P: 01)
6																	
7																	
8																	
9																	
10																	

REGULATORY CRITERIA

SPECIAL INSTRUCTIONS

Please inform BV Labs immediately if you are not accredited for the requested test(s).
Please return a copy of this form with the report.
Full-scale analysis (EDS, XRD, Microscopy) + particle size

TURNAROUND TIME

☐ Rush Required

2021/04/26

Date Required

Please inform us if rush charges will be incurred.

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

RELINQUISHED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
1.Kevin Chong	2021/04/23	15:00	1. MA. MELBA HABLADO	2021/04/26	8:51
2.			2.		

Sent To: University of British Columbia
Sally Finora, Frank Forward Bd 6350 Stores Rd (Room 517)
Vancouver, BC, V6T 1Z4
Tel: (604) 822-4292

CHAIN OF CUSTODY RECORD FOR SUBCONTRACTED WORK

COC # C119656-VUBC-01-01

REPORT INFORMATION

Company:	Bureau Veritas Laboratories
Address:	4606 Canada Way, Burnaby, British Columbia, V5G 1K5
Contact Name:	Customer Solutions
Email:	customersolutionswest@bureauveritas.com, customerservice@bvlabs.com
Phone:	
BV Labs Project #:	C119656

ANALYSIS REQUESTED

#	SAMPLE ID	MATRIX	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	SAMPLER INITIALS	# CONT.	PSD - Micromeritics Elzone Elzone II										ADDITIONAL SAMPLE INFORMATION
1	ZN6715-FIELD BLANK CLOSED 2	WATER	2021/03/24	11:15		1	X										(P: 01)
2	ZN6716-FIELD BLANK OPEN 2	WATER	2021/03/24	11:15		1	X										(P: 01)
3	ZN6717-SIEVE SAMPEL 4	WATER	2021/03/24	12:41		1	X										(P: 01)
4	ZN6718-SIEVE SAMPLE 5	WATER	2021/03/24	12:53		1	X										(P: 01)
5	ZN6719-SIEVE SAMPLE 6	WATER	2021/03/24	16:23		1	X										(P: 01)
6	ZN6720-SIEVE CONTROL 2	WATER	2021/03/24	16:59		1	X										(P: 01)
7	ZN6721-SPIKE SAMPLE 2	WATER	2021/03/25	10:25		1	X										(P: 01)
8																	
9																	
10																	

REGULATORY CRITERIA

SPECIAL INSTRUCTIONS

Please inform BV Labs immediately if you are not accredited for the requested test(s).
Please return a copy of this form with the report.
Full-scale analysis (EDS, XRD, Microscopy) + particle size

TURNAROUND TIME

☐ Rush Required

2021/04/12

Date Required

Please inform us if rush charges will be incurred.

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

COOLER ID:	YES	NO	Temp: (°C)	1	2	3
Custody Seal Present						
Custody Seal Intact						
Cooling Media Present						

RELINQUISHED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (SIGN & PRINT)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
1.Renegie Lampong	2021/03/29	1500	1. Frank Yan	2021/04/01	
2.			2.		

THE UNIVERSITY OF BRITISH COLUMBIA
NORMAN B. KEEVIL Institute of Mining Engineering

tel: 604 822 2540 fax: 604 822 5599 517, 6350 Stores Road, Vancouver, BC V6T 1Z4 www.mining.ubc.ca

Report Date:	April 27, 2021
Company:	Bureau Veritas Laboratories
Attention:	Customer Solutions 4606 Canada Way Burnaby, B.C., Canada, V5G 1K5 Email: Customersolutionswest@bvlabs.com; customerservice@bvlabs.com
COC #	C119656-VUBC-01-01
Date Received:	April 1, 2021
Analyst:	Frank Yan
Department Contact:	Frank Yan, frank.yan@ubc.ca; (604) 822-4292

Description:
Analysis Requested: Particle Size Distribution test for seven water samples
Sample ID: ZN6715-FIELD BLANK CLOSED2; ZN6716-FIELD BLANK OPEN2; ZN6717-SIEVE SAMPLE 4; ZN6718-SIEVE SAMPLE 5; ZN6719-SIEVE SAMPLE 6; ZN6720-SIEVE CONTROL 2; ZN6721-SPIKE SAMPLE 2
Instrument used: Micromeritics Elzone II 5390

General Comments:

Representative aliquots of the sample were taken and diluted with filtered background conducting electrolyte and filtered distilled water to obtain samples for testing over two ranges (coarse - ~8-200 microns and fine - ~1.5 - 32 microns), which were then blended at the overlap to obtain the sample particle size distribution between ~1.5 - 200 microns.

Sample ZN6715, ZN6716 and ZN6721 are too clean to close our background solutions. So there are no reports for the three samples.

Please use caution in interpreting percent values since these are based on what you see in the histogram.

Results attached.

Sincerely,

Frank

micromeritics®

Micromeritics Instrument Corporation

Sample: ZN6717
Operator: Frank
Submitter: Sublet
File: C:\...\ZN6717\BV6717BL.SMP
Material/Electrolyte Solution: Water Sample / 2 % Sodium Chloride
Measurement Principle: Electrical Sensing Zone
ASTM Practice E 1617 Compliant

Reported: 4/27/2021 9:03:03PM
Coinc. Correction: Off
Smoothing: Off
Background Sub.: Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 65,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Report by Size Table

Low Particle Diameter (µm)	Incremental Volume Percent	Cumulative Volume Percent	Low Particle Diameter (µm)	Incremental Volume Percent	Cumulative Volume Percent
200.00	0.0	100.0	80.00	2.9	80.3
187.50	0.3	99.7	77.50	3.1	77.2
184.38	0.0	99.7	75.00	3.9	73.3
181.25	0.0	99.7	72.50	4.5	68.7
178.13	0.2	99.5	70.00	5.2	63.5
175.00	0.0	99.4	67.50	5.5	58.0
162.50	1.1	98.3	65.00	6.5	51.6
159.38	0.3	98.0	62.50	6.5	45.1
156.25	0.1	97.8	60.00	6.5	38.6
153.13	0.0	97.8	57.50	6.4	32.2
150.00	0.4	97.4	55.00	5.4	26.8
146.88	0.1	97.2	52.50	4.3	22.5
143.75	0.1	97.1	50.00	2.8	19.7
140.63	0.1	97.0	47.50	2.0	17.7
137.50	0.3	96.6	45.00	1.4	16.3
134.38	0.1	96.5	42.50	1.2	15.0
131.25	0.1	96.4	40.00	1.0	14.0
128.13	0.2	96.2	37.50	0.8	13.3
125.00	0.3	95.9	35.00	0.7	12.6
121.88	0.5	95.4	32.50	0.5	12.1
118.75	0.2	95.2	30.00	0.3	11.8
115.63	0.4	94.8	27.50	0.3	11.5
112.50	0.6	94.1	25.00	0.3	11.3
109.38	0.5	93.7	22.50	0.3	11.0
106.25	0.5	93.2	20.00	0.3	10.7
103.13	0.5	92.7	17.50	0.4	10.2
100.00	0.6	92.0	15.00	0.5	9.8
97.50	0.7	91.4	12.50	0.4	9.3
95.00	1.2	90.2	10.00	0.3	9.0
92.50	0.9	89.3	7.50	0.3	8.8
90.00	0.9	88.4	5.00	4.5	4.3
87.50	1.4	87.0	2.50	4.3	0.0
85.00	1.7	85.3	1.00	0.0	0.0
82.50	2.2	83.2			

Sample: ZN6717
Operator: Frank
Submitter: Sublet
File: C:\...\ZN6717\BV6717BL.SMP
Material/Electrolyte Solution: Water Sample / 2 % Sodium Chloride
Measurement Principle: Electrical Sensing Zone
ASTM Practice E 1617 Compliant

Reported: 4/27/2021 9:03:03PM
Coinc. Correction: Off
Smoothing: Off
Background Sub.: Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 65,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Report by Volume Percent

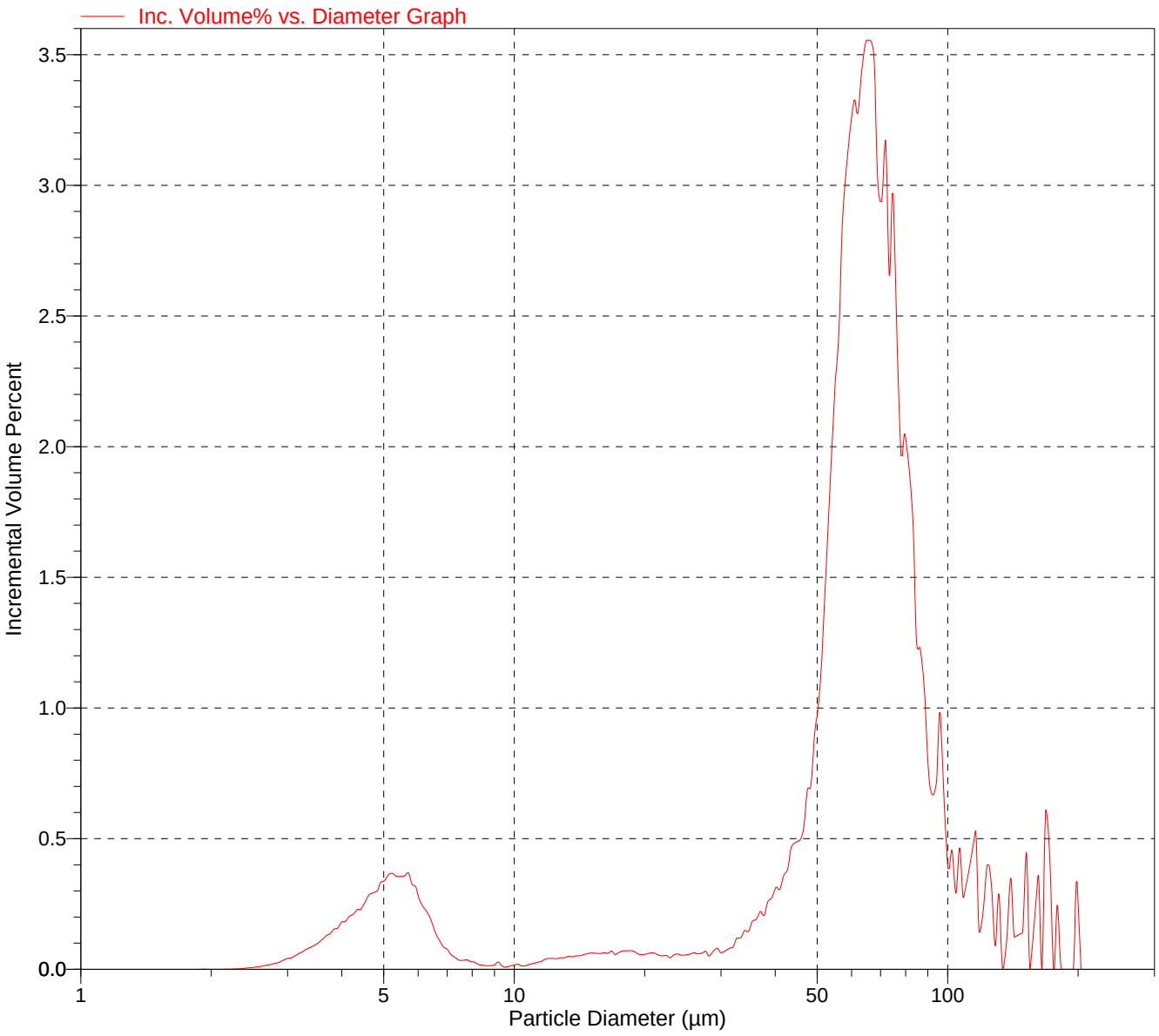
Cumulative Volume Percent	Low Particle Diameter (µm)	Cumulative Volume Percent	Low Particle Diameter (µm)	Cumulative Volume Percent	Low Particle Diameter (µm)	Cumulative Volume Percent	Low Particle Diameter (µm)
100.0	200.98	93.5	107.93	83.7	82.99	42.5	61.49
99.7	197.67	93.2	106.43	83.1	82.44	40.0	60.54
99.4	173.51	92.9	104.73	82.5	81.90	37.5	59.59
99.1	170.99	92.5	102.32	81.9	81.37	35.0	58.62
98.8	169.11	92.2	100.91	81.3	80.85	32.5	57.62
98.5	167.53	91.9	99.26	80.7	80.34	30.0	56.58
98.2	161.65	91.6	98.11	80.0	79.78	27.5	55.36
97.8	152.87	91.3	97.27	77.5	77.73	25.0	54.06
97.5	151.13	91.0	96.60	75.0	75.95	22.5	52.50
97.2	145.75	90.6	95.85	72.5	74.61	20.0	50.36
96.9	140.11	90.3	95.23	70.0	73.20	17.5	47.24
96.6	137.17	90.0	94.43	67.5	71.92	15.0	42.46
96.2	127.60	89.4	92.75	65.0	70.73	12.5	34.51
95.9	125.11	88.8	91.03	62.5	69.49	10.0	16.18
95.6	123.18	88.1	89.31	60.0	68.30	7.5	6.07
95.3	120.77	87.5	88.21	57.5	67.28	5.0	5.22
95.0	116.69	86.9	87.28	55.0	66.31	2.5	4.39
94.7	115.41	86.3	86.39	52.5	65.35	1.0	3.70
94.4	113.97	85.7	85.51	50.0	64.40	0.1	2.81
94.1	112.32	85.0	84.51	47.5	63.45		
93.8	110.37	84.4	83.71	45.0	62.48		

Sample: ZN6717
Operator: Frank
Submitter: Sublet
File: C:\...\ZN6717\BV6717BL.SMP
Material/Electrolyte Solution: Water Sample / 2 % Sodium Chloride
Measurement Principle: Electrical Sensing Zone
ASTM Practice E 1617 Compliant

Reported: 4/27/2021 9:03:03PM
Coinc. Correction: Off
Smoothing: Off
Background Sub.: Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 65,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Incremental Volume Percent vs. Particle Diameter Graph



Sample:	ZN6717
Operator:	Frank
Submitter:	Sublet
File:	C:\...\ZN6717\BV6717BL.SMP
Material/Electrolyte Solution:	Water Sample / 2 % Sodium Chloride
Measurement Principle:	Electrical Sensing Zone ASTM Practice E 1617 Compliant

Reported:	4/27/2021 9:03:03PM	Smoothing:	Off
Coinc. Correction:	Off	Background Sub.:	Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 65,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Summary Report

Sample Statistics

Total Volume 1.2294e+09 µm³

Weighted Statistics (Volume Distribution)

Mean	64.62	Mode	66.10
Median	64.40		

Geometric Statistics (Volume Distribution)

Mean	52.36	Mode	66.10
Median	64.40		

micromeritics®

Micromeritics Instrument Corporation

Sample: ZN6718
Operator: Frank
Submitter: Sublet
File: C:\...\ZN6718\BV6718BL.SMP
Material/Electrolyte Solution: Water Sample / 2 % Sodium Chloride
Measurement Principle: Electrical Sensing Zone
ASTM Practice E 1617 Compliant

Reported: 4/27/2021 9:10:06PM
Coinc. Correction: Off
Smoothing: Off
Background Sub.: Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 69,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Report by Size Table

Low Particle Diameter (µm)	Incremental Volume Percent	Cumulative Volume Percent	Low Particle Diameter (µm)	Incremental Volume Percent	Cumulative Volume Percent
187.50	0.5	99.5	80.00	2.5	75.9
184.38	0.0	99.5	77.50	3.3	72.6
181.25	0.2	99.3	75.00	3.9	68.7
178.13	0.0	99.3	72.50	4.5	64.2
175.00	0.0	99.3	70.00	4.9	59.3
162.50	0.5	98.9	67.50	5.2	54.1
159.38	0.0	98.8	65.00	5.8	48.2
156.25	0.2	98.6	62.50	5.6	42.7
153.13	0.0	98.6	60.00	5.9	36.8
150.00	0.4	98.2	57.50	5.3	31.5
146.88	0.7	97.5	55.00	4.7	26.8
143.75	0.1	97.4	52.50	3.4	23.3
140.63	0.2	97.3	50.00	2.6	20.8
137.50	0.1	97.2	47.50	1.9	18.9
134.38	0.4	96.7	45.00	1.3	17.5
131.25	0.3	96.4	42.50	1.0	16.5
128.13	0.5	96.0	40.00	0.8	15.7
125.00	0.3	95.6	37.50	0.6	15.1
121.88	0.5	95.1	35.00	0.5	14.5
118.75	0.7	94.4	32.50	0.4	14.1
115.63	0.4	94.0	30.00	0.3	13.8
112.50	0.6	93.4	27.50	0.3	13.5
109.38	0.7	92.8	25.00	0.3	13.3
106.25	0.9	91.9	22.50	0.3	13.0
103.13	1.0	90.9	20.00	0.3	12.7
100.00	1.2	89.7	17.50	0.4	12.3
97.50	1.1	88.6	15.00	0.4	11.9
95.00	1.2	87.4	12.50	0.4	11.5
92.50	1.5	85.9	10.00	0.3	11.2
90.00	1.4	84.5	7.50	0.3	10.8
87.50	1.5	83.0	5.00	5.0	5.8
85.00	2.3	80.7	2.50	5.8	0.0
82.50	2.4	78.3	1.00	0.0	0.0

Sample: ZN6718
Operator: Frank
Submitter: Sublet
File: C:\...\ZN6718\BV6718BL.SMP
Material/Electrolyte Solution: Water Sample / 2 % Sodium Chloride
Measurement Principle: Electrical Sensing Zone
ASTM Practice E 1617 Compliant

Reported: 4/27/2021 9:10:06PM
Coinc. Correction: Off
Smoothing: Off
Background Sub.: Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 69,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Report by Volume Percent

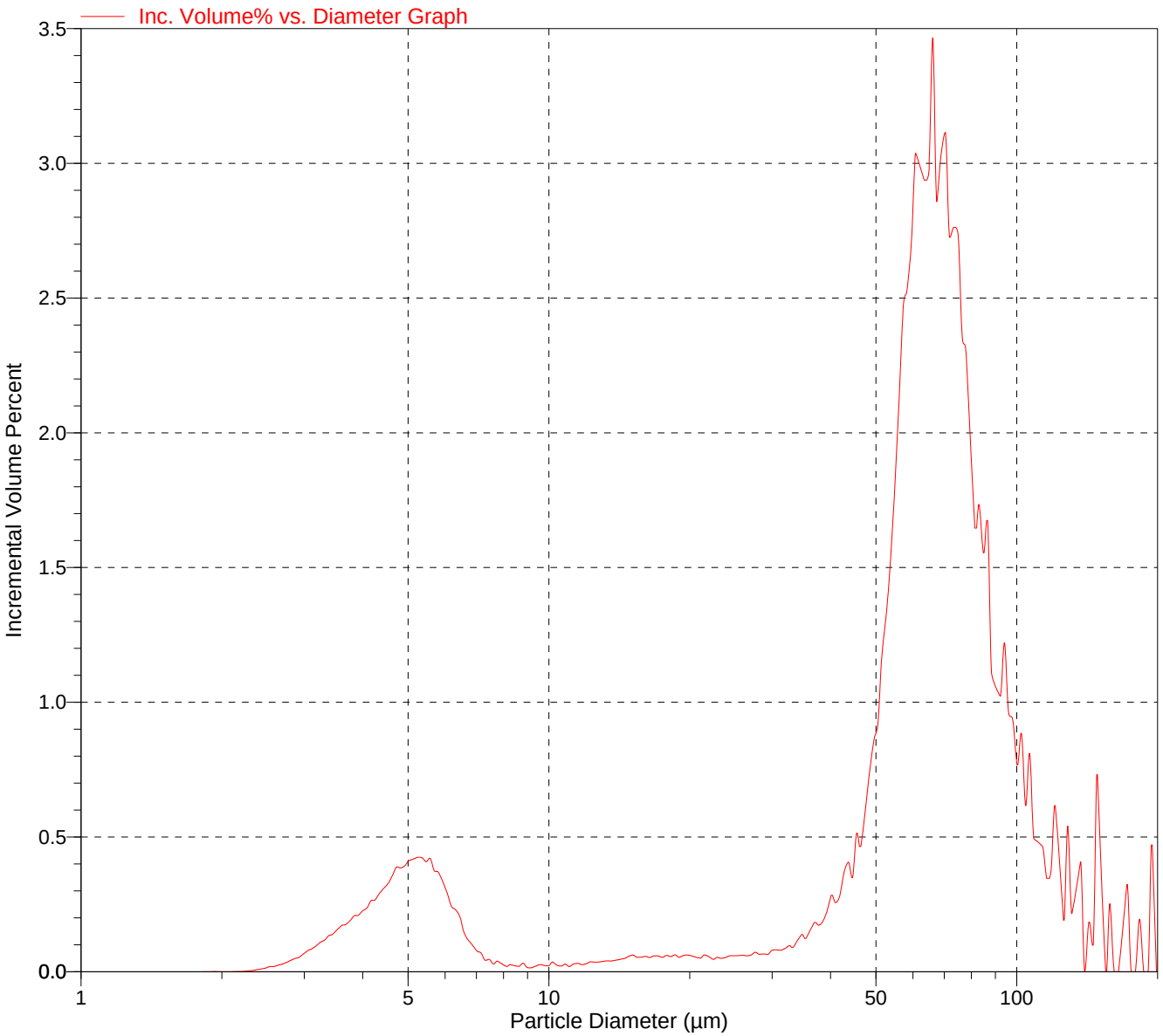
Cumulative Volume Percent	Low Particle Diameter (µm)	Cumulative Volume Percent	Low Particle Diameter (µm)	Cumulative Volume Percent	Low Particle Diameter (µm)	Cumulative Volume Percent	Low Particle Diameter (µm)
100.0	196.85	93.5	112.89	83.7	88.58	42.5	62.43
99.7	194.44	93.2	111.44	83.1	87.61	40.0	61.35
99.4	182.62	92.9	110.00	82.5	86.88	37.5	60.32
99.1	171.17	92.5	108.15	81.9	86.28	35.0	59.19
98.8	158.76	92.2	107.06	81.3	85.65	32.5	58.00
98.5	151.98	91.9	106.32	80.7	84.95	30.0	56.80
98.2	149.86	91.6	105.53	80.0	84.16	27.5	55.44
97.8	148.44	91.3	104.44	77.5	81.64	25.0	53.81
97.5	146.31	91.0	103.40	75.0	79.28	22.5	51.80
97.2	137.75	90.6	102.42	72.5	77.46	20.0	49.10
96.9	135.81	90.3	101.73	70.0	75.76	17.5	44.91
96.6	133.17	90.0	100.97	67.5	74.33	15.0	37.27
96.2	129.14	89.4	99.31	65.0	72.95	12.5	18.84
95.9	127.87	88.8	97.97	62.5	71.56	10.0	6.35
95.6	124.65	88.1	96.47	60.0	70.32	7.5	5.44
95.3	122.69	87.5	95.23	57.5	69.16	5.0	4.79
95.0	121.31	86.9	94.22	55.0	67.97	2.5	4.05
94.7	120.20	86.3	93.30	52.5	66.74	1.0	3.42
94.4	118.49	85.7	92.18	50.0	65.78	0.1	2.65
94.1	116.41	85.0	90.89	47.5	64.67		
93.8	114.41	84.4	89.82	45.0	63.54		

Sample: ZN6718
Operator: Frank
Submitter: Sublet
File: C:\...\ZN6718\BV6718BL.SMP
Material/Electrolyte Solution: Water Sample / 2 % Sodium Chloride
Measurement Principle: Electrical Sensing Zone
ASTM Practice E 1617 Compliant

Reported: 4/27/2021 9:10:06PM
Coinc. Correction: Off
Smoothing: Off
Background Sub.: Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 69,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Incremental Volume Percent vs. Particle Diameter Graph



Sample:	ZN6718
Operator:	Frank
Submitter:	Sublet
File:	C:\...\ZN6718\BV6718BL.SMP
Material/Electrolyte Solution:	Water Sample / 2 % Sodium Chloride
Measurement Principle:	Electrical Sensing Zone ASTM Practice E 1617 Compliant

Reported:	4/27/2021 9:10:06PM	Smoothing:	Off
Coinc. Correction:	Off	Background Sub.:	Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 69,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Summary Report

Sample Statistics

Total Volume 1.6452e+09 µm³

Weighted Statistics (Volume Distribution)

Mean	65.38	Mode	66.10
Median	65.78		

Geometric Statistics (Volume Distribution)

Mean	50.89	Mode	66.10
Median	65.78		

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Micromeritics Instrument Corporation

Sample: ZN6719
Operator: Frank
Submitter: Sublet
File: C:\...\ZN6719\BV6719BL.SMP
Material/Electrolyte Solution: Water Sample / 2 % Sodium Chloride
Measurement Principle: Electrical Sensing Zone
ASTM Practice E 1617 Compliant

Reported: 4/27/2021 9:13:47PM
Coinc. Correction: Off
Smoothing: Off
Background Sub.: Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 68,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Report by Size Table

Low Particle Diameter (µm)	Incremental Volume Percent	Cumulative Volume Percent	Low Particle Diameter (µm)	Incremental Volume Percent	Cumulative Volume Percent
200.00	0.0	100.0	80.00	2.7	77.8
187.50	0.5	99.5	77.50	3.5	74.3
184.38	0.2	99.3	75.00	3.8	70.5
181.25	0.2	99.2	72.50	4.0	66.5
178.13	0.3	98.8	70.00	4.8	61.7
175.00	0.1	98.8	67.50	5.4	56.3
162.50	0.4	98.3	65.00	6.4	49.9
159.38	0.0	98.3	62.50	6.8	43.1
156.25	0.5	97.8	60.00	7.0	36.1
153.13	0.1	97.7	57.50	6.2	29.9
150.00	0.2	97.5	55.00	5.4	24.5
146.88	0.1	97.4	52.50	4.3	20.2
143.75	0.2	97.2	50.00	2.7	17.5
140.63	0.3	96.9	47.50	1.9	15.6
137.50	0.7	96.1	45.00	1.3	14.3
134.38	0.2	96.0	42.50	1.2	13.1
131.25	0.3	95.6	40.00	0.9	12.3
128.13	0.4	95.2	37.50	0.7	11.6
125.00	0.2	95.0	35.00	0.5	11.1
121.88	0.4	94.6	32.50	0.4	10.7
118.75	0.5	94.1	30.00	0.3	10.4
115.63	0.5	93.6	27.50	0.2	10.2
112.50	0.5	93.1	25.00	0.3	9.9
109.38	0.5	92.6	22.50	0.3	9.6
106.25	0.8	91.8	20.00	0.2	9.4
103.13	0.5	91.4	17.50	0.3	9.1
100.00	0.6	90.8	15.00	0.3	8.8
97.50	0.9	89.9	12.50	0.3	8.4
95.00	0.9	89.1	10.00	0.3	8.1
92.50	1.4	87.7	7.50	0.2	7.9
90.00	1.6	86.1	5.00	3.6	4.3
87.50	1.5	84.6	2.50	4.2	0.0
85.00	2.0	82.6	1.00	0.0	0.0
82.50	2.1	80.5			

Sample: ZN6719
Operator: Frank
Submitter: Sublet
File: C:\...\ZN6719\BV6719BL.SMP
Material/Electrolyte Solution: Water Sample / 2 % Sodium Chloride
Measurement Principle: Electrical Sensing Zone
ASTM Practice E 1617 Compliant

Reported: 4/27/2021 9:13:47PM
Coinc. Correction: Off
Smoothing: Off
Background Sub.: Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 68,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Report by Volume Percent

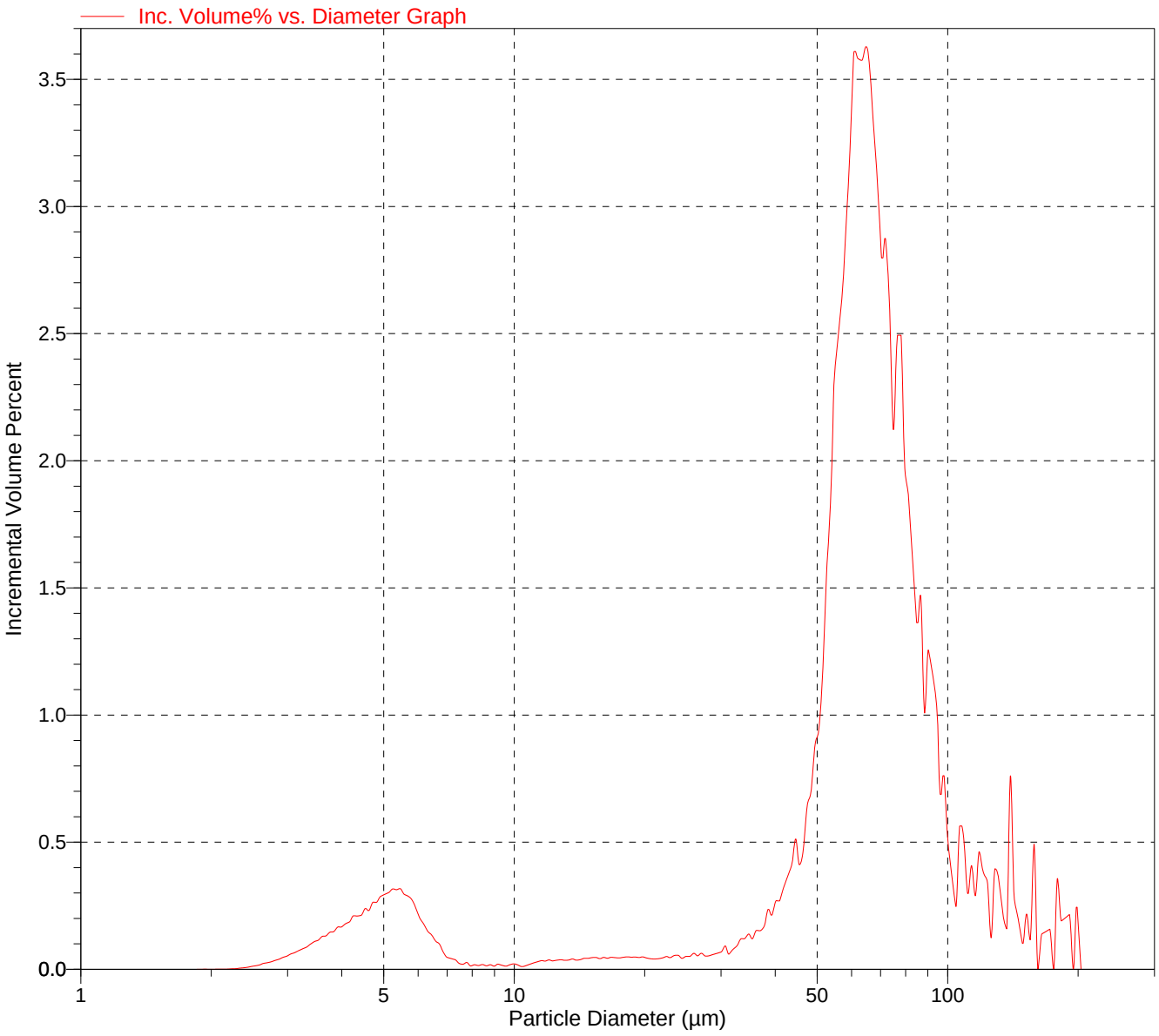
Cumulative Volume Percent	Low Particle Diameter (µm)	Cumulative Volume Percent	Low Particle Diameter (µm)	Cumulative Volume Percent	Low Particle Diameter (µm)	Cumulative Volume Percent	Low Particle Diameter (µm)
100.0	200.98	93.5	114.95	83.7	86.39	42.5	62.27
99.7	191.75	93.2	113.17	83.1	85.66	40.0	61.37
99.4	186.13	92.9	111.01	82.5	84.87	37.5	60.50
99.1	180.49	92.5	108.84	81.9	84.10	35.0	59.59
98.8	177.60	92.2	107.60	81.3	83.39	32.5	58.59
98.5	167.06	91.9	106.45	80.7	82.74	30.0	57.54
98.2	158.74	91.6	105.12	80.0	82.05	27.5	56.42
97.8	155.10	91.3	102.58	77.5	79.76	25.0	55.25
97.5	149.75	91.0	100.93	75.0	77.97	22.5	54.00
97.2	143.74	90.6	99.27	72.5	76.36	20.0	52.39
96.9	140.81	90.3	98.41	70.0	74.62	17.5	50.02
96.6	139.80	90.0	97.64	67.5	73.05	15.0	46.52
96.2	138.30	89.4	95.89	65.0	71.72	12.5	40.72
95.9	133.54	88.8	94.46	62.5	70.42	10.0	25.98
95.6	130.91	88.1	93.23	60.0	69.15	7.5	6.53
95.3	128.79	87.5	92.23	57.5	68.02	5.0	5.26
95.0	125.61	86.9	91.26	55.0	66.96	2.5	4.31
94.7	122.78	86.3	90.35	52.5	65.98	1.0	3.56
94.4	120.74	85.7	89.47	50.0	65.03	0.1	2.68
94.1	118.90	85.0	88.15	47.5	64.11		
93.8	117.37	84.4	87.23	45.0	63.18		

Sample: ZN6719
Operator: Frank
Submitter: Sublet
File: C:\...\ZN6719\BV6719BL.SMP
Material/Electrolyte Solution: Water Sample / 2 % Sodium Chloride
Measurement Principle: Electrical Sensing Zone
ASTM Practice E 1617 Compliant

Reported: 4/27/2021 9:13:47PM
Coinc. Correction: Off
Smoothing: Off
Background Sub.: Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 68,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Incremental Volume Percent vs. Particle Diameter Graph



Sample:	ZN6719
Operator:	Frank
Submitter:	Sublet
File:	C:\...\ZN6719\BV6719BL.SMP
Material/Electrolyte Solution:	Water Sample / 2 % Sodium Chloride
Measurement Principle:	Electrical Sensing Zone ASTM Practice E 1617 Compliant

Reported:	4/27/2021 9:13:47PM	Smoothing:	Off
Coinc. Correction:	Off	Background Sub.:	Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 68,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Summary Report

Sample Statistics

Total Volume 1.6882e+09 µm³

Weighted Statistics (Volume Distribution)

Mean	66.78	Mode	64.75
Median	65.03		

Geometric Statistics (Volume Distribution)

Mean	54.70	Mode	64.75
Median	65.03		

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Micromeritics Instrument Corporation

Sample: ZN6720
Operator: Frank
Submitter: Sublet
File: C:\...\ZN6720\BV6720BL.SMP
Material/Electrolyte Solution: Water Sample / 2 % Sodium Chloride
Measurement Principle: Electrical Sensing Zone
ASTM Practice E 1617 Compliant

Reported: 4/27/2021 9:34:55PM
Coinc. Correction: Off
Smoothing: 9, 1
Background Sub.: Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 11,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Report by Size Table

Low Particle Diameter (µm)	Incremental Volume Percent	Cumulative Volume Percent	Low Particle Diameter (µm)	Incremental Volume Percent	Cumulative Volume Percent
162.50	1.9	98.1	72.50	1.9	37.3
159.38	0.7	97.4	70.00	2.2	35.1
156.25	0.7	96.6	67.50	2.5	32.6
153.13	1.4	95.3	65.00	2.5	30.1
150.00	1.3	94.0	62.50	2.4	27.7
146.88	1.3	92.7	60.00	2.3	25.4
143.75	1.8	90.9	57.50	2.5	23.0
140.63	1.7	89.2	55.00	2.4	20.5
137.50	1.6	87.6	52.50	2.0	18.6
134.38	1.5	86.1	50.00	1.8	16.8
131.25	1.6	84.4	47.50	2.1	14.7
128.13	2.2	82.3	45.00	2.2	12.5
125.00	2.6	79.7	42.50	2.0	10.6
121.88	2.6	77.1	40.00	1.4	9.1
118.75	2.8	74.3	37.50	0.9	8.2
115.63	2.7	71.6	35.00	0.8	7.4
112.50	2.5	69.0	32.50	0.8	6.6
109.38	2.5	66.6	30.00	0.5	6.0
106.25	2.6	64.0	27.50	0.5	5.5
103.13	2.4	61.5	25.00	0.5	5.1
100.00	2.4	59.1	22.50	0.6	4.5
97.50	2.0	57.2	20.00	0.6	3.9
95.00	2.0	55.1	17.50	0.7	3.2
92.50	2.0	53.1	15.00	0.8	2.4
90.00	2.3	50.7	12.50	1.1	1.2
87.50	2.3	48.4	10.00	0.9	0.3
85.00	2.3	46.1	7.50	0.0	0.3
82.50	2.1	44.0	5.00	0.2	0.2
80.00	1.8	42.3	2.50	0.2	0.0
77.50	1.5	40.7	1.00	0.0	0.0
75.00	1.6	39.1			

Sample: ZN6720
Operator: Frank
Submitter: Sublet
File: C:\...\ZN6720\BV6720BL.SMP
Material/Electrolyte Solution: Water Sample / 2 % Sodium Chloride
Measurement Principle: Electrical Sensing Zone
ASTM Practice E 1617 Compliant

Reported: 4/27/2021 9:34:55PM
Coinc. Correction: Off
Smoothing: 9, 1
Background Sub.: Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 11,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Report by Volume Percent

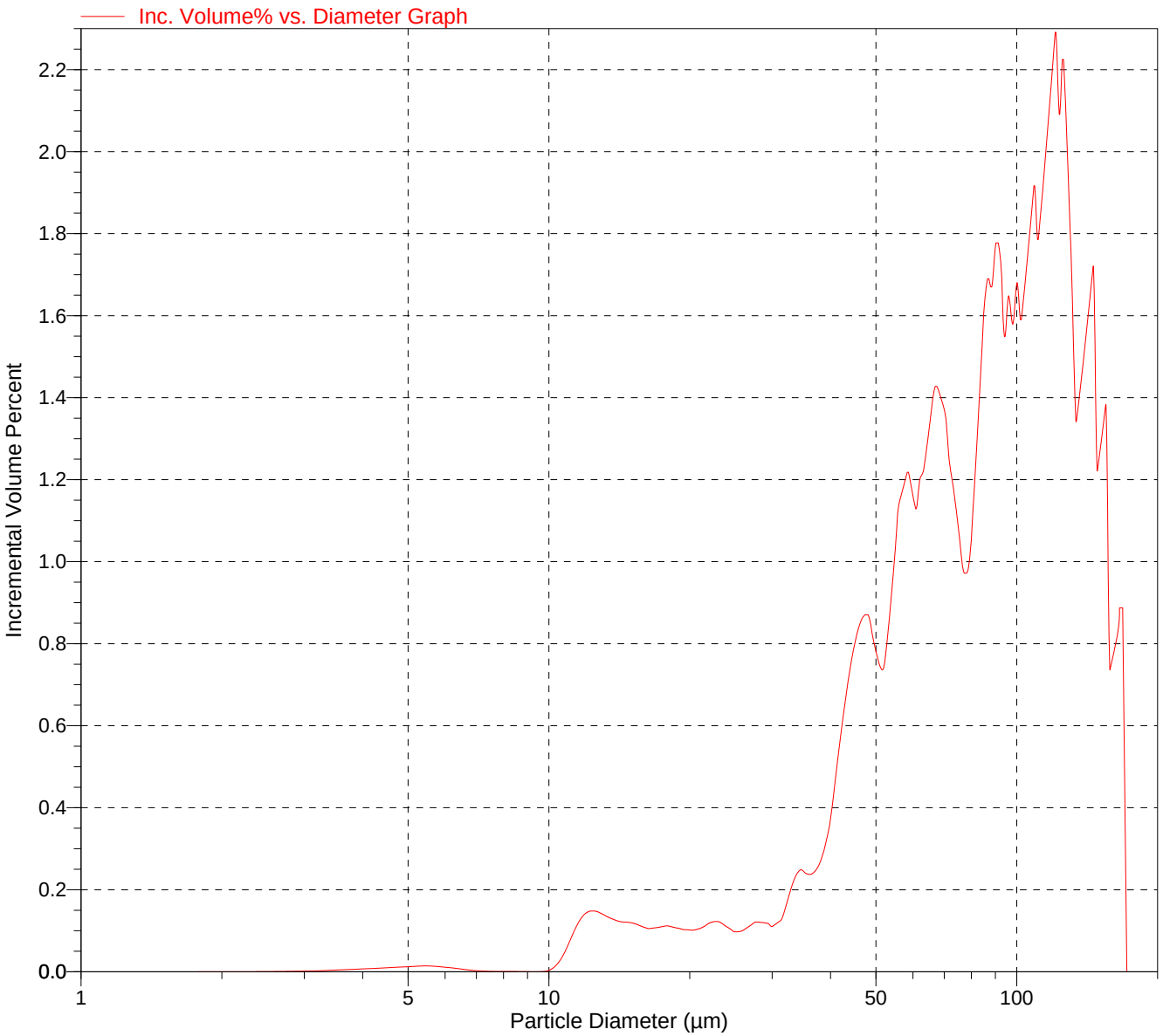
Cumulative Volume Percent	Low Particle Diameter (µm)	Cumulative Volume Percent	Low Particle Diameter (µm)	Cumulative Volume Percent	Low Particle Diameter (µm)	Cumulative Volume Percent	Low Particle Diameter (µm)
100.0	170.20	93.5	148.73	83.7	130.12	42.5	80.39
99.7	168.56	93.2	147.95	83.1	129.25	40.0	76.30
99.4	167.66	92.9	147.25	82.5	128.42	37.5	72.80
99.1	166.64	92.5	146.46	81.9	127.63	35.0	69.91
98.8	165.41	92.2	145.93	81.3	126.89	32.5	67.38
98.5	164.19	91.9	145.43	80.7	126.18	30.0	64.91
98.2	162.93	91.6	144.93	80.0	125.37	27.5	62.26
97.8	161.22	91.3	144.42	77.5	122.33	25.0	59.52
97.5	159.93	91.0	143.88	75.0	119.57	22.5	57.01
97.2	158.50	90.6	143.15	72.5	116.70	20.0	54.37
96.9	157.13	90.3	142.60	70.0	113.69	17.5	50.98
96.6	156.14	90.0	142.05	67.5	110.49	15.0	47.82
96.2	155.19	89.4	140.94	65.0	107.50	12.5	44.98
95.9	154.55	88.8	139.80	62.5	104.39	10.0	41.67
95.6	153.91	88.1	138.46	60.0	101.08	7.5	35.40
95.3	153.21	87.5	137.27	57.5	97.94	5.0	24.65
95.0	152.48	86.9	136.07	55.0	94.85	2.5	15.34
94.7	151.75	86.3	134.86	52.5	91.87	1.0	12.11
94.4	151.03	85.7	133.58	50.0	89.21	0.1	4.39
94.1	150.30	85.0	132.20	47.5	86.49		
93.8	149.54	84.4	131.19	45.0	83.74		

Sample: ZN6720
Operator: Frank
Submitter: Sublet
File: C:\...\ZN6720\BV6720BL.SMP
Material/Electrolyte Solution: Water Sample / 2 % Sodium Chloride
Measurement Principle: Electrical Sensing Zone
ASTM Practice E 1617 Compliant

Reported: 4/27/2021 9:34:55PM
Coinc. Correction: Off
Smoothing: 9, 1
Background Sub.: Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 11,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Incremental Volume Percent vs. Particle Diameter Graph



Sample:	ZN6720
Operator:	Frank
Submitter:	Sublet
File:	C:\...\ZN6720\BV6720BL.SMP
Material/Electrolyte Solution:	Water Sample / 2 % Sodium Chloride
Measurement Principle:	Electrical Sensing Zone ASTM Practice E 1617 Compliant

Reported:	4/27/2021 9:34:55PM	Smoothing:	9, 1
Coinc. Correction:	Off	Background Sub.:	Off

Comments: The sample was diluted with well-filtered distilled water and sodium chloride solution to get to a proper conductivity and concentration level for testing on the Elzone. Approximately 11,000 particles were counted. Particles were counted over two ranges and blended at the overlap.

Summary Report

Sample Statistics

Total Volume 2.8189e+08 µm³

Weighted Statistics (Volume Distribution)

Mean	89.48	Mode	120.8
Median	89.21		

Geometric Statistics (Volume Distribution)

Mean	78.87	Mode	120.8
Median	89.21		

XRD, SEM, Elemental and Particle Size Analysis

of

Seven Solid Samples

for

Bureau Veritas Laboratories

Project #: C119656

GR 33361 2021

GR Petrology Consultants Inc.
Suite 8, 1323 – 44th Avenue N.E.
Calgary, Alberta T2E 6L5
Tel: 403-291-3420 Fax: 403-250-7212
E-mail: berna.hablado@grpetrology.com

April 2021

GR Petrology CONSULTANTS Inc.

Summary of Analyses

Seven solid samples were submitted by Bureau Veritas Laboratories for bulk X-ray Diffraction Analysis (XRD), elemental analysis by X-ray Energy Dispersive Spectrometry (EDS), Scanning Electron Microscopy (SEM) and Particle Size Analysis.

Quantitative elemental analysis was performed by an **Oxford INCA** microanalysis system attached to a **JEOL JSM-6610** scanning electron microscope. The INCA system was designed to obtain standardless quantitative elemental analysis from rough samples by SEM. The INCA system has enhanced light element capabilities, and is able to identify beryllium (Be), and quantify boron (B), and carbon (C).

Particle size analysis was conducted on SEM photomicrographs. Particle size was measured using Image Pro Plus software.

The following Tables, Figures and Plates are included in this report:

- Table A: Bulk Fraction X-Ray Diffraction Data
- Table B: Comparison of Elemental Composition by EDS and XRD
- Table C: Particle Size Data
- Plates 1 to 7: Photographs and EDS Results
- Plate 8: EDS Results for Blank Filter
- Tables 1 to 7: EDS and XRD Results
- Figures 1 to 7: Bulk X-Ray Diffractograms
- Figure 8: Bulk X-Ray Diffractogram for Blank Filter
- Plates PSD-1 to PSD-7: Particle Size Statistics and Photographs

The following samples were analyzed:

- GR-001: ZN6708-Field Blank Closed (2021/03/24 11:15)
- GR-002: ZN6709-Field Blank Open (2021/03/24 11:15)

- GR-003: ZN6710-Sieve Control 1 (2021/03/24 16:57)
- GR-004: ZN6711-Sieve Sample 1 (2021/03/24 11:57)
- GR-005: ZN6712-Sieve Sample 2 (2021/03/24 12:08)
- GR-006: ZN6713-Sieve Sample 3 (2021/03/24 12:41)
- GR-007: ZN6714-Spike Sample 1 (2021/03/25 10:28)

COMPANY: Bureau Veritas Laboratories
PROJECT #: C119656
GR FILE #: GR 33361 2021

TABLE A
BULK FRACTION X-RAY DIFFRACTION DATA

GR Sample #	Sample ID	Qtz	KFd	Plag	Cri	Sil	Kaol	Ill	Chl	M-L	Smec	Total Clay
GR-001	ZN6708-Field Blank Closed	tr	-	-	-	-	-	-	-	-	-	-
GR-002	ZN6709-Field Blank Open	tr	-	-	-	tr	-	-	-	-	-	-
GR-003	ZN6710-Sieve Control 1	tr	-	-	-	-	-	-	-	-	-	-
GR-004	ZN6711-Sieve Sample 1	21.9	5.0	24.7	7.9	3.6	11.3	18.4	7.2	-	-	36.9
GR-005	ZN6712-Sieve Sample 2	13.7	10.0	24.6	-	10.2	22.9	13.9	4.7	-	-	41.5
GR-006	ZN6713-Sieve Sample 3	39.5	12.2	7.6	2.8	-	22.2	9.6	6.1	-	-	37.9
GR-007	ZN6714-Spike Sample 1	tr	-	-	-	-	-	-	-	-	-	-

Qtz - Quartz - SiO_2
KFd - Potassium Feldspar - $KAlSi_3O_8$
Plag - Sodium Feldspar - $NaAlSi_3O_8$
Cri - Cristobalite - SiO_2
Sil - Silicon Oxide - SiO_2
Kaol - Kaolinite - $Al_2Si_2O_5(OH)_4$
Ill - Illite - $(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$
Chl - Chlorite - $(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$
M-L - Mixed Layer
Smec - Smectite
Total Clay - Kaol+Ill+Chl+M-L+Smec
tr - trace

GR Petrology CONSULTANTS Inc.

COMPANY: Bureau Veritas Laboratories
PROJECT #: C119656
GR PROJECT #: GR 33361 2021

TABLE B
Comparison of Elemental Composition by EDS and XRD

GR Sample #	Sample ID	H	C	N	O	Na	Mg	Al	Si	P	S	Cl	K	Ca	Fe	Ni	Cu
GR-001	ZN6708-Field Blank Closed	-	26.42	8.48	64.85	-	-	0.14	0.02	-	0.03	-	-	-	0.02	-	0.04
		-	-	-	tr	-	-	-	tr	-	-	-	-	-	-	-	-
GR-002	ZN6709-Field Blank Open	-	25.67	15.95	58.08	-	0.02	0.07	0.02	-	0.09	-	-	0.03	-	-	0.05
		-	-	-	tr	-	-	-	tr	-	-	-	-	-	-	-	-
GR-003	ZN6710-Sieve Control 1	-	27.38	8.18	64.17	-	-	0.10	0.02	-	0.10	0.01	-	-	-	-	0.04
		-	-	-	tr	-	-	-	tr	-	-	-	-	-	-	-	-
GR-004	ZN6711-Sieve Sample 1	-	27.79	6.62	64.93	0.06	0.04	0.12	0.22	-	0.10	-	0.01	0.03	0.04	-	0.06
		0.41	-	-	48.92	2.17	0.99	10.79	32.00	-	-	-	2.43	-	2.28	-	-
GR-005	ZN6712-Sieve Sample 2	-	25.82	9.01	64.52	0.07	0.05	0.13	0.28	-	0.06	-	0.01	0.02	0.04	0.04	0.03
		0.53	-	-	49.89	2.16	0.65	12.18	30.39	-	-	-	2.71	-	1.49	-	-
GR-006	ZN6713-Sieve Sample 3	-	28.27	5.70	65.43	0.08	0.06	0.09	0.21	-	0.11	-	0.12	0.03	0.04	-	0.05
		0.47	-	-	50.12	0.67	0.84	10.02	33.32	-	-	-	2.61	-	1.93	-	-
GR-007	ZN6714-Spike Sample 1	-	28.21	6.05	65.55	-	-	0.08	0.02	-	0.03	-	-	0.01	0.01	-	0.03
		-	-	-	tr	-	-	-	tr	-	-	-	-	-	-	-	-

H - Hydrogen	Mg - Magnesium	Cl - Chlorine	Cu - Copper
C - Carbon	Al - Aluminum	K - Potassium	
N - Nitrogen	Si - Silicon	Ca - Calcium	tr - trace
O - Oxygen	P - Phosphorus	Fe - Iron	Black - EDS Analysis
Na - Sodium	S - Sulphur	Ni - Nickel	Red - Calculated from XRD

GR Petrology CONSULTANTS Inc.

COMPANY: Bureau Veritas Laboratories
PROJECT #: C119656
GR PROJECT #: GR 33361 2021

TABLE C
PARTICLE SIZE DATA

GR Sample #	Sample ID	Maximum (µm)	Quartile 3 (µm)	Mean (µm)	Median (µm)	Quartile 1 (µm)	Minimum (µm)	Standard Deviation
GR-001	ZN6708-Field Blank Closed	32.52	0.79	0.85	0.36	0.08	0.01	2.22
GR-002	ZN6709-Field Blank Open	19.52	0.42	0.47	0.19	0.06	0.01	1.35
GR-003	ZN6710-Sieve Control 1	196.48	0.85	3.05	0.34	0.09	0.01	13.50
GR-004	ZN6711-Sieve Sample 1	182.00	4.48	6.42	0.61	0.14	0.01	16.37
GR-005	ZN6712-Sieve Sample 2	276.34	2.55	4.84	0.83	0.33	0.01	17.24
GR-006	ZN6713-Sieve Sample 3	204.42	4.42	6.60	1.12	0.37	0.02	18.89
GR-007	ZN6714-Spike Sample 1	30.29	0.71	0.68	0.25	0.06	0.01	1.86

Summary of XRD Results

X-ray diffraction analysis was conducted on samples GR-001 to GR-007. Trace amounts of silicates were detected in samples GR-001 to GR-003 and GR-007. GR-004 to GR-006 contain silicates that form about 100% of each sample.

Comparison of EDS and XRD Results

In many cases the EDS weight percent calculation for some of the elements is different from the XRD weight percent calculation. EDS analysis identifies and quantifies elements present in both crystalline and non-crystalline components. XRD analysis only detects elements in crystalline compounds because only crystalline components of the sample diffract X-rays. Thus our XRD weight percent calculation can only include those elements present in the crystalline compounds. It must be emphasized that each element identified by X-ray diffraction analysis should also be detected by EDS; however, the reverse is not necessarily true.

Note: Hydrogen (H) can not be detected in EDS analysis; therefore, can not be compared.

Table B summarizes the following comments regarding the comparison of EDS and XRD results.

Sample GR-001 showed a poor correlation between the XRD and EDS results.

A significant difference with respect to oxygen was found in sample GR-001.

- In the elemental analysis, oxygen forms 64.85% of the sample, whereas XRD analysis detected trace amounts of oxygen.

A moderate difference with respect to carbon was found in sample GR-001.

- Carbon was measured at 26.42% in the elemental analysis, while XRD analysis detected no carbon.

A minor difference with respect to nitrogen was found in sample GR-001.

- EDS analysis detected 8.48% nitrogen, while no nitrogen was detected in XRD analysis.

The EDS results for carbon, nitrogen and oxygen are greater than the XRD results indicating the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds.

Sample GR-002 showed a poor correlation between the XRD and EDS results.

Significant differences with respect to carbon and oxygen were found in sample GR-002.

- Carbon was measured at 25.67% in the elemental analysis, while XRD analysis did not detect carbon.
- In the elemental analysis, oxygen forms 58.08% of the sample, while trace amounts of oxygen was detected in XRD analysis.

A moderate difference with respect to nitrogen was found in sample GR-002.

- Nitrogen represents 15.95% in the EDS analysis, while XRD analysis did not detect nitrogen.

The EDS results for carbon, nitrogen and oxygen are greater than the XRD results indicating the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds.

Sample GR-003 showed a poor correlation between the XRD and EDS results.

Significant differences with respect to carbon and oxygen were found in sample GR-003.

- In the elemental analysis, carbon forms 27.38% of the sample, while XRD analysis detected no carbon.
- Oxygen represents 64.17% in the EDS analysis, while XRD analysis detected trace amounts of oxygen.

A minor difference with respect to nitrogen was observed in sample GR-003.

- In the elemental analysis, nitrogen forms 8.18% of the sample, whereas XRD analysis did not detect nitrogen.

The EDS results for carbon, nitrogen and oxygen are greater than the XRD results indicating the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds.

Sample GR-004 showed a moderate correlation between the XRD and EDS results.

Moderate differences with respect to carbon, oxygen, silicon and aluminum were observed in sample GR-004.

- Carbon was measured at 27.79% in the elemental analysis, while no carbon was detected in XRD analysis.
- EDS analysis detected 64.93% oxygen, while 48.92% oxygen was detected in XRD analysis.
- Silicon represents 0.22% in the EDS analysis, while XRD analysis detected 32.00% silicon.
- Aluminum was measured at 0.12% in the elemental analysis, while XRD analysis calculated aluminum to be 10.79%.

Minor differences with respect to nitrogen, sodium, potassium and iron were found in sample GR-004.

- EDS analysis detected 6.62% nitrogen, while XRD analysis detected no nitrogen.
- Sodium represents 0.06% in the EDS analysis, whereas XRD analysis calculated sodium to be 2.17%.
- EDS analysis detected 0.01% potassium, while 2.43% potassium was detected in XRD analysis.
- Iron represents 0.04% in the EDS analysis, whereas XRD analysis calculated iron to be 2.28%.

The EDS results for carbon, nitrogen and oxygen are greater than the XRD results indicating the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. The XRD results for sodium, aluminum, silicon, potassium and iron are greater than the EDS results indicating these elements occur in well-crystalline compounds.

Sample GR-005 showed a moderate correlation between the XRD and EDS results.

Moderate differences with respect to carbon, oxygen, aluminum and silicon were noted in sample GR-005.

- EDS analysis detected 25.82% carbon, while XRD analysis did not detect carbon.
- In the elemental analysis, oxygen forms 64.52% of the sample, while XRD analysis detected 49.89% oxygen.
- EDS analysis detected 0.13% aluminum, while XRD analysis calculated aluminum to be 12.18%.

- Silicon was measured at 0.28% in the elemental analysis, whereas XRD analysis calculated silicon to be 30.39%.

Minor differences with respect to nitrogen, sodium and potassium were observed in sample GR-005.

- In the elemental analysis, nitrogen forms 9.01% of the sample, while no nitrogen was detected in XRD analysis.
- Sodium represents 0.07% in the EDS analysis, whereas XRD analysis calculated sodium to be 2.16%.
- In the elemental analysis, potassium forms 0.01% of the sample, while 2.71% potassium was detected in XRD analysis.

The EDS results for carbon, nitrogen and oxygen are greater than the XRD results indicating the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. The XRD results for sodium, aluminum, silicon and potassium are greater than the EDS results indicating these elements occur in well-crystalline compounds.

Sample GR-006 showed a moderate correlation between the XRD and EDS results.

Moderate differences with respect to carbon, oxygen and silicon were observed in sample GR-006.

- Carbon was measured at 28.27% in the elemental analysis, whereas XRD analysis did not detect carbon.
- Oxygen represents 65.43% in the EDS analysis, while 50.12% oxygen was detected in XRD analysis.
- EDS analysis detected 0.21% silicon, while XRD analysis detected 33.32% silicon.

Minor differences with respect to nitrogen, aluminum and potassium were noted in sample GR-006.

- Nitrogen was measured at 5.70% in the elemental analysis, whereas XRD analysis did not detect nitrogen.
- In the elemental analysis, aluminum forms 0.09% of the sample, while XRD analysis calculated aluminum to be 10.02%.

- EDS analysis detected 0.12% potassium, while 2.61% potassium was detected in XRD analysis.

The EDS results for carbon, nitrogen and oxygen are greater than the XRD results indicating the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. The XRD results for aluminum, silicon and potassium are greater than the EDS results indicating these elements occur in well-crystalline compounds.

Sample GR-007 showed a poor correlation between the XRD and EDS results.

Significant differences with respect to carbon and oxygen were noted in sample GR-007.

- In the elemental analysis, carbon forms 28.21% of the sample, whereas XRD analysis did not detect carbon.
- EDS analysis detected 65.55% oxygen, while XRD analysis detected trace amounts of oxygen.

A minor difference with respect to nitrogen was observed in sample GR-007.

- Nitrogen represents 6.05% in the EDS analysis, whereas XRD analysis did not detect nitrogen.

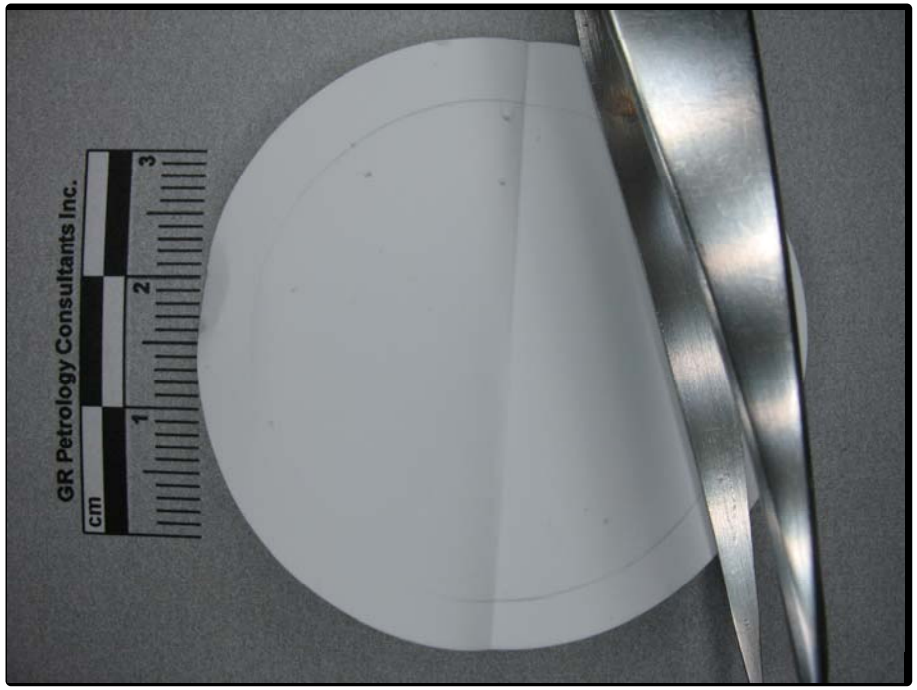
The EDS results for carbon, nitrogen and oxygen are greater than the XRD results indicating the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds.

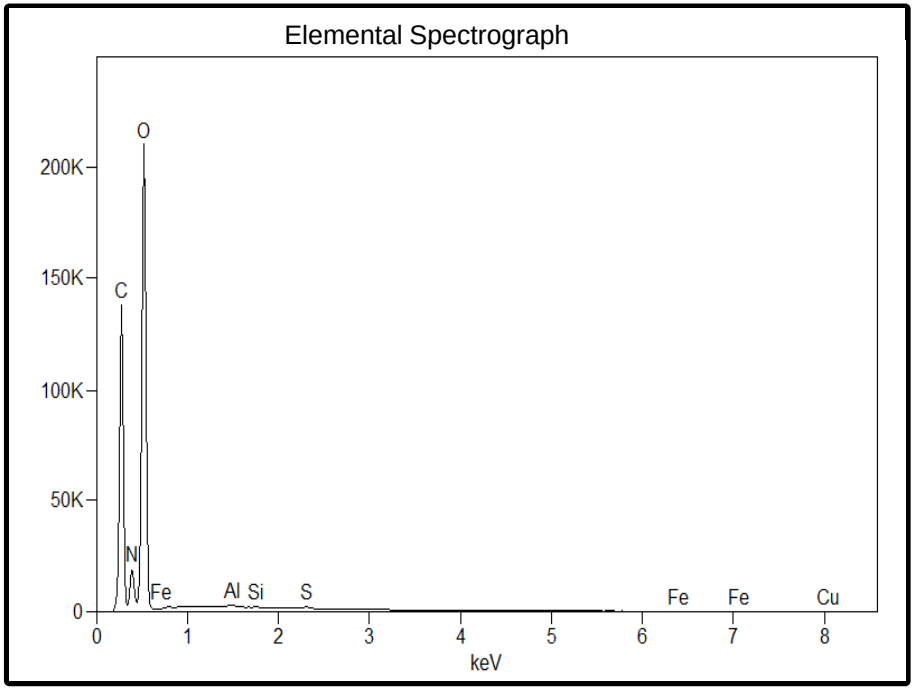
GR Petrology usually mounts filter paper on a glass slide for X-ray diffraction analysis. The X-ray beam scans an area of approximately 250mm^2; however, the electron beam in the EDS that generates the elemental analysis scans a much smaller area of approximately 6mm^2. We attempted to obtain the elemental analysis from the most representative area of the sample; however, the irregular distribution of the materials in the sample may have skewed the EDS results in some instances.

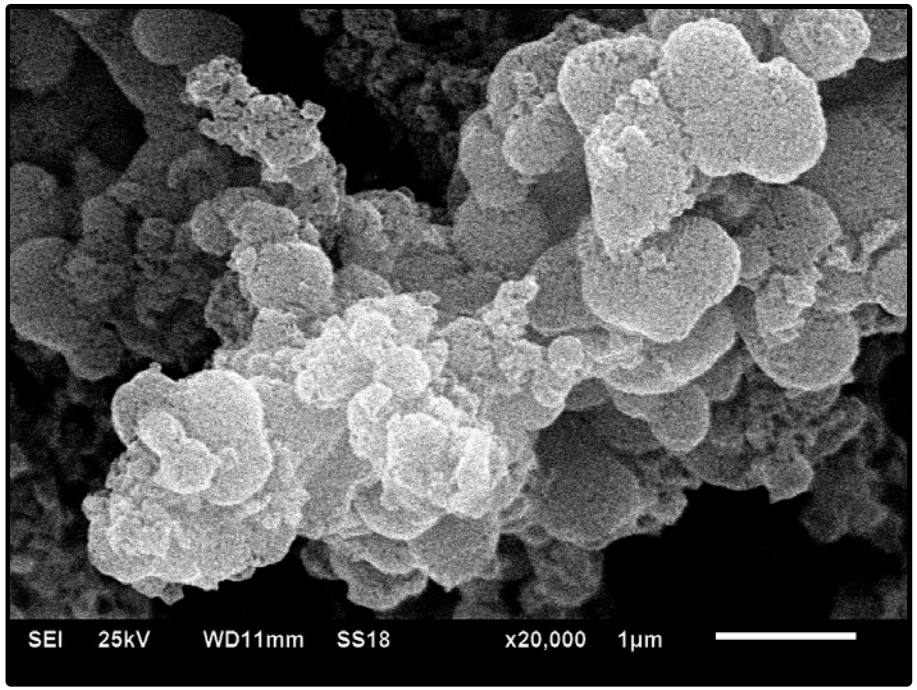
Apparent differences in the elemental weight percent calculation of the above-mentioned elements are a function of:

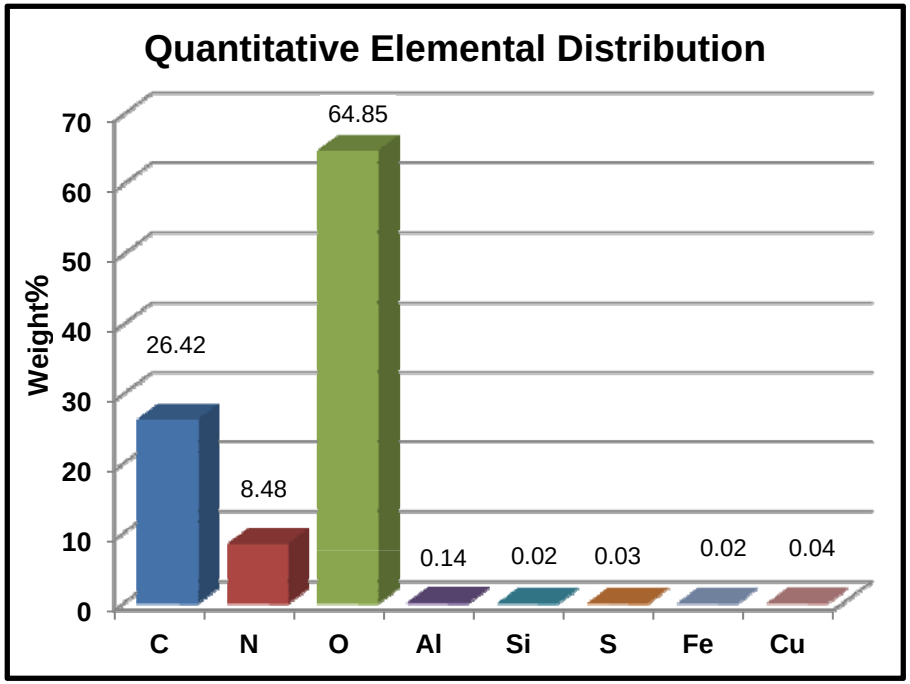
1) The presence of non-crystalline components in the sample.
2) The difference in the area analysed by both methods.
3) The affect of the filter paper on the X-ray diffractograms.

