Trace Element Geochemistry of Chatanika Eclogites and Accompanying Potential Protoliths

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GEOL394

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II. ABSTRACTS

SCIENTIFIC ABSTRACT

The Tintina fault, stretching from eastern Alaska to the southern Yukon region of Canada, consists of regionally metamorphosed and deformed basalts of Paleozoic age such as greenschist, amphibolite, and eclogites. Eclogites from Chatanika, slightly north of Fairbanks, are specifically of interest for the purposes of this research and occupy the northwest part of the Tintina fault. The Tintina fault has been studied in the past and has proven to have tectonically complex history, and there is still uncertainty in formation conditions and environments. Previous geologic work along the Tintina Fault has provided information regarding thermobarometry (P = 1.3 GPa and $T \approx 495 \pm 20$ °C), pressure-temperature-time paths (P=20 kbar and T=660 °C), and trace element geochemical (Petrie *et al.*, 2016 and Erdmer *et al.*, 1998). However, the trace element data are incomplete and primarily used collection sites on the far east side of the fault, thus the prompt for this research. To better understand the faulting of this region, trace element geochemistry was determined using solution ICP-MS, which were then compared to each other as well as to existing trace element data of the Yukon side of the fault. Analysis of eclogites and potential protoliths for high field strength fluid immobile elements was used to perform a comparison of diagenetic processes and the protoliths associated with the region. The conclusion is that the tested eclogites come from an ocean island basalt protolith, while the tested "potential protoliths" are mid-ocean ridge basalts and thus cannot be the protolith of the tested eclogites. However, the tested protoliths align very closely to previously studied eclogites labeled as metamorphosed MORB rocks. The null hypothesis states that trace element compositions fall within a reasonable range compared to previously tested rocks of the Yukon region, and the data suggests that the hypothesis is refuted but supported when previously tested rocks are considered. While the predicted protoliths are not the parent rocks of the tested eclogites, they are the protolith of previously tested eclogites in the same region. More comprehensive trace element analysis of both regions allowed for this comparison to be made, which was used to make predictions related to the protolith, origin and processes of the studied samples. Research questions considered in the data collection process included whether the protolith sample compositions fell within the specified range as given in previous research of the region, along with addressing whether consistencies are present between all the tested rocks and existing data collected in the Yukon region. Beyond the scope of this research, a continuation of geochemical testing and aging techniques on rocks along the Tintina fault contributes to a more thorough geologic timescale of the region. The comparison of the trace element concentrations will be discussed in this paper and will be compared to various figures from past research focused around the Tintina Fault. Predictions revolve around the tested hypothesis: trace element signatures of mafic Chatanika eclogites and protoliths fall within the range of previously analyzed Yukon eclogites.

PLAIN TEXT ABSTRACT

Geological features such as faults provide valuable information on the ancient characteristics and behaviors of our Earth. Fault systems are present along modern plate boundaries, such as the well-known San Andreas Fault or a textbook convergent boundary that is the Pacific Ring of Fire. However, many ancient faults are no longer tectonically active but still show displays of change in the rock structure because of plate movement. One example of this is the Tintina Fault that extends from Alaska to Western Canada. The Tintina Fault is an inactive

fault where one slab of oceanic crust (the footwall plate) slid under another known as the hanging-wall plate at its period(s) of movement. This environment, known as a subduction zone, is characterized by metamorphic rocks that have mineralogical conditions characterized by zones of high pressure and high temperature. The scope of this research is addressing whether both ends of the Tintina contain similar rock, allowing for a stronger prediction regarding the history of plate movement. To better understand if this is true and if there is variation in conditions on two opposing ends of the fault, geochemical data was collected and compared to existing analyses. Comprehensive fluid immobile trace element data has previously been collected of Yukon samples on the eastern side of the fault, allowing for comparison of equivalent Chatanika samples on the western side. The method being used to perform this comparison was inductively coupled plasma mass spectrometry (ICP-MS). The process consists of grinding the rock into a powder and then fully dissolving it in a set of acids, under which it will then be tested using ICP-MS and analyzed for a list of trace elements that have traits making them immobile under metamorphism. By testing for trace elements, the protoliths or "parent rocks" were determined from the metamorphic samples and compared to protolith igneous samples. That analysis, along with the existing data on Yukon region samples, refuted the hypothesis that trace element signatures of mafic Chatanika eclogites and protoliths fall within the range of previously analyzed Yukon eclogites. Trace element signatures of potential "protolith" rocks do not align with the eclogite samples. Thus, they are determined to not be protoliths and the rocks analyzed in the scopes of this research are opposing in tectonic setting.

III. INTRODUCTION AND BACKGROUND

Metamorphosed basaltic rocks such as blueschist and eclogite occupy a large portion of the region surrounding the Tintina fault of eastern Alaska and western Yukon. The area of focus for the purposes of this research is on the Alaskan side of the fault. The protoliths of these rocks formed during the Paleozoic, possibly extending into the Proterozoic (Dusel-Bacon *et al.*, 2006). As of 1998, this region has been named the Chatanika assemblage by Hansen and Dusel-Bacon (1998) because of the related continental margin setting of the protoliths relative to other assemblages in the region. The Chatanika assemblage is characterized by its abundance of high-grade metamorphic rocks including lenses of high-grade eclogite amongst lower-grade pelitic schist, garnet-bearing mica-rich schists, and quartzite (Douglas et al., 2002). Samples matching these descriptions were collected by researchers at the University of South Carolina in Summer of 2023, which were then passed on for the purposes of this research. After initial chemical analysis of two eclogites, potential protolith rocks were obtained and analyzed in a similar manner (although sample preparation was adjusted slightly as explained in Method of Analysis).

As discussed, the analyzed samples came from the Chatanika region which is roughly described as the western-most section of the fault. The Tintina Fault runs through central Alaska into the Yukon region of Canada, extending for approximately 600 miles as shown in Fig. 2 (National Park Service, 2018). The primary rock types are Paleozoic (252-540 Ma) eclogite and Devonian (359-419 Ma) quartzite and pelitic schist. However, USGS also notes that there are problems in the age of rocks in the Chatanika allochthon, thus credited ages are a running point of discussion (USGS).

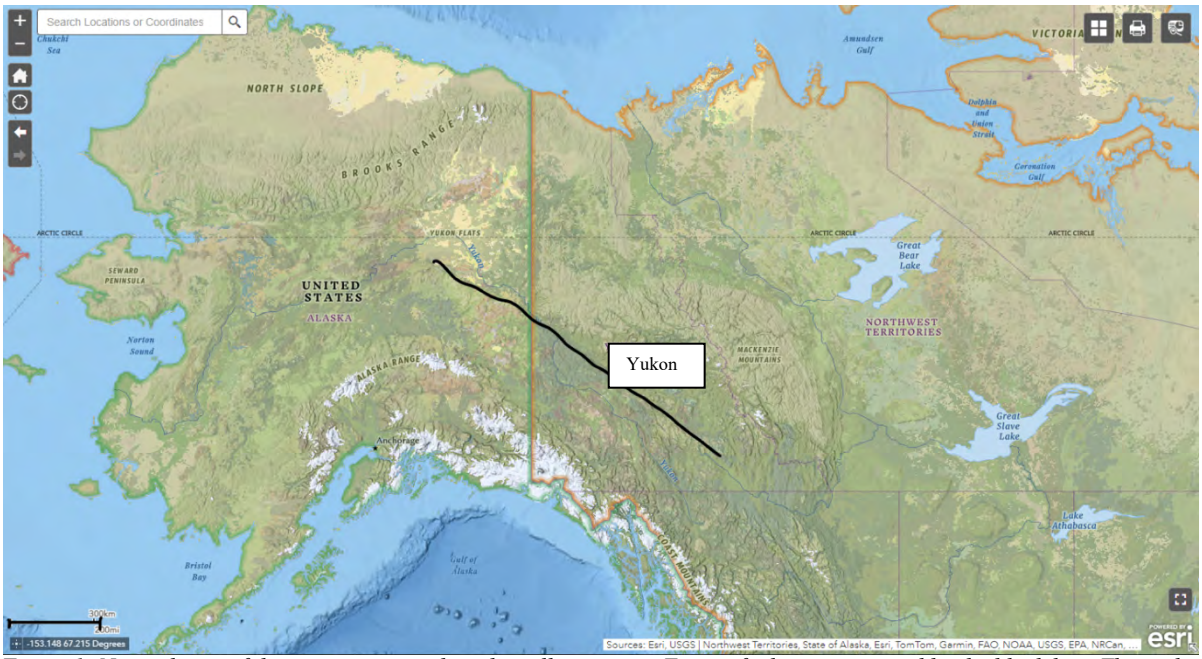


Figure 1: Notated map of the region surrounding the collection site. Tintina fault is represented by the black line. The scale bar is showing a length of 300 km.

Analysis of geochemical properties in the region provides concentration values used to interpret and compare to rock protoliths. Trace element data does not directly correlate with determining age or pressure and temperature conditions, but the interpretation of protolith and environmental influences is used to better understand and explain the metamorphic processes and parent rocks of the eclogite samples.

Movement along the Tintina Fault is characterized as a strike-slip fault that underwent primarily dextral (right-lateral) movement along with a series of subduction and uplift events. It is part of a system of faults that are the Mackenzie fold and thrust belt and the Denali fault systems (Hansen and Dusel-Bacon, 1998). However, there is debate about the set of events contributing to the formation and metamorphism of rocks along the fault. Faulting did not occur as one flush movement, but rather as a collection of fracturing and breakage as movement continued (Fig. 2). Theories proposed by Erdmer and Helmstaedt (1983) describe Tintina fault history as

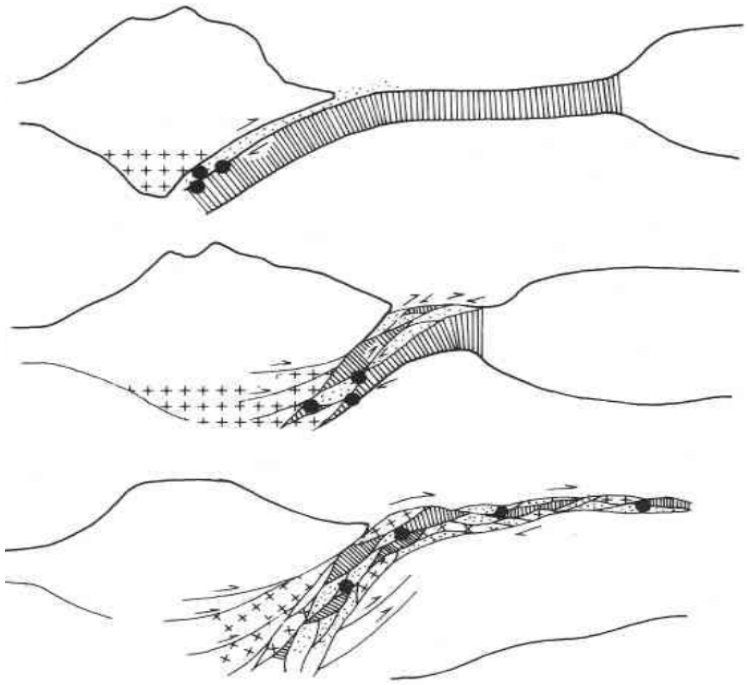


Fig. 2: Series of faulting and metamorphic events based on a collection of P-T analyses of Yukon eclogites (Erdmer and Helmstaedt, 1983). The last image is illustrated as such primarily due to the presence of glaucophane and absence of lawsonite, suggesting high temperatures (>400 °C) during retrograde metamorphism.

assemblage of igneous rocks, possibly a dike, being buried and metamorphosed into schist. The best interpretation is that some form of basaltic greenschist or blueschist is the result of partially metamorphosed igneous basalts). The first image in figure 2 illustrates the predicted initial fault movement. The shaded thinner oceanic plate is subducting under the continental plate and it is at this point where metamorphism is first characterized. The middle image in figure 2 is characterized by the presence of amphibole. At the peak of metamorphism, pressure and temperature reach ≥1.2 GPa and 400-600 °C, respectively (Fig. 3). During this event, the eclogite is uplifted, pressure decreases, prompting the formation of an amphibole categorized as edenite. A final event is hypothesized due to the presence of glaucophane which occurs at 700-900 MPa. Characteristics of modern subduction are referenced and led to the conclusion that the Yukon region underwent many phases of loading and unloading, ultimately reaching shallower depths. The last event (Fig. 2) provides a visual of the eclogite interleaved with other rocks displaced into the thrust sheet (Hansen, 1992; Erdmer and Helmstaedt, 1983). The final illustration is especially interesting to consider as the hypothesis of retrograde metamorphism is tackled.

Another similar hypothesis suggested by Erdmer and Helmstaedt (1983) interprets the activity along the Tintina Fault as three major deformation events. The three events include roughly the same components as the five outlined in Figure 3. The Yukon region was analyzed using kinematic, *P-T*, and thermochronometric data. These three events were labeled as follows:

1) Pre-Early Jurassic (>212 Ma)
   a) Northeast movement, normal tectonic movement relative to margin.
   b) High *P-T* subduction zone with downflow and backflow.
2) Late Early to early Middle Jurassic (>188-185 Ma).
   a) Northwest movement, parallel relative to margin.
   b) High *P-T* with collision.
3) Early Cretaceous (135-110 Ma)
   a) Southeast-directed crustal extension, resulting in exposure of structurally deepest rocks.

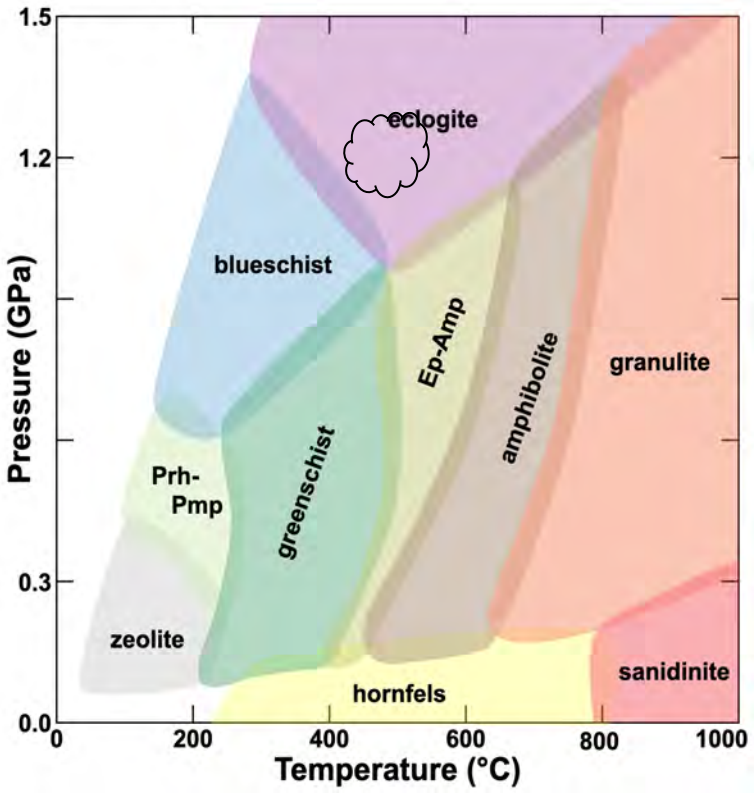


Fig. 3: Metamorphic facies diagram, with formation conditions of Yukon eclogites marked with a cloud bubble. The marked eclogite estimate was calculated using geobarometers in the Erdmer and Helmstaedt study (1983).

When compared to the outline of subduction and uplift events illustrated in figure three, there is significant parallelism in the sequence of events. Event one consists of normal subduction, followed by an increase in P-T conditions because of collision and uplift. The final event varies in that one source predicts crustal extension and one predicts a thrust sheet. However despite the slightly different labels of this movement the result of exposed rock that was previously subducted (which in this case includes eclogites).

Additional regional geology research includes a comprehensive review and tectonic analysis of British Columbia, Yukon and Alaska, which mainly focuses on post-protolith dextral fault movement from the mid-Cretaceous to the Eocene (110-33.9 Ma) (Nelson *et al.*, 2013). It is predicted that the right-lateral shear totals to about 800 km movement. Tectonics of central Alaska also represent original re-entrant angles in collision zones and the dextral movement following. However, available information primarily covers the tectonic movements as an entity of the entire region rather than the individual evolution of the Tintina fault. Additionally, conclusions state many unresolved problems related to the faulting in the area, ultimately leading to many more questions than answers. Furthermore, the Tintina fault is not directly referenced in that work beyond general questions and issues related to the region as a whole. Issues include inconsistencies in geologic versus paleomagnetic reconstructions during the Cretaceous. For the purposes of the Tintina fault, this causes some questioning of any hypothesized crustal extension or other metamorphism during the Cretaceous Period. Because the inconsistencies and identified problems are not directly relevant to the purposes of the research outlined later in this proposal, it

will not cause any major issues when drawing conclusions based off the hypothesis that there is correlation in the trace element concentrations of metamorphosed Chatanika rocks, igneous greywackes of the surrounding region, and existing concentration values of Yukon metamorphic rocks.

IV. METHOD OF ANALYSIS AND OBJECTIVES OF RESEARCH

The scope of the research being addressed by performing geochemical analysis of the eclogites is whether the trace element signatures of a collection Chatanika eclogites are statistically similar in trace element content to studied samples of the Yukon region, and furthermore display those same similarities with potential protolith samples. There are currently many unknowns regarding the formation of the Tintina fault and its surrounding regions, and this problem was chosen because it provided the opportunity to execute more trace element geochemical testing of metamorphosed rocks and unmetamorphosed suspected protoliths along the fault. There are two primary research questions currently being explored. The first is addressing whether the Chatanika and Yukon eclogites display similarities (within a defined deviation) in trace element geochemistry based on rare earth elements and high-field strength immobile elements. Analysis of the trace element signatures allowed for the second research question of whether the aforementioned signatures fall within the specified range of various tectonic settings.

Thus, the null hypothesis is as follows: **Trace element signatures of mafic Chatanika Eclogites and unmetamorphosed potential protoliths fall within the range of previously analyzed Yukon eclogites.**

As previously discussed, data were collected using solution-based Inductively Coupled Plasma-Mass Spectrometry. Whole rock samples were first observed by hand using a hand lens to evaluate structure and locate microcracks. These areas were avoided and cut off to minimize alteration and weathering in subsequent analysis. Outside influences such as a weathered surface could potentially affect the trace element concentrations and removing any exposed surfaces eliminated that concern. A thin section of one of the samples was provided with one eclogite sample. The thin section of 23FBE-2A was studied using an optical microscope to perform mineral and textural identification. This revealed a more precise mineral makeup with large amounts of pyroxene and garnet (Fig. 4). Opaque phases were determined to be rutile and colorless phases are quartz. After determining the major mineral composition to confirm the label of eclogite, the samples were crushed and powdered. All solid material needed to be digested, so the sample preparation for acid dissolution was as follows: crush each sample in a jaw crusher, then powder each one in a Shatterbox puck mill, cleaning with quartz sand between samples. Each of the five samples yielded between 10-50 grams of powder, which left plenty of extra powder to redo or run more tests. The asset of extra powdered sample was utilized to redo the dissolution and data collection, which is explained in

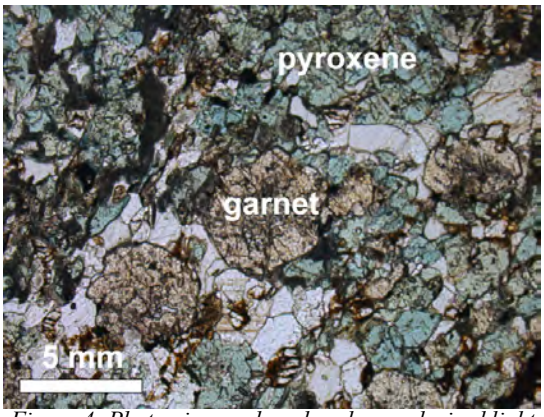


Figure 4: Photomicrograh under plane polarized light, showing sample 23FBE-2A.

the caption of table 1. Given the constraints of sample accessibility, the largest amount that could be collected was 10-50 grams per sample, although acknowledging that smaller amounts may not adequately represent the heterogeneity in the sample as well as a larger bulk rock sample size.

Following the powdering of the samples, ~100 mg of each was measured out and placed in Parr bombs (Table 1). Parr Teflon bombs were chosen for the digestion process because of their ability to handle high temperatures and acids, but also because of their sealing properties compared to other methods. The Teflon bombs are capable of being placed in metal casings that are airtight and at high pressures to confirm that no solution escapes under high temperatures when in the oven. Along with 100 milligrams of powder, 1 mL of 2M nitric acid (HNO_3) and 4 mL of 2M hydrofluoric acid (HF) were added to each Teflon bomb. In addition to the two samples, one replicate, two reference standards (BHVO-2 and BCR-2), and a blank were weighed and prepared in a similar fashion to the samples (Table 1).

Sample Number:	**1:** 23FBE-1C (eclogite) 65° 2’ 9.6” -147° 39’ 31.9”	**2:** 23FBE-1C (eclogite) 65° 2’ 9.6” -147° 39’ 31.9”	**3:** 23FBE-2A (eclogite) 65° 16’ 1.2” -146° 43’ 29.1”	**5: Standard** BCR-2	**6: Standard** BHV0-2	**7: Blank**
Mass of Powder in Bomb:	104.48 mg	103.02 mg	97.19 mg	99.90 mg	98.04 mg	0 mg

Sample Number:	**8:** 23FBE-1C (eclogite) 65° 2’ 9.6” -147° 39’ 31.9”	**9:** 23FBE-2A (eclogite) 65° 16’ 1.2” -146° 43’ 29.1”	**10:** 6B1DB (gabbro) 64° 58’ 42.1” -143° 2’ 23.8”	**11:** 75AFr0052A (basalt) 64° 44' 51.0" -145° 49' 23.0"	**12:** 75AFr0050C (gabbro) 64° 44' 47.4" -145° 49' 23.0"	**13: Standard** BCR-2
Mass of Powder in Bomb:	99.72 mg	100.35 mg	100.15 mg	99.61 mg	99.05 mg	101.63 mg

Table 1: Tables of samples undergoing trace element analysis, including two tested samples, two standards, and one blank. Mass of powder in bomb refers to the initial weight of powder placed in the Teflon bomb with 1mL of nitric acid and 4 mL of hydrofluoric acid. Coordinates plotted in appendix 4.

The Teflon bombs were then placed in metal casings and heated in a furnace at 160 °C for six/seven days*. During the first round of digestion, minerals in the rock were dissolved in hydrofluoric acid. There is a need for all leftover insoluble residue to be dissolved to run the solution testing, so all samples were removed from the Teflon bombs and moved to beakers, at which they were placed on a hotplate set to 150 °C. Once all acid was evaporated (~6 hours), approximately 3 mL of nitric acid (HNO_3) was put into each beaker. During the second round of testing, this was swapped for perchloric acid ($HClO_4$) because of concern of leftover residue in the initial round of digestion and testing. The lids were screwed on with 4 layers of Teflon tape

around the threads to avoid escaping moisture and placed back on the hotplate at 170 °C. The acid dissolving process is repeated with hydrochloric acid (HCl) and nitric acid (HNO_3) until there is no residue left, leaving only an acid solution-containing sample ready for analysis. Dilution factors varied significantly between the two rounds of testing, and this is discussed further in appendix 2.

Due to the timeline and purposes of the research, the two eclogite samples were first analyzed to demonstrate feasibility. Additionally, a total of only six Teflon bombs were accessible at a time thus the breakage of data collection into two rounds. During the acid digestion of the two eclogite and two standard samples, there appeared to be a small amount of precipitate left behind. The residue left behind was mostly digested after multiple rounds of acid but due to time constraints there was a very small amount of residue at the time of dilution. Because of the complications with sample preparation, it was determined that the two eclogite samples and standards would be repeated entirely at the time of the potential protolith analysis. This also allowed for a test of uncertainty to determine how factors such as small amounts of solids can impact the concentration values.

*The first round of digesting eclogite samples was heated for six days. This was increased to seven days the second time due to thinking that the precipitate might have been a result of not enough heating time in the airtight casings.

V. PRESENTATION OF DATA, AND ANALYSIS OF UNCERTAINTY

Because the five samples are being compared to equivalent samples in the Yukon region, this procedure is being fingerprinted from the tests conducted in Yukon-Tanana Upland (Dusel-Bacon et al., 2006). Multiple relevant studies (Creaser et al., 1999 and Dusel-Bacon et al., 2006) were used as a valuable point of reference when conducting and interpreting this data. A basis was created using reference materials from a variety of tectonic settings (Fig. 5). The diagram referenced throughout the analysis process as a representative pattern to compare to tested data. This was crucial for two reasons: Alaskan samples were compared to average compositions as labeled in Fig. 5 as well as to the preexisting Yukon geochemistry outlined in past research. Comparing the results to the tectonic settings noted in the representative patterns on Fig. 5 allowed for prediction of the protolith type for the metamorphic samples. Rare earth and high field strength fluid immobile trace elements were decided as the source of data because changes to initial composition can be a consequence of metamorphic processes. By using fluid immobile elements, the change of initial compositions of the protolith basalt will not cause any issues with the comparisons, meaning that they ideally stay consistent regardless of metamorphic processes. High field strength elements (including rare earth elements) are

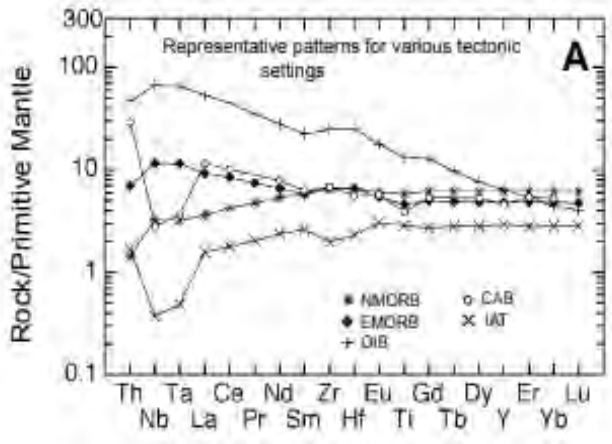


Fig. 5: Diagram created to demonstrate a representative pattern for different tectonic settings including NMORB (normal mid-ocean ridge basalts, EMORB (enriched mid-ocean ridge basalts), OIB (ocean island basalts), CAB (continental arc basalts), and IAB (island arc basalts) (Dusel-Bacon et al., 2006).

resistant to metamorphism and alteration relative to other element groups (John et al., 2010). Comparing the ICP-MS data to the existing data from the Yukon region allowed for interpretation of similarities in tectonic setting, thus answering the research question of whether the Yukon and Alaskan exhibit similar trace element signatures and comparison of potential protoliths with the eclogite samples.

A total of five samples and two standards were tested using ICP-MS iCAP Q. The instrument is housed at Carnegie Institution for Science in Washington, DC and was generously loaned out for use. The staff assisted with calibration curves of each element of interest to ensure that the instrument is detecting accurate intensities. Regarding the instrument performance, a tray of small solution cups houses the sample solution along with a collection of standards and wash (nitric acid). There is also a hose running an internal standard of indium, causing elevated indium intensities in detection. The instrument has a small arm with a straw-like tip that dips into one cup at a time. The solution is pumped into the instrument and introduced to the ICP torch, causing ionization. It them moves to the cone-shaped ion lenses, followed by the separation and detection of elements. Data is outputted as intensity in counts per second but is automatically converted to concentration in parts per million.

The first round of data appeared to be reliable and fell within a standard deviation of less than seven percent. A few values were removed from this calculation because they were outliers in the data set. This is explained further in attached excel files and in discussion. Reliability was determined by comparing raw data to expected concentration ranges of basaltic rocks. The raw data were translated from solution values to bulk rock values by dividing the original powder mass by the dilution factor:

$$\frac{original\ mass\ (\sim 100\ mg)}{1} * \frac{HCl\ taken\ after\ digestion\ (\sim 1\ mL)}{total\ HCl\ (\sim 4\ mL)} * \frac{1}{total\ dilution\ using\ HNO_3\ (\sim 50\ mL)} * \frac{amt.\ of\ sample\ added\ to\ instrument\ tray\ (\sim 0.185\ mL)}{HNO_3\ added\ to\ instrument\ tray\ (\sim 1.635\ mL)}$$

Please see A-2 for more information on concentration calculations.

Uncertainties in the first round of testing (i.e. testing that did not include the suspected protoliths) were found using calculations of standard deviation between rounds of testing. Each solution in the instrument tray of the iCAP Q was tested twice and the variance of the two values was calculated for each element of interest. All values yielded relative standard deviations of less than seven percent. All graphs from past research showing trace element concentrations (Creaser *et al*., 1999; Dusel-Bacon *et al*., 2002, 2006; Petrie *et al*., 2015) were organized in a spreadsheet and diagrams were made with trace elements on the x-axis and ratio of rock and primitive mantle on the y-axis. To determine whether the tested Alaskan samples had comparable trace element signatures to those of the Yukon rocks, diagrams were compared, and concentrations of the elements were analyzed. General trends and similar values were used to make initial inferences on relationships to potential protoliths. Additionally, calibration curves are included in the iCap Q raw data, and these curves include error bars for reference (please see appendix 1 for all calibration curves).

