

Experimental study of the sublimation behaviour of volatile trace metals during volcanism

by

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B.Sc., Saint Mary's University, 2012

M.Sc., University of Iceland, 2015

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

in the School of Earth and Ocean Sciences

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University of Victoria

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Abstract

Volcanoes are a key component of the Earth system, with volcanic activity reaching from deep in the Earth's mantle and extending to interactions with volcanic gases and the atmosphere. Volatile trace metals degas from volcanic eruptions and at fumaroles, but their behaviour is poorly understood. I designed and built a benchtop fumarole, from which I degassed a silicate melt with trace metals, to simulate the volatilization and sublimation of trace metals from volcanic gases. I collected sublimates along a temperature gradient to examine the behaviour of the trace metals. The experimental sublimates were analysed for their chemical composition and phase identification. Lithium, Cu, As, Rb, Mo, Ag, Cd, Cs, W, Pt, Tl, Pb and Bi were found to be volatile and sublimed in elevated concentrations at various temperatures between 250-600°C. Compared to natural fumarole studies, similar volatile behaviour is seen for Cu, As, Ag and Tl. Variability between the experimental and natural fumarole sublimates is proposed to be from a lack of ligands in the experiments. Ligands can complex with trace metals, to transport and sublime mineralogical phases.

Given the importance of ligands to metal complexation, I proceeded to examine the importance of chloride as a ligand in volatile transport and sublimation of trace metals. I degassed a silicate melt with trace metals and variable concentrations of Cl⁻, up to 2 wt% Cl⁻, in air. Sublimates produced from these experiments were analysed for mineralogical and chemical information. Raman spectroscopy and scanning electron microscopy helped to determine that silica polymorphs occur at all temperatures and that halite forms below 600°C. Additional phases, including hydrated phases transporting Mo, Cu and Pb also formed as sublimates. These hydrated

phases are suggested to be hydrated post-experiment or are Cl⁻-bearing analogues. The addition of Cl⁻ to the experiments increases the concentration of Li, Rb, Cs, Ag, Cr, Cu, Mo and W in the sublimates compared to Cl-free experiments and Cl-bearing phases are likely hosts of volatile trace metals.

Volcanic gases in nature do not have the oxygen fugacity of air and contain considerable S. To conduct sublimation experiments at various lower oxygen fugacities and with S as it is a redox sensitive ligand, I adapted my original benchtop fumarole design to a gas-mixing furnace, in which I degassed silicate melts containing S, Cl and trace metals. Substantial loss of S and Zn, Sn, As, Bi, Pb and Cd occurred from the starting material melt in the most reduced experiment at 4.6 log units below the FMQ buffer. This loss corresponded to increased concentrations of the same elements in the sublimates of the same experiment. These trace elements are likely hosted as sulfide minerals, as the fO_2 conditions are in the sulfide stability field. This agrees with thermodynamic calculations that determine that sulfides should be stable in similar conditions to this experiment. Chlorides are sublimed in experiments from ~200-650°C and are likely subliming as a NaCl-KCl-FeCl₃ solid solution. Halite is calculated to form at all temperatures in the experiments, based on modelling. These chlorides are probably hosting Cu, Cd, Bi, Li, Rb and Ag in the experiments. In nature, if these metals are in soluble salts, when leached they provide a source of metals to the environment where they are deposited. Overall, I demonstrated that trace metal behaviour in the sublimates from volcanic gases will be affected by available ligands and the oxygen fugacity of the melt and the gas. Chlorides are a likely phase to host trace metals and

are ubiquitous in experiments, even with variable melt compositions, fO_2 conditions and across a wide temperature range.

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Acknowledgments

I would likely first and foremost to thank Dr. Dante Canil. It was through his guidance and support that I was able to start and complete this PhD. I am grateful for his dedication to this work. His eagerness to help and our discussions about this work, made this dissertation both possible and enjoyable.

I would like to thank and recognize my current committee members for their assistance throughout this work. Thank you to Dr. Kathy Gillis, Dr. Jay Cullen and Dr. Frank van Veggel for their expertise. Additionally, I would like to acknowledge former committee members, Dr. Stephen Rowins and Dr. Michael Whiticar for their input in the early stages of this work. I'd also like to extend my gratitude to Dr. James Brenan for severing as the external examiner and for his comprehensive review of my dissertation.

Many of the analyses for these projects were carried out in various labs and I am grateful for the knowledgeable and supportive people who assisted me. Many thanks are due to Dr. Jody Spence. His patience and willingness to teach was much appreciated. Thanks to Alex Wlasenko for help with Raman spectroscopy analysis and XRD trials. Thanks to Dr. Elaine Humphrey, Dr. Milton Wang and Jonathan Rudge for their help with SEM and EDS analyses. Thanks to Edith Czech at the University of British Columbia for help with probe analysis. Thanks to Sean Adams for helping source and prepare glass tubes for my experiments. Additionally, I'd like to thank Alex Geen for his help by saving me immense amounts of time making Raman plots with his code and Cole Glover for saving me time by cutting many glass tubes.

Teaching at UVic was truly one of the highlights of the last five years. Thank you to David Nelles and Duncan Johannessen for their assistance with making teaching possible.

Many thanks to Rameses D'Souza, Siobhan McGoldrick, Rebecca Morris, Alex Geen and Mina Seyedali for their many discussions and fun in the lab.

Finally, many thanks are due to my friends and family members. Without their emotional support, this dissertation would have been all the more difficult. I am grateful to have parents who always encouraged me to learn and have supported me every step of the way. Vielen dank auch an meine deutsche Familie für ihre endlose Zuversicht und Unterstützung.

Enormous thanks to Sven for believing in me, encouraging me and moving all the way to Vancouver Island.

Dedication

For my husband Sven,
my rock.

Chapter 1. Introduction

1.1. Volcanism

Volcanic activity is a central component of the Earth system and drives many environmental processes (e.g. Lee et al., 2018; Timmreck, 2012). Beginning with magma production and ascent towards the surface of the Earth, volcanism can culminate with eruptions and the production of volcanic material including gas. This process begins deep in Earth's mantle or crust and extends all the way to atmospheric interactions (Gerlach, 2004). Volcanic activity can encompass subaerial, subsurface, submarine and subglacial processes. Fundamentally, volcanism has been shaping the planet since its infancy and continues to recycle and generate new material (Gaillard et al., 2011).

Many of the ~550 historically active volcanoes are located at plate boundaries, with a considerable amount of the activity occurring on the ocean floor (Simkin et al., 2000). The extensional tectonics of mid-ocean ridges and collisional subduction zone tectonics provide the mechanism for melt production. Decompression of mantle material at divergent boundaries and lowering of the melting temperature of the mantle through water from a subducting slab, produces the magma for volcanism (Perfit and Davidson, 2000). However, there are also intraplate volcanoes that are derived from mantle plumes, sourced from hot mantle material rising from great depths (Campbell, 2005).

Part of what makes volcanology a topic of interest is that each volcano is unique, with its own composition and eruptive history; this is also what makes understanding volcanoes difficult. Another difficulty is that the source of the volcanism is occurring out of sight, with magma chambers below the crust and volcanoes on the seafloor (e.g. Singh et al., 2006). Research conducted on volcanic emissions is a way to examine a part of the volcanic cycle that effects the planet above the crust, where gases emitted from volcanoes interact with the world's oceans, atmosphere and biosphere (e.g. Duggen et al., 2010; Gerlach, 2004). Additionally, volcanoes are dynamic systems, making eruptions hard to predict. Volcanic gases and eruptive material can pose real threats to communities and organisms of the planet (Sparks, 2003). Gas emission is an important signal of volcanism, and for these reasons, gaining a better understanding of volcanic processes involving gases is valuable.

Volcanic eruptions are categorized on the numeric Volcanic Explosivity Index (VEI) scale, based on the explosivity of historic eruptions (Newhall and Self, 1982). The VEI scale takes into consideration the quantity of rock material produced by the explosion, the height of the volcanic plume and the duration of the eruption. The scale is logarithmic after VEI = 2, with the volume of erupted products reaching $>1000 \text{ km}^3$ at VEI = 8 and plumes of $>20 \text{ km}$. The duration of the eruptions goes from a continuous blast occurring for $<1 \text{ hour}$ to $>12 \text{ hours}$ (Newhall and Self, 1982).

Eruptions categorized as VEI=0 are continuously happening worldwide. For example, lava flows at Kilauea's Pu'u 'O'o-Kupaianaha crater, erupted continuously from 1983-2018 (United States Geological Survey, 2019). The frequency of eruptions decreases with increasing intensity and based on eruption frequency of the last 36 million years, eruptions of size VEI = 8 occur ~1.4 times every million years somewhere on Earth (Mason et al., 2004).

Volcanism can be broadly categorized into effusive and explosive style eruptions. Effusive eruptions are dominantly extruding lava quiescently onto the surface in lava flows, with variable shapes, durations and discharge rates. Explosive eruptions are more energetic and often eject ash plumes and pyroclastics. The behaviour of gases during an eruption governs whether an eruption will be effusive or explosive. If the gas cannot easily escape from the magma as it is ascending, it will explode violently (Degruyter et al., 2012). Other factors controlling eruption style are debated, however, it is generally true that water-rich, high silica magmas with high viscosity due to greater polymerization of the magma, will erupt explosively (Wang et al., 2014; Woods and Koyaguchi, 1994).

In contrast, more effusive eruptions of lower viscosity basalt typify Large Igneous Provinces (LIPS) - large eruption events that have occurred at least 10 times over the last 3 billion years, each creating large amounts of new material ($>10^6 \text{ km}^3$) in just a few million years (Witze, 2017). Along with the large volumes of magma, these eruptions also release large quantities of

gases, which may be linked to changes in ocean chemistry, changes in temperatures of the globe, acid rain and mass extinctions of marine life (Witze, 2017). Modelling suggests that the Siberian Traps that were erupted in the Permian and Triassic periods, may have caused global temperatures to rise by up to 7°C during the eruptions (Stordal et al., 2017).

Large Igneous Provinces and their associated gas release is sometimes linked to mass extinctions; however, this is not well understood. It has been suggested that the Siberian Trap activity may have contributed large amounts of CO₂, helping to trigger the extreme global warming, which, associated with other factors, led to the largest mass extinction at the end of the Permian (Brand et al., 2012). The Deccan Traps coincided with a bolide impact and a mass extinction of 66 million years ago, over the Cretaceous-Paleogene boundary that wiped out the non-avian dinosaurs. Fluxes of gas from this eruption may or may not have had an impact on the climate, forcing extinctions however, a better understanding of the characteristics of the volatiles released during this eruption and the associated climatic effects needs to be determined (Renne et al., 2015; Sprain et al., 2019). The loading of the Earth system with toxic metals from LIP events has also been discussed (Grasby et al., 2019; Peate, 2009).

Volcanic activity has shaped much of the world around us in the past and the present. The impacts that volcanoes have on the planet and life around us is still incredibly relevant and in some cases urgently needing study. Today, 800 million people live within 100 km of an active volcano

(Papale and Marzocchi, 2019), making the study of volcanoes and their impacts important for human lives.

1.2. Volcanic hazards

Volcanoes can be dangerous due to localized and far-reaching hazards. In recent years, two to four fatal eruptions have occurred per year, with most fatalities occurring from pyroclastic flows, indirect reasons such as famine, tsunamis and mudflows (Simkin et al., 2001). Ash can accumulate and cause damage to buildings or contaminate water supplies (Blong, 2003; Stewart et al., 2006) and may also lead to respiratory health problems for humans (Horwell and Baxter, 2006). Eruptions have caused severe famines, including a devastating famine that occurred in Iceland following the eruption of Laki in 1783-1784. The eruption released ~122 Mt SO₂ into the atmosphere, causing acid rain and a fog over the Northern Hemisphere for months, killing vegetation and 75% of Icelandic livestock. The haze lingered, causing climate perturbations and cooling of -1.3°C in North America and Europe for up to three years (Thordarson and Self, 2003; White and Humphreys, 1994).

Ash can be dispersed and fall thousands of kilometers from the eruption site, causing environmental impacts sometimes far from the source, given the right conditions (e.g. Jenkins et al., 2012; Sulpizio et al., 2008). Ash is defined as having a diameter of <2 mm and therefore the dispersion and deposition of ash is greatly dependent on gravity, wind and atmospheric viscosity

(Sulpizio et al., 2008). Ash decreases permeability and increases runoff, increasing the flood probability of some areas (Favalli et al., 2006). Furthermore, atmospheric reactions can occur upon release of tephra in a volcanic plume and alkali salts have been demonstrated to release halogens when reacting with atmospheric gases (Rossi, 2003).

Ash has been shown to transport soluble salts adhered to the surface from volcanic gas interactions. These salts contain several metals (Mn, Fe, Co, Ni, Cu) that are rapidly released when they come into contact with water (Jones and Gislason, 2008). While marine plankton may be fertilized by Fe that is bioavailable in tephra deposited in oceans (Duggen et al., 2010; Hamme et al., 2010; Mélançon et al., 2014), the effects of other bioavailable trace metals such as Cu and As on phytoplankton is unknown (Ayris and Delmelle, 2012). Leachates of the ash from the 1980's Mt. St. Helens eruption had quantities of Zn, Cu and Cd that could be hazardous to some aquatic life (McKnight et al., 1981; Smith et al., 1983). Soluble salts derived from leaching ash particles deposited on soil and vegetation can lead to increased levels of metals in crops, death of vegetation and toxic contamination of grass used for livestock, as well as potentially useful fertilizing elements for agriculture such as Se, K and Mg (Witham et al., 2005 and references therein).

1.3. Volcanic gases

The total quantity of volatiles in a magma varies from ~1-10 wt%, with the most abundant components being H₂O, CO₂ and sulfur species (Wallace, 2005). Volatiles are dissolved in melts

at depth and pressure (Métrich and Wallace, 2008). Other volatiles can be present at a few wt%, including HCl, noble gases and trace metals from ppb levels up to 10000 ppm (Vlastélic et al., 2011; Wallace et al., 2015). The quantity of volatile components in a volcanic eruption varies based on the composition of the magma, the eruption style, the temperature and oxygen fugacity. For example, Kilauea, Hawaii is a basaltic volcano and Vulcano, Italy is a rhyolitic volcano with a higher silica content melt, and they have vastly different major volatile component distributions in their volcanic gases (Figure 1.1) (Oppenheimer et al., 2011 and references therein).

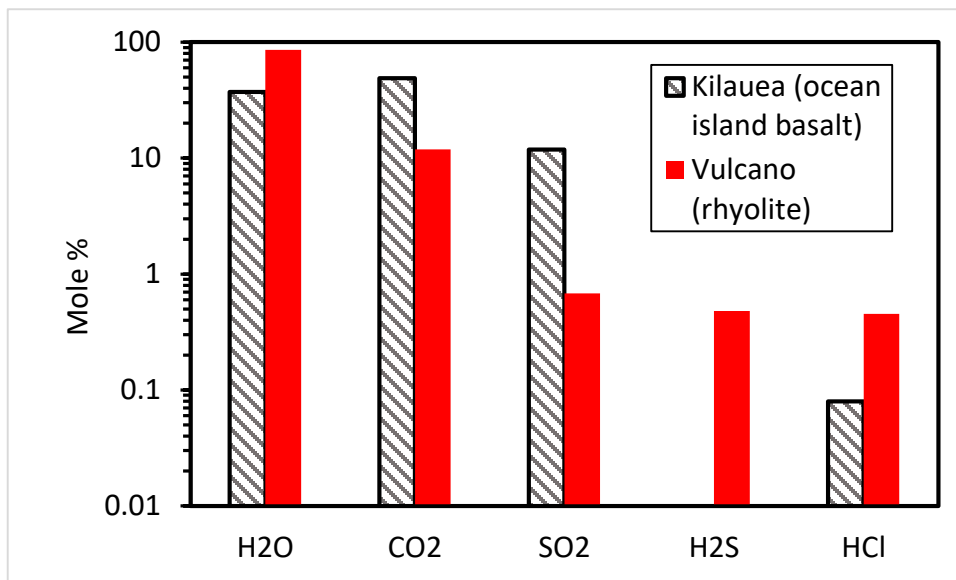


Figure 1.1: Volatile concentrations in high temperature volcanic gases at Kilauea and Vulcano (Oppenheimer et al., 2011 and references therein).

The solubility of H₂O and CO₂ in silicate melts increases with increasing pressure and H₂O is more soluble in silica-rich melts (Wallace et al., 2015). During decompression and cooling, the solubility of a volatile component in a melt reaches a saturation point, where the maximum quantity of dissolved volatiles is in equilibrium with a separate vapour phase. As the magma and dissolved volatiles ascend toward the surface, pressure decreases and the solubility of most volatiles in the magma subsequently decreases. This reduction in solubility supports the exsolution of volatiles from the magma, forming a separate vapour phase and the nucleation of bubbles (Wallace, 2001). Additional diffusion of volatiles into the bubbles leads to bubble growth (Mangan et al., 1993) and volatile trace elements can be expected to migrate to the bubble-melt interface (MacKenzie and Canil, 2008; Huber et al., 2012).

Volatiles degas from a main volcanic vent, a fumarole, through cracks or diffusely in the soil surrounding a volcano (Baubron, 1990; Wallace et al., 2015). Once reaching the surface, magmas can release gas quiescently or by an explosive eruption in a plume (Pyle and Mather, 2003). The sequence of volatile components in a volcano going from being dissolved in a magma reservoir to their release into the atmosphere in a plume, is shown in Figure 1.2.

Volatiles exit a volcano at high temperatures, usually between a few hundred to 1000°C as a gas, and can form aerosols or attach to dust or ash particles (Henley and Berger, 2013). The abundant volcanic gas components are measured in plumes by airborne in situ measurements, lidar

and other remote sensing techniques, satellite measurements and more recently, through instrumentation mounted on drones (e.g. Carn et al., 2017; Hobbs et al., 1991; Oppenheimer et al., 1998; Stix et al., 2018).

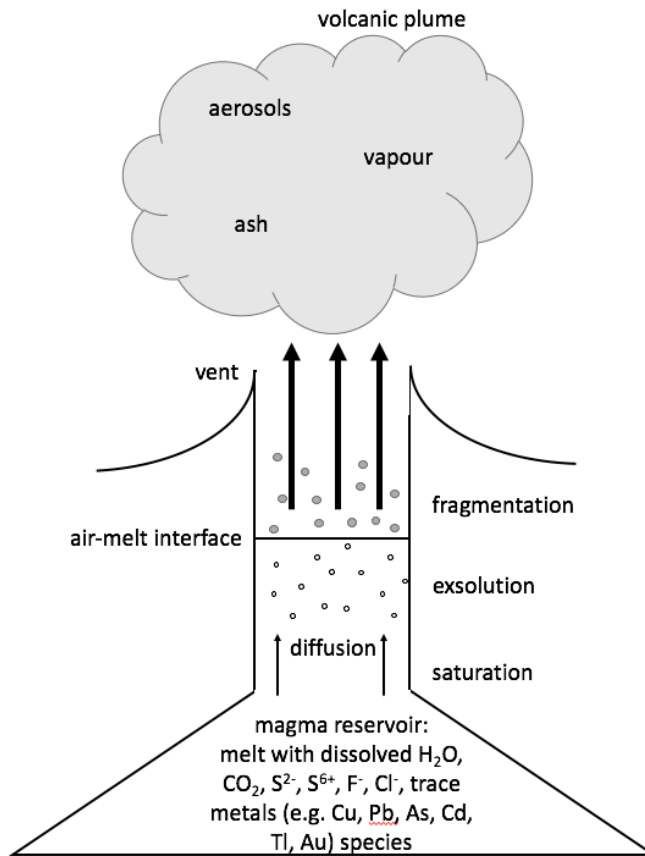


Figure 1.2: Volatile metal cycle in volcanoes.

Gases released during volcanic eruptions need to also be considered for environmental impacts. Large volcanic eruptions from 1883-1992 have been demonstrated to cause warming in Eurasia and North America, from wind from a warmer tropical stratosphere and cooling in the Middle East, due to sunlight being blocked by volcanic aerosols (Robock and Mao, 1992). Proxies provide evidence for explosive volcanism increasing the likelihood of El Niño events, although this link is debated (Adams et al., 2003 and references therein). Climatic forcing occurs from the release of SO₂ and conversion to SO₄²⁻. Emissions of natural sources reach ~25 Tg S/year, namely from volcanic gases and are shown to be at least as important as anthropogenic sources of S to the atmosphere (Graf et al., 1997). While volcanoes emit greenhouse gases such as CO₂, CH₄ and H₂O, volcanoes have been demonstrated to emit modest amounts of CO₂, compared to anthropogenic sources (Gerlach, 2011).

1.4. Trace metals in volcanic gases

Volcanoes load the atmosphere with trace metals such as Cd, Cu, Pb, Sn and Bi and are a significant natural contributor of these metals (e.g. Hinkley et al., 1999). These metals are typically in quantities of less than 1000 ppm in magma (e.g. Rogers and Hawkesworth, 2000). Volatile metal solubility in the melt is in part dependent on the other volatiles present. Trace metals in the melt diffuse toward the gas-melt interface, depending on the element and composition of the melt (MacKenzie and Canil, 2008). Metals are especially soluble with H₂O present, as hydrogen bonded

clusters act as a solubility mechanism (van Hinsberg et al., 2016). Acidic vapour components such as H₂O, SO₂, HCl, HF and H₂S can act as ligands and provide stability for metals during transport (Williams-Jones and Heinrich, 2005).

Volatile trace metals such as As, Bi, Cd, Cu, Ni, Pb, Sb, Se, Sn, Te, Tl and Zn are also released to the atmosphere by anthropogenic sources. Anthropogenic sources include fossil fuel emissions, industrial processes and waste incineration. Besides volcanic emissions, natural sources of trace metals to the atmosphere are soil dusts, seasalt spray, forest fires and vegetation exudates (Nriagu, 1979). Nriagu (1979) estimates that volcanic emissions can account for up to 15% of natural emissions of Ni to the atmosphere, 16% of Zn, 19% of Cu, 26% of Pb and 63% of Cd, which equates to 9600 tons/yr of Zn, 9400 tons/yr of Cu, 3300 tons/yr of Pb, and 820 tons/yr of Cd. Hinkley et al. (1999) suggests that upper limits of the volcanic emissions are lower at 7200 tons/yr of Zn, 1035 tons/yr of Cu, 855 tons/yr of Pb and 820 tons/yr of Cd. Although the quantity of volcanic emissions of metals do not currently exceed anthropogenic sources today, they were significant sources prior to industrialization (Matsumoto and Hinkley, 2001).

The volatility of a trace metal is dependent on the temperature, oxygen fugacity, composition of the magma and the ligands available for complexation in the melt and gas phase. Fumaroles are vents in volcanically active areas that release gases and steam, from which gases can be sampled. These vents are often active when the nearby volcanoes are not erupting and

therefore provide a safer and easier to access source of volcanic gases to sample. In particular, trace metals in gases can be studied by collecting sublimed material. Sublimates can be collected by inserting a silica glass tube into an active fumarole for a few weeks and allowing gases to cool along a temperature gradient. As the fumarolic gases cool, they sublime material containing trace metals. The sublimates are then analysed for their mineralogy and bulk chemistry (Le Guern and Bernard, 1982). An alternative method to study the metals in gases is to sample plume gas, by collecting aerosols on filters and precipitated material in a bubbler system (e.g. Zelenski et al., 2013).

Using the silica tube method, volatile metals sublime in mineral phases, which can then be identified (e.g. Africano et al., 2002; Toutain et al., 1990; Zelenski et al., 2013). Common minerals found in condensates include sulfides such as molybdenite (MoS_2), pyrite (FeS_2) and halides such as, halite (NaCl) (Africano et al., 2002). Zelenski et al. (2013) systematically arranged sublimate mineralogy groups by temperature from Erta Ale volcano and suggest that oxides and silicates occur at high temperatures, sulfides at mid-temperatures and sulfates and halides at mid- to low temperatures. Common minerals found in sublimates, including SiO_2 polymorphs, halite (NaCl), sylvite (KCl), sulfides, sulfates and molybdenite (MoS_2), were collected at several volcanoes over a temperature range and are summarized in Figure 1.3.

Sublimed material from a basaltic composition volcano tends to have elevated concentrations of Zn, Pb, Sb, As, Ag and Au and at andesitic volcanoes, have elevated concentrations of Zn, Pb, Mo, W, As, Au and Hg (Williams-Jones et al., 2002). The concentration of trace metals collected in sublimates from Piton de la Fournaise (Vlastélic et al., 2011), Colima (Taran et al., 2001), Merapi (Symonds et al., 1987) and Kudryavy (Taran et al. 1995) indicate that there are some differences in the concentration of these elements in the gas phase from volcano to volcano (Figure 1.4). Piton de la Fournaise is a hotspot volcano (Albarède et al., 1997), while Colima, Merapi and Kudryavy are arc volcanoes (Zobin et al., 2002; Toutain et al., 2008; Taran et al., 1995). Recent research suggests that the setting of the volcano may play a role in the concentration of some of these elements. For example, Edmonds et al. (2018) conclude that arc volcanic plumes emit higher quantities of certain metals that have a high affinity for aqueous saline fluids (U, Cs, W, Zn and Mo) compared to hotspot volcanic plumes.

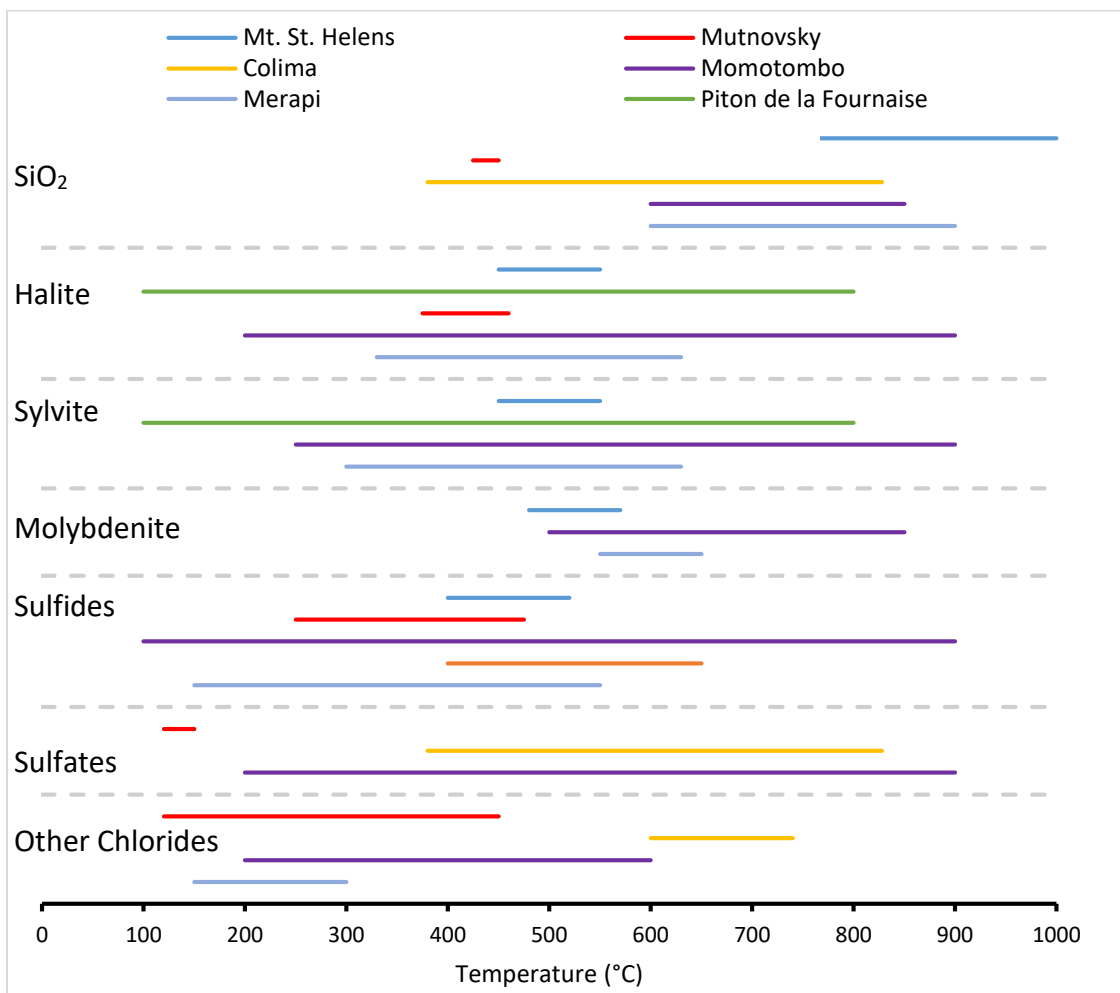


Figure 1.3: Mineralogy of sublimates across temperature from silica tube studies from various volcanoes. Data from Mount St Helens (Bernard and Le Guern, 1986); Piton de la Fournaise (Toutain et al., 1990); Mutnovsky (Zelenski and Bortnikova, 2005); Colima (Taran et al., 2001); Momotombo (Quisefit et al., 1989); Merapi (Toutain et al., 2008 and references therein); Vulcano (Cheynet et al., 2000).

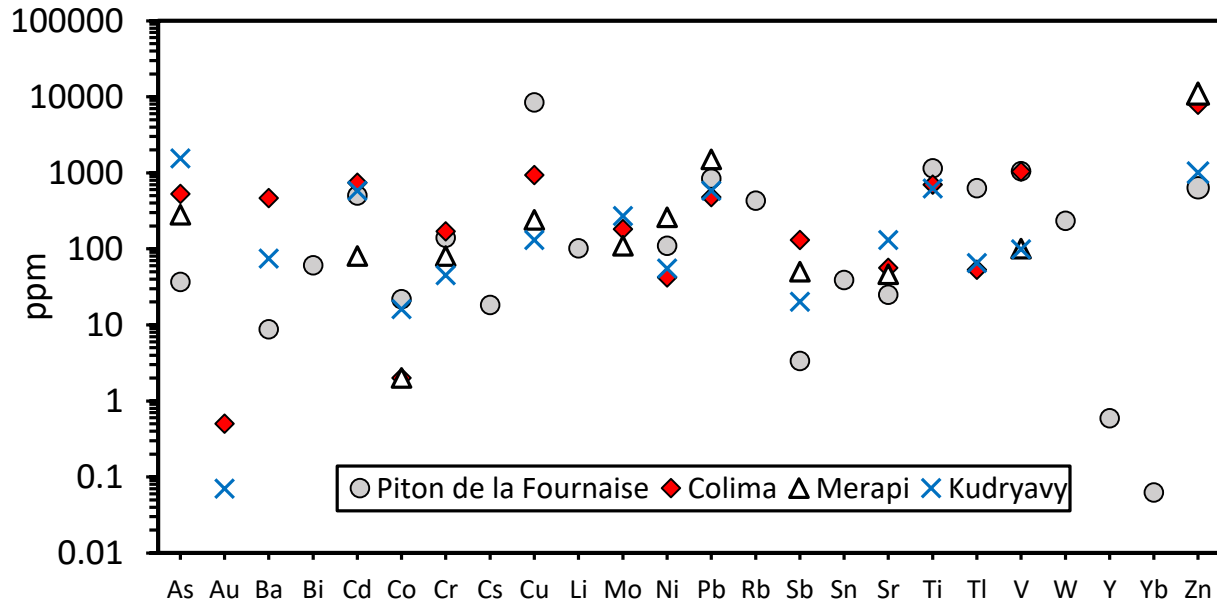


Figure 1.4: Trace element concentration (ppm) in sublimates collected at Piton de la Fournaise (Vlastélic et al., 2011), Colima (Taran et al., 2001), Merapi (Symonds et al., 1987) and Kudryavy (Taran et al., 1995).

Volcanologists use the enrichment factor (EF) as a measure of the enrichment of a trace metal in a gas compared to the lava (Symonds et al., 1987):

$$EF_X = \frac{C_X / C_R (gas\ sublimates)}{C_X / C_R (lava)} \quad (1)$$

where C_x is the concentration of an element of interest and C_R is the concentration of a reference, non-volatile element. Elements that have $EF > 1$ are considered more compatible in the vapour phase and are therefore volatile (Vlastélic et al., 2011). Based on several studies, the EF for Mo, Tl, Pb, Rb, Cd, As, Cu and Bi are > 1 and are therefore considered volatile (Figure 1.5).

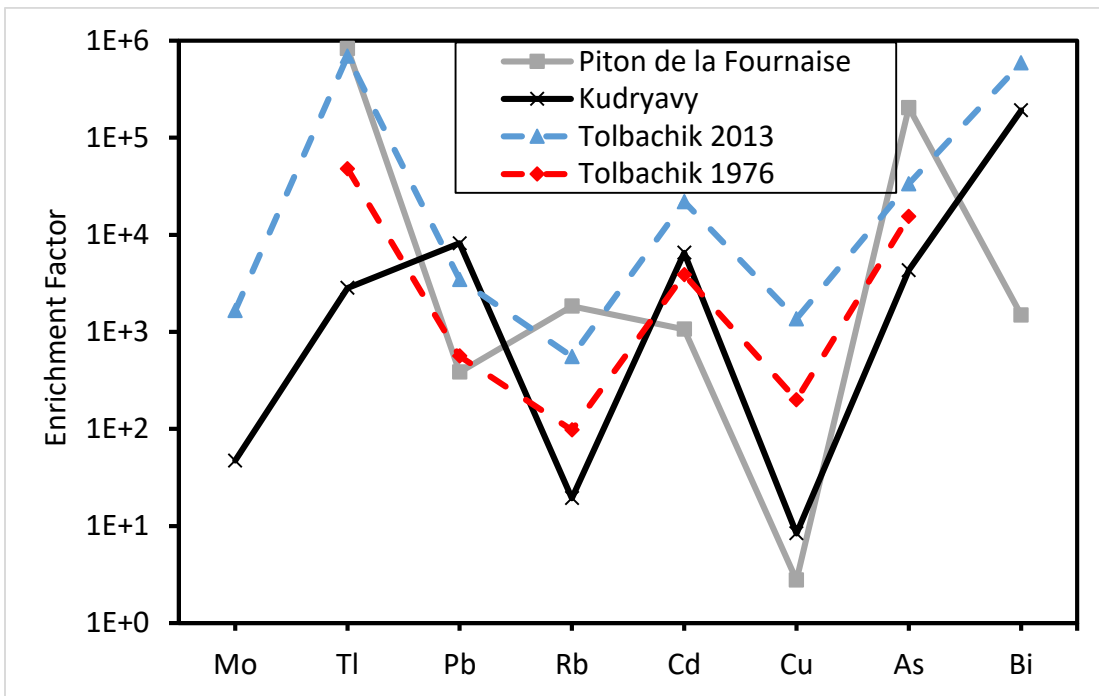


Figure 1.5: Enrichment factor for sublimates from at a hotspot volcano, Piton de la Fournaise (Vlastélic et al., 2011) and two arc volcanoes, Kudryavy (Taran et al., 1995) and Tolbachik (Chaplygin et al., 2016 and references therein).

During an explosive eruption, volatile elements can also sublime and adhere to ash, forming soluble salts with metals, such as chlorides and sulfates (Ayris and Delmelle, 2012; Mueller et al., 2017). A collection of ash leachate studies, shows the highest mean concentrations occur for Na, Ni, Ba, Cl, S, Ca, Ti and Sr (Figure 1.6) (Ayris and Delmelle, 2012 and references therein).

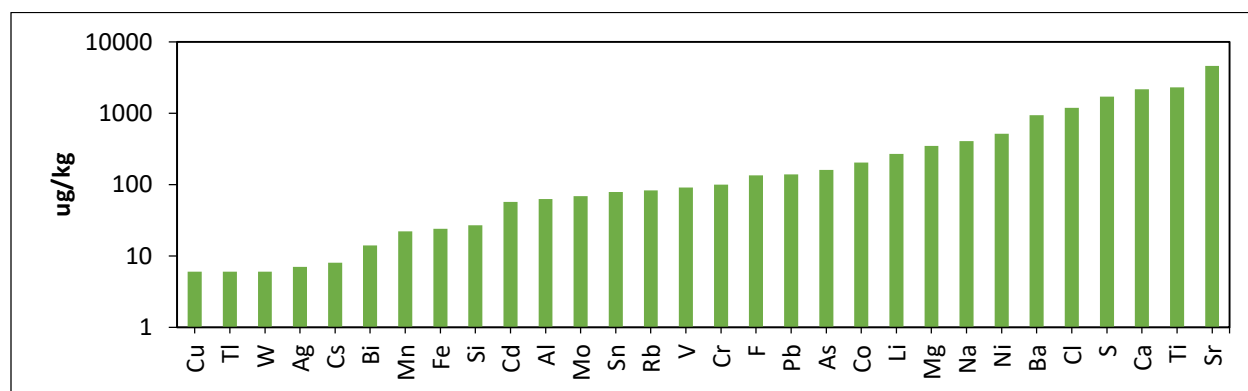


Figure 1.6: Ash leachate data compiled from various leachate studies (Ayris and Delmelle, 2012). The mean from the studies is plotted for elements of interest.

As a complement to direct measurement of elements and phases in gases, sublimates and leachates, thermodynamic calculations have been used to calculate the solubility and sublimation of material from volcanic gases at fumaroles (e.g. Quisefit et al., 1989; Wahrenberger et al., 2002). These calculations use the principals of Gibbs Free Energy minimizations to determine the phases present and assume that the system is reaching equilibrium. These models attempt to simulate the

conditions of a fumarole and may miss the intricacies of natural systems. Many studies use inconsistent data sets that do not have gas and sublimate compositions from the same vent or they do not include solid solutions in their databases. Additionally, assumptions of ideality of phases and equilibrium may not be realistic (Wahrenberger et al., 2002). While they have some shortcomings, models can be useful for predicting sublimation behaviour.

Experimental studies have also very recently been carried out to look at the mineralogy and other characteristics of the gas-solid reaction of volcanic volatiles. Experiments of metal oxides with and without Cl and S, degassed in a vacuum, recreate some of the mineralogy of natural sublimates including oxides, chlorides and sulfides. However, these experiments are carried out at fO_2 conditions that are dissimilar to the conditions of volcanic gases on Earth (Renggli and Klemme, 2020). Experimental studies also model sublimation on Mars. These experiments sublimed chlorides, sulfides and sulfates, demonstrating the importance of ligands to Martian volcanic gases (DiFrancesco et al., 2016; Nekvasil et al., 2019). Several of these studies have been published during the last five years, however they focus on extraterrestrial rather than terrestrial volcanism, with some conditions (i.e. composition of melt and redox conditions) that differ from those on Earth.

1.5. Outstanding problems and purpose of this study

The degassing of volatile metals is still a poorly understood component of the rock cycle. Since gases leave the immediate system, they might seem intractable for study, but can be examined through their solid reaction products. Compared to solid-fluid-melt reactions, gas–solid reactions are a comparatively immature field in petrology and geochemistry (King et al 2019). Much interest has developed in the last few years and more studies are being conducted on gas–solid reactions and their applicability to nature (e.g. Edmonds et al., 2018; King et al., 2019).

As it stands, the understanding of how volatile trace metals are being transported in the gas phase, particularly in conjunction with the relative importance of volatile ligands, is not well understood. More work is needed to determine if the presence of particular ligands will increase the release of metals to the environment during an eruption. Additionally, the redox conditions of a magma or gas likely play a role in the volatility of metals that is undefined. My dissertation aims to explore these topics and to elucidate a better understanding of the controls on the volatilization of trace metals in volcanoes.

The purpose of this study is to investigate the behaviour of volatile trace metals in natural gases and fumaroles through laboratory experimentation. The experiments allow simplification of the natural system with focus and isolation of various variables. A systematic approach is taken to examine the sublimate mineralogy, metal concentrations in the sublimates and temperature

relationships, while varying parameters, such as composition of the melt, complexing ligands and oxygen fugacity. By running experiments under controlled conditions, these relationships are examined more effectively than at a natural fumarole, with fluctuating conditions. This kind of experimental work has not been done before at atmospheric pressure, in an open gas system or in gases of variable oxygen fugacity. The caveat is that the laboratory experiments need to be scaled down and thus cannot simulate the much longer durations, or larger masses of magma or gas involved in natural degassing and sublimation. The information from both perspectives are complementary to one another in helping define or explain trace metal behaviour in volcanic gases.

1.6. Research methods

In Chapter 2, the initial experimental approach, design and method are discussed. A benchtop fumarole was designed, constructed and used to perform experiments. Synthetic silicate melts, doped with trace metals of interest (i.e. V, Cu, Zn, As, Mo, Cd, Sn, Y, Yb, Pb, Bi) were degassed in a box furnace. A silica tube was suspended through an opening in the top of the furnace, creating a thermal gradient from 25-900°C along the tube. As the gas traveled up the tube it cooled, sublimating phases along the tube. These phases were analysed and characterized, both chemically and physically by ICP-MS, SEM and Raman methods.

Chapter 3 expands on the initial design and study by adding a source of ligands to degassing experiments. Chlorine was added to experiments to determine whether a ligand changes the

behaviour of volatile trace metals. The sublimates were characterized and determined to include chlorine-bearing phases.

Chapter 4 uses the initial method as a starting point for a new design in which experiments were conducted in a gas-mixing furnace. Sulfur was added to the experiments as an additional ligand, as it is vulnerable to redox changes. The experiments were performed with variable oxygen fugacity conditions by changing the gas composition in the furnace. Sublimates were found to include S-bearing species and metal volatilities were affected by the changes in redox conditions.

1.7. Dissertation outline

This dissertation is organized into five chapters. Chapter 1 introduces the background information for this dissertation. Chapters 2, 3 and 4 are presented in their complete article format. I am the primary researcher and first author of all articles. They have been co-authored with my supervisor, Dante Canil. Chapter 2 was published in *Chemical Geology* (Scholtysik and Canil, 2018) and highlights the method development for this research and initial experiment results. Chapter 3 was published in the *Journal of Volcanology and Geothermal Research* (Scholtysik and Canil, 2020) and focuses on the effects of Cl as a ligand for volatile trace metals. Chapter 4 is in preparation for submission for publication. This chapter provides an updated method that allows for the addition of S as a redox sensitive ligand and for experiments to be conducted under various

oxygen fugacity conditions. Chapter 5 is a conclusion chapter that offers a summary of the work completed for this dissertation and suggestions for future developments to the project.

Chapter 2. Condensation behaviour of volatile trace metals in laboratory benchtop fumarole experiments

2.1. Introduction

Volcanoes are a natural source for pollution of toxic trace metals in the atmosphere (Bernard and Le Guern, 1986; Calabrese et al., 2011; Lantzy and Mackenzie, 1979; Nriagu, 1979). Anthropogenic activities of fossil fuel combustion, non-ferrous metal production, and waste incineration load the modern atmosphere with volatile trace metals (e.g. Se, Tl, As, Cd, Cu, and Pb - Pacyna and Pacyna, 2001), but over the course of Earth history actively and passively degassing volcanoes contribute to the global cycle of these and other trace metals (Oppenheimer et al., 2014). Quantifying the contributions of toxic trace metals to the atmosphere from volcanism is essential for understanding their overall geochemical cycle and impact on the environment both now and in the past.

Volatile trace metals in volcanic emissions are originally dissolved in a melt, and partition into a gas that exsolves as magmas ascend and erupt (Hinkley et al., 1994). The quantity of metal released during a persistent degassing event can vary with the relative abundance of the metal in the melt and its partition coefficient into the gas phase. An empirical measure of the release of a trace metal to the gas phase is its emanation coefficient, ϵ defined as:

$$\varepsilon = \frac{C_i - C_f}{C_i} \quad (2)$$

where C_i is the concentration of the metal in the melt initially and C_f is the concentration of the metal in the melt after degassing occurs (Hinkley et al., 1994; Pennisi, 1988). Emanation coefficients vary over orders of magnitude from 0.35 for highly volatile elements such as Bi to 4.3×10^{-7} for non-volatile elements such as Al (Rubin, 1997).

Metals partition from the melt phase into volcanic gases depending on several factors. Ligands such as S, Cl, and F dissolved in the melt (Aiuppa et al., 2009; Calabrese et al., 2011) may assist with transport of metals to the gas-melt interface, or by complexation to favour their partition into the gas phase for eventual release to the atmosphere (Johnson et al., 2013; Williams-Jones and Heinrich, 2005). Toxic trace metals are then released from volcanoes to the environment as species dissolved in volcanic gases (e.g. H-C-O-S mixture). The metals can condense or adsorb from such gases on to ash particles or other surfaces during an eruption (Hinkley et al., 1994; Mather et al., 2003).

Le Guern and Bernard (1982) established a method to measure gas condensates from an active volcanic fumarole along a thermal gradient in a silica tube inserted into a fumarole. Particulate and volatile metals in volcanic plumes can also be collected by pumping gas through filters during an eruption (e.g Hinkley, 1991). These methods are widely used to study the

precipitation and budget of metals from volcanic emissions at volcanoes worldwide (e.g. Bernard et al., 1990; Cheynet et al., 2000; Symonds, 1993; Zelenski and Bortnikova, 2005).

Both the silica glass tube and filter methods provide information on the chemistry of phases with changing temperature, gas composition, or oxidation state of volcanic gases. Many of these variables, however, can change erratically depending on the phase or nature of the volcanic eruption. To investigate the role of these variables in condensation of trace metals in volcanic gases in a more controlled environment, we constructed a ‘benchtop fumarole’ apparatus, wherein volatile trace metals are degassed from a silicate liquid and precipitated on a silica glass tube along a stable temperature gradient. My method is a simple analogue for natural systems and allows for investigation of the volatilization of trace metals from melts and their condensation behaviour, with independent control of the variables of temperature, melt, and eventually gas composition. The mineralogy and chemistry of the condensates that are collected inform what metallic species may be present in volcanic gases as well as their condensation behaviour. Such data can be compared with natural observations (e.g. Taran et al., 2001; Toutain and Meyer, 1989), or thermodynamic calculations used to model natural systems (e.g. Symonds et al., 1992). In this paper, we describe the method and some initial experiments and observations. The ultimate aim is to increase our understanding of the condensation behaviour of trace metals to inform

interpretations of the trace metal loading from volcanoes, and their impact on the atmosphere and environment.

2.2. A ‘benchtop’ fumarole design

For these experiments, we suspended a 1 cm diameter, 30 cm long silica glass tube from a ring stand above a crucible of degassing silicate melt inside a high-temperature box furnace (Figure 2.1). The silica glass tube exited through the top of the furnace near room temperature, creating a strong thermal gradient. Before each experiment, the temperature gradient inside the silica glass tube was measured at 0.5 cm intervals using an S-type (Pt₉₀Rh₁₀-Pt) thermocouple. A peak of ~925°C is observed inside the furnace, just above the crucible, decreasing to near room temperature after exiting the furnace (Figure 2.2). During the experiment, volatile trace metals dissolved in the synthetic silicate melt degas across the air-melt interface, rise and condense along the silica glass tube along a temperature gradient. An exhaust funnel with minor suction was placed at the top of the tube to obviate traces of toxic metals in the gas from entering the lab atmosphere.

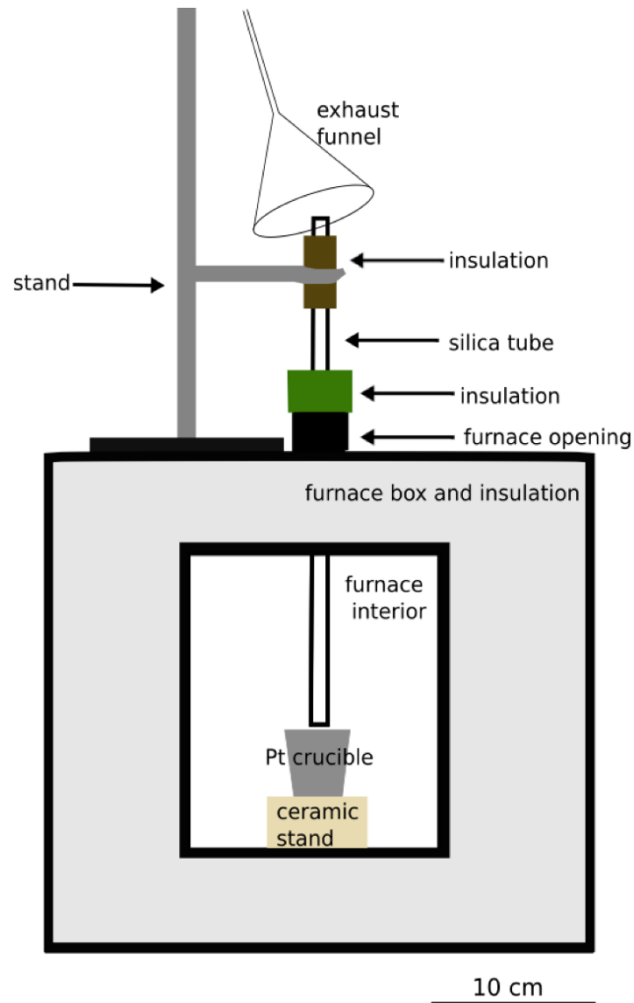


Figure 2.1: Schematic of the experimental design for the benchtop fumarole. The Pt crucible contains the melt composition doped with added trace metals. The gases released from the melt rise through the silica glass tube, cool and condensate forms along the tube as a function of decreasing temperature. Upper insulation insures a reproducible temperature gradient inside the tube and the exhaust funnel collects and disposes of excess gas.

My design was limited by the annealing point of silica glass (viscosity of 10^{13} Pa.s) to peak temperatures of 1190°C (Bansal and Doremus, 2013), well within the temperature range of most natural volcanic gas emission measurements (Symonds et al., 1992), but above the temperature limit of the box furnace. Given these upper temperature limits, we used synthetic melts with low melting points in the systems $\text{Na}_2\text{O}-\text{Al}_2\text{O}_3-\text{SiO}_2$ (NAS) and $\text{Na}_2\text{O}-\text{Fe}_2\text{O}_3-\text{SiO}_2$ (NFS), having eutectic points of $740\pm 5^{\circ}\text{C}$ and $\sim 800^{\circ}\text{C}$ respectively (Schairer and Bowen, 1956; Bailey and Schairer, 1966). These two melts represent broadly phonolitic compositions with and without Fe, to compare the effect of Fe on metal degassing behaviour in silicate liquids. Starting materials were made by weighing out dried reagent grade SiO_2 , Al_2O_3 , Fe_2O_3 and Na_2CO_3 , which were then mixed by shaking in a canister for 15 min. The oxide mixture was then decarbonated and fused in a Pt crucible at 1400°C for 24 h. The starting material was quenched to a glass, removed from the crucible, crushed, and powdered. Trace elements of varying volatility observed in natural systems (V, Cu, Zn, As, Mo, Cd, Sn, Y, Yb, Pb and Bi) were doped into the glass powder at a concentration of 100 ppm in a solution of in 2% HNO_3 . The final slurry was dried under a heat lamp and mixed. The trace element concentrations in the starting material powder determined by solution ICP MS are slightly higher than in the added doping solution of 100 ppm and some elements are present that were not directly added (Table 2.1). These trace elements were likely contributed by the reagent grade oxides.

Table 2.1: Composition of starting material

wt%¹	NAS	NFS
SiO ₂	54.78 ± 0.32	62.14 ± 0.31
Na ₂ O	25.33 ± 0.38	19.84 ± 0.33
Al ₂ O ₃	10.72 ± 0.11	0.53 ± 0.03
Fe ₂ O ₃	0.11 ± 0.04	11.84 ± 0.20
K ₂ O	0.14 ± 0.04	0.10 ± 0.03
MgO	0.03 ± 0.02	0.03 ± 0.02
CaO	0.02 ± 0.02	0.03 ± 0.02
TiO ₂	0.03 ± 0.02	0.02 ± 0.02
Total	91.15	94.53

Dopant (ppm)²	NAS	NFS³
Be	0.2 ± 0.01	0.1 ± 0.005
P	284.6 ± 2.8	185.2 ± 1.9
Sc	17.2 ± 0.2	9.7 ± 0.1
Ti	230.5 ± 2.3	154.5 ± 1.5
V	160.8 ± 1.6	108.4 ± 1.1
Cr	6.6 ± 0.1	40.2 ± 0.4
Mn	4.1 ± 0.04	167.2 ± 1.7
Co	0.6 ± 0.01	3.1 ± 0.03
Ni	6.6 ± 0.07	15.9 ± 0.16
Cu	277.6 ± 2.8	177.2 ± 1.8

¹ Oxides determined from microprobe analyses of starting glass. Reported in weight percent (wt%).

² Dopant trace quantities from dissolution of starting glass and ICP-MS analyses. Reported in ppm.

³ NFS glass measured for dopant composition is post-experiment.

Dopant (ppm)	NAS	NFS
Zn	170.1 ± 1.7	114.2 ± 1.1
As	104.1 ± 1.0	110.1 ± 1.1
Rb	2.3 ± 0.02	1.6 ± 0.02
Sr	187.9 ± 1.9	130.6 ± 1.3
Y	207.3 ± 2.1	130.1 ± 1.3
Nb	0.9 ± 0.01	0.6 ± 0.01
Mo	50.8 ± 0.5	54.2 ± 0.5
Cd	178.0 ± 7.1	113.7 ± 4.5
Sn	160.5 ± 3.2	100.4 ± 2.0
Sb	0.1 ± 0.003	0.3 ± 0.01
Cs	0.2 ± 0.002	0.2 ± 0.002
Ba	25.7 ± 0.5	19.5 ± 0.2
La	8.9 ± 0.09	6.2 ± 0.06
Ce	10.9 ± 0.2	7.7 ± 0.2
Ho	0.5 ± 0.02	0.3 ± 0.01
Yb	189.3 ± 3.8	118.8 ± 2.4
Tl	0.021 ± 0.001	0.002 ± 0.0001
Pb	180.5 ± 5.4	115.6 ± 3.5
Bi	175.8 ± 3.5	113.2 ± 2.3
Th	1.3 ± 0.04	0.9 ± 0.03
U	0.6 ± 0.02	0.4 ± 0.02

For each experiment, 10 g of starting material was loaded into a Pt crucible and positioned on a ceramic stand inside the box furnace below the silica glass tube, at a temperature of 500°C (Figure 2.1). The temperature was raised in increments of 100°C every 10 minutes. At 900°C, the crucible was removed and an alumina rod was used to puncture the surface of the melt, which

would often inflate due to rise and coagulation of air bubbles during initial degassing. The crucible was then replaced in seconds into the furnace and the degassing experiment carried out for 2 or 7 days. At the end of the experiment the silica glass tube was removed from the furnace and allowed to cool. A blank experiment was also conducted by running an experiment with a silica tube but without a crucible of melt, to determine any elements that could be mobilized from the furnace. The glass tube was then cut into 1 cm segments along the length of its thermal gradient using a diamond saw. Temperatures were assigned to the mid-point of each 1 cm segment from a polynomial function fit to the measured thermal gradient (Figure 2.2). Segments of the silica glass tube were reserved for further analysis and examination of the condensates.

2.3. Analytical methods

The crystal sizes, textures and X-ray chemical maps of the condensates on the glass segments at different temperatures along the tube were imaged by SEM (Scanning Electron Microscope) using a Hitachi S-4800 FESEM instrument with an Energy Dispersive detector (EDS) at the University of Victoria. Solution ICP-MS (Inductively coupled plasma mass spectrometry) analyses were used to determine the trace metal content of leachates of the condensates on the silica glass tube segments. Condensates from a piece of each tube segment were leached in 5 ml of 16M HNO₃ on a hotplate for 2 days. The glass was then removed and the solution was diluted with 30 ml of deionized water. Four aliquots of each solution were analysed using a Thermo X-

Series II (X7) quadrupole ICP-MS. The counts-per-second (CPS) data were corrected for drift using In from an internal standard SLRS-5 (Ottawa River Water - Jochum et al., 2005) measured after every eight unknown samples. The reproduction of SLRS-5 standard values was better than 20% for Al, Ca, Cr, Mn, Fe, Cu, As, Sr, Mo, Ba, between 20-30% for V, Co, Ni, Zn, and above 40% for Cd (Appendix A). All other elements did not have certified values for SLRS-5. Metal concentrations in leachates were lower than in the standard for many elements. Values below the detection limit of the ICP-MS were removed from further consideration. Platinum and Cs had no reliable calibration standards and their concentrations are reported as CPS values (Figure 2.6).

The major element composition of quenched glass after an experiment was determined using the Cameca SX50 electron microprobe at the University of British Columbia (Table 2.1). Trace elements in glasses after two experiments were measured at the University of Victoria by laser ablation-inductively coupled plasma-mass spectrometry (LAICP-MS) using a New Wave Research, solid-state, 213 nm Nd:YAG UV laser coupled with a Thermo-Instruments X- Series II ICP-MS (Table 2.2). A peak counting time of 10 ms was used for all elements. Each analysis consisted of measuring an initial background signal for 25–30 seconds, after which the laser was fired at 10 Hz and a fluence of 0.4-1 mJ for 40 seconds, using a spot size of 80-100 μm rastered over a line length of 100 μm at a scan rate of 10 $\mu\text{m}/\text{s}$. The data was recorded as time-resolved spectra of counts per second and counts were reduced to concentrations in a custom spreadsheet.

NIST glasses (611, 613, and 615 - Jochum et al., 2005) were used with ^{29}Si as the internal standard. Accuracy on USGS BCR2g reference glass is better than: 5% for Li, Ti, V, Rb, Sr, Cs, Cd, Y, Mo, Pb and W; 10% for Cr; 20% Cu and Sn; and 30% Zn. Reference values for As, Ag, or Pt in BCR2g are either unknown or highly uncertain. Detection limits for each element are calculated as three times the standard deviation of the gas background signal.

Table 2.2: Concentration of elements in post-experimental glass, from LA-ICP-MS analyses.

Run	Vul5	Vul6	Vul7	Vul8
Composition	NAS	NAS	NFS	NFS
Duration	7 days	7 days	7 days	2 days
	ppm	ppm	ppm	ppm
Li	3.3 ± 0.1	4.2 ± 0.4	2.7 ± 0.2	1.3 ± 0.1
Be	0.15 ± 0.04	0.15 ± 0.05	0.13 ± 0.05	0.14 ± 0.06
Ti	129 ± 1	124 ± 2	128 ± 1	129 ± 2
V	127 ± 6	95 ± 3	94 ± 8	101 ± 3
Cu	163 ± 4	171 ± 5	155 ± 8	125 ± 6
Zn	116 ± 3	87 ± 5	113 ± 4	115 ± 2
As	131 ± 17	98 ± 3	99 ± 19	104 ± 8
Rb	1.4 ± 0.05	1.4 ± 0.05	1.5 ± 0.04	1.5 ± 0.05
Sr	92 ± 2	97 ± 3	107 ± 4	113 ± 3
Y	114 ± 6	104 ± 4	108 ± 5	128 ± 7
Mo	43 ± 10	32 ± 2	43 ± 11	55 ± 18
Ag	0.001 ± 0.004	0.006 ± 0.005	0.013 ± 0.005	0.011 ± 0.010
Cd	88 ± 2	67 ± 2	96 ± 3	99 ± 2
Sn	122 ± 3	99 ± 3	92 ± 2	101 ± 3
Cs	0.8 ± 0.3	0.5 ± 0.5	0.3 ± 0.05	0.3 ± 0.2
Pt	60 ± 3	44 ± 8	53 ± 3	42 ± 4
Pb	125 ± 3	94 ± 1	95 ± 2	105 ± 4

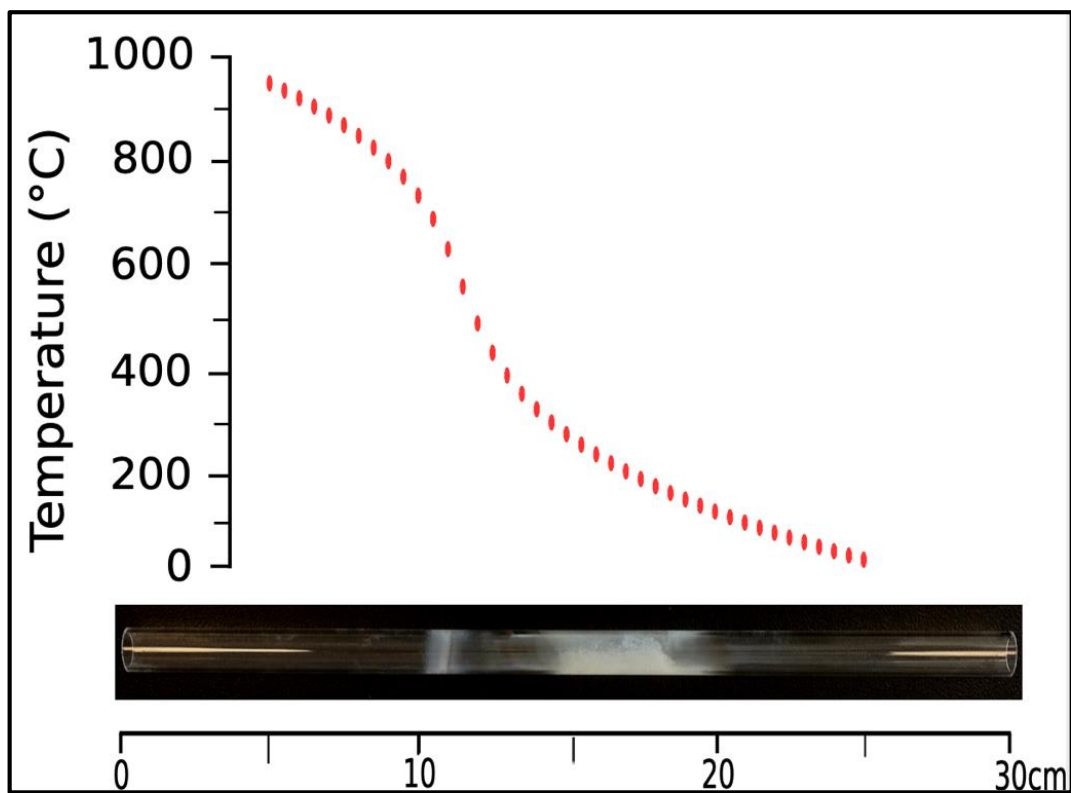


Figure 2.2: Temperature gradient over the length of the silica glass tube measured with a S-type (Pt₉₀Rh₁₀-Pt) thermocouple. Lower image shows visible precipitates (white) occurring between 10 to 20 cm on a silica glass tube (~ 125-725°C) after 7-day experiment with NFS composition.

2.4. Results

2.4.1. Petrography of condensates

In all experiments, condensates on the silica glass tube are visible as frosting over an approximately 10 cm long interval corresponding to a temperature range from 125 to 725°C (Figure 2.2). An SEM image of the highest temperature segment (553°C) from a 7-day experiment with the NFS composition (Figure 2.3a), shows anhedral crystals and $> 1\mu\text{m}$ cubic crystals. At 427°C (Figure 2.3b) the cubic crystals are absent, but elongated crystals appear, with a maximum length of $5\mu\text{m}$. At 350°C (Figure 2.3c) there are anomalously large, anhedral crystals of $\sim 15\mu\text{m}$. At 295°C (Figure 2.3d) the elongated crystals from higher temperature samples persist and hexagonal crystals of $>10\mu\text{m}$ appear. At 218°C (Figure 2.3e) the hexagonal crystals are absent and elongated crystals are longer, $>20\mu\text{m}$, and more densely packed. At 138°C (Figure 2.3f) all crystals are $<5\mu\text{m}$ and anhedral.

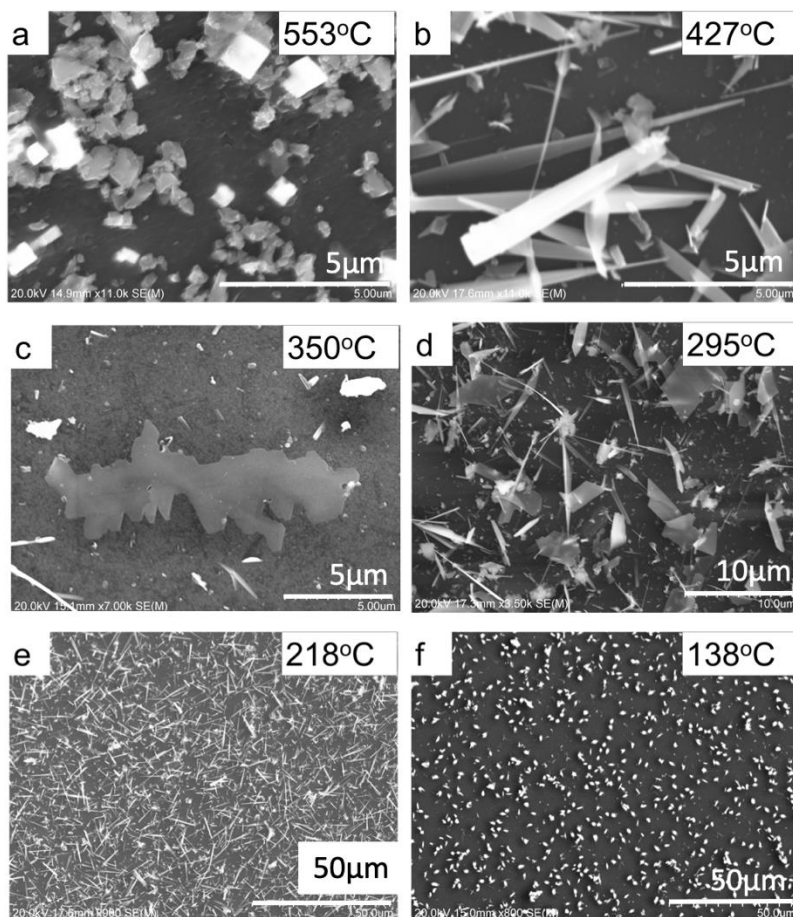


Figure 2.3: Secondary electron images of condensates forming with decreasing temperature ($^{\circ}\text{C}$) along the glass tube for a 7-day experiment NFS composition. Scale bars vary. Temperatures given are the mid-point of the range of temperatures from a 1-cm segment of tube. a) Condensates at 553°C have 1-2mm bright white cubic crystals and a larger anhedral phase. b) Condensates at 427°C have elongated crystals, with a maximum length of 5mm. c) An anomalously large, anhedral crystal of $\sim 15\text{mm}$ at 350°C . d) Condensates at 295°C have elongated crystals $>10\text{mm}$ and hexagonal crystals of $>10\text{mm}$. e) Condensates at 218°C have longer elongated crystals, $>20\text{mm}$, and are more densely packed than at 295°C . f) All crystals in condensates at 138°C are $<5\text{mm}$ and anhedral.

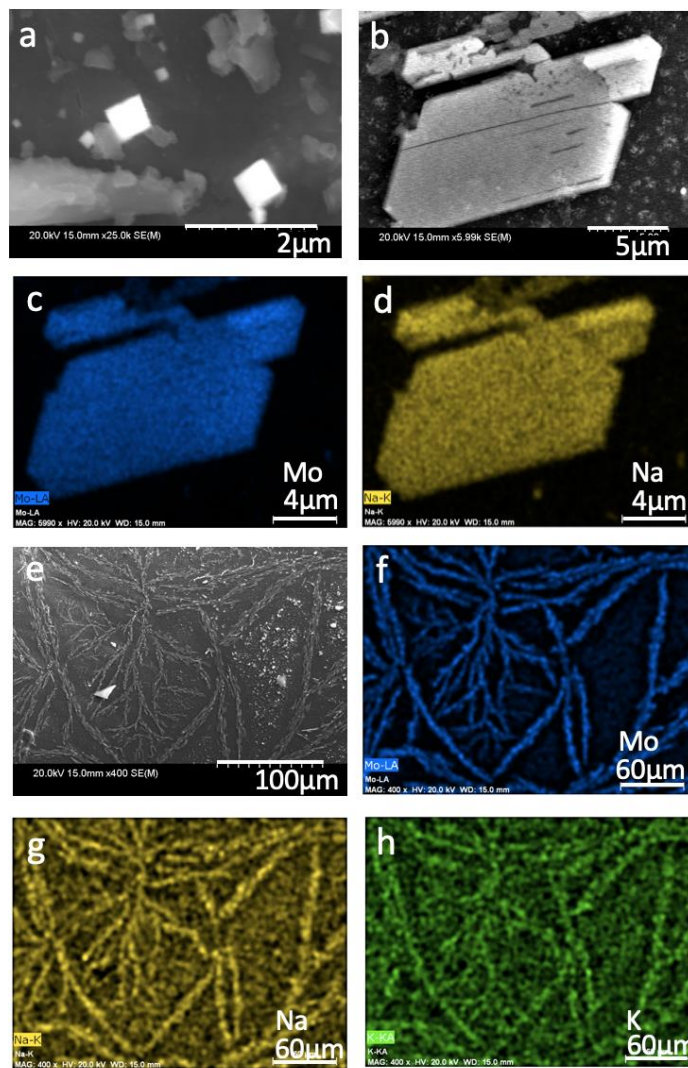


Figure 2.4: Secondary electron images and chemical maps of crystals from condensates from a 7-day experiment in the NAS composition. a) At 427°C bright cubic phases contain Pt. b) At 350°C a hexagonal phase contains Mo (c) and Na (d). e) At 253°C elongated crystals occur in a dendritic pattern, and contain Mo (f), Na (g), and K (h).

Chemical maps reveal some semi-quantitative chemical information of the condensates from a 7-day NAS experiment (Figure 2.4). At 427°C a small cubic (>1µm) phase appearing as bright white squares in the SEM image (Figure 2.4a), is Pt metal. A hexagonal Na-Mo-oxide phase appears with maximum length of crystals of 10-20µm appears at 350°C (Figure 2.4b, c, d). At 253°C individual elongated crystals longer than 200µm occur together in a dendritic pattern and also contain Mo, Na, and K (Figure 2.4e, f, g). Similar Na-K-Mo compounds were observed as condensates in the NFS experiments and are likely molybdates. Molybdates are common in incrustations from fumaroles (Stoiber and Rose, 1974), and in condensates from volcanic gases (Symonds et al., 1992; Africano et al., 2002). A more detailed mineralogical investigation of the condensates is in progress.

2.4.2. Bulk chemistry of the condensates

The trace metals added to the starting melt have varied volatility in natural volcanic systems. Several trace elements (Cu, Rb, Mo, Cd, Pb and Bi) are present in lower concentrations in the post-experiment glass than in the initial starting material (Table 2.1, 2.2) confirming they were volatile. For example, emanation coefficients (ϵ) for the NAS experiments calculated using equation (2) (Rubin, 1997) with initial and post-experiment glass (Table 2.1, 2.2) are high for Pb, Cd and Cu, 1.5×10^{-2} , 2.6×10^{-1} and 1.0×10^{-2} respectively, and lower for Mo and Li (1.4×10^{-3} and 1.7×10^{-4}).

The minute abundance (by weight) of the condensates along the tube precluded physical removal for direct bulk analysis and necessitated an estimate of their trace metal composition by acid leaching. We assume the composition of the acid leachate for a given segment along the silica glass tube reflects that of the condensate. Although not originally added to the starting melt composition, trace amounts of Li, Cr, Mn, Rb, Cs, Ag, W, Pt and Tl were also detectable in the condensate leachates. The Cr or Mn may be sourced from the Kanthal FeCrAl alloy heating elements used in the furnace. Platinum is derived from the Pt crucible used to contain the starting material. Trace levels of the remaining elements may be present due to: (1) their occurrence as impurities in the silica glass tube, or in the reagent grade oxides used to produce the starting melt material, or (2) residual ‘memory’ of trace element contamination in the box furnace from previous use in the laboratory.

As observed in natural fumaroles and volcanic gases (Mather, 2015; Taran et al., 2001; Toutain and Meyer, 1989; Vlastelic et al., 2013; Zelenski et al., 2014) all of Li, Cu, As, Rb, Mo, Ag, Cd, Cs, W, Pt, Tl, Pb and Bi are found to be volatile and present in enhanced concentrations in the condensates from the experiments. Several elements (Ca, V, Cr, Mn, Fe, Co, Ni, Ga, Se, Sr, Yb, Rh, Pd, In, Ba, Re, Zn, Y, Sn and Au) are not enriched in the condensates, and will not be discussed further (data in Appendix A).

To examine element trends as functions of temperature of condensation, the concentration of volatile elements in the condensate leachates along the silica glass tube is normalized to a non-volatile but leachable element. Cobalt is chosen as a normalizing element due to the fact that it is leachable but non-volatile in my experiments.

The Co-normalized concentration of volatile elements in leachates of condensate along the silica glass tube in the experiments can be compared with background levels from blank experiments. For a blank experiment, a silica tube was inserted in the furnace without a crucible of melt for several days. The trace metals detected along the tube during the blank experiments, presumably provided from degassing the furnace components, are in significantly lower concentrations than in experiments with a melt present (Figure 2.5a,b; Appendix A), confirming that the melt is the dominant contributor of most volatile trace metals to the condensates.

The Co-normalized concentration of volatile elements in the condensate leachates as functions of temperature for an NAS composition experiment show peaks at various temperatures between 200 to 600°C (Figure 2.5a, Figure. 2.6a,c,e). Molybdenum has the highest overall concentration of all volatile elements in the leachates (Figure 2.5a). Lead, Li, Cd, Cu, Bi, As, W, and Tl (Figure 2.5, 2.6a-d)) appear in relatively high concentrations and condense over a large range of temperatures. Cadmium, Bi, As, and Ag (Figure 2.6a and 2.6b) have concentration maxima between ~300-550°C. Copper and Rb have peaks in concentration close to 300°C (Figure

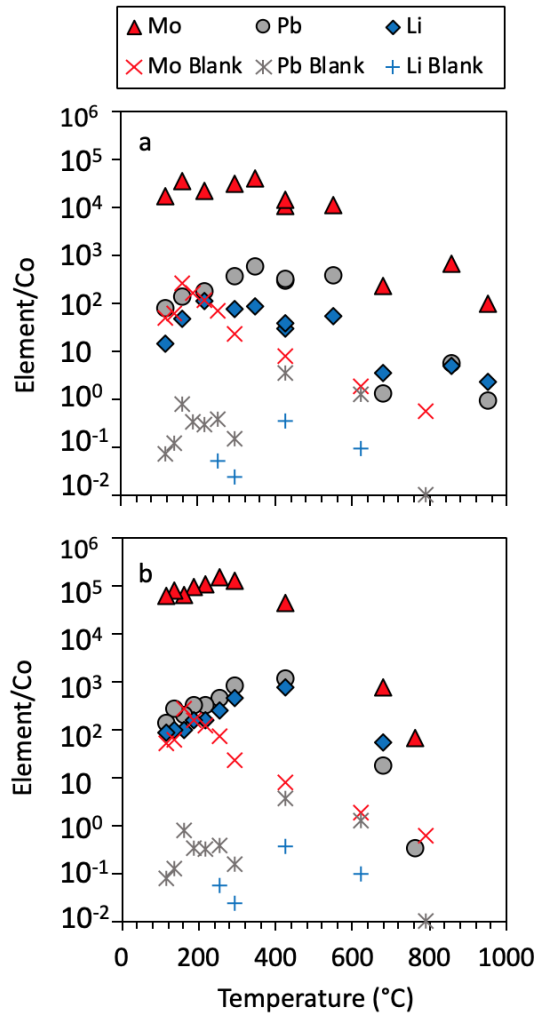


Figure 2.5: The concentration of volatile elements in leachates of condensates from silica glass tube normalized to Co. Normalized values increase to a maximum at a particular temperature for each element. Concentrations in blank experiments for a few elements are also shown a) Leachate concentration of Mo, Pb and Li versus temperature (°C), for 7-day NAS experiment b) Leachate concentration of Mo, Pb and Li normalized to Co versus temperature (°C), for 7-day NFS experiment. Uncertainty values are reported in Appendix A, with 1 σ values smaller than

2.6c and 2.6d). Tungsten shows no particular trend for the NAS composition experiment, but shows peaks at $\sim 300^{\circ}\text{C}$ for the NFS composition (Figure 2.6c,d). Cesium has a peak concentration at 350°C and the concentration of Pt peaks around 160°C (Figure 2.6e).

Similarly, in the NFS experiments, Mo (Figure 2.5b) has the highest overall concentration with peaks in abundance between $215\text{-}300^{\circ}\text{C}$. Lead and Li have the next highest peak normalized leachate concentrations at 425°C (Figure 2.5b). Bismuth, As and Ag have distinct peak concentrations at 425°C and Cd has a peak concentration between $250\text{-}300^{\circ}\text{C}$ (Figure 2.6b). Copper, W and Rb have less defined peak concentrations between $250\text{-}685^{\circ}\text{C}$ (Figure 2.6d). Thallium (Figure 2.6d) has a peak concentration at 295°C for the NFS composition, significantly higher than the peak at 160°C observed in the NAS experiment. Due to the sharp decrease in concentration above the peak temperature, some condensate samples have Tl concentrations below the detection limit. Cesium has a peak (CPS data only) at $\sim 220^{\circ}\text{C}$ and Pt peaks between 250°C and 425°C (Figure 2.6f). Comparison of 2- and 7-day experiments in the NFS composition indicate that concentrations are lower in the 2-day experiments for a given temperature, but that experimental duration does not affect the condensation pattern or sequence of volatile elements.

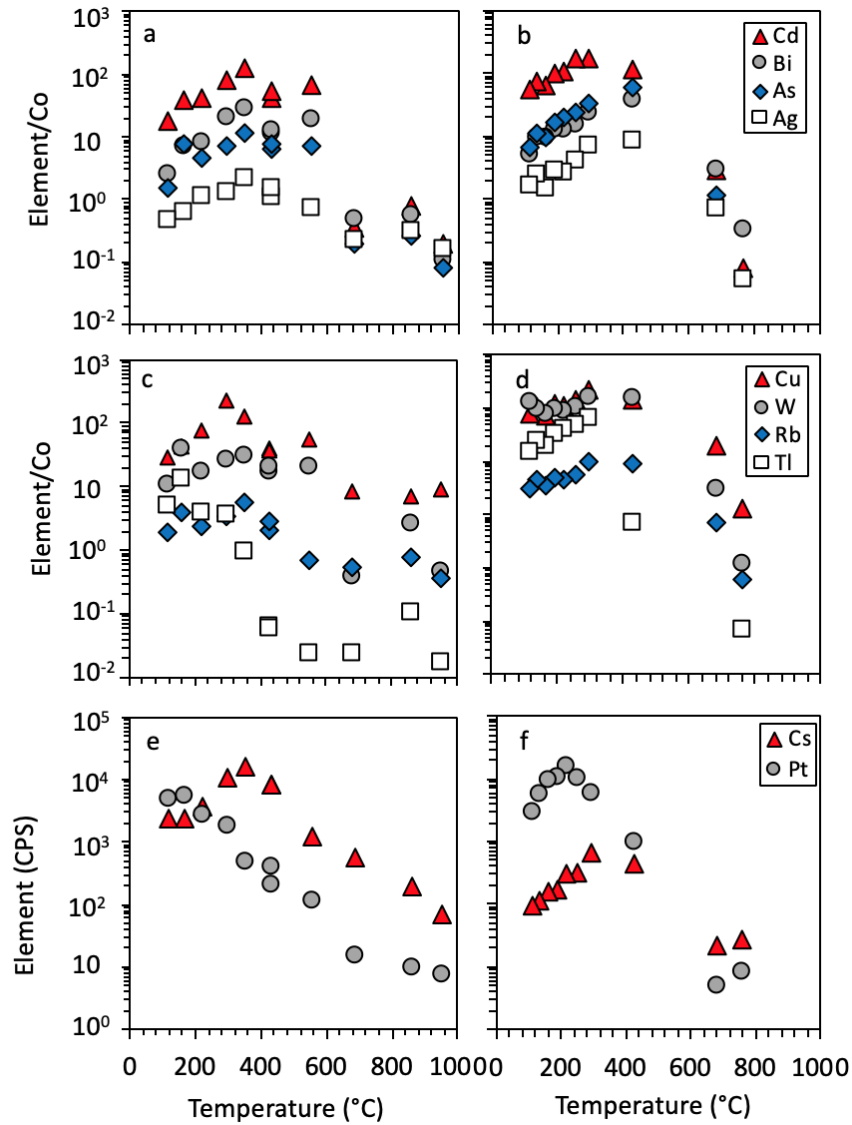


Figure 2.6: Normalized concentrations for (a,b) Cd, Bi, As, Ag, (c,d) Cu, W, Pb and Tl and (e, f) Cs and Pt in condensates for 7 day experiments in NAS and NFS compositions. Cesium and Pt reported in counts per second (CPS). Uncertainty values for element concentrations (1σ) are reported in Appendix A, with 1σ values smaller than the symbols plotted in this figure.

2.5. Discussion

2.5.1. Volatile trace metal transport in the gas phase

The concentration of trace elements in the starting material, and in the glass after an experiment, can be compared (Tables 2.1 & 2.2). For the volatile elements Cu, As, Rb, Mo, Cd, Pb, and Bi, the loss from the starting melt in a 7-day experiment is ~ 15 to 40%, and 5-20% relative, for the NAS and NFS compositions, respectively. These losses suggest a significant amount of the volatile elements were mobilized from the melts, degassed from the crucible across the melt-gas interface, and transported in a gas phase to form condensates at lower temperatures along the glass tube. On the other hand, using experimentally determined diffusion coefficients in melts of basalt, dacite and rhyolite (Johnson and Canil, 2011; Mackenzie and Canil, 2008; 2011), the calculated diffusion distances over 7 days vary from ~ 10^{-5} m for Tl to ~ 10^{-13} m for As. These diffusion distances are orders of magnitude less than the crucible depth (3.1×10^{-2} m) suggesting it would be difficult to degas much of the volatile trace metals. To explain this dichotomy, we note that samples of melt taken by dipping an alumina rod during initial start of the experiments contain numerous bubbles (~ 50% vesicularity). We surmise that during the frothing of the starting material at the inception of the experiments, volatile trace metals degassed into free air/gas bubbles that were trapped between particles of the starting glass. These bubbles subsequently rise over time to the surface of the melt, and degas deeper parts of the crucible more thoroughly than simple volume

diffusion through the melt–gas interface, and explain the element depletion in the glass of the crucible post-experiment.

2.5.2. Comparison with natural condensates

To compare results from my simple experimental design to nature, we contrast the normalized concentrations of volatile elements in condensates from the experiments with those measured in natural fumaroles at Colima (Taran et al., 2001) and Piton de la Fournaise from two studies 23 years apart (Toutain and Meyer, 1989, Vlastélic et al., 2011). In this comparison, Pb is used as the normalizing element as, despite being volatile, it is an element that is included in several studies of natural systems. Thallium, Ag, As, and Cu show volatile behaviour in both the experimental and natural systems (Figure 2.7). Scatter of the natural data is to be expected given that the conditions of sampling a natural volcanic system are variable and can change over time scales of minutes to hours. The experimental condensates are typically within one order of magnitude of the natural fumarole data, however the experimental condensate concentrations are lower than natural data for Tl and Ag especially, possibly because fluxes in natural volcanic gases are higher. Natural volcanic gases also contain fluid species that are important complexing agents for metals (e.g. HCl, HF, H₂S), which are absent in my initial simple system experiments.

Thallium shows peaks at lower temperatures when normalized to Pb in both experimental compositions compared to natural data and has a similar behaviour to Piton de la Fournaise in 1985

(Figure 2.7a). Copper and Ag show similar trends to the natural data, with peaks in concentration at higher temperatures (Figure 2.7b and 2.7d). The temperature for peak condensation for As varies between studies (Figure 2.7c).

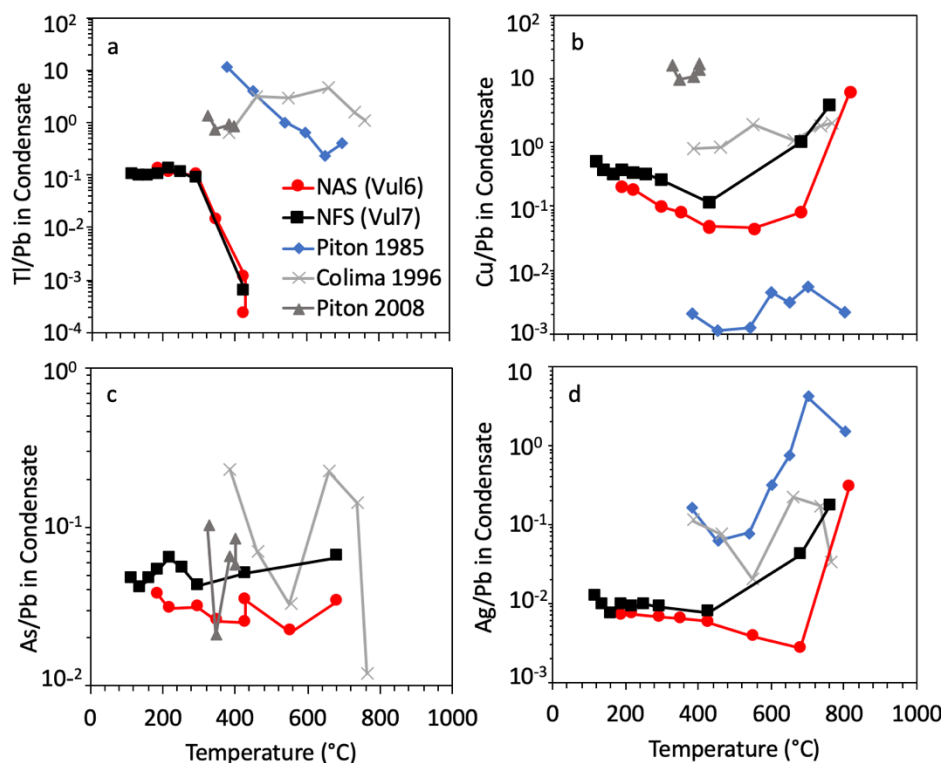


Figure 2.7: Pb-normalized concentrations of leachates of volatile elements in condensates from 7 day experiments for NAS and NFS compositions, compared to those for condensates collected from 1985 and 2008 Piton de la Fournaise (Toutain and Meyer, 1989; Vlastélic et al., 2011) and 1996 Colima (Taran et al., 2001) eruptions. Experimental values are potentially lower due to the lack of important complexing ligands (e.g. HCl, HF, H₂S) that are present in natural volcanic gases but not present in experiments. Uncertainty values for element concentrations (1 σ) of this study are reported in Appendix A.

The offset of the temperature for peak concentrations of volatile elements in condensates in the experiments compared to natural data could be due to several factors. Firstly, my design necessitated a simple bulk chemical composition of the melts that lack Cl and S, key species that complex with trace metals in melt and the gas phase (Williams-Jones et al., 2002; Williams-Jones and Heinrich, 2005). For example, Cu can complex with Cl^- (Liu and McPhail 2005; Pasteris, 1996) and HS^- (Heinrich et al., 1999). Secondly, water and acidic vapour is another key component that helps transport metals in natural systems (Williams-Jones et al., 2002) and is not possible to include in my experiments performed at atmospheric conditions. The length of the experiment (days) also differs from a natural system collection (on the order of months) and may be contributing to differences in the total quantity of condensed volatile trace metals. These variables all deserve further study.

The concentration of volatile elements measured in volcanic gases relative to that in a degassing parent magma is commonly expressed as the enrichment factor:

$$EF_X = \frac{C_X / C_R \text{ (gas condensate)}}{C_X / C_R \text{ (starting melt)}} \quad (3)$$

where C_X is the concentration of the element and C_R is the concentration of a reference element (Symonds et al., 1987). The EF value indicates how enriched or depleted in a trace metal the condensates are compared to the starting material. Elements having $EF > 1$ are considered more

compatible in the vapour phase. Using Co, as the reference element (C_R) the EF values of volatile elements from the experimental condensates of NAS experiments at 350°C are compared to those measured at three volcanoes, Piton de la Fournaise, Kudryavy, and Tolbachik, that erupt basalt, basaltic andesite, and basaltic trachyandesite, respectively (Vlastélic et al., 2011; Taran et al., 1995; Chaplygin et al., 2016) (Figure 2.8). Enrichment factors are above 1 for all elements in the natural samples, indicating that these elements are more compatible in the vapour phase than the melt. Enrichment factors for the elements can vary nearly orders of magnitude between volcanoes. The EF values for Mo are the only ones that are similar for the experiments and natural systems. This is possibly related to the fact that Mo can be transported as an oxide species in natural volcanic gases (Bernard et al, 1990; Symonds et al, 1992), as would also be expected in my experiments in air. It is notable that Mo-oxides are observed both in natural condensates, and in my experiments. In contrast, there are order of magnitude differences in EF values for Tl, Cd, As and Bi, but these differences depend on what system is being compared (Figure 2.8). The enrichment of the natural condensates in Pb, Cd, As and Bi is likely from enhanced transport into the volatile phase from ligands (Cl, S) present in the natural systems. These and other variables can be added to my experiments to test the effects of various parameters on metal degassing and condensation at natural volcanoes.

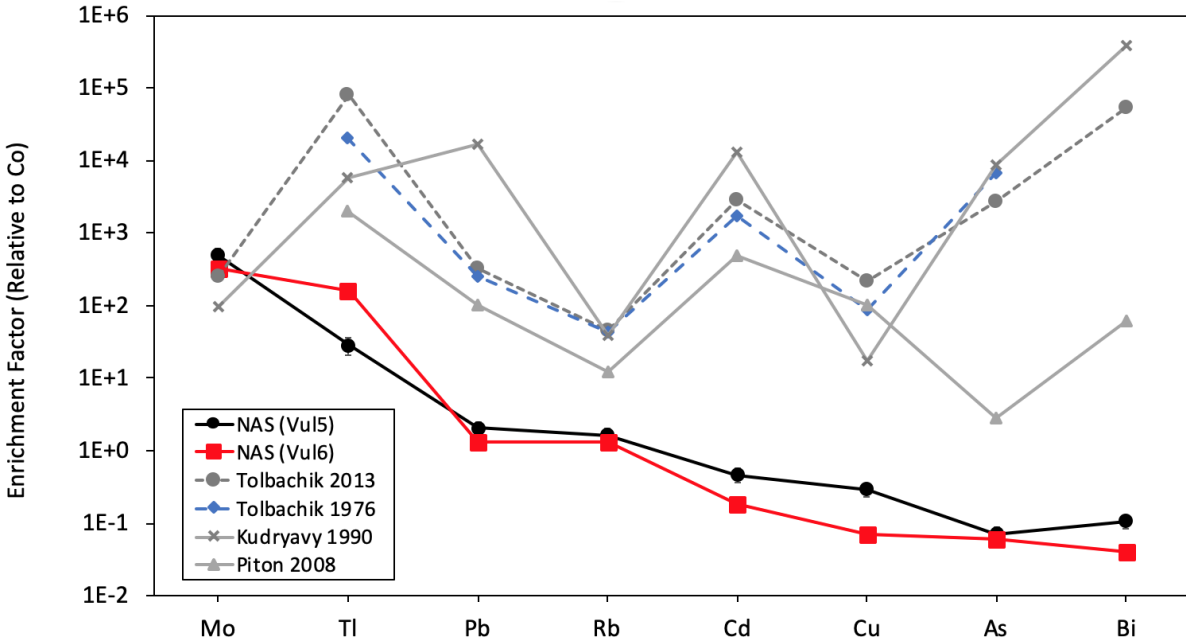


Figure 2.8: Enrichment factors (EF; calculated using equation (3) in text) for volatile experimental condensates from two NAS composition experiments (Vu15 and Vu16), sampled at 350°C compared to those from various natural volcanic condensates from 1976 and 2013 Tolbachik (Zelenski et al., 2014), 1990 Kudryavy 1990 (Taran et al., 1995), and 2008 Piton de la Fournaise 2008 (Vlastélic et al., 2011) eruptions. Error bars are included for experiments from this study and are not visible if smaller than the symbol on the graph. Experimental and natural samples use Co as the reference element (CR). The EF of Mo is most similar between the experimental and natural samples, whereas that of Tl, Cd, Bi and As are much higher in natural condensates, likely due to the lack of ligands (Cl, S) or water vapour in the initial experiments.

2.6. Summary and implications

My preliminary experiments show that the benchtop fumarole experimental apparatus can be used to study the volatility and condensation behaviour of trace metals commonly found in natural volcanic fumaroles. We degas melts in simple three component systems with doped trace metals and collect condensates along a silica glass tube over a temperature gradient of 900°C to 25°C. Elevated concentrations of Li, Cu, As, Rb, Mo, Ag, Cd, Cs, W, Pt, Tl, Pb, and Bi are observed in the condensates therefore showing these elements to be volatile in my experiments. Each trace element also shows a maximum in concentration at certain temperatures. Condensate crystals imaged by SEM and mapped using EDS are found to vary and contain Pt or occur as Mo-Na-K oxides. When compared to natural fumarole condensates, the enrichment factors of experimental condensates compare particularly well for Mo. Natural samples have much higher enrichment factors for Pb, Cd, As, and Bi, most likely be due to the lack of ligands in my simple experimental system. Given the demonstrated utility of my simple experimental design, however, future work can examine the roles of ligands (F, Cl, and S), melt composition and oxygen fugacity in the transport and condensation of volatile trace metals in volcanic emissions.

Chapter 3. Investigation of the effect of Cl on the transport and sublimation of volatile trace metals in volcanic gases using benchtop fumarole experiments

3.1. Introduction

Volcanoes emit an extensive array of volatile trace metals to the atmosphere (e.g. Allard et al., 2000; Calabrese et al., 2011; Gauthier and Le Cloarec, 1998). Anthropogenic fossil fuel emissions and waste incineration are presently the largest polluters of such metals, but volcanoes have been a natural source throughout Earth history (e.g. Le Cloarec and Marty, 1991; Nriagu, 1979). The volatile trace metals (e.g. Cu, As, Mo, Cd, Tl, Pb, Bi) are originally dissolved in melts at trace concentrations (e.g. Nash and Crecraft, 1985) but upon degassing, can partition into the gas phase, depending on their solubility and the presence of certain key ligands for complexation (e.g. Hinkley, 1991; Rubin, 1997). Volatile trace metals may then exit a volcano at temperatures up to 1000°C, either dissolved in the gas phase, as an aerosol particle or adsorbed to dust and ash to be transported great distances from their source (e.g. Henley and Berger, 2013). Adsorption of HCl onto ash particles in plumes (Ayris et al., 2014) demonstrates the importance of ash as a transport mechanism of soluble chlorides that can export metals to the oceans, perhaps enhancing primary productivity (Duggen et al., 2007; Watson, 1997). Chlorides adhered to ash particles can

also lead to the production of reactive halogen species such as $\text{HCl}_{(g)}$ (Ayrís and Delmelle, 2012; Rossi, 2003) and can enhance the overall deposition of ash by cementing particles into aggregates (Mueller et al., 2017).

Fumaroles represent a source of volcanic gas from which metals dissolved in the gas phase commonly sublime into a solid phase as the temperature decreases away from the vent. These sublimates document the volatile components of the gas-solid reaction occurring in a fumarole (e.g. Africano et al., 2002; Bernard and Le Guern, 1986; King et al., 2018; Stoiber and Rose Jr, 1974). The volcanic gases from actively degassing fumaroles can be sampled through a silica tube (Le Guern and Bernard, 1982), onto which sublimates form and can be identified (e.g. Africano et al., 2002; Taran et al., 2000; Yudovskaya et al.; 2006, Zelenski et al., 2013). The studies of such sublimates indicate that trace metals tend to complex with ligands in the gas phase (e.g. Zelenski et al., 2013). The ligands are negatively or neutrally charged ions or molecules that can act as electron donors (e.g. Cl^- , SO_4^{2-} , S^{2-} , F^- , OH^-), bonding to create coordination complexes with metals. In a natural system, ligands are present as acidic species in the vapour phase (e.g. HCl , SO_2 , HF , H_2O , CO_2) and can provide stability for complexation with metals (Williams-Jones and Heinrich, 2005). As a ligand, Cl^- is particularly important. For example, the presence of Cl in melts increases the volatility of some trace metals by two- to five-fold (Johnson and Canil, 2011). In

hydrothermal systems, metals that complex with Cl^- , such as Ag, Cd, Fe, Pb, Rb, Sn, Tl and Zn, will tend to concentrate in a saline fluid phase (Heinrich et al., 1999).

The principal Cl species in volcanic gases is HCl, being at least a factor of 10^6 more concentrated than any other Cl species (Symonds et al., 1988) and comprising up to 6 mol% of bulk volcanic vapour of eruptions (Williams-Jones and Heinrich, 2005). Before it degasses, Cl is dissolved in a silicate melt, with a solubility of up to a few weight percent depending on melt composition (Carroll, 2005; Carroll and Webster, 1994; Heinrich et al., 1999). Estimates of HCl released by modern volcanic emissions are 4.3 to 170 Tg/a (Halmer et al., 2002; Pyle and Mather, 2009).

In a natural multicomponent system with fluctuating temperature and composition, it is difficult to isolate the role of various ligands in the transport or sublimation of trace metals in volcanic gases. In this study, we investigate the effect and role of Cl in gas on the transport and sublimation of volatile trace metals in a thermal gradient above a degassing silicate melt in the laboratory. The goals of the experiments are to examine what trace metals complex with Cl to change their volatility or sublimation behaviour, and to identify what sublimates may sequester or partition Cl and trace metals from volcanic gases.

3.2. Methods

3.2.1. Experimental methods

Experiments were conducted by degassing a crucible of silicate melt doped with volatile trace elements situated 2 cm below a 30-cm-long, 1-cm-diameter, 1-mm-thick silica glass tube. During the experiments, gas traveled up the tube and cooled, sublimating phases inside the tube along a temperature gradient from 900°C to 25°C. More details of this ‘benchtop’ fumarole design are given in Scholtysik and Canil (2018).

The melt compositions were chosen by necessity to have melting points below that of the annealing point of the silica tube and to have low for ease of degassing. We used two broadly phonolitic compositions in the Na₂O-Al₂O₃-SiO₂ (NAS) and Na₂O-Fe₂O₃-SiO₂ (NFS) systems (Fe-free and Fe-bearing melts) with eutectic melting points of 740 ± 5°C and ~800°C respectively (Schaerer and Bowen, 1956; Bailey and Schairer, 1966). Using the Giordano et al. (2008) method, the viscosities of these melts are 10^{2.04} and 10^{-0.96} Pa s, respectively, at 900°C. Melt compositions were synthesized with reagent grade oxides of Na₂CO₃, Al₂O₃, SiO₂ and Fe₂O₃, by weighing the oxides into a container, shaking for 15 minutes to homogenize and transferring to a Pt crucible for decarbonation at 800°C and fusion at 1400°C for 24 h. The glass was removed from the crucible, crushed, powdered and doped with ~200 ppm each of V, Cu, Zn, As, Y, Mo, Cd, Sn, Yb, Pb and Bi hosted in a 2% HNO₃ ICP standard solution. The slurry was then dried under a heat lamp.

To investigate the role of Cl, 1 or 2 wt% Cl was added as NaCl powder to the doped starting material. Prior studies show the solubility of Cl to be ~0.6 wt% phonolitic melts at 850°C and 100 MPa (Metrich and Rutherford, 1992) and 925°C and 25 MPa (Signorelli and Carroll, 2002). Chlorine solubility decreases with increasing pressure, particularly with HCl predominant gases at low-temperature volcanic systems (Shinohara, 2009). Experiments at 100 kPa indicate that Cl solubility can reach 2.03 wt% in basalt and 1.65% in andesite, although natural silicate melt inclusions have <0.8 wt% Cl (Webster et al., 1999). The solubility of Cl in the broadly phonolitic NAS and NFS melts of this study is estimated to be ~1 wt% Cl.

Approximately 7 g of starting material was loaded into a Pt crucible below a suspended silica glass tube in a furnace at 500°C. The temperature was immediately increased at 10 °C/min to 900°C and held for 7 to 21 days. After the experiments, the silica tube was removed from the apparatus and allowed to cool in air. A blank experiment with no melt was performed with the same conditions after the furnace had been running empty at 500°C for a period of four months prior to the melt-present experiments. After an experiment, the silica tubes were cut dry into 0.5 to 1.0 cm slices with a diamond saw and stored in sealed plastic bags under desiccant (anhydrous calcium sulfate). The measured thermal gradient was used to assign a median temperature to each segment of the tube (Figure 3.1b). Table 3.1 outlines the name, melt composition, Cl content and duration of the experiments.

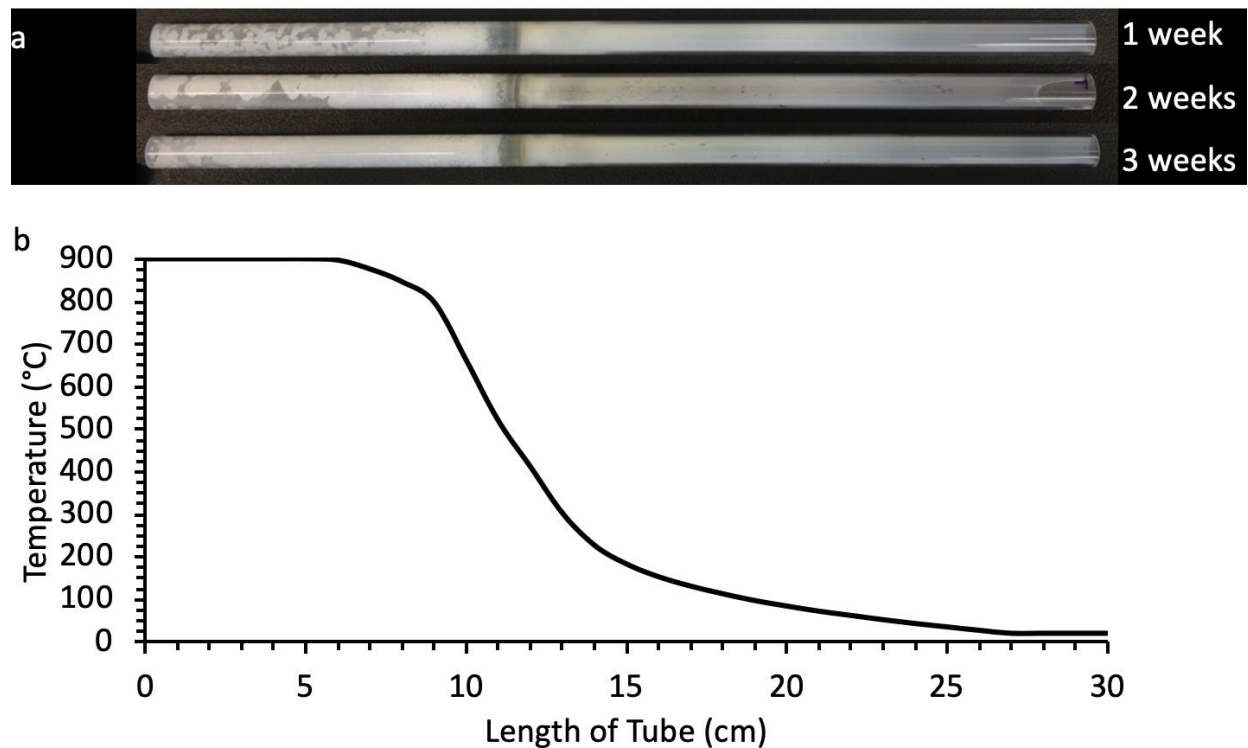


Figure 3.1: Images of sublimates in 30-cm-long silica glass tube from experiments performed using NAS composition melt and 2 wt% Cl, with variable experiment durations. White sublimates at high temperatures occur in semi-circular concentric patterns, with circles increasing in size with more time and are likely SiO₂. Multiple phase transitions occur at ~500°C. At lower temperatures, sublimates pictured are likely NaCl. b) Average thermal gradient from the experiments relative to tube length.

Table 3.1: Experimental conditions

Experiment Name	Melt Composition	Cl (wt%)	Duration (days)
Blank	N/A	N/A	7
Vul9NAS	NAS	0	7
Vul10NAS+1%Cl	NAS	1	7
Vul11NFS	NFS	0	7
Vul12NAS+2%Cl	NAS	2	14
Vul13NFS+2%Cl	NFS	2	14
Vul14NFS+1%Cl	NFS	1	7
Vul15NAS+2%Cl	NAS	2	7
Vul16NAS+2%Cl	NAS	2	21

3.2.2. Analytical methods

Fine sublimates that formed on the interior of the segments of the silica tubes were imaged and analysed for their chemical composition using a Hitachi S-4800 FESEM (Field Emission Scanning Electron Microscope) with EDS (Energy Dispersive X-Ray Spectroscopy) at the University of Victoria. Energy Dispersive X-Ray spectra were gathered with an accelerating voltage of 20 kV and current of 20 μ A. Phase identification was also carried out by microRaman

spectroscopy in air, using a Renishaw inVia Confocal Raman Microscope at the University of Victoria, with a 532-nm laser, 2400 line/mm grating, 20x objective lens and ~0.8 μm laser beam diameter. The spectrometer was calibrated before each session using a Si wafer to its peak of ~520 cm^{-1} . Spectra were collected over the range of 200-1800 cm^{-1} , with laser power between 0.5 – 10%, typically at 5% for 10s. The spectra of five or more sublimate products were gathered per sample. Spectral data were interpreted using CrystalSleuth (Laetsch and Downs, 2006) and the associated RRUFF database with over 10,000 high resolution Raman spectra (Lafuente et al., 2015). X-Ray diffraction was attempted to determine mineralogy with a PANalytical Empyrean X-Ray System using multiple techniques, however, count levels were too low given the small amount of material sublimed on the silica tube surfaces.

The bulk trace element concentration of the sublimates in each tube segment was determined by SN ICP-MS using an Agilent ICP-QQQ_MS in MS/MS mode. Solutions were prepared using two different methods: leaching the sublimates from the silica tube in HNO_3 and full dissolution of the silica tube and sublimate in HF- HNO_3 . For the first method, a shard of silica tube with encrusted sublimates was placed in a Teflon vial with 3 ml of 16N Environmental Grade HNO_3 and left on a hotplate at 120°C for 48 hours. The leached silica tube shards were removed from the solution and samples were diluted to 30 ml with deionized water. The second method was a full digestion, by dissolving an encrusted silica tube shard in 5 ml HF (~50% HF) and 0.5

ml 16M HNO₃ on a hotplate for 48 hours. This was dried down and 2 ml 8N HNO₃ and 2 ml 6N HCl were added and left on the hotplate for a further 24 hours. The resulting solution was dried and then diluted with deionized water to 30 ml. The SN ICP-MS data was first corrected for drift using In in a standard of Ottawa River Water (SLRS-5 from Jochum et al., 2005) that was run after every 16 unknown samples. For those elements with certified values in SLRS-5 (Heimbürger et al., 2013), the accuracy was better than 10% for Al, As, Ca, Cu, Mn, Mo and Sr; 20% for Cd, Ni and Zn; 30% for Co; and 60% for Cr. The corrected data was converted from counts-per-second (CPS) to concentration in the solution by calibration with standard solutions. Most trace elements have concentrations in the solution lower than in the standard. Elements are reported as CPS values when a calibration standard for the element is not available. The detection limit was calculated as three times the standard deviation of the background. Data is not considered further if it is below the detection limit (Appendix B).

Full fusion of trace element-doped glasses was not undertaken prior to experiments to avoid loss of volatile trace metals before the sublimation experiments. Samples of melt taken during initial stages of the experiments were too vesicular to analyse. The major and trace element composition of the melts were instead determined after an experiment on glass chips removed from the crucibles. Major elements (Table 3.2) were determined by electron microprobe (EPMA) using a CAMECA SX100 instrument at the University of Alberta. Operating conditions were 15 kV, 10

nA, with a 20 μm beam. The peak count time was 20 s but to obviate the effect of Na loss during analysis, counting was divided into 6 intervals for a linear time-dependent-intensity (TDI) correction for Si, Na, Fe, K and Al (Morgan and London, 1996). Chlorine was also measured by EPMA but produced better results on standards without TDI correction. Tugtupite was used as a standard for Na and Cl. Comparisons with reported values for standard glasses BHVO-G and Lipari rhyolite (Kuehn et al., 2011) show accuracy was better than 1.5% relative for Na, Al, Si, Fe and Cl. Ten spots were analysed and averaged per glass chip. Analytical totals for glasses were low, most likely due to the hygroscopic nature of alkali-rich glasses (Table 3.2). When exposed to humid conditions, powdered $\text{Na}_2\text{O-SiO}_2$ glass with $\sim 60\%$ SiO_2 , can adsorb $\sim 2\text{x}$ its weight in H_2O over 6 days (Hubbard, 1946) and despite efforts to keep the glasses dry (e.g. desiccant), it is likely that H has been taken up by the starting material glasses. Low $\text{Na}_2\text{O/Al}_2\text{O}_3$, $\text{Na}_2\text{O/SiO}_2$ and $\text{Na}_2\text{O/FeO}$ in the glasses measured by EPMA (Table 3.2) indicate Na loss from the melt over time (i.e. Muan and Osborne, 1965; O'Neill, 2005), and may be explained by Na substantially volatilizing and sublimating in Na-bearing phases, as described below.

Table 3.2: Compositions of post-experimental glasses

wt% ⁴	Vul9NAS	Vul10NAS	Vul11NFS	Vul12NAS	Vul13NFS	Lipari	BHVO
		+1%Cl		+2%Cl	+2%Cl	ID3506	-2G
SiO ₂	59.74 ± 0.54	58.47 ± 0.64	60.98 ± 0.37	58.67 ± 0.53	61.08 ± 0.37	74.23 ± 0.37	50.06 ± 0.40
Al ₂ O ₃	9.44 ± 0.67	8.84 ± 0.36	0.55 ± 0.01	7.97 ± 0.61	0.53 ± 0.02	13.32 ± 0.05	13.56 ± 0.04
FeO	0.31 ± 0.02	0.23 ± 0.03	11.20 ± 0.06	0.22 ± 0.02	11.06 ± 0.09	1.53 ± 0.05	11.03 ± 0.08
Na ₂ O	23.99 ± 0.58	23.69 ± 0.83	22.14 ± 0.44	23.37 ± 4.21	21.85 ± 0.52	4.15 ± 0.26	2.30 ± 0.11
K ₂ O	0.12 ± 0.01	0.29 ± 0.03	0.10 ± 0.01	0.18 ± 0.02	0.11 ± 0.01	5.24 ± 0.04	0.51 ± 0.01
TiO ₂	0.04 ± 0.05	0.03 ± 0.04	0.03 ± 0.06	0.03 ± 0.04	0.03 ± 0.05	0.08 ± 0.04	2.71 ± 0.05
Cl	0	0.75 ± 0.04	0.01 ± 0.01	0.61 ± 0.11	0.23 ± 0.01	0.34 ± 0.02	0.09 ± 0.12
Total	93.64	92.30	95.00	91.05	94.89	98.89	80.26
Na ₂ O/Al ₂ O ₃	2.54 ± 0.19	2.68 ± 0.14		2.93 ± 0.57			
Na ₂ O/SiO ₂	0.40 ± 0.01	0.41 ± 0.02	0.36 ± 0.01	0.40 ± 0.07	0.36 ± 0.01		
Na ₂ O/FeO			1.98 ± 0.08		1.98 ± 0.05		
ppm⁵ ± 1s							
Li	8.82 ± 0.94	5.61 ± 0.59	4.39 ± 0.19	5.06 ± 0.33	4.49 ± 0.38		
V	199 ± 6	205 ± 16	214 ± 10	211 ± 8	215 ± 2		
Cr	6.0 ± 0.4	5.9 ± 0.5	16.0 ± 0.2	10.1 ± 0.6	16.6 ± 0.1		
Mn	9.26 ± 0.06	6.24 ± 0.18	217 ± 4	7.03 ± 0.12	216 ± 1		
Co	1.04 ± 0.10	0.32 ± 0.23	5.89 ± 0.12	0.45 ± 0.08	5.67 ± 0.09		
Ni	7.32 ± 0.92	2.00 ± 1.36	27.4 ± 1.31	2.56 ± 1.60	26.6 ± 1.95		

⁴ Measurements by EPMA⁵ Measurements by laser ICP-MS

Cu	289 ± 5	281 ± 9	271 ± 13	261 ± 26	272 ± 3
Zn	209 ± 9	211 ± 6	246 ± 9	222 ± 9	254 ± 2
As	197 ± 18	218 ± 34	241 ± 22	215 ± 15	225 ± 23
Rb	2.93 ± 0.26	2.22 ± 0.24	3.48 ± 0.16	1.98 ± 0.14	1.69 ± 0.11
Y	249 ± 10	254 ± 10	278 ± 8	258 ± 4	272 ± 5
Mo	77.5 ± 2.6	68.1 ± 8.7	75.5 ± 15.3	60.4 ± 2.7	61.7 ± 0.9
Cd	180 ± 11	191 ± 9	233 ± 10	192 ± 5	235 ± 3
Sn	126 ± 6	132 ± 4	142 ± 2	136 ± 2	145 ± 2
Yb	193 ± 17	202 ± 12	218 ± 11	206 ± 2	220 ± 6
Cs	1.94 ± 0.21	3.07 ± 1.32	1.06 ± 0.34	3.59 ± 0.44	2.81 ±
Ba	15.8 ± 0.4	16.7 ± 0.3	19.5 ± 0.5	18.1 ± 0.4	19.9 ± 0.3
W	1.80 ± 0.13	0.45 ± 0.26	0.65 ± 0.06	0.62 ± 0.08	0.68 ± 0.10
Pt	81.0 ± 13.5	84.4 ± 11.5	125.2 ± 24.1	81.6 ± 2.8	95.5 ± 2.4
Pb	234 ± 20	258 ± 13	271 ± 16	256 ± 5	268 ± 5
Bi	232 ± 14	246 ± 14	260 ± 14	249 ± 4	259 ± 6
Total trace elements	2404.16	3562.23	2878.87	4133.75	3162.47

The trace element composition of the post-experiment glasses were determined by laser ablation inductively coupled plasma mass spectrometry (LA ICP-MS) with a New Wave Research, solid-state, 213nm Nd:YAG UV laser coupled with a Thermo-Instruments X-Series II ICP-MS using He carrier gas at the University of Victoria (Table 3.2). Glasses were analysed using a 55 μm spot size and a 100 μm raster length with four passes at 10 $\mu\text{m}/\text{s}$ and a peak counting time of

10 ms for all elements. Each analysis began with collecting background for 25 seconds, followed by 40 seconds of the laser firing at 10 Hz and a fluence of 4.5-8.5 J/cm². Signals were calibrated using NIST glasses 611, 613 and 615 (Jochum et al., 2005) and were converted to concentrations using the method of Longerich et al. (1996) with Si as the internal standard. Five analyses were performed for each glass and averaged. Detection limits were calculated using three times the standard deviation of the background. Previous work using identical analytical conditions with this method (Scholtysik and Canil, 2018) shows accuracy on USGS BCR2g reference glass is better than: 5% for Li, V, Rb, Cs, Cd, Y, Mo, Pb and W; 10% for Cr; 20% for Cu and Sn; and 30% for Zn.

3.3. Results

The low-temperature portion of the silica tubes have a much thinner coating (<25µm) of sublimates than the high temperature end at 900°C, which also tends to grow larger crystals. Bright white crystals with a distinctive semi-circular growth pattern, approximately 2 mm across, occur above temperatures of ~700°C along the tube. A transition to brown, yellow and gray phases occurs from ~400-650°C. Microscopic, yellow-white crystals cover the low-temperature end of the tubes from ~25-400°C (Figure 3.1a). A ‘blank’ experiment tube has a coating of sublimates only at low temperatures of ~50-250°C. The blank experiment was run prior to all other experiments, however volatile elements may have been mobilized and remobilized from

contaminants or remnant elements from prior use of the furnace. Thus, the blank experiment represents the empty state of the furnace.

3.3.1. Effects of experiment duration

The sublimates produced on silica tubes from experiments for the NAS melt with 2 wt% Cl (Table 3.1- Vul16NAS+2%Cl, Vul13NAS+2%Cl and Vul15NAS+2%Cl) all increase in thickness and quantity with increasing durations of 7, 14 and 21 days (Figure 3.1a). There is no systematic variation in the relative concentration of elements nor any differences in sublimate phase assemblages with increasing experiment duration. The sum of the concentration of volatile elements (Li, V, Cr, Cu, Zn, As, Rb, Mo, Ag, Cd, Sn, W, Pt, Tl, Pb, Bi) in leachates, normalized to Al in the leachates for experiments with the same composition (NAS+2%Cl) and variable experiment durations (7, 14 and 21 days; experiments Vul16NAS+2%Cl, Vul13NAS+2%Cl and Vul15NAS+2%Cl, respectively), demonstrates that duration of the experiment does not affect the temperature at which the elements sublime, only the quantity (Figure 3.2). Overall, a longer experiment is expected to sublime a higher concentration of trace elements, normalized to Al, with all other experimental variables being the same.

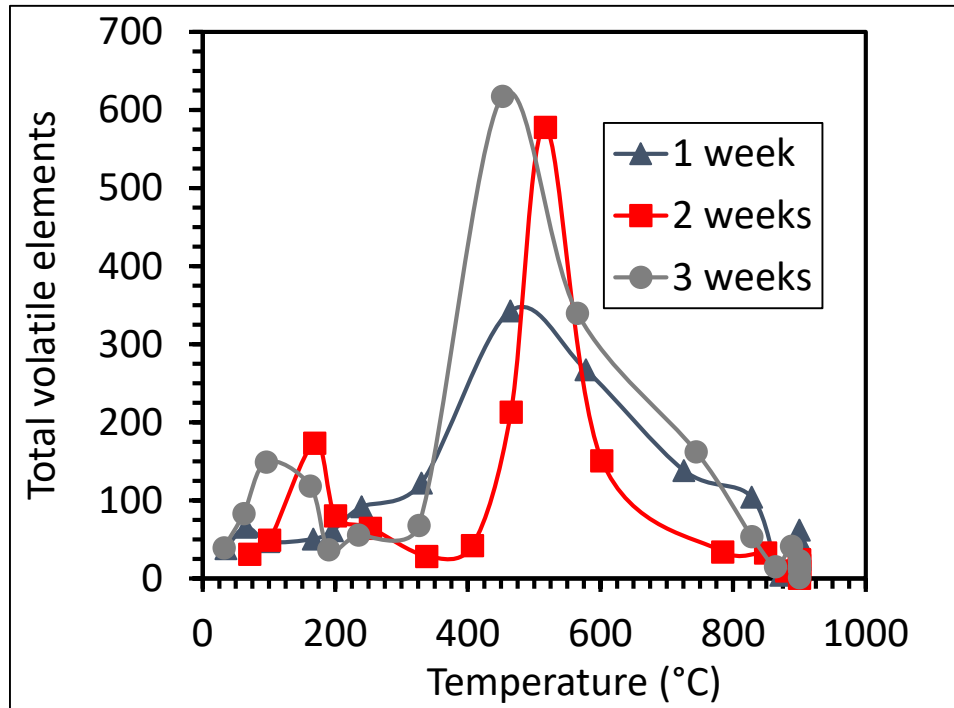


Figure 3.2: The sum of the concentration of all volatile elements (Li, V, Cr, Cu, Zn, As, Rb, Mo, Ag, Cd, Sn, Cs, W, Pt, Tl, Pb, Bi) in leachates of sublimates (ppb) normalized to Al in the leachate (ppb) by temperature of the silica tube segment, for experiments with composition NAS+2%Cl over experiment durations of 7, 14 and 21 days (Vul16NAS+2%Cl, Vul13NAS+2%Cl and Vul15NAS+2%Cl, respectively). Uncertainty values for element concentrations (1σ) of this study are reported in Appendix B.

