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Geochemical Characterisation of Waste Rock and Ore

Castile Resources Rover 1

S1313 / J000706 / R1523

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CASTILE RESOURCES ROVER 1

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LIST OF ABBREVIATIONS

ABBREVIATIONS USED IN GEOCHEMICAL ASSESSMENT

ARD	Acid Rock Drainage
AMD	Acid and Metalliferous Drainage
NMD	Neutral and Metalliferous Drainage
SD	Saline Drainage
ABA	Acid Base Account
$pH_{1:2}$	pH of a sample slurry with a solid to water ratio of 1:2 (by weight)
$EC_{1:2}$	Electrical Conductivity of a sample slurry with a solid to water ratio of 1:2 (by weight)
CRS	Chromium Reducible Sulphur
ANC	Acid Neutralising Capacity in kg H_2SO_4/t
MPA	Maximum Potential Acidity, calculated from total S in kg H_2SO_4/t
NAPP	Net Acid Producing Potential, calculated from ANC and total S (or MPA) in kg H_2SO_4/t.
NAG	Net Acid Generation (test)
NAGpH	pH of NAG solution before titration
$NAG_{pH4.5}$	NAG acidity titrated to pH 4.5 in kg H_2SO_4/t
$NAG_{pH7.0}$	NAG acidity titrated to pH 7.0 in kg H_2SO_4/t
ABCC	Acid Buffering Characteristic Curve
GAI	Geochemical Abundance Index
PAF	Potentially Acid Forming
PAF-LC	Potentially Acid Forming - Low Capacity
NAF	Non Acid Forming
NAF-HS	Non Acid Forming – High Sulphur
UC	Uncertain
AC	Acid Consuming

UNITS OF MEASUREMENTS

°C	Degree Celsius
dS	Deci Siemens
µm	Micrometre
mm	Millimetre
m	Metre
mg	Milligram
g	Gram
kg	Kilogram
t	Tonne
L	Litre
ml	Millilitre

OTHER ABBREVIATIONS

EGi	Environmental Geochemistry International Pty Ltd
Project	Rover 1 Copper Gold Project

EXECUTIVE SUMMARY

Castile Resources are planning an underground operation at the Rover 1 copper gold deposit, accessed through a portal and decline developed in competent rock of the Wiso Basin via a box cut. Rover 1 is located 80 km southwest of the township of Tennant Creek in the Northern Territory and is a high-grade Iron Oxide Copper Gold (IOCG) polymetallic asset. The company is undertaking a pre-feasibility study for Rover 1, and EcOz Environmental Consultants (EcOz) are coordinating the studies required to obtain environmental approvals. EGi was commissioned by EcOz to carry out an AMD assessment, as proposed by EGi in a 2020 study, using drill core collected during the 2021 drilling program conducted by Castile Resources for the Rover 1 project.

Geochemical characterisation was carried out on 110 representative samples to assess the risk of AMD or NMD/SD generation from the mine waste material to be produced from the Rover 1 polymetallic project. The test results infer the following:

- The mine waste material from the Wiso Basin at shallow depths of up to approximately 60 m is expected to be highly weathered and contain relatively high dolomitic content. As such, the five samples representing this type of material had high ANC and were all NAF.
- The samples representing the mine waste and mineralised waste material collected from greater depths were generally all fresh material. The total S content in these samples varied over a wide range from around the detection limit of 0.01% to over 5%, and potentially acid producing sulphidic S is the predominant species of S in the samples.
- The ANC values of the tested samples also varied widely. The samples can possibly be grouped into three categories based on the ANC, which are (i) dolomitic materials with high ANC (>200 kg H_2SO_4/t), (ii) ironstone with moderate ANC (20 - 100 kg H_2SO_4/t) and (iii) all other lithotypes with low ANC (<20 kg H_2SO_4/t). Carbon speciation tests identified that inorganic C is the dominant C species in these samples, with almost all ANC in the samples belonging to the first and second categories in the form of readily available carbonates. ANC in samples from category (iii) is principally derived from silicate minerals and consequently is likely to be much less effective.
- Using the standard and specialised test results, nearly half of the 110 samples were classified as NAF or NAF-HS, and the remaining samples as PAF or PAF-LC. Lithotype does not appear to control AMD generation potential of these samples, except for the dolomitic samples which are all NAF.
- A large portion of the waste materials that were tested for multi-element composition were significantly enriched with several environmentally important elements, including Bi (82% of the 39 samples tested), Co (67%), Cu (62%), Fe (82%), Mo (54%), and As (46%). Sulphur was enriched in all tested samples, but this is due to the selection of samples biased to those with higher S content. The DI water extraction results indicate that most of the tested samples are not expected to pose a risk to the environment in terms of AMD or NMD/SD, when they are exposed to atmospheric condition over a short period of time. However, as shown by the peroxide extraction results, if sulphides in these samples are oxidised, the PAF material will generate a large amount of acidity, which results in low pH with elevated concentrations of sulphate and a number of minor and trace elements, while the NAF-HS materials may also generate NMD/SD with high salinity.
- Material segregation criteria based on the total S and NAPP values were developed, which can reasonably segregate the mined materials on site according to their AMD generation potential.
- A site visit to inspect drill core used during the current test program and other drill core, including that used for recent CoreScan assessment, will be conducted in the near future, depending on availability of site geologists. The results of the drill core inspection will be correlated with the geochemical test results generated during the current test program, with a view to potentially deriving geology-based AMD classification criteria. Such criteria, if they can be developed, will provide more operationally useful segregation criteria for PAF materials than those based on S content or S and NAPP values. The results of this work will be provided in an updated report once the site visit is completed.

In order to understand the long-term geochemical performance of mine waste materials and respond to the request by the NT Department of Mines and Energy (DME) for additional information and details on the AMD risk (EGi 2020), EGi recommends the following tasks to be carried out:

- Representative ore samples should be tested for AMD potential, as the number of ore samples assayed in the past was insufficient in the opinion of DME and ore samples were not included in the current assessment.
- The construction of the box cut will result in removal of a large volume (1.1 M BCM) of waste material from a relatively shallow depth. This waste will represent both the largest volume of waste rock which will be surface stored and used as backfill at closure. While previous testing has demonstrated that these materials are likely to be devoid of sulphides and classify as NAF, the NT EPA noted that previous testing did not properly evaluate the leaching potential of these materials to generate NMD. Additional samples should therefore be sourced from the disturbed area and tested for their leaching characteristics. The results can be used to demonstrate any risk of NMD and determine mitigation and management options if required.
- It is understood that a processing plant will be constructed on site, which will produce a number of tailings streams. Given the complexity of the proposed processing flow sheet, it is considered that ore samples will not adequately represent the tailings which will be produced. Therefore, it is recommended that tailings samples of each tailings stream from the various processing units should be collected during metallurgical pilot plant tests and sent to EGi for geochemical testing as they become available.
- Column leach testing should be carried out on representative waste rock samples from each of the AMD classes, i.e., PAF, PAF-LC, NAF-HS and NAF, as well as selected tailings as required. Column leach testing will provide insight on the leaching behaviour and leachate quality of these materials under environmental conditions similar to the mine site. Leach testing can be conducted under oxidising conditions simulating surface storage and exposure to atmospheric oxygen, followed by leaching under saturated conditions simulating leaching of previously oxidised materials used for backfill and following inundation after groundwater rebound, where appropriate. Leach testing of oxidised cover sequence material can be undertaken using sequential batch leaching methods, which provide leaching kinetics without the need for the oxidising conditions of the leach column test, as these materials have been previously oxidised. EGi will assist with designing and undertaking the kinetic column and batch leach testing once samples become available and mining and mineral processing options are finalised.

1. INTRODUCTION

The Rover Project is 100% owned by Castile Resources. It is located 80 km southwest of the township of Tennant Creek in the Northern Territory. The total tenement area, approximately 1054 km^2, covers a significant proportion of the Rover Mineral Field. There are three advanced deposits with mineral resources in the Rover Mineral Field, including the Rover 1 Copper Gold project (Rover 1 project) which is a high-grade Iron Oxide Copper Gold (IOCG) polymetallic asset typical of the Tennant Creek goldfields (Figure 1). The Rover 1 deposit is also known to contain cobalt, bismuth and silver.

Castile Resources are planning an underground operation at Rover 1, accessed through a portal and decline developed in competent rock of the Wiso Basin via a box cut. The company is undertaking a pre-feasibility study for Rover 1, and EcOz Environmental Consultants (EcOz) are coordinating the studies required to obtain environmental approvals for the project.

Environmental Geochemistry International Pty Ltd (EGi) was previously contracted by EcOz to review existing mine waste characterisation reports relating to the Rover 1 project, and to provide advice about the requirements for assessment to an EIS level for acid and metalliferous drainage (AMD) that could potentially arise from the project (EGi 2020). The primary findings of that desktop study are:

- Wiso Basin rock is dominated by dolomitic material, though the presence of pyrite and jarosite at trace levels was indicated by XRD analysis. ABA analysis and water extraction results suggested that Wiso Basin basal rock materials would not produce low pH, saline, or metalliferous drainage.
- Basement rock appeared to typically lack carbonate mineralogy, but also often contain low total S. Most samples representing basement rock were classified non-acid forming (NAF), but the risk of AMD generation cannot be precluded.
- The banded ironstone (only one sample tested previously), which could represent ore, possibly contains chalcopyrite and pyrite with some dolomite. ABA analysis of the sample suggested that materials represented by this sample would likely produce low pH drainage but with a substantial lag time due to dolomitic content.

In the current study, EcOz commissioned EGi to carry out an AMD assessment, as proposed by EGi in the 2020 study, using drill core collected during the 2021 drilling program conducted by Castile Resources for the Rover 1 project. The tasks include:

- Review of background project information including available historical geochemical data
- Review of geology and assay data to understand the geological and geochemical variation of mine materials
- Selection of representative samples in conjunction with site geologists
- Coordination of sample retrieval, preparation and transportation to EGi lab
- Laboratory testing (standard and specialised testing) of samples
- Assessment of results and reporting.

This report documents the methodology and procedures of sample selection and testing, and interprets the testing results, and discusses the implications for mine material management as well as the recommendations for follow-up investigations.

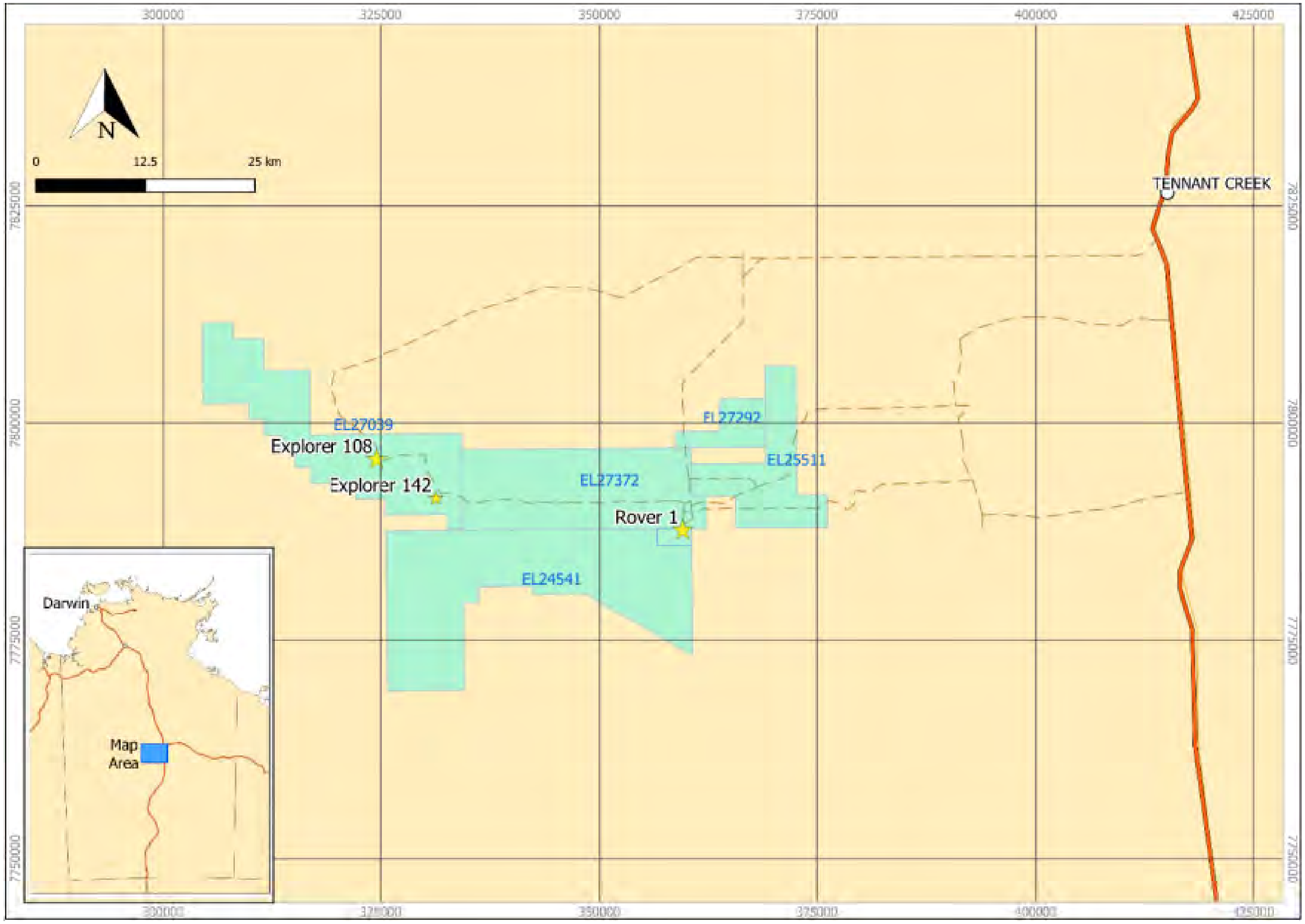


Figure 1: Rover project tenure as of February 2021 (Castile Resources, 2021).

2. GEOLOGY AND MINERALISATION

The Rover project area is covered entirely by recent sediments which blanket extensive flat-lying Cambrian siltstone, dolomitic siltstone and sandstone units of the Wiso Basin. This basinal sedimentary sequence unconformably overlies Proterozoic basement, with a thickening trend from less than 70 m in the east to in excess of 200 m in the west. Montejinni limestone forms the basal rock of the Wiso Basin, consisting of basal conglomerate and sandstones grading upwards into a predominantly sandstone sequence and separated by a layer of mudstone (Figure 2). The upper sequence of the Montejinni limestone consists of dolomitic sandstones grading upwards to dolomitic siltstones. Mudstone layers are found towards the top of the sequence interspersed with pyritic dolomite. An approximately 75 m sequence of the Hooker formation overlays the Montejinni limestone extending to the surface. The top 60 – 65 m consists of sediments that have been weathered to soil, which is underlain by weathered to fresher sandstones, siltstones, and dolomite (Figure 2).

As an IOCG deposit, the Rover 1 ore body contains copper, gold, cobalt, bismuth mineralisation hosted in magnetite and hematite ironstones at a depth of between 300 and 600 m. The ironstones consist principally of magnetite-quartz/chlorite with zones of magnetite-carbonate. Sulphides include pyrite enriched with cobalt. Native gold is found in quartz veins associated with talc-magnetite-chlorite with traces of muscovite and sericite. Copper is present mainly as chalcopyrite found in talc-magnetite-dolomite gangue or in massive magnetite-quartz. Bismuth is found as bismuthinite (Bi_2S_3) closely associated with gold. Pyrite is also associated with copper and bismuth. The ironstones are located within the basement rock of the Warramunga formation, consisting of weakly metamorphosed greywacke, shale and siltstones folded around an east-west fold axis (Figure 3). There is a 10 – 20 m halo adjacent to the mineralised ironstones containing >0.1% sulphides in chloritised and hematitised sediments, which also contains calcite and dolomite (EGi, 2020).

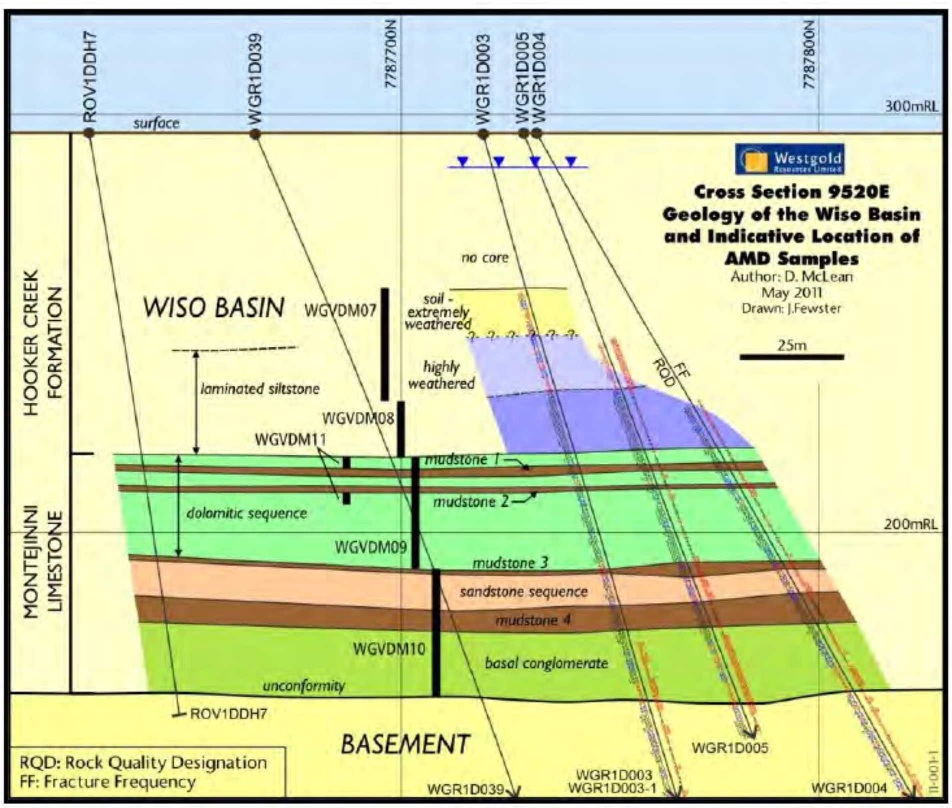


Figure 2: Schematic geological sequence of the Wiso Basin at Rover 1 (EGi, 2020).

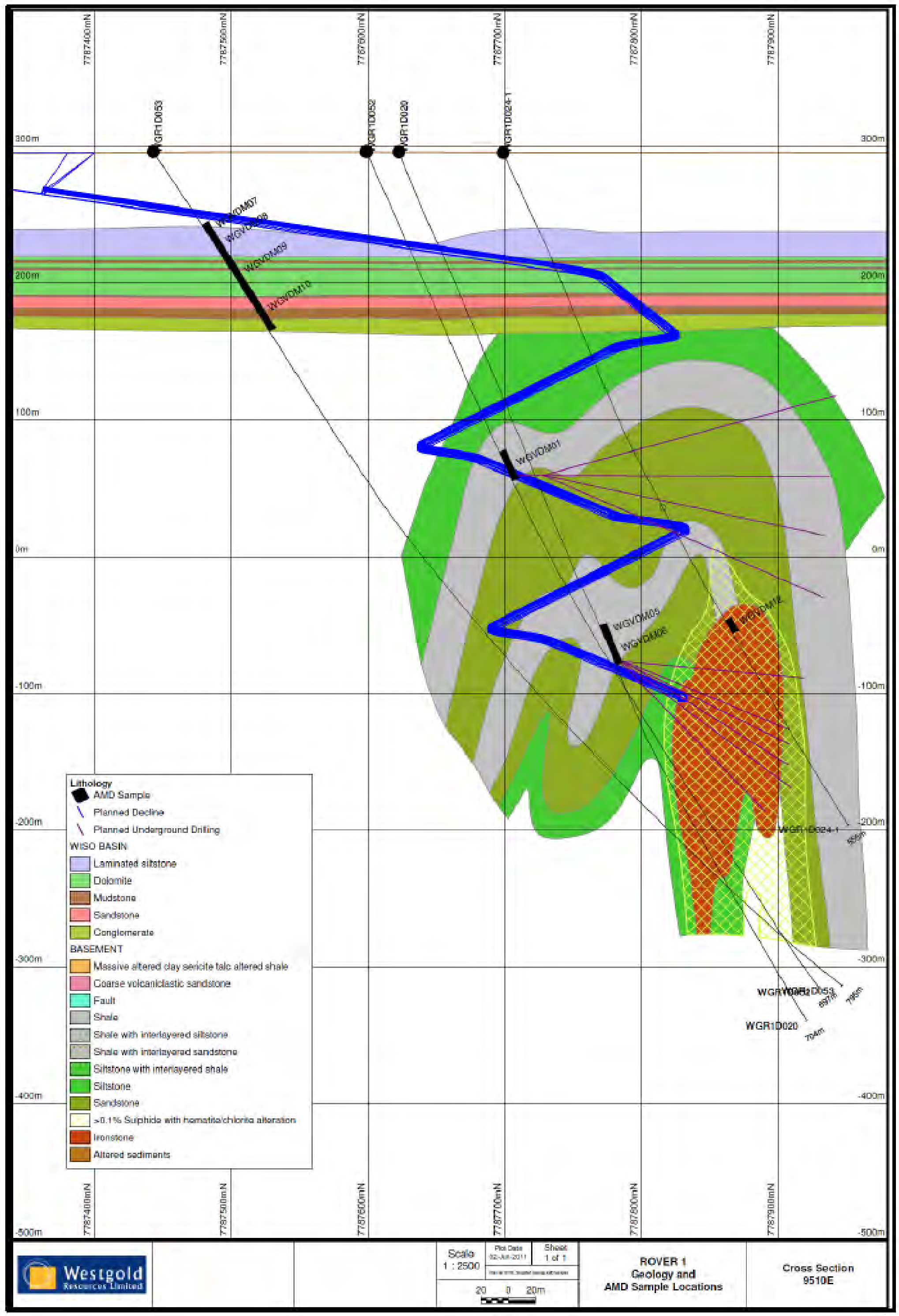
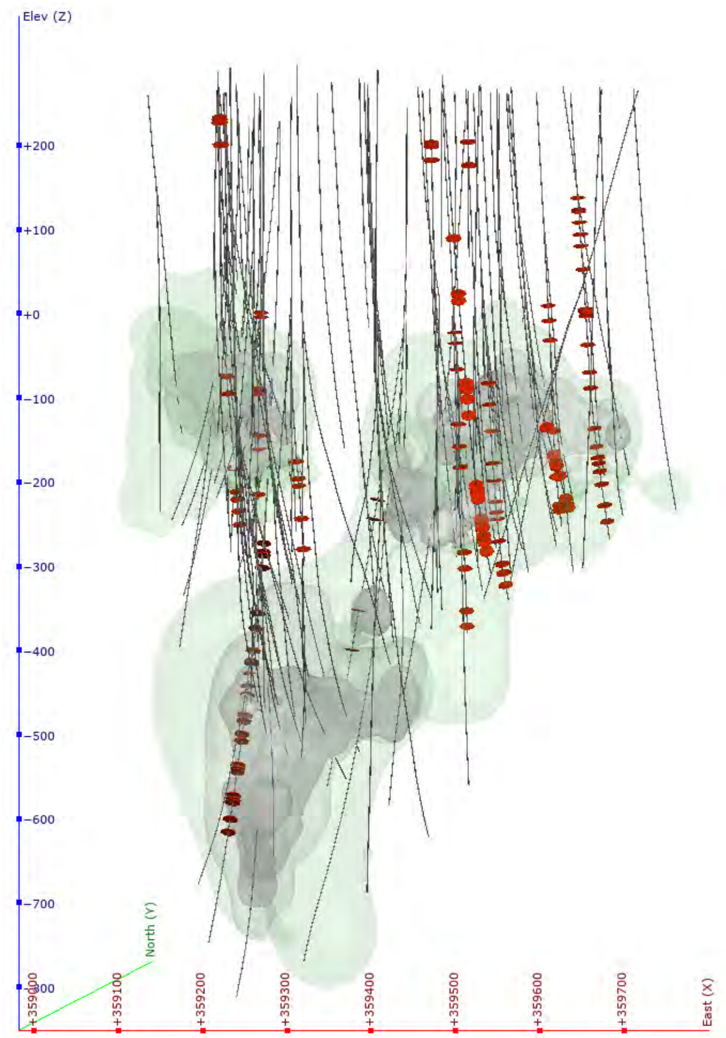


Figure 3: Rover 1 geology showing location of mineralised ironstones (EGi, 2020).

3. SAMPLE SELECTION

Geology logs and assay data for the drill cores were provided to EGi for the Rover 1 project. The datasets were merged by EGi to form a database that comprises nearly 50,000 core intervals from over 250 drill holes and includes information for hole ID, sample ID, depth, sample type, lithology, core assay results and other parameters.

With the assistance of the Castile Resources' geologist, 157 samples were selected from the database and retrieved from the core storage yard in Tennant Creek. The sample selection considered the total S content, the spatial distribution of the samples, the representation of various lithology types, and the availability of the core intervals. The approximate locations of the samples are shown in Figure 4.



Note: green areas indicate chlorite alteration halo; light grey quartz-magnetite ironstone (ISQ), and dark grey magnetite ironstone (ISM)

Figure 4: Locations of samples selected for this assessment.

Note that:

- According to the Rover 1 Exploration Decline Mining Management Plan developed in 2012, a box cut through the weathered rock to a depth of approximately 65 m and a decline through the Wiso Basin rock to the ore body in the basement rock will be constructed. According to Castile Resources, the drilling programs and previous assessments indicate that the material above the depth of 60 m and within the Wiso Basin can be considered highly weathered clay sediments, and no samples from less than 60 m deep were retained, as holes at Rover 1 were pre-collared by RC or mud rotary methods.

- The core intervals from a depth between approximately 60 and 120 m were only available from the holes with prefixes of 20CRD and 21CRD. These were primarily Wiso dolomite (SDOL), dolomitic sediment (SDSL, SDST), and mud, silt and sandstones (SMUD, SSL, and SST).
- Only a very small number of core intervals in the database were assigned weathering status. No weathering conditions were provided for the samples selected for this assessment. Castile Resources indicated that fresh material was not encountered during drilling until the Ooradidgiee group, which is approximately 140 – 180 m below surface. Therefore, all of the samples selected for this study were considered fresh when collected with the exception for the five dolomitic samples collected from the Wiso Basin. Nevertheless, this will be verified by core observation during the site visit by EGi.
- Castile Resources indicated that a Cu concentration cut-off value of 1% was applied to differentiate ore from mineralised waste and waste, and therefore all intervals included in the datasets and the database were considered mineralised waste or waste due to lower Cu content than the cut-off value.

