

Report on metal content mobilisation using mild leaching

CHPM2030 Deliverable D2.2

Version: December 2017



CHPM2030



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n° 654100.



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Published by the CHPM2030 project, 2017

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CHPM2030 DELIVERABLE D2.2

REPORT ON METAL CONTENT MOBILISATION USING MILD LEACHING

Summary:

We describe leaching experiments using samples of lead-zinc mineralisation (UK), porphyry copper mineralisation (Hungary), skarn (Romania), and massive sulphide mineralisation (Portugal). The experiments used a range of fluid types and pressure/temperature conditions to identify fluid-rock reactions and quantify the potential for enhancing metal release. The results provide quantitative data to help underpin the CHPM concept.

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1 EXECUTIVE SUMMARY

The CHPM2030 project aims to develop a novel technological solution of Combined Heat, Power and Metal (CHPM) extraction from ultra-deep ore bodies, that will pave the way for pilot-scale systems to be operational by 2030. This technology will help increase the attractiveness of renewable geothermal energy and also reduce Europe's dependency on the import of metals and fossil fuels ¹. In the envisioned technology, an engineered geothermal system is established within a metal-bearing geological formation at depths of 4 km or more, which will be manipulated in such a way that the co-production of energy and metals will be possible. Critical to this, is an understanding of the natural networks of hydraulically-conductive mineral veins that could function as heat-exchange surfaces, and sources of metals. If metals can be leached from the orebodies in high concentrations, and over a prolonged period of time, then their recovery may substantially influence the economics of engineered geothermal systems. Furthermore, leaching of metals from subsurface pathways in a controlled way has the potential to improve fluid flow, and so increase system performance over time.

A key aspect of the CHPM2030 concept is that metals can be transported in solution and extracted at the surface. That extraction process will be more efficient with higher dissolved metal concentrations. Equally however, too large a dissolved load may lead to problems of precipitation within production boreholes or surface infrastructure. Thus, there is a need to balance the potential for increased revenue generation from recovering more metals, against potential increased costs resulting from increased maintenance operations. Dosing the recirculating geothermal fluid with additives could be a way to enhance ore dissolution and maintain metal solubility. However, there is also a need to be mindful of environmental considerations, and consider additives that are relatively 'environmentally benign' and which could act as 'mild' leaching agents. The experiments described in this report were aimed at testing a range of possible additives in terms of their leaching behaviour of several different types of mineralised rocks.

The rock types chosen covered a range of mineralisation types and contained a range of ore minerals, though all were dominated by sulphide mineralisation. They were: lead-zinc mineralisation from the UK, porphyry copper mineralisation from Hungary and Sweden, skarn from Romania, and massive sulphide mineralisation from Portugal. These were reacted with a range of leaching solutions that included: de-ionised water, tap water, dilute brine (0.6 M sodium chloride), de-ionised water with 20 bar Pco₂, 0.1 M ethylenediaminetetraacetic acid (EDTA), 0.1 M acetic acid, 0.1 M sodium dodecyl sulfate (SDS), 0.1 M ammonia (NH₃), 0.1 M hydrogen peroxide (H₂O₂), 0.1 M hydrochloric acid (HCL) with 0.03 M nitric acid (HNO₃) and, 0.01 M hydrochloric acid with 0.003 M nitric acid. Not all fluid-solid combinations were run in this study, and we worked initially at lower temperatures (70 °C), reacting all fluids with a sample of UK material in order to rank the leaching potential of the different fluids. Once the most promising fluids were identified, we then used just those fluids for both a wider range of rock types and also a wider range of temperatures (from 100 °C to 200 °C). Comparative assessment was facilitated by reacting all solids with 0.6 M NaCl solution, and also a mixed solution of 0.01 M hydrochloric acid with 0.003 M nitric acid.

¹ <http://www.chpm2030.eu/introduction/>

Three types of experimental equipment were used for the leaching tests:

- A rotating mixing assembly holding up to twenty 250 ml HDPE bottles filled with approximately 200 ml of leaching solution and 5 g of granulated ore. The equipment was gently rotated approximately 6 times per minute to ensure good mixing between solid and liquid. This equipment was maintained at 70 °C inside an oven and used to react the ore samples with a wide variety of different leaching solutions.
- Titanium or PTFE-lined stainless-steel autoclaves, which held approximately 330 ml of leaching solution and 8.8 g of granulated ore. These were periodically, rather than continuously, stirred, and ran at 100 °C, 150 °C and 200 °C and 200 bar pressure.
- Titanium-lined Dickson-type rocking autoclaves, which held 200 ml of leaching solution and 5 g of granulated ore. These were run at 200 °C and 200 bar pressure.

The elevated temperatures and pressures of the latter two types of experiments make them more representative of *in-situ* conditions within an ultra-deep orebody. Most experiments ran successfully for approximately 4 weeks, apart for the 200 °C rocking autoclave experiments, which suffered major corrosion issues and had to be terminated early. Most analytical data were obtained from samples of solution and solids extracted at the end of the experiments, though certain experiments were subsampled more regularly to provide time-series data. Corrosion was the reason that some experiments failed, and this took the form of deep (5 mm) pitting of titanium in some 200 °C batch experiments, and severe cracking of 5 mm thick titanium linings in the rocking autoclave experiments. Some Viton seals disintegrated, became brittle, or swelled significantly at 200 °C.

Analysis of reaction products showed that we were successful in enhancing the mobilisation of a range of metals (relative to water or dilute brine), and leaching occurred relatively quickly (reaching steady-state concentrations in the first few tens of hours. However, not all metals behaved in the same way – some were leached relatively easily (e.g. lead, which reached approximately 1000 ppm in some experiments) whereas others proved much harder to mobilise (e.g. tin, tungsten, which did not rise above 1 ppm in most cases). Metal concentrations were initially controlled by the rates of dissolution/oxidation, which appears to have been fast within the first few hours of the experiments. Subsequently however, the concentration of many metals reached steady-state values after just a few tens of hours, and minerals such as anglesite (lead sulphate) precipitated.

The mixture of mineral acids was the most effective solution used for liberating a range of metals, however solutions containing organic compounds (EDTA, acetic acid, SDS) also proved effective. However, EDTA and SDS (like mineral acids) led to higher concentrations of dissolved aluminium and silica, whereas acetic acid did not. This could be an advantage, as lower concentrations of aluminium and silica would tend to disfavour clay formation - clays could potentially occlude fluid flow if they formed within flow zones.

Oxidation reactions were critical in breaking down sulphide minerals, and experiments with more oxygen appeared to result in more dissolution (e.g. in experiments with hydrogen peroxide or ones that were regularly exposed to the atmosphere). However, too much oxygen could potentially lead to dissolved iron being precipitated as Fe oxide/oxy-hydroxide. As well as also potentially occluding fluid flow, these phases are also effective sorbants of metals of interest and can reduce their concentration in solution. Where

Fe³⁺ ions did stay in solution, then their formation (e.g. from chalcopryrite or pyrite dissolution) appears to be key in enhancing the rates of dissolution of other sulphide minerals – largely because Fe³⁺ can act as a very effective oxidising agent and catalyse sulphide oxidation reactions.

Based upon what was seen in the experimental residues, and combining all the results, a tentative relative order of reactivity for the ore minerals studied is: galena ≈ chalcopryrite > sphalerite ≈ pyrite ≈ magnetite > bournonite. Of the other minerals observed: calcite ≈ dolomite > chlorite > szaibelyite ² ≈ quartz. Mineral dissolution took the form of pitting of mineral surfaces, which was often severe, especially for galena. Within and around etch pits in galena we found evidence for enrichments in copper and silver, and postulate that galena dissolution caused localised competition for ligands between lead and silver/copper ions – with lead winning and staying in solution, and silver/copper precipitating.

Sulphide oxidation produced acidity, and whilst this might benefit metal mobility, it may lead to corrosion issues for well linings and surface infrastructure. Reaction of this acidity with carbonate or aluminosilicate minerals was observed, as evidenced by dissolution features such as etch pits. Such reaction of gangue minerals in fractures or minerals in the wallrock has the potential to buffer fluid pH to more neutral values, though reaction types will be site-specific. Whilst acidity, together with a range of ligands, may aid metal mobility, the addition of phosphate reduced concentrations of rare earth elements and possibly uranium. There could be benefits in the prevention of uranium mobilisation, as this may reduce the amount of NORM well scales formed.

The physical mobilisation of fines was observed within just a few weeks. Dissolution of carbonate released needles of szaibelyite, and these moved through the stirred solution and deposited on the walls of the reaction vessel. Whilst we have no data to quantify how these would behave within a flowing fracture, they appear to have the potential to migrate and clog smaller-aperture flow paths. Whilst we postulate the formation of clays over timescales longer than the experiments (which could also migrate and occlude fluid flow), we did not observe any in the experiments conducted for this study.

Whilst we acknowledge that our study was somewhat ‘idealised’ in places, it has provided data on metal release behaviour from samples sourced from pilot site areas being studied within the CHPM2030 project. We were constrained by lack of data from appropriate depths, with key uncertainties including: lack of knowledge about fracture mineralogy, and plus lack of deep fluid chemistry. Reducing such uncertainty requires newly-drilled deep boreholes that can facilitate gathering new sampling and providing valuable new data.

² Szaibelyite is a fibrous magnesium borate phase (MgBO₂[OH]).

2 INTRODUCTION

2.1 Background to the CHPM2030 project

The strategic objective of the CHPM2030 project is to develop a novel technological solution (Combined Heat, Power and Metal extraction from ultra-deep ore bodies), which will make renewable geothermal energy more attractive, and also reduce Europe's dependency on the import of metals and fossil fuels³.

In the envisioned technology, an Enhanced Geothermal System (EGS) is established within a metal-bearing geological formation at depths of 4 km or more (Figure 2.1), which will be manipulated in a way that the co-production of energy and metals will be possible. The project, at a laboratory scale, intends to prove the concept that the composition and structure of ore bodies have certain characteristics that could be used as an advantage when developing an EGS.

CHPM2030 is organised into several Work Packages, and the results presented in this report fall within Work Package 2. The overall objective of this Work Package is to understand the natural networks of hydraulically-conductive mineral veins that could function both as heat-exchange surfaces, and sources of metals. Specific objectives are to: i) develop the tools and methods for orebody EGS reservoir management, and ii) test and validate the methods using simulations and laboratory experiments reaching and exceeding Technology Readiness Level 4 (TRL-4 = mid-range technology development).

In order to achieve these objectives, we will test three hypotheses in this Work Package:

1. That the composition and structure of orebodies have certain advantages that could be used to our advantage when developing an EGS.
2. Metals can be leached from the orebodies in high concentrations over a prolonged period of time and may substantially influence the economics of EGS.
3. That continuous leaching of metals will increase system's performance over time in a controlled way and without having to use high-pressure reservoir stimulation, minimizing potential detrimental impacts of both heat and metal extraction.

Many of the technical activities within Work Package 2 are related to laboratory-scale testing and measurement, and these are implemented through several Tasks, each with a specific deliverable:

Task 2.1: Concepts and simulations for integrated reservoir management.

Task 2.2: Metal content mobilization using mild leaching (results presented in this report).

Task 2.3: Metal content mobilization with nanoparticles.

Task 2.4: Overall systems dynamics and data for environmental assessment.

The project is supported by the European Union as part of its Horizon 2020 programme. Project partners within Work Package 2 are: University of Miskolc, Hungary (project coordinator); University of Szeged, Hungary; Iceland Geosurvey (ÍSOR), British Geological Survey, UK; Vlaamse Instelling voor Technologisch Onderzoek (VITO), Belgium.

³ <http://www.chpm2030.eu/introduction/>

2.2 Rationale behind the metal leaching experiments

A key aspect of the CHPM2030 concept, is that metals can be transported in solution from mineralised structures at depth, to surface infrastructure where they can be extracted (Figure 2.1). The extraction process will be more efficient with higher dissolved concentrations of metals and faster rates of dissolution of metal-bearing minerals. Equally however, too large a dissolved load may lead to problems of precipitation within production boreholes or surface infrastructure, and hence increased maintenance. Thus, there is a need to balance the potential for increased revenue generation from recovering more metals, against potential increased costs resulting from increased maintenance operations. There is also a need to consider the wider physical environment in which the systems will need to operate. This includes being mindful of environmental considerations, and where possible, using additives that act as 'mild' leaching agents that are relatively 'environmentally benign'.

Factors underpinning the above factors are the rates and magnitudes of metal release, and laboratory experiments simulating in-situ conditions are a useful way to provide well-constrained data to help understand these. Such experiments also allow us to test different fluid compositions in order to ascertain if there are specific additives that might help the metal recovery process.

Within the project, four pilot areas are being considered for more detailed investigation, but the matrix of possible experiments is unrealistically large if we were to treat all samples from all the areas in the same way. Our approach therefore, has been to work initially at lower temperatures with UK material (with a focus mainly on a single sample) in order to rank the leaching potential of the different fluids. Once the most promising fluids were identified, then we worked with just those fluids for wider range of types of mineralised rock.

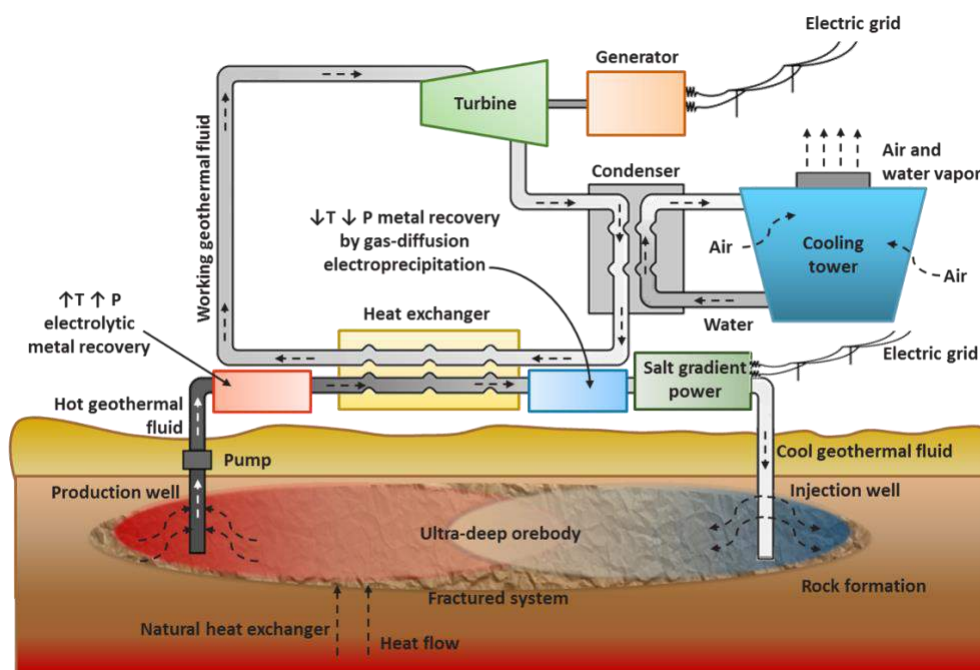


Figure 2.1: Schematic representation of the CHPM concept. The information presented in this report relates to the release of metals from the 'ultra-deep orebody' and into the recirculating geothermal fluid.

2.3 Metal leaching in the mining industry

Many current mining operations use leaching methodologies to extract metals, though they are typically applied to lower-grade ores that require a method to extract and concentrate the metal in an economic way. We will not attempt to provide a detailed review of these processes in this report, as recent reviews can be found elsewhere (e.g. Baba et al., 2012; Ghorbani et al., 2015; Kumar and Vengatasalam, 2015). However, in broad terms, the process involves: mining the ore, crushing it to a suitable size to increase surface area, and reacting it with either acid or alkali solutions to extract specific metals, and lastly electrowinning to extract the metals from solution.

The physical leaching process can be conducted in two main ways:

- *Heap leaching*: This involves a non-permeable membrane laid on a gentle slope and covered by several metres of crushed ore. Ore piles can cover a several hectares and involve millions of tonnes of ore. The leaching solution is fed by drip irrigation into the top of the ore pile, trickles through it, and the 'pregnant solution' channelled by the membrane into collection ponds. Whilst newer operations are tightly controlled, loss of leaching solutions into the environment from older operations had caused significant environmental issues. These include, pH changes in groundwaters and river waters, and a very large increase in dissolved metal concentrations (e.g. the Fort Belknap Gold Mine in Montana [Woody et al. 2011], and the Rum Jungle Mine in Northern Territory, Australia [Ferguson et al. 2011; Mudd and Patterson 2011]). Recovery of metal is achieved via electrowinning of the 'pregnant solution', and the 'barren solution' returned to the top of the ore pile. Recovery rates of 30-90% are possible, and can take 2 months for simple oxide ores, to 2 years for nickel ores.
- *Tank leaching*: A smaller-scale leaching process where ore concentrates are reacted in large tanks at atmospheric pressure. These have the advantage of a higher degree of control compared to heap leaching, and the possibility of adding heat to increase leaching rates. A variant uses autoclaves, being pressurised these can be heated to above 100 °C, and rates of leaching increased even further.

In terms of leachate chemistry, a range of solutions has been trialled, including: thiourea, thiosulphate, hypochlorite, and also bromine. However, the two most successful approaches are:

- *Dilute sulphuric acid*: This is useful for oxide and sulphide ores. Oxidation of the sulphide can produce more acid during the reaction, though usually needs to be enhanced through bacterial processes. Nickel ores require a higher concentration of acid compared to copper or uranium ores. A variant of the technique involves two solvent extraction steps using proprietary organic solvents - first extracting the metal from the 'pregnant solution' into the organic solvent, and then concentrating the metal into much smaller volume of highly acidic aqueous solution. Metals are recovered via electrowinning techniques. The sulphuric acid is recycled after the metal has been extracted.
- *Alkaline cyanide solution*: This is particularly useful for the recovery of precious metals (e.g. gold and silver). It requires a sodium cyanide (NaCN) solution (at about 100-600 ppm cyanide) with a pH between 9.5 and 11. Typically this consumes 0.1-1 kg of NaCN and 0.5-400 kg of lime per tonne of ore (Marsden and House, 1992). The precious metal is dissolved through the formation of a cyanide complex, and it is recovered as a metallic solid in the Merrill-Crowe process through the addition of metallic zinc.

3 METHODOLOGIES

3.1 Preparation of starting materials

3.1.1 Solids

Solids used in the experimental work were three samples from Cornwall, UK, and six samples from various organisations involved in the project (see Table 3.1 for location details). Samples generally consist of either massive mineralisation, or mineralised material together with surrounding country rock.

All samples were repeatedly crushed in a tempered steel jaw crusher to obtain a powdered fraction of <500 µm. This fraction was then sieved, to produce 500-250 µm, 250-125 µm, and <125 µm fractions. Unless otherwise stated, the 500-250 µm fraction was used for all experimental and analytical work. This fraction was cleaned, to remove fines and surface impurities, by repeated rinsing in acetone, until the supernatant ran clear. These ‘washed’ samples were then oven dried at 30 °C.

Solid samples will be referred to throughout this report by a unique three-digit identifier. Five samples were collected by BGS from sites in South West England, and labelled HTL315-HTL319 (not all of these were used – see below). Samples from European partner organisations are labelled HTL320-HTL325. The exception to this identification scheme is ‘HTLMix’ which is a mixture of HTL316, 317 and 318 in a 1:1:0.5 ratio. These three samples were taken across a mineralised quartz vein (with galena, sphalerite and some chalcopyrite) found at Herod’s Foot, SW England. The mixture was used to provide a more representative ‘bulk’ mineralogy for use in experiments. Starting materials were characterised using X-ray diffraction, for bulk composition, and BET (Brunauer–Emmett–Teller theory) for surface area.

For use in experiments, solid samples were carefully weighed and added to the appropriate fluid in a 40:1 fluid:rock ratio.

Details of the solid samples, including their sampling location, geological setting, and a summary of their bulk composition, as determined by XRD, can be found in Table 3.1. All UK samples were collected from the surface, generally from mine dumps or rockfalls adjacent to exposures. Efforts were made to ensure that the material used for experiments was as ‘fresh’ as possible, i.e. material at or near (within ~10 cm) weathered surfaces was avoided. The full results from the solids analysis can be found in Appendix A.

3.1.2 Solutions

A variety of solutions were used in the experiments in order to test their relative potential for liberation of metals from ore bearing deposits. Most of these were created using a single reagent, dissolved or diluted to the desired concentration. Several experiments were also carried out using CO₂-rich water as the experimental fluid. In these cases, the experiments were set up as normal, but were subject to a CO₂ partial pressure as well as the usual nitrogen gas overpressure. The various fluids used, as well as the temperature/pressure conditions of the experiments using various solids are summarised in Table 3.2.

		Sample Locality	Geological Setting	Summary of bulk mineralogy
BGS Sample ID	CHPM Sample ID			
HTL315		South Caradon, SW England	Mainstage mineralisation, associated with granite bodies	70% quartz, 7% schorl, 5% chlorite, 2% calcite, 10% pyrite, 5 % arseonpyrite, minor greigite and biotite
HTL316		Herod's Foot, SW England	Baked sediments with partial quartz vein	91% quartz, 6% muscovite, minor albite, schorl, chlorite, calcite, pyrite, and galena
HTL317		Herod's Foot, SW England	Baked sediments with partial quartz vein	81% quartz, 2% albite, 6% muscovite, 11% galena, minor chlorite, pyrite, chalcopryite, and sphalerite
HTL318		Herod's Foot, SW England	Baked sediments with partial quartz vein	88% quartz, 4% muscovite, 5% dolomite, 1% galena, 1% sphalerite, minor albite, chlorite, calcite, and pyrite
HTL319		Cligga Head, SW England	Tin-tungsten mineralisation, associated with granite bodies	88% quartz, 2% muscovite, 3% cassiterite, 3% columbite, and 4% ferberite
HTLMix		Herod's Foot, SW England	Mix of HTL316, 317, 318	87% quartz, 5% muscovite, 2% dolomite, 5% galena, minor albite, chlorite, pyrite, and spalerite
HTL320	CHPM18	Pietroasa, Romania	Skarn	3% quartz, 2% tourmaline, 3% kaolinite, 61% calcite, 31% szailbelyite, and minor albite
HTL321	CHPM12	Masca-Cocovaleni, Romania	Mineralised country rock	22% dolomite, 49% pyrite, 27% magnetite, minor quartz, calcite, and barite
HTL322	CHPM4	Rudabauya, Hungary	Carbonate hosted lead-zinc mineralisation	8% quartz, 2% calcite, 68% magnesite, 6% cerrusite, 1% sphalerite, 1% columbite, 11% barite, 2% magnetite, and minor dolomite
HTL323	CHPM26	Corvoinferior, Portugal	Massive sulphide deposit	1% quartz, 33% pyrite, 22% galena, 43% chalcopryite, minor dolomite, and magnetite
HTL324	CHPM5	Recsk, Hungary	Porphyry	7% quartz, 5% calcite, 9% pyrite, 11% magnetite, minor albite, dolomite, and sphalerite
HTL325	CHPM20	Kristinebergsgruvan, Sweden	Porphyry	38% quartz, 18% chlorite, 4% calcite, 37% pyrite, 3% chalcopryite, and minor magnesite

Table 3.1: Summary of starting samples.

Sample ID.	70 °C, 1 bar	Deionised Water	70 °C, 1 bar	Tap Water	70 °C, 1 bar	100 °C, 200 bar	0.6M NaCl	150 °C, 200 bar	70 °C, 1 bar	0.1M SDS	70 °C, 1 bar	0.001M SDS	70 °C, 1 bar	0.1M EDTA	150 °C, 200 bar	70 °C, 1 bar	0.001M EDTA	70 °C, 1 bar	0.1M Acetic Acid	150 °C, 200 bar	70 °C, 1 bar	0.001M Acetic Acid	70 °C, 1 bar	0.1M Ammonia	70 °C, 1 bar	0.001M Ammonia	100 °C, 200 bar	0.1M H2O2	100 °C, 200 bar	CO2 Rich Water	100 °C, 200 bar	0.1M HCl, 0.03M HNO3	200 °C, 200 bar	100 °C, 200 bar	0.1M HCl, 0.03M HNO3	150 °C, 200 bar	Coke	
HTL325					✓																										✓			✓				
HTL324					✓																										✓			✓				
HTL323					✓																										✓			✓				
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HTL319	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓									
HTL315	✓	✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓									
HTLMix	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 3.2: Summary of experimental conditions and solutions used.

The rationale behind these solutions was to provide a range of possible additive types, and be able to compare their performance against each other. Thus, distilled water and tap water were used to provide a 'low reactivity' baseline. A dilute brine was included to investigate the impact that the presence of NaCl would have, but this was kept dilute to facilitate any subsequent geochemical modelling. EDTA was included to investigate whether a strong organic complexing agent would enhance metal mobility, and SDS added to study whether an organic surfactant would enhance fluid-mineral reactions. Acetic acid was included because it was both an acid and also because acetate can be a complexing agent for metals. Ammonia was chosen to represent an alkaline leaching agent, and to contrast with that of acid leaching agents such as acetic acid. The hydrochloric acid – nitric acid mix represented strong mineral acids, and to provide a likely maximum reaction case. The nitric acid also served as an oxidizing agent to see how that enhanced sulphide mineral reaction, and could also be compared with hydrogen peroxide as a second oxidizing agent. Coca Cola was not on our original list of potential solutions, but we found it a well-known liquid that members of the public had contact with, and which we could use to explain how our solutions compared with everyday liquids. Acetic acid (present in vinegar) also served a similar purpose.

3.1.3 Gases

Two gases were used in the experiments: carbon dioxide (CO₂) and nitrogen (N₂).

The CO₂ was sourced from high purity (99.99%) liquid CO₂ (Air Products, 4.5 Grade). This liquid CO₂ was obtained in a cylinder fitted with a dip tube and pressurised with 2000 psi (approximately 14 MPa) of helium. However, the actual experimental pressure was controlled by an ISCO 360D syringe pump, which has its pressure transducer periodically 'zeroed' to maintain accuracy.

The N₂ was obtained from BOC Gases and classified as 'oxygen free' (99.998% pure). It was delivered in a cylinder pressurised to 230 bar (23 MPa). As per the CO₂, the actual experimental pressure was controlled by an ISCO 360D syringe pump, which has its pressure transducer periodically 'zeroed' to maintain accuracy.

3.2 Experimental methodologies

Three main experimental approaches were used, ranging from simpler techniques at lower temperatures and for multiple tests, through to specialised pressurised autoclaves for work at representative *in-situ* conditions of pressure and temperature. Each of the experiments was given a unique experimental 'Run number' (see Appendix B for detailed run information). The different types of experiments are summarised below.

3.2.1 70 °C experiments in rotating shakers

These were very simple experiments, based around 20 high density polyethylene (HDPE) bottles fixed into a rotating mixing assembly made of stainless steel (Figure 3.1). They consisted of adding an accurately known amount of granulated rock sample (of approximately 5 g), together with 200 ml of reactant solution. The tops of the HDPE bottles were securely tightened, the vessels arranged symmetrically on the mixer, and the entire assembly placed into a thermostatically-controlled fan-assisted oven. When running, the mixer turned at approximately 6 revolutions per minute – enough to ensure good mixing between solid and solution, without causing too much mechanical damage to the solid grains.

Sampling the solutions from each experiment consisted of stopping the mixer, removing each HDPE bottle, allowing each sample to settle for a few minutes, and then extracting a known volume of solution with a syringe. Each HDPE bottle was then replaced onto the mixer, and allowed to react further.

3.2.2 100 °C, 150 °C and 200 °C experiments in batch reactors

Unlike the 70 °C experiments described above, experiments at or above the boiling point of water need to be conducted in containers that are far more rigid than HDPE and able to withstand higher pressures. In this study, we mainly used titanium batch reactors inside thermostatically-controlled, fan-assisted ovens. This arrangement has been shown to operate reliably with little maintenance for at least 5 years for pressurised systems, and at least 15-20 years for non-pressurised systems (Bateman et al., 2013; Moyce et al., 2014; Rochelle et al., 2016). The basic layout of the 316 stainless steel variant of the batch reactors used is shown schematically in Figure 3.2 (the titanium variant is very similar, but omits the PTFE lining). The PTFE lining is added to prevent corrosion of the 316 stainless steel, and to prevent contamination of the solution with metals such as iron and chromium. Viton O-rings are used between the vessel body and vessel head to prevent loss of pressure. A large retaining ring is screwed onto the top of the vessel to keep the vessel body and vessel head together when pressurised. We initially used this equipment for only the 100 °C and 150 °C experiments, as parts would offer poorer performance or be damaged at higher temperatures. However, problems with the rocking autoclaves (see following section), meant that a few experiments were conducted at 200 °C. For these highest temperatures, the stirrer assembly and stirrer bead had to be removed, and the vessels were periodically agitated by hand (on average about once per day).

Loading the vessel consisted of adding accurately known amounts of granulated rock (of approximately 8.75 g), and synthetic groundwater or other leaching solution (350 ml), plus a magnetic stirrer bead. The head of the reaction vessel was then pushed on, and the retaining ring securely screwed down. The headspace of the vessel was flushed with either nitrogen or CO₂ prior to pressurisation. This ensured exclusion of as much atmospheric oxygen as possible – though we acknowledge that some would have been dissolved in the leaching solution. A titanium dip tube (and associated valve), fitted with a PTFE filter assembly, was added to the vessel. When pressurised via a second port, carefully opening the dip tube valve allowed for periodic fluid sampling. The latter involved attaching a syringe to the sampling valve, and carefully bleeding out a known volume of solution of approximately 12 ml (the first 1-2 ml were discarded as this was used to flush out the sample tube).

The stirrer bead ensured good mixing between the solution and granulated solid. To minimise mechanical damage to the solid, the stirrer bead was both held in a small cage, and only activated for approximately 2 minutes every 4 hours.

Pressurisation of the gas was via an ISCO 360D syringe pump running in ‘constant pressure’ mode. For experiments containing CO₂-rich gas, the headspace of this gas was first charged with 20 bar of CO₂, prior to bringing up to full pressure with nitrogen.

At the end of each experiment, as much of the solution as possible was removed prior to cooling and depressurisation of the vessel. The reason for this was in case degassing of the solution caused precipitation (i.e. an experimental artefact and not a true reflection of the reaction process). Once well below 100 °C (i.e. the boiling point of the leachate being used), the vessel was slowly depressurised, dismantled, and reacted rock grains recovered.

3.2.3 200 °C rocking autoclave experiments

For the highest temperatures of this study, we initially used direct sampling (Dickson-type) rocking autoclaves (Dickson et al., 1963; Seyfried et al., 1979). These pieces of traditional hydrothermal experimental equipment are designed to work up to at least 300 °C. A key aspect of this equipment is that all parts in contact with the experimental charge are made of very low reactivity metals, and so are virtually inert to all but the most aggressive fluids. The equipment consists of a pressure vessel housed within a heating jacket,

which rocks through approximately $\pm 30^\circ$ of horizontal to ensure mixing between solid and solution (see Figure 3.4). Pressurisation of the vessel is via argon gas. Sampling is conducted via a sample tube and valve assembly which exits the hot part of the experiment.

The traditional Dickson-type rocking autoclave used a flexible gold reaction cell to contain the experimental solid and solution. In this study however, gold is an element we might wish to analyse for, so we utilised a titanium piston assembly instead (Figure 3.5). This has previously been successfully used in elevated temperature water-rock- CO_2 experiments (Purser et al., 2014). A bubble of gas inside the piston assembly can be useful in some experiments to help keep the solution well-mixed and gas-saturated, though we omitted this in these experiments as we considered that the rocking motion would be sufficient for effective mixing.

Sampling of the solutions involved stopping the rocking motion of the heating jacket/autoclave assembly, attaching a syringe to the high-pressure titanium sampling valve, and carefully bleeding out a known volume of solution (the first 1-2 ml was discarded as this flushes out the sample tube).

Unlike the batch reactors, it is not possible to extract all the remaining solution from inside the titanium piston assembly (to do this would damage the equipment). Therefore, at the end of each experiment, the reactor was cooled and depressurised as fast as reasonably possible, and the reacted solid recovered. Doing this quickly minimised artefacts due to experimental ‘quenching’, but we acknowledge that this could not be completely avoided.

Unfortunately, problems with this equipment limited the information gained from experiments using it, so while some experiments were carried out using this equipment initially, results from these are not presented here, due to the presence of experimental artefacts in the final solutions and solids, although results from these runs can be found in Appendix B. Key 200 °C experiments were instead carried out using titanium batch reactors, as described previously.

3.3 Sampling and analysis of reacted fluids

For sampling the 70 °C experiments, which were carried out using a ‘rotating shaker’ set-up and HDPE bottles as the experimental vessels, the rotating shaker was stopped, and bottles were removed from the assembly one at a time, to minimise any cooling following removal from the oven. Upon removal, bottles were unsealed, and a sample removed using a polyethylene syringe, and subsequently filtered using a 0.2 μm nylon syringe filter prior to sub-sampling for analyses. Bottles were then resealed, and replaced in the oven. Upon completion of sampling, the rotating shaker was restarted.

Experiments at 100 °C, 150 °C, and 200 °C were carried out in titanium batch reactors housed inside ovens set to the appropriate temperature (see Section 3.2). To sample, a valve on top of the vessel, attached to an internal titanium sampling tube, was opened to a syringe attached to the valve via a length of polyetheretherketone (PEEK) tubing. An accurately-known quantity (typically 1-5 ml) of fluid was allowed to flow into the syringe in order to flush the sample tube, valve, and tubing with sample. This syringe was removed and discarded. A second syringe was then attached, and used to withdraw an accurately known amount (typically approximately 10 ml) of fluid, this being the sample. This sample was subsequently filtered using a 0.2 μm nylon syringe filter. Upon completion of sampling, the sampling valve was closed, and the vessel pressure ‘topped up’ to 200 bar via a syringe pump filled with nitrogen.

Once a sample of filtered fluid was obtained, each was split into several subsamples, with the analysis of pH, Eh and bicarbonate/carbonate being conducted as soon as possible.



Figure 3.1: Left: 250 ml HDPE bottles mounted into the rotating mixer. Right: Mixing assembly inside oven.

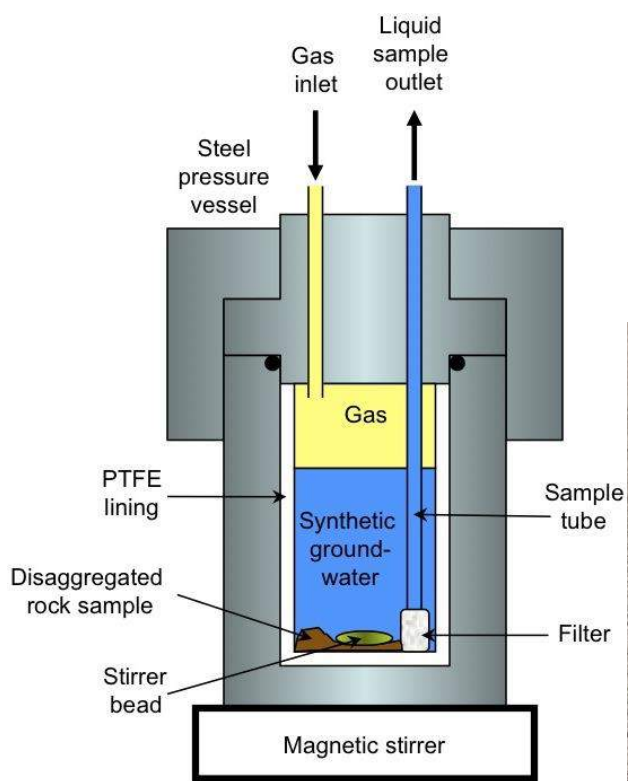


Figure 3.2: Schematic diagram and photograph of a steel batch reactor.

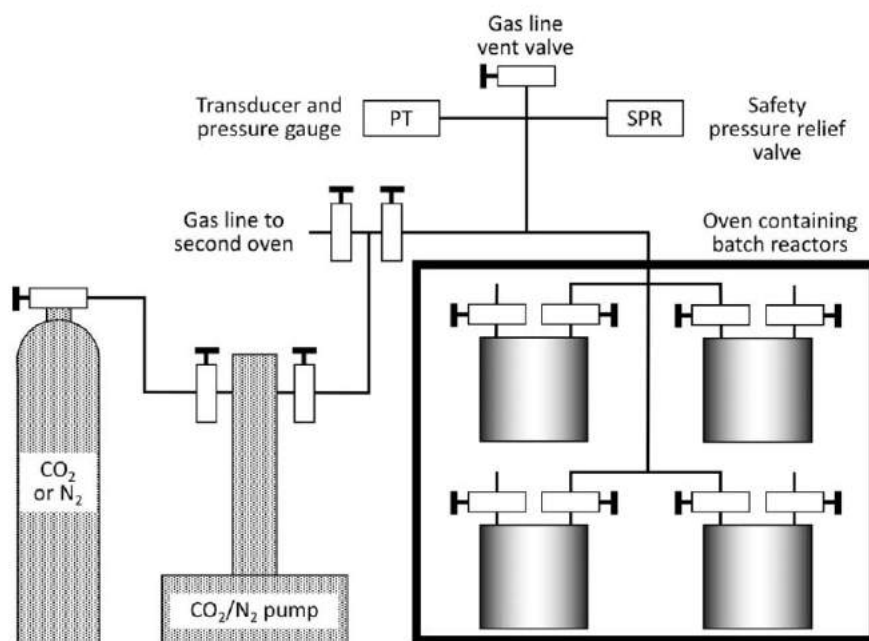


Figure 3.3: Schematic diagram and photograph of several batch reactors inside an oven.

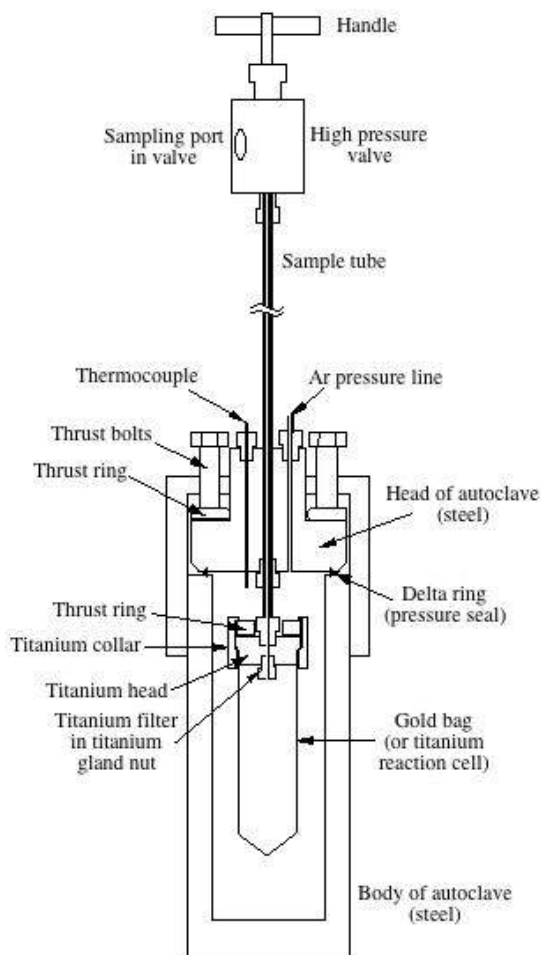


Figure 3.4: Schematic diagram and photograph of a Dickson-type rocking autoclave.

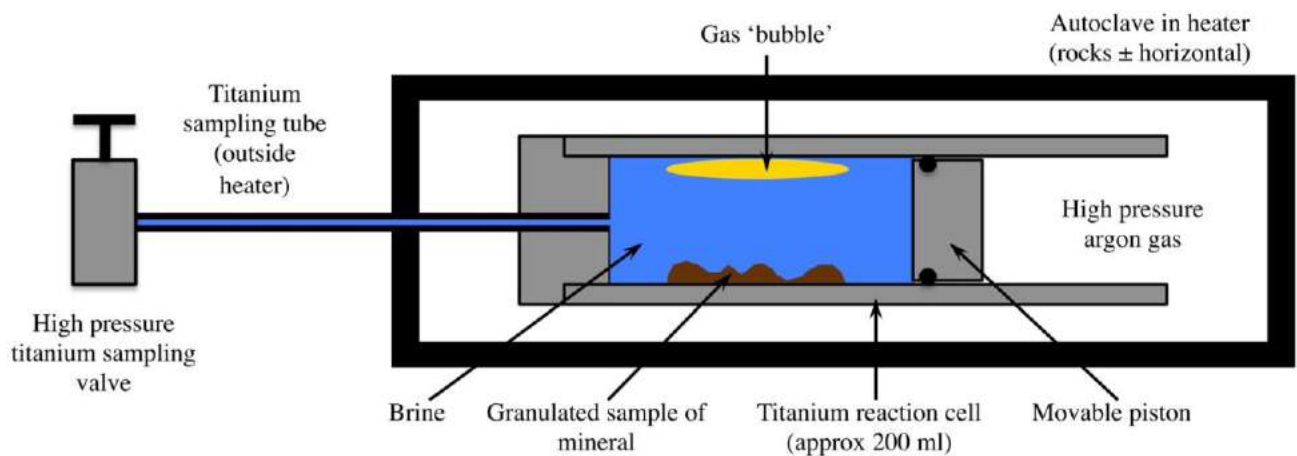


Figure 3.5: Schematic diagram of a titanium piston assembly used inside a Dickson-type rocking autoclave (the 'gas bubble' was omitted in this study).

pH was measured at room temperature and pressure on sub-samples using a Thermo Scientific Orion VersaStar meter with an Orion 9103BNWP semi-micro combination pH electrode calibrated using Whatman® NBS traceable buffers at pH 4, 7 and 10, and Eh was measured on the same sample using a Hanna Instruments HI3230 platinum electrode (with internal silver/silver chloride reference electrode) connected to a Thermo Scientific Orion VersaStar meter. The subsample temperature was also taken at this time, using a thermocouple attached to the pH meter.

Analytical sub-samples from the main filtered sample were prepared as follows:

- 1 ml of each of the samples was placed into a polystyrene tube, with 3 ml deionised water, and acidified with 1% (i.e. 0.04 ml) of concentrated 'ARISTAR'® nitric acid. These samples were stored in a fridge (at about 5 °C) prior to analysis. Subsequent analysis was for major and trace cations by inductively coupled plasma – mass spectroscopy (ICP-MS).
- Another 1 ml of the filtered samples was taken and placed in a polyethylene tube with 3 ml of deionised water for analysis of anions by ion chromatography (IC). Samples were also stored in a fridge prior to analysis.
- 0.6 ml of the filtered samples was added to 2.1 ml deionised water and treated with dipyrldyl solution for the preservation of Fe²⁺.
- 1 ml of the filtered samples was taken and added to a polystyrene tube with 3 ml of deionised water for analysis of HCO₃⁻ by titration against a known strength of sulphuric acid.

The sub-samples were labelled according to their run number and then the fluid sample number (e.g. 1778/2 for the second sample from Run 1778). Details of the sampling schedule and the fluid volumes taken for sample preparation for each experiment are given in tabulated form in Appendix B, and shown diagrammatically for some experiments in Appendix C.

Details of elements/species analysed and typical detection limits are given in Appendix B. However, there are a couple of points that are worth noting:

- 1) The actual detection limit of any element/species will depend on whether the sample had to be diluted prior to analysis. For example, the apparent detection limit of a particular analyte for a sample diluted by a factor of 10, will be 10 times greater than for an undiluted sample.
- 2) The uncertainty (error) associated with a single analytical datum will depend upon how close that value is to the detection limit for that analyte. For example, a useful 'rule of thumb' is as follows:

Nearness to detection limit	Degree of uncertainty/error
<10x detection limit	>10%
~10x detection limit	10%
~10-100x detection limit	5-10%
>100x detection limit	<5%

3.4 Sampling and analysis of starting and reacted solid phases

The petrographic work presented here is primarily based on scanning electron microscope (SEM) techniques (see below), with quantitative mineralogy from X-ray diffraction (XRD) analysis, and trace element chemistry from digestion and ICP-MS analysis.

At the end of experimental runs, the experimental vessels were depressurised and cooled as quickly as possible, following removal of as much fluid as possible, in order to minimise the formation of precipitates. After opening of the reaction vessels, a final sample was taken directly from the vessel (and then sub-sampled and preserved as per 'normal' samples described above) to allow characterisation of chemical changes in the system during depressurisation and cooling. Any remaining fluid was drained and its volume measured. The reacted solids were removed from the vessel and split into two sub-samples. One of these was rinsed with acetone, in order to remove any adherent fluid, preventing later precipitation of solids. The other sample was left unrinsed. Samples were then oven dried at 30 °C. Once dry, the samples were placed in an airtight container, which in turn was stored under a nitrogen atmosphere. Sub-samples of the starting material and reacted solids were mounted and carbon coated in preparation for SEM analysis.

3.4.1 Scanning Electron Microscopy

Scanning electron microscope (SEM) analysis was used to characterise both experimental starting and product materials. SEM analyses were performed using a FEI Company Quanta 600 environmental SEM equipped with a standards-calibrated Oxford Instruments integrated INCA Energy 450 energy-dispersive X-ray (EDX) analysis (50 mm² Peltier-cooled X-max silicon drift X-ray detector (SDD)) and WAVE wavelength-dispersive X-ray (WDX) systems. The EDX system was used qualitatively to aid phase identification and for element distribution. The WDX system was used to confirm EDX element identifications where they were present in near-trace amounts, and to check for the presence of selected elements in trace amounts.

Most analyses were performed on grain mounts, a select few on polished thin-sections (PTS). Grain mounts were prepared by dipping a 12 mm diameter SEM pin stub, topped with an adhesive electrically conductive tab, into a coned sub sample of the starting or product materials. PTS were prepared by impregnating a portion of the starting or product materials with blue-dyed epoxy resin under vacuum. The blue dye allows easy distinction between resin and mineral and also highlights porosity. Sections were thinned and polished to a standard thickness of 30 µm.

Samples were examined in the SEM with conductive coatings (carbon at 25 nm thickness when applied) under high vacuum conditions ($< 10^{-3}$ Pa). SEM operating conditions were 20kV accelerating voltage, spot size 4-6 (nominal beam current 0.3-4.5 nA), 10-15 mm working distance. Images were obtained using secondary electron (SE) and backscatter electron (BSE) imaging. For WDX analysis, performed only on PTS, operating conditions were 20kV, spot size 7.2 (beam current 10 nA), working distance 10 mm, 60 s peak analytical time. Under these operating conditions typical detection limits for elements is 0.03 wt %.

Modal analysis of the starting material 'HTLMix' was performed on a PTS, at 10 mm working distance, utilising the 'Feature' component of the INCA system. This combines image analysis protocols with EDX point analyses to both identify and quantify (area %) minerals present. Mineral identifications were operator-confirmed and cross-checked with other data sets.

3.4.2 X-Ray Diffraction

For quantitative whole-rock X-ray diffraction (XRD) analysis >5 g samples were ball-milled and then micronized under water to a fine powder (<10 µm). A 10% portion of corundum standard was added to each sample prior to micronizing to allow the validation of quantification results and also the detection of any

amorphous species present in the samples. The samples were then spray-dried following the method and apparatus described by Hillier (Hillier 1999) and front-loaded into standard sample holders for analysis.

XRD analysis was carried out using a PANalytical X'Pert Pro series diffractometer equipped with a cobalt-target tube and operated at 45 kV and 40 mA. The samples were scanned from 4.5-85°2 θ at 2.76°2 θ /minute. Diffraction data were initially analysed using PANalytical X'Pert Highscore Plus version 2.2e software coupled to the latest version of the International Centre for Diffraction Data (ICDD) database. Quantitative mineralogical data was accomplished by using a least squares fitting process applying the Rietveld refinement technique (Snyder and Bish 1989).

Analytical errors for the quoted whole-rock mineral contents are typically $\pm 2.5\%$ for concentrations >60 wt%, $\pm 5\%$ for concentrations between 60 and 30 wt%, $\pm 10\%$ for concentrations between 30 and 10 wt%, $\pm 20\%$ for concentrations between 10 and 3 wt% and $\pm 40\%$ for concentrations <3 wt% (Hillier et al., 2001). Where a phase was detected but its concentration was indicated to be below 0.5%, it is assigned a value of $<0.5\%$, since the error associated with quantification at such low levels becomes too large.

3.4.3 Acid digestion and trace element analysis

A subsample of the crushed solids was dissolved using hydrofluoric acid digestion, and the resulting liquid analysed using ICP-MS as per the fluid samples from the experiments.

4 RESULTS OF EXPERIMENTAL INVESTIGATIONS

A considerable amount of data was produced from the experiments undertaken in this study. These data include analyses of pre- and post-reaction solid and liquid phases, information on run conditions, and the behaviour of the equipment. For the solid phases, the detail of the analyses is given in this section in summary tables. However, there are considerably more fluid chemical data, and for ease of describing this data, only summary tables and figures are given in this section (the full set of data are found in Appendixes 1 and 2 at the end of this report).

Prior to describing the results of the experiments, it is worth noting some important points, as these will influence how far we can interpret and extrapolate the experimental observations:

- 1) The starting solids came from surface and mined material, so in some cases this material had been at the surface for a number of years. Even when in-situ, the samples were considerably shallower than the 'deep orebody concept' of CHPM. Though samples were selected based on their relatively high sulphide mineral content and generally fresher appearance, there is potential for oxygenated groundwaters or atmospheric oxygen to have reacted with them. This will have resulted in changes relative to material at depth (such as oxidation of mineral surfaces, dissolution of primary phases etc). Consequently, some reactions may be different to those that would occur in-situ (e.g. rates of oxidation may be slower due to the presence of surface coating instead of fresh surfaces). This appeared to be the most appropriate approach given the lack of access to deep borehole core samples at specific sites.
- 2) One consequence of the 'pre-altered' nature of the starting material, is that when crushed and cleaned of fines, individual grains can show a greater or lesser amount of alteration depending on whether they came from the outside or inside of the original specimen. This makes it hard to uniquely-identify a reaction solely due to the experiment (unless the reaction in an experiment is considerable). In order to make our observations as meaningful as possible, we looked at many reacted grains to ascertain representative amounts of alteration, and also looked at the starting materials at the same time as the reacted materials. However, at low degrees of experimental alteration, a degree of uncertainty is unavoidable.
- 3) The starting solids were ground rather than being kept 'intact'. This was done to increase surface area, and as a consequence, allow for faster reaction of the solution, maximising fluid chemical changes. However, this will spread reaction of the solids over a larger surface area, potentially making reaction on the surface of an individual grain that bit smaller, making the analysis of the solids that bit harder. Crushing will have created fresh mineral surfaces, which might not be present in-situ deep underground. Conversely, the material may already have undergone near-surface reactions (see point [1]). Again, these effects are largely unavoidable in these types of experiments.
- 4) We have no information on the deep fluids at the study sites, and without having precise information from deep boreholes we would be guessing at potential fluid compositions. We chose therefore, to use a range of relatively simple and relatively dilute fluid compositions, with and without different additives. This will facilitate a 'relative' comparison of the fluids to be made, and the dilute nature of the fluids lend themselves to future geochemical modelling of the data (higher salinities would be harder to model, encountering issues of lack of thermodynamic data and problems with activity correction at elevated temperatures). Subsequent work within the CHPM2030 project may be able to provide some of the necessary site-specific data, but this was not available at the time of writing this report.

Most of the work carried out in this project was focused on the material collected from South West England (UK). Hence, the majority of the following results describe the outcome of experiments based on these samples (HTL315, HTL319, HTLMix), while the partner samples (HTL320-HTL325) were reacted with only two of the selected fluids.

We found it useful to display fluid chemical information for selected elemental concentrations as summary diagrams using data for the final/near-final samples of the experimental runs, which generally lasted for around four weeks. This enables simple comparison between runs using different solids, fluids, and temperatures. Elements selected for plotting are subdivided into three main groups: selected 'At Risk' metals, metals common to South West England, and Rare Earth Elements (REEs). The 'At Risk' metals were selected from the BGS Risk List (2015), a supply risk index for elements of economic value, which ranks these elements from 1 (low risk) to 10 (high risk). Elements ranked at 8 or above were selected from this list, where they were part of the fluid analysis: vanadium, cobalt, gallium, strontium, molybdenum, and antimony. The next grouping was based on metals commonly found, or mined, in South West England: manganese, copper, zinc, iron, arsenic, silver, tin, lead, uranium, and tungsten. The final comprises the Rare Earth Elements: yttrium, lanthanum, caesium, praseodymium, neodymium, samarium, europium, terbium, gadolinium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium, all of which are considered economically 'at risk'.

In places, elemental analyses are summed as groups of elements, based on their likely source mineral. Hence silicate related elements silica, aluminium, sodium, potassium, and magnesium are grouped together, sulphide related elements sulphur, arsenic, lead, zinc, and copper are grouped together, and tin-tungsten related elements tin, niobium, and tungsten are grouped together. Again, these groupings provide simple synthesis of data, and comparison between experiments.

In the following sections, we describe work to characterise the starting solids, with a focus on the sample 'HTLMix', which was used as the primary UK sample for the experiments. This is followed by the results of the laboratory experiments arranged in terms of the type of fluids used. For each fluid type, we then subdivide the results in terms of the type of mineralised material used. Though we conducted many experiments, not all combinations of solids and fluids were run, and not all reacted solids were characterised. Towards the end of this section are observations related to corrosion problems encountered with the equipment.

4.1 Starting material characterisation (HTLMix sample)

The experiments used three different UK samples, but most work was focussed on one particular solid, 'HTLMix' (itself a mixture of 3 samples, see Table 3.1), which was used the most often in the experiments (Table 4.1). The following section therefore provides some detail on the mineralogical analysis of this solid, along with a summary of the mineralogy of the partner samples. Summary information on all of the solids can be found in Table 3.1, with more detailed bulk and trace analysis results available in Appendix A.

Run Temp. °C	DI/Tap	Coke	0.1M Acetic acid	0.1M EDTA	0.1M SDS	0.1M NH ₃	0.1M H ₂ O ₂	0.1M HCL, 0.03M HNO ₃	0.01M HCL, 0.003M HNO ₃	0.6M NaCl
70	1715, 8		1739	1727	1-15	1745				
100							1761	1779	1780	1757
150		1763	1765	1766*						1764
200								1772,7,8		1767,74

* - PTS also analysed

Table 4.1: List of petrographically analysed runs of 'HTLMIX' sample, listed by fluid type and temperature.

4.1.1 Quantitative bulk mineralogy (HTLMix sample)

The mineralogy of the sample HTLMix was determined both by XRD analysis (Table 4.2) and by SEM modal analysis (Table 4.3) and SEM observations (Plate 1). Note that these present weight % and area % data respectively. Both analyses show that the sample is silicate-rich, with quartz the dominant silicate, lesser muscovite and feldspar (albite), and rare chlorite. SEM analysis shows that a substantial portion of the muscovite is present in grains where quartz and muscovite are intergrown, some also contain feldspar. There is minor carbonate in the form of dolomite; SEM EDX analysis additionally shows that the dolomite is an Fe-bearing type that also contains trace Mn. Some of the dolomite is present intergrown with quartz. A single grain of siderite was identified in this sample (outside of the modal analysis).

Sulphides are a moderate constituent, dominated by galena (PbS) with lesser sphalerite (ZnS) and trace pyrite (FeS₂). The SEM modal analysis has been more sensitive to the minor and trace minerals and reveals the additional presence of the sulphides chalcopyrite (FeCuS₂) and bournonite (PbCuSbS₃). Some iron oxide was also identified by SEM.

4.1.2 Galena microchemistry (HTLMix sample)

Both EDX and WDX analyses were used to determine the minor and trace element compositions of the galena from a PTS of the HTLMix sample. During this analysis, two different types of galena were identified in terms of their intra-crystal textures and compositions.

The most common type of galena appears fresh internally with no intra-crystal pores and has a composition in which no minor elements are detectable, and Ag and Au are not detectable by WDX. The second type, which is rare, typically displays heterogeneous internal textures defined by convoluted zones of microporosity that are themselves cross-cut by later non-porous planar features. This second type typically contains Ag up to 0.86 wt% (though Au is not detectable). The Ag content appears to be associated with the later cross-cutting features. The porous zones locally contain traces of the elements Sb and Cu, leading to the suggestion that these zones may have been inclusions of bournonite.

4.1.3 Other mineral microchemistry (HTLMix sample)

Other minerals that were analysed by WDX for the presence of Ag include: sphalerite, chalcopyrite, bournonite and dolomite. None of these minerals contain Ag detectable by WDX analysis.

Trace elements detected include As in bournonite (up to 1 wt %) and Fe in sphalerite (0.3 wt %).

4.1.4 Grain textures (HTLMix sample)

In order to assess the grain surface textures, sub-samples of the starting material were analysed as grain mounts. This approach identified a potential source of heterogeneity in the starting material as different sub samples show galena present in different forms. In one type, galena is present as a fine powder partially coating many of the other grains (Plate 1A). In the other type, whilst there is some of the fine galena, it is predominantly present as blocky grains (Plate 1B). These galena grains show a range of surface textures from clean and angular to pitted and rounded, an example of the latter is shown in Plate 1C. Other sulphide grains also show a similar range of surface textures. Similarly, the carbonate mineral dolomite is present as blocky grains with a mix of surface textures; some are moderately pitted, most have slightly pitted surfaces (Plate 1D).

Quartz grains are the dominant constituent of the sample and the grain surfaces are defined by a mix of crystal faces, choncoidal fractures and crystal intergrowth faces. The last commonly have the euhedrally faceted pits and striae typical of competitive growth.

4.1.5 Partner samples

Six samples from partners in the CHPM2030 project were shipped to the BGS, and were used in some of the experiments. Bulk and trace analyses of these samples can be found along with those of the UK samples in Appendix A at the end of this report, while a summary is given in Table 3.1.1. A summary of the mineralogical features of these solids, as obtained by SEM analysis, is given below:

- HTL320 (Pietroasa, Romania). The grains comprise of calcite intergrown with fibrous szaibelyite (Mg borate). There are also scattered silicate fines (mostly quartz, trace of possible mica).
- HTL 321 (Masca-Cocovaleni, Romania). The grains are predominantly either of dolomite or of pyrite, the latter with slightly altered surfaces (reflected in significant O contents in EDX analyses).
- HTL323 (Corvoinferior, Portugal). Most grains are either of intergrown pyrite and sphalerite, or of chalcopryrite. Dolomite (ferroan) and muscovite are minor phases. Zn and Sn were detected in some of the chalcopryrite. Rare specks of Sb and Sn oxides, rare clusters of fine galena and a minor surface deposit of likely chloride were observed.
- HTL324 (Recsk, Hungary). Predominantly comprises angular grains of quartz with variable contents of coarsely intergrown pyrite, both minerals appeared fresh. Lesser phases include blocky Fe oxide grains (likely magnetite) with finely pitted surfaces, (also containing Mn and Ca), chalcopryrite and chlorite.
- HTL325 (Kristinebergsgruvan, Sweden). Predominantly comprises angular grains of quartz and of pyrite, both fresh, and rounded plates of chlorite. Minor etching was identified at some faces of the lesser chalcopryrite. Muscovite flakes, Fe oxide (likely magnetite) and sphalerite are rare. An inclusion of probable Mo sulphide was observed in pyrite. Scrapings of Cr-steel were noted on some angular quartz edges (presumably derived from the crushing process).

Sample code	Locality	MPLU No.	Mineralogy (wt%)								BET Surface area		
			Silicates				Carbonate: Dolomite	Sulphides				Surface Area (m²/g)	error
			Qurtz	Albite	Muscovite	Chlorite		Pyrite	Galena	Sphalerite	Chalcopyrite		
HTLMix/01	Herod's Foot	749	85.4	1.1	5.2	<0.5	1.1	<0.5	6.3	0.7		0.5517	0.0024
HTLMix/02		750	88.2	0.8	4.3	<0.5	2.0	<0.5	4.0	0.7		0.5404	0.0012

Table 4.2: XRD-derived mineralogy and BET-derived surface area for sample HTLMix.

Mineral	Group	No. Features	% total features	Feature area (µm ²)	% total area	Modal area %	Area % sulphides
Quartz	Silicates	2937	89.2	136000000	38.4	89.1	
Quartz w. dolomite		17	0.5	957000	0.3	0.6	
Lithic Fragments		45	1.4	1500000	0.4	1.0	
Muscovite		14	0.4	517000	0.1	0.3	
Dolomite	Carbonate	54	1.6	2580000	0.7	1.7	
Fe Oxides	Oxide	3	0.1	224000	0.1	0.1	
Galena	Sulphides	165	5.0	8880000	2.5	5.8	81.1
Sphalerite		46	1.4	1660000	0.5	1.1	15.2
Pyrite		4	0.1	112100	<0.1	0.1	1.0
Chalcopyrite		3	0.1	89500	<0.1	0.1	0.8
Bournonite		5	0.2	210000	0.1	0.1	1.9
Total		3293	100	153229600	43.1	100.0	100.0

Table 4.3: SEM-derived modal data from PTS of HTLMix starting material.

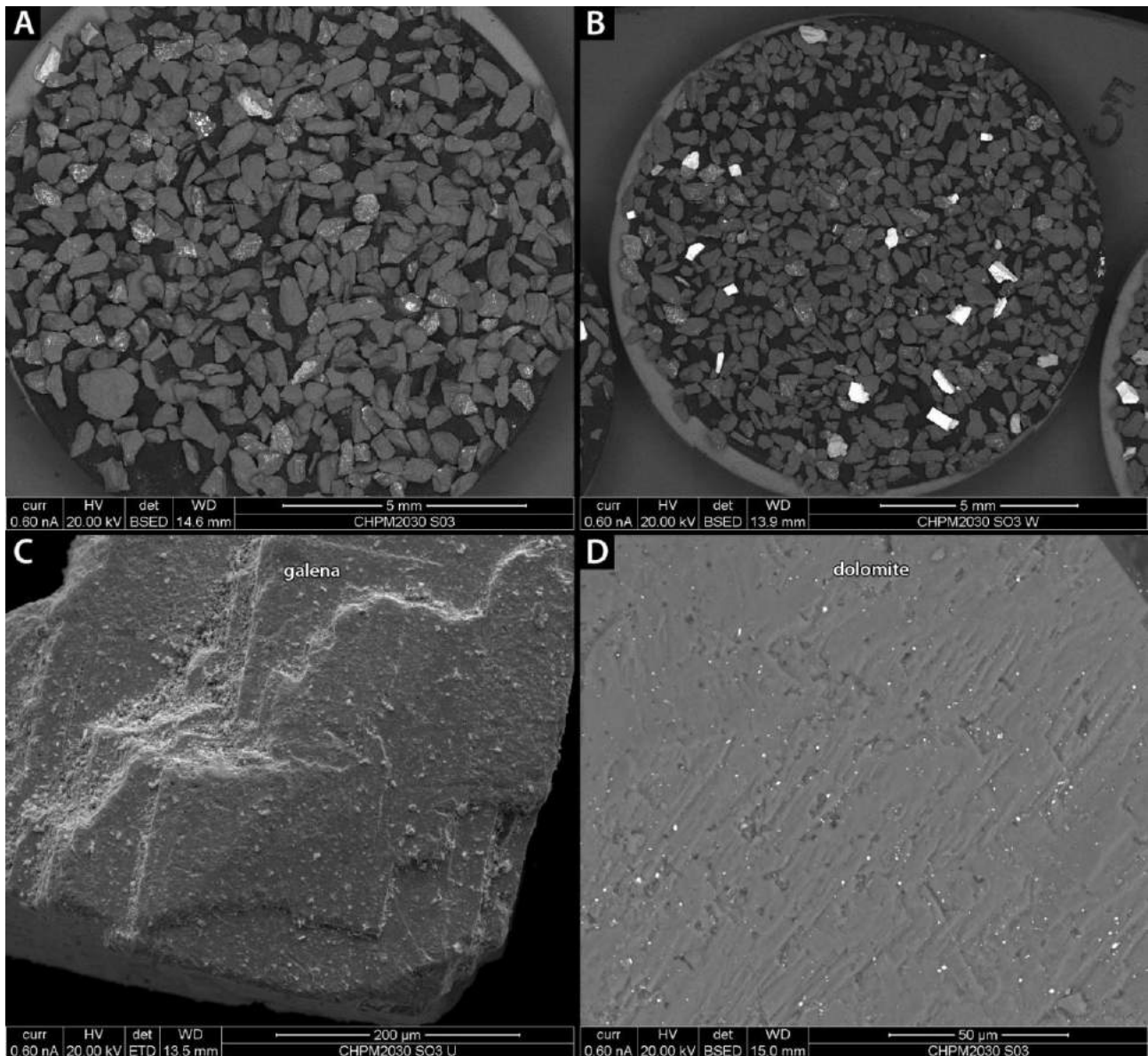


Plate 1: SEM images of HTLMix starting material.

A: BSE image of starting material. This shows the entire SEM grain mount and is the type of starting material with no galena grains; it is present as a partial grain-coating intermixed with silicates and partially oxidised galena. These show as grains with high brightness speckled patches. B: BSE image of starting material. This shows the entire SEM grain mount and is the type of starting material with galena grains; these show as blocky high brightness grains. C: SE image of a galena grain, showing a rough and finely pitted surface and slight rounding of edges. Galena grains show a range of surface textures from clean and angular to pitted and rounded, this is an example of the latter. D: BSE image of a dolomite grain surface. The regular pitting and striations are typical of this carbonate in the starting material. The high brightness specks are galena.

4.2 Summary of experimental results

A detailed description of the results is given in Appendix C – covering both fluid chemical and solid phase information. In the following sections, just a summary of the main findings is given.

4.2.1 Summary of fluid chemical changes

Appendix C provides much detailed information about changing fluid chemistry in individual experiments, but it is less easy to ascertain the relative effectiveness of the different fluids used in relation to metal mobilisation. Therefore, to make these comparisons easier, we have grouped together key observations from experiments of the same fluid type. We have also plotted summary results as bar charts to compare the effectiveness of different fluids for different groups of metals (Figures 4.1-4.12).

De-ionised water: This was very much a base case from which to compare other fluids. As a consequence, the experiment was not expected to mobilise a lot of metals.

For solid HTL315 (which was relatively rich in pyrite), we saw notably higher metal concentrations and lower pH in the 70 °C experiment compared to 100 °C. This suggests more pyrite dissolution in the former experiment relative to the latter experiment. We speculate that we probably had more atmospheric oxygen contaminate the 70 °C experiment, which caused more extensive oxidation of the sulphides (though we acknowledge that we cannot completely rule out sample inhomogeneity causing some of this difference).

For solids HTL319 and HTLMix, there was much reduced leaching relative to solid HTL315. We think that this could be explained by differences in pyrite content, as the latter sample was richer in pyrite.

Tap water: In terms of metals leached, this performed worse than de-ionised water. We found that some metal concentrations actually decreased (e.g. copper, lead, silver were higher in the starting fluid than in the final leachates). We are unsure if they are being removed via sorption processes. Also, we are not sure where the silver in our tap water is coming from (possibly solder?).

NaCl solution: A number of elements were found at higher concentrations in the 70 °C experiments compared to those at 100 °C. This solution was reasonable at leaching a variety of elements, but makes little impact on the REEs. We found complex patterns in the time series data (concentrations of some element groups rise whereas others fall, some peak whereas others trough). Potentially may have precipitation and re-dissolution, but this behaviour is as yet unexplained.

CO₂-rich water: This proved to be poor at leaching metals, even though we have found Cu and Ni mobilised in previous experiments enriched in dissolved CO₂. No REEs were mobilised, so it performed worse than de-ionised water. REEs are located in carbonate phases, so maybe dissolution of these is being suppressed.

Ammonia: This was relatively poor at mobilizing REEs, but did seem to enhance release of tungsten-group elements (though absolute concentrations were still very low). On several occasions, we found higher concentrations of metals in experiments with lower ammonia concentrations. The reason for this is not entirely clear, though we wonder if the higher pH might have reduced metal solubility, or possibly increased sorption. We noticed a couple of very large pH drops: 9.96 to 2.87 for Experiment 1734, 9.96 to 6.57 for Experiment 1736 (both were 0.001 M experiments, using different solids). Higher dissolved Fe concentrations in Experiment 1734 suggest significant pyrite oxidation occurred, which would have contributed acid to solution. This would tie in with larger amounts of pyrite in the solid sample used.

Hydrogen peroxide: This was reasonably effective at leaching a broad spectrum of metals compared to some of the other solutions – presumably through increased degrees of oxidation. However, absolute

concentrations are still relatively low, particularly the REEs. Patterns in element release broadly follow the composition of the starting solid. However, an exception was for some of the REEs more common in the solid HTL319, which were not seen in solution.

Hydrochloric acid/nitric acid mix: This solution was the most aggressive solution used in the tests. Indeed, the starting pH values were very low (<1 in one of the experiments), and remained low for the duration of the tests, two of them ending up at 1.6 and 1.4 after four weeks. Hence this type of solution may not be acceptable as an 'environmentally benign fluid', or be acceptable in terms of its corrosion potential, or the low pH conditions be maintainable within an upscaled semi-open system. Whilst we do not anticipate its use in a real CHPM operation, its use in the experiments allowed us to study the relative amounts of metal release, and also to compare the results with literature data. The higher concentration solution proved very effective at leaching several metals of interest (though this was to be expected). Several elements reached higher concentrations in the lower temperature experiments compared to the higher temperature ones. This mirrored time series data, which showed decreasing concentration trends following initial very rapid rises in concentration. This suggests precipitation or sorption of metals, or breakdown of the leaching agent. The more dilute leachate was very ineffective at leaching REEs. To get the benefit of this acid mix as a leachant, it really needs to be used at 0.1 M concentration or above.

SDS: This was one of the more effective leachants for a range of metals. The higher concentration solution was relatively effective at leaching a range of REEs and 'At Risk' metals, but was less good at low concentrations.

EDTA: This was also one of the more effective leachants for a range of metals. It was relatively successful at leaching REEs, both in terms of range of elements, and in concentration. EDTA concentration had a big impact (higher concentrations = larger dissolved metal load), but even the more dilute fluid was relatively successfully at mobilising many elements.

Acetic acid: Alongside SDS and EDTA, this was also one of the more effective leachants for a range of metals and achieved reasonable results with sample HTLMix. In the HTLMix experiments, concentration played an important factor - far fewer REEs leached using the more dilute solution, whereas 0.1 M was quite effective. The higher temperature experiment showed lower concentrations of REEs, and time series data show a gradual decrease in REE concentrations, suggesting possible precipitation. However, it was relatively poor at leaching REEs from other samples.

Coke: Whilst not part of the main leaching focus of our study (partly because it contained a range of chemical components), the use of Coca Cola did give some interesting results. It was quite acidic, and had low pH of approximately 2.5 (presumably due to the presence of citric and phosphoric acids), which did not change much during the experiment. It was relatively good at mobilising certain elements (e.g. cobalt, lead, iron), so may suggest some selectivity. The presence of citrate may have helped mobilise these, as per acetate in the acetic acid experiments. The spread of REE data matches that of the starting solid, but concentrations were very low concentrations. Uranium concentration was depressed, and we tentatively suggest that the solubility of this element (possibly together with some REEs) may have been suppressed by the presence of phosphate.

In order to underline the above comments, the relative effectiveness of each fluid is compared in Figures 4.1-4.12. These show combined data for experiments with the HTLMix sample at both 70 °C and 150 °C/200 °C. In general terms, the dilute solution (i.e. de-ionised water and tap water are worst performing, with NaCl a little better. Ammonia is not much better than NaCl solution, except for tin-tungsten group elements

(Figure 4.6) where it performs relatively well (though absolute concentrations are still low). At 70 °C the best performing leaching solutions were those containing organic components (i.e. EDTA, SDS and acetic acid), and in particular for sulphide group elements (i.e. those metals linked to sulphide minerals) - which are also common in SW England (Figures 4.1 and 4.3).

A similar pattern was found for experiments at 150 °C/200 °C, though not all fluid types were used at these higher temperatures. EDTA and 0.6 M NaCl appeared to perform equally as well as at 70 °C, though acetic acid performed a little less well. The hydrochloric-nitric acid mix was (unsurprisingly) the best performing leachate overall, though it was just beaten by EDTA for liberating RREs. Coca-Cola performed better at liberating metals compared to acetic acid, but not quite as well as EDTA. It did however, appear to be very poorly-performing in terms of solubilising REEs.

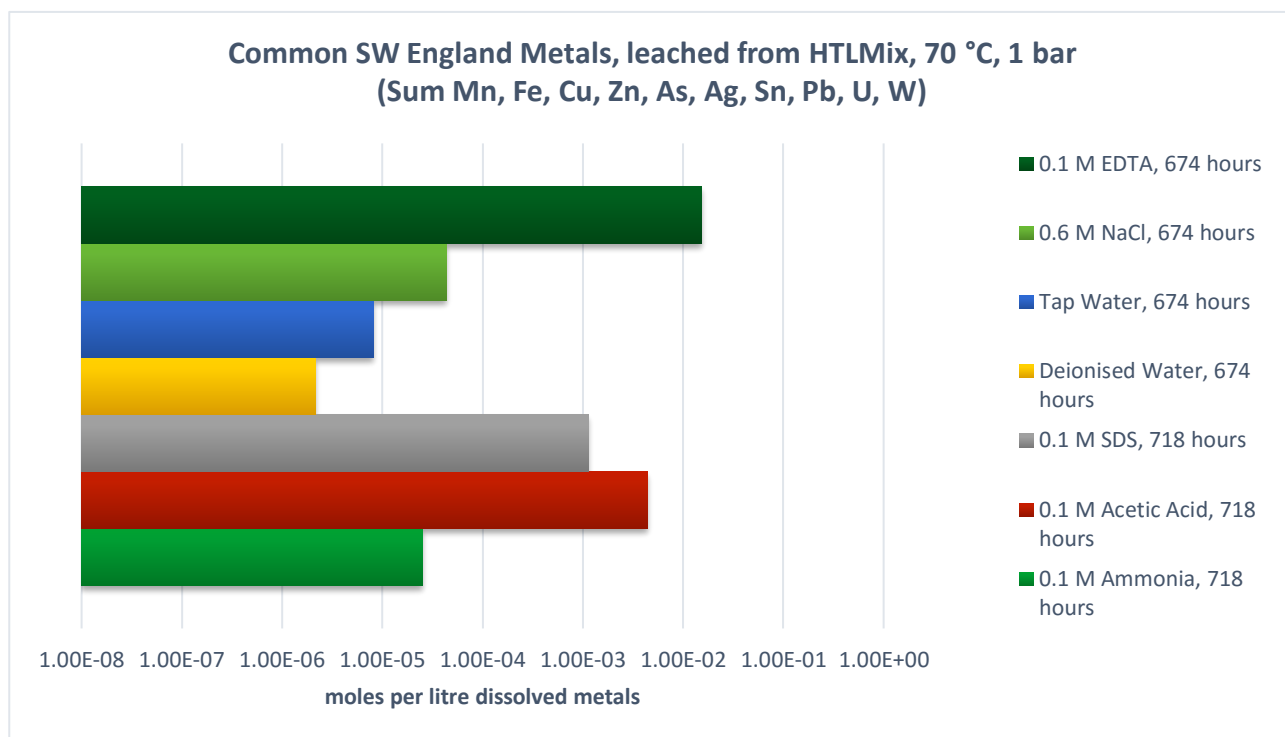


Figure 4.1: Relative concentrations of common SW England metals for experiments at 70 °C with different fluids.

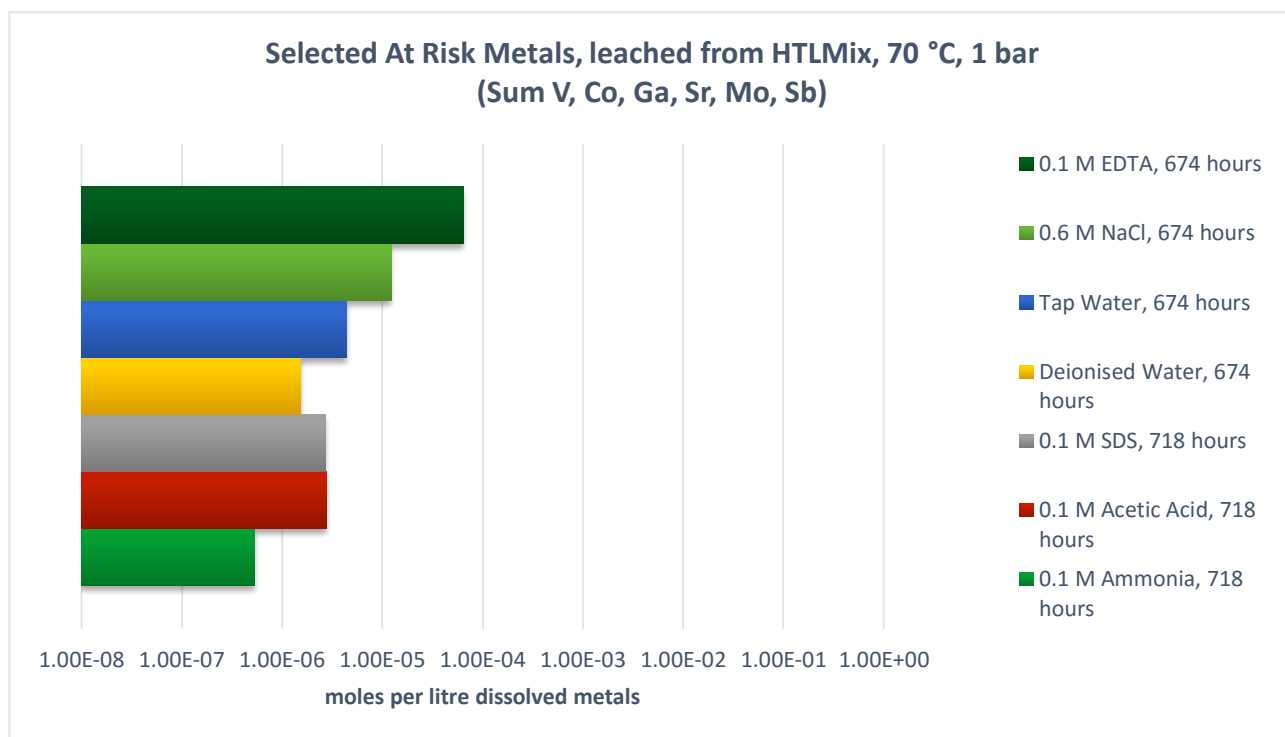


Figure 4.2: Relative concentrations of 'At Risk' metals for experiments at 70 °C with different fluids.

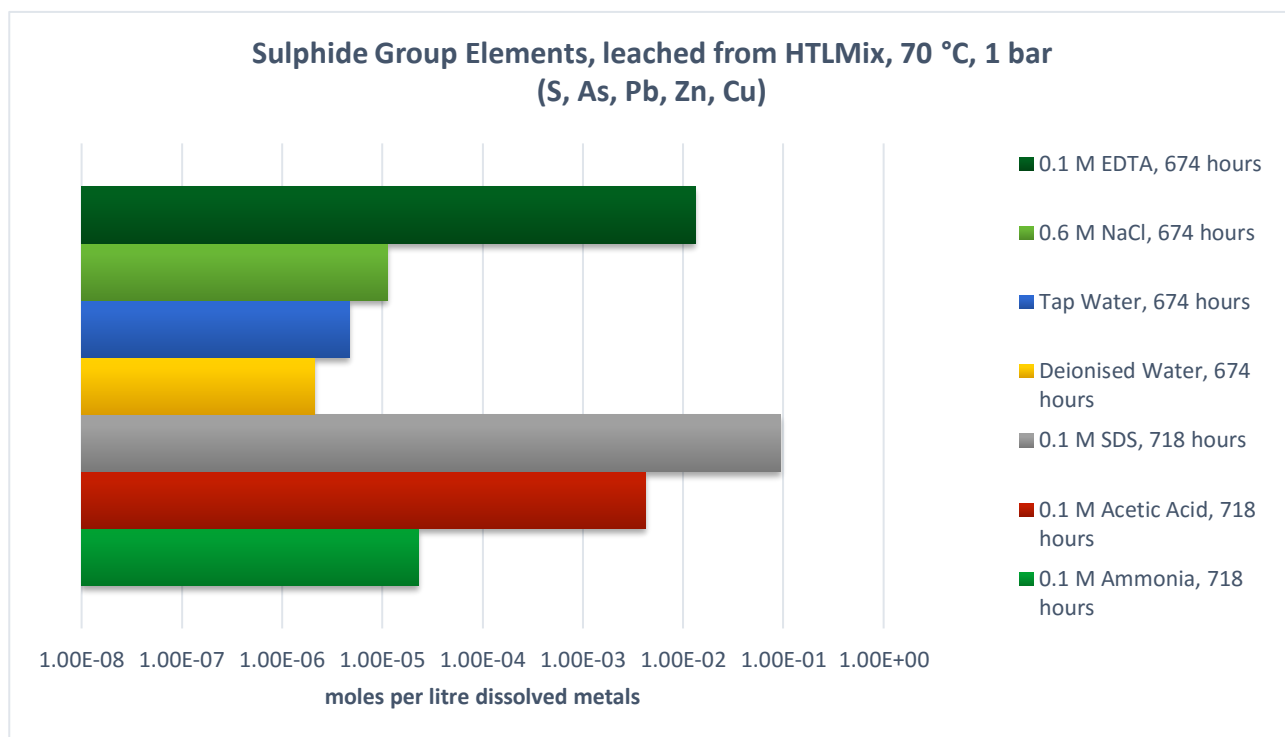


Figure 4.3: Relative concentrations of sulphide group elements for experiments at 70 °C with different fluids.

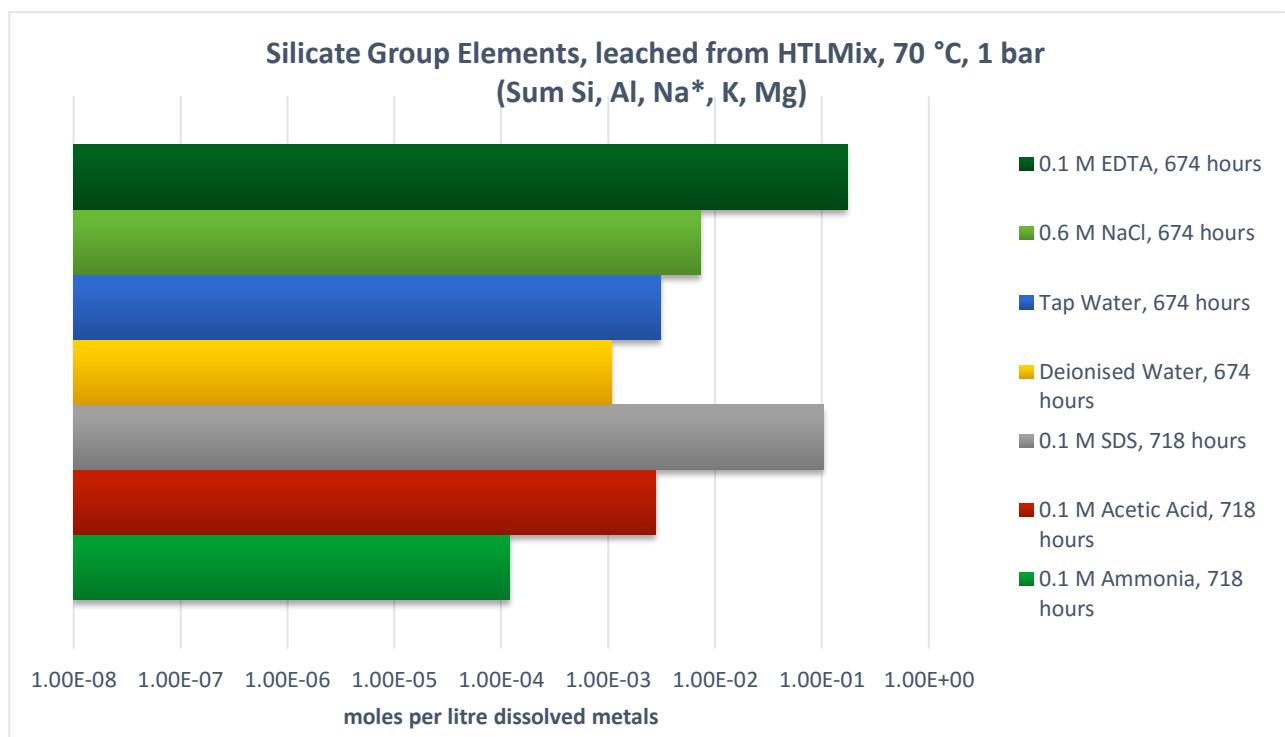


Figure 4.4: Relative concentrations of silicate group elements for experiments at 70 °C with different fluids.

(Note that the NaCl experiment results were corrected for starting concentration).

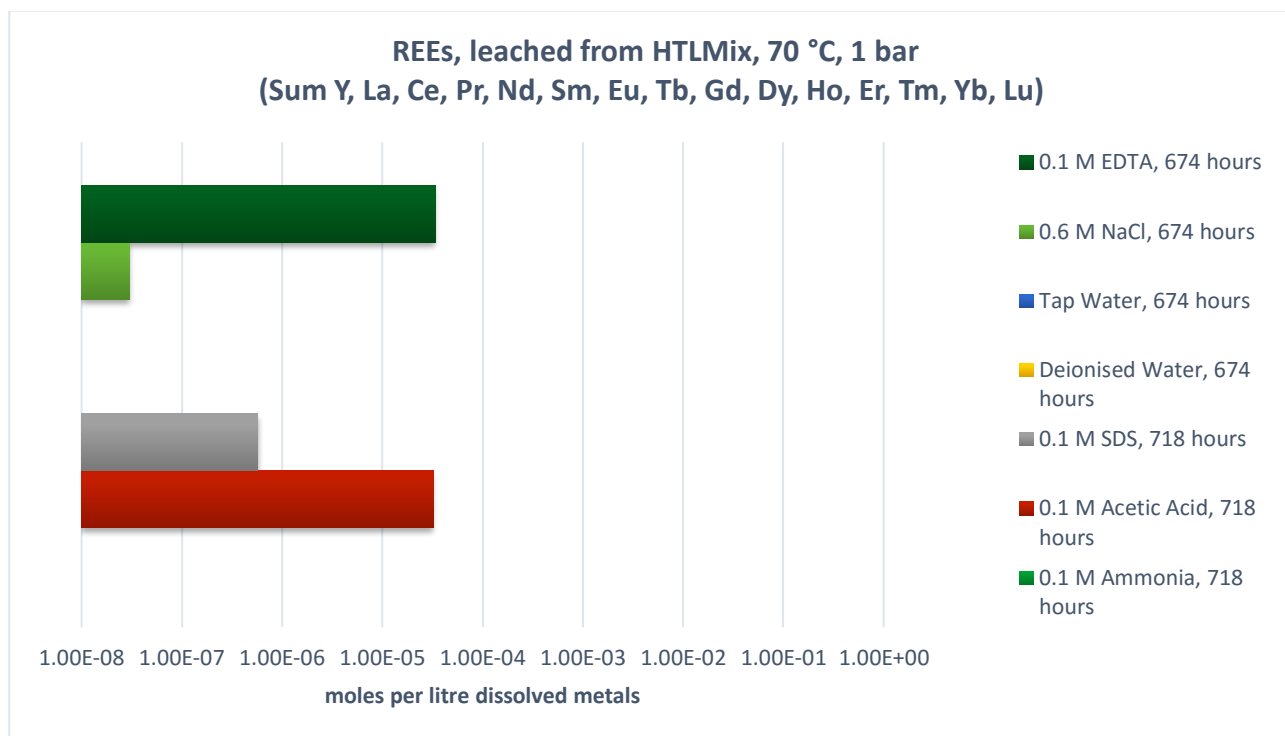


Figure 4.5: Relative concentrations of REEs for experiments at 70 °C with different fluids.

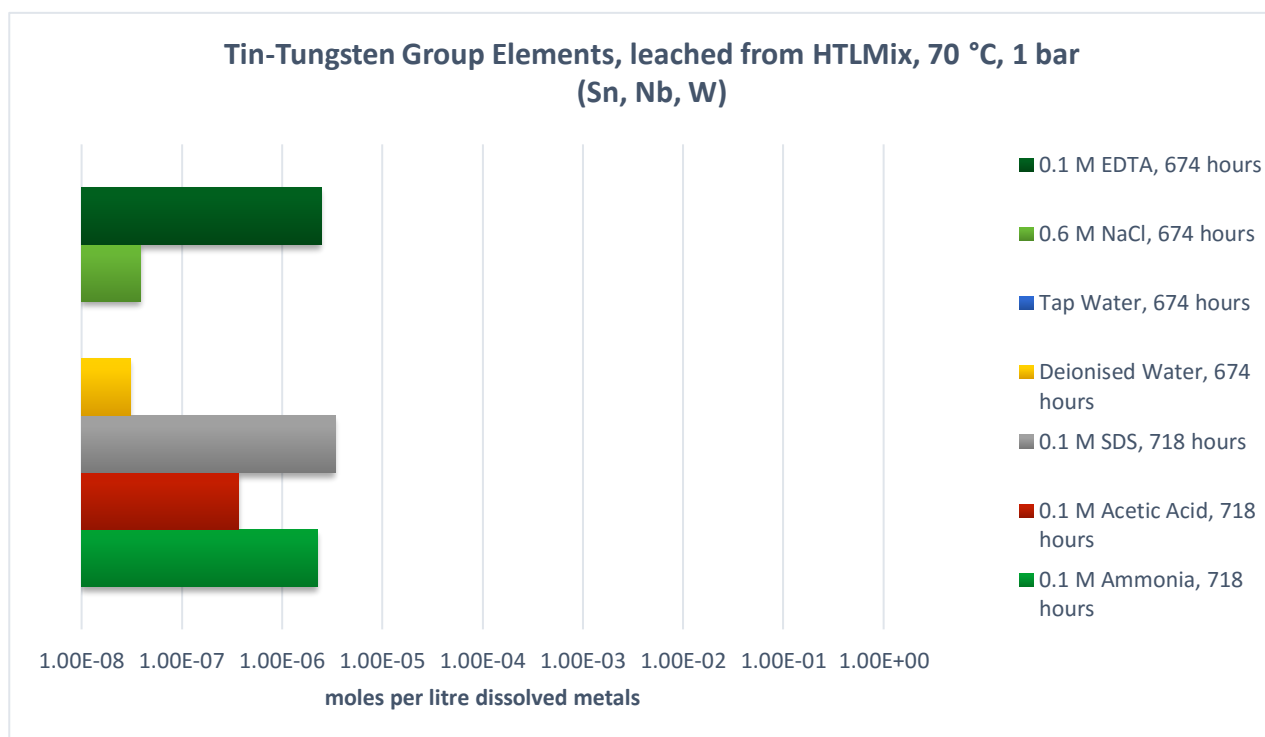


Figure 4.6: Relative concentrations of tin-tungsten group elements for experiments at 70 °C with different fluids.

