CHEMICAL COMPOSITION OF WEATHERED AND LESS WEATHERED STRATA OF THE MEADE PEAK PHOSPHATIC SHALE MEMBER OF THE PERMIAN PHOSPHORIA FORMATION
C. Measured Sections E and F, Rasmussen Ridge, Caribou County, Idaho

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Open-File Report 99-147-C
paper edition

2000

Prepared in Collaboration With
U.S. Bureau of Land Management
U.S. Forest Service
Agrium U.S. Inc.
Astaris LLC
J.R. Simplot Company
Rhodia Inc.
Monsanto Co.

U. S. DEPARTMENT OF THE INTERIOR
U. S. GEOLOGICAL SURVEY

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CONTENTS

FIGURES

TABLES

Table 3. Accuracy and precision—concentrations of major, minor, and trace elements in standard reference materials, three phosphatic shale quality control check materials, and in duplicate samples that accompanied samples from Section E and F for analysis. Relative standard differences and relative standard deviations specify the departures from accepted concentration values or group mean concentrations.

ABSTRACT

This study, one in a series, reports bulk chemical composition of rocks collected from two exposed, measured stratigraphic sections at the Rasmussen Ridge phosphate mine in southeastern Idaho. The rock samples from Section E constitute a set of channel-sampled intervals across the entire thickness of the Meade Peak Phosphatic Shale Member of the Phosphoria Formation at a location exposed during mining. These samples characterize the lower phosphate ore, interlayered middle waste rock, upper ore, and upper waste units of the member. The rocks from measured Section F lie within a few feet of the original, pre-mined ground surface and are more oxidized and weathered than those of the deeper Section E. Section E includes a channel sample of the uppermost 15 feet of the Grandeur Tongue Member of the Park City Formation, a dolomitic unit that directly underlies the Meade Peak.

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 all scientific disciplines within 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, 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.

Location and General Geology

The location of the measured sections is shown in figure 1. The sections lie approximately 20 miles northeast of Soda Springs, Idaho, in a region of southeastern Idaho that has had extensive phosphate mining over the past several decades and currently has four active phosphate mines. 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 Soda Springs. Gulbrandsen (1966, 1975, and 1979) summarized bulk chemical compositional data for various lithologies of the phosphatic intervals in the Phosphoria Formation.

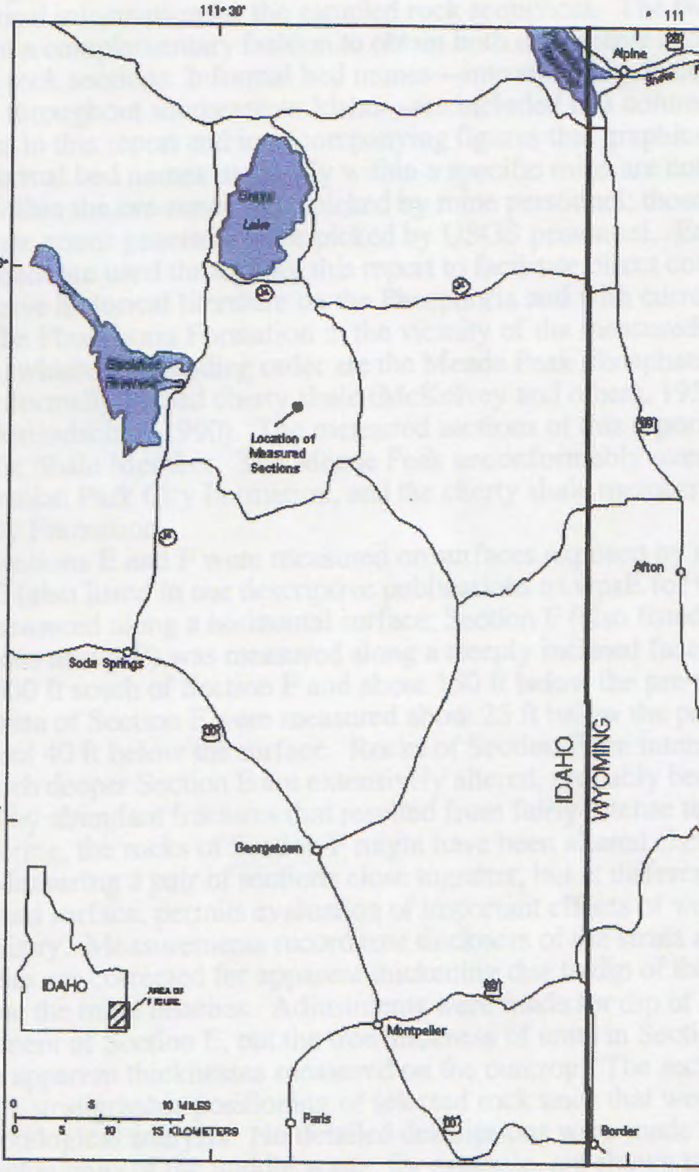

Figure 1. Index map of southeastern Idaho showing location of measured sections from which samples were collected.