All retrieved core intervals were delivered to Northern Australian Laboratory (NAL) in Pine Creek, NT, for the following sample preparation:

- Crush the entire core section to -4 mm
- Split out approximately 250 – 300 g of crushed rock
- Pulverise the entire split to -75 um
- Retain the remaining -4 mm crushed rock for future testing
- Send the pulps to the EGi lab in Sydney

Upon receival of the pulp samples, EGi selected 110 samples from the sample set for the standard geochemical characterisation tests. The lithotypes of the 110 samples are summarised in Table 1. Based on the test results, a subset of the samples was selected for the specialised tests. The sample testing is introduced in the following section.

Table 1: Summary of lithotypes of samples selected.

Lithotype	Number of Samples
Dolomite	2
Dolomitic sandstone	2
Dolomitic siltstone	1
Felsic Volc	9
Greywacke	17
Magnetite ironstone	19
Mudstone	5
Sandstone	5
Shale	5
Siltstone	43
Vein	2
Total	**110**

4. TESTING METHODOLOGY

A phased testing program was designed and carried out by EGi. In the first stage, all 110 selected samples underwent standard geochemical characterisation tests (Table 2). In the second stage, subsets of the samples were selected based on the Stage 1 test results and underwent various specialised tests to better understand the nature of sulphur and ANC present in the sample materials. All standard and specialised tests were performed following the test methods specified in ARD Test Handbook (AMIRA, 2002) or GARD Guide (INAP, 2014). Note that EGi was the major contributor to the ARD Test Handbook. The testing program is summarised in Table 2.

Table 2: Summary of geochemical characterisation tests.

	Tests Included	Number of Samples
Standard tests	$pH_{1:2}$ / $EC_{1:2}$ ANC Total S Chromium reducible sulphur (CRS) C forms (total C, organic C and inorganic C) Single addition NAG Multi-element composition	110 110 110 30 110 110 39
Specialised tests	ABCC Sequential NAG Kinetic NAG Water extraction Peroxide extraction	15 20 9 27 25

5. TEST RESULTS

5.1. pH and EC

The $pH_{1:2}$ and $EC_{1:2}$ results were determined by equilibrating the samples in deionised water for approximately 16 hours at a solid to water ratio of 1:2 (w/w). They gave an indication of the inherent acidity and salinity of the mined material.

The $pH_{1:2}$ values ranged from 4.0 to 8.4 (Figure 5). The lowest pH was measured for the sample 23073 with the highest total S content of 7.61%. Generally, the samples with higher total S content spread over a wider range of pH with an increasing proportion of acidic pH values.

The $EC_{1:2}$ values of the majority of the samples ranged from 0.124 to 0.629 dS/m, indicating low salinity (Figure 5). Three samples (23102, 23103 and 23073) with lithological types of FEM or FEMQ had high salinities exceeding 1.5 dS/m. The highest salinity of 4.41 dS/m was measured for the sample 23073, which also reported the most acidic pH and highest total S content.

Overall, results suggest circumneutral to alkaline pH and low salinity for most samples. This is expected for fresh material where there is limited or no oxidation prior to testing. Based on the test results, it would be expected that fresh waste rock would pose no immediate risk of low pH or high salinity run-off. However, leachable acidity may occur for materials with higher total S.

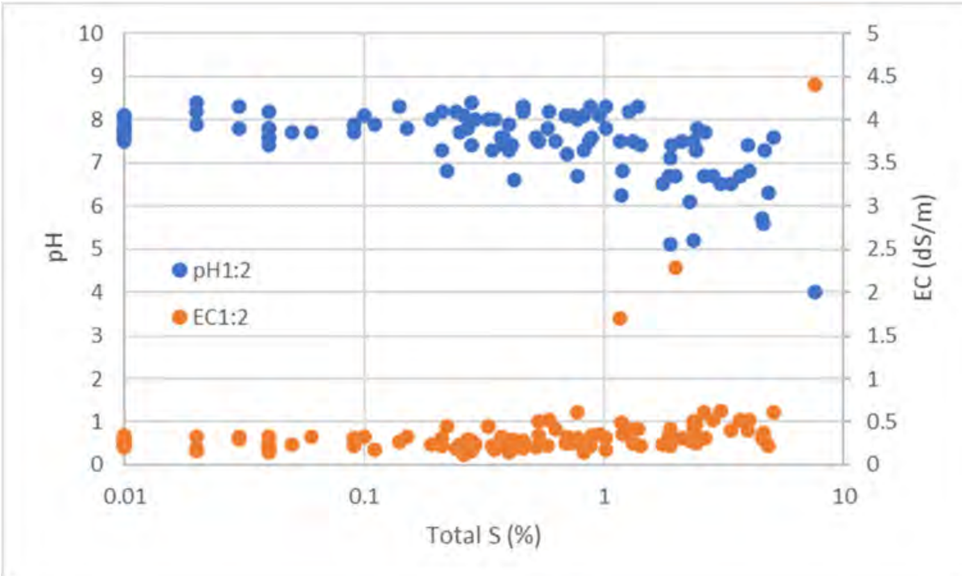


Figure 5: $pH_{1:2}$ and $EC_{1:2}$ versus total S for the samples tested.

5.2. Sulphur Speciation and MPA

All 110 samples were tested for total S content and a subset comprising 30 samples also underwent the test for CRS. The test results are provided in Appendix A.

The total S values of the 110 samples ranged from below the reporting limit of 0.01% to 7.61% with a median of 0.46%. Figure 6 shows the distribution of total S by lithology types of the samples. Magnetite ironstone lithotypes (i.e., FEM and FEMQ), with a median of 1.9%, appear to have higher total S content relative to the samples of other lithotypes. It needs to be noted that very limited number of samples were selected for some lithotypes and therefore the statistics may not reflect the actual S distribution in those lithotypes (e.g., veins and shale). Overall, the test results indicate that lithology is not a strong controller of total S in the mined material from Rover 1.

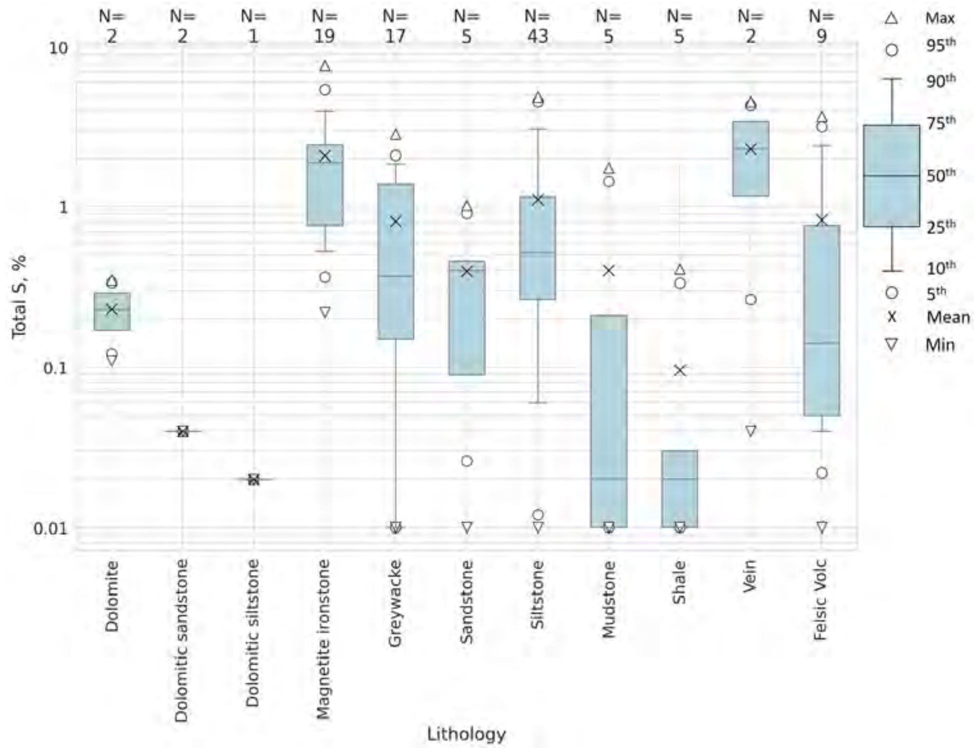


Figure 6: Distribution of total S content in samples tested, split by sample lithology.

The CRS content is compared to total S for the 30 samples selected for both tests in Figure 7. Overall, CRS is linearly associated with total S at a ratio slightly less than 1:1, indicating some non-pyritic S in the samples. For the samples with total S less than 1%, the acid generating S can be reasonably represented by the total S content. However, total S may overestimate the acid generation potential of the samples with total S above 1%.

The total S content measured by the LECO method was also compared to the S results provided by Castile Resources for the sample set in Figure 8 (except for the 9 samples from the holes with pre-fix 20CRD and 21CRD, for which the S content was not provided). Overall, the data are largely correlated at a ratio close to 1:1, but individual variation could be substantial, especially for the samples with high S content (above 4%).

The maximum potential acidity (MPA) of the 110 samples was calculated from the total S results using the following formula:

$$MPA\ (kg\ H_2SO_4/t) = total\ S \times 30.6$$

The calculated MPA values are provided in Appendix A with other ABA results.

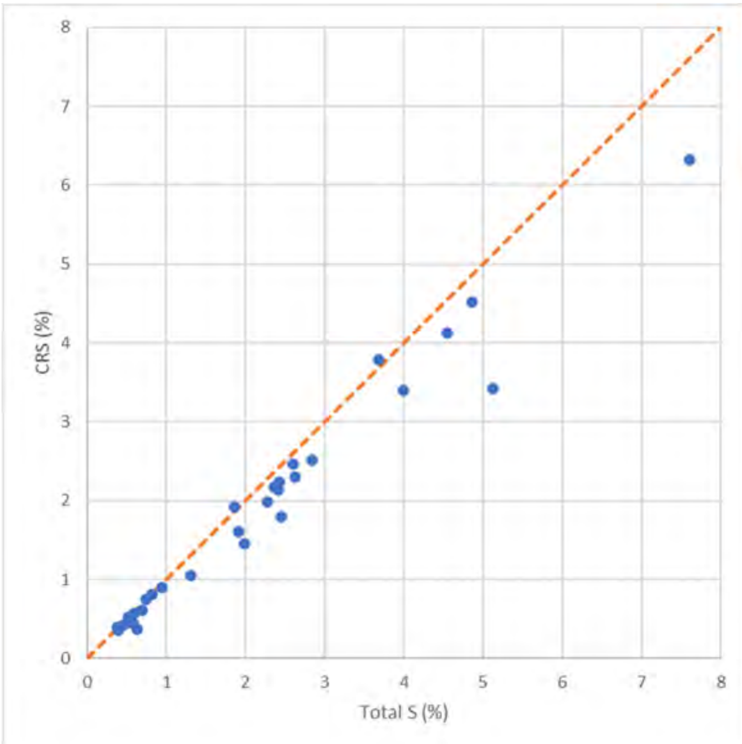


Figure 7: Comparison of total S and CRS in the 30 samples tested.

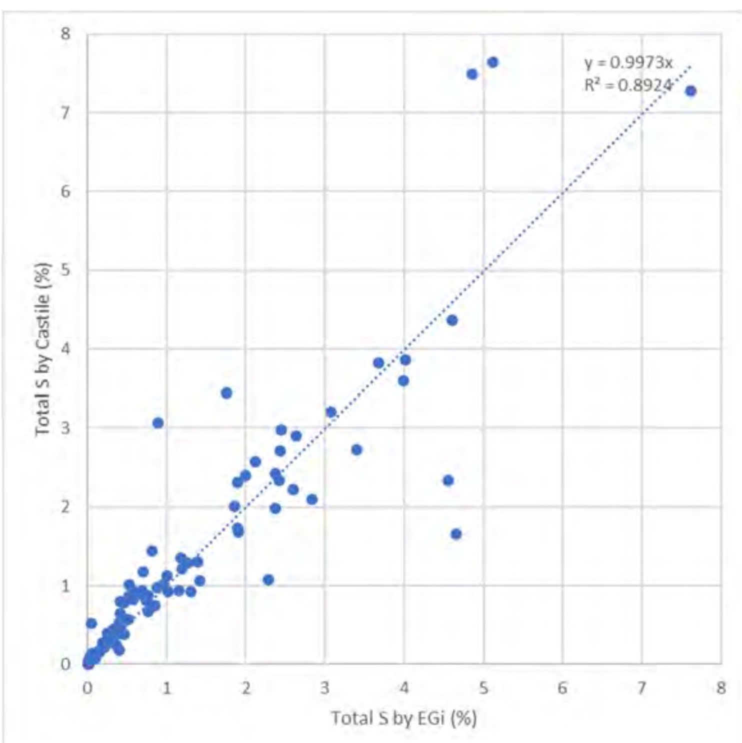


Figure 8: Comparison of total S results by EGi and by Castile.

5.3. ANC

The ANC of the 110 samples ranged widely from less than 1 to 870 kg H_2SO_4/t. The five dolomitic samples collected from the 20CRD and 21CRD drill holes at a depth between 60 and 120 m, reported the highest ANC. For the remaining samples that were collected from greater depths, ANC values were relatively low, with the median values for different lithologies often less than 10 kg H_2SO_4/t. A small portion (approximately 5%) of the sandstone, siltstone and mudstone samples reported ANC exceeding 100 kg H_2SO_4/t, which may indicate dolomitic content in these samples. The distribution of ANC split by the lithology is presented in Figure 9. The samples tested could be summarised as three types of materials with respect to ANC: (i) dolomitic materials with high ANC (>200 kg H_2SO_4/t), (ii) ironstone with moderate ANC (20 - 100 kg H_2SO_4/t) and (iii) all other lithotypes with low ANC (<20 kg H_2SO_4/t).

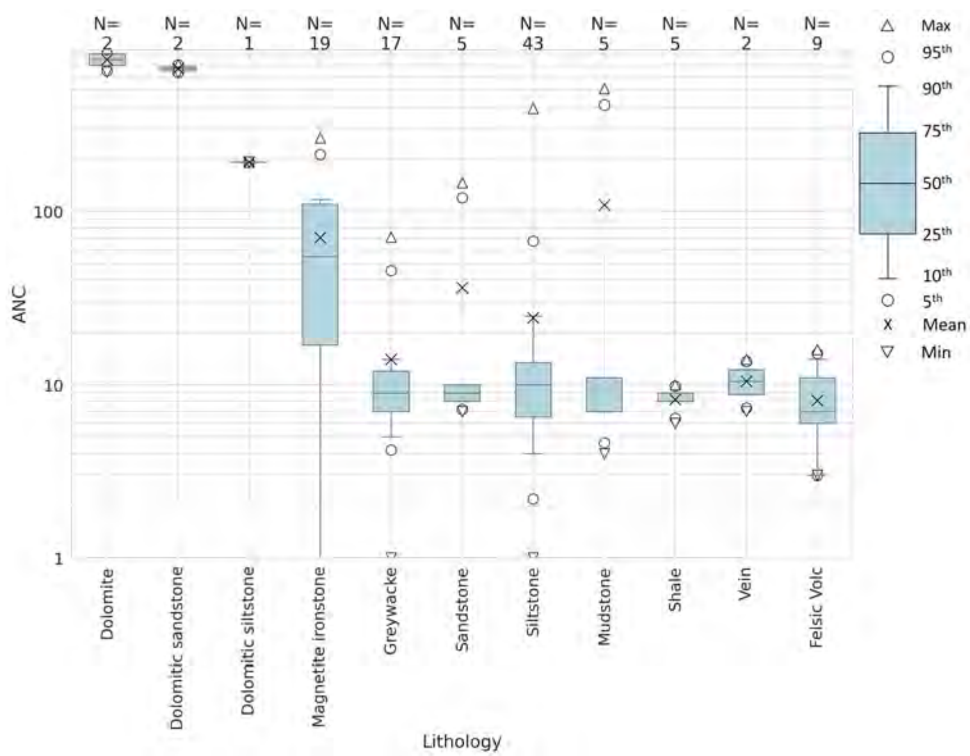


Figure 9: ANC (kg H_2SO_4/t) distribution in 110 samples by lithology type.

5.4. Carbon Forms

All 110 samples selected were tested for total C and organic C, the difference of which was calculated as the inorganic C content of the samples. Results showed that the organic C contents in these samples were negligible, typically less than or near the reporting limit of 0.02%, demonstrating that inorganic C was the predominant C form (Figure 10). These results suggest that the inorganic C content of waste rock generated at Rover 1 can be represented by the total C content.

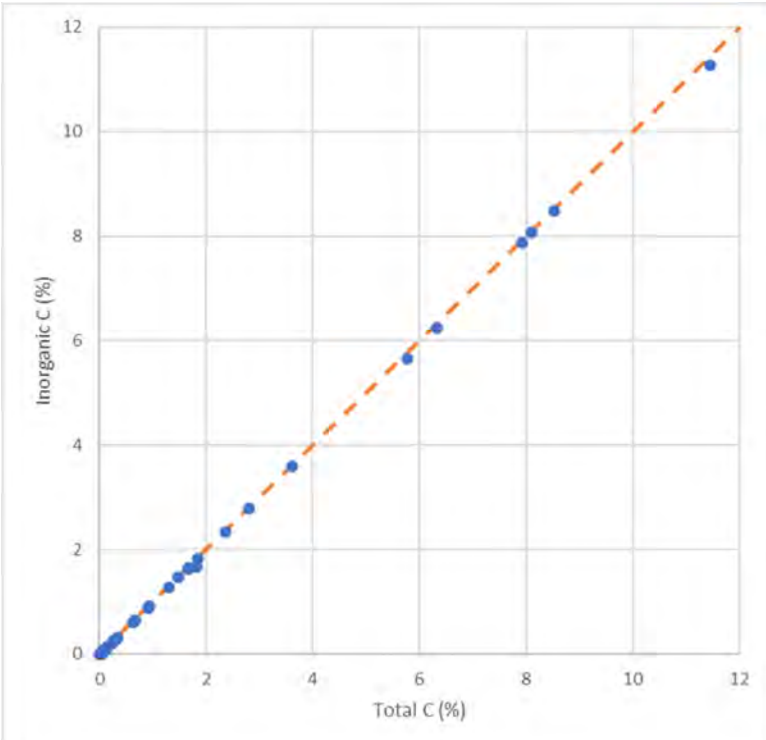


Figure 10: Comparison of total C and inorganic C in 110 samples tested.

The total C content was compared to the Ca and Mg concentrations in the 39 samples that were submitted for multi-element analysis (see Section 5.10) in Figure 11. For the samples with total C above 0.1%, the concentrations of Ca + Mg and C (measured as mol %) form a strong linear relation at a ratio close to the mol ratio of 1:1 in dolomite ($(Ca,Mg)(CO_3)_2$), suggesting dolomite as the dominant carbonate and that the majority of Ca and Mg in these samples is associated with dolomite. However, for samples with total C less than 0.1%, concentrations of Mg were typically significantly higher than Ca. This may indicate that, especially at low C content, Mg in these samples is most likely associated with silicate minerals rather than carbonates.

The total C content was used to estimate the ANC_{TC} of the samples using the formula:

$$ANC_{TC} = \text{Total C} \times 81.67$$

This is based on the assumption that all C within the samples occurs as effective acid neutralising carbonates such as dolomite or calcite.

The calculated ANC_{TC} is compared to the standard ANC by titration in Figure 12. For the samples with low ANC_{TC} (less than 10 kg H_2SO_4/t; accounting for 75% of all 110 samples), the standard ANC often exceeded ANC_{TC}, and this is consistent with the 0.1% C threshold identified for dolomite in Figure 11. This observation indicates that ANC measured using the standard bulk acid digestion method may overestimate the effective ANC of samples with little or no carbonate, as the measured ANC is most likely due to the dissolution of silicate minerals. This type of ANC may not be readily available for acid neutralisation in the natural environment. For the samples with higher ANC values, the standard ANC was correlated with the ANC_{TC} at a ratio near 1:1 indicative of ANC provided by dolomite or calcite.

Further investigation of the effective ANC evaluated using ABCC testing was undertaken on selected samples and is discussed in Section 5.9.

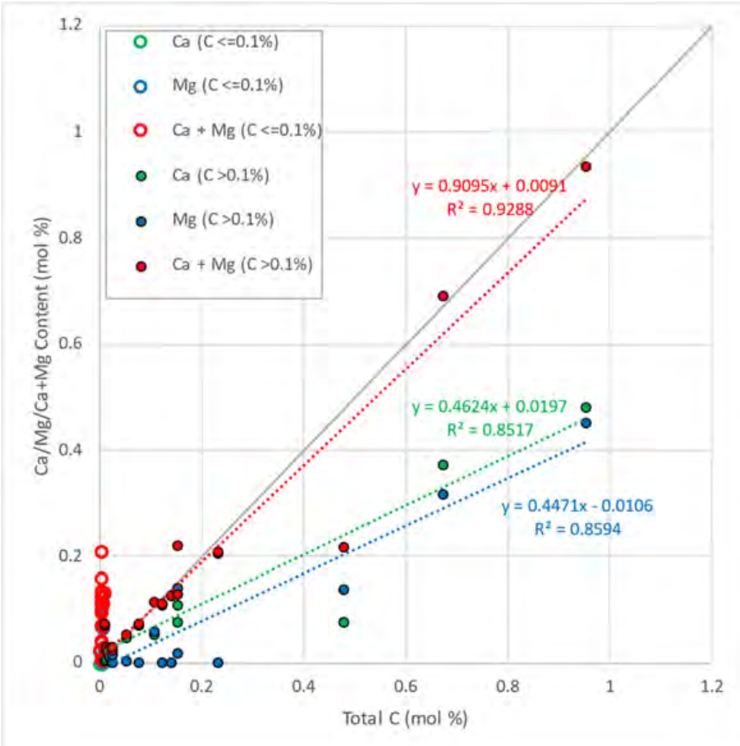


Figure 11: Comparison of total C and Ca and Mg content.

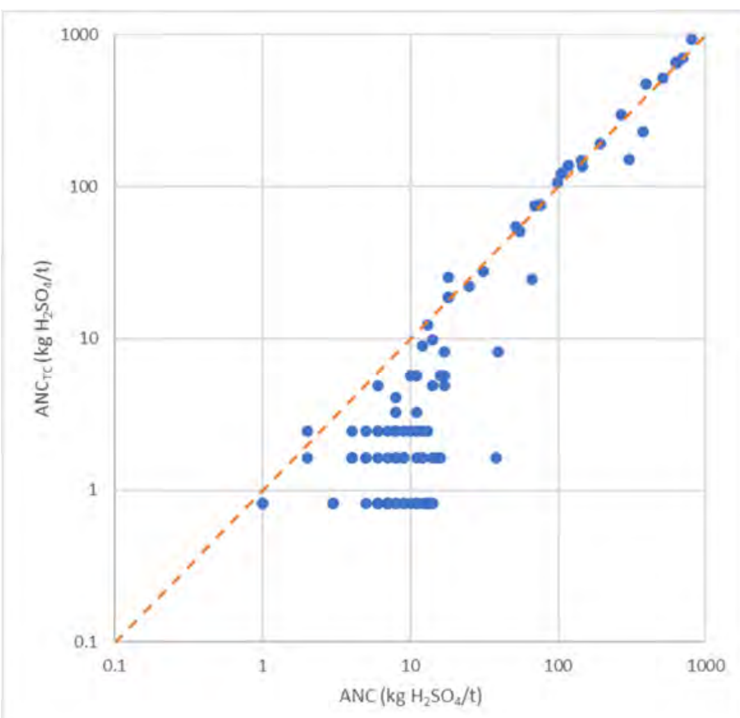


Figure 12: Comparison of standard ANC by titration and ANC_{TC} in 110 samples tested.

5.5. NAPP

The net acid producing potential (NAPP) value represents the balance between the acid generating component and the acid neutralising component of a sample and was calculated from the following formula:

$$NAPP = MPA - ANC$$

A positive NAPP value indicates that the sample may be acid generating. Conversely, a negative NAPP value indicates that it may have sufficient ANC to prevent acid generation.

Figure 13 shows a plot of total S versus ANC for the samples categorised by lithology. The orange NAPP zero line, which is equivalent to an ANC/MPA ratio of 1, defines the boundary between the NAPP positive and the NAPP negative domains. The grey line represents an ANC/MPA ratio of 2. The ANC/MPA ratio is used as an indication of the relative factor of safety within the NAPP negative domain. Usually, a ratio of 2 or higher signifies a high probability that the material will remain circumneutral in pH and should not be problematic with respect to AMD. However, this does not preclude the generation of metalliferous or saline drainage in sulphide rich samples. An ANC/MPA ratio between 1 and 2 indicates a lower factor of safety and additional test work (e.g., kinetic column leach test) may be required as the existing ANC might not be sufficient to maintain circumneutral drainage over time.

The figure shows over half of the tested samples plot in the positive NAPP domain, which had a wide range of total S content but typically very low ANC. The NAPP values do not appear to be closely associated with the sample lithology, except for the five dolomitic samples from the depth of 60 to 120 m that plot in the negative NAPP domain with strongly negative NAPP values.

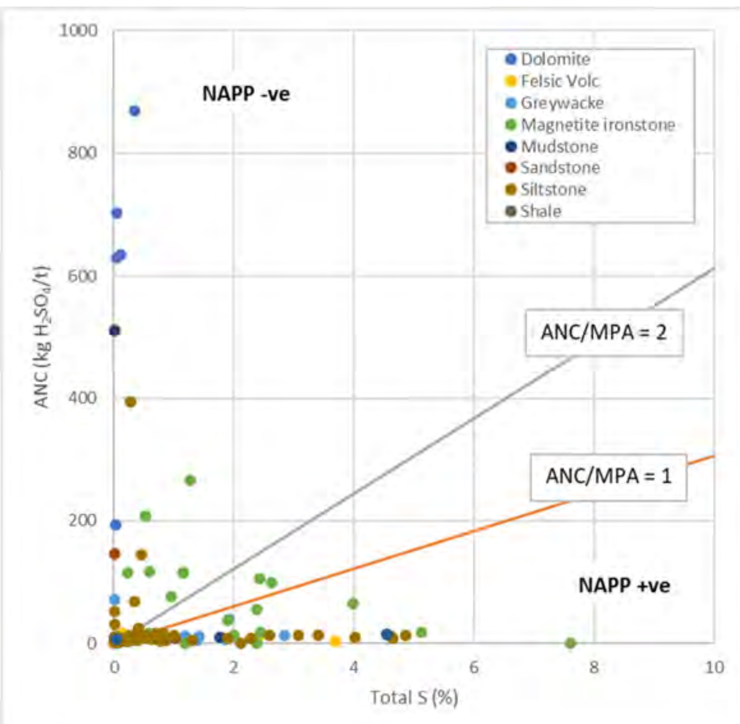


Figure 13: Total S versus ANC (note that dolomite includes dolomite, dolomitic sandstone and dolomitic siltstone).

