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PHOSPHATIC SHALE ANALYTICAL QUALITY CONTROL MATERIALS OF THE USGS WESTERN U.S. PHOSPHATE PROJECT—Bulk geochemical characterization and water leachate analysis

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ABSTRACT

This report presents results of bulk geochemical, mineralogical, and water leachate analysis of three analytical quality-control materials (check standards) that have been prepared for the Western U.S. Phosphate Project of the U.S. Geological Survey. The purpose of the report is to publish best-consensus analytical values currently known for these materials. The materials are designated POW-1, POW-2, and POI-1, and they are made from rocks taken from channel-sampled sections of the middle waste shale, upper ore zone, and upper waste shale zone of the Meade Peak Member of the Phosphoria Formation. These materials have been prepared from the same trace element-enriched rocks that are being studied as part of the project, and it is a distinct analytical advantage to have check standards with similar concentrations of trace elements and similar lithologic matrix to samples being analyzed. The preparation and use of these check standards are intended to provide better analytical quality control for research on phosphatic shale by the USGS and others. As the check standards contain elevated concentrations of many trace elements compared with typical, unmineralized rock standards, especially for Cd, Cr, Mo, Ni, Se, V, and Zn, they may be useful quality control materials to other geochemical research that involves elevated concentrations of these elements in rocks.

The bulk chemical concentration of various major, minor, and trace elements in the check standards has been analyzed by a variety of analytical methodologies using an outside contractor and by energy-dispersive x-ray analysis as in-house analysis. In addition, we report the bulk mineralogy as determined by x-ray diffraction analysis and the water leachate concentrations of elements in the materials that are solubilized over reaction times ranging from 24 hours to 2 weeks.

Although these materials are not certified U.S. Geological Survey reference materials. They are intended to facilitate quality control within the Phosphate Project. The check standards are available to all interested persons and collaborators within the project upon request.

INTRODUCTION

Background

U.S. Geological Survey (USGS) geologists have studied the Permian Phosphoria Formation in southeastern Idaho and the Western U.S. Phosphate Field throughout much of the twentieth century. In response to a request by the U.S. Bureau of Land Management (BLM), a new series of resource and geoenvironmental studies was initiated by the USGS in 1998. Present studies involve many core scientific disciplines within the USGS and consist of (1) integrated, multidisciplinary research directed toward resource and reserve estimations of phosphate in selected 7.5-minute quadrangles; (2) elemental residence, mineralogical and petrochemical characteristics; (3) mobilization and reaction pathways, transport, and disposition of potentially toxic trace elements associated with the occurrence, development, and use of phosphate rock; (4) geophysical signatures; and (5) improving the understanding of depositional origin.

To carry out these studies, the USGS has formed cooperative research relationships with: two Federal agencies, the BLM and the U.S. Forest Service (USFS), which are responsible for land management and resource conservation on public lands; and with five private companies currently leasing or developing phosphate resources in southeastern Idaho. The companies are Agrium U.S. Inc. (Rasmussen Ridge mine), Astaris LLC (Dry Valley mine), Rhodia Inc. (Wooley Valley mine-inactive), J.R. Simplot Company (Smoky Canyon mine), and Monsanto Co. (Enoch Valley mine). Because raw data acquired during the project will require time to interpret, the data are released in open-file reports for prompt availability to other workers. The open-file reports associated with this series of resource and geoenvironmental studies are submitted to each of the Federal and industry collaborators for technical comment; however, the USGS is solely responsible for the data contained in the reports.

Approximately 12 percent of the nation's annual demand for phosphate is satisfied by the mining of the Permian Phosphoria Formation in the northwest United States, a marine sedimentary phosphorite deposit that extends over a 5-state region (McKelvey and others, 1959). Service (1966) provided an evaluation of the western phosphate industry in Idaho and a brief description of the mining history, ore occurrence, and geology. More detailed discussion of the Phosphoria Formation in the Western Phosphate Field is given by McKelvey and others (1959). Cressman and Swanson (1964) discussed detailed stratigraphy and petrology of these same rock units in nearby southwestern Montana. Gulbrandsen and Krier (1980) discussed general aspects of the large and rich phosphorus resources in the Phosphoria Formation in the vicinity of the Soda Springs, Idaho. Oberlindacher (1990) mapped the geology of contiguous rocks, including the members of the Phosphoria Formation, directly to the south of the area from which the rocks that comprise the standards were sampled. Gulbrandsen (1966, 1975, and 1979) summarized bulk chemical compositional data for various lithologies of the phosphatic intervals in the Phosphoria Formation. Swanson (1970) discussed the mineral resources of the area.

In this part of southeastern Idaho from which the samples were taken, the Phosphoria Formation consists of three members, which in ascending order are the Meade Peak Phosphatic Shale, Rex Chert, and the informally named cherty shale

(McKelvey and others, 1959; Oberlindacher, 1990). Structurally, the formation is a folded, often steeply dipping unit with elongate surface or near surface exposures with north to northwest strike. Depending on the dip of the strata, a typical phosphate mine will be up to a few hundred meters deep and several km long. Over the 15 to 20 year life of a typical mine, 20 to 40 million tonnes of ore will be extracted and an amount of waste shale and chert of 2 to 5 times this amount will be generated and require disposal.

The Meade Peak is approximately 50 to 55m in thickness. It has a lower phosphate ore zone and an upper ore zone of approximately 10 and 5 m thickness, respectively. A waste shale zone, the upper waste, of 5 to 15 m thickness exists between the upper ore zone and the chert. The two ore zones are separated by a middle waste unit of shale that is approximately 18 to 20m thick. When the formation is mined, the two ore zones are removed and the middle waste shale is removed and backfilled into the mine pit or placed in a cross-valley fill waste pile.

The USGS has measured, described, and sampled a pair of stratigraphic sections from the Meade Peak at each of the four working phosphate mines in southeast Idaho (Tysdal and others, 1999, 2000a, 2000b, and 2000c). The rocks used to make the three standards were obtained from the same exposure of the Meade Peak that was described and sampled as Section B at the Enoch Valley mine (Tysdal and others, 1999). The section was measured on a horizontal surface exposed by mining equipment. Section B is relatively deep within the mine with respect to the land surface that existed prior to mining. As such, the rocks from this deep section are considerably less altered relative to shallower occurrences of the Meade Peak.

Environmental Concerns—Se and other trace elements

Compared to most other marine shale, elevated concentrations of Se and other geoenvironmentally-sensitive trace elements (e.g. As, Cd, Cr, Cu, Mo, Ni, Se, Tl, U, V, and Zn) occur within the middle waste shale unit of the Meade Peak (Herring and others, 1999, 2000a, 2000b, and 2000c), and their presence has raised concerns about introduction of these trace elements into the ecosystem as a result of mining and disposal of the waste shale. Elevated concentrations of Se and other trace elements known to be enriched in the middle waste shale can be mobilized from the rocks and transported into various components of the ecosystem (Herring, unpublished data; Stillings and others, 2000; Piper and others, 2000)

Purpose and Utility of Project Check Standards

The purpose of the present study was to prepare, analyze, and distribute analytical standards with similar mineralogy and composition to the typical rocks being analyzed within the project. It is a distinct analytical advantage to have standards with concentrations of trace elements similar to those in the samples being analyzed. These standards are finely ground splits of composite channel samples of two sections of middle waste rock and one of ore and upper waste from Section B. Tysdal and others (1999) described this section, and Herring and others (1999) reported its analytical data. The standards also consist of the same matrix composition—on average an organic-rich, carbonate-containing mudstone or siltstone with moderate to significant enrichment of phosphorite—although minor interbeds of dominant concentrations of the various end-member lithology also exist in the middle waste. Compared to typical, unmineralized rock standards, these standards contain elevated concentrations of many geoenvironmentally-sensitive trace elements, especially Cd, Cr, Mo, Ni, V, and Zn.

Location

The location of the sample site is shown in figure 1. The site lies approximately 30 km northeast of Soda Springs, Idaho, in an area of southeastern Idaho that has had extensive phosphate mining over the past several decades and currently has four active phosphate mines.

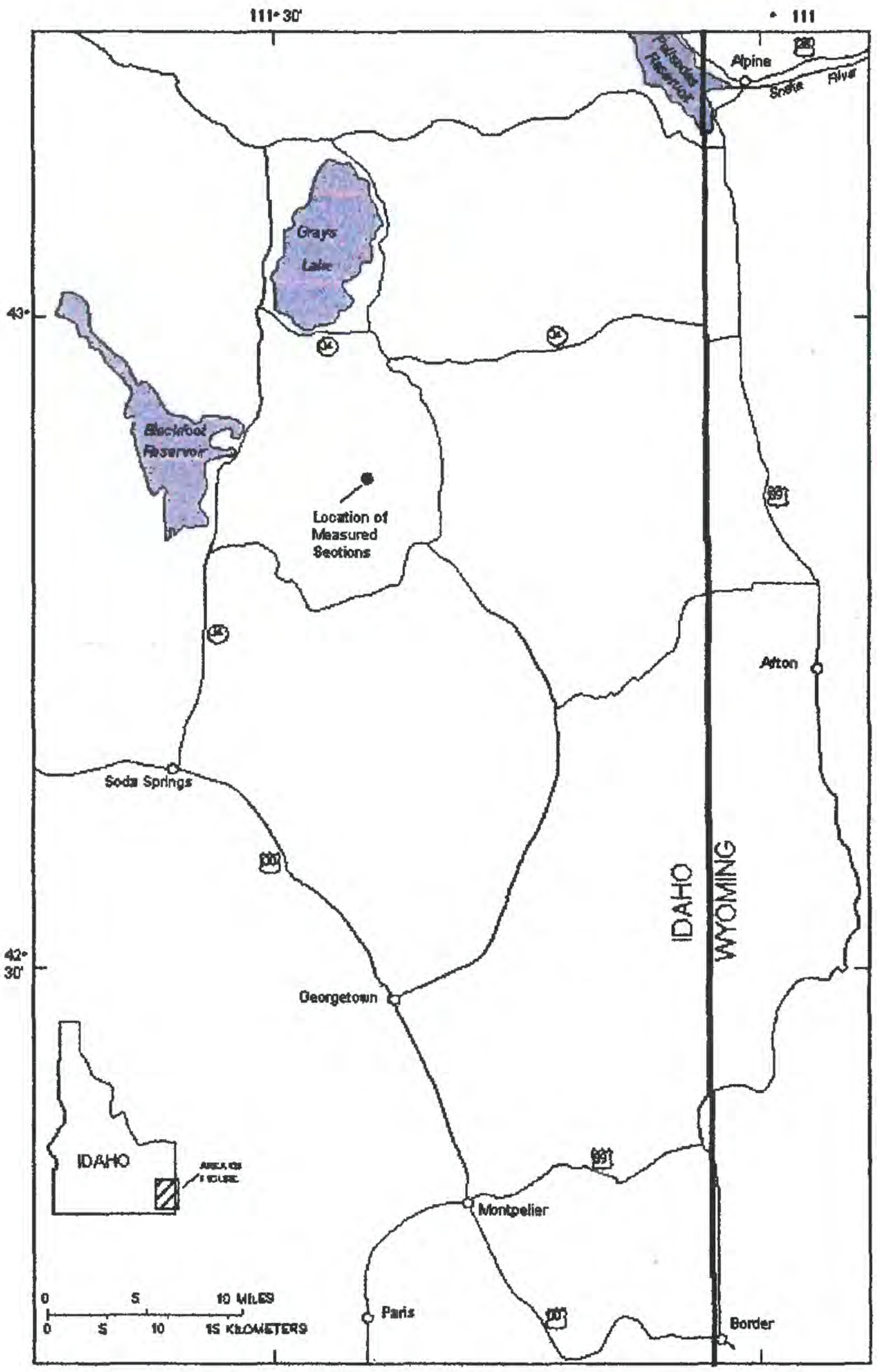

Figure 1. Index map of southeastern Idaho showing location of measured sections from which samples were collected.

STUDY DESIGN AND SAMPLE COLLECTION

The rocks from which the standards were made were taken as channeled samples across three intervals of the middle waste, upper ore (partial) and upper waste zones (partial) of the Meade Peak. Sample intervals were arbitrary and taken across approximately 5 m of stratigraphic thickness. Samples were taken in a consistent manner over the entire interval and are intended to be generally representative of the composition of the interval as a whole. Approximately 50 kg of rock was collected at each of the three intervals. The bulk samples were shipped to the laboratories of the USGS in Denver, Colorado, for sample preparation.

Rock samples were dried in air at ambient temperature. Large pieces were disaggregated in a mechanical jaw crusher, and the entire sample was then ground in a ceramic ball rotary mill to 100 percent <100 mesh (0.15 mm). In reality, the particle size is even finer; for example, in POW-2 about one-half of the material is <200 mesh (0.075 mm) and the other half is close to 200 mesh. Each standard was homogenized in a tumbler then transferred into a rotary splitter to ensure that splits are similar to the whole sample.