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6708-Field Blank Closed
Date Sampled: 2021/03/24 11:15









Description of Samples

GR-001: ZN6708-Field Blank Closed (2021/03/24 11:15)

The scanning electron photomicrograph on the facing page (lower left) shows sample GR-001 consists of aggregates of angular, subangular, subrounded and rounded, clay size to coarse silt size particles. The upper left photograph illustrates the bulk sample on filter paper.

Carbon (C) and oxygen (O) dominate the elemental spectrograph, respectively forming about 26.4% and 64.9% of the sample. Nitrogen (N) is moderately abundant, forming about 8.5% of the sample. Trace to minor amounts of aluminum (Al), silicon (Si), sulphur (S), iron (Fe) and copper (Cu) are present.

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of trace amounts of silicates **(quartz [SiO_2])**.

Elemental analysis shows the sample is mainly composed of carbon, nitrogen and oxygen bearing compounds which represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace volumes of aluminum, sulphur, iron and copper bearing compounds were detected during elemental analysis.

The particle size distribution histogram shows a bimodal distribution centering around 0.13 microns and 1.00 microns. Mean particle size was measured at 0.85 microns and median particle size was measured at 0.36 microns. Particles vary in size from 0.01 microns (clay size) to 32.52 microns (coarse silt size). The Quartile 3 size is 0.79 microns and the Quartile 1 size is 0.08 microns. Standard deviation was measured at 2.22 microns.

TABLE 1: EDS and XRD Results
Bureau Veritas Laboratories; Project #: C119656; Sample ID: ZN6708-Field Blank Closed; Date Sampled: 2021/03/24 11:15
GR 33361-01 2021

ELEMENTS:

DOMINANT: C, O
MODERATE: N
COMMON:
MINOR-TRACE: Al, Si, S, Fe, Cu

COMPOUNDS:

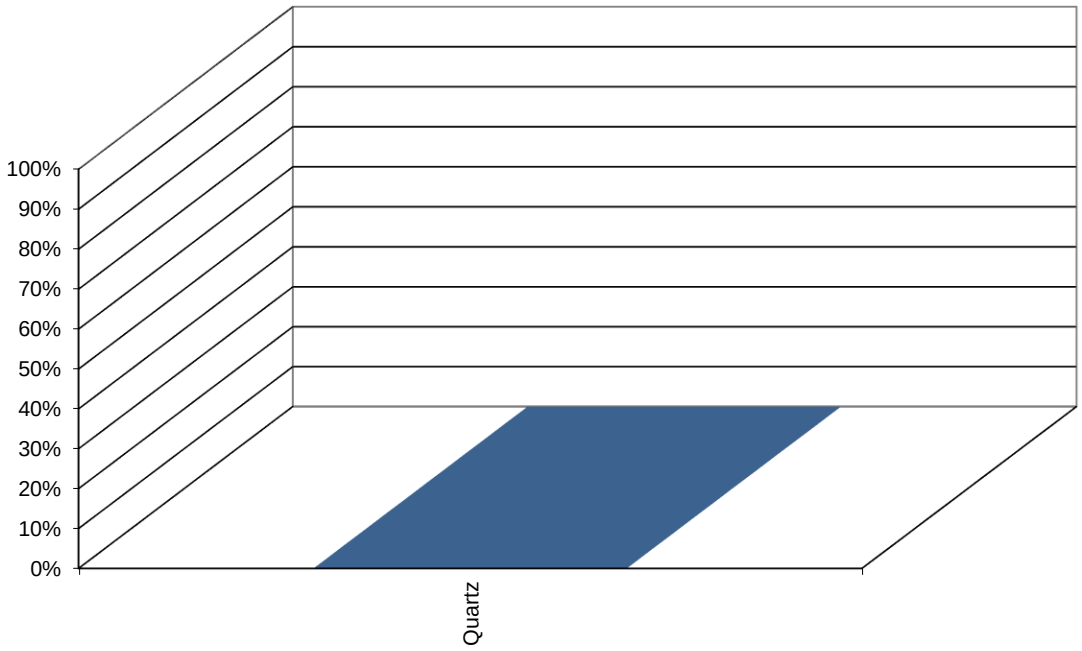
Formula	*Name*	*Percentage*
SiO_2	**Quartz**	**trace**

COMMENTS:

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of trace amounts of silicates.

Elemental analysis shows the sample is mainly composed of carbon, nitrogen and oxygen bearing compounds which represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace volumes of aluminum, sulphur, iron and copper bearing compounds were detected during elemental analysis.

ABUNDANCE OF COMPOUNDS



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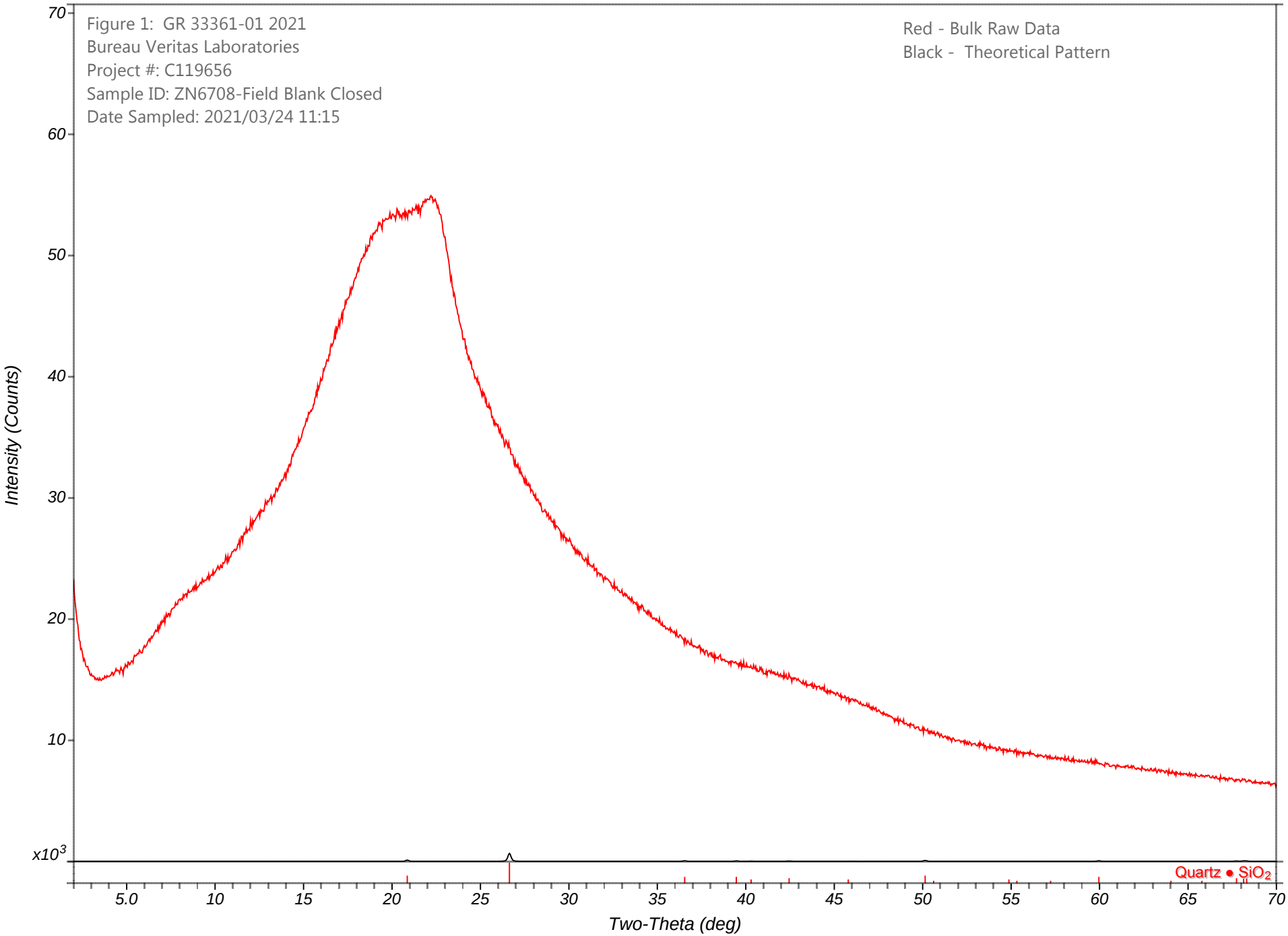
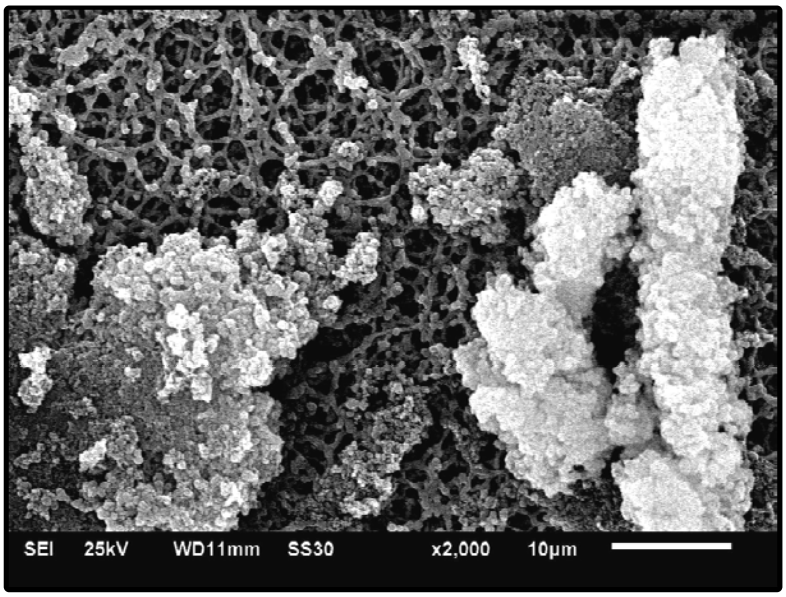
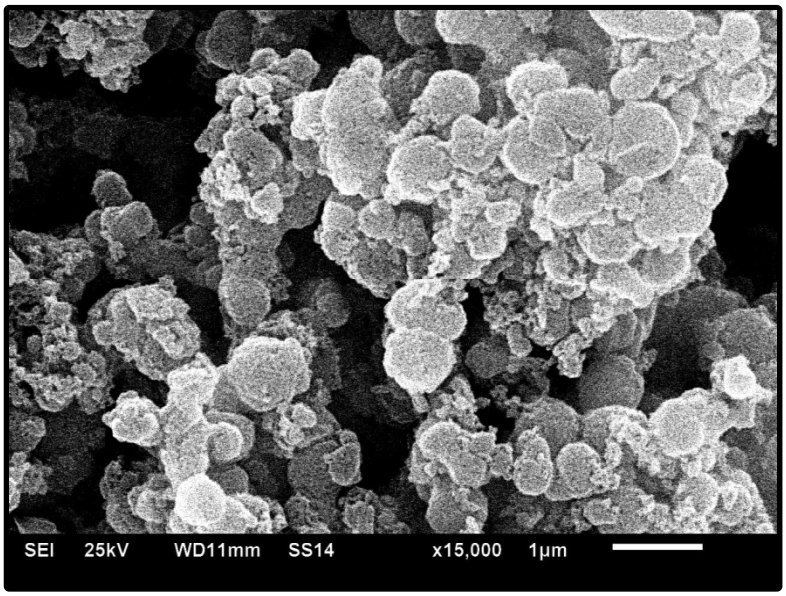
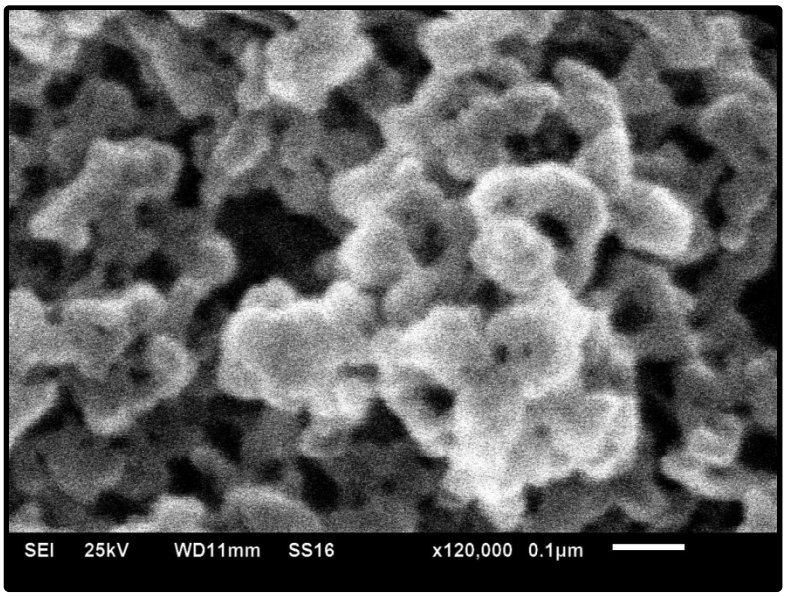


Figure 1: GR 33361-01 2021
Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZN6708-Field Blank Closed
Date Sampled: 2021/03/24 11:15
Red - Bulk Raw Data
Black - Theoretical Pattern
Intensity (Counts)
x10^3
70
60
50
40
30
20
10
5.0
10
15
20
25
30
35
40
45
50
55
60
65
70
Two-Theta (deg)
Quartz • SiO2

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6708-Field Blank Closed
Date Sampled: 2021/03/24 11:15







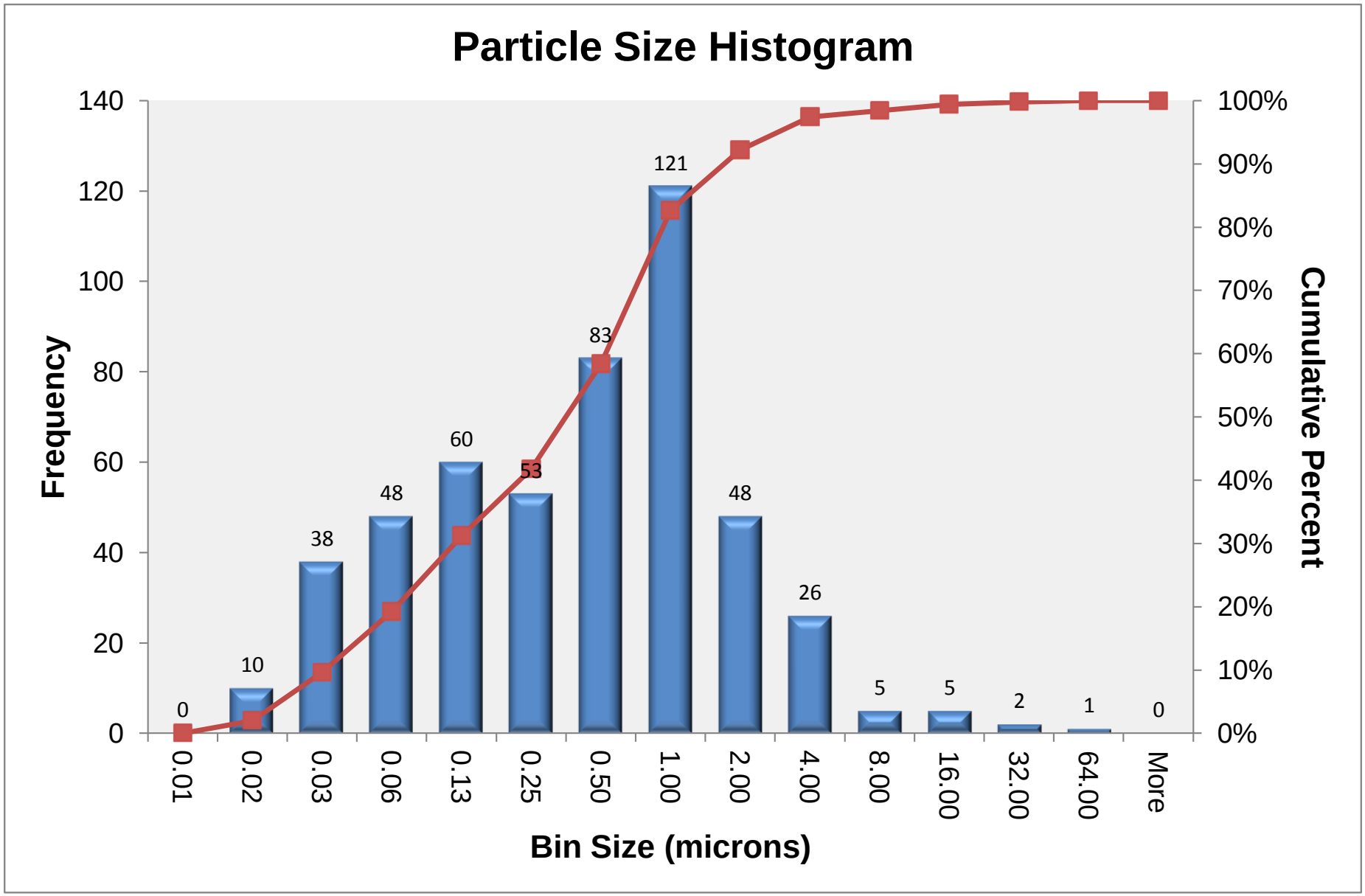
Particle Size Statistics

Size in Micrometers	
Mean	0.853
Median	0.357
Maximum	32.515
Quartile 3	0.789
Quartile 1	0.085
Minimum	0.009
Standard Deviation	2.225
Mode	0.029
Sample Variance	4.950
Kurtosis	95.861
Skewness	8.476
Range	32.506
Standard Error	0.100
Confidence Level (95%)	0.195
Sum	426.327
Count	500

Histogram Statistics

Microns	Frequency	Cumulative
0.01	0	0.00%
0.02	10	2.00%
0.03	38	9.60%
0.06	48	19.20%
0.13	60	31.20%
0.25	53	41.80%
0.50	83	58.40%
1.00	121	82.60%
2.00	48	92.20%
4.00	26	97.40%
8.00	5	98.40%
16.00	5	99.40%
32.00	2	99.80%
64.00	1	100.00%
More	0	100.00%

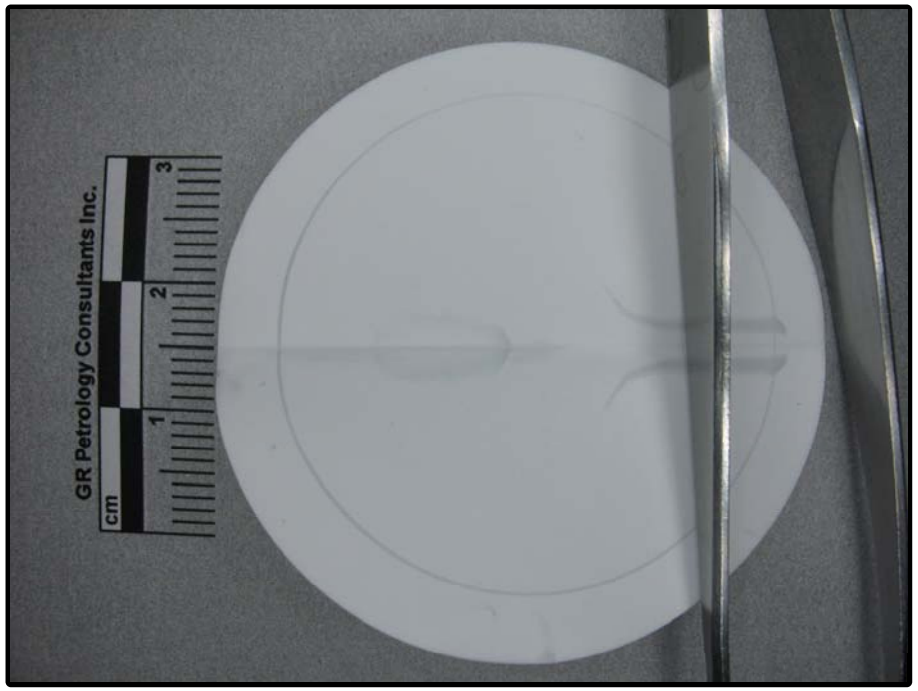
GR Petrology CONSULTANTS Inc.

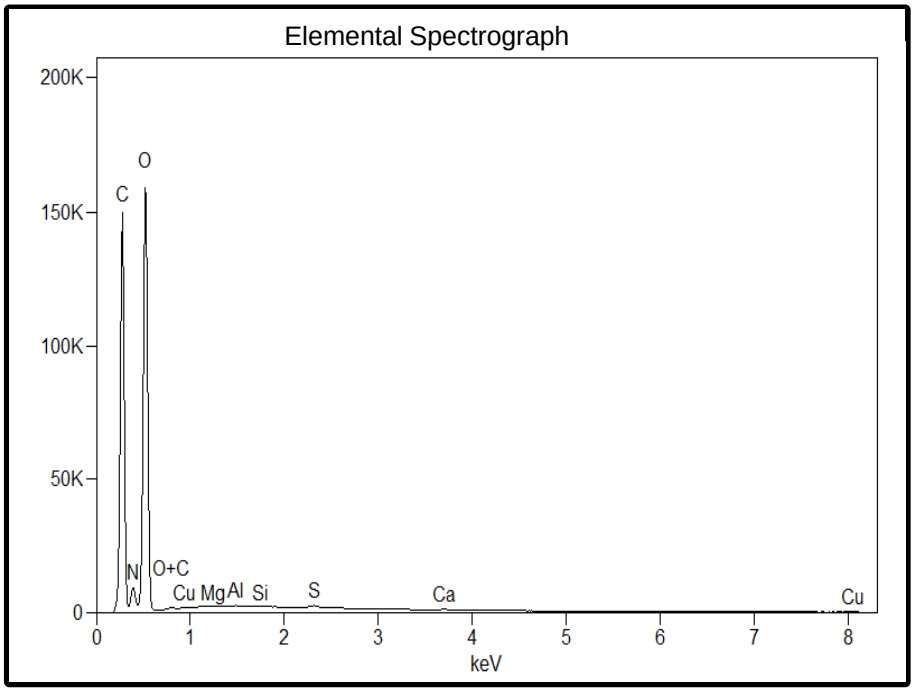

Particle Size Histogram
Frequency
Cumulative Percent
Bin Size (microns)
0
10
38
48
60
53
83
121
48
26
5
5
2
1
0
0.01
0.02
0.03
0.06
0.13
0.25
0.50
1.00
2.00
4.00
8.00
16.00
32.00
64.00
More

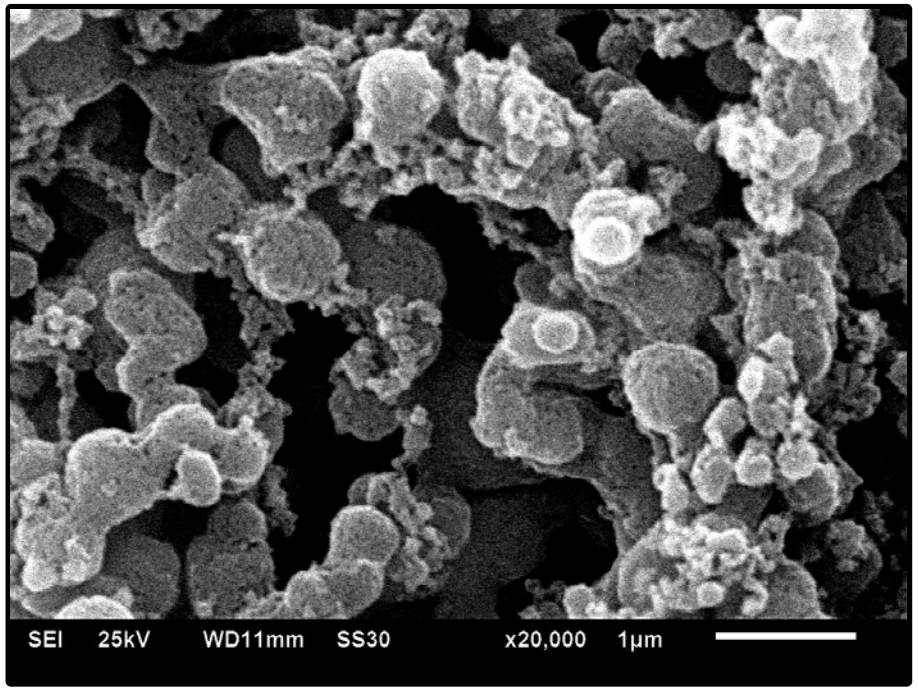
Raw Particle Size Data (microns) Number of measurements: 500

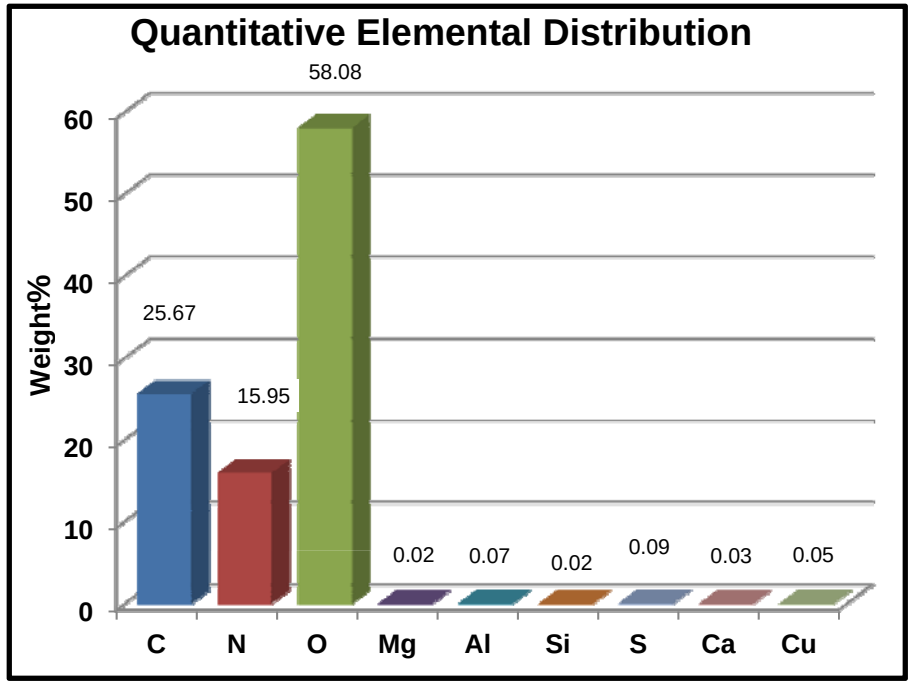
1.980	0.038	2.376	0.722	0.109	0.226	0.539	0.927	0.068	0.192
2.335	0.015	1.562	0.405	0.064	0.335	0.438	0.403	0.027	0.223
0.724	0.023	2.001	0.500	0.050	0.134	0.657	1.300	0.033	0.319
0.509	0.025	1.329	0.608	0.082	0.333	0.500	1.241	0.054	0.286
0.387	0.011	1.366	0.342	0.052	0.094	0.316	0.623	0.047	1.342
0.393	0.023	2.099	0.539	0.043	0.120	0.573	1.217	0.029	0.833
0.283	0.029	0.650	0.462	0.021	0.089	0.612	1.327	0.040	0.721
0.265	0.062	0.702	0.341	0.085	0.032	0.285	1.312	0.039	0.564
0.230	0.066	1.601	2.181	0.114	0.165	0.543	0.948	7.612	0.789
0.196	0.070	1.432	2.792	0.014	0.150	0.801	1.797	3.622	0.532
0.372	0.037	0.922	0.666	0.067	0.936	0.707	1.300	2.687	0.890
0.441	0.025	0.585	0.424	0.064	0.568	0.632	1.813	2.269	0.554
0.359	0.041	0.791	0.505	0.261	0.499	0.785	1.035	1.142	0.815
0.289	0.021	0.602	0.569	0.106	0.265	0.137	0.136	0.912	0.552
0.395	0.033	1.063	0.368	0.164	0.136	0.105	0.119	0.728	0.676
0.151	0.055	0.962	0.595	0.053	0.145	0.243	0.074	0.721	0.580
0.126	0.011	0.658	0.494	0.065	0.352	0.709	0.055	1.809	0.639
0.197	0.050	0.854	0.161	0.081	0.311	0.615	0.070	0.639	0.617
0.225	0.014	0.412	0.393	0.076	0.097	3.866	0.095	2.365	0.322
0.134	0.026	0.450	0.204	0.078	0.035	3.399	0.146	2.040	0.289
0.101	0.027	0.906	0.614	0.048	0.040	3.377	0.082	1.696	0.603
0.067	0.023	0.814	0.988	0.061	0.259	2.253	0.145	1.594	0.783
0.027	0.018	0.986	0.621	0.101	0.170	1.908	0.059	0.801	0.340
0.041	0.020	2.214	0.482	0.090	16.220	2.373	0.026	0.754	0.483
0.036	0.017	0.922	0.433	0.042	11.331	4.029	0.024	0.971	0.576
0.029	0.012	1.972	0.394	0.037	12.773	3.568	0.060	0.696	0.404
0.032	0.044	0.570	0.263	0.050	3.333	3.996	0.068	1.659	0.528
0.016	0.028	0.403	0.340	0.051	3.420	1.407	0.079	0.687	0.296
0.045	0.022	0.650	0.655	1.122	2.857	0.933	0.024	0.741	0.469
0.273	0.027	0.854	0.653	1.278	2.267	1.245	0.034	0.348	0.307
0.311	0.029	0.510	0.544	0.881	1.357	1.556	0.031	0.401	0.146
0.095	0.020	0.354	0.328	1.150	1.194	2.079	0.042	0.500	0.320
0.067	0.014	1.063	0.198	0.631	1.595	1.690	0.115	0.281	0.253
0.059	0.009	0.814	0.883	0.445	0.898	1.561	0.033	0.230	0.312
0.057	0.019	0.602	0.677	0.807	0.680	1.687	0.029	0.218	0.155
0.072	0.012	0.602	0.687	0.342	0.601	0.608	0.097	0.242	0.186
0.063	0.024	0.806	0.805	0.147	0.825	1.328	0.055	0.406	0.177
0.095	0.025	0.602	0.365	0.240	0.875	5.781	0.059	0.525	0.161
0.063	0.040	13.641	0.507	0.362	0.435	0.834	0.068	0.349	0.078
0.092	0.019	1.004	0.944	0.107	0.634	1.118	0.123	0.361	0.150
0.037	0.016	0.874	0.698	0.130	0.778	0.960	0.063	0.286	0.054
0.088	0.013	0.833	0.443	0.446	0.632	0.756	0.018	0.348	0.071
0.034	32.515	1.281	0.440	0.091	0.664	0.582	0.098	0.432	0.063
0.039	10.904	0.789	0.222	0.128	0.778	1.253	0.054	0.146	0.099
0.096	16.201	1.459	0.163	0.131	0.623	1.374	0.023	0.586	0.348
0.057	8.223	0.609	0.195	0.745	1.288	0.869	0.043	0.294	0.141
0.127	7.109	0.632	0.142	0.679	1.149	0.539	0.069	0.389	0.067
0.093	6.732	0.354	0.129	0.107	0.601	0.412	0.028	0.286	0.104
0.110	3.421	0.449	0.190	0.199	1.682	0.400	0.028	0.319	0.504
0.105	2.476	1.012	0.084	0.233	0.194	0.888	0.024	0.167	0.140

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6709-Field Blank Open
Date Sampled: 2021/03/24 11:15









GR-002: ZN6709-Field Blank Open (2021/03/24 11:15)

The scanning electron photomicrograph on the facing page (lower left) shows sample GR-002 consists of aggregates of angular, subangular, subrounded and rounded, clay size to medium silt size particles. The upper left photograph illustrates the bulk sample on filter paper.

Carbon (C) and oxygen (O) dominate the elemental spectrograph, respectively forming about 25.7% and 58.1% of the sample. Nitrogen (N) is common, forming about 16.0% of the sample. Trace to minor amounts of magnesium (Mg), aluminum (Al), silicon (Si), sulphur (S), calcium (Ca) and copper (Cu) are present.

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of trace amounts of silicates **(quartz [SiO_2]** and **silicon oxide [SiO_2])**.

Elemental analysis shows the sample is mainly composed of carbon, nitrogen and oxygen bearing compounds which represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace volumes of magnesium, aluminum, sulphur, calcium and copper bearing compounds were detected during elemental analysis.

The particle size distribution histogram shows a skewed unimodal distribution centering around 0.50 microns. Mean particle size was measured at 0.47 microns and median particle size was measured at 0.19 microns. Particles vary in size from 0.01 microns (clay size) to 19.52 microns (medium silt size). The Quartile 3 size is 0.42 microns and the Quartile 1 size is 0.06 microns. Standard deviation was measured at 1.35 microns.

TABLE 2: EDS and XRD Results
Bureau Veritas Laboratories; Project #: C119656; Sample ID: ZN6709-Field Blank Open; Date Sampled: 2021/03/24 11:15
GR 33361-02 2021

ELEMENTS:

DOMINANT: C, O
MODERATE:
COMMON: N
MINOR-TRACE: Mg, Al, Si, S, Ca, Cu

COMPOUNDS:

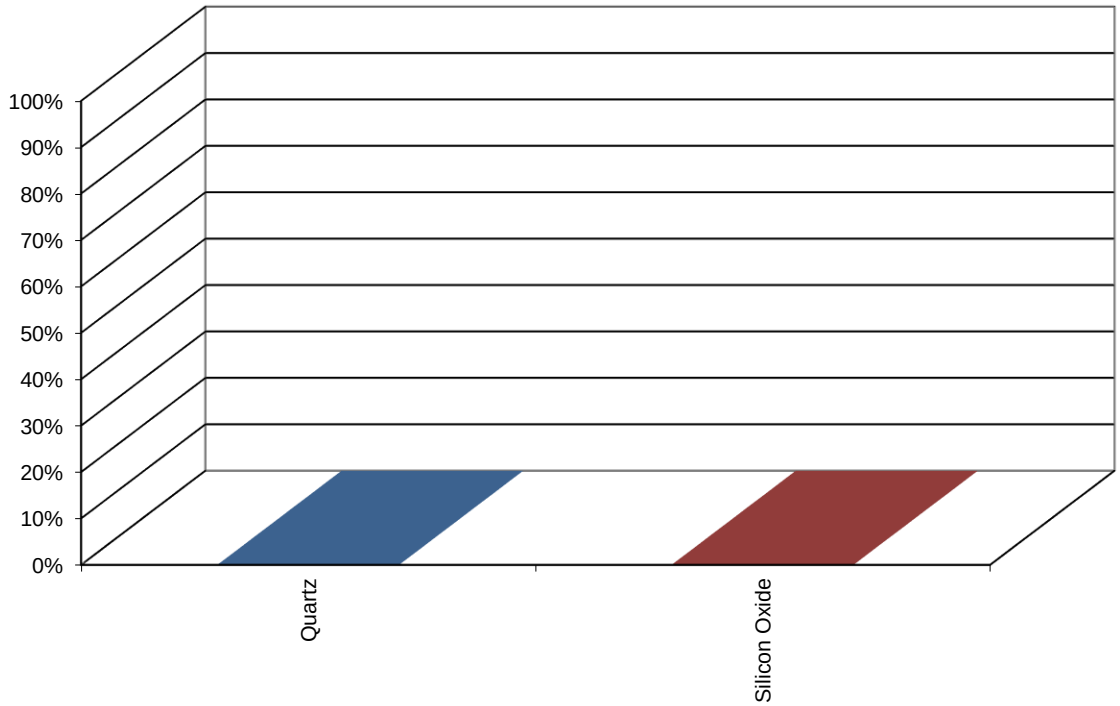
Formula	*Name*	*Percentage*
SiO_2	**Quartz**	**trace**
SiO_2	**Silicon Oxide**	**trace**

COMMENTS:

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of trace amounts of silicates.

Elemental analysis shows the sample is mainly composed of carbon, nitrogen and oxygen bearing compounds which represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace volumes of magnesium, aluminum, sulphur, calcium and copper bearing compounds were detected during elemental analysis.

ABUNDANCE OF COMPOUNDS



GR Petrology CONSULTANTS Inc.

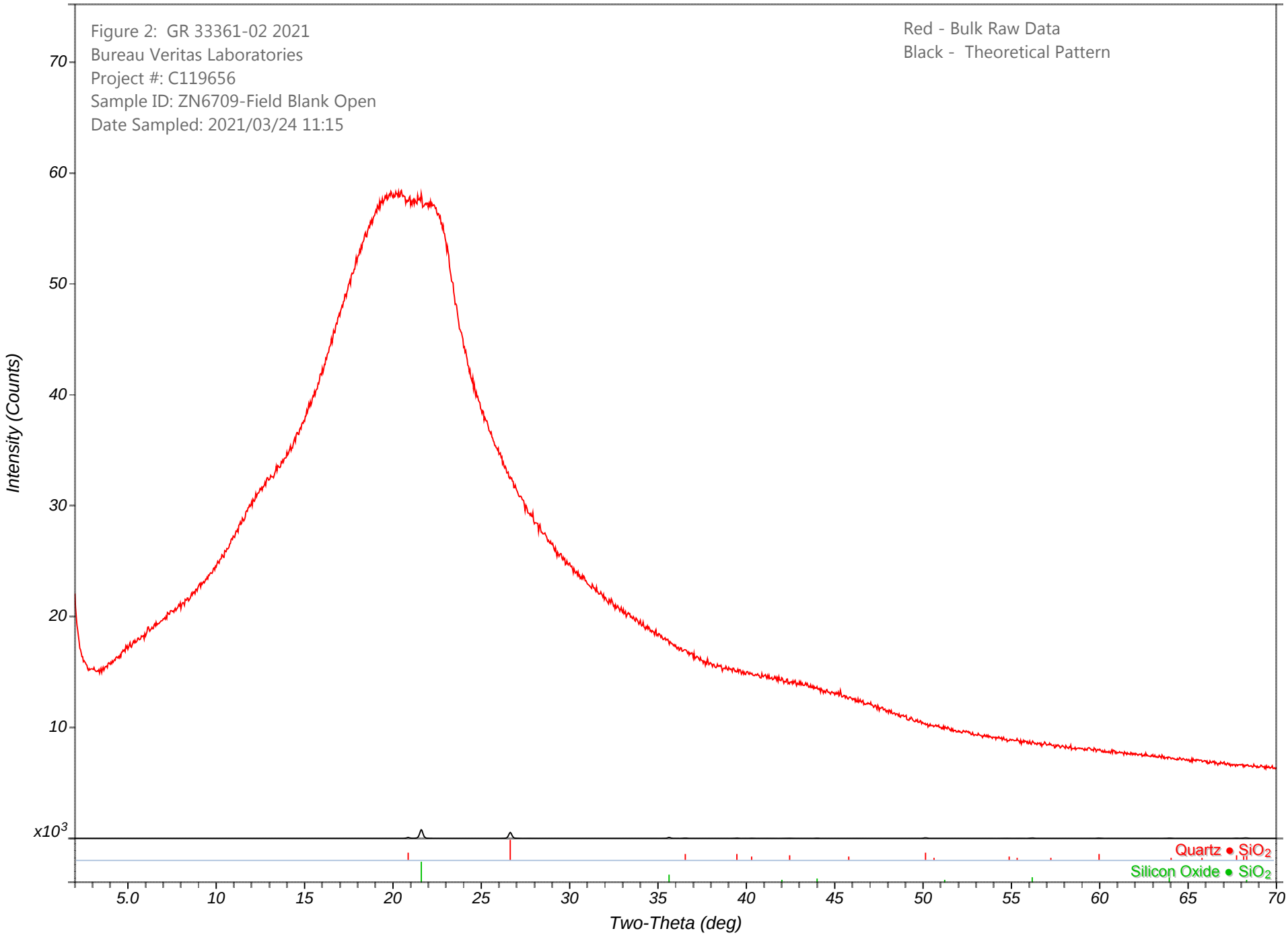
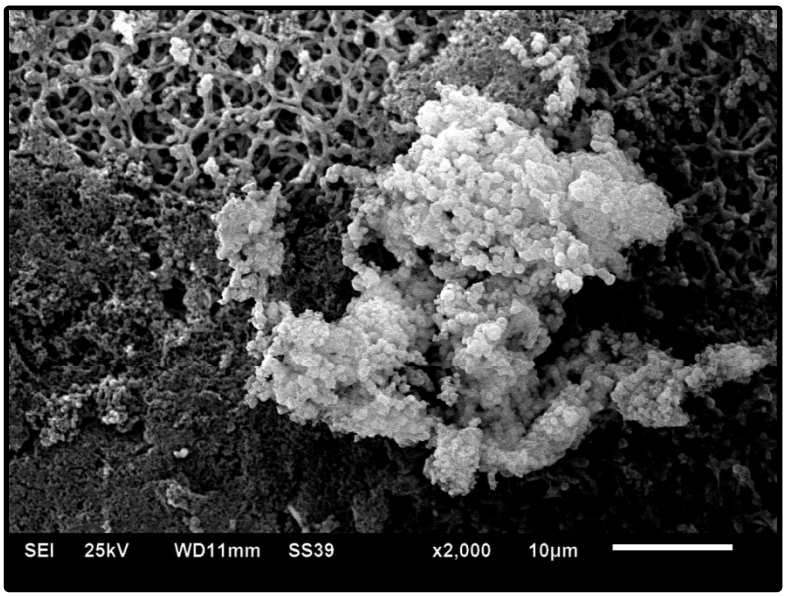
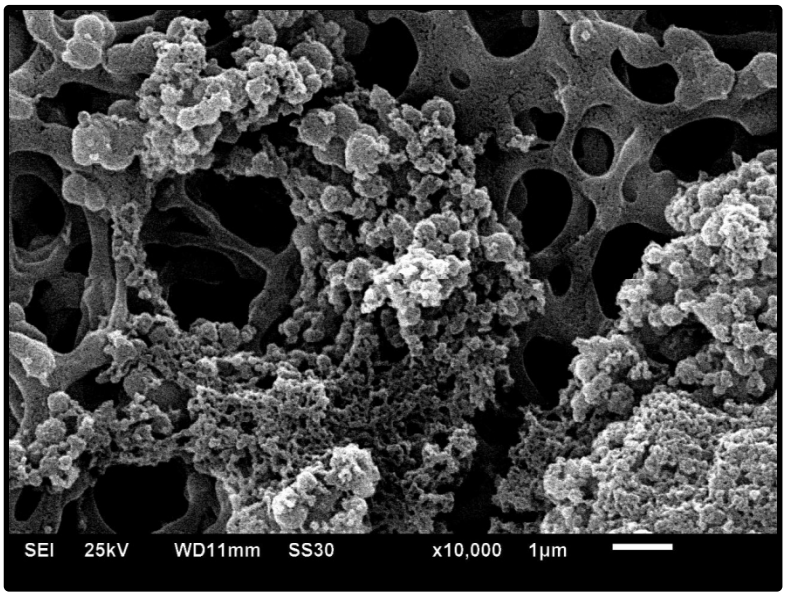
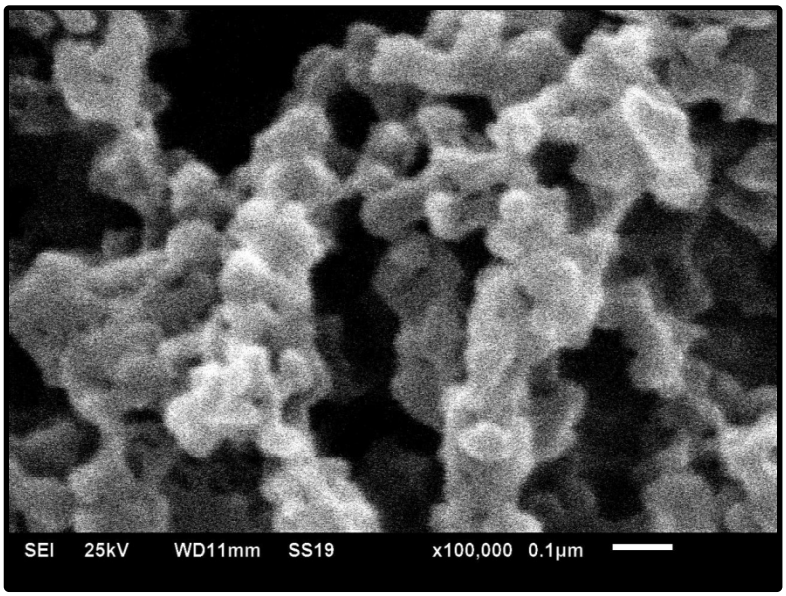


Figure 2: GR 33361-02 2021
Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZN6709-Field Blank Open
Date Sampled: 2021/03/24 11:15
Red - Bulk Raw Data
Black - Theoretical Pattern
Intensity (Counts)
x10^3
70
60
50
40
30
20
10
5.0
10
15
20
25
30
35
40
45
50
55
60
65
70
Two-Theta (deg)
Quartz • SiO2
Silicon Oxide • SiO2

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6709-Field Blank Open
Date Sampled: 2021/03/24 11:15







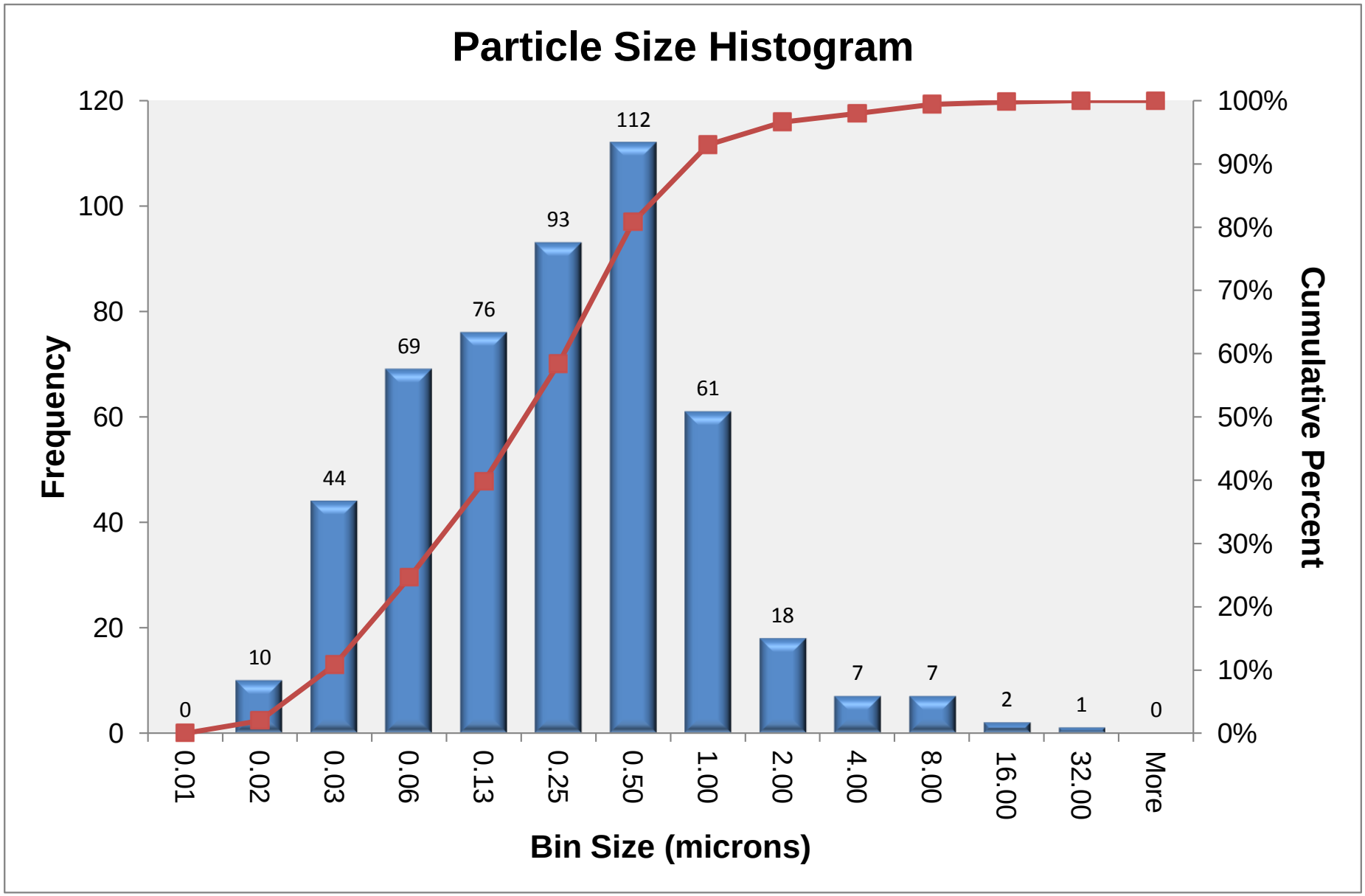
Particle Size Statistics

Size in Micrometers	
Mean	0.470
Median	0.186
Maximum	19.516
Quartile 3	0.420
Quartile 1	0.064
Minimum	0.010
Standard Deviation	1.351
Mode	0.018
Sample Variance	1.824
Kurtosis	103.043
Skewness	9.037
Range	19.506
Standard Error	0.060
Confidence Level (95%)	0.119
Sum	234.986
Count	500

Histogram Statistics

Microns	*Frequency*	*Cumulative*
0.01	0	0.00%
0.02	10	2.00%
0.03	44	10.80%
0.06	69	24.60%
0.13	76	39.80%
0.25	93	58.40%
0.50	112	80.80%
1.00	61	93.00%
2.00	18	96.60%
4.00	7	98.00%
8.00	7	99.40%
16.00	2	99.80%
32.00	1	100.00%
More	0	100.00%

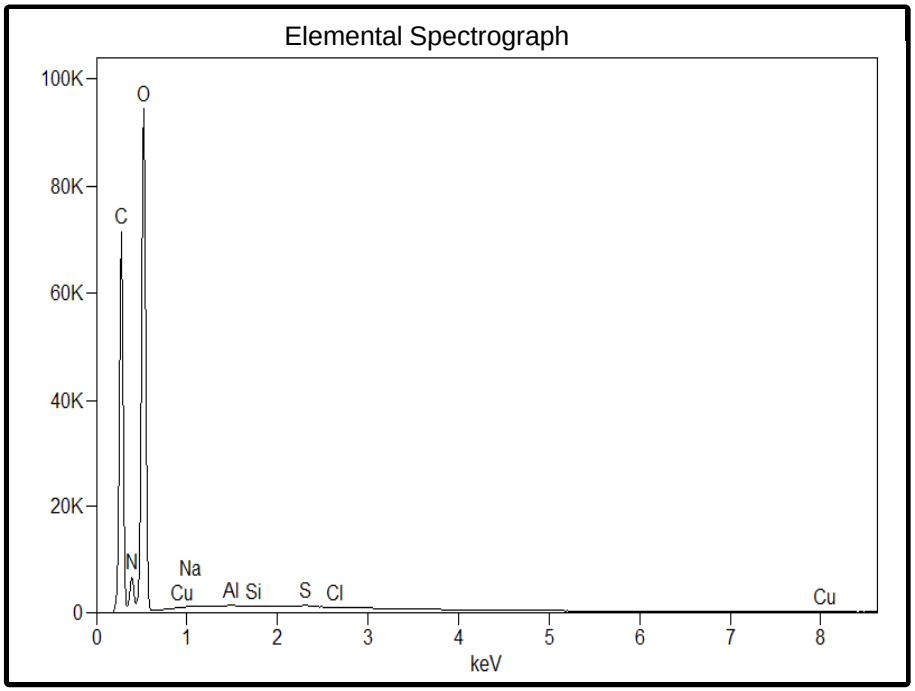
GR Petrology CONSULTANTS Inc.

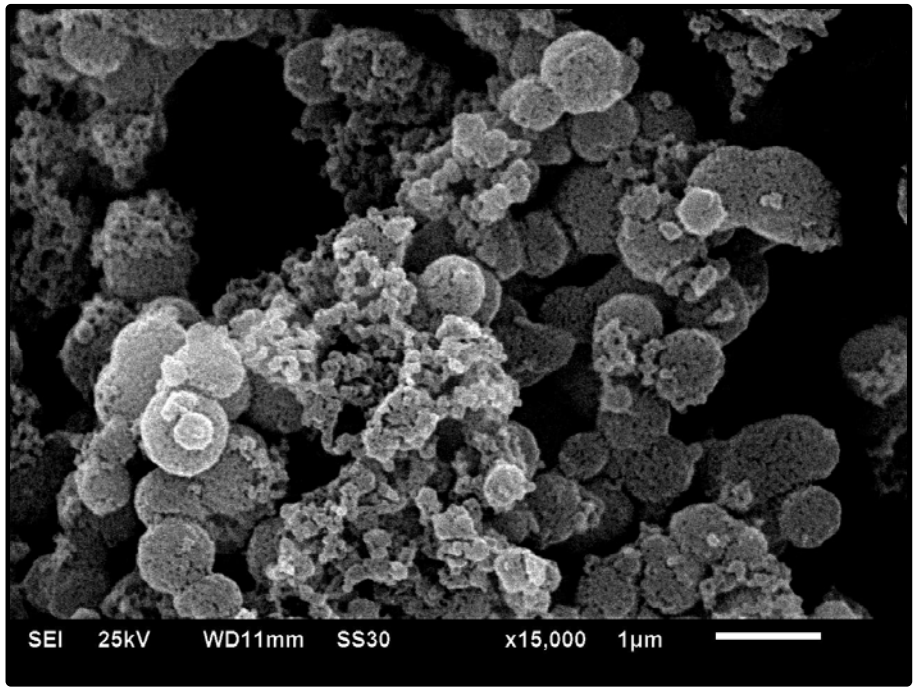

Particle Size Histogram
Frequency
Cumulative Percent
Bin Size (microns)
120
100
80
60
40
20
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
10
44
69
76
93
112
61
18
7
7
2
1
0
0.01
0.02
0.03
0.06
0.13
0.25
0.50
1.00
2.00
4.00
8.00
16.00
32.00
More

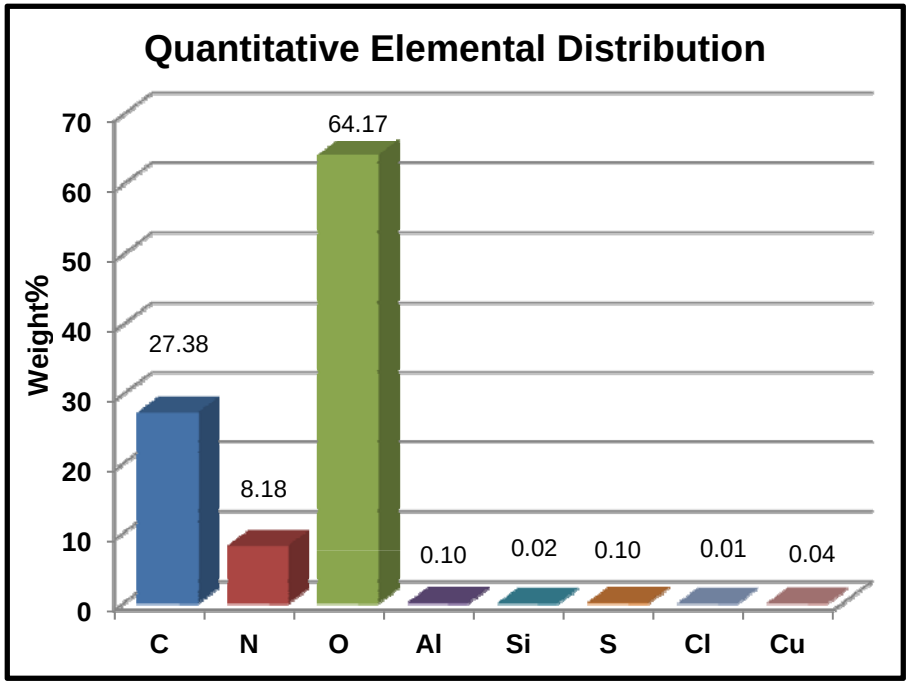
Raw Particle Size Data (microns) Number of measurements: 500

0.804	0.173	0.072	0.160	0.018	0.924	0.313	0.283	0.470	0.130
0.741	0.191	0.065	0.320	0.016	0.639	0.155	0.216	0.654	0.180
0.664	0.041	0.130	0.180	0.019	0.863	0.431	0.250	0.278	0.228
0.462	0.073	0.237	0.123	0.112	0.623	0.321	0.416	0.197	0.146
0.363	0.050	0.226	0.158	0.057	0.727	0.304	0.474	0.304	0.148
0.409	0.101	0.139	0.147	0.018	0.719	0.185	0.497	0.158	0.202
0.576	0.172	0.101	0.109	0.018	0.780	0.196	0.535	0.224	0.073
0.397	0.099	0.069	0.151	0.011	0.471	0.140	0.286	0.358	0.041
0.515	0.069	0.049	0.171	0.056	0.866	0.155	0.323	0.219	0.020
0.378	0.067	0.041	0.401	0.143	0.639	0.043	0.419	0.206	19.516
0.391	0.101	0.096	0.140	0.135	0.623	0.039	0.342	0.260	8.493
0.555	0.038	0.213	0.084	0.056	0.455	0.089	0.452	0.301	13.650
0.377	0.018	0.042	0.113	0.021	0.337	0.044	0.248	0.407	3.777
0.456	0.043	0.059	0.102	0.047	0.441	0.067	0.429	0.170	5.365
0.251	0.033	0.029	0.125	0.026	0.336	0.043	0.464	0.112	5.489
0.400	0.025	0.034	0.150	0.021	0.325	0.188	0.396	0.130	5.952
0.092	0.021	0.056	0.115	0.024	0.263	0.073	0.249	0.114	3.147
0.184	0.025	0.066	0.234	0.061	0.140	0.116	0.342	7.821	1.710
0.112	0.015	0.126	0.202	0.041	0.086	0.037	0.347	0.502	2.052
0.187	0.023	0.068	0.124	0.016	0.262	0.027	0.609	0.557	1.820
0.190	0.061	0.050	0.057	0.011	0.553	0.043	0.103	0.488	4.306
0.088	0.024	0.051	0.052	0.012	0.429	0.035	0.218	0.515	1.061
0.122	0.024	0.086	0.046	0.079	0.316	0.054	0.094	0.293	1.200
0.278	0.036	0.192	0.058	0.051	0.259	0.206	0.164	0.440	0.765
0.068	0.050	0.053	0.086	0.061	0.280	0.042	0.426	0.253	2.093
0.153	0.042	1.122	0.038	0.100	0.255	0.365	1.256	0.112	1.044
0.196	0.045	1.174	0.031	0.060	0.146	0.261	0.640	0.492	0.585
0.134	0.041	0.678	0.051	0.051	0.087	0.077	0.750	0.496	1.315
0.096	0.022	0.683	0.031	0.051	0.120	0.091	0.636	0.330	0.791
0.063	0.062	0.659	0.100	0.023	0.105	0.155	0.379	0.180	1.061
0.104	0.010	0.600	0.055	0.026	0.267	0.150	0.432	0.200	1.150
0.176	0.027	0.392	0.048	0.018	0.124	0.063	0.477	0.364	0.450
0.075	0.022	0.419	0.031	0.060	0.105	0.154	0.421	0.322	1.000
0.104	0.018	0.363	0.026	0.048	0.099	0.137	0.398	0.361	0.650
0.064	0.709	0.100	0.016	0.025	0.150	7.458	0.546	0.301	0.522
0.024	0.338	0.166	0.036	0.010	0.081	4.501	0.538	0.250	0.750
0.070	0.581	0.158	0.037	0.013	0.146	1.906	0.282	0.297	0.658
0.032	0.484	0.307	0.040	0.022	0.070	2.000	0.206	0.640	1.079
0.183	0.312	0.253	0.064	0.020	0.058	2.090	0.280	0.114	1.350
0.260	0.236	0.241	0.018	0.097	0.045	1.895	0.345	0.170	0.403
0.193	0.221	0.318	0.054	0.071	0.049	2.483	0.275	0.110	0.474
0.127	0.297	0.107	0.014	0.023	0.117	2.128	0.674	0.094	0.632
0.546	0.291	0.157	0.011	0.045	0.508	1.049	0.342	0.061	0.200
0.370	0.319	0.115	0.029	0.029	0.544	0.648	0.161	0.108	0.900
0.320	0.353	0.173	0.056	0.062	0.544	0.991	0.231	0.238	0.391
0.380	0.181	0.108	0.051	0.056	0.311	1.575	0.228	0.549	0.403
0.271	0.273	0.326	0.071	0.030	0.248	0.786	0.208	0.466	0.354
0.303	0.158	0.742	0.021	0.058	0.592	0.877	0.212	0.143	0.224
0.236	0.196	0.453	0.025	0.015	0.575	0.943	0.432	0.089	0.680
0.110	0.058	0.263	0.031	0.033	0.478	0.432	0.260	0.191	0.600

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6710-Sieve Control 1
Date Sampled: 2021/03/24 16:57







GR-003: ZN6710-Sieve Control 1 (2021/03/24 16:57)

The scanning electron photomicrograph on the facing page (lower left) shows sample GR-003 consists of aggregates of angular, subangular, subrounded and rounded, clay size to fine sand size particles. The upper left photograph illustrates the bulk sample on filter paper.

Carbon (C) and oxygen (O) dominate the elemental spectrograph, respectively forming about 27.4% and 64.2% of the sample. Nitrogen (N) is moderately abundant, forming about 8.2% of the sample. Trace to minor amounts of aluminum (Al), silicon (Si), sulphur (S), chlorine (Cl) and copper (Cu) are present.

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds or there is insufficient sample. X-ray diffraction analysis shows the crystalline components of the sample consist of trace amounts of silicates **(quartz [SiO_2])**.

Elemental analysis shows the sample is mainly composed of carbon, nitrogen and oxygen bearing compounds which represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace volumes of aluminum, sulphur, chlorine and copper bearing compounds were detected during elemental analysis.

The particle size distribution histogram shows a polymodal distribution centering around 0.03 microns, 1.00 microns, 8.00 microns, 32.00 microns and 256.00 microns. Mean particle size was measured at 3.05 microns and median particle size was measured at 0.34 microns. Particles vary in size from 0.01 microns (clay size) to 196.48 microns (fine sand size). The Quartile 3 size is 0.85 microns and the Quartile 1 size is 0.09 microns. Standard deviation was measured at 13.50 microns.

TABLE 3: EDS and XRD Results
Bureau Veritas Laboratories; Project #: C119656; Sample ID: ZN6710-Sieve Control 1; Date Sampled: 2021/03/24 16:57
GR 33361-03 2021

ELEMENTS:

DOMINANT: C, O
MODERATE: N
COMMON:
MINOR-TRACE: Al, Si, S, Cl, Cu

COMPOUNDS:

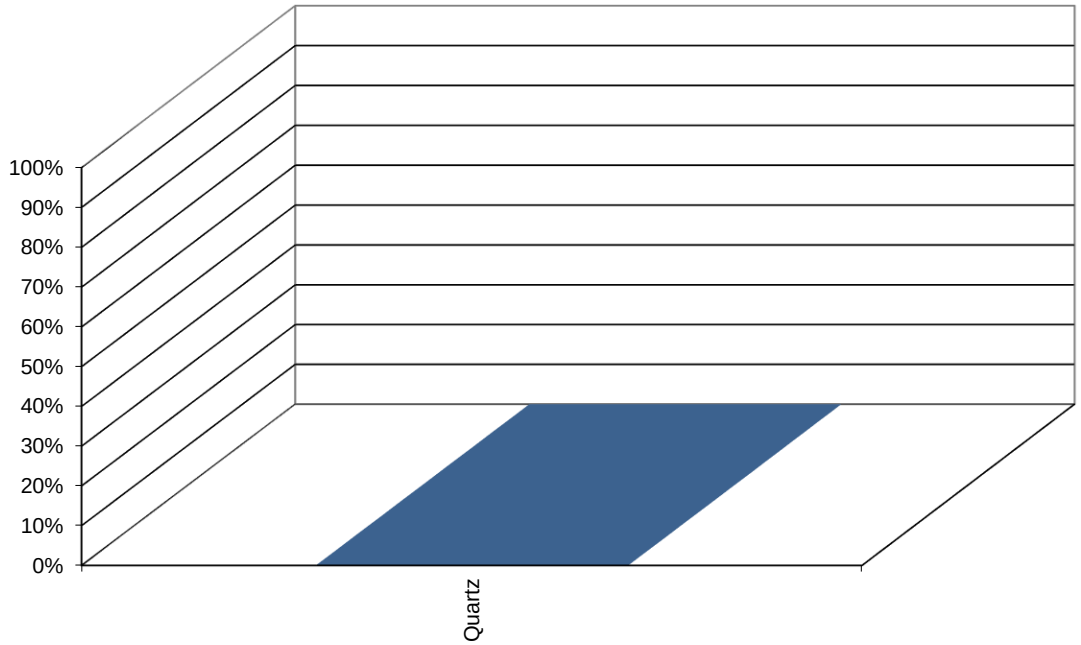
Formula	*Name*	*Percentage*
SiO_2	**Quartz**	**trace**

COMMENTS:

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of trace amounts of silicates.