5.6. Single Addition NAG

Single addition NAG testing was carried out on all 110 samples. During the NAG test, the sulphide content (i.e., iron sulphides/pyrite) in the sample is oxidised by peroxide, which generates acidity. The acidity then reacts with any neutralising minerals in the sample. Consequently, the net result in terms of NAGpH represents the balance between the acid generating and acid neutralising potentials of the sample. For the samples reporting NAGpH ≤4.5, the acidities to NAGpH 4.5 and 7.0 (i.e., $NAG_{pH4.5}$ and $NAG_{pH7.0}$) were measured by titrating the NAG liquor to pH 4.5 and 7.0. The test results are provided in Appendix A and summarised in Table 3.

Table 3: Summary of single addition NAG test results.

Lithology	Number of Samples	NAGpH > 4.5	NAGpH ≤ 4.5 and $NAG_{pH4.5}$ ≤ 5 kg H_2SO_4/t	NAGpH ≤ 4.5 and $NAG_{pH4.5}$ > 5 kg H_2SO_4/t
Dolomite	2	2	0	0
Dolomitic sandstone	2	2	0	0
Dolomitic siltstone	1	1	0	0
Magnetite ironstone	19	12	3	4
Greywacke	17	6	5	6
Mudstone	5	3	1	1
Sandstone	5	2	1	2
Siltstone	43	17	13	13
Shale	5	4	1	0
Felsic Volc	9	5	2	2
Vein	2	1	0	1

Overall, a large portion of samples of most lithotypes reported NAGpH less than 4.5. This indicates that lithology is not a control of the AMD generation potential of the samples, except for the dolomitic material which was typically found in the shallow depths (60 to 120 m).

NAGpH is used in conjunction with NAPP to provide an indication of AMD classification of the samples in Figure 14 and Figure 15, with the samples categorised by lithology. Potentially acid forming (PAF), non-acid forming (NAF) and uncertain (UC) classification domains are indicated. A sample is classified PAF when it has a positive NAPP and a NAGpH < 4.5. A NAF classification is assigned when a sample has a negative NAPP and a NAGpH ≥ 4.5. Samples are classified UC when there is an apparent contradiction between the NAPP and NAG results, i.e., when the NAPP is positive and the NAGpH ≥ 4.5, or when the NAPP is negative and the NAGpH < 4.5.

A total of 46 samples (42% of all 110 samples tested) plot in the NAF domain, approximately 80% of which had an ANC/MPA ratio above 2. There are 53 samples (48%) plotting in the PAF domain, 21 of which had $NAG_{pH4.5}$ less than 5 kg H_2SO_4/t, indicating low capacities to generate acid (PAF-LC). The remaining 11 samples primarily plot in the upper-right UC domain. Three of the UC samples contained high total S content (above 2 %) and positive NAPP, but with NAGpH above 4.5. Further investigation including sequential NAG testing was carried to confirm the acid generation potential of these samples, which is detailed in the following sections.

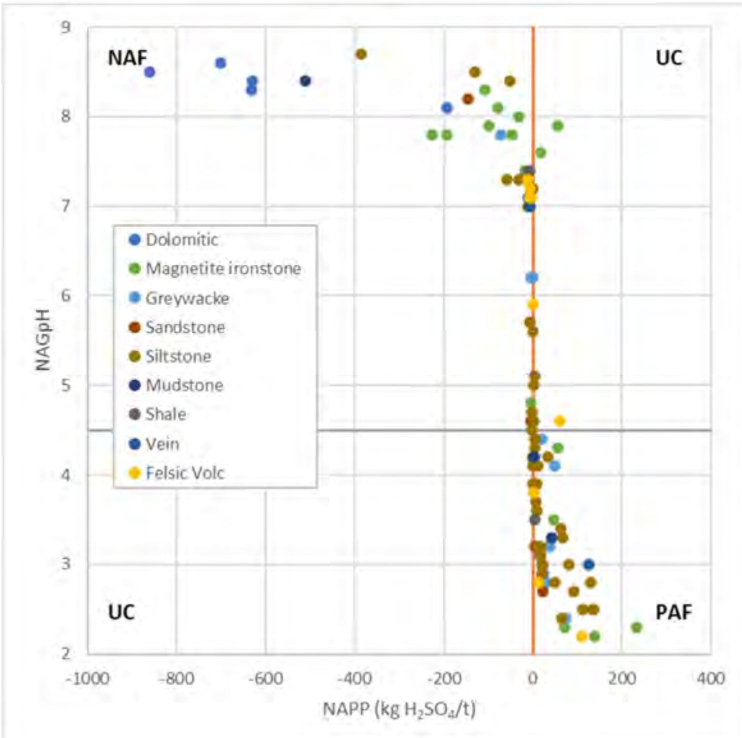


Figure 14: AMD classification of 110 samples tested.

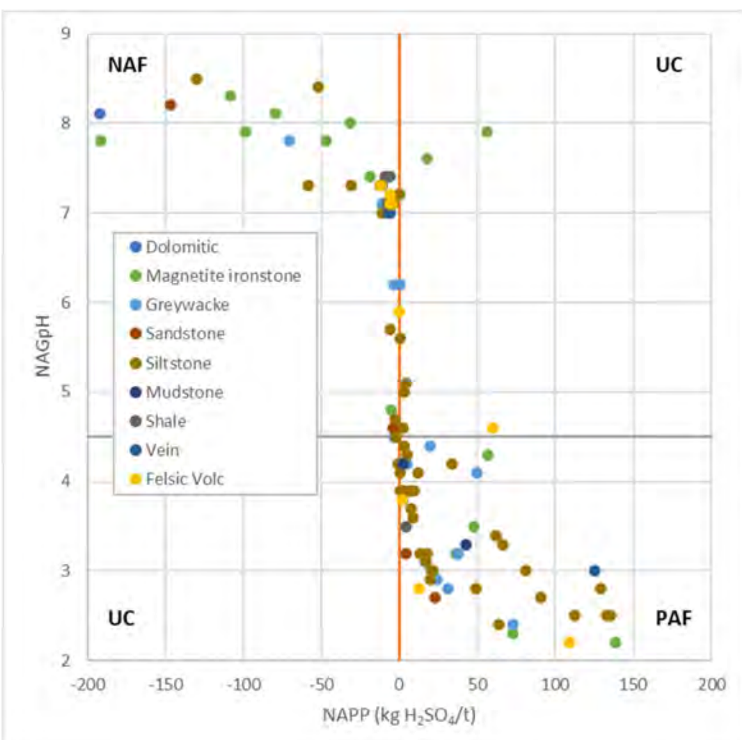


Figure 15: Same as Figure 14, but focusing on the samples with a NAPP in the range between -200 and 200 kg H_2SO_4/t.

5.7. Sequential NAG

When testing samples with high sulphide contents it is common that oxidation is incomplete in the single addition NAG test. Sequential NAG testing overcomes this limitation via successive additions of peroxide to the same sample. Twenty samples were selected for the sequential NAG testing, including eight samples (22998, 23000, 23012, 23024, 23034, 23062, 23065, and 23106) with NAGpH above 4.5 by single addition NAG testing. The results of the sequential NAG testing are provided in Appendix B and summarised in Table 4.

The samples 22998 with total S of 3.99% and 23106 with 2.42%, had acidic NAGpH of 2.8 with high cumulative $NAG_{pH4.5}$ released after multi stages of peroxide oxidation, indicating these two samples are possibly PAF.

The NAGpH of samples 23000 and 23012 remained above 7.0 over the course of the sequential NAG testing, and sample 23024 reported acidic NAGpH but it was above 4.5. Sample 23012 had a negative NAPP and it is possibly NAF-HS. Sample 23024 can be conservatively assumed to be PAF-LC. Sample 23000 is more likely to be NAF-HS, but the classification for this sample may need to be reviewed during the site visit..

Samples 23034 and 23062 had positive NAPP and lowest NAGpH less than 4.5, indicating they are possibly PAF-LC. The lowest NAGpH of sample 23065 was 4.5, it is conservatively classified PAF-LC.

Eight samples (23013, 23015, 23026, 23064, 23072, 23076, 23102, and 23104) reported acidic NAGpH less than 4.5 and high cumulative $NAG_{pH4.5}$ over multi-stages of S oxidation. With positive NAPP, these samples are possibly PAF.

The remaining 3 samples (23036, 23056 and 23066) showed NAGpH less than 4.5 but $NAG_{pH4.5}$ less than 5 kg H_2SO_4/t. These samples are possibly PAF-LC.

Table 4: Summary of sequential NAG results.

EGi Sample Code	Total S (%)	ANC (kg H_2SO_4/t)	NAPP (kg H_2SO_4/t)	Single NAGpH	$NAG_{pH4.5}$ (kg H_2SO_4/t)	Number of Stages	Lowest NAGpH	Cumulative $NAG_{pH4.5}$ (kg H_2SO_4/t)
22994	0.63	7	12	4.1	1.5	4	4.1	1.0
22998	3.99	66	56	7.9	0	4	2.8	19.2
23000	2.37	55	18	7.6	0	5	7.4	0.0
23012	2.43	106	-32	8.0	0	5	7.7	0.0
23013	1.18	0	36	3.2	4.8	4	3.1	8.3
23015	1.31	6	34	4.2	0.7	4	2.9	13.5
23024	0.46	11	3	5.0	0	4	4.7	0.0
23026	2.28	8	62	3.4	4.5	4	2.7	27.7
23034	0.58	17	1	7.2	0	5	4.3	0.4
23036	0.74	13	10	3.9	3.8	4	3.8	2.4
23056	0.82	16	9	3.6	4.4	4	3.6	3.7
23062	0.69	17	4	5.1	0	4	3.8	1.1
23064	1.91	39	19	4.4	0	4	3.4	8.1
23065	0.53	14	2	4.6	0	4	4.5	0.0
23066	0.52	9	7	3.9	2.9	4	3.8	2.2
23072	2.45	18	57	4.3	0	4	2.7	24.5
23076	1.86	7	50	4.1	0.7	4	3.1	13.4
23102	1.99	13	48	3.5	3.0	4	3.3	7.3
23104	2.6	13	67	3.3	4.8	4	2.6	28.7
23106	2.42	14	60	4.6	1.3	4	2.8	24.1

5.8. Kinetic NAG

Kinetic NAG tests provide an indication of the kinetics of sulphide oxidation and acid generation for a sample. Nine samples were selected to undergo the kinetic NAG testing. The majority of the selected samples had high total S contents (except for 23072 with a total S of 0.53%) and low ANC (mostly less than 20 kg H_2SO_4/t, except for 22998 and 23000). Results are summarised in Table 5 and the temperature and pH profiles of the tested samples are presented in Appendix C.

Seven samples with total S ranging from 1.99% to 5.12% show distinct temperature peaks exceeding 70 °C in their kinetic NAG profiles, which is typical of pyrite samples with pyritic S greater than 0.7%. The remaining two samples 23000 (2.37% of total S) and 23065 (0.53%) did not have distinct temperature peaks, which probably infers partial pyrite oxidation in the NAG test

The time for the decline of NAGpH to 4 can be used to estimate the lag time before acid conditions develop in a sample under atmospheric oxidation conditions. Two samples (23014 and 23072) with high total S (5.12% and 2.45% respectively) and low ANC (both 18 kg H_2SO_4/t, but entirely in the form of carbonate) show relatively slow reaction rates; the pH decline to 4 took 100 and 140 minutes respectively, indicating moderate lags in the order of 12-24 months. Four samples (23029, 23055, 23057, and 23102) with total S ranging between 1.99% and 4.86% and a limited amount of effective ANC (less than 20 kg H_2SO_4/t, but none derived from carbonates except for 23102) show moderate to fast reaction rates with pH dropping to 4 in 10 to 50 minutes, indicating short lags from days to weeks. The remaining 3 samples (22998, 23000 and 23065) did not develop acidic NAG pH, as they had substantial carbonate content as calcite or dolomite, suggesting very long lags, potentially decades, or that they may never develop acidic conditions below pH 4.

Table 5: Summary of sample characterisation and kinetic NAG results.

EGi ID	Total S (%)	MPA (kg H_2SO_4/t)	ANC (kg H_2SO_4/t)	NAPP (kg H_2SO_4/t)	NAGpH	Temperature peak (°C)	Time to pH 4 (min)
22998	3.99	122	66	56	7.9	~85	n/a
23000	2.37	73	55	18	7.6	n/a	n/a
23014	5.12	157	18	139	2.2	~90	~100
23029	2.84	87	14	73	2.4	~80	~50
23055	4.55	139	14	125	3.0	~90	~20
23057	4.86	149	13	136	2.5	~90	~15
23065	0.53	16	14	2	4.6	n/a	n/a
23072	2.45	75	18	57	4.3	~75	~140
23102	1.99	61	13	48	3.5	~90	~10

5.9. ABCC

Acid buffering characteristic curve (ABCC) testing involves slow titration of a sample with acid while measuring the solution pH. The acid buffering of a sample to pH 4 can be used as an estimate of the proportion of reactive ANC as compared to total ANC measured by the modified Sobek titration method.

The ABCC test was carried out on 15 samples. The results are summarised in Table 6 and the ABCC profiles are provided in Appendix D. The curves for calcite, dolomite, ferroan dolomite and siderite standards are also presented as references. Calcite and dolomite readily dissolve in acid and exhibit strongly buffered pH curves in the ABCC test, but the pH drops rapidly once the ANC value is reached. The siderite standard provides very poor acid buffering, exhibiting a steep pH curve in the ABCC test. Ferroan dolomite is between siderite and dolomite in acid buffering availability.

The ABCC curves of 10 samples (22996, 22997, 23000, 23010, 23011, 23012, 23014, 23071, 23114, and 23133) are similar to the calcite or dolomite standard curves, indicating strong buffering of these samples. The effective ANC accounted for up to 100% of the ANC measured by titration, although a couple of samples (23011 and 23012) had lower proportions of readily available ANC.

The remaining 5 samples have profiles similar to the ferroan dolomite or the mixture of ferroan dolomite and dolomite standard curves, indicating the ANC could be less reactive in these samples compared to dolomite and calcite. The portions of readily available ANC in these samples varied between approximately 40% and 100%.

Table 6: Summary of ABCC test results.

EGi ID	Measured ANC (kg H_2SO_4/t)	Effective ANC (to pH 4) (kg H_2SO_4/t)	Effective ANC as % of Measured ANC (%)	Type of Carbonate Buffering
22996	208	153	74	Calcite / dolomite
22997	115	93	81	Calcite
22998	66	26	39	Dolomite / ferroan dolomite
23000	55	52	95	Calcite
23010	76	56	74	Calcite / dolomitic material
23011	117	62	53	Calcite / calcitic material
23012	106	48	45	Calcite / calcitic material
23014	18	25	139	Calcite
23064	39	28	72	Ferroan dolomite
23071	99	88	89	Dolomite
23078	15	16	107	Ferroan dolomite
23107	17	16	94	Ferroan dolomite
23114	870	931	107	Dolomite
23133	144	137	95	Dolomite
23140	394	447	113	Ferroan dolomite / dolomite

5.10. Multi-element Analysis

The multi-element composition of 39 selected samples is provided in Appendix E, together with corresponding geochemical abundance indices (GAI). The purpose of GAIs is to identify elements that occur at concentrations significantly greater than the median soil abundance values in non-mineralised areas. GAIs were calculated using the following formula:

$$GAI = \log_2 [\, C / (1.5 \times S) \,]$$

where *C* is the concentration of the element in the sample and *S* is the median soil content (from Bowen, 1979) for that element. GAIs are truncated to integer increments. A GAI of 0 indicates the element is present at a concentration similar to, or less than, the median soil abundance value for that element. A GAI of 3 or higher indicates significant enrichment above the median soil abundance.

Figure 16 shows the frequency of enrichment factors for elements that may be environmentally important. Over half of the samples were significantly enriched in S, but this is mainly due to sample selection biased to high S samples. Approximately 50% to 80% of samples were enriched in As, Bi, Co, Cu, and Mo, including four samples reporting Cu exceeding 1%. Other elements significantly enriched in at least 20% of the samples include Ag, Be, Sb, Se, and W.

Overall, results indicate the samples were enriched in relation to a number of environmentally important metals/metalloids that may require further investigation. A preliminary assessment of the potential for elemental leaching from these materials was undertaken as described in the following sections.

Figure 16: Distribution of GAIs for environmentally important elements for the 39 samples tested for multi-element analysis.

5.11. Water Extraction

Water extraction with deionised (DI) water was carried out at a solid to liquid ratio of 1:5 on 27 samples, including 11 PAF (including PAF-LC and UC(PAF-LC)), 2 NAF-HS (including UC(NAF-HS)) and 14 NAF (including UC(NAF)) samples. The compositions of extracts provide an indication of the mine drainage that might ensue following exposure of freshly mined waste material to a rainfall event. The test results are provided in Appendix F, and the main findings are as follows:

- The extraction solutions of most samples tested were circumneutral to alkaline, with pH ranging from 6.5 to 8.8. The only sample reporting acidic extract pH is 23073 (pH 4.0), which is PAF with total S of 7.61% and negligible total C.
- The salinities of most water extracts were generally low, with EC ranging between 0.089 to 0.612 dS/m. The exceptions include samples 22998, 23013, 23072 and 23073, which reported EC above 1 dS/m. The highest EC of 2.56 dS/m was measured for the water extract of 23073, which is also the most acidic.
- Sulphate and Ca were the major anion and cation, respectively. The concentrations varied widely from negligible levels to 1780 mg/L for SO_4 and to 250 mg/L for Ca. The highest concentrations were measured for the extract of 23073, suggesting S oxidation products accumulated in this sample.

- The concentrations of minor and trace elements were generally very low, and often below or close to detection limits. However, due to its acidic extract pH of 4.0, sample 23073 reported some high metal concentrations, including Al (8.19 mg/L), Co (8.2 mg/L), Cu (79.2 mg/L), Fe (78.2 mg/L), Mn (22.3 mg/L), and Ni (0.95 mg/L). Median concentrations of environmentally important elements are summarised in Table 7.

Overall, the DI water extraction results indicate no immediate risk of AMD and NMD after short-term exposure of the fresh waste materials to a rainfall.

Table 7: Median concentrations of environmentally important elements in DI water extracts.

Concentration Range	Element
≤0.0001 mg/L	Hg, Cd,
≤0.001 mg/L	Ag, As, Be, Co, Cr, Ni, Pb, Sb, Sn, Th, Tl, U
≤0.01 mg/L	Cu, Se
≤0.1 mg/L	Al, B, Mn, Mo, Sr, Zn
≤1 mg/L	Ba, F, Fe

5.12. Peroxide Extraction

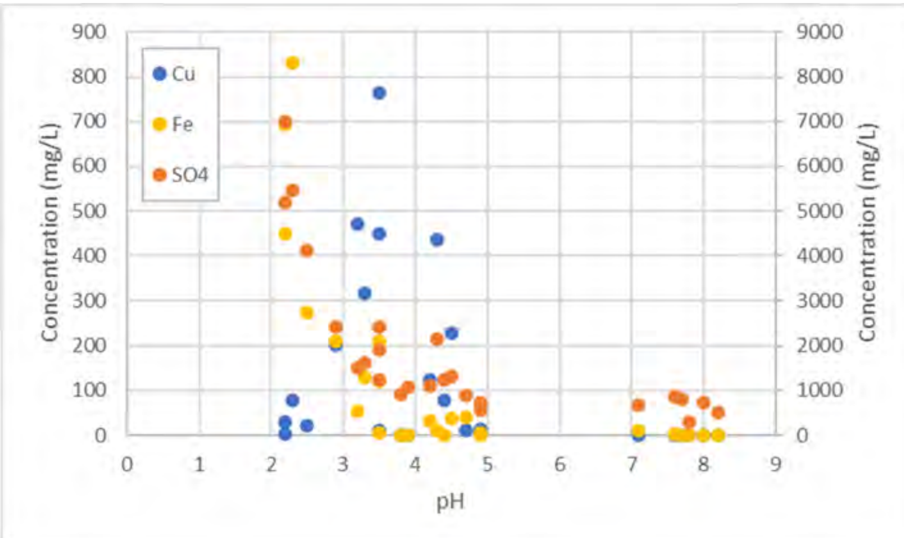
Peroxide extraction was undertaken on 25 samples, including 19 PAF (including PAF-LC and UC(PAF-LC)), 2 NAF-HS (including UC(NAF-HS)) and 4 NAF (including (UC(NAF)) samples, of which 17 samples were also submitted for DI water extraction. The peroxide extraction is based on the single-stage NAG test, which involves rapid oxidation of sulphides present in the samples with hydrogen peroxide. Following the oxidation stage, a sub-sample of the NAG solution is filtered and assayed to determine the extent of elemental release from the sample as a consequence of sulphide oxidation and potentially acidification. As such, the peroxide extraction provides an indication of potential drainage water quality from fully oxidised material.

The test results of peroxide extracts are provided in Appendix G. When assessing the results, it should be noted that the method involves a leach ratio of 100 mL/g which is high in comparison to leach rates typically encountered under field conditions, as well as leach rates typically used in column leach tests. As such, the peroxide extracts may represent a diluted condition in comparison to the “average” leachate quality. Therefore, from experience, EGi typically applies a scaling factor of 5 to the concentrations reported for peroxide extracts. This can provide a reasonable guide to what might be expected from column leach tests and make the results more meaningful for the field situation. The main findings are as follows:

- Most PAF samples reported acidic peroxide extracts, ranging between 2.2 and 7.1. The exception is sample 22998 (pH 8), which is due to incomplete oxidation of S in this high S sample (see the sequential NAG results of this sample in Section 5.7). The pH of peroxide extracts for NAF and NAF-HS samples ranged from 4.9 and 8.2. The generally higher pH of the NAF-HS samples relative to the NAF samples is also partly due to the incomplete S oxidation with the single stage peroxide extraction and high carbonate content.
- Due to sulphide oxidation, the dissolved sulphate concentrations of the PAF samples ranged between 720 and 5450 mg/L. This compares to between 670 and 1225 mg/L for the PAF-LC and 290 and 865 mg/L for the NAF (including and NAF-HS) samples.
- Under the acidic conditions, the concentrations of most minor and trace elements were significantly higher than the concentrations reported for the water extracts under circumneutral pH conditions. Figure 17 and Figure 18 show the association of concentrations of selected ions with pH, which generally increase with the declining pH as expected. Zn and Cu show different patterns, which may be affected by other mechanisms and factors. The median concentrations of environmentally important elements are summarised in Table 8.

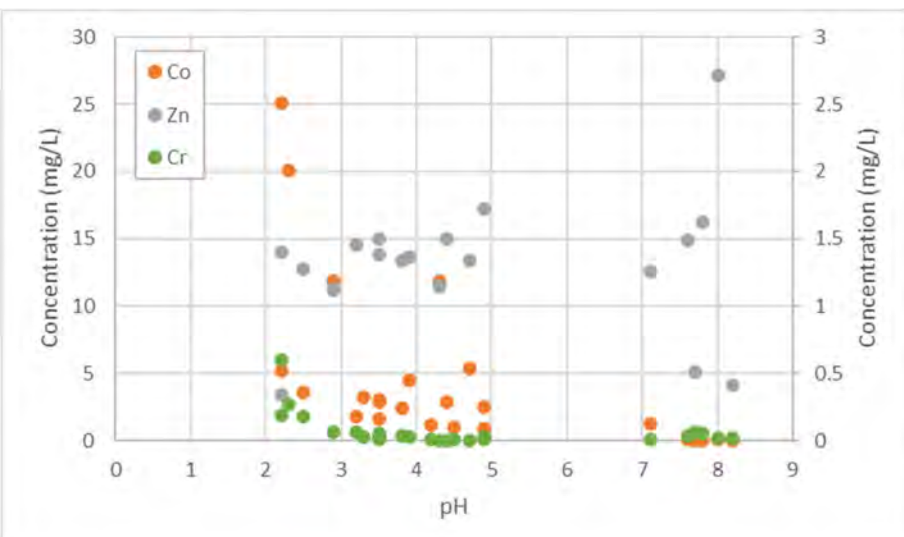
- The dissolved concentration of Fe appears to be correlated with SO_4 for the samples where SO_4 concentration is above 1000 mg/L. The concentration of Cu shows a similar pattern. However, the four samples with the highest SO_4, reported relatively low Cu concentrations, which indicates that SO_4 was released primarily from oxidised pyrite rather than chalcopyrite in these samples (Figure 19).

The peroxide extraction results indicate that AMD will be generated from the PAF material when the S is oxidised. For the NAF material, while AMD is not likely to form, NMD and SD could be an issue due to the elevated salinity.



Note: Cu and Fe are plotted on the left Y axis, and SO4 on the right Y axis.

Figure 17: Association of dissolved concentrations of Cu, Fe and SO_4 with extractant pH.



Note: Co is plotted on the left Y axis, and Zn and Cr on the right Y axis.

Figure 18: Association of dissolved concentrations of Co, Zn and Cr with extractant pH.

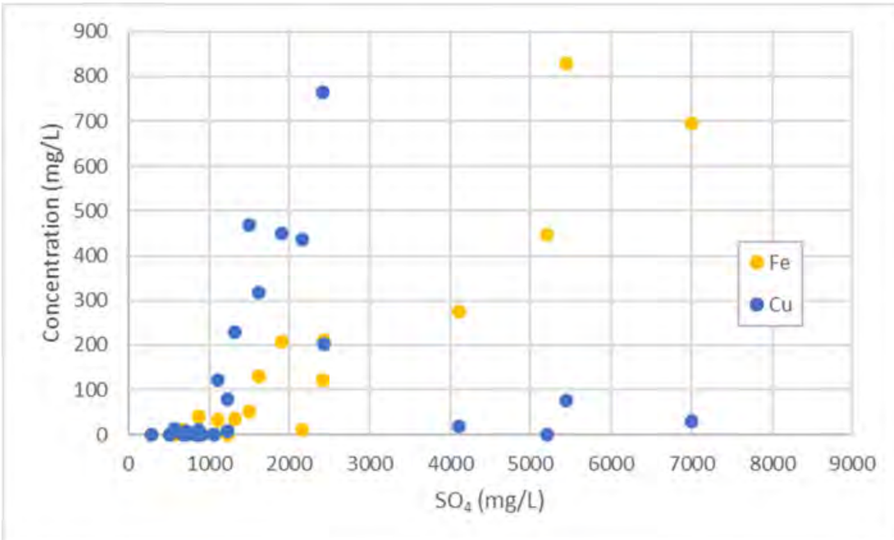


Figure 19: Dissolved concentrations of Fe and Cu versus SO4 of the samples tested.

Table 8: Median concentrations of environmentally important elements in peroxide extracts.