3.3.2. Effects of melt composition

The sublimate assemblages as functions of temperature from 14-day experiments with two different starting compositions (Vul12NAS+2%Cl and Vul13NFS+2%Cl) were examined in detail

by SEM, EDS and microRaman spectroscopy. In all cases, crystal habits, crystal density N (number of crystals per unit area) and textures change with temperature. Raman spectroscopy confirms the identity of some phases inferred by EDS, or reveals other phases that were not apparent in SEM examination due to their small size, low concentration or complex intergrowths.

3.3.3. Sublimate phases

Secondary electron images from experiments run for 14 days, with 2 wt% Cl and either NAS or NFS melt (Vul12NAS-2%Cl and Vul13NFS-2%C, respectively) show the sequence of phases in sublimates from high (785°C) to low (120°C) temperatures (Figure 3.3, 3.4). Phases identified by SEM and EDS are similar in experiments with the two different compositions. At high temperatures, SiO₂ is the dominant phase, forming in large sheets (Figure 3.3a). At 600°C, a radiating, acicular Na-silicate forms on a substrate of SiO₂ (Figure 3.3b). The Vul13NFS+2%Cl experiment is used to examine a succession of sublimates, visible as changes of colour over a section of silica tube that extends from ~440-540°C (Figure 3.4a). At the low temperature end of this section, Na-silicates and SiO₂ sublime, as well as a string of hexagonal-shaped, 50 µm-wide crystals of Na-molybdate (Figure 3.4b). As temperature increases across this section, crystals of Na-silicates dominate, along with sparser molybdates (Figure 3.4c). The highest temperature portion of the sequence features cubic halite crystals up to 70 µm-across, molybdates and bright crystals of Pt (Figure 3.4d). Sublimates at temperatures below this sequence are primarily halite

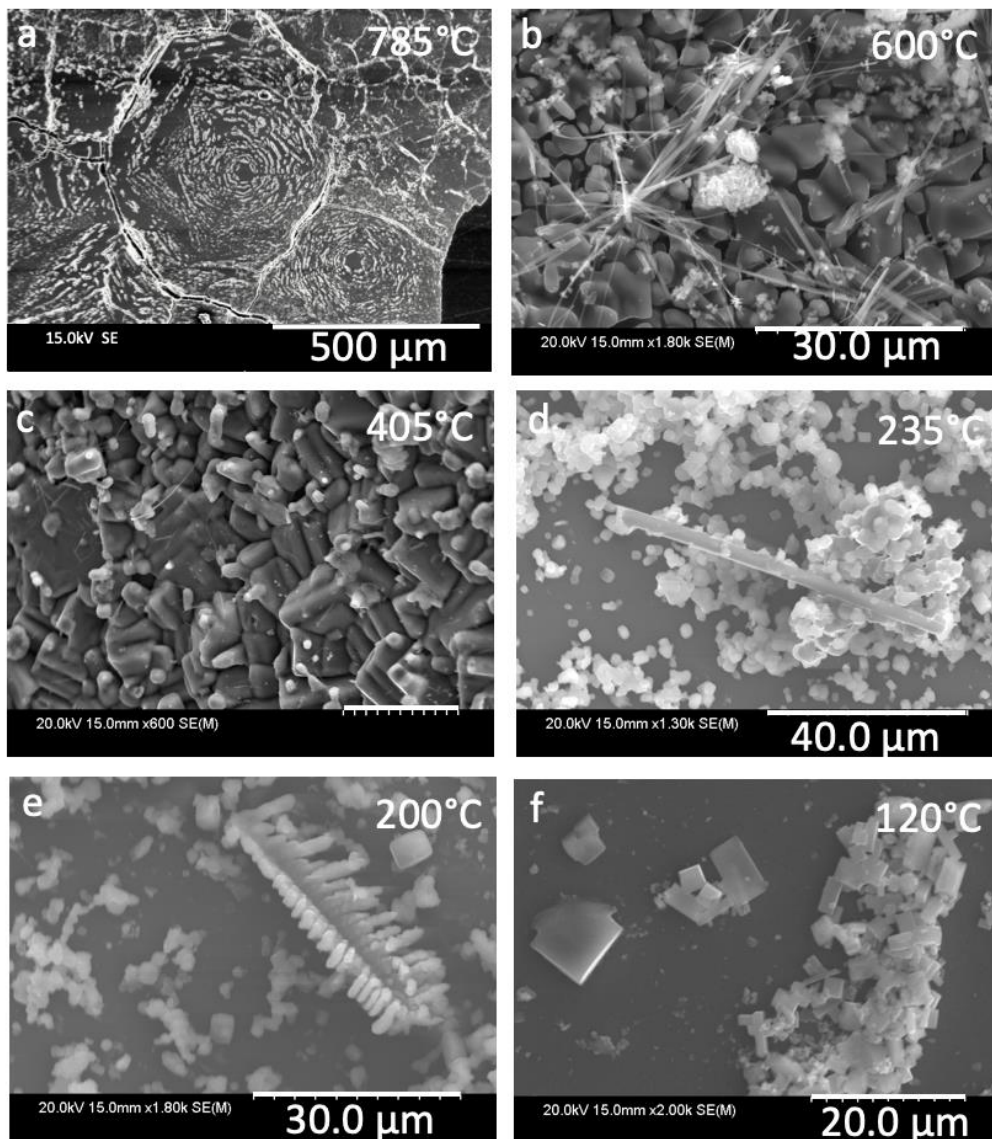


Figure 3.3: Secondary electron images of sublimates from Vul12NAS-2%Cl (b, c, e) and Vul13NFS-2%Cl (a, d, f). a) Large plates of quartz at 785°C; b) Background composed of quartz and wispy crystals of Na-silicate at 600°C; c) Halite crystals at 405°C; d) Halite crystals and an elongated Al-oxide at 235°C; e) Dendritic halite crystals at 200°C; f) Cubic halite crystals at 120°C.

(NaCl): at 405°C as tightly packed cubes, at 235°C as sub-rounded cubes, as dendrites at 200°C and as cubes at 120°C (Figure 3.3c-f). Additional low-temperature phases include an elongated, Al-silicate crystal at 235°C that is identified as mullite ($3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$) (Figure 3.3d).

Quartz (SiO_2) or opal (hydrated SiO_2) are identified by Raman spectroscopy at all temperatures in sublimates from experiments with both NAS and NFS starting compositions. Despite efforts to keep the sublimates dry (e.g. storage with desiccants), humidity in the lab may have caused the original sublimate phases in experiments to form secondary hydrated equivalents during storage. We consider opal a post-experiment hydration of a SiO_2 phase, as it is not stable at magmatic temperatures, but has been found as post-depositional alteration of volcanic products and fumarole incrustations (e.g. Jacobsen et al., 2014; Lowenstern et al., 2018; Stoiber and Rose Jr, 1974). Raman spectra show additional hydrates such as szenicsite ($\text{Cu}_3(\text{MoO}_4)(\text{OH})_4$) and molybdoformacite ($\text{CuPb}_2(\text{MoO}_4)(\text{AsO}_4)(\text{OH})$) occurring from 435-725°C in Vul13NFS+2%Cl and from 490-545°C in Vul12NAS+2%Cl (Figure 3.5). Murdochite ($\text{Cu}_{12}\text{Pb}_2\text{O}_{15}\text{OH}_2$) and strakhovite ($\text{NaBa}_3(\text{Mn}^{2+}, \text{Mn}^{3+})_4[\text{Si}_4\text{O}_{10}(\text{OH})_2][\text{Si}_2\text{O}_7]\text{O}_2 \cdot (\text{F}, \text{OH}) \cdot \text{H}_2\text{O}$) are identified between 435-540°C in the Vul13NFS+2%Cl experiment sublimates, as well as macfallite ($\text{Ca}_2\text{Mn}^{3+}_3(\text{SiO}_4)(\text{Si}_2\text{O}_7)(\text{OH})_3$) between 175-265°C (Figure 3.5). We interpret the occurrence of these minerals as either: (1) secondary hydrates formed from original high-T anhydrous

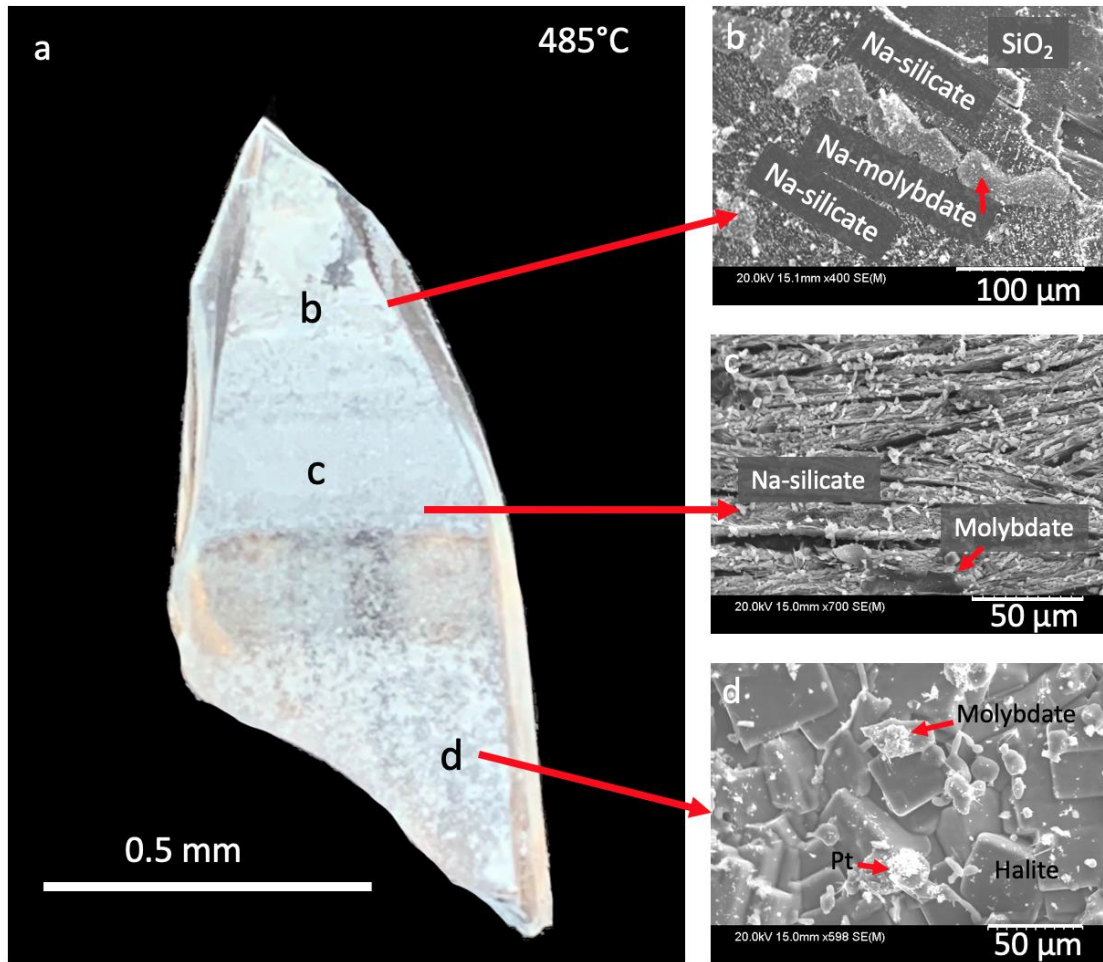


Figure 3.4: a) Photograph of glass chip of the tube from experiment Vul13NFS+2%Cl, showing three zones in sublimates over temperature interval (from ~440-540°C, median temperature 485°C) increasing from b to d; Secondary electron images from SEM b) Na-molybdate, surrounded by SiO₂ and Na-silicates; c) Na-silicate elongated crystals and molybdate; d) Predominately cubic halite crystals, with some molybdate and Pt.

molybdates or arsenates forming in the experiments, or as (2) Cl-based analogues of szenicsite, molybdoformacite or murdochite, stable at higher T in the experiments, with Cl⁻ replacing OH⁻ in the structure. Given the pervasiveness of chlorides at temperatures below ~500°C both in my experiments and in sublimates from natural fumaroles (e.g. Toutain et al., 1990, Zelenski and Bortnikova, 2005), the replacement of OH⁻ by Cl⁻ in these structures seems feasible.

Nepheline ($\text{Na}_3\text{K}(\text{Al}_4\text{Si}_4\text{O}_{16})$), bradaczekite ($\text{NaCu}_4(\text{AsO}_4)_3$) and/or leningradite ($\text{PbCu}_3(\text{VO}_4)_2\text{Cl}_2$) are also identified by Raman spectroscopy at different temperatures for the different composition experiments. They are found at ~200°C for Vul12NAS+2%Cl and 900°C for Vul13NFS+2%Cl. Both leningradite ($\text{PbCu}_3(\text{VO}_4)_2\text{Cl}_2$) and bradaczekite ($\text{NaCu}_4(\text{AsO}_4)_3$) are documented in fumaroles at Tolbachik (Vergasova and Filatov, 2012).

A complete summary of sublimate phase occurrences by temperature is shown in Figure 3.5. Representative Raman spectra for these various phases are from experiment Vul13NFS-2%Cl and are given in Appendix C. As some phases are not pervasive across a silica tube segment, the lack of any given phase at a particular temperature may be due to difficulty locating all the sublimates with the techniques used for phase identification.

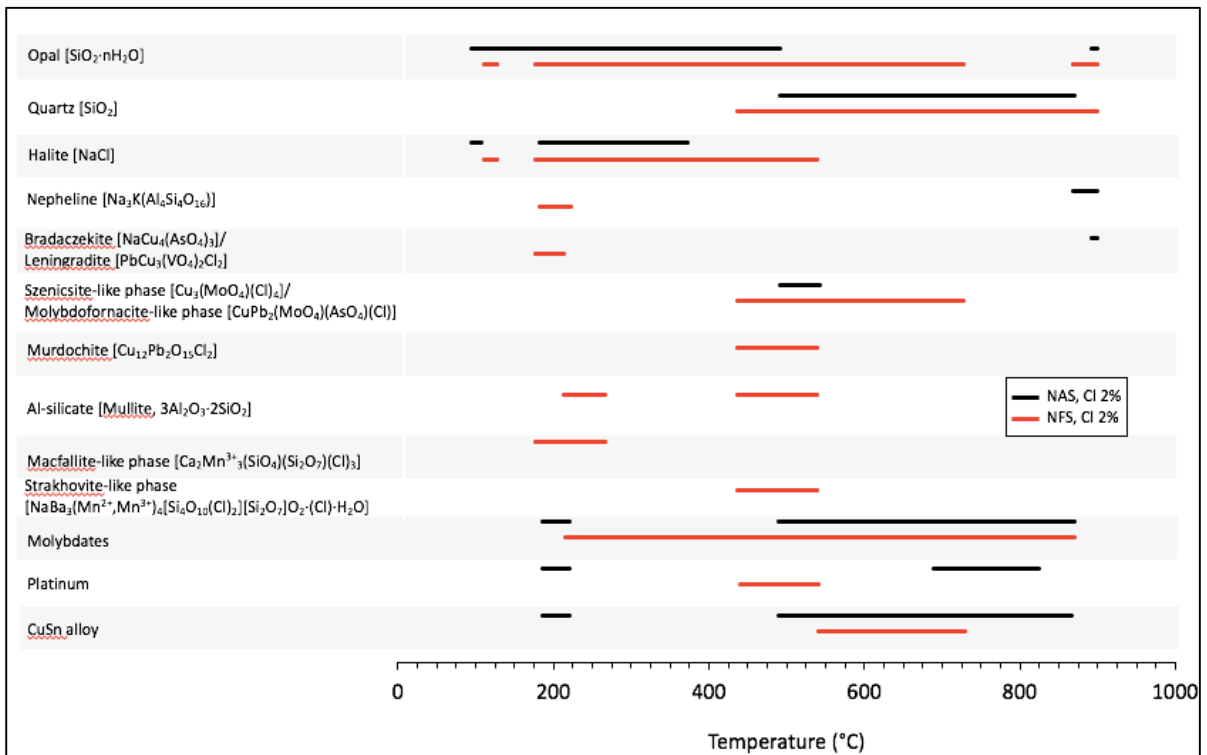


Figure 3.5: Summary of phases from experiments for Vul12NAS+2%Cl and Vul13NFS+2%Cl as determined using SEM, EDS and microRaman spectroscopy.

3.3.4. Trace element distribution

The bulk composition of the sublimates on the silica tube segments at each temperature for experiment Vul14NFS-1%Cl were measured using: (1) a total HF-HNO₃ dissolution of both silica tube and sublimates, in which all material was dissolved and (2) partial dissolution using only HNO₃, in which the sublimates were leached from the silica tube.

We note that Pt, along with several other elements that were detected in the sublimates e.g. Li, Rb, Ag, Cr, Cs, W), were not added directly as doped elements in the starting material (Table 3.2). These elements may represent contaminants from the crucible (i.e. Pt), reagent grade oxides used for starting materials or from the furnace components.

The HF-HNO₃ dissolution method produced higher bulk concentrations due to the full dissolution of material. Nevertheless, most element concentrations normalized to Al have similar patterns as a function of temperature along the tube using both methods, as exemplified by Cu, Mo, Pb and Bi (Figure 3.6). Normalization is used here as different quantities of sublimate are digested into solution for each segment at a given temperature. Aluminum is chosen as it is leachable (James and Riha, 1989) and non-volatile (Mather, 2015). In what follows, ICP-MS analyses of HNO₃ dissolutions are used for interpretations because absolute concentrations are not needed to compare the relative volatilities of the elements with temperature. Full results of the concentration of trace elements in the solution using both dissolution methods can be found in the Appendix B.

The Al-normalized trace element concentrations in the sublimate leachates from the HNO₃ method are compared for two experiments, Vul12NAS+2%Cl and Vul13NFS+2%Cl (Figure 3.7). The trends show volatile trace metals are transported in the gas phase and deposit at elevated concentrations on the silica glass tube as sublimates at certain “peak concentration temperatures”.

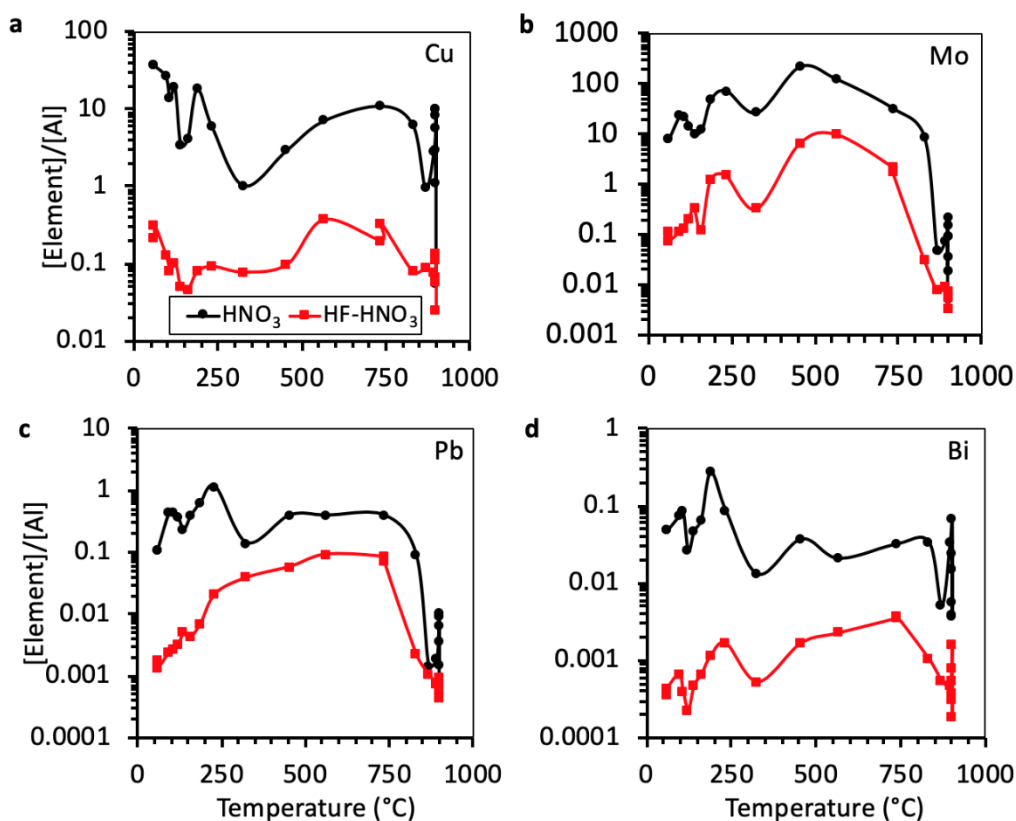


Figure 3.6: Concentrations of Cu, Mo, Pb and Bi normalized to Al in sublimates from the same experiment (Vul14NFS-1%Cl) by HNO₃ and HF-HNO₃ dissolutions. Similar trends in concentration are acquired with both digestion methods. Uncertainty values for element concentrations (1σ) of this study are reported in Appendix B and are typically smaller than the symbols plotted in this figure.

For example, Li sublimes at highest concentrations between ~250-850°C (Figure 3.7a) and Cr sublimes in higher concentrations between 400 and 600°C (Figure 3.7b). The concentration of volatile elements Mo, Pt, Pb and Bi, show a negligible effect of the melt composition (Fe content) on their sublimation behaviour (Figure 3.7).

3.3.1. Effects of Cl concentration

Given the similarity of volatile element behaviour in experiments on NAS and NFS melts (Figure 3.7), a single NAS composition is chosen to examine the effects of varying Cl content on the sublimation behaviour. The trace element distribution in the sublimates for the blank experiment and those containing 0, 1 and 2 wt% Cl are compared in Figure 8 - 10 (Table 3.1-Blank, Vul9NAS, Vul10NAS+1%Cl and Vul15NAS+2%Cl, all 7 days, respectively). Missing data points for the blank experiment are due to the concentrations being below detection limits.

Element concentrations normalized to Al in the blank are mostly below those for experiments containing melt, particularly for Li, Rb, Ag, Cs and Pt (Figure 3.8-3.10). The addition of Cl to the experiments (1 - 2 wt%), increases the concentration of Li, Rb, Ag and Cr in sublimates (Figure 3.8). The highest concentration of Rb and Ag in both the 1 and 2 wt% Cl experiments occurs at ~250°C (Figure 3.8b-c). The increase in concentration for Li and Cr occurs at ~250°C and is particularly substantial between ~450-750°C at 2 wt% Cl compared to 1 wt% Cl (Figure 3.8a&d). The data indicate that these elements may occur in different sublimate phases at different

temperatures.

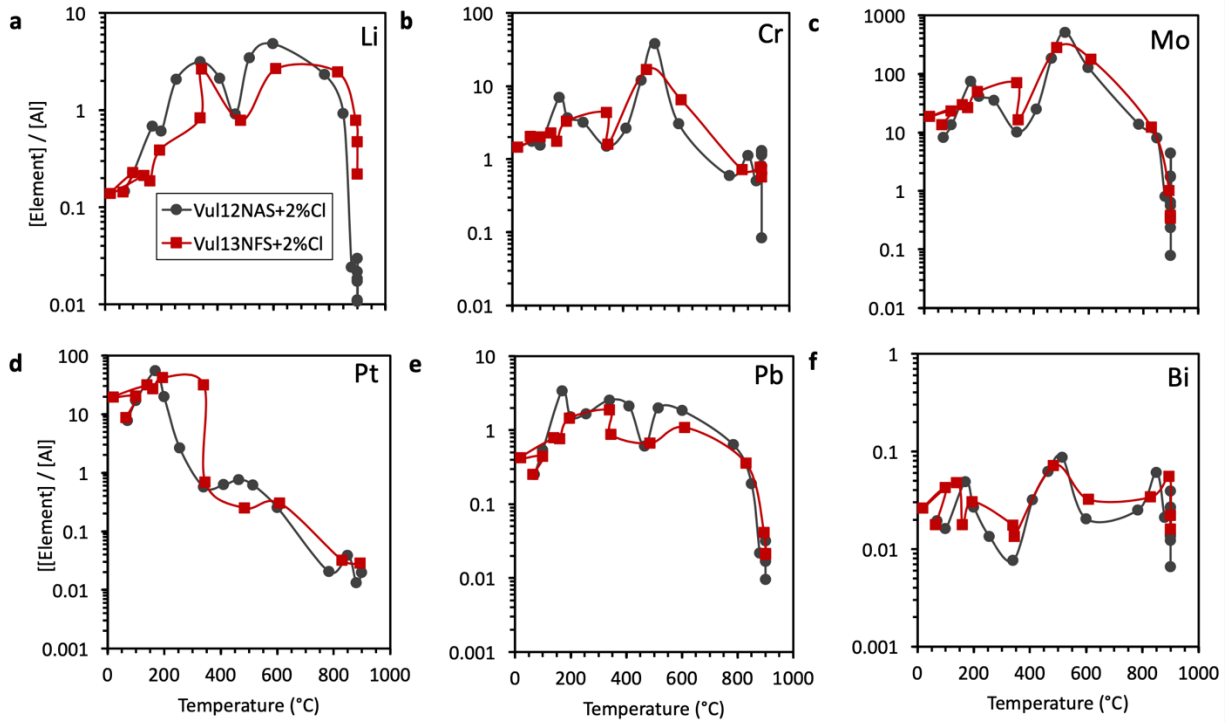


Figure 3.7: The concentrations of Li, Cr, Mo, Pt, Pb and Bi normalized to Al, in the sublimates by temperature, for experiments with different melt compositions. Melt composition does not affect the behaviour of the sublimation of volatile elements. Experiments analysed are Vul12NAS+2%Cl and Vul13NFS+2%Cl, 14-day experiments with NAS and NFS melt compositions, respectively. All data is from a HNO₃ digestion method. Uncertainty values for element concentrations (1 σ) of this study are reported in Appendix B and are typically smaller than the symbols plotted in this figure.

The concentrations of Cu and Cs only change in experiments with 2 wt% Cl added; at $>250^{\circ}\text{C}$ for Cu and $<330^{\circ}\text{C}$ for Cs (Figure 3.9a&b). The concentrations of Mo and W in the sublimates also increased with the addition of 2 wt% Cl, with peaks in concentrations from $\sim 400\text{-}500^{\circ}\text{C}$ (Figure 3.9c&d).

The behaviour of Pt differs from the other elements, with the 0 and 1 wt% Cl experiment sublimates having significant peaks in concentration of Pt at temperatures $<300^{\circ}\text{C}$ and a less substantial increase in concentration from the addition of 2 wt% Cl at these temperatures (Figure 3.10). The addition of the Pt crucible to the furnace is the only possible source for Pt to the experiments.

3.4. Discussion

During degassing, volatile trace metals dissolved in magmas partition into the co-existing gas phase depending on their partition coefficient and diffusion rate in the melt (e.g. Mackenzie and Canil, 2008). The diffusion of the trace metal from the melt into the gas phase is related to its volatility and the composition of both the gas and magma. In particular, acidic volatile ligands such as HCl and H₂S enhance transport of many trace metals in the melt or gas (e.g. Archibald et al., 2002; Johnson and Canil, 2011; Williams-Jones and Heinrich, 2005). With cooling, the solubility of trace metals in the gas decreases, resulting in deposition of a solid

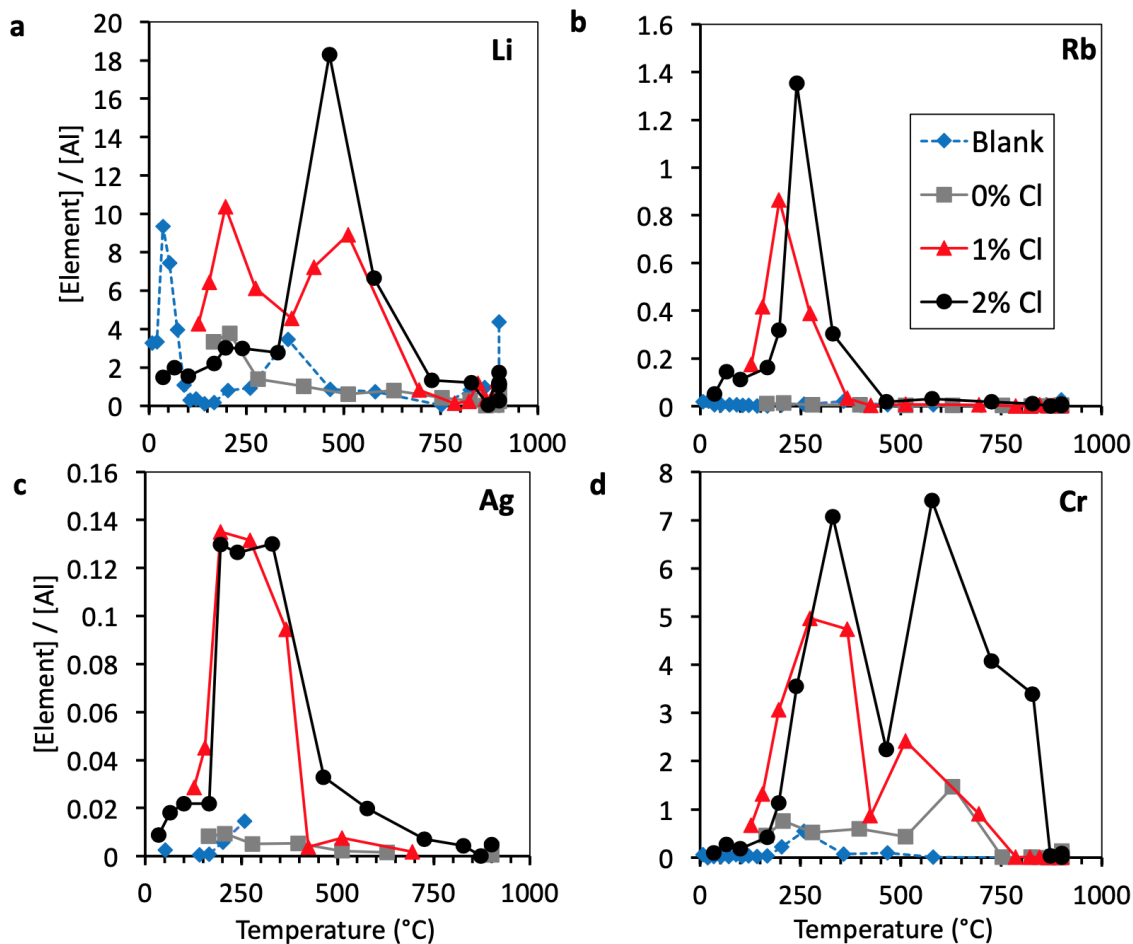


Figure 3.8: The concentration of Li, Rb, Ag and Cr normalized to Al, in the sublimates by temperature, for experiments with different Cl concentrations. The addition of Cl increases the sublimation of these elements. Experiments used for comparison are blank experiment (Blank), Vul9NAS with 0 wt% Cl (0% Cl), Vul10NAS+1%Cl with 1 wt% Cl (1% Cl) and Vul15NAS+2%Cl with 2 wt% Cl (2% Cl). Experiments analysed are all 7 day experiments and all data is from a HNO₃ digestion method. Uncertainty values for element concentrations (1σ) of this study are reported in Appendix B.

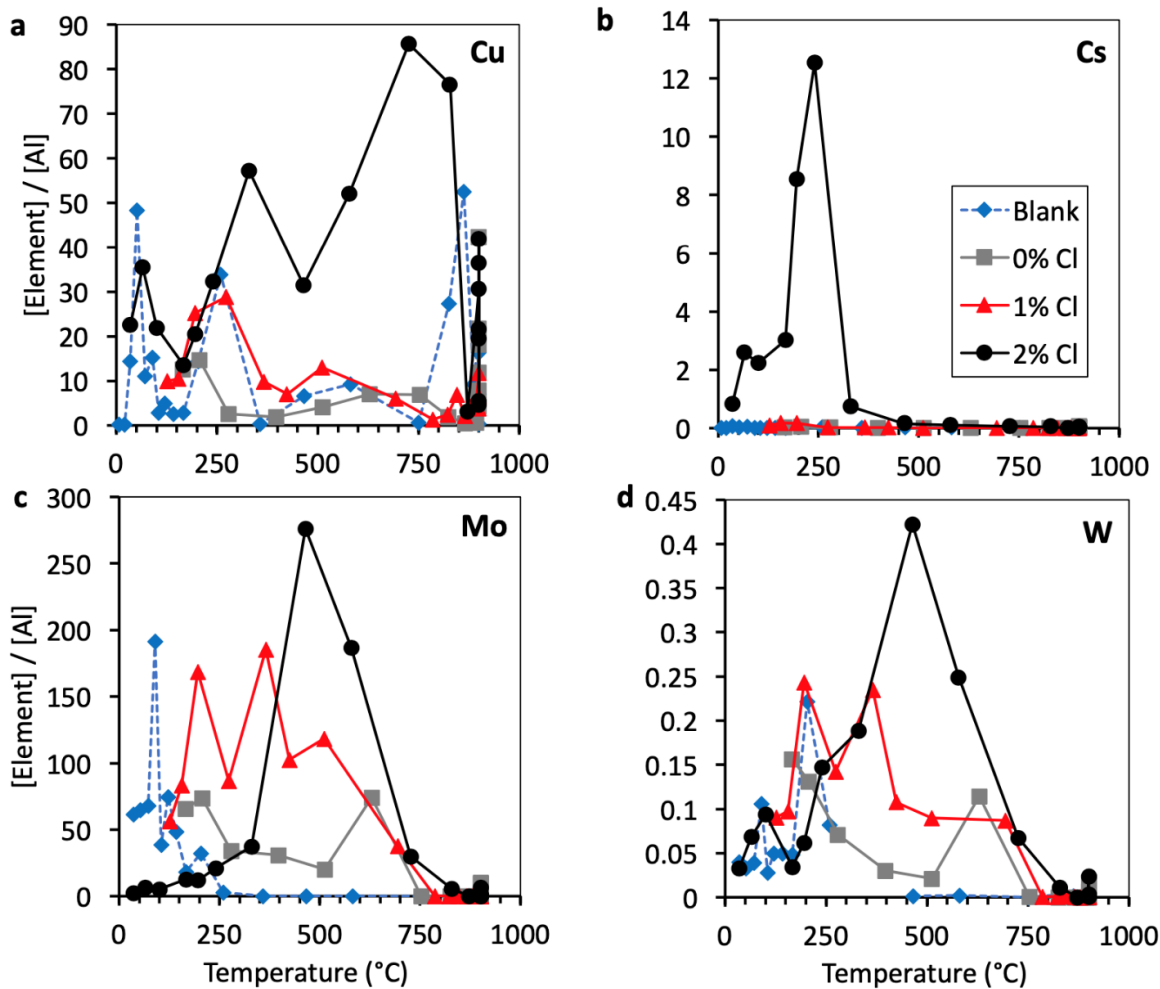


Figure 3.9: The concentration Cu, Cs, Mo and W normalized to Al, in the sublimates by temperature, for experiments with different Cl concentrations. The addition of 2 wt% Cl increases the concentration of these elements. Experiments used for comparison are blank experiment (Blank), Vul9NAS with 0 wt% Cl (0% Cl), Vul10NAS+1%Cl with 1 wt% Cl (1% Cl) and Vul15NAS+2%Cl with 2 wt% Cl (2% Cl). Experiments analysed are all 7 day experiments and all data is from a HNO₃ digestion method. Uncertainty values for element concentrations (1σ) of this study are reported in Appendix B.

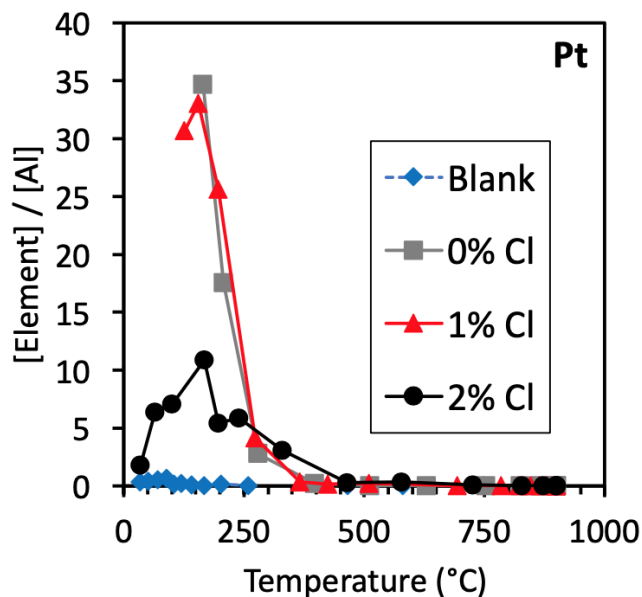


Figure 3.10: The concentration Pt normalized to Al, in the sublimates by temperature, for experiments with different Cl concentrations. The addition of melt with 0% Cl and 1 wt% Cl increases the concentration of Pt at low temperatures. Experiments used for comparison are blank experiment (Blank), Vul9NAS with 0 wt% Cl (0% Cl), Vul10NAS+1%Cl with 1 wt% Cl (1% Cl) and Vul15NAS+2%Cl with 2 wt% Cl (2% Cl). Experiments analysed are all 7 day experiments and all data is from a HNO₃ digestion method. Uncertainty values for element concentrations (1 σ) of this study are reported in Appendix B.

sublimate by a gas-solid reaction (e.g. Binnewies et al., 2017; Symonds et al., 1987; Wahrenberger et al., 2002). Thus, the sublimates observed in the experiments at specific temperatures reflect the solubility of a given trace metal with changing temperature and gas composition.

The compatibility of an element in the gas phase can be examined by calculating enrichment factors (EF) for volatile trace elements (Mo, W, Cu, Cl, V, Pb, Pt, Rb, Cd, Zn and Bi) for the sublimates from experiments. The EF is the concentration of a volatile element in a gas in relation to the concentration of that element in the parent magma, or starting melt in these experiments:

$$EF_X = \frac{(C_X/C_R)_{gas\ sublimates}}{(C_X/C_R)_{starting\ melt}} \quad (4)$$

where C_X is the concentration of the element of interest and C_R is the concentration of a reference element (Symonds et al., 1987). For this calculation, Al is chosen as the reference element (C_R), because it is non-volatile and is measured in both the gas sublimate and the melt compositions. The highest concentration of each element in the leachates (i.e. at its ‘peak temperature’) is used for the calculations. If the enrichment factor is >1 , the element is volatile and more compatible in the gas sublimate phase than in the starting melt.

The EF in the sublimates have values above 1 for all elements except Bi from the NFS melt composition experiments (Figure 3.11). Experiments with NAS melt show generally higher EF values compared to NFS melts. For experiments of the same duration, NFS melt experiments are expected to degas and sublime more given their lower viscosity ($10^{-0.96}$ Pa s) than NAS melts ($10^{2.04}$). This is confirmed by more extensive depletion from NFS experiments (Table 3.2). The lower EF values for NFS melt experiments must be due to other undefined factors such as gas transport or due to the vastly different denominators of the EF calculation, as NFS melts have significantly less Al than NAS melts.

Overall enrichment factors vary by two to three orders of magnitude for a given element. Comparing two experiments of the same duration and composition (Vul9NAS and Vul10NAS+1%Cl), the addition of Cl increases the EF for Mo, W, Pt, Pb and Zn by at least 5- to 10-fold. Compared to previous experiments on NAS and NFS in Cl-free gases (Scholtysik and Canil, 2018), Mo remains the trace element with the largest EF value, although the addition of Cl as a ligand increases its EF by nearly a factor of 2 (Figure 3.11). Consequently, Mo is the most compatible in the gas in the experiments, explain the preponderance of molybdates as sublimates (e.g. Figure 3.5) and its greatest depletion as a trace metal from the glasses (Table 3.2). The behaviour of the volatile elements in the sublimates is unaffected by the major element composition of the melt or whether it is Fe-bearing.

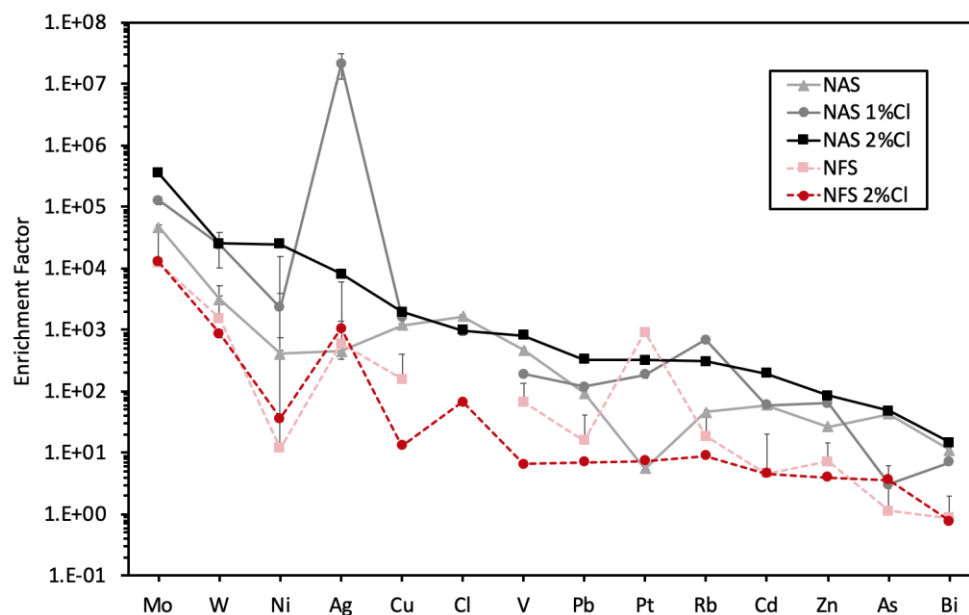


Figure 3.11: Enrichment factors (EF) for sublimates, calculated relative to Al from samples at the highest concentration for each element for experiments Vul9NAS (NAS), Vul10NAS+1%Cl (NAS 1%Cl; no data available for calculation of EF of Cl), Vul12NAS+2%Cl (NAS 2%Cl), Vul11NFS (NFS) and Vul13NFS+2%Cl (NFS 2%Cl). Plotted error bars are 1σ and are not visible if smaller than the symbols.

Sublimates collected at various volcanoes can be compared to the experimental sublimates of this study across a range of temperatures (Figure 3.12 and 3.5). The SiO_2 polymorphs reported at several volcanoes typically occur above 400°C (Figure 3.12), while the experiments sublime SiO_2 over a wider temperature range ($\sim 100\text{-}900^\circ\text{C}$) (Figure 3.5). Given that Si is generally non-volatile (Mather, 2015), in my experiments, Si is likely derived from the silica glass tube substrate.

The experiments also show sublimation of halite (NaCl) at similar temperatures to natural sublimates (<500°C) although a few volcanoes have reported halite at >500°C (Figure 3.12). Sylvite, a phase common in natural sublimates (e.g. Bernard and le Guern, 1986; Toutain et al., 1990) is not sublimated in the experiments, as K is not an added component.

Chlorides other than halite and sylvite, such as PbCl₂, KPb₂Cl₅, Pb₂TlCl₅, NH₄Cl, NH₄Pb₂Cl₅, NH₄CdCl₃, CuCl₂ and CuZnCl₂, occur in natural sublimates at <750°C (Figure 3.12). Other chlorides in the experimental sublimates include leningradite, murdochite and phases where the OH⁻ is derived from post-experiment hydration, or is being replaced by Cl⁻ to form a chloride in my experiments, such as in the molybdoformacite, szenicsite, macfallite and strakhovite that may contain Cl⁻ (Figure 3.5). These chloride phases occur at similar temperatures in both natural and experimental sublimates from ~150-750°C and tend to include similar additional Pb and Cu in their structure (Figure 3.5, 3.12).

In addition to phases found in natural fumarole sublimates, calculations and models of sublimation from volcanic gases have similarities to the experimental sublimates. Phases that are calculated to be forming from the cooling of a high temperature gas from Satsuma-Iwojima volcano indicate that PbCl₂ would occur as a solid phase from ~150-375°C and halite from ~250-650°C (Africano et al., 2002). Quisefit et al. (1989) indicate that NaCl sublimates from ~350-600°C in a thermochemical model and Wahrenberger et al. (2002) predict solid NaCl from

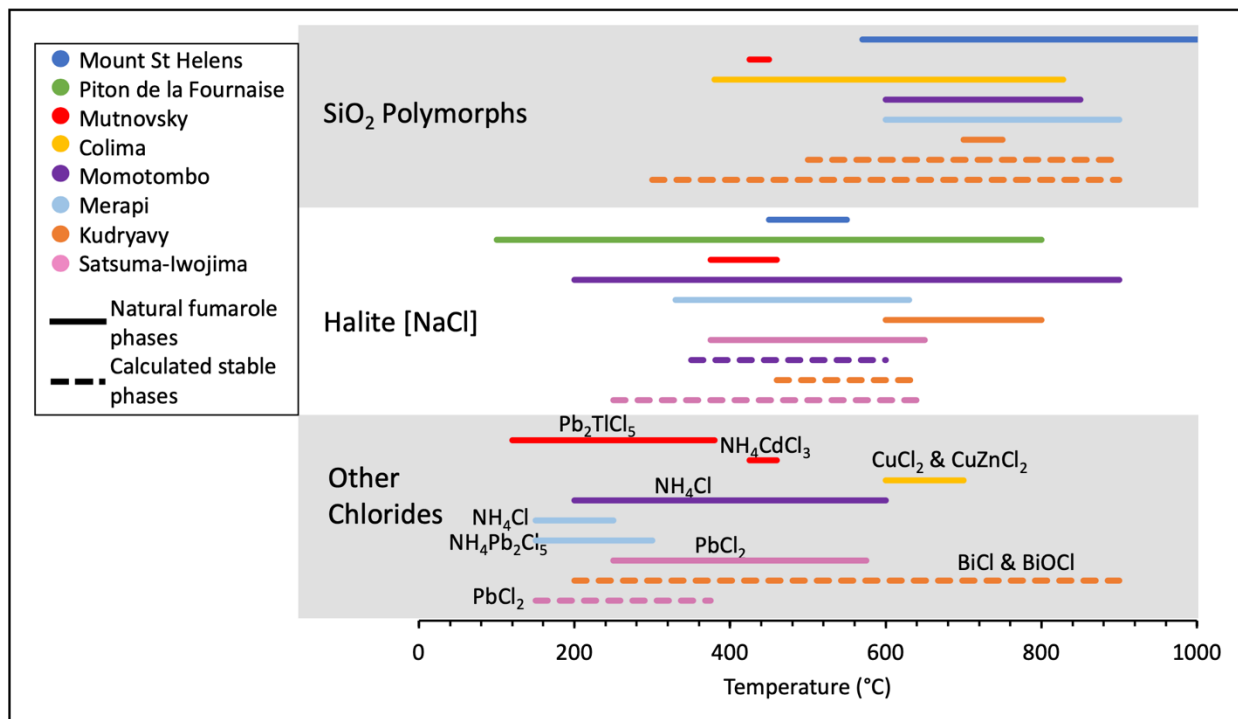


Figure 3.12: Temperatures of occurrence of sublimates in nature (non-dashed lines). Data from Mount St Helens (Bernard and Le Guern, 1986); Piton de la Fournaise (Toutain et al., 1990); Mutnovsky (Zelenski and Bortnikova, 2005); Colima (Taran et al., 2001); Momotombo (Quisefit et al., 1989); Merapi (Toutain et al., 2008 and references therein); Kudryavy (Africano et al., 2003); and Satsuma-Iwojima (Africano et al., 2002). Calculated stable temperatures of occurrence of sublimates, based on volcanic gas data (dashed lines). Data from Momotombo (Quisefit et al. 1989); Kudryavy (Henley and Seward, 2018; Wahrenberger et al., 2002) and Satsuma-Iwojima (Africano et al., 2002).

~640-460°C. The sublimation of NaCl in the experiments from ~550-100°C (Figure 3.5) is consistent with these calculations. Calculations show SiO₂ polymorphs occur from at least 300-1000°C (Wahrenberger et al., 2002), which is in agreement with my experiments. Additional

calculations for solid phases in equilibrium with gases from Kudryavy suggest that SiO_2 polymorphs are present from at least 500-1100°C and that BiCl and BiOCl occur from 200-1100°C (Henley and Seward, 2018) (Figure 3.12).

The volatile trace elements associated with Cl may be sublimating as metal-salts. Metals such as Cd, Zn, Pb, Cu and As have been shown to be volatile as chlorides in refuse incineration furnaces and through model calculations (Verhulst et al., 1995). Metal salts are predicted to volatilize in sequence as follows; CdCl_2 between 300-400°C, ZnCl_2 at 280°C, multiple Pb-chlorides between 200-400°C, CuCl_2 at 200°C and additional Cu-chlorides at higher temperatures such as Cu_3Cl_3 from 700-900°C (Verhulst et al., 1995). One complication is that other sublimation experiments have shown that salts are susceptible to hydration or deliquescence, potentially re-solidifying with altered compositions post-experiment, which could affect the distribution of phases we observe (Gough et al., 2016; Nekvasil et al., 2019).

My experiments show Mo is consistently the trace element in highest concentration in the sublimates, possibly partitioning into molybdates or as part of szenicsite or molybdoformacite from ~870-185°C. Africano et al. (2002) calculate that MoO_3 would sublime at temperatures lower than ~350°C and MoS_2 from ~650-300°C. Wahrenberger, et al. (2002) conclude an even wider range for MoS_2 sublimation, from ~700-400°C. Given the lack of S in the experiments, however, no comparison to these works is possible.

Elements that partition into the same sublimating phase should be correlated. Correlations of elements with one another are qualitatively implied by the grouping of elements at their highest concentrations at the same temperature (e.g. Figure 3.8, 3.9, 3.10). The host phases of the volatile elements can be inferred, by cross-referencing element groups with the sublimate occurrences (Figure 3.13). For example, Cu, Sn and Tl show a peak in concentration in the sublimates at ~100°C, and likely sublimate in a chloride, while Cr, Zn, As, Rb, Mo, Ag, Cd, W, Pt, Pb and Bi are concentrated at 200°C and could be sublimating in either of halite, bradazcekite/leningradite, macfallite or molybdates (Figure 3.13). Lithium, Cr, Zn, As, Mo, Cd, W and Bi show their highest concentrations in the sublimates at ~490°C and could be associated with halite, molybdates, murdochite, strakhovite or szenicsite/molybdoformacite phases. Vanadium, Cu, Ag, Sn and Pb are in high concentrations at ~610°C and are likely associated with the CuSn alloy found in sublimates at this temperature or with molybdates or the szenicsite/molybdoformacite phases (Figure 3.13). The peak of Pt concentration at approximately 200°C does not overlap with the identification of Pt in the sublimate phases by SEM and EDS (Figure 3.4c) and is likely due to the difficulty in finding sparse and minute phases by SEM and EDS. For example, appearance of a Pt crystal at any given temperature may dramatically increase the concentration of Pt in the tube segment.

Sulfur-bearing phases, such as sulfides and sulfates, dominate many volcanic sublimates (e.g. Quisefit et al., 1989; Zelenski and Bortnikova, 2005). Bi-sulfides are common fumarole

sublimates (e.g. Cheynet et al., 2000; Zelenski and Bortnikova, 2005) and the lack of appropriate ligand (i.e. S) may explain the low EF for Bi in the experiments. The addition of S to the

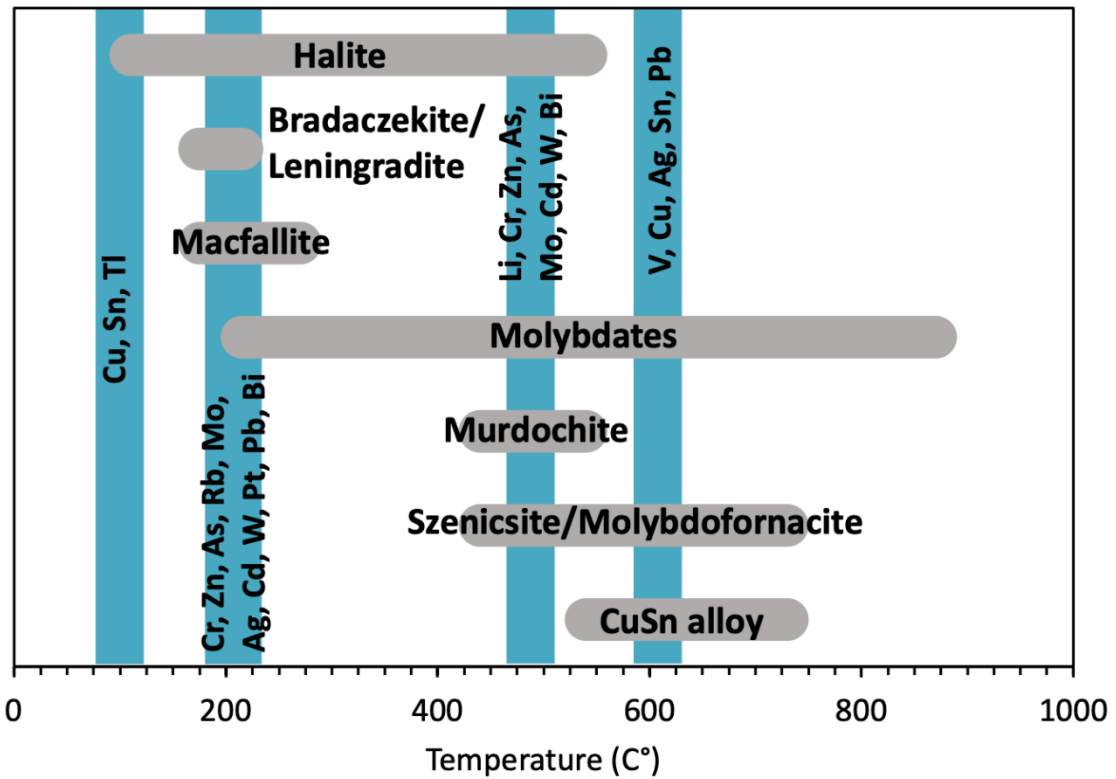


Figure 3.13: The experimental sublimate phases (grey bars) compared to the peak concentration temperatures of volatile trace elements (listed corresponding to blue bars). Blue bars overlapping with the grey bars indicate the likely host phase of the trace elements.

experiments would be expected to in turn produce sulfide or sulfate, depending on redox conditions and would also transport and host trace elements. A change in oxygen fugacity may also affect multi-valent elements (i.e. Fe, V, Cr). Future work will focus on the addition of ligands other than Cl and the role of oxygen fugacity/redox conditions on the formation of sublimates and the behaviour of volatile trace metals from emissions of a volcanic fumarole.

3.5. Summary and implications

My work using a benchtop fumarole design, (Scholtysik and Canil, 2018) shows that Cl can increase the volatility and sublimation of trace metals. The addition of 1-2 wt% Cl increases the concentration of Li, Cr, Cu, Rb, Mo, Ag, Cs and W in the sublimates. Sublimate phases include ubiquitous SiO_2 polymorphs, halite at temperatures below 550°C and szenicsite ($\text{Cu}_3(\text{MoO}_4)(\text{OH})_4$) and molybdoferrocite ($\text{CuPb}_2(\text{MoO}_4)(\text{AsO}_4)(\text{OH})$) at $\sim 500^\circ\text{C}$, in which OH^- is inferred to be post-experiment hydration or to be replaced by Cl^- . Fumarole minerals, bradaczekite ($\text{NaCu}_4(\text{AsO}_4)_3$) and/or leningradite ($\text{PbCu}_3(\text{VO}_4)_2\text{Cl}_2$), are identified in the sublimates. Chlorides other than halite may host trace elements such as Pb, Tl, As, Cu, Bi and Zn. These halides may be meaningful soluble sources of trace metals to the atmosphere and oceans.

Chapter 4. The effects of S, Cl and variable fO_2 on the transport and sublimation of volatile trace metals in volcanic gases investigated in experiments at atmospheric pressure

4.1. Introduction

Many moderately volatile trace metals, such as Cd, As, Tl, Pb and Bi are liberated during volcanic eruptions or associated fumarole activity (Mather 2015). Some metals, including Cu, Pb, Zn and Cd have emissions at rates of over 100 kg/d in volcanic plumes during eruptions (Edmonds et al., 2018) and load the atmosphere both now and in the past. Achieving a greater understanding of the degassing of these trace metals has implications for their geochemical cycles. Trace metals often sublime from the gas phase into solid phases and may adhere to aerosols and ash particles that are deposited wet or dry locally (Liotta et al., 2017) or can travel long distances in the atmosphere (Ayris and Delmelle, 2012; Mueller et al., 2017). Subsequently these sublimates can dissolve, mobilizing metals to the environment (Jones and Gislason, 2008), causing positive or negative consequences for organisms (e.g. Duggen et al., 2010; McKnight et al., 1981). The study of the transport and sublimation of trace metals, particularly with associated ligands, also has connections with ore deposit formation (Williams-Jones and Heinrich, 2005).

Oxygen fugacity (f_{O_2}) of modern volcanic emissions, vary orders of magnitude $\log f_{O_2}$ from -19 to -8 for temperatures between 600-1200°C and generally plot near the FMQ (fayalite-magnetite-quartz) and NNO (Ni-NiO) buffers (Holland, 2002). The f_{O_2} of volcanic gases is an important determinant of the speciation of major gas components (H, C, S, O) as well as the volatility of the dissolved trace metals, and stability of the phases in which they sublime when the gas cools (Taran et al., 2000). The gases from an eruption oxidize upon mixing with air upon emission (Gerlach, 1980). During the collection of sublimates from volcanic gases in silica glass tubes, the gases are thought to remain under reducing conditions due to their proximity to the source (Le Guern and Bernard, 1982). Of the phases that sublime from volcanic gases, S-bearing species are greatly affected due to variable redox states. Stable sublimate phases in calculations carried out at f_{O_2} conditions slightly more reducing than the NNO (nickel-nickel oxide) buffer indicate that Na_2SO_4 is stable from 420-300°C, K_2SO_4 from 380-300°C and $CaSO_4$ from 600-300°C (with minor amounts of $CaSO_4$ from 600-780°C). Sulfides are also stable, with FeS_2 from 560-400°C and FeS from 340-300°C (Wahrenberger et al., 2002).

As many of the trace metals (e.g. As, Cr, Cd, Cu, Mo, Pb, Tl, V, etc.) in volcanic gases have multiple oxidation states, the f_{O_2} conditions will have an impact on their speciation in the gas phase, ligand association and thus the nature of the sublimates they form. For example, some trace metals are found to condense in their reduced native state, or as oxidized compounds (Renggli

et al., 2017). The effect could be profound during volcanism on other planets (Moon, Mars) which occurs at orders of magnitude lower fO_2 compared to earth (King and McSween, 2005; King et al., 2018; Nekvasil et al., 2019).

Terrestrial volcanic gases are composed principally of H_2O and CO_2 but SO_2 , H_2S and HCl are important minor components. From volcanic activity worldwide, $15-21 \times 10^{12}$ g of SO_2 and $1.5-37.1 \times 10^{12}$ g H_2S are contributed to the atmosphere per year (Halmer et al., 2002). Sulfide liquids may serve as a significant source in degassing metals from silicate melts by attaching to buoyant vapour bubbles (Mungall et al., 2015). Sulfide melt inclusions from Merapi volcano show enriched concentrations of Fe, Cu, Co, Ni, Mo and Ti (Nadeau et al., 2010). Immiscible sulfide liquids may also destabilize and form Fe-oxides that are enriched in chalcophile elements, such as Cu and Bi (Vlastélic et al., 2016). Additionally, HCl is approximately 6 mol% of the bulk vapour of eruptions (Williams-Jones and Heinrich, 2005). The quantity of HCl released by volcanoes is estimated to between $4.3-170 \times 10^{12}$ g per year (Halmer et al., 2002; Pyle and Mather, 2009). Saline fluid phases in magmatic-hydrothermal systems, have been shown to have elevated concentrations of Cd, Fe, Pb, Sn, Tl and Zn - metals that can complex with Cl^- (Heinrich et al., 1999).

Due to its variable oxidation states, the S solubility in a melt is controlled primarily by the oxygen fugacity (fO_2) (Jugo, 2009). Sulfide (S^{2-}) is the dominant sulfur species at fO_2 below the NNO buffer and sulfate (SO_4^{2-}) is the dominant species above the NNO buffer (Sigurdsson et al.,

2015). The solubility of S increases overall with increasing temperature, but depends on the speciation of S (Sigurdsson et al., 2015). Increasing pressure lowers the solubility of sulfide in silicate melts (Mavrogenes & O'Neill, 1999). Sulfur solubility generally increases as fO_2 increases, when (SO_4^{2-}) species becomes more stable than reduced (S^{2-}) (Nagashima and Katsura, 1973).

Chloride (Cl^-) solubility in a silicate melt is a few thousand ppm to ~2 wt%, although overall Cl^- prefers aqueous fluids over melts (Carroll, 2005). The maximum solubility of Cl^- is 2.9 wt% in basalt in experiments at 1040-1210°C, 2000 bars and high fO_2 , close to the NNO buffer. Instead of a single volatile phase, Cl^- partitions into an aqueous vapour and hydrosaline liquid (at <1 wt% and <2 wt%, respectively) in andesitic experiments with <4 wt% H_2O (Webster et al., 1999).

The presence of Cl and S has been shown to increase the volatility of trace metals (Bi, Pb, Tl, Au, Re, Sb, Sn, Cd, Mo, As and Cu) from silicate melts by up to five-fold (Johnson and Canil, 2011). Once degassed, S and Cl, present as acidic gaseous species SO_2 , H_2S and HCl , can provide stability as ligands for complexation with trace metals in volcanic vapour (Williams-Jones and Heinrich, 2005). In the gas phase, trace metals eventually cool and sublime into a variety of solid phases - sulfides, sulfates, halides, oxides and silicates (e.g. Bernard and Le Guern, 1986; Quisefit et al., 1989; Toutain et al., 1990; Zelenski et al., 2013). Thermodynamic calculations have been used to simulate the sublimation process (e.g. Africano et al., 2002; Henley and Seward, 2018;

Quisefit et al., 1989; Wahrenberger et al., 2002) but can be inaccurate or hampered by the lack of thermodynamic data for some species and do not consider solid solution behaviour. Many studies report metal concentrations in sublimates as well (Taran et al., 2001; Vlastélic et al., 2011) and infer an association of volatile metals with subliming phases (e.g. Symonds et al., 1987).

As complements to thermodynamic calculation and field studies, previous experiments attempted to simulate the transport of metals in volcanic gases but were conducted in air (Scholtysik and Canil, 2018; 2020) and at reduced conditions in vacuum with or without a silicate melt source of metals (Nekvasil et al, 2019; Renggli and Klemme, 2020). A previous study in air showed the presence of Cl as the ligand increases the concentrations of Li, Rb, Cs, Ag, Cr, Cu, Mo and W that are transported in gas, and showed various chlorides are determined to be likely hosts of metals (Scholtysik and Canil, 2020). Nekvasil et al. (2019) determined that Martian magmatic volatiles contributed significant Fe, S and Cl by subliming Fe-oxides, chlorides, sulfides and sulfates. Renggli and Klemme, (2020), degas 30 metal oxides, with and without S and Cl, in experiments between the MW (magnetite-wüstite) and MH (magnetite-hematite) buffers. They determine that experiments with both Cl and S are the most mineralogically diverse and produce oxides, chlorides and sulfides as sublimates. No previous experimental study has addressed trace metal transport or sublimation at fO_2 near or within the range of most volcanic gases (i.e. NNO to FMQ buffers), in a system containing both S and Cl. Herein I modify an original ‘benchtop

fumarole' design (Scholtysik and Canil, 2018; 2020) to a gas-mixing furnace, to examine the effects of fO_2 , S and Cl on the transport and sublimation of trace elements from volcanic gases degassed from silicate melt.

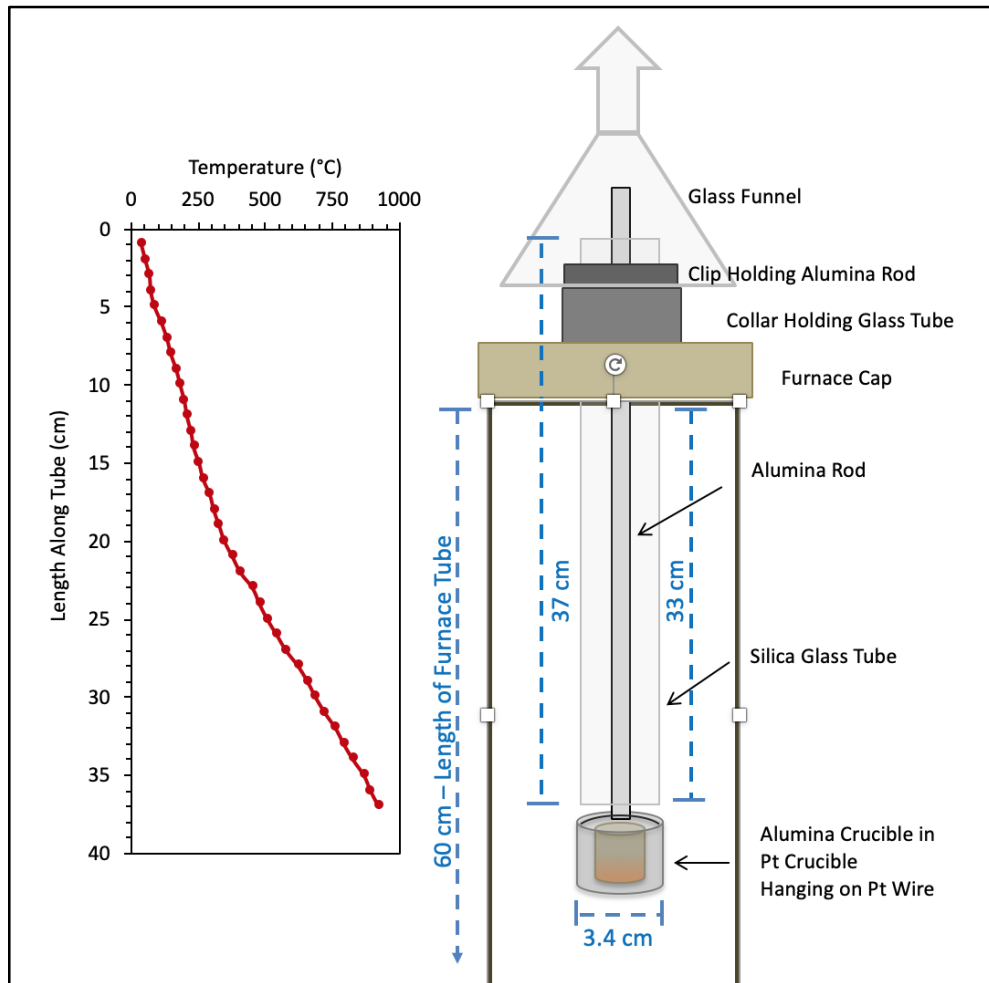


Figure 4.1: Design of gas mixing furnace fumarole and the thermal gradient measured in suspended tube with 200 cc/min gas. Horizontal scale is exaggerated.

4.2. Methods

4.2.1. Experimental methods

Experiments to collect sublimates from a degassing melt along a thermal gradient under various fO_2 conditions were carried out in a modified Deltech gas-mixing furnace. The design consisted of a vertical alumina (Al_2O_3) tube into which samples were loaded from the top and samples suspended at $\sim 950^\circ C$ in a gas flow. The thermal gradient was measured over the length of the furnace tube using an S-type ($Pt_{90}Rh_{10}/Pt$) thermocouple, with the hotspot of the furnace set to $1000^\circ C$ and a gas flow of $200\text{cm}^3/\text{min}$ (Figure 4.1).

The fO_2 in the furnace was controlled by mixing CO and CO_2 gases into the bottom of the furnace tube at a flow rate of $200\text{cm}^3/\text{min}$ and exiting from a separate exhaust near the top of the furnace. The fO_2 for each experiment was set between $\log fO_2$ -6.4 to -16.3 at $950^\circ C$ using gas-mixing ratios from Deines et al. (1974) and checked with an EMF cell to be within 0.2 $\log fO_2$ units of those values. Compared to the FMQ (fayalite-magnetite-quartz) redox buffer, these values equate to a range from FMQ+5.4 to FMQ-4.6, respectively (Frost, 1991). Oxygen fugacity was held stable for the duration of an experiment.

The starting melt composition was synthesized using reagent grade oxides of Na_2CO_3 , Al_2O_3 , SiO_2 and Fe_2O_3 in proportions that were approximately phonolitic in composition, based on $Na_2O-Al_2O_3-SiO_2$ (NAS) and $Na_2O-Fe_2O_3-SiO_2$ (NFS) compositions of previous experiments

in air (Scholtysik and Canil, 2018; 2020). The target compositions for NAS were 32% Na₂O, 10% Al₂O₃ and 58% SiO₂ and for NFS were 29% Na₂O, 11% Fe₂O₃ and 29% SiO₂, by weight percent. These compositions were chosen because they have melting points below ~800°C (Schairer and Bowen, 1956; Bailey and Schairer, 1966) and have low viscosities to permit degassing. The oxides and carbonates of the starting material were weighed into a container and shaken for 15 minutes to homogenize. Trace metals were added to the powder in a 2% HNO₃ ICP standard solution at ~200 ppm each of V, Cu, Zn, As, Y, Mo, Cd, Sn, Yb, Pb and Bi. The solution was dried down under a heat lamp. Chlorine and S were added to the starting material at 2 wt% and 1 wt%, respectively, by the addition of NaCl and Na₂SO₄ as powders. Unlike previous work (Scholtysik and Canil, 2018), the starting material was not pre-fused to a glass, in order to avoid degassing of all Cl and S (and volatile trace metals) before insertion into the gas furnace.

For each experiment, ~3 g of starting material was compressed into a new, 5ml alumina crucible. The alumina crucible was fitted inside a larger Pt crucible, and suspended on a Pt wire at the end of an alumina rod that was suspended in the centre of a 1.55-mm-diameter, 37-cm-long, 1-mm-thick silica glass tube held in place at the top by an alumina holder (Figure 4.1). The silica tube and adjoining crucible was lowered into the furnace at 600°C with 4 cm of the tube residing above the furnace (Figure 4.1). The furnace was then sealed and the CO-CO₂ gas mixture was immediately turned on at a flow rate of 200 cm³/min of mixed CO-CO₂ gas. After seven minutes,

once the tube filled with gas, the furnace temperature was increased in four minutes to 1000°C. The temperature at the top of the crucible was measured to be 950°C and the gas flow was continuous for the duration of the experiment. Experiment duration was 5 days, long enough to degas the melt based on previous work (Scholtysik and Canil, 2018). To terminate experiments, the silica glass tube was quickly lifted out of the apparatus and allowed to cool to below red heat in air over a period of seconds. Once cooled, silica tubes were then sliced into 2-cm-long segments with a dry diamond saw and stored in sealed plastic bags under an anhydrous calcium sulfate desiccant. Each tube segment was assigned the median temperature of its length, based on its location in the measured thermal gradient of the furnace (Figure 4.1).

A blank experiment was conducted in the furnace using the same procedure as the other experiments, but without any starting silicate melt. The blank was performed in 60% CO₂ (FMQ-3) after several melt-present experiments had been conducted in the furnace, to check if any residual volatile elements have been remobilized. Table 4.1 outlines the number, melt composition and fO₂ for all experiments, in the order in which they were performed.

Table 4.1: Experiment conditions

Experiment Name	Melt Composition	CO ₂ :CO Mix	logfO ₂ (950°C) ⁶	Conditions	fO ₂ Compared to FMQ ⁷
740NASCIS	NAS	100% CO ₂	-6.4		FMQ+5.4
741NASCIS	NAS	80:20	-13.2		FMQ-1.5
742NASCIS	NAS	20:80	-16.3		FMQ-4.6
743BLANK	-	60:40	-14.7		FMQ-3.0
745NASCIS	NAS	60:40	-14.7		FMQ-3.0
746NASCIS	NAS	40:60	-15.4		FMQ-3.7
747NFSCIS	NFS	60:40	-14.7		FMQ-3.0

4.2.2. Analytical methods

As noted above, fusion of the starting material into a glass was not done prior to the experiments to avoid the loss of volatile elements. Melt composition of the starting material was examined post-experiment from a glass quenched in the alumina crucible. The glass was removed by sawing the crucible lengthwise, removing a section of glass, mounting the glass in epoxy and polishing the glass. Major element composition of the glass (Table 4.2) was determined with

⁶ As calculated at 950°C according to Deines et al. (1974).

⁷ In relation to the FMQ buffer at 950°C (according to Frost, 1991).

electron-probe micro-analyses using a fully automated CAMECA SX-50 at the University of British Columbia. Wavelength-dispersion mode was used with an excitation voltage of 15 kV, beam current of 10nA and spot size of 20 μm . The peak count time was 20 s for all elements, except S and Cl, which was 40 s. Sodium and K were measured first to reduce loss during analysis. Data reduction for the EPMA analysis was done using the 'PAP' $\phi(\rho Z)$ method (Pouchou & Pichoir, 1985). Low analytical totals can be accounted for with absorbed H_2O due to the hygroscopic nature of the glasses and trace elements.

Minor and trace elements in the glass were determined using laser ablation inductively coupled plasma mass spectrometry (LA ICP-MS) using a Teledyne CETAC LSX-213 G2+ with a HelEx II sample cell connected to a Thermo-Instruments X-Series II ICPMS at the University of Victoria (Table 4.2). Trace elements were measured by first collecting background for 30 s, followed by a 60 s ablation using a laser with a 100 μm spot size over a 300 μm raster line with four passes at 15 $\mu\text{m/s}$ in an He carrier gas. Laser output was at 30%, 10 Hz and with a fluence of 6.12 J/cm^2 . Each glass was measured five times, signals were averaged and detection limits were calculated as three times the standard deviation of the background. The calibration of signals used standard NIST glasses 611, 613 and 615 (Jochum et al., 2005) and concentrations were calculated using Si as an internal standard and the Longerich et al. (1996) method. Analyses using similar

settings had accuracy on USGS BCR2g reference glass better than: 5% for Li, V, Rb, Cs, Cd, Y, Mo, Pb and W; 10% for Cr; 20% for Cu and Sn; and 30% for Zn.

Table 4.2: Compositions of post-experimental glasses

	740NASCIS		741NASCIS		742NASCIS		745NASCIS		746NASCIS		747NFSCIS	
	FMQ+5.4		FMQ-1.5		FMQ-4.6		FMQ-3.0		FMQ-3.7		FMQ-3.0	
wt% ⁸	1 σ		1 σ		1 σ		1 σ		1 σ		1 σ	
Na ₂ O	27.69	1.58	28.42	0.79	30.23	0.77	29.38	0.36	29.26	0.43	25.56	0.79
MgO	0.03	0.02	0.01	0.01	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02
Al ₂ O ₃	8.90	1.84	8.41	0.95	10.84	1.29	9.62	1.30	8.55	0.93	5.01	2.53
SiO ₂	57.76	1.34	56.22	0.75	55.81	1.26	55.99	1.19	57.00	0.68	56.95	1.40
S	0.76	0.29	0.89	0.15	0.12	0.03	0.76	0.19	0.84	0.12	0.33	0.07
Cl	0.58	0.47	0.46	0.31	0.34	0.10	0.25	0.27	0.35	0.21	0.14	0.13
K ₂ O	0.30	0.18	0.28	0.11	0.19	0.08	0.15	0.03	0.16	0.03	0.06	0.02
CaO	0.06	0.03	0.05	0.02	0.05	0.01	0.08	0.02	0.04	0.02	0.07	0.03
FeO	0.04	0.03	0.04	0.03	0.06	0.03	0.05	0.03	0.04	0.03	9.64	0.42
ppm ⁹												
Li	6.7	0.2	6.1	0.2	7.9	0.1	4.8	0.3	5.2	1.2	2.3	0.1
Ti	250	4	235	5	223	4	224	6	236	4	226	2
V	226	7	219	7	208	4	192	12	212	2	199	1

⁸ Major elements in the glasses, measured by EPMA.

⁹ Trace elements in the glasses, measured by LA-ICP-MS.

Cr	6.1	0.8	6.3	0.6	8.3	0.2	3.9	0.7	5.3	0.2	7.3	0.3
Mn	3.7	1.0	2.8	0.1	2.8	0.1	2.5	0.1	2.8	0.0	232.5	2.8
Fe	508	5	481	3	486	21	468	6	461	21	115043	824
Co	0.3	0.0	0.3	0.1	0.3	0.0	0.2	0.0	0.3	0.1	4.0	0.1
Ni	1.2	0.2	1.0	0.1	1.2	0.1	1.4	0.1	1.3	0.7	18.8	0.2
Cu	533	55	463	57	374	58	319	27	324	23	252	3
Zn	219	20	207	15	128	22	186	12	210	8	222	2
As	218	14	215	6	13	3	175	15	197	4	173	1
Rb	1.9	0.1	1.6	0.0	1.0	0.0	1.0	0.0	1.4	0.1	1.3	0.1
Sr	214	6	188	11	169	13	180	8	189	11	184	6
Y	279	9	267	20	243	21	263	14	266	21	259	8
Mo	49.6	8.2	56.3	4.8	70.2	1.2	35.5	6.9	41.7	0.7	33.9	0.7
Ag	0.07	0.01	0.09	0.04	0.01	0.00	0.05	0.00	0.05	0.01	0.05	0.01
Cd	147	9	141	4	0	0	141	7	158	2	209	3
Sn	205	1	193	2	75	6	175	3	179	1	161	3
Cs	16.3	4.3	5.8	1.4	2.3	0.5	2.0	0.3	5.7	1.0	0.5	0.0
Ba	27.8	0.7	24.9	1.2	23.2	1.3	22.8	0.6	23.2	1.0	21.3	0.6
Yb	250	8	235	14	209	16	222	10	223	16	204	7
W	0.8	0.1	0.9	0.2	1.3	0.1	0.2	0.0	0.1	0.3	0.2	0.0
Pb	242	10	225	3	0	0	188	7	206	3	185	2
Bi	250	13	240	7	3	1	201	9	211	3	196	2

Sublimates deposited on the interior of the silica glass tubes were examined using a Hitachi S-4800 Field Emission Scanning Electron Microscope (FESEM) and accompanying Energy

Dispersive X-Ray Spectroscopy (EDS), at the University of Victoria. Images were collected using a back-scatter (BSE) detector and the EDS analyses were carried out with a current of 20 μ A and an accelerating voltage of 20kV.

Sublimates were chemically characterized for bulk trace elements composition on each glass segment over the thermal gradient using solution nebulization ICP-MS. The sublimates were leached from each segment of the silica tube in 3 ml of 16 N Environmental Grade HNO₃ for 48 h on a 120°C hotplate. This solution was diluted to 30 ml with deionized water and the solutions were run using an Agilent ICP-QQQ-MS in MS/MS mode. To avoid mass interferences, solutions were run a second time for this study, using a collision cell and either O₂ or H₂ gas, to use mass shift in order to measure S as SO⁺ and Cl as ClH₂⁺ (Sugiyama, 2013). Some isotopes were analysed multiple times, with and without the mass shift modes. Isotopes of V, Cr, Fe, Co, Ni, Cu, Zn, As, Se, Rh, Ag, In, Sn and Re were run in O₂ mode and V, Fe, Rh, Sn and Re were also run in H₂ mode. Additionally, isotopes of V, Mn, Fe, Co, Ni, Cu, Zn, As, Rh, In and Sn were run with a collision cell mode using He in the reaction cell and kinetic energy discrimination to analyse the masses (McCurdy and Sugiyama, 2010). The ICP-MS signals were corrected using an internal standard of In in a 2% HNO₃ solution that was measured after ten unknown samples. Data were converted from counts-per-second (CPS) signals to concentrations with standard solutions. Trace element concentrations in the samples are typically below the element concentrations in the

standards and are reported as concentrations in ppb, unless a standard was not available, in which case they are given as CPS. Data was not considered if the signal is below detection limited defined as three times the standard deviation of the background (Appendix D).

Sublimate phases from the experiments were compared to gas and solid phase stabilities calculated for the system in this study using Gibbs Energy minimization in GEM-Selektor v.3.5 (GEMS3; (<http://gems.web.psi.ch>)), a thermodynamic modelling freeware (Kulik et al., 2013; Wagner et al., 2012). Details of the thermodynamic calculations and modelling methods can be found in Wagner et al. (2012). The thermodynamic database used was the SUPCRT92 dataset and the Helgeson-Kirkham-Flowers equations of state (Helgeson et al., 1981; Johnson et al., 1992). The input composition was the NAS composition melt, with weighed-in amounts of Cl, S, Mg, K, Ca and trace elements (Table 4.3). Three model calculations were run with the same starting material input but variable fO_2 of FMQ+5.4, FMQ-1.5 and FMQ-4.6. The model was run in 10°C intervals from 200-800°C (only 380-800°C for 100% CO₂ model was possible).

Table 4.3: Model inputs

Ratio of gases	fO_2	Amount of gas added (g)
100% CO ₂	FMQ+5.4	4.9
80% CO ₂ , 20% CO	FMQ-1.5	4.545
20% CO ₂ , 80% CO	FMQ-4.6	3.493

For all models:

Amount added (g)

Al ₂ O ₃	0.23
Na ₂ CO ₃	1.27
Na ₂ SO ₄	0.15
NaCl	0.1
SiO ₂	1.35
Ag	3.00E-07
As	0.00067
Bi	0.00074
Ca	0.0001
Cd	0.00062
Cu	0.00144
Fe	0.00142
K	0.0071
Li	2.50E-05
Mg	0.00054
Mo	0.00062
Pb	0.0007
Pt	3.00E-06
Rb	5.00E-06

Sn	0.0006
Ti	0.00048
V	0.00068
Y	0.00084
Zn	0.00065

4.3. Results

4.3.1. Melt composition

Major element composition of the glass was homogeneous (standard deviation <10%) for Na₂O and SiO₂ in NAS composition melts and Na₂O, FeO and SiO₂ in the NFS melt. The Al₂O₃ in the glasses has consistently higher standard deviations, with values above 10%. These heterogeneities may represent some Al contamination from the alumina crucible containing the melt (Table 4.2). Due to degassing, volatile elements such as S and Cl have heterogeneous concentrations in glasses. Some trace elements also have high standard deviations (>20%) such as Mn, Co, Cu, Zn, As, Ni, Mo, Ag, Cs, W, Pb and Bi, although this varies by experiment (Table 4.2, Figure 4.2).

Analyses of S and Cl in the post-experiment glass show significantly more loss of S, and slightly more loss of Cl, as the fO₂ decreases from FMQ+5.4 to FMQ-4.6 (Figure 4.2a-b). Little to

no loss of Zn, Sn, As, Bi, Pb and Cd is seen from the starting material in the four most oxidized experiments. Some loss of Zn, Sn and As and significant loss (by a factor of ~5 - 2000) is observed for Bi, Pb and Cd in the glass from the experiment with the most reduced conditions at FMQ-4.6 (Figure 4.2c). The concentration of Cu in the glass is higher than that added to the starting material. Some Cu may have been taken up from the gas in the furnace or gas mixing apparatus, possibly via Cu tubing and/or likely from brass components on the gas input. Copper uptake is most notable in the most oxidized experiments 740NASCIS FMQ+5.4 (Figure 4.2d). Significant loss of Mo from the glass is observed in all experiments. Little to no loss of Y, Yb and V occurred (Figure 4.2d).

4.3.2. Sublimate phases

Sublimates form along the full length of the 37 cm-long silica tubes from 25-925°C. Sublimates are all white in experiment 740NASCIS FMQ+5.4, but vary in colour for all other more reducing experiments, being white at temperatures >580°C and orange-brown at lower temperatures. Sublimates are fine-grained, and the lower temperature phases are not well adhered to the silica tube glass. The blank experiment tube, 743BLANK FMQ-3.0, showed no visible sublimates.

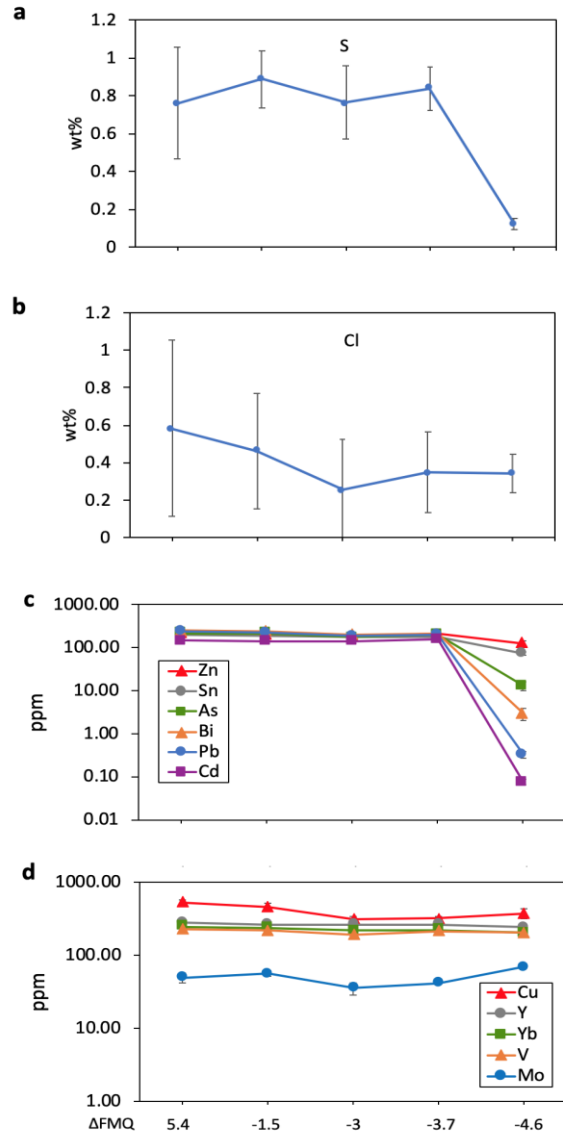


Figure 4.2: Analyses of (a) S and (b) Cl in the starting material glass removed from the crucible post-experiment (experiment name on x-axis) by EPMA and (c, d) doped trace metals by laser ablation ICP-MS. Error bars are 1σ standard deviation.

Examples of sublimate phases determined by FESEM and EDS analyses are depicted with BSE images (Figure 4.3). Only common phases that form crystals of $> \sim 5 \mu\text{m}$ can be well characterized by SEM at the operating conditions used. Textures and features of the sublimates are in many ways similar to those of Scholtysik and Canil (2020), but phase identities differ. Sublimates from experiment 741NASCIS FMQ-1.5 include crystals of Na_2SO_4 at 510°C , as well as SiO_2 (Figure 4.3a). Sublimates from experiment 742NASCIS FMQ-4.6 include cubic NaCl crystals at 455°C (Figure 4.3b), acmite ($\text{NaFe}(\text{SiO}_3)_2$) and Na-silicates at 510°C (Figure 4.3c) and SiO_2 crystals in circular configurations at 580°C (Figure 4.3d).

4.3.3. Trace element distribution measured by ICP-MS

Elements that are volatile degas from the melt, and eventually sublime into solid phases along the silica tube as the gas cools. The distribution for a volatile element can at times show a peak in concentration at a temperature where the phase hosting it preferentially sublimates (Scholtysik and Canil, 2018; 2020). Trace element concentrations measured in the sublimates along the temperature gradient are normalized to Al to compare all experiments with the NAS melt composition and the blank experiment. Normalization is used to get rid any effects of possible variable masses of sublimate leached between each glass tube segment. Absolute abundances, however, show the identical trends to Al-normalized data.

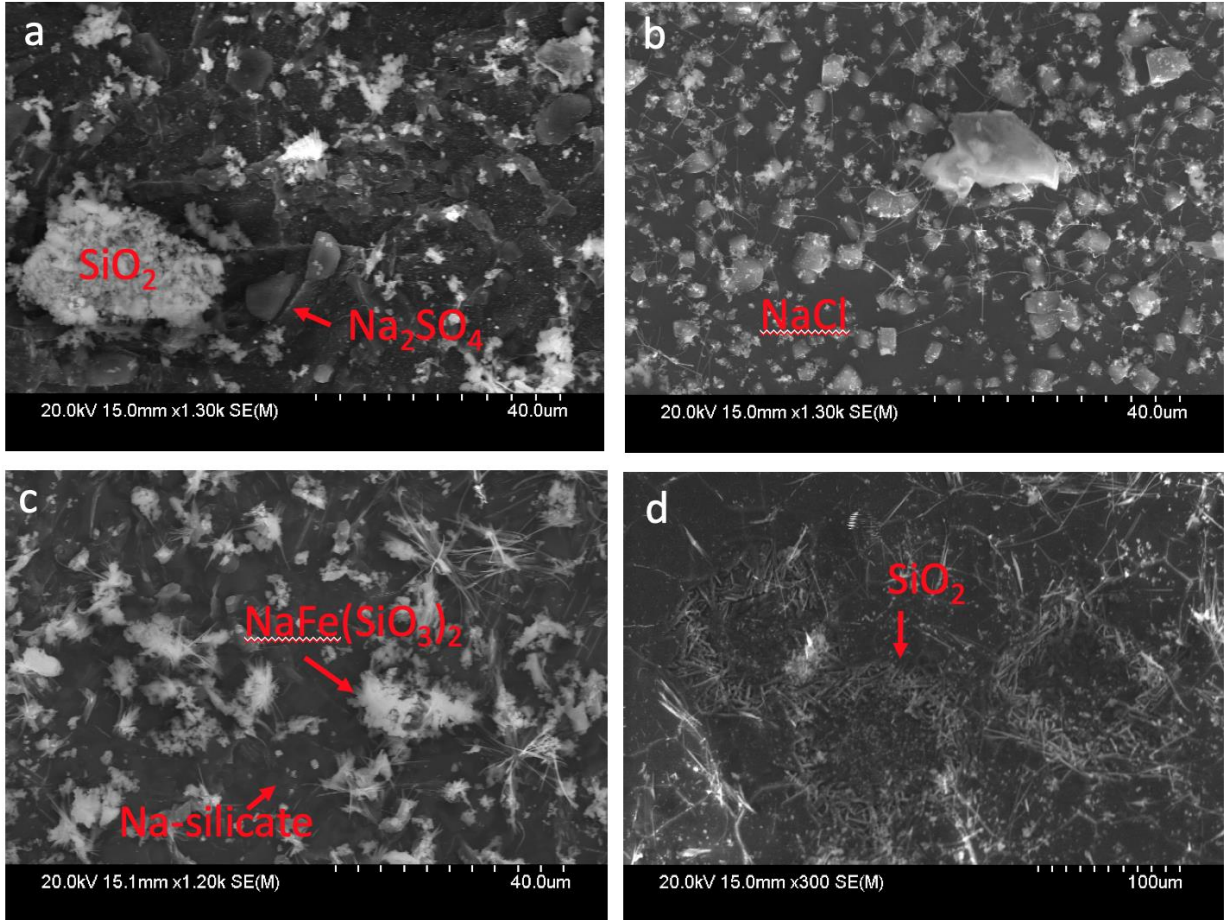


Figure 4.3: Sublimates as BSE images from FESEM and mineralogically characterized by EDS analyses. Image of sublimates from experiment 741NASCIS FMQ-1.5 a) 510°C: Crystals of Na_2SO_4 , surrounded by a background of SiO_2 and a cluster of SiO_2 crystals. Images of sublimates from experiment 742NASCIS FMQ-4.6 b) 455°C: Crystals of NaCl with SiO_2 background; c) 510°C: Crystals of acmite, $\text{NaFe}(\text{SiO}_3)_2$ with a Na-silicate background; d) 580°C: SiO_2 crystals in circular configurations.

The blank experiment was run as the fourth in a sequence of seven experiments and any concentration may be as a result of contamination of volatile elements remobilized in the furnace. Blank concentrations are notably high for Zn, As and Bi (Figure 4.6 a-b, e) at temperatures close to 400°C. Only in the experiments with melt under the most reduced conditions do concentrations of Zn, As and Bi exceed the blank values. All other elements in the blank experiment have lower concentrations than in the experiments with silicate melt.

Element concentrations in the sublimates show some general trends with fO_2 . Under the least reduced conditions, FMQ+5.4 and FMQ-1.5, Cu, Rb and Ag sublime in their highest concentrations of all experiments. Lithium and Ag in particular have high concentrations at FMQ+5.4 (Figure 4.4a&d) and Cu and Rb have high concentrations at FMQ-1.5 (Figure 4.4b-c). Tin also sublimates in high concentrations above ~650°C, in the FMQ-1.5 experiment (Figure 4.6f). At more reducing conditions, FMQ-3.7, only S has anomalously high concentrations, below ~300°C (Figure 4.5a). In the experiment under the most reducing conditions, FMQ-4.6, Zn, As, Cd, Pb, Bi and Sn sublime in higher concentrations compared to all other experiments (Figure 4.6). Additionally, while Y, Mo and Cs show some volatility, their concentrations in the sublimates do not appear to be affected by the fO_2 conditions of the experiment (Figure 4.5b-d).

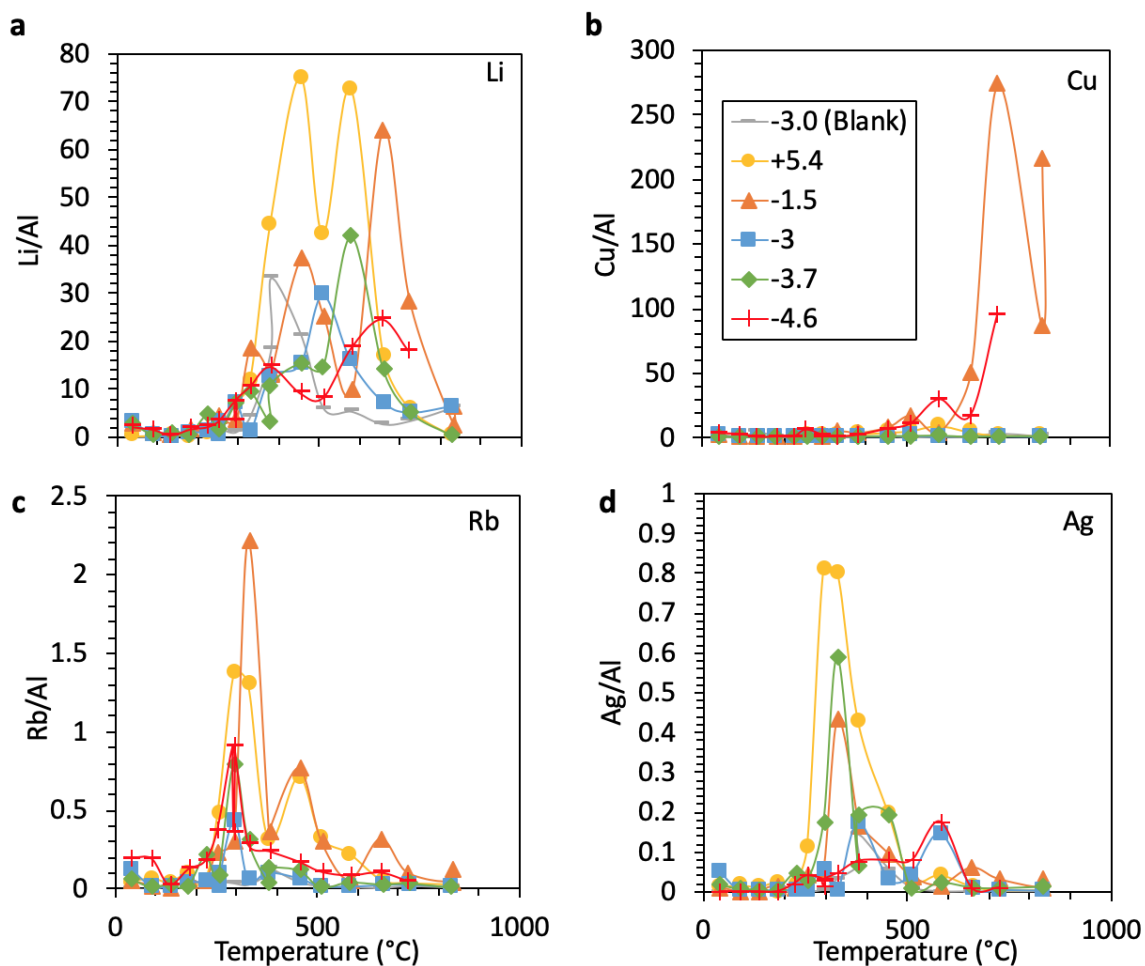


Figure 4.4: Elements with increased concentrations in the experiment with the least reduced conditions, 740NASCIS FMQ+5.4. Delta FMQ values in legend represent the fO_2 conditions of the experiment plotted. Concentration of elements normalized to Al in sublimates, for experiments with NAS composition melt and blank experiment, determined with solution ICP-MS. a) Li; b) Cu; c) Rb; d) Ag. Uncertainty values for element concentrations (1σ) of this study are reported in Appendix D.

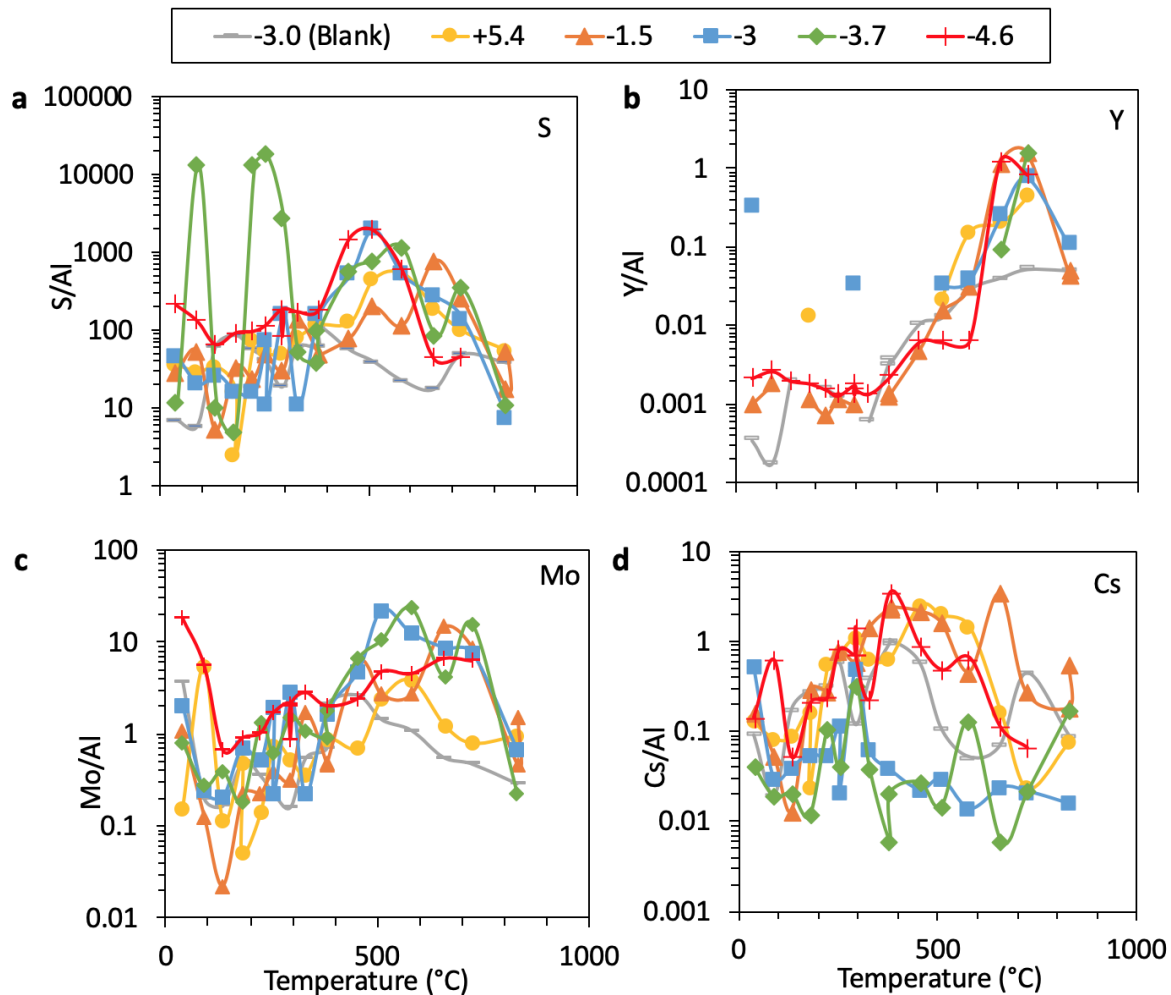


Figure 4.5: Elements with no discernable increase in concentration under a particular condition. Delta FMQ values in legend represent the fO_2 conditions of the experiment plotted. Concentration of elements normalized to Al in sublimates, for experiments with NAS composition melt and blank experiment, determined with solution ICP-MS. a) S; b) Y; c) Mo; d) Cs. Uncertainty values for element concentrations (1σ) of this study are reported in Appendix D.

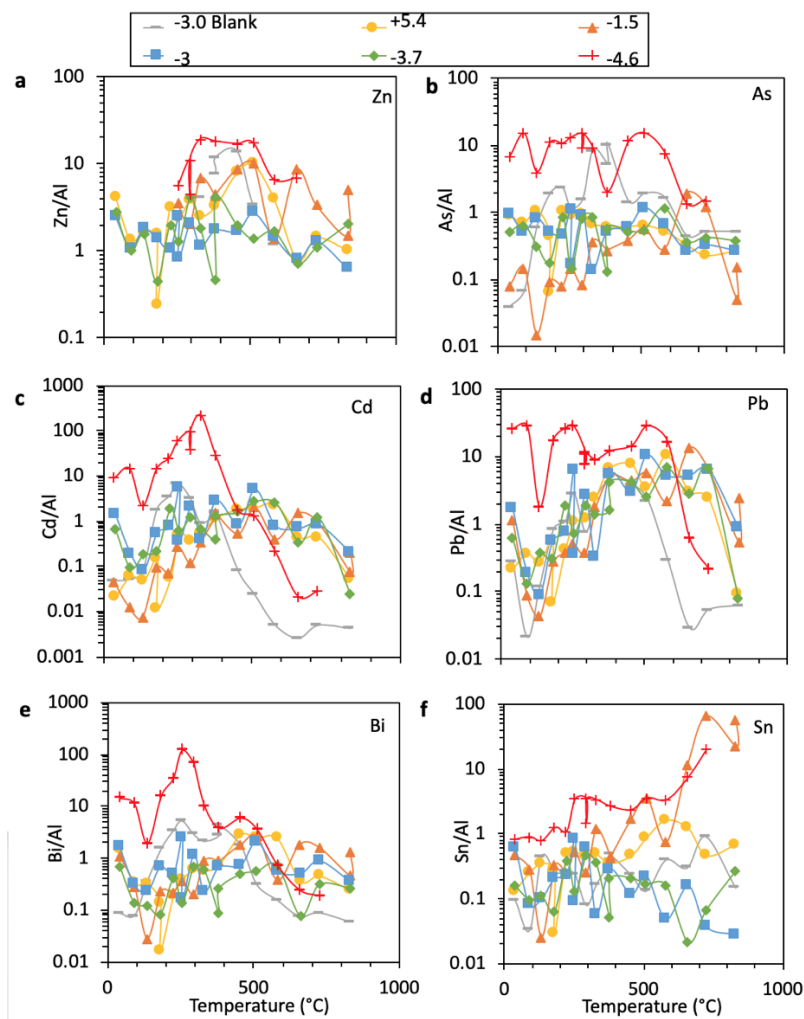


Figure 4.6: Elements with increased concentrations in the experiment with the most reduced conditions, 742NAS CIS FMQ-4.6. Delta FMQ values in legend represent the fO_2 conditions of the experiment plotted. Concentrations of elements normalized to Al in sublimates, for experiments with NAS composition melt and blank experiment, determined with solution ICP-MS. a) Zn; b) As; c) Cd; d) Pb; e) Bi; f) Sn. Uncertainty values for element concentrations (1σ) of this study are reported in Appendix D.

4.3.4. Effects of melt composition

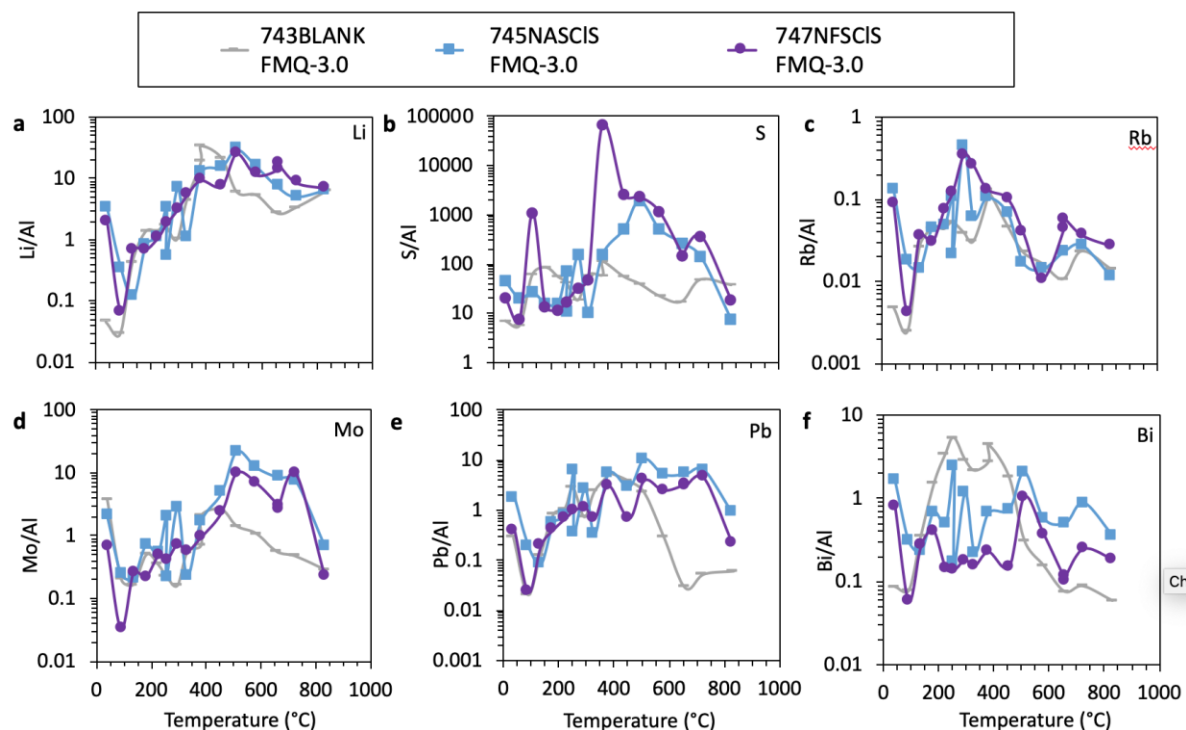


Figure 4.7: Concentration of elements normalized to Al in sublimates, for experiments with variable melt composition. Oxygen fugacity conditions are the same at FMQ-3.0. a) Li; b) S; c) Rb; d) Mo; e) Pb; f) Bi. Uncertainty values for element concentrations (1σ) of this study are reported in Appendix D.

To compare the effects of Fe, two experiments were run at the same fO_2 conditions with two different compositions, one in the NAS (<0.05 wt% FeO) and NFS (9.5 wt% FeO) systems (experiments 745NASCIS and 747NFSCIS – Table 4.1). The volatile element trends in the sublimates do not differ in their sublimation behaviour and sublime in highest quantities at the

same ‘peak’ temperature (Figure 4.7). The concentration of S in the sublimates differs near 380°C, as the experiment with NFS composition sublimates higher S than in the NAS composition experiment at this temperature (Figure 4.7b). Molybdenum, Pb and Bi sublime with similar behaviour, but are at slightly higher concentrations in NAS melt experiments compared to the NFS melt experiment at most temperatures (Figure 4.7d-f).

4.3.5. Phase stability from thermodynamic modelling

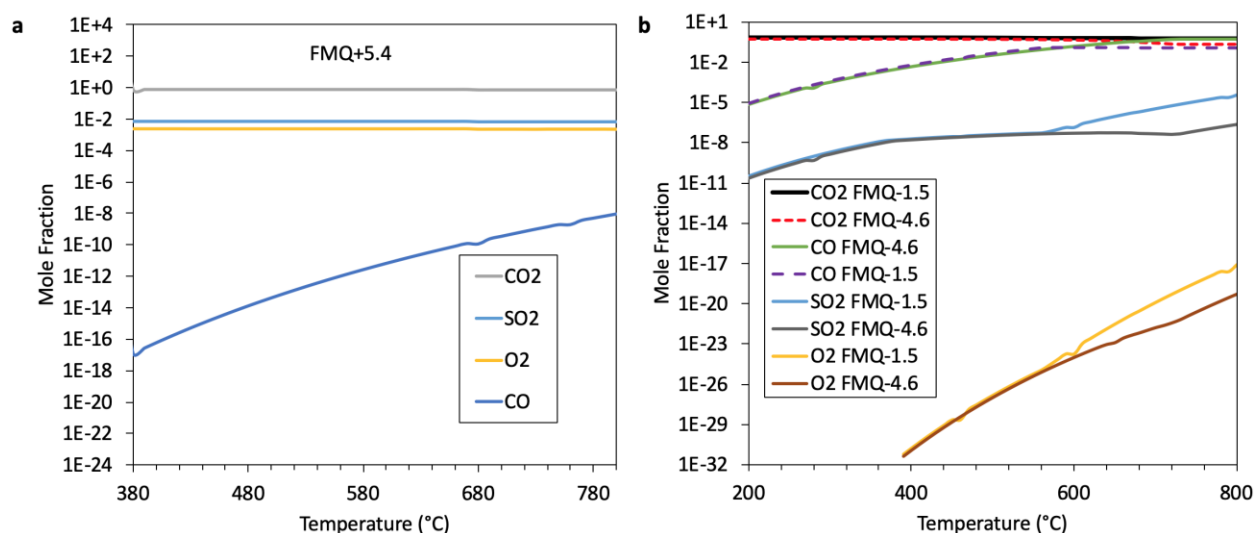


Figure 4.8: Gas compositions calculated by thermodynamic modelling of experiments. Model calculation results plotted for a) fO₂ conditions at FMQ+5.4 and b) fO₂ conditions at FMQ-1.5 and FMQ-4.6. All curves on (b) are for both experiments unless otherwise indicated in the legend.

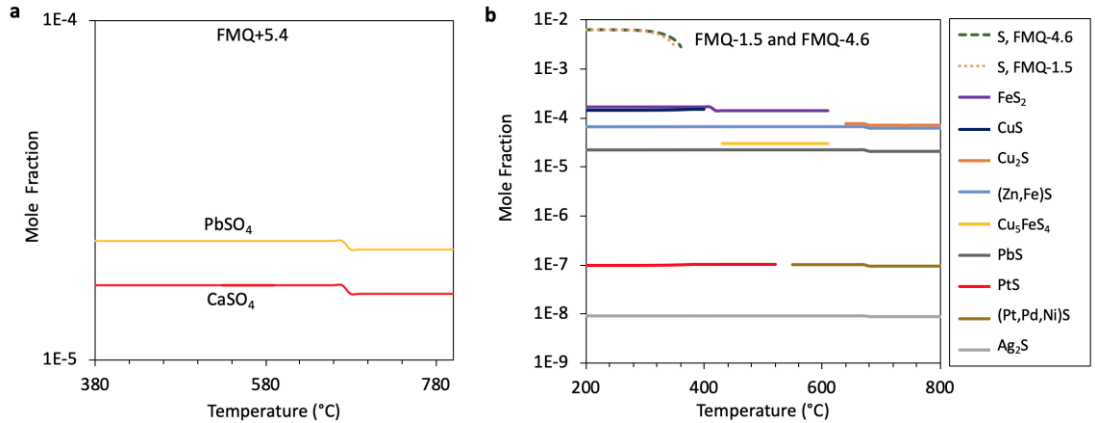


Figure 4.9: Sulfur-bearing solid sublimate phases calculated by thermodynamic modelling of experiments. Model calculation results plotted for a) fO_2 conditions at FMQ+5.4 and b) fO_2 conditions at FMQ-1.5 and FMQ-4.6. All curves on (b) are for both experiments unless otherwise indicated in the legend.

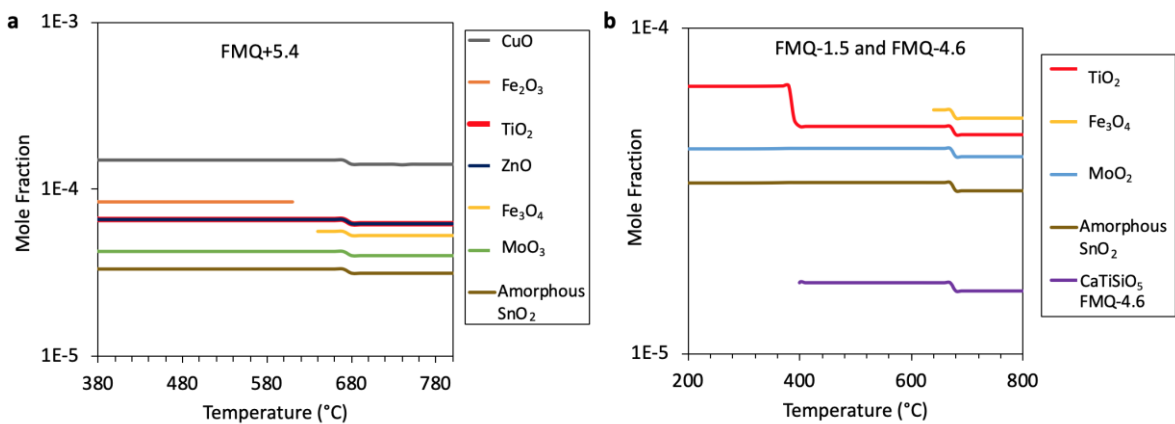


Figure 4.10: Metal oxide solid sublimate phases calculated by thermodynamic modelling of experiments. Model calculation results plotted for a) fO_2 conditions at FMQ+5.4 and b) fO_2 conditions at FMQ-1.5 and FMQ-4.6. All curves on (b) are for both experiments unless otherwise indicated in the legend.

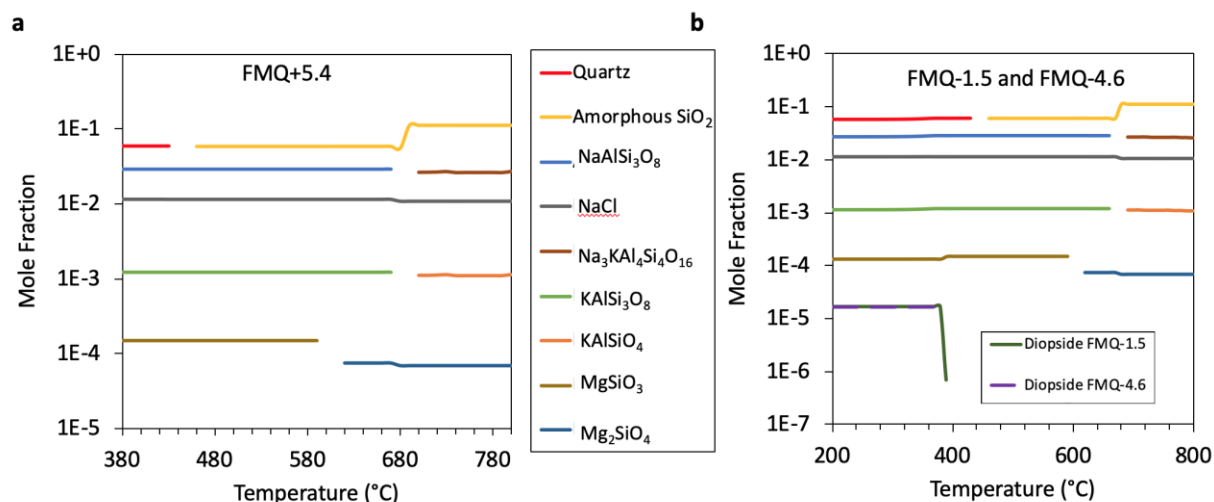


Figure 4.11: Other phases calculated by thermodynamic modelling of experiments. Model calculation results plotted for a) fO_2 conditions at FMQ+5.4 and b) fO_2 conditions at FMQ-1.5 and FMQ-4.6. All curves on (b) are for both experiments unless otherwise indicated in the legend.

Results from the thermodynamic modelling using GEMS3 show the speciation of gases and the sublimation of phases under conditions of the experiments. The solid phases presented are limited to phases in concentrations $>10^{-5}$ mole fractions. For models at FMQ+5.4, CO₂, O₂ and SO₂ concentrations remain constant over the thermal gradient and CO concentrations increase with temperature (Figure 4.8a). At FMQ-1.5, the model shows that CO₂ decreases slightly from 200-800°C, while CO and SO₂ increase over the temperature range. In this model, O₂ only begins to appear at 380°C (Figure 4.8b). Comparatively, models for FMQ-1.5 and FMQ-4.6 produced

approximately the same CO₂ and CO for temperatures from 200-800°C (Figure 4.8b). At FMQ-1.5 the model calculations produce more SO₂ and O₂, particularly above 580°C (Figure 4.8b).

Thermodynamic modelling also shows changes in the sublimation of S-bearing phases with fO₂. At FMQ+5.4, the model shows sulfates forming, with anglesite (PbSO₄) in higher quantities than anhydrite (CaSO₄) (Figure 4.9a). At lower fO₂ of FMQ-1.5 and FMQ-4.6 the model produces, sphalerite ((Zn,Fe)S), galena (PbS) and acanthite (Ag₂S), in nearly constant quantities from 200-800°C. Covellite (CuS) occurs below 400°C, Pt-sulfide (PtS) below 520°C and pyrite (FeS₂) below 620°C. Bornite (Cu₅FeS₄) occurs between 410-620°C. Cooperite ((Pt,Pd,Ni)S) forms from 540-800°C and chalcocite (Cu₂S) from 630-800°C. Elemental S sublimates at temperatures below 370°C, however, the exact concentrations differ slightly between the FMQ-1.5 and FMQ-4.6 models (Figure 4.9b).

Metal oxides forming in the three thermodynamic models decrease in concentration between 670-680°C. For all model conditions, rutile (TiO₂) and amorphous SnO₂ sublime at all temperatures and magnetite (Fe₃O₄) sublimates from 630-800°C (Figure 4.10). Molybdenite (MoO₃), zincite (ZnO) and tenorite (CuO) form at all temperatures and hematite (Fe₂O₃) forms below 620°C in the FMQ+5.4 condition model (Figure 4.10a). Rutile decreases in concentration between 380-400°C in FMQ-1.5 and FMQ-4.6 models (Figure 4.10b). Tugarinov (MoO₂) occurs in the two

more reduced experiments across the entire temperature range. Titanite (CaTiSiO_5) only occurs in the more reduced, FMQ-4.6 conditions (Figure 4.10b).