ANALYSIS

Rock Chemical Analysis

Samples were analyzed for 40 major, minor, and trace elements using 4-acid digestion in conjunction with inductively coupled plasma-atomic emission spectrometry (ICP-AES). For the 40-element analysis (referred to as ICP-40), a 200 mg split was dissolved using a low-temperature (<150° C) digestion with concentrated hydrochloric, hydrofluoric, nitric, and perchloric acids (Jackson and others, 1987). The acidic sample solution was taken to dryness and the residue was dissolved with 1 ml of aqua regia and then diluted to 10.0 g with 1% (volume/volume) nitric acid. Sr concentrations are determined in both the ICP-40 and ICP-16 (see below) techniques, and the data from both techniques have been reported. The two techniques agree well; the R^2 between them is >0.99 (Herring and others, 2000c). Based on other rock standards of known composition that accompanied analysis of the standards and the much larger set of rock samples, both ICP techniques also detect and measure Mn with similar accuracy and precision. However, the ICP-40 technique has a much lower detection limit, 4 parts per million (ppm) compared to the ICP-16 technique, 100 ppm. This lower detection limit is important in analyzing a few of the check standards with low Mn concentrations, particularly POW-1 and POW-2. Nonetheless, analytical data for both procedures are included in the data tables. The ICP-40 technique measures Au above 8 ppm and Ta above 40 ppm; however, no samples from either of the two sections had concentrations above these detection limits. Consequently, those data have been eliminated from the data files.

Another split of the sample was fused in lithium metaborate then analyzed by ICP-AES after acid dissolution of the fusion mixture. This technique, referred to as ICP-16, provides analysis of all major elements, including Si, and a few minor and trace elements, 16 in all. Most importantly, this is the only analytical technique of those used that measures Si concentrations in these siliceous, phosphatic shale samples. Although the Meade Peak Phosphatic Shale Member is known mostly for its phosphorite content, it also contains minor to significant amounts of siliceous components, which occur in aluminosilicate minerals, quartz, or biogenic silica. Si measurement is not possible using the 4-acid digestion ICP-40 technique because the Si is lost as a volatile fluoride compound during digestion. Analysis of major elements using the fusion technique also provides a compositional check on the concentrations of these same elements as measured by acid digestion. Ti and Cr were analyzed using both ICP techniques, and the concentration data for both techniques are included in the analytical tables. However, the fusion technique is superior to acid digestion because of its ability to more completely digest resistant minerals that might contain those elements.

Se analysis was performed using hydride generation followed by atomic absorption (AA) spectroscopy. Se is not reported using either of the ICP techniques, as it is partially volatilized during sample preparation. The hydride/AA technique also is used for the analysis of As and Sb. For the analysis of As, the hydride analytical technique is considered to be more sensitive than the acid digestion ICP-AES analytical technique. Most Tl analyses were performed using hydride generation followed by atomic absorption spectroscopy. However, the earliest measurements of Tl concentrations on the phosphatic check standards included some analyses using a graphite furnace AA measurement after fusion of the sample and extraction using an organic solvent or by using ICP-Mass Spectrometry (ICP-MS). The concentration of Te, measured using AA graphite furnace spectroscopy, was only determined in early submissions of the samples and accompanying standards. For the three standards, it was reported only for the first submission sample of each standard listed in table 1. Its value was <LDL, 0.1 ppm, for all three standards.

Total S and total C were measured using combustion in oxygen followed by infrared measurement of the evolved CO_2 and SO_2. For the other forms of carbon, carbonate carbon was measured as evolved CO_2 after acidification of the sample, and organic carbon was calculated as the difference between total and carbonate carbon.

The compilations by Arbogast (1996) and Baedecker (1987) include additional discussions about the various types of analytical methodology used in this study. As an indication of accuracy of the technique, data for the analysis of two standards that accompany sample submission to the analytical contractor are included in the table. These data include the relative standard deviation and the relative standard difference of quintuplicated analysis versus the known values of the standards SARL-1 and SARM-1 (see Herring and others, 2000c, for additional discussion of these standards).

In addition to the above-discussed bulk chemical analysis using the analytical contractor, the standards were analyzed in-house using Energy Dispersive X-ray Fluorescence (EDXRF) analysis using a Spectro X-lab 2000 instrument. Table 2 lists the results of the individual analyses for each standard as well as the mean, relative standard deviation, and number of unqualified analyses for each of the three standards. As an indication of accuracy of the technique, the one-sigma error in percent for the analysis of two standard reference materials, NBS 2711 and NBS 2720, is included in the table. In addition to the elements listed, the technique also measures Bi and Ge, but none of the analyses was greater than the LDL for the method, 5 and 2 ppm, respectively. Ga and W are also detected by this method, but all analyses had interference from other elements that prevented quantification.

X-ray Diffraction Analysis

Powder mounts of the three standards were analyzed using an x-ray diffractometer. The scans are shown in figure 2. The analytical data show that the most common mineral is quartz. POW-1 contains minor carbonate fluorapatite (CFA) and muscovite; POW-2 contains major CFA along with the quartz and minor muscovite, buddingtonite, and albite; and POI-1 contains minor dolomite, pyrite, CFA, muscovite, and albite. In POW-2, the minor buddingtonite explains in part its oxide sum <100%, because of nitrogen in that mineral. The nitrogen in buddingtonite or any other form is not detected by any of the analytical techniques used in this report.

Water Leachate Analysis

The analytical protocol for the water leachate experiments used 2.5g aliquots of each ground check standard mixed with 18 MΩ deionized water in a water:rock ratio of 20:1 by mass. After equilibration with the atmosphere, the pH of the deionized water typically reached 5.5. Leaching was passive, with no continuous agitation or shaking other than an initial gentle shake to ensure wetting of all ground rock and a second gentle shake to repeat the resuspension of solids after one hour. The samples were allowed to react at room temperature for 24 hours. In addition, extended leachate experiments were conducted on splits of each standard for 2, 5, and 10 days, and these extended leachate experiments had an accompanying single daily gentle shake for solids resuspension. After the reaction time, samples were centrifuged to separate most of the solids, then the solutions were decanted into rinsed syringes and filtered through a rinsed, 0.45 µm pore-size, cellulose nitrate depth filter. Immediately after filtration, the pH and conductivity (for total dissolved solids—TDS) of the filtrates were measured. Filtrate samples for metals analysis by ICP-MS were acidified with Ultrex HNO_3 to a pH between 1 and 2, and those for anion analysis by ion chromatography (IC) were left untreated until analysis. We also evaluated another parameter, the ease of filtration, by noting subjectively whether the samples were easy, moderately difficult, or very difficult to force through the syringe filter compared to other leachate samples of the same rocks. In essence this provides a qualitative measure of how much fine-grained material on the order of one µm in size remains in the water and, by caking or clogging, reduces flow through the filter.

Dissolved cations were measured using ICP-MS (Lamothe and others, 1999), and dissolved anions were measured using a Dionex AS-14 ion chromatograph with bicarbonate eluent. The IC measures nitrate, sulfate, chloride, and fluoride, and these data are reported. Orthophosphate is detected but was negligible in all samples.

RESULTS

Table 1 lists the concentrations of various major, minor, and trace elements determined by the bulk chemical analysis. Accuracy is evaluated by examining the results obtained for two reference materials of known composition that are submitted with samples to be analyzed. Relative standard deviations specify the departures from accepted group mean concentrations. For the three phosphatic shale quality control check standards, the mean of the total number of analyses is shown and is italicized when there are one or more qualified concentrations. No replacements have been made of the qualified values to calculate mean concentrations. When more than one-half of the concentrations are qualified, the mean and standard deviation are not calculated.

The samples of the check standards were submitted to the contract laboratory a few at a time accompanying batches of other project rock samples. As such, this submission mimics a randomized sequence and minimizes errors from sources such as instrumental drift.

The abbreviations for analytical techniques in the column headings of tables with analytical results are defined as follows:
XRD: X-ray diffraction
EDXRF: Energy-dispersive x-ray fluorescence
Hyd.: hydride generation
CVAA: cold vapor atomic absorption
FAA: flame atomic absorption
ICP-MS: inductively-coupled plasma spectrometry, mass spectrometry
ICP-16: inductively-coupled plasma spectrometry, fusion digestion
ICP-40: inductively-coupled plasma spectrometry, acid digestion
IC: ion chromatography

A few of the phosphatic middle waste shale samples of the Meade Peak analyzed as a part of the Core J special chemistry samples (Herring and others, work in progress) were analyzed for ferrous iron (Fe^{+2}). None of the three standards described in this report have been analyzed for Fe^{+2}. It is likely, however, because of the geoçhemical similarity of the standards to these middle waste shale rocks of the J Core, that some of the iron reported in the standards occurs as Fe^{+2}. In the 11 samples of the Core J special chemistry samples, the concentration of Fe^{+2} averaged 29 percent and ranged from 4 to 100 percent of total iron. For the 4 samples of the middle waste shale of Core J—the rocks likely to be most similar to the three standards—Fe^{+2} averaged 13 percent of total Fe.

Analytical data for EDXRF analysis are listed in table 2. Accuracy information, based on analysis of standards with published, known values, is included in the table. Analytical data for the leachate analyses are listed in table 3. Analyses of deionized water blanks for the IC and ICP-MS techniques are included in the table.

SUMMARY

The preparation and use of these standards are intended to provide better quality control for analytical research on phosphatic shales by USGS researchers and others. These materials are not certified as U.S. Geological Survey reference materials. The check standards are available to all interested persons and collaborators within the project upon request.

ACKNOWLEDGMENTS

The rocks from which the standards were prepared were collected on the site of the Enoch Valley phosphate mine, operated by Monsanto Co. We thank Monsanto Co. for providing access and, especially, Ray Petrun for discussions about the geology and composition of the rocks. We appreciate comments and reviews on the manuscript by Paul Lamothe and J. Hein.

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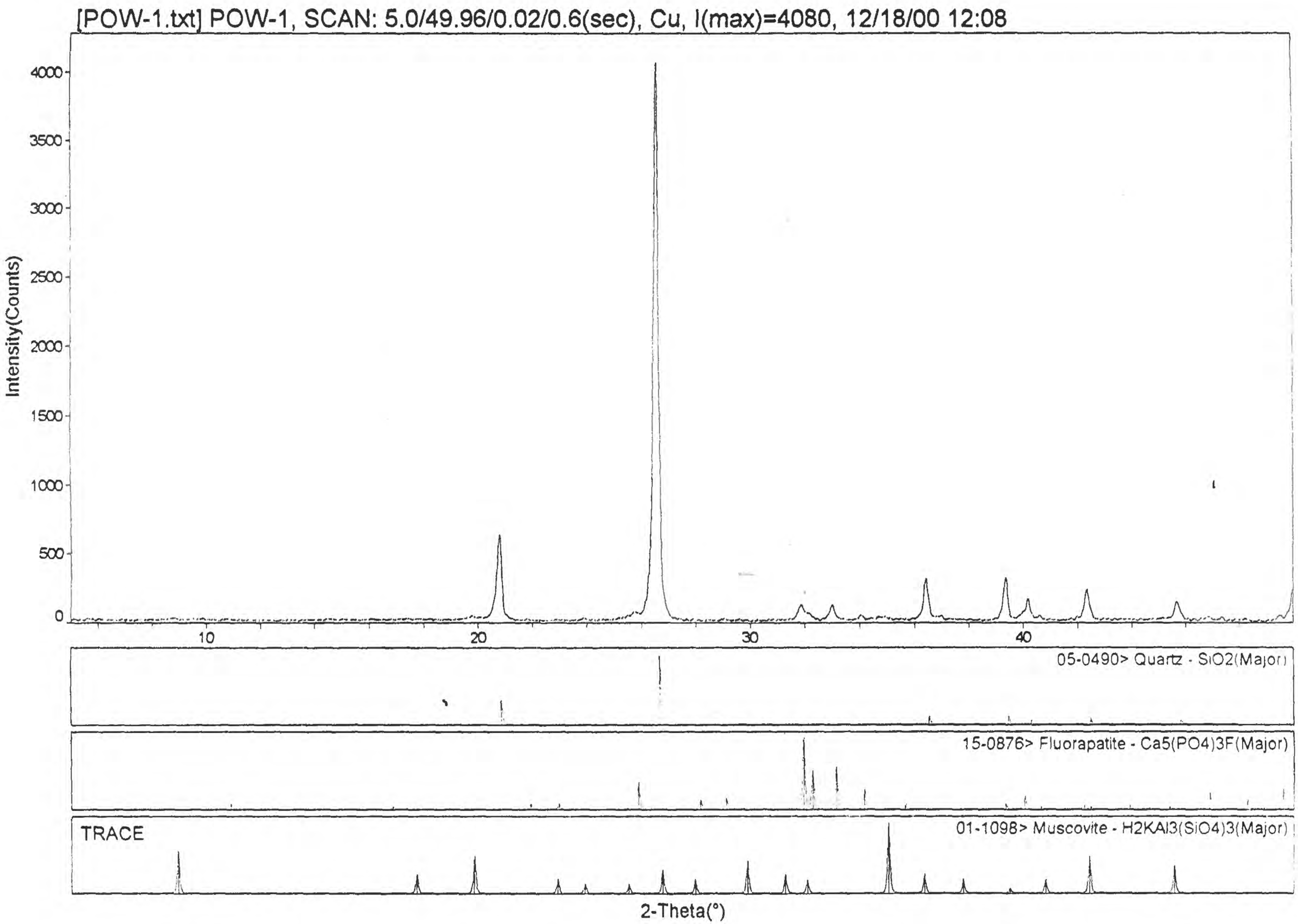
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Intensity(Counts)
4000
3500
3000
2500
2000
1500
1000
500
0
10
20
30
40
05-0490> Quartz - SiO2(Major)
15-0876> Fluorapatite - Ca5(PO4)3F(Major)
TRACE
01-1098> Muscovite - H2KAl3(SiO4)3(Major)
2-Theta(°)