Concentration Range	Element
≤0.001 mg/L	Cd, Hg
≤0.01 mg/L	Ag, As, Be, Bi, Cs, Mo, Sb, Sn, Th, Tl,
≤0.1 mg/L	Li, Pb, Se, Sr, U
≤1 mg/L	B, Ba, Cr, Ni,
≤10 mg/L	Co, F, Mn, Zn
≤100 mg/L	Al, Cu, Fe,

Note: a multiplication factor of 5 was applied to the concentrations in the peroxide extracts.

5.13. AMD Classification

The results and discussions presented above were used to classify samples as NAF, NAF-HS, PAF, or PAF-LC. NAF-HS samples are NAF samples having a total S content greater than 1%, with potential to leach salinity and elevated metals. PAF-LC samples are PAF but with a limited acid capacity of 5 kg H_2SO_4/t or less. All samples with S values less than or equal to 0.05 % were classified NAF due to the negligible risk of acid formation. The proportions of AMD classes of all 110 samples are presented in Figure 20 by lithology types. Note that each of the classes also includes respective uncertain classes (i.e., UC(PAF), UC(PAF-LC), UC(NAF-HS), and UC(NAF)). The key findings are:

- All dolomite or dolomitic samples are NAF. These samples were collected from the relatively shallow depths of 60 to 120 m.
- Only one quarter of the magnetite ironstone samples were classified NAF, with the remaining 75% either NAF-HS, PAF or PAF-LC. This is as expected, as some samples with relatively higher Cu concentrations were collected from this lithology. The high Cu is most likely due to the presence of acid forming chalcopyrite.

- Up to 70% of sandstone, greywacke (essentially sandstone), and siltstone samples were classified PAF or PAF-LC, suggesting that mined wastes from these lithologies could be problematic.
- Over 50% of the samples from other lithotypes (mudstone, vein, felsic volc, and shale) were NAF. However, due to the limited sample numbers for some lithologies (e.g., vein), the proportions of various AMD classes in the tested sample set may not correctly reflect what might be true for mined materials. Nevertheless, the amount (tonnage) of these materials to be mined is expected to be low.
- Overall, lithology does not show significant control on AMD class, except for the dolomitic rock which are all classified as NAF.

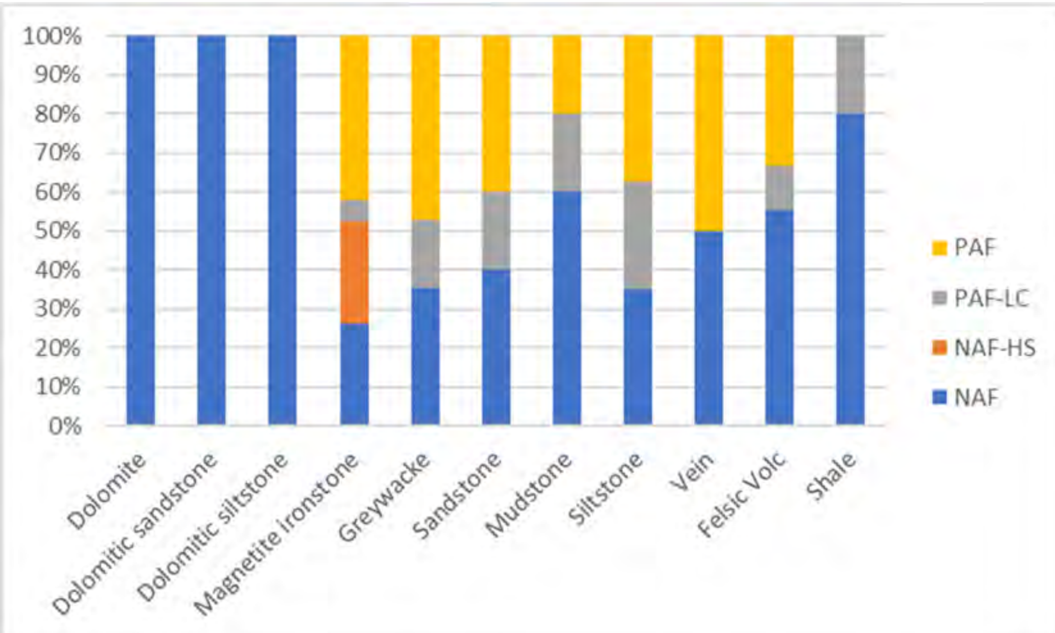


Figure 20: AMD classification of 110 samples by lithology.

5.14. Material Segregation Criteria

The dataset of the 110 samples was used to determine whether total S alone could be used as an indicator of AMD potential. Figure 21 shows the distribution of total S split into AMD classes. A total S cut-off of 0.25% discriminates reasonably well between NAF and other AMD classes, though up to 25% of the NAF material may be conservatively included in the PAF-LC material, and 25% of the PAF-LC with relatively low S content may be included in the NAF material. This should not be critical, as operational mixing would generally be expected to account for any acid generated. A total S cut-off of 0.7% effectively discriminates between PAF-LC and PAF / NAF-HS samples. Operational segregation of PAF and NAF-HS waste rock from NAF and PAF-LC wastes will likely be required, as wastes from the former two AMD classes may require operational management, since oxidation during surface storage is likely to lead to AMD and NMD, respectively.

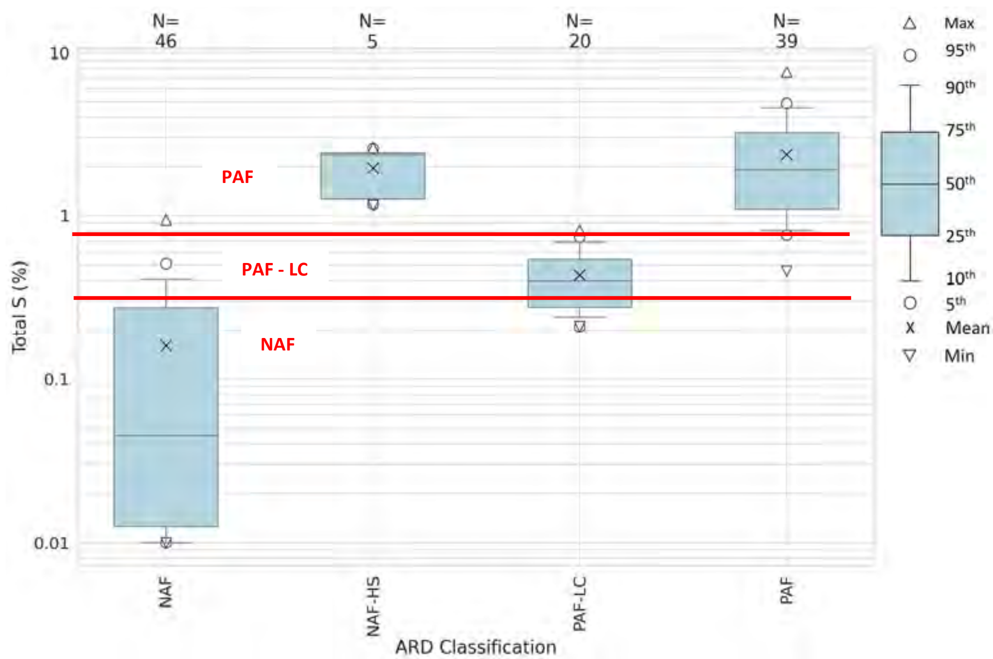
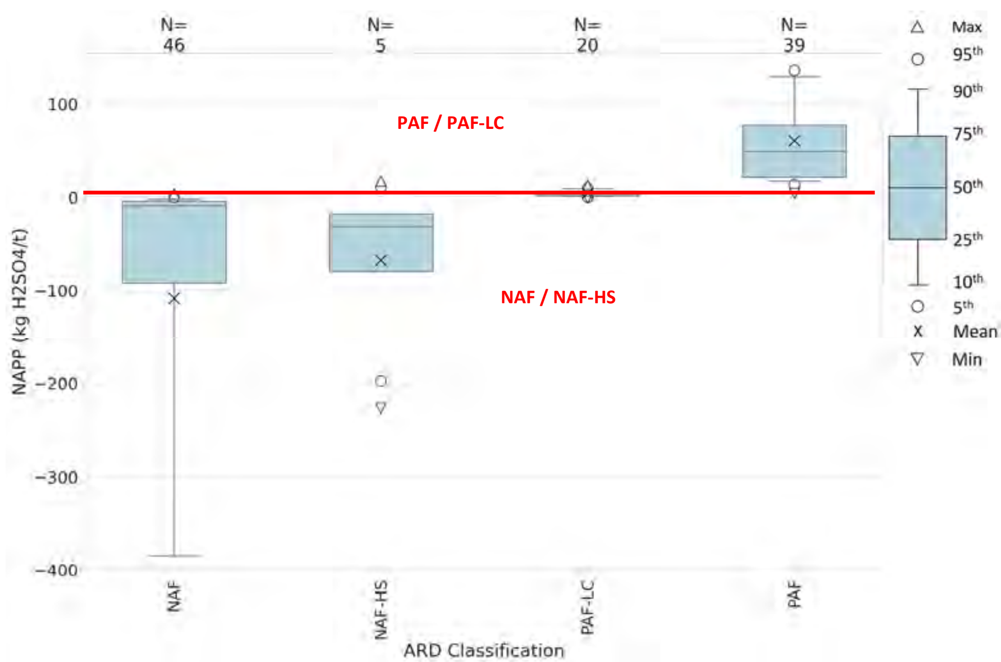


Figure 21: Distribution of total S for the samples split by AMD classification.

The dataset was also used to determine whether NAPP, calculated using ANC and total S, could be used as an indicator of AMD potential. Figure 22 shows the distribution of NAPP split into AMD classes for the 110 samples tested. A NAPP cut-off of 0 kg H_2SO_4/t appears to discriminate well between NAF / NAF-HS and PAF / PAF-LC samples.



Note: the Y axis (NAPP) is truncated at -400 kg H_2SO_4/t for more focused presentation. The minimum NAPP value for NAF is less than -800 kg H_2SO_4/t.

Figure 22: Distribution of NAPP for the samples split by AMD classification.

Table 9 summarises the material segregation criteria for AMD potential based on the total S and NAPP values of the samples. When the combined criteria derived from total S and NAPP are used, the materials can be reasonably segregated, delivering similar results (Figure 23) to what was concluded in the previous section (Figure 20).

Table 9: Material segregation criteria based on total S and NAPP of the samples tested.

AMD class	Criteria based on total S	Criteria based on NAPP	Criteria based on total S and NAPP
NAF	Total S < 0.25%	NAPP ≤ 0 kg H_2SO_4/t	Total S < 0.25% ***OR*** Total S < 1% and NAPP ≤ 0 kg H_2SO_4/t
NAF-HS	Total S > 1% [1]	NAPP ≤ 0 kg H_2SO_4/t [2]	Total S ≥ 1% ***AND*** NAPP ≤ 0 kg H_2SO_4/t
PAF-LC	Total S ≥ 0.25% and < 0.7%	NAPP > 0 kg H_2SO_4/t	Total S ≥ 0.25% and < 1%
PAF	Total S ≥ 0.7%	NAPP > 0 kg H_2SO_4/t	Total S ≥ 1% ***AND*** NAPP > 0 kg H_2SO_4/t

Note: [1] this is the definition of NAF-HS and this type of material cannot be differentiated from the PAF material based solely on total S content.
[2] the NAF-HS material cannot be differentiated from the NAF material based solely on NAPP.

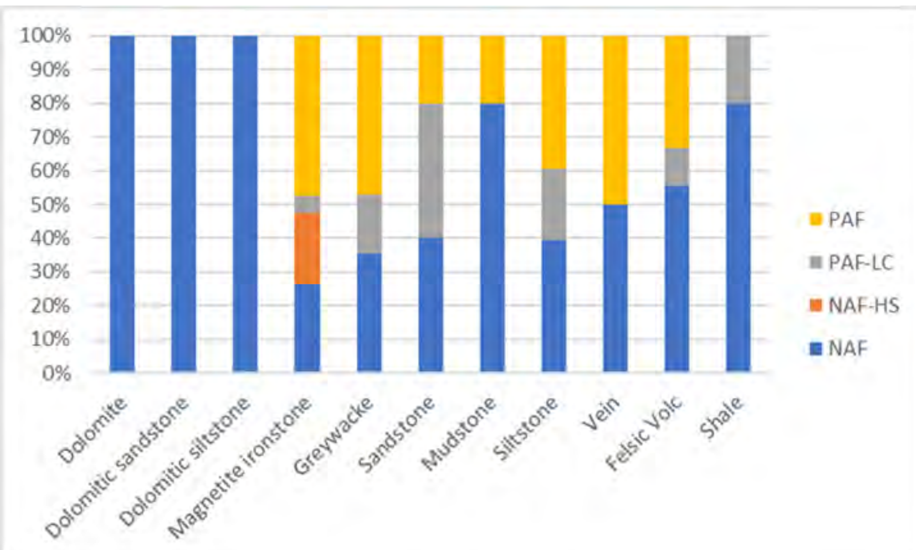
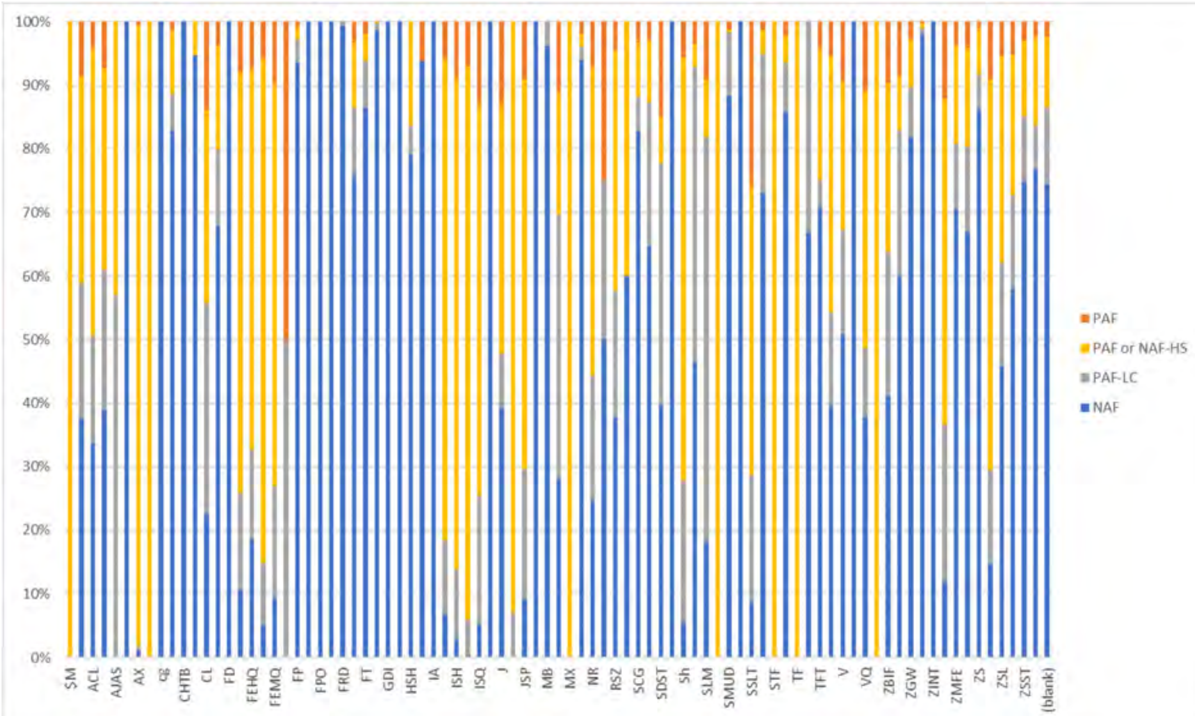


Figure 23: Sample segregation results using the criteria adopting both total S and NAPP values.

It is noted that assay data in the merged database included total S and Mg, but not total C or Ca. ANC measured using the modified Sobek method was compared to ANC_{TC} calculated from total C or ANC_{Ca+Mg} calculated from Ca and Mg content for the 110 samples used in this test program. The comparison showed that ANC of these materials may be reasonably estimated using either ANC_{TC} or ANC_{Ca+Mg}. However, the lack of total C or Ca assay data means that neither ANC_{TC} nor ANC_{Ca+Mg} can be calculated for the samples in the Rover 1 drill core database and, as a consequence, the NAPP of these materials cannot be evaluated. Therefore, the material segregation criteria based on total S only, were applied to a total of 39171 samples in the Rover 1 drill core database provided by Castile Resources for which S assay data were included. S content provided in the Rover 1 drill core database was measured by ICP-OES after 4-acid digestion of the samples, while the S assays used to derive the segregation criteria shown in Table 9 were determined using a high temperature combustion method (e.g. LECO) which is typically adopted for total S assay. As discussed in Section 5.2, the difference in the S content by these two methods could be significant for some samples, but the two datasets are statistically correlated well at a ratio near 1:1 (Figure 8). The AMD classification results split by lithology are shown in Figure 24. It should be noted that no attempt was made to use only samples which will represent disturbed rock during the mining to assign AMD classes. Therefore, the percentage of each AMD class for each lithotype mined may vary from that shown in Figure 25.



Note: the samples classified "PAF" in the plot contained total S between 0.7% and 1% and those classified as "PAF or NAF-HS" contained total S >1%.

Figure 24: Sample AMD classification results for samples in the Rover 1 drill core database (n = 39,171) using criteria based on the database assay S values only.

6. CONCLUSIONS AND RECOMMENDATIONS

Geochemical characterisation was carried out on 110 representative samples to assess the risk of AMD or NMD/SD generation from the mine waste material to be produced from the Rover 1 polymetallic project. The test results infer the following:

- The mine waste material from the Wiso Basin at shallow depths of up to approximately 60 m is expected to be highly weathered and contain relatively high dolomitic content. As such, the five samples representing this type of material had high ANC and were all NAF.
- The samples representing the mine waste and mineralised waste material collected from greater depths were generally all fresh material. The total S content in these samples varied over a wide range from around the detection limit of 0.01% to over 5%, and potentially acid producing sulphidic S is the predominant species of S in the samples.
- The ANC values of the tested samples also varied widely. The samples can possibly be grouped into three categories based on the ANC, which are (i) dolomitic materials with high ANC (>200 kg H_2SO_4/t), (ii) ironstone with moderate ANC (20 - 100 kg H_2SO_4/t) and (iii) all other lithotypes with low ANC (<20 kg H_2SO_4/t). Carbon speciation tests identified that inorganic C is the dominant C species in these samples, with almost all ANC in the samples belonging to the first and second categories in the form of readily available carbonates. ANC in samples from category (iii) is principally derived from silicate minerals and consequently is likely to be much less effective.
- Using the standard and specialised test results, nearly half of the 110 samples were classified as NAF or NAF-HS, and the remaining samples as PAF or PAF-LC. Lithotype does not appear to control AMD generation potential of these samples, except for the dolomitic samples which are all NAF.

- A large portion of the waste materials that were tested for multi-element composition were significantly enriched with several environmentally important elements, including Bi (82% of the 39 samples tested), Co (67%), Cu (62%), Fe (82%), Mo (54%), and As (46%). Sulphur was enriched in all tested samples, but this is due to the selection of samples biased to those with higher S content. The DI water extraction results indicate that most of the tested samples are not expected to pose a risk to the environment in terms of AMD or NMD/SD, when they are exposed to atmospheric condition over a short period of time. However, as shown by the peroxide extraction results, if sulphides in these samples are oxidised, the PAF material will generate a large amount of acidity, which results in low pH with elevated concentrations of sulphate and a number of minor and trace elements, while the NAF-HS materials may also generate NMD/SD with high salinity.
- Material segregation criteria based on the total S and NAPP values were developed, which can reasonably segregate the mined materials on site according to their AMD generation potential.
- A site visit to inspect drill core used during the current test program and other drill core, including that used for recent CoreScan assessment, will be conducted in the near future, depending on availability of site geologists. The results of the drill core inspection will be correlated with the geochemical test results generated during the current test program, with a view to potentially deriving geology-based AMD classification criteria. Such criteria, if they can be developed, will provide more operationally useful segregation criteria for PAF materials than those based on S content or S and NAPP values. The results of this work will be provided in an updated report once the site visit is completed.

In order to understand the long-term geochemical performance of mine waste materials and respond to the request by the NT Department of Mines and Energy (DME) for additional information and details on the AMD risk (EGi 2020), EGi recommends the following tasks to be carried out:

- Representative ore samples should be tested for AMD potential, as the number of ore samples assayed in the past was insufficient in the opinion of DME and ore samples were not included in the current assessment.
- The construction of the box cut will result in removal of a large volume (1.1 M BCM) of waste material from a relatively shallow depth. This waste will represent both the largest volume of waste rock which will be surface stored and used as backfill at closure. While previous testing has demonstrated that these materials are likely to be devoid of sulphides and classify as NAF, the NT EPA noted that previous testing did not properly evaluate the leaching potential of these materials to generate NMD. Additional samples should therefore be sourced from the disturbed area and tested for their leaching characteristics. The results can be used to demonstrate any risk of NMD and determine mitigation and management options if required.
- It is understood that a processing plant will be constructed on site, which will produce a number of tailings streams. Given the complexity of the proposed processing flow sheet, it is considered that ore samples will not adequately represent the tailings which will be produced. Therefore, it is recommended that tailings samples (approximately 5 kg dry wt. equivalent) of each tailings stream from the various processing units should be collected during metallurgical pilot plant tests and sent as slurries to EGi for geochemical testing as they become available. If slurry samples cannot be dispatched in a timely fashion, the slurry should be filtered, and the filter cake dried (60^{o}C) before dispatch to EGi.
- Column leach testing should be carried out on representative waste rock samples from each of the AMD classes, i.e., PAF, PAF-LC, NAF-HS and NAF, as well as selected tailings as required. Column leach testing will provide insight on the leaching behaviour and leachate quality of these materials under environmental conditions similar to the mine site. Leach testing can be conducted under oxidising conditions simulating surface storage and exposure to atmospheric oxygen, followed by leaching under saturated conditions simulating leaching of previously oxidised materials used for backfill and following inundation after groundwater rebound, where appropriate. Leach testing of oxidised cover sequence material can be undertaken using sequential batch leaching methods, which provide leaching kinetics without the need for the oxidising conditions of the leach column test, as these materials have been previously oxidised. EGi will assist with designing and undertaking the kinetic column and batch leach testing once samples become available and mining and mineral processing options are finalised.

REFERENCES

Castile Resources, 2021. Exploration mining management plan for Rover Project (mining management plan A0417-04). July 2021.

EGi, 2020. Rover 1 copper gold project gap analysis for waste characterisation. December 2020.

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APPENDIX A
Acid forming characteristics of samples