Silica (SiO_2) polymorphs form in the highest concentration of all sublimates in the model. Quartz forms between 200-440°C and transitions to amorphous SiO_2 from 450-800°C (Figure 4.11). Amorphous silica increases in concentration between 680°C and 690°C. At this same temperature are several other transitions involving silicate minerals. Albite ($\text{NaAlSi}_3\text{O}_8$) and microcline (KAlSi_3O_8) form at temperatures below 680°C and nepheline ($\text{Na}_3\text{KAl}_4\text{Si}_4\text{O}_{16}$) and kalsilite (KAlSiO_4) form above 690°C. Enstatite (MgSiO_3) occurs below 600°C and forsterite (Mg_2SiO_4) occurs above 610°C. Diopside ($\text{MgCaSi}_2\text{O}_6$) occurs only in the more reduced models (FMQ-1.5 and FMQ-4.6), and forms at temperatures up to ~400°C (Figure 4.11b).

Halite (NaCl) is the only sublimate that hosts Cl in the models, forming at all temperatures, but decreasing in concentration slightly between 680-690°C in the FMQ-1.5 and FMQ-4.6 model calculations (Figure 4.11b).

4.4. Discussion

4.4.1. The effects of $f\text{O}_2$ on volatilization

Overall the evaporation of volatile trace metals from the melt, or their sublimation from the gas phase does not show any significant variability in behaviour between the NAS and NFS

(Fe-bearing) silicate melt composition experiments, except in an increase in the amount of S sublimed in the NFS melt composition at ~380°C (Figure 4.7). Melt fO_2 effects the volatility of several elements in the experiments and is recorded by the loss of an element from the starting material glass (Figure 4.2). The volatility of an element from a silicate melt is affected by partial pressure of O_2 and the stoichiometry of vaporization equations, based on the general equation (5):



Where M is a metal, x is the charge of the metal and n is the number of electrons in the reaction (Sossi et al., 2019). For moderately volatile elements of $x = 1$ (e.g. Cu, K, Rb) and $x = 2$ (Zn, Cd), when $n > 0$, these elements are strongly volatile, with their gas species having oxidation states lower than in the silicate melt. The opposite is true of Mo and Cr and they will volatilize when $n < 0$, because of their oxide gas species having oxidation states higher than in the melt. This explains the overall strong volatility of Mo and its related loss from the starting glass, as well its increased volatility at more oxidized conditions (Figure 4.2d). Experiments conducted at 1400°C and fO_2 between air and $\log fO_2 = -10$, Na and Cu become more volatile as fO_2 decreases (Sossi et al., 2019). This explanation also supports the increased Cu volatilization and loss from the starting melt at lower fO_2 (Figure 4.2c).

Significant loss of S and Zn, Sn, As, Bi, Pb and Cd from the melt occurs at the lowest fO_2 of FMQ-4.6 (Figure 4.2a&c). These trace metals are significantly volatilized from the melt due to

lower fO_2 coupled with their complexation with S or Cl species that are also being exsolved from the liquid. The fO_2 of the experiments do not significantly affect the volatilization of Cl, as it has an oxidation state (Cl^-) that is constant across all fO_2 conditions investigated. This is confirmed by a lack of any strong correlation of Cl loss from the starting material glasses with fO_2 (Figure 4.2). Contrary to Cl, the solubility of S and its speciation in both the melt and gas phases are affected by the fO_2 , as seen by increased volatilization from the starting melt at lower fO_2 conditions (Figure 4.2). The most reduced experiment at FMQ-4.6 is below the IW (iron-wustite) buffer, which is more reducing than typical volcanic emissions on Earth (Holland, 2002) and more similar to redox conditions on the Moon or Mars (Wadhwa, 2008).

Once in the cooling gas phase, the trace metals can potentially complex with S or Cl and sublime into S- or Cl-bearing phases at lower T. Thus, fO_2 must play some role on partitioning from the melt to gas phase, transport in the gas phase and its eventual sublimation on cooling. While the fO_2 of the melt is an important influence on the volatilization of metals, the sublimation of species will also be affected by the fO_2 of the gas, particularly due to variable oxidation states of S.

4.4.2. The role of sulfur in sublimation

Sulfur is an important component of many volcanic gases, and both sulfides and sulfates are common sublimates in fumaroles or adhered to ash in volcanic plumes (e.g. Quisefit et al.,

1989; Witham et al., 2005). The effects of S on metal transport and sublimation need to be viewed in context with changing fO_2 and its effect of S solubility in the melt as well as changing speciation in the gas phase. The experiments of this study were intentionally chosen to span several orders of magnitude fO_2 range, and S solubility and speciation in both melt and gas is expected to change.

Sulfur speciation in silicate melts varies greatly with fO_2 . Sulfur can dissolve as sulfide (S^{2-}) at low fO_2 or as sulfate (SO_4^{2-}) at high fO_2 , with the transition between these species producing a minimum in solubility over a narrow fO_2 range. For natural melts, this transition is narrow at about the FMQ buffer (e.g. Jugo, 2009). Most experiments on S solubility in natural melts are performed at higher pressure (e.g. Jugo et al., 2005), and there are few studies of S speciation and stability at atmospheric conditions for comparison to the experimental design used in this study.

Nagashima and Katsura (1973) measured total S solubility and the transition from sulfate (SO_4^{2-}) to sulfide (S^{2-}) species in the melts in the simple system Na_2O-SiO_2 , not unlike the composition of the melts from this study, at 1100-1300°C and 1 atm over the range from FMQ-4.7 to FMQ+4. At a constant T of 1250°C, they show the amount of sulfide sulphur ($S^{2-}/[S^{2-} + SO_4^{2-}]$) drops precipitously from 0.98 at FMQ-4.7 to 0.5 at FMQ-0.5 to < 0.01 at fO_2 above FMQ+1 (Figure 4.12a). As T decreases, however, the minimum in S solubility shifts to lower fO_2 , and the solubility of sulfate (SO_4^{2-}) increases at a given fO_2 . Thus, for experiments of this study, it can be inferred that S^{2-} is the dominant melt species at all conditions except one (FMQ+5.4) and that the

sulfide-sulfate transition in NAS melts of the current experiments in melts at 950°C is shifted to lower fO_2 than Nagashima and Katsura's experiments (Figure 4.12b). Therefore, it is expected that if trace metals are pairing with S, it would be as S^{2-} in all experiments except at FMQ+5.4.

For the gas phase, the thermodynamic calculations (Figure 4.8) show high and constant SO_2 at FMQ+5.4 but SO_2 decreases by several orders of magnitude with decreasing T (from 200-800°C) in all other models at more reduced conditions (FMQ-1.5, FMQ-4.6). Water is not present in the system so the model run conditions or experiments cannot produce H_2S .

Sulfur is in large quantities in all the experimental sublimates (up to 12000 ppb, average ~250 ppb). Sulfur concentration in the sublimates is particularly high in the more reduced experiments and at temperatures $>450^\circ C$ (Figure 4.5a). This follows from the overall S solubility in melt experiments (i.e. Figure 4.12b), as the solubility of S is lowest near FMQ-3.0 and the concentrations of S in the sublimates is highest in the more reduced conditions. Additionally, S is significantly depleted from the starting melt (Figure 4.2a) in the most reduced condition, FMQ-4.6. This signifies a decrease in S solubility in the melt and a greater loss of S from the melt by volatilization.

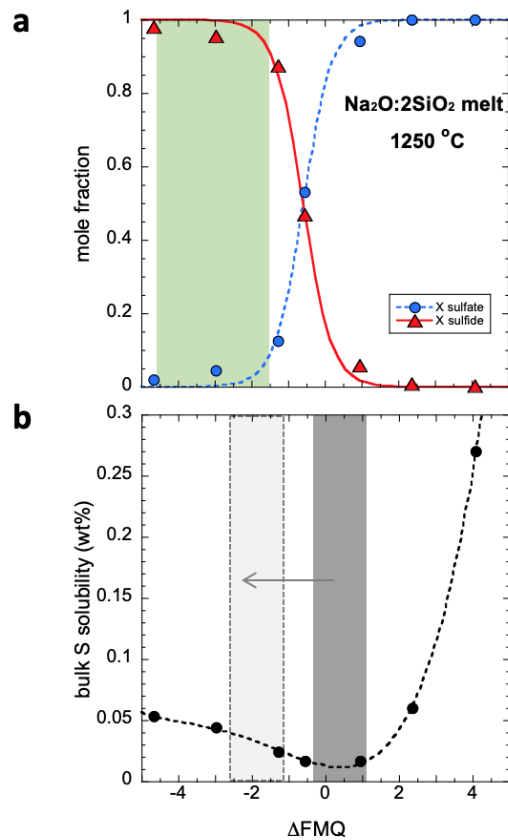


Figure 4.12: a) Mole fraction of sulfate and sulfide sulfur at various conditions (relative to FMQ buffer), in the melts of Na_2O - SiO_2 experiments at 1250°C and 1 atm (Nagashima and Katsura, 1973). Green shaded box encompasses the fO_2 conditions of the four most reduced experiments from this study (FMQ-4.6 to FMQ-1.5). b) The total sulfur solubility in experiments of Nagashima and Katsura (1973) at 1250°C . Grey bars are showing the minimum S solubility and the expected shift of the minimum, due to experiments in this study being carried out at 950°C , instead of at 1250°C .

Along with S, Zn, Sn, As, Bi, Pb and Cd were also significantly depleted from the glass of the lowest fO_2 experiment (FMQ-4.6) (Figure 4.2). This corresponds to the high concentrations of these same metals in the sublimates (Figure 4.6). Given this strong association, it might be assumed that these metals are complexed with S in the sublimates. More specifically, this S complex is expected to be in its reduced form, S^{2-} at an fO_2 of FMQ-4.6, based on Nagashima and Katsura (1973) (Figure 4.12) and should form metal-sulfides. Moreover, the model calculations predict various trace metal sulfides to form at fO_2 FMQ-4.6 and FMQ-1.5 (Figure 4.9b), suggesting the likelihood of sulphide sublimates. Sulfates are only predicted to sublime in the highest fO_2 model, FMQ+5.4 (Figure 4.9a).

In contrast, the only S-bearing solid phase found in the sublimates is $NaSO_4$, sodium sulfate, observed by FESEM and EDS at temperatures near $500^\circ C$ in the experiment at fO_2 conditions FMQ-1.5 (Figure 4.3a). An experiment at FMQ-1.5 should have approximately 0.1 mole fraction sulfate in total sulfur species, and therefore 10% of S is predicted to be in its oxidized state (Figure 4.12). This means that it is feasible to have stable sulfates forming in the sublimates at FMQ-1.5. Although no sulfides were found using the FESEM, the majority of the S concentration measured in sublimates from the FMQ-1.5 experiment and all of the S in sublimates from lower fO_2 experiments (Figure 4.5a), should be present in the lower oxidation state and should form sulfides.

Based on the model calculations and the predicted S speciation in melt, sulfides of Zn, Sn, As, Bi, Pb and Cd should form in all experiments except the least reduced (FMQ+5.4). These metals were significantly degassed from the melt and occur in high concentrations in the sublimates from the experiment in highly reduced FMQ-4.6 conditions. Other metals (i.e. Li, Cu, Rb, Ag, Y, Mo, Cs) show less of a relationship with S and thus could be subliming in some other phase, possibly as halides or oxides.

Sulfur is abundant in the experimental sublimates, with a maximum concentration of ~12ppm, as measured by ICP-MS (Appendix D). The equivalent amount of sulfide sublimates per gram of sublimated material would therefore $<1.2 \times 10^{-5}$ g. This low concentration in the sublimates may explain why sulfides were not observed with the FESEM and EDS method. Also, while the model predicts sulfides at both FMQ-1.5 and FMQ-4.6, due to the shift of the sulfide-sulfate saturation in lower temperature experiments, sulfide may not be the dominant species at FMQ-1.5, making it less likely that sulfides sublimed in this experiment in high enough concentrations to locate using FESEM. Furthermore, the model calculations use a closed system, which may miss complexities of an open fumarole system and therefore, predictions of sulfide sublimation at FMQ-1.5 may not be correct.

4.4.3. Trace metals in chlorides

Because Cl occurs in one oxidation state, its solubility and volatility from a melt and subsequent sublimation should show no dependence on fO_2 . Halite is the most common phase observed by SEM in the sublimates from 180-655°C. Other chlorides, sylvite (KCl) and molysite ($FeCl_3$), are also observed. Several metals have high and steady concentrations in the sublimates over the T range of 800 – 400°C irrespective of fO_2 . These include Li, Rb, Ag, Sn, Cs, Cu, and Pb, Bi, Cd in all but lowest fO_2 experiment of FMQ-4.6. All these metals make halides of their own or can have considerable extents of solid solution in NaCl. Solid solution in NaCl can occur below 600°C for $FeCl_3$ (Cook and Dunn, 1961) and RbCl and $CdCl_2$ (Hu et al., 2007; Königsberger, 1990). The thermodynamic modelling of the NAS melt produces halite (NaCl) as the only Cl-bearing, sublimate phase, at all fO_2 conditions from 200-800°C (Figure 4.11) but the solid solution of these other metal components in NaCl is not encompassed by the thermodynamic input.

Halite is the most common sublimate in other experiments 300-1025°C (Nekvasil et al., 2019; Renggli and Klemme, 2020; Scholtysik and Canil, 2020) and is ubiquitous in natural volcanic sublimates from 100-800°C (Toutain et al., 1990). Many other chlorides are stable in the range of NaCl occurrence in the NAS experiments. For example, solid $ZnCl_2$ is stable from ~25-318°C, Na_2ZnCl_4 from ~25-427°C and K-Zn-chlorides from 35-477°C (Robelin et al., 2004). Furthermore, metal chlorides such as $CuCl_2$, $CuZnCl_2$ and $PbCl_2$ are known as sublimates at

fumaroles (Africano et al., 2002; Taran et al., 2001). In general, Pb, Bi, Zn and Cu-chlorides are phases commonly found at fumaroles or predicted as minerals with thermochemical modelling (e.g. Taran et al., 2001; Wahrenberger et al., 2002; Zelenski and Bortnikova, 2005). Given this body of evidence, it is inferred that a large number of trace metals are sublimating in a halide phase (mostly NaCl) over a large T range. At the trace concentrations (i.e. < 0.1 wt%) observed, most of these metals are easily taken up in NaCl solid solution. The steady decrease in concentration of Li, Rb, Ag, Sn, Cs, Cu, and in some cases Bi and Cd with decreasing T (Figure 4.6) could be explained as the T-effect on the extent of possible solid solution in solid NaCl observed by FESEM.

4.4.4. Comparisons with other experiments and natural fumaroles

The experimental sublimates and the phases derived from the GEMS3 model calculations performed for this study did not show total agreement with each other. Models do not use solid solutions because of missing information in their thermodynamic databases and in this way should be seen instead as a guide for possible phases (Wahrenberger et al., 2002). Most model studies of fumaroles (e.g. Symonds and Reed, 1993) do not have consistent databases of phases from the same volcanic eruption, making them hard to correlate to experimental and natural fumarole sublimates.

In natural fumaroles, most minerals are observed across a wide range of temperatures. For example, fumarole sublimates compiled from Colima, Piton de la Fournaise and Momotombo,

show halite and sylvite forming from 100-800°C, other metal chlorides from 200-600°C, silica from 380-828°C, sulfides from 100-900°C and sulfates from 200-900°C (Quisefit et al., 1989; Taran et al., 2001; Toutain et al., 1990). While these minerals form in similar temperature ranges to the NAS experiments and model calculations, many factors at play make it difficult to make direct correlations in behaviour. For example, the cooling rates of gases differ with flow rates, which in the case of some fumaroles, is 80 m/s (Mandon et al., 2019), orders of magnitude more than in the experiments conducted as a part of this study. Additionally, the vastly different melt to gas ratio in fumaroles and experiments make direct comparison difficult.

Compared to S-free experiments at highest fO_2 (air) (data from Scholtysik and Canil, 2020), the experiments of this study with S and lower fO_2 showed higher concentrations of Zn, As, Cd, Bi and Pb in the sublimates (Figure 4.12a-e). This increase was up to $\sim 10^4$ for As and Bi, $\sim 10^3$ for Cd and Zn and $\sim 10^2$ for Pb in the most reduced experiment (FMQ-4.6). These are the same metals that are pairing to sublime as sulfides in the more reduced experiments and models and occur in highest concentrations in the most reduced experiment (Figure 4.4a-e). In contrast, Mo and Cu mostly sublime in higher quantities in the experiments without S (Figure 4.12f-g). This confirms that Mo and Cu at lower temperatures, are likely not paired with S for volatile transport or sublimation. Based on modelling, Mo is likely to form as an oxide in all experiments and this is reflected by Mo not pairing with Cl or S.

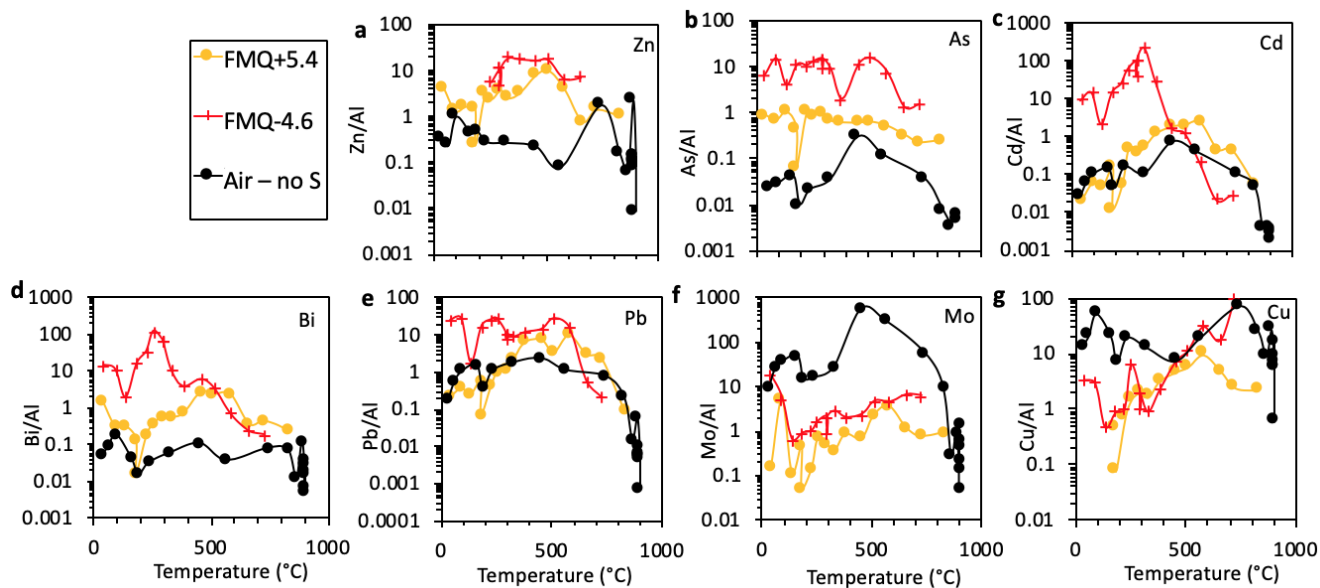


Figure 4.13: The normalized concentration of elements in the sublimates for the least (740NASCIS FMQ+5.4) and most (742NASCIS FMQ-4.6) reduced experiments compared to the normalized concentration of elements in the sublimates of experiments conducted in in air, without S (Vul15NAS+2wt%, data from Scholtysik and Canil, 2020). a) Zn; b) As; c) Cd; d) Bi; e) Pb; f) Mo; g) Cu. Uncertainty values for element concentrations (1σ) of this study are reported in Appendix D.

The results from this study can also be compared to those from other gas-solid reaction experiments (Nekvasil et al., 2019; Renggli and Klemme, 2020), which differ by being done in a sealed evacuated silica glass tube, and so the system is completely closed. Halite, including as a solid solution with sylvite (KCl) and molysite (FeCl_3) occurs in both studies. Their occurrence

overlaps with my experiments from 500-655°C, although they occur at higher temperatures in the other studies as well (Figure 4.13). Other similarities are seen with metal chlorides reported by Renggli and Klemme (2020) from 300-500°C. SiO₂ also overlaps entirely with the occurrence of silica in the experiments of Nekvasil et al. (2019). Sulfates are not reported in the other studies; however, sulfides occur at temperatures above 425°C (Figure 4.13). It is likely due to their vacuum conditions and lack of a silicate melt in the case of Renggli and Klemme (2020), that the more reduced conditions more readily produce sulfides. Additionally, they confirm the likelihood of chloride solid solutions as being the primary sublimate to contain trace metals.

4.4.5. Implications for trace metal emissions to the environment

A long list of evidence supports the importance of volcanic sourced halides in trace metal loading from volcanoes. Ash particles have long been shown to have soluble salts adhered to their surface (e.g. Óskarsson, 1980; Rose, 1977). Leachate studies show that many metals adhere to ash particles and that these trace metals derived from the gas phase, are surmised to be substituting into salt phases (Ayrís and Delmelle, 2012 and references therein – see also Figure 1.6).

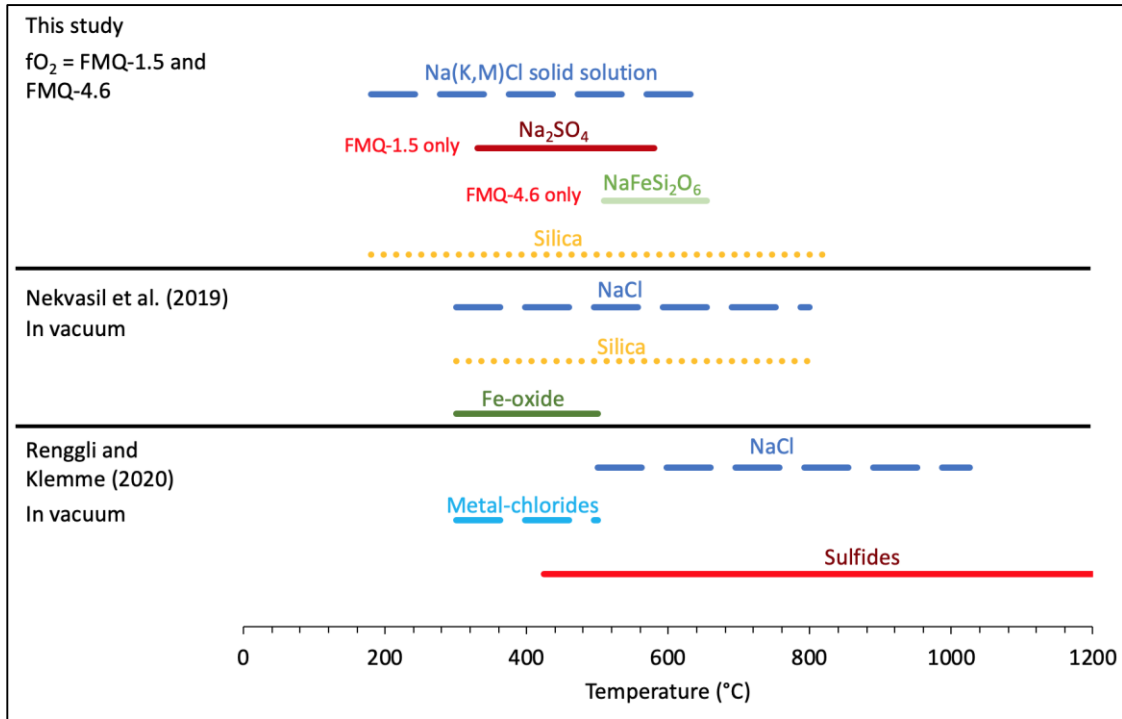


Figure 4.14: Sublimed phases from this study by temperature compared to phases from gas-solid reaction experiments conducted in vacuum (Nekvasil et al., 2019, Renggli and Klemme, 2020).

The solubility of the salts adhering to ash is an important source of trace metals to the environment (Witham et al., 2005). As tephra coated in metal-laden salts is deposited in waters, such as a river or ocean, or through interaction with rainwater, these leachable salts can dissolve and mobilize (Jones and Gislason, 2008). Metals derived from volcanic exhalations from the 1980 Mt. St. Helens' eruption contained Zn, Cu and Cd in quantities that could be hazardous to some

aquatic life (Smith et al., 1983, McKnight et al., 1981). The effects on phytoplankton of volatile-derived bioavailable Cu and As is still unknown (Ayris and Delmelle, 2012). In contrast, other studies have asserted that metals from ash such as Fe, can promote primary productivity in the oceans (Duggen et al., 2010; Hamme et al., 2010; Mélançon et al., 2014).

Elements detrimental to human health can also leach into drinking water if tephra is deposited into a drinking water source. Some tephra have leachate values that exceed WHO drinking water guidelines for As, Pb and Se (Witham et al., 2005). Soluble salts on ash can also be deposited on soil and vegetation, which can lead to increased levels of elements in crops, death of vegetation and toxic contamination of grass used for livestock, as well as potentially useful fertilizing elements for agriculture such as Se, K and Mg (Witham et al., 2005 and references therein). Regardless of the negative or positive impacts of these trace metals, the experiments from this study, coupled with natural volcanic sublimates, show that salts are a ubiquitous sublimation product from S and Cl-bearing volcanic gases over large ranges in T and fO_2 of volcanic eruptions. For this reason, it would appear most volatile trace metals adhering to ash particles (i.e. Li, Rb, Ag, Cs, Cu), and a large proportion of the metal emissions to the atmosphere in pre-industrial times, are ultimately derived from sublimation of halides from volcanic gases.

4.5. Conclusions

By conducting experiments in a gas mixing furnace, volatile trace metals are degassed and sublimed with Cl and S in various fO_2 conditions. By running experiments at significantly reduced conditions (FMQ-4.6), substantial loss of both S and trace metals Zn, Sn, As, Bi, Pb and Cd occurs from the starting material melt. This loss correlates with elevated concentrations of these metals, in the experimental sublimates of the most reduced condition experiments and these elements are inferred to be subliming as sulfides, as they are above sulfide saturation. This conclusion is supported by sulfide formation in model calculations run for this study at the same fO_2 conditions. Compared to experiments performed in air, without S, normalized concentration of As and Bi increased by $\sim 10^4$, Cd and Zn by $\sim 10^3$ and for Pb by $\sim 10^2$.

From ~ 200 - 650°C , chlorides are found in the experimental sublimates and are theorized to be subliming as part of a NaCl-KCl-FeCl₃ solid solution, which is a likely host of metals Cu, Sn, Li, Rb and Ag, particularly at less reducing conditions. The finding that many metals will be transported and sublime with Cl suggests that they are forming soluble salts that can easily liberate metals to the environment. Should they form as chlorides on the surface of ash, they may be distributed to oceans or agricultural land, causing negative or positive effects depending on the identity and concentration of the metal. Based on calculations, these halides may be forming at all temperatures and under a large range of fO_2 conditions (FMQ+5.4 to FMQ-4.6).

Chapter 5. Conclusions

5.1. Research summary and significance

Interest in the behaviour of volatile trace metals has increased in the last decades. This interest likely stems from the applicability of volatile trace metal research to other topics such as ore deposit formation and transport of metals to oceans via ash particles (e.g. Duggen et al., 2010; Williams-Jones and Heinrich, 2005). Metal fluid-melt partitioning experiments have been performed quite extensively (e.g. Brenan et al., 1995; Zajacz et al., 2008), but they cover metal partitioning at higher pressures, below the surface of the Earth. Experiments looking to determine conditions that affect and enhance the sublimation of metals from gases have only been carried out recently.

My research has taken place at the beginning of this branch of study. While studies of sublimates from natural fumaroles have been taking place since at least 1872, when Cu and Pb-oxides were observed subliming from gases at Vesuvius (Palmieri, 1873), the interest in understanding these gas-solid reactions has led to a need for more information about the behaviour of volatile trace metals. This research will allow volcanologists and a broader audience interested in gas-solid reactions of metals, to learn more about the conditions under which strong sublimation of trace metals can be expected.

The initial part of this research focussed on designing and building an apparatus that would produce a system to collect sublimates from volcanic-like gases. I decided to choose a simple system melt and a box furnace for my initial experiments, to determine if apparatus could be used to collect sublimates and if the duration of the experiments had any effect on the sublimation of material. The experiments successfully produced sublimates along a temperature gradient. I was able to analyse the sublimates for their mineralogy using SEM and EDS techniques, as well as Raman spectroscopy. I quantified the chemistry of the sublimates using solution ICP-MS.

The initial sublimation experiments collected volatile metals over a thermal gradient and demonstrated that particular metals would sublime at different temperatures. The comparative concentrations of the metals in the starting melt versus in the sublimed phases was used to compare the volatility of the metals to one another and to measurements from natural studies. Similarities between the experimental sublimates and natural sublimate examples, are seen for Cu, As, Ag and Tl. Comparisons of the enrichment factors (EF) show that Mo in my experiments was the most similar to natural sublimate enrichments for the trace elements considered. I also showed that increasing the duration of the experiments has only the effect of collecting a higher concentration of elements, due to a thicker coating of sublimates, and does not affect the sublimation temperature of the elements. This initial project demonstrated that sublimates can be collected in air and that

this apparatus could be used to investigate further factors that enhance or diminish the volatilization and sublimation of trace metals.

The second study that I undertook was to use the initial design to investigate the role of ligands on the volatilization and sublimation of trace metals. Ligands have been shown to be pairing with metals for transportation in gas and fluid phases (Williams-Jones and Heinrich, 2005) and in particular, Cl and S have been shown to increase the diffusion of metals (Cu, Mo, Sn, Sb, Bi, etc.) to the melt-air interface in experiments (Johnson and Canil, 2011).

I carried out eight experiments in the benchtop fumarole with variable quantities of Cl and different melt compositions. The mineralogy of the sublimates included silica polymorphs, halite, metal-bearing oxides and chlorides, as well as hydrated phases. The hydration is thought to be post-experiment hydration or OH^- being replaced by Cl^- . Experiments conducted with NAS (Fe-free) and NFS (Fe-bearing) melt compositions had similar results in metals sublimation and therefore, melt composition is not thought to be a strong factor influencing the volatilization or sublimation of the trace metals.

Experiments conducted with Cl versus without Cl, show an increase in the sublimation of elements Li, Rb, Ag and Cr, when Cl is added. Experiments conducted with 2 wt% Cl versus 1 wt% Cl, have increased concentrations of Cu, Cs, Mo and W, when more Cl is added to the system. Overall, this work demonstrates that Cl is an important ligand for complexation with some metals.

To further investigate the importance of ligands on volatile trace metal behaviour, I selected Cl, and S as an additional ligand. Sulfur has been shown to increase the diffusion of some metals more strongly than Cl (Johnson and Canil, 2011). Sulfur also plays an important role in ore deposit formation (Williams-Jones and Heinrich, 2005) and has been hypothesized to form compound drops as sulfide liquids with vapour bubbles, to transport metals in melts (Mungall et al., 2015). I also chose to investigate S, as it is redox sensitive and magma and volcanic gases have variable oxygen fugacity conditions that will affect the redox state of S (Holland, 2002; Jugo, 2009).

The results from the experiments determined that Cu, Cd, Bi, Li, Rb and Ag will pair with Cl and form halides, likely in NaCl-KCl-FeCl₃ solid solutions. Modelling calculations carried out in this study suggest that halides are stable under a large range of fO_2 conditions (FMQ+5.4 to FMQ-4.6). Additional metals will pair with S, forming sulfides in the most reduced experiment, (FMQ-4.6). Substantial loss of Zn, Sn, As, Bi, Pb and Cd, as well as S occurs from the starting material melt from this experiment and gives a strong reasoning for these metals pairing with S. At low fO_2 conditions, ~FMQ-0.5, these elements are inferred to be subliming as sulfides, as they are above the sulfide saturation (Nagashima and Katsura, 1973). Thermodynamic modelling confirms that sulfide formation should occur in both FMQ-1.5 and FMQ-4.6 experiments but not the FMQ+5.4 experiment. When compared to experiments without S and performed in air from

Chapter 3, the normalized concentration of As, Bi, Cd, Zn and Pb increased with the addition of S. Overall, the transport and sublimation of volatile trace metals in fumarole gases is shown to be supported by ligands. Furthermore, sublimate mineral speciation is dependent on the fO_2 conditions of the system.

5.2.Future research directions

As work in this field has been moving swiftly, particularly with novel experiments (e.g. King et al., 2018; Nekvasil et al., 2019; Renggli and Klemme, 2020), additional experiments will be valuable to those in the field. My work could be expanded upon in a few key ways; by exploring additional fO_2 conditions, adding water to the system or investigating the interaction of gas-solid reactions in plumes with ash.

Using the apparatus from Chapter 4, experiments could be run in various fO_2 conditions. When volatiles are released, the fO_2 conditions of the plume are reduced compared to atmospheric gas. The mixing of plumes and atmospheric gas at high temperature, may cause reactions products of interest, particularly those that are ozone-depleting. Calculations suggest that the addition of as little as a few percent of air to the hot magmatic gas can oxidize HBr and HCl, forming reactive Br, Cl and HO (Gerlach, 2004; Martin et al., 2006). Experiments could be devised to have reduced conditions that oxidize over a period of time. For example, sublimates could be collected at various

magmatic-air mixing ratios, for different lengths of time. The study of sublimates from these experiments may lead to more information about the reaction products.

While having water in my experiments was not possible due to a lack of pressure and therefore solubility of water in the melt being too low, it would be incredibly useful if sublimation experiments could be carried out with water present. While water cannot easily be added to a starting melt for degassing at atmospheric pressure, using H₂ in a furnace might be possible, although it would be necessary to find a way to do so safely. Additional experiments could be considered at pressure to increase water solubility in the melt, with decreasing pressure to simulate degassing.

Since soluble salts form on ash and are an effective way to distribute volatile trace metals to the environment (e.g. Ayris and Delmelle, 2012; Duggen et al. 2010), more experiments are needed to determine the way in which these salts form and under what conditions metals are concentrated in the salts. Ideally, different ash substrates could be tested for their likelihood to have salts adhere to them from the gas. Additionally, the debate between whether these salts are derived from the gas phase or are reaction products from the ash surface, needs to be settled (Delmelle et al., 2018). Experiments investigating this salt formation on ash have begun. A few studies used an apparatus to interact ash and glass with gas, however trace metals were not examined (Ayris et al., 2015; Casas et al., 2019; Delmelle et al., 2018). My experimental apparatus,

particularly the gas-mixing furnace from Chapter 4, could be used as a starting point for a study to integrate volatile metals in salts adhered to ash. Experiments using a starting melt that degasses Cl, S and volatile metals could be in the gas-mixing furnace and sublimates could be collected on ash particles, under various fO_2 conditions. A method in which to suspend ash would need to be devised. Ash particle chemistry, angularity and size, as well as dilution of the plume by air, could be factors to consider for these experiments.

Although volcanoes play a relatively small role in emitting metals to the atmosphere compared to anthropogenic sources (Hinkley et al., 1999), experiments and some research of volcanic volatile trace metals could potentially be applied to our understanding of anthropogenic sources. While volatile trace metals such as Zn, Cu, Cd and Pb may be harmful or helpful to organisms on our planet (Witham et al., 2005), there is no doubt that gaining a better understanding of metal cycles is important. Volatile trace metal degassing may represent the final step in the volcanic cycle of the metals; however, it can also represent the first step in the trace metals entering the atmosphere or ocean. While this dissertation may focus on research of volcanic volatile trace metals, it could have further reaching implications for enquiries and effects of metal behaviour in other settings.

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Appendices

Appendix A: Supplementary solution ICP-MS data for Chapter 2

Run Composition Duration Temperature (°C)	Average	1σ	Average	1σ	Average	1σ	Average	1σ
	Vul5	Vul5	Vul5	Vul5	Vul5	Vul5	Vul5	Vul5
	NAS	NAS	NAS	NAS	NAS	NAS	NAS	NAS
	7 days	7 days	7 days	7 days	7 days	7 days	7 days	7 days
	951	951	859	859	761	761	553	553
Li	0.030	0.002	0.030	0.001	0.030	0.001	0.480	0.023
Al	2.670	0.045	1.400	0.016	1.060	0.025	2.060	0.051
Ca	8.000	0.948	8.000	0.378	8.000	0.829	10.000	0.628
V	0.460	0.012	0.860	0.000	0.760	0.011	2.190	0.041
Cr	0.190	0.004	0.170	0.004	0.230	0.003	0.560	0.008
Mn	0.040	0.001	0.030	0.001	0.030	0.001	0.040	0.002
Fe	5.600	0.164	5.200	0.170	5.700	0.095	5.400	0.108
Co	0.011	0.002	0.006	0.001	0.007	0.000	0.009	0.001
Ni	1.620	0.039	0.910	0.004	1.580	0.031	3.750	0.059
Cu	0.100	0.001	0.040	0.001	0.060	0.002	0.470	0.010
Zn	2.200	0.040	1.100	0.054	2.000	0.078	2.500	0.043
Ga*	640.000	16.978	302.000	13.767	630.000	18.416	386.000	8.953
As	BDa		BD		BD		0.066	0.005
Se	2.000	0.054	2.000	0.035	2.000	0.006	2.000	0.020
Rb	0.004	0.000	0.004	0.000	0.004	0.000	0.006	0.001
Sr	0.030	0.000	0.020	0.000	0.030	0.000	0.020	0.001
Y	0.000	0.000	0.000	0.000	BD		0.000	0.000
Mo	1.100	0.014	3.800	0.041	1.700	0.030	96.900	1.485
Rh*	326187.000	3053.081	324828.000	4537.619	325659.000	3632.934	323487.000	3890.280
Pd*	7.400	4.872	4.600	1.784	6.600	0.495	12.300	4.045
Ag	0.002	0.000	0.002	0.000	0.002	0.000	0.007	0.000
Cd	0.002	0.001	0.005	0.001	0.003	0.001	0.602	0.030
In*	436486.000	3884.698	436486.000	5355.609	436486.000	3115.312	436486.000	5068.091
Sn	0.006	0.000	0.006	0.001	0.006	0.000	0.006	0.001
Cs*	69.000	4.439	187.000	8.167	537.000	17.082	1191.000	42.099
Ba	1.310	0.033	0.620	0.014	1.300	0.040	0.850	0.004
Yb	BD		BD		BD		BD	
W	0.005	0.000	0.015	0.001	0.003	0.000	0.179	0.006
Re*	242404.000	1212.944	243372.000	2708.044	243793.000	2858.030	246756.000	2410.312
Pt*	7.000	0.883	10.000	1.371	15.000	0.533	113.000	2.422
Au*	60.000	3.496	17.000	3.683	23.000	5.904	114.000	16.494
Tl	BD		0.001	0.000	BD		BD	
Pb	0.010	0.002	0.030	0.002	0.010	0.001	3.500	0.038
Bi	0.001	0.000	0.003	0.000	0.004	0.000	0.170	0.002

* Concentration in CPS (counts per second). All other leachate concentrations in ppb.

CPS given when standards for element unavailable.

a) BD: below detection

b) Certified values of SLRS-5 from Heimbürger et al., (2013).

c) Except Pb, which has an average of 6 measurements of SLRS-5.

d) Variance % = [(Average SLRS-5 - Recommended Value)/Recommended value]

Run Composition Duration Temperature (°C)	Average	1σ	Average	1σ	Average	1σ	Average	1σ
	Vul5	Vul5	Vul5	Vul5	Vul5	Vul5	Vul5	Vul5
	NAS	NAS	NAS	NAS	NAS	NAS	NAS	NAS
	7 days	7 days	7 days	7 days	7 days	7 days	7 days	7 days
	427	427	427	427	350	350	295	295
Li	0.400	0.014	0.390	0.019	0.460	0.022	0.490	0.013
Al	2.020	0.048	1.610	0.024	0.900	0.018	0.890	0.023
Ca	16.000	2.006	8.000	0.419	14.000	0.056	7.000	0.191
V	3.220	0.052	1.970	0.027	1.690	0.034	1.700	0.027
Cr	1.070	0.022	1.160	0.024	0.740	0.013	0.750	0.010
Mn	0.040	0.002	0.040	0.001	0.030	0.001	0.030	0.001
Fe	5.200	0.186	5.900	0.223	5.000	0.160	4.800	0.139
Co	0.013	0.001	0.010	0.001	0.005	0.001	0.006	0.001
Ni	4.720	0.110	3.930	0.058	0.990	0.015	1.010	0.028
Cu	0.520	0.009	0.360	0.009	0.700	0.020	1.430	0.006
Zn	4.700	0.080	2.300	0.052	2.800	0.048	2.100	0.022
Ga*	450.000	37.593	376.000	4.061	583.000	21.919	539.000	25.417
As	0.087	0.001	0.077	0.004	0.064	0.004	0.047	0.003
Se	1.900	0.055	2.000	0.058	1.900	0.061	1.900	0.054
Rb	0.027	0.002	0.028	0.000	0.033	0.001	0.022	0.001
Sr	0.040	0.002	0.020	0.000	0.020	0.001	0.020	0.000
Y	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mo	139.100	1.704	145.600	1.316	219.400	2.482	190.300	1.852
Rh*	323016.000	3632.193	326291.000	3482.239	321779.000	3566.911	321634.000	5492.804
Pd*	9.800	1.796	7.200	3.599	3.200	1.323	5.000	2.200
Ag	0.015	0.001	0.015	0.001	0.013	0.001	0.009	0.000
Cd	0.581	0.015	0.564	0.008	0.718	0.027	0.531	0.006
In*	436486.000	5729.095	436486.000	2920.818	436486.000	3849.336	436486.000	4987.285
Sn	0.006	0.001	0.006	0.001	0.007	0.001	0.006	0.001
Cs*	7946.000	84.227	7816.000	102.052	15855.000	89.496	10592.000	47.159
Ba	0.970	0.014	0.730	0.025	1.230	0.021	1.200	0.012
Yb	BD		BD		BD		0.002	0.000
W	0.235	0.005	0.202	0.003	0.165	0.000	0.178	0.002
Re*	249399.000	2134.813	246198.000	1100.669	248928.000	2486.226	250851.000	2323.783
Pt*	401.000	17.003	211.000	21.817	488.000	5.562	1722.000	25.787
Au*	14.000	4.775	10.000	2.779	51.000	3.276	50.000	6.614
Tl	0.001	0.000	0.001	0.000	0.005	0.001	0.025	0.001
Pb	3.910	0.048	3.270	0.015	3.240	0.017	2.300	0.009
Bi	0.160	0.001	0.135	0.001	0.161	0.002	0.134	0.005

Run	Average	1 σ	Average	1 σ	Average	1 σ	Average	1 σ
Composition	Vul5	Vul5	Vul5	Vul5	Vul5	Vul5	Vul6	Vul6
Duration	NAS	NAS	NAS	NAS	NAS	NAS	NAS	NAS
Temperature (°C)	7 days	7 days	7 days	7 days	7 days	7 days	7 days	7 days
	253	253	162	162	116	116	816	816
Li	0.620	0.016	0.240	0.010	0.110	0.006	0.020	0.002
Al	1.430	0.065	1.030	0.025	0.940	0.021	1.260	0.026
Ca	6.000	0.685	7.000	0.390	8.000	0.317	6.000	0.302
V	0.710	0.006	1.750	0.018	1.070	0.019	0.510	0.008
Cr	0.410	0.010	1.130	0.013	3.460	0.056	0.170	0.004
Mn	0.030	0.000	0.030	0.001	0.040	0.001	0.030	0.000
Fe	4.500	0.138	4.600	0.120	5.600	0.195	4.600	0.199
Co	0.005	0.000	0.005	0.001	0.008	0.000	0.005	0.001
Ni	1.410	0.056	0.820	0.022	1.000	0.028	0.870	0.006
Cu	0.410	0.010	0.210	0.013	0.220	0.007	0.040	0.001
Zn	3.100	0.058	2.200	0.756	3.100	0.188	3.200	0.044
Ga*	148.000	2.863	438.000	3.604	1011.000	21.104	75.000	14.051
As	0.025	0.005	0.039	0.006	0.012	0.004	BD	
Se	1.900	0.054	1.800	0.055	1.800	0.036	1.800	0.066
Rb	0.013	0.001	0.020	0.001	0.014	0.001	0.003	0.000
Sr	0.010	0.000	0.020	0.000	0.030	0.001	0.010	0.000
Y	BD		0.000	0.000	0.000	0.000	0.000	0.000
Mo	119.000	1.272	165.600	1.560	125.300	0.862	1.100	0.015
Rh*	320458.000	3307.260	318963.000	2979.676	320671.000	2494.188	321841.000	705.208
Pd*	4.400	1.758	2.100	0.510	4.200	1.364	3.000	1.039
Ag	0.007	0.000	0.003	0.000	0.004	0.000	0.002	0.000
Cd	0.240	0.018	0.196	0.013	0.143	0.008	0.001	0.000
In*	436486.000	3323.804	436486.000	2780.352	436486.000	2441.319	436486.000	2970.789
Sn	0.006	0.001	0.008	0.001	0.009	0.001	0.005	0.002
Cs*	3598.000	90.153	2375.000	78.297	2379.000	46.549	154.000	8.021
Ba	0.330	0.017	1.000	0.010	2.310	0.018	0.170	0.006
Yb	BD		BD		BD		BD	
W	0.093	0.001	0.195	0.005	0.086	0.002	0.004	0.000
Re*	251422.000	2450.477	251934.000	265.570	253873.000	2620.468	254724.000	1533.344
Pt*	2630.000	17.558	5505.000	25.723	4771.000	76.077	9.000	1.005
Au*	13.000	1.400	7.000	2.311	16.000	4.034	10.000	2.147
Tl	0.021	0.001	0.067	0.001	0.039	0.001	BD	
Pb	0.960	0.005	0.670	0.007	0.620	0.002	0.010	0.001
Bi	0.047	0.002	0.037	0.001	0.020	0.001	0.002	0.000

Run Composition Duration Temperature (°C)	Average	1σ	Average	1σ	Average	1σ	Average	1σ
	Vul6	Vul6	Vul6	Vul6	Vul6	Vul6	Vul6	Vul6
	NAS	NAS	NAS	NAS	NAS	NAS	NAS	NAS
	7 days	7 days	7 days	7 days	7 days	7 days	7 days	7 days
	681	681	553	553	427	427	427	427
Li	1.220	0.037	1.860	0.062	2.820	0.118	3.540	0.121
Al	2.920	0.055	1.800	0.036	1.840	0.045	1.160	0.032
Ca	6.000	0.260	11.000	0.236	9.000	0.446	6.000	0.280
V	2.700	0.043	3.690	0.045	4.350	0.078	4.000	0.057
Cr	0.310	0.004	0.670	0.011	0.720	0.013	0.780	0.016
Mn	0.040	0.001	0.040	0.001	0.030	0.001	0.030	0.000
Fe	5.000	0.130	5.300	0.127	4.900	0.092	5.000	0.158
Co	0.006	0.001	0.012	0.000	0.013	0.000	0.007	0.001
Ni	1.390	0.016	1.980	0.019	0.370	0.012	1.790	0.007
Cu	0.130	0.001	0.180	0.011	0.170	0.001	0.220	0.009
Zn	2.900	0.070	1.900	0.176	2.400	0.055	1.400	0.133
Ga*	122.000	3.598	942.000	37.593	957.000	67.719	651.000	24.386
As	0.055	0.004	0.087	0.005	0.122	0.003	0.116	0.008
Se	1.800	0.038	2.000	0.051	1.900	0.083	1.800	0.030
Rb	0.004	0.001	0.012	0.000	0.044	0.001	0.049	0.003
Sr	0.010	0.001	0.040	0.001	0.040	0.000	0.030	0.000
Y	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
Mo	74.400	0.731	125.100	1.225	225.200	2.392	322.800	2.023
Rh*	320000.000	2232.014	325150.000	3344.508	323651.000	3545.047	322877.000	2381.136
Pd*	2.100	2.061	2.300	0.507	2.700	0.887	3.500	1.520
Ag	0.004	0.001	0.015	0.001	0.020	0.001	0.027	0.002
Cd	0.260	0.003	0.464	0.008	0.604	0.013	0.815	0.026
In*	436486.000	3845.338	436486.000	5406.931	436486.000	4541.261	436486.000	4996.850
Sn	0.006	0.002	0.007	0.001	0.005	0.001	0.005	0.001
Cs*	420.000	8.237	1553.000	23.204	1134.000	26.029	1090.000	45.393
Ba	0.240	0.002	2.000	0.031	2.140	0.013	1.580	0.048
Yb	BD		BD		0.000	0.000	BD	
W	0.186	0.007	0.214	0.001	0.192	0.003	0.264	0.006
Re*	254639.000	1029.504	249799.000	1221.179	253428.000	1624.073	255265.000	2514.057
Pt*	29.000	2.361	95.000	8.897	3613.000	525.461	3726.000	41.338
Au*	5.000	1.838	7.000	2.363	10.000	4.051	22.000	4.935
Tl	BD		BD		0.001	0.000	0.005	0.000
Pb	1.630	0.013	4.000	0.007	3.540	0.020	4.600	0.018
Bi	0.065	0.001	0.116	0.002	0.119	0.001	0.158	0.001

Run Composition Duration Temperature (°C)	Average	1 σ	Average	1 σ	Average	1 σ	Average	1 σ
	Vul6	Vul6	Vul6	Vul6	Vul6	Vul6	Vul6	Vul6
	NAS	NAS	NAS	NAS	NAS	NAS	NAS	NAS
	7 days	7 days	7 days	7 days	7 days	7 days	7 days	7 days
	350	350	295	295	218	218	188	188
Li	1.050	0.049	0.840	0.023	0.300	0.008	0.260	0.005
Al	3.050	0.053	0.920	0.009	2.220	0.035	2.060	0.037
Ca	7.000	0.281	8.000	0.690	6.000	0.459	10.000	0.977
V	2.750	0.042	3.050	0.033	1.000	0.019	1.990	0.026
Cr	0.400	0.008	0.300	0.005	0.270	0.003	0.300	0.005
Mn	0.040	0.002	0.040	0.001	0.030	0.000	0.030	0.001
Fe	5.500	0.286	5.500	0.218	5.000	0.237	5.100	0.153
Co	0.005	0.001	0.007	0.000	0.004	0.001	0.033	0.001
Ni	0.460	0.008	1.260	0.024	0.230	0.003	1.180	0.029
Cu	0.160	0.003	0.190	0.007	0.130	0.005	0.160	0.006
Zn	2.200	0.010	1.900	0.050	1.100	0.032	2.200	0.031
Ga*	610.000	20.687	1385.000	29.805	538.000	7.948	425.000	22.055
As	0.050	0.001	0.060	0.006	0.022	0.001	0.030	0.004
Se	1.800	0.033	1.800	0.047	1.800	0.016	1.800	0.033
Rb	0.025	0.000	0.024	0.001	0.011	0.001	0.013	0.001
Sr	0.030	0.000	0.050	0.001	0.030	0.001	0.030	0.001
Y	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mo	135.300	1.449	236.200	2.383	149.300	0.624	151.900	0.724
Rh*	320568.000	4683.563	321689.000	3223.126	319511.000	4373.329	321204.000	3002.789
Pd*	1.500	0.512	3.900	1.357	4.400	1.539	8.400	1.862
Ag	0.012	0.000	0.013	0.000	0.005	0.000	0.006	0.000
Cd	0.267	0.007	0.351	0.018	0.173	0.014	0.165	0.009
In*	436486.000	4675.353	436486.000	5663.604	436486.000	5317.593	436486.000	3389.672
Sn	0.005	0.001	0.007	0.001	0.009	0.001	0.010	0.001
Cs*	684.000	19.966	1055.000	38.421	425.000	59.051	642.000	10.802
Ba	1.390	0.044	3.290	0.044	1.340	0.018	1.030	0.002
Yb	BD		0.001	0.000	BD		BD	
W	0.168	0.004	0.224	0.004	0.121	0.001	0.179	0.005
Re*	255500.000	2456.325	258824.000	2193.629	257483.000	2638.875	258554.000	1869.427
Pt*	3582.000	20.447	6137.000	723.486	15330.000	98.471	16078.000	127.772
Au*	14.000	1.859	23.000	3.603	21.000	4.947	37.000	6.451
Tl	0.028	0.002	0.191	0.001	0.076	0.001	0.102	0.002
Pb	1.980	0.014	1.930	0.006	0.700	0.013	0.780	0.012
Bi	0.058	0.001	0.084	0.002	0.024	0.001	0.035	0.001

Run Composition Duration Temperature (°C)	Average	1σ	Average	1σ	Average	1σ	Average	1σ
	Vul7	Vul7	Vul7	Vul7	Vul7	Vul7	Vul7	Vul7
	NFS	NFS	NFS	NFS	NFS	NFS	NFS	NFS
	7 days	7 days	7 days	7 days	7 days	7 days	7 days	7 days
	761	761	681	681	427	427	295	295
Li	BD		0.120	0.006	2.000	0.118	1.000	0.056
Al	1.800	0.084	2.930	0.047	1.460	0.030	0.730	0.032
Ca	6.000	1.100	6.000	0.497	7.000	0.718	7.000	0.330
V	1.010	0.025	1.750	0.017	5.960	0.153	3.930	0.105
Cr	0.140	0.004	0.150	0.003	0.730	0.020	0.200	0.009
Mn	0.030	0.001	0.030	0.000	0.040	0.001	0.040	0.002
Fe	3.400	0.201	3.200	0.130	3.800	0.151	3.600	0.138
Co	0.024	0.001	0.002	0.000	0.003	0.000	0.002	0.001
Ni	0.070	0.007	0.090	0.007	0.080	0.003	0.080	0.003
Cu	0.030	0.002	0.040	0.001	0.350	0.011	0.460	0.018
Zn	0.900	0.034	0.700	0.026	1.100	0.072	1.300	0.030
Ga*	48.000	11.426	44.000	1.827	50.000	4.497	73.000	3.963
As	BD		0.003	0.001	0.154	0.010	0.073	0.007
Se	2.100	0.065	2.200	0.062	2.200	0.130	2.100	0.002
Rb	0.001	0.000	0.002	0.000	0.023	0.000	0.021	0.002
Sr	0.010	0.001	0.010	0.000	0.010	0.002	0.010	0.001
Y	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
Mo	1.600	0.037	1.600	0.049	111.300	2.239	266.200	5.749
Rh*	247215.000	3158.938	247912.000	4796.713	248942.000	5370.032	247691.000	4698.409
Pd*	1.800	0.581	1.700	0.561	0.700	0.608	1.300	1.162
Ag	0.001	0.000	0.002	0.000	0.023	0.001	0.015	0.001
Cd	0.002	0.000	0.006	0.001	0.297	0.009	0.359	0.009
In*	341024.000	4860.439	341024.000	4385.245	341024.000	5786.216	341024.000	8270.336
Sn	0.004	0.001	0.004	0.001	0.004	0.001	0.007	0.002
Cs*	27.000	2.141	22.000	2.635	430.000	20.980	632.000	45.205
Ba	0.100	0.010	0.080	0.006	0.120	0.008	0.170	0.004
Yb	BD		D		BD		BD	
W	0.003	0.001	0.006	0.001	0.400	0.017	0.349	0.003
Re*	218781.000	2008.715	214995.000	1803.179	215553.000	2900.228	216472.000	4405.874
Pt*	8.000	1.106	5.000	0.572	950.000	17.773	5970.000	354.523
Au*	10.000	6.703	2.000	2.453	15.000	10.362	14.000	1.595
Tl	0.000	0.000	BD		0.002	0.000	0.142	0.002
Pb	0.010	0.004	0.040	0.034	3.040	0.060	1.720	0.056
Bi	0.008	0.000	0.007	0.000	0.103	0.001	0.052	0.002

	Average	1 σ	Average	1 σ	Average	1 σ	Average	1 σ
Run	Vul7	Vul7	Vul7	Vul7	Vul7	Vul7	Vul7	Vul7
Composition	NFS	NFS	NFS	NFS	NFS	NFS	NFS	NFS
Duration	7 days	7 days	7 days	7 days	7 days	7 days	7 days	7 days
Temperature (°C)	253	253	218	218	188	188	162	162
Li	0.480	0.026	0.370	0.017	0.200	0.014	0.180	0.012
Al	0.870	0.025	0.780	0.027	0.590	0.018	0.740	0.042
Ca	7.000	0.229	7.000	0.560	7.000	0.664	7.000	0.697
V	1.950	0.039	2.160	0.040	1.050	0.020	0.960	0.011
Cr	0.220	0.006	0.380	0.012	0.240	0.005	0.370	0.009
Mn	0.030	0.001	0.050	0.003	0.030	0.000	0.030	0.001
Fe	3.300	0.064	4.600	0.203	3.300	0.171	3.700	0.145
Co	0.002	0.000	0.002	0.001	0.001	0.001	0.002	0.000
Ni	0.070	0.001	0.210	0.009	0.110	0.005	0.210	0.010
Cu	0.270	0.010	0.250	0.007	0.160	0.008	0.130	0.002
Zn	0.800	0.011	0.900	0.075	0.700	0.015	1.000	0.038
Ga*	29.000	3.830	31.000	1.915	20.000	5.460	46.000	1.917
As	0.047	0.006	0.047	0.003	0.022	0.002	0.018	0.001
Se	2.100	0.065	2.100	0.080	2.000	0.053	2.000	0.059
Rb	0.011	0.000	0.010	0.001	0.006	0.000	0.006	0.001
Sr	0.010	0.001	0.010	0.000	0.010	0.000	0.010	0.001
Y	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mo	295.800	4.505	256.400	4.939	129.700	3.572	122.800	2.126
Rh*	248023.000	4729.388	248468.000	5482.054	246221.000	2124.793	247128.000	4531.946
Pd*	0.400	0.613	1.700	0.564	1.100	0.000	2.100	1.026
Ag	0.008	0.001	0.006	0.000	0.004	0.000	0.003	0.000
Cd	0.339	0.011	0.261	0.015	0.134	0.008	0.122	0.002
In*	341024.000	5063.347	341024.000	5120.363	341024.000	4109.848	341024.000	4852.270
Sn	0.005	0.000	0.008	0.001	0.007	0.001	0.006	0.001
Cs*	311.000	42.059	292.000	18.499	168.000	10.395	155.000	13.901
Ba	0.090	0.004	0.090	0.004	0.060	0.006	0.130	0.007
Yb	BD		BD		BD		BD	
W	0.190	0.001	0.202	0.002	0.129	0.001	0.138	0.005
Re*	218679.000	2896.113	222153.000	3180.780	221261.000	1486.147	222371.000	4181.219
Pt*	10309.000	122.594	15876.000	184.214	10393.000	241.286	9206.000	126.986
Au*	29.000	3.375	20.000	6.787	14.000	4.130	10.000	1.662
Tl	0.094	0.001	0.093	0.000	0.042	0.000	0.036	0.001
Pb	0.850	0.011	0.740	0.009	0.420	0.029	0.380	0.009
Bi	0.030	0.000	0.029	0.001	0.017	0.001	0.018	0.001

Run Composition Duration Temperature (°C)	Average	1σ	Average	1σ	Average	1σ	Average	1σ
	Vul7	Vul7	Vul7	Vul7	Vul8	Vul8	Vul8	Vul8
	NFS	NFS	NFS	NFS	NFS	NFS	NFS	NFS
	7 days	7 days	7 days	7 days	2 days	2 days	2 days	2 days
	138	138	116	116	761	761	681	681
Li	0.100	0.003	0.100	0.007	BD		0.110	0.002
Al	0.500	0.010	1.340	0.040	1.010	0.022	1.300	0.035
Ca	5.000	0.351	6.000	0.491	6.000	0.402	6.000	0.626
V	0.600	0.019	0.320	0.011	0.440	0.011	1.320	0.014
Cr	0.650	0.005	1.060	0.022	0.150	0.002	0.150	0.003
Mn	0.020	0.001	0.030	0.001	0.020	0.000	0.030	0.000
Fe	3.200	0.060	3.200	0.140	3.400	0.104	3.600	0.088
Co	0.001	0.000	0.001	0.000	0.002	0.001	0.003	0.001
Ni	0.070	0.008	0.060	0.008	0.080	0.005	0.160	0.002
Cu	0.100	0.004	0.090	0.002	0.040	0.003	0.080	0.004
Zn	0.900	0.042	1.000	0.026	0.900	0.008	1.000	0.021
Ga*	13.000	3.160	60.000	8.235	25.000	3.916	35.000	5.991
As	0.011	0.003	0.008	0.003	BD		BD	
Se	2.000	0.023	2.000	0.019	2.100	0.111	2.000	0.090
Rb	0.004	0.000	0.004	0.000	0.001	0.000	0.002	0.000
Sr	0.010	0.000	0.010	0.001	0.010	0.001	0.010	0.000
Y	0.000	0.000	0.000	0.000	BD		0.000	0.000
Mo	81.000	0.951	72.000	0.991	0.500	0.011	1.400	0.017
Rh*	245477.000	5372.479	246242.000	5460.223	245740.000	3893.306	246927.000	3904.089
Pd*	0.300	0.604	1.000	1.023	1.200	0.000	BD	
Ag	0.003	0.000	0.002	0.000	0.001	0.000	0.001	0.000
Cd	0.076	0.005	0.069	0.001	0.001	0.000	0.004	0.001
In*	341024.000	9300.636	341024.000	5871.814	341024.000	4274.381	341024.000	6281.276
Sn	0.005	0.001	0.006	0.001	0.004	0.001	0.005	0.001
Cs*	116.000	14.354	92.000	4.532	19.000	4.842	19.000	5.004
Ba	0.030	0.002	0.160	0.012	0.040	0.002	0.080	0.003
Yb	BD		BD		BD		BD	
W	0.096	0.005	0.152	0.004	0.000	0.000	0.009	0.000
Re*	221818.000	6971.476	223224.000	3577.108	215637.000	2342.089	218099.000	3091.696
Pt*	5478.000	47.883	2894.000	59.285	5.000	0.148	6.000	0.433
Au*	13.000	3.780	3.000	1.674	4.000	2.460	7.000	4.308
Tl	0.025	0.000	0.018	0.000	BD		BD	
Pb	0.270	0.002	0.170	0.008	0.000	0.003	0.040	0.018
Bi	0.010	0.000	0.007	0.000	0.002	0.000	0.005	0.000

Run	Average	1 σ	Average	1 σ	Average	1 σ	Average	1 σ
Composition	Vul8	Vul8	Vul8	Vul8	Vul8	Vul8	Vul8	Vul8
Duration	NFS	NFS	NFS	NFS	NFS	NFS	NFS	NFS
Temperature (°C)	2 days	2 days	2 days	2 days	2 days	2 days	2 days	2 days
	427	427	295	295	253	253	218	218
Li	1.790	0.098	0.500	0.039	0.340	0.027	0.220	0.017
Al	0.710	0.018	0.640	0.026	1.080	0.030	0.580	0.021
Ca	8.000	0.239	7.000	0.715	8.000	0.588	7.000	0.572
V	4.650	0.152	0.880	0.033	0.980	0.022	0.450	0.008
Cr	0.410	0.013	0.170	0.003	0.200	0.002	0.830	0.016
Mn	0.030	0.001	0.030	0.001	0.030	0.002	0.090	0.000
Fe	3.500	0.132	3.300	0.241	3.600	0.165	5.800	0.122
Co	0.002	0.000	0.001	0.000	0.001	0.000	0.004	0.000
Ni	0.100	0.005	0.160	0.011	0.140	0.005	0.660	0.010
Cu	0.320	0.026	0.170	0.003	0.220	0.015	0.120	0.003
Zn	1.200	0.040	1.000	0.052	1.000	0.020	1.000	0.016
Ga*	40.000	5.110	11.000	1.472	20.000	5.498	39.000	7.557
As	0.070	0.001	0.019	0.006	0.022	0.006	0.013	0.002
Se	2.200	0.083	2.100	0.058	2.100	0.052	2.100	0.059
Rb	0.014	0.000	0.006	0.000	0.006	0.000	0.004	0.000
Sr	0.010	0.000	0.010	0.000	0.010	0.001	0.010	0.000
Y	0.000	0.000	BD		0.000	0.000	0.000	0.000
Mo	44.600	0.420	68.700	1.462	147.000	3.010	106.600	1.262
Rh*	248652.000	3656.678	250050.000	4755.178	248579.000	5357.744	247179.000	4818.129
Pd*	2.500	2.222	BD		0.700	0.638	2.400	1.558
Ag	0.020	0.002	0.008	0.001	0.007	0.001	0.004	0.000
Cd	0.118	0.006	0.097	0.007	0.156	0.016	0.109	0.011
In*	341024.000	6933.883	341024.000	5795.988	341024.000	6401.220	341024.000	6158.877
Sn	0.005	0.001	0.004	0.001	0.006	0.001	0.008	0.001
Cs*	298.000	40.162	186.000	24.950	181.000	3.954	137.000	3.662
Ba	0.100	0.010	0.030	0.002	0.040	0.000	0.090	0.002
Yb	BD		BD		BD		BD	
W	0.368	0.008	0.216	0.006	0.185	0.007	0.125	0.002
Re*	212605.000	2722.775	212554.000	2921.838	214516.000	3389.550	218344.000	3953.135
Pt*	1697.000	48.429	5418.000	116.018	5861.000	131.806	6294.000	56.393
Au*	3.000	0.000	9.000	2.404	6.000	4.609	8.000	0.856
Tl	0.001	0.000	0.058	0.000	0.071	0.002	0.040	0.001
Pb	1.530	0.258	0.440	0.021	0.370	0.013	0.220	0.006
Bi	0.059	0.002	0.018	0.001	0.016	0.001	0.010	0.000

Run Composition Duration Temperature (°C)	Average	1 σ	Average	1 σ	Average	1 σ	Average	1 σ
	Vul8	Vul8	Vul8	Vul8	Vul8	Vul8	Vul8	Vul8
	NFS	NFS	NFS	NFS	NFS	NFS	NFS	NFS
	2 days	2 days	2 days	2 days	2 days	2 days	2 days	2 days
	188	188	162	162	138	138	106	106
Li	0.210	0.002	0.190	0.008	0.090	0.006	0.070	0.005
Al	0.950	0.022	0.680	0.011	0.540	0.024	0.790	0.013
Ca	8.000	0.195	6.000	0.542	6.000	0.239	9.000	0.424
V	1.650	0.034	0.530	0.011	0.350	0.011	0.220	0.003
Cr	0.450	0.013	0.710	0.012	0.790	0.019	1.470	0.034
Mn	0.030	0.001	0.030	0.000	0.040	0.001	0.040	0.002
Fe	3.500	0.238	3.600	0.207	3.800	0.199	3.800	0.122
Co	0.002	0.000	0.001	0.000	0.002	0.001	0.002	0.000
Ni	0.140	0.004	0.130	0.008	0.190	0.007	0.100	0.002
Cu	0.240	0.003	0.160	0.006	0.110	0.007	0.130	0.010
Zn	0.900	0.024	1.100	0.006	1.300	0.030	1.700	0.027
Ga*	16.000	1.968	28.000	4.401	8.000	6.419	17.000	1.991
As	0.020	0.008	0.009	0.003	0.009	0.004	BD	
Se	2.100	0.073	2.100	0.076	2.100	0.055	2.100	0.049
Rb	0.007	0.001	0.005	0.000	0.003	0.000	0.003	0.000
Sr	0.010	0.000	0.010	0.001	0.010	0.001	0.010	0.000
Y	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mo	131.000	3.110	91.500	1.534	39.000	0.748	43.700	0.724
Rh*	245967.000	6044.356	246193.000	5363.461	246727.000	4743.727	247070.000	3779.468
Pd*	0.700	0.628	2.200	1.869	1.100	1.067	0.700	1.217
Ag	0.004	0.001	0.004	0.000	0.002	0.000	0.002	0.000
Cd	0.131	0.008	0.091	0.002	0.037	0.004	0.047	0.008
In*	341024.000	7973.188	341024.000	7121.807	341024.000	6662.481	341024.000	4791.533
Sn	0.007	0.001	0.008	0.001	0.006	0.001	0.006	0.001
Cs*	246.000	30.301	146.000	22.393	81.000	14.978	147.000	9.929
Ba	0.050	0.003	0.070	0.004	0.010	0.001	0.040	0.005
Yb	BD		BD		BD		BD	
W	0.183	0.007	0.112	0.004	0.058	0.002	0.041	0.001
Re*	216290.000	4107.701	217009.000	2797.360	216306.000	2966.703	217732.000	2936.523
Pt*	8156.000	193.153	5617.000	77.639	2171.000	33.083	1755.000	23.667
Au*	8.000	4.143	7.000	4.087	3.000	1.873	16.000	4.238
Tl	0.054	0.000	0.032	0.000	0.016	0.000	0.010	0.000
Pb	0.400	0.014	0.210	0.009	0.120	0.007	0.080	0.008
Bi	0.017	0.002	0.010	0.000	0.007	0.000	0.004	0.000

Run Composition Duration Temperature (°C)	Average	1σ	Average	1σ	Average	1σ	Average	1σ
	Blank2	Blank2	Blank2	Blank2	Blank2	Blank2	Blank2	Blank2
	2 days	2 days	2 days	2 days	2 days	2 days	2 days	2 days
	791	791	624	624	427	427	295	295
Li	BD		0.147	3.577	0.135	5.053	0.068	8.330
Al	0.662	2.957	0.635	4.125	0.693	2.911	4.283	3.399
Ca	6.189	11.589	8.098	5.979	6.590	10.087	6.512	15.463
V	0.423	2.755	3.926	2.280	4.208	1.761	3.539	2.889
Cr	0.390	3.175	0.341	3.599	0.342	3.243	0.292	2.721
Mn	0.051	1.400	0.055	5.849	0.041	1.214	0.044	5.260
Fe	4.521	4.194	4.022	1.082	3.929	4.083	4.282	3.682
Co	0.492	2.613	1.532	2.226	0.377	0.675	2.865	2.452
Ni	0.449	0.473	0.810	2.745	0.307	4.449	1.306	3.811
Cu	2.367	1.695	7.979	3.501	2.045	1.333	15.186	2.542
Zn	0.857	3.240	1.092	1.127	0.954	2.807	1.209	0.644
Ga*	21.448	18.115	10.236	57.097	13.091	32.760	17.001	22.636
As	0.002	69.282	0.021	23.668	0.029	25.158	0.012	18.659
Se	2.154	2.936	2.163	4.282	2.170	5.645	2.141	6.798
Rb	0.002	12.486	0.002	32.145	0.002	8.723	0.002	24.573
Sr	0.009	2.796	0.010	4.209	0.009	4.190	0.010	7.456
Y	0.000	16.496	0.000	0.000	0.001	7.315	0.000	31.152
Mo	0.293	3.899	2.895	1.213	2.962	2.441	67.582	2.138
Rh*	249752.439	1.715	248959.605	1.536	249514.589	2.037	247888.440	1.726
Pd*	3.133	22.294	3.462	88.305	3.473	58.246	3.108	56.070
Ag	0.001	29.039	0.002	32.678	0.002	9.910	0.002	13.416
Cd	BD		0.011	23.238	0.007	22.974	0.064	12.114
In*	341024.000	1.770	341024.000	1.713	341024.000	1.369	341024.000	2.188
Sn	0.608	2.559	1.843	1.421	0.462	1.551	3.502	2.005
Cs*	4.188	95.948	46.857	20.737	114.678	4.414	89.981	8.066
Ba	0.048	4.574	0.012	20.340	0.028	11.517	0.022	7.768
Yb	BD		BD		BD		BD	
W	0.137	3.398	0.522	1.361	0.136	2.502	1.006	1.347
Re*	207568.096	2.087	209396.404	0.902	208664.153	1.075	209249.120	1.687
Pt*	11.308	28.571	72.924	0.935	118.173	12.888	651.876	8.121
Au*	2.990	84.324	14.171	30.060	3.974	22.294	4.986	45.984
Tl	BD		0.001	10.278	0.006	9.967	0.028	0.857
Pb	0.005	8.672	1.972	1.697	1.368	0.516	0.436	0.586
Bi	0.002	7.496	0.039	2.439	0.022	3.787	0.009	4.691

Run Composition Duration Temperature (°C)	Average	1 σ	Average	1 σ	Average	1 σ	Average	1 σ
	Blank2	Blank2	Blank2	Blank2	Blank2	Blank2	Blank2	Blank2
	2 days	2 days	2 days	2 days	2 days	2 days	2 days	2 days
	253	253	218	218	188	188	162	162
Li	0.070	7.810	BD		BD		BD	
Al	0.856	1.183	0.680	2.984	0.618	4.240	0.778	3.648
Ca	9.195	3.561	5.959	8.211	6.948	4.383	7.088	2.744
V	3.757	1.942	1.846	2.596	1.757	1.366	2.105	1.781
Cr	0.296	4.068	0.386	2.098	0.220	3.153	0.424	2.624
Mn	0.040	2.278	0.045	4.184	0.030	1.392	0.046	2.408
Fe	3.661	3.524	4.338	1.471	3.775	1.704	4.313	5.956
Co	1.290	1.774	0.802	2.661	0.733	1.354	0.479	2.346
Ni	0.644	0.538	0.529	6.193	0.341	2.064	0.375	4.994
Cu	6.749	3.003	4.194	1.709	3.783	2.429	2.555	2.365
Zn	3.847	3.355	1.079	1.484	0.825	3.865	0.927	2.779
Ga*	72.180	18.391	8.939	36.883	12.889	23.194	25.432	8.456
As	0.020	18.775	0.013	16.762	0.013	40.062	0.023	5.336
Se	2.130	1.466	2.192	3.620	2.185	2.684	2.204	2.938
Rb	0.004	12.710	0.002	23.916	0.002	3.123	0.004	12.227
Sr	0.025	2.369	0.009	4.741	0.009	14.333	0.013	7.051
Y	0.000	65.875	0.000	56.713	0.000	24.841	0.000	45.984
Mo	88.600	1.397	96.212	1.519	118.261	1.723	128.213	1.143
Rh*	246560.892	1.665	248557.842	1.827	249001.276	1.504	248064.026	2.080
Pd*	1.170	98.711	1.883	91.968	2.703	48.653	1.499	86.603
Ag	0.002	4.742	0.002	8.862	0.002	18.119	0.002	3.936
Cd	0.086	1.686	0.090	11.516	0.114	9.543	0.124	10.972
In*	341024.000	2.039	341024.000	1.719	341024.000	1.294	341024.000	2.180
Sn	1.564	1.357	0.952	3.530	0.814	1.919	0.572	2.519
Cs*	42.568	26.644	11.729	38.010	17.827	12.500	72.229	12.435
Ba	0.185	3.014	0.011	18.185	0.022	11.513	0.041	5.244
Yb	BD		BD		BD		BD	
W	0.588	1.847	0.335	0.975	0.349	1.789	0.326	1.498
Re*	209731.576	1.150	205916.683	1.917	206686.951	0.567	207159.935	1.228
Pt*	1444.967	6.741	868.748	2.385	944.935	3.267	1154.919	4.204
Au*	5.013	95.920	4.960	45.984	14.586	36.476	3.507	108.146
Tl	0.026	4.059	0.013	1.756	0.013	2.643	0.022	2.638
Pb	0.491	0.961	0.247	0.259	0.245	0.568	0.381	1.319
Bi	0.011	4.315	0.006	7.227	0.007	2.261	0.025	1.251

Run Composition Duration Temperature (°C)	Average	1σ	Average	1σ	Average	1σ	Average	1σ
	Blank2	Blank2	Blank2	Blank2	Blank7	Blank7	Blank7	Blank7
	2 days	2 days	2 days	2 days	7 days	7 days	7 days	7 days
	138	138	116	116	791	791	681	681
Li	BD		BD		BD		BD	
Al	0.630	3.898	0.802	3.528	0.773	1.052	0.999	4.219
Ca	6.897	8.611	8.957	14.244	6.307	8.691	6.651	20.658
V	0.966	1.017	0.848	2.747	0.444	3.715	0.745	1.055
Cr	0.347	4.592	1.373	2.230	0.167	2.388	0.400	1.004
Mn	0.030	4.692	0.059	4.548	0.029	4.408	0.073	1.381
Fe	3.751	6.881	5.184	2.741	3.369	1.124	4.790	5.769
Co	1.261	3.673	1.759	2.291	0.002	52.522	0.003	11.152
Ni	0.532	5.836	0.989	1.661	0.048	7.311	0.407	5.988
Cu	6.659	2.848	9.127	1.224	0.041	1.942	0.048	4.930
Zn	0.860	4.327	1.149	1.189	0.776	5.218	1.020	2.062
Ga*	9.815	54.881	50.516	24.020	68.588	11.823	36.798	34.833
As	0.009	19.727	0.005	17.321	BD		BD	
Se	2.133	2.823	2.144	1.766	2.136	1.279	2.132	2.674
Rb	0.002	6.162	0.002	21.281	0.001	19.748	0.003	16.478
Sr	0.008	2.519	0.014	8.728	0.010	7.190	0.011	4.115
Y	0.000	33.195	0.000	58.246	BD		0.000	74.269
Mo	75.982	2.640	91.625	2.010	0.128	10.450	0.277	2.872
Rh*	247777.365	1.736	248125.748	2.215	246643.855	2.191	250485.954	1.898
Pd*	1.557	113.607	1.531	40.754	1.106	98.711	3.395	65.789
Ag	0.001	25.920	0.002	18.185	0.001	14.423	0.001	27.369
Cd	0.070	11.630	0.084	1.861	BD		0.001	22.294
In*	341024.000	1.575	341024.000	1.831	341024.000	1.446	341024.000	1.809
Sn	1.416	1.936	2.046	1.843	0.005	22.592	0.009	4.313
Cs*	31.753	10.102	90.737	13.806	8.199	49.113	21.533	25.541
Ba	0.019	8.995	0.124	2.739	0.183	5.057	0.078	2.655
Yb	BD		BD		BD		BD	
W	0.374	1.729	0.549	2.090	0.005	11.459	0.003	6.623
Re*	207795.051	1.527	209811.168	1.388	211326.584	1.553	211851.318	1.730
Pt*	837.778	2.483	1478.597	1.970	3.798	12.500	2.925	36.464
Au*	4.609	87.302	8.624	53.535	2.002	40.754	6.579	80.359
Tl	0.007	7.503	0.007	7.741	BD		BD	
Pb	0.160	2.280	0.133	2.815	0.003	3.089	0.038	3.417
Bi	0.007	2.211	0.004	12.255	0.001	32.746	0.005	4.507

Run Composition Duration Temperature (°C)	Average	1 σ	Average	1 σ	Average	1 σ	Average	1 σ
	Blank7	Blank7	Blank7	Blank7	Blank7	Blank7	Blank7	Blank7
	7 days	7 days	7 days	7 days	7 days	7 days	7 days	7 days
	427	427	295	295	253	253	218	218
Li	0.279	5.953	0.162	6.339	0.158	2.167	0.120	11.783
Al	0.677	7.586	1.307	4.775	0.600	86.842	1.778	23.950
Ca	6.137	6.394	9.725	3.859	8.677	7.551	15.117	9.934
V	7.952	1.511	11.725	2.298	12.044	2.814	9.664	2.324
Cr	0.216	2.583	0.200	1.370	0.285	4.431	0.324	2.083
Mn	0.042	4.827	0.034	5.839	0.041	1.780	0.042	2.044
Fe	3.482	4.952	3.941	4.238	4.106	3.940	4.111	1.643
Co	0.001	36.913	0.002	16.970	0.129	2.580	0.580	1.134
Ni	0.112	4.766	0.140	5.431	0.261	3.664	0.407	0.975
Cu	0.399	4.443	0.380	1.615	41.319	1.951	89.243	1.876
Zn	0.788	5.375	0.868	2.127	1.251	2.831	1.027	0.542
Ga*	11.715	33.203	46.101	11.816	34.189	11.064	35.467	11.783
As	0.042	6.703	0.061	5.056	0.052	8.979	0.082	6.695
Se	2.152	3.075	2.217	3.476	2.135	1.507	2.058	2.449
Rb	0.008	9.271	0.006	9.556	0.007	8.058	0.009	20.578
Sr	0.008	1.064	0.016	7.546	0.013	2.268	0.017	4.867
Y	0.000	56.396	0.000	34.743	0.000	33.905	0.000	61.767
Mo	5.599	1.576	431.811	2.188	348.271	1.659	557.520	1.483
Rh*	249114.585	1.758	247607.934	2.785	246821.484	1.572	244196.644	1.470
Pd*	1.504	86.603	0.750	86.603	5.122	80.967	6.636	49.780
Ag	0.007	14.279	0.004	5.330	0.005	5.889	0.006	11.310
Cd	0.013	5.013	0.398	4.305	0.335	6.675	0.516	5.625
In*	341024.000	2.106	341024.000	2.359	341024.000	1.790	341024.000	1.630
Sn	0.005	30.264	0.007	7.736	5.410	11.910	13.194	1.793
Cs*	663.739	3.587	825.420	4.479	160.919	7.763	173.493	2.151
Ba	0.023	12.771	0.120	7.489	0.073	2.231	0.069	10.951
Yb	BD		BD		BD		BD	
W	0.209	1.183	0.838	1.416	0.752	0.736	0.634	0.794
Re*	210002.185	1.240	209608.618	2.002	210331.692	1.676	211569.112	0.745
Pt*	44.535	7.779	1553.265	1.540	1389.951	2.063	1966.231	1.263
Au*	21.550	18.970	7.053	32.176	15.232	20.000	10.336	31.198
Tl	0.010	9.747	0.123	0.219	0.112	2.545	0.091	2.238
Pb	2.455	0.272	1.433	8.104	1.413	0.124	1.153	0.774
Bi	0.048	2.437	0.033	3.773	0.045	6.784	0.034	2.044

Run Composition Duration Temperature (°C)	Average	1σ	Average	1σ	Average	1σ	Average	1σ
	Blank7	Blank7	Blank7	Blank7	Blank7	Blank7	Blank7	Blank7
	7 days	7 days	7 days	7 days	7 days	7 days	7 days	7 days
	188	188	162	162	138	138	116	116
Li	0.084	5.841	0.056	10.384	0.043	2.798	BD	
Al	0.987	3.731	0.728	4.912	0.466	92.213	1.191	2.623
Ca	7.618	10.889	7.448	2.596	6.821	5.929	8.484	2.057
V	5.931	2.607	4.058	2.921	2.238	3.044	1.381	1.209
Cr	0.286	5.599	0.301	4.475	0.381	3.891	2.274	2.368
Mn	0.033	4.817	0.031	3.910	0.038	4.597	0.049	4.686
Fe	3.744	4.304	3.505	4.064	3.799	3.874	4.637	3.192
Co	0.202	2.986	0.042	2.096	0.031	5.482	0.040	3.844
Ni	0.185	4.737	0.088	10.055	0.122	1.623	0.182	6.956
Cu	71.492	2.290	17.003	1.899	12.549	1.965	6.224	1.550
Zn	1.101	2.895	1.073	2.650	0.781	2.714	1.292	2.142
Ga*	51.572	12.819	24.359	12.887	39.041	11.439	33.485	10.684
As	0.051	19.935	0.029	9.821	0.016	5.320	0.014	27.792
Se	2.048	6.304	2.074	4.424	2.074	3.608	2.086	4.246
Rb	0.004	5.045	0.005	3.463	0.002	41.617	0.003	4.409
Sr	0.013	8.379	0.011	3.282	0.012	5.247	0.012	3.916
Y	0.000	41.660	0.000	64.353	BD		0.000	50.649
Mo	511.199	2.465	339.678	1.843	238.055	2.134	154.509	1.893
Rh*	243864.576	1.583	244508.420	2.329	245290.960	2.548	246943.053	2.482
Pd*	5.207	54.073	1.143	173.205	2.646	25.587	BD	
Ag	0.005	8.179	0.003	14.199	0.002	15.288	0.002	16.955
Cd	0.439	2.538	0.300	2.823	0.212	3.768	0.135	3.225
In*	341024.000	1.899	341024.000	1.589	341024.000	1.904	341024.000	2.433
Sn	11.247	2.066	2.682	1.036	1.193	0.660	1.155	2.333
Cs*	110.375	25.874	99.725	5.014	70.265	12.163	86.280	2.665
Ba	0.134	1.798	0.053	11.039	0.135	2.779	0.072	8.796
Yb	BD		BD		BD		BD	
W	0.442	2.675	0.282	1.885	0.188	3.575	0.166	1.631
Re*	213586.525	1.378	213598.988	1.343	214615.674	0.738	217558.280	1.009
Pt*	2087.592	2.005	1230.884	0.667	1642.367	1.382	1312.968	1.027
Au*	15.178	23.792	3.792	97.306	9.118	27.202	3.263	49.355
Tl	0.049	2.538	0.040	1.677	0.017	4.875	0.012	9.983
Pb	0.740	1.348	0.513	0.935	0.286	2.081	0.176	0.860
Bi	0.022	8.391	0.020	2.791	0.011	3.432	0.010	5.132

Run Composition Duration Temperature (°C)	Detection limit of ICP-MS	Standard SLRS-5 Certified values ^b (µg/l)	SLRS-5 Certified values Uncertainty (±)	SLRS-5 Average from 12 measurements ^c	SLRS-5 Variance (%) ^d
Li	0.021			0.230	
Al	0.033	49.500	5.000	42.010	-15.1
Ca	1.646	10500.000	500.000	9916.000	-5.6
V	0.001	0.317	0.033	0.390	22.9
Cr	0.069	0.208	0.023	0.240	14.0
Mn	0.004	4.330	0.180	3.570	-17.6
Fe	1.261	91.200	5.800	95.100	4.2
Co	0.001	0.050		0.062	24.8
Ni	0.004	0.476	0.064	0.600	25.1
Cu	0.010	17.400	1.300	16.570	-4.7
Zn	0.038	0.845	0.095	1.100	26.1
Ga*				6520.000	
As	0.002	0.413	0.039	0.476	15.2
Se	0.301			2.000	
Rb	0.001			1.159	
Sr	0.001	53.600	1.300	43.300	-19.2
Y	0.000			0.102	
Mo	0.022	0.270	0.040	0.200	-19.3
Rh*				275194.000	
Pd*				46.700	
Ag	0.001			0.002	
Cd	0.001	0.006	0.001	0.009	49.0
In*				380800.000	
Sn	0.002			0.008	
Cs*				103.000	
Ba	0.003	14.000	0.500	15.710	12.2
Yb	0.000			0.010	
W	0.001			0.010	
Re*				232370.000	
Pt*				19.000	
Au*				12.000	
Tl	0.000			0.004	
Pb	0.001	0.081	0.006	0.070	-11.4
Bi	0.001			0.002	

Appendix B: Supplementary solution ICP-MS data for Chapter 3

HNO3 Method	Temperature (°C)	7Li	7Li RSD	27Al	27Al RSD	Cl [H2]	Cl [H2] RSD	43Ca	43Ca RSD
Sample Name									
STD M+Cs+Pt 1/1000		0.120	2.791	0.560	1.361			8.791	4.177
STD M+Cs+Pt 1/100		1.060	0.550	1.465	2.259			5.842	2.744
STD M+Cs+Pt 1/10		10.675	0.829	10.675	0.792			10.675	2.346
STD A - D2/2		0.103	2.591	0.397	1.379			125.674	1.491
Clean glass 1		0.010	9.012	0.552	1.354	25.512	2.011	4.694	4.502
Blank	10	0.009	12.248	0.147	22.906			4.108	4.665
Blank	20			0.144	19.637			3.965	7.810
Blank	35	0.026	7.433	1.059	2.907			4.791	7.140
Blank	50	0.019	11.618	0.818	2.086			4.473	7.085
Blank	70	0.019	5.910	0.782	1.725			4.798	4.203
Blank	90	0.040	7.385	0.723	2.017			5.003	2.792
Blank	105	0.037	7.690	2.077	1.139			4.593	3.058
Blank	120	0.051	9.960	1.843	2.563			4.798	2.539
Blank	140	0.162	3.598	6.790	1.678	24.842	1.194	4.862	4.206
Blank	170	0.102	4.754	3.787	1.844			5.794	7.088
Blank	205	0.214	2.560	0.964	2.055			4.658	3.771
Blank	260	0.449	3.612	0.825	2.206			4.288	8.319
Blank	360	0.010	11.366	0.140	23.738			3.793	4.248
Blank	465	0.092	6.689	0.974	1.094			4.632	4.902
Blank	580	0.013	9.284	1.017	2.843			4.339	2.963
Blank	750	0.011	8.496	24.125	1.883			4.530	4.847
Blank	825	0.011	23.705	0.775	1.590			4.382	6.530
Blank	860	0.011	14.140	0.679	2.197			4.349	5.603
Blank	890	0.012	17.638	2.660	1.674			4.353	6.470
Blank	900	0.012	9.800	0.730	1.557			5.163	6.271
Blank	900	0.009	16.249	0.795	2.623			4.189	7.545
Blank	900	0.012	13.253	0.715	1.498			4.426	3.645
Blank	900	0.012	13.377	0.861	1.666			4.860	5.106
Blank	900	0.009	15.773	0.906	2.707			4.898	1.801
Blank	900			0.119	18.958			3.895	7.228
Vul9NAS	165	0.518	2.388	1.119	1.981			5.855	9.684
Vul9NAS	210	1.038	1.322	1.374	1.723			4.802	5.451
Vul9NAS	280	2.495	2.296	4.800	2.073			5.202	5.644
Vul9NAS	400	4.568	1.744	7.614	1.658	24.762	1.703	4.429	1.571
Vul9NAS	510	1.556	2.854	3.617	1.708			4.683	3.890
Vul9NAS	630	3.723	2.374	2.529	1.260	20.372	1.075	4.369	4.488
Vul9NAS	755	0.017	7.924	1.611	1.842			4.358	3.423
Vul9NAS	825	0.011	8.175	2.695	2.095			4.247	7.415
Vul9NAS	865	0.010	16.492	40.817	1.612			4.641	2.983
Vul9NAS	895	0.011	16.288	19.510	1.718			4.809	5.359
Vul9NAS	900			1.234	1.968			4.333	9.362
Vul9NAS	900	0.009	12.560	1.140	2.268			4.360	4.963
Vul9NAS	900	0.021	10.975	1.401	1.870			5.209	5.014
Vul9NAS	900	0.009	25.874	3.392	2.058			4.711	4.523
Vul9NAS	900	0.107	2.621	2.322	2.117			4.822	4.388
Vul9NAS	900	0.498	1.401	3.925	1.812			5.164	8.628
Vul10NAS+1%Cl	130	0.528	3.261	0.785	2.337			6.265	6.701
Vul10NAS+1%Cl	155	1.238	2.982	0.937	1.448			4.542	8.560
Vul10NAS+1%Cl	195	2.214	2.600	0.724	2.650			4.881	3.266
Vul10NAS+1%Cl	275	3.933	2.423	0.792	2.626			4.476	2.959
Vul10NAS+1%Cl	365	3.506	2.590	0.740	1.643			3.996	5.885

HNO3 Method	Temperature (°C)	51V	51V RSD	52Cr	52Cr RSD	53Cr	53Cr RSD	55Mn	55Mn RSD
Sample Name									
STD M+Cs+Pt 1/1000		0.198	1.190	0.710	0.586	0.456	2.579	0.171	1.859
STD M+Cs+Pt 1/100		1.131	1.015	1.556	0.600	1.343	1.598	1.102	1.401
STD M+Cs+Pt 1/10		10.675	0.816	10.675	0.719	10.675	0.963	10.675	1.003
STD A - D2/2		1.898	0.944	1.025	2.852	0.608	3.740	0.052	2.668
Clean glass 1				0.610	1.613	0.299	5.091	0.096	2.239
Blank	10			0.480	1.761			0.051	4.522
Blank	20			0.482	0.756			0.050	5.959
Blank	35	0.609	2.080	9.910	1.671	9.678	1.823	0.145	1.799
Blank	50	0.504	2.056	6.088	1.536	5.792	1.245	0.108	1.268
Blank	70	0.522	1.688	3.100	2.483	2.733	1.453	0.101	2.178
Blank	90	1.266	1.598	0.793	3.165	0.387	1.517	0.106	3.270
Blank	105	0.973	1.127	0.638	1.874			0.085	1.766
Blank	120	1.520	1.449	0.665	2.446			0.099	3.778
Blank	140	5.252	1.754	0.708	3.177			0.107	1.145
Blank	170	2.687	1.902	0.704	3.198			0.097	1.238
Blank	205	5.175	1.314	0.783	1.983	0.351	2.167	0.103	2.895
Blank	260	6.064	1.848	0.775	1.461	0.347	2.450	0.111	3.558
Blank	360			0.486	3.069			0.047	3.404
Blank	465	0.482	1.872	0.832	2.744	0.380	3.542	0.105	2.077
Blank	580	0.221	2.018	0.756	2.922	0.309	3.407	0.102	2.763
Blank	750	0.220	2.689	0.838	2.116	0.387	1.018	0.125	3.025
Blank	825	0.221	2.991	0.652	1.902			0.087	4.003
Blank	860	0.243	1.215	0.641	2.123			0.100	2.881
Blank	890	0.276	2.101	0.834	2.055	0.406	4.320	0.121	2.055
Blank	900	0.256	2.076	0.819	3.077	0.363	4.794	0.101	3.443
Blank	900	0.160	2.690	0.643	2.009			0.097	2.301
Blank	900	0.163	1.098	0.620	2.382			0.080	2.061
Blank	900	0.415	0.694	0.872	3.838	0.422	4.081	0.704	1.903
Blank	900	0.250	1.739	0.697	2.284			0.097	2.420
Blank	900			0.522	1.213			0.044	6.362
Vul9NAS	165	0.593	1.480	3.733	1.823	3.313	2.452	0.092	3.456
Vul9NAS	210	1.093	1.795	5.199	2.044	4.815	1.981	0.095	2.214
Vul9NAS	280	1.464	1.202	6.736	1.799	6.328	1.537	0.108	4.258
Vul9NAS	400	2.497	2.144	7.702	1.850	7.315	2.284	0.121	3.103
Vul9NAS	510	0.939	1.641	2.161	1.678	1.663	0.871	0.090	2.195
Vul9NAS	630	4.773	1.748	2.060	1.625	1.550	2.387	0.105	4.594
Vul9NAS	755	0.894	2.097	0.666	1.476			0.088	4.043
Vul9NAS	825	0.269	1.139	0.764	0.970	0.265	5.523	0.095	1.002
Vul9NAS	865	0.497	2.282	1.132	2.216	0.589	2.487	0.211	1.263
Vul9NAS	895	0.388	3.017	0.943	2.749	0.432	5.717	0.119	3.206
Vul9NAS	900	0.564	1.219	0.845	2.019	0.350	1.688	0.104	2.101
Vul9NAS	900	0.490	1.925	0.695	2.374			0.085	2.291
Vul9NAS	900	1.092	1.985	0.777	2.518			0.108	2.773
Vul9NAS	900	0.731	1.850	0.747	1.552			0.093	2.848
Vul9NAS	900	2.189	1.936	1.248	1.963	0.776	1.887	0.103	1.433
Vul9NAS	900	1.189	1.652	1.104	1.834	0.606	2.891	0.113	3.360
Vul10NAS+1%Cl	130	0.627	2.656	3.358	2.486	2.839	2.011	0.107	2.676
Vul10NAS+1%Cl	155	0.978	1.405	6.036	2.056	5.549	2.382	0.143	2.396
Vul10NAS+1%Cl	195	1.856	1.879	7.505	1.871	7.180	1.412	0.143	0.834
Vul10NAS+1%Cl	275	0.859	1.643	4.837	1.574	4.359	1.910	0.111	2.480
Vul10NAS+1%Cl	365	0.616	1.013	3.376	1.435	2.862	2.662	0.101	2.651

HNO3 Method	Temperature (°C)	55Mn [He] RSD	55Mn [He] RSD	56Fe [He] RSD	56Fe [He] RSD	57Fe
Sample Name						
STD M+Cs+Pt 1/1000		0.109	9.625	0.490	4.710	9.093
STD M+Cs+Pt 1/100		1.047	1.381	1.320	1.627	9.186
STD M+Cs+Pt 1/10		10.675	2.015	10.675	0.755	10.675
STD A - D2/2		0.006	42.176	0.513	3.419	8.660
Clean glass 1		0.008	18.179	0.769	4.083	9.262
Blank	10			0.192	4.527	8.741
Blank	20			0.197	5.826	8.999
Blank	35	0.050	5.008	4.126	0.795	9.998
Blank	50	0.014	15.989	1.095	2.131	9.353
Blank	70	0.015	28.093	1.034	1.389	9.350
Blank	90	0.018	27.433	1.082	0.829	9.362
Blank	105	0.007	12.533	0.556	2.316	9.233
Blank	120	0.008	22.138	0.676	2.505	9.359
Blank	140	0.022	10.387	2.171	1.339	9.450
Blank	170	0.013	13.911	0.878	1.985	9.261
Blank	205	0.018	17.793	1.169	2.951	9.249
Blank	260	0.029	10.217	1.932	2.833	9.325
Blank	360			0.196	5.587	8.630
Blank	465	0.029	17.820	1.493	1.676	9.464
Blank	580	0.017	18.521	1.183	1.765	9.359
Blank	750	0.047	5.053	1.574	0.711	9.492
Blank	825	0.006	18.424	0.456	2.869	9.054
Blank	860	0.028	13.615	3.523	1.285	9.496
Blank	890	0.039	7.984	5.839	0.623	10.034
Blank	900	0.019	14.923	1.468	1.369	9.279
Blank	900	0.007	6.792	0.727	1.790	9.356
Blank	900	0.007	23.314	0.663	1.140	9.106
Blank	900	0.659	2.426	96.208	0.852	23.507
Blank	900	0.012	13.155	1.092	1.060	9.316
Blank	900			0.197	4.430	8.722
Vul9NAS	165	0.008	16.700	0.544	1.626	9.120
Vul9NAS	210	0.010	14.253	0.594	3.447	9.054
Vul9NAS	280	0.022	6.626	0.790	2.503	9.150
Vul9NAS	400	0.039	15.461	2.357	0.642	9.393
Vul9NAS	510	0.012	10.807	0.686	2.529	9.035
Vul9NAS	630	0.025	15.967	1.337	0.935	9.232
Vul9NAS	755	0.008	38.609	0.627	2.455	9.125
Vul9NAS	825	0.013	19.516	1.055	1.705	9.260
Vul9NAS	865	0.142	7.406	12.844	0.958	10.903
Vul9NAS	895	0.044	5.370	1.742	0.870	9.274
Vul9NAS	900	0.029	8.250	1.576	2.095	9.101
Vul9NAS	900	0.007	22.377	0.543	0.779	9.071
Vul9NAS	900	0.028	8.590	1.113	3.380	9.073
Vul9NAS	900	0.014	16.218	0.963	3.251	9.183
Vul9NAS	900	0.030	15.423	3.009	2.735	9.105
Vul9NAS	900	0.046	9.416	4.866	1.443	9.498
Vul10NAS+1%Cl	130	0.012	20.543	0.614	2.926	9.234
Vul10NAS+1%Cl	155	0.064	13.405	6.843	0.871	10.028
Vul10NAS+1%Cl	195	0.063	6.846	2.062	1.099	9.334
Vul10NAS+1%Cl	275	0.021	11.744	0.930	2.566	9.198
Vul10NAS+1%Cl	365	0.015	38.515	1.030	1.539	9.270

HNO3 Method	Temperature (°C)	57Fe RSD	59Co	59Co RSD	50Ni	50Ni RSD	63Cu	63Cu RSD
Sample Name								
STD M+Cs+Pt 1/1000		0.602	0.116	1.988	0.118	3.813	0.411	1.816
STD M+Cs+Pt 1/100		0.247	1.055	0.782	1.047	0.912	1.322	2.497
STD M+Cs+Pt 1/10		0.556	10.675	0.778	10.277	0.965	10.675	0.506
STD A - D2/2		0.566	1.228	0.564	2.925	0.844	12.456	0.871
Clean glass 1		0.254	0.008	7.986	0.070	6.667	3.209	1.617
Blank	10	1.164	0.006	10.013	0.012	14.528	0.236	6.583
Blank	20	0.376	0.006	6.993	0.012	16.957	0.257	3.050
Blank	35	0.883	0.025	5.828	0.517	2.604	14.507	1.236
Blank	50	0.962	0.020	6.543	0.079	5.213	36.911	0.888
Blank	70	0.452	0.010	5.237	0.078	7.218	8.267	1.136
Blank	90	0.844	0.010	5.124	0.072	8.451	10.637	1.490
Blank	105	0.209	0.008	3.378	0.022	11.323	5.724	1.498
Blank	120	1.247	0.008	8.101	0.027	7.689	8.763	2.198
Blank	140	0.765	0.010	7.287	0.030	7.785	16.741	1.396
Blank	170	0.771	0.010	4.988	0.031	9.775	10.558	2.129
Blank	205	0.413	0.012	5.474	0.102	5.722	13.308	2.224
Blank	260	0.639	0.013	4.880	0.079	6.674	26.424	1.856
Blank	360	0.565	0.006	11.888	0.012	26.739	0.275	22.294
Blank	465	0.761	0.010	4.610	0.125	2.936	6.167	1.765
Blank	580	0.327	0.009	9.745	0.068	7.768	9.027	2.046
Blank	750	1.049	0.010	3.457	0.111	4.322	12.886	0.789
Blank	825	0.605	0.010	4.942	0.026	4.880	19.757	1.579
Blank	860	0.555	0.014	5.567	0.038	7.317	33.804	1.380
Blank	890	1.135	0.015	7.266	0.121	2.481	23.131	1.736
Blank	900	0.901	0.012	9.121	0.132	2.310	14.964	1.363
Blank	900	0.789	0.009	4.184	0.025	4.621	12.334	2.354
Blank	900	0.572	0.007	9.228	0.022	15.413	3.889	1.838
Blank	900	0.710	0.018	6.762	0.189	1.840	5.842	1.620
Blank	900	0.739	0.010	7.822	0.033	6.998	16.829	1.992
Blank	900	0.788	0.006	4.921	0.011	5.619	0.258	15.981
Vul9NAS	165	0.703	0.011	8.330	0.030	10.548	13.561	2.151
Vul9NAS	210	0.653	0.010	9.992	0.042	12.057	19.383	1.654
Vul9NAS	280	0.984	0.011	5.643	0.046	5.651	12.159	2.066
Vul9NAS	400	1.014	0.013	5.389	0.244	2.800	13.575	2.156
Vul9NAS	510	0.586	0.009	7.998	0.056	2.414	14.615	1.631
Vul9NAS	630	1.136	0.013	6.353	0.153	3.337	17.402	2.005
Vul9NAS	755	0.606	0.009	9.143	0.026	9.499	10.695	1.724
Vul9NAS	825	0.923	0.009	4.256	0.090	4.062	4.973	1.243
Vul9NAS	865	0.744	0.017	4.567	0.417	3.048	19.637	1.386
Vul9NAS	895	0.587	0.013	5.803	0.205	3.471	11.746	2.123
Vul9NAS	900	0.632	0.015	7.731	0.119	5.261	25.266	1.999
Vul9NAS	900	0.530	0.010	10.936	0.026	13.266	13.030	1.882
Vul9NAS	900	0.572	0.012	5.873	0.052	5.147	24.130	1.494
Vul9NAS	900	0.434	0.013	3.909	0.100	5.482	13.655	1.365
Vul9NAS	900	0.965	0.028	4.595	0.134	3.200	93.625	1.539
Vul9NAS	900	0.257	0.017	1.788	0.090	5.022	29.638	1.101
Vul10NAS+1%Cl	130	0.674	0.010	11.527	0.042	7.187	7.617	1.839
Vul10NAS+1%Cl	155	0.508	0.009	6.414	0.062	4.711	9.643	1.414
Vul10NAS+1%Cl	195	0.760	0.012	7.475	0.197	3.230	17.868	1.949
Vul10NAS+1%Cl	275	0.763	0.011	3.896	0.070	3.164	22.077	2.021
Vul10NAS+1%Cl	365	1.001	0.009	5.567	0.073	7.536	7.262	1.847

HNO3 Method	Temperature (°C)	63Cu [He]	63Cu [He] RSD	65Cu	65Cu RSD	65Cu [He]	65Cu [He] RSD
Sample Name							
STD M+Cs+Pt 1/1000		0.162	9.897	0.383	0.969	0.161	8.411
STD M+Cs+Pt 1/100		1.101	1.734	1.290	1.278	1.085	4.709
STD M+Cs+Pt 1/10		10.675	0.706	10.675	0.682	10.675	0.984
STD A - D2/2		12.423	0.646	12.541	0.780	12.308	1.157
Clean glass 1		3.257	2.217	3.185	1.477	3.239	1.279
Blank	10	0.035	8.764	0.200	5.736	0.036	14.268
Blank	20	0.038	11.052	0.227	3.323	0.040	22.432
Blank	35	15.166	1.002	14.611	1.780	14.894	1.073
Blank	50	39.503	0.968	37.767	1.560	39.242	0.693
Blank	70	8.625	0.371	8.286	1.459	8.498	1.364
Blank	90	10.986	0.572	10.743	1.499	10.842	1.064
Blank	105	5.788	1.217	5.709	1.636	5.786	1.495
Blank	120	9.064	0.686	8.796	1.896	9.008	1.120
Blank	140	17.103	1.396	16.861	1.836	16.937	0.682
Blank	170	10.915	0.487	10.623	1.631	10.784	0.683
Blank	205	13.853	1.052	13.384	1.857	13.627	1.293
Blank	260	27.961	0.688	26.575	1.626	27.759	0.830
Blank	360	0.039	16.163	0.237	26.822	0.035	17.658
Blank	465	6.363	1.022	6.133	1.933	6.266	0.976
Blank	580	9.341	0.669	9.037	2.089	9.215	1.171
Blank	750	13.657	0.606	12.935	1.195	13.594	1.114
Blank	825	21.150	0.341	19.938	1.673	21.018	0.585
Blank	860	35.618	0.760	34.147	2.017	35.373	0.811
Blank	890	24.470	0.951	23.258	1.653	24.244	0.643
Blank	900	15.823	1.109	15.063	1.778	15.586	1.108
Blank	900	13.022	0.712	12.365	2.354	12.800	1.071
Blank	900	3.940	0.786	3.870	1.532	3.867	1.128
Blank	900	6.088	1.316	5.827	2.174	5.977	1.743
Blank	900	17.758	0.462	16.882	1.519	17.577	1.076
Blank	900	0.034	16.032	0.217	19.391		15.140
Vul9NAS	165	14.114	0.551	13.544	1.653	13.974	1.139
Vul9NAS	210	20.090	0.888	19.465	2.152	19.758	1.175
Vul9NAS	280	12.596	0.990	12.207	1.572	12.409	1.630
Vul9NAS	400	13.733	0.205	13.641	2.109	13.591	1.037
Vul9NAS	510	14.961	1.414	14.590	0.994	14.780	0.743
Vul9NAS	630	17.838	1.167	17.448	1.807	17.571	1.006
Vul9NAS	755	11.105	0.279	10.816	1.746	11.082	0.886
Vul9NAS	825	5.109	0.995	4.969	2.092	5.091	2.059
Vul9NAS	865	20.917	0.227	19.725	1.690	20.672	0.417
Vul9NAS	895	12.420	0.340	11.830	1.637	12.273	1.298
Vul9NAS	900	26.823	0.470	25.518	1.473	26.630	0.341
Vul9NAS	900	13.566	0.209	13.012	1.165	13.390	0.867
Vul9NAS	900	25.451	1.188	24.323	1.834	25.096	0.890
Vul9NAS	900	14.577	1.048	13.790	1.915	14.315	0.746
Vul9NAS	900	98.421	0.344	94.028	1.830	98.653	0.624
Vul9NAS	900	31.026	0.689	29.837	1.148	30.618	0.750
Vul10NAS+1%Cl	130	7.846	1.115	7.560	2.575	7.721	1.060
Vul10NAS+1%Cl	155	9.859	1.222	9.595	2.071	9.859	1.005
Vul10NAS+1%Cl	195	18.262	0.183	17.948	1.989	18.143	0.864
Vul10NAS+1%Cl	275	22.831	1.198	22.095	2.111	22.597	1.061
Vul10NAS+1%Cl	365	7.275	1.298	7.169	2.358	7.250	0.881

HNO3 Method	Temperature (°C)	66Zn	66Zn RSD	75As	75As RSD	75As [He]	75As [He] RSD	76Se
Sample Name								
STD M+Cs+Pt 1/1000		0.155	5.532	2.861	0.721	0.118	12.043	10.416
STD M+Cs+Pt 1/100		1.104	1.378	3.513	1.009	1.053	3.506	10.395
STD M+Cs+Pt 1/10		10.675	1.190	10.675	0.445	10.675	1.551	10.675
STD A - D2/2		13.111	0.588	3.134	1.891	0.640	4.011	10.129
Clean glass 1		0.287	0.691	2.842	1.017			10.534
Blank	10	0.065	34.315	2.723	0.941			10.218
Blank	20	0.066	35.489	2.751	0.786			10.318
Blank	35	0.262	4.541	2.843	1.287	0.007	63.761	10.610
Blank	50	0.179	5.651	2.809	1.145	0.007	61.405	10.553
Blank	70	0.417	2.906	2.827	1.087			10.564
Blank	90	0.229	2.454	2.812	1.232	0.010	87.892	10.584
Blank	105	0.140	5.132	2.787	0.581	0.007	52.336	10.513
Blank	120	0.242	1.858	2.814	0.984	0.012	30.115	10.600
Blank	140	0.238	4.721	2.797	0.511	0.034	22.662	10.474
Blank	170	2.453	1.854	2.787	0.718	0.015	38.869	10.500
Blank	205	0.214	5.414	2.796	0.743	0.018	39.626	10.444
Blank	260	0.252	6.224	2.800	0.906	0.050	21.090	10.460
Blank	360	0.063	34.737	2.687	0.805			10.121
Blank	465	0.199	4.955	2.769	0.729	0.004	104.614	10.453
Blank	580	0.172	2.972	2.799	0.732			10.491
Blank	750	0.210	2.761	2.771	0.562			10.514
Blank	825	0.246	3.585	2.736	0.642			10.358
Blank	860	0.314	4.206	2.735	1.063	0.003	106.062	10.289
Blank	890	0.240	2.793	2.785	1.226			10.436
Blank	900	0.226	3.330	2.775	0.739			10.446
Blank	900	0.167	3.070	2.834	0.547			10.580
Blank	900	0.207	5.641	2.742	0.676			10.359
Blank	900	0.263	4.975	2.804	0.779	0.011	54.801	10.604
Blank	900	0.323	4.137	2.801	0.530			10.448
Blank	900	0.070	62.694	2.700	0.585			10.115
Vul9NAS	165	0.233	2.154	2.850	0.621	0.092	10.984	10.488
Vul9NAS	210	0.356	3.366	2.866	0.888	0.125	8.603	10.355
Vul9NAS	280	0.583	3.147	2.897	0.460	0.187	16.929	10.363
Vul9NAS	400	0.729	2.327	3.015	0.591	0.336	9.048	10.402
Vul9NAS	510	0.277	3.439	2.854	0.479	0.112	13.822	10.348
Vul9NAS	630	0.283	3.074	3.099	0.532	0.423	13.238	10.319
Vul9NAS	755	0.243	4.141	2.775	0.601			10.349
Vul9NAS	825	0.176	3.196	2.769	0.508			10.375
Vul9NAS	865	0.246	4.085	2.787	0.674	0.006	57.340	10.333
Vul9NAS	895	1.982	1.262	2.799	1.412			10.434
Vul9NAS	900	0.251	4.460	2.724	1.368			10.244
Vul9NAS	900	0.193	3.607	2.751	0.482			10.369
Vul9NAS	900	0.314	3.732	2.766	0.939			10.318
Vul9NAS	900	0.217	5.226	2.766	0.978			10.413
Vul9NAS	900	0.227	3.835	2.662	0.643	0.008	91.642	9.982
Vul9NAS	900	0.279	4.586	2.728	0.832	0.019	28.266	10.150
Vul10NAS+1%Cl	130	0.219	4.690	2.802	1.263	0.014	32.170	10.535
Vul10NAS+1%Cl	155	0.253	2.507	2.774	1.300	0.022	30.962	10.412
Vul10NAS+1%Cl	195	0.290	3.835	2.796	0.877	0.032	22.518	10.470
Vul10NAS+1%Cl	275	0.239	6.775	2.810	1.451	0.016	51.347	10.520
Vul10NAS+1%Cl	365	0.213	2.210	2.812	1.026	0.011	47.651	10.540

HNO3 Method	Temperature (°C)	76Se RSD	77Se	77Se RSD	78Se	78Se RSD	78Se [He]	78Se [He] RSD
Sample Name								
STD M+Cs+Pt 1/1000		0.253	0.873	3.430	1.842	7.017	0.309	42.351
STD M+Cs+Pt 1/100		0.200	1.767	6.663	2.462	8.058	1.332	16.395
STD M+Cs+Pt 1/10		0.577	10.675	2.354	10.675	2.441	10.675	5.560
STD A - D2/2		0.533	3.552	6.857	4.162	10.347	3.295	12.228
Clean glass 1		0.648	0.675	15.804	1.943	6.957	0.201	33.072
Blank	10	0.407	0.694	8.189	1.669	15.347	0.143	39.310
Blank	20	0.363	0.652	16.285	1.691	10.464	0.144	37.376
Blank	35	0.341	0.603	7.326	1.769	12.689	0.252	20.006
Blank	50	0.554	0.687	8.958	1.661	10.769	0.136	50.027
Blank	70	0.483	0.673	6.428	1.800	16.038	0.141	74.291
Blank	90	0.472	0.647	10.089	1.590	19.076	0.196	33.184
Blank	105	0.329	0.656	9.165	1.567	7.908	0.180	28.455
Blank	120	0.564	0.711	7.185	1.630	13.842	0.201	17.682
Blank	140	0.628	0.649	12.651	1.567	12.676	0.140	70.989
Blank	170	0.214	0.620	6.613	1.579	7.891	0.145	41.167
Blank	205	0.625	0.611	7.884	1.711	12.851	0.195	46.579
Blank	260	0.281	0.601	4.912	1.564	13.790	0.254	51.596
Blank	360	0.634	0.552	4.485	1.549	15.133	0.181	48.341
Blank	465	0.338	0.607	7.493	1.612	7.059	0.150	23.567
Blank	580	0.328	0.568	9.923	1.711	5.848	0.206	37.981
Blank	750	0.393	0.617	7.763	1.488	6.945	0.201	31.876
Blank	825	0.697	0.571	12.497	1.500	10.178	0.208	13.571
Blank	860	0.682	0.596	9.204	1.619	17.552	0.218	38.870
Blank	890	0.442	0.588	11.778	1.723	14.315	0.225	32.402
Blank	900	0.290	0.602	4.969	1.639	7.816	0.169	54.436
Blank	900	0.509	0.563	13.081	1.800	3.738	0.233	37.181
Blank	900	0.449	0.568	7.257	1.539	8.259	0.188	46.147
Blank	900	0.488	0.616	5.485	1.539	15.378	0.223	75.124
Blank	900	0.605	0.551	4.375	1.796	9.211	0.196	36.718
Blank	900	0.498	0.546	15.176	1.675	6.909	0.172	39.133
Vul9NAS	165	0.522	0.493	15.481	1.654	4.271	0.158	26.507
Vul9NAS	210	0.416	0.461	6.374	1.785	10.818	0.241	29.096
Vul9NAS	280	0.476	0.492	17.270	1.605	7.625	0.216	17.637
Vul9NAS	400	0.495	0.461	7.765	1.579	8.418	0.217	39.941
Vul9NAS	510	0.606	0.504	13.401	1.758	8.327	0.181	34.581
Vul9NAS	630	0.529	0.448	8.310	1.888	7.772	0.221	32.531
Vul9NAS	755	0.514	0.486	14.975	1.820	9.283	0.242	20.299
Vul9NAS	825	0.422	0.477	13.377	1.720	6.753	0.206	31.563
Vul9NAS	865	0.320	0.492	11.522	1.939	10.461	0.242	33.437
Vul9NAS	895	0.534	0.467	16.136	1.802	17.942	0.218	34.488
Vul9NAS	900	0.581	0.468	9.187	1.599	14.530	0.199	36.450
Vul9NAS	900	0.380	0.489	10.072	1.601	2.662	0.230	29.168
Vul9NAS	900	0.217	0.466	14.608	1.780	8.133	0.235	30.641
Vul9NAS	900	0.779	0.484	7.334	1.596	10.923	0.176	26.735
Vul9NAS	900	0.399	0.527	8.850	1.630	6.771	0.238	39.776
Vul9NAS	900	0.512	0.482	6.541	1.703	13.279	0.232	28.739
Vul10NAS+1%Cl	130	0.327	0.486	13.456	1.597	15.169	0.137	53.343
Vul10NAS+1%Cl	155	0.480	0.502	10.841	1.592	15.979	0.181	60.856
Vul10NAS+1%Cl	195	0.461	0.525	14.356	1.579	13.160	0.181	31.661
Vul10NAS+1%Cl	275	0.556	0.504	11.677	1.638	18.088	0.227	28.324
Vul10NAS+1%Cl	365	0.466	0.531	4.763	1.687	16.241	0.273	21.116