Figure 2

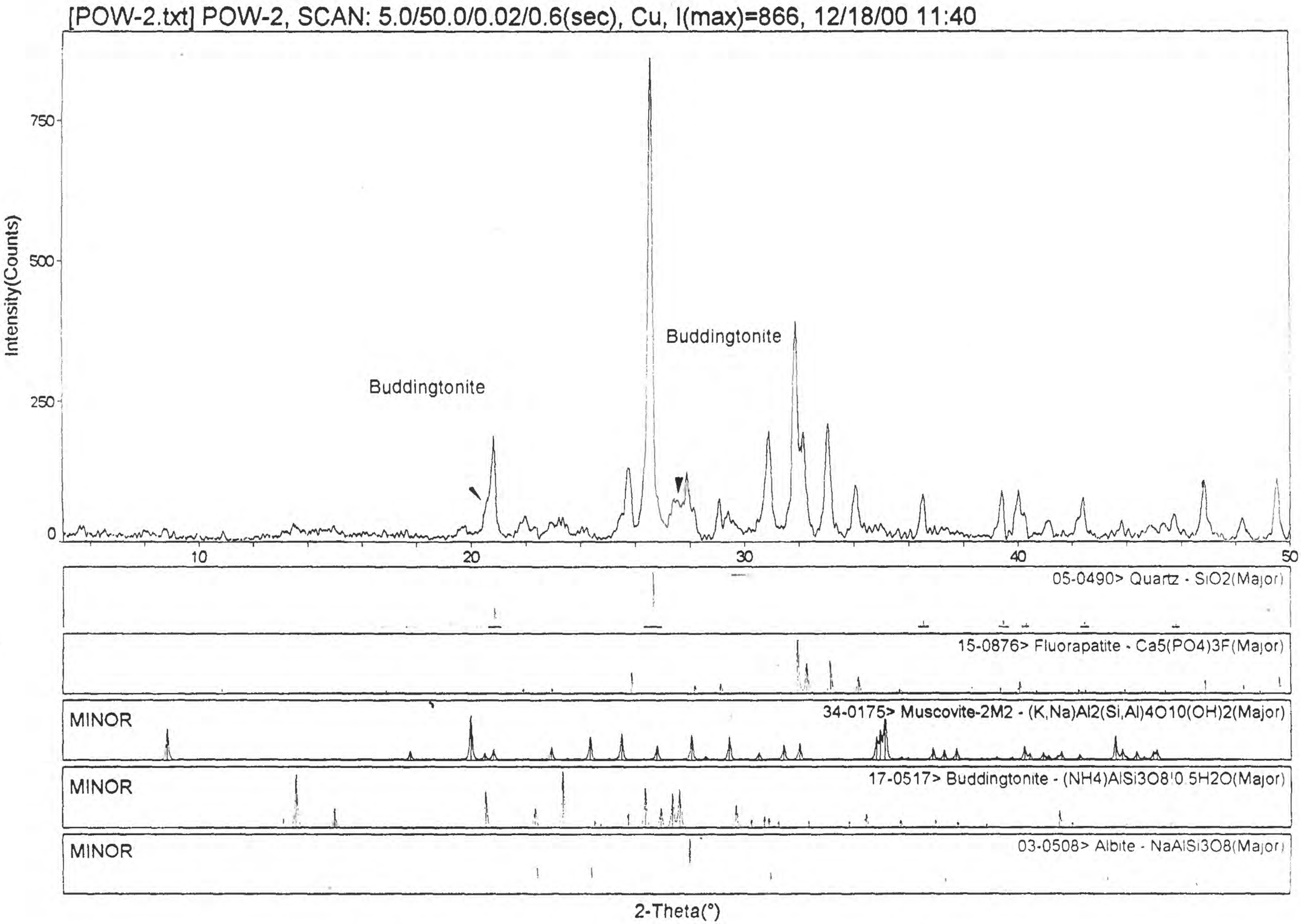


Figure 2, continued

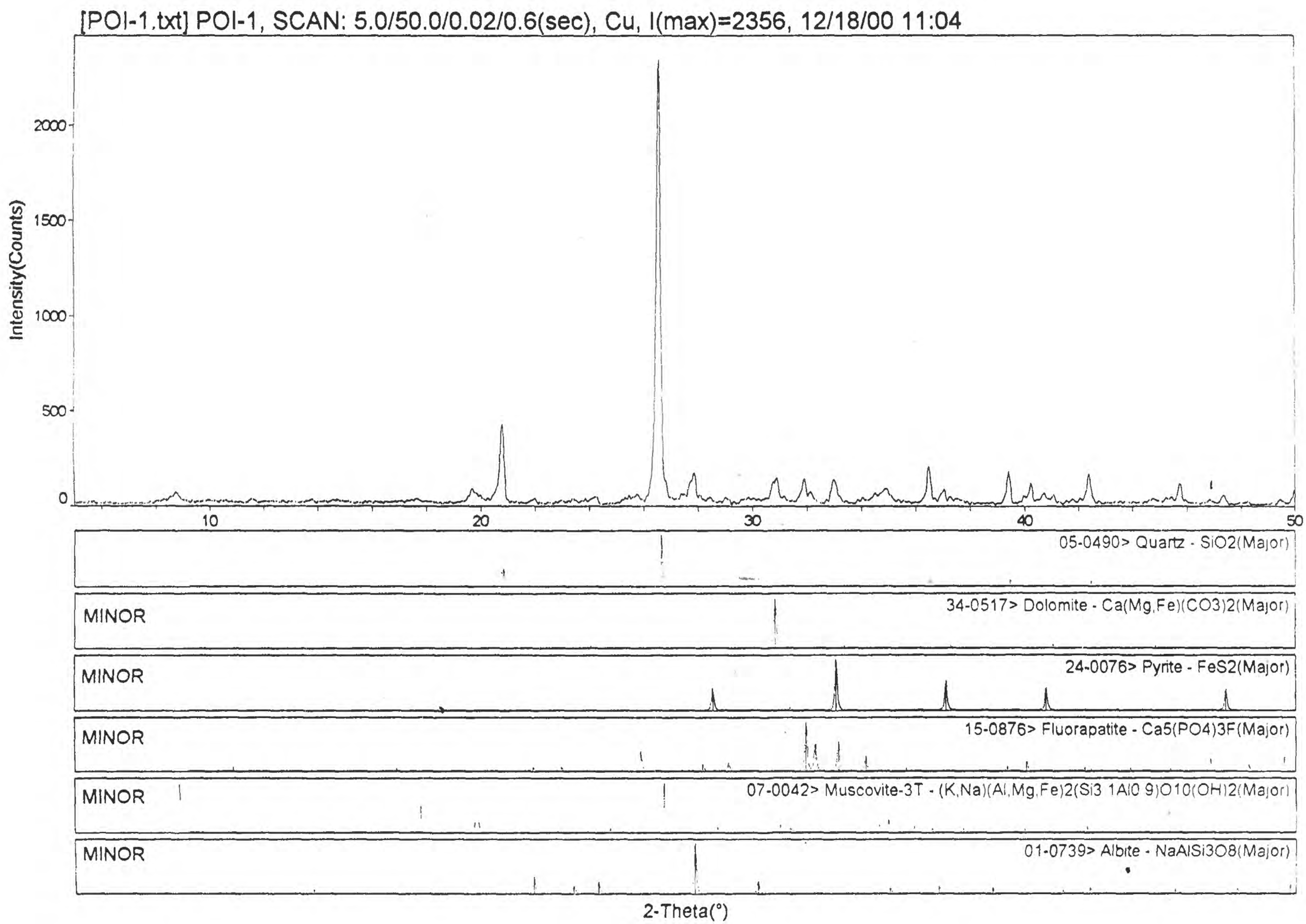
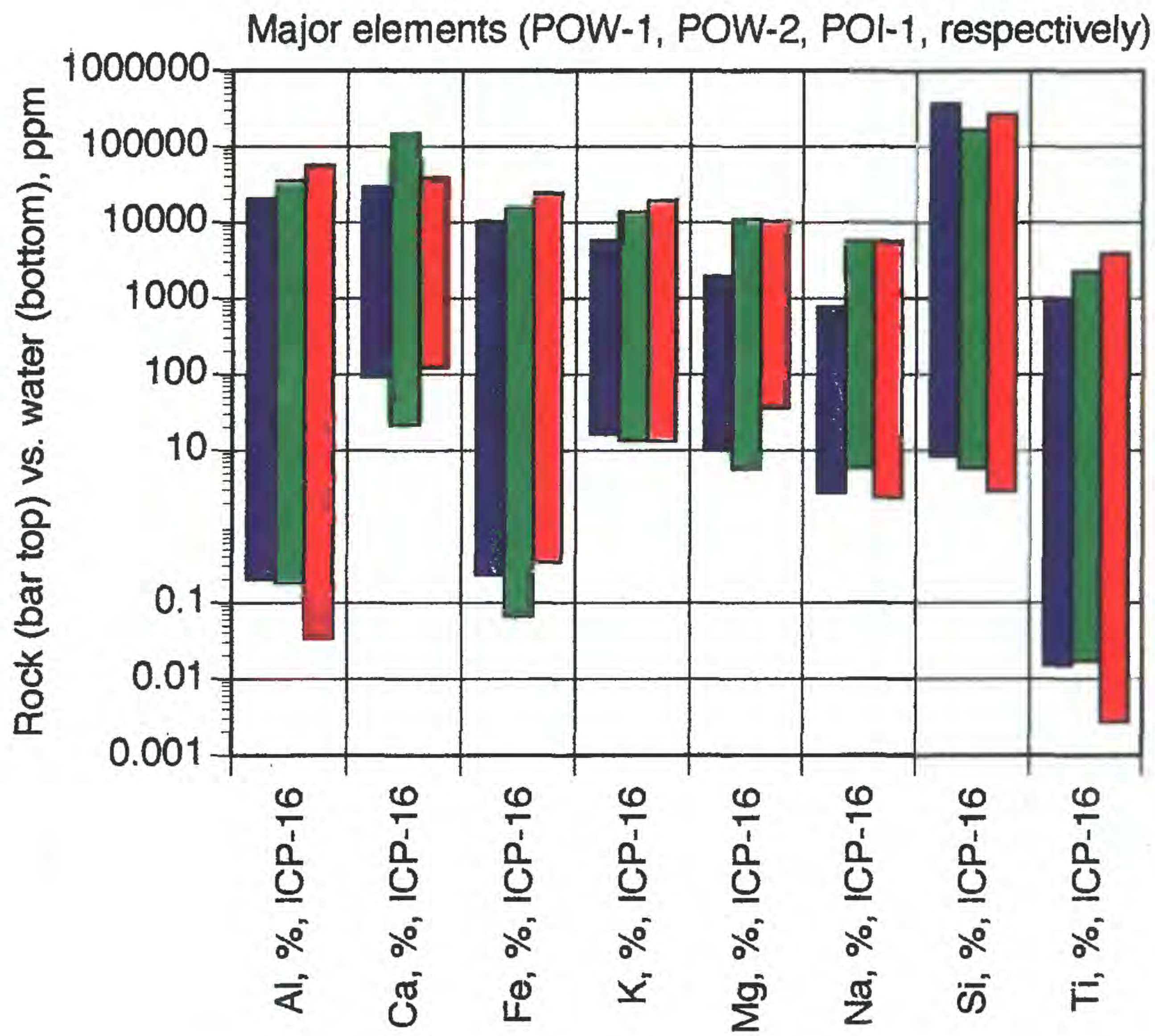