EGi Code	Hole ID	Sample ID	Lith Code	Acr.	Lithology	From	To	Interval	$pH_{1:2}$	$EC_{1:2}$	Total S (client)	Total S	CRS	Total C	Org C	TIC	MPA	ANC	ANC_{TC}	NAPP	ANC/MPA	NAGpH	$NAG_{pH4.5}$	$NAG_{pH7.0}$	AMD Class
						m	m	m		dS/m	%	%	%	%	%	%	kg H_2SO_4/t	kg H_2SO_4/t	kg H_2SO_4/t	kg H_2SO_4/t			kg H_2SO_4/t	kg H_2SO_4/t	
22983	R1ARD33-4	CST004168	ZSLT	MSS	Siltstone	624	624.3	0.3	7.3	0.276	1.66	4.65		0.02	0.02	0	142.3	9	1.6	133.3	0.1	2.5	55	86	PAF
22984	R1ARD33-4	CST004169	ZSLT	MSS	Siltstone	636	637	1	7.5	0.281	0.75	0.86		0.02	0.02	0	26.3	5	1.6	21.3	0.2	3	11	21	PAF
22986	R1ARD33-4	CST004171	ZMUD	MSS	Mudstone	659	660	1	8.2	0.315	0.26	0.21		0.02	0.02	0	6.4	4	1.6	2.4	0.6	4.2	1	5	PAF-LC
22988	R1ARD33-4	CST004173	ZMUD	MSS	Mudstone	748	749	1	7.8	0.245	0.04	0.01		0.02	0.02	0	0.3	11	1.6	-10.7	35.9	7.3	0	0	NAF
22989	R1ARD33-4	CST004174	ZSLT	MSS	Siltstone	780	781	1	7.7	0.329	0.14	0.06		0.03	0.02	0.01	1.8	6	2.5	-4.2	3.3	7.1	0	0	NAF
22991	R1ARD33-4	CST004176	ZSLT	MSS	Siltstone	799	800	1	7.9	0.313	0.07	0.09		0.02	<0.02	0	2.8	2	1.6	0.8	0.7	5.6	0	2	UC(NAF)
22993	R1ARD33-4	CST004178	ZGW	Greywacke	Greywacke	816	817	1	8.3	0.412	1.3	1.39		0.03	<0.02	0.01	42.5	5	2.5	37.5	0.1	3.2	8	17	PAF
22994	R1ARD33-4	CST004179	ZSLT	MSS	Siltstone	833	834	1	7.5	0.421	0.89	0.63	0.37	0.02	0.02	0	19.3	7	1.6	12.3	0.4	4.1	2	8	UC(PAF-LC)
22995	R1ARD33-4	CST004180	FEMQ	Iron Steon	Magnetite ironstone	845	846	1	8.2	0.421	1.29	1.27		3.62	0.02	3.6	38.9	266	295.8	-227.1	6.8	7.8	0	0	NAF-HS
22996	R1ARD33-4	CST004181	FEM	Iron Steon	Magnetite ironstone	875	876	1	7.5	0.511	0.87	0.53		2.8	0.02	2.78	16.2	376	228.8	-191.8	12.8	7.8	0	0	NAF
22997	R1ARD33-4	CST004182	FEMQ	Iron Steon	Magnetite ironstone	883	884	1	6.8	0.446	0.22	0.22		1.85	0.02	1.83	6.7	304	151.1	-108.3	17.1	8.3	0	0	NAF
22998	R1ARD33-4	CST004183	FEM	Iron Steon	Magnetite ironstone	902	903	1	7.4	0.396	3.6	3.99	3.4	0.3	0.03	0.27	122.1	66	24.5	56.1	0.5	7.9	0	0	PAF
23000	R1ARD33-4	CST004185	FEMQ	Iron Steon	Magnetite ironstone	947	948	1	7.5	0.513	1.99	2.37	2.17	0.62	0.02	0.6	72.5	55	50.7	17.5	0.8	7.6	0	0	NAF-HS
23001	R1ARD33-4	CST004186	ZSLT	MSS	Siltstone	953	954	1	6.6	0.279	0.8	0.42		0.03	0.03	0	12.9	8	2.5	4.9	0.6	4.3	1	6	PAF-LC
23002	R1ARD33-4	CST004187	ZMUD	MSS	Mudstone	957	958	1	6.5	0.235	3.45	1.76		0.04	0.03	0.01	53.9	11	3.3	42.9	0.2	3.3	12	29	PAF
23004	R1ARD33-4	CST004189	ZGW	Greywacke	Greywacke	998	999	1	7.8	0.329	0.16	0.15		0.03	0.02	0.01	4.6	8	2.5	-3.4	1.7	6.2	0	1	NAF
23006	R1ARD33-4	CST004191	ZSLT	MSS	Siltstone	1025	1026	1	6.7	0.313	0.67	0.77		0.02	<0.02	0	23.6	4	1.6	19.6	0.2	2.9	11	20	PAF
23007	R1ARD33-4	CST004192	ZSLT	MSS	Siltstone	1044	1045	1	7.4	0.326	0.04	0.04		0.03	<0.02	0.01	1.2	2	2.5	-0.8	1.6	7.2	0	0	NAF
23008	WGR1D002-1	CST004193	ZGW	Greywacke	Greywacke	378	379	1	8	0.446	0.45	0.33		0.02	<0.02	0	10.1	5	1.6	5.1	0.5	4.2	1	6	PAF-LC
23010	WGR1D002-1	CST004195	FEMQ	Iron Steon	Magnetite ironstone	407	408	1	8.1	0.353	1.01	0.95	0.9	0.94	0.03	0.91	29.1	76	76.8	-46.9	2.6	7.8	0	0	NAF
23011	WGR1D002-1	CST004196	FEMQ	Iron Steon	Magnetite ironstone	442	443	1	8.2	0.529	0.92	0.59	0.57	1.68	0.03	1.65	18.1	117	137.3	-98.9	6.5	7.9	0	0	NAF
23012	WGR1D002-1	CST004197	FEMQ	Iron Steon	Magnetite ironstone	485	486	1	7.3	0.476	2.71	2.43	2.23	1.48	0.02	1.46	74.4	106	120.9	-31.6	1.4	8	0	0	NAF-HS
23013	WGR1D002-1	CST004198	FEM	Iron Steon	Magnetite ironstone	508	509	1	6.25	0.489	1.36	1.18		0.05	0.03	0.02	36.1	0	4.1	36.1	0.0	3.2	5	19	PAF
23014	WGR1D002-1	CST004199	FEM	Iron Steon	Magnetite ironstone	537	538	1	7.6	0.612	7.65	5.12	3.42	0.31	0.03	0.28	156.7	18	25.3	138.7	0.1	2.2	79	92	PAF
23015	WGR1D002-1	CST004200	ZSLT	MSS	Siltstone	551	552	1	7.5	0.246	0.93	1.31	1.05	0.01	0.03	0	40.1	6	0.8	34.1	0.1	4.2	1	7	PAF
23017	WGR1D002-1	CST004202	ZSLT	MSS	Siltstone	590	591	1	7.3	0.216	0.27	0.34		0.92	0.04	0.88	10.4	69	75.2	-58.6	6.6	7.3	0	0	NAF
23018	WGR1D002-1	CST004203	ZGW	Greywacke	Greywacke	622	623	1	7.4	0.229	1.06	1.42		0.11	0.02	0.09	43.5	12	9.0	31.5	0.3	2.8	17	29	PAF
23019	WGR1D002-1	CST004204	ZSLT	MSS	Siltstone	635	636	1	7.5	0.309	2.58	2.12		0.01	0.02	0	64.9	1	0.8	63.9	0.0	2.4	37	47	PAF
23021	WGR1D006-4	CST004206	ZGW	Greywacke	Greywacke	306	307	1	7.6	0.246	0.11	0.04		0.01	0.03	0	1.2	1	0.8	0.2	0.8	6.2	0	3	NAF
23022	WGR1D006-4	CST004207	FP	Felsic Volc	Felsic Volc	320	321	1	8.1	0.329	0.08	0.1		0.01	0.02	0	3.1	3	0.8	0.1	1.0	5.9	0	1	UC(NAF)
23023	WGR1D006-4	CST004208	ZHL	Shale	Shale	354	355	1	8	0.312	0.01	0.01		0.06	0.03	0.03	0.3	6	4.9	-5.7	19.6	7.4	0	0	NAF
23024	WGR1D006-4	CST004209	ZSLT	MSS	Siltstone	427	428	1	8.2	0.276	0.38	0.46	0.42	0.01	0.03	0	14.1	11	0.8	3.1	0.8	5	0	3	UC(NAF)
23025	WGR1D006-4	CST004210	ZSLT	MSS	Siltstone	457	458	1	7.8	0.301	0.34	0.27		0.02	0.02	0	8.3	9	1.6	-0.7	1.1	4.2	1	5	UC(PAF-LC)
23026	WGR1D006-4	CST004211	ZSLT	MSS	Siltstone	485	486	1	6.1	0.281	1.08	2.28	1.98	0.01	0.02	0	69.8	8	0.8	61.8	0.1	3.4	5	28	PAF
23027	WGR1D006-4	CST004212	ZGW	Greywacke	Greywacke	603	604	1	7.6	0.345	3.07	0.89		0.01	0.02	0	27.2	11	0.8	16.2	0.4	3.1	10	21	PAF
23028	WGR1D006-4	CST004213	ZGW	Greywacke	Greywacke	626	627	1	6.8	0.355	1.21	1.19		0.01	0.03	0	36.4	12	0.8	24.4	0.3	2.9	15	27	PAF
23029	WGR1D006-4	CST004214	ZGW	Greywacke	Greywacke	687	688	1	6.7	0.529	2.1	2.84	2.51	0.01	0.02	0	86.9	14	0.8	72.9	0.2	2.4	45	65	PAF
23030	WGR1D006-4	CST004215	ZGW	Greywacke	Greywacke	710	711	1	7.7	0.341	0.01	0.01		0.01	0.02	0	0.3	9	0.8	-8.7	29.4	7.1	0	0	NAF
23031	WGR1D007-2	CST004216	ZGW	Greywacke	Greywacke	275	276	1	7.6	0.335	0.24	0.37		0.02	0.02	0	11.3	9	1.6	2.3	0.8	3.8	3	8	PAF-LC
23032	WGR1D007-2	CST004217	FP	Felsic Volc	Felsic Volc	295	296	1	7.8	0.321	0.01	0.01		0.01	0.02	0	0.3	6	0.8	-5.7	19.6	7.2	0	0	NAF
23033	WGR1D007-2	CST004218	ZHL	Shale	Shale	321	322	1	7.9	0.329	0.03	0.02		0.07	0.02	0.05	0.6	10	5.7	-9.4	16.3	7.4	0	0	NAF
23034	WGR1D007-2	CST004219	FEMQ	Iron Steon	Magnetite ironstone	447	448	1	7.8	0.219	0.83	0.58	0.45	0.1	0.02	0.08	17.7	17	8.2	0.7	1.0	7.2	0	0	PAF-LC
23035	WGR1D007-2	CST004220	ZGW	Greywacke	Greywacke	490	491	1	8	0.239	0.37	0.29		0.02	0.02	0	8.9	12	1.6	-3.1	1.4	4.5	0	4	NAF
23036	WGR1D007-2	CST004221	ZSLT	MSS	Siltstone	513	514	1	8.1	0.248	0.81	0.74	0.75	0.01	0.02	0	22.6	13	0.8	9.6	0.6	3.9	4	13	UC(PAF-LC)
23037	WGR1D007-2	CST004222	FP	Felsic Volc	Felsic Volc	555	556	1	6.7	0.522	3.82	3.68	3.79	<0.01	<0.02	0	112.6	3	0.8	109.6	0.0	2.2	82	96	PAF
23038	WGR1D007-2	CST004223	FP	Felsic Volc	Felsic Volc	563	564	1	7.4	0.276	0.31	0.28		0.01	0.02	0	8.6	7	0.8	1.6	0.8	3.8	2	6	PAF-LC
23041	WGR1D009	CST004226	ZGW	Greywacke	Greywacke	154	155	1	7.5	0.305	0.01	0.01		0.07	<0.02	0.05	0.3	11	5.7	-10.7	35.9	7.1	0	0	NAF
23043	WGR1D009	CST004228	ZHL	Shale	Shale	184	185	1	7.6	0.246	0.01	0.01		0.04	0.02	0.02	0.3	8	3.3	-7.7	26.1	7	0	0	NAF
23047	WGR1D009	CST004232	ZHL	Shale	Shale	286	287	1	7.4	0.179	0.45	0.41		0.01	0.02	0	12.5	8	0.8	4.5	0.6	3.5	4	9	PAF-LC
23048	WGR1D009	CST004233	V	Vein	Vein	291	292	1	7.6	0.241	0.08	0.04		0.01	0.02	0	1.2	7	0.8	-5.8	5.7	7	0	0	NAF
23050	WGR1D009	CST004235	ZGW	Greywacke	Greywacke	331	332	1	7.7	0.235	0.4	0.25		0.01	0.03	0	7.7	7	0.8	0.7	0.9	4.2	0	4	PAF-LC
23052	WGR1D009	CST004237	ZSLT	MSS	Siltstone	389	390	1	8.1	0.124	0.34	0.26		0.06	0.06	0	8.0	14	4.9	-6.0	1.8	5.7	0	1	NAF
23053	WGR1D009	CST004238	FEMQ	Iron Steon	Magnetite ironstone	444	445	1	5.1	0.421	2.31	1.9		0.02	0.02	0	58.1	38	1.6	20.1	0.7	3	17	30	PAF
23054	WGR1D009	CST004239	ZSLT	MSS	Siltstone	469	470	1	5.6	0.376	4.37	4.61		0.03	0.02	0.01	141.1	12	2.5	129.1	0.1	2.8	16	41	PAF
23055	WGR1D009	CST004240	V	Vein	Vein	484	485	1	5.7	0.319	2.34	4.55	4.13	0.01	0.03	0	139.2	14	0.8	125.2	0.1	3	10	30	PAF
23056	WGR1D009	CST004241	ZSLT	MSS	Siltstone	492	493	1	7.3	0.146	0.74	0.82	0.81	0.02	0.02	0	25.1	16	1.6	9.1	0.6	3.6	4	15	UC(PAF-LC)
23057	WGR1D009	CST004242	ZSLT	MSS	Siltstone	503	504	1	6.3	0.219	7.49	4.86	4.52	0.01	0.02	0	148.7	13	0.8	135.7	0.1	2.5	32	57	PAF
23058	WGR1D009	CST004243	FEMQ	Iron Steon	Magnetite ironstone	521	522	1	5.2	0.425	2.42	2.37		0.01	0.04	0	72.5	0	0.8	72.5	0.0	2.3	50	58	PAF
23059	WGR1D009	CST004244	ZSLT	MSS	Siltstone	550	551	1	7.3	0.222	0.22	0.21		0.01	0.03	0	6.4	6	0.8	0.4	0.9	3.9	1	5	PAF-LC
23060	WGR1D009	CST004245	ZGW	Greywacke	Greywacke	573	574	1	7.6	0.235	0.01	<0.01	0.306	0.92	0.04	0.88	0.3	71	75.2	-70.7	232.0	7.8	0	0	NAF
23061	WGR1D019-3	CST004246	ZSLT	MSS	Siltstone	466	467	1	7.8	0.247	0.01	<0.01		0.02	0.03	0	0.3	4	1.6	-3.7	13.1	7.1	0	0	NAF
23062	WGR1D019-3	CST004247	ZSLT	MSS	Siltstone	514	515	1	8.1	0.255	0.94	0.69	0.61	0.07	0.03	0.04	21.1	17	5.7	4.1	0.8	5.1	0	5	UC(PAF-LC)
23063	WGR1D019-3	CST004248	F	Felsic Volc	Felsic Volc	533	534	1	8.3	0.261	0.17	0.14		0.07	0.02	0.05	4.3	16	5.7	-11.7	3.7	7.3	0	0	NAF
23064	WGR1D019-3	CST004249	ZGW	Greywacke	Greywacke	535	536	1	7.4	0.311	1.68	1.91	1.61	0.1	0.03	0.07	58.4	39	8.2	19.4	0.7	4.4	0	6	PAF
23065	WGR1D019-3	CST004250	ZSLT	MSS	Siltstone	554	555	1	7.5	0.342	1.01	0.53	0.46	0.12	0.03	0.09	16.2	14	9.8	2.2	0.9	4.6	0	4	PAF-LC
23066	WGR1D019-3	CST004251	ZSLT	MSS	Siltstone	598	599	1	7.6	0.209	0.57	0.52	0.52	0.01	0.03	0	15.9	9	0.8	6.9	0.6	3.9	3	10	UC(PAF-LC)
23067	WGR1D019-3	CST004252	F	Felsic Volc	Felsic Volc	615	616	1	8.2	0.221	0.05	0.04		0.01	0.02	0	1.2	7	0.8	-5.8	5.7	7.1	0	0	NAF
23068	WGR1D034-1	CST004253	ZGW	Greywacke	Greywacke	284	285	1	8.3	0.216	0.97	0.88		0.02	0.02	0	26.9	6	1.6	20.9	0.2	2.9	12	22	PAF

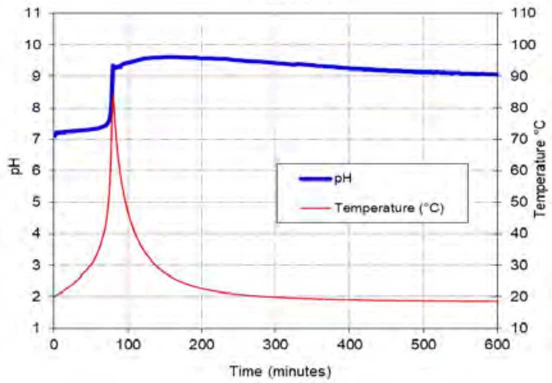
EGi Code	Hole ID	Sample ID	Lith Code	Acr.	Lithology	From	To	Interval	$pH_{1:2}$	$EC_{1:2}$	Total S (client)	Total S	CRS	Total C	Org C	TIC	MPA	ANC	ANC_{TC}	NAPP	ANC/MPA	NAGpH	$NAG_{pH4.5}$	$NAG_{pH7.0}$	AMD Class
						m	m	m		dS/m	%	%	%	%	%	%	kg H_2SO_4/t	kg H_2SO_4/t	kg H_2SO_4/t	kg H_2SO_4/t			kg H_2SO_4/t	kg H_2SO_4/t	
23070	WGR1D034-1	CST004255	ZSLT	MSS	Siltstone	387	388	1	8	0.245	0.27	0.19		0.02	0.03	0	5.8	8	1.6	-2.2	1.4	4.5	0	4	NAF
23071	WGR1D034-1	CST004256	FEM	Iron Steon	Magnetite ironstone	393	394	1	7.7	0.313	2.91	2.63	2.3	1.3	0.03	1.27	80.5	99	106.2	-18.5	1.2	7.4	0	0	UC(NAF-HS)
23072	WGR1D034-1	CST004257	FEMQ	Iron Steon	Magnetite ironstone	451	452	1	7.8	0.321	2.98	2.45	1.79	0.23	0.04	0.19	75.0	18	18.8	57.0	0.2	4.3	0	18	PAF
23073	WGR1D034-1	CST004258	FEM	Iron Steon	Magnetite ironstone	469	470	1	4	4.41	7.28	7.61	6.32	0.01	0.03	0	232.9	0	0.8	232.9	0.0	2.3	62	84	PAF
23074	WGR1D034-1	CST004259	ZSLT	MSS	Siltstone	533	534	1	7.2	0.324	1.18	0.7		0.02	0.02	0	21.4	8	1.6	13.4	0.4	3.2	7	15	PAF
23075	WGR1D043-3	CST004260	ZSLT	MSS	Siltstone	519	520	1	7.1	0.229	1.73	1.9		0.02	0.03	0	58.1	9	1.6	49.1	0.2	2.8	22	41	PAF
23076	WGR1D043-3	CST004261	ZGW	Greywacke	Greywacke	545	546	1	6.7	0.346	2.01	1.86	1.92	0.01	0.03	0	56.9	7	0.8	49.9	0.1	4.1	1	10	PAF
23077	WGR1D043-3	CST004262	ZSLT	MSS	Siltstone	667	668	1	6.5	0.409	2.73	3.4		0.01	0.03	0	104.0	13	0.8	91.0	0.1	2.7	17	35	PAF
23078	WGR1D043-3	CST004263	ZSLT	MSS	Siltstone	719	720	1	7.3	0.285	0.18	0.4	0.36	0.02	0.03	0	12.2	15	1.6	-2.8	1.2	4.7	0	2	NAF
23079	WGR1D044-3	CST004264	ZSLT	MSS	Siltstone	479	480	1	7.4	0.291	0.65	0.41		0.27	0.02	0.25	12.5	25	22.1	-12.5	2.0	7.3	0	0	NAF
23081	WGR1D044-3	CST004266	ZSLT	MSS	Siltstone	513	514	1	6.5	0.629	3.21	3.07		0.01	0.02	0	93.9	13	0.8	80.9	0.1	3	9	26	PAF
23082	WGR1D044-3	CST004267	ZSLT	MSS	Siltstone	559	560	1	7.4	0.271	0.38	0.38		0.01	0.03	0	11.6	11	0.8	0.6	0.9	4.1	1	6	PAF-LC
23083	WGR1D044-3	CST004268	ZSLT	MSS	Siltstone	602	603	1	7.9	0.289	0.53	0.4		<0.01	0.03	0	12.2	5	0.8	7.2	0.4	3.7	2	6	PAF-LC
23084	WGR1D049-2	CST004269	ZSLT	MSS	Siltstone	376	377	1	6.8	0.524	3.86	4.01		0.01	0.03	0	122.7	10	0.8	112.7	0.1	2.5	32	53	PAF
23085	WGR1D049-2	CST004270	ZSST	MSS	Sandstone	400	401	1	7.7	0.224	0.12	0.09		0.01	0.03	0	2.8	7	0.8	-4.2	2.5	4.6	0	3	NAF
23086	WGR1D049-2	CST004271	ZSLT	MSS	Siltstone	504	505	1	7.8	0.316	1.13	1.01		0.01	0.03	0	30.9	13	0.8	17.9	0.4	3.2	11	23	PAF
23087	WGR1D049-2	CST004272	FS	Felsic Volc	Felsic Volc	538	539	1	8	0.611	0.88	0.77		0.03	0.03	0	23.6	11	2.5	12.6	0.5	2.8	12	22	PAF
23088	WGR1D049-2	CST004273	ZSLT	MSS	Siltstone	549	550	1	8.2	0.189	0.29	0.24		0.03	<0.02	0.01	7.3	4	2.5	3.3	0.5	4.4	0	3	PAF-LC
23089	WGR1D049-2	CST004274	ZSST	MSS	Sandstone	566	567	1	8.3	0.239	0.79	0.46		0.03	0.02	0.01	14.1	10	2.5	4.1	0.7	3.2	5	10	PAF
23091	WGR1D053	CST004276	ZSLT	MSS	Siltstone	228	229	1	7.9	0.249	0.005	0.01		0.34	0.02	0.32	0.3	31	27.8	-30.7	101.3	7.3	0	0	NAF
23093	WGR1D053	CST004278	ZSLT	MSS	Siltstone	319	320	1	7.7	0.276	0.01	0.01		0.67	0.02	0.65	0.3	52	54.7	-51.7	169.9	8.4	0	0	NAF
23094	WGR1D053	CST004279	ZHL	Shale	Shale	448	449	1	7.8	0.304	0.06	0.03		0.03	0.03	0	0.9	9	2.5	-8.1	9.8	7.1	0	0	NAF
23095	WGR1D053	CST004280	ZSLT	MSS	Siltstone	455	456	1	8.3	0.324	0.08	0.03		0.02	0.02	0	0.9	12	1.6	-11.1	13.1	7	0	0	NAF
23098	WGR1D053	CST004283	ZMUD	MSS	Mudstone	502	503	1	8.1	0.229	0.03	0.01		0.03	<0.02	0.01	0.3	7	2.5	-6.7	22.9	7.1	0	0	NAF
23099	WGR1D053	CST004284	F	Felsic Volc	Felsic Volc	625	626	1	7.7	0.235	0.52	0.05		0.03	0.03	0	1.5	6	2.5	-4.5	3.9	7.1	0	0	NAF
23101	WGR1D053	CST004286	ZSST	MSS	Sandstone	640	641	1	7.4	0.146	0.4	0.4		0.02	0.02	0	12.2	9	1.6	3.2	0.7	3.9	2	7	PAF-LC
23102	WGR1D053	CST004287	FEM	Iron Steon	Magnetite ironstone	650	651	1	6.7	2.28	2.4	1.99	1.45	0.15	0.02	0.13	60.9	13	12.3	47.9	0.2	3.5	3	27	PAF
23103	WGR1D053	CST004288	FEMQ	Iron Steon	Magnetite ironstone	687	688	1	7.5	1.71	0.94	1.16		1.66	0.02	1.64	35.5	115	135.6	-79.5	3.2	8.1	0	0	NAF-HS
23104	WGR1D053	CST004289	ZSLT	MSS	Siltstone	691	692	1	6.7	0.612	2.23	2.6	2.46	0.03	0.03	0	79.6	13	2.5	66.6	0.2	3.3	5	22	PAF
23106	WGR1D053	CST004291	F	Felsic Volc	Felsic Volc	703	704	1	7.3	0.255	2.34	2.42	2.14	0.02	<0.02	0	74.1	14	1.6	60.1	0.2	4.6	1	14	PAF
23107	WGR1D053	CST004292	FEM	Iron Steon	Magnetite ironstone	720	721	1	7.6	0.269	0.46	0.38	0.39	0.06	0.02	0.04	11.6	17	4.9	-5.4	1.5	4.8	0	2	NAF
23108	WGR1D053	CST004293	ZSLT	MSS	Siltstone	732	733	1	8.1	0.203	1.44	0.82		0.05	<0.02	0.03	25.1	8	4.1	17.1	0.3	3.1	7	16	PAF
23109	WGR1D053	CST004294	ZSST	MSS	Sandstone	750	751	1	8.3	0.185	0.93	1.02		0.01	<0.02	0	31.2	8	0.8	23.2	0.3	2.7	16	27	PAF
23110	20CRD002	CST004295	SDSL		Dolomitic siltstone	67	68.8	1.8	8.4	0.196		0.02		2.36	<0.02	2.34	0.6	193	192.8	-192.4	315.4	8.1	0	0	NAF
23114	20CRD002	CST004299	SDO		Dolomite	96.66	97	0.34	8	0.179		0.35		11.45	0.17	11.28	10.7	797	935.5	-859.3	81.2	8.5	0	0	NAF
23119	20CRD003	CST004304	SDSS		Dolomitic sandstone	66.2	66.4	0.2	7.8	0.188		0.04		8.1	0.04	8.06	1.2	630	661.8	-628.8	514.7	8.4	0	0	NAF
23120	20CRD003	CST004305	SDST		Dolomitic sandstone	94.8	95	0.2	7.8	0.146		0.04		8.52	0.03	8.49	1.2	702	696.1	-700.8	573.5	8.6	0	0	NAF
23121	21CRD002	CST004306	SST		Sandstone	68.5	68.75	0.25	8.1	0.203		0.01		1.66	0.03	1.63	0.3	147	135.6	-146.7	480.4	8.2	0	0	NAF
23129	21CRD002	CST004314	SDO		Dolomite	91.33	91.47	0.14	7.9	0.185		0.11		7.93	0.06	7.87	3.4	635	647.9	-631.6	188.7	8.3	0	0	NAF
23133	21CRD005	CST004318	SSL		Siltstone	57.68	57.92	0.24	8.3	0.194		0.46		1.82	0.16	1.66	14.1	144	148.7	-129.9	10.2	8.5	0	0	NAF
23140	21CRD005	CST004325	SSL		Siltstone	64.25	64.4	0.15	8.4	0.166		0.28		5.76	0.11	5.65	8.6	394	470.6	-385.4	46.0	8.7	0	0	NAF
23143	21CRD005	CST004328	SMD		Mudstone	92.55	92.75	0.2	8.2	0.157		0.02		6.32	0.07	6.25	0.6	511	516.3	-510.4	835.0	8.4	0	0	NAF

APPENDIX B
Sequential NAG test results

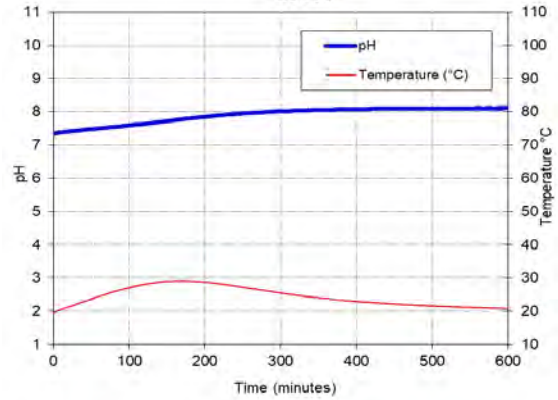
EGi Sample Code	CRS	Total S	ANC	NAPP	STAGE 1			STAGE 2			STAGE 3			STAGE 4			STAGE 5			Cumulative NAG	
					NAGpH	$NAG_{pH4.5}$	$NAG_{pH7.0}$	NAGpH	$NAG_{pH4.5}$	$NAG_{pH7.0}$	NAGpH	$NAG_{pH4.5}$	$NAG_{pH7.0}$	NAGpH	$NAG_{pH4.5}$	$NAG_{pH7.0}$	NAGpH	$NAG_{pH4.5}$	$NAG_{pH7.0}$	$NAG_{pH4.5}$	$NAG_{pH7.0}$
	%	%	kg H_2SO_4/t			kg H_2SO_4/t			kg H_2SO_4/t			kg H_2SO_4/t			kg H_2SO_4/t			kg H_2SO_4/t		kg H_2SO_4/t	
22994	0.37	0.63	7	12	4.1	1	6	4.3	0.2	2	4.8	0	1	6.2	0	0.3		0	0	1.0	9.0
22998	3.4	3.99	66	56	7.8	0	0	7.7	0	0	7.2	0	0	2.8	19	38		0	0	19.2	37.5
23000	2.17	2.37	55	18	7.7	0	0	7.5	0	0	7.4	0	0	7.6	0	0	7.9	0	0	0.0	0.0
23012	2.23	2.43	106	-32	7.8	0	0	7.8	0	0	7.9	0	0	7.7	0	0	8.1	0	0	0.0	0.0
23013	-	1.18	0	36	3.2	3	18	3.1	4	6	3.4	1	3	4.7	0	2		0	0	8.3	27.9
23015	1.05	1.31	6	34	4	1	6	2.9	8	14	3.2	4	6	4.4	0.1	1		0	0	13.5	27.5
23024	0.42	0.46	11	3	4.8	0	1	4.7	0	1	7.2	0	0	7.1	0	0		0	0	0.0	2.0
23026	1.98	2.28	8	62	3.3	4	26	2.8	11	16	2.7	12	15	3.8	1	3		0	0	27.7	59.5
23034	0.45	0.58	17	1	7.3	0	0	5.9	0	0.3	4.3	0.2	6	4.4	0.2	2	7.5	0	0	0.4	7.8
23036	0.75	0.74	13	10	3.8	2	10	4.5	0	1	4.8	0	1	5.8	0	0.2		0	0	2.4	12.1
23056	0.81	0.82	16	9	3.6	3	11	4.3	0.2	2	4.7	0	1	5.4	0	0.2		0	0	3.7	13.7
23062	0.61	0.69	17	4	4.9	0	4	3.8	1	4	4.1	0	2	5.1	0	1		0	0	1.1	10.7
23064	1.61	1.91	39	19	4.7	0	5	3.9	1	6	3.5	3	7	3.4	5	11		0	0	8.1	29.3
23065	0.46	0.53	14	2	4.5	0	3	4.6	0	1	4.8	0	0.4	4.9	0	1		0	0	0.0	5.2
23066	0.52	0.52	9	7	3.8	2	9	4.4	0	2	4.9	0	0.4	5.9	0	0.2		0	0	2.2	11.0
23072	1.79	2.45	18	57	4.1	2	17	2.9	9	15	2.7	13	15	4	0.4	2		0	0	24.5	48.0
23076	1.92	1.86	7	50	4	1	8	3.1	7	17	3.2	5	9	4.1	0.3	2		0	0	13.4	35.1
23102	1.45	1.99	13	48	3.5	3	24	3.4	2	8	3.3	2	4	4.2	0.3	1		0	0	7.3	37.5
23104	2.46	2.6	13	67	3.3	3	21	2.7	11	19	2.6	14	17	4.1	0.4	2		0	0	28.7	59.3
23106	2.14	2.42	14	60	4.3	1	12	2.8	10	21	2.8	12	17	4.2	0.4	2		0	0	24.1	51.0