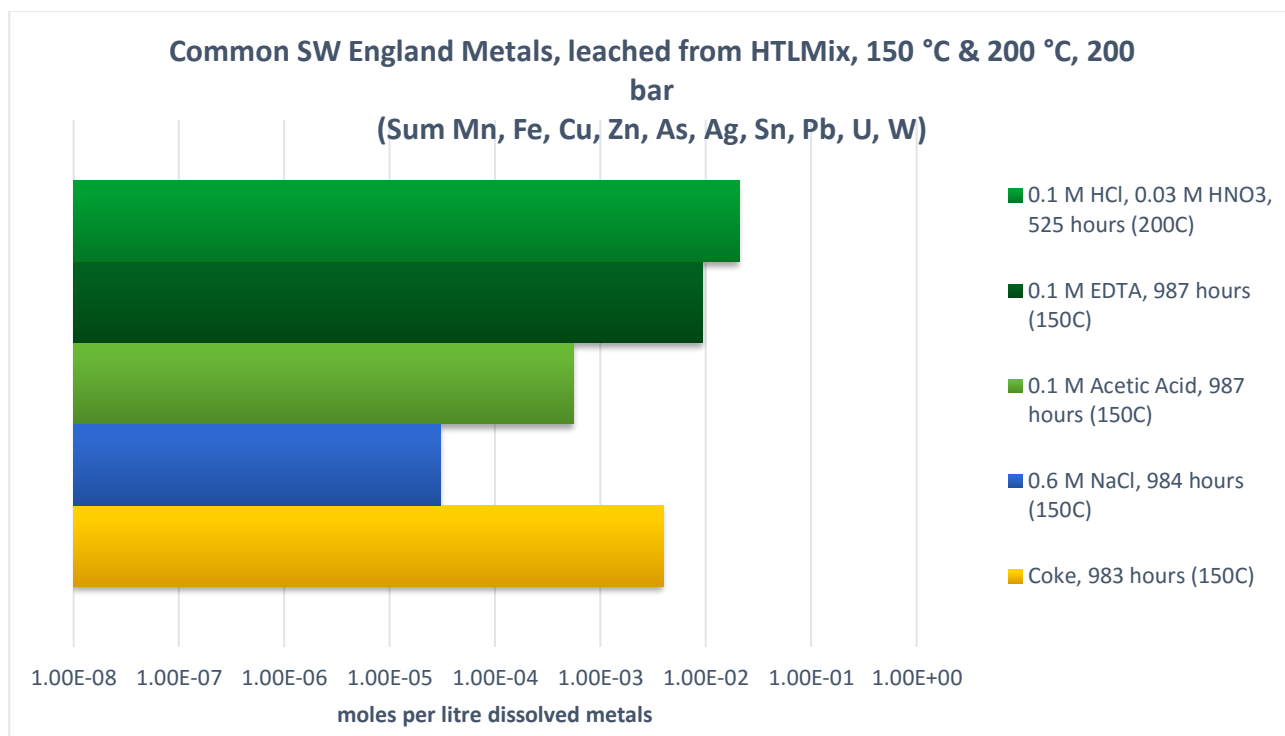


Figure 4.7: Relative concentrations of common SW England metals for high temp experiments with different fluids.

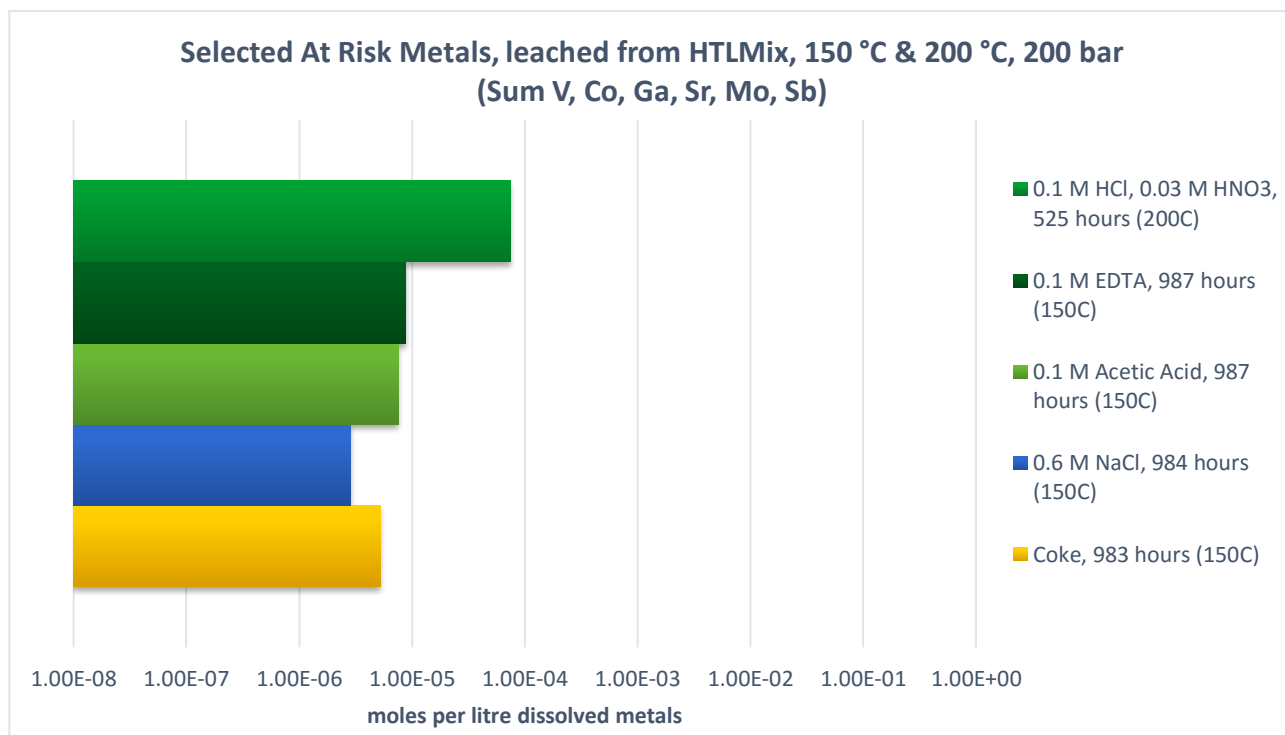


Figure 4.8: Relative concentrations of 'At Risk' metals for high temp experiments with different fluids.

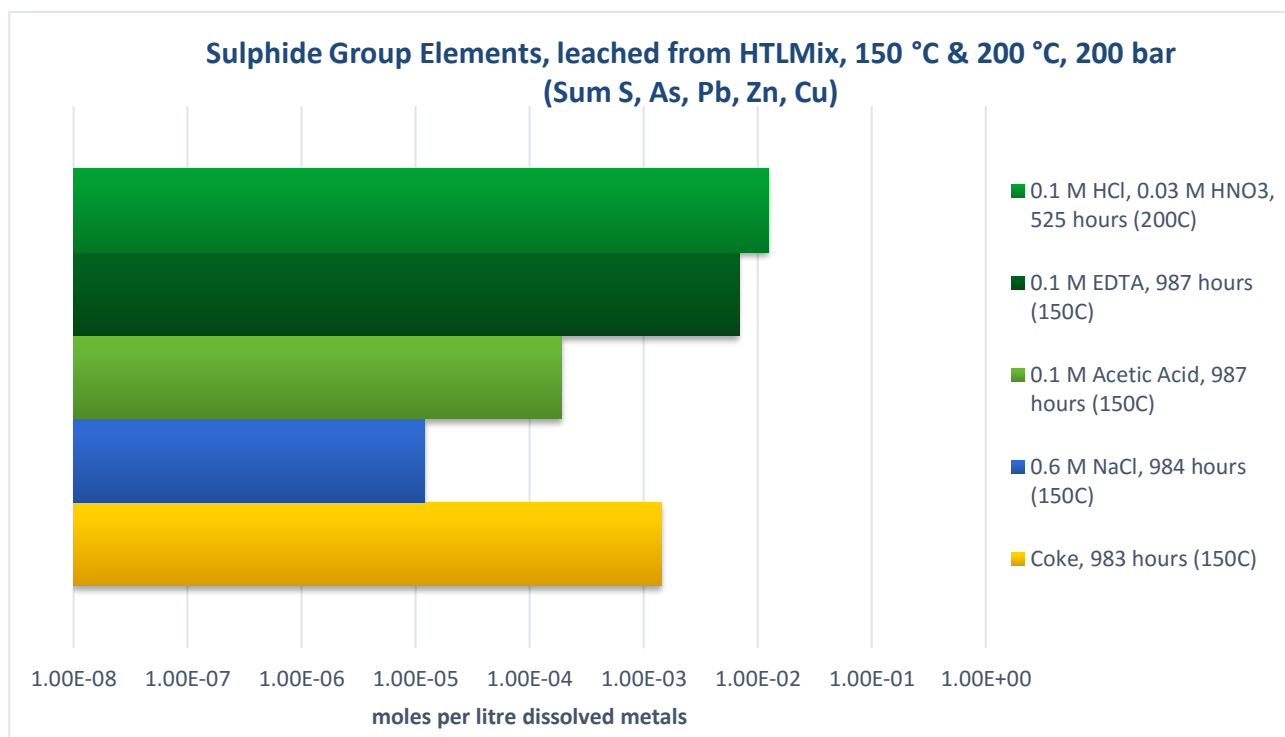


Figure 4.9: Relative concentrations of sulphide group elements for high temp experiments with different fluids.

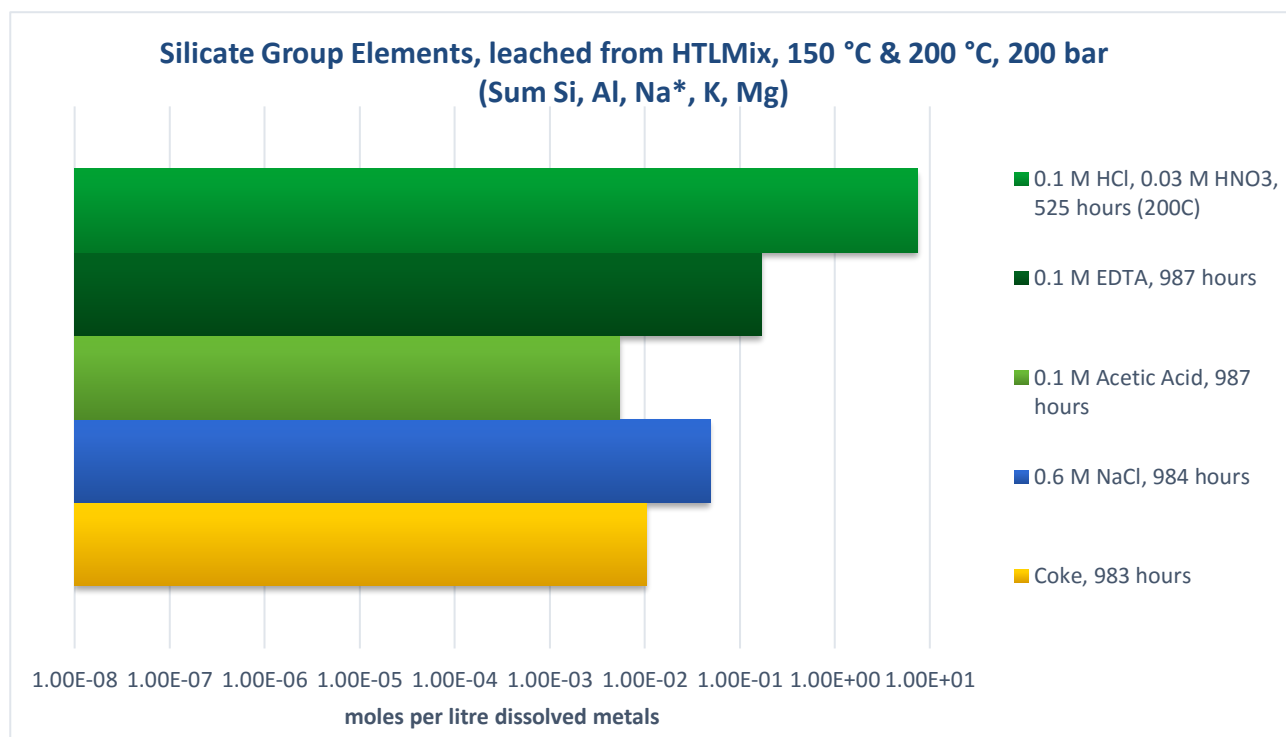


Figure 4.10: Relative concentrations of silicate group elements for high temp experiments with different fluids.

(Note that the NaCl experiment results were corrected for starting concentration).

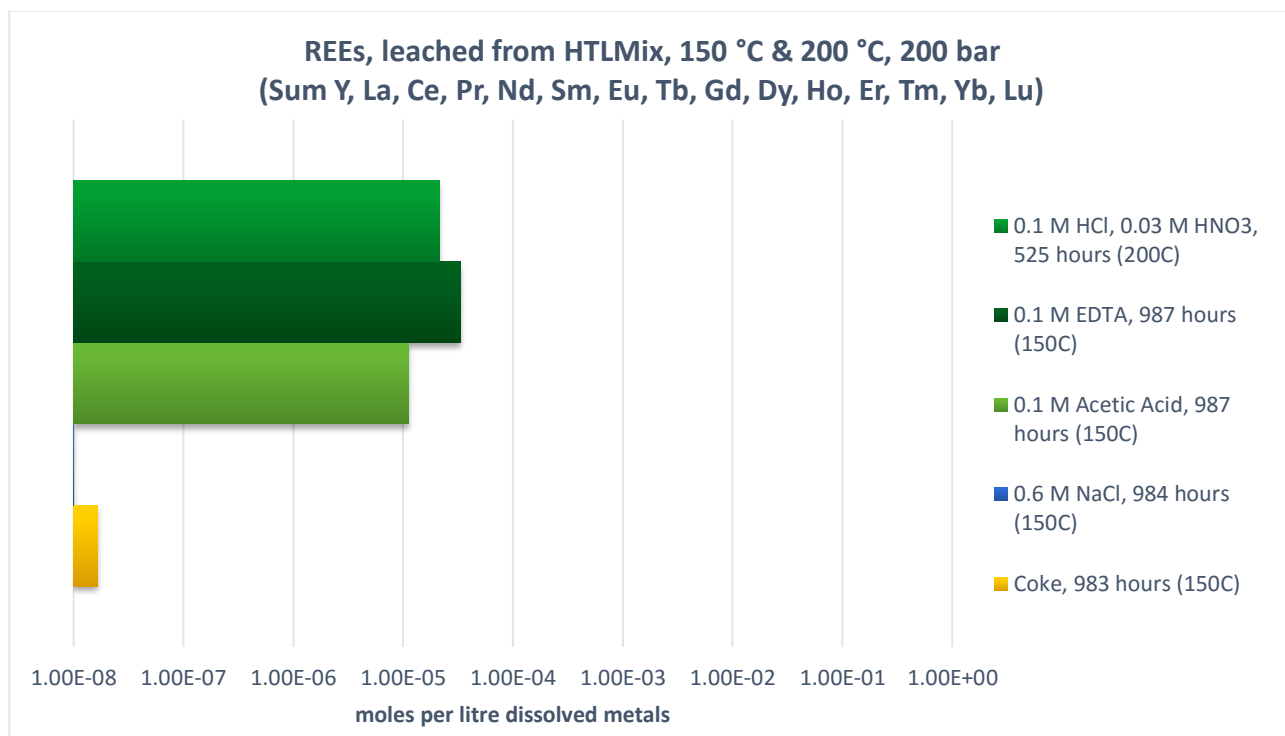


Figure 4.11: Relative concentrations of REEs for high temp experiments with different fluids.

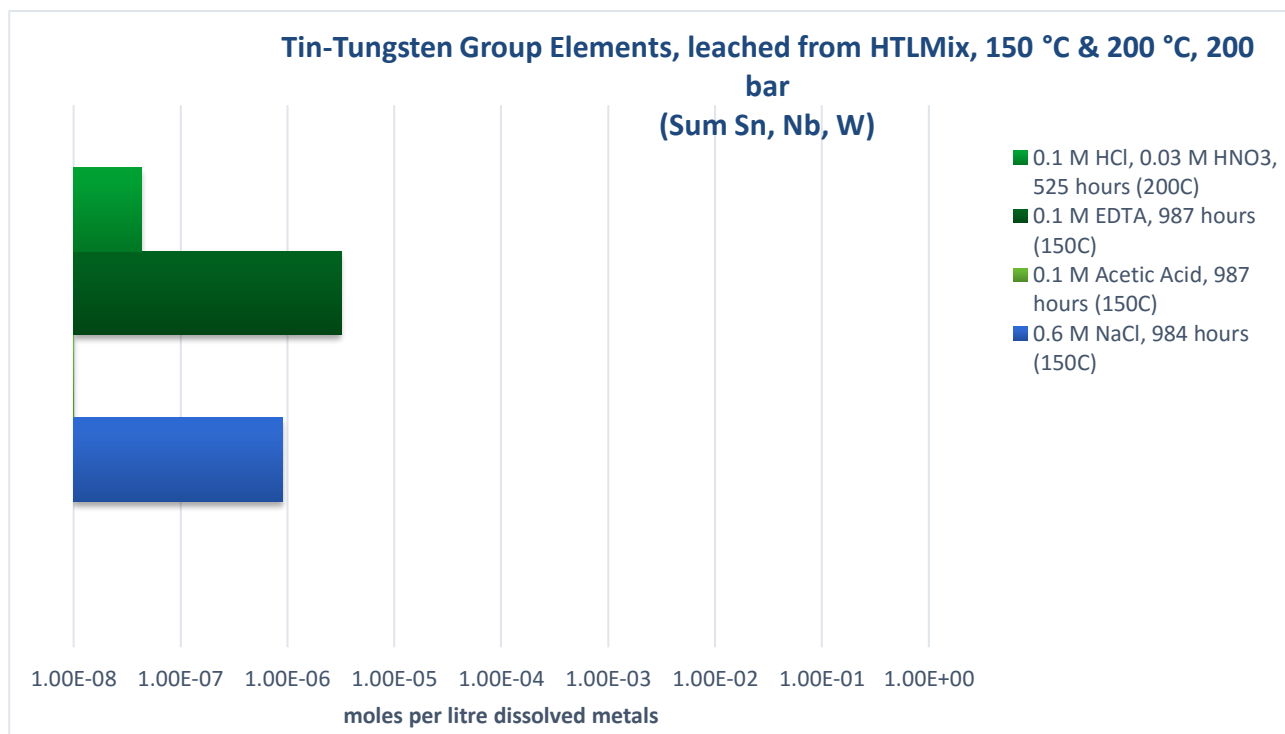


Figure 4.12: Relative concentrations of tin-tungsten group elements for high temp experiments with different fluids.

4.2.2 Summary of petrographical changes for the HTLMix sample

That several different starting solids were used in the experiments makes it more difficult to clearly compare the differing degrees of reaction between solid phases. Therefore, in order to make the relative changes of UK material clearer, we present the summary below based on observations of just the HTLMix sample. This sample was relatively rich in galena, plus also some sphalerite, with more minor amounts of copper minerals such as chalcopyrite. The observations made during the petrographic study of reaction products are also summarised in Table 4.4.

Galena:

- 70 °C experiments: Completely dissolved by EDTA, etched in other experiments (Ag, Cu enrichment found in etch pits with acetic and SDS), no reaction in the water experiments.
- 100 °C experiments: Etched in the hydrochloric/nitric acid experiments (more so in the more concentrated mixture, which also yielded trace Ag, Sb, Cu, Fe in etch pits), altered and pseudomorphed by mixed Pb sulphates and oxide / carbonate in peroxide. Not affected in the NaCl experiment.
- 150 °C experiments: Etched in Coke, acetic acid and EDTA, but greatest in the EDTA in which etch pits contain enrichments in Ag and Cu. Not affected by NaCl solution.
- 200 °C experiments: Completely dissolved in dilute hydrochloric/nitric acid mix, deeply etched in NaCl solution (though possibly affected by equipment failure).

Outcomes:

- Release of Pb, S, and trace Ag, Cu and Sb,
- Concentration of some trace elements at dissolution sites (e.g. Ag) suggests trace elements may only be finally released to solution if all of the host mineral is dissolved,
- Can reduce pH with the formation of sulphate ions,
- A higher degree of dissolution occurred in EDTA at 70 °C than at 150 °C, which may relate to higher levels of oxygen being available in the lower temperature experiment.

Associated precipitates:

- Pb sulphates limited to 70 °C peroxide and 200 °C mixed hydrochloric/nitric acid experiments, so supply of oxidising agent may be a control on this,
- Both Pb and S also precipitated in the alum minerals that formed in the 200 °C mixed hydrochloric/nitric acid experiment.
- Pb chlorides were observed in several experiment products; these may form on quenching / drying, as have other deposits with associated Fe and As.

Silicates:

- 70 °C experiments: Slight etching in all except the ammonia and water experiments.
- 100 °C experiments: Slight etching only in the mixed dilute hydrochloric/nitric acid experiment.
- 150 °C experiments: Etching except in the NaCl solution.
- 200 °C experiments: Etched in the mixed acid experiments, and slight etching in one NaCl experiment.

Outcomes:

- Release of Si, Al, and cations such as Na, Mg and K.

Associated precipitates:

- Al phosphate in the Coke experiment,
- Alum minerals in the 200 °C mixed dilute hydrochloric/nitric acid experiments,
- Silica coating to dolomite in the NaCl experiments,
- However, no clays were recognised.

Dolomite:

- 70 °C experiments: Completely dissolved except for ammonia experiment (etched), and the water experiments (no significant change).
- 100 °C experiments: Completely dissolved except for NaCl experiment (etched and silica-coated)
- 150 °C experiments: Completely dissolved except for NaCl experiment (deeply etched and silica-coated)
- 200 °C experiments: Completely dissolved except for NaCl experiment (rare remnants only)

Outcomes:

- pH was moderated,
- Release of CO₂, Ca and Mg.

Associated precipitates:

- Phosphate in the coke experiment,
- Fluorides in the high temperature NaCl experiments (equipment failure was the source of the F),
- Silica in some NaCl experiments.

Sphalerite:

- 70 °C experiments: Etched to slightly etched except for the water experiments. Ag, Cu and Cd detected in some etch pits.
- 100 °C experiments: Dissolved in peroxide, etched in dilute hydrochloric/nitric acid mix experiments, not affected by NaCl solution.
- 150 °C experiments: Dissolved in acetic acid, deeply etched in EDTA, not affected by NaCl solution.
- 200 °C experiments: Dissolved.

Outcomes:

- Release of Zn, S, and trace Fe,
- The concentration of some trace elements at dissolution sites (e.g. Ag, Cu) suggests similar mechanisms for dissolution of galena are taking place
- Can reduce pH with formation of sulphate ions.

Associated precipitates

- Zn-specific precipitates were only detected in the 100 °C peroxide experiment,
- The S released from sphalerite dissolution could contribute to any of the S-bearing precipitates noted in the galena section.

Other sulphides

The minor sulphide phases bournonite, chalcopyrite and pyrite are present in the starting material in amounts that mean their non-detection in experimental products could be a result of sampling bias rather than dissolution. However, it is noted that bournonite was detected in reaction products far more often than the other minor sulphides, suggesting that it is more resistant to dissolution (whilst its formation as a reaction product cannot be completely ruled out, we consider it unlikely). In the 200 °C mixed dilute hydrochloric/nitric acid experiments the bournonite has had Pb preferentially dissolved.

Outcomes:

- Release of Pb, Cu, Fe, Sb, S, and trace As,
- This group is probably the source of the Cu concentrated in galena dissolution pits
- Can reduce pH with formation of sulphate ions.

Associated precipitates:

- Sb-based precipitate limited to 150 °C EDTA experiment is the only significant precipitate identified that could have resulted from this group.

Partner samples summary

Time constraints meant that only a selection of the partner experimental run products could be studied, but here are the more notable observations:

- Sample HTL320 (Skarn from Romania): This comprises szaibelyite (Mg borate) cemented by calcite. With dilute hydrochloric/nitric acid (experimental run 1781), the calcite is partially dissolved and appears to have released the szaibelyite as mobile fines. (A white 'precipitate' was found lining the reaction vessel. This was not tested, but may well have been released szaibelyite).
- Sample HTL323 (Massive sulphide from Portugal): In experiments 1769 (NaCl solution) and 1783 (dilute hydrochloric/nitric acid mix) the dolomite was completely dissolved, but little else had changed. The effect on dolomite is similar to the BGS 100 °C experiments, although some dolomite remained in the BGS NaCl solution experiment.
- Samples HTL324 and HTL325 (both porphyry mineralization, one from Hungary and one from Sweden): These are mineralogically similar. In all tests (NaCl solution and dilute hydrochloric/nitric acid mix) the chlorite has possibly been partially dissolved. NaCl solution had no other effect. In the dilute acid mix (Runs 1784, 1785) there is additional probable slight dissolution of chalcopyrite and (in 1784) of magnetite.
- In all samples containing pyrite (HTL323, HTL324 and HTL325), the mineral shows no sign of having reacted / dissolved. It looks like chalcopyrite reacts in preference.

Table 4.4: Summary of petrographic observations made on HTLMIX experiment products.

HTLMix	Experiment	DI/ Tap water	Coke	0.1M Acetic	0.1M EDTA	0.1M SDS	0.1M NH ₃	0.1M H ₂ O ₂	0.1M HCL, 0.03M HNO ₃	0.01M HCL, 0.003M HNO ₃	0.6M NaCl
Lab Run numbers	70 °C	2-3, 2-6		1739	1727	1-15	1-3				
Silicates		NSC		Slightly etched	Slightly etched	Slightly etched	NSC				
Galena		NSC		Etched Ag, Cu in pits	ND	Etched Cu in pits	Slightly etched				
Sphalerite		NSC		Slightly etched Cu in pits	Slightly Etched Ag, Cd in pits	Etched	Slightly etched				
Dolomite		NSC		ND	ND	ND	Etched				
Other sulphides		NSC		Slightly etched	Bourn. present						
Precipitates		NSC		Poss Pb sulphate	ND	Fine discs of Pb-S-O	Common Pb-rich. Fe-Mn-Pb on dol.				
Other				Part dissolution of inherited Fe oxide							
Lab Run numbers	100 °C							1761	1779	1780	1757
Silicates								NSC	Slightly etched	NSC	NSC
Galena								Altered & dissolved	Deeply etched Ag,Sb,Cu, Fe in pits	Etched	NSC
Sphalerite								ND	Etched	Etched	NSC
Dolomite								ND	ND	ND	Etched
Other sulphides								ND	Etched	Etched	NSC
Precipitates								Common Pb and Zn phases	Patchy Fe-Sb deposit. Pb chloride		Silica skin on dolomite
Other								Mats of porous Fe-Mn-Pb			NSC to inherited Fe oxides

HTLMix	Experiment	DI/ Tap water	Coke	0.1M Acetic	0.1M EDTA	0.1M SDS	0.1M NH ₃	0.1M H ₂ O ₂	0.1M HCL, 0.03M HNO ₃	0.01M HCL, 0.003M HNO ₃	0.6M NaCl
Lab Run numbers	150 °C		1763	1765	1766						1764
Silicates			Etched	Etched	Etched						NSC
Galena			Etched	Slightly etched	Deeply etched. Ag, Cu in pits						NSC
Sphalerite				ND	Deeply etched						NSC
Dolomite			ND	ND	ND						Mostly dissolved
Other sulphides				ND	ND						NSC
Precipitates			Phosphate (Pb, Al, Ca) Sulphate (Ca)	Pb-As and Sb phase cementations grains. Possible drying ppt							Silica skin on dolomite Rare Pb chloride
Other			Poor grain recovery.		Ti-rich deposit						NSC to inherited Fe oxide
Lab Run numbers	200 °C								1772, 1778		1767, 1774
Silicates									Etched		NSC to slightly etched
Galena									ND		Deeply etched
Sphalerite									ND		ND
Dolomite									ND		ND to trace
Other sulphides									Bourn. stripped of Pb		ND / bourn. present
Precipitates									Pb-bearing alums. Pb sulphate		Abundant fluorides (Na, Mg, Ca, Al)
Other									Alum enclosed by Pb sulphate		Some Pb and Cu deposits also

NSC – No significant change

ND – None detected

Bourn. - Bournonite

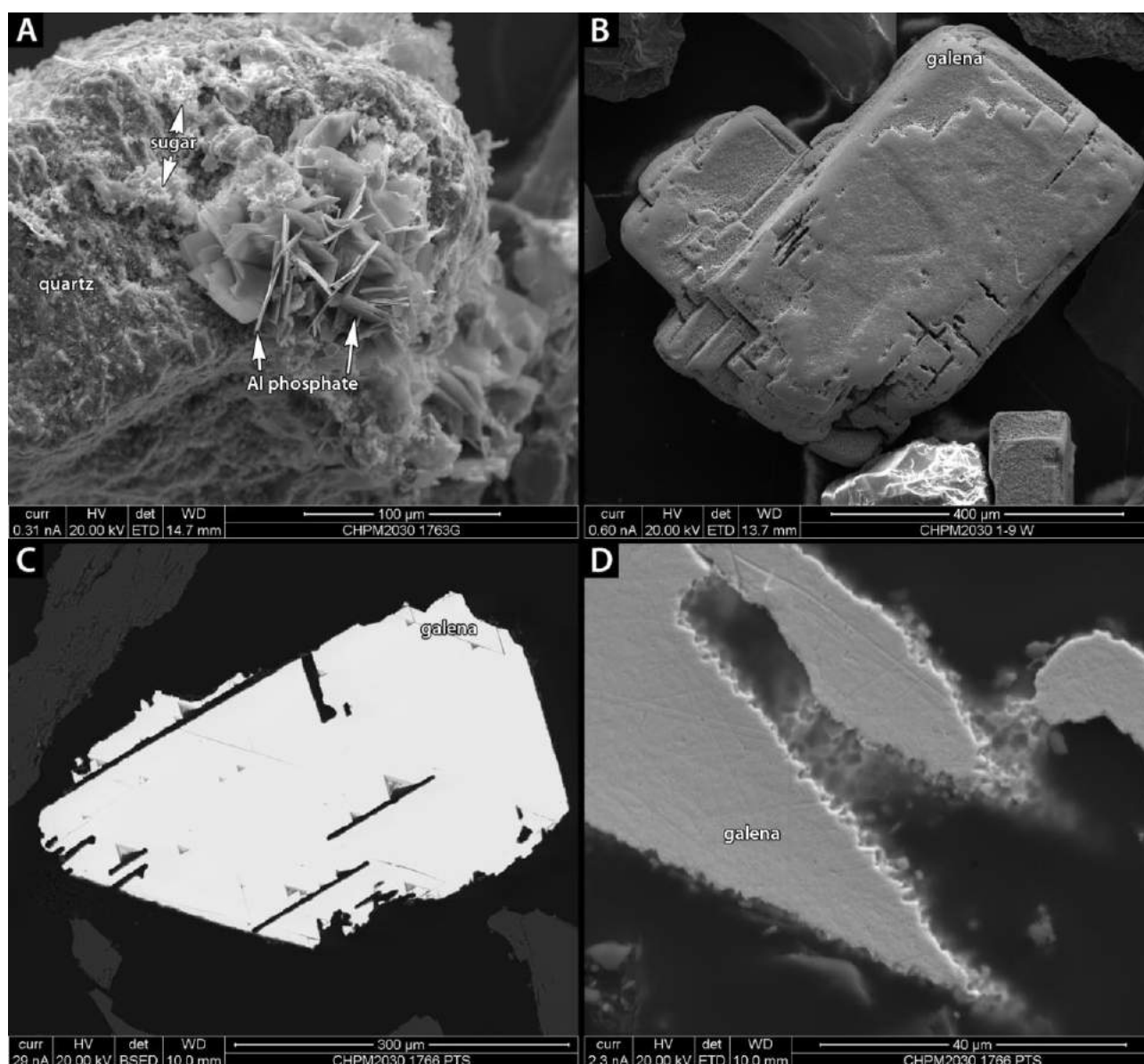


Plate 2: SEM images of experimental run products.

A: SE image, run 1763, Coke @ 150 °C. A quartz grain partially coated by fine granular sugar also has a rosette-like precipitate of probable Al phosphate. B: SE image, run 1739, 0.1M acetic acid @ 70 °C. A galena grain with rounded edges, finely pitted faces and deep notches aligned with cleavage planes. C: BSE image, PTS of run 1766, 0.1M EDTA @ 150 °C. Cross-section of a deeply pitted galena grain showing their internal alignment with cleavage planes. D: SE image, PTS of run 1766, 0.1M EDTA @ 150 °C. This shows the spongy porous texture of the edges of the notches in galena. Ag and Cu are present in the porous material, but are not detectable in the unaffected galena.

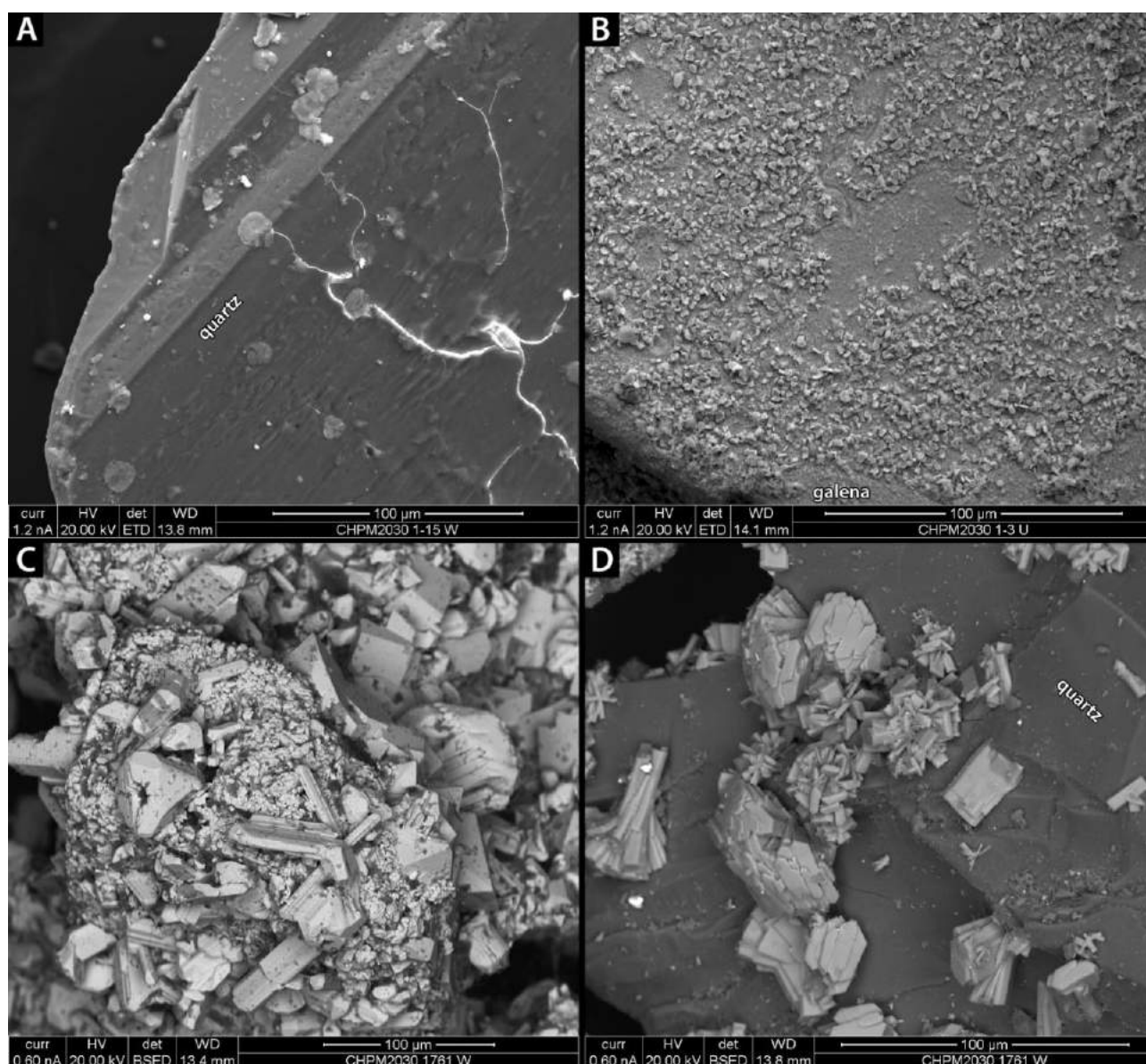


Plate 3: SEM images of experimental run products.

A: SE image, run 1745, 0.1M SDS @ 70 °C. A quartz grain with a form defined by crystal faces, with a scattered disc-like deposit of a Pb-S-O phase (possibly Pb sulphate). These may themselves be partially dissolved. Some of the pits and striae on the quartz faces are inherited from the starting material (a common competitive growth style), but the rounded margins to these and the shallow stepping on the non-competitive face (top) are signs of slight dissolution. B: SE image, run 1733, 0.1M NH₃ @ 70 °C. A galena grain coated by euhedral Pb-rich platy crystals with hexagonal forms. The underlying galena has rounded edges and a finely pitted face. C: BSE image, run 1761, 0.1M H₂O₂ @ 100 °C. This collection of euhedral and subhedral Pb-rich phases has formed in place of a galena grain. Some prismatic crystal forms contain S (probable sulphate). D: BSE image, run 1761, 0.1M H₂O₂ @ 100 °C. Euhedral bladed and elongate crystals of a Zn-rich precipitate are clustered on a quartz grain that shows no evidence of dissolution.

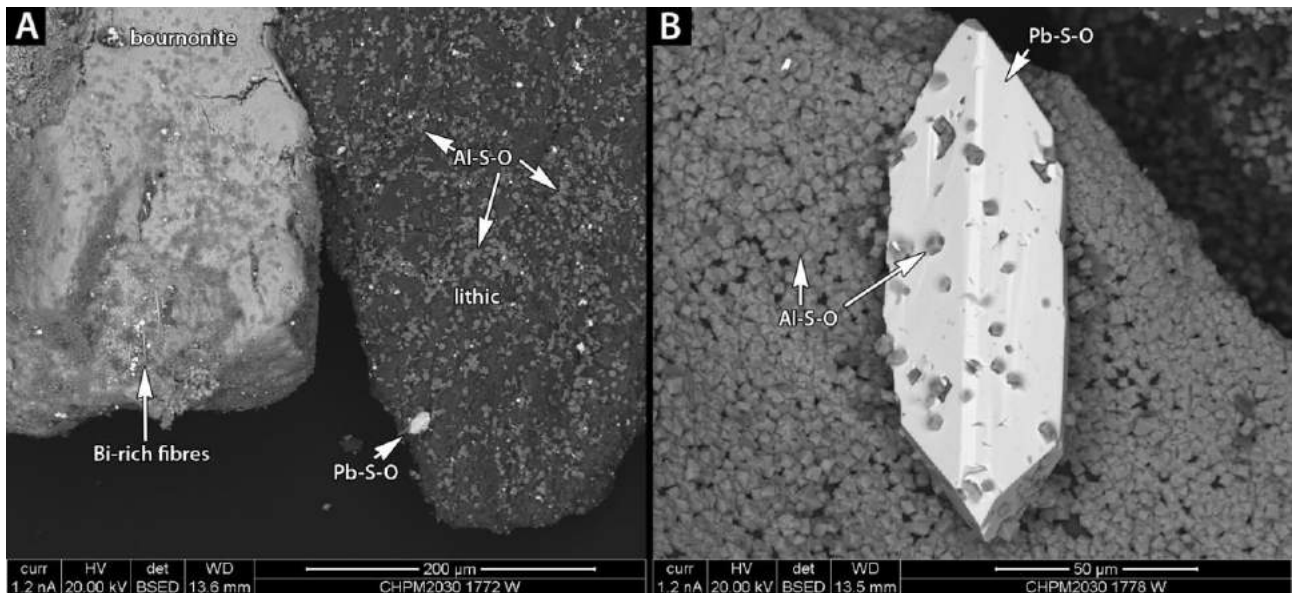


Plate 4: SEM images of experimental run products.

A: BSE image, run 1772, 0.1M HCL, 0.3M HNO₃ @ 200 °C. To the left a bournonite grain has an altered, crusty and porous surface, depleted of Pb. To the right a clay-rich lithic has a truncated and etched surface that is partially coated by probable alum (Al-S-O) with lesser Pb-S-O (Pb sulphate). Note the fine fibres of a Bi-rich phase; these were only observed associated with the bournonite. B: BSE image, run 1778, 0.1M HCL, 0.3M HNO₃ @ 200 °C. The grain is completely coated with equant crystals of probable alum (Al-S-O). The coarse crystal of Pb-S-O (Pb sulphate) post-dates the alum as it partially encloses it.

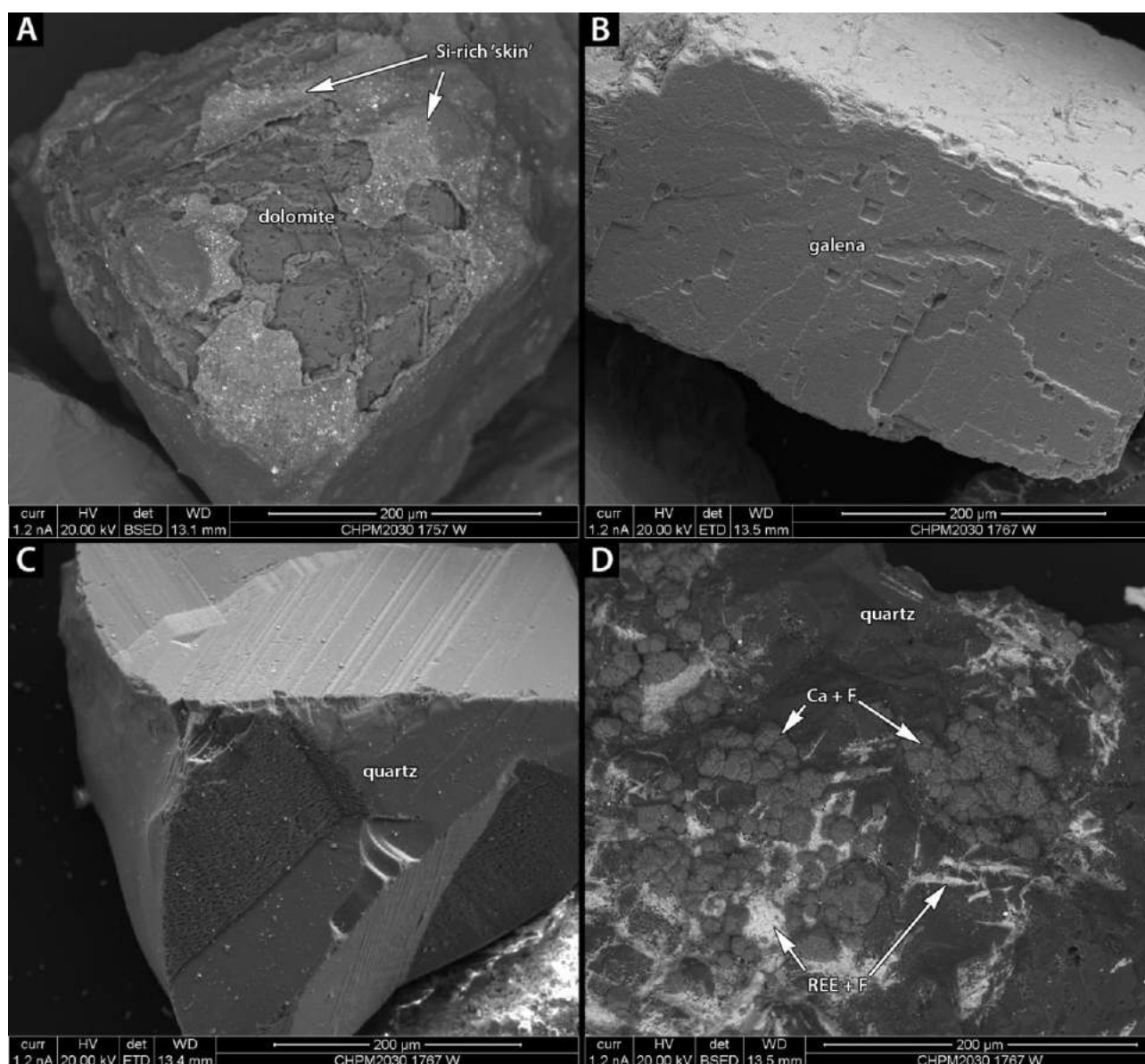


Plate 5: SEM images of experimental run products.

A: BSE image, run 1757, 0.6M NaCl @ 100 °C. This shows a grain of dolomite that is rounded and pitted by dissolution. It has a partial slightly detached skin of Si-rich material; some of the bright specks entrained in this skin are of probable Pb sulphate. B: SE image, run 1767, 0.6M NaCl @ 200 °C. This galena grain shows common surface pitting attributed to dissolution; pits are particularly prevalent along the crystal edge. Minor to trace Cu and Fe are detectable from within some pits. C: SE image, run 1767, 0.6M NaCl @ 200 °C. This quartz grain shows varied styles and degrees of pitting dependant on the face orientation, most of which are crystal faces. This shows that face orientation can be a control on the degree of dissolution. D: BSE image, run 1767, 0.6M NaCl @ 200 °C. Part of a grain that comprises fractured quartz with REE mineral vein fill. The surface is partially coated by Ca fluoride (Ca + F crystals). Partial alteration of the vein fill (high brightness areas) is indicated by in the fine, granular REE + F deposit associated with the veins.

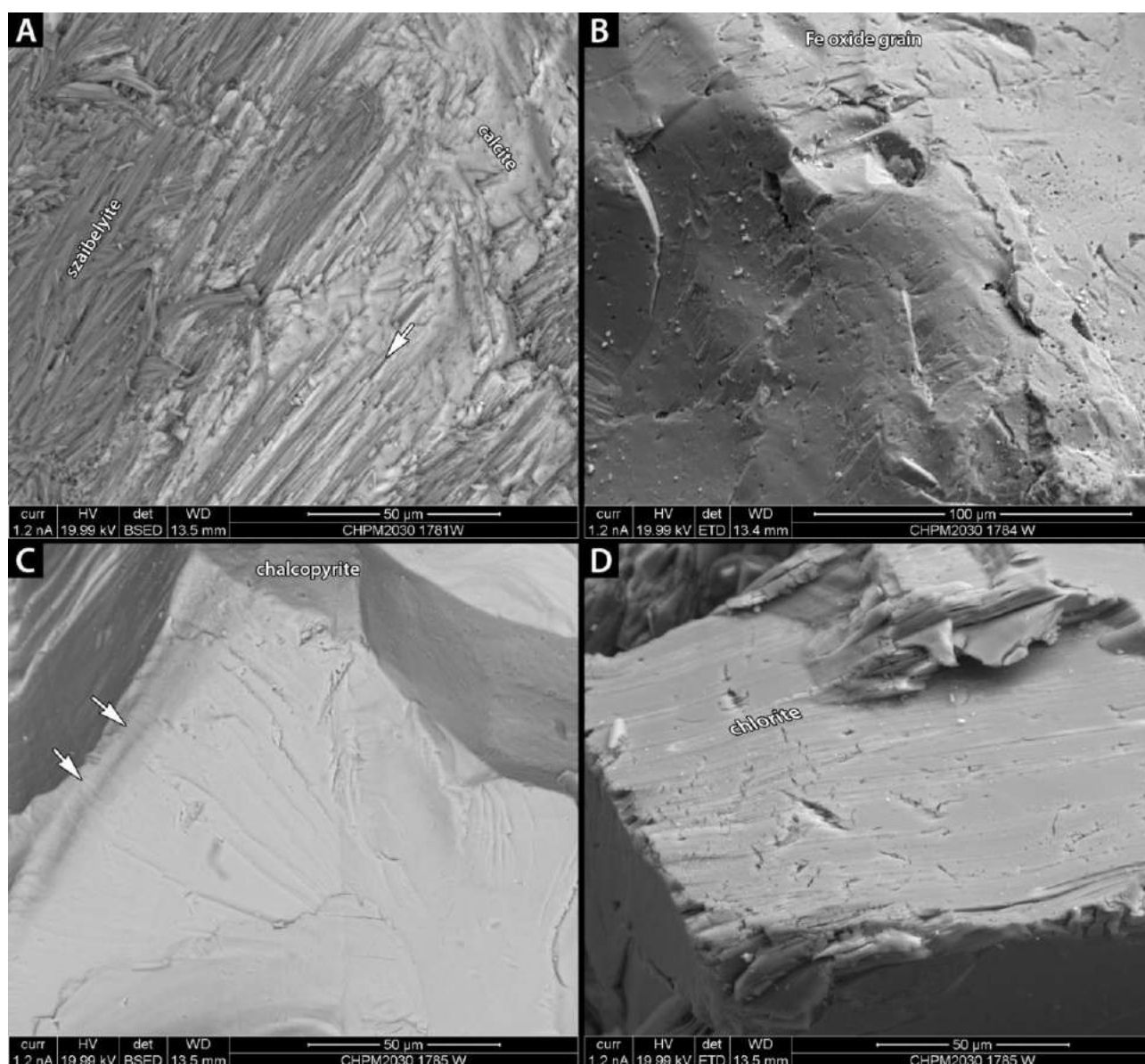


Plate 6: SEM images of run products, partner samples, all with 0.01M HCl, 0.003M HNO₃ at 100 °C.

A: BSE image, run 1781, using HTL320 starting material. This shows typical fibrous *szaibelyite* partially enclosed by *calcite*. The former appears unaffected by the testing. The *calcite* is partially dissolved and fibre casts (arrow) show where the *szaibelyite* has detached from the *calcite*. B: SE image, run 1784, using HTL324 starting material. An example of a grain of *Fe oxide* (probable magnetite) showing the widespread pitting at its surface. This is a texture also shown in the starting material but appears to be more significant in the run product. C: BSE image, run 1785, using HTL325 starting material. A fractured surface of *chalcopyrite*; notches across the conchoidal fracture marks (below centre) and at the edge of the fracture (arrowed) suggest minor dissolution. D: SE image, run 1785, using HTL325 starting material. This is the edge of a *chlorite* grain. The notching at the edge was not recognised in the starting material and may indicate minor dissolution.

4.3 Performance of the experimental equipment

Overall, the experimental equipment performed well at lower temperatures, but we encountered some issues at higher temperatures:

- 1) The rotating mixer equipment worked well, but was found to operate best with HDPE bottles. Their lower density equivalent (LDPE) was found to soften in the oven, leading to leaks around the cap. The best HDPE bottle found was produced by Nalgine – the top did not leak, and the more rounded corners at the base of the bottles allowed for easier mounting onto the mixer.
- 2) The titanium batch vessels with magnetic stirrer worked very well at 100 °C and 150 °C. However, when we took them to 200 °C we found evidence for a few severe corrosion pits in the base of one vessel. These were up to 5 mm wide/deep, and reduced the effective wall thickness of the pressure vessel by about 30% (resulting in the vessel having to be discarded). We are unsure of the exact mechanism driving this corrosion, but suspect reducing conditions may have removed the protective oxide coating on the titanium in places. The filling of the corrosion pits with sulphide grains may have made the corrosion worse. The problem may be avoidable through the use of liners inside the vessels to protect wetted parts.

The titanium moving pistons within the Dickson-type rocking autoclaves worked well for the first few hours, but stopped working after 2 or 3 days, and the water samples carried much gas. On dismantling the equipment, we found that in two of the 5 mm thick piston assemblies had split (Figure 4.13), indicating that considerable expansion had occurred inside them (the equipment was damaged beyond repair), and the pistons were immovable. We have not experienced such acute problems with this equipment before, and are not sure of its exact cause. However, we suspect that it may have been due to a combination of reaction of Viton components with the fluids (there is evidence that F was released from the Viton and into solution), plus probably corrosion of the titanium. The problem with the Viton seals may be avoided through the use of all-metal systems (e.g. ‘gold bags’ or ‘titanium bags’). However, it may be more difficult to avoid metal corrosion, and consideration of key fluid chemical factors (such as salinity, Eh, pH etc) would be needed to ascertain whether gold or titanium would be the least reactive approach.



Figure 4.13: Severe cracking at one end of a titanium piston assembly used inside a Dickson-type rocking autoclave.

5 ENERGY RELEASED DURING SULPHIDE MINERAL OXIDATION

The oxidation of sulphides is thermodynamically favoured, and is an intensely exothermic reaction. The degree to which oxidation can cause heating can be demonstrated by: i) information from the coal mining/processing industry, where oxidation of iron sulphides (pyrite, pyrrhotite) can cause enough heating to initiate spontaneous combustion of coal (e.g. Deng, 2015; Stracher, 2007; Weintrit, 2013), and ii) sulphide mineral mining industry where oxidation of waste tips (or underground) can give rise to high temperatures and environmental (or safety) issues (e.g. Lefebvre et al., 1997; Payant et al., 2012; Yang et al., 2011).

In the industrial examples above, the rocks are exposed to an excess of atmospheric oxygen, and in the case of rock piles can generate convection of air through the material, and continuous resupply of oxygen. However, being unsaturated, these systems retain much of their heat in the solid phase – which in the case of coal can lead to feedback mechanisms that drive temperatures high enough for the coal to combust. Within a deep, water-saturated EGS, oxidants will be in shorter supply, and water will be more effective than air in removing any heat generated. Localised temperature increases are therefore likely to be much less. However, it is worthwhile undertaking some scoping calculations as the release of energy as heat could be advantageous in two ways:

- 1) It could increase temperatures within the EGS, and hence the geothermal power potential.
- 2) Heating would be focussed along flow paths, increasing the rates of fluid-mineral reactions and the dissolution rates of sulphides and gangue minerals – facilitating both metal release and fluid flow.

Many metals of interest to the CHPM2030 project occur as sulphides, or as a component part of pyrite (iron sulphide, FeS_2), and oxidation of these will release metals to solution. Whilst most of our experiments avoided the inclusion of oxidizing agents, two included strong oxidants (hydrogen peroxide [H_2O_2] and nitric acid [HNO_3]) to assess their leaching behaviour (see previous sections). Whilst pyrite is not the only sulphide in our experiments or in mineral deposits, we consider it in the following section as representing sulphides generally - partly because of its common occurrence in many ore deposits, and partly because of the crucial role it plays in releasing iron to solution.

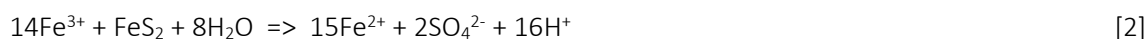
In terms of quantifying the amount of heat produced, Banks et al. (2004) note that the complete oxidation of 1 kg of pyrite will liberate 11.7 MJ of energy. Since pyrite is only one of the several potential metallic minerals in an orebody, the theoretical heat output from the oxidation of sulphides in a metal bearing formation might appear to be substantial. Banks et al. (2004) compare the energy released from pyrite to the combustion of coal: 14 MJ/kg for lignite, to > 33 MJ/kg for anthracite. Sulphide mineral oxidation could therefore provide a significant amount of heat energy (it will also produce a significant amount of acidity).

There are two key reactions of pyrite that govern its overall rate of oxidation (Lefebvre et al., 1993; Norstrom, 1977; Rimstidt and Vaughan, 2003):

- 1) Direct reaction of pyrite with oxygen and water:

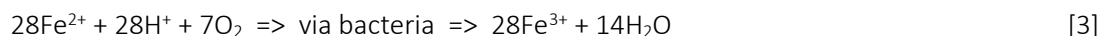


- 2) A coupled 2-stage oxidation of pyrite by ferric iron:



Note that these do not oxidise the iron, but oxidise the sulphur, this is the rate-limiting step. Rimstidt et al. (1994) showed a similar control for the oxidation of galena, sphalerite, chalcopyrite and arsenopyrite, and Rimstidt and Vaughan (2003) suggest that it may be generally true for sulphide minerals.

The oxidation of release Fe^{2+} would to pull reaction [2] to the right, but at low temperatures and low pH the formation of Fe^{3+} from Fe^{2+} is slow, and this provides a limit to the rate of reaction [2]. However, bacteria such as *Thiobacillus ferrooxidans* use the ferrous-ferric oxidation as an energy source, and reaction [2] is effectively catalyzed by ferric iron-producing bacteria (Lefebvre et al., 1993):



The combination of reactions [2] and [3] is equivalent to reaction [1].

Within the CHPM concept, the depth of orebodies being considered will likely result in *in-situ* temperatures around or above about 120 °C – the current upper limit for the viability of living organisms. As a consequence, microbially-catalysed reactions may not occur within deep orebodies, and reactions will be largely inorganic. However, the higher temperatures at depth will facilitate faster reaction kinetics.

A simple relationship can be used to illustrate how the energy produced links to change in temperature:

$$Q = c_p m dT \quad [4]$$

Where:

Q = amount of heat (kJ)

c_p = specific heat (kJ/kgK)

m = mass (kg)

dT = temperature difference between hot and cold side (K)

Given a specific heat of water of 4.19 kJ/kg°C, then the energy required to heat 1 kg of it by 100 °C is 419 kJ. In theory therefore, if 1 kg of pyrite oxidation provides 11.7 MJ of energy, then only 35.8 g of pyrite will be needed to warm 1 kg of water by 100 °C. Given a pyrite density of 5 g/cm³ (Deer et al., 1992), then a volume of only 7.2 cm³ of pyrite would be needed to cause such heating.

By way of an example (and assuming an unlimited oxidising agent – the practical limitations in the supply of oxygen are discussed later), consider the theoretical case of a single fracture of a notional 1 mm aperture within 1 m³ of cube of rock (i.e fracture volume = 1 litre), and whose surfaces were uniformly-coated with pyrite. 35.8 g of pyrite would equate to a maximum pyrite layer thickness of 3.6 µm on each side of the fracture. This layer is thin, diffusion of oxidants might be relatively efficient over these distances, and reaction would probably progress quickly.

A slightly more realistic example (though again assuming unlimited oxidising agent) would be a fracture having only a proportion of its surfaces covered by pyrite crystals 1 mm across. A 10% coating would equate to 200 cm³ of pyrite on the fracture surfaces (i.e. 1 kg), and a 1% coating would equate to 100 g of pyrite. These would have the capacity to deliver 11.7 MJ of energy, and 117 kJ of energy respectively. The former case has the theoretical potential therefore to heat 28 kg of water by 100 °C, and the latter case the potential to only heat 2.8 kg of water to 100 °C. However, for sustained heat production, larger amounts of pyrite would be needed (i.e. thicker linings to fractures), though how surface coatings might impact ingress of oxidants to the sulphide surface would have to be considered.

The above (very simplified) calculations assume complete oxidation, and omit the issue of getting oxidants to the sulphides. In the case of an EGS that is water-saturated, oxidants will be transported in dissolved form, and there are limits as to how much can dissolve. For example, consider the theoretical limiting case of an ‘open loop’ EGS, where recirculating pure water is exposed to atmospheric oxygen and saturates (i.e. a low-cost system such as a water ‘cascade’). This would give a maximum dissolved oxygen concentration of approximately 9 mg/kg at 20 °C – this is small, and would decrease further with increasing salinity and

temperature. By comparison, the effective concentration of oxygen used in our oxidising lab experiments (see Section 4) is 0.1 molar (approximately 3.2 g/kg) for hydrogen peroxide – over 350 times as much.

In reaction [1], 3.5 times as many moles of oxygen are required compared to pyrite – equivalent to approximately 112 g of oxygen to 120 g of pyrite. Assuming pure water with maximum oxygen saturation at 20 °C in air, only 9.6 mg of pyrite would be oxidised by 1 kg of water. This amount of oxidation would produce only 112 J of energy – enough to heat the water by a meagre 0.027 °C. In the case of 0.1 molar hydrogen peroxide, 3.4 g of pyrite would be oxidised. For a kg of water, this would produce a temperature increase of approximately 9.5 °C.

The above calculations suggest that meaningful amounts of heat will only be produced through the addition of significant amounts of dissolved oxidants. However, even in such cases, it is difficult to assess exactly how the energy release from sulphide oxidation would relate to temperature increases *in-situ*. There are several important variables in any such calculation, and modelling these goes beyond this study. It is clear however, that there will be competing rates of processes, and site-specific factors will therefore play important roles in determining the amount of any extra heat released. Factors to consider include:

- Timescale of interest (e.g. longevity of the EGS operation). Reaction kinetics and supply of oxidants will place a limit on degree of reactivity, and hence maximum heat produced in a useable timescale.
- The mass of sulphide mineral present. This should be the mass that will actually contact the water and be oxidized. If it was too far within a block of intact rock, then it would not oxidise and release heat within the timescale of interest.
- Surface area over which oxidation could occur. This is one of the larger unknowns when considering reaction kinetics. Estimating the approximate geometric surface area of a fracture is straightforward, and a reasonable estimate of a 'surface roughness factor' can be made. More difficult however, are: estimating the percentage cover of the sulphide, the proportion of the sulphide surface that will actually be reactive, how etching will change (usually increase) the surface area, and how deposition of secondary phases such as oxides will change (usually decrease) the surface area or passivate it.
- Rate of reaction of the sulphide mineral. Whilst some kinetic parameters are available at lower temperatures, higher temperature data of more relevance to EGS conditions are generally absent. Overall rates are also closely linked to surface areas (see above). Overall rate of the heat-producing oxidation reaction will probably be limited by reaction kinetics.
- Rate of addition of oxidant. This is closely linked to reaction rates above. For a rock rich in sulphide minerals, the rate of addition of oxidizing agents may provide the overall control on heat production.
- Cost of oxidant. This could include costs of purchasing and handling oxidizing agents such as hydrogen peroxide or nitric acid. Or the cost of aerating the circulation fluid using atmospheric oxygen.
- Rate of circulation of water. There is clearly an inverse link between how much water flows through the system and how hot that water might get. However, it will also be important to consider the concentration of oxidizing agent in the water.
- Rate of heat loss into the rock mass. Heat energy will be apportioned between circulating water and the rock mass. Thus, whilst all the energy from oxidization reactions may eventually be recovered, some will be stored within the rock mass (i.e. there will be a delay in recovering some of the heat).

6 DISCUSSION AND IMPLICATIONS

The results of the experiments detailed in Section 4 provide quantitative data to help confirm two key aims of the CHPM2030 project:

- 1) That metals can be leached from the ore body within an EGS.
- 2) That leaching improves the performance of the EGS.

In the following sub-sections, we discuss what the possible implications of the experimental observations are in terms of these broad aims, and whether they have potentially advantageous or deleterious consequences. In order to provide some focus to the discussion, these have been arranged as a series of questions relevant to the CHPM concept.

A) Is there evidence to support increased leaching of metals?

Yes, though the amount of increase is variable.

The experiments utilised several different fluids, ranging from distilled water to dilute mineral acids. In general terms, water without additives (de-ionised water, tap water) was least effective at mobilising metals, with 0.6 M NaCl solution only slightly better performing. The introduction of a range of other additives progressively improved leaching characteristics – through either reducing pH (e.g. dilute mineral acids, dilute organic acids), improving interaction between water and the mineral surfaces (e.g. SDS), or complexing with metal ions (e.g. EDTA, acetic acid, chloride, and possibly SDS) (e.g. Figures 4.1-4.12). However, the exact behaviour was dependent upon the specific metal and which additive was used.

That strong acids could liberate metals was not surprising, though the addition of some dilute nitric acid does have potential advantages in terms of oxidising sulphide minerals and enhancing dissolution (see later discussion reaction mechanisms). However, strong acids will react with carbonate phases and aluminosilicate minerals such as feldspars, neutralising the acidity, and this may limit their effectiveness over longer flow paths (see later discussion on reaction mechanisms and pH). Organic acids however, provide negatively charged complexing agents (e.g. acetate, citrate etc), which can bind with metals even if acidity is neutralised, and in general terms, we found that they performed relatively well for leaching ‘common’ ore elements (e.g. Pb, Zn, Cu). There were however, some exceptions to a model of acid-driven dissolution. For example, elements associated with tungsten mineralisation (W, Sn, Nb) were found to also be soluble in an alkaline, ammonia-rich solution (although absolute concentrations remained low, at <1 ppm).

Whilst some metals were released in relatively high concentrations (e.g. Pb attained concentrations of up to 1000 ppm in some experiments), others remained at low concentrations (<1 ppm for many elements). The reasons for this include several factors (some of which are described in more detail below), but a key one is the composition of the starting solid. Low abundances of metals in the ore are unlikely to lead to elevated concentrations in solution.

B) Is there evidence for processes that may limit metal solubility?

Yes, though the extent of these is situation specific.

There are limitations on metal solubility, and thermodynamic constraints ultimately dictate how much of a particular metal will dissolve – largely controlled by the pressure and temperature conditions, and the natures of the solution, dissolving phase, and precipitates. Time series data suggest that steady concentrations were reached very quickly for some elements, within a few tens of hours (see figures in

Appendix C). This pattern of data suggests saturation with respect to either the dissolving phase, or more likely a secondary precipitate. For example, in experiments involving the UK sample rich in galena (PbS), dissolution led to the precipitation of anglesite (PbSO₄), and the latter would have controlled concentrations of Pb in solution. Anglesite formation is in agreement with previous work (Çopur et al., 2001; Zárate-Gutiérrez et al., 2012).

For other elements however, reaction kinetics can play an important role. Rates of reactions are dependent upon both the nature of the mineral involved, and upon the surface area over which dissolution can occur. The latter is thus also a function of the abundance of the ore mineral in the sample. Kinetic limitations might typically be more of an issue for low abundance phases, where the relatively short duration of the experiments meant that equilibrium conditions may not have been reached in our tests.

As well as the above general limitations, we identified two specific processes that warrant description:

- 1) Precipitation of iron oxides. Iron is one of the main elements transferred to solution, but extensive oxidation of Fe²⁺ to Fe³⁺ can lead to oversaturation with respect to iron oxides/oxy-hydroxides, and the formation of coatings on mineral grains. If these coatings are thick, they can occlude the surface and limit further reaction, and they can also capture other metals through sorption processes (see below).
- 2) Precipitation of metals around dissolution pits. Some samples displayed elevated concentrations of Cu and Ag around dissolution pits in galena. It appears that very localised competition for complexants (e.g. possibly transport-controlled limits to the availability of chloride ions around individual etch pits) might favour the dissolution of Pb, but cause the re-precipitation of previously dissolved Cu and Ag. We do not have enough data from these experiments to describe the exact form of such precipitates, or whether they might subsequently undergo dissolution once complexants became more available.

The formation of iron oxide/oxy-hydroxide phases could have important consequences in terms of both the operation of an EGS, and also the CHPM concept. This could also apply to the formation of significant amounts of other secondary phases (e.g. clays). Consequences include:

- Precipitates are likely to form along flow paths (i.e. fractures). Decreasing apertures of flow paths could lead to reduction of flow and heat recovery, and possibly increase pumping costs. Hence it might impact the overall economics of the EGS.
- Fe oxide/oxy-hydroxide phases can have very high surface areas, and are very efficient sorbants for other metals. Thus, their formation could reduce the dissolved concentrations of useful metals.

Solution pH can be the main controlling factor for surface-binding sorption reaction of metals onto oxide minerals (Smith, 1999). Typically binding is effective at higher pH and less effective at lower pH, resulting in an 'adsorption edge'. The position of this adsorption edge varies with the type and amount of oxide, and the adsorbing metal, but a generic example is shown in Figure 6.1. Keeping metals in solution is therefore helped by more acidic conditions, and this may be another factor why our more acidic experiments favoured higher metal concentrations (see Section 4). There can be sorption selectivity for metals, and Smith (1999) notes that in the case of iron oxides: Cu > Pb > Zn > Cd, Co, Mn. Thus, for the CHPM concept of an aqueous solution-based carrier of metals, limiting the amounts of sorption will be important for maximizing metal recovery at the surface.

Iron oxides/oxy-hydroxides are not the only common sorbants of metals. Clays can also be effective sorbants, especially the smectite group of clays. Uddin (2017) reports a relative maximum adsorption capacity over a range of clays as: Cd > Cr, Hg > Zn, Pb > Mn, Ni, Co > Cu. This relative order is quite different to that for iron oxides, where copper was found to sorb most strongly. In our experiments, we found no evidence for significant clay mineral formation. However, we also note that these phases might have been

less favoured – partly because of the relatively short duration of the experiments, and partly because we used fracture-fill assemblages (aluminosilicate mineral poor) rather than wall rock assemblages (richer in aluminosilicate minerals). Previous experimental studies of the reaction of granite with dilute waters for 80 days at 200 °C indicated clay phases as possible reaction products (Savage et al., 1989).

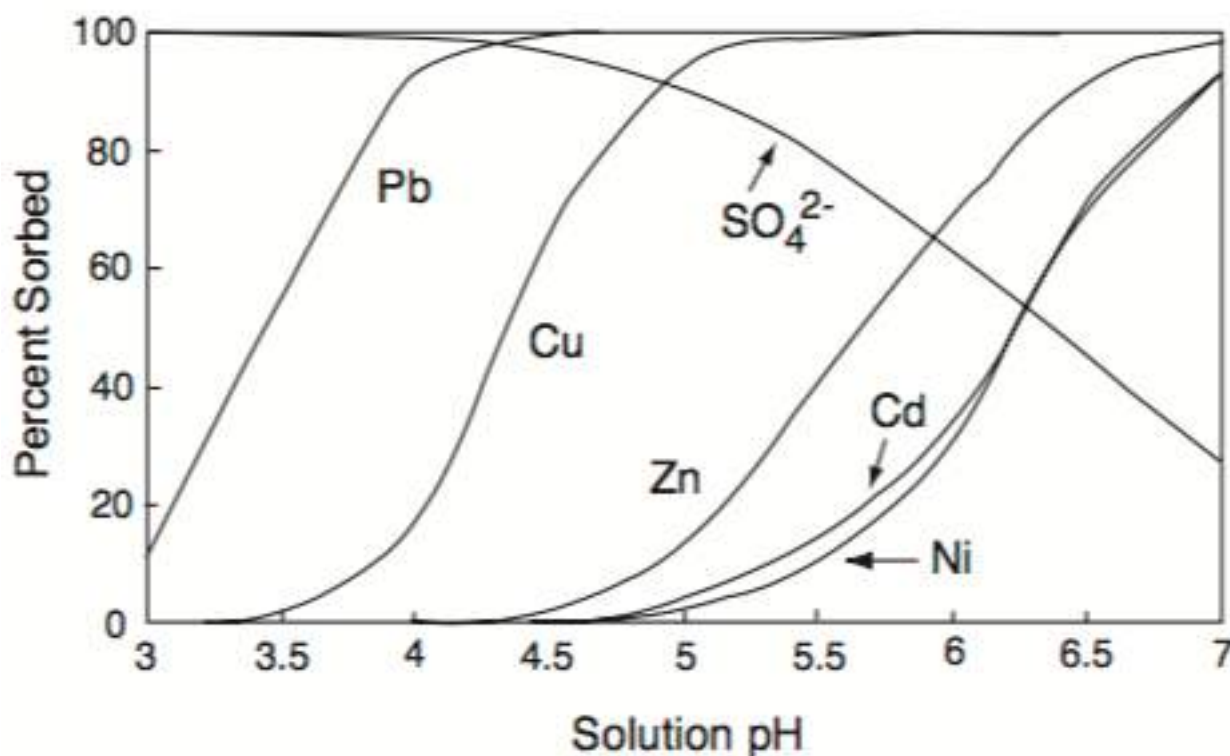


Figure 6.1: Illustrative plot of metal sorption on iron oxide at Earth surface conditions and relevant to acid mine drainage (from Smith, 1999).

One of our experiments utilized a fizzy drink-based solution (Experiment 1763, Coca Cola). The rationale behind the experiments was to show comparative behaviour between our leaching solutions (several of which we would like to claim to be relatively ‘environmentally benign’) and an every-day liquid that members of the public are used to (i.e. it was aimed more at a communication tool rather than a rigorous scientific test). Though the presence of sugar in the experiment resulted in a black gelatinous mess within the reaction vessel, the presence of citric acid and phosphoric acid did change metal concentrations. The citric acid appeared to behave in a similar way to acetic acid, enhancing the solubility of many common metals (see Figure 4.7). The presence of phosphate ions however, caused precipitation of platelets of Al-phosphate (see Plate 2), and an apparent reduction in concentrations of (or at least non-dissolution of) REE and uranium. As the concentrations of these elements in the sample are low, we cannot confirm if they simply did not dissolve, or were precipitated. Regardless of this, that phosphate might limit their mobility could have some advantageous (unless of course, RRE element concentrations were high enough to make it economic to extract them, which was not the case in our experiments). If radioactive elements such as U were not mobilized from the rock, then they would not be incorporated into borehole scales, and as a consequence of that, there would be reduced costs of periodic borehole workovers and disposal of mildly radioactive scale (NORM). There could be benefits therefore, in engineering reservoir chemistry to prevent the dissolution of, or cause the precipitation of, ‘problematical’ elements such as U.

C) How do the different samples compare in terms of reactivity?

We used natural material in the experiments, and a consequence of this was that they contained not only different assemblages of ore minerals, but also at different abundances. Furthermore, reactions varied with the solution used. As a consequence, it proved tricky to derive a single order of reactivity with a high degree of confidence.

In the UK samples, there was an abundance of galena and sphalerite, with much lesser amounts of chalcopyrite, pyrite and bournonite. Galena was distinctly more reactive than sphalerite. The relative degree of chalcopyrite reaction may have been similar to galena, but its low abundance made this hard to confirm. Bournonite seemed to preferentially leach Pb, but was otherwise relatively unreactive.

The partner samples had more varied compositions. Where chalcopyrite and pyrite occurred together, then chalcopyrite appeared to react faster than pyrite. Magnetite was seen to dissolve, but possibly slower than chalcopyrite. Bournonite had relatively low reactivity.

A tentative relative order reactivity is:

galena \approx chalcopyrite > sphalerite \approx pyrite \approx magnetite > bournonite

Of the other minerals observed:

calcite \approx dolomite > chlorite > szaibelyite \approx quartz

D) Will there be an impact of increased salinity?

Probably.

In our experiments, we utilised relatively dilute fluids, with the most saline being 0.6 M NaCl solution. In part, this was because modelling the fluids using geochemical codes would be facilitated by lower salinities. However, it also reflected the general lack of information on groundwater compositions at 4-5 km deep, though we speculate that fluids from that depth are likely to be saline. One implication for low salinity fluids in the experiments is that metal solubility may be lowered (i.e. results would tend towards more pessimistic estimates).

We recognise however, that chloride ions can be important in forming metal complexes, which can help metal solubility. Not only might the use of lower salinity solutions reduce overall metal concentrations in solution, but potentially it might lead to competition for the available chloride ions where release of metals outstripped the supply of chloride ions. Thus, during relatively rapid dissolution of a mixed metal phase, the impact could be that two metals both dissolve initially, but as concentrations increase, then one metal binds more strongly with the chloride, causing the weaker binding metal to precipitate. The results of such a mechanism of dissolution followed by re-precipitation may have been seen where elevated amounts of Cu and Ag were found within and around dissolution pits in galena. We do not think that this increase in abundance was due to the preferential leaching of Pb (i.e. an apparent increase simply by it being a residue after dissolution), and we postulate that release of Pb^{2+} ions from relatively fast dissolution of the galena has out-competed the Ag (or Cu) for Cl^- . This caused any $\text{AgCl}_{(\text{aq})}$ or AgCl_2^- (or Cu-Cl) complexes to break down, leading to precipitation of silver (or copper). We did not find Cu or Ag residues in experiments where all the galena had reacted suggesting that deposited Cu and Ag would re-dissolve once the galena had been removed.

We also recognise that the presence of saline waters in a deep EGS could have important consequences in terms of metal mobility, with higher concentrations of chloride ions facilitating dissolution of ore minerals (i.e. metal concentrations may already be elevated at depth). Previous work studying the composition of deep groundwaters has shown increasing groundwater salinity with depth, potentially leading to a stratification in salinity (e.g. in geothermal areas [Bucher and Stober, 2016], and in crystalline basement close to sedimentary basins [e.g. Bath et al., 2006]). Indeed, Bath et al. (2006) note that the transition between relatively dilute shallower waters and deep saline waters can be relatively sudden, and marked by what they describe as a distinct 'saline transition zone'. There is thus potential for deep groundwaters to be significantly saline even if shallower waters are relatively dilute. Without site-specific data however, it is hard to make realistic estimates of deep groundwater compositions, and this remains an area of uncertainty.

E) Is there evidence that reactions might impact fluid flow?

Yes, but qualitatively rather than measured.

One of the central themes within the CHPM2030 project is that dissolution of ore minerals during the leaching process could improve the characteristics of the EGS. The experiments reported here were not designed to measure changes in flow properties directly, and were focussed on identifying reaction mechanisms of metal dissolution. However, we are able to make some general comments. By and large, most of our experiments supported the CHPM concept - many reacted solids showing dissolution features, and fluids increased in dissolved load. There were however, at least two situations where we found evidence of precipitation. The formation of significant amounts of secondary phases has the potential to impact fluid flow, especially if it is focussed along fluid flow paths. Both of these cases involved different mechanisms:

1) Oxidation and precipitation

The 70 °C experiments were exposed to more atmospheric oxygen than higher temperature experiments. The latter were in metallic vessels and with a gas overpressure, minimising the potential for air ingress. However, the former were in HDPE bottles which had their lids periodically removed to allow fluid sampling, and so air could enter the bottles. The relatively thin HDPE walls of the bottles may also have allowed some diffusion of oxygen from the atmosphere into the experiments. A consequence of the availability of oxygen, was the oxidation of Fe²⁺ ions released by sulphide dissolution and formation of Fe oxide/oxy-hydroxide precipitates. In general terms, this is what we see – Fe-rich precipitates in the lower temperature experiments, but relatively little of these in the high temperature experiments. Higher temperature experiments appeared to experience relatively smaller amounts of precipitation, even when oxidising agents such as hydrogen peroxide or dilute nitric acid were added.

If extrapolated to EGS-scales, then we suggest that limiting the availability of dissolved oxygen will be important (i.e. adding just enough oxygen to get the dissolution reactions started, but not enough to initiate significant amounts of precipitation). Also important, may be real-time monitoring of the redox state of both injection and production fluids, in order to facilitate optimisation of the rate of sulphide mineral reaction. Accurate Eh sensors capable of operating at elevated temperatures and pressures are available (e.g. for research-grade probes see Corr Instruments ⁴).

⁴ http://www.corrinstruments.com/High_T_High_P_Probes/H_T_H_P_probes.html

Although there were a few experiments where small quantities of precipitates were found to form (such as platelets of Al-phosphate in experiment 1763, anglesite [PbSO₄] in several experiments [including runs 1761, 1778 and 1775], and alum in experiments 1772 and 1778), most of the experiments showed little evidence for the formation of secondary solids. This is generally positive news, with no major evidence for fast formation of precipitates which might significantly occlude porosity and hence potentially reduce fluid flow (though see comments/caveats relating to control of solution pH and potential for clay precipitation).

2) *Release of fines*

The migration of fine particles has been a recurring issue within the hydrocarbon industry, in both production and injection wells, and they could play an equally important role in EGS operations. If fine particles are released and move into areas of the rock mass which are key at controlling fluid flow (e.g. pore throats or narrow fractures), then they can play a critical role in limiting overall fluid circulation. Whilst this is a physical process that is more of an issue where flow rates are locally high, the way that those fines are generated can be dependent upon geochemical reactions. So, for example, in Experimental run using skarn material (Partner Sample HTL320), dissolution of calcite in the batch experiments at 100 °C and 200 bar released szaibelyite fibres which were visible as a white deposit around the inside of the reactor. Whilst this was only a batch experiment and we have no data on how this might impact the permeability of a flowing experiment, there is clear potential for dissolution of 'Partner sample HTL320' to produce mobile fines.

Without site-specific information, it is hard to quantify what impact the migration of fine might have on system performance. However, it is likely to be potentially more of an issue where fluid flow rates are high – such as in the near-wellbore region.

F) *How important are redox reactions in controlling metal release?*

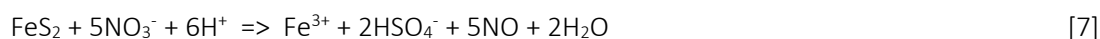
Very important.

Many metals of interest to the CHPM2030 project occur as sulphides, or as a component part of pyrite (iron sulphide, FeS₂), and oxidation of these will release metals to solution. Whilst most of our experiments avoided the inclusion of oxidizing agents, two included strong oxidants (hydrogen peroxide [H₂O₂] and nitric acid [HNO₃]) to assess their leaching behaviour (see previous sections). Whilst pyrite is not the only sulphide in our experiments or in mineral deposits, we consider it in the following section as representing sulphides generally - partly because of its common occurrence in many ore deposits, and partly because of the crucial role it plays in releasing iron to solution.

The oxidizing agents added to the experiments help the sulphide mineral oxidation (see reaction [1]), and in the case of hydrogen peroxide it decomposes to liberate oxygen directly:

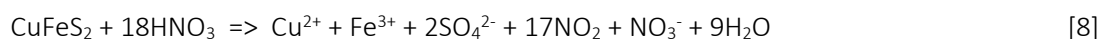


Nitric acid reacts differently, with Zárate-Gutiérrez et al. (2012) suggesting direct production of Fe³⁺ via nitrate ions in acid solution:



The Fe³⁺ can then oxidise pyrite as per reaction [2]. The work by Zárate-Gutiérrez et al. (2012) used dilute nitric acid between 0.1 and 1 molar on pure galena, pure pyrite, and a galena-pyrite mix. In the case of pure

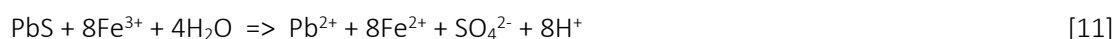
galena, oxidation was limited, with galena surfaces passivated by anglesite (PbSO_4). Of note however, is the observation that for a mixed pyrite-galena sample, the production of Fe^{3+} ions from pyrite oxidation aids the oxidation of galena, and hence liberation of Pb^{2+} to solution. Indeed, these authors note both faster and more complete reaction of the galena in the presence of pyrite (no unreacted galena remained after heating it with 1 litre of >0.4 molal nitric acid for 90 minutes [and possibly as short as 20 minutes], though there was also precipitation of some anglesite and plumbojarosite [$\text{PbFe}_6(\text{SO}_4)_4(\text{OH})_{12}$]). Çopur et al. (2001) note broadly similar behaviour, with nitric acid enhancing not just pyrite dissolution, but also chalcopryrite and sphalerite dissolution (releasing Fe^{2+} , Cu^{2+} and Zn^{2+} ions to solution), e.g.:



As per pyrite, the formation of Fe^{3+} could provide an oxidizing agent to assist chalcopryrite dissolution:



And also for galena dissolution (though at high enough concentrations anglesite (PbSO_4) could precipitate):



Our experiments thus appear to corroborate this earlier work.

If the concentration of oxidants becomes too great, then there is potential for the Fe^{3+} to precipitate as oxide/oxy-hydroxide phases, hindering oxidation reactions such as the above. This may have happened in our lower temperature experiments with relatively higher concentrations of oxygen - less dissolution occurred (but more Fe oxide/oxy-hydroxide formed). Whereas in most of our higher temperature experiments there were more limited amounts of oxidants, more dissolution occurred and less Fe oxide/oxy-hydroxide formed – though we do acknowledge that the temperature difference may have also contributed. It does appear that limited oxidation of Fe-rich sulphides (such as pyrite or chalcopryrite) to form soluble Fe^{3+} is beneficial in the subsequent oxidation of other sulphide minerals.

There are several important observations related to having Fe^{3+} available to catalyse sulphide mineral dissolution:

- 1) That the Fe must stay in solution and move between Fe^{2+} and Fe^{3+} oxidation states.
- 2) That the solution must not be too oxidizing, or Fe^{3+} will be precipitated as oxide/oxy-hydroxide phases, and hence be removed from solution.
- 3) That the ore being leached contains at least some Fe-rich phases (e.g. pyrite, chalcopryrite) to provide a source of Fe.

Whilst recognising that pyrite is ubiquitous in many mineralised systems, we note scenarios where different generations of mineralised features cut each other. This example might be typified by mineralisation in SW England, where earlier E-W trending chalcopryrite-cassiterite mineral veins are cut by later N-S trending galena-sphalerite mineral veins. If Fe^{3+} were to catalyse dissolution of galena and sphalerite, then leaching might be particularly enhanced along the contact zones of these two vein systems. There may thus be some advantages in targeting areas of mixed mineralisation.

G) What role do acid fluids play?

Potentially both helpful and unhelpful roles – depending on the situation.

The near-surface oxidation of sulphide minerals has long been known to create acid conditions through the formation of dilute sulphuric acid, and the acid conditions facilitate the solubility of many metals. We tried to create acid conditions in the experiments through the direct addition of mineral acids (i.e. the nitric/hydrochloric acid mix) and acetic acid, plus the addition of a strong oxidant (hydrogen peroxide) that would drive sulphide mineral oxidation. Metal mobility is helped by the formation of positively charged ions (e.g. Fe^{2+} , Cu^{2+} etc) under acidic conditions, whereas at higher pH conditions oxide/oxy-hydroxide solids may form instead (e.g. FeOOH). Equally, more acid conditions favour desorption of metals from high surface area phases such as iron oxides and clays (see previous question about processes limiting metal solubility).

One potentially problematical aspect as circulating waters become more acidic is increased likelihood of corrosion within well and surface infrastructure. Whilst engineering solutions can reduce the effects of this (e.g. through the use of higher grades of steel), these are likely to incur increases in costs.

Even if acid fluids are injected directly into the EGS or created through oxidation reactions, fluid-rock reactions will act to moderate this acidity as the circulating EGS fluid moves between injection and production boreholes. This could involve parts of flow paths filled by gangue phases (such as calcite or dolomite) or minerals in the wall rocks (such as feldspars or micas):



Calcite

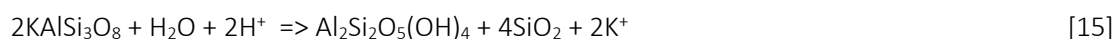


Dolomite



K-feldspar

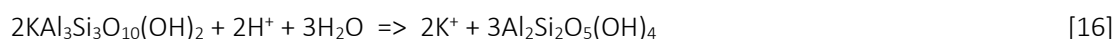
quartz



K-feldspar

kaolinite

quartz



muscovite

kaolinite

Not only will these help neutralise the solutions (which could be advantageous in terms of reducing the potential for corrosion), but consumption of acidity will also help facilitate sulphide mineral oxidation (effectively driving reaction [1] in Section 3 to the right). This positive scenario is however, not completely without potential problems. The dissolution of aluminosilicate minerals could lead to the formation of sheet silicates (such as kaolinite reaction [14] and [15]), or illite/smectite clays with the addition of Mg (possibly sourced from dissolution of dolomite, or Mg-rich aluminosilicate phases). Clays have a relatively high molar volume, and when combined with their platy form, means that they can be effective at blocking flow paths. Potentially therefore, the formation of clays could impact fluid flow within an EGS. Indeed, Savage et al. (1989) noted illite-smectite clays as a product of high temperature (200 °C) reaction between granite and simulated EGS water, and that these were associated with an increase in a slight increase of solids volume. As mentioned earlier, clays can also be effective sorbants for metals (Uddin, 2017).

Secondary clay phases were not observed to any significant extent in the experimental residues from this study. That said, the experiments were aimed primarily at identifying metal mobility, and were of relatively

short duration (i.e. they may have not had long enough to form), and tended to involve samples of fracture fill rather than containing appreciable amounts of wall rock (i.e. they were relatively poor in aluminosilicates). It could be useful for future experimental and/or modelling work to consider the impact that clay formation could have on fluid permeability.

In terms of an EGS operation, there could be benefits associated with the real-time monitoring of the pH of both injection and production fluids. Whilst relatively long flow paths within the rock mass might lead to buffering of the pH by fluid-rock reactions and constant pH of produced fluids, variation in pH might indicate a change in subsurface fluid flow (e.g. through the creation of new, or blocking of old, flow paths). Accurate pH sensors capable of operating at elevated temperatures and pressures are available (e.g. for research-grade probes see Corr Instruments ⁵).

H) What areas of uncertainty remain?

The experiments we have conducted revealed some important information about the directions, relative rates and magnitudes of different reactions between water and minerals under simulated EGS conditions. That the conditions were just ‘simulated’ highlights one of the largest unknowns we face – that of almost no constraints on *in-situ* conditions at the 4-5 km depth of interest to the CHPM concept. In this study, we had to use solids derived from the near surface, solutions which were simplified (and probably too dilute in terms of salinity, and having overly high concentrations of additives), and pressure/temperature conditions that were estimates based on extrapolations from shallower measurements. Provision of new quantitative data on these aspects from direct measurements at depths of interest would be very beneficial (it is noted that in relation to the UK study area in SW England, planned new deep drilling in 2018 at United Downs in Cornwall has the potential to provide new samples and relevant data ⁶). However, it will also be important to understand how fluids move through fracture networks, so logging deep boreholes at high resolution to aid in quantifying fracture connectivity is also a crucial aspect.