Figure 2, continued

Figure 3. Element concentrations in bulk rock versus 24-hour water leachates, ppm



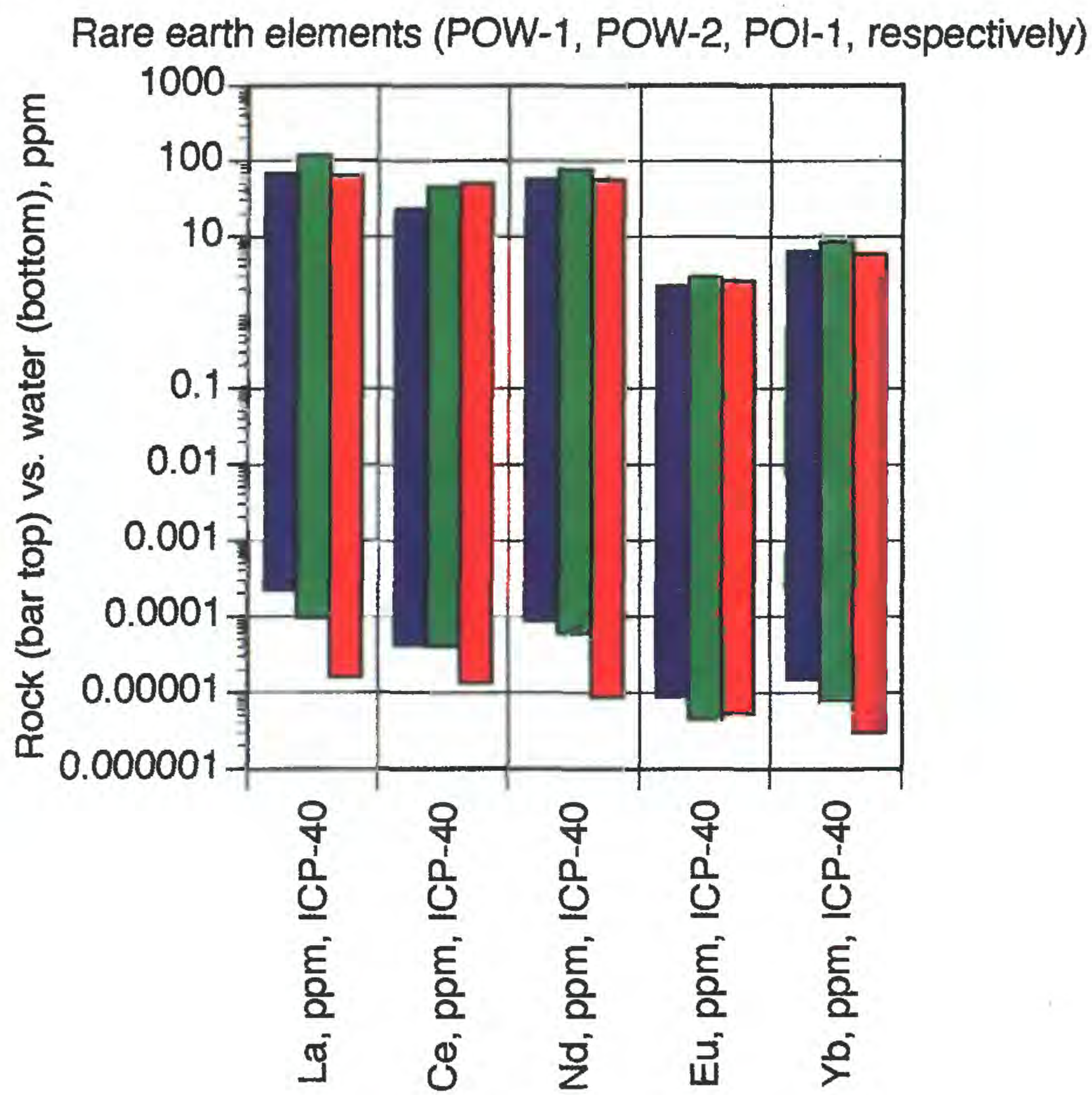


Figure 3 (continued). Trace element cocncentrations in bulk rock versus 24-hour water leachates, ppm
(POW-1, POW-2, and POI-1, respectively)

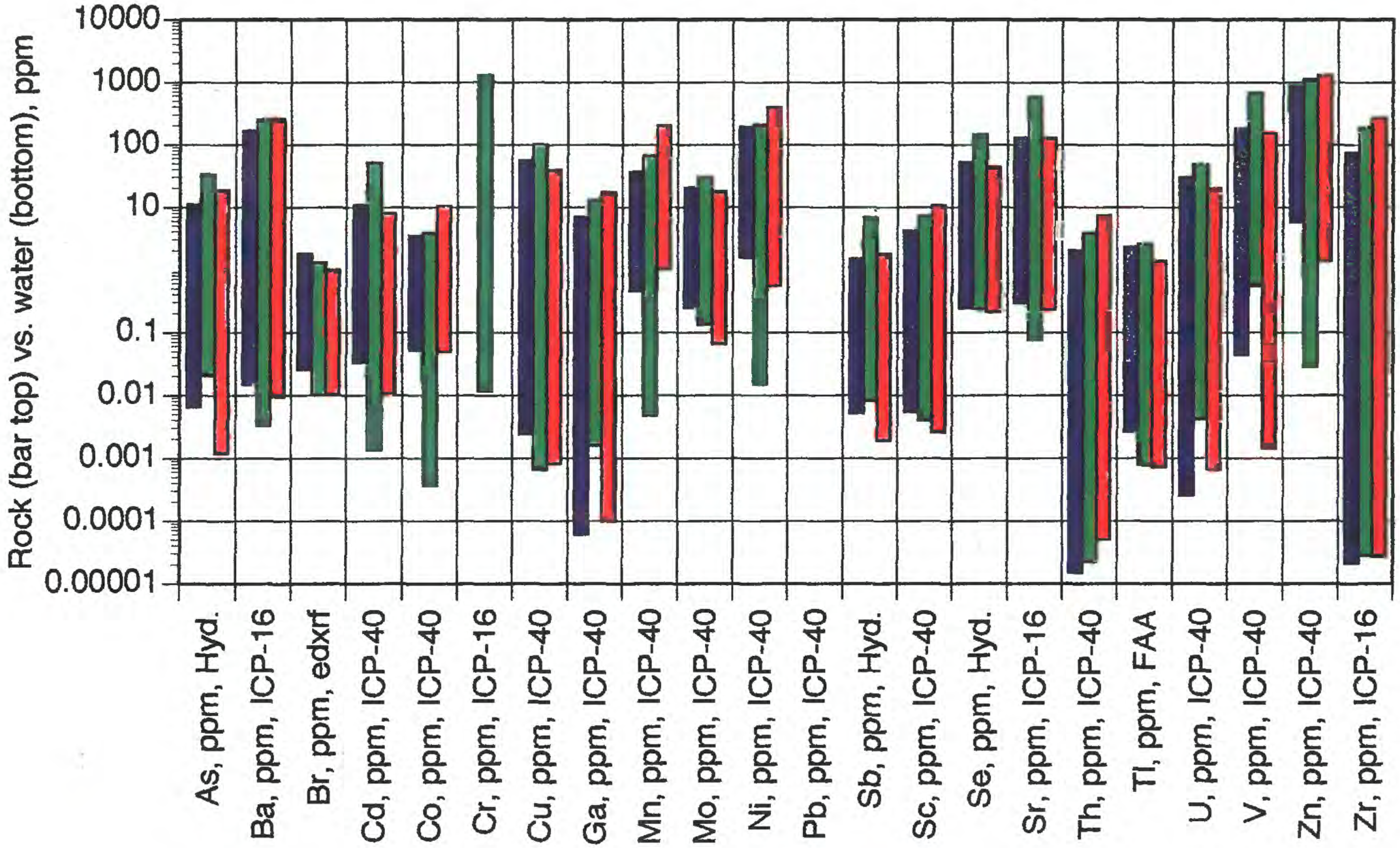


Table 1. Major, minor, and trace element concentrations for Check Standards POW-1, POW-2, and POI-1

Check Standard	Lab No.	Section	Reference	As, ppm, Hyd.	Hg, ppm, CVAA	Sb, ppm, Hyd.	Se, ppm, Hyd.	Tl, ppm, FAA	C, %, Combustion	CO2, %, Acidification	Carbonate C, %, Acidification	Organic C, %, difference	S, %, Combustion	Al, %, ICP 16	AlOx, %, ICP-16	Ca, %, ICP-16	CaOx, %, ICP-16	Fe, %, ICP-16	FeOx, %, ICP-16
Standard SARL-1: Rel. Std. Difference				0%	14%	-12%	4%	-21%	11%	-5%	-5%	13%	3%	1%		-6%		4%	
Standard SARL-1: Rel. Std. Deviation				7%	2%	6%	6%	13%	2%	3%	5%	3%	6%	3%		3%		5%	
Standard SARM-1: Rel. Std. Difference				12%	-4%	13%	21%	-12%	-2%	0%	0%	-2%	-12%	2%		-7%		1%	
Standard SARM-1: Rel. Std. Deviation				4%	4%	3%	0%	9%	6%	0%	0%	6%	9%	3%		3%		2%	
POW-1	C-136227	D Channel	Herring and others, 2000a	10.9	0.22	1.5	54.3	1.9	3.03	0.15	0.04	2.99	1.29	2.22	4.19	3.02	4.22	1.00	1.43
	C-141293	E/F Channel	Herring and others, 2000b	12.4	0.24	2.4	47.3	2.2	3.09	0.14	0.04	3.05	1.28	2.10	3.97	3.07	4.29	1.01	1.44
	C-141409	G/H Channel	Herring and others, 2000c	9.9	0.24	1.2	55.0	2.3	3.05	0.13	0.04	3.01	1.27	2.12	4.00	2.87	3.74	1.31	1.87
	C-186378	J Channel	in preparation	10.5	0.21	1.0	51.6	2.1	3.11	0.13	0.04	3.07	1.36	2.02	3.82	2.63	3.88	1.06	1.52
	C-166303	J Special	in preparation	11.2	0.22	1.5	51.5	2.5	3.02	0.11	0.03	2.99	1.22	1.95	3.88	2.98	4.17	0.94	1.34
	C-175047	P	in preparation	11.8	0.2	1.1	57.5	2.4	3.11	0.13	0.04	3.07	1.33	1.96	3.70	2.99	4.18	0.98	1.40
	C-175074	P	in preparation	11.3	0.21	1.6	50.1	2.7	3.1	0.12	0.03	3.07	1.29	2.00	3.78	3.00	4.20	0.96	1.37
7-Sample Mean				11.1	0.2	1.5	62.5	2.3	3.07	0.13	0.04	3.04	1.29	2.06	3.88	2.91	4.07	1.04	1.48
Rel. Std. Dev.				7%	7%	32%	6%	12%	1%	10%	13%	1%	3%	5%		6%		12%	
Number of unqualified analyses				7	7	7	7	7	7	7	7	7	7	7		7		7	
POW-2	C-138247	D Channel	Herring and others, 2000a	31.9	0.49	7.0	134	2.4	7.52	4.48	1.22	8.30	0.88	3.48	6.57	14.8	20.71	1.45	2.07
	C-141292	E/F Channel	Herring and others, 2000b	30.4	0.52	8.0	128	2.2	7.71	4.38	1.20	6.51	0.94	3.80	6.80	16.4	22.94	1.58	2.26
	C-141408	G/H Channel	Herring and others, 2000c	35.2	0.54	8.3	154	2.6	7.68	4.40	1.20	6.48	0.88	3.60	6.80	13.8	19.31	1.69	2.42
	C-168377	J Channel	in preparation	29.8	0.47	8.1	144	2.5	7.71	4.42	1.21	6.50	0.92	3.57	8.74	13.7	19.17	1.57	2.25
	C-168300	J Special	in preparation	31.8	0.49	7.4	152	2.5	7.74	4.43	1.21	6.53	0.79	3.44	6.50	15.3	21.40	1.56	2.23
	C-175038	P	in preparation	35.7	0.46	6.8	151	3	7.65	4.42	1.21	6.44	0.91	3.37	6.37	14.8	20.43	1.46	2.09
	C-175062	P	in preparation	41.5	0.47	7.1	149	3	7.56	4.42	1.21	6.35	0.84	3.49	8.59	15.2	21.26	1.47	2.10
7-Sample Mean				33.8	0.5	6.9	145	2.6	7.65	4.42	1.21	6.44	0.88	3.51	5.62	14.8	20.75	1.54	2.20
Rel. Std. Dev.				12%	6%	9%	7%	12%	1%	1%	1%	1%	6%	2%		6%		6%	
Number of unqualified analyses				7	7	7	7	7	7	7	7	7	7	7		7		7	
POI-1	C-138229	D Channel	Herring and others, 2000a	19.1	0.22	1.8	43.1	1.5	3.70	2.49	0.68	3.02	2.55	5.83	11.01	4.13	5.78	2.39	3.42
	C-141273	E/F Channel	Herring and others, 2000b	18.6	0.25	2.4	47.5	1.4	3.88	2.51	0.89	3.19	2.75	5.63	10.64	4.10	5.74	2.51	3.59
	C-141338	G/H Channel	Herring and others, 2000c	16.4	0.21	2.0	43.8	1.5	3.83	2.50	0.68	3.15	2.89	5.84	11.03	3.92	5.48	2.44	3.49
	C-168378	J Channel	in preparation	16.0	0.22	1.4	43.7	1.3	3.83	2.50	0.68	3.15	2.79	5.82	10.62	3.36	4.70	2.49	3.56
	C-186320	J Special	in preparation	18.4	0.21	1.3	40.8	1.1	3.75	2.49	0.88	3.07	2.70	5.25	9.92	3.67	5.13	2.40	3.43
5-Sample Mean				18.5	0.2	1.8	43.7	1.4	3.80	2.50	0.68	3.12	2.70	5.63	10.64	3.84	5.37	2.45	3.50
Rel. Std. Dev.				2%	7%	25%	6%	12%	2%	0%	1%	2%	3%	4%		8%		2%	
Number of unqualified analyses				5	5	5	5	5	5	5	5	5	5	5		5		5	