APPENDIX C
Kinetic NAG test results

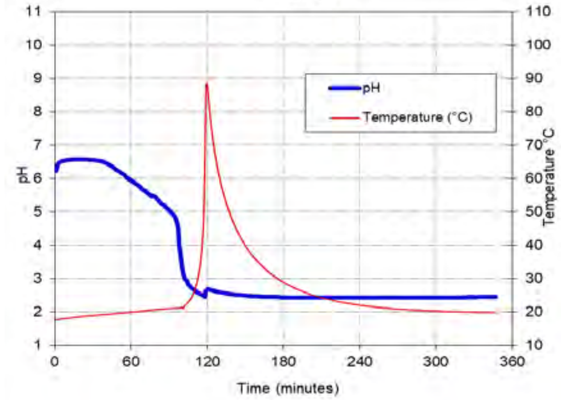
22998



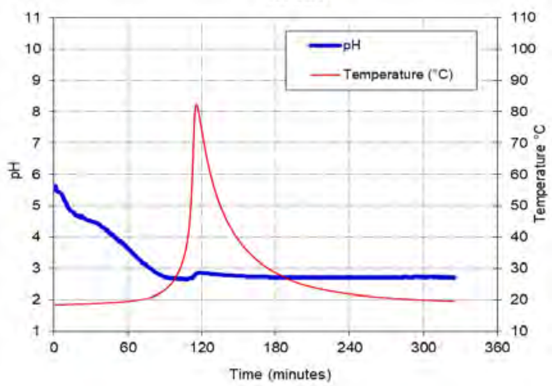
23000



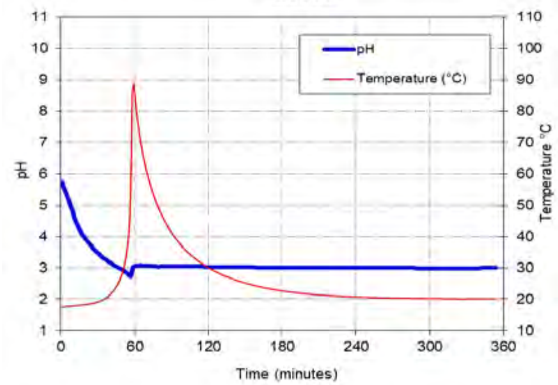
23014



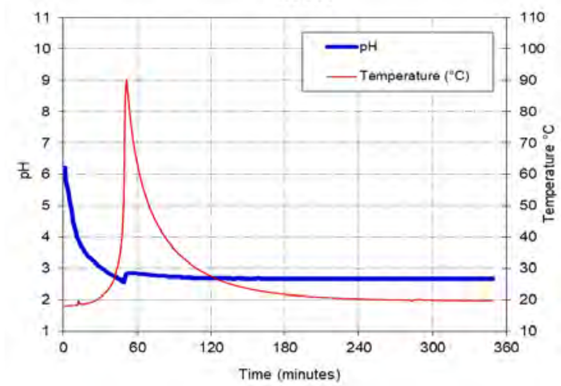
23029



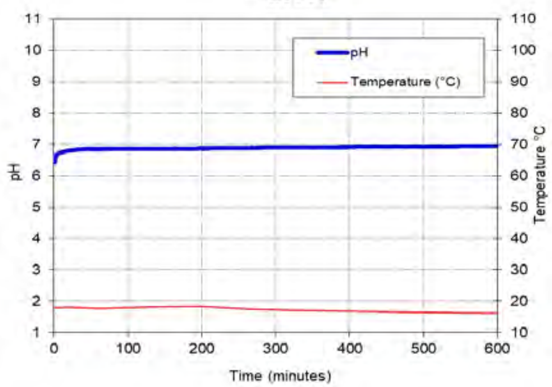
23055



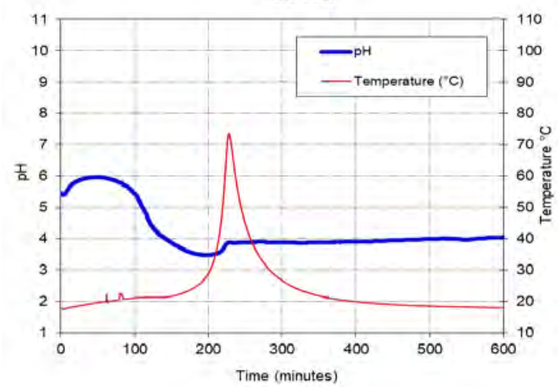
23057



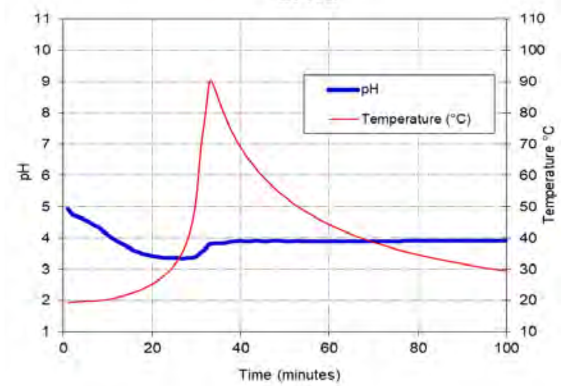
23065



23072



23102



APPENDIX D
ABCC test results

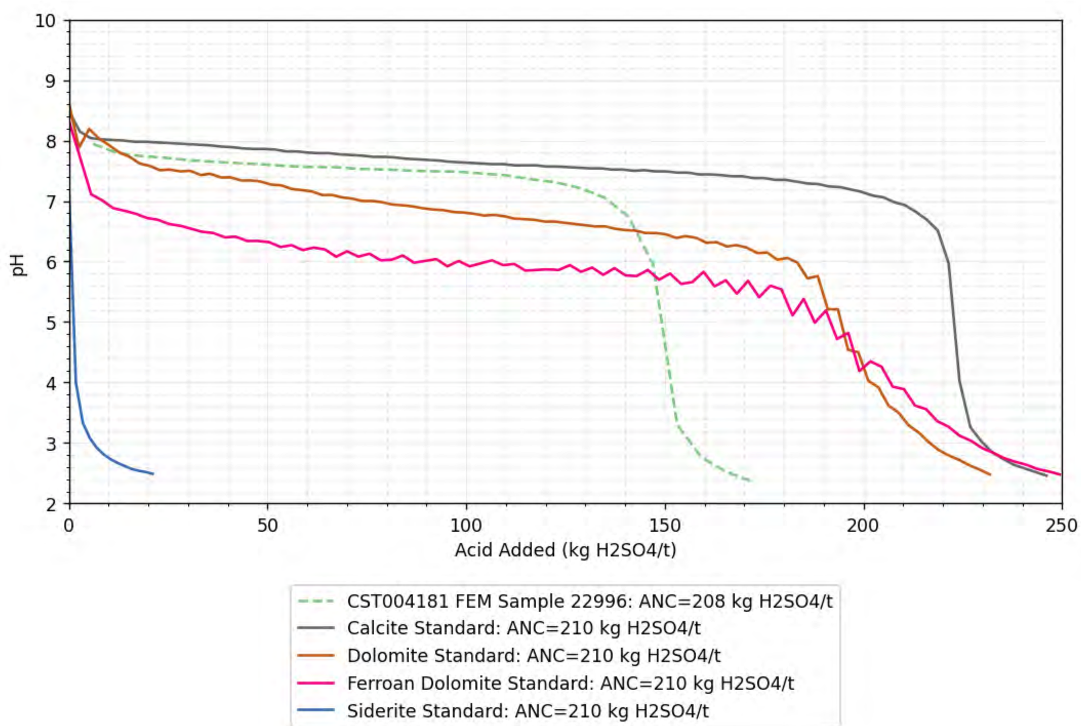


Figure 1: ABCC profile for sample 22996 with an ANC value close to 210 kg H2SO4/t. Carbonate standard curves are included for reference.

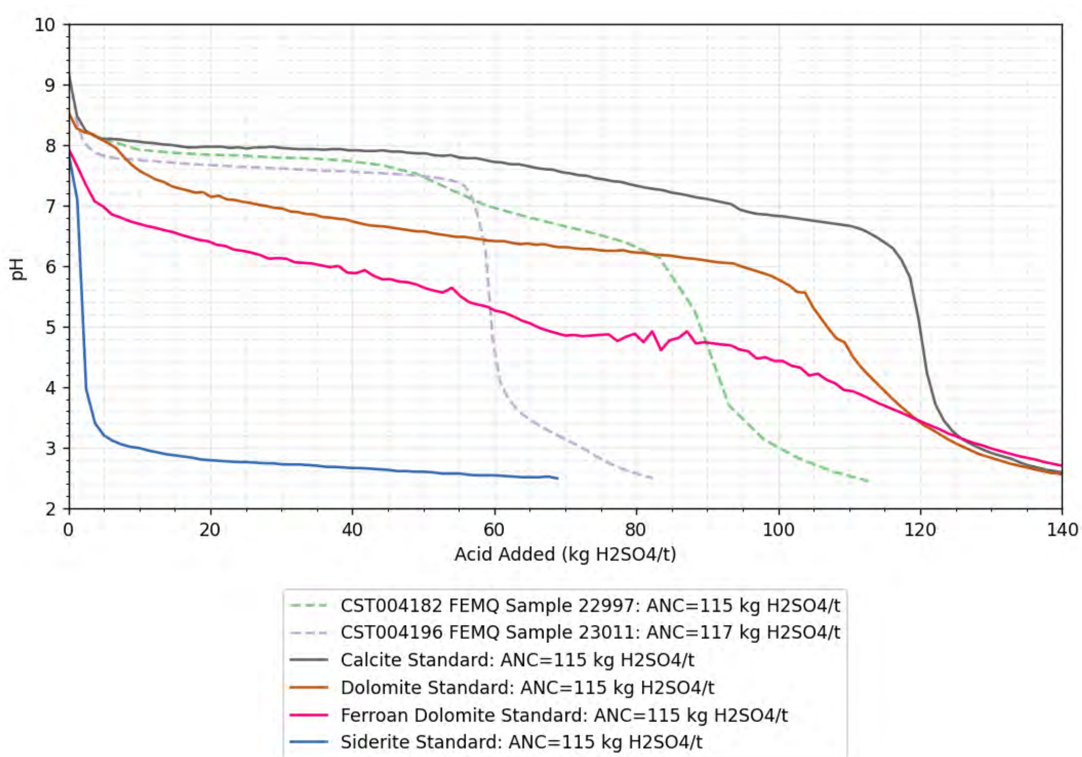


Figure 2: ABCC profile for samples 22997, 23011 with an ANC value close to 115 kg H2SO4/t. Carbonate standard curves are included for reference.

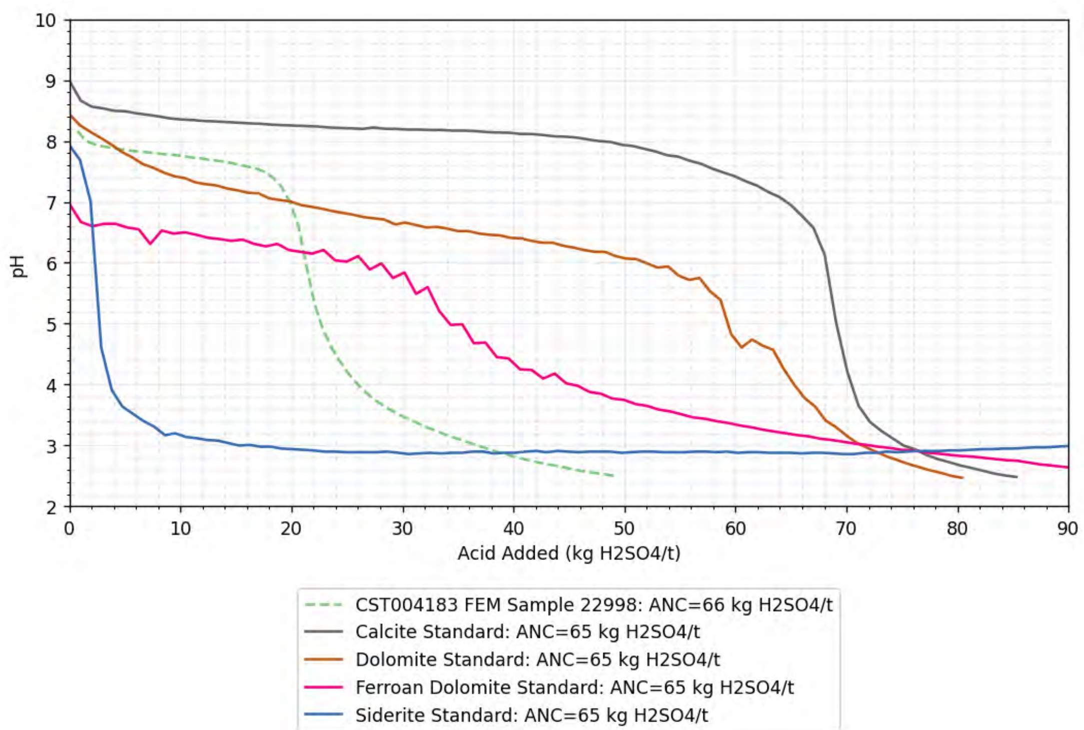


Figure 3: ABCC profile for sample 22998 with an ANC value close to 65 kg H2SO4/t. Carbonate standard curves are included for reference.

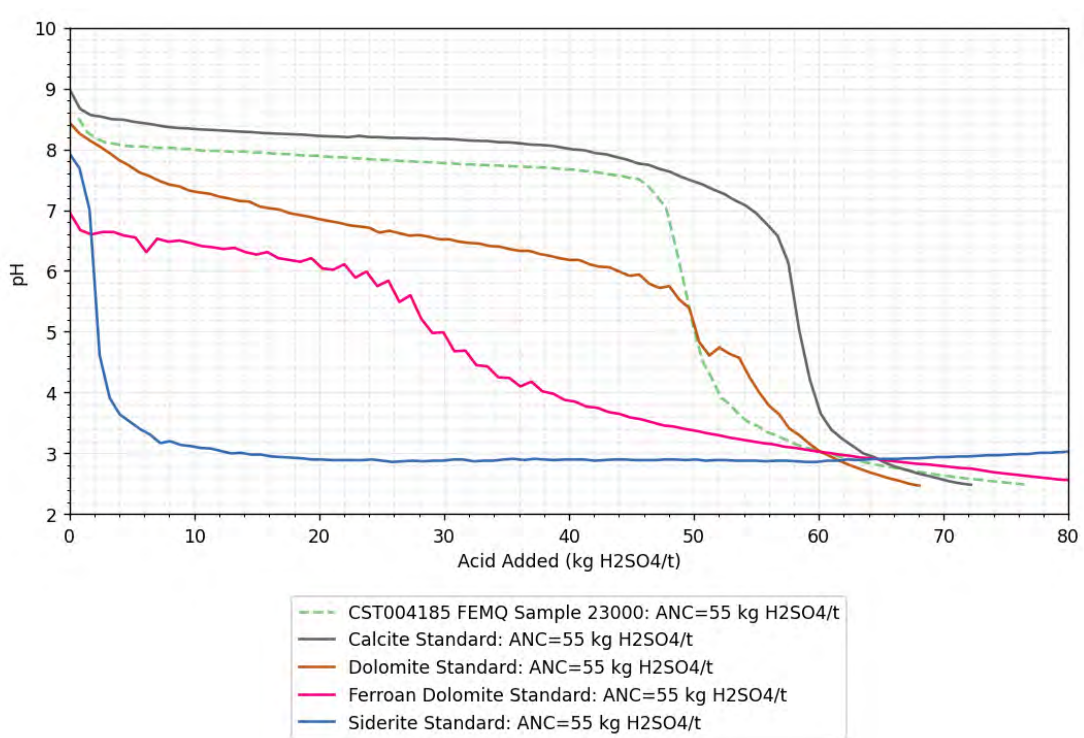


Figure 4: ABCC profile for sample 23000 with an ANC value close to 55 kg H2SO4/t. Carbonate standard curves are included for reference.

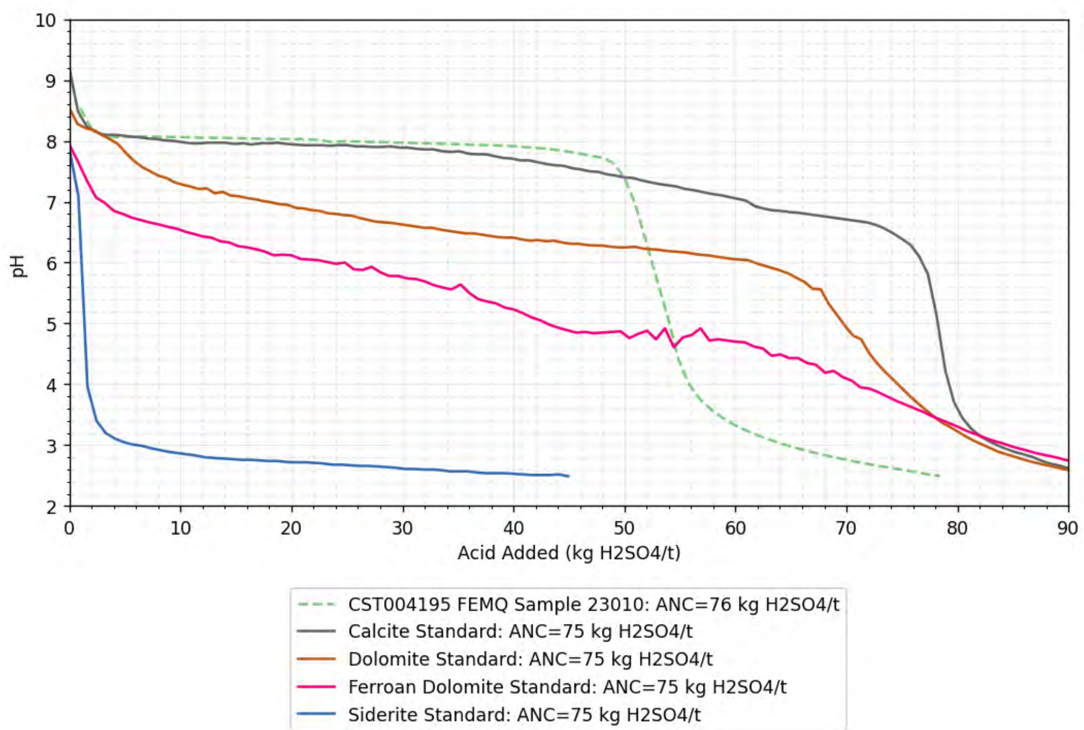


Figure 5: ABCC profile for sample 23010 with an ANC value close to 75 kg H2SO4/t. Carbonate standard curves are included for reference.

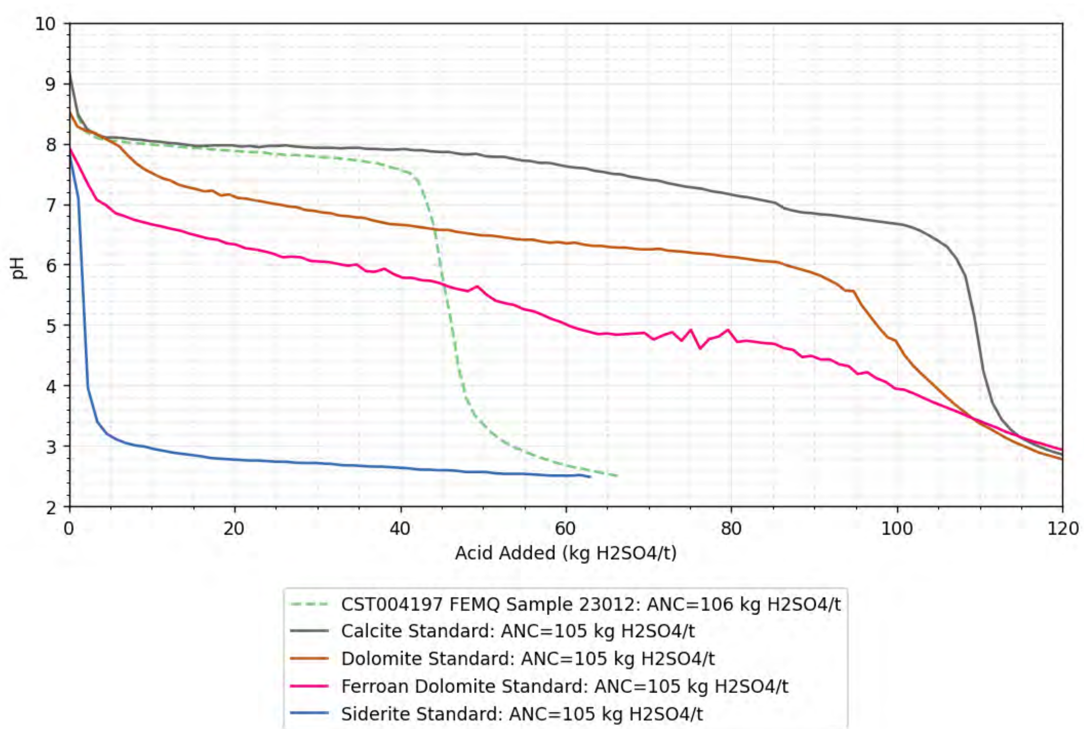


Figure 6: ABCC profile for sample 23012 with an ANC value close to 105 kg H2SO4/t. Carbonate standard curves are included for reference.

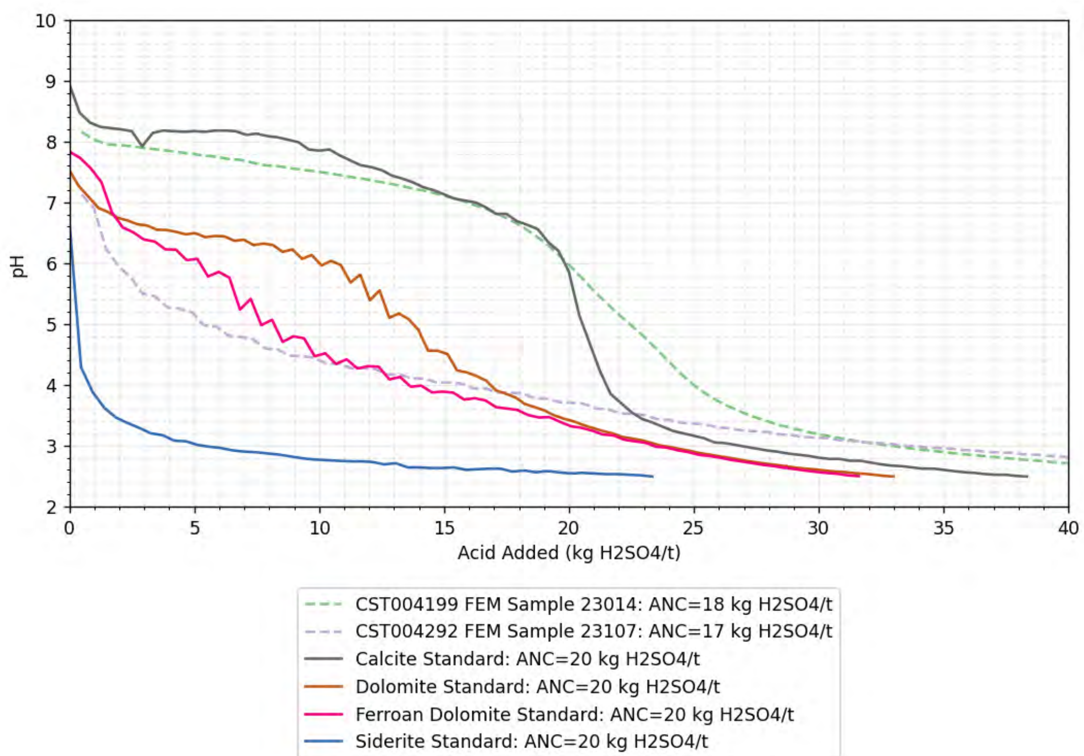


Figure 7: ABCC profile for samples 23014, 23107 with an ANC value close to 20 kg H2SO4/t. Carbonate standard curves are included for reference.