Correlation with Measured Sections

Stratigraphic sections of the Phosphoria Formation were measured and described by the USGS at the Rasmussen Ridge mine in southeastern Idaho. Samples were then collected from the same measured section such that descriptions directly correlate with the samples. These brief descriptions of the measured strata from which the samples discussed in this report were collected are already published (Tysdal and others, 2000), although no thin section, X-ray, or analytical technique other than gamma-ray spectrometry has been used to augment the field descriptions of the rock units of that report. In this report we list the analytical information for the sampled rock sequences. The two reports are best used together in a complementary fashion to obtain both descriptive and analytical information about the rock sections. Informal bed names—introduced by Hale (1967, p. 152) and used generally throughout southeastern Idaho—are included in a column of each of the analytical data tables in this report and in accompanying figures that graphically display the analytical data. Informal bed names used only within a specific mine are not presented here. Contacts of units within the ore zones were picked by mine personnel; those within the middle and upper waste zones generally were picked by USGS personnel. English units of measurement are used throughout this report to facilitate direct correspondence with units in the extensive historical literature on the Phosphoria and with current industry usage.

The Phosphoria Formation in the vicinity of the measured sections consists of three members, which in ascending order are the Meade Peak Phosphatic Shale, the Rex Chert, and the informally named cherty shale (McKelvey and others, 1959; Rioux and others, 1975; Oberlindacher, 1990). The measured sections of this report focus on the Meade Peak Phosphatic Shale Member. The Meade Peak unconformably overlies the Grandeur Tongue of the Permian Park City Formation, and the cherty shale member is overlain by the Triassic Dinwoody Formation.

Sections E and F were measured on surfaces exposed by mining equipment. Section E (also listed in our descriptive publications as wpsE for western phosphate section E) was measured along a horizontal surface; Section F (also listed in our descriptive publications as wpsF) was measured along a steeply inclined face. Section E is located about 1,400 ft south of Section F and about 150 ft below the pre-mining land surface. Lower strata of Section F were measured about 25 ft below the pre-mining surface, upper strata about 40 ft below the surface. Rocks of Section F are intensely weathered and those of the much deeper Section E are extensively altered, probably because fluid pathways were provided by abundant fractures that resulted from fairly intense tectonic deformation. Prior to weathering, the rocks of Section F might have been altered chemically by subsurface fluids. Measuring a pair of sections close together, but at different depths below the pre-mining land surface, permits evaluation of important effects of weathering on rock geochemistry. Measurements record true thickness of the strata at the sample site; these thicknesses are corrected for apparent thickening due to dip of the strata at the exposed sections at the mine benches. Adjustments were made for dip of beds at the time of measurement of Section E, but the true thickness of units in Section F were calculated later from the apparent thicknesses measured on the outcrop. The section was measured solely to provide stratigraphic positioning of selected rock units that were sampled for chemical and mineralogical analysis. No detailed descriptions were made of the strata in the sections. Stratigraphic units of the middle waste, for example, are shown mainly as mudstone, although interbeds of other rock types also exist in the middle waste. The two sections are of unlike thickness, chiefly because the middle waste zone of Section E has been thinned tectonically. Moreover, not all of Section F is well exposed and some strata of the middle waste might be tectonically repeated.

METHODS

Field Sampling

The samples within the measured sections that were obtained for geochemical and petrological analysis were taken as channeled samples across the entire thickness of the interval, as noted in the data tables. The choice of sampling intervals is intended to characterize strata of more or less uniform lithology and of a broad thickness that can be handled by typical mine equipment should the results of our analyses suggest that separate handling of such zones would be advantageous. Within these broad intervals, we have sampled thinner intervals, sometimes as thin as one foot, where we have noted a lithology different or distinct from the thick interval as a whole.