Table 1. Major, minor, and trace element concentrations for Check Standards POW-1, POW-2, and POI-1

Check Standard	Lab No.	K, %, ICP-18	KOx, %, ICP-18	Mg, %, ICP-16	MgOx, %, ICP-16	Na, %, ICP-16	NaOx, %, ICP-18	P, %, ICP-16	POx, %, ICP-16	Si, %, ICP 16	SiOx, %, ICP-16	Ti, %, ICP 16	TiOx, %, ICP-16	Sum Oxides + C + S, %	Ba, ppm, ICP-18	Cr, ppm, ICP-16	Mn, ppm, ICP-16	Nb, ppm, ICP-16	Sr, ppm, ICP-16	Y, ppm, ICP-16	Zr, ppm, ICP-18	Al, % ICP-40	Ca, ppm, ICP-40
Standard SARL-1: Rel. Std. Difference		-2%		-4%		-2%		-9%		-3%		23%			7%	2%	-1%	9%	-9%	21%	-3%	-5%	-3%
Standard SARL-1: Rel. Std. Deviation		11%		8%		6%		5%		8%		4%			5%	9%	8%	5%	3%	7%	5%	4%	2%
Standard SARM-1: Rel. Std. Difference		-5%		-7%		-3%		-13%		-6%		6%			8%	-8%	-2%	24%	-9%	7%	1%	-2%	-4%
Standard SARM-1: Rel. Std. Deviation		2%		1%		2%		0%		2%		3%			3%	3%	2%	8%	2%	3%	5%	2%	2%
POW-1	C-136227	0.56	0.67	0.20	0.33	0.07	0.09	1.28	2.93	38.0	81.28	0.11	0.18	99.8	172	607	<100	<10	138	123	82	1.99	3.02
	C-141293	0.59	0.71	0.19	0.32	0.08	0.11	1.33	3.05	36.0	77.00	0.10	0.17	95.5	176	577	<100	<10	131	122	65	1.80	2.94
	C-141409	0.63	0.76	0.21	0.35	0.08	0.11	1.39	3.19	36.2	77.43	0.10	0.17	98.0	175	643	<100	<10	127	119	67	1.78	2.65
	C-166376	0.63	0.76	0.18	0.30	0.08	0.11	1.23	2.82	35.8	76.58	0.10	0.17	94.3	189	577	<100	<10	133	122	66	1.88	2.65
	C-166303	0.51	0.61	0.17	0.28	0.07	0.09	1.04	2.38	34.8	74.44	0.10	0.17	91.5	163	533	<100	<10	123	113	86	1.91	3.11
	C-175047	0.55	0.66	0.21	0.35	0.08	0.11	1.24	2.84	37.1	79.36	0.09	0.15	97.3	156	587	<100	<10	127	115	95	1.84	2.89
	C-175074	0.59	0.71	0.20	0.33	0.08	0.11	1.22	2.80	36.4	77.86	0.09	0.15	95.8	163	564	<100	<10	128	118	79	1.89	3.01
7-Sample Mean		**0.58**	**0.70**	**0.19**	**0.32**	**0.08**	**0.10**	**1.25**	**2.86**	**36.3**	**77.7**	**0.10**	**0.16**	**95.7**	**168**	**584**			**129**	**119**	**74**	**1.87**	**2.89**
Rel. Std. Dev.		**8%**		**8%**		**8%**		**9%**		**3%**		**7%**			**4%**	**8%**			**4%**	**3%**	**15%**	**4%**	**6%**
Number of unqualified analyses		7		7		7		7		7		7			7	7	0	0	7	7	7	7	7
POW-2	C-136247	1.31	1.58	1.09	1.81	0.56	0.75	5.62	12.88	15.8	33.80	0.23	0.38	92.2	246	1270	<100	<10	579	166	182	3.54	14.5
	C-141292	1.39	1.67	1.15	1.91	0.60	0.81	6.09	13.95	18.8	35.94	0.24	0.40	98.5	268	1300	<100	10	810	173	180	3.20	16.3
	C-141408	1.48	1.78	1.19	1.97	0.60	0.81	6.13	14.05	17.6	37.85	0.24	0.40	96.9	265	1430	243	<10	571	167	188	3.11	12.8
	C-168377	1.46	1.78	1.05	1.74	0.58	0.78	5.36	12.28	16.1	34.44	0.22	0.37	91.4	252	1200	<100	11	606	168	181	3.42	13.0
	C-186300	1.33	1.80	1.06	1.76	0.6	0.81	5.04	11.55	17.5	37.43	0.24	0.40	95.4	261	1280	<100	<10	600	160	190	3.22	14.2
	C-175038	1.27	1.53	1.07	1.77	0.52	0.70	5.32	12.19	16.1	34.44	0.21	0.35	91.6	233	1300	<100	16	542	153	186	3.25	14.3
	C-175062	1.35	1.63	1.09	1.81	0.53	0.71	5.3	12.14	16.3	34.87	0.21	0.35	93.1	238	1250	<100	12	566	170	197	3.50	15.1
7-Sample Mean		**1.37**	**1.65**	**1.10**	**1.82**	**0.57**	**0.77**	**5.55**	**12.72**	**18.6**	**35.5**	**0.23**	**0.38**	**94.2**	**252**	**1290**		**12**	**582**	**165**	**186**	**3.32**	**14.3**
Rel. Std. Dev.		**6%**		**5%**		**6%**		**8%**		**4%**		**6%**			**6%**	**5%**		**21%**	**4%**	**4%**	**3%**	**5%**	**8%**
Number of unqualified analyses		7		7		7		7		7		7			7	7	1	4	7	7	7	7	7
POI-1	C-136229	1.97	2.37	1.07	1.77	0.56	0.75	1.13	2.59	26.8	57.33	0.39	0.65	93.7	255	501	229	<10	130	91	279	6.08	4.13
	C-141273	1.92	2.31	1.08	1.79	0.57	0.77	1.16	2.66	26.8	57.33	0.39	0.65	93.9	276	503	221	<10	128	91	270	5.34	3.87
	C-141338	1.91	2.30	1.02	1.69	0.58	0.75	1.09	2.50	25.8	55.19	0.41	0.68	91.5	259	495	196	14	124	84	226	5.73	3.99
	C-166378	2.09	2.52	0.99	1.84	0.55	0.74	1.06	2.43	28.2	56.04	0.36	0.60	91.3	253	474	206	<10	129	86	279	5.64	3.48
	C-166320	1.85	2.23	0.97	1.61	0.55	0.74	0.97	2.22	28.2	60.32	0.38	0.63	94.5	253	498	203	<10	122	82	282	5.48	3.96
5-Sample Mean		**1.95**	**2.35**	**1.03**	**1.70**	**0.56**	**0.76**	**1.08**	**2.48**	**26.8**	**57.2**	**0.39**	**0.64**	**93.0**	**259**	**494**	**211**		**127**	**87**	**267**	**5.65**	**3.89**
Rel. Std. Dev.		**5%**		**5%**		**1%**		**7%**		**3%**		**5%**			**4%**	**2%**	**6%**		**3%**	**5%**	**9%**	**5%**	**6%**
Number of unqualified analyses		5		5		5		5		5		5			5	5	5	1	5	5	5	5	5

Table 1. Major, minor, and trace element concentrations for Check Standards POW-1, POW-2, and POI-1

Check Standard	Lab No.	Fe, %, ICP-40	K, %, ICP-40	Mg, %, ICP-40	Na, %, ICP-40	P, %, ICP-40	Ti, %, ICP-40	Ag, ppm, ICP-40	As, ppm, ICP-40	Au, ppm, ICP-40	Ba, ppm, ICP-40	Be, ppm, ICP-40	Bi, ppm, ICP-40	Cd, ppm, ICP-40	Ce, ppm, ICP-40	Co, ppm, ICP-40	Cr, ppm, ICP-40	Cu, ppm, ICP-40	Eu, ppm, ICP-40	Ga, ppm, ICP-40	Ho, ppm, ICP-40	La, ppm, ICP-40	Li, ppm, ICP-40
Standard SARL-1: Rel. Std. Difference		-3%	-3%	-8%	-7%	-15%	9%	-4%	-5%		-1%	0%		-20%	-3%	-1%	-3%	-3%		-5%		-3%	-4%
Standard SARL-1: Rel. Std. Deviation		2%	3%	4%	3%	5%	3%	23%	4%		3%	14%		0%	5%	15%	6%	6%		3%		4%	5%
Standard SARM-1: Rel. Std. Difference		-4%	0%	-9%	-5%	-15%	-10%	13%	-7%		2%	-17%		-5%	-2%	-7%	-2%	-1%		3%		-3%	-3%
Standard SARM-1: Rel. Std. Deviation		2%	2%	2%	2%	0%	1%	16%	7%		3%	0%		13%	6%	5%	3%	2%		6%		7%	3%
POW-1	C-136227	0.99	0.57	0.18	0.074	1.29	0.065	<2	15	<8	176	<1	<50	11	19	5	95	54	2	5	<4	71	17
	C-141293	1.01	0.56	0.16	0.072	1.35	0.081	<2	<10	<8	180	<1	<50	11	21	3	510	55	2	9	<4	75	16
	C-141409	1.00	0.55	0.18	0.070	1.10	0.085	<2	<10	<8	166	<1	<50	11	18	4	514	56	2	7	<4	67	18
	C-166376	1.02	0.58	0.17	0.071	1.21	0.069	<2	<10	<8	160	<1	<50	10	30	3	563	53	2	7	<4	68	18
	C-166303	1.04	0.57	0.16	0.072	1.15	0.069	<2	<10	<8	189	<1	<50	11	29	3	257	55	2	8	<4	73	17
	C-175047	1.01	0.54	0.19	0.069	1.27	0.077	2	10	<8	161	<1	<50	11	18	3	304	56	3	6	6	66	17
	C-175074	0.96	0.57	0.19	0.069	1.30	0.077	<2	<10	<8	165	<1	<50	11	30	3	266	59	3	7	<4	66	18
7-Sample Mean		1.01	0.56	0.18	0.071	1.24	0.078				168			11	23	3	362	55	2	7		69	17
Rel. Std. Dev.		2%	2%	4%	3%	7%	9%				4%			3%	26%	23%	47%	3%	21%	18%		5%	4%
Number of unqualified analyses		7	7	7	7	7	7	1	2	0	7	0	0	7	7	7	7	7	7	7	1	7	7
POW-2	C-136247	1.46	1.41	1.05	0.56	5.76	0.116	8	23	<8	246	<1	<50	51	44	3	1160	101	3	11	<4	123	18
	C-141292	1.46	1.36	1.04	0.59	5.87	0.114	8	18	<8	255	<1	<50	49	46	4	1240	103	3	14	<4	132	17
	C-141408	1.49	1.30	1.04	0.55	5.02	0.137	9	22	<6	239	<1	<50	52	43	7	1300	102	3	13	<4	114	19
	C-166377	1.53	1.40	0.99	0.58	5.22	0.092	12	18	<8	218	<1	<50	49	43	2	1040	99	3	13	<4	121.	17
	C-166300	1.46	1.32	1.01	0.55	4.82	0.058	11	16	<8	229	<1	<50	52	47	4	968	95	3	14	<4	121	16
	C-175038	1.49	1.35	1.06	0.55	5.67	0.121	6	29	<6	229	<1	<50	51	52	<2	1250	101	3	13	6	115	18
	C-175062	1.57	1.42	1.13	0.58	5.66	0.121	9	24	<8	244	<1	<50	56	47	3	719	107	3	13	<4	120	19
7-Sample Mean		1.5	1.4	1.0	0.57	5.43	0.106	9	21		237			51	46	4	1097	101	3	13		121	18
Rel. Std. Dev.		3%	3%	4%	3%	8%	24%	17%	21%		5%			5%	7%	45%	19%	4%	0%	8%		5%	6%
Number of unqualified analyses		7	7	7	7	7	7	7	7	0	7	0	0	7	7	6	7	7	7	7	1	7	7
POI-1	C-136229	2.45	2.13	1.09	0.58	1.20	0.268	<2	23	<8	268	1	<50	9	55	12	163	43	3	19	<4	66	25
	C-141273	2.47	2.02	1.09	0.57	1.14	0.255	<2	11	<6	269	<1	<60	6	49	11	505	42	3	19	<4	67	22
	C-141338	2.49	2.00	1.04	0.56	1.13	0.261	<2	13	<8	271	<1	<50	8	55	10	461	42	<2	14	<4	67	22
	C-166376	2.51	2.02	0.95	0.54	1.04	0.247	<2	<10	<8	247	1	<50	7	46	10	474	35	2	16	<4	61	22
	C-166320	2.44	1.92	1.01	0.55	1.01	0.247	<2	15	<8	249	1	<50	8	54	10	435	36	<2	18	<4	67	22
5-Sample Mean		2.47	2.02	1.03	0.56	1.10	0.260		16		265	1		8	52	11	412	40	3	17		66	23
Rel. Std. Dev.		1%	4%	6%	3%	7%	6%		34%		7%	0%		9%	8%	8%	34%	10%	22%	13%		4%	6%
Number of unqualified analyses		5	5	5	5	5	5	0	4	0	5	3	0	5	5	5	5	5	3	5	0	5	5