For many of our experiments, fluid analytical data were only available for the final sample. Whilst this can provide some general constraints on the rates of mineral dissolution, it does not allow for accurate determination of reaction kinetics. Other of our experiments involved periodic sampling, and the time series data can be used to provide a more accurate determination of rate processes. However, key uncertainties remain in terms of applying any rate data generated from somewhat idealised, short-term experiments to ‘real world’ situations. Most experiments commonly involve crushed materials and run under far from equilibrium conditions (as did our experiments). Both of these impact rates of reactions – crushing by exposing fresh surfaces and increasing surface areas, and far from equilibrium conditions maximising reaction rates). Whilst it may be more reasonable to draw direct comparison to conditions within the near-borehole region (where relatively fresh water – or at least ‘less reacted’ water), within the bulk rock reactions will probably proceed far more slowly, under near-equilibrium conditions. Rate processes are difficult to measure under such circumstances. The issue of comparing laboratory versus field data has long been a subject of debate amongst geochemists (e.g. Lasaga and Kirkpatrick, 1981; White and Brantley, 1995) and it is likely to remain an area of uncertainty for the foreseeable future.

⁵ http://www.corrinstruments.com/High_T_High_P_Probes/H_T_H_P_probes.html

⁶ <http://www.cornwallislesofscillygrowthprogramme.org.uk/hot-opportunity-european-investment/?platform=hootsuite%20>

Our experiments contained mainly vein-fill material, and concentrated on metal release processes. However, in an actual EGS, many gangue phases and wall rock minerals would also react, and we have so far not investigated these in detail. Dissolution of fracture-filling gangue minerals could lead to creation of extra void space, and hence the potential for increased fluid flow – though we note that some pre-existing flow would need to be present in order for the EGS fluid to transport dissolved components away from that part of the fracture. Conversely, the reaction of aluminosilicate minerals in the wall rock could lead to clay formation and the narrowing of flow features. Quantifying the changes in solids volume and their impact is important, and is perhaps something that should be considered during the more site-specific investigations as part of Task 6 within CHPM2030.

7 CONCLUSIONS

A fundamental requirement for the effective application of Combined Heat Power and Metals (CHPM) technology is an understanding of metal release within the subsurface, and ideally, an understanding of how metal release can be enhanced. Here we report the results of experimental investigations into metal leaching studies as part of Work Package 2 within the CHPM2030 project. The work involved many simple experiments at relatively low pressures and temperatures, through to experiments under more realistic *in-situ* conditions. Our matrix of experiments involved samples from different ore deposits, though most work was conducted on UK material. Leaching agents were chosen to be relatively 'mild' and 'environmentally benign', although for comparative purposes a dilute mineral acid mixture was also used. Key points resulting from the study are:

- Solids studied were dominated by sulphide mineralisation. They were: lead-zinc mineralisation from the UK, porphyry mineralisation from Hungary, skarn from Romania, and massive sulphide mineralisation from Portugal and Sweden. These cover a range of mineralisation types and range of ore minerals.
- The leaching solutions used were: de-ionised water, tap water, 0.6M NaCl, de-ionised water with 20 bar P_{CO_2} , 0.1 M acetic acid, 0.1 M EDTA, 0.1 M SDS, 0.1 M NH_3 , 0.1 M H_2O_2 , 0.1 M HCl & 0.03 M HNO_3 , 0.01 M HCl & 0.003 M HNO_3 . De-ionised water and dilute mineral acids serve as comparative reference points rather than being likely to be employed in a CHPM scheme. Most solutions were chosen to be relatively mild leaching agents and to be relatively 'environmentally benign'. Solutions were likely of relatively low salinity compared to possible deep groundwaters, but we have no data on what likely *in-situ* salinities are at the pilot site areas. However, low salinities will facilitate any subsequent geochemical modelling.
- We were successful in enhancing the mobilisation of a range of metals (relative to water or dilute brine), and leaching occurred relatively quickly. However, not all metals behaved in the same way – some were leached relatively easily (e.g. lead) whereas others proved much harder to mobilise (e.g. tin, tungsten). The concentration of many metals reached steady-state values after just a few tens of hours.
- As expected, the mixture of mineral acids was the most effective solution used for liberating a range of metals, however solutions containing organic compounds (EDTA, acetic acid, SDS) also proved effective. Relative to mineral acids, EDTA and SDS, acetic acid led to lower concentrations of dissolved aluminium and silica – which could be an added benefit. Though we did not observe any clay precipitates, higher concentrations of aluminium and silica would tend to favour their formation. Clays could occlude fluid flow if they formed within flow zones.
- The formation of Fe^{3+} ions (e.g. from chalcopyrite or pyrite dissolution) appears to be key in enhancing the rates of dissolution of other sulphide minerals - because Fe^{3+} can act as a very effective oxidising agent.
- Oxidation is required to initiate sulphide mineral reaction, and experiments with more oxygen appeared to result in more dissolution (e.g. in experiments hydrogen peroxide or that were regularly exposed to the atmosphere). However, too much oxygen could potentially lead to dissolved iron being precipitated as Fe oxide/oxy-hydroxide, and this would reduce the rates of Fe^{3+} -catalysed sulphide oxidation reactions. Fe oxide/oxy-hydroxides are also effective sorbants of metals of interest and can reduce their concentration in solution. If Fe oxide/oxy-hydroxide formation and precipitation were extensive, then this might also occlude fluid flow paths.
- Metal concentrations were initially controlled by the rates of dissolution/oxidation and, if concentrations reached high enough values, subsequently by reaching saturation with respect to secondary phases. There was clear evidence for the precipitation of (and hence saturation with) secondary anglesite ($PbSO_4$), and also smaller amounts of a zinc-rich secondary phase.

- Evidence for dissolution was observed as etching of mineral surfaces. This was most noticeable for galena, which showed rounding of individual grains, and deep etch pit formation along cleavage planes.
- We found evidence for enrichments in copper and silver around etch pits in galena. We postulate that galena dissolution caused localised competition for ligands/negative ions (e.g. PbCl^+ formation caused the breakdown of copper/silver complex ions such as CuCl^+ , AgCl^+).
- Based upon what was seen in the experimental residues, a tentative relative order of reactivity for the ore minerals studied is:
galena \approx chalcopyrite $>$ sphalerite \approx pyrite \approx magnetite $>$ bournonite
Of the other minerals observed:
calcite \approx dolomite $>$ chlorite $>$ szaibelyite \approx quartz
- Sulphide oxidation generated acidity. Whilst this appears to have benefitted metal mobility, it may lead to corrosion issues for well linings and surface infrastructure. Reaction of this acidity with carbonate or aluminosilicate minerals was observed. Such reaction in fractures or wallrocks has the potential to buffer fluid pH to more neutral values, though reaction types will be site-specific.
- Whilst organic acids helped metal mobilisation, there was evidence that the addition of phosphate reduced concentrations of rare earth elements and possibly uranium. We tentatively suggest that if incorporation of mobilised uranium in borehole scales was a problem, then the addition of some phosphate to the EGS fluid might reduce its mobility.
- Physical mobilisation of fines was observed for the skarn sample from Romania. Dissolution of carbonate released needles of szaibelyite, and these moved through the stirred solution and deposited on the walls of the reaction vessel. Whilst we have no data to quantify how these would behave within a flowing fracture, they appear to have the potential to migrate and clog smaller-aperture flow paths. Though we did not observe clay phases in the experiments, they have the potential to form over longer timescales, and may also be prone to migration.
- The experiments were relatively 'idealised' systems – well-mixed systems using cleaned grains and relatively high concentrations of additives. This would not be the case within a deep EGS, where overall reaction might proceed more slowly. Conversely, the solids used in the experiments were from near-surface samples, which may have had some of their more reactive phases removed already – so their reactivity might have been reduced. It would be very useful to have fresh samples from depth from the pilot study sites.
- Key uncertainties include lack of knowledge about the precise nature of mineralogy and fluid chemistry at depth for the pilot study sites. Reducing this uncertainty requires new sampling and analysis, ideally from newly-drilled deep boreholes - though drilling such boreholes is outside the scope of CHPM2030 project.

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APPENDIX A – SOLID SAMPLE ANALYSES

This appendix presents the results of analyses carried out on solid samples used in the experiments.

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A1: Sample summary

		Sample Locality	Geological Setting	Summary of bulk mineralogy
BGS Sample ID	CHPM Sample ID			
HTL315		South Caradon, SW England	Mainstage mineralisation, associated with granite bodies	70% quartz, 7% schorl, 5% chlorite, 2% calcite, 10% pyrite, 5 % arseonpyrite, minor greigite and biotite
HTL316		Herod's Foot, SW England	Baked sediments with partial quartz vein	91% quartz, 6% muscovite, minor albite, schorl, chlorite, calcite, pyrite, and galena
HTL317		Herod's Foot, SW England	Baked sediments with partial quartz vein	81% quartz, 2% albite, 6% muscovite, 11% galena, minor chlorite, pyrite, chalcopryite, and spahelerite
HTL318		Herod's Foot, SW England	Baked sediments with partial quartz vein	88% quartz, 4% muscovite, 5% dolomite, 1% galena, 1% spalerite, minot albite, chlorite, calcite, and pyrite
HTL319		Cligga Head, SW England	Tin-tungsten mineralisation, associated with granite bodies	88% quartz, 2% muscovite, 3% cassiterite, 3% columbite, and 4% ferberite
HTLMix		Herod's Foot, SW England	Mix of HTL316, 317, 318	87% quartz, 5% muscovite, 2% dolomite, 5% galena, minor albite, chlorite, pyrite, and spahlerite
HTL320	CHPM18	Pietroasa, Romania	Skarn	3% quartz, 2% tourmaline, 3% kaolinite, 61% calcite, 31% szailbelyite, and minor albite
HTL321	CHPM12	Masca-Cocovaleni, Romania	Mineralised country rock	22% dolomite, 49% pyrite, 27% magnetite, minor quartz, calcite, and barite
HTL322	CHPM4	Rudabauya, Hungary	Carbonate hosted lead-zinc mineralisation	8% quartz, 2% calcite, 68% magnesite, 6% cerrusite, 1% spalerite, 1% columbite, 11% barite, 2% magnetite, and minor dolomite
HTL323	CHPM26	Corvoinferior, Portugal	Massive sulphide deposit	1% quartz, 33% pyrite, 22% galena, 43% chalcopryite, minor dolomite, and magnetite
HTL324	CHPM5	Recsk, Hungary	Porphyry	7% quartz, 5% calcite, 9% pyrite, 11% magnetite, minor albite, dolomite, and sphalerite
HTL325	CHPM20	Kristineberggruvan, Sweden	Porphyry	38% quartz, 18% chlorite, 4% calcite, 37% pyrite, 3% chalcopryite, and minor magnesite

Table A1: Sample Summary

A2: Mineralogy from XRD analysis, and BET surface area

		Mineralogy (wt%)																	
		Silicates				Phyllosilicates/ clay mins				Carbonates				Sulphides					
		Quartz	Albite	Tourmaline	Schorl	Muscovite	Biotite	Kaolinite	Chlorite	Calcite	Dolomite	Magnesite	Cerussite	Pyrite	Arsenopyrite	Greigite	Galena	Sphalerite	Chalcopyrite
BGS Sample ID	CHPM Sample ID																		
HTL315		70.32	<0.5		7.36	<0.5	<0.5		4.65	2.27				10.13	4.87	<0.5			
HTL316		91.22	<0.5		0.67	6.11			0.78	<0.5				<0.5			<0.5		
HTL317		81.25	2.12			5.47			<0.5					<0.5			10.60	0.56	<0.5
HTL318		88.05	<0.5			3.98			<0.5	0.66	4.65			<0.5			1.22	1.11	
HTL319		87.71				2.00													
HTLMix		86.81	0.95			4.79			<0.5		1.56			<0.5			5.18	0.67	
HTL320	CHPM18	3.2	<0.5	1.5				3.3		61.0									
HTL321	CHPM12	0.7								<0.5	22.4			48.9					
HTL322	CHPM4	8.3								1.7	<0.5	68.3	6.2					1.4	
HTL323	CHPM26	1.4									0.6			32.6				21.7	42.9
HTL324	CHPM5	73.5	<0.5							4.9	<0.5			9.0				<0.5	
HTL325	CHPM20	38.3							17.9	4.1		<0.5		37.2					2.6

Table A2: Mineralogy from XRD analysis, and BET surface area

		Mineralogy (wt%)						BET SA (m ² /g)	error
		Other							
		Cassiterite	Columbite	Barite	Szaibelyite	Magnetite	Ferberite		
BGS Sample ID	CHPM Sample ID								
HTL315								0.84	3.35E-03
HTL316								1.14	2.30E-03
HTL317								0.12	1.90E-03
HTL318								0.66	2.60E-03
HTL319		3.17	2.50				4.17	0.69	4.10E-03
HTLMix								0.55	1.80E-03
HTL320	CHPM18				30.9			0.97	3.70E-03
HTL321	CHPM12			<0.5		27.4		0.71	7.20E-03
HTL322	CHPM4		1.1	10.8		1.9		1.77	1.90E-02
HTL323	CHPM26					0.8		0.10	1.60E-03
HTL324	CHPM5					10.8		0.41	1.80E-03
HTL325	CHPM20							0.09	9.00E-04

Table A2: Mineralogy from XRD analysis, and BET surface area (cont.)

A3: Results from solid digestion and elemental analysis

		Trace elemental analysis, from digestion & ICP-MS analysis, mol/kg											
		Li	Be	Na	Mg	Al	P	S	K	Ca	Ti	V	Cr
BGS Sample ID	CHPM Sample ID												
HTL315		1.41E-02	1.43E-04	2.22E-02	7.93E-02	6.08E-01	3.30E-03	2.86E+00	2.22E-02	9.33E-03	7.83E-03	1.52E-04	4.54E-04
HTL316		2.47E-02	2.72E-04	3.81E-02	1.11E-01	1.13E+00	4.58E-03	4.87E-02	2.89E-01	1.61E-02	2.01E-02	8.08E-04	7.26E-04
HTL317		7.53E-03	7.95E-05	5.64E-03	2.00E-03	3.95E-02	2.77E-05	4.31E-01	7.99E-03	7.60E-03	2.23E-04	1.41E-05	1.56E-04
HTL318		1.37E-02	1.27E-04	2.53E-02	3.38E-01	4.24E-01	2.09E-03	3.37E-01	1.17E-01	4.46E-01	3.03E-03	3.75E-04	4.25E-04
HTL319		7.84E-03	5.80E-05	4.52E-03	2.11E-03	1.27E-01	2.58E-03	1.84E-03	3.23E-02	2.72E-03	2.73E-04	1.41E-05	5.30E-04
HTLMix		1.72E-02	1.64E-04	2.50E-02	1.25E-01	5.67E-01	2.59E-03	4.57E-01	1.49E-01	1.04E-01	5.04E-03	3.90E-04	4.82E-04
HTL320	CHPM18	3.05E-05	1.13E-05	1.21E-03	5.14E+00	1.87E-01	9.95E-04	4.78E-03	8.96E-04	5.24E+00	4.36E-03	2.14E-04	9.76E-05
HTL321	CHPM12	2.57E-04	6.26E-06	2.41E-03	1.53E+00	1.92E-02	3.23E-04	6.77E+00	8.73E-04	1.29E+00	3.16E-04	4.40E-04	2.00E-04
HTL322	CHPM4	2.42E-04	1.74E-05	2.72E-03	8.28E-02	4.79E-02	4.32E-04	8.51E-02	1.40E-02	2.25E-01	5.33E-04	5.72E-05	2.65E-04
HTL323	CHPM26	2.25E-04	0.00E+00	6.37E-03	4.20E-02	2.59E-02	0.00E+00	1.04E+01	5.85E-03	4.00E-02	5.49E-05	1.21E-04	5.15E-05
HTL324	CHPM5	3.62E-04	1.29E-05	3.93E-02	1.89E-01	4.32E-01	1.79E-03	2.37E+00	4.52E-02	3.73E-02	3.48E-02	5.00E-03	1.39E-04
HTL325	CHPM20	5.55E-04	1.35E-05	3.93E-03	1.03E+00	1.17E+00	7.33E-04	7.26E+00	1.94E-02	1.20E-03	2.46E-03	3.89E-04	8.37E-05

Table A3: Results from solid digestion and elemental analysis

		Trace elemental analysis, from digestion & ICP-MS analysis, mol/kg											
		Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Rb	Sr
BGS Sample ID	CHPM Sample ID												
HTL315		1.39E-02	2.37E+00	4.23E-03	1.44E-04	2.11E-01	3.81E-03	1.40E-04	1.90E-06	5.55E-01	5.72E-05	9.50E-05	1.76E-04
HTL316		1.21E-03	1.54E-01	9.64E-05	2.50E-04	2.11E-03	3.88E-04	1.12E-04	6.24E-06	3.84E-04	9.74E-07	8.80E-04	3.07E-04
HTL317		1.83E-04	1.49E-02	1.15E-05	2.31E-05	7.84E-04	1.13E-01	1.26E-05	2.01E-06	1.16E-04	2.97E-06	2.80E-05	2.03E-05
HTL318		2.86E-02	1.93E-01	1.36E-04	2.73E-04	3.96E-02	2.73E-01	6.03E-05	5.51E-06	2.32E-03	1.52E-06	3.40E-04	2.91E-04
HTL319		8.48E-02	2.94E-01	7.30E-06	1.70E-05	1.16E-03	1.05E-03	1.72E-05	2.08E-06	1.51E-03	8.81E-07	2.99E-04	1.14E-04
HTLMix		6.35E-03	1.06E-01	7.06E-05	1.57E-04	9.86E-03	1.03E-01	6.02E-05	4.10E-06	6.92E-04	1.24E-06	4.53E-04	1.92E-04
HTL320	CHPM18	2.58E-02	6.15E-02	7.75E-06	2.80E-05	1.31E-04	1.65E-03	2.19E-05	5.92E-08	1.79E-03	4.91E-07	1.31E-06	6.90E-04
HTL321	CHPM12	1.42E-02	7.12E+00	1.34E-03	1.31E-04	2.27E-02	2.17E-03	2.00E-05	1.20E-06	2.28E-04	4.40E-05	6.06E-07	1.76E-04
HTL322	CHPM4	5.49E-03	2.95E-01	6.84E-05	1.11E-04	1.30E-04	2.74E+00	1.84E-05	1.60E-05	5.70E-03	1.19E-05	1.92E-05	1.32E-02
HTL323	CHPM26	2.38E-03	4.84E+00	9.07E-03	3.31E-04	2.63E+00	2.09E+00	7.75E-05	1.73E-06	1.20E-02	2.94E-03	1.19E-05	2.69E-05
HTL324	CHPM5	1.04E-02	3.27E+00	8.35E-04	5.55E-04	1.81E-01	2.93E-03	2.60E-04	3.74E-06	3.16E-04	3.44E-04	8.76E-05	6.56E-05
HTL325	CHPM20	1.63E-02	4.49E+00	2.48E-03	1.40E-04	3.00E-01	1.84E-02	3.60E-04	7.79E-07	5.49E-04	1.09E-04	1.07E-05	1.52E-05

Table A3: Results from solid digestion and elemental analysis (cont.)

		Trace elemental analysis, from digestion & ICP-MS analysis, mol/kg											
		Y	Zr	Nb	Mo	Ag	Cd	In	Sn	Sb	Te	Cs	Ba
BGS Sample ID	CHPM Sample ID												
HTL315		1.08E-04	2.09E-04	1.41E-05	8.14E-06	1.11E-04	6.43E-06	1.09E-04	1.43E-04	1.19E-03	1.44E-06	5.39E-06	1.32E-04
HTL316		8.44E-05	3.50E-04	4.61E-05	2.53E-06	1.06E-04	5.83E-07	3.44E-07	9.94E-06	3.92E-04	0.00E+00	5.09E-05	9.94E-04
HTL317		1.21E-04	4.84E-06	4.92E-07	1.71E-06	8.19E-04	3.75E-04	1.06E-05	2.07E-06	2.92E-03	0.00E+00	4.33E-06	2.27E-06
HTL318		1.65E-04	1.07E-04	3.83E-06	2.33E-06	8.44E-05	8.26E-04	1.59E-05	4.35E-06	1.83E-02	0.00E+00	2.59E-05	3.11E-04
HTL319		2.23E-05	2.08E-05	2.68E-04	1.60E-05	5.93E-06	1.20E-06	7.42E-06	4.35E-04	4.53E-05	0.00E+00	2.55E-05	7.70E-05
HTLMix		1.18E-04	1.58E-04	1.16E-05	2.50E-06	4.19E-04	3.39E-04	7.95E-06	6.47E-06	7.20E-03	1.86E-07	2.88E-05	2.90E-04
HTL320	CHPM18	1.44E-04	5.76E-05	9.05E-06	6.75E-07	2.17E-07	1.50E-06	1.95E-06	1.59E-05	3.47E-05	0.00E+00	5.03E-08	1.31E-05
HTL321	CHPM12	8.76E-06	5.81E-06	9.46E-07	7.30E-06	3.94E-06	2.54E-06	4.22E-06	2.34E-04	4.78E-04	1.07E-05	3.41E-07	5.55E-05
HTL322	CHPM4	4.28E-06	2.32E-05	1.24E-06	2.49E-05	4.95E-03	9.56E-03	3.08E-05	8.65E-06	2.05E-02	3.18E-07	1.22E-06	1.82E-02
HTL323	CHPM26	2.18E-06	1.67E-06	1.65E-07	1.18E-04	3.80E-04	1.08E-03	1.19E-03	1.51E-02	3.18E-03	2.51E-06	5.35E-07	4.68E-05
HTL324	CHPM5	3.21E-05	2.13E-06	2.87E-05	2.28E-04	3.07E-05	7.66E-06	3.67E-06	2.83E-05	1.00E-05	7.06E-06	7.97E-07	2.57E-04
HTL325	CHPM20	2.97E-05	7.65E-04	2.00E-06	3.17E-04	7.06E-05	6.97E-05	7.71E-05	8.64E-05	2.48E-06	4.30E-05	1.49E-07	1.14E-04

Table A3: Results from solid digestion and elemental analysis (cont.)

		Trace elemental analysis, from digestion & ICP-MS analysis, mol/kg											
		La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm
BGS Sample ID	CHPM Sample ID												
HTL315		2.41E-05	5.02E-05	6.34E-06	2.57E-05	7.90E-06	9.54E-07	8.39E-06	1.23E-06	7.28E-06	1.27E-06	3.58E-06	4.76E-07
HTL316		1.94E-04	3.56E-04	4.22E-05	1.59E-04	3.18E-05	1.02E-05	2.32E-05	2.21E-06	1.04E-05	1.59E-06	4.06E-06	5.88E-07
HTL317		3.93E-04	7.66E-04	9.36E-05	4.04E-04	8.92E-05	3.50E-05	6.66E-05	5.32E-06	1.79E-05	1.78E-06	2.35E-06	2.12E-07
HTL318		3.10E-04	5.59E-04	6.15E-05	2.48E-04	5.65E-05	3.11E-05	5.11E-05	5.24E-06	2.27E-05	3.06E-06	6.25E-06	7.17E-07
HTL319		3.01E-05	6.39E-05	7.34E-06	2.66E-05	5.57E-06	7.53E-07	4.14E-06	6.23E-07	3.94E-06	7.00E-07	2.33E-06	3.68E-07
HTLMix		3.62E-04	6.75E-04	7.45E-05	2.93E-04	6.08E-05	2.52E-05	4.77E-05	4.17E-06	1.63E-05	2.02E-06	3.76E-06	4.74E-07
HTL320	CHPM18	2.76E-04	2.21E-04	3.83E-05	1.28E-04	1.85E-05	6.67E-06	1.52E-05	2.03E-06	1.26E-05	2.30E-06	6.68E-06	8.49E-07
HTL321	CHPM12	2.82E-06	6.14E-06	8.13E-07	3.39E-06	7.13E-07	1.08E-07	6.93E-07	1.07E-07	6.14E-07	1.53E-07	5.06E-07	6.17E-08
HTL322	CHPM4	1.16E-05	1.32E-05	1.25E-06	4.42E-06	8.08E-07	4.90E-07	4.90E-07	5.97E-08	4.22E-07	7.95E-08	2.08E-07	3.38E-08
HTL323	CHPM26	6.24E-07	1.09E-06	1.48E-07	5.65E-07	2.29E-07	1.25E-07	4.55E-07	5.52E-08	2.86E-07	4.17E-08	1.10E-07	1.37E-08
HTL324	CHPM5	1.63E-05	4.02E-05	5.52E-06	2.30E-05	4.23E-06	8.31E-07	3.93E-06	5.15E-07	3.19E-06	5.93E-07	1.71E-06	2.33E-07
HTL325	CHPM20	6.31E-05	1.33E-04	1.69E-05	6.56E-05	1.30E-05	4.90E-06	9.22E-06	1.01E-06	4.35E-06	6.71E-07	2.10E-06	3.43E-07

Table A3: Results from solid digestion and elemental analysis (cont.)

		Trace elemental analysis, from digestion & ICP-MS analysis, mol/kg									
		Yb	Lu	Hf	Ta	W	Tl	Pb	Bi	Th	U
BGS Sample ID	CHPM Sample ID										
HTL315		3.12E-06	4.22E-07	3.19E-06	9.67E-07	1.18E-03	4.12E-07	1.37E-04	4.06E-04	1.01E-05	8.66E-06
HTL316		3.60E-06	5.73E-07	5.62E-06	1.66E-06	7.34E-06	1.85E-06	3.04E-02	1.55E-06	1.43E-05	3.09E-06
HTL317		6.91E-07	8.76E-08	8.91E-08	4.65E-08	0.00E+00	1.65E-06	4.22E-01	1.70E-05	2.83E-07	1.60E-07
HTL318		3.86E-06	4.86E-07	1.46E-06	8.37E-08	2.34E-05	9.07E-07	3.11E-02	4.31E-05	4.99E-06	1.30E-06
HTL319		3.53E-06	4.81E-07	2.95E-07	1.15E-05	9.62E-02	2.02E-07	1.29E-04	2.50E-04	1.81E-06	2.44E-05
HTLMix		2.48E-06	3.57E-07	2.74E-06	3.52E-07	1.48E-04	1.61E-06	3.86E-01	2.03E-05	6.51E-06	1.46E-06
HTL320	CHPM18	4.90E-06	6.23E-07	8.83E-07	5.05E-07	1.20E-04	6.49E-09	6.73E-05	1.18E-06	3.59E-06	4.70E-06
HTL321	CHPM12	4.18E-07	5.26E-08	9.51E-08	8.46E-08	1.37E-04	5.06E-06	3.20E-05	4.43E-05	1.32E-07	3.86E-06
HTL322	CHPM4	2.32E-07	3.66E-08	3.31E-07	0.00E+00	5.05E-05	5.48E-06	2.85E-01	2.44E-07	7.98E-07	9.20E-06
HTL323	CHPM26	9.79E-08	1.70E-08	2.19E-08	0.00E+00	6.12E-05	6.62E-06	3.36E-03	3.03E-04	1.63E-08	2.16E-06
HTL324	CHPM5	1.53E-06	2.28E-07	7.48E-08	7.12E-07	3.03E-05	1.17E-06	8.88E-05	9.04E-06	3.10E-06	4.52E-07
HTL325	CHPM20	2.91E-06	4.77E-07	1.07E-05	4.49E-08	3.42E-05	7.13E-07	1.85E-05	4.16E-05	6.26E-06	8.61E-06

Table A3: Results from solid digestion and elemental analysis (cont.)

APPENDIX B – FLUID ANALYSES

This appendix presents the results of fluid analyses done on experimental samples.

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B1: Runs 1731, 1732, & 1733

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh (mV)	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1736_0	0.1M Ammonia	N/A	N/A	N/A			4788.0	7.85E-02	2.3	4.2E-05	11.24	38.3	19.9
1731_1	0.1M Ammonia	HTL315	70	1	121	200	4776.0	7.83E-02	0.223	4.0E-06	10.33	104	29.3
1731_2	0.1M Ammonia	HTL315	70	1	286	189			0.060	1.1E-06	10.1	99.1	28.8
1731_3	0.1M Ammonia	HTL315	70	1	550	179			0.021	3.7E-07	9.95	87.6	23.8
1731_4	0.1M Ammonia	HTL315	70	1	718	169.1 (152)			<0.5	0.0E+00	9.79	135.2	24.5
1736_0	0.1M Ammonia	N/A	N/A	N/A			4788.0	7.85E-02	2.3	4.2E-05	11.24	38.3	19.9
1732_1	0.1M Ammonia	HTL319	70	1	121	200	5080.0	8.33E-02	0.261	4.7E-06	10.86	50.4	29.3
1732_2	0.1M Ammonia	HTL319	70	1	286	190			0.352	6.3E-06	10.87	16.3	27.8
1732_3	0.1M Ammonia	HTL319	70	1	550	179			0.508	9.1E-06	10.58	14.9	25.2
1732_4	0.1M Ammonia	HTL319	70	1	718	170 (152)			<0.5	0.0E+00	10.88	85.6	25.4
1736_0	0.1M Ammonia	N/A	N/A	N/A			4788.0	7.85E-02	2.3	4.2E-05	11.24	38.3	19.9
1733_1	0.1M Ammonia	HTLMix	70	1	121	200	5020.0	8.23E-02	0.016	2.9E-07	10.86	41.8	27
1733_2	0.1M Ammonia	HTLMix	70	1	286	190			<0.5	0.0E+00	10.82	4.9	27.1
1733_3	0.1M Ammonia	HTLMix	70	1	550	180			<0.5	0.0E+00	10.71	18.1	23.4
1733_4	0.1M Ammonia	HTLMix	70	1	718	170.4 (70)			<0.5	0.0E+00	10.63	69.7	25.8

Table B1: Runs 1731, 1732, & 1733, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1731_1										
1731_2										
1731_3										
1731_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.58E-05	1.20E-04	0.00E+00	1.01E-02	0.00E+00	0.00E+00
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1732_1										
1732_2										
1732_3										
1732_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.36E-05	4.53E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1733_1										
1733_2										
1733_3										
1733_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.30E-05	8.73E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B1: Runs 1731, 1732, & 1733, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E-07	0.00E+00	0.00E+00	0.00E+00
1731_1										
1731_2										
1731_3										
1731_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.19E-05	6.66E-08	1.44E-07	3.91E-05	0.00E+00	1.41E-07
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E-07	0.00E+00	0.00E+00	0.00E+00
1732_1										
1732_2										
1732_3										
1732_4	0.00E+00	0.00E+00	7.04E-08	3.76E-06	0.00E+00	0.00E+00	0.00E+00	5.79E-06	0.00E+00	0.00E+00
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E-07	0.00E+00	0.00E+00	0.00E+00
1733_1										
1733_2										
1733_3										
1733_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.45E-07	9.12E-06	0.00E+00

Table B1: Runs 1731, 1732, & 1733, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1731_1										
1731_2										
1731_3										
1731_4	1.25E-03	2.16E-07	2.49E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.56E-08	0.00E+00	0.00E+00
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1732_1										
1732_2										
1732_3										
1732_4	9.08E-06	0.00E+00	1.10E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.69E-08	0.00E+00	0.00E+00
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1733_1										
1733_2										
1733_3										
1733_4	0.00E+00	0.00E+00	2.63E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B1: Runs 1731, 1732, & 1733, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1731_1										
1731_2										
1731_3										
1731_4	0.00E+00	2.48E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1732_1										
1732_2										
1732_3										
1732_4	6.45E-08	8.84E-08	1.57E-08	0.00E+00	0.00E+00	1.08E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1733_1										
1733_2										
1733_3										
1733_4	0.00E+00	5.27E-07	1.09E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B1: Runs 1731, 1732, & 1733, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1731_1										
1731_2										
1731_3										
1731_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.67E-07
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1732_1										
1732_2										
1732_3										
1732_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.48E-04
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1733_1										
1733_2										
1733_3										
1733_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.24E-06

Table B1: Runs 1731, 1732, & 1733, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1736_0	0.00E+00	6.65E-07	0.00E+00	0.00E+00								
1731_1												
1731_2												
1731_3												
1731_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1736_0	0.00E+00	6.65E-07	0.00E+00	0.00E+00								
1732_1												
1732_2												
1732_3												
1732_4	0.00E+00	0.00E+00	0.00E+00	1.28E-08								
1736_0	0.00E+00	6.65E-07	0.00E+00	0.00E+00								
1733_1												
1733_2												
1733_3												
1733_4	8.16E-09	1.36E-05	0.00E+00	0.00E+00								

Table B1: Runs 1731, 1732, & 1733, fluid analyses (cont.)

B2: Runs 1734, 1735, & 1736

Table B2: Runs 1734, 1735, & 1736, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh (mV)	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1737_0	0.001M Ammonia	N/A	N/A	N/A			23.6	3.87E-04	<0.5	0.0E+00	9.96	60.2	19.7
1734_1	0.001M Amm	HTL315	70	1	119	200	0.00	0.00E+00	1.6	2.8E-05	4.12	240.8	27.1
1734_2	0.001M Amm	HTL315	70	1	286	190			11.1	2.0E-04	3.47	245.4	26
1734_3	0.001M Amm	HTL315	70	1	550	180			28.8	5.2E-04	3.1	228.7	24.9
1734_4	0.001M Amm	HTL315	70	1	718	170.9 (48)			54.6	9.8E-04	2.87	256.2	25.6
1737_0	0.001M Ammonia	N/A	N/A	N/A			23.6	3.87E-04	<0.5	0.0E+00	9.96	60.2	19.7
1735_1	0.001M Amm	HTL319	70	1	120	200	0.00	0.00E+00	0.05	9.7E-07	9.44	157	26.1
1735_2	0.001M Amm	HTL319	70	1	286	190			0.09	1.6E-06	9.43	125.4	23.6
1735_3	0.001M Amm	HTL319	70	1	550	180			0.13	2.3E-06	9.2	87.3	24.2
1735_4	0.001M Amm	HTL319	70	1	718	170.5 (156)			0.98	1.8E-05	9.01	127.6	24.9
1737_0	0.001M Ammonia		70	1			23.6	3.87E-04	<0.5	0.0E+00	9.96	60.2	19.7
1736_1	0.001M Amm	HTLMix	70	1	120	200	27.0	4.43E-04	<0.5	0.0E+00	9.03	136.7	25.1
1736_2	0.001M Amm	HTLMix	70	1	287	190			<0.5	0.0E+00	8.1	140.5	30.3
1736_3	0.001M Amm	HTLMix	70	1	550	180			<0.5	0.0E+00	6.15	148.1	24.6
1736_4	0.001M Amm	HTLMix	70	1	718	170.5 (152)			0.8	1.4E-05	6.57	155.1	25.3

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1737_0	0.00E+00	0.00E+00	7.06E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1734_1										
1734_2										
1734_3										
1734_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.13E-04	7.64E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1737_0	0.00E+00	0.00E+00	7.06E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1735_1										
1735_2										
1735_3										
1735_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.69E-05	2.60E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1737_0	0.00E+00	0.00E+00	7.06E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1736_1										
1736_2										
1736_3										
1736_4	0.00E+00	0.00E+00	0.00E+00	1.21E-03	0.00E+00	1.83E-04	0.00E+00	4.58E-03	0.00E+00	1.74E-03

Table B2: Runs 1734, 1735, & 1736, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1737_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E-07	0.00E+00	0.00E+00
1734_1										
1734_2										
1734_3										
1734_4	0.00E+00	0.00E+00	0.00E+00	1.45E-05	8.73E-04	1.92E-05	6.30E-07	1.41E-04	2.16E-05	0.00E+00
1737_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E-07	0.00E+00	0.00E+00
1735_1										
1735_2										
1735_3										
1735_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.82E-07	0.00E+00	0.00E+00
1737_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E-07	0.00E+00	0.00E+00
1736_1										
1736_2										
1736_3										
1736_4	0.00E+00	0.00E+00	0.00E+00	5.92E-05	0.00E+00	6.07E-08	0.00E+00	4.47E-07	1.77E-05	0.00E+00

Table B2: Runs 1734, 1735, & 1736, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1737_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1734_1										
1734_2										
1734_3										
1734_4	3.03E-04	4.55E-08	2.93E-08	0.00E+00	4.02E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1737_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1735_1										
1735_2										
1735_3										
1735_4	6.91E-06	0.00E+00	1.09E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1737_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1736_1										
1736_2										
1736_3										
1736_4	0.00E+00	0.00E+00	2.72E-07	8.07E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.52E-07	3.77E-07

Table B2: Runs 1734, 1735, & 1736, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1737_0	0.00E+00	0.00E+00	0.00E+00	2.47E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1734_1										
1734_2										
1734_3										
1734_4	0.00E+00	5.09E-07	0.00E+00	0.00E+00	2.35E-08	4.07E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1737_0	0.00E+00	0.00E+00	0.00E+00	2.47E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1735_1										
1735_2										
1735_3										
1735_4	4.32E-08	4.05E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1737_0	0.00E+00	0.00E+00	0.00E+00	2.47E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1736_1										
1736_2										
1736_3										
1736_4	0.00E+00	6.52E-07	8.16E-08	4.96E-07	1.27E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B2: Runs 1734, 1735, & 1736, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1737_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1734_1										
1734_2										
1734_3										
1734_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.21E-06
1737_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1735_1										
1735_2										
1735_3										
1735_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.41E-05
1737_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1736_1										
1736_2										
1736_3										
1736_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.85E-07

Table B2: Runs 1734, 1735, & 1736, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1737_0	0.00E+00	7.02E-07	0.00E+00	0.00E+00								
1734_1												
1734_2												
1734_3												
1734_4	0.00E+00	0.00E+00	0.00E+00	7.03E-09								
1737_0	0.00E+00	7.02E-07	0.00E+00	0.00E+00								
1735_1												
1735_2												
1735_3												
1735_4	0.00E+00	0.00E+00	0.00E+00	4.81E-09								
1737_0	0.00E+00	7.02E-07	0.00E+00	0.00E+00								
1736_1												
1736_2												
1736_3												
1736_4	2.68E-08	1.03E-04	0.00E+00	0.00E+00								

Table B2: Runs 1734, 1735, & 1736, fluid analyses (cont.)

B3: Runs 1737, 1738, & 1739

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh (mV)	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO ₃	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1738_0	0.1M Acetic Acid	N/A	N/A	N/A			0.0	0.00E+00	0.6	1.0E-05	2.76	456.3	19.9
1737_1	0.1M Acetic	HTL315	70	1	121	200	0.00	0.00E+00	34.0	6.1E-04	3.05	318.3	26.3
1737_2	0.1M Acetic	HTL315	70	1	287	190			41.2	7.4E-04	2.95	314.5	29.8
1737_3	0.1M Acetic	HTL315	70	1	550	180			51.7	9.3E-04	2.98	284.7	25
1737_4	0.1M Acetic	HTL315	70	1	718	170.8 (90)			61.1	1.1E-03	2.82	295.9	25.6
1738_0	0.1M Acetic Acid	N/A	N/A	N/A			0.0	0.00E+00	0.6	1.0E-05	2.76	456.3	19.9
1738_1	0.1M Acetic	HTL319	70	1	121	200	0.00	0.00E+00	3.5	6.2E-05	2.89	370	24.7
1738_2	0.1M Acetic	HTL319	70	1	287	191			4.7	8.4E-05	2.89	383.6	28.4
1738_3	0.1M Acetic	HTL319	70	1	551	180			5.4	9.7E-05	2.97	348.1	23.8
1738_4	0.1M Acetic	HTL319	70	1	718	171.3 (142)			6.1	1.1E-04	2.92	379.5	25.9
1738_0	0.1M Acetic Acid	N/A	N/A	N/A			0.0	0.00E+00	0.6	1.0E-05	2.76	456.3	19.9
1739_1	0.1M Acetic	HTLMix	70	1	121	200	600.0	9.83E-03	0.03	6.0E-07	3.71	343.4	23.5
1739_2	0.1M Acetic	HTLMix	70	1	287	190			0.03	4.9E-07	3.75	332.2	26.8
1739_3	0.1M Acetic	HTLMix	70	1	550	180			0.00	6.3E-08	3.84	311.9	23.9
1739_4	0.1M Acetic	HTLMix	70	1	718	171 (118)			1.35	2.4E-05	3.86	339.9	24.6

Table B3: Runs 1737, 1738, & 1739, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1738_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1737_1										
1737_2										
1737_3										
1737_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.75E-04	7.48E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1738_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1738_1										
1738_2										
1738_3										
1738_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.14E-04	3.14E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1738_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1739_1										
1739_2										
1739_3										
1739_4	0.00E+00	0.00E+00	0.00E+00	2.14E-03	6.09E-05	5.08E-04	0.00E+00	0.00E+00	8.70E-05	2.29E-03

Table B3: Runs 1737, 1738, & 1739, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1738_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1737_1										
1737_2										
1737_3										
1737_4	0.00E+00	0.00E+00	0.00E+00	1.42E-05	1.00E-03	1.82E-05	5.27E-07	1.63E-04	1.71E-05	0.00E+00
1738_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1738_1										
1738_2										
1738_3										
1738_4	0.00E+00	0.00E+00	6.89E-07	1.52E-05	8.54E-05	0.00E+00	0.00E+00	2.07E-06	0.00E+00	0.00E+00
1738_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1739_1										
1739_2										
1739_3										
1739_4	0.00E+00	0.00E+00	0.00E+00	1.51E-04	0.00E+00	1.31E-06	2.00E-06	2.33E-07	4.79E-05	2.46E-07

Table B3: Runs 1737, 1738, & 1739, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1738_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1737_1										
1737_2										
1737_3										
1737_4	4.29E-04	6.02E-08	5.45E-08	0.00E+00	5.78E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1738_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1738_1										
1738_2										
1738_3										
1738_4	7.81E-07	0.00E+00	3.63E-07	0.00E+00	2.46E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1738_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1739_1										
1739_2										
1739_3										
1739_4	6.27E-07	0.00E+00	2.56E-07	1.05E-06	2.12E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.55E-07

Table B3: Runs 1737, 1738, & 1739, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1738_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1737_1										
1737_2										
1737_3										
1737_4	0.00E+00	7.40E-07	0.00E+00	0.00E+00	2.68E-08	5.19E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1738_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1738_1										
1738_2										
1738_3										
1738_4	3.16E-08	0.00E+00	2.91E-08	0.00E+00	2.34E-08	5.57E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1738_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1739_1										
1739_2										
1739_3										
1739_4	0.00E+00	1.68E-07	5.32E-08	0.00E+00	6.90E-06	1.25E-05	1.43E-06	5.85E-06	1.27E-06	5.41E-07

Table B3: Runs 1737, 1738, & 1739, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1738_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1737_1										
1737_2										
1737_3										
1737_4	0.00E+00	6.20E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.00E-07
1738_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1738_1										
1738_2										
1738_3										
1738_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.98E-07
1738_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1739_1										
1739_2										
1739_3										
1739_4	9.13E-08	1.01E-06	3.20E-07	3.66E-08	7.20E-08	5.66E-09	3.23E-08	0.00E+00	0.00E+00	3.69E-07

Table B3: Runs 1737, 1738, & 1739, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1738_0	0.00E+00	4.56E-07	0.00E+00	0.00E+00								
1737_1												
1737_2												
1737_3												
1737_4	0.00E+00	0.00E+00	0.00E+00	8.10E-09								
1738_0	0.00E+00	4.56E-07	0.00E+00	0.00E+00								
1738_1												
1738_2												
1738_3												
1738_4	0.00E+00	0.00E+00	0.00E+00	2.68E-08								
1738_0	0.00E+00	4.56E-07	0.00E+00	0.00E+00								
1739_1												
1739_2												
1739_3												
1739_4	7.56E-07	4.20E-03	0.00E+00	4.47E-09								

Table B3: Runs 1737, 1738, & 1739, fluid analyses (cont.)

B4: Runs 1740, 1741, & 1742

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh (mV)	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1739_0	0.001M Acetic Acid	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	3.85	375	19.9
1740_1	0.001M Acetic	HTL315	70	1	120	200	0.00	0.00E+00	11.2	2.0E-04	3.57	225.6	24.4
1740_2	0.001M Acetic	HTL315	70	1	287	190			24.3	4.3E-04	3.13	313.5	25.4
1740_3	0.001M Acetic	HTL315	70	1	550	180			46.2	8.3E-04	2.93	322.8	23.4
1740_4	0.001M Acetic	HTL315	70	1	718	170.1 (110)			60.9	1.1E-03	2.76	338.3	24
1739_0	0.001M Acetic Acid	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	3.85	375	19.9
1741_1	0.001M Acetic	HTL319	70	1	120	200	0.00	0.00E+00	0.3	6.2E-06	3.97	217.3	23.5
1741_2	0.001M Acetic	HTL319	70	1	288	190			0.3	6.1E-06	4.02	276.6	31.6
1741_3	0.001M Acetic	HTL319	70	1	550	180			0.3	5.1E-06	4.05	278	23
1741_4	0.001M Acetic	HTL319	70	1	718	170 (148)			<0.5	0.0E+00	4.04	294.9	23.6
1739_0	0.001M Acetic Acid	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	3.85	375	19.9
1742_1	0.001M Acetic	HTLMix	70	1	120	200	0.00	0.00E+00	<0.5	0.0E+00	6.45	179.8	23
1742_2	0.001M Acetic	HTLMix	70	1	288	190			<0.5	0.0E+00	6.13	191.8	30.8
1742_3	0.001M Acetic	HTLMix	70	1	550	180			<0.5	0.0E+00	6.1	210.3	23.7
1742_4	0.001M Acetic	HTLMix	70	1	718	170.3 (138)			1.6	2.8E-05	6.09	218.9	24.1

Table B4: Runs 1740, 1741, & 1742, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1739_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1740_1										
1740_2										
1740_3										
1740_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-04	7.36E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1739_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1741_1										
1741_2										
1741_3										
1741_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.21E-05	2.21E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1739_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1742_1										
1742_2										
1742_3										
1742_4	0.00E+00	0.00E+00	0.00E+00	1.27E-03	0.00E+00	2.31E-04	0.00E+00	0.00E+00	1.66E-04	1.66E-03

Table B4: Runs 1740, 1741, & 1742, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1739_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1740_1										
1740_2										
1740_3										
1740_4	0.00E+00	0.00E+00	0.00E+00	1.70E-05	9.93E-04	2.24E-05	5.87E-07	9.49E-05	2.71E-05	0.00E+00
1739_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1741_1										
1741_2										
1741_3										
1741_4	0.00E+00	0.00E+00	0.00E+00	7.83E-06	3.64E-06	0.00E+00	0.00E+00	2.54E-07	0.00E+00	0.00E+00
1739_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1742_1										
1742_2										
1742_3										
1742_4	0.00E+00	0.00E+00	0.00E+00	7.77E-05	0.00E+00	8.41E-08	0.00E+00	5.01E-07	3.03E-05	0.00E+00

Table B4: Runs 1740, 1741, & 1742, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1739_0	0.00E+00	0.00E+00	0.00E+00	6.02E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1740_1										
1740_2										
1740_3										
1740_4	2.81E-04	6.05E-08	5.48E-08	0.00E+00	2.48E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1739_0	0.00E+00	0.00E+00	0.00E+00	6.02E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1741_1										
1741_2										
1741_3										
1741_4	0.00E+00	0.00E+00	1.62E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1739_0	0.00E+00	0.00E+00	0.00E+00	6.02E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1742_1										
1742_2										
1742_3										
1742_4	0.00E+00	0.00E+00	1.99E-07	7.25E-07	2.57E-08	0.00E+00	0.00E+00	0.00E+00	9.10E-08	4.06E-07

Table B4: Runs 1740, 1741, & 1742, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1739_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1740_1										
1740_2										
1740_3										
1740_4	3.33E-08	5.96E-07	3.43E-08	0.00E+00	2.16E-08	3.42E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1739_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1741_1										
1741_2										
1741_3										
1741_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.00E-09	1.26E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1739_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1742_1										
1742_2										
1742_3										
1742_4	0.00E+00	4.00E-07	2.28E-08	4.91E-07	1.12E-07	9.41E-08	9.62E-09	0.00E+00	0.00E+00	0.00E+00

Table B4: Runs 1740, 1741, & 1742, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1739_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1740_1										
1740_2										
1740_3										
1740_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.07E-07
1739_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1741_1										
1741_2										
1741_3										
1741_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.01E-07
1739_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1742_1										
1742_2										
1742_3										
1742_4	0.00E+00	5.71E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.30E-07

Table B4: Runs 1740, 1741, & 1742, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1739_0	0.00E+00	4.44E-07	0.00E+00	0.00E+00								
1740_1												
1740_2												
1740_3												
1740_4	0.00E+00	0.00E+00	0.00E+00	3.50E-09								
1739_0	0.00E+00	4.44E-07	0.00E+00	0.00E+00								
1741_1												
1741_2												
1741_3												
1741_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1739_0	0.00E+00	4.44E-07	0.00E+00	0.00E+00								
1742_1												
1742_2												
1742_3												
1742_4	3.65E-08	1.88E-04	0.00E+00	0.00E+00								

Table B4: Runs 1740, 1741, & 1742, fluid analyses (cont.)

B5: Runs 1743, 1744, & 1745

Table B5: Runs 1743, 1744, & 1745, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh (mV)	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO ₃	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1740_0	0.1M SDS	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	5.91	306.5	20.1
1743_1	0.1M SDS	HTL315	70	1	122	200	0.00	0.00E+00	34.8	6.2E-04	3.77	329.2	29.8
1743_2	0.1M SDS	HTL315	70	1	288	190			140.5	2.5E-03	2.8	339.8	28.8
1743_3	0.1M SDS	HTL315	70	1	550	180			352.0	6.3E-03	2.12	368.4	23.7
1743_4	0.1M SDS	HTL315	70	1	718	171			155.8	2.8E-03	1.84	384.8	23.8
1743_4D	0.1M SDS	HTL315	70	1	718	159.7 (138)			147.3	2.6E-03	1.81	392.2	23.8
1740_0	0.1M SDS	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	5.91	306.5	20.1
1744_1	0.1M SDS	HTL319	70	1	122	200	0.00	0.00E+00	14.6	2.6E-04	2.46	482	30.3
1744_2	0.1M SDS	HTL319	70	1	288	190			37.3	6.7E-04	1.4	506	27
1744_3	0.1M SDS	HTL319	70	1	550	180			7.5	1.3E-04	1.33	506.4	23.6
1744_4	0.1M SDS	HTL319	70	1	718	170.1 (152)			14.4	2.6E-04	1.32	516.2	23.5
1740_0	0.1M SDS	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	5.91	306.5	20.1
1745_1	0.1M SDS	HTLMix	70	1	122	200	0.00	0.00E+00	0.2	3.8E-06	7.39	276	25.5
1745_2	0.1M SDS	HTLMix	70	1	288	190			0.2	4.0E-06	7.18	243.6	26.4
1745_3	0.1M SDS	HTLMix	70	1	552	180			0.1	2.2E-06	6.76	236.2	22.5
1745_4	0.1M SDS	HTLMix	70	1	718	171 (156)			<0.5	0.0E+00	6.86	215.1	22.6

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1740_0	0.00E+00	0.00E+00	1.03E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.12E-02	0.00E+00	0.00E+00
1743_1										
1743_2										
1743_3										
1743_4	1.55E-04	0.00E+00	1.04E-01	7.38E-04	2.58E-03	5.81E-03	0.00E+00	7.31E-02	0.00E+00	0.00E+00
1743_4D	1.54E-04	0.00E+00	1.02E-01	6.97E-04	2.42E-03	5.65E-03	0.00E+00	7.59E-02	0.00E+00	0.00E+00
1740_0	0.00E+00	0.00E+00	1.03E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.12E-02	0.00E+00	0.00E+00
1744_1										
1744_2										
1744_3										
1744_4	6.11E-05	0.00E+00	1.10E-01	0.00E+00	4.23E-04	8.24E-04	0.00E+00	1.06E-01	1.99E-04	0.00E+00
1740_0	0.00E+00	0.00E+00	1.03E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.12E-02	0.00E+00	0.00E+00
1745_1										
1745_2										
1745_3										
1745_4	0.00E+00	0.00E+00	1.03E-01	5.59E-04	7.53E-06	1.77E-04	0.00E+00	9.26E-02	0.00E+00	0.00E+00

Table B5: Runs 1743, 1744, & 1745, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E-07	8.40E-08	4.56E-06	0.00E+00
1743_1										
1743_2										
1743_3										
1743_4	1.23E-06	6.45E-07	1.31E-06	1.45E-04	7.43E-03	2.34E-05	8.53E-07	3.60E-04	2.60E-05	3.74E-07
1743_4D	6.52E-07	7.56E-07	1.32E-06	1.38E-04	7.21E-03	2.18E-05	7.03E-07	3.45E-04	2.57E-05	3.14E-07
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E-07	8.40E-08	4.56E-06	0.00E+00
1744_1										
1744_2										
1744_3										
1744_4	0.00E+00	0.00E+00	9.71E-07	2.32E-05	6.64E-04	0.00E+00	0.00E+00	4.23E-06	0.00E+00	0.00E+00
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E-07	8.40E-08	4.56E-06	0.00E+00
1745_1										
1745_2										
1745_3										
1745_4	0.00E+00	0.00E+00	1.12E-07	1.45E-05	1.89E-05	7.02E-08	0.00E+00	1.20E-06	5.49E-05	0.00E+00

Table B5: Runs 1743, 1744, & 1745, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1740_0	0.00E+00	0.00E+00	0.00E+00	1.09E-06	0.00E+00	0.00E+00	2.19E-08	0.00E+00	0.00E+00	0.00E+00
1743_1										
1743_2										
1743_3										
1743_4	2.20E-03	0.00E+00	5.99E-08	0.00E+00	2.54E-08	0.00E+00	0.00E+00	0.00E+00	2.83E-07	0.00E+00
1743_4D	2.10E-03	0.00E+00	5.81E-08	0.00E+00	2.55E-08	0.00E+00	0.00E+00	3.17E-08	2.74E-07	0.00E+00
1740_0	0.00E+00	0.00E+00	0.00E+00	1.09E-06	0.00E+00	0.00E+00	2.19E-08	0.00E+00	0.00E+00	0.00E+00
1744_1										
1744_2										
1744_3										
1744_4	6.33E-06	0.00E+00	2.17E-06	0.00E+00	9.37E-08	0.00E+00	0.00E+00	4.13E-08	0.00E+00	0.00E+00
1740_0	0.00E+00	0.00E+00	0.00E+00	1.09E-06	0.00E+00	0.00E+00	2.19E-08	0.00E+00	0.00E+00	0.00E+00
1745_1										
1745_2										
1745_3										
1745_4	0.00E+00	0.00E+00	2.09E-07	0.00E+00	6.89E-08	0.00E+00	0.00E+00	0.00E+00	1.15E-06	2.24E-07

Table B5: Runs 1743, 1744, & 1745, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1743_1										
1743_2										
1743_3										
1743_4	5.09E-08	1.16E-06	0.00E+00	0.00E+00	1.76E-08	3.37E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1743_4D	4.50E-08	8.96E-07	1.22E-08	0.00E+00	1.90E-08	3.40E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1744_1										
1744_2										
1744_3										
1744_4	9.82E-08	4.53E-08	3.28E-07	0.00E+00	3.28E-08	8.35E-08	0.00E+00	0.00E+00	1.21E-08	0.00E+00
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1745_1										
1745_2										
1745_3										
1745_4	4.41E-08	2.63E-06	1.03E-07	3.17E-07	1.53E-07	2.04E-07	2.26E-08	8.46E-08	1.52E-08	0.00E+00

Table B5: Runs 1743, 1744, & 1745, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.57E-06
1743_1										
1743_2										
1743_3										
1743_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-07
1743_4D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.59E-07
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.57E-06
1744_1										
1744_2										
1744_3										
1744_4	0.00E+00	1.65E-08	2.42E-08	0.00E+00	7.13E-09	0.00E+00	9.91E-09	0.00E+00	0.00E+00	9.62E-06
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.57E-06
1745_1										
1745_2										
1745_3										
1745_4	0.00E+00	1.73E-08	8.24E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.34E-06

Table B5: Runs 1743, 1744, & 1745, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1743_1												
1743_2												
1743_3												
1743_4	0.00E+00	5.32E-07	8.29E-09	1.97E-08								
1743_4D	0.00E+00	0.00E+00	1.47E-08	1.79E-08								
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1744_1												
1744_2												
1744_3												
1744_4	0.00E+00	4.30E-07	1.08E-08	1.38E-07								
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1745_1												
1745_2												
1745_3												
1745_4	8.93E-08	1.05E-03	0.00E+00	0.00E+00								

Table B5: Runs 1743, 1744, & 1745, fluid analyses (cont.)

B6: Runs 1746, 1747, & 1748

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh (mV)	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1741_0	0.001M SDS	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	6.05	261.4	20
1746_1	S01 +0.001M SDS	HTL315	70	1	120	200	0.00	0.00E+00	4.3	7.7E-05	4.09	248.1	37
1746_2	S01 +0.001M SDS	HTL315	70	1	289	190			9.8	1.8E-04	3.47	304.5	29.3
1746_3	S01 +0.001M SDS	HTL315	70	1	550	180			20.6	3.7E-04	3.38	309.5	22.6
1746_4	S01 +0.001M SDS	HTL315	70	1	718	170.8 (156)			26.8	4.8E-04	3.1	310.3	22.5
1741_0	0.001M SDS	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	6.05	261.4	20
1747_1	0.001M SDS	HTL319	70	1	121	200	0.00	0.00E+00	0.1	1.1E-06	5.57	208.1	32.5
1747_2	0.001M SDS	HTL319	70	1	289	190			0.1	1.8E-06	5.36	239.6	28.5
1747_3	0.001M SDS	HTL319	70	1	550	179			0.0	6.0E-07	5.41	251.2	23.2
1747_4	0.001M SDS	HTL319	70	1	718	169.1 (118)			<0.5	0.0E+00	5.24	259.9	22.6
1741_0	0.001M SDS	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	6.05	261.4	20
1748_1	0.001M SDS	HTLMix	70	1	121	200	0.00	0.00E+00	0.1	1.6E-06	7.04	186.8	29.6
1748_2	0.001M SDS	HTLMix	70	1	289	190			<0.5	0.0E+00	6.47	215.5	27.3
1748_3	0.001M SDS	HTLMix	70	1	550	180			<0.5	0.0E+00	5.84	252.1	23.1
1748_4	0.001M SDS	HTLMix	70	1	718	170 (132)			0.9	1.6E-05	5.8	262.5	22.7

Table B6: Runs 1746, 1747, & 1748, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1741_0	0.00E+00	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1746_1										
1746_2										
1746_3										
1746_4	0.00E+00	0.00E+00	1.30E-03	0.00E+00	1.05E-04	5.50E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1741_0	0.00E+00	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1747_1										
1747_2										
1747_3										
1747_4	0.00E+00	0.00E+00	1.33E-03	0.00E+00	1.22E-05	2.09E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1741_0	0.00E+00	0.00E+00	1.14E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1748_1										
1748_2										
1748_3										
1748_4	0.00E+00	0.00E+00	1.35E-03	1.26E-04	0.00E+00	2.16E-04	0.00E+00	0.00E+00	1.08E-04	0.00E+00

Table B6: Runs 1746, 1747, & 1748, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1741_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.61E-08	0.00E+00	0.00E+00
1746_1										
1746_2										
1746_3										
1746_4	0.00E+00	0.00E+00	0.00E+00	9.57E-06	4.63E-04	1.19E-05	4.52E-07	1.38E-04	1.46E-05	0.00E+00
1741_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.61E-08	0.00E+00	0.00E+00
1747_1										
1747_2										
1747_3										
1747_4	0.00E+00	0.00E+00	0.00E+00	4.54E-06	7.12E-06	0.00E+00	0.00E+00	7.00E-07	0.00E+00	0.00E+00
1741_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.61E-08	0.00E+00	0.00E+00
1748_1										
1748_2										
1748_3										
1748_4	0.00E+00	0.00E+00	0.00E+00	2.84E-06	0.00E+00	4.42E-08	0.00E+00	1.18E-07	4.71E-06	0.00E+00

Table B6: Runs 1746, 1747, & 1748, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1741_0	0.00E+00	0.00E+00	0.00E+00	1.23E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1746_1										
1746_2										
1746_3										
1746_4	2.76E-04	0.00E+00	4.43E-08	0.00E+00	5.27E-08	0.00E+00	0.00E+00	0.00E+00	1.28E-07	0.00E+00
1741_0	0.00E+00	0.00E+00	0.00E+00	1.23E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1747_1										
1747_2										
1747_3										
1747_4	9.77E-07	0.00E+00	1.22E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1741_0	0.00E+00	0.00E+00	0.00E+00	1.23E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1748_1										
1748_2										
1748_3										
1748_4	0.00E+00	0.00E+00	1.22E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B6: Runs 1746, 1747, & 1748, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1741_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1746_1										
1746_2										
1746_3										
1746_4	3.19E-08	4.48E-07	0.00E+00	0.00E+00	2.24E-08	4.50E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1741_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1747_1										
1747_2										
1747_3										
1747_4	1.35E-07	2.13E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1741_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1748_1										
1748_2										
1748_3										
1748_4	3.09E-08	5.00E-08	1.93E-08	3.16E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B6: Runs 1746, 1747, & 1748, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1741_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1746_1										
1746_2										
1746_3										
1746_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1741_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1747_1										
1747_2										
1747_3										
1747_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.28E-06
1741_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1748_1										
1748_2										
1748_3										
1748_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B6: Runs 1746, 1747, & 1748, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1741_0	0.00E+00	6.30E-07	0.00E+00	0.00E+00								
1746_1												
1746_2												
1746_3												
1746_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1741_0	0.00E+00	6.30E-07	0.00E+00	0.00E+00								
1747_1												
1747_2												
1747_3												
1747_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1741_0	0.00E+00	6.30E-07	0.00E+00	0.00E+00								
1748_1												
1748_2												
1748_3												
1748_4	0.00E+00	3.04E-05	0.00E+00	0.00E+00								

Table B6: Runs 1746, 1747, & 1748, fluid analyses (cont.)

B7: Runs 1749, 1750, & 1713

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh (mV)	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1736_0	0.1M Ammonia	N/A	N/A	N/A			4788.0	7.85E-02	2.3	4.2E-05	11.24	38.3	19.9
1749_1	0.1M Amm	HTL315	70	1	122	200	4832.0	7.92E-02	0.2	3.7E-06	10.1	89	24.1
1749_2	0.1M Amm	HTL315	70	1	289	190			0.1	2.0E-06	9.95	98.5	27
1749_3	0.1M Amm	HTL315	70	1	550	180			0.1	1.5E-06	9.86	140.8	22.8
1749_4	0.1M Amm	HTL315	70	1	718	170					9.75	124.4	22.3
1749_4D	0.1M Amm	HTL315	70	1	719	158 (132)					9.74	121.4	22
1740_0	0.1M SDS	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	5.91	306.5	20.1
1750_1	0.1M SDS	HTLMix	70	1	122	200	0.00	0.00E+00	0.023	4.1E-07	7.6	179.4	23.5
1750_2	0.1M SDS	HTLMix	70	1	289	190			0.064	1.1E-06	7.4	190	26.2
1731_0	DI Water	N/A	N/A	N/A			0.0	0.00E+00	1.6	2.9E-05	5.98	203.9	20.2
1713_1	DI	HTL315	70	1	69	200	0.00	0.00E+00	8.3	1.5E-04	3.71	229.4	29.3
1713_2	DI	HTL315	70	1	237	190			21.2	3.8E-04	3.23	256.9	27.7
1713_3	DI	HTL315	70	1	530	180			44.0	7.9E-04	2.89	313.3	25
1713_4	DI	HTL315	70	1	674	170.3 (142)	0.00	0.00E+00	45.6	8.2E-04	2.88	311.4	26.1

Table B7: Runs 1749, 1750, & 1713, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1749_1										
1749_2										
1749_3										
1749_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.98E-05	9.42E-05	0.00E+00	1.07E-02	0.00E+00	0.00E+00
1749_4D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.56E-05	9.29E-05	0.00E+00	1.10E-02	0.00E+00	0.00E+00
1740_0	0.00E+00	0.00E+00	1.03E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.12E-02	0.00E+00	0.00E+00
1750_1										
1750_2	0.00E+00	0.00E+00	1.04E-01	4.07E-04	6.59E-06	1.13E-04	0.00E+00	9.19E-02	0.00E+00	0.00E+00
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1713_1										
1713_2										
1713_3										
1713_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.96E-04	6.12E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B7: Runs 1749, 1750, & 1713, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E-07	0.00E+00	0.00E+00	0.00E+00
1749_1										
1749_2										
1749_3										
1749_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.08E-05	5.03E-08	0.00E+00	6.03E-05	0.00E+00	0.00E+00
1749_4D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.08E-05	0.00E+00	0.00E+00	6.06E-05	0.00E+00	0.00E+00
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E-07	8.40E-08	4.56E-06	0.00E+00
1750_1										
1750_2	0.00E+00	0.00E+00	1.92E-07	5.79E-06	1.25E-05	0.00E+00	0.00E+00	5.28E-07	1.77E-05	0.00E+00
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1713_1										
1713_2										
1713_3										
1713_4	0.00E+00	0.00E+00	0.00E+00	1.28E-05	7.29E-04	1.70E-05	4.64E-07	6.29E-05	2.94E-05	0.00E+00

Table B7: Runs 1749, 1750, & 1713, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1749_1										
1749_2										
1749_3										
1749_4	9.31E-04	1.81E-07	3.04E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.38E-08	0.00E+00	0.00E+00
1749_4D	9.44E-04	1.81E-07	3.04E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.31E-08	8.25E-08	0.00E+00
1740_0	0.00E+00	0.00E+00	0.00E+00	1.09E-06	0.00E+00	0.00E+00	2.19E-08	0.00E+00	0.00E+00	0.00E+00
1750_1										
1750_2	0.00E+00	0.00E+00	1.57E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.85E-08	1.15E-07
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1713_1										
1713_2										
1713_3										
1713_4	1.36E-04	4.80E-08	4.85E-08	0.00E+00	3.19E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B7: Runs 1749, 1750, & 1713, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1749_1										
1749_2										
1749_3										
1749_4	0.00E+00	1.95E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1749_4D	0.00E+00	1.92E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1750_1										
1750_2	0.00E+00	2.38E-06	9.89E-08	0.00E+00	4.64E-08	2.88E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1731_0	0.00E+00	1.64E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1713_1										
1713_2										
1713_3										
1713_4	4.19E-08	5.91E-07	0.00E+00	0.00E+00	2.22E-08	3.75E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B7: Runs 1749, 1750, & 1713, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1736_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1749_1										
1749_2										
1749_3										
1749_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.15E-07
1749_4D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.10E-07
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.57E-06
1750_1										
1750_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.36E-06
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-07
1713_1										
1713_2										
1713_3										
1713_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B7: Runs 1749, 1750, & 1713, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1736_0	0.00E+00	6.65E-07	0.00E+00	0.00E+00								
1749_1												
1749_2												
1749_3												
1749_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1749_4D	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1740_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1750_1												
1750_2	1.17E-08	6.20E-05	0.00E+00	0.00E+00								
1731_0	0.00E+00	2.58E-06	0.00E+00	0.00E+00								
1713_1												
1713_2												
1713_3												
1713_4	0.00E+00	0.00E+00	0.00E+00	5.22E-09								

Table B7: Runs 1749, 1750, & 1713, fluid analyses (cont.)

B8: Runs 1714, 1715, & 1716

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh (mV)	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1731_0	DI Water	N/A	N/A	N/A			0.0	0.00E+00	1.6	2.9E-05	5.98	203.9	20.2
1714_1	DI	HTL319	70	1	69	200	0.00	0.00E+00	<0.5	0.0E+00	5.31	184.6	27.3
1714_2	DI	HTL319	70	1	237	190			0.009	1.6E-07	5.12	219.4	28.9
1714_3	DI	HTL319	70	1	530	179			0.067	1.2E-06	4.91	283.7	22.2
1714_4	DI	HTL319	70	1	674	169.3 (130)	0.00	0.00E+00	1.447007853	2.6E-05	5.17	258.2	27
1731_0	DI Water	N/A	N/A	N/A			0.0	0.00E+00	1.6	2.9E-05	5.98	203.9	20.2
1715_1	DI	HTLMix	70	1	69	200	23.3	3.81E-04	0.02	3.3E-07	6.99	148.6	25.3
1715_2	DI	HTLMix	70	1	237	190			<5	0.0E+00	6.78	196.3	27.3
1715_3	DI	HTLMix	70	1	530	180			0.004	7.7E-08	7.22	227	26.1
1715_4	DI	HTLMix	70	1	674	170.8 (156)	30.1	4.93E-04	LOST SAMPLE	0.0E+00	7.55	221	27.3
1732_0	Tap Water	N/A	N/A	N/A			546.4	8.95E-03	<0.5	0.0E+00	7.34	198	20
1716_1	Tap	HTL315	70	1	69	200	70.2	1.15E-03	0.015	2.6E-07	7.39	160.6	23.8
1716_2	Tap	HTL315	70	1	237	190			0.006	1.1E-07	7.48	172.3	26.3
1716_3	Tap	HTL315	70	1	530	180			0.026	4.6E-07	7.06	227.9	26
1716_4	Tap	HTL315	70	1	674	170.8 (158)	0	0.00E+00	1.605	2.9E-05	6.56	216.6	25.8

Table B8: Runs 1714, 1715, & 1716, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1714_1										
1714_2										
1714_3										
1714_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1715_1										
1715_2										
1715_3										
1715_4	0.00E+00	0.00E+00	0.00E+00	7.96E-04	3.90E-06	1.53E-04	0.00E+00	0.00E+00	1.20E-04	0.00E+00
1732_0	0.00E+00	0.00E+00	1.91E-03	5.26E-04	0.00E+00	1.00E-04	0.00E+00	0.00E+00	1.49E-04	1.87E-03
1716_1										
1716_2										
1716_3										
1716_4	0.00E+00	0.00E+00	1.92E-03	4.35E-04	3.87E-06	4.06E-04	0.00E+00	0.00E+00	1.58E-04	1.21E-03

Table B8: Runs 1714, 1715, & 1716, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1714_1										
1714_2										
1714_3										
1714_4	0.00E+00	0.00E+00	0.00E+00	3.75E-06	0.00E+00	0.00E+00	0.00E+00	1.80E-07	0.00E+00	0.00E+00
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1715_1										
1715_2										
1715_3										
1715_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E-07	0.00E+00	0.00E+00
1732_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.97E-06	0.00E+00	0.00E+00
1716_1										
1716_2										
1716_3										
1716_4	0.00E+00	0.00E+00	0.00E+00	8.83E-07	0.00E+00	1.88E-07	0.00E+00	1.54E-06	0.00E+00	0.00E+00

Table B8: Runs 1714, 1715, & 1716, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1714_1										
1714_2										
1714_3										
1714_4	1.00E-06	0.00E+00	9.11E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1715_1										
1715_2										
1715_3										
1715_4	0.00E+00	0.00E+00	1.40E-07	5.85E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1732_0	0.00E+00	5.09E-08	4.83E-08	2.43E-06	0.00E+00	0.00E+00	0.00E+00	5.11E-08	1.47E-07	0.00E+00
1716_1										
1716_2										
1716_3										
1716_4	2.54E-05	0.00E+00	5.84E-08	2.06E-06	0.00E+00	0.00E+00	0.00E+00	3.68E-08	0.00E+00	0.00E+00

Table B8: Runs 1714, 1715, & 1716, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	1.64E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1714_1										
1714_2										
1714_3										
1714_4	0.00E+00	1.98E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1731_0	0.00E+00	1.64E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1715_1										
1715_2										
1715_3										
1715_4	3.07E-08	9.56E-07	1.34E-08	3.35E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1732_0	0.00E+00	0.00E+00	0.00E+00	6.48E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1716_1										
1716_2										
1716_3										
1716_4	0.00E+00	2.28E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B8: Runs 1714, 1715, & 1716, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-07
1714_1										
1714_2										
1714_3										
1714_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.92E-07
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-07
1715_1										
1715_2										
1715_3										
1715_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1732_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1716_1										
1716_2										
1716_3										
1716_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B8: Runs 1714, 1715, & 1716, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	2.58E-06	0.00E+00	0.00E+00								
1714_1												
1714_2												
1714_3												
1714_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1731_0	0.00E+00	2.58E-06	0.00E+00	0.00E+00								
1715_1												
1715_2												
1715_3												
1715_4	0.00E+00	2.02E-06	0.00E+00	0.00E+00								
1732_0	0.00E+00	1.03E-06	0.00E+00	3.48E-09								
1716_1												
1716_2												
1716_3												
1716_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00								

Table B8: Runs 1714, 1715, & 1716, fluid analyses (cont.)

B9: Runs 1717, 1718, & 1719

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1732_0	Tap Water	N/A	N/A	N/A			546.4	8.95E-03	<0.5	0.0E+00	7.34	198	20
1717_1	Tap	HTL319	70	1	69	200	132.3	2.17E-03	0.011	2.0E-07	7.87	155.6	22.9
1717_2	Tap	HTL319	70	1	237	190			0.013	2.3E-07	8.21	160.7	24.7
1717_3	Tap	HTL319	70	1	530	180			0.168	3.0E-06	8.31	198.3	25.5
1717_4	Tap	HTL319	70	1	674	170 (154)	105.3	1.73E-03	0.779	1.4E-05	8.51	187.8	25.1
1732_0	Tap Water	N/A	N/A	N/A			546.4	8.95E-03	<0.5	0.0E+00	7.34	198	20
1718_1	Tap	HTLMix	70	1	70	200	73.4	1.20E-03	<0.5	0.0E+00	7.42	158.4	32
1718_2	Tap	HTLMix	70	1	239	190			0.009	1.6E-07	7.56	186.8	36.3
1718_3	Tap	HTLMix	70	1	530	180			0.0015	2.7E-08	7.5	193.4	25.5
1718_4	Tap	HTLMix	70	1	674	169.4 (152)	0.0	0.00E+00	<0.5	0.0E+00	7.57	183.9	25.5
1733_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	6.31	216.7	21.3
1719_1	0.6M NaCl	HTL315	70	1	70	200	0.00	0.00E+00	22.679	4.1E-04	3.82	265.4	30.6
1719_2	0.6M NaCl	HTL315	70	1	239	190			77.143	1.4E-03	3.3	274.6	33.6
1719_3	0.6M NaCl	HTL315	70	1	530	180			137.930	2.5E-03	3.22	287.3	25.4
1719_4	0.6M NaCl	HTL315	70	1	674	170.4 (158)	0.00	0.00E+00	96.849	1.7E-03	2.93	318.1	26

Table B9: Runs 1717, 1718, & 1719, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1732_0	0.00E+00	0.00E+00	1.91E-03	5.26E-04	0.00E+00	1.00E-04	0.00E+00	0.00E+00	1.49E-04	1.87E-03
1717_1										
1717_2										
1717_3										
1717_4	0.00E+00	0.00E+00	2.04E-03	4.35E-04	1.49E-05	2.22E-04	0.00E+00	0.00E+00	1.74E-04	1.45E-03
1732_0	0.00E+00	0.00E+00	1.91E-03	5.26E-04	0.00E+00	1.00E-04	0.00E+00	0.00E+00	1.49E-04	1.87E-03
1718_1										
1718_2										
1718_3										
1718_4	0.00E+00	0.00E+00	1.99E-03	6.26E-04	3.55E-06	2.36E-04	0.00E+00	0.00E+00	2.29E-04	1.64E-03
1733_0	3.69E-06	0.00E+00	6.10E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.08E-06	0.00E+00
1719_1										
1719_2										
1719_3										
1719_4	6.60E-05	0.00E+00	6.09E-01	0.00E+00	1.40E-04	5.21E-04	0.00E+00	6.99E-03	0.00E+00	0.00E+00

Table B9: Runs 1717, 1718, & 1719, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1732_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.97E-06	0.00E+00	0.00E+00
1717_1										
1717_2										
1717_3										
1717_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.04E-07	0.00E+00	0.00E+00
1732_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.97E-06	0.00E+00	0.00E+00
1718_1										
1718_2										
1718_3										
1718_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.46E-06	0.00E+00	0.00E+00	1.22E-06	0.00E+00	0.00E+00
1733_0	0.00E+00	0.00E+00	1.54E-08	0.00E+00	0.00E+00	0.00E+00	3.93E-08	4.24E-07	5.05E-07	0.00E+00
1719_1										
1719_2										
1719_3										
1719_4	0.00E+00	0.00E+00	0.00E+00	1.30E-05	2.82E-03	5.69E-05	1.03E-06	1.67E-04	4.91E-05	0.00E+00

Table B9: Runs 1717, 1718, & 1719, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1732_0	0.00E+00	5.09E-08	4.83E-08	2.43E-06	0.00E+00	0.00E+00	0.00E+00	5.11E-08	1.47E-07	0.00E+00
1717_1										
1717_2										
1717_3										
1717_4	1.73E-06	0.00E+00	1.42E-07	2.21E-06	0.00E+00	0.00E+00	0.00E+00	4.27E-08	0.00E+00	0.00E+00
1732_0	0.00E+00	5.09E-08	4.83E-08	2.43E-06	0.00E+00	0.00E+00	0.00E+00	5.11E-08	1.47E-07	0.00E+00
1718_1										
1718_2										
1718_3										
1718_4	0.00E+00	0.00E+00	2.04E-07	2.49E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1733_0	0.00E+00	5.98E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-09	0.00E+00	5.36E-09
1719_1										
1719_2										
1719_3										
1719_4	3.17E-03	1.15E-07	1.29E-07	9.79E-07	2.10E-08	0.00E+00	0.00E+00	0.00E+00	2.06E-06	0.00E+00

Table B9: Runs 1717, 1718, & 1719, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1732_0	0.00E+00	0.00E+00	0.00E+00	6.48E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1717_1										
1717_2										
1717_3										
1717_4	0.00E+00	2.60E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1732_0	0.00E+00	0.00E+00	0.00E+00	6.48E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1718_1										
1718_2										
1718_3										
1718_4	0.00E+00	1.87E-06	2.27E-08	6.69E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1733_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1719_1										
1719_2										
1719_3										
1719_4	5.01E-08	1.13E-06	1.81E-08	0.00E+00	1.56E-08	1.87E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B9: Runs 1717, 1718, & 1719, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1732_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1717_1										
1717_2										
1717_3										
1717_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-05
1732_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1718_1										
1718_2										
1718_3										
1718_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1733_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1719_1										
1719_2										
1719_3										
1719_4	0.00E+00	7.43E-09	1.35E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B9: Runs 1717, 1718, & 1719, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1732_0	0.00E+00	1.03E-06	0.00E+00	3.48E-09								
1717_1												
1717_2												
1717_3												
1717_4	0.00E+00	0.00E+00	0.00E+00	1.41E-08								
1732_0	0.00E+00	1.03E-06	0.00E+00	3.48E-09								
1718_1												
1718_2												
1718_3												
1718_4	0.00E+00	3.47E-06	0.00E+00	0.00E+00								
1733_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1719_1												
1719_2												
1719_3												
1719_4	0.00E+00	0.00E+00	1.47E-08	4.44E-09								

Table B9: Runs 1717, 1718, & 1719, fluid analyses (cont.)

B10: Runs 1720, 1721, & 1722

Table B10: Runs 1720, 1721, & 1722, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1733_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	6.31	216.7	21.3
1720_1	0.6M NaCl	HTL319	70	1	70	200	0.00	0.00E+00	<0.5	0.0E+00	5.29	226.3	27.7
1720_2	0.6M NaCl	HTL319	70	1	241	190			<0.5	0.0E+00	5.37	234.2	31
1720_3	0.6M NaCl	HTL319	70	1	530	180			<0.5	0.0E+00	5.2	248.7	24.8
1720_4	0.6M NaCl	HTL319	70	1	674	170.4 (156)	0.00	0.00E+00	<0.5	0.0E+00	5.12	266.3	25.9
1733_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	6.31	216.7	21.3
1721_1	0.6M NaCl	HTLMix	70	1	70	200	40.4	6.62E-04	<0.5	0.0E+00	7.46	186.6	25.3
1721_2	0.6M NaCl	HTLMix	70	1	239	190			<0.5	0.0E+00	7.55	202.9	28.1
1721_3	0.6M NaCl	HTLMix	70	1	530	180			<0.5	0.0E+00	7.38	225.5	24.8
1721_4	0.6M NaCl	HTLMix	70	1	674	171.1 (154)	85.9	1.41E-03	1.81962504	3.3E-05	7.77	229.6	25.4
1734_0	0.001M EDTA	N/A	N/A	N/A			0.0	0.00E+00	3.7	6.7E-05	5.02	207.6	20.1
1722_1	0.001M EDTA	HTL315	70	1	70	200	0.00	0.00E+00	3.326	6.0E-05	5.22	178.2	24.7
1722_2	0.001M EDTA	HTL315	70	1	239	190			9.382	1.7E-04	3.6	287	25.7
1722_3	0.001M EDTA	HTL315	70	1	530	180			25.058	4.5E-04	3.21	299	24.6
1722_4	0.001M EDTA	HTL315	70	1	674	170 (158)	0.00	0.00E+00	27.651	5.0E-04	3.11	313.9	24.6

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1733_0	3.69E-06	0.00E+00	6.10E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.08E-06	0.00E+00
1720_1										
1720_2										
1720_3										
1720_4	5.38E-05	0.00E+00	6.13E-01	0.00E+00	0.00E+00	2.44E-04	0.00E+00	0.00E+00	9.33E-05	0.00E+00
1733_0	3.69E-06	0.00E+00	6.10E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.08E-06	0.00E+00
1721_1										
1721_2										
1721_3										
1721_4	4.51E-05	0.00E+00	6.06E-01	9.26E-04	3.25E-06	1.43E-04	0.00E+00	0.00E+00	1.62E-04	1.18E-03
1734_0	0.00E+00	0.00E+00	1.75E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1722_1										
1722_2										
1722_3										
1722_4	3.71E-05	0.00E+00	2.17E-03	0.00E+00	1.10E-04	5.24E-04	0.00E+00	4.41E-03	0.00E+00	0.00E+00

Table B10: Runs 1720, 1721, & 1722, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1733_0	0.00E+00	0.00E+00	1.54E-08	0.00E+00	0.00E+00	0.00E+00	3.93E-08	4.24E-07	5.05E-07	0.00E+00
1720_1										
1720_2										
1720_3										
1720_4	0.00E+00	0.00E+00	0.00E+00	6.94E-06	0.00E+00	6.00E-08	0.00E+00	3.52E-07	0.00E+00	0.00E+00
1733_0	0.00E+00	0.00E+00	1.54E-08	0.00E+00	0.00E+00	0.00E+00	3.93E-08	4.24E-07	5.05E-07	0.00E+00
1721_1										
1721_2										
1721_3										
1721_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.16E-07	0.00E+00	0.00E+00
1734_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.58E-07	0.00E+00	0.00E+00
1722_1										
1722_2										
1722_3										
1722_4	0.00E+00	0.00E+00	1.25E-07	9.66E-06	5.64E-04	1.61E-05	3.39E-07	1.61E-04	2.20E-05	1.69E-07

Table B10: Runs 1720, 1721, & 1722, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1733_0	0.00E+00	5.98E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-09	0.00E+00	5.36E-09
1720_1										
1720_2										
1720_3										
1720_4	1.33E-06	4.21E-08	7.28E-07	8.29E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.12E-07	0.00E+00
1733_0	0.00E+00	5.98E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-09	0.00E+00	5.36E-09
1721_1										
1721_2										
1721_3										
1721_4	5.44E-07	0.00E+00	2.69E-07	1.58E-06	0.00E+00	0.00E+00	0.00E+00	3.58E-08	0.00E+00	3.65E-07
1734_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1722_1										
1722_2										
1722_3										
1722_4	2.64E-04	7.97E-08	3.51E-08	5.78E-07	2.96E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B10: Runs 1720, 1721, & 1722, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1733_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1720_1										
1720_2										
1720_3										
1720_4	3.90E-08	1.97E-08	5.87E-08	0.00E+00	7.07E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1733_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1721_1										
1721_2										
1721_3										
1721_4	3.90E-08	1.06E-05	9.62E-08	8.51E-07	5.98E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1734_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1722_1										
1722_2										
1722_3										
1722_4	3.94E-08	1.15E-06	0.00E+00	0.00E+00	1.13E-08	1.43E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B10: Runs 1720, 1721, & 1722, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1733_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1720_1										
1720_2										
1720_3										
1720_4	0.00E+00	5.52E-09	7.81E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.61E-06
1733_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1721_1										
1721_2										
1721_3										
1721_4	5.05E-09	5.36E-09	8.63E-09	0.00E+00	0.00E+00	4.96E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1734_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1722_1										
1722_2										
1722_3										
1722_4	0.00E+00	6.24E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.76E-09	0.00E+00	0.00E+00	0.00E+00

Table B10: Runs 1720, 1721, & 1722, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1733_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1720_1												
1720_2												
1720_3												
1720_4	8.32E-09	0.00E+00	1.18E-08	4.95E-09								
1733_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1721_1												
1721_2												
1721_3												
1721_4	8.46E-09	1.05E-05	1.01E-08	3.56E-09								
1734_0	0.00E+00	7.52E-07	0.00E+00	0.00E+00								
1722_1												
1722_2												
1722_3												
1722_4	0.00E+00	0.00E+00	8.52E-09	4.88E-09								

Table B10: Runs 1720, 1721, & 1722, fluid analyses (cont.)

B11: Runs 1723, 1724, & 1725

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO ₃	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1734_0	0.001M EDTA	N/A	N/A	N/A			0.0	0.00E+00	3.7	6.7E-05	5.02	207.6	20.1
1723_1	0.001M EDTA	HTL319	70	1	71	200	0.00	0.00E+00	2.4	4.4E-05	5.77	162.9	32.2
1723_2	0.001M EDTA	HTL319	70	1	239	190			1.4	2.5E-05	5.65	208.4	33.3
1723_3	0.001M EDTA	HTL319	70	1	530	180			0.4	7.3E-06	5.86	228	24.2
1723_4	0.001M EDTA	HTL319	70	1	674	170.3 (158)	0.00	0.00E+00	0.6	1.1E-05	5.95	239.8	24.2
1734_0	0.001M EDTA	N/A	N/A	N/A			0.0	0.00E+00	3.7	6.7E-05	5.02	207.6	20.1
1724_1	0.001M EDTA	HTLMix	70	1	71	200	0.00100629	1.65E-08	0.121	2.2E-06	7.24	142.2	28.9
1724_2	0.001M EDTA	HTLMix	70	1	239	190			0.094	1.7E-06	6.8	169.6	31.7
1724_3	0.001M EDTA	HTLMix	70	1	530	180			1.886	3.4E-05	5.94	207	24
1724_4	0.001M EDTA	HTLMix	70	1	674	171 (160)	0	0.00E+00	<0.5	0.0E+00	6.15	213.8	24.3
1735_0	0.1M EDTA	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	4.35	212.7	20
1725_1	0.1M EDTA	HTL315	70	1	71	200	492.0	8.06E-03	11.586	2.1E-04	5.13	173.4	25.6
1725_2	0.1M EDTA	HTL315	70	1	239	190			8.551	1.5E-04	5.39	154.7	28
1725_3	0.1M EDTA	HTL315	70	1	530	180			10.815	1.9E-04	5.65	161.9	24.4
1725_4	0.1M EDTA	HTL315	70	1	674	171.1 (160)	1317.6	2.16E-02	10.621	1.9E-04	5.67	158.9	24.3

Table B11: Runs 1723, 1724, & 1725, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1734_0	0.00E+00	0.00E+00	1.75E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1723_1										
1723_2										
1723_3										
1723_4	0.00E+00	0.00E+00	2.12E-03	0.00E+00	5.14E-05	2.80E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1734_0	0.00E+00	0.00E+00	1.75E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1724_1										
1724_2										
1724_3										
1724_4	0.00E+00	0.00E+00	2.14E-03	9.62E-04	0.00E+00	1.99E-04	0.00E+00	5.04E-03	1.22E-04	1.99E-03
1735_0	0.00E+00	0.00E+00	1.64E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1725_1										
1725_2										
1725_3										
1725_4	2.05E-04	4.30E-07	1.64E-01	1.04E-03	5.96E-03	6.70E-03	9.20E-05	0.00E+00	0.00E+00	0.00E+00

Table B11: Runs 1723, 1724, & 1725, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1734_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.58E-07	0.00E+00	0.00E+00
1723_1										
1723_2										
1723_3										
1723_4	0.00E+00	0.00E+00	3.73E-07	5.03E-05	4.59E-04	4.44E-08	0.00E+00	2.66E-06	0.00E+00	0.00E+00
1734_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.58E-07	0.00E+00	0.00E+00
1724_1										
1724_2										
1724_3										
1724_4	0.00E+00	0.00E+00	7.87E-08	5.39E-05	0.00E+00	5.22E-07	1.18E-06	8.07E-07	7.90E-05	0.00E+00
1735_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.26E-07	0.00E+00	0.00E+00
1725_1										
1725_2										
1725_3										
1725_4	9.44E-06	1.03E-06	3.02E-06	2.08E-04	1.47E-02	3.55E-05	1.24E-06	3.03E-04	3.18E-05	1.57E-06

Table B11: Runs 1723, 1724, & 1725, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1734_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1723_1										
1723_2										
1723_3										
1723_4	6.92E-06	0.00E+00	1.03E-07	0.00E+00	3.86E-08	7.49E-08	6.89E-08	5.99E-08	0.00E+00	0.00E+00
1734_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1724_1										
1724_2										
1724_3										
1724_4	0.00E+00	0.00E+00	1.98E-07	9.36E-07	2.64E-07	0.00E+00	0.00E+00	0.00E+00	1.12E-07	3.53E-07
1735_0	0.00E+00	0.00E+00	0.00E+00	6.61E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1725_1										
1725_2										
1725_3										
1725_4	4.41E-03	6.45E-08	6.06E-08	8.02E-07	7.91E-07	1.90E-07	2.29E-08	7.28E-08	0.00E+00	0.00E+00

Table B11: Runs 1723, 1724, & 1725, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1734_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1723_1										
1723_2										
1723_3										
1723_4	8.25E-08	6.04E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1734_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1724_1										
1724_2										
1724_3										
1724_4	3.39E-08	1.99E-07	3.45E-08	5.95E-07	5.95E-08	6.42E-08	1.28E-08	0.00E+00	1.95E-08	1.58E-08
1735_0	0.00E+00	0.00E+00	0.00E+00	5.91E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1725_1										
1725_2										
1725_3										
1725_4	4.09E-07	8.97E-06	1.71E-08	2.96E-06	2.68E-07	5.64E-07	7.03E-08	2.76E-07	9.00E-08	1.35E-08

Table B11: Runs 1723, 1724, & 1725, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1734_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1723_1										
1723_2										
1723_3										
1723_4	5.07E-09	7.83E-09	1.45E-08	5.62E-09	6.51E-09	5.03E-09	7.59E-09	0.00E+00	0.00E+00	1.07E-04
1734_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1724_1										
1724_2										
1724_3										
1724_4	9.06E-09	4.56E-08	3.67E-08	8.08E-09	1.30E-08	0.00E+00	9.37E-09	0.00E+00	0.00E+00	1.64E-06
1735_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1725_1										
1725_2										
1725_3										
1725_4	1.55E-08	9.52E-08	7.98E-08	1.38E-08	2.66E-08	6.01E-09	2.11E-08	5.51E-09	0.00E+00	3.59E-05

Table B11: Runs 1723, 1724, & 1725, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1734_0	0.00E+00	7.52E-07	0.00E+00	0.00E+00								
1723_1												
1723_2												
1723_3												
1723_4	0.00E+00	0.00E+00	7.37E-09	3.01E-08								
1734_0	0.00E+00	7.52E-07	0.00E+00	0.00E+00								
1724_1												
1724_2												
1724_3												
1724_4	1.62E-07	8.76E-04	7.69E-09	0.00E+00								
1735_0	0.00E+00	6.31E-07	0.00E+00	0.00E+00								
1725_1												
1725_2												
1725_3												
1725_4	0.00E+00	1.32E-06	1.23E-07	8.72E-08								

Table B11: Runs 1723, 1724, & 1725, fluid analyses (cont.)