Two reference standards were used alongside the samples to confirm that the instrument function and digestion process was producing reasonable outcomes. The concentrations of the two standards were calculated and compared to GeoRem reference values (Fig. 6; Fig. 7). All of the tested values fell slightly below the reference values, but all element concentrations fell

within the standard deviation of 7% except for some outlier values. Despite those outliers, the tested values align with the GeoRem values. One prediction for the tested values falling slightly below the references is that small amounts of residue left in the Teflon bomb after digestion contributed to a lower concentration of all elements. For this reason, the testing process was repeating for BCR-2 in the second round of testing. As shown in figure 6, the tested values are still slightly depleted but elements such as zircon, yttrium, and lutetium yielded concentrations that are closer to the reference values.

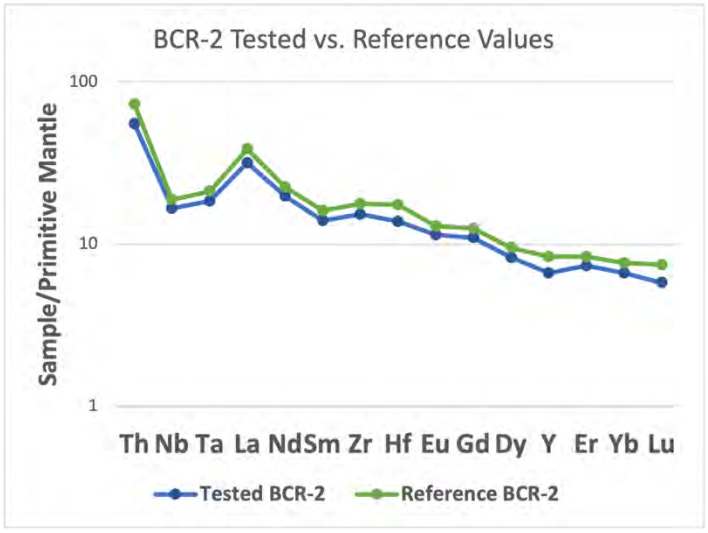
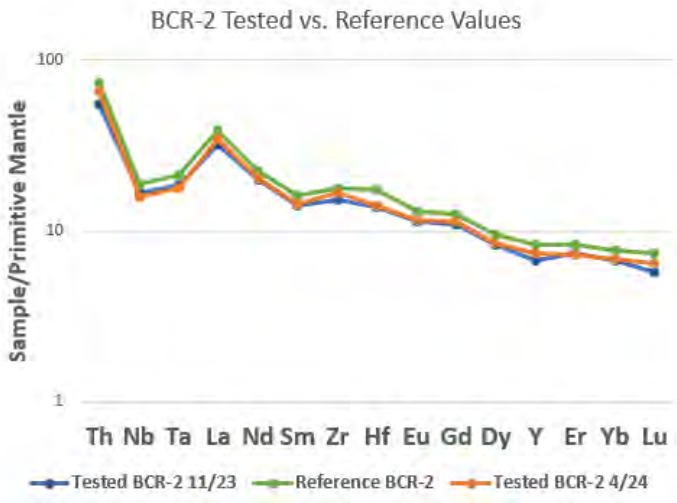


Fig. 6: Graph showing GeoRem (accepted reference values) high field strength fluid-immobile trace element data (see A-4 for values) in green, compared with the ICP-MS iCap Q raw data. The tested values all fall slightly below the references. The exact reason is unclear, but one prediction is that the very small amounts of residue left in the Teflon bomb at time of dilution might have contributed to this slight overall decrease in concentration.



BCR-2 was used as the standard for the second round of ICP-MS iCap Q analyses. The reference values compared with the two tested values are shown on the left. All values align closely with the reference, and the second round of testing shows improved values (meaning closer to the reference) for zircon, yttrium, and lutetium).

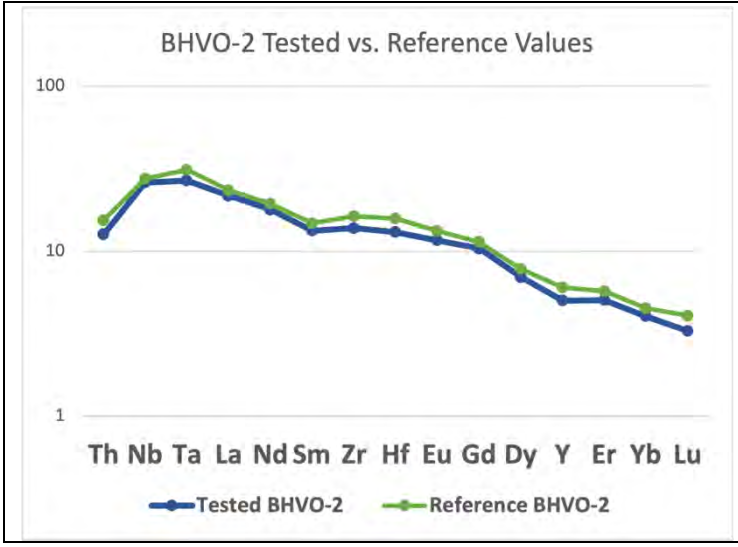


Figure 7: Graph constructed using reference BHVO-2 values from GeoRem values (see A-4). Constructed the same way as Figure 9, the reference values are shown in green, and the analysis output is shown in navy blue. The two concentration lines have similar trends of tested being slightly lower than reference. This suggests that all the iCap Q data from this round of analysis is likely a little low. However, the curves line up well and overall, the uncertainly remains relatively low. BCR-2 was digested a second time and run with the second round of samples, but BHVO-2 was not due to limitations of Teflon bombs. As mentioned previously, there were only six available for use at a time so it was not within the limitations of this research to include both standards in the second round of testing.

VI. DISCUSSION OF RESULTS

Testing of the two eclogite samples (23FBE-1C and 23FBE-2A) yielded results which align quite closely with assemblages labeled as being ocean island basalt settings. Additional existing data that was used to form the conclusion that the analyzed proposed protoliths are not ocean island basalts but rather mid-ocean ridge basalts. Other previously tested samples are compared from Dusel-Bacon *et al.* (1998, 2002, 2006) and Creaser *et al.* (1999), all of which reference a set of standard systematics for ocean basalts developed by Sun and McDonough (1989), shown in figure five The set of standard systematics was normalized using "a literary survey and internal consistency of elemental ratios" and has since been widely used in oceanic basalt trace element data collection. The wide use and proven efficacy of the standards allows for reliable comparisons of the samples of interest, the two eclogites and three potential protoliths.

The existing trace element concentrations for eclogites and other metamorphosed rocks were referenced to identify the presence (or lack) of similarities in concentration by varying location along the fault (Fig. 8). Elevated concentrations of elements on the left side of the graph such as thorium, niobium, tantalum, and lanthanum are all characteristic of ocean island basalts, and this is present in the testing of the two eclogite samples (Fig. 9). When trendlines of the two eclogite concentrations are compared with the previously collected data of the Yukon region and northern Alaskan Range the two lines overlap, supporting the thought that the two eclogite samples are from an ocean island basalt system. Figure 9 is a graph of the first semester data from the iCAP Q analysis. These values are post-normalization and can be directly compared to each other and to the previously studied samples. Both samples exhibit extremely similar concentration patterns suggesting that these rocks came from an extremely similar protolith, which in this case is predicted to be an ocean island basalt.

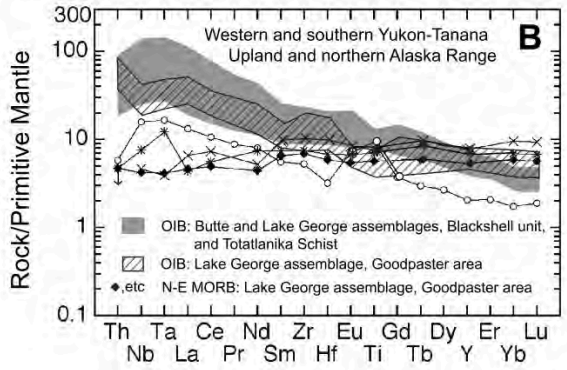


Figure 8: The graph displays the appropriate ranges of values per trace element datum of the Western and southern Yukon-Tanana Upland (modernly referred to as the Yukon region) and northern Alaska Range (Dusel-Bacon et al., 2006).

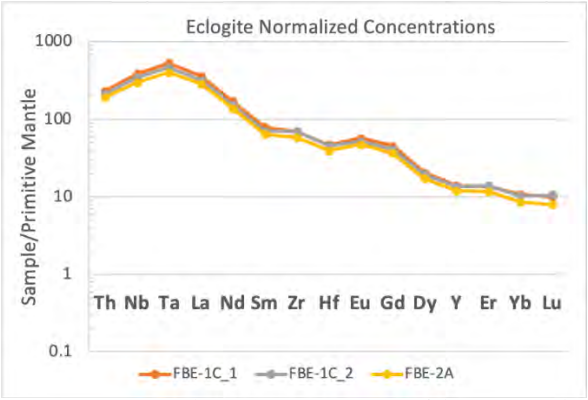


Figure 9: Trace element concentrations of the two tested eclogite samples. 23FBE-1C filled two spots in the instrument tray and was digested in two Teflon bombs and beakers because there were four bombs available and testing 23FBE-1C twice would allow for all spots to be filled. Duplicating the entire process also provided information on variability in the digestion process. The values are nearly identical, meaning low variability.

The eclogites exhibited overall elevated concentrations in all geochemical data relative to ranged established in the Western and southern Yukon-Tanana Upland as plotted in figure 8. This remained true in the retests of FBE-1C and FBE-2A, thus it is believed that the elevated numbers are accurate. Elevated trace element content can be found in some other eclogites from around the world and the general trendline aligns very closely with that of an ocean island basalt, therefore the elevated concentrations do not negate the validity.

Normalized concentrations of the Chatanika eclogites plot slightly higher than the range shaded on the Dusel-Bacon reference graph (Fig. 8; Fig.9). Part of the reasoning for reanalyzing the two eclogite samples was to better understand if the elevated concentrations were correct or an error in the digestion and/or testing process. Results presented an interesting issue: the redo concentration curves have significantly lowered values for some high field strength elements such as tantalum (Fig. 10). Because the rest of the values align quite closely with the previous test's results, it was determined that this is not a result of an instrumentation error but rather an anomalous low value caused by an issue in digestion or some other sample preparation error. Therefore, those values were ignored. The re-test still had value in determining that the initial values are reliable despite the increase in concentration relative to reference values as shown in figure 8.

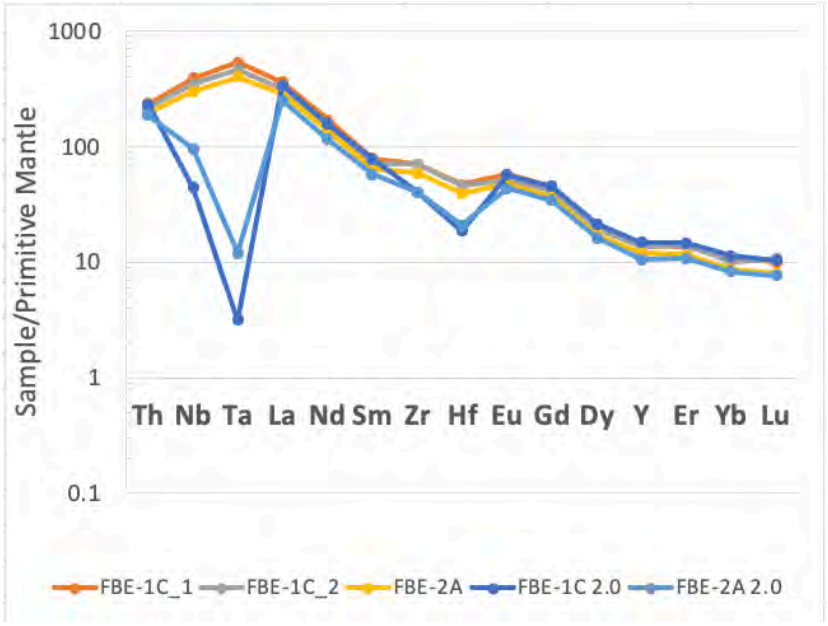


Figure 10: The re-tested values are displayed with the original iCap Q data. The newer tests had anomalous lowered values of some high field strengths. Besides the anonymous values, the rest of the concentrations line up with original data, suggesting that the concentrations are truly higher in concentration than the reference figure shows.

The graph below features data from Creaser *et al.,* (1999) and exhibits trends that align more to those of a MORB (Fig. 11). The tested eclogites in this research do not exhibit similarities in trendline to any geochemical data of previous studies in the region (Figure 5). However, the trendlines do align very closely with the reference phase of OIB as given in Dusel-Bacon, *et al.*, 2006. Given the eclogites are likely a result of an ocean island basalt environment, the protolith of the two tested eclogites are intra-plate basalts. A very simplified representation of ocean island and mid-ocean ridge environments is illustrated below (Fig. 12). This is not surprising for a subduction zone environment such as the Tintina fault, as primary component of OIB environments is recycled basaltic oceanic crust from subduction zones (Weaver, 1990).

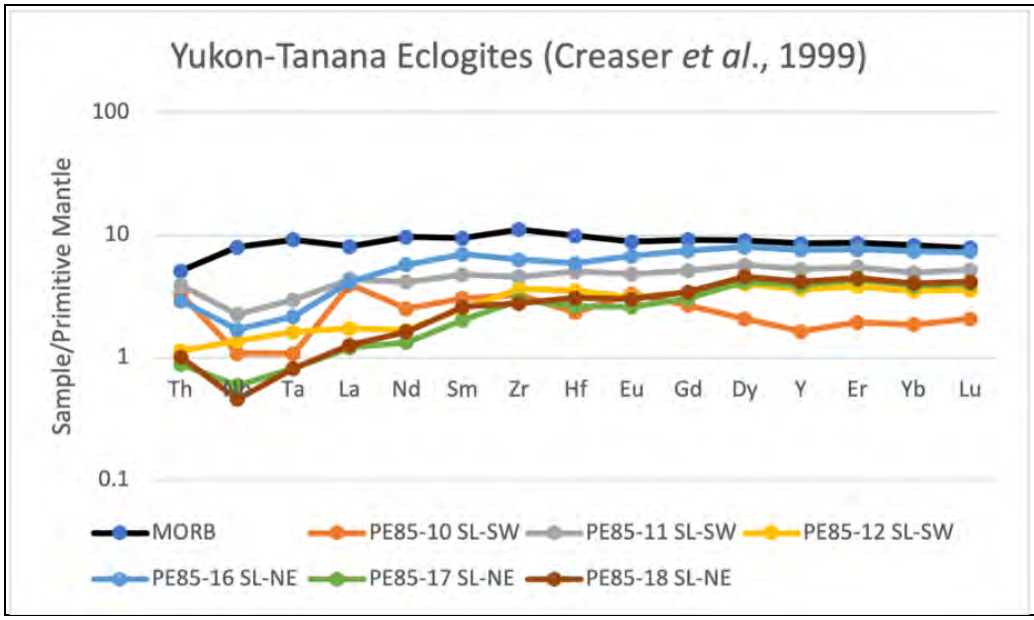


Figure 11: Trace element concentrations of eclogites collected from the Yukon region. These were identified as MORB-environment rocks by Creaser et al., 1999).

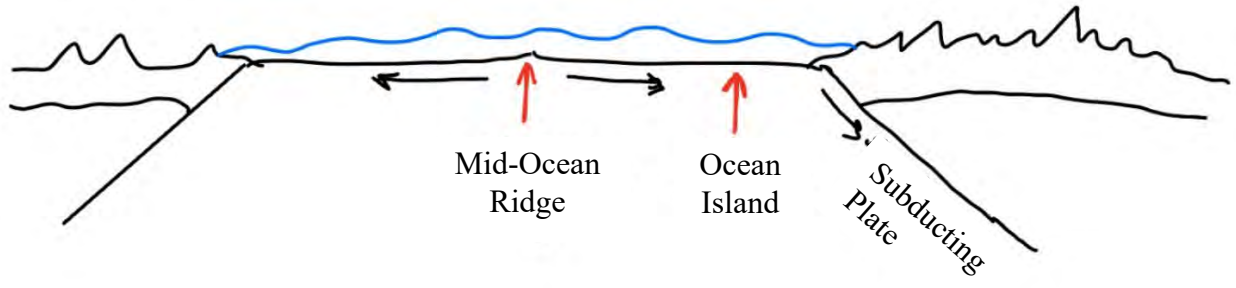
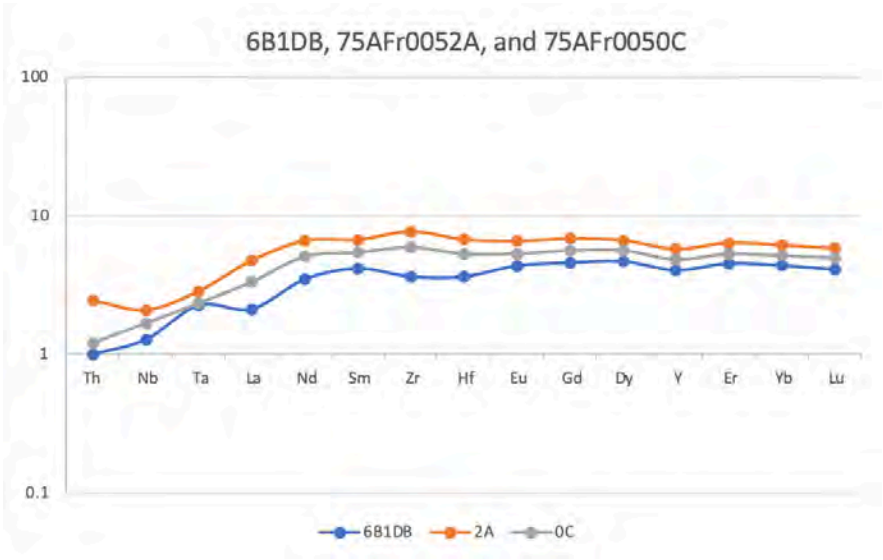


Figure 12: A very oversimplified illustration of mid-ocean ridge and ocean island environments in aa subduction environment. Please note that ocean island is labeled as an intraplate environment.

Addressing the overall hypothesis that trace element signatures exhibit the same patterns across various locations cannot be true because of the presence of two protolith tectonic settings. The collected eclogites come from the Yukon region, labeled on Fig. 2. The previously reported eclogite compositions of this region are drastically different than those of 23FBE-1C and 23FBE-2A and are labeled as mid-ocean ridge basalts. Therefore, it is predicted that the tested samples and Yukon samples being compared have a *different* protolith basalt. This rejects the null hypothesis that trace element signatures of mafic Chatanika Eclogites and potential protoliths fall within the range of previously analyzed Yukon eclogites.

Analyses of the potential protolith rocks revealed vastly different trace element concentrations than those present in the eclogites (Fig. 13). They exhibit traits more commonly seen in MORBs, specifically NMORBs. Contrary to the tested eclogites and ocean island basalts, the "protoliths" have the opposite traits: lowered concentrations on the left portion of the graph, and an overall more level trend. When referenced to figure 5, these rocks align closely with the levels seen in NMORBs, thus that classification for these unmetamorphosed. However, that also means that the hypothesis that these rocks are protoliths to the eclogites is to be refuted. These rocks are *not* the parent rock and exhibit vastly different trace element data.

Figure 13: Trace element concentrations of the three proposed protolith rocks. Please note that shorthand was used in the legend for readability, full sample numbers are listed in the title.



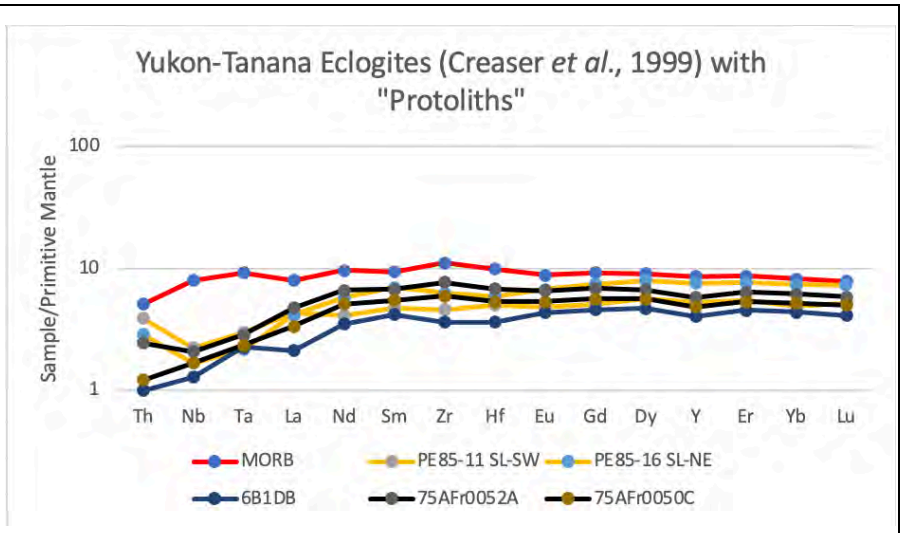


Figure 14: Potential protolith rocks shown with trace element data of previously tested eclogites. MORB reference value is shown in red, two significant eclogite samples are in yellow, and the three tested rocks are in black.

When overlayed with samples used in Creaser's work (1999), these "protolith rocks" align quite closely (Fig. 14). Characteristics such as the depleted concentrations of Th, Nb, and Ta are all present in all shown analyses. Therefore, the following conclusion can be: although the null hypothesis had been refuted and still is false, it can be said that the suspected protoliths *are* protoliths of the Yukon region eclogites despite not being protoliths of samples 23FBE-1C and 23FBE-2A.

VII. SUGGESTIONS FOR FUTURE WORK

A major hindrance in the data collection of this project was the lack of accessibility to samples. Traveling to Alaska to collect samples was *not* within the budget or scope of this project and thus a total of two eclogites and three potential protoliths were able to be obtained. This is a relatively small sample size relative to other comparable research such as trace element signatures of the MORB samples in the Yukon region. A continuation of this research question and hypothesis should occur with a larger sample size and broader area of collection sites around the fault. Allowing for such provides a more reasonable data set where more definite conclusions can be drawn. The comparable research referenced in this project had sample sizes of anywhere between eight to thirty-five, so a similar sample size would be necessary to answer the research questions of this project as well.

VIII. CONCLUSION AND BROADER IMPLICATIONS

The Tintina Fault is a tectonically complex ancient fault whose history remains somewhat unknown. Limited geochemical and petrological research presents challenges in deducing the tectonic past of the region, and the western portion of the fault is especially lacking. Further analysis of rocks in the Chatanika region has provided insight on the protolith tectonic settings. It has been determined that Chatanika eclogites exhibit trace element compositions of OIB protoliths. Unmetamorphosed gabbro and basalts were then analyzed as potential protoliths. ICP-MS testing revealed that they are not protoliths of the Chatanika eclogites. However, they exhibit extremely similar characteristics to those of previously tested eclogites in the Yukon region (Creaser et al., 1999). Continuing research of the geology of Tintina Fault provides an outlook

into our tectonic past. Comprehensive geochemical data allows for more thorough reconstruction of the fault system (as simply demonstrated in figure 12). Furthermore, the analyses can be applied to more modern fault systems to better understand the movement and metamorphic products of similar fault environments. In the scope of this research, trace element composition of five samples from the Tintina fault was determined through ICP-MS. Along with existing trace element data of other areas of the fault, compositions were compared to predict protolith tectonic environment. Results show that the Chatanika eclogite samples exhibit traits of and ocean island basalt protolith, while suspected protolith rocks exhibit concentrations better aligned with mid-ocean ridge basalts. In addition, previously tested eclogites from further east along the fault are also identified as MORB and align very closely with the tested proposed protolith. Therefore, it can be determined that between the location of the Chatanika region and the collection sites of the protoliths slightly further east, there is a change in tectonic setting from ocean island basalt to mid-ocean ridge basalt. This finding rejects the null hypothesis that trace element compositions fall within the range of previously tested rocks. The tested eclogites do not fall within this range. However, the hypothesis has been built off of by the tested protolith rocks, as they align in trace element composition to previously tested eclogites.

IX. ACKNOWLEDGEMENTS

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Bibliography

Coleman, R. G., et al. “Eclogites and Eclogites: Their Differences and Similarities.” *Geological Society of America Bulletin*, vol. 76, no. 5, 1965, p. 483, https://doi.org/10.1130/0016-7606(1965)76[483:eaetda]2.0.co;2.

Creaser, Robert A., et al. “Geochemical and Nd Isotopic Constraints for the Origin of Eclogite Protoliths, Northern Cordillera: Implications for the Paleozoic Tectonic Evolution of the Yukon-Tanana Terrane.” *Canadian Journal of Earth Sciences*, vol. 36, no. 10, Oct. 1999, pp. 1697–709, https://doi.org/10.1139/e99-070.

Douglas, Thomas A., et al. “Geochronologic and Thermobarometric Constraints on the Metamorphic History of the Fairbanks Mining District, Western Yukon-Tanana Terrane, Alaska.” *Canadian Journal of Earth Sciences*, vol. 39, no. 7, July 2002, pp. 1107–26, https://doi.org/10.1139/e02-024.

Dusel-Bacon, Cynthia, et al. “Mesozoic Thermal History and Timing of Structural Events for the Yukon-Tanana Upland, East-Central Alaska: 40Ar/39Ar Data from Metamorphic and Plutonic Rocks.” *Canadian Journal of Earth Sciences*, vol. 39, no. 6, June 2002, pp. 1013–51, https://doi.org/10.1139/e02-018.

Dusel-Bacon, C., Hopkins, M. J., Mortensen, J. K., Dashevsky, S. S., Bressler, J. R., & Day, W. C. (2006). Paleozoic tectonic and metallogenic evolution of the pericratonic rocks of east-central Alaska and adjacent Yukon 1.

Erdmer, Philippe, et al. “Paleozoic and Mesozoic High-Pressure Metamorphism at the Margin of Ancestral North America in Central Yukon.” *Geological Society of America Bulletin*, vol. 110, no. 5, May 1998, pp. 615–29, https://doi.org/10.1130/0016-7606(1998)110<0615:pamhpm>2.3.co;2.

Erdmer, P., & Helmstaedt, H. (1983). Eclogite from central Yukon: a record of subduction at the western margin of ancient North America. *Canadian Journal of Earth Sciences*(Vol. 20).

Geology of Alaska Map Viewer, alaska.usgs.gov/science/geology/state_map/interactive_map/AKgeologic_map.html. Accessed 22 Apr. 2024.

“Geologic Map of Alaska, Alaska Resource Data File.” *Geology of Alaska Map Viewer*, USGS, alaska.usgs.gov/science/geology/state_map/interactive_map/AKgeologic_map.html. Accessed 1 Dec. 2023.

Hansen, V. L. (1992). Backflow and margin-parallel shear within an ancient subduction complex. Geology, 20(1), 71–74. https://doi.org/10.1130/0091-7613(1992)020

Hansen, V. L., & Dusel-Bacon, C. (1998). Structural and kinematic evolution of the Yukon-Tanana upland tectonites, east-central Alaska: A record of late Paleozoic to Mesozoic crustal assembly. https://doi.org/10.1130/0016-7606(1998)110<0211:SAKEOT>2.3.CO;2

Hansen, Vicki L. "Yukon-Tanana Terrane: A Partial Acquittal." *Geology*, vol. 18, no. 4, Apr. 1990, pp. 365–69, https://doi.org/10.1130/0091-7613(1990)018<0365:YTTAPA>2.3.CO;2.

John, Timm, et al. "Subducted Seamounts in an Eclogite-Facies Ophiolite Sequence: The Andean Raspas Complex, SW Ecuador." *Contributions to Mineralogy and Petrology*, vol. 159, no. 2, July 2009, pp. 265–84, https://doi.org/10.1007/s00410-009-0427-0.

National Park Service (2018). *Geology on the Yukon River*, https://www.nps.gov/yuch/learn/nature/geology-on-the-yukon-river.html. Accessed 30 Nov. 2023.

Nelson, J. L., Colpron, M., & Israel, S. (2013). The Cordillera of British Columbia, Yukon, and Alaska: Tectonics and Metallogeny. In Special Publication (Vol. 17), p. 755-792

Petrie, Meredith Blair, et al. "Geologic Setting of Eclogite-Facies Assemblages in the St. Cyr Klippe, Yukon–Tanana Terrane, Yukon, Canada." *Geoscience Canada*, vol. 42, no. 3, July 2015, p. 327, https://doi.org/10.12789/geocanj.2015.42.073.

Petrie, Meredith B., et al. "The P–T Path of Eclogites in the St. Cyr Klippe, Yukon, Canada: Permian Metamorphism of a Coherent High-Pressure Unit in an Accreted Terrane of the North American Cordillera." *European Journal of Mineralogy*, vol. 28, no. 6, Mar. 2016, pp. 1111–30, https://doi.org/10.1127/ejm/2016/0028-2576.