Table 1. Major, minor, and trace element concentrations for Check Standsrds POW-1, POW-2, and POI-1

Check Standard	Lab No.	Mn, ppm, ICP-40	Mo, ppm, ICP-40	Nb, ppm, ICP-40	Nd, ppm, ICP-40	Ni, ppm, ICP-40	Pb, ppm, ICP-40	Sc, ppm, ICP-40	Sn, ppm, ICP-40	Sr, ppm, ICP-40	Ta, ppm, ICP-40	Th, ppm, ICP-40	U, ppm, ICP-40	V, ppm, ICP-40	Y, ppm, ICP-40	Yb, ppm, ICP-40	Zn, ppm, ICP-40
Standard SARL-1: Rel. Std. Difference		-5%	11%	2%	2%	-2%	0%	3%		-11%		23%		-9%	-15%	9%	1%
Standard SARL-1: Rel. Std. Deviation		4%	4%	4%	7%	4%	3%	0%		5%		6%		6%	10%	0%	4%
Standard SARM-1: Rel. Std. Difference		-4%	13%	10%	1%	-1%	3%	-1%		-10%		17%		0%	-26%	-6%	6%
Standard SARM-1: Rel. Std. Deviation		2%	4%	6%	6%	5%	3%	6%		2%		8%		3%	2%	0%	2%
POW-1	C-136227	33	22	<4	51	193	5	5	<50	127	<40	<6	<100	184	127	6	869
	C-141293	28	21	<4	58	186	6	5	<50	125	<40	<6	<100	171	117	7	836
	C-141409	39	21	<4	58	193	17	4	<50	125	<40	<6	<100	169	119	6	828
	C-166378	42	19	<4	60	177	13	4	<50	126	<40	<6	<100	176	112	6	864
	C-166303	32	19	<4	61	199	10	4	<50	133	<40	<8	<100	184	121	6	812
	C-175047	38	21	5	62	184	6	4	<50	126	<40	<6	<100	183	119	7	839
	C-175074	46	21	7	51	196	6	4	<50	129	<40	<6	<100	182	120	7	847
7-Sample Mean		37	21		57	190	9	4		127				178	119	6	842
Rel. Std. Dev.		17%	6%		6%	4%	51%	11%		2%				4%	4%	6%	2%
Number of unqualified analyses		7	7	2	7	7	7	7	0	7	0	0	0	7	7	7	7
POW-2	C-136247	66	31	<4	65	216	9	8	<50	561	<40	7	<100	890	175	8	1140
	C-141292	64	29	<4	75	200	12	8	<50	545	<40	8	<100	635	166	9	1080
	C-141408	67	31	<4	66	210	29	7	<50	541	<40	<8	<100	671	171	9	1160
	C-166377	66	27	<4	91	186	21	7	<50	564	<40	12	<100	660	160	6	1120
	C-166300	69	28	<4	76	209	17	6	<50	554	<40	9	<100	641	163	8	1030
	C-175036	64	31	9	86	207	12	7	<50	571	<40	<6	<100	681	169	9	1110
	C-175062	66	33	9	86	218	12	8	<50	604	<40	10	<100	718	177	9	1190
7-Sample Mean		66	30		76	207	16	7		563		9		671	169	9	1119
Rel. Std. Dev.		3%	7%		13%	5%	44%	10%		4%		21%		4%	4%	6%	5%
Number of unqualified analyses		7	7	2	7	7	7	7	0	7	0	5	0	7	7	7	7
POI-1	C-136229	208	18	6	51	422	21	11	<50	125	<40	12	<100	160	94	6	1380
	C-141273	205	18	9	47	396	14	11	<50	119	<40	11	<100	149	89	6	1330
	C-141338	187	16	12	52	388	13	11	<50	122	<40	10	<100	146	84	8	1270
	C-166376	206	16	6	65	378	25	10	<50	123	<40	7	<100	145	80	5	1290
	C-166320	206	17	9	67	394	20	10	<50	126	<40	13	<100	154	89	6	1190
5-Sample Mean		202	16	8	56	396	19	11		123		11		161	67	6	1292
Rel. Std. Dev.		4%	3%	30%	16%	4%	27%	5%		2%		22%		4%	6%	6%	5%
Number of unqualified analyses		5	5	5	5	5	5	5	0	5	0	5	0	5	5	5	5

Table 2. Results of Energy-dipersive X-ray Anaysis

	Ag, ppm	As, ppm	Ba, ppm	Br, ppm	Cd, ppm	Ce, ppm	Cr, ppm	Cs, ppm	Cu, ppm	La, ppm	Mo, ppm	Nb, ppm	Nd, ppm	Ni, ppm	Pb, ppm	Rb, ppm	Sb, ppm
NBS2711, 1-sigma error, %	0.3	4.9	3.1	0.5	0.6	2.5	1.0	0.6	2.7	1.9	0.2	0.4	5.9	1.7	5.0	0.8	0.4
NBS2710, 1-sigma error, %	0.6	11.3	2.6	1.3	0.5	2.3	1.7	1.1	14.0	1.6	1.0	0.4	5.9	0.8	13.0	0.9	0.4
Standard POW-1																	
POW-1	2	11	160	1.8	12	24	512	3	54	75	22	5	55	186	7.3	29	4.3
POW-1	3	11	181	2.1	13	29	526	4	55	75	21	4	65	192	7.2	32	2.9
POW-1	2	11	182	2.0	13	27	518	5	61	79	21	4	62	197	7.6	30	3.9
POW-1-GR5	2	12	185	1.7	11	24	502	<3	56	74	20	4	60	191	5.5	32	<2
POW-1-GR7	2	10	185	1.9	12	30	499	5	55	79	19	4	61	187	7.6	31	<2
POW-1-GR8	2	10	187	1.9	12	22	503	<3	53	76	22	4	60	194	7.8	29	<2
POW-1-GR10	2	11	165	1.7	11	23	512	3	54	77	20	4	59	194	7.1	32	<2
POW-1-GR11	2	10	185	1.9	13	25	511	3	55	75	21	5	64	194	8.4	32	<2
POW-1	2	12	185	2.0	13	26	507	<3	53	76	21	4	62	194	6.9	32	<2
POW-1	2	11	178	1.5	14	29	517	4	54	77	23	4	60	202	6.8	32	2.1
gr18-pow1	2	11	178	2.0	14	24	510	4	55	76	22	4	58	196	7.3	31	2.3
STD-1	2	11	162	1.6	13	26	519	<3	54	76	22	3	71	196	8.4	31	4.0
Mean	2	11	163	1.8	12.7	26	511	4	55	76	21	4	61	194	7.3	31	3.3
Rel. Std. Dev.	14%	6%	2%	10%	8%	10%	2%	15%	4%	2%	5%	10%	7%	2%	11%	4%	29%
unqualified analyses of 12	12	12	12	12	12	12	12	8	12	12	12	12	12	12	12	12	6
Standard POW-2																	
POW-2	12	30	245	1.3	68	46	1150	<3	94	113	31	7	66	238	11	54	10
POW-2	11	29	244	1.2	83	40	1150	<3	98	111	32	6	63	243	14	57	12
POW-2C	11	31	238	1.0	65	41	1130	<3	97	110	32	8	80	229	13	54	12
POW-2-GR6	11	30	260	1.1	65	44	1130	<3	97	118	32	8	66	233	12	56	7
POW-2GR7	12	31	252	1.7	66	44	1120	<3	95	112	30	8	72	230	11	55	6
POW-2-GR9	10	32	254	1.1	63	43	1130	<3	96	116	31	9	71	229	12	54	7
POW-2-GR10	12	32	252	1.3	66	48	1130	<3	97	114	30	9	50	238	13	49	6
POW-2-GR12	12	31	253	<1	62	46	1130	<3	100	116	30	8	61	227	11	·55	7
POW-2	11	31	257	<1	64	49	1150	<3	102	116	31	8	73	233	10	56	6
GR14-POW2	11	30	251	<1	64	38	1150	<3	104	113	29	9	59	239	12	56	7
POW-2-GR17	13	31	239	<1	74	44	1140	<3	100	113	33	9	79	232	13	56	8
gr16-pow2	12	31	241	1.7	74	42	1140	<3	96	109	35	9	74	232	10	56	9
STD-2	12	31	238	1.3	73	38	1140	<3	104	107	32	6	68	233	12	55	10
STD2	13	29	239	1.3	72	42	1130	<3	97	107	33	7	72	232	14	50	9
Mean	12	31	247	1.3	67	43	1137		98	112	31	8	67	233	12	54	8
Rel. Std. Dev.	7%	3%	3%	18%	6%	8%	1%		3%	3%	5%	6%	11%	2%	10%	4%	23%
Number of unqualified analyses of 14	14	14	14	10	14	14	14	0	14	14	14	14	14	14	14	14	14
Standard POI-1																	
POI-1	1.4	18	271	<1	11	62	515	6.3	36	74	17	14	51	423	13	89	5.2
POI-1	1.9	19	269	<1	10	64	494	6.5	36	78	17	13	58	417	17	87	5.0
POI-1-GR5	1.5	17	276	<1	10	59	489	5.7	42	74	19	13	60	419	14	67	<2
POI-1-GR6	1.8	18	281	<1	9	66	486	5.4	37	77	17	12	59	415	13	87	<2
POI-1-GR6	<1	19	274	<1	10	59	491	4.7	38	71	16	13	53	410	12	66	<2
POI-1-GR9	1.6	18	276	<1	10	61	490	5.6	40	73	17	13	57	406	13	86	<2
POI-1-GR11	1.6	19	283	<1	8	65	492	6.7	37	74	16	13	64	411	12	87	<2
STD-3	1.1	18	269	<1	10	62	489	5.6	35	72	17	14	57	416	15	87	3.5
POI-1-GR12	2.0	18	272	<1	9	63	495	6.0	41	72	17	13	55	402	15	87	<2
GR14-POI1	1.3	19	266	<1	11	59	503	4.1	43	68	16	14	56	434	14	88	<2
GR15-POI-1	1.6	20	268	<1	10	60	506	5.8	37	70	19	13	52	424	12	89	2.2
POI-1	1.5	18	263	1	11	62	501	4.9	40	69	17	13	51	428	13	90	2.0
POI-1-GR17	1.4	18	266	<1	12	61	508	5.6	37	70	18	13	55	426	18	90	2.2
Mean	1.6	16	272	1	10	62	497	5.8	38	73	17	13	56	418	14	88	3.4
Rel. Std. Dev.	16%	4%	2%		9%	4%	2%	16%	7%	4%	5%	4%	7%	2%	10%	1%	44%
Number of unqualified analyses of 13	12	13	13	1	13	13	13	13	13	13	13	13	13	13	13	13	8