Elemental analysis shows the sample is mainly composed of carbon, nitrogen and oxygen bearing compounds which represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace volumes of aluminum, sulphur, chlorine and copper bearing compounds were detected during elemental analysis.

ABUNDANCE OF COMPOUNDS



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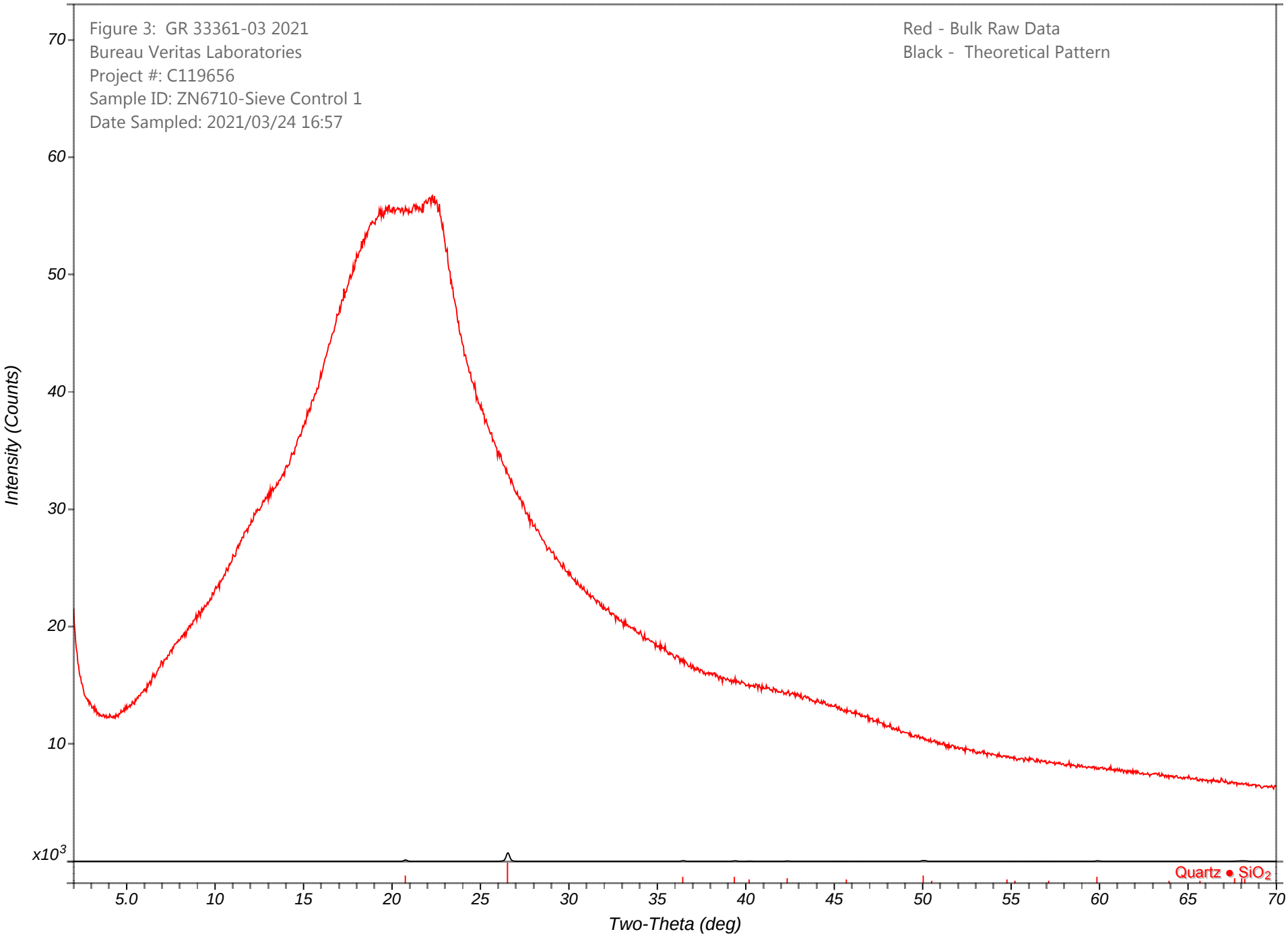
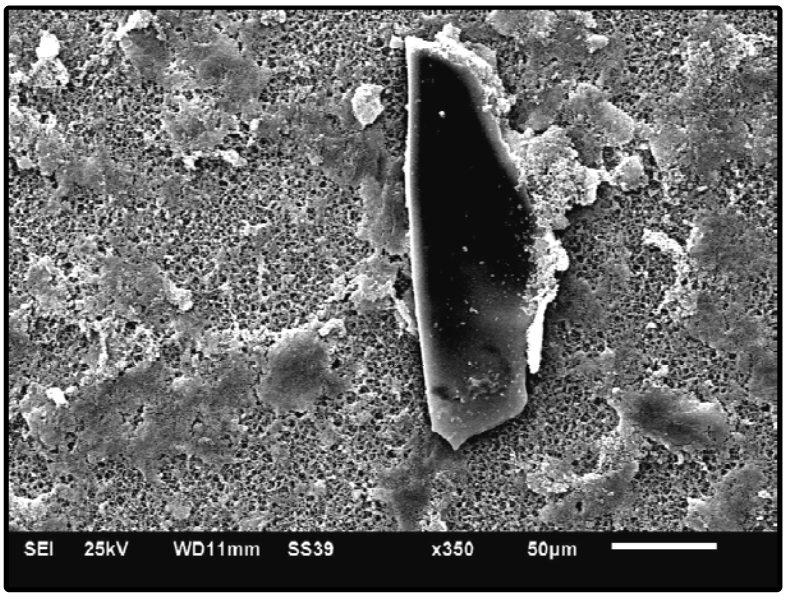
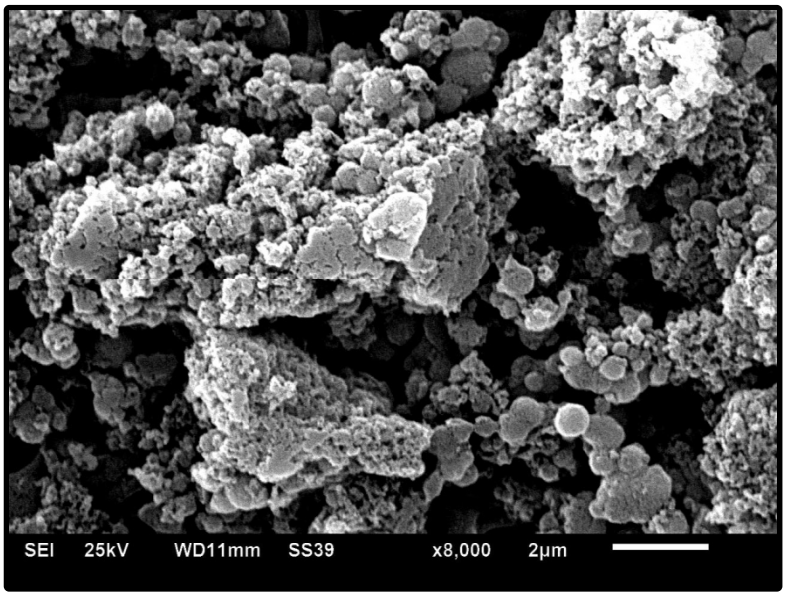
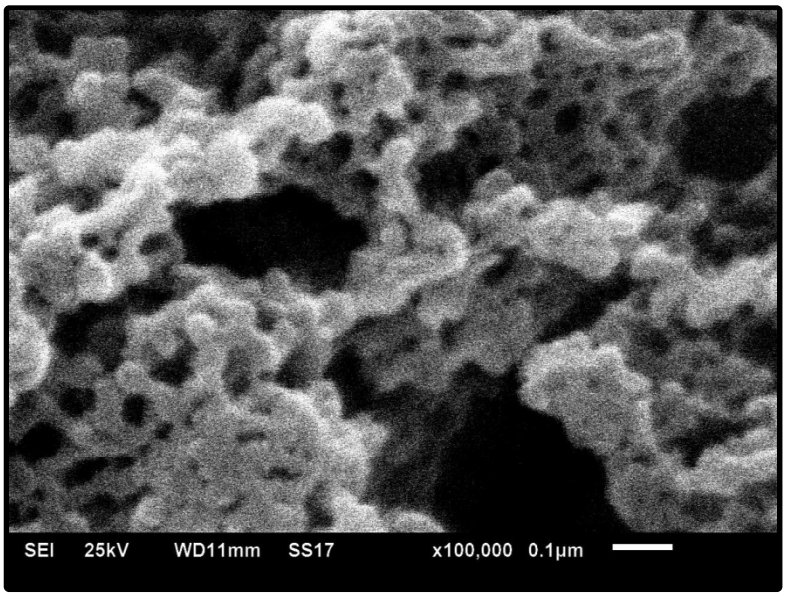


Figure 3: GR 33361-03 2021
Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZN6710-Sieve Control 1
Date Sampled: 2021/03/24 16:57
Red - Bulk Raw Data
Black - Theoretical Pattern
Intensity (Counts)
x10^3
70
60
50
40
30
20
10
5.0
10
15
20
25
30
35
40
45
50
55
60
65
70
Two-Theta (deg)
Quartz • SiO2

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6710-Sieve Control 1
Date Sampled: 2021/03/24 16:57







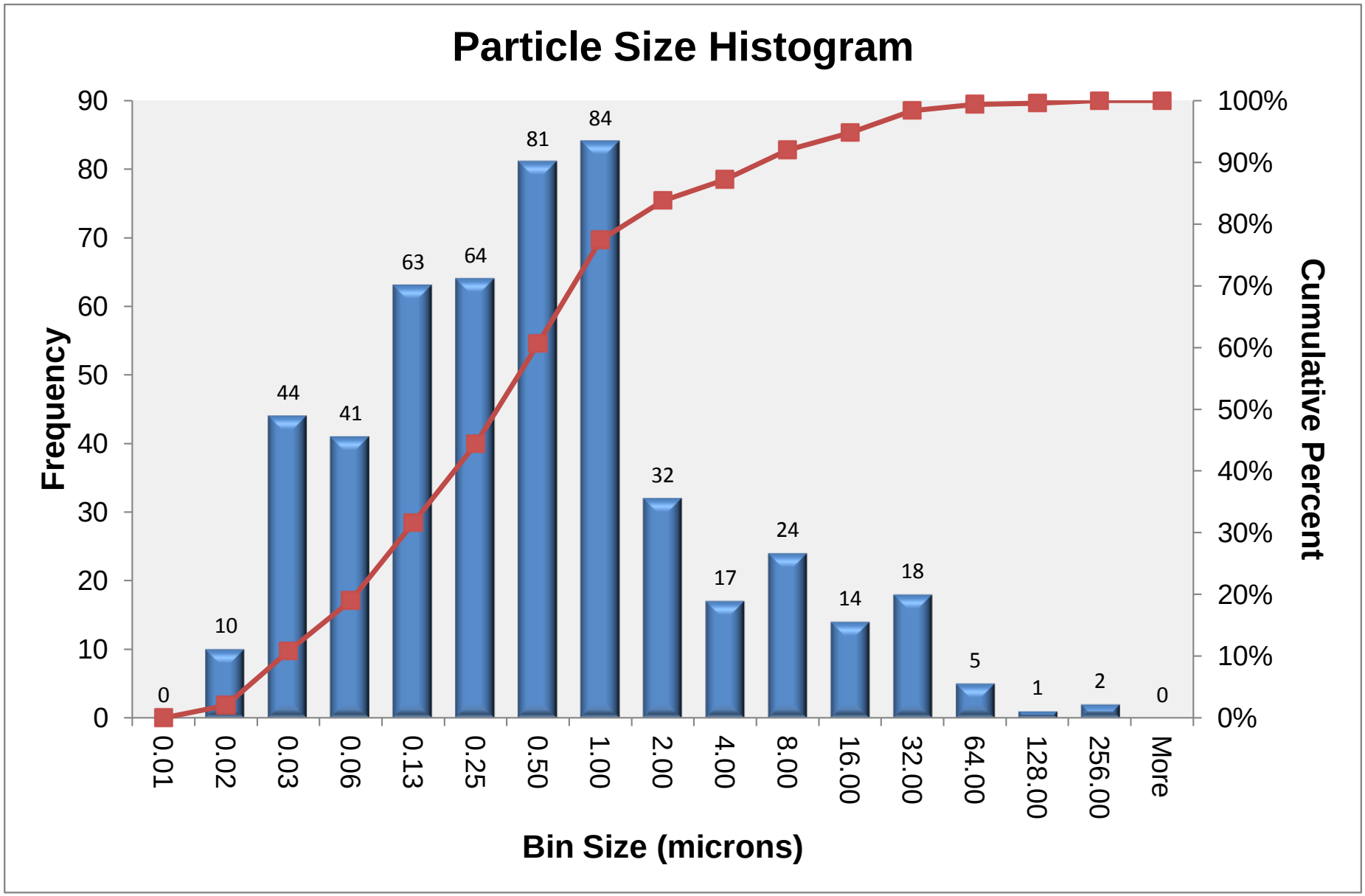
Particle Size Statistics

Size in Micrometers	
Mean	3.048
Median	0.343
Maximum	196.479
Quartile 3	0.850
Quartile 1	0.089
Minimum	0.010
Standard Deviation	13.498
Mode	0.027
Sample Variance	182.205
Kurtosis	146.162
Skewness	11.099
Range	196.469
Standard Error	0.604
Confidence Level (95%)	1.186
Sum	1524.041
Count	500

Histogram Statistics

Microns	Frequency	Cumulative
0.01	0	0.00%
0.02	10	2.00%
0.03	44	10.80%
0.06	41	19.00%
0.13	63	31.60%
0.25	64	44.40%
0.50	81	60.60%
1.00	84	77.40%
2.00	32	83.80%
4.00	17	87.20%
8.00	24	92.00%
16.00	14	94.80%
32.00	18	98.40%
64.00	5	99.40%
128.00	1	99.60%
256.00	2	100.00%
More	0	100.00%

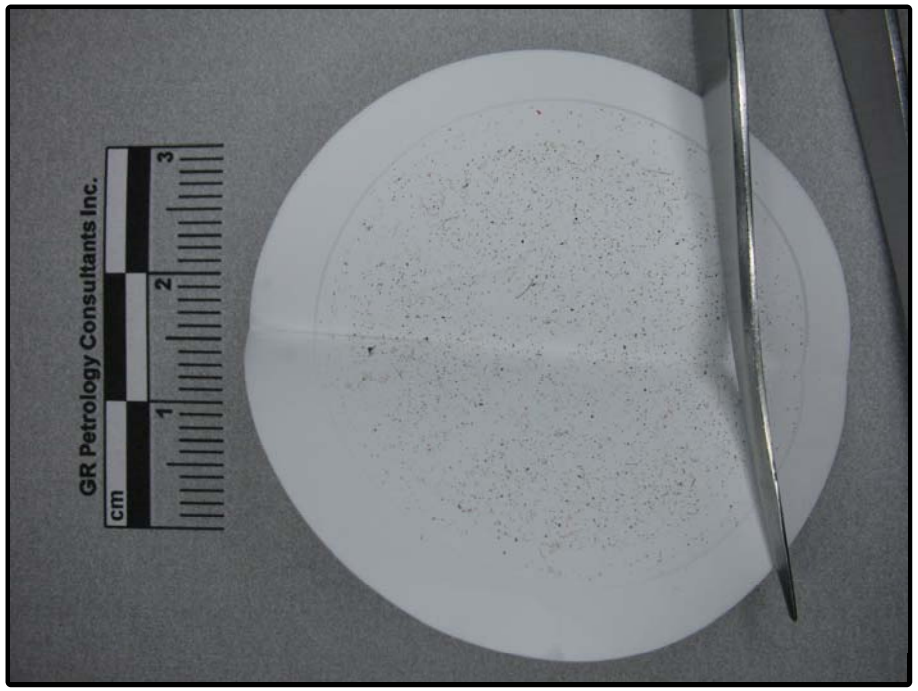
GR Petrology CONSULTANTS Inc.

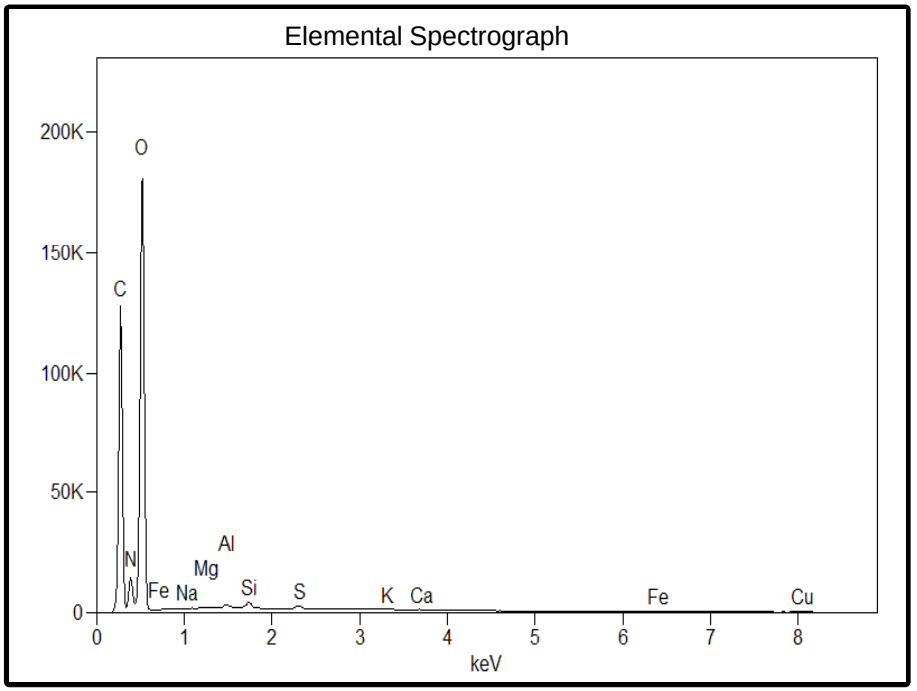

Particle Size Histogram
Frequency
Cumulative Percent
Bin Size (microns)
0
10
44
41
63
64
81
84
32
17
24
14
18
5
1
2
0
0.01
0.02
0.03
0.06
0.13
0.25
0.50
1.00
2.00
4.00
8.00
16.00
32.00
64.00
128.00
256.00
More

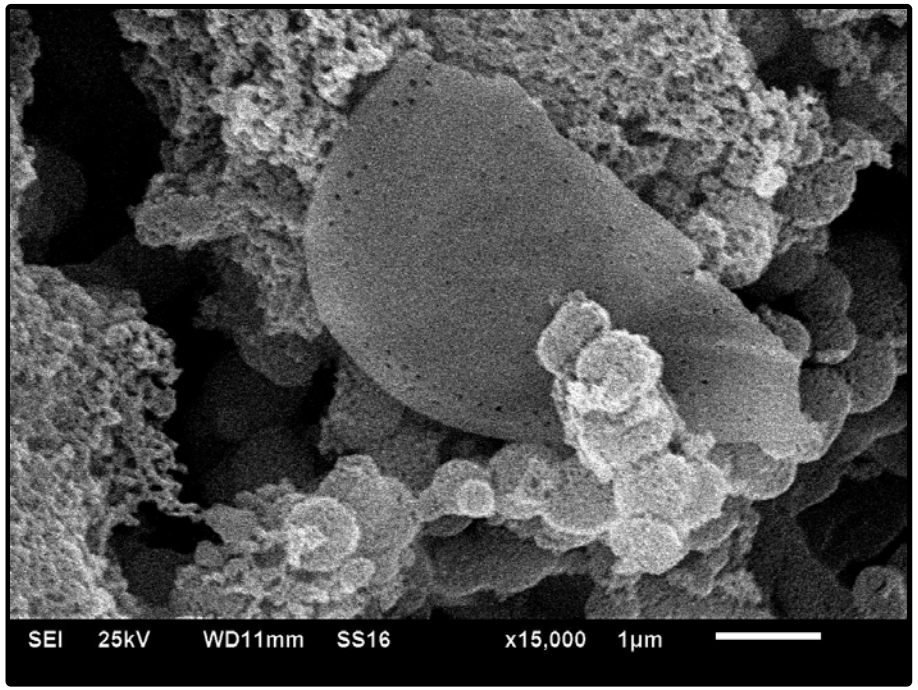
Raw Particle Size Data (microns) Number of measurements: 500

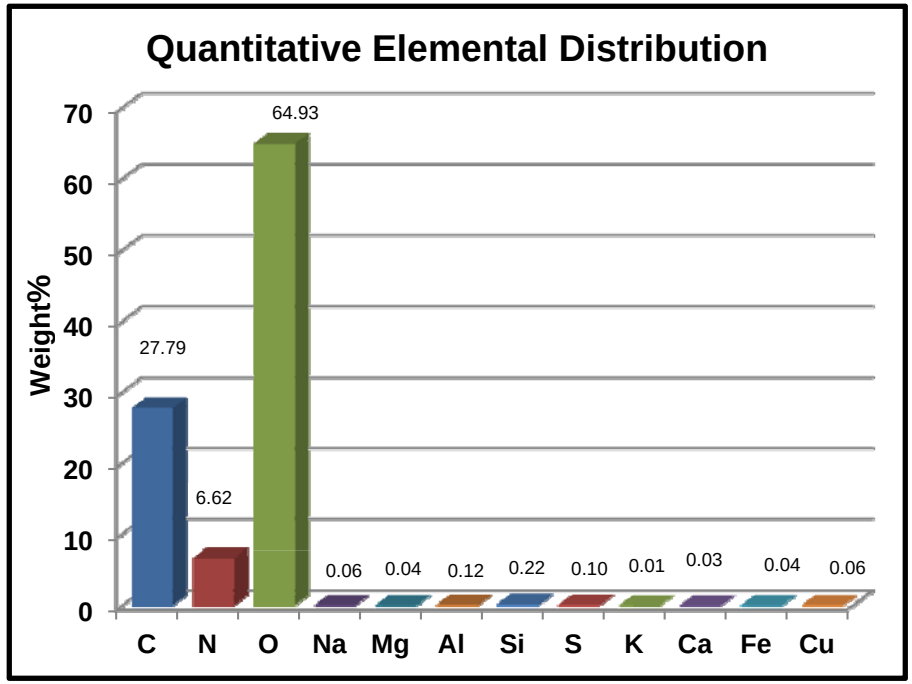
196.479	19.400	0.500	0.132	0.033	0.310	0.120	0.064	0.572	0.825
54.338	25.042	0.280	0.104	0.027	0.072	0.091	0.103	1.086	0.500
65.968	18.004	0.922	0.070	0.025	0.196	0.027	0.089	0.920	0.344
31.698	26.947	0.406	0.052	0.020	0.547	0.048	0.055	0.486	0.398
39.147	19.893	0.211	0.032	0.082	0.383	0.151	0.059	0.461	0.471
33.406	26.753	0.443	0.085	0.045	0.057	0.090	0.101	0.555	1.004
15.167	23.963	0.228	1.342	0.025	0.085	0.051	0.077	0.861	0.304
18.626	9.402	0.354	1.172	0.035	0.191	0.046	0.153	0.334	0.286
21.618	16.260	0.899	0.801	0.018	0.051	0.180	0.088	0.707	0.805
34.023	8.884	0.149	0.969	0.012	0.040	0.122	0.029	0.774	0.794
11.432	4.534	0.133	0.594	0.028	0.080	0.091	0.017	0.716	0.244
18.324	1.200	0.249	0.585	0.015	0.114	0.060	0.019	0.458	0.256
12.229	1.265	0.243	0.746	0.016	0.208	0.157	0.025	0.487	3.165
10.065	4.327	0.136	0.582	0.012	0.177	0.106	0.035	0.802	3.300
7.798	3.606	0.131	0.713	0.028	0.113	0.276	0.021	0.539	1.416
7.500	0.894	0.214	0.502	0.016	0.054	0.154	0.020	0.425	0.906
34.537	1.281	0.461	0.699	0.022	0.057	0.058	0.015	0.384	1.492
19.437	1.020	1.055	0.405	0.039	0.093	0.106	0.031	0.796	1.353
20.268	0.800	0.900	0.188	0.018	0.076	0.073	0.019	0.831	0.693
10.506	0.566	1.128	0.266	0.017	0.040	0.068	0.030	1.177	0.689
12.971	1.077	0.765	0.603	0.027	0.410	0.022	0.047	0.755	0.397
6.664	0.447	0.507	0.597	0.020	0.531	0.021	0.024	0.452	0.565
20.571	0.632	0.751	0.339	0.029	0.476	0.030	0.027	0.805	0.639
15.056	4.104	0.636	0.355	0.022	0.236	0.023	0.024	0.257	0.368
10.302	1.200	0.731	0.458	0.010	0.136	0.074	0.078	2.515	0.406
4.371	1.562	0.551	0.560	0.013	0.187	0.327	0.079	3.853	0.388
2.176	1.166	0.382	0.322	0.012	0.410	0.123	0.028	3.360	0.363
5.459	1.217	0.252	0.397	0.012	0.304	0.097	0.030	6.671	0.593
6.266	6.077	0.846	0.223	0.026	0.257	0.145	0.013	3.903	0.510
8.241	0.829	0.356	0.167	0.022	0.401	0.038	0.035	2.269	0.388
4.990	1.153	0.252	0.100	0.029	0.682	0.100	0.035	6.100	0.334
6.240	0.662	0.243	0.226	0.027	0.064	0.147	0.021	3.247	0.186
5.945	0.442	0.307	0.511	1.631	0.090	0.054	0.036	2.739	0.236
4.990	0.663	0.128	0.019	1.138	0.091	0.068	0.018	2.486	0.222
4.998	0.534	0.092	0.613	0.965	0.212	0.051	0.015	2.309	0.213
4.463	0.427	0.287	0.155	2.338	0.280	0.069	22.234	1.837	0.453
3.725	0.881	0.410	0.109	1.468	0.181	0.069	2.574	0.802	0.230
4.286	1.341	0.339	0.173	0.647	0.138	0.054	1.048	0.521	0.152
2.634	0.654	0.270	0.377	0.796	0.103	0.160	1.804	1.152	0.202
181.400	0.467	0.097	0.450	0.473	0.052	0.086	1.289	0.912	0.225
14.401	0.507	0.074	0.490	0.731	0.095	0.019	1.975	0.376	0.045
5.235	0.327	0.062	0.190	0.530	0.060	0.084	0.389	0.639	0.178
5.099	0.341	0.137	0.265	0.667	0.128	0.089	0.489	0.492	0.240
22.969	0.382	0.120	0.063	0.228	0.057	0.038	0.506	0.499	0.276
21.384	0.502	0.141	0.172	0.212	0.086	0.024	0.663	0.754	0.225
10.826	0.525	0.061	0.139	0.247	0.069	0.094	1.013	0.865	0.302
5.235	0.521	0.145	0.067	0.060	0.146	0.119	0.517	0.631	0.459
4.025	0.310	0.064	0.042	0.048	0.070	0.105	1.229	0.486	0.151
4.903	0.710	0.068	0.043	0.091	0.089	0.093	0.202	0.473	0.163
11.044	0.543	0.207	0.051	0.353	0.048	0.074	0.534	0.563	0.240

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6711-Sieve Sample 1
Date Sampled: 2021/03/24 11:57









GR-004: ZN6711-Sieve Sample 1 (2021/03/24 11:57)

The scanning electron photomicrograph on the facing page (lower left) shows sample GR-004 consists of aggregates of angular, subangular, subrounded and rounded, clay size to fine sand size particles. The upper left photograph illustrates the bulk sample on filter paper.

Carbon (C) and oxygen (O) dominate the elemental spectrograph, respectively forming about 27.8% and 64.9% of the sample. Nitrogen (N) is moderately abundant, forming about 6.6% of the sample. Trace to minor amounts of sodium (Na), magnesium (Mg), aluminum (Al), silicon (Si), sulphur (S), potassium (K), calcium (Ca), iron (Fe) and copper (Cu) are present.

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds with minor amounts of crystalline compounds present or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of about 100% silicates **(albite [$NaAlSi_3O_8$]**, **quartz [SiO_2]**, **illite [$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$]**, **kaolinite [$Al_2Si_2O_5(OH)_4$]**, **cristobalite [$SiO_2$]**, **clinochlore [$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$]**, **microcline [$KAlSi_3O_8$]** and **silicon oxide [SiO2])**.

Carbon, nitrogen and part of the oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace volumes of sulphur, calcium and copper bearing compounds were detected during elemental analysis.

The particle size distribution histogram shows a polymodal distribution centering around 1.00 microns, 8.00 microns and 64.00 microns. Mean particle size was measured at 6.42 microns and median particle size was measured at 0.61 microns. Particles vary in size from 0.01 microns (clay size) to 182.00 microns (fine sand size). The Quartile 3 size is 4.48 microns and the Quartile 1 size is 0.14 microns. Standard deviation was measured at 16.37 microns.

TABLE 4: EDS and XRD Results
Bureau Veritas Laboratories; Project #: C119656; Sample ID: ZN6711-Sieve Sample 1; Date Sampled: 2021/03/24 11:57
GR 33361-04 2021

ELEMENTS:

DOMINANT: C, O

MODERATE: N

COMMON:

MINOR-TRACE: Na, Mg, Al, Si, S, K, Ca, Fe, Cu

COMPOUNDS:

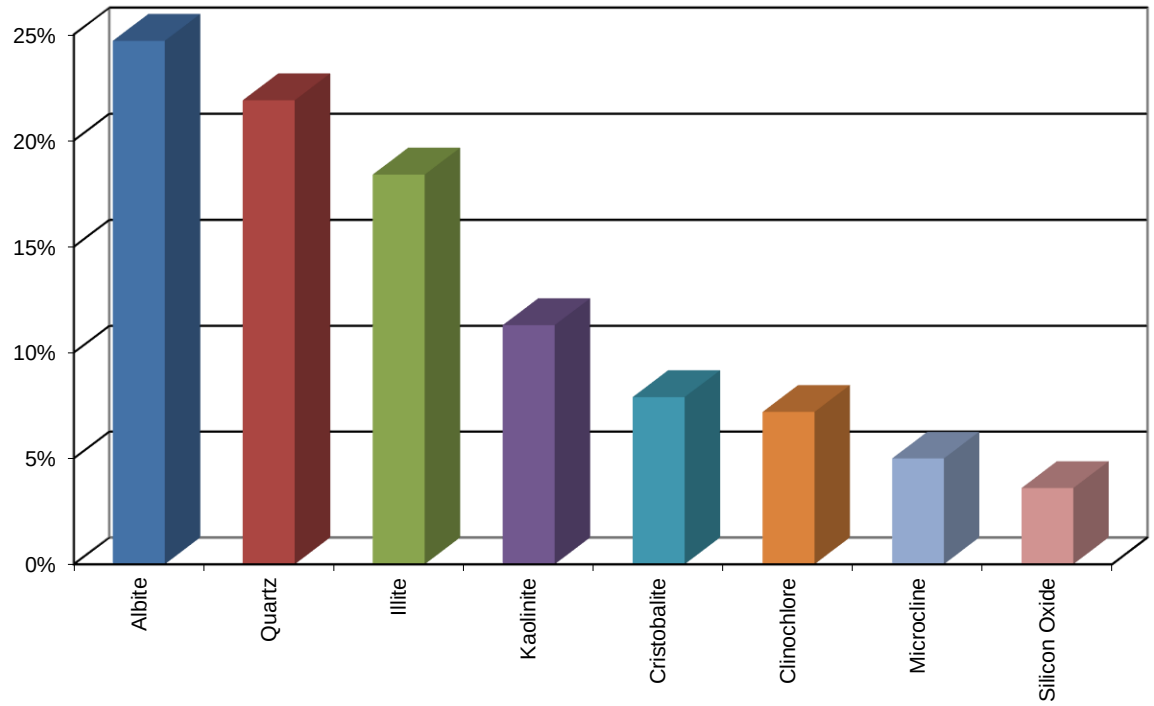
Formula	*Name*	*Percentage*
$NaAlSi_3O_8$	Albite	24.7%
SiO_2	Quartz	21.9%
$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$	Illite	18.4%
$Al_2Si_2O_5(OH)_4$	Kaolinite	11.3%
SiO_2	Cristobalite	7.9%
$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$	Clinochlore	7.2%
$KAlSi_3O_8$	Microcline	5.0%
SiO2	Silicon Oxide	3.6%
		100.0%

COMMENTS:

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds with minor amounts of crystalline compounds present or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of about 100% silicates.

Carbon, nitrogen and part of the oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace volumes of sulphur, calcium and copper bearing compounds were detected during elemental analysis.

ABUNDANCE OF COMPOUNDS



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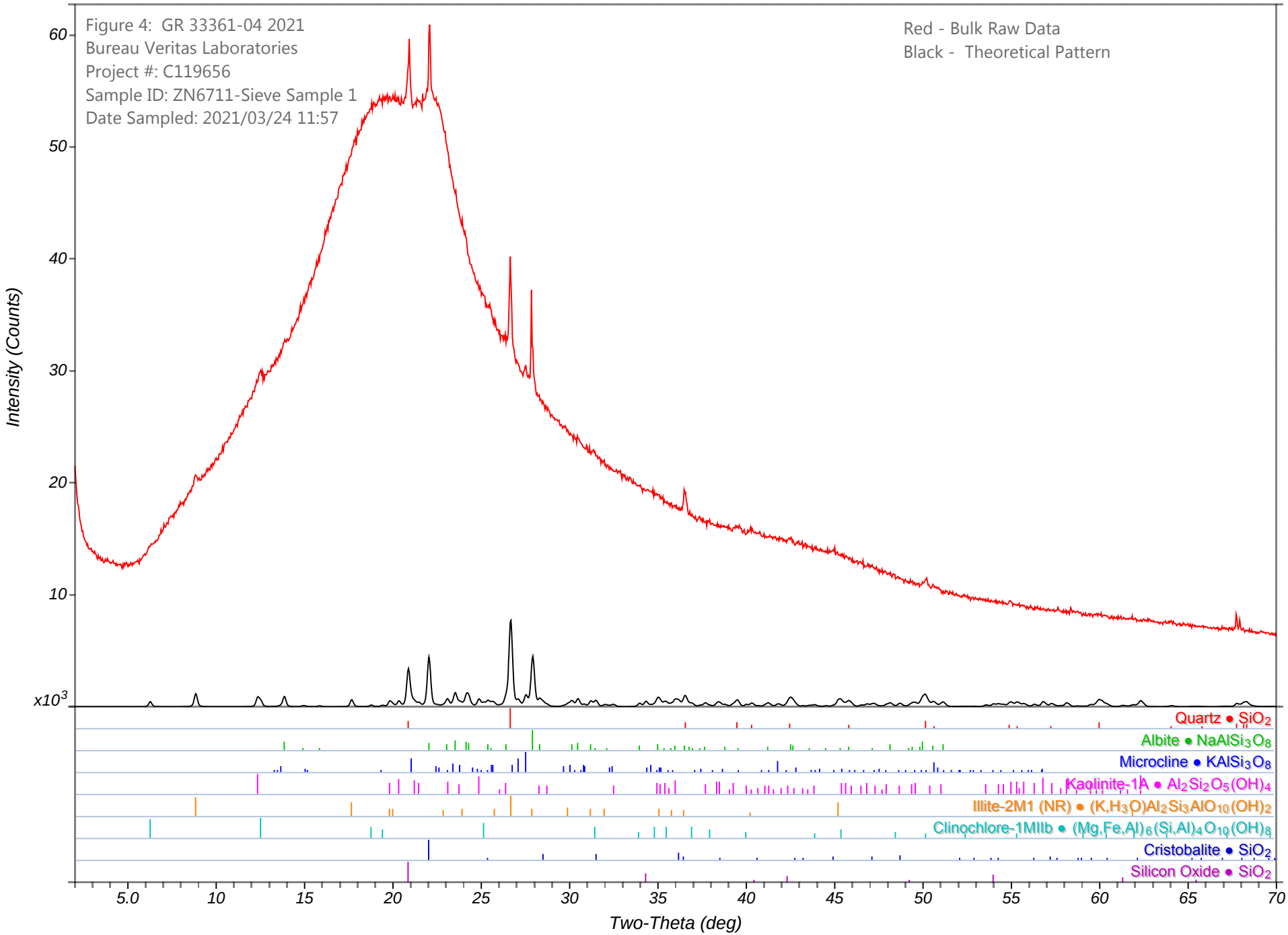
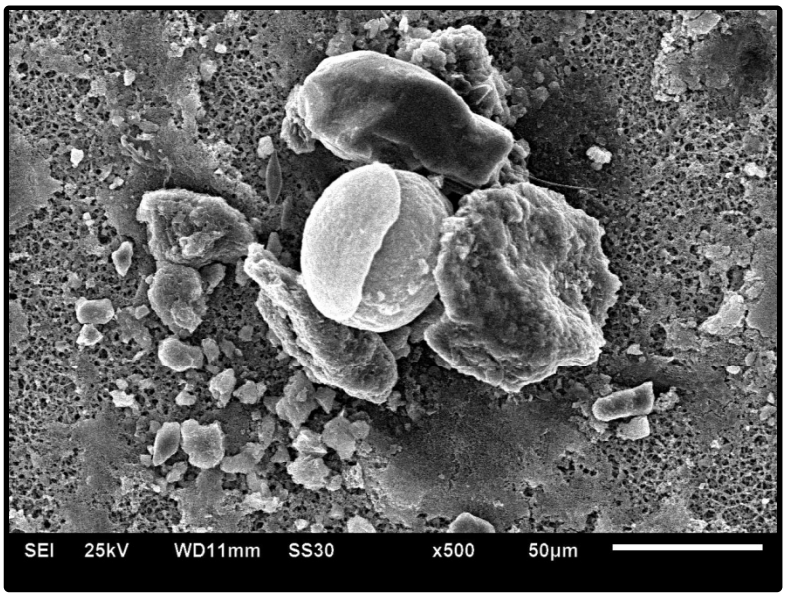
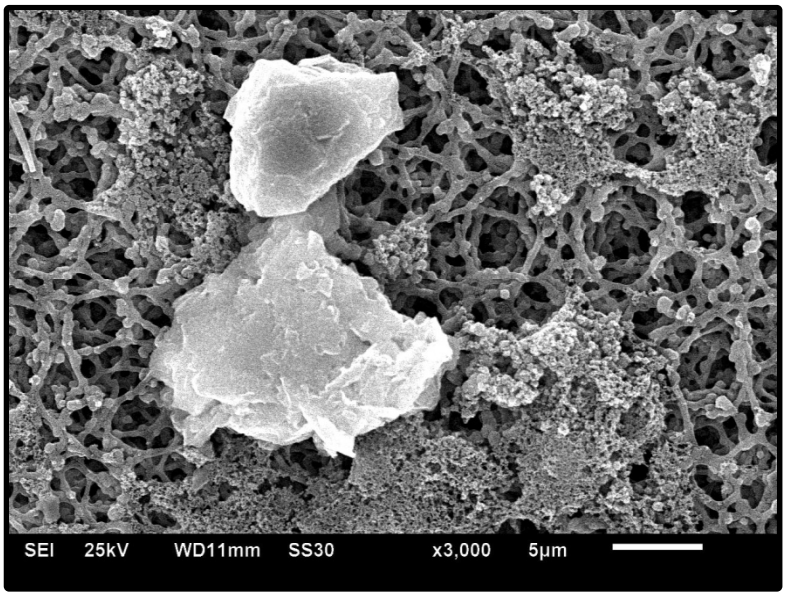
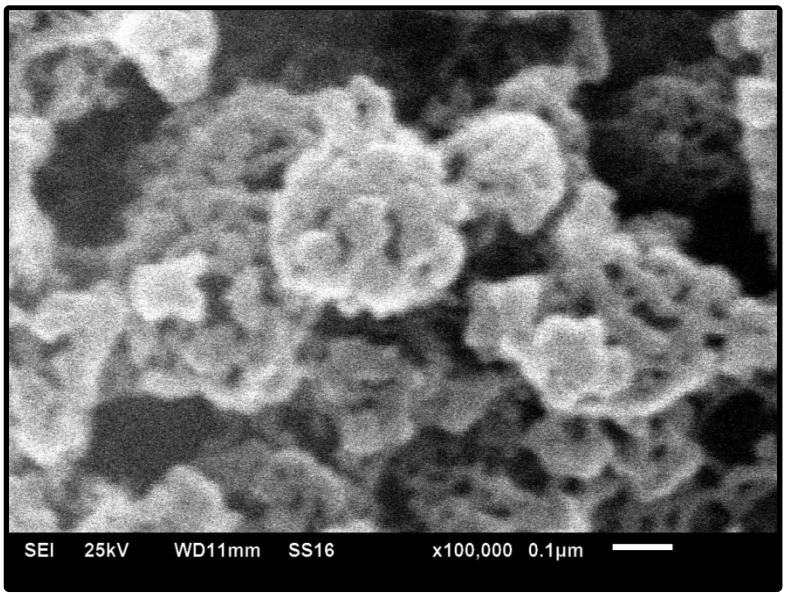


Figure 4: GR 33361-04 2021
Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZN6711-Sieve Sample 1
Date Sampled: 2021/03/24 11:57
Red - Bulk Raw Data
Black - Theoretical Pattern
Intensity (Counts)
x10^3
60
50
40
30
20
10
5.0
10
15
20
25
30
35
40
45
50
55
60
65
70
Two-Theta (deg)
Quartz • SiO2
Albite • NaAlSi3O8
Microcline • KAlSi3O8
Kaolinite-1A • Al2Si2O5(OH)4
Illite-2M1 (NR) • (K,H3O)Al2Si3AlO10(OH)2
Clinochlore-1MIIb • (Mg,Fe,Al)6(Si,Al)4O10(OH)8
Cristobalite • SiO2
Silicon Oxide • SiO2

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6711-Sieve Sample 1
Date Sampled: 2021/03/24 11:57







Particle Size Statistics

Size in Micrometers	
Mean	6.420
Median	0.611
Maximum	181.999
Quartile 3	4.484
Quartile 1	0.141
Minimum	0.012
Standard Deviation	16.374
Mode	0.027
Sample Variance	268.100
Kurtosis	33.436
Skewness	4.833
Range	181.987
Standard Error	0.732
Confidence Level (95%)	1.439
Sum	3210.116
Count	500

Histogram Statistics

Microns	Frequency	Cumulative
0.01	0	0.00%
0.02	5	1.00%
0.03	34	7.80%
0.06	37	15.20%
0.13	38	22.80%
0.25	51	33.00%
0.50	67	46.40%
1.00	77	61.80%
2.00	30	67.80%
4.00	30	73.80%
8.00	48	83.40%
16.00	30	89.40%
32.00	21	93.60%
64.00	22	98.00%
128.00	9	99.80%
256.00	1	100.00%
More	0	100.00%

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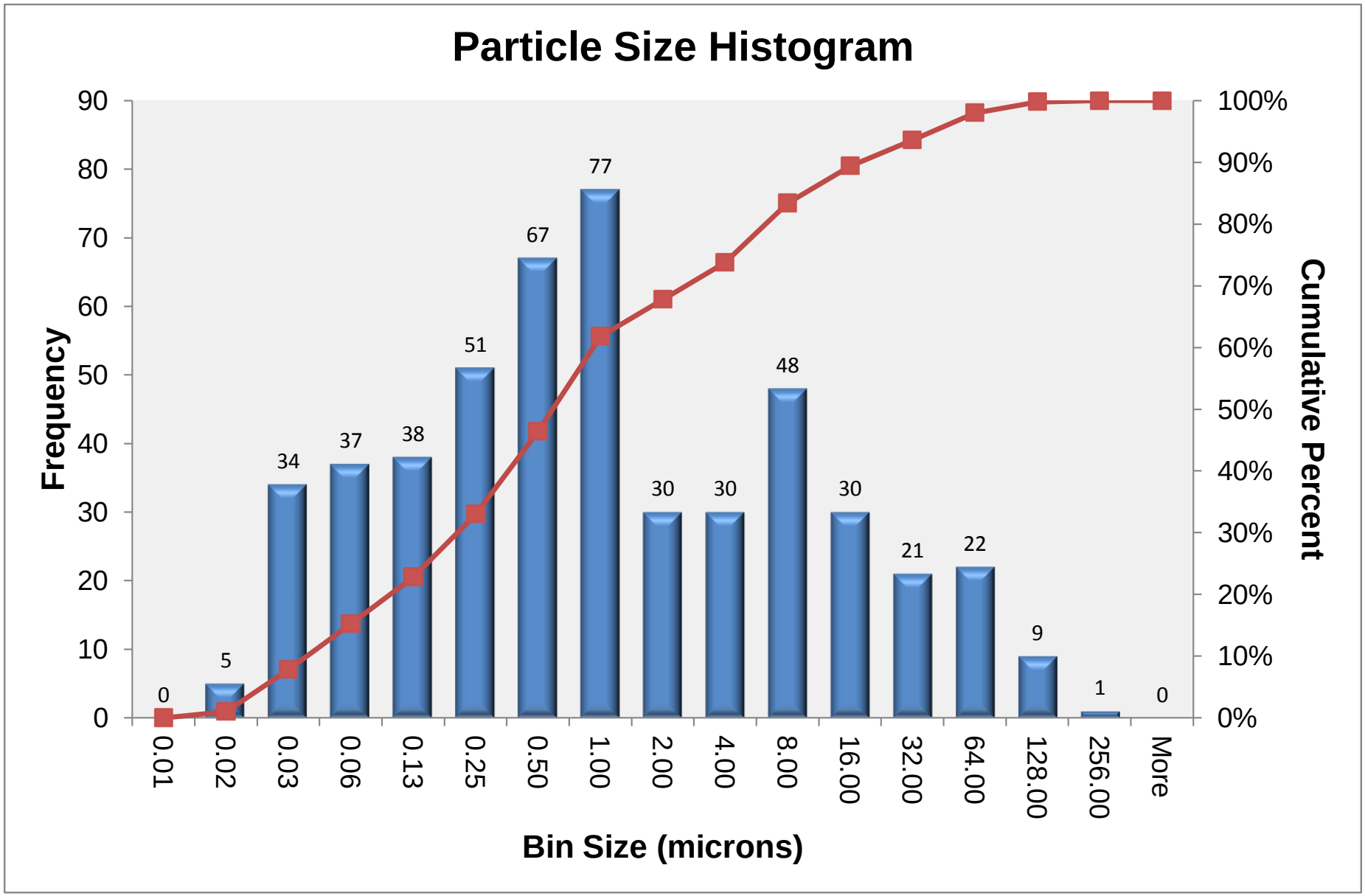
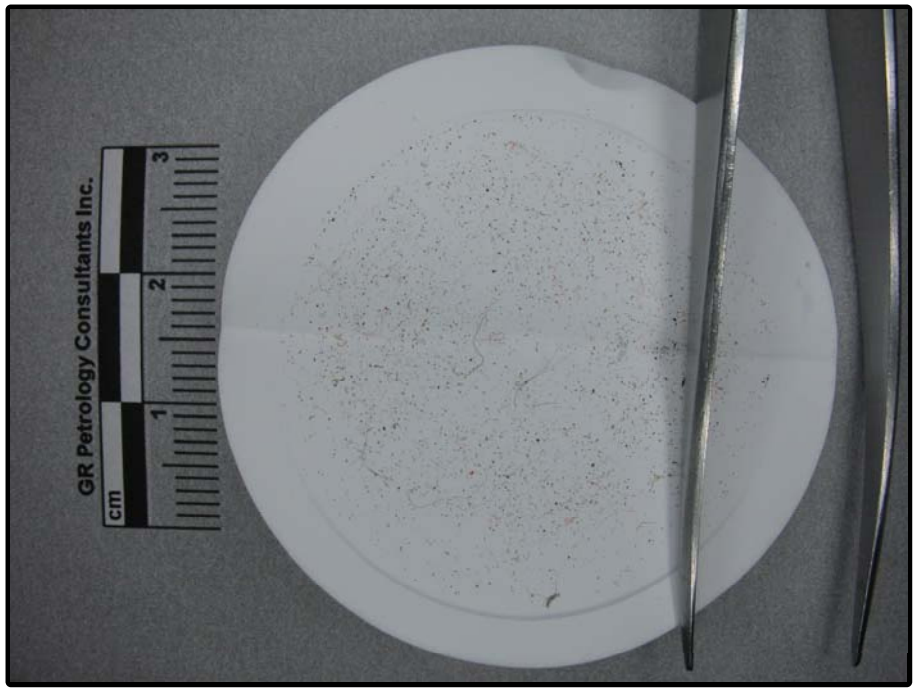
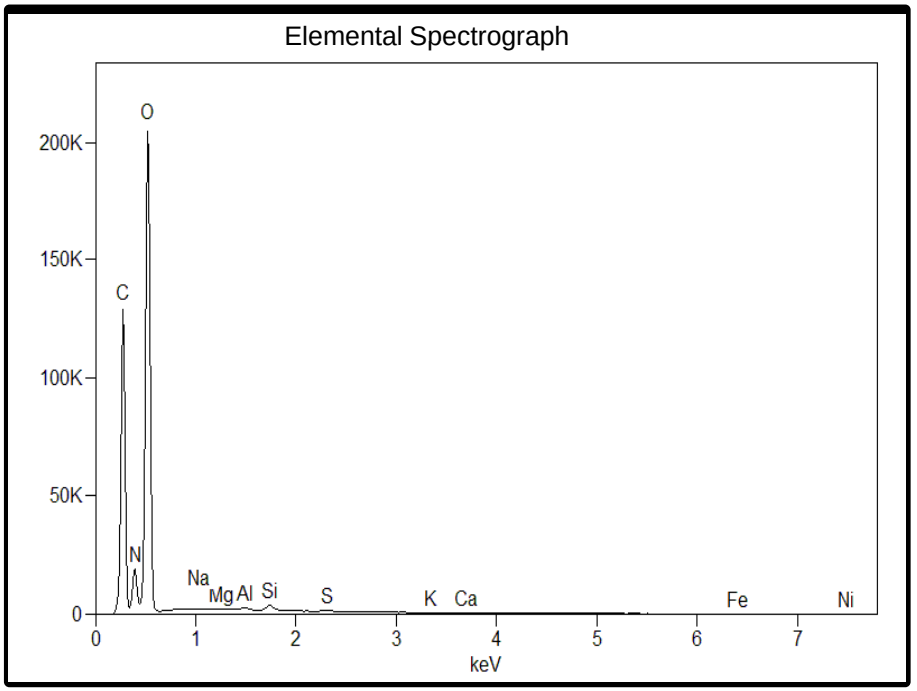

Particle Size Histogram
Frequency
Cumulative Percent
Bin Size (microns)
0
5
34
37
38
51
67
77
30
30
48
30
21
22
9
1
0
0.01
0.02
0.03
0.06
0.13
0.25
0.50
1.00
2.00
4.00
8.00
16.00
32.00
64.00
128.00
256.00
More

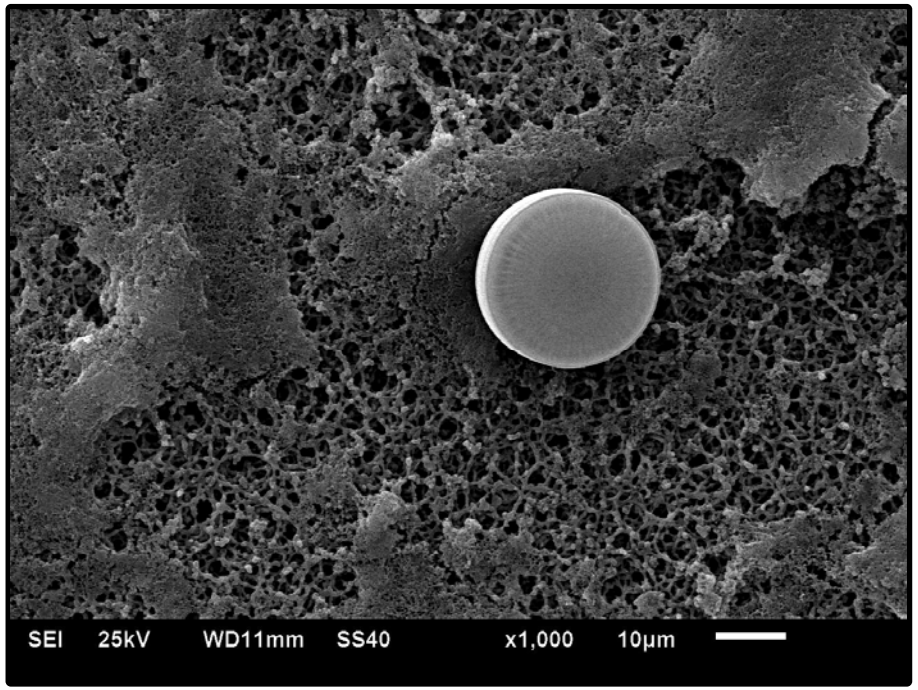
Raw Particle Size Data (microns) Number of measurements: 500

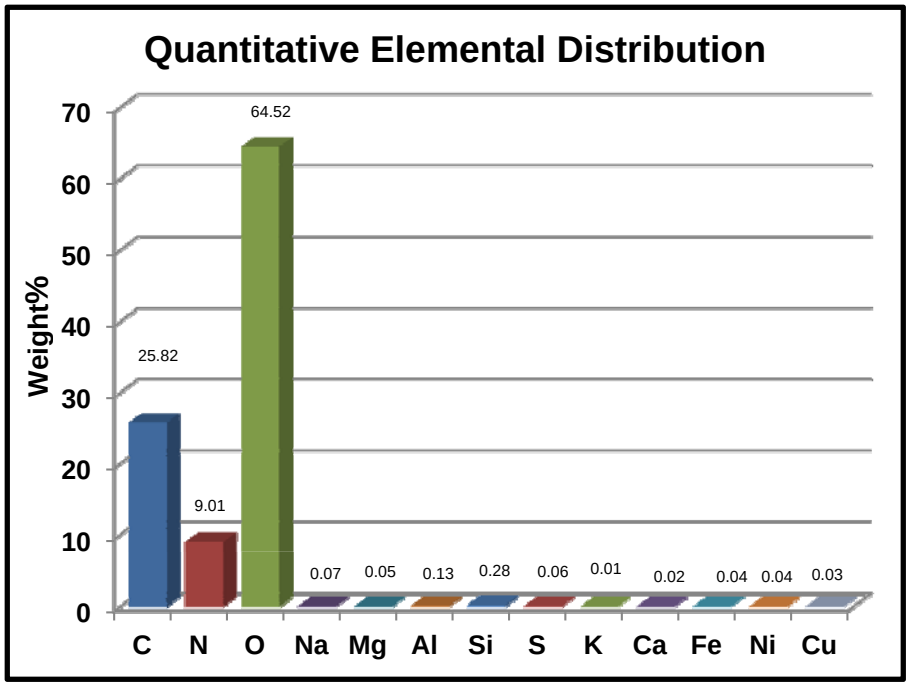
181.999	0.716	61.385	20.863	0.393	0.040	1.216	0.320	0.562	0.643
77.820	0.831	61.931	26.215	0.275	0.021	0.892	0.341	0.241	0.378
67.594	0.960	61.397	19.906	0.200	0.064	1.208	0.691	0.086	0.675
29.451	1.802	46.459	14.714	0.095	0.023	0.901	0.550	0.076	0.175
49.091	0.143	22.773	39.217	0.071	0.030	0.915	0.313	0.081	0.084
19.846	1.289	17.195	22.677	0.045	0.019	0.727	0.197	0.077	0.348
22.022	0.794	12.795	17.335	0.121	0.020	0.528	0.233	0.113	0.695
39.019	0.400	12.498	25.000	0.030	0.012	0.469	0.210	0.141	0.373
24.328	2.462	10.132	21.225	0.055	0.024	0.806	0.140	0.210	0.605
15.717	1.435	7.741	11.885	0.075	0.017	0.447	0.246	0.098	0.485
51.114	0.700	7.647	12.298	0.033	0.038	0.520	0.251	0.146	0.329
8.051	0.904	8.799	21.541	0.047	0.039	0.343	0.117	0.074	0.194
4.916	0.128	7.165	8.500	0.024	0.036	0.453	0.121	0.132	0.357
5.151	0.525	15.199	7.433	0.015	0.031	0.474	0.162	0.099	0.127
23.843	0.291	8.001	7.280	0.041	0.027	0.284	0.250	0.145	0.113
7.543	0.257	8.139	10.012	0.036	0.050	0.461	0.141	0.108	0.326
8.172	0.521	4.948	5.831	0.023	0.022	0.534	0.127	0.064	0.177
4.518	73.012	4.806	68.377	0.014	16.903	0.380	2.927	0.064	0.452
9.498	35.456	5.826	64.245	0.013	11.164	0.168	0.804	0.036	0.708
4.121	5.763	4.138	71.735	0.018	0.850	0.364	0.868	0.044	0.237
5.613	7.181	10.273	38.774	0.032	1.135	0.275	0.831	0.109	0.169
4.041	6.537	4.991	22.099	0.017	2.127	0.368	0.960	0.064	0.193
6.344	3.111	4.079	12.445	0.027	1.603	0.194	0.667	0.058	0.175
5.966	2.561	5.188	18.139	0.019	1.229	0.186	0.855	0.059	0.179
5.111	1.921	3.211	13.852	0.030	1.449	0.119	0.620	0.050	0.084
6.446	1.903	3.412	21.068	0.028	0.770	0.146	0.331	0.034	0.042
6.007	5.334	2.031	15.401	0.027	0.687	0.241	0.729	0.057	0.027
1.738	4.780	1.664	54.120	0.025	0.778	0.534	0.301	0.027	0.274
2.871	1.581	2.272	13.200	0.016	0.731	0.294	0.474	0.090	0.145
2.020	3.114	3.609	10.469	0.035	1.099	0.484	0.267	0.061	0.130
2.020	5.731	3.739	10.984	0.024	1.092	0.266	0.405	0.031	0.033
2.458	4.472	2.716	5.882	0.023	1.493	0.105	0.247	0.048	0.090
2.080	0.500	3.061	11.962	0.028	0.539	0.213	0.559	0.044	0.089
5.421	2.110	2.894	11.089	0.064	0.701	0.193	0.507	0.016	0.123
14.271	1.020	89.443	12.108	0.289	0.701	3.462	0.233	5.103	0.141
3.516	1.972	83.918	10.830	0.199	0.401	2.129	0.387	0.680	0.060
1.720	1.221	99.562	5.855	0.140	1.042	2.260	0.409	0.737	0.057
1.829	0.806	57.630	5.604	0.298	0.836	1.177	0.322	0.976	0.052
1.188	1.655	36.003	5.546	0.088	0.716	0.295	0.132	0.619	0.054
0.859	1.414	50.596	5.632	0.117	0.260	0.970	0.412	0.693	0.061
0.515	1.100	51.442	5.886	0.114	0.641	0.617	0.163	0.591	0.161
0.688	7.061	38.243	7.871	0.069	0.667	0.671	0.202	0.699	0.080
0.373	4.082	36.895	3.650	0.039	0.453	0.671	0.271	0.705	0.072
0.954	0.943	24.683	5.142	0.026	0.694	0.424	0.313	0.407	0.054
0.597	2.354	20.156	12.806	0.018	0.407	0.709	0.275	0.456	0.251
0.686	2.642	44.162	6.315	0.016	0.302	0.500	0.140	0.862	0.044
0.458	3.711	51.313	5.886	0.012	0.575	0.491	0.094	0.592	0.093
0.829	0.900	52.794	7.211	0.020	0.267	0.355	0.187	0.439	0.132
0.750	0.860	38.422	2.600	0.035	0.467	0.398	0.173	0.193	0.027
1.110	1.200	36.235	6.325	0.035	0.401	0.518	0.057	0.185	0.037

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6712-Sieve Sample 2
Date Sampled: 2021/03/24 12:08









GR-005: ZN6712-Sieve Sample 2 (2021/03/24 12:08)

The scanning electron photomicrograph on the facing page (lower left) shows sample GR-005 consists of aggregates of angular, subangular, subrounded and rounded, clay size to medium sand size particles. The top photomicrograph (Plate PSD-5) shows the sample also contains elongated (rod like) particles. The upper left photograph illustrates the bulk sample on filter paper.

Carbon (C) and oxygen (O) dominate the elemental spectrograph, respectively forming about 25.8% and 64.5% of the sample. Nitrogen (N) is moderately abundant, forming about 9.0% of the sample. Trace to minor amounts of sodium (Na), magnesium (Mg), aluminum (Al), silicon (Si), sulphur (S), potassium (K), calcium (Ca), iron (Fe), nickel (Ni) and copper (Cu) are present.

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds with minor amounts of crystalline compounds present or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of about 100% silicates **(albite [$NaAlSi_3O_8$]**, **kaolinite [$Al_2Si_2O_5(OH)_4$]**, **illite [$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$]**, **quartz [$SiO_2$]**, **silicon oxide [$SiO_2$]**, **microcline [$KAlSi_3O_8$]** and **clinochlore [$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$])**.

Carbon, nitrogen and part of the oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace volumes of sulphur, calcium, nickel and copper bearing compounds were detected during elemental analysis.

The particle size distribution histogram shows a slightly skewed unimodal distribution centering around 1.00 microns. Mean particle size was measured at 4.84 microns and median particle size was measured at 0.83 microns. Particles vary in size from 0.01 microns (clay size) to 276.34 microns (medium sand size). The Quartile 3 size is 2.55 microns and the Quartile 1 size is 0.33 microns. Standard deviation was measured at 17.24 microns.

TABLE 5: EDS and XRD Results
Bureau Veritas Laboratories; Project #: C119656; Sample ID: ZN6712-Sieve Sample 2; Date Sampled: 2021/03/24 12:08
GR 33361-05 2021

ELEMENTS:

DOMINANT: C, O

MODERATE: N

COMMON:

MINOR-TRACE: Na, Mg, Al, Si, S, K, Ca, Fe, Ni, Cu

COMPOUNDS:

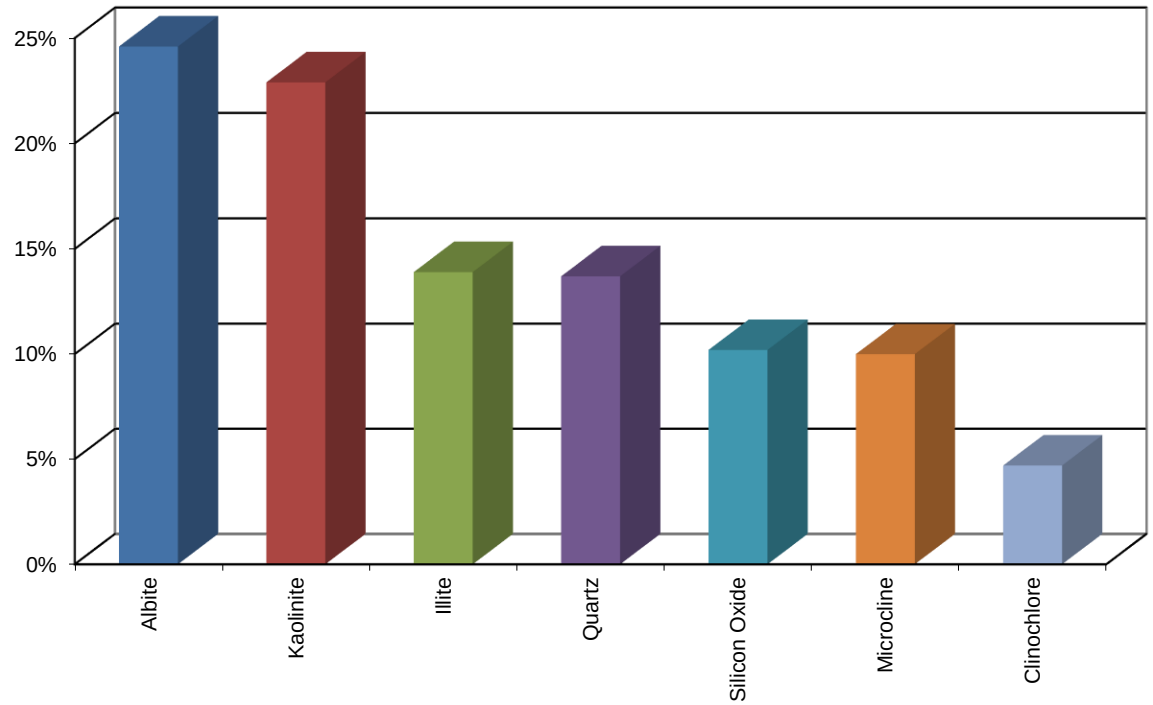
Formula	*Name*	*Percentage*
$NaAlSi_3O_8$	Albite	24.6%
$Al_2Si_2O_5(OH)_4$	Kaolinite	22.9%
$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$	Illite	13.9%
SiO_2	Quartz	13.7%
SiO_2	Silicon Oxide	10.2%
$KAlSi_3O_8$	Microcline	10.0%
$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$	Clinochlore	4.7%
		100.0%

COMMENTS:

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds with minor amounts of crystalline compounds present or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of about 100% silicates.

Carbon, nitrogen and part of the oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace volumes of sulphur, calcium, nickel and copper bearing compounds were detected during elemental analysis.