HNO3 Method	Temperature (°C)	82Se	82Se RSD	85Rb	85Rb RSD	88Sr	88Sr RSD	89Y	89Y RSD
Sample Name									
STD M+Cs+Pt 1/1000		0.694	4.598	0.003	4.194	0.127	0.930		
STD M+Cs+Pt 1/100		1.611	3.327	0.003	13.143	1.055	0.694		
STD M+Cs+Pt 1/10		10.675	1.346	0.004	3.619	10.675	0.684		
STD A - D2/2		3.499	6.171	5.045	0.506	739.321	0.632	50.998	0.669
Clean glass 1		0.528	7.652	0.004	10.137			0.000	19.543
Blank	10	0.480	5.538	0.003	11.318				
Blank	20	0.471	17.017	0.003	11.925				
Blank	35	0.487	8.327	0.005	4.268			0.004	4.389
Blank	50	0.504	9.976	0.004	3.290				
Blank	70	0.513	3.884	0.004	10.661				
Blank	90	0.503	4.767	0.003	14.565			0.000	39.998
Blank	105	0.507	11.038	0.004	8.142				
Blank	120	0.476	5.824	0.003	14.278			0.001	12.059
Blank	140	0.495	5.769	0.005	10.977			0.003	7.809
Blank	170	0.520	2.982	0.004	4.835				
Blank	205	0.488	12.325	0.005	14.179			0.004	7.608
Blank	260	0.472	14.469	0.006	3.478			0.004	7.666
Blank	360	0.458	12.661	0.003	12.422				
Blank	465	0.496	7.548	0.004	8.745				
Blank	580	0.439	5.932	0.005	6.993				
Blank	750	0.473	9.995	0.004	5.195				
Blank	825	0.453	14.372	0.003	11.479			0.004	7.520
Blank	860	0.457	8.694	0.003	11.108				
Blank	890	0.499	10.941	0.004	11.264	0.031	1.485		
Blank	900	0.469	6.990	0.005	9.494			0.002	8.270
Blank	900	0.472	9.356	0.003	5.025			0.002	10.013
Blank	900	0.493	7.699	0.003	11.838			0.001	26.760
Blank	900	0.483	5.533	0.004	10.786			0.001	10.788
Blank	900	0.489	11.725	0.003	7.147				
Blank	900	0.494	10.613	0.003	12.398				
Vul9NAS	165	0.580	10.796	0.011	7.315	0.039	12.884	0.002	13.613
Vul9NAS	210	0.530	9.538	0.016	4.057			0.014	3.592
Vul9NAS	280	0.522	8.727	0.024	5.377			0.002	6.989
Vul9NAS	400	0.525	9.891	0.032	3.185			0.001	15.623
Vul9NAS	510	0.563	3.483	0.007	6.327			0.003	6.234
Vul9NAS	630	0.542	9.939	0.007	2.979			0.010	6.218
Vul9NAS	755	0.583	10.595	0.003	9.911				
Vul9NAS	825	0.538	7.756	0.004	8.565				
Vul9NAS	865	0.536	8.090	0.006	8.172	0.040	4.052		
Vul9NAS	895	0.513	8.975	0.006	9.024				
Vul9NAS	900	0.493	9.037	0.004	8.816				
Vul9NAS	900	0.532	5.918	0.004	12.872				
Vul9NAS	900	0.548	6.341	0.004	3.914	0.027	3.408		
Vul9NAS	900	0.519	13.262	0.004	11.933	0.037	3.295	0.002	4.700
Vul9NAS	900	0.513	2.217	0.007	5.747	0.030	4.836	0.000	56.127
Vul9NAS	900	0.518	6.178	0.007	4.615	0.032	1.981	0.002	9.958
Vul10NAS+1%Cl	130	0.537	6.469	0.137	3.185	0.040	19.203		
Vul10NAS+1%Cl	155	0.545	5.331	0.389	1.826				
Vul10NAS+1%Cl	195	0.513	7.020	0.624	1.638				
Vul10NAS+1%Cl	275	0.528	6.990	0.306	2.885				
Vul10NAS+1%Cl	365	0.546	9.326	0.024	3.743				

HNO3 Method	Temperature (°C)	95Mo	95Mo RSD	107Ag	107Ag RSD	111Cd	111Cd RSD	115In (CPS)
Sample Name								
STD M+Cs+Pt 1/1000		0.108	3.801	0.105	3.010	0.108	6.348	243234.924
STD M+Cs+Pt 1/100		1.052	1.398	1.045	0.889	1.049	2.942	243234.924
STD M+Cs+Pt 1/10		10.675	0.457	10.675	0.494	10.675	0.682	243234.924
STD A - D2/2				0.019	3.428	3.043	0.988	243234.924
Clean glass 1						0.005	41.225	243234.924
Blank	10							243234.924
Blank	20							243234.924
Blank	35	65.318	1.786		21.100	0.065	3.990	243234.924
Blank	50	53.093	1.689	0.002	23.304	0.052	4.188	243234.924
Blank	70	53.285	1.665			0.054	5.689	243234.924
Blank	90	138.305	1.066			0.140	3.111	243234.924
Blank	105	80.289	1.108			0.080	8.904	243234.924
Blank	120	137.379	1.463			0.144	4.171	243234.924
Blank	140	327.906	1.821	0.004	5.381	0.331	2.833	243234.924
Blank	170	69.593	1.034	0.003	20.194	0.075	7.958	243234.924
Blank	205	30.882	1.418	0.006	8.884	0.036	14.032	243234.924
Blank	260	2.515	1.233	0.012	6.150	0.012	21.408	243234.924
Blank	360	0.016	25.413					243234.924
Blank	465	0.133	1.852			0.004	25.392	243234.924
Blank	580	0.302	1.706				64.993	243234.924
Blank	750	0.169	3.712					243234.924
Blank	825	0.219	4.200			0.002	43.410	243234.924
Blank	860	0.198	3.308					243234.924
Blank	890	0.313	2.986					243234.924
Blank	900	0.321	2.498					243234.924
Blank	900	0.149	4.833					243234.924
Blank	900	0.190	4.030					243234.924
Blank	900	0.862	1.892			0.002	39.036	243234.924
Blank	900	0.188	4.598					243234.924
Blank	900							243234.924
Vul9NAS	165	73.624	1.308	0.009	10.953	0.243	3.877	243234.924
Vul9NAS	210	101.532	1.834	0.013	8.484	0.374	3.873	243234.924
Vul9NAS	280	163.128	1.822	0.024	6.335	0.649	2.592	243234.924
Vul9NAS	400	235.127	2.244	0.041	3.300	1.057	2.528	243234.924
Vul9NAS	510	72.810	1.614	0.008	9.706	0.433	3.418	243234.924
Vul9NAS	630	187.198	1.571	0.004	13.814	0.548	2.901	243234.924
Vul9NAS	755	0.299	1.127			0.002	35.141	243234.924
Vul9NAS	825	0.180	2.641					243234.924
Vul9NAS	865	0.246	4.066			0.002	19.763	243234.924
Vul9NAS	895	0.223	3.056			0.002	35.949	243234.924
Vul9NAS	900	0.300	2.965					243234.924
Vul9NAS	900	0.275	3.777					243234.924
Vul9NAS	900	0.555	2.135			0.002	57.600	243234.924
Vul9NAS	900	0.187	3.354				66.110	243234.924
Vul9NAS	900	23.669	1.312	0.007	10.233	0.024	17.139	243234.924
Vul9NAS	900	36.119	1.034	0.002	17.314	0.038	14.587	243234.924
Vul10NAS+1%Cl	130	44.412	2.184	0.022	3.061	0.106	6.257	243234.924
Vul10NAS+1%Cl	155	78.211	1.899	0.042	6.360	0.171	3.938	243234.924
Vul10NAS+1%Cl	195	122.169	1.499	0.098	1.390	0.256	2.675	243234.924
Vul10NAS+1%Cl	275	68.782	2.008	0.104	1.599	0.143	5.132	243234.924
Vul10NAS+1%Cl	365	137.171	1.797	0.070	4.391	0.180	1.788	243234.924

HNO3 Method	Temperature (°C)	115In (CPS) RSD	115In [He] (CPS)	115In [He] (CPS) RSD	118Sn	118Sn RSD
Sample Name						
STD M+Cs+Pt 1/1000		0.260	49967.149	1.242	0.006	13.955
STD M+Cs+Pt 1/100		0.813	48977.512	1.025	0.006	29.288
STD M+Cs+Pt 1/10		0.861	51070.384	1.667	0.006	8.814
STD A - D2/2		1.051	49743.588	0.766	0.007	19.549
Clean glass 1		0.865	51808.884	0.789	0.534	2.048
Blank	10	0.580	51015.367	2.024	0.006	36.710
Blank	20	1.838	50843.748	0.493	0.006	12.372
Blank	35	1.343	52264.209	1.176	2.305	2.137
Blank	50	0.872	52367.250	2.021	6.061	1.847
Blank	70	0.995	52309.259	2.593	1.142	2.450
Blank	90	0.716	52521.879	2.126	1.673	1.568
Blank	105	0.723	51669.062	1.060	0.754	1.596
Blank	120	1.049	52850.421	2.007	1.347	1.347
Blank	140	0.748	52140.034	2.021	2.436	2.501
Blank	170	0.948	51499.346	2.210	1.596	1.972
Blank	205	0.859	51538.638	0.884	2.017	1.605
Blank	260	0.566	51842.226	0.690	4.060	1.680
Blank	360	0.431	50460.810	1.677	0.013	82.185
Blank	465	0.750	51055.814	1.397	0.826	1.726
Blank	580	1.161	51724.825	0.950	1.372	3.116
Blank	750	0.959	52286.242	1.761	1.923	1.092
Blank	825	1.092	51760.815	1.124	2.975	1.398
Blank	860	0.787	51191.869	1.177	4.734	1.297
Blank	890	1.383	52248.020	2.326	2.887	1.345
Blank	900	1.213	51296.052	2.140	2.342	2.262
Blank	900	1.185	52621.480	1.303	2.068	1.782
Blank	900	0.507	51737.500	1.565	0.608	2.835
Blank	900	0.546	52044.399	0.961	0.893	1.784
Blank	900	1.294	52421.580	1.072	2.422	2.003
Blank	900	0.371	50920.796	1.019	0.009	67.171
Vul9NAS	165	0.664	52847.104	2.293	2.016	2.101
Vul9NAS	210	0.994	52421.993	0.880	2.701	2.070
Vul9NAS	280	1.267	52529.590	1.597	1.304	1.862
Vul9NAS	400	1.074	52135.504	1.327	0.790	4.073
Vul9NAS	510	0.926	52226.361	1.669	2.281	2.045
Vul9NAS	630	0.588	52553.298	1.867	2.560	1.938
Vul9NAS	755	0.721	51684.791	2.037	1.605	2.367
Vul9NAS	825	1.175	51690.576	1.956	0.717	3.290
Vul9NAS	865	0.913	52299.696	0.761	2.909	1.567
Vul9NAS	895	0.771	52675.470	1.074	1.837	1.899
Vul9NAS	900	0.623	52072.698	1.766	3.912	1.081
Vul9NAS	900	0.936	51816.327	2.282	2.072	2.004
Vul9NAS	900	1.289	52068.092	1.733	3.771	1.727
Vul9NAS	900	1.445	52677.185	0.704	2.117	1.777
Vul9NAS	900	0.650	52151.255	1.642	14.239	1.801
Vul9NAS	900	0.978	51502.089	1.418	4.749	1.656
Vul10NAS+1%Cl	130	1.363	52437.332	1.021	1.202	2.279
Vul10NAS+1%Cl	155	1.085	53018.274	1.568	1.466	1.534
Vul10NAS+1%Cl	195	0.491	52380.640	2.095	2.506	1.544
Vul10NAS+1%Cl	275	1.091	52811.298	2.023	2.833	2.143
Vul10NAS+1%Cl	365	1.013	53253.748	1.322	0.871	2.215

HNO3 Method	Temperature (°C)	133Cs	133Cs RSD	137Ba	137Ba RSD	172Yb	172Yb RSD	182W	182W RSD
Sample Name									
STD M+Cs+Pt 1/1000		0.011	6.923	0.124	6.201	0.104	5.241	0.000	67.713
STD M+Cs+Pt 1/100		0.104	1.518	1.057	1.877	1.056	0.866	0.001	31.443
STD M+Cs+Pt 1/10		1.065	0.874	10.675	0.514	10.675	0.703	0.010	5.149
STD A - D2/2		0.012	2.471	2.456	1.179			0.007	17.214
Clean glass 1		0.049	1.599	0.079	2.843			0.003	25.012
Blank	10	0.000	43.943						
Blank	20	0.000	24.403						
Blank	35	0.056	1.559	0.224	3.245			0.043	2.794
Blank	50	0.014	4.206	0.219	1.801			0.027	10.021
Blank	70	0.027	2.298	0.107	4.853			0.031	6.365
Blank	90	0.002	3.542	0.041	5.620			0.077	3.770
Blank	105	0.012	4.125	0.066	9.437			0.059	3.897
Blank	120	0.005	3.369	0.727	3.004			0.092	1.926
Blank	140	0.011	4.381	0.368	1.633			0.339	1.883
Blank	170	0.007	6.080	0.131	3.578			0.184	2.464
Blank	205	0.040	2.223	0.164	3.564			0.214	2.862
Blank	260	0.008	3.635	0.095	5.826			0.068	4.033
Blank	360	0.000	23.789						
Blank	465	0.027	3.978	0.058	9.973			0.002	20.634
Blank	580	0.010	4.981	0.155	3.740			0.002	22.819
Blank	750	0.004	7.600	0.092	5.040			0.001	57.330
Blank	825	0.003	5.269	0.304	1.711			0.002	22.182
Blank	860	0.002	8.987	0.253	1.969			0.001	43.996
Blank	890	0.002	4.941	1.140	1.407			0.003	24.370
Blank	900	0.016	5.539	0.159	2.414			0.002	52.482
Blank	900	0.002	18.650	0.062	4.473			0.001	18.269
Blank	900	0.002	14.670	0.046	3.385			0.001	63.604
Blank	900	0.002	9.221	0.328	2.787			0.007	6.498
Blank	900	0.001	12.855	0.342	3.372			0.002	16.837
Blank	900	0.000	35.842						
Vul9NAS	165	0.024	5.771	0.293	5.388	0.002	50.662	0.175	1.989
Vul9NAS	210	0.049	1.359	0.085	3.955			0.181	1.904
Vul9NAS	280	0.047	2.410	0.484	3.210			0.339	2.459
Vul9NAS	400	0.042	4.326	0.235	1.404			0.231	3.512
Vul9NAS	510	0.012	4.859	0.484	1.191			0.075	5.717
Vul9NAS	630	0.020	3.032	0.172	2.744			0.290	2.330
Vul9NAS	755	0.005	9.043	0.089	7.776			0.001	39.988
Vul9NAS	825	0.013	7.774	0.130	4.219			0.001	52.981
Vul9NAS	865	0.032	0.949	1.370	2.399			0.001	23.566
Vul9NAS	895	0.047	3.964	0.393	3.027			0.001	15.591
Vul9NAS	900	0.022	3.730	0.095	6.846			0.002	22.350
Vul9NAS	900	0.056	2.225	0.596	1.612			0.001	52.949
Vul9NAS	900	0.018	3.684	0.767	2.125			0.001	26.879
Vul9NAS	900	0.119	2.242	1.179	2.208			0.001	33.721
Vul9NAS	900	0.134	2.127	0.929	0.764			0.041	2.862
Vul9NAS	900	0.077	1.601	0.858	2.452			0.028	3.511
Vul10NAS+1%Cl	130	0.061	2.202	0.160	7.384	0.002	39.851	0.071	7.000
Vul10NAS+1%Cl	155	0.167	2.731	0.105	7.958			0.092	2.008
Vul10NAS+1%Cl	195	0.119	2.576	0.224	4.608			0.176	3.050
Vul10NAS+1%Cl	275	0.019	3.697	0.263	2.796			0.113	1.860
Vul10NAS+1%Cl	365	0.010	4.411	0.129	4.140			0.174	3.992

HNO3 Method	Temperature (°C)	185Re (CPS)	185Re (CPS) RSD	195Pt	196Pt RSD	197Au (CPS)
Sample Name						
STD M+Cs+Pt 1/1000		76342.166	67.713	0.023	4.886	7.802
STD M+Cs+Pt 1/100		74878.282	31.443	0.212	2.196	16.197
STD M+Cs+Pt 1/10		76070.085	5.149	2.148	1.206	9.904
STD A - D2/2		76297.025	17.214			8.972
Clean glass 1		74180.291	25.012	0.003	8.293	230.638
Blank	10	73170.160	119.523			4.150
Blank	20	72863.204	163.903			5.554
Blank	35	73402.617	2.794	0.395	2.128	279.515
Blank	50	73501.504	10.021	0.348	2.786	152.699
Blank	70	74718.716	6.365	0.418	1.353	124.300
Blank	90	74548.795	3.770	0.471	3.566	277.130
Blank	105	74399.457	3.897	0.332	1.768	39.272
Blank	120	74677.323	1.926	0.378	2.790	95.949
Blank	140	74299.437	1.883	0.788	1.570	226.051
Blank	170	74612.833	2.464	0.177	4.652	90.652
Blank	205	73593.143	2.862	0.130	1.736	208.400
Blank	260	73820.973	4.033	0.038	8.126	229.692
Blank	360	73383.105	104.639			4.808
Blank	465	73377.615	20.634	0.003	19.549	87.062
Blank	580	73737.287	22.819	0.003	35.229	149.293
Blank	750	73862.120	57.330	0.003	37.484	129.829
Blank	825	72806.378	22.182			335.327
Blank	860	72998.132	43.996			262.832
Blank	890	73712.890	24.370	0.002	26.238	194.862
Blank	900	73808.597	52.482	0.003	26.638	263.084
Blank	900	74413.269	18.269			213.717
Blank	900	73567.205	63.604			77.148
Blank	900	74085.911	6.498	0.002	17.705	161.134
Blank	900	73500.290	16.837			105.155
Blank	900	72953.098	223.607			5.512
Vul9NAS	165	75039.307	1.989	38.802	1.415	945.510
Vul9NAS	210	74600.949	1.904	24.116	1.720	2423.036
Vul9NAS	280	75057.340	2.459	13.385	1.650	5669.349
Vul9NAS	400	76158.583	3.512	1.593	1.275	675.231
Vul9NAS	510	75046.396	5.717	0.085	3.801	711.136
Vul9NAS	630	75525.628	2.330	0.023	9.236	1706.741
Vul9NAS	755	74322.208	39.988	0.011	5.306	1038.598
Vul9NAS	825	74027.474	52.981	0.014	14.249	484.171
Vul9NAS	865	74649.486	23.566	0.012	2.080	2288.813
Vul9NAS	895	74468.628	15.591	0.016	3.628	664.226
Vul9NAS	900	73337.186	22.350	0.014	11.955	6167.458
Vul9NAS	900	74131.807	52.949	0.017	4.319	1126.380
Vul9NAS	900	73789.171	26.879	0.034	6.809	13816.331
Vul9NAS	900	73964.578	33.721	0.010	17.174	2338.794
Vul9NAS	900	71659.838	2.862	0.018	6.729	7140.469
Vul9NAS	900	75475.057	3.511	0.020	9.757	9181.307
Vul10NAS+1%Cl	130	76140.934	7.000	24.092	1.961	351.764
Vul10NAS+1%Cl	155	75953.332	2.008	30.977	1.531	500.791
Vul10NAS+1%Cl	195	76198.981	3.050	18.539	2.096	1000.650
Vul10NAS+1%Cl	275	76046.303	1.860	3.295	1.337	101.283
Vul10NAS+1%Cl	365	76699.882	3.992	0.250	2.621	41.848

HNO3 Method	Temperature (°C)	197Au (CPS)	RSD	205TI	205TI RSD	208Pb	208Pb RSD	209Bi	209Bi RSD
Sample Name									
STD M+Cs+Pt 1/1000		59.258	0.109	1.780	0.108	1.471	0.107	2.935	
STD M+Cs+Pt 1/100		54.572	1.049	1.015	1.048	0.824	1.048	0.498	
STD M+Cs+Pt 1/10		46.551	10.675	0.530	10.675	0.899	10.675	0.406	
STD A - D2/2		103.913	0.063	0.888	0.066	2.308	0.063	0.991	
Clean glass 1		26.461			0.014	6.705	0.027	3.384	
Blank	10	69.772							
Blank	20	71.271							
Blank	35	17.077	0.005	13.218	0.140	1.401	0.007	6.398	
Blank	50	8.405	0.004	8.618	0.110	3.604	0.007	8.603	
Blank	70	7.074	0.004	13.237	0.100	2.151	0.008	4.619	
Blank	90	17.662	0.013	4.337	0.225	1.320	0.005	6.699	
Blank	105	29.207	0.009	2.391	0.182	1.833	0.005	13.333	
Blank	120	21.499	0.014	3.607	0.261	3.140	0.016	5.540	
Blank	140	19.228	0.051	3.774	0.936	1.938	0.023	3.059	
Blank	170	18.057	0.033	2.619	0.529	1.435	0.014	6.589	
Blank	205	11.660	0.041	1.493	1.237	1.695	0.023	4.166	
Blank	260	18.470	0.015	3.961	2.710	2.055	0.048	3.414	
Blank	360	81.475			0.005	94.530			
Blank	465	28.429			0.140	1.369	0.008	5.987	
Blank	580	12.768			0.026	5.779	0.009	11.850	
Blank	750	18.270			0.016	3.096	0.007	6.749	
Blank	825	10.496			0.016	8.203	0.004	10.388	
Blank	860	12.355			0.013	3.270	0.009	8.273	
Blank	890	12.630			0.017	5.939	0.008	4.953	
Blank	900	16.635			0.015	8.136	0.011	8.362	
Blank	900	15.243			0.005	8.124	0.004	3.867	
Blank	900	16.674			0.005	12.865	0.004	7.702	
Blank	900	26.598			0.008	6.654	0.012	6.902	
Blank	900	18.439			0.012	3.463	0.013	1.654	
Blank	900	129.620							
Vul9NAS	165	4.566	0.106	1.579	1.242	1.964	0.077	1.063	
Vul9NAS	210	6.675	0.068	1.314	2.169	2.015	0.107	2.826	
Vul9NAS	280	4.353	0.010	7.200	3.677	1.659	0.167	3.286	
Vul9NAS	400	8.862			6.986	2.162	0.291	1.640	
Vul9NAS	510	7.467			2.983	1.376	0.160	1.984	
Vul9NAS	630	4.567			1.096	1.788	0.128	2.142	
Vul9NAS	755	4.893			0.015	8.020	0.009	7.245	
Vul9NAS	825	6.668			0.010	7.863	0.005	12.350	
Vul9NAS	865	6.484			0.022	5.718	0.009	8.598	
Vul9NAS	895	7.533			0.020	1.498	0.009	7.673	
Vul9NAS	900	3.809			0.017	4.938	0.018	4.262	
Vul9NAS	900	2.612			0.011	12.222	0.007	8.001	
Vul9NAS	900	3.062			0.016	6.006	0.011	5.181	
Vul9NAS	900	6.908			0.011	7.236	0.045	1.656	
Vul9NAS	900	3.336	0.012	6.162	0.268	1.706	0.029	1.887	
Vul9NAS	900	1.151	0.006	9.608	0.117	3.499	0.047	4.497	
Vul10NAS+1%Cl	130	6.439	0.034	2.094	1.179	2.558	0.025	3.737	
Vul10NAS+1%Cl	155	5.786	0.019	4.519	1.687	2.440	0.030	3.738	
Vul10NAS+1%Cl	195	4.094	0.002	17.630	3.096	1.956	0.043	3.961	
Vul10NAS+1%Cl	275	22.197			2.085	2.198	0.024	6.505	
Vul10NAS+1%Cl	365	42.111			0.481	2.594	0.028	5.212	

HNO3 Method	Temperature (°C)	7Li	7Li RSD	27Al	27Al RSD	Cl [H2]	Cl [H2] RSD	43Ca	43Ca RSD
Vul10NAS+1%Cl	425	1.975	3.258	2.276	2.420			4.105	5.255
Vul10NAS+1%Cl	510	4.858	1.917	2.010	1.726			4.514	6.180
Vul10NAS+1%Cl	695	1.303	3.273	1.433	1.993			4.495	3.564
Vul10NAS+1%Cl	785	0.017	10.232	5.489	1.886			4.548	5.611
Vul10NAS+1%Cl	820	0.012	18.442	3.714	2.066			4.331	5.445
Vul10NAS+1%Cl	845	0.009	7.675	0.804	2.273			4.460	2.728
Vul10NAS+1%Cl	865	0.010	19.993	2.157	2.541			4.250	5.943
Vul10NAS+1%Cl	880	0.011	9.326	2.010	1.465			4.769	3.537
Vul10NAS+1%Cl	895	0.010	11.446	0.649	2.710			5.511	7.391
Vul10NAS+1%Cl	900	0.012	7.121	1.374	0.902			4.405	4.347
Vul10NAS+1%Cl	900			0.586	2.350			4.254	3.081
Vul10NAS+1%Cl	900			1.368	1.096			4.640	2.540
Vul16NAS+2%Cl	35	0.053	6.840	0.538	2.406			5.688	5.520
Vul16NAS+2%Cl	65	0.122	4.146	0.461	1.308			4.004	5.749
Vul16NAS+2%Cl	100	0.117	5.592	0.650	3.052			4.555	3.896
Vul16NAS+2%Cl	170	0.267	5.617	0.635	2.715			3.914	4.226
Vul16NAS+2%Cl	195	0.511	1.196	0.454	1.242			3.890	8.046
Vul16NAS+2%Cl	240	1.712	2.105	0.482	1.348			3.937	5.956
Vul16NAS+2%Cl	330	5.996	3.035	0.849	2.184			4.014	8.923
Vul16NAS+2%Cl	465	1.665	1.963	0.742	1.955			4.125	1.155
Vul16NAS+2%Cl	580	6.751	2.338	0.912	1.670			4.404	3.549
Vul16NAS+2%Cl	725	3.140	1.789	0.770	0.832			4.359	2.930
Vul16NAS+2%Cl	830	2.072	2.039	0.611	1.791			4.003	3.459
Vul16NAS+2%Cl	870	0.355	2.384	11.866	1.389			6.128	2.681
Vul16NAS+2%Cl	900	0.037	11.772	0.484	1.898			3.793	9.385
Vul16NAS+2%Cl	900	0.037	3.223	2.445	1.714			5.790	6.568
Vul16NAS+2%Cl	900	0.012	11.325	0.773	1.251			4.396	2.313
Vul16NAS+2%Cl	900	0.018	9.262	0.675	0.688			4.043	3.492
Vul16NAS+2%Cl	900	0.011	18.801	0.615	1.506			3.984	3.133
Vul16NAS+2%Cl	900	0.040	2.546	0.668	1.403			4.519	6.112
Vul16NAS+2%Cl	900	0.012	13.075	2.347	1.809			4.001	5.431
Vul12NAS+2%Cl	70	0.097	5.005	0.662	2.009	24.877	0.839	3.687	3.716
Vul12NAS+2%Cl	100	0.270	4.996	1.198	1.787	115.635	0.490	3.979	5.874
Vul12NAS+2%Cl	170	0.398	3.494	0.583	1.620	29.605	2.261	4.806	7.403
Vul12NAS+2%Cl	200	0.770	2.249	1.280	1.816	200.762	0.460	4.108	3.961
Vul12NAS+2%Cl	255	1.439	2.928	0.695	1.634	41.768	0.523	4.040	5.613
Vul12NAS+2%Cl	340	2.375	2.496	0.757	2.438	112.089	0.389	3.892	4.914
Vul12NAS+2%Cl	410	2.723	2.471	1.296	1.842	505.159	0.408	4.076	4.494
Vul12NAS+2%Cl	465	0.819	3.225	0.904	1.048	31.250	4.878	4.051	8.275
Vul12NAS+2%Cl	520	2.775	2.778	0.809	1.580	35.656	0.817	3.968	5.912
Vul12NAS+2%Cl	600	9.932	1.730	2.076	1.983	24.266	1.192	4.050	6.861
Vul12NAS+2%Cl	785	4.935	2.062	2.142	1.971	32.674	0.951	4.187	4.506
Vul12NAS+2%Cl	850	0.854	3.118	0.930	1.245	30.257	1.039	4.086	2.272
Vul12NAS+2%Cl	880	0.034	7.096	1.419	1.951	28.855	0.320	4.188	4.436
Vul12NAS+2%Cl	900	0.021	4.113	0.699	1.935	29.311	0.585	4.176	2.113
Vul12NAS+2%Cl	900	0.012	12.040	1.094	1.912	30.869	0.860	4.053	3.223
Vul12NAS+2%Cl	900	0.012	11.597	1.048	2.202	27.662	0.791	3.934	5.490
Vul12NAS+2%Cl	900	0.015	10.420	0.837	1.291	27.054	0.506	4.095	4.239
Vul12NAS+2%Cl	900	0.011	11.723	0.619	1.863	28.359	1.025	4.086	5.394
Vul12NAS+2%Cl	900	0.019	14.858	0.882	1.689	26.747	1.695	4.037	4.764
Vul12NAS+2%Cl	900	0.017	13.356	12.204	1.830	29.873	1.030	4.249	6.793
Vul15NAS+2%Cl	30	0.055	7.508	0.593	1.382			6.303	10.732

HNO3 Method	Temperature (°C)	51V	51V RSD	52Cr	52Cr RSD	53Cr	53Cr RSD	55Mn	55Mn RSD
Vul10NAS+1%Cl	425	3.529	1.750	16.399	1.977	16.151	1.529	0.093	2.023
Vul10NAS+1%Cl	510	3.161	1.872	17.898	1.202	17.616	1.522	0.113	3.957
Vul10NAS+1%Cl	695	4.058	1.941	1.212	1.862	0.682	1.962	0.116	3.335
Vul10NAS+1%Cl	785	0.910	1.718	0.728	2.778			0.093	1.224
Vul10NAS+1%Cl	820	0.523	2.461	0.854	1.611	0.319	4.480	0.096	1.266
Vul10NAS+1%Cl	845	0.627	1.065	0.942	3.091	0.346	4.396	0.179	1.949
Vul10NAS+1%Cl	865	0.594	1.206	0.755	1.773			0.090	2.054
Vul10NAS+1%Cl	880	0.624	1.720	0.744	2.042			0.092	3.800
Vul10NAS+1%Cl	895	0.549	1.650	0.847	1.798	0.332	4.553	0.093	1.912
Vul10NAS+1%Cl	900	0.923	1.662	0.727	2.004			0.092	1.476
Vul10NAS+1%Cl	900	0.578	2.115	0.909	1.692	0.378	3.123	0.103	2.692
Vul10NAS+1%Cl	900	0.567	0.995	0.808	1.815	0.298	5.763	0.091	1.883
Vul16NAS+2%Cl	35			0.799	2.499			0.090	1.949
Vul16NAS+2%Cl	65			0.912	1.132	0.426	1.810	0.071	1.866
Vul16NAS+2%Cl	100			1.009	1.605	0.465	4.827	0.110	3.352
Vul16NAS+2%Cl	170			1.392	1.952	0.863	3.214	0.086	3.307
Vul16NAS+2%Cl	195			1.367	2.201	0.795	3.392	0.079	2.879
Vul16NAS+2%Cl	240			1.440	1.814	0.912	3.454	0.081	2.075
Vul16NAS+2%Cl	330	0.691	1.574	2.362	1.131	1.869	1.424	0.089	2.141
Vul16NAS+2%Cl	465	2.348	2.014	13.579	1.566	13.269	1.873	0.083	1.262
Vul16NAS+2%Cl	580	1.011	1.068	6.077	1.578	5.652	0.987	0.093	3.834
Vul16NAS+2%Cl	725	0.262	2.153	1.031	2.037	0.526	4.249	0.082	1.815
Vul16NAS+2%Cl	830	0.583	1.716	0.741	1.091			0.090	1.577
Vul16NAS+2%Cl	870	1.022	1.529	0.675	1.806			0.481	1.442
Vul16NAS+2%Cl	900	0.745	0.875	0.841	2.225	0.280	4.169	0.083	2.745
Vul16NAS+2%Cl	900	0.744	1.852	0.717	2.117			0.081	2.732
Vul16NAS+2%Cl	900	0.655	0.919	0.882	0.917	0.395	2.581	0.083	2.493
Vul16NAS+2%Cl	900	0.650	1.456	0.713	2.405			0.084	2.097
Vul16NAS+2%Cl	900	0.630	1.200	0.683	1.977			0.080	3.275
Vul16NAS+2%Cl	900	1.046	1.988	0.802	1.174	0.276	5.000	0.085	1.831
Vul16NAS+2%Cl	900	0.836	2.295	0.660	1.304			0.086	1.418
Vul12NAS+2%Cl	70			1.161	1.396	0.612	3.602	0.079	2.417
Vul12NAS+2%Cl	100	0.147	2.300	1.847	1.497	1.267	2.366	0.082	1.508
Vul12NAS+2%Cl	170	0.503	2.751	4.037	1.788	3.540	2.297	0.085	3.061
Vul12NAS+2%Cl	200	0.432	1.569	4.706	1.359	4.232	1.920	0.080	2.556
Vul12NAS+2%Cl	255	0.182	2.177	2.228	1.231	1.690	2.919	0.081	2.230
Vul12NAS+2%Cl	340	0.229	2.379	1.132	2.005	0.575	4.009	0.077	4.537
Vul12NAS+2%Cl	410	0.860	1.960	3.422	1.829	2.887	1.263	0.082	1.644
Vul12NAS+2%Cl	465	2.084	1.325	10.828	1.120	10.461	1.410	0.073	0.993
Vul12NAS+2%Cl	520	3.273	1.333	30.603	1.447	30.127	1.547	0.085	3.232
Vul12NAS+2%Cl	600	2.451	1.192	6.362	1.596	5.962	2.364	0.080	2.250
Vul12NAS+2%Cl	785	1.030	1.057	1.282	1.698	0.699	3.555	0.086	2.648
Vul12NAS+2%Cl	850	3.255	1.609	1.036	1.666	0.463	1.562	0.087	2.071
Vul12NAS+2%Cl	880	1.054	1.789	0.721	0.940			0.088	2.065
Vul12NAS+2%Cl	900	0.667	1.955	0.834	2.497			0.078	3.312
Vul12NAS+2%Cl	900	0.480	2.007	0.883	1.229	0.325	3.915	0.079	2.506
Vul12NAS+2%Cl	900	0.579	2.141	0.667	1.214			0.079	2.124
Vul12NAS+2%Cl	900	0.739	2.801	0.957	1.972	0.396	3.851	0.081	3.683
Vul12NAS+2%Cl	900	0.540	1.692	0.780	1.785			0.075	2.537
Vul12NAS+2%Cl	900	0.535	1.277	1.157	1.667	0.579	1.641	0.078	1.404
Vul12NAS+2%Cl	900	1.035	2.283	1.018	1.676	0.422	1.299	0.086	2.373
Vul15NAS+2%Cl	30	0.083	2.975	1.088	1.657	0.500	4.041	0.094	1.871

HNO3 Method	Temperature (°C)	55Mn [He] RSD	55Mn [He] RSD	56Fe [He] RSD	56Fe [He] RSD	57Fe
Vul10NAS+1%Cl	425	0.012	22.955	0.827	0.980	9.186
Vul10NAS+1%Cl	510	0.035	13.327	1.259	2.465	9.134
Vul10NAS+1%Cl	695	0.032	19.140	0.848	1.495	9.161
Vul10NAS+1%Cl	785	0.014	18.889	0.981	0.765	9.236
Vul10NAS+1%Cl	820	0.016	27.442	1.195	1.093	9.293
Vul10NAS+1%Cl	845	0.100	7.280	12.762	0.985	11.188
Vul10NAS+1%Cl	865	0.012	27.819	0.796	2.394	9.321
Vul10NAS+1%Cl	880	0.014	16.105	0.860	1.976	9.371
Vul10NAS+1%Cl	895	0.018	19.083	1.246	2.341	9.387
Vul10NAS+1%Cl	900	0.008	19.843	0.767	2.201	9.383
Vul10NAS+1%Cl	900	0.022	12.053	1.517	2.117	9.511
Vul10NAS+1%Cl	900	0.018	15.394	1.343	1.116	9.437
Vul16NAS+2%Cl	35	0.009	14.372	0.833	3.051	9.386
Vul16NAS+2%Cl	65	0.009	39.958	1.437	1.789	9.196
Vul16NAS+2%Cl	100	0.029	13.897	1.072	1.264	9.479
Vul16NAS+2%Cl	170	0.008	29.879	1.502	2.542	9.500
Vul16NAS+2%Cl	195	0.006	27.391	0.750	0.962	9.301
Vul16NAS+2%Cl	240	0.006	47.154	0.613	1.006	9.318
Vul16NAS+2%Cl	330	0.013	25.706	1.687	1.254	9.400
Vul16NAS+2%Cl	465	0.006	19.744	0.678	1.660	9.338
Vul16NAS+2%Cl	580	0.018	24.258	1.077	0.963	9.364
Vul16NAS+2%Cl	725	0.008	11.110	1.505	2.209	9.306
Vul16NAS+2%Cl	830	0.013	13.606	1.264	1.914	9.439
Vul16NAS+2%Cl	870	0.440	3.802	18.156	0.546	11.934
Vul16NAS+2%Cl	900	0.008	31.324	1.714	0.911	9.597
Vul16NAS+2%Cl	900	0.007	20.193	0.806	2.691	9.384
Vul16NAS+2%Cl	900	0.019	14.646	2.951	1.744	9.579
Vul16NAS+2%Cl	900	0.012	12.971	1.101	2.893	9.458
Vul16NAS+2%Cl	900	0.006	22.483	0.723	3.148	9.427
Vul16NAS+2%Cl	900	0.012	16.994	2.314	0.775	9.539
Vul16NAS+2%Cl	900	0.008	22.331	0.744	1.608	9.384
Vul12NAS+2%Cl	70	0.009	16.035	1.596	1.783	9.613
Vul12NAS+2%Cl	100	0.006	17.542	0.883	1.612	9.458
Vul12NAS+2%Cl	170	0.007	29.919	0.577	1.795	9.379
Vul12NAS+2%Cl	200	0.007	35.271	1.179	1.462	9.404
Vul12NAS+2%Cl	255	0.006	22.585	1.096	2.377	9.473
Vul12NAS+2%Cl	340	0.004	14.673	0.504	2.794	9.316
Vul12NAS+2%Cl	410	0.007	15.418	1.422	1.835	9.526
Vul12NAS+2%Cl	465	0.006	36.550	0.707	0.713	9.313
Vul12NAS+2%Cl	520	0.011	19.417	1.644	0.931	9.496
Vul12NAS+2%Cl	600	0.016	24.104	0.716	2.588	9.233
Vul12NAS+2%Cl	785	0.012	15.601	1.425	1.532	9.547
Vul12NAS+2%Cl	850	0.016	25.369	2.213	1.366	9.722
Vul12NAS+2%Cl	880	0.012	23.428	0.930	1.925	9.589
Vul12NAS+2%Cl	900	0.008	18.032	1.422	1.101	9.584
Vul12NAS+2%Cl	900	0.007	31.660	2.037	1.516	9.740
Vul12NAS+2%Cl	900	0.011	31.416	1.028	3.378	9.535
Vul12NAS+2%Cl	900	0.009	21.221	2.170	1.939	9.727
Vul12NAS+2%Cl	900	0.008	29.034	1.319	2.622	9.533
Vul12NAS+2%Cl	900	0.014	12.756	3.444	1.117	9.821
Vul12NAS+2%Cl	900	0.012	29.980	2.954	1.182	9.996
Vul15NAS+2%Cl	30	0.012	13.074	0.702	1.672	9.587

HNO3 Method	Temperature (°C)	57Fe RSD	59Co	59Co RSD	50Ni	50Ni RSD	63Cu	63Cu RSD
Vul10NAS+1%Cl	425	0.800	0.010	4.849	0.047	4.900	15.729	1.597
Vul10NAS+1%Cl	510	1.398	0.013	6.456	0.121	3.030	25.914	1.503
Vul10NAS+1%Cl	695	0.950	0.009	5.443	0.064	6.835	8.461	1.873
Vul10NAS+1%Cl	785	0.661	0.008	8.215	0.031	6.804	6.997	2.079
Vul10NAS+1%Cl	820	0.348	0.011	6.963	0.125	7.363	8.525	1.876
Vul10NAS+1%Cl	845	0.512	0.011	7.634	0.238	2.077	5.367	2.394
Vul10NAS+1%Cl	865	1.063	0.007	7.474	0.044	5.017	4.488	1.693
Vul10NAS+1%Cl	880	0.796	0.008	5.748	0.046	7.617	8.143	1.933
Vul10NAS+1%Cl	895	0.661	0.010	5.359	0.144	2.378	3.499	1.900
Vul10NAS+1%Cl	900	0.451	0.009	8.937	0.025	8.097	15.482	2.100
Vul10NAS+1%Cl	900	0.908	0.009	3.976	0.143	2.695	3.826	1.300
Vul10NAS+1%Cl	900	0.780	0.010	5.339	0.123	3.226	5.174	1.580
Vul16NAS+2%Cl	35	0.559	0.010	6.198	0.053	9.433	11.675	2.308
Vul16NAS+2%Cl	65	0.393	0.008	7.793	0.035	4.946	15.641	1.386
Vul16NAS+2%Cl	100	0.538	0.009	11.582	0.027	8.189	13.501	1.978
Vul16NAS+2%Cl	170	0.617	0.008	12.506	0.022	11.367	8.423	1.604
Vul16NAS+2%Cl	195	0.239	0.008	6.344	0.020	9.552	9.087	1.736
Vul16NAS+2%Cl	240	0.719	0.009	6.698	0.027	3.766	14.990	1.537
Vul16NAS+2%Cl	330	0.407	0.014	4.405	0.033	8.911	45.732	2.178
Vul16NAS+2%Cl	465	0.148	0.010	3.720	0.039	9.627	23.119	1.513
Vul16NAS+2%Cl	580	0.943	0.015	6.086	0.318	3.427	46.274	1.560
Vul16NAS+2%Cl	725	0.449	0.020	3.741	0.153	3.518	62.246	1.265
Vul16NAS+2%Cl	830	0.645	0.016	9.009	0.119	4.377	44.458	1.736
Vul16NAS+2%Cl	870	0.617	0.020	2.989	0.033	4.983	34.752	1.465
Vul16NAS+2%Cl	900	0.967	0.009	13.299	0.023	8.979	14.317	1.695
Vul16NAS+2%Cl	900	0.634	0.009	5.413	0.017	5.085	10.900	1.610
Vul16NAS+2%Cl	900	0.562	0.009	8.225	0.067	6.705	14.717	1.485
Vul16NAS+2%Cl	900	0.861	0.010	8.084	0.060	7.097	13.844	1.356
Vul16NAS+2%Cl	900	0.801	0.010	6.389	0.022	11.022	21.600	1.620
Vul16NAS+2%Cl	900	0.511	0.011	9.953	0.168	1.952	26.950	1.281
Vul16NAS+2%Cl	900	0.804	0.008	7.541	0.020	13.978	12.485	1.639
Vul12NAS+2%Cl	70	0.625	0.007	7.978	0.016	7.623	4.795	1.505
Vul12NAS+2%Cl	100	0.501	0.008	5.815	0.051	2.859	13.755	1.888
Vul12NAS+2%Cl	170	0.490	0.010	12.637	0.031	6.204	13.350	1.233
Vul12NAS+2%Cl	200	0.501	0.008	8.197	0.320	2.028	11.232	1.684
Vul12NAS+2%Cl	255	0.923	0.008	13.779	0.023	8.086	8.753	1.978
Vul12NAS+2%Cl	340	0.454	0.007	7.905	0.087	8.524	3.965	1.162
Vul12NAS+2%Cl	410	0.561	0.009	3.916	0.039	9.854	7.230	1.293
Vul12NAS+2%Cl	465	0.778	0.008	6.567	0.036	8.326	6.693	1.795
Vul12NAS+2%Cl	520	0.905	0.010	9.669	1.235	2.434	9.977	2.210
Vul12NAS+2%Cl	600	0.424	0.011	7.833	0.034	3.511	19.242	1.288
Vul12NAS+2%Cl	785	0.975	0.017	5.832	0.645	1.518	26.983	1.698
Vul12NAS+2%Cl	850	0.892	0.011	8.044	0.053	6.151	12.263	2.073
Vul12NAS+2%Cl	880	1.126	0.008	6.385	0.022	9.889	6.966	2.250
Vul12NAS+2%Cl	900	0.366	0.009	5.468	0.078	6.698	9.609	1.490
Vul12NAS+2%Cl	900	0.951	0.008	7.872	0.255	1.712	4.959	1.801
Vul12NAS+2%Cl	900	0.611	0.007	7.302	0.023	5.731	4.599	1.839
Vul12NAS+2%Cl	900	0.911	0.008	4.766	0.027	10.705	8.198	1.545
Vul12NAS+2%Cl	900	0.666	0.009	3.910	0.036	5.981	7.925	2.019
Vul12NAS+2%Cl	900	0.936	0.009	5.147	0.045	10.599	5.387	1.600
Vul12NAS+2%Cl	900	0.884	0.008	10.672	0.047	7.655	1.356	1.757
Vul15NAS+2%Cl	30	0.714	0.010	10.798	0.038	6.696	8.034	2.187

HNO3 Method	Temperature (°C)	63Cu [He]	63Cu [He] RSD	65Cu	65Cu RSD	65Cu [He]	65Cu [He] RSD
Vul10NAS+1%Cl	425	15.939	0.793	15.851	1.498	15.597	0.449
Vul10NAS+1%Cl	510	26.208	0.508	26.083	1.340	25.916	0.903
Vul10NAS+1%Cl	695	8.625	0.896	8.389	1.881	8.505	1.229
Vul10NAS+1%Cl	785	7.246	0.635	7.003	1.556	7.094	2.180
Vul10NAS+1%Cl	820	9.005	0.825	8.531	1.445	8.828	1.376
Vul10NAS+1%Cl	845	5.504	0.938	5.385	1.723	5.467	1.413
Vul10NAS+1%Cl	865	4.589	0.972	4.484	1.643	4.551	2.313
Vul10NAS+1%Cl	880	8.375	1.084	8.088	1.639	8.418	2.043
Vul10NAS+1%Cl	895	3.543	1.442	3.485	2.510	3.483	1.187
Vul10NAS+1%Cl	900	16.197	0.492	15.557	2.023	15.975	1.002
Vul10NAS+1%Cl	900	3.861	1.247	3.781	1.489	3.730	2.145
Vul10NAS+1%Cl	900	5.300	1.425	5.160	2.188	5.188	1.126
Vul16NAS+2%Cl	35	12.117	1.260	11.592	2.378	12.038	1.399
Vul16NAS+2%Cl	65	16.371	0.959	15.724	1.122	16.105	0.741
Vul16NAS+2%Cl	100	14.231	0.947	13.540	1.638	13.959	1.289
Vul16NAS+2%Cl	170	8.635	0.560	8.395	1.386	8.598	1.012
Vul16NAS+2%Cl	195	9.301	0.933	9.075	1.746	9.209	0.251
Vul16NAS+2%Cl	240	15.566	0.292	14.951	1.128	15.307	0.908
Vul16NAS+2%Cl	330	48.598	0.459	46.538	1.682	47.815	0.422
Vul16NAS+2%Cl	465	23.368	0.526	23.042	1.534	23.196	1.018
Vul16NAS+2%Cl	580	47.446	0.992	47.089	1.788	47.036	0.686
Vul16NAS+2%Cl	725	65.922	0.608	62.999	1.353	64.904	0.838
Vul16NAS+2%Cl	830	46.791	0.405	45.360	1.639	46.142	0.955
Vul16NAS+2%Cl	870	36.481	0.130	34.934	1.426	36.233	0.688
Vul16NAS+2%Cl	900	14.848	0.886	14.305	1.376	14.776	0.720
Vul16NAS+2%Cl	900	11.414	0.759	10.914	1.760	11.206	1.591
Vul16NAS+2%Cl	900	15.137	0.772	14.691	1.196	14.994	1.330
Vul16NAS+2%Cl	900	14.578	0.845	13.900	1.448	14.302	1.440
Vul16NAS+2%Cl	900	22.429	0.951	21.721	1.364	22.200	0.767
Vul16NAS+2%Cl	900	28.019	1.085	27.135	1.358	27.698	0.776
Vul16NAS+2%Cl	900	12.997	0.938	12.540	2.328	13.014	1.319
Vul12NAS+2%Cl	70	4.822	1.612	4.728	1.793	4.790	1.400
Vul12NAS+2%Cl	100	14.015	1.250	13.655	1.772	13.832	1.406
Vul12NAS+2%Cl	170	13.715	0.657	13.364	1.776	13.634	0.861
Vul12NAS+2%Cl	200	11.440	0.878	11.200	1.511	11.266	0.700
Vul12NAS+2%Cl	255	8.865	0.942	8.665	1.907	8.752	0.516
Vul12NAS+2%Cl	340	3.918	1.053	3.888	2.011	3.900	1.503
Vul12NAS+2%Cl	410	7.258	0.353	7.089	1.665	7.173	1.483
Vul12NAS+2%Cl	465	6.493	1.725	6.610	1.003	6.422	1.581
Vul12NAS+2%Cl	520	9.755	0.296	9.860	1.518	9.753	0.918
Vul12NAS+2%Cl	600	19.188	0.363	19.094	1.806	18.797	0.400
Vul12NAS+2%Cl	785	27.800	0.365	27.151	1.480	27.440	0.347
Vul12NAS+2%Cl	850	12.638	0.857	12.224	1.216	12.413	0.478
Vul12NAS+2%Cl	880	7.039	1.043	6.904	1.763	7.013	1.084
Vul12NAS+2%Cl	900	9.820	1.317	9.561	1.310	9.625	0.746
Vul12NAS+2%Cl	900	5.001	0.834	4.922	1.223	4.945	1.346
Vul12NAS+2%Cl	900	4.657	0.718	4.578	1.939	4.584	0.930
Vul12NAS+2%Cl	900	8.509	0.561	8.212	1.632	8.405	1.338
Vul12NAS+2%Cl	900	8.188	0.496	7.932	1.105	8.032	0.726
Vul12NAS+2%Cl	900	5.502	0.795	5.357	1.342	5.365	2.620
Vul12NAS+2%Cl	900	1.240	2.173	1.282	1.860	1.215	3.751
Vul15NAS+2%Cl	30	8.275	1.218	7.997	2.074	8.124	0.629

HNO3 Method	Temperature (°C)	66Zn	66Zn RSD	75As	75As RSD	75As [He]	75As [He] RSD	76Se
Vul10NAS+1%Cl	425	0.264	3.856	2.817	0.968	0.054	16.029	10.440
Vul10NAS+1%Cl	510	0.293	2.169	2.805	1.188	0.098	17.714	10.340
Vul10NAS+1%Cl	695	0.295	3.210	2.811	0.977	0.029	35.565	10.507
Vul10NAS+1%Cl	785	0.391	4.634	2.776	0.723	0.003	86.655	10.406
Vul10NAS+1%Cl	820	0.175	5.205	2.773	1.335			10.447
Vul10NAS+1%Cl	845	0.198	2.828	2.811	0.735	0.004	43.853	10.604
Vul10NAS+1%Cl	865	0.159	3.896	2.783	1.120			10.453
Vul10NAS+1%Cl	880	0.216	1.813	2.809	0.729			10.470
Vul10NAS+1%Cl	895	4.754	2.122	2.792	1.021			10.447
Vul10NAS+1%Cl	900	0.211	2.811	2.792	0.981			10.449
Vul10NAS+1%Cl	900	0.158	4.275	2.788	1.106			10.537
Vul10NAS+1%Cl	900	0.254	2.766	2.786	1.160	0.004	81.310	10.459
Vul16NAS+2%Cl	35	0.282	2.950	2.821	0.389	0.004	74.723	10.591
Vul16NAS+2%Cl	65	0.286	2.732	2.708	0.668	0.006	68.435	10.177
Vul16NAS+2%Cl	100	0.357	3.464	2.819	1.031	0.009	51.442	10.606
Vul16NAS+2%Cl	170	0.261	1.340	2.805	1.337	0.016	35.013	10.455
Vul16NAS+2%Cl	195	0.236	2.517	2.761	0.652	0.017	47.223	10.365
Vul16NAS+2%Cl	240	0.244	3.506	2.782	0.746	0.040	23.653	10.434
Vul16NAS+2%Cl	330	0.315	3.974	2.802	1.486	0.045	17.516	10.369
Vul16NAS+2%Cl	465	0.490	2.281	2.904	0.603	0.161	4.722	10.495
Vul16NAS+2%Cl	580	0.462	2.806	2.853	1.023	0.133	18.386	10.375
Vul16NAS+2%Cl	725	0.323	2.417	2.724	0.601	0.028	24.955	10.180
Vul16NAS+2%Cl	830	0.133	1.990	2.751	0.986	0.010	66.885	10.344
Vul16NAS+2%Cl	870	0.309	4.008	2.754	1.055	0.006	57.608	10.341
Vul16NAS+2%Cl	900	0.092	3.403	2.760	1.457			10.473
Vul16NAS+2%Cl	900	0.114	4.411	2.767	0.628	0.005	111.241	10.399
Vul16NAS+2%Cl	900	0.088	6.774	2.719	0.295			10.281
Vul16NAS+2%Cl	900	0.078	6.874	2.764	1.346			10.393
Vul16NAS+2%Cl	900	0.074	5.901	2.758	0.691			10.405
Vul16NAS+2%Cl	900	0.075	5.408	2.751	0.514	0.003	50.030	10.349
Vul16NAS+2%Cl	900	0.072	8.334	2.771	0.370			10.451
Vul12NAS+2%Cl	70	0.134	4.588	2.760	1.136	0.004	74.699	10.335
Vul12NAS+2%Cl	100	0.223	1.990	2.738	1.070	0.019	41.613	10.296
Vul12NAS+2%Cl	170	0.237	2.724	2.807	1.013	0.032	25.514	10.458
Vul12NAS+2%Cl	200	0.202	3.392	2.791	1.111	0.034	9.463	10.418
Vul12NAS+2%Cl	255	0.239	2.849	2.800	0.762	0.012	58.440	10.463
Vul12NAS+2%Cl	340	0.166	3.971	2.743	0.444	0.008	24.496	10.337
Vul12NAS+2%Cl	410	0.254	4.218	2.794	0.932	0.028	33.703	10.504
Vul12NAS+2%Cl	465	0.472	3.023	2.810	1.362	0.089	16.978	10.310
Vul12NAS+2%Cl	520	0.360	1.328	2.924	0.620	0.201	13.442	10.413
Vul12NAS+2%Cl	600	0.478	3.414	2.809	0.763	0.123	7.187	10.283
Vul12NAS+2%Cl	785	0.246	3.081	2.770	0.451	0.025	43.493	10.360
Vul12NAS+2%Cl	850	0.308	1.891	2.767	1.189	0.003	50.030	10.373
Vul12NAS+2%Cl	880	0.190	4.968	2.769	0.691			10.402
Vul12NAS+2%Cl	900	0.188	3.988	2.733	1.491			10.364
Vul12NAS+2%Cl	900	0.154	2.410	2.766	1.269			10.387
Vul12NAS+2%Cl	900	0.208	3.912	2.789	0.664			10.342
Vul12NAS+2%Cl	900	0.273	4.390	2.758	0.663			10.377
Vul12NAS+2%Cl	900	0.133	5.228	2.710	0.991	0.003	93.549	10.248
Vul12NAS+2%Cl	900	0.267	2.937	2.703	0.283			10.195
Vul12NAS+2%Cl	900	0.390	4.024	2.785	1.470			10.513
Vul15NAS+2%Cl	30	0.195	3.125	2.815	0.972			10.571

HNO3 Method	Temperature (°C)	76Se RSD	77Se	77Se RSD	78Se	78Se RSD	78Se [He]	78Se [He] RSD
Vul10NAS+1%Cl	425	0.309	0.494	11.311	1.626	11.924	0.141	43.006
Vul10NAS+1%Cl	510	0.194	0.451	8.853	1.529	14.257	0.225	39.289
Vul10NAS+1%Cl	695	0.214	0.475	6.665	1.645	16.747	0.304	36.318
Vul10NAS+1%Cl	785	0.462	0.440	11.319	1.682	10.387	0.242	36.529
Vul10NAS+1%Cl	820	0.449	0.457	9.641	1.613	12.204	0.273	21.116
Vul10NAS+1%Cl	845	0.345	0.423	13.702	1.562	13.275	0.184	35.949
Vul10NAS+1%Cl	865	0.574	0.480	6.140	1.674	14.285	0.263	52.490
Vul10NAS+1%Cl	880	0.554	0.492	13.560	1.845	6.834	0.137	28.079
Vul10NAS+1%Cl	895	0.368	0.469	7.328	1.734	12.738	0.147	71.493
Vul10NAS+1%Cl	900	0.394	0.471	6.418	1.736	13.427	0.258	18.853
Vul10NAS+1%Cl	900	0.387	0.478	18.744	1.576	14.027	0.218	42.402
Vul10NAS+1%Cl	900	0.415	0.486	6.528	1.697	12.517	0.193	42.220
Vul16NAS+2%Cl	35	0.344	0.429	9.127	1.662	8.428	0.209	46.755
Vul16NAS+2%Cl	65	0.090	0.496	9.922	1.633	6.073	0.173	28.580
Vul16NAS+2%Cl	100	0.520	0.422	9.949	1.571	6.803	0.194	68.738
Vul16NAS+2%Cl	170	0.315	0.482	9.372	1.788	18.534	0.157	60.787
Vul16NAS+2%Cl	195	0.421	0.458	8.983	1.591	9.015	0.175	44.025
Vul16NAS+2%Cl	240	0.652	0.500	7.189	1.527	6.597	0.221	30.495
Vul16NAS+2%Cl	330	0.421	0.518	6.971	1.706	19.105	0.205	33.849
Vul16NAS+2%Cl	465	0.639	0.569	6.130	1.575	8.901	0.202	34.228
Vul16NAS+2%Cl	580	0.260	0.557	11.579	1.670	10.424	0.205	45.133
Vul16NAS+2%Cl	725	0.447	0.505	8.092	1.642	5.886	0.238	31.768
Vul16NAS+2%Cl	830	0.293	0.429	11.156	1.602	9.752	0.190	11.777
Vul16NAS+2%Cl	870	0.380	0.459	6.244	1.644	11.435	0.246	33.370
Vul16NAS+2%Cl	900	0.525	0.513	4.961	1.520	16.079	0.193	42.229
Vul16NAS+2%Cl	900	0.594	0.463	10.804	1.670	6.413	0.304	25.000
Vul16NAS+2%Cl	900	0.465			1.489	7.155	0.211	28.669
Vul16NAS+2%Cl	900	0.546	0.439	5.405	1.617	20.349	0.242	27.168
Vul16NAS+2%Cl	900	0.328	0.441	7.588	1.543	9.698	0.222	52.929
Vul16NAS+2%Cl	900	0.442	0.434	8.447	1.623	9.037	0.191	27.277
Vul16NAS+2%Cl	900	0.176	0.490	4.160	1.640	3.218	0.213	49.519
Vul12NAS+2%Cl	70	0.739			1.677	12.761	0.218	33.498
Vul12NAS+2%Cl	100	0.353			1.526	8.321	0.161	84.561
Vul12NAS+2%Cl	170	0.604	0.470	13.790	1.699	17.266	0.183	31.661
Vul12NAS+2%Cl	200	0.262	0.488	12.571	1.611	12.699	0.172	62.737
Vul12NAS+2%Cl	255	0.568			1.656	12.068	0.182	49.492
Vul12NAS+2%Cl	340	0.310	0.460	7.951	1.552	3.335	0.246	30.092
Vul12NAS+2%Cl	410	0.675	0.555	9.734	1.555	7.222	0.284	30.543
Vul12NAS+2%Cl	465	0.304	0.463	9.242	1.684	16.655	0.135	44.597
Vul12NAS+2%Cl	520	0.542	0.458	10.443	1.629	11.624	0.197	47.449
Vul12NAS+2%Cl	600	0.230	0.454	6.001	1.450	8.648	0.194	73.877
Vul12NAS+2%Cl	785	0.476			1.544	10.207	0.236	70.813
Vul12NAS+2%Cl	850	0.464	0.468	11.808	1.717	13.323	0.228	55.004
Vul12NAS+2%Cl	880	0.138	0.466	12.825	1.677	6.946	0.249	36.368
Vul12NAS+2%Cl	900	0.450	0.451	8.468	1.475	22.394	0.146	41.167
Vul12NAS+2%Cl	900	0.535			1.667	21.780	0.163	32.405
Vul12NAS+2%Cl	900	0.356	0.427	12.085	1.931	8.956	0.218	44.741
Vul12NAS+2%Cl	900	0.603			1.607	9.691	0.188	41.203
Vul12NAS+2%Cl	900	0.650	0.443	17.730	1.527	13.543	0.216	44.741
Vul12NAS+2%Cl	900	0.216	0.425	16.205	1.562	8.637	0.211	50.933
Vul12NAS+2%Cl	900	0.607			1.569	18.651	0.201	55.442
Vul15NAS+2%Cl	30	0.225	0.442	15.728	1.699	12.038	0.210	61.825

HNO3 Method	Temperature (°C)	82Se	82Se RSD	85Rb	85Rb RSD	88Sr	88Sr RSD	89Y	89Y RSD
Vul10NAS+1%Cl	425	0.513	4.223	0.007	10.351			0.000	24.330
Vul10NAS+1%Cl	510	0.554	11.211	0.015	4.181			0.021	3.456
Vul10NAS+1%Cl	695	0.541	8.250	0.007	7.987			0.026	4.275
Vul10NAS+1%Cl	785	0.529	10.014	0.004	8.284			0.002	14.577
Vul10NAS+1%Cl	820	0.495	3.929	0.003	9.008				
Vul10NAS+1%Cl	845	0.575	8.766	0.003	10.043				
Vul10NAS+1%Cl	865	0.538	4.545	0.004	12.681			0.000	11.174
Vul10NAS+1%Cl	880	0.559	6.508	0.004	11.778				
Vul10NAS+1%Cl	895	0.534	6.346	0.004	5.980				
Vul10NAS+1%Cl	900	0.501	6.922	0.004	6.529	0.041	4.770		
Vul10NAS+1%Cl	900	0.539	11.217	0.003	13.426				
Vul10NAS+1%Cl	900	0.530	7.091	0.004	7.828	0.082	1.257		
Vul16NAS+2%Cl	35	0.574	5.142	0.027	3.816	0.031	24.443		
Vul16NAS+2%Cl	65	0.540	10.684	0.067	1.859				
Vul16NAS+2%Cl	100	0.535	8.128	0.072	2.248				
Vul16NAS+2%Cl	170	0.540	5.947	0.103	3.395				
Vul16NAS+2%Cl	195	0.547	7.072	0.143	2.231				
Vul16NAS+2%Cl	240	0.555	13.281	0.651	1.527				
Vul16NAS+2%Cl	330	0.552	5.814	0.257	2.427				
Vul16NAS+2%Cl	465	0.565	8.065	0.013	6.434				
Vul16NAS+2%Cl	580	0.531	15.367	0.028	3.257			0.000	17.161
Vul16NAS+2%Cl	725	0.560	8.494	0.014	5.812				
Vul16NAS+2%Cl	830	0.555	6.121	0.007	8.502			0.000	22.196
Vul16NAS+2%Cl	870	0.529	8.550	0.007	11.578	0.027	5.858	0.004	7.648
Vul16NAS+2%Cl	900	0.539	8.505	0.004	8.940				
Vul16NAS+2%Cl	900	0.558	6.698	0.006	5.044				
Vul16NAS+2%Cl	900	0.526	12.887	0.003	6.972				
Vul16NAS+2%Cl	900	0.545	5.275	0.004	10.511				
Vul16NAS+2%Cl	900	0.513	9.518	0.004	9.623				
Vul16NAS+2%Cl	900	0.525	3.841	0.005	10.946				
Vul16NAS+2%Cl	900	0.530	8.026	0.004	3.072				
Vul12NAS+2%Cl	70	0.594	10.055	0.073	1.704				
Vul12NAS+2%Cl	100	0.592	8.405	0.193	2.528				
Vul12NAS+2%Cl	170	0.523	7.780	0.282	1.544				
Vul12NAS+2%Cl	200	0.577	3.709	0.667	1.747				
Vul12NAS+2%Cl	255	0.574	11.930	0.395	1.151				
Vul12NAS+2%Cl	340	0.537	4.731	0.082	1.946				
Vul12NAS+2%Cl	410	0.536	12.391	0.021	4.102				
Vul12NAS+2%Cl	465	0.525	5.813	0.008	3.604				
Vul12NAS+2%Cl	520	0.544	6.647	0.012	3.688			0.003	13.701
Vul12NAS+2%Cl	600	0.527	5.469	0.039	4.684			0.050	2.342
Vul12NAS+2%Cl	785	0.549	10.978	0.018	2.450			0.043	2.486
Vul12NAS+2%Cl	850	0.513	4.124	0.009	9.611			0.024	2.230
Vul12NAS+2%Cl	880	0.534	6.960	0.006	6.138			0.004	3.443
Vul12NAS+2%Cl	900	0.518	11.303	0.005	10.647			0.004	4.699
Vul12NAS+2%Cl	900	0.527	8.831	0.005	6.304			0.001	21.061
Vul12NAS+2%Cl	900	0.544	13.508	0.004	11.868			0.001	12.856
Vul12NAS+2%Cl	900	0.528	10.077	0.004	6.069			0.003	3.778
Vul12NAS+2%Cl	900	0.613	3.915	0.004	7.683			0.001	9.015
Vul12NAS+2%Cl	900	0.530	7.501	0.004	10.450				
Vul12NAS+2%Cl	900	0.560	11.109	0.007	5.100			0.000	30.185
Vul15NAS+2%Cl	30	0.640	8.542	0.030	3.936	0.042	13.169		

HNO3 Method	Temperature (°C)	95Mo	95Mo RSD	107Ag	107Ag RSD	111Cd	111Cd RSD	115In (CPS)
Vul10NAS+1%Cl	425	233.444	1.453	0.009	8.233	0.297	4.082	243234.924
Vul10NAS+1%Cl	510	237.509	1.724	0.015	6.291	0.385	0.716	243234.924
Vul10NAS+1%Cl	695	53.910	1.781	0.003	8.227	0.142	1.822	243234.924
Vul10NAS+1%Cl	785	0.383	2.815					243234.924
Vul10NAS+1%Cl	820	0.112	3.823					243234.924
Vul10NAS+1%Cl	845	0.079	2.114					243234.924
Vul10NAS+1%Cl	865	0.054	3.036					243234.924
Vul10NAS+1%Cl	880	0.075	5.580					243234.924
Vul10NAS+1%Cl	895	0.052	6.326					243234.924
Vul10NAS+1%Cl	900	0.148	2.479					243234.924
Vul10NAS+1%Cl	900	0.068	7.856					243234.924
Vul10NAS+1%Cl	900	0.092	5.042					243234.924
Vul16NAS+2%Cl	35	1.271	2.057	0.005	6.872	0.006	20.623	243234.924
Vul16NAS+2%Cl	65	3.145	1.177	0.008	13.464	0.010	26.989	243234.924
Vul16NAS+2%Cl	100	3.430	1.344	0.014	7.495	0.015	14.263	243234.924
Vul16NAS+2%Cl	170	8.121	1.458	0.014	10.016	0.032	8.190	243234.924
Vul16NAS+2%Cl	195	5.452	1.431	0.059	4.250	0.035	9.786	243234.924
Vul16NAS+2%Cl	240	10.235	1.456	0.061	3.089	0.071	6.848	243234.924
Vul16NAS+2%Cl	330	31.723	1.675	0.110	3.805	0.077	8.523	243234.924
Vul16NAS+2%Cl	465	204.869	1.049	0.024	6.197	0.247	3.087	243234.924
Vul16NAS+2%Cl	580	170.445	1.525	0.018	5.279	0.237	6.036	243234.924
Vul16NAS+2%Cl	725	23.030	1.552	0.005	13.073	0.034	8.346	243234.924
Vul16NAS+2%Cl	830	3.525	1.648	0.003	10.300	0.015	9.651	243234.924
Vul16NAS+2%Cl	870	1.183	1.682	0.002	17.366	0.006	12.326	243234.924
Vul16NAS+2%Cl	900	0.359	5.274			0.003	26.017	243234.924
Vul16NAS+2%Cl	900	4.002	2.154			0.005	36.196	243234.924
Vul16NAS+2%Cl	900	0.137	4.353					243234.924
Vul16NAS+2%Cl	900	0.239	3.443					243234.924
Vul16NAS+2%Cl	900	0.302	3.045					243234.924
Vul16NAS+2%Cl	900	4.530	2.091	0.003	13.829	0.005	25.026	243234.924
Vul16NAS+2%Cl	900	0.717	1.168			0.002	29.182	243234.924
Vul12NAS+2%Cl	70	5.458	1.417	0.007	9.254	0.019	10.765	243234.924
Vul12NAS+2%Cl	100	16.025	1.558	0.018	3.609	0.067	11.040	243234.924
Vul12NAS+2%Cl	170	43.085	1.604	0.035	2.777	0.190	3.766	243234.924
Vul12NAS+2%Cl	200	52.562	1.403	0.056	2.432	0.214	4.667	243234.924
Vul12NAS+2%Cl	255	24.279	1.530	0.041	6.414	0.112	6.200	243234.924
Vul12NAS+2%Cl	340	7.706	1.606	0.033	6.677	0.079	4.499	243234.924
Vul12NAS+2%Cl	410	32.307	1.776	0.124	2.213	0.153	6.959	243234.924
Vul12NAS+2%Cl	465	166.396	1.397	0.012	9.621	0.260	4.504	243234.924
Vul12NAS+2%Cl	520	413.291	1.866	0.014	6.220	0.716	1.835	243234.924
Vul12NAS+2%Cl	600	264.302	1.378	0.023	5.557	0.543	2.448	243234.924
Vul12NAS+2%Cl	785	29.247	1.214	0.006	11.355	0.172	3.742	243234.924
Vul12NAS+2%Cl	850	7.466	1.624			0.038	5.529	243234.924
Vul12NAS+2%Cl	880	1.143	3.161			0.005	24.063	243234.924
Vul12NAS+2%Cl	900	1.246	2.353			0.002	28.313	243234.924
Vul12NAS+2%Cl	900	0.614	2.372					243234.924
Vul12NAS+2%Cl	900	0.666	2.283					243234.924
Vul12NAS+2%Cl	900	0.196	3.375			0.002	33.931	243234.924
Vul12NAS+2%Cl	900	1.065	3.468			0.002	38.518	243234.924
Vul12NAS+2%Cl	900	3.899	1.024			0.004	13.493	243234.924
Vul12NAS+2%Cl	900	0.961	2.356			0.003	26.519	243234.924
Vul15NAS+2%Cl	30	5.761	1.570	0.004	15.082	0.015	16.717	243234.924

HNO3 Method	Temperature (°C)	115In (CPS) RSD	115In [He] (CPS)	115In [He] (CPS) RSD	118Sn	118Sn RSD
Vul10NAS+1%Cl	425	1.001	52301.646	1.492	2.466	1.898
Vul10NAS+1%Cl	510	1.105	51752.774	2.242	3.986	1.876
Vul10NAS+1%Cl	695	1.085	52126.628	0.852	1.381	2.631
Vul10NAS+1%Cl	785	1.311	52120.161	1.219	1.199	2.171
Vul10NAS+1%Cl	820	0.936	52933.596	1.155	1.458	2.243
Vul10NAS+1%Cl	845	0.947	52755.086	2.206	0.874	1.512
Vul10NAS+1%Cl	865	0.749	52948.394	0.736	0.742	2.612
Vul10NAS+1%Cl	880	0.616	52268.583	1.527	1.331	1.825
Vul10NAS+1%Cl	895	0.368	52480.078	1.624	0.574	2.584
Vul10NAS+1%Cl	900	1.049	52530.070	1.173	2.590	1.743
Vul10NAS+1%Cl	900	0.933	52718.899	1.581	0.652	3.839
Vul10NAS+1%Cl	900	1.222	52059.535	1.430	0.862	1.632
Vul16NAS+2%Cl	35	1.131	52149.636	2.409	1.765	2.392
Vul16NAS+2%Cl	65	2.360	51091.675	0.855	2.337	1.274
Vul16NAS+2%Cl	100	0.727	52608.303	1.251	2.170	1.973
Vul16NAS+2%Cl	170	1.363	52236.989	0.665	1.257	1.774
Vul16NAS+2%Cl	195	0.251	51593.455	0.305	1.441	1.089
Vul16NAS+2%Cl	240	0.472	52430.089	1.475	2.215	1.751
Vul16NAS+2%Cl	330	0.436	52501.946	1.466	6.571	1.291
Vul16NAS+2%Cl	465	0.661	52894.399	1.733	3.518	1.155
Vul16NAS+2%Cl	580	0.512	52442.517	1.215	7.134	1.290
Vul16NAS+2%Cl	725	0.877	52577.195	0.240	9.338	1.416
Vul16NAS+2%Cl	830	0.557	52463.817	2.162	6.963	1.735
Vul16NAS+2%Cl	870	0.558	52701.369	1.308	5.264	1.258
Vul16NAS+2%Cl	900	0.738	52416.174	1.747	2.284	2.069
Vul16NAS+2%Cl	900	1.046	52374.812	1.084	1.698	1.441
Vul16NAS+2%Cl	900	1.024	51867.240	1.426	2.434	1.447
Vul16NAS+2%Cl	900	0.830	52408.709	1.459	2.225	1.865
Vul16NAS+2%Cl	900	0.781	52542.038	1.468	3.443	1.386
Vul16NAS+2%Cl	900	0.243	52052.627	1.436	4.100	1.727
Vul16NAS+2%Cl	900	0.570	53082.764	2.169	1.924	1.658
Vul12NAS+2%Cl	70	1.159	52665.254	1.362	0.815	1.382
Vul12NAS+2%Cl	100	0.871	52528.892	1.688	2.269	1.760
Vul12NAS+2%Cl	170	0.447	51719.701	1.274	1.901	1.624
Vul12NAS+2%Cl	200	0.782	51913.197	2.727	1.617	0.719
Vul12NAS+2%Cl	255	0.745	51953.097	0.979	1.262	1.003
Vul12NAS+2%Cl	340	1.144	51863.978	2.098	0.614	1.398
Vul12NAS+2%Cl	410	0.874	52520.569	1.009	1.193	1.000
Vul12NAS+2%Cl	465	1.759	51894.073	1.737	1.034	2.369
Vul12NAS+2%Cl	520	0.790	52430.754	1.261	1.629	1.987
Vul12NAS+2%Cl	600	2.615	52290.358	1.438	3.051	1.542
Vul12NAS+2%Cl	785	1.097	52331.373	1.875	4.381	1.309
Vul12NAS+2%Cl	850	0.786	51937.130	1.503	2.017	2.359
Vul12NAS+2%Cl	880	0.860	52363.623	2.082	1.164	1.439
Vul12NAS+2%Cl	900	0.428	51947.195	1.234	1.497	1.177
Vul12NAS+2%Cl	900	0.622	52332.403	1.539	0.817	1.313
Vul12NAS+2%Cl	900	0.675	52209.060	1.299	0.784	2.058
Vul12NAS+2%Cl	900	1.099	53112.787	1.373	1.470	1.536
Vul12NAS+2%Cl	900	1.787	51502.590	1.843	1.357	1.161
Vul12NAS+2%Cl	900	2.364	51324.302	1.241	0.933	1.242
Vul12NAS+2%Cl	900	0.822	52654.550	1.134	0.199	1.362
Vul15NAS+2%Cl	30	1.004	52521.506	2.427	1.201	2.868

HNO3 Method	Temperature (°C)	133Cs	133Cs RSD	137Ba	137Ba RSD	172Yb	172Yb RSD	182W	182W RSD
Vul10NAS+1%Cl	425	0.038	1.421	0.264	2.348			0.245	2.161
Vul10NAS+1%Cl	510	0.005	6.294	0.315	3.427			0.180	2.320
Vul10NAS+1%Cl	695	0.006	5.662	0.096	4.821	0.001	20.689	0.125	2.417
Vul10NAS+1%Cl	785	0.018	2.450	0.086	6.611			0.005	13.197
Vul10NAS+1%Cl	820	0.002	11.354	0.106	2.259			0.003	22.029
Vul10NAS+1%Cl	845	0.002	8.661	0.679	2.190			0.001	24.847
Vul10NAS+1%Cl	865	0.003	4.062	0.435	2.374			0.001	56.788
Vul10NAS+1%Cl	880	0.002	6.079	0.449	2.223			0.001	33.029
Vul10NAS+1%Cl	895	0.001	14.458	0.187	4.745			0.000	57.578
Vul10NAS+1%Cl	900	0.002	9.478	1.360	2.380			0.001	18.704
Vul10NAS+1%Cl	900	0.001	19.327	0.441	4.158			0.000	27.167
Vul10NAS+1%Cl	900	0.002	15.063	3.051	1.643			0.000	50.027
Vul16NAS+2%Cl	35	0.450	1.789	0.025	7.812	0.001	48.686	0.018	8.759
Vul16NAS+2%Cl	65	1.190	1.196	0.068	4.986			0.032	5.606
Vul16NAS+2%Cl	100	1.451	1.360	0.027	2.015			0.061	5.291
Vul16NAS+2%Cl	170	1.908	1.423	0.007	19.070			0.022	4.585
Vul16NAS+2%Cl	195	3.875	1.325	0.007	13.775			0.028	5.907
Vul16NAS+2%Cl	240	6.032	1.524	0.006	20.080			0.071	4.113
Vul16NAS+2%Cl	330	0.632	1.897	0.030	7.597			0.160	3.239
Vul16NAS+2%Cl	465	0.117	1.695	0.021	10.095			0.314	3.070
Vul16NAS+2%Cl	580	0.099	2.098	0.076	3.414			0.227	1.832
Vul16NAS+2%Cl	725	0.049	3.054	0.025	10.110			0.052	3.396
Vul16NAS+2%Cl	830	0.032	3.948	0.024	10.082			0.007	8.969
Vul16NAS+2%Cl	870	0.032	2.508	0.021	10.902			0.004	21.890
Vul16NAS+2%Cl	900	0.010	4.871	0.009	14.602			0.001	36.772
Vul16NAS+2%Cl	900	0.032	1.507	0.016	12.414			0.008	3.519
Vul16NAS+2%Cl	900	0.009	6.044	0.016	15.389			0.001	27.656
Vul16NAS+2%Cl	900	0.022	4.291	0.011	5.117			0.001	15.310
Vul16NAS+2%Cl	900	0.016	4.440	0.011	12.070			0.001	34.155
Vul16NAS+2%Cl	900	0.028	2.343	0.019	9.122			0.016	12.699
Vul16NAS+2%Cl	900	0.023	3.794	0.018	7.056			0.005	10.001
Vul12NAS+2%Cl	70	0.101	3.831	0.014	3.429			0.023	4.781
Vul12NAS+2%Cl	100	0.089	4.678	0.029	11.667			0.047	5.599
Vul12NAS+2%Cl	170	0.234	3.029	0.034	7.154			0.094	4.065
Vul12NAS+2%Cl	200	0.428	1.675	0.034	5.992			0.086	3.916
Vul12NAS+2%Cl	255	0.049	2.437	0.021	9.084			0.086	4.537
Vul12NAS+2%Cl	340	0.077	0.787	0.051	7.831			0.075	1.880
Vul12NAS+2%Cl	410	0.037	3.070	0.239	1.905			0.101	2.314
Vul12NAS+2%Cl	465	0.032	3.761	0.212	3.714			0.175	1.808
Vul12NAS+2%Cl	520	0.026	3.529	0.086	3.149			0.301	1.326
Vul12NAS+2%Cl	600	0.034	2.902	0.072	3.555	0.003	17.628	0.179	2.122
Vul12NAS+2%Cl	785	0.011	5.831	0.044	8.715	0.003	25.300	0.050	2.341
Vul12NAS+2%Cl	850	0.015	2.881	0.042	7.012			0.015	3.511
Vul12NAS+2%Cl	880	0.007	12.461	0.045	6.948			0.003	13.982
Vul12NAS+2%Cl	900	0.033	3.149	0.056	7.468			0.001	12.655
Vul12NAS+2%Cl	900	0.006	8.875	0.016	8.163			0.001	32.321
Vul12NAS+2%Cl	900	0.025	5.169	0.044	8.211			0.001	27.795
Vul12NAS+2%Cl	900	0.018	3.615	0.042	5.285			0.001	20.788
Vul12NAS+2%Cl	900	0.010	3.148	0.079	5.876			0.002	21.326
Vul12NAS+2%Cl	900	0.010	6.077	0.046	9.058			0.009	10.821
Vul12NAS+2%Cl	900	0.044	3.278	0.299	1.654			0.002	19.968
Vul15NAS+2%Cl	30	0.038	0.742	0.368	2.306	0.002	39.242	0.081	3.096

HNO3 Method	Temperature (°C)	185Re (CPS)	185Re (CPS) RSD	195Pt	196Pt RSD	197Au (CPS)
Vul10NAS+1%Cl	425	76219.604	2.161	0.399	154.497	362.672
Vul10NAS+1%Cl	510	75063.195	2.320	0.437	2.878	696.577
Vul10NAS+1%Cl	695	76077.016	2.417	0.020	7.044	235.164
Vul10NAS+1%Cl	785	74592.858	13.197	0.005	14.985	188.178
Vul10NAS+1%Cl	820	73454.889	22.029	0.007	10.388	177.653
Vul10NAS+1%Cl	845	74040.781	24.847	0.007	17.222	789.765
Vul10NAS+1%Cl	865	73737.070	56.788	0.009	11.004	197.081
Vul10NAS+1%Cl	880	73576.965	33.029	0.004	10.921	457.119
Vul10NAS+1%Cl	895	73307.617	57.578			153.685
Vul10NAS+1%Cl	900	73425.756	18.704	0.045	3.895	505.542
Vul10NAS+1%Cl	900	74254.091	27.167	0.004	8.625	177.196
Vul10NAS+1%Cl	900	73790.455	50.027	0.011	5.899	216.967
Vul16NAS+2%Cl	35	75455.300	8.759	0.960	2.676	108.683
Vul16NAS+2%Cl	65	74482.348	5.606	2.928	1.959	92.120
Vul16NAS+2%Cl	100	75587.545	5.291	4.579	1.541	107.885
Vul16NAS+2%Cl	170	75618.786	4.585	6.893	1.254	2209.939
Vul16NAS+2%Cl	195	75007.312	5.907	2.469	1.972	153.803
Vul16NAS+2%Cl	240	74985.624	4.113	2.836	1.453	39.425
Vul16NAS+2%Cl	330	74720.903	3.239	2.634	4.526	67.291
Vul16NAS+2%Cl	465	75854.967	3.070	0.194	3.668	208.507
Vul16NAS+2%Cl	580	74407.197	1.832	0.308	5.222	80.457
Vul16NAS+2%Cl	725	74225.204	3.396	0.057	5.024	1172.898
Vul16NAS+2%Cl	830	74512.412	8.969	0.025	4.292	3677.288
Vul16NAS+2%Cl	870	74856.701	21.890	0.014	15.583	94.170
Vul16NAS+2%Cl	900	73417.557	36.772	0.013	14.354	213.895
Vul16NAS+2%Cl	900	74024.688	3.519	0.006	13.629	120.018
Vul16NAS+2%Cl	900	75578.953	27.656	0.002	17.427	162.258
Vul16NAS+2%Cl	900	73086.778	15.310			157.858
Vul16NAS+2%Cl	900	73208.605	34.155			140.855
Vul16NAS+2%Cl	900	72902.531	12.699	0.003	20.405	213.372
Vul16NAS+2%Cl	900	73515.313	10.001			187.342
Vul12NAS+2%Cl	70	76070.245	4.781	5.125	1.629	35.522
Vul12NAS+2%Cl	100	74577.093	5.599	20.215	1.744	95.844
Vul12NAS+2%Cl	170	75147.232	4.065	31.665	1.783	184.634
Vul12NAS+2%Cl	200	75334.596	3.916	25.116	1.400	590.292
Vul12NAS+2%Cl	255	76115.925	4.537	1.829	1.637	72.400
Vul12NAS+2%Cl	340	75408.192	1.880	0.429	3.510	104.718
Vul12NAS+2%Cl	410	76327.171	2.314	0.804	0.948	3521.438
Vul12NAS+2%Cl	465	75986.279	1.808	0.686	1.676	212.439
Vul12NAS+2%Cl	520	76132.103	1.326	0.500	1.863	1080.893
Vul12NAS+2%Cl	600	76435.280	2.122	0.531	1.955	3662.658
Vul12NAS+2%Cl	785	74662.896	2.341	0.044	5.081	380.780
Vul12NAS+2%Cl	850	75378.121	3.511	0.036	3.133	250.093
Vul12NAS+2%Cl	880	74753.418	13.982	0.019	7.074	140.025
Vul12NAS+2%Cl	900	74403.310	12.655	0.014	12.415	385.164
Vul12NAS+2%Cl	900	73898.048	32.321	0.005	14.647	76.226
Vul12NAS+2%Cl	900	74359.007	27.795			223.430
Vul12NAS+2%Cl	900	74221.266	20.788	0.002	35.788	479.074
Vul12NAS+2%Cl	900	73333.737	21.326			2191.597
Vul12NAS+2%Cl	900	74254.066	10.821	0.003	17.205	204.726
Vul12NAS+2%Cl	900	74808.363	19.968	0.005	7.573	84.328
Vul15NAS+2%Cl	30	75693.210	3.096	3.604	2.037	25.894

HNO3 Method	Temperature (°C)	197Au (CPS) RSD	205TI	205TI RSD	208Pb	208Pb RSD	209Bi	209Bi RSD
Vul10NAS+1%Cl	425	4.391			1.334	1.806	0.042	3.524
Vul10NAS+1%Cl	510	7.379			2.562	1.329	0.045	3.182
Vul10NAS+1%Cl	695	11.864			1.101	1.739	0.040	4.422
Vul10NAS+1%Cl	785	16.885			0.013	10.953	0.003	8.675
Vul10NAS+1%Cl	820	13.614			0.004	14.240	0.003	15.847
Vul10NAS+1%Cl	845	8.646			0.004	7.925	0.005	10.544
Vul10NAS+1%Cl	865	16.610			0.005	11.411	0.012	8.928
Vul10NAS+1%Cl	880	10.516			0.005	11.516	0.010	7.490
Vul10NAS+1%Cl	895	29.715			0.007	14.128	0.007	7.981
Vul10NAS+1%Cl	900	5.378			0.009	5.674	0.023	3.759
Vul10NAS+1%Cl	900	14.012			0.003	14.017	0.013	2.909
Vul10NAS+1%Cl	900	20.737			0.004	12.826	0.028	1.686
Vul16NAS+2%Cl	35	15.357	0.008	10.212	0.052	4.891	0.026	2.361
Vul16NAS+2%Cl	65	29.193	0.022	0.957	0.132	3.812	0.020	4.314
Vul16NAS+2%Cl	100	17.740	0.073	2.400	0.200	2.020	0.031	2.012
Vul16NAS+2%Cl	170	4.316	0.004	10.708	0.390	1.099	0.018	8.373
Vul16NAS+2%Cl	195	18.150			0.158	1.604	0.015	6.264
Vul16NAS+2%Cl	240	56.954			0.347	1.552	0.008	7.189
Vul16NAS+2%Cl	330	25.882			0.912	1.313	0.034	2.104
Vul16NAS+2%Cl	465	10.020	0.003	12.947	0.550	2.078	0.057	4.930
Vul16NAS+2%Cl	580	29.805			0.651	2.186	0.041	4.495
Vul16NAS+2%Cl	725	6.935			0.473	1.076	0.026	3.967
Vul16NAS+2%Cl	830	3.358			0.087	4.631	0.018	3.806
Vul16NAS+2%Cl	870	12.208			0.049	3.771	0.027	5.941
Vul16NAS+2%Cl	900	9.353			0.009	13.645	0.008	9.063
Vul16NAS+2%Cl	900	16.123			0.034	4.153	0.007	8.516
Vul16NAS+2%Cl	900	48.927			0.005	18.854	0.006	5.367
Vul16NAS+2%Cl	900	10.347			0.005	12.460	0.005	9.548
Vul16NAS+2%Cl	900	27.547			0.005	13.412	0.042	3.351
Vul16NAS+2%Cl	900	12.920	0.003	11.266	0.072	3.479	0.007	5.354
Vul16NAS+2%Cl	900	24.048			0.006	2.994	0.010	9.724
Vul12NAS+2%Cl	70	33.910	0.035	2.160	0.167	3.939	0.013	7.993
Vul12NAS+2%Cl	100	27.806	0.253	1.862	0.646	1.169	0.019	4.354
Vul12NAS+2%Cl	170	19.083	0.039	5.200	1.987	2.250	0.029	2.866
Vul12NAS+2%Cl	200	7.925	0.012	9.641	1.930	1.278	0.034	4.831
Vul12NAS+2%Cl	255	16.841			1.160	1.170	0.009	10.694
Vul12NAS+2%Cl	340	24.704			1.935	1.703	0.006	10.013
Vul12NAS+2%Cl	410	3.827			2.725	1.074	0.041	4.239
Vul12NAS+2%Cl	465	11.046			0.546	1.494	0.056	3.380
Vul12NAS+2%Cl	520	5.699			1.612	1.665	0.070	1.631
Vul12NAS+2%Cl	600	5.596			3.834	1.274	0.042	2.529
Vul12NAS+2%Cl	785	11.679			1.366	1.937	0.054	3.468
Vul12NAS+2%Cl	850	6.983			0.176	2.783	0.056	4.568
Vul12NAS+2%Cl	880	15.503			0.031	3.449	0.030	2.881
Vul12NAS+2%Cl	900	8.483			0.012	8.678	0.019	3.187
Vul12NAS+2%Cl	900	38.335			0.007	11.086	0.013	3.980
Vul12NAS+2%Cl	900	15.225			0.007	8.328	0.014	4.808
Vul12NAS+2%Cl	900	12.192			0.007	6.612	0.012	1.743
Vul12NAS+2%Cl	900	3.814			0.006	8.469	0.024	4.079
Vul12NAS+2%Cl	900	15.196			0.028	3.919	0.024	3.128
Vul12NAS+2%Cl	900	20.626			0.009	5.503	0.080	3.033
Vul15NAS+2%Cl	30	42.132	0.011	8.384	0.106	2.636	0.031	3.737

HNO3 Method	Temperature (°C)	7Li	7Li RSD	27Al	27Al RSD	Cl [H2]	Cl [H2] RSD	43Ca	43Ca RSD
Vul15NAS+2%Cl	60	0.129	4.176	0.602	4.079			3.785	3.541
Vul15NAS+2%Cl	95	0.147	3.352	0.515	2.183			4.187	4.714
Vul15NAS+2%Cl	160	0.214	1.948	0.443	2.101			4.856	4.697
Vul15NAS+2%Cl	190	0.401	3.840	0.611	1.497			4.344	3.401
Vul15NAS+2%Cl	235	0.996	2.733	0.443	1.792			3.565	4.169
Vul15NAS+2%Cl	325	5.675	2.582	0.541	1.613			3.732	3.040
Vul15NAS+2%Cl	450	3.604	3.269	1.380	1.393			4.769	3.369
Vul15NAS+2%Cl	565	6.208	2.808	1.866	1.680			4.051	6.725
Vul15NAS+2%Cl	745	6.549	2.070	0.902	2.217			4.439	4.539
Vul15NAS+2%Cl	830	1.295	2.590	0.745	0.974			3.573	3.056
Vul15NAS+2%Cl	865	0.032	8.209	1.049	0.623			3.593	3.751
Vul15NAS+2%Cl	890	0.019	9.774	0.668	3.789			4.127	8.221
Vul15NAS+2%Cl	900	0.018	11.235	0.649	1.945			3.771	5.912
Vul15NAS+2%Cl	900	0.023	7.881	1.165	2.976			3.738	5.282
Vul15NAS+2%Cl	900	0.015	23.457	0.759	1.627			3.786	2.687
Vul15NAS+2%Cl	900	0.015	20.190	0.952	2.133			3.800	3.573
Vul15NAS+2%Cl	900	0.022	8.435	1.358	1.678			3.923	3.174
Vul15NAS+2%Cl	900	0.013	10.349	10.197	1.774			3.918	8.753
Vul11NFS	35	0.097	7.261	0.568	1.968			5.499	8.723
Vul11NFS	95	0.230	6.005	0.587	2.736			4.148	6.084
Vul11NFS	105	0.470	1.360	0.691	1.855			4.254	3.757
Vul11NFS	130	0.427	3.226	0.534	2.084			4.504	6.725
Vul11NFS	160	1.096	0.964	1.018	2.068			6.380	1.507
Vul11NFS	200	1.569	3.567	0.677	1.353			4.823	6.461
Vul11NFS	260	1.145	2.953	0.491	1.935			3.708	3.462
Vul11NFS	330	5.323	1.941	1.072	2.052			4.705	5.702
Vul11NFS	405	3.561	2.780	1.443	1.730	27.814	0.655	6.162	5.025
Vul11NFS	485	2.788	1.355	3.138	1.473			5.113	6.577
Vul11NFS	600	0.709	2.303	1.800	1.609	26.854	1.868	4.124	6.246
Vul11NFS	765	0.018	4.960	1.712	1.495			4.103	4.995
Vul11NFS	815	0.011	23.019	0.855	2.069			4.002	10.595
Vul11NFS	840	0.011	15.559	7.489	1.721			5.234	4.965
Vul11NFS	865	0.011	12.510	0.798	1.717			4.006	7.105
Vul11NFS	880	0.010	24.693	0.679	1.318			3.845	6.232
Vul11NFS	895	0.009	16.234	1.076	24.873			4.155	2.935
Vul11NFS	900	0.018	7.801	0.698	1.647			4.228	4.821
Vul11NFS	900	0.011	14.950	2.408	1.684			3.892	3.356
Vul11NFS	900	0.010	11.055	1.223	1.721			4.267	7.531
Vul11NFS	900	0.012	16.983	4.806	1.514			4.183	5.827
Vul14NFS+1%Cl	60	0.042	7.705	0.459	2.346			5.200	10.277
Vul14NFS+1%Cl	95	0.116	3.480	0.504	3.121			4.152	5.437
Vul14NFS+1%Cl	110	0.106	2.448	0.525	1.398			3.710	3.783
Vul14NFS+1%Cl	120	0.078	4.630	0.484	2.170			3.337	4.627
Vul14NFS+1%Cl	140	0.100	4.650	1.037	2.351			3.537	5.737
Vul14NFS+1%Cl	160	0.215	3.441	0.595	0.865			3.663	3.946
Vul14NFS+1%Cl	190	0.830	1.843	0.461	1.940			3.643	8.914
Vul14NFS+1%Cl	235	1.430	1.700	0.586	2.215			3.878	6.228
Vul14NFS+1%Cl	330	2.940	2.044	5.169	2.046			4.270	3.942
Vul14NFS+1%Cl	455	2.788	2.270	1.543	1.160			4.003	4.563
Vul14NFS+1%Cl	565	4.687	1.891	2.049	2.149			3.896	6.283
Vul14NFS+1%Cl	735	5.909	2.849	1.869	1.824			4.398	5.687
Vul14NFS+1%Cl	830	1.123	2.300	0.937	1.388			3.741	3.240

HNO3 Method	Temperature (°C)	51V	51V RSD	52Cr	52Cr RSD	53Cr	53Cr RSD	55Mn	55Mn RSD
Vul15NAS+2%Cl	60	0.192	2.456	1.904	1.383	1.312	3.137	0.085	1.102
Vul15NAS+2%Cl	95	0.226	1.564	1.901	1.483	1.293	2.012	0.088	2.451
Vul15NAS+2%Cl	160	0.208	1.946	2.059	2.676	1.442	2.258	0.083	1.436
Vul15NAS+2%Cl	190	0.132	0.952	1.289	1.934	0.677	2.794	0.077	2.771
Vul15NAS+2%Cl	235	0.291	2.708	1.207	1.480	0.636	4.094	0.070	3.123
Vul15NAS+2%Cl	325	0.338	0.906	1.707	1.762	1.102	0.960	0.084	2.932
Vul15NAS+2%Cl	450	8.242	1.878	54.260	1.466	53.824	1.860	0.099	3.012
Vul15NAS+2%Cl	565	6.453	1.494	9.143	1.664	8.704	1.662	0.091	2.816
Vul15NAS+2%Cl	745	1.782	1.783	1.402	1.211	0.882	3.247	0.081	2.549
Vul15NAS+2%Cl	830	4.784	1.658	1.149	1.436	0.628	1.751	0.096	2.876
Vul15NAS+2%Cl	865	1.137	1.415	0.709	1.391			0.080	2.360
Vul15NAS+2%Cl	890	1.024	2.131	0.641	1.954			0.083	4.195
Vul15NAS+2%Cl	900	0.473	1.923	0.729	1.425			0.080	1.989
Vul15NAS+2%Cl	900	0.830	2.179	0.899	1.520	0.377	3.234	0.086	1.695
Vul15NAS+2%Cl	900	0.533	1.571	0.771	2.353			0.085	2.922
Vul15NAS+2%Cl	900	0.629	2.502	0.777	2.497			0.083	1.095
Vul15NAS+2%Cl	900	1.292	1.354	0.777	0.651	0.334	4.058	0.075	1.699
Vul15NAS+2%Cl	900	0.864	1.284	0.698	1.746			0.087	1.964
Vul11NFS	35	0.120	1.022	4.473	1.589	3.987	1.852	0.087	3.291
Vul11NFS	95	0.279	1.970	2.041	2.497	1.483	2.311	0.084	2.681
Vul11NFS	105	0.570	1.753	1.690	1.926	1.132	1.141	0.089	2.754
Vul11NFS	130	1.476	2.050	0.970	2.619	0.401	2.936	0.085	2.007
Vul11NFS	160	5.064	1.668	0.908	2.163	0.372	3.313	0.109	2.771
Vul11NFS	200	3.687	1.871	0.815	1.439	0.277	5.126	0.093	3.435
Vul11NFS	260	1.019	1.232	0.783	2.055	0.273	5.428	0.079	1.778
Vul11NFS	330	2.996	1.718	1.701	2.406	1.159	2.504	0.091	2.655
Vul11NFS	405	4.957	1.606	3.501	1.460	3.008	2.702	0.090	3.179
Vul11NFS	485	3.509	0.984	1.858	1.451	1.385	3.008	0.096	2.679
Vul11NFS	600	2.394	1.741	0.726	1.460			0.092	1.380
Vul11NFS	765	0.649	1.473	0.668	2.779			0.086	3.123
Vul11NFS	815	0.357	1.577	0.676	2.113			0.077	2.546
Vul11NFS	840	0.371	2.356	1.212	2.192	0.674	4.108	0.085	1.068
Vul11NFS	865	0.380	2.342	0.923	2.303	0.394	2.217	0.084	3.380
Vul11NFS	880	0.558	1.299	0.667	1.593			0.079	0.408
Vul11NFS	895	0.612	1.256	0.686	1.406			0.082	2.286
Vul11NFS	900	0.431	1.352	1.368	1.524	0.835	3.937	0.090	2.905
Vul11NFS	900	0.607	1.584	0.678	1.688			0.082	3.357
Vul11NFS	900	0.325	1.965	0.713	2.476			0.077	1.756
Vul11NFS	900	0.586	1.787	0.672	2.390			0.080	2.554
Vul14NFS+1%Cl	60			1.013	1.976	0.504	1.210	0.090	1.434
Vul14NFS+1%Cl	95			1.304	1.253	0.824	1.239	0.082	4.606
Vul14NFS+1%Cl	110	0.083	3.401	1.257	1.929	0.755	1.664	0.083	3.387
Vul14NFS+1%Cl	120			0.977	2.215	0.457	5.959	0.076	3.759
Vul14NFS+1%Cl	140			1.326	1.323	0.831	1.872	0.093	3.704
Vul14NFS+1%Cl	160			1.016	1.926	0.525	2.700	0.077	3.153
Vul14NFS+1%Cl	190	0.087	3.447	2.029	1.827	1.525	2.198	0.083	2.364
Vul14NFS+1%Cl	235	0.365	2.329	2.072	1.808	1.562	1.547	0.084	1.225
Vul14NFS+1%Cl	330	1.673	1.412	4.946	1.487	4.498	0.947	0.083	0.740
Vul14NFS+1%Cl	455	2.345	1.592	21.787	1.831	21.027	2.061	0.085	1.963
Vul14NFS+1%Cl	565	1.208	0.632	6.611	1.288	6.190	1.886	0.086	1.989
Vul14NFS+1%Cl	735	0.757	2.781	1.359	2.568	0.838	2.917	0.092	1.906
Vul14NFS+1%Cl	830	1.561	1.568	0.776	1.263	0.277	2.983	0.083	1.171

HNO3 Method	Temperature (°C)	55Mn [He] RSD	55Mn [He] RSD	56Fe [He] RSD	56Fe [He] RSD	57Fe
Vul15NAS+2%Cl	60	0.009	27.205	1.091	1.754	9.427
Vul15NAS+2%Cl	95	0.010	9.182	0.641	3.137	9.338
Vul15NAS+2%Cl	160	0.007	13.736	1.038	1.768	9.437
Vul15NAS+2%Cl	190	0.010	22.604	0.972	2.847	9.431
Vul15NAS+2%Cl	235	0.008	24.515	0.507	2.416	9.266
Vul15NAS+2%Cl	325	0.008	28.900	0.731	0.725	9.570
Vul15NAS+2%Cl	450	0.019	12.578	2.409	1.090	9.803
Vul15NAS+2%Cl	565	0.012	27.357	0.732	1.600	9.391
Vul15NAS+2%Cl	745	0.007	10.952	0.477	2.654	9.243
Vul15NAS+2%Cl	830	0.026	7.221	3.113	0.480	9.830
Vul15NAS+2%Cl	865	0.008	8.501	1.299	1.105	9.702
Vul15NAS+2%Cl	890	0.008	40.958	0.853	1.921	9.607
Vul15NAS+2%Cl	900	0.008	27.426	1.428	1.972	9.839
Vul15NAS+2%Cl	900	0.011	32.442	1.994	1.336	9.968
Vul15NAS+2%Cl	900	0.012	29.577	1.799	0.827	9.781
Vul15NAS+2%Cl	900	0.008	16.885	1.860	1.925	9.846
Vul15NAS+2%Cl	900	0.021	16.260	2.978	1.840	9.661
Vul15NAS+2%Cl	900	0.009	22.330	1.332	1.050	9.887
Vul11NFS	35	0.011	16.629	1.169	1.490	9.886
Vul11NFS	95	0.007	35.501	0.880	2.540	9.880
Vul11NFS	105	0.017	12.059	1.461	2.309	9.774
Vul11NFS	130	0.010	33.862	1.756	1.815	9.858
Vul11NFS	160	0.040	12.475	1.695	2.050	9.760
Vul11NFS	200	0.013	21.922	0.929	2.527	9.812
Vul11NFS	260	0.008	36.648	1.031	1.951	9.659
Vul11NFS	330	0.016	14.010	1.160	1.645	9.802
Vul11NFS	405	0.020	34.797	1.246	2.180	9.692
Vul11NFS	485	0.033	14.291	7.001	1.574	10.489
Vul11NFS	600	0.023	12.852	1.099	1.856	9.698
Vul11NFS	765	0.014	19.524	1.038	2.487	9.670
Vul11NFS	815	0.009	28.395	1.001	1.865	9.662
Vul11NFS	840	0.014	28.460	5.060	1.432	10.429
Vul11NFS	865	0.010	42.652	2.719	1.136	9.954
Vul11NFS	880	0.010	19.641	0.968	1.479	9.616
Vul11NFS	895	0.010	19.723	1.111	2.408	9.770
Vul11NFS	900	0.019	13.370	5.390	0.847	10.361
Vul11NFS	900	0.007	20.686	0.946	3.797	9.701
Vul11NFS	900	0.006	23.581	1.367	0.944	9.663
Vul11NFS	900	0.006	27.370	0.801	1.111	9.703
Vul14NFS+1%Cl	60	0.011	16.760	2.068	1.206	9.870
Vul14NFS+1%Cl	95	0.008	18.987	0.757	2.205	9.597
Vul14NFS+1%Cl	110	0.007	19.921	0.798	1.686	9.544
Vul14NFS+1%Cl	120	0.007	17.496	0.487	3.028	9.488
Vul14NFS+1%Cl	140	0.018	13.583	1.170	1.600	9.759
Vul14NFS+1%Cl	160	0.004	21.641	1.216	2.235	9.656
Vul14NFS+1%Cl	190	0.008	25.175	0.877	2.289	9.631
Vul14NFS+1%Cl	235	0.010	27.684	2.094	1.032	9.751
Vul14NFS+1%Cl	330	0.009	25.158	0.638	2.610	9.671
Vul14NFS+1%Cl	455	0.009	35.688	1.035	2.086	9.693
Vul14NFS+1%Cl	565	0.016	13.664	1.031	1.087	9.640
Vul14NFS+1%Cl	735	0.012	18.469	0.975	1.435	9.792
Vul14NFS+1%Cl	830	0.007	29.326	0.995	2.661	9.757

HNO3 Method	Temperature (°C)	57Fe RSD	59Co	59Co RSD	50Ni	50Ni RSD	63Cu	63Cu RSD
Vul15NAS+2%Cl	60	0.645	0.009	8.685	0.026	6.680	12.629	1.700
Vul15NAS+2%Cl	95	1.045	0.010	7.978	0.038	8.630	27.107	1.378
Vul15NAS+2%Cl	160	0.599	0.008	5.661	0.034	11.380	9.052	1.302
Vul15NAS+2%Cl	190	0.702	0.007	6.628	0.029	7.974	4.192	2.231
Vul15NAS+2%Cl	235	0.692	0.008	12.211	0.023	6.357	8.635	1.561
Vul15NAS+2%Cl	325	1.109	0.007	7.458	0.071	4.017	6.865	1.205
Vul15NAS+2%Cl	450	1.070	0.009	9.186	0.039	9.276	10.016	1.847
Vul15NAS+2%Cl	565	0.541	0.014	3.966	0.033	7.430	35.846	1.641
Vul15NAS+2%Cl	745	0.538	0.019	3.999	0.036	4.446	66.125	1.627
Vul15NAS+2%Cl	830	0.538	0.009	4.388	0.128	1.342	18.849	1.628
Vul15NAS+2%Cl	865	0.852	0.008	7.076	0.021	12.979	9.338	1.190
Vul15NAS+2%Cl	890	0.988	0.009	9.109	0.074	3.560	17.800	1.691
Vul15NAS+2%Cl	900	1.078	0.007	12.274	0.021	8.422	3.489	2.474
Vul15NAS+2%Cl	900	0.739	0.008	9.932	0.027	10.708	6.652	1.971
Vul15NAS+2%Cl	900	0.888	0.008	11.396	0.031	6.211	6.698	1.395
Vul15NAS+2%Cl	900	1.001	0.009	4.784	0.183	2.098	14.473	1.742
Vul15NAS+2%Cl	900	0.412	0.009	8.770	0.139	4.139	9.191	0.746
Vul15NAS+2%Cl	900	0.747	0.008	7.074	1.068	1.805	5.905	1.858
Vul11NFS	35	0.575	0.008	14.522	0.086	5.180	0.879	2.239
Vul11NFS	95	0.611	0.009	10.442	0.045	6.575	4.484	1.922
Vul11NFS	105	0.619	0.007	7.552	0.047	9.275	5.632	1.597
Vul11NFS	130	0.756	0.008	9.249	0.106	7.232	5.974	1.745
Vul11NFS	160	0.637	0.012	8.186	0.116	5.524	15.128	1.042
Vul11NFS	200	0.479	0.008	5.815	0.388	2.620	4.969	1.526
Vul11NFS	260	0.809	0.007	7.037	0.025	5.868	2.967	1.557
Vul11NFS	330	0.254	0.010	10.373	0.053	5.629	5.552	1.582
Vul11NFS	405	0.581	0.010	7.481	0.194	3.269	5.527	1.525
Vul11NFS	485	0.780	0.010	11.437	0.055	12.957	5.980	1.105
Vul11NFS	600	0.702	0.012	7.832	0.038	4.875	8.839	1.004
Vul11NFS	765	0.706	0.010	6.887	0.384	2.038	4.225	1.794
Vul11NFS	815	0.734	0.007	12.523	0.020	13.444	2.013	1.305
Vul11NFS	840	0.347	0.008	2.538	0.056	9.538	4.849	1.387
Vul11NFS	865	1.128	0.010	10.485	0.669	1.315	5.347	1.985
Vul11NFS	880	0.993	0.008	6.940	0.788	1.976	6.246	1.472
Vul11NFS	895	0.493	0.007	4.491	0.037	5.444	4.021	1.377
Vul11NFS	900	0.294	0.009	4.338	0.076	5.748	2.607	2.170
Vul11NFS	900	1.121	0.007	5.330	0.046	4.783	4.955	1.519
Vul11NFS	900	0.626	0.008	2.511	1.032	1.586	5.904	1.579
Vul11NFS	900	0.737	0.014	3.393	0.045	9.423	3.572	2.068
Vul14NFS+1%Cl	60	0.893	0.011	7.976	0.137	3.803	16.911	2.080
Vul14NFS+1%Cl	95	0.644	0.009	12.332	0.094	5.058	13.382	2.103
Vul14NFS+1%Cl	110	0.600	0.008	9.299	0.032	5.255	7.211	1.712
Vul14NFS+1%Cl	120	0.293	0.007	7.402	0.024	4.903	9.375	1.662
Vul14NFS+1%Cl	140	0.924	0.007	7.054	0.018	6.178	3.555	1.456
Vul14NFS+1%Cl	160	0.749	0.006	9.951	0.031	7.968	2.453	1.750
Vul14NFS+1%Cl	190	0.283	0.007	7.314	0.033	4.691	8.502	1.858
Vul14NFS+1%Cl	235	1.095	0.007	10.816	0.065	7.112	3.439	1.235
Vul14NFS+1%Cl	330	0.266	0.007	11.851	0.049	4.597	5.273	1.749
Vul14NFS+1%Cl	455	0.838	0.007	8.318	0.024	8.791	4.545	1.694
Vul14NFS+1%Cl	565	0.521	0.011	5.920	0.024	12.945	14.483	1.393
Vul14NFS+1%Cl	735	0.698	0.012	6.619	0.038	10.189	20.779	1.502
Vul14NFS+1%Cl	830	0.751	0.007	8.289	0.062	4.744	5.890	1.767

HNO3 Method	Temperature (°C)	63Cu [He]	63Cu [He] RSD	65Cu	65Cu RSD	65Cu [He]	65Cu [He] RSD
Vul15NAS+2%Cl	60	13.116	0.776	12.666	1.740	12.794	0.920
Vul15NAS+2%Cl	95	28.181	1.050	27.334	1.629	27.687	1.707
Vul15NAS+2%Cl	160	9.326	1.279	9.000	1.586	9.235	1.114
Vul15NAS+2%Cl	190	4.231	1.226	4.122	1.221	4.148	2.080
Vul15NAS+2%Cl	235	8.942	0.747	8.625	1.506	8.824	2.068
Vul15NAS+2%Cl	325	6.939	0.651	6.753	1.699	6.760	1.936
Vul15NAS+2%Cl	450	9.859	0.890	9.880	1.954	9.743	0.855
Vul15NAS+2%Cl	565	36.611	0.760	35.985	1.572	36.344	0.677
Vul15NAS+2%Cl	745	68.653	0.426	66.876	1.369	68.050	0.262
Vul15NAS+2%Cl	830	19.344	0.788	18.993	1.568	19.108	1.289
Vul15NAS+2%Cl	865	9.558	1.095	9.306	1.107	9.344	0.879
Vul15NAS+2%Cl	890	18.476	0.600	17.744	1.477	18.212	0.952
Vul15NAS+2%Cl	900	3.463	1.392	3.412	1.630	3.421	1.442
Vul15NAS+2%Cl	900	6.751	1.221	6.596	1.986	6.695	1.019
Vul15NAS+2%Cl	900	6.797	0.456	6.634	1.635	6.709	1.283
Vul15NAS+2%Cl	900	14.893	0.637	14.530	1.356	14.760	0.864
Vul15NAS+2%Cl	900	9.384	0.667	9.162	1.190	9.289	1.002
Vul15NAS+2%Cl	900	6.088	1.510	5.869	1.367	5.988	1.252
Vul11NFS	35	0.710	3.073	0.789	0.798	0.732	2.705
Vul11NFS	95	4.464	0.837	4.376	1.255	4.393	1.898
Vul11NFS	105	5.554	0.468	5.576	1.904	5.464	0.506
Vul11NFS	130	5.860	1.002	5.925	1.736	5.757	1.696
Vul11NFS	160	15.124	0.476	15.154	1.329	15.086	0.658
Vul11NFS	200	4.865	1.415	4.928	1.231	4.815	0.496
Vul11NFS	260	2.871	1.122	2.885	1.174	2.805	2.776
Vul11NFS	330	5.504	0.774	5.499	1.684	5.363	0.659
Vul11NFS	405	5.470	1.459	5.456	1.428	5.456	0.992
Vul11NFS	485	5.908	0.716	5.924	1.136	5.807	1.595
Vul11NFS	600	9.011	1.087	8.783	1.247	8.816	1.043
Vul11NFS	765	4.238	1.167	4.181	1.281	4.249	1.563
Vul11NFS	815	1.891	1.797	1.925	2.396	1.840	1.953
Vul11NFS	840	4.871	0.324	4.744	1.508	4.826	1.817
Vul11NFS	865	5.449	1.050	5.301	1.318	5.393	1.473
Vul11NFS	880	6.315	0.732	6.194	1.683	6.190	1.324
Vul11NFS	895	4.054	2.553	3.942	1.998	3.942	2.938
Vul11NFS	900	2.563	2.198	2.525	2.548	2.541	2.693
Vul11NFS	900	5.052	1.381	4.934	1.910	4.912	1.629
Vul11NFS	900	5.930	1.172	5.857	1.479	5.860	0.885
Vul11NFS	900	3.546	0.916	3.491	2.581	3.448	2.253
Vul14NFS+1%Cl	60	17.638	0.757	16.909	1.326	17.474	0.770
Vul14NFS+1%Cl	95	13.719	0.571	13.335	1.491	13.435	0.984
Vul14NFS+1%Cl	110	7.277	0.885	7.147	1.998	7.213	1.126
Vul14NFS+1%Cl	120	9.664	0.571	9.339	1.149	9.605	1.136
Vul14NFS+1%Cl	140	3.466	1.954	3.452	1.918	3.446	1.109
Vul14NFS+1%Cl	160	2.392	0.954	2.382	2.898	2.366	1.962
Vul14NFS+1%Cl	190	8.613	0.473	8.473	1.688	8.544	1.310
Vul14NFS+1%Cl	235	3.314	2.222	3.348	1.634	3.260	2.407
Vul14NFS+1%Cl	330	5.080	0.951	5.066	2.082	5.014	1.334
Vul14NFS+1%Cl	455	4.206	0.873	4.313	1.989	4.144	0.781
Vul14NFS+1%Cl	565	14.179	0.498	14.310	0.881	14.010	0.626
Vul14NFS+1%Cl	735	21.093	0.866	20.777	2.317	20.789	0.538
Vul14NFS+1%Cl	830	5.861	0.758	5.771	1.568	5.716	1.405

HNO3 Method	Temperature (°C)	66Zn	66Zn RSD	75As	75As RSD	75As [He]	75As [He] RSD	76Se
Vul15NAS+2%Cl	60	0.143	3.782	2.785	0.651	0.015	23.295	10.380
Vul15NAS+2%Cl	95	0.524	3.788	2.735	0.897	0.015	32.434	10.295
Vul15NAS+2%Cl	160	0.194	3.672	2.758	1.378	0.019	29.486	10.300
Vul15NAS+2%Cl	190	0.298	4.254	2.748	0.726	0.006	77.649	10.306
Vul15NAS+2%Cl	235	0.123	4.365	2.702	1.206	0.010	41.167	10.224
Vul15NAS+2%Cl	325	0.146	4.536	2.806	1.321	0.019	25.575	10.481
Vul15NAS+2%Cl	450	0.310	3.254	3.134	1.584	0.420	8.894	10.574
Vul15NAS+2%Cl	565	0.147	4.227	2.924	1.070	0.222	6.154	10.383
Vul15NAS+2%Cl	745	1.641	1.742	2.710	0.815	0.034	21.973	10.125
Vul15NAS+2%Cl	830	0.117	2.274	2.729	0.962	0.006	64.466	10.298
Vul15NAS+2%Cl	865	0.069	3.328	2.763	0.776	0.004	74.716	10.387
Vul15NAS+2%Cl	890	1.542	1.300	2.753	1.170			10.354
Vul15NAS+2%Cl	900	0.088	8.952	2.789	1.548	0.004	108.645	10.468
Vul15NAS+2%Cl	900	0.097	4.498	2.784	0.390			10.506
Vul15NAS+2%Cl	900	0.103	4.535	2.756	0.837	0.004	103.647	10.390
Vul15NAS+2%Cl	900	0.110	4.774	2.747	0.599			10.373
Vul15NAS+2%Cl	900	0.140	5.602	2.670	0.983			10.014
Vul15NAS+2%Cl	900	0.084	1.566	2.761	1.641			10.475
Vul11NFS	35	0.162	2.799	2.805	0.430	0.005	74.528	10.562
Vul11NFS	95	0.195	2.763	2.802	0.858	0.016	39.398	10.588
Vul11NFS	105	0.225	1.224	2.771	0.871	0.026	56.544	10.449
Vul11NFS	130	0.281	2.105	2.824	0.820	0.033	20.327	10.423
Vul11NFS	160	0.619	3.620	2.819	0.551	0.096	8.014	10.327
Vul11NFS	200	0.248	3.621	2.853	0.689	0.084	18.140	10.524
Vul11NFS	260	0.143	1.770	2.781	0.318	0.041	30.698	10.342
Vul11NFS	330	0.412	4.151	2.864	0.698	0.144	11.902	10.395
Vul11NFS	405	0.258	2.281	2.872	1.549	0.182	12.929	10.303
Vul11NFS	485	1.110	3.004	2.782	0.834	0.113	5.226	10.229
Vul11NFS	600	0.179	3.811	2.790	0.817	0.041	25.373	10.332
Vul11NFS	765	0.149	4.382	2.742	0.766			10.309
Vul11NFS	815	0.104	6.448	2.733	0.947			10.308
Vul11NFS	840	0.237	3.953	2.760	0.785			10.425
Vul11NFS	865	0.137	2.579	2.770	0.526			10.385
Vul11NFS	880	0.157	5.320	2.715	0.754			10.274
Vul11NFS	895	0.121	5.101	2.750	1.720			10.372
Vul11NFS	900	0.100	6.453	2.763	0.567			10.390
Vul11NFS	900	0.169	5.848	2.759	0.555			10.394
Vul11NFS	900	0.359	2.005	2.714	0.948			10.272
Vul11NFS	900	0.102	5.122	2.757	0.701			10.384
Vul14NFS+1%Cl	60	0.213	1.821	2.819	1.629	0.007	79.735	10.500
Vul14NFS+1%Cl	95	0.191	2.989	2.756	0.667	0.024	32.432	10.337
Vul14NFS+1%Cl	110	0.188	4.163	2.770	0.591	0.028	25.772	10.333
Vul14NFS+1%Cl	120	0.130	1.899	2.734	0.806	0.017	48.472	10.286
Vul14NFS+1%Cl	140	0.151	6.249	2.776	0.622	0.016	62.154	10.463
Vul14NFS+1%Cl	160	0.208	2.315	2.756	0.713	0.010	69.397	10.303
Vul14NFS+1%Cl	190	0.201	2.588	2.784	1.264	0.039	34.267	10.401
Vul14NFS+1%Cl	235	0.169	8.292	2.777	0.995	0.065	26.042	10.308
Vul14NFS+1%Cl	330	0.264	4.125	2.866	1.035	0.094	12.014	10.490
Vul14NFS+1%Cl	455	0.437	2.397	3.038	0.464	0.346	10.026	10.513
Vul14NFS+1%Cl	565	0.160	4.712	2.914	1.082	0.193	6.874	10.347
Vul14NFS+1%Cl	735	0.320	3.862	2.833	0.764	0.077	34.812	10.469
Vul14NFS+1%Cl	830	0.127	4.962	2.773	0.684	0.005	60.115	10.391