Sun, S. and W. F. McDonough. "Chemical and Isotopic Systematics of Oceanic Basalts: Implications for Mantle Composition and Processes." *Geological Society, London, Special Publications*, vol. 42, no. 1, Jan. 1989, pp. 313–45, https://doi.org/10.1144/gsl.sp.1989.042.01.19.

Weaver, B.L. Geochemistry of highly-undersaturated ocean island basalt suites from the South Atlantic Ocean: Fernando de Noronha and Trindade islands. *Contr. Mineral. and Petrol.* 105, 502–515 (1990). https://doi.org/10.1007/BF00302491

A-1. ICP-MS iCAP Q Raw Output

SEMESTER ONE DATA

Concentrations

11/17/2023 3:11:17 PM

QTEGRA

Instrument Name	Serial Number
iCAP Q	Undefined

LabBook	LabBook Path
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Concentration average 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	100.000 %
Concentration per Run 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	100.000 %
Concentration RSD 1	0.0 %	16.7 %	0.2 %	0.5 %	0.1 %	0.7 %	1.0 %	0.3 %	0.4 %	0.0 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration per Run 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration RSD 1	0.3 %	1.0 %	0.5 %	1.0 %	N/A	0.5 %	3.2 %		3.2 %	2.1 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	100.000 %	0.000 ppb
Concentration per Run 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	100.000 %	0.000 ppb
Concentration RSD 1	1.2 %	2.1 %	2.1 %	3.2 %	2.1 %		1.1 %	0.4 %	0.0 %	0.7 %

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Concentration average 1	29.358 ppb	37.563 ppb	4.635 ppb	0.267 ppb	0.043 ppb	0.194 ppb	0.016 ppb	0.125 ppb	0.008 ppb	101.160 %
Concentration per Run 1	31.054 ppb	38.401 ppb	4.527 ppb	0.277 ppb	0.046 ppb	0.215 ppb	0.017 ppb	0.115 ppb	0.006 ppb	101.773 %
Concentration per Run 2	28.069 ppb	37.144 ppb	4.578 ppb	0.256 ppb	0.038 ppb	0.163 ppb	0.015 ppb	0.128 ppb	0.008 ppb	101.458 %
Concentration per Run 3	28.951 ppb	37.144 ppb	4.798 ppb	0.267 ppb	0.046 ppb	0.206 ppb	0.017 ppb	0.133 ppb	0.009 ppb	100.248 %
Concentration RSD 1	5.2 %	1.9 %	3.1 %	4.0 %	9.9 %	14.4 %	7.5 %	7.4 %	16.0 %	0.8 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	0.297 ppb	0.018 ppb	0.018 ppb	0.019 ppb	N/A	0.019 ppb	0.020 ppb	0.021 ppb	0.019 ppb	0.019 ppb
Concentration per Run 1	0.296 ppb	0.019 ppb	0.019 ppb	0.020 ppb	N/A	0.021 ppb	0.020 ppb	0.021 ppb	0.018 ppb	0.018 ppb
Concentration per Run 2	0.311 ppb	0.018 ppb	0.018 ppb	0.017 ppb	N/A	0.020 ppb	0.020 ppb	0.022 ppb	0.020 ppb	0.020 ppb
Concentration per Run 3	0.284 ppb	0.018 ppb	0.018 ppb	0.019 ppb	N/A	0.018 ppb	0.019 ppb	0.020 ppb	0.019 ppb	0.019 ppb
Concentration RSD 1	4.5 %	5.3 %	3.3 %	6.5 %	N/A	7.6 %	3.0 %	4.8 %	5.8 %	3.5 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.019 ppb	0.018 ppb	0.018 ppb	0.019 ppb	0.020 ppb	0.019 ppb	0.008 ppb	0.006 ppb	99.910 %	0.015 ppb
Concentration per Run 1	0.019 ppb	0.018 ppb	0.018 ppb	0.019 ppb	0.019 ppb	0.019 ppb	0.007 ppb	0.006 ppb	101.312 %	0.014 ppb
Concentration per Run 2	0.019 ppb	0.018 ppb	0.019 ppb	0.018 ppb	0.020 ppb	0.020 ppb	0.007 ppb	0.006 ppb	97.381 %	0.015 ppb
Concentration per Run 3	0.018 ppb	0.017 ppb	0.018 ppb	0.020 ppb	0.020 ppb	0.018 ppb	0.009 ppb	0.006 ppb	101.038 %	0.016 ppb
Concentration RSD 1	3.5 %	4.1 %	2.9 %	3.4 %	3.4 %	4.5 %	12.3 %	4.0 %	2.2 %	6.5 %

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Concentration average 1	60.192 ppb	74.949 ppb	9.950 ppb	0.561 ppb	0.094 ppb	0.374 ppb	0.040 ppb	0.268 ppb	0.017 ppb	99.915 %
Concentration per Run 1	60.135 ppb	73.598 ppb	9.456 ppb	0.557 ppb	0.098 ppb	0.368 ppb	0.038 ppb	0.255 ppb	0.016 ppb	100.759 %
Concentration per Run 2	60.921 ppb	76.113 ppb	10.409 ppb	0.558 ppb	0.074 ppb	0.372 ppb	0.039 ppb	0.277 ppb	0.018 ppb	98.187 %
Concentration per Run 3	59.521 ppb	75.135 ppb	9.985 ppb	0.568 ppb	0.111 ppb	0.382 ppb	0.042 ppb	0.272 ppb	0.017 ppb	100.800 %
Concentration RSD 1	1.2 %	1.7 %	4.8 %	1.1 %	20.2 %	2.0 %	5.6 %	4.3 %	4.8 %	1.5 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	0.609 ppb	0.040 ppb	0.037 ppb	0.036 ppb	N/A	0.040 ppb	0.039 ppb	0.039 ppb	0.036 ppb	0.040 ppb
Concentration per Run 1	0.565 ppb	0.039 ppb	0.036 ppb	0.035 ppb	N/A	0.037 ppb	0.041 ppb	0.039 ppb	0.037 ppb	0.040 ppb
Concentration per Run 2	0.648 ppb	0.043 ppb	0.039 ppb	0.039 ppb	N/A	0.043 ppb	0.039 ppb	0.040 ppb	0.037 ppb	0.039 ppb
Concentration per Run 3	0.615 ppb	0.040 ppb	0.036 ppb	0.035 ppb	N/A	0.039 ppb	0.037 ppb	0.040 ppb	0.035 ppb	0.040 ppb
Concentration RSD 1	6.9 %	5.4 %	5.5 %	6.2 %	N/A	7.0 %	6.4 %	1.5 %	2.7 %	1.1 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.039 ppb	0.039 ppb	0.039 ppb	0.039 ppb	0.039 ppb	0.038 ppb	0.018 ppb	0.014 ppb	100.510 %	0.033 ppb
Concentration per Run 1	0.036 ppb	0.039 ppb	0.038 ppb	0.036 ppb	0.038 ppb	0.037 ppb	0.018 ppb	0.013 ppb	101.657 %	0.032 ppb
Concentration per Run 2	0.043 ppb	0.041 ppb	0.041 ppb	0.043 ppb	0.038 ppb	0.040 ppb	0.017 ppb	0.014 ppb	98.014 %	0.034 ppb
Concentration per Run 3	0.038 ppb	0.039 ppb	0.037 ppb	0.038 ppb	0.041 ppb	0.037 ppb	0.017 ppb	0.014 ppb	101.860 %	0.033 ppb
Concentration RSD 1	9.2 %	2.6 %	5.9 %	9.1 %	5.0 %	3.5 %	4.3 %	5.0 %	2.2 %	3.3 %

Analysis index: 4 Analysis started at: 11/17/2023 12:27:04 PM
Analysis label: Cal Std C User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	2,960.269 ppb	3,654.468 ppb	516.525 ppb	28.713 ppb	4.775 ppb	18.714 ppb	1.874 ppb	13.571 ppb	0.884 ppb	101.115 %
Concentration per Run 1	2,949.857 ppb	3,646.057 ppb	509.356 ppb	28.728 ppb	4.734 ppb	18.710 ppb	1.847 ppb	13.772 ppb	0.883 ppb	101.311 %
Concentration per Run 2	2,917.038 ppb	3,632.792 ppb	515.519 ppb	28.494 ppb	4.802 ppb	18.837 ppb	1.891 ppb	13.289 ppb	0.862 ppb	102.285 %
Concentration per Run 3	3,013.911 ppb	3,684.555 ppb	524.699 ppb	28.917 ppb	4.789 ppb	18.596 ppb	1.885 ppb	13.653 ppb	0.907 ppb	99.750 %
Concentration RSD 1	1.7 %	0.7 %	1.5 %	0.7 %	0.8 %	0.6 %	1.3 %	1.9 %	2.6 %	1.3 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	29.778 ppb	1.972 ppb	1.818 ppb	1.808 ppb	N/A	1.982 ppb	1.893 ppb	1.905 ppb	1.919 ppb	1.921 ppb
Concentration per Run 1	30.257 ppb	2.007 ppb	1.843 ppb	1.831 ppb	N/A	1.974 ppb	1.907 ppb	1.904 ppb	1.967 ppb	1.895 ppb
Concentration per Run 2	29.187 ppb	1.939 ppb	1.806 ppb	1.803 ppb	N/A	1.951 ppb	1.871 ppb	1.885 ppb	1.884 ppb	1.856 ppb
Concentration per Run 3	29.889 ppb	1.970 ppb	1.807 ppb	1.790 ppb	N/A	2.020 ppb	1.901 ppb	1.924 ppb	1.905 ppb	2.011 ppb
Concentration RSD 1	1.8 %	1.8 %	1.2 %	1.2 %	N/A	1.8 %	1.0 %	1.0 %	2.2 %	4.2 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	1.844 ppb	1.853 ppb	1.831 ppb	1.975 ppb	1.800 ppb	1.896 ppb	0.868 ppb	0.834 ppb	97.461 %	1.765 ppb
Concentration per Run 1	1.901 ppb	1.887 ppb	1.825 ppb	1.968 ppb	1.827 ppb	1.913 ppb	0.876 ppb	0.862 ppb	95.534 %	1.766 ppb
Concentration per Run 2	1.783 ppb	1.777 ppb	1.768 ppb	1.915 ppb	1.746 ppb	1.823 ppb	0.859 ppb	0.809 ppb	101.366 %	1.684 ppb
Concentration per Run 3	1.849 ppb	1.895 ppb	1.901 ppb	2.042 ppb	1.829 ppb	1.954 ppb	0.871 ppb	0.830 ppb	95.484 %	1.847 ppb
Concentration RSD 1	3.2 %	3.6 %	3.6 %	3.2 %	2.6 %	3.5 %	1.0 %	3.1 %	3.5 %	4.6 %

Analysis index: 5 Analysis started at: 11/17/2023 12:30:16 PM
Analysis label: Cal Std D User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	6,316.786 ppb	7,684.356 ppb	1,085.408 ppb	60.050 ppb	9.965 ppb	38.799 ppb	3.880 ppb	28.385 ppb	1.997 ppb	99.346 %
Concentration per Run 1	6,160.989 ppb	7,773.672 ppb	1,059.689 ppb	59.041 ppb	9.754 ppb	38.269 ppb	3.821 ppb	27.950 ppb	1.965 ppb	102.969 %
Concentration per Run 2	6,330.123 ppb	7,607.754 ppb	1,078.721 ppb	59.579 ppb	9.796 ppb	38.441 ppb	3.878 ppb	28.407 ppb	1.990 ppb	99.267 %
Concentration per Run 3	6,459.245 ppb	7,671.671 ppb	1,117.813 ppb	61.529 ppb	10.345 ppb	39.687 ppb	3.939 ppb	28.798 ppb	2.037 ppb	95.803 %
Concentration RSD 1	2.4 %	1.1 %	2.7 %	2.2 %	3.3 %	2.0 %	1.5 %	1.5 %	1.8 %	3.6 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	61.929 ppb	4.080 ppb	3.716 ppb	3.688 ppb	N/A	4.067 ppb	4.032 ppb	3.962 ppb	4.017 ppb	4.024 ppb
Concentration per Run 1	60.040 ppb	4.022 ppb	3.676 ppb	3.578 ppb	N/A	4.097 ppb	3.969 ppb	3.793 ppb	3.978 ppb	3.877 ppb
Concentration per Run 2	61.683 ppb	4.030 ppb	3.723 ppb	3.684 ppb	N/A	3.932 ppb	4.069 ppb	3.953 ppb	4.010 ppb	3.963 ppb
Concentration per Run 3	64.064 ppb	4.189 ppb	3.750 ppb	3.801 ppb	N/A	4.170 ppb	4.058 ppb	4.139 ppb	4.064 ppb	4.231 ppb
Concentration RSD 1	3.3 %	2.3 %	1.0 %	3.0 %	N/A	3.0 %	1.4 %	4.4 %	1.1 %	4.6 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	4.015 ppb	3.922 ppb	3.957 ppb	4.046 ppb	3.944 ppb	3.982 ppb	1.819 ppb	2.013 ppb	92.949 %	3.808 ppb
Concentration per Run 1	3.948 ppb	3.950 ppb	3.677 ppb	3.877 ppb	3.927 ppb	3.839 ppb	1.785 ppb	1.964 ppb	92.869 %	3.732 ppb
Concentration per Run 2	4.007 ppb	3.873 ppb	4.069 ppb	4.084 ppb	3.962 ppb	4.049 ppb	1.790 ppb	2.034 ppb	94.098 %	3.833 ppb
Concentration per Run 3	4.091 ppb	3.942 ppb	4.125 ppb	4.177 ppb	3.943 ppb	4.058 ppb	1.882 ppb	2.042 ppb	91.881 %	3.860 ppb
Concentration RSD 1	1.8 %	1.1 %	6.2 %	3.8 %	0.4 %	3.1 %	3.0 %	2.1 %	1.2 %	1.8 %

Analysis index: 6 Analysis started at: 11/17/2023 12:33:29 PM
Analysis label: Cal Std E User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	15,957.968 ppb	19,121.915 ppb	2,700.868 ppb	147.563 ppb	25.004 ppb	96.474 ppb	9.640 ppb	69.578 ppb	4.929 ppb	99.077 %
Concentration per Run 1	15,559.231 ppb	19,114.588 ppb	2,686.574 ppb	146.367 ppb	24.503 ppb	97.785 ppb	9.467 ppb	68.757 ppb	4.913 ppb	100.735 %
Concentration per Run 2	16,378.630 ppb	19,247.452 ppb	2,748.032 ppb	149.598 ppb	25.505 ppb	98.329 ppb	9.684 ppb	70.531 ppb	4.991 ppb	96.875 %
Concentration per Run 3	15,936.042 ppb	19,003.704 ppb	2,667.997 ppb	146.724 ppb	25.005 ppb	93.308 ppb	9.769 ppb	69.445 ppb	4.883 ppb	99.623 %
Concentration RSD 1	2.6 %	0.6 %	1.6 %	1.2 %	2.0 %	2.9 %	1.6 %	1.3 %	1.1 %	2.0 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	152.995 ppb	9.735 ppb	9.764 ppb	9.664 ppb	N/A	9.917 ppb	9.740 ppb	9.872 ppb	9.760 ppb	9.939 ppb
Concentration per Run 1	152.245 ppb	9.739 ppb	9.829 ppb	9.332 ppb	N/A	9.800 ppb	9.618 ppb	9.816 ppb	9.768 ppb	9.992 ppb
Concentration per Run 2	156.034 ppb	9.932 ppb	9.899 ppb	10.002 ppb	N/A	9.960 ppb	9.558 ppb	9.722 ppb	9.651 ppb	9.769 ppb
Concentration per Run 3	150.705 ppb	9.533 ppb	9.565 ppb	9.658 ppb	N/A	9.992 ppb	10.046 ppb	10.078 ppb	9.861 ppb	10.058 ppb
Concentration RSD 1	1.8 %	2.1 %	1.8 %	3.5 %	N/A	1.0 %	2.7 %	1.9 %	1.1 %	1.5 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	9.669 ppb	9.733 ppb	9.869 ppb	9.842 ppb	9.679 ppb	9.805 ppb	4.543 ppb	5.016 ppb	87.498 %	9.657 ppb
Concentration per Run 1	9.696 ppb	9.633 ppb	9.740 ppb	9.662 ppb	9.427 ppb	9.762 ppb	4.489 ppb	4.835 ppb	88.113 %	9.629 ppb
Concentration per Run 2	9.338 ppb	9.330 ppb	9.742 ppb	9.933 ppb	9.581 ppb	9.874 ppb	4.693 ppb	4.872 ppb	88.897 %	9.759 ppb
Concentration per Run 3	9.973 ppb	10.238 ppb	10.125 ppb	9.930 ppb	10.031 ppb	9.779 ppb	4.448 ppb	5.341 ppb	85.483 %	9.584 ppb
Concentration RSD 1	3.3 %	4.7 %	2.2 %	1.6 %	3.2 %	0.6 %	2.9 %	5.6 %	2.0 %	0.9 %

Analysis index: 7 Analysis started at: 11/17/2023 12:36:41 PM
Analysis label: Cal Std F User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	33,479.499 ppb	40,679.585 ppb	5,613.151 ppb	300.215 ppb	50.027 ppb	202.268 ppb	19.188 ppb	140.145 ppb	10.048 ppb	101.097 %
Concentration per Run 1	32,942.840 ppb	40,886.904 ppb	5,498.410 ppb	294.959 ppb	49.539 ppb	199.310 ppb	19.124 ppb	138.705 ppb	9.931 ppb	102.312 %
Concentration per Run 2	33,628.026 ppb	40,036.958 ppb	5,509.031 ppb	297.472 ppb	48.996 ppb	200.868 ppb	19.167 ppb	140.839 ppb	10.087 ppb	101.200 %
Concentration per Run 3	33,867.633 ppb	41,114.892 ppb	5,832.014 ppb	308.215 ppb	51.547 ppb	206.627 ppb	19.274 ppb	140.890 ppb	10.125 ppb	99.779 %
Concentration RSD 1	1.4 %	1.4 %	3.4 %	2.3 %	2.7 %	1.9 %	0.4 %	0.9 %	1.0 %	1.3 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	300.985 ppb	19.091 ppb	19.164 ppb	19.221 ppb	N/A	19.001 ppb	19.106 ppb	19.053 ppb	19.096 ppb	19.005 ppb
Concentration per Run 1	287.556 ppb	19.231 ppb	18.717 ppb	19.443 ppb	N/A	19.830 ppb	18.748 ppb	19.198 ppb	19.794 ppb	18.599 ppb
Concentration per Run 2	302.943 ppb	19.279 ppb	19.232 ppb	18.860 ppb	N/A	18.386 ppb	18.940 ppb	19.213 ppb	18.772 ppb	19.240 ppb
Concentration per Run 3	312.456 ppb	18.764 ppb	19.545 ppb	19.361 ppb	N/A	18.788 ppb	19.630 ppb	18.748 ppb	18.723 ppb	19.176 ppb
Concentration RSD 1	4.2 %	1.5 %	2.2 %	1.6 %	N/A	3.9 %	2.4 %	1.4 %	3.2 %	1.9 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	19.150 ppb	19.135 ppb	19.063 ppb	19.044 ppb	19.163 ppb	19.083 ppb	8.985 ppb	10.003 ppb	83.854 %	19.205 ppb
Concentration per Run 1	19.627 ppb	18.698 ppb	19.541 ppb	19.241 ppb	19.149 ppb	19.733 ppb	8.926 ppb	10.106 ppb	83.375 %	19.196 ppb
Concentration per Run 2	18.973 ppb	19.082 ppb	19.061 ppb	19.214 ppb	19.460 ppb	18.770 ppb	9.008 ppb	10.170 ppb	85.170 %	18.559 ppb
Concentration per Run 3	18.850 ppb	19.627 ppb	18.586 ppb	18.677 ppb	18.881 ppb	18.747 ppb	9.022 ppb	9.734 ppb	83.016 %	19.859 ppb
Concentration RSD 1	2.2 %	2.4 %	2.5 %	1.7 %	1.5 %	2.9 %	0.6 %	2.4 %	1.4 %	3.4 %

Analysis index: 8 Analysis started at: 11/17/2023 12:39:53 PM
Analysis label: Nitric Acid Wash User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	10.179 ppb	0.233 ppb	0.067 ppb	0.007 ppb	-0.005 ppb	0.002 ppb	0.000 ppb	0.004 ppb	0.001 ppb	106.977 %
Concentration per Run 1	10.952 ppb	0.140 ppb	0.082 ppb	0.009 ppb	-0.003 ppb	0.001 ppb	0.000 ppb	0.004 ppb	0.001 ppb	105.297 %
Concentration per Run 2	9.890 ppb	0.279 ppb	0.073 ppb	0.006 ppb	-0.007 ppb	0.004 ppb	0.000 ppb	0.003 ppb	0.001 ppb	108.212 %
Concentration per Run 3	9.695 ppb	0.279 ppb	0.048 ppb	0.008 ppb	-0.006 ppb	0.001 ppb	0.000 ppb	0.004 ppb	0.002 ppb	107.421 %
Concentration RSD 1	6.6 %	34.6 %	26.4 %	23.9 %	37.9 %	84.7 %	416.1 %	18.3 %	9.7 %	1.4 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	0.001 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration per Run 1	-0.002 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration per Run 2	0.001 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration per Run 3	0.005 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.001 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration RSD 1	299.0 %	156.6 %	58.7 %	20.3 %	N/A	52.8 %	207.4 %	41.5 %	94.1 %	19.7 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.002 ppb	104.194 %	0.002 ppb
Concentration per Run 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.002 ppb	101.236 %	0.002 ppb
Concentration per Run 2	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.002 ppb	104.878 %	0.002 ppb
Concentration per Run 3	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.002 ppb	106.470 %	0.002 ppb
Concentration RSD 1	68.7 %	29.5 %	74.0 %	31.8 %	219.0 %	33.1 %	20.0 %	6.8 %	2.6 %	11.7 %

Analysis index: 9 Analysis started at: 11/17/2023 12:43:00 PM
Analysis label: FBE-1C_1 User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	97.387 ppb	8,971.485 ppb	605.175 ppb	17.018 ppb	0.314 ppb	72.808 ppb	3.536 ppb	43.016 ppb	14.915 ppb	109.375 %
Concentration per Run 1	98.199 ppb	9,036.028 ppb	603.037 ppb	17.187 ppb	0.297 ppb	74.023 ppb	3.536 ppb	43.947 ppb	14.942 ppb	109.986 %
Concentration per Run 2	96.461 ppb	9,010.741 ppb	604.780 ppb	16.902 ppb	0.310 ppb	72.058 ppb	3.556 ppb	42.573 ppb	14.744 ppb	110.030 %
Concentration per Run 3	97.500 ppb	8,867.686 ppb	607.708 ppb	16.965 ppb	0.335 ppb	72.342 ppb	3.515 ppb	42.527 ppb	15.058 ppb	108.108 %
Concentration RSD 1	0.9 %	1.0 %	0.4 %	0.9 %	6.0 %	1.5 %	0.6 %	1.9 %	1.1 %	1.0 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	33.084 ppb	13.926 ppb	28.350 ppb	3.124 ppb	N/A	12.823 ppb	1.896 ppb	0.522 ppb	1.447 ppb	0.174 ppb
Concentration per Run 1	33.462 ppb	13.684 ppb	27.988 ppb	3.121 ppb	N/A	13.105 ppb	1.963 ppb	0.523 ppb	1.481 ppb	0.180 ppb
Concentration per Run 2	32.112 ppb	13.937 ppb	28.404 ppb	3.112 ppb	N/A	12.583 ppb	1.879 ppb	0.518 ppb	1.401 ppb	0.168 ppb
Concentration per Run 3	33.677 ppb	14.157 ppb	28.657 ppb	3.138 ppb	N/A	12.780 ppb	1.845 ppb	0.526 ppb	1.459 ppb	0.174 ppb
Concentration RSD 1	2.6 %	1.7 %	1.2 %	0.4 %	N/A	2.1 %	3.2 %	0.7 %	2.8 %	3.6 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.822 ppb	0.141 ppb	0.363 ppb	0.047 ppb	0.275 ppb	0.041 ppb	0.786 ppb	1.167 ppb	102.490 %	1.089 ppb
Concentration per Run 1	0.826 ppb	0.142 ppb	0.375 ppb	0.046 ppb	0.281 ppb	0.042 ppb	0.798 ppb	1.140 ppb	103.029 %	1.085 ppb
Concentration per Run 2	0.796 ppb	0.137 ppb	0.358 ppb	0.047 ppb	0.262 ppb	0.042 ppb	0.787 ppb	1.142 ppb	105.125 %	1.046 ppb
Concentration per Run 3	0.843 ppb	0.144 ppb	0.356 ppb	0.048 ppb	0.283 ppb	0.040 ppb	0.772 ppb	1.221 ppb	99.317 %	1.136 ppb
Concentration RSD 1	2.9 %	2.8 %	2.8 %	1.6 %	4.2 %	2.5 %	1.7 %	3.9 %	2.9 %	4.2 %

Analysis index: 10 Analysis started at: 11/17/2023 12:46:09 PM
Analysis label: FBE-1C_2 User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	90.974 ppb	8,451.668 ppb	519.822 ppb	15.360 ppb	0.279 ppb	68.706 ppb	3.258 ppb	40.689 ppb	12.425 ppb	112.008 %
Concentration per Run 1	90.833 ppb	8,392.343 ppb	523.499 ppb	15.438 ppb	0.274 ppb	68.356 ppb	3.312 ppb	41.863 ppb	12.795 ppb	110.407 %
Concentration per Run 2	91.568 ppb	8,351.507 ppb	515.161 ppb	15.224 ppb	0.278 ppb	69.261 ppb	3.271 ppb	40.326 ppb	12.222 ppb	111.784 %
Concentration per Run 3	90.519 ppb	8,611.154 ppb	520.807 ppb	15.419 ppb	0.287 ppb	68.502 ppb	3.190 ppb	39.878 ppb	12.258 ppb	113.832 %
Concentration RSD 1	0.6 %	1.7 %	0.8 %	0.8 %	2.4 %	0.7 %	1.9 %	2.6 %	2.6 %	1.5 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	29.923 ppb	11.485 ppb	23.876 ppb	2.587 ppb	N/A	10.699 ppb	1.586 ppb	0.444 ppb	1.237 ppb	0.154 ppb
Concentration per Run 1	30.916 ppb	11.547 ppb	24.211 ppb	2.609 ppb	N/A	10.844 ppb	1.606 ppb	0.454 ppb	1.255 ppb	0.159 ppb
Concentration per Run 2	29.206 ppb	11.309 ppb	23.505 ppb	2.619 ppb	N/A	10.762 ppb	1.567 ppb	0.444 ppb	1.246 ppb	0.153 ppb
Concentration per Run 3	29.646 ppb	11.598 ppb	23.911 ppb	2.533 ppb	N/A	10.489 ppb	1.584 ppb	0.435 ppb	1.209 ppb	0.149 ppb
Concentration RSD 1	3.0 %	1.3 %	1.5 %	1.8 %	N/A	1.7 %	1.2 %	2.0 %	2.0 %	3.4 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.733 ppb	0.130 ppb	0.345 ppb	0.042 ppb	0.249 ppb	0.039 ppb	0.717 ppb	0.963 ppb	102.766 %	0.965 ppb
Concentration per Run 1	0.749 ppb	0.128 ppb	0.356 ppb	0.041 ppb	0.245 ppb	0.038 ppb	0.712 ppb	0.977 ppb	102.865 %	0.971 ppb
Concentration per Run 2	0.743 ppb	0.131 ppb	0.341 ppb	0.043 ppb	0.248 ppb	0.039 ppb	0.718 ppb	0.954 ppb	102.931 %	0.959 ppb
Concentration per Run 3	0.708 ppb	0.132 ppb	0.338 ppb	0.042 ppb	0.254 ppb	0.039 ppb	0.722 ppb	0.959 ppb	102.501 %	0.966 ppb
Concentration RSD 1	3.0 %	1.6 %	2.8 %	2.8 %	1.9 %	2.3 %	0.6 %	1.3 %	0.2 %	0.7 %