B12: Runs 1726, 1727, & 1728

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO ₃	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1735_0	0.1M EDTA	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	4.35	212.7	20
1726_1	0.1M EDTA	HTL319	70	1	71	200	0.0	0.00E+00	23.621	4.2E-04	4.59	193.3	24.5
1726_2	0.1M EDTA	HTL319	70	1	239	190			23.242	4.2E-04	4.77	171.4	27.2
1726_3	0.1M EDTA	HTL319	70	1	530	180			3.198	5.7E-05	5.08	165	24.4
1726_4	0.1M EDTA	HTL319	70	1	674	169.8 (158)	490.8	8.04E-03	4.768	8.5E-05	5.16	159.3	24.3
1735_0	0.1M EDTA	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	4.35	212.7	20
1727_1	0.1M EDTA	HTLMix	70	1	71	200	525.2	8.61E-03	5.717	1.0E-04	5.03	182.5	23.6
1727_2	0.1M EDTA	HTLMix	70	1	239	190			4.417	7.9E-05	5.33	173.8	25.6
1727_3	0.1M EDTA	HTLMix	70	1	530	180			2.989	5.4E-05	5.45	166.9	24
1727_4	0.1M EDTA	HTLMix	70	1	674	170.2 (158)	901.2	1.48E-02	2.587	4.6E-05	5.46	159.1	23.5
1732_0	Tap Water	N/A	N/A	N/A			546.4	8.95E-03	<0.5	0.0E+00	7.34	198	20
1728_1	Tap	HTL315	70	1	72	200	75.5	1.24E-03	<0.5	0.0E+00	7.37	154.4	33.7
1728_2	Tap	HTL315	70	1	240	190			<0.5	0.0E+00	7.37	139.2	38.6
1728_3	Tap	HTL315	70	1	530	150			0.017	3.0E-07	6.92	144.2	23.3
1728_4	Tap	HTL315	70	1	674	140.9 (128)	0.0	0.00E+00	0.752	1.3E-05	6.4	143.6	23.2

Table B12: Runs 1726, 1727, & 1728, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1735_0	0.00E+00	0.00E+00	1.64E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1726_1										
1726_2										
1726_3										
1726_4	0.00E+00	0.00E+00	1.68E-01	0.00E+00	1.51E-04	3.95E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1735_0	0.00E+00	0.00E+00	1.64E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1727_1										
1727_2										
1727_3										
1727_4	4.33E-05	2.87E-07	1.67E-01	2.63E-03	1.19E-03	1.62E-03	8.87E-05	0.00E+00	0.00E+00	2.69E-03
1732_0	0.00E+00	0.00E+00	1.91E-03	5.26E-04	0.00E+00	1.00E-04	0.00E+00	0.00E+00	1.49E-04	1.87E-03
1728_1										
1728_2										
1728_3										
1728_4	0.00E+00	0.00E+00	2.29E-03	4.49E-04	0.00E+00	4.08E-04	0.00E+00	0.00E+00	1.49E-04	2.17E-03

Table B12: Runs 1726, 1727, & 1728, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1735_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.26E-07	0.00E+00	0.00E+00
1726_1										
1726_2										
1726_3										
1726_4	0.00E+00	0.00E+00	1.43E-06	8.42E-04	3.05E-03	1.48E-07	1.90E-07	9.97E-06	1.50E-05	0.00E+00
1735_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.26E-07	0.00E+00	0.00E+00
1727_1										
1727_2										
1727_3										
1727_4	2.44E-06	8.62E-07	2.35E-06	1.44E-04	1.98E-03	1.40E-06	3.41E-06	1.75E-05	5.05E-05	2.78E-07
1732_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.97E-06	0.00E+00	0.00E+00
1728_1										
1728_2										
1728_3										
1728_4	0.00E+00	0.00E+00	0.00E+00	9.33E-07	0.00E+00	7.16E-08	0.00E+00	1.08E-06	0.00E+00	0.00E+00

Table B12: Runs 1726, 1727, & 1728, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1735_0	0.00E+00	0.00E+00	0.00E+00	6.61E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1726_1										
1726_2										
1726_3										
1726_4	1.64E-06	0.00E+00	3.68E-07	6.45E-07	1.16E-07	2.81E-07	2.65E-07	6.83E-08	0.00E+00	0.00E+00
1735_0	0.00E+00	0.00E+00	0.00E+00	6.61E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1727_1										
1727_2										
1727_3										
1727_4	5.76E-06	6.69E-08	2.53E-07	1.82E-06	2.17E-06	3.01E-07	0.00E+00	0.00E+00	0.00E+00	2.43E-07
1732_0	0.00E+00	5.09E-08	4.83E-08	2.43E-06	0.00E+00	0.00E+00	0.00E+00	5.11E-08	1.47E-07	0.00E+00
1728_1										
1728_2										
1728_3										
1728_4	2.33E-05	4.91E-08	7.14E-08	2.33E-06	0.00E+00	0.00E+00	0.00E+00	6.12E-08	0.00E+00	0.00E+00

Table B12: Runs 1726, 1727, & 1728, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1735_0	0.00E+00	0.00E+00	0.00E+00	5.91E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1726_1										
1726_2										
1726_3										
1726_4	7.08E-06	2.41E-07	5.11E-08	3.03E-06	1.59E-08	3.08E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1735_0	0.00E+00	0.00E+00	0.00E+00	5.91E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1727_1										
1727_2										
1727_3										
1727_4	5.72E-08	6.00E-05	1.27E-07	3.99E-06	7.49E-06	1.30E-05	1.47E-06	6.10E-06	1.28E-06	5.40E-07
1732_0	0.00E+00	0.00E+00	0.00E+00	6.48E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1728_1										
1728_2										
1728_3										
1728_4	3.16E-08	2.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B12: Runs 1726, 1727, & 1728, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1735_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1726_1										
1726_2										
1726_3										
1726_4	0.00E+00	1.18E-08	2.13E-08	5.77E-09	1.55E-08	5.41E-09	2.38E-08	6.40E-09	1.44E-08	2.20E-04
1735_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1727_1										
1727_2										
1727_3										
1727_4	9.91E-08	1.01E-06	3.48E-07	4.18E-08	7.74E-08	9.78E-09	3.41E-08	6.46E-09	0.00E+00	2.39E-06
1732_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1728_1										
1728_2										
1728_3										
1728_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.31E-07

Table B12: Runs 1726, 1727, & 1728, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1735_0	0.00E+00	6.31E-07	0.00E+00	0.00E+00								
1726_1												
1726_2												
1726_3												
1726_4	0.00E+00	4.24E-07	8.87E-09	6.01E-08								
1735_0	0.00E+00	6.31E-07	0.00E+00	0.00E+00								
1727_1												
1727_2												
1727_3												
1727_4	2.41E-06	1.32E-02	2.15E-08	7.68E-09								
1732_0	0.00E+00	1.03E-06	0.00E+00	3.48E-09								
1728_1												
1728_2												
1728_3												
1728_4	0.00E+00	1.31E-06	6.58E-09	0.00E+00								

Table B12: Runs 1726, 1727, & 1728, fluid analyses (cont.)

B13: Runs 1729, 1730, & 1763

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1733_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	6.31	216.7	21.3
1729_1	0.6M NaCl	HTL319	70	1	72	200	0.00	0.00E+00	<0.5	0.0E+00	5.73	211.6	29.8
1729_2	0.6M NaCl	HTL319	70	1	240	190			0.076	1.4E-06	5.84	187.3	33.3
1729_3	0.6M NaCl	HTL319	70	1	530	180			<0.5	0.0E+00	5.57	193.8	22.8
1729_4	0.6M NaCl	HTL319	70	1	674	171	0.00	0.00E+00			5.44	198.7	23.3
1729_4D	0.6M NaCl	HTL319	70	1	674	159.8 (132)	0.00	0.00E+00			5.44	193.4	23.3
1735_0	0.1M EDTA	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	4.35	212.7	20
1730_1	0.1M EDTA	HTLMix	70	1	72	200	8.71	1.43E-04	7.8	1.4E-04	5.02	186.7	27.7
1730_2	0.1M EDTA	HTLMix	70	1	240	190			4.8	8.5E-05	5.21	157.6	30.9
1730_3	0.1M EDTA	HTLMix	70	1	531	181			1.9	3.4E-05	5.39	180	22.8
1730_4	0.1M EDTA	HTLMix	70	1	674	171	15.18	2.49E-04			5.41	171.6	23.1
1730_4D	0.1M EDTA	HTLMix	70	1	674	160.1 (148)	15.63	2.56E-04			5.41	165.4	22.8
1763_0	Coke	N/A	N/A	N/A	0		0.00	0.00E+00	0.0	0.0E+00	2.41	217.4	19.9
1763_1	Coke	HTLMix	150	200	117.83	350	0.00	0.00E+00	60.5	1.1E-03	2.49	174.8	20.9
1763_2	Coke	HTLMix	150	200	550.42	337							
1763_3	Coke	HTLMix	150	200	982.50	333 (320)			99.5	1.8E-03	2.91	119.5	29.4

Table B13: Runs 1729, 1730, & 1763, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1733_0	3.69E-06	0.00E+00	6.10E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.08E-06	0.00E+00
1729_1										
1729_2										
1729_3										
1729_4	3.52E-05	0.00E+00	6.10E-01	0.00E+00	0.00E+00	2.22E-04	0.00E+00	0.00E+00	8.86E-05	0.00E+00
1729_4D	0.00E+00	0.00E+00	6.22E-01	0.00E+00	0.00E+00	2.30E-04	0.00E+00	0.00E+00	8.95E-05	0.00E+00
1735_0	0.00E+00	0.00E+00	1.64E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1730_1										
1730_2										
1730_3										
1730_4	3.86E-05	3.54E-07	1.63E-01	2.71E-03	1.27E-03	1.72E-03	8.69E-05	0.00E+00	9.99E-05	2.60E-03
1730_4D	3.73E-05	4.21E-07	1.74E-01	2.93E-03	1.35E-03	1.77E-03	0.00E+00	0.00E+00	8.36E-05	2.71E-03
1763_0	0.00E+00	0.00E+00	1.39E-03	3.08E-04	2.08E-06	2.93E-04	6.02E-03	1.75E-03	1.31E-03	5.99E-04
1763_1	1.33E-05	1.95E-07	1.91E-03	2.35E-03	4.30E-06	1.23E-03	5.78E-03	1.62E-03	1.44E-03	3.16E-03
1763_2	3.00E-05	1.33E-07	2.61E-03	3.02E-03	7.86E-06	2.88E-03	4.66E-03	1.87E-03	1.56E-03	3.34E-03
1763_3	3.80E-05	1.15E-07	1.57E-03	3.19E-03	5.49E-06	3.86E-03	3.58E-03	1.37E-03	1.80E-03	3.33E-03

Table B13: Runs 1729, 1730, & 1763, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1733_0	0.00E+00	0.00E+00	1.54E-08	0.00E+00	0.00E+00	0.00E+00	3.93E-08	4.24E-07	5.05E-07	0.00E+00
1729_1										
1729_2										
1729_3										
1729_4	0.00E+00	0.00E+00	0.00E+00	5.32E-06	0.00E+00	0.00E+00	0.00E+00	1.81E-07	0.00E+00	0.00E+00
1729_4D	0.00E+00	0.00E+00	0.00E+00	5.66E-06	0.00E+00	0.00E+00	0.00E+00	2.06E-07	0.00E+00	0.00E+00
1735_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.26E-07	0.00E+00	0.00E+00
1730_1										
1730_2										
1730_3										
1730_4	1.97E-06	9.19E-07	2.79E-06	1.44E-04	2.08E-03	1.52E-06	3.84E-06	1.72E-05	6.65E-05	3.06E-07
1730_4D	3.08E-06	9.63E-07	2.91E-06	1.53E-04	2.23E-03	1.66E-06	3.79E-06	1.77E-05	7.17E-05	3.02E-07
1763_0	1.34E-07	7.85E-09	3.85E-08	5.10E-08	7.16E-07	0.00E+00	4.77E-08	1.89E-07	9.42E-06	0.00E+00
1763_1	1.34E-07	7.85E-09	1.27E-06	1.40E-04	1.21E-03	4.98E-07	3.78E-06	1.01E-06	4.14E-05	0.00E+00
1763_2	8.36E-08	0.00E+00	9.08E-07	1.48E-04	1.77E-03	5.61E-07	3.35E-06	1.89E-07	8.50E-05	0.00E+00
1763_3	3.34E-08	0.00E+00	8.92E-07	1.55E-04	1.92E-03	5.88E-07	3.62E-06	1.89E-07	3.19E-05	0.00E+00

Table B13: Runs 1729, 1730, & 1763, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1733_0	0.00E+00	5.98E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-09	0.00E+00	5.36E-09
1729_1										
1729_2										
1729_3										
1729_4	7.44E-07	0.00E+00	7.22E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.03E-08	0.00E+00	0.00E+00
1729_4D	7.02E-07	0.00E+00	7.23E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.13E-08	0.00E+00	0.00E+00
1735_0	0.00E+00	0.00E+00	0.00E+00	6.61E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1730_1										
1730_2										
1730_3										
1730_4	6.39E-06	0.00E+00	2.44E-07	1.61E-06	2.22E-06	3.24E-07	0.00E+00	3.39E-08	0.00E+00	2.30E-07
1730_4D	6.83E-06	5.65E-08	2.67E-07	1.64E-06	2.47E-06	3.42E-07	0.00E+00	0.00E+00	0.00E+00	2.46E-07
1763_0	2.14E-08	5.07E-09	8.85E-08	3.01E-06	9.00E-10	8.33E-09	0.00E+00	1.33E-08	0.00E+00	2.49E-09
1763_1	8.82E-06	0.00E+00	2.98E-07	4.27E-06	3.96E-08	0.00E+00	0.00E+00	3.75E-09	0.00E+00	2.14E-08
1763_2	9.68E-06	0.00E+00	6.15E-07	4.81E-06	1.39E-08	0.00E+00	0.00E+00	5.84E-09	0.00E+00	2.53E-08
1763_3	9.50E-06	0.00E+00	1.41E-06	4.68E-06	4.95E-09	0.00E+00	0.00E+00	2.50E-09	0.00E+00	2.35E-08

Table B13: Runs 1729, 1730, & 1763, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1733_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1729_1										
1729_2										
1729_3										
1729_4	0.00E+00	2.66E-08	5.16E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1729_4D	0.00E+00	2.12E-08	5.56E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1735_0	0.00E+00	0.00E+00	0.00E+00	5.91E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1730_1										
1730_2										
1730_3										
1730_4	5.25E-08	3.36E-05	1.22E-07	3.68E-06	7.79E-06	1.35E-05	1.54E-06	6.14E-06	1.34E-06	5.71E-07
1730_4D	5.49E-08	3.71E-05	1.36E-07	3.96E-06	8.55E-06	1.48E-05	1.68E-06	6.90E-06	1.42E-06	6.32E-07
1763_0	4.04E-09	8.21E-09	0.00E+00	1.01E-05	3.46E-10	0.00E+00	3.41E-10	1.94E-09	0.00E+00	0.00E+00
1763_1	0.00E+00	3.29E-09	1.18E-07	2.82E-05	1.09E-08	1.26E-08	1.39E-09	9.71E-09	2.39E-09	2.21E-09
1763_2	0.00E+00	1.22E-08	8.29E-08	4.23E-05	6.94E-09	8.56E-09	1.22E-09	8.04E-09	1.06E-09	8.42E-10
1763_3	0.00E+00	7.23E-09	1.92E-07	1.51E-05	3.46E-09	3.71E-09	3.97E-10	2.22E-09	0.00E+00	3.16E-10

Table B13: Runs 1729, 1730, & 1763, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1733_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1729_1										
1729_2										
1729_3										
1729_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.53E-06
1729_4D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.47E-06
1735_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1730_1										
1730_2										
1730_3										
1730_4	1.04E-07	1.04E-06	3.35E-07	4.19E-08	7.88E-08	6.96E-09	3.88E-08	6.02E-09	0.00E+00	1.39E-06
1730_4D	1.10E-07	1.16E-06	3.72E-07	4.66E-08	9.16E-08	8.95E-09	4.56E-08	5.38E-09	0.00E+00	1.27E-06
1763_0	0.00E+00	1.27E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.85E-10	0.00E+00	0.00E+00	0.00E+00
1763_1	4.78E-10	3.54E-09	2.46E-09	4.85E-10	1.27E-09	1.89E-10	1.04E-09	1.83E-10	0.00E+00	0.00E+00
1763_2	1.76E-10	1.50E-09	8.86E-10	2.18E-10	4.54E-10	7.10E-11	8.09E-10	2.06E-10	0.00E+00	0.00E+00
1763_3	0.00E+00	5.09E-10	3.94E-10	0.00E+00	2.15E-10	0.00E+00	3.00E-10	6.86E-11	0.00E+00	0.00E+00

Table B13: Runs 1729, 1730, & 1763, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1733_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1729_1												
1729_2												
1729_3												
1729_4	0.00E+00	9.89E-07	5.28E-09	3.62E-09								
1729_4D	0.00E+00	6.72E-07	0.00E+00	0.00E+00								
1735_0	0.00E+00	6.31E-07	0.00E+00	0.00E+00								
1730_1												
1730_2												
1730_3												
1730_4	1.26E-06	6.95E-03	1.52E-08	5.78E-09								
1730_4D	1.40E-06	7.67E-03	1.43E-08	6.36E-09								
1763_0	1.96E-10	0.00E+00	0.00E+00	1.53E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.52E-03	0.00E+00
1763_1	7.63E-09	2.79E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.97E-03	0.00E+00
1763_2	9.59E-09	3.90E-05	0.00E+00	1.01E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.05E-03	0.00E+00
1763_3	9.39E-09	2.67E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.24E-03	0.00E+00

Table B13: Runs 1729, 1730, & 1763, fluid analyses (cont.)

B14: Runs 1764, 1765, & 1766

Table B14: Runs 1764, 1765, & 1766, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1764_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	6.31	216.7	21.3
1764_1	0.6M NaCl	HTLMix	150	200	119	350	107.2	1.76E-03	<0.5	0.0E+00	7.21	-7.5	35
1764_2	0.6M NaCl	HTLMix	150	200	527	338	145.2	2.38E-03	<0.5	0.0E+00	7.09	223.8	33.7
1764_3	0.6M NaCl	HTLMix	150	200	984	325.75 (234)	165.7	2.72E-03	<0.5	0.0E+00	7.17	75.7	41.5
1765_0	0.1M Acetic	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	6.31	216.7	21.3
1765_1	0.1M Acetic	HTLMix	150	200	119	350	580.4	9.51E-03	1.6	2.9E-05	3.73	53.7	27.8
1765_2	0.1M Acetic	HTLMix	150	200	528	338	637.2	1.04E-02	7.6	1.4E-04	3.65	266.1	25.5
1765_3	0.1M Acetic	HTLMix	150	200	987	327.2 (307)	641.6	1.05E-02			3.62	237.1	37.5
1766_0	0.1M EDTA	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	4.35	212.7	20
1766_1	0.1M EDTA	HTLMix	150	200	118	350	858.4	1.41E-02	20.7	3.7E-04	5.43	-457.6	29.6
1766_2	0.1M EDTA	HTLMix	150	200	513	339			<0.5	0.0E+00			
1766_3	0.1M EDTA	HTLMix	150	200	987	337 (327)	813.6	1.33E-02	64.0	1.1E-03	6.37	-144.6	37.9

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1764_0	0.00E+00	0.00E+00	6.02E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.23E-05	0.00E+00
1764_1	1.33E-05	0.00E+00	6.51E-01	7.74E-05	4.00E-06	2.75E-03	0.00E+00	0.00E+00	1.95E-04	1.15E-03
1764_2	2.31E-05	0.00E+00	6.41E-01	8.89E-05	0.00E+00	3.34E-03	3.87E-06	0.00E+00	2.03E-04	1.46E-03
1764_3	2.82E-05	0.00E+00	6.45E-01	1.00E-04	0.00E+00	3.47E-03	6.46E-06	0.00E+00	2.28E-04	1.67E-03
1765_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1765_1	5.19E-06	2.84E-07	6.96E-04	2.08E-03	1.08E-05	1.31E-03	0.00E+00	0.00E+00	1.17E-04	2.72E-03
1765_2	9.80E-06	3.02E-07	6.96E-04	2.13E-03	8.45E-06	2.40E-03	3.87E-06	0.00E+00	1.37E-04	2.82E-03
1765_3	1.33E-05	3.11E-07	5.22E-04	2.06E-03	1.70E-05	2.69E-03	6.46E-06	0.00E+00	1.52E-04	2.79E-03
1766_0	0.00E+00	0.00E+00	1.59E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.02E-05	8.98E-05
1766_1	3.28E-05	9.10E-07	1.64E-01	2.97E-03	4.76E-03	4.88E-03	6.20E-05	2.00E-03	1.27E-03	2.71E-03
1766_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1766_3	3.52E-05	7.55E-07	1.55E-01	2.80E-03	5.08E-03	4.68E-03	4.13E-05	1.37E-03	1.32E-03	2.71E-03

Table B14: Runs 1764, 1765, & 1766, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1764_0	6.69E-08	0.00E+00	0.00E+00	2.18E-08	2.15E-07	0.00E+00	0.00E+00	4.41E-07	5.51E-07	0.00E+00
1764_1	0.00E+00	0.00E+00	3.08E-08	1.08E-05	5.73E-07	2.24E-08	7.91E-07	1.01E-06	7.34E-06	0.00E+00
1764_2	0.00E+00	7.85E-09	3.08E-08	1.42E-05	2.15E-07	5.43E-09	1.64E-07	7.55E-07	8.14E-06	0.00E+00
1764_3	0.00E+00	1.57E-08	3.85E-08	1.75E-05	1.43E-07	0.00E+00	6.13E-08	4.41E-07	5.75E-06	0.00E+00
1765_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.15E-07	0.00E+00	0.00E+00	0.00E+00	4.89E-07	0.00E+00
1765_1	0.00E+00	0.00E+00	2.15E-07	1.44E-04	5.74E-05	4.87E-07	2.86E-06	5.67E-07	8.99E-05	1.09E-07
1765_2	0.00E+00	0.00E+00	5.00E-07	1.40E-04	1.64E-04	5.00E-07	3.64E-06	3.78E-07	1.02E-04	8.61E-08
1765_3	0.00E+00	0.00E+00	5.39E-08	1.27E-04	2.34E-04	4.49E-07	1.21E-06	1.89E-07	9.57E-05	5.74E-08
1766_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.30E-07	0.00E+00	0.00E+00	1.26E-07	3.67E-07	0.00E+00
1766_1	4.62E-03	3.82E-06	1.35E-05	1.68E-04	2.59E-03	6.87E-07	8.78E-06	2.52E-07	5.22E-05	6.71E-07
1766_2	2.01E-07	0.00E+00	0.00E+00	0.00E+00	2.15E-07	0.00E+00	1.36E-08	2.52E-07	6.73E-07	0.00E+00
1766_3	2.52E-06	3.90E-06	1.10E-05	1.34E-04	2.49E-03	6.87E-07	3.01E-06	3.78E-07	4.61E-05	7.06E-07

Table B14: Runs 1764, 1765, & 1766, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1764_0	0.00E+00	0.00E+00	3.28E-09	9.13E-09	0.00E+00	0.00E+00	0.00E+00	2.50E-09	0.00E+00	3.20E-09
1764_1	2.62E-07	0.00E+00	4.92E-07	8.72E-07	0.00E+00	0.00E+00	0.00E+00	2.29E-07	1.15E-08	3.13E-08
1764_2	4.54E-07	0.00E+00	5.34E-07	9.68E-07	0.00E+00	0.00E+00	0.00E+00	2.17E-07	1.15E-08	3.52E-08
1764_3	6.46E-07	0.00E+00	5.44E-07	1.03E-06	0.00E+00	0.00E+00	0.00E+00	6.56E-07	8.53E-09	4.41E-08
1765_0	0.00E+00	0.00E+00	1.40E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.78E-09
1765_1	3.76E-06	3.04E-08	9.73E-08	1.39E-06	1.60E-06	0.00E+00	0.00E+00	2.62E-07	0.00E+00	2.07E-07
1765_2	5.52E-06	3.04E-08	1.10E-07	1.57E-06	1.58E-06	0.00E+00	0.00E+00	1.00E-07	0.00E+00	2.26E-07
1765_3	6.17E-06	3.04E-08	1.73E-07	1.62E-06	1.46E-06	0.00E+00	0.00E+00	1.08E-08	0.00E+00	1.99E-07
1766_0	1.07E-08	0.00E+00	1.40E-09	5.11E-07	0.00E+00	0.00E+00	0.00E+00	2.50E-09	0.00E+00	0.00E+00
1766_1	1.71E-06	6.08E-08	3.79E-06	3.12E-06	2.35E-06	1.20E-06	6.85E-08	4.28E-07	2.60E-09	1.20E-07
1766_2	1.60E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1766_3	1.37E-06	6.08E-08	4.01E-06	3.40E-06	2.35E-06	1.26E-06	0.00E+00	6.17E-08	3.71E-09	1.12E-07

Table B14: Runs 1764, 1765, & 1766, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1764_0	2.02E-09	9.86E-10	3.01E-10	8.74E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E-10
1764_1	1.68E-09	2.04E-06	2.31E-07	1.66E-05	6.62E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1764_2	0.00E+00	2.71E-06	2.44E-07	1.35E-05	4.90E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E-10
1764_3	1.68E-09	1.14E-06	2.36E-07	1.73E-05	2.02E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.11E-10
1765_0	1.68E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1765_1	2.02E-09	8.03E-07	1.39E-08	1.61E-05	4.87E-06	8.29E-06	9.93E-07	4.23E-06	9.47E-07	3.97E-07
1765_2	0.00E+00	2.41E-06	1.23E-08	1.61E-05	3.26E-06	5.67E-06	7.29E-07	3.32E-06	8.25E-07	3.64E-07
1765_3	1.01E-09	5.39E-06	1.98E-08	1.57E-05	1.78E-06	3.32E-06	4.63E-07	2.30E-06	6.46E-07	2.86E-07
1766_0	2.70E-09	9.86E-10	0.00E+00	6.12E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1766_1	3.40E-06	7.33E-08	3.69E-07	1.70E-05	7.69E-06	1.30E-05	1.57E-06	6.42E-06	1.31E-06	5.84E-07
1766_2	1.35E-09	6.57E-09	0.00E+00	0.00E+00	2.30E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1766_3	3.13E-06	6.34E-08	3.65E-07	9.50E-06	7.41E-06	1.25E-05	1.49E-06	6.03E-06	1.26E-06	5.47E-07

Table B14: Runs 1764, 1765, & 1766, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1764_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-10	0.00E+00	0.00E+00	0.00E+00
1764_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.91E-10	0.00E+00	2.08E-10	6.86E-11	0.00E+00	8.09E-07
1764_2	5.03E-11	0.00E+00	1.97E-10	0.00E+00	1.43E-10	0.00E+00	1.16E-10	6.86E-11	0.00E+00	9.03E-07
1764_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.54E-10	6.86E-11	0.00E+00	8.96E-07
1765_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1765_1	7.15E-08	7.06E-07	2.12E-07	2.80E-08	5.37E-08	4.00E-09	2.32E-08	2.72E-09	0.00E+00	0.00E+00
1765_2	6.55E-08	6.59E-07	2.11E-07	2.75E-08	5.16E-08	3.95E-09	2.37E-08	2.83E-09	0.00E+00	0.00E+00
1765_3	5.72E-08	5.60E-07	1.91E-07	2.46E-08	4.56E-08	3.93E-09	2.23E-08	2.45E-09	0.00E+00	0.00E+00
1766_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1766_1	1.09E-07	1.03E-06	3.55E-07	4.48E-08	9.77E-08	8.62E-09	4.84E-08	6.13E-09	6.63E-10	2.29E-06
1766_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1766_3	1.04E-07	9.86E-07	3.44E-07	4.45E-08	9.88E-08	8.43E-09	4.97E-08	6.54E-09	0.00E+00	4.79E-08

Table B14: Runs 1764, 1765, & 1766, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1764_0	0.00E+00	1.35E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1764_1	8.02E-09	2.20E-05	0.00E+00	0.00E+00	0.00E+00	5.29E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1764_2	9.79E-09	2.80E-05	0.00E+00	0.00E+00	0.00E+00	5.01E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1764_3	4.50E-09	5.05E-06	0.00E+00	0.00E+00	0.00E+00	5.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1765_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1765_1	2.76E-08	1.33E-04	0.00E+00	3.83E-09	1.34E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1765_2	2.23E-08	1.07E-04	0.00E+00	2.29E-09	1.34E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1765_3	1.94E-08	8.93E-05	0.00E+00	3.87E-09	1.34E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1766_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.15E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1766_1	1.06E-06	5.14E-03	5.67E-08	1.87E-08	2.62E-08	0.00E+00	0.00E+00	6.49E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1766_2	0.00E+00	5.79E-08	1.38E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1766_3	1.12E-06	5.45E-03	6.36E-08	1.94E-08	2.44E-08	0.00E+00	0.00E+00	2.30E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B14: Runs 1764, 1765, & 1766, fluid analyses (cont.)

B15: Runs 1751, & 1752

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1731_0	DI Water	N/A	N/A	N/A			0.0	0.00E+00	1.6	0.0	5.98	203.9	20.2
1751_1	DI+CO2	HTL315	100	200	7	350	0.0	0.00E+00	9.3	1.7E-04	5.05	194.5	24.1
1751_2	DI+CO2	HTL315	100	200	55	345	0.0	0.00E+00	3.9	7.1E-05	5.04	126	39.6
1751_3	DI+CO2	HTL315	100	200	125	336			10.4	1.9E-04	5.08	110	33.3
1751_4	DI+CO2	HTL315	100	200	216	328	0.0	0.00E+00	23.1	4.1E-04	5.62	57.7	40
1751_5	DI+CO2	HTL315	100	200	361	318	0.0	0.00E+00	25.8	4.6E-04	5.39	54.7	39.3
1751_6	DI+CO2	HTL315	100	200	623	309	0.0	0.00E+00	28.6	5.1E-04	5.35	90.3	35.4
1751_7	DI+CO2	HTL315	100	200	1013	299	0.0	0.00E+00	31.1	5.6E-04	5.44	21.5	42.1
1751_7D	DI+CO2	HTL315	100	200	1013	280	0.0	0.00E+00	30.6	5.5E-04	5.52	-11	43.6
1731_0	DI Water	N/A	N/A	N/A			0.0	0.00E+00	1.6	0.0	5.98	203.9	20.2
1752_1	DI+CO2	HTL319	100	200	7	350	0.0	0.00E+00	5.2	9.4E-05	4.67	171.8	31.1
1752_2	DI+CO2	HTL319	100	200	55	341	0.0	0.00E+00	3.9	7.0E-05	4.76	146.3	38.4
1752_3	DI+CO2	HTL319	100	200	125	332	0.0	0.00E+00	1.3	2.3E-05	4.85	144.5	36.1
1752_4	DI+CO2	HTL319	100	200	216	324	0.0	0.00E+00	2.0	3.5E-05	5.16	138.2	38.5
1752_5	DI+CO2	HTL319	100	200	361	316	0.0	0.00E+00	3.5	6.3E-05	5.03	171.1	42.2
1752_6	DI+CO2	HTL319	100	200	623	307	0.0	0.00E+00	5.1	9.2E-05	4.79	135.2	43.2
1752_7	DI+CO2	HTL319	100	200	1013	297	0.0	0.00E+00	5.7	1.0E-04	4.94	125.8	45.9
1752_7D	DI+CO2	HTL319	100	200	1013	274	0.0	0.00E+00	5.3	9.6E-05	4.96	119.6	40.6

Table B15: Runs 1751, & 1752, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1751_1										
1751_2										
1751_3										
1751_4										
1751_5										
1751_6										
1751_7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.25E-06	6.24E-04	0.00E+00	0.00E+00	0.00E+00	1.25E-03
1751_7D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.75E-06	6.41E-04	0.00E+00	0.00E+00	0.00E+00	1.20E-03
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1752_1										
1752_2										
1752_3										
1752_4										
1752_5										
1752_6										
1752_7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.06E-06	1.24E-04	0.00E+00	0.00E+00	0.00E+00	1.32E-03
1752_7D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.03E-06	1.27E-04	0.00E+00	0.00E+00	0.00E+00	1.54E-03

Table B15: Runs 1751, & 1752, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1751_1										
1751_2										
1751_3										
1751_4										
1751_5										
1751_6										
1751_7	0.00E+00	0.00E+00	0.00E+00	4.35E-06		6.09E-07	5.66E-07	0.00E+00	1.21E-05	0.00E+00
1751_7D	0.00E+00	0.00E+00	0.00E+00	4.20E-06		6.56E-07	5.20E-07	1.37E-07	1.24E-05	0.00E+00
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1752_1										
1752_2										
1752_3										
1752_4										
1752_5										
1752_6										
1752_7	0.00E+00	0.00E+00	0.00E+00	3.27E-06		0.00E+00	6.66E-07	4.45E-07	7.62E-06	0.00E+00
1752_7D	0.00E+00	0.00E+00	8.21E-08	2.74E-06		0.00E+00	6.77E-07	4.30E-07	6.79E-06	0.00E+00

Table B15: Runs 1751, & 1752, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1751_1										
1751_2										
1751_3										
1751_4										
1751_5										
1751_6										
1751_7	1.76E-04	0.00E+00	4.99E-08	1.27E-06	0.00E+00	0.00E+00	0.00E+00	8.63E-08	0.00E+00	0.00E+00
1751_7D	1.83E-04	0.00E+00	5.55E-08	1.21E-06	0.00E+00	0.00E+00	0.00E+00	9.07E-08	0.00E+00	0.00E+00
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1752_1										
1752_2										
1752_3										
1752_4										
1752_5										
1752_6										
1752_7	0.00E+00	0.00E+00	6.71E-08	1.25E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1752_7D	0.00E+00	0.00E+00	7.66E-08	1.27E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B15: Runs 1751, & 1752, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	1.64E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1751_1										
1751_2										
1751_3										
1751_4										
1751_5										
1751_6										
1751_7	3.09E-08	8.79E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1751_7D	0.00E+00	9.25E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1731_0	0.00E+00	1.64E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1752_1										
1752_2										
1752_3										
1752_4										
1752_5										
1752_6										
1752_7	3.19E-08	0.00E+00	1.43E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1752_7D	0.00E+00	0.00E+00	1.37E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B15: Runs 1751, & 1752, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-07
1751_1										
1751_2										
1751_3										
1751_4										
1751_5										
1751_6										
1751_7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1751_7D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-07
1752_1										
1752_2										
1752_3										
1752_4										
1752_5										
1752_6										
1752_7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1752_7D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B15: Runs 1751, & 1752, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	2.58E-06	0.00E+00	0.00E+00								
1751_1												
1751_2												
1751_3												
1751_4												
1751_5												
1751_6												
1751_7	0.00E+00	5.38E-07	0.00E+00	0.00E+00								
1751_7D	0.00E+00	0.00E+00	7.94E-09	0.00E+00								
1731_0	0.00E+00	2.58E-06	0.00E+00	0.00E+00								
1752_1												
1752_2												
1752_3												
1752_4												
1752_5												
1752_6												
1752_7	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1752_7D	0.00E+00	0.00E+00	0.00E+00	0.00E+00								

Table B15: Runs 1751, & 1752, fluid analyses (cont.)

B16: Runs 1753, & 1754

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO ₃	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1731_0	DI Water	N/A	N/A	N/A			0.0	0.00E+00	1.6	0.0	5.98	203.9	20.2
1753_1	DI+ 20 bar pCO ₂	HTLMix	100	200	7	350	128.2	2.10E-03	8.2	1.5E-04	5.62	131.3	26.9
1753_2	DI+ 20 bar pCO ₂	HTLMix	100	200	55	344	254.7	4.17E-03	1.2	2.1E-05	6.12	82.2	44
1753_3	DI+ 20 bar pCO ₂	HTLMix	100	200	126	335	221.2	3.63E-03	0.3	5.4E-06	6.44	78.5	40.8
1753_4	DI+ 20 bar pCO ₂	HTLMix	100	200	216	325	276.4	4.53E-03	1.1	2.0E-05	6.55	28.5	39.1
1753_5	DI+ 20 bar pCO ₂	HTLMix	100	200	361	315	495.6	8.12E-03	1.8	3.2E-05	6.67	-34.9	43.3
1753_6	DI+ 20 bar pCO ₂	HTLMix	100	200	624	304	180.3	2.96E-03	2.6	4.7E-05	6.56	-67.7	45.4
1753_7	DI+ 20 bar pCO ₂	HTLMix	100	200	1013	292	271.4	4.45E-03	3.9	6.9E-05	6.49	-63	48.2
1753_7D	DI+ 20 bar pCO ₂	HTLMix	100	200	1013	269	298.0	4.88E-03	2.4	4.4E-05	6.46	-66.2	46
1731_0	DI Water	N/A	N/A	N/A			0.0	0.00E+00	1.6	0.0	5.98	203.9	20.2
1754_1	DI+20 bar pCO ₂		100	200	7	350	0.0	0.00E+00	17.9	3.2E-04	4.38	184.6	35.3
1754_2	DI+20 bar pCO ₂		100	200	55	342	0.0	0.00E+00	0.9	1.6E-05	4.54	158.6	41
1754_3	DI+20 bar pCO ₂		100	200	126	334	0.0	0.00E+00	0.2	4.5E-06	4.75	180.5	36.7
1754_4	DI+20 bar pCO ₂		100	200	216	327	0.0	0.00E+00	0.4	7.6E-06	4.87	138.1	36.6
1754_5	DI+20 bar pCO ₂		100	200	361	319	0.0	0.00E+00	<0.5	0.0E+00	4.83	161.3	43.5
1754_6	DI+20 bar pCO ₂		100	200	624	310	0.0	0.00E+00	1.3	2.3E-05	4.69	192.4	44.5
1754_7	DI+20 bar pCO ₂		100	200	1014	301	0.0	0.00E+00	1.1	1.9E-05	4.66	136.2	47.1
1754_7D	DI+20 bar pCO ₂		100	200	1014	277	0.0	0.00E+00	1.6	2.9E-05	4.57	179.3	44.7

Table B16: Runs 1753, & 1754, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1753_1										
1753_2										
1753_3										
1753_4										
1753_5										
1753_6										
1753_7	0.00E+00	0.00E+00	0.00E+00	1.64E-03	0.00E+00	7.29E-04	0.00E+00	0.00E+00	8.99E-05	2.98E-03
1753_7D	0.00E+00	0.00E+00	0.00E+00	1.74E-03	0.00E+00	7.82E-04	0.00E+00	0.00E+00	0.00E+00	3.39E-03
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1754_1										
1754_2										
1754_3										
1754_4										
1754_5										
1754_6										
1754_7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.03E-06	1.16E-04	0.00E+00	0.00E+00	0.00E+00	1.18E-03
1754_7D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.91E-06	1.16E-04	0.00E+00	0.00E+00	0.00E+00	1.78E-03

Table B16: Runs 1753, & 1754, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1753_1										
1753_2										
1753_3										
1753_4										
1753_5										
1753_6										
1753_7	0.00E+00	0.00E+00	0.00E+00	1.08E-04		3.16E-07	9.98E-07	1.15E-07	3.49E-05	0.00E+00
1753_7D	0.00E+00	0.00E+00	0.00E+00	1.17E-04		3.72E-07	9.90E-07	9.10E-08	3.71E-05	0.00E+00
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1754_1										
1754_2										
1754_3										
1754_4										
1754_5										
1754_6										
1754_7	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	7.55E-07	9.34E-07	5.63E-06	0.00E+00
1754_7D	0.00E+00	0.00E+00	0.00E+00	0.00E+00		0.00E+00	7.62E-07	1.03E-06	6.75E-06	0.00E+00

Table B16: Runs 1753, & 1754, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1753_1										
1753_2										
1753_3										
1753_4										
1753_5										
1753_6										
1753_7	5.44E-07	0.00E+00	1.62E-07	2.11E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E-07
1753_7D	4.67E-07	0.00E+00	1.73E-07	2.29E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E-07
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1754_1										
1754_2										
1754_3										
1754_4										
1754_5										
1754_6										
1754_7	0.00E+00	0.00E+00	0.00E+00	1.25E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1754_7D	0.00E+00	0.00E+00	0.00E+00	1.21E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B16: Runs 1753, & 1754, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	1.64E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1753_1										
1753_2										
1753_3										
1753_4										
1753_5										
1753_6										
1753_7	0.00E+00	7.01E-07	8.54E-08	7.73E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1753_7D	0.00E+00	7.63E-07	8.54E-08	8.76E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1731_0	0.00E+00	1.64E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1754_1										
1754_2										
1754_3										
1754_4										
1754_5										
1754_6										
1754_7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.85E-09	0.00E+00	2.32E-08	0.00E+00	0.00E+00	0.00E+00
1754_7D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.51E-09	0.00E+00	2.35E-08	0.00E+00	0.00E+00	0.00E+00

Table B16: Runs 1753, & 1754, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-07
1753_1										
1753_2										
1753_3										
1753_4										
1753_5										
1753_6										
1753_7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1753_7D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1731_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-07
1754_1										
1754_2										
1754_3										
1754_4										
1754_5										
1754_6										
1754_7	0.00E+00	6.20E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1754_7D	0.00E+00	6.89E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B16: Runs 1753, & 1754, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1731_0	0.00E+00	2.58E-06	0.00E+00	0.00E+00								
1753_1												
1753_2												
1753_3												
1753_4												
1753_5												
1753_6												
1753_7	0.00E+00	8.92E-06	0.00E+00	0.00E+00								
1753_7D	0.00E+00	9.56E-06	0.00E+00	0.00E+00								
1731_0	0.00E+00	2.58E-06	0.00E+00	0.00E+00								
1754_1												
1754_2												
1754_3												
1754_4												
1754_5												
1754_6												
1754_7	0.00E+00	0.00E+00	0.00E+00	0.00E+00								
1754_7D	0.00E+00	0.00E+00	0.00E+00	0.00E+00								

Table B16: Runs 1753, & 1754, fluid analyses (cont.)

B17: Runs 1759, 1760, & 1761

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1759_0	0.1M H2O2	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	4.88	451.7	18.7
1759_1	0.1M H2O2	HTL315	100	200	48	350	0.0	0.00E+00	9.9	1.8E-04	2.62	336.5	44.3
1759_2	0.1M H2O2	HTL315	100	200	550	338	0.0	0.00E+00	62.1	1.1E-03	2.22	378.1	45.4
1759_3	0.1M H2O2	HTL315	100	200	1002	327 (290)	0.0	0.00E+00	99.8	1.8E-03	2.35	366.9	47.6
1759_0	0.1M H2O2	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0	4.88	451.7	18.7
1760_1	0.1M H2O2	HTL319	100	200	48	350	0.0	0.00E+00	<0.5	0.0E+00	7.08	264.3	51.2
1760_2	0.1M H2O2	HTL319	100	200	550	336	0.0	0.00E+00	<0.5	0.0E+00	3.49	317	44.2
1760_3	0.1M H2O2	HTL319	100	200	1002	324.2 (303)	0.0	0.00E+00	<0.5	0.0E+00	3.43	303.9	49.8
1759_0	0.1M H2O2	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0	4.88	451.7	18.7
1761_1	0.1M H2O2	HTLMix	100	200	48	350	0.0	0.00E+00	<0.5	0.0E+00	6.17	278.2	53.1
1761_2	0.1M H2O2	HTLMix	100	200	550	339	0.0	0.00E+00	<0.5	0.0E+00	6.42	295	40.4
1761_3	0.1M H2O2	HTLMix	100	200	1003	328.5 (311)	0.0	0.00E+00	<0.5	0.0E+00	6.29	275.2	43.8

Table B17: Runs 1759, 1760, & 1761, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.42E-05	6.46E-06	0.00E+00	0.00E+00	0.00E+00
1759_1										
1759_2										
1759_3	1.15E-04	2.00E-07	5.22E-04	6.43E-04	2.87E-03	4.34E-03	0.00E+00	1.12E-02	1.06E-04	9.98E-05
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.42E-05	6.46E-06	0.00E+00	0.00E+00	0.00E+00
1760_1										
1760_2										
1760_3	0.00E+00	4.44E-08	5.22E-04	1.48E-05	5.77E-05	2.07E-04	2.58E-06	0.00E+00	8.08E-05	0.00E+00
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.42E-05	6.46E-06	0.00E+00	0.00E+00	0.00E+00
1761_1										
1761_2										
1761_3	0.00E+00	0.00E+00	3.48E-04	1.99E-03	0.00E+00	6.91E-04	0.00E+00	3.74E-03	4.71E-05	2.60E-03

Table B17: Runs 1759, 1760, & 1761, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1759_0	3.34E-08	0.00E+00	0.00E+00	0.00E+00	2.15E-07	0.00E+00	0.00E+00	1.26E-07	3.06E-07	0.00E+00
1759_1										
1759_2										
1759_3	5.01E-08	2.36E-08	5.85E-07	1.33E-04	2.45E-03	4.42E-05	2.55E-06	6.86E-06	8.69E-05	1.72E-08
1759_0	3.34E-08	0.00E+00	0.00E+00	0.00E+00	2.15E-07	0.00E+00	0.00E+00	1.26E-07	3.06E-07	0.00E+00
1760_1										
1760_2										
1760_3	2.51E-08	0.00E+00	4.54E-07	2.39E-06	4.73E-06	4.00E-08	4.50E-07	5.16E-06	2.15E-05	0.00E+00
1759_0	3.34E-08	0.00E+00	0.00E+00	0.00E+00	2.15E-07	0.00E+00	0.00E+00	1.26E-07	3.06E-07	0.00E+00
1761_1										
1761_2										
1761_3	0.00E+00	0.00E+00	0.00E+00	1.62E-05	1.43E-07	3.07E-07	9.27E-07	5.54E-06	2.56E-04	0.00E+00

Table B17: Runs 1759, 1760, & 1761, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.61E-10	0.00E+00	0.00E+00	0.00E+00
1759_1										
1759_2										
1759_3	2.55E-04	2.03E-08	1.42E-07	2.69E-07	8.53E-07	0.00E+00	0.00E+00	3.04E-08	4.45E-09	8.86E-08
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.61E-10	0.00E+00	0.00E+00	0.00E+00
1760_1										
1760_2										
1760_3	2.15E-06	0.00E+00	5.24E-08	2.65E-07	3.15E-09	0.00E+00	0.00E+00	8.42E-08	3.34E-09	0.00E+00
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.61E-10	0.00E+00	0.00E+00	0.00E+00
1761_1										
1761_2										
1761_3	4.81E-08	0.00E+00	2.15E-08	3.42E-07	1.03E-08	0.00E+00	0.00E+00	2.63E-08	0.00E+00	5.03E-06

Table B17: Runs 1759, 1760, & 1761, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1759_0	5.03E-07	6.57E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.55E-10	0.00E+00	0.00E+00	0.00E+00
1759_1										
1759_2										
1759_3	2.02E-09	1.19E-07	8.34E-09	7.21E-06	1.95E-07	4.34E-07	5.99E-08	2.70E-07	8.19E-08	1.46E-08
1759_0	5.03E-07	6.57E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.55E-10	0.00E+00	0.00E+00	0.00E+00
1760_1										
1760_2										
1760_3	2.02E-09	2.30E-09	1.29E-09	1.32E-05	2.88E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1759_0	5.03E-07	6.57E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.55E-10	0.00E+00	0.00E+00	0.00E+00
1761_1										
1761_2										
1761_3	1.68E-09	1.00E-06	8.10E-09	6.33E-06	3.46E-08	2.77E-08	5.79E-09	2.44E-08	2.93E-09	1.16E-09

Table B17: Runs 1759, 1760, & 1761, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.25E-11	0.00E+00	0.00E+00	0.00E+00
1759_1										
1759_2										
1759_3	1.16E-08	7.87E-08	5.81E-08	1.05E-08	2.49E-08	3.01E-09	1.81E-08	1.97E-09	0.00E+00	0.00E+00
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.25E-11	0.00E+00	0.00E+00	0.00E+00
1760_1										
1760_2										
1760_3	7.55E-11	1.53E-10	6.40E-10	9.70E-11	4.07E-10	7.10E-11	8.32E-10	1.14E-10	0.00E+00	1.96E-08
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.25E-11	0.00E+00	0.00E+00	0.00E+00
1761_1										
1761_2										
1761_3	1.51E-10	2.65E-09	3.94E-10	0.00E+00	1.43E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B17: Runs 1759, 1760, & 1761, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1759_1												
1759_2												
1759_3	1.96E-09	2.51E-08	3.96E-09	7.67E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1760_1												
1760_2												
1760_3	0.00E+00	0.00E+00	0.00E+00	1.13E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1761_1												
1761_2												
1761_3	3.91E-09	1.93E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B17: Runs 1759, 1760, & 1761, fluid analyses (cont.)

B18: Runs 1762, & 1757

Table B18: Runs 1762, & 1757, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1759_0	0.1M H2O2	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0	4.88	451.7	18.7
1762_1	0.1M H2O2	HTLMix	100	200	48	350	0.0	0.00E+00	<0.5	0.0E+00	4.88	451.7	18.7
1762_3	0.1M H2O2	HTLMix	100	200	1005	331.5 (108)	0.0	0.00E+00	<0.5	0.0E+00	6.41	264	45.2
1755_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	5.1	0.0	6.31	216.7	21.3
1757_1	0.6M NaCl	HTLMix	100	200	29	350	0.0	0.00E+00	<0.5	0.0E+00	7.11	95.9	42.1
1757_2	0.6M NaCl	HTLMix	100	200	51	338	0.0	0.00E+00	<0.5	0.0E+00	7.3	51.5	44.4
1757_3	0.6M NaCl	HTLMix	100	200	96	326	42.6	6.99E-04	0.6	1.0E-05	7.88	41.4	43.4
1757_4	0.6M NaCl	HTLMix	100	200	192	315	78.0	1.28E-03	<0.5	0.0E+00	7.88	34.6	46.5
1757_5	0.6M NaCl	HTLMix	100	200	269	304	71.9	1.18E-03	1.2	2.2E-05	5.84	83.4	37
1757_6	0.6M NaCl	HTLMix	100	200	436	293	79.1	1.30E-03	<0.5	0.0E+00	7.93	29.1	49
1757_7	0.6M NaCl	HTLMix	100	200	744	283	63.5	1.04E-03	<0.5	0.0E+00	8.02	14.4	47
1757_7D	0.6M NaCl	HTLMix	100	200	744	270 (142)	88.9	1.46E-03			8.17	19.9	43.3

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.42E-05	6.46E-06	0.00E+00	0.00E+00	0.00E+00
1762_1										
1762_3	4.03E-06	0.00E+00	0.00E+00	3.92E-03	0.00E+00	1.04E-03	0.00E+00	7.73E-03	7.98E-05	5.14E-03
1755_0	0.00E+00	0.00E+00	6.38E-01	1.65E-06	0.00E+00	1.74E-04	2.58E-06	0.00E+00	6.04E-05	0.00E+00
1757_1	0.00E+00	0.00E+00	5.66E-01	1.15E-04	7.41E-07	6.98E-05	0.00E+00	0.00E+00	1.33E-04	0.00E+00
1757_2	0.00E+00	0.00E+00	6.41E-01	1.79E-04	0.00E+00	1.22E-04	0.00E+00	0.00E+00	1.64E-04	3.99E-04
1757_3	0.00E+00	0.00E+00	5.73E-01	1.82E-04	0.00E+00	2.04E-04	0.00E+00	0.00E+00	1.43E-04	4.99E-04
1757_4	0.00E+00	0.00E+00	5.52E-01	1.58E-04	5.93E-07	4.44E-04	0.00E+00	0.00E+00	1.53E-04	6.99E-04
1757_5	0.00E+00	0.00E+00	0.00E+00	1.18E-05	0.00E+00	2.76E-04	0.00E+00	0.00E+00	3.07E-05	0.00E+00
1757_6	0.00E+00	0.00E+00	5.65E-01	1.43E-04	0.00E+00	6.04E-04	0.00E+00	0.00E+00	1.53E-04	8.98E-04
1757_7	4.03E-06	0.00E+00	6.55E-01	6.58E-05	0.00E+00	1.30E-03	0.00E+00	0.00E+00	1.47E-04	9.88E-04
1757_7D	4.61E-06	0.00E+00	6.56E-01	6.42E-05	0.00E+00	1.27E-03	0.00E+00	0.00E+00	1.54E-04	1.06E-03

Table B18: Runs 1762, & 1757, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1759_0	3.34E-08	0.00E+00	0.00E+00	0.00E+00	2.15E-07	0.00E+00	0.00E+00	1.26E-07	3.06E-07	0.00E+00
1762_1										
1762_3	0.00E+00	0.00E+00	0.00E+00	1.69E-05	-1.43E-07	1.74E-07	1.84E-07	1.45E-06	5.09E-05	0.00E+00
1755_0	2.17E-07	0.00E+00	5.39E-08	2.18E-08	1.36E-06	0.00E+00	2.04E-08	0.00E+00	7.04E-06	0.00E+00
1757_1	0.00E+00	0.00E+00	4.62E-08	5.08E-06	0.00E+00	1.76E-08	4.50E-07	7.55E-08	5.87E-06	0.00E+00
1757_2	0.00E+00	0.00E+00	4.62E-08	5.31E-06	1.43E-07	9.50E-09	4.50E-07	1.38E-07	3.67E-06	0.00E+00
1757_3	0.00E+00	0.00E+00	4.62E-08	2.43E-06	0.00E+00	0.00E+00	8.18E-08	1.20E-07	3.43E-06	0.00E+00
1757_4	0.00E+00	0.00E+00	5.39E-08	1.10E-06	0.00E+00	0.00E+00	6.13E-08	1.26E-07	2.75E-06	0.00E+00
1757_5	0.00E+00	0.00E+00	5.39E-08	1.75E-06	9.63E-05	1.46E-07	1.70E-07	4.41E-08	2.57E-06	0.00E+00
1757_6	0.00E+00	0.00E+00	5.39E-08	1.17E-06	0.00E+00	0.00E+00	3.41E-08	1.51E-07	2.94E-06	0.00E+00
1757_7	0.00E+00	0.00E+00	3.85E-08	1.37E-06	1.43E-07	4.75E-09	2.73E-08	1.26E-07	1.96E-06	0.00E+00
1757_7D	0.00E+00	0.00E+00	3.85E-08	1.27E-06	-1.43E-07	0.00E+00	2.04E-08	0.00E+00	2.26E-06	0.00E+00

Table B18: Runs 1762, & 1757, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.61E-10	0.00E+00	0.00E+00	0.00E+00
1762_1										
1762_3	2.67E-08	5.07E-09	1.00E-07	1.38E-06	1.53E-08	0.00E+00	0.00E+00	3.92E-08	0.00E+00	4.57E-06
1755_0	1.07E-08	0.00E+00	1.68E-08	1.42E-07	0.00E+00	0.00E+00	0.00E+00	5.42E-09	0.00E+00	2.49E-09
1757_1	1.60E-07	0.00E+00	2.39E-07	4.29E-07	0.00E+00	0.00E+00	0.00E+00	8.76E-08	0.00E+00	1.39E-08
1757_2	0.00E+00	0.00E+00	3.00E-07	5.07E-07	0.00E+00	0.00E+00	0.00E+00	1.17E-07	0.00E+00	1.53E-08
1757_3	0.00E+00	0.00E+00	2.67E-07	4.98E-07	0.00E+00	0.00E+00	0.00E+00	1.13E-07	0.00E+00	1.21E-08
1757_4	0.00E+00	0.00E+00	2.95E-07	6.12E-07	0.00E+00	0.00E+00	0.00E+00	1.42E-07	0.00E+00	1.17E-08
1757_5	1.03E-04	0.00E+00	9.36E-09	1.14E-07	0.00E+00	1.75E-09	0.00E+00	3.34E-08	0.00E+00	0.00E+00
1757_6	6.94E-07	0.00E+00	2.90E-07	6.62E-07	0.00E+00	0.00E+00	0.00E+00	1.33E-07	0.00E+00	1.21E-08
1757_7	9.61E-08	5.07E-09	2.89E-07	7.99E-07	0.00E+00	0.00E+00	0.00E+00	1.30E-07	0.00E+00	1.17E-08
1757_7D	1.01E-07	0.00E+00	3.01E-07	7.99E-07	0.00E+00	0.00E+00	0.00E+00	1.25E-07	0.00E+00	1.32E-08

Table B18: Runs 1762, & 1757, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1759_0	5.03E-07	6.57E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.55E-10	0.00E+00	0.00E+00	0.00E+00
1762_1										
1762_3	0.00E+00	8.92E-07	3.56E-08	2.63E-06	2.59E-08	4.00E-09	2.58E-09	9.71E-09	1.86E-09	1.11E-09
1755_0	1.01E-09	1.97E-09	3.61E-10	7.99E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_1	0.00E+00	4.14E-07	1.78E-07	1.37E-05	3.46E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_2	1.68E-09	6.21E-07	1.93E-07	1.71E-05	4.61E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_3	1.35E-09	7.36E-07	1.75E-07	1.79E-05	5.76E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_4	1.68E-09	8.74E-07	1.72E-07	1.77E-05	4.90E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_5	2.02E-09	9.20E-08	0.00E+00	7.52E-06	2.88E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_6	3.03E-09	9.82E-07	1.77E-07	2.05E-05	6.62E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_7	0.00E+00	1.13E-06	1.76E-07	1.46E-05	2.30E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_7D	1.01E-09	1.13E-06	1.78E-07	1.70E-05	2.30E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B18: Runs 1762, & 1757, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.25E-11	0.00E+00	0.00E+00	0.00E+00
1762_1										
1762_3	1.26E-10	1.73E-09	5.17E-10	0.00E+00	2.15E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.62E-10	6.86E-11	0.00E+00	0.00E+00
1757_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.70E-08
1757_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.48E-08
1757_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.26E-08
1757_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.79E-08
1757_5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.74E-08
1757_6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.54E-10	0.00E+00	0.00E+00	5.66E-08
1757_7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.85E-10	6.86E-11	0.00E+00	1.00E-07
1757_7D	0.00E+00	1.53E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-10	4.57E-11	0.00E+00	1.26E-07

Table B18: Runs 1762, & 1757, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1759_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1762_1												
1762_3	5.68E-09	2.68E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_0	1.96E-10	1.74E-08	0.00E+00	0.00E+00	0.00E+00	4.89E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_1	1.82E-09	5.58E-06	0.00E+00	0.00E+00	0.00E+00	5.89E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_2	2.29E-09	7.53E-08	0.00E+00	0.00E+00	0.00E+00	6.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_3	2.23E-09	1.54E-08	0.00E+00	0.00E+00	0.00E+00	5.89E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_4	2.29E-09	2.51E-08	0.00E+00	0.00E+00	0.00E+00	5.95E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_6	2.11E-09	1.93E-08	0.00E+00	0.00E+00	0.00E+00	5.96E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_7	2.15E-09	1.76E-07	0.00E+00	1.18E-10	0.00E+00	5.09E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1757_7D	2.35E-09	1.06E-07	0.00E+00	0.00E+00	0.00E+00	4.84E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B18: Runs 1762, & 1757, fluid analyses (cont.)

B19: Runs 1756, & 1755

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1755_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	5.1	0.0	6.31	216.7	21.3
1756_1	0.6M NaCl	HTL319	100	200	29	350	0.0	0.00E+00	<0.5	0.0E+00	6.12	50.4	45.3
1756_2	0.6M NaCl	HTL319	100	200	51	338	0.0	0.00E+00	1.8	3.2E-05	5.82	49.9	46.8
1756_3	0.6M NaCl	HTL319	100	200	96	325	0.0	0.00E+00	1.0	1.8E-05	5.95	45.6	49.1
1756_4	0.6M NaCl	HTL319	100	200	191	314	0.0	0.00E+00	0.9	1.6E-05	5.89	28.2	48.5
1756_5	0.6M NaCl	HTL319	100	200	269	303	0.0	0.00E+00	1.5	2.6E-05	5.92	40.6	50.2
1756_6	0.6M NaCl	HTL319	100	200	436	290	0.0	0.00E+00	1.3	2.4E-05	6.01	52.8	51.9
1756_7	0.6M NaCl	HTL319	100	200	744	279	0.0	0.00E+00	<0.5	0.0E+00	5.97	37	43.8
1756_7D	0.6M NaCl		100	200	744	264.5 (255)			2.7	4.9E-05	5.87	48.8	43.1
1755_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	5.1	9.2E-05	6.31	216.7	21.3
1755_1	0.6M NaCl	HTL315	100	200	28	350	0.0	0.00E+00	8.1	1.5E-04	6.12	50.4	45.3
1755_2	0.6M NaCl	HTL315	100	200	50	338	0.0	0.00E+00	8.5	1.5E-04	6.15	35.2	42.9
1755_3	0.6M NaCl	HTL315	100	200	96	328	0.0	0.00E+00	9.9	1.8E-04	6.13	15.1	40.8
1755_4	0.6M NaCl	HTL315	100	200	191	318	0.0	0.00E+00	8.9	1.6E-04	6.27	-6.1	46.2
1755_5	0.6M NaCl	HTL315	100	200	269	307	0.0	0.00E+00	8.9	1.6E-04	6.25	-8.5	43.9
1755_6	0.6M NaCl	HTL315	100	200	436	292	0.0	0.00E+00	8.0	1.4E-04	6.3	-1.9	43.7
1755_7	0.6M NaCl	HTL315	100	200	743	281	0.0	0.00E+00	5.9	1.1E-04	6.43	-9.3	44
1755_7D	0.6M NaCl	HTL315	100	200	743	270.4 (252)	0.0	0.00E+00			6.32	3.3	43.7

Table B19: Runs 1756, & 1755, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1755_0	0.00E+00	0.00E+00	6.38E-01	1.65E-06	0.00E+00	1.74E-04	2.58E-06	0.00E+00	6.04E-05	0.00E+00
1756_1	0.00E+00	0.00E+00	5.72E-01	1.14E-05	7.41E-07	9.97E-05	0.00E+00	0.00E+00	1.23E-04	0.00E+00
1756_2	0.00E+00	0.00E+00	5.54E-01	1.14E-05	0.00E+00	1.54E-04	0.00E+00	0.00E+00	1.23E-04	0.00E+00
1756_3	0.00E+00	0.00E+00	5.72E-01	1.10E-05	7.41E-07	2.08E-04	0.00E+00	0.00E+00	1.33E-04	0.00E+00
1756_4	0.00E+00	0.00E+00	5.67E-01	1.17E-05	0.00E+00	2.48E-04	0.00E+00	0.00E+00	1.43E-04	0.00E+00
1756_5	0.00E+00	0.00E+00	6.21E-01	1.37E-05	0.00E+00	3.02E-04	0.00E+00	0.00E+00	1.64E-04	0.00E+00
1756_6	0.00E+00	0.00E+00	5.69E-01	1.30E-05	0.00E+00	3.42E-04	0.00E+00	0.00E+00	1.53E-04	0.00E+00
1756_7	0.00E+00	0.00E+00	6.68E-01	1.32E-05	0.00E+00	6.28E-04	3.87E-06	0.00E+00	1.37E-04	0.00E+00
1756_7D	0.00E+00	0.00E+00	6.84E-01	1.48E-05	0.00E+00	6.45E-04	3.87E-06	0.00E+00	1.51E-04	0.00E+00
1755_0	0.00E+00	0.00E+00	6.38E-01	1.65E-06	0.00E+00	1.74E-04	2.58E-06	0.00E+00	6.04E-05	0.00E+00
1755_1	0.00E+00	0.00E+00	5.62E-01	1.25E-05	1.19E-06	1.14E-04	0.00E+00	0.00E+00	9.21E-05	2.00E-04
1755_2	0.00E+00	0.00E+00	5.68E-01	1.32E-05	0.00E+00	1.81E-04	0.00E+00	0.00E+00	9.21E-05	0.00E+00
1755_3	0.00E+00	0.00E+00	5.87E-01	1.46E-05	0.00E+00	2.41E-04	0.00E+00	0.00E+00	1.02E-04	0.00E+00
1755_4	0.00E+00	0.00E+00	5.72E-01	1.35E-05	0.00E+00	2.75E-04	0.00E+00	0.00E+00	1.02E-04	0.00E+00
1755_5	3.46E-06	0.00E+00	5.95E-01	1.51E-05	1.48E-06	3.09E-04	0.00E+00	0.00E+00	1.13E-04	0.00E+00
1755_6	0.00E+00	0.00E+00	5.75E-01	1.70E-05	8.89E-07	3.16E-04	6.46E-06	0.00E+00	1.23E-04	0.00E+00
1755_7	3.46E-06	0.00E+00	6.40E-01	1.65E-05	0.00E+00	5.26E-04	1.16E-05	4.99E-04	9.00E-05	0.00E+00
1755_7D	0.00E+00	0.00E+00	6.86E-01	1.81E-05	0.00E+00	5.48E-04	1.16E-05	0.00E+00	9.31E-05	0.00E+00

Table B19: Runs 1756, & 1755, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1755_0	2.17E-07	0.00E+00	5.39E-08	2.18E-08	1.36E-06	0.00E+00	2.04E-08	0.00E+00	7.04E-06	0.00E+00
1756_1	0.00E+00	0.00E+00	4.62E-08	8.96E-07	2.01E-06	2.09E-07	9.00E-07	9.95E-07	7.83E-06	0.00E+00
1756_2	0.00E+00	0.00E+00	5.39E-08	1.41E-06	1.59E-05	1.36E-07	1.49E-06	5.98E-07	7.71E-06	0.00E+00
1756_3	0.00E+00	0.00E+00	4.62E-08	1.54E-06	7.59E-06	9.91E-08	6.20E-07	2.71E-07	7.22E-06	0.00E+00
1756_4	0.00E+00	0.00E+00	3.85E-08	2.37E-06	7.59E-06	9.43E-08	6.00E-07	4.85E-07	7.34E-06	0.00E+00
1756_5	0.00E+00	0.00E+00	4.62E-08	3.02E-06	9.02E-06	9.37E-08	3.82E-07	2.01E-07	8.14E-06	0.00E+00
1756_6	0.00E+00	0.00E+00	5.39E-08	3.55E-06	1.12E-05	9.57E-08	6.00E-07	5.41E-07	8.57E-06	0.00E+00
1756_7	0.00E+00	0.00E+00	3.85E-08	5.61E-06	2.61E-05	9.71E-08	1.37E-06	2.52E-07	7.65E-06	0.00E+00
1756_7D	0.00E+00	0.00E+00	3.85E-08	5.06E-06	2.20E-05	9.37E-08	5.72E-07	0.00E+00	7.83E-06	0.00E+00
1755_0	2.17E-07	0.00E+00	5.39E-08	2.18E-08	1.36E-06	0.00E+00	2.04E-08	0.00E+00	7.04E-06	0.00E+00
1755_1	0.00E+00	0.00E+00	1.15E-07	1.97E-06	1.26E-04	4.13E-07	1.32E-06	1.07E-07	2.12E-05	0.00E+00
1755_2	0.00E+00	0.00E+00	7.69E-08	2.05E-06	1.36E-04	3.31E-07	1.42E-06	1.07E-07	1.90E-05	0.00E+00
1755_3	0.00E+00	0.00E+00	9.23E-08	2.46E-06	1.45E-04	2.56E-07	3.46E-06	1.20E-07	1.84E-05	0.00E+00
1755_4	0.00E+00	0.00E+00	5.39E-08	2.64E-06	1.35E-04	1.51E-07	4.14E-06	1.13E-07	1.55E-05	0.00E+00
1755_5	0.00E+00	0.00E+00	1.23E-07	2.73E-06	1.30E-04	1.15E-07	3.50E-06	1.03E-06	1.60E-05	0.00E+00
1755_6	0.00E+00	0.00E+00	3.08E-08	2.96E-06	1.12E-04	1.11E-07	4.12E-06	8.81E-08	1.66E-05	0.00E+00
1755_7	0.00E+00	0.00E+00	3.08E-08	3.31E-06	9.56E-05	7.87E-08	2.94E-06	0.00E+00	1.19E-05	0.00E+00
1755_7D	0.00E+00	0.00E+00	3.08E-08	3.26E-06	9.59E-05	5.29E-08	1.89E-06	0.00E+00	1.27E-05	0.00E+00

Table B19: Runs 1756, & 1755, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1755_0	1.07E-08	0.00E+00	1.68E-08	1.42E-07	0.00E+00	0.00E+00	0.00E+00	5.42E-09	0.00E+00	2.49E-09
1756_1	9.08E-07	0.00E+00	3.79E-07	2.56E-07	0.00E+00	0.00E+00	0.00E+00	6.25E-08	1.22E-08	2.85E-09
1756_2	4.81E-07	0.00E+00	4.35E-07	2.24E-07	2.25E-09	0.00E+00	0.00E+00	1.00E-07	4.45E-09	2.14E-09
1756_3	5.87E-07	0.00E+00	4.73E-07	2.28E-07	0.00E+00	0.00E+00	0.00E+00	1.25E-07	1.85E-09	1.07E-09
1756_4	9.61E-07	0.00E+00	5.01E-07	2.65E-07	0.00E+00	0.00E+00	0.00E+00	1.46E-07	1.85E-09	2.49E-09
1756_5	1.60E-06	0.00E+00	5.62E-07	2.88E-07	0.00E+00	1.32E-09	0.00E+00	1.63E-07	7.79E-09	2.49E-09
1756_6	1.98E-06	0.00E+00	5.57E-07	2.74E-07	9.00E-10	0.00E+00	0.00E+00	2.04E-07	0.00E+00	2.49E-09
1756_7	3.19E-06	0.00E+00	5.96E-07	2.78E-07	0.00E+00	0.00E+00	0.00E+00	2.47E-07	0.00E+00	6.05E-09
1756_7D	3.35E-06	0.00E+00	5.92E-07	3.10E-07	0.00E+00	0.00E+00	0.00E+00	2.23E-07	0.00E+00	2.85E-09
1755_0	1.07E-08	0.00E+00	1.68E-08	1.42E-07	0.00E+00	0.00E+00	0.00E+00	5.42E-09	0.00E+00	2.49E-09
1755_1	5.67E-05	0.00E+00	7.02E-08	2.51E-07	0.00E+00	0.00E+00	0.00E+00	7.50E-08	5.93E-09	6.41E-09
1755_2	8.18E-05	0.00E+00	7.96E-08	2.51E-07	0.00E+00	0.00E+00	0.00E+00	7.92E-08	4.08E-09	5.34E-09
1755_3	1.14E-04	0.00E+00	8.89E-08	2.24E-07	0.00E+00	0.00E+00	0.00E+00	8.34E-08	0.00E+00	4.27E-09
1755_4	1.34E-04	0.00E+00	8.89E-08	1.96E-07	0.00E+00	0.00E+00	0.00E+00	1.46E-07	0.00E+00	0.00E+00
1755_5	1.44E-04	0.00E+00	9.83E-08	2.33E-07	9.00E-10	0.00E+00	0.00E+00	1.67E-07	7.05E-09	0.00E+00
1755_6	1.46E-04	0.00E+00	1.03E-07	2.42E-07	9.00E-10	0.00E+00	0.00E+00	1.79E-07	0.00E+00	0.00E+00
1755_7	1.63E-04	5.07E-09	1.01E-07	1.92E-07	0.00E+00	0.00E+00	0.00E+00	1.84E-07	0.00E+00	2.49E-09
1755_7D	1.30E-04	0.00E+00	1.06E-07	6.03E-07	0.00E+00	0.00E+00	0.00E+00	1.83E-07	0.00E+00	2.85E-09

Table B19: Runs 1756, & 1755, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1755_0	1.01E-09	1.97E-09	3.61E-10	7.99E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_1	1.68E-09	0.00E+00	3.01E-08	1.59E-05	5.18E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_2	2.70E-09	0.00E+00	3.10E-08	1.37E-05	2.04E-09	3.14E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_3	1.35E-09	0.00E+00	3.31E-08	1.68E-05	5.47E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_4	1.68E-09	0.00E+00	3.43E-08	1.74E-05	5.47E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_5	2.36E-09	0.00E+00	3.97E-08	1.68E-05	6.05E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_6	2.02E-09	0.00E+00	3.79E-08	1.64E-05	5.18E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_7	2.02E-09	1.31E-08	4.20E-08	1.31E-05	8.64E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_7D	2.02E-09	1.35E-08	4.05E-08	1.71E-05	2.59E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_0	1.01E-09	1.97E-09	3.61E-10	7.99E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_1	1.68E-09	1.05E-07	7.22E-09	1.73E-05	6.62E-10	8.56E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_2	2.02E-09	1.31E-07	7.83E-09	2.01E-05	5.18E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_3	0.00E+00	1.54E-07	8.73E-09	1.81E-05	4.61E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_4	2.02E-09	1.45E-07	8.43E-09	1.68E-05	4.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_5	3.07E-08	1.38E-07	9.33E-09	1.75E-05	3.37E-09	3.71E-09	0.00E+00	0.00E+00	0.00E+00	7.90E-11
1755_6	2.36E-09	1.02E-07	9.03E-09	1.97E-05	4.90E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_7	1.35E-09	7.16E-08	9.66E-09	1.49E-05	1.27E-09	1.43E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_7D	1.35E-09	7.69E-08	1.04E-08	1.76E-05	1.12E-09	5.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B19: Runs 1756, & 1755, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1755_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.62E-10	6.86E-11	0.00E+00	0.00E+00
1756_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-07
1756_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.16E-10	0.00E+00	0.00E+00	1.14E-06
1756_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.54E-06
1756_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.37E-06
1756_5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.19E-06
1756_6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E-05
1756_7	0.00E+00	1.78E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.62E-10	6.86E-11	8.84E-10	1.45E-05
1756_7D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.39E-10	4.57E-11	1.11E-09	1.48E-05
1755_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.62E-10	6.86E-11	0.00E+00	0.00E+00
1755_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.08E-10	0.00E+00	0.00E+00	1.52E-08
1755_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.83E-08
1755_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.57E-11	0.00E+00	5.22E-08
1755_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-07
1755_5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.89E-07
1755_6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.02E-07
1755_7	0.00E+00	2.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.85E-10	6.86E-11	0.00E+00	5.59E-07
1755_7D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-10	0.00E+00	1.16E-10	6.86E-11	0.00E+00	6.14E-07

Table B19: Runs 1756, & 1755, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1755_0	1.96E-10	1.74E-08	0.00E+00	0.00E+00	0.00E+00	4.89E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_1	1.29E-09	1.54E-08	0.00E+00	0.00E+00	0.00E+00	5.94E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_2	1.37E-09	1.35E-08	0.00E+00	0.00E+00	0.00E+00	6.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_3	1.66E-09	9.65E-09	0.00E+00	0.00E+00	0.00E+00	6.18E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_4	1.60E-09	9.65E-09	0.00E+00	0.00E+00	0.00E+00	6.27E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_5	1.76E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.21E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_6	1.76E-09	0.00E+00	0.00E+00	3.36E-10	0.00E+00	5.57E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_7	2.15E-09	0.00E+00	0.00E+00	2.69E-10	0.00E+00	4.82E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1756_7D	1.96E-09	0.00E+00	0.00E+00	2.69E-10	0.00E+00	5.19E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_0	1.96E-10	1.74E-08	0.00E+00	0.00E+00	0.00E+00	4.89E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_1	1.98E-09	2.22E-07	0.00E+00	0.00E+00	0.00E+00	6.17E-01	1.40E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_2	1.90E-09	4.44E-08	0.00E+00	0.00E+00	0.00E+00	5.97E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_3	1.96E-09	2.90E-08	0.00E+00	0.00E+00	0.00E+00	5.65E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_4	1.59E-09	2.32E-08	0.00E+00	0.00E+00	0.00E+00	6.06E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_5	1.53E-09	4.05E-08	0.00E+00	0.00E+00	0.00E+00	6.00E-01	2.08E-04	2.46E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_6	1.41E-09	1.74E-08	0.00E+00	0.00E+00	0.00E+00	5.73E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_7	1.17E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.77E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1755_7D	1.37E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.99E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B19: Runs 1756, & 1755, fluid analyses (cont.)

B20: Runs 1758, & 1767

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO ₃	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1758_0	Deionised Water	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0E+00	5.98	203.9	20.2
1758_1	DI	HTL315	100	200	29	350	0.0	0.00E+00	2.9	5.2E-05	6.47	1.9	47.4
1758_2	DI	HTL315	100	200	52	338	0.0	0.00E+00	4.9	8.7E-05	6.15	-29.1	43.3
1758_3	DI	HTL315	100	200	97	325	0.0	0.00E+00	3.9	7.0E-05	6.26	-38.3	46.7
1758_4	DI	HTL315	100	200	192	316	0.0	0.00E+00	5.4	9.7E-05	6.04	-80.8	47.6
1758_5	DI	HTL315	100	200	270	305	0.0	0.00E+00	7.1	1.3E-04	6.04	-17.5	49.9
1758_6	DI	HTL315	100	200	436	294	0.0	0.00E+00	5.1	9.2E-05	6.04	-28.8	47.1
1758_7	DI	HTL315	100	200	745	283	0.0	0.00E+00	7.1	1.3E-04	6.05	-44	41.6
1758_7D	DI	HTL315	100	200	745	270.2 (244)	0.0	0.00E+00	7.4	1.3E-04	5.98	-28.8	40.5
1767_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	5.1	9.2E-05	6.31	216.7	21.3
1767_1	0.6M NaCl	HTLMix	200	200	365	350	0.0	0.00E+00	63.2	1.1E-03	4.07	182.1	24.5
1767_2	0.6M NaCl	HTLMix	200	200	847	339	0.0	0.00E+00	121.9	2.2E-03	2.2	19.9	27.2
1767_3	0.6M NaCl	HTLMix	200	200	1056	327	0.0	0.00E+00	116.2	2.1E-03	9.5	-68.3	22.4
1767_4	0.6M NaCl	HTLMix	200	200	1056	315	0.0	0.00E+00	114.5	2.1E-03	10	-220	33.6

Table B20: Runs 1758, & 1767, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1758_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.27E-05	0.00E+00	0.00E+00	4.91E-05	0.00E+00
1758_1	0.00E+00	0.00E+00	0.00E+00	8.72E-06	0.00E+00	1.08E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_2	0.00E+00	0.00E+00	0.00E+00	9.87E-06	0.00E+00	1.74E-04	0.00E+00	0.00E+00	3.07E-05	0.00E+00
1758_3	0.00E+00	0.00E+00	0.00E+00	1.07E-05	7.41E-07	2.18E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_4	0.00E+00	0.00E+00	0.00E+00	1.17E-05	8.89E-07	2.48E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_5									0.00E+00	
1758_6	0.00E+00	0.00E+00	0.00E+00	1.10E-05	0.00E+00	2.95E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_7	0.00E+00	0.00E+00	5.22E-04	1.65E-05	0.00E+00	4.97E-04	5.17E-06	0.00E+00	1.64E-05	0.00E+00
1758_7D	0.00E+00	0.00E+00	5.22E-04	1.48E-05	0.00E+00	5.01E-04	5.17E-06	0.00E+00	1.53E-05	0.00E+00
1767_0	4.03E-06	0.00E+00	6.50E-01	3.46E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.09E-05	0.00E+00
1767_1	7.55E-05	5.59E-07	6.80E-01	1.12E-03	6.41E-04	9.69E-03	8.27E-05	6.24E-04	9.26E-04	7.09E-04
1767_2	1.50E-04	2.16E-06	6.46E-01	8.23E-05	1.79E-03	2.37E-02	8.27E-05	1.37E-03	5.40E-03	4.09E-04
1767_3	1.62E-04	2.10E-06	6.43E-01	2.63E-05	1.51E-03	2.91E-02	4.91E-05	1.62E-03	5.57E-03	1.90E-04
1767_4	1.54E-04	2.04E-06	6.23E-01	2.63E-05	1.49E-03	2.92E-02	5.42E-05	1.62E-03	5.40E-03	1.30E-04

Table B20: Runs 1758, & 1767, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1758_0	5.85E-08	0.00E+00	3.08E-08	1.46E-08	2.15E-07	0.00E+00	0.00E+00	0.00E+00	7.34E-07	0.00E+00
1758_1	0.00E+00	0.00E+00	3.08E-08	1.28E-06	3.96E-05	2.21E-07	2.52E-07	4.41E-08	1.84E-06	0.00E+00
1758_2	0.00E+00	0.00E+00	2.31E-08	1.67E-06	7.44E-05	2.33E-07	3.20E-07	3.78E-08	3.06E-06	0.00E+00
1758_3	0.00E+00	0.00E+00	1.54E-08	1.46E-06	6.07E-05	1.90E-07	2.32E-07	3.78E-08	2.20E-06	0.00E+00
1758_4	0.00E+00	0.00E+00	3.08E-08	1.67E-06	8.82E-05	1.69E-07	1.98E-07	4.41E-08	2.57E-06	0.00E+00
1758_5										
1758_6	0.00E+00	0.00E+00	3.08E-08	1.75E-06	9.28E-05	9.91E-08	1.02E-07	7.55E-08	2.63E-06	0.00E+00
1758_7	0.00E+00	0.00E+00	2.31E-08	2.18E-06	1.06E-04	4.21E-08	5.45E-08	0.00E+00	2.75E-06	0.00E+00
1758_7D	0.00E+00	0.00E+00	4.62E-08	2.21E-06	1.13E-04	3.87E-08	5.45E-08	0.00E+00	3.85E-06	0.00E+00
1767_0	0.00E+00	0.00E+00	3.85E-08	0.00E+00	2.87E-07	0.00E+00	0.00E+00	1.89E-07	4.59E-06	0.00E+00
1767_1	1.92E-07	0.00E+00	4.62E-08	1.80E-04	1.04E-03	5.89E-07	1.03E-05	4.41E-06	1.93E-04	0.00E+00
1767_2	3.97E-04	7.16E-06	2.15E-06	2.76E-04	1.24E-02	2.42E-06	1.18E-05	1.89E-07	1.13E-03	3.56E-07
1767_3	2.20E-03	2.79E-05	3.75E-06	3.31E-04	2.04E-02	2.64E-06	6.15E-06	1.89E-07	1.62E-03	2.70E-07
1767_4	2.06E-03	3.76E-05	3.01E-06	3.26E-04	2.01E-02	2.58E-06	5.66E-06	3.15E-07	1.56E-03	2.70E-07

Table B20: Runs 1758, & 1767, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1758_0	0.00E+00	0.00E+00	4.68E-09	1.37E-08	0.00E+00	0.00E+00	0.00E+00	5.42E-09	0.00E+00	0.00E+00
1758_1	4.52E-05	0.00E+00	4.68E-09	1.19E-07	0.00E+00	2.19E-09	0.00E+00	3.34E-08	0.00E+00	0.00E+00
1758_2	7.01E-05	0.00E+00	4.68E-09	1.23E-07	0.00E+00	1.32E-09	0.00E+00	3.34E-08	0.00E+00	1.07E-09
1758_3	7.78E-05	0.00E+00	4.68E-09	1.32E-07	0.00E+00	0.00E+00	0.00E+00	3.34E-08	0.00E+00	0.00E+00
1758_4	9.73E-05	0.00E+00	4.68E-09	1.05E-07	0.00E+00	0.00E+00	0.00E+00	3.34E-08	1.85E-09	0.00E+00
1758_5										
1758_6	1.09E-04	0.00E+00	4.68E-09	1.05E-07	0.00E+00	0.00E+00	0.00E+00	1.04E-07	0.00E+00	0.00E+00
1758_7	1.13E-04	0.00E+00	4.21E-09	1.10E-07	0.00E+00	0.00E+00	0.00E+00	5.17E-08	0.00E+00	0.00E+00
1758_7D	1.14E-04	0.00E+00	3.28E-09	9.13E-08	0.00E+00	0.00E+00	0.00E+00	4.54E-08	0.00E+00	0.00E+00
1767_0	5.87E-07	0.00E+00	9.36E-09	1.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1767_1	3.04E-07	5.07E-09	1.83E-06	8.90E-06	5.40E-09	9.43E-08	0.00E+00	5.24E-07	1.82E-08	3.44E-07
1767_2	2.14E-08	0.00E+00	1.43E-05	7.70E-06	1.26E-08	5.70E-06	5.60E-09	1.84E-07	1.93E-08	2.27E-06
1767_3	3.20E-08	0.00E+00	1.46E-05	9.61E-06	1.39E-08	7.66E-06	2.07E-08	1.10E-07	2.48E-08	3.21E-06
1767_4	2.67E-08	0.00E+00	1.45E-05	9.08E-06	1.39E-08	7.50E-06	2.63E-08	1.26E-07	2.52E-08	2.92E-06

Table B20: Runs 1758, & 1767, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1758_0	2.02E-09	1.31E-09	0.00E+00	6.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_1	2.02E-09	7.88E-08	0.00E+00	6.76E-06	3.46E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_2	1.68E-09	1.02E-07	0.00E+00	7.81E-06	3.74E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_3	1.68E-09	9.86E-08	0.00E+00	7.37E-06	2.59E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_4	2.02E-09	1.02E-07	0.00E+00	7.19E-06	2.88E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	2.63E-10
1758_5										
1758_6	2.36E-09	7.88E-08	0.00E+00	6.98E-06	4.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_7	0.00E+00	6.18E-08	0.00E+00	7.15E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_7D	0.00E+00	6.44E-08	0.00E+00	7.33E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1767_0	2.36E-09	0.00E+00	0.00E+00	5.06E-06	4.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1767_1	1.45E-08	1.31E-08	3.76E-07	8.38E-05	1.76E-09	1.43E-09	0.00E+00	0.00E+00	5.32E-10	2.11E-10
1767_2	4.31E-08	4.27E-09	7.41E-07	8.86E-05	3.23E-09	6.28E-09	9.94E-10	5.82E-09	2.39E-09	1.08E-09
1767_3	1.57E-07	4.27E-09	7.67E-07	6.81E-05	2.04E-09	3.43E-09	5.11E-10	3.05E-09	1.33E-09	8.16E-10
1767_4	2.25E-07	3.61E-09	7.57E-07	6.68E-05	1.76E-09	2.85E-09	4.26E-10	0.00E+00	1.60E-09	6.32E-10

Table B20: Runs 1758, & 1767, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1758_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.85E-10	0.00E+00	0.00E+00	0.00E+00
1758_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_5										
1758_6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.18E-08
1758_7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.48E-08
1758_7D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.26E-08
1767_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1767_1	7.55E-11	4.32E-10	2.95E-10	0.00E+00	3.11E-10	9.47E-11	1.06E-09	2.97E-10	0.00E+00	8.27E-08
1767_2	3.52E-10	1.86E-09	1.70E-09	3.40E-10	1.22E-09	2.60E-10	2.13E-09	4.57E-10	1.99E-09	5.00E-08
1767_3	2.52E-10	1.20E-09	1.53E-09	2.91E-10	9.81E-10	2.37E-10	1.85E-09	3.66E-10	3.54E-09	8.70E-08
1767_4	2.52E-10	9.41E-10	1.58E-09	3.15E-10	9.57E-10	1.89E-10	1.87E-09	2.74E-10	2.87E-09	6.31E-08

Table B20: Runs 1758, & 1767, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1758_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.64E-05	7.97E-06	3.23E-05	0.00E+00	4.35E-04	0.00E+00	1.05E-03
1758_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.64E-05	7.97E-06	3.23E-05	0.00E+00	4.35E-04	0.00E+00	1.05E-03
1758_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.64E-05	7.97E-06	3.23E-05	0.00E+00	4.35E-04	0.00E+00	1.05E-03
1758_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_5						7.46E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.49E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1758_7D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1767_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1767_1	4.60E-08	1.61E-04	4.48E-09	2.02E-10	2.91E-09	5.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1767_2	3.05E-08	2.83E-05	3.62E-09	5.18E-09	8.07E-08	5.34E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.57E-02
1767_3	3.76E-08	6.74E-05	2.93E-09	6.34E-09	9.05E-08	5.30E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.84E-02
1767_4	4.15E-08	9.44E-05	1.90E-09	6.08E-09	8.90E-08	5.58E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.12E-02

Table B20: Runs 1758, & 1767, fluid analyses (cont.)