HNO3 Method	Temperature (°C)	76Se RSD	77Se	77Se RSD	78Se	78Se RSD	78Se [He]	78Se [He] RSD
Vul15NAS+2%Cl	60	0.508	0.461	13.280	1.793	12.448	0.197	56.183
Vul15NAS+2%Cl	95	0.645	0.457	14.971	1.561	12.311	0.240	46.344
Vul15NAS+2%Cl	160	0.497	0.424	10.327	1.710	12.872	0.226	24.843
Vul15NAS+2%Cl	190	0.259			1.629	10.204	0.171	16.117
Vul15NAS+2%Cl	235	0.445			1.450	22.819	0.240	37.990
Vul15NAS+2%Cl	325	0.324			1.692	18.762	0.143	43.006
Vul15NAS+2%Cl	450	0.695	0.426	13.858	1.748	19.444	0.180	46.290
Vul15NAS+2%Cl	565	0.621	0.475	17.568	1.691	7.055	0.207	18.083
Vul15NAS+2%Cl	745	0.421	0.444	13.629	1.574	4.955	0.237	15.794
Vul15NAS+2%Cl	830	0.886			1.513	15.934	0.232	24.784
Vul15NAS+2%Cl	865	0.351			1.640	10.852	0.168	55.249
Vul15NAS+2%Cl	890	0.469	0.428	12.415	1.629	8.101	0.254	41.835
Vul15NAS+2%Cl	900	0.414	0.430	10.903	1.680	18.629	0.221	41.606
Vul15NAS+2%Cl	900	0.677	0.441	7.766	1.593	3.625	0.222	34.488
Vul15NAS+2%Cl	900	0.700			1.547	13.714	0.184	46.480
Vul15NAS+2%Cl	900	0.571			1.559	13.810	0.173	28.295
Vul15NAS+2%Cl	900	0.746			1.621	20.348	0.148	20.414
Vul15NAS+2%Cl	900	0.263	0.442	10.803	1.491	19.704	0.227	33.514
Vul11NFS	35	0.449	0.427	6.674	1.627	5.958	0.269	30.854
Vul11NFS	95	0.347			1.494	13.401	0.181	42.863
Vul11NFS	105	0.386	0.422	6.721	1.459	8.039	0.133	64.366
Vul11NFS	130	0.314			1.882	10.768	0.220	33.498
Vul11NFS	160	0.357			1.645	4.437	0.209	23.463
Vul11NFS	200	0.417	0.449	12.855	1.603	4.368	0.176	49.214
Vul11NFS	260	0.427	0.433	11.226	1.655	6.312	0.174	40.801
Vul11NFS	330	0.327	0.436	12.088	1.633	5.667	0.159	48.921
Vul11NFS	405	0.386			1.656	15.451	0.189	47.392
Vul11NFS	485	0.379			1.434	15.964	0.166	29.543
Vul11NFS	600	0.332			1.708	10.988	0.184	22.819
Vul11NFS	765	0.448	0.475	8.676	1.697	11.036	0.199	30.614
Vul11NFS	815	0.462			1.577	10.135	0.204	23.383
Vul11NFS	840	0.912			1.513	15.083	0.293	42.794
Vul11NFS	865	0.349	0.424	5.118	1.722	5.140	0.231	27.215
Vul11NFS	880	0.453	0.435	21.112	1.498	5.641	0.198	64.352
Vul11NFS	895	0.382	0.430	8.258	1.582	20.905	0.200	37.824
Vul11NFS	900	0.374	0.430	11.124	1.667	7.434	0.241	48.520
Vul11NFS	900	0.442	0.435	4.947	1.633	5.982	0.210	29.120
Vul11NFS	900	0.397			1.474	7.866	0.172	36.603
Vul11NFS	900	0.393			1.576	5.858	0.293	23.697
Vul14NFS+1%Cl	60	0.432	0.425	10.314	1.827	19.272	0.154	42.484
Vul14NFS+1%Cl	95	0.359			1.538	12.176	0.198	16.718
Vul14NFS+1%Cl	110	0.654			1.641	7.605	0.259	51.133
Vul14NFS+1%Cl	120	0.478	0.430	10.752	1.546	6.795	0.208	40.801
Vul14NFS+1%Cl	140	0.197	0.430	17.071	1.540	9.673	0.169	44.949
Vul14NFS+1%Cl	160	0.386			1.651	12.489	0.183	34.581
Vul14NFS+1%Cl	190	0.369			1.520	14.184	0.204	37.495
Vul14NFS+1%Cl	235	0.118			1.530	15.937	0.223	38.024
Vul14NFS+1%Cl	330	0.374	0.471	15.132	1.736	13.163	0.201	37.824
Vul14NFS+1%Cl	455	0.757	0.480	14.680	1.630	6.802	0.154	56.522
Vul14NFS+1%Cl	565	0.587	0.466	8.732	1.736	17.877	0.224	65.488
Vul14NFS+1%Cl	735	0.233	0.466	8.217	1.629	9.820	0.231	45.819
Vul14NFS+1%Cl	830	0.425			1.677	8.479	0.226	52.934

HNO3 Method	Temperature (°C)	82Se	82Se RSD	85Rb	85Rb RSD	88Sr	88Sr RSD	89Y	89Y RSD
Vul15NAS+2%Cl	60	0.602	8.496	0.089	3.594				
Vul15NAS+2%Cl	95	0.577	7.971	0.097	1.543				
Vul15NAS+2%Cl	160	0.592	9.897	0.080	2.269				
Vul15NAS+2%Cl	190	0.575	8.731	0.077	1.426			0.000	15.471
Vul15NAS+2%Cl	235	0.588	6.204	0.137	2.346				
Vul15NAS+2%Cl	325	0.602	10.376	0.096	2.015				
Vul15NAS+2%Cl	450	0.605	5.587	0.029	1.717				
Vul15NAS+2%Cl	565	0.620	5.837	0.051	0.983				
Vul15NAS+2%Cl	745	0.500	11.508	0.022	1.662			0.000	17.182
Vul15NAS+2%Cl	830	0.482	5.189	0.007	4.094				
Vul15NAS+2%Cl	865	0.477	3.261	0.004	9.085				
Vul15NAS+2%Cl	890	0.496	5.342	0.004	4.815			0.001	8.918
Vul15NAS+2%Cl	900	0.482	12.347	0.004	7.036				
Vul15NAS+2%Cl	900	0.459	10.311	0.004	7.128				
Vul15NAS+2%Cl	900	0.504	6.292	0.004	12.590				
Vul15NAS+2%Cl	900	0.486	6.346	0.004	6.818				
Vul15NAS+2%Cl	900	0.458	5.053	0.004	8.092			0.001	12.393
Vul15NAS+2%Cl	900	0.488	16.597	0.006	10.633				
Vul11NFS	35	0.528	6.716	0.004	13.182	0.044	10.713		
Vul11NFS	95	0.480	7.086	0.006	7.131				
Vul11NFS	105	0.473	4.926	0.008	7.247				
Vul11NFS	130	0.470	8.033	0.010	8.942				
Vul11NFS	160	0.482	11.951	0.023	3.781				
Vul11NFS	200	0.500	4.905	0.021	3.571				
Vul11NFS	260	0.491	8.916	0.011	3.075				
Vul11NFS	330	0.464	13.510	0.030	1.933				
Vul11NFS	405	0.520	3.624	0.022	6.004			0.000	21.890
Vul11NFS	485	0.520	6.269	0.007	9.926				
Vul11NFS	600	0.483	4.055	0.004	5.943				
Vul11NFS	765	0.476	10.117	0.004	10.249				
Vul11NFS	815	0.485	9.579	0.003	7.962				
Vul11NFS	840	0.494	3.446	0.004	10.121	0.031	5.141	0.000	26.359
Vul11NFS	865	0.483	12.509	0.004	8.533				
Vul11NFS	880	0.508	15.251	0.004	16.442				
Vul11NFS	895	0.473	12.097	0.004	8.376				
Vul11NFS	900	0.472	10.867	0.004	7.169				
Vul11NFS	900	0.529	4.991	0.004	5.581			0.001	10.688
Vul11NFS	900	0.478	8.029	0.004	6.136				
Vul11NFS	900	0.488	9.143	0.004	9.924				
Vul14NFS+1%Cl	60	0.500	11.943	0.027	2.519	0.025	24.499		
Vul14NFS+1%Cl	95	0.478	8.278	0.078	2.222				
Vul14NFS+1%Cl	110	0.480	7.982	0.056	3.197				
Vul14NFS+1%Cl	120	0.462	11.276	0.029	1.407				
Vul14NFS+1%Cl	140	0.484	7.280	0.038	3.463				
Vul14NFS+1%Cl	160	0.491	11.744	0.041	1.829				
Vul14NFS+1%Cl	190	0.482	11.996	0.204	1.492				
Vul14NFS+1%Cl	235	0.448	13.974	0.291	1.304				
Vul14NFS+1%Cl	330	0.479	10.020	0.025	5.788				
Vul14NFS+1%Cl	455	0.480	4.087	0.020	3.538			0.001	13.662
Vul14NFS+1%Cl	565	0.489	8.779	0.030	3.499				
Vul14NFS+1%Cl	735	0.501	9.295	0.023	5.981			0.000	10.687
Vul14NFS+1%Cl	830	0.470	11.188	0.007	12.960			0.000	20.797

HNO3 Method	Temperature (°C)	95Mo	95Mo RSD	107Ag	107Ag RSD	111Cd	111Cd RSD	115In (CPS)
Vul15NAS+2%Cl	60	16.495	1.412	0.011	10.281	0.039	10.547	243234.924
Vul15NAS+2%Cl	95	19.630	1.855	0.012	2.906	0.055	5.827	243234.924
Vul15NAS+2%Cl	160	22.307	1.476	0.011	10.309	0.062	13.362	243234.924
Vul15NAS+2%Cl	190	9.409	1.259	0.007	8.515	0.027	14.052	243234.924
Vul15NAS+2%Cl	235	7.114	1.530	0.010	10.721	0.071	8.982	243234.924
Vul15NAS+2%Cl	325	14.535	1.690	0.105	1.442	0.058	6.741	243234.924
Vul15NAS+2%Cl	450	765.293	1.477	0.044	4.511	1.008	1.274	243234.924
Vul15NAS+2%Cl	565	562.450	1.558	0.046	3.386	0.729	2.979	243234.924
Vul15NAS+2%Cl	745	52.081	1.006	0.011	4.793	0.097	5.946	243234.924
Vul15NAS+2%Cl	830	7.260	1.400			0.036	5.073	243234.924
Vul15NAS+2%Cl	865	0.305	1.106			0.004	29.415	243234.924
Vul15NAS+2%Cl	890	0.644	2.707			0.003	27.274	243234.924
Vul15NAS+2%Cl	900	0.156	3.533					243234.924
Vul15NAS+2%Cl	900	1.776	1.742			0.004	13.385	243234.924
Vul15NAS+2%Cl	900	0.333	0.971					243234.924
Vul15NAS+2%Cl	900	0.136	2.365			0.002	73.020	243234.924
Vul15NAS+2%Cl	900	0.908	1.605			0.004	32.294	243234.924
Vul15NAS+2%Cl	900	0.485	2.372					243234.924
Vul11NFS	35	19.179	1.251	0.002	13.625	0.026	9.532	243234.924
Vul11NFS	95	54.867	1.838	0.003	14.968	0.066	6.156	243234.924
Vul11NFS	105	106.845	0.868	0.005	11.553	0.131	3.940	243234.924
Vul11NFS	130	142.602	1.600	0.006	5.208	0.162	2.287	243234.924
Vul11NFS	160	327.942	1.587	0.020	10.930	0.380	3.047	243234.924
Vul11NFS	200	170.088	1.522	0.019	5.784	0.273	3.884	243234.924
Vul11NFS	260	76.414	1.402	0.012	5.603	0.156	3.039	243234.924
Vul11NFS	330	137.315	1.701	0.034	3.779	0.426	1.986	243234.924
Vul11NFS	405	95.094	1.569	0.032	2.250	0.323	5.684	243234.924
Vul11NFS	485	45.237	1.451	0.005	8.784	0.262	1.523	243234.924
Vul11NFS	600	9.119	2.590			0.021	5.461	243234.924
Vul11NFS	765	0.353	2.718					243234.924
Vul11NFS	815	0.289	2.969					243234.924
Vul11NFS	840	0.319	1.668					243234.924
Vul11NFS	865	0.484	1.665			0.002	17.572	243234.924
Vul11NFS	880	0.563	2.369					243234.924
Vul11NFS	895	0.382	3.275					243234.924
Vul11NFS	900	2.356	0.889			0.002	39.385	243234.924
Vul11NFS	900	0.307	1.155					243234.924
Vul11NFS	900	0.368	2.574			0.002	37.905	243234.924
Vul11NFS	900	0.497	4.535			0.002	33.491	243234.924
Vul14NFS+1%Cl	60	3.695	1.823	0.004	16.332	0.009	33.556	243234.924
Vul14NFS+1%Cl	95	12.229	1.026	0.007	2.247	0.028	5.843	243234.924
Vul14NFS+1%Cl	110	11.771	1.717	0.006	7.772	0.028	16.387	243234.924
Vul14NFS+1%Cl	120	7.031	1.050	0.004	13.298	0.015	14.509	243234.924
Vul14NFS+1%Cl	140	9.961	1.407	0.004	9.657	0.023	21.938	243234.924
Vul14NFS+1%Cl	160	7.313	0.889	0.004	5.223	0.018	14.363	243234.924
Vul14NFS+1%Cl	190	22.590	1.465	0.010	12.109	0.048	6.241	243234.924
Vul14NFS+1%Cl	235	41.689	1.463	0.040	4.932	0.097	6.166	243234.924
Vul14NFS+1%Cl	330	137.327	1.604	0.050	6.179	0.171	3.673	243234.924
Vul14NFS+1%Cl	455	331.484	1.617	0.037	2.564	0.368	2.244	243234.924
Vul14NFS+1%Cl	565	252.248	1.308	0.018	7.759	0.306	3.370	243234.924
Vul14NFS+1%Cl	735	60.424	1.525	0.006	6.242	0.101	2.317	243234.924
Vul14NFS+1%Cl	830	7.988	1.181			0.017	22.563	243234.924

HNO3 Method	Temperature (°C)	115In (CPS) RSD	115In [He] (CPS)	115In [He] (CPS) RSD	118Sn	118Sn RSD
Vul15NAS+2%Cl	60	1.259	52191.215	2.571	1.738	1.829
Vul15NAS+2%Cl	95	1.166	52261.256	1.645	3.165	1.368
Vul15NAS+2%Cl	160	0.648	52615.737	1.617	1.288	1.557
Vul15NAS+2%Cl	190	0.704	52732.205	1.428	0.591	2.563
Vul15NAS+2%Cl	235	1.502	51483.967	1.681	1.242	1.460
Vul15NAS+2%Cl	325	1.303	52321.198	1.913	1.049	2.556
Vul15NAS+2%Cl	450	0.843	52514.971	1.593	1.399	2.194
Vul15NAS+2%Cl	565	0.834	53449.697	1.927	6.028	1.438
Vul15NAS+2%Cl	745	1.774	53000.220	1.288	10.664	1.318
Vul15NAS+2%Cl	830	0.896	52087.854	1.193	3.086	1.807
Vul15NAS+2%Cl	865	0.508	51979.093	0.709	1.598	1.645
Vul15NAS+2%Cl	890	1.105	51824.259	1.199	2.476	1.557
Vul15NAS+2%Cl	900	0.737	52568.879	1.741	0.608	1.012
Vul15NAS+2%Cl	900	0.901	52687.875	1.386	1.194	1.600
Vul15NAS+2%Cl	900	0.455	52039.546	0.692	1.136	1.123
Vul15NAS+2%Cl	900	1.300	52293.562	2.550	2.554	1.508
Vul15NAS+2%Cl	900	3.483	50609.325	0.362	1.599	1.698
Vul15NAS+2%Cl	900	0.496	52712.624	0.798	1.028	1.688
Vul11NFS	35	0.849	51842.817	1.265	0.106	3.612
Vul11NFS	95	1.241	52593.820	1.419	0.666	1.902
Vul11NFS	105	0.498	52247.005	1.330	0.834	2.290
Vul11NFS	130	1.243	52141.686	0.506	0.877	2.586
Vul11NFS	160	0.201	52539.361	1.678	2.234	1.604
Vul11NFS	200	0.467	53073.462	2.282	0.670	1.546
Vul11NFS	260	1.443	51967.248	1.799	0.439	1.488
Vul11NFS	330	0.749	52352.159	1.860	0.512	2.436
Vul11NFS	405	0.442	52215.246	1.528	0.814	2.026
Vul11NFS	485	2.235	51181.315	1.934	0.937	1.252
Vul11NFS	600	0.992	51530.104	0.704	1.326	2.116
Vul11NFS	765	0.586	51256.317	0.873	0.686	2.303
Vul11NFS	815	1.240	51956.286	1.687	0.303	3.878
Vul11NFS	840	1.382	52056.045	1.877	0.738	1.924
Vul11NFS	865	0.684	52067.133	0.599	0.857	1.235
Vul11NFS	880	0.916	51519.866	1.377	1.022	1.243
Vul11NFS	895	0.505	52300.932	0.927	0.671	2.002
Vul11NFS	900	1.007	52459.411	1.478	0.377	1.932
Vul11NFS	900	0.885	52560.448	0.648	0.798	2.729
Vul11NFS	900	1.352	51191.077	1.432	0.957	2.139
Vul11NFS	900	0.434	51909.349	0.947	0.541	1.387
Vul14NFS+1%Cl	60	1.515	52795.531	1.357	2.635	1.351
Vul14NFS+1%Cl	95	0.401	51894.872	1.494	2.077	1.933
Vul14NFS+1%Cl	110	0.615	51536.196	0.447	1.171	1.623
Vul14NFS+1%Cl	120	1.430	51734.278	1.189	1.449	0.734
Vul14NFS+1%Cl	140	1.171	52485.514	0.876	0.527	1.265
Vul14NFS+1%Cl	160	0.727	52185.869	0.415	0.381	2.486
Vul14NFS+1%Cl	190	0.942	52100.290	1.931	1.464	2.016
Vul14NFS+1%Cl	235	0.861	51662.048	1.236	0.417	2.331
Vul14NFS+1%Cl	330	0.512	52918.662	2.315	0.681	1.845
Vul14NFS+1%Cl	455	1.028	51826.906	1.423	0.617	2.423
Vul14NFS+1%Cl	565	0.696	52930.687	1.169	2.296	1.237
Vul14NFS+1%Cl	735	1.129	52251.506	1.566	3.583	2.289
Vul14NFS+1%Cl	830	0.933	51758.706	1.146	0.995	1.962

HNO3 Method	Temperature (°C)	133Cs	133Cs RSD	137Ba	137Ba RSD	172Yb	172Yb RSD	182W	182W RSD
Vul15NAS+2%Cl	60	0.038	1.222	0.031	7.430			0.104	3.217
Vul15NAS+2%Cl	95	0.047	1.490	0.039	12.655			0.037	4.712
Vul15NAS+2%Cl	160	0.060	2.221	0.021	9.844			0.140	3.107
Vul15NAS+2%Cl	190	0.029	1.681	0.011	14.739			0.135	4.235
Vul15NAS+2%Cl	235	0.031	4.712	0.008	19.041			0.069	3.592
Vul15NAS+2%Cl	325	0.037	3.779	0.013	13.352			0.148	3.255
Vul15NAS+2%Cl	450	0.039	1.904	0.105	4.121			0.785	2.697
Vul15NAS+2%Cl	565	0.212	1.609	0.130	2.101			0.641	1.963
Vul15NAS+2%Cl	745	0.084	2.397	0.073	3.908			0.127	3.496
Vul15NAS+2%Cl	830	0.010	4.103	0.030	7.541			0.016	8.997
Vul15NAS+2%Cl	865	0.008	7.488	0.030	4.521			0.001	24.618
Vul15NAS+2%Cl	890	0.009	6.478	0.042	8.632			0.002	26.716
Vul15NAS+2%Cl	900	0.019	2.920	0.022	10.173			0.001	22.974
Vul15NAS+2%Cl	900	0.010	6.440	0.019	6.858			0.003	31.011
Vul15NAS+2%Cl	900	0.013	3.990	0.040	8.383			0.002	25.665
Vul15NAS+2%Cl	900	0.012	4.066	0.037	9.221			0.001	25.715
Vul15NAS+2%Cl	900	0.017	2.745	0.046	4.990			0.002	31.209
Vul15NAS+2%Cl	900	0.230	2.031	0.072	6.795			0.003	16.312
Vul11NFS	35	0.003	10.194	0.600	1.499	0.001	52.845	0.036	6.935
Vul11NFS	95	0.006	6.693	0.062	5.961			0.072	4.563
Vul11NFS	105	0.008	4.808	0.208	8.054			0.109	4.354
Vul11NFS	130	0.013	4.578	0.058	4.517			0.132	3.256
Vul11NFS	160	0.029	2.863	0.113	2.761			0.355	1.954
Vul11NFS	200	0.021	4.375	0.192	6.164			0.308	3.584
Vul11NFS	260	0.016	4.619	0.244	3.059			0.118	4.110
Vul11NFS	330	0.045	0.911	0.116	7.015			0.247	1.465
Vul11NFS	405	0.023	3.850	0.149	3.319			0.394	1.555
Vul11NFS	485	0.006	3.415	0.080	5.724			0.111	3.378
Vul11NFS	600	0.006	6.596	0.046	4.237			0.040	5.533
Vul11NFS	765	0.080	1.271	0.105	3.660			0.001	28.035
Vul11NFS	815	0.001	23.225	0.063	3.939			0.000	57.067
Vul11NFS	840	0.005	11.096	0.054	5.687			0.001	43.327
Vul11NFS	865	0.003	11.484	0.152	4.700			0.002	37.935
Vul11NFS	880	0.001	8.831	0.104	6.496			0.001	44.747
Vul11NFS	895	0.013	9.062	0.357	3.668			0.002	8.276
Vul11NFS	900	0.005	6.420	0.125	2.673			0.006	17.319
Vul11NFS	900	0.002	13.823	0.334	3.457			0.001	37.915
Vul11NFS	900	0.006	10.422	0.247	6.842			0.001	40.380
Vul11NFS	900	0.002	12.041	0.210	4.613			0.001	27.472
Vul14NFS+1%Cl	60	0.027	1.742	0.043	6.883			0.014	16.995
Vul14NFS+1%Cl	95	0.118	2.278	0.013	10.950			0.046	4.742
Vul14NFS+1%Cl	110	0.212	0.975	0.011	15.858			0.060	1.341
Vul14NFS+1%Cl	120	0.080	0.901	0.288	2.668			0.058	5.822
Vul14NFS+1%Cl	140	0.066	2.042	0.078	5.478			0.139	1.876
Vul14NFS+1%Cl	160	0.143	1.476	0.010	6.506			0.194	2.101
Vul14NFS+1%Cl	190	0.318	1.526	0.026	10.302			0.302	2.658
Vul14NFS+1%Cl	235	0.251	1.237	0.014	8.592			0.382	2.761
Vul14NFS+1%Cl	330	0.551	1.546	0.041	5.362			0.327	2.166
Vul14NFS+1%Cl	455	0.073	1.847	0.037	10.133			0.416	3.470
Vul14NFS+1%Cl	565	0.097	2.633	0.079	3.658			0.321	3.133
Vul14NFS+1%Cl	735	0.347	2.431	0.041	10.164			0.142	5.777
Vul14NFS+1%Cl	830	0.195	3.295	0.019	7.690			0.018	3.447

HNO3 Method	Temperature (°C)	185Re (CPS)	185Re (CPS) RSD	195Pt	196Pt RSD	197Au (CPS)
Vul15NAS+2%Cl	60	75120.863	3.217	12.971	1.679	104.786
Vul15NAS+2%Cl	95	74330.137	4.712	19.357	1.784	378.244
Vul15NAS+2%Cl	160	75762.893	3.107	13.204	1.254	272.840
Vul15NAS+2%Cl	190	76116.071	4.235	3.068	1.972	193.887
Vul15NAS+2%Cl	235	75604.467	3.592	1.226	1.287	60.178
Vul15NAS+2%Cl	325	76315.725	3.255	2.185	2.223	341.446
Vul15NAS+2%Cl	450	76878.740	2.697	1.013	2.350	46.880
Vul15NAS+2%Cl	565	75743.943	1.963	0.421	3.238	685.257
Vul15NAS+2%Cl	745	73556.353	3.496	0.086	2.371	5419.631
Vul15NAS+2%Cl	830	75094.661	8.997	0.032	3.074	355.734
Vul15NAS+2%Cl	865	74673.418	24.618	0.017	14.769	254.626
Vul15NAS+2%Cl	890	73974.408	26.716	0.020	5.951	146.761
Vul15NAS+2%Cl	900	74824.900	22.974	0.004	24.877	59.664
Vul15NAS+2%Cl	900	74960.222	31.011	0.005	9.813	218.171
Vul15NAS+2%Cl	900	73584.143	25.665			66.484
Vul15NAS+2%Cl	900	73777.594	25.715			165.447
Vul15NAS+2%Cl	900	74439.344	31.209	0.003	11.365	101.282
Vul15NAS+2%Cl	900	73967.623	16.312	0.007	9.199	147.420
Vul11NFS	35	74576.080	6.935	3.055	1.124	207.693
Vul11NFS	95	74351.836	4.563	4.790	2.172	43.517
Vul11NFS	105	74318.485	4.354	16.345	1.208	90.265
Vul11NFS	130	74624.752	3.256	17.380	1.227	188.743
Vul11NFS	160	74505.717	1.954	40.411	1.410	172.161
Vul11NFS	200	75272.613	3.584	23.466	1.879	210.750
Vul11NFS	260	74439.633	4.110	7.319	1.164	94.537
Vul11NFS	330	74339.156	1.465	15.298	1.320	235.732
Vul11NFS	405	75194.103	1.555	1.918	2.011	689.466
Vul11NFS	485	73749.465	3.378	0.063	9.664	113.808
Vul11NFS	600	73970.593	5.533	0.011	12.048	188.217
Vul11NFS	765	73557.596	28.035	0.017	7.579	222.694
Vul11NFS	815	74083.650	57.067	0.007	34.644	32.091
Vul11NFS	840	74019.949	43.327	0.007	11.435	41.787
Vul11NFS	865	73314.320	37.935	0.005	19.220	104.297
Vul11NFS	880	72985.064	44.747	0.004	22.396	310.399
Vul11NFS	895	73776.371	8.276	0.004	18.908	64.619
Vul11NFS	900	73646.316	17.319	0.004	22.016	145.910
Vul11NFS	900	73817.848	37.915	0.005	20.259	157.654
Vul11NFS	900	73589.464	40.380	0.004	21.814	72.508
Vul11NFS	900	74842.303	27.472	0.007	15.392	46.029
Vul14NFS+1%Cl	60	74262.433	16.995	2.192	1.115	276.842
Vul14NFS+1%Cl	95	74882.989	4.742	10.217	1.381	63.447
Vul14NFS+1%Cl	110	75600.555	1.341	10.267	1.427	148.018
Vul14NFS+1%Cl	120	75119.154	5.822	5.586	2.177	69.565
Vul14NFS+1%Cl	140	75776.024	1.876	5.903	1.413	33.082
Vul14NFS+1%Cl	160	76228.592	2.101	3.896	1.517	212.870
Vul14NFS+1%Cl	190	75560.078	2.658	6.902	1.762	197.584
Vul14NFS+1%Cl	235	75870.200	2.761	3.977	2.475	46.264
Vul14NFS+1%Cl	330	76456.798	2.166	0.670	2.178	513.544
Vul14NFS+1%Cl	455	76677.520	3.470	0.642	1.658	10.821
Vul14NFS+1%Cl	565	75466.214	3.133	0.462	1.394	204.414
Vul14NFS+1%Cl	735	75082.256	5.777	0.103	6.143	141.539
Vul14NFS+1%Cl	830	75884.591	3.447	0.011	18.181	216.902

HNO3 Method	Temperature (°C)	197Au (CPS)	RSD	205TI	205TI RSD	208Pb	208Pb RSD	209Bi	209Bi RSD
Vul15NAS+2%Cl	60	28.922	0.039	4.116	0.357	1.555	0.053	2.831	
Vul15NAS+2%Cl	95	11.839	0.085	3.840	0.573	1.539	0.098	2.343	
Vul15NAS+2%Cl	160	14.916	0.013	7.625	0.723	1.675	0.019	9.000	
Vul15NAS+2%Cl	190	11.783	0.002	13.868	0.233	1.608	0.010	8.237	
Vul15NAS+2%Cl	235	28.599			0.510	1.599	0.015	3.825	
Vul15NAS+2%Cl	325	11.378	0.002	12.890	1.014	1.300	0.034	2.110	
Vul15NAS+2%Cl	450	41.428			3.373	1.494	0.153	2.917	
Vul15NAS+2%Cl	565	5.330	0.038	3.189	2.192	1.801	0.072	5.053	
Vul15NAS+2%Cl	745	2.310	0.005	11.550	0.726	1.186	0.076	2.942	
Vul15NAS+2%Cl	830	17.585			0.164	2.463	0.056	2.133	
Vul15NAS+2%Cl	865	21.518			0.017	10.062	0.014	8.681	
Vul15NAS+2%Cl	890	19.972			0.040	3.473	0.087	2.624	
Vul15NAS+2%Cl	900	6.870			0.004	9.959	0.011	9.598	
Vul15NAS+2%Cl	900	23.636			0.006	4.854	0.034	6.301	
Vul15NAS+2%Cl	900	13.495			0.005	10.362	0.015	5.250	
Vul15NAS+2%Cl	900	13.425			0.005	9.561	0.007	6.689	
Vul15NAS+2%Cl	900	22.898			0.013	8.884	0.051	4.384	
Vul15NAS+2%Cl	900	18.779			0.007	15.512	0.056	1.758	
Vul11NFS	35	8.863	0.008	10.519	0.092	3.681	0.011	8.546	
Vul11NFS	95	22.821	0.021	3.796	0.213	3.829	0.032	3.457	
Vul11NFS	105	19.521	0.041	3.546	0.417	1.869	0.032	5.677	
Vul11NFS	130	25.530	0.056	4.791	0.582	1.441	0.037	3.149	
Vul11NFS	160	13.237	0.155	2.941	1.509	1.852	0.080	4.949	
Vul11NFS	200	21.569	0.156	3.585	1.712	1.296	0.066	4.386	
Vul11NFS	260	29.899	0.057	3.865	0.882	1.308	0.043	3.987	
Vul11NFS	330	24.309	0.011	8.008	2.665	1.878	0.117	1.223	
Vul11NFS	405	4.244			3.303	1.446	0.108	2.181	
Vul11NFS	485	18.554			1.999	1.060	0.085	1.787	
Vul11NFS	600	16.443			0.083	4.881	0.014	8.964	
Vul11NFS	765	19.385			0.009	4.706	0.002	15.709	
Vul11NFS	815	27.218			0.004	10.239			
Vul11NFS	840	47.059			0.007	12.327	0.003	12.260	
Vul11NFS	865	35.418			0.007	12.299	0.003	2.803	
Vul11NFS	880	13.602			0.005	14.294	0.004	0.610	
Vul11NFS	895	25.758			0.004	21.108	0.004	8.652	
Vul11NFS	900	24.481			0.020	3.738	0.003	18.616	
Vul11NFS	900	9.909			0.005	4.373	0.008	11.783	
Vul11NFS	900	16.481			0.007	8.348	0.008	6.116	
Vul11NFS	900	16.004			0.007	6.968	0.008	6.004	
Vul14NFS+1%Cl	60	8.458	0.012	10.393	0.050	4.941	0.022	3.599	
Vul14NFS+1%Cl	95	18.381	0.060	3.755	0.220	3.081	0.038	4.875	
Vul14NFS+1%Cl	110	22.524	0.008	14.896	0.236	2.392	0.045	1.951	
Vul14NFS+1%Cl	120	31.160	0.003	13.473	0.178	1.811	0.013	6.766	
Vul14NFS+1%Cl	140	35.560	0.004	10.807	0.241	2.314	0.050	6.366	
Vul14NFS+1%Cl	160	9.636			0.230	3.356	0.040	3.530	
Vul14NFS+1%Cl	190	16.174			0.289	2.476	0.130	2.308	
Vul14NFS+1%Cl	235	18.041			0.671	1.125	0.052	4.578	
Vul14NFS+1%Cl	330	129.736			0.735	2.181	0.068	3.528	
Vul14NFS+1%Cl	455	62.365			0.613	1.749	0.059	2.444	
Vul14NFS+1%Cl	565	6.815			0.807	1.667	0.044	3.492	
Vul14NFS+1%Cl	735	21.729			0.744	3.344	0.061	2.458	
Vul14NFS+1%Cl	830	27.694			0.088	3.131	0.033	6.561	

HNO3 Method	Temperature (°C)	7Li	7Li RSD	27Al	27Al RSD	Cl [H2]	Cl [H2] RSD	43Ca	43Ca RSD
Vul14NFS+1%Cl	870	0.053	9.965	4.640	1.255			3.882	6.807
Vul14NFS+1%Cl	895	0.034	5.281	2.879	1.745			3.810	3.764
Vul14NFS+1%Cl	900	0.014	13.867	0.716	3.387			3.962	4.007
Vul14NFS+1%Cl	900	0.019	15.234	5.130	1.667			4.082	4.273
Vul14NFS+1%Cl	900	0.012	22.861	0.631	2.268			3.785	3.795
Vul14NFS+1%Cl	900	0.017	6.990	0.527	2.775			3.804	4.529
Vul14NFS+1%Cl	900	0.014	25.733	1.465	2.364			3.830	7.648
Vul14NFS+1%Cl	900	0.013	4.314	19.754	1.541			4.290	8.814
Vul13NFS+2%Cl	65	0.096	5.457	0.672	2.081			5.341	8.237
Vul13NFS+2%Cl	100	0.161	1.933	0.712	1.643			3.999	6.888
Vul13NFS+2%Cl	120	0.155	2.942	1.127	1.377			4.684	4.365
Vul13NFS+2%Cl	140	0.261	2.448	1.235	0.760			4.287	4.653
Vul13NFS+2%Cl	160	0.259	2.990	1.390	1.977			4.111	3.515
Vul13NFS+2%Cl	95	0.512	3.801	1.322	1.382			4.143	5.495
Vul13NFS+2%Cl	240	0.591	0.865	0.713	1.817			3.844	6.375
Vul13NFS+2%Cl	345	2.213	2.540	0.844	1.337	21.334	1.287	3.894	4.256
Vul13NFS+2%Cl	485	1.615	2.662	2.060	1.688			4.882	5.572
Vul13NFS+2%Cl	610	4.080	2.260	1.538	1.642	27.122	1.414	4.785	4.300
Vul13NFS+2%Cl	830	3.692	2.046	1.506	0.394	27.158	1.048	4.009	7.409
Vul13NFS+2%Cl	895	0.723	2.620	0.925	1.434			4.276	3.270
Vul13NFS+2%Cl	900	0.438	2.016	0.933	0.811	29.032	1.177	3.988	9.880
Vul13NFS+2%Cl	900	0.381	1.399	1.752	1.123			3.946	4.572
Detection limit		0.009		0.038		2.298		2.082	

HNO3 Method	Temperature (°C)	51V	51V RSD	52Cr	52Cr RSD	53Cr	53Cr RSD	55Mn	55Mn RSD
Vul14NFS+1%Cl	870	0.662	1.331	0.667	1.986			0.085	2.438
Vul14NFS+1%Cl	895	0.602	1.983	0.638	1.653			0.086	1.806
Vul14NFS+1%Cl	900	0.642	1.288	0.729	1.873			0.084	2.420
Vul14NFS+1%Cl	900	0.627	1.452	0.656	2.093			0.084	2.017
Vul14NFS+1%Cl	900	0.490	2.659	0.621	1.140			0.078	1.770
Vul14NFS+1%Cl	900	0.594	0.728	0.854	0.818	0.375	3.262	0.082	3.774
Vul14NFS+1%Cl	900	0.580	1.388	0.682	0.858			0.081	2.327
Vul14NFS+1%Cl	900	0.505	1.433	0.638	0.834			0.086	2.236
Vul13NFS+2%Cl	65			1.374	2.821	0.796	3.129	0.086	1.509
Vul13NFS+2%Cl	100			1.438	1.566	0.905	3.827	0.083	3.178
Vul13NFS+2%Cl	120			1.641	1.797	1.100	2.946	0.091	1.428
Vul13NFS+2%Cl	140			2.826	2.120	2.303	2.467	0.096	1.093
Vul13NFS+2%Cl	160			2.444	2.315	1.968	1.729	0.078	2.757
Vul13NFS+2%Cl	95	0.112	2.230	4.338	1.409	3.840	1.814	0.089	1.499
Vul13NFS+2%Cl	240	0.095	3.522	3.093	2.036	2.592	0.800	0.077	5.255
Vul13NFS+2%Cl	345	0.198	0.673	1.342	1.595	0.831	4.673	0.090	3.358
Vul13NFS+2%Cl	485	1.041	1.867	34.588	1.978	33.941	2.075	0.111	0.771
Vul13NFS+2%Cl	610	1.241	1.566	9.958	1.370	9.487	2.703	0.100	2.126
Vul13NFS+2%Cl	830	0.285	2.825	1.082	2.494	0.538	2.684	0.096	3.463
Vul13NFS+2%Cl	895	0.397	1.879	0.718	2.622			0.089	3.862
Vul13NFS+2%Cl	900	0.374	2.277	0.675	2.078			0.081	0.949
Vul13NFS+2%Cl	900	0.666	2.154	1.003	2.079	0.455	2.338	0.121	2.404
Detection limit		0.080		0.091		0.259		0.013	

HNO3 Method	Temperature (°C)	55Mn [He] RSD	55Mn [He] RSD	56Fe [He] RSD	56Fe [He] RSD	57Fe
Vul14NFS+1%Cl	870	0.007	48.624	0.670	1.746	9.800
Vul14NFS+1%Cl	895	0.006	34.751	0.627	0.926	9.748
Vul14NFS+1%Cl	900	0.007	16.959	1.431	1.079	9.799
Vul14NFS+1%Cl	900	0.007	17.455	1.012	1.261	9.809
Vul14NFS+1%Cl	900	0.007	39.871	0.773	1.655	9.672
Vul14NFS+1%Cl	900	0.010	42.582	2.632	1.664	9.984
Vul14NFS+1%Cl	900	0.006	22.105	1.090	0.482	9.797
Vul14NFS+1%Cl	900	0.010	16.844	1.073	1.932	9.824
Vul13NFS+2%Cl	65	0.009	19.092	0.702	2.764	9.712
Vul13NFS+2%Cl	100	0.009	24.261	1.135	1.496	9.685
Vul13NFS+2%Cl	120	0.007	59.197	1.110	1.293	10.225
Vul13NFS+2%Cl	140	0.020	22.605	4.655	0.868	10.180
Vul13NFS+2%Cl	160	0.008	23.323	0.906	2.592	9.601
Vul13NFS+2%Cl	95	0.011	15.987	2.897	1.544	9.931
Vul13NFS+2%Cl	240	0.004	24.060	0.447	5.149	9.508
Vul13NFS+2%Cl	345	0.025	9.062	2.770	1.237	9.963
Vul13NFS+2%Cl	485	0.040	10.202	1.923	2.729	9.828
Vul13NFS+2%Cl	610	0.028	5.923	3.695	0.844	9.959
Vul13NFS+2%Cl	830	0.024	23.964	2.086	0.732	9.829
Vul13NFS+2%Cl	895	0.014	16.241	1.145	1.675	9.787
Vul13NFS+2%Cl	900	0.006	13.258	0.612	2.869	9.759
Vul13NFS+2%Cl	900	0.045	19.785	7.030	0.796	10.851
Detection limit		0.003		0.041		0.644

HNO3 Method	Temperature (°C)	57Fe RSD	59Co	59Co RSD	50Ni	50Ni RSD	63Cu	63Cu RSD
Vul14NFS+1%Cl	870	0.426	0.007	9.424	0.031	16.186	4.395	1.256
Vul14NFS+1%Cl	895	0.747	0.008	3.743	0.023	8.456	8.141	2.523
Vul14NFS+1%Cl	900	0.575	0.007	7.924	0.023	5.303	4.003	1.097
Vul14NFS+1%Cl	900	0.658	0.008	6.143	0.065	6.183	5.719	2.171
Vul14NFS+1%Cl	900	0.583	0.007	7.377	0.024	10.980	5.237	1.743
Vul14NFS+1%Cl	900	0.815	0.007	5.876	0.034	3.492	5.262	1.616
Vul14NFS+1%Cl	900	0.594	0.009	5.453	0.035	15.071	4.335	1.752
Vul14NFS+1%Cl	900	0.986	0.007	7.373	0.046	8.262	1.097	1.746
Vul13NFS+2%Cl	65	0.722	0.009	5.832	0.020	10.246	4.220	1.974
Vul13NFS+2%Cl	100	0.641	0.007	5.517	0.022	6.780	6.449	1.420
Vul13NFS+2%Cl	120	0.773	0.009	4.676	0.046	3.603	10.449	1.446
Vul13NFS+2%Cl	140	0.652	0.009	8.125	3.285	1.421	7.792	2.116
Vul13NFS+2%Cl	160	0.439	0.008	8.361	0.033	5.301	6.001	1.670
Vul13NFS+2%Cl	95	0.843	0.008	8.112	0.141	5.534	9.791	1.334
Vul13NFS+2%Cl	240	0.487	0.008	13.233	0.060	4.951	8.785	1.651
Vul13NFS+2%Cl	345	0.522	0.017	3.369	0.330	4.689	3.847	1.981
Vul13NFS+2%Cl	485	1.043	0.010	8.606	0.708	1.633	2.946	2.476
Vul13NFS+2%Cl	610	0.299	0.020	7.783	0.434	3.294	39.143	1.404
Vul13NFS+2%Cl	830	0.597	0.011	9.100	0.082	3.432	17.553	1.395
Vul13NFS+2%Cl	895	1.267	0.008	4.588	0.100	5.027	4.271	2.112
Vul13NFS+2%Cl	900	0.728	0.007	5.541	0.045	7.072	4.926	1.144
Vul13NFS+2%Cl	900	0.558	0.008	6.990	0.127	5.266	1.448	2.127
Detection limit			0.002		0.005		0.118	

HNO3 Method	Temperature (°C)	63Cu [He]	63Cu [He] RSD	65Cu	65Cu RSD	65Cu [He]	65Cu [He] RSD
Vul14NFS+1%Cl	870	4.323	0.915	4.346	1.416	4.270	1.684
Vul14NFS+1%Cl	895	8.237	0.860	8.155	1.836	8.195	1.044
Vul14NFS+1%Cl	900	3.966	1.061	3.921	1.473	3.926	1.596
Vul14NFS+1%Cl	900	5.715	0.512	5.619	2.084	5.632	1.175
Vul14NFS+1%Cl	900	5.279	1.505	5.188	1.274	5.166	1.398
Vul14NFS+1%Cl	900	5.288	0.886	5.207	1.692	5.209	1.432
Vul14NFS+1%Cl	900	4.318	1.219	4.223	1.730	4.261	1.676
Vul14NFS+1%Cl	900	0.929	1.670	0.984	2.579	0.879	2.469
Vul13NFS+2%Cl	65	4.165	1.002	4.133	1.927	4.139	2.293
Vul13NFS+2%Cl	100	6.545	0.506	6.352	1.146	6.403	0.934
Vul13NFS+2%Cl	120	10.598	0.811	10.391	1.336	10.431	0.753
Vul13NFS+2%Cl	140	7.724	1.526	7.638	2.191	7.681	1.161
Vul13NFS+2%Cl	160	5.939	1.969	5.848	2.240	5.914	1.132
Vul13NFS+2%Cl	95	9.816	0.576	9.667	0.957	9.704	1.414
Vul13NFS+2%Cl	240	8.730	0.701	8.716	1.769	8.648	1.109
Vul13NFS+2%Cl	345	3.691	1.436	3.717	1.459	3.696	2.095
Vul13NFS+2%Cl	485	2.676	1.771	2.709	2.067	2.621	1.932
Vul13NFS+2%Cl	610	38.898	0.454	39.249	1.599	38.717	0.863
Vul13NFS+2%Cl	830	17.767	1.659	17.447	1.520	17.512	0.688
Vul13NFS+2%Cl	895	4.298	0.706	4.230	1.782	4.194	2.143
Vul13NFS+2%Cl	900	4.861	1.811	4.843	1.929	4.847	2.089
Vul13NFS+2%Cl	900	1.264	1.925	1.333	1.578	1.256	2.113
Detection limit		0.030		0.180		0.031	

HNO3 Method	Temperature (°C)	66Zn	66Zn RSD	75As	75As RSD	75As [He]	75As [He] RSD	76Se
Vul14NFS+1%Cl	870	0.164	1.267	2.793	0.775			10.503
Vul14NFS+1%Cl	895	0.262	3.525	2.800	0.574	0.005	68.694	10.470
Vul14NFS+1%Cl	900	0.085	3.537	2.775	0.841			10.378
Vul14NFS+1%Cl	900	0.140	4.736	2.772	0.530			10.424
Vul14NFS+1%Cl	900	0.064	9.866	2.727	0.965			10.289
Vul14NFS+1%Cl	900	0.081	3.872	2.745	0.644			10.376
Vul14NFS+1%Cl	900	0.073	6.004	2.737	0.865			10.393
Vul14NFS+1%Cl	900	0.230	2.120	2.776	1.150			10.441
Vul13NFS+2%Cl	65	0.119	7.085	2.779	1.019	0.018	31.712	10.420
Vul13NFS+2%Cl	100	0.151	5.305	2.761	0.442	0.033	33.390	10.341
Vul13NFS+2%Cl	120	0.144	5.688	2.921	1.025	0.042	22.340	10.884
Vul13NFS+2%Cl	140	0.231	3.213	2.761	0.817	0.066	9.550	10.279
Vul13NFS+2%Cl	160	0.162	3.060	2.762	0.826	0.067	26.055	10.247
Vul13NFS+2%Cl	95	0.219	4.459	2.815	0.752	0.107	7.740	10.287
Vul13NFS+2%Cl	240	0.149	3.723	2.785	1.315	0.078	15.587	10.266
Vul13NFS+2%Cl	345	0.179	5.581	2.744	0.852	0.031	43.611	10.261
Vul13NFS+2%Cl	485	0.732	1.497	3.232	0.998	0.603	4.537	10.458
Vul13NFS+2%Cl	610	0.410	5.161	2.964	0.856	0.315	5.556	10.244
Vul13NFS+2%Cl	830	0.220	3.924	2.772	0.906	0.032	37.029	10.300
Vul13NFS+2%Cl	895	0.241	4.329	2.748	0.840	0.006	57.028	10.323
Vul13NFS+2%Cl	900	0.195	1.780	2.740	0.439	0.005	29.849	10.360
Vul13NFS+2%Cl	900	0.348	2.326	2.779	0.746	0.005	71.256	10.482
Detection limit		0.016		0.115		0.003		0.419

HNO3 Method	Temperature (°C)	76Se RSD	77Se	77Se RSD	78Se	78Se RSD	78Se [He]	78Se [He] RSD
Vul14NFS+1%Cl	870	0.257			1.630	7.434	0.207	24.994
Vul14NFS+1%Cl	895	0.343	0.428	12.468	1.769	8.444	0.211	35.962
Vul14NFS+1%Cl	900	0.364			1.705	10.191	0.200	46.588
Vul14NFS+1%Cl	900	0.395	0.438	5.669	1.651	9.499	0.304	33.575
Vul14NFS+1%Cl	900	0.129	0.432	12.698	1.559	13.896	0.251	41.074
Vul14NFS+1%Cl	900	0.785			1.521	12.072	0.200	19.014
Vul14NFS+1%Cl	900	0.356	0.425	5.692	1.441	13.327	0.185	48.510
Vul14NFS+1%Cl	900	0.740	0.434	6.729	1.637	15.621	0.171	80.608
Vul13NFS+2%Cl	65	0.478	0.472	6.687	1.666	16.880	0.252	60.975
Vul13NFS+2%Cl	100	0.281	0.430	3.962	1.540	5.543	0.199	27.787
Vul13NFS+2%Cl	120	0.305	0.476	7.213	1.708	9.868	0.210	39.931
Vul13NFS+2%Cl	140	0.798			1.440	14.918	0.153	112.427
Vul13NFS+2%Cl	160	0.567	0.481	8.824	1.570	6.736	0.203	46.769
Vul13NFS+2%Cl	95	0.479	0.424	15.445	1.570	12.696	0.204	29.318
Vul13NFS+2%Cl	240	0.421	0.459	9.448	1.612	14.797	0.269	35.672
Vul13NFS+2%Cl	345	0.300	0.460	11.836	1.597	10.676	0.259	28.913
Vul13NFS+2%Cl	485	0.711	0.510	6.677	1.572	20.198	0.201	50.805
Vul13NFS+2%Cl	610	0.473	0.443	8.001	1.766	8.647	0.202	42.390
Vul13NFS+2%Cl	830	0.707			1.612	11.777	0.214	47.319
Vul13NFS+2%Cl	895	0.361	0.445	8.436	1.627	9.920	0.154	26.358
Vul13NFS+2%Cl	900	0.408			1.486	5.969	0.200	24.654
Vul13NFS+2%Cl	900	0.226	0.434	8.981	1.582	9.231	0.202	53.160
Detection limit			0.421		0.312		0.110	

HNO3 Method	Temperature (°C)	82Se	82Se RSD	85Rb	85Rb RSD	88Sr	88Sr RSD	89Y	89Y RSD
Vul14NFS+1%Cl	870	0.443	11.787	0.005	6.952				
Vul14NFS+1%Cl	895	0.461	20.200	0.005	8.380				
Vul14NFS+1%Cl	900	0.469	7.988	0.004	6.730				
Vul14NFS+1%Cl	900	0.482	6.439	0.006	6.506				
Vul14NFS+1%Cl	900	0.481	3.524	0.004	10.809				
Vul14NFS+1%Cl	900	0.496	7.701	0.005	6.420				
Vul14NFS+1%Cl	900	0.438	11.366	0.005	12.522				
Vul14NFS+1%Cl	900	0.487	9.841	0.007	7.542			0.000	36.111
Vul13NFS+2%Cl	65	0.474	11.736	0.107	2.481	0.031	15.490		
Vul13NFS+2%Cl	100	0.493	3.398	0.156	2.813				
Vul13NFS+2%Cl	120	0.480	12.477	0.144	2.978				
Vul13NFS+2%Cl	140	0.485	6.551	0.229	2.588				
Vul13NFS+2%Cl	160	0.467	10.633	0.208	1.048				
Vul13NFS+2%Cl	95	0.479	9.523	0.393	1.171				
Vul13NFS+2%Cl	240	0.440	14.015	0.520	1.732				
Vul13NFS+2%Cl	345	0.480	9.633	0.256	1.052	0.526	1.576	0.001	14.146
Vul13NFS+2%Cl	485	0.481	13.167	0.011	6.953	0.288	1.598	0.001	18.975
Vul13NFS+2%Cl	610	0.448	8.601	0.029	2.819	0.045	1.044		
Vul13NFS+2%Cl	830	0.483	4.726	0.015	5.854			0.001	12.658
Vul13NFS+2%Cl	895	0.453	12.810	0.006	6.184			0.000	19.270
Vul13NFS+2%Cl	900	0.457	12.442	0.005	6.968			0.001	15.767
Vul13NFS+2%Cl	900	0.470	7.451	0.006	15.439	0.061	4.180		
Detection limit		0.159		0.001		0.024		0.000	

HNO3 Method	Temperature (°C)	95Mo	95Mo RSD	107Ag	107Ag RSD	111Cd	111Cd RSD	115In (CPS)
Vul14NFS+1%Cl	870	0.216	4.711					243234.924
Vul14NFS+1%Cl	895	0.216	2.683					243234.924
Vul14NFS+1%Cl	900	0.105	2.875					243234.924
Vul14NFS+1%Cl	900	0.095	6.061					243234.924
Vul14NFS+1%Cl	900	0.134	4.684					243234.924
Vul14NFS+1%Cl	900	0.049	5.636					243234.924
Vul14NFS+1%Cl	900	0.052	4.474					243234.924
Vul14NFS+1%Cl	900	0.100	2.839					243234.924
Vul13NFS+2%Cl	65	9.079	1.878	0.010	5.734	0.022	8.494	243234.924
Vul13NFS+2%Cl	100	16.531	1.387	0.014	2.874	0.040	14.919	243234.924
Vul13NFS+2%Cl	120	20.934	1.469	0.013	6.266	0.053	8.730	243234.924
Vul13NFS+2%Cl	140	36.315	1.676	0.021	5.932	0.096	6.355	243234.924
Vul13NFS+2%Cl	160	36.643	1.443	0.021	4.438	0.093	6.552	243234.924
Vul13NFS+2%Cl	95	65.186	1.239	0.040	3.273	0.171	3.592	243234.924
Vul13NFS+2%Cl	240	50.022	1.719	0.038	6.283	0.131	3.582	243234.924
Vul13NFS+2%Cl	345	13.712	1.428	0.032	3.004	0.054	7.191	243234.924
Vul13NFS+2%Cl	485	577.766	1.622	0.020	6.768	0.788	2.316	243234.924
Vul13NFS+2%Cl	610	272.952	1.553	0.024	4.736	0.431	3.088	243234.924
Vul13NFS+2%Cl	830	18.563	1.399	0.003	11.925	0.097	2.867	243234.924
Vul13NFS+2%Cl	895	0.939	0.675			0.005	38.957	243234.924
Vul13NFS+2%Cl	900	0.353	2.694			0.003	40.693	243234.924
Vul13NFS+2%Cl	900	0.587	0.777			0.003	40.585	243234.924
Detection limit		0.012		0.002		0.002		

HNO3 Method	Temperature (°C)	115In (CPS) RSD	115In [He] (CPS)	115In [He] (CPS) RSD	118Sn	118Sn RSD
Vul14NFS+1%Cl	870	0.770	52483.191	1.672	0.769	2.640
Vul14NFS+1%Cl	895	1.184	52373.295	1.503	1.439	1.781
Vul14NFS+1%Cl	900	1.010	52324.081	1.717	0.685	2.007
Vul14NFS+1%Cl	900	0.676	52379.413	1.240	0.974	1.522
Vul14NFS+1%Cl	900	0.969	51370.651	0.907	0.912	2.076
Vul14NFS+1%Cl	900	0.614	52127.196	1.407	0.895	1.520
Vul14NFS+1%Cl	900	0.485	52771.779	1.682	0.766	1.484
Vul14NFS+1%Cl	900	0.498	52272.766	1.607	0.141	4.489
Vul13NFS+2%Cl	65	0.791	52077.131	1.775	0.696	1.692
Vul13NFS+2%Cl	100	0.825	51911.405	1.280	1.032	2.036
Vul13NFS+2%Cl	120	4.180	54228.660	1.341	1.753	1.906
Vul13NFS+2%Cl	140	0.674	53093.217	1.150	1.290	1.421
Vul13NFS+2%Cl	160	0.752	51997.604	1.844	0.955	1.946
Vul13NFS+2%Cl	95	0.524	52747.889	3.278	1.509	1.150
Vul13NFS+2%Cl	240	0.861	52296.939	1.728	1.294	1.767
Vul13NFS+2%Cl	345	1.503	52083.831	1.067	0.490	1.660
Vul13NFS+2%Cl	485	0.735	53201.292	1.598	0.386	3.961
Vul13NFS+2%Cl	610	1.440	52617.277	1.002	7.085	1.713
Vul13NFS+2%Cl	830	1.099	51970.830	1.356	2.873	2.251
Vul13NFS+2%Cl	895	0.901	52582.792	2.088	0.671	2.873
Vul13NFS+2%Cl	900	0.923	52004.769	1.707	0.791	3.372
Vul13NFS+2%Cl	900	0.644	52791.567	1.402	0.176	5.350
Detection limit					0.002	

HNO3 Method	Temperature (°C)	133Cs	133Cs RSD	137Ba	137Ba RSD	172Yb	172Yb RSD	182W	182W RSD
Vul14NFS+1%Cl	870	0.061	1.579	0.018	5.994			0.001	25.822
Vul14NFS+1%Cl	895	0.140	2.191	0.039	8.705			0.002	22.957
Vul14NFS+1%Cl	900	0.054	2.566	0.032	9.110			0.000	15.202
Vul14NFS+1%Cl	900	0.185	2.411	0.148	4.178			0.001	19.090
Vul14NFS+1%Cl	900	0.119	0.870	0.024	5.314			0.001	35.388
Vul14NFS+1%Cl	900	0.127	2.744	0.033	7.723			0.001	33.851
Vul14NFS+1%Cl	900	0.125	2.055	0.023	13.627			0.001	19.727
Vul14NFS+1%Cl	900	0.234	1.243	0.057	10.855			0.001	42.313
Vul13NFS+2%Cl	65	1.912	1.680	0.054	10.461			0.059	3.605
Vul13NFS+2%Cl	100	0.072	1.726	0.031	9.514			0.036	2.902
Vul13NFS+2%Cl	120	0.071	1.083	0.032	7.302			0.039	4.183
Vul13NFS+2%Cl	140	0.107	2.160	0.132	3.748			0.123	2.696
Vul13NFS+2%Cl	160	0.104	2.296	0.016	6.736			0.102	4.853
Vul13NFS+2%Cl	95	0.171	1.806	0.135	5.085			0.212	2.204
Vul13NFS+2%Cl	240	0.217	2.137	0.103	6.615			0.142	3.982
Vul13NFS+2%Cl	345	0.225	1.481	21.666	1.420			0.127	1.525
Vul13NFS+2%Cl	485	0.546	2.220	11.619	1.986			0.431	1.983
Vul13NFS+2%Cl	610	0.385	1.450	1.464	1.239			0.217	2.734
Vul13NFS+2%Cl	830	0.065	2.906	0.389	4.155			0.042	3.470
Vul13NFS+2%Cl	895	0.177	1.553	0.475	2.717			0.006	14.029
Vul13NFS+2%Cl	900	0.005	10.226	0.013	14.837			0.003	22.926
Vul13NFS+2%Cl	900	0.150	2.385	0.674	3.477			0.005	5.878
Detection limit		0.000		0.004		0.001		0.000	

HNO3 Method	Temperature (°C)	185Re (CPS)	185Re (CPS) RSD	195Pt	196Pt RSD	197Au (CPS)
Vul14NFS+1%Cl	870	75445.212	25.822	0.012	12.890	41.282
Vul14NFS+1%Cl	895	74893.932	22.957	0.006	24.314	76.536
Vul14NFS+1%Cl	900	74451.805	15.202	0.004	25.687	90.737
Vul14NFS+1%Cl	900	74906.791	19.090	0.003	18.315	745.706
Vul14NFS+1%Cl	900	73754.096	35.388			69.506
Vul14NFS+1%Cl	900	73764.689	33.851	0.002	29.692	494.763
Vul14NFS+1%Cl	900	73907.086	19.727			72.073
Vul14NFS+1%Cl	900	74871.066	42.313	0.002	41.291	172.616
Vul13NFS+2%Cl	65	75442.311	3.605	5.874	1.501	78.693
Vul13NFS+2%Cl	100	75131.172	2.902	14.246	1.519	170.628
Vul13NFS+2%Cl	120	75781.338	4.183	22.017	1.786	161.917
Vul13NFS+2%Cl	140	75550.582	2.696	38.538	1.579	410.884
Vul13NFS+2%Cl	160	75874.745	4.853	37.041	1.406	101.494
Vul13NFS+2%Cl	95	75651.957	2.204	55.570	1.063	254.181
Vul13NFS+2%Cl	240	75399.432	3.982	22.501	1.346	1140.489
Vul13NFS+2%Cl	345	75697.408	1.525	0.584	1.421	828.028
Vul13NFS+2%Cl	485	76806.476	1.983	0.513	1.939	950.965
Vul13NFS+2%Cl	610	75291.003	2.734	0.464	1.308	355.779
Vul13NFS+2%Cl	830	74136.205	3.470	0.048	6.065	258.994
Vul13NFS+2%Cl	895	75116.153	14.029	0.026	5.156	92.499
Vul13NFS+2%Cl	900	75464.748	22.926	0.005	24.482	20.874
Vul13NFS+2%Cl	900	76183.744	5.878	0.006	17.321	144.914
Detection limit				0.002		

HNO3 Method	Temperature (°C)	197Au (CPS)	RSD	205Tl	205Tl RSD	208Pb	208Pb RSD	209Bi	209Bi RSD
Vul14NFS+1%Cl	870		35.418			0.007	12.907	0.024	8.289
Vul14NFS+1%Cl	895		36.752			0.005	4.863	0.099	2.846
Vul14NFS+1%Cl	900		19.723			0.007	14.296	0.050	3.699
Vul14NFS+1%Cl	900		10.283			0.008	6.937	0.021	4.758
Vul14NFS+1%Cl	900		25.670			0.004	8.712	0.015	6.186
Vul14NFS+1%Cl	900		12.698			0.005	12.793	0.008	9.513
Vul14NFS+1%Cl	900		51.598			0.005	8.586	0.008	12.722
Vul14NFS+1%Cl	900		12.123			0.009	1.297	0.076	3.164
Vul13NFS+2%Cl	65		23.026	0.043	3.478	0.168	2.972	0.012	9.293
Vul13NFS+2%Cl	100		20.679	0.163	1.555	0.317	2.270	0.030	4.534
Vul13NFS+2%Cl	120		8.222	0.031	4.852	0.476	1.701	0.030	2.353
Vul13NFS+2%Cl	140		9.437	0.034	6.790	0.968	2.209	0.059	2.291
Vul13NFS+2%Cl	160		18.763	0.027	3.835	1.054	1.607	0.025	4.100
Vul13NFS+2%Cl	95		8.508	0.039	2.151	1.905	1.058	0.040	3.118
Vul13NFS+2%Cl	240		7.065	0.012	5.143	1.332	1.373	0.012	6.385
Vul13NFS+2%Cl	345		7.211			0.736	0.475	0.011	4.797
Vul13NFS+2%Cl	485		6.632			1.368	2.488	0.147	2.438
Vul13NFS+2%Cl	610		14.683			1.679	1.361	0.049	2.920
Vul13NFS+2%Cl	830		20.721			0.538	1.905	0.051	2.621
Vul13NFS+2%Cl	895		23.800			0.038	4.676	0.051	2.899
Vul13NFS+2%Cl	900		55.056			0.019	7.089	0.021	2.119
Vul13NFS+2%Cl	900		16.583			0.038	1.851	0.028	2.449
Detection limit				0.002		0.003		0.002	

HF Method	Temperature (°C)	7Li	7Li RSD	27Al	27Al RSD	43Ca	43Ca RSD	51V	51V RSD
Sample name									
STD M+Cs+Pt 1/1000		0.115	2.620	0.679	1.322	7.077	1.587	0.117	2.919
STD M+Cs+Pt 1/100		1.117	1.923	1.572	1.661	4.770	6.166	1.109	1.855
STD M+Cs+Pt 1/10		11.370	0.916	11.370	0.706	11.370	0.464	11.370	0.634
STD A - D2		0.167	1.337	0.852	0.867	412.816	1.177	3.194	1.110
Vul14NFS+1%Cl	60	1.875	0.991	47.916	1.094	3.936	4.515	0.040	3.085
Vul14NFS+1%Cl	60	1.464	0.823	35.863	1.135	3.757	6.034		
Vul14NFS+1%Cl	95	1.037	2.076	27.603	0.844	3.228	4.019		
Vul14NFS+1%Cl	110	1.571	1.319	39.126	1.237	3.753	4.283	0.046	1.630
Vul14NFS+1%Cl	120	1.480	1.065	38.154	1.588	3.658	3.616	0.094	1.910
Vul14NFS+1%Cl	140	1.719	1.437	42.005	0.786	3.526	3.802	0.144	1.499
Vul14NFS+1%Cl	160	1.576	1.394	38.905	0.418	3.505	5.971		
Vul14NFS+1%Cl	190	1.269	1.534	29.311	2.004	3.475	6.011	0.384	1.716
Vul14NFS+1%Cl	235	2.155	0.753	40.842	0.901	3.795	4.353	1.054	1.711
Vul14NFS+1%Cl	330	7.157	1.322	35.926	1.590	4.731	2.264	0.135	2.184
Vul14NFS+1%Cl	455	2.815	1.516	60.932	0.647	3.723	3.679	14.794	0.994
Vul14NFS+1%Cl	565	3.988	7.215	33.004	7.256	3.496	4.332	6.445	6.805
Vul14NFS+1%Cl	735	4.932	1.168	41.635	1.507	3.409	3.643	2.739	0.765
Vul14NFS+1%Cl	735	4.135	1.060	33.086	0.498	3.406	2.880	2.403	1.335
Vul14NFS+1%Cl	830	0.785	1.253	39.010	1.445	3.249	2.539	3.351	0.855
Vul14NFS+1%Cl	870	0.373	2.790	39.134	3.256	3.589	7.700	1.320	3.091
Vul14NFS+1%Cl	895	0.303	2.065	40.652	0.699	3.334	3.679	1.421	1.139
Vul14NFS+1%Cl	900	0.523	2.258	77.876	0.878	3.785	3.883	2.480	0.603
Vul14NFS+1%Cl	900	0.275	1.710	52.176	1.175	3.432	5.621	2.129	1.595
Vul14NFS+1%Cl	900	0.130	0.975	28.712	0.658	3.118	4.601	0.627	1.629
Vul14NFS+1%Cl	900	0.163	2.560	43.938	1.285	3.143	3.830	1.325	1.459
Vul14NFS+1%Cl	900	0.242	2.277	50.391	0.975	3.489	4.573	1.823	0.746
Vul14NFS+1%Cl	900	0.245	1.552	49.667	2.030	3.595	4.336	2.696	1.418
Vul14NFS+1%Cl	900	0.165	0.886	88.228	1.797	3.589	6.167	4.841	2.422
Detection limit		0.005		0.027		1.104		0.035	

HF Method	Temperature (°C)	52Cr	52Cr RSD	53Cr	53Cr RSD	55Mn	55Mn RSD	55Mn [He] RSD
Sample name								
STD M+Cs+Pt 1/1000		0.992	5.642	0.196	3.521	0.195	2.219	0.118
STD M+Cs+Pt 1/100		1.657	2.907	1.163	0.841	1.167	1.868	1.096
STD M+Cs+Pt 1/10		11.370	0.576	11.370	0.641	11.370	0.365	11.370
STD A - D2		1.395	4.763	0.632	2.598	0.066	1.990	0.011
Vul14NFS+1%Cl	60	1.059	1.693	0.476	2.269	0.084	2.424	0.024
Vul14NFS+1%Cl	60	0.829	2.134	0.281	2.633	0.070	1.962	0.018
Vul14NFS+1%Cl	95	1.249	2.634	0.719	1.692	0.086	0.695	0.037
Vul14NFS+1%Cl	110	1.143	2.696	0.561	2.237	0.078	1.308	0.022
Vul14NFS+1%Cl	120	0.962	1.279	0.480	2.528	0.079	0.979	0.022
Vul14NFS+1%Cl	140	0.904	0.988	0.383	3.431	0.074	1.388	0.018
Vul14NFS+1%Cl	160	0.802	1.871	0.304	3.078	0.071	2.832	0.016
Vul14NFS+1%Cl	190	1.222	1.960	0.665	3.861	0.076	1.367	0.018
Vul14NFS+1%Cl	235	2.232	1.169	1.754	2.502	0.078	1.403	0.016
Vul14NFS+1%Cl	330	1.349	0.735	0.823	2.137	0.094	1.995	0.034
Vul14NFS+1%Cl	455	18.656	0.919	18.836	1.212	0.095	1.385	0.038
Vul14NFS+1%Cl	565	8.362	6.715	8.172	6.953	0.089	1.164	0.036
Vul14NFS+1%Cl	735	1.576	1.681	1.003	1.790	0.081	1.711	0.023
Vul14NFS+1%Cl	735	1.286	0.945	0.743	2.348	0.077	2.339	0.026
Vul14NFS+1%Cl	830	0.768	2.101	0.183	4.056	0.076	0.972	0.026
Vul14NFS+1%Cl	870	0.684	0.674	0.160	3.002	0.080	1.965	0.021
Vul14NFS+1%Cl	895	0.742	3.012	0.164	3.912	0.117	1.125	0.062
Vul14NFS+1%Cl	900	0.761	2.645	0.156	3.384	0.083	1.343	0.028
Vul14NFS+1%Cl	900	0.709	1.119	0.181	3.905	0.088	1.777	0.034
Vul14NFS+1%Cl	900	0.587	1.537		12.140	0.067	2.375	0.019
Vul14NFS+1%Cl	900	0.629	0.781	0.111	2.467	0.076	3.241	0.026
Vul14NFS+1%Cl	900	0.930	1.417	0.409	2.331	0.095	1.888	0.037
Vul14NFS+1%Cl	900	0.667	1.296	0.154	2.842	0.078	3.128	0.029
Vul14NFS+1%Cl	900	0.753	1.017	0.295	3.773	0.120	1.699	0.071
Detection limit		0.135		0.105		0.012		0.002

HF Method	Temperature (°C)	55Mn [He] RSD	56Fe [He] RSD	56Fe [He] RSD	57Fe	57Fe RSD	59Co
Sample name							
STD M+Cs+Pt 1/1000		5.711	0.789	2.183	8.279	0.903	0.115
STD M+Cs+Pt 1/100		1.812	1.466	1.607	8.675	1.261	1.119
STD M+Cs+Pt 1/10		1.379	11.370	0.886	11.370	0.301	11.370
STD A - D2		35.703	0.571	1.703	8.096	0.958	2.167
Vul14NFS+1%Cl	60	22.082	2.014	2.900	8.109	1.155	0.005
Vul14NFS+1%Cl	60	12.951	1.080	0.492	7.838	1.091	0.006
Vul14NFS+1%Cl	95	21.978	4.618	1.276	8.618	0.444	0.005
Vul14NFS+1%Cl	110	4.401	1.905	1.251	8.233	0.965	0.004
Vul14NFS+1%Cl	120	18.919	2.105	2.030	8.292	1.092	0.005
Vul14NFS+1%Cl	140	23.539	1.083	1.787	7.976	1.073	0.004
Vul14NFS+1%Cl	160	22.959	1.104	2.112	7.873	0.666	0.004
Vul14NFS+1%Cl	190	23.456	1.048	2.111	8.137	0.855	0.004
Vul14NFS+1%Cl	235	25.061	1.632	0.815	8.378	0.472	0.004
Vul14NFS+1%Cl	330	12.314	1.612	1.706	8.219	1.091	0.005
Vul14NFS+1%Cl	455	10.367	4.636	4.808	9.148	0.241	0.006
Vul14NFS+1%Cl	565	15.718	2.558	0.782	9.036	3.435	0.008
Vul14NFS+1%Cl	735	7.044	1.578	1.367	8.429	0.496	0.005
Vul14NFS+1%Cl	735	13.847	1.848	0.635	8.375	0.470	0.006
Vul14NFS+1%Cl	830	17.498	1.560	1.952	8.476	0.900	0.005
Vul14NFS+1%Cl	870	18.727	1.606	6.458	8.842	0.966	0.005
Vul14NFS+1%Cl	895	10.695	1.700	0.788	8.403	0.613	0.005
Vul14NFS+1%Cl	900	6.459	1.801	1.307	8.293	0.455	0.006
Vul14NFS+1%Cl	900	8.322	2.093	1.105	8.451	0.404	0.005
Vul14NFS+1%Cl	900	8.503	0.908	4.036	7.990	0.557	0.004
Vul14NFS+1%Cl	900	10.642	1.416	1.908	8.169	1.256	0.005
Vul14NFS+1%Cl	900	13.743	3.349	1.475	8.904	0.450	0.006
Vul14NFS+1%Cl	900	13.270	1.495	1.625	8.359	0.788	0.005
Vul14NFS+1%Cl	900	13.011	5.165	1.945	9.137	0.752	0.010
Detection limit			0.039		1.844		0.001

HF Method	Temperature (°C)	59Co RSD	50Ni	50Ni RSD	63Cu	63Cu RSD	63Cu [He]	63Cu [He] RSD
Sample name								
STD M+Cs+Pt 1/1000		1.417	0.069	3.667	0.144	4.290	0.122	6.370
STD M+Cs+Pt 1/100		2.069	0.647	3.465	1.151	3.456	1.087	1.994
STD M+Cs+Pt 1/10		0.347	6.579	1.023	11.370	0.902	11.370	1.604
STD A - D2		0.665	3.114	1.306	22.046	1.070	21.718	1.635
Vul14NFS+1%Cl	60	11.099	0.008	10.242	10.134	1.791	9.765	1.110
Vul14NFS+1%Cl	60	4.585	0.012	4.028	10.898	1.244	10.573	0.758
Vul14NFS+1%Cl	95	7.105	0.009	7.050	3.446	1.372	3.442	2.271
Vul14NFS+1%Cl	110	5.898	0.008	6.360	3.148	1.507	3.114	1.128
Vul14NFS+1%Cl	120	2.422	0.012	1.648	3.900	1.553	3.771	1.597
Vul14NFS+1%Cl	140	10.745	0.006	8.017	2.044	0.808	2.004	3.849
Vul14NFS+1%Cl	160	11.542	0.005	8.862	1.793	1.643	1.793	3.192
Vul14NFS+1%Cl	190	5.035	0.007	5.236	2.288	1.998	2.168	3.163
Vul14NFS+1%Cl	235	12.265	0.011	4.355	3.724	1.053	3.650	1.983
Vul14NFS+1%Cl	330	10.152	0.022	4.431	2.760	1.721	2.689	1.235
Vul14NFS+1%Cl	455	2.449	0.022	5.086	5.883	1.406	5.191	5.075
Vul14NFS+1%Cl	565	9.790	0.015	11.056	12.064	7.078	12.729	1.485
Vul14NFS+1%Cl	735	4.606	0.010	6.078	8.238	0.589	8.203	1.943
Vul14NFS+1%Cl	735	5.955	0.011	5.758	10.766	1.019	10.804	1.204
Vul14NFS+1%Cl	830	4.953	0.012	5.193	3.030	0.816	3.049	1.398
Vul14NFS+1%Cl	870	1.913	0.009	10.519	3.431	3.114	3.049	7.808
Vul14NFS+1%Cl	895	5.055	0.009	8.007	3.028	1.173	3.023	1.668
Vul14NFS+1%Cl	900	10.045	0.016	5.241	4.663	0.276	4.593	2.877
Vul14NFS+1%Cl	900	6.942	0.013	3.770	3.497	1.904	3.393	0.479
Vul14NFS+1%Cl	900	12.391	0.007	13.453	3.833	1.139	3.872	1.492
Vul14NFS+1%Cl	900	5.276	0.023	4.267	4.739	1.088	4.543	1.164
Vul14NFS+1%Cl	900	6.007	0.013	8.881	5.533	1.654	5.370	1.746
Vul14NFS+1%Cl	900	10.233	0.011	5.477	2.828	1.459	2.772	3.320
Vul14NFS+1%Cl	900	7.929	0.049	2.840	2.207	1.692	2.179	2.431
Detection limit			0.002		0.011		0.006	

HF Method	Temperature (°C)	65Cu	65Cu RSD	65Cu [He]	65Cu [He] RSD	66Zn	66Zn RSD	75As
Sample name								
STD M+Cs+Pt 1/1000		0.129	2.975	0.126	12.692	0.154	3.692	4.021
STD M+Cs+Pt 1/100		1.124	1.959	1.090	1.514	1.218	3.041	4.774
STD M+Cs+Pt 1/10		11.370	0.785	11.370	1.161	11.370	1.037	11.370
STD A - D2		22.154	1.073	21.862	1.199	24.391	0.304	4.531
Vul14NFS+1%Cl	60	10.131	1.030	9.696	0.831	0.140	3.550	3.793
Vul14NFS+1%Cl	60	10.927	1.499	10.579	1.444	0.272	2.601	3.791
Vul14NFS+1%Cl	95	3.444	0.335	3.445	2.563	0.582	1.317	3.681
Vul14NFS+1%Cl	110	3.128	1.661	3.091	2.362	0.178	3.395	3.861
Vul14NFS+1%Cl	120	3.896	0.885	3.798	1.749	0.197	3.238	3.830
Vul14NFS+1%Cl	140	2.045	0.822	1.994	3.295	0.194	4.116	3.809
Vul14NFS+1%Cl	160	1.798	1.026	1.811	2.608	0.138	3.474	3.864
Vul14NFS+1%Cl	190	2.282	1.376	2.156	1.820	0.170	7.081	3.915
Vul14NFS+1%Cl	235	3.710	0.792	3.632	2.938	0.248	2.921	3.971
Vul14NFS+1%Cl	330	2.736	1.627	2.726	1.573	0.688	1.593	3.870
Vul14NFS+1%Cl	455	5.841	1.141	5.342	5.791	0.335	1.555	4.130
Vul14NFS+1%Cl	565	12.055	6.840	12.797	2.181	0.312	6.591	4.427
Vul14NFS+1%Cl	735	8.238	1.246	8.205	2.892	0.131	2.702	4.178
Vul14NFS+1%Cl	735	10.778	0.670	10.775	0.862	0.125	4.929	3.975
Vul14NFS+1%Cl	830	3.006	0.796	3.029	0.587	0.156	4.396	3.824
Vul14NFS+1%Cl	870	3.418	2.617	3.056	9.507	0.200	2.340	4.140
Vul14NFS+1%Cl	895	3.033	1.596	3.011	2.367	0.119	4.458	3.816
Vul14NFS+1%Cl	900	4.652	1.281	4.573	1.437	0.182	5.245	3.751
Vul14NFS+1%Cl	900	3.496	1.732	3.347	2.487	0.151	3.148	3.794
Vul14NFS+1%Cl	900	3.863	0.521	3.824	2.064	0.113	6.032	3.800
Vul14NFS+1%Cl	900	4.712	1.295	4.537	2.128	0.512	2.294	3.770
Vul14NFS+1%Cl	900	5.480	0.559	5.413	2.332	0.219	3.235	3.838
Vul14NFS+1%Cl	900	2.801	1.806	2.848	2.672	0.125	5.809	3.849
Vul14NFS+1%Cl	900	2.180	1.178	2.216	3.611	0.476	3.486	3.766
Detection limit		0.007		0.006		0.035		0.501

HF Method	Temperature (°C)	75As RSD	75As [He]	75As [He] RSD	76Se	76Se RSD	77Se	77Se RSD
Sample name								
STD M+Cs+Pt 1/1000		0.424	0.127	16.834	11.084	0.184	0.379	8.707
STD M+Cs+Pt 1/100		0.461	1.159	6.858	11.356	0.239	1.421	5.310
STD M+Cs+Pt 1/10		0.838	11.370	0.479	11.370	0.285	11.370	1.551
STD A - D2		0.800	1.188	7.547	10.769	0.160	6.086	2.853
Vul14NFS+1%Cl	60	0.385	0.020	38.459	10.729	0.505	0.306	8.207
Vul14NFS+1%Cl	60	0.595	0.020	33.166	10.775	0.482	0.275	7.730
Vul14NFS+1%Cl	95	0.546	0.020	67.001	10.381	0.570	0.262	6.194
Vul14NFS+1%Cl	110	0.468	0.024	36.801	10.957	0.495	0.267	8.594
Vul14NFS+1%Cl	120	0.541	0.028	43.300	10.873	0.340		
Vul14NFS+1%Cl	140	1.065	0.032	20.063	10.772	0.573	0.267	9.933
Vul14NFS+1%Cl	160	0.778	0.020	30.101	10.973	0.248	0.269	13.243
Vul14NFS+1%Cl	190	0.843	0.033	23.386	11.078	0.426	0.275	9.573
Vul14NFS+1%Cl	235	0.985	0.136	16.979	11.006	0.355	0.306	10.549
Vul14NFS+1%Cl	330	0.413	0.112	21.705	10.952	0.150		
Vul14NFS+1%Cl	455	0.405	0.452	11.326	10.982	0.187	0.280	14.836
Vul14NFS+1%Cl	565	0.379	0.497	3.329	11.737	0.360	0.323	15.624
Vul14NFS+1%Cl	735	0.707	0.573	10.220	10.960	0.217	0.296	5.837
Vul14NFS+1%Cl	735	1.096	0.417	8.339	10.633	0.446	0.275	5.503
Vul14NFS+1%Cl	830	0.689	0.012	30.856	10.683	0.237	0.287	10.329
Vul14NFS+1%Cl	870	0.407	0.020	17.863	11.674	0.222	0.281	13.727
Vul14NFS+1%Cl	895	0.668	0.015	34.311	10.916	0.284	0.267	15.411
Vul14NFS+1%Cl	900	0.555	0.019	38.798	10.715	0.209	0.287	9.413
Vul14NFS+1%Cl	900	0.803	0.020	19.995	10.832	0.315	0.290	9.224
Vul14NFS+1%Cl	900	0.789	0.008	62.828	10.698	0.275	0.274	8.332
Vul14NFS+1%Cl	900	0.894	0.010	55.058	10.527	0.260		
Vul14NFS+1%Cl	900	0.348	0.014	68.507	10.989	0.203	0.297	12.702
Vul14NFS+1%Cl	900	0.698	0.016	65.626	10.933	0.443	0.292	7.589
Vul14NFS+1%Cl	900	0.330	0.013	33.196	10.529	0.433	0.271	6.856
Detection limit			0.005		1.409		0.260	

HF Method	Temperature (°C)	78Se	78Se RSD	78Se [He]	78Se [He] RSD	82Se	82Se RSD	85Rb
Sample name								
STD M+Cs+Pt 1/1000		1.569	10.606	0.337	29.488	0.819	8.887	0.001
STD M+Cs+Pt 1/100		2.628	7.553	1.428	16.787	1.666	4.217	0.001
STD M+Cs+Pt 1/10		11.370	2.796	11.370	3.013	11.370	0.899	0.002
STD A - D2		6.437	2.204	6.387	8.050	6.111	2.421	5.372
Vul14NFS+1%Cl	60	1.166	12.803	0.306	36.094	0.712	4.188	0.025
Vul14NFS+1%Cl	60	1.033	12.210	0.333	13.926	0.680	7.857	0.014
Vul14NFS+1%Cl	95	1.193	17.467	0.340	46.537	0.629	7.425	0.013
Vul14NFS+1%Cl	110	1.027	17.432	0.376	41.286	0.695	5.599	0.015
Vul14NFS+1%Cl	120	1.049	19.886	0.292	42.957	0.665	5.174	0.010
Vul14NFS+1%Cl	140	1.133	24.631	0.296	25.080	0.661	4.603	0.015
Vul14NFS+1%Cl	160	1.073	19.998	0.246	36.405	0.654	13.661	0.018
Vul14NFS+1%Cl	190	1.133	29.022	0.354	15.767	0.679	5.208	0.053
Vul14NFS+1%Cl	235	1.272	26.568	0.354	48.286	0.692	5.823	0.093
Vul14NFS+1%Cl	330	0.784	21.355	0.301	15.783	0.667	8.689	0.042
Vul14NFS+1%Cl	455	0.761	15.727	0.388	36.615	0.659	7.855	0.023
Vul14NFS+1%Cl	565	1.262	9.864	0.291	30.650	0.726	8.375	0.020
Vul14NFS+1%Cl	735	1.071	15.612	0.235	13.355	0.715	5.317	0.013
Vul14NFS+1%Cl	735	1.108	17.476	0.391	16.753	0.669	4.769	0.010
Vul14NFS+1%Cl	830	1.529	14.321	0.330	56.396	0.682	7.018	0.005
Vul14NFS+1%Cl	870	1.355	9.882	0.482	29.237	0.683	7.092	0.005
Vul14NFS+1%Cl	895	0.887	26.042	0.255	47.794	0.660	4.484	0.005
Vul14NFS+1%Cl	900	0.936	20.236	0.279	15.809	0.642	7.459	0.007
Vul14NFS+1%Cl	900	0.946	17.753	0.310	34.018	0.683	8.383	0.006
Vul14NFS+1%Cl	900	1.345	15.761	0.294	25.072	0.675	11.933	0.004
Vul14NFS+1%Cl	900	1.527	14.442	0.281	22.363	0.679	8.911	0.005
Vul14NFS+1%Cl	900	0.903	10.996	0.320	50.665	0.676	4.179	0.006
Vul14NFS+1%Cl	900	1.120	25.953	0.398	30.055	0.694	5.420	0.005
Vul14NFS+1%Cl	900	1.499	10.466	0.342	49.995	0.644	5.598	0.008
Detection limit		0.274		0.140		0.075		0.000

HF Method	Temperature (°C)	85Rb RSD	88Sr	88Sr RSD	89Y	89Y RSD	95Mo	95Mo RSD
Sample name								
STD M+Cs+Pt 1/1000		6.386	0.128	2.378			0.116	3.377
STD M+Cs+Pt 1/100		9.734	1.130	2.373			1.113	1.590
STD M+Cs+Pt 1/10		10.272	11.370	0.595			11.370	0.671
STD A - D2		1.284	1304.008	0.827	54.301	1.108	0.008	9.061
Vul14NFS+1%Cl	60	1.786	0.080	2.079	0.001	8.638	5.318	1.373
Vul14NFS+1%Cl	60	4.881	0.059	2.063	0.001	7.727	2.701	1.089
Vul14NFS+1%Cl	95	1.421	0.042	4.950	0.001	4.955	3.131	0.713
Vul14NFS+1%Cl	110	3.284	0.062	2.837	0.001	6.633	5.226	1.601
Vul14NFS+1%Cl	120	6.689	0.072	2.953	0.002	8.108	7.603	1.586
Vul14NFS+1%Cl	140	1.819	0.069	1.088	0.002	1.624	13.892	1.677
Vul14NFS+1%Cl	160	4.098	0.063	2.296	0.001	7.808	4.553	1.240
Vul14NFS+1%Cl	190	2.810	0.051	1.565	0.001	12.345	35.215	1.387
Vul14NFS+1%Cl	235	1.231	0.063	1.972	0.001	5.704	61.637	1.305
Vul14NFS+1%Cl	330	1.258	0.074	1.283	0.001	13.492	11.820	2.093
Vul14NFS+1%Cl	455	1.816	0.067	2.054	0.001	6.935	385.949	0.885
Vul14NFS+1%Cl	565	5.563	0.051	7.644	0.001	13.937	324.848	7.293
Vul14NFS+1%Cl	735	4.828	0.056	3.418	0.002	7.572	90.379	0.791
Vul14NFS+1%Cl	735	3.998	0.055	1.706	0.001	5.989	55.855	0.947
Vul14NFS+1%Cl	830	5.725	0.048	1.981	0.001	14.714	1.193	1.321
Vul14NFS+1%Cl	870	2.995	0.052	3.932	0.001	9.544	0.309	3.261
Vul14NFS+1%Cl	895	4.515	0.057	2.486	0.001	9.040	0.361	1.884
Vul14NFS+1%Cl	900	4.010	0.072	1.251	0.002	4.551	0.543	1.103
Vul14NFS+1%Cl	900	2.632	0.061	1.442	0.001	3.370	0.320	3.099
Vul14NFS+1%Cl	900	3.446	0.046	2.836	0.001	6.280	0.203	2.478
Vul14NFS+1%Cl	900	9.282	0.080	2.433	0.001	7.599	0.263	1.434
Vul14NFS+1%Cl	900	2.433	0.065	1.639	0.001	7.243	0.167	2.640
Vul14NFS+1%Cl	900	6.851	0.050	3.763	0.001	9.315	0.279	1.722
Vul14NFS+1%Cl	900	5.682	0.051	1.505	0.001	5.997	0.297	2.005
Detection limit			0.024		0.001		0.005	

HF Method	Temperature (°C)	107Ag	107Ag RSD	111Cd	111Cd RSD	115In (CPS)	115In (CPS) RSD
Sample name							
STD M+Cs+Pt 1/1000		0.111	4.309	0.111	4.156	601685.496	0.811
STD M+Cs+Pt 1/100		1.112	1.742	1.106	2.539	601685.496	3.051
STD M+Cs+Pt 1/10		11.370	0.675	11.370	0.465	601685.496	3.300
STD A - D2		0.032	3.735	5.495	1.328	601685.496	1.089
Vul14NFS+1%Cl	60	0.004	13.438	0.011	6.986	601685.496	2.825
Vul14NFS+1%Cl	60	0.003	16.509	0.006	24.909	601685.496	0.829
Vul14NFS+1%Cl	95	0.002	8.892	0.008	12.954	601685.496	3.516
Vul14NFS+1%Cl	110	0.003	9.191	0.011	11.162	601685.496	1.972
Vul14NFS+1%Cl	120	0.002	7.195	0.011	8.429	601685.496	2.564
Vul14NFS+1%Cl	140	0.004	14.200	0.021	14.130	601685.496	1.557
Vul14NFS+1%Cl	160	0.004	12.324	0.014	10.340	601685.496	0.834
Vul14NFS+1%Cl	190	0.009	7.730	0.048	8.674	601685.496	2.440
Vul14NFS+1%Cl	235	0.034	5.856	0.119	4.344	601685.496	1.449
Vul14NFS+1%Cl	330	0.035	2.682	0.092	6.394	601685.496	1.489
Vul14NFS+1%Cl	455	0.021	3.288	0.546	2.182	601685.496	1.378
Vul14NFS+1%Cl	565	0.014	7.846	0.610	7.531	601685.496	13.484
Vul14NFS+1%Cl	735	0.006	5.265	0.416	2.639	601685.496	0.952
Vul14NFS+1%Cl	735	0.006	9.598	0.312	2.691	601685.496	1.051
Vul14NFS+1%Cl	830			0.027	11.961	601685.496	0.873
Vul14NFS+1%Cl	870			0.007	16.348	601685.496	3.358
Vul14NFS+1%Cl	895			0.004	10.500	601685.496	1.366
Vul14NFS+1%Cl	900	0.001	13.834	0.011	12.500	601685.496	1.706
Vul14NFS+1%Cl	900			0.004	23.459	601685.496	1.187
Vul14NFS+1%Cl	900			0.002	38.089	601685.496	2.810
Vul14NFS+1%Cl	900			0.003	19.295	601685.496	2.017
Vul14NFS+1%Cl	900			0.005	16.383	601685.496	1.184
Vul14NFS+1%Cl	900	0.001	12.931	0.010	20.672	601685.496	4.836
Vul14NFS+1%Cl	900	0.002	19.676	0.004	38.959	601685.496	1.393
Detection limit		0.001		0.001			

HF Method	Temperature (°C)	115In [He] (CPS)	115In [He] (CPS) RSD	118Sn	118Sn RSD	133Cs	133Cs RSD
Sample name							
STD M+Cs+Pt 1/1000		74724.024	0.661			0.012	6.051
STD M+Cs+Pt 1/100		77414.634	1.890			0.112	2.446
STD M+Cs+Pt 1/10		75772.908	1.402			1.134	0.890
STD A - D2		75636.501	0.654			0.022	4.157
Vul14NFS+1%Cl	60	75551.819	1.850	1.957	0.954	0.053	3.990
Vul14NFS+1%Cl	60	74901.405	3.041	2.218	1.724	0.034	3.523
Vul14NFS+1%Cl	95	76059.084	2.143	0.671	0.645	0.038	2.227
Vul14NFS+1%Cl	110	78845.382	0.571	0.631	1.741	0.233	1.744
Vul14NFS+1%Cl	120	78014.674	5.949	0.704	2.579	0.103	1.797
Vul14NFS+1%Cl	140	77453.046	2.968	0.415	1.204	0.138	2.868
Vul14NFS+1%Cl	160	77330.113	2.712	0.337	1.509	0.088	1.190
Vul14NFS+1%Cl	190	75146.306	1.637	0.463	1.201	0.284	1.678
Vul14NFS+1%Cl	235	76410.594	4.478	0.716	1.246	0.481	1.505
Vul14NFS+1%Cl	330	76300.717	1.681	0.492	2.250	0.114	2.473
Vul14NFS+1%Cl	455	67932.943	5.972	0.995	1.654	0.840	0.786
Vul14NFS+1%Cl	565	80836.095	4.692	2.247	7.124	0.099	7.166
Vul14NFS+1%Cl	735	77855.520	1.237	1.508	1.168	0.076	1.724
Vul14NFS+1%Cl	735	79836.053	1.347	2.026	0.199	0.027	1.559
Vul14NFS+1%Cl	830	78488.583	1.365	0.522	2.332	0.096	1.539
Vul14NFS+1%Cl	870	59198.374	25.439	0.620	3.574	0.029	2.745
Vul14NFS+1%Cl	895	76677.329	4.472	0.619	1.059	0.029	2.421
Vul14NFS+1%Cl	900	76005.231	1.380	0.904	1.438	0.134	1.386
Vul14NFS+1%Cl	900	76027.661	1.067	0.694	1.963	0.139	2.421
Vul14NFS+1%Cl	900	78608.621	0.793	0.775	1.274	0.042	3.911
Vul14NFS+1%Cl	900	73371.965	2.247	0.889	1.962	0.013	3.631
Vul14NFS+1%Cl	900	78915.589	2.588	1.105	1.208	0.027	2.552
Vul14NFS+1%Cl	900	79227.259	1.365	0.512	2.249	0.015	3.349
Vul14NFS+1%Cl	900	78200.114	0.606	0.288	2.527	0.109	1.217
Detection limit				0.034		0.000	

HF Method	Temperature (°C)	137Ba	137Ba RSD	172Yb	172Yb RSD	182W	182W RSD	185Re (CPS)
Sample name								
STD M+Cs+Pt 1/1000		0.134	3.769	0.110	2.785	0.000	37.268	195377.797
STD M+Cs+Pt 1/100		1.119	2.142	1.116	2.386	0.001	32.141	193837.481
STD M+Cs+Pt 1/10		11.370	0.494	11.370	0.845	0.009	11.175	195643.544
STD A - D2		4.318	1.077	0.001	7.695	0.013	9.172	195978.879
Vul14NFS+1%Cl	60	0.240	4.037			0.240	3.161	195093.180
Vul14NFS+1%Cl	60	0.181	3.256			0.285	1.462	194699.439
Vul14NFS+1%Cl	95	0.149	2.125			0.144	1.559	191649.728
Vul14NFS+1%Cl	110	0.190	3.979			0.366	2.355	195821.674
Vul14NFS+1%Cl	120	0.224	1.904			0.287	0.951	195347.116
Vul14NFS+1%Cl	140	0.201	1.739			0.229	1.447	194550.550
Vul14NFS+1%Cl	160	0.207	0.900			0.183	2.112	194410.983
Vul14NFS+1%Cl	190	0.155	5.661			0.304	1.835	194531.855
Vul14NFS+1%Cl	235	0.190	2.197			0.535	0.994	195092.898
Vul14NFS+1%Cl	330	0.195	2.089			0.392	2.029	191813.344
Vul14NFS+1%Cl	455	0.243	1.629			0.933	1.584	195306.106
Vul14NFS+1%Cl	565	0.185	6.894			0.656	6.791	194959.276
Vul14NFS+1%Cl	735	0.183	1.549			0.487	1.010	194749.280
Vul14NFS+1%Cl	735	0.192	2.437			0.367	1.607	192826.767
Vul14NFS+1%Cl	830	0.139	3.496			0.063	2.392	193660.246
Vul14NFS+1%Cl	870	0.153	7.685			0.063	1.067	195548.902
Vul14NFS+1%Cl	895	0.167	2.857			0.051	1.771	194196.781
Vul14NFS+1%Cl	900	0.272	1.197			0.110	2.458	194205.873
Vul14NFS+1%Cl	900	0.200	3.971			0.049	6.102	195136.480
Vul14NFS+1%Cl	900	0.138	3.098			0.054	4.247	193928.025
Vul14NFS+1%Cl	900	1.304	1.769			0.037	5.623	194170.607
Vul14NFS+1%Cl	900	0.199	3.168			0.111	1.451	193352.882
Vul14NFS+1%Cl	900	0.160	3.883			0.069	3.066	196440.939
Vul14NFS+1%Cl	900	0.180	2.457			0.091	3.817	193537.742
Detection limit		0.004		0.001		0.000		

HF Method	Temperature (°C)	185Re (CPS)	RSD	195Pt	196Pt RSD	197Au (CPS)	197Au (CPS)	RSD	205TI
Sample name									
STD M+Cs+Pt 1/1000		1.792		0.024		5.553	6.010		136.931 0.114
STD M+Cs+Pt 1/100		2.660		0.227		3.552	2.298		149.118 1.115
STD M+Cs+Pt 1/10		1.425		2.288		0.499	7.532		117.283 11.370
STD A - D2		1.052					12.492		98.867 0.108
Vul14NFS+1%Cl	60	1.380		3.159		1.602	8.634		91.330 0.019
Vul14NFS+1%Cl	60	0.466		1.669		0.867	34.409		34.231 0.008
Vul14NFS+1%Cl	95	1.811		2.925		0.668	53.761		29.970 0.007
Vul14NFS+1%Cl	110	1.736		4.219		1.304	26.108		30.117 0.003
Vul14NFS+1%Cl	120	2.061		2.894		1.801	329.321		13.556 0.004
Vul14NFS+1%Cl	140	1.189		3.798		0.777	9.398		107.407 0.007
Vul14NFS+1%Cl	160	1.197		2.441		0.922	13.846		86.085 0.001
Vul14NFS+1%Cl	190	1.857		4.943		5.636	24.341		40.944 0.003
Vul14NFS+1%Cl	235	0.812		4.117		0.633	26.586		42.121 0.001
Vul14NFS+1%Cl	330	2.110		1.490		1.879	29.642		33.839
Vul14NFS+1%Cl	455	1.095		124.855		0.895	343.346		8.377
Vul14NFS+1%Cl	565	13.132		12.301		6.606	83.485		26.973
Vul14NFS+1%Cl	735	0.782		0.960		1.974	51.026		32.734
Vul14NFS+1%Cl	735	1.468		0.638		1.571	147.609		54.017
Vul14NFS+1%Cl	830	0.698		0.144		2.452	30.348		37.260
Vul14NFS+1%Cl	870	2.609		0.083		3.138	17.280		47.118
Vul14NFS+1%Cl	895	1.376		0.083		2.366	20.885		35.344
Vul14NFS+1%Cl	900	1.349		0.104		3.575	48.220		27.803
Vul14NFS+1%Cl	900	1.017		0.036		4.652	2.866		55.902
Vul14NFS+1%Cl	900	1.604					10.060		52.988
Vul14NFS+1%Cl	900	1.727		0.025		3.548	5.720		55.954
Vul14NFS+1%Cl	900	0.944		0.091		2.932	185.082		19.753
Vul14NFS+1%Cl	900	3.301		0.134		3.262	28.580		127.706
Vul14NFS+1%Cl	900	0.780		0.620		1.740	60.609		49.046
Detection limit				0.023					0.001

HF Method	Temperature (°C)	205Tl RSD	208Pb	208Pb RSD	209Bi	209Bi RSD
Sample name						
STD M+Cs+Pt 1/1000		2.144	0.114	2.805	0.113	3.095
STD M+Cs+Pt 1/100		2.412	1.118	2.194	1.118	2.165
STD M+Cs+Pt 1/10		0.573	11.370	0.482	11.370	0.289
STD A - D2		2.550	0.116	1.592	0.110	1.597
Vul14NFS+1%Cl	60	4.907	0.085	1.749	0.018	3.439
Vul14NFS+1%Cl	60	4.396	0.048	4.100	0.016	7.351
Vul14NFS+1%Cl	95	8.175	0.068	1.265	0.018	3.946
Vul14NFS+1%Cl	110	8.757	0.110	2.526	0.015	2.653
Vul14NFS+1%Cl	120	9.838	0.125	0.891	0.009	2.458
Vul14NFS+1%Cl	140	7.274	0.215	0.640	0.020	3.359
Vul14NFS+1%Cl	160	33.219	0.171	2.571	0.026	4.579
Vul14NFS+1%Cl	190	7.222	0.208	1.190	0.034	2.484
Vul14NFS+1%Cl	235	11.214	0.882	0.595	0.069	1.921
Vul14NFS+1%Cl	330		1.412	1.376	0.019	5.668
Vul14NFS+1%Cl	455		3.585	0.729	0.104	1.609
Vul14NFS+1%Cl	565		3.085	7.199	0.076	7.107
Vul14NFS+1%Cl	735		3.521	1.762	0.150	2.031
Vul14NFS+1%Cl	735		2.368	1.882	0.127	0.963
Vul14NFS+1%Cl	830		0.089	2.039	0.042	2.212
Vul14NFS+1%Cl	870		0.042	4.787	0.022	2.845
Vul14NFS+1%Cl	895		0.030	4.364	0.020	8.748
Vul14NFS+1%Cl	900		0.060	1.373	0.128	1.312
Vul14NFS+1%Cl	900		0.032	4.389	0.042	3.051
Vul14NFS+1%Cl	900		0.015	5.839	0.009	3.184
Vul14NFS+1%Cl	900		0.033	3.303	0.017	3.377
Vul14NFS+1%Cl	900		0.038	4.380	0.009	6.878
Vul14NFS+1%Cl	900		0.047	2.012	0.017	3.317
Vul14NFS+1%Cl	900		0.040	1.253	0.049	4.052
Detection limit			0.002		0.001	

Appendix C: Supplementary Raman spectra for Chapter 3

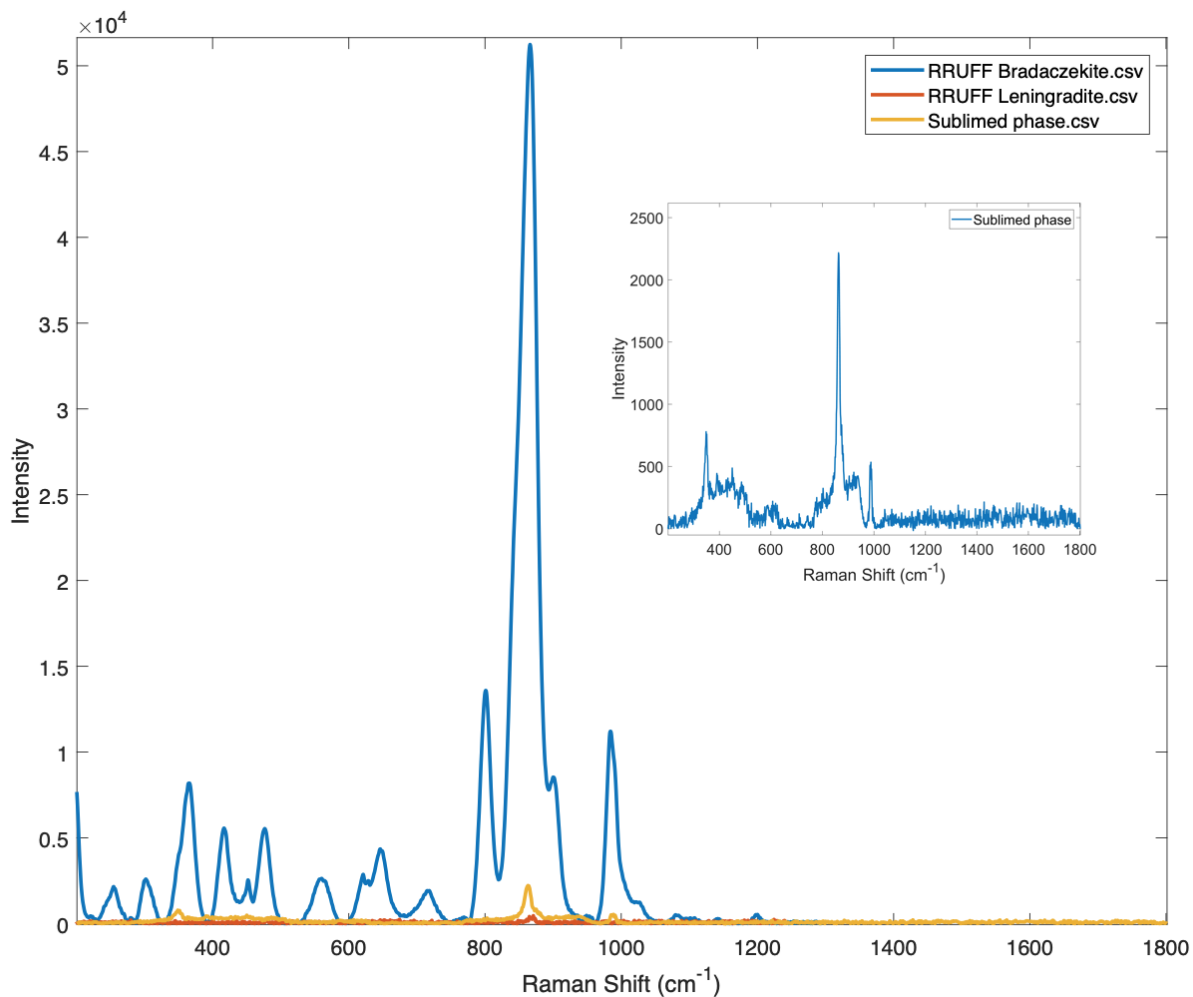


Figure A.1: Raman spectra for sublimated phase compared to suggested corresponding mineral, bradaczekite and leningradite.

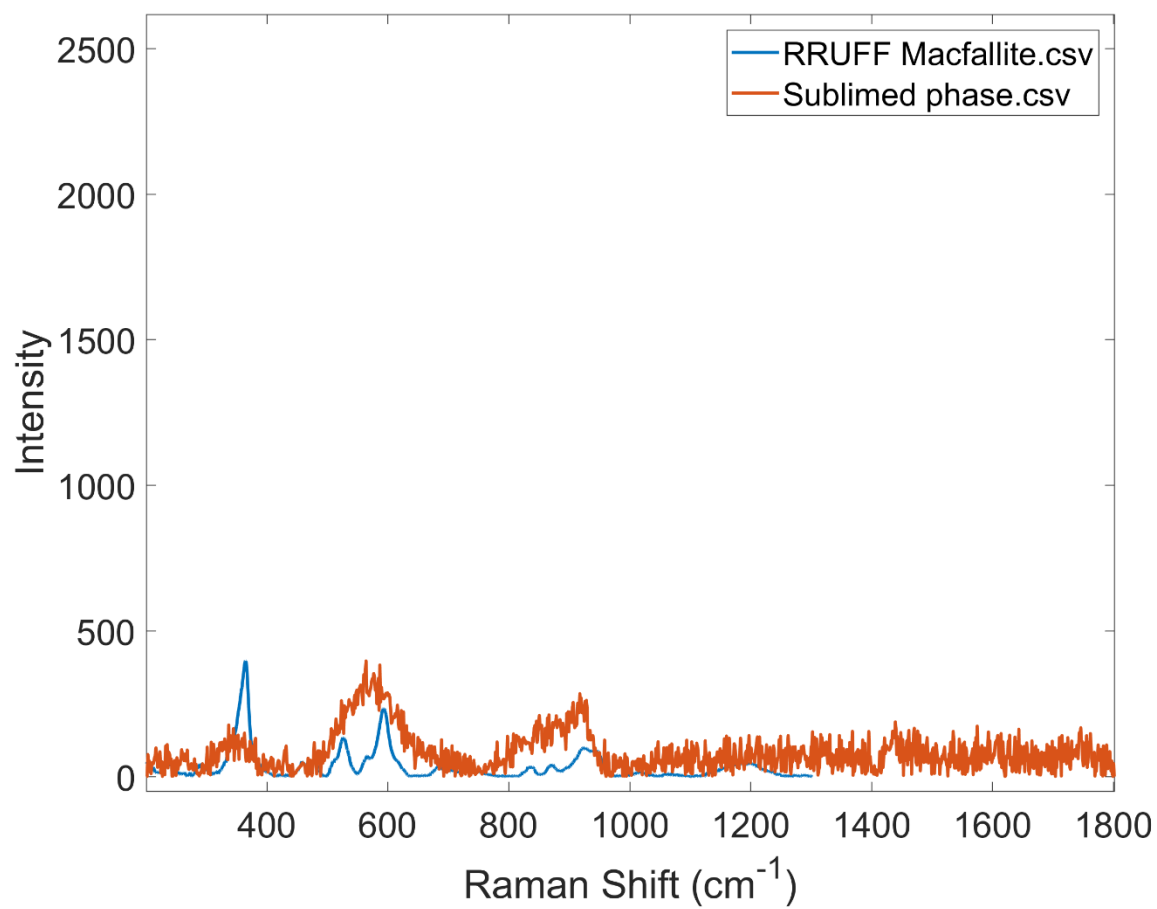


Figure A.2: Raman spectra for sublimated phase compared to suggested corresponding mineral, macfallite.

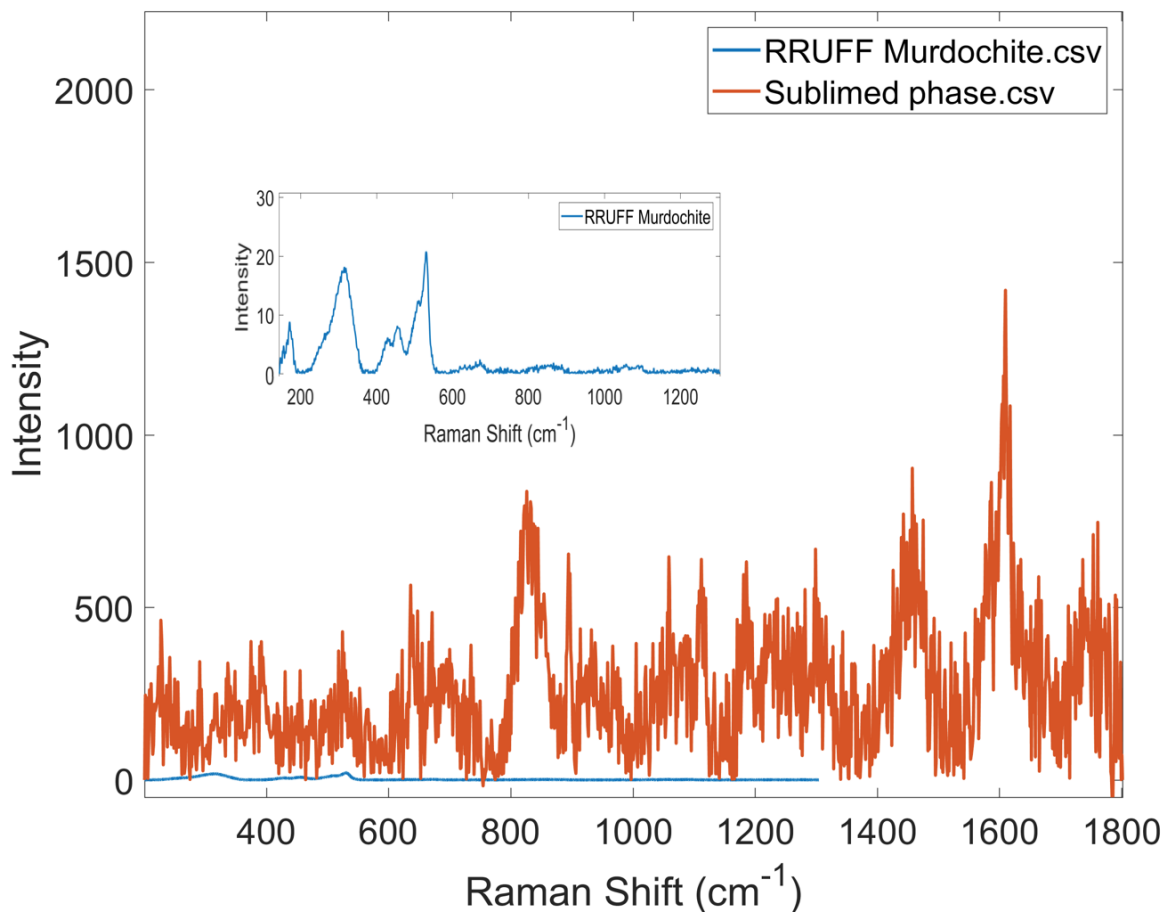


Figure A.3: Raman spectra for sublimated phase compared to suggested corresponding mineral, murdochite.

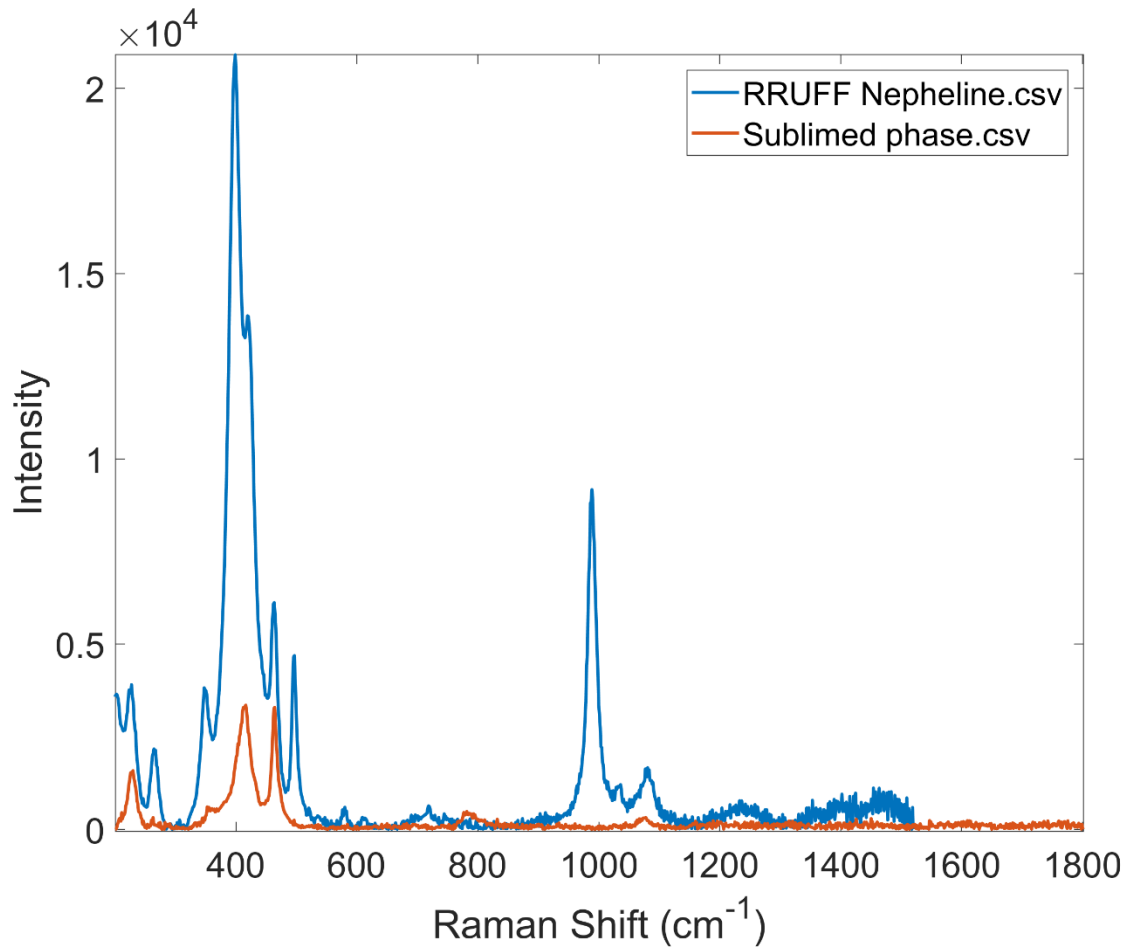


Figure A.4: Raman spectra for sublimated phase compared to suggested corresponding mineral, nepheline.

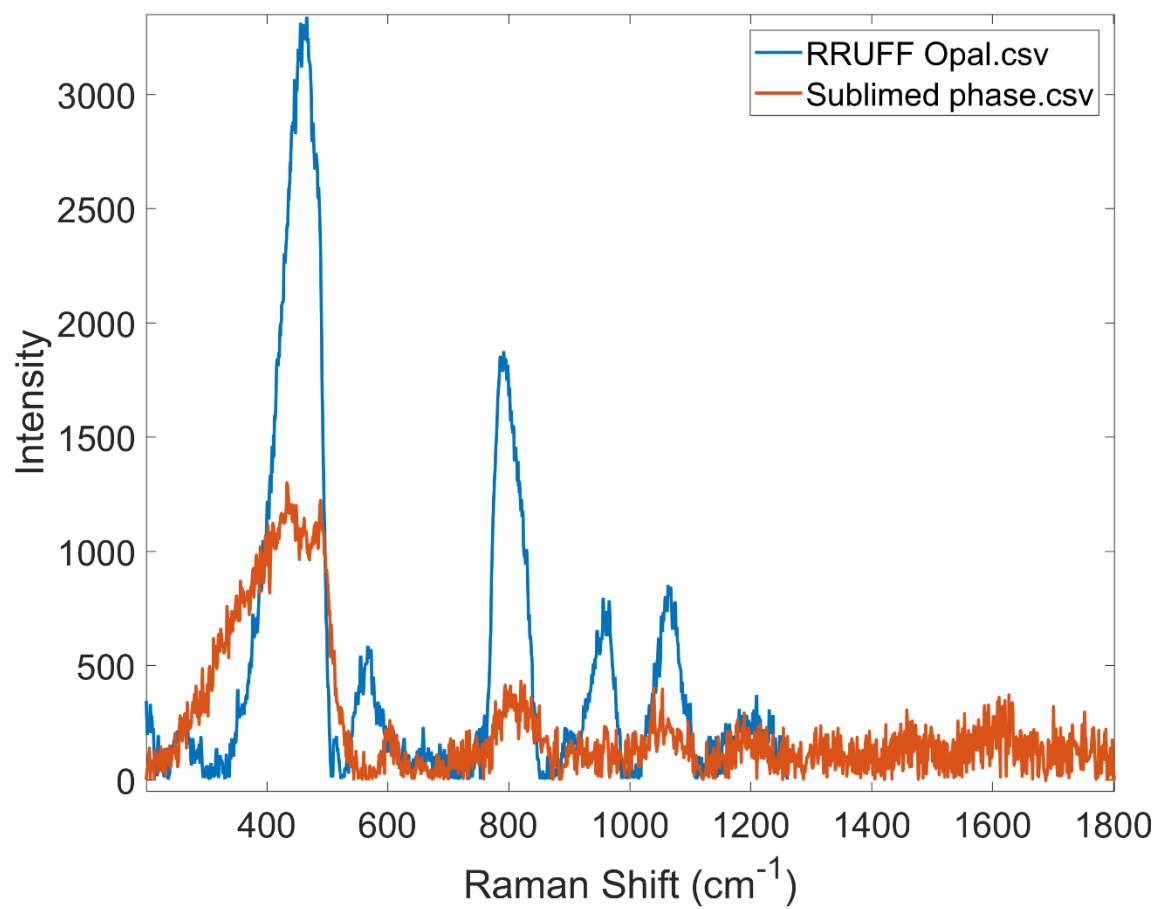


Figure A.5: Raman spectra for sublimated phase compared to suggested corresponding mineral, opal.