ABUNDANCE OF COMPOUNDS



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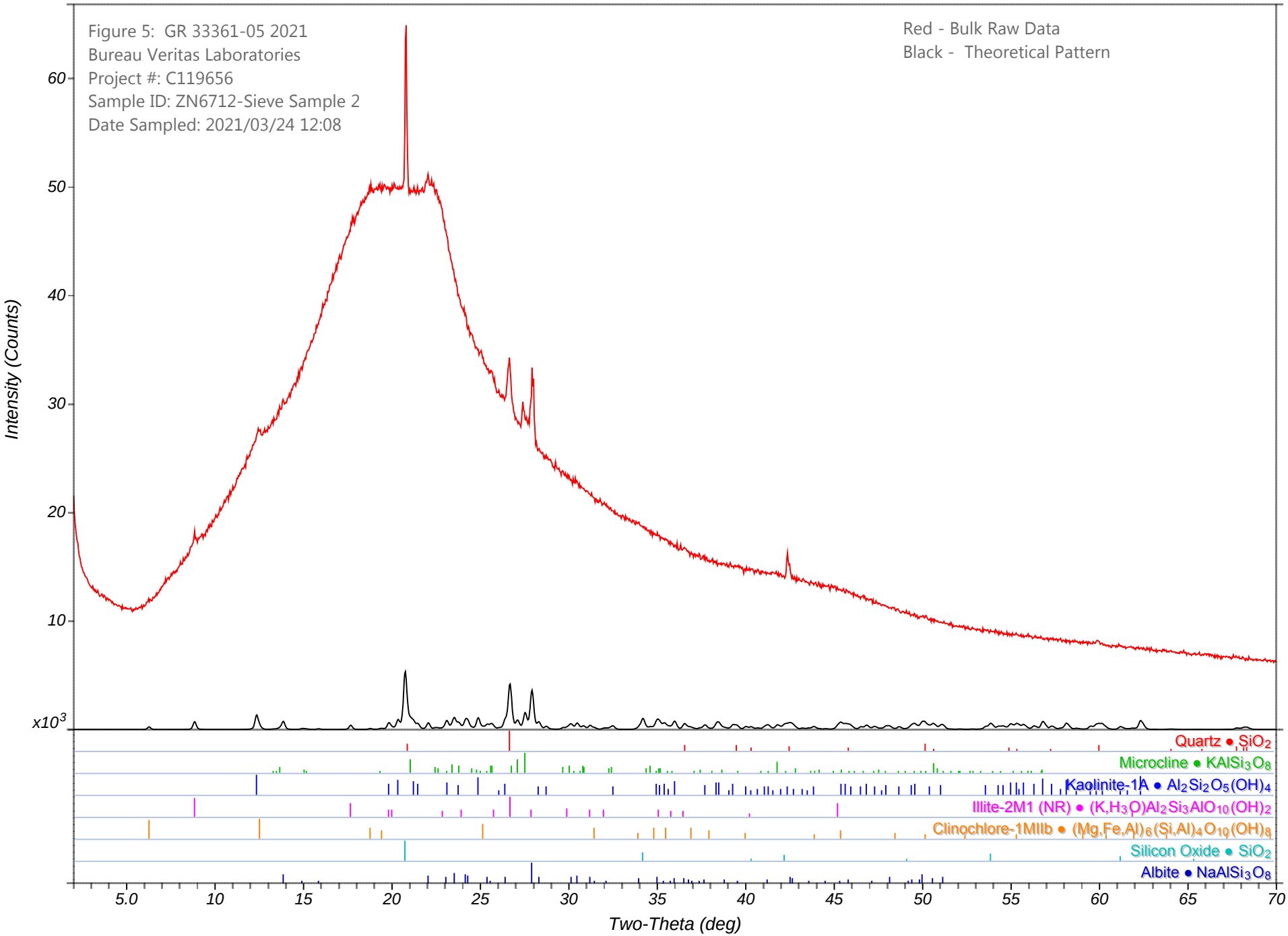
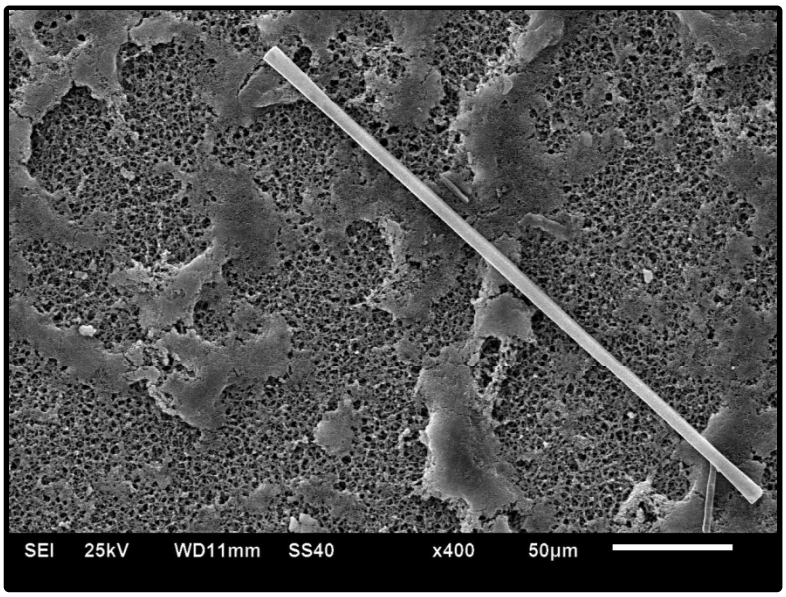
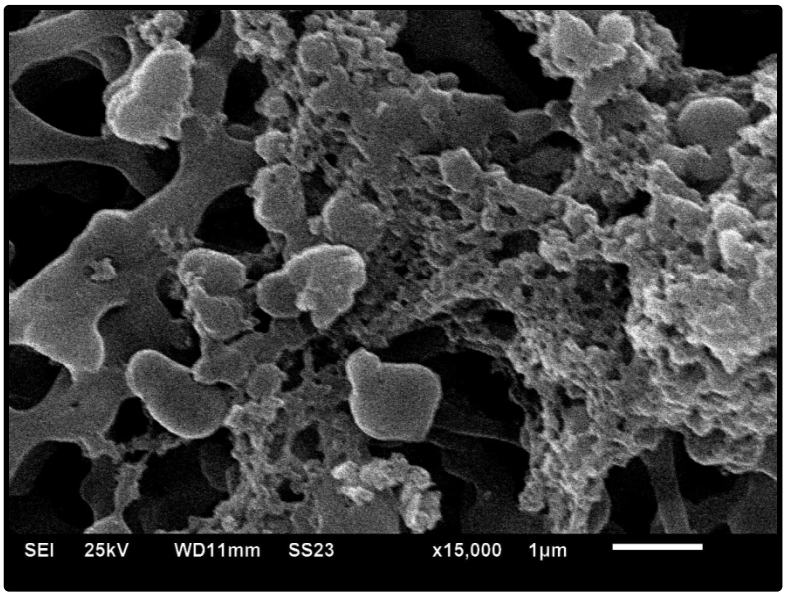
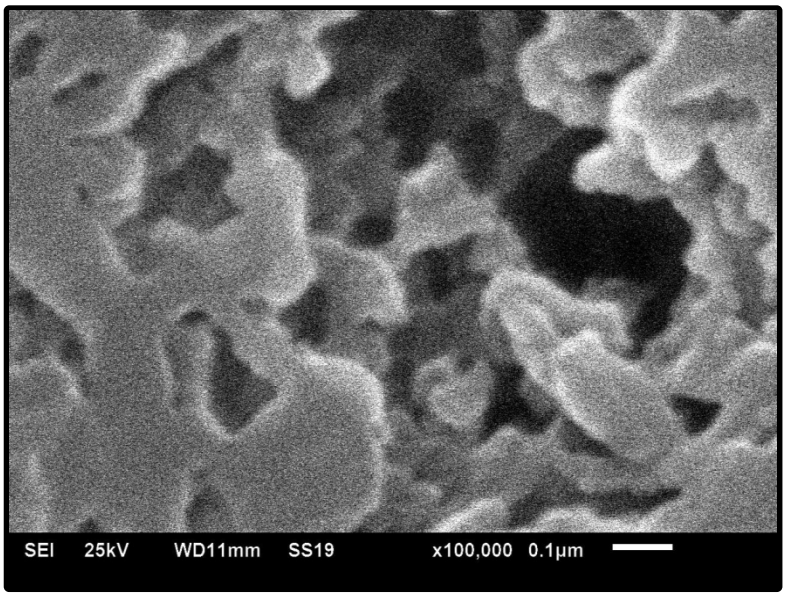


Figure 5: GR 33361-05 2021
Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZN6712-Sieve Sample 2
Date Sampled: 2021/03/24 12:08
Red - Bulk Raw Data
Black - Theoretical Pattern
Intensity (Counts)
x10^3
60
50
40
30
20
10
Quartz • SiO2
Microcline • KAlSi3O8
Kaolinite-1A • Al2Si2O5(OH)4
Illite-2M1 (NR) • (K,H3O)Al2Si3AlO10(OH)2
Clinochlore-1MIIb • (Mg,Fe,Al)6(Si,Al)4O10(OH)8
Silicon Oxide • SiO2
Albite • NaAlSi3O8
5.0
10
15
20
25
30
35
40
45
50
55
60
65
70
Two-Theta (deg)

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6712-Sieve Sample 2
Date Sampled: 2021/03/24 12:08







Particle Size Statistics

Size in Micrometers	
Mean	4.843
Median	0.827
Maximum	276.343
Quartile 3	2.548
Quartile 1	0.329
Minimum	0.009
Standard Deviation	17.244
Mode	0.806
Sample Variance	297.359
Kurtosis	137.386
Skewness	10.141
Range	276.334
Standard Error	0.771
Confidence Level (95%)	1.515
Sum	2421.502
Count	500

Histogram Statistics

Microns	Frequency	Cumulative
0.01	0	0.00%
0.02	5	1.00%
0.03	15	4.00%
0.06	20	8.00%
0.13	27	13.40%
0.25	39	21.20%
0.50	64	34.00%
1.00	107	55.40%
2.00	78	71.00%
4.00	57	82.40%
8.00	35	89.40%
16.00	19	93.20%
32.00	17	96.60%
64.00	11	98.80%
128.00	4	99.60%
256.00	1	99.80%
More	1	100.00%

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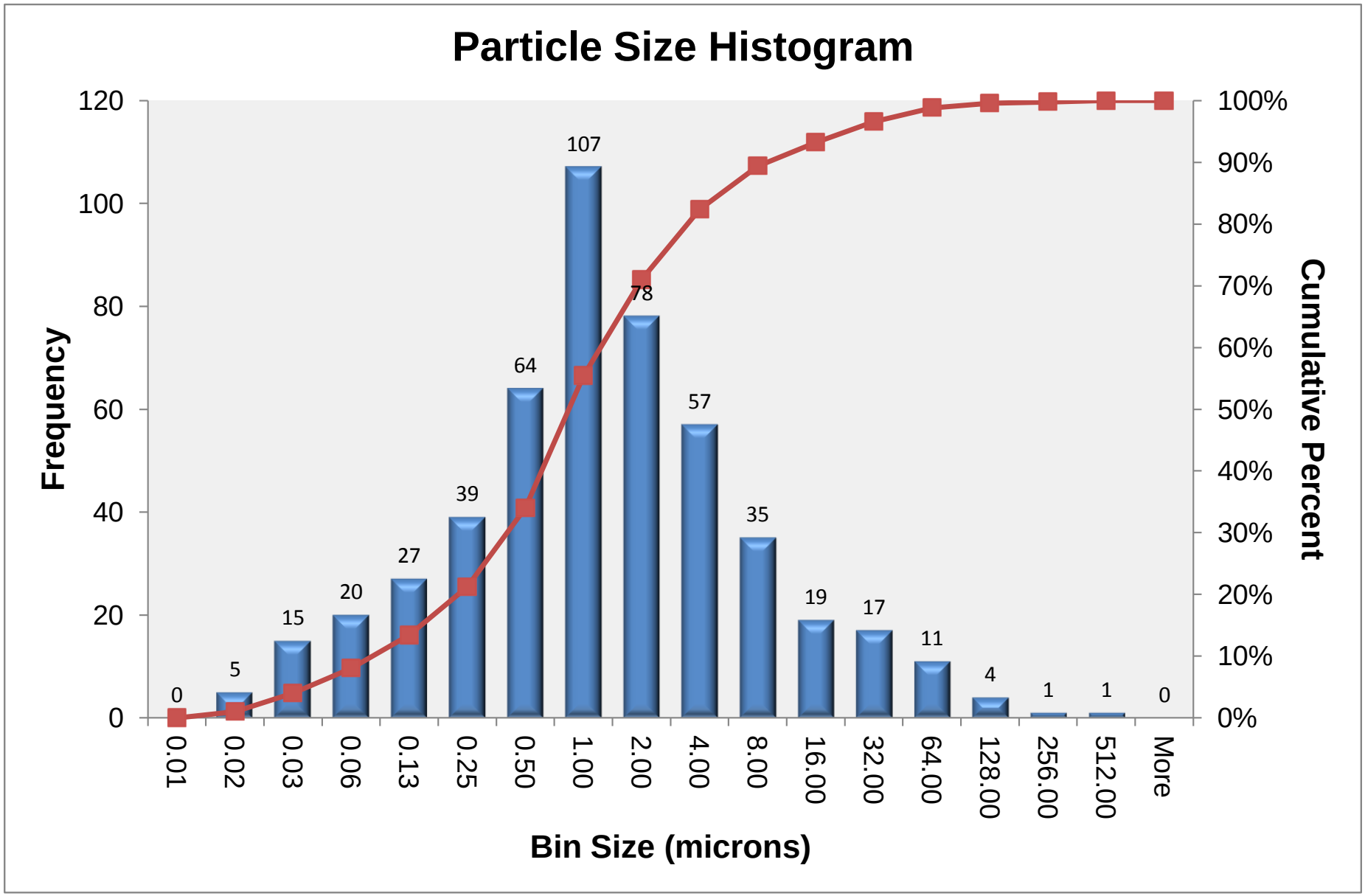
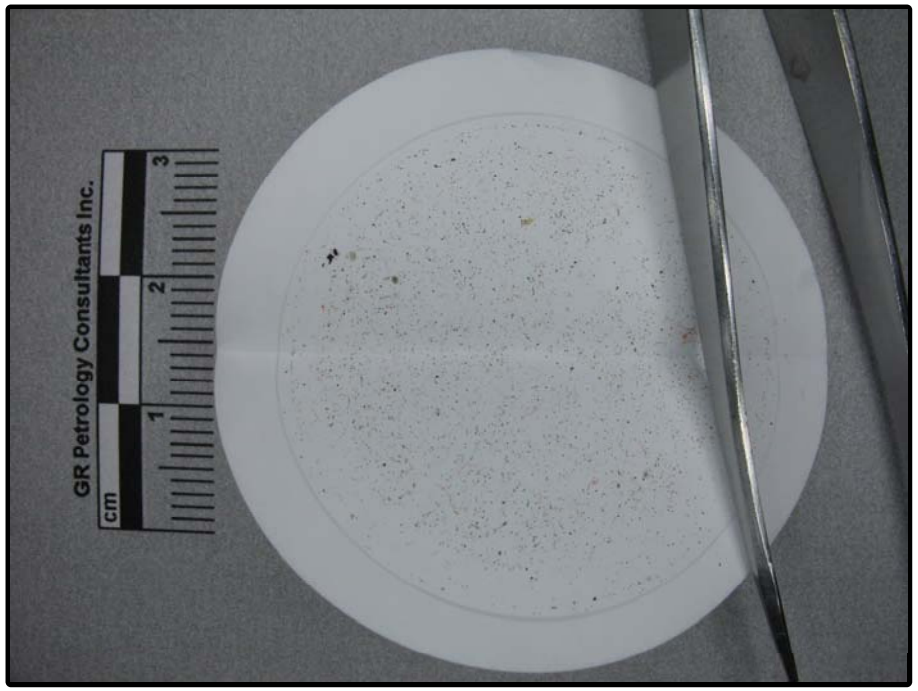
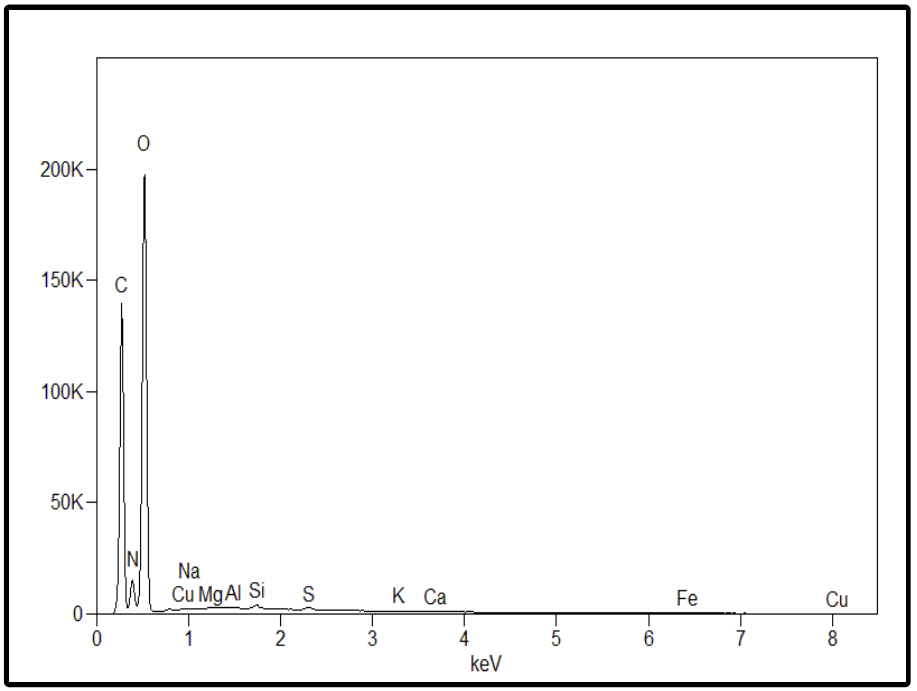

Particle Size Histogram
Frequency
Cumulative Percent
Bin Size (microns)
120
100
80
60
40
20
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
5
15
20
27
39
64
107
78
57
35
19
17
11
4
1
1
0
0.01
0.02
0.03
0.06
0.13
0.25
0.50
1.00
2.00
4.00
8.00
16.00
32.00
64.00
128.00
256.00
512.00
More

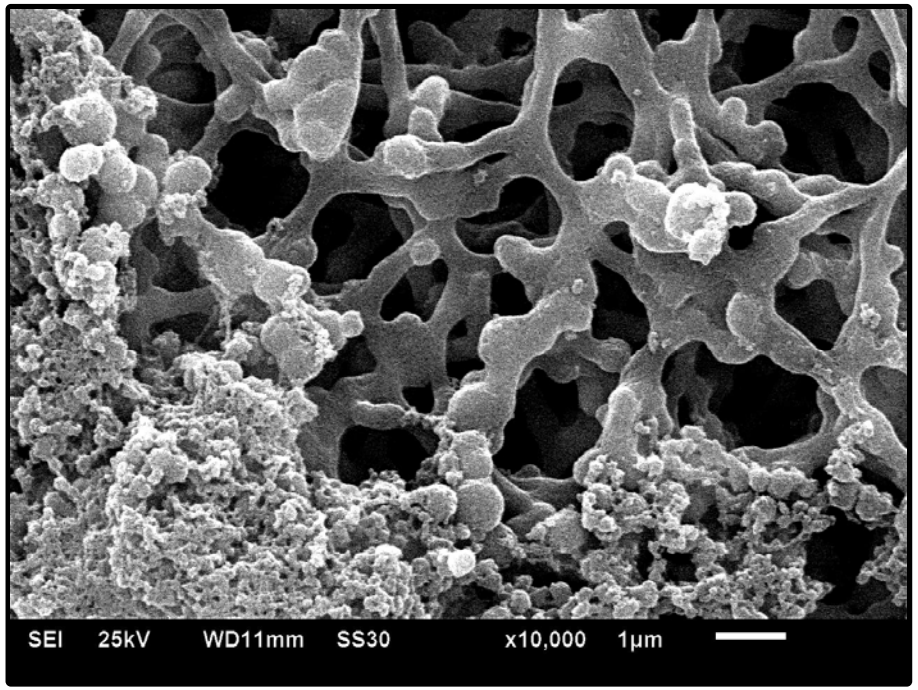
Raw Particle Size Data (microns) Number of measurements: 500

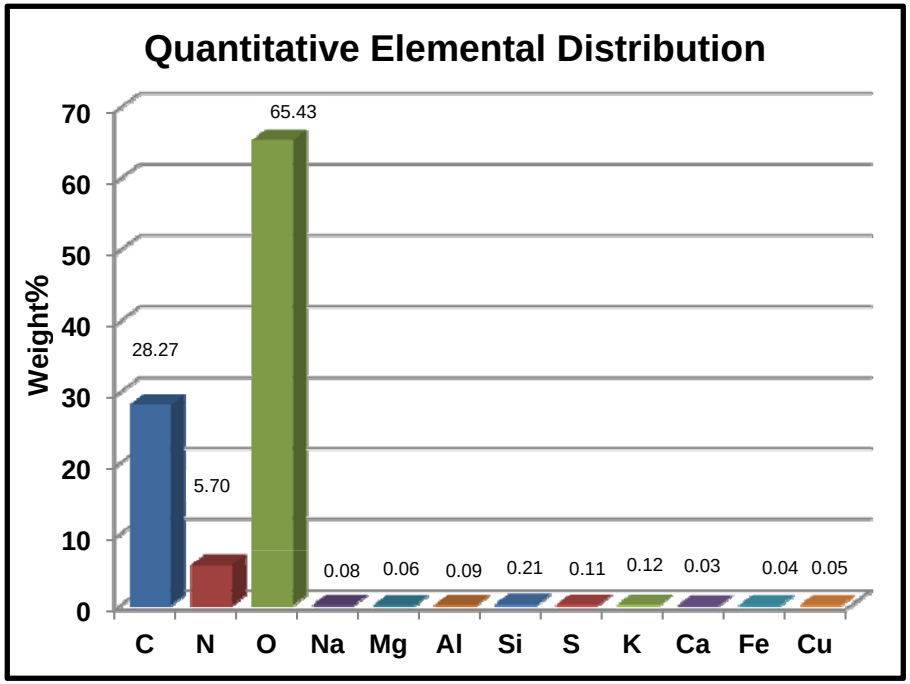
21.967	0.940	0.181	0.057	0.400	65.843	30.056	20.684	0.756	1.265
6.820	0.603	0.293	0.039	0.412	43.533	14.577	9.647	0.792	2.052
13.440	0.528	0.205	0.049	0.361	33.715	23.068	18.016	0.461	0.640
3.440	0.354	0.322	0.077	0.316	40.017	23.032	5.799	1.609	1.118
5.609	0.760	0.125	0.086	0.707	25.640	13.873	5.534	0.525	0.707
3.395	0.891	0.304	0.074	0.447	24.559	6.483	4.854	0.829	1.342
1.298	0.500	0.864	0.110	1.500	16.440	9.098	6.325	0.728	0.806
2.530	0.602	0.291	0.029	2.081	6.966	4.649	14.496	0.371	0.922
1.531	0.645	0.206	0.015	1.030	5.968	4.180	5.799	0.236	0.600
1.874	0.620	0.330	0.075	19.841	8.021	7.120	6.250	1.358	0.806
2.642	0.269	0.500	0.073	10.560	7.122	4.413	3.913	0.601	0.500
0.966	0.278	0.640	0.059	4.922	3.701	4.362	7.616	0.785	0.671
1.297	0.268	0.141	0.028	4.538	5.100	2.167	9.804	0.488	0.762
0.783	0.402	0.087	0.030	9.451	3.324	3.269	276.343	0.514	0.707
0.632	0.197	0.080	0.023	3.826	2.802	1.213	69.086	0.447	0.806
1.140	0.240	0.158	0.031	6.524	2.062	1.537	6.562	0.546	0.671
1.006	0.120	0.175	0.054	4.375	2.209	1.067	2.761	0.287	0.297
0.750	0.362	0.162	0.081	10.288	3.162	3.659	3.640	0.485	0.239
1.662	0.671	0.381	0.078	5.030	1.063	1.333	3.913	0.345	0.085
1.262	0.349	0.389	86.293	7.604	1.487	3.060	2.305	0.309	0.145
0.806	0.322	0.509	14.073	3.504	0.906	0.601	3.640	0.183	0.112
0.716	0.653	0.207	8.927	2.947	0.922	1.067	3.288	0.181	0.038
0.500	0.723	0.156	30.514	4.508	0.922	1.537	5.130	0.270	0.042
0.986	0.340	0.108	3.298	1.282	1.077	1.434	4.257	0.167	0.057
0.711	0.394	0.137	4.428	0.680	1.204	0.333	2.151	0.487	0.037
0.150	0.213	0.783	2.773	1.258	2.500	0.833	15.000	0.229	0.038
0.361	0.283	0.395	3.847	0.811	2.818	0.527	2.305	24.411	0.019
0.224	0.380	0.351	3.162	3.829	1.709	0.833	1.750	23.439	0.009
0.335	0.447	0.284	2.508	0.955	1.924	1.302	1.677	6.378	0.054
0.532	0.221	0.215	2.302	1.179	1.237	2.088	1.581	4.588	0.037
0.472	0.234	0.183	1.910	4.830	0.781	0.687	1.346	3.607	0.029
1.166	0.184	0.314	1.600	2.749	2.040	1.213	1.031	3.523	0.015
1.063	0.224	0.320	2.693	0.825	0.583	1.269	0.707	1.811	0.025
0.851	0.553	0.186	2.600	1.342	0.949	0.333	1.768	3.265	0.012
0.224	1.172	0.102	1.442	3.543	0.949	0.745	8.290	1.836	0.022
0.250	1.227	0.174	1.581	2.448	1.304	0.601	8.038	0.608	0.013
0.250	1.169	0.338	0.900	1.135	2.202	0.471	0.687	2.818	0.035
0.100	0.767	0.139	1.772	0.736	0.806	0.850	0.691	2.900	0.064
0.100	0.897	0.066	0.762	0.667	0.608	0.373	1.110	1.780	0.038
0.206	0.691	0.127	2.702	1.268	0.510	0.745	0.723	1.980	0.024
0.112	0.505	0.167	2.285	0.400	0.361	1.667	0.603	1.204	0.052
0.447	0.763	0.065	0.583	0.521	158.518	1.213	0.723	2.025	0.021
4.083	0.700	0.124	0.608	0.929	48.997	66.574	0.603	1.931	0.022
3.328	0.380	0.105	1.389	3.884	23.411	56.166	1.657	2.214	0.029
1.700	0.416	0.092	5.886	1.202	37.711	40.147	0.471	1.030	0.035
1.204	0.534	0.149	0.922	1.294	28.178	40.307	0.657	1.166	0.021
1.714	0.324	0.048	0.860	0.854	15.816	49.882	1.194	1.300	0.031
0.833	0.390	0.129	0.906	0.745	12.671	54.397	0.588	1.476	0.040
0.894	0.251	0.067	0.922	0.333	12.000	57.987	2.373	1.304	0.036
0.716	0.333	0.071	0.583	0.680	17.755	25.164	1.094	0.632	0.032

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6713-Sieve Sample 3
Date Sampled: 2021/03/24 12:41









GR-006: ZN6713-Sieve Sample 3 (2021/03/24 12:41)

The scanning electron photomicrograph on the facing page (lower left) shows sample GR-006 consists of aggregates of angular, subangular, subrounded and rounded, clay size to fine sand size particles. The top and middle photomicrographs (Plate PSD-6) show the sample also contains elongated (rod like) particles. The upper left photograph illustrates the bulk sample on filter paper.

Carbon (C) and oxygen (O) dominate the elemental spectrograph, respectively forming about 28.3% and 65.4% of the sample. Nitrogen (N) is moderately abundant, forming about 5.7% of the sample. Trace to minor amounts of sodium (Na), magnesium (Mg), aluminum (Al), silicon (Si), sulphur (S), potassium (K), calcium (Ca), iron (Fe) and copper (Cu) are present.

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds with minor amounts of crystalline compounds present or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of about 100% silicates **(quartz [SiO_2]**, **kaolinite [$Al_2Si_2O_5(OH)_4$]**, **microcline [$KAlSi_3O_8$]**, **illite [$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$]**, **albite [$NaAlSi_3O_8$]**, **clinochlore [$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$]** and **cristobalite [$SiO_2$])**.

Carbon, nitrogen and part of the oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace volumes of sulphur, calcium and copper bearing compounds were detected during elemental analysis.

The particle size distribution histogram shows a polymodal distribution centering around 1.00 microns, 4.00 microns and 128.00 microns. Mean particle size was measured at 6.60 microns and median particle size was measured at 1.12 microns. Particles vary in size from 0.02 microns (clay size) to 204.42 microns (fine sand size). The Quartile 3 size is 4.42 microns and the Quartile 1 size is 0.37 microns. Standard deviation was measured at 18.89 microns.

TABLE 6: EDS and XRD Results

Bureau Veritas Laboratories; Project #: C119656; Sample ID: ZN6713-Sieve Sample 3; Date Sampled: 2021/03/24 12:41

GR 33361-06 2021

ELEMENTS:

DOMINANT: C, O

MODERATE: N

COMMON:

MINOR-TRACE: Na, Mg, Al, Si, S, K, Ca, Fe, Cu

COMPOUNDS:

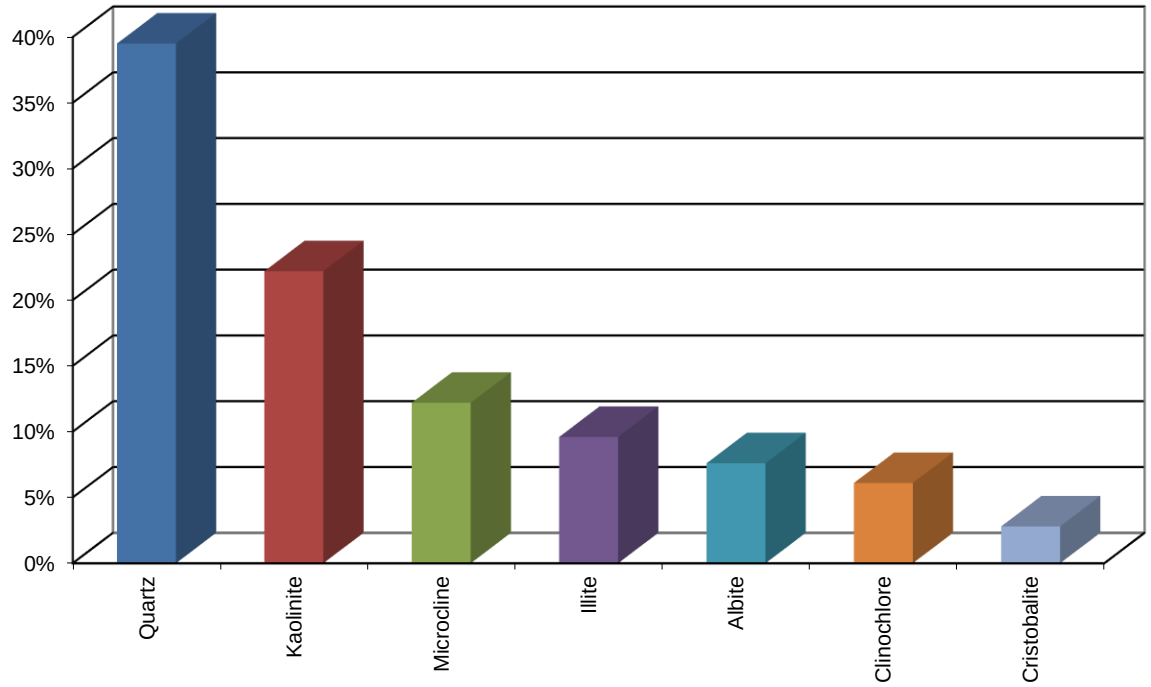
Formula	*Name*	*Percentage*
SiO_2	Quartz	39.5%
$Al_2Si_2O_5(OH)_4$	Kaolinite	22.2%
$KAlSi_3O_8$	Microcline	12.2%
$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$	Illite	9.6%
$NaAlSi_3O_8$	Albite	7.6%
$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$	Clinochlore	6.1%
SiO_2	Cristobalite	2.8%
		100.0%

COMMENTS:

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds with minor amounts of crystalline compounds present or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of about 100% silicates.

Carbon, nitrogen and part of the oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace volumes of sulphur, calcium and copper bearing compounds were detected during elemental analysis.

ABUNDANCE OF COMPOUNDS



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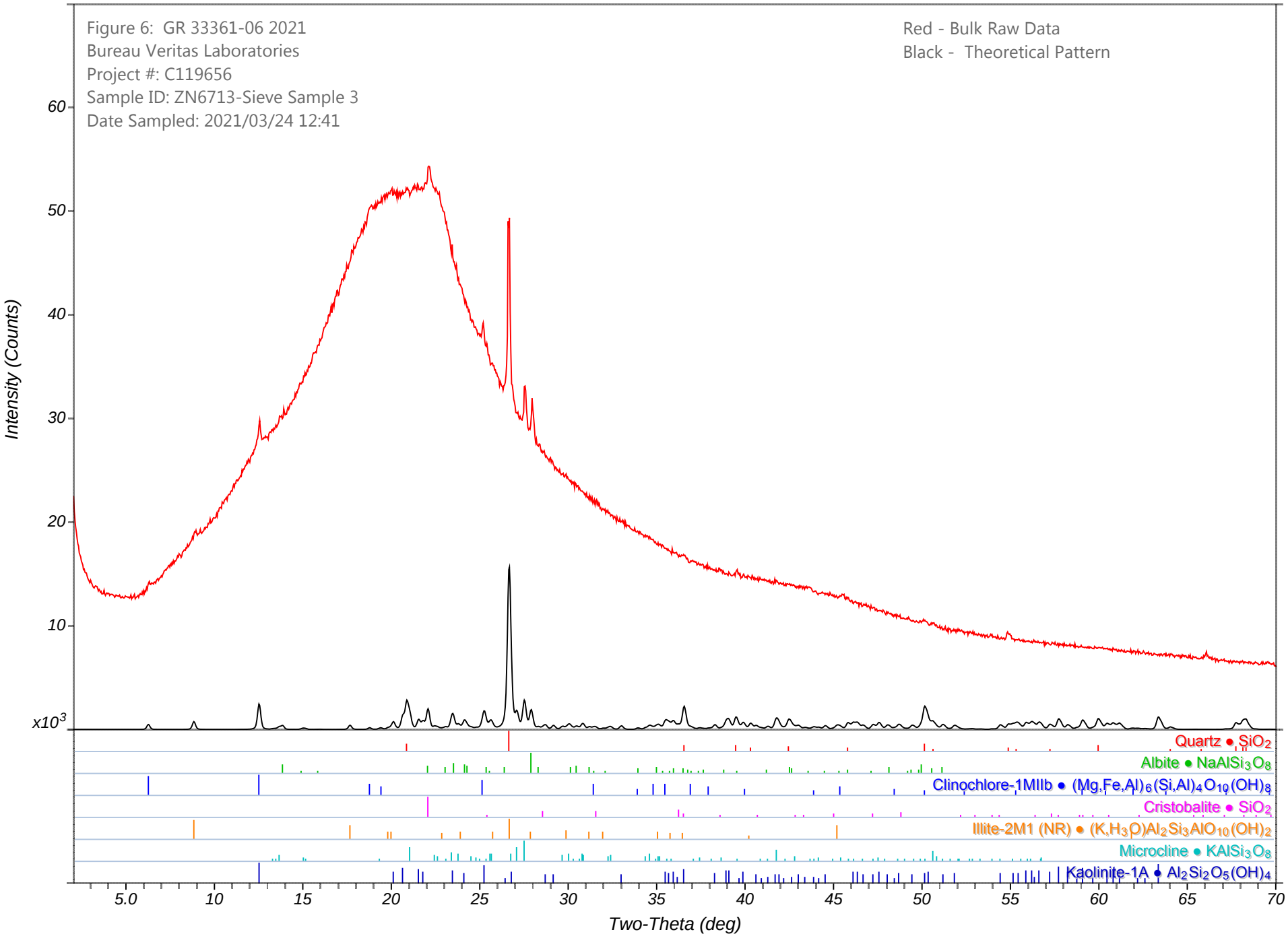
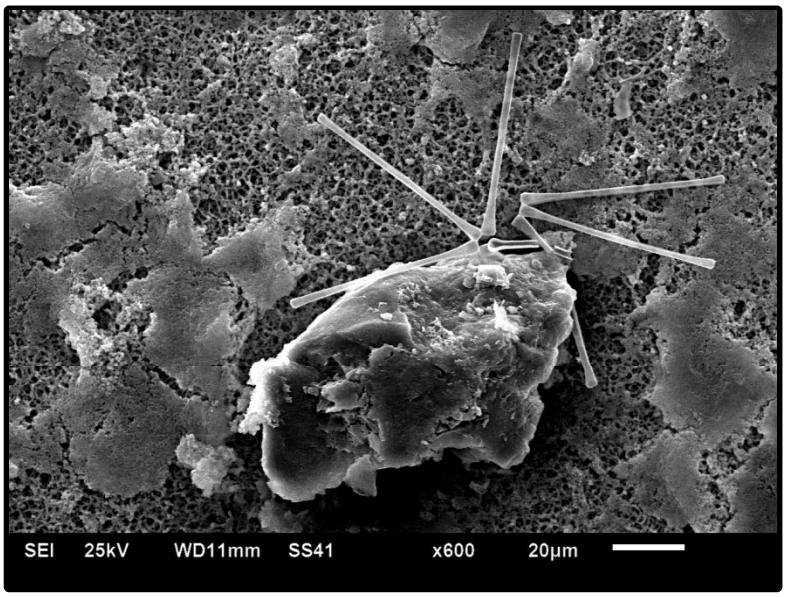
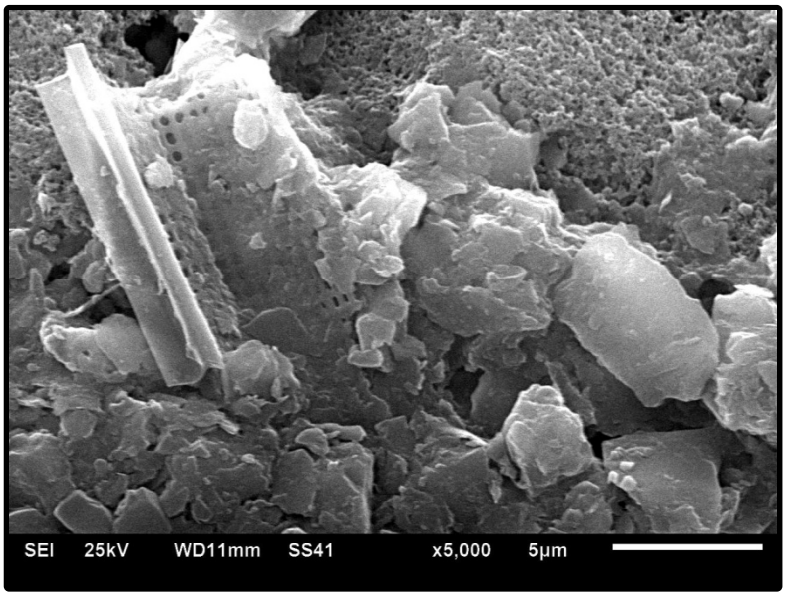
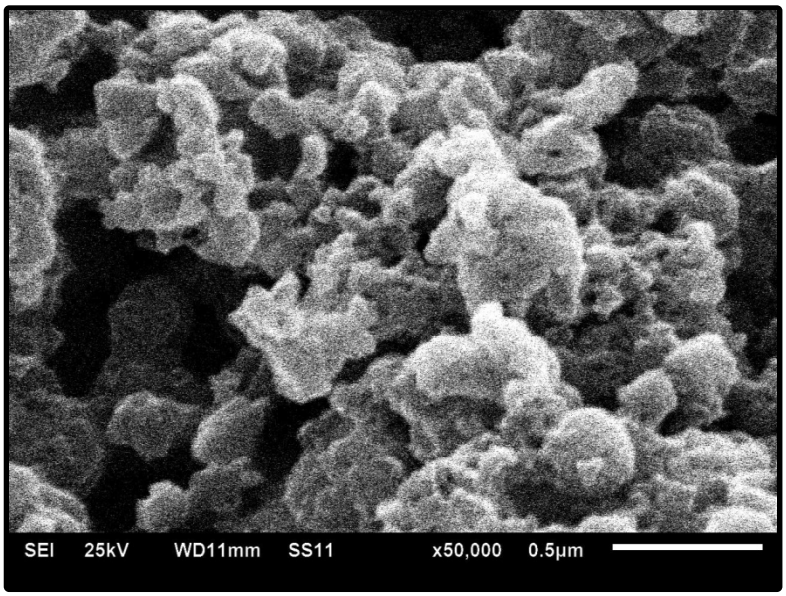


Figure 6: GR 33361-06 2021
Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZN6713-Sieve Sample 3
Date Sampled: 2021/03/24 12:41
Red - Bulk Raw Data
Black - Theoretical Pattern
Intensity (Counts)
x10^3
60
50
40
30
20
10
Quartz • SiO2
Albite • NaAlSi3O8
Clinochlore-1MIIb • (Mg,Fe,Al)6(Si,Al)4O10(OH)8
Cristobalite • SiO2
Illite-2M1 (NR) • (K,H3O)Al2Si3AlO10(OH)2
Microcline • KAlSi3O8
Kaolinite-1A • Al2Si2O5(OH)4
5.0
10
15
20
25
30
35
40
45
50
55
60
65
70
Two-Theta (deg)

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6713-Sieve Sample 3
Date Sampled: 2021/03/24 12:41







Particle Size Statistics

Size in Micrometers	
Mean	6.604
Median	1.119
Maximum	204.420
Quartile 3	4.417
Quartile 1	0.369
Minimum	0.018
Standard Deviation	18.887
Mode	0.215
Sample Variance	356.718
Kurtosis	48.077
Skewness	6.175
Range	204.402
Standard Error	0.845
Confidence Level (95%)	1.660
Sum	3302.043
Count	500

Histogram Statistics

Microns	Frequency	Cumulative
0.02	0	0.00%
0.03	9	1.80%
0.06	14	4.60%
0.13	26	9.80%
0.25	44	18.60%
0.50	64	31.40%
1.00	82	47.80%
2.00	58	59.40%
4.00	69	73.20%
8.00	57	84.60%
16.00	37	92.00%
32.00	16	95.20%
64.00	10	97.20%
128.00	11	99.40%
256.00	3	100.00%
More	0	100.00%

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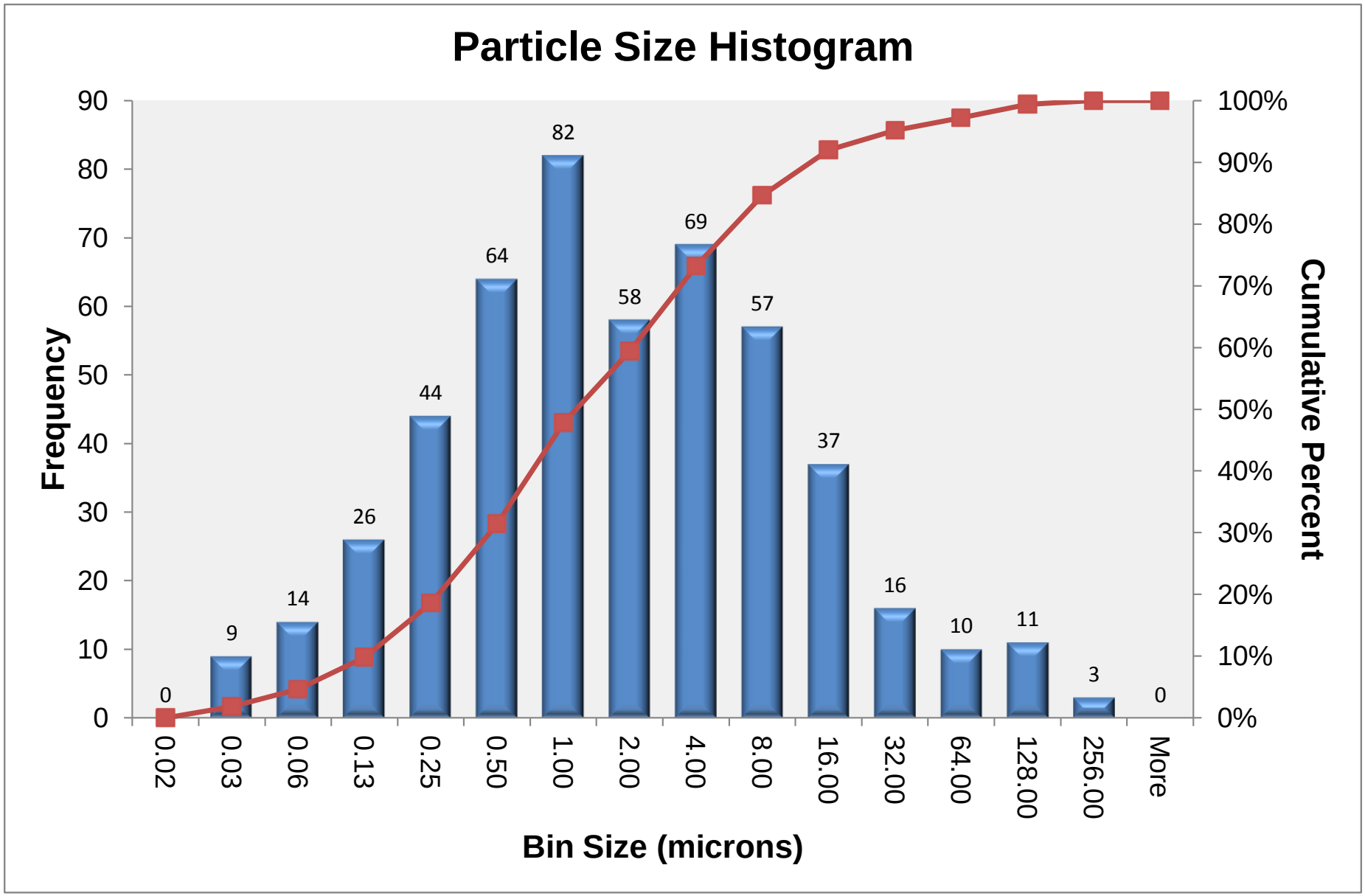
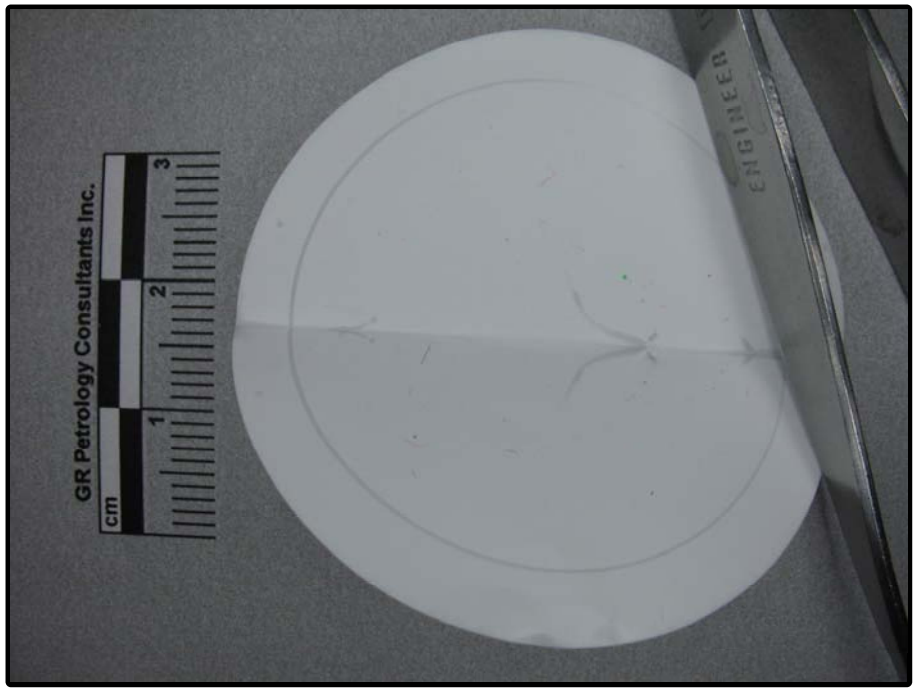
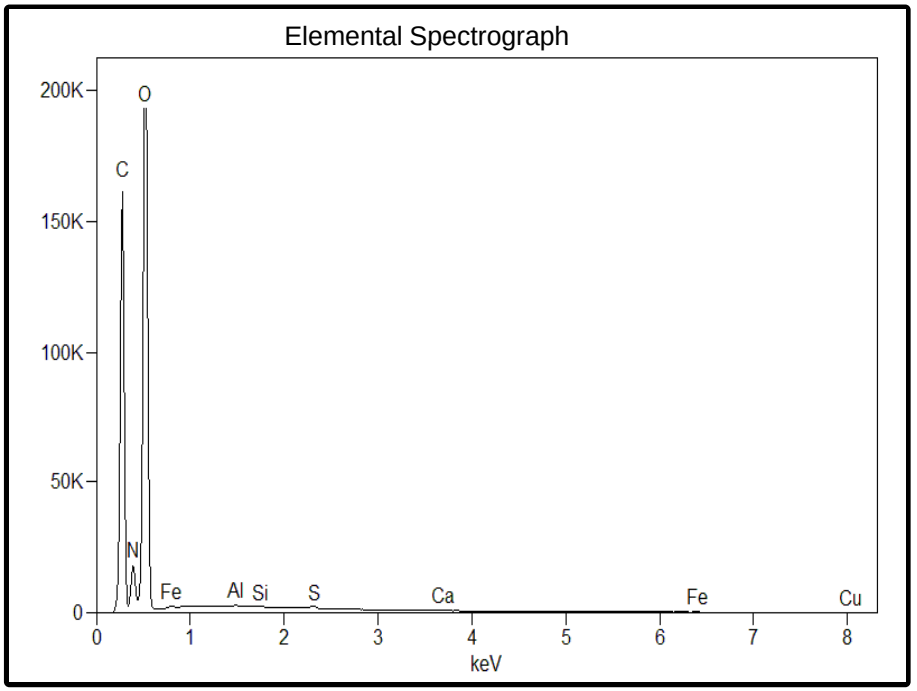

Particle Size Histogram
Frequency
Cumulative Percent
Bin Size (microns)
0
9
14
26
44
64
82
58
69
57
37
16
10
11
3
0
0.02
0.03
0.06
0.13
0.25
0.50
1.00
2.00
4.00
8.00
16.00
32.00
64.00
128.00
256.00
More

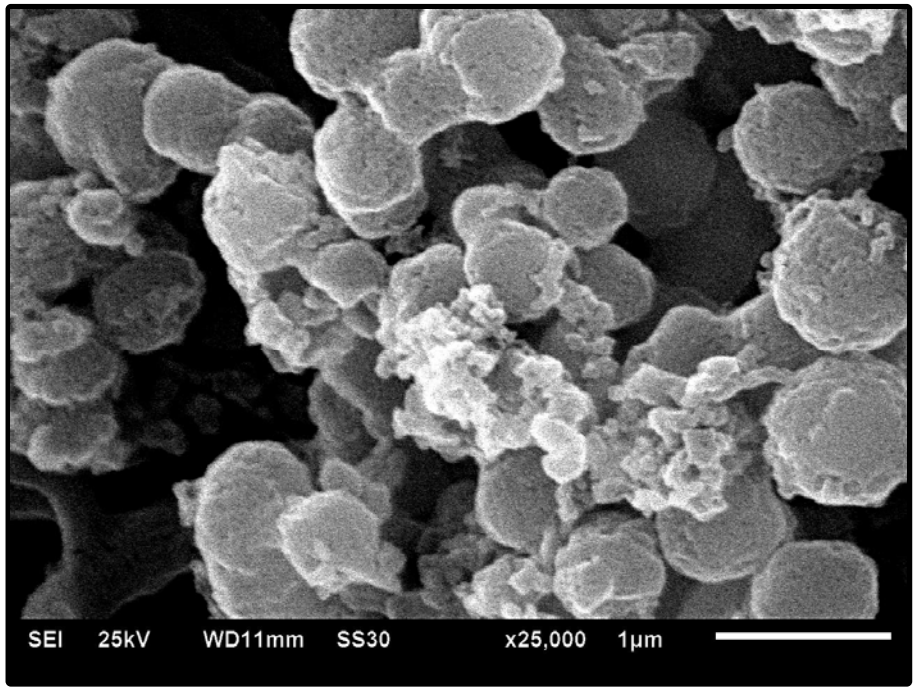
Raw Particle Size Data (microns) Number of measurements: 500

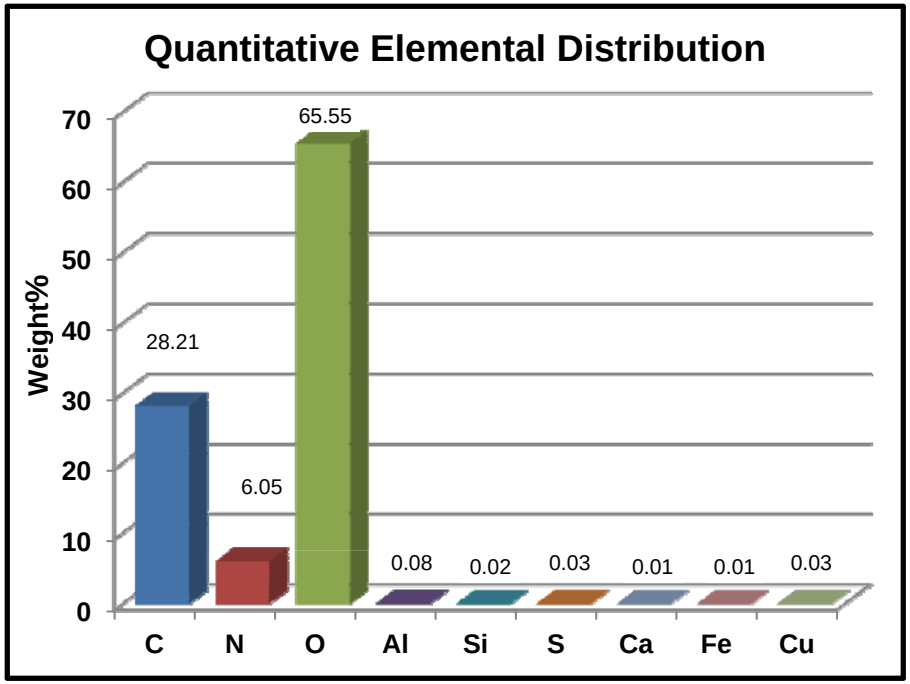
104.881	10.430	1.112	2.973	0.254	0.063	0.323	64.196	2.874	0.117
55.636	4.003	0.560	1.709	0.195	0.060	0.226	64.500	3.495	8.314
55.650	11.829	1.360	1.844	0.144	0.038	0.330	65.284	4.964	2.322
56.419	6.752	0.295	2.040	0.154	0.057	0.525	66.188	2.174	1.808
55.267	5.002	0.134	2.433	0.083	0.029	0.690	64.080	0.888	2.216
50.475	3.758	0.209	4.565	0.063	0.099	0.501	32.377	3.756	1.351
54.189	6.069	0.402	204.420	0.269	0.027	0.390	9.512	1.920	0.710
42.442	2.575	0.234	92.704	0.252	0.018	0.735	5.148	1.797	1.042
24.748	2.433	0.165	31.304	0.226	0.145	0.241	8.604	1.035	0.449
9.812	1.143	0.200	19.105	0.183	0.075	20.871	4.220	1.119	1.016
28.151	4.219	1.020	12.876	0.191	0.028	8.372	10.734	0.931	0.840
12.526	0.915	1.032	24.061	0.324	0.208	3.828	7.883	1.548	0.548
25.055	3.687	0.376	10.742	0.152	0.144	7.259	4.859	0.523	1.351
30.968	2.304	0.730	5.906	0.107	0.088	3.095	2.267	0.940	0.536
34.796	2.020	0.538	2.778	0.175	0.036	2.545	6.283	1.312	0.209
13.234	2.634	0.312	4.123	0.154	0.040	2.699	4.743	0.528	0.944
16.925	1.348	148.594	13.206	0.134	0.024	3.542	2.911	0.907	0.540
14.472	1.597	28.001	20.192	0.071	0.025	4.601	2.386	0.860	0.793
6.379	1.152	24.645	13.979	0.167	0.084	1.160	3.219	0.560	0.417
7.063	2.308	22.906	7.725	0.067	0.034	4.472	2.539	1.040	0.564
7.976	2.124	23.601	11.764	0.128	0.066	1.753	2.713	0.444	0.534
5.689	1.879	11.812	5.660	0.050	0.614	3.672	8.290	0.447	0.359
6.654	3.750	13.813	3.863	0.026	0.653	1.818	4.622	0.788	0.769
18.868	2.365	21.498	1.887	0.114	0.340	1.754	2.236	0.243	0.354
6.491	2.714	33.474	4.079	0.073	0.448	1.365	1.014	0.501	0.109
10.233	0.769	14.314	6.812	0.099	0.459	0.320	2.828	1.610	0.794
5.657	2.893	5.689	6.223	0.254	0.765	0.482	4.249	0.544	0.216
3.887	2.828	8.490	4.833	0.061	0.382	0.914	1.500	0.422	0.286
6.067	11.471	6.229	6.800	0.038	0.719	0.988	1.213	0.431	0.459
4.116	9.874	10.668	2.209	0.034	0.350	1.059	0.898	0.215	0.269
1.863	6.285	6.403	1.897	0.065	0.671	0.699	2.853	0.260	0.272
2.427	4.972	5.579	5.381	0.077	0.403	0.769	1.118	0.171	0.450
1.833	4.484	9.808	4.707	0.028	0.175	0.923	2.007	0.385	0.355
1.269	2.849	3.053	2.332	0.408	0.391	0.809	0.745	0.799	0.508
1.213	4.399	4.837	8.099	0.936	0.309	0.691	0.333	0.762	0.186
2.759	4.725	6.490	6.986	0.272	0.660	0.680	180.205	1.768	0.404
14.182	2.072	3.758	2.000	0.254	0.946	0.973	11.659	0.841	0.154
1.167	1.853	2.864	2.332	0.160	0.538	0.612	3.396	0.563	0.241
3.073	2.131	2.341	1.612	0.225	0.381	0.761	2.124	0.301	0.246
100.961	0.816	2.884	1.970	0.054	0.371	0.605	2.304	0.709	0.404
12.143	0.465	5.200	1.281	0.358	0.530	0.961	3.223	0.720	0.332
15.780	0.956	1.897	1.000	0.099	0.763	0.651	1.286	0.718	0.468
9.460	1.030	8.022	2.843	0.056	0.912	0.215	2.124	0.201	0.534
6.027	1.665	3.677	1.414	0.049	0.363	0.609	2.308	0.326	0.308
8.244	0.970	4.294	1.649	0.040	0.342	0.418	5.151	0.605	0.433
9.923	0.418	3.847	0.801	0.030	0.595	1.809	13.348	0.244	0.243
3.488	0.190	2.800	0.418	0.112	0.141	0.738	1.720	0.113	0.603
3.687	0.416	1.442	0.541	0.237	0.342	66.236	1.720	0.117	0.734
4.716	0.377	1.166	0.496	0.170	0.098	65.918	2.527	0.108	0.331
4.474	0.638	4.833	0.215	0.072	0.215	65.094	9.341	0.072	0.737

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6714-Spike Sample 1
Date Sampled: 2021/03/25 10:28









GR-007: ZN6714-Spike Sample 1 (2021/03/25 10:28)

The scanning electron photomicrograph on the facing page (lower left) shows sample GR-007 consists of aggregates of angular, subangular, subrounded and rounded, clay size to medium silt size particles. The upper left photograph illustrates the bulk sample on filter paper.

Carbon (C) and oxygen (O) dominate the elemental spectrograph, respectively forming about 28.2% and 65.6% of the sample. Nitrogen (N) is moderately abundant, forming about 6.1% of the sample. Trace to minor amounts of aluminum (Al), silicon (Si), sulphur (S), calcium (Ca), iron (Fe) and copper (Cu) are present.

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of trace amounts of silicates **(quartz [SiO_2])**.

Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace to minor volumes of nitrogen, aluminum, sulphur, calcium, iron and copper bearing compounds were detected during elemental analysis.

The particle size distribution histogram shows a bimodal distribution centering around 0.06 microns and 1.00 microns. Mean particle size was measured at 0.68 microns and median particle size was measured at 0.25 microns. Particles vary in size from 0.01 microns (clay size) to 30.29 microns (medium silt size). The Quartile 3 size is 0.71 microns and the Quartile 1 size is 0.06 microns. Standard deviation was measured at 1.86 microns.

TABLE 7: EDS and XRD Results
Bureau Veritas Laboratories; Project #: C119656; Sample ID: ZN6714-Spike Sample 1; Date Sampled: 2021/03/25 10:28
GR 33361-07 2021

ELEMENTS:

DOMINANT: C, O
MODERATE: N
COMMON:
MINOR-TRACE: Al, Si, S, Ca, Fe, Cu

COMPOUNDS:

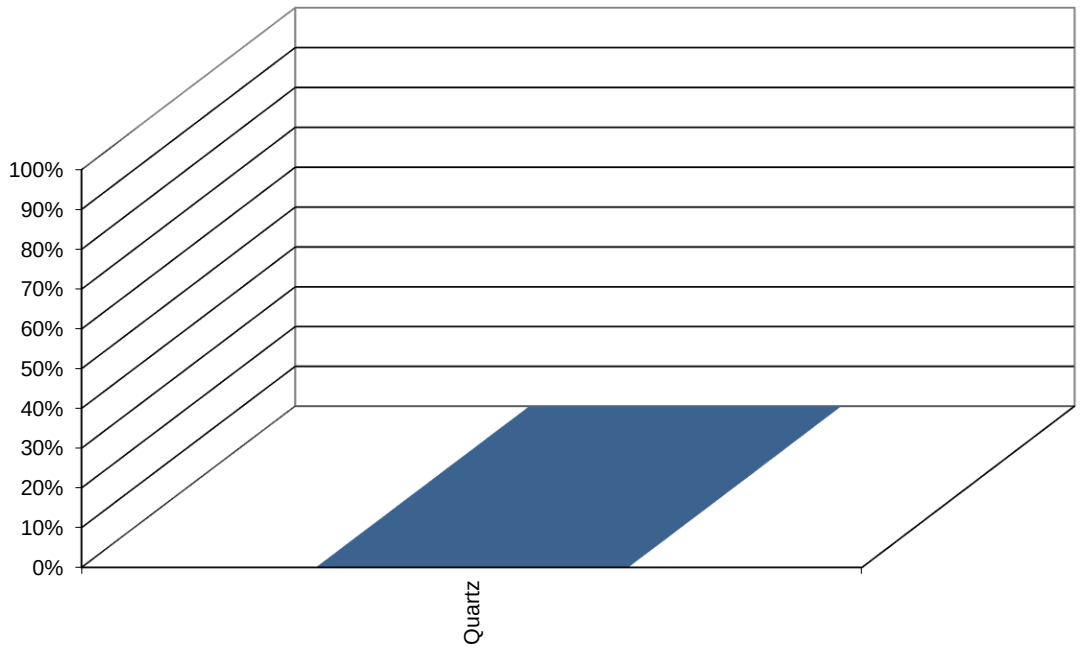
Formula	*Name*	*Percentage*
SiO_2	**Quartz**	**trace**

COMMENTS:

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of trace amounts of silicates.

Elemental analysis shows the sample is mainly composed of carbon, nitrogen and oxygen bearing compounds which represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace volumes of aluminum, sulphur, calcium, iron and copper bearing compounds were detected during elemental analysis.