Analysis index: 11 Analysis started at: 11/17/2023 12:49:19 PM
Analysis label: FBE-2A User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	25.075 ppb	9,489.322 ppb	554.313 ppb	15.242 ppb	0.057 ppb	110.657 ppb	2.919 ppb	35.720 ppb	11.218 ppb	108.283 %
Concentration per Run 1	24.374 ppb	9,564.297 ppb	524.273 ppb	14.731 ppb	0.057 ppb	107.710 ppb	2.809 ppb	34.846 ppb	10.786 ppb	112.435 %
Concentration per Run 2	24.529 ppb	9,650.425 ppb	544.449 ppb	14.875 ppb	0.052 ppb	106.585 ppb	2.828 ppb	33.785 ppb	11.116 ppb	111.158 %
Concentration per Run 3	26.323 ppb	9,253.243 ppb	594.218 ppb	16.120 ppb	0.060 ppb	117.677 ppb	3.119 ppb	38.528 ppb	11.751 ppb	101.257 %
Concentration RSD 1	4.3 %	2.2 %	6.5 %	5.0 %	7.5 %	5.5 %	5.9 %	7.0 %	4.4 %	5.7 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	6.765 ppb	10.727 ppb	22.432 ppb	2.407 ppb	N/A	9.812 ppb	1.506 ppb	0.415 ppb	1.132 ppb	0.144 ppb
Concentration per Run 1	6.743 ppb	10.503 ppb	21.760 ppb	2.365 ppb	N/A	9.640 ppb	1.495 ppb	0.409 ppb	1.101 ppb	0.143 ppb
Concentration per Run 2	6.601 ppb	10.286 ppb	22.144 ppb	2.279 ppb	N/A	9.524 ppb	1.396 ppb	0.410 ppb	1.071 ppb	0.139 ppb
Concentration per Run 3	6.952 ppb	11.392 ppb	23.391 ppb	2.578 ppb	N/A	10.272 ppb	1.627 ppb	0.427 ppb	1.225 ppb	0.151 ppb
Concentration RSD 1	2.6 %	5.5 %	3.8 %	6.4 %	N/A	4.1 %	7.7 %	2.5 %	7.2 %	4.3 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.658 ppb	0.119 ppb	0.299 ppb	0.040 ppb	0.225 ppb	0.033 ppb	0.640 ppb	0.826 ppb	101.309 %	0.902 ppb
Concentration per Run 1	0.632 ppb	0.113 ppb	0.295 ppb	0.037 ppb	0.211 ppb	0.031 ppb	0.618 ppb	0.806 ppb	100.975 %	0.891 ppb
Concentration per Run 2	0.611 ppb	0.115 ppb	0.282 ppb	0.040 ppb	0.222 ppb	0.032 ppb	0.620 ppb	0.816 ppb	103.276 %	0.867 ppb
Concentration per Run 3	0.731 ppb	0.129 ppb	0.321 ppb	0.042 ppb	0.241 ppb	0.036 ppb	0.684 ppb	0.857 ppb	99.677 %	0.948 ppb
Concentration RSD 1	9.8 %	7.3 %	6.7 %	6.9 %	6.8 %	7.7 %	5.9 %	3.3 %	1.8 %	4.6 %

Analysis index: 12 Analysis started at: 11/17/2023 12:52:30 PM
Analysis label: BCR-2 User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	631.382 ppb	2,513.293 ppb	623.086 ppb	20.528 ppb	0.980 ppb	14.513 ppb	1.492 ppb	8.272 ppb	0.551 ppb	110.213 %
Concentration per Run 1	646.982 ppb	2,545.111 ppb	638.756 ppb	21.147 ppb	1.028 ppb	15.035 ppb	1.580 ppb	8.410 ppb	0.530 ppb	107.865 %
Concentration per Run 2	632.860 ppb	2,486.914 ppb	620.905 ppb	20.274 ppb	0.970 ppb	14.359 ppb	1.452 ppb	8.257 ppb	0.562 ppb	110.357 %
Concentration per Run 3	614.304 ppb	2,507.853 ppb	609.599 ppb	20.163 ppb	0.941 ppb	14.144 ppb	1.445 ppb	8.149 ppb	0.561 ppb	112.416 %
Concentration RSD 1	2.6 %	1.2 %	2.4 %	2.6 %	4.5 %	3.2 %	5.1 %	1.6 %	3.3 %	2.1 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	20.498 ppb	1.046 ppb	2.230 ppb	0.272 ppb	N/A	1.248 ppb	0.289 ppb	0.091 ppb	0.307 ppb	0.049 ppb
Concentration per Run 1	21.099 ppb	1.056 ppb	2.291 ppb	0.276 ppb	N/A	1.281 ppb	0.295 ppb	0.094 ppb	0.317 ppb	0.048 ppb
Concentration per Run 2	20.015 ppb	1.035 ppb	2.161 ppb	0.263 ppb	N/A	1.198 ppb	0.284 ppb	0.087 ppb	0.309 ppb	0.048 ppb
Concentration per Run 3	20.380 ppb	1.047 ppb	2.239 ppb	0.276 ppb	N/A	1.266 ppb	0.287 ppb	0.091 ppb	0.294 ppb	0.051 ppb
Concentration RSD 1	2.7 %	1.0 %	2.9 %	2.9 %	N/A	3.5 %	2.1 %	3.4 %	3.8 %	3.7 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.291 ppb	0.058 ppb	0.171 ppb	0.023 ppb	0.156 ppb	0.022 ppb	0.204 ppb	0.036 ppb	101.766 %	0.227 ppb
Concentration per Run 1	0.296 ppb	0.062 ppb	0.169 ppb	0.023 ppb	0.164 ppb	0.022 ppb	0.206 ppb	0.031 ppb	99.966 %	0.233 ppb
Concentration per Run 2	0.290 ppb	0.055 ppb	0.168 ppb	0.022 ppb	0.153 ppb	0.021 ppb	0.206 ppb	0.036 ppb	104.015 %	0.214 ppb
Concentration per Run 3	0.289 ppb	0.058 ppb	0.176 ppb	0.025 ppb	0.151 ppb	0.023 ppb	0.200 ppb	0.041 ppb	101.319 %	0.235 ppb
Concentration RSD 1	1.3 %	6.3 %	2.6 %	6.9 %	4.2 %	4.4 %	1.5 %	14.4 %	2.0 %	5.0 %

Analysis index: 13 Analysis started at: 11/17/2023 12:55:39 PM
Analysis label: BHVO-2 User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	198.000 ppb	3,998.296 ppb	734.326 ppb	14.932 ppb	0.378 ppb	17.589 ppb	1.093 ppb	7.304 ppb	0.873 ppb	112.773 %
Concentration per Run 1	203.447 ppb	4,063.237 ppb	750.588 ppb	15.316 ppb	0.361 ppb	17.737 ppb	1.097 ppb	7.373 ppb	0.872 ppb	112.093 %
Concentration per Run 2	195.174 ppb	3,952.135 ppb	716.644 ppb	14.627 ppb	0.399 ppb	17.396 ppb	1.103 ppb	7.217 ppb	0.867 ppb	114.410 %
Concentration per Run 3	195.378 ppb	3,979.515 ppb	735.746 ppb	14.851 ppb	0.375 ppb	17.636 ppb	1.079 ppb	7.321 ppb	0.879 ppb	111.816 %
Concentration RSD 1	2.4 %	1.4 %	2.3 %	2.4 %	5.2 %	1.0 %	1.1 %	1.1 %	0.7 %	1.3 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	5.989 ppb	0.699 ppb	1.589 ppb	0.222 ppb	N/A	1.133 ppb	0.281 ppb	0.094 ppb	0.287 ppb	0.043 ppb
Concentration per Run 1	5.948 ppb	0.697 ppb	1.611 ppb	0.221 ppb	N/A	1.124 ppb	0.273 ppb	0.094 ppb	0.291 ppb	0.042 ppb
Concentration per Run 2	5.912 ppb	0.700 ppb	1.533 ppb	0.220 ppb	N/A	1.150 ppb	0.273 ppb	0.092 ppb	0.279 ppb	0.043 ppb
Concentration per Run 3	6.107 ppb	0.700 ppb	1.623 ppb	0.226 ppb	N/A	1.125 ppb	0.297 ppb	0.096 ppb	0.292 ppb	0.046 ppb
Concentration RSD 1	1.7 %	0.2 %	3.1 %	1.3 %	N/A	1.3 %	4.8 %	2.2 %	2.5 %	4.5 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.236 ppb	0.046 ppb	0.113 ppb	0.015 ppb	0.088 ppb	0.013 ppb	0.186 ppb	0.049 ppb	99.672 %	0.053 ppb
Concentration per Run 1	0.226 ppb	0.045 ppb	0.106 ppb	0.015 ppb	0.085 ppb	0.012 ppb	0.182 ppb	0.047 ppb	98.737 %	0.053 ppb
Concentration per Run 2	0.241 ppb	0.045 ppb	0.113 ppb	0.015 ppb	0.089 ppb	0.012 ppb	0.189 ppb	0.049 ppb	102.682 %	0.052 ppb
Concentration per Run 3	0.242 ppb	0.048 ppb	0.120 ppb	0.015 ppb	0.091 ppb	0.013 ppb	0.187 ppb	0.053 ppb	97.597 %	0.053 ppb
Concentration RSD 1	3.8 %	3.3 %	6.2 %	0.7 %	3.7 %	2.9 %	2.0 %	6.0 %	2.7 %	1.5 %

Analysis index: 14 Analysis started at: 11/17/2023 12:58:50 PM
Analysis label: BLANK User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	7.494 ppb	4.328 ppb	0.086 ppb	0.021 ppb	-0.010 ppb	0.005 ppb	0.000 ppb	0.002 ppb	0.001 ppb	114.650 %
Concentration per Run 1	7.433 ppb	2.932 ppb	0.113 ppb	0.019 ppb	-0.007 ppb	0.008 ppb	0.000 ppb	0.003 ppb	0.000 ppb	114.692 %
Concentration per Run 2	7.535 ppb	5.166 ppb	0.066 ppb	0.022 ppb	-0.008 ppb	0.002 ppb	0.000 ppb	0.001 ppb	0.002 ppb	116.062 %
Concentration per Run 3	7.415 ppb	4.887 ppb	0.080 ppb	0.022 ppb	-0.014 ppb	0.004 ppb	0.000 ppb	0.001 ppb	0.001 ppb	113.195 %
Concentration RSD 1	1.6 %	28.1 %	28.3 %	7.7 %	38.3 %	57.8 %	68.6 %	57.9 %	58.9 %	1.3 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	0.019 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration per Run 1	0.012 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration per Run 2	0.024 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.001 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration per Run 3	0.020 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration RSD 1	34.0 %	8.4 %	88.1 %	172.8 %	N/A	105.0 %	0.0 %	N/A	258.3 %	512.6 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.001 ppb	101.961 %	0.000 ppb
Concentration per Run 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	99.153 %	0.000 ppb
Concentration per Run 2	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.001 ppb	99.698 %	0.000 ppb
Concentration per Run 3	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.001 ppb	107.030 %	0.000 ppb
Concentration RSD 1	16,897.2 %	256.1 %	0.0 %	256.6 %	0.0 %	86.7 %	103.5 %	25.0 %	4.3 %	32.7 %

Analysis index: 15 Analysis started at: 11/17/2023 1:02:00 PM
Analysis label: FBE-1C_1 User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	96.739 ppb	9,507.233 ppb	628.708 ppb	17.382 ppb	0.293 ppb	76.055 ppb	3.572 ppb	43.867 ppb	15.296 ppb	113.331 %
Concentration per Run 1	98.514 ppb	9,571.439 ppb	630.375 ppb	17.513 ppb	0.305 ppb	76.488 ppb	3.544 ppb	43.194 ppb	15.089 ppb	113.753 %
Concentration per Run 2	95.607 ppb	9,502.023 ppb	626.253 ppb	16.902 ppb	0.286 ppb	75.181 ppb	3.488 ppb	43.620 ppb	15.455 ppb	113.899 %
Concentration per Run 3	96.095 ppb	9,448.237 ppb	629.496 ppb	17.732 ppb	0.287 ppb	76.495 ppb	3.685 ppb	44.787 ppb	15.343 ppb	112.342 %
Concentration RSD 1	1.6 %	0.6 %	0.3 %	2.5 %	3.6 %	1.0 %	2.8 %	1.9 %	1.2 %	0.8 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	33.336 ppb	13.648 ppb	28.228 ppb	3.066 ppb	N/A	12.607 ppb	1.902 ppb	0.515 ppb	1.467 ppb	0.173 ppb
Concentration per Run 1	32.609 ppb	13.789 ppb	28.505 ppb	3.085 ppb	N/A	12.701 ppb	1.821 ppb	0.526 ppb	1.437 ppb	0.168 ppb
Concentration per Run 2	32.526 ppb	13.293 ppb	27.099 ppb	3.036 ppb	N/A	12.262 ppb	1.980 ppb	0.508 ppb	1.468 ppb	0.173 ppb
Concentration per Run 3	34.873 ppb	13.862 ppb	29.081 ppb	3.076 ppb	N/A	12.859 ppb	1.905 ppb	0.511 ppb	1.495 ppb	0.177 ppb
Concentration RSD 1	4.0 %	2.3 %	3.6 %	0.8 %	N/A	2.5 %	4.2 %	1.9 %	2.0 %	2.4 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.824 ppb	0.144 ppb	0.355 ppb	0.049 ppb	0.276 ppb	0.041 ppb	0.779 ppb	1.167 ppb	100.511 %	1.105 ppb
Concentration per Run 1	0.814 ppb	0.145 ppb	0.344 ppb	0.047 ppb	0.276 ppb	0.040 ppb	0.784 ppb	1.165 ppb	102.180 %	1.086 ppb
Concentration per Run 2	0.814 ppb	0.144 ppb	0.355 ppb	0.051 ppb	0.275 ppb	0.042 ppb	0.758 ppb	1.176 ppb	99.584 %	1.109 ppb
Concentration per Run 3	0.844 ppb	0.142 ppb	0.365 ppb	0.048 ppb	0.278 ppb	0.040 ppb	0.796 ppb	1.160 ppb	99.770 %	1.122 ppb
Concentration RSD 1	2.1 %	0.9 %	3.0 %	3.3 %	0.5 %	2.0 %	2.5 %	0.7 %	1.4 %	1.6 %

Analysis index: 16 Analysis started at: 11/17/2023 1:05:09 PM
Analysis label: FBE-1C_2 User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	90.824 ppb	8,684.380 ppb	531.350 ppb	15.656 ppb	0.269 ppb	68.845 ppb	3.246 ppb	41.180 ppb	13.017 ppb	114.527 %
Concentration per Run 1	93.702 ppb	8,606.042 ppb	536.209 ppb	15.800 ppb	0.290 ppb	68.439 ppb	3.207 ppb	41.847 ppb	12.435 ppb	114.492 %
Concentration per Run 2	87.806 ppb	8,708.813 ppb	521.795 ppb	15.484 ppb	0.256 ppb	69.793 ppb	3.199 ppb	40.588 ppb	12.719 ppb	115.243 %
Concentration per Run 3	90.964 ppb	8,738.285 ppb	536.047 ppb	15.685 ppb	0.262 ppb	68.301 ppb	3.332 ppb	41.105 ppb	13.896 ppb	113.846 %
Concentration RSD 1	3.2 %	0.8 %	1.6 %	1.0 %	6.7 %	1.2 %	2.3 %	1.5 %	6.0 %	0.6 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	30.324 ppb	11.529 ppb	24.107 ppb	2.570 ppb	N/A	10.729 ppb	1.588 ppb	0.444 ppb	1.248 ppb	0.148 ppb
Concentration per Run 1	29.470 ppb	11.293 ppb	23.395 ppb	2.615 ppb	N/A	10.686 ppb	1.586 ppb	0.421 ppb	1.283 ppb	0.147 ppb
Concentration per Run 2	31.343 ppb	11.691 ppb	24.536 ppb	2.510 ppb	N/A	10.668 ppb	1.536 ppb	0.456 ppb	1.203 ppb	0.144 ppb
Concentration per Run 3	30.158 ppb	11.601 ppb	24.391 ppb	2.584 ppb	N/A	10.834 ppb	1.641 ppb	0.456 ppb	1.257 ppb	0.155 ppb
Concentration RSD 1	3.1 %	1.8 %	2.6 %	2.1 %	N/A	0.9 %	3.3 %	4.6 %	3.3 %	3.8 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.739 ppb	0.129 ppb	0.332 ppb	0.042 ppb	0.252 ppb	0.036 ppb	0.723 ppb	0.956 ppb	103.286 %	0.933 ppb
Concentration per Run 1	0.716 ppb	0.130 ppb	0.319 ppb	0.042 ppb	0.250 ppb	0.037 ppb	0.723 ppb	0.918 ppb	105.041 %	0.870 ppb
Concentration per Run 2	0.745 ppb	0.134 ppb	0.335 ppb	0.043 ppb	0.255 ppb	0.037 ppb	0.716 ppb	0.940 ppb	102.593 %	0.971 ppb
Concentration per Run 3	0.757 ppb	0.123 ppb	0.342 ppb	0.041 ppb	0.251 ppb	0.035 ppb	0.729 ppb	1.010 ppb	102.224 %	0.958 ppb
Concentration RSD 1	2.9 %	4.1 %	3.6 %	1.8 %	1.1 %	2.9 %	0.9 %	5.1 %	1.5 %	5.9 %

Analysis index: 17 Analysis started at: 11/17/2023 1:08:19 PM
Analysis label: FBE-2A User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	21.484 ppb	9,736.509 ppb	532.203 ppb	14.412 ppb	0.053 ppb	104.101 ppb	2.774 ppb	33.100 ppb	10.834 ppb	114.708 %
Concentration per Run 1	20.721 ppb	9,622.079 ppb	528.397 ppb	14.497 ppb	0.054 ppb	102.706 ppb	2.804 ppb	33.563 ppb	11.069 ppb	113.609 %
Concentration per Run 2	22.275 ppb	9,882.079 ppb	542.652 ppb	14.542 ppb	0.055 ppb	105.525 ppb	2.752 ppb	33.136 ppb	10.756 ppb	115.202 %
Concentration per Run 3	21.456 ppb	9,705.369 ppb	525.559 ppb	14.197 ppb	0.050 ppb	104.074 ppb	2.767 ppb	32.602 ppb	10.678 ppb	115.314 %
Concentration RSD 1	3.6 %	1.4 %	1.7 %	1.3 %	5.8 %	1.4 %	1.0 %	1.5 %	1.9 %	0.8 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	6.405 ppb	10.103 ppb	20.974 ppb	2.285 ppb	N/A	9.421 ppb	1.405 ppb	0.405 ppb	1.079 ppb	0.131 ppb
Concentration per Run 1	6.338 ppb	10.183 ppb	20.605 ppb	2.264 ppb	N/A	9.483 ppb	1.439 ppb	0.409 ppb	1.094 ppb	0.129 ppb
Concentration per Run 2	6.420 ppb	10.040 ppb	21.616 ppb	2.288 ppb	N/A	9.460 ppb	1.402 ppb	0.404 ppb	1.040 ppb	0.136 ppb
Concentration per Run 3	6.455 ppb	10.087 ppb	20.700 ppb	2.305 ppb	N/A	9.318 ppb	1.374 ppb	0.401 ppb	1.103 ppb	0.129 ppb
Concentration RSD 1	0.9 %	0.7 %	2.7 %	0.9 %	N/A	0.9 %	2.3 %	1.0 %	3.2 %	3.2 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.626 ppb	0.108 ppb	0.275 ppb	0.035 ppb	0.202 ppb	0.030 ppb	0.599 ppb	0.816 ppb	105.478 %	0.820 ppb
Concentration per Run 1	0.618 ppb	0.107 ppb	0.273 ppb	0.034 ppb	0.203 ppb	0.029 ppb	0.593 ppb	0.821 ppb	109.092 %	0.781 ppb
Concentration per Run 2	0.625 ppb	0.111 ppb	0.272 ppb	0.035 ppb	0.209 ppb	0.031 ppb	0.628 ppb	0.822 ppb	103.244 %	0.850 ppb
Concentration per Run 3	0.635 ppb	0.107 ppb	0.280 ppb	0.035 ppb	0.195 ppb	0.030 ppb	0.577 ppb	0.804 ppb	104.099 %	0.830 ppb
Concentration RSD 1	1.3 %	2.0 %	1.6 %	1.8 %	3.3 %	4.1 %	4.3 %	1.2 %	3.0 %	4.3 %

Analysis index: 18 Analysis started at: 11/17/2023 1:11:29 PM
Analysis label: BCR-2 User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	621.754 ppb	2,542.359 ppb	631.775 ppb	20.334 ppb	0.980 ppb	14.260 ppb	1.442 ppb	8.183 ppb	0.569 ppb	112.915 %
Concentration per Run 1	611.927 ppb	2,518.612 ppb	627.113 ppb	20.192 ppb	0.933 ppb	14.515 ppb	1.413 ppb	8.298 ppb	0.582 ppb	113.281 %
Concentration per Run 2	639.287 ppb	2,581.366 ppb	645.501 ppb	20.797 ppb	1.017 ppb	14.199 ppb	1.436 ppb	8.053 ppb	0.591 ppb	111.840 %
Concentration per Run 3	614.049 ppb	2,527.098 ppb	622.712 ppb	20.013 ppb	0.989 ppb	14.065 ppb	1.475 ppb	8.198 ppb	0.534 ppb	113.624 %
Concentration RSD 1	2.4 %	1.3 %	1.9 %	2.0 %	4.4 %	1.6 %	2.2 %	1.5 %	5.3 %	0.8 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	20.022 ppb	1.045 ppb	2.201 ppb	0.270 ppb	N/A	1.276 ppb	0.290 ppb	0.087 ppb	0.298 ppb	0.049 ppb
Concentration per Run 1	19.907 ppb	1.050 ppb	2.210 ppb	0.267 ppb	N/A	1.303 ppb	0.289 ppb	0.093 ppb	0.302 ppb	0.049 ppb
Concentration per Run 2	19.775 ppb	1.057 ppb	2.187 ppb	0.272 ppb	N/A	1.261 ppb	0.288 ppb	0.082 ppb	0.298 ppb	0.049 ppb
Concentration per Run 3	20.385 ppb	1.029 ppb	2.207 ppb	0.271 ppb	N/A	1.264 ppb	0.295 ppb	0.087 ppb	0.294 ppb	0.048 ppb
Concentration RSD 1	1.6 %	1.4 %	0.6 %	0.9 %	N/A	1.9 %	1.3 %	6.1 %	1.3 %	1.8 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.283 ppb	0.058 ppb	0.162 ppb	0.023 ppb	0.142 ppb	0.022 ppb	0.199 ppb	0.034 ppb	102.765 %	0.220 ppb
Concentration per Run 1	0.284 ppb	0.059 ppb	0.157 ppb	0.025 ppb	0.141 ppb	0.023 ppb	0.196 ppb	0.034 ppb	102.663 %	0.225 ppb
Concentration per Run 2	0.275 ppb	0.057 ppb	0.172 ppb	0.022 ppb	0.143 ppb	0.023 ppb	0.202 ppb	0.034 ppb	103.535 %	0.217 ppb
Concentration per Run 3	0.291 ppb	0.059 ppb	0.158 ppb	0.023 ppb	0.140 ppb	0.021 ppb	0.198 ppb	0.033 ppb	102.097 %	0.217 ppb
Concentration RSD 1	2.8 %	1.5 %	4.9 %	4.6 %	0.9 %	4.0 %	1.6 %	2.3 %	0.7 %	2.3 %

Analysis index: 19 Analysis started at: 11/17/2023 1:14:39 PM
Analysis label: BHVO-2 User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	197.889 ppb	4,003.838 ppb	744.182 ppb	14.996 ppb	0.381 ppb	17.422 ppb	1.094 ppb	7.328 ppb	0.861 ppb	112.838 %
Concentration per Run 1	197.538 ppb	4,073.238 ppb	745.121 ppb	14.866 ppb	0.380 ppb	17.225 ppb	1.098 ppb	7.253 ppb	0.842 ppb	114.698 %
Concentration per Run 2	197.521 ppb	3,940.454 ppb	745.524 ppb	15.167 ppb	0.373 ppb	17.546 ppb	1.097 ppb	7.305 ppb	0.874 ppb	111.813 %
Concentration per Run 3	198.609 ppb	3,997.821 ppb	741.899 ppb	14.956 ppb	0.391 ppb	17.494 ppb	1.087 ppb	7.427 ppb	0.868 ppb	112.004 %
Concentration RSD 1	0.3 %	1.7 %	0.3 %	1.0 %	2.4 %	1.0 %	0.6 %	1.2 %	2.0 %	1.4 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	6.035 ppb	0.721 ppb	1.569 ppb	0.225 ppb	N/A	1.125 ppb	0.266 ppb	0.091 ppb	0.282 ppb	0.041 ppb
Concentration per Run 1	6.073 ppb	0.724 ppb	1.551 ppb	0.216 ppb	N/A	1.082 ppb	0.249 ppb	0.088 ppb	0.275 ppb	0.040 ppb
Concentration per Run 2	5.998 ppb	0.691 ppb	1.575 ppb	0.224 ppb	N/A	1.154 ppb	0.269 ppb	0.087 ppb	0.292 ppb	0.039 ppb
Concentration per Run 3	6.034 ppb	0.748 ppb	1.580 ppb	0.236 ppb	N/A	1.138 ppb	0.279 ppb	0.098 ppb	0.277 ppb	0.044 ppb
Concentration RSD 1	0.6 %	4.0 %	1.0 %	4.4 %	N/A	3.4 %	5.8 %	6.8 %	3.4 %	5.8 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.234 ppb	0.044 ppb	0.114 ppb	0.015 ppb	0.090 ppb	0.012 ppb	0.184 ppb	0.050 ppb	102.678 %	0.052 ppb
Concentration per Run 1	0.237 ppb	0.045 ppb	0.115 ppb	0.016 ppb	0.088 ppb	0.012 ppb	0.187 ppb	0.053 ppb	99.861 %	0.054 ppb
Concentration per Run 2	0.224 ppb	0.044 ppb	0.116 ppb	0.014 ppb	0.090 ppb	0.012 ppb	0.186 ppb	0.052 ppb	107.512 %	0.049 ppb
Concentration per Run 3	0.242 ppb	0.043 ppb	0.109 ppb	0.015 ppb	0.092 ppb	0.013 ppb	0.178 ppb	0.046 ppb	100.663 %	0.052 ppb
Concentration RSD 1	4.0 %	2.0 %	3.2 %	4.0 %	2.4 %	5.9 %	2.5 %	6.8 %	4.1 %	4.2 %

Analysis index: 20 Analysis started at: 11/17/2023 1:17:49 PM
Analysis label: BLANK User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (KEDS)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	6.777 ppb	4.096 ppb	0.134 ppb	0.022 ppb	-0.017 ppb	0.005 ppb	0.000 ppb	0.001 ppb	0.001 ppb	114.741 %
Concentration per Run 1	6.615 ppb	4.049 ppb	0.139 ppb	0.021 ppb	-0.010 ppb	0.004 ppb	0.000 ppb	0.001 ppb	0.001 ppb	114.987 %
Concentration per Run 2	6.409 ppb	3.910 ppb	0.132 ppb	0.025 ppb	-0.022 ppb	0.006 ppb	0.000 ppb	0.001 ppb	0.001 ppb	114.109 %
Concentration per Run 3	7.308 ppb	4.328 ppb	0.132 ppb	0.020 ppb	-0.020 ppb	0.006 ppb	0.000 ppb	0.001 ppb	0.001 ppb	115.126 %
Concentration RSD 1	6.9 %	5.2 %	2.8 %	10.4 %	37.2 %	21.5 %	0.0 %	35.8 %	5.8 %	0.5 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	0.025 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration per Run 1	0.024 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration per Run 2	0.027 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration per Run 3	0.024 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.001 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration RSD 1	7.6 %	136.5 %	141.1 %	2.1 %	N/A	194.4 %	0.0 %	173.2 %	0.0 %	0.0 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.001 ppb	103.849 %	0.000 ppb
Concentration per Run 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.001 ppb	101.748 %	0.000 ppb
Concentration per Run 2	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	104.159 %	0.000 ppb
Concentration per Run 3	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.001 ppb	105.640 %	0.000 ppb
Concentration RSD 1	6,508.2 %	524.0 %	491.1 %	254.1 %	0.0 %	N/A	52.6 %	19.2 %	1.9 %	64.8 %

SEMESTER TWO DATA

Analysis index: 1 Analysis started at: 4/19/2024 3:02:26 PM
Analysis label: Blank User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (STD)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	100.000 %
Concentration per Run 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	100.000 %
Concentration RSD 1	0.0 %	2.7 %	0.2 %	0.5 %	0.2 %	0.3 %	0.6 %	0.5 %	0.2 %	0.0 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration per Run 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	N/A	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb
Concentration RSD 1	0.2 %	0.3 %	0.2 %	0.4 %	N/A	0.7 %	1.9 %	1.8 %	0.9 %	0.9 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	100.000 %	0.000 ppb
Concentration per Run 1	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	0.000 ppb	100.000 %	0.000 ppb
Concentration RSD 1	1.0 %	1.5 %	2.1 %	1.7 %	1.7 %	1.6 %	3.2 %	0.3 %	0.0 %	0.4 %