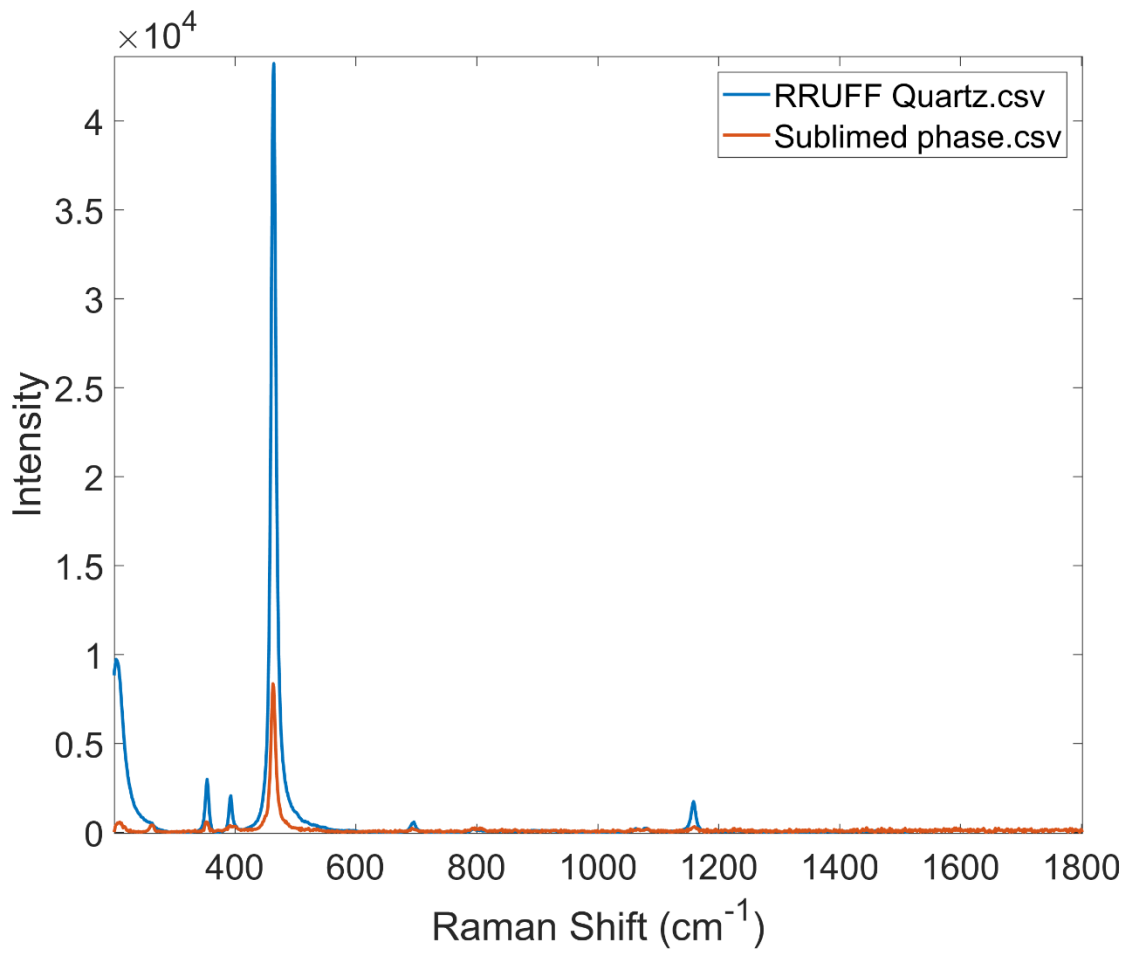


Figure A.6: Raman spectra for sublimated phase compared to suggested corresponding mineral, quartz.

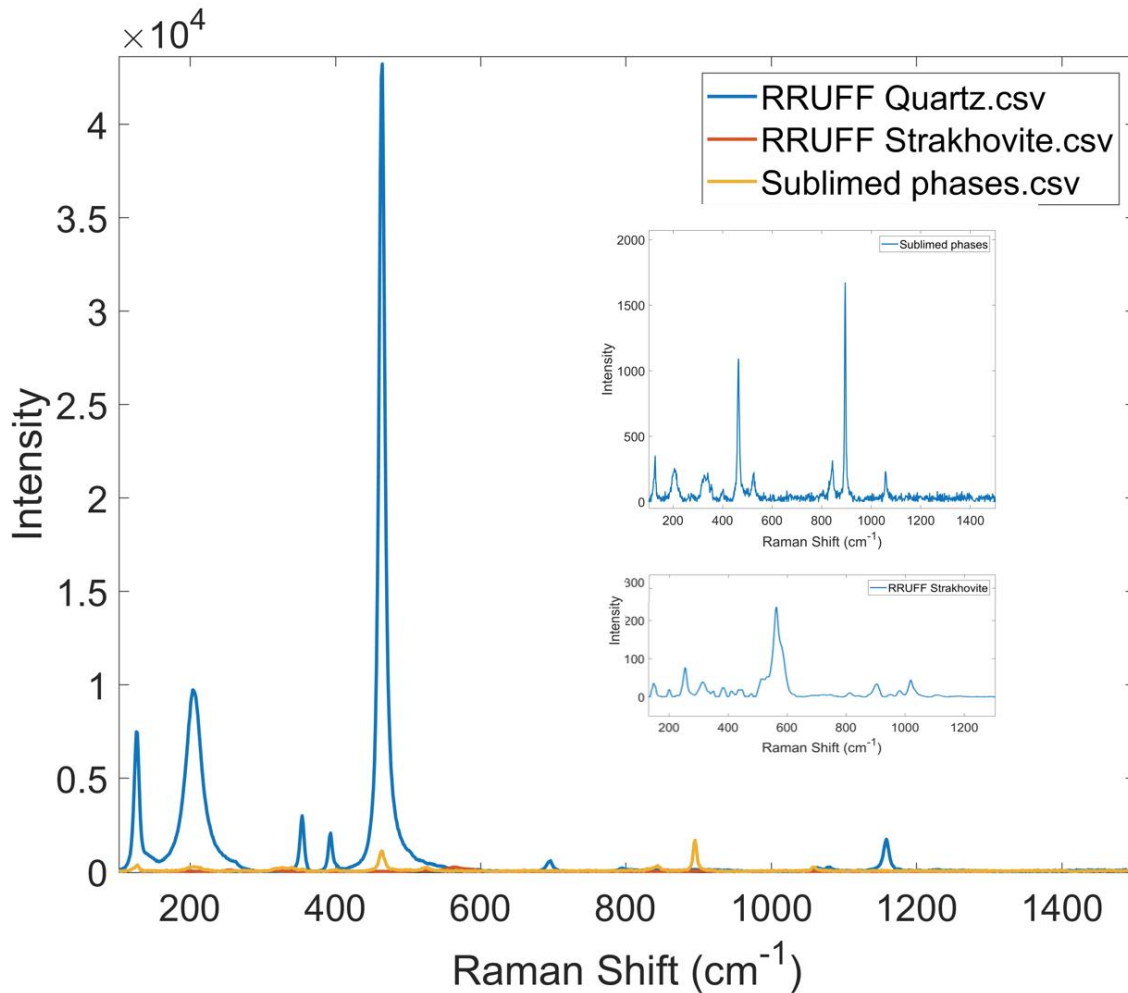


Figure A.7: Raman spectra for sublimated phase compared to suggested corresponding minerals, quartz and strakhovite.

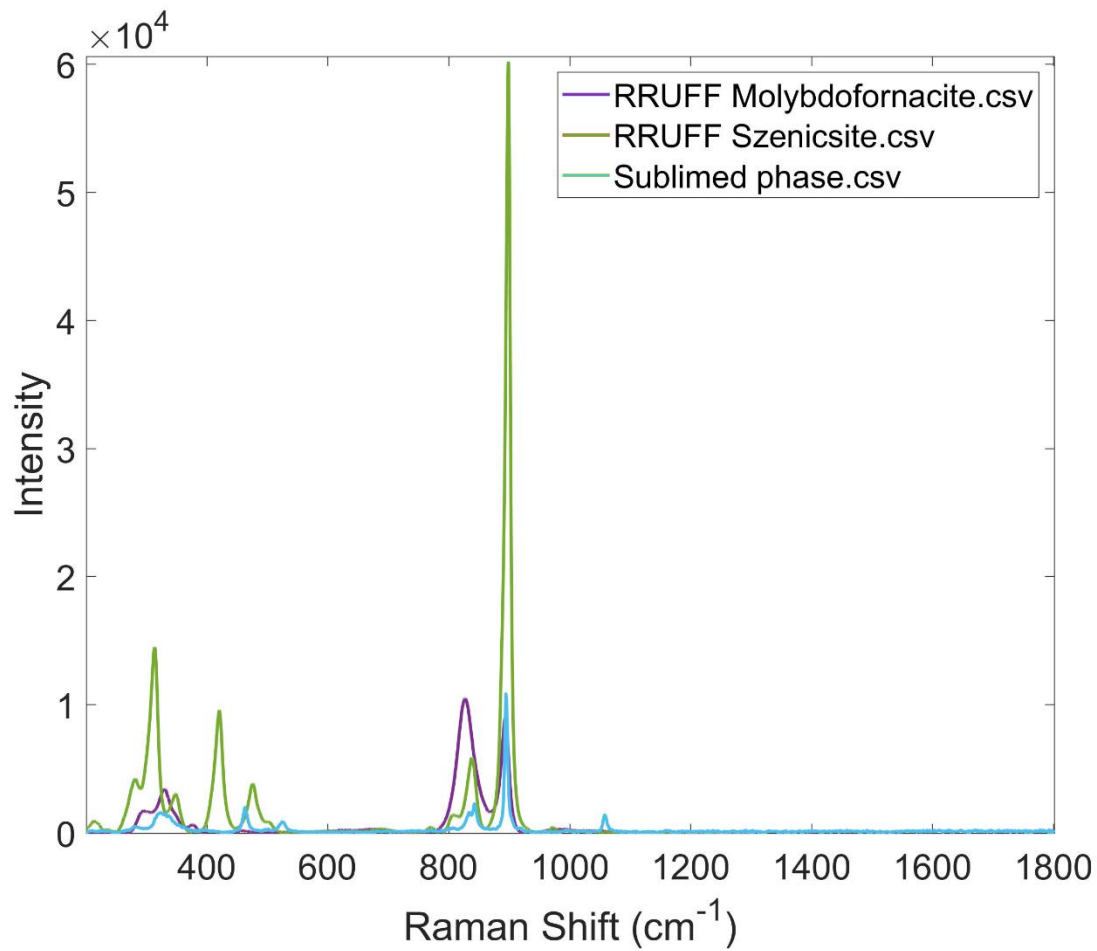


Figure A.8: Raman spectra for sublimated phase compared to suggested corresponding minerals, molybdoformacite and szenicsite.

Appendix D: Supplementary solution ICP-MS data for Chapter 4

Sample Name	Temperature (°C)	7 Li [No Gas]* ppb	7 Li [No Gas] RSD %	27 Al [No Gas] ppb	27 Al [No Gas] RSD %
STD M+Cs+Pt / 1000		0.102	3.580	0.102	1.580
STD M+Cs+Pt / 100		0.768	1.764	0.178	2.424
STD M+Cs+Pt / 10		3.504	1.443	0.590	1.213
REF / 1000		0.030	7.308	0.071	2.146
REF / 100		0.026	3.885	0.059	2.393
A D2/20		0.034	3.459		
Sulphur 102.7ppb		0.029	7.659	0.060	2.582
SLRS-5		0.370	1.612	5.295	2.137
741NASCIS FMQ-1.5 40		0.692	2.082	0.252	4.022
741NASCIS FMQ-1.5 90		0.089	2.446	0.116	3.533
741NASCIS FMQ-1.5 135		0.259	2.745	1.168	1.471
741NASCIS FMQ-1.5 180		0.295	4.411	0.190	1.561
741NASCIS FMQ-1.5 225		0.376	3.032	0.266	2.657
741NASCIS FMQ-1.5 255		0.635	2.361	0.150	1.579
741NASCIS FMQ-1.5 295		0.848	3.465	0.255	1.921
741NASCIS FMQ-1.5 330		1.261	2.402	0.069	1.556
741NASCIS FMQ-1.5 380		3.822	4.601	0.297	3.643
741NASCIS FMQ-1.5 380		3.890	2.191	0.294	2.332
741NASCIS FMQ-1.5 455		6.885	0.495	0.186	1.788
741NASCIS FMQ-1.5 510		5.465	1.496	0.218	0.628
741NASCIS FMQ-1.5 580		8.507	1.031	0.860	1.731
741NASCIS FMQ-1.5 660		10.266	3.321	0.161	3.472
741NASCIS FMQ-1.5 725		8.896	3.766	0.318	2.580
741NASCIS FMQ-1.5 830		1.535	2.195	0.623	1.853
741NASCIS FMQ-1.5 830		1.080	1.495	0.169	2.093
742NASCIS FMQ-4.6 40		0.182	2.906	0.082	2.589
742NASCIS FMQ-4.6 90		0.165	2.119	0.099	1.095
742NASCIS FMQ-4.6 135		0.060	3.306	0.113	1.279
742NASCIS FMQ-4.6 180		0.198	2.488	0.113	2.051
742NASCIS FMQ-4.6 225		0.280	1.337	0.128	1.735
742NASCIS FMQ-4.6 255		0.683	2.088	0.193	3.284
742NASCIS FMQ-4.6 295		0.863	1.303	0.114	2.034
742NASCIS FMQ-4.6 295		0.628	2.274	0.184	1.740
742NASCIS FMQ-4.6 295		0.874	2.282	0.116	2.598
742NASCIS FMQ-4.6 330		1.618	2.919	0.152	2.178
742NASCIS FMQ-4.6 380		2.612	2.041	0.177	1.284
742NASCIS FMQ-4.6 455		4.199	2.673	0.455	2.678
742NASCIS FMQ-4.6 510		2.939	1.780	0.351	0.977
742NASCIS FMQ-4.6 580		3.985	2.207	0.213	0.263
742NASCIS FMQ-4.6 660		4.515	2.955	0.183	2.207
742NASCIS FMQ-4.6 725		3.099	0.798	0.172	2.070
743NASCIS FMQ-3.0 40		0.047	2.481	1.024	2.140

Sample Name	Temperature (°C)	32 -> 48 S [O2] ppb	32 -> 48 S [O2] RSD %	35 -> 37 Cl [H2] CPS
STD M+Cs+Pt / 1000		6.755	4.202	39644.386
STD M+Cs+Pt / 100		11.904	2.658	38259.238
STD M+Cs+Pt / 10		7.320	2.799	40251.918
REF / 1000		17.098	1.040	43509.382
REF / 100		7.829	3.102	46536.794
A D2/20		7.053	2.772	48977.596
Sulphur 102.7ppb		107.338	1.897	44586.724
SLRS-5		2345.792	1.663	123908.804
741NASCIS FMQ-1.5 40		7.212	1.417	14028.070
741NASCIS FMQ-1.5 90		6.300	3.112	13463.938
741NASCIS FMQ-1.5 135		6.173	0.903	13350.110
741NASCIS FMQ-1.5 180		6.464	1.724	14022.444
741NASCIS FMQ-1.5 225		6.497	1.327	13932.382
741NASCIS FMQ-1.5 255		7.106	2.206	13945.514
741NASCIS FMQ-1.5 295		7.830	1.426	14001.192
741NASCIS FMQ-1.5 330		9.184	2.044	11816.634
741NASCIS FMQ-1.5 380		14.024	1.551	12502.054
741NASCIS FMQ-1.5 380		14.008	1.926	10293.916
741NASCIS FMQ-1.5 455		15.000	3.678	12193.116
741NASCIS FMQ-1.5 510		43.092	1.817	11598.386
741NASCIS FMQ-1.5 580		100.425	1.640	11256.312
741NASCIS FMQ-1.5 660		126.846	0.887	11705.324
741NASCIS FMQ-1.5 725		78.803	1.847	11383.886
741NASCIS FMQ-1.5 830		10.551	2.295	11166.888
741NASCIS FMQ-1.5 830		8.940	2.377	9876.200
742NASCIS FMQ-4.6 40		17.479	1.769	11142.504
742NASCIS FMQ-4.6 90		13.021	2.713	11061.830
742NASCIS FMQ-4.6 135		7.434	2.828	11043.070
742NASCIS FMQ-4.6 180		10.496	1.209	10561.554
742NASCIS FMQ-4.6 225		12.408	2.373	10353.950
742NASCIS FMQ-4.6 255		22.186	1.916	15482.898
742NASCIS FMQ-4.6 295		20.859	2.880	14666.034
742NASCIS FMQ-4.6 295		15.223	3.049	10077.562
742NASCIS FMQ-4.6 295		21.375	2.654	13694.080
742NASCIS FMQ-4.6 330		26.455	0.633	11388.884
742NASCIS FMQ-4.6 380		32.054	1.996	10721.648
742NASCIS FMQ-4.6 455		686.711	1.923	10331.440
742NASCIS FMQ-4.6 510		687.137	2.299	11489.568
742NASCIS FMQ-4.6 580		129.347	0.990	10834.214
742NASCIS FMQ-4.6 660		8.011	2.020	10981.788
742NASCIS FMQ-4.6 725		7.869	2.667	10452.124
743NASCIS FMQ-3.0 40		7.175	1.670	35817.846

Sample Name	Temperature (°C)	35 -> 37 Cl [H2] RSD %	43 Ca [No Gas] ppb	43 Ca [No Gas] RSD %
STD M+Cs+Pt / 1000		2.935	0.102	7.637
STD M+Cs+Pt / 100		3.579	0.090	3.402
STD M+Cs+Pt / 10		2.886	0.127	2.331
REF / 1000		3.379	0.075	8.388
REF / 100		2.250	0.074	6.594
A D2/20		3.125	0.371	3.116
Sulphur 102.7ppb		3.301	0.089	6.159
SLRS-5		3.894	71.005	0.881
741NASCIS FMQ-1.5 40		2.116	0.108	4.558
741NASCIS FMQ-1.5 90		0.793	0.089	6.918
741NASCIS FMQ-1.5 135		6.142	0.086	2.894
741NASCIS FMQ-1.5 180		1.028	0.081	6.914
741NASCIS FMQ-1.5 225		3.918	0.088	4.051
741NASCIS FMQ-1.5 255		4.323	0.083	9.467
741NASCIS FMQ-1.5 295		5.453	0.084	8.448
741NASCIS FMQ-1.5 330		3.636	0.075	3.880
741NASCIS FMQ-1.5 380		3.413	0.092	4.414
741NASCIS FMQ-1.5 380		2.991	0.096	7.002
741NASCIS FMQ-1.5 455		2.670	0.120	5.261
741NASCIS FMQ-1.5 510		4.720	0.140	5.565
741NASCIS FMQ-1.5 580		4.717	0.145	2.779
741NASCIS FMQ-1.5 660		1.320	0.183	3.865
741NASCIS FMQ-1.5 725		3.021	0.161	7.026
741NASCIS FMQ-1.5 830		1.924	0.164	3.490
741NASCIS FMQ-1.5 830		4.558	0.131	3.922
742NASCIS FMQ-4.6 40		3.487	0.087	6.201
742NASCIS FMQ-4.6 90		4.184	0.108	8.809
742NASCIS FMQ-4.6 135		3.440	0.108	8.070
742NASCIS FMQ-4.6 180		3.570	0.093	4.769
742NASCIS FMQ-4.6 225		5.133	0.086	5.732
742NASCIS FMQ-4.6 255		1.133	0.108	7.141
742NASCIS FMQ-4.6 295		4.876	0.089	6.155
742NASCIS FMQ-4.6 295		3.108	0.081	7.714
742NASCIS FMQ-4.6 295		1.714	0.086	10.244
742NASCIS FMQ-4.6 330		1.820	0.079	5.683
742NASCIS FMQ-4.6 380		5.022	0.097	5.881
742NASCIS FMQ-4.6 455		3.772	0.191	3.946
742NASCIS FMQ-4.6 510		4.919	0.139	5.089
742NASCIS FMQ-4.6 580		5.194	0.098	5.155
742NASCIS FMQ-4.6 660		5.616	0.101	7.476
742NASCIS FMQ-4.6 725		1.995	0.118	5.095
743NASCIS FMQ-3.0 40		4.197	0.156	4.177

Sample Name	Temperature (°C)	51 V [No Gas] ppb	51 V [No Gas] RSD %	51 -> 51 V [O2] ppb	51 -> 51 V [O2] RSD %
STD M+Cs+Pt / 1000		0.102	4.549	0.102	6.961
STD M+Cs+Pt / 100		0.920	0.685	0.619	6.491
STD M+Cs+Pt / 10		4.143	2.093	2.723	2.519
REF / 1000		0.011	10.919	0.035	18.621
REF / 100		0.010	11.457	0.038	16.306
A D2/20		0.168	1.298	0.148	4.352
Sulphur 102.7ppb		0.011	7.514	0.043	19.432
SLRS-5		0.286	2.017	0.213	7.639
741NASCIS FMQ-1.5 40		0.015	3.955	0.030	18.336
741NASCIS FMQ-1.5 90		0.011	4.356	0.028	10.557
741NASCIS FMQ-1.5 135		0.011	8.577	0.024	33.536
741NASCIS FMQ-1.5 180		0.017	6.404	0.025	8.374
741NASCIS FMQ-1.5 225		0.011	11.500	0.026	23.920
741NASCIS FMQ-1.5 255		0.011	7.704	0.024	33.968
741NASCIS FMQ-1.5 295		0.012	3.298	0.028	21.471
741NASCIS FMQ-1.5 330		0.011	2.336	0.022	17.044
741NASCIS FMQ-1.5 380		0.021	8.427	0.029	10.366
741NASCIS FMQ-1.5 380		0.020	6.138	0.026	23.554
741NASCIS FMQ-1.5 455		0.024	5.447	0.028	23.376
741NASCIS FMQ-1.5 510		0.018	5.364	0.025	15.771
741NASCIS FMQ-1.5 580		0.023	3.692	0.027	14.169
741NASCIS FMQ-1.5 660		0.022	7.899	0.029	13.478
741NASCIS FMQ-1.5 725		0.024	4.671	0.033	30.473
741NASCIS FMQ-1.5 830		0.045	3.660	0.044	20.708
741NASCIS FMQ-1.5 830		0.024	5.668	0.030	28.815
742NASCIS FMQ-4.6 40		0.013	8.669	0.026	15.578
742NASCIS FMQ-4.6 90		0.013	9.768	0.022	22.517
742NASCIS FMQ-4.6 135		0.011	1.629	0.027	16.157
742NASCIS FMQ-4.6 180		0.009	11.155	0.022	20.611
742NASCIS FMQ-4.6 225		0.010	8.444	0.020	31.844
742NASCIS FMQ-4.6 255		0.013	8.028	0.023	9.880
742NASCIS FMQ-4.6 295		0.028	4.225	0.032	14.208
742NASCIS FMQ-4.6 295		0.011	9.537	0.021	23.707
742NASCIS FMQ-4.6 295		0.028	4.504	0.034	12.947
742NASCIS FMQ-4.6 330		0.019	6.644	0.028	15.639
742NASCIS FMQ-4.6 380		0.011	9.013	0.021	20.234
742NASCIS FMQ-4.6 455		0.023	6.928	0.027	20.833
742NASCIS FMQ-4.6 510		0.017	5.258	0.027	21.982
742NASCIS FMQ-4.6 580		0.019	9.406	0.023	9.799
742NASCIS FMQ-4.6 660		0.037	3.643	0.035	18.460
742NASCIS FMQ-4.6 725		0.015	9.599	0.026	8.646
743NASCIS FMQ-3.0 40		0.019	4.771	0.034	17.997

Sample Name	Temperature (°C)	51 -> 51 V [H2] ppb	51 -> 51 V [H2] RSD %	52 Cr [No Gas] ppb
STD M+Cs+Pt / 1000		0.102	1.955	0.102
STD M+Cs+Pt / 100		0.923	2.966	0.322
STD M+Cs+Pt / 10		4.232	2.272	1.247
REF / 1000		0.009	17.411	0.070
REF / 100		0.008	12.509	0.066
A D2/20		0.166	2.682	0.076
Sulphur 102.7ppb		0.009	12.942	0.062
SLRS-5		0.291	3.803	0.111
741NASCIS FMQ-1.5 40		0.013	13.163	0.118
741NASCIS FMQ-1.5 90		0.010	15.882	0.110
741NASCIS FMQ-1.5 135		0.011	22.173	0.101
741NASCIS FMQ-1.5 180		0.017	11.485	0.086
741NASCIS FMQ-1.5 225		0.011	2.211	0.098
741NASCIS FMQ-1.5 255		0.010	15.359	0.112
741NASCIS FMQ-1.5 295		0.011	6.711	0.074
741NASCIS FMQ-1.5 330		0.013	11.043	0.070
741NASCIS FMQ-1.5 380		0.021	8.850	0.099
741NASCIS FMQ-1.5 380		0.021	18.647	0.102
741NASCIS FMQ-1.5 455		0.022	18.377	0.124
741NASCIS FMQ-1.5 510		0.018	12.549	0.135
741NASCIS FMQ-1.5 580		0.021	12.250	0.119
741NASCIS FMQ-1.5 660		0.022	10.643	0.459
741NASCIS FMQ-1.5 725		0.023	8.485	0.217
741NASCIS FMQ-1.5 830		0.046	8.035	0.214
741NASCIS FMQ-1.5 830		0.024	9.337	0.326
742NASCIS FMQ-4.6 40		0.012	17.609	0.149
742NASCIS FMQ-4.6 90		0.012	23.250	0.091
742NASCIS FMQ-4.6 135		0.012	3.013	0.111
742NASCIS FMQ-4.6 180		0.007	15.314	0.077
742NASCIS FMQ-4.6 225		0.008	9.011	0.134
742NASCIS FMQ-4.6 255		0.011	4.383	0.081
742NASCIS FMQ-4.6 295		0.027	7.298	0.104
742NASCIS FMQ-4.6 295		0.009	18.411	0.098
742NASCIS FMQ-4.6 295		0.026	11.014	0.107
742NASCIS FMQ-4.6 330		0.019	8.779	0.079
742NASCIS FMQ-4.6 380		0.009	5.051	0.110
742NASCIS FMQ-4.6 455		0.022	12.395	0.098
742NASCIS FMQ-4.6 510		0.014	15.950	0.226
742NASCIS FMQ-4.6 580		0.021	13.258	0.108
742NASCIS FMQ-4.6 660		0.036	6.048	0.117
742NASCIS FMQ-4.6 725		0.014	11.692	0.261
743NASCIS FMQ-3.0 40		0.018	5.432	0.083

Sample Name	Temperature (°C)	52 Cr [No Gas] RSD %	52 -> 52 Cr [O2] ppb	52 -> 52 Cr [O2] RSD %
STD M+Cs+Pt / 1000		3.135	0.102	2.096
STD M+Cs+Pt / 100		1.632	0.413	2.517
STD M+Cs+Pt / 10		2.171	1.657	0.961
REF / 1000		1.947	0.071	2.211
REF / 100		1.713	0.068	3.520
A D2/20		1.695	0.076	2.413
Sulphur 102.7ppb		1.079	0.069	3.146
SLRS-5		1.466	0.136	2.132
741NASCIS FMQ-1.5 40		1.126	0.136	2.539
741NASCIS FMQ-1.5 90		0.460	0.127	2.067
741NASCIS FMQ-1.5 135		1.312	0.109	1.965
741NASCIS FMQ-1.5 180		1.935	0.090	0.993
741NASCIS FMQ-1.5 225		2.789	0.105	1.263
741NASCIS FMQ-1.5 255		1.458	0.122	2.293
741NASCIS FMQ-1.5 295		1.404	0.075	3.109
741NASCIS FMQ-1.5 330		1.949	0.075	2.900
741NASCIS FMQ-1.5 380		1.092	0.102	1.100
741NASCIS FMQ-1.5 380		1.855	0.107	1.912
741NASCIS FMQ-1.5 455		1.571	0.139	1.338
741NASCIS FMQ-1.5 510		1.321	0.157	2.092
741NASCIS FMQ-1.5 580		1.004	0.141	1.952
741NASCIS FMQ-1.5 660		3.083	0.592	1.503
741NASCIS FMQ-1.5 725		2.924	0.266	2.318
741NASCIS FMQ-1.5 830		2.247	0.256	1.417
741NASCIS FMQ-1.5 830		1.242	0.403	2.720
742NASCIS FMQ-4.6 40		2.235	0.173	1.324
742NASCIS FMQ-4.6 90		0.974	0.098	1.648
742NASCIS FMQ-4.6 135		1.796	0.123	1.799
742NASCIS FMQ-4.6 180		1.581	0.084	2.147
742NASCIS FMQ-4.6 225		1.268	0.157	1.403
742NASCIS FMQ-4.6 255		0.858	0.081	1.450
742NASCIS FMQ-4.6 295		3.222	0.115	1.868
742NASCIS FMQ-4.6 295		0.969	0.107	1.919
742NASCIS FMQ-4.6 295		1.429	0.115	2.088
742NASCIS FMQ-4.6 330		1.145	0.080	2.810
742NASCIS FMQ-4.6 380		0.892	0.124	0.551
742NASCIS FMQ-4.6 455		2.829	0.110	2.048
742NASCIS FMQ-4.6 510		2.179	0.274	1.551
742NASCIS FMQ-4.6 580		2.365	0.121	0.776
742NASCIS FMQ-4.6 660		1.105	0.123	1.664
742NASCIS FMQ-4.6 725		1.461	0.321	1.760
743NASCIS FMQ-3.0 40		0.922	0.085	2.377

Sample Name	Temperature (°C)	56 -> 56 Fe [O2] ppb	56 -> 56 Fe [O2] RSD %	56 -> 56 Fe [H2] ppb
STD M+Cs+Pt / 1000		0.102	1.643	0.102
STD M+Cs+Pt / 100		0.209	1.510	0.202
STD M+Cs+Pt / 10		0.791	1.871	0.740
REF / 1000				0.062
REF / 100				
A D2/20				
Sulphur 102.7ppb				
SLRS-5		14.269	1.553	13.493
741NASCIS FMQ-1.5 40		26.977	1.772	25.093
741NASCIS FMQ-1.5 90		2.800	1.766	2.612
741NASCIS FMQ-1.5 135		9.334	2.357	8.724
741NASCIS FMQ-1.5 180		8.593	1.586	7.888
741NASCIS FMQ-1.5 225		10.928	1.550	10.499
741NASCIS FMQ-1.5 255		16.023	2.492	14.973
741NASCIS FMQ-1.5 295		16.407	3.298	15.332
741NASCIS FMQ-1.5 330		20.011	1.393	19.333
741NASCIS FMQ-1.5 380		25.504	2.161	25.061
741NASCIS FMQ-1.5 380		26.897	0.664	25.501
741NASCIS FMQ-1.5 455		12.038	2.526	11.456
741NASCIS FMQ-1.5 510		15.762	0.807	14.563
741NASCIS FMQ-1.5 580		7.147	1.758	6.687
741NASCIS FMQ-1.5 660		10.852	1.527	10.300
741NASCIS FMQ-1.5 725		13.822	0.990	12.977
741NASCIS FMQ-1.5 830		4.182	1.263	4.011
741NASCIS FMQ-1.5 830		4.549	2.285	4.375
742NASCIS FMQ-4.6 40		38.129	0.504	36.131
742NASCIS FMQ-4.6 90		35.832	4.631	32.645
742NASCIS FMQ-4.6 135		2.304	0.439	2.158
742NASCIS FMQ-4.6 180		20.880	1.196	19.904
742NASCIS FMQ-4.6 225		28.081	1.280	26.316
742NASCIS FMQ-4.6 255		72.240	2.100	68.306
742NASCIS FMQ-4.6 295		46.949	1.677	44.442
742NASCIS FMQ-4.6 295		45.886	1.066	43.572
742NASCIS FMQ-4.6 295		47.658	1.188	45.304
742NASCIS FMQ-4.6 330		48.209	1.265	46.011
742NASCIS FMQ-4.6 380		41.840	1.365	39.586
742NASCIS FMQ-4.6 455		59.212	1.622	56.060
742NASCIS FMQ-4.6 510		41.511	1.646	38.779
742NASCIS FMQ-4.6 580		19.590	0.543	18.614
742NASCIS FMQ-4.6 660		6.836	1.685	6.368
742NASCIS FMQ-4.6 725		5.680	1.946	5.456
743NASCIS FMQ-3.0 40		4.447	0.963	4.151

Sample Name	Temperature (°C)	56 -> 56 Fe [H2] RSD %	57 Fe [No Gas] ppb	57 Fe [No Gas] RSD %
STD M+Cs+Pt / 1000		2.453	0.102	1.759
STD M+Cs+Pt / 100		1.518	0.105	0.531
STD M+Cs+Pt / 10		1.317	0.116	1.621
REF / 1000		3.050	0.101	2.021
REF / 100			0.098	1.473
A D2/20			0.098	0.942
Sulphur 102.7ppb			0.102	1.313
SLRS-5		1.253	0.497	1.253
741NASCIS FMQ-1.5 40		1.471	0.692	1.557
741NASCIS FMQ-1.5 90		2.052	0.167	1.158
741NASCIS FMQ-1.5 135		2.371	0.319	1.660
741NASCIS FMQ-1.5 180		0.928	0.290	1.390
741NASCIS FMQ-1.5 225		2.002	0.355	3.097
741NASCIS FMQ-1.5 255		3.965	0.457	1.123
741NASCIS FMQ-1.5 295		1.304	0.464	1.639
741NASCIS FMQ-1.5 330		1.476	0.548	1.727
741NASCIS FMQ-1.5 380		2.032	0.677	2.590
741NASCIS FMQ-1.5 380		1.085	0.697	1.745
741NASCIS FMQ-1.5 455		1.755	0.364	1.882
741NASCIS FMQ-1.5 510		2.081	0.451	1.052
741NASCIS FMQ-1.5 580		1.786	0.263	1.195
741NASCIS FMQ-1.5 660		1.906	0.334	2.897
741NASCIS FMQ-1.5 725		1.384	0.400	3.411
741NASCIS FMQ-1.5 830		1.875	0.192	1.476
741NASCIS FMQ-1.5 830		1.524	0.207	0.718
742NASCIS FMQ-4.6 40		2.207	0.943	1.587
742NASCIS FMQ-4.6 90		2.031	0.929	2.801
742NASCIS FMQ-4.6 135		2.215	0.153	1.380
742NASCIS FMQ-4.6 180		1.395	0.570	1.343
742NASCIS FMQ-4.6 225		1.703	0.731	1.561
742NASCIS FMQ-4.6 255		3.355	1.813	2.383
742NASCIS FMQ-4.6 295		1.251	1.147	1.038
742NASCIS FMQ-4.6 295		1.715	1.140	1.209
742NASCIS FMQ-4.6 295		1.856	1.172	2.375
742NASCIS FMQ-4.6 330		1.674	1.183	2.701
742NASCIS FMQ-4.6 380		1.113	1.036	1.435
742NASCIS FMQ-4.6 455		2.069	1.409	1.895
742NASCIS FMQ-4.6 510		1.834	1.022	2.241
742NASCIS FMQ-4.6 580		1.809	0.541	1.199
742NASCIS FMQ-4.6 660		1.587	0.261	0.959
742NASCIS FMQ-4.6 725		1.752	0.235	1.411
743NASCIS FMQ-3.0 40		1.509	0.201	1.309

Sample Name	Temperature (°C)	59 Co [No Gas] ppb	59 Co [No Gas] RSD %	59 -> 59 Co [O2] ppb
STD M+Cs+Pt / 1000		0.102	2.471	0.102
STD M+Cs+Pt / 100		0.920	2.070	0.999
STD M+Cs+Pt / 10		4.142	1.916	4.560
REF / 1000		0.010	11.786	0.003
REF / 100		0.009	5.587	0.004
A D2/20		0.112	2.864	0.120
Sulphur 102.7ppb		0.010	7.416	0.004
SLRS-5		0.062	3.870	0.057
741NASCIS FMQ-1.5 40		0.016	9.604	0.011
741NASCIS FMQ-1.5 90		0.011	4.596	0.005
741NASCIS FMQ-1.5 135		0.011	6.601	0.006
741NASCIS FMQ-1.5 180		0.011	2.813	0.006
741NASCIS FMQ-1.5 225		0.012	3.196	0.008
741NASCIS FMQ-1.5 255		0.013	3.869	0.008
741NASCIS FMQ-1.5 295		0.012	7.573	0.006
741NASCIS FMQ-1.5 330		0.013	6.080	0.007
741NASCIS FMQ-1.5 380		0.015	5.886	0.010
741NASCIS FMQ-1.5 380		0.017	5.831	0.010
741NASCIS FMQ-1.5 455		0.013	5.042	0.007
741NASCIS FMQ-1.5 510		0.020	7.198	0.016
741NASCIS FMQ-1.5 580		0.016	5.529	0.012
741NASCIS FMQ-1.5 660		0.018	3.042	0.013
741NASCIS FMQ-1.5 725		0.020	2.556	0.015
741NASCIS FMQ-1.5 830		0.018	6.323	0.014
741NASCIS FMQ-1.5 830		0.017	13.309	0.012
742NASCIS FMQ-4.6 40		0.014	6.496	0.009
742NASCIS FMQ-4.6 90		0.015	8.890	0.009
742NASCIS FMQ-4.6 135		0.010	9.501	0.005
742NASCIS FMQ-4.6 180		0.012	4.070	0.006
742NASCIS FMQ-4.6 225		0.012	12.189	0.007
742NASCIS FMQ-4.6 255		0.017	5.993	0.011
742NASCIS FMQ-4.6 295		0.014	4.379	0.008
742NASCIS FMQ-4.6 295		0.013	7.750	0.010
742NASCIS FMQ-4.6 295		0.014	8.378	0.008
742NASCIS FMQ-4.6 330		0.014	4.310	0.009
742NASCIS FMQ-4.6 380		0.017	4.318	0.012
742NASCIS FMQ-4.6 455		0.029	4.655	0.024
742NASCIS FMQ-4.6 510		0.023	7.190	0.018
742NASCIS FMQ-4.6 580		0.014	3.981	0.007
742NASCIS FMQ-4.6 660		0.012	7.163	0.006
742NASCIS FMQ-4.6 725		0.017	4.660	0.012
743NASCIS FMQ-3.0 40		0.017	5.965	0.013

Sample Name	Temperature (°C)	59 -> 59 Co [O2] RSD %	60 Ni [No Gas] ppb	60 Ni [No Gas] RSD %
STD M+Cs+Pt / 1000		3.729	0.105	4.912
STD M+Cs+Pt / 100		2.336	0.921	2.173
STD M+Cs+Pt / 10		2.175	4.200	2.373
REF / 1000		16.325	0.026	10.195
REF / 100		11.086	0.022	13.568
A D2/20		4.146	0.282	3.849
Sulphur 102.7ppb		19.264	0.011	21.685
SLRS-5		7.424	0.469	1.670
741NASCIS FMQ-1.5 40		5.456	7.421	0.466
741NASCIS FMQ-1.5 90		3.095	0.855	2.115
741NASCIS FMQ-1.5 135		16.686	2.652	2.462
741NASCIS FMQ-1.5 180		9.530	2.630	2.776
741NASCIS FMQ-1.5 225		18.075	3.138	4.391
741NASCIS FMQ-1.5 255		20.323	4.308	2.306
741NASCIS FMQ-1.5 295		12.105	4.349	2.856
741NASCIS FMQ-1.5 330		10.368	5.431	1.990
741NASCIS FMQ-1.5 380		11.413	7.035	2.964
741NASCIS FMQ-1.5 380		13.654	7.139	2.146
741NASCIS FMQ-1.5 455		5.544	3.486	1.055
741NASCIS FMQ-1.5 510		8.120	5.230	3.164
741NASCIS FMQ-1.5 580		11.067	1.589	1.662
741NASCIS FMQ-1.5 660		8.796	2.369	3.826
741NASCIS FMQ-1.5 725		5.241	2.343	4.415
741NASCIS FMQ-1.5 830		6.891	0.914	2.127
741NASCIS FMQ-1.5 830		5.193	1.002	2.396
742NASCIS FMQ-4.6 40		11.286	8.748	1.315
742NASCIS FMQ-4.6 90		13.710	8.425	1.181
742NASCIS FMQ-4.6 135		7.601	0.990	4.092
742NASCIS FMQ-4.6 180		17.027	4.923	1.208
742NASCIS FMQ-4.6 225		10.486	6.258	2.189
742NASCIS FMQ-4.6 255		9.323	16.908	2.465
742NASCIS FMQ-4.6 295		10.513	10.360	2.320
742NASCIS FMQ-4.6 295		9.433	10.179	2.111
742NASCIS FMQ-4.6 295		7.186	10.408	3.121
742NASCIS FMQ-4.6 330		3.982	10.702	2.452
742NASCIS FMQ-4.6 380		14.159	9.344	1.704
742NASCIS FMQ-4.6 455		6.529	15.707	2.823
742NASCIS FMQ-4.6 510		9.593	13.706	2.072
742NASCIS FMQ-4.6 580		11.882	8.406	2.405
742NASCIS FMQ-4.6 660		9.617	2.001	1.335
742NASCIS FMQ-4.6 725		8.913	1.050	1.866
743NASCIS FMQ-3.0 40		13.302	1.746	1.208

Sample Name	Temperature (°C)	60 -> 60 Ni [O2] ppb	60 -> 60 Ni [O2] RSD %	63 Cu [No Gas] ppb
STD M+Cs+Pt / 1000		0.112	7.709	0.102
STD M+Cs+Pt / 100		0.958	3.684	0.832
STD M+Cs+Pt / 10		4.222	0.486	3.766
REF / 1000		0.030	4.557	0.019
REF / 100		0.023	12.587	0.019
A D2/20		0.282	3.014	1.007
Sulphur 102.7ppb		0.015	15.705	0.020
SLRS-5		0.443	3.716	14.260
741NASCIS FMQ-1.5 40		7.619	2.253	0.502
741NASCIS FMQ-1.5 90		0.871	2.703	0.061
741NASCIS FMQ-1.5 135		2.557	2.375	0.095
741NASCIS FMQ-1.5 180		2.660	2.504	0.164
741NASCIS FMQ-1.5 225		3.026	2.425	0.159
741NASCIS FMQ-1.5 255		4.322	3.726	0.254
741NASCIS FMQ-1.5 295		4.428	2.211	0.296
741NASCIS FMQ-1.5 330		5.497	1.878	0.342
741NASCIS FMQ-1.5 380		6.965	2.097	0.871
741NASCIS FMQ-1.5 380		7.224	1.314	0.893
741NASCIS FMQ-1.5 455		3.511	3.019	1.482
741NASCIS FMQ-1.5 510		5.296	1.734	3.677
741NASCIS FMQ-1.5 580		1.604	1.640	3.621
741NASCIS FMQ-1.5 660		2.394	1.597	8.123
741NASCIS FMQ-1.5 725		2.372	1.793	86.984
741NASCIS FMQ-1.5 830		0.914	2.555	53.833
741NASCIS FMQ-1.5 830		0.978	1.769	36.483
742NASCIS FMQ-4.6 40		8.676	1.794	0.272
742NASCIS FMQ-4.6 90		8.138	5.030	0.279
742NASCIS FMQ-4.6 135		0.965	1.388	0.052
742NASCIS FMQ-4.6 180		4.862	2.724	0.096
742NASCIS FMQ-4.6 225		6.289	0.636	0.124
742NASCIS FMQ-4.6 255		16.170	2.038	1.203
742NASCIS FMQ-4.6 295		10.313	1.178	0.217
742NASCIS FMQ-4.6 295		10.033	0.728	0.170
742NASCIS FMQ-4.6 295		10.320	1.007	0.213
742NASCIS FMQ-4.6 330		10.787	1.436	0.132
742NASCIS FMQ-4.6 380		9.475	1.885	0.374
742NASCIS FMQ-4.6 455		15.690	1.387	3.183
742NASCIS FMQ-4.6 510		13.687	0.637	3.878
742NASCIS FMQ-4.6 580		8.377	1.178	6.336
742NASCIS FMQ-4.6 660		2.032	1.998	3.065
742NASCIS FMQ-4.6 725		1.070	3.803	16.338
743NASCIS FMQ-3.0 40		1.781	1.338	0.599

Sample Name	Temperature (°C)	63 Cu [No Gas] RSD %	63 -> 63 Cu [O2] ppb	63 -> 63 Cu [O2] RSD %
STD M+Cs+Pt / 1000		2.463	0.102	4.054
STD M+Cs+Pt / 100		2.230	0.827	0.968
STD M+Cs+Pt / 10		1.849	3.631	0.911
REF / 1000		6.278	0.021	14.091
REF / 100		8.449	0.017	7.106
A D2/20		0.872	1.012	3.092
Sulphur 102.7ppb		6.294	0.022	13.308
SLRS-5		1.624	13.483	0.594
741NASCIS FMQ-1.5 40		2.383	0.508	2.909
741NASCIS FMQ-1.5 90		2.477	0.060	6.278
741NASCIS FMQ-1.5 135		1.271	0.088	6.377
741NASCIS FMQ-1.5 180		3.644	0.152	4.908
741NASCIS FMQ-1.5 225		5.182	0.148	3.332
741NASCIS FMQ-1.5 255		3.640	0.246	2.154
741NASCIS FMQ-1.5 295		3.256	0.289	2.355
741NASCIS FMQ-1.5 330		2.597	0.338	3.593
741NASCIS FMQ-1.5 380		3.308	0.831	2.233
741NASCIS FMQ-1.5 380		1.395	0.874	1.842
741NASCIS FMQ-1.5 455		2.121	1.437	2.526
741NASCIS FMQ-1.5 510		1.643	3.587	1.206
741NASCIS FMQ-1.5 580		0.978	3.542	1.417
741NASCIS FMQ-1.5 660		2.185	8.140	0.522
741NASCIS FMQ-1.5 725		3.466	86.501	1.173
741NASCIS FMQ-1.5 830		2.142	51.383	0.974
741NASCIS FMQ-1.5 830		0.961	34.918	1.520
742NASCIS FMQ-4.6 40		1.296	0.260	2.510
742NASCIS FMQ-4.6 90		3.813	0.259	3.687
742NASCIS FMQ-4.6 135		2.568	0.049	5.504
742NASCIS FMQ-4.6 180		3.703	0.090	2.532
742NASCIS FMQ-4.6 225		2.227	0.118	2.724
742NASCIS FMQ-4.6 255		2.674	1.136	1.455
742NASCIS FMQ-4.6 295		1.799	0.201	3.155
742NASCIS FMQ-4.6 295		1.543	0.158	2.080
742NASCIS FMQ-4.6 295		2.024	0.204	2.390
742NASCIS FMQ-4.6 330		4.189	0.128	3.159
742NASCIS FMQ-4.6 380		3.046	0.370	1.878
742NASCIS FMQ-4.6 455		3.024	3.120	1.143
742NASCIS FMQ-4.6 510		1.489	3.767	1.904
742NASCIS FMQ-4.6 580		1.437	6.103	1.996
742NASCIS FMQ-4.6 660		2.549	2.986	0.801
742NASCIS FMQ-4.6 725		1.594	15.654	1.829
743NASCIS FMQ-3.0 40		2.430	0.591	1.506

Sample Name	Temperature (°C)	65 Cu [No Gas] ppb	65 Cu [No Gas] RSD %	65 -> 65 Cu [O2] ppb
STD M+Cs+Pt / 1000		0.102	3.343	0.102
STD M+Cs+Pt / 100		0.847	1.996	0.798
STD M+Cs+Pt / 10		3.755	2.982	3.479
REF / 1000		0.018	6.210	0.018
REF / 100		0.017	7.492	0.015
A D2/20		1.002	1.581	0.944
Sulphur 102.7ppb		0.021	13.735	0.021
SLRS-5		14.384	1.182	12.646
741NASCIS FMQ-1.5 40		0.517	2.736	0.477
741NASCIS FMQ-1.5 90		0.063	3.634	0.056
741NASCIS FMQ-1.5 135		0.092	6.984	0.089
741NASCIS FMQ-1.5 180		0.158	4.382	0.153
741NASCIS FMQ-1.5 225		0.159	5.072	0.136
741NASCIS FMQ-1.5 255		0.256	3.165	0.240
741NASCIS FMQ-1.5 295		0.285	2.911	0.272
741NASCIS FMQ-1.5 330		0.342	4.159	0.326
741NASCIS FMQ-1.5 380		0.876	3.326	0.781
741NASCIS FMQ-1.5 380		0.900	2.107	0.839
741NASCIS FMQ-1.5 455		1.471	0.709	1.358
741NASCIS FMQ-1.5 510		3.678	1.263	3.325
741NASCIS FMQ-1.5 580		3.623	1.781	3.311
741NASCIS FMQ-1.5 660		8.176	2.655	7.602
741NASCIS FMQ-1.5 725		87.539	3.106	79.581
741NASCIS FMQ-1.5 830		53.564	1.834	48.348
741NASCIS FMQ-1.5 830		36.440	1.787	33.070
742NASCIS FMQ-4.6 40		0.273	4.148	0.253
742NASCIS FMQ-4.6 90		0.275	2.354	0.245
742NASCIS FMQ-4.6 135		0.051	5.926	0.045
742NASCIS FMQ-4.6 180		0.096	6.539	0.087
742NASCIS FMQ-4.6 225		0.119	3.441	0.107
742NASCIS FMQ-4.6 255		1.227	3.249	1.070
742NASCIS FMQ-4.6 295		0.213	2.761	0.190
742NASCIS FMQ-4.6 295		0.165	4.368	0.150
742NASCIS FMQ-4.6 295		0.212	1.437	0.197
742NASCIS FMQ-4.6 330		0.128	8.004	0.119
742NASCIS FMQ-4.6 380		0.385	1.991	0.345
742NASCIS FMQ-4.6 455		3.237	1.709	2.900
742NASCIS FMQ-4.6 510		3.886	1.390	3.504
742NASCIS FMQ-4.6 580		6.408	1.594	5.675
742NASCIS FMQ-4.6 660		3.076	1.139	2.813
742NASCIS FMQ-4.6 725		16.188	1.790	14.711
743NASCIS FMQ-3.0 40		0.598	3.035	0.564

Sample Name	Temperature (°C)	65 -> 65 Cu [O2] RSD %	66 Zn [No Gas] ppb	66 Zn [No Gas] RSD %
STD M+Cs+Pt / 1000		4.129		
STD M+Cs+Pt / 100		4.340	0.708	1.473
STD M+Cs+Pt / 10		2.009	3.134	0.993
REF / 1000		15.322		
REF / 100		12.139		
A D2/20		2.051	0.904	1.698
Sulphur 102.7ppb		9.981		12.667
SLRS-5		2.047	0.694	1.882
741NASCIS FMQ-1.5 40		1.842		
741NASCIS FMQ-1.5 90		7.627		
741NASCIS FMQ-1.5 135		6.268		
741NASCIS FMQ-1.5 180		3.005		
741NASCIS FMQ-1.5 225		5.323		
741NASCIS FMQ-1.5 255		5.881	0.525	4.173
741NASCIS FMQ-1.5 295		3.538	0.515	2.654
741NASCIS FMQ-1.5 330		4.432	0.471	2.655
741NASCIS FMQ-1.5 380		3.426	1.276	3.838
741NASCIS FMQ-1.5 380		1.140	1.303	0.753
741NASCIS FMQ-1.5 455		1.654	1.630	0.969
741NASCIS FMQ-1.5 510		1.942	2.175	1.870
741NASCIS FMQ-1.5 580		1.643	1.188	2.066
741NASCIS FMQ-1.5 660		1.403	1.367	2.002
741NASCIS FMQ-1.5 725		2.471	1.072	5.299
741NASCIS FMQ-1.5 830		0.620	0.926	2.759
741NASCIS FMQ-1.5 830		1.040	0.842	1.959
742NASCIS FMQ-4.6 40		3.754		
742NASCIS FMQ-4.6 90		3.713		
742NASCIS FMQ-4.6 135		8.517		
742NASCIS FMQ-4.6 180		5.453		
742NASCIS FMQ-4.6 225		6.391		
742NASCIS FMQ-4.6 255		3.364	1.075	3.951
742NASCIS FMQ-4.6 295		4.100	1.267	1.337
742NASCIS FMQ-4.6 295		4.612	0.828	2.326
742NASCIS FMQ-4.6 295		3.246	1.271	1.639
742NASCIS FMQ-4.6 330		7.955	2.909	1.798
742NASCIS FMQ-4.6 380		4.356	3.191	2.229
742NASCIS FMQ-4.6 455		1.338	7.682	2.142
742NASCIS FMQ-4.6 510		2.225	6.059	2.446
742NASCIS FMQ-4.6 580		0.729	1.421	2.100
742NASCIS FMQ-4.6 660		1.465	1.268	1.397
742NASCIS FMQ-4.6 725		1.400		
743NASCIS FMQ-3.0 40		1.266	2.380	2.538

Sample Name	Temperature (°C)	66 -> 66 Zn [O2] ppb	66 -> 66 Zn [O2] RSD %	75 As [No Gas] ppb
STD M+Cs+Pt / 1000				0.102
STD M+Cs+Pt / 100		0.712	4.914	0.893
STD M+Cs+Pt / 10		3.185	1.998	4.074
REF / 1000				0.019
REF / 100				0.016
A D2/20		0.901	2.589	0.073
Sulphur 102.7ppb			15.401	0.023
SLRS-5		0.657	2.981	0.391
741NASCIS FMQ-1.5 40				0.020
741NASCIS FMQ-1.5 90				0.017
741NASCIS FMQ-1.5 135				0.018
741NASCIS FMQ-1.5 180				0.018
741NASCIS FMQ-1.5 225				0.021
741NASCIS FMQ-1.5 255		0.512	4.819	0.022
741NASCIS FMQ-1.5 295		0.516	3.220	0.022
741NASCIS FMQ-1.5 330		0.468	5.986	0.026
741NASCIS FMQ-1.5 380		1.257	3.642	0.079
741NASCIS FMQ-1.5 380		1.279	2.498	0.080
741NASCIS FMQ-1.5 455		1.625	2.221	0.073
741NASCIS FMQ-1.5 510		2.126	1.315	0.125
741NASCIS FMQ-1.5 580		1.175	2.018	0.245
741NASCIS FMQ-1.5 660		1.385	1.469	0.315
741NASCIS FMQ-1.5 725		1.090	1.265	0.402
741NASCIS FMQ-1.5 830		0.903	3.469	0.033
741NASCIS FMQ-1.5 830		0.814	4.236	0.026
742NASCIS FMQ-4.6 40				0.568
742NASCIS FMQ-4.6 90				1.516
742NASCIS FMQ-4.6 135				0.461
742NASCIS FMQ-4.6 180				1.300
742NASCIS FMQ-4.6 225				1.406
742NASCIS FMQ-4.6 255		1.022	3.485	2.613
742NASCIS FMQ-4.6 295		1.244	3.712	1.775
742NASCIS FMQ-4.6 295		0.798	3.315	1.709
742NASCIS FMQ-4.6 295		1.270	4.117	1.791
742NASCIS FMQ-4.6 330		2.893	0.604	1.413
742NASCIS FMQ-4.6 380		3.164	1.558	0.361
742NASCIS FMQ-4.6 455		7.704	1.022	5.419
742NASCIS FMQ-4.6 510		5.985	0.869	5.531
742NASCIS FMQ-4.6 580		1.368	0.568	1.674
742NASCIS FMQ-4.6 660		1.262	3.218	0.247
742NASCIS FMQ-4.6 725				0.268
743NASCIS FMQ-3.0 40		2.421	2.654	0.042

Sample Name	Temperature (°C)	75 As [No Gas] RSD %	78 Se [No Gas] ppb	78 Se [No Gas] RSD %
STD M+Cs+Pt / 1000		4.210	0.102	1.155
STD M+Cs+Pt / 100		2.293	0.108	1.215
STD M+Cs+Pt / 10		2.113	0.121	0.484
REF / 1000		10.266	0.103	0.708
REF / 100		33.439	0.101	1.203
A D2/20		5.200	0.102	0.713
Sulphur 102.7ppb		15.192	0.104	1.874
SLRS-5		2.531	0.099	1.154
741NASCIS FMQ-1.5 40		16.838	0.108	1.205
741NASCIS FMQ-1.5 90		10.906	0.109	1.171
741NASCIS FMQ-1.5 135		8.179	0.105	1.624
741NASCIS FMQ-1.5 180		10.748	0.107	1.605
741NASCIS FMQ-1.5 225		6.364	0.109	1.093
741NASCIS FMQ-1.5 255		17.073	0.110	0.998
741NASCIS FMQ-1.5 295		10.532	0.109	1.629
741NASCIS FMQ-1.5 330		16.417	0.107	0.982
741NASCIS FMQ-1.5 380		6.802	0.109	1.388
741NASCIS FMQ-1.5 380		10.910	0.117	1.791
741NASCIS FMQ-1.5 455		7.756	0.106	0.984
741NASCIS FMQ-1.5 510		6.313	0.106	0.659
741NASCIS FMQ-1.5 580		3.463	0.106	0.959
741NASCIS FMQ-1.5 660		7.407	0.110	1.540
741NASCIS FMQ-1.5 725		3.618	0.108	0.765
741NASCIS FMQ-1.5 830		7.874	0.106	0.945
741NASCIS FMQ-1.5 830		8.083	0.111	1.786
742NASCIS FMQ-4.6 40		3.546	0.110	1.017
742NASCIS FMQ-4.6 90		2.548	0.110	0.944
742NASCIS FMQ-4.6 135		2.249	0.110	1.497
742NASCIS FMQ-4.6 180		1.724	0.111	1.115
742NASCIS FMQ-4.6 225		2.099	0.109	0.687
742NASCIS FMQ-4.6 255		1.547	0.111	0.688
742NASCIS FMQ-4.6 295		1.057	0.111	0.924
742NASCIS FMQ-4.6 295		2.640	0.115	1.666
742NASCIS FMQ-4.6 295		1.023	0.115	1.195
742NASCIS FMQ-4.6 330		1.469	0.110	0.864
742NASCIS FMQ-4.6 380		5.770	0.112	0.725
742NASCIS FMQ-4.6 455		1.691	0.115	1.025
742NASCIS FMQ-4.6 510		2.602	0.113	1.288
742NASCIS FMQ-4.6 580		2.190	0.113	0.911
742NASCIS FMQ-4.6 660		5.030	0.115	1.237
742NASCIS FMQ-4.6 725		3.767	0.113	1.133
743NASCIS FMQ-3.0 40		7.260	0.108	1.220

Sample Name	Temperature (°C)	85 Rb [No Gas] ppb	85 Rb [No Gas] RSD %	89 Y [No Gas] ppb
STD M+Cs+Pt / 1000		0.002	17.341	
STD M+Cs+Pt / 100		0.002	6.422	
STD M+Cs+Pt / 10		0.002	19.111	0.000
REF / 1000		0.001	18.883	
REF / 100		0.001	16.007	
A D2/20		0.487	2.830	4.923
Sulphur 102.7ppb		0.002	14.916	0.000
SLRS-5		1.020	0.897	0.091
741NASCIS FMQ-1.5 40		0.013	2.701	0.000
741NASCIS FMQ-1.5 90		0.002	14.569	0.000
741NASCIS FMQ-1.5 135		0.008	4.522	
741NASCIS FMQ-1.5 180		0.010	3.342	0.000
741NASCIS FMQ-1.5 225		0.013	6.306	0.000
741NASCIS FMQ-1.5 255		0.035	4.568	0.000
741NASCIS FMQ-1.5 295		0.076	2.041	0.000
741NASCIS FMQ-1.5 330		0.153	2.971	
741NASCIS FMQ-1.5 380		0.107	6.679	0.000
741NASCIS FMQ-1.5 380		0.107	3.820	0.000
741NASCIS FMQ-1.5 455		0.143	3.338	0.001
741NASCIS FMQ-1.5 510		0.065	4.966	0.003
741NASCIS FMQ-1.5 580		0.047	2.924	0.026
741NASCIS FMQ-1.5 660		0.051	0.919	0.182
741NASCIS FMQ-1.5 725		0.032	3.752	0.496
741NASCIS FMQ-1.5 830		0.028	5.447	0.025
741NASCIS FMQ-1.5 830		0.022	3.343	0.008
742NASCIS FMQ-4.6 40		0.016	6.987	0.000
742NASCIS FMQ-4.6 90		0.019	5.250	0.000
742NASCIS FMQ-4.6 135		0.004	15.257	0.000
742NASCIS FMQ-4.6 180		0.015	4.443	0.000
742NASCIS FMQ-4.6 225		0.023	6.293	0.000
742NASCIS FMQ-4.6 255		0.072	6.687	0.000
742NASCIS FMQ-4.6 295		0.105	1.310	0.000
742NASCIS FMQ-4.6 295		0.067	1.481	0.000
742NASCIS FMQ-4.6 295		0.106	3.342	0.000
742NASCIS FMQ-4.6 330		0.044	2.900	0.000
742NASCIS FMQ-4.6 380		0.043	2.444	0.000
742NASCIS FMQ-4.6 455		0.081	4.061	0.003
742NASCIS FMQ-4.6 510		0.040	3.957	0.002
742NASCIS FMQ-4.6 580		0.019	5.184	0.001
742NASCIS FMQ-4.6 660		0.020	3.453	0.228
742NASCIS FMQ-4.6 725		0.010	8.978	0.142
743NASCIS FMQ-3.0 40		0.005	10.603	0.000

Sample Name	Temperature (°C)	89 Y [No Gas] RSD %	75 -> 91 As [O2] ppb	75 -> 91 As [O2] RSD %
STD M+Cs+Pt / 1000			0.102	7.737
STD M+Cs+Pt / 100			0.986	1.912
STD M+Cs+Pt / 10		13.087	4.476	2.316
REF / 1000			0.006	38.028
REF / 100			0.003	64.924
A D2/20		2.376	0.060	3.898
Sulphur 102.7ppb		12.232	0.003	112.168
SLRS-5		1.521	0.394	3.310
741NASCIS FMQ-1.5 40		10.200	0.010	28.461
741NASCIS FMQ-1.5 90		43.332	0.004	18.882
741NASCIS FMQ-1.5 135			0.005	20.210
741NASCIS FMQ-1.5 180		56.048	0.006	58.265
741NASCIS FMQ-1.5 225		35.558	0.007	45.402
741NASCIS FMQ-1.5 255		36.447	0.008	16.718
741NASCIS FMQ-1.5 295		31.382	0.010	40.126
741NASCIS FMQ-1.5 330			0.014	8.411
741NASCIS FMQ-1.5 380		22.664	0.072	9.275
741NASCIS FMQ-1.5 380		26.174	0.069	9.226
741NASCIS FMQ-1.5 455		18.203	0.069	7.504
741NASCIS FMQ-1.5 510		7.857	0.127	9.511
741NASCIS FMQ-1.5 580		4.292	0.244	7.451
741NASCIS FMQ-1.5 660		4.168	0.333	4.500
741NASCIS FMQ-1.5 725		3.195	0.401	3.690
741NASCIS FMQ-1.5 830		2.914	0.024	12.322
741NASCIS FMQ-1.5 830		5.605	0.020	25.930
742NASCIS FMQ-4.6 40		30.314	0.608	4.309
742NASCIS FMQ-4.6 90		37.471	1.589	5.654
742NASCIS FMQ-4.6 135		19.276	0.500	7.545
742NASCIS FMQ-4.6 180		35.353	1.395	2.568
742NASCIS FMQ-4.6 225		26.142	1.527	4.798
742NASCIS FMQ-4.6 255		22.051	2.699	1.498
742NASCIS FMQ-4.6 295		18.256	1.922	2.043
742NASCIS FMQ-4.6 295		40.819	1.835	1.222
742NASCIS FMQ-4.6 295		26.765	1.959	1.770
742NASCIS FMQ-4.6 330		38.721	1.512	2.194
742NASCIS FMQ-4.6 380		38.134	0.372	6.415
742NASCIS FMQ-4.6 455		8.345	6.054	1.564
742NASCIS FMQ-4.6 510		14.743	6.024	1.591
742NASCIS FMQ-4.6 580		18.697	1.774	2.624
742NASCIS FMQ-4.6 660		0.329	0.243	3.294
742NASCIS FMQ-4.6 725		1.734	0.282	3.860
743NASCIS FMQ-3.0 40		22.030	0.028	14.434

Sample Name	Temperature (°C)	78 -> 94 Se [O2] ppb	78 -> 94 Se [O2] RSD %	95 Mo [No Gas] ppb
STD M+Cs+Pt / 1000		0.102	73.011	0.102
STD M+Cs+Pt / 100		0.920	18.251	0.978
STD M+Cs+Pt / 10		4.366	6.637	15.417
REF / 1000				0.213
REF / 100				1.931
A D2/20		0.314	18.377	0.004
Sulphur 102.7ppb				
SLRS-5		0.081	46.326	0.183
741NASCIS FMQ-1.5 40				0.271
741NASCIS FMQ-1.5 90				0.015
741NASCIS FMQ-1.5 135				0.026
741NASCIS FMQ-1.5 180				0.042
741NASCIS FMQ-1.5 225				0.061
741NASCIS FMQ-1.5 255				0.057
741NASCIS FMQ-1.5 295				0.080
741NASCIS FMQ-1.5 330				0.117
741NASCIS FMQ-1.5 380				0.136
741NASCIS FMQ-1.5 380		0.022	136.931	0.143
741NASCIS FMQ-1.5 455				1.130
741NASCIS FMQ-1.5 510				0.586
741NASCIS FMQ-1.5 580				2.391
741NASCIS FMQ-1.5 660				2.380
741NASCIS FMQ-1.5 725				2.718
741NASCIS FMQ-1.5 830				0.284
741NASCIS FMQ-1.5 830		0.016	149.022	0.255
742NASCIS FMQ-4.6 40				1.494
742NASCIS FMQ-4.6 90				0.548
742NASCIS FMQ-4.6 135				0.075
742NASCIS FMQ-4.6 180				0.103
742NASCIS FMQ-4.6 225				0.130
742NASCIS FMQ-4.6 255				0.326
742NASCIS FMQ-4.6 295				0.242
742NASCIS FMQ-4.6 295				0.161
742NASCIS FMQ-4.6 295				0.236
742NASCIS FMQ-4.6 330				0.430
742NASCIS FMQ-4.6 380				0.358
742NASCIS FMQ-4.6 455				1.116
742NASCIS FMQ-4.6 510				1.685
742NASCIS FMQ-4.6 580				0.967
742NASCIS FMQ-4.6 660				1.218
742NASCIS FMQ-4.6 725				1.077
743NASCIS FMQ-3.0 40				3.812

Sample Name	Temperature (°C)	95 Mo [No Gas] RSD %	103 Rh [No Gas] CPS	103 Rh [No Gas] RSD %
STD M+Cs+Pt / 1000		3.285	200804.258	2.172
STD M+Cs+Pt / 100		1.269	202684.398	0.366
STD M+Cs+Pt / 10		2.913	203079.658	2.639
REF / 1000		3.379	200565.358	2.551
REF / 100		0.883	200858.662	1.465
A D2/20		19.612	205135.428	1.235
Sulphur 102.7ppb			193788.726	2.720
SLRS-5		6.057	213086.868	0.604
741NASCIS FMQ-1.5 40		3.237	218945.740	1.932
741NASCIS FMQ-1.5 90		7.462	198447.256	2.533
741NASCIS FMQ-1.5 135		11.159	203708.008	2.958
741NASCIS FMQ-1.5 180		3.824	205411.686	1.798
741NASCIS FMQ-1.5 225		4.382	201451.844	2.527
741NASCIS FMQ-1.5 255		9.249	207632.656	3.771
741NASCIS FMQ-1.5 295		8.805	208865.996	3.553
741NASCIS FMQ-1.5 330		3.372	212673.748	2.446
741NASCIS FMQ-1.5 380		3.567	243089.634	3.437
741NASCIS FMQ-1.5 380		5.347	238243.568	2.752
741NASCIS FMQ-1.5 455		1.632	232137.716	0.925
741NASCIS FMQ-1.5 510		0.250	239844.288	1.580
741NASCIS FMQ-1.5 580		1.835	215219.600	1.543
741NASCIS FMQ-1.5 660		3.210	218454.176	2.617
741NASCIS FMQ-1.5 725		4.270	236500.260	2.441
741NASCIS FMQ-1.5 830		4.960	203714.242	2.932
741NASCIS FMQ-1.5 830		2.030	202611.160	1.175
742NASCIS FMQ-4.6 40		2.295	203628.408	0.974
742NASCIS FMQ-4.6 90		1.830	200090.032	1.288
742NASCIS FMQ-4.6 135		8.717	202347.658	4.899
742NASCIS FMQ-4.6 180		7.332	198974.870	1.826
742NASCIS FMQ-4.6 225		5.184	201836.098	1.416
742NASCIS FMQ-4.6 255		3.393	202142.490	3.738
742NASCIS FMQ-4.6 295		4.386	200029.644	1.233
742NASCIS FMQ-4.6 295		6.254	200928.562	5.164
742NASCIS FMQ-4.6 295		4.920	198865.072	1.605
742NASCIS FMQ-4.6 330		5.164	203752.666	1.139
742NASCIS FMQ-4.6 380		3.671	203440.870	2.901
742NASCIS FMQ-4.6 455		2.112	206025.756	2.660
742NASCIS FMQ-4.6 510		0.736	212858.268	2.455
742NASCIS FMQ-4.6 580		1.538	204309.598	2.427
742NASCIS FMQ-4.6 660		4.018	199364.674	1.220
742NASCIS FMQ-4.6 725		4.213	198000.794	0.798
743NASCIS FMQ-3.0 40		0.859	197809.986	1.024

Sample Name	Temperature (°C)	103 -> 103 Rh [O2] CPS	103 -> 103 Rh [O2] RSD %	103 -> 103 Rh [H2] CPS
STD M+Cs+Pt / 1000		111353.792	1.380	62782.184
STD M+Cs+Pt / 100		108755.876	2.621	61827.206
STD M+Cs+Pt / 10		112792.842	1.363	63227.422
REF / 1000		108346.042	0.999	62437.352
REF / 100		110640.922	2.239	62335.672
A D2/20		113707.032	0.524	62767.168
Sulphur 102.7ppb		108066.818	2.219	61255.408
SLRS-5		109692.026	1.666	64985.348
741NASCIS FMQ-1.5 40		119154.006	2.112	67967.742
741NASCIS FMQ-1.5 90		110239.908	1.221	62246.064
741NASCIS FMQ-1.5 135		105615.392	3.358	62824.206
741NASCIS FMQ-1.5 180		110449.654	5.131	63438.852
741NASCIS FMQ-1.5 225		107623.962	1.623	63878.418
741NASCIS FMQ-1.5 255		114485.394	2.058	64526.300
741NASCIS FMQ-1.5 295		113982.092	1.434	64789.746
741NASCIS FMQ-1.5 330		116342.166	1.476	70027.184
741NASCIS FMQ-1.5 380		127683.764	2.056	76718.740
741NASCIS FMQ-1.5 380		129732.810	0.857	76729.402
741NASCIS FMQ-1.5 455		127902.418	0.966	73747.492
741NASCIS FMQ-1.5 510		129362.616	2.871	75069.554
741NASCIS FMQ-1.5 580		114110.388	4.711	66678.070
741NASCIS FMQ-1.5 660		121488.802	1.297	70330.092
741NASCIS FMQ-1.5 725		128976.106	2.643	75694.694
741NASCIS FMQ-1.5 830		111030.624	1.209	64732.634
741NASCIS FMQ-1.5 830		109171.592	0.926	64351.168
742NASCIS FMQ-4.6 40		109907.952	1.933	64752.606
742NASCIS FMQ-4.6 90		105713.676	4.539	59456.428
742NASCIS FMQ-4.6 135		108055.944	1.902	63564.886
742NASCIS FMQ-4.6 180		108321.106	2.180	62935.838
742NASCIS FMQ-4.6 225		108214.792	0.672	64385.134
742NASCIS FMQ-4.6 255		104490.438	1.378	60519.986
742NASCIS FMQ-4.6 295		107559.174	1.125	63025.500
742NASCIS FMQ-4.6 295		109915.460	1.424	64851.766
742NASCIS FMQ-4.6 295		105874.154	1.543	64445.404
742NASCIS FMQ-4.6 330		109557.758	0.594	64650.406
742NASCIS FMQ-4.6 380		108478.476	0.906	64167.594
742NASCIS FMQ-4.6 455		117542.220	3.634	67366.738
742NASCIS FMQ-4.6 510		112243.242	0.565	66694.464
742NASCIS FMQ-4.6 580		108456.836	1.745	64109.806
742NASCIS FMQ-4.6 660		107973.476	1.148	62265.510
742NASCIS FMQ-4.6 725		108409.222	1.085	66293.728
743NASCIS FMQ-3.0 40		109670.660	0.595	62367.738

Sample Name	Temperature (°C)	103 -> 103 Rh [H2] RSD %	107 Ag [No Gas] ppb	107 Ag [No Gas] RSD %
STD M+Cs+Pt / 1000		1.810	0.102	1.753
STD M+Cs+Pt / 100		1.687	1.029	2.802
STD M+Cs+Pt / 10		1.389	4.688	1.716
REF / 1000		1.513	0.001	29.444
REF / 100		0.948		
A D2/20		1.806	0.002	11.949
Sulphur 102.7ppb		3.675		
SLRS-5		3.148	0.001	15.630
741NASCIS FMQ-1.5 40		1.361	0.003	20.989
741NASCIS FMQ-1.5 90		1.449		
741NASCIS FMQ-1.5 135		1.676	0.002	29.791
741NASCIS FMQ-1.5 180		4.126	0.003	22.817
741NASCIS FMQ-1.5 225		2.054	0.002	16.993
741NASCIS FMQ-1.5 255		4.100	0.006	13.317
741NASCIS FMQ-1.5 295		2.810	0.012	8.127
741NASCIS FMQ-1.5 330		2.509	0.030	7.306
741NASCIS FMQ-1.5 380		2.592	0.049	5.270
741NASCIS FMQ-1.5 380		2.136	0.049	5.825
741NASCIS FMQ-1.5 455		0.797	0.018	11.431
741NASCIS FMQ-1.5 510		1.856	0.008	15.179
741NASCIS FMQ-1.5 580		2.521	0.014	9.377
741NASCIS FMQ-1.5 660		2.782	0.010	6.090
741NASCIS FMQ-1.5 725		1.746	0.010	15.297
741NASCIS FMQ-1.5 830		1.932	0.006	6.800
741NASCIS FMQ-1.5 830		1.086	0.006	6.578
742NASCIS FMQ-4.6 40		2.085		
742NASCIS FMQ-4.6 90		3.506		
742NASCIS FMQ-4.6 135		2.075		
742NASCIS FMQ-4.6 180		1.180		
742NASCIS FMQ-4.6 225		2.470	0.003	26.528
742NASCIS FMQ-4.6 255		5.071	0.008	9.083
742NASCIS FMQ-4.6 295		1.867	0.004	22.419
742NASCIS FMQ-4.6 295		1.697	0.003	16.802
742NASCIS FMQ-4.6 295		3.579	0.003	12.570
742NASCIS FMQ-4.6 330		2.938	0.007	11.840
742NASCIS FMQ-4.6 380		2.006	0.014	3.047
742NASCIS FMQ-4.6 455		2.803	0.036	5.946
742NASCIS FMQ-4.6 510		2.749	0.028	3.226
742NASCIS FMQ-4.6 580		2.681	0.038	4.815
742NASCIS FMQ-4.6 660		3.596	0.002	14.650
742NASCIS FMQ-4.6 725		2.906	0.002	20.668
743NASCIS FMQ-3.0 40		2.906	0.002	18.757

Sample Name	Temperature (°C)	107 -> 107 Ag [O2] ppb	107 -> 107 Ag [O2] RSD %	111 Cd [No Gas] ppb
STD M+Cs+Pt / 1000		0.102	6.420	0.102
STD M+Cs+Pt / 100		1.074	2.802	1.005
STD M+Cs+Pt / 10		4.827	0.810	4.628
REF / 1000				
REF / 100				0.003
A D2/20		0.002	14.537	0.294
Sulphur 102.7ppb				
SLRS-5				0.009
741NASCIS FMQ-1.5 40		0.003	19.691	0.011
741NASCIS FMQ-1.5 90				0.001
741NASCIS FMQ-1.5 135		0.001	36.358	0.009
741NASCIS FMQ-1.5 180		0.003	22.506	0.018
741NASCIS FMQ-1.5 225		0.003	27.205	0.019
741NASCIS FMQ-1.5 255		0.007	9.623	0.041
741NASCIS FMQ-1.5 295		0.012	15.902	0.030
741NASCIS FMQ-1.5 330		0.030	7.344	0.024
741NASCIS FMQ-1.5 380		0.047	6.244	0.420
741NASCIS FMQ-1.5 380		0.049	6.797	0.442
741NASCIS FMQ-1.5 455		0.018	6.038	0.099
741NASCIS FMQ-1.5 510		0.009	10.715	0.443
741NASCIS FMQ-1.5 580		0.014	9.609	0.350
741NASCIS FMQ-1.5 660		0.010	15.718	0.252
741NASCIS FMQ-1.5 725		0.009	9.947	0.292
741NASCIS FMQ-1.5 830		0.007	5.313	0.047
741NASCIS FMQ-1.5 830		0.006	13.762	0.035
742NASCIS FMQ-4.6 40				0.735
742NASCIS FMQ-4.6 90				1.432
742NASCIS FMQ-4.6 135				0.243
742NASCIS FMQ-4.6 180				1.637
742NASCIS FMQ-4.6 225		0.003	18.857	3.160
742NASCIS FMQ-4.6 255		0.007	13.541	11.425
742NASCIS FMQ-4.6 295		0.003	27.128	11.045
742NASCIS FMQ-4.6 295		0.003	21.457	7.031
742NASCIS FMQ-4.6 295		0.003	24.305	10.980
742NASCIS FMQ-4.6 330		0.006	31.524	32.966
742NASCIS FMQ-4.6 380		0.013	5.870	4.871
742NASCIS FMQ-4.6 455		0.040	7.267	0.781
742NASCIS FMQ-4.6 510		0.027	6.457	0.450
742NASCIS FMQ-4.6 580		0.037	11.070	0.045
742NASCIS FMQ-4.6 660		0.002	39.914	0.004
742NASCIS FMQ-4.6 725				0.005
743NASCIS FMQ-3.0 40		0.002	32.058	0.050

Sample Name	Temperature (°C)	111 Cd [No Gas] RSD %	111 -> 111 Cd [O2] ppb	111 -> 111 Cd [O2] RSD %
STD M+Cs+Pt / 1000		3.726	0.102	6.698
STD M+Cs+Pt / 100		2.947	1.066	4.155
STD M+Cs+Pt / 10		3.147	4.749	0.600
REF / 1000				
REF / 100		49.670		
A D2/20		4.881	0.311	5.425
Sulphur 102.7ppb				
SLRS-5		22.628	0.007	17.814
741NASCIS FMQ-1.5 40		11.690	0.010	18.765
741NASCIS FMQ-1.5 90		68.082	0.002	34.404
741NASCIS FMQ-1.5 135		16.907	0.007	24.135
741NASCIS FMQ-1.5 180		14.576	0.016	20.620
741NASCIS FMQ-1.5 225		13.187	0.019	18.896
741NASCIS FMQ-1.5 255		10.518	0.038	14.236
741NASCIS FMQ-1.5 295		2.952	0.038	12.811
741NASCIS FMQ-1.5 330		20.333	0.023	12.454
741NASCIS FMQ-1.5 380		4.338	0.402	5.142
741NASCIS FMQ-1.5 380		5.919	0.426	2.384
741NASCIS FMQ-1.5 455		6.394	0.104	5.087
741NASCIS FMQ-1.5 510		4.046	0.434	4.372
741NASCIS FMQ-1.5 580		3.785	0.352	3.224
741NASCIS FMQ-1.5 660		6.646	0.269	5.676
741NASCIS FMQ-1.5 725		5.364	0.285	2.678
741NASCIS FMQ-1.5 830		18.820	0.053	8.395
741NASCIS FMQ-1.5 830		14.898	0.030	17.234
742NASCIS FMQ-4.6 40		1.647	0.734	3.720
742NASCIS FMQ-4.6 90		3.057	1.401	4.186
742NASCIS FMQ-4.6 135		2.105	0.241	4.806
742NASCIS FMQ-4.6 180		2.578	1.649	3.433
742NASCIS FMQ-4.6 225		1.613	3.207	2.983
742NASCIS FMQ-4.6 255		2.805	10.860	2.060
742NASCIS FMQ-4.6 295		2.316	10.906	2.038
742NASCIS FMQ-4.6 295		1.999	6.959	1.647
742NASCIS FMQ-4.6 295		2.814	10.951	1.285
742NASCIS FMQ-4.6 330		1.609	33.203	1.111
742NASCIS FMQ-4.6 380		1.570	4.810	1.684
742NASCIS FMQ-4.6 455		1.381	0.786	4.776
742NASCIS FMQ-4.6 510		3.997	0.438	5.797
742NASCIS FMQ-4.6 580		10.191	0.045	12.964
742NASCIS FMQ-4.6 660		24.046	0.003	42.582
742NASCIS FMQ-4.6 725		19.862	0.006	42.310
743NASCIS FMQ-3.0 40		9.772	0.055	14.563

Sample Name	Temperature (°C)	115 In [No Gas] CPS	115 In [No Gas] RSD %	115 -> 115 In [O2] CPS
STD M+Cs+Pt / 1000		208101.640	2.171	111313.764
STD M+Cs+Pt / 100		206294.274	1.082	106297.052
STD M+Cs+Pt / 10		212535.566	2.732	112700.446
REF / 1000		206136.558	2.772	105880.834
REF / 100		209468.250	2.948	111082.006
A D2/20		209508.916	1.046	110279.940
Sulphur 102.7ppb		201628.992	2.613	107683.874
SLRS-5		220238.372	1.711	110062.026
741NASCIS FMQ-1.5 40		202739.116	3.088	106156.512
741NASCIS FMQ-1.5 90		199656.828	3.464	106000.448
741NASCIS FMQ-1.5 135		204939.122	1.788	101013.062
741NASCIS FMQ-1.5 180		205605.232	1.289	104171.890
741NASCIS FMQ-1.5 225		201674.630	2.365	100569.412
741NASCIS FMQ-1.5 255		201521.550	3.806	104928.560
741NASCIS FMQ-1.5 295		200426.872	1.503	106199.222
741NASCIS FMQ-1.5 330		205593.550	3.646	107186.664
741NASCIS FMQ-1.5 380		205719.358	4.128	105136.060
741NASCIS FMQ-1.5 380		200335.744	2.162	105769.730
741NASCIS FMQ-1.5 455		206429.776	2.210	106758.184
741NASCIS FMQ-1.5 510		206587.134	0.984	105659.402
741NASCIS FMQ-1.5 580		207517.454	2.045	103131.676
741NASCIS FMQ-1.5 660		205701.726	2.482	108673.270
741NASCIS FMQ-1.5 725		211249.378	3.450	112531.320
741NASCIS FMQ-1.5 830		212651.340	1.970	109159.138
741NASCIS FMQ-1.5 830		210278.728	1.967	108259.782
742NASCIS FMQ-4.6 40		205549.848	2.219	106785.506
742NASCIS FMQ-4.6 90		205524.630	2.879	102583.240
742NASCIS FMQ-4.6 135		207259.058	5.103	105929.958
742NASCIS FMQ-4.6 180		203807.436	1.831	106790.662
742NASCIS FMQ-4.6 225		206990.514	0.736	106747.472
742NASCIS FMQ-4.6 255		204306.572	2.921	102480.428
742NASCIS FMQ-4.6 295		206499.108	0.732	105369.532
742NASCIS FMQ-4.6 295		206770.282	6.318	105463.986
742NASCIS FMQ-4.6 295		203567.030	3.184	103565.668
742NASCIS FMQ-4.6 330		205891.110	1.274	107424.712
742NASCIS FMQ-4.6 380		206328.742	2.814	106987.458
742NASCIS FMQ-4.6 455		198747.662	3.616	108437.038
742NASCIS FMQ-4.6 510		204150.456	1.895	105096.604
742NASCIS FMQ-4.6 580		205862.432	3.135	106458.180
742NASCIS FMQ-4.6 660		202737.964	1.985	105263.818
742NASCIS FMQ-4.6 725		205333.536	0.913	108159.036
743NASCIS FMQ-3.0 40		203991.598	1.012	107697.832

Sample Name	Temperature (°C)	115 -> 115 In [O2] RSD %	115 -> 115 In [H2] CPS	115 -> 115 In [H2] RSD %
STD M+Cs+Pt / 1000		1.631	104799.556	1.043
STD M+Cs+Pt / 100		3.175	101070.342	1.441
STD M+Cs+Pt / 10		2.221	106032.248	1.369
REF / 1000		2.761	104915.052	1.871
REF / 100		1.732	104314.252	0.788
A D2/20		0.133	104525.862	1.576
Sulphur 102.7ppb		1.063	102257.548	2.039
SLRS-5		0.726	108079.746	1.417
741NASCIS FMQ-1.5 40		1.339	101458.268	1.157
741NASCIS FMQ-1.5 90		1.086	101636.176	1.311
741NASCIS FMQ-1.5 135		2.618	100088.638	1.956
741NASCIS FMQ-1.5 180		6.259	101956.000	4.926
741NASCIS FMQ-1.5 225		3.243	101713.858	2.305
741NASCIS FMQ-1.5 255		2.935	101023.912	5.103
741NASCIS FMQ-1.5 295		1.462	99521.988	2.580
741NASCIS FMQ-1.5 330		2.450	104950.646	3.357
741NASCIS FMQ-1.5 380		1.879	103876.720	3.125
741NASCIS FMQ-1.5 380		1.282	101680.686	1.199
741NASCIS FMQ-1.5 455		2.690	102862.122	0.978
741NASCIS FMQ-1.5 510		3.765	103058.732	1.723
741NASCIS FMQ-1.5 580		5.124	100645.722	2.901
741NASCIS FMQ-1.5 660		0.785	102713.432	1.780
741NASCIS FMQ-1.5 725		2.098	101653.256	2.509
741NASCIS FMQ-1.5 830		1.985	101962.138	2.176
741NASCIS FMQ-1.5 830		1.719	100400.452	3.014
742NASCIS FMQ-4.6 40		0.839	104240.376	1.674
742NASCIS FMQ-4.6 90		4.937	95426.894	2.372
742NASCIS FMQ-4.6 135		1.942	102478.370	2.295
742NASCIS FMQ-4.6 180		1.907	101496.892	1.867
742NASCIS FMQ-4.6 225		2.971	104756.596	2.642
742NASCIS FMQ-4.6 255		1.856	95098.672	4.892
742NASCIS FMQ-4.6 295		0.919	102078.618	2.245
742NASCIS FMQ-4.6 295		1.654	102785.484	1.665
742NASCIS FMQ-4.6 295		1.980	101714.586	2.970
742NASCIS FMQ-4.6 330		1.143	103847.448	2.998
742NASCIS FMQ-4.6 380		1.138	103415.942	1.909
742NASCIS FMQ-4.6 455		4.623	102333.672	2.326
742NASCIS FMQ-4.6 510		1.341	101444.246	1.932
742NASCIS FMQ-4.6 580		0.786	103668.424	2.182
742NASCIS FMQ-4.6 660		1.810	100975.984	2.062
742NASCIS FMQ-4.6 725		1.630	105303.530	2.681
743NASCIS FMQ-3.0 40		1.677	105086.272	3.525

Sample Name	Temperature (°C)	118 Sn [No Gas]	118 Sn [No Gas] RSD %	118 -> 118 Sn [O2] ppb
STD M+Cs+Pt / 1000		0.005	19.995	
STD M+Cs+Pt / 100		0.004	24.331	0.005
STD M+Cs+Pt / 10		11.060	1.949	11.737
REF / 1000		0.212	5.286	0.212
REF / 100		1.923	2.578	2.051
A D2/20		0.005	14.762	0.004
Sulphur 102.7ppb		0.004	10.540	
SLRS-5		0.008	19.030	0.008
741NASCIS FMQ-1.5 40		0.117	1.724	0.129
741NASCIS FMQ-1.5 90		0.032	8.154	0.031
741NASCIS FMQ-1.5 135		0.030	9.471	0.031
741NASCIS FMQ-1.5 180		0.063	1.782	0.070
741NASCIS FMQ-1.5 225		0.067	9.267	0.067
741NASCIS FMQ-1.5 255		0.077	4.143	0.077
741NASCIS FMQ-1.5 295		0.063	1.785	0.066
741NASCIS FMQ-1.5 330		0.082	2.242	0.085
741NASCIS FMQ-1.5 380		0.129	6.827	0.130
741NASCIS FMQ-1.5 380		0.130	1.720	0.130
741NASCIS FMQ-1.5 455		0.312	2.555	0.329
741NASCIS FMQ-1.5 510		0.759	0.861	0.779
741NASCIS FMQ-1.5 580		0.638	2.384	0.671
741NASCIS FMQ-1.5 660		1.860	2.776	1.970
741NASCIS FMQ-1.5 725		20.476	2.909	21.685
741NASCIS FMQ-1.5 830		13.643	1.899	14.274
741NASCIS FMQ-1.5 830		9.316	2.734	9.503
742NASCIS FMQ-4.6 40		0.067	4.911	0.069
742NASCIS FMQ-4.6 90		0.088	4.878	0.090
742NASCIS FMQ-4.6 135		0.087	5.321	0.091
742NASCIS FMQ-4.6 180		0.141	2.333	0.146
742NASCIS FMQ-4.6 225		0.139	3.536	0.147
742NASCIS FMQ-4.6 255		0.663	3.797	0.647
742NASCIS FMQ-4.6 295		0.395	3.456	0.395
742NASCIS FMQ-4.6 295		0.262	3.954	0.269
742NASCIS FMQ-4.6 295		0.399	3.305	0.409
742NASCIS FMQ-4.6 330		0.509	2.898	0.519
742NASCIS FMQ-4.6 380		0.467	3.139	0.490
742NASCIS FMQ-4.6 455		1.070	1.983	1.130
742NASCIS FMQ-4.6 510		1.256	2.324	1.286
742NASCIS FMQ-4.6 580		0.713	2.712	0.745
742NASCIS FMQ-4.6 660		1.360	0.658	1.393
742NASCIS FMQ-4.6 725		3.520	2.098	3.607
743NASCIS FMQ-3.0 40		0.098	2.880	0.109

Sample Name	Temperature (°C)	118 -> 118 Sn [O2] RSD %	118 -> 118 Sn [H2] ppb	118 -> 118 Sn [H2] RSD %
STD M+Cs+Pt / 1000			0.004	35.016
STD M+Cs+Pt / 100		19.955	0.004	6.480
STD M+Cs+Pt / 10		1.332	11.229	1.301
REF / 1000		7.002	0.212	4.253
REF / 100		1.658	1.967	0.974
A D2/20		17.287	0.006	20.038
Sulphur 102.7ppb			0.004	44.084
SLRS-5		12.125	0.008	17.136
741NASCIS FMQ-1.5 40		6.153	0.124	5.510
741NASCIS FMQ-1.5 90		11.857	0.034	9.720
741NASCIS FMQ-1.5 135		7.069	0.031	9.665
741NASCIS FMQ-1.5 180		6.445	0.064	11.889
741NASCIS FMQ-1.5 225		6.881	0.066	6.161
741NASCIS FMQ-1.5 255		4.240	0.074	5.188
741NASCIS FMQ-1.5 295		5.206	0.065	4.057
741NASCIS FMQ-1.5 330		6.839	0.082	8.372
741NASCIS FMQ-1.5 380		2.099	0.136	4.503
741NASCIS FMQ-1.5 380		6.683	0.128	3.577
741NASCIS FMQ-1.5 455		3.062	0.313	3.392
741NASCIS FMQ-1.5 510		2.110	0.742	2.965
741NASCIS FMQ-1.5 580		1.577	0.636	3.145
741NASCIS FMQ-1.5 660		1.151	1.899	1.798
741NASCIS FMQ-1.5 725		1.531	20.829	1.651
741NASCIS FMQ-1.5 830		1.401	13.784	1.494
741NASCIS FMQ-1.5 830		0.584	9.173	1.590
742NASCIS FMQ-4.6 40		2.383	0.064	4.178
742NASCIS FMQ-4.6 90		7.296	0.081	4.284
742NASCIS FMQ-4.6 135		3.052	0.087	3.508
742NASCIS FMQ-4.6 180		2.752	0.142	3.842
742NASCIS FMQ-4.6 225		1.636	0.135	5.367
742NASCIS FMQ-4.6 255		1.814	0.626	4.853
742NASCIS FMQ-4.6 295		2.736	0.389	3.377
742NASCIS FMQ-4.6 295		3.690	0.262	3.732
742NASCIS FMQ-4.6 295		2.306	0.400	3.475
742NASCIS FMQ-4.6 330		3.469	0.501	2.934
742NASCIS FMQ-4.6 380		3.138	0.470	4.259
742NASCIS FMQ-4.6 455		4.023	1.109	3.501
742NASCIS FMQ-4.6 510		2.565	1.249	2.284
742NASCIS FMQ-4.6 580		1.746	0.728	0.514
742NASCIS FMQ-4.6 660		2.934	1.322	1.916
742NASCIS FMQ-4.6 725		3.239	3.466	1.248
743NASCIS FMQ-3.0 40		3.608	0.096	5.077

Sample Name	Temperature (°C)	133 Cs [No Gas]	133 Cs [No Gas] %	137 Ba [No Gas] ppb	137 Ba [No Gas] RSD %
STD M+Cs+Pt / 1000		0.010	6.003	0.102	5.550
STD M+Cs+Pt / 100		0.098	2.780	0.518	3.195
STD M+Cs+Pt / 10		0.441	1.914	2.336	1.033
REF / 1000					
REF / 100					
A D2/20		0.001	20.991	0.119	3.816
Sulphur 102.7ppb				0.010	19.211
SLRS-5		0.004	5.521	7.265	0.646
741NASCIS FMQ-1.5 40		0.041	4.350	0.083	7.284
741NASCIS FMQ-1.5 90		0.006	5.074	0.015	18.475
741NASCIS FMQ-1.5 135		0.015	8.270	0.007	12.559
741NASCIS FMQ-1.5 180		0.057	3.489	0.011	10.732
741NASCIS FMQ-1.5 225		0.076	4.421	0.009	8.439
741NASCIS FMQ-1.5 255		0.117	2.035	0.007	16.614
741NASCIS FMQ-1.5 295		0.156	2.436	0.022	7.218
741NASCIS FMQ-1.5 330		0.099	3.426	0.007	5.564
741NASCIS FMQ-1.5 380		0.712	4.663	0.060	7.700
741NASCIS FMQ-1.5 380		0.720	2.434	0.059	7.488
741NASCIS FMQ-1.5 455		0.408	1.758	0.126	3.975
741NASCIS FMQ-1.5 510		0.350	0.935	0.092	1.987
741NASCIS FMQ-1.5 580		0.399	0.631	0.097	4.918
741NASCIS FMQ-1.5 660		0.553	3.085	0.094	1.459
741NASCIS FMQ-1.5 725		0.086	5.533	0.069	6.273
741NASCIS FMQ-1.5 830		0.116	3.267	0.104	2.774
741NASCIS FMQ-1.5 830		0.091	3.762	0.118	6.197
742NASCIS FMQ-4.6 40		0.012	4.255	0.085	2.967
742NASCIS FMQ-4.6 90		0.061	3.131	0.032	3.155
742NASCIS FMQ-4.6 135		0.006	6.712		
742NASCIS FMQ-4.6 180		0.024	3.721	0.008	18.620
742NASCIS FMQ-4.6 225		0.030	3.202	0.025	7.640
742NASCIS FMQ-4.6 255		0.156	3.138	0.050	7.946
742NASCIS FMQ-4.6 295		0.082	3.061		
742NASCIS FMQ-4.6 295		0.271	1.778		
742NASCIS FMQ-4.6 295		0.082	4.072		
742NASCIS FMQ-4.6 330		0.036	4.820	0.009	10.113
742NASCIS FMQ-4.6 380		0.620	2.654	0.030	7.784
742NASCIS FMQ-4.6 455		0.409	3.073	0.129	3.168
742NASCIS FMQ-4.6 510		0.169	3.978	0.114	1.684
742NASCIS FMQ-4.6 580		0.138	2.493	0.043	8.807
742NASCIS FMQ-4.6 660		0.020	5.561	0.027	6.609
742NASCIS FMQ-4.6 725		0.011	5.951	0.053	6.359
743NASCIS FMQ-3.0 40		0.094	3.452	0.575	2.929

Sample Name	Temperature (°C)	172 Yb [No Gas] ppb	172 Yb [No Gas] RSD %	185 Re [No Gas] CPS
STD M+Cs+Pt / 1000		0.102	5.353	78836.858
STD M+Cs+Pt / 100		1.014	0.997	77206.274
STD M+Cs+Pt / 10		4.555	1.766	78765.170
REF / 1000		0.000	81.405	76114.258
REF / 100		0.000	162.942	75952.192
A D2/20		0.000	136.931	78819.066
Sulphur 102.7ppb		0.000	223.607	74344.754
SLRS-5		0.009	10.350	84899.824
741NASCIS FMQ-1.5 40		0.000	91.287	76429.224
741NASCIS FMQ-1.5 90				74751.516
741NASCIS FMQ-1.5 135				74042.974
741NASCIS FMQ-1.5 180	0.000	136.931	75731.224	
741NASCIS FMQ-1.5 225	0.000	149.022	74732.330	
741NASCIS FMQ-1.5 255	0.000	223.607	76925.284	
741NASCIS FMQ-1.5 295			76837.944	
741NASCIS FMQ-1.5 330	0.000	136.931	76163.768	
741NASCIS FMQ-1.5 380	0.000	149.022	77052.974	
741NASCIS FMQ-1.5 380	0.000	149.022	73452.226	
741NASCIS FMQ-1.5 455	0.000	65.471	77224.702	
741NASCIS FMQ-1.5 510	0.002	26.251	75672.868	
741NASCIS FMQ-1.5 580	0.002	21.244	76493.880	
741NASCIS FMQ-1.5 660	0.010	10.204	74391.410	
741NASCIS FMQ-1.5 725	0.024	4.005	74545.616	
741NASCIS FMQ-1.5 830	0.002	26.727	75888.230	
741NASCIS FMQ-1.5 830	0.001	34.805	76088.450	
742NASCIS FMQ-4.6 40	0.000	136.931	76143.786	
742NASCIS FMQ-4.6 90	0.000	136.931	75846.072	
742NASCIS FMQ-4.6 135			75853.824	
742NASCIS FMQ-4.6 180	0.000	91.287	75941.526	
742NASCIS FMQ-4.6 225			76454.374	
742NASCIS FMQ-4.6 255	0.000	104.523	75713.868	
742NASCIS FMQ-4.6 295			76369.570	
742NASCIS FMQ-4.6 295	0.000	223.607	77188.274	
742NASCIS FMQ-4.6 295	0.000	69.669	74414.416	
742NASCIS FMQ-4.6 330			75335.736	
742NASCIS FMQ-4.6 380	0.000	141.433	75460.664	
742NASCIS FMQ-4.6 455	0.002	49.999	74179.656	
742NASCIS FMQ-4.6 510	0.001	47.512	74998.078	
742NASCIS FMQ-4.6 580	0.000	70.643	76904.448	
742NASCIS FMQ-4.6 660	0.013	5.557	75402.346	
742NASCIS FMQ-4.6 725	0.008	12.759	75232.094	
743NASCIS FMQ-3.0 40	0.000	162.942	75401.844	

Sample Name	Temperature (°C)	185 Re [No Gas] RSD %	185 -> 185 Re [O2] CPS	185 -> 185 Re [O2] RSD %
STD M+Cs+Pt / 1000		2.466	18192.570	2.430
STD M+Cs+Pt / 100		1.063	17729.598	1.930
STD M+Cs+Pt / 10		1.815	18567.954	2.305
REF / 1000		3.699	17377.996	2.985
REF / 100		2.111	18049.302	2.080
A D2/20		1.879	18920.206	3.455
Sulphur 102.7ppb		2.676	17328.578	1.437
SLRS-5		0.727	18877.676	2.376
741NASCIS FMQ-1.5 40		2.071	17941.052	1.988
741NASCIS FMQ-1.5 90		2.028	17446.810	1.916
741NASCIS FMQ-1.5 135		1.935	16389.546	1.811
741NASCIS FMQ-1.5 180		2.840	17541.916	3.753
741NASCIS FMQ-1.5 225		3.137	16946.332	2.470
741NASCIS FMQ-1.5 255		2.354	18145.018	3.315
741NASCIS FMQ-1.5 295		1.916	18068.688	1.605
741NASCIS FMQ-1.5 330		2.056	17724.580	1.550
741NASCIS FMQ-1.5 380		3.592	17427.422	2.806
741NASCIS FMQ-1.5 380		3.620	17180.296	2.580
741NASCIS FMQ-1.5 455		1.912	17686.428	1.791
741NASCIS FMQ-1.5 510		0.781	17498.736	1.184
741NASCIS FMQ-1.5 580		1.285	17363.610	1.602
741NASCIS FMQ-1.5 660		2.763	17580.064	1.044
741NASCIS FMQ-1.5 725		2.610	17147.770	3.077
741NASCIS FMQ-1.5 830		1.766	17245.368	1.292
741NASCIS FMQ-1.5 830		1.196	17205.942	1.817
742NASCIS FMQ-4.6 40		1.813	17546.922	3.787
742NASCIS FMQ-4.6 90		1.617	16875.012	5.365
742NASCIS FMQ-4.6 135		3.163	17548.160	1.578
742NASCIS FMQ-4.6 180		1.768	17857.860	2.774
742NASCIS FMQ-4.6 225		1.319	17583.200	1.593
742NASCIS FMQ-4.6 255		3.906	16736.120	2.291
742NASCIS FMQ-4.6 295		2.281	17458.692	0.703
742NASCIS FMQ-4.6 295		2.631	17413.022	1.602
742NASCIS FMQ-4.6 295		1.947	16983.228	1.439
742NASCIS FMQ-4.6 330		0.964	17539.406	1.137
742NASCIS FMQ-4.6 380		1.436	17407.406	1.450
742NASCIS FMQ-4.6 455		2.467	17189.676	2.280
742NASCIS FMQ-4.6 510		1.076	17244.118	1.942
742NASCIS FMQ-4.6 580		1.161	17297.918	1.816
742NASCIS FMQ-4.6 660		0.929	17336.070	1.841
742NASCIS FMQ-4.6 725		1.082	16996.996	1.844
743NASCIS FMQ-3.0 40		2.113	18234.488	2.019

Sample Name	Temperature (°C)	185 -> 185 Re [O2]	185 -> 185 Re [O2] RSD %	195 Pt [No Gas] ppb
STD M+Cs+Pt / 1000		36229.886	1.912	0.021
STD M+Cs+Pt / 100		34225.858	1.712	0.149
STD M+Cs+Pt / 10		36508.610	1.061	0.674
REF / 1000		34860.236	1.410	0.004
REF / 100		34713.096	1.001	0.004
A D2/20		35996.300	1.930	0.003
Sulphur 102.7ppb		34170.726	1.430	0.002
SLRS-5		37817.566	1.502	
741NASCIS FMQ-1.5 40	40	34850.234	2.021	0.071
741NASCIS FMQ-1.5 90	90	34135.692	2.692	0.023
741NASCIS FMQ-1.5 135	135	33530.784	1.593	0.039
741NASCIS FMQ-1.5 180	180	34890.306	2.814	0.062
741NASCIS FMQ-1.5 225	225	34249.042	1.409	0.146
741NASCIS FMQ-1.5 255	255	35395.696	2.914	0.495
741NASCIS FMQ-1.5 295	295	34818.312	2.806	0.300
741NASCIS FMQ-1.5 330	330	35640.570	1.906	0.492
741NASCIS FMQ-1.5 380	380	34245.294	3.677	2.859
741NASCIS FMQ-1.5 380	380	33692.364	0.967	2.833
741NASCIS FMQ-1.5 455	455	35111.360	2.270	1.913
741NASCIS FMQ-1.5 510	510	34255.916	1.473	1.638
741NASCIS FMQ-1.5 580	580	33997.952	2.735	0.603
741NASCIS FMQ-1.5 660	660	34582.208	1.666	0.787
741NASCIS FMQ-1.5 725	725	34482.610	0.929	0.610
741NASCIS FMQ-1.5 830	830	34912.864	2.220	0.144
741NASCIS FMQ-1.5 830	830	33897.130	2.131	0.210
742NASCIS FMQ-4.6 40	40	35065.642	1.126	0.035
742NASCIS FMQ-4.6 90	90	32479.438	2.496	0.022
742NASCIS FMQ-4.6 135	135	34414.986	1.580	0.009
742NASCIS FMQ-4.6 180	180	34275.332	0.804	0.018
742NASCIS FMQ-4.6 225	225	34897.792	1.043	0.020
742NASCIS FMQ-4.6 255	255	32249.096	5.685	0.034
742NASCIS FMQ-4.6 295	295	34521.416	1.363	0.025
742NASCIS FMQ-4.6 295	295	34937.264	1.695	0.023
742NASCIS FMQ-4.6 295	295	33932.772	1.711	0.024
742NASCIS FMQ-4.6 330	330	34255.958	1.299	0.049
742NASCIS FMQ-4.6 380	380	34105.006	1.365	0.146
742NASCIS FMQ-4.6 455	455	34662.378	2.595	0.253
742NASCIS FMQ-4.6 510	510	33985.408	3.230	0.221
742NASCIS FMQ-4.6 580	580	34050.506	1.995	0.108
742NASCIS FMQ-4.6 660	660	33396.150	1.958	0.056
742NASCIS FMQ-4.6 725	725	34818.284	2.415	0.029
743NASCIS FMQ-3.0 40	40	35184.052	3.238	0.043

Sample Name	Temperature (°C)	195 Pt [No Gas] RSD %	197 Au [No Gas] CPS	197 Au [No Gas] RSD %
STD M+Cs+Pt / 1000		5.758	42.502	41.133
STD M+Cs+Pt / 100		2.659	19.378	55.166
STD M+Cs+Pt / 10		3.076	360.628	13.914
REF / 1000		18.937	21.254	39.459
REF / 100		17.042	58.752	34.754
A D2/20		16.509	8.126	84.257
Sulphur 102.7ppb		26.310	13.126	54.285
SLRS-5			16.880	60.840
741NASCIS FMQ-1.5 40		4.778	341.880	16.838
741NASCIS FMQ-1.5 90		6.873	40.628	38.845
741NASCIS FMQ-1.5 135		5.119	140.002	24.421
741NASCIS FMQ-1.5 180		10.137	146.252	9.722
741NASCIS FMQ-1.5 225		4.314	313.128	11.540
741NASCIS FMQ-1.5 255		2.995	171.254	10.354
741NASCIS FMQ-1.5 295		2.697	127.502	25.552
741NASCIS FMQ-1.5 330		2.204	38.752	29.405
741NASCIS FMQ-1.5 380		4.149	178.128	18.935
741NASCIS FMQ-1.5 380		2.416	173.750	8.203
741NASCIS FMQ-1.5 455		1.746	38.128	35.443
741NASCIS FMQ-1.5 510		1.309	31.878	25.381
741NASCIS FMQ-1.5 580		1.664	79.378	16.842
741NASCIS FMQ-1.5 660		3.530	155.628	23.304
741NASCIS FMQ-1.5 725		3.029	89.376	17.056
741NASCIS FMQ-1.5 830		2.920	53.126	23.530
741NASCIS FMQ-1.5 830		3.462	59.378	31.797
742NASCIS FMQ-4.6 40		6.570	78.128	6.324
742NASCIS FMQ-4.6 90		11.331	26.878	29.192
742NASCIS FMQ-4.6 135		4.754	20.628	64.797
742NASCIS FMQ-4.6 180		10.296	41.878	25.089
742NASCIS FMQ-4.6 225		5.112	23.752	47.971
742NASCIS FMQ-4.6 255		7.529	358.754	10.640
742NASCIS FMQ-4.6 295		10.151	123.754	4.923
742NASCIS FMQ-4.6 295		3.940	31.876	22.354
742NASCIS FMQ-4.6 295		8.816	175.002	11.363
742NASCIS FMQ-4.6 330		2.545	69.380	27.472
742NASCIS FMQ-4.6 380		2.598	123.752	13.667
742NASCIS FMQ-4.6 455		2.787	168.130	21.127
742NASCIS FMQ-4.6 510		2.981	1271.296	8.649
742NASCIS FMQ-4.6 580		5.557	3726.654	2.503
742NASCIS FMQ-4.6 660		2.687	2085.752	7.663
742NASCIS FMQ-4.6 725		9.206	22.502	40.954
743NASCIS FMQ-3.0 40		3.932	1161.290	10.620

Sample Name	Temperature (°C)	201 Hg [No Gas] CPS	201 Hg [No Gas] RSD %	205 Tl [No Gas] ppb
STD M+Cs+Pt / 1000		60.002	35.594	0.102
STD M+Cs+Pt / 100		43.752	32.342	1.014
STD M+Cs+Pt / 10		56.876	28.658	4.589
REF / 1000		48.752	36.990	
REF / 100		58.130	17.667	
A D2/20		56.878	25.591	0.006
Sulphur 102.7ppb		50.002	22.964	
SLRS-5		56.878	26.179	0.004
741NASCIS FMQ-1.5 40		46.254	26.345	0.004
741NASCIS FMQ-1.5 90		46.878	14.136	
741NASCIS FMQ-1.5 135		48.128	25.393	
741NASCIS FMQ-1.5 180		45.626	27.221	
741NASCIS FMQ-1.5 225		53.128	19.946	
741NASCIS FMQ-1.5 255		48.752	28.880	
741NASCIS FMQ-1.5 295		37.500	33.333	
741NASCIS FMQ-1.5 330		44.378	18.223	
741NASCIS FMQ-1.5 380		60.004	22.817	
741NASCIS FMQ-1.5 380		40.002	25.551	
741NASCIS FMQ-1.5 455		39.378	14.422	
741NASCIS FMQ-1.5 510		44.378	16.810	
741NASCIS FMQ-1.5 580		43.128	39.485	
741NASCIS FMQ-1.5 660		53.128	23.154	
741NASCIS FMQ-1.5 725		91.252	29.795	
741NASCIS FMQ-1.5 830		60.626	30.840	
741NASCIS FMQ-1.5 830		63.130	22.792	
742NASCIS FMQ-4.6 40		41.252	41.281	
742NASCIS FMQ-4.6 90		51.252	30.059	
742NASCIS FMQ-4.6 135		40.004	29.437	
742NASCIS FMQ-4.6 180		48.126	38.303	
742NASCIS FMQ-4.6 225		46.252	27.614	
742NASCIS FMQ-4.6 255		50.628	24.454	
742NASCIS FMQ-4.6 295		43.754	14.287	
742NASCIS FMQ-4.6 295		56.254	39.668	
742NASCIS FMQ-4.6 295		46.876	27.487	
742NASCIS FMQ-4.6 330		50.628	17.130	
742NASCIS FMQ-4.6 380		52.504	22.429	
742NASCIS FMQ-4.6 455		56.250	31.427	
742NASCIS FMQ-4.6 510		56.876	34.835	
742NASCIS FMQ-4.6 580		56.876	11.261	
742NASCIS FMQ-4.6 660		71.878	21.518	
742NASCIS FMQ-4.6 725		61.878	29.749	
743NASCIS FMQ-3.0 40		51.252	34.110	

Sample Name	Temperature (°C)	205 Tl [No Gas] RSD %	208 Pb [No Gas] ppb	208 Pb [No Gas] RSD %
STD M+Cs+Pt / 1000		1.839	0.102	1.060
STD M+Cs+Pt / 100		2.065	1.010	2.055
STD M+Cs+Pt / 10		2.048	4.599	1.663
REF / 1000			0.002	27.057
REF / 100				
A D2/20		6.854	0.007	10.614
Sulphur 102.7ppb			0.002	18.176
SLRS-5		8.630	0.076	4.485
741NASCIS FMQ-1.5 40		13.522	0.292	1.752
741NASCIS FMQ-1.5 90			0.010	10.794
741NASCIS FMQ-1.5 135			0.051	5.072
741NASCIS FMQ-1.5 180			0.053	7.804
741NASCIS FMQ-1.5 225			0.102	2.455
741NASCIS FMQ-1.5 255			0.076	4.324
741NASCIS FMQ-1.5 295			0.094	4.428
741NASCIS FMQ-1.5 330			0.122	3.408
741NASCIS FMQ-1.5 380			1.755	2.740
741NASCIS FMQ-1.5 380			1.748	2.149
741NASCIS FMQ-1.5 455			0.818	1.767
741NASCIS FMQ-1.5 510			1.265	1.739
741NASCIS FMQ-1.5 580			1.871	1.439
741NASCIS FMQ-1.5 660			2.163	3.042
741NASCIS FMQ-1.5 725			2.085	4.099
741NASCIS FMQ-1.5 830			0.341	1.295
741NASCIS FMQ-1.5 830			0.410	3.229
742NASCIS FMQ-4.6 40			2.096	2.414
742NASCIS FMQ-4.6 90			2.804	2.446
742NASCIS FMQ-4.6 135			0.203	2.668
742NASCIS FMQ-4.6 180			1.999	2.291
742NASCIS FMQ-4.6 225			3.343	1.665
742NASCIS FMQ-4.6 255			5.430	4.286
742NASCIS FMQ-4.6 295			1.299	1.887
742NASCIS FMQ-4.6 295			1.428	3.038
742NASCIS FMQ-4.6 295			1.296	1.636
742NASCIS FMQ-4.6 330			1.371	1.879
742NASCIS FMQ-4.6 380			2.138	2.572
742NASCIS FMQ-4.6 455			6.607	1.987
742NASCIS FMQ-4.6 510			9.986	2.401
742NASCIS FMQ-4.6 580			3.447	1.759
742NASCIS FMQ-4.6 660			0.113	3.545
742NASCIS FMQ-4.6 725			0.037	3.310
743NASCIS FMQ-3.0 40			0.290	4.685

Sample Name	Temperature (°C)	209 Bi [No Gas] ppb	209 Bi [No Gas] RSD %
STD M+Cs+Pt / 1000		0.102	2.721
STD M+Cs+Pt / 100		1.017	2.259
STD M+Cs+Pt / 10		4.661	1.419
REF / 1000		0.000	38.082
REF / 100		0.000	52.703
A D2/20		0.006	15.125
Sulphur 102.7ppb			
SLRS-5		0.002	20.074
741NASCIS FMQ-1.5 40		0.279	3.680
741NASCIS FMQ-1.5 90		0.033	5.405
741NASCIS FMQ-1.5 135		0.033	5.194
741NASCIS FMQ-1.5 180		0.044	4.285
741NASCIS FMQ-1.5 225		0.059	6.660
741NASCIS FMQ-1.5 255		0.054	1.644
741NASCIS FMQ-1.5 295		0.051	2.520
741NASCIS FMQ-1.5 330		0.062	2.743
741NASCIS FMQ-1.5 380		0.258	4.892
741NASCIS FMQ-1.5 380		0.257	3.455
741NASCIS FMQ-1.5 455		0.341	1.208
741NASCIS FMQ-1.5 510		0.570	1.216
741NASCIS FMQ-1.5 580		0.325	1.758
741NASCIS FMQ-1.5 660		0.293	3.393
741NASCIS FMQ-1.5 725		0.509	5.001
741NASCIS FMQ-1.5 830		0.290	2.967
741NASCIS FMQ-1.5 830		0.216	1.898
742NASCIS FMQ-4.6 40		1.213	1.977
742NASCIS FMQ-4.6 90		1.127	3.146
742NASCIS FMQ-4.6 135		0.223	2.824
742NASCIS FMQ-4.6 180		1.843	1.818
742NASCIS FMQ-4.6 225		4.520	1.220
742NASCIS FMQ-4.6 255		23.733	3.249
742NASCIS FMQ-4.6 295		7.932	1.901
742NASCIS FMQ-4.6 295		13.032	2.322
742NASCIS FMQ-4.6 295		7.914	2.317
742NASCIS FMQ-4.6 330		1.586	2.854
742NASCIS FMQ-4.6 380		0.687	1.691
742NASCIS FMQ-4.6 455		2.764	2.272
742NASCIS FMQ-4.6 510		1.261	1.519
742NASCIS FMQ-4.6 580		0.156	1.534
742NASCIS FMQ-4.6 660		0.046	6.417
742NASCIS FMQ-4.6 725		0.034	3.872
743NASCIS FMQ-3.0 40		0.089	3.762

Sample Name	Temperature (°C)	7 Li [No Gas]* ppb	7 Li [No Gas] RSD %	27 Al [No Gas] ppb	27 Al [No Gas] RSD %
743NASCIS FMQ-3.0	90	0.034	3.259	1.186	1.988
743NASCIS FMQ-3.0	135	0.042	5.244	0.099	2.725
743NASCIS FMQ-3.0	180	0.096	3.557	0.070	3.330
743NASCIS FMQ-3.0	225	0.154	4.396	0.112	2.771
743NASCIS FMQ-3.0	255	0.252	4.068	0.149	2.104
743NASCIS FMQ-3.0	295	0.342	2.350	0.343	2.033
743NASCIS FMQ-3.0	330	1.637	3.004	0.372	2.392
743NASCIS FMQ-3.0	380	2.539	1.397	0.139	1.596
743NASCIS FMQ-3.0	380	2.992	1.568	0.090	3.268
743NASCIS FMQ-3.0	455	2.765	2.572	0.130	3.344
743NASCIS FMQ-3.0	510	1.128	2.337	0.191	3.806
743NASCIS FMQ-3.0	580	2.114	2.479	0.399	3.900
743NASCIS FMQ-3.0	660	1.299	1.654	0.487	2.534
743NASCIS FMQ-3.0	725	0.433	1.907	0.129	2.535
743NASCIS FMQ-3.0	830	1.028	4.513	0.167	3.572

Sample Name	Temperature (°C)	32 -> 48 S [O2] ppb	32 -> 48 S [O2] RSD %	35 -> 37 Cl [H2] CPS
743NASCIS FMQ-3.0	90	6.848	0.729	33842.490
743NASCIS FMQ-3.0	135	6.022	3.039	24359.880
743NASCIS FMQ-3.0	180	5.952	3.503	21684.310
743NASCIS FMQ-3.0	225	6.218	3.567	21175.012
743NASCIS FMQ-3.0	255	6.176	2.473	19171.726
743NASCIS FMQ-3.0	295	6.316	1.140	18504.232
743NASCIS FMQ-3.0	330	22.173	1.942	16340.454
743NASCIS FMQ-3.0	380	8.271	2.491	16474.312
743NASCIS FMQ-3.0	380	9.991	1.046	9626.706
743NASCIS FMQ-3.0	455	7.163	2.758	15685.562
743NASCIS FMQ-3.0	510	7.527	2.070	14317.036
743NASCIS FMQ-3.0	580	8.872	1.207	14515.918
743NASCIS FMQ-3.0	660	8.352	4.488	14776.114
743NASCIS FMQ-3.0	725	6.215	2.204	13720.980
743NASCIS FMQ-3.0	830	6.245	3.837	14710.458