ABUNDANCE OF COMPOUNDS



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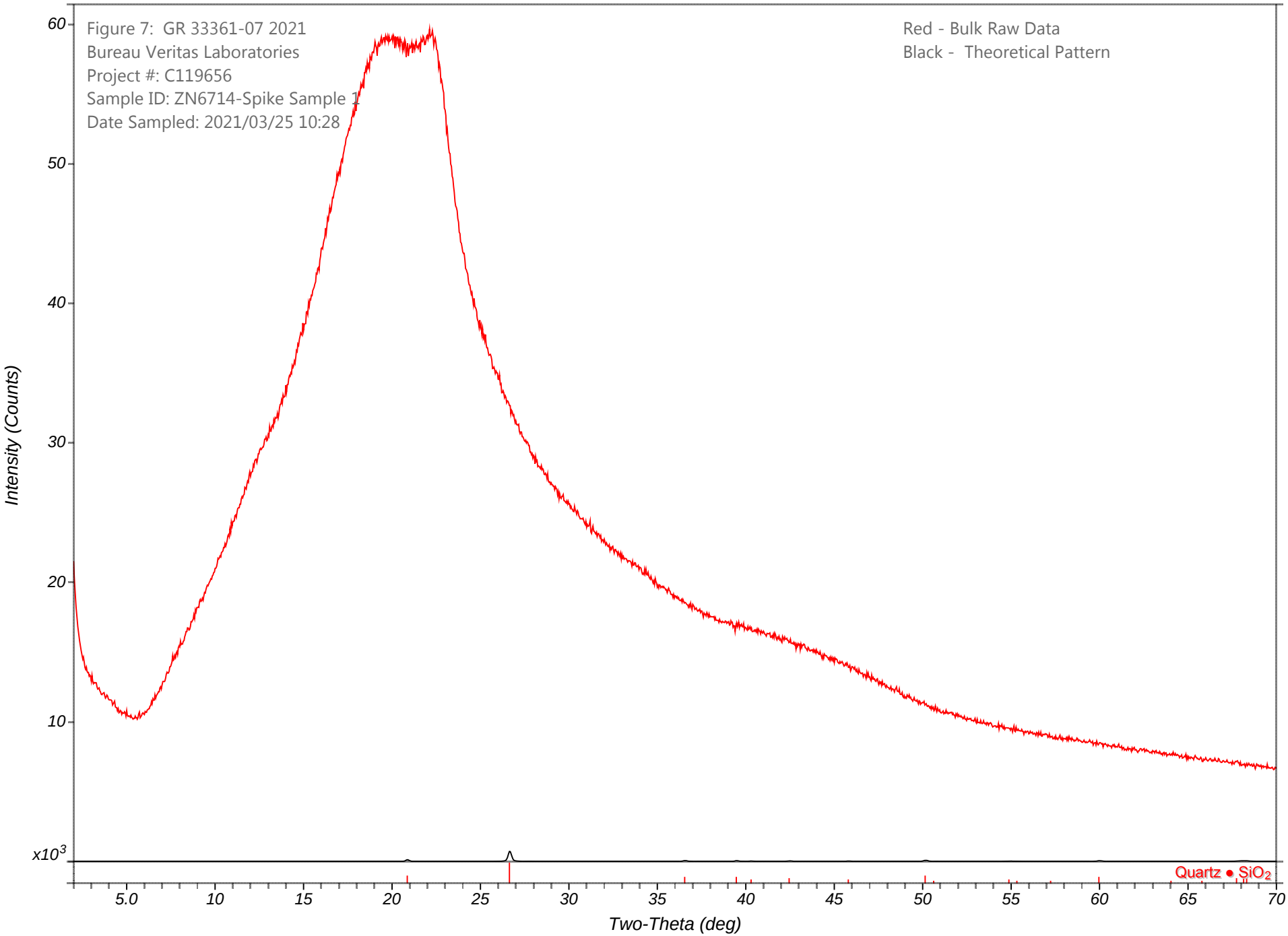
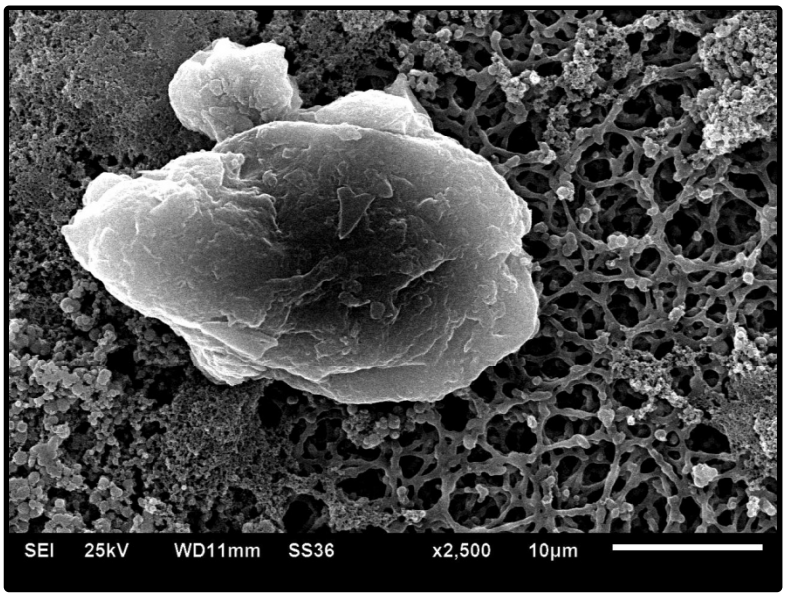
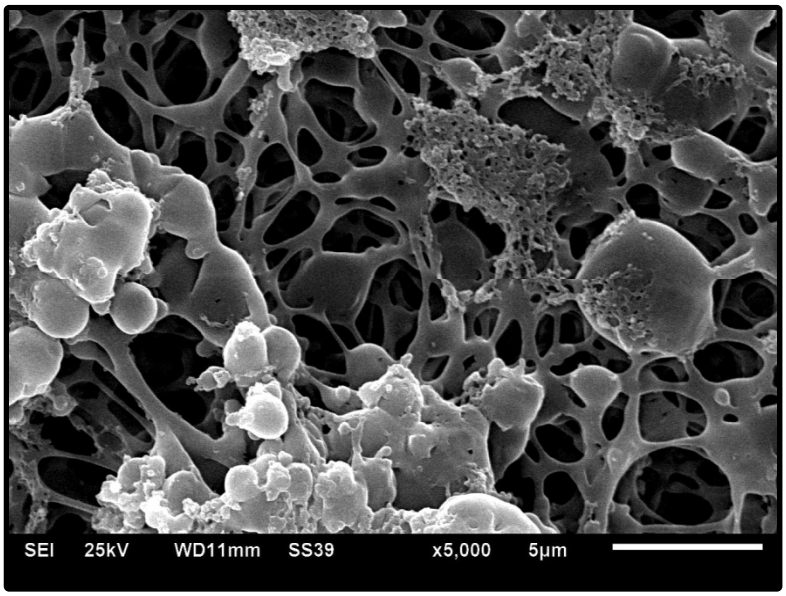
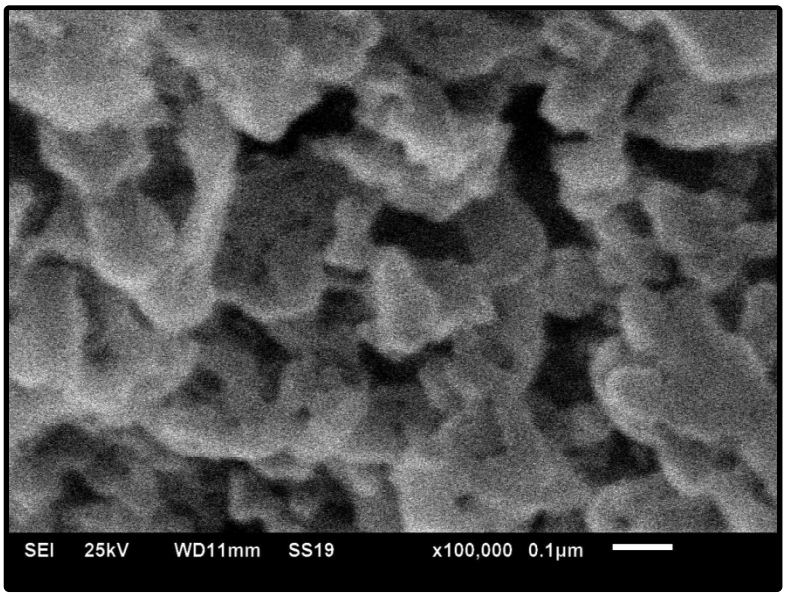


Figure 7: GR 33361-07 2021
Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZN6714-Spike Sample 1
Date Sampled: 2021/03/25 10:28
Red - Bulk Raw Data
Black - Theoretical Pattern
Intensity (Counts)
x10^3
60
50
40
30
20
10
5.0
10
15
20
25
30
35
40
45
50
55
60
65
70
Two-Theta (deg)
Quartz • SiO2

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6714-Spike Sample 1
Date Sampled: 2021/03/25 10:28







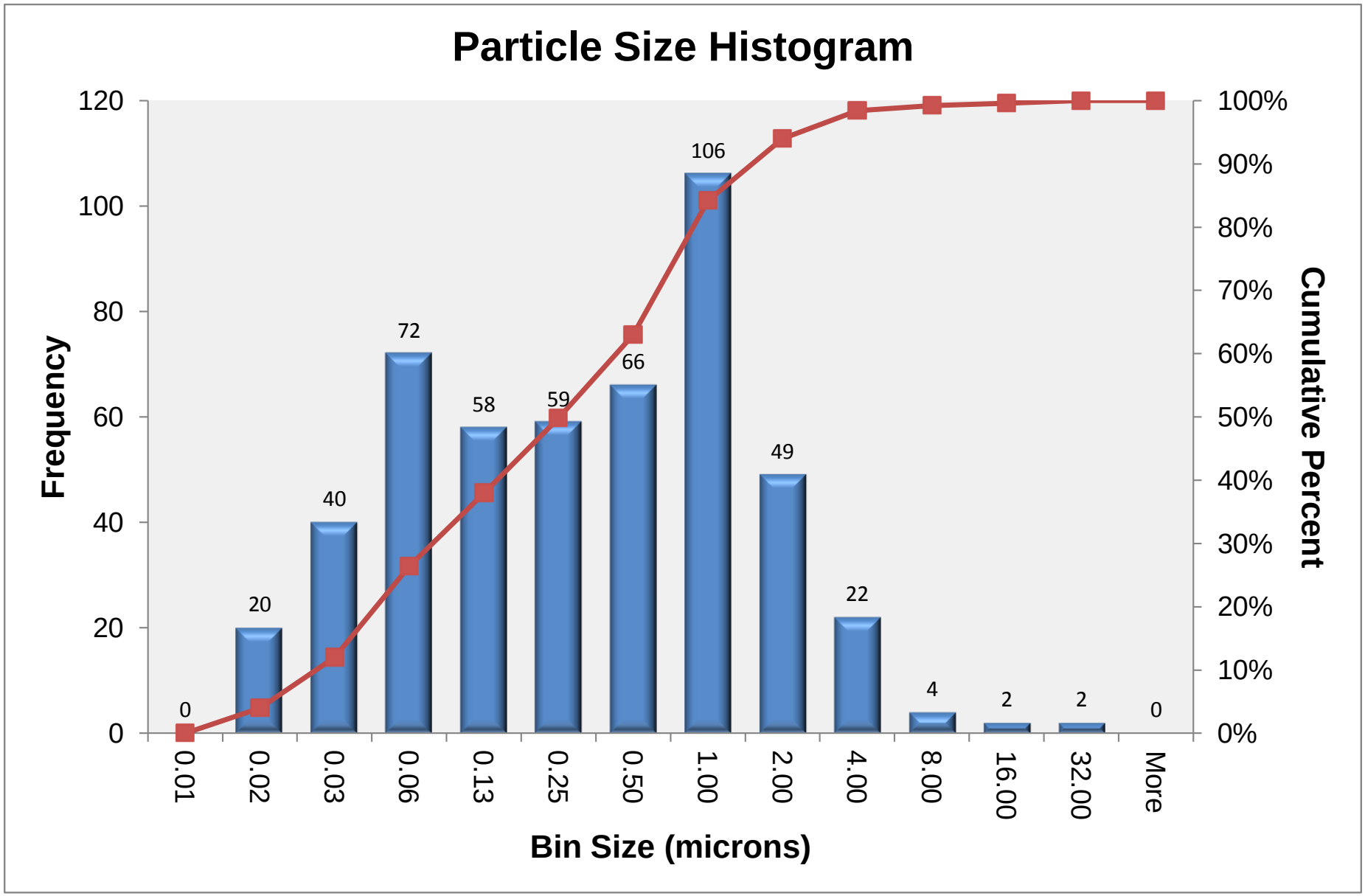
Particle Size Statistics

Size in Micrometers	
Mean	0.682
Median	0.253
Maximum	30.289
Quartile 3	0.711
Quartile 1	0.057
Minimum	0.009
Standard Deviation	1.855
Mode	0.014
Sample Variance	3.441
Kurtosis	148.238
Skewness	10.732
Range	30.280
Standard Error	0.083
Confidence Level (95%)	0.163
Sum	341.224
Count	500

Histogram Statistics

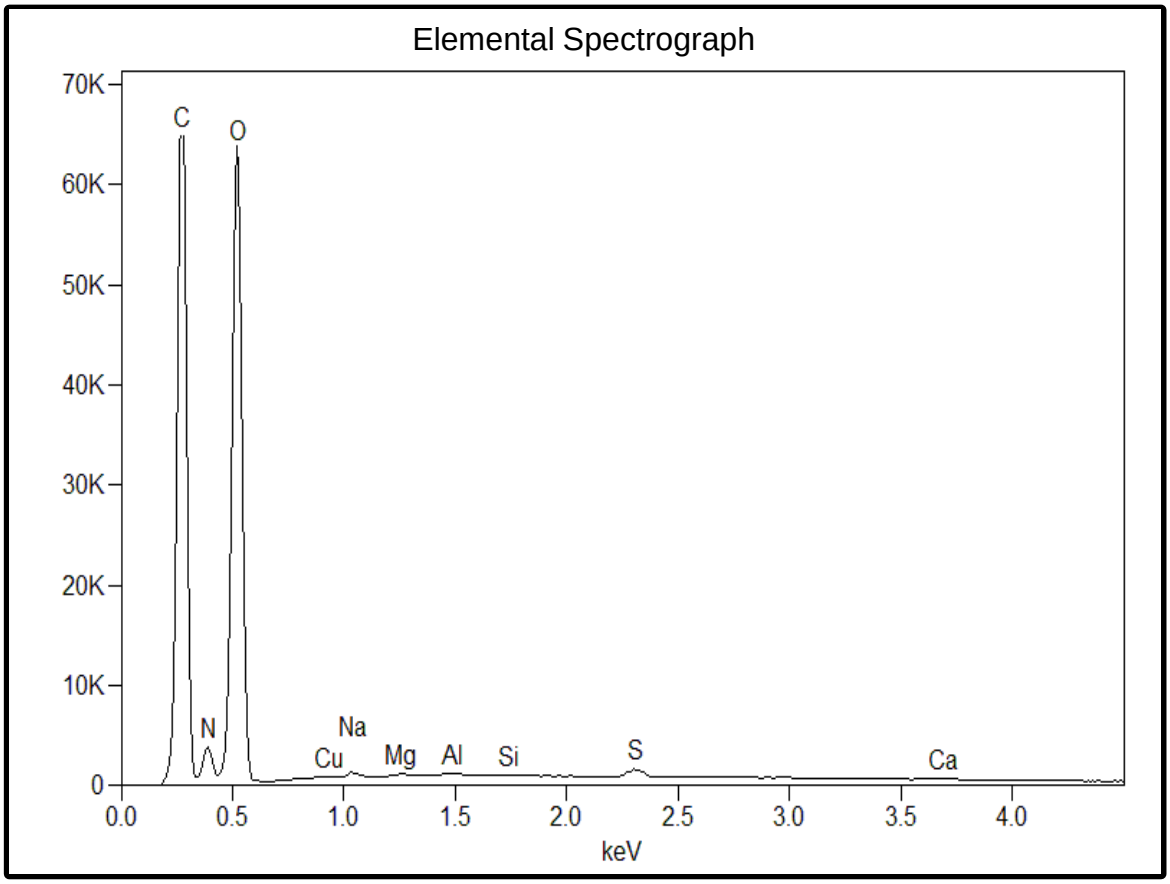
Microns	Frequency	Cumulative
0.01	0	0.00%
0.02	20	4.00%
0.03	40	12.00%
0.06	72	26.40%
0.13	58	38.00%
0.25	59	49.80%
0.50	66	63.00%
1.00	106	84.20%
2.00	49	94.00%
4.00	22	98.40%
8.00	4	99.20%
16.00	2	99.60%
32.00	2	100.00%
More	0	100.00%

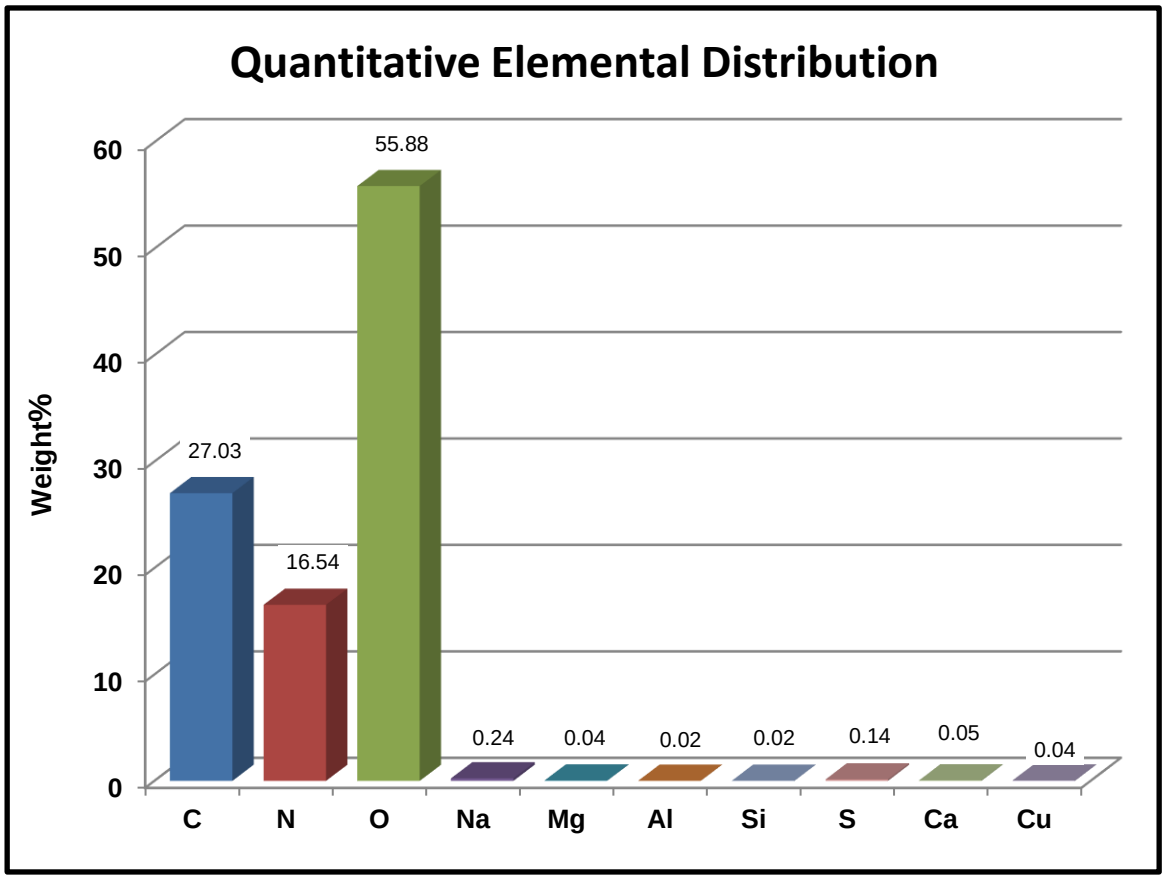
GR Petrology CONSULTANTS Inc.

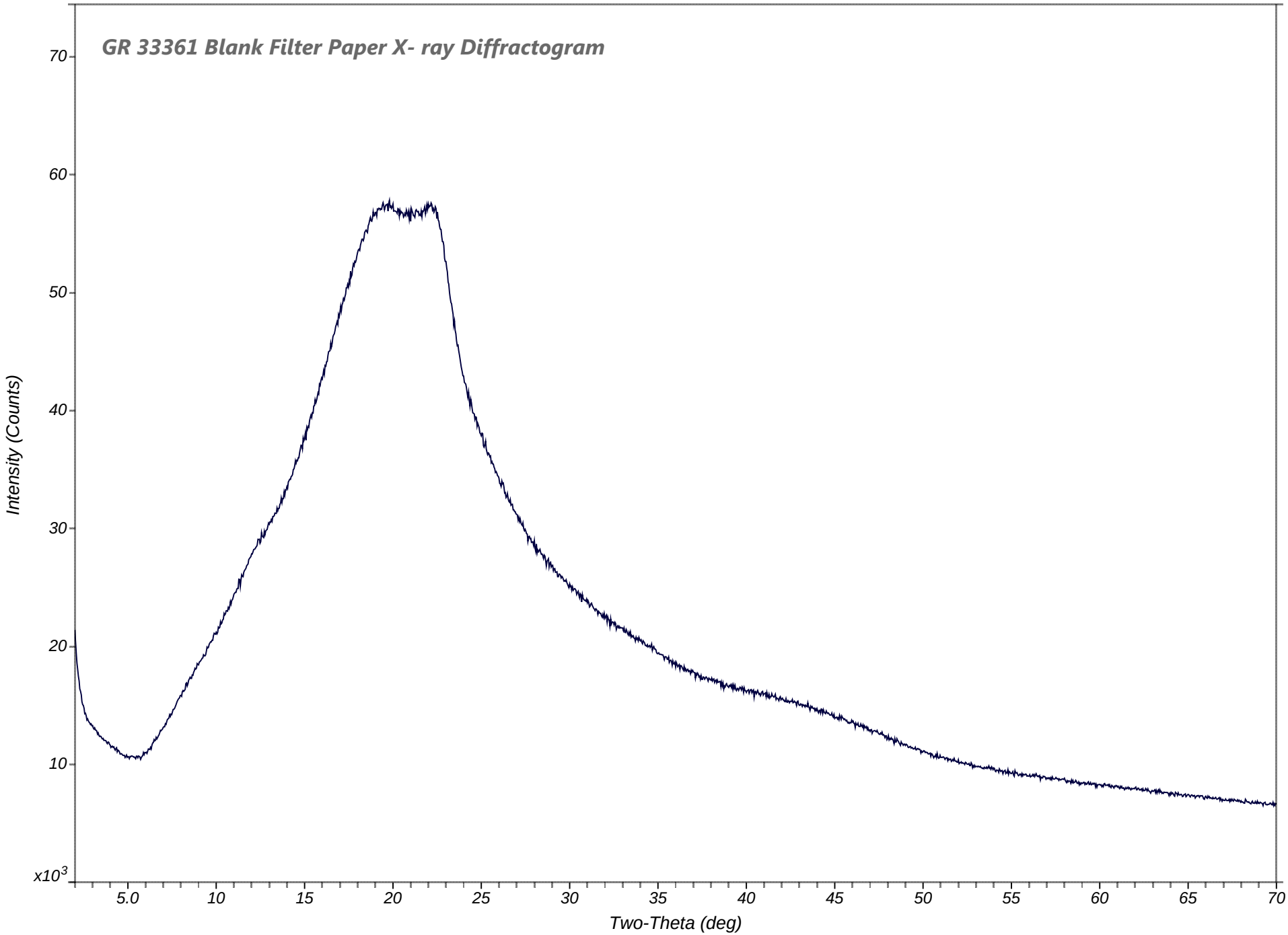

Particle Size Histogram
Frequency
Cumulative Percent
Bin Size (microns)
120
100
80
60
40
20
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
20
40
72
58
59
66
106
49
22
4
2
2
0
0.01
0.02
0.03
0.06
0.13
0.25
0.50
1.00
2.00
4.00
8.00
16.00
32.00
More

Raw Particle Size Data (microns) Number of measurements: 500

4.795	1.273	2.773	7.091	0.154	0.753	0.455	0.097	30.289	13.485
3.739	0.367	3.606	3.712	0.128	0.732	0.199	0.156	17.557	1.776
2.137	0.091	2.657	4.868	0.126	0.590	0.178	0.136	8.062	2.740
1.821	0.208	3.060	2.153	0.165	0.752	0.140	0.108	6.201	1.851
1.722	0.209	2.013	3.522	0.159	0.518	0.207	0.035	3.007	2.308
1.571	0.372	1.785	0.887	0.223	0.875	0.143	0.051	1.584	1.531
2.300	0.119	2.215	1.133	0.131	0.872	0.163	0.056	1.508	0.899
1.516	0.053	1.604	0.956	0.110	0.691	0.158	0.035	1.043	1.188
0.825	0.032	2.531	0.843	0.206	0.592	0.096	0.027	1.286	0.699
1.476	0.026	2.025	0.550	0.112	0.525	0.138	0.065	0.582	1.250
2.163	0.073	1.519	0.492	0.049	0.533	0.092	0.057	3.305	3.794
1.501	0.066	1.318	0.899	0.043	0.648	0.332	0.018	0.930	1.809
0.543	0.081	1.261	0.507	0.046	0.665	0.160	0.031	0.849	1.133
1.049	0.118	1.821	0.527	0.025	0.550	0.140	0.035	0.569	1.354
0.730	0.126	1.119	0.401	0.018	0.666	0.109	0.017	0.734	1.597
0.800	0.126	1.389	0.351	0.012	0.314	0.077	0.023	0.600	0.951
0.900	0.170	0.924	0.518	0.032	0.471	0.132	0.053	0.447	1.221
0.418	0.156	0.399	0.846	0.032	0.434	0.067	0.063	0.681	1.093
0.701	0.418	0.424	0.912	0.029	0.441	0.058	0.054	1.092	1.077
0.680	0.026	0.366	0.815	0.056	0.586	0.060	0.035	1.013	0.934
2.022	0.057	0.260	0.809	0.072	0.509	0.036	0.015	0.914	1.256
1.516	0.055	0.364	0.768	0.040	0.377	0.062	0.012	0.312	0.671
0.516	0.026	0.540	0.871	0.033	0.623	0.048	0.050	0.632	0.735
1.794	0.035	0.473	0.677	0.014	0.356	0.037	0.010	0.699	0.967
0.871	0.029	0.455	0.709	0.045	0.490	0.040	0.073	0.144	0.884
0.879	0.088	0.212	0.648	0.010	0.494	0.068	0.047	0.089	0.951
0.475	0.101	0.399	0.709	0.028	0.231	0.020	0.009	0.165	0.977
0.326	0.049	0.540	0.530	0.014	0.227	0.014	0.014	0.080	0.560
0.412	0.063	0.469	0.689	0.014	0.180	0.052	0.014	0.165	1.407
0.385	0.088	0.207	0.874	0.011	0.126	0.022	0.015	0.305	1.816
0.354	0.049	0.164	0.394	0.014	0.115	0.065	0.058	0.288	1.063
0.500	0.059	1.122	0.607	0.012	0.120	0.063	0.019	0.080	0.651
0.837	0.042	0.219	0.771	0.016	0.070	0.044	0.024	0.215	0.794
0.340	0.082	0.359	0.199	0.021	0.080	0.151	0.036	0.268	0.495
0.215	0.176	0.253	1.183	0.020	0.079	0.227	0.043	0.358	0.662
0.100	0.055	0.466	0.561	0.037	0.079	0.148	0.012	0.506	0.759
0.374	0.072	0.490	0.716	0.048	0.057	0.089	0.036	0.256	0.605
0.312	0.051	0.200	0.676	0.030	0.068	0.107	0.066	0.322	0.660
0.286	0.044	0.237	1.281	0.010	0.052	0.117	0.121	0.253	0.759
0.224	0.055	0.313	0.356	0.016	0.100	0.043	0.024	0.215	1.495
0.428	0.071	0.122	0.617	0.016	0.128	0.018	0.034	0.165	0.699
0.492	0.031	0.265	0.646	0.063	0.084	0.033	0.016	0.113	0.483
0.286	0.044	0.334	0.598	0.025	0.049	0.022	0.065	0.170	0.805
0.280	0.024	0.318	0.624	0.020	0.032	0.042	0.027	0.215	3.055
0.358	0.033	0.196	0.925	0.040	0.058	0.050	0.083	0.506	0.699
0.388	0.043	0.127	0.519	0.047	0.024	0.047	0.012	0.165	0.923
1.372	0.037	0.091	0.724	0.042	0.041	0.109	0.042	0.520	1.112
1.126	0.077	0.200	0.512	0.024	0.023	0.027	0.018	0.283	0.666
1.306	0.033	0.098	0.549	0.042	0.157	0.018	0.016	0.253	0.789
0.621	0.044	0.093	0.384	0.080	0.051	0.024	0.014	0.215	0.645


Elemental Spectrograph
70K
60K
50K
40K
30K
20K
10K
0
C
O
N
Na
Cu
Mg
Al
Si
S
Ca
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
keV


Quantitative Elemental Distribution
Weight%
60
50
40
30
20
10
0
55.88
27.03
16.54
0.24
0.04
0.02
0.02
0.14
0.05
0.04
C
N
O
Na
Mg
Al
Si
S
Ca
Cu


GR 33361 Blank Filter Paper X- ray Diffractogram
Intensity (Counts)
x10^3
70
60
50
40
30
20
10
5.0
10
15
20
25
30
35
40
45
50
55
60
65
70
Two-Theta (deg)

XRD, SEM, Elemental and Particle Size Analysis

of

Seven Solid Samples

for

Bureau Veritas Laboratories

Project #: C119656

GR 33445 2021

GR Petrology Consultants Inc.
Suite 8, 1323 – 44th Avenue N.E.
Calgary, Alberta T2E 6L5
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May 2021

GR Petrology CONSULTANTS Inc.

Summary of Analyses

Seven solid samples were submitted by Bureau Veritas Laboratories for bulk X-ray Diffraction Analysis (XRD), elemental analysis by X-ray Energy Dispersive Spectrometry (EDS), Scanning Electron Microscopy (SEM) and Particle Size Analysis.

Quantitative elemental analysis was performed by an **Oxford INCA** microanalysis system attached to a **JEOL JSM-6610** scanning electron microscope. The INCA system was designed to obtain standardless quantitative elemental analysis from rough samples by SEM. The INCA system has enhanced light element capabilities, and is able to identify beryllium (Be), and quantify boron (B), and carbon (C).

Particle size analysis was conducted on SEM photomicrographs. Particle size was measured using Image Pro Plus software.

The following Tables, Figures and Plates are included in this report:

- Table A: Bulk Fraction X-Ray Diffraction Data
- Table B: Comparison of Elemental Composition by EDS and XRD
- Table C: Particle Size Data
- Plates 1 to 7: Photographs and EDS Results
- Tables 1 to 7: EDS and XRD Results
- Figures 1 to 7: Bulk X-Ray Diffractograms
- Plates PSD-1 to PSD-7: Particle Size Statistics and Photographs

The following samples were analyzed:

- GR-001: ZN6701-F1 (2021/03/24 11:50)
- GR-002: ZN6702-F2 (2021/03/24 12:27)
- GR-003: ZN6703-F3 (2021/03/24 13:01)
- GR-004: ZN6704-F4 (2021/03/24 13:30)

- GR-005: ZN6705-F5 (2021/03/24 14:02)
- GR-006: ZN6706-F6 (2021/03/24 15:43)
- GR-007: ZN6707-F7 (2021/03/25 10:50)

COMPANY: Bureau Veritas Laboratories
PROJECT #: C119656
GR FILE #: GR 33445 2021

TABLE A
BULK FRACTION X-RAY DIFFRACTION DATA

GR Sample #	Sample ID	Qtz	KFd	Plag	Sil	Kaol	Ill	Chl	M-L	Smec	Total Clay
GR-001	ZN6701-F1	16.2	8.9	13.4	1.0	29.9	14.8	15.8	-	-	60.5
GR-002	ZN6702-F2	22.1	2.8	5.6	1.8	27.4	20.1	20.2	-	-	67.7
GR-003	ZN6703-F3	15.9	8.9	13.1	1.6	29.3	14.4	16.8	-	-	60.5
GR-004	ZN6704-F4	14.7	4.9	15.7	-	18.3	24.1	22.3	-	-	64.7
GR-005	ZN6705-F5	tr	tr	tr	tr	tr	tr	tr	-	-	tr
GR-006	ZN6706-F6	NON-CRYSTALLINE									
GR-007	ZN6707-F7	tr	-	-	-	-	-	-	-	-	-

Qtz - Quartz - SiO_2
KFd - Potassium Feldspar - $KAlSi_3O_8$
Plag - Sodium Feldspar - $NaAlSi_3O_8$
Sil - Silicon Oxide - SiO_2
Kaol - Kaolinite - $Al_2Si_2O_5(OH)_4$
Ill - Illite - $(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$
Chl - Chlorite - $(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$
M-L - Mixed Layer
M-L - Mixed Layer
Total Clay - Kaol+Ill+Chl+M-L+Smec

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COMPANY: Bureau Veritas Laboratories
PROJECT #: C119656
GR PROJECT #: GR 33445 2021

TABLE B
Comparison of Elemental Composition by EDS and XRD

GR Sample #	Sample ID	H	C	N	O	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	Cr	Fe	Ni	Cu
GR-001	ZN6701-F1	-	33.00	11.44	51.72	0.33	0.33	0.76	1.37	0.02	0.91	-	0.03	0.02	-	-	0.01	-	0.05
		0.68	-	-	46.72	1.17	2.18	15.40	26.21	-	-	-	2.64	-	-	-	5.01	-	-
GR-002	ZN6702-F2	-	45.73	-	44.44	0.47	0.34	1.05	1.93	-	5.50	-	0.10	0.10	-	-	0.24	0.03	0.07
		0.71	-	-	45.72	0.49	2.79	15.63	25.99	-	-	-	2.28	-	-	-	6.40	-	-
GR-003	ZN6703-F3	-	50.00	-	40.68	-	0.19	0.64	1.55	0.09	6.46	-	0.08	0.05	-	-	0.22	-	0.04
		0.66	-	-	46.38	1.15	2.32	15.42	26.15	-	-	-	2.60	-	-	-	5.33	-	-
GR-004	ZN6704-F4	-	29.87	-	52.59	0.90	0.70	2.28	6.65	0.10	5.41	0.04	0.31	0.29	0.06	-	0.74	-	0.06
		0.62	-	-	44.01	1.38	3.08	16.28	24.62	-	-	-	2.95	-	-	-	7.07	-	-
GR-005	ZN6705-F5	-	42.36	-	41.23	0.34	0.18	0.68	1.72	0.16	12.80	-	0.09	0.08	-	-	0.28	-	0.08
		tr	-	-	tr	tr	tr	tr	tr	-	-	-	tr	-	-	-	tr	-	-
GR-006	ZN6706-F6	-	50.39	-	33.12	-	-	-	-	-	16.18	0.19	-	-	-	-	-	-	0.12
		NON-CHRYSTALLINE																	
GR-007	ZN6707-F7	-	70.29	-	25.09	-	0.14	2.37	0.08	-	1.55	0.04	-	0.02	-	0.04	0.15	0.10	0.12
		-	-	-	tr	-	-	-	tr	-	-	-	-	-	-	-	-	-	-

H - Hydrogen	Al - Aluminum	Ca - Calcium	Sn - Tin
C - Carbon	Si - Silicon	Ti - Titanium	
N - Nitrogen	P - Phosphorus	Cr - Chromium	
O - Oxygen	S - Sulphur	Fe - Iron	tr - trace
Na - Sodium	Cl - Chlorine	Ni - Nickel	Black - EDS Analysis
Mg - Magnesium	K - Potassium	Cu - Copper	Red - Calculated from XRD

GR Petrology CONSULTANTS Inc.

COMPANY: Bureau Veritas Laboratories
PROJECT #: C119656
GR PROJECT #: GR 33445 2021

TABLE C
PARTICLE SIZE DATA

GR Sample #	Sample ID	Maximum (µm)	Quartile 3 (µm)	Mean (µm)	Median (µm)	Quartile 1 (µm)	Minimum (µm)	Standard Deviation
GR-001	ZN6701-F1	66.61	3.72	3.14	1.00	0.22	0.02	5.74
GR-002	ZN6702-F2	338.01	4.63	4.92	2.37	1.19	0.06	16.28
GR-003	ZN6703-F3	92.58	4.73	4.15	2.07	0.73	0.05	7.19
GR-004	ZN6704-F4	274.26	8.01	7.86	2.61	0.86	0.03	19.69
GR-005	ZN6705-F5	90.53	3.03	2.93	1.14	0.36	0.02	6.35
GR-006	ZN6706-F6	27.85	0.71	0.86	0.28	0.13	0.01	2.49
GR-007	ZN6707-F7	62.54	2.11	2.11	0.71	0.29	0.03	4.50

Summary of XRD Results

X-ray diffraction analysis was conducted on samples GR-001 to GR-007. Samples GR-001 to GR-004 are mainly composed of silicates, forming about 100% of each sample. Trace amounts of silicates were detected in GR-005 and GR-007. GR-006 is a non-crystalline sample.

Comparison of EDS and XRD Results

In many cases the EDS weight percent calculation for some of the elements is different from the XRD weight percent calculation. EDS analysis identifies and quantifies elements present in both crystalline and non-crystalline components. XRD analysis only detects elements in crystalline compounds because only crystalline components of the sample diffract X-rays. Thus our XRD weight percent calculation can only include those elements present in the crystalline compounds. It must be emphasized that each element identified by X-ray diffraction analysis should also be detected by EDS; however, the reverse is not necessarily true.

Note: Hydrogen (H) can not be detected in EDS analysis; therefore, can not be compared.

Table B summarizes the following comments regarding the comparison of EDS and XRD results.

Sample GR-001 showed a poor to moderate correlation between the XRD and EDS results.

A significant difference with respect to carbon was found in sample GR-001.

- Carbon was measured at 33.00% in the elemental analysis, while XRD analysis detected no carbon.

Moderate differences with respect to nitrogen, aluminum and silicon were found in sample GR-001.

- EDS analysis detected 11.44% nitrogen, while no nitrogen was detected in XRD analysis.

- Aluminum represents 0.76% in the EDS analysis, while XRD analysis detected 15.40% aluminum.
- In the elemental analysis, silicon forms 1.37% of the sample, whereas XRD analysis calculated silicon to be 26.21%.

Minor differences with respect to oxygen, potassium and iron were noted in sample GR-001.

- In the elemental analysis, oxygen forms 51.72% of the sample, while 46.72% oxygen was detected in XRD analysis.
- Potassium represents 0.03% in the EDS analysis, whereas XRD analysis calculated potassium to be 2.64%.
- EDS analysis detected 0.01% iron, while 5.01% iron was detected in XRD analysis.

The EDS results for carbon, nitrogen and oxygen are greater than the XRD results indicating the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. The XRD results for aluminum, silicon, potassium and iron are greater than the EDS results indicating these elements occur in well-crystalline compounds.

Sample GR-002 showed a poor correlation between the XRD and EDS results.

A significant difference with respect to carbon was observed in sample GR-002.

- Carbon was measured at 45.73% in the elemental analysis, while XRD analysis did not detect carbon.

Moderate differences with respect to aluminum and silicon were observed in sample GR-002.

- Aluminum was measured at 1.05% in the elemental analysis, while 15.63% aluminum was detected in XRD analysis.
- In the elemental analysis, silicon forms 1.93% of the sample, whereas XRD analysis calculated silicon to be 25.99%.

Minor differences with respect to magnesium, sulphur, potassium and iron were found in sample GR-002.

- Magnesium represents 0.34% in the EDS analysis, while XRD analysis calculated magnesium to be 2.79%.

- Sulphur was measured at 5.50% in the elemental analysis, while no sulphur was detected in XRD analysis.
- EDS analysis detected 0.10% potassium, while XRD analysis detected 2.28% potassium.
- Iron represents 0.24% in the EDS analysis, while XRD analysis calculated iron to be 6.40%.

The EDS results for carbon and sulphur are greater than the XRD results indicating the presence of non-crystalline carbon and sulphur bearing compounds. The XRD results for magnesium, aluminum, silicon, potassium and iron are greater than the EDS results indicating these elements occur in well-crystalline compounds.

Sample GR-003 showed a poor correlation between the XRD and EDS results.

A significant differences with respect to carbon was observed in sample GR-003.

- EDS analysis detected 50.00% carbon, while no carbon was detected in XRD analysis.

Moderate differences with respect to aluminum and silicon were noted in sample GR-003.

- Aluminum represents 0.64% in the EDS analysis, while 15.42% aluminum was detected in XRD analysis.
- In the elemental analysis, silicon forms 1.55% of the sample, while XRD analysis calculated silicon to be 26.15%.

Minor differences with respect to oxygen, magnesium, sulphur, potassium and iron were observed in sample GR-003.

- In the elemental analysis, oxygen forms 40.68% of the sample, while XRD analysis calculated oxygen to be 46.38%.
- EDS analysis detected 0.19% magnesium, while XRD analysis detected 2.32% magnesium.
- In the elemental analysis, sulphur forms 6.46% of the sample, whereas XRD analysis did not detect sulphur.
- Potassium was measured at 0.08% in the elemental analysis, while XRD analysis detected 2.60% potassium.
- EDS analysis detected 0.22% iron, while XRD analysis calculated iron to be 5.33%.

The EDS results for carbon and sulphur are greater than the XRD results indicating the presence of non-crystalline carbon and sulphur bearing compounds. The XRD results for oxygen, magnesium, aluminum, silicon, potassium and iron are greater than the EDS results indicating these elements occur in well-crystalline compounds.

Sample GR-004 showed a poor to moderate correlation between the XRD and EDS results.

Moderate differences with respect to carbon, aluminum and silicon were observed in sample GR-004.

- In the elemental analysis, carbon forms 29.87% of the sample, while no carbon was detected in XRD analysis.
- Aluminum represents 2.28% in the EDS analysis, whereas XRD analysis calculated aluminum to be 16.28%.
- In the elemental analysis, silicon forms 6.65% of the sample, while 24.62% silicon was detected in XRD analysis.

Minor differences with respect to oxygen, magnesium, sulphur, potassium and iron were observed in sample GR-004.

- Oxygen was measured at 52.59% in the elemental analysis, whereas XRD analysis calculated oxygen to be 44.01%.
- EDS analysis detected 0.70% magnesium, while XRD analysis detected 3.08% magnesium.
- Sulphur was measured at 5.41% in the elemental analysis, while no sulphur was detected in XRD analysis.
- Potassium represents 0.31% in the EDS analysis, while XRD analysis calculated potassium to be 2.95%.
- Iron was measured at 0.74% in the elemental analysis, while 7.07% iron was detected in XRD analysis.

The EDS results for carbon, oxygen and sulphur are greater than the XRD results indicating the presence of non-crystalline carbon, oxygen and sulphur bearing compounds. The XRD results for magnesium, aluminum, silicon, potassium and iron are greater than the EDS results indicating these elements occur in well-crystalline compounds.

Sample GR-005 showed a poor correlation between the XRD and EDS results.

Significant differences with respect to carbon and oxygen were observed in sample GR-005.

- In the elemental analysis, carbon forms 42.36% of the sample, whereas XRD analysis did not detect carbon.
- EDS analysis detected 41.23% oxygen, while XRD analysis detected trace amounts of oxygen.

A moderate difference with respect to sulphur was found in sample GR-005.

- In the elemental analysis, sulphur forms 12.80% of the sample, whereas XRD analysis did not detect sulphur.

The EDS results for carbon, oxygen and sulphur are greater than the XRD results indicating the presence of non-crystalline carbon, oxygen and sulphur bearing compounds.

Sample GR-006 showed no correlation between the XRD and EDS results.

Sample GR-007 showed a poor correlation between the XRD and EDS results.

Significant differences with respect to carbon and oxygen were found in sample GR-007.

- Carbon represents 70.29% in the EDS analysis, while XRD analysis detected no carbon.

A moderate difference with respect to oxygen was found in sample GR-007.

- EDS analysis detected 25.09% oxygen, while XRD analysis detected trace amounts of oxygen.

A minor difference with respect to aluminum was noted in sample GR-007.

- In the elemental analysis, aluminum forms 2.37% of the sample, while XRD analysis detected no aluminum.

The EDS results for carbon, oxygen and aluminum are greater than the XRD results indicating the presence of non-crystalline carbon, oxygen and aluminum bearing compounds.

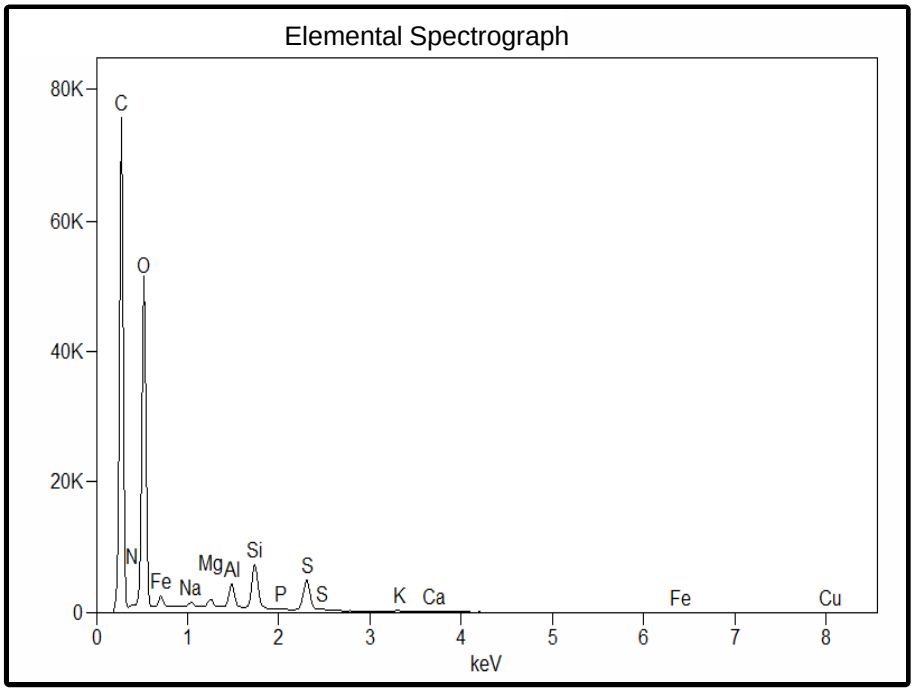
GR Petrology usually mounts filter paper on a glass slide for X-ray diffraction analysis. The X-ray beam scans an area of approximately 250mm^2; however, the electron beam in the EDS that generates the elemental analysis scans a much smaller area of approximately 6mm^2. We attempted

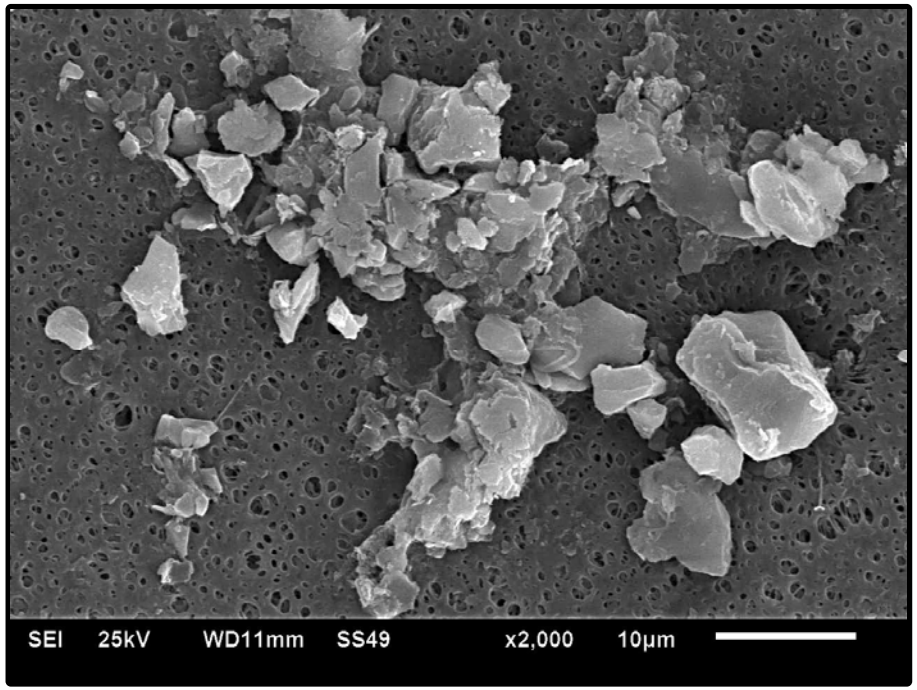
to obtain the elemental analysis from the most representative area of the sample; however, the irregular distribution of the materials in the sample may have skewed the EDS results in some instances.

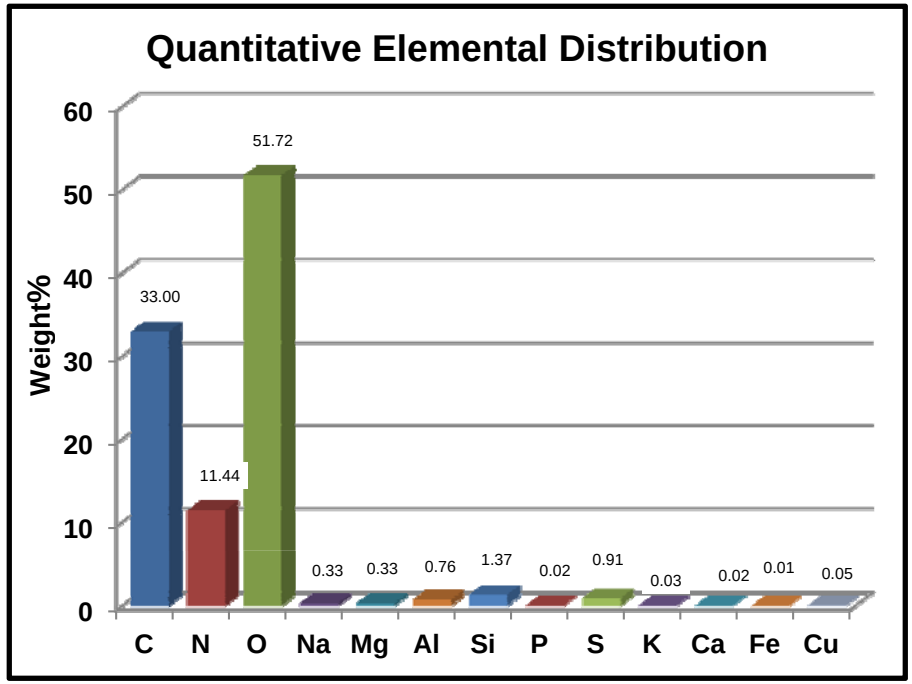
Apparent differences in the elemental weight percent calculation of the above-mentioned elements are a function of:

1) The presence of non-crystalline components in the sample.
2) The difference in the area analysed by both methods.
3) The affect of the filter paper on the X-ray diffractograms.

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6701-F1
Date Sampled: 2021/03/24 11:50







Description of Samples

GR-001: ZN6701-F1 (2021/03/24 11:50)

The scanning electron photomicrograph on the facing page (lower left) shows sample GR-001 consists of aggregates of angular, subangular, subrounded and elongated, clay size to very fine sand size particles. The upper left photograph illustrates the bulk sample on filter paper.

Carbon (C) and oxygen (O) dominate the elemental spectrograph, respectively forming about 33.0% and 51.7% of the sample. Nitrogen (N) is common, forming about 11.4% of the sample. Trace to minor amounts of sodium (Na), magnesium (Mg), aluminum (Al), silicon (Si), phosphorus (P), sulphur (S), potassium (K), calcium (Ca), iron (Fe) and copper (Cu) are present.

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds with minor amounts of crystalline compounds present or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of about 100% silicates **(kaolinite [$Al_2Si_2O_5(OH)_4$]**, **quartz [SiO_2]**, **clinochlore [$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$]**, **illite [$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$]**, **albite [$NaAlSi_3O_8$]**, **microcline [$KAlSi_3O_8$]** and **silicon oxide [SiO_2])**.

Carbon and some of the oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace volumes of phosphorus, sulphur, calcium and copper bearing compounds were detected during elemental analysis.

The particle size distribution histogram shows a skewed unimodal distribution centering around 4.00 microns. Mean particle size was measured at 3.14 microns and median particle size was measured at 1.00 microns. Particles vary in size from 0.02 microns (clay size) to 66.61 microns (very fine sand size). The Quartile 3 size is 3.72 microns and the Quartile 1 size is 0.22 microns. Standard deviation was measured at 5.74 microns.

TABLE 1: EDS and XRD Results

Bureau Veritas Laboratories; Project #: C119656; Sample ID: ZN6701-F1; Date Sampled: 2021/03/24 11:50

GR 33445-01 2021

ELEMENTS:

DOMINANT: C, O
COMMON: N
MODERATE:
MINOR-TRACE: Na, Mg, Al, Si, P, S, K, Ca, Fe, Cu

COMPOUNDS:

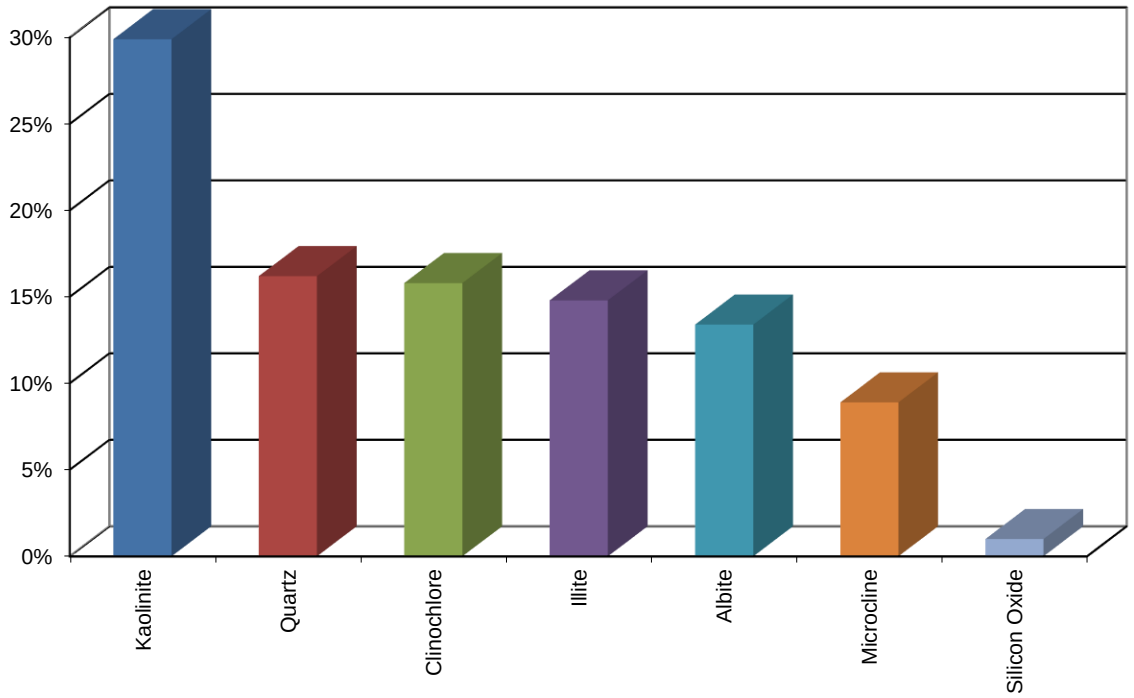
Formula	*Name*	*Percentage*
$Al_2Si_2O_5(OH)_4$	Kaolinite	29.9%
SiO_2	Quartz	16.2%
$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$	Clinochlore	15.8%
$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$	Illite	14.8%
$NaAlSi_3O_8$	Albite	13.4%
$KAlSi_3O_8$	Microcline	8.9%
SiO_2	Silicon Oxide	1.0%
		100.0%

COMMENTS:

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds with minor amounts of crystalline compounds present or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of about 100% silicates.

Carbon and part of oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, nitrogen and oxygen bearing compounds. Trace volumes of phosphorus, sulphur, calcium and copper bearing compounds were detected during elemental analysis.

ABUNDANCE OF COMPOUNDS



GR Petrology CONSULTANTS Inc.

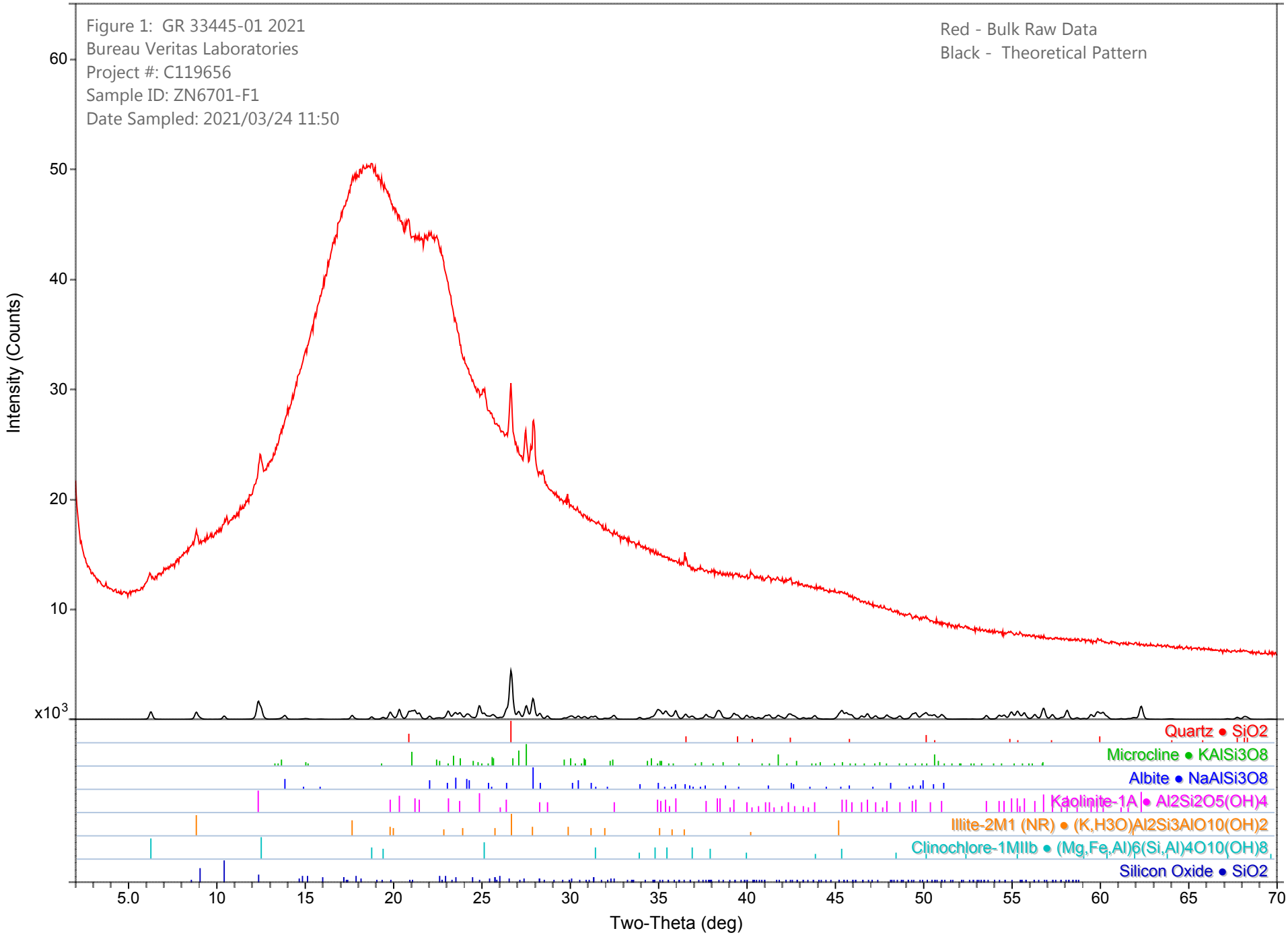
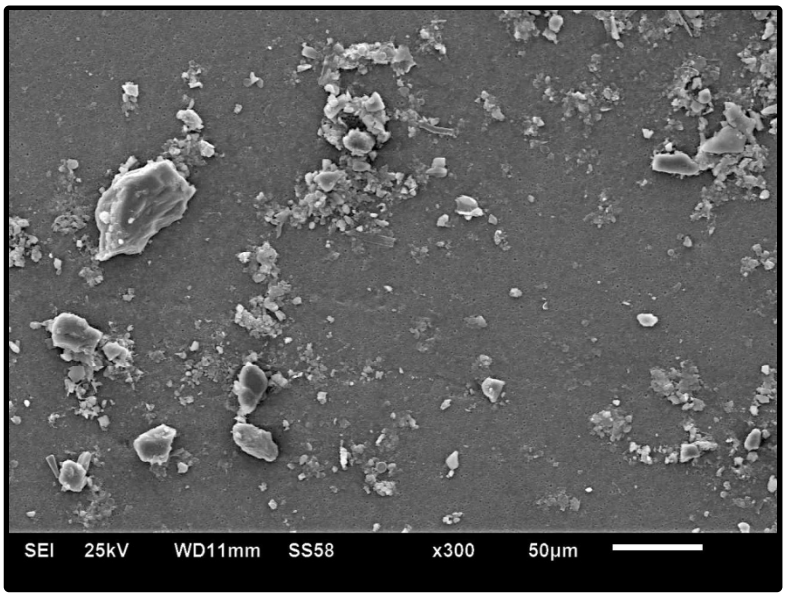
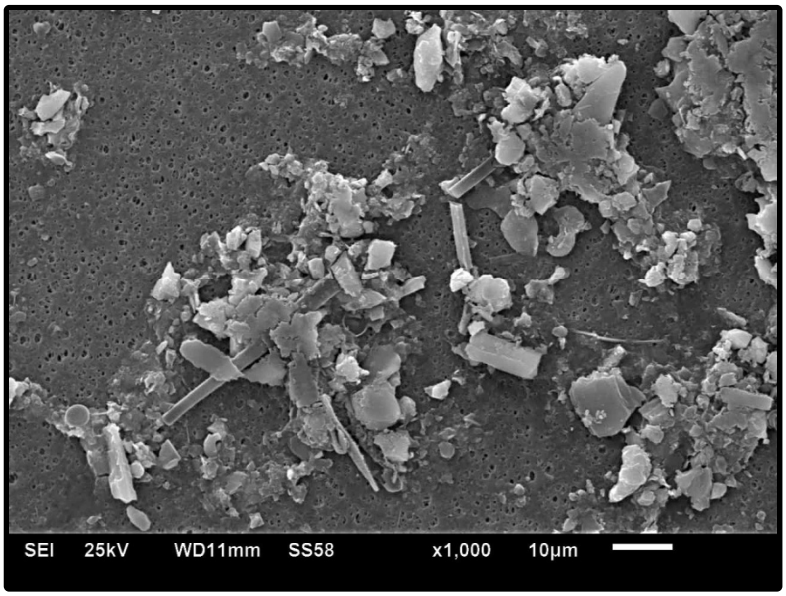
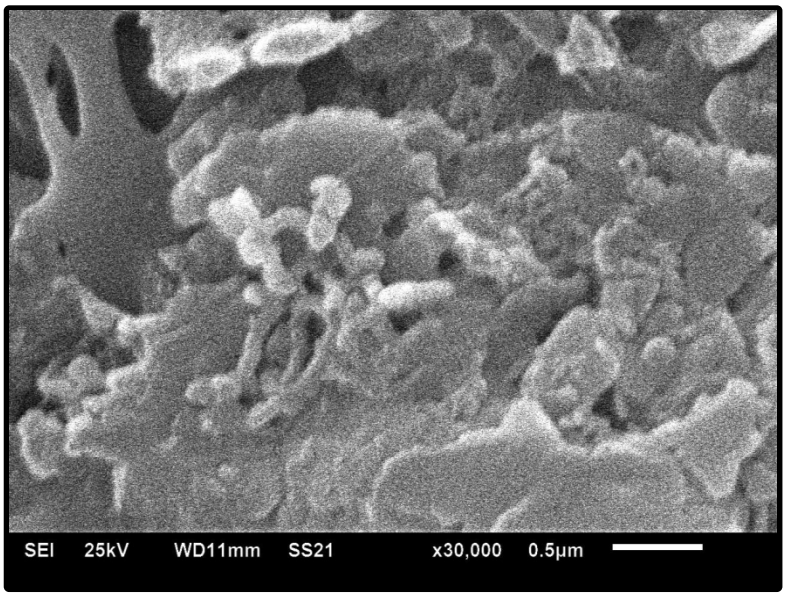


Figure 1: GR 33445-01 2021
Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZN6701-F1
Date Sampled: 2021/03/24 11:50
Red - Bulk Raw Data
Black - Theoretical Pattern
Intensity (Counts)
x10^3
Two-Theta (deg)
Quartz • SiO2
Microcline • KAlSi3O8
Albite • NaAlSi3O8
Kaolinite-1A • Al2Si2O5(OH)4
Illite-2M1 (NR) • (K,H3O)Al2Si3AlO10(OH)2
Clinochlore-1MIIb • (Mg,Fe,Al)6(Si,Al)4O10(OH)8
Silicon Oxide • SiO2

Bureau Veritas Laboratories; **Project #:** C119656
Sample ID: ZN6701-F1
Date Sampled: 2021/03/24 11:50







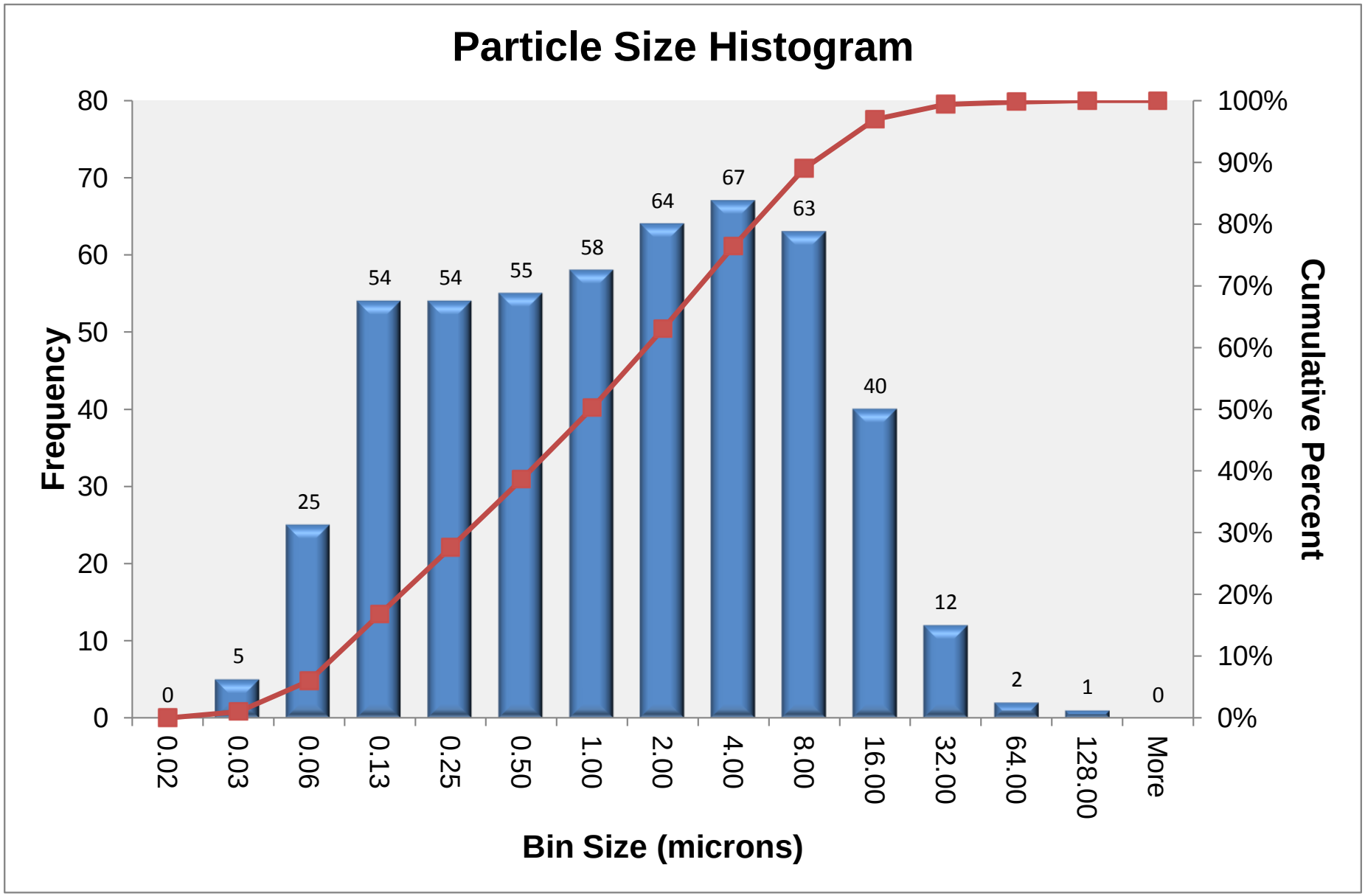
Particle Size Statistics

Size in Micrometers	
Mean	3.144
Median	0.995
Maximum	66.611
Quartile 3	3.718
Quartile 1	0.222
Minimum	0.016
Standard Deviation	5.743
Mode	0.100
Sample Variance	32.983
Kurtosis	37.181
Skewness	4.865
Range	66.595
Standard Error	0.257
Confidence Level (95%)	0.505
Sum	1572.017
Count	500

Histogram Statistics

Microns	Frequency	Cumulative
0.02	0	0.00%
0.03	5	1.00%
0.06	25	6.00%
0.13	54	16.80%
0.25	54	27.60%
0.50	55	38.60%
1.00	58	50.20%
2.00	64	63.00%
4.00	67	76.40%
8.00	63	89.00%
16.00	40	97.00%
32.00	12	99.40%
64.00	2	99.80%
128.00	1	100.00%
More	0	100.00%

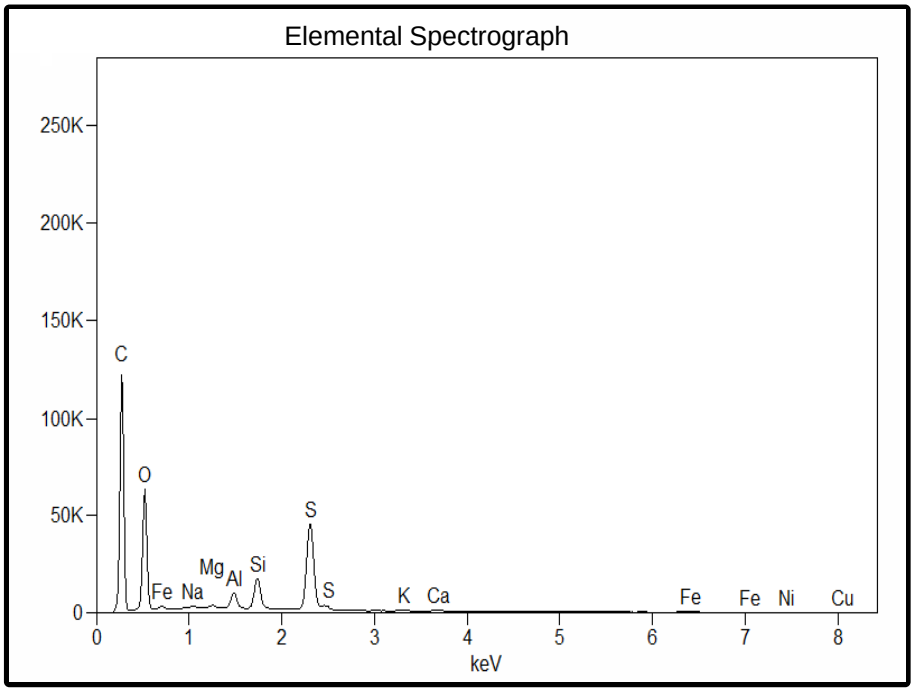
GR Petrology CONSULTANTS Inc.