B21: Runs 1768, & 1769

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1768_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	1.0870299	1.9E-05	6.1	-11.4	22.3
1768_1	0.6M NaCl	HTL325	100	200	71	350	0.0	0.00E+00	1.4900472	2.7E-05	6.21	156.8	37.9
1768_2	0.6M NaCl	HTL325	100	200	239	339	0.0	0.00E+00	2.2001253	3.9E-05	6.28	-36.4	45.6
1768_3	0.6M NaCl	HTL325	100	200	409	323	0.0	0.00E+00	2.7182904	4.9E-05	6.57		37.3
1768_4	0.6M NaCl	HTL325	100	200	577	311	0.0	0.00E+00	0	0.0E+00	7.08	178.4	37.6
1768_4D	0.6M NaCl	HTL325	100	200	577	294	0.0	0.00E+00	0	0.0E+00	6.51	152.9	31.3
1768/F	0.6M NaCl	HTL325	100	200	580	279.6 (152)	0.0	0.00E+00	0	0.0E+00	6.91	109.4	37.3
1768_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	1.0870299	0.0	6.1	-11.4	22.3
1769_1	0.6M NaCl	HTL323	100	200	71	350	0.0	0.00E+00	1.989021	3.6E-05	7.13	128.6	42.4
1769_2	0.6M NaCl	HTL323	100	200	239	337	0.0	0.00E+00	0.6840126	1.2E-05	6.89	-42.9	43.5
1769_3	0.6M NaCl	HTL323	100	200	408	322	58.5	9.58E-04	0	0.0E+00	6.49		52
1769_4	0.6M NaCl	HTL323	100	200	577	307	54.3	8.90E-04	0	0.0E+00	6.51	152.9	32.1
1769_4D	0.6M NaCl	HTL323	100	200	577	293	57.9	9.49E-04	0	0.0E+00	7.38	189.5	39.6
1769_F	0.6M NaCl	HTL323	100	200	579	283 (170)	61.6	1.01E-03	0	0.0E+00	7.37	177	39.4

Table B21: Runs 1768, & 1769, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	4.03E-06	0.00E+00	6.50E-01	3.46E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.09E-05	0.00E+00
1768_1	6.92E-06	0.00E+00	6.00E-01	6.35E-05	2.08E-06	6.55E-05	0.00E+00	0.00E+00	7.16E-05	0.00E+00
1768_2	7.49E-06	0.00E+00	5.98E-01	7.01E-05	7.41E-07	1.10E-04	0.00E+00	0.00E+00	6.14E-05	0.00E+00
1768_3	7.49E-06	0.00E+00	6.15E-01	8.11E-05	7.41E-07	1.38E-04	0.00E+00	0.00E+00	8.18E-05	0.00E+00
1768_4	6.92E-06	0.00E+00	6.06E-01	7.78E-05	8.89E-07	1.54E-04	0.00E+00	0.00E+00	7.16E-05	0.00E+00
1768_4D	6.34E-06	0.00E+00	5.96E-01	8.20E-05	0.00E+00	1.62E-04	0.00E+00	0.00E+00	8.18E-05	0.00E+00
1768/F	5.76E-06	0.00E+00	5.94E-01	8.33E-05	1.33E-06	1.61E-04	0.00E+00	0.00E+00	7.16E-05	0.00E+00
1768_0	4.03E-06	0.00E+00	6.50E-01	3.46E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.09E-05	0.00E+00
1769_1	5.76E-06	0.00E+00	6.00E-01	4.69E-04	8.89E-07	1.42E-05	0.00E+00	1.62E-03	8.18E-05	5.99E-04
1769_2	5.76E-06	0.00E+00	5.74E-01	6.98E-04	0.00E+00	2.85E-05	0.00E+00	1.37E-03	8.18E-05	9.98E-04
1769_3	5.76E-06	0.00E+00	5.96E-01	7.76E-04	0.00E+00	4.27E-05	0.00E+00	9.98E-04	8.18E-05	1.10E-03
1769_4	5.76E-06	0.00E+00	6.15E-01	8.50E-04	0.00E+00	5.55E-05	0.00E+00	1.37E-03	1.02E-04	1.10E-03
1769_4D	5.19E-06	0.00E+00	5.74E-01	8.30E-04	2.22E-06	5.41E-05	0.00E+00	1.87E-03	9.21E-05	9.98E-04
1769_F	3.46E-06	0.00E+00	5.86E-01	8.45E-04	7.41E-07	5.41E-05	0.00E+00	1.75E-03	8.18E-05	1.10E-03

Table B21: Runs 1768, & 1769, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	0.00E+00	0.00E+00	3.85E-08	0.00E+00	2.87E-07	0.00E+00	0.00E+00	1.89E-07	4.59E-06	0.00E+00
1768_1	0.00E+00	0.00E+00	6.92E-08	1.35E-06	6.49E-05	6.72E-08	1.70E-06	4.41E-07	1.17E-05	0.00E+00
1768_2	0.00E+00	0.00E+00	3.08E-08	1.34E-06	2.62E-05	2.24E-08	4.36E-07	2.71E-07	7.46E-06	0.00E+00
1768_3	0.00E+00	0.00E+00	3.85E-08	1.36E-06	6.88E-06	1.15E-08	3.20E-07	1.95E-07	5.26E-06	0.00E+00
1768_4	0.00E+00	0.00E+00	5.39E-08	1.25E-06	2.79E-06	0.00E+00	6.82E-08	1.57E-07	4.22E-06	0.00E+00
1768_4D	0.00E+00	0.00E+00	4.62E-08	1.23E-06	2.22E-06	4.75E-09	1.16E-07	1.95E-07	4.59E-06	0.00E+00
1768/F	0.00E+00	0.00E+00	6.15E-08	1.30E-06	3.29E-06	5.43E-09	3.41E-08	1.89E-07	4.59E-06	0.00E+00
1768_0	0.00E+00	0.00E+00	3.85E-08	0.00E+00	2.87E-07	0.00E+00	0.00E+00	1.89E-07	4.59E-06	0.00E+00
1769_1	0.00E+00	0.00E+00	4.62E-08	2.10E-05	1.65E-06	1.83E-06	4.43E-07	2.14E-07	6.54E-04	0.00E+00
1769_2	0.00E+00	0.00E+00	5.39E-08	2.89E-05	5.73E-07	6.24E-07	2.39E-07	2.39E-07	1.96E-04	0.00E+00
1769_3	0.00E+00	0.00E+00	3.85E-08	3.14E-05	5.73E-07	2.52E-07	8.86E-08	3.84E-07	1.14E-04	0.00E+00
1769_4	0.00E+00	0.00E+00	4.62E-08	3.20E-05	7.88E-07	1.02E-07	2.73E-08	1.95E-07	3.52E-05	0.00E+00
1769_4D	0.00E+00	0.00E+00	5.39E-08	3.12E-05	9.31E-07	9.64E-08	5.45E-08	2.14E-07	3.60E-05	0.00E+00
1769_F	1.00E-07	0.00E+00	4.62E-08	3.27E-05	2.36E-06	1.05E-07	7.50E-08	3.02E-07	6.33E-05	0.00E+00

Table B21: Runs 1768, & 1769, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	5.87E-07	0.00E+00	9.36E-09	1.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_1	3.20E-07	0.00E+00	3.28E-08	1.42E-07	0.00E+00	1.75E-09	0.00E+00	7.92E-08	5.12E-08	1.60E-08
1768_2	1.60E-07	0.00E+00	3.28E-08	1.23E-07	0.00E+00	0.00E+00	0.00E+00	7.92E-08	5.93E-09	6.76E-09
1768_3	1.07E-07	0.00E+00	3.28E-08	1.69E-07	0.00E+00	0.00E+00	0.00E+00	7.17E-07	0.00E+00	1.07E-09
1768_4	0.00E+00	0.00E+00	3.28E-08	1.46E-07	0.00E+00	0.00E+00	0.00E+00	1.29E-07	0.00E+00	0.00E+00
1768_4D	0.00E+00	0.00E+00	3.74E-08	1.69E-07	0.00E+00	0.00E+00	0.00E+00	2.63E-07	0.00E+00	7.12E-10
1768/F	0.00E+00	0.00E+00	2.81E-08	1.37E-07	0.00E+00	0.00E+00	0.00E+00	7.92E-08	4.08E-09	0.00E+00
1768_0	5.87E-07	0.00E+00	9.36E-09	1.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_1	0.00E+00	1.01E-07	3.74E-08	3.70E-07	0.00E+00	0.00E+00	0.00E+00	2.17E-07	1.82E-08	2.86E-07
1769_2	0.00E+00	0.00E+00	4.21E-08	4.02E-07	0.00E+00	0.00E+00	0.00E+00	1.42E-07	0.00E+00	2.92E-08
1769_3	0.00E+00	0.00E+00	4.21E-08	4.20E-07	0.00E+00	1.75E-09	0.00E+00	2.29E-07	1.85E-09	9.96E-09
1769_4	0.00E+00	0.00E+00	4.68E-08	4.61E-07	0.00E+00	0.00E+00	0.00E+00	9.59E-08	0.00E+00	3.91E-09
1769_4D	0.00E+00	0.00E+00	4.21E-08	4.47E-07	0.00E+00	0.00E+00	0.00E+00	1.42E-07	0.00E+00	4.98E-09
1769_F	0.00E+00	0.00E+00	3.74E-08	4.43E-07	0.00E+00	0.00E+00	0.00E+00	1.00E-07	0.00E+00	4.27E-09

Table B21: Runs 1768, & 1769, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	2.36E-09	0.00E+00	0.00E+00	5.06E-06	4.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_1	3.37E-09	0.00E+00	0.00E+00	1.43E-05	6.05E-10	8.56E-10	0.00E+00	0.00E+00	5.32E-10	7.90E-11
1768_2	3.71E-09	0.00E+00	0.00E+00	1.21E-05	4.61E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_3	2.70E-09	0.00E+00	0.00E+00	1.66E-05	5.18E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_4	2.70E-09	0.00E+00	1.20E-09	1.43E-05	4.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_4D	2.36E-09	0.00E+00	1.20E-09	1.53E-05	4.32E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E-10
1768/F	9.10E-09	0.00E+00	0.00E+00	1.21E-05	4.32E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_0	2.36E-09	0.00E+00	0.00E+00	5.06E-06	4.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_1	3.03E-09	0.00E+00	4.82E-09	1.38E-05	5.47E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	1.05E-10
1769_2	2.36E-09	0.00E+00	5.12E-09	1.34E-05	5.47E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_3	3.37E-09	0.00E+00	5.12E-09	1.33E-05	4.61E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E-10
1769_4	4.04E-09	0.00E+00	5.12E-09	2.00E-05	6.34E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_4D	3.71E-09	0.00E+00	5.12E-09	1.49E-05	4.90E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_F	2.02E-09	0.00E+00	5.12E-09	1.45E-05	6.05E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	1.58E-10

Table B21: Runs 1768, & 1769, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_1	7.55E-11	0.00E+00	0.00E+00	7.28E-11	0.00E+00	4.74E-11	0.00E+00	9.14E-11	0.00E+00	0.00E+00
1768_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.52E-08
1768_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.57E-08
1768_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.70E-07
1768_4D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.39E-07
1768/F	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.02E-07
1768_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_4D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.77E-10	0.00E+00	0.00E+00	0.00E+00
1769_F	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B21: Runs 1768, & 1769, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_1	4.50E-10	6.56E-08	0.00E+00	0.00E+00	0.00E+00	6.22E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_2	4.89E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.07E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_3	3.72E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.93E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_4	5.09E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.04E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_4D	4.31E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.03E-01	8.59E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768/F	3.52E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.77E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_1	4.07E-09	6.45E-07	0.00E+00	0.00E+00	0.00E+00	5.94E-01	5.11E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_2	4.27E-09	1.72E-07	0.00E+00	0.00E+00	0.00E+00	6.16E-01	5.47E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_3	4.83E-09	1.00E-07	0.00E+00	0.00E+00	0.00E+00	6.29E-01	5.66E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_4	4.93E-09	3.28E-08	0.00E+00	0.00E+00	0.00E+00	5.98E-01	5.35E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_4D	4.95E-09	2.70E-08	0.00E+00	0.00E+00	0.00E+00	6.06E-01	5.41E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1769_F	4.76E-09	8.69E-08	0.00E+00	0.00E+00	0.00E+00	5.69E-01	5.06E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B21: Runs 1768, & 1769, fluid analyses (cont.)

B22: Runs 1770, 1771, & 1772

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1768_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	1.0870299	0.0	6.1	-11.4	22.3
1770_1	0.6M NaCl	HTL321	100	200	71	350	83.4	1.37E-03	0	0.0E+00	8.17	124.9	44.5
1770_2	0.6M NaCl	HTL321	100	200	239	336	108.5	1.78E-03	0	0.0E+00	7.92	-38.6	48.9
1770_3	0.6M NaCl	HTL321	100	200	409	323	106.9	1.75E-03	0.002802	5.0E-08	7.59		51.5
1770_4	0.6M NaCl	HTL321	100	200	577	310	104.7	1.72E-03	0	0.0E+00	8	152.9	43.9
1770_4D	0.6M NaCl	HTL321	100	200	577	295			0	0.0E+00	8.02	139.6	42.3
1770_F	0.6M NaCl	HTL321	100	200	579	283 (194)	102.4	1.68E-03	0.002802	5.0E-08	7.97	134.6	35.8
1768_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	1.0870299	0.0	6.1	-11.4	22.3
1771_1	0.6M NaCl	HTL324	100	200	71	350	109.0	1.79E-03	0.096432	1.7E-06	6.57	-35.6	44
1771_2	0.6M NaCl	HTL324	100	200	239	338	0.0	0.00E+00	0	0.0E+00	7.03	-57.5	39.2
1771_3	0.6M NaCl	HTL324	100	200	409	326	0.0	0.00E+00	0.09019	1.6E-06	6.72		49.7
1771_4	0.6M NaCl	HTL324	100	200	578	312	0.0	0.00E+00	0	0.0E+00	7.06	139.3	45.9
1771_4D	0.6M NaCl	HTL324	100	200	578	299	0.0	0.00E+00	0.009044	1.6E-07	6.96	152.7	40.2
1771_F	0.6M NaCl	HTL324	100	200	579	288.2 (252)	0.0	0.00E+00	0.002802	5.0E-08	7.01	200.5	36
1777_0	0.1M HCl, 0.03M HNO3	N/A	N/A	N/A	-16			0.00E+00	0	0.0	0.92	490.2	Room
1772_1	0.1M HCl, 0.03M HNO3	HTLMix	200	200	-3	200			11.4695232	2.1E-04	0.95		22.4
1772_2	0.1M HCl, 0.03M HNO3	HTLMix	200	200	19	183			56.5115043	1.0E-03	2.43		37

Table B22: Runs 1770, 1771, & 1772, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	4.03E-06	0.00E+00	6.50E-01	3.46E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.09E-05	0.00E+00
1770_1	4.03E-06	0.00E+00	6.10E-01	5.88E-04	0.00E+00	1.07E-04	0.00E+00	1.25E-03	7.16E-05	1.30E-03
1770_2	4.61E-06	0.00E+00	5.73E-01	6.57E-04	0.00E+00	1.44E-04	0.00E+00	1.25E-03	8.18E-05	1.60E-03
1770_3	4.61E-06	0.00E+00	5.94E-01	6.65E-04	4.15E-06	1.58E-04	0.00E+00	1.62E-03	8.18E-05	1.50E-03
1770_4	4.03E-06	0.00E+00	5.91E-01	6.67E-04	1.04E-06	1.64E-04	0.00E+00	1.37E-03	7.16E-05	1.40E-03
1770_4D	3.46E-06	0.00E+00	5.82E-01	6.55E-04	1.19E-06	1.65E-04	0.00E+00	1.25E-03	7.16E-05	1.60E-03
1770_F	3.46E-06	0.00E+00	5.92E-01	6.71E-04	0.00E+00	1.69E-04	0.00E+00	1.25E-03	9.21E-05	1.50E-03
1768_0	4.03E-06	0.00E+00	6.50E-01	3.46E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.09E-05	0.00E+00
1771_1	0.00E+00	0.00E+00	6.22E-01	1.39E-04	1.41E-05	1.50E-04	0.00E+00	0.00E+00	1.53E-04	4.99E-04
1771_2	0.00E+00	0.00E+00	5.93E-01	1.55E-04	0.00E+00	2.05E-04	0.00E+00	0.00E+00	1.64E-04	5.99E-04
1771_3	0.00E+00	0.00E+00	5.94E-01	1.34E-04	0.00E+00	2.39E-04	0.00E+00	0.00E+00	1.64E-04	5.99E-04
1771_4	0.00E+00	0.00E+00	5.88E-01	1.22E-04	0.00E+00	2.68E-04	0.00E+00	9.98E-04	1.74E-04	5.99E-04
1771_4D	0.00E+00	0.00E+00	5.80E-01	1.18E-04	0.00E+00	2.69E-04	0.00E+00	0.00E+00	1.64E-04	5.99E-04
1771_F	0.00E+00	0.00E+00	6.12E-01	1.26E-04	7.41E-07	2.78E-04	0.00E+00	9.98E-04	1.53E-04	6.99E-04
1777_0	0.00E+00	0.00E+00	0.00E+00	2.63E-06	1.78E-06	1.14E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1772_1	0.00E+00	1.55E-07	0.00E+00	1.30E-03	7.96E-05	6.12E-05	3.62E-05	0.00E+00	1.02E-04	2.20E-03
1772_2	7.90E-05	7.63E-07	1.22E-03	2.37E-03	1.89E-03	4.69E-03	3.75E-05	3.87E-03	8.18E-04	2.69E-03

Table B22: Runs 1770, 1771, & 1772, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	0.00E+00	0.00E+00	3.85E-08	0.00E+00	2.87E-07	0.00E+00	0.00E+00	1.89E-07	4.59E-06	0.00E+00
1770_1	0.00E+00	0.00E+00	3.85E-08	6.55E-07	2.87E-07	4.75E-09	3.00E-07	2.08E-07	2.02E-06	0.00E+00
1770_2	0.00E+00	0.00E+00	4.62E-08	7.86E-07	2.87E-07	9.50E-09	5.32E-07	2.01E-07	2.02E-06	0.00E+00
1770_3	0.00E+00	0.00E+00	5.39E-08	7.06E-07	7.16E-07	0.00E+00	1.91E-07	3.15E-07	2.02E-06	0.00E+00
1770_4	0.00E+00	0.00E+00	4.62E-08	5.39E-07	1.15E-06	0.00E+00	7.50E-08	2.39E-07	2.08E-06	0.00E+00
1770_4D	0.00E+00	0.00E+00	3.85E-08	4.88E-07	5.01E-07	0.00E+00	4.77E-08	1.83E-07	1.90E-06	0.00E+00
1770_F	0.00E+00	0.00E+00	3.85E-08	3.86E-07	5.01E-07	0.00E+00	2.73E-08	2.27E-07	2.63E-06	0.00E+00
1768_0	0.00E+00	0.00E+00	3.85E-08	0.00E+00	2.87E-07	0.00E+00	0.00E+00	1.89E-07	4.59E-06	0.00E+00
1771_1	0.00E+00	0.00E+00	6.15E-08	3.99E-06	1.07E-05	1.83E-08	8.18E-08	3.27E-07	8.99E-06	0.00E+00
1771_2	0.00E+00	2.36E-08	3.85E-08	2.37E-06	5.01E-07	4.07E-09	3.41E-08	2.01E-07	4.04E-06	0.00E+00
1771_3	0.00E+00	0.00E+00	3.85E-08	1.37E-06	9.38E-06	1.22E-08	1.34E-06	3.46E-07	5.32E-06	0.00E+00
1771_4	0.00E+00	0.00E+00	4.62E-08	7.21E-07	7.16E-07	0.00E+00	1.84E-07	3.34E-07	4.10E-06	0.00E+00
1771_4D	0.00E+00	0.00E+00	6.15E-08	7.06E-07	1.36E-06	0.00E+00	7.50E-08	2.01E-07	3.55E-06	0.00E+00
1771_F	0.00E+00	3.14E-08	3.85E-08	7.14E-07	4.30E-07	0.00E+00	2.04E-08	1.70E-07	4.41E-06	0.00E+00
1777_0	0.00E+00	0.00E+00	1.54E-08	0.00E+00	2.15E-07	0.00E+00	0.00E+00	2.08E-07	1.59E-06	0.00E+00
1772_1	2.86E-05	2.04E-07	7.00E-07	1.03E-04	4.60E-04	2.70E-07	8.11E-07	3.12E-06	2.37E-05	7.46E-08
1772_2	1.60E-05	5.89E-07	2.62E-07	1.39E-04	2.16E-03	4.21E-07	1.50E-07	2.39E-07	2.04E-03	6.88E-08

Table B22: Runs 1770, 1771, & 1772, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	5.87E-07	0.00E+00	9.36E-09	1.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1770_1	0.00E+00	0.00E+00	2.81E-08	5.75E-07	0.00E+00	0.00E+00	0.00E+00	2.08E-07	1.85E-09	0.00E+00
1770_2	0.00E+00	0.00E+00	2.81E-08	6.53E-07	0.00E+00	0.00E+00	0.00E+00	1.92E-07	0.00E+00	1.07E-09
1770_3	0.00E+00	0.00E+00	3.28E-08	6.67E-07	0.00E+00	0.00E+00	0.00E+00	4.09E-07	0.00E+00	0.00E+00
1770_4	0.00E+00	0.00E+00	2.81E-08	6.53E-07	0.00E+00	1.32E-09	0.00E+00	3.04E-07	0.00E+00	0.00E+00
1770_4D	0.00E+00	0.00E+00	2.81E-08	6.44E-07	0.00E+00	0.00E+00	0.00E+00	2.21E-07	0.00E+00	0.00E+00
1770_F	0.00E+00	0.00E+00	2.81E-08	7.17E-07	9.00E-10	0.00E+00	0.00E+00	1.96E-07	2.97E-09	0.00E+00
1768_0	5.87E-07	0.00E+00	9.36E-09	1.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1771_1	0.00E+00	0.00E+00	1.59E-07	3.10E-07	0.00E+00	0.00E+00	0.00E+00	7.92E-08	2.52E-08	2.60E-08
1771_2	0.00E+00	0.00E+00	1.87E-07	3.06E-07	0.00E+00	0.00E+00	0.00E+00	8.34E-08	0.00E+00	3.56E-09
1771_3	1.07E-07	0.00E+00	1.92E-07	3.01E-07	0.00E+00	1.75E-09	0.00E+00	1.55E-06	0.00E+00	1.78E-09
1771_4	2.14E-07	0.00E+00	1.92E-07	3.29E-07	0.00E+00	0.00E+00	0.00E+00	5.25E-07	0.00E+00	0.00E+00
1771_4D	2.14E-07	0.00E+00	1.83E-07	2.97E-07	0.00E+00	0.00E+00	0.00E+00	3.21E-07	0.00E+00	0.00E+00
1771_F	2.67E-07	0.00E+00	1.92E-07	2.97E-07	0.00E+00	0.00E+00	0.00E+00	1.88E-07	0.00E+00	0.00E+00
1777_0	0.00E+00	0.00E+00	0.00E+00	3.20E-08	0.00E+00	1.75E-09	0.00E+00	0.00E+00	0.00E+00	1.07E-09
1772_1	5.34E-07	0.00E+00	1.08E-07	1.09E-06	1.23E-06	3.90E-08	0.00E+00	2.08E-08	4.82E-09	1.25E-08
1772_2	3.74E-07	0.00E+00	2.26E-06	1.64E-06	1.41E-06	5.09E-08	9.04E-10	3.34E-08	0.00E+00	4.90E-06

Table B22: Runs 1770, 1771, & 1772, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	2.36E-09	0.00E+00	0.00E+00	5.06E-06	4.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1770_1	2.02E-09	8.87E-08	5.42E-09	1.37E-05	3.74E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1770_2	1.68E-09	7.56E-08	5.42E-09	1.38E-05	3.17E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E-10
1770_3	2.70E-09	7.23E-08	5.72E-09	1.53E-05	4.61E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1770_4	2.36E-09	7.23E-08	5.42E-09	1.34E-05	5.18E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1770_4D	3.03E-09	6.90E-08	5.12E-09	1.36E-05	4.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E-10
1770_F	3.03E-09	7.23E-08	5.42E-09	1.64E-05	4.90E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_0	2.36E-09	0.00E+00	0.00E+00	5.06E-06	4.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1771_1	2.70E-09	0.00E+00	8.43E-09	1.77E-05	4.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E-10
1771_2	3.03E-09	0.00E+00	8.73E-09	1.76E-05	5.47E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1771_3	2.36E-09	0.00E+00	8.13E-09	1.55E-05	3.74E-10	0.00E+00	0.00E+00	0.00E+00	5.32E-10	0.00E+00
1771_4	2.02E-09	0.00E+00	7.83E-09	1.67E-05	4.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1771_4D	2.36E-09	0.00E+00	8.43E-09	1.55E-05	5.18E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1771_F	3.03E-09	0.00E+00	7.83E-09	1.21E-05	4.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1777_0	2.02E-09	0.00E+00	0.00E+00	6.99E-07	2.30E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1772_1	4.82E-08	1.45E-07	6.41E-08	1.40E-05	4.09E-06	7.04E-06	7.92E-07	3.19E-06	7.00E-07	3.06E-07
1772_2	7.11E-08	5.91E-08	4.05E-07	1.05E-05	3.34E-06	6.30E-06	7.81E-07	3.44E-06	7.58E-07	3.80E-07

Table B22: Runs 1770, 1771, & 1772, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1770_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.31E-10	0.00E+00	0.00E+00	1.74E-08
1770_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.74E-08
1770_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.74E-08
1770_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.74E-08
1770_4D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.96E-08
1770_F	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.08E-10	0.00E+00	0.00E+00	1.74E-08
1768_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1771_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1771_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1771_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.61E-08
1771_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.39E-08
1771_4D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.08E-10	0.00E+00	0.00E+00	2.39E-08
1771_F	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.61E-08
1777_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1772_1	5.16E-08	5.39E-07	1.85E-07	2.07E-08	4.26E-08	3.72E-09	1.83E-08	2.10E-09	0.00E+00	0.00E+00
1772_2	6.02E-08	6.02E-07	2.07E-07	2.41E-08	4.65E-08	3.91E-09	2.05E-08	2.58E-09	0.00E+00	0.00E+00

Table B22: Runs 1770, 1771, & 1772, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1770_1	1.14E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.94E-01	3.82E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1770_2	1.10E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.18E-01	4.07E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1770_3	1.10E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.13E-01	4.08E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1770_4	1.08E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.04E-01	3.96E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1770_4D	1.00E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.23E-01	4.25E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1770_F	7.42E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.02E-01	3.99E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1771_1	2.35E-09	2.70E-08	0.00E+00	0.00E+00	0.00E+00	5.94E-01	1.33E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.82E-04
1771_2	1.96E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.02E-01	1.36E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.91E-04
1771_3	1.47E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.09E-01	1.45E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.89E-04
1771_4	1.43E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.98E-01	1.35E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.25E-04
1771_4D	1.19E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.92E-01	1.29E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.21E-04
1771_F	1.12E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.09E-01	1.36E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.98E-04
1777_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00							
1772_1	1.72E-09	1.11E-04	1.31E-09	1.68E-09	6.72E-10							
1772_2	1.70E-08	1.31E-03	2.93E-10	0.00E+00	8.96E-10							

Table B22: Runs 1770, 1771, & 1772, fluid analyses (cont.)

B23: Runs 1773, & 1774

Table B23: Runs 1773, & 1774, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1758_0	DI	N/A	N/A	N/A			0.0	0.00E+00	<0.5	0.0	5.98	203.9	20.2
1773/1	DI Water	HTLMix	200	200	27	150	271	4.44E-03	2.3	4.1E-05	8.03		46.4
1773/2	DI Water	HTLMix	200	200	142	138	966.8	1.58E-02	0.4	6.7E-06	9.86	-207.4	31
1773/3	DI Water	HTLMix	200	200	192	124	1130.4	1.85E-02	2.3	4.1E-05	10.21	-190.4	Room
1773/4	DI Water	HTLMix	200	200	336	114	1410.4	2.31E-02	3.1	5.6E-05	10.04	-159.8	Room
1773/5	DI Water	HTLMix	200	200	552	105					8.91		Room
1768_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	1.1	0.0	6.1	-11.4	22.3
1774/1	0.6M NaCl	HTLMix	200	200	115	100	612.4	1.00E-02	2.1	3.7E-05	8.4	-162.6	42.6
1774/2	0.6M NaCl	HTLMix	200	200	166	86	999.2	1.64E-02	1.6	2.9E-05	9.49	-96	Room
1774/3	0.6M NaCl	HTLMix	200	200	262	76					9.17		Room

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1758_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.27E-05	0.00E+00	0.00E+00	4.91E-05	0.00E+00
1773/1	7.49E-06	0.00E+00	0.00E+00	5.18E-05	5.19E-06	2.78E-03	4.13E-05	0.00E+00	1.33E-04	2.99E-04
1773/2	1.38E-05	3.99E-08	0.00E+00	7.57E-06	1.19E-05	4.62E-03	3.75E-05	0.00E+00	1.64E-04	0.00E+00
1773/3	1.27E-05	8.43E-08	1.57E-03	9.71E-06	2.12E-05	4.80E-03	2.45E-05	0.00E+00	2.35E-04	0.00E+00
1773/4	1.67E-05	1.78E-07	2.09E-03	8.06E-06	7.00E-05	5.74E-03	2.32E-05	0.00E+00	2.76E-04	0.00E+00
1773/5	9.80E-06	0.00E+00	2.23E-03	8.23E-06	4.00E-06	0.00E+00	5.17E-06	1.25E-04	5.73E-04	0.00E+00
1768_0	4.03E-06	0.00E+00	6.50E-01	3.46E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.09E-05	0.00E+00
1774/1	3.63E-05	8.88E-09	9.57E-01	1.31E-04	5.04E-06	3.93E-03	2.84E-05	2.37E-03	3.27E-04	9.98E-04
1774/2	6.22E-05	4.84E-07	1.02E+00	1.14E-05	9.04E-06	7.86E-03	3.23E-05	2.99E-03	7.06E-04	0.00E+00
1774/3	1.79E-05	3.46E-07	2.51E-01	2.29E-05	1.29E-05	1.95E-03	0.00E+00	0.00E+00	1.45E-03	7.98E-04

Table B23: Runs 1773, & 1774, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1758_0	5.85E-08	0.00E+00	3.08E-08	1.46E-08	2.15E-07	0.00E+00	0.00E+00	0.00E+00	7.34E-07	0.00E+00
1773/1	8.36E-08	7.85E-08	3.85E-08	5.82E-07	7.16E-07	0.00E+00	2.73E-08	1.89E-07	2.02E-06	0.00E+00
1773/2	4.60E-07	6.28E-08	4.62E-08	5.10E-08	7.88E-07	0.00E+00	2.04E-08	2.14E-07	3.43E-06	0.00E+00
1773/3	5.01E-08	0.00E+00	4.62E-08	2.91E-08	5.73E-07	0.00E+00	0.00E+00	2.83E-07	5.81E-06	0.00E+00
1773/4	1.34E-07	0.00E+00	6.15E-08	6.55E-08	7.16E-07	7.47E-09	2.73E-08	2.20E-07	8.20E-06	0.00E+00
1773/5	1.24E-06	3.14E-08	1.00E-07	1.75E-07	9.31E-07	1.49E-08	2.45E-08	7.55E-08	8.38E-06	0.00E+00
1768_0	0.00E+00	0.00E+00	3.85E-08	0.00E+00	2.87E-07	0.00E+00	0.00E+00	1.89E-07	4.59E-06	0.00E+00
1774/1	0.00E+00	0.00E+00	5.39E-08	8.83E-06	1.65E-06	0.00E+00	4.09E-08	2.01E-07	2.14E-05	0.00E+00
1774/2	2.77E-06	0.00E+00	4.62E-08	7.56E-06	1.27E-05	0.00E+00	0.00E+00	2.77E-07	2.84E-05	0.00E+00
1774/3	2.29E-05	2.36E-08	5.31E-07	2.48E-06	2.37E-05	5.77E-08	2.19E-06	3.15E-07	1.86E-05	0.00E+00

Table B23: Runs 1773, & 1774, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1758_0	0.00E+00	0.00E+00	4.68E-09	1.37E-08	0.00E+00	0.00E+00	0.00E+00	5.42E-09	0.00E+00	0.00E+00
1773/1	1.98E-06	0.00E+00	2.62E-07	3.47E-07	0.00E+00	0.00E+00	0.00E+00	7.09E-08	0.00E+00	1.42E-09
1773/2	5.34E-07	0.00E+00	3.14E-07	1.23E-07	0.00E+00	2.63E-09	0.00E+00	4.17E-08	0.00E+00	0.00E+00
1773/3	0.00E+00	0.00E+00	3.32E-07	2.74E-07	0.00E+00	8.77E-09	0.00E+00	1.67E-08	0.00E+00	0.00E+00
1773/4	0.00E+00	0.00E+00	3.84E-07	3.38E-07	9.00E-10	3.90E-08	0.00E+00	6.25E-08	0.00E+00	0.00E+00
1773/5	2.14E-08	0.00E+00	1.45E-07	3.38E-07	9.90E-10	1.45E-08	0.00E+00	7.09E-09	2.63E-08	7.12E-10
1768_0	5.87E-07	0.00E+00	9.36E-09	1.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1774/1	2.88E-06	0.00E+00	8.14E-07	7.76E-07	0.00E+00	0.00E+00	0.00E+00	1.29E-07	0.00E+00	3.17E-08
1774/2	2.67E-07	1.01E-07	1.78E-06	2.42E-07	1.80E-09	2.04E-06	2.02E-09	4.17E-08	4.08E-09	7.12E-10
1774/3	0.00E+00	0.00E+00	7.07E-07	1.83E-06	4.50E-09	1.65E-06	1.64E-09	6.25E-08	7.79E-09	1.03E-08

Table B23: Runs 1773, & 1774, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1758_0	2.02E-09	1.31E-09	0.00E+00	6.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1773/1	4.72E-09	4.79E-06	1.63E-07	4.21E-06	9.21E-10	1.43E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1773/2	1.04E-08	1.45E-07	2.16E-07	4.21E-06	1.44E-09	2.57E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1773/3	6.74E-09	2.30E-08	2.14E-07	9.55E-06	2.82E-09	3.71E-09	0.00E+00	1.39E-09	0.00E+00	0.00E+00
1773/4	7.41E-09	2.63E-08	2.26E-07	1.13E-05	1.01E-09	1.71E-09	0.00E+00	0.00E+00	5.32E-10	0.00E+00
1773/5	0.00E+00	1.69E-08	0.00E+00	9.73E-06	1.44E-09	2.00E-09	0.00E+00	0.00E+00	0.00E+00	1.58E-10
1768_0	2.36E-09	0.00E+00	0.00E+00	5.06E-06	4.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1774/1	1.65E-08	4.84E-06	2.50E-07	7.91E-06	6.05E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	1.32E-10
1774/2	4.58E-08	9.53E-08	3.07E-07	7.86E-06	1.09E-09	1.43E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1774/3	2.16E-08	2.30E-08	8.28E-08	3.50E-05	1.56E-09	2.00E-09	0.00E+00	2.22E-09	0.00E+00	2.63E-10

Table B23: Runs 1773, & 1774, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1758_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1773/1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1773/2	0.00E+00	1.78E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.35E-08
1773/3	0.00E+00	0.00E+00	1.48E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.79E-08
1773/4	0.00E+00	0.00E+00	1.72E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.22E-08
1773/5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1774/1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.53E-08
1774/2	4.03E-10	6.87E-10	4.92E-10	4.37E-10	2.39E-10	3.31E-10	5.78E-10	3.89E-10	3.09E-09	3.70E-08
1774/3	0.00E+00	0.00E+00	3.20E-10	0.00E+00	0.00E+00	0.00E+00	3.93E-10	4.57E-11	1.55E-09	0.00E+00

Table B23: Runs 1773, & 1774, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1758_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1773/1	1.41E-09	5.68E-07	0.00E+00	0.00E+00	0.00E+00	3.07E-04	2.38E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.22E-04
1773/2	8.61E-10	6.99E-07	0.00E+00	0.00E+00	0.00E+00	5.21E-04	2.38E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.66E-03
1773/3	5.87E-10	1.75E-06	1.03E-10	0.00E+00	0.00E+00	1.04E-03	2.62E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.48E-03
1773/4	8.42E-10	3.80E-07	8.62E-11	0.00E+00	8.96E-10	1.23E-03	2.47E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.91E-02
1773/5	2.35E-09	3.28E-07	0.00E+00	1.51E-10	0.00E+00							
1768_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1774/1	4.83E-09	7.16E-07	0.00E+00	0.00E+00	0.00E+00	9.93E-01	5.60E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.65E-03
1774/2	7.32E-09	1.74E-08	7.93E-10	0.00E+00	2.33E-08	1.01E+00	5.92E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.20E-02
1774/3	1.49E-09	1.16E-08	5.52E-10	3.19E-09	1.64E-08							

Table B23: Runs 1773, & 1774, fluid analyses (cont.)

B24: Runs 1775, & 1776

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1768_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	1.1	0.0	6.1	-11.4	22.3
1775_1	0.6M NaCl	HTL320	100	200	43	350	78.2	1.28E-03	0.0	0.0E+00	9.78	171.6	Room
1775/2	0.6M NaCl	HTL320	100	200	235	338	86.9	1.42E-03	0.0	0.0E+00	10.09	138.9	Room
1775/3	0.6M NaCl	HTL320	100	200	408	325	96.2	1.58E-03	0.0	5.0E-08	10.05	175.9	Room
1775/4	0.6M NaCl	HTL320	100	200	572	313	67.3	1.10E-03	0.0	0.0E+00	9.95	36.3	Room
1775/F	0.6M NaCl	HTL320	100	200	669	300	109.6	1.80E-03	0.0	5.0E-08	9.37	145.7	44.9
1775/FD	0.6M NaCl	HTL320	100	200	669	287	66.0	1.08E-03	0.0	0.0E+00	9.47	80.4	36.8
1775/REM	0.6M NaCl	HTL320	100	200	672	276.7 (258)	115.4	1.89E-03	0.0	1.6E-07	9.65	111.2	36.9
1768_0	0.6M NaCl	N/A	N/A	N/A			0.0	0.00E+00	1.1	0.0	6.1	-11.4	22.3
1776_1	0.6M NaCl	HTL322	100	200	45	350	97.7	1.60E-03	0.0	0.0E+00	7.76	194.1	Room
1776/2	0.6M NaCl	HTL322	100	200	235	338			0.6	1.0E-05	7.1	-53.3	Room
1776/3	0.6M NaCl	HTL322	100	200	408	326	183.2	3.00E-03	0.0	0.0E+00	7.94	151.6	Room
1776/4	0.6M NaCl	HTL322	100	200	572	314	151.3	2.48E-03	0.0	0.0E+00	7.93	91.4	Room
1776/F	0.6M NaCl	HTL322	100	200	669	300			0.0	0.0E+00	7.53	113.8	39.6
1776/FD	0.6M NaCl	HTL322	100	200	669	287			0.0	0.0E+00	7.44	105.3	39.9
1776/REM	0.6M NaCl	HTL322	100	200	672	276.4 (254)			0.0	3.9E-07	6.95	21	33.9

Table B24: Runs 1775, & 1776, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	4.03E-06	0.00E+00	6.50E-01	3.46E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.09E-05	0.00E+00
1775_1	9.80E-06	0.00E+00	6.02E-01	3.84E-04	0.00E+00	3.70E-05	0.00E+00	0.00E+00	8.18E-05	4.99E-04
1775/2	9.22E-06	0.00E+00	5.81E-01	4.96E-04	5.93E-07	3.56E-05	0.00E+00	0.00E+00	1.13E-04	2.99E-04
1775/3	2.31E-06	0.00E+00	5.93E-01	4.93E-04	0.00E+00	0.00E+00	0.00E+00	1.25E-04	1.13E-04	4.99E-04
1775/4	8.64E-06	0.00E+00	6.27E-01	5.84E-04	1.19E-06	6.27E-05	0.00E+00	0.00E+00	1.33E-04	4.99E-04
1775/F	8.07E-06	0.00E+00	5.95E-01	5.13E-04	2.52E-06	6.69E-05	0.00E+00	0.00E+00	1.23E-04	4.99E-04
1775/FD	6.92E-06	0.00E+00	5.74E-01	5.25E-04	8.89E-07	5.98E-05	0.00E+00	0.00E+00	8.18E-05	3.99E-04
1775/REM	6.92E-06	0.00E+00	6.47E-01	6.26E-04	1.04E-06	6.69E-05	0.00E+00	0.00E+00	7.16E-05	4.99E-04
1768_0	4.03E-06	0.00E+00	6.50E-01	3.46E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.09E-05	0.00E+00
1776_1	6.34E-06	1.33E-08	5.94E-01	1.14E-04	1.63E-06	5.27E-05	0.00E+00	0.00E+00	1.33E-04	1.20E-03
1776/2	4.03E-06	0.00E+00	5.96E-01	2.18E-04	2.08E-06	1.01E-04	0.00E+00	0.00E+00	1.33E-04	1.40E-03
1776/3	1.44E-05	0.00E+00	6.25E-01	2.67E-04	0.00E+00	0.00E+00	0.00E+00	1.25E-04	1.64E-04	1.30E-03
1776/4	5.76E-06	0.00E+00	6.14E-01	3.25E-04	0.00E+00	9.26E-05	0.00E+00	1.12E-03	1.53E-04	1.20E-03
1776/F	4.61E-06	0.00E+00	5.73E-01	3.51E-04	5.93E-07	9.83E-05	0.00E+00	0.00E+00	1.13E-04	1.20E-03
1776/FD	4.61E-06	0.00E+00	5.88E-01	3.34E-04	0.00E+00	9.54E-05	0.00E+00	0.00E+00	1.02E-04	1.30E-03
1776/REM	4.03E-06	0.00E+00	5.77E-01	3.54E-04	0.00E+00	9.83E-05	0.00E+00	0.00E+00	9.21E-05	1.30E-03

Table B24: Runs 1775, & 1776, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	0.00E+00	0.00E+00	3.85E-08	0.00E+00	2.87E-07	0.00E+00	0.00E+00	1.89E-07	4.59E-06	0.00E+00
1775_1	0.00E+00	0.00E+00	6.92E-08	6.55E-08	2.87E-07	0.00E+00	1.16E-07	4.91E-07	2.75E-06	0.00E+00
1775/2	0.00E+00	0.00E+00	9.23E-08	2.18E-08	3.58E-07	4.75E-09	4.09E-08	2.71E-07	2.94E-06	0.00E+00
1775/3	0.00E+00	0.00E+00	9.23E-08	0.00E+00	5.01E-07	6.11E-09	3.07E-08	2.45E-07	2.39E-06	0.00E+00
1775/4	0.00E+00	3.14E-08	8.46E-08	0.00E+00	3.58E-07	4.07E-09	4.09E-08	2.77E-07	1.96E-06	0.00E+00
1775/F	0.00E+00	0.00E+00	4.62E-08	0.00E+00	7.16E-07	4.07E-09	2.73E-08	2.08E-07	1.04E-06	0.00E+00
1775/FD	0.00E+00	0.00E+00	6.15E-08	0.00E+00	1.00E-06	0.00E+00	2.04E-08	1.83E-07	1.04E-06	0.00E+00
1775/REM	0.00E+00	0.00E+00	6.92E-08	2.18E-08	1.22E-06	0.00E+00	2.04E-08	2.14E-07	1.10E-06	0.00E+00
1768_0	0.00E+00	0.00E+00	3.85E-08	0.00E+00	2.87E-07	0.00E+00	0.00E+00	1.89E-07	4.59E-06	0.00E+00
1776_1	6.69E-08	0.00E+00	6.92E-08	4.80E-06	2.87E-07	3.19E-08	9.06E-07	3.59E-07	5.76E-05	0.00E+00
1776/2	0.00E+00	0.00E+00	3.08E-08	7.12E-06	5.66E-05	7.60E-08	3.46E-06	1.20E-07	4.31E-05	0.00E+00
1776/3	0.00E+00	0.00E+00	7.69E-08	5.16E-06	2.87E-07	1.70E-08	1.91E-07	2.33E-07	1.59E-05	0.00E+00
1776/4	0.00E+00	0.00E+00	6.92E-08	4.38E-06	0.00E+00	1.02E-08	1.09E-07	1.01E-07	1.95E-05	0.00E+00
1776/F	0.00E+00	0.00E+00	4.62E-08	4.73E-06	1.43E-07	4.75E-09	8.86E-08	8.18E-08	2.90E-05	0.00E+00
1776/FD	0.00E+00	0.00E+00	3.85E-08	4.65E-06	0.00E+00	4.07E-09	5.45E-08	6.92E-08	4.33E-05	0.00E+00
1776/REM	0.00E+00	0.00E+00	4.62E-08	4.44E-06	2.36E-06	7.47E-09	1.36E-08	5.67E-08	1.99E-04	0.00E+00

Table B24: Runs 1775, & 1776, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	5.87E-07	0.00E+00	9.36E-09	1.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1775_1	1.60E-07	0.00E+00	2.34E-08	4.20E-07	0.00E+00	1.75E-09	3.44E-10	3.04E-07	2.60E-09	0.00E+00
1775/2	1.07E-07	0.00E+00	3.74E-08	5.30E-07	0.00E+00	1.75E-09	0.00E+00	4.25E-07	0.00E+00	0.00E+00
1775/3	1.87E-07	0.00E+00	4.68E-08	5.34E-07	9.00E-10	0.00E+00	0.00E+00	3.51E-07	0.00E+00	0.00E+00
1775/4	1.60E-07	0.00E+00	4.21E-08	5.66E-07	9.00E-10	2.63E-09	0.00E+00	3.29E-07	7.42E-09	0.00E+00
1775/F	1.60E-07	0.00E+00	2.81E-08	4.98E-07	0.00E+00	2.63E-09	0.00E+00	3.38E-07	9.31E-08	0.00E+00
1775/FD	1.60E-07	0.00E+00	2.81E-08	4.93E-07	0.00E+00	3.07E-09	0.00E+00	2.84E-07	2.60E-09	0.00E+00
1775/REM	1.60E-07	0.00E+00	2.34E-08	5.48E-07	0.00E+00	2.19E-09	0.00E+00	3.34E-07	0.00E+00	0.00E+00
1768_0	5.87E-07	0.00E+00	9.36E-09	1.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1776_1	0.00E+00	0.00E+00	7.96E-08	5.97E-05	4.50E-09	1.32E-09	0.00E+00	1.63E-07	1.71E-08	7.85E-06
1776/2	0.00E+00	0.00E+00	7.96E-08	8.07E-05	3.15E-09	0.00E+00	0.00E+00	7.09E-08	1.41E-08	1.38E-05
1776/3	1.60E-08	0.00E+00	1.08E-07	9.77E-05	5.13E-09	0.00E+00	0.00E+00	9.42E-08	4.45E-09	1.49E-05
1776/4	0.00E+00	0.00E+00	9.36E-08	1.01E-04	4.05E-09	1.75E-09	0.00E+00	8.34E-08	1.08E-08	1.59E-05
1776/F	0.00E+00	0.00E+00	9.36E-08	1.03E-04	3.15E-09	1.32E-09	0.00E+00	7.50E-08	0.00E+00	1.68E-05
1776/FD	0.00E+00	0.00E+00	8.89E-08	1.01E-04	3.60E-09	0.00E+00	0.00E+00	6.25E-08	0.00E+00	1.64E-05
1776/REM	0.00E+00	0.00E+00	7.49E-08	1.04E-04	2.25E-09	0.00E+00	0.00E+00	4.59E-08	2.22E-09	1.67E-05

Table B24: Runs 1775, & 1776, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	2.36E-09	0.00E+00	0.00E+00	5.06E-06	4.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1775_1	2.70E-09	0.00E+00	1.20E-09	1.84E-05	3.46E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1775/2	4.38E-09	2.30E-08	1.20E-09	2.43E-05	4.61E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1775/3	0.00E+00	2.45E-08	0.00E+00	2.66E-05	6.62E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1775/4	4.04E-09	2.30E-08	1.50E-09	2.72E-05	6.62E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	2.11E-10
1775/F	4.04E-09	2.63E-08	1.20E-09	1.34E-05	4.90E-10	0.00E+00	0.00E+00	0.00E+00	5.32E-10	0.00E+00
1775/FD	6.07E-09	2.63E-08	1.20E-09	1.43E-05	3.74E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1775/REM	7.41E-09	2.96E-08	1.50E-09	1.38E-05	4.03E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_0	2.36E-09	0.00E+00	0.00E+00	5.06E-06	4.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1776_1	1.35E-09	1.61E-07	6.32E-09	1.14E-04	2.02E-09	8.56E-10	0.00E+00	0.00E+00	7.98E-10	0.00E+00
1776/2	1.68E-09	6.90E-08	4.82E-09	8.97E-05	1.64E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1776/3	0.00E+00	1.06E-07	0.00E+00	1.04E-04	1.47E-09	0.00E+00	0.00E+00	0.00E+00	1.06E-09	0.00E+00
1776/4	0.00E+00	9.20E-08	5.72E-09	9.40E-05	1.32E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1776/F	1.68E-09	1.97E-07	6.02E-09	7.92E-05	1.44E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1776/FD	0.00E+00	2.00E-07	6.02E-09	7.85E-05	1.38E-09	0.00E+00	0.00E+00	0.00E+00	5.32E-10	0.00E+00
1776/REM	1.68E-09	2.04E-07	5.42E-09	4.32E-05	9.21E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B24: Runs 1775, & 1776, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1775_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E-10	0.00E+00	0.00E+00	2.22E-07
1775/2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.31E-10	6.86E-11	0.00E+00	3.44E-07
1775/3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.82E-07
1775/4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.85E-10	0.00E+00	0.00E+00	4.37E-07
1775/F	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.42E-07
1775/FD	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.42E-07
1775/REM	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.96E-07
1768_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1776_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.16E-10	1.60E-10	0.00E+00	0.00E+00
1776/2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.47E-10	9.14E-11	0.00E+00	0.00E+00
1776/3	0.00E+00	1.02E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-09
1776/4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.32E-10	1.60E-10	0.00E+00	0.00E+00
1776/F	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.32E-10	1.37E-10	0.00E+00	0.00E+00
1776/FD	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.93E-10	1.83E-10	0.00E+00	0.00E+00
1776/REM	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.24E-10	6.86E-11	0.00E+00	0.00E+00

Table B24: Runs 1775, & 1776, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1768_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1775_1	2.15E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.03E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1775/2	3.72E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.63E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1775/3	7.83E-10	3.86E-07	0.00E+00	3.53E-10	0.00E+00	6.28E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1775/4	4.50E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.18E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1775/F	3.33E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.19E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1775/FD	3.13E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.33E-01	0.00E+00	0.00E+00	0.00E+00	4.70E-05	0.00E+00	0.00E+00
1775/REM	3.13E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.66E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1768_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1776_1	1.56E-08	3.59E-05	0.00E+00	3.36E-10	0.00E+00	6.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1776/2	2.29E-08	2.40E-05	0.00E+00	0.00E+00	0.00E+00	6.38E-01	8.72E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1776/3	3.11E-08	2.41E-05	0.00E+00	0.00E+00	0.00E+00	6.40E-01	1.01E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1776/4	3.59E-08	2.83E-05	0.00E+00	0.00E+00	0.00E+00	6.26E-01	9.28E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1776/F	4.00E-08	3.82E-05	0.00E+00	0.00E+00	0.00E+00	6.20E-01	9.61E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1776/FD	3.93E-08	4.30E-05	0.00E+00	0.00E+00	0.00E+00	6.04E-01	9.02E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1776/REM	3.93E-08	1.27E-05	0.00E+00	0.00E+00	0.00E+00	5.92E-01	8.43E-05	3.29E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B24: Runs 1775, & 1776, fluid analyses (cont.)

B25: Runs 1777, & 1778

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1777_0	0.1M HCl, 0.03M HNO3	N/A	N/A	N/A	-16				0.0	0.0E+00	0.92	490.2	Room
1777_1	0.1M HCl, 0.03M HNO3	HTLMix	200	200	95	350			0.0	0.0E+00	1.17	129	Room
1777_2	0.1M HCl, 0.03M HNO3	HTLMix	200	200	189	337			0.0	5.0E-08	0.95	115.7	Room
1777_3	0.1M HCl, 0.03M HNO3	HTLMix	200	200	290	324	0	0.00E+00	0.0	0.0E+00	1.06	228.6	Room
1777/4	0.1M HCl, 0.03M HNO3	HTLMix	200	200	361	312	0	0.00E+00	0.0	0.0E+00	0.97	169.9	Room
1777/5	0.1M HCl, 0.03M HNO3	HTLMix	200	200	524	298 (281)			0.0	5.0E-08	1.14	292.6	Room
1778_0	0.1M HCl, 0.03M HNO3	N/A	N/A	N/A	0		0	0.00E+00	0.0	5.0E-08	0.86	528.7	20.3
1778_1	0.1M HCl, 0.03M HNO3	HTLMix	200	200	23	250	0	0.00E+00	OR	OR	1.09	251.4	34.5
1778_2	0.1M HCl, 0.03M HNO3	HTLMix	200	200	46	235	0	0.00E+00	OR	OR	1.13	314.3	44.3
1778_3	0.1M HCl, 0.03M HNO3	HTLMix	200	200	142	221	0	0.00E+00	OR	OR	1.16	340.5	40.3
1778_4	0.1M HCl, 0.03M HNO3	HTLMix	200	200	214	207	0	0.00E+00	OR	OR	1.21	311.7	39.6
1778_5	0.1M HCl, 0.03M HNO3	HTLMix	200	200	384	193	0	0.00E+00	OR	OR	1.51	343.2	40.5
1778/F	0.1M HCl, 0.03M HNO3	HTLMix	200	200	525	179	0	0.00E+00	OR	OR	1.56	336.7	40.9
1778/FD	0.1M HCl, 0.03M HNO3	HTLMix	200	200	525	164	0	0.00E+00	OR	OR	1.53	332.8	44.6
1778/R	0.1M HCl, 0.03M HNO3	HTLMix	200	200	527	154.7 (136)	0	0.00E+00	OR	OR	1.6	318.6	43.2

Table B25: Runs 1777, & 1778, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1777_0	0.00E+00	0.00E+00	0.00E+00	2.63E-06	1.78E-06	1.14E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1777_1	6.40E-05	1.15E-06	1.22E-03	2.58E-03	3.98E-03	8.62E-03	1.03E-05	2.25E-03	1.69E-03	2.69E-03
1777_2	7.78E-05	1.45E-06	1.13E-03	3.00E-03	6.32E-03	0.00E+00	9.04E-06	1.50E-03	2.34E-03	2.69E-03
1777_3	9.39E-05	1.64E-06	1.29E-03	3.25E-03	8.68E-03	0.00E+00	7.75E-06	1.25E-04	3.06E-03	2.89E-03
1777/4	1.03E-04	1.73E-06	1.29E-03	3.22E-03	1.00E-02	0.00E+00	9.04E-06	1.25E-04	3.36E-03	2.69E-03
1777/5	1.50E-04	2.11E-06	1.22E-03	3.63E-03	1.51E-02	1.46E-02	1.42E-05	0.00E+00	4.77E-03	3.39E-03
1778_0	0.00E+00	0.00E+00	0.00E+00	1.81E-06	7.41E-06	7.12E-06	0.00E+00	0.00E+00	6.14E-05	0.00E+00
1778_1	2.59E-05	6.21E-07	0.00E+00	2.35E-03	2.68E-03	3.08E+00	0.00E+00	7.24E-03	1.43E-03	0.00E+00
1778_2	2.59E-05	1.15E-06	0.00E+00	2.19E-03	2.20E-03	3.85E+00	0.00E+00	7.24E-03	1.64E-03	0.00E+00
1778_3	2.59E-05	9.76E-07	0.00E+00	2.37E-03	1.14E-03	5.38E+00	0.00E+00	7.24E-03	1.53E-03	0.00E+00
1778_4	2.59E-05	9.32E-07	0.00E+00	2.50E-03	9.17E-04	6.11E+00	0.00E+00	7.24E-03	1.74E-03	0.00E+00
1778_5	9.57E-05	1.15E-06	0.00E+00	2.67E-03	8.20E-04	7.33E+00	0.00E+00	7.24E-03	1.94E-03	5.59E-03
1778/F	9.68E-05	1.46E-06	0.00E+00	2.60E-03	8.59E-04	7.42E+00	0.00E+00	7.24E-03	1.84E-03	0.00E+00
1778/FD	1.02E-04	1.46E-06	0.00E+00	2.67E-03	9.42E-04	7.36E+00	0.00E+00	7.24E-03	1.94E-03	0.00E+00
1778/R	1.08E-04	1.33E-06	0.00E+00	2.58E-03	1.10E-03	7.51E+00	0.00E+00	7.24E-03	1.94E-03	0.00E+00

Table B25: Runs 1777, & 1778, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1777_0	0.00E+00	0.00E+00	1.54E-08	0.00E+00	2.15E-07	0.00E+00	0.00E+00	2.08E-07	1.59E-06	0.00E+00
1777_1	9.91E-06	2.80E-06	6.00E-05	1.53E-04	3.87E-03	3.83E-06	8.29E-05	1.57E-07	3.35E-03	1.32E-07
1777_2	8.97E-06	1.75E-06	1.80E-05	1.52E-04	3.18E-03	2.16E-06	4.30E-05	6.92E-08	3.32E-03	0.00E+00
1777_3	1.11E-05	8.17E-07	1.40E-05	1.59E-04	3.52E-03	2.26E-06	3.85E-05	4.41E-08	3.47E-03	0.00E+00
1777/4	1.26E-05	8.09E-07	1.21E-05	1.56E-04	3.34E-03	2.25E-06	4.02E-05	0.00E+00	3.11E-03	0.00E+00
1777/5	1.14E-05	3.69E-07	1.42E-05	1.80E-04	4.43E-03	2.78E-06	2.51E-05	1.76E-07	4.23E-03	1.09E-07
1778_0	0.00E+00	0.00E+00	3.08E-08	0.00E+00	1.00E-06	6.11E-09	1.36E-08	5.04E-08	1.24E-05	0.00E+00
1778_1	4.68E-06	1.81E-06	2.86E-05	2.43E-04	2.45E-03	5.09E-06	1.66E-04	5.85E-06	2.39E-03	1.15E-07
1778_2	1.34E-06	2.43E-06	2.88E-05	3.41E-04	4.31E-03	9.77E-06	3.82E-04	2.27E-06	2.32E-03	1.15E-07
1778_3	4.18E-07	3.30E-06	1.49E-05	3.86E-04	7.53E-03	1.11E-05	5.06E-04	0.00E+00	2.32E-03	1.15E-07
1778_4	4.18E-07	3.45E-06	9.62E-06	4.07E-04	9.40E-03	1.20E-05	5.56E-04	5.67E-07	2.41E-03	1.15E-07
1778_5	4.18E-07	3.93E-06	7.54E-06	4.58E-04	1.28E-02	1.45E-05	6.64E-04	3.34E-06	2.52E-03	1.15E-07
1778/F	2.17E-06	4.16E-06	4.15E-06	4.59E-04	1.49E-02	1.60E-05	7.31E-04	9.76E-06	2.44E-03	1.15E-07
1778/FD	4.18E-07	4.32E-06	5.54E-06	4.60E-04	1.45E-02	1.63E-05	7.26E-04	1.20E-05	2.45E-03	1.15E-07
1778/R	4.18E-07	4.55E-06	5.85E-06	4.71E-04	1.52E-02	1.66E-05	7.30E-04	1.45E-05	2.80E-03	1.15E-07

Table B25: Runs 1777, & 1778, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1777_0	0.00E+00	0.00E+00	0.00E+00	3.20E-08	0.00E+00	1.75E-09	0.00E+00	0.00E+00	0.00E+00	1.07E-09
1777_1	9.08E-06	0.00E+00	4.81E-06	2.74E-06	2.09E-06	4.74E-08	7.41E-09	1.04E-07	4.45E-09	9.34E-06
1777_2	9.70E-06	0.00E+00	7.60E-06	3.13E-06	2.18E-06	8.16E-08	1.38E-08	1.14E-07	2.97E-09	9.12E-06
1777_3	7.69E-06	0.00E+00	9.53E-06	3.42E-06	2.19E-06	1.09E-07	1.33E-08	1.22E-07	2.97E-09	8.99E-06
1777/4	1.23E-05	0.00E+00	1.08E-05	3.20E-06	2.19E-06	9.91E-08	7.75E-09	4.00E-08	0.00E+00	8.77E-06
1777/5	1.28E-06	0.00E+00	1.31E-05	2.47E-06	2.38E-06	9.43E-08	1.42E-08	5.84E-08	8.90E-09	1.04E-05
1778_0	0.00E+00	0.00E+00	2.34E-08	1.46E-07	1.35E-09	9.65E-09	0.00E+00	0.00E+00	0.00E+00	7.12E-10
1778_1	8.28E-06	4.05E-07	2.39E-06	1.78E-06	2.05E-06	0.00E+00	0.00E+00	2.08E-07	0.00E+00	7.07E-06
1778_2	9.66E-06	4.05E-07	2.95E-06	1.73E-06	1.99E-06	0.00E+00	0.00E+00	2.92E-07	0.00E+00	6.75E-06
1778_3	1.26E-05	4.05E-07	4.12E-06	2.01E-06	1.96E-06	0.00E+00	0.00E+00	2.92E-07	0.00E+00	6.79E-06
1778_4	1.29E-05	4.05E-07	4.82E-06	2.33E-06	2.04E-06	0.00E+00	0.00E+00	3.34E-07	0.00E+00	7.24E-06
1778_5	1.38E-05	4.05E-07	5.57E-06	2.74E-06	2.20E-06	0.00E+00	0.00E+00	4.59E-07	0.00E+00	7.39E-06
1778/F	1.42E-05	4.05E-07	6.27E-06	2.60E-06	2.02E-06	0.00E+00	0.00E+00	4.17E-07	1.11E-07	7.21E-06
1778/FD	1.47E-05	4.05E-07	6.04E-06	2.47E-06	2.07E-06	0.00E+00	0.00E+00	5.42E-07	5.19E-07	7.11E-06
1778/R	1.41E-05	4.05E-07	6.13E-06	2.51E-06	2.15E-06	0.00E+00	0.00E+00	1.83E-06	9.64E-07	7.20E-06

Table B25: Runs 1777, & 1778, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1777_0	2.02E-09	0.00E+00	0.00E+00	6.99E-07	2.30E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1777_1	2.97E-08	5.26E-08	3.89E-07	3.58E-05	4.74E-06	9.04E-06	1.15E-06	4.85E-06	1.15E-06	5.03E-07
1777_2	6.57E-08	1.62E-07	4.57E-07	3.66E-05	3.39E-06	7.07E-06	9.27E-07	4.53E-06	1.13E-06	4.91E-07
1777_3	3.43E-07	1.87E-07	5.00E-07	4.03E-05	2.84E-06	6.01E-06	8.17E-07	4.24E-06	1.11E-06	4.95E-07
1777/4	1.28E-07	1.64E-07	5.33E-07	3.45E-05	1.83E-06	4.87E-06	7.14E-07	3.94E-06	1.11E-06	4.76E-07
1777/5	2.19E-07	1.41E-07	6.73E-07	2.36E-05	2.90E-07	1.95E-06	4.94E-07	3.31E-06	1.13E-06	3.61E-07
1778_0	1.68E-09	0.00E+00	0.00E+00	1.23E-05	1.61E-09	5.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1778_1	6.74E-08	6.57E-07	3.52E-07	1.76E-05	4.49E-06	9.01E-06	1.21E-06	5.19E-06	1.14E-06	5.33E-07
1778_2	0.00E+00	3.48E-06	3.64E-07	1.54E-05	3.16E-06	7.19E-06	1.05E-06	4.64E-06	1.11E-06	4.70E-07
1778_3	0.00E+00	1.61E-05	4.00E-07	1.58E-05	3.43E-06	7.48E-06	1.06E-06	4.58E-06	1.04E-06	5.01E-07
1778_4	0.00E+00	3.33E-05	4.33E-07	1.65E-05	3.48E-06	7.58E-06	1.07E-06	4.82E-06	1.08E-06	5.15E-07
1778_5	0.00E+00	4.49E-05	4.63E-07	1.93E-05	3.62E-06	7.82E-06	1.12E-06	4.95E-06	1.12E-06	5.05E-07
1778/F	0.00E+00	5.11E-05	4.48E-07	1.92E-05	3.27E-06	7.25E-06	1.05E-06	4.76E-06	1.16E-06	5.05E-07
1778/FD	0.00E+00	5.31E-05	4.57E-07	2.08E-05	2.87E-06	6.49E-06	9.82E-07	4.40E-06	1.06E-06	4.42E-07
1778/R	0.00E+00	5.83E-05	4.39E-07	1.03E-05	2.70E-06	6.04E-06	9.11E-07	4.49E-06	1.09E-06	4.74E-07

Table B25: Runs 1777, & 1778, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1777_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1777_1	8.43E-08	9.00E-07	3.10E-07	3.51E-08	7.58E-08	6.56E-09	3.82E-08	4.14E-09	0.00E+00	0.00E+00
1777_2	8.01E-08	8.74E-07	2.98E-07	3.58E-08	7.27E-08	6.96E-09	3.05E-08	4.46E-09	0.00E+00	2.18E-09
1777_3	7.85E-08	8.65E-07	2.99E-07	3.62E-08	7.27E-08	7.29E-09	3.28E-08	4.37E-09	0.00E+00	2.39E-09
1777/4	7.73E-08	8.50E-07	2.95E-07	3.64E-08	7.37E-08	7.34E-09	3.56E-08	4.55E-09	0.00E+00	1.52E-09
1777/5	8.89E-08	9.67E-07	3.40E-07	4.10E-08	8.72E-08	8.48E-09	4.64E-08	5.40E-09	6.63E-10	0.00E+00
1778_0	0.00E+00	0.00E+00	1.48E-10	0.00E+00	0.00E+00	0.00E+00	2.77E-10	0.00E+00	0.00E+00	0.00E+00
1778_1	8.53E-08	8.67E-07	2.76E-07	3.61E-08	6.94E-08	6.16E-09	4.39E-08	3.89E-09	0.00E+00	4.35E-08
1778_2	7.83E-08	8.50E-07	3.00E-07	3.52E-08	7.17E-08	6.87E-09	3.24E-08	3.89E-09	0.00E+00	4.35E-08
1778_3	8.38E-08	8.22E-07	2.76E-07	3.23E-08	6.46E-08	6.39E-09	3.00E-08	3.66E-09	0.00E+00	4.35E-08
1778_4	8.18E-08	8.27E-07	2.98E-07	3.86E-08	7.17E-08	5.68E-09	3.47E-08	2.97E-09	0.00E+00	4.35E-08
1778_5	9.09E-08	8.62E-07	3.18E-07	3.98E-08	6.70E-08	6.39E-09	3.70E-08	5.03E-09	0.00E+00	4.35E-08
1778/F	8.73E-08	8.62E-07	3.18E-07	3.66E-08	8.13E-08	7.81E-09	4.39E-08	4.80E-09	0.00E+00	4.35E-08
1778/FD	7.93E-08	8.29E-07	3.05E-07	3.73E-08	5.98E-08	8.05E-09	4.16E-08	3.66E-09	0.00E+00	4.35E-08
1778/R	8.38E-08	8.72E-07	3.03E-07	3.59E-08	7.89E-08	6.39E-09	3.70E-08	3.89E-09	0.00E+00	4.35E-08

Table B25: Runs 1777, & 1778, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1777_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00							
1777_1	2.53E-08	8.24E-04	2.31E-09	5.04E-10	1.12E-09							
1777_2	3.25E-08	1.00E-03	2.24E-09	1.34E-10	1.12E-09							
1777_3	3.72E-08	1.09E-03	2.76E-09	0.00E+00	1.12E-09							
1777/4	4.23E-08	1.33E-03	3.28E-09	1.34E-10	1.34E-09	1.02E-01	0.00E+00		0.00E+00	0.00E+00	0.00E+00	1.70E-02
1777/5	5.40E-08	2.34E-03	3.84E-09	0.00E+00	2.02E-09							
1778_0	2.54E-10	2.95E-07	0.00E+00	0.00E+00	0.00E+00							
1778_1	1.96E-08	1.63E-03	3.62E-09	8.40E-09	0.00E+00							
1778_2	1.76E-08	1.47E-03	5.17E-09	6.72E-09	0.00E+00							
1778_3	2.15E-08	1.90E-03	6.03E-09	0.00E+00	0.00E+00							
1778_4	2.15E-08	2.28E-03	6.55E-09	0.00E+00	0.00E+00							
1778_5	2.94E-08	2.71E-03	8.79E-09	0.00E+00	0.00E+00							
1778/F	3.13E-08	2.82E-03	7.41E-09	0.00E+00	0.00E+00							
1778/FD	2.74E-08	3.14E-03	8.10E-09	0.00E+00	0.00E+00							
1778/R	2.74E-08	3.89E-03	1.33E-08	1.01E-08	0.00E+00							

Table B25: Runs 1777, & 1778, fluid analyses (cont.)

B26: Runs 1779, & 1780

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1777_0	0.1M HCl, 0.03M HNO3	N/A	N/A	N/A	-16			0.00E+00	0.0	0.0	0.92	490.2	Room
1779_1	0.1M HCl, 0.03M HNO3	HTLMix	100	200	-1	350	0	0.00E+00	10.0	1.8E-04	1.01	421.5	21
1779_2	0.1M HCl, 0.03M HNO3	HTLMix	100	200	70	334	0	0.00E+00	12.5	2.2E-04	1.36	615.4	44.6
1779_3	0.1M HCl, 0.03M HNO3	HTLMix	100	200	286	317	0	0.00E+00	5.1	9.1E-05	1.4	572.2	42.1
1779_F	0.1M HCl, 0.03M HNO3	HTLMix	100	200	769	308.1 (116)	0	0.00E+00			1.54	632	37.5
1781_0	0.01MHCl, 0.003M HNO3	N/A	N/A	N/A							2.17	512.8	20.9
1780_1	0.01MHCl, 0.003M HNO3	HTLMix	100	200	-1	350	0.0	0.00E+00	0.3	6.1E-06	2.34	438.8	20.9
1780_2	0.01MHCl, 0.003M HNO3	HTLMix	100	200	69	333	0.0	0.00E+00	6.2	1.1E-04	4.06	196.1	48.3
1780_3	0.01MHCl, 0.003M HNO3	HTLMix	100	200	263	320	0.0	0.00E+00	0.0	0.0E+00	7.55	196	34.9
1780_4	0.01MHCl, 0.003M HNO3	HTLMix	100	200	432	309	31.9	5.24E-04	0.0	0.0E+00	7.61	247.5	37.8
1780_5	0.01MHCl, 0.003M HNO3	HTLMix	100	200	598	297	30.1	4.93E-04	0.0	0.0E+00	7.65	224.5	41.4
1780_6	0.01MHCl, 0.003M HNO3	HTLMix	100	200	767	286	34.8	5.71E-04	0.0	0.0E+00	7.9	179.3	44.6
1780_6D	0.01MHCl, 0.003M HNO3	HTLMix	100	200	767	273	33.5	5.50E-04	1.2	2.2E-05	7.77	180.3	48.3
1780_F	0.01MHCl, 0.003M HNO3	HTLMix	100	200	769	262.1 (228)	33.0	5.41E-04			7.22	100	37.5

Table B26: Runs 1779, & 1780, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1777_0	0.00E+00	0.00E+00	0.00E+00	2.63E-06	1.78E-06	1.14E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1779_1	2.31E-06	1.38E-07	4.18E-04	1.13E-03	4.77E-05	2.91E-04	2.71E-05	1.25E-04	9.21E-05	1.90E-03
1779_2	2.48E-05	4.22E-07	3.48E-04	2.75E-03	1.62E-03	2.94E-04	1.42E-05	1.25E-04	2.15E-04	2.69E-03
1779_3	3.46E-05	5.55E-07	7.31E-04	3.20E-03	2.49E-03	2.98E-04	0.00E+00	1.25E-04	3.48E-04	2.79E-03
1779_F	3.46E-05	6.70E-07	2.78E-04	4.65E-03	2.85E-03	2.89E-03	0.00E+00	1.25E-04	3.99E-04	3.09E-03
1781_0	2.31E-06	0.00E+00	1.74E-04	1.48E-06	3.71E-06	0.00E+00	0.00E+00	1.25E-04	3.07E-05	0.00E+00
1780_1	2.31E-06	4.88E-08	3.31E-04	8.52E-05	1.02E-05	3.55E-03	0.00E+00	1.25E-04	6.14E-05	0.00E+00
1780_2	2.31E-06	1.20E-07	4.35E-04	9.65E-04	1.50E-05	3.70E-03	0.00E+00	1.25E-04	9.21E-05	1.40E-03
1780_3	2.31E-06	0.00E+00	3.31E-04	1.25E-03	0.00E+00	1.39E-05	0.00E+00	1.25E-04	0.00E+00	1.70E-03
1780_4	2.31E-06	0.00E+00	3.13E-04	1.34E-03	0.00E+00	2.49E-05	0.00E+00	1.25E-04	0.00E+00	2.00E-03
1780_5	2.31E-06	0.00E+00	2.78E-04	1.29E-03	0.00E+00	6.05E-05	0.00E+00	1.25E-04	0.00E+00	2.10E-03
1780_6	2.31E-06	0.00E+00	2.44E-04	1.30E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	0.00E+00	2.00E-03
1780_6D	2.31E-06	0.00E+00	2.44E-04	1.31E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	0.00E+00	1.90E-03
1780_F	2.31E-06	0.00E+00	1.74E-04	1.33E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	0.00E+00	2.00E-03

Table B26: Runs 1779, & 1780, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1777_0	0.00E+00	0.00E+00	1.54E-08	0.00E+00	2.15E-07	0.00E+00	0.00E+00	2.08E-07	1.59E-06	0.00E+00
1779_1	8.52E-07	1.18E-07	2.66E-06	8.84E-05	3.79E-04	2.54E-07	1.14E-06	5.36E-06	2.14E-05	0.00E+00
1779_2	5.85E-07	2.20E-07	7.34E-06	1.49E-04	2.23E-03	2.14E-06	7.23E-06	3.29E-04	3.86E-03	1.15E-07
1779_3	1.67E-07	7.85E-08	1.82E-05	1.53E-04	4.78E-04	2.64E-06	1.89E-05	5.81E-04	4.99E-03	1.72E-07
1779_F	2.01E-07	0.00E+00	2.10E-05	1.54E-04	2.17E-04	2.70E-06	1.90E-05	5.41E-04	4.94E-03	1.72E-07
1781_0	0.00E+00	0.00E+00	4.62E-08	0.00E+00	3.58E-07	4.75E-09	1.50E-08	0.00E+00	1.03E-05	0.00E+00
1780_1	7.52E-08	0.00E+00	5.08E-07	8.66E-06	3.53E-05	1.15E-07	1.25E-06	2.07E-06	1.64E-05	0.00E+00
1780_2	0.00E+00	0.00E+00	2.77E-07	8.10E-05	2.53E-04	2.72E-07	1.79E-06	1.70E-07	2.23E-05	0.00E+00
1780_3	0.00E+00	0.00E+00	5.39E-08	9.28E-05	2.15E-06	1.59E-07	6.21E-07	7.55E-08	7.95E-07	0.00E+00
1780_4	0.00E+00	0.00E+00	4.62E-08	1.02E-04	1.36E-06	1.18E-07	3.30E-07	6.92E-08	7.34E-07	0.00E+00
1780_5	0.00E+00	0.00E+00	4.62E-08	9.31E-05	2.15E-07	7.74E-08	1.80E-07	4.41E-08	8.57E-07	0.00E+00
1780_6	0.00E+00	0.00E+00	5.39E-08	9.62E-05	1.43E-07	6.11E-08	1.20E-07	0.00E+00	5.51E-07	0.00E+00
1780_6D	0.00E+00	0.00E+00	4.62E-08	9.67E-05	1.43E-07	6.24E-08	1.34E-07	0.00E+00	5.51E-07	0.00E+00
1780_F	0.00E+00	0.00E+00	3.85E-08	1.03E-04	2.15E-06	6.38E-08	1.31E-07	0.00E+00	1.84E-06	0.00E+00

Table B26: Runs 1779, & 1780, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1777_0	0.00E+00	0.00E+00	0.00E+00	3.20E-08	0.00E+00	1.75E-09	0.00E+00	0.00E+00	0.00E+00	1.07E-09
1779_1	8.76E-07	0.00E+00	8.42E-08	9.54E-07	7.81E-07	2.10E-08	1.29E-09	2.13E-07	3.71E-09	9.25E-09
1779_2	6.47E-06	0.00E+00	4.45E-07	1.52E-06	2.04E-06	0.00E+00	2.15E-09	2.04E-07	2.39E-06	1.07E-05
1779_3	3.63E-07	0.00E+00	6.22E-07	1.75E-06	2.15E-06	0.00E+00	3.01E-09	3.14E-07	2.22E-06	1.39E-05
1779_F	9.08E-08	0.00E+00	9.64E-07	1.70E-06	2.22E-06	0.00E+00	0.00E+00	1.82E-07	2.14E-06	1.38E-05
1781_0	0.00E+00	0.00E+00	0.00E+00	1.00E-07	8.55E-10	0.00E+00	0.00E+00	4.17E-09	0.00E+00	0.00E+00
1780_1	1.23E-07	0.00E+00	3.28E-08	2.47E-07	3.74E-08	2.63E-09	0.00E+00	2.88E-08	3.23E-08	6.76E-09
1780_2	1.92E-07	0.00E+00	7.02E-08	8.31E-07	5.21E-07	0.00E+00	0.00E+00	1.79E-08	5.56E-09	1.49E-08
1780_3	1.07E-07	0.00E+00	0.00E+00	9.40E-07	0.00E+00	0.00E+00	0.00E+00	1.25E-08	2.97E-09	8.18E-09
1780_4	1.23E-07	0.00E+00	0.00E+00	9.63E-07	0.00E+00	0.00E+00	0.00E+00	2.04E-08	0.00E+00	8.54E-09
1780_5	1.23E-07	0.00E+00	0.00E+00	9.31E-07	0.00E+00	0.00E+00	0.00E+00	2.08E-08	0.00E+00	6.76E-09
1780_6	1.28E-07	0.00E+00	0.00E+00	9.40E-07	5.85E-10	3.07E-09	0.00E+00	2.67E-08	0.00E+00	7.83E-09
1780_6D	1.44E-07	0.00E+00	0.00E+00	9.40E-07	5.40E-10	0.00E+00	0.00E+00	2.58E-08	0.00E+00	9.96E-09
1780_F	1.39E-07	0.00E+00	0.00E+00	9.68E-07	0.00E+00	0.00E+00	0.00E+00	2.75E-08	0.00E+00	1.67E-08

Table B26: Runs 1779, & 1780, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1777_0	2.02E-09	0.00E+00	0.00E+00	6.99E-07	2.30E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1779_1	5.39E-09	2.69E-07	4.21E-08	1.56E-05	2.32E-06	3.98E-06	4.28E-07	1.76E-06	3.95E-07	1.76E-07
1779_2	2.36E-09	2.08E-06	1.87E-07	1.09E-05	7.20E-06	1.24E-05	1.27E-06	6.27E-06	1.31E-06	5.83E-07
1779_3	3.03E-09	6.56E-08	1.90E-07	2.22E-05	7.35E-06	1.28E-05	1.29E-06	6.67E-06	1.38E-06	6.06E-07
1779_F	2.70E-09	2.87E-08	2.23E-07	6.98E-06	7.64E-06	1.31E-05	1.34E-06	6.80E-06	1.42E-06	6.07E-07
1781_0	0.00E+00	2.56E-09	0.00E+00	8.09E-06	3.17E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1780_1	2.70E-09	4.96E-08	0.00E+00	1.50E-05	9.61E-08	1.65E-07	1.87E-08	7.15E-08	1.68E-08	7.19E-09
1780_2	0.00E+00	1.63E-07	1.50E-08	1.55E-05	1.76E-06	3.17E-06	3.28E-07	1.39E-06	2.99E-07	1.29E-07
1780_3	0.00E+00	6.41E-08	0.00E+00	8.79E-06	3.46E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.16E-10
1780_4	0.00E+00	1.45E-07	0.00E+00	1.11E-05	4.61E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1780_5	0.00E+00	2.03E-07	0.00E+00	1.01E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E-10
1780_6	0.00E+00	2.67E-07	0.00E+00	9.31E-06	3.46E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1780_6D	0.00E+00	2.75E-07	0.00E+00	8.68E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1780_F	0.00E+00	2.64E-07	0.00E+00	7.06E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E-10

Table B26: Runs 1779, & 1780, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1777_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1779_1	2.93E-08	3.09E-07	1.10E-07	1.36E-08	2.48E-08	2.39E-09	1.20E-08	1.53E-09	0.00E+00	2.35E-08
1779_2	7.42E-08	8.66E-07	2.72E-07	3.22E-08	6.91E-08	6.35E-09	2.33E-08	3.09E-09	0.00E+00	2.83E-09
1779_3	7.44E-08	8.84E-07	2.83E-07	3.37E-08	7.51E-08	7.27E-09	2.64E-08	3.61E-09	0.00E+00	1.74E-09
1779_F	7.89E-08	9.13E-07	2.93E-07	3.48E-08	7.85E-08	7.86E-09	2.94E-08	4.09E-09	0.00E+00	1.52E-09
1781_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.05E-09
1780_1	1.11E-09	1.30E-08	4.90E-09	6.55E-10	1.12E-09	2.13E-10	6.93E-10	0.00E+00	0.00E+00	2.83E-09
1780_2	1.88E-08	2.22E-07	6.78E-08	8.15E-09	1.44E-08	1.21E-09	4.85E-09	7.77E-10	0.00E+00	1.31E-09
1780_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-09
1780_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.52E-09
1780_5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.79E-09
1780_6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.96E-09
1780_6D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.39E-09
1780_F	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-09

Table B26: Runs 1779, & 1780, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1777_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00							
1779_1	1.17E-09	8.31E-05	1.55E-09	1.31E-09	0.00E+00	7.96E-02	0.00E+00	2.76E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1779_2	2.43E-08	1.70E-02	1.72E-09	4.60E-09	0.00E+00	8.23E-02	0.00E+00	1.94E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1779_3	2.60E-08	1.70E-02	3.79E-09	8.47E-09	0.00E+00	8.42E-02	0.00E+00	1.32E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1779_F	2.82E-08	1.77E-02	3.79E-09	1.19E-08	4.48E-10	8.33E-02	0.00E+00	1.20E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1781_0	0.00E+00	3.67E-07	0.00E+00	0.00E+00	0.00E+00	4.93E-03	0.00E+00	1.21E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1780_1	7.83E-10	2.17E-05	0.00E+00	2.69E-10	0.00E+00	4.48E-03	0.00E+00	1.23E-03	0.00E+00	0.00E+00	1.03E-04	0.00E+00
1780_2	0.00E+00	3.74E-05	0.00E+00	3.87E-10	0.00E+00	4.58E-03	0.00E+00	1.24E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1780_3	0.00E+00	7.92E-07	0.00E+00	0.00E+00	0.00E+00	4.69E-03	0.00E+00	1.26E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1780_4	0.00E+00	6.37E-07	0.00E+00	0.00E+00	0.00E+00	4.14E-03	0.00E+00	1.32E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1780_5	0.00E+00	5.41E-07	0.00E+00	0.00E+00	0.00E+00	5.52E-03	0.00E+00	1.35E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1780_6	0.00E+00	4.83E-07	0.00E+00	0.00E+00	0.00E+00	4.76E-03	0.00E+00	1.34E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1780_6D	0.00E+00	4.25E-07	0.00E+00	0.00E+00	0.00E+00	4.57E-03	0.00E+00	2.01E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1780_F	0.00E+00	3.86E-07	0.00E+00	0.00E+00	0.00E+00	4.32E-03	0.00E+00	1.23E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B26: Runs 1779, & 1780, fluid analyses (cont.)