Sample Name	Temperature (°C)	35 -> 37 Cl [H2] RSD %	43 Ca [No Gas] ppb	43 Ca [No Gas] RSD %
743NASCIS FMQ-3.0	90	3.745	0.086	5.154
743NASCIS FMQ-3.0	135	2.143	0.088	6.913
743NASCIS FMQ-3.0	180	4.161	0.080	8.417
743NASCIS FMQ-3.0	225	2.165	0.079	7.132
743NASCIS FMQ-3.0	255	2.040	0.084	2.328
743NASCIS FMQ-3.0	295	3.061	0.083	8.507
743NASCIS FMQ-3.0	330	2.342	0.129	4.440
743NASCIS FMQ-3.0	380	2.576	0.116	2.766
743NASCIS FMQ-3.0	380	2.949	0.106	3.986
743NASCIS FMQ-3.0	455	4.301	0.096	6.093
743NASCIS FMQ-3.0	510	2.633	0.084	3.625
743NASCIS FMQ-3.0	580	4.322	0.095	4.721
743NASCIS FMQ-3.0	660	3.186	0.115	5.329
743NASCIS FMQ-3.0	725	1.690	0.091	3.270
743NASCIS FMQ-3.0	830	4.196	0.100	4.919

Sample Name	Temperature (°C)	51 V [No Gas] ppb	51 V [No Gas] RSD %	51 -> 51 V [O2] ppb	51 -> 51 V [O2] RSD %
743NASCIS FMQ-3.0	90	0.013	5.720	0.035	13.260
743NASCIS FMQ-3.0	135	0.022	5.355	0.034	6.956
743NASCIS FMQ-3.0	180	0.010	3.860	0.028	14.956
743NASCIS FMQ-3.0	225	0.016	5.797	0.034	9.555
743NASCIS FMQ-3.0	255	0.012	4.518	0.033	20.118
743NASCIS FMQ-3.0	295	0.011	5.262	0.029	20.653
743NASCIS FMQ-3.0	330	0.011	2.875	0.029	23.387
743NASCIS FMQ-3.0	380	0.013	10.230	0.025	29.497
743NASCIS FMQ-3.0	380	0.010	7.560	0.022	24.860
743NASCIS FMQ-3.0	455	0.012	12.426	0.032	14.704
743NASCIS FMQ-3.0	510	0.017	9.658	0.031	19.006
743NASCIS FMQ-3.0	580	0.012	5.308	0.027	14.906
743NASCIS FMQ-3.0	660	0.017	6.026	0.029	14.649
743NASCIS FMQ-3.0	725	0.018	9.247	0.026	28.903
743NASCIS FMQ-3.0	830	0.016	10.307	0.030	21.970

Sample Name	Temperature (°C)	51 -> 51 V [H2] ppb	51 -> 51 V [H2] RSD %	52 Cr [No Gas] ppb
743NASCIS FMQ-3.0	90	0.012	17.093	0.082
743NASCIS FMQ-3.0	135	0.019	7.111	0.140
743NASCIS FMQ-3.0	180	0.009	8.338	0.085
743NASCIS FMQ-3.0	225	0.017	4.312	0.139
743NASCIS FMQ-3.0	255	0.010	10.002	0.082
743NASCIS FMQ-3.0	295	0.010	15.288	0.078
743NASCIS FMQ-3.0	330	0.011	17.414	0.088
743NASCIS FMQ-3.0	380	0.011	15.528	0.205
743NASCIS FMQ-3.0	380	0.008	18.538	0.101
743NASCIS FMQ-3.0	455	0.009	14.165	0.108
743NASCIS FMQ-3.0	510	0.017	13.716	0.126
743NASCIS FMQ-3.0	580	0.011	17.150	0.077
743NASCIS FMQ-3.0	660	0.016	13.393	0.136
743NASCIS FMQ-3.0	725	0.017	8.566	0.082
743NASCIS FMQ-3.0	830	0.017	12.978	0.295

Sample Name	Temperature (°C)	52 Cr [No Gas] RSD %	52 -> 52 Cr [O2] ppb	52 -> 52 Cr [O2] RSD %
743NASCIS FMQ-3.0	90	2.088	0.081	2.606
743NASCIS FMQ-3.0	135	2.359	0.159	3.294
743NASCIS FMQ-3.0	180	1.175	0.093	0.798
743NASCIS FMQ-3.0	225	1.170	0.162	2.631
743NASCIS FMQ-3.0	255	0.964	0.089	2.094
743NASCIS FMQ-3.0	295	1.234	0.082	1.644
743NASCIS FMQ-3.0	330	1.798	0.096	2.291
743NASCIS FMQ-3.0	380	2.810	0.247	0.547
743NASCIS FMQ-3.0	380	1.812	0.109	2.023
743NASCIS FMQ-3.0	455	3.529	0.117	1.315
743NASCIS FMQ-3.0	510	2.781	0.149	2.105
743NASCIS FMQ-3.0	580	1.552	0.078	3.331
743NASCIS FMQ-3.0	660	0.909	0.155	3.525
743NASCIS FMQ-3.0	725	0.966	0.090	2.417
743NASCIS FMQ-3.0	830	2.900	0.376	1.914

Sample Name	Temperature (°C)	56 -> 56 Fe [O2] ppb	56 -> 56 Fe [O2] RSD %	56 -> 56 Fe [H2] ppb
743NASCIS FMQ-3.0	90	3.490	1.468	3.189
743NASCIS FMQ-3.0	135	2.660	3.717	2.379
743NASCIS FMQ-3.0	180	6.235	0.892	5.800
743NASCIS FMQ-3.0	225	7.401	0.585	6.855
743NASCIS FMQ-3.0	255	7.172	0.670	6.755
743NASCIS FMQ-3.0	295	7.450	2.858	7.516
743NASCIS FMQ-3.0	330	18.516	1.093	17.496
743NASCIS FMQ-3.0	380	11.626	0.653	11.001
743NASCIS FMQ-3.0	380	14.688	1.423	14.044
743NASCIS FMQ-3.0	455	11.382	2.003	10.903
743NASCIS FMQ-3.0	510	4.208	1.219	3.983
743NASCIS FMQ-3.0	580	3.389	0.978	3.145
743NASCIS FMQ-3.0	660	3.125	2.418	2.928
743NASCIS FMQ-3.0	725	0.848	1.732	0.800
743NASCIS FMQ-3.0	830	1.400	1.721	1.324

Sample Name	Temperature (°C)	56 -> 56 Fe [H2] RSD %	57 Fe [No Gas] ppb	57 Fe [No Gas] RSD %
743NASCIS FMQ-3.0	90	2.278	0.181	1.354
743NASCIS FMQ-3.0	135	2.466	0.162	1.664
743NASCIS FMQ-3.0	180	1.157	0.242	1.716
743NASCIS FMQ-3.0	225	0.817	0.268	2.102
743NASCIS FMQ-3.0	255	1.372	0.266	1.652
743NASCIS FMQ-3.0	295	1.045	0.283	2.396
743NASCIS FMQ-3.0	330	2.866	0.508	1.560
743NASCIS FMQ-3.0	380	1.871	0.362	1.053
743NASCIS FMQ-3.0	380	1.979	0.432	1.768
743NASCIS FMQ-3.0	455	1.791	0.367	3.758
743NASCIS FMQ-3.0	510	1.788	0.197	1.479
743NASCIS FMQ-3.0	580	1.444	0.177	1.311
743NASCIS FMQ-3.0	660	1.981	0.172	0.638
743NASCIS FMQ-3.0	725	1.917	0.122	1.628
743NASCIS FMQ-3.0	830	1.866	0.132	0.944

Sample Name	Temperature (°C)	59 Co [No Gas] ppb	59 Co [No Gas] RSD %	59 -> 59 Co [O2] ppb
743NASCIS FMQ-3.0	90	0.012	3.922	0.005
743NASCIS FMQ-3.0	135	0.011	4.562	0.006
743NASCIS FMQ-3.0	180	0.010	4.346	0.005
743NASCIS FMQ-3.0	225	0.010	3.345	0.005
743NASCIS FMQ-3.0	255	0.010	5.895	0.004
743NASCIS FMQ-3.0	295	0.009	7.452	0.004
743NASCIS FMQ-3.0	330	0.107	4.575	0.109
743NASCIS FMQ-3.0	380	0.011	10.722	0.006
743NASCIS FMQ-3.0	380	0.017	3.289	0.012
743NASCIS FMQ-3.0	455	0.016	8.870	0.011
743NASCIS FMQ-3.0	510	0.010	7.610	0.004
743NASCIS FMQ-3.0	580	0.012	6.685	0.007
743NASCIS FMQ-3.0	660	0.011	6.707	0.005
743NASCIS FMQ-3.0	725	0.010	10.341	0.004
743NASCIS FMQ-3.0	830	0.012	4.343	0.006

Sample Name	Temperature (°C)	59 -> 59 Co [O2] RSD %	60 Ni [No Gas] ppb	60 Ni [No Gas] RSD %
743NASCIS FMQ-3.0	90	9.507	1.052	1.941
743NASCIS FMQ-3.0	135	5.257	0.715	3.789
743NASCIS FMQ-3.0	180	10.180	1.885	2.286
743NASCIS FMQ-3.0	225	10.917	2.188	1.468
743NASCIS FMQ-3.0	255	20.050	2.181	3.530
743NASCIS FMQ-3.0	295	8.794	2.447	3.495
743NASCIS FMQ-3.0	330	3.400	5.176	2.058
743NASCIS FMQ-3.0	380	15.653	4.142	1.270
743NASCIS FMQ-3.0	380	10.254	5.919	0.752
743NASCIS FMQ-3.0	455	10.501	6.809	3.888
743NASCIS FMQ-3.0	510	8.582	1.972	2.328
743NASCIS FMQ-3.0	580	20.140	1.837	2.390
743NASCIS FMQ-3.0	660	20.265	1.011	1.794
743NASCIS FMQ-3.0	725	14.014	0.316	3.210
743NASCIS FMQ-3.0	830	15.086	0.172	2.208

Sample Name	Temperature (°C)	60 -> 60 Ni [O2] ppb	60 -> 60 Ni [O2] RSD %	63 Cu [No Gas] ppb
743NASCIS FMQ-3.0	90	1.064	2.436	0.144
743NASCIS FMQ-3.0	135	0.714	4.800	0.516
743NASCIS FMQ-3.0	180	1.942	1.797	0.048
743NASCIS FMQ-3.0	225	2.202	2.380	0.093
743NASCIS FMQ-3.0	255	2.216	3.245	0.076
743NASCIS FMQ-3.0	295	2.341	4.256	0.122
743NASCIS FMQ-3.0	330	5.282	2.035	0.125
743NASCIS FMQ-3.0	380	4.184	1.880	0.194
743NASCIS FMQ-3.0	380	5.912	1.673	0.135
743NASCIS FMQ-3.0	455	6.530	1.708	0.204
743NASCIS FMQ-3.0	510	2.020	1.924	0.159
743NASCIS FMQ-3.0	580	1.865	1.819	0.441
743NASCIS FMQ-3.0	660	1.015	1.855	0.550
743NASCIS FMQ-3.0	725	0.319	5.040	0.489
743NASCIS FMQ-3.0	830	0.178	6.975	0.240

Sample Name	Temperature (°C)	63 Cu [No Gas] RSD %	63 -> 63 Cu [O2] ppb	63 -> 63 Cu [O2] RSD %
743NASCIS FMQ-3.0	90	2.123	0.147	6.865
743NASCIS FMQ-3.0	135	2.059	0.498	5.301
743NASCIS FMQ-3.0	180	3.333	0.048	8.219
743NASCIS FMQ-3.0	225	3.478	0.091	6.921
743NASCIS FMQ-3.0	255	4.567	0.075	4.489
743NASCIS FMQ-3.0	295	3.778	0.113	8.183
743NASCIS FMQ-3.0	330	3.532	0.126	3.953
743NASCIS FMQ-3.0	380	2.928	0.186	1.764
743NASCIS FMQ-3.0	380	1.098	0.127	3.767
743NASCIS FMQ-3.0	455	3.174	0.187	2.307
743NASCIS FMQ-3.0	510	3.144	0.162	3.333
743NASCIS FMQ-3.0	580	3.912	0.434	3.253
743NASCIS FMQ-3.0	660	1.760	0.536	1.815
743NASCIS FMQ-3.0	725	4.106	0.480	1.123
743NASCIS FMQ-3.0	830	2.112	0.249	3.694

Sample Name	Temperature (°C)	65 Cu [No Gas] ppb	65 Cu [No Gas] RSD %	65 -> 65 Cu [O2] ppb
743NASCIS FMQ-3.0	90	0.145	4.619	0.128
743NASCIS FMQ-3.0	135	0.508	2.511	0.458
743NASCIS FMQ-3.0	180	0.045	9.662	0.046
743NASCIS FMQ-3.0	225	0.095	5.088	0.089
743NASCIS FMQ-3.0	255	0.076	4.521	0.072
743NASCIS FMQ-3.0	295	0.120	7.928	0.103
743NASCIS FMQ-3.0	330	0.134	4.390	0.116
743NASCIS FMQ-3.0	380	0.184	5.060	0.170
743NASCIS FMQ-3.0	380	0.128	3.200	0.116
743NASCIS FMQ-3.0	455	0.201	4.970	0.181
743NASCIS FMQ-3.0	510	0.161	5.233	0.162
743NASCIS FMQ-3.0	580	0.434	1.807	0.401
743NASCIS FMQ-3.0	660	0.551	1.825	0.506
743NASCIS FMQ-3.0	725	0.489	3.653	0.455
743NASCIS FMQ-3.0	830	0.239	3.683	0.225

Sample Name	Temperature (°C)	65 -> 65 Cu [O2] RSD %	66 Zn [No Gas] ppb	66 Zn [No Gas] RSD %
743NASCIS FMQ-3.0	90	2.940		4.024
743NASCIS FMQ-3.0	135	6.674		2.272
743NASCIS FMQ-3.0	180	8.125		3.581
743NASCIS FMQ-3.0	225	7.220		4.660
743NASCIS FMQ-3.0	255	5.968		7.685
743NASCIS FMQ-3.0	295	7.999		4.641
743NASCIS FMQ-3.0	330	9.395	1.526	2.503
743NASCIS FMQ-3.0	380	4.774	1.066	1.118
743NASCIS FMQ-3.0	380	3.136	1.048	2.266
743NASCIS FMQ-3.0	455	4.880	1.824	5.097
743NASCIS FMQ-3.0	510	0.989	0.641	3.397
743NASCIS FMQ-3.0	580	5.553	0.468	3.941
743NASCIS FMQ-3.0	660	4.010		
743NASCIS FMQ-3.0	725	2.150		
743NASCIS FMQ-3.0	830	0.651		

Sample Name	Temperature (°C)	66 -> 66 Zn [O2] ppb	66 -> 66 Zn [O2] RSD %	75 As [No Gas] ppb
743NASCIS FMQ-3.0	90		3.859	0.084
743NASCIS FMQ-3.0	135		4.302	0.062
743NASCIS FMQ-3.0	180		6.977	0.140
743NASCIS FMQ-3.0	225		7.506	0.267
743NASCIS FMQ-3.0	255		4.755	0.174
743NASCIS FMQ-3.0	295		3.278	0.547
743NASCIS FMQ-3.0	330	1.539	2.914	3.210
743NASCIS FMQ-3.0	380	1.077	2.351	0.766
743NASCIS FMQ-3.0	380	0.987	1.360	0.957
743NASCIS FMQ-3.0	455	1.726	1.260	0.191
743NASCIS FMQ-3.0	510	0.632	4.335	0.374
743NASCIS FMQ-3.0	580	0.464	4.448	0.672
743NASCIS FMQ-3.0	660			0.224
743NASCIS FMQ-3.0	725			0.068
743NASCIS FMQ-3.0	830			0.088

Sample Name	Temperature (°C)	75 As [No Gas] RSD %	78 Se [No Gas] ppb	78 Se [No Gas] RSD %
743NASCIS FMQ-3.0	90	4.667	0.108	0.858
743NASCIS FMQ-3.0	135	6.088	0.110	0.701
743NASCIS FMQ-3.0	180	11.611	0.108	1.015
743NASCIS FMQ-3.0	225	2.718	0.107	1.841
743NASCIS FMQ-3.0	255	2.418	0.110	0.520
743NASCIS FMQ-3.0	295	4.121	0.110	0.914
743NASCIS FMQ-3.0	330	2.253	0.108	1.668
743NASCIS FMQ-3.0	380	2.306	0.108	2.062
743NASCIS FMQ-3.0	380	2.450	0.113	1.094
743NASCIS FMQ-3.0	455	7.969	0.112	1.605
743NASCIS FMQ-3.0	510	3.763	0.109	1.958
743NASCIS FMQ-3.0	580	4.149	0.107	1.365
743NASCIS FMQ-3.0	660	5.809	0.108	1.099
743NASCIS FMQ-3.0	725	6.498	0.110	1.569
743NASCIS FMQ-3.0	830	7.689	0.110	1.688

Sample Name	Temperature (°C)	85 Rb [No Gas] ppb	85 Rb [No Gas] RSD %	89 Y [No Gas] ppb
743NASCIS FMQ-3.0	90	0.003	12.584	0.000
743NASCIS FMQ-3.0	135	0.003	15.884	0.000
743NASCIS FMQ-3.0	180	0.003	9.881	
743NASCIS FMQ-3.0	225	0.005	8.574	0.000
743NASCIS FMQ-3.0	255	0.008	7.082	0.000
743NASCIS FMQ-3.0	295	0.014	8.868	
743NASCIS FMQ-3.0	330	0.011	10.172	0.000
743NASCIS FMQ-3.0	380	0.014	7.161	0.000
743NASCIS FMQ-3.0	380	0.012	4.162	0.000
743NASCIS FMQ-3.0	455	0.006	5.145	0.001
743NASCIS FMQ-3.0	510	0.004	12.309	0.002
743NASCIS FMQ-3.0	580	0.007	6.202	0.011
743NASCIS FMQ-3.0	660	0.005	13.072	0.019
743NASCIS FMQ-3.0	725	0.003	5.770	0.007
743NASCIS FMQ-3.0	830	0.002	17.671	0.008

Sample Name	Temperature (°C)	89 Y [No Gas] RSD %	75 -> 91 As [O2] ppb	75 -> 91 As [O2] RSD %
743NASCIS FMQ-3.0	90	33.525	0.079	10.701
743NASCIS FMQ-3.0	135	64.777	0.048	19.227
743NASCIS FMQ-3.0	180		0.141	9.531
743NASCIS FMQ-3.0	225	26.070	0.277	2.060
743NASCIS FMQ-3.0	255	14.810	0.184	7.945
743NASCIS FMQ-3.0	295		0.559	3.206
743NASCIS FMQ-3.0	330	25.695	3.556	1.246
743NASCIS FMQ-3.0	380	35.721	0.821	3.104
743NASCIS FMQ-3.0	380	23.705	1.002	3.008
743NASCIS FMQ-3.0	455	18.293	0.176	5.432
743NASCIS FMQ-3.0	510	10.164	0.407	4.732
743NASCIS FMQ-3.0	580	6.458	0.713	2.380
743NASCIS FMQ-3.0	660	3.684	0.235	2.927
743NASCIS FMQ-3.0	725	4.975	0.063	9.454
743NASCIS FMQ-3.0	830	9.461	0.083	6.035

Sample Name	Temperature (°C)	78 -> 94 Se [O2] ppb	78 -> 94 Se [O2] RSD %	95 Mo [No Gas] ppb
743NASCIS FMQ-3.0	90			0.237
743NASCIS FMQ-3.0	135			0.016
743NASCIS FMQ-3.0	180			0.035
743NASCIS FMQ-3.0	225			0.039
743NASCIS FMQ-3.0	255			0.035
743NASCIS FMQ-3.0	295			0.055
743NASCIS FMQ-3.0	330			0.200
743NASCIS FMQ-3.0	380			0.098
743NASCIS FMQ-3.0	380			0.188
743NASCIS FMQ-3.0	455			0.339
743NASCIS FMQ-3.0	510			0.272
743NASCIS FMQ-3.0	580			0.435
743NASCIS FMQ-3.0	660			0.271
743NASCIS FMQ-3.0	725	0.017	149.022	0.061
743NASCIS FMQ-3.0	830			0.048

Sample Name	Temperature (°C)	95 Mo [No Gas] RSD %	103 Rh [No Gas] CPS	103 Rh [No Gas] RSD %
743NASCIS FMQ-3.0	90	3.307	199178.356	2.156
743NASCIS FMQ-3.0	135	6.934	198527.022	1.969
743NASCIS FMQ-3.0	180	14.225	196195.064	2.606
743NASCIS FMQ-3.0	225	7.222	200179.522	2.838
743NASCIS FMQ-3.0	255	9.680	198004.344	1.906
743NASCIS FMQ-3.0	295	2.878	194191.754	4.992
743NASCIS FMQ-3.0	330	3.482	199831.278	1.996
743NASCIS FMQ-3.0	380	6.102	198897.248	1.297
743NASCIS FMQ-3.0	380	3.825	199796.352	2.373
743NASCIS FMQ-3.0	455	4.443	191833.708	3.697
743NASCIS FMQ-3.0	510	3.574	194502.556	1.615
743NASCIS FMQ-3.0	580	4.227	197131.060	0.986
743NASCIS FMQ-3.0	660	2.632	199779.806	2.667
743NASCIS FMQ-3.0	725	4.238	193405.098	2.003
743NASCIS FMQ-3.0	830	12.399	194213.434	2.144

Sample Name	Temperature (°C)	103 -> 103 Rh [O2] CPS	103 -> 103 Rh [O2] RSD %	103 -> 103 Rh [H2] CPS
743NASCIS FMQ-3.0	90	110564.208	0.853	63684.054
743NASCIS FMQ-3.0	135	108715.448	4.753	58573.666
743NASCIS FMQ-3.0	180	110310.772	2.522	62935.894
743NASCIS FMQ-3.0	225	110594.282	1.324	61664.116
743NASCIS FMQ-3.0	255	108794.168	4.451	60342.376
743NASCIS FMQ-3.0	295	101379.884	3.131	61107.538
743NASCIS FMQ-3.0	330	109683.960	0.630	62826.150
743NASCIS FMQ-3.0	380	109734.446	1.815	64091.048
743NASCIS FMQ-3.0	380	108383.372	1.509	64839.118
743NASCIS FMQ-3.0	455	102427.430	3.597	59205.640
743NASCIS FMQ-3.0	510	108947.238	1.185	61359.968
743NASCIS FMQ-3.0	580	107466.994	2.526	62157.558
743NASCIS FMQ-3.0	660	108408.604	2.048	61706.310
743NASCIS FMQ-3.0	725	104455.798	1.173	60381.234
743NASCIS FMQ-3.0	830	108942.300	1.023	62649.976

Sample Name	Temperature (°C)	103 -> 103 Rh [H2] RSD %	107 Ag [No Gas] ppb	107 Ag [No Gas] RSD %
743NASCIS FMQ-3.0	90	2.309		
743NASCIS FMQ-3.0	135	1.675		
743NASCIS FMQ-3.0	180	2.675		
743NASCIS FMQ-3.0	225	0.923		
743NASCIS FMQ-3.0	255	2.233		
743NASCIS FMQ-3.0	295	5.008	0.001	18.694
743NASCIS FMQ-3.0	330	3.382	0.012	9.085
743NASCIS FMQ-3.0	380	1.805	0.010	10.698
743NASCIS FMQ-3.0	380	1.441	0.013	7.349
743NASCIS FMQ-3.0	455	2.085	0.008	5.088
743NASCIS FMQ-3.0	510	1.475	0.002	27.095
743NASCIS FMQ-3.0	580	1.083		
743NASCIS FMQ-3.0	660	4.721		
743NASCIS FMQ-3.0	725	1.418		
743NASCIS FMQ-3.0	830	2.176		

Sample Name	Temperature (°C)	107 -> 107 Ag [O2] ppb	107 -> 107 Ag [O2] RSD %	111 Cd [No Gas] ppb
743NASCIS FMQ-3.0	90			0.062
743NASCIS FMQ-3.0	135			0.008
743NASCIS FMQ-3.0	180			0.126
743NASCIS FMQ-3.0	225			0.402
743NASCIS FMQ-3.0	255			1.004
743NASCIS FMQ-3.0	295	0.002	24.942	1.118
743NASCIS FMQ-3.0	330	0.013	7.202	0.343
743NASCIS FMQ-3.0	380	0.009	19.774	0.213
743NASCIS FMQ-3.0	380	0.012	16.966	0.149
743NASCIS FMQ-3.0	455	0.007	16.290	0.011
743NASCIS FMQ-3.0	510	0.002	20.252	0.005
743NASCIS FMQ-3.0	580			0.002
743NASCIS FMQ-3.0	660			0.001
743NASCIS FMQ-3.0	725			0.001
743NASCIS FMQ-3.0	830			0.001

Sample Name	Temperature (°C)	111 Cd [No Gas] RSD %	111 -> 111 Cd [O2] ppb	111 -> 111 Cd [O2] RSD %
743NASCIS FMQ-3.0	90	8.556	0.069	5.530
743NASCIS FMQ-3.0	135	27.114	0.008	44.368
743NASCIS FMQ-3.0	180	6.959	0.124	4.389
743NASCIS FMQ-3.0	225	3.296	0.397	2.327
743NASCIS FMQ-3.0	255	4.999	1.039	3.833
743NASCIS FMQ-3.0	295	2.600	1.096	6.126
743NASCIS FMQ-3.0	330	3.671	0.338	4.875
743NASCIS FMQ-3.0	380	6.116	0.226	4.985
743NASCIS FMQ-3.0	380	2.128	0.143	9.521
743NASCIS FMQ-3.0	455	19.719	0.014	26.584
743NASCIS FMQ-3.0	510	37.893	0.005	58.287
743NASCIS FMQ-3.0	580	37.035	0.003	49.994
743NASCIS FMQ-3.0	660	46.462	0.002	67.420
743NASCIS FMQ-3.0	725	120.414	0.001	55.846
743NASCIS FMQ-3.0	830	93.533		

Sample Name	Temperature (°C)	115 In [No Gas] CPS	115 In [No Gas] RSD %	115 -> 115 In [O2] CPS
743NASCIS FMQ-3.0	90	206471.192	1.458	108333.472
743NASCIS FMQ-3.0	135	203067.198	2.047	106600.786
743NASCIS FMQ-3.0	180	203661.764	3.007	106652.918
743NASCIS FMQ-3.0	225	203929.392	1.788	107856.786
743NASCIS FMQ-3.0	255	201669.486	2.640	106568.998
743NASCIS FMQ-3.0	295	199945.826	4.415	99584.696
743NASCIS FMQ-3.0	330	204020.780	1.849	107734.714
743NASCIS FMQ-3.0	380	206089.438	0.915	107277.794
743NASCIS FMQ-3.0	380	205405.526	1.717	105332.546
743NASCIS FMQ-3.0	455	196826.360	4.558	99753.860
743NASCIS FMQ-3.0	510	201598.768	2.705	106738.356
743NASCIS FMQ-3.0	580	204443.336	2.167	104529.334
743NASCIS FMQ-3.0	660	204732.622	2.527	106946.580
743NASCIS FMQ-3.0	725	199753.008	2.373	103596.538
743NASCIS FMQ-3.0	830	201454.010	2.857	106454.258

Sample Name	Temperature (°C)	115 -> 115 In [O2] RSD %	115 -> 115 In [H2] CPS	115 -> 115 In [H2] RSD %
743NASCIS FMQ-3.0	90	2.173	104464.656	2.360
743NASCIS FMQ-3.0	135	2.217	97398.668	2.438
743NASCIS FMQ-3.0	180	1.313	102442.112	2.670
743NASCIS FMQ-3.0	225	1.022	103166.654	1.116
743NASCIS FMQ-3.0	255	2.688	98935.744	2.339
743NASCIS FMQ-3.0	295	2.695	101582.350	3.696
743NASCIS FMQ-3.0	330	1.174	103322.736	2.420
743NASCIS FMQ-3.0	380	1.621	103472.018	2.431
743NASCIS FMQ-3.0	380	2.253	103068.114	1.726
743NASCIS FMQ-3.0	455	4.656	96141.016	2.908
743NASCIS FMQ-3.0	510	0.529	101334.324	1.471
743NASCIS FMQ-3.0	580	2.443	102421.634	0.720
743NASCIS FMQ-3.0	660	1.949	101466.598	4.420
743NASCIS FMQ-3.0	725	1.537	99174.872	1.682
743NASCIS FMQ-3.0	830	2.244	102015.332	1.955

Sample Name	Temperature (°C)	118 Sn [No Gas]	118 Sn [No Gas] RSD %	118 -> 118 Sn [O2] ppb
743NASCIS FMQ-3.0	90	0.039	6.676	0.039
743NASCIS FMQ-3.0	135	0.046	6.426	0.051
743NASCIS FMQ-3.0	180	0.018	4.561	0.019
743NASCIS FMQ-3.0	225	0.030	8.600	0.033
743NASCIS FMQ-3.0	255	0.037	5.026	0.043
743NASCIS FMQ-3.0	295	0.028	7.835	0.027
743NASCIS FMQ-3.0	330	0.062	3.295	0.065
743NASCIS FMQ-3.0	380	0.057	5.157	0.057
743NASCIS FMQ-3.0	380	0.044	4.736	0.048
743NASCIS FMQ-3.0	455	0.031	2.264	0.028
743NASCIS FMQ-3.0	510	0.026	3.896	0.030
743NASCIS FMQ-3.0	580	0.161	3.921	0.167
743NASCIS FMQ-3.0	660	0.148	5.478	0.152
743NASCIS FMQ-3.0	725	0.120	4.590	0.122
743NASCIS FMQ-3.0	830	0.025	5.858	0.026

Sample Name	Temperature (°C)	118 -> 118 Sn [O2] RSD %	118 -> 118 Sn [H2] ppb	118 -> 118 Sn [H2] RSD %
743NASCIS FMQ-3.0	90	7.579	0.039	5.446
743NASCIS FMQ-3.0	135	7.280	0.048	3.543
743NASCIS FMQ-3.0	180	12.432	0.019	15.472
743NASCIS FMQ-3.0	225	12.642	0.029	8.180
743NASCIS FMQ-3.0	255	9.073	0.040	1.973
743NASCIS FMQ-3.0	295	14.453	0.028	6.995
743NASCIS FMQ-3.0	330	2.030	0.059	6.565
743NASCIS FMQ-3.0	380	6.102	0.057	4.506
743NASCIS FMQ-3.0	380	10.304	0.051	8.754
743NASCIS FMQ-3.0	455	5.650	0.033	11.913
743NASCIS FMQ-3.0	510	12.007	0.024	6.692
743NASCIS FMQ-3.0	580	4.725	0.158	2.962
743NASCIS FMQ-3.0	660	5.397	0.150	4.424
743NASCIS FMQ-3.0	725	5.012	0.119	5.409
743NASCIS FMQ-3.0	830	11.909	0.026	9.582

Sample Name	Temperature (°C)	133 Cs [No Gas]	133 Cs [No Gas] %	137 Ba [No Gas] ppb	137 Ba [No Gas] RSD %
743NASCIS FMQ-3.0	90	0.023	3.029	0.086	3.352
743NASCIS FMQ-3.0	135	0.018	4.172	0.040	7.502
743NASCIS FMQ-3.0	180	0.020	3.763	0.015	9.836
743NASCIS FMQ-3.0	225	0.035	6.969	0.028	10.465
743NASCIS FMQ-3.0	255	0.089	1.962	0.037	10.114
743NASCIS FMQ-3.0	295	0.041	4.388	0.026	10.638
743NASCIS FMQ-3.0	330	0.143	1.683	0.079	5.122
743NASCIS FMQ-3.0	380	0.136	1.623	0.093	3.212
743NASCIS FMQ-3.0	380	0.095	2.844	0.046	7.871
743NASCIS FMQ-3.0	455	0.077	2.042	0.073	10.302
743NASCIS FMQ-3.0	510	0.020	1.901	0.024	8.856
743NASCIS FMQ-3.0	580	0.021	3.746	0.099	6.434
743NASCIS FMQ-3.0	660	0.034	6.105	0.129	3.299
743NASCIS FMQ-3.0	725	0.058	6.756	0.106	3.854
743NASCIS FMQ-3.0	830	0.015	7.743	0.162	7.591

Sample Name	Temperature (°C)	172 Yb [No Gas] ppb	172 Yb [No Gas] RSD %	185 Re [No Gas] CPS
743NASCIS FMQ-3.0	90	0.000	149.022	76622.588
743NASCIS FMQ-3.0	135			75831.622
743NASCIS FMQ-3.0	180			74416.958
743NASCIS FMQ-3.0	225			76668.360
743NASCIS FMQ-3.0	255			76357.788
743NASCIS FMQ-3.0	295	0.000	223.607	75849.470
743NASCIS FMQ-3.0	330	0.000	223.607	75501.500
743NASCIS FMQ-3.0	380			78254.136
743NASCIS FMQ-3.0	380			75187.080
743NASCIS FMQ-3.0	455	0.001	54.756	74194.288
743NASCIS FMQ-3.0	510	0.001	56.725	76460.806
743NASCIS FMQ-3.0	580	0.002	30.911	76173.754
743NASCIS FMQ-3.0	660	0.003	24.351	75705.494
743NASCIS FMQ-3.0	725	0.001	58.287	73954.410
743NASCIS FMQ-3.0	830	0.001	85.668	74864.480

Sample Name	Temperature (°C)	185 Re [No Gas] RSD %	185 -> 185 Re [O2] CPS	185 -> 185 Re [O2] RSD %
743NASCIS FMQ-3.0	90	1.944	17766.510	3.335
743NASCIS FMQ-3.0	135	1.643	17623.238	3.552
743NASCIS FMQ-3.0	180	2.001	17577.568	1.977
743NASCIS FMQ-3.0	225	2.379	18079.334	3.510
743NASCIS FMQ-3.0	255	2.118	18273.270	2.287
743NASCIS FMQ-3.0	295	2.495	16838.726	4.396
743NASCIS FMQ-3.0	330	2.451	18186.308	2.543
743NASCIS FMQ-3.0	380	2.040	18308.330	3.145
743NASCIS FMQ-3.0	380	2.377	17010.772	2.819
743NASCIS FMQ-3.0	455	4.214	16826.850	4.009
743NASCIS FMQ-3.0	510	3.291	17978.596	2.004
743NASCIS FMQ-3.0	580	1.219	17805.302	1.086
743NASCIS FMQ-3.0	660	0.750	17434.912	2.315
743NASCIS FMQ-3.0	725	2.016	17197.816	3.329
743NASCIS FMQ-3.0	830	2.927	17979.228	3.286

Sample Name	Temperature (°C)	185 -> 185 Re [O2]	185 -> 185 Re [O2] RSD %	195 Pt [No Gas] ppb
743NASCIS FMQ-3.0	90	34797.020	2.367	0.059
743NASCIS FMQ-3.0	135	33172.596	1.628	0.052
743NASCIS FMQ-3.0	180	35021.178	1.907	0.009
743NASCIS FMQ-3.0	225	34453.856	1.850	0.021
743NASCIS FMQ-3.0	255	34806.394	3.173	0.037
743NASCIS FMQ-3.0	295	34890.928	2.283	0.066
743NASCIS FMQ-3.0	330	35375.022	1.951	0.085
743NASCIS FMQ-3.0	380	35702.574	2.711	0.087
743NASCIS FMQ-3.0	380	34348.000	1.961	0.068
743NASCIS FMQ-3.0	455	33540.822	2.471	0.028
743NASCIS FMQ-3.0	510	34947.308	1.633	0.035
743NASCIS FMQ-3.0	580	35406.342	1.355	0.056
743NASCIS FMQ-3.0	660	34363.632	1.881	0.042
743NASCIS FMQ-3.0	725	33818.874	3.232	0.011
743NASCIS FMQ-3.0	830	34620.388	2.398	0.016

Sample Name	Temperature (°C)	195 Pt [No Gas] RSD %	197 Au [No Gas] CPS	197 Au [No Gas] RSD %
743NASCIS FMQ-3.0	90	4.487	3405.338	4.631
743NASCIS FMQ-3.0	135	1.240	78.752	12.980
743NASCIS FMQ-3.0	180	10.183	28.752	17.858
743NASCIS FMQ-3.0	225	9.500	13.752	52.327
743NASCIS FMQ-3.0	255	6.838	15.628	42.433
743NASCIS FMQ-3.0	295	4.523	4056.102	4.580
743NASCIS FMQ-3.0	330	7.290	83.754	24.808
743NASCIS FMQ-3.0	380	2.658	243.150	115.693
743NASCIS FMQ-3.0	380	4.735	1973.866	6.231
743NASCIS FMQ-3.0	455	7.937	1208.168	8.443
743NASCIS FMQ-3.0	510	6.470	91.252	13.568
743NASCIS FMQ-3.0	580	5.715	2164.510	5.733
743NASCIS FMQ-3.0	660	3.602	24.376	49.988
743NASCIS FMQ-3.0	725	17.275	16.878	53.349
743NASCIS FMQ-3.0	830	3.410	18.754	57.719

Sample Name	Temperature (°C)	201 Hg [No Gas] CPS	201 Hg [No Gas] RSD %	205 Tl [No Gas] ppb
743NASCIS FMQ-3.0	90	49.376	24.673	
743NASCIS FMQ-3.0	135	46.250	18.130	
743NASCIS FMQ-3.0	180	40.626	38.466	
743NASCIS FMQ-3.0	225	52.502	32.983	
743NASCIS FMQ-3.0	255	46.252	28.429	
743NASCIS FMQ-3.0	295	40.628	34.823	
743NASCIS FMQ-3.0	330	44.378	41.483	
743NASCIS FMQ-3.0	380	50.628	19.226	
743NASCIS FMQ-3.0	380	51.878	12.493	
743NASCIS FMQ-3.0	455	37.504	41.665	
743NASCIS FMQ-3.0	510	53.752	28.298	
743NASCIS FMQ-3.0	580	80.004	23.695	
743NASCIS FMQ-3.0	660	51.254	14.682	
743NASCIS FMQ-3.0	725	40.628	54.115	
743NASCIS FMQ-3.0	830	38.752	33.547	

Sample Name	Temperature (°C)	205 Tl [No Gas] RSD %	208 Pb [No Gas] ppb	208 Pb [No Gas] RSD %
743NASCIS FMQ-3.0	90		0.025	2.661
743NASCIS FMQ-3.0	135		0.012	9.587
743NASCIS FMQ-3.0	180		0.059	2.429
743NASCIS FMQ-3.0	225		0.122	1.887
743NASCIS FMQ-3.0	255		0.419	4.058
743NASCIS FMQ-3.0	295		0.258	3.298
743NASCIS FMQ-3.0	330		0.905	3.296
743NASCIS FMQ-3.0	380		0.725	1.739
743NASCIS FMQ-3.0	380		0.522	2.377
743NASCIS FMQ-3.0	455		0.507	3.025
743NASCIS FMQ-3.0	510		0.426	1.991
743NASCIS FMQ-3.0	580		0.115	2.942
743NASCIS FMQ-3.0	660		0.014	10.100
743NASCIS FMQ-3.0	725		0.007	5.413
743NASCIS FMQ-3.0	830		0.010	4.955

Sample Name	Temperature (°C)	209 Bi [No Gas] ppb	209 Bi [No Gas] RSD %
743NASCIS FMQ-3.0	90	0.094	3.213
743NASCIS FMQ-3.0	135	0.036	4.761
743NASCIS FMQ-3.0	180	0.109	3.425
743NASCIS FMQ-3.0	225	0.386	2.456
743NASCIS FMQ-3.0	255	0.802	2.447
743NASCIS FMQ-3.0	295	1.007	3.273
743NASCIS FMQ-3.0	330	0.804	2.184
743NASCIS FMQ-3.0	380	0.385	2.202
743NASCIS FMQ-3.0	380	0.396	3.348
743NASCIS FMQ-3.0	455	0.235	2.418
743NASCIS FMQ-3.0	510	0.060	5.070
743NASCIS FMQ-3.0	580	0.062	5.192
743NASCIS FMQ-3.0	660	0.037	3.672
743NASCIS FMQ-3.0	725	0.011	5.138
743NASCIS FMQ-3.0	830	0.010	8.060

Sample Name	Temperature (°C)	7 Li [NoGas] ppb	7 Li [NoGas] RSD %	27 Al [NoGas] ppb	27 Al [NoGas] RSD %
Std M+Cs+Pt / 1000		0.101	4.161	0.101	1.938
Std M+Cs+Pt / 100		0.933	2.932	0.167	3.293
REF / 1000		0.007	20.188	0.066	2.603
REF / 100				0.056	1.230
A-D2 / 20		0.014	10.063	0.041	2.003
A-D2		0.120	1.933	0.041	2.627
S 102.7 ppb		0.006	34.153	0.063	2.210
SLRS-5		0.349	2.353	3.577	1.207
740NASCIS FMQ+5.4 40		0.021	14.260	0.111	1.262
740NASCIS FMQ+5.4 90		0.046	7.988	0.143	0.979
740NASCIS FMQ+5.4 135		0.024	13.685	0.094	0.834
740NASCIS FMQ+5.4 180		0.100	8.947	0.219	1.557
740NASCIS FMQ+5.4 180		0.086	7.562	1.537	2.122
740NASCIS FMQ+5.4 225		0.086	5.876	0.096	3.517
740NASCIS FMQ+5.4 255		0.256	6.545	0.105	1.465
740NASCIS FMQ+5.4 295		0.740	2.377	0.103	1.540
740NASCIS FMQ+5.4 330		1.684	3.051	0.146	1.718
740NASCIS FMQ+5.4 380		7.169	1.915	0.161	1.895
740NASCIS FMQ+5.4 455		12.283	2.409	0.164	2.407
740NASCIS FMQ+5.4 510		6.691	2.843	0.158	2.618
740NASCIS FMQ+5.4 580		13.880	3.475	0.192	2.052
740NASCIS FMQ+5.4 660		5.052	4.312	0.299	1.951
740NASCIS FMQ+5.4 725		2.605	3.701	0.433	5.898
740NASCIS FMQ+5.4 830		0.081	4.804	0.370	1.539
745NASCIS FMQ-3.0 40		0.339	2.083	0.103	1.135
745NASCIS FMQ-3.0 90		0.063	3.805	0.187	2.488
745NASCIS FMQ-3.0 135		0.014	12.095	0.119	1.280
745NASCIS FMQ-3.0 180		0.161	5.569	0.195	0.797
745NASCIS FMQ-3.0 225		0.236	3.668	0.216	1.833
745NASCIS FMQ-3.0 255		0.304	3.028	0.093	1.682
745NASCIS FMQ-3.0 255		0.306	4.289	0.583	1.704
745NASCIS FMQ-3.0 295		0.753	2.927	0.110	1.015
745NASCIS FMQ-3.0 330		0.788	2.592	0.717	2.598
745NASCIS FMQ-3.0 380		2.519	2.585	0.201	1.977
745NASCIS FMQ-3.0 455		2.586	1.265	0.170	1.627
745NASCIS FMQ-3.0 510		2.923	2.087	0.098	6.013
745NASCIS FMQ-3.0 580		2.616	3.666	0.165	1.660
745NASCIS FMQ-3.0 660		3.191	2.749	0.444	1.674
745NASCIS FMQ-3.0 725		1.872	2.669	0.373	2.451
745NASCIS FMQ-3.0 830		2.322	2.469	0.364	2.378
746NASCIS FMQ-3.7 40		0.517	1.567	0.191	1.501
746NASCIS FMQ-3.7 90		0.074	8.956	0.152	0.570

Sample Name	Temperature (°C)	35 -> 37 CI [H2] CPS	35 -> 37 CI [H2] RSD %	37 -> 39 CI [H2] CPS
Std M+Cs+Pt / 1000		16504.588	1.183	6554.590
Std M+Cs+Pt / 100		15430.278	2.380	6075.080
REF / 1000		15368.200	3.081	6041.070
REF / 100		15161.350	2.767	5975.046
A-D2 / 20		16364.448	1.752	6680.640
A-D2		13549.346	0.976	5546.232
S 102.7 ppb		14054.422	1.161	5802.986
SLRS-5		128400.406	2.850	51370.000
740NASCIS FMQ+5.4 40		14105.786	2.393	5624.934
740NASCIS FMQ+5.4 90		14849.078	1.857	5965.708
740NASCIS FMQ+5.4 135		14359.334	2.348	5684.948
740NASCIS FMQ+5.4 180		15266.110	1.710	6477.228
740NASCIS FMQ+5.4 180		14570.172	2.283	5927.696
740NASCIS FMQ+5.4 225		13523.344	7.443	5414.200
740NASCIS FMQ+5.4 255		14141.164	6.239	5664.278
740NASCIS FMQ+5.4 295		16352.444	1.227	6595.274
740NASCIS FMQ+5.4 330		20129.794	2.010	8141.268
740NASCIS FMQ+5.4 380		14753.672	2.835	5949.702
740NASCIS FMQ+5.4 455		18556.020	2.447	7260.872
740NASCIS FMQ+5.4 510		13992.376	1.728	5511.558
740NASCIS FMQ+5.4 580		14329.974	2.472	5768.306
740NASCIS FMQ+5.4 660		15147.354	4.210	6130.436
740NASCIS FMQ+5.4 725		13072.972	1.827	5217.464
740NASCIS FMQ+5.4 830		13371.868	2.126	5313.496
745NASCIS FMQ-3.0 40		12968.894	2.927	5250.808
745NASCIS FMQ-3.0 90		13022.274	3.811	5341.504
745NASCIS FMQ-3.0 135		13411.234	2.228	5267.480
745NASCIS FMQ-3.0 180		13605.390	2.855	5434.200
745NASCIS FMQ-3.0 225		14231.896	3.258	5606.254
745NASCIS FMQ-3.0 255		12809.442	2.243	5220.798
745NASCIS FMQ-3.0 255		13988.360	1.935	5637.598
745NASCIS FMQ-3.0 295		13918.968	1.870	5484.214
745NASCIS FMQ-3.0 330		13387.216	1.856	5360.174
745NASCIS FMQ-3.0 380		12992.908	1.841	5242.806
745NASCIS FMQ-3.0 455		12857.484	2.690	4932.046
745NASCIS FMQ-3.0 510		12972.908	1.480	5366.178
745NASCIS FMQ-3.0 580		13036.946	2.666	5187.456
745NASCIS FMQ-3.0 660		12685.350	2.856	5086.090
745NASCIS FMQ-3.0 725		12491.220	2.385	5002.070
745NASCIS FMQ-3.0 830		12530.574	2.311	4964.056
746NASCIS FMQ-3.7 40		13725.486	3.504	5491.554
746NASCIS FMQ-3.7 90		13016.264	3.069	5339.502

Sample Name	Temperature (°C)	37 -> 39 Cl [H2] RSD %	43 Ca [NoGas] ppb	43 Ca [NoGas] RSD %
Std M+Cs+Pt / 1000		2.692	0.101	4.484
Std M+Cs+Pt / 100		5.090	0.087	7.583
REF / 1000		3.309	0.077	4.471
REF / 100		3.591	0.080	5.645
A-D2 / 20		1.656	0.214	2.796
A-D2		3.821	2.060	1.399
S 102.7 ppb		3.253	0.084	4.450
SLRS-5		2.381	41.096	0.359
740NASCIS FMQ+5.4	40	7.322	0.080	3.631
740NASCIS FMQ+5.4	90	3.660	0.082	8.030
740NASCIS FMQ+5.4	135	4.322	0.082	5.544
740NASCIS FMQ+5.4	180	2.640	0.082	5.903
740NASCIS FMQ+5.4	180	4.164	0.236	2.831
740NASCIS FMQ+5.4	225	10.011	0.076	5.189
740NASCIS FMQ+5.4	255	8.686	0.074	7.414
740NASCIS FMQ+5.4	295	3.938	0.076	6.900
740NASCIS FMQ+5.4	330	0.947	0.082	1.935
740NASCIS FMQ+5.4	380	3.281	0.083	3.563
740NASCIS FMQ+5.4	455	3.690	0.099	4.744
740NASCIS FMQ+5.4	510	4.318	0.103	1.096
740NASCIS FMQ+5.4	580	2.773	0.097	5.360
740NASCIS FMQ+5.4	660	2.002	0.076	4.939
740NASCIS FMQ+5.4	725	3.049	0.110	4.428
740NASCIS FMQ+5.4	830	2.476	0.090	4.203
745NASCIS FMQ-3.0	40	2.468	0.077	6.862
745NASCIS FMQ-3.0	90	3.270	0.087	7.823
745NASCIS FMQ-3.0	135	5.129	0.075	3.696
745NASCIS FMQ-3.0	180	2.863	0.100	2.469
745NASCIS FMQ-3.0	225	3.216	0.082	3.938
745NASCIS FMQ-3.0	255	2.669	0.078	4.790
745NASCIS FMQ-3.0	255	5.444	0.074	3.584
745NASCIS FMQ-3.0	295	1.998	0.079	6.265
745NASCIS FMQ-3.0	330	1.936	0.073	5.326
745NASCIS FMQ-3.0	380	1.991	0.096	5.544
745NASCIS FMQ-3.0	455	2.837	0.094	6.751
745NASCIS FMQ-3.0	510	1.081	0.090	3.007
745NASCIS FMQ-3.0	580	4.333	0.086	6.434
745NASCIS FMQ-3.0	660	5.057	0.130	4.972
745NASCIS FMQ-3.0	725	3.103	0.098	5.799
745NASCIS FMQ-3.0	830	4.687	0.089	3.362
746NASCIS FMQ-3.7	40	2.523	0.077	1.863
746NASCIS FMQ-3.7	90	2.101	0.075	5.250

Sample Name	Temperature (°C)	43 -> 43 Ca [H2] ppb	43 -> 43 Ca [H2] RSD %	44 Ca [NoGas] ppb
Std M+Cs+Pt / 1000		0.101	22.627	0.101
Std M+Cs+Pt / 100		0.078	19.692	0.091
REF / 1000		0.048	7.212	0.084
REF / 100		0.038	39.947	0.087
A-D2 / 20		0.581	7.540	0.124
A-D2		7.746	1.893	0.631
S 102.7 ppb		0.073	15.460	0.089
SLRS-5		180.552	0.681	20.653
740NASCIS FMQ+5.4 40		0.080	13.357	0.089
740NASCIS FMQ+5.4 90		0.087	15.654	0.086
740NASCIS FMQ+5.4 135		0.080	16.477	0.088
740NASCIS FMQ+5.4 180		0.083	6.940	0.091
740NASCIS FMQ+5.4 180		0.692	7.109	0.172
740NASCIS FMQ+5.4 225		0.078	25.483	0.086
740NASCIS FMQ+5.4 255		0.071	38.475	0.093
740NASCIS FMQ+5.4 295		0.079	10.165	0.086
740NASCIS FMQ+5.4 330		0.084	13.961	0.089
740NASCIS FMQ+5.4 380		0.120	11.224	0.092
740NASCIS FMQ+5.4 455		0.163	14.151	0.098
740NASCIS FMQ+5.4 510		0.173	4.770	0.102
740NASCIS FMQ+5.4 580		0.174	9.060	0.101
740NASCIS FMQ+5.4 660		0.091	15.752	0.086
740NASCIS FMQ+5.4 725		0.187	13.759	0.104
740NASCIS FMQ+5.4 830		0.150	16.617	0.093
745NASCIS FMQ-3.0 40		0.081	27.429	0.087
745NASCIS FMQ-3.0 90		0.126	8.094	0.089
745NASCIS FMQ-3.0 135		0.077	20.836	0.088
745NASCIS FMQ-3.0 180		0.191	11.482	0.100
745NASCIS FMQ-3.0 225		0.103	12.949	0.089
745NASCIS FMQ-3.0 255		0.102	22.420	0.089
745NASCIS FMQ-3.0 255		0.088	24.339	0.090
745NASCIS FMQ-3.0 295		0.115	14.651	0.087
745NASCIS FMQ-3.0 330		0.090	15.737	0.086
745NASCIS FMQ-3.0 380		0.165	18.232	0.100
745NASCIS FMQ-3.0 455		0.132	8.703	0.094
745NASCIS FMQ-3.0 510		0.133	12.982	0.092
745NASCIS FMQ-3.0 580		0.115	10.072	0.091
745NASCIS FMQ-3.0 660		0.294	4.878	0.114
745NASCIS FMQ-3.0 725		0.168	10.852	0.097
745NASCIS FMQ-3.0 830		0.124	6.040	0.087
746NASCIS FMQ-3.7 40		0.108	12.347	0.087
746NASCIS FMQ-3.7 90		0.082	29.366	0.087

Sample Name	Temperature (°C)	44 Ca [NoGas] RSD %	32 -> 48 S [O2] ppb	32 -> 48 S [O2] RSD %	34 -> 50 S [O2] ppb
Std M+Cs+Pt / 1000		1.544	2.314	1.800	3.259
Std M+Cs+Pt / 100		1.076	7.579	2.664	8.438
REF / 1000		2.012	12.924	2.630	14.422
REF / 100		2.375	3.470	3.446	4.488
A-D2 / 20		1.698	3.017	2.927	3.724
A-D2		1.732	2.083	5.732	2.970
S 102.7 ppb		1.521	101.584	0.947	101.584
SLRS-5		2.203	2419.250	2.012	2390.509
740NASCIS FMQ+5.4 40		1.041	3.934	3.601	4.527
740NASCIS FMQ+5.4 90		0.803	4.181	2.595	5.039
740NASCIS FMQ+5.4 135		1.063	3.181	2.855	4.002
740NASCIS FMQ+5.4 180		1.310	3.580	2.751	4.162
740NASCIS FMQ+5.4 180		1.870	3.679	2.867	4.396
740NASCIS FMQ+5.4 225		1.394	6.970	10.483	7.593
740NASCIS FMQ+5.4 255		1.369	5.367	3.738	5.994
740NASCIS FMQ+5.4 295		1.747	4.943	2.925	5.554
740NASCIS FMQ+5.4 330		0.706	11.750	3.093	12.202
740NASCIS FMQ+5.4 380		0.803	18.665	0.960	19.535
740NASCIS FMQ+5.4 455		2.119	20.629	1.156	21.193
740NASCIS FMQ+5.4 510		2.067	70.695	0.782	70.054
740NASCIS FMQ+5.4 580		1.344	102.845	1.205	102.850
740NASCIS FMQ+5.4 660		2.476	55.600	1.745	55.969
740NASCIS FMQ+5.4 725		1.720	41.577	1.770	43.371
740NASCIS FMQ+5.4 830		0.292	20.194	1.557	20.717
745NASCIS FMQ-3.0 40		1.136	4.652	2.834	5.578
745NASCIS FMQ-3.0 90		0.693	3.807	2.706	4.933
745NASCIS FMQ-3.0 135		1.504	3.196	2.682	4.272
745NASCIS FMQ-3.0 180		2.056	3.194	1.971	4.335
745NASCIS FMQ-3.0 225		2.208	3.422	1.871	4.386
745NASCIS FMQ-3.0 255		0.785	6.798	1.193	7.812
745NASCIS FMQ-3.0 255		0.615	6.531	2.482	7.911
745NASCIS FMQ-3.0 295		2.693	16.969	2.905	16.940
745NASCIS FMQ-3.0 330		1.257	7.578	1.587	8.165
745NASCIS FMQ-3.0 380		1.442	31.441	2.234	33.064
745NASCIS FMQ-3.0 455		0.531	87.359	1.490	89.274
745NASCIS FMQ-3.0 510		1.443	193.500	0.520	188.490
745NASCIS FMQ-3.0 580		1.353	85.093	0.491	85.249
745NASCIS FMQ-3.0 660		1.063	120.204	1.290	118.629
745NASCIS FMQ-3.0 725		2.424	52.363	2.057	53.018
745NASCIS FMQ-3.0 830		1.138	2.771	4.014	3.815
746NASCIS FMQ-3.7 40		1.611	2.222	3.423	2.722
746NASCIS FMQ-3.7 90		0.871	2006.770	1.310	1939.596

Sample Name	Temperature (°C)	34 -> 50 S [O2] RSD %	44 -> 44 Ca [H2] ppb	44 -> 44 Ca [H2] RSD %
Std M+Cs+Pt / 1000		9.690	0.101	3.986
Std M+Cs+Pt / 100		12.833	0.058	10.339
REF / 1000		5.470	0.039	2.489
REF / 100		15.669	0.033	10.165
A-D2 / 20		9.908	0.293	2.458
A-D2		10.205	3.858	1.095
S 102.7 ppb		5.078	0.056	3.871
SLRS-5		1.126	152.240	4.917
740NASCIS FMQ+5.4 40		12.723	0.062	7.248
740NASCIS FMQ+5.4 90		12.564	0.063	3.910
740NASCIS FMQ+5.4 135		15.234	0.063	1.898
740NASCIS FMQ+5.4 180		16.459	0.072	5.965
740NASCIS FMQ+5.4 180		19.982	0.606	2.235
740NASCIS FMQ+5.4 225		9.260	0.064	9.131
740NASCIS FMQ+5.4 255		3.458	0.056	11.815
740NASCIS FMQ+5.4 295		8.203	0.062	3.897
740NASCIS FMQ+5.4 330		3.584	0.071	4.802
740NASCIS FMQ+5.4 380		7.769	0.090	4.325
740NASCIS FMQ+5.4 455		2.554	0.140	2.594
740NASCIS FMQ+5.4 510		2.272	0.152	3.738
740NASCIS FMQ+5.4 580		3.606	0.143	1.975
740NASCIS FMQ+5.4 660		4.267	0.081	2.560
740NASCIS FMQ+5.4 725		3.832	0.162	2.591
740NASCIS FMQ+5.4 830		6.301	0.123	3.199
745NASCIS FMQ-3.0 40		8.060	0.072	4.412
745NASCIS FMQ-3.0 90		11.559	0.105	3.765
745NASCIS FMQ-3.0 135		12.062	0.081	2.400
745NASCIS FMQ-3.0 180		6.324	0.154	2.640
745NASCIS FMQ-3.0 225		10.555	0.084	2.194
745NASCIS FMQ-3.0 255		9.749	0.081	3.616
745NASCIS FMQ-3.0 255		10.577	0.071	3.519
745NASCIS FMQ-3.0 295		4.001	0.085	3.693
745NASCIS FMQ-3.0 330		5.346	0.070	5.645
745NASCIS FMQ-3.0 380		4.475	0.134	2.120
745NASCIS FMQ-3.0 455		0.685	0.115	2.497
745NASCIS FMQ-3.0 510		2.683	0.107	2.364
745NASCIS FMQ-3.0 580		2.325	0.100	3.566
745NASCIS FMQ-3.0 660		1.896	0.250	2.606
745NASCIS FMQ-3.0 725		2.251	0.137	4.398
745NASCIS FMQ-3.0 830		9.336	0.102	2.889
746NASCIS FMQ-3.7 40		9.194	0.081	3.222
746NASCIS FMQ-3.7 90		2.143	0.062	7.124

Sample Name	Temperature (°C)	51 V [NoGas] ppb	51 V [NoGas] RSD %	51 -> 51 V [He KED] ppb
Std M+Cs+Pt / 1000		0.101	5.272	0.101
Std M+Cs+Pt / 100		0.395	1.797	0.924
REF / 1000		0.060	3.242	0.008
REF / 100		0.060	3.857	0.009
A-D2 / 20		0.121	2.456	0.160
A-D2		0.909	1.395	2.360
S 102.7 ppb		0.055	3.821	0.008
SLRS-5		0.136	1.048	0.268
740NASCIS FMQ+5.4 40		0.063	1.341	0.008
740NASCIS FMQ+5.4 90		0.063	0.773	0.011
740NASCIS FMQ+5.4 135		0.061	1.499	0.008
740NASCIS FMQ+5.4 180		0.063	2.473	0.010
740NASCIS FMQ+5.4 180		0.077	2.276	0.056
740NASCIS FMQ+5.4 225		0.063	2.028	0.008
740NASCIS FMQ+5.4 255		0.055	2.417	0.009
740NASCIS FMQ+5.4 295		0.051	4.297	0.009
740NASCIS FMQ+5.4 330		0.051	2.816	0.008
740NASCIS FMQ+5.4 380		0.050	3.489	0.008
740NASCIS FMQ+5.4 455		0.053	1.485	0.013
740NASCIS FMQ+5.4 510		0.053	4.199	0.016
740NASCIS FMQ+5.4 580		0.051	2.907	0.020
740NASCIS FMQ+5.4 660		0.049	5.588	0.015
740NASCIS FMQ+5.4 725		0.058	3.310	0.038
740NASCIS FMQ+5.4 830		0.047	10.444	0.019
745NASCIS FMQ-3.0 40		0.066	1.895	0.051
745NASCIS FMQ-3.0 90		0.051	3.778	0.009
745NASCIS FMQ-3.0 135		0.051	1.943	0.012
745NASCIS FMQ-3.0 180		0.053	3.161	0.016
745NASCIS FMQ-3.0 225		0.055	2.779	0.015
745NASCIS FMQ-3.0 255		0.055	2.269	0.013
745NASCIS FMQ-3.0 255		0.054	2.464	0.013
745NASCIS FMQ-3.0 295		0.056	2.520	0.024
745NASCIS FMQ-3.0 330		0.056	1.091	0.017
745NASCIS FMQ-3.0 380		0.054	1.816	0.024
745NASCIS FMQ-3.0 455		0.052	2.393	0.016
745NASCIS FMQ-3.0 510		0.055	6.879	0.025
745NASCIS FMQ-3.0 580		0.054	4.603	0.017
745NASCIS FMQ-3.0 660		0.054	4.545	0.028
745NASCIS FMQ-3.0 725		0.059	1.288	0.036
745NASCIS FMQ-3.0 830		0.055	2.973	0.024
746NASCIS FMQ-3.7 40		0.053	2.336	0.013
746NASCIS FMQ-3.7 90		0.049	2.271	0.007

Sample Name	Temperature (°C)	51 -> 51 V [He KED] RSD %	52 Cr [NoGas] ppb	52 Cr [NoGas] RSD %
Std M+Cs+Pt / 1000		9.337	0.101	5.804
Std M+Cs+Pt / 100		5.316	0.246	1.126
REF / 1000		39.933	0.075	3.880
REF / 100		31.130	0.075	2.762
A-D2 / 20		8.311	0.081	3.292
A-D2		2.849	0.134	0.814
S 102.7 ppb		41.633	0.068	3.104
SLRS-5		6.422	0.091	1.588
740NASCIS FMQ+5.4 40		30.296	0.081	1.589
740NASCIS FMQ+5.4 90		41.236	0.082	0.544
740NASCIS FMQ+5.4 135		26.999	0.090	0.779
740NASCIS FMQ+5.4 180		30.936	0.130	0.832
740NASCIS FMQ+5.4 180		3.567	0.163	1.647
740NASCIS FMQ+5.4 225		24.355	0.084	1.113
740NASCIS FMQ+5.4 255		13.791	0.072	0.928
740NASCIS FMQ+5.4 295		11.186	0.077	1.823
740NASCIS FMQ+5.4 330		45.930	0.080	1.599
740NASCIS FMQ+5.4 380		21.982	0.078	1.650
740NASCIS FMQ+5.4 455		12.723	0.083	1.588
740NASCIS FMQ+5.4 510		25.545	0.088	1.253
740NASCIS FMQ+5.4 580		27.163	0.091	1.088
740NASCIS FMQ+5.4 660		17.751	0.122	1.235
740NASCIS FMQ+5.4 725		8.768	0.073	0.513
740NASCIS FMQ+5.4 830		16.088	0.243	2.193
745NASCIS FMQ-3.0 40		21.462	0.067	1.195
745NASCIS FMQ-3.0 90		20.039	0.095	0.672
745NASCIS FMQ-3.0 135		12.207	0.065	1.025
745NASCIS FMQ-3.0 180		27.105	0.121	1.155
745NASCIS FMQ-3.0 225		29.113	0.074	1.712
745NASCIS FMQ-3.0 255		24.154	0.068	2.252
745NASCIS FMQ-3.0 255		16.457	0.073	1.531
745NASCIS FMQ-3.0 295		15.518	0.074	0.931
745NASCIS FMQ-3.0 330		13.067	0.069	0.706
745NASCIS FMQ-3.0 380		25.098	0.071	1.002
745NASCIS FMQ-3.0 455		9.008	0.090	1.662
745NASCIS FMQ-3.0 510		18.387	0.112	1.200
745NASCIS FMQ-3.0 580		26.662	0.109	1.564
745NASCIS FMQ-3.0 660		12.980	0.124	0.845
745NASCIS FMQ-3.0 725		13.334	0.078	0.911
745NASCIS FMQ-3.0 830		4.635	0.078	1.758
746NASCIS FMQ-3.7 40		25.629	0.093	1.455
746NASCIS FMQ-3.7 90		36.024	0.085	1.726

Sample Name	Temperature (°C)	52 -> 52 Cr [He KED] ppb	52 -> 52 Cr [He KED] RSD %	53 V [NoGas] ppb
Std M+Cs+Pt / 1000		0.101	2.360	0.101
Std M+Cs+Pt / 100		0.519	2.880	0.666
REF / 1000		0.059	10.150	0.041
REF / 100		0.057	5.745	0.039
A-D2 / 20		0.064	6.360	0.051
A-D2		0.259	1.945	0.316
S 102.7 ppb		0.054	6.517	0.033
SLRS-5		0.173	3.559	0.162
740NASCIS FMQ+5.4 40		0.073	3.830	0.048
740NASCIS FMQ+5.4 90		0.068	7.493	0.050
740NASCIS FMQ+5.4 135		0.091	7.322	0.086
740NASCIS FMQ+5.4 180		0.192	3.413	0.220
740NASCIS FMQ+5.4 180		0.295	1.677	0.350
740NASCIS FMQ+5.4 225		0.073	7.921	0.059
740NASCIS FMQ+5.4 255		0.072	5.996	0.049
740NASCIS FMQ+5.4 295		0.096	7.142	0.083
740NASCIS FMQ+5.4 330		0.108	4.512	0.098
740NASCIS FMQ+5.4 380		0.105	7.562	0.092
740NASCIS FMQ+5.4 455		0.114	7.251	0.102
740NASCIS FMQ+5.4 510		0.128	5.479	0.120
740NASCIS FMQ+5.4 580		0.147	4.902	0.146
740NASCIS FMQ+5.4 660		0.228	2.020	0.259
740NASCIS FMQ+5.4 725		0.092	5.299	0.076
740NASCIS FMQ+5.4 830		0.570	4.570	0.695
745NASCIS FMQ-3.0 40		0.082	7.664	0.051
745NASCIS FMQ-3.0 90		0.144	2.443	0.148
745NASCIS FMQ-3.0 135		0.069	4.974	0.043
745NASCIS FMQ-3.0 180		0.219	3.042	0.241
745NASCIS FMQ-3.0 225		0.081	6.031	0.063
745NASCIS FMQ-3.0 255		0.074	7.770	0.044
745NASCIS FMQ-3.0 255		0.087	6.521	0.065
745NASCIS FMQ-3.0 295		0.096	3.924	0.073
745NASCIS FMQ-3.0 330		0.080	5.982	0.048
745NASCIS FMQ-3.0 380		0.091	3.446	0.069
745NASCIS FMQ-3.0 455		0.137	4.078	0.133
745NASCIS FMQ-3.0 510		0.197	1.595	0.214
745NASCIS FMQ-3.0 580		0.189	3.255	0.194
745NASCIS FMQ-3.0 660		0.236	3.168	0.262
745NASCIS FMQ-3.0 725		0.108	5.061	0.090
745NASCIS FMQ-3.0 830		0.116	4.121	0.092
746NASCIS FMQ-3.7 40		0.142	4.118	0.135
746NASCIS FMQ-3.7 90		0.128	2.094	0.119

Sample Name	Temperature (°C)	53 V [NoGas] RSD %	55 Mn [NoGas] CPS	55 Mn [NoGas] RSD %
Std M+Cs+Pt / 1000		2.159	20978.304	1.543
Std M+Cs+Pt / 100		2.268	151777.230	1.163
REF / 1000		5.737	5886.360	3.337
REF / 100		10.671	5524.238	2.638
A-D2 / 20		6.897	5728.974	4.819
A-D2		4.394	5210.808	3.307
S 102.7 ppb		13.205	5688.966	3.638
SLRS-5		4.033	530122.218	1.545
740NASCIS FMQ+5.4 40		8.730	9517.344	1.740
740NASCIS FMQ+5.4 90		5.205	9903.566	3.056
740NASCIS FMQ+5.4 135		2.403	8244.680	4.108
740NASCIS FMQ+5.4 180		3.344	10258.448	2.972
740NASCIS FMQ+5.4 180		1.666	67909.594	1.317
740NASCIS FMQ+5.4 225		3.815	10086.346	5.031
740NASCIS FMQ+5.4 255		7.882	9470.660	4.463
740NASCIS FMQ+5.4 295		4.081	9591.380	2.519
740NASCIS FMQ+5.4 330		4.576	11197.032	1.372
740NASCIS FMQ+5.4 380		8.717	13854.998	1.781
740NASCIS FMQ+5.4 455		4.242	13574.116	2.204
740NASCIS FMQ+5.4 510		4.701	14180.600	2.962
740NASCIS FMQ+5.4 580		4.265	12638.714	2.848
740NASCIS FMQ+5.4 660		5.131	11701.374	0.902
740NASCIS FMQ+5.4 725		6.756	26466.624	1.400
740NASCIS FMQ+5.4 830		1.060	19276.948	1.590
745NASCIS FMQ-3.0 40		8.635	9181.826	2.392
745NASCIS FMQ-3.0 90		4.944	9878.886	2.324
745NASCIS FMQ-3.0 135		7.152	8965.716	3.641
745NASCIS FMQ-3.0 180		2.713	10320.480	1.785
745NASCIS FMQ-3.0 225		3.722	9443.306	3.954
745NASCIS FMQ-3.0 255		11.026	9756.148	4.145
745NASCIS FMQ-3.0 255		6.736	10239.764	2.859
745NASCIS FMQ-3.0 295		4.077	10114.360	2.707
745NASCIS FMQ-3.0 330		3.564	9826.852	1.427
745NASCIS FMQ-3.0 380		3.410	8812.960	1.865
745NASCIS FMQ-3.0 455		6.225	9081.776	4.775
745NASCIS FMQ-3.0 510		7.475	9669.430	3.968
745NASCIS FMQ-3.0 580		2.737	9282.552	2.206
745NASCIS FMQ-3.0 660		3.062	16454.646	2.625
745NASCIS FMQ-3.0 725		3.008	12405.876	2.635
745NASCIS FMQ-3.0 830		2.308	10256.444	1.910
746NASCIS FMQ-3.7 40		4.405	11032.932	1.552
746NASCIS FMQ-3.7 90		4.168	11241.066	2.030

Sample Name	Temperature (°C)	55 -> 55 Mn [He KED] CPS	55 -> 55 Mn [He KED] RSD %	56 -> 56 Fe [He KED] ppb
Std M+Cs+Pt / 1000		364.004	6.055	0.101
Std M+Cs+Pt / 100		3298.990	3.964	0.192
REF / 1000		27.334	46.755	0.068
REF / 100		41.334	59.157	0.067
A-D2 / 20		35.332	31.707	0.039
A-D2		41.334	19.421	0.078
S 102.7 ppb		32.666	40.431	0.050
SLRS-5		11772.094	2.482	10.373
740NASCIS FMQ+5.4 40		36.666	59.620	0.138
740NASCIS FMQ+5.4 90		33.336	46.363	0.107
740NASCIS FMQ+5.4 135		50.668	19.950	0.159
740NASCIS FMQ+5.4 180		49.332	19.932	0.345
740NASCIS FMQ+5.4 180		1445.394	2.911	3.303
740NASCIS FMQ+5.4 225		65.334	12.288	0.172
740NASCIS FMQ+5.4 255		57.332	50.915	0.088
740NASCIS FMQ+5.4 295		39.998	10.207	0.155
740NASCIS FMQ+5.4 330		88.000	28.171	0.444
740NASCIS FMQ+5.4 380		136.000	17.792	1.389
740NASCIS FMQ+5.4 455		157.334	13.764	0.270
740NASCIS FMQ+5.4 510		187.336	13.039	0.296
740NASCIS FMQ+5.4 580		134.666	23.061	0.295
740NASCIS FMQ+5.4 660		113.334	30.989	0.526
740NASCIS FMQ+5.4 725		504.006	4.869	0.857
740NASCIS FMQ+5.4 830		290.668	9.116	1.201
745NASCIS FMQ-3.0 40		74.000	10.273	23.499
745NASCIS FMQ-3.0 90		54.000	30.681	3.932
745NASCIS FMQ-3.0 135		38.000	42.794	0.232
745NASCIS FMQ-3.0 180		88.668	31.071	10.248
745NASCIS FMQ-3.0 225		52.000	13.294	12.010
745NASCIS FMQ-3.0 255		57.998	44.628	12.384
745NASCIS FMQ-3.0 255		64.002	23.982	12.923
745NASCIS FMQ-3.0 295		64.666	24.346	22.560
745NASCIS FMQ-3.0 330		58.666	28.013	13.550
745NASCIS FMQ-3.0 380		61.334	21.944	22.648
745NASCIS FMQ-3.0 455		62.666	16.135	10.598
745NASCIS FMQ-3.0 510		62.000	17.258	12.633
745NASCIS FMQ-3.0 580		45.334	26.813	1.877
745NASCIS FMQ-3.0 660		211.332	6.748	2.590
745NASCIS FMQ-3.0 725		132.002	12.827	1.974
745NASCIS FMQ-3.0 830		64.666	24.343	1.175
746NASCIS FMQ-3.7 40		80.002	26.187	31.090
746NASCIS FMQ-3.7 90		81.334	20.206	3.952

Sample Name	Temperature (°C)	56 -> 56 Fe [He KED] RSD %	57 Fe [NoGas] ppb	57 Fe [NoGas] RSD %
Std M+Cs+Pt / 1000		2.313	0.101	2.028
Std M+Cs+Pt / 100		2.371	0.107	1.166
REF / 1000		5.424	0.096	1.003
REF / 100		4.671	0.098	1.937
A-D2 / 20		1.904	0.098	1.794
A-D2		3.616	0.093	0.920
S 102.7 ppb		3.718	0.092	1.363
SLRS-5		1.511	0.835	1.438
740NASCIS FMQ+5.4 40		3.351	0.106	1.877
740NASCIS FMQ+5.4 90		3.134	0.104	1.358
740NASCIS FMQ+5.4 135		1.726	0.103	1.617
740NASCIS FMQ+5.4 180		2.154	0.118	0.623
740NASCIS FMQ+5.4 180		0.546	0.287	1.236
740NASCIS FMQ+5.4 225		2.251	0.107	0.648
740NASCIS FMQ+5.4 255		2.779	0.085	1.709
740NASCIS FMQ+5.4 295		3.022	0.096	1.476
740NASCIS FMQ+5.4 330		3.835	0.117	1.126
740NASCIS FMQ+5.4 380		1.143	0.173	0.953
740NASCIS FMQ+5.4 455		1.484	0.108	0.666
740NASCIS FMQ+5.4 510		1.617	0.111	0.948
740NASCIS FMQ+5.4 580		2.682	0.109	0.956
740NASCIS FMQ+5.4 660		1.351	0.122	1.256
740NASCIS FMQ+5.4 725		1.316	0.147	0.946
740NASCIS FMQ+5.4 830		1.962	0.165	0.555
745NASCIS FMQ-3.0 40		1.502	1.476	1.309
745NASCIS FMQ-3.0 90		0.935	0.322	1.255
745NASCIS FMQ-3.0 135		1.967	0.108	1.125
745NASCIS FMQ-3.0 180		1.413	0.696	0.838
745NASCIS FMQ-3.0 225		0.498	0.809	1.529
745NASCIS FMQ-3.0 255		0.575	0.810	0.756
745NASCIS FMQ-3.0 255		0.727	0.847	1.283
745NASCIS FMQ-3.0 295		0.720	1.411	1.314
745NASCIS FMQ-3.0 330		0.726	0.900	1.405
745NASCIS FMQ-3.0 380		0.625	1.430	0.787
745NASCIS FMQ-3.0 455		0.677	0.715	1.006
745NASCIS FMQ-3.0 510		0.494	0.836	1.225
745NASCIS FMQ-3.0 580		1.868	0.207	2.664
745NASCIS FMQ-3.0 660		1.789	0.245	2.485
745NASCIS FMQ-3.0 725		1.480	0.209	1.947
745NASCIS FMQ-3.0 830		0.783	0.164	1.506
746NASCIS FMQ-3.7 40		1.646	1.916	1.622
746NASCIS FMQ-3.7 90		0.872	0.329	1.505

Sample Name	Temperature (°C)	59 Co [NoGas] ppb	59 Co [NoGas] RSD %	59 -> 59 Co [He KED] ppb
Std M+Cs+Pt / 1000		0.101	3.763	0.101
Std M+Cs+Pt / 100		0.991	1.302	1.048
REF / 1000		0.002	11.962	
REF / 100				0.002
A-D2 / 20		0.116	1.431	0.129
A-D2		1.699	0.262	1.799
S 102.7 ppb				
SLRS-5		0.051	4.125	0.051
740NASCIS FMQ+5.4 40		0.003	8.829	0.003
740NASCIS FMQ+5.4 90		0.005	5.021	0.005
740NASCIS FMQ+5.4 135		0.007	5.374	0.006
740NASCIS FMQ+5.4 180		0.003	12.414	0.003
740NASCIS FMQ+5.4 180		0.041	4.216	0.042
740NASCIS FMQ+5.4 225		0.017	3.750	0.017
740NASCIS FMQ+5.4 255		0.004	10.836	0.004
740NASCIS FMQ+5.4 295		0.003	16.005	0.002
740NASCIS FMQ+5.4 330		0.003	12.562	0.003
740NASCIS FMQ+5.4 380		0.005	10.240	0.004
740NASCIS FMQ+5.4 455		0.007	6.539	0.006
740NASCIS FMQ+5.4 510		0.006	3.518	0.008
740NASCIS FMQ+5.4 580		0.008	6.272	0.007
740NASCIS FMQ+5.4 660		0.005	11.050	0.003
740NASCIS FMQ+5.4 725		0.009	1.315	0.009
740NASCIS FMQ+5.4 830		0.011	3.122	0.010
745NASCIS FMQ-3.0 40		0.005	2.521	0.004
745NASCIS FMQ-3.0 90		0.003	14.418	0.002
745NASCIS FMQ-3.0 135		0.003	20.174	0.002
745NASCIS FMQ-3.0 180		0.005	9.431	0.005
745NASCIS FMQ-3.0 225		0.003	6.906	0.002
745NASCIS FMQ-3.0 255		0.003	16.047	0.002
745NASCIS FMQ-3.0 255		0.003	11.455	0.003
745NASCIS FMQ-3.0 295		0.006	9.012	0.005
745NASCIS FMQ-3.0 330		0.003	9.706	0.003
745NASCIS FMQ-3.0 380		0.005	12.341	0.004
745NASCIS FMQ-3.0 455		0.005	6.915	0.006
745NASCIS FMQ-3.0 510		0.006	6.759	0.005
745NASCIS FMQ-3.0 580		0.004	12.220	0.005
745NASCIS FMQ-3.0 660		0.027	1.653	0.031
745NASCIS FMQ-3.0 725		0.005	5.296	0.004
745NASCIS FMQ-3.0 830		0.009	5.688	0.009
746NASCIS FMQ-3.7 40		0.007	6.031	0.005
746NASCIS FMQ-3.7 90		0.005	11.810	0.004

Sample Name	Temperature (°C)	59 -> 59 Co [He KED] RSD %	60 Ni [NoGas] ppb	60 Ni [NoGas] RSD %
Std M+Cs+Pt / 1000		6.836	0.126	4.397
Std M+Cs+Pt / 100		1.658	0.888	2.124
REF / 1000				
REF / 100		37.806		
A-D2 / 20		3.874	0.284	1.742
A-D2		1.365	3.674	1.581
S 102.7 ppb				
SLRS-5		10.542	0.413	3.882
740NASCIS FMQ+5.4 40		37.069	0.101	4.446
740NASCIS FMQ+5.4 90		24.200	0.082	2.865
740NASCIS FMQ+5.4 135		28.283	0.132	2.286
740NASCIS FMQ+5.4 180		58.792	0.092	5.431
740NASCIS FMQ+5.4 180		8.343	0.170	3.912
740NASCIS FMQ+5.4 225		15.826		
740NASCIS FMQ+5.4 255		37.486	0.079	2.437
740NASCIS FMQ+5.4 295		55.258	0.257	2.108
740NASCIS FMQ+5.4 330		49.776	0.093	4.181
740NASCIS FMQ+5.4 380		31.866	0.090	3.991
740NASCIS FMQ+5.4 455		41.502	0.461	1.380
740NASCIS FMQ+5.4 510		17.650	0.216	1.135
740NASCIS FMQ+5.4 580		19.645	0.249	4.306
740NASCIS FMQ+5.4 660		19.442	0.149	2.493
740NASCIS FMQ+5.4 725		8.463	0.169	3.686
740NASCIS FMQ+5.4 830		20.439	0.130	1.077
745NASCIS FMQ-3.0 40		50.866	8.482	1.358
745NASCIS FMQ-3.0 90		35.388	1.371	1.594
745NASCIS FMQ-3.0 135		50.298	0.142	2.882
745NASCIS FMQ-3.0 180		20.277	3.630	0.881
745NASCIS FMQ-3.0 225		37.264	4.357	1.011
745NASCIS FMQ-3.0 255		49.099	4.510	0.943
745NASCIS FMQ-3.0 255		37.082	4.636	0.926
745NASCIS FMQ-3.0 295		24.062	8.127	2.493
745NASCIS FMQ-3.0 330		41.254	4.901	1.544
745NASCIS FMQ-3.0 380		30.156	8.478	0.549
745NASCIS FMQ-3.0 455		19.014	4.778	1.843
745NASCIS FMQ-3.0 510		26.938	6.310	0.511
745NASCIS FMQ-3.0 580		42.614	0.728	2.467
745NASCIS FMQ-3.0 660		3.296	3.013	1.202
745NASCIS FMQ-3.0 725		35.540	1.230	2.747
745NASCIS FMQ-3.0 830		11.021	0.679	2.367
746NASCIS FMQ-3.7 40		33.565	15.243	2.047
746NASCIS FMQ-3.7 90		26.215	2.847	1.305

Sample Name	Temperature (°C)	60 -> 60 Ni [He KED] ppb	60 -> 60 Ni [He KED] RSD %	63 Cu [NoGas] ppb
Std M+Cs+Pt / 1000		0.118	8.460	0.101
Std M+Cs+Pt / 100		0.838	2.256	0.678
REF / 1000				
REF / 100				
A-D2 / 20		0.284	6.652	0.808
A-D2		3.472	2.211	11.150
S 102.7 ppb				
SLRS-5		0.357	2.971	10.051
740NASCIS FMQ+5.4 40		0.109	10.582	
740NASCIS FMQ+5.4 90		0.077	11.914	
740NASCIS FMQ+5.4 135		0.131	7.979	
740NASCIS FMQ+5.4 180		0.088	8.453	0.101
740NASCIS FMQ+5.4 180		0.164	12.999	0.112
740NASCIS FMQ+5.4 225		0.071	6.663	0.071
740NASCIS FMQ+5.4 255		0.073	9.759	0.163
740NASCIS FMQ+5.4 295		0.263	5.901	0.201
740NASCIS FMQ+5.4 330		0.094	10.493	0.239
740NASCIS FMQ+5.4 380		0.091	8.286	0.520
740NASCIS FMQ+5.4 455		0.455	2.657	0.771
740NASCIS FMQ+5.4 510		0.201	9.658	0.920
740NASCIS FMQ+5.4 580		0.244	5.633	1.848
740NASCIS FMQ+5.4 660		0.149	4.168	1.430
740NASCIS FMQ+5.4 725		0.175	4.223	1.042
740NASCIS FMQ+5.4 830		0.130	5.892	0.810
745NASCIS FMQ-3.0 40		8.018	1.644	0.242
745NASCIS FMQ-3.0 90		1.322	3.018	0.071
745NASCIS FMQ-3.0 135		0.126	7.260	
745NASCIS FMQ-3.0 180		3.420	1.425	0.081
745NASCIS FMQ-3.0 225		4.202	1.974	0.078
745NASCIS FMQ-3.0 255		4.219	2.285	0.087
745NASCIS FMQ-3.0 255		4.450	1.965	0.090
745NASCIS FMQ-3.0 295		7.735	1.619	0.129
745NASCIS FMQ-3.0 330		4.651	0.751	0.104
745NASCIS FMQ-3.0 380		7.962	1.649	0.145
745NASCIS FMQ-3.0 455		4.520	1.965	0.138
745NASCIS FMQ-3.0 510		6.020	0.927	0.141
745NASCIS FMQ-3.0 580		0.707	3.617	0.127
745NASCIS FMQ-3.0 660		2.821	2.669	0.485
745NASCIS FMQ-3.0 725		1.174	3.080	0.361
745NASCIS FMQ-3.0 830		0.664	7.703	0.184
746NASCIS FMQ-3.7 40		14.410	1.299	0.129
746NASCIS FMQ-3.7 90		2.708	2.207	0.074

Sample Name	Temperature (°C)	63 Cu [NoGas] RSD %	63 -> 63 Cu [He KED] ppb	63 -> 63 Cu [He KED] RSD %
Std M+Cs+Pt / 1000		2.034	0.101	3.324
Std M+Cs+Pt / 100		0.538	0.865	2.453
REF / 1000			0.009	20.054
REF / 100			0.008	14.508
A-D2 / 20		1.001	1.042	1.498
A-D2		0.704	14.887	1.032
S 102.7 ppb			0.011	5.932
SLRS-5		1.354	12.117	1.245
740NASCIS FMQ+5.4 40			0.044	6.047
740NASCIS FMQ+5.4 90			0.033	6.936
740NASCIS FMQ+5.4 135			0.031	15.026
740NASCIS FMQ+5.4 180		2.006	0.097	8.694
740NASCIS FMQ+5.4 180		3.912	0.114	4.886
740NASCIS FMQ+5.4 225		3.506	0.054	5.357
740NASCIS FMQ+5.4 255		2.337	0.174	0.855
740NASCIS FMQ+5.4 295		1.783	0.241	2.611
740NASCIS FMQ+5.4 330		2.307	0.270	3.315
740NASCIS FMQ+5.4 380		1.030	0.653	2.963
740NASCIS FMQ+5.4 455		1.256	0.957	3.685
740NASCIS FMQ+5.4 510		0.838	1.173	1.444
740NASCIS FMQ+5.4 580		1.550	2.424	1.903
740NASCIS FMQ+5.4 660		1.381	1.851	2.582
740NASCIS FMQ+5.4 725		2.500	1.361	2.408
740NASCIS FMQ+5.4 830		1.711	1.064	1.515
745NASCIS FMQ-3.0 40		1.081	0.277	2.039
745NASCIS FMQ-3.0 90		2.427	0.050	4.999
745NASCIS FMQ-3.0 135			0.035	5.788
745NASCIS FMQ-3.0 180		2.226	0.060	6.625
745NASCIS FMQ-3.0 225		4.177	0.056	11.268
745NASCIS FMQ-3.0 255		2.631	0.067	8.861
745NASCIS FMQ-3.0 255		2.121	0.071	5.921
745NASCIS FMQ-3.0 295		2.060	0.130	5.041
745NASCIS FMQ-3.0 330		3.996	0.093	5.966
745NASCIS FMQ-3.0 380		1.056	0.136	8.222
745NASCIS FMQ-3.0 455		2.334	0.110	4.992
745NASCIS FMQ-3.0 510		1.892	0.116	6.636
745NASCIS FMQ-3.0 580		2.386	0.097	3.594
745NASCIS FMQ-3.0 660		1.913	0.577	4.009
745NASCIS FMQ-3.0 725		2.093	0.423	4.101
745NASCIS FMQ-3.0 830		1.657	0.190	6.627
746NASCIS FMQ-3.7 40		1.762	0.120	4.348
746NASCIS FMQ-3.7 90		1.957	0.043	7.206

Sample Name	Temperature (°C)	66 Zn [NoGas] ppb	66 Zn [NoGas] RSD %	66 -> 66 Zn [He KED] ppb
Std M+Cs+Pt / 1000		0.101	5.752	0.101
Std M+Cs+Pt / 100		0.776	0.983	0.696
REF / 1000		0.065	7.965	0.056
REF / 100		0.043	5.272	0.040
A-D2 / 20		0.978	1.254	0.855
A-D2		13.893	1.525	12.624
S 102.7 ppb		0.053	9.828	0.050
SLRS-5		0.656	1.956	0.521
740NASCIS FMQ+5.4 40		0.455	1.040	0.385
740NASCIS FMQ+5.4 90		0.192	3.256	0.172
740NASCIS FMQ+5.4 135		0.154	5.892	0.130
740NASCIS FMQ+5.4 180		0.342	2.522	0.334
740NASCIS FMQ+5.4 180		0.368	1.125	0.343
740NASCIS FMQ+5.4 225		0.302	4.622	0.264
740NASCIS FMQ+5.4 255		0.256	4.130	0.223
740NASCIS FMQ+5.4 295		0.384	3.437	0.344
740NASCIS FMQ+5.4 330		0.367	1.367	0.357
740NASCIS FMQ+5.4 380		0.528	1.913	0.521
740NASCIS FMQ+5.4 455		1.330	1.403	1.218
740NASCIS FMQ+5.4 510		1.572	1.669	1.410
740NASCIS FMQ+5.4 580		0.762	0.998	0.732
740NASCIS FMQ+5.4 660		0.235	4.771	0.222
740NASCIS FMQ+5.4 725		0.616	3.729	0.568
740NASCIS FMQ+5.4 830		0.382	2.806	0.351
745NASCIS FMQ-3.0 40		0.255	4.489	0.234
745NASCIS FMQ-3.0 90		0.199	5.841	0.186
745NASCIS FMQ-3.0 135		0.215	4.755	0.198
745NASCIS FMQ-3.0 180		0.271	4.075	0.243
745NASCIS FMQ-3.0 225		0.227	1.441	0.232
745NASCIS FMQ-3.0 255		0.234	1.224	0.212
745NASCIS FMQ-3.0 255		0.481	2.306	0.433
745NASCIS FMQ-3.0 295		0.224	1.210	0.200
745NASCIS FMQ-3.0 330		0.809	2.179	0.737
745NASCIS FMQ-3.0 380		0.347	1.563	0.292
745NASCIS FMQ-3.0 455		0.284	2.499	0.248
745NASCIS FMQ-3.0 510		0.269	3.880	0.262
745NASCIS FMQ-3.0 580		0.236	3.786	0.196
745NASCIS FMQ-3.0 660		0.349	2.639	0.316
745NASCIS FMQ-3.0 725		0.479	3.409	0.430
745NASCIS FMQ-3.0 830		0.230	2.916	0.215
746NASCIS FMQ-3.7 40		0.543	3.924	0.523
746NASCIS FMQ-3.7 90		0.151	4.070	0.134

Sample Name	Temperature (°C)	66 -> 66 Zn [He KED] RSD %	75 As [NoGas] ppb	75 As [NoGas] RSD %
Std M+Cs+Pt / 1000		18.519	0.101	0.942
Std M+Cs+Pt / 100		4.393	0.111	0.490
REF / 1000		19.433	0.098	0.367
REF / 100		19.598	0.099	0.247
A-D2 / 20		4.986	0.101	0.358
A-D2		2.475	0.105	0.650
S 102.7 ppb		21.064	0.099	0.185
SLRS-5		10.497	0.100	1.251
740NASCIS FMQ+5.4 40		10.027	0.100	0.580
740NASCIS FMQ+5.4 90		11.344	0.101	0.768
740NASCIS FMQ+5.4 135		10.358	0.099	0.547
740NASCIS FMQ+5.4 180		8.073	0.101	0.668
740NASCIS FMQ+5.4 180		2.660	0.102	0.616
740NASCIS FMQ+5.4 225		7.778	0.101	0.888
740NASCIS FMQ+5.4 255		16.067	0.098	0.707
740NASCIS FMQ+5.4 295		4.876	0.100	0.530
740NASCIS FMQ+5.4 330		3.043	0.099	0.396
740NASCIS FMQ+5.4 380		5.622	0.100	1.072
740NASCIS FMQ+5.4 455		6.989	0.100	0.317
740NASCIS FMQ+5.4 510		4.730	0.102	0.558
740NASCIS FMQ+5.4 580		7.233	0.101	0.707
740NASCIS FMQ+5.4 660		10.406	0.099	0.721
740NASCIS FMQ+5.4 725		2.238	0.100	0.555
740NASCIS FMQ+5.4 830		3.306	0.099	0.482
745NASCIS FMQ-3.0 40		13.333	0.100	0.933
745NASCIS FMQ-3.0 90		12.476	0.100	0.508
745NASCIS FMQ-3.0 135		8.431	0.099	0.563
745NASCIS FMQ-3.0 180		16.445	0.101	0.548
745NASCIS FMQ-3.0 225		19.709	0.102	0.588
745NASCIS FMQ-3.0 255		18.044	0.102	0.477
745NASCIS FMQ-3.0 255		6.169	0.100	0.459
745NASCIS FMQ-3.0 295		4.726	0.103	0.595
745NASCIS FMQ-3.0 330		8.311	0.102	0.772
745NASCIS FMQ-3.0 380		5.373	0.104	0.401
745NASCIS FMQ-3.0 455		9.105	0.102	0.635
745NASCIS FMQ-3.0 510		9.770	0.116	0.660
745NASCIS FMQ-3.0 580		12.182	0.110	0.816
745NASCIS FMQ-3.0 660		7.958	0.119	0.600
745NASCIS FMQ-3.0 725		10.997	0.124	0.920
745NASCIS FMQ-3.0 830		8.147	0.100	0.668
746NASCIS FMQ-3.7 40		6.841	0.099	0.555
746NASCIS FMQ-3.7 90		13.943	0.099	0.809

Sample Name	Temperature (°C)	75 -> 75 As [He KED] ppb	75 -> 75 As [He KED] RSD %	77 [As] [NoGas] ppb
Std M+Cs+Pt / 1000		0.101	14.009	0.101
Std M+Cs+Pt / 100		1.130	10.650	0.260
REF / 1000				0.074
REF / 100				0.084
A-D2 / 20		0.056	25.476	0.139
A-D2		0.984	5.812	0.822
S 102.7 ppb				0.081
SLRS-5		0.391	9.924	0.091
740NASCIS FMQ+5.4 40				0.093
740NASCIS FMQ+5.4 90				0.080
740NASCIS FMQ+5.4 135				0.086
740NASCIS FMQ+5.4 180		0.019	45.786	0.077
740NASCIS FMQ+5.4 180		0.013	39.134	0.081
740NASCIS FMQ+5.4 225				0.084
740NASCIS FMQ+5.4 255		0.022	86.018	0.074
740NASCIS FMQ+5.4 295		0.018	17.688	0.073
740NASCIS FMQ+5.4 330		0.031	48.433	0.075
740NASCIS FMQ+5.4 380		0.068	18.708	0.073
740NASCIS FMQ+5.4 455		0.078	27.127	0.070
740NASCIS FMQ+5.4 510		0.153	32.735	0.078
740NASCIS FMQ+5.4 580		0.299	11.282	0.074
740NASCIS FMQ+5.4 660		0.240	17.294	0.070
740NASCIS FMQ+5.4 725		0.145	21.853	0.076
740NASCIS FMQ+5.4 830		0.023	58.325	0.069
745NASCIS FMQ-3.0 40		0.254	13.107	0.076
745NASCIS FMQ-3.0 90		0.067	22.609	0.070
745NASCIS FMQ-3.0 135		0.036	41.717	0.072
745NASCIS FMQ-3.0 180		0.197	19.994	0.074
745NASCIS FMQ-3.0 225		0.213	8.913	0.074
745NASCIS FMQ-3.0 255		0.330	15.828	0.072
745NASCIS FMQ-3.0 255		0.268	15.925	0.081
745NASCIS FMQ-3.0 295		0.505	8.416	0.061
745NASCIS FMQ-3.0 330		0.283	18.133	0.067
745NASCIS FMQ-3.0 380		0.595	6.851	0.076
745NASCIS FMQ-3.0 455		0.544	19.178	0.077
745NASCIS FMQ-3.0 510		1.872	6.032	0.064
745NASCIS FMQ-3.0 580		1.287	3.569	0.081
745NASCIS FMQ-3.0 660		2.521	4.137	0.080
745NASCIS FMQ-3.0 725		3.092	1.397	0.075
745NASCIS FMQ-3.0 830		0.167	31.634	0.072
746NASCIS FMQ-3.7 40		0.040	28.292	0.077
746NASCIS FMQ-3.7 90		0.011	47.498	0.079

Sample Name	Temperature (°C)	77 [As] [NoGas] RSD %	78 [As] [NoGas] ppb	78 [As] [NoGas] RSD %
Std M+Cs+Pt / 1000		6.709	0.101	0.910
Std M+Cs+Pt / 100		5.099	0.103	0.634
REF / 1000		16.590	0.099	0.291
REF / 100		9.045	0.100	0.285
A-D2 / 20		13.126	0.102	0.295
A-D2		1.727	0.103	0.671
S 102.7 ppb		8.203	0.100	0.193
SLRS-5		13.197	0.097	1.334
740NASCIS FMQ+5.4 40		2.023	0.101	0.556
740NASCIS FMQ+5.4 90		3.433	0.102	0.775
740NASCIS FMQ+5.4 135		3.719	0.100	0.511
740NASCIS FMQ+5.4 180		12.067	0.102	0.650
740NASCIS FMQ+5.4 180		14.422	0.103	0.690
740NASCIS FMQ+5.4 225		15.302	0.102	0.814
740NASCIS FMQ+5.4 255		8.967	0.099	0.747
740NASCIS FMQ+5.4 295		10.746	0.100	0.533
740NASCIS FMQ+5.4 330		12.744	0.100	0.417
740NASCIS FMQ+5.4 380		15.077	0.100	0.951
740NASCIS FMQ+5.4 455		14.002	0.100	0.368
740NASCIS FMQ+5.4 510		13.895	0.101	0.644
740NASCIS FMQ+5.4 580		13.718	0.099	0.685
740NASCIS FMQ+5.4 660		10.363	0.098	0.761
740NASCIS FMQ+5.4 725		12.586	0.099	0.582
740NASCIS FMQ+5.4 830		11.911	0.099	0.469
745NASCIS FMQ-3.0 40		15.358	0.099	0.981
745NASCIS FMQ-3.0 90		7.126	0.101	0.539
745NASCIS FMQ-3.0 135		9.707	0.099	0.546
745NASCIS FMQ-3.0 180		16.300	0.100	0.568
745NASCIS FMQ-3.0 225		10.182	0.101	0.536
745NASCIS FMQ-3.0 255		13.964	0.100	0.477
745NASCIS FMQ-3.0 255		13.807	0.099	0.564
745NASCIS FMQ-3.0 295		9.154	0.100	0.726
745NASCIS FMQ-3.0 330		9.362	0.100	0.755
745NASCIS FMQ-3.0 380		6.266	0.099	0.362
745NASCIS FMQ-3.0 455		9.001	0.098	0.662
745NASCIS FMQ-3.0 510		10.161	0.100	0.566
745NASCIS FMQ-3.0 580		11.571	0.100	0.705
745NASCIS FMQ-3.0 660		8.642	0.099	0.433
745NASCIS FMQ-3.0 725		22.398	0.098	0.698
745NASCIS FMQ-3.0 830		18.856	0.099	0.688
746NASCIS FMQ-3.7 40		6.276	0.099	0.578
746NASCIS FMQ-3.7 90		11.414	0.100	0.795

Sample Name	Temperature (°C)	85 Rb [NoGas] ppb	85 Rb [NoGas] RSD %	89 Y [NoGas] ppb	89 Y [NoGas] RSD %
Std M+Cs+Pt / 1000		0.001		21.490	
Std M+Cs+Pt / 100		0.001		14.392	
REF / 1000		0.001		27.371	
REF / 100		0.001		12.371	
A-D2 / 20		0.491		0.620	4.959 0.999
A-D2		7.077		1.502	70.835 1.504
S 102.7 ppb		0.002		18.321	0.008 28.181
SLRS-5		0.917		2.452	0.083 2.027
740NASCIS FMQ+5.4 40		0.005		8.529	
740NASCIS FMQ+5.4 90		0.009		9.094	
740NASCIS FMQ+5.4 135		0.004		5.548	
740NASCIS FMQ+5.4 180		0.022		3.361	
740NASCIS FMQ+5.4 180		0.052		3.250	0.020 6.430
740NASCIS FMQ+5.4 225		0.005		7.715	
740NASCIS FMQ+5.4 255		0.051		2.616	
740NASCIS FMQ+5.4 295		0.141		2.443	
740NASCIS FMQ+5.4 330		0.191		1.773	
740NASCIS FMQ+5.4 380		0.051		2.056	
740NASCIS FMQ+5.4 455		0.117		2.246	
740NASCIS FMQ+5.4 510		0.052		2.604	0.003 10.954
740NASCIS FMQ+5.4 580		0.043		2.817	0.029 3.860
740NASCIS FMQ+5.4 660		0.016		10.510	0.059 2.469
740NASCIS FMQ+5.4 725		0.015		5.885	0.181 1.847
740NASCIS FMQ+5.4 830		0.010		3.907	
745NASCIS FMQ-3.0 40		0.013		2.803	0.032 3.161
745NASCIS FMQ-3.0 90		0.003		9.031	
745NASCIS FMQ-3.0 135		0.002		12.848	
745NASCIS FMQ-3.0 180		0.009		5.435	
745NASCIS FMQ-3.0 225		0.010		4.740	
745NASCIS FMQ-3.0 255		0.010		6.573	
745NASCIS FMQ-3.0 255		0.012		5.675	
745NASCIS FMQ-3.0 295		0.048		4.071	0.004 6.335
745NASCIS FMQ-3.0 330		0.043		2.189	
745NASCIS FMQ-3.0 380		0.021		3.247	
745NASCIS FMQ-3.0 455		0.011		6.605	
745NASCIS FMQ-3.0 510		0.002		6.426	0.003 7.044
745NASCIS FMQ-3.0 580		0.002		8.059	0.006 3.635
745NASCIS FMQ-3.0 660		0.010		8.116	0.110 1.644
745NASCIS FMQ-3.0 725		0.010		7.427	0.274 1.950
745NASCIS FMQ-3.0 830		0.004		9.891	0.037 3.946
746NASCIS FMQ-3.7 40		0.013		5.676	
746NASCIS FMQ-3.7 90		0.002		6.964	

Sample Name	Temperature (°C)	95 Mo [NoGas] ppb	95 Mo [NoGas] RSD %	103 Rh [NoGas] CPS
Std M+Cs+Pt / 1000		0.101	2.894	398059.360
Std M+Cs+Pt / 100		1.053	2.916	400651.422
REF / 1000		0.206	3.364	401525.628
REF / 100		2.033	1.158	403608.254
A-D2 / 20				393278.782
A-D2		0.006	14.836	405072.812
S 102.7 ppb		0.002	25.922	394529.020
SLRS-5		0.200	1.798	364488.288
740NASCIS FMQ+5.4 40		0.017	6.184	398228.918
740NASCIS FMQ+5.4 90		0.773	1.060	397018.786
740NASCIS FMQ+5.4 135		0.011	17.561	399222.510
740NASCIS FMQ+5.4 180		0.105	3.375	396837.688
740NASCIS FMQ+5.4 180		0.079	1.775	389366.040
740NASCIS FMQ+5.4 225		0.014	9.627	395325.302
740NASCIS FMQ+5.4 255		0.079	5.237	398777.436
740NASCIS FMQ+5.4 295		0.054	2.931	396153.730
740NASCIS FMQ+5.4 330		0.053	4.968	409161.020
740NASCIS FMQ+5.4 380		0.142	3.172	429239.888
740NASCIS FMQ+5.4 455		0.114	2.920	440338.550
740NASCIS FMQ+5.4 510		0.374	1.911	403166.742
740NASCIS FMQ+5.4 580		0.731	2.294	445381.014
740NASCIS FMQ+5.4 660		0.364	2.503	428387.556
740NASCIS FMQ+5.4 725		0.342	2.842	416319.984
740NASCIS FMQ+5.4 830		0.352	3.772	397372.196
745NASCIS FMQ-3.0 40		0.212	3.655	481470.158
745NASCIS FMQ-3.0 90		0.046	1.897	399452.314
745NASCIS FMQ-3.0 135		0.025	8.358	392262.220
745NASCIS FMQ-3.0 180		0.136	4.246	422225.734
745NASCIS FMQ-3.0 225		0.115	3.745	426718.882
745NASCIS FMQ-3.0 255		0.181	2.851	428930.942
745NASCIS FMQ-3.0 255		0.129	1.720	425475.150
745NASCIS FMQ-3.0 295		0.309	3.292	457586.650
745NASCIS FMQ-3.0 330		0.160	1.341	436938.064
745NASCIS FMQ-3.0 380		0.337	3.816	484699.712
745NASCIS FMQ-3.0 455		0.819	1.365	456151.470
745NASCIS FMQ-3.0 510		2.171	2.146	461180.336
745NASCIS FMQ-3.0 580		2.037	1.730	402300.154
745NASCIS FMQ-3.0 660		3.782	0.794	408707.408
745NASCIS FMQ-3.0 725		2.780	1.306	420458.696
745NASCIS FMQ-3.0 830		0.247	2.333	393351.218
746NASCIS FMQ-3.7 40		0.154	3.185	446178.838
746NASCIS FMQ-3.7 90		0.041	5.795	393737.124

Sample Name	Temperature (°C)	103 Rh [NoGas] RSD %	103 -> 103 Rh [He KED] CPS	103 -> 103 Rh [He KED] RSD %
Std M+Cs+Pt / 1000		0.947	73955.478	1.004
Std M+Cs+Pt / 100		0.978	73262.450	2.321
REF / 1000		1.025	74404.726	1.523
REF / 100		1.099	73686.296	1.418
A-D2 / 20		1.168	73787.386	0.832
A-D2		0.733	73059.546	1.444
S 102.7 ppb		1.085	72984.444	1.034
SLRS-5		1.888	65524.010	1.200
740NASCIS FMQ+5.4 40		1.025	72947.596	1.269
740NASCIS FMQ+5.4 90		1.055	74187.796	2.225
740NASCIS FMQ+5.4 135		1.041	73664.376	1.442
740NASCIS FMQ+5.4 180		1.190	75159.110	1.603
740NASCIS FMQ+5.4 180		0.897	75017.084	1.182
740NASCIS FMQ+5.4 225		1.478	73328.024	1.633
740NASCIS FMQ+5.4 255		1.778	74044.526	1.701
740NASCIS FMQ+5.4 295		1.183	75285.606	1.470
740NASCIS FMQ+5.4 330		1.527	75799.206	0.827
740NASCIS FMQ+5.4 380		2.272	80441.322	1.163
740NASCIS FMQ+5.4 455		1.173	81560.196	2.009
740NASCIS FMQ+5.4 510		1.451	75446.360	2.046
740NASCIS FMQ+5.4 580		3.335	81518.700	2.628
740NASCIS FMQ+5.4 660		2.771	79015.792	2.329
740NASCIS FMQ+5.4 725		2.488	77925.154	1.440
740NASCIS FMQ+5.4 830		2.049	73542.958	0.937
745NASCIS FMQ-3.0 40		2.614	90750.380	1.130
745NASCIS FMQ-3.0 90		2.596	74778.672	1.896
745NASCIS FMQ-3.0 135		2.023	74039.132	1.071
745NASCIS FMQ-3.0 180		2.202	79128.876	1.189
745NASCIS FMQ-3.0 225		3.238	79213.250	0.996
745NASCIS FMQ-3.0 255		0.895	80910.968	0.930
745NASCIS FMQ-3.0 255		1.470	80739.418	1.406
745NASCIS FMQ-3.0 295		1.054	87116.066	1.356
745NASCIS FMQ-3.0 330		2.474	81325.644	1.293
745NASCIS FMQ-3.0 380		0.851	90672.724	2.713
745NASCIS FMQ-3.0 455		2.423	83235.264	1.231
745NASCIS FMQ-3.0 510		1.094	87113.496	1.355
745NASCIS FMQ-3.0 580		2.228	76614.458	1.655
745NASCIS FMQ-3.0 660		1.835	75416.334	1.735
745NASCIS FMQ-3.0 725		2.202	77327.058	1.419
745NASCIS FMQ-3.0 830		3.102	73946.886	1.359
746NASCIS FMQ-3.7 40		1.126	84039.426	2.042
746NASCIS FMQ-3.7 90		1.261	74026.598	1.114

Sample Name	Temperature (°C)	103 -> 103 Rh [H2] CPS	103 -> 103 Rh [H2] RSD %	103 -> 103 Rh [O2] CPS
Std M+Cs+Pt / 1000		83055.794	0.892	188590.490
Std M+Cs+Pt / 100		84733.470	1.431	189358.272
REF / 1000		84322.782	1.853	190538.158
REF / 100		84741.628	0.983	189311.536
A-D2 / 20		83395.960	1.615	189195.148
A-D2		82588.702	1.287	187594.746
S 102.7 ppb		82571.416	1.759	185651.906
SLRS-5		71075.846	4.121	174026.620
740NASCIS FMQ+5.4 40		82189.932	1.819	186796.200
740NASCIS FMQ+5.4 90		83865.838	1.671	184812.190
740NASCIS FMQ+5.4 135		83312.924	0.765	187289.828
740NASCIS FMQ+5.4 180		82877.402	0.827	190219.580
740NASCIS FMQ+5.4 180		83124.576	0.756	187251.642
740NASCIS FMQ+5.4 225		76137.592	16.641	183902.534
740NASCIS FMQ+5.4 255		80621.442	9.838	182357.894
740NASCIS FMQ+5.4 295		82085.450	1.970	188321.158
740NASCIS FMQ+5.4 330		85210.714	1.406	189031.894
740NASCIS FMQ+5.4 380		88338.586	1.772	200747.530
740NASCIS FMQ+5.4 455		91322.126	0.797	204625.618
740NASCIS FMQ+5.4 510		83829.624	0.913	190587.208
740NASCIS FMQ+5.4 580		90527.704	0.770	206794.988
740NASCIS FMQ+5.4 660		88212.476	1.128	196926.770
740NASCIS FMQ+5.4 725		86294.352	1.056	196537.516
740NASCIS FMQ+5.4 830		81547.602	1.393	184906.998
745NASCIS FMQ-3.0 40		99375.650	1.917	222839.320
745NASCIS FMQ-3.0 90		83519.364	2.360	187427.646
745NASCIS FMQ-3.0 135		81664.020	1.506	183606.772
745NASCIS FMQ-3.0 180		87035.628	1.649	195330.472
745NASCIS FMQ-3.0 225		88479.352	0.913	201813.268
745NASCIS FMQ-3.0 255		89262.836	1.039	203102.676
745NASCIS FMQ-3.0 255		89444.640	0.907	203684.282
745NASCIS FMQ-3.0 295		95737.476	1.149	218139.942
745NASCIS FMQ-3.0 330		91375.218	0.884	205109.060
745NASCIS FMQ-3.0 380		101550.140	1.927	227331.590
745NASCIS FMQ-3.0 455		91207.584	1.527	210183.674
745NASCIS FMQ-3.0 510		96499.110	1.779	218878.418
745NASCIS FMQ-3.0 580		83999.300	2.839	193353.318
745NASCIS FMQ-3.0 660		83841.752	0.755	190732.472
745NASCIS FMQ-3.0 725		85742.758	1.415	194502.438
745NASCIS FMQ-3.0 830		80985.324	1.460	185440.072
746NASCIS FMQ-3.7 40		93297.712	1.693	214223.124
746NASCIS FMQ-3.7 90		80572.658	1.370	185573.024

Sample Name	Temperature (°C)	103 -> 103 Rh [O2] RSD %	107 Ag [NoGas] ppb	107 Ag [NoGas] RSD %
Std M+Cs+Pt / 1000		1.740	0.101	4.131
Std M+Cs+Pt / 100		1.324	1.028	1.475
REF / 1000		1.590	0.002	26.880
REF / 100		0.545	0.001	24.222
A-D2 / 20		1.230	0.002	12.163
A-D2		0.544	0.025	2.073
S 102.7 ppb		0.725	0.001	15.662
SLRS-5		2.253	0.001	28.016
740NASCIS FMQ+5.4 40		1.823	0.001	20.453
740NASCIS FMQ+5.4 90		1.295	0.003	16.363
740NASCIS FMQ+5.4 135		0.905	0.001	28.889
740NASCIS FMQ+5.4 180		1.264	0.005	9.844
740NASCIS FMQ+5.4 180		0.675	0.003	9.381
740NASCIS FMQ+5.4 225		0.782	0.002	6.734
740NASCIS FMQ+5.4 255		1.811	0.012	17.064
740NASCIS FMQ+5.4 295		0.850	0.083	4.865
740NASCIS FMQ+5.4 330		1.354	0.117	1.057
740NASCIS FMQ+5.4 380		0.886	0.069	4.927
740NASCIS FMQ+5.4 455		1.424	0.032	6.027
740NASCIS FMQ+5.4 510		1.167	0.005	14.316
740NASCIS FMQ+5.4 580		0.519	0.008	9.890
740NASCIS FMQ+5.4 660		0.972	0.004	11.711
740NASCIS FMQ+5.4 725		1.205	0.003	11.653
740NASCIS FMQ+5.4 830		1.725	0.002	30.314
745NASCIS FMQ-3.0 40		1.179	0.006	13.768
745NASCIS FMQ-3.0 90		1.295	0.001	23.873
745NASCIS FMQ-3.0 135		0.861	0.001	53.682
745NASCIS FMQ-3.0 180		1.209	0.001	20.779
745NASCIS FMQ-3.0 225		1.449	0.001	13.354
745NASCIS FMQ-3.0 255		0.896	0.001	15.534
745NASCIS FMQ-3.0 255		1.498	0.002	10.557
745NASCIS FMQ-3.0 295		1.532	0.006	6.214
745NASCIS FMQ-3.0 330		0.879	0.005	6.796
745NASCIS FMQ-3.0 380		1.346	0.035	5.967
745NASCIS FMQ-3.0 455		2.349	0.006	9.981
745NASCIS FMQ-3.0 510		0.507	0.004	12.406
745NASCIS FMQ-3.0 580		2.042	0.024	5.827
745NASCIS FMQ-3.0 660		1.084	0.005	16.046
745NASCIS FMQ-3.0 725		0.836	0.002	9.880
745NASCIS FMQ-3.0 830		0.866	0.002	29.970
746NASCIS FMQ-3.7 40		2.490	0.004	16.949
746NASCIS FMQ-3.7 90		1.390	0.001	9.753

Sample Name	Temperature (°C)	111 Cd [NoGas] ppb	111 Cd [NoGas] RSD %	115 In [NoGas] CPS
Std M+Cs+Pt / 1000		0.101	4.599	384974.600
Std M+Cs+Pt / 100		1.037	1.978	382252.558
REF / 1000				391525.390
REF / 100		0.002	43.974	385002.962
A-D2 / 20		0.305	2.913	381006.928
A-D2		4.413	1.841	391470.846
S 102.7 ppb				390271.284
SLRS-5		0.009	25.828	365902.818
740NASCIS FMQ+5.4 40		0.002	49.671	383854.668
740NASCIS FMQ+5.4 90		0.009	17.149	383296.302
740NASCIS FMQ+5.4 135		0.005	26.912	384950.286
740NASCIS FMQ+5.4 180		0.032	2.549	381179.636
740NASCIS FMQ+5.4 180		0.018	7.385	376592.294
740NASCIS FMQ+5.4 225		0.005	31.500	379390.128
740NASCIS FMQ+5.4 255		0.053	7.765	385806.322
740NASCIS FMQ+5.4 295		0.037	12.053	381430.032
740NASCIS FMQ+5.4 330		0.079	3.906	385238.302
740NASCIS FMQ+5.4 380		0.186	2.537	387076.502
740NASCIS FMQ+5.4 455		0.292	3.285	384849.730
740NASCIS FMQ+5.4 510		0.304	3.851	383274.182
740NASCIS FMQ+5.4 580		0.438	2.104	388633.968
740NASCIS FMQ+5.4 660		0.131	7.838	393610.778
740NASCIS FMQ+5.4 725		0.187	6.775	388021.836
740NASCIS FMQ+5.4 830		0.020	12.630	382907.914
745NASCIS FMQ-3.0 40		0.141	4.831	384550.542
745NASCIS FMQ-3.0 90		0.036	11.956	377529.556
745NASCIS FMQ-3.0 135		0.010	19.065	384450.416
745NASCIS FMQ-3.0 180		0.108	3.723	378856.018
745NASCIS FMQ-3.0 225		0.163	2.969	377471.538
745NASCIS FMQ-3.0 255		0.521	4.496	376722.570
745NASCIS FMQ-3.0 255		0.211	3.644	380753.090
745NASCIS FMQ-3.0 295		0.231	4.723	379855.436
745NASCIS FMQ-3.0 330		0.292	1.491	374919.192
745NASCIS FMQ-3.0 380		0.566	1.624	377229.368
745NASCIS FMQ-3.0 455		0.142	5.717	382875.300
745NASCIS FMQ-3.0 510		0.493	4.142	377159.358
745NASCIS FMQ-3.0 580		0.126	6.894	375356.962
745NASCIS FMQ-3.0 660		0.314	3.830	381153.806
745NASCIS FMQ-3.0 725		0.310	5.278	382797.086
745NASCIS FMQ-3.0 830		0.075	4.987	378882.034
746NASCIS FMQ-3.7 40		0.124	8.373	375319.500
746NASCIS FMQ-3.7 90		0.014	15.908	379174.094

Sample Name	Temperature (°C)	115 In [NoGas] RSD %	115 -> 115 In [He KED] CPS	115 -> 115 In [He KED] RSD %
Std M+Cs+Pt / 1000		1.020	21672.520	1.124
Std M+Cs+Pt / 100		1.159	21613.746	2.019
REF / 1000		1.306	21751.262	1.185
REF / 100		1.963	21298.684	1.895
A-D2 / 20		0.975	21525.630	2.119
A-D2		0.592	21806.012	1.908
S 102.7 ppb		1.705	21743.914	1.011
SLRS-5		0.648	18939.080	1.249
740NASCIS FMQ+5.4 40		1.910	22062.356	1.948
740NASCIS FMQ+5.4 90		0.985	21412.154	2.106
740NASCIS FMQ+5.4 135		1.172	21986.922	2.072
740NASCIS FMQ+5.4 180		1.000	21708.538	1.777
740NASCIS FMQ+5.4 180		2.040	21603.734	1.797
740NASCIS FMQ+5.4 225		1.495	21388.814	2.738
740NASCIS FMQ+5.4 255		1.209	21673.198	1.446
740NASCIS FMQ+5.4 295		1.086	21930.864	1.465
740NASCIS FMQ+5.4 330		2.410	21310.694	1.822
740NASCIS FMQ+5.4 380		1.862	22161.828	1.416
740NASCIS FMQ+5.4 455		1.846	22030.978	0.442
740NASCIS FMQ+5.4 510		0.582	21579.698	1.639
740NASCIS FMQ+5.4 580		2.481	22145.818	2.442
740NASCIS FMQ+5.4 660		4.536	22043.678	2.484
740NASCIS FMQ+5.4 725		2.041	21378.774	1.080
740NASCIS FMQ+5.4 830		3.266	21874.102	0.934
745NASCIS FMQ-3.0 40		3.243	21941.508	1.468
745NASCIS FMQ-3.0 90		2.331	21252.626	1.546
745NASCIS FMQ-3.0 135		1.874	21705.882	1.848
745NASCIS FMQ-3.0 180		1.090	21740.600	2.927
745NASCIS FMQ-3.0 225		2.180	21418.824	1.964
745NASCIS FMQ-3.0 255		1.094	21538.998	1.536
745NASCIS FMQ-3.0 255		1.662	21350.758	2.133
745NASCIS FMQ-3.0 295		0.764	21419.514	2.622
745NASCIS FMQ-3.0 330		1.721	20841.422	2.045
745NASCIS FMQ-3.0 380		0.974	21248.610	2.473
745NASCIS FMQ-3.0 455		2.790	21714.590	2.807
745NASCIS FMQ-3.0 510		1.434	21707.888	3.344
745NASCIS FMQ-3.0 580		0.680	21389.472	1.649
745NASCIS FMQ-3.0 660		1.976	20996.944	1.460
745NASCIS FMQ-3.0 725		2.422	21593.098	2.550
745NASCIS FMQ-3.0 830		1.789	21353.396	0.719
746NASCIS FMQ-3.7 40		1.889	21175.166	1.011
746NASCIS FMQ-3.7 90		1.852	21023.678	1.216