Analysis index: 2 Analysis started at: 4/19/2024 3:06:46 PM
Analysis label: Cal Std A User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (STD)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	23.698 ppb	299.892 ppb	3.845 ppb	0.238 ppb	0.044 ppb	0.183 ppb	0.018 ppb	0.117 ppb	0.009 ppb	99.108 %
Concentration per Run 1	22.417 ppb	649.310 ppb	3.811 ppb	0.233 ppb	0.041 ppb	0.169 ppb	0.016 ppb	0.121 ppb	0.009 ppb	99.507 %
Concentration per Run 2	26.304 ppb	148.871 ppb	4.051 ppb	0.239 ppb	0.045 ppb	0.191 ppb	0.020 ppb	0.115 ppb	0.010 ppb	95.928 %
Concentration per Run 3	22.374 ppb	101.497 ppb	3.672 ppb	0.240 ppb	0.045 ppb	0.188 ppb	0.019 ppb	0.116 ppb	0.008 ppb	101.888 %
Concentration RSD 1	9.5 %	101.2 %	5.0 %	1.7 %	5.0 %	6.6 %	13.2 %	2.6 %	13.5 %	3.0 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	0.302 ppb	0.019 ppb	0.021 ppb	0.021 ppb	N/A	0.021 ppb	0.019 ppb	0.020 ppb	0.021 ppb	0.020 ppb
Concentration per Run 1	0.269 ppb	0.019 ppb	0.022 ppb	0.021 ppb	N/A	0.022 ppb	0.020 ppb	0.020 ppb	0.017 ppb	0.020 ppb
Concentration per Run 2	0.301 ppb	0.019 ppb	0.021 ppb	0.021 ppb	N/A	0.022 ppb	0.017 ppb	0.020 ppb	0.023 ppb	0.020 ppb
Concentration per Run 3	0.336 ppb	0.019 ppb	0.019 ppb	0.022 ppb	N/A	0.020 ppb	0.020 ppb	0.020 ppb	0.024 ppb	0.018 ppb
Concentration RSD 1	11.2 %	2.2 %	7.2 %	2.0 %	N/A	6.9 %	10.3 %	2.2 %	16.1 %	5.6 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.020 ppb	0.020 ppb	0.019 ppb	0.020 ppb	0.021 ppb	0.020 ppb	0.009 ppb	0.007 ppb	97.643 %	0.016 ppb
Concentration per Run 1	0.019 ppb	0.019 ppb	0.018 ppb	0.019 ppb	0.021 ppb	0.019 ppb	0.008 ppb	0.008 ppb	99.123 %	0.015 ppb
Concentration per Run 2	0.019 ppb	0.021 ppb	0.019 ppb	0.021 ppb	0.021 ppb	0.021 ppb	0.009 ppb	0.007 ppb	95.293 %	0.017 ppb
Concentration per Run 3	0.020 ppb	0.020 ppb	0.019 ppb	0.019 ppb	0.022 ppb	0.019 ppb	0.009 ppb	0.007 ppb	98.514 %	0.017 ppb
Concentration RSD 1	4.1 %	5.0 %	2.5 %	4.2 %	1.5 %	6.0 %	3.6 %	6.1 %	2.1 %	5.3 %

Analysis index: 3 Analysis started at: 4/19/2024 3:10:43 PM
Analysis label: Cal Std B User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (STD)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	45.175 ppb	-255.277 ppb	7.497 ppb	0.455 ppb	0.083 ppb	0.347 ppb	0.038 ppb	0.261 ppb	0.016 ppb	99.785 %
Concentration per Run 1	44.086 ppb	184.956 ppb	7.382 ppb	0.442 ppb	0.084 ppb	0.335 ppb	0.039 ppb	0.259 ppb	0.016 ppb	99.331 %
Concentration per Run 2	45.464 ppb	-518.010 ppb	7.465 ppb	0.459 ppb	0.089 ppb	0.347 ppb	0.038 ppb	0.248 ppb	0.015 ppb	101.464 %
Concentration per Run 3	45.975 ppb	-432.777 ppb	7.644 ppb	0.465 ppb	0.075 ppb	0.360 ppb	0.036 ppb	0.275 ppb	0.016 ppb	98.559 %
Concentration RSD 1	2.2 %	150.3 %	1.8 %	2.6 %	8.3 %	3.6 %	3.2 %	5.3 %	5.3 %	1.5 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	0.582 ppb	0.038 ppb	0.039 ppb	0.040 ppb	N/A	0.040 ppb	0.040 ppb	0.039 ppb	0.037 ppb	0.040 ppb
Concentration per Run 1	0.592 ppb	0.038 ppb	0.036 ppb	0.043 ppb	N/A	0.036 ppb	0.038 ppb	0.039 ppb	0.037 ppb	0.038 ppb
Concentration per Run 2	0.583 ppb	0.036 ppb	0.038 ppb	0.040 ppb	N/A	0.045 ppb	0.043 ppb	0.038 ppb	0.040 ppb	0.041 ppb
Concentration per Run 3	0.572 ppb	0.040 ppb	0.041 ppb	0.038 ppb	N/A	0.038 ppb	0.039 ppb	0.041 ppb	0.035 ppb	0.041 ppb
Concentration RSD 1	1.7 %	4.8 %	6.4 %	6.0 %	N/A	10.8 %	6.6 %	3.8 %	6.7 %	4.6 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.037 ppb	0.041 ppb	0.038 ppb	0.040 ppb	0.039 ppb	0.039 ppb	0.018 ppb	0.016 ppb	97.641 %	0.036 ppb
Concentration per Run 1	0.040 ppb	0.043 ppb	0.037 ppb	0.041 ppb	0.037 ppb	0.038 ppb	0.019 ppb	0.016 ppb	97.449 %	0.035 ppb
Concentration per Run 2	0.039 ppb	0.041 ppb	0.039 ppb	0.039 ppb	0.038 ppb	0.042 ppb	0.017 ppb	0.017 ppb	96.255 %	0.037 ppb
Concentration per Run 3	0.033 ppb	0.039 ppb	0.039 ppb	0.040 ppb	0.042 ppb	0.038 ppb	0.019 ppb	0.017 ppb	99.218 %	0.035 ppb
Concentration RSD 1	10.0 %	5.6 %	3.3 %	2.1 %	6.5 %	6.3 %	4.6 %	3.9 %	1.5 %	2.8 %

Analysis index: 4 Analysis started at: 4/19/2024 3:14:40 PM
Analysis label: Cal Std C User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (STD)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	2,220.466 ppb	6,547.491 ppb	365.909 ppb	20.851 ppb	3.927 ppb	15.494 ppb	1.515 ppb	11.856 ppb	0.757 ppb	110.113 %
Concentration per Run 1	1,993.861 ppb	7,165.906 ppb	327.033 ppb	18.458 ppb	3.621 ppb	13.870 ppb	1.333 ppb	10.442 ppb	0.668 ppb	115.773 %
Concentration per Run 2	2,270.047 ppb	6,513.949 ppb	372.873 ppb	21.238 ppb	4.057 ppb	15.701 ppb	1.557 ppb	12.105 ppb	0.773 ppb	108.739 %
Concentration per Run 3	2,397.491 ppb	5,962.619 ppb	397.820 ppb	22.858 ppb	4.105 ppb	16.911 ppb	1.654 ppb	13.021 ppb	0.829 ppb	105.825 %
Concentration RSD 1	9.3 %	9.2 %	9.8 %	10.7 %	6.8 %	9.9 %	10.9 %	11.0 %	10.8 %	4.6 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	25.766 ppb	1.625 ppb	1.669 ppb	1.670 ppb	N/A	1.678 ppb	1.626 ppb	1.647 ppb	1.618 ppb	1.671 ppb
Concentration per Run 1	23.095 ppb	1.458 ppb	1.460 ppb	1.428 ppb	N/A	1.420 ppb	1.428 ppb	1.424 ppb	1.441 ppb	1.512 ppb
Concentration per Run 2	25.812 ppb	1.659 ppb	1.700 ppb	1.709 ppb	N/A	1.736 ppb	1.652 ppb	1.664 ppb	1.683 ppb	1.672 ppb
Concentration per Run 3	28.391 ppb	1.757 ppb	1.848 ppb	1.872 ppb	N/A	1.879 ppb	1.799 ppb	1.853 ppb	1.731 ppb	1.829 ppb
Concentration RSD 1	10.3 %	9.4 %	11.7 %	13.5 %	N/A	14.0 %	11.5 %	13.1 %	9.6 %	9.5 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	1.677 ppb	1.659 ppb	1.654 ppb	1.680 ppb	1.659 ppb	1.643 ppb	0.769 ppb	0.756 ppb	103.953 %	1.511 ppb
Concentration per Run 1	1.511 ppb	1.439 ppb	1.492 ppb	1.522 ppb	1.448 ppb	1.473 ppb	0.678 ppb	0.664 ppb	110.599 %	1.343 ppb
Concentration per Run 2	1.714 ppb	1.705 ppb	1.660 ppb	1.712 ppb	1.696 ppb	1.684 ppb	0.791 ppb	0.777 ppb	104.760 %	1.527 ppb
Concentration per Run 3	1.807 ppb	1.835 ppb	1.811 ppb	1.807 ppb	1.835 ppb	1.772 ppb	0.837 ppb	0.828 ppb	96.500 %	1.664 ppb
Concentration RSD 1	9.0 %	12.2 %	9.7 %	8.6 %	11.8 %	9.4 %	10.7 %	11.1 %	6.8 %	10.7 %

Analysis index: 5 Analysis started at: 4/19/2024 3:18:37 PM
Analysis label: Cal Std D User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (STD)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	5,435.003 ppb	9,222.928 ppb	939.030 ppb	52.288 ppb	9.254 ppb	37.091 ppb	3.684 ppb	28.982 ppb	1.845 ppb	99.435 %
Concentration per Run 1	5,452.864 ppb	10,433.850 ppb	948.235 ppb	53.137 ppb	9.328 ppb	37.497 ppb	3.641 ppb	29.027 ppb	1.859 ppb	98.286 %
Concentration per Run 2	5,451.092 ppb	8,675.541 ppb	942.541 ppb	52.333 ppb	9.261 ppb	36.551 ppb	3.683 ppb	29.345 ppb	1.839 ppb	98.806 %
Concentration per Run 3	5,401.051 ppb	8,559.392 ppb	926.315 ppb	51.393 ppb	9.174 ppb	37.226 ppb	3.728 ppb	28.573 ppb	1.836 ppb	101.212 %
Concentration RSD 1	0.5 %	11.4 %	1.2 %	1.7 %	0.8 %	1.3 %	1.2 %	1.3 %	0.7 %	1.6 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	59.495 ppb	3.881 ppb	3.945 ppb	4.041 ppb	N/A	3.984 ppb	3.915 ppb	3.877 ppb	3.919 ppb	3.981 ppb
Concentration per Run 1	61.175 ppb	3.894 ppb	4.051 ppb	4.064 ppb	N/A	4.103 ppb	3.967 ppb	3.946 ppb	3.984 ppb	4.021 ppb
Concentration per Run 2	58.809 ppb	3.824 ppb	3.892 ppb	4.040 ppb	N/A	3.820 ppb	3.947 ppb	3.806 ppb	3.945 ppb	3.956 ppb
Concentration per Run 3	58.501 ppb	3.924 ppb	3.890 ppb	4.017 ppb	N/A	4.030 ppb	3.830 ppb	3.880 ppb	3.827 ppb	3.967 ppb
Concentration RSD 1	2.5 %	1.3 %	2.3 %	0.6 %	N/A	3.7 %	1.9 %	1.8 %	2.1 %	0.9 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	3.940 ppb	4.043 ppb	3.891 ppb	3.998 ppb	3.993 ppb	3.936 ppb	1.890 ppb	2.018 ppb	88.031 %	3.883 ppb
Concentration per Run 1	4.049 ppb	4.065 ppb	3.930 ppb	3.984 ppb	3.960 ppb	3.953 ppb	1.901 ppb	2.001 ppb	89.085 %	3.901 ppb
Concentration per Run 2	3.941 ppb	4.057 ppb	3.813 ppb	4.031 ppb	4.053 ppb	3.966 ppb	1.870 ppb	2.012 ppb	87.932 %	3.778 ppb
Concentration per Run 3	3.831 ppb	4.005 ppb	3.931 ppb	3.980 ppb	3.966 ppb	3.888 ppb	1.900 ppb	2.040 ppb	87.075 %	3.971 ppb
Concentration RSD 1	2.8 %	0.8 %	1.7 %	0.7 %	1.3 %	1.1 %	0.9 %	1.0 %	1.1 %	2.5 %

Analysis index: 7 Analysis started at: 4/19/2024 3:26:33 PM
Analysis label: Cal Std F User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (STD)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	34,225.890 ppb	37,992.913 ppb	5,724.291 ppb	308.965 ppb	50.890 ppb	194.793 ppb	19.484 ppb	151.511 ppb	10.158 ppb	91.262 %
Concentration per Run 1	33,779.312 ppb	44,850.994 ppb	5,675.005 ppb	307.012 ppb	50.337 ppb	192.729 ppb	19.289 ppb	152.074 ppb	10.120 ppb	90.840 %
Concentration per Run 2	34,639.732 ppb	34,456.195 ppb	5,813.120 ppb	310.459 ppb	51.364 ppb	198.422 ppb	19.807 ppb	151.443 ppb	10.311 ppb	90.525 %
Concentration per Run 3	34,258.625 ppb	34,671.551 ppb	5,684.747 ppb	309.424 ppb	50.969 ppb	193.229 ppb	19.356 ppb	151.017 ppb	10.043 ppb	92.422 %
Concentration RSD 1	1.3 %	15.9 %	1.3 %	0.6 %	1.0 %	1.6 %	1.4 %	0.4 %	1.4 %	1.1 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	302.426 ppb	19.251 ppb	19.276 ppb	19.203 ppb	N/A	19.265 ppb	19.263 ppb	19.285 ppb	19.177 ppb	19.208 ppb
Concentration per Run 1	300.047 ppb	19.778 ppb	19.590 ppb	19.325 ppb	N/A	19.462 ppb	19.348 ppb	19.421 ppb	19.581 ppb	19.355 ppb
Concentration per Run 2	307.536 ppb	19.013 ppb	19.116 ppb	19.162 ppb	N/A	19.039 ppb	19.485 ppb	19.229 ppb	19.024 ppb	19.437 ppb
Concentration per Run 3	299.695 ppb	18.963 ppb	19.121 ppb	19.122 ppb	N/A	19.297 ppb	18.956 ppb	19.204 ppb	18.926 ppb	18.831 ppb
Concentration RSD 1	1.5 %	2.4 %	1.4 %	0.6 %	N/A	1.1 %	1.4 %	0.6 %	1.8 %	1.7 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	19.209 ppb	19.087 ppb	19.277 ppb	19.106 ppb	19.199 ppb	19.238 ppb	8.973 ppb	10.008 ppb	64.697 %	19.409 ppb
Concentration per Run 1	19.553 ppb	18.734 ppb	19.155 ppb	19.331 ppb	18.648 ppb	19.254 ppb	8.905 ppb	10.098 ppb	64.400 %	19.970 ppb
Concentration per Run 2	19.003 ppb	19.383 ppb	19.128 ppb	19.451 ppb	19.071 ppb	19.605 ppb	8.721 ppb	9.837 ppb	65.451 %	19.318 ppb
Concentration per Run 3	19.070 ppb	19.145 ppb	19.548 ppb	18.538 ppb	19.880 ppb	18.856 ppb	9.292 ppb	10.090 ppb	64.240 %	18.938 ppb
Concentration RSD 1	1.6 %	1.7 %	1.2 %	2.6 %	3.3 %	1.9 %	3.2 %	1.5 %	1.0 %	2.7 %

Analysis index: 8 Analysis started at: 4/19/2024 3:30:30 PM
Analysis label: Rinse User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (STD)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	32.244 ppb	-4,129.461 ppb	5.490 ppb	0.320 ppb	0.032 ppb	0.176 ppb	0.018 ppb	0.185 ppb	0.019 ppb	1.[illegible] %
Concentration per Run 1	34.200 ppb	-3,903.115 ppb	6.325 ppb	0.359 ppb	0.032 ppb	0.203 ppb	0.022 ppb	0.211 ppb	0.020 ppb	130.354 %
Concentration per Run 2	30.477 ppb	-4,090.338 ppb	5.007 ppb	0.286 ppb	0.030 ppb	0.160 ppb	0.016 ppb	0.174 ppb	0.017 ppb	112.839 %
Concentration per Run 3	32.055 ppb	-4,394.931 ppb	5.138 ppb	0.313 ppb	0.033 ppb	0.165 ppb	0.017 ppb	0.171 ppb	0.019 ppb	107.301 %
Concentration RSD 1	5.8 %	6.0 %	13.2 %	11.6 %	4.7 %	13.3 %	18.0 %	11.9 %	9.2 %	[illegible]

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	0.300 ppb	0.020 ppb	0.019 ppb	0.021 ppb	N/A	0.018 ppb	0.017 ppb	0.020 ppb	0.018 ppb	0.020 ppb
Concentration per Run 1	0.353 ppb	0.024 ppb	0.024 ppb	0.026 ppb	N/A	0.021 ppb	0.021 ppb	0.024 ppb	0.024 ppb	0.025 ppb
Concentration per Run 2	0.261 ppb	0.016 ppb	0.016 ppb	0.019 ppb	N/A	0.018 ppb	0.016 ppb	0.017 ppb	0.014 ppb	0.015 ppb
Concentration per Run 3	0.287 ppb	0.019 ppb	0.016 ppb	0.018 ppb	N/A	0.014 ppb	0.016 ppb	0.019 ppb	0.015 ppb	0.020 ppb
Concentration RSD 1	15.8 %	21.5 %	24.2 %	19.4 %	N/A	19.1 %	16.2 %	17.9 %	29.5 %	24.2 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.020 ppb	0.020 ppb	0.020 ppb	0.020 ppb	0.020 ppb	0.018 ppb	0.011 ppb	0.025 ppb	91.315 %	0.030 ppb
Concentration per Run 1	0.024 ppb	0.026 ppb	0.023 ppb	0.023 ppb	0.022 ppb	0.020 ppb	0.013 ppb	0.029 ppb	93.842 %	0.034 ppb
Concentration per Run 2	0.017 ppb	0.017 ppb	0.019 ppb	0.018 ppb	0.017 ppb	0.017 ppb	0.011 ppb	0.024 ppb	92.675 %	0.028 ppb
Concentration per Run 3	0.019 ppb	0.019 ppb	0.017 ppb	0.019 ppb	0.020 ppb	0.018 ppb	0.010 ppb	0.023 ppb	87.429 %	0.029 ppb
Concentration RSD 1	16.4 %	22.8 %	17.1 %	13.9 %	12.5 %	7.5 %	14.6 %	12.9 %	3.7 %	12.0 %

Analysis index: 9 Analysis started at: 4/19/2024 3:34:22 PM
Analysis label: Cal Std C User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (STD)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	3,213.960 ppb	80.731 ppb	531.923 ppb	29.517 ppb	4.780 ppb	19.267 ppb	1.872 ppb	14.652 ppb	0.953 ppb	103.986 %
Concentration per Run 1	3,244.944 ppb	400.968 ppb	538.117 ppb	29.792 ppb	4.830 ppb	19.357 ppb	1.875 ppb	14.919 ppb	0.957 ppb	103.328 %
Concentration per Run 2	3,214.430 ppb	18.143 ppb	530.489 ppb	29.612 ppb	4.713 ppb	18.790 ppb	1.897 ppb	14.393 ppb	0.940 ppb	104.278 %
Concentration per Run 3	3,182.507 ppb	-176.918 ppb	527.164 ppb	29.148 ppb	4.796 ppb	19.655 ppb	1.844 ppb	14.646 ppb	0.962 ppb	104.351 %
Concentration RSD 1	1.0 %	364.2 %	1.1 %	1.1 %	1.3 %	2.3 %	1.4 %	1.8 %	1.2 %	0.5 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	29.300 ppb	1.916 ppb	1.917 ppb	1.896 ppb	N/A	1.885 ppb	1.920 ppb	1.865 ppb	1.861 ppb	1.861 ppb
Concentration per Run 1	29.847 ppb	1.950 ppb	1.972 ppb	1.918 ppb	N/A	1.943 ppb	1.951 ppb	1.883 ppb	1.904 ppb	1.849 ppb
Concentration per Run 2	28.827 ppb	1.852 ppb	1.955 ppb	1.843 ppb	N/A	1.860 ppb	1.948 ppb	1.910 ppb	1.801 ppb	1.905 ppb
Concentration per Run 3	29.225 ppb	1.944 ppb	1.823 ppb	1.927 ppb	N/A	1.851 ppb	1.863 ppb	1.804 ppb	1.877 ppb	1.829 ppb
Concentration RSD 1	1.8 %	2.9 %	4.2 %	2.4 %	N/A	2.7 %	2.6 %	3.0 %	2.9 %	2.1 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	1.905 ppb	1.860 ppb	1.839 ppb	1.936 ppb	1.888 ppb	1.837 ppb	0.870 ppb	0.866 ppb	83.513 %	1.770 ppb
Concentration per Run 1	1.927 ppb	1.875 ppb	1.831 ppb	1.957 ppb	1.875 ppb	1.809 ppb	0.866 ppb	0.892 ppb	81.625 %	1.794 ppb
Concentration per Run 2	1.897 ppb	1.865 ppb	1.871 ppb	1.886 ppb	1.871 ppb	1.882 ppb	0.825 ppb	0.883 ppb	82.402 %	1.796 ppb
Concentration per Run 3	1.892 ppb	1.839 ppb	1.815 ppb	1.964 ppb	1.919 ppb	1.819 ppb	0.917 ppb	0.823 ppb	86.513 %	1.720 ppb
Concentration RSD 1	1.0 %	1.0 %	1.6 %	2.2 %	1.4 %	2.2 %	5.3 %	4.3 %	3.1 %	2.5 %

Analysis index: 10 Analysis started at: 4/19/2024 3:38:20 PM
Analysis label: FBE-2A User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (STD)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)
Concentration average 1	235.234 ppb	153.543.424 ppb	5,319.529 ppb	253.516 ppb	0.863 ppb	1,873.980 ppb	45.043 ppb	422.464 ppb	63.353 ppb
Concentration per Run 1	231.207 ppb	158,245.475 ppb	5,128.953 ppb	248.593 ppb	0.793 ppb	1,838.589 ppb	43.644 ppb	413.508 ppb	61.532 ppb
Concentration per Run 2	239.203 ppb	153,239.477 ppb	5,427.532 ppb	255.767 ppb	0.893 ppb	1,870.795 ppb	44.870 ppb	420.304 ppb	63.251 ppb
Concentration per Run 3	235.291 ppb	149,145.321 ppb	5,402.102 ppb	256.186 ppb	0.904 ppb	1,912.556 ppb	46.616 ppb	433.579 ppb	65.277 ppb
Concentration RSD 1	1.7 %	3.0 %	3.1 %	1.7 %	7.1 %	2.0 %	3.3 %	2.4 %	3.0 %

Category	115In (KEDS)	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)
Concentration average 1	[illegible]	103.625 ppb	163.064 ppb	347.367 ppb	41.070 ppb	N/A	143.878 ppb	23.503 ppb	6.707 ppb
Concentration per Run 1	85.566 %	100.927 ppb	159.376 ppb	337.713 ppb	39.605 ppb	N/A	137.669 ppb	22.656 ppb	6.348 ppb
Concentration per Run 2	83.825 %	103.341 ppb	163.001 ppb	348.912 ppb	41.206 ppb	N/A	147.167 ppb	23.301 ppb	6.862 ppb
Concentration per Run 3	[illegible]	106.607 ppb	166.815 ppb	355.477 ppb	42.399 ppb	N/A	146.799 ppb	24.551 ppb	6.911 ppb
Concentration RSD 1	[illegible]	2.8 %	2.3 %	2.6 %	3.4 %	N/A	3.7 %	4.1 %	4.6 %

Category	157Gd (KEDS)	159Tb (KEDS)	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)
Concentration average 1	18.691 ppb	2.228 ppb	10.863 ppb	1.914 ppb	4.707 ppb	0.604 ppb	3.664 ppb	0.516 ppb	5.894 ppb
Concentration per Run 1	18.425 ppb	2.160 ppb	10.580 ppb	1.830 ppb	4.636 ppb	0.581 ppb	3.621 ppb	0.506 ppb	5.749 ppb
Concentration per Run 2	18.628 ppb	2.243 ppb	10.532 ppb	1.911 ppb	4.656 ppb	0.597 ppb	3.496 ppb	0.518 ppb	5.815 ppb
Concentration per Run 3	19.019 ppb	2.283 ppb	11.477 ppb	2.000 ppb	4.928 ppb	0.632 ppb	3.873 ppb	0.525 ppb	6.118 ppb
Concentration RSD 1	1.6 %	2.8 %	4.9 %	4.5 %	4.2 %	4.3 %	5.2 %	1.9 %	3.3 %

Category	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.443 ppb	56.038 %	14.834 ppb
Concentration per Run 1	0.432 ppb	58.912 %	14.195 ppb
Concentration per Run 2	0.547 ppb	53.959 %	15.350 ppb
Concentration per Run 3	0.351 ppb	55.408 %	14.957 ppb
Concentration RSD 1	22.1 %	4.5 %	4.0 %

Analysis index: 11 Analysis started at: 4/19/2024 3:42:14 PM
Analysis label: BCR-2 User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (STD)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	10,955.313 ppb	44,664.559 ppb	13,921.864 ppb	420.715 ppb	29.475 ppb	324.061 ppb	31.765 ppb	175.460 ppb	10.468 ppb	83.977 %
Concentration per Run 1	11,433.462 ppb	44,884.458 ppb	14,871.303 ppb	450.765 ppb	31.186 ppb	343.166 ppb	33.727 ppb	184.988 ppb	11.127 ppb	81.300 %
Concentration per Run 2	10,920.194 ppb	45,823.996 ppb	13,711.302 ppb	418.409 ppb	29.352 ppb	321.360 ppb	31.741 ppb	174.395 ppb	10.325 ppb	85.185 %
Concentration per Run 3	10,512.283 ppb	43,285.223 ppb	13,182.987 ppb	392.970 ppb	27.888 ppb	307.657 ppb	29.828 ppb	166.995 ppb	9.952 ppb	85.446 %
Concentration RSD 1	4.2 %	2.9 %	6.2 %	6.9 %	5.6 %	5.5 %	6.1 %	5.2 %	5.7 %	2.8 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	593.463 ppb	22.394 ppb	47.937 ppb	6.003 ppb	N/A	25.620 ppb	5.869 ppb	1.786 ppb	6.194 ppb	0.937 ppb
Concentration per Run 1	619.525 ppb	24.048 ppb	50.975 ppb	6.302 ppb	N/A	26.680 ppb	6.287 ppb	1.889 ppb	6.535 ppb	1.005 ppb
Concentration per Run 2	586.271 ppb	21.850 ppb	46.973 ppb	5.950 ppb	N/A	25.646 ppb	5.763 ppb	1.750 ppb	6.087 ppb	0.927 ppb
Concentration per Run 3	574.593 ppb	21.283 ppb	45.862 ppb	5.757 ppb	N/A	24.535 ppb	5.558 ppb	1.718 ppb	5.959 ppb	0.879 ppb
Concentration RSD 1	3.9 %	6.5 %	5.6 %	4.6 %	N/A	4.2 %	6.4 %	5.1 %	4.9 %	6.8 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	5.729 ppb	1.198 ppb	3.192 ppb	0.478 ppb	3.049 ppb	0.436 ppb	4.001 ppb	0.658 ppb	58.512 %	5.226 ppb
Concentration per Run 1	6.104 ppb	1.275 ppb	3.388 ppb	0.501 ppb	3.227 ppb	0.445 ppb	4.304 ppb	0.668 ppb	57.295 %	5.620 ppb
Concentration per Run 2	5.602 ppb	1.176 ppb	3.152 ppb	0.475 ppb	2.993 ppb	0.440 ppb	3.982 ppb	0.671 ppb	58.368 %	5.207 ppb
Concentration per Run 3	5.482 ppb	1.143 ppb	3.037 ppb	0.459 ppb	2.928 ppb	0.423 ppb	3.718 ppb	0.634 ppb	59.872 %	4.852 ppb
Concentration RSD 1	5.8 %	5.7 %	5.6 %	4.4 %	5.2 %	2.7 %	7.3 %	3.2 %	2.2 %	7.4 %

Analysis index: 12 Analysis started at: 4/19/2024 3:46:09 PM
Analysis label: FBE-1C User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (STD)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)
Concentration average 1	1,186.441 ppb	147,638.760 ppb	1,900.453 ppb	254.983 ppb	3.875 ppb	1,178.048 ppb	54.313 ppb	369.051 ppb	28.197 ppb
Concentration per Run 1	1,220.469 ppb	153,899.044 ppb	1,989.416 ppb	262.903 ppb	3.895 ppb	1,202.716 ppb	54.967 ppb	379.610 ppb	28.571 ppb
Concentration per Run 2	1,201.777 ppb	146,046.448 ppb	1,865.086 ppb	256.650 ppb	3.879 ppb	1,165.231 ppb	54.434 ppb	365.188 ppb	28.324 ppb
Concentration per Run 3	1,137.077 ppb	142,970.788 ppb	1,846.856 ppb	245.395 ppb	3.852 ppb	1,166.197 ppb	53.537 ppb	362.354 ppb	27.698 ppb
Concentration RSD 1	3.7 %	3.8 %	4.1 %	3.5 %	0.6 %	1.8 %	1.3 %	2.5 %	1.6 %