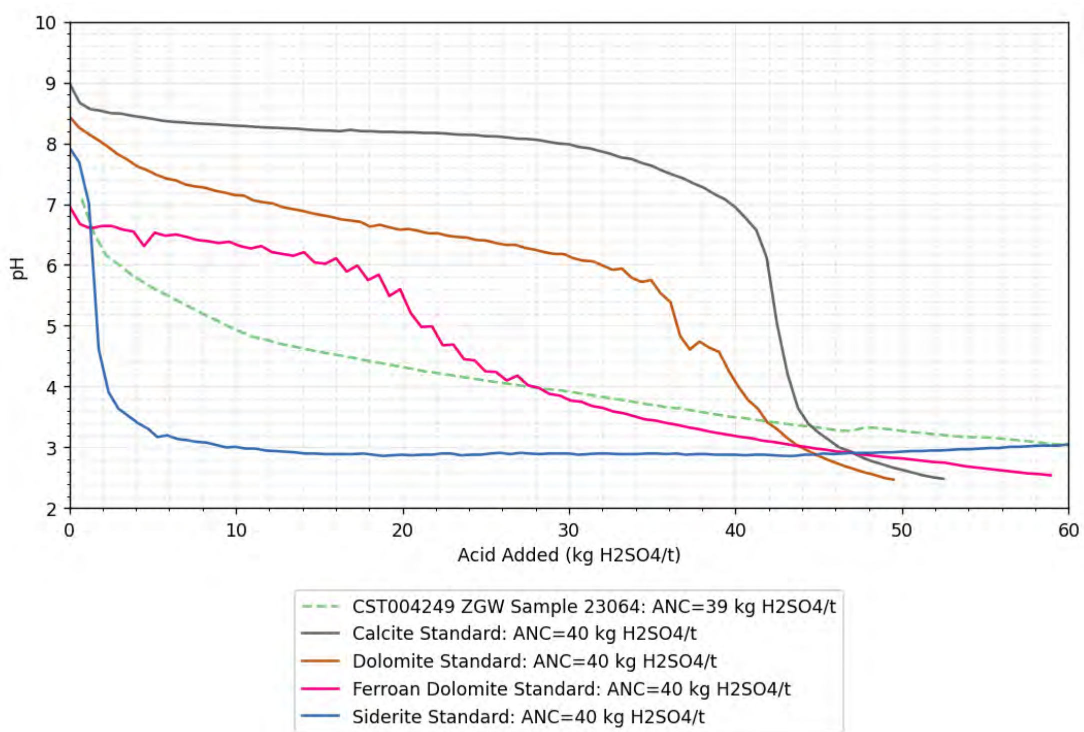


Figure 8: ABCC profile for sample 23064 with an ANC value close to 40 kg H2SO4/t. Carbonate standard curves are included for reference.

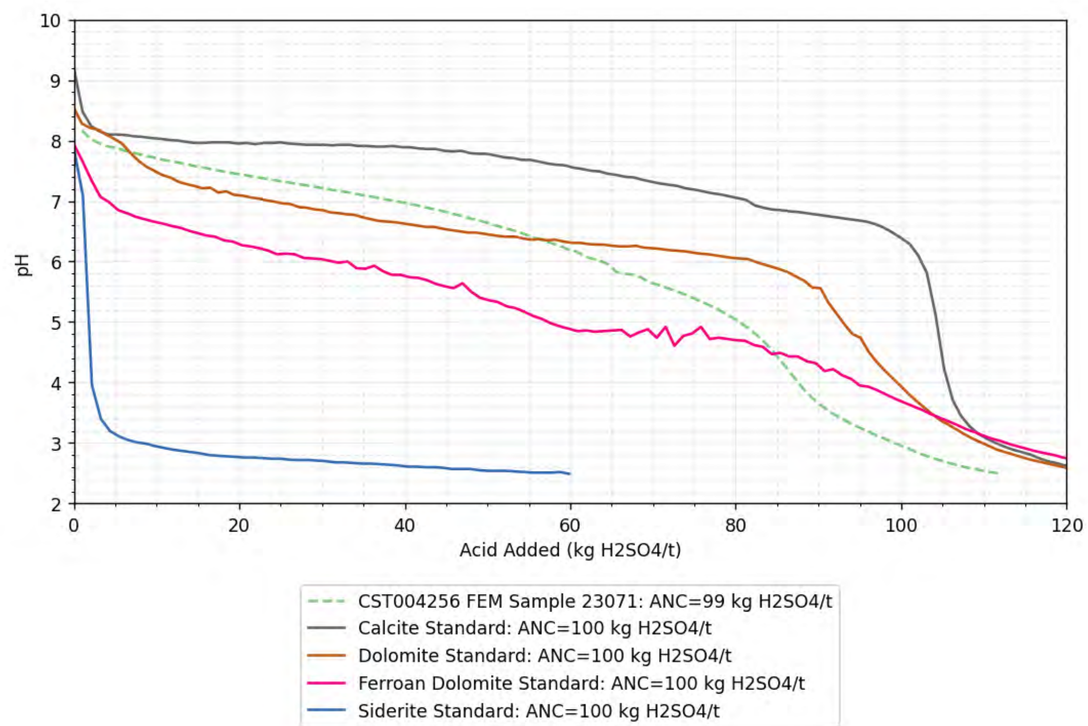


Figure 9: ABCC profile for sample 23071 with an ANC value close to 100 kg H2SO4/t. Carbonate standard curves are included for reference.

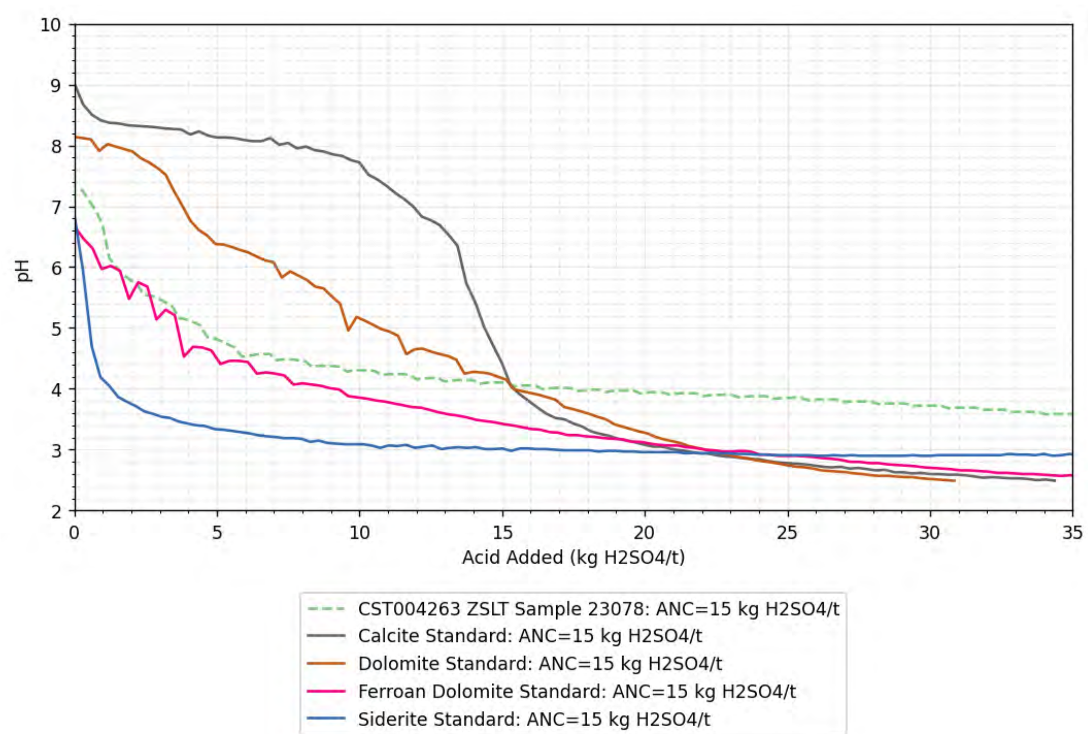


Figure 10: ABCC profile for sample 23078 with an ANC value close to 15 kg H2SO4/t. Carbonate standard curves are included for reference.

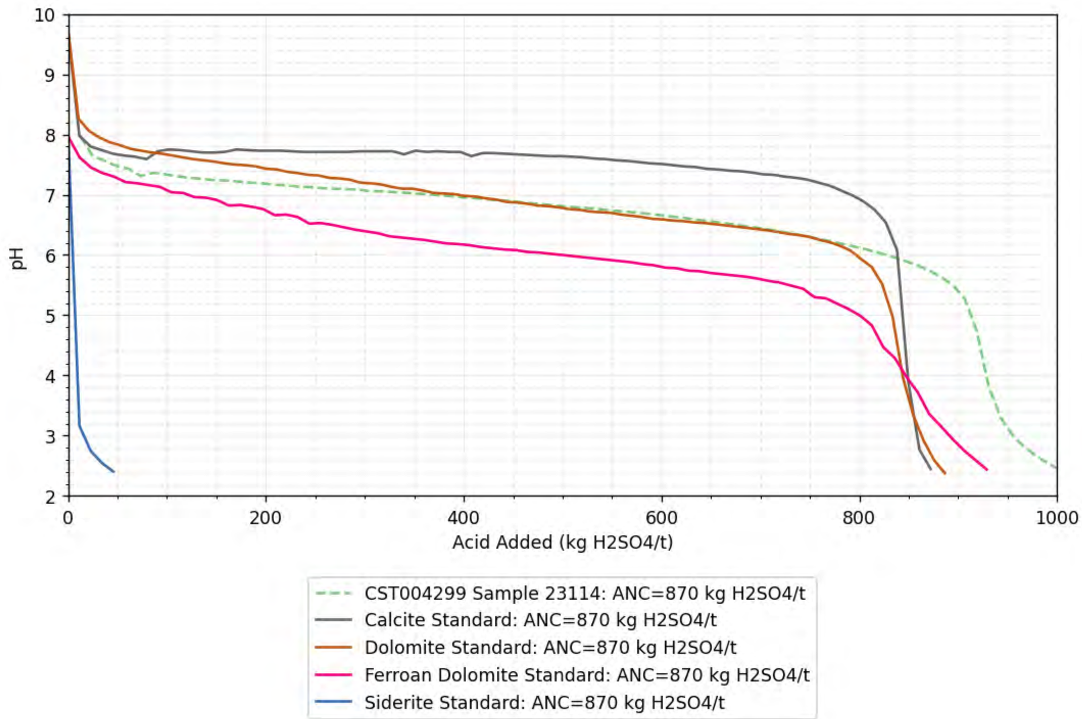


Figure 11: ABCC profile for sample 23114 with an ANC value close to 870 kg H2SO4/t. Carbonate standard curves are included for reference.

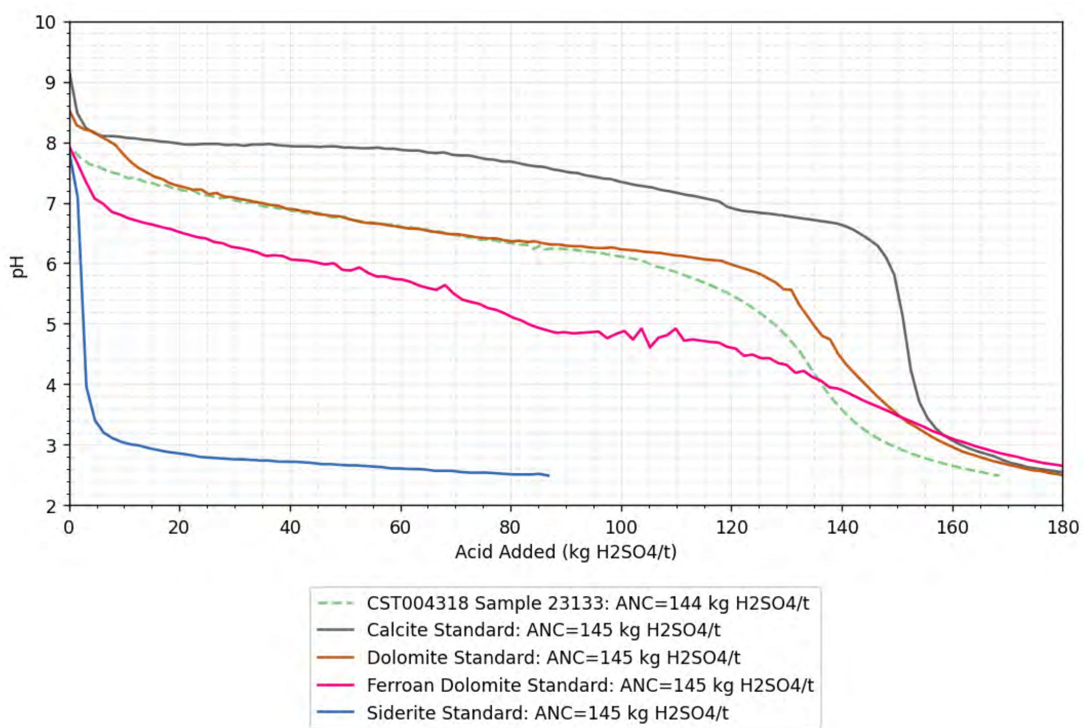


Figure 12: ABCC profile for sample 23133 with an ANC value close to 145 kg H2SO4/t. Carbonate standard curves are included for reference.

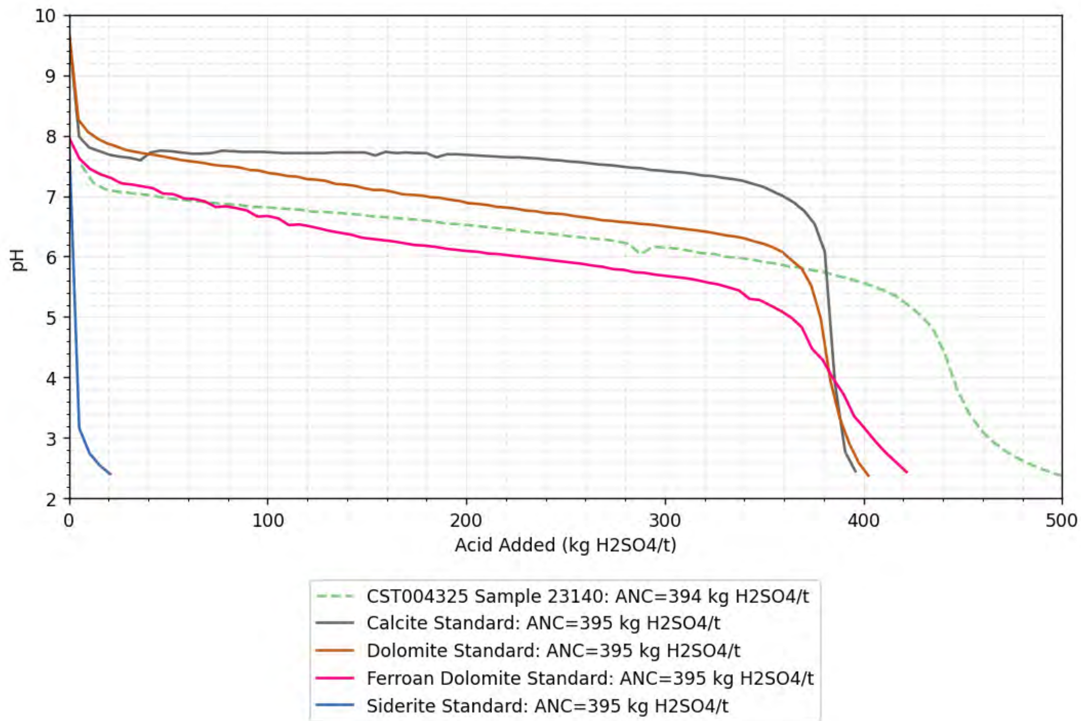


Figure 13: ABCC profile for sample 23140 with an ANC value close to 395 kg H2SO4/t. Carbonate standard curves are included for reference.

APPENDIX E
Multi-element analysis results and GAI

Element	Detection Limit	Sample Numl																			
		22988	22994	22996	22997	22998	23000	23010	23011	23012	23013	23014	23015	23022	23024	23026	23029	23034	23036	23037	23055
Ag	0.01	<0.01	0.08	0.2	0.22	2.05	0.2	0.22	0.1	0.53	2.28	0.39	0.35	0.01	0.05	0.98	0.46	0.97	0.14	0.29	0.63
Al	0.01%	6.77%	5.01%	0.05%	0.04%	0.03%	0.21%	0.14%	0.08%	0.03%	0.06%	0.15%	3.60%	5.42%	5.10%	1.68%	3.72%	1.03%	5.34%	7.46%	4.57%
As	0.2	1.4	8.7	74.2	26	877	294	65.3	53.1	331	38.3	262	120.5	1.7	9.6	24	73.6	156	22.5	163	258
Ba	10	10	20	<10	<10	<10	<10	<10	<10	<10	<10	10	10	190	<10	10	10	<10	20	230	<10
Be	0.05	1.48	1.96	24.2	15.55	3.07	8.23	13	14.3	9.09	4.22	1.19	0.94	1.72	1.83	0.59	0.64	6.89	1.28	4.34	0.63
Bi	0.01	0.44	3.02	4.23	91.3	109.5	5.68	4.44	14.65	88.8	395	618	125.5	0.46	1.28	50.4	96.2	2860	11.5	31.9	286
Ca	0.01%	0.06%	0.01%	8.35%	4.43%	1.04%	2.02%	2.89%	5.10%	4.47%	0.16%	0.63%	0.01%	0.06%	0.06%	0.01%	0.04%	0.31%	0.01%	0.05%	0.02%
Cd	0.02	<0.02	<0.02	0.02	<0.02	<0.02	0.02	0.02	0.02	0.03	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02
Ce	0.01	72.3	263	16.6	6.04	10.6	7.77	10.1	7.98	21.4	1.8	2.93	76	73	76.6	29.8	61.6	15	52.3	100.5	76.2
Co	0.1	32.4	354	123.5	50.1	1450	178.5	79.5	122.5	458	174	550	366	16.6	96	259	90.7	446	119.5	105.5	807
Cr	1	107	306	113	128	386	186	257	114	158	112	421	229	245	219	459	224	375	149	171	271
Cs	0.05	0.48	0.4	0.12	0.1	0.08	0.16	0.25	0.15	0.05	0.06	<0.05	0.08	2.93	0.18	0.07	0.1	0.13	0.29	5.61	0.09
Cu	0.2	3.1	320	816	1670	12200	847	1675	48.9	6200	9340	174.5	1400	156	925	10050	18.8	2500	26.5	31.6	4240
Fe	0.01%	13.40%	11.75%	37.50%	36.70%	>50%	>50%	>50%	43.70%	>50%	>50%	>50%	9.58%	9.97%	14.45%	6.49%	11.95%	34.50%	12.00%	5.88%	14.20%
Ga	0.05	28.7	28.8	4.74	7.69	12	9	11.3	10.8	6.8	13.95	17.4	18.1	14.2	25.4	14.35	39.5	45.1	23.8	20.5	32.7
Ge	0.05	0.47	0.4	0.29	0.52	3.19	4.53	6.44	5.26	7.43	5.3	2.4	0.14	0.18	0.16	0.07	0.2	6.33	0.1	0.17	0.25
Hf	0.1	3	4.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	2.7	4.4	2.6	0.9	1.1	0.4	6.4	4.4	2.1
Hg	0.005	<0.005	0.197	0.009	0.015	0.53	0.111	0.013	0.006	0.043	0.074	0.167	0.317	0.005	0.006	0.047	0.034	0.027	0.017	0.059	0.141
In	0.005	0.19	0.104	1.755	1.72	4.25	1.07	0.753	0.67	5.38	4.09	0.726	0.492	0.205	0.254	0.908	0.139	1.74	0.304	0.355	1.295
K	0.01%	0.02%	0.01%	0.01%	0.01%	0.01%	0.01%	0.03%	0.02%	0.01%	0.01%	0.01%	0.01%	1.22%	0.02%	0.01%	0.01%	0.01%	0.11%	3.66%	0.01%
La	0.5	37.2	144.5	9.7	3.3	6.6	3.7	5.5	4.4	12.8	0.9	1.1	39.9	38	39.7	17.4	35.6	8.1	29.1	48.2	45.9
Li	0.2	35.7	28.8	0.6	0.6	0.7	0.6	0.7	0.6	0.6	0.5	0.8	8.2	13.2	15.8	6.9	12.4	3	24.4	6	20.7
Mg	0.01%	5.11%	3.05%	0.07%	0.49%	0.03%	0.11%	0.06%	0.04%	0.07%	0.07%	0.38%	2.57%	1.08%	3.08%	1.04%	2.76%	0.63%	2.89%	0.60%	2.54%
Mn	5	660	591	2790	2700	476	663	1175	1460	1865	195	188	439	496	506	282	414	381	470	97	699
Mo	0.05	1.36	4.25	9.55	12.4	57.4	10.8	29	15.45	28.4	91.2	33	23.3	4.04	6.16	76.8	75.8	138.5	9.64	7.59	63.8
Na	0.01%	0.02%	0.01%	0.02%	0.02%	0.01%	0.02%	0.03%	0.02%	0.01%	0.02%	0.01%	0.01%	0.02%	0.01%	0.01%	0.01%	0.02%	0.01%	0.06%	0.01%
Nb	0.1	7.9	14.6	0.3	0.2	0.2	0.4	0.3	0.2	0.1	0.1	0.3	6.3	8.6	6.7	2.6	3.7	1	15.7	12.1	5.7
Ni	0.2	26.9	24.9	21.9	39.8	51.1	30.1	40.2	42	23.5	35.7	27.5	25.1	17.3	35.6	56.2	27.9	56.2	11	20.6	33.4
P	10	260	140	300	160	110	460	190	160	110	120	300	50	300	290	40	210	510	30	230	130
Pb	0.5	1.9	6.4	3.4	18.6	27.2	6	6.2	5.9	35.3	58.8	58.4	16.2	2.4	3.1	25.2	20	103.5	6.9	11.7	37.9
Rb	0.1	1.3	1	0.3	0.4	0.3	0.3	1.1	0.5	0.4	0.3	0.2	0.6	71.3	1.1	0.6	0.7	0.6	5.6	185.5	0.3
Re	0.002	<0.002	<0.002	0.002	0.002	0.004	0.002	0.002	0.002	0.002	0.005	0.007	0.003	<0.002	<0.002	0.003	0.01	0.015	<0.002	0.003	0.003
S	0.01%	0.01%	0.66%	0.55%	0.22%	4.04%	2.29%	1.01%	0.62%	2.30%	1.15%	4.83%	1.34%	0.10%	0.46%	2.25%	2.73%	0.60%	0.77%	3.72%	4.23%
Sb	0.05	1.68	2.91	15.8	20.4	36.7	25.3	34.8	27.4	22.6	18	17.15	4.82	3.52	5.69	2.87	2.19	59.3	3.33	4.88	12.9
Sc	0.1	11.7	4.3	0.3	0.1	0.1	0.7	0.9	0.4	0.2	0.8	0.6	3.2	6	8.5	1.8	3.9	1.9	4.6	12.9	6.8
Se	1	<1	1	<1	<1	<1	1	1	1	1	40	25	1	<1	<1	1	30	11	<1	<1	1
Sn	0.2	1.5	1.6	2.1	1.3	1.6	5	1.2	1	0.6	2.8	1.6	1	2.9	3.7	1.1	12.1	1.6	1.3	4.3	0.9
Sr	0.2	2	2.5	40.9	14.4	5.5	12.5	10.7	29.9	14.4	1.2	2.1	1.7	3.1	2.3	1	1	2.2	2.3	4.5	1
Ta	0.05	0.67	0.89	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.53	0.74	0.56	0.23	0.36	0.07	1.28	1.09	0.54
Te	0.05	<0.05	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.79	<0.05	<0.05	<0.05	<0.05
Th	0.01	15.35	18.5	0.1	0.04	0.03	0.37	0.23	0.06	0.04	0.03	0.06	12.15	16.05	12.05	5.04	6.73	1.91	20.4	21	11
Ti	0.005%	0.177%	0.081%	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.039%	0.125%	0.141%	0.037%	0.062%	0.017%	0.067%	0.206%	0.106%
Tl	0.02	<0.02	0.04	<0.02	<0.02	0.11	0.04	<0.02	<0.02	<0.02	0.05	0.05	0.09	0.17	0.03	0.25	0.08	0.07	0.04	0.8	0.12
U	0.1	2.6	4.5	0.9	3	7.7	10	3	4.7	6	8.1	119.5	5	3.8	3.8	6.5	25	12.5	6.1	4.8	4
V	1	36	14	7	4	9	13	14	11	7	7	16	5	16	31	9	20	14	3	33	19
W	0.1	2.3	1.7	26.6	13.8	15.2	59.5	19.8	23.1	2.8	24.2	21.1	0.6	1.3	11	1.4	15	8.1	0.5	4.1	1.8
Y	0.1	18.7	28.9	19	6.3	2.7	7.2	10.3	9.8	10.4	3.2	5	17.1	27.1	17.4	6.7	19	8.8	36.6	29.8	10.5
Zn	2	113	76	5	6	9	8	7	4	12	7	5	51	63	80	30	43	19	69	11	74
Zr	0.5	107.5	135	0.9	<0.5	<0.5	2.3	1.8	<0.5	<0.5	<0.5	<0.5	91.2	162.5	92.4	29.6	34.7	15	206	143.5	70.1
	Note: the unit of the element concentrations is mg/kg, except for the ones which "%" is used.																				