Sample Name	Temperature (°C)	115 -> 115 In [H2] CPS	115 -> 115 In [H2] RSD %	115 -> 115 In [O2] CPS
Std M+Cs+Pt / 1000		140637.628	1.573	201423.560
Std M+Cs+Pt / 100		143351.192	2.860	202747.922
REF / 1000		141157.384	1.744	205422.468
REF / 100		141408.566	2.172	204820.186
A-D2 / 20		138892.980	0.996	201798.726
A-D2		139919.920	1.272	203891.946
S 102.7 ppb		138702.202	1.724	200000.938
SLRS-5		134330.564	0.937	188600.098
740NASCIS FMQ+5.4	40	140566.008	1.001	199161.580
740NASCIS FMQ+5.4	90	140605.568	1.209	200100.856
740NASCIS FMQ+5.4	135	138645.850	1.163	199851.826
740NASCIS FMQ+5.4	180	140899.784	2.012	198093.670
740NASCIS FMQ+5.4	180	139000.546	2.019	199756.506
740NASCIS FMQ+5.4	225	131943.984	18.584	198965.084
740NASCIS FMQ+5.4	255	136252.634	8.406	192869.576
740NASCIS FMQ+5.4	295	140574.974	1.470	200763.820
740NASCIS FMQ+5.4	330	141223.242	1.019	200691.784
740NASCIS FMQ+5.4	380	141076.368	1.028	203131.202
740NASCIS FMQ+5.4	455	141550.726	1.261	199586.646
740NASCIS FMQ+5.4	510	140454.846	0.440	198006.748
740NASCIS FMQ+5.4	580	141181.160	2.083	199659.264
740NASCIS FMQ+5.4	660	140706.320	1.533	201841.236
740NASCIS FMQ+5.4	725	139994.286	1.610	198744.970
740NASCIS FMQ+5.4	830	137908.796	1.014	198957.916
745NASCIS FMQ-3.0	40	139785.784	1.738	196921.844
745NASCIS FMQ-3.0	90	138213.244	1.790	196676.382
745NASCIS FMQ-3.0	135	140189.724	2.654	197839.900
745NASCIS FMQ-3.0	180	138244.804	1.582	196253.692
745NASCIS FMQ-3.0	225	138889.664	1.463	197114.724
745NASCIS FMQ-3.0	255	138875.334	0.975	197975.884
745NASCIS FMQ-3.0	255	139689.102	1.463	197666.872
745NASCIS FMQ-3.0	295	140069.426	0.887	199081.724
745NASCIS FMQ-3.0	330	137997.896	1.351	192119.486
745NASCIS FMQ-3.0	380	137869.188	1.377	195365.776
745NASCIS FMQ-3.0	455	137518.336	2.020	194997.208
745NASCIS FMQ-3.0	510	136546.142	2.076	195106.778
745NASCIS FMQ-3.0	580	137594.900	2.244	196947.244
745NASCIS FMQ-3.0	660	137552.032	2.312	194701.992
745NASCIS FMQ-3.0	725	137157.000	1.273	195853.862
745NASCIS FMQ-3.0	830	137637.184	2.122	196082.692
746NASCIS FMQ-3.7	40	138432.460	0.909	195055.706
746NASCIS FMQ-3.7	90	140694.594	2.074	197192.624

Sample Name	Temperature (°C)	115 -> 115 In [O2] RSD %	118 Sn [NoGas] ppb	118 Sn [NoGas] RSD %
Std M+Cs+Pt / 1000		1.849	0.003	12.093
Std M+Cs+Pt / 100		1.246	0.003	15.530
REF / 1000		1.010	0.205	1.718
REF / 100		1.335	1.945	1.498
A-D2 / 20		1.455	0.004	8.977
A-D2		0.561	0.005	5.809
S 102.7 ppb		0.864	0.003	29.665
SLRS-5		2.421	0.007	19.445
740NASCIS FMQ+5.4 40		0.502	0.015	4.120
740NASCIS FMQ+5.4 90		1.246	0.035	6.320
740NASCIS FMQ+5.4 135		0.514	0.033	7.464
740NASCIS FMQ+5.4 180		1.703	0.061	5.230
740NASCIS FMQ+5.4 180		0.593	0.044	4.138
740NASCIS FMQ+5.4 225		0.310	0.048	4.238
740NASCIS FMQ+5.4 255		2.115	0.056	7.336
740NASCIS FMQ+5.4 295		1.840	0.047	2.069
740NASCIS FMQ+5.4 330		1.915	0.071	6.253
740NASCIS FMQ+5.4 380		1.701	0.057	3.198
740NASCIS FMQ+5.4 455		0.634	0.075	4.280
740NASCIS FMQ+5.4 510		1.477	0.138	3.888
740NASCIS FMQ+5.4 580		1.107	0.313	1.972
740NASCIS FMQ+5.4 660		1.198	0.366	1.093
740NASCIS FMQ+5.4 725		1.219	0.200	3.903
740NASCIS FMQ+5.4 830		0.806	0.252	1.597
745NASCIS FMQ-3.0 40		1.267	0.064	3.000
745NASCIS FMQ-3.0 90		0.689	0.015	7.962
745NASCIS FMQ-3.0 135		1.116	0.012	7.589
745NASCIS FMQ-3.0 180		1.289	0.039	5.047
745NASCIS FMQ-3.0 225		1.489	0.050	9.027
745NASCIS FMQ-3.0 255		0.494	0.079	3.517
745NASCIS FMQ-3.0 255		1.130	0.053	2.571
745NASCIS FMQ-3.0 295		1.458	0.065	7.010
745NASCIS FMQ-3.0 330		1.313	0.041	2.397
745NASCIS FMQ-3.0 380		1.786	0.056	2.326
745NASCIS FMQ-3.0 455		1.035	0.020	2.656
745NASCIS FMQ-3.0 510		1.132	0.022	6.011
745NASCIS FMQ-3.0 580		1.207	0.008	11.088
745NASCIS FMQ-3.0 660		0.737	0.070	6.990
745NASCIS FMQ-3.0 725		0.513	0.014	4.625
745NASCIS FMQ-3.0 830		1.234	0.010	15.193
746NASCIS FMQ-3.7 40		1.991	0.030	5.436
746NASCIS FMQ-3.7 90		1.258	0.015	6.690

Sample Name	Temperature (°C)	118 -> 118 Sn [He KED] ppb	118 -> 118 Sn [He KED] RSD %	118 -> 118 Sn [O2] ppb
Std M+Cs+Pt / 1000				0.003
Std M+Cs+Pt / 100				0.003
REF / 1000		0.205	15.551	0.205
REF / 100		1.868	4.401	1.936
A-D2 / 20				0.005
A-D2		0.004	63.888	0.004
S 102.7 ppb		0.007	92.628	0.004
SLRS-5		0.007	67.420	0.008
740NASCIS FMQ+5.4 40		0.011	39.528	0.017
740NASCIS FMQ+5.4 90		0.035	19.569	0.036
740NASCIS FMQ+5.4 135		0.035	17.668	0.036
740NASCIS FMQ+5.4 180		0.042	42.573	0.064
740NASCIS FMQ+5.4 180		0.039	42.111	0.048
740NASCIS FMQ+5.4 225		0.042	25.906	0.048
740NASCIS FMQ+5.4 255		0.061	36.247	0.052
740NASCIS FMQ+5.4 295		0.038	45.581	0.050
740NASCIS FMQ+5.4 330		0.065	23.687	0.072
740NASCIS FMQ+5.4 380		0.067	17.922	0.065
740NASCIS FMQ+5.4 455		0.077	21.061	0.075
740NASCIS FMQ+5.4 510		0.130	9.094	0.139
740NASCIS FMQ+5.4 580		0.319	9.275	0.313
740NASCIS FMQ+5.4 660		0.347	3.788	0.373
740NASCIS FMQ+5.4 725		0.206	9.492	0.198
740NASCIS FMQ+5.4 830		0.247	17.973	0.264
745NASCIS FMQ-3.0 40		0.065	20.160	0.066
745NASCIS FMQ-3.0 90		0.012	56.844	0.016
745NASCIS FMQ-3.0 135		0.016	44.628	0.016
745NASCIS FMQ-3.0 180		0.037	27.196	0.046
745NASCIS FMQ-3.0 225		0.036	24.593	0.051
745NASCIS FMQ-3.0 255		0.065	25.175	0.076
745NASCIS FMQ-3.0 255		0.060	11.664	0.055
745NASCIS FMQ-3.0 295		0.057	25.249	0.064
745NASCIS FMQ-3.0 330		0.042	38.319	0.042
745NASCIS FMQ-3.0 380		0.060	20.203	0.058
745NASCIS FMQ-3.0 455		0.018	48.914	0.019
745NASCIS FMQ-3.0 510		0.020	28.287	0.026
745NASCIS FMQ-3.0 580		0.008	34.401	0.010
745NASCIS FMQ-3.0 660		0.063	21.561	0.070
745NASCIS FMQ-3.0 725		0.008	39.123	0.014
745NASCIS FMQ-3.0 830		0.008	63.888	0.013
746NASCIS FMQ-3.7 40		0.024	26.082	0.030
746NASCIS FMQ-3.7 90		0.015	53.363	0.014

Sample Name	Temperature (°C)	118 -> 118 Sn [O2] RSD %	118 -> 118 Sn [H2] ppb	118 -> 118 Sn [H2] RSD %
Std M+Cs+Pt / 1000		19.174	0.004	85.267
Std M+Cs+Pt / 100		27.794	0.005	56.983
REF / 1000		6.536	0.205	7.612
REF / 100		2.280	2.087	3.974
A-D2 / 20		46.414	0.007	39.491
A-D2		14.582	0.006	41.458
S 102.7 ppb		20.738	0.003	39.123
SLRS-5		27.350	0.007	17.861
740NASCIS FMQ+5.4 40		13.160	0.018	12.870
740NASCIS FMQ+5.4 90		17.870	0.037	29.575
740NASCIS FMQ+5.4 135		11.918	0.039	18.684
740NASCIS FMQ+5.4 180		14.126	0.069	11.142
740NASCIS FMQ+5.4 180		8.897	0.046	15.240
740NASCIS FMQ+5.4 225		17.465	0.046	31.287
740NASCIS FMQ+5.4 255		14.197	0.057	6.876
740NASCIS FMQ+5.4 295		19.070	0.041	29.897
740NASCIS FMQ+5.4 330		14.351	0.083	23.079
740NASCIS FMQ+5.4 380		8.775	0.064	20.008
740NASCIS FMQ+5.4 455		8.506	0.079	12.501
740NASCIS FMQ+5.4 510		10.925	0.152	8.431
740NASCIS FMQ+5.4 580		4.262	0.325	8.671
740NASCIS FMQ+5.4 660		2.703	0.386	4.905
740NASCIS FMQ+5.4 725		5.949	0.213	9.191
740NASCIS FMQ+5.4 830		4.629	0.253	6.236
745NASCIS FMQ-3.0 40		19.279	0.075	9.488
745NASCIS FMQ-3.0 90		19.573	0.015	20.531
745NASCIS FMQ-3.0 135		29.226	0.012	50.773
745NASCIS FMQ-3.0 180		7.782	0.041	17.984
745NASCIS FMQ-3.0 225		4.444	0.060	16.481
745NASCIS FMQ-3.0 255		10.862	0.084	6.330
745NASCIS FMQ-3.0 255		13.589	0.056	12.430
745NASCIS FMQ-3.0 295		11.854	0.070	16.020
745NASCIS FMQ-3.0 330		23.503	0.046	8.225
745NASCIS FMQ-3.0 380		8.336	0.063	18.842
745NASCIS FMQ-3.0 455		12.517	0.018	34.445
745NASCIS FMQ-3.0 510		17.328	0.025	25.482
745NASCIS FMQ-3.0 580		7.873	0.011	40.933
745NASCIS FMQ-3.0 660		14.064	0.087	21.181
745NASCIS FMQ-3.0 725		22.466	0.015	40.624
745NASCIS FMQ-3.0 830		25.915	0.012	30.942
746NASCIS FMQ-3.7 40		7.753	0.039	15.296
746NASCIS FMQ-3.7 90		26.321	0.019	24.951

Sample Name	Temperature (°C)	120 Sn [NoGas] ppb	120 Sn [NoGas] RSD %	133 Cs [NoGas]ppb
Std M+Cs+Pt / 1000		0.003	14.317	0.010
Std M+Cs+Pt / 100		0.003	9.978	0.102
REF / 1000		0.205	2.117	0.000
REF / 100		1.930	1.171	
A-D2 / 20		0.005	5.205	0.001
A-D2		0.005	15.138	0.017
S 102.7 ppb		0.003	10.395	
SLRS-5		0.007	9.404	0.004
740NASCIS FMQ+5.4 40		0.016	6.990	0.014
740NASCIS FMQ+5.4 90		0.036	2.656	0.012
740NASCIS FMQ+5.4 135		0.035	4.914	0.008
740NASCIS FMQ+5.4 180		0.061	1.529	0.036
740NASCIS FMQ+5.4 180		0.042	9.219	0.037
740NASCIS FMQ+5.4 225		0.050	2.655	0.052
740NASCIS FMQ+5.4 255		0.053	3.849	0.079
740NASCIS FMQ+5.4 295		0.045	3.013	0.112
740NASCIS FMQ+5.4 330		0.073	2.720	0.095
740NASCIS FMQ+5.4 380		0.058	3.426	0.105
740NASCIS FMQ+5.4 455		0.074	5.265	0.417
740NASCIS FMQ+5.4 510		0.138	2.958	0.315
740NASCIS FMQ+5.4 580		0.316	2.403	0.283
740NASCIS FMQ+5.4 660		0.360	1.724	0.047
740NASCIS FMQ+5.4 725		0.194	1.621	0.010
740NASCIS FMQ+5.4 830		0.252	1.398	0.029
745NASCIS FMQ-3.0 40		0.064	3.117	0.053
745NASCIS FMQ-3.0 90		0.015	9.536	0.006
745NASCIS FMQ-3.0 135		0.013	5.794	0.005
745NASCIS FMQ-3.0 180		0.039	4.111	0.011
745NASCIS FMQ-3.0 225		0.049	3.020	0.011
745NASCIS FMQ-3.0 255		0.075	4.630	0.010
745NASCIS FMQ-3.0 255		0.052	3.848	0.012
745NASCIS FMQ-3.0 295		0.064	3.042	0.052
745NASCIS FMQ-3.0 330		0.041	4.747	0.044
745NASCIS FMQ-3.0 380		0.057	3.792	0.007
745NASCIS FMQ-3.0 455		0.019	8.866	0.004
745NASCIS FMQ-3.0 510		0.022	5.954	0.003
745NASCIS FMQ-3.0 580		0.010	8.887	0.002
745NASCIS FMQ-3.0 660		0.068	4.799	0.010
745NASCIS FMQ-3.0 725		0.014	6.913	0.008
745NASCIS FMQ-3.0 830		0.011	11.009	0.006
746NASCIS FMQ-3.7 40		0.031	4.423	0.008
746NASCIS FMQ-3.7 90		0.016	4.296	0.003

Sample Name	Temperature (°C)	133 Cs [NoGas] RSD %	137 Ba [NoGas] ppb	137 Ba [NoGas] RSD %
Std M+Cs+Pt / 1000		4.067	0.101	3.968
Std M+Cs+Pt / 100		2.093	0.480	1.219
REF / 1000		49.209		
REF / 100				
A-D2 / 20		25.675	0.115	1.908
A-D2		2.756	1.650	1.448
S 102.7 ppb				
SLRS-5		6.383	6.397	1.619
740NASCIS FMQ+5.4 40		7.498	0.039	2.552
740NASCIS FMQ+5.4 90		3.612		
740NASCIS FMQ+5.4 135		8.242		
740NASCIS FMQ+5.4 180		1.165	0.019	7.100
740NASCIS FMQ+5.4 180		3.484	0.803	1.792
740NASCIS FMQ+5.4 225		1.889		
740NASCIS FMQ+5.4 255		1.726		
740NASCIS FMQ+5.4 295		1.314		
740NASCIS FMQ+5.4 330		2.272		
740NASCIS FMQ+5.4 380		2.753		
740NASCIS FMQ+5.4 455		1.250	0.057	3.235
740NASCIS FMQ+5.4 510		1.278	0.045	3.673
740NASCIS FMQ+5.4 580		1.888	0.039	1.898
740NASCIS FMQ+5.4 660		3.512	0.030	5.238
740NASCIS FMQ+5.4 725		5.666	0.208	2.718
740NASCIS FMQ+5.4 830		1.638	0.046	5.503
745NASCIS FMQ-3.0 40		1.422		
745NASCIS FMQ-3.0 90		8.662	0.016	7.080
745NASCIS FMQ-3.0 135		7.621		
745NASCIS FMQ-3.0 180		4.460		
745NASCIS FMQ-3.0 225		4.038		
745NASCIS FMQ-3.0 255		4.093		
745NASCIS FMQ-3.0 255		6.275		
745NASCIS FMQ-3.0 295		2.935		
745NASCIS FMQ-3.0 330		1.105		
745NASCIS FMQ-3.0 380		5.507		
745NASCIS FMQ-3.0 455		7.393	0.018	6.818
745NASCIS FMQ-3.0 510		4.666		
745NASCIS FMQ-3.0 580		12.679		
745NASCIS FMQ-3.0 660		2.227	0.075	2.659
745NASCIS FMQ-3.0 725		4.214	0.018	5.290
745NASCIS FMQ-3.0 830		11.226	0.096	6.371
746NASCIS FMQ-3.7 40		5.842		
746NASCIS FMQ-3.7 90		8.793		

Sample Name	Temperature (°C)	172 Yb [NoGas] ppb	172 Yb [NoGas] RSD %	182 W [NoGas] CPS
Std M+Cs+Pt / 1000		0.101	4.357	4.000
Std M+Cs+Pt / 100		1.056	1.963	40.668
REF / 1000		0.000	24.493	810.026
REF / 100				8585.742
A-D2 / 20				34.000
A-D2				438.674
S 102.7 ppb				2.666
SLRS-5		0.009	12.033	284.004
740NASCIS FMQ+5.4 40				5.332
740NASCIS FMQ+5.4 90				13.334
740NASCIS FMQ+5.4 135				7.332
740NASCIS FMQ+5.4 180				46.666
740NASCIS FMQ+5.4 180		0.003	11.764	81.334
740NASCIS FMQ+5.4 225				14.000
740NASCIS FMQ+5.4 255				50.668
740NASCIS FMQ+5.4 295				30.666
740NASCIS FMQ+5.4 330				34.000
740NASCIS FMQ+5.4 380		0.000	63.952	70.668
740NASCIS FMQ+5.4 455		0.001	24.327	88.666
740NASCIS FMQ+5.4 510		0.002	21.067	138.000
740NASCIS FMQ+5.4 580		0.002	20.351	522.676
740NASCIS FMQ+5.4 660		0.004	24.630	520.010
740NASCIS FMQ+5.4 725		0.011	8.867	662.016
740NASCIS FMQ+5.4 830		0.001	81.476	123.334
745NASCIS FMQ-3.0 40		0.030	4.487	53.332
745NASCIS FMQ-3.0 90		0.001	22.974	24.000
745NASCIS FMQ-3.0 135		0.001	40.708	14.668
745NASCIS FMQ-3.0 180		0.001	29.611	27.332
745NASCIS FMQ-3.0 225		0.001	31.426	68.000
745NASCIS FMQ-3.0 255		0.001	59.029	15.332
745NASCIS FMQ-3.0 255		0.001	30.459	28.000
745NASCIS FMQ-3.0 295		0.004	17.290	42.000
745NASCIS FMQ-3.0 330		0.002	23.843	34.666
745NASCIS FMQ-3.0 380		0.002	25.485	33.332
745NASCIS FMQ-3.0 455		0.001	35.765	79.334
745NASCIS FMQ-3.0 510		0.003	27.385	191.334
745NASCIS FMQ-3.0 580		0.001	48.660	422.004
745NASCIS FMQ-3.0 660		0.009	15.082	1130.710
745NASCIS FMQ-3.0 725		0.023	4.728	1183.380
745NASCIS FMQ-3.0 830		0.004	22.516	123.332
746NASCIS FMQ-3.7 40				61.336
746NASCIS FMQ-3.7 90				34.668

Sample Name	Temperature (°C)	182 W [NoGas] RSD %	195 Pt [NoGas] ppb	195 Pt [NoGas] RSD %
Std M+Cs+Pt / 1000		69.772	0.020	12.870
Std M+Cs+Pt / 100		55.101	0.216	1.791
REF / 1000		6.546		
REF / 100		0.885		
A-D2 / 20		25.376		
A-D2		11.619		
S 102.7 ppb		163.016		
SLRS-5		11.270		
740NASCIS FMQ+5.4 40		94.801	0.080	6.136
740NASCIS FMQ+5.4 90		39.523	0.512	3.091
740NASCIS FMQ+5.4 135		74.699	0.389	0.335
740NASCIS FMQ+5.4 180		31.136	1.225	1.251
740NASCIS FMQ+5.4 180		18.007	0.643	1.615
740NASCIS FMQ+5.4 225		63.888	0.206	2.581
740NASCIS FMQ+5.4 255		33.353	0.497	3.118
740NASCIS FMQ+5.4 295		54.029	0.568	0.845
740NASCIS FMQ+5.4 330		36.951	2.139	1.431
740NASCIS FMQ+5.4 380		17.462	9.157	1.299
740NASCIS FMQ+5.4 455		22.017	9.862	2.139
740NASCIS FMQ+5.4 510		16.702	1.059	1.536
740NASCIS FMQ+5.4 580		9.475	6.518	3.106
740NASCIS FMQ+5.4 660		11.001	2.201	0.901
740NASCIS FMQ+5.4 725		12.617	2.118	2.376
740NASCIS FMQ+5.4 830		7.879	0.198	2.442
745NASCIS FMQ-3.0 40		20.724	0.225	21.628
745NASCIS FMQ-3.0 90		30.117	0.431	6.936
745NASCIS FMQ-3.0 135		76.406	0.535	1.841
745NASCIS FMQ-3.0 180		47.548	0.635	4.875
745NASCIS FMQ-3.0 225		22.083	0.708	2.429
745NASCIS FMQ-3.0 255		56.692	0.945	3.922
745NASCIS FMQ-3.0 255		32.160	0.873	2.716
745NASCIS FMQ-3.0 295		48.471	2.014	2.229
745NASCIS FMQ-3.0 330		19.944	0.836	2.908
745NASCIS FMQ-3.0 380		25.494	6.960	0.360
745NASCIS FMQ-3.0 455		22.703	4.841	4.468
745NASCIS FMQ-3.0 510		12.480	4.410	17.619
745NASCIS FMQ-3.0 580		11.207	0.231	18.080
745NASCIS FMQ-3.0 660		6.175	0.447	2.953
745NASCIS FMQ-3.0 725		7.941	0.193	2.083
745NASCIS FMQ-3.0 830		27.892	0.107	44.529
746NASCIS FMQ-3.7 40		18.269	0.462	3.103
746NASCIS FMQ-3.7 90		32.321	0.538	14.786

Sample Name	Temperature (°C)	197 Au [NoGas] CPS	197 Au [NoGas] RSD %	205 Tl [NoGas] ppb
Std M+Cs+Pt / 1000		2.666	163.016	0.101
Std M+Cs+Pt / 100		1.334	223.607	1.041
REF / 1000		3.332	70.774	
REF / 100		33.334	48.477	
A-D2 / 20		2.668	136.931	0.006
A-D2		8.666	92.633	0.088
S 102.7 ppb		3.334	141.411	
SLRS-5		20.000	56.511	0.004
740NASCIS FMQ+5.4 40		10.664	40.754	0.002
740NASCIS FMQ+5.4 90		60.666	32.603	
740NASCIS FMQ+5.4 135		24.666	28.015	
740NASCIS FMQ+5.4 180		429.340	12.070	
740NASCIS FMQ+5.4 180		108.000	23.055	
740NASCIS FMQ+5.4 225		56.000	28.668	
740NASCIS FMQ+5.4 255		120.668	45.784	
740NASCIS FMQ+5.4 295		692.014	3.400	
740NASCIS FMQ+5.4 330		792.020	4.749	
740NASCIS FMQ+5.4 380		292.004	31.939	
740NASCIS FMQ+5.4 455		616.012	12.318	
740NASCIS FMQ+5.4 510		46.002	36.374	
740NASCIS FMQ+5.4 580		278.672	26.188	
740NASCIS FMQ+5.4 660		615.346	11.290	
740NASCIS FMQ+5.4 725		158.668	22.162	
740NASCIS FMQ+5.4 830		102.000	22.239	
745NASCIS FMQ-3.0 40		28.000	70.733	0.002
745NASCIS FMQ-3.0 90		20.666	26.507	
745NASCIS FMQ-3.0 135		12.666	60.015	
745NASCIS FMQ-3.0 180		19.998	100.697	
745NASCIS FMQ-3.0 225		61.332	24.185	
745NASCIS FMQ-3.0 255		42.666	70.613	
745NASCIS FMQ-3.0 255		55.336	21.550	
745NASCIS FMQ-3.0 295		149.334	28.209	
745NASCIS FMQ-3.0 330		230.002	8.875	
745NASCIS FMQ-3.0 380		254.004	37.883	
745NASCIS FMQ-3.0 455		114.002	42.445	
745NASCIS FMQ-3.0 510		45.998	45.084	
745NASCIS FMQ-3.0 580		54.668	61.216	
745NASCIS FMQ-3.0 660		122.000	45.948	
745NASCIS FMQ-3.0 725		110.666	30.748	
745NASCIS FMQ-3.0 830		61.334	28.399	
746NASCIS FMQ-3.7 40		86.666	6.081	0.003
746NASCIS FMQ-3.7 90		14.000	74.175	

Sample Name	Temperature (°C)	205 Tl [NoGas] RSD %	208 Pb [NoGas] ppb	208 Pb [NoGas] RSD %
Std M+Cs+Pt / 1000		2.009	0.101	4.321
Std M+Cs+Pt / 100		1.431	1.020	1.924
REF / 1000			0.002	16.213
REF / 100			0.002	26.998
A-D2 / 20		9.910	0.007	8.308
A-D2		2.784	0.090	1.170
S 102.7 ppb			0.002	16.070
SLRS-5		11.108	0.070	3.911
740NASCIS FMQ+5.4 40		17.898	0.023	3.647
740NASCIS FMQ+5.4 90			0.052	4.973
740NASCIS FMQ+5.4 135			0.025	3.138
740NASCIS FMQ+5.4 180			0.125	2.724
740NASCIS FMQ+5.4 180			0.103	5.117
740NASCIS FMQ+5.4 225			0.040	7.168
740NASCIS FMQ+5.4 255			0.113	2.963
740NASCIS FMQ+5.4 295			0.122	3.641
740NASCIS FMQ+5.4 330			0.353	1.937
740NASCIS FMQ+5.4 380			1.084	1.214
740NASCIS FMQ+5.4 455			1.286	3.238
740NASCIS FMQ+5.4 510			0.554	2.144
740NASCIS FMQ+5.4 580			1.993	1.256
740NASCIS FMQ+5.4 660			0.900	0.678
740NASCIS FMQ+5.4 725			1.077	2.480
740NASCIS FMQ+5.4 830			0.034	6.602
745NASCIS FMQ-3.0 40		15.597	0.177	2.951
745NASCIS FMQ-3.0 90			0.035	6.112
745NASCIS FMQ-3.0 135			0.010	6.829
745NASCIS FMQ-3.0 180			0.110	1.956
745NASCIS FMQ-3.0 225			0.166	1.599
745NASCIS FMQ-3.0 255			0.587	1.940
745NASCIS FMQ-3.0 255			0.212	2.379
745NASCIS FMQ-3.0 295			0.291	2.688
745NASCIS FMQ-3.0 330			0.236	2.401
745NASCIS FMQ-3.0 380			1.073	0.610
745NASCIS FMQ-3.0 455			0.493	1.552
745NASCIS FMQ-3.0 510			1.010	1.841
745NASCIS FMQ-3.0 580			0.845	1.760
745NASCIS FMQ-3.0 660			2.320	3.201
745NASCIS FMQ-3.0 725			2.388	1.106
745NASCIS FMQ-3.0 830			0.320	2.468
746NASCIS FMQ-3.7 40		18.607	0.118	3.253
746NASCIS FMQ-3.7 90			0.020	8.480

Sample Name	Temperature (°C)	209 Bi [NoGas] ppb	209 Bi [NoGas] RSD %
Std M+Cs+Pt / 1000		0.101	2.090
Std M+Cs+Pt / 100		1.026	1.744
REF / 1000		0.001	15.954
REF / 100			
A-D2 / 20		0.006	4.708
A-D2		0.088	2.675
S 102.7 ppb			
SLRS-5		0.001	8.377
740NASCIS FMQ+5.4 40		0.164	1.294
740NASCIS FMQ+5.4 90		0.048	4.732
740NASCIS FMQ+5.4 135		0.031	4.600
740NASCIS FMQ+5.4 180		0.031	2.388
740NASCIS FMQ+5.4 180		0.026	2.643
740NASCIS FMQ+5.4 225		0.019	7.040
740NASCIS FMQ+5.4 255		0.042	2.316
740NASCIS FMQ+5.4 295		0.061	3.484
740NASCIS FMQ+5.4 330		0.083	2.276
740NASCIS FMQ+5.4 380		0.119	2.754
740NASCIS FMQ+5.4 455		0.469	2.122
740NASCIS FMQ+5.4 510		0.387	2.789
740NASCIS FMQ+5.4 580		0.471	0.930
740NASCIS FMQ+5.4 660		0.110	2.543
740NASCIS FMQ+5.4 725		0.198	1.724
740NASCIS FMQ+5.4 830		0.092	1.133
745NASCIS FMQ-3.0 40		0.170	0.769
745NASCIS FMQ-3.0 90		0.058	4.094
745NASCIS FMQ-3.0 135		0.027	4.385
745NASCIS FMQ-3.0 180		0.134	1.633
745NASCIS FMQ-3.0 225		0.109	1.650
745NASCIS FMQ-3.0 255		0.232	1.980
745NASCIS FMQ-3.0 255		0.099	3.160
745NASCIS FMQ-3.0 295		0.127	2.928
745NASCIS FMQ-3.0 330		0.161	2.048
745NASCIS FMQ-3.0 380		0.134	2.296
745NASCIS FMQ-3.0 455		0.124	3.512
745NASCIS FMQ-3.0 510		0.202	2.424
745NASCIS FMQ-3.0 580		0.095	3.197
745NASCIS FMQ-3.0 660		0.227	2.082
745NASCIS FMQ-3.0 725		0.331	1.494
745NASCIS FMQ-3.0 830		0.132	2.179
746NASCIS FMQ-3.7 40		0.134	1.527
746NASCIS FMQ-3.7 90		0.021	3.684

Sample Name	Temperature (°C)	7 Li [NoGas] ppb	7 Li [NoGas] RSD %	27 Al [NoGas] ppb	27 Al [NoGas] RSD %
746NASCIS FMQ-3.7	135	0.249	6.048	0.306	9.233
746NASCIS FMQ-3.7	180	0.294	4.952	0.549	1.930
746NASCIS FMQ-3.7	225	0.506	1.083	0.110	1.333
746NASCIS FMQ-3.7	255	0.936	1.681	0.674	1.307
746NASCIS FMQ-3.7	295	0.806	3.441	0.116	1.003
746NASCIS FMQ-3.7	330	1.050	2.878	0.110	2.460
746NASCIS FMQ-3.7	380	2.349	3.640	0.733	1.433
746NASCIS FMQ-3.7	380	1.759	3.055	0.165	3.090
746NASCIS FMQ-3.7	455	2.833	2.580	0.184	0.975
746NASCIS FMQ-3.7	510	2.651	2.637	0.184	2.054
746NASCIS FMQ-3.7	580	3.717	2.975	0.089	2.501
746NASCIS FMQ-3.7	660	3.744	3.256	0.267	2.596
746NASCIS FMQ-3.7	725	1.275	2.776	0.248	2.825
746NASCIS FMQ-3.7	830	0.047	12.930	0.260	2.969
747NFSCIS FMQ-3.0	40	0.213	7.092	0.111	2.188
747NFSCIS FMQ-3.0	90	0.023	12.164	0.349	1.107
747NFSCIS FMQ-3.0	135	0.064	8.364	0.094	1.893
747NFSCIS FMQ-3.0	180	0.102	4.301	0.148	2.897
747NFSCIS FMQ-3.0	225	0.232	5.402	0.212	2.394
747NFSCIS FMQ-3.0	255	0.314	4.416	0.174	2.900
747NFSCIS FMQ-3.0	295	0.412	7.088	0.133	2.248
747NFSCIS FMQ-3.0	330	0.589	4.255	0.109	1.989
747NFSCIS FMQ-3.0	380	1.029	1.908	0.110	1.394
747NFSCIS FMQ-3.0	455	2.047	1.617	0.272	1.442
747NFSCIS FMQ-3.0	510	2.438	3.036	0.096	1.579
747NFSCIS FMQ-3.0	580	2.589	2.858	0.225	3.470
747NFSCIS FMQ-3.0	660	3.881	1.804	0.276	1.831
747NFSCIS FMQ-3.0	660	3.426	0.454	0.197	3.033
747NFSCIS FMQ-3.0	725	2.182	6.031	0.252	4.493
747NFSCIS FMQ-3.0	830	0.891	2.591	0.127	3.091
Detection limit		0.006		0.005	

*Explanations of various modes used (No Gas, He, H2 and O2) are in Section 4.2.2

Sample Name	Temperature (°C)	35 -> 37 CI [H2] CPS	35 -> 37 CI [H2] RSD %	37 -> 39 CI [H2] CPS
746NASCIS FMQ-3.7	135	13864.268	2.079	5636.266
746NASCIS FMQ-3.7	180	13271.794	3.097	5312.828
746NASCIS FMQ-3.7	225	13383.886	2.541	5509.558
746NASCIS FMQ-3.7	255	18105.538	2.538	7232.860
746NASCIS FMQ-3.7	295	12604.624	1.504	4856.026
746NASCIS FMQ-3.7	330	12932.204	2.420	5114.102
746NASCIS FMQ-3.7	380	12834.128	1.901	5100.764
746NASCIS FMQ-3.7	380	13353.858	2.474	5375.510
746NASCIS FMQ-3.7	455	13509.310	2.936	5428.194
746NASCIS FMQ-3.7	510	12815.450	2.193	5281.484
746NASCIS FMQ-3.7	580	11918.812	2.036	4594.624
746NASCIS FMQ-3.7	660	12051.562	2.010	4956.720
746NASCIS FMQ-3.7	725	12722.044	4.029	5087.424
746NASCIS FMQ-3.7	830	11882.776	2.349	4984.060
747NFSCIS FMQ-3.0	40	11988.186	2.274	4808.010
747NFSCIS FMQ-3.0	90	12203.672	2.955	5053.414
747NFSCIS FMQ-3.0	135	13593.380	1.793	5328.166
747NFSCIS FMQ-3.0	180	12182.326	3.158	4952.052
747NFSCIS FMQ-3.0	225	12365.126	2.717	4783.336
747NFSCIS FMQ-3.0	255	12980.902	1.806	5248.810
747NFSCIS FMQ-3.0	295	11600.580	3.164	4770.004
747NFSCIS FMQ-3.0	330	11184.308	2.590	4517.266
747NFSCIS FMQ-3.0	380	17938.688	3.498	7160.164
747NFSCIS FMQ-3.0	455	11956.160	0.924	4834.686
747NFSCIS FMQ-3.0	510	12934.204	1.910	5188.124
747NFSCIS FMQ-3.0	580	10635.298	2.954	4240.530
747NFSCIS FMQ-3.0	660	18032.798	2.110	7338.242
747NFSCIS FMQ-3.0	660	18058.812	2.605	7202.850
747NFSCIS FMQ-3.0	725	17839.252	1.116	6978.756
747NFSCIS FMQ-3.0	830	10710.674	2.203	4215.856

Detection limit

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	37 -> 39 Cl [H2] RSD %	43 Ca [NoGas] ppb	43 Ca [NoGas] RSD %
746NASCIS FMQ-3.7	135	4.020	0.083	7.438
746NASCIS FMQ-3.7	180	3.280	0.072	5.911
746NASCIS FMQ-3.7	225	3.830	0.073	4.744
746NASCIS FMQ-3.7	255	1.613	0.079	4.815
746NASCIS FMQ-3.7	295	4.537	0.068	5.514
746NASCIS FMQ-3.7	330	2.629	0.072	7.750
746NASCIS FMQ-3.7	380	2.994	0.092	1.759
746NASCIS FMQ-3.7	380	2.045	0.073	4.710
746NASCIS FMQ-3.7	455	5.671	0.099	2.878
746NASCIS FMQ-3.7	510	5.018	0.080	6.920
746NASCIS FMQ-3.7	580	3.967	0.075	7.138
746NASCIS FMQ-3.7	660	1.870	0.083	3.662
746NASCIS FMQ-3.7	725	3.102	0.101	3.308
746NASCIS FMQ-3.7	830	1.132	0.152	4.396
747NFSCIS FMQ-3.0	40	2.864	0.067	3.675
747NFSCIS FMQ-3.0	90	3.571	0.068	7.804
747NFSCIS FMQ-3.0	135	1.776	0.067	3.574
747NFSCIS FMQ-3.0	180	2.846	0.075	6.203
747NFSCIS FMQ-3.0	225	3.584	0.074	5.359
747NFSCIS FMQ-3.0	255	3.273	0.068	7.508
747NFSCIS FMQ-3.0	295	5.888	0.065	9.287
747NFSCIS FMQ-3.0	330	2.373	0.072	6.016
747NFSCIS FMQ-3.0	380	1.952	0.072	2.720
747NFSCIS FMQ-3.0	455	2.243	0.076	3.500
747NFSCIS FMQ-3.0	510	3.528	0.076	4.066
747NFSCIS FMQ-3.0	580	3.857	0.072	5.079
747NFSCIS FMQ-3.0	660	1.222	0.092	3.671
747NFSCIS FMQ-3.0	660	5.309	0.085	5.293
747NFSCIS FMQ-3.0	725	2.927	0.102	1.398
747NFSCIS FMQ-3.0	830	2.491	0.086	3.854
Detection limit			0.053	

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	43 -> 43 Ca [H2] ppb	43 -> 43 Ca [H2] RSD %	44 Ca [NoGas] ppb
746NASCIS FMQ-3.7	135	0.102	10.100	0.092
746NASCIS FMQ-3.7	180	0.073	22.480	0.084
746NASCIS FMQ-3.7	225	0.078	22.531	0.085
746NASCIS FMQ-3.7	255	0.125	18.222	0.087
746NASCIS FMQ-3.7	295	0.078	34.933	0.082
746NASCIS FMQ-3.7	330	0.099	22.607	0.081
746NASCIS FMQ-3.7	380	0.156	12.538	0.098
746NASCIS FMQ-3.7	380	0.104	8.514	0.090
746NASCIS FMQ-3.7	455	0.198	9.126	0.100
746NASCIS FMQ-3.7	510	0.120	11.305	0.091
746NASCIS FMQ-3.7	580	0.090	7.535	0.091
746NASCIS FMQ-3.7	660	0.134	5.917	0.093
746NASCIS FMQ-3.7	725	0.195	10.341	0.101
746NASCIS FMQ-3.7	830	0.433	11.116	0.128
747NFSCIS FMQ-3.0	40	0.072	25.234	0.086
747NFSCIS FMQ-3.0	90	0.065	36.906	0.089
747NFSCIS FMQ-3.0	135	0.078	5.262	0.089
747NFSCIS FMQ-3.0	180	0.084	25.023	0.091
747NFSCIS FMQ-3.0	225	0.111	21.596	0.092
747NFSCIS FMQ-3.0	255	0.082	25.494	0.089
747NFSCIS FMQ-3.0	295	0.078	19.793	0.092
747NFSCIS FMQ-3.0	330	0.117	22.682	0.092
747NFSCIS FMQ-3.0	380	0.099	26.795	0.090
747NFSCIS FMQ-3.0	455	0.118	14.635	0.095
747NFSCIS FMQ-3.0	510	0.122	3.852	0.092
747NFSCIS FMQ-3.0	580	0.108	12.085	0.092
747NFSCIS FMQ-3.0	660	0.182	13.673	0.103
747NFSCIS FMQ-3.0	660	0.137	9.387	0.103
747NFSCIS FMQ-3.0	725	0.223	12.710	0.106
747NFSCIS FMQ-3.0	830	0.168	15.035	0.110
Detection limit		0.017		0.018

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	44 Ca [NoGas] RSD %	32 -> 48 S [O2] ppb	32 -> 48 S [O2] RSD %	34 -> 50 S [O2] ppb
746NASCIS FMQ-3.7	135	2.257	3.140	2.127	4.804
746NASCIS FMQ-3.7	180	1.470	2.727	4.765	3.217
746NASCIS FMQ-3.7	225	1.205	1459.736	4.258	1375.189
746NASCIS FMQ-3.7	255	1.887	12097.343	1.840	12244.085
746NASCIS FMQ-3.7	295	1.586	312.628	0.896	313.032
746NASCIS FMQ-3.7	330	1.299	5.600	2.329	6.351
746NASCIS FMQ-3.7	380	1.243	29.150	2.210	29.989
746NASCIS FMQ-3.7	380	1.339	16.296	1.633	17.513
746NASCIS FMQ-3.7	455	1.542	106.344	1.241	107.524
746NASCIS FMQ-3.7	510	0.718	144.512	1.512	142.372
746NASCIS FMQ-3.7	580	1.462	102.130	1.001	101.123
746NASCIS FMQ-3.7	660	1.690	22.950	1.128	23.718
746NASCIS FMQ-3.7	725	0.973	83.917	1.979	83.751
746NASCIS FMQ-3.7	830	1.777	2.782	5.801	3.543
747NFSCIS FMQ-3.0	40	1.093	2.290	10.089	3.238
747NFSCIS FMQ-3.0	90	1.299	2.586	3.486	3.393
747NFSCIS FMQ-3.0	135	1.546	103.213	1.462	103.809
747NFSCIS FMQ-3.0	180	1.490	2.009	3.002	2.959
747NFSCIS FMQ-3.0	225	1.521	2.450	1.999	3.335
747NFSCIS FMQ-3.0	255	2.350	3.012	5.041	4.244
747NFSCIS FMQ-3.0	295	1.849	4.332	2.466	5.050
747NFSCIS FMQ-3.0	330	1.491	5.272	3.794	6.372
747NFSCIS FMQ-3.0	380	1.006	7378.678	2.464	7454.105
747NFSCIS FMQ-3.0	455	1.162	690.904	0.816	669.572
747NFSCIS FMQ-3.0	510	0.510	220.727	1.657	217.329
747NFSCIS FMQ-3.0	580	0.600	256.938	1.321	262.319
747NFSCIS FMQ-3.0	660	0.915	41.573	1.154	42.284
747NFSCIS FMQ-3.0	660	2.258	29.714	1.500	30.675
747NFSCIS FMQ-3.0	725	0.818	92.193	0.983	90.238
747NFSCIS FMQ-3.0	830	1.440	2.377	6.115	3.160
Detection limit			0.313		0.573

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	34 -> 50 S [O2] RSD %	44 -> 44 Ca [H2] ppb	44 -> 44 Ca [H2] RSD %
746NASCIS FMQ-3.7	135	10.506	0.092	4.686
746NASCIS FMQ-3.7	180	18.708	0.057	2.651
746NASCIS FMQ-3.7	225	1.739	0.060	4.408
746NASCIS FMQ-3.7	255	1.575	0.102	3.939
746NASCIS FMQ-3.7	295	1.387	0.073	4.228
746NASCIS FMQ-3.7	330	6.420	0.072	4.845
746NASCIS FMQ-3.7	380	3.864	0.136	3.000
746NASCIS FMQ-3.7	380	3.931	0.086	4.902
746NASCIS FMQ-3.7	455	2.967	0.160	4.346
746NASCIS FMQ-3.7	510	3.078	0.105	3.178
746NASCIS FMQ-3.7	580	3.111	0.072	5.426
746NASCIS FMQ-3.7	660	6.054	0.095	2.787
746NASCIS FMQ-3.7	725	1.288	0.160	3.271
746NASCIS FMQ-3.7	830	10.930	0.349	2.589
747NFSCIS FMQ-3.0	40	13.484	0.048	4.919
747NFSCIS FMQ-3.0	90	9.613	0.058	3.061
747NFSCIS FMQ-3.0	135	3.165	0.058	3.744
747NFSCIS FMQ-3.0	180	19.565	0.071	7.481
747NFSCIS FMQ-3.0	225	3.356	0.078	4.065
747NFSCIS FMQ-3.0	255	10.422	0.056	3.218
747NFSCIS FMQ-3.0	295	14.346	0.056	6.211
747NFSCIS FMQ-3.0	330	8.395	0.083	4.062
747NFSCIS FMQ-3.0	380	0.699	0.084	3.103
747NFSCIS FMQ-3.0	455	1.996	0.099	6.882
747NFSCIS FMQ-3.0	510	1.263	0.098	4.159
747NFSCIS FMQ-3.0	580	1.732	0.089	2.132
747NFSCIS FMQ-3.0	660	4.950	0.158	2.585
747NFSCIS FMQ-3.0	660	6.242	0.111	5.095
747NFSCIS FMQ-3.0	725	3.374	0.189	2.290
747NFSCIS FMQ-3.0	830	14.312	0.135	3.060
Detection limit			0.013	

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	51 V [NoGas] ppb	51 V [NoGas] RSD %	51 -> 51 V [He KED] ppb
746NASCIS FMQ-3.7	135	0.051	2.767	0.013
746NASCIS FMQ-3.7	180	0.052	2.329	0.010
746NASCIS FMQ-3.7	225	0.053	0.976	0.012
746NASCIS FMQ-3.7	255	0.053	3.661	0.013
746NASCIS FMQ-3.7	295	0.051	2.345	0.013
746NASCIS FMQ-3.7	330	0.052	3.661	0.010
746NASCIS FMQ-3.7	380	0.053	1.081	0.014
746NASCIS FMQ-3.7	380	0.048	2.706	0.012
746NASCIS FMQ-3.7	455	0.052	2.974	0.015
746NASCIS FMQ-3.7	510	0.050	2.611	0.016
746NASCIS FMQ-3.7	580	0.050	2.629	0.010
746NASCIS FMQ-3.7	660	0.051	2.992	0.011
746NASCIS FMQ-3.7	725	0.047	7.341	0.017
746NASCIS FMQ-3.7	830	0.056	3.312	0.019
747NFSCIS FMQ-3.0	40	0.054	1.400	0.014
747NFSCIS FMQ-3.0	90	0.054	1.934	0.010
747NFSCIS FMQ-3.0	135	0.052	1.469	0.010
747NFSCIS FMQ-3.0	180	0.051	3.111	0.011
747NFSCIS FMQ-3.0	225	0.053	1.661	0.011
747NFSCIS FMQ-3.0	255	0.053	2.681	0.010
747NFSCIS FMQ-3.0	295	0.050	2.185	0.008
747NFSCIS FMQ-3.0	330	0.045	7.465	0.012
747NFSCIS FMQ-3.0	380	0.051	2.721	0.012
747NFSCIS FMQ-3.0	455	0.051	3.710	0.014
747NFSCIS FMQ-3.0	510	0.047	4.553	0.012
747NFSCIS FMQ-3.0	580	0.053	2.975	0.013
747NFSCIS FMQ-3.0	660	0.046	3.788	0.011
747NFSCIS FMQ-3.0	660	0.052	3.812	0.010
747NFSCIS FMQ-3.0	725	0.053	1.509	0.013
747NFSCIS FMQ-3.0	830	0.052	1.989	0.010
Detection limit		0.011		0.004

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	51 -> 51 V [He KED] RSD %	52 Cr [NoGas] ppb	52 Cr [NoGas] RSD %
746NASCIS FMQ-3.7	135	27.796	0.116	1.231
746NASCIS FMQ-3.7	180	23.619	0.066	1.242
746NASCIS FMQ-3.7	225	31.660	0.068	1.013
746NASCIS FMQ-3.7	255	13.830	0.077	2.186
746NASCIS FMQ-3.7	295	27.496	0.068	0.988
746NASCIS FMQ-3.7	330	24.197	0.068	1.996
746NASCIS FMQ-3.7	380	14.604	0.090	1.028
746NASCIS FMQ-3.7	380	38.958	0.085	0.365
746NASCIS FMQ-3.7	455	23.579	0.098	2.094
746NASCIS FMQ-3.7	510	6.666	0.100	0.872
746NASCIS FMQ-3.7	580	24.321	0.106	1.128
746NASCIS FMQ-3.7	660	34.464	0.103	1.759
746NASCIS FMQ-3.7	725	21.254	0.175	1.135
746NASCIS FMQ-3.7	830	27.386	0.083	1.899
747NFSCIS FMQ-3.0	40	14.368	0.067	1.438
747NFSCIS FMQ-3.0	90	40.784	0.068	1.587
747NFSCIS FMQ-3.0	135	31.016	0.081	1.266
747NFSCIS FMQ-3.0	180	19.686	0.071	1.509
747NFSCIS FMQ-3.0	225	18.675	0.087	2.025
747NFSCIS FMQ-3.0	255	21.858	0.073	1.383
747NFSCIS FMQ-3.0	295	32.799	0.065	1.044
747NFSCIS FMQ-3.0	330	26.353	0.121	1.149
747NFSCIS FMQ-3.0	380	14.539	0.077	1.538
747NFSCIS FMQ-3.0	455	20.847	0.077	1.092
747NFSCIS FMQ-3.0	510	26.728	0.123	1.142
747NFSCIS FMQ-3.0	580	24.994	0.112	1.457
747NFSCIS FMQ-3.0	660	21.941	0.151	1.129
747NFSCIS FMQ-3.0	660	35.540	0.099	2.657
747NFSCIS FMQ-3.0	725	18.695	0.085	1.627
747NFSCIS FMQ-3.0	830	22.239	0.113	1.317
Detection limit			0.012	

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	52 -> 52 Cr [He KED] ppb	52 -> 52 Cr [He KED] RSD %	53 V [NoGas] ppb
746NASCIS FMQ-3.7	135	0.213	3.220	0.226
746NASCIS FMQ-3.7	180	0.079	2.762	0.045
746NASCIS FMQ-3.7	225	0.081	5.282	0.049
746NASCIS FMQ-3.7	255	0.109	3.387	0.083
746NASCIS FMQ-3.7	295	0.087	7.924	0.053
746NASCIS FMQ-3.7	330	0.082	5.493	0.047
746NASCIS FMQ-3.7	380	0.146	4.796	0.127
746NASCIS FMQ-3.7	380	0.134	6.025	0.126
746NASCIS FMQ-3.7	455	0.167	2.554	0.164
746NASCIS FMQ-3.7	510	0.180	3.413	0.177
746NASCIS FMQ-3.7	580	0.189	4.592	0.192
746NASCIS FMQ-3.7	660	0.179	4.286	0.178
746NASCIS FMQ-3.7	725	0.383	2.536	0.456
746NASCIS FMQ-3.7	830	0.121	4.477	0.102
747NFSCIS FMQ-3.0	40	0.085	2.629	0.048
747NFSCIS FMQ-3.0	90	0.081	8.376	0.040
747NFSCIS FMQ-3.0	135	0.113	2.408	0.091
747NFSCIS FMQ-3.0	180	0.100	4.665	0.059
747NFSCIS FMQ-3.0	225	0.134	5.508	0.112
747NFSCIS FMQ-3.0	255	0.102	2.577	0.063
747NFSCIS FMQ-3.0	295	0.094	5.190	0.047
747NFSCIS FMQ-3.0	330	0.256	3.340	0.268
747NFSCIS FMQ-3.0	380	0.117	4.607	0.086
747NFSCIS FMQ-3.0	455	0.123	7.371	0.090
747NFSCIS FMQ-3.0	510	0.243	3.176	0.267
747NFSCIS FMQ-3.0	580	0.208	3.147	0.200
747NFSCIS FMQ-3.0	660	0.309	2.395	0.368
747NFSCIS FMQ-3.0	660	0.170	0.866	0.160
747NFSCIS FMQ-3.0	725	0.148	6.779	0.110
747NFSCIS FMQ-3.0	830	0.206	1.782	0.213
Detection limit		0.046		0.006

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	53 V [NoGas] RSD %	55 Mn [NoGas] CPS	55 Mn [NoGas] RSD %
746NASCIS FMQ-3.7	135	2.732	10922.192	1.365
746NASCIS FMQ-3.7	180	9.174	9554.034	4.422
746NASCIS FMQ-3.7	225	2.618	9902.238	1.807
746NASCIS FMQ-3.7	255	5.742	10918.190	2.297
746NASCIS FMQ-3.7	295	7.958	9808.176	2.450
746NASCIS FMQ-3.7	330	11.098	9580.046	1.949
746NASCIS FMQ-3.7	380	4.019	10382.516	2.633
746NASCIS FMQ-3.7	380	4.543	10061.318	12.466
746NASCIS FMQ-3.7	455	2.513	9709.452	3.149
746NASCIS FMQ-3.7	510	2.535	9764.822	4.903
746NASCIS FMQ-3.7	580	5.388	9970.938	2.942
746NASCIS FMQ-3.7	660	3.804	11463.218	3.638
746NASCIS FMQ-3.7	725	2.363	15366.960	1.229
746NASCIS FMQ-3.7	830	3.388	15110.742	1.156
747NFSCIS FMQ-3.0	40	5.450	9586.716	0.896
747NFSCIS FMQ-3.0	90	5.125	9877.552	1.838
747NFSCIS FMQ-3.0	135	4.535	9393.284	2.168
747NFSCIS FMQ-3.0	180	6.782	10936.872	3.919
747NFSCIS FMQ-3.0	225	4.545	10710.052	1.169
747NFSCIS FMQ-3.0	255	8.065	9443.308	3.210
747NFSCIS FMQ-3.0	295	4.963	8932.362	2.618
747NFSCIS FMQ-3.0	330	4.050	8229.336	3.382
747NFSCIS FMQ-3.0	380	8.154	8215.336	2.465
747NFSCIS FMQ-3.0	455	9.102	10708.056	3.046
747NFSCIS FMQ-3.0	510	2.170	10250.438	3.038
747NFSCIS FMQ-3.0	580	3.858	12217.740	0.855
747NFSCIS FMQ-3.0	660	2.122	13208.494	2.421
747NFSCIS FMQ-3.0	660	3.046	11878.850	1.604
747NFSCIS FMQ-3.0	725	4.537	12663.408	2.972
747NFSCIS FMQ-3.0	830	1.062	9875.564	3.591

Detection limit

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	55 -> 55 Mn [He KED] CPS	55 -> 55 Mn [He KED] RSD %	56 -> 56 Fe [He KED] ppb
746NASCIS FMQ-3.7	135	80.666	38.698	14.375
746NASCIS FMQ-3.7	180	69.998	31.044	15.557
746NASCIS FMQ-3.7	225	57.334	11.186	21.551
746NASCIS FMQ-3.7	255	126.000	19.204	40.576
746NASCIS FMQ-3.7	295	78.666	37.135	24.577
746NASCIS FMQ-3.7	330	54.666	52.736	18.021
746NASCIS FMQ-3.7	380	71.334	16.717	32.994
746NASCIS FMQ-3.7	380	64.666	43.680	22.619
746NASCIS FMQ-3.7	455	76.664	25.164	38.877
746NASCIS FMQ-3.7	510	55.334	23.172	36.308
746NASCIS FMQ-3.7	580	64.668	41.653	7.403
746NASCIS FMQ-3.7	660	87.334	15.359	1.250
746NASCIS FMQ-3.7	725	227.336	10.441	2.107
746NASCIS FMQ-3.7	830	187.334	12.794	1.055
747NFSCIS FMQ-3.0	40	64.666	22.646	11.078
747NFSCIS FMQ-3.0	90	47.336	12.599	0.877
747NFSCIS FMQ-3.0	135	52.000	39.926	2.946
747NFSCIS FMQ-3.0	180	90.000	25.393	4.507
747NFSCIS FMQ-3.0	225	80.668	29.131	10.560
747NFSCIS FMQ-3.0	255	52.666	36.466	9.629
747NFSCIS FMQ-3.0	295	50.666	28.449	9.638
747NFSCIS FMQ-3.0	330	84.000	13.863	6.959
747NFSCIS FMQ-3.0	380	81.334	47.139	8.425
747NFSCIS FMQ-3.0	455	86.000	13.812	11.445
747NFSCIS FMQ-3.0	510	84.668	18.798	11.115
747NFSCIS FMQ-3.0	580	106.668	22.096	5.126
747NFSCIS FMQ-3.0	660	150.000	26.897	1.471
747NFSCIS FMQ-3.0	660	104.666	19.186	1.090
747NFSCIS FMQ-3.0	725	120.000	23.486	1.566
747NFSCIS FMQ-3.0	830	66.668	40.775	0.877
Detection limit				0.021

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	56 -> 56 Fe [He KED] RSD %	57 Fe [NoGas] ppb	57 Fe [NoGas] RSD %
746NASCIS FMQ-3.7	135	1.124	0.932	1.467
746NASCIS FMQ-3.7	180	1.838	0.997	1.675
746NASCIS FMQ-3.7	225	2.067	1.385	1.019
746NASCIS FMQ-3.7	255	0.951	2.536	1.625
746NASCIS FMQ-3.7	295	2.280	1.566	1.787
746NASCIS FMQ-3.7	330	1.392	1.163	2.003
746NASCIS FMQ-3.7	380	1.066	2.030	0.606
746NASCIS FMQ-3.7	380	0.876	1.430	1.164
746NASCIS FMQ-3.7	455	0.667	2.399	1.198
746NASCIS FMQ-3.7	510	1.851	2.277	1.638
746NASCIS FMQ-3.7	580	1.484	0.530	1.021
746NASCIS FMQ-3.7	660	0.553	0.168	0.588
746NASCIS FMQ-3.7	725	1.025	0.217	0.925
746NASCIS FMQ-3.7	830	1.387	0.159	1.433
747NFSCIS FMQ-3.0	40	1.417	0.764	0.599
747NFSCIS FMQ-3.0	90	1.182	0.146	1.828
747NFSCIS FMQ-3.0	135	1.381	0.267	1.098
747NFSCIS FMQ-3.0	180	1.006	0.362	1.153
747NFSCIS FMQ-3.0	225	1.442	0.724	0.446
747NFSCIS FMQ-3.0	255	1.694	0.656	1.065
747NFSCIS FMQ-3.0	295	1.176	0.668	1.313
747NFSCIS FMQ-3.0	330	1.036	0.516	1.233
747NFSCIS FMQ-3.0	380	0.883	0.603	0.912
747NFSCIS FMQ-3.0	455	1.502	0.786	1.748
747NFSCIS FMQ-3.0	510	1.653	0.763	1.809
747NFSCIS FMQ-3.0	580	1.651	0.397	1.301
747NFSCIS FMQ-3.0	660	2.260	0.183	1.386
747NFSCIS FMQ-3.0	660	0.500	0.163	1.237
747NFSCIS FMQ-3.0	725	0.676	0.186	0.253
747NFSCIS FMQ-3.0	830	1.707	0.149	1.458

Detection limit 0.010

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	59 Co [NoGas] ppb	59 Co [NoGas] RSD %	59 -> 59 Co [He KED] ppb
746NASCIS FMQ-3.7	135	0.007	6.089	0.007
746NASCIS FMQ-3.7	180	0.006	4.225	0.006
746NASCIS FMQ-3.7	225	0.004	9.896	0.004
746NASCIS FMQ-3.7	255	0.005	6.476	0.006
746NASCIS FMQ-3.7	295	0.005	10.579	0.004
746NASCIS FMQ-3.7	330	0.014	5.633	0.016
746NASCIS FMQ-3.7	380	0.005	5.937	0.006
746NASCIS FMQ-3.7	380	0.006	7.043	0.006
746NASCIS FMQ-3.7	455	0.028	4.887	0.028
746NASCIS FMQ-3.7	510	0.004	8.376	0.003
746NASCIS FMQ-3.7	580	0.004	12.309	0.002
746NASCIS FMQ-3.7	660	0.005	10.771	0.005
746NASCIS FMQ-3.7	725	0.021	6.265	0.022
746NASCIS FMQ-3.7	830	0.024	1.876	0.027
747NFSCIS FMQ-3.0	40	0.006	10.926	0.005
747NFSCIS FMQ-3.0	90	0.003	8.209	0.002
747NFSCIS FMQ-3.0	135	0.004	23.754	0.002
747NFSCIS FMQ-3.0	180	0.003	17.861	0.002
747NFSCIS FMQ-3.0	225	0.003	6.314	0.004
747NFSCIS FMQ-3.0	255	0.003	12.013	0.003
747NFSCIS FMQ-3.0	295	0.003	14.308	0.003
747NFSCIS FMQ-3.0	330	0.004	7.832	0.003
747NFSCIS FMQ-3.0	380	0.003	8.177	0.003
747NFSCIS FMQ-3.0	455	0.006	3.132	0.005
747NFSCIS FMQ-3.0	510	0.007	3.912	0.007
747NFSCIS FMQ-3.0	580	0.005	11.573	0.004
747NFSCIS FMQ-3.0	660	0.010	9.285	0.009
747NFSCIS FMQ-3.0	660	0.005	10.178	0.004
747NFSCIS FMQ-3.0	725	0.005	7.508	0.005
747NFSCIS FMQ-3.0	830	0.005	10.582	0.005
Detection limit		0.002		0.002

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	59 -> 59 Co [He KED] RSD %	60 Ni [NoGas] ppb	60 Ni [NoGas] RSD %
746NASCIS FMQ-3.7	135	30.696	10.660	0.688
746NASCIS FMQ-3.7	180	29.666	10.336	1.181
746NASCIS FMQ-3.7	225	24.324	9.295	0.558
746NASCIS FMQ-3.7	255	12.341	16.506	0.869
746NASCIS FMQ-3.7	295	34.146	9.785	1.801
746NASCIS FMQ-3.7	330	8.952	7.121	1.516
746NASCIS FMQ-3.7	380	19.571	13.020	0.670
746NASCIS FMQ-3.7	380	21.737	9.084	0.732
746NASCIS FMQ-3.7	455	12.514	15.420	1.404
746NASCIS FMQ-3.7	510	53.561	15.714	1.075
746NASCIS FMQ-3.7	580	40.017	2.984	1.427
746NASCIS FMQ-3.7	660	27.618	0.632	2.344
746NASCIS FMQ-3.7	725	8.210	1.467	1.652
746NASCIS FMQ-3.7	830	11.031	2.299	1.158
747NFSCIS FMQ-3.0	40	11.181	4.675	1.124
747NFSCIS FMQ-3.0	90	59.370	0.513	3.372
747NFSCIS FMQ-3.0	135	21.125	1.296	1.734
747NFSCIS FMQ-3.0	180	24.654	1.874	0.649
747NFSCIS FMQ-3.0	225	35.456	4.371	1.721
747NFSCIS FMQ-3.0	255	63.988	4.058	0.792
747NFSCIS FMQ-3.0	295	48.247	3.994	1.655
747NFSCIS FMQ-3.0	330	33.535	2.813	1.310
747NFSCIS FMQ-3.0	380	18.919	3.778	0.634
747NFSCIS FMQ-3.0	455	29.596	5.151	1.441
747NFSCIS FMQ-3.0	510	25.904	8.078	1.579
747NFSCIS FMQ-3.0	580	10.390	2.392	1.519
747NFSCIS FMQ-3.0	660	15.423	0.868	1.957
747NFSCIS FMQ-3.0	660	16.111	1.275	2.206
747NFSCIS FMQ-3.0	725	18.670	1.645	1.936
747NFSCIS FMQ-3.0	830	38.494	0.328	1.599

Detection limit 0.078

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	60 -> 60 Ni [He KED] ppb	60 -> 60 Ni [He KED] RSD %	63 Cu [NoGas] ppb
746NASCIS FMQ-3.7	135	10.041	0.898	0.124
746NASCIS FMQ-3.7	180	9.785	1.131	0.116
746NASCIS FMQ-3.7	225	8.591	2.226	0.126
746NASCIS FMQ-3.7	255	15.167	1.813	0.173
746NASCIS FMQ-3.7	295	9.059	1.040	0.133
746NASCIS FMQ-3.7	330	6.741	2.056	0.125
746NASCIS FMQ-3.7	380	12.067	1.821	0.184
746NASCIS FMQ-3.7	380	8.405	1.322	0.146
746NASCIS FMQ-3.7	455	14.368	0.641	0.242
746NASCIS FMQ-3.7	510	14.636	1.578	0.257
746NASCIS FMQ-3.7	580	2.820	1.920	0.153
746NASCIS FMQ-3.7	660	0.598	1.937	0.141
746NASCIS FMQ-3.7	725	1.355	4.742	0.278
746NASCIS FMQ-3.7	830	2.128	3.300	0.280
747NFSCIS FMQ-3.0	40	4.338	1.258	0.091
747NFSCIS FMQ-3.0	90	0.476	3.984	0.083
747NFSCIS FMQ-3.0	135	1.194	2.072	0.093
747NFSCIS FMQ-3.0	180	1.749	3.457	0.094
747NFSCIS FMQ-3.0	225	4.034	1.021	0.101
747NFSCIS FMQ-3.0	255	3.806	1.583	0.109
747NFSCIS FMQ-3.0	295	3.687	0.589	0.116
747NFSCIS FMQ-3.0	330	2.615	2.439	0.101
747NFSCIS FMQ-3.0	380	3.477	1.386	0.123
747NFSCIS FMQ-3.0	455	4.769	0.779	0.161
747NFSCIS FMQ-3.0	510	7.478	1.860	0.238
747NFSCIS FMQ-3.0	580	2.297	3.132	0.210
747NFSCIS FMQ-3.0	660	0.789	2.995	0.184
747NFSCIS FMQ-3.0	660	1.180	2.233	0.169
747NFSCIS FMQ-3.0	725	1.524	2.485	0.217
747NFSCIS FMQ-3.0	830	0.292	4.683	0.162
Detection limit		0.053		0.066

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	63 Cu [NoGas] RSD %	63 -> 63 Cu [He KED] ppb	63 -> 63 Cu [He KED] RSD %
746NASCIS FMQ-3.7	135	3.333	0.109	5.622
746NASCIS FMQ-3.7	180	2.116	0.098	11.566
746NASCIS FMQ-3.7	225	2.795	0.105	9.144
746NASCIS FMQ-3.7	255	1.570	0.166	2.848
746NASCIS FMQ-3.7	295	4.200	0.114	6.110
746NASCIS FMQ-3.7	330	4.083	0.112	6.450
746NASCIS FMQ-3.7	380	2.919	0.161	8.554
746NASCIS FMQ-3.7	380	2.462	0.109	6.715
746NASCIS FMQ-3.7	455	2.152	0.210	2.944
746NASCIS FMQ-3.7	510	1.612	0.245	2.213
746NASCIS FMQ-3.7	580	2.756	0.091	9.486
746NASCIS FMQ-3.7	660	1.458	0.087	4.453
746NASCIS FMQ-3.7	725	1.645	0.290	3.577
746NASCIS FMQ-3.7	830	1.456	0.295	3.890
747NFSCIS FMQ-3.0	40	1.693	0.052	5.740
747NFSCIS FMQ-3.0	90	2.311	0.036	5.597
747NFSCIS FMQ-3.0	135	2.388	0.050	13.886
747NFSCIS FMQ-3.0	180	2.857	0.042	4.424
747NFSCIS FMQ-3.0	225	0.635	0.050	10.393
747NFSCIS FMQ-3.0	255	3.701	0.064	8.269
747NFSCIS FMQ-3.0	295	4.119	0.067	4.104
747NFSCIS FMQ-3.0	330	1.604	0.045	14.540
747NFSCIS FMQ-3.0	380	4.280	0.071	11.458
747NFSCIS FMQ-3.0	455	1.791	0.103	4.799
747NFSCIS FMQ-3.0	510	3.694	0.194	4.423
747NFSCIS FMQ-3.0	580	2.545	0.151	6.402
747NFSCIS FMQ-3.0	660	1.779	0.113	5.752
747NFSCIS FMQ-3.0	660	3.348	0.086	6.989
747NFSCIS FMQ-3.0	725	2.425	0.187	5.506
747NFSCIS FMQ-3.0	830	2.071	0.111	10.225

Detection limit 0.004

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	66 Zn [NoGas] ppb	66 Zn [NoGas] RSD %	66 -> 66 Zn [He KED] ppb
746NASCIS FMQ-3.7	135	0.469	1.270	0.426
746NASCIS FMQ-3.7	180	0.241	3.965	0.182
746NASCIS FMQ-3.7	225	0.219	4.029	0.196
746NASCIS FMQ-3.7	255	0.852	1.781	0.714
746NASCIS FMQ-3.7	295	0.477	4.473	0.432
746NASCIS FMQ-3.7	330	0.200	5.415	0.176
746NASCIS FMQ-3.7	380	0.333	1.855	0.303
746NASCIS FMQ-3.7	380	0.685	2.109	0.640
746NASCIS FMQ-3.7	455	0.362	4.642	0.334
746NASCIS FMQ-3.7	510	0.254	6.103	0.228
746NASCIS FMQ-3.7	580	0.149	4.907	0.141
746NASCIS FMQ-3.7	660	0.194	5.315	0.169
746NASCIS FMQ-3.7	725	0.273	1.508	0.224
746NASCIS FMQ-3.7	830	0.525	0.903	0.504
747NFSCIS FMQ-3.0	40	0.122	5.460	0.099
747NFSCIS FMQ-3.0	90	0.298	1.715	0.259
747NFSCIS FMQ-3.0	135	0.103	5.272	0.090
747NFSCIS FMQ-3.0	180	0.247	3.350	0.229
747NFSCIS FMQ-3.0	225	1.148	1.814	1.061
747NFSCIS FMQ-3.0	255	0.230	2.136	0.203
747NFSCIS FMQ-3.0	295	0.107	5.076	0.096
747NFSCIS FMQ-3.0	330	0.103	2.725	0.084
747NFSCIS FMQ-3.0	380	0.195	4.109	0.169
747NFSCIS FMQ-3.0	455	0.301	2.815	0.287
747NFSCIS FMQ-3.0	510	0.343	4.260	0.299
747NFSCIS FMQ-3.0	580	0.423	0.912	0.390
747NFSCIS FMQ-3.0	660	0.329	3.803	0.288
747NFSCIS FMQ-3.0	660	0.279	4.734	0.217
747NFSCIS FMQ-3.0	725	0.248	2.067	0.234
747NFSCIS FMQ-3.0	830	0.258	4.191	0.214
Detection limit		0.010		0.015

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	66 -> 66 Zn [He KED] RSD %	75 As [NoGas] ppb	75 As [NoGas] RSD %
746NASCIS FMQ-3.7	135	5.762	0.099	0.636
746NASCIS FMQ-3.7	180	10.829	0.099	1.166
746NASCIS FMQ-3.7	225	17.575	0.099	0.538
746NASCIS FMQ-3.7	255	3.337	0.098	0.436
746NASCIS FMQ-3.7	295	6.764	0.098	0.288
746NASCIS FMQ-3.7	330	12.407	0.097	0.275
746NASCIS FMQ-3.7	380	4.881	0.099	0.557
746NASCIS FMQ-3.7	380	8.264	0.098	0.824
746NASCIS FMQ-3.7	455	2.645	0.098	0.995
746NASCIS FMQ-3.7	510	9.950	0.100	0.752
746NASCIS FMQ-3.7	580	25.439	0.103	1.060
746NASCIS FMQ-3.7	660	17.080	0.100	0.291
746NASCIS FMQ-3.7	725	15.761	0.105	0.646
746NASCIS FMQ-3.7	830	5.825	0.098	0.541
747NFSCIS FMQ-3.0	40	5.771	0.098	0.600
747NFSCIS FMQ-3.0	90	12.330	0.099	0.506
747NFSCIS FMQ-3.0	135	23.400	0.098	0.356
747NFSCIS FMQ-3.0	180	10.861	0.098	0.872
747NFSCIS FMQ-3.0	225	5.648	0.098	0.522
747NFSCIS FMQ-3.0	255	5.779	0.097	1.470
747NFSCIS FMQ-3.0	295	22.850	0.098	0.710
747NFSCIS FMQ-3.0	330	13.015	0.096	0.781
747NFSCIS FMQ-3.0	380	21.472	0.100	1.274
747NFSCIS FMQ-3.0	455	11.208	0.101	0.610
747NFSCIS FMQ-3.0	510	17.282	0.099	0.405
747NFSCIS FMQ-3.0	580	6.280	0.101	0.371
747NFSCIS FMQ-3.0	660	9.362	0.101	0.658
747NFSCIS FMQ-3.0	660	7.918	0.102	0.193
747NFSCIS FMQ-3.0	725	11.178	0.104	0.964
747NFSCIS FMQ-3.0	830	13.009	0.100	0.628

Detection limit 0.016

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	75 -> 75 As [He KED] ppb	75 -> 75 As [He KED] RSD %	77 [As] [NoGas] ppb
746NASCIS FMQ-3.7	135	0.036	30.607	0.075
746NASCIS FMQ-3.7	180	0.027	47.839	0.082
746NASCIS FMQ-3.7	225	0.039	28.004	0.084
746NASCIS FMQ-3.7	255	0.096	10.659	0.086
746NASCIS FMQ-3.7	295	0.052	31.388	0.070
746NASCIS FMQ-3.7	330	0.033	28.455	0.076
746NASCIS FMQ-3.7	380	0.118	29.057	0.076
746NASCIS FMQ-3.7	380	0.057	21.786	0.071
746NASCIS FMQ-3.7	455	0.218	20.486	0.069
746NASCIS FMQ-3.7	510	0.364	20.152	0.068
746NASCIS FMQ-3.7	580	0.208	18.392	0.074
746NASCIS FMQ-3.7	660	0.082	28.043	0.076
746NASCIS FMQ-3.7	725	0.958	8.307	0.074
746NASCIS FMQ-3.7	830			0.083
747NFSCIS FMQ-3.0	40	0.027	89.099	0.086
747NFSCIS FMQ-3.0	90	0.016	44.596	0.084
747NFSCIS FMQ-3.0	135			0.078
747NFSCIS FMQ-3.0	180	0.020	35.311	0.080
747NFSCIS FMQ-3.0	225	0.034	55.039	0.077
747NFSCIS FMQ-3.0	255	0.034	43.249	0.078
747NFSCIS FMQ-3.0	295	0.028	26.358	0.082
747NFSCIS FMQ-3.0	330	0.035	69.290	0.076
747NFSCIS FMQ-3.0	380	0.044	50.048	0.079
747NFSCIS FMQ-3.0	455	0.126	21.826	0.078
747NFSCIS FMQ-3.0	510	0.248	8.656	0.081
747NFSCIS FMQ-3.0	580	0.276	16.979	0.078
747NFSCIS FMQ-3.0	660	0.089	41.669	0.074
747NFSCIS FMQ-3.0	660	0.054	37.844	0.087
747NFSCIS FMQ-3.0	725	0.527	12.691	0.075
747NFSCIS FMQ-3.0	830			0.097
Detection limit		0.009		0.039

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	77 [As] [NoGas] RSD %	78 [As] [NoGas] ppb	78 [As] [NoGas] RSD %
746NASCIS FMQ-3.7	135	10.784	0.100	0.666
746NASCIS FMQ-3.7	180	16.615	0.100	1.234
746NASCIS FMQ-3.7	225	12.449	0.099	0.579
746NASCIS FMQ-3.7	255	7.416	0.099	0.443
746NASCIS FMQ-3.7	295	13.641	0.099	0.279
746NASCIS FMQ-3.7	330	19.438	0.098	0.298
746NASCIS FMQ-3.7	380	4.420	0.098	0.572
746NASCIS FMQ-3.7	380	6.675	0.098	0.828
746NASCIS FMQ-3.7	455	17.998	0.097	0.919
746NASCIS FMQ-3.7	510	11.399	0.098	0.802
746NASCIS FMQ-3.7	580	17.057	0.101	1.061
746NASCIS FMQ-3.7	660	10.359	0.100	0.341
746NASCIS FMQ-3.7	725	7.814	0.098	0.630
746NASCIS FMQ-3.7	830	16.571	0.099	0.431
747NFSCIS FMQ-3.0	40	12.091	0.098	0.533
747NFSCIS FMQ-3.0	90	14.312	0.100	0.484
747NFSCIS FMQ-3.0	135	11.858	0.098	0.364
747NFSCIS FMQ-3.0	180	17.345	0.099	0.831
747NFSCIS FMQ-3.0	225	12.197	0.098	0.531
747NFSCIS FMQ-3.0	255	12.056	0.098	1.452
747NFSCIS FMQ-3.0	295	6.880	0.099	0.746
747NFSCIS FMQ-3.0	330	11.702	0.097	0.799
747NFSCIS FMQ-3.0	380	14.657	0.101	1.204
747NFSCIS FMQ-3.0	455	9.788	0.100	0.690
747NFSCIS FMQ-3.0	510	12.775	0.097	0.446
747NFSCIS FMQ-3.0	580	10.306	0.099	0.374
747NFSCIS FMQ-3.0	660	8.754	0.101	0.695
747NFSCIS FMQ-3.0	660	8.353	0.102	0.254
747NFSCIS FMQ-3.0	725	10.169	0.101	1.004
747NFSCIS FMQ-3.0	830	9.981	0.101	0.572
Detection limit			0.016	

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	85 Rb [NoGas] ppb	85 Rb [NoGas] RSD %	89 Y [NoGas] ppb	89 Y [NoGas] RSD %
746NASCIS FMQ-3.7	135	0.010		6.971	
746NASCIS FMQ-3.7	180	0.009		3.855	
746NASCIS FMQ-3.7	225	0.024		3.508	
746NASCIS FMQ-3.7	255	0.059		1.922	
746NASCIS FMQ-3.7	295	0.092		1.963	
746NASCIS FMQ-3.7	330	0.034		3.505	
746NASCIS FMQ-3.7	380	0.030		1.516	
746NASCIS FMQ-3.7	380	0.022		2.131	
746NASCIS FMQ-3.7	455	0.022		4.545	
746NASCIS FMQ-3.7	510	0.002		10.302	
746NASCIS FMQ-3.7	580	0.004		12.447	
746NASCIS FMQ-3.7	660	0.008		5.569	0.025
746NASCIS FMQ-3.7	725	0.009		7.467	0.379
746NASCIS FMQ-3.7	830	0.003		5.443	0.865
747NFSCIS FMQ-3.0	40	0.010		9.145	0.003
747NFSCIS FMQ-3.0	90	0.001		14.980	2.446
747NFSCIS FMQ-3.0	135	0.003		8.458	
747NFSCIS FMQ-3.0	180	0.004		9.870	
747NFSCIS FMQ-3.0	225	0.016		2.420	
747NFSCIS FMQ-3.0	255	0.021		3.202	
747NFSCIS FMQ-3.0	295	0.045		3.826	
747NFSCIS FMQ-3.0	330	0.028		1.293	
747NFSCIS FMQ-3.0	380	0.015		4.829	
747NFSCIS FMQ-3.0	455	0.028		4.496	
747NFSCIS FMQ-3.0	510	0.004		10.817	
747NFSCIS FMQ-3.0	580	0.002		9.089	0.004
747NFSCIS FMQ-3.0	660	0.012		10.141	0.017
747NFSCIS FMQ-3.0	660	0.011		7.401	0.005
747NFSCIS FMQ-3.0	725	0.009		3.885	0.221
747NFSCIS FMQ-3.0	830	0.003		6.973	1.275
Detection limit		0.000			0.003

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	95 Mo [NoGas] ppb	95 Mo [NoGas] RSD %	103 Rh [NoGas] CPS
746NASCIS FMQ-3.7	135	0.121	4.384	415721.034
746NASCIS FMQ-3.7	180	0.100	7.200	414672.800
746NASCIS FMQ-3.7	225	0.145	4.292	446114.472
746NASCIS FMQ-3.7	255	0.411	2.465	488420.386
746NASCIS FMQ-3.7	295	0.176	4.199	453814.628
746NASCIS FMQ-3.7	330	0.121	1.720	427643.722
746NASCIS FMQ-3.7	380	0.677	1.174	473924.576
746NASCIS FMQ-3.7	380	0.290	3.009	435890.622
746NASCIS FMQ-3.7	455	1.242	1.894	486837.480
746NASCIS FMQ-3.7	510	1.968	0.979	512890.200
746NASCIS FMQ-3.7	580	2.113	2.431	416818.480
746NASCIS FMQ-3.7	660	1.092	1.757	383793.244
746NASCIS FMQ-3.7	725	3.888	0.742	390898.922
746NASCIS FMQ-3.7	830	0.058	5.305	375972.040
747NFSCIS FMQ-3.0	40	0.073	5.369	395529.124
747NFSCIS FMQ-3.0	90	0.011	11.006	375569.922
747NFSCIS FMQ-3.0	135	0.024	7.135	379972.912
747NFSCIS FMQ-3.0	180	0.033	7.716	378782.004
747NFSCIS FMQ-3.0	225	0.100	4.605	394468.162
747NFSCIS FMQ-3.0	255	0.070	5.741	401783.780
747NFSCIS FMQ-3.0	295	0.096	3.953	389619.596
747NFSCIS FMQ-3.0	330	0.062	8.998	387353.922
747NFSCIS FMQ-3.0	380	0.102	5.115	395004.474
747NFSCIS FMQ-3.0	455	0.633	2.587	390848.328
747NFSCIS FMQ-3.0	510	0.945	1.775	401471.218
747NFSCIS FMQ-3.0	580	1.564	1.430	386240.658
747NFSCIS FMQ-3.0	660	0.839	2.109	372232.814
747NFSCIS FMQ-3.0	660	0.530	2.215	358150.460
747NFSCIS FMQ-3.0	725	2.425	3.159	374143.444
747NFSCIS FMQ-3.0	830	0.028	8.045	359414.934
Detection limit		0.002		

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	103 Rh [NoGas] RSD %	103 -> 103 Rh [He KED] CPS	103 -> 103 Rh [He KED] RSD %
746NASCIS FMQ-3.7	135	1.492	78853.716	1.795
746NASCIS FMQ-3.7	180	1.463	77628.758	2.471
746NASCIS FMQ-3.7	225	1.575	84093.774	1.041
746NASCIS FMQ-3.7	255	1.156	88480.002	1.084
746NASCIS FMQ-3.7	295	2.258	85274.312	1.016
746NASCIS FMQ-3.7	330	0.873	81187.060	1.764
746NASCIS FMQ-3.7	380	1.929	89074.074	0.942
746NASCIS FMQ-3.7	380	1.076	81224.692	0.891
746NASCIS FMQ-3.7	455	2.832	89993.260	2.057
746NASCIS FMQ-3.7	510	2.250	95525.518	0.512
746NASCIS FMQ-3.7	580	1.633	78743.064	1.387
746NASCIS FMQ-3.7	660	0.986	70351.652	0.957
746NASCIS FMQ-3.7	725	3.430	72530.536	1.095
746NASCIS FMQ-3.7	830	0.950	69562.338	1.172
747NFSCIS FMQ-3.0	40	2.739	73382.410	2.647
747NFSCIS FMQ-3.0	90	1.746	70908.196	1.373
747NFSCIS FMQ-3.0	135	1.480	71613.304	1.878
747NFSCIS FMQ-3.0	180	2.284	71459.798	1.061
747NFSCIS FMQ-3.0	225	0.195	74454.520	2.455
747NFSCIS FMQ-3.0	255	0.877	75167.060	1.270
747NFSCIS FMQ-3.0	295	1.886	74080.068	1.840
747NFSCIS FMQ-3.0	330	0.771	72484.936	0.689
747NFSCIS FMQ-3.0	380	1.167	73701.108	0.978
747NFSCIS FMQ-3.0	455	1.770	72771.648	1.626
747NFSCIS FMQ-3.0	510	0.436	75614.424	1.125
747NFSCIS FMQ-3.0	580	0.860	72776.568	3.083
747NFSCIS FMQ-3.0	660	1.635	68657.930	2.344
747NFSCIS FMQ-3.0	660	1.111	67556.094	1.571
747NFSCIS FMQ-3.0	725	2.161	69937.910	2.352
747NFSCIS FMQ-3.0	830	1.100	65994.290	1.034

Detection limit

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	103 -> 103 Rh [H2] CPS	103 -> 103 Rh [H2] RSD %	103 -> 103 Rh [O2] CPS
746NASCIS FMQ-3.7	135	86816.414	2.396	197369.390
746NASCIS FMQ-3.7	180	85551.826	1.049	194726.102
746NASCIS FMQ-3.7	225	92445.318	1.585	211853.908
746NASCIS FMQ-3.7	255	95903.702	1.817	225586.930
746NASCIS FMQ-3.7	295	93985.298	2.404	215652.496
746NASCIS FMQ-3.7	330	87832.010	1.862	203878.548
746NASCIS FMQ-3.7	380	97031.638	1.064	222917.914
746NASCIS FMQ-3.7	380	88240.728	1.278	207914.358
746NASCIS FMQ-3.7	455	99946.584	2.123	229779.960
746NASCIS FMQ-3.7	510	105658.824	1.244	244121.538
746NASCIS FMQ-3.7	580	86432.538	1.368	200025.348
746NASCIS FMQ-3.7	660	78804.888	1.630	181612.686
746NASCIS FMQ-3.7	725	79354.004	0.886	184448.936
746NASCIS FMQ-3.7	830	78148.230	1.592	179229.924
747NFSCIS FMQ-3.0	40	81054.368	1.584	187168.716
747NFSCIS FMQ-3.0	90	77573.632	2.290	180164.002
747NFSCIS FMQ-3.0	135	78179.800	1.032	183742.092
747NFSCIS FMQ-3.0	180	77167.734	1.419	181602.048
747NFSCIS FMQ-3.0	225	81708.888	0.878	189678.802
747NFSCIS FMQ-3.0	255	82479.476	1.291	191078.028
747NFSCIS FMQ-3.0	295	78735.098	1.599	186522.302
747NFSCIS FMQ-3.0	330	79763.420	0.381	182779.470
747NFSCIS FMQ-3.0	380	80259.070	1.049	188357.474
747NFSCIS FMQ-3.0	455	79139.764	1.979	186704.830
747NFSCIS FMQ-3.0	510	82336.064	0.971	193009.552
747NFSCIS FMQ-3.0	580	79203.412	1.039	186140.260
747NFSCIS FMQ-3.0	660	75414.966	1.185	175236.416
747NFSCIS FMQ-3.0	660	73418.010	0.799	173129.200
747NFSCIS FMQ-3.0	725	75775.854	1.628	177830.006
747NFSCIS FMQ-3.0	830	72449.572	0.912	170889.086

Detection limit

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	103 -> 103 Rh [O2] RSD %	107 Ag [NoGas] ppb	107 Ag [NoGas] RSD %
746NASCIS FMQ-3.7	135	0.915	0.002	10.005
746NASCIS FMQ-3.7	180	1.225	0.002	20.509
746NASCIS FMQ-3.7	225	1.121	0.005	10.716
746NASCIS FMQ-3.7	255	0.968	0.018	6.578
746NASCIS FMQ-3.7	295	0.881	0.020	4.282
746NASCIS FMQ-3.7	330	1.244	0.065	1.957
746NASCIS FMQ-3.7	380	1.135	0.048	1.183
746NASCIS FMQ-3.7	380	1.499	0.032	3.409
746NASCIS FMQ-3.7	455	0.870	0.036	7.628
746NASCIS FMQ-3.7	510	1.202	0.002	20.481
746NASCIS FMQ-3.7	580	0.804	0.002	21.313
746NASCIS FMQ-3.7	660	1.515	0.003	12.647
746NASCIS FMQ-3.7	725	0.970	0.002	20.351
746NASCIS FMQ-3.7	830	1.467	0.003	12.767
747NFSCIS FMQ-3.0	40	0.920	0.001	33.757
747NFSCIS FMQ-3.0	90	1.200	0.001	41.848
747NFSCIS FMQ-3.0	135	1.290	0.001	24.351
747NFSCIS FMQ-3.0	180	1.561	0.001	23.272
747NFSCIS FMQ-3.0	225	0.602	0.002	18.209
747NFSCIS FMQ-3.0	255	1.837	0.002	13.958
747NFSCIS FMQ-3.0	295	1.390	0.003	17.276
747NFSCIS FMQ-3.0	330	1.601	0.004	4.365
747NFSCIS FMQ-3.0	380	0.708	0.010	5.764
747NFSCIS FMQ-3.0	455	1.609	0.016	8.776
747NFSCIS FMQ-3.0	510	0.624	0.002	22.718
747NFSCIS FMQ-3.0	580	2.373	0.003	14.148
747NFSCIS FMQ-3.0	660	1.743	0.004	21.293
747NFSCIS FMQ-3.0	660	1.125	0.039	2.996
747NFSCIS FMQ-3.0	725	0.854	0.002	5.106
747NFSCIS FMQ-3.0	830	1.372	0.001	32.351
Detection limit			0.000	

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	111 Cd [NoGas] ppb	111 Cd [NoGas] RSD %	115 In [NoGas] CPS
746NASCIS FMQ-3.7	135	0.056	2.739	369869.192
746NASCIS FMQ-3.7	180	0.122	7.658	372654.728
746NASCIS FMQ-3.7	225	0.208	2.604	379576.230
746NASCIS FMQ-3.7	255	0.424	2.987	384509.278
746NASCIS FMQ-3.7	295	0.146	3.975	372406.392
746NASCIS FMQ-3.7	330	0.075	7.787	372899.418
746NASCIS FMQ-3.7	380	0.278	4.632	371991.002
746NASCIS FMQ-3.7	380	0.211	4.538	374185.294
746NASCIS FMQ-3.7	455	0.291	1.780	378766.324
746NASCIS FMQ-3.7	510	0.507	3.299	375346.936
746NASCIS FMQ-3.7	580	0.226	4.919	358093.740
746NASCIS FMQ-3.7	660	0.093	4.660	363829.226
746NASCIS FMQ-3.7	725	0.296	3.394	373517.380
746NASCIS FMQ-3.7	830	0.006	19.205	364335.040
747NFSCIS FMQ-3.0	40	0.035	18.042	367170.618
747NFSCIS FMQ-3.0	90	0.006	23.922	362045.732
747NFSCIS FMQ-3.0	135	0.011	16.406	367505.690
747NFSCIS FMQ-3.0	180	0.026	23.754	361933.450
747NFSCIS FMQ-3.0	225	0.062	7.683	365383.656
747NFSCIS FMQ-3.0	255	0.096	2.891	365307.626
747NFSCIS FMQ-3.0	295	0.076	11.450	360313.426
747NFSCIS FMQ-3.0	330	0.036	5.164	364952.082
747NFSCIS FMQ-3.0	380	0.229	1.527	360421.638
747NFSCIS FMQ-3.0	455	0.080	4.661	355291.996
747NFSCIS FMQ-3.0	510	0.233	2.151	365187.482
747NFSCIS FMQ-3.0	580	0.272	2.214	361253.246
747NFSCIS FMQ-3.0	660	0.133	6.853	352084.260
747NFSCIS FMQ-3.0	660	0.099	5.547	342783.546
747NFSCIS FMQ-3.0	725	0.255	3.142	347320.140
747NFSCIS FMQ-3.0	830	0.015	29.155	345048.246

Detection limit 0.001

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	115 In [NoGas] RSD %	115 -> 115 In [He KED] CPS	115 -> 115 In [He KED] RSD %
746NASCIS FMQ-3.7	135	1.884	21255.936	1.304
746NASCIS FMQ-3.7	180	1.832	20949.564	1.192
746NASCIS FMQ-3.7	225	0.793	21197.210	1.242
746NASCIS FMQ-3.7	255	2.733	20377.470	1.632
746NASCIS FMQ-3.7	295	1.925	20411.546	1.640
746NASCIS FMQ-3.7	330	2.003	20529.684	1.413
746NASCIS FMQ-3.7	380	1.839	20465.598	1.068
746NASCIS FMQ-3.7	380	1.078	20448.258	3.423
746NASCIS FMQ-3.7	455	3.082	20330.778	1.659
746NASCIS FMQ-3.7	510	1.184	20288.036	0.783
746NASCIS FMQ-3.7	580	0.702	20000.358	3.661
746NASCIS FMQ-3.7	660	0.532	20136.530	3.274
746NASCIS FMQ-3.7	725	2.698	20241.972	1.985
746NASCIS FMQ-3.7	830	1.007	20075.790	1.320
747NFSCIS FMQ-3.0	40	2.944	19765.410	1.799
747NFSCIS FMQ-3.0	90	1.658	20215.292	0.947
747NFSCIS FMQ-3.0	135	1.002	20370.820	3.494
747NFSCIS FMQ-3.0	180	0.601	19896.236	1.897
747NFSCIS FMQ-3.0	225	1.133	20266.700	1.361
747NFSCIS FMQ-3.0	255	0.875	20515.004	1.933
747NFSCIS FMQ-3.0	295	2.220	20103.822	2.766
747NFSCIS FMQ-3.0	330	1.537	19970.324	1.847
747NFSCIS FMQ-3.0	380	0.915	19374.258	0.866
747NFSCIS FMQ-3.0	455	2.859	19339.586	2.830
747NFSCIS FMQ-3.0	510	0.777	20097.834	2.872
747NFSCIS FMQ-3.0	580	0.938	19955.644	2.051
747NFSCIS FMQ-3.0	660	0.409	19308.888	3.045
747NFSCIS FMQ-3.0	660	0.625	18851.652	2.130
747NFSCIS FMQ-3.0	725	1.148	18899.742	3.594
747NFSCIS FMQ-3.0	830	1.871	18338.396	2.053

Detection limit

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	115 -> 115 In [H2] CPS	115 -> 115 In [H2] RSD %	115 -> 115 In [O2] CPS
746NASCIS FMQ-3.7	135	136287.852	1.645	194076.394
746NASCIS FMQ-3.7	180	138096.904	1.568	192719.058
746NASCIS FMQ-3.7	225	138977.914	2.057	197774.952
746NASCIS FMQ-3.7	255	141679.248	1.013	194685.310
746NASCIS FMQ-3.7	295	138441.106	1.910	195335.836
746NASCIS FMQ-3.7	330	140490.998	1.877	195302.672
746NASCIS FMQ-3.7	380	139652.210	0.449	195110.190
746NASCIS FMQ-3.7	380	138643.326	0.586	194543.692
746NASCIS FMQ-3.7	455	139612.750	1.693	194402.466
746NASCIS FMQ-3.7	510	136590.234	0.798	193118.732
746NASCIS FMQ-3.7	580	134487.582	1.669	189468.078
746NASCIS FMQ-3.7	660	137452.212	1.840	193692.472
746NASCIS FMQ-3.7	725	136826.310	1.912	193788.242
746NASCIS FMQ-3.7	830	138005.638	2.446	190164.578
747NFSCIS FMQ-3.0	40	136968.828	1.510	191888.488
747NFSCIS FMQ-3.0	90	137121.948	2.017	192222.150
747NFSCIS FMQ-3.0	135	137293.576	1.985	193592.828
747NFSCIS FMQ-3.0	180	137316.588	1.773	190807.982
747NFSCIS FMQ-3.0	225	137139.464	1.805	190088.580
747NFSCIS FMQ-3.0	255	135778.098	0.583	192161.172
747NFSCIS FMQ-3.0	295	135186.476	1.765	189244.546
747NFSCIS FMQ-3.0	330	135568.518	1.574	190414.136
747NFSCIS FMQ-3.0	380	135771.688	1.635	187663.872
747NFSCIS FMQ-3.0	455	136876.158	0.867	189973.012
747NFSCIS FMQ-3.0	510	138419.118	1.802	190249.388
747NFSCIS FMQ-3.0	580	138569.324	1.366	189502.322
747NFSCIS FMQ-3.0	660	133118.790	1.067	185258.338
747NFSCIS FMQ-3.0	660	132576.476	1.353	182663.370
747NFSCIS FMQ-3.0	725	132149.730	2.081	181137.518
747NFSCIS FMQ-3.0	830	130292.254	1.639	182728.280

Detection limit

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	115 -> 115 In [O2] RSD %	118 Sn [NoGas] ppb	118 Sn [NoGas] RSD %
746NASCIS FMQ-3.7	135	1.680	0.033	4.310
746NASCIS FMQ-3.7	180	1.086	0.035	2.547
746NASCIS FMQ-3.7	225	1.073	0.043	3.180
746NASCIS FMQ-3.7	255	1.050	0.086	4.083
746NASCIS FMQ-3.7	295	0.444	0.055	8.189
746NASCIS FMQ-3.7	330	1.329	0.039	3.983
746NASCIS FMQ-3.7	380	0.973	0.037	5.733
746NASCIS FMQ-3.7	380	0.760	0.033	7.019
746NASCIS FMQ-3.7	455	1.317	0.039	5.330
746NASCIS FMQ-3.7	510	1.338	0.031	2.889
746NASCIS FMQ-3.7	580	0.804	0.014	8.426
746NASCIS FMQ-3.7	660	1.446	0.006	11.665
746NASCIS FMQ-3.7	725	1.465	0.017	5.112
746NASCIS FMQ-3.7	830	1.327	0.070	6.734
747NFSCIS FMQ-3.0	40	2.025	0.019	8.605
747NFSCIS FMQ-3.0	90	0.953	0.016	7.891
747NFSCIS FMQ-3.0	135	1.220	0.015	14.323
747NFSCIS FMQ-3.0	180	1.111	0.025	5.124
747NFSCIS FMQ-3.0	225	1.366	0.026	5.194
747NFSCIS FMQ-3.0	255	0.630	0.037	7.951
747NFSCIS FMQ-3.0	295	1.376	0.034	6.543
747NFSCIS FMQ-3.0	330	1.848	0.026	3.332
747NFSCIS FMQ-3.0	380	0.964	0.029	7.494
747NFSCIS FMQ-3.0	455	0.762	0.031	5.099
747NFSCIS FMQ-3.0	510	1.314	0.030	1.708
747NFSCIS FMQ-3.0	580	0.976	0.014	14.156
747NFSCIS FMQ-3.0	660	1.881	0.008	15.101
747NFSCIS FMQ-3.0	660	1.078	0.007	14.765
747NFSCIS FMQ-3.0	725	1.493	0.009	6.058
747NFSCIS FMQ-3.0	830	2.169	0.009	6.366
Detection limit			0.001	

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	118 -> 118 Sn [He KED] ppb	118 -> 118 Sn [He KED] RSD %	118 -> 118 Sn [O2] ppb
746NASCIS FMQ-3.7	135	0.022	52.858	0.033
746NASCIS FMQ-3.7	180	0.033	39.123	0.033
746NASCIS FMQ-3.7	225	0.038	21.500	0.041
746NASCIS FMQ-3.7	255	0.098	28.289	0.086
746NASCIS FMQ-3.7	295	0.051	30.028	0.056
746NASCIS FMQ-3.7	330	0.037	49.841	0.037
746NASCIS FMQ-3.7	380	0.036	26.812	0.038
746NASCIS FMQ-3.7	380	0.031	43.133	0.034
746NASCIS FMQ-3.7	455	0.050	19.927	0.038
746NASCIS FMQ-3.7	510	0.042	24.845	0.033
746NASCIS FMQ-3.7	580	0.012	34.312	0.014
746NASCIS FMQ-3.7	660			0.005
746NASCIS FMQ-3.7	725	0.019	84.577	0.018
746NASCIS FMQ-3.7	830	0.072	28.106	0.071
747NFSCIS FMQ-3.0	40	0.026	44.304	0.021
747NFSCIS FMQ-3.0	90	0.023	35.551	0.015
747NFSCIS FMQ-3.0	135	0.010	26.307	0.015
747NFSCIS FMQ-3.0	180	0.026	18.672	0.025
747NFSCIS FMQ-3.0	225	0.023	42.906	0.025
747NFSCIS FMQ-3.0	255	0.040	35.241	0.037
747NFSCIS FMQ-3.0	295	0.037	35.445	0.041
747NFSCIS FMQ-3.0	330	0.023	50.799	0.022
747NFSCIS FMQ-3.0	380	0.027	35.392	0.030
747NFSCIS FMQ-3.0	455	0.034	44.536	0.031
747NFSCIS FMQ-3.0	510	0.035	31.367	0.030
747NFSCIS FMQ-3.0	580	0.015	20.000	0.015
747NFSCIS FMQ-3.0	660	0.006	99.381	0.008
747NFSCIS FMQ-3.0	660	0.007	87.434	0.007
747NFSCIS FMQ-3.0	725	0.007	103.652	0.012
747NFSCIS FMQ-3.0	830	0.009	70.711	0.010
Detection limit		0.004		0.002

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	118 -> 118 Sn [O2] RSD %	118 -> 118 Sn [H2] ppb	118 -> 118 Sn [H2] RSD %
746NASCIS FMQ-3.7	135	11.461	0.039	12.612
746NASCIS FMQ-3.7	180	5.475	0.041	8.282
746NASCIS FMQ-3.7	225	8.520	0.045	18.310
746NASCIS FMQ-3.7	255	8.712	0.103	8.041
746NASCIS FMQ-3.7	295	10.955	0.060	13.258
746NASCIS FMQ-3.7	330	19.378	0.042	21.256
746NASCIS FMQ-3.7	380	14.998	0.050	21.479
746NASCIS FMQ-3.7	380	9.534	0.036	10.249
746NASCIS FMQ-3.7	455	3.967	0.042	11.023
746NASCIS FMQ-3.7	510	10.900	0.044	20.427
746NASCIS FMQ-3.7	580	32.282	0.017	32.075
746NASCIS FMQ-3.7	660	30.288	0.007	70.234
746NASCIS FMQ-3.7	725	14.533	0.024	20.611
746NASCIS FMQ-3.7	830	3.441	0.076	24.984
747NFSCIS FMQ-3.0	40	12.030	0.021	28.484
747NFSCIS FMQ-3.0	90	10.277	0.019	18.547
747NFSCIS FMQ-3.0	135	22.765	0.019	22.027
747NFSCIS FMQ-3.0	180	29.375	0.028	18.884
747NFSCIS FMQ-3.0	225	16.317	0.026	26.472
747NFSCIS FMQ-3.0	255	14.571	0.042	5.120
747NFSCIS FMQ-3.0	295	12.885	0.040	9.651
747NFSCIS FMQ-3.0	330	19.704	0.027	12.727
747NFSCIS FMQ-3.0	380	6.150	0.032	28.128
747NFSCIS FMQ-3.0	455	14.700	0.032	12.751
747NFSCIS FMQ-3.0	510	10.899	0.035	12.747
747NFSCIS FMQ-3.0	580	14.052	0.015	30.879
747NFSCIS FMQ-3.0	660	22.667	0.011	50.144
747NFSCIS FMQ-3.0	660	34.319	0.007	23.385
747NFSCIS FMQ-3.0	725	6.588	0.014	19.216
747NFSCIS FMQ-3.0	830	43.668	0.012	18.763
Detection limit			0.003	

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	120 Sn [NoGas] ppb	120 Sn [NoGas] RSD %	133 Cs [NoGas]ppb
746NASCIS FMQ-3.7	135	0.031	4.253	0.006
746NASCIS FMQ-3.7	180	0.034	2.597	0.006
746NASCIS FMQ-3.7	225	0.042	4.470	0.011
746NASCIS FMQ-3.7	255	0.087	4.625	0.028
746NASCIS FMQ-3.7	295	0.054	3.526	0.038
746NASCIS FMQ-3.7	330	0.039	2.672	0.004
746NASCIS FMQ-3.7	380	0.039	4.688	0.005
746NASCIS FMQ-3.7	380	0.034	4.144	0.003
746NASCIS FMQ-3.7	455	0.040	4.982	0.005
746NASCIS FMQ-3.7	510	0.032	3.159	0.003
746NASCIS FMQ-3.7	580	0.013	6.756	0.012
746NASCIS FMQ-3.7	660	0.006	15.826	0.002
746NASCIS FMQ-3.7	725	0.017	6.001	0.005
746NASCIS FMQ-3.7	830	0.069	6.253	0.045
747NFSCIS FMQ-3.0	40	0.018	10.371	0.020
747NFSCIS FMQ-3.0	90	0.017	7.174	0.007
747NFSCIS FMQ-3.0	135	0.016	6.685	0.011
747NFSCIS FMQ-3.0	180	0.024	8.686	0.009
747NFSCIS FMQ-3.0	225	0.026	2.731	0.020
747NFSCIS FMQ-3.0	255	0.036	5.171	0.037
747NFSCIS FMQ-3.0	295	0.034	4.152	0.018
747NFSCIS FMQ-3.0	330	0.024	6.376	0.005
747NFSCIS FMQ-3.0	380	0.029	5.703	0.005
747NFSCIS FMQ-3.0	455	0.030	3.561	0.025
747NFSCIS FMQ-3.0	510	0.030	6.877	0.006
747NFSCIS FMQ-3.0	580	0.013	10.337	0.004
747NFSCIS FMQ-3.0	660	0.008	14.967	0.031
747NFSCIS FMQ-3.0	660	0.006	20.710	0.003
747NFSCIS FMQ-3.0	725	0.010	5.854	0.002
747NFSCIS FMQ-3.0	830	0.010	14.629	0.022
Detection limit		0.001		0.000

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	133 Cs [NoGas]RSD %	137 Ba [NoGas] ppb	137 Ba [NoGas] RSD %
746NASCIS FMQ-3.7	135	4.224		
746NASCIS FMQ-3.7	180	8.349		
746NASCIS FMQ-3.7	225	3.084		
746NASCIS FMQ-3.7	255	1.684	0.016	5.642
746NASCIS FMQ-3.7	295	1.950		
746NASCIS FMQ-3.7	330	4.169		
746NASCIS FMQ-3.7	380	10.933		
746NASCIS FMQ-3.7	380	12.781		
746NASCIS FMQ-3.7	455	6.739		
746NASCIS FMQ-3.7	510	10.453		
746NASCIS FMQ-3.7	580	4.122	0.105	3.599
746NASCIS FMQ-3.7	660	7.896	0.033	2.988
746NASCIS FMQ-3.7	725	6.564		
746NASCIS FMQ-3.7	830	2.407	0.055	4.244
747NFSCIS FMQ-3.0	40	2.813	0.026	5.434
747NFSCIS FMQ-3.0	90	3.809	0.061	4.758
747NFSCIS FMQ-3.0	135	4.915	0.046	4.499
747NFSCIS FMQ-3.0	180	4.457	0.129	2.933
747NFSCIS FMQ-3.0	225	2.575	0.169	0.994
747NFSCIS FMQ-3.0	255	2.785	0.041	2.061
747NFSCIS FMQ-3.0	295	5.042	0.040	4.887
747NFSCIS FMQ-3.0	330	9.602		
747NFSCIS FMQ-3.0	380	5.944	0.018	6.995
747NFSCIS FMQ-3.0	455	5.288	0.039	11.721
747NFSCIS FMQ-3.0	510	7.862		
747NFSCIS FMQ-3.0	580	3.685	0.046	5.511
747NFSCIS FMQ-3.0	660	3.633	0.020	4.512
747NFSCIS FMQ-3.0	660	8.895		
747NFSCIS FMQ-3.0	725	8.018	0.030	8.068
747NFSCIS FMQ-3.0	830	7.652		
Detection limit			0.015	

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	172 Yb [NoGas] ppb	172 Yb [NoGas] RSD %	182 W [NoGas] CPS
746NASCIS FMQ-3.7	135			26.000
746NASCIS FMQ-3.7	180			13.334
746NASCIS FMQ-3.7	225			16.000
746NASCIS FMQ-3.7	255			44.000
746NASCIS FMQ-3.7	295			29.998
746NASCIS FMQ-3.7	330			19.334
746NASCIS FMQ-3.7	380			46.002
746NASCIS FMQ-3.7	380	0.001	125.502	25.334
746NASCIS FMQ-3.7	455	0.000	45.164	89.334
746NASCIS FMQ-3.7	510	0.001	33.083	112.666
746NASCIS FMQ-3.7	580			203.334
746NASCIS FMQ-3.7	660	0.002	23.897	433.342
746NASCIS FMQ-3.7	725	0.020	8.211	1861.450
746NASCIS FMQ-3.7	830	0.001	34.318	37.332
747NFSCIS FMQ-3.0	40	0.003	29.755	14.000
747NFSCIS FMQ-3.0	90			9.332
747NFSCIS FMQ-3.0	135			7.332
747NFSCIS FMQ-3.0	180			22.000
747NFSCIS FMQ-3.0	225			53.334
747NFSCIS FMQ-3.0	255	0.000	49.750	23.332
747NFSCIS FMQ-3.0	295	0.000	39.523	14.002
747NFSCIS FMQ-3.0	330	0.000	31.665	16.670
747NFSCIS FMQ-3.0	380			26.002
747NFSCIS FMQ-3.0	455	0.002	19.814	107.332
747NFSCIS FMQ-3.0	510	0.002	20.886	128.668
747NFSCIS FMQ-3.0	580	0.001	42.931	332.672
747NFSCIS FMQ-3.0	660	0.001	36.733	226.668
747NFSCIS FMQ-3.0	660	0.001	50.468	136.668
747NFSCIS FMQ-3.0	725	0.013	6.728	586.012
747NFSCIS FMQ-3.0	830	0.001	88.256	48.668
Detection limit		0.000		

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	182 W [NoGas] RSD %	195 Pt [NoGas] ppb	195 Pt [NoGas] RSD %
746NASCIS FMQ-3.7	135	39.931	2.212	1.521
746NASCIS FMQ-3.7	180	72.875	1.051	1.674
746NASCIS FMQ-3.7	225	45.154	1.542	1.343
746NASCIS FMQ-3.7	255	22.981	3.296	7.816
746NASCIS FMQ-3.7	295	40.830	2.335	1.508
746NASCIS FMQ-3.7	330	57.703	2.302	1.243
746NASCIS FMQ-3.7	380	28.254	15.292	12.118
746NASCIS FMQ-3.7	380	50.627	5.916	7.824
746NASCIS FMQ-3.7	455	16.349	19.787	6.397
746NASCIS FMQ-3.7	510	20.218	25.410	3.059
746NASCIS FMQ-3.7	580	12.753	0.903	1.403
746NASCIS FMQ-3.7	660	6.880	0.141	1.708
746NASCIS FMQ-3.7	725	4.424	0.144	10.733
746NASCIS FMQ-3.7	830	39.126	0.073	5.264
747NFSCIS FMQ-3.0	40	31.048	0.117	3.889
747NFSCIS FMQ-3.0	90	105.341	0.145	1.480
747NFSCIS FMQ-3.0	135	59.280	0.133	6.276
747NFSCIS FMQ-3.0	180	48.636	0.190	1.368
747NFSCIS FMQ-3.0	225	26.144	0.727	1.800
747NFSCIS FMQ-3.0	255	91.479	0.738	1.281
747NFSCIS FMQ-3.0	295	59.278	1.440	3.345
747NFSCIS FMQ-3.0	330	59.988	0.984	1.249
747NFSCIS FMQ-3.0	380	49.986	1.736	2.406
747NFSCIS FMQ-3.0	455	32.305	3.018	3.554
747NFSCIS FMQ-3.0	510	12.505	4.047	9.511
747NFSCIS FMQ-3.0	580	10.542	0.652	90.221
747NFSCIS FMQ-3.0	660	13.030	0.209	6.180
747NFSCIS FMQ-3.0	660	11.307	0.197	28.114
747NFSCIS FMQ-3.0	725	9.246	0.347	4.019
747NFSCIS FMQ-3.0	830	36.755	0.141	5.310
Detection limit			0.003	

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	197 Au [NoGas] CPS	197 Au [NoGas] RSD %	205 Tl [NoGas] ppb
746NASCIS FMQ-3.7	135	206.668	16.528	
746NASCIS FMQ-3.7	180	20.000	39.096	
746NASCIS FMQ-3.7	225	90.668	30.911	
746NASCIS FMQ-3.7	255	466.674	9.649	0.002
746NASCIS FMQ-3.7	295	60.666	21.769	
746NASCIS FMQ-3.7	330	37.332	61.024	
746NASCIS FMQ-3.7	380	113.332	30.425	
746NASCIS FMQ-3.7	380	88.668	26.528	
746NASCIS FMQ-3.7	455	54.668	21.384	
746NASCIS FMQ-3.7	510	46.002	74.325	
746NASCIS FMQ-3.7	580	18.000	106.863	
746NASCIS FMQ-3.7	660	65.332	28.996	
746NASCIS FMQ-3.7	725	212.002	25.173	
746NASCIS FMQ-3.7	830	344.672	10.318	
747NFSCIS FMQ-3.0	40	16.002	37.250	
747NFSCIS FMQ-3.0	90	14.668	52.323	
747NFSCIS FMQ-3.0	135	108.000	31.371	
747NFSCIS FMQ-3.0	180	10.668	40.732	
747NFSCIS FMQ-3.0	225	39.334	54.388	
747NFSCIS FMQ-3.0	255	86.000	34.385	
747NFSCIS FMQ-3.0	295	66.000	17.640	
747NFSCIS FMQ-3.0	330	28.668	64.529	
747NFSCIS FMQ-3.0	380	628.014	9.152	
747NFSCIS FMQ-3.0	455	140.004	62.791	
747NFSCIS FMQ-3.0	510	12.668	65.520	
747NFSCIS FMQ-3.0	580	5.334	71.271	
747NFSCIS FMQ-3.0	660	88.666	36.509	
747NFSCIS FMQ-3.0	660	42.668	12.836	
747NFSCIS FMQ-3.0	725	254.670	20.164	
747NFSCIS FMQ-3.0	830	34.000	38.229	
Detection limit		#DIV/0!		0.002

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	205 TI [NoGas] RSD %	208 Pb [NoGas] ppb	208 Pb [NoGas] RSD %
746NASCIS FMQ-3.7	135		0.112	2.596
746NASCIS FMQ-3.7	180		0.169	3.120
746NASCIS FMQ-3.7	225		0.213	2.624
746NASCIS FMQ-3.7	255	18.843	0.484	2.034
746NASCIS FMQ-3.7	295		0.219	2.441
746NASCIS FMQ-3.7	330		0.157	3.096
746NASCIS FMQ-3.7	380		1.190	1.747
746NASCIS FMQ-3.7	380		0.713	0.396
746NASCIS FMQ-3.7	455		0.768	2.391
746NASCIS FMQ-3.7	510		0.475	2.483
746NASCIS FMQ-3.7	580		0.607	2.314
746NASCIS FMQ-3.7	660		0.748	2.899
746NASCIS FMQ-3.7	725		1.685	1.357
746NASCIS FMQ-3.7	830		0.020	4.788
747NFSCIS FMQ-3.0	40		0.043	5.617
747NFSCIS FMQ-3.0	90		0.008	6.970
747NFSCIS FMQ-3.0	135		0.019	2.522
747NFSCIS FMQ-3.0	180		0.061	2.533
747NFSCIS FMQ-3.0	225		0.149	2.476
747NFSCIS FMQ-3.0	255		0.170	2.356
747NFSCIS FMQ-3.0	295		0.154	1.782
747NFSCIS FMQ-3.0	330		0.075	4.849
747NFSCIS FMQ-3.0	380		0.343	2.776
747NFSCIS FMQ-3.0	455		0.188	4.401
747NFSCIS FMQ-3.0	510		0.377	1.798
747NFSCIS FMQ-3.0	580		0.561	1.409
747NFSCIS FMQ-3.0	660		0.906	1.769
747NFSCIS FMQ-3.0	660		0.596	1.218
747NFSCIS FMQ-3.0	725		1.158	1.824
747NFSCIS FMQ-3.0	830		0.028	3.610
Detection limit			0.001	

*Explanations of various modes used (Nc

Sample Name	Temperature (°C)	209 Bi [NoGas] ppb	209 Bi [NoGas] RSD %
746NASCIS FMQ-3.7	135	0.036	1.185
746NASCIS FMQ-3.7	180	0.045	2.576
746NASCIS FMQ-3.7	225	0.045	3.502
746NASCIS FMQ-3.7	255	0.095	2.205
746NASCIS FMQ-3.7	295	0.080	1.018
746NASCIS FMQ-3.7	330	0.066	2.603
746NASCIS FMQ-3.7	380	0.065	2.515
746NASCIS FMQ-3.7	380	0.042	5.220
746NASCIS FMQ-3.7	455	0.090	4.568
746NASCIS FMQ-3.7	510	0.102	2.112
746NASCIS FMQ-3.7	580	0.064	4.129
746NASCIS FMQ-3.7	660	0.021	3.264
746NASCIS FMQ-3.7	725	0.077	4.119
746NASCIS FMQ-3.7	830	0.070	4.073
747NFSCIS FMQ-3.0	40	0.092	1.435
747NFSCIS FMQ-3.0	90	0.021	3.657
747NFSCIS FMQ-3.0	135	0.026	6.753
747NFSCIS FMQ-3.0	180	0.061	3.068
747NFSCIS FMQ-3.0	225	0.030	7.689
747NFSCIS FMQ-3.0	255	0.024	6.225
747NFSCIS FMQ-3.0	295	0.024	2.403
747NFSCIS FMQ-3.0	330	0.017	4.311
747NFSCIS FMQ-3.0	380	0.025	7.584
747NFSCIS FMQ-3.0	455	0.042	5.281
747NFSCIS FMQ-3.0	510	0.099	2.866
747NFSCIS FMQ-3.0	580	0.084	2.469
747NFSCIS FMQ-3.0	660	0.029	6.484
747NFSCIS FMQ-3.0	660	0.023	5.217
747NFSCIS FMQ-3.0	725	0.063	3.029
747NFSCIS FMQ-3.0	830	0.024	6.685
Detection limit		0.001	

*Explanations of various modes used (Nc