Category	115In (KEDS)	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)
Concentration average 1	83.277 %	492.934 ppb	188.019 ppb	388.150 ppb	47.350 ppb	N/A	162.397 ppb	26.891 ppb	7.382 ppb
Concentration per Run 1	83.541 %	517.343 ppb	191.959 ppb	392.654 ppb	47.288 ppb	N/A	162.782 ppb	27.166 ppb	7.621 ppb
Concentration per Run 2	82.971 %	486.980 ppb	187.057 ppb	396.058 ppb	47.656 ppb	N/A	164.103 ppb	26.839 ppb	7.295 ppb
Concentration per Run 3	83.318 %	474.479 ppb	185.039 ppb	375.739 ppb	47.107 ppb	N/A	160.306 ppb	26.669 ppb	7.229 ppb
Concentration RSD 1	0.3 %	4.5 %	1.9 %	2.8 %	0.6 %	N/A	1.2 %	0.9 %	2.8 %

Category	157Gd (KEDS)	159Tb (KEDS)	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)
Concentration average 1	21.165 ppb	2.520 ppb	12.213 ppb	2.149 ppb	5.390 ppb	0.693 ppb	4.165 ppb	0.584 ppb	4.462 ppb
Concentration per Run 1	21.439 ppb	2.561 ppb	12.526 ppb	2.182 ppb	5.423 ppb	0.704 ppb	4.291 ppb	0.596 ppb	4.567 ppb
Concentration per Run 2	21.255 ppb	2.539 ppb	11.917 ppb	2.150 ppb	5.361 ppb	0.687 ppb	4.070 ppb	0.575 ppb	4.292 ppb
Concentration per Run 3	20.802 ppb	2.461 ppb	12.197 ppb	2.114 ppb	5.385 ppb	0.688 ppb	4.135 ppb	0.582 ppb	4.526 ppb
Concentration RSD 1	1.5 %	2.1 %	2.5 %	1.6 %	0.6 %	1.4 %	2.7 %	1.9 %	3.3 %

Category	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.089 ppb	57.845 %	15.899 ppb
Concentration per Run 1	0.097 ppb	56.972 %	16.527 ppb
Concentration per Run 2	0.107 ppb	58.158 %	15.334 ppb
Concentration per Run 3	0.064 ppb	58.404 %	15.836 ppb
Concentration RSD 1	25.2 %	1.3 %	3.8 %

Analysis index: 13 Analysis started at: 4/19/2024 3:50:05 PM
Analysis label: 6B1DB User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (STD)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	614.576 ppb	89,853.311 ppb	5,160.628 ppb	222.213 ppb	0.725 ppb	130.455 ppb	17.507 ppb	38.428 ppb	0.844 ppb	90.818 %
Concentration per Run 1	634.040 ppb	92,715.265 ppb	5,366.231 ppb	230.527 ppb	0.690 ppb	133.377 ppb	17.831 ppb	39.335 ppb	0.862 ppb	89.375 %
Concentration per Run 2	613.500 ppb	89,907.660 ppb	5,077.029 ppb	219.901 ppb	0.749 ppb	131.310 ppb	17.289 ppb	38.567 ppb	0.844 ppb	91.488 %
Concentration per Run 3	596.187 ppb	86,937.008 ppb	5,038.625 ppb	216.212 ppb	0.736 ppb	126.679 ppb	17.401 ppb	37.381 ppb	0.826 ppb	91.590 %
Concentration RSD 1	3.1 %	3.2 %	3.5 %	3.3 %	4.3 %	2.6 %	1.6 %	2.6 %	2.2 %	1.4 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	16.543 ppb	1.380 ppb	4.321 ppb	0.779 ppb	N/A	4.382 ppb	1.698 ppb	0.674 ppb	2.506 ppb	0.457 ppb
Concentration per Run 1	17.087 ppb	1.456 ppb	4.413 ppb	0.792 ppb	N/A	4.448 ppb	1.750 ppb	0.682 ppb	2.530 ppb	0.467 ppb
Concentration per Run 2	16.292 ppb	1.351 ppb	4.315 ppb	0.774 ppb	N/A	4.382 ppb	1.697 ppb	0.663 ppb	2.545 ppb	0.453 ppb
Concentration per Run 3	16.251 ppb	1.334 ppb	4.234 ppb	0.771 ppb	N/A	4.315 ppb	1.648 ppb	0.676 ppb	2.444 ppb	0.450 ppb
Concentration RSD 1	2.9 %	4.8 %	2.1 %	1.5 %	N/A	1.5 %	3.0 %	1.4 %	2.2 %	1.9 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	3.178 ppb	0.685 ppb	1.989 ppb	0.300 ppb	1.939 ppb	0.278 ppb	1.034 ppb	0.084 ppb	63.423 %	0.080 ppb
Concentration per Run 1	3.293 ppb	0.696 ppb	2.055 ppb	0.305 ppb	1.981 ppb	0.277 ppb	1.042 ppb	0.078 ppb	64.089 %	0.084 ppb
Concentration per Run 2	3.094 ppb	0.685 ppb	1.920 ppb	0.295 ppb	1.930 ppb	0.279 ppb	1.030 ppb	0.085 ppb	62.155 %	0.079 ppb
Concentration per Run 3	3.145 ppb	0.673 ppb	1.990 ppb	0.300 ppb	1.906 ppb	0.278 ppb	1.031 ppb	0.090 ppb	63.024 %	0.078 ppb
Concentration RSD 1	3.3 %	1.7 %	3.4 %	1.7 %	2.0 %	0.4 %	0.6 %	6.9 %	0.9 %	4.3 %

Analysis index: 14 Analysis started at: 4/19/2024 3:54:00 PM
Analysis label: 75AFr0052A User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (STD)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	1,959.896 ppb	52,544.706 ppb	7,104.776 ppb	258.219 ppb	2.675 ppb	139.810 ppb	24.800 ppb	81.087 ppb	1.374 ppb	86.872 %
Concentration per Run 1	2,034.911 ppb	55,748.172 ppb	7,337.791 ppb	266.759 ppb	2.695 ppb	144.421 ppb	25.409 ppb	83.211 ppb	1.412 ppb	86.672 %
Concentration per Run 2	1,968.425 ppb	51,858.180 ppb	7,047.001 ppb	260.742 ppb	2.716 ppb	140.283 ppb	24.930 ppb	81.393 ppb	1.365 ppb	86.840 %
Concentration per Run 3	1,876.351 ppb	50,027.766 ppb	6,929.536 ppb	247.157 ppb	2.614 ppb	134.725 ppb	24.060 ppb	78.657 ppb	1.345 ppb	87.105 %
Concentration RSD 1	4.1 %	5.6 %	3.0 %	3.9 %	2.0 %	3.5 %	2.8 %	2.8 %	2.5 %	0.3 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	52.006 ppb	3.096 ppb	9.360 ppb	1.532 ppb	N/A	8.269 ppb	2.741 ppb	1.015 ppb	3.736 ppb	0.676 ppb
Concentration per Run 1	52.873 ppb	3.176 ppb	9.721 ppb	1.590 ppb	N/A	8.459 ppb	2.810 ppb	1.069 ppb	3.845 ppb	0.696 ppb
Concentration per Run 2	52.369 ppb	3.083 ppb	9.199 ppb	1.533 ppb	N/A	8.266 ppb	2.765 ppb	0.996 ppb	3.737 ppb	0.666 ppb
Concentration per Run 3	50.777 ppb	3.028 ppb	9.159 ppb	1.471 ppb	N/A	8.082 ppb	2.646 ppb	0.981 ppb	3.626 ppb	0.667 ppb
Concentration RSD 1	2.1 %	2.4 %	3.3 %	3.9 %	N/A	2.3 %	3.1 %	4.7 %	2.9 %	2.5 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	4.494 ppb	0.979 ppb	2.800 ppb	0.419 ppb	2.714 ppb	0.395 ppb	1.918 ppb	0.106 ppb	61.729 %	0.195 ppb
Concentration per Run 1	4.731 ppb	0.996 ppb	3.007 ppb	0.430 ppb	2.853 ppb	0.407 ppb	1.969 ppb	0.110 ppb	60.759 %	0.202 ppb
Concentration per Run 2	4.374 ppb	0.987 ppb	2.777 ppb	0.418 ppb	2.680 ppb	0.395 ppb	1.916 ppb	0.104 ppb	62.035 %	0.196 ppb
Concentration per Run 3	4.377 ppb	0.954 ppb	2.617 ppb	0.408 ppb	2.609 ppb	0.384 ppb	1.869 ppb	0.105 ppb	62.343 %	0.188 ppb
Concentration RSD 1	4.6 %	2.3 %	7.0 %	2.5 %	4.6 %	2.9 %	2.6 %	2.9 %	1.4 %	3.7 %

Analysis index: 15 Analysis started at: 4/19/2024 3:57:55 PM
Analysis label: 75AFr0050C User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (STD)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)	115In (KEDS)
Concentration average 1	1,025.084 ppb	62,416.483 ppb	6,441.473 ppb	243.939 ppb	1.774 ppb	145.495 ppb	20.922 ppb	62.536 ppb	1.110 ppb	94.480 %
Concentration per Run 1	934.335 ppb	66,063.014 ppb	5,742.609 ppb	219.575 ppb	1.660 ppb	129.674 ppb	19.008 ppb	56.186 ppb	1.005 ppb	100.455 %
Concentration per Run 2	1,031.886 ppb	63,400.024 ppb	6,530.612 ppb	246.149 ppb	1.768 ppb	147.852 ppb	21.108 ppb	63.289 ppb	1.134 ppb	93.693 %
Concentration per Run 3	1,109.031 ppb	57,786.412 ppb	7,051.199 ppb	266.093 ppb	1.895 ppb	158.959 ppb	22.649 ppb	68.133 ppb	1.191 ppb	89.291 %
Concentration RSD 1	8.5 %	6.8 %	10.2 %	9.6 %	6.6 %	10.2 %	8.7 %	9.6 %	8.6 %	6.0 %

Category	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)	157Gd (KEDS)	159Tb (KEDS)
Concentration average 1	48.726 ppb	2.175 ppb	6.875 ppb	1.161 ppb	N/A	6.378 ppb	2.222 ppb	0.825 ppb	3.073 ppb	0.557 ppb
Concentration per Run 1	44.869 ppb	1.932 ppb	6.367 ppb	1.032 ppb	N/A	5.594 ppb	2.040 ppb	0.744 ppb	2.755 ppb	0.506 ppb
Concentration per Run 2	49.264 ppb	2.264 ppb	6.974 ppb	1.199 ppb	N/A	6.442 ppb	2.300 ppb	0.844 ppb	3.121 ppb	0.571 ppb
Concentration per Run 3	52.046 ppb	2.329 ppb	7.283 ppb	1.252 ppb	N/A	7.096 ppb	2.325 ppb	0.886 ppb	3.342 ppb	0.594 ppb
Concentration RSD 1	7.4 %	9.8 %	6.8 %	9.9 %	N/A	11.8 %	7.1 %	8.8 %	9.7 %	8.2 %

Category	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	3.811 ppb	0.828 ppb	2.337 ppb	0.351 ppb	2.283 ppb	0.338 ppb	1.513 ppb	0.087 ppb	69.642 %	0.097 ppb
Concentration per Run 1	3.377 ppb	0.756 ppb	2.095 ppb	0.328 ppb	2.033 ppb	0.300 ppb	1.357 ppb	0.078 ppb	73.487 %	0.087 ppb
Concentration per Run 2	3.964 ppb	0.833 ppb	2.345 ppb	0.348 ppb	2.311 ppb	0.344 ppb	1.543 ppb	0.088 ppb	68.441 %	0.098 ppb
Concentration per Run 3	4.093 ppb	0.895 ppb	2.570 ppb	0.376 ppb	2.505 ppb	0.370 ppb	1.637 ppb	0.095 ppb	65.997 %	0.105 ppb
Concentration RSD 1	10.0 %	8.4 %	10.2 %	6.8 %	10.4 %	10.5 %	9.4 %	10.1 %	5.4 %	9.9 %

Analysis index: 16 Analysis started at: 4/19/2024 4:01:51 PM
Analysis label: FBE-1C re-run User name: ICAPQC-2\Michelle Jordan

Category	39K (KEDS)	44Ca (STD)	48Ti (KEDS)	51V (KEDS)	85Rb (KEDS)	88Sr (KEDS)	89Y (KEDS)	90Zr (KEDS)	93Nb (KEDS)
Concentration average 1	1,281.822 ppb	164,040.097 ppb	2,183.891 ppb	290.905 ppb	4.182 ppb	1,379.335 ppb	63.687 ppb	426.295 ppb	29.173 ppb
Concentration per Run 1	1,330.093 ppb	170,158.952 ppb	2,247.089 ppb	298.537 ppb	4.343 ppb	1,442.224 ppb	65.799 ppb	444.799 ppb	30.140 ppb
Concentration per Run 2	1,292.248 ppb	168,069.261 ppb	2,233.865 ppb	294.080 ppb	4.173 ppb	1,361.941 ppb	64.232 ppb	422.007 ppb	29.191 ppb
Concentration per Run 3	1,223.124 ppb	153,892.079 ppb	2,070.720 ppb	280.097 ppb	4.031 ppb	1,333.840 ppb	61.030 ppb	412.078 ppb	28.187 ppb
Concentration RSD 1	4.2 %	5.4 %	4.5 %	3.3 %	3.7 %	4.1 %	3.8 %	3.9 %	3.3 %

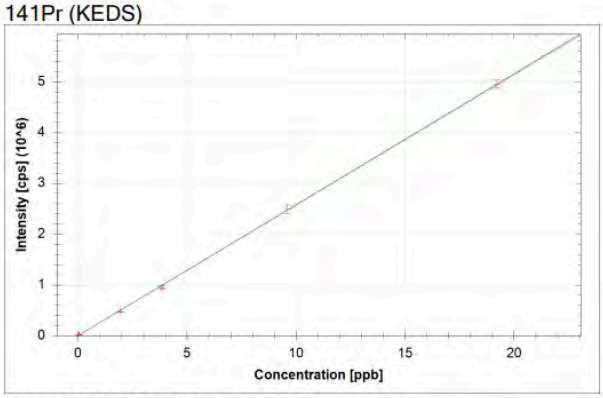
Category	115In (KEDS)	137Ba (KEDS)	139La (KEDS)	140Ce (KEDS)	141Pr (KEDS)	145Pm (KEDS)	146Nd (KEDS)	147Sm (KEDS)	153Eu (KEDS)
Concentration average 1	82.669 %	578.763 ppb	221.456 ppb	458.919 ppb	54.726 ppb	N/A	195.507 ppb	31.723 ppb	8.780 ppb
Concentration per Run 1	81.274 %	605.359 ppb	226.112 ppb	480.716 ppb	55.663 ppb	N/A	201.922 ppb	32.805 ppb	9.204 ppb
Concentration per Run 2	82.701 %	572.334 ppb	223.898 ppb	456.370 ppb	55.100 ppb	N/A	196.227 ppb	31.862 ppb	8.705 ppb
Concentration per Run 3	84.032 %	558.596 ppb	214.357 ppb	439.670 ppb	53.416 ppb	N/A	188.372 ppb	30.502 ppb	8.431 ppb
Concentration RSD 1	1.7 %	4.2 %	2.8 %	4.5 %	2.1 %	N/A	3.5 %	3.6 %	4.5 %

Category	157Gd (KEDS)	159Tb (KEDS)	163Dy (KEDS)	165Ho (KEDS)	166Er (KEDS)	169Tm (KEDS)	172Yb (KEDS)	175Lu (KEDS)	178Hf (KEDS)
Concentration average 1	24.625 ppb	2.995 ppb	14.418 ppb	2.568 ppb	6.435 ppb	0.818 ppb	5.043 ppb	0.700 ppb	5.250 ppb
Concentration per Run 1	24.987 ppb	3.104 ppb	14.590 ppb	2.652 ppb	6.652 ppb	0.819 ppb	5.227 ppb	0.716 ppb	5.457 ppb
Concentration per Run 2	25.175 ppb	3.034 ppb	14.435 ppb	2.604 ppb	6.488 ppb	0.815 ppb	5.076 ppb	0.696 ppb	5.223 ppb
Concentration per Run 3	23.712 ppb	2.846 ppb	14.231 ppb	2.448 ppb	6.166 ppb	0.820 ppb	4.825 ppb	0.689 ppb	5.070 ppb
Concentration RSD 1	3.2 %	4.5 %	1.3 %	4.2 %	3.8 %	0.4 %	4.0 %	2.0 %	3.7 %

Category	181Ta (KEDS)	209Bi (KEDS)	232Th (KEDS)
Concentration average 1	0.117 ppb	57.759 %	18.483 ppb
Concentration per Run 1	0.228 ppb	57.035 %	18.953 ppb
Concentration per Run 2	0.052 ppb	57.586 %	18.427 ppb
Concentration per Run 3	0.072 ppb	58.595 %	18.070 ppb
Concentration RSD 1	82.3 %	1.3 %	2.4 %

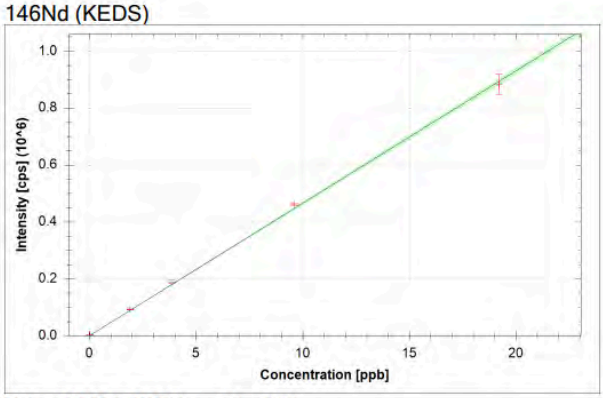
SEMESTER ONE CALIBRATION CURVES

141Pr (KEDS)



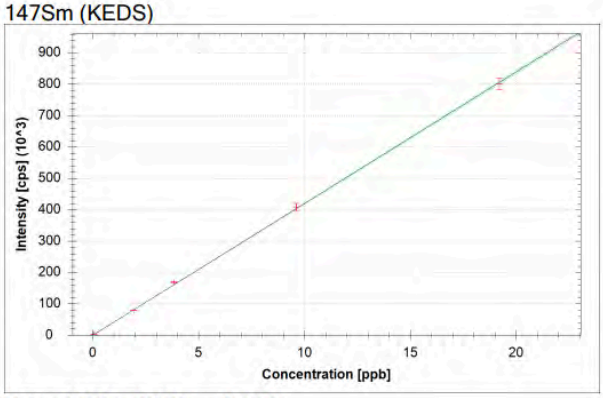
f(x) = 257618.5270*x + 12.8023
R² = 0.9999
BEC = 0.000 ppb
LoD = 0.0002 ppb

146Nd (KEDS)



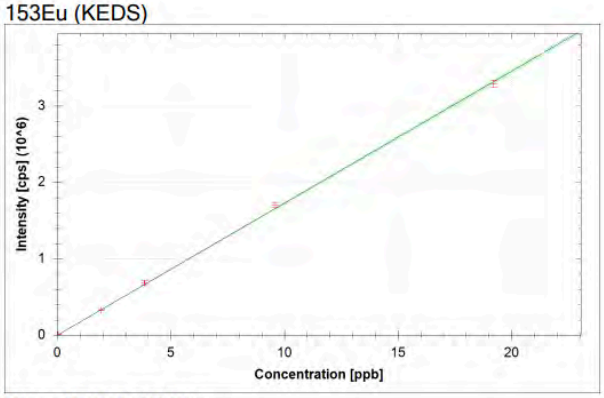
f(x) = 46492.9581*x + 20.0030
R² = 0.9994
BEC = 0.000 ppb
LoD = 0.0007 ppb

147Sm (KEDS)



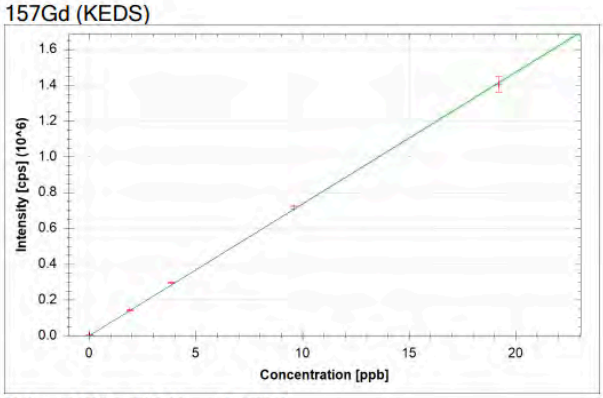
f(x) = 41948.3565*x + 1.0255
R² = 0.9998
BEC = 0.000 ppb
LoD = 0.0002 ppb

153Eu (KEDS)



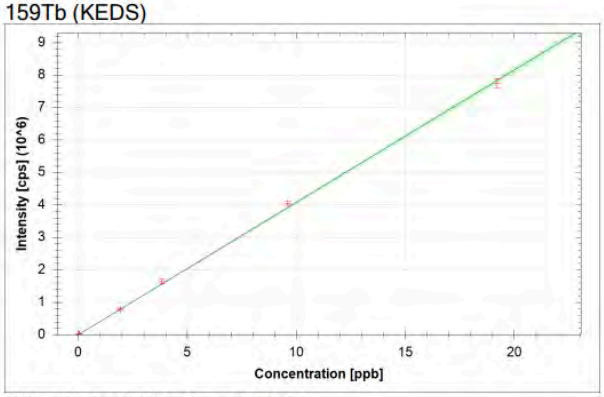
f(x) = 172800.3645*x
R² = 0.9996
BEC = 0.000 ppb
LoD = 0.0000 ppb

157Gd (KEDS)



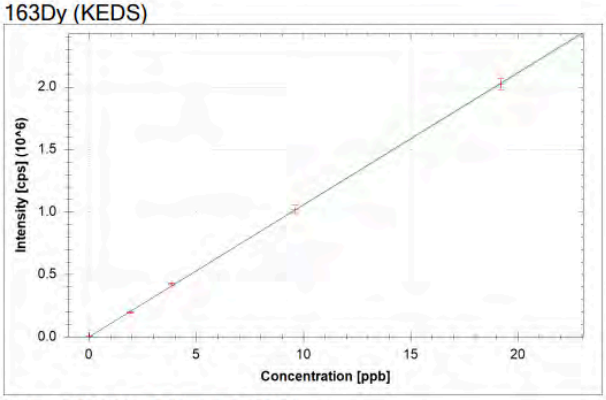
f(x) = 73562.0191*x + 1.0094
R² = 0.9998
BEC = 0.000 ppb
LoD = 0.0001 ppb

159Tb (KEDS)



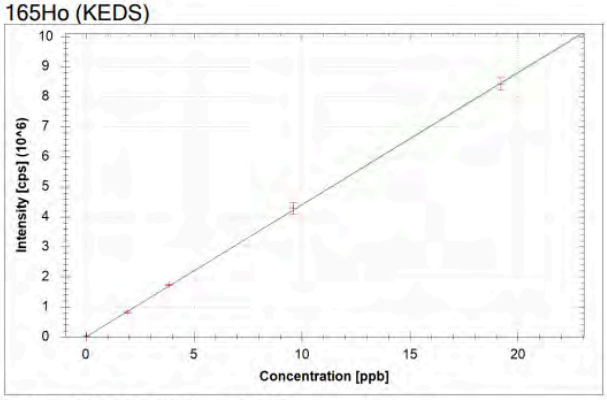
f(x) = 407507.4309*x + 2.0007
R² = 0.9994
BEC = 0.000 ppb
LoD = 0.0000 ppb

163Dy (KEDS)



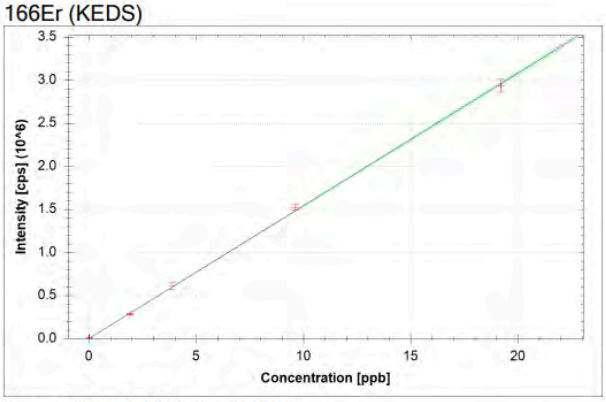
f(x) = 105662.1380*x + 5.9959
R² = 0.9999
BEC = 0.000 ppb
LoD = 0.0002 ppb

165Ho (KEDS)



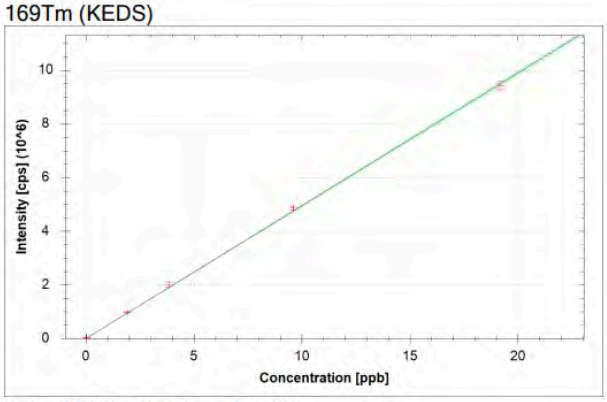
f(x) = 440138.6667*x + 2.0271
R² = 0.9999
BEC = 0.000 ppb
LoD = 0.0000 ppb

166Er (KEDS)



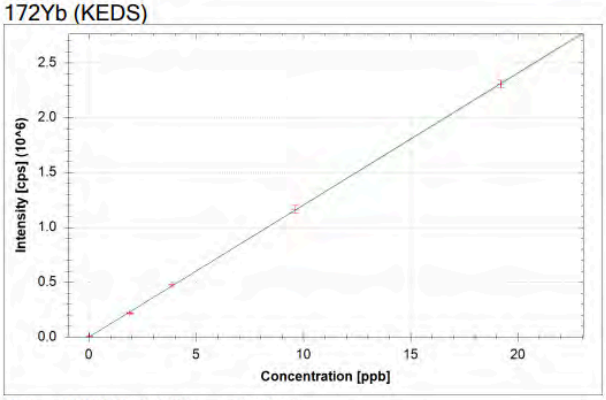
f(x) = 153962.4885*x + 2.0016
R² = 0.9996
BEC = 0.000 ppb
LoD = 0.0001 ppb

169Tm (KEDS)



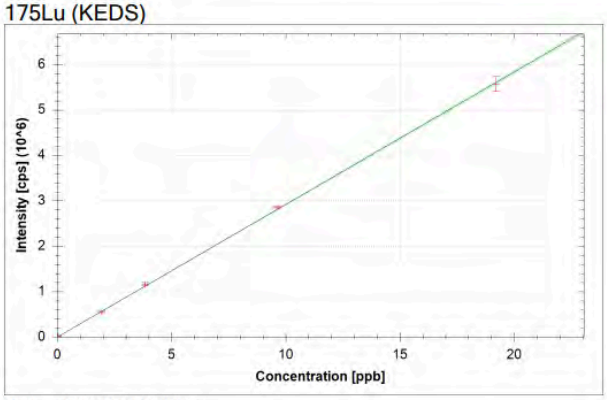
f(x) = 494808.0712*x + 0.9883
R² = 0.9996
BEC = 0.000 ppb
LoD = 0.0000 ppb

172Yb (KEDS)



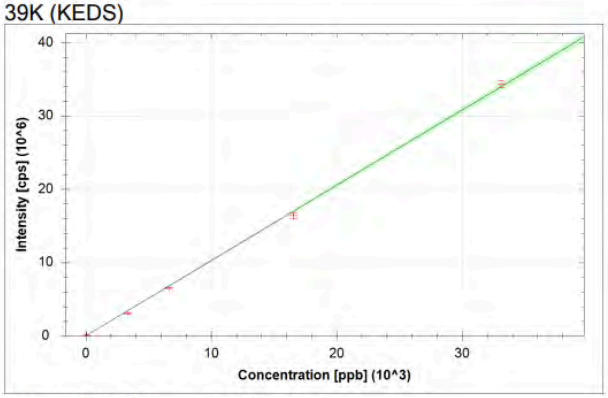
f(x) = 120325.6896*x + 1.9695
R² = 0.9999
BEC = 0.000 ppb
LoD = 0.0001 ppb

175Lu (KEDS)



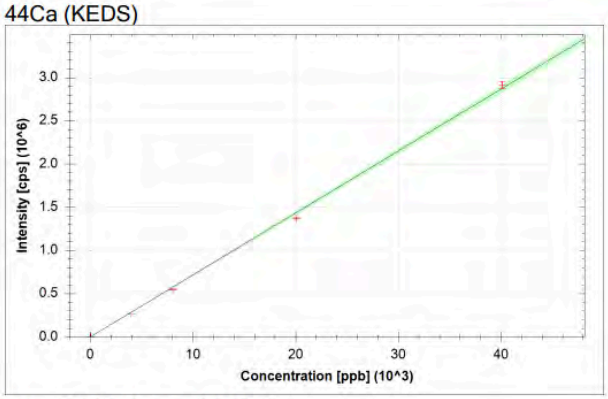
f(x) = 291727.0775*x
R² = 0.9998
BEC = 0.000 ppb
LoD = 0.0000 ppb