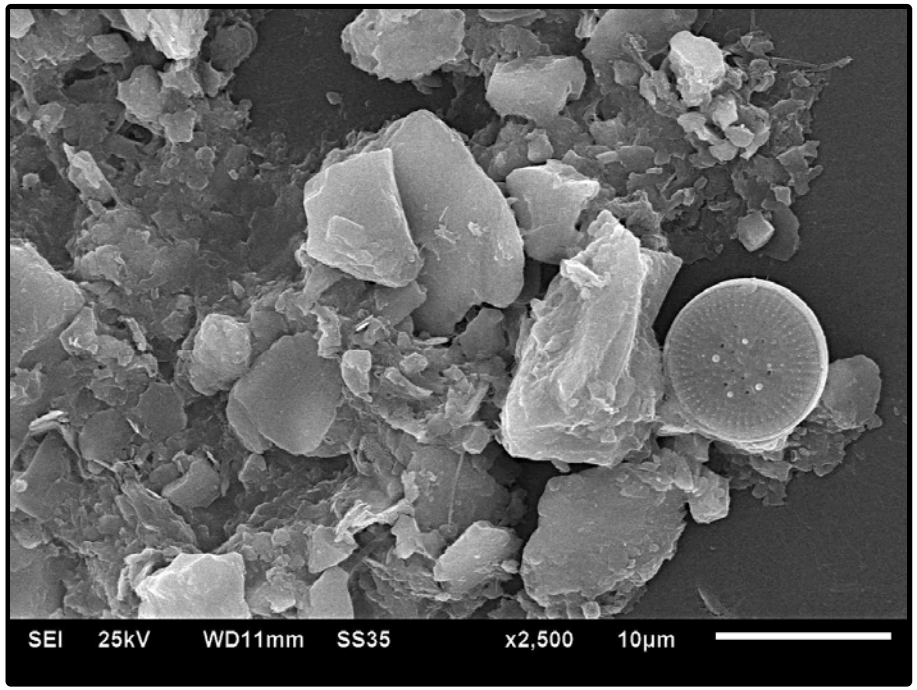

Particle Size Histogram
Frequency
Cumulative Percent
Bin Size (microns)
0
5
25
54
54
55
58
64
67
63
40
12
2
1
0
0.02
0.03
0.06
0.13
0.25
0.50
1.00
2.00
4.00
8.00
16.00
32.00
64.00
128.00
More

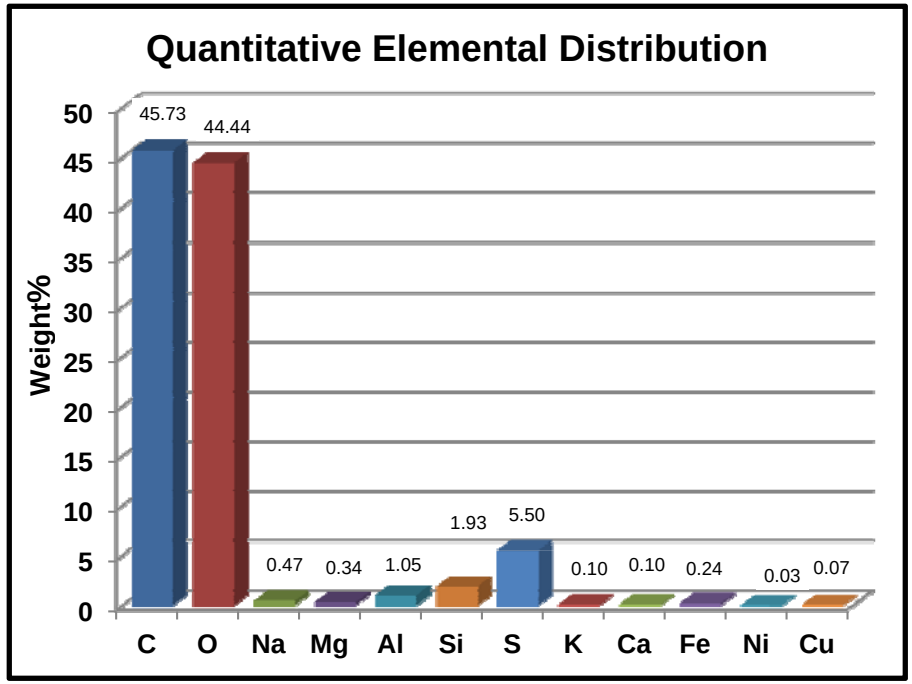
Raw Particle Size Data (microns) Number of measurements: 500

66.611	7.816	2.024	0.061	0.100	36.477	1.880	0.760	0.612	0.101
28.738	5.025	1.762	0.048	0.056	16.204	3.142	0.956	0.627	0.100
25.719	4.072	1.471	0.031	0.024	8.575	1.217	0.458	0.556	0.035
27.341	5.240	1.133	0.170	0.064	11.091	1.106	0.285	0.537	0.074
22.825	6.280	0.755	0.364	0.016	6.653	1.200	0.703	0.477	0.116
26.130	3.859	0.171	0.127	0.032	3.087	1.465	0.497	0.378	0.233
25.634	7.083	0.372	0.064	0.028	5.216	2.213	0.160	0.372	0.046
21.934	5.731	0.623	0.111	0.020	5.762	1.418	0.240	0.471	0.100
11.705	5.994	5.608	0.048	0.041	12.006	1.176	3.308	0.403	0.736
12.019	5.948	2.440	0.057	0.057	6.034	1.935	2.238	0.239	0.231
17.904	3.640	0.683	0.099	0.060	3.466	1.688	1.901	0.307	0.849
10.858	3.812	0.949	0.069	0.061	4.095	1.052	2.089	0.224	0.185
13.408	2.377	0.941	0.077	0.115	6.270	0.520	0.985	0.281	0.032
13.744	4.500	0.453	0.146	0.065	4.500	1.242	0.645	0.230	0.075
8.692	6.801	0.393	0.078	0.070	3.272	2.355	3.477	0.251	15.381
16.499	7.912	0.420	0.063	11.588	1.754	1.808	1.819	0.189	7.091
12.374	4.742	0.153	0.065	9.405	2.915	1.679	0.846	0.169	7.124
8.944	4.977	0.471	0.039	7.786	3.579	0.730	0.718	0.181	7.686
8.172	3.106	0.594	0.066	6.938	2.915	1.129	1.516	0.450	4.382
10.296	3.231	0.085	0.055	8.207	2.183	0.990	0.669	0.304	4.588
9.718	2.751	0.082	0.122	6.810	1.375	0.881	0.532	0.152	3.931
10.541	2.460	0.059	0.050	7.927	3.553	0.595	0.595	0.149	3.462
14.337	10.243	0.542	0.120	5.660	2.250	23.282	1.734	0.190	3.504
6.037	7.383	0.255	0.198	5.711	1.275	5.437	0.481	0.222	3.693
9.286	2.404	0.333	0.080	6.400	3.147	2.049	0.250	0.127	2.702
8.969	1.643	0.121	0.043	5.996	1.625	2.222	0.655	0.091	5.579
7.667	1.501	0.212	0.162	2.778	6.007	2.956	0.309	0.074	2.419
9.153	1.553	0.101	0.087	4.540	2.250	2.228	0.294	0.115	2.461
5.467	2.746	0.042	0.496	3.023	1.790	1.095	0.150	0.084	2.506
5.935	1.475	0.184	0.239	4.472	1.008	1.056	0.355	0.105	3.805
12.671	2.548	0.130	1.947	4.405	1.521	0.726	0.376	1.722	5.297
3.902	2.132	0.215	0.420	4.013	1.186	1.067	0.197	1.290	3.940
7.008	1.702	1.765	0.383	3.791	2.684	1.399	0.243	0.983	1.886
11.743	0.684	2.001	0.256	3.296	1.591	0.827	0.135	1.182	3.134
9.434	1.306	0.500	0.276	4.342	1.425	0.814	0.081	0.800	2.600
4.346	0.330	0.118	0.131	2.147	1.250	1.560	0.081	0.374	4.251
38.928	0.322	0.105	0.187	4.317	22.596	0.888	0.264	0.591	1.989
12.615	0.931	0.118	0.179	1.820	12.222	0.588	0.144	0.435	2.650
10.218	0.648	0.138	0.093	1.415	8.761	2.803	0.448	0.343	2.138
10.572	0.424	0.085	0.735	1.000	9.337	0.497	0.152	0.325	2.100
13.054	0.200	0.035	0.251	1.070	6.996	0.268	0.126	0.411	1.239
11.287	0.456	0.059	0.246	2.970	5.993	0.219	0.221	0.110	1.100
8.273	0.260	0.053	0.119	2.482	5.571	0.133	0.156	0.078	0.660
8.050	1.067	0.237	0.073	1.651	3.550	0.259	0.122	0.114	0.634
11.585	0.523	0.151	0.103	1.387	4.787	0.685	2.755	0.266	0.634
9.750	0.253	0.100	0.072	0.814	6.610	0.253	1.656	0.110	0.736
7.473	1.732	0.147	0.123	2.301	2.898	0.757	1.457	0.228	0.477
4.301	0.603	0.206	0.053	1.312	4.098	0.348	1.103	0.096	0.875
8.711	0.305	0.133	0.054	0.150	5.713	0.954	0.864	0.091	0.880
5.162	0.769	0.190	0.039	1.172	2.933	0.921	0.802	0.073	0.367

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6702-F2
Date Sampled: 2021/03/24 12:27







GR-002: ZN6702-F2 (2021/03/24 12:27)

The scanning electron photomicrograph on the facing page (lower left) shows sample GR-002 consists of aggregates of angular, subangular and subrounded, clay size to medium sand size particles and diatoms. The upper left photograph illustrates the bulk sample on filter paper.

Carbon (C) and oxygen (O) dominate the elemental spectrograph, respectively forming about 45.7% and 44.4% of the sample. Sulphur (S) is moderately abundant, forming about 5.5% of the sample. Trace to minor amounts of sodium (Na), magnesium (Mg), aluminum (Al), silicon (Si), potassium (K), calcium (Ca), iron (Fe), nickel (Ni) and copper (Cu) are present.

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds with minor amounts of crystalline compounds present or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of about 100% silicates **(kaolinite [$Al_2Si_2O_5(OH)_4$]**, **quartz [SiO_2]**, **clinochlore [$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$]**, **illite [$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$]**, **albite [$NaAlSi_3O_8$]**, **microcline [$KAlSi_3O_8$]** and **silicon oxide [SiO_2])**.

Carbon and some of the oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon and sulphur bearing compounds. Trace volumes of calcium, nickel and copper bearing compounds were detected during elemental analysis.

The particle size distribution histogram shows a bimodal distribution centering around 4.00 microns and 512.00 microns. Mean particle size was measured at 4.92 microns and median particle size was measured at 2.37 microns. Particles vary in size from 0.06 microns (clay size) to 338.01 microns (medium sand size). The Quartile 3 size is 4.63 microns and the Quartile 1 size is 1.19 microns. Standard deviation was measured at 16.28 microns.

TABLE 2: EDS and XRD Results

Bureau Veritas Laboratories; Project #: C119656; Sample ID: ZN6702-F2; Date Sampled: 2021/03/24 12:27

GR 33445-02 2021

ELEMENTS:

DOMINANT: C, O

MODERATE: S

COMMON:

MINOR-TRACE: Na, Mg, Al, Si, K, Ca, Fe, Ni, Cu

COMPOUNDS:

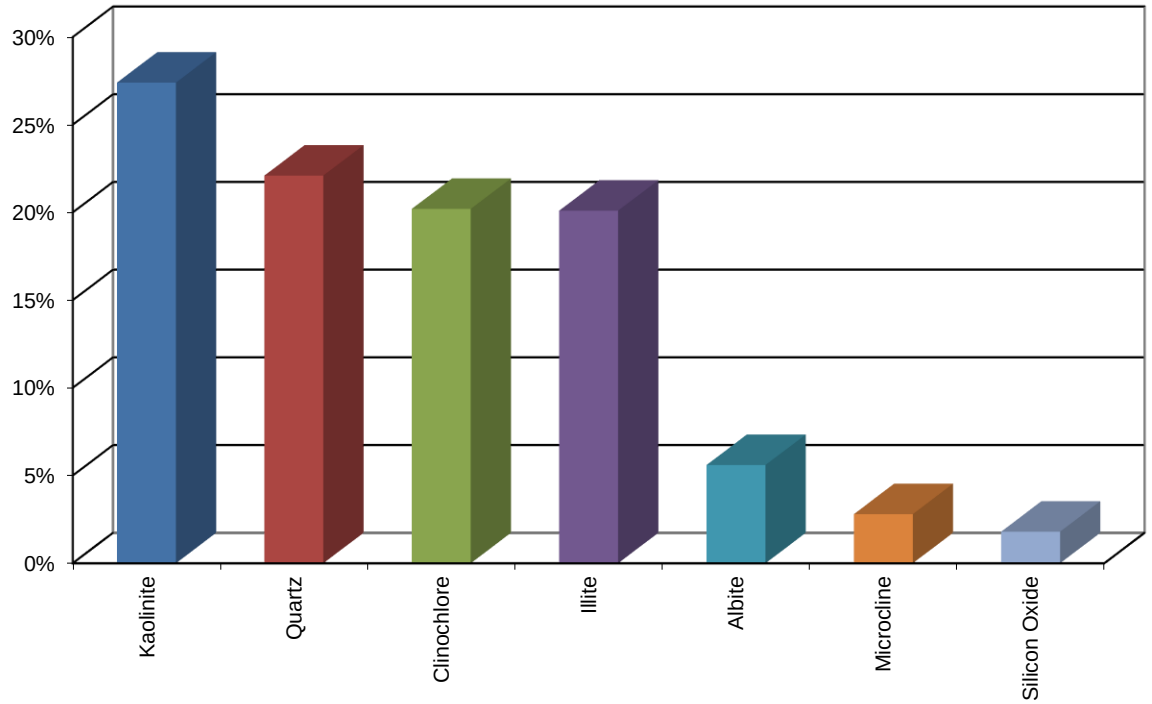
Formula	*Name*	*Percentage*
$Al_2Si_2O_5(OH)_4$	Kaolinite	27.4%
SiO_2	Quartz	22.1%
$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$	Clinochlore	20.2%
$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$	Illite	20.1%
$NaAlSi_3O_8$	Albite	5.6%
$KAlSi_3O_8$	Microcline	2.8%
SiO_2	Silicon Oxide	1.8%
		100.0%

COMMENTS:

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds with minor amounts og crystalline compounds present or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of about 100% silicates.

Carbon and some of the oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon and sulphur bearing compounds. Trace volumes of calcium, nickel and copper bearing compounds were detected during elemental analysis.

ABUNDANCE OF COMPOUNDS



GR Petrology CONSULTANTS Inc.

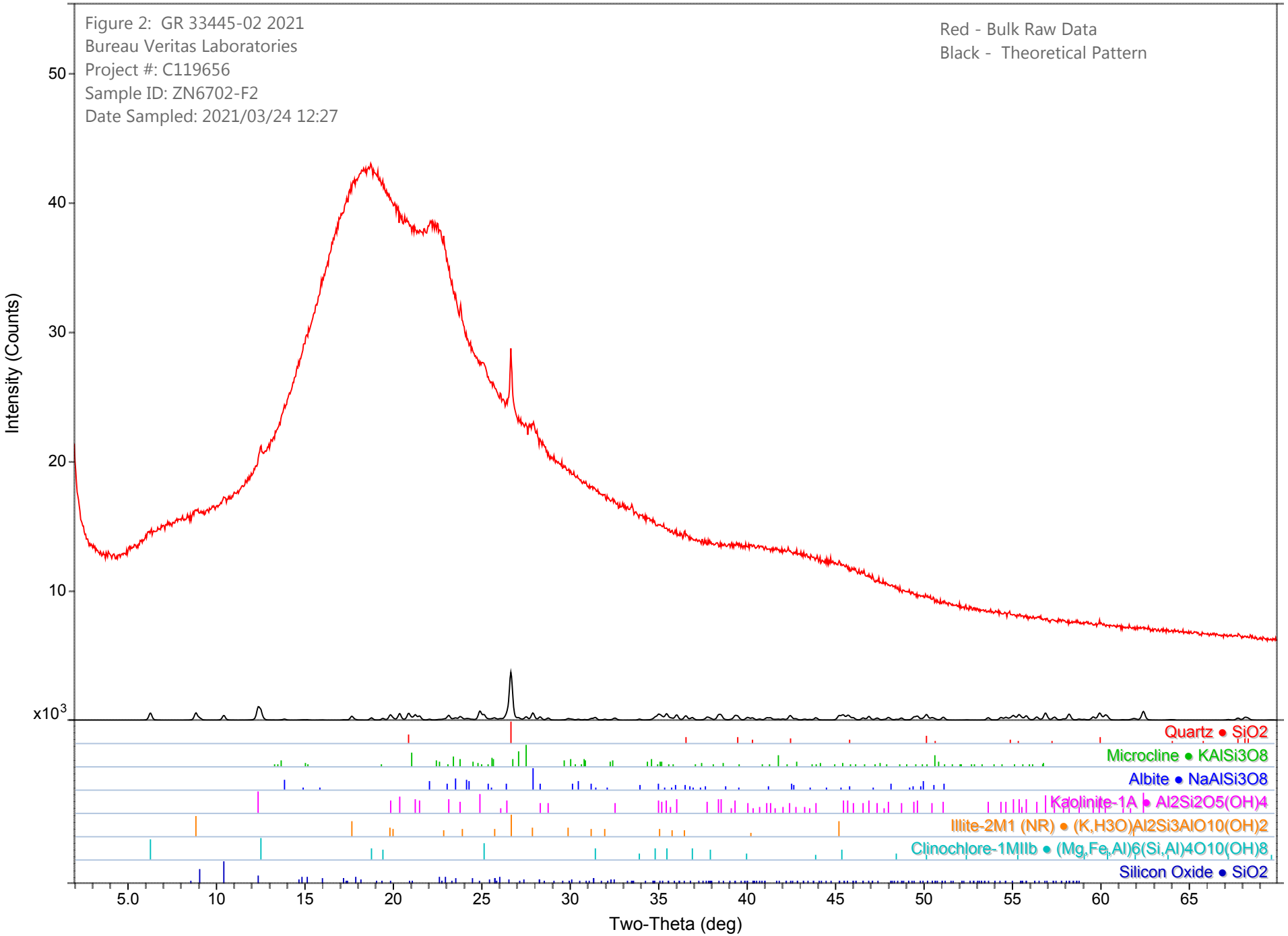
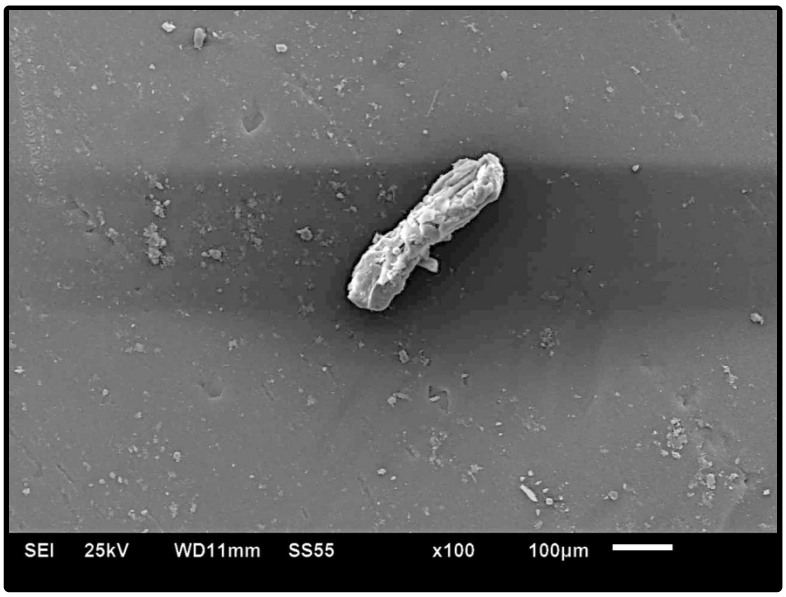
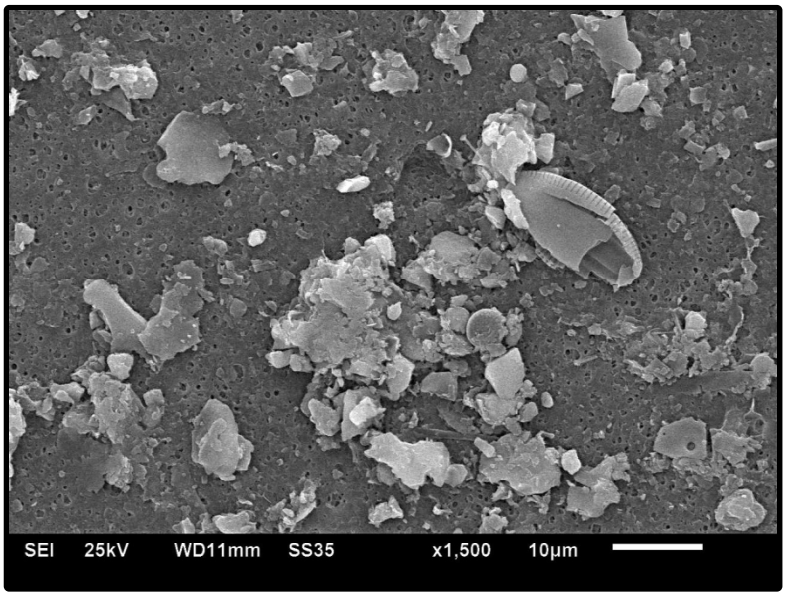
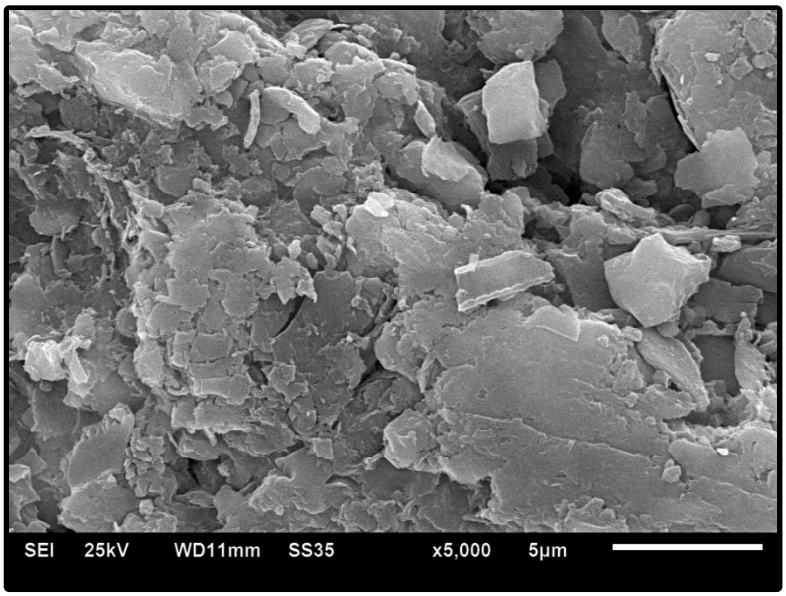


Figure 2: GR 33445-02 2021
Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZN6702-F2
Date Sampled: 2021/03/24 12:27
Red - Bulk Raw Data
Black - Theoretical Pattern
Intensity (Counts)
x10^3
Quartz • SiO2
Microcline • KAlSi3O8
Albite • NaAlSi3O8
Kaolinite-1A • Al2Si2O5(OH)4
Illite-2M1 (NR) • (K,H3O)Al2Si3AlO10(OH)2
Clinochlore-1MIIb • (Mg,Fe,Al)6(Si,Al)4O10(OH)8
Silicon Oxide • SiO2
Two-Theta (deg)

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6702-F2
Date Sampled: 2021/03/24 12:27







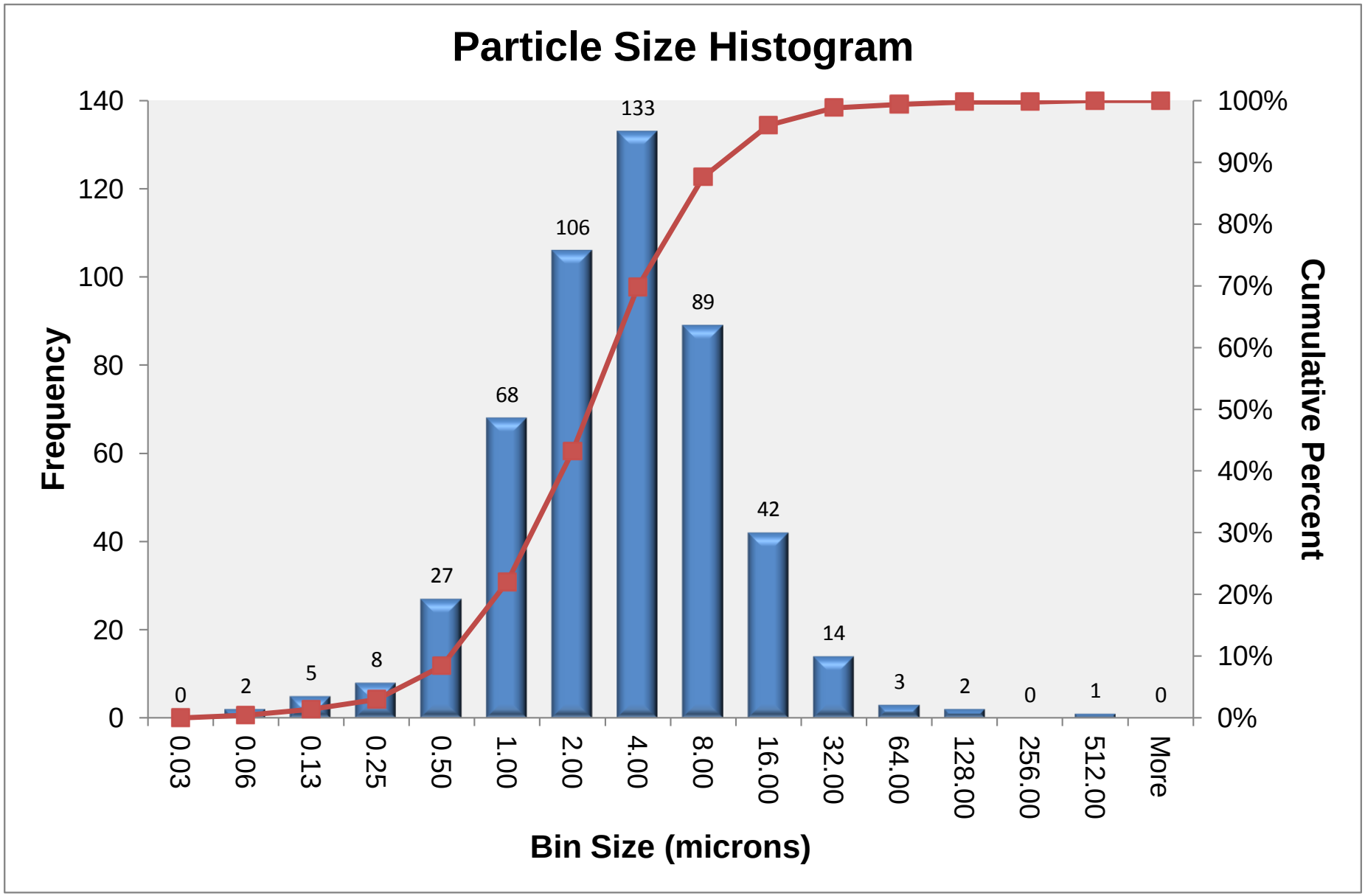
Particle Size Statistics

Size in Micrometers	
Mean	4.920
Median	2.372
Maximum	338.009
Quartile 3	4.632
Quartile 1	1.192
Minimum	0.056
Standard Deviation	16.282
Mode	0.750
Sample Variance	265.092
Kurtosis	353.476
Skewness	17.566
Range	337.953
Standard Error	0.728
Confidence Level (95%)	1.431
Sum	2459.823
Count	500

Histogram Statistics

Microns	Frequency	Cumulative
0.03	0	0.00%
0.06	2	0.40%
0.13	5	1.40%
0.25	8	3.00%
0.50	27	8.40%
1.00	68	22.00%
2.00	106	43.20%
4.00	133	69.80%
8.00	89	87.60%
16.00	42	96.00%
32.00	14	98.80%
64.00	3	99.40%
128.00	2	99.80%
256.00	0	99.80%
512.00	1	100.00%
More	0	100.00%

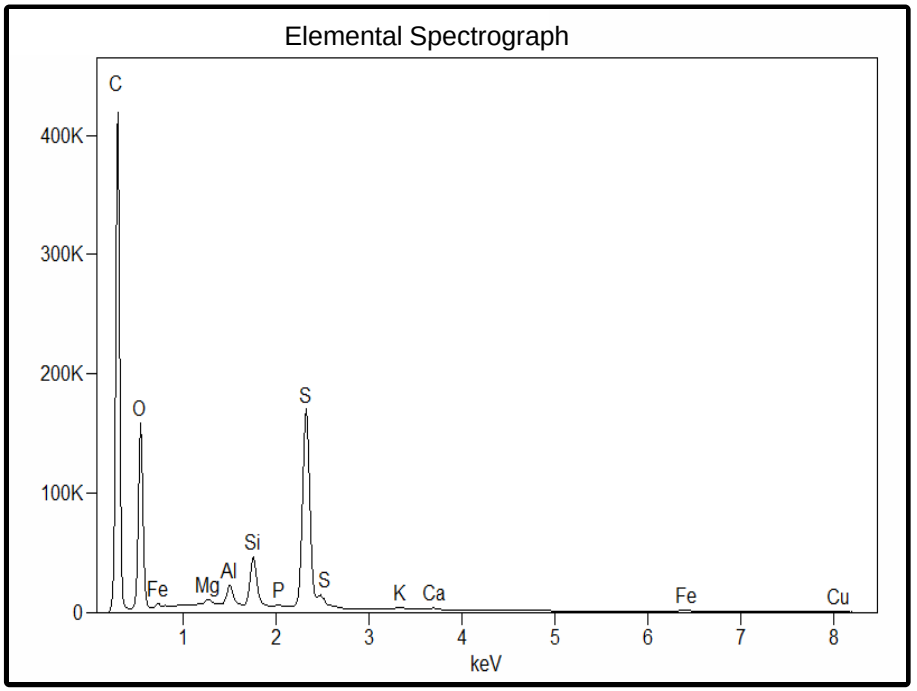
GR Petrology CONSULTANTS Inc.

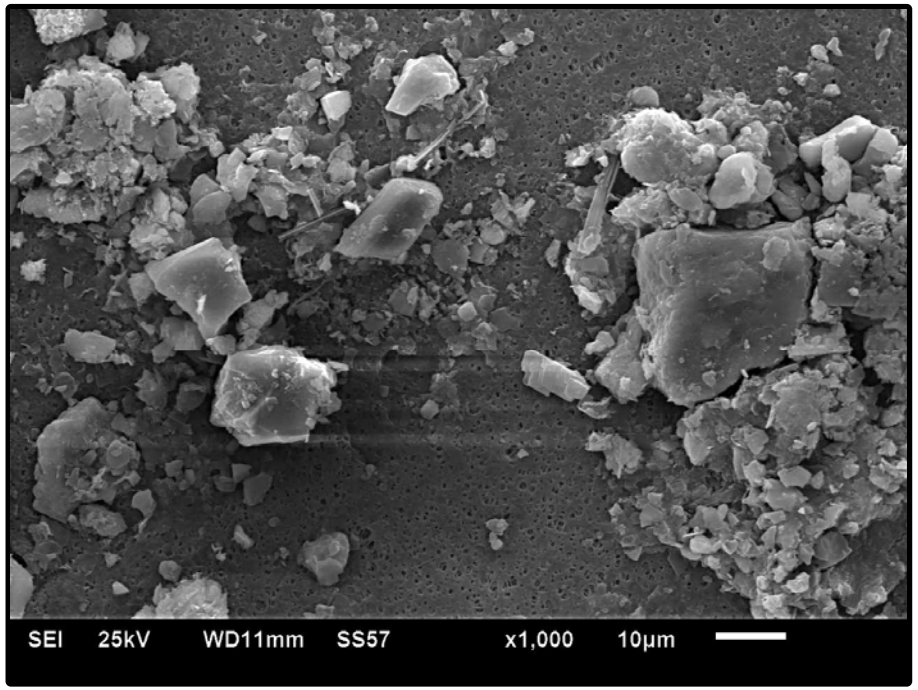

Particle Size Histogram
Frequency
Cumulative Percent
Bin Size (microns)
0
2
5
8
27
68
106
133
89
42
14
3
2
0
1
0
0.03
0.06
0.13
0.25
0.50
1.00
2.00
4.00
8.00
16.00
32.00
64.00
128.00
256.00
512.00
More

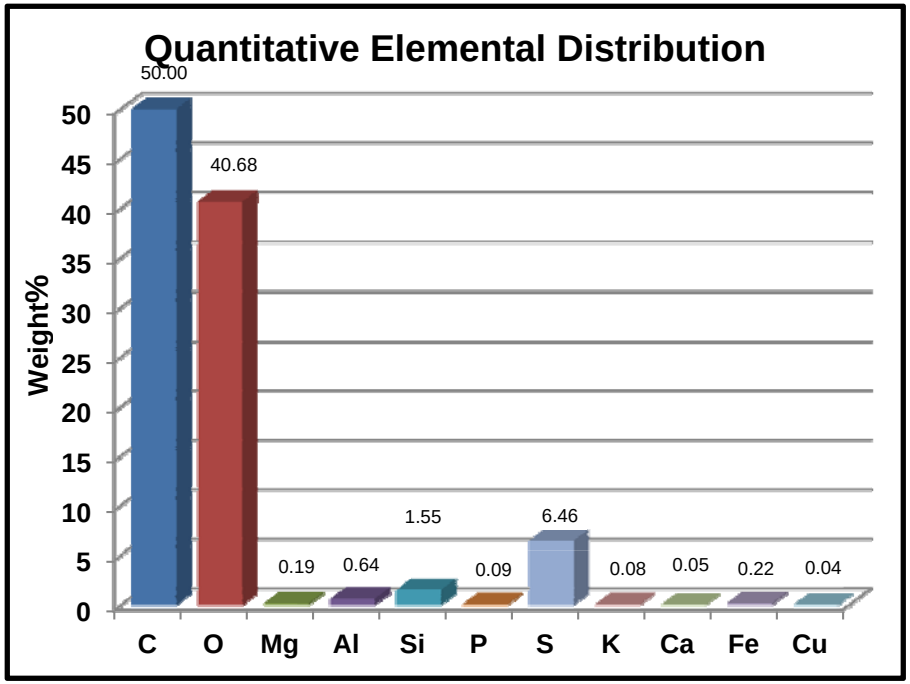
Raw Particle Size Data (microns) Number of measurements: 500

3.441	6.395	2.477	18.682	1.194	21.250	2.504	1.736	2.236	0.400
3.383	4.632	1.569	12.000	1.108	10.213	2.872	1.421	6.438	1.400
2.871	3.276	1.923	27.857	0.298	8.381	2.546	0.765	3.073	0.687
2.112	13.017	1.871	26.401	0.713	7.973	2.405	0.951	2.108	0.433
1.750	5.220	2.601	18.385	0.657	7.837	1.951	0.863	3.480	0.640
4.827	5.727	2.734	15.000	0.637	6.295	3.923	0.600	3.018	0.792
3.177	4.238	1.268	9.055	0.875	4.417	2.727	0.743	10.984	0.601
1.498	3.000	1.896	10.817	0.566	5.331	1.506	0.922	7.955	0.849
1.281	4.535	74.887	14.318	0.500	6.368	2.241	11.075	5.791	0.533
0.988	3.360	14.109	11.705	0.566	3.994	2.102	6.560	4.078	18.963
0.987	3.140	11.448	6.083	1.023	3.436	1.088	4.598	3.874	11.421
3.834	4.610	6.021	4.243	0.328	5.034	1.211	3.211	10.447	10.215
2.458	2.474	4.430	20.125	0.590	4.180	1.146	2.369	4.280	11.085
2.326	4.500	6.600	12.728	1.348	3.137	1.265	2.305	3.276	5.940
1.952	4.500	3.553	15.297	0.533	7.338	1.296	2.131	3.287	5.507
1.972	2.668	3.132	8.062	5.473	3.670	0.899	1.681	4.695	5.554
2.652	2.717	2.372	7.000	2.060	5.964	1.193	1.800	3.082	5.824
2.114	2.900	2.475	11.705	2.831	4.851	0.456	1.921	2.779	10.719
2.041	2.247	4.451	5.099	1.915	3.640	0.506	1.548	4.799	4.894
1.500	1.389	2.016	4.123	3.317	4.360	0.645	1.479	1.791	3.592
1.177	1.562	4.123	7.810	2.131	0.089	0.632	1.405	1.611	2.642
0.451	1.942	1.500	4.123	1.822	5.303	0.777	1.287	1.908	2.626
0.621	17.689	1.250	6.403	2.689	0.129	32.244	1.375	7.455	1.529
0.365	8.498	2.236	11.180	1.683	0.098	18.023	0.802	2.601	1.341
0.750	10.160	3.750	3.162	2.040	3.839	11.776	4.421	2.148	2.493
0.481	6.675	3.010	8.062	0.994	3.124	7.529	0.985	1.273	2.343
0.537	7.922	3.750	6.403	1.088	3.111	6.058	0.932	2.943	1.755
0.628	8.427	3.182	6.000	0.916	2.981	10.066	0.420	1.442	2.865
1.486	5.467	1.953	2.000	0.555	4.105	3.969	1.273	1.733	4.421
0.469	6.093	1.414	2.236	0.665	2.256	3.374	0.181	0.716	7.033
0.267	9.004	2.372	30.571	0.506	0.060	3.612	1.103	1.844	2.497
0.140	7.265	1.346	9.547	0.474	1.752	3.897	0.990	1.434	2.875
0.335	4.209	1.275	4.187	1.268	0.056	3.204	0.840	3.663	3.144
0.384	5.967	1.904	6.505	0.653	1.294	5.411	0.279	0.976	3.291
0.412	3.401	1.601	2.326	0.480	1.031	3.495	0.665	1.692	2.975
0.322	4.027	1.000	1.298	0.747	0.901	2.936	0.595	1.476	0.882
14.728	4.681	1.275	2.033	1.501	13.882	3.084	0.303	1.118	3.685
18.457	2.762	1.250	1.367	0.204	12.771	2.438	0.113	1.655	1.666
11.921	2.720	1.458	2.088	0.126	9.410	3.468	0.680	3.093	2.294
15.881	3.853	0.750	1.814	0.626	11.922	2.365	0.128	0.481	1.248
7.653	2.976	0.750	1.187	0.632	7.656	1.628	0.361	0.568	2.049
10.424	5.009	1.000	2.543	0.649	6.590	1.845	0.500	2.219	1.224
6.488	4.905	0.559	3.802	0.312	4.736	2.900	0.069	1.961	1.065
6.090	2.201	0.750	1.437	0.552	5.832	1.601	0.639	1.372	1.598
8.127	2.848	338.009	3.262	0.305	5.370	2.941	66.219	0.706	1.322
4.460	2.187	17.889	2.147	0.303	3.571	2.560	36.518	0.971	1.344
6.958	2.459	23.022	1.795	0.165	3.808	0.960	8.876	0.825	1.060
4.632	1.164	32.202	1.521	0.082	3.406	3.182	6.146	0.860	2.042
7.506	2.177	28.320	1.392	0.140	4.281	1.931	3.073	1.767	1.973
7.507	1.573	10.296	1.054	0.322	3.640	1.692	2.687	0.709	1.184

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6703-F3
Date Sampled: 2021/03/24 13:01







GR-003: ZN6703-F3 (2021/03/24 13:01)

The scanning electron photomicrograph on the facing page (lower left) shows sample GR-003 consists of aggregates of angular, subangular, subrounded and elongated, clay size to very fine sand size particles. The upper left photograph illustrates the bulk sample on filter paper.

Carbon (C) and oxygen (O) dominate the elemental spectrograph, respectively forming about 50.0% and 40.7% of the sample. Sulphur (S) is moderately abundant, forming about 6.5% of the sample. Trace to minor amounts of magnesium (Mg), aluminum (Al), silicon (Si), phosphorus (P), potassium (K), calcium (Ca), iron (Fe) and copper (Cu) are present.

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds with minor amounts of crystalline compounds present or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of about 100% silicates **(kaolinite [$Al_2Si_2O_5(OH)_4$]**, **clinochlore [$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$]**, **quartz [$SiO_2$]**, **illite [$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$]**, **albite [$NaAlSi_3O_8$]**, **microcline [$KAlSi_3O_8$]** and **silicon oxide [SiO_2])**.

Carbon and part of the oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon and sulphur bearing compounds. Trace volumes of phosphorus, calcium and copper bearing compounds were detected during elemental analysis.

The particle size distribution histogram shows a skewed unimodal distribution centering around 4.00 microns. Mean particle size was measured at 4.15 microns and median particle size was measured at 2.07 microns. Particles vary in size from 0.05 microns (clay size) to 92.58 microns (very fine sand size). The Quartile 3 size is 4.73 microns and the Quartile 1 size is 0.73 microns. Standard deviation was measured at 7.19 microns.

TABLE 3: EDS and XRD Results

Bureau Veritas Laboratories; Project #: C119656; Sample ID: ZN6703-F3; Date Sampled: 2021/03/24 13:01

GR 33445-03 2021

ELEMENTS:

DOMINANT: C, O

MODERATE: S

COMMON:

MINOR-TRACE: Mg, Al, Si, P, K, Ca, Fe, Cu

COMPOUNDS:

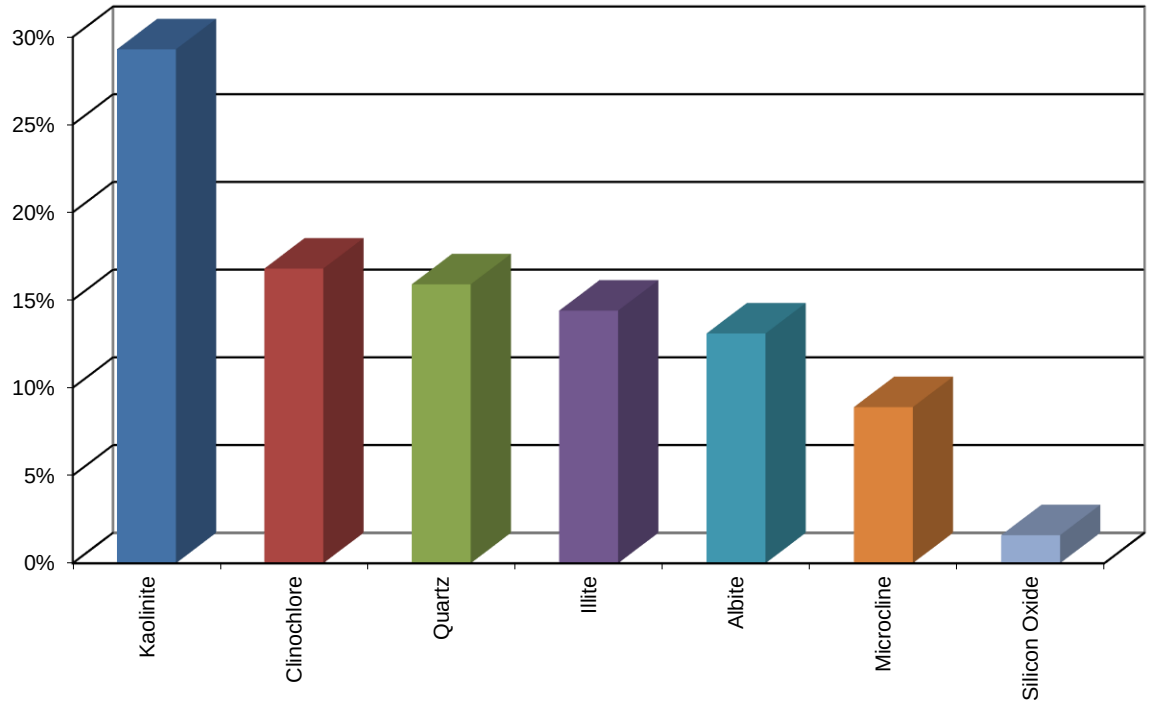
Formula	*Name*	*Percentage*
$Al_2Si_2O_5(OH)_4$	Kaolinite	29.3%
$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$	Clinochlore	16.8%
SiO_2	Quartz	15.9%
$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$	Illite	14.4%
$NaAlSi_3O_8$	Albite	13.1%
$KAlSi_3O_8$	Microcline	8.9%
SiO_2	Silicon Oxide	1.6%
		100.0%

COMMENTS:

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds with minor amounts of crystalline compounds present or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of about 100% silicates.

Carbon and part of oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon and sulphur bearing compounds. Trace volumes of phosphorus, calcium and copper bearing compounds were detected during elemental analysis.

ABUNDANCE OF COMPOUNDS



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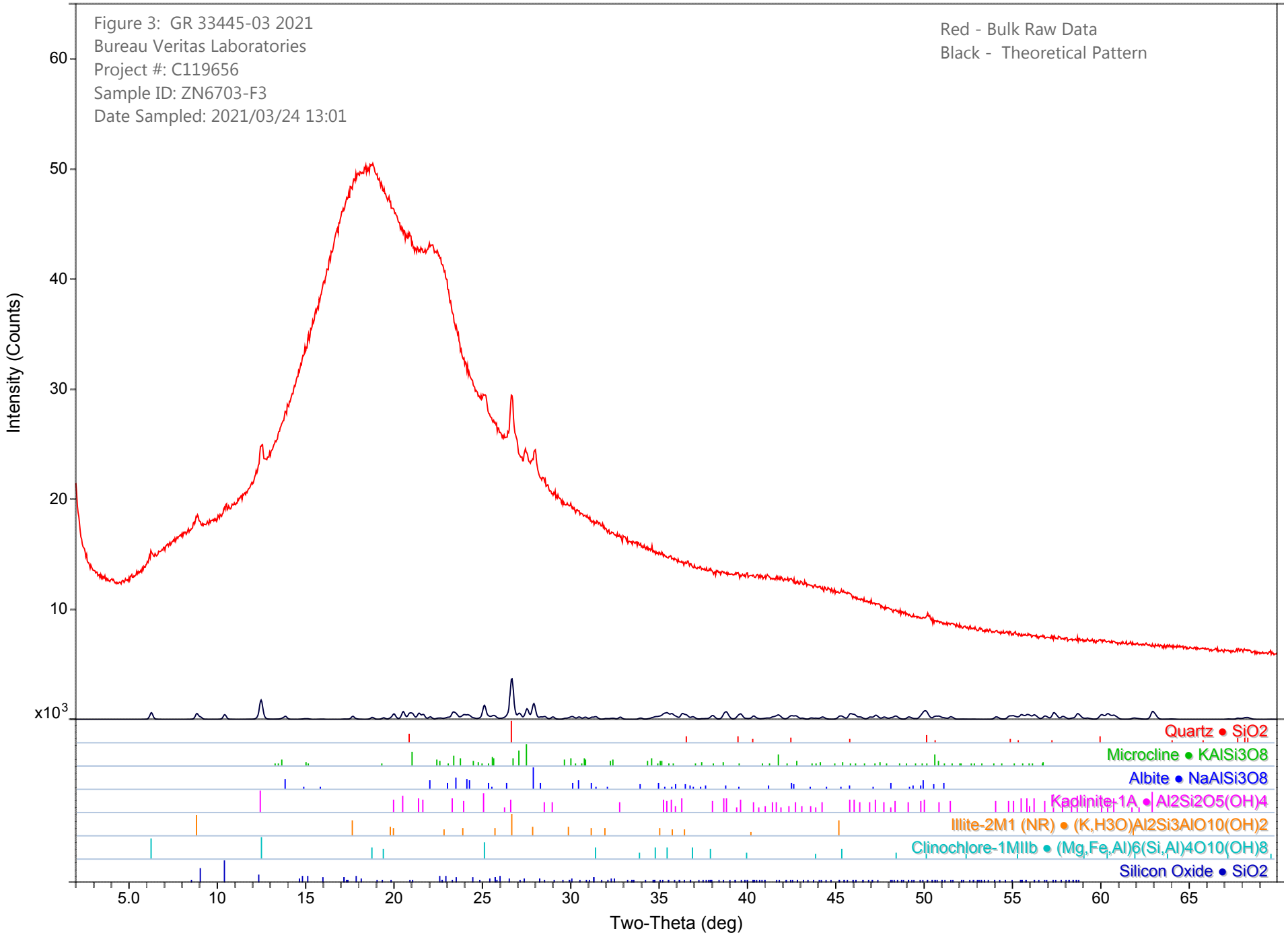
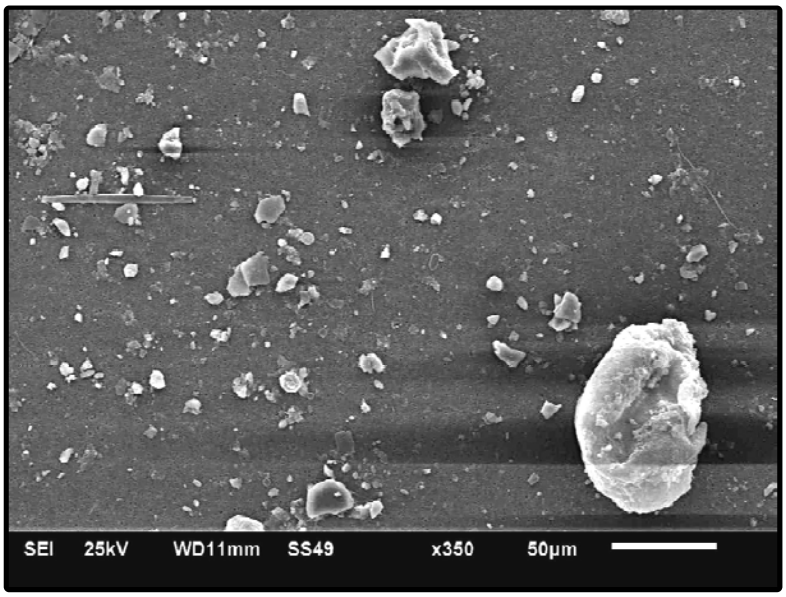
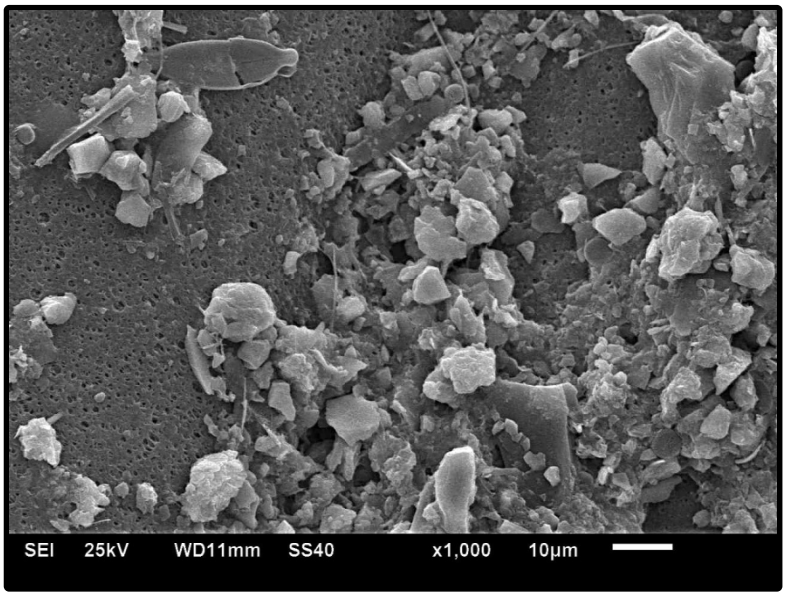
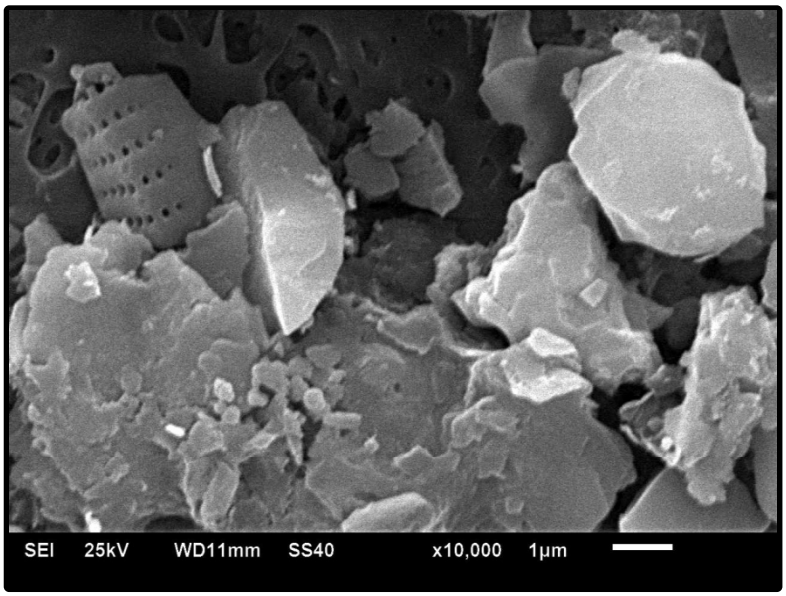


Figure 3: GR 33445-03 2021
Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZN6703-F3
Date Sampled: 2021/03/24 13:01
Red - Bulk Raw Data
Black - Theoretical Pattern
Intensity (Counts)
x10^3
Two-Theta (deg)
Quartz • SiO2
Microcline • KAlSi3O8
Albite • NaAlSi3O8
Kaolinite-1A • Al2Si2O5(OH)4
Illite-2M1 (NR) • (K,H3O)Al2Si3AlO10(OH)2
Clinochlore-1MIIb • (Mg,Fe,Al)6(Si,Al)4O10(OH)8
Silicon Oxide • SiO2

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6703-F3
Date Sampled: 2021/03/24 13:01







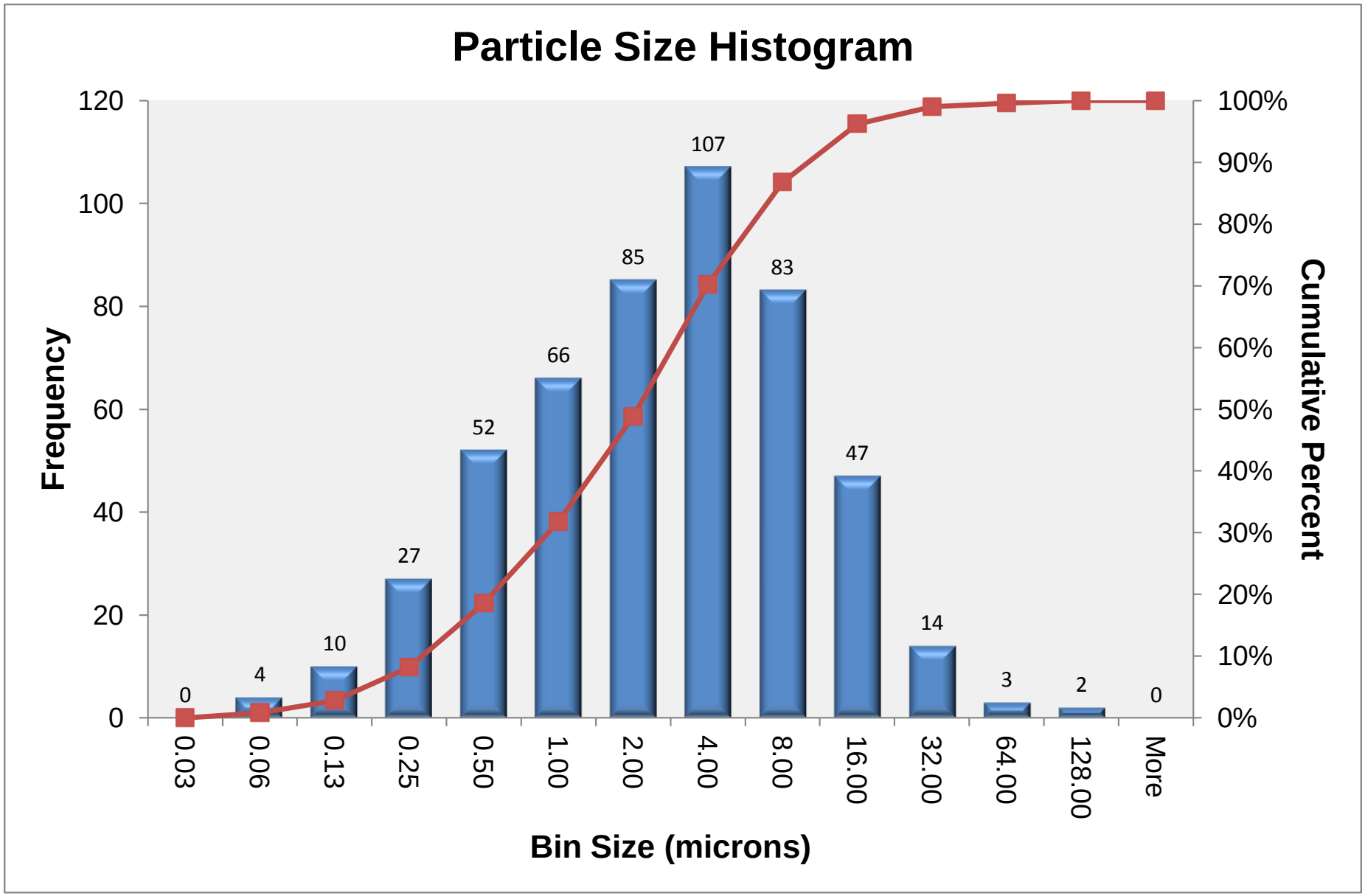
Particle Size Statistics

Size in Micrometers	
Mean	4.150
Median	2.065
Maximum	92.582
Quartile 3	4.730
Quartile 1	0.734
Minimum	0.050
Standard Deviation	7.193
Mode	0.334
Sample Variance	51.732
Kurtosis	62.658
Skewness	6.467
Range	92.532
Standard Error	0.322
Confidence Level (95%)	0.632
Sum	2074.790
Count	500

Histogram Statistics

Microns	*Frequency*	*Cumulative*
0.03	0	0.00%
0.06	4	0.80%
0.13	10	2.80%
0.25	27	8.20%
0.50	52	18.60%
1.00	66	31.80%
2.00	85	48.80%
4.00	107	70.20%
8.00	83	86.80%
16.00	47	96.20%
32.00	14	99.00%
64.00	3	99.60%
128.00	2	100.00%
More	0	100.00%

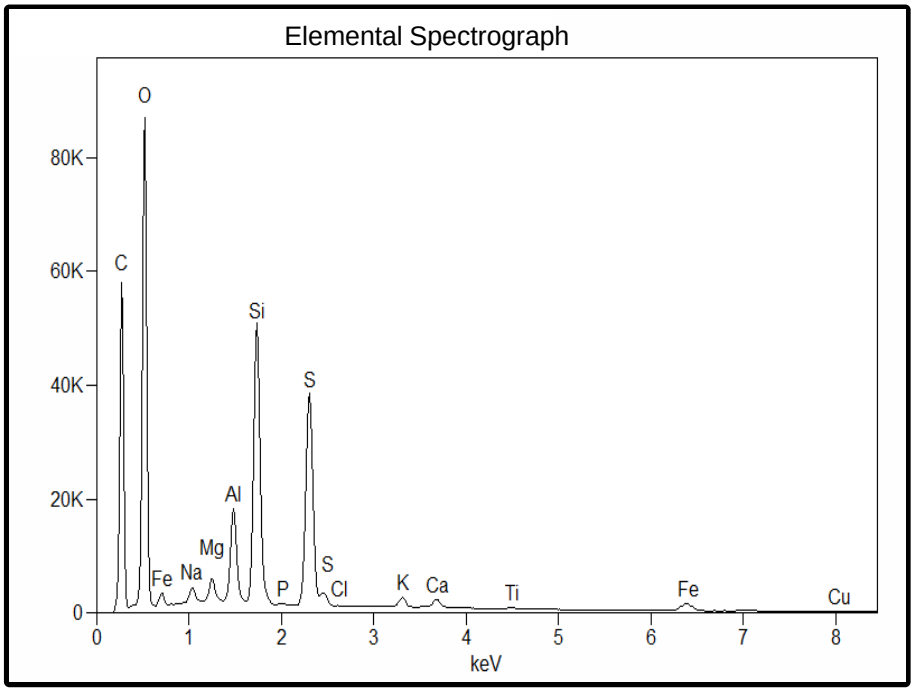
GR Petrology CONSULTANTS Inc.