Table 2. Results of Energy-dipersive X-ray Anaysis

	Se, ppm	Sn, ppm	Sr, ppm	Th, ppm	U, ppm	V, ppm	Y, ppm	Zn, ppm	Zr, ppm
NBS2711, 1-sigma error, %	0.9	0.2	1.0	0.5	1.4	2.8	0.2	3.7	1.1
NBS2710, 1-sigma error, %	1.2	0.3	1.0	0.4	1.9	4.1	0.0	16.0	1.2
Standard POW-1									
POW-1	46	<2	126	<2	30	140	123	859	76
POW-1	46	<2	130	2	30	143	127	887	76
POW-1	48	<2	132	<2	32	145	127	892	76
POW-1-GR5	47	<2	127	<2	29	142	123	857	73
POW-1-GR7	45	<2	126	<2	30	142	124	850	76
POW-1-GR8	47	<2	128	<2	34	141	125	846	76
POW-1-GR10	46	<2	128	<2	30	139	125	669	74
POW-1-GR11	47	<2	129	<2	29	140	125	670	75
POW-1	47	<2	128	<2	30	140	125	870	74
POW-1	47	<2	130	<2	30	144	127	886	80
gr16-pow1	47	<2	129	<2	29	142	124	871	75
STD-1	48	<2	128	<2	28	144	125	694	75
Mean	47		128	2	30	142	125	671	76
Rel. Std. Dev.	2%		1%		5%	1%	1%	2%	2%
unqualified analyses of 12	12	0	12	1	12	12	12	12	12
Standard POW-2									
POW-2	140	<2	546	2.9	46	478	167	1230	175
POW-2	143	<2	567	2.7	50	478	172	1250	176
POW-2C	138	<2	554	5.2	51	471	171	1220	169
POW-2-GR6	138	<2	557	4.9	47	461	170	1210	176
POW-2GR7	140	<2	553	2.8	46	463	168	1200	178
POW-2-GR9	143	<2	556	2.9	49	466	169	1220	173
POW-2-GR10	141	<2	557	4.4	52	472	169	1240	174
POW-2-GR12	141	<2	558	2.7	46	474	170	1230	173
POW-2	141	<2	563	<2	49	478	172	1250	176
GR14-POW2	142	<2	563	4.0	50	470	173	1240	176
POW-2-GR17	142	<2	562	5.3	46	477	170	1240	176
gr18-pow2	141	<2	557	4.3	47	465	170	1220	177
STD-2	141	2	557	2.7	52	467	172	1240	170
STD2	141	<2	555	4.8	51	473	169	1240	177
Mean	141	2	568	3.8	49	471	170	1231	175
Rel. Std. Dev.	1%		1%	28%	4%	1%	1%	1%	2%
Number of unqualified analyses of 14	14	1	14	13	14	14	14	14	14
Standard POI-1									
POI-1	42	<2	129	6.2	20	140	98	1360	276
POI-1	42	<2	130	9.5	20	135	99	1370	282
POI-1-GR5	41	<2	130	5.3	20	132	97	1360	281
POI-1-GR6	43	<2	128	7.5	19	129	97	1360	277
POI-1-GR8	43	<2	128	5.6	19	128	97	1360	275
POI-1-GR9	41	<2	128	6.0	18	130	96	1350	274
POI-1-GR11	41	<2	128	7.9	20	135	97	1390	279
STD-3	41	2	128	5.0	20	139	96	1390	278
POI-1-GR12	42	<2	129	8.6	21	137	98	1400	279
GR14-POI1	42	<2	130	6.0	19	136	100	1400	280
GR15-POI-1	43	<2	131	9.2	19	139	99	1410	281
POI-1	43	2	129	8.9	19	132	98	1390	260
POI-1-GR17	43	<2	130	8.3	21	139	97	1430	281
Mean	42	2	129	7.4	20	135	98	1364	279
Rel. Std. Dev.	2%	10%	1%	21%	4%	3%	1%	2%	1%
Number of unqualified analyses of 13	13	2	13	13	13	13	13	13	13

Table 3. Water leachate concentrations of various elements, parts per billion

Sample, WPS-	pH	Conductivity, uSi/cm	duration; notes	F, ppm, IC	Cl, ppm, IC	NO3, ppm, IC	SO4, ppm, IC	Li, ppb, ICP-MS	Be, ppb, ICP-MS	B, ppb, ICP-MS	Na, ppb, ICP-MS	Mg, ppb, ICP-MS	Al, ppb, ICP-MS	Si, ppb, ICP-MS	K, ppb, ICP MS	Ca, ppb, ICP MS	Sc, ppb, ICP-MS
POW-1	5.9	536	24-hr	1.4	2.0	0.00	242.1	19	0.1	148	2,700	9,890	172	10,700	16,500	88,800	7
POW-1X	5.8	549	24-hr, duplicate	1.2	2.7	0.79	304.3	15	0.1	126	2,820	10,100	230	5,630	15,900	94,500	4
24-hr average				**1.3**	**2.3**	**0.4**	**273**	**17**	**0.1**	**137**	**2,760**	**9,995**	**201**	**8,165**	**16,200**	**91,650**	**5**
24-hr rel. std. dev.				**11%**	**19%**	**141%**	**16%**	**17%**	**2%**	**12%**	**3%**	**1%**	**20%**	**44%**	**3%**	**4%**	**29%**
POW-1-2	5.7	550	2-day	1.5	2.2	0.00	283.3	17	0.1	138	2,640	9,920	176	10,500	15,700	89,600	7
POW-1-5	5.9	620	5-day	2.5	2.5	0.00	322.4	21	0.1	171	2,900	11,900	179	19,600	17,000	96,700	11
POW-1-10	6.0	579	10-day	1.6	2.4	0.00	302.6	20	-0.1	175	2,730	12,100	207	23,300	16,300	95,600	12
POW-2	8.0	203	24-hr	4.7	1.6	0.60	23.9	14	-0.1	109	6,110	6,020	152	7,130	14,400	23,500	5
POW-2X	7.2	179	24-hr, duplicate	4.2	1.5	0.44	22.3	11	-0.1	83	5,420	5,170	201	4,180	12,500	19,200	3
24-hr average			**24-hr average**	**4**	**2**	**1**	**23**	**12**		**96**	**5,765**	**5,595**	**176**	**5,655**	**13,450**	**21,350**	**4**
24-hr rel. std. dev.			**24-hr rel. std. dev.**	**7%**	**2%**	**22%**	**5%**	**16%**		**19%**	**8%**	**11%**	**20%**	**37%**	**10%**	**14%**	**24%**
POW-2-2	7.5	194	2-day	4.5	1.7	0.54	25.6	13	-0.1	99	6,000	5,960	112	5,230	13,300	22,200	4
POW-2-5	7.7	239	5-day	4.4	1.6	0.70	27.3	13	-0.1	104	6,040	6,830	137	8,990	13,900	26,000	5
POW-2-10	7.8	220	10-day	3.2	1.2	0.48	24.7	16	-0.1	121	6,420	8,260	169	9,810	14,400	30,400	6
POI-1	6.6	817	24-hr	2.5	1.4	0.00	471.6	7	-0.1	85	2,320	35,400	10	4,070	13,400	120,000	3
POI-1X	6.1	803	24-hr, duplicate	2.3	1.3	0.00	482.6	6	-0.1	66	2,340	36,400	57	1,630	12,900	123,000	2
24-hr avarage			**24-hr avarage**	**2**	**1**	**0**	**477**	**6**		**76**	**2,330**	**35,900**	**34**	**2,850**	**13,150**	**121,500**	**3**
24-hr rel. std. dev.			**24-hr ral. std. dev.**	**8%**	**3%**		**2%**	**17%**		**18%**	**1%**	**2%**	**98%**	**61%**	**3%**	**2%**	**32%**
POI-1-2	6.5	803	2-day	2.4	1.4	0.00	449.3	6	-0.1	76	2,240	36,000	11	3,160	12,100	122,000	3
POI-1-5	6.8	910	5-day	2.9	0.9	3.23	480.9	7	-0.1	94	2,530	42,200	5	7,700	13,000	132,000	5
POI-1-10	6.8	900	10-day	2.0	1.2	0.00	491.6	7	-0.1	100	2,470	44,000	9	9,190	12,700	137,000	6
Lab de-ionized water blank																	
De-ionized blank	5.4	1	24-hour	0	0.018	0	0	-1	-0.1	7	65	96	4.1	-50	160	211	-1
De-ionized blank	5.8	1	24-hour					-1	-0.1	6	-5	19	2.4	-50	14	-50	-1
Average										6	30	57	3.2		87		

Table 3. Water leachate concentrations of various elements, parts per billion

Sample, WPS-	Ti, ppb, ICP-MS	V, ppb, ICP-MS	Cr, ppb, ICP-MS	Mn, ppb, ICP-MS	Fe, ppb, ICP-MS	Co, ppb, ICP-MS	Ni, ppb, ICP-MS	Cu, ppb, ICP-MS	Zn, ppb, ICP-MS	Ga, ppb, ICP-MS	Ge, ppb, ICP-MS	As, ppb, ICP-MS	Se, ppb, ICP-MS	Br, ppb, ICP-MS	Rb, ppb, ICP-MS	Sr, ppb, ICP-MS	Y, ppb, ICP-MS	Zr, ppb, ICP-MS	Nb, ppb, ICP-MS	Mo, ppb, ICP-MS
POW-1	14.9	53.7	-0.5	465	225	52.7	1,580	1.8	5,320	0.1	2.9	7.2	248	26	30.4	279	0.44	0.02	0.006	300
POW-1X	14.6	34.9	0.6	454	237	53.5	1,550	3.1	6,310	0.1	2.0	5.7	231	27	29.5	315	0.61	0.02	0.006	197
24-hr average	**15**	**44**		**459**	**231**	**53**	**1,565**	**2**	**5,815**	**0.1**	**2.5**	**6.4**	**240**	**26**	**29.9**	**297**	**0.52**	**0.02**	**0.006**	**249**
24-hr rel. std. dev.	**2%**	**30%**		**2%**	**4%**	**1%**	**1%**	**38%**	**12%**	**1%**	**26%**	**16%**	**5%**	**3%**	**2%**	**9%**	**22%**	**11%**	**5%**	**29%**
POW-1-2	13.4	40.5	-0.5	469	217	53.9	1,560	1.7	5,950	0.1	2.3	5.0	239	25	28.9	292	0.50	0.01	0.006	311
POW-1-5	16.3	40.6	-0.5	530	237	60.0	1,650	2.0	6,350	0.1	2.6	3.4	273	33	31.5	312	0.50	0.02	0.006	407
POW-1-10	17.0	30.3	-0.5	512	223	57.9	1,600	1.7	6,480	0.1	2.4	2.3	257	31	28.0	300	0.46	0.02	0.005	402
POW-2	18.5	604	13.6	6.4	76	0.53	20	0.8	44	1.5	1.2	21	246	11	19.3	83.2	0.19	0.04	0.009	143
POW-2X	15.6	497	9.8	3.1	57	0.20	10	0.5	13	1.6	1.0	20	222	9	15.9	67.1	0.09	0.02	0.007	121
24-hr average	**17**	**551**	**11.7**	**4.8**	**67**	**0.36**	**15**	**0.7**	**28**	**1.6**	**1.1**	**20**	**234**	**10**	**18**	**75**	**0.14**	**0.03**	**0.008**	**132**
24-hr rel. std. dev.	**12%**	**14%**	**23%**	**49%**	**20%**	**66%**	**46%**	**38%**	**77%**	**2%**	**11%**	**2%**	**7%**	**13%**	**14%**	**15%**	**52%**	**44%**	**15%**	**11%**
POW-2-2	14.2	564	10.6	3.1	56	0.19	10.6	0.6	11	1.5	1.1	22	260	10	16.8	73.4	0.01	0.02	0.008	137
POW-2-5	15.3	597	14.7	3.2	106	0.16	9.6	3.1	10	1.2	1.4	21	315	38	17.0	86.2	0.50	0.06	0.012	147
POW-2-10	17.8	574	17.5	4.9	150	0.27	12.7	1.4	20	0.9	1.2	19	258	22	17.4	93.4	0.84	0.08	0.010	162
POI-1	1.7	1.58	-0.5	978	290	43.6	521	1.2	1,050	0.1	1.0	1.4	210	12	21.3	230	0.02	0.04	0.007	77
POI-1X	3.7	1.28	-0.5	1,050	393	53.4	574	0.4	1,670	0.1	1.0	1.0	209	9	21.5	229	0.03	0.02	0.006	54
24-hr average	**2.7**	**1.43**		**1,014**	**341**	**48.5**	**547**	**0.8**	**1,360**	**0.1**	**1.0**	**1.2**	**209**	**10**	**21.4**	**230**	**0.03**	**0.03**	**0.007**	**66**
24-hr rel. std. dev.	**53%**	**15%**		**5%**	**21%**	**14%**	**7%**	**73%**	**32%**	**11%**	**5%**	**27%**	**0%**	**24%**	**1%**	**0%**	**15%**	**53%**	**8%**	**25%**
POI-1-2	5.1	1.30	-0.5	931	293	40.8	456	0.3	1,050	0.1	0.9	0.9	201	9	19.0	212	0.02	0.02	0.006	77
POI-1-5	8.9	1.59	-0.5	897	311	27.4	272	0.3	421	0.1	1.0	1.1	216	19	19.4	230	0.01	0.02	0.007	125
POI-1-10	10.4	1.28	-0.5	1,020	340	30.8	268	0.3	685	0.1	1.0	0.9	208	21	17.8	231	0.01	0.06	0.006	133
Lab de-ionized wa																				
De-ionized blank	5.3	6.4	-0.50	0.33	-5	0.03	0.6	-0.2	3.6	0.02	0.02	0.30	4.7	-3	0.47	1.63	0.01	-0.01	-0.005	7.4
De-ionized blank	3.9	0.3	-0.50	0.38	-5	0.05	1.0	-0.2	3.2	-0.01	-0.01	-0.03	0.4	-3	0.05	0.48	0.004	-0.01	-0.005	1.2
Average	4.6	3.4		0.36		0.04	0.8		3.4				2.55401		0.26227	1.05354	0.01			4.3