39K (KEDS)



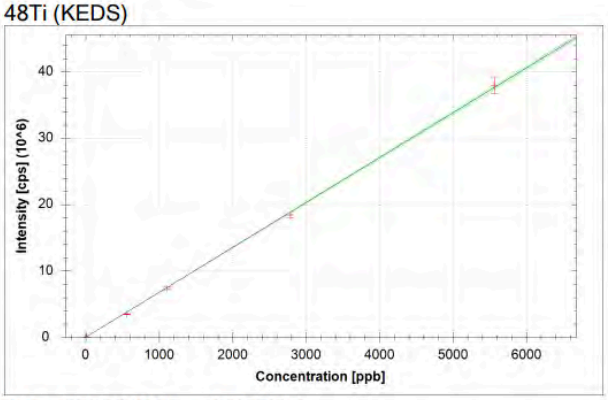
f(x) = 1026.1889*x + 17163.0884
R² = 0.9992
BEC = 16.725 ppb
LoD = 2.4194 ppb

44Ca (KEDS)



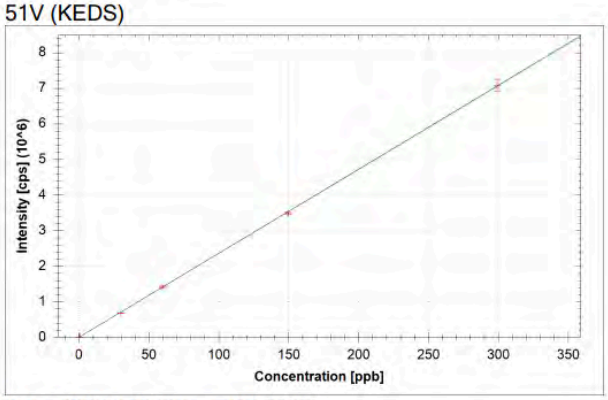
f(x) = 71.6210*x + 120.0011
R² = 0.9989
BEC = 1.676 ppb
LoD = 0.8378 ppb

48Ti (KEDS)



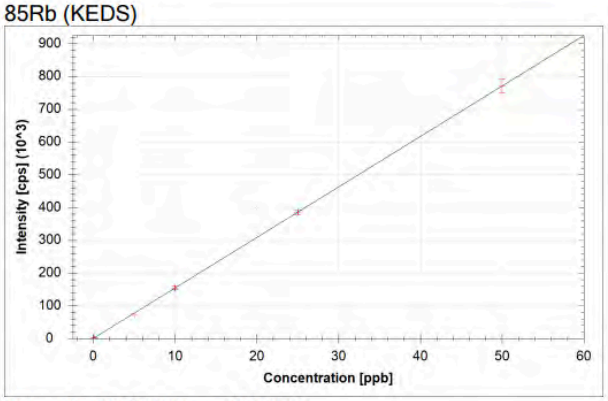
f(x) = 6766.2407*x + 366.5327
R² = 0.9996
BEC = 0.054 ppb
LoD = 0.0333 ppb

51V (KEDS)



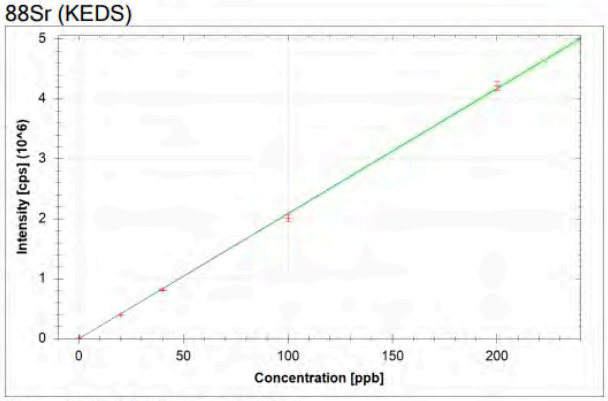
f(x) = 23604.0668*x + 100.7385
R² = 0.9999
BEC = 0.004 ppb
LoD = 0.0063 ppb

85Rb (KEDS)



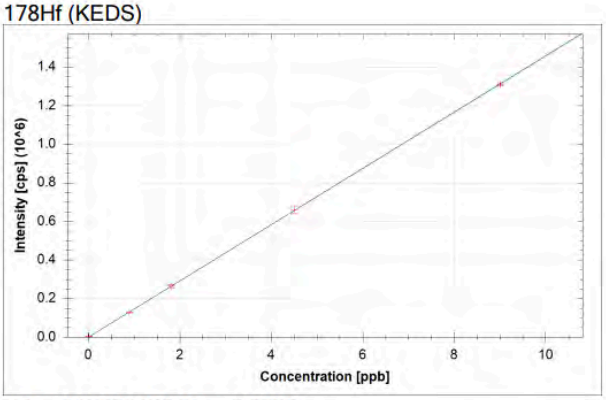
f(x) = 15403.9866*x + 719.8515
R² = 1.0000
BEC = 0.047 ppb
LoD = 0.0122 ppb

88Sr (KEDS)



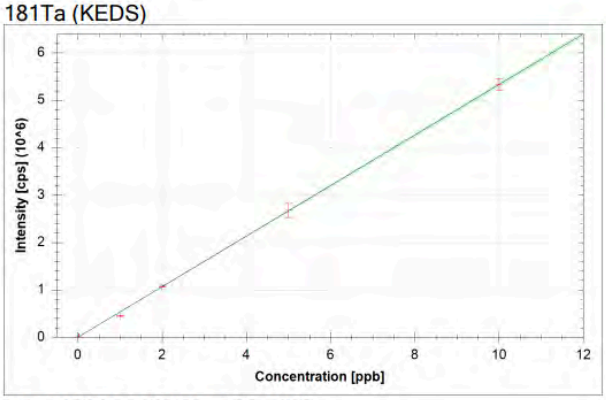
f(x) = 20851.9642*x + 40.1961
R² = 0.9994
BEC = 0.002 ppb
LoD = 0.0042 ppb

178Hf (KEDS)



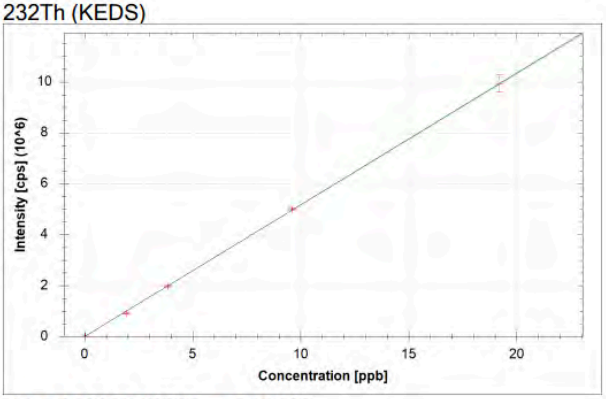
f(x) = 145727.4051*x + 5.0766
R² = 0.9999
BEC = 0.000 ppb
LoD = 0.0001 ppb

181Ta (KEDS)



f(x) = 533017.5657*x + 65.1203
R² = 0.9997
BEC = 0.000 ppb
LoD = 0.0002 ppb

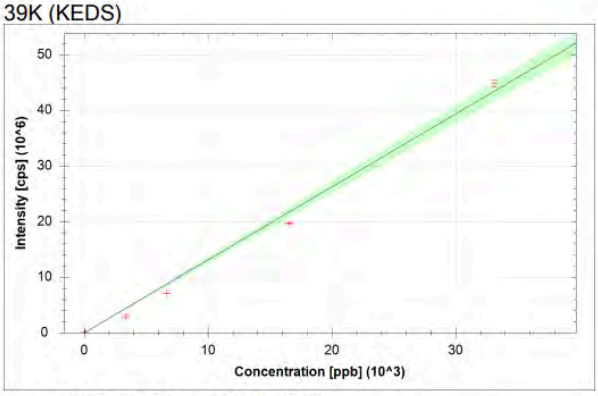
232Th (KEDS)



f(x) = 516974.4369*x + 17.9995
R² = 0.9999
BEC = 0.000 ppb
LoD = 0.0001 ppb

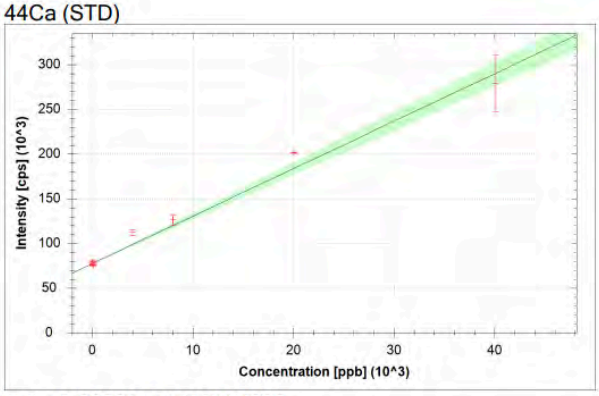
SEMESTER TWO CALIBRATION CURVES

39K (KEDS)



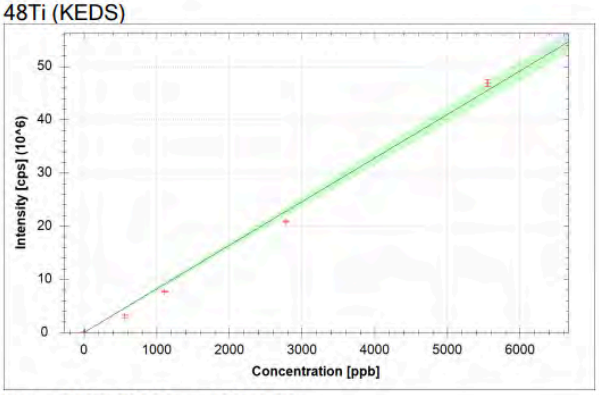
f(x) = 1310.7609*x + 18554.5060
R² = 0.9935
BEC = 14.156 ppb
LoD = 1.4726 ppb

44Ca (STD)



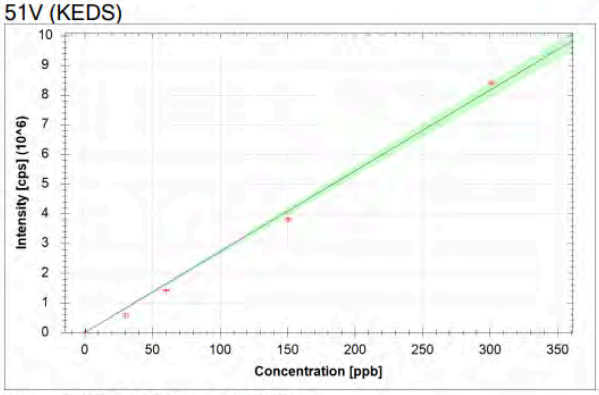
f(x) = 5.3099*x + 77534.2678
R² = 0.9816
BEC = 14601.734 ppb
LoD = 1175.3753 ppb

48Ti (KEDS)



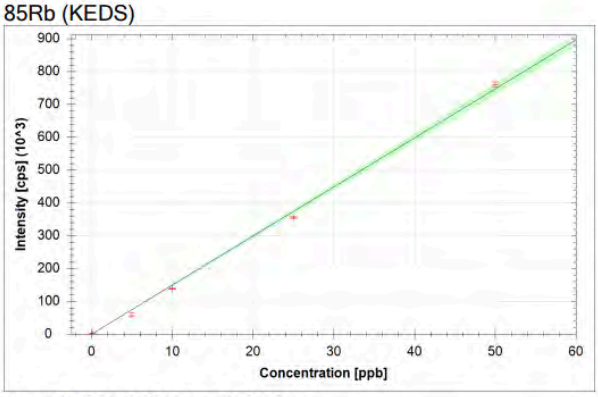
f(x) = 8196.2889*x + 428.1556
R² = 0.9945
BEC = 0.052 ppb
LoD = 0.0261 ppb

51V (KEDS)



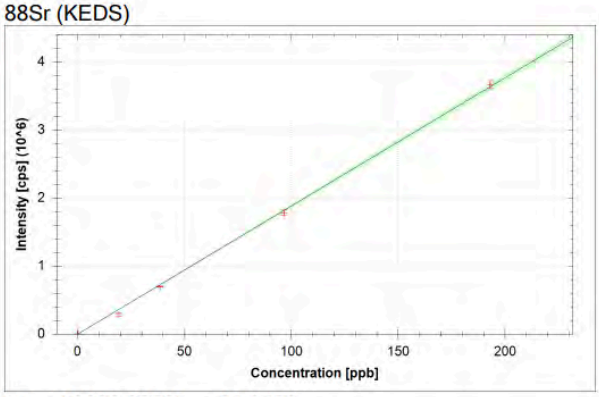
f(x) = 27202.1703*x + 54.9385
R² = 0.9959
BEC = 0.002 ppb
LoD = 0.0028 ppb

85Rb (KEDS)



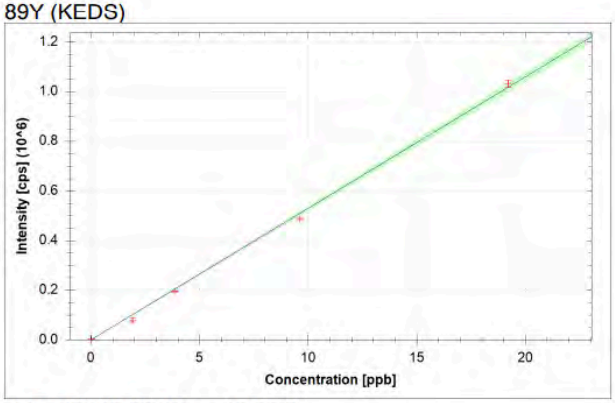
f(x) = 14931.5661*x + 389.3211
R² = 0.9981
BEC = 0.026 ppb
LoD = 0.0135 ppb

88Sr (KEDS)



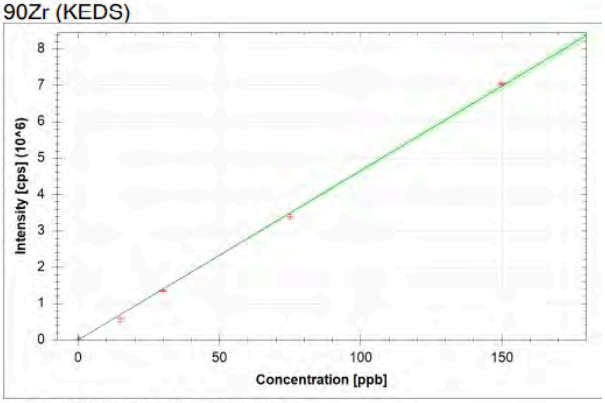
f(x) = 18836.9778*x + 81.9150
R² = 0.9993
BEC = 0.004 ppb
LoD = 0.0033 ppb

89Y (KEDS)



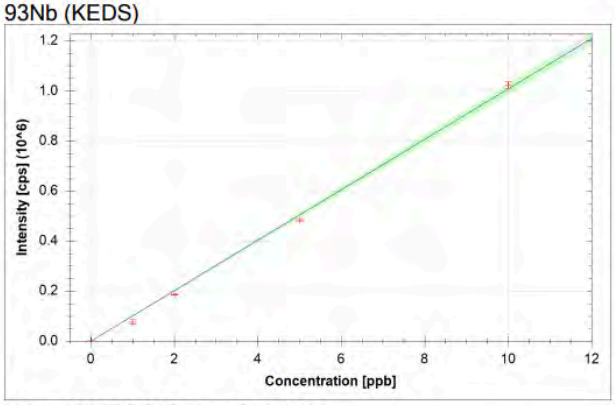
f(x) = 52933.9221*x + 22.0575
R² = 0.9986
BEC = 0.000 ppb
LoD = 0.0008 ppb

90Zr (KEDS)



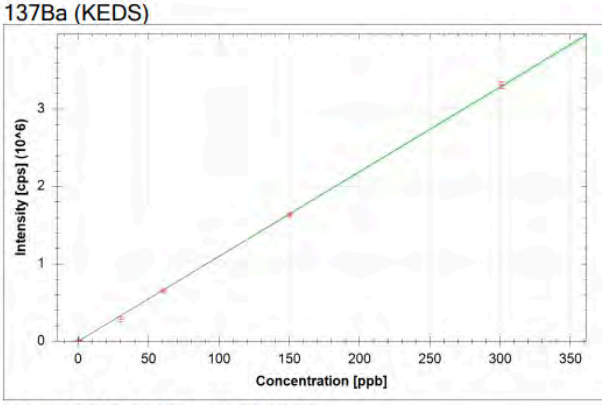
f(x) = 46508.2374*x + 57.9240
R² = 0.9991
BEC = 0.001 ppb
LoD = 0.0018 ppb

93Nb (KEDS)



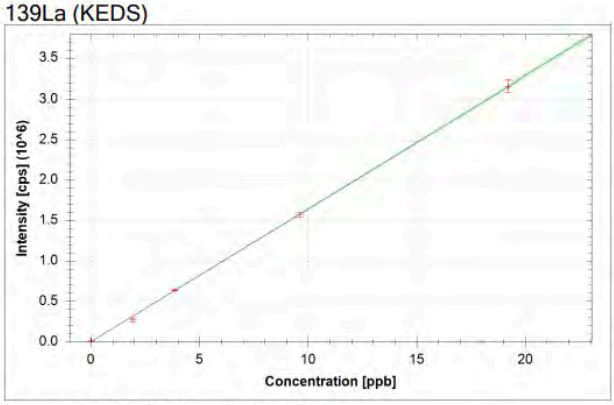
f(x) = 100779.3497*x + 213.8454
R² = 0.9983
BEC = 0.002 ppb
LoD = 0.0014 ppb

137Ba (KEDS)



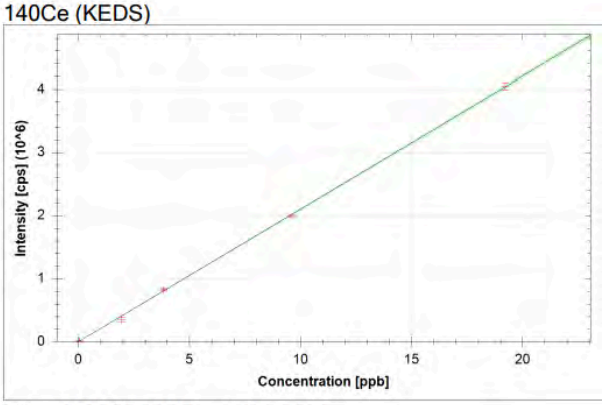
f(x) = 10943.2089*x + 178.9553
R² = 0.9997
BEC = 0.016 ppb
LoD = 0.0092 ppb

139La (KEDS)



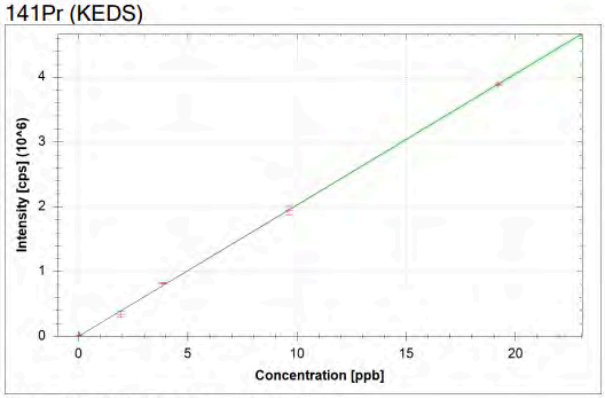
f(x) = 164183.6189*x + 187.8337
R² = 0.9997
BEC = 0.001 ppb
LoD = 0.0010 ppb

140Ce (KEDS)



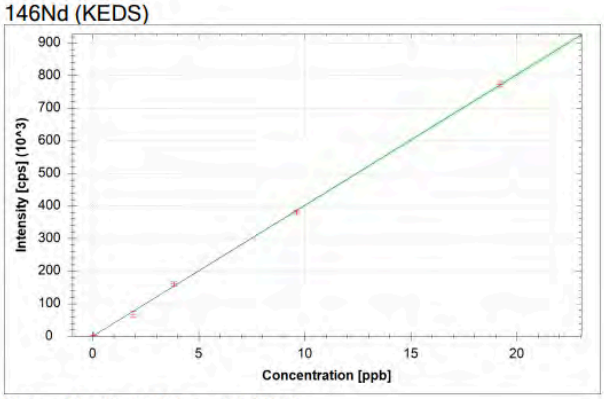
f(x) = 210139.6907*x + 266.1326
R² = 0.9997
BEC = 0.001 ppb
LoD = 0.0007 ppb

141Pr (KEDS)



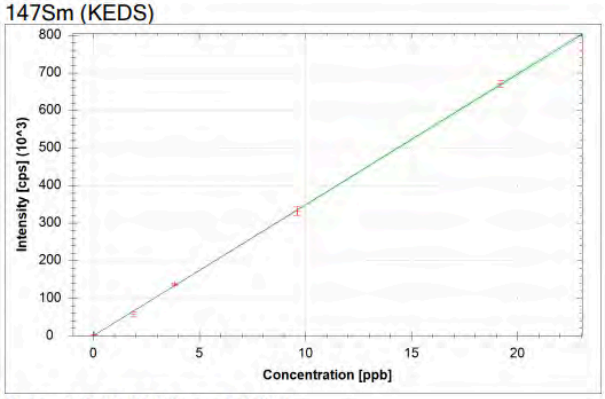
f(x) = 202425.6843*x + 56.9161
R² = 0.9997
BEC = 0.000 ppb
LoD = 0.0004 ppb

146Nd (KEDS)



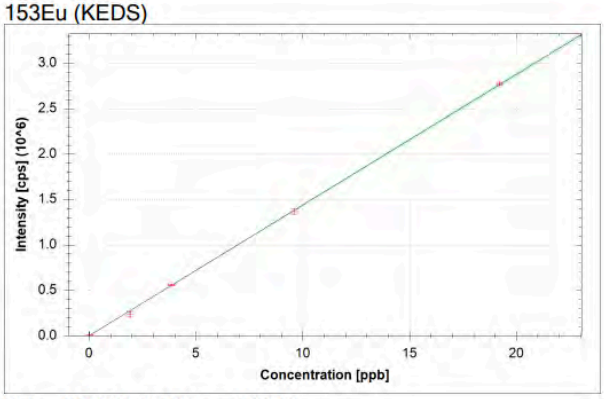
f(x) = 40129.4115*x + 38.9978
R² = 0.9997
BEC = 0.001 ppb
LoD = 0.0020 ppb

147Sm (KEDS)



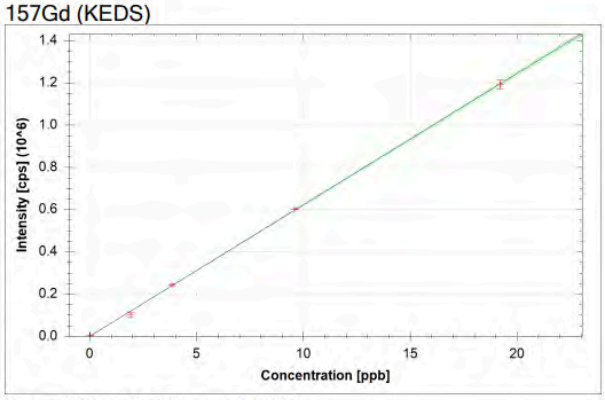
f(x) = 34808.8697*x + 4.9737
R² = 0.9997
BEC = 0.000 ppb
LoD = 0.0008 ppb

153Eu (KEDS)



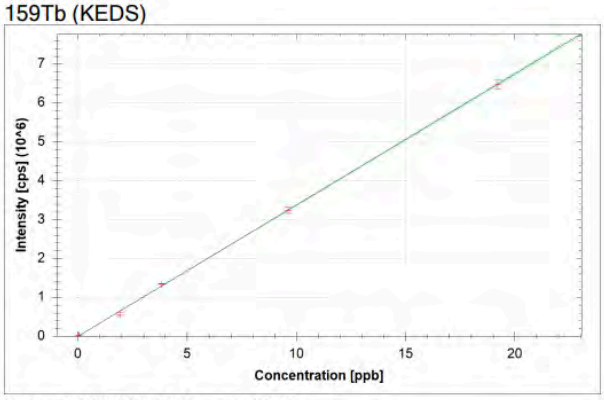
f(x) = 143825.8743*x + 4.0310
R² = 0.9997
BEC = 0.000 ppb
LoD = 0.0001 ppb

157Gd (KEDS)



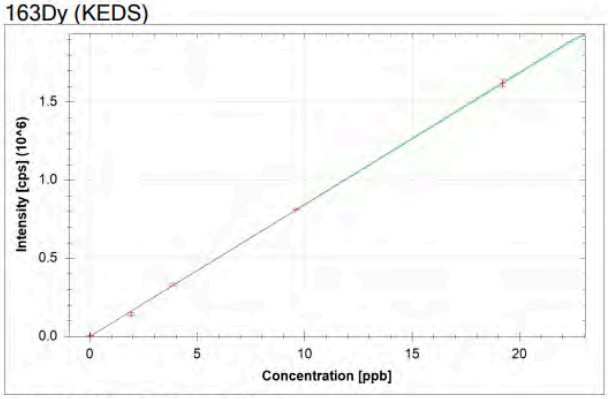
f(x) = 62212.1417*x + 12.0098
R² = 0.9997
BEC = 0.000 ppb
LoD = 0.0005 ppb

159Tb (KEDS)



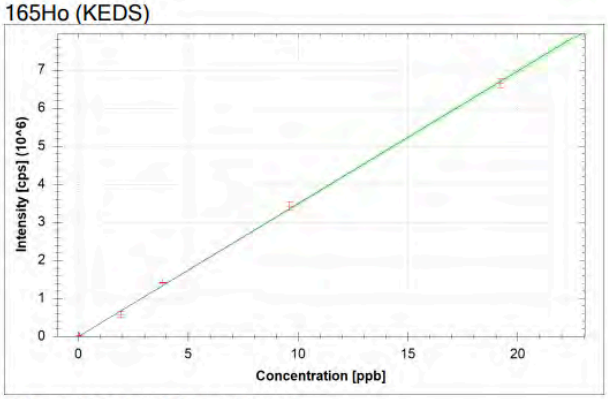
f(x) = 337262.3114*x + 5.9862
R² = 0.9997
BEC = 0.000 ppb
LoD = 0.0000 ppb

163Dy (KEDS)



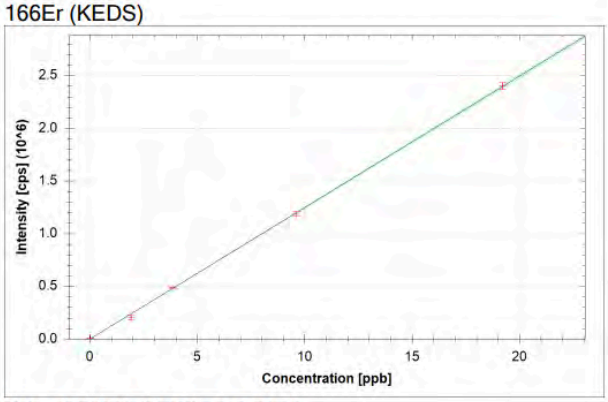
f(x) = 84368.1746*x + 9.9863
R² = 0.9998
BEC = 0.000 ppb
LoD = 0.0004 ppb

165Ho (KEDS)



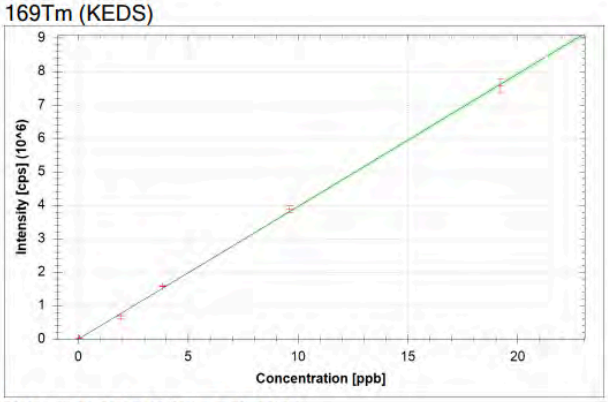
f(x) = 348883.1379*x + 7.9885
R² = 0.9994
BEC = 0.000 ppb
LoD = 0.0001 ppb

166Er (KEDS)



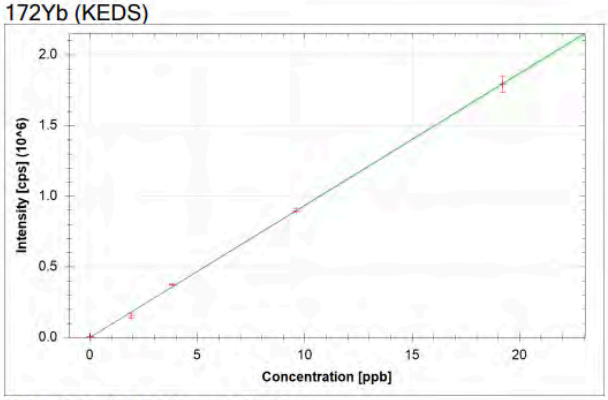
f(x) = 124688.4197*x + 2.0056
R² = 0.9997
BEC = 0.000 ppb
LoD = 0.0001 ppb