B27: Runs 1781, & 1782

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1781_0	0.01MHCl, 0.003M HNO3	N/A	N/A	N/A	-1		0	0.00E+00	0.0	0.0E+00	2.17	512.8	20.9
1781_1	0.01MHCl, 0.003M HNO3	HTL320	100	200	-1	350	0	0.00E+00	0.0	0.0E+00	5.03	325.6	20.8
1781_2	0.01MHCl, 0.003M HNO3	HTL320	100	200	69	335	7.051	1.16E-04	0.0	0.0E+00	8.03	131.6	49.6
1781_3	0.01MHCl, 0.003M HNO3	HTL320	100	200	286	322	7.564	1.24E-04	0.0	0.0E+00	8.16	191.3	50.1
1781_4	0.01MHCl, 0.003M HNO3	HTL320	100	200	432	309	0	0.00E+00	0.0	0.0E+00	8.53	231.8	37.8
1781_5	0.01MHCl, 0.003M HNO3	HTL320	100	200	598	297	6.778	1.11E-04	0.0	0.0E+00	8.47	252.2	42.3
1781_6	0.01MHCl, 0.003M HNO3	HTL320	100	200	767	286	0	0.00E+00	0.0	0.0E+00	8.47	136.1	46.8
1781_6D	0.01MHCl, 0.003M HNO3	HTL320	100	200	767	273	5.801	9.51E-05	0.0	0.0E+00	8.34	137.7	50
1781_F	0.01MHCl, 0.003M HNO3	HTL320	100	200	769	261.9 (220)	0	0.00E+00	0.0	0.0E+00	8.43	217.7	39.9
1781_0	0.01MHCl, 0.003M HNO3	N/A	N/A	N/A							2.17	512.8	20.9
1782_1	0.01MHCl, 0.003M HNO3	HTL321	100	200	-1	350	0	0.00E+00	0.0	0.0E+00	2.21	475.4	21.5
1782_2	0.01MHCl, 0.003M HNO3	HTL321	100	200	70	334	0	0.00E+00	4.1	7.3E-05	5.25	117.3	46.8
1782_3	0.01MHCl, 0.003M HNO3	HTL321	100	200	263	320	5.502	9.02E-05	0.2	4.0E-06	6.96	261.2	33.3
1782_4	0.01MHCl, 0.003M HNO3	HTL321	100	200	433	311	0	0.00E+00	0.0	0.0E+00	7.54	247.4	39.5
1782_5	0.01MHCl, 0.003M HNO3	HTL321	100	200	598	299	8.506	1.39E-04	0.0	0.0E+00	7.61	225.4	43.1
1782_6	0.01MHCl, 0.003M HNO3	HTL321	100	200	767	287	8.409	1.38E-04	0.0	0.0E+00	7.63	167.8	44.8
1782_6D	0.01MHCl, 0.003M HNO3	HTL321	100	200	767	269	6.24	1.02E-04	0.0	0.0E+00	7.66	184.4	46.1
1782_F	0.01MHCl, 0.003M HNO3	HTL321	100	200	769	258.8 (206)	10.16	1.67E-04	0.0	0.0E+00	6.8	216.9	37.2

Table B27: Runs 1781, & 1782, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1781_0	2.31E-06	0.00E+00	1.74E-04	1.48E-06	3.71E-06	0.00E+00	0.00E+00	1.25E-04	3.07E-05	0.00E+00
1781_1	2.31E-06	0.00E+00	2.09E-04	5.97E-04	7.41E-07	0.00E+00	0.00E+00	1.25E-04	0.00E+00	2.59E-03
1781_2	2.31E-06	0.00E+00	2.09E-04	1.50E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	0.00E+00	1.60E-03
1781_3	2.31E-06	0.00E+00	2.09E-04	1.69E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	0.00E+00	1.50E-03
1781_4	2.31E-06	0.00E+00	2.26E-04	1.65E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	0.00E+00	1.50E-03
1781_5	2.31E-06	0.00E+00	2.26E-04	1.90E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	0.00E+00	1.50E-03
1781_6	2.31E-06	0.00E+00	1.91E-04	1.82E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	0.00E+00	1.50E-03
1781_6D	2.31E-06	0.00E+00	2.44E-04	1.73E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	0.00E+00	1.50E-03
1781_F	2.31E-06	0.00E+00	0.00E+00	1.77E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	0.00E+00	1.50E-03
1781_0	2.31E-06	0.00E+00	1.74E-04	1.48E-06	3.71E-06	0.00E+00	0.00E+00	1.25E-04	3.07E-05	0.00E+00
1782_1	2.31E-06	0.00E+00	3.31E-04	1.10E-05	8.75E-06	0.00E+00	0.00E+00	1.25E-04	6.14E-05	0.00E+00
1782_2	2.31E-06	0.00E+00	3.13E-04	1.09E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	5.12E-05	1.60E-03
1782_3	2.31E-06	0.00E+00	3.31E-04	1.48E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	3.07E-05	2.10E-03
1782_4	2.31E-06	0.00E+00	3.13E-04	1.49E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	0.00E+00	2.10E-03
1782_5	2.31E-06	0.00E+00	3.13E-04	1.52E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	0.00E+00	2.30E-03
1782_6	2.31E-06	0.00E+00	2.61E-04	1.50E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	0.00E+00	2.40E-03
1782_6D	2.31E-06	0.00E+00	2.61E-04	1.55E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	2.05E-05	2.30E-03
1782_F	2.31E-06	0.00E+00	1.57E-04	1.55E-03	0.00E+00	0.00E+00	0.00E+00	1.25E-04	3.07E-05	2.30E-03

Table B27: Runs 1781, & 1782, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1781_0	0.00E+00	0.00E+00	4.62E-08	0.00E+00	3.58E-07	4.75E-09	1.50E-08	0.00E+00	1.03E-05	0.00E+00
1781_1	0.00E+00	0.00E+00	6.92E-08	2.40E-06	1.50E-06	7.47E-09	1.79E-07	9.44E-08	3.43E-06	0.00E+00
1781_2	0.00E+00	0.00E+00	7.69E-08	8.74E-08	2.15E-07	3.39E-09	6.68E-08	5.04E-08	4.89E-07	0.00E+00
1781_3	0.00E+00	0.00E+00	5.39E-08	0.00E+00	1.43E-07	4.07E-09	1.77E-08	0.00E+00	5.51E-07	0.00E+00
1781_4	0.00E+00	0.00E+00	6.92E-08	4.37E-08	1.43E-07	3.39E-09	3.34E-08	0.00E+00	7.34E-07	0.00E+00
1781_5	0.00E+00	0.00E+00	6.92E-08	3.64E-08	2.15E-07	3.39E-09	3.48E-08	5.04E-08	6.12E-07	0.00E+00
1781_6	0.00E+00	0.00E+00	4.62E-08	4.37E-08	1.43E-07	2.71E-09	2.04E-08	0.00E+00	4.28E-07	0.00E+00
1781_6D	0.00E+00	0.00E+00	5.39E-08	5.10E-08	2.15E-07	3.39E-09	3.48E-08	8.81E-08	8.57E-07	0.00E+00
1781_F	0.00E+00	0.00E+00	5.39E-08	5.10E-08	1.43E-07	0.00E+00	1.98E-08	5.67E-08	5.51E-07	0.00E+00
1781_0	0.00E+00	0.00E+00	4.62E-08	0.00E+00	3.58E-07	4.75E-09	1.50E-08	0.00E+00	1.03E-05	0.00E+00
1782_1	0.00E+00	0.00E+00	8.00E-07	9.90E-07	6.37E-06	2.17E-08	4.38E-07	6.29E-07	1.71E-05	0.00E+00
1782_2	0.00E+00	0.00E+00	0.00E+00	9.44E-05	8.80E-05	4.38E-07	1.13E-06	0.00E+00	1.82E-05	0.00E+00
1782_3	0.00E+00	0.00E+00	5.39E-08	1.19E-04	4.30E-07	4.22E-07	4.92E-07	1.13E-07	1.66E-05	0.00E+00
1782_4	0.00E+00	0.00E+00	4.62E-08	1.18E-04	1.43E-07	3.26E-07	2.73E-07	0.00E+00	5.38E-06	0.00E+00
1782_5	0.00E+00	0.00E+00	6.15E-08	1.18E-04	2.15E-07	2.54E-07	1.50E-07	0.00E+00	2.81E-06	0.00E+00
1782_6	0.00E+00	0.00E+00	3.85E-08	1.14E-04	7.16E-08	1.78E-07	1.07E-07	0.00E+00	1.04E-06	0.00E+00
1782_6D	0.00E+00	0.00E+00	3.85E-08	1.17E-04	1.43E-07	1.81E-07	9.75E-08	0.00E+00	9.18E-07	0.00E+00
1782_F	0.00E+00	0.00E+00	3.08E-08	1.22E-04	1.43E-07	1.98E-07	9.95E-08	0.00E+00	1.16E-05	0.00E+00

Table B27: Runs 1781, & 1782, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1781_0	0.00E+00	0.00E+00	0.00E+00	1.00E-07	8.55E-10	0.00E+00	0.00E+00	4.17E-09	0.00E+00	0.00E+00
1781_1	9.08E-08	0.00E+00	0.00E+00	4.93E-07	6.75E-10	0.00E+00	0.00E+00	1.04E-08	0.00E+00	1.78E-09
1781_2	2.14E-08	0.00E+00	0.00E+00	5.39E-07	3.60E-10	0.00E+00	0.00E+00	4.59E-08	0.00E+00	0.00E+00
1781_3	2.14E-08	0.00E+00	0.00E+00	5.89E-07	0.00E+00	0.00E+00	0.00E+00	5.55E-08	3.34E-08	0.00E+00
1781_4	1.60E-08	0.00E+00	0.00E+00	6.21E-07	4.50E-10	0.00E+00	0.00E+00	5.21E-08	5.56E-09	0.00E+00
1781_5	1.07E-08	0.00E+00	0.00E+00	6.85E-07	0.00E+00	0.00E+00	0.00E+00	8.84E-08	0.00E+00	0.00E+00
1781_6	0.00E+00	0.00E+00	0.00E+00	6.48E-07	0.00E+00	0.00E+00	0.00E+00	6.96E-08	0.00E+00	0.00E+00
1781_6D	1.60E-08	0.00E+00	0.00E+00	6.30E-07	4.05E-10	0.00E+00	0.00E+00	5.75E-08	0.00E+00	1.42E-09
1781_F	2.14E-08	0.00E+00	0.00E+00	5.75E-07	4.95E-10	0.00E+00	0.00E+00	8.51E-08	0.00E+00	0.00E+00
1781_0	0.00E+00	0.00E+00	0.00E+00	1.00E-07	8.55E-10	0.00E+00	0.00E+00	4.17E-09	0.00E+00	0.00E+00
1782_1	5.87E-08	0.00E+00	0.00E+00	2.10E-07	7.78E-09	3.51E-09	0.00E+00	1.38E-08	0.00E+00	7.12E-09
1782_2	8.54E-08	0.00E+00	5.15E-08	8.49E-07	3.38E-07	0.00E+00	0.00E+00	5.42E-09	0.00E+00	2.95E-08
1782_3	0.00E+00	0.00E+00	0.00E+00	1.08E-06	4.05E-10	3.07E-09	0.00E+00	1.04E-08	0.00E+00	1.46E-07
1782_4	0.00E+00	0.00E+00	0.00E+00	1.10E-06	4.50E-10	0.00E+00	0.00E+00	1.38E-08	0.00E+00	1.54E-07
1782_5	0.00E+00	0.00E+00	0.00E+00	1.14E-06	0.00E+00	0.00E+00	0.00E+00	2.38E-08	0.00E+00	1.21E-07
1782_6	0.00E+00	0.00E+00	0.00E+00	1.07E-06	4.50E-10	0.00E+00	0.00E+00	2.58E-08	0.00E+00	1.33E-07
1782_6D	0.00E+00	0.00E+00	0.00E+00	1.11E-06	3.60E-10	0.00E+00	0.00E+00	2.38E-08	0.00E+00	1.36E-07
1782_F	0.00E+00	0.00E+00	0.00E+00	1.15E-06	6.75E-10	0.00E+00	0.00E+00	2.71E-08	0.00E+00	2.05E-07

Table B27: Runs 1781, & 1782, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1781_0	0.00E+00	2.56E-09	0.00E+00	8.09E-06	3.17E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1781_1	2.70E-09	2.86E-09	0.00E+00	9.94E-06	4.32E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1781_2	0.00E+00	7.62E-09	0.00E+00	7.40E-06	3.74E-10	2.00E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1781_3	0.00E+00	1.10E-08	0.00E+00	7.32E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.11E-10
1781_4	0.00E+00	1.19E-08	0.00E+00	7.56E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E-10
1781_5	0.00E+00	1.45E-08	0.00E+00	7.37E-06	2.88E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1781_6	0.00E+00	1.36E-08	0.00E+00	6.42E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1781_6D	3.71E-09	1.51E-08	0.00E+00	6.86E-06	6.05E-10	8.56E-10	3.12E-10	0.00E+00	0.00E+00	0.00E+00
1781_F	0.00E+00	1.50E-08	0.00E+00	5.14E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.37E-10
1781_0	0.00E+00	2.56E-09	0.00E+00	8.09E-06	3.17E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_1	0.00E+00	5.61E-08	0.00E+00	1.52E-05	2.02E-08	3.34E-08	3.75E-09	1.86E-08	3.46E-09	1.29E-09
1782_2	0.00E+00	3.49E-08	2.41E-08	1.06E-05	1.90E-06	3.08E-06	2.94E-07	1.13E-06	1.71E-07	6.62E-08
1782_3	3.03E-09	4.62E-07	0.00E+00	1.05E-05	8.06E-10	5.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_4	0.00E+00	3.82E-07	0.00E+00	1.27E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_5	0.00E+00	3.33E-07	0.00E+00	1.01E-05	3.17E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E-10
1782_6	0.00E+00	3.18E-07	0.00E+00	9.65E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_6D	0.00E+00	3.08E-07	0.00E+00	1.03E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_F	0.00E+00	3.57E-07	0.00E+00	6.31E-06	2.88E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B27: Runs 1781, & 1782, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1781_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.05E-09
1781_1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-09
1781_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.53E-08
1781_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-08
1781_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.44E-08
1781_5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.63E-08
1781_6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.54E-08
1781_6D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.46E-08
1781_F	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.50E-08
1781_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.05E-09
1782_1	3.02E-10	2.80E-09	1.08E-09	1.46E-10	3.11E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.18E-09
1782_2	8.36E-09	1.50E-07	2.33E-08	2.79E-09	4.52E-09	2.84E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_6D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_F	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B27: Runs 1781, & 1782, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1781_0	0.00E+00	3.67E-07	0.00E+00	0.00E+00	0.00E+00	4.93E-03	0.00E+00	1.21E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1781_1	0.00E+00	3.28E-07	0.00E+00	0.00E+00	0.00E+00	4.07E-03	0.00E+00	1.25E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1781_2	0.00E+00	2.90E-07	0.00E+00	0.00E+00	0.00E+00	4.04E-03	0.00E+00	1.22E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1781_3	1.37E-09	2.70E-07	0.00E+00	2.69E-10	0.00E+00	4.25E-03	0.00E+00	1.26E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1781_4	0.00E+00	2.32E-07	0.00E+00	0.00E+00	0.00E+00	5.26E-03	0.00E+00	1.35E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1781_5	0.00E+00	2.32E-07	0.00E+00	0.00E+00	0.00E+00	4.56E-03	0.00E+00	1.39E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1781_6	0.00E+00	1.93E-08	0.00E+00	0.00E+00	0.00E+00	4.40E-03	0.00E+00	1.39E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1781_6D	0.00E+00	1.93E-08	0.00E+00	0.00E+00	0.00E+00	4.28E-03	0.00E+00	1.26E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1781_F	0.00E+00	1.93E-08	0.00E+00	0.00E+00	0.00E+00	4.28E-03	0.00E+00	1.30E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1781_0	0.00E+00	3.67E-07	0.00E+00	0.00E+00	0.00E+00	4.93E-03	0.00E+00	1.21E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_1	0.00E+00	9.23E-06	0.00E+00	1.34E-10	0.00E+00	5.65E-03	0.00E+00	1.48E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_2	0.00E+00	7.66E-05	0.00E+00	0.00E+00	0.00E+00	4.33E-03	0.00E+00	1.31E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_3	0.00E+00	1.93E-08	0.00E+00	0.00E+00	0.00E+00	4.68E-03	1.70E-04	1.38E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_4	0.00E+00	1.93E-08	0.00E+00	0.00E+00	0.00E+00	4.41E-03	1.89E-04	1.32E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_5	0.00E+00	1.93E-08	0.00E+00	0.00E+00	0.00E+00	5.04E-03	2.29E-04	1.68E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_6	0.00E+00	1.93E-08	0.00E+00	0.00E+00	0.00E+00	4.83E-03	2.23E-04	1.49E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_6D	0.00E+00	1.93E-08	0.00E+00	0.00E+00	0.00E+00	4.90E-03	2.15E-04	1.38E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1782_F	0.00E+00	1.93E-08	0.00E+00	0.00E+00	0.00E+00	4.25E-03	1.92E-04	1.23E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B27: Runs 1781, & 1782, fluid analyses (cont.)

B28: Runs 1783, & 1784

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1783_0	0.01M HCl, 0.003M HNO3	N/A	N/A	N/A	8		0	0.00E+00	0.0	0.0E+00	2.26	504.1	20.3
1783_1	0.01M HCl, 0.003M HNO3	HTL323	100	200	22	350	0	0.00E+00	15.6	2.8E-04	2.91	357.3	52.7
1783_2	0.01M HCl, 0.003M HNO3	HTL323	100	200	167	336	0	0.00E+00	23.1	4.1E-04	3.72	250.4	46.8
1783_3	0.01M HCl, 0.003M HNO3	HTL323	100	200	311	323	0	0.00E+00	26.8	4.8E-04	3.81	298.4	31.3
1783_4	0.01M HCl, 0.003M HNO3	HTL323	100	200	476	309	0	0.00E+00	26.0	4.6E-04	3.57	321.3	31.6
1783_5	0.01M HCl, 0.003M HNO3	HTL323	100	200	647	298	0	0.00E+00	26.9	4.8E-04	3.45	315.4	48.7
1783_5D	0.01M HCl, 0.003M HNO3	HTL323	100	200	647	286	0	0.00E+00	26.0	4.7E-04	33.9	321.4	49.5
1783_F	0.01M HCl, 0.003M HNO3	HTL323	100	200	650	274.6 (204)	0	0.00E+00	26.9	4.8E-04	3.27	332.6	36.5
1784_0	0.01M HCl, 0.003M HNO3	N/A	N/A	N/A	8		0	0.00E+00	0.0	0.0E+00	1.94	546	20
1784_1	0.01M HCl, 0.003M HNO3	HTL324	100	200	23	350	0	0.00E+00	41.7	7.5E-04	2.21	430.7	54
1784_2	0.01M HCl, 0.003M HNO3	HTL324	100	200	167	336	0	0.00E+00	57.3	1.0E-03	2.43	380.4	47.7
1784_3	0.01M HCl, 0.003M HNO3	HTL324	100	200	312	323	0	0.00E+00	61.1	1.1E-03	2.85	365.1	36.9
1784_4	0.01M HCl, 0.003M HNO3	HTL324	100	200	476	311	0	0.00E+00	OR	OR	2.67	355.8	27.2
1784_5	0.01M HCl, 0.003M HNO3	HTL324	100	200	648	300	0	0.00E+00	OR	OR	2.82	349.8	49.4
1784_5D	0.01M HCl, 0.003M HNO3	HTL324	100	200	648	286	0	0.00E+00	OR	OR	2.77	341.2	48.1
1784_F	0.01M HCl, 0.003M HNO3	HTL324	100	200	650	274.8 (190)	0	0.00E+00	OR	OR	2.76	332.2	34.2

Table B28: Runs 1783, & 1784, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1783_0	2.31E-06	0.00E+00	1.74E-04	0.00E+00	2.82E-06	0.00E+00	0.00E+00	1.25E-04	3.07E-05	0.00E+00
1783_1	1.04E-05	0.00E+00	5.74E-04	7.02E-04	3.85E-06	0.00E+00	0.00E+00	2.49E-03	8.18E-05	6.99E-04
1783_2	2.31E-06	0.00E+00	5.39E-04	9.07E-04	2.22E-06	0.00E+00	0.00E+00	2.12E-03	8.18E-05	1.10E-03
1783_3	2.31E-06	0.00E+00	5.22E-04	9.11E-04	2.82E-06	0.00E+00	0.00E+00	1.87E-03	7.16E-05	1.10E-03
1783_4	2.31E-06	0.00E+00	5.39E-04	8.84E-04	5.04E-06	0.00E+00	0.00E+00	2.00E-03	8.18E-05	9.98E-04
1783_5	2.31E-06	0.00E+00	4.87E-04	8.79E-04	5.49E-06	0.00E+00	0.00E+00	1.37E-03	7.16E-05	9.98E-04
1783_5D	2.31E-06	0.00E+00	4.70E-04	8.85E-04	6.08E-06	0.00E+00	0.00E+00	1.87E-03	7.16E-05	1.10E-03
1783_F	2.31E-06	0.00E+00	2.96E-04	8.89E-04	8.45E-06	0.00E+00	0.00E+00	2.00E-03	4.09E-05	9.98E-04
1784_0	2.31E-06	0.00E+00	2.44E-04	1.48E-06	4.30E-06	0.00E+00	0.00E+00	1.25E-04	4.09E-05	0.00E+00
1784_1	2.31E-06	1.15E-07	4.00E-04	6.07E-04	6.47E-04	0.00E+00	2.58E-06	1.25E-04	8.18E-05	5.99E-04
1784_2	2.31E-06	1.46E-07	5.05E-04	9.08E-04	9.87E-04	0.00E+00	0.00E+00	1.25E-04	1.02E-04	6.99E-04
1784_3	2.31E-06	1.29E-07	5.57E-04	8.26E-04	9.10E-04	0.00E+00	0.00E+00	1.25E-04	9.21E-05	5.99E-04
1784_4	2.31E-06	1.55E-07	8.00E-04	9.79E-04	1.03E-03	0.00E+00	0.00E+00	1.25E-04	1.23E-04	8.98E-04
1784_5	2.31E-06	1.55E-07	6.79E-04	9.54E-04	9.54E-04	0.00E+00	0.00E+00	1.25E-04	1.02E-04	7.98E-04
1784_5D	2.31E-06	1.64E-07	6.61E-04	9.44E-04	9.36E-04	0.00E+00	0.00E+00	1.25E-04	9.21E-05	6.99E-04
1784_F	2.31E-06	1.69E-07	5.05E-04	9.41E-04	9.87E-04	0.00E+00	0.00E+00	1.25E-04	6.14E-05	7.98E-04

Table B28: Runs 1783, & 1784, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1783_0	0.00E+00	0.00E+00	3.85E-08	0.00E+00	3.58E-07	4.07E-09	1.23E-08	0.00E+00	9.05E-06	0.00E+00
1783_1	0.00E+00	1.02E-07	7.62E-07	3.74E-05	5.31E-04	5.08E-06	7.94E-06	6.08E-06	1.44E-03	0.00E+00
1783_2	0.00E+00	7.85E-08	1.54E-07	4.56E-05	7.94E-04	4.46E-06	7.26E-06	1.13E-07	1.47E-03	0.00E+00
1783_3	0.00E+00	1.02E-07	1.08E-07	4.19E-05	8.64E-04	2.96E-06	5.64E-07	1.32E-07	1.47E-03	0.00E+00
1783_4	0.00E+00	8.64E-08	1.62E-07	4.02E-05	8.76E-04	1.77E-06	3.46E-07	2.33E-07	1.34E-03	0.00E+00
1783_5	0.00E+00	1.10E-07	1.62E-07	4.11E-05	8.98E-04	1.24E-06	9.54E-07	1.83E-07	1.27E-03	0.00E+00
1783_5D	0.00E+00	1.26E-07	1.38E-07	4.09E-05	8.95E-04	1.23E-06	3.17E-07	9.44E-08	1.26E-03	0.00E+00
1783_F	0.00E+00	1.49E-07	4.62E-08	4.05E-05	9.01E-04	1.21E-06	1.70E-07	0.00E+00	1.27E-03	0.00E+00
1784_0	0.00E+00	0.00E+00	3.85E-08	0.00E+00	1.65E-06	0.00E+00	1.29E-08	5.67E-08	1.03E-05	0.00E+00
1784_1	1.09E-07	1.78E-06	2.27E-06	1.53E-05	1.36E-03	8.82E-08	2.37E-06	1.36E-04	3.27E-05	0.00E+00
1784_2	0.00E+00	1.41E-07	6.54E-07	2.35E-05	1.90E-03	1.79E-07	9.61E-06	3.70E-05	3.97E-05	0.00E+00
1784_3	0.00E+00	1.10E-07	5.15E-07	2.08E-05	1.79E-03	1.13E-07	3.18E-06	3.60E-06	3.66E-05	0.00E+00
1784_4	0.00E+00	6.36E-07	5.92E-07	2.62E-05	2.33E-03	2.14E-07	9.38E-06	9.76E-07	4.72E-05	0.00E+00
1784_5	0.00E+00	1.13E-06	4.77E-07	2.49E-05	2.56E-03	1.35E-07	2.81E-06	1.24E-06	3.96E-05	0.00E+00
1784_5D	0.00E+00	1.16E-06	3.31E-07	2.39E-05	2.56E-03	1.00E-07	1.09E-06	2.77E-07	3.78E-05	0.00E+00
1784_F	0.00E+00	1.22E-06	2.23E-07	2.39E-05	2.57E-03	9.37E-08	5.32E-07	2.08E-07	3.05E-05	0.00E+00

Table B28: Runs 1783, & 1784, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1783_0	0.00E+00	0.00E+00	0.00E+00	1.00E-07	8.10E-10	0.00E+00	0.00E+00	4.17E-09	0.00E+00	0.00E+00
1783_1	1.08E-06	2.28E-07	4.21E-08	5.11E-07	2.25E-08	0.00E+00	0.00E+00	1.63E-08	1.33E-08	9.59E-07
1783_2	2.53E-06	1.01E-07	3.28E-08	5.57E-07	2.97E-08	0.00E+00	0.00E+00	1.13E-08	3.71E-09	6.09E-07
1783_3	4.76E-06	4.05E-08	2.34E-08	5.02E-07	3.30E-08	0.00E+00	0.00E+00	1.00E-08	3.34E-09	1.40E-07
1783_4	5.69E-06	0.00E+00	2.81E-08	5.34E-07	3.24E-08	0.00E+00	0.00E+00	1.46E-08	0.00E+00	2.46E-08
1783_5	6.17E-06	0.00E+00	3.28E-08	4.75E-07	3.31E-08	0.00E+00	0.00E+00	1.67E-08	0.00E+00	1.42E-08
1783_5D	6.30E-06	0.00E+00	3.28E-08	5.02E-07	3.27E-08	0.00E+00	0.00E+00	1.33E-08	0.00E+00	1.42E-08
1783_F	6.08E-06	0.00E+00	0.00E+00	3.97E-07	3.17E-08	0.00E+00	0.00E+00	7.92E-09	0.00E+00	1.28E-08
1784_0	1.07E-08	0.00E+00	0.00E+00	1.05E-07	1.30E-09	0.00E+00	0.00E+00	3.75E-09	0.00E+00	1.42E-08
1784_1	3.74E-08	0.00E+00	7.02E-08	3.61E-07	2.60E-07	0.00E+00	0.00E+00	1.13E-07	7.16E-08	4.27E-08
1784_2	1.07E-08	0.00E+00	8.42E-08	5.48E-07	5.16E-07	0.00E+00	0.00E+00	4.50E-08	1.97E-08	5.59E-08
1784_3	1.07E-08	0.00E+00	6.55E-08	5.43E-07	4.73E-07	0.00E+00	0.00E+00	3.04E-08	4.45E-09	5.23E-08
1784_4	2.14E-08	0.00E+00	7.49E-08	8.22E-07	5.91E-07	0.00E+00	0.00E+00	8.30E-08	0.00E+00	6.41E-08
1784_5	2.67E-08	0.00E+00	7.96E-08	7.99E-07	5.77E-07	0.00E+00	0.00E+00	9.59E-09	0.00E+00	6.65E-08
1784_5D	3.20E-08	0.00E+00	7.96E-08	7.81E-07	5.61E-07	0.00E+00	0.00E+00	1.33E-08	0.00E+00	6.37E-08
1784_F	2.14E-08	0.00E+00	6.55E-08	6.67E-07	5.64E-07	0.00E+00	0.00E+00	4.59E-09	0.00E+00	6.26E-08

Table B28: Runs 1783, & 1784, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1783_0	0.00E+00	7.56E-10	0.00E+00	7.30E-06	4.90E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1783_1	2.70E-09	1.53E-07	0.00E+00	1.32E-05	2.27E-09	3.43E-09	3.41E-10	0.00E+00	1.60E-09	6.84E-10
1783_2	0.00E+00	8.10E-08	0.00E+00	1.28E-05	3.02E-09	4.00E-09	5.68E-10	2.77E-09	1.86E-09	1.16E-09
1783_3	0.00E+00	4.50E-08	0.00E+00	1.07E-05	2.91E-09	4.57E-09	5.11E-10	3.88E-09	1.60E-09	1.08E-09
1783_4	0.00E+00	4.11E-08	0.00E+00	1.08E-05	2.53E-09	4.57E-09	5.39E-10	3.05E-09	2.93E-09	1.05E-09
1783_5	0.00E+00	5.36E-08	0.00E+00	1.14E-05	2.88E-09	4.57E-09	6.53E-10	4.16E-09	2.13E-09	1.42E-09
1783_5D	0.00E+00	5.69E-08	0.00E+00	1.11E-05	2.74E-09	4.28E-09	6.25E-10	5.27E-09	2.39E-09	1.55E-09
1783_F	0.00E+00	1.30E-08	0.00E+00	7.06E-06	2.65E-09	4.00E-09	6.25E-10	5.55E-09	2.13E-09	1.24E-09
1784_0	3.37E-09	1.08E-09	0.00E+00	9.28E-06	4.90E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1784_1	0.00E+00	3.55E-09	0.00E+00	1.68E-05	4.12E-08	1.31E-07	2.03E-08	9.43E-08	2.08E-08	5.03E-09
1784_2	0.00E+00	1.54E-09	0.00E+00	1.75E-05	7.92E-08	2.56E-07	4.02E-08	1.85E-07	4.36E-08	1.14E-08
1784_3	2.36E-09	1.87E-09	0.00E+00	1.72E-05	7.33E-08	2.36E-07	3.70E-08	1.82E-07	4.12E-08	1.08E-08
1784_4	0.00E+00	2.14E-09	0.00E+00	2.25E-05	9.40E-08	2.98E-07	4.75E-08	2.23E-07	5.32E-08	1.27E-08
1784_5	0.00E+00	1.61E-09	0.00E+00	1.62E-05	8.98E-08	2.86E-07	4.54E-08	2.16E-07	5.03E-08	1.34E-08
1784_5D	0.00E+00	1.71E-09	0.00E+00	1.54E-05	8.81E-08	2.79E-07	4.48E-08	2.01E-07	4.95E-08	1.21E-08
1784_F	0.00E+00	1.28E-09	0.00E+00	9.42E-06	8.94E-08	2.83E-07	4.42E-08	2.10E-07	4.97E-08	1.39E-08

Table B28: Runs 1783, & 1784, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1783_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.39E-09
1783_1	5.29E-10	3.82E-09	2.39E-09	4.61E-10	8.37E-10	1.66E-10	9.25E-10	1.83E-10	0.00E+00	1.31E-09
1783_2	7.05E-10	4.58E-09	3.72E-09	5.82E-10	1.36E-09	1.42E-10	9.25E-10	0.00E+00	0.00E+00	0.00E+00
1783_3	7.55E-10	5.09E-09	3.37E-09	5.82E-10	1.22E-09	2.37E-10	9.25E-10	1.83E-10	0.00E+00	8.70E-10
1783_4	7.55E-10	4.83E-09	4.14E-09	5.34E-10	1.41E-09	2.13E-10	9.25E-10	2.29E-10	0.00E+00	0.00E+00
1783_5	7.55E-10	5.85E-09	3.96E-09	7.28E-10	1.43E-09	1.89E-10	1.16E-09	2.29E-10	0.00E+00	0.00E+00
1783_5D	8.81E-10	5.09E-09	3.32E-09	7.28E-10	1.60E-09	3.55E-10	1.16E-09	3.43E-10	0.00E+00	5.44E-09
1783_F	7.80E-10	5.09E-09	4.14E-09	5.58E-10	1.36E-09	1.66E-10	1.16E-09	0.00E+00	0.00E+00	0.00E+00
1784_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1784_1	3.20E-09	2.29E-08	2.07E-08	4.24E-09	1.23E-08	1.85E-09	1.04E-08	1.67E-09	0.00E+00	8.70E-09
1784_2	6.90E-09	4.53E-08	4.54E-08	9.09E-09	2.56E-08	3.76E-09	2.17E-08	3.04E-09	0.00E+00	2.61E-09
1784_3	6.49E-09	4.17E-08	4.18E-08	8.44E-09	2.38E-08	3.29E-09	1.99E-08	2.81E-09	0.00E+00	0.00E+00
1784_4	8.10E-09	5.19E-08	5.21E-08	1.03E-08	2.93E-08	4.12E-09	2.61E-08	3.50E-09	0.00E+00	0.00E+00
1784_5	7.80E-09	5.09E-08	5.17E-08	1.01E-08	2.97E-08	4.12E-09	2.40E-08	3.66E-09	0.00E+00	0.00E+00
1784_5D	7.88E-09	5.04E-08	5.05E-08	9.53E-09	2.90E-08	3.74E-09	2.33E-08	3.27E-09	0.00E+00	0.00E+00
1784_F	8.08E-09	5.04E-08	5.09E-08	1.00E-08	2.85E-08	4.14E-09	2.47E-08	3.54E-09	0.00E+00	0.00E+00

Table B28: Runs 1783, & 1784, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1783_0	0.00E+00	1.93E-08	0.00E+00	0.00E+00	0.00E+00	4.15E-03	0.00E+00	1.29E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1783_1	1.37E-09	7.68E-06	3.45E-10	5.95E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1783_2	5.87E-10	4.65E-06	0.00E+00	4.55E-09	0.00E+00	7.21E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1783_3	0.00E+00	2.90E-06	0.00E+00	4.05E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1783_4	0.00E+00	2.68E-06	0.00E+00	3.81E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1783_5	0.00E+00	3.13E-06	0.00E+00	4.03E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1783_5D	0.00E+00	3.11E-06	0.00E+00	4.15E-09	0.00E+00	1.06E-02	0.00E+00	2.26E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1783_F	0.00E+00	4.09E-06	0.00E+00	4.30E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1784_0	0.00E+00	1.93E-08	0.00E+00	0.00E+00	0.00E+00	1.00E-02	0.00E+00	3.07E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1784_1	1.37E-09	4.44E-07	0.00E+00	2.03E-09	0.00E+00	9.07E-03	0.00E+00	2.46E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1784_2	1.37E-09	3.86E-07	0.00E+00	2.62E-09	0.00E+00	8.61E-03	0.00E+00	2.62E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1784_3	7.83E-10	1.93E-08	0.00E+00	2.32E-09	0.00E+00	7.85E-03	0.00E+00	2.23E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1784_4	5.87E-10	1.93E-08	0.00E+00	2.89E-09	0.00E+00	7.81E-03	0.00E+00	2.40E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1784_5	9.79E-10	1.93E-08	0.00E+00	2.62E-09	0.00E+00	9.10E-03	0.00E+00	3.23E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1784_5D	9.79E-10	1.93E-08	0.00E+00	2.69E-09	0.00E+00	8.46E-03	0.00E+00	2.37E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1784_F	9.79E-10	1.93E-08	0.00E+00	2.50E-09	0.00E+00	9.17E-03	0.00E+00	2.57E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B28: Runs 1783, & 1784, fluid analyses (cont.)

B29: Run 1785

Table B29: Run 1785, fluid analyses

Run & Sample Number (Runs highlighted in red failed due to leakage)	Fluid	Solid ID	Temperature	Pressure	Elapsed Time	Calculated fluid Volume Before sample	Alkalinity	Alkalinity	Fe2+	Fe2+	pH	Eh	Temperature on sampling
			°C	bar	hours	ml	ppm	eq. M HCO3	ppm	Mol/l		mV	°C
						(measured volume at end of run)							
1785_0	0.01M HCl, 0.003M HNO3	N/A	N/A	N/A			0	0.00E+00	0.0	0.0E+00	1.94	546	20
1785_1	0.01M HCl, 0.003M HNO3	HTL325	100	200	23	350	0	0.00E+00	18.4	3.3E-04	2.07	406.5	45.4
1785_2	0.01M HCl, 0.003M HNO3	HTL325	100	200	167	336	0	0.00E+00	33.0	5.9E-04	2.28	395.8	54.3
1785_3	0.01M HCl, 0.003M HNO3	HTL325	100	200	312	323	0	0.00E+00	35.4	6.3E-04	2.63	381.1	34.9
1785_4	0.01M HCl, 0.003M HNO3	HTL325	100	200	476	311	0	0.00E+00	34.4	6.2E-04	2.4	366.3	38
1785_5	0.01M HCl, 0.003M HNO3	HTL325	100	200	648	299	0	0.00E+00	37.8	6.8E-04	2.44	351.7	51.5
1785_5D	0.01M HCl, 0.003M HNO3	HTL325	100	200	648	284	0	0.00E+00	36.2	6.5E-04	2.41	356.1	47.9
1785_F	0.01M HCl, 0.003M HNO3	HTL325	100	200	650	272.8 (228)	0	0.00E+00	38.3	6.9E-04	2.42	314.4	35.3

Run & Sample Number (Runs highlighted in red failed due to leakage)	Li	Be	Na	Mg	Al	Si	P	S	K	Ca
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1785_0	2.31E-06	0.00E+00	2.44E-04	1.48E-06	4.30E-06	0.00E+00	0.00E+00	1.25E-04	4.09E-05	0.00E+00
1785_1	2.31E-06	0.00E+00	3.65E-04	5.10E-04	6.25E-04	0.00E+00	3.87E-06	1.25E-04	7.16E-05	0.00E+00
1785_2	2.31E-06	0.00E+00	3.65E-04	9.75E-04	1.19E-03	0.00E+00	3.87E-06	1.25E-04	7.16E-05	0.00E+00
1785_3	2.31E-06	0.00E+00	4.70E-04	1.05E-03	1.28E-03	0.00E+00	3.87E-06	1.25E-04	9.21E-05	0.00E+00
1785_4	2.31E-06	0.00E+00	4.35E-04	1.02E-03	1.25E-03	0.00E+00	0.00E+00	1.25E-04	8.18E-05	0.00E+00
1785_5	2.31E-06	0.00E+00	3.48E-04	1.04E-03	1.27E-03	0.00E+00	0.00E+00	1.25E-04	7.16E-05	0.00E+00
1785_5D	2.31E-06	0.00E+00	3.48E-04	1.03E-03	1.27E-03	0.00E+00	0.00E+00	1.25E-04	7.16E-05	0.00E+00
1785_F	2.31E-06	0.00E+00	2.09E-04	1.08E-03	1.31E-03	0.00E+00	3.87E-06	1.25E-04	4.09E-05	0.00E+00

Table B29: Run 1785, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Ti	V	Cr	Mn	Ox. Fe	Co	Ni	Cu	Zn	Ga
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1785_0	0.00E+00	0.00E+00	3.85E-08	0.00E+00	1.65E-06	0.00E+00	1.29E-08	5.67E-08	1.03E-05	0.00E+00
1785_1	0.00E+00	1.73E-07	2.02E-06	8.82E-06	6.28E-04	9.84E-08	1.81E-06	3.83E-05	2.62E-05	0.00E+00
1785_2	0.00E+00	2.20E-07	8.54E-07	1.58E-05	1.10E-03	7.53E-08	5.00E-07	2.70E-05	3.32E-05	0.00E+00
1785_3	0.00E+00	2.98E-07	9.00E-07	1.68E-05	1.19E-03	7.74E-08	4.88E-07	1.46E-05	3.71E-05	0.00E+00
1785_4	0.00E+00	3.14E-07	9.15E-07	1.68E-05	1.19E-03	8.76E-08	1.26E-06	1.00E-06	3.63E-05	0.00E+00
1785_5	0.00E+00	3.61E-07	8.92E-07	1.70E-05	1.22E-03	7.67E-08	7.42E-07	6.29E-07	3.29E-05	0.00E+00
1785_5D	0.00E+00	3.53E-07	8.39E-07	1.71E-05	1.21E-03	8.28E-08	8.63E-07	5.98E-07	3.38E-05	0.00E+00
1785_F	0.00E+00	3.61E-07	7.69E-07	1.73E-05	1.24E-03	7.47E-08	3.95E-07	5.85E-07	2.51E-05	0.00E+00

Table B29: Run 1785, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	As	Se	Rb	Sr	Y	Zr	Nb	Mo	Ag	Cd
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1785_0	1.07E-08	0.00E+00	0.00E+00	1.05E-07	1.30E-09	0.00E+00	0.00E+00	3.75E-09	0.00E+00	1.42E-08
1785_1	6.41E-08	0.00E+00	3.28E-08	2.42E-07	1.70E-08	0.00E+00	0.00E+00	2.75E-08	4.86E-08	2.24E-08
1785_2	1.28E-07	0.00E+00	3.74E-08	2.33E-07	2.02E-08	0.00E+00	0.00E+00	2.67E-08	2.82E-08	3.31E-08
1785_3	1.28E-07	0.00E+00	3.28E-08	2.97E-07	2.33E-08	0.00E+00	0.00E+00	1.96E-08	1.89E-08	3.91E-08
1785_4	1.28E-07	0.00E+00	3.74E-08	2.56E-07	2.40E-08	0.00E+00	0.00E+00	8.76E-09	4.82E-09	3.99E-08
1785_5	1.92E-07	0.00E+00	3.28E-08	2.28E-07	2.47E-08	0.00E+00	0.00E+00	1.88E-08	4.82E-09	3.70E-08
1785_5D	1.66E-07	0.00E+00	3.28E-08	2.74E-07	2.51E-08	0.00E+00	0.00E+00	9.59E-09	0.00E+00	4.13E-08
1785_F	1.76E-07	0.00E+00	0.00E+00	1.64E-07	2.45E-08	0.00E+00	0.00E+00	2.04E-08	2.97E-09	4.02E-08

Table B29: Run 1785, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Sn	Sb	Cs	Ba	La	Ce	Pr	Nd	Sm	Eu
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1785_0	3.37E-09	1.08E-09	0.00E+00	9.28E-06	4.90E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1785_1	2.36E-09	2.69E-08	0.00E+00	1.57E-05	1.02E-08	2.26E-08	2.81E-09	1.36E-08	3.19E-09	6.84E-10
1785_2	0.00E+00	8.40E-08	0.00E+00	1.60E-05	2.30E-08	5.02E-08	6.50E-09	3.02E-08	5.59E-09	2.16E-09
1785_3	0.00E+00	5.42E-08	0.00E+00	2.16E-05	2.88E-08	6.45E-08	7.86E-09	3.24E-08	6.12E-09	1.79E-09
1785_4	0.00E+00	2.89E-08	0.00E+00	2.04E-05	3.29E-08	7.34E-08	9.25E-09	3.99E-08	6.92E-09	1.74E-09
1785_5	0.00E+00	3.20E-08	0.00E+00	1.55E-05	3.71E-08	8.42E-08	1.03E-08	4.19E-08	7.18E-09	2.34E-09
1785_5D	0.00E+00	3.33E-08	0.00E+00	1.56E-05	3.78E-08	8.59E-08	1.06E-08	4.60E-08	7.18E-09	2.42E-09
1785_F	0.00E+00	1.55E-08	0.00E+00	9.85E-06	3.83E-08	8.74E-08	1.12E-08	4.41E-08	7.45E-09	2.08E-09

Table B29: Run 1785, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Ta	W
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1785_0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1785_1	3.02E-10	2.54E-09	1.94E-09	4.61E-10	1.36E-09	1.42E-10	1.39E-09	2.06E-10	0.00E+00	1.96E-09
1785_2	4.78E-10	3.56E-09	2.58E-09	4.37E-10	1.34E-09	1.89E-10	1.85E-09	3.66E-10	0.00E+00	1.09E-09
1785_3	4.53E-10	4.07E-09	2.90E-09	5.34E-10	1.29E-09	2.84E-10	1.85E-09	2.06E-10	0.00E+00	0.00E+00
1785_4	5.54E-10	4.83E-09	3.13E-09	6.55E-10	1.48E-09	2.37E-10	1.85E-09	3.66E-10	0.00E+00	0.00E+00
1785_5	5.03E-10	5.34E-09	3.32E-09	5.58E-10	1.72E-09	2.37E-10	1.62E-09	3.20E-10	0.00E+00	4.59E-08
1785_5D	5.54E-10	4.83E-09	2.83E-09	5.58E-10	1.70E-09	3.55E-10	2.08E-09	2.74E-10	0.00E+00	2.18E-09
1785_F	6.04E-10	5.09E-09	2.95E-09	5.09E-10	1.65E-09	2.84E-10	1.85E-09	2.97E-10	0.00E+00	0.00E+00

Table B29: Run 1785, fluid analyses (cont.)

Run & Sample Number (Runs highlighted in red failed due to leakage)	Tl	Pb	Th	U	Hf	Cl-	SO42-	NO3-	Br-	NO2-	HPO42-	F-
	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l	Mol/l
1785_0	0.00E+00	1.93E-08	0.00E+00	0.00E+00	0.00E+00	1.00E-02	0.00E+00	3.07E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1785_1	1.96E-09	5.60E-07	0.00E+00	1.04E-08	0.00E+00	8.43E-03	0.00E+00	2.25E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1785_2	9.79E-10	3.28E-07	0.00E+00	1.41E-08	0.00E+00	9.58E-03	0.00E+00	2.36E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1785_3	0.00E+00	2.51E-07	0.00E+00	1.60E-08	0.00E+00	9.48E-03	0.00E+00	2.21E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1785_4	5.87E-10	1.93E-08	0.00E+00	1.58E-08	0.00E+00	9.41E-03	0.00E+00	2.49E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1785_5	5.87E-10	1.93E-08	0.00E+00	1.64E-08	0.00E+00	8.09E-03	0.00E+00	2.16E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1785_5D	0.00E+00	1.93E-08	0.00E+00	1.67E-08	0.00E+00	8.41E-03	0.00E+00	2.33E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1785_F	0.00E+00	1.93E-08	0.00E+00	1.71E-08	0.00E+00	1.67E-02	0.00E+00	2.78E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table B29: Run 1785, fluid analyses (cont.)

APPENDIX C – DESCRIPTION OF RESULTS FROM THE EXPERIMENTS

This appendix contains a detailed description of results from the experiments.

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C1: Experiments with deionised water and UK samples HTL315, HTL319, HTLMix

Four experiments were carried out using deionised water and the UK samples HTL315, HTL319 and HTLMix.

Full details on the sample compositions can be found in Table 3.1.1 and in Appendix A.

The experiments carried out using deionised water as a leaching agent are summarised in Table C1 and Figures C1.1 – C1.5. The figures show selected elemental concentrations for the final fluid sample taken from the experiments, along with a time series for Run 1758.

Lab. Run Number	1713	1714	1715	1758
Experiment Type	Rotating Shaker	Rotating shaker	Rotating shaker	Ti Batch
Solid ID	HTL315	HTL319	HTLMix	HTL315
Solution Concentration	N/A	N/A	N/A	N/A
Temperature, C	70	70	70	100
Pressure, bar	1	1	1	200
Duration, hours	674	674	674	718
Solid Weight, g	5	5	5	8.75
Solution Volume, ml	200	200	200	350
Starting pH	5.98	5.98	5.98	5.98
Starting Eh	203.9	203.9	203.9	203.9
Final pH	2.88	5.17	7.55	6.05
Final Eh	311.4	258.2	221	-44

Table C1: Summary of experiments carried out using deionised water and UK samples

C1.1 Experiments using UK material (sample HTL315)

Two experiments were carried out using HTL315 and deionised water, one at 70 °C (Run 1713) and atmospheric pressure, and one at 100 °C and 200 bar pressure (Run 1758). Selected elemental concentrations measured in the final samples from these runs are shown in Figures C1.1 and C1.2. A time series of summed elemental concentrations is shown in Figure C1.5.

Both experiments show some, minor, leaching of the selected ‘At Risk’ metals, elevated leaching of elements common to South West England, and very limited leaching of REEs. The spread of elements leached and their relative concentrations are broadly in line with the composition of the starting solid.

Notably, the spread of leached elements is larger, and their concentrations generally slightly higher in the lower temperature experiment, possibly due to the more acidic conditions generated in the lower temperature experiment.

In terms of the selected 'At Risk' metals, only cobalt and antimony are detected in the lower temperature leachate, at concentrations of 2E-5 M and 6E-7 M respectively. The higher temperature leachate shows a broader range of these elements, with cobalt, strontium, molybdenum and antimony all present in detectable amounts, though at very low concentrations, none exceeding 1E-7 M.

In terms of metals common to South West England, manganese, zinc, arsenic, and iron are all elevated in leachates from both experiments, though are all slightly higher in the lower temperature leachate, at concentrations of 1E-5 M, 3E-5 M, 1E-4 M and 2E-3 M respectively. Copper is also elevated in the lower temperature leachate, at a concentration of 6E-5 M, though is not detected in the higher temperature leachate.

In terms of REEs, none are detected in the leachate from the higher temperature experiment. In the 70°C experiment, yttrium, lanthanum, and caesium are all detected, albeit at very low concentrations, none exceeding 1E-7 M.

In terms of pH, there is a marked difference between the runs at the two different temperatures: the higher temperature run sees a slight increase in pH from 5.98 to 6.05, while the lower temperature run sees a large drop in pH from 5.98 to 2.88, presumably from pyrite oxidation.

C1.2: Experiments using UK material (sample HTL319)

One experiment was carried out using HTL319 and deionised water, at 70 °C (Run 1714). Selected elemental concentrations measured in the final sample from this run are shown in Figure C1.3.

Very limited concentrations of leached elements were detected in this experiment. Of the selected 'At Risk' metals, only antimony was detected, at a concentration of 2E-8 M. In terms of metals common to South West England, only manganese, copper, arsenic and tungsten were found in the leachate, and of these, only manganese was found at concentrations above 1E-6 M. No REEs were detected in the leachate.

In terms of pH the experiment sees a slight drop from 5.98 to 5.17.

C1.3: Experiments using UK material (sample HTLMIX)

One experiment was carried out using HTLMix and deionised water, at 70 °C and atmospheric pressure (Run 1715). Selected elemental concentrations measured in the final sample from this run are shown in Figure C1.4.

As for the experiment using deionised water and HTL319, leaching from this solid was very limited. Of the selected 'At Risk' metals only strontium and antimony were detected, at concentrations of 6E-7 M

and $1\text{E-}6$ M respectively. Low concentrations of copper and tin were detected ($1\text{E-}7$ M and $3\text{E-}8$ M respectively), while lead was relatively elevated, at a concentration of $2\text{E-}6$. As for the experiment using HTL319, no REEs were detected in the leachate.

In contrast to the experiment using HTL319, the HTLMix leachate sees a rise in pH, from 5.98 to 7.55.

An SEM analysis of the reacted solid from this run was carried out. The starting material for this run was of the type where much of the galena is present as partially oxidised fines coating silicate grains. The reaction products showed no significant changes.

Run 1713: HTL315, De-ionised Water, 70°C, 1 bar

Elemental Concentration, M, after 674 hours

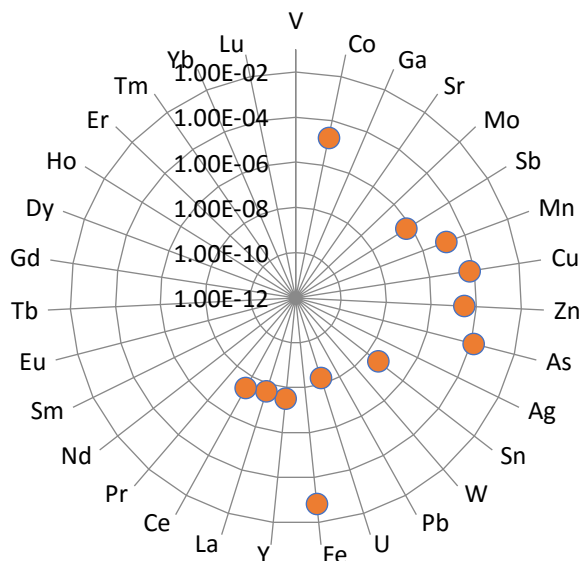


Figure C1.1: Dissolved metal concentrations for UK sample HTL315 (Run 1713: De-ionised Water, 70°C, 1 bar).

Run 1758: HTL315, De-ionised Water, 100°C, 200 bar

Elemental Concentration, M, after 745 hours

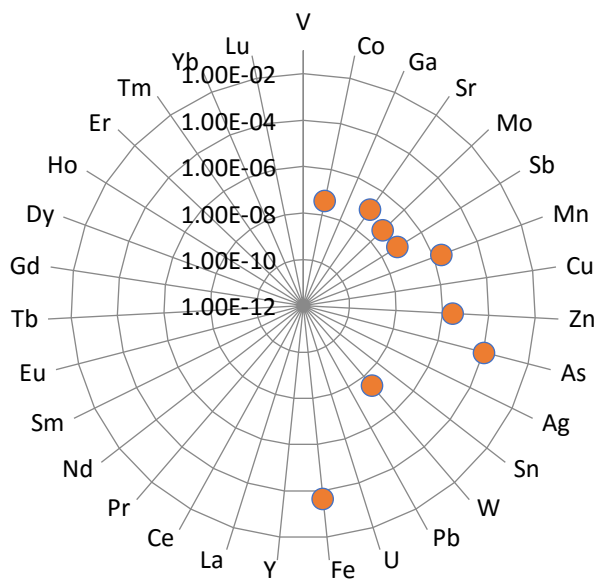


Figure C1.2: Dissolved metal concentrations for UK sample HTL315 (Run 1713: De-ionised Water, 100°C, 200 bar).

Run 1714: HTL319, Deionised Water, 70°C, 1 bar

Elemental Concentration, M, after 674 hours

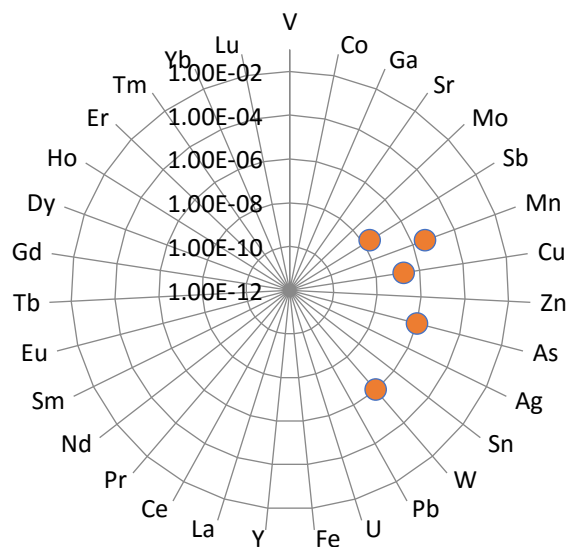


Figure C1.3: Dissolved metal concentrations for UK sample HTL319 (Run 1714: De-ionised Water, 70°C, 1 bar).

Run 1715: HTLMix, De-ionised Water, 70°C, 1 bar

Elemental Concentration, M, after 674 hours

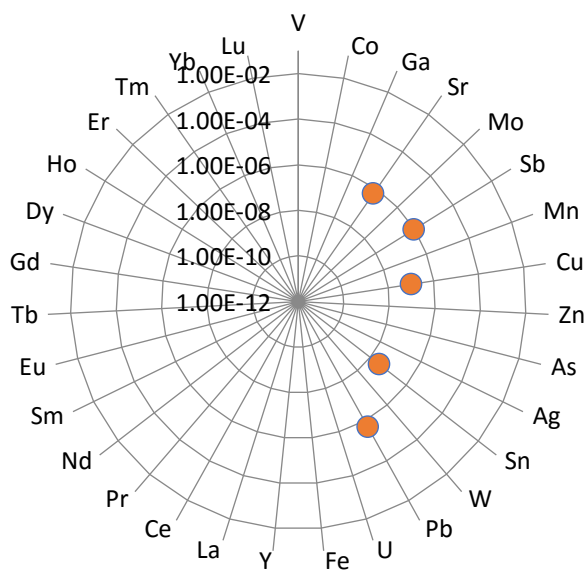


Figure C1.4: Dissolved metal concentrations for UK sample HTLMix (Run 1715: De-ionised water, 70°C, 1 bar).

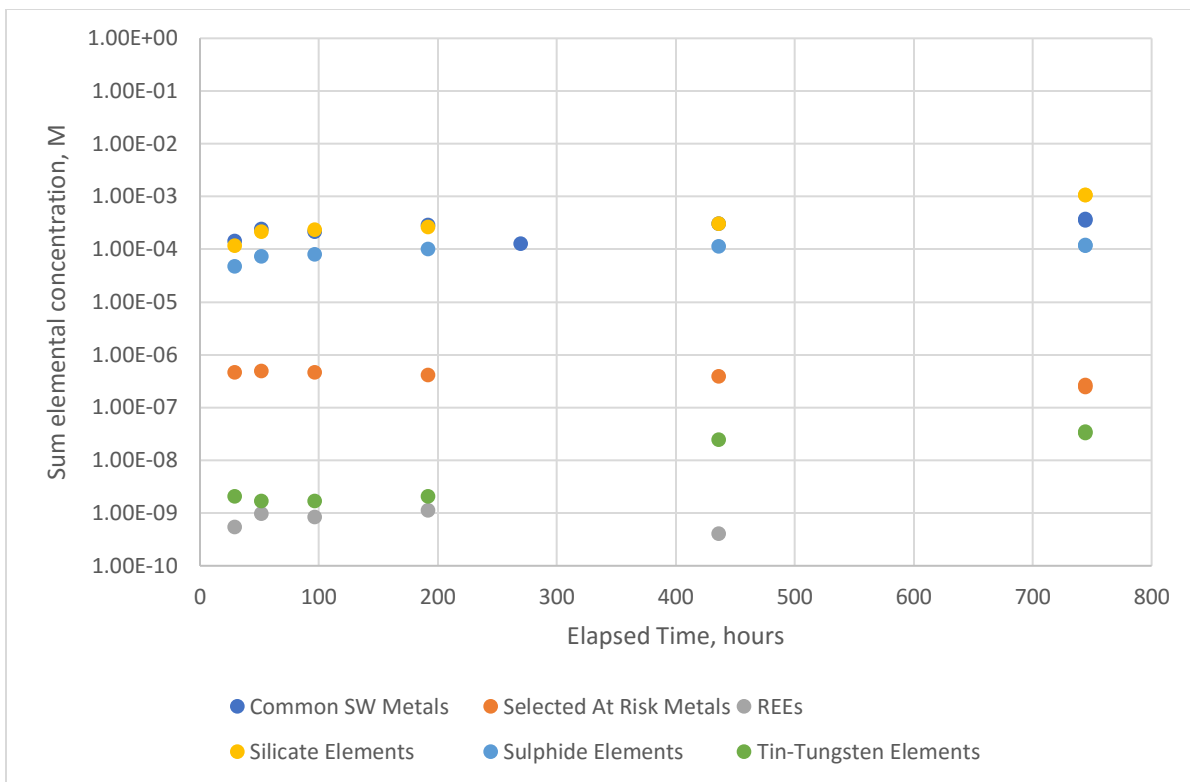


Figure C1.5: Sum of dissolved metal concentrations for an experiment using HTL315 (Run 17x58: deionised water, 100 °C, 200 bar).

C2: Experiments with tap water and UK samples HTL315, HTL319 and HTLMix

Four experiments were carried out using tap water and the UK samples HTL315, HTL319 and HTLMix.

Full details on the sample compositions can be found in Table 3.1.1 and Appendix A.

The experiments carried out using tap water as a leaching agent are summarised in Table C2 and Figures C2.1-C2.1 below. The starting fluid composition in terms of the selected metals of interest, is shown in Figure C2.5.

Lab. Run Number	1716	1717	1718	1728
Experiment Type	Rotating Shaker	Rotating shaker	Rotating shaker	Ti Batch
Solid ID	HTL315	HTL319	HTLMix	HTL315
Solution Concentration	N/A	N/A	N/A	N/A
Temperature, C	70	70	70	70
Pressure, bar	1	1	1	1
Duration, hours	674	674	674	674
Solid Weight, g	5	5	5	5
Solution Volume, ml	200	200	200	200
Starting pH	7.34	7.34	7.34	7.34
Starting Eh	198	198	198	198
Final pH	6.56	8.51	7.57	6.4
Final Eh	216.6	187.8	183.9	143.6

Table C2: Summary of experiments using tap water and UK samples

C2.1: Experiments using HTL315

Two experiments were carried out using HTL315 and tap water: Run 1716, at 70°C and atmospheric pressure, and a duplicate, Run 1728. Selected elemental concentrations measured in the final samples from these runs are shown in Figures C2.1 and C2.2.

The variety and concentration of elements leached in these two experiments is broadly similar, with low concentrations of some selected 'At Risk' metals, higher concentrations of metals common to South

West England, and no detectable REEs. The duplicate Run 1728, does contain low levels of tin, tungsten and lead, which are not detected in Run 1716, likely due to minor sample heterogeneity.

In terms of the selected 'At Risk' metals, cobalt, strontium, molybdenum, and antimony are all present in detectable amounts, though at very low concentrations, the highest being strontium at $2\text{E-}6\text{ M}$, though it should be noted that strontium levels in the starting fluid were roughly the same as this, indicating little contribution from leaching.

In terms of metals common to South West England, manganese, copper, arsenic, and iron are present in the leachate at concentrations of $9\text{E-}7\text{ M}$, $2\text{E-}6\text{ M}$, $3\text{E-}5\text{ M}$ and $3\text{E-}5\text{ M}$ respectively. In terms of copper this represents a decrease in concentration from the starting tap water. Likewise silver and lead concentrations ($2\text{E-}7\text{ M}$ and $1\text{E-}6\text{ M}$ respectively in the starting tap water), are lower in the final leachate than in the starting fluid, suggesting some precipitation of these elements may be occurring.

In terms of pH, both runs experience a slight drop in pH, from at starting pH of 7.34, to 6.56 for Run 1716, and 6.40 for Run 1728.

C2.2: Experiments using HTL319

One experiment was carried out using HTL319 and deionised water, at 70°C and atmospheric pressure (Run 1717). Selected elemental concentrations measured in the final sample from this run are shown in Figure C2.3.

Leaching using this solid and deionised water is very limited. Of the selected 'At Risk' metals, strontium, molybdenum, and antimony are present at concentrations of $2\text{E-}6\text{ M}$, $4\text{E-}8\text{ M}$, and $3\text{E-}8\text{ M}$ respectively, though of these, strontium and molybdenum were present in the starting solution at roughly the same concentrations. As in the experiments using HTL315, there was an overall decrease in concentration of copper, silver, and lead from the starting fluid, while some leaching of arsenic, tungsten, uranium and iron did occur, reaching concentrations of $2\text{E-}6\text{ M}$, $2\text{E-}5\text{ M}$, $1\text{E-}8\text{ M}$, and $1\text{E-}5\text{ M}$, respectively. No REEs were leached from this solid.

In terms of pH, the fluid saw a slight rise, from 7.34 to 8.51.

C2.3: Experiments using HTLMix

One experiment was carried out using HTLMix and deionised water, at 70°C and atmospheric pressure (Run 1718). Selected elemental concentrations measured in the final sample from this run are shown in Figure C2.3.

Leaching was very limited from this solid. The only of the selected 'At Risk' metals detected in the final leachate were strontium, at a concentration of $3\text{E-}6\text{ M}$, comparable to that of the starting fluid, and antimony, at $2\text{E-}6\text{ M}$. The only other of the elements of interest detected were copper (at a concentration below that of the starting fluid), lead ($4\text{E-}6\text{ M}$), and iron ($4\text{E-}6\text{ M}$).

The experiment showed a very slight increase in pH, from 7.34 to 7.57.

An SEM analysis of the reacted solid from this experiment was also carried out. The starting material for this run was of the type where much of the galena is present as partially oxidised fines coating silicate grains. The reaction products showed no significant changes.

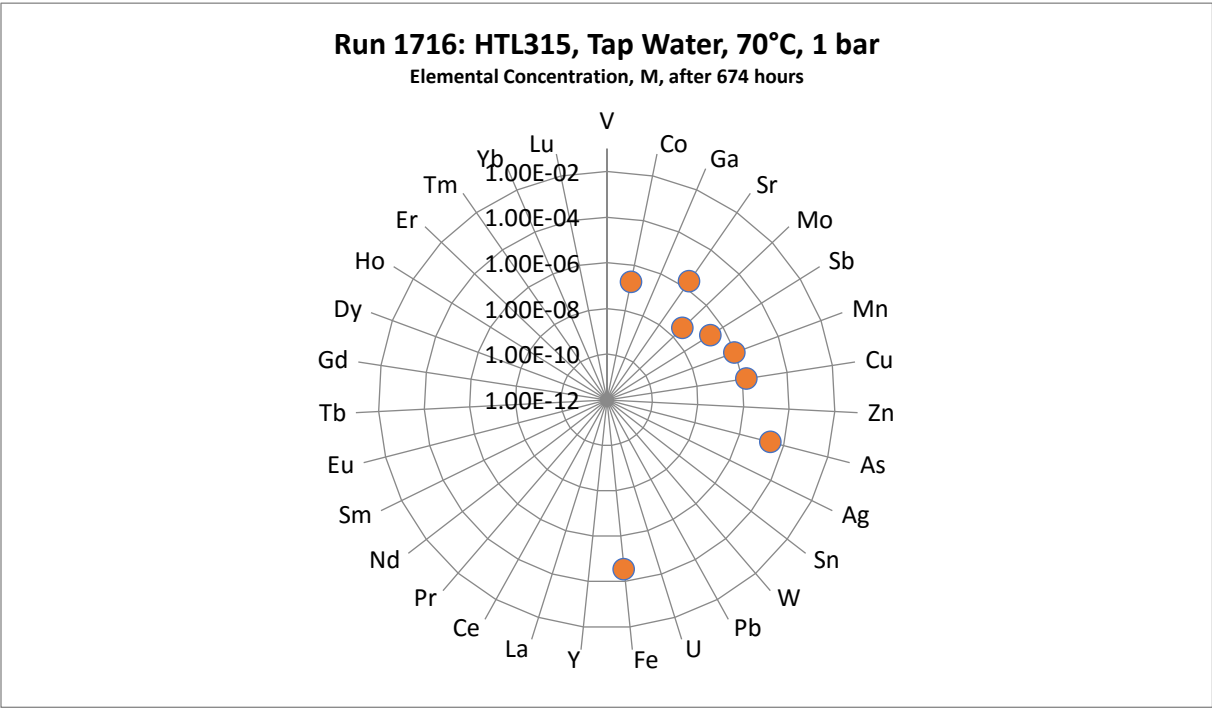


Figure C2.1: Dissolved metal concentrations for UK sample HTL315 (Run 1716: tap water, 70 °C, 1 bar).

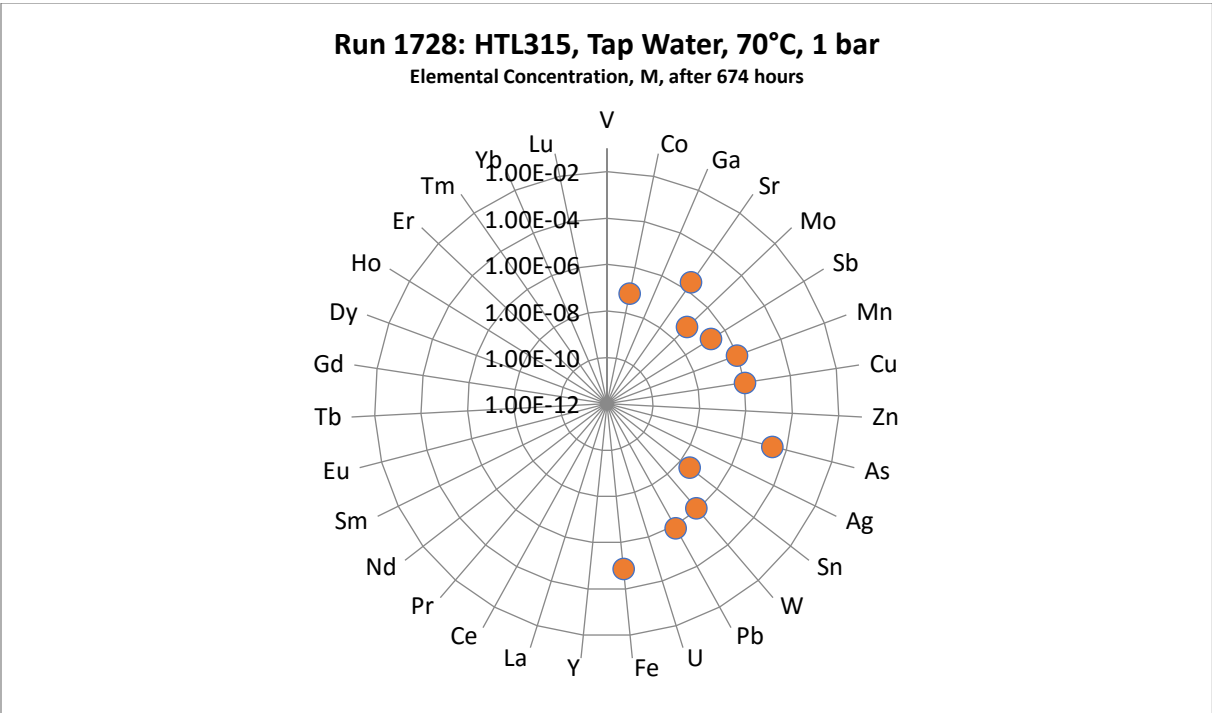


Figure C2.2: Dissolved metal concentrations for UK sample HTL315 (Run 1728: tap water, 70 °C, 1 bar).

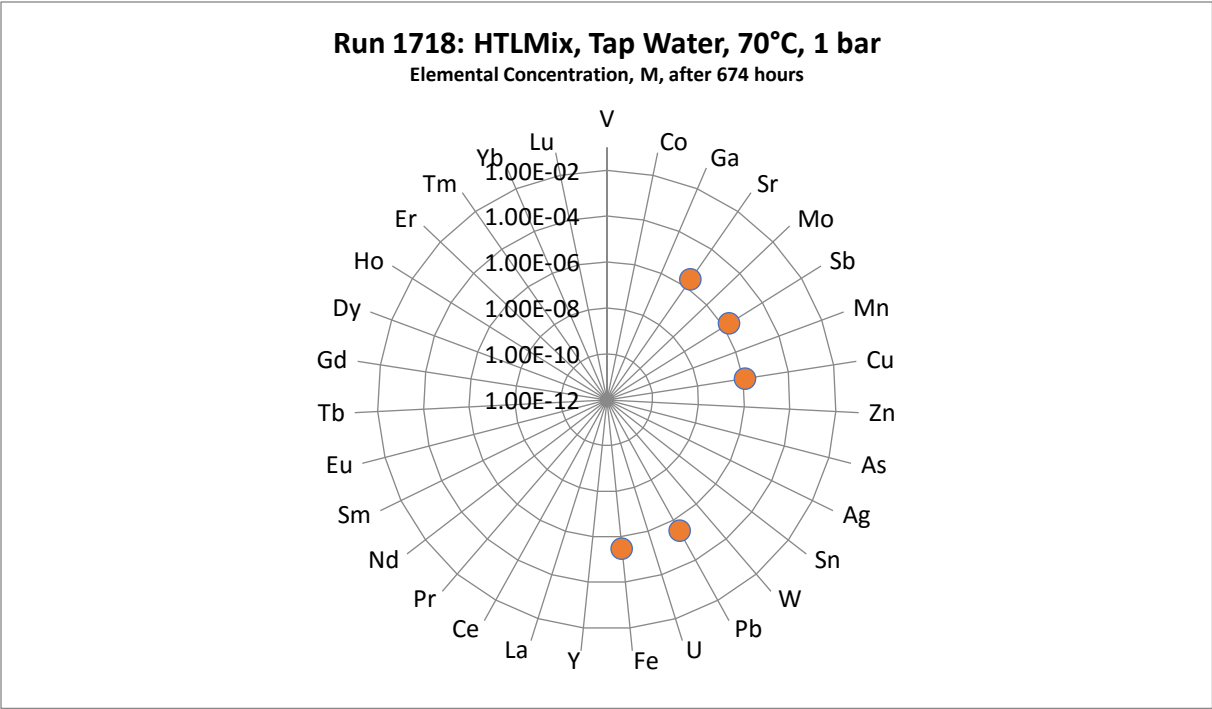


Figure C2.3: Dissolved metal concentrations for UK sample HTLMix (Run 1718: tap water, 70 °C, 1 bar).

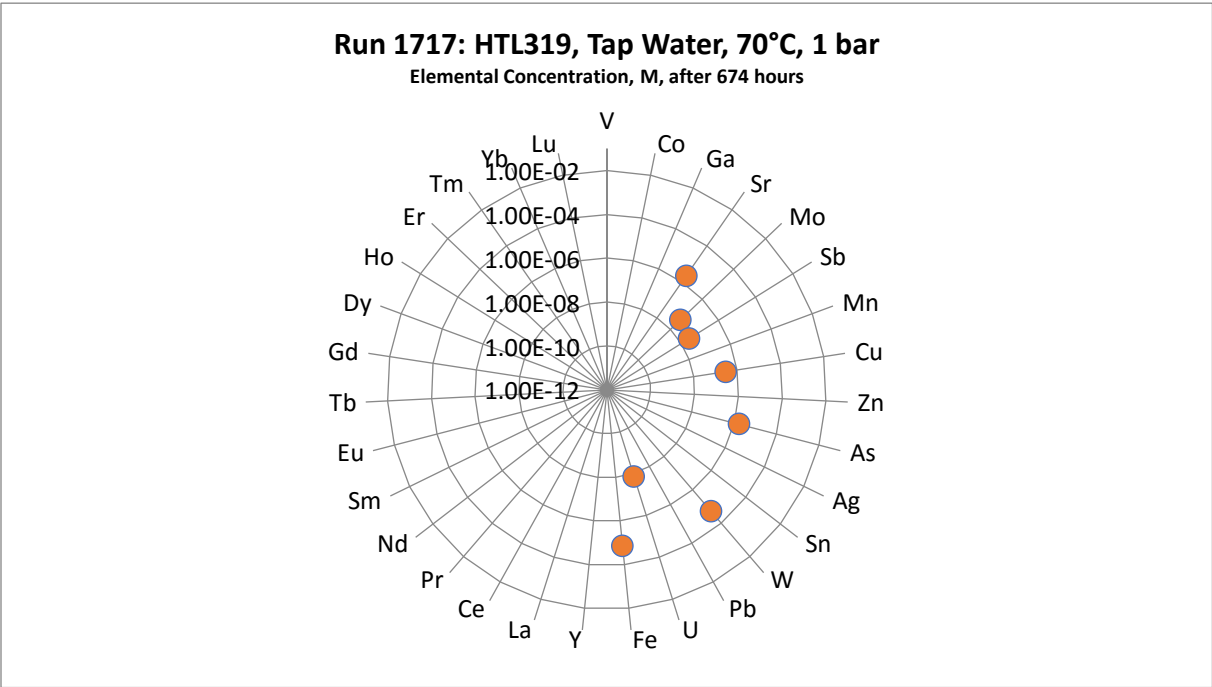


Figure C2.4: Dissolved metal concentrations for UK sample HTL319 (Run 1717: tap water, 70°C, 1 bar).

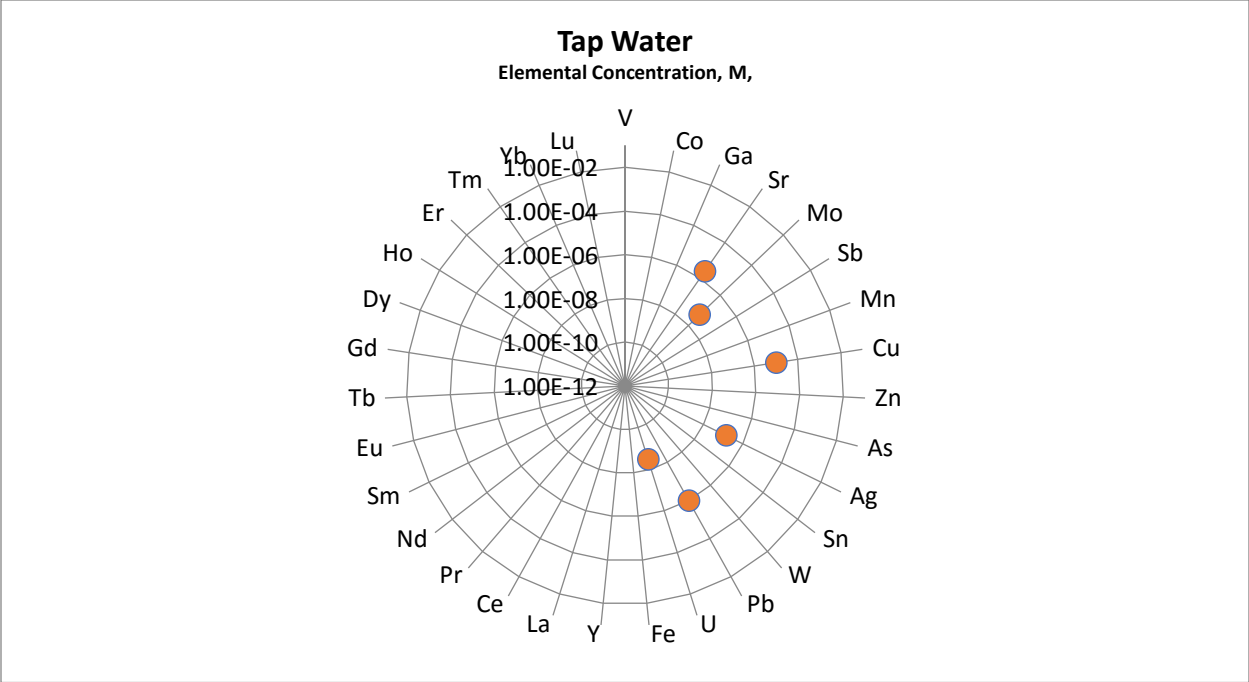


Figure C2.5: Metal concentrations in the tap water starting fluid.

C3: Experiments with 0.6M NaCl and UK samples

Eight experiments were carried out using 0.6 M NaCl and the UK samples HTL315, HTL319 and HTLMix.

Full details on the sample compositions can be found in Table 3.1.1 and Appendix A.

The experiments carried out using 0.6 M NaCl as a leaching agent are summarised in Table C3 and Figures C3.1-C3.11 below. Figures C3.1-C3.8 show selected elemental concentrations for the final sample of the experimental runs, while Figures C3.8-C3.11 show summed elemental time series for selected runs.

C3.1: Experiments using HTL315

Two experiments were carried out using HTL315 and 0.6 M NaCl, one (Run 1719) at 70°C and atmospheric pressure, and one (Run 1755) at 100°C and 200 bar pressure. Selected elemental concentrations measured in the final samples from these runs are shown in Figures C3.1 and C3.8, while a time series of summed elemental concentrations is shown for Run 1755 in figure C3.11.

The spread of elements leached in the two experiments is very similar, and relatively broad. Concentrations tend to be higher in the lower temperature experiment.

In terms of the selected 'At Risk' metals, cobalt, gallium, and antimony are present in both solutions, while molybdenum was also detected in the higher temperature leachate. Concentrations of these elements are higher in the lower temperature leachate, cobalt, for example, is found at 6E-5 M in the lower temperature leachate, and at only 8E-8 M in the higher temperature run. This trend is also true for strontium and antimony.

In terms of the metals common to South West England, manganese, copper, zinc, arsenic, and iron are relatively elevated in both leachates, found at concentrations of 1E-5 M, 2E-4 M, 5E-5 M, 3E-3 M, and 5E-5 M respectively. Again, concentrations of these elements are higher in the lower temperature leachate, generally by one or two orders of magnitude. The exception to this trend is tungsten, which is measured in the higher temperature solution (6E-7 M), but was not detected in the lower temperature leachate.

In terms of REEs, detectable leaching in the lower temperature experiment was limited to yttrium, lanthanum, caesium, gadolinium, and dysprosium, all at concentrations below 1E-7 M. In the higher temperature experiment, meanwhile, lanthanum, caesium, gadolinium, ytterbium, and lutetium are all detected, again at low concentrations, all below 1E-8 M.

In terms of pH, the higher temperature experiment sees a slight increase, from 6.31 to 6.43, while the lower temperature experiment sees a large increase in acidity, with pH dropping from 6.31 to 2.93. This increased acidity may explain the relatively high amounts of leaching observed in the lower temperature experiment.

The time series for Run 1755 can be seen in Figure C3.11. Total silicate related, sulphide related and tungsten related elements increase sharply for the first few 10s of hours of the experiment, followed by a more gradual increase in concentration for the remainder of the experiment, with a slight dip in concentration of the sulphide related elements in the final few hundred hours, possibly indicating some precipitation. Total metals common to south west England show an increase for the first few hundred hours of the run, but show a notable decrease during the second half of the experiment (from a maximum of $4.5\text{E-}4$ M, to a final concentration of around $4\text{E-}4$ M. Following their initial rise, 'At Risk' metals also show a strong decreasing trend over the course of the experiment, from around $8.5\text{E-}7$ M to a final concentration of $5\text{E-}7$ M. REEs show no particular trend over the course of the experiment.

C3.2: Experiments using HTL319

Three experiments were carried out using HTL319 and 0.6 M NaCl, two (runs 1720 and a duplicate, Run 1729) at 70°C and atmospheric pressure, and one (Run 1756) at 100°C and 200 bar pressure. Selected elemental concentrations measured in the final samples from these runs are shown in Figures C3.2 and C3.6, while a time series of summed elemental concentrations is shown for Run 1756 in figure C3.10.

Leachates from these experiments show a reasonable spread of 'At Risk' and metals common to South West England, though generally at low concentrations. Leaching of REEs however is much more suppressed for experiments at both temperatures. The spread of elements leached during Run 1720 is broadly similar to that leached during its duplicate, Run 1729, though some elements are detected in Run 1720 not found in its duplicate, presumably due to some minor heterogeneity in the starting solid. The remainder of this section will focus on the results from runs 1720 and 1756.

In terms of the selected 'At Risk' metals, the lower temperature leachate contains only molybdenum and antimony, both at concentrations below $1\text{E-}7$ M. The higher temperature leachate contains a larger spread of these elements, with cobalt at $1\text{E-}7$ M, strontium at $3\text{E-}7$ M, molybdenum at $3\text{E-}7$ M, and antimony at $1\text{E-}8$ M.

In terms of metals common to South West England, both leachates contain a good spread of elements. The higher temperature leachate contains elevated levels of manganese, zinc, arsenic, tungsten, and iron, all at concentrations above $1\text{E-}6$ M. Copper, tin, and uranium are also present, though at lower concentrations. In the lower temperature leachate, only manganese, arsenic, and tungsten are detected at concentrations above $1\text{E-}6$ M, the highest being manganese at $7\text{E-}6$ M. Copper, silver, tin, and uranium are also present in low concentrations.

In terms of REEs, the lower temperature leachate contains lanthanum, gadolinium, and dysprosium, all at concentrations below $1\text{E-}8$ M. The higher temperature experiment contains detectable concentrations of lanthanum, gadolinium, yttrium, and lutetium, though all at very low concentrations, all below $1\text{E-}9$ M.

In terms of pH, both experiments experienced a slight drop, from 6.31 to 5.12 for the lower temperature experiment, and from 6.31 to 5.97 for the higher temperature experiment.

The time series for Run 1756 is shown in Figure C3.10. Silicate and tin-tungsten derived elements show a general increase over the course of the experiment, while sulphide elements show a dip within the first 100 hours of the run, before trending upward for the remaining run time. Metals common to south west England and selected 'At Risk' metals also show an early dip in concentration before rising again and remaining relatively stable for the remainder of the run. REEs show a rise in concentration for the first 500 hours of the experiment, before dropping slightly towards the end of the run.

C3.3: Experiments using HTLMix

Three experiments were carried out using HTLMix and 0.6 M NaCl, one (Run 1721) at 70°C and atmospheric pressure, one (Run 1757) at 100°C and 200 bar pressure, and one (Run 1764) at 150°C and 200 bar pressure. Selected elemental concentrations measured in the final samples from these runs are shown in Figures C3.3, C3.5, and C3.4, while a time series of summed elemental concentrations is shown for Run 1757 in Figure C3.9.

The spread of selected elements leached during these experiments is reasonably broad, though, as in other experiments using NaCl as a leaching agent, concentrations of REEs in solution remain low, though reasonable concentrations of 'At Risk' and metals common to South West England are present. The spread of elements is lower in the 70°C experiment, but concentrations are higher for some specific elements (such as antimony) than in the higher temperature counterparts, possibly suggesting precipitation effects. Broadly however, concentrations are comparable across the three temperatures.

In terms of the selected 'At Risk' metals, strontium, molybdenum, and antimony are present in all three leachates, with the addition of vanadium in the 200°C leachate. Strontium and antimony show the highest concentrations, at 2E-6 M and 1E-5 M in the 70°C experiment, 7E-7 M and 1E-6 M in the 100°C experiment, and 1E-6 M and 1E-6 M in the 200°C experiment, respectively.

In terms of elements common to south west England, all three experiments show a broad spread of these elements, with copper arsenic, tin, lead, and iron present in all of the experiments. Zinc and tungsten are also present in the two higher temperature experiments. In the 70°C iron and lead are the most concentrated of these elements, at 1E-5 M and 3E-5 M respectively. In the 100°C experiment zinc shows the highest concentration, at 3E-6 M. In the 200°C experiment manganese, zinc, and lead are all relatively elevated, at concentrations of 2E-5 M, 6E-6 M, and 5E-6 M, respectively.

Leaching of REEs was much more limited in the experiments. In the 70°C run, lanthanum, terbium, gadolinium, dysprosium, and thulium are all present at concentrations below 1E-8 M. In the 100°C only lanthanum, caesium, and ytterbium are present, all at concentrations below 1E-9 M. In the 200°C experiment lanthanum, europium, ytterbium, and lutetium are present in the leachate, again at concentrations below 1E-9 M.

In terms of pH, all three experiments showed a rise in pH, from 6.31 to 7.77 for the 70°C experiment, from 6.31 to 8.02 for the 100°C experiment, and from 6.31 to 7.17 for the 150°C experiment.

A time series for Run 1757 is shown in Figure C3.9. Elements derived from silicates, tin-tungsten, and sulphides show no clear trend for the duration of the experiment, and their concentration remains relatively stable following the initial rise in the first few hours of the run. REEs and the selected 'At Risk' metals generally increase in concentration over the duration of the experiment, while metals common to South West England show a slight decrease in concentration during the run, following their initial rise in the first few hours of experiment.

SEM analyses were also carried out for selected runs using HTLMix, details of which are supplied below.

For Run 1757 (100°C), no evidence of significant experimentally-induced dissolution of the silicate and sulphide grains was observed. The grain-coating fines and minor patchy surface deposits containing Fe and Pb present in some portions of the starting material were also identified in these reaction products. All of the dolomite grains, however, showed evidence of partial dissolution (Plate 5A). All of the partially dissolved dolomite grains were observed to have thin coating 'skins' of Si-rich material (Plate 5A), most likely silica.

For 1764 (150°C), no evidence of significant experimentally-induced dissolution of the silicate and sulphide grains was observed. The grain-coating fines and minor patchy surface deposits containing Fe and Pb present in some portions of the starting material were also identified in these reaction products. All of the dolomite grains, however, showed evidence of significant dissolution; grains were observed to be rounded and deeply pitted.

The rare lead (Pb) chloride and antimony (Sb)-rich phases that were identified on a few grain surfaces are potential run products. The rare dolomite grain remnants had a thin and minor silicon (Si)-rich coating, most likely silica (but much less than in Run 1757, above).

Lab. Run Number	1719	1720	1721	1729	1764	1757	1756	1755
Experiment Type	Rotating Shaker	Rotating shaker	Rotating shaker	Rotating shaker	Ti Batch	Ti Batch	Ti Batch	Ti Batch
Solid ID	HTL315	HTL319	HTLMix	HTL319	HTLMix	HTLMix	HTL319	HTL315
Solution Concentration	0.6 M	0.6 M	0.6 M	0.6 M	0.6 M	0.6 M	0.6 M	0.6 M
Temperature, C	70	70	70	70	150	100	100	100
Pressure, bar	1	1	1	1	200	200	200	200
Duration, hours	674	674	674	674	984	744	744	743
Solid Weight, g	5	5	5	5	8.75	8.75	8.75	8.75
Solution Volume, ml	200	200	200	200	350	350	350	350
Starting pH	6.31	6.31	6.31	6.31	6.31	6.31	6.31	6.31
Starting Eh	216.7	216.7	216.7	216.7	216.7	216.7	216.7	216.7
Final pH	2.93	5.12	7.77	5.44	7.17	8.02	5.97	6.43
Final Eh	318.1	266.3	229.6	198.7	75.7	14.4	37	-9.3

Table C3: Summary of experiments using 0.6 M NaCl and UK samples

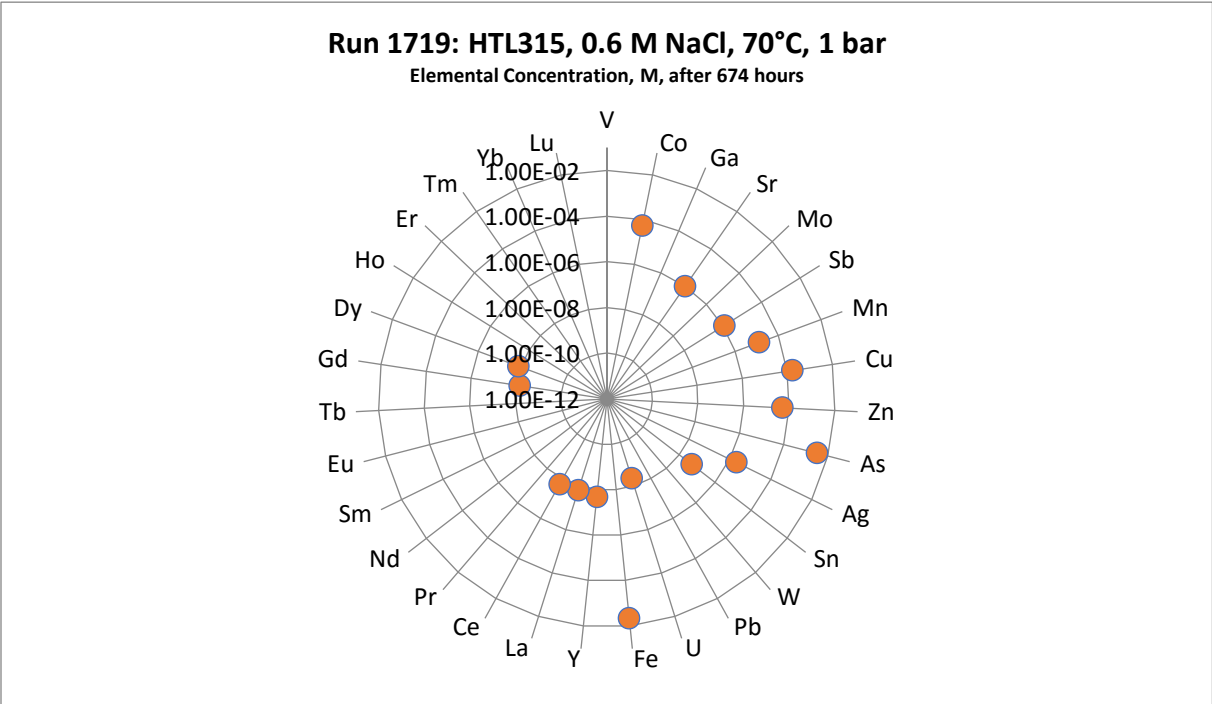


Figure C3.1: Selected metal concs. For Run 1719 final fluid (UK sample HTL315: 0.6M NaCl, 70 °C, 1 bar).

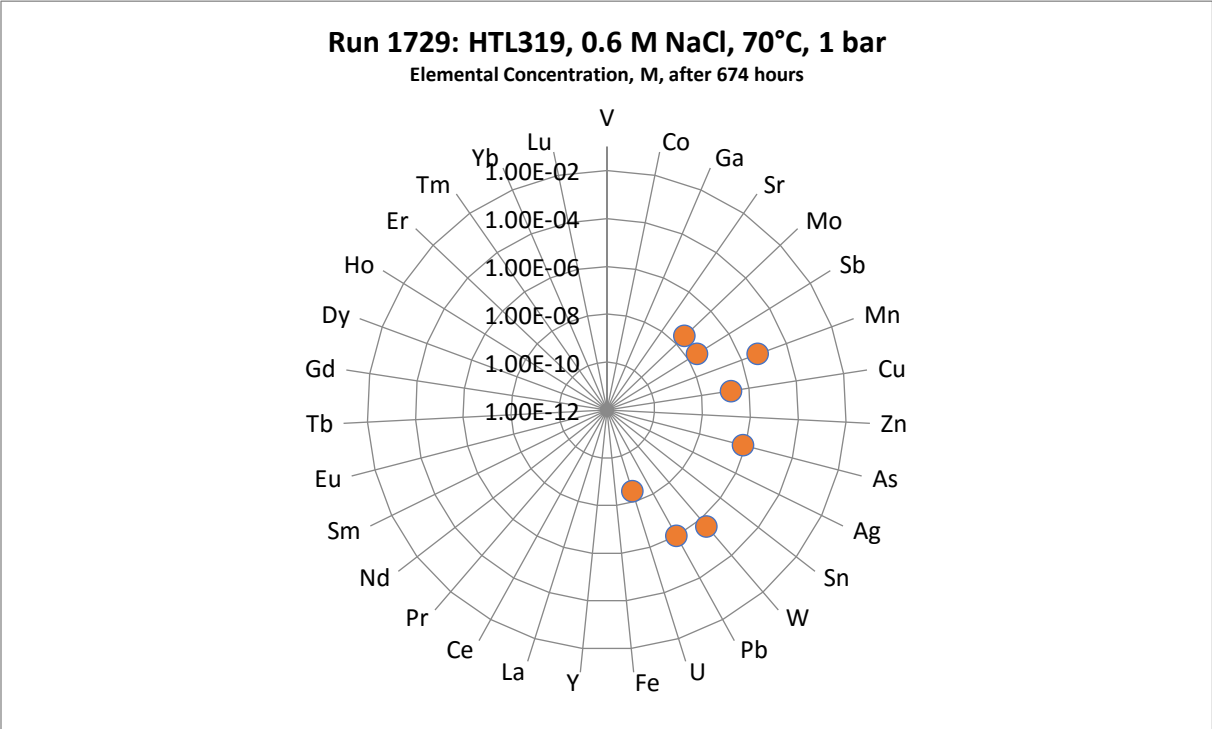


Figure C3.2: Selected metal concs. For Run 1729 final fluid (UK sample HTL319: 0.6M NaCl, 70 °C, 1 bar).