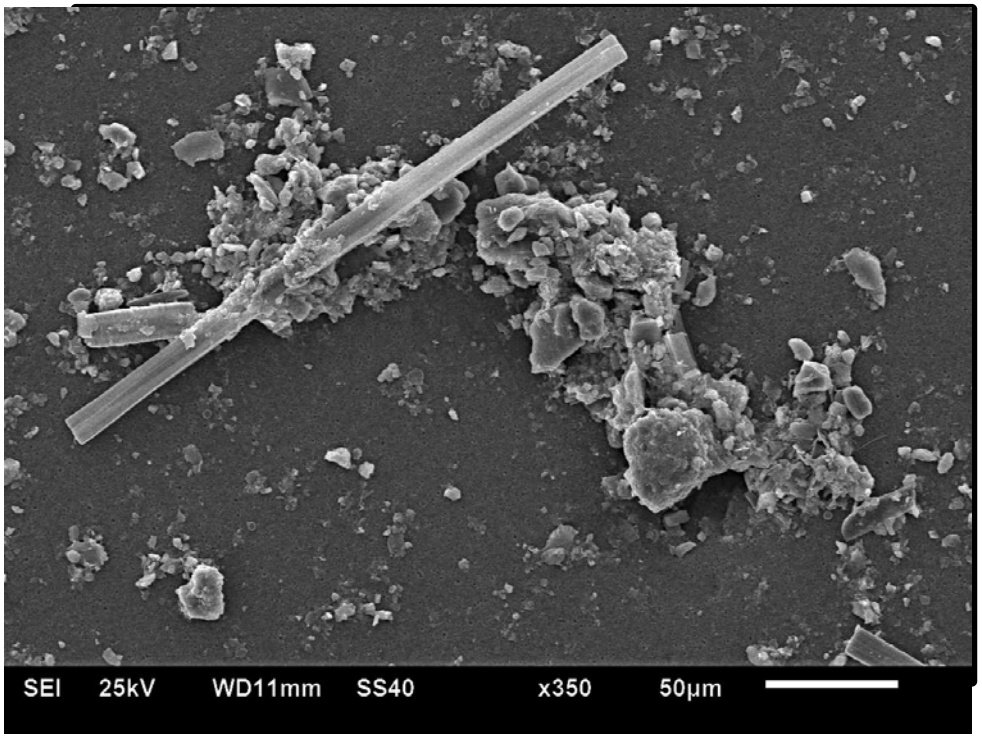

Particle Size Histogram
Frequency
Cumulative Percent
Bin Size (microns)
120
100
80
60
40
20
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
4
10
27
52
66
85
107
83
47
14
3
2
0
0.03
0.06
0.13
0.25
0.50
1.00
2.00
4.00
8.00
16.00
32.00
64.00
128.00
More

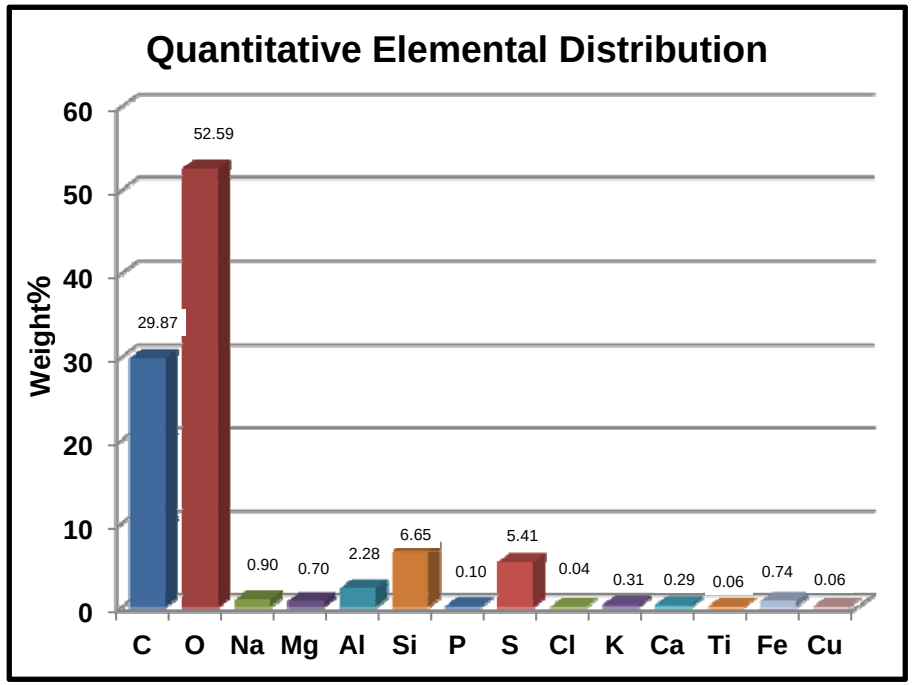
Raw Particle Size Data (microns) Number of measurements: 500

92.582	2.396	0.522	1.273	1.595	8.896	0.071	2.490	1.023	0.383
31.951	1.290	1.000	0.862	1.523	5.416	0.054	4.885	1.343	0.644
25.841	3.803	0.971	1.154	0.812	3.852	0.130	1.994	0.824	0.264
22.286	2.962	0.560	0.560	0.713	2.953	0.165	1.981	0.493	0.740
71.145	1.874	0.250	1.361	2.100	1.934	0.259	4.495	0.229	0.592
14.647	2.818	0.408	0.786	0.510	2.275	0.279	1.372	0.563	0.361
16.243	3.581	0.823	0.506	1.038	1.538	0.306	1.854	0.589	0.266
14.999	1.726	0.335	34.359	0.200	2.077	0.142	1.345	31.434	0.338
15.992	2.001	0.289	19.217	0.307	1.572	0.177	1.386	15.869	0.236
10.400	1.360	0.221	12.795	0.591	1.434	0.085	2.165	18.941	0.485
11.025	1.540	0.149	12.842	1.240	1.317	0.085	0.671	17.296	0.297
10.710	0.541	0.070	7.890	0.401	2.007	0.191	0.973	13.238	0.139
6.007	0.814	0.071	7.283	0.316	1.918	0.227	0.985	9.420	0.314
5.750	3.575	0.143	9.579	0.867	2.114	23.740	0.772	13.114	0.334
8.647	2.824	0.108	11.668	0.203	1.297	18.529	0.457	8.319	0.133
9.498	3.624	0.367	8.041	0.448	1.049	12.858	0.297	9.604	0.151
8.690	2.384	0.221	4.673	1.104	0.708	18.422	0.608	5.482	0.301
8.899	1.680	0.080	6.577	0.435	1.009	9.496	0.326	10.155	0.430
8.647	2.082	0.130	6.506	0.224	0.885	14.015	0.209	4.045	0.211
9.718	3.897	0.058	6.648	9.853	0.932	7.211	0.700	10.481	21.982
7.097	2.599	0.060	7.654	8.602	0.874	4.294	0.475	6.438	22.006
10.940	1.980	0.251	3.206	9.187	0.550	4.561	0.557	7.398	22.118
7.284	2.032	0.050	2.707	7.326	0.653	3.333	0.412	8.814	14.895
4.247	2.052	0.092	2.349	5.357	0.634	2.953	0.305	12.997	11.724
5.459	0.874	0.073	2.603	5.761	0.300	2.311	0.233	3.561	10.465
5.496	1.739	8.765	2.534	2.474	0.664	5.221	12.493	2.400	11.149
3.452	1.444	6.244	3.350	1.902	0.465	8.432	6.241	3.324	11.332
6.911	1.883	6.337	5.257	1.924	0.331	5.071	3.984	5.523	8.382
6.596	2.028	7.536	2.721	2.353	0.589	1.794	4.560	3.601	7.864
4.324	2.227	2.852	2.936	3.720	0.211	2.553	4.171	3.130	7.601
6.292	1.145	2.495	2.241	1.706	0.287	4.036	4.554	2.335	6.462
4.990	0.976	4.024	3.569	1.271	0.752	2.654	2.354	2.823	5.831
34.794	0.740	2.382	2.981	1.600	3.604	4.643	2.659	2.631	7.433
14.107	0.796	4.642	0.485	3.419	1.812	5.888	1.645	2.864	7.654
7.703	0.350	5.517	1.839	1.387	0.667	2.475	1.218	3.324	6.607
6.018	1.639	1.979	2.798	1.138	0.547	2.843	2.053	2.377	5.016
4.952	0.777	2.618	1.754	1.809	0.599	1.647	4.400	1.404	2.693
7.385	0.141	3.880	2.405	1.628	0.502	4.114	1.229	3.706	10.500
7.409	0.341	3.705	37.633	0.934	0.573	2.912	1.116	3.755	5.770
6.153	0.747	1.901	4.863	0.832	0.608	2.365	2.567	2.666	3.847
5.242	0.260	3.113	4.043	0.968	0.374	1.402	2.428	3.730	5.471
4.729	0.410	4.306	2.667	0.699	0.279	2.539	3.029	2.960	6.612
4.540	0.863	3.113	3.016	1.050	0.184	2.299	1.985	3.365	2.400
4.732	1.022	1.976	1.609	0.456	0.366	2.400	1.744	0.631	1.836
4.996	4.181	3.307	1.439	1.193	0.275	8.545	1.054	1.070	1.500
3.750	3.068	2.736	1.208	1.154	0.427	7.765	1.790	0.717	2.081
3.897	1.992	1.604	0.974	1.076	0.132	5.081	1.276	0.958	2.236
2.599	1.393	1.915	1.400	0.865	0.489	5.865	0.897	0.908	3.890
2.864	0.891	2.593	1.595	0.358	0.453	4.400	0.334	0.334	4.632
2.344	0.850	1.395	1.612	0.269	0.122	3.460	1.084	0.605	4.401

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6704-F4
Date Sampled: 2021/03/24 13:30







GR 33445-04 2021

GR-004: ZN6704-F4 (2021/03/24 13:30)

The scanning electron photomicrograph on the facing page (lower left) shows sample GR-004 consists of aggregates of angular, subangular, subrounded and elongated (rod like), clay size to medium sand size particles. The upper left photograph illustrates the bulk sample on filter paper.

Carbon (C) and oxygen (O) dominate the elemental spectrograph, respectively forming about 29.9% and 52.6% of the sample. Aluminum (Al), silicon (Si) and sulphur (S) are moderately abundant, respectively forming about 2.3%, 6.7% and 5.4% of the sample. Trace to minor amounts of sodium (Na), magnesium (Mg), phosphorus (P), chlorine (Cl), potassium (K), calcium (Ca), titanium (Ti), iron (Fe) and copper (Cu) are present.

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds with minor amounts of crystalline compounds present or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of about 100% silicates **(illite [$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$]**, **clinochlore [$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$]**, **kaolinite [$Al_2Si_2O_5(OH)_4$]**, **albite [$NaAlSi_3O_8$]**, **quartz [$SiO_2$]** and **microcline [$KAlSi_3O_8$])**.

Carbon and some of the oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, oxygen and sulphur bearing compounds. Trace volumes of phosphorus, chlorine, calcium, titanium and copper bearing compounds were detected during elemental analysis.

The particle size distribution histogram shows a skewed unimodal distribution centering around 4.00 microns. Mean particle size was measured at 7.86 microns and median particle size was measured at 2.61 microns. Particles vary in size from 0.03 microns (clay size) to 274.26 microns (medium sand size). The Quartile 3 size is 8.01 microns and the Quartile 1 size is 0.86 microns. Standard deviation was measured at 19.69 microns.

TABLE 4: EDS and XRD Results

Bureau Veritas Laboratories; Project #: C119656; Sample ID: ZN6704-F4; Date Sampled: 2021/03/24 13:30

GR 33445-04 2021

ELEMENTS:

DOMINANT: C, O

MODERATE: Al, Si, S

COMMON:

MINOR-TRACE: Na, Mg, P, Cl, K, Ca, Ti, Fe, Cu

COMPOUNDS:

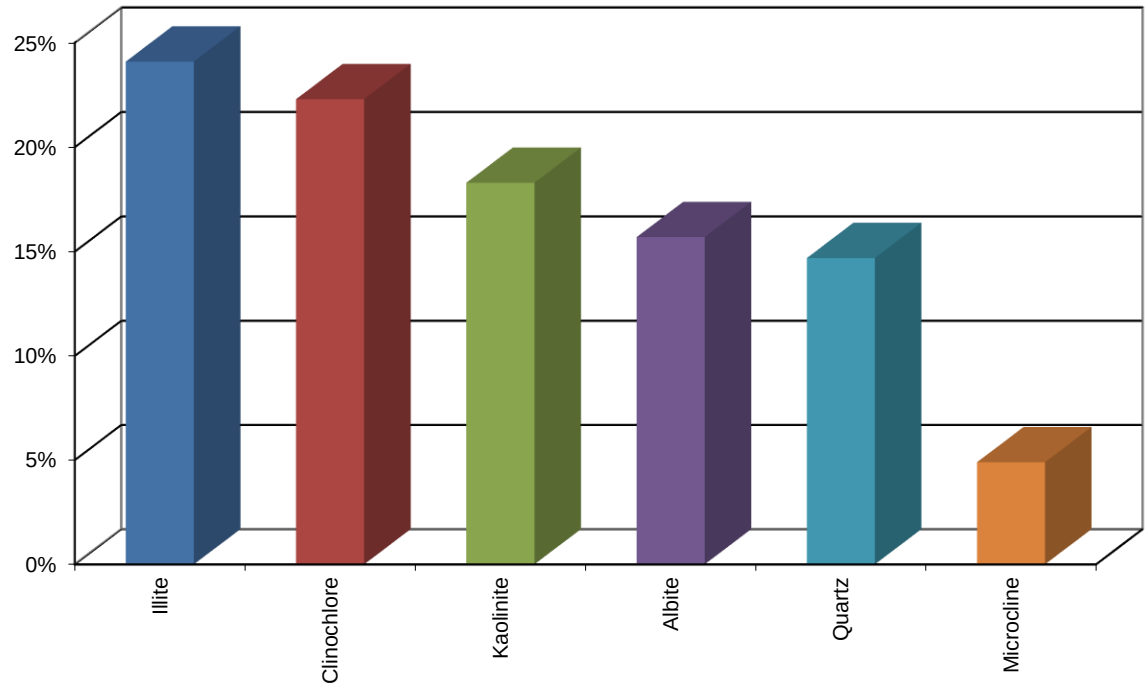
Formula	*Name*	*Percentage*
$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$	Illite	24.1%
$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$	Clinochlore	22.3%
$Al_2Si_2O_5(OH)_4$	Kaolinite	18.3%
$NaAlSi_3O_8$	Albite	15.7%
SiO_2	Quartz	14.7%
$KAlSi_3O_8$	Microcline	4.9%
		100.0%

COMMENTS:

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds with minor amounts of crystalline compounds present or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of about 100% silicates.

Carbon and some of the oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, oxygen and sulphur bearing compounds. Trace volumes of phosphorus, chlorine, calcium, titanium and copper bearing compounds were detected during elemental analysis.

ABUNDANCE OF COMPOUNDS



GR Petrology CONSULTANTS Inc.

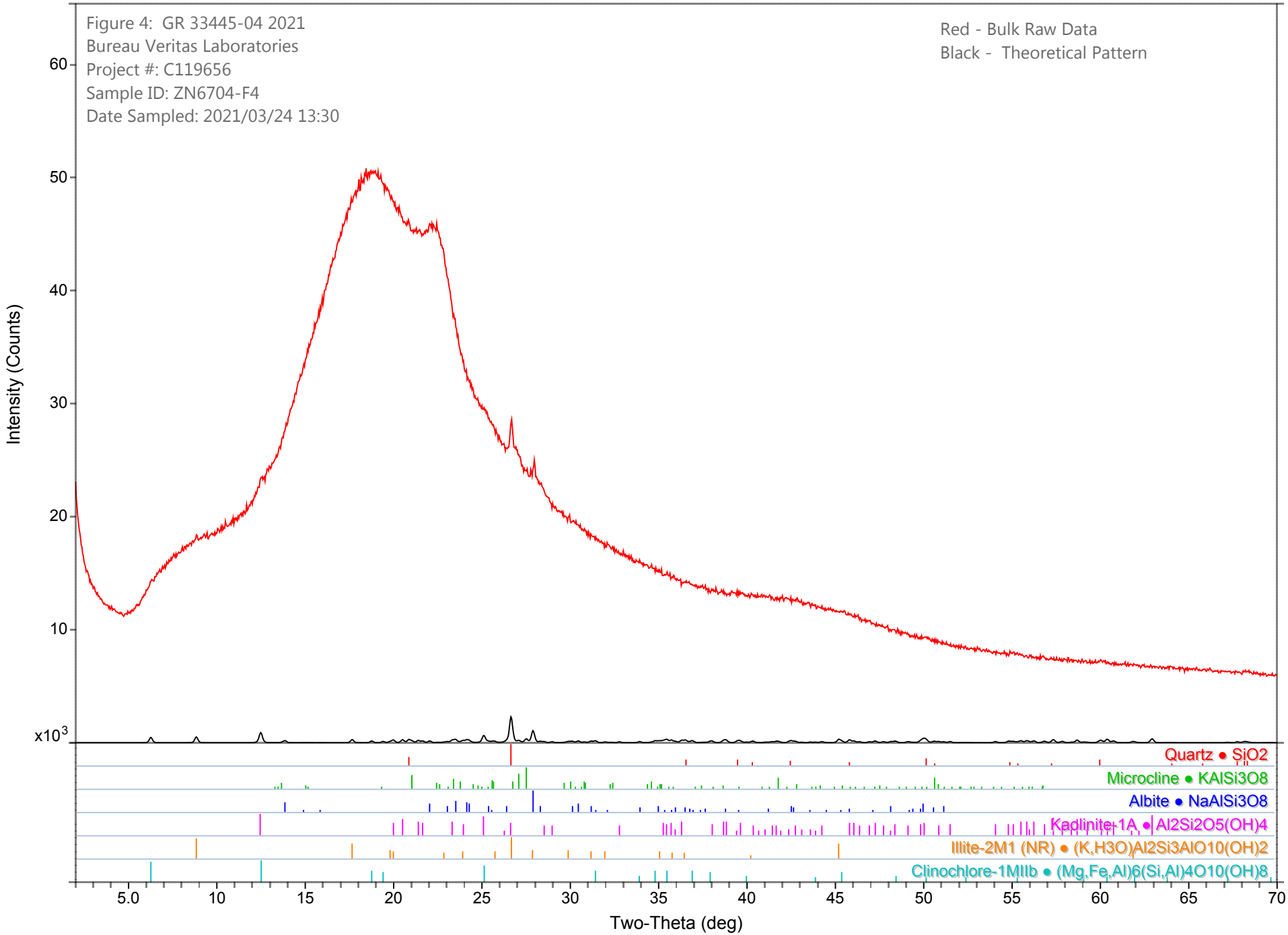
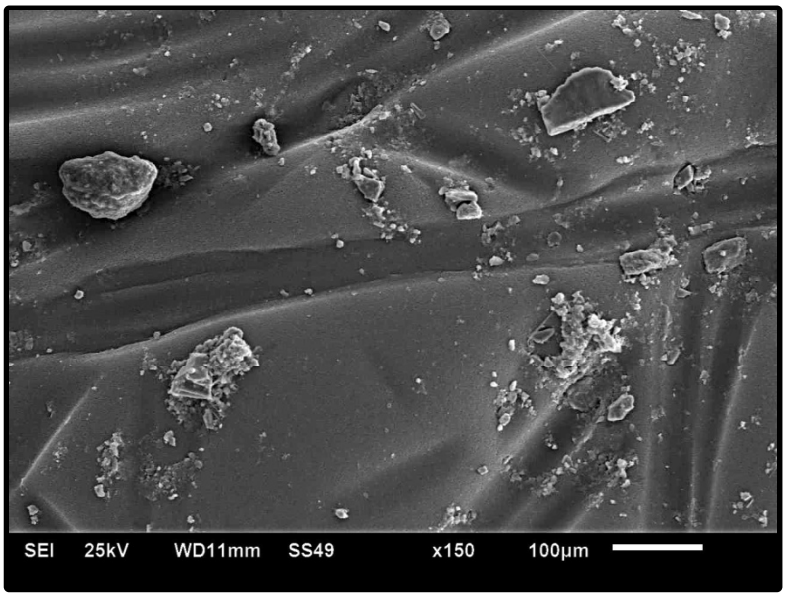
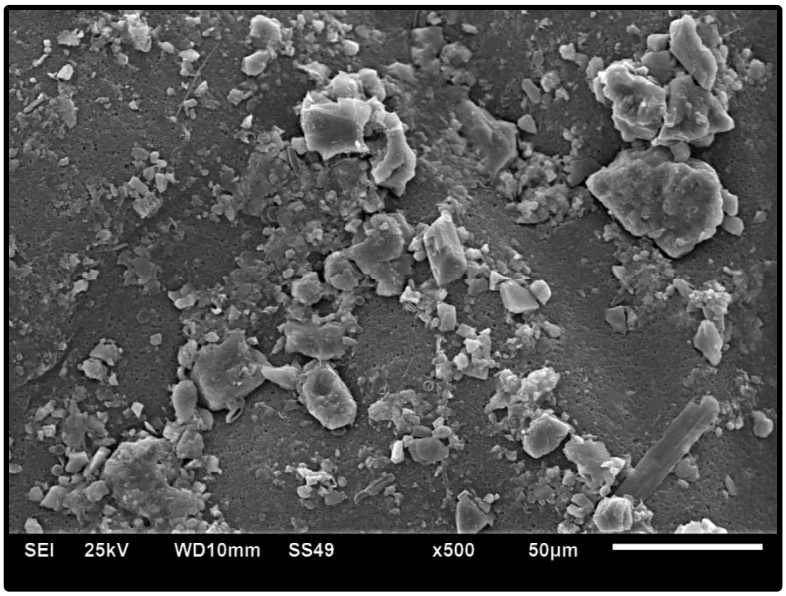
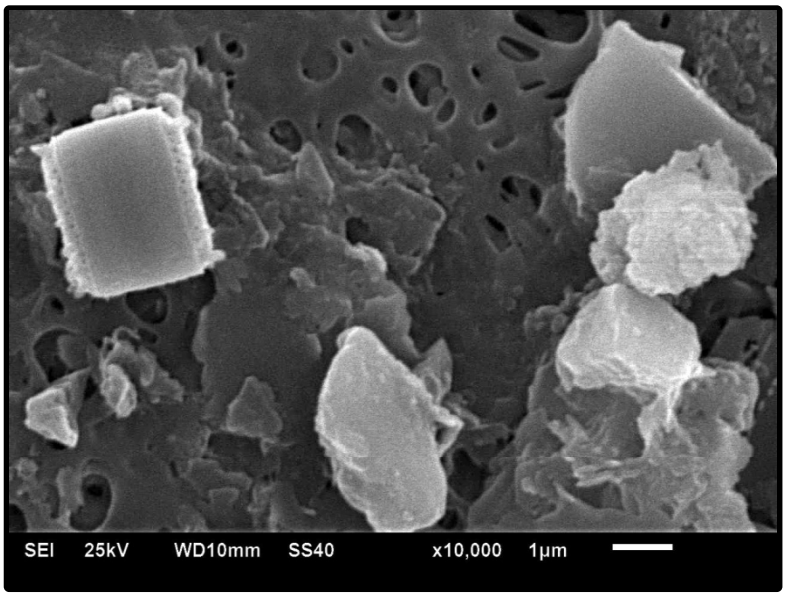


Figure 4: GR 33445-04 2021
Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZN6704-F4
Date Sampled: 2021/03/24 13:30
Red - Bulk Raw Data
Black - Theoretical Pattern
Intensity (Counts)
x10^3
Two-Theta (deg)
Quartz • SiO2
Microcline • KAlSi3O8
Albite • NaAlSi3O8
Kaolinite-1A • Al2Si2O5(OH)4
Illite-2M1 (NR) • (K,H3O)Al2Si3AlO10(OH)2
Clinochlore-1MIIb • (Mg,Fe,Al)6(Si,Al)4O10(OH)8

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6704-F4
Date Sampled: 2021/03/24 13:30







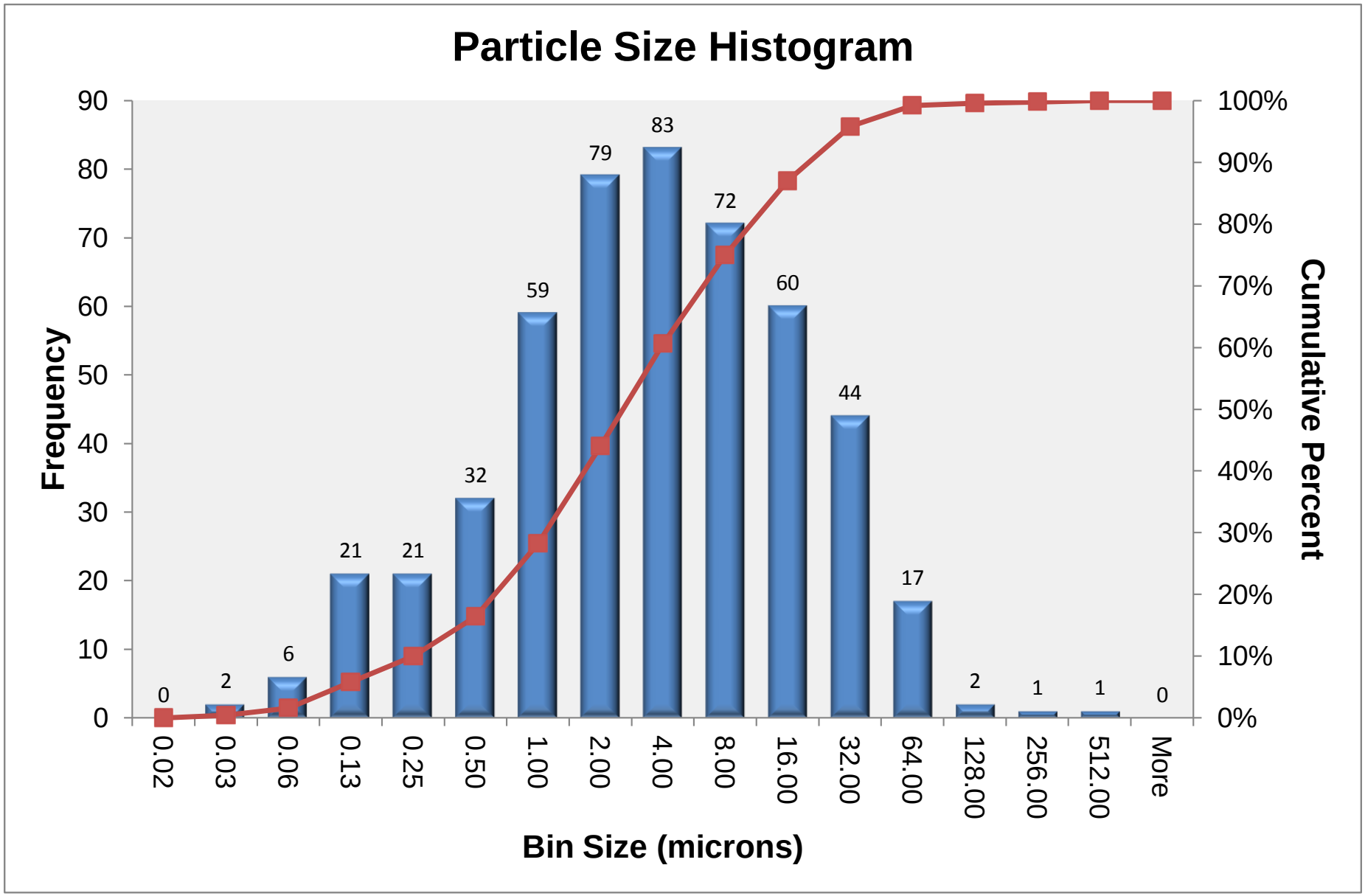
Particle Size Statistics

Size in Micrometers	
Mean	7.856
Median	2.613
Maximum	274.255
Quartile 3	8.012
Quartile 1	0.863
Minimum	0.025
Standard Deviation	19.690
Mode	0.284
Sample Variance	387.713
Kurtosis	116.769
Skewness	9.560
Range	274.230
Standard Error	0.881
Confidence Level (95%)	1.730
Sum	3927.956
Count	500

Histogram Statistics

Microns	*Frequency*	*Cumulative*
0.02	0	0.00%
0.03	2	0.40%
0.06	6	1.60%
0.13	21	5.80%
0.25	21	10.00%
0.50	32	16.40%
1.00	59	28.20%
2.00	79	44.00%
4.00	83	60.60%
8.00	72	75.00%
16.00	60	87.00%
32.00	44	95.80%
64.00	17	99.20%
128.00	2	99.60%
256.00	1	99.80%
512.00	1	100.00%
More	0	100.00%

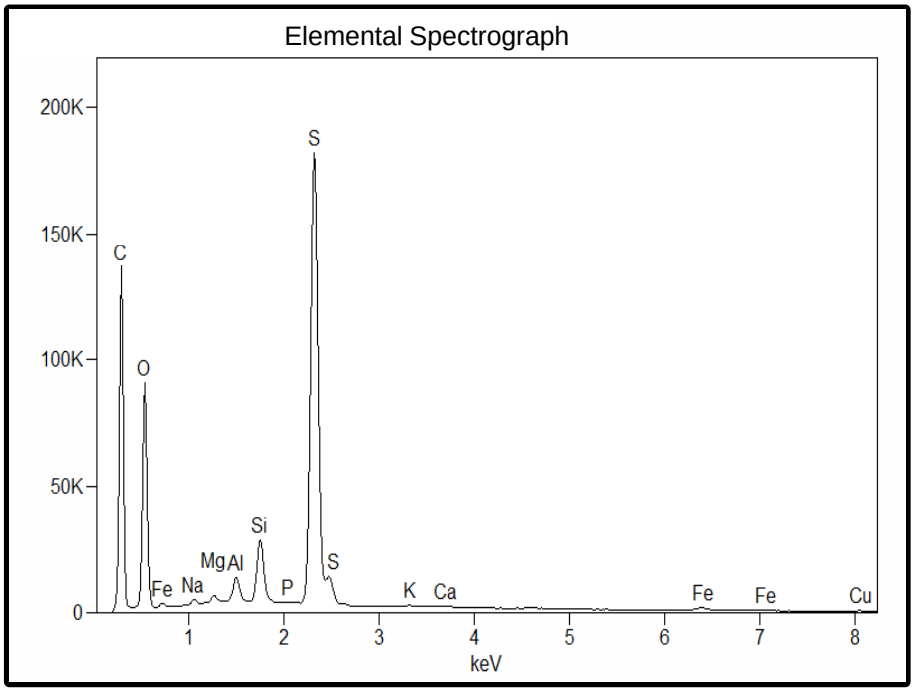
GR Petrology CONSULTANTS Inc.

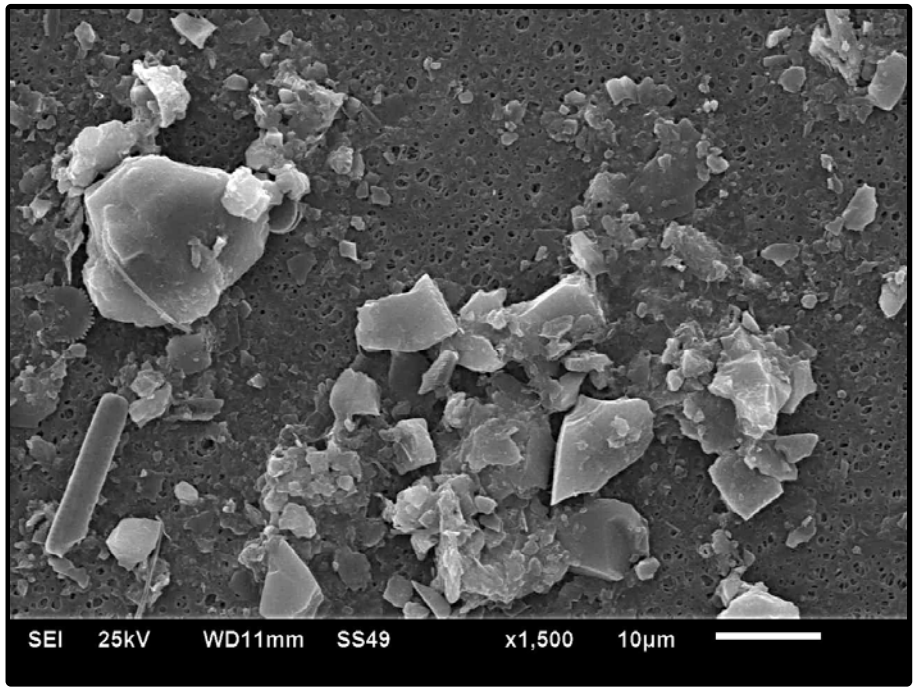

Particle Size Histogram
Frequency
Cumulative Percent
Bin Size (microns)
0
2
6
21
21
32
59
79
83
72
60
44
17
2
1
1
0
0.02
0.03
0.06
0.13
0.25
0.50
1.00
2.00
4.00
8.00
16.00
32.00
64.00
128.00
256.00
512.00
More

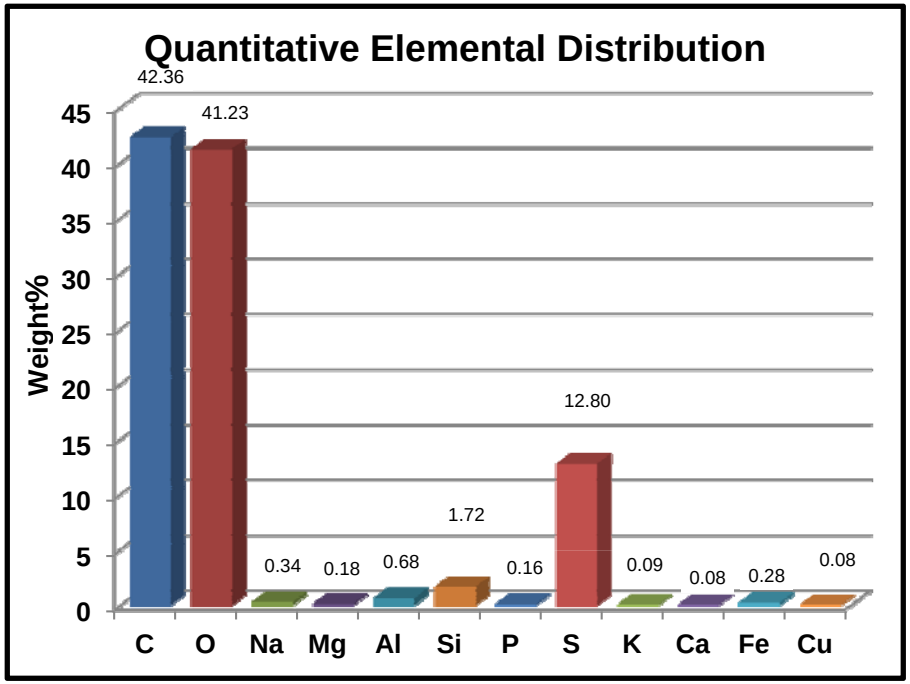
Raw Particle Size Data (microns) Number of measurements: 500

17.207	2.089	35.399	0.491	46.174	0.816	15.685	2.119	253.471	6.310
9.728	1.579	16.941	2.359	43.422	0.905	4.238	1.834	41.712	4.423
6.766	1.451	6.126	1.107	23.022	1.347	1.576	1.340	37.438	6.897
7.236	1.603	7.524	1.687	24.878	0.588	3.420	1.015	33.915	7.080
5.436	1.259	3.642	0.427	26.102	0.621	1.023	2.839	26.840	1.953
5.252	1.710	3.296	0.305	21.190	0.512	2.734	3.003	13.319	2.658
4.941	4.365	5.316	0.350	23.259	0.284	1.498	3.113	10.146	7.198
4.338	3.169	1.844	0.605	19.506	0.781	1.579	1.476	9.271	7.045
3.670	2.191	1.700	0.696	24.003	0.241	0.960	1.468	7.735	4.451
2.594	0.996	2.266	0.426	14.369	0.181	0.995	0.629	11.205	6.083
3.491	1.601	2.826	0.305	13.724	0.557	0.717	0.889	11.658	4.430
1.934	2.482	2.266	0.760	17.055	0.320	0.507	1.947	10.842	3.889
2.108	1.092	2.052	0.596	13.298	0.256	0.227	1.229	9.035	5.942
1.635	1.601	2.302	0.779	25.223	0.488	0.167	0.926	15.215	4.507
1.871	1.358	1.521	0.822	18.322	0.240	0.967	1.820	8.305	2.704
2.000	1.662	0.985	0.526	16.639	0.330	0.604	3.829	9.328	2.704
2.805	1.914	0.808	0.414	7.725	0.443	0.174	1.374	4.607	2.250
1.488	31.254	1.098	104.802	8.616	41.655	0.291	3.528	8.172	4.231
1.044	19.003	1.201	104.565	9.202	9.385	0.317	3.390	16.586	5.375
4.127	19.375	3.337	39.061	6.325	15.977	0.167	3.199	10.633	1.591
2.941	20.847	2.108	47.376	7.335	6.299	0.486	2.371	10.049	0.960
0.508	15.646	2.191	49.035	13.161	4.616	0.288	2.299	6.389	0.739
1.110	17.000	2.483	44.791	9.434	2.094	0.107	0.945	3.452	0.301
1.064	16.011	0.602	38.326	5.200	3.484	0.134	0.689	3.258	0.481
1.468	14.560	0.707	28.944	5.692	5.153	0.120	1.041	2.983	0.476
0.740	9.434	0.820	33.340	6.841	3.453	0.101	1.212	4.580	0.171
0.936	10.511	0.971	31.241	3.298	3.151	0.097	0.868	8.437	0.108
0.703	13.153	0.550	35.201	1.844	3.954	0.284	0.440	6.881	0.175
0.749	18.160	0.721	23.142	1.442	3.260	0.271	0.440	10.633	0.098
1.108	18.530	2.413	25.725	1.562	2.818	0.717	0.361	13.087	0.102
1.227	9.297	1.100	24.909	2.720	1.828	0.969	0.192	11.332	0.067
0.980	14.224	0.791	12.649	2.126	1.043	0.664	0.094	7.959	0.042
0.775	13.917	1.868	24.037	2.236	2.157	0.335	0.092	8.408	0.255
1.709	14.751	0.849	10.750	4.940	0.777	0.142	0.751	5.436	0.149
7.456	11.007	6.522	14.000	10.174	1.281	41.386	0.248	274.255	0.080
6.110	10.720	4.078	16.879	3.339	2.185	25.425	0.114	31.429	0.082
7.498	9.849	4.463	22.361	2.139	1.209	16.755	0.599	28.001	0.060
5.381	6.603	3.552	9.911	1.897	1.211	10.190	0.222	42.960	0.110
4.906	3.256	3.045	12.526	1.852	3.160	7.914	0.106	29.026	0.202
3.688	4.604	3.877	14.981	1.757	1.712	7.335	0.064	42.362	0.025
3.265	8.955	4.087	6.289	2.609	0.825	6.220	0.132	24.755	0.029
2.332	7.800	2.985	16.055	1.493	1.853	3.819	0.081	24.956	0.042
3.994	7.280	1.868	10.154	1.726	0.825	5.123	0.284	29.323	0.061
2.530	5.016	2.207	12.166	2.036	0.810	6.024	0.076	24.152	0.067
3.363	9.784	3.132	9.545	1.531	0.612	4.338	0.143	12.191	0.041
1.953	5.967	4.088	9.428	1.259	3.383	5.387	0.063	21.268	0.303
4.056	6.223	1.028	10.687	1.076	1.775	3.201	0.149	19.007	0.045
1.481	3.400	1.051	6.566	1.547	1.358	4.395	0.283	11.560	0.400
2.617	2.631	1.225	8.246	0.969	0.506	4.240	0.364	14.648	0.130
2.326	3.231	1.105	6.289	1.630	0.769	2.697	0.181	16.509	0.092

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6705-F5
Date Sampled: 2021/03/24 14:02







GR-005: ZN6705-F5 (2021/03/24 14:02)

The scanning electron photomicrograph on the facing page (lower left) shows sample GR-005 consists of aggregates of angular, subangular, subrounded and elongated, clay size to very fine sand size particles. The upper left photograph illustrates the bulk sample on filter paper.

Carbon (C) and oxygen (O) dominate the elemental spectrograph, respectively forming about 42.4% and 41.2% of the sample. Sulphur (S) is common, forming about 12.8% of the sample. Trace to minor amounts of sodium (Na), magnesium (Mg), aluminum (Al), silicon (Si), phosphorus (P), potassium (K), calcium (Ca), iron (Fe) and copper (Cu) are present.

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of trace amounts of silicates **(kaolinite [$Al_2Si_2O_5(OH)_4$]**, **illite [$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$]**, **clinochlore [$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$]**, **quartz [$SiO_2$]**, **albite [$NaAlSi_3O_8$]**, **microcline [$KAlSi_3O_8$]** and **silicon oxide [SiO_2])**.

Carbon and some of the oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, oxygen and sulphur bearing compounds. Trace volumes of phosphorus, calcium and copper bearing compounds were detected during elemental analysis.

The particle size distribution histogram shows a skewed unimodal distribution centering around 4.00 microns. Mean particle size was measured at 2.93 microns and median particle size was measured at 1.14 microns. Particles vary in size from 0.02 microns (clay size) to 90.53 microns (very fine sand size). The Quartile 3 size is 3.03 microns and the Quartile 1 size is 0.36 microns. Standard deviation was measured at 6.35 microns.

TABLE 5: EDS and XRD Results

Bureau Veritas Laboratories; Project #: C119656; Sample ID: ZN6705-F5; Date Sampled: 2021/03/24 14:02

GR 33445-05 2021

ELEMENTS:

DOMINANT: C, O
COMMON: S
MODERATE:
MINOR-TRACE: Na, Mg, Al, Si, P, K, Ca, Fe, Cu

COMPOUNDS:

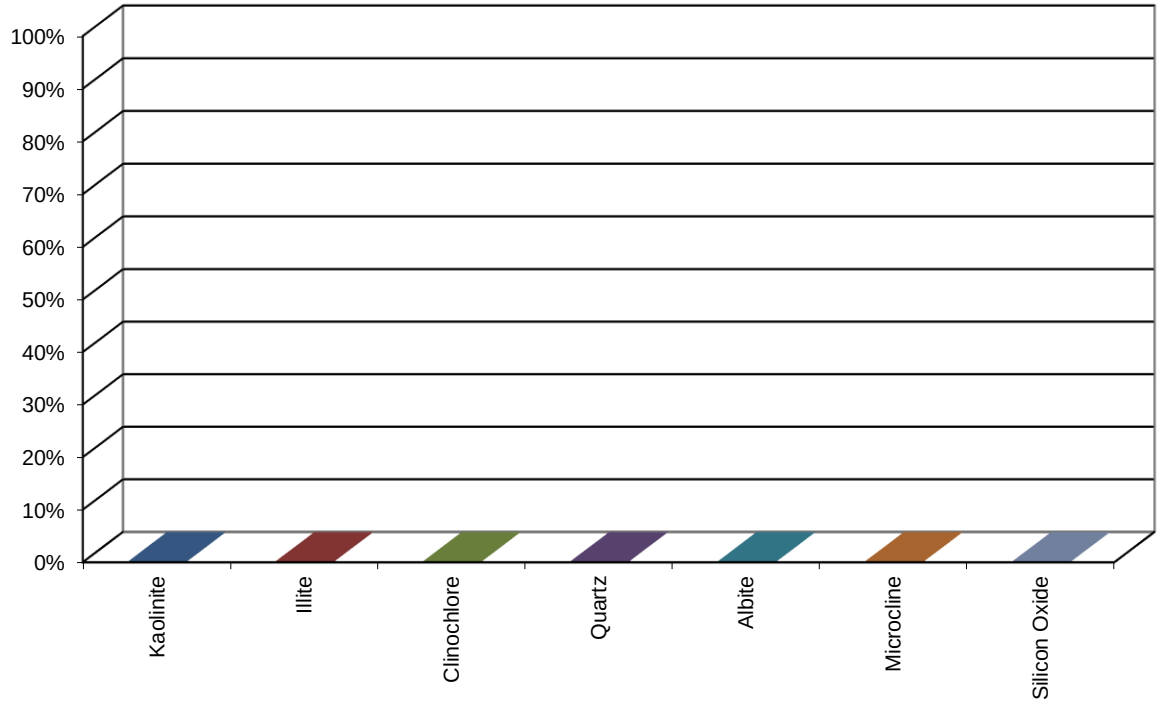
Formula	*Name*	*Percentage*
$Al_2Si_2O_5(OH)_4$	Kaolinite	trace
$(K,H_3O)Al_2Si_3AlO_{10}(OH)_2$	Illite	trace
$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_2$	Clinochlore	trace
SiO_2	Quartz	trace
$NaAlSi_3O_8$	Albite	trace
$KAlSi_3O_8$	Microcline	trace
SiO_2	Silicon Oxide	trace

COMMENTS:

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds or there is insufficient sample on the filter paper . X-ray diffraction analysis shows the crystalline components of the sample consist of trace amounts of silicates.

Carbon and part of oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, oxygen and sulphur bearing compounds. Trace volumes of phosphorus, calcium and copper bearing compounds were detected during elemental analysis.

ABUNDANCE OF COMPOUNDS



GR Petrology CONSULTANTS Inc.

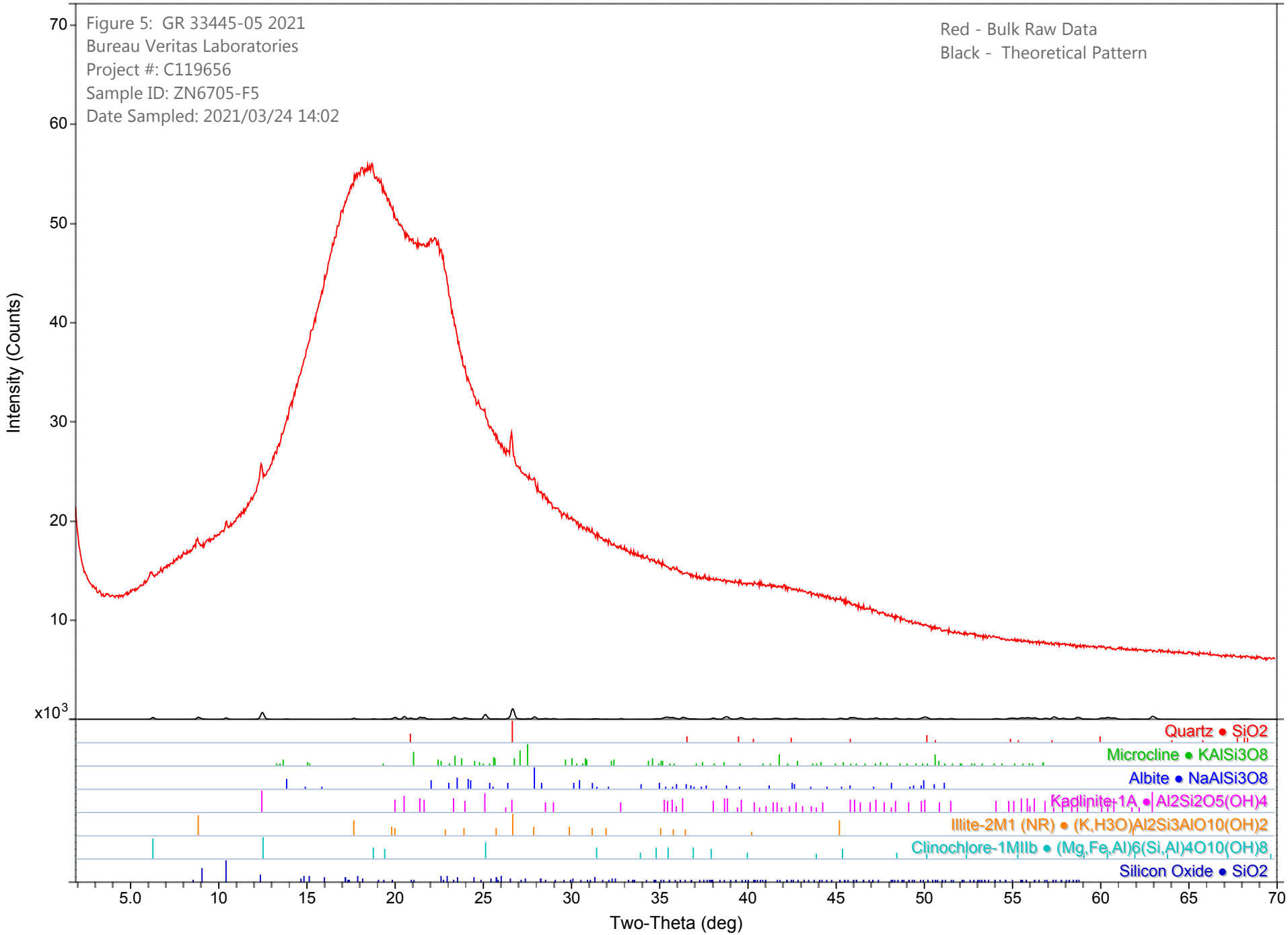
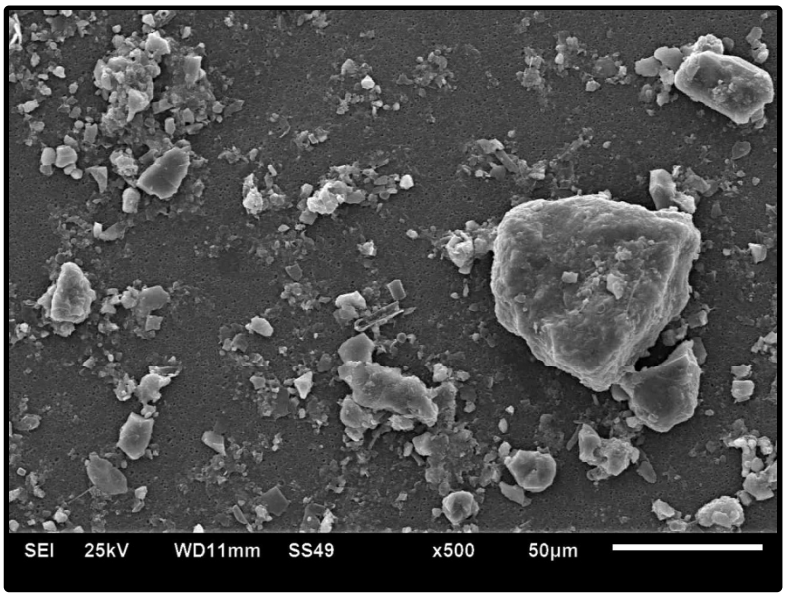
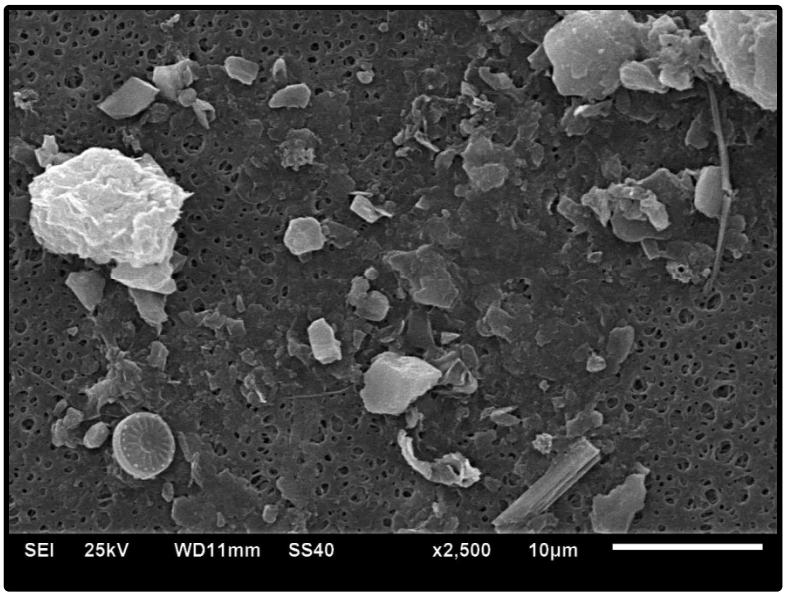
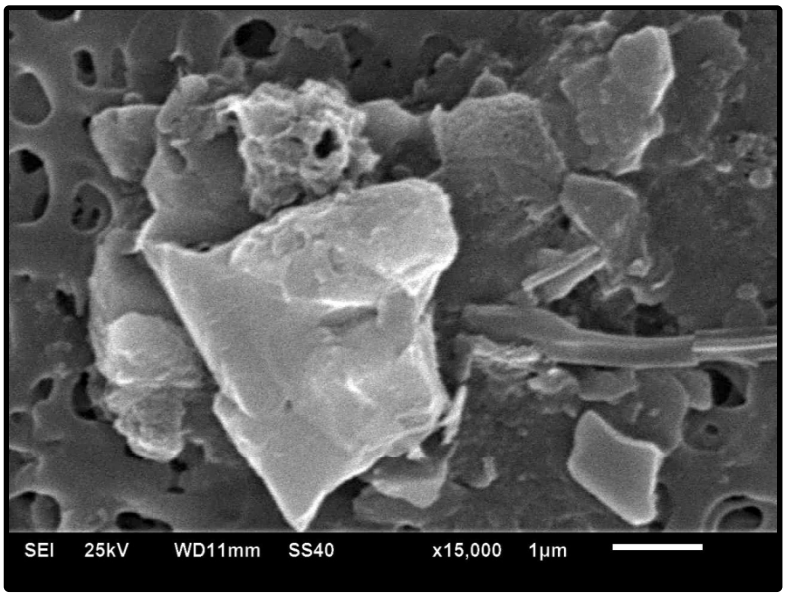


Figure 5: GR 33445-05 2021
Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZN6705-F5
Date Sampled: 2021/03/24 14:02
Red - Bulk Raw Data
Black - Theoretical Pattern
Intensity (Counts)
x10^3
Quartz • SiO2
Microcline • KAlSi3O8
Albite • NaAlSi3O8
Kaolinite-1A • Al2Si2O5(OH)4
Illite-2M1 (NR) • (K,H3O)Al2Si3AlO10(OH)2
Clinochlore-1MIIb • (Mg,Fe,Al)6(Si,Al)4O10(OH)8
Silicon Oxide • SiO2
Two-Theta (deg)

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6705-F5
Date Sampled: 2021/03/24 14:02







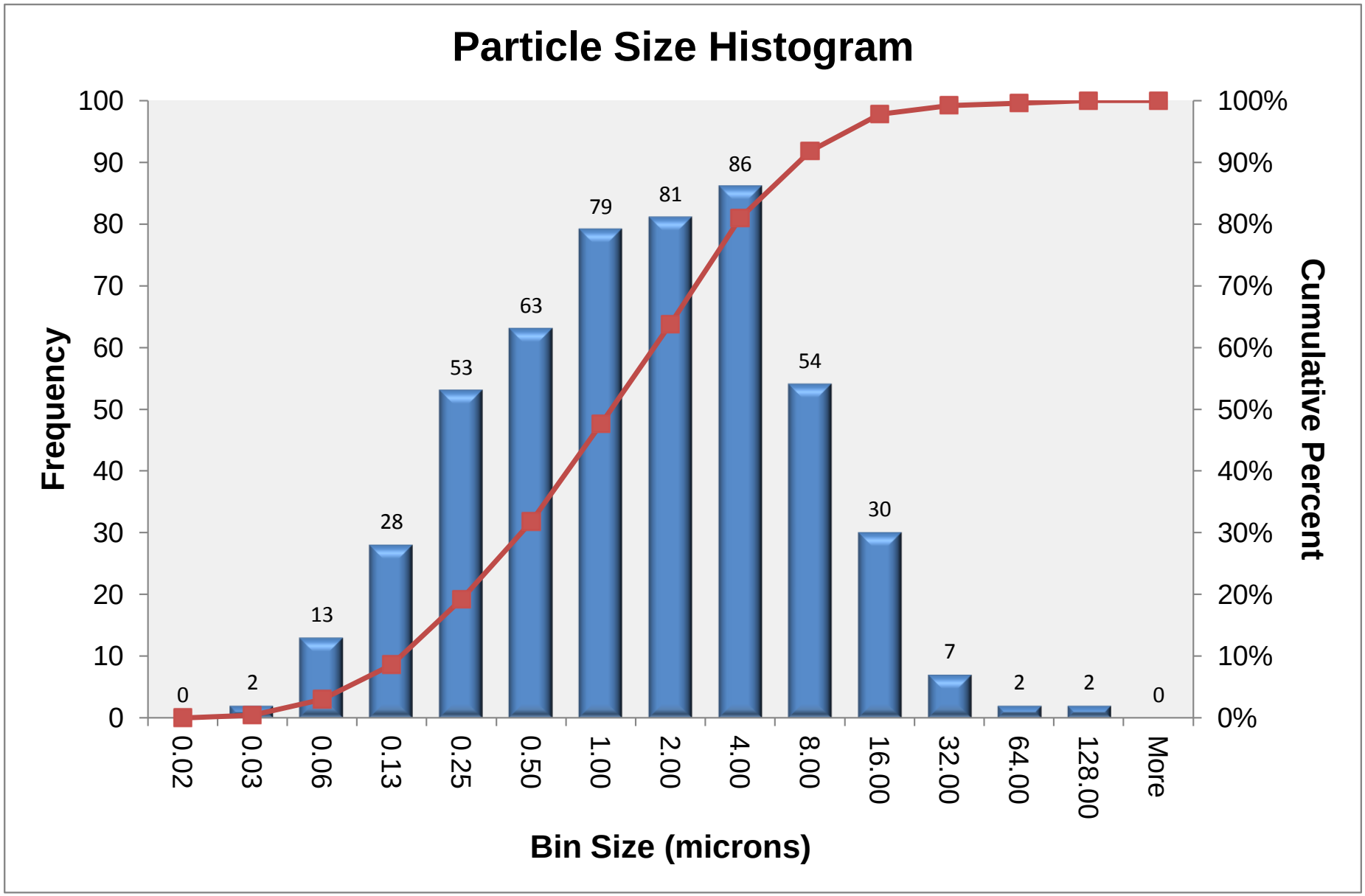
Particle Size Statistics

Size in Micrometers	
Mean	2.929
Median	1.138
Maximum	90.529
Quartile 3	3.030
Quartile 1	0.358
Minimum	0.024
Standard Deviation	6.355
Mode	0.134
Sample Variance	40.386
Kurtosis	92.570
Skewness	8.112
Range	90.505
Standard Error	0.284
Confidence Level (95%)	0.558
Sum	1464.387
Count	500

Histogram Statistics

Microns	Frequency	Cumulative
0.02	0	0.00%
0.03	2	0.40%
0.06	13	3.00%
0.13	28	8.60%
0.25	53	19.20%
0.50	63	31.80%
1.00	79	47.60%
2.00	81	63.80%
4.00	86	81.00%
8.00	54	91.80%
16.00	30	97.80%
32.00	7	99.20%
64.00	2	99.60%
128.00	2	100.00%
More	0	100.00%

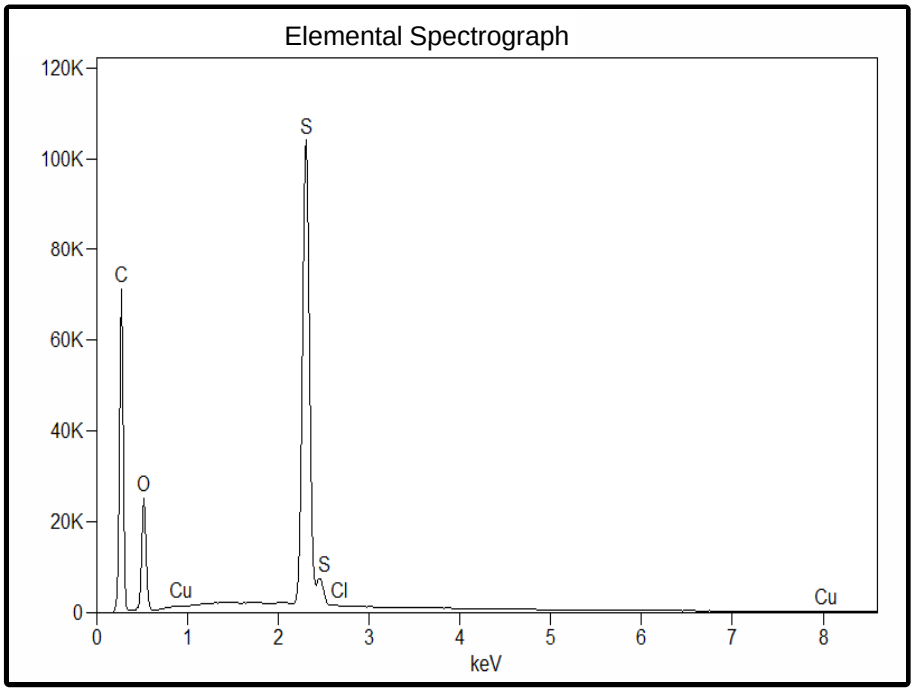
GR Petrology CONSULTANTS Inc.

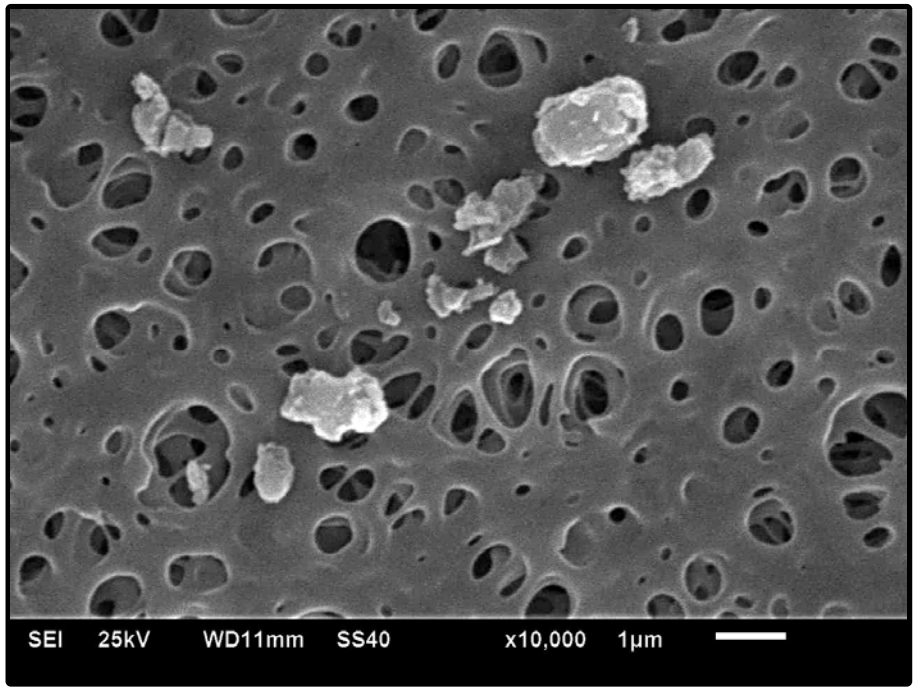

Particle Size Histogram
Frequency
Cumulative Percent
Bin Size (microns)
100
90
80
70
60
50
40
30
20
10
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
2
13
28
53
63
79
81
86
54
30
7
2
2
0
0.02
0.03
0.06
0.13
0.25
0.50
1.00
2.00
4.00
8.00
16.00
32.00
64.00
128.00
More

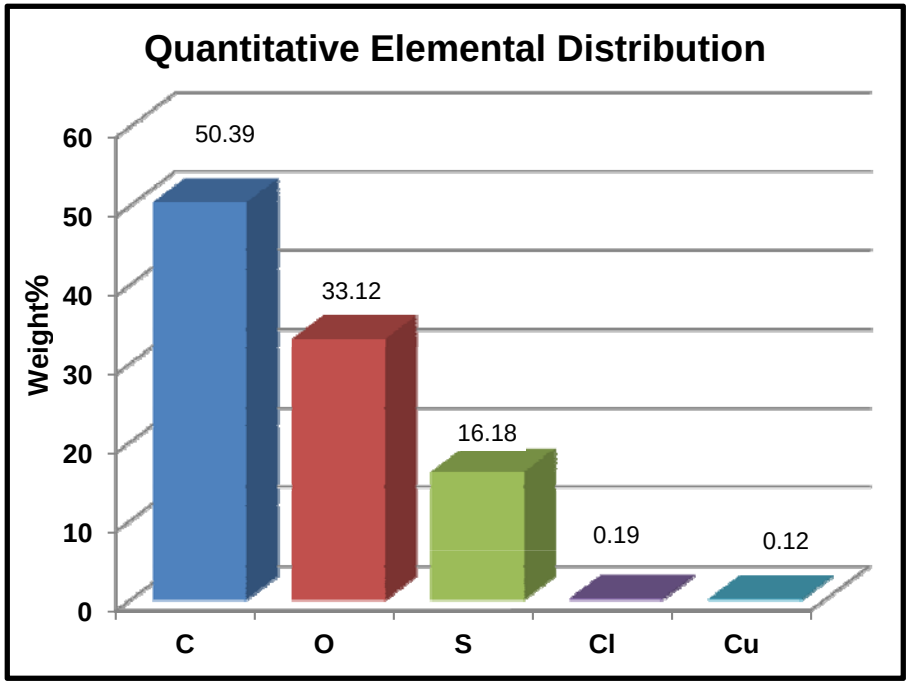
Raw Particle Size Data (microns) Number of measurements: 500

9.109	0.099	90.529	1.834	3.691	0.877	4.842	0.450	8.072	1.123
5.190	0.241	13.412	0.632	3.012	0.450	1.676	0.378	4.526	1.308
4.443	0.219	14.912	0.343	1.787	0.661	2.186	0.270	7.522	2.184
4.779	0.055	7.546	0.103	3.177	0.340	1.252	0.275	4.271	1.523
4.561	0.195	8.799	1.317	1.827	0.509	1.196	0.493	6.681	2.668
3.040	0.588	9.613	0.371	2.911	0.571	0.959	0.356	2.600	4.382
2.565	0.124	15.651	0.555	1.468	0.050	0.508	1.018	3.960	4.631
4.305	0.069	7.670	0.994	1.688	0.133	2.619	0.703	2.379	1.798
3.543	0.346	1.600	0.291	0.913	0.183	3.039	0.419	2.160	0.708
3.077	0.090	7.351	0.154	0.877	0.186	0.793	0.345	2.748	0.761
2.640	0.127	6.368	0.259	1.217	0.151	0.578	1.663	3.759	1.624
4.470	0.321	5.787	0.246	0.766	0.134	0.469	0.050	1.897	0.640
2.213	0.185	4.429	0.808	0.783	0.033	0.701	0.476	2.256	0.878
3.027	1.028	4.242	0.287	0.666	0.211	0.715	0.472	0.848	0.280
2.499	0.467	4.642	0.333	0.694	1.577	0.454	0.471	1.321	0.165
3.451	0.284	9.418	0.314	0.659	0.425	0.134	0.690	1.895	0.243
2.430	0.246	6.253	0.229	0.614	0.217	0.180	0.253	0.482	1.336
2.824	15.810	3.365	65.208	0.440	9.130	0.184	4.900	0.841	2.128
1.950	16.105	3.993	34.238	0.350	6.884	0.067	3.349	0.777	1.692
2.813	12.971	4.954	33.373	0.768	4.838	0.141	2.614	0.809	2.523
1.443	5.923	2.055	29.006	0.211	2.393	0.094	2.670	1.836	1.455
1.746	8.682	3.830	18.810	0.472	1.003	0.201	2.215	1.544	0.701
1.256	8.480	1.315	18.630	0.198	2.192	0.235	2.006	1.093	1.327
0.962	8.621	5.484	16.086	0.278	1.853	0.368	1.102	1.138	0.488
1.127	6.300	2.344	17.464	0.208	2.044	0.195	0.869	1.330	0.740
2.105	7.069	1.474	10.526	0.085	1.762	0.633	1.221	1.154	0.654
1.504	4.043	0.706	15.201	0.196	2.326	0.379	0.788	1.321	0.469
1.166	4.771	2.948	14.931	0.140	1.378	0.253	0.695	0.963	0.264
0.988	4.391	1.529	7.790	0.110	0.707	0.226	0.424	1.028	0.194
0.495	3.477	1.267	6.621	0.124	0.628	0.107	0.805	0.691	0.119
0.600	3.067	2.631	11.650	0.190	0.328	0.201	0.311	0.165	0.055
0.747	2.268	1.341	5.016	0.168	0.636	0.294	0.134	0.200	0.609
0.595	1.811	0.970	9.610	0.157	1.039	0.111	0.487	0.322	0.359
1.727	2.448	0.333	3.499	0.082	0.925	0.168	0.428	0.253	0.107
5.788	3.413	22.608	8.490	5.669	0.442	13.644	1.623	14.959	0.406
4.970	3.556	13.908	9.091	4.458	0.365	2.722	0.730	10.996	0.070
7.724	1.606	11.781	15.689	3.117	0.322	4.929	0.542	5.795	0.042
2.242	3.688	5.290	8.161	1.794	0.429	2.988	0.333	9.958	0.116
3.260	3.887	3.757	6.957	2.504	0.534	3.575	0.074	7.113	0.109
1.439	1.771	3.535	4.176	2.697	0.569	2.213	0.216	5.581	0.094
1.460	1.000	6.692	6.403	1.455	0.134	1.857	0.112	3.897	0.040
3.188	0.471	0.902	6.174	1.133	0.531	2.302	0.129	2.401	0.034
1.414	0.447	2.259	3.800	0.881	0.432	1.673	0.059	2.319	0.365
1.601	0.533	2.344	2.720	0.753	0.495	2.060	0.047	1.243	0.027
0.990	0.760	2.379	1.897	1.429	0.120	0.902	0.186	1.800	0.042
1.298	0.604	2.207	5.946	0.969	0.165	0.663	0.166	3.805	0.043
0.651	3.344	1.519	1.811	0.232	0.310	1.284	0.247	4.591	0.662
0.205	1.606	1.329	8.000	0.613	0.197	1.125	0.035	2.448	0.024
0.164	2.481	0.686	2.864	0.069	0.113	0.512	0.072	1.665	0.100
0.099	2.778	0.823	2.691	0.134	0.100	0.629	9.729	1.138	0.196

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6706-F6
Date Sampled: 2021/03/24 15:43







GR-006: ZN6706-F6 (2021/03/24 15:43)

The scanning electron photomicrograph on the facing page (lower left) shows sample GR-006 consists of aggregates of angular, subangular and subrounded, clay size to medium silt size particles. The upper left photograph illustrates the bulk sample on filter paper.