169Tm (KEDS)



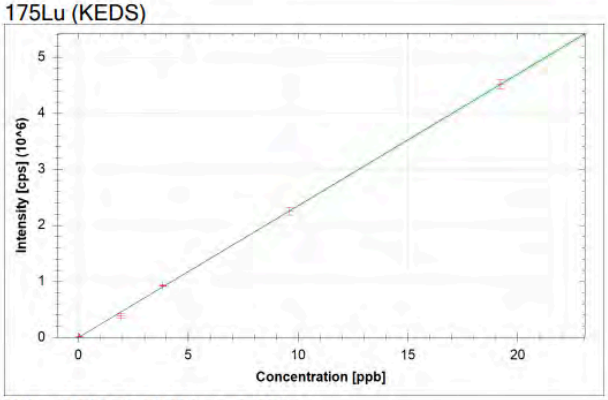
f(x) = 396379.3858*x + 4.0069
R² = 0.9996
BEC = 0.000 ppb
LoD = 0.0001 ppb

172Yb (KEDS)



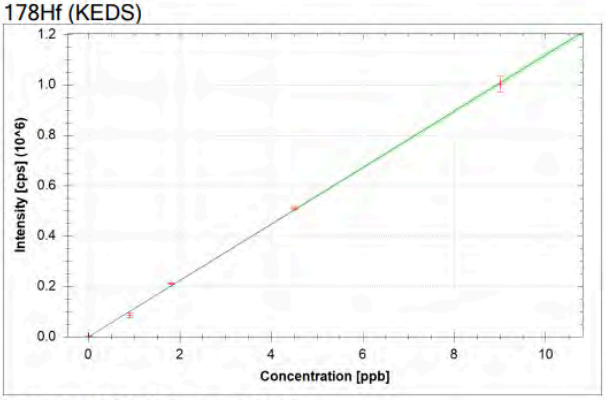
f(x) = 93375.0545*x + 3.9920
R² = 0.9997
BEC = 0.000 ppb
LoD = 0.0002 ppb

175Lu (KEDS)



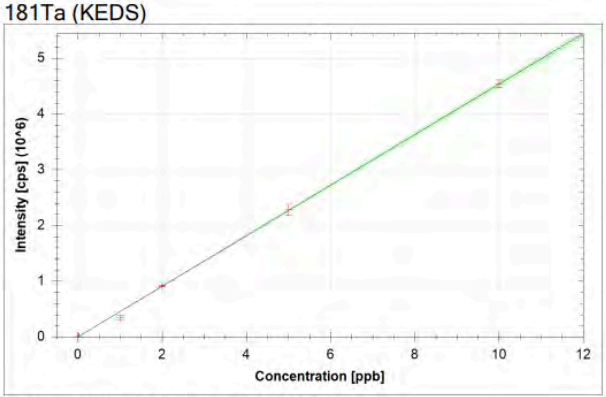
f(x) = 234854.2609*x + 3.0260
R² = 0.9997
BEC = 0.000 ppb
LoD = 0.0001 ppb

178Hf (KEDS)



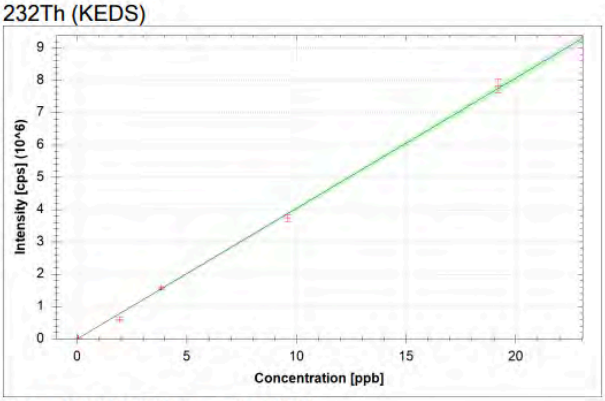
f(x) = 111907.7001*x + 0.9929
R² = 0.9996
BEC = 0.000 ppb
LoD = 0.0001 ppb

181Ta (KEDS)



f(x) = 453601.4840*x + 151.0457
R² = 0.9993
BEC = 0.000 ppb
LoD = 0.0003 ppb

232Th (KEDS)



f(x) = 403209.3606*x + 39.9660
R² = 0.9990
BEC = 0.000 ppb
LoD = 0.0001 ppb

A-2. Discussion of Trace Element Concentration Calculations

The first round of analyses presented some issues with dilution factor. After digestion, 4 mL of 4M HCl was added to the beakers and transferred to centrifuge tubes. After being run in the centrifuge for five minutes, one mL of the solution was transferred to new beakers and dried on the hotplate. To dilute further, the beakers were washed out with nitric acid twice and a remainder of nitric was added to make a total of 40 mL of HNO3 with the ¼ of the original 100 mg of sample (so now 25 mg of the initial sample). At the time of analysis, another 10 mL of nitric acid was added to dilute the samples further.

This initially caused some problems in analysis and led to concentrations that were far too low. After some backtracking and review of the dilution processes, it was determined that there were errors in the dilution calculations. Additionally, it was determined that the concentration outputs were far too low. Values were given in extremely small parts per billion, and further inquiry led to the belief that this is an error, and it should be labeled as parts per

million. Given that, the numbers are in the correct range. The final dilution factor calculations are as follows:

$$\frac{original\ mass\ (\sim 100\ mg)}{1} * \frac{HCl\ taken\ after\ digestion\ (\sim 1\ mL)}{total\ HCl\ (\sim 4\ mL)} * \frac{1}{total\ dilution\ using\ HNO_3\ (\sim 50\ mL)} * \frac{amt.\ of\ sample\ added\ to\ instrument\ tray\ (\sim 0.185\ mL)}{HNO_3\ added\ to\ instrument\ tray\ (\sim 1.635\ mL)}$$

Note: all amounts were weighed in mg for greater accuracy. 1 mg = 1 mL

Excel was used to make these calculations and the exact values are:

	Original Mass (mg)	*Diluted amt. used in analysis (~1 mL)*	*Dissolved Sample with HNO3(~4 mL)*	***Amt. of sample used in analysis***	*Dilution at UMD (mg)*
1 (FBE-1C)	104.48	1.0667	4.16255	26.77416872	39.9946
2 (FBE-1C)	103.02	1.0382	4.17449	25.62118103	40.1613
3 (FBE-2A)	97.19	1.0669	4.17832	24.81667536	39.9846
5 (BCR-2)	99.9	1.0482	4.16393	25.14816051	39.9953
6 (BHVO-2)	98.04	1.065	4.1741	25.01439831	40.0143
7 (Blank)	0	1.0614	4.16601	0	40.0121

	Dilution at Carnegie (mg)	*Total dilution amount (mg)*	*Amt. of sample/total dilution*	*Final Dilution f*	****Final concentration****	*Amt. of sample in tube (mg)*
1 (FBE-1C)	10.15	50.1446	0.533939222	1.639	0.058964612	0.181
2 (FBE-1C)	10.134	50.2953	0.509415016	1.641	0.055566903	0.179
3 (FBE-2A)	10.112	50.0966	0.49537644	1.638	0.055646682	0.184
5 (BCR-2)	10.147	50.1423	0.501535839	1.632	0.056853021	0.185
6 (BHVO-2)	10.137	50.1513	0.498778662	1.635	0.056131666	0.184
7 (Blank)	10.121	50.1331	0	1.64	0	0.181

As seen, the final concentrations were around 5.6%. The staff assisting with using the iCAP Q later informed that the ideal concentration should be about 20% so this is clearly too low, thus why some of the final values seem low even after the normalization (see Appendix 3).

The analyses that took place during the second semester were much more streamlined and simpler. Rather than only using 25% of the original dissolved sample amount and diluting further, a small amount (0.036 g) of the dissolved sample in 10 mL of HNO_3 plus 1.672 mL of pure HNO_3.

A-3. Discussion of Normalization for Determining Concentrations

In determining the correct concentrations, the raw concentrations in parts per million were divided by the final concentration values (around 0.056). The resulting values are normalized for dilution factor and remain in parts per million, which is the same unit used in the reference values. Elements used in analyses of Sun and McDonough (1989) are highlighted in yellow.

Concentration		51V	85Rb	88Sr	89Y	90Zr	93Nb	137Ba	139La	140Ce
Concentrations adjusted for dilution factor										
9	FBE-1C_1	288.65	5.26	1234.81	60.04	729.59	252.95	561.01	236.24	480.79
10	FBE-1C_2	276.42	5.04	1236.53	58.67	732.27	223.60	538.45	206.60	429.68
11	FBE-2A	273.87	1.08	1988.62	52.47	641.91	201.59	121.66	192.82	403.11
12	BCR-2	361.11	17.24	255.22	26.21	145.46	9.69	360.58	18.47	39.23
13	BHVO-2	265.98	6.77	313.37	19.42	130.05	15.55	106.71	12.47	28.31
14	BLANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	FBE-1C_1	294.75	4.92	1289.76	60.54	744.01	259.40	565.42	231.49	478.73
16	FBE-1C_2	281.82	4.86	1238.87	58.49	741.09	234.26	545.65	207.50	433.84
17	FBE-2A	258.96	0.90	1870.73	49.78	594.82	194.70	115.01	181.50	376.91
18	BCR-2	357.59	17.24	250.82	25.33	143.88	10.00	352.14	18.47	38.72
19	BHVO-2	267.16	6.79	310.37	19.49	130.56	15.34	107.52	12.84	27.95

146Nd	147Sm	153Eu	157Gd	163Dy	166Er	172Yb	175Lu	178Hf	181Ta	232Th
217.42	32.22	8.82	24.54	13.94	6.16	4.75	0.68	13.40	19.84	18.49
192.56	28.61	7.92	22.26	13.19	6.21	4.50	0.72	12.96	17.28	17.46
176.29	27.14	7.55	20.35	11.82	5.38	3.95	0.54	11.50	14.92	16.17
21.99	5.10	1.58	5.40	5.13	3.01	2.81	0.35	3.52	0.70	4.05
20.13	4.99	1.60	5.12	4.21	2.02	1.60	0.18	3.38	0.89	0.89
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
213.86	32.22	8.82	24.88	13.98	6.01	4.75	0.68	13.23	19.84	18.82
193.10	28.61	7.92	22.46	13.30	5.97	4.50	0.72	12.96	17.28	16.74
169.28	25.34	7.19	19.39	11.24	4.94	3.59	0.54	10.78	14.74	14.74
22.51	5.10	1.58	5.24	4.98	2.86	2.46	0.35	3.52	0.53	3.87
20.04	4.74	1.62	5.02	4.17	2.02	1.60	0.22	3.27	0.90	0.92

The second semester data did not require any normalization. This is because the dilution factor was automatically calculated in the ICP-MS output. Therefore, the raw output is useable for comparison purposes.

The data was also compared using a y-axis of normalized output divided by primitive mantle. The primitive mantle values used are from Sun and McDonough, 1995. Please note that the letters before each element were used for organization purposes and are not relevant to the element names or values. All values are given in parts per million.

MANTLE CONCENTRATIONS	
A Th	0.0795
B Nb	0.658
C Ta	0.037
D La	0.648
E Nd	1.25
F Sm	0.406
G Zr	10.5
H Hf	0.283
I Eu	0.154
J Gd	0.544
K Dy	0.674
L Y	4.3
M Er	0.438
N Yb	0.441
O Lu	0.0675

The final calculations used in the creation of figures 9, 10, and 13 are as follows:

Concentration		39K	44Ca	48Ti	51V	85Rb	88Sr	89Y	90Zr	93Nb	115In	137Ba	139La	140Ce	141Pr
9	FBE-1C_1	1651.67	152150.41	10263.44	288.65	5.26	1234.81	60.04	729.59	252.86	1854.84	561.01	236.24	480.80	52.91
10	FBE-1C_2	1637.13	152098.99	9354.85	276.42	5.04	1236.53	58.67	732.27	223.51	2015.77	538.45	206.60	429.75	46.61
11	FBE-2A	450.70	170528.05	9961.24	273.87	1.08	1988.62	52.47	641.91	201.63	1945.85	121.66	192.82	403.08	43.31
12	BCR-2	11105.48	44206.80	10959.66	361.11	17.24	255.22	26.21	145.46	9.67	1938.51	360.58	18.47	39.22	4.75
13	BHVO-2	3527.42	71230.74	13082.28	265.98	6.77	313.37	19.42	130.05	15.50	2009.03	106.71	12.47	28.33	3.92
14	BLANK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	FBE-1C_1	1640.65	161236.20	10662.50	294.75	4.92	1289.76	60.54	744.01	259.48	1922.00	565.42	231.49	478.76	52.07
16	FBE-1C_2	1634.43	156286.92	9562.35	281.82	4.86	1238.87	58.49	741.09	234.31	2061.12	545.65	207.50	433.89	46.25
17	FBE-2A	386.01	174970.18	9563.91	258.96	0.90	1870.73	49.78	594.82	194.62	2061.40	115.01	181.50	376.84	41.15
18	BCR-2	10936.09	44718.12	11112.51	357.59	17.24	250.82	25.33	143.88	10.03	1986.17	352.14	18.47	38.70	4.75
	BHVO-2	0.00	0.00	0.00	267.16	6.79	310.37	19.49	130.56	15.34	0.00	107.52	12.84	27.95	0.00

146Nd	147Sm	153Eu	157Gd	159Tb	163Dy	165Ho	166Er	169Tm	172Yb	175Lu	178Hf	181Ta	209Bi	232Th
217.42	32.22	8.82	24.59	2.88	13.91	2.37	6.11	0.85	4.75	0.68	13.40	19.84	1738.16	18.49
192.56	28.61	7.92	22.32	2.70	13.14	2.34	6.30	0.72	4.50	0.72	12.96	17.28	1849.48	17.46
176.29	27.14	7.55	20.31	2.52	11.86	2.16	5.39	0.72	3.95	0.54	11.50	14.92	1820.59	16.17
21.99	5.10	1.58	5.45	0.88	5.10	1.06	2.99	0.35	2.81	0.35	3.52	0.70	1790.05	4.05
20.13	4.99	1.60	5.17	0.71	4.28	0.89	1.96	0.36	1.60	0.18	3.38	0.89	1775.65	0.89
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
213.86	32.22	8.82	24.93	2.88	13.91	2.37	5.94	0.85	4.75	0.68	13.23	19.84	1704.58	18.82
193.10	28.61	7.92	22.50	2.70	13.32	2.34	5.94	0.72	4.50	0.72	12.96	17.28	1858.84	16.74
169.28	25.34	7.19	19.41	2.34	11.32	1.98	4.85	0.54	3.59	0.54	10.78	14.74	1895.53	14.74
22.51	5.10	1.58	5.28	0.88	4.92	1.06	2.81	0.35	2.46	0.35	3.52	0.53	1807.64	3.87
20.04	4.74	1.62	5.02	0.00	4.17	0.00	2.02	0.00	1.60	0.22	3.27	0.90	0.00	0.92

Second semester data, organized slightly differently (apologies):

	Concentratic Adjusted to mantle			Concentratic Adjusted to mantle			Concentratic Adjusted to mantle	
FBE-2A			**BCR-2**			**FBE-1C**		
A Th	14.834	186.5912	A Th	5.226	65.73585	A Th	15.899	199.9874
B Nb	63.353	96.28116	B Nb	10.468	15.90881	B Nb	28.197	42.85258
C Ta	0.443	11.97297	C Ta	0.658	17.78378	C Ta	0.089	2.405405
D La	163.064	251.642	D La	22.394	34.55864	D La	188.019	290.1528
E Nd	143.878	115.1024	E Nd	25.62	20.496	E Nd	162.397	129.9176
F Sm	23.503	57.88916	F Sm	5.869	14.45567	F Sm	26.891	66.23399
G Zr	422.464	40.23467	G Zr	175.46	16.71048	G Zr	369.051	35.14771
H Hf	5.894	20.82686	H Hf	4.001	14.13781	H Hf	4.462	15.76678
I Eu	6.707	43.55195	I Eu	1.786	11.5974	I Eu	7.382	47.93506
J Gd	18.691	34.35846	J Gd	6.194	11.38603	J Gd	21.165	38.90625
K Dy	10.863	16.11721	K Dy	5.729	8.5	K Dy	12.213	18.12018
L Y	45.043	10.47512	L Y	31.765	7.387209	L Y	54.313	12.63093
M Er	4.707	10.74658	M Er	3.192	7.287671	M Er	5.39	12.30594
N Yb	3.664	8.30839	N Yb	3.049	6.913832	N Yb	4.165	9.444444
O Lu	0.516	7.644444	O Lu	0.436	6.459259	O Lu	0.584	8.651852

	Concentratic Adjusted to mantle		Concentratic Adjusted to mantle		Concentratic Adjusted to mantle			Concentratic Adjusted to mantle	
6B1DB			**75AFr0052A**		**75AFr0050C**			**FBE-1C**	
A Th	0.08	1.006289	A Th	0.195	2.45283	A Th	0.097	1.220126	A Th	18.483	232.4906
B Nb	0.844	1.282675	B Nb	1.374	2.088146	B Nb	1.11	1.68693	B Nb	29.173	44.33587
C Ta	0.084	2.27027	C Ta	0.106	2.864865	C Ta	0.087	2.351351	C Ta	0.117	3.162162
D La	1.38	2.12963	D La	3.096	4.777778	D La	2.175	3.356481	D La	221.456	341.7531
E Nd	4.382	3.5056	E Nd	8.269	6.6152	E Nd	6.378	5.1024	E Nd	195.507	156.4056
F Sm	1.698	4.182266	F Sm	2.741	6.751232	F Sm	2.222	5.472906	F Sm	31.723	78.13547
G Zr	38.428	3.65981	G Zr	81.087	7.722571	G Zr	62.536	5.95581	G Zr	426.295	40.59952
H Hf	1.034	3.65371	H Hf	1.918	6.777385	H Hf	1.513	5.34629	H Hf	5.25	18.55124
I Eu	0.674	4.376623	I Eu	1.015	6.590909	I Eu	0.825	5.357143	I Eu	8.78	57.01299
J Gd	2.506	4.606618	J Gd	3.736	6.867647	J Gd	3.073	5.648897	J Gd	24.625	45.26654
K Dy	3.178	4.715134	K Dy	4.494	6.667656	K Dy	3.811	5.654303	K Dy	14.418	21.39169
L Y	17.507	4.071395	L Y	24.8	5.767442	L Y	20.922	4.865581	L Y	63.687	14.81093
M Er	1.989	4.541096	M Er	2.8	6.392694	M Er	2.337	5.335616	M Er	6.435	14.69178
N Yb	1.939	4.396825	N Yb	2.714	6.154195	N Yb	2.283	5.176871	N Yb	5.043	11.43537
O Lu	0.278	4.118519	O Lu	0.395	5.851852	O Lu	0.338	5.007407	O Lu	0.7	10.37037

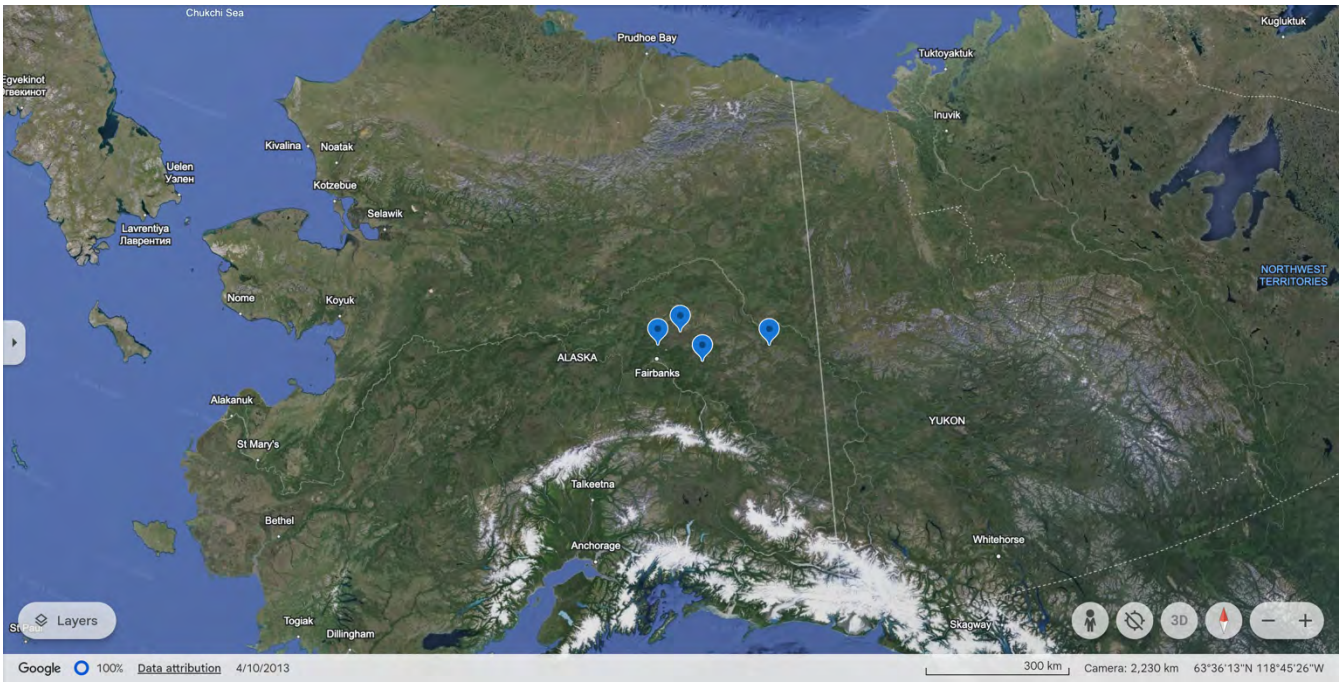
A-4. GeoReM Preferred Values of BHVO-2 and BCR-2

GeoReM preferred values were compared to the tested output of BHVO-2 and BCR-2 to confirm that the values align. If they did not line up, this would have suggested issues with digestion or the instrument. As previously outlined, the curves both came out a little bit lower overall than the preferred values for the first round of data collection in the first semester.

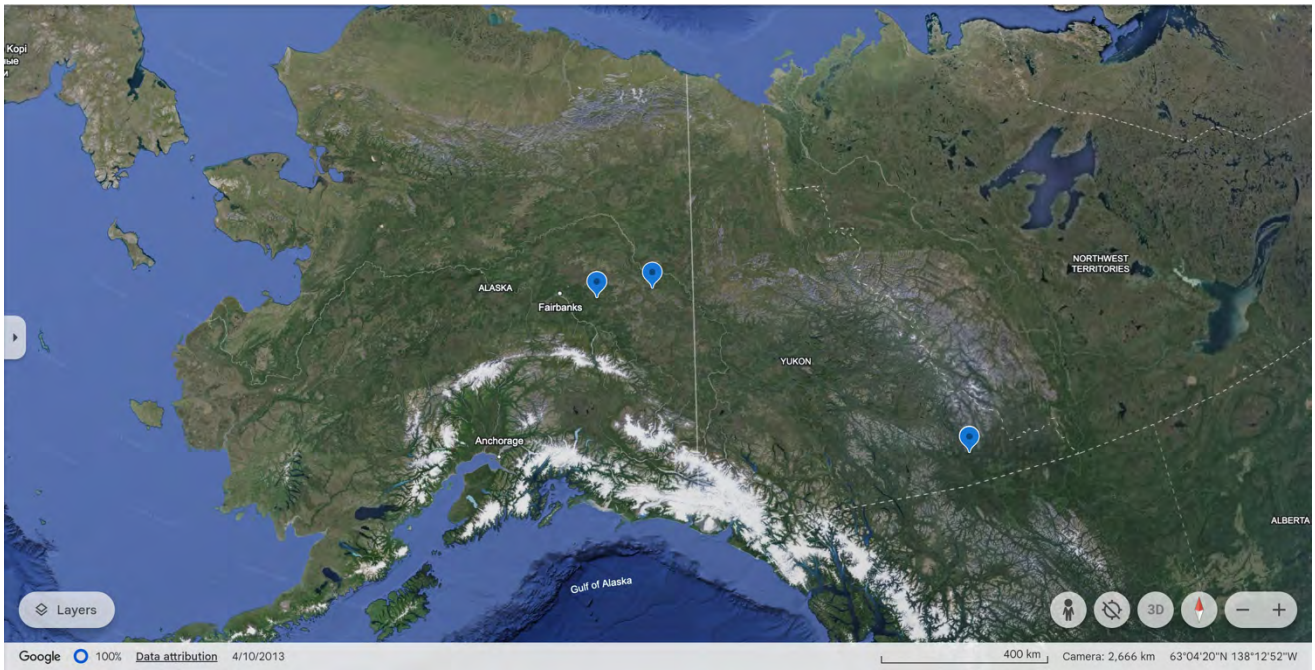
GeoRem preferred values									
BCR-2 reference values								mantle	BCR-2/mantle
A Th		5.828	0.05	95%CL	µg/g	GeoReM 8689	reference val	0.0795	73.3082
B Nb		12.44	0.2	95%CL	µg/g	GeoReM 8689	reference val	0.658	18.9058
C Ta		0.785	0.018	95%CL	µg/g	GeoReM 8689	reference val	0.037	21.2162
D La		25.08	0.16	95%CL	µg/g	GeoReM 8689	information	0.648	38.7037
E Nd		28.26	0.37	95%CL	µg/g	GeoReM 8689	reference val	1.25	22.608
F Sm		6.547	0.047	95%CL	µg/g	GeoReM 8689	reference val	0.406	16.1256
G Zr		186.5	1.5	95%CL	µg/g	GeoReM 8689	reference val	10.5	17.7619
H Hf		4.972	0.034	95%CL	µg/g	GeoReM 8689	reference val	0.283	17.5689
I Eu		1.989	0.024	95%CL	µg/g	GeoReM 8689	reference val	0.154	12.9156
J Gd		6.811	0.078	95%CL	µg/g	GeoReM 8689	reference val	0.544	12.5202
K Dy		6.424	0.055	95%CL	µg/g	GeoReM 8689	reference val	0.674	9.53116
L Y		36.07	0.37	95%CL	µg/g	GeoReM 8689	reference val	4.3	8.38837
M Er		3.67	0.038	95%CL	µg/g	GeoReM 8689	reference val	0.438	8.379
N Yb		3.392	0.036	95%CL	µg/g	GeoReM 8689	reference val	0.441	7.69161
O Lu		0.5049	0.0078	95%CL	µg/g	GeoReM 8689	reference val	0.0675	7.48

USGS BHVO-2: New reference values following ISO guidelines see Jochum et al. 2016 (free access)									
BHVO-2: GeoReM preferred Values									
Jochum et al. (Max-Planck-Institut fuer Chemie)									
(2/ 2016)									
Item	less/more	Value	Uncertainty	Uncertainty Type	Unit	GeoReM-Id	Comment	mantle	BHVO-2/mantle
A Th		1.224	0.016	95%CL	µg/g	GeoReM 8689	reference	0.0795	15.3962
B Nb		18.1	0.2	95%CL	µg/g	GeoReM 8689	reference	0.658	27.5076
C Ta		1.154	0.019	95%CL	µg/g	GeoReM 8689	reference	0.037	31.1892
D La		15.2	0.08	95%CL	µg/g	GeoReM 8689	reference	0.648	23.4568
E Nd		24.27	0.25	95%CL	µg/g	GeoReM 8689	reference	1.25	19.416
F Sm		6.023	0.057	95%CL	µg/g	GeoReM 8689	reference	0.406	14.835
G Zr		171.2	1.3	95%CL	µg/g	GeoReM 8689	reference	10.5	16.3048
H Hf		4.47	0.025	95%CL	µg/g	GeoReM 8689	reference	0.283	15.7951
I Eu		2.043	0.012	95%CL	µg/g	GeoReM 8689	reference	0.154	13.2662
J Gd		6.207	0.038	95%CL	µg/g	GeoReM 8689	reference	0.544	11.4099
K Dy		5.28	0.028	95%CL	µg/g	GeoReM 8689	reference	0.674	7.83383
L Y		25.91	0.28	95%CL	µg/g	GeoReM 8689	reference	4.3	6.02558
M Er		2.511	0.014	95%CL	µg/g	GeoReM 8689	reference	0.438	5.73288
N Yb		1.994	0.027	95%CL	µg/g	GeoReM 8689	reference	0.441	4.52154
O Lu		0.2754	0.0024	95%CL	µg/g	GeoReM 8689	reference	0.0675	4.08

A-5: Sample Locations



Plotted are all five samples analyzed in this research, with a scale bar of 300 km. The western-most pins are the eclogites and the two on the east are the protolith rocks. The easternmost pin is 6B1DB. When the three non-eclogite rocks are pinned with the eclogites presented in the Creaser *et al*. data, it looks as follows:



Scale bar is in the bottom right and is at a scale of 400 km.