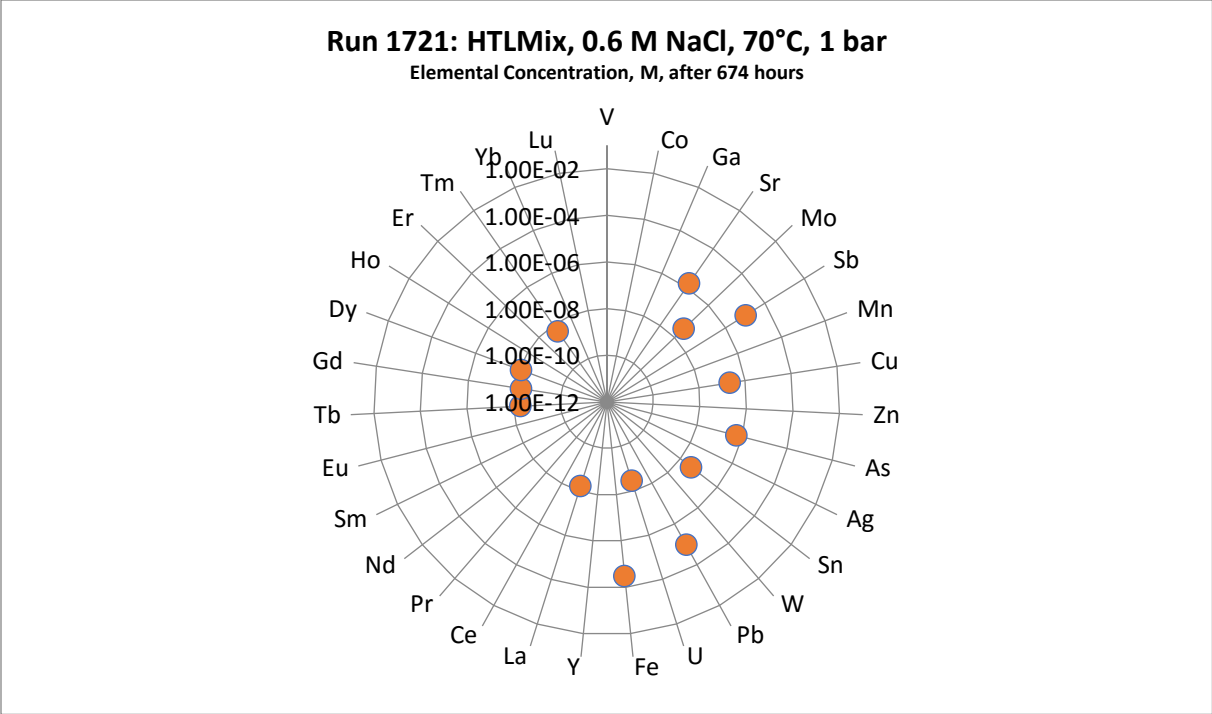


Figure C3.3: Selected metal concs. For Run 1721 final fluid (UK sample HTLMix: 0.6M NaCl, 70 °C, 1 bar).

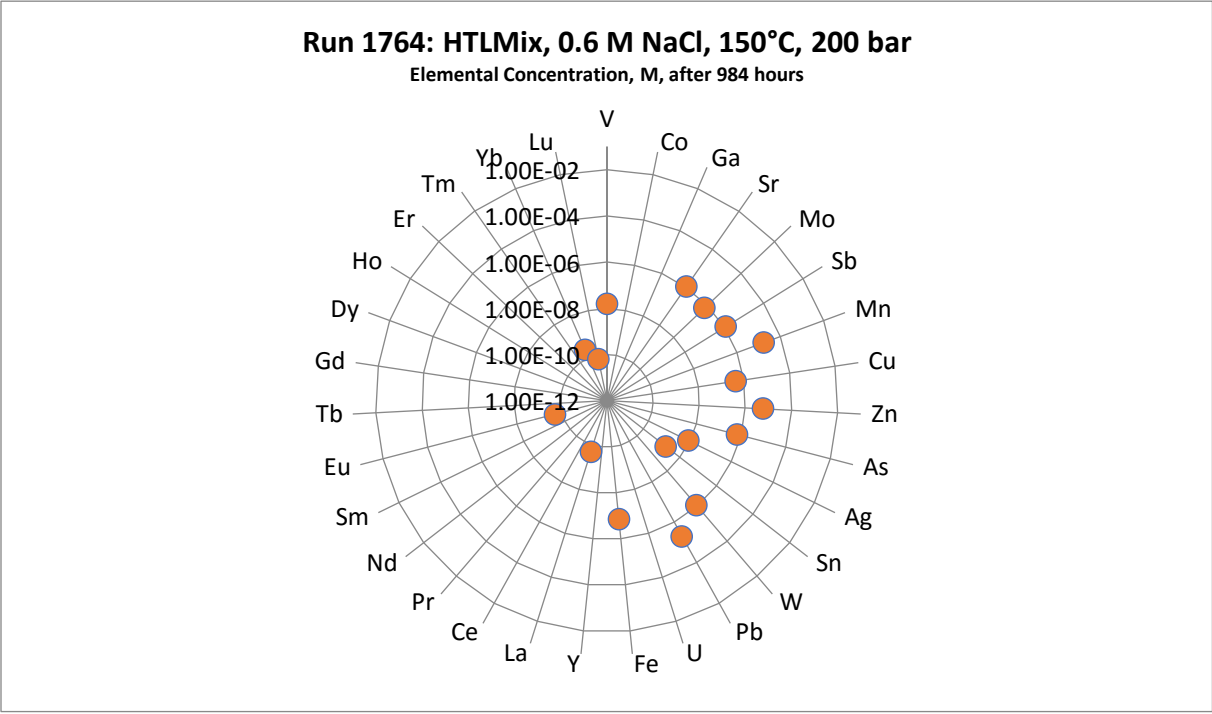


Figure C3.4: Selected metal concs. For Run 1764 final fluid (UK sample HTLMix: 0.6M NaCl, 150 °C, 200 bar).

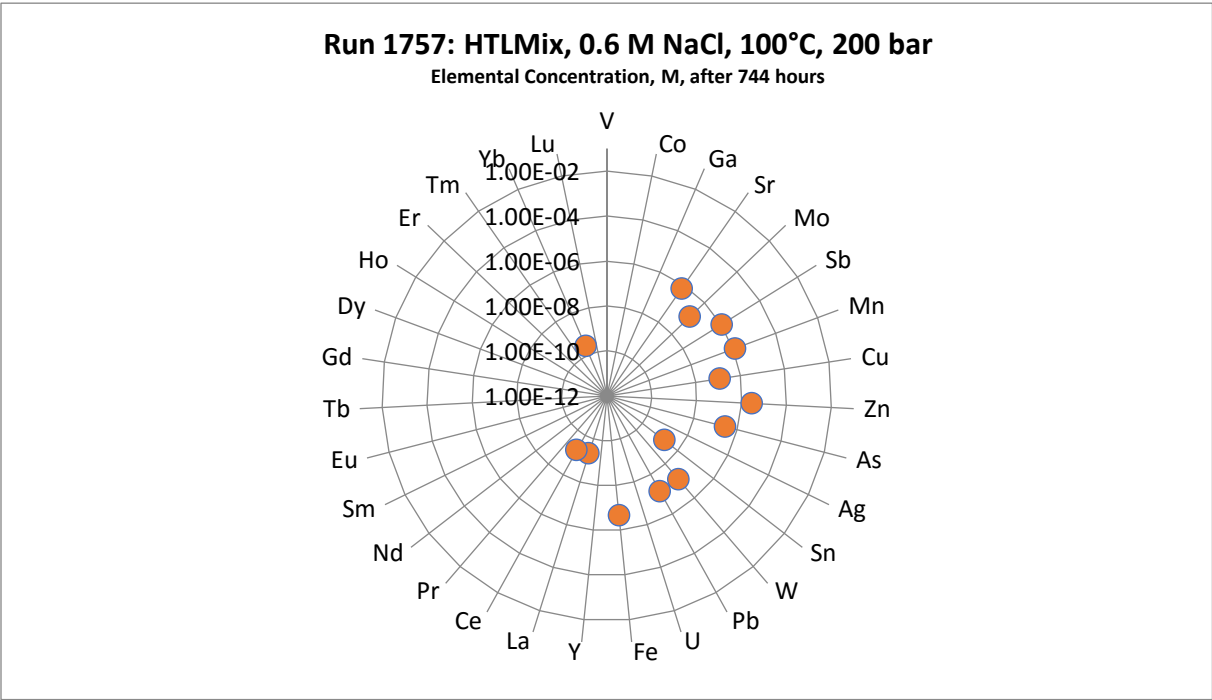


Figure C3.5: Selected metal concs. For Run 1757 final fluid (UK sample HTLMix: 0.6M NaCl, 100 °C, 200 bar).

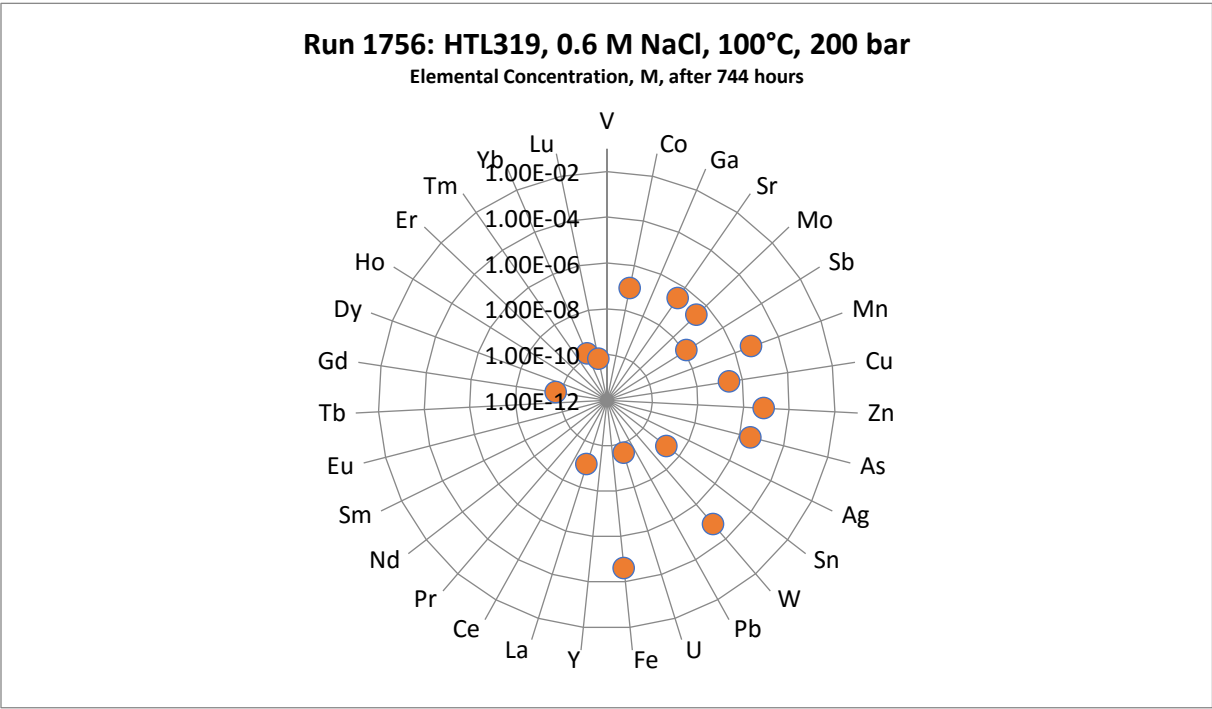


Figure C3.6: Selected metal concs. For Run 1756 final fluid (UK sample HTL319: 0.6M NaCl, 100 °C, 200 bar).

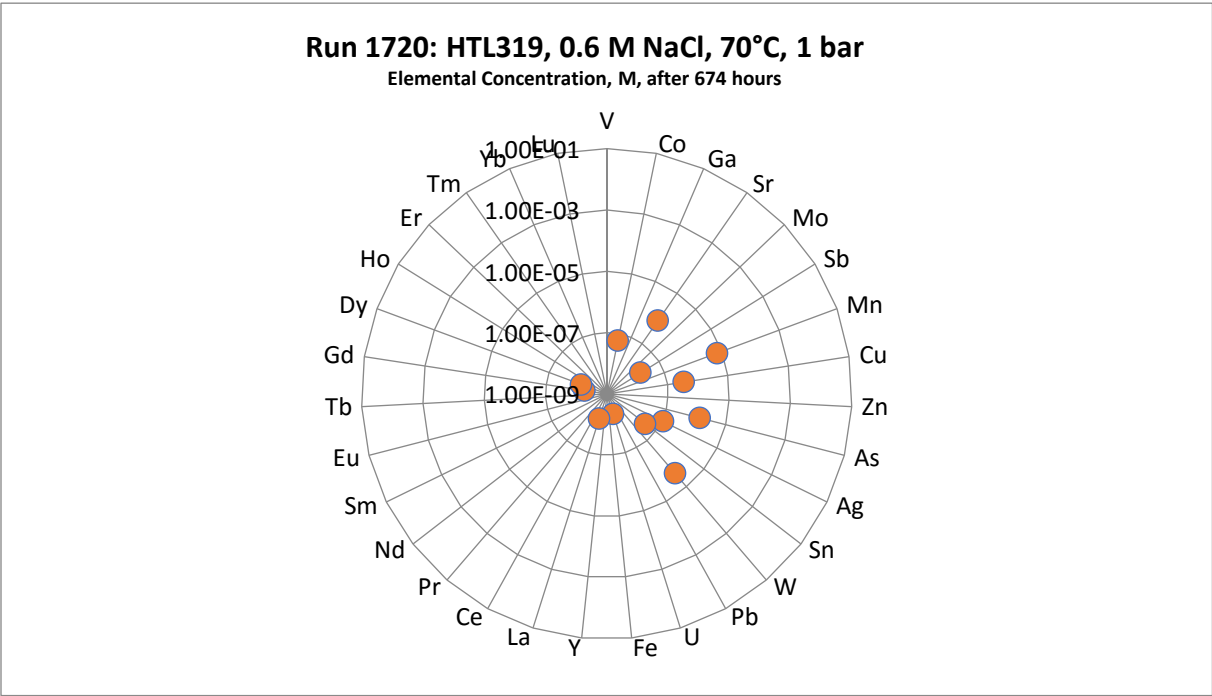


Figure C3.7: Selected metal concs. For Run 1720 final fluid (UK sample HTL319: 0.6M NaCl, 70 °C, 1 bar).

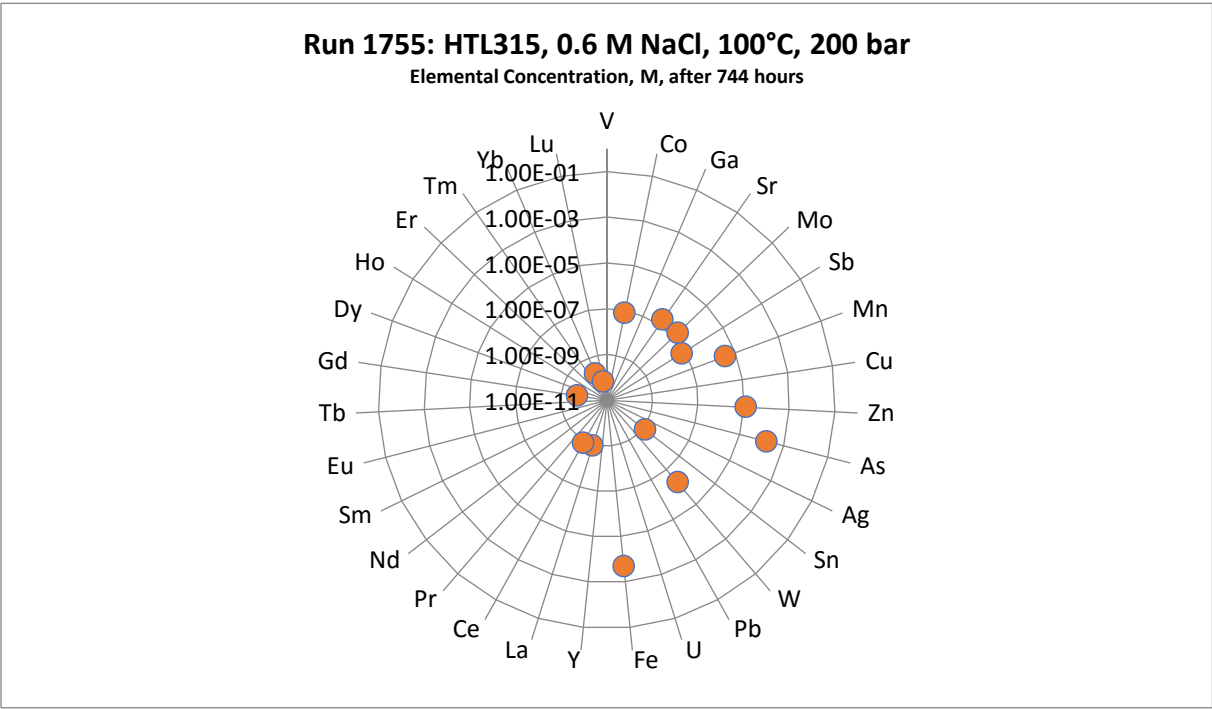


Figure C3.8: Selected metal concs. For Run 1755 final fluid (UK sample HTL315: 0.6M NaCl, 100 °C, 200 bar).

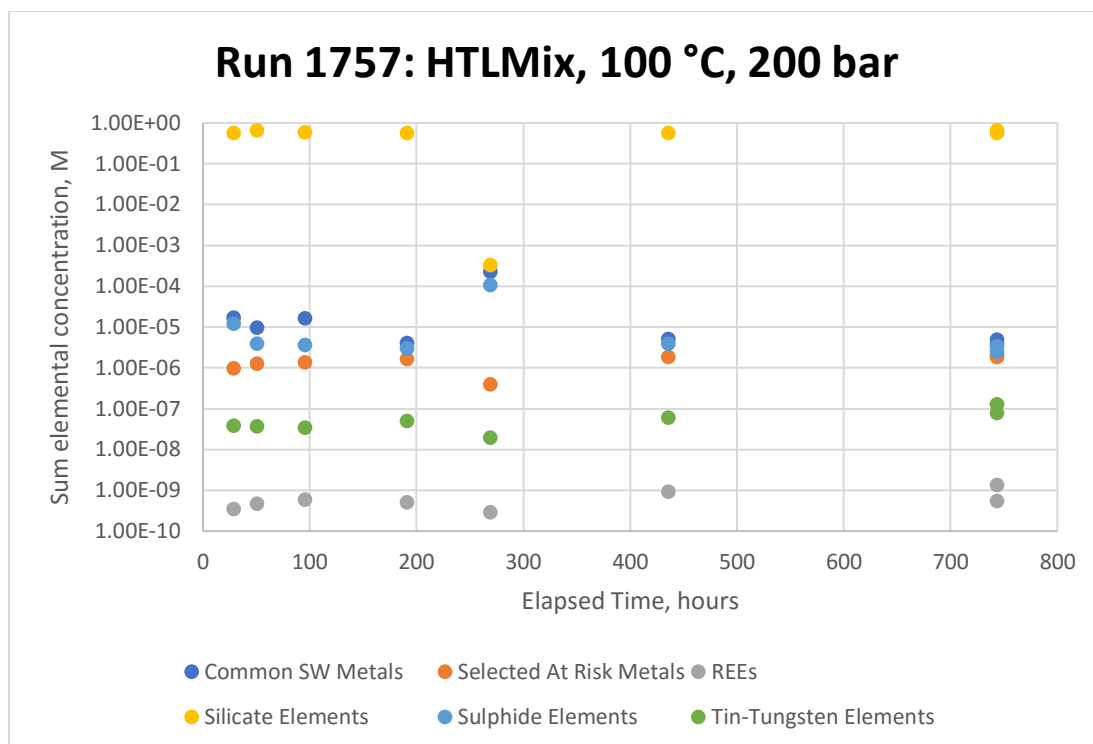


Figure C3.9: Sum of dissolved metal concentrations for UK sample HTLMix as broken down into different metal types (Run 1757: 0.6M NaCl, 100 °C, 200 bar).



Figure C3.10: Sum of dissolved metal concentrations for UK sample HTL319 as broken down into different metal types (Run 1756: 0.6M NaCl, 100 °C, 200 bar).

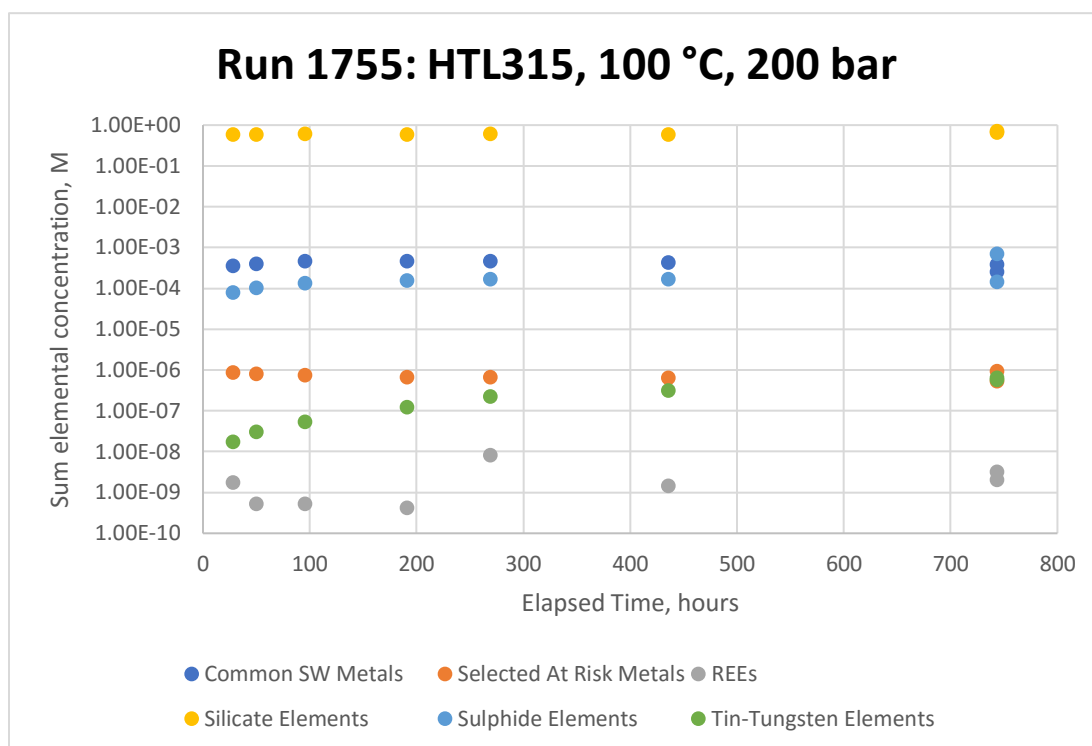


Figure C3.11: Sum of dissolved metal concentrations for UK sample HTL315 as broken down into different metal types (Run 1755: 0.6M NaCl, 100 °C, 200 bar).

C4: Experiments with Deionised Water, CO₂, and UK Samples HTL315, HTL319, HTLMix

Three experiments were carried out using deionised water, 20 bar pCO₂, and the UK samples HTL315, HTL319 and HTLMix.

Full details on the sample compositions can be found in Table 3.1 and Appendix A.

The experiments carried out using deionised water and CO₂ as a leaching agent are summarised in Table C4 and Figures C4.1-C4.3 below. Figures C4.1-C4.3 show selected elemental concentrations for the final sample of the experimental runs.

Lab. Run Number	1751	1752	1753
Experiment Type	Ti batch	Ti batch	Ti batch
Solid ID	HTL315	HTL319	HTLMix
Solution Concentration	20 bar pCO ₂	20 bar pCO ₂	20 bar pCO ₂
Temperature, C	100	100	100
Pressure, bar	200	200	200
Duration, hours	1013	1013	1013
Solid Weight, g	8.75	8.75	8.75
Solution Volume, ml	350	350	350
Starting pH	5.98	5.98	5.98
Starting Eh	203.9	203.9	203.9
Final pH	5.44	4.94	6.49
Final Eh	21.5	125.8	-63

Table C4: Summary of experiments carried out using deionised water, CO₂, and UK samples

C4.1: Experiments Using HTL315

One experiment was carried out using HTL315 and deionised water, at 100°C and 200 bar pressure (including 20 bar pCO₂) (Run 1751). Selected elemental concentrations measured in the final sample from this run are shown in Figure C4.1.

Elements leached using this fluid-solid combination include a reasonably broad spread of selected 'At Risk' metals and metals common to South West England.

In terms of selected 'At Risk' metals, cobalt, strontium, molybdenum, and antimony were all detected in the final leachate, though at low concentrations, the highest being strontium at 1E-6 M.

In terms of elements common to South West England, manganese, zinc, arsenic and iron are relatively elevated, at concentrations of $4\text{E-}6$ M, $1\text{E-}5$ M, $2\text{E-}4$ M, and $6\text{E-}4$ M respectively, with minor concentrations of tin and lead also present. No REEs were detected in the leachate.

In terms of pH, the leachate (degassed of CO_2), showed a slight drop in pH from 5.98 to 5.44 over the course of the experiment, though these measurements (as for other pH measurements in this section) are problematic, since pH within the experiment, under CO_2 pressure, is likely to have been lower.

C4.2: Experiments Using HTL319

One experiment was carried out using HTL319 and deionised water, at 100°C and 200 bar pressure (including 20 bar pCO_2) (Run 1752). Selected elemental concentrations measured in the final sample from this run are shown in Figure C4.3.

Leaching from this sample using deionised water and CO_2 was extremely limited. Of the selected 'At Risk' metals, only strontium was detected, at a concentration of $1\text{E-}6$ M. Of the metals common to South West England, only manganese, copper, zinc, tin and iron were detected, and of these only manganese, zinc and iron exceeded concentrations of $1\text{E-}6$ M. As for the other experiments in this section, no REEs were detected.

In terms of pH, the degassed solutions showed a slight drop in pH, from 5.98 to 4.94.

C4.3: Experiments Using HTLMix

One experiment was carried out using HTLMix and deionised water, at 100°C and 200 bar pressure (including 20 bar pCO_2) (Run 1753). Selected elemental concentrations measured in the final sample from this run are shown in Figure C4.2.

Again, leaching from this sample was fairly limited. Of the selected 'At Risk' metals, cobalt, strontium, and antimony were detected in the leachate, at concentrations of $3\text{E-}7$ M, $2\text{E-}6$ M and $7\text{E-}7$ M, respectively. Of the metals common to South West England, manganese, zinc, lead, and iron were fairly elevated, with concentrations of $1\text{E-}4$ M, $4\text{E-}5$ M, $9\text{E-}6$ M, and $7\text{E-}5$ M respectively. Copper and arsenic were also present, though at levels below $1\text{E-}6$ M. As for the other experiments in this section, no REEs were present in the leachates.

In contrast to the other experiments in this section, the degassed leachate here appears to have undergone a small rise in pH, from 5.98 to 6.49.

Run 1751: HTL315, Deionised Water & 20 bar pCO₂, 100°C, 200 bar

Elemental Concentration, M, after 1013 hours

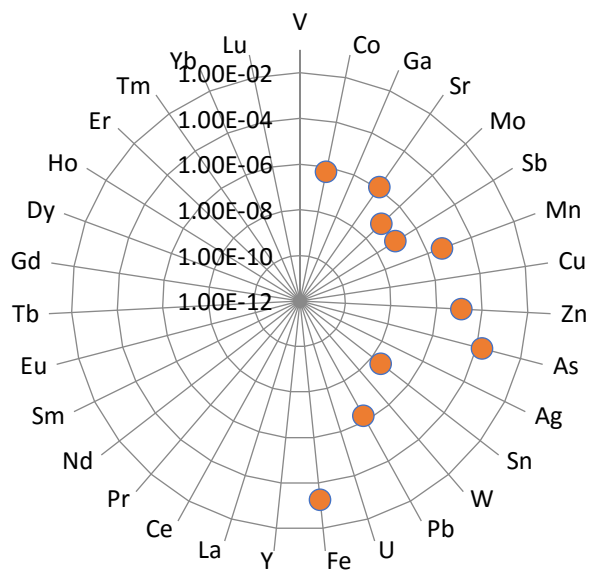


Figure C4.1: Selected metal concs. For Run 1751 final fluid (UK sample HTL315: de-ionised water with 20 bar Pco₂, 100 °C, 200 bar).

Run 1753: HTLMix, Deionised Water & 20 bar pCO₂, 100°C, 200 bar

Elemental Concentration, M, after 1013 hours

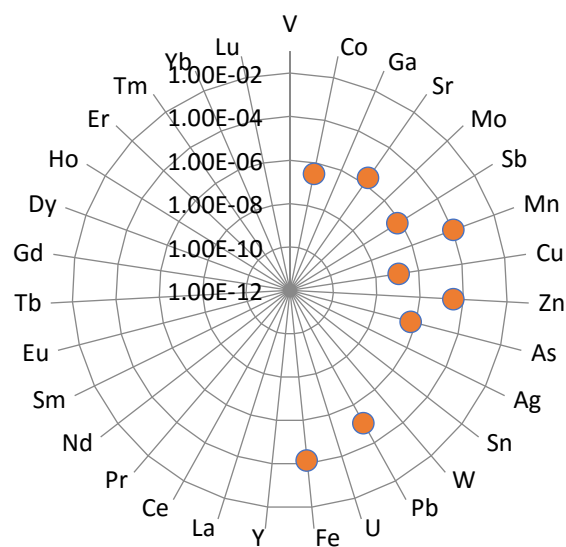


Figure C4.2: Selected metal concs. For Run 1753 final fluid (UK sample HTLMix: de-ionised water with 20 bar Pco₂, 100 °C, 200 bar).

Run 1752: HTL319, Deionised Water & 20 bar pCO₂, 100°C, 200 bar
 Elemental Concentration, M, after 1013 hours

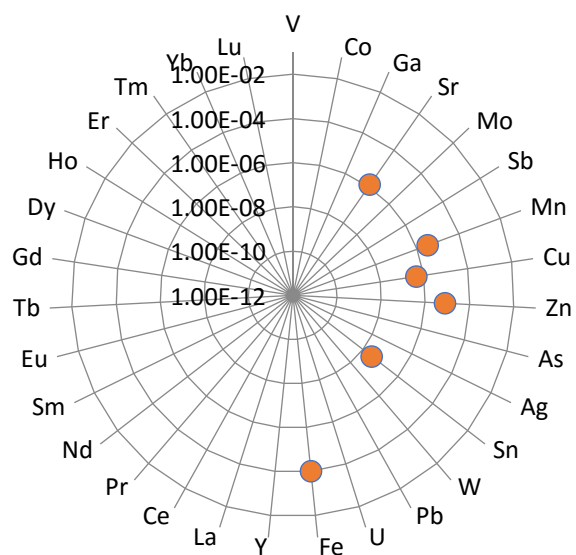


Figure C4.3: Selected metal concs. For Run 1752 final fluid (UK sample HTL319: de-ionised water with 20 bar Pco₂, 100 °C, 200 bar).

C5: Experiments with acetic acid and UK samples HTL315, HTL319 and HTLMix

Seven experiments were carried out using acetic acid and the UK samples HTL315, HTL319 and HTLMix. Experiments were conducted at 70°C in a rotating mixer, and at 150°C in a pressurised batch vessel.

Full details on the sample composition can be found in Table 3.1.1 and Appendix A.

The experiments carried out using acetic acid as a leaching agent are summarised in Table C5 and Figures C5.1-C5.8. Figures C5.1-C5.7 show selected elemental concentrations for the final sample of the experimental run (i.e. the sample likely to have the highest concentration of metals). Figure C5.8 shows a time series of summed elemental concentrations, grouped into, e.g., REEs, metals common to South-West England, etc.

C5.1: Experiments using sample HTL315

HTL315 is a sample of mainstage mineralisation from a granite body in Cornwall, South-West England. Its major components, as determined by XRD, are quartz (70%), tourmaline (7%), chlorite (5%), calcite (2%), pyrite (10%), and arsenopyrite (5%).

Two experiments were carried out using this sample and acetic acid as a leaching agent, one using acetic acid at a concentration of 0.1 M (Run 1737), and one using a concentration of 0.001 M (Run 1740). Both experiments were carried out at 70 °C and atmospheric pressure.

Elemental concentrations from the final samples of these runs are shown in Figures C5.1 and C5.2. The spread of target elements extracted during both experiments are broadly similar, showing detectable concentrations of limited numbers of the selected 'At Risk' metals and REEs, but a broader selection of those elements commonly associated with South-West England orebodies. A comparison of concentrations between the two experimental runs show that both produced leached elements in very similar concentrations, suggesting that leachant concentration, or starting pH had very little impact on the final results, within the range of concentrations used here.

Of the selected 'At Risk' metals, only cobalt and antimony are present in detectable amounts in the final samples, on the order of 2E-5 M and 7E-5 M respectively. While other 'At Risk' metals are present in the HTL315 starting solid, cobalt and antimony are present in the largest quantities, presumably leading to their relative abundance in the final leachates.

Of the metals common to South-West England manganese, copper, arsenic, and iron are present in relatively high amounts in the starting solid, and these are the three most abundant of the selected elements in the leachates, measured on the order of 1E-5 M, 1E-4 M, 4E-4 M, and 1E-3 M respectively. Other of the Cornwall associated elements, such as uranium, tungsten and tin, are present in the leachates, but at much lower concentrations, none reaching concentrations above 5E-7 M.

A handful of REEs (yttrium, lanthanum, caesium, terbium) are present in the leachates, but at very low concentrations, none reaching higher than 5E-8 M. Similarly, the concentrations of these elements in the starting solid are relatively low.

In terms of pH, the more acidic experiment shows a slight rise, from an initial pH of 2.76, to a final pH of 2.86. In contrast the more dilute experiment shows a notable decrease in pH from 3.85 to 2.76, possibly due to the oxidation of pyrite.

C5.1: Experiments using sample HTL319

HTL319 is a sample of tin-tungsten mineralisation, again from a granite body in Cornwall, South-West England. Its major components are quartz (88%), muscovite (2%), cassiterite (3%), columbite (3%), and ferberite (4%).

Two experiments were carried out using this sample and acetic acid as a leaching agent, one using acetic acid at a concentration of 0.1 M (Run 1738), and one using a concentration of 0.001 M (Run 1741). Both experiments were carried out at 70°C and atmospheric pressure.

In contrast to the two acetic acid experiments using HTL315, there are notable differences between the 0.1 M acetic acid run and the 0.001 M acetic acid run using HTL319 (see Figures C5.3 and C5.4). The spread of elements detected in the leachates is limited in both runs, but to a greater extent in the 0.001 M run, where of the selected elements of interest, only six are present in detectable amounts. Likewise, concentrations are suppressed in the 0.001 M compared to the 0.1 M run, again in contrast to the experimental runs using HTL315.

Of the selected 'At Risk' metals, none are detected in the leachate from either experiment, corresponding to their relatively low abundance in the starting solid.

Of the metals common to South West England manganese, copper, arsenic, tungsten and iron are relatively abundant in the leachates, reaching concentrations of on the order of 2E-5 M, 2E-6 M, 8E-7 M, 7E-7 M, and 1E-4 M respectively in the more concentrated acid run, again corresponding to relatively abundant elements in the starting solid. Notably tin and lead are also relatively abundant in the starting solid, but are not detected in the leachates, other than tin which was found in very low concentrations in the more concentrated acid run. This may suggest some selectivity on the part of the leachant, or may reflect relative element accessibility.

Of the selected REEs only yttrium, lanthanum and caesium were detected in the leachates, but at very low concentrations, all below 1E-7 M. Again, this probably reflects the relatively low concentrations of these elements in the starting solids.

In terms of pH both experiments show a slight rise. The more acidic run sees a rise from 2.76 to 2.92, while the pH in the more dilute run increases from 3.85 to 4.04.

C5.3: Experiments using sample HTLMix

HTLMix is a mixture of samples taken across a mineralised quartz vein, again from South-West England. Its major components are quartz (87%), albite (1%), muscovite (5%), dolomite (2%), galena (5%) and sphalerite (1%).

Three experiments were carried out using this sample and acetic acid as a leaching agent, two using acetic acid at a concentration of 0.1 M (Runs 1739 and 1765), and one using an acid concentration of 0.001 M (Run 1742). Runs 1739 and 1742 were carried out at 70 °C and atmospheric pressure, while Run 1765 was carried out at the higher temperature and pressure of 150 °C and 200 bar.

As for the experiments carried out using HTL319, there are notable differences between the 0.1 M acid and 0.001 M acid runs in terms of the spread of elements leached and their concentrations, with a much wider spread of elements detected in the more concentrated acid runs (see Figures C5.5 to C5.7). All of the runs

using this material had a much wider spread in terms of the elements released compared to the other runs using UK solids, and this is reflected in the relative abundance of REEs in this sample.

In terms of the selected 'At Risk' metals, cobalt, gallium, molybdenum and antimony are detected in the leachates. Notably, concentrations of cobalt and gallium in the 70 °C experiment (Run 1739), than in the 150 °C experiment (Run 1765). This is also true for lead, and various of the REEs, possibly suggesting the formation of a precipitate in the higher temperature experiment, scavenging some of these elements. Additional evidence for this comes from the time series plot of solution concentration data for the Run 1765 (Figure C3.8), where sum concentrations of elements can be seen decreasing at later times.

The reacted solids from runs 1739 and 1765 also underwent SEM analysis, details of which are given below.

Regarding Run 1739 the starting material for this run was of the type with galena dominantly present as euhedral grains. Common deeply pitted faces were observed to both sphalerite and galena (Plate 2B) grains. Some pitting of quartz faces was identified. No dolomite was detected. Enrichment in Cu and Ag at dissolution pits in the galena was noted and similarly enriched Cu was associated with some notch sites on sphalerite. The Fe-based surface deposits observed appeared to be residual (similar material is present in the starting material).

Regarding Run 1765 common slightly pitted faces were observed to both quartz and galena grains. No dolomite, sphalerite or other sulphides were detected. Platy silicate clays were recognised with morphologies as per the pre-test matter. In the unwashed sample, a widespread finely crystalline phase was seen, sparsely scattered on grain surfaces as single or clustered <5 µm lozenge-shaped crystals, containing Pb and As, as were rare patches of a web-like deposit containing Pb, S and O. These phases were not seen in the washed sample, so probably detached or dissolved with the washing.

Lab. Run Number	1737	1740	1738	1741	1739	1742	1765
Experiment Type	Rotating Shaker	Rotating shaker	Rotating shaker	Rotating shaker	Rotating shaker	Rotating shaker	Ti Batch Vessel
Solid ID	HTL315	HTL315	HTL319	HTL319	HTLMix	HTLMix	HTLMix
Solution Concentration	0.1 M	0.001 M	0.1 M	0.001 M	0.1 M	0.001 M	0.1 M
Temperature, C	70	70	70	70	70	70	150
Pressure, bar	1	1	1	1	1	1	200
Duration, hours	718	718	718	718	718	718	987
Solid Weight, g	5	5	5	5	5	5	8.75
Solution Volume, ml	200	200	200	200	200	200	350
Starting pH	2.76	3.85	2.76	3.85	2.76	3.85	2.76
Starting Eh	456.3	375	456.3	375	456.3	375	216.7
Final pH	2.82	2.76	2.92	4.04	3.86	6.09	3.62
Final Eh	295.9	338.3	379.5	294.9	339.9	218.9	237.1

Table C5: Summary of experiments carried out using acetic acid and UK samples

Run 1737: HTL315, 0.1 M Acetic Acid, 70°C, 1 bar
 Elemental Concentration, M, after 718 hours

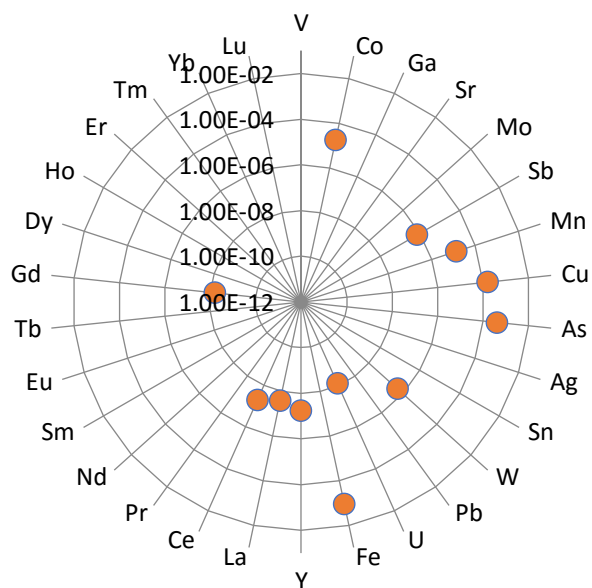


Figure C5.1: Selected metal concs. For Run 1737 final fluid (UK sample HTL315: 0.1M acetic acid, 70 °C, 1 bar).

Run 1740: HTL315, 0.001 M Acetic Acid, 70°C, 1 bar
 Elemental Concentration, M, after 718 hours

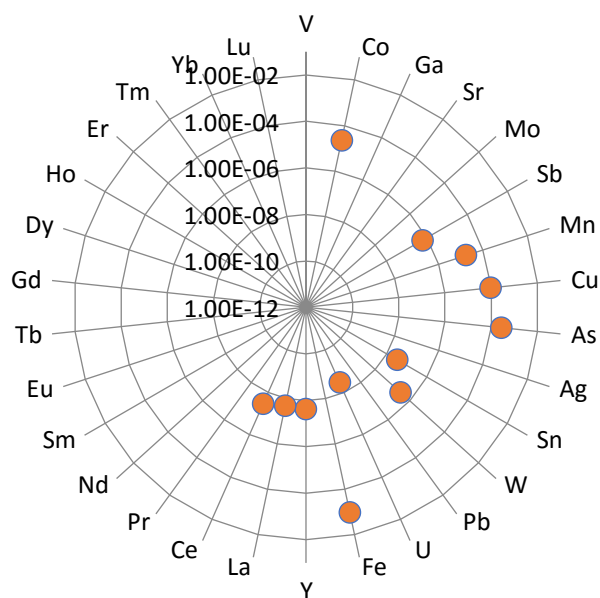


Figure C5.2: Selected metal concs. For Run 1740 final fluid (UK sample HTL315: 0.001M acetic acid, 70 °C, 1 bar).

Run 1738: HTL319, 0.1 M Acetic Acid, 70°C, 1 bar

Elemental Concentration, M, after 718 hours

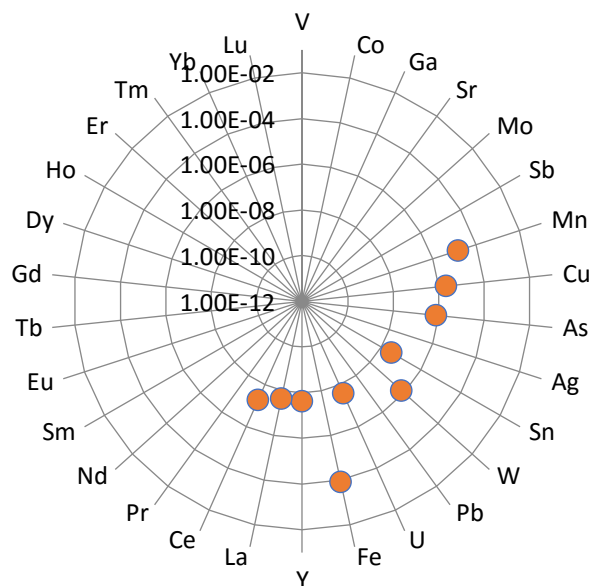


Figure C5.3: Selected metal concs. For Run 1738 final fluid (UK sample HTL319: 0.1M acetic acid, 70 °C, 1 bar).

Run 1741: HTL319, 0.001 M Acetic Acid, 70°C, 1 bar

Elemental Concentration, M, after 718 hours

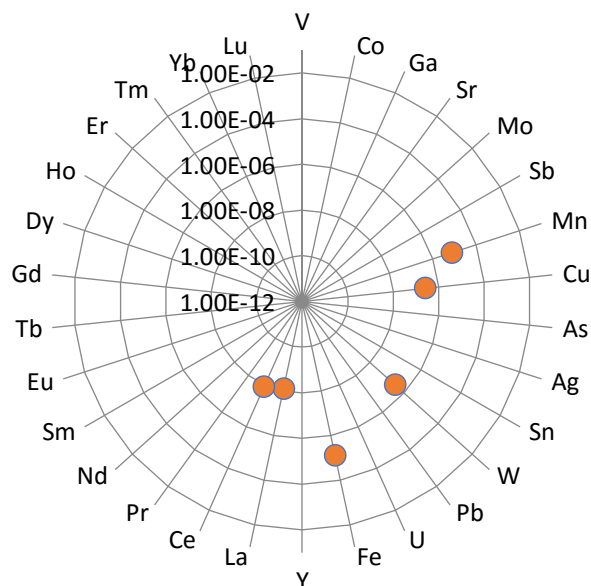


Figure C5.4: Selected metal concs. For Run 1741 final fluid (UK sample HTL319: 0.001M acetic acid, 70 °C, 1 bar).

Run 1739: HTLMix, 0.1 M Acetic Acid, 70°C, 1 bar

Elemental Concentration, M, after 718 hours

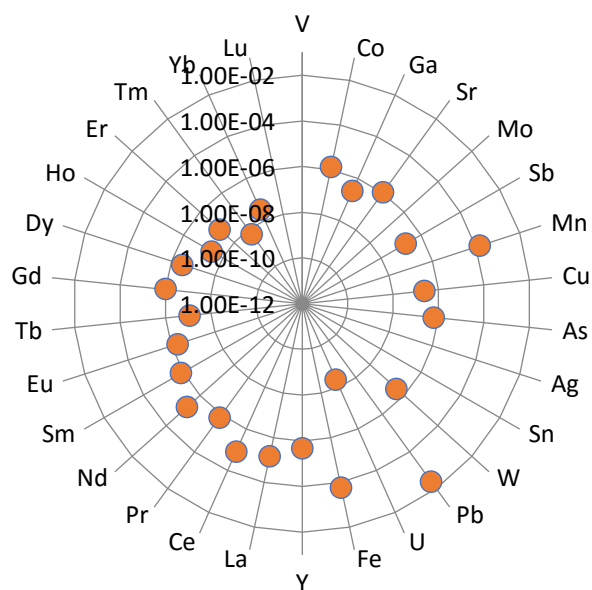


Figure C5.5: Selected metal concs. For Run 1739 final fluid (UK sample HTLMix: 0.1M acetic acid, 70 °C, 1 bar).

Run 1742: HTLMix, 0.001 M Acetic Acid, 70°C, 1 bar

Elemental Concentration, M, after 718 hours

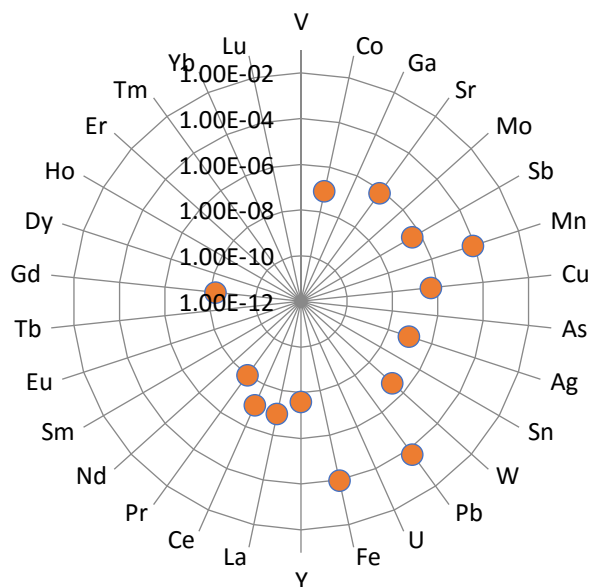


Figure C5.6: Selected metal concs. For Run 1742 final fluid (UK sample HTLMix: 0.001M acetic acid, 70 °C, 1 bar).

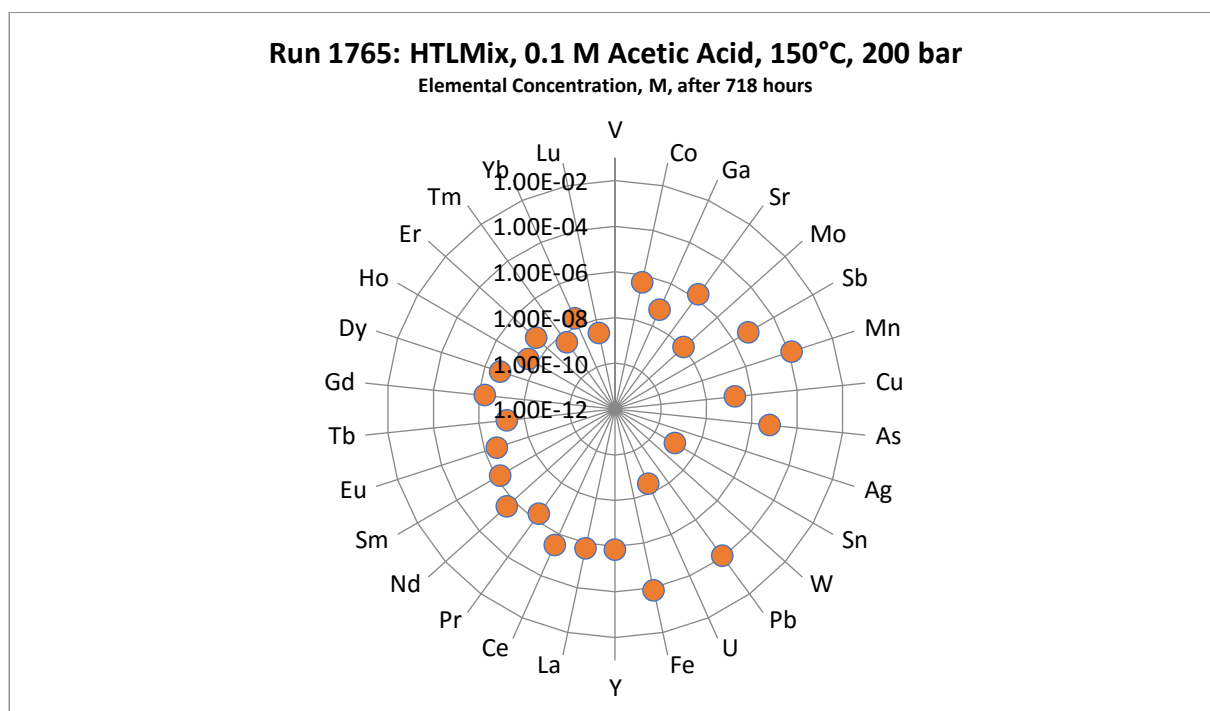


Figure C5.7: Selected metal concs. For Run 1765 final fluid (UK sample HTLMix: 0.1M acetic acid, 150 °C, 200 bar).

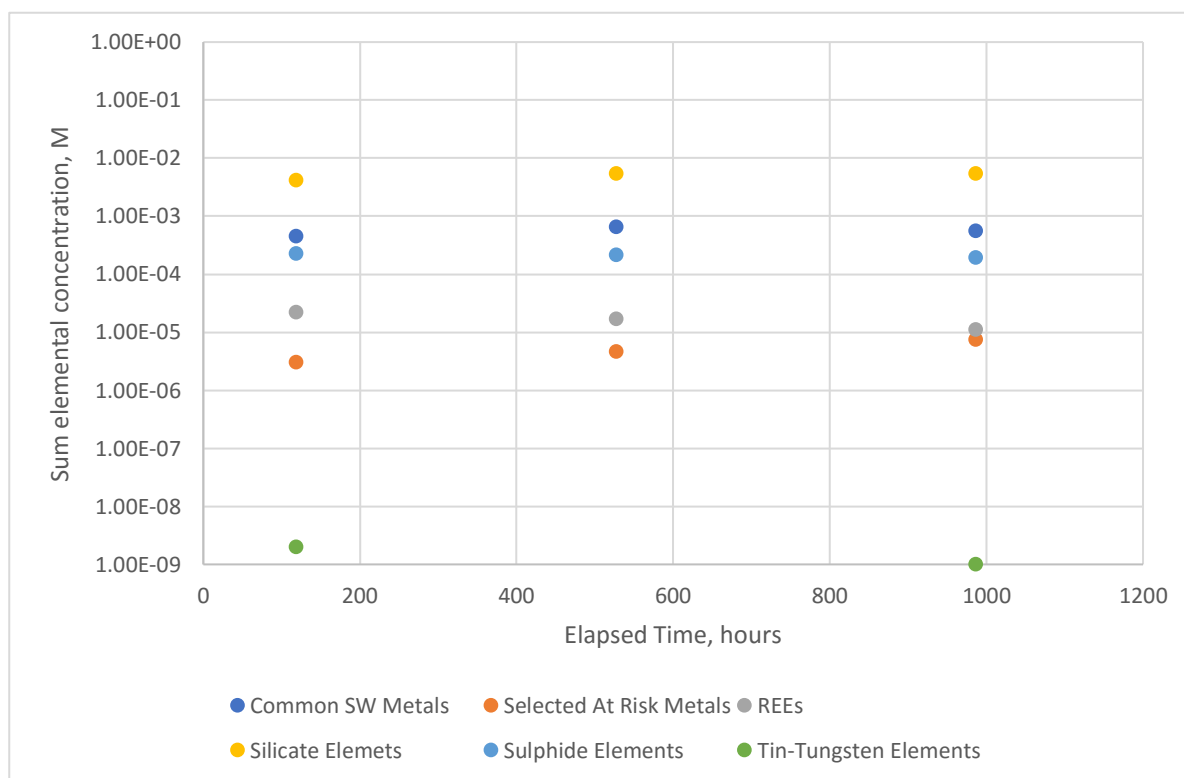


Figure C5.8: Sum of dissolved metal concentrations for UK sample HTLMix as broken down into different metal types (Run 1765: 0.1M acetic acid, 150 °C, 200 bar).

C6: Experiments with EDTA and UK samples HTL315, HTL319 and HTLMix

Eight experiments were carried out using EDTA and the UK samples HTL315, HTL319 and HTLMix.

Full details on the sample composition can be found in Table 3.1 and Appendix A.

The experiments carried out using EDTA as a leaching agent are summarised in Table C6 and Figures C6.1-C6.9 below. Figures C6.1-C6.9 show selected elemental concentrations for the final sample of each experimental run.

C6.1: Experiments using sample HTL315

Two experiments were carried out using HTL315 and EDTA, one using an EDTA concentration of 0.1 M (1725), and one using a concentration of 0.001 M (1722). Selected elemental concentrations measured in the final samples from these runs are shown in Figures 4.7.1 and 4.7.5. Both experiments were carried out at 70°C and atmospheric pressure.

Both experiments show a relatively broad spread of elements of interest in solution, though the experiment using the higher concentration EDTA (1725) shows a notably wider range of selected elements at levels above detection, and of the elements detected in leachates from both experiments, those in the higher concentration leachant are elevated relative to the more dilute experimental fluid. The spread of elements and relative concentrations in the leachates broadly correspond to their relative distributions in the starting solid.

In terms of the selected 'At Risk' elements, cobalt, gallium, strontium, and antimony are all present in detectable amounts in both leachates. Of these cobalt and antimony are present in the highest concentrations, at 1.6E-5 M and 1.2 E-6 M in the 0.001 M EDTA leachate, and at 3.6E-5 M and 9.0E-6 M in the 0.1 M leachate, respectively. The higher concentration leachate also contains detectable levels of vanadium and molybdenum, not found in the more dilute leachate.

Of the elements selected for their abundance in South-West England, manganese, copper, zinc and arsenic are found in relatively high (on the order of 1E-5 to 1E-3 M) concentrations in the leachates. Notably tungsten was not detected in the lower concentration leachate, but was present in relatively high amounts (4E-5 M) in the higher concentration leachate.

A handful of REEs were detected in the lower concentration leachate, at very low concentrations (all less than 1E-7 M). A much more comprehensive spread of REEs were detected in the 0.1 M EDTA leachate, at slightly higher concentrations, the highest being yttrium at around 8E-7 M.

In terms of pH, the 0.001 M EDTA experiments sees a fall in pH, from 5.02 to 3.11, while the higher concentrations EDTA experiments rises more than one pH unit, from 4.35 to 5.67.

C6.2: Experiments using HTL319

Two experiments were carried out using HTL319 and EDTA, one using an EDTA concentration of 0.1 M (1726), and one using a concentration of 0.001 M (1723). Selected elemental concentrations measured in the final samples from these runs are shown in Figures 4.7.2 and 4.7.6. Both experiments were carried out at 70°C and atmospheric pressure.

Leachates from both experiments show a broad range of the selected elements at concentrations above detection, with a slightly broader range of elements, at higher concentrations found in the higher concentration EDTA experiment. Again, the range of elements released, and their relative concentrations broadly reflect the composition of the starting solid, with relatively high concentrations of manganese and tungsten. Detectable concentrations of samarium, europium, neodymium, and silver were not found in either leachate, despite being present in relatively large amounts in the starting solid, possibly a relative immobility of these elements under these conditions.

In terms of the selected 'At Risk' elements, cobalt, gallium, molybdenum, and antimony are present, at relatively low concentrations (less than $7\text{E-}7\text{ M}$) in both leachates, with strontium also present in low concentrations ($6\text{E-}7\text{ M}$) in the 0.1 M EDTA leachate.

The selected metals common to South West England are present in relatively high concentrations in both leachates. Manganese and tungsten are the most abundant of these, found at concentrations of $8\text{E-}4\text{ M}$ and $2\text{E-}4\text{ M}$ in the 0.1 M EDTA leachate, respectively.

A large number of REEs are found in both leachates, though at relatively low concentrations, the highest found being yttrium at $3\text{E-}8\text{ M}$ in the 0.001 M EDTA leachate, and $1\text{E-}7\text{ M}$ in the 0.1 M EDTA leachate. Other REEs are all below $1\text{E-}7\text{ M}$ in both leachates.

Both experiments show a slight rise in pH, from 5.02 to 5.95 in the 0.001 M EDTA experiment, and from 4.35 to 5.16 in the 0.1 M experiment.

C6.3: Experiments using HTLMix

Four experiments were carried out using HTLMix and EDTA, three using an EDTA concentration of 0.1 M (1727, 1735, and 1766), and one using a concentration of 0.001 M (1724). Selected elemental concentrations measured in the final samples from these runs are shown in Figures 4.7.4, 4.7.7, 4.7.8, and 4.7.9. Experiments 1727, 1735, and 1724 were carried out at 70°C and atmospheric pressure, while Run 1766 was carried out at 150°C and 200 bar.

All four experiments show a broad distribution of selected elements at concentrations above detection, again broadly in line with their relative distribution in the starting solid. The higher concentration EDTA leachates have a wider range of selected elements, at high concentrations than the more dilute leachant. Both of the 70°C 0.1 M EDTA experiments (1727 and its duplicate 1735) show very similar results in terms of leachate composition, and so only 1727 will be used as an example for the remainder of this section.

In terms of the selected 'At Risk' metals, vanadium, cobalt, gallium, strontium and antimony are all present in the 70°C 0.1 M EDTA leachate, with antimony found at the highest concentration ($6\text{E-}5\text{ M}$). Fewer 'At Risk' metals were detected in the 0.001 M EDTA leachate, with only cobalt, strontium, and antimony found in detectable amounts, all below $1\text{E-}6\text{ M}$. In the 150°C leachate, the 'At Risk' elements present match those detected in the 70°C . Notably antimony concentrations are considerably lower in this leachate ($6\text{E-}8\text{ M}$ compared to $3\text{E-}5\text{ M}$ in the lower temperature leachate).

A wide range of elements commonly found in South West England ore deposits are found in both leachates. Manganese, zinc, and lead are found in relatively high concentrations in the 0.001 M EDTA leachate, reaching concentrations of $5\text{E-}5\text{ M}$, $8\text{E-}5\text{ M}$, and $9\text{E-}4\text{ M}$ respectively. In the 70°C 0.1 M EDTA leachate, manganese, copper, zinc, tungsten, and arsenic are all found at concentrations greater than $1\text{E-}6$. Again,

lead is the highest concentration elements in this group, found at a concentration of $1\text{E-}2$ M. As for the 'At Risk' metals, some of these elements are present in lower concentrations in the higher temperature 0.1 M EDTA experiment. Copper, arsenic, and tungsten all show depressed concentrations, relative to the 70°C 0.1 M EDTA experiment, while tin is relatively elevated ($3\text{E-}6$ M).

In terms of REEs, both leachates show a wide range of elements present. In the 0.001 M EDTA leachate, yttrium is the most abundant of the selected REEs, at a concentration of $3\text{E-}7$ M, with all other REEs found at concentrations below $1\text{E-}7$ M. In the 0.1 M EDTA leachate, caesium, praseodymium, neodymium, and samarium are the highest concentration REEs, ranging in concentration from $1\text{E-}6$ M to $1\text{E-}5$ M. Other REE concentrations are $1\text{E-}6$ or lower. The distribution and concentrations of REEs measured in the leachate from the 150°C 0.1 M EDTA experiment, closely mirror those of the 70°C counterpart.

pH rises by about 1.1 pH units in all four of the experiments.

SEM analysis was also carried out for Run 1727 and 1766, details of which are provided below.

For 1727 no galena was observed. The sample appears very clean with no surface fines nor deposits. Sphalerite showed evidence of slight pitting with Ag and Cd detectable in some pitted areas. The Pb-Cu-Sb sulphide (bournonite) was still present. Minor pitting of silicates was identified.

Regarding Run 1766, the starting material for this run was of the type with galena dominantly present as euhedral grains. Some pitting of quartz surfaces indicates there was minor dissolution of silicates. Both galena and sphalerite were observed to have intense surface pitting with some deep incisions, implying significant dissolution. In the galena, deep pitting follows cleavage planes (Plate 2C) and pit walls showed a thin spongy porous texture (Plate 2D). Ag and Cu were detectable in the porous sites (by EDX; presence of Ag confirmed by WD analysis), even where these elements were not detectable (by WD) in the host grain. A widespread surface deposit of Ti-rich material was observed. A rare euhedral Sb-rich phase cementing grains into a cluster was observed and is interpreted as a precipitate that formed during the experiment. This phase was additionally observed (in PTS) to be highly beam-sensitive and to contain significant Na.

Lab. Run Number	1722	1725	1723	1726	1724	1727	1735	1766
Experiment Type	Rotating Shaker	Rotating shaker	Rotating shaker	Rotating shaker	Rotating shaker	Rotating shaker	Rotating shaker	Ti Batch Vessel
Solid ID	HTL315	HTL315	HTL319	HTL319	HTLMix	HTLMix	HTLMix	HTLMix
Solution Concentration	0.001 M	0.1 M	0.001 M	0.1 M	0.001 M	0.001 M	0.1 M	0.1 M
Temperature, C	70	70	70	70	70	70	70	150
Pressure, bar	1	1	1	1	1	1	1	200
Duration, hours	674	674	674	674	674	674	674	987
Solid Weight, g	5	5	5	5	5	5	5	8.75
Solution Volume, ml	200	200	200	200	200	200	200	350
Starting pH	5.02	4.35	5.02	4.35	5.02	4.35	4.35	4.35
Starting Eh	207.6	212.7	207.6	212.7	207.6	212.7	212.7	212.7
Final pH	3.11	5.67	5.95	5.16	6.15	5.46	5.41	6.37
Final Eh	313.9	158.9	239.8	159.3	213.8	159.1	165.4	-144.6

Table C6: Summary of experiments carried out using EDTA and UK samples

Run 1722: HTL315, 0.001 M EDTA, 70°C, 1 bar
 Elemental Concentration, M, after 674 hours

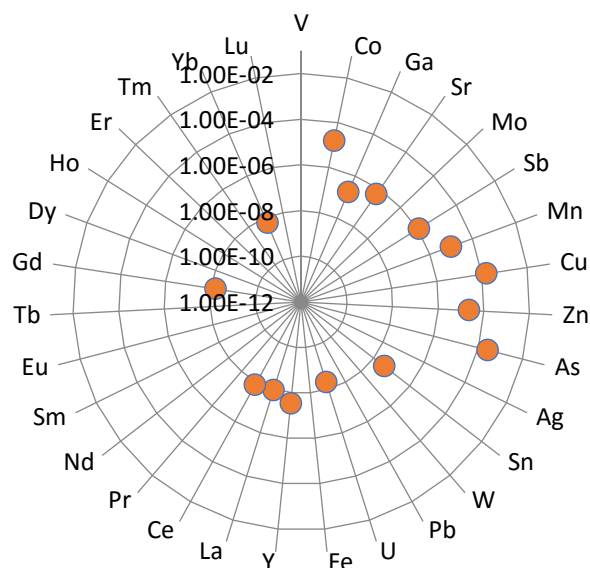


Figure C6.1: Selected metal concs for Run 1722 final fluid (UK sample HTL315: 0.001M EDTA, 70 °C, 1 bar).

Run 1726: HTL319, 0.1 M EDTA, 70°C, 1 bar
 Elemental Concentration, M, after 674 hours

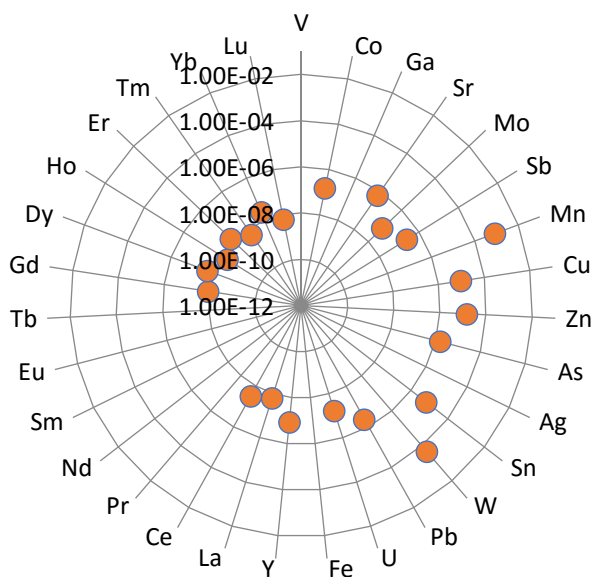


Figure C6.2: Selected metal concs for Run 1726 final fluid (UK sample HTL319: 0.1M EDTA, 70 °C, 1 bar).

Run 1723: HTL319, 0.001 M EDTA, 70°C, 1 bar

Elemental Concentration, M, after 674 hours

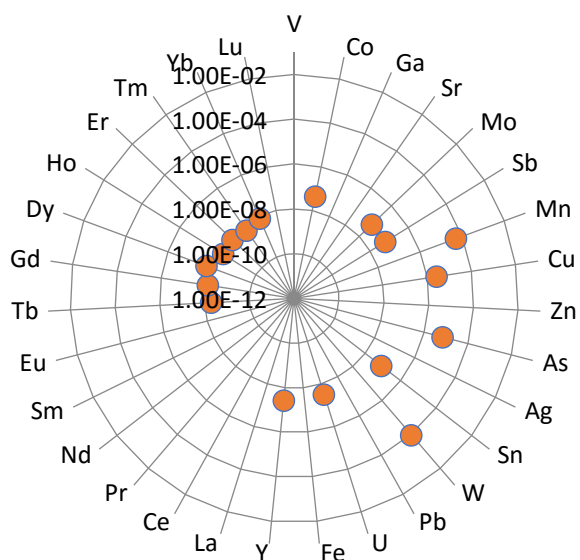


Figure C6.3: Selected metal concs for Run 1723 final fluid (UK sample HTL319: 0.001M EDTA, 70 °C, 1 bar).

Run 1724: HTLMix, 0.001 M EDTA, 70°C, 1 bar

Elemental Concentration, M, after 674 hours

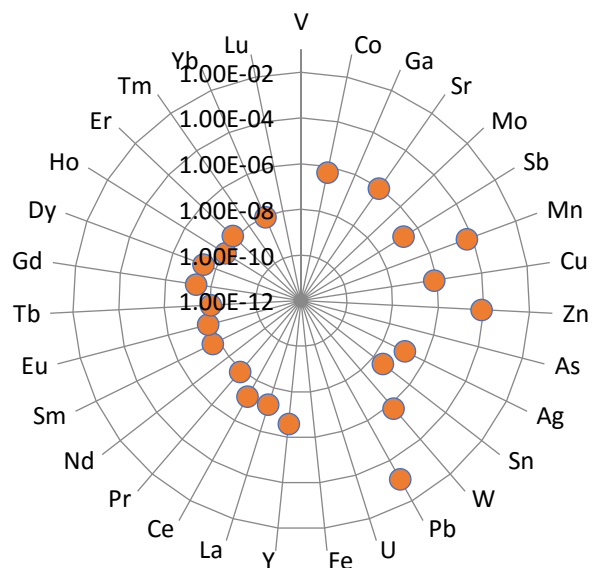


Figure C6.4: Selected metal concs for Run 1724 final fluid (UK sample HTLMix: 0.001M EDTA, 70 °C, 1 bar).

Run 1725: HTL315, 0.1 M EDTA, 70°C, 1 bar
Elemental Concentration, M, after 674 hours

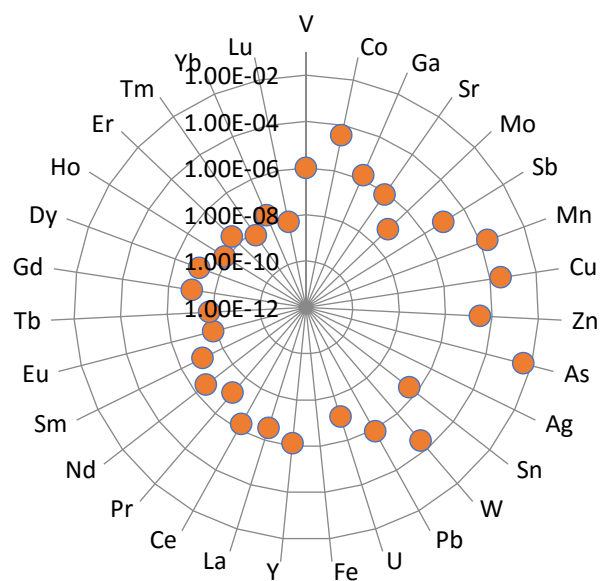


Figure C6.5: Selected metal concs for Run 1725 final fluid (UK sample HTL315: 0.1M EDTA, 70 °C, 1 bar).

Run 1726: HTL319, 0.1 M EDTA, 70°C, 1 bar
Elemental Concentration, M, after 674 hours

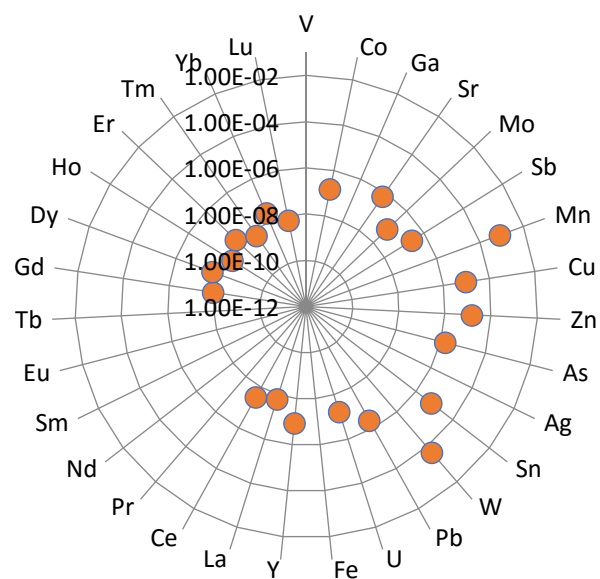


Figure C6.6: Selected metal concs for Run 1726 final fluid (UK sample HTL319: 0.1M EDTA, 70 °C, 1 bar).

Run 1727: HTLMix, 0.1 M EDTA, 70°C, 1 bar
Elemental Concentration, M, after 674 hours

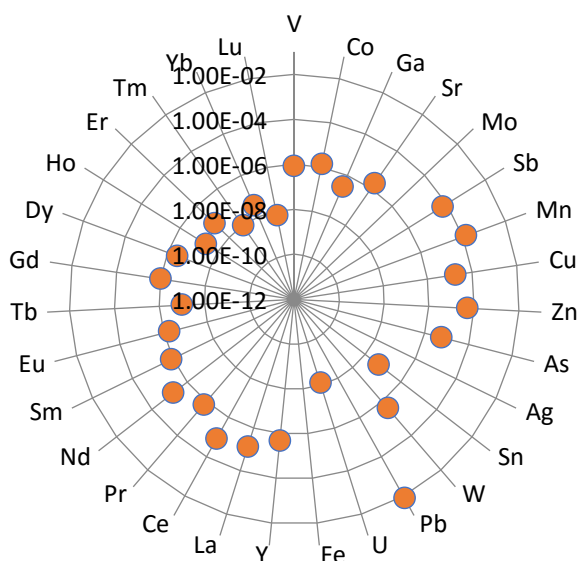


Figure C6.7: Selected metal concs for Run 1727 final fluid (UK sample HTLMix: 0.1M EDTA, 70 °C, 1 bar).

Run 1735: HTLMix, 0.1 M EDTA, 70°C, 1 bar
Elemental Concentration, M, after 674 hours

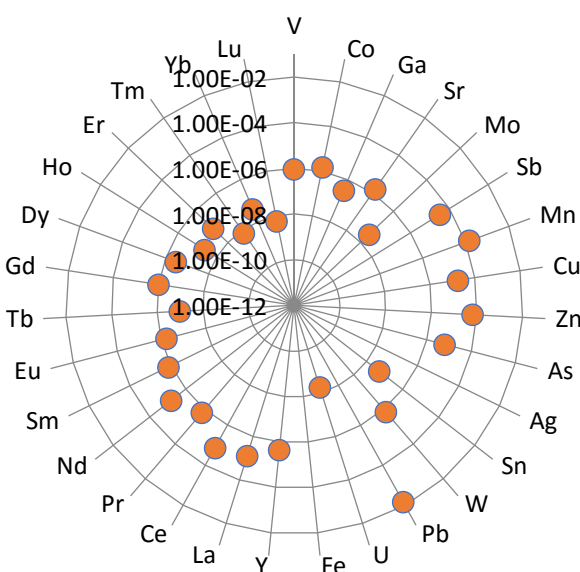


Figure C6.8: Selected metal concs for Run 1735 final fluid (UK sample HTLMix: 0.1M EDTA, 70 °C, 1 bar).

Run 1766: HTLMix, 0.1 M EDTA, 150°C, 200 bar
Elemental Concentration, M, after 987 hours

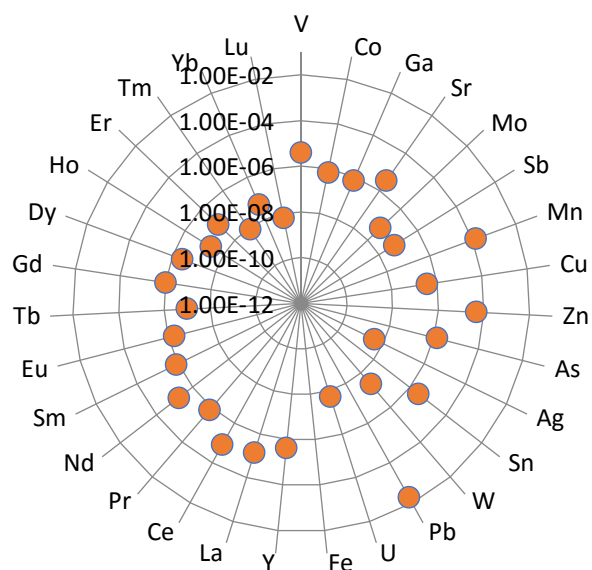


Figure C6.9: Selected metal concs for Run 1766 final fluid (UK sample HTLMix: 0.1M EDTA, 150 °C, 200 bar).

C7: Experiments with 0.1M SDS and UK sample CHPMMIX (S03)

Six experiments were carried out using SDS and the UK samples HTL315, HTL319 and HTLMix.

Full details on the sample composition can be found in Table 3.1.1 and Appendix A.

The experiments carried out using SDS as a leaching agent are summarised in Table C7 and Figures C7.1-C7.6 below. Figures C7.1-C7.6 show selected elemental concentrations for the final sample of the experimental run.

C7.1: Experiments using HTL315

Two experiments were carried out using HTL315 and SDS, one using an SDS concentration of 0.1 M (1743), and one using a concentration of 0.001 M (1746). Selected elemental concentrations measured in the final samples from these runs are shown in Figures C7.1 and C7.2. Both experiments were carried out at 70°C and atmospheric pressure.

Of the selected 'At Risk' metals, only cobalt and antimony were detectable in the leachate from the 0.001 M SDS experiment, at 1E-5 M and 4E-7 M respectively. In the 0.1 M SDS leachate vanadium, cobalt, gallium, and antimony are present, with cobalt present at the highest concentration (2E-5 M). Strontium is not present in either leachate, despite being present at levels comparable to that of gallium and vanadium in the starting solid.

In terms of elements common to South West England, copper, arsenic, and iron are the most abundant elements in both leachates, present at concentrations of 4E-4 M, 2E-3 M, and 1E-2 M in the 0.1 M leachate, respectively. Manganese and zinc are also relatively elevated in both leachates, with other selected elements only found at concentrations below 1E-6 M, in both leachates.

Of the REEs, none are detected at levels above 1E-7 M, in either leachate, despite some, such as yttrium and caesium, being relatively abundant in the starting solid.

Both experiments show a large decrease in pH, from 5.91 to 1.84 for the 0.1 M SDS experiment, and 6.05 and 1.32 for the 0.001 M SDS experiment.

C7.2: Experiments using HTL319

Two experiments were carried out using HTL319 and SDS, one using an SDS concentration of 0.1 M (1744), and one using a concentration of 0.001 M (1747). Selected elemental concentrations measured in the final samples from these runs are shown in Figures C7.4 and C7.6. Both experiments were carried out at 70°C and atmospheric pressure.

The 0.001 M SDS experiment shows a very narrow range of selected metals at detectable concentrations. The 0.1 M experiment shows a much broader range of elements, at higher concentrations.

In terms of the selected 'At Risk' metals, none are present in detectable amounts in the leachate from the 0.001 M SDS experiment, perhaps reflecting their relatively low concentrations in the starting solid. In the 0.1 M SDS experiment, only molybdenum and antimony are present, at concentrations of 4E-8 M and 5E-8 M respectively.

Both experiments show a wide range of South West England associated elements. In the 0.001 M leachate, only iron, manganese, and tungsten are found at concentrations greater than $1\text{E-}6$ M, while for the 0.1 M leachate manganese, copper, arsenic, tungsten, and iron are all found exceeding this concentration.

No REEs were detected in the 0.001 M SDS leachate. A wide range were detected in the 0.1 M SDS leachate, although these were all at concentrations below $1\text{E-}7$ M, the highest being yttrium, lanthanum and caesium, reflecting their relative abundance in the starting solid.

In terms of pH, the 0.001 M SDS experiment shows a drop, from 6.05 to 3.1, while the 0.1 M SDS experiment sees a rise, from 5.91 to 6.86.

C7.3: Experiments using HTLMix

Two experiments were carried out using HTL319 and SDS, one using an SDS concentration of 0.1 M (1745), and one using a concentration of 0.001 M (1748). Selected elemental concentrations measured in the final samples from these runs are shown in Figures C7.3 and C7.5. Both experiments were carried out at 70°C and atmospheric pressure.

As for the experiments using HTL319, these experiments show a fairly narrow range of elements in terms of the selected 'At Risk' metals and REEs leached, indicating that in the case of SDS, the solution is exerting more of a control on the metals leached, rather than the starting solid itself (i.e. SDS appears to be relatively poor at mobilising the 'At Risk' metals and REEs).

Of the 'At Risk' metals, only cobalt and antimony are present in detectable concentrations in both leachates, both at concentrations less than $1\text{E-}7$ M in the 0.001 M leachate, and at $7\text{E-}8$ M and $3\text{E-}6$ M respectively in the 0.1 M leachate. Vanadium and gallium are not present in the leachates, despite being as or more abundant as cobalt in the starting solid, again suggesting that SDS is not efficient in leaching these metals.

The selected elements common to South West England show a broader distribution, and higher concentrations. Manganese, zinc, lead, and iron are found in the 0.001 M leachate at concentrations ranging from $2\text{E-}6$ M to $3\text{E-}5$ M. Manganese, copper, zinc, silver, tungsten, lead, and iron are all relatively elevated in the 0.1 M SDS leachate, with the most abundant elements being zinc ($6\text{E-}5$ M), and lead ($1\text{E-}3$ M). Notably, the 0.1 M SDS experiment was one of the few SDS runs where silver was present in the leachate, reaching levels of $1\text{E-}6$ M, partly reflecting the fact that silver is more abundant in HTLMix ($4\text{E-}4$ mol/kg), than in the other UK solids used.

As for HTL319, the 0.001 M SDS leachate contains no detectable concentrations of REEs. The 0.1 M leachate contains a reasonably broad range, though at low concentrations, with caesium and lanthanum being the most abundant, both at $2\text{E-}7$ M.

Both experiments showed a decrease in pH, though the changes were much smaller than those seen in SDS runs using the other UK solids. The 0.1 M SDS experiment showed a small drop from 5.91 to 5.24, while the 0.001 M SDS experiment showed a drop from 6.05 to 5.8.

The reacted solid from Run 1745 also underwent SEM analysis. The starting material for this run was mostly of the type with galena dominantly present as euhedral grains, but there were also some grains with coatings of galena-based fines. Widespread evidence for the etching of galena, sphalerite and quartz (Plate 3A) was observed. The sulphates showed more significant etching. Cu was detected in more deeply pitted galena sites. A disc-like deposit of a Pb-S-O phase (possibly Pb sulphate) was observed on most grain

surfaces (Plate 3A). The rough edges and pitted forms shown by this phase suggest it may itself have been partially dissolved.

Lab. Run Number	1743	1746	1744	1747	1745	1748
Experiment Type	Rotating Shaker	Rotating shaker	Rotating shaker	Rotating shaker	Rotating shaker	Rotating shaker
Solid ID	HTL315	HTL315	HTL319	HTL319	HTLMix	HTLMix
Solution Concentration	0.1 M	0.001 M	0.1 M	0.001 M	0.1 M	0.001 M
Temperature, C	70	70	70	70	70	70
Pressure, bar	1	1	1	1	1	1
Duration, hours	718	718	718	718	718	718
Solid Weight, g	5	5	5	5	5	5
Solution Volume, ml	200	200	200	200	200	200
Starting pH	5.91	6.05	5.91	6.05	5.91	6.05
Starting Eh	306.5	261.4	306.5	261.4	306.5	261.4
Final pH	1.84	1.32	6.86	3.1	5.24	5.8
Final Eh	384.8	516.2	215.1	310.3	259.9	262.5

Table C7: Summary of experiments carried out using SDS and UK samples

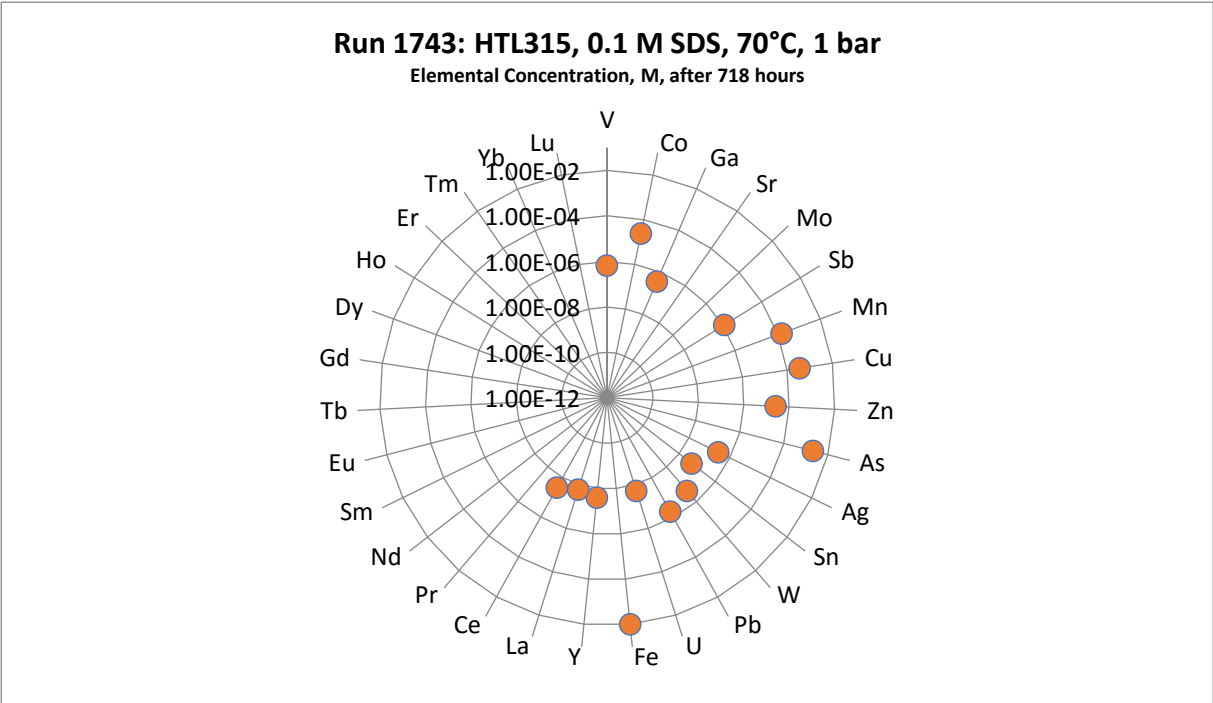


Figure C7.1: Selected metal concs. For Run 1743 final fluid (UK sample HTL315: 0.1M SDS, 70 °C, 1 bar).

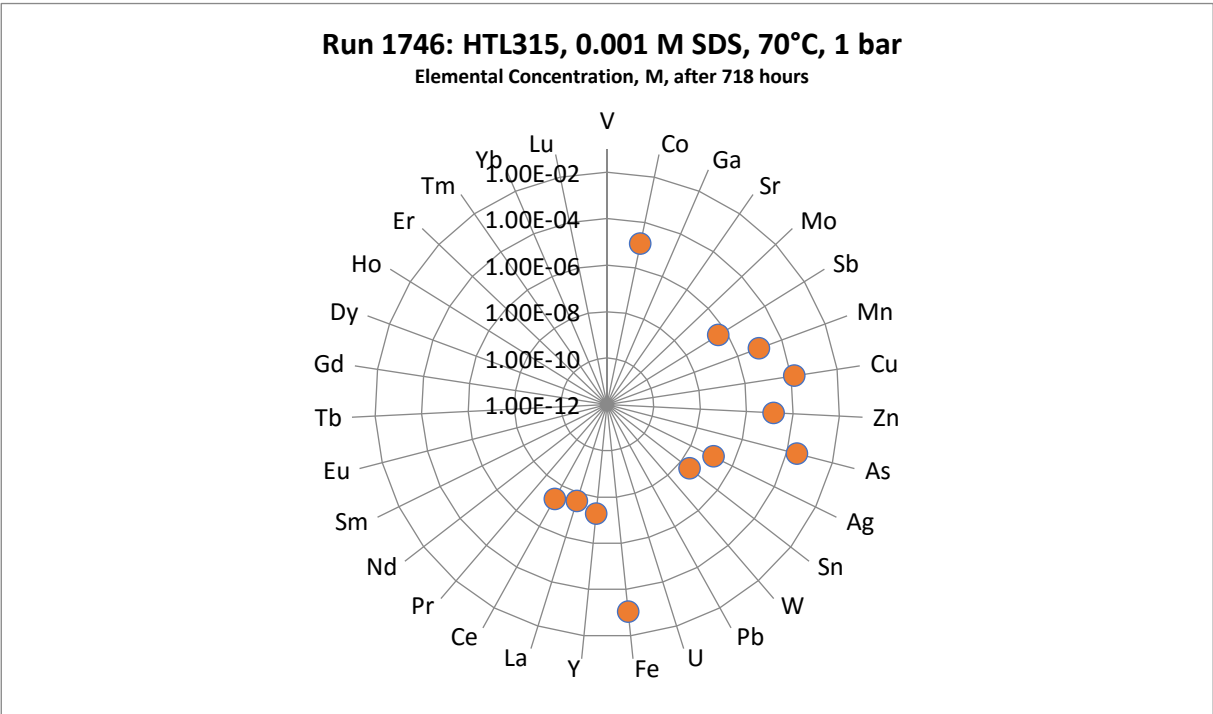


Figure C7.2: Selected metal concs. For Run 1746 final fluid (UK sample HTL315: 0.001M SDS, 70 °C, 1 bar).

Run 1745: HTLMix, 0.1 M SDS, 70°C, 1 bar

Elemental Concentration, M, after 718 hours

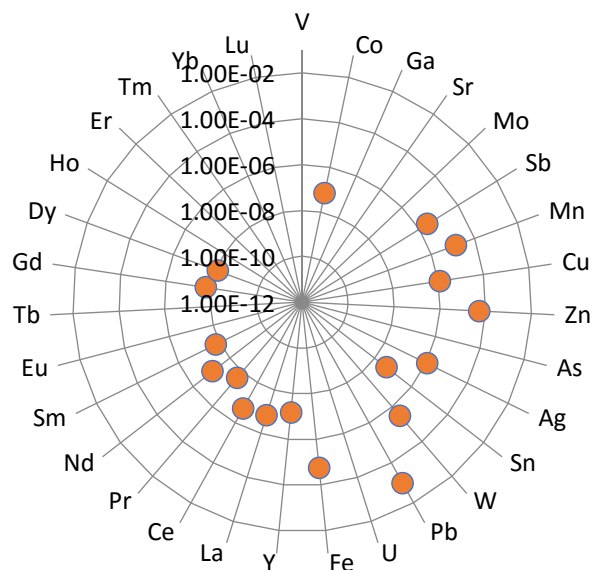


Figure C7.3: Selected metal concs. For Run 1745 final fluid (UK sample HTLMix: 0.1M SDS, 70 °C, 1 bar).