Element	ber																		
	23056	23057	23062	23064	23065	23066	23071	23072	23073	23076	23078	23102	23104	23106	23107	23114	23119	23133	23140
Ag	0.11	0.38	0.27	0.37	0.29	0.08	0.85	5.48	0.5	0.28	0.11	1.56	1.18	0.34	0.52	0.16	0.04	0.35	0.4
Al	7.48%	4.86%	2.53%	4.36%	2.53%	7.65%	0.76%	0.37%	0.20%	6.64%	3.89%	0.85%	2.88%	4.86%	3.31%	0.25%	1.74%	6.87%	6.79%
As	61.1	122	75.4	98.9	24.7	62.7	106.5	206	161.5	21.9	14.2	26.3	82.5	92.2	18.8	8.9	13.1	4.5	4.4
Ba	<10	20	<10	<10	<10	170	<10	<10	<10	10	10	<10	<10	<10	<10	60	110	370	360
Be	0.9	1.12	6.97	2.28	0.92	4.71	11.15	6.14	7.91	0.9	31.3	3.5	0.87	0.78	1.1	0.23	0.91	2.79	2.84
Bi	13.6	34.4	92.3	1310	54.1	3.55	30	418	24.2	93.3	3.07	2990	572	138.5	131	0.35	0.17	0.63	0.59
Ca	0.04%	0.06%	0.14%	0.16%	0.20%	0.03%	2.16%	0.49%	0.19%	0.04%	0.02%	0.30%	0.13%	0.06%	0.15%	19.35%	14.95%	3.16%	3.13%
Cd	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	0.02	0.03
Ce	14.3	30.3	58.5	87.8	65.7	47.7	11.8	30.2	2.91	60.8	116	48.1	47.2	78.1	59.5	5.88	35.6	49.7	50.1
Co	149	99.7	383	316	134.5	69.8	510	715	795	25.1	185.5	149	275	72.6	46.3	2.9	4.9	11.4	11.4
Cr	322	192	252	181	236	111	170	496	164	140	297	282	434	190	318	36	117	149	148
Cs	0.12	0.39	0.11	0.17	0.06	4.13	0.17	0.1	0.08	0.17	0.39	0.11	0.1	0.12	0.14	0.34	2.05	9.97	10
Cu	52.1	528	3920	3770	250	15.6	5860	10950	1040	2770	938	16200	6720	4910	371	17.8	7	16.2	16.2
Fe	18.10%	14.15%	27.70%	16.90%	7.30%	9.66%	37.10%	33.80%	>50%	17.10%	10.65%	46.40%	9.23%	12.35%	19.00%	0.69%	1.84%	3.63%	3.58%
Ga	55.8	13.4	32.7	45.2	31.6	22.3	19.3	13.2	11.05	17.8	31.2	60.2	34.3	53.3	44.6	0.74	4.02	19.2	18.05
Ge	2.84	0.1	0.71	0.28	0.11	0.14	3.68	0.92	4.36	0.41	0.18	3.51	0.12	0.16	0.19	<0.05	0.08	0.11	0.11
Hf	3.3	2.7	1.1	2.7	2	4	0.6	0.1	0.1	3.1	2.4	0.7	1.3	2.5	1.2	0.2	1.2	3.1	3
Hg	0.037	0.128	0.008	0.252	0.071	0.156	0.217	0.263	0.061	0.119	0.008	0.189	0.406	0.251	0.012	0.01	0.007	0.073	0.084
In	0.516	0.214	2.54	1.34	0.404	0.599	0.929	2.15	0.575	0.272	0.239	2.97	1.96	0.752	0.269	<0.005	0.029	0.065	0.079
K	0.02%	0.17%	0.01%	0.02%	0.01%	2.50%	0.03%	0.02%	0.01%	0.01%	0.11%	0.01%	0.01%	0.01%	0.01%	0.17%	1.42%	4.22%	4.22%
La	7.7	16	33.9	49.9	38.3	22.9	6.7	17.4	1.5	31.7	59.3	28.4	25.7	43.4	33.5	3.9	17.9	27.5	26.9
Li	32.7	17.4	7.6	12.8	8.1	15	3.1	1.1	0.5	33.4	13.3	3	5.7	15.4	9.7	8.9	10.6	60.9	59.3
Mg	3.94%	2.79%	1.64%	3.19%	1.74%	1.76%	1.50%	0.37%	0.15%	2.84%	2.39%	0.60%	2.41%	3.36%	2.69%	11.00%	7.77%	3.44%	3.41%
Mn	1065	443	437	562	415	411	1380	566	201	452	485	385	393	479	393	1115	1075	380	376
Mo	9.6	69.4	15.3	43.2	46.2	4.3	17.35	477	32.6	2.57	14.1	208	150	13.75	44.6	2.19	2.77	0.77	0.74
Na	0.01%	0.01%	0.01%	0.01%	0.01%	0.05%	0.03%	0.02%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.05%	0.06%	0.10%	0.10%
Nb	9.1	8.4	2.8	4.3	5.3	11	1.1	0.2	0.4	7.4	5.5	1.3	3.2	6.4	3.3	0.6	2.6	11.1	10.9
Ni	21.8	23.7	34.2	46.7	30.3	18.2	37	45.1	28.4	12.8	32.4	35.2	38.5	27.8	24.4	5.2	16	30.3	30.3
P	200	270	200	130	90	180	310	270	100	200	140	230	570	280	440	>10000	8180	1540	1510
Pb	8.5	17.1	9.3	66.6	9.3	4	12.6	118	10.4	14	2.1	636	56.4	22.3	14.2	27.1	12.1	10.5	10
Rb	0.7	8.3	0.5	0.8	0.4	76.1	1.4	0.9	0.2	0.7	6.3	0.4	0.4	0.6	0.4	5.1	45.1	170.5	171
Re	<0.002	0.002	0.002	0.005	0.002	<0.002	0.002	0.004	0.002	<0.002	0.002	0.005	0.012	0.002	0.002	0.007	<0.002	<0.002	<0.002
S	0.85%	4.73%	0.67%	1.85%	0.54%	0.54%	2.48%	2.30%	7.00%	1.82%	0.42%	1.82%	2.52%	2.29%	0.40%	0.39%	0.05%	0.49%	0.48%
Sb	2.27	5.9	27.8	8.55	4.09	4.37	15.55	36	20.3	2.47	2.61	33	4.63	4.2	4.84	0.13	0.28	0.46	0.43
Sc	10.9	6.3	3	6.4	3.2	12.7	2.3	1.1	0.8	9.5	4	3.7	3.7	6.3	4.5	0.8	3.8	16.2	15.6
Se	<1	<1	1	18	1	<1	3	3	1	<1	1	3	10	11	16	9	<1	7	7
Sn	1	1.3	2.2	3.6	1.7	6.1	6.4	1.2	1.6	0.6	2.6	12.1	2	4.4	8.8	0.2	1.3	4.8	4.8
Sr	1.1	1.9	1.6	1.5	1.1	3.5	5.6	1.7	1.1	1.9	1.1	1.4	1.2	1.3	1.3	61.3	62.6	41.3	41.2
Ta	0.93	0.74	0.24	0.41	0.46	1.12	0.1	<0.05	<0.05	0.79	0.57	0.12	0.28	0.65	0.31	<0.05	0.26	0.91	0.88
Te	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.18	0.13	<0.05	<0.05	<0.05	<0.05
Th	12.75	16.75	4.69	8.67	8.5	11.8	2.09	0.21	0.39	16.9	11.1	2.02	5.01	11.4	5.94	0.67	4.13	14.05	13.1
Ti	0.189%	0.127%	0.043%	0.088%	0.038%	0.209%	0.013%	<0.00005	<0.00005	0.115%	0.049%	0.027%	0.044%	0.126%	0.062%	0.014%	0.083%	0.332%	0.327%
Tl	0.06	0.28	<0.02	0.02	0.04	0.75	0.03	0.35	0.02	0.03	0.03	0.05	0.11	0.18	0.02	0.1	0.19	0.63	0.64
U	3.6	3.1	6	10.4	9.4	4.4	2.7	3.4	2.8	3.8	4	9.2	30.5	29.3	15	2.1	2.1	2.4	2.3
V	30	19	16	20	5	35	11	9	9	21	6	12	14	25	27	5	23	93	93
W	2.6	1.3	10.2	14.2	3.5	3.8	60.8	15.2	32.3	2.2	6	104.5	4.3	6.2	55.6	0.1	0.6	2.1	2
Y	9.5	15.3	9.6	13.8	12.2	16.7	16.3	3.5	4.5	23.7	12.3	12	16.3	15.1	11.5	6.3	17	17.7	16.7
Zn	111	56	37	65	42	58	18	12	6	54	54	15	44	59	41	18	18	57	55
Zr	100	89.6	33.5	97.1	68.5	127.5	18.6	1.5	3.2	96	77.6	26.6	41.7	80	43.2	6.6	38.6	114	113.5

Element	Median Soil Abundance*	Sample Numl																			
		22988	22994	22996	22997	22998	23000	23010	23011	23012	23013	23014	23015	23022	23024	23026	23029	23034	23036	23037	23055
Ag	0.05	0	0	1	2	≥3	1	2	0	≥3	≥3	2	2	0	0	≥3	≥3	≥3	1	2	≥3
Al	7.1%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
As	6	0	0	≥3	2	≥3	≥3	≥3	≥3	≥3	2	≥3	≥3	0	0	1	≥3	≥3	1	≥3	≥3
Ba	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Be	0.3	2	2	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	1	1	2	2	0	1	≥3	2	3	0
Bi	0.2	1	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	1	2	≥3	≥3	≥3	≥3	≥3	≥3
Ca	1.5%	0	0	2	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Cd	0.35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ce	50	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Co	8	1	≥3	≥3	2	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	0	≥3	≥3	≥3	≥3	≥3	≥3	≥3
Cr	70	0	2	0	0	2	1	1	0	1	0	2	1	1	1	2	1	2	1	1	1
Cs	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cu	30	0	≥3	≥3	≥3	≥3	≥3	≥3	0	≥3	≥3	2	≥3	2	≥3	≥3	0	≥3	0	0	≥3
Fe	4.0%	1	1	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	1	1	1	0	1	≥3	1	0	1
Ga	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Ge	1	0	0	0	0	1	2	2	2	2	2	1	0	0	0	0	0	2	0	0	0
Hf	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hg	0.06	0	1	0	0	≥3	0	0	0	0	0	1	2	0	0	0	0	0	0	0	1
In	1	0	0	0	0	2	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0
K	1.4%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
La	40	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Li	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mg	0.5%	3	2	0	0	0	0	0	0	0	0	0	2	1	2	0	2	0	2	0	2
Mn	1000	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mo	1.2	0	1	2	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	1	2	≥3	≥3	≥3	2	2	≥3
Na	0.5%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nb	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ni	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P	800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pb	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Rb	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	0.07%	0	≥3	2	1	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	0	2	≥3	≥3	≥3	≥3	≥3	≥3
Sb	1	0	1	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	2	1	2	1	1	≥3	1	2	≥3
Sc	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Se	0.4	1	1	1	1	1	1	1	1	1	≥3	≥3	1	1	1	1	≥3	≥3	1	1	1
Sn	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Sr	250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ta	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Th	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Ti	0.5%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tl	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
U	2	0	1	0	0	1	2	0	1	1	1	≥3	1	0	0	1	≥3	2	1	1	0
V	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	1.5	0	0	≥3	≥3	≥3	≥3	≥3	≥3	0	≥3	≥3	0	0	2	0	≥3	2	0	1	0
Y	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zn	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zr	400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Element	ber																	
	23056	23057	23062	23064	23065	23066	23071	23072	23073	23076	23078	23102	23104	23106	23107	23114	23119	23133	23140
Ag	1	2	2	2	2	0	≥3	≥3	≥3	2	1	≥3	≥3	2	≥3	1	0	2	2
Al	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
As	≥3	≥3	≥3	≥3	1	≥3	≥3	≥3	≥3	1	1	2	≥3	≥3	1	0	1	0	0
Ba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Be	1	1	≥3	2	1	≥3	≥3	≥3	≥3	1	≥3	≥3	1	1	1	0	1	≥3	≥3
Bi	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	0	0	1	1
Ca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	≥3	≥3	0	0
Cd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ce	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Co	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	1	≥3	≥3	≥3	≥3	2	0	0	0	0
Cr	2	1	1	1	1	0	1	2	1	0	2	1	2	1	2	0	0	1	0
Cs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Cu	0	≥3	≥3	≥3	2	0	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	≥3	0	0	0	0
Fe	2	1	2	1	0	1	≥3	2	≥3	2	1	≥3	1	1	2	0	0	0	0
Ga	1	0	0	1	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0
Ge	1	0	0	0	0	0	1	0	2	0	0	1	0	0	0	0	0	0	0
Hf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hg	0	1	0	1	0	1	1	2	0	0	0	1	2	1	0	0	0	0	0
In	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
K	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
La	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Li	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Mg	2	2	1	2	1	1	1	0	0	2	2	0	2	2	2	≥3	≥3	2	2
Mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mo	2	≥3	3	≥3	≥3	1	≥3	≥3	≥3	1	≥3	≥3	≥3	≥3	≥3	0	1	0	0
Na	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	>3	≥3	0	0
Pb	0	0	0	0	0	0	0	1	0	0	0	≥3	0	0	0	0	0	0	0
Rb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	≥3	≥3	≥3	≥3	2	2	≥3	≥3	≥3	≥3	2	≥3	≥3	≥3	2	2	0	2	2
Sb	1	2	≥3	≥3	1	2	≥3	≥3	≥3	1	1	≥3	≥3	1	2	0	0	0	0
Sc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Se	1	1	1	≥3	1	1	2	2	1	1	1	2	≥3	≥3	≥3	≥3	1	≥3	≥3
Sn	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Sr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Th	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ti	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tl	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1
U	0	0	1	2	2	1	0	0	0	0	0	2	≥3	≥3	2	0	0	0	0
V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	0	0	2	≥3	1	1	≥3	≥3	≥3	0	1	≥3	1	1	≥3	0	0	0	0
Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX F
DI water extraction results

Parameter		Detection Limit	Sample ID													
			22988	22996	22997	22998	23000	23010	23011	23012	23013	23022	23024	23029	23034	23036
pH	-	0.1	8	7.9	7.8	8	8.3	8.4	8.5	8.1	6.7	8.2	8.3	7.1	7.7	7.9
EC	dS/m	0.001	0.121	0.211	0.329	1.14	0.451	0.421	0.359	0.612	1.19	0.196	0.185	0.335	0.349	0.169
Acidity	mg $CaCO_3$/l	1														
Alkalinity	mg $CaCO_3$/l	1	36	50	58	44	46	41	44	45	33	32	24	17	32	27
Ag	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Al	mg/l	0.01	0.13	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.29	0.12	0.21	0.12	0.07
As	mg/l	0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
B	mg/l	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.09	<0.05	<0.05	<0.05	0.05
Ba	mg/l	0.001	0.258	0.305	0.246	0.198	0.222	0.23	0.307	0.244	0.172	0.825	0.307	0.232	0.246	0.315
Be	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ca	mg/l	1	1	26	23	292	75	76	25	150	179	8	<1	3	51	2
Cd	mg/l	0.0001	<0.0001	<0.0001	0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	0.0004	<0.0001	<0.0001	<0.0001	0.0008	<0.0001
Cl	mg/l	1	4	12	13	14	11	10	11	19	23	8	6	5	11	6
Co	mg/l	0.001	<0.001	<0.001	<0.001	0.11	0.003	<0.001	<0.001	0.003	0.234	0.007	<0.001	<0.001	0.002	<0.001
Cr	mg/l	0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.002	<0.001
Cu	mg/l	0.001	0.002	0.002	0.002	0.016	0.006	0.004	0.002	0.011	0.07	0.005	0.002	0.002	0.003	0.005
F	mg/l	0.1	1.1	0.2	0.1	0.2	0.3	0.1	0.1	0.1	0.1	0.6	0.5	0.2	0.4	0.4
Fe	mg/l	0.05	0.13	0.1	<0.05	0.08	0.07	0.09	<0.05	<0.05	0.5	0.71	0.23	0.54	0.33	0.15
Hg	mg/l	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
K	mg/l	1	<1	<1	<1	<1	<1	2	1	<1	1	11	<1	<1	<1	1
Mg	mg/l	1	4	2	11	5	7	5	1	6	74	3	10	32	19	8
Mn	mg/l	0.001	0.003	0.038	0.041	0.65	0.075	0.092	0.036	0.224	13.5	0.498	0.036	0.076	0.108	0.012
Mo	mg/l	0.001	0.003	0.041	0.071	0.344	0.079	0.152	0.123	0.239	0.018	0.01	0.016	0.082	2.25	0.157
Na	mg/l	1	5	6	6	5	4	3	4	4	10	7	4	4	5	5
Ni	mg/l	0.001	<0.001	<0.001	<0.001	0.012	0.002	0.002	0.001	0.004	0.554	0.016	0.001	0.002	0.002	<0.001
P	mg/l	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Pb	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sb	mg/l	0.001	<0.001	0.002	0.002	<0.001	0.002	0.001	0.002	0.001	<0.001	<0.001	<0.001	<0.001	0.005	<0.001
Se	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.67	0.02	<0.01	0.1	0.02	<0.01
Si	mg/l	0.1	0.8	1.8	2.2	1.7	0.7	0.9	2.1	1	1.2	1.6	1	1.9	1.6	1.1
Sn	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SO_4	mg/l	1	<1	38	60	785	206	194	27	383	782	36	32	142	207	29
Sr	mg/l	0.001	0.004	0.096	0.033	0.157	0.092	0.076	0.091	0.125	0.064	0.012	0.004	0.016	0.036	0.009
Th	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Tl	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
U	mg/l	0.001	<0.001	<0.001	<0.001	0.005	0.002	<0.001	0.001	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	mg/l	0.005	0.019	0.012	0.006	0.054	0.018	0.022	0.005	0.037	0.085	0.042	0.028	0.043	0.037	0.029

Parameter		23056	23065	23071	23072	23073	23076	23078	23106	23107	23114	23119	23133	23140
pH	**-**	7.6	8.1	7.9	8	4	6.5	7.4	7.6	7.4	8.4	8.6	8.7	8.8
EC	**dS/m**	0.116	0.226	0.416	0.921	2.56	0.246	0.197	0.203	0.211	0.089	0.146	0.155	0.142
Acidity	**mg $CaCO_3$/l**					586								
Alkalinity	**mg $CaCO_3$/l**	33	37	49	51		18	18	24	37	44	74	47	62
Ag	**mg/l**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Al	**mg/l**	0.16	0.2	0.12	0.06	8.19	0.31	0.11	0.15	0.1	0.06	0.02	0.08	0.05
As	**mg/l**	<0.001	<0.001	<0.001	<0.001	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.001	<0.001
B	**mg/l**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.1	0.07	0.06
Ba	**mg/l**	0.304	0.349	0.23	0.178	0.102	0.206	0.326	0.227	0.291	0.265	0.767	0.33	0.298
Be	**mg/l**	<0.001	<0.001	<0.001	<0.001	0.009	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ca	**mg/l**	<1	6	85	144	250	10	1	3	4	71	12	11	25
Cd	**mg/l**	<0.0001	0.0002	<0.0001	0.0006	0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl	**mg/l**	6	7	30	15	10	5	14	6	5	64	41	11	27
Co	**mg/l**	<0.001	<0.001	<0.001	0.056	8.2	0.265	0.006	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cr	**mg/l**	0.001	0.003	0.002	0.002	0.031	0.002	0.001	0.003	0.002	0.001	<0.001	<0.001	0.002
Cu	**mg/l**	0.002	0.002	0.006	0.025	79.2	2.06	0.062	0.015	0.009	0.002	0.002	0.001	0.002
F	**mg/l**	0.4	0.4	0.3	0.4	0.4	0.2	0.5	0.2	0.5	0.8	1.5	1.8	1.4
Fe	**mg/l**	0.33	0.55	0.32	0.26	78.2	6.06	0.37	0.43	0.23	0.13	<0.05	0.08	0.07
Hg	**mg/l**	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
K	**mg/l**	<1	<1	2	2	<1	<1	3	<1	<1	6	17	25	24
Mg	**mg/l**	8	7	30	64	154	37	12	41	8	42	13	9	14
Mn	**mg/l**	0.009	0.013	0.044	3.06	22.3	0.742	0.033	0.06	0.011	0.006	0.004	0.003	0.005
Mo	**mg/l**	0.116	0.434	0.091	1.62	0.09	0.004	0.014	0.028	0.25	0.031	0.016	0.003	0.007
Na	**mg/l**	4	5	19	13	4	7	6	6	4	16	16	24	17
Ni	**mg/l**	<0.001	<0.001	<0.001	0.013	0.95	0.037	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
P	**mg/l**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Pb	**mg/l**	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sb	**mg/l**	<0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Se	**mg/l**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.02	0.03	<0.01	0.07	0.01
Si	**mg/l**	0.9	2.1	1	1.6	4.1	1.7	1.3	1.8	1.4	1.52	2.61	3.22	2.62
Sn	**mg/l**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SO_4	**mg/l**	13	24	346	662	1780	213	50	186	22	309	24	99	109
Sr	**mg/l**	0.005	0.01	0.071	0.061	0.014	0.016	0.006	0.019	0.008	0.437	0.086	0.092	0.178
Th	**mg/l**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Tl	**mg/l**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
U	**mg/l**	<0.001	<0.001	<0.001	0.001	0.076	0.002	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001
Zn	**mg/l**	0.038	0.013	0.02	0.07	0.424	0.065	0.037	0.04	0.021	0.01	<0.005	<0.005	0.006

APPENDIX G
Peroxide extraction results

Parameter		Detection Limit	Sample ID												
			22998	23000	23010	23012	23013	23014	23024	23026	23029	23034	23036	23037	23055
NAGpH	-	0.1	8	7.7	7.8	8.2	3.2	2.2	4.9	3.5	2.5	7.1	3.9	2.2	2.9
Ag	mg/l	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001
Al	mg/l	0.01	0.01	<0.01	0.04	0.02	<0.01	0.47	5.37	0.39	7.13	34.4	1.49	18	24
As	mg/l	0.001	0.001	0.021	0.002	<0.001	<0.001	0.003	0.03	<0.001	<0.001	0.003	<0.001	<0.001	0.012
B	mg/l	0.05	0.05	0.09	<0.05	<0.05	0.11	0.1	0.12	0.17	0.05	0.12	<0.05	0.1	0.12
Ba	mg/l	0.001	0.001	0.279	0.247	0.271	0.35	0.088	0.106	0.117	0.118	0.092	0.245	0.151	0.045
Be	mg/l	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.004	<0.001	0.003	0.007
Ca	mg/l	1	1	63	75	33	49	20	70	4	2	2	22	2	2
Cd	mg/l	0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl	mg/l	1	1	12	2	2	4	3	2	3	<1	1	2	2	1
Co	mg/l	0.001	0.001	0.026	0.001	<0.001	0.003	0.35	5.02	0.506	0.581	0.714	0.252	0.905	1.04
Cr	mg/l	0.001	0.001	0.022	0.059	0.051	0.022	0.064	0.603	0.027	0.053	0.178	0.008	0.028	0.189
Cu	mg/l	0.001	0.001	0.018	0.002	0.002	0.005	94	5.81	1.72	90	4.05	0.186	0.155	0.325
F	mg/l	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.5	0.3	0.2	0.3	0.2	0.3	0.4
Fe	mg/l	0.05	0.05	<0.05	<0.05	<0.05	<0.05	10.5	139	1.22	41.8	55.1	2.18	0.2	89.7
Hg	mg/l	0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
K	mg/l	1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	14
Mg	mg/l	1	1	1	2	2	3	7	40	23	11	31	11	23	6
Mn	mg/l	0.001	0.001	0.135	0.054	0.058	0.165	1.5	1.76	0.531	1	0.901	0.86	0.5	0.253
Mo	mg/l	0.001	0.001	0.34	0.027	0.067	0.177	0.008	0.002	<0.001	<0.001	0.002	0.182	0.078	0.008
Na	mg/l	1	1	4	3	3	3	4	4	8	2	4	3	4	5
Ni	mg/l	0.001	0.001	0.004	<0.001	<0.001	<0.001	0.196	0.188	0.034	0.456	0.172	0.024	0.01	0.153
P	mg/l	1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Pb	mg/l	0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.026	0.194	<0.001	0.044	0.049	0.005	<0.001	0.008
Sb	mg/l	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Se	mg/l	0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.23	0.18	0.01	<0.01	0.19	0.1	<0.01	<0.01
Si	mg/l	0.1	0.1	2	1.2	1.3	1.2	2.3	9.4	17.1	15.4	43.5	4.6	24.4	21
Sn	mg/l	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SO_4	mg/l	1	1	144	164	58	102	301	1400	143	380	822	134	213	1040
Sr	mg/l	0.001	0.001	0.037	0.049	0.034	0.045	0.014	0.021	0.018	0.008	0.008	0.012	0.016	0.018
Th	mg/l	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.003	<0.001	<0.001	0.009
Tl	mg/l	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
U	mg/l	0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.027	90.2	0.027	0.013	0.084	0.002	<0.001	0.004
Zn	mg/l	0.005	0.005	0.053	0.053	0.033	0.04	0.296	0.291	0.543	0.102	0.324	0.082	0.29	0.28

Parameter		23056	23064	23065	23066	23071	23072	23073	23076	23102	23104	23106	23107
NAGpH	**-**	3.5	4.4	4.7	3.8	7.6	4.3	2.3	4.2	3.5	3.3	4.5	4.9
Ag	**mg/l**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Al	**mg/l**	21.7	20	1.19	1.88	15.4	0.18	0.47	6.64	9.29	3.34	10	11.8
As	**mg/l**	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.012	<0.001	<0.001	0.001	<0.001
B	**mg/l**	0.09	0.1	0.06	0.06	0.09	<0.05	0.06	0.1	0.08	0.07	0.1	0.08
Ba	**mg/l**	0.105	0.143	0.198	0.24	0.118	0.243	0.198	0.052	0.164	0.088	0.191	0.165
Be	**mg/l**	0.002	0.002	<0.001	0.001	0.005	<0.001	<0.001	0.002	0.002	0.002	0.002	0.001
Ca	**mg/l**	<1	<1	17	22	2	45	51	24	2	31	3	1
Cd	**mg/l**	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl	**mg/l**	5	2	2	2	2	3	2	2	1	2	2	2
Co	**mg/l**	2.36	0.605	0.575	1.07	0.476	0.012	2.37	4.02	0.234	0.317	0.654	0.193
Cr	**mg/l**	0.059	0.028	<0.001	0.001	0.038	0.033	0.002	0.267	0.012	0.008	0.031	0.006
Cu	**mg/l**	40.4	1.95	15.6	2.3	0.197	0.008	87.2	15.4	24.6	153	63.6	45.9
F	**mg/l**	0.3	0.3	0.2	0.2	0.3	0.2	0.2	0.3	0.3	0.3	0.4	0.3
Fe	**mg/l**	42	1.22	0.26	8.23	0.1	0.35	2.29	166	6.34	24.1	25.8	7.38
Hg	**mg/l**	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
K	**mg/l**	1	<1	<1	<1	13	<1	<1	<1	<1	<1	<1	<1
Mg	**mg/l**	19	23	33	20	13	20	23	14	21	22	16	23
Mn	**mg/l**	0.826	0.792	1.94	2.04	0.44	0.028	4.86	2.06	0.53	2.83	0.903	0.645
Mo	**mg/l**	0.002	0.024	<0.001	<0.001	0.042	0.041	<0.001	0.002	<0.001	<0.001	<0.001	<0.001
Na	**mg/l**	4	4	4	4	5	4	4	4	4	4	4	4
Ni	**mg/l**	0.188	0.042	0.153	0.164	0.13	0.003	0.304	0.232	0.036	0.238	0.251	0.107
P	**mg/l**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Pb	**mg/l**	0.03	0.003	0.004	0.002	<0.001	<0.001	0.032	0.002	0.002	1.57	0.142	0.011
Sb	**mg/l**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Se	**mg/l**	<0.01	<0.01	0.05	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.02	0.03	0.03
Si	**mg/l**	24.6	22.6	17.6	11.7	24.9	1.9	6.1	8.9	22.5	8.97	16.8	21.2
Sn	**mg/l**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SO_4	**mg/l**	486	245	246	175	184	173	433	1090	223	484	323	264
Sr	**mg/l**	0.008	0.01	0.014	0.012	0.017	0.02	0.012	0.007	0.012	0.011	0.009	0.01
Th	**mg/l**	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Tl	**mg/l**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
U	**mg/l**	0.004	0.002	<0.001	0.007	<0.001	<0.001	0.008	0.01	0.002	0.012	0.043	0.035
Zn	**mg/l**	0.344	0.3	0.255	0.251	0.273	0.069	0.224	0.276	0.299	0.268	0.268	0.297

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