Table 3. Water leachate concentrations of various elements, parts per billion

Sample, WPS-	Ru, ppb, ICP-MS	Pd, ppb, ICP-MS	Ag, ppb, ICP-MS	Cd, ppb, ICP-MS	In, ppb, ICP-MS	Sn, ppb, ICP-MS	Sb, ppb, ICP-MS	Te, ppb, ICP-MS	I, ppb, ICP MS	Cs, ppb, ICP-MS	Ba, ppb, ICP-MS	La, ppb, ICP-MS	Ce, ppb, ICP-MS	Pr, ppb; ICP-MS	Nd, ppb, ICP-MS	Sm, ppb, ICP-MS	Eu, ppb, ICP-MS	Gd, ppb, ICP-MS	Tb, ppb, ICP-MS	Dy, ppb, ICP-MS
POW-1	-0.01	-0.01	-0.2	31.5	0.001	-0.1	6.8	0.03	9	0.60	15.1	0.177	0.035	0.019	0.073	0.018	0.008	0.030	0.005	0.019
POW-1X	-0.01	-0.01	-0.2	34.3	0.001	1.6	3.6	0.02	6	0.61	14.7	0.266	0.050	0.027	0.102	0.021	0.010	0.033	0.008	0.027
24-hr average				**32.9**	**0.001**		**5**	**0.02**	**7**	**0.61**	**14.9**	**0.221**	**0.042**	**0.023**	**0.087**	**0.020**	**0.009**	**0.032**	**0.007**	**0.023**
24-hr rel. std. dev.				**6%**	**1%**		**43%**	**33%**	**30%**	**2%**	**2%**	**28%**	**25%**	**22%**	**23%**	**11%**	**14%**	**7%**	**25%**	**24%**
POW-1-2	-0.01	-0.01	-0.2	32.9	0.002	-0.1	5.7	0.02	9	0.56	14.8	0.203	0.035	0.019	0.080	0.020	0.007	0.027	0.005	0.021
POW-1-5	-0.01	-0.01	-0.2	39.1	0.001	0.5	9.3	0.02	3	0.62	18.4	0.190	0.038	0.021	0.074	0.018	0.008	0.027	0.006	0.020
POW-1-10	-0.01	-0.01	-0.2	41.0	0.002	-0.1	9.5	0.02	5	0.51	19.2	0.186	0.036	0.020	0.075	0.016	0.006	0.028	0.005	0.020
POW-2	-0.01	-0.01	-0.2	1.63	0.001	-0.1	9.2	0.01	5	0.16	3.8	0.130	0.054	0.022	0.080	0.019	0.005	0.019	0.004	0.016
POW-2X	-0.01	-0.01	-0.2	1.06	0.001	-0.1	6.9	0.01	3	0.11	2.8	0.063	0.027	0.012	0.037	0.008	0.004	0.011	0.003	0.008
24-hr average				**1.35**	**0.001**		**8.0**	**0.01**	**4**	**0.14**	**3.3**	**0.097**	**0.040**	**0.017**	**0.059**	**0.014**	**0.004**	**0.015**	**0.003**	**0.012**
24-hr rel. std. dev.				**30%**	**20%**		**20%**	**6%**	**45%**	**28%**	**21%**	**49%**	**48%**	**43%**	**53%**	**57%**	**16%**	**36%**	**29%**	**45%**
POW-2-2	-0.01	-0.01	-0.2	1.18	-0.001	-0.1	7.7	-0.01	3	0.12	3.2	0.006	0.005	0.003	-0.004	0.003	0.002	0.003	0.001	0.001
POW-2-5	-0.01	-0.01	-0.2	1.48	0.001	-0.1	9.0	-0.01	5	0.14	4.1	0.355	0.146	0.056	0.219	0.053	0.012	0.049	0.008	0.036
POW-2-10	-0.01	-0.01	-0.2	1.75	0.002	-0.1	8.3	-0.01	3	0.14	4.5	0.578	0.231	0.093	0.353	0.068	0.020	0.087	0.013	0.068
POI-1	-0.01	-0.01	-0.2	9.14	0.002	-0.1	2.4	0.01	5	0.55	9.2	0.014	0.013	0.006	0.008	0.005	0.006	0.005	0.003	0.004
POI-1X	-0.01	-0.01	-0.2	12.1	-0.001	0.2	1.4	-0.01	2	0.51	9.6	0.017	0.013	0.006	0.010	0.003	0.005	0.005	0.003	0.002
24-hr average				**10.6**			**1.9**		**3**	**0.53**	**9.4**	**0.016**	**0.013**	**0.006**	**0.009**	**0.004**	**0.005**	**0.005**	**0.003**	**0.003**
24-hr rel. std. dev.				**19%**			**38%**		**72%**	**5%**	**3%**	**13%**	**2%**	**1%**	**15%**	**24%**	**13%**	**10%**	**12%**	**31%**
POI-1-2	-0.01	-0.01	-0.2	8.52	0.002	-0.1	1.6	-0.01	3	0.44	7.9	0.010	0.008	0.005	0.005	0.003	0.004	0.004	0.003	0.003
POI-1-5	-0.01	-0.01	-0.2	6.55	0.002	0.7	2.5	-0.01	1	0.47	8.5	0.007	0.007	0.004	0.005	0.005	0.004	0.003	0.003	0.003
POI-1-10	-0.01	-0.01	-0.2	7.85	0.001	-0.1	2.4	-0.01	5	0.40	9.2	0.008	0.008	0.004	0.005	0.003	0.004	0.003	0.003	0.002
Lab de-ionized wa																				
De-ionized blank	-0.01	-0.01	-0.2	0.06	-0.001	0.34	0.14	-0.01	1.0	0.004	0.311	0.008	0.005	0.002	-0.004	-0.002	-0.001	0.002	-0.001	-0.001
De-ionized blank	-0.01	-0.01	-0.2	0.02	-0.001	0.66	-0.01	-0.01	-1.0	-0.002	0.135	0.003	0.004	0.001	-0.004	-0.002	-0.001	-0.002	-0.001	-0.001
Average				0.04		0.50					0.22281	0.00551	0.00425	0.00154						

Table 3. Water leachate concentrations of various elements, parts per billion

Sample, WPS-	Ho, ppb, ICP-MS	Er, ppb, ICP-MS	Tm, ppb, ICP-MS	Yb, ppb, ICP-MS	Lu, ppb, ICP-MS	Hf, ppb, ICP-MS	Ta, ppb, ICP-MS	W, ppb, ICP-MS	Re, ppb, ICP-MS	Os, ppb, ICP-MS	Pt, ppb, ICP-MS	Au, ppb, ICP-MS	Hg, ppb, ICP-MS	Tl, ppb, ICP-MS	Pb, ppb, ICP-MS	Bi, ppb, ICP-MS	Th, ppb, ICP-MS	U, ppb, ICP-MS
POW-1	0.006	0.018	0.002	0.013	0.004	-0.002	0.001	0.19	0.022	-0.002	-0.01	-0.002	-0.2	2.8	-0.1	0.05	0.02	0.31
POW-1X	0.008	0.022	0.002	0.017	0.005	-0.002	0.001	0.10	0.032	-0.002	-0.01	-0.002	-0.2	2.5	-0.1	0.04	0.01	0.20
24-hr average	**0.007**	**0.020**	**0.002**	**0.015**	**0.004**		**0.001**	**0.14**	**0.027**					**2.6**		**0.04**	**0.01**	**0.26**
24-hr rel. std. dev.	**19%**	**15%**	**7%**	**19%**	**12%**		**9%**	**43%**	**27%**					**9%**		**8%**	**7%**	**30%**
POW-1-2	0.006	0.019	0.002	0.011	0.003	-0.002	-0.001	0.16	0.011	-0.002	-0.01	-0.002	-0.2	2.6	-0.1	0.03	0.01	0.22
POW-1-5	0.007	0.019	0.002	0.015	0.005	0.002	0.001	0.21	0.020	-0.002	-0.01	-0.002	-0.2	3.0	-0.1	0.04	0.02	0.29
POW-1-10	0.006	0.017	0.002	0.011	0.003	-0.002	-0.001	0.14	0.013	-0.002	-0.01	-0.002	-0.2	2.8	-0.1	0.03	0.01	0.30
POW-2	0.004	0.011	0.001	0.010	0.002	0.003	0.002	0.43	7.35	-0.002	-0.01	-0.002	0.2	0.9	-0.1	0.07	0.02	3.96
POW-2X	0.002	0.005	0.001	0.005	0.002	-0.002	0.001	0.31	6.13	-0.002	-0.01	-0.002	-0.2	0.6	-0.1	0.05	0.02	4.20
24-hr average	**0.003**	**0.008**	**0.001**	**0.008**	**0.002**		**0.001**	**0.37**	**6.74**					**0.8**		**0.06**	**0.02**	**4.08**
24-hr rel. std. dev.	**46%**	**53%**	**17%**	**47%**	**10%**		**9%**	**22%**	**13%**					**27%**		**20%**	**17%**	**4%**
POW-2-2	0.001	0.001	-0.001	0.001	-0.001	0.002	0.001	0.42	6.61	-0.002	-0.01	-0.002	-0.2	0.7	-0.1	0.05	0.02	4.53
POW-2-5	0.009	0.026	0.003	0.020	0.004	0.004	0.002	0.53	5.86	-0.002	-0.01	-0.002	0.2	0.8	-0.1	0.06	0.04	4.69
POW-2-10	0.016	0.045	0.006	0.040	0.008	0.007	0.002	0.57	4.32	-0.002	-0.01	-0.002	-0.2	0.8	-0.1	0.05	0.04	5.33
POI-1	0.003	0.003	-0.001	0.004	0.003	-0.002	0.001	0.05	0.014	-0.002	-0.01	-0.002	-0.2	0.8	-0.1	0.06	0.06	0.74
POI-1X	0.002	0.002	-0.001	0.002	0.002	0.002	-0.001	-0.02	0.005	-0.002	-0.01	-0.002	-0.2	0.7	-0.1	0.04	0.04	0.55
24-hr average	**0.002**	**0.003**		**0.003**	**0.002**				**0.009**					**0.7**		**0.05**	**0.05**	**0.64**
24-hr rel. std. dev.	**30%**	**19%**		**34%**	**37%**				**68%**					**9%**		**39%**	**37%**	**21%**
POI-1-2	0.001	0.002	-0.001	0.003	0.002	-0.002	-0.001	-0.02	0.007	-0.002	-0.01	-0.002	-0.2	0.6	-0.1	0.04	0.03	0.82
POI-1-5	0.002	0.002	-0.001	0.002	0.002	-0.002	0.001	0.08	0.020	-0.002	-0.01	-0.002	-0.2	0.6	-0.1	0.06	0.03	2.03
POI-1-10	0.001	0.002	-0.001	0.003	0.002	0.002	0.001	0.06	0.013	-0.002	-0.01	-0.002	-0.2	0.6	-0.1	0.04	0.02	2.18
Lab de-ionized wa																		
De-ionized blank	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002	-0.001	-0.02	0.064	-0.002	-0.01	-0.002	-0.2	0.013	-0.1	-0.01	0.001	0.200
De-ionized blank	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002	-0.001	-0.02	-0.001	-0.002	-0.01	-0.002	-0.2	-0.005	-0.1	-0.01	-0.001	0.043
Average																		0.1213