Carbon (C) and oxygen (O) dominate the elemental spectrograph, respectively forming about 50.4% and 33.1% of the sample. Sulphur (S) is common, forming about 16.2% of the sample. Trace to minor amounts of chlorine (Cl) and copper (Cu) are present.

The sample generated a non-crystalline diffractogram indicating the sample is either composed of non-crystalline compounds or there is insufficient sample on the filter paper.

Carbon and oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, oxygen and sulphur bearing compounds. Trace volumes of chlorine and copper bearing compounds were detected during elemental analysis.

The particle size distribution histogram shows a bimodal distribution centering around 0.25 microns and 32.00 microns. Mean particle size was measured at 0.86 microns and median particle size was measured at 0.28 microns. Particles vary in size from 0.01 microns (clay size) to 27.85 microns (medium silt size). The Quartile 3 size is 0.71 microns and the Quartile 1 size is 0.13 microns. Standard deviation was measured at 2.49 microns.

TABLE 6: EDS and XRD Results

Bureau Veritas Laboratories; Project #: C119656; Sample ID: ZN6706-F6; Date Sampled: 2021/03/24 15:43

GR 33445-06 2021

ELEMENTS:

DOMINANT: C, O

MODERATE:

COMMON: S

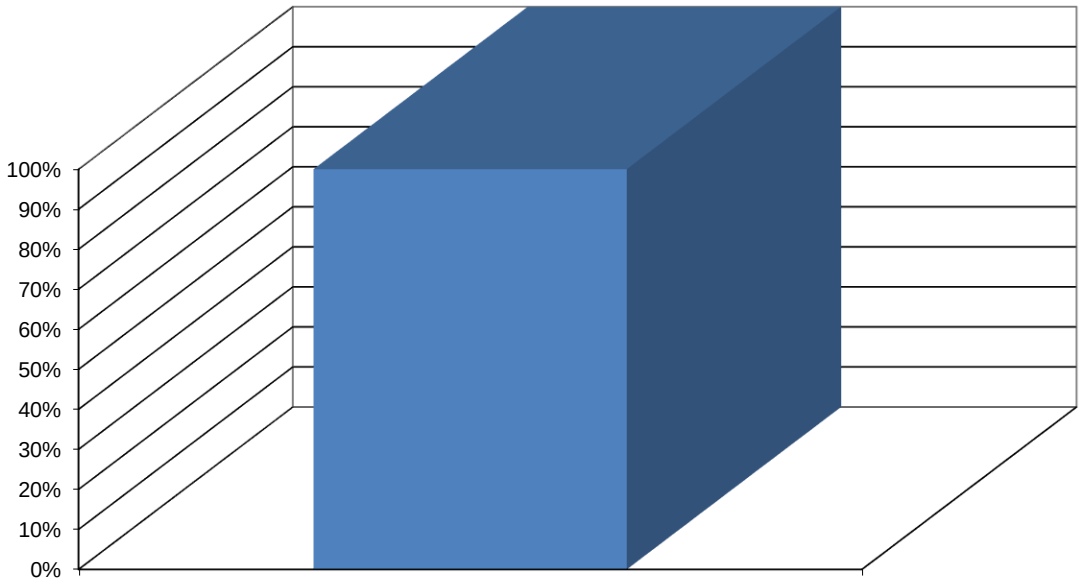
MINOR-TRACE: Cl, Cu

COMMENTS:

The sample generated a non-crystalline diffractogram indicating the sample is either composed of non-crystalline compounds or there is insufficient sample or there is insufficient sample on the filter paper.

Carbon and oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, oxygen and sulphur bearing compounds. Trace volumes of chlorine and copper bearing compounds were detected during elemental analysis.

ABUNDANCE OF COMPOUNDS



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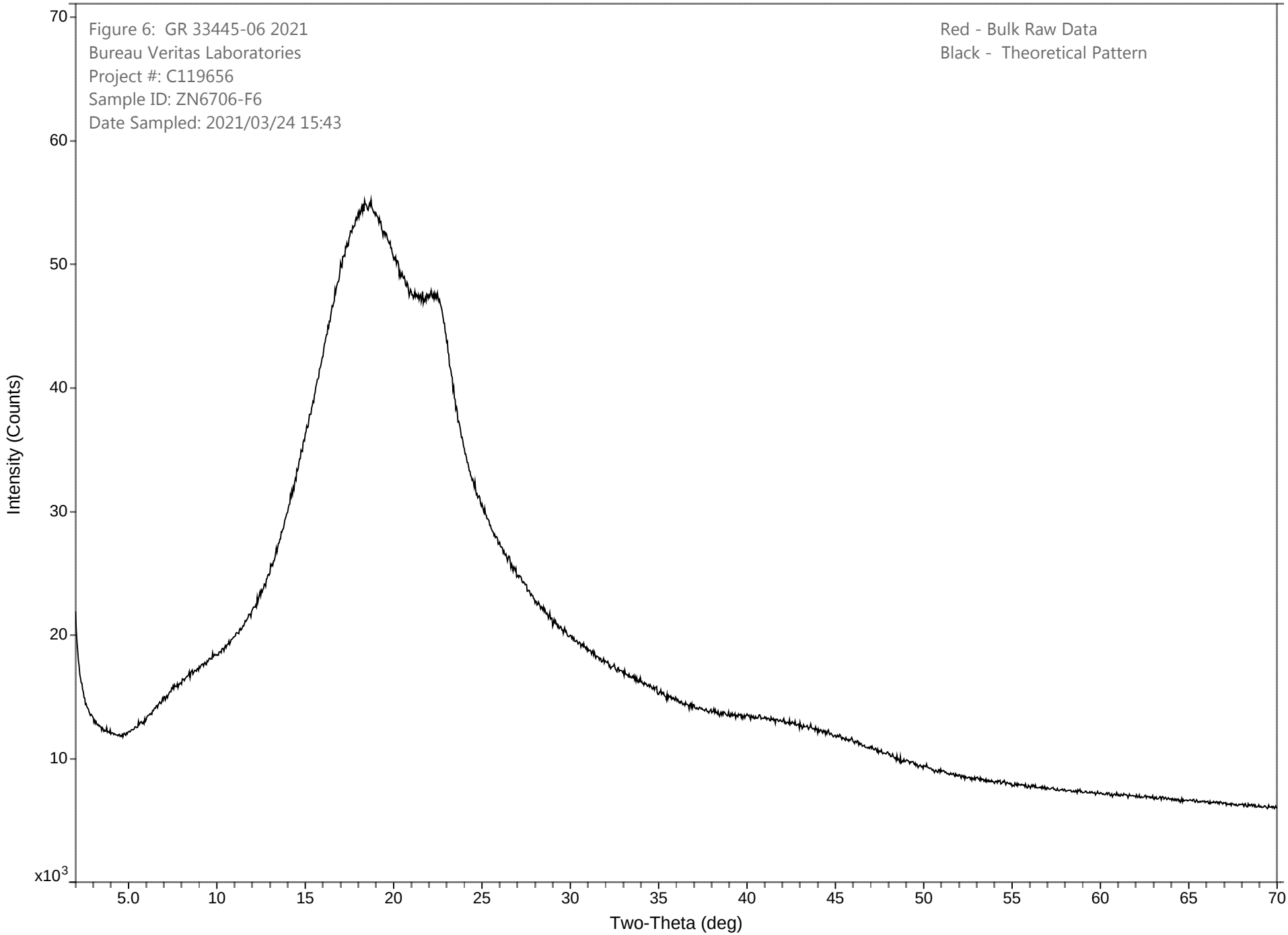
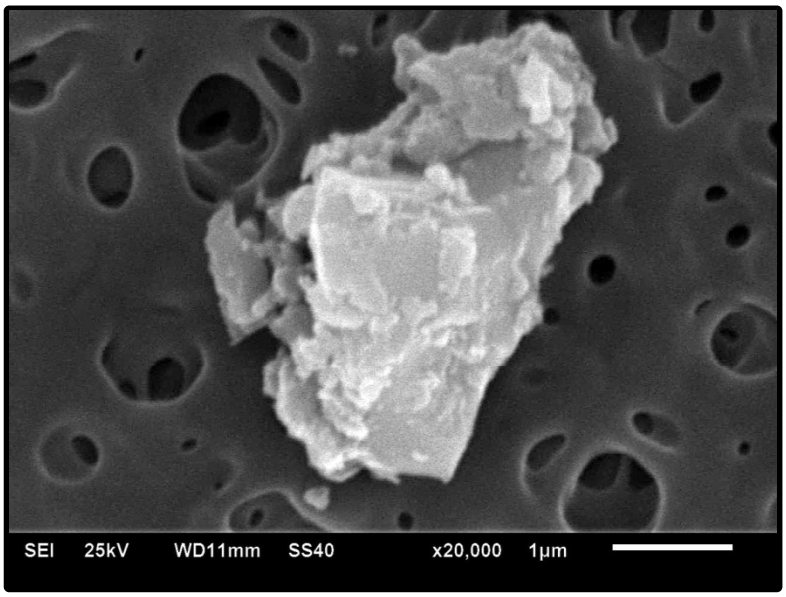
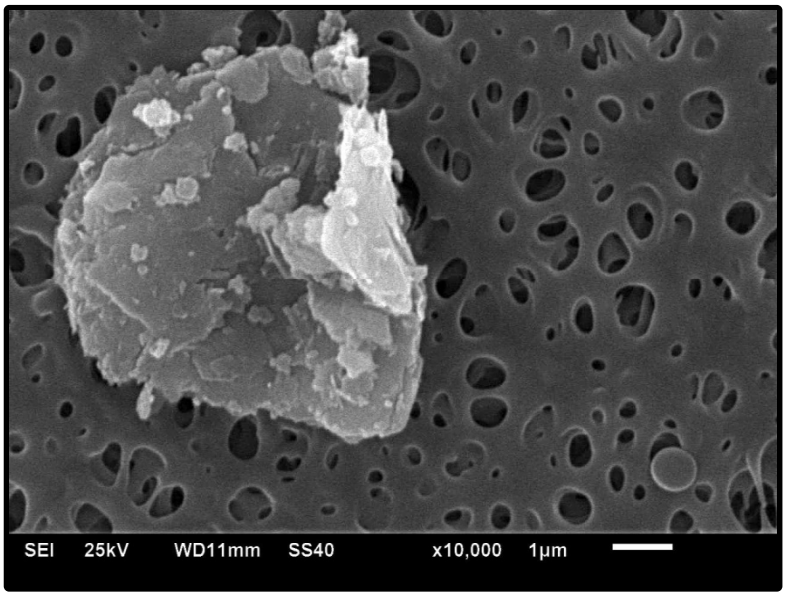
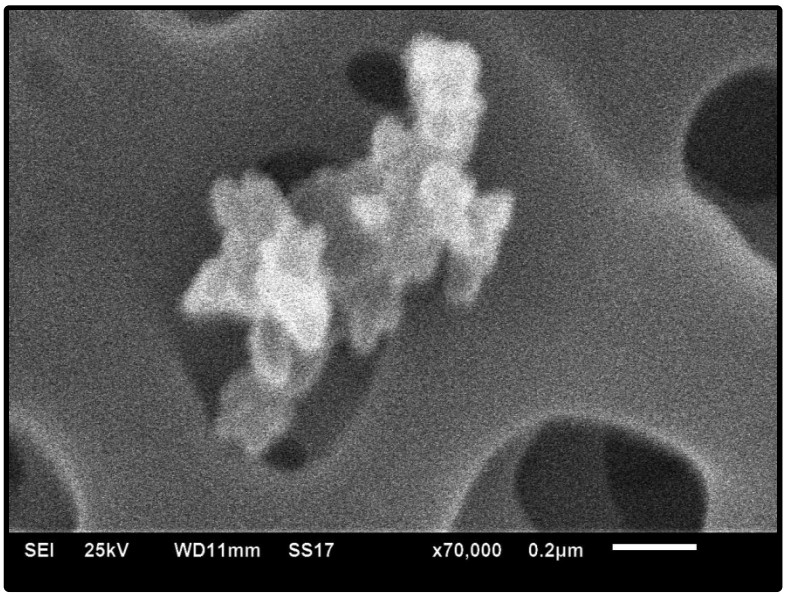


Figure 6: GR 33445-06 2021
Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZN6706-F6
Date Sampled: 2021/03/24 15:43
Red - Bulk Raw Data
Black - Theoretical Pattern
Intensity (Counts)
x10^3
70
60
50
40
30
20
10
5.0
10
15
20
25
30
35
40
45
50
55
60
65
70
Two-Theta (deg)

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6706-F6
Date Sampled: 2021/03/24 15:43







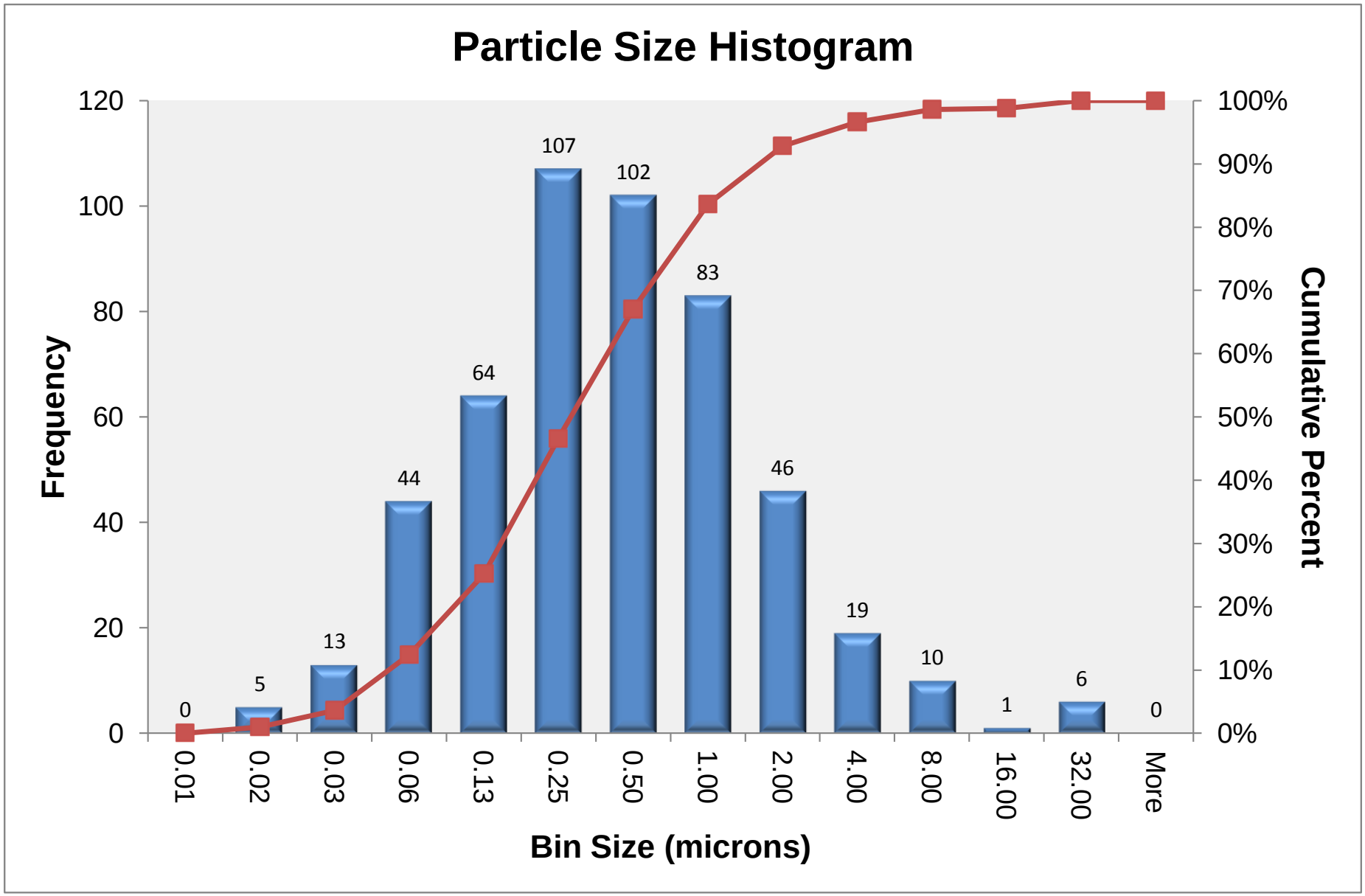
Particle Size Statistics

Size in Micrometers	
Mean	0.863
Median	0.278
Maximum	27.852
Quartile 3	0.711
Quartile 1	0.125
Minimum	0.010
Standard Deviation	2.490
Mode	0.141
Sample Variance	6.200
Kurtosis	63.186
Skewness	7.459
Range	27.842
Standard Error	0.111
Confidence Level (95%)	0.219
Sum	431.714
Count	500

Histogram Statistics

Microns	*Frequency*	*Cumulative*
0.01	0	0.00%
0.02	5	1.00%
0.03	13	3.60%
0.06	44	12.40%
0.13	64	25.20%
0.25	107	46.60%
0.50	102	67.00%
1.00	83	83.60%
2.00	46	92.80%
4.00	19	96.60%
8.00	10	98.60%
16.00	1	98.80%
32.00	6	100.00%
More	0	100.00%

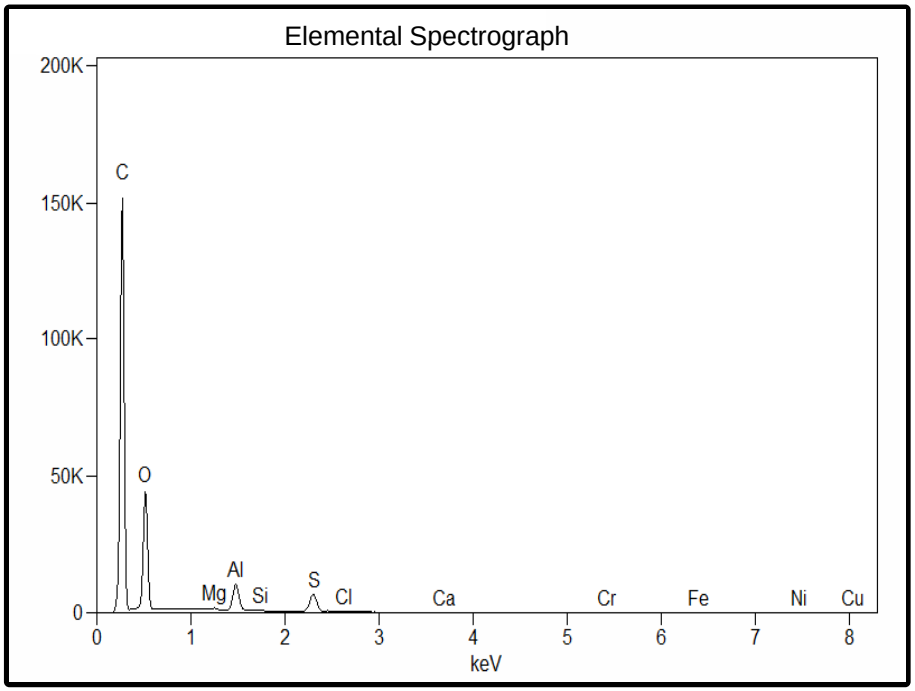
GR Petrology CONSULTANTS Inc.

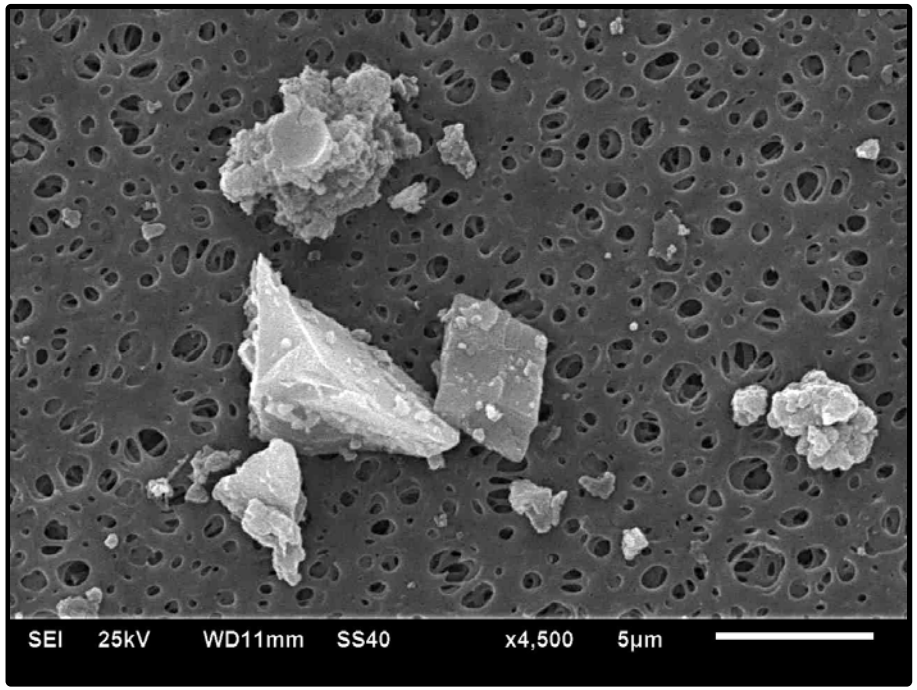

Particle Size Histogram
Frequency
Cumulative Percent
Bin Size (microns)
0
5
13
44
64
107
102
83
46
19
10
1
6
0
0.01
0.02
0.03
0.06
0.13
0.25
0.50
1.00
2.00
4.00
8.00
16.00
32.00
More

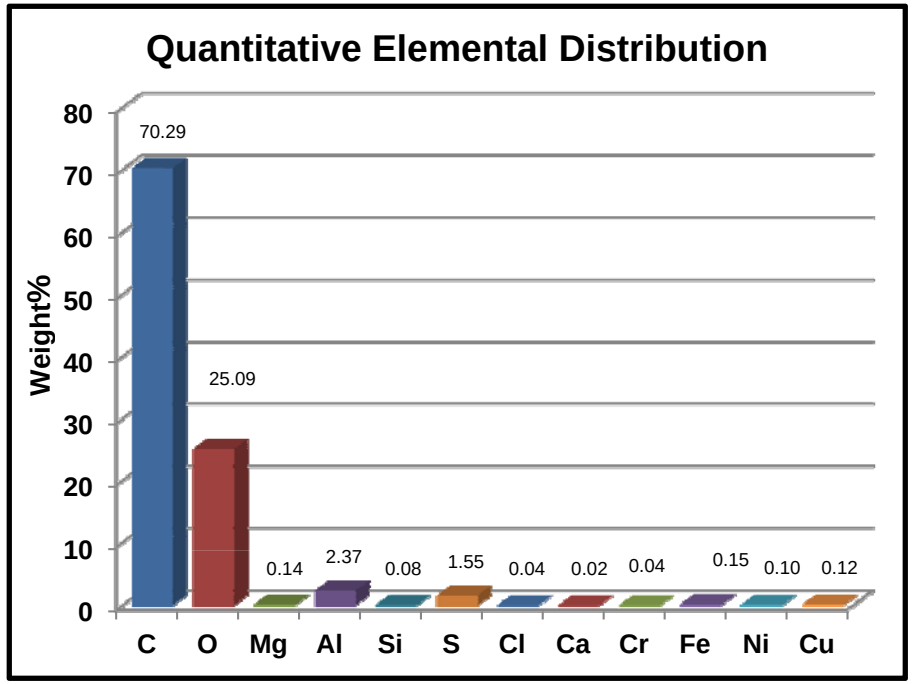
Raw Particle Size Data (microns) Number of measurements: 500

22.328	0.213	0.876	0.375	0.085	0.241	0.152	0.302	0.157	0.051
6.921	0.373	0.609	0.214	0.113	0.501	20.181	0.467	0.080	0.101
2.755	0.260	0.564	0.255	0.044	0.474	4.177	0.179	0.157	0.046
2.193	0.283	1.226	0.125	0.027	0.100	1.904	0.133	0.245	0.066
1.903	0.307	0.849	0.214	0.044	0.181	0.583	0.099	0.142	0.032
3.414	0.348	0.973	0.583	0.032	0.126	1.761	0.133	0.044	0.040
0.969	0.275	1.152	0.682	0.147	0.209	1.887	0.179	0.089	0.050
0.314	0.623	2.380	0.498	0.085	0.305	1.253	0.141	0.067	0.051
2.983	0.330	1.259	0.236	0.023	0.060	0.194	0.220	2.245	0.199
1.302	0.298	1.025	0.447	0.042	0.321	0.117	0.070	2.223	0.164
1.012	0.401	0.980	0.292	16.539	0.742	0.058	0.067	1.000	0.070
0.823	0.867	0.950	0.447	4.937	0.439	0.036	0.089	6.910	0.080
0.550	0.133	0.608	0.475	2.314	0.484	0.019	0.400	2.828	0.449
1.187	2.829	0.450	0.112	2.985	0.349	0.033	0.835	1.126	27.852
1.034	1.454	0.100	0.135	1.476	0.534	0.081	0.094	0.542	6.368
0.728	0.445	0.182	0.255	1.687	0.215	0.121	0.223	0.483	3.614
1.757	0.457	0.326	0.177	1.573	0.241	0.045	0.099	0.746	4.577
1.601	0.076	0.426	0.526	1.640	0.165	0.047	0.160	0.507	4.177
0.543	0.127	0.546	0.135	1.649	0.189	0.092	0.156	0.353	3.458
0.801	0.055	0.358	0.261	1.207	0.128	0.049	0.126	0.182	2.345
1.157	0.045	0.474	0.127	1.193	0.735	0.029	0.205	0.260	1.274
0.943	0.082	0.625	0.576	0.894	0.580	0.043	0.111	0.379	0.777
0.343	0.086	0.160	0.075	0.926	0.328	0.105	0.178	0.403	0.508
0.433	0.072	0.158	0.100	1.224	0.117	0.054	0.162	0.495	0.709
0.285	0.076	0.650	1.261	1.135	0.108	0.018	0.205	0.774	1.315
0.141	0.028	0.150	0.780	0.533	0.144	0.023	0.851	0.372	0.537
0.067	0.092	0.334	0.347	0.780	0.089	0.051	1.240	0.226	1.104
0.243	0.177	1.532	0.227	0.427	0.141	0.041	0.820	0.149	0.680
0.236	0.326	0.806	0.229	0.406	0.216	0.042	0.232	0.180	0.721
1.269	0.045	0.225	0.231	0.359	0.206	0.052	0.396	0.100	3.133
1.181	0.066	0.403	0.060	0.359	0.152	0.050	0.205	0.041	2.801
0.302	0.172	0.549	0.141	0.718	5.687	0.058	0.199	0.106	0.869
17.869	0.147	0.372	0.298	0.333	1.526	0.036	0.788	0.175	1.373
0.801	0.027	0.625	0.074	0.657	1.057	0.037	0.299	0.162	1.645
0.167	0.025	0.251	0.040	0.240	0.906	0.014	0.245	0.190	1.298
0.211	0.132	0.195	0.263	0.189	0.292	0.057	0.160	0.184	0.765
0.267	0.057	0.141	0.238	0.422	0.596	0.011	0.382	0.202	0.483
0.354	0.091	0.833	0.062	0.275	0.791	0.010	0.133	0.092	0.539
0.335	0.159	0.180	0.060	0.721	0.777	0.014	0.259	0.063	0.440
0.418	0.028	0.376	0.040	0.667	0.513	0.017	0.475	0.080	0.260
0.390	0.305	0.601	0.083	0.471	0.548	0.069	0.141	3.822	1.443
0.213	0.065	0.215	0.028	0.537	0.090	0.015	0.135	1.468	0.508
0.471	0.121	0.275	0.052	3.460	0.276	0.064	0.070	0.987	0.740
0.269	0.082	0.125	0.027	1.843	0.375	8.235	0.070	0.386	0.345
0.807	0.129	0.354	0.035	2.807	0.237	1.734	0.070	0.432	0.487
0.424	0.096	0.483	0.729	1.135	0.720	0.696	0.120	0.452	0.294
0.211	0.079	0.146	0.199	0.534	0.180	0.673	0.126	0.155	0.483
0.233	22.510	0.075	0.086	0.753	0.280	5.459	0.179	0.065	0.276
0.260	4.869	0.750	0.040	0.449	0.202	0.358	0.236	0.152	0.522
0.438	1.546	0.152	0.050	0.566	0.035	0.299	0.111	0.233	0.184

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6707-F7
Date Sampled: 2021/03/25 10:50







GR-007: ZN6707-F7 (2021/03/25 10:50)

The scanning electron photomicrograph on the facing page (lower left) shows sample GR-007 consists of aggregates of angular, subangular and subrounded, clay size to very fine sand size particles. The upper left photograph illustrates the bulk sample on filter paper.

Carbon (C) and oxygen (O) dominate the elemental spectrograph, respectively forming about 70.3% and 25.1% of the sample. Aluminum (Al) is moderately abundant, forming about 2.4% of the sample. Trace to minor amounts of magnesium (Mg), silicon (Si), sulphur (S), chlorine (Cl), calcium (Ca), chromium (Cr), iron (Fe), nickel (Ni) and copper (Cu) are present.

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of trace amounts of silicates **(quartz [SiO_2])**.

Carbon and some of the oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, oxygen and aluminum bearing compounds. Trace volumes of magnesium, sulphur, chlorine, calcium, chromium, iron, nickel and copper bearing compounds were detected during elemental analysis.

The particle size distribution histogram shows a unimodal distribution centering around 1.00 microns. Mean particle size was measured at 2.11 microns and median particle size was measured at 0.71 microns. Particles vary in size from 0.03 microns (clay size) to 62.54 microns (very fine sand size). The Quartile 3 size is 2.11 microns and the Quartile 1 size is 0.29 microns. Standard deviation was measured at 4.50 microns.

TABLE 7: EDS and XRD Results

Bureau Veritas Laboratories; Project #: C119656; Sample ID: ZN6707-F7; Date Sampled: 2021/03/25 10:50

GR 33445-07 2021

ELEMENTS:

DOMINANT: C, O

MODERATE: Al

COMMON:

MINOR-TRACE: Mg, Si, S, Cl, Ca, Cr, Fe, Ni, Cu

COMPOUNDS:

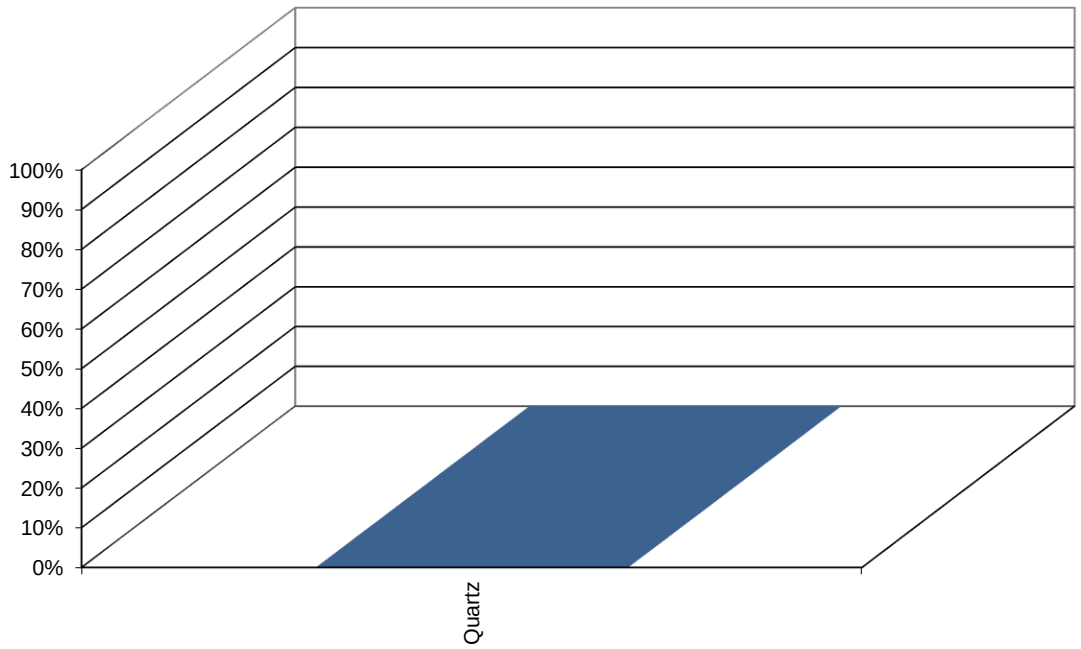
Formula	*Name*	*Percentage*
SiO_2	Quartz	trace

COMMENTS:

The sample generated a poor quality diffractogram indicating the sample is either mainly composed of non-crystalline compounds or there is insufficient sample on the filter paper. X-ray diffraction analysis shows the crystalline components of the sample consist of trace amounts of silicates.

Carbon and some of the oxygen in the elemental analysis represent the filter paper. Elemental analysis also suggests the presence of non-crystalline carbon, oxygen and aluminum bearing compounds. Trace volumes of magnesium, sulphur, chlorine, calcium, chromium, iron, nickel and copper bearing compounds were detected during elemental analysis.

ABUNDANCE OF COMPOUNDS



GR Petrology CONSULTANTS Inc.

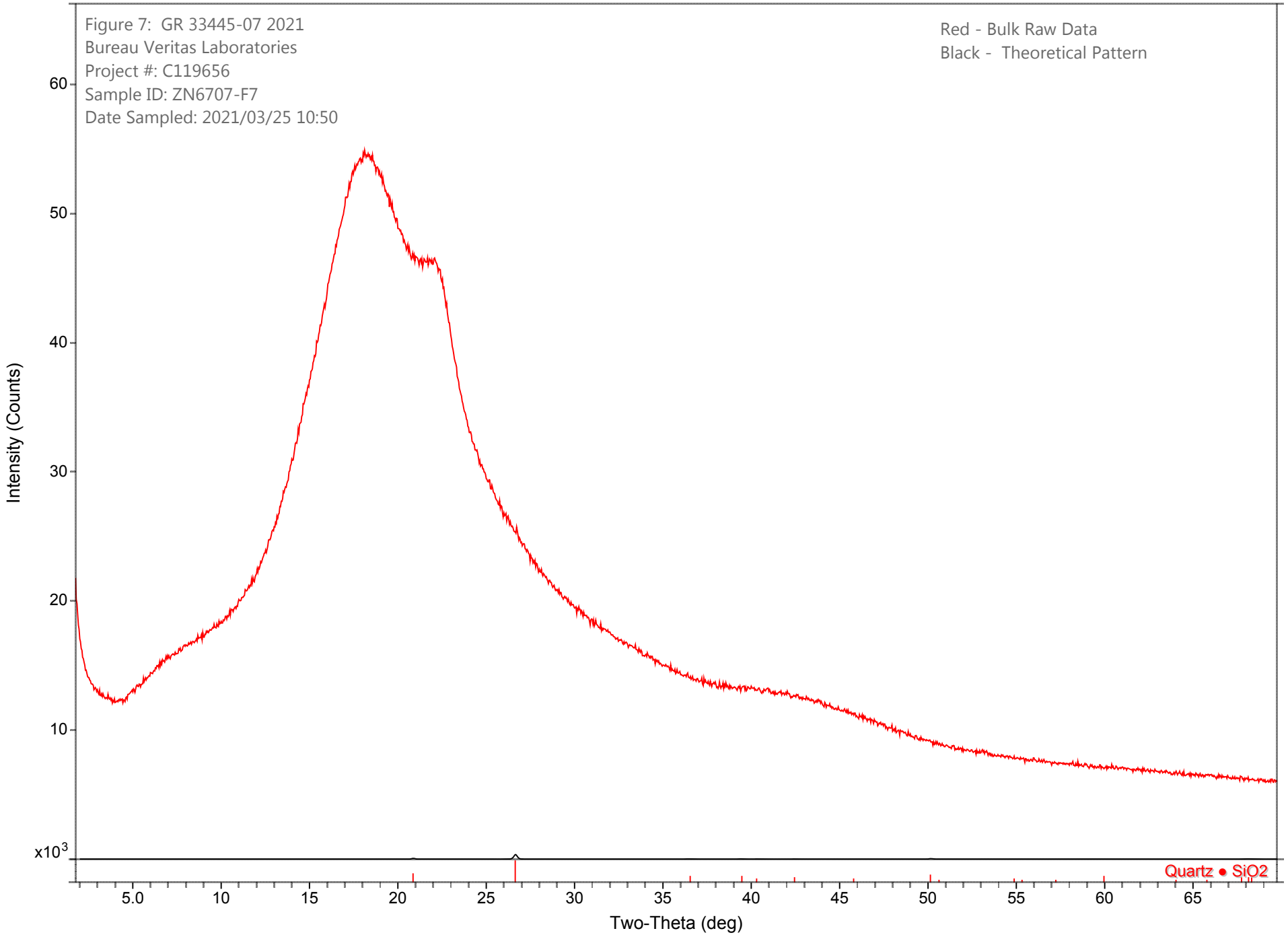
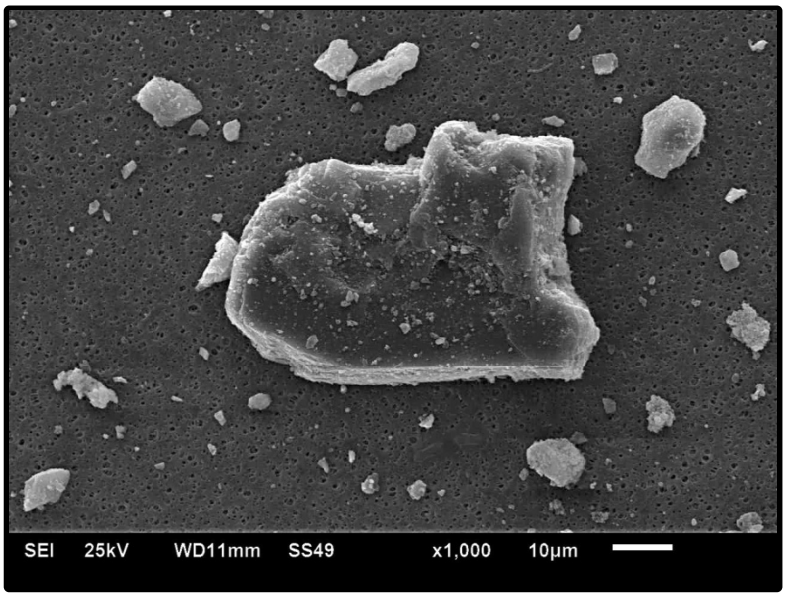
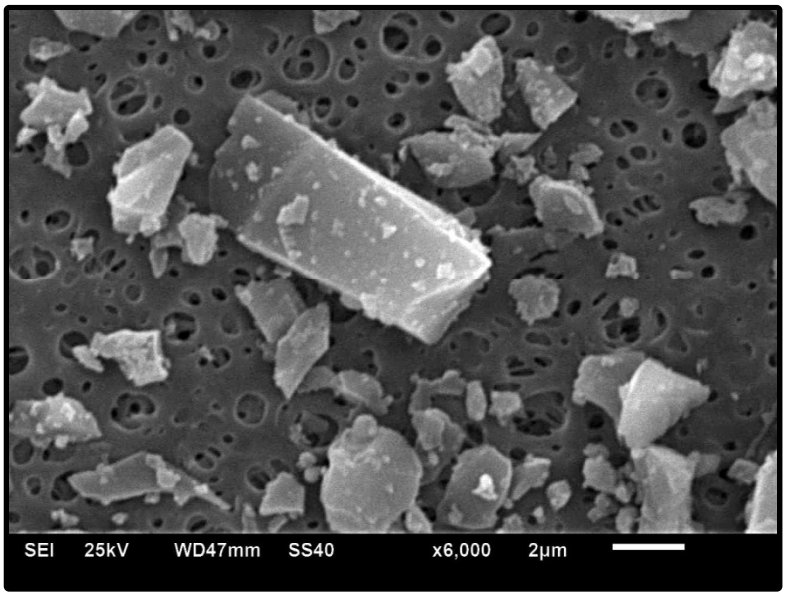
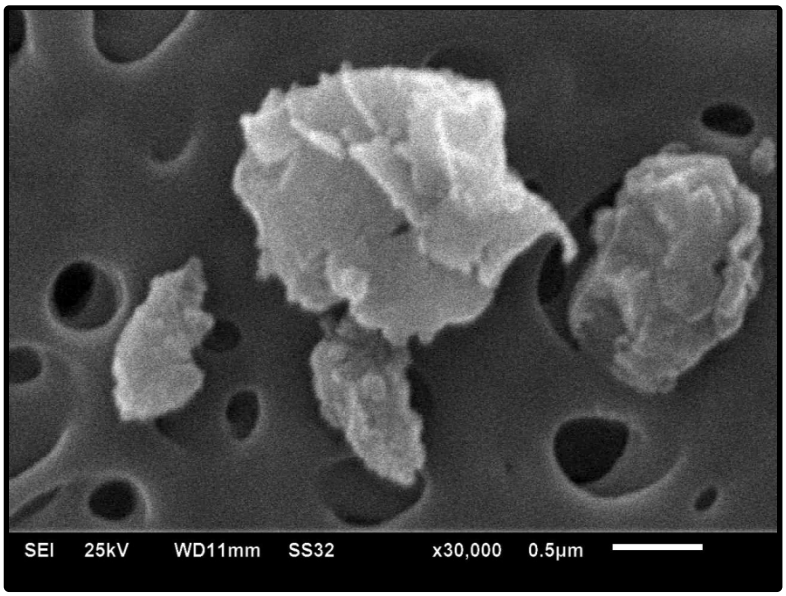


Figure 7: GR 33445-07 2021
Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZN6707-F7
Date Sampled: 2021/03/25 10:50
Red - Bulk Raw Data
Black - Theoretical Pattern
Intensity (Counts)
x10^3
60
50
40
30
20
10
5.0
10
15
20
25
30
35
40
45
50
55
60
65
Two-Theta (deg)
Quartz • SiO2

Bureau Veritas Laboratories; Project #: C119656
Sample ID: ZN6707-F7
Date Sampled: 2021/03/25 10:50







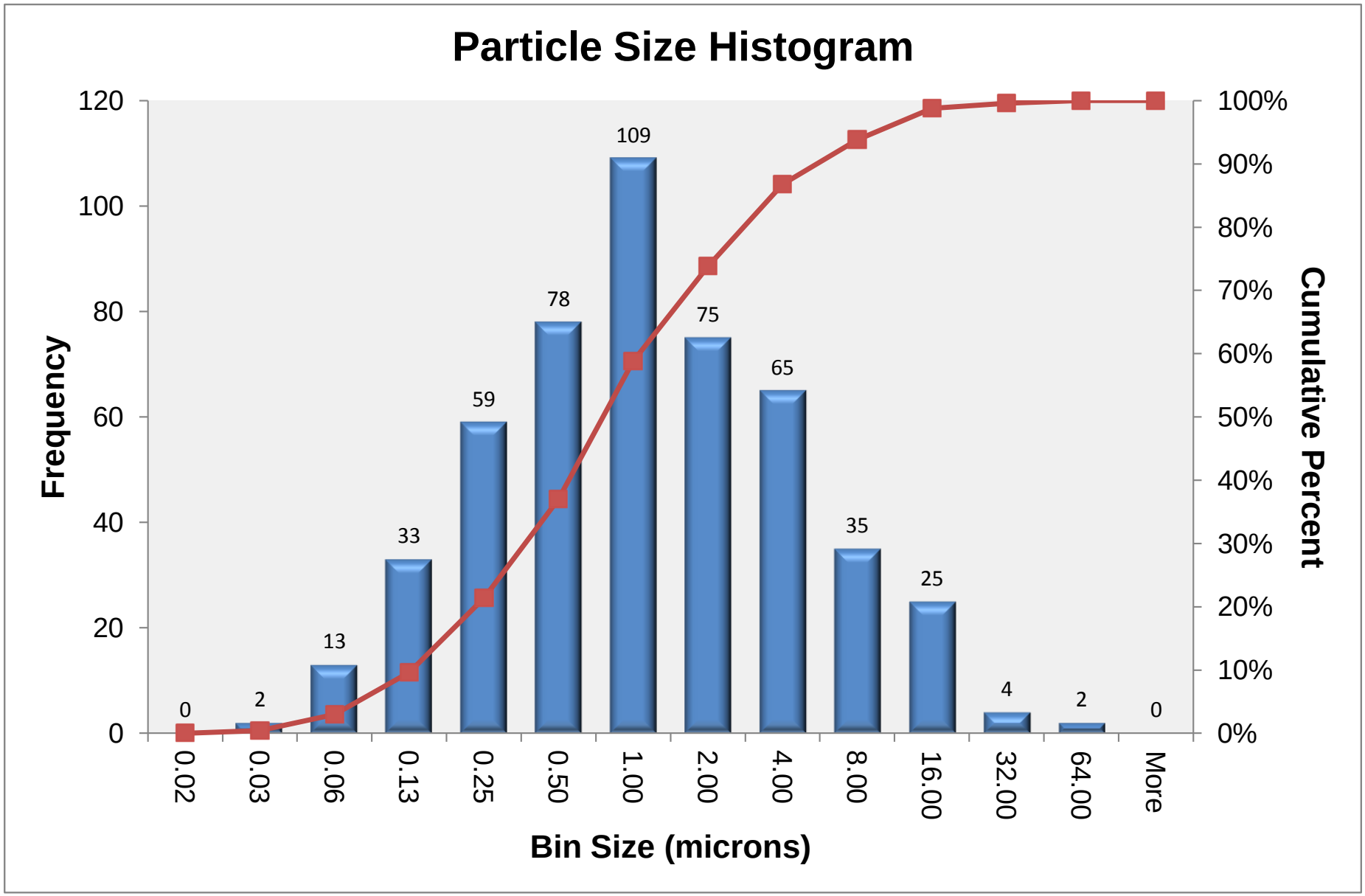
Particle Size Statistics

Size in Micrometers	
Mean	2.107
Median	0.709
Maximum	62.542
Quartile 3	2.113
Quartile 1	0.292
Minimum	0.027
Standard Deviation	4.500
Mode	0.040
Sample Variance	20.252
Kurtosis	78.296
Skewness	7.344
Range	62.515
Standard Error	0.201
Confidence Level (95%)	0.395
Sum	1053.415
Count	500

Histogram Statistics

Microns	Frequency	Cumulative
0.02	0	0.00%
0.03	2	0.40%
0.06	13	3.00%
0.13	33	9.60%
0.25	59	21.40%
0.50	78	37.00%
1.00	109	58.80%
2.00	75	73.80%
4.00	65	86.80%
8.00	35	93.80%
16.00	25	98.80%
32.00	4	99.60%
64.00	2	100.00%
More	0	100.00%

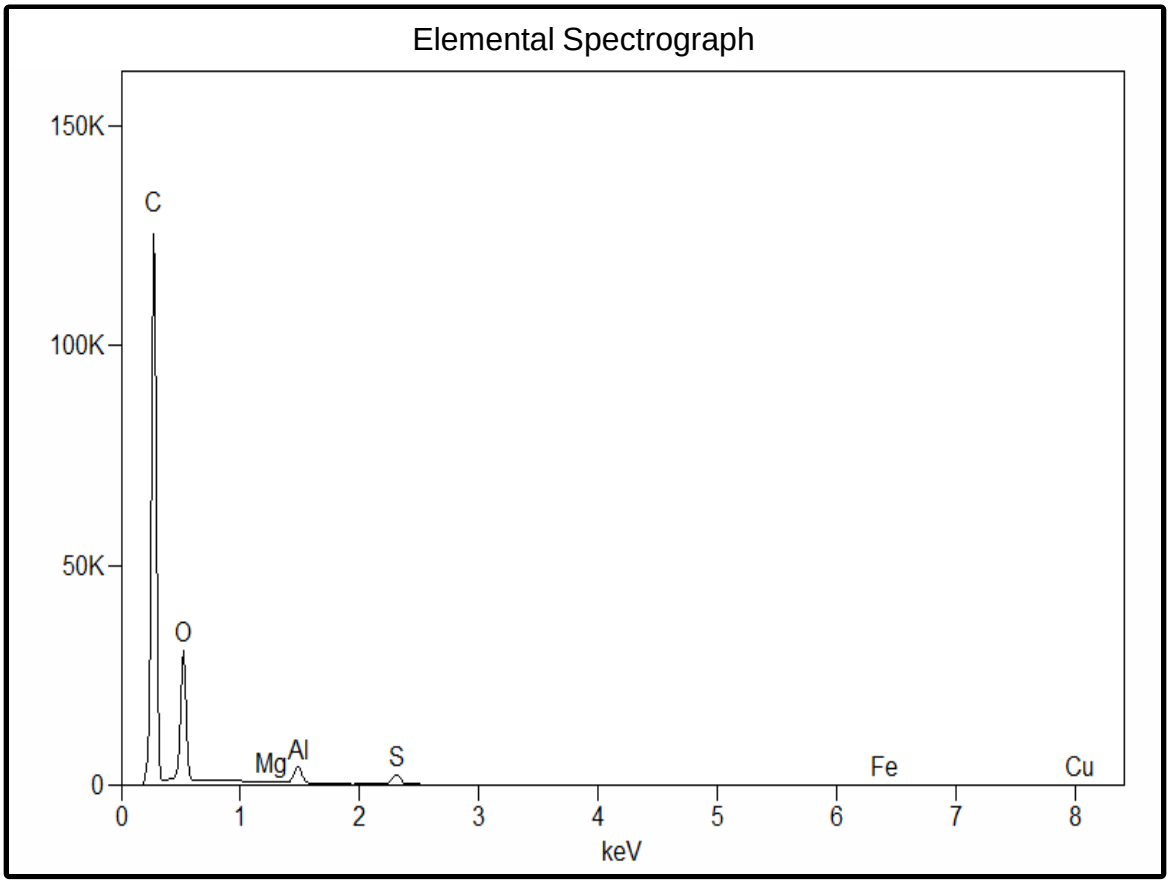
GR Petrology CONSULTANTS Inc.

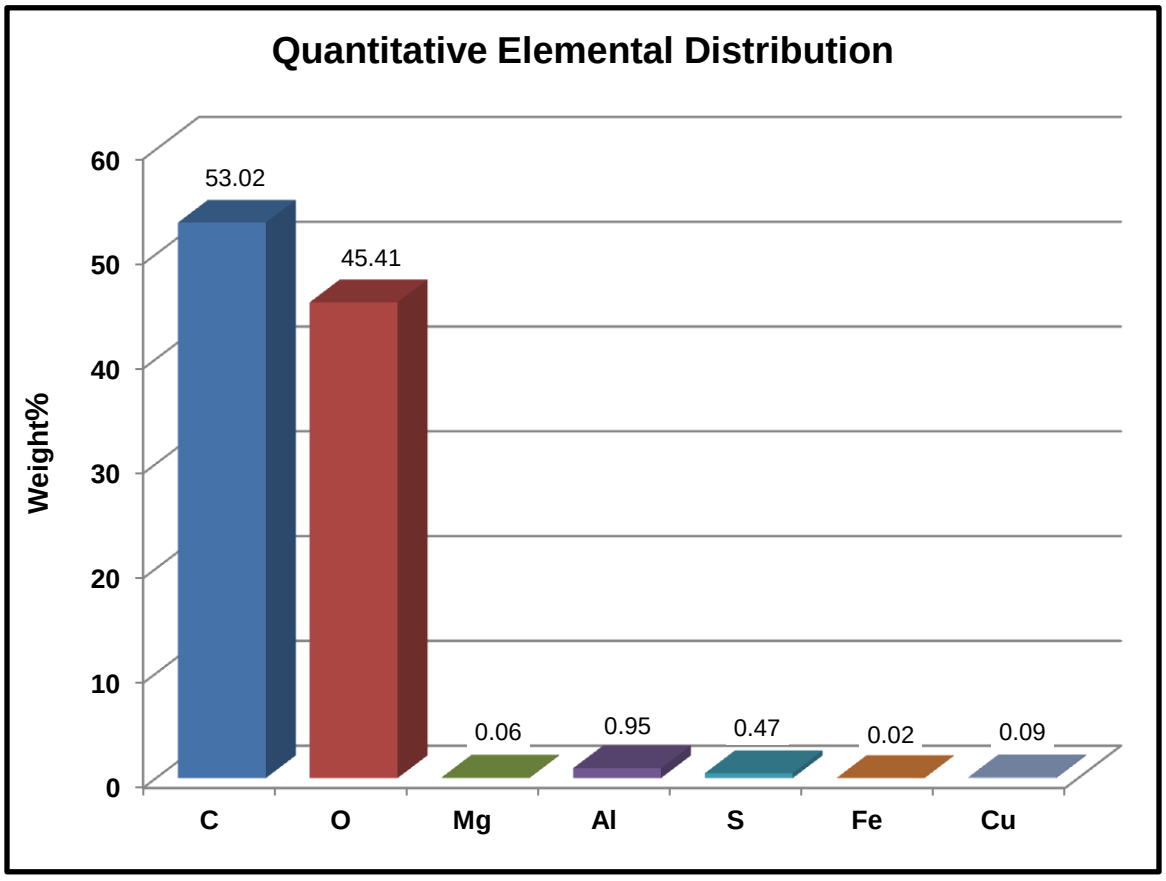

Particle Size Histogram
Frequency
Cumulative Percent
Bin Size (microns)
120
100
80
60
40
20
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
2
13
33
59
78
109
75
65
35
25
4
2
0
0.02
0.03
0.06
0.13
0.25
0.50
1.00
2.00
4.00
8.00
16.00
32.00
64.00
More

Raw Particle Size Data (microns) Number of measurements: 500

0.761	0.342	0.126	0.179	3.002	3.119	0.521	1.900	0.133	0.680
0.625	0.582	1.139	0.100	4.031	2.349	0.559	2.209	12.297	0.541
0.699	0.408	0.556	0.063	3.202	3.591	0.307	2.121	6.530	0.702
0.800	2.293	0.817	2.002	3.454	2.426	0.674	1.720	4.912	0.559
0.525	7.710	0.668	1.010	3.900	1.457	0.999	1.513	3.894	0.650
0.530	0.842	0.267	1.001	4.533	2.530	0.671	1.628	4.952	38.203
0.457	0.333	0.290	1.650	3.007	1.497	0.875	0.806	3.202	17.117
0.586	0.510	0.378	1.886	1.444	1.197	0.343	2.729	4.092	5.731
0.649	0.347	0.130	1.251	2.067	1.753	0.552	2.202	4.563	5.482
0.663	0.184	0.141	1.028	1.956	1.104	0.575	0.854	1.947	4.727
0.427	0.235	0.211	0.960	0.734	1.156	0.302	0.894	2.945	5.233
0.727	0.230	0.396	0.460	0.545	0.406	0.644	1.811	2.209	4.438
0.657	0.210	0.157	0.120	0.495	0.872	0.481	1.655	2.610	3.513
0.650	0.212	0.578	0.301	0.409	0.897	0.509	0.894	1.603	3.228
0.781	0.170	0.099	0.290	0.379	0.923	0.629	0.949	2.620	4.704
0.420	0.371	5.313	0.104	0.256	0.425	1.542	0.640	1.513	2.683
0.440	0.114	2.530	0.168	0.873	0.436	1.354	0.495	1.501	4.588
0.409	0.054	1.794	0.085	0.149	0.574	0.948	5.333	1.956	3.225
0.465	0.057	1.154	0.061	0.291	0.607	0.612	5.472	1.373	3.306
0.408	0.067	1.050	0.144	0.249	0.326	1.064	3.304	1.458	3.625
0.422	0.250	0.288	0.070	0.275	0.515	0.167	2.630	1.379	2.907
0.543	0.264	0.420	0.124	0.187	0.200	0.547	2.481	1.947	2.470
0.346	0.623	0.316	0.209	0.120	0.246	0.522	1.462	1.595	2.377
0.519	0.100	0.322	0.110	0.267	0.349	0.839	1.127	2.504	2.100
0.040	0.117	0.420	0.071	0.256	0.539	0.435	1.197	1.365	3.200
0.048	0.192	0.620	0.040	0.228	0.869	29.904	1.271	1.530	1.868
0.226	0.399	0.146	0.063	0.187	0.589	12.279	1.640	1.124	0.922
0.040	0.292	0.161	0.127	0.227	0.398	10.823	0.760	1.055	2.022
0.057	0.156	0.180	0.150	0.181	0.256	10.721	0.801	0.743	1.921
0.034	0.197	0.141	0.076	0.346	0.479	13.046	0.775	1.612	1.780
0.081	0.092	0.108	0.201	0.434	0.692	8.443	0.755	1.281	1.389
0.047	0.103	0.201	0.072	0.233	0.200	5.908	0.567	1.664	1.703
0.027	0.073	0.513	0.045	0.221	0.206	7.767	0.547	3.662	1.556
0.047	0.095	0.428	62.542	0.155	0.353	5.503	1.267	1.188	1.676
0.030	0.082	0.412	13.608	0.078	0.515	4.357	0.485	0.851	8.236
17.353	0.112	0.484	13.548	0.115	0.316	4.249	0.557	1.492	2.480
8.766	29.177	0.165	9.124	0.510	0.281	4.245	0.278	0.930	2.877
3.444	8.884	0.165	9.694	0.640	0.167	7.181	0.472	0.886	2.181
1.189	8.115	0.505	9.930	0.224	0.555	2.648	0.943	0.808	2.062
0.280	7.690	0.560	6.673	0.854	0.309	4.809	0.248	0.875	2.110
0.089	2.729	0.206	10.381	0.900	4.286	5.590	0.044	0.695	1.952
0.160	4.504	0.197	6.021	1.649	12.048	1.900	0.339	0.335	1.793
0.716	0.632	0.102	3.716	1.204	13.208	2.907	0.190	0.716	2.485
0.402	0.894	0.102	3.008	0.985	9.168	0.510	0.259	0.650	1.350
0.253	0.632	0.117	7.799	0.632	8.435	1.221	0.149	1.154	2.121
0.396	12.488	0.247	3.848	1.005	8.515	1.600	0.648	1.059	2.543
0.425	8.502	0.253	5.901	0.424	2.690	1.400	0.537	0.762	1.326
0.291	0.356	0.100	2.524	9.100	2.206	3.106	0.244	0.602	1.320
0.322	0.803	0.156	2.602	5.111	1.703	2.267	0.222	0.585	0.997
0.322	0.613	0.134	2.886	10.567	2.775	2.642	0.296	0.716	0.640

Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZR0439-F8; Blank Filter





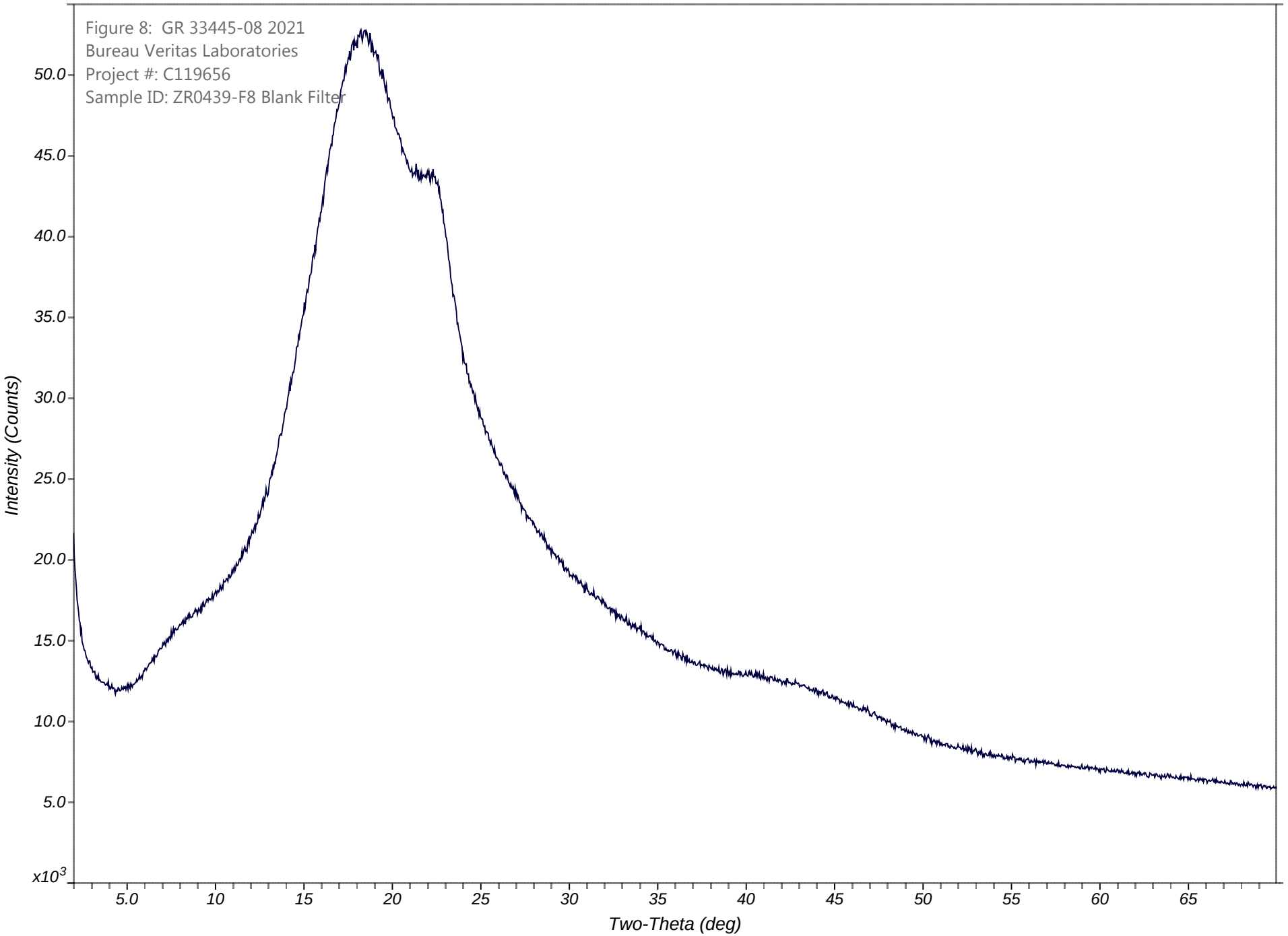


Figure 8: GR 33445-08 2021
Bureau Veritas Laboratories
Project #: C119656
Sample ID: ZR0439-F8 Blank Filter
Intensity (Counts)
x10^3
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
5.0
10
15
20
25
30
35
40
45
50
55
60
65
Two-Theta (deg)