Run 1747: HTL319, 0.001 M SDS, 70°C, 1 bar

Elemental Concentration, M, after 718 hours

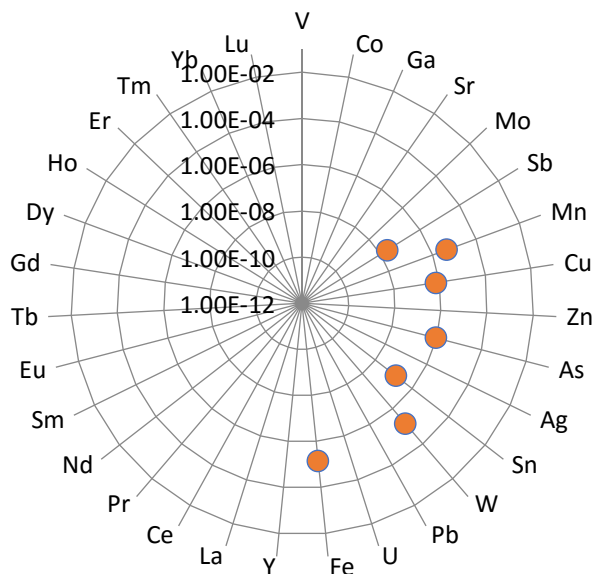


Figure C7.4: Selected metal concs. For Run 1747 final fluid (UK sample HTL319: 0.001M SDS, 70 °C, 1 bar).

Run 1748: HTLMix, 0.001 M SDS, 70°C, 1 bar

Elemental Concentration, M, after 718 hours

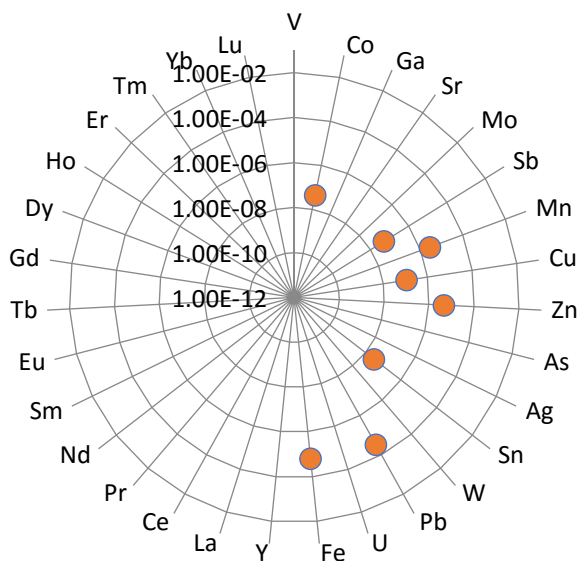


Figure C7.5: Selected metal concs. For Run 1748 final fluid (UK sample HTLMix: 0.001M SDS, 70 °C, 1 bar).

Run 1744: HTL319, 0.1 M SDS, 70°C, 1 bar

Elemental Concentration, M, after 718 hours

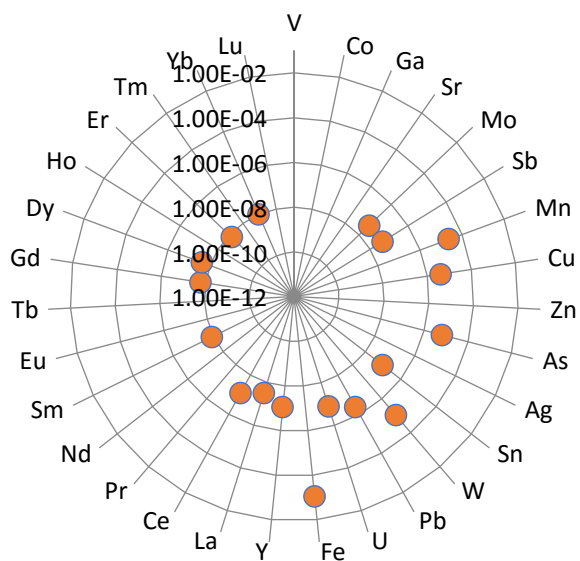


Figure C7.6: Selected metal concs. For Run 1744 final fluid (UK sample HTL319: 0.1M SDS, 70 °C, 1 bar).

C8: Experiments with ammonia and UK samples HTL315, HTL319 and HTLMix

The purpose of this experiment was to see whether an alkaline solution would be effective in leaching metals. The lead author has previously used alkaline dissolution methods to recover copper and lead from material recovered from waste dumps from mines exploiting limestone-hosted copper mineralisation. Alkaline solutions can be preferable to acidic solutions when there is a significant amount of carbonate minerals present (i.e. the acidity is not 'wasted' dissolving the bulk of the host rock).

Seven experiments were carried out using ammonia and the UK samples HTL315, HTL319 and HTLMix.

Full details on the sample composition can be found in Table 3.1.1 and Appendix A.

The experiments carried out using ammonia as a leaching agent are summarised in Table C8 and Figures C8.1-C8.7 below. Figures C8.1-C8.7 show selected elemental concentrations for the final sample of the experimental run.

C8.1: Experiments using HTL315

Three experiments were carried out using HTL315 and ammonia, two using a concentration of 0.1 M (1731 and its duplicate 1749), and one using a concentration of 0.001 M (1732). Selected elemental concentrations measured in the final samples from these runs are shown in Figures C8.1, C8.2, and C8.6. All three experiments were carried out at 70°C and atmospheric pressure. Since Run 1749 was a duplicate of Run 1731, and produced very similar results in terms of the spread and concentration of selected element, only Run 1731 will be used in the following description of results.

The spread of selected elements detectable in the leachates is relatively narrow, with very few of the selected REEs present in significant concentrations. There are some significant differences between the two leachants used, with the lower concentration leachate containing a broader range of elements, often at higher concentrations, than its more concentrated counterpart. The spread and relative amounts of elements leached broadly match the composition of the starting solid, with low to middling concentrations of the selected 'At Risk' metals, elevated concentrations of the elements common to South West England, and very low concentrations of REEs.

In terms of the selected 'At Risk' metals, the 0.001 M ammonia experiment contains only cobalt and antimony in detectable amounts, although cobalt is relatively elevated, at a concentration of 2E-5 M. The 0.1 M ammonia leachate contains a slightly broader spread of these elements, with detectable concentrations of cobalt, gallium, molybdenum, and antimony, although these concentrations are generally low, with only antimony reaching concentrations greater than 1E-6 M.

Metals common to South West England show a broader spread and elevated concentrations relative to the other groups studied. Copper, arsenic, and iron are all elevated in both leachates, all present in concentrations ranging from 1E-5 M to 1E-3 M. Notably, manganese and zinc are also elevated in the 0.001 M leachate, both reaching concentrations of 2E-5 M, but are not present in detectable concentrations in the 0.1 M ammonia leachate

In terms of REEs, only yttrium, lanthanum, and caesium are present in detectable concentrations in the 0.001 M ammonia leachate, all at concentrations below 1E-7 M, while no REEs are present in detectable

concentrations in the 0.1 M ammonia leachates. These results, together with those above, suggest that, above certain concentrations, ammonia may actually inhibit the leaching of certain elements.

In terms of pH, the 0.1 M ammonia leachate sees a slight drop from 11.24 to 9.79, while the more dilute 0.001 M ammonia solutions sees a very large drop in pH, from a starting value of 9.96 to 2.87.

C8.2: Experiments using HTL319

Two experiments were carried out using HTL319 and ammonia, one using an ammonia concentration of 0.1 M (1732), and one using a concentration of 0.001 M (1735). Selected elemental concentrations measured in the final samples from these runs are shown in Figures C8.4 and C8.7. Both experiments were carried out at 70°C and atmospheric pressure.

Leachates from these experiments show a very narrow range of selected elements at detectable concentrations, especially in terms of the 'At Risk' metals and REEs. In contrast to the experiments using ammonia and solid HTL315, the higher concentration leachate here produces a slightly wider spread of elements, at slightly higher concentrations, than its lower concentration counterpart. The elevated concentrations of elements common to South West England broadly correspond to the composition of the starting solid, though some discrepancies, such as relatively depressed concentrations of manganese and zinc, and no detectable concentrations of the lighter REEs, such as yttrium or lanthanum, suggest that ammonia is relatively ineffective at leaching some of these elements.

Leaching of 'At Risk' metals by the experimental solutions is very limited, corresponding to the low concentrations of these elements in the starting solid, relative to the two other UK solids used. Of the selected metals, only antimony is present in detectable amounts in the 0.001 M ammonia leachate, at a concentration of 4E-8 M. Molybdenum and antimony are both present in the 0.1 M ammonia leachate, though again at low concentrations, 5E-8 M and 9E-8 M respectively.

Metals common to south west England show a broader spread and higher concentrations in the analysed leachates, as would be expected from their relative abundance in the starting solid. Concentrations of manganese, copper, arsenic and tungsten are all relatively elevated in the 0.1 M ammonia leachate, found in concentrations from 4E-6 M (Manganese) to 2E-4 M (tungsten). Measured concentrations in the 0.001 M leachate are generally lower, with the exception of iron (sum of reduced and oxidised forms), found at a concentration of 2E-5 M in the more dilute leachate and not detected at all in the 0.1 M leachate.

As for the other experiments using ammonia, concentrations of REEs in the leachates are very limited, even for lighter REEs such as yttrium and lanthanum which are relatively abundant in the starting solid. Only caesium was found at detectable concentrations, and only in the 0.1 M ammonia leachate.

In terms of pH, both experiments see a slight drop in pH, from 11.24 to 10.88 for the 0.1 M ammonia leachate, and 9.96 to 9.01 for the 0.001 M ammonia leachate.

C8.3: Experiments using HTLMix

Two experiments were carried out using HTLMix and ammonia, one using an ammonia concentration of 0.1 M (1733), and one using a concentration of 0.001 M (1736). Selected elemental concentrations measured

in the final samples from these runs are shown in Figures C8.3 and C8.5. Both experiments were carried out at 70°C and atmospheric pressure.

The leachates from these runs show a reasonable spread of elements common to South West England, but as for other ammonia experiments, leaching of 'At Risk' metals or REEs is very limited. Notably the spread of elements leached using the 0.001 M solution is much broader than that achieved using the 0.1 M ammonia solution.

In terms of the selected 'At Risk' metals, cobalt, and strontium were found at detectable concentrations (6 E-8 M and 8E-7 M respectively) in the 0.001 M ammonia leachate, while only antimony was detected in the 0.1 M ammonia solution, at 5E-7 M.

A reasonable spread of elements common to South West England were detected in the 0.001 M ammonia leachate, although only manganese, zinc, lead, and iron were found at levels in excess of 1E-6 M. Only copper, zinc, tungsten, and lead were detected in the 0.1 M ammonia leachate, the highest being lead at a concentration of 1E-5 M.

As for other ammonia experiments, leaching of REEs was very limited, with only lanthanum being detected in the 0.001 M ammonia solution, at a concentration of only 1E-8 M, while none at all were detected in the 0.1 M ammonia leachate.

In terms of pH, the 0.1 M ammonia leachate sees a slight drop over the course of the experiments, from 11.24 to 10.63, while the 0.001 M ammonia experiment sees a much more substantial drop, from 9.96 to 6.57.

The reacted product from Run 1733 was also analysed by SEM. The starting material for this run was mostly of the type with galena dominantly present as euhedral grains, but there were also common grains with coatings of galena-based fines. Minor surface etching and edge rounding of galena (Plate 3B) and sphalerite was observed. There was no evidence of silicate alteration or dissolution. Neither Cu nor Ag concentrations were detectable in galena pit sites. The dolomite present was observed to have been partially dissolved. Widespread coatings of Pb-rich phase were observed, some as <10 µm euhedral platy crystals with hexagonal forms (Plate 3B), different to anything seen in the pre-test material where the coatings are irregular /anhedral fines. These may be oxide or carbonate. Dolomite grains had surface deposits containing Fe and Mn, locally with additional Pb.

Lab. Run Number	1731	1734	1732	1735	1733	1736	1749
Experiment Type	Rotating Shaker	Rotating shaker	Rotating shaker	Rotating shaker	Rotating shaker	Rotating shaker	Rotating Shaker
Solid ID	HTL315	HTL315	HTL319	HTL319	HTLMix	HTLMix	HTL315
Solution Concentration	0.1 M	0.001 M	0.1 M	0.001 M	0.1 M	0.001 M	0.1 M
Temperature, C	70	70	70	70	70	70	70
Pressure, bar	1	1	1	1	1	1	1
Duration, hours	718	718	718	718	718	718	718
Solid Weight, g	5	5	5	5	5	5	5
Solution Volume, ml	200	200	200	200	200	200	200
Starting pH	11.24	9.96	11.24	9.96	11.24	9.96	11.24
Starting Eh	38.3	60.2	38.3	60.2	38.3	60.2	38.3
Final pH	9.79	2.87	10.88	9.01	10.63	6.57	9.74
Final Eh	135.2	256.2	85.6	127.6	69.7	155.1	121.4

Table C8: Summary of experiments carried out using ammonia and UK samples

Run 1731: HTL315, 0.1 M Ammonia, 70°C, 1 bar

Elemental Concentration, M, after 718 hours

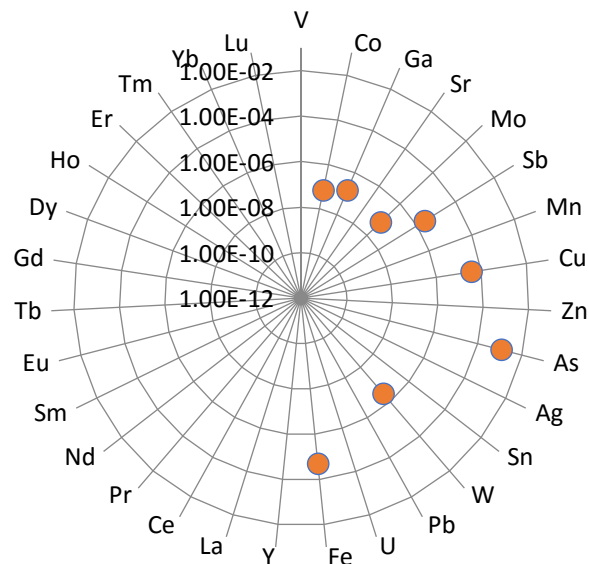


Figure C8.1: Selected metal concs. For Run 1731 final fluid (UK sample HTL315: 0.1M ammonia, 70 °C, 1 bar).

Run 1734: HTL315, 0.001 M Ammonia, 70°C, 1 bar

Elemental Concentration, M, after 718 hours

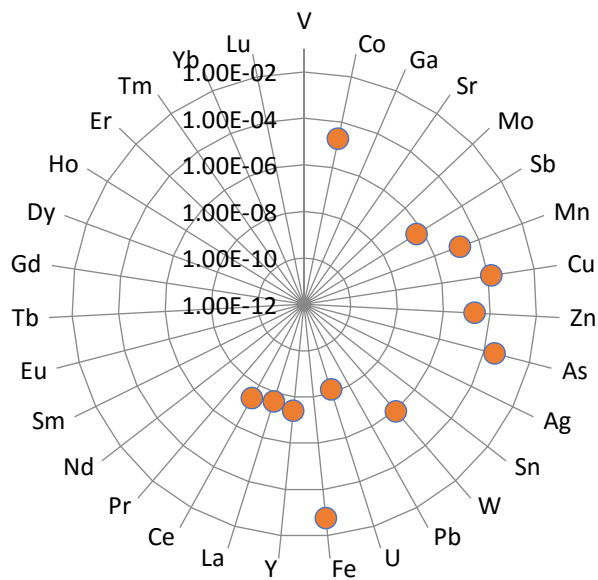


Figure C8.2: Selected metal concs. For Run 1734 final fluid (UK sample HTL315: 0.001M ammonia, 70 °C, 1 bar).

Run 1733: HTLMix, 0.1 M Ammonia, 70°C, 1 bar

Elemental Concentration, M, after 718 hours

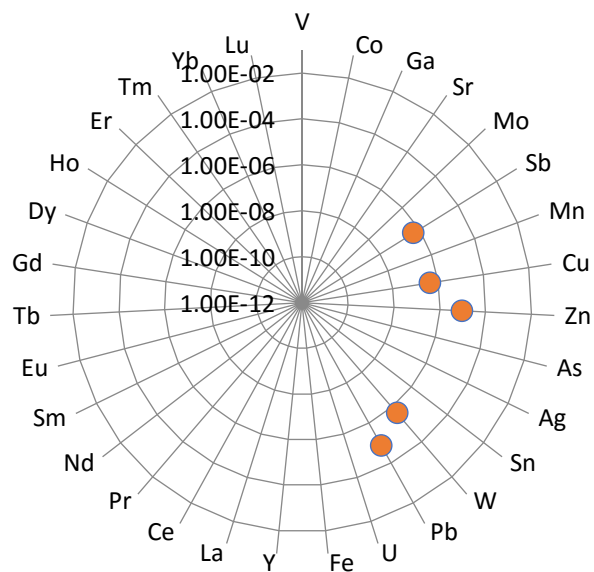


Figure C8.3: Selected metal concs. For Run 1733 final fluid (UK sample HTLMix: 0.1M ammonia, 70 °C, 1 bar).

Run 1735: HTL319, 0.001 M Ammonia, 70°C, 1 bar

Elemental Concentration, M, after 718 hours

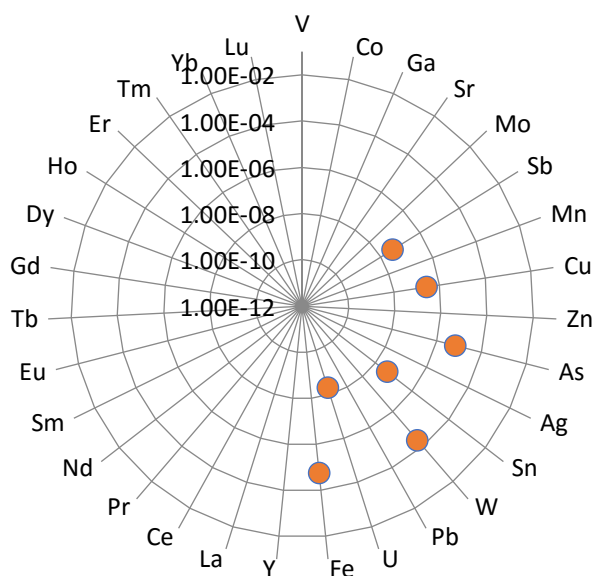


Figure C8.4: Selected metal concs. For Run 1735 final fluid (UK sample HTL319: 0.001M ammonia, 70 °C, 1 bar).

Run 1736: HTLMix, 0.001 M Ammonia, 70°C, 1 bar

Elemental Concentration, M, after 718 hours

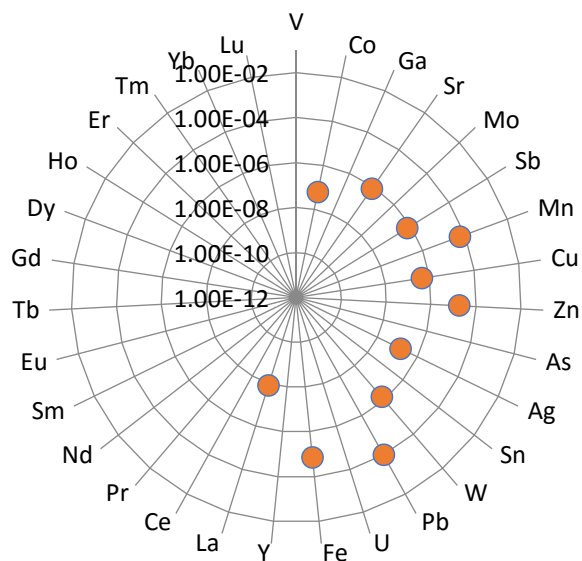


Figure C8.5: Selected metal concs. For Run 1736 final fluid (UK sample HTLMix: 0.001M ammonia, 70 °C, 1 bar).

Run 1749: HTL315, 0.1 M Ammonia, 70°C, 1 bar

Elemental Concentration, M, after 718 hours

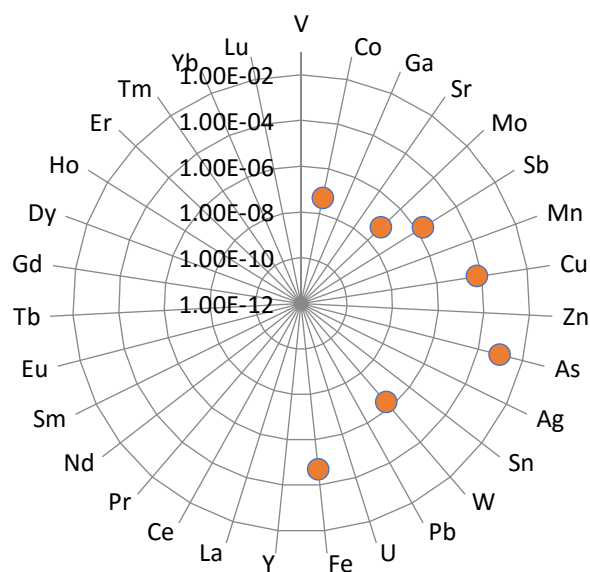


Figure C8.6: Selected metal concs. For Run 1749 final fluid (UK sample HTL315: 0.1M ammonia, 70 °C, 1 bar).

Run 1732: HTL319, 0.1 M Ammonia, 70°C, 1 bar
Elemental Concentration, M, after 718 hours

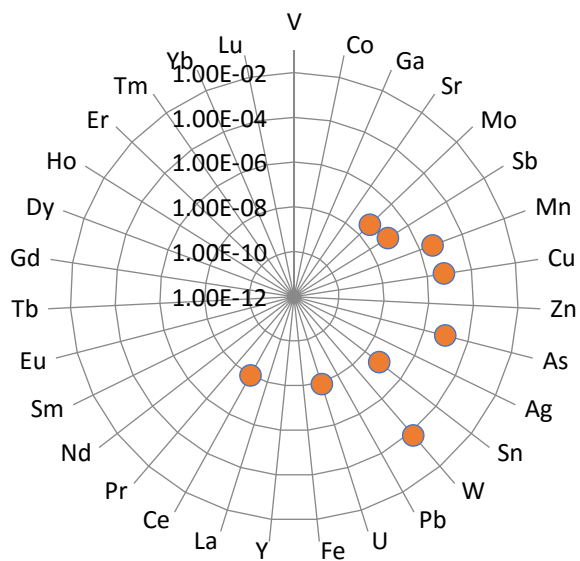


Figure C8.7: Selected metal concs. For Run 1732 final fluid (UK sample HTL319: 0.1M ammonia, 70 °C, 1 bar).

C9: Experiments with 0.1M H₂O₂ and UK sample CHPMMIX (S03)

Three experiments were carried out using 0.1 M hydrogen peroxide (H₂O₂) and the UK samples HTL315, HTL319 and HTLMix.

Full details on the sample compositions can be found in Table 3.1.1 and Appendix A.

The experiments carried out using H₂O₂ as a leaching agent are summarised in Table C9 and Figures C9.1-C9.3 below. Figures C9.1-C9.3 show selected elemental concentrations for the final sample of the experimental runs.

Lab. Run Number	1759	1760	1761
Experiment Type	Ti Batch	Ti Batch	Ti Batch
Solid ID	HTL315	HTL319	HTLMix
Solution Concentration	0.1 M	0.1 M	0.1 M
Temperature, C	100	100	100
Pressure, bar	200	200	200
Duration, hours	1002	1002	1002
Solid Weight, g	8.75	8.75	8.75
Solution Volume, ml	350	350	350
Starting pH	4.88	4.88	4.88
Starting Eh	451.7	451.7	451.7
Final pH	2.35	3.43	6.29
Final Eh	366.9	303.9	275.2

Table C9: Summary of experiments using H₂O₂ and UK samples

C9.1: Experiments using HTL315

One experiment was carried out using HTL315 and 0.1 M H₂O₂, at 100°C and 200 bar pressure (Run 1759). Selected elemental concentrations measured in the final sample from this run are shown in Figure C9.1.

A wide range of elements of interest were leached from the sample using hydrogen peroxide, though generally at relatively low concentrations. The range and relative concentrations of elements leached closely mirrors the starting composition of HTL315.

All of the selected 'At Risk' elements are present in the leachate (vanadium, cobalt, gallium, strontium, molybdenum, and antimony). Of these, only cobalt, strontium, and antimony are present at concentrations greater than 1E-7 M, at 4E-5 M, 3E-7 M, and 1E-7 M respectively.

Likewise, all of the selected elements common to South West England are present in the leachate, with the exception of tungsten (manganese, copper, zinc, arsenic, silver, tin, lead, uranium, and iron). Of these,

manganese, copper, zinc, arsenic, and iron are relatively elevated, at concentrations of $1\text{E-}4$ M, $7\text{E-}6$ M, $9\text{E-}5$ M, $2\text{E-}4$ M, and $4\text{E-}3$ M respectively. Silver, tin, lead and uranium all occur at concentrations below $1\text{E-}7$ M.

Likewise, all of the selected REEs are detectable in the final leachate, though at very low concentrations, and showing a slight decrease in concentration from the lighter elements (yttrium for example is found at a concentration of $9\text{E-}7$ M) to the heavier elements (lutetium concentration was measured at $2\text{E-}9$ M).

In terms of pH, the leachate drops from a starting pH of 4.88 to 2.35 over the course of the experiment.

C9.2: Experiments using HTM319

One experiment was carried out using HTL319 and 0.1 M H_2O_2 , at 100°C and 200 bar pressure (Run 1760). Selected elemental concentrations measured in the final sample from this run are shown in Figure C9.3.

Again, the range of elements leached is quite wide, though not as wide as that leached from HTL315, and again concentrations are relatively low. Several of the REEs are not present in solution, despite them being relatively abundant in the starting solid, suggesting some preferential dissolution of certain phases during the experiment, or a precipitation effect.

In terms of the selected 'At Risk' elements, cobalt, strontium, molybdenum and antimony are all present in the leachate, at concentrations of $4\text{E-}8$ M, $3\text{E-}7$ M, $8\text{E-}8$ M, and $2\text{E-}9$ M respectively.

In terms of the selected metal common to South West England, as for the experiment using HTL315, manganese, copper, zinc, arsenic, and iron are all relatively elevated, at concentrations of $2\text{E-}6$ M, $5\text{E-}6$ M, $2\text{E-}5$ M, $2\text{E-}6$ M, and $5\text{E-}6$ M, respectively. Silver, tin, tungsten and uranium are also present, but at concentrations below $1\text{E-}7$ M.

Almost all of the selected REEs are present in the final leachate, with the exceptions of caesium, praseodymium, neodymium, samarium, and europium, despite these being present in the starting solid. The elements present only occur at very low concentrations however, the highest being yttrium at $3\text{E-}9$ M.

The leachate pH drops from a starting value of 4.88 to 3.43 over the course of the experiment.

C9.3: Experiments using HTLMix

One experiment was carried out using HTLMix and 0.1 M H_2O_2 , at 100°C and 200 bar pressure (Run 1761). Selected elemental concentrations measured in the final sample from this run are shown in Figure C9.2.

As for the other H_2O_2 experiments, a wide range of elements were leached from the solid.

In terms of the selected 'At Risk' elements, cobalt, strontium, molybdenum, and antimony are all present in the leachate, at concentrations of $3\text{E-}7$ M, $3\text{E-}7$ M, $3\text{E-}8$ M, and $1\text{E-}6$ M respectively.

The most elevated elements from the group of metals common to south West England are, manganese, copper, zinc, and lead, at concentrations of $2\text{E-}5$ M, $6\text{E-}6$ M, $3\text{E-}4$ M, and $2\text{E-}5$ M, respectively. Arsenic, tin, and iron are also present, though at concentrations below $1\text{E-}6$ M.

A broad range of REEs are also present, though the heavier elements in this grouping (thulium, ytterbium, and lutetium) are not detected. The REEs present follow a decreasing trend in concentration from lightest

to heaviest, mimicking the composition of the starting solid. The highest concentration element in this group is lanthanum, at a concentration of $4\text{E-}8\text{ M}$.

In terms of pH, in contrast to the other experiments using H_2O_2 , the leachate shows a rise in pH, from 4.88 to 6.29.

The solids retrieved from Run 1761 were also analysed by SEM. No intact sulphides were observed. Silicates showed no evidence of dissolution. No dolomite was detected. Blocky, grain-sized, mixes of fine subhedral and coarser euhedral, dominantly Pb-rich, phases were recognised (Plate 3C). Their form, size and composition suggest they formed in the place of galena. The euhedral crystals were of blocky and prismatic forms. Some of the prismatic forms contained detectable S (possible Pb sulphate). S was not detectable from prismatic crystals with twinned forms. A scattered, locally clustered, Zn-rich deposit was also observed (Plate 3D), typically with euhedral platy to bladed forms and present on top of other phases. Rare microporous patches of Fe-Mn-Pb-based phase were present on some grain surfaces.

Run 1759: HTL315, 0.1 M H₂O₂, 100°C, 200 bar

Elemental Concentration, M, after 1002 hours

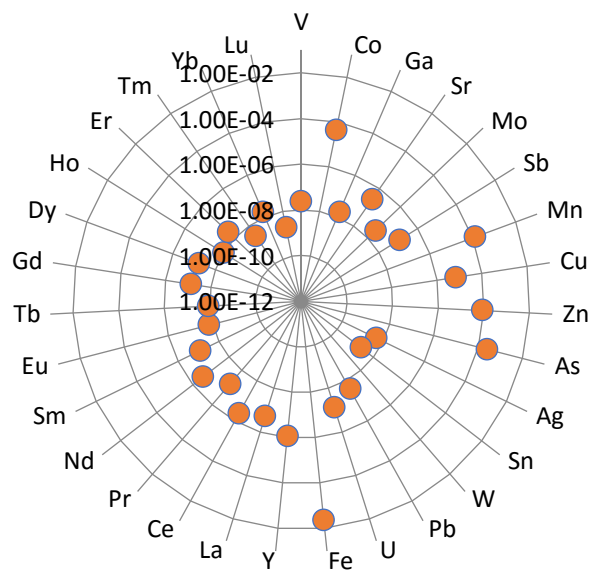


Figure C9.1: Selected metal concs. For Run 1759 final fluid (UK sample HTL315: 0.1M H₂O₂, 100 °C, 200 bar).

Run 1761: HTLMix, 0.1 M H₂O₂, 100°C, 200 bar

Elemental Concentration, M, after 1002 hours

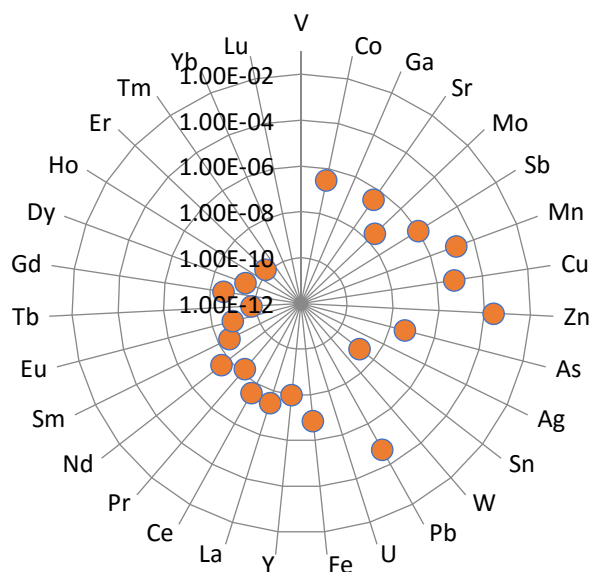


Figure C9.2: Selected metal concs. For Run 1761 final fluid (UK sample HTLMix: 0.1M H₂O₂, 100 °C, 200 bar).

Run 1760: HTL319, 0.1 M H₂O₂, 100°C, 200 bar

Elemental Concentration, M, after 1002 hours

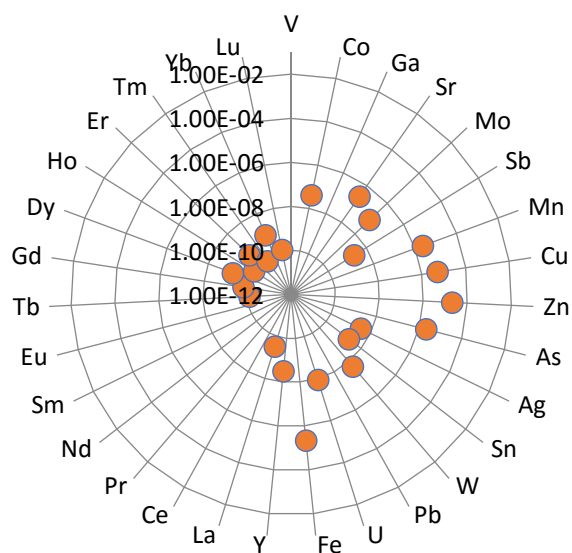


Figure C9.3: Selected metal concs. For Run 1760 final fluid (UK sample HTL319: 0.1M H₂O₂, 100 °C, 200 bar).

C10: Experiments with HCl / HNO₃ mix and UK sample HTLMix

Three experiments were carried out using dilute hydrochloric/nitric acid mix (dilute aqua regia) and the UK sample HTLMix.

Full details on the sample compositions can be found in Table 3.1.1 and Appendix A.

The experiments carried out using dilute aqua regia as a leaching agent are summarised in Table C10 and Figures C10.1-C10.6 below. Figures C10.1-C10.3 show selected elemental concentrations for the final sample of the experimental runs. Time series of summed elements from each of the experiments are shown in Figures C10.4-C10.6.

Lab. Run Number	1778	1779	1780
Experiment Type	Ti Batch	Ti Batch	Ti Batch
Solid ID	HTLMix	HTLMix	HTLMix
Solution Concentration	0.13 M	0.13 M	0.013 M
Temperature, C	200	100	100
Pressure, bar	200	200	200
Duration, hours	527	769	769
Solid Weight, g	8.75	8.75	8.75
Solution Volume, ml	350	350	350
Starting pH	1.09	0.92	2.34
Starting Eh	251.4	490.2	438.8
Final pH	1.56	1.4	7.9
Final Eh	336.7	572.2	179.3

Table C10: Summary of experiments using HCl/HNO₃ mix and UK samples

C10.1: Experiments using HTLMix

Two experiments were carried out using HTLMix and 0.1 M HCl, 0.03 M HNO₃, one at 200°C and 200 bar pressure (Run 1778), and one at 100°C and 200 bar pressure. One experiment was carried out using a more dilute solution of 0.01 M HCl, 0.003 M HNO₃ (Run 1780) at 100°C and 200 bar pressure. Selected elemental concentrations measured in the final samples from these runs are shown in Figures C10.1 and C10.2, while the time series of the experimental runs are shown in Figures C10.4 and C10.6.

Both of the more concentrated experimental leachates contain a broad range of elements, many at relatively elevated concentrations, broadly mimicking the relative abundance of elements in the starting

solid, though with a few exceptions such as vanadium, antimony, and tungsten, which while relatively abundant in the starting solid, are relatively depressed in the final leachates, suggesting either some selectivity on the part of the fluid, or some scavenging of these elements by precipitation. The more dilute leachate contains a much narrower spread of elements, generally at lower concentrations.

All of the selected 'At Risk' metals are present in both leachates, at concentrations ranging from 2E-5 M (cobalt) to 1E-7 M (gallium) in the 200°C leachate, and 3E-6 M (cobalt) to 8E-8 M (vanadium) in the 100°C leachate. In the more dilute leachate, cobalt, strontium, molybdenum, and antimony were detected, at concentrations ranging from 9E-7 M (strontium) to 3E-8 M (molybdenum).

In terms of metals common to South West England, the two experiments using the more concentrated leachates again include a broad selection of elements, at relatively elevated concentrations. Comparing the two experimental runs at 200°C and 100°C respectively, manganese is found at 5E-4 M and 2E-4 M, copper at 10E-5 M and 6E-4 M, zinc at 2E-3 M and 5E-3 M, and lead at 3E-3 M and 2E-2 M. The fact that higher concentrations of some of these elements are seen in the lower temperature experiment may reflect precipitation effects, or possibly the breakdown or neutralisation of the leaching agent at higher temperatures. Silver is also at a higher concentration in the lower temperature leachate (2E-6 M). Tungsten is also present in both leachates, but at very low concentrations (less than 1E-7 M). The more dilute leachate also shows a reasonable spread of these elements, with manganese at the highest concentration (1E-4 M), followed by zinc (6E-7 M), lead (5E-7 M), and arsenic (1E-7 M).

In terms of REEs, both of the higher concentration leachates contain detectable concentrations of all of the selected REEs. These follow the general trend of decreasing concentration with atomic weight, reflected in the starting composition of the solid. For the 100°C experiment, these concentrations range from 1E-5 M (caesium) to 4E-9 M (lutetium), and for the 200°C experiment range from 7E-6 M (caesium) to 5E-9 M (lutetium). In the lower concentration leachate, only yttrium and lanthanum are present in detectable amounts, at concentrations of 6E-10 M and 4E-10 M respectively.

In terms of pH, all three of these experiments see a rise. In the case of the more concentrated leachate experiments leachates rise from 1.09 to 1.56 for the 200°C experiment, and from 0.92 to 1.4 for the 100°C experiment. For the more dilute experiment pH sees a rise from 2.34 to 7.90 over the course of the experiment.

In terms of the time series of the experiments plotted in Figures C10.4-C10.6, all experiments show a relatively rapid rise in solute concentration in the first few 10s of hours. For the two experiments using the more concentrated leachate, silicate derived element concentrations continue to rise for the duration of the experiment, albeit at a reduced rate, as do sulphide derived elements, while tin-tungsten related elements show a slight decrease over longer periods, perhaps reflecting precipitation or scavenging. In terms of the elements common to South West England and the selected 'At Risk' metals, these concentrations increase over longer periods in the 200°C experiment, but decrease slightly in the 100°C experiment. REEs, meanwhile, show a gradual rise over the course of the 100°C experiment, but a slight decrease in the 200°C experiment.

In the experiment using the more dilute leachate, silicate and sulphide derived elements show a gradual decrease over time, while tin-tungsten element concentrations generally increase during the experiment. The sum of selected metals common to South West England show a general decrease over the course of

the experiment, while the total REEs and 'At Risk' metals show no clear trends, perhaps due to their generally low concentrations.

The solid products from runs 1779 and 1780 were also analysed by SEM, details of which are provided below.

In the reacted solids from Run 1779 only traces of the sulphide phases remained, present as striated, pitted and rounded galena. Minor to trace Ag, Sb, Cu and Fe was detected from some galena pit sites. Minor dissolution of silicate grains was identified in the form of very finely pitted and striated quartz grain surfaces, and the truncated appearance of clay-bearing lithics. No dolomite was detected. A patchy thin amorphous deposit containing Fe and Sb was observed on a few grains. Pb chloride was seen as a widespread deposit of fine elongate, locally branching, subhedral crystals.

For the Run 1780 reacted solid evidence for minor dissolution of most sulphides was observed; grains are intact but fine surface pitting was visible. No dolomite was detected. No other effects were detected.

Run 1778: HTLMix, 0.1 M HCl, 0.03 M HNO₃ EDTA, 200°C, 200 bar

Elemental Concentration, M, after 527 hours

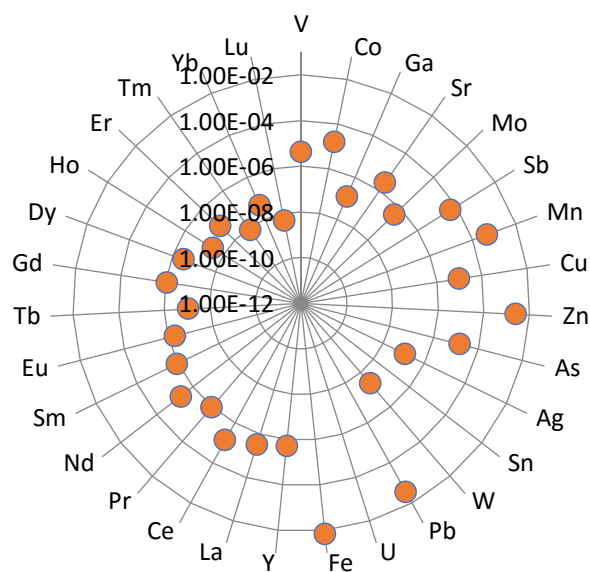


Figure C10.1: Selected metal concs. For Run 1778 final fluid (UK sample HTLMix: 0.1M HCl and 0.03M HNO₃, 200 °C, 200 bar).

Run 1780: HTLMix, 0.01 M HCl, 0.003 M HNO₃, 100°C, 200 bar

Elemental Concentration, M, after 769 hours

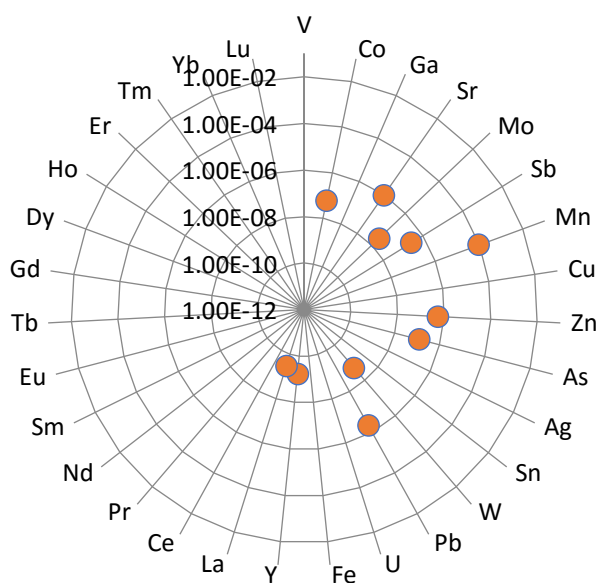


Figure C10.2: Selected metal concs. For Run 1780 final fluid (UK sample HTLMix: 0.01M HCl and 0.003M HNO₃, 100 °C, 200 bar).

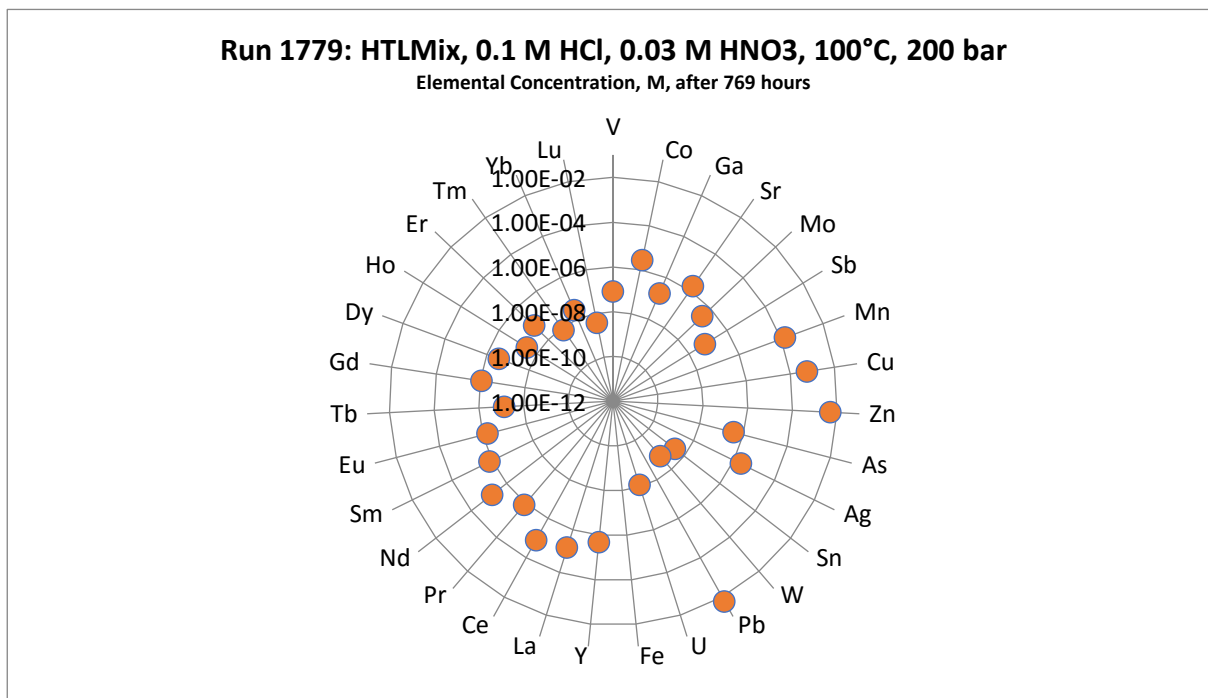


Figure C10.3: Selected metal concs. For Run 1779 final fluid (UK sample HTLMix: 0.1 M HCl and 0.03 M HNO₃, 100 °C, 200 bar).

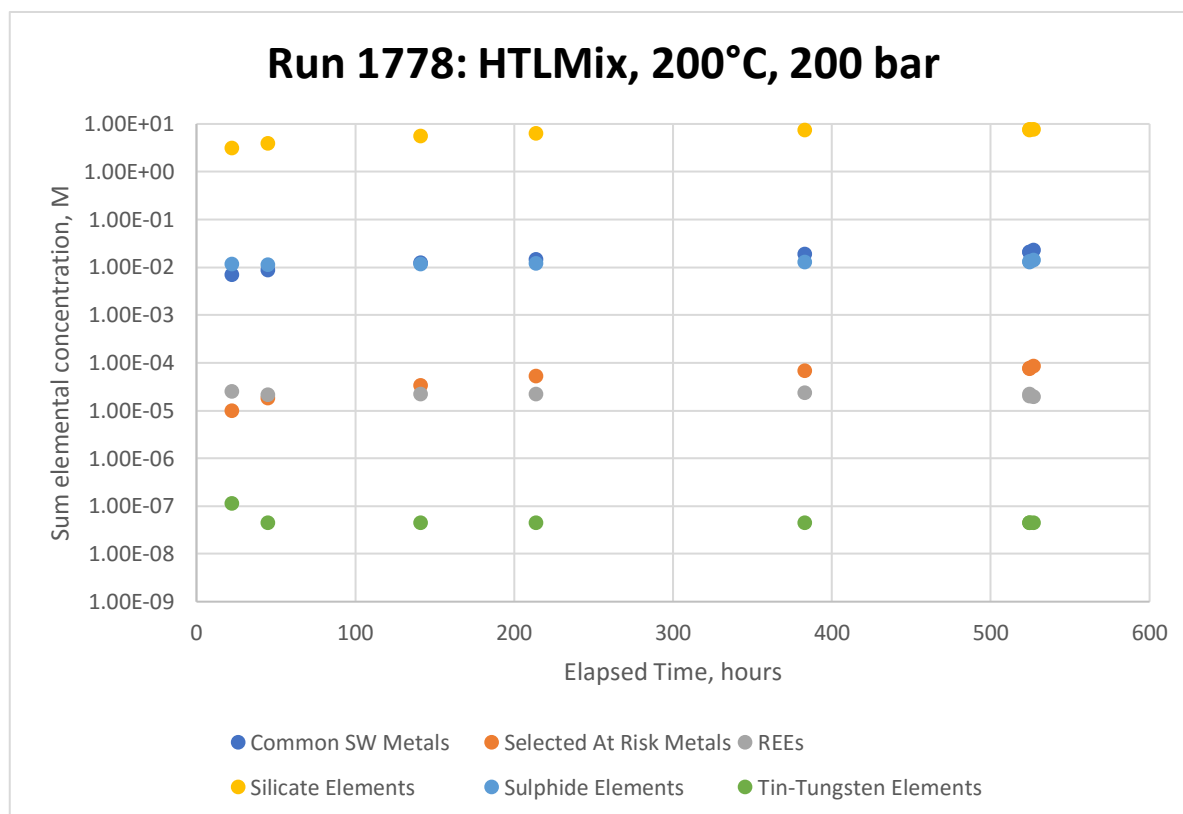


Figure C10.4: Sum of dissolved metal concentrations for UK sample HTLMix as broken down into different metal types (Run 1778: 0.1 M HCl and 0.03 M HNO₃, 200 °C, 200 bar).

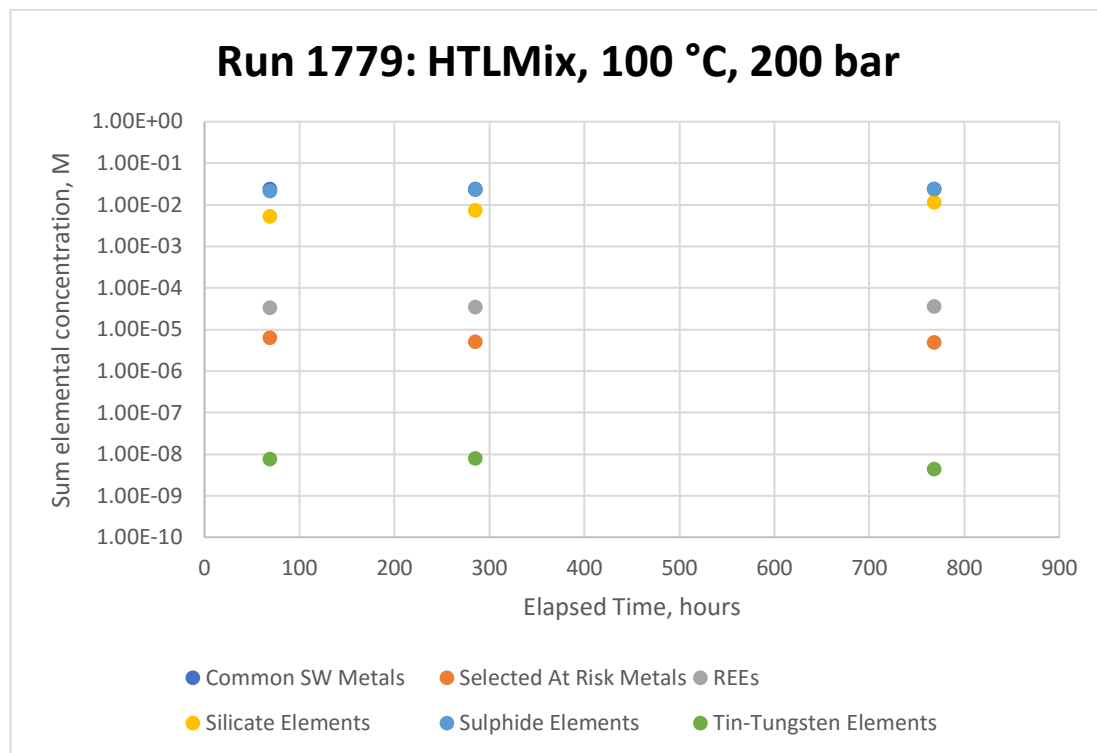


Figure C10.5: Sum of dissolved metal concentrations for UK sample HTLMix as broken down into different metal types (Run 1779: 0.1 M HCl and 0.03 M HNO₃, 100 °C, 200 bar).

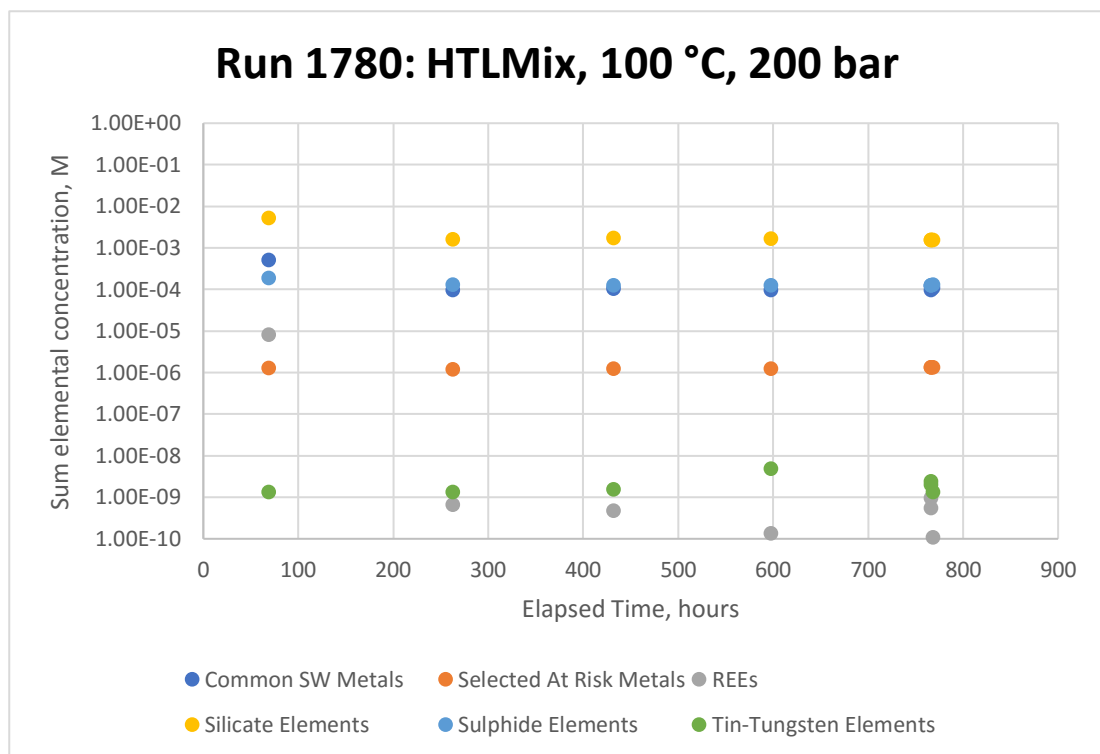


Figure C10.6: Sum of dissolved metal concentrations for UK sample HTLMix as broken down into different metal types (Run 1780: 0.01 M HCl and 0.003 M HNO₃, 100 °C, 200 bar).

C11: Experiments with Coke and UK sample HTLMix

C11.1: Experiments using HTLMix

One experiment using Coca-cola as a leaching agent was carried-out, using HTLMix. A summary of the experimental conditions is shown in Table C11.1, Figure C11.1 shows selected elemental concentrations in the leachate at the end of the run, while Figure C11.2 shows the starting concentrations prior to the run start.

Lab. Run Number	1763
Experiment Type	Ti Batch
Solid ID	HTLMix
Solution Concentration	N/A
Temperature, C	150
Pressure, bar	200
Duration, hours	983
Solid Weight, g	8.75
Solution Volume, ml	350
Starting pH	2.41
Starting Eh	217.4
Final pH	2.91
Final Eh	119.5

Table C11: Summary of experiments using HCl/HNO₃ mix and UK samples

The starting fluid contains a wide spread of elements. Of the selected 'At Risk' elements, strontium is present, at a relatively high concentration of 3E-6 M, as are vanadium, molybdenum, and antimony, at concentrations below 1E-8 M. Of the elements common to South West England, zinc is notably high, at 9E-6 M, with copper, manganese, arsenic, tin, and uranium all present at concentrations below 1E-7 M. A reasonably broad selection of REEs are also present, though at low concentrations: yttrium, lanthanum, praseodymium, neodymium, galladium, and ytterbium are all detected at concentrations below 1E-8 M.

Following leaching the composition is somewhat different. Vanadium concentrations have decreased, while cobalt is not found at a concentration of 6E-7 M. Manganese, arsenic, lead, and iron concentrations increase to values of 2E-4 M, 1E-5 M, 3E-5 M, and 4E-3 M respectively, while tin and uranium are no longer detectable. In terms of REEs, the range of elements and their relative concentrations more closely match that of the starting solid following leaching, with a large number detectable, generally decreasing in

concentrations from the heavier elements to the lighter ones, with yttrium showing the highest concentration at 5E-9 M.

In terms of pH, values rise slightly from 2.41 in the starting fluid, to a final value of 2.91.

The reaction products from this run were also analysed using SEM. The starting material for this run was of the type with galena dominantly present as euhedral grains. Reaction products were analysed as recovered grains and fines entrained in sugar-rich deposits. Grain recovery was noted to be poor and phase identification complicated by the presence of sugar. Galena was noted to be etching, to varied degrees, possibly reflecting inherited differences in their condition from the pre-test galena. Evidence for some silicate dissolution was also noted. No dolomite could be found.

Widespread precipitates were also identified, including a crystalline Al phosphate phase (Plate 2A), possible Pb phosphate and local grain coatings containing Ca and S (probable Ca sulphate).

Fe-rich, Fe-Cr-bearing, Fe-Mn-W and Sn-bearing particles were also identified in the sugar.

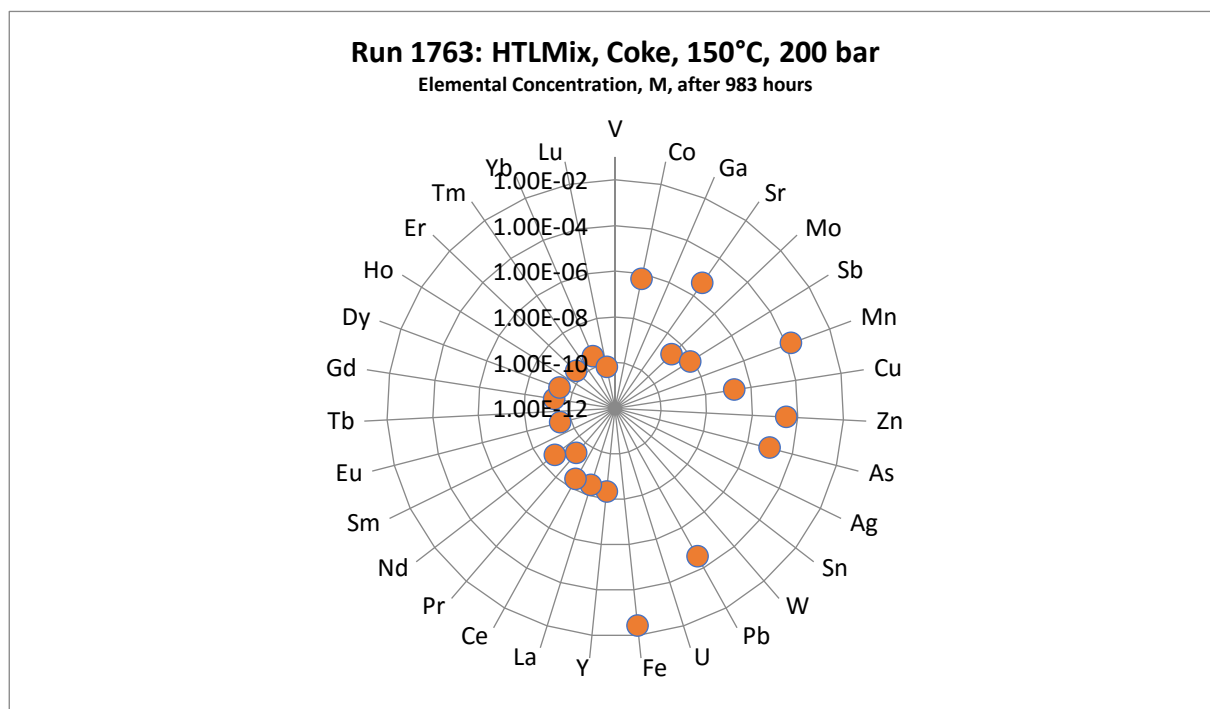


Figure C11.1: Selected metal concs. For Run 1763 final fluid (UK sample HTLMix: Coca-Cola, 150 °C, 200 bar).

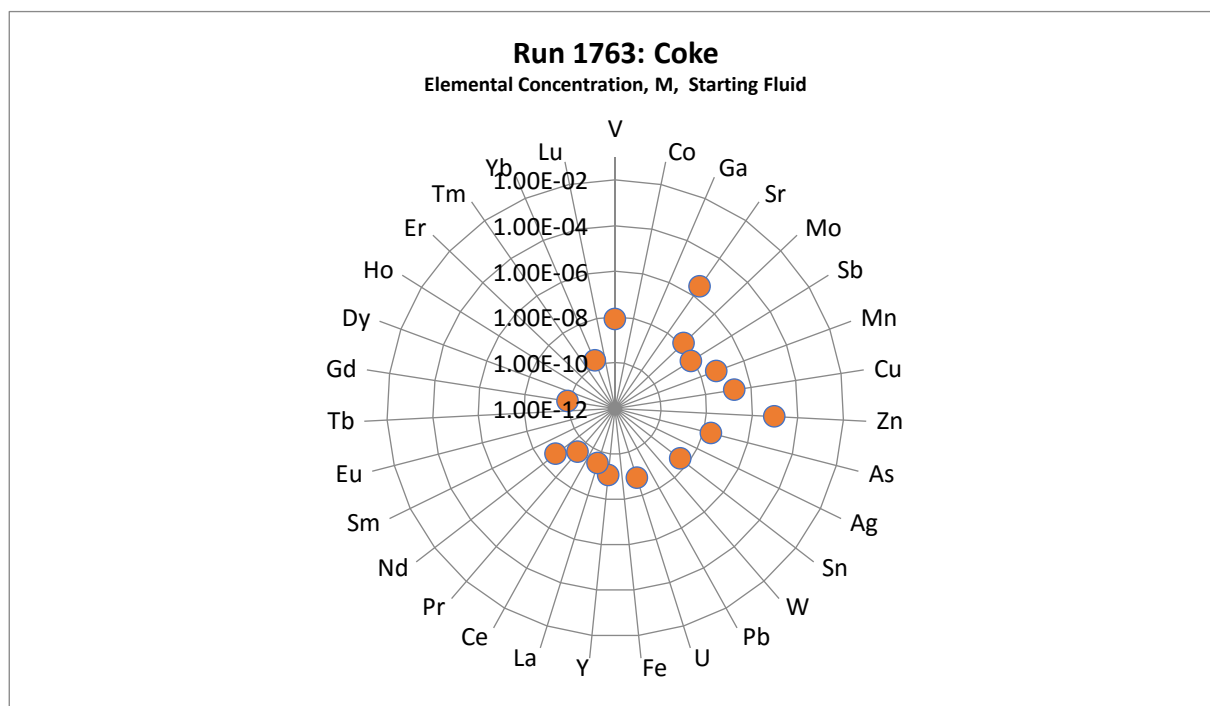


Figure C11.2: Selected metal concs. for coca-cola starting fluid

C12: Experiments with partner samples

A number of experiments were also carried out using the samples supplied by project partners, the results of which are summarised below.

C12.1: Experiments with 0.6M NaCl at 100°C

Experiments using 0.6 M NaCl as a leaching were carried out on partner samples HTL325 (from Kristinebergsgruvan Sweden, Run 1768), HTL323 (from Corvoinferior, Portugal, Run 1769), HTL321 (from Masca-Cocovaleni, Romania, Run 1770), HTL324 (from Recsk, Hungary, Run 1771), HTL320 (from Pietroasa, Romania, Run 1775), and HTL322 (from Rudabauya, Hungary, Run 1776). The experiments were all carried out at 100°C and 200 bar pressure. Selected final elemental concentrations for these runs can be found in Figures C12.1-C12.6. A summary of the experiments is provided in Table C12.

The results of these runs broadly agree with those of the runs using UK samples detailed above. A reasonable number of the selected 'At Risk', and more common metals are leached from the solids, but the spread and concentrations of REEs leached remain relatively low.

Run 1768 shows some minor leaching of the selected 'At Risk' metals, with strontium and molybdenum at concentrations of 2E-7 M and 3E-7 M respectively. In terms of more common metals, manganese, copper, zinc and tungsten are relatively elevated, at concentrations of 1E-6 M, 2E-7 M, 5E-6 M, and 1E-7 M respectively. In terms of REEs, only lanthanum and europium are detectable, at concentrations of 4E-10 M and 1E-10M respectively.

Run 1769 again shows some minor leaching of the selected 'At Risk' metals, with cobalt, strontium, and molybdenum present in the leachate at concentrations of 1E-07 M, 5E-7 M, and 1E-7 M respectively. In terms of more common metals, manganese, zinc and iron are relatively elevated in the leachate, at concentrations of 3E-5 M, 4E-5 M, and 8E-7 M respectively. In terms of REEs, only lanthanum and caesium are present in detectable concentrations, both below 1E-9 M.

The leachate from Run 1770 contains strontium, molybdenum, and antimony, at concentrations of 7E-7 M, 3E-7 M, and 7E-8M respectively. Manganese, copper, zinc, and iron are relatively elevated, though none are found at concentrations exceeding 1E-5 M. As for Run 1769, only lanthanum and caesium are detected in the leachate, both at concentrations below 1E-9 M.

The leachate from Run 1771 contains strontium and molybdenum, at concentrations of 3E-7 M and 3E-7 M respectively. Manganese, copper, zinc, and arsenic are all relatively elevated, although only zinc exceeds a concentration of 1E-6 M. In terms of REEs, only lanthanum and ytterbium are detected, both at concentrations below 1E-9 M.

Run 1775 shows a similar spread of elements. Strontium and molybdenum are relatively elevated in the leachate, at concentrations of 5E-7 M and 3E-7 M respectively. Copper, zinc, arsenic, silver, tungsten and iron are all present, but of these only zinc is found in concentrations above 1E-6 M. in terms of REEs, only lanthanum and samarium, both at concentrations below 1E-9 M.

Run 1776 shows a slightly broader spread of elements than the other experiments described in this section. Cobalt, strontium, molybdenum, and antimony are all detected, with strontium at a relatively high concentration of 1E-4 M, and the others below 1E-6 M. Manganese, zinc, and lead relatively elevated, with concentrations of 5E-6 M, 3E-5 M, and 4E-5 M respectively. In terms of REEs, yttrium, lanthanum, ytterbium, and lutetium are all present, at concentrations below 1E-8 M.

SEM analysis was carried out on the reacted solids from runs 1768 and 1769. For Run 1768, the reacted solid was, overall, similar to the starting material. A rare patchy coating of Cu sulphide plates was observed on some chalcopyrite grains; these are considered likely to have been inherited from the starting material (not seen in it, but because they are rare they could have been missed). Chlorite flakes displayed notched and fractured margins which may be a sign of slight dissolution.

For Run 1769, the reacted solid was similar to the starting material, except that no dolomite was detected. The likely chloride was also absent.

Lab. Run Number	1768	1769	1770	1771	1775	1776
Experiment Type	Ti Batch	Ti Batch	Ti Batch	Ti Batch	Ti Batch	Ti Batch
Solid ID	HTL325	HTL323	HTL321	HTL324	HTL320	HTL322
Solution Concentration	0.6 M	0.6 M	0.6 M	0.6 M	0.6 M	0.6 M
Temperature, C	100	100	100	100	100	100
Pressure, bar	200	200	200	200	200	200
Duration, hours	580	580	580	580	672	672
Solid Weight, g	8.75	8.75	8.75	8.75	8.75	8.75
Solution Volume, ml	350	350	350	350	350	350
Starting pH	6.1	6.1	6.1	6.1	6.1	6.1
Starting Eh	-11.4	-11.4	-11.4	-11.4	-11.4	-11.4
Final pH	7.08	6.51	8	7.06	9.37	7.53
Final Eh	178.4	152.9	152.9	139.3	145.7	113.8

Table C12: Summary of experiments using 0.6 M NaCl and partner samples

Run 1768: HTL325, 0.6 M NaCl, 100°C, 200 bar
 Elemental Concentration, M, after 580 hours

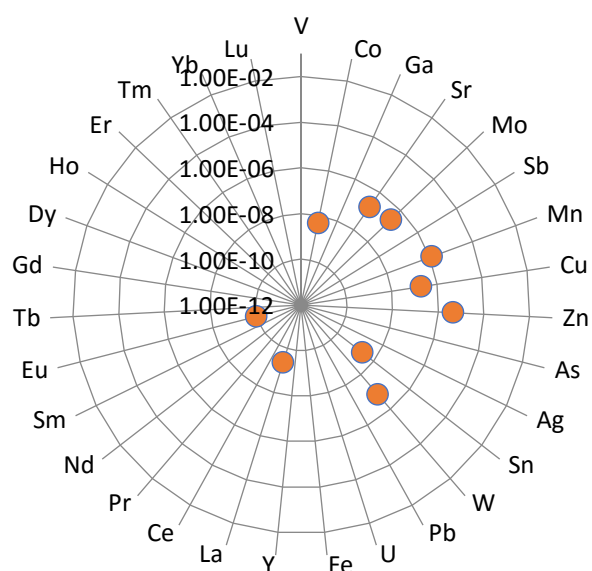


Figure C12.1: Selected metal concs. For Run 1768 final fluid (partner sample HTL325: 0.6 M NaCl, 100 °C, 200 bar).

Run 1769: HTL323, 0.6 M NaCl, 100°C, 200 bar
 Elemental Concentration, M, after 580 hours

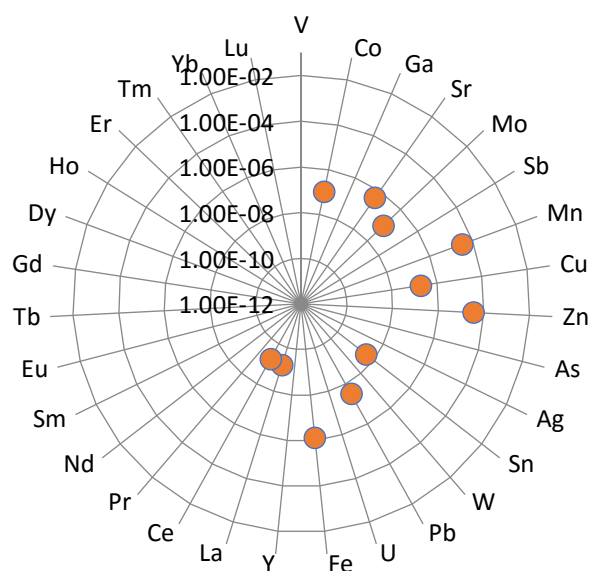


Figure C12.2: Selected metal concs. For Run 1769 final fluid (partner sample HTL323: 0.6 M NaCl, 100 °C, 200 bar).

Run 1770: HTL321, 0.6 M NaCl, 100°C, 200 bar

Elemental Concentration, M, after 580 hours

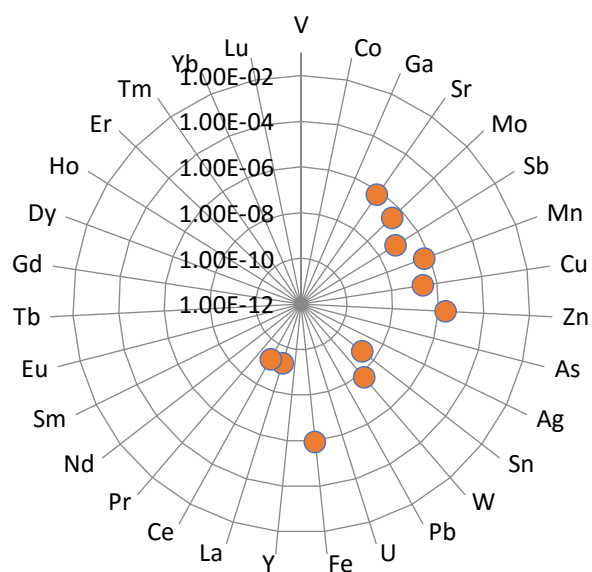


Figure C12.3: Selected metal concs. For Run 1770 final fluid (partner sample HTL321: 0.6 M NaCl, 100 °C, 200 bar).

Run 1771: HTL324, 0.6 M NaCl, 100°C, 200 bar

Elemental Concentration, M, after 580 hours

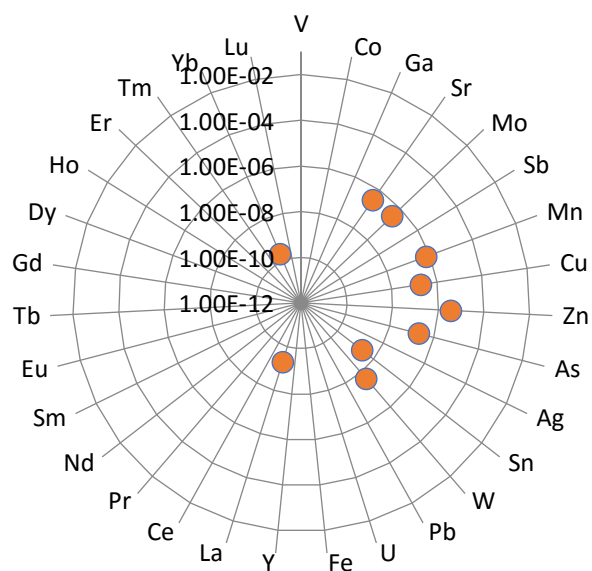


Figure C12.4: Selected metal concs. For Run 1771 final fluid (partner sample HTL324: 0.6 M NaCl, 100 °C, 200 bar).

Run 1775: HTL320, 0.6 M NaCl, 100°C, 200 bar

Elemental Concentration, M, after 672 hours

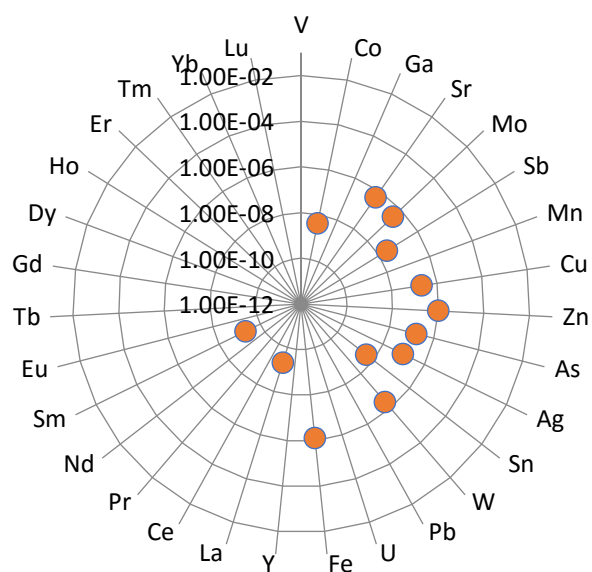


Figure C12.5: Selected metal concs. For Run 1775 final fluid (partner sample HTL320: 0.6 M NaCl, 100 °C, 200 bar)

Run 1776: HTL322, 0.6 M NaCl, 100°C, 200 bar

Elemental Concentration, M, after 672 hours

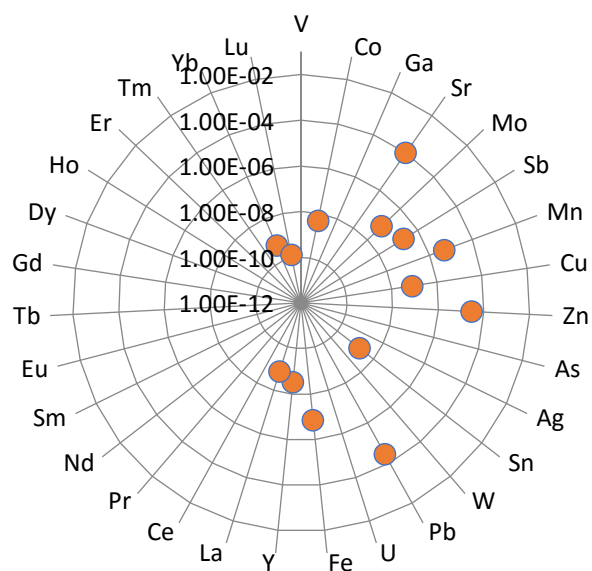


Figure C12.6: Selected metal concs. For Run 1776 final fluid (partner sample HTL322, 0.6 M NaCl, 100°, 200 bar)

C12.2: Experiments with 0.01M HCl, 0.003M HNO₃ at 100°C

Experiments using 0.01 M HCl, 0.003 M HNO₃ as a leaching were carried out on partner samples HTL320 (from Pietroasa, Romania, Run 1781), HTL321 (from Masca-Cocovaleni,, Romania, Run 1782), HTL323 (from Corvoinferior, Portugal, Run 1783), HTL324 (from Recsk, Hungary, Run 1784), and HTL325 (from Kristinebergsgruvan Sweden, Run 1785). The experiments were all carried out at 100°C and 200 bar pressure. Selected final elemental concentrations for these runs can be found in Figures C12.7-C12.11. A summary of the experiments is provided in Table C12.2.

Leaching using these combinations of fluids and solids was reasonably successful, particularly for the runs using solids HTL323, HTL324, and HTL325, where large numbers of REEs are present in the leachates. Runs using the solids HTL320 and HTL321 were less successful, despite these being comparable in REE content to some of the other solids, suggesting that mineralogical factors limiting leaching may be important for these solids.

For Run 1781, of the selected 'At Risk' metals, cobalt, strontium, molybdenum and antimony are present in the leachate, with strontium being the most abundant at 7E-7 M. In terms of the more common metals, only zinc is relatively elevated, at a concentration of 4E-7 M. Tungsten and lead are also present, but at concentrations below 1E-7 M. No REEs were detected in the leachate from this run.

For Run 1782, cobalt, strontium, molybdenum, and antimony are present in the leachate, with strontium having the highest concentration at 1E-6 M. Manganese, zinc and lead are present, at concentrations of 1E-4 M, 1E-6 M, and 2E-8 M, respectively. In terms of REEs, only yttrium was detected, at a concentration of 5E-10 M.

Run 1783 shows a wider spread of elements in the leachate. Of the 'At Risk' metals, vanadium, cobalt, strontium, molybdenum, and antimony are all present, with cobalt showing the highest concentration at 1E-6 M. Of the more common metals, manganese, copper, zinc, arsenic, and lead are all relatively elevated, with concentrations of 4E-5 M, 2E-7 M, 1E-3 M, 6E-6 M, and 3E-6 M respectively. In terms of REEs, a wide spread of elements were detected in the leachate, generally following a trend of dropping concentration from the heavier to the lighter elements, with yttrium having the highest concentrations of 3E-8 M.

Run 1784 shows a similar spread of elements. Vanadium, cobalt, gallium, molybdenum and antimony are all present in the leachate, with vanadium and strontium having the highest concentrations of 1E-6 M and 8E-7 M respectively. Of the more common metals, manganese, copper and zinc are relatively elevated, with concentrations of 3E-5 M, 1E-6 M and 4E-5 M respectively. As for Run 1783, a broad range of REEs are present in the leachant, falling in concentration from light to heavy elements, with yttrium having the highest concentration of 6E-7 M.

Run 1785 follows a similar pattern in terms of elemental spread. Vanadium, cobalt, strontium, molybdenum, and antimony are all present in the leachate, with vanadium and strontium having the highest concentrations of 4E-7 M and 2E-7 M respectively. In terms of the more common metals, manganese, copper, zinc and arsenic are relatively elevated, with concentrations of 2E-5 M, 6E-7 M, 3E-5 M, and 2E-7 M respectively. In terms of REEs, the leachate again contains a wide range of elements, generally falling in concentration from lighter elements to heavier elements, caesium having the highest concentration of 8E-8 M.

SEM analysis on some of the reacted solids from these experiments was also carried out. For the reacted solid from Run 1781, grains comprise calcite intergrown with fibrous szaibelyite, as was observed in the starting material. However, much of the calcite appeared etched and the abundant fibrous pits identified (Plate 6A) indicate that some of the szaibelyite has detached from the calcite, representing the physical loss (i.e. mobilisation) of the fibrous phase.

Regarding Run 1783, the reacted solid was, overall, similar to the starting material, except no dolomite was detected. The likely chloride was also absent.

For Run 1784, the reacted solid was again, overall, similar to the starting material. The probable magnetite appeared more intensely pitted (Plate 6B), suggesting minor dissolution. Pyrite and quartz were similar in appearance to the starting material. Chlorite flakes displayed notched and fractured margins which may be a sign of slight dissolution. Pitting in chalcopyrite surfaces overall appeared to be more significantly developed. Chalcocite overgrowth textures observed on one chalcopyrite grain is most likely an inherited texture.

As for the other reacted solids analysed, the solid from Run 1785 was, overall, similar to the starting material. In particular the dominant quartz and pyrite constituents showed no significant differences. Pitting in chalcopyrite surfaces overall appeared to be more significantly developed (Plate 6C) and chlorite flakes displayed notched and fractured margins (Plate 6D). Both chalcopyrite and chlorite may have been slightly dissolution.

Lab. Run Number	1781	1782	1783	1784	1785
Experiment Type	Ti Batch	Ti Batch	Ti Batch	Ti Batch	Ti Batch
Solid ID	HTL320	HTL321	HTL323	HTL324	HTL325
Solution Concentration	0.013 M	0.013 M	0.013 M	0.013 M	0.013 M
Temperature, C	100	100	100	100	100
Pressure, bar	200	200	200	200	200
Duration, hours	769	769	769	769	769
Solid Weight, g	8.75	8.75	8.75	8.75	8.75
Solution Volume, ml	350	350	350	350	350
Starting pH	2.17	2.21	2.26	1.94	2.07
Starting Eh	512.8	475.4	504.1	546	406.5
Final pH	8.47	7.63	3.45	2.82	2.44
Final Eh	136.1	167.8	315.4	349.8	351.7

Table C13: Summary of experiments using HCl/HNO₃ mixture and partner samples

Run 1781: HTL320, 0.01 M HCl, 0.003 M HNO₃, 100°C, 200 bar

Elemental Concentration, M, after 650 hours

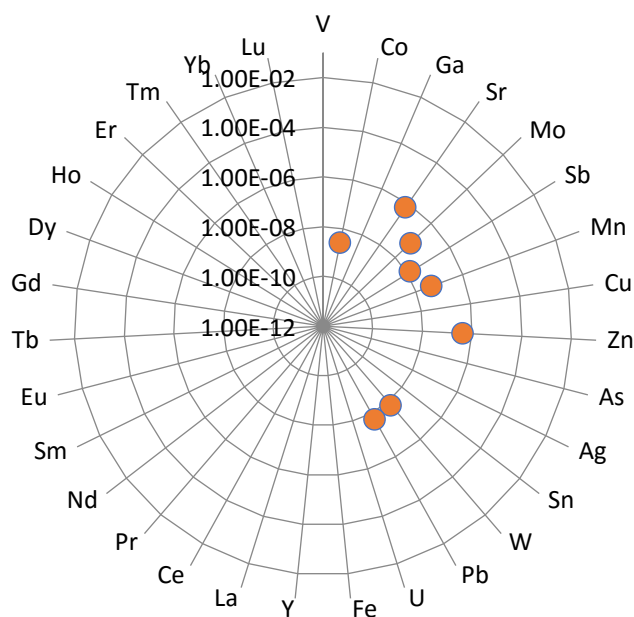


Figure C12.7: Selected metal concs. For Run 1781 final fluid (partner sample HTL320: HCl/HNO₃ mix, 100 °C, 200 bar).

Run 1782: HTL321, 0.1 M HCl, 0.003 M HNO₃, 100°C, 200 bar

Elemental Concentration, M, after 650 hours

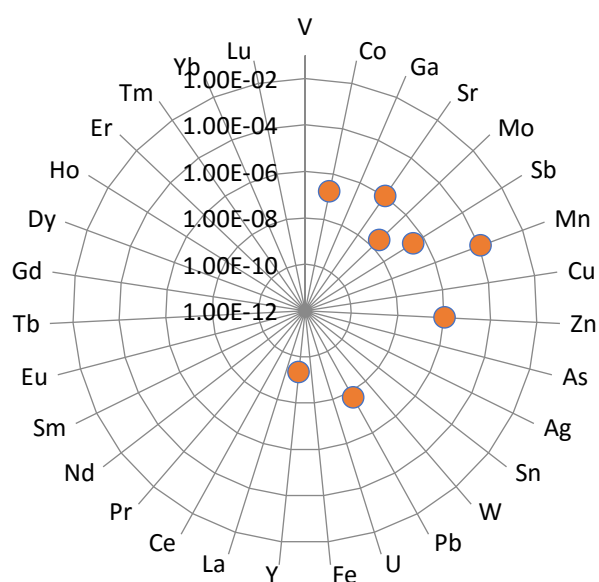


Figure C12.8: Selected metal concs. For Run 1782 final fluid (partner sample HTL321: HCl/HNO₃ mix, 100 °C, 200 bar).

Run 1783: HTL323, 0.01 M HCl, 0.003 M HNO₃, 100°C, 200 bar

Elemental Concentration, M, after 650 hours

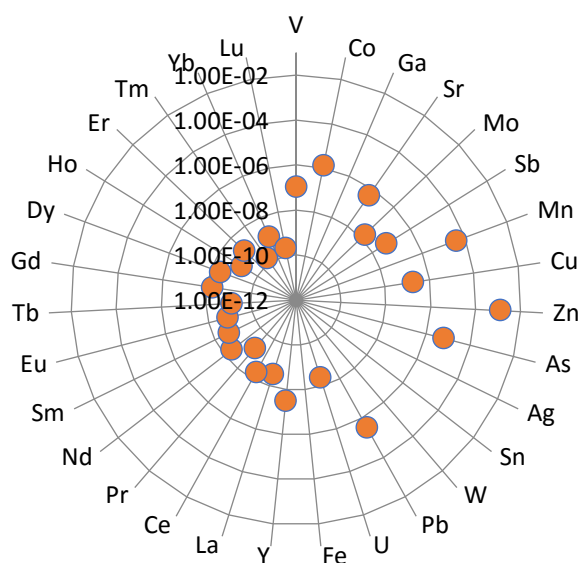


Figure C12.9: Selected metal concs. For Run 1783 final fluid (partner sample HTL323: HCl/HNO₃ mix, 100 °C, 200 bar).

Run 1784: HTL324, 0.01 M HCl, 0.003 M HNO₃ 100°C, 200 bar

Elemental Concentration, M, after 650 hours

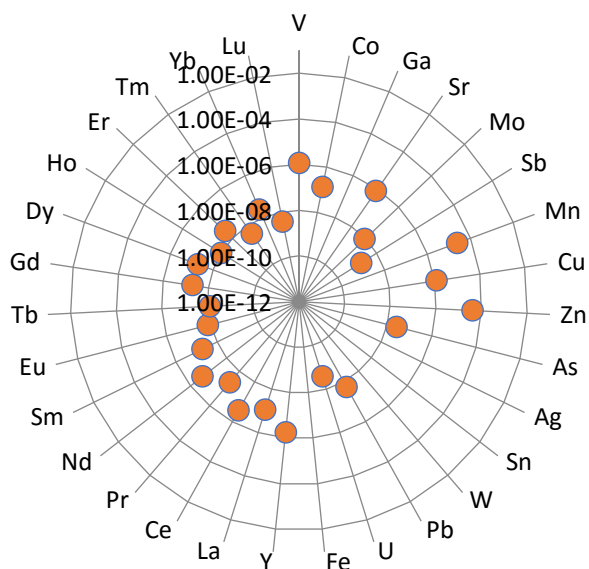


Figure C12.10: Selected metal concs. For Run 1784 final fluid (partner sample HTL324: HCl/HNO₃ mix, 100 °C, 200 bar).

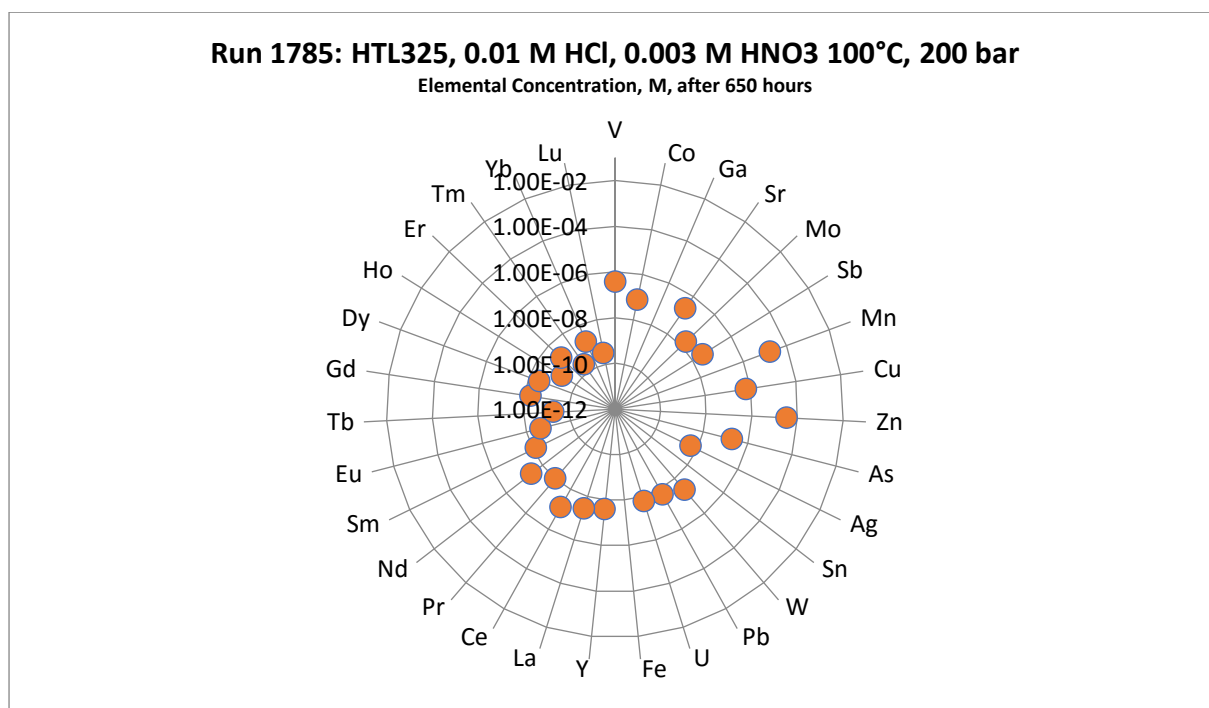


Figure C12.11: Selected metal concs. For Run 1785 final fluid (partner sample HTL325: HCl/HNO₃ mix, 100 °C, 200 bar).