Approximately 1/2 to 1 kg of rock was collected for each sample interval. Rock samples were scraped or chiseled in a consistent manner across each interval of uniform lithology in order to obtain a representative single sample of the entire interval. The bulk samples were shipped to the laboratories of the USGS in Denver, Colorado, for sample preparation.

Rock Sample Preparation

Rock samples were dried in air at ambient temperature. Samples as received first were disaggregated in a mechanical jaw crusher and then a split was ground in a ceramic plate grinder to <100 mesh (<0.15 mm). Splits of the latter material were provided to various collaborators and to the contract laboratory for analysis. All splits were obtained with a riffle splitter to ensure similarity with the whole sample. Splits of about 50 g in size were sent to the contract laboratory, where they were prepared for analysis. A set of similar size splits for all samples was archived by USGS.

Analysis

Samples were analyzed for 40 major, minor, and trace elements using acid digestion in conjunction with inductively coupled plasma-atomic emission spectrometry (ICP-AES). For the 40-element analysis (referred to as ICP-40), a split was dissolved using a low-temperature (<150° C) digestion with concentrated hydrochloric, hydrofluoric, nitric, and perchloric acids (Jackson and others, 1987). The analytical contractor has modified this procedure to shorten the digestion time (P. Lamothe, USGS, oral communication). 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. This technique also provides analysis of Bi and Sn. Because an inconsistent bias in the Bi and Sn data presently exists for the analytical contractor (P. Lamothe, USGS, oral communication), the concentration data for these two elements have been eliminated from the original analytical data set. 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. Both ICP techniques also detect and measure Mn and have comparable accuracy and precision. However, the ICP-40 technique is considered to be superior to the ICP-16 technique because it has a much lower detection limit, 4 parts per million (ppm) compared to 100 ppm. This lower detection limit is important in analyzing a few of the check standards with low Mn concentrations. Nonetheless, analytical data for both procedures are included in the data tables. The ICP-40 technique measures Au above 8 ppm, Bi above 50 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 phosphatic 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 generally is volatilized and lost during sample preparation. The hydride combined with AA technique also is used for the analysis of As and Sb. Most Tl analyses were performed using graphite furnace AA after fusion of the sample and extraction using an organic solvent. Alternatively, a few measurements of Tl concentrations, especially for the phosphatic check standards, included some measurements using hydride generation followed by atomic absorption spectroscopy. For the analysis of As, the hydride analytical technique is considered to be more sensitive than the acid digestion ICP-AES analytical technique.

Total S and total C were measured using combustion in a LECO furnace followed by gas chromatographic measurement. 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.

The element concentration data for Section E includes a profile of the equivalent uranium (eU) measurements taken with a GAD-6 gamma-ray spectrometer. Concentrations of eU are given in ppm. This instrument measures gross gamma-ray flux (including cosmic rays) and provides a quantitative measure of K, U, and Th. Abundance of U and Th were determined via detection and counting of gamma rays of specific energy associated with a particular daughter radionuclide of each element, ^{214}Bi with a 1.76 MeV (million electron volt) gamma-ray in the case of U. Calculation of total abundance of U and Th assumes secular equilibrium between the measured daughter nuclide and the parent isotope and all intermediate daughter nuclides for each individual element. Potassium abundance is determined from the measurement of gamma rays associated with the decay of ^{40}K. The spectrometer integrates detection over a 2π geometry of approximately 1/2 m^3 and, because gamma rays are emitted in random directions, has proportionally higher detection likelihood for those gamma rays that are emitted closer to the detector. The calibration equations for the spectrometer assume this geometry on a planar surface and are based on analysis of concrete pads of known composition of the three elements. The calibration coefficients, as well as the constants for subtracted background counts, are a function of latitude, altitude, rock density, and moisture. The coefficients become less reliable as location and rock conditions change from those of the calibration.

In Herring and others (2000), we discussed the rationale for reporting eU concentration data after normalization of the highest eU concentration to 200 ppm for Section A and B. This scaling was done because published reports from the 1970's and earlier on U and eU concentrations in the Meade Peak state that few U concentrations from this member exceed 200 ppm (see Swanson, 1970, and references therein) and we had little independent check on accuracy of the spectrometer data. However, new analytical data as part of our study question these past published relationships. Recently, we re-analyzed a subset of samples using delayed neutron (DN) analysis, which has a precision of better than 3 percent and an accuracy of generally better than 5 percent (McKown and Millard, 1987). The relationship between the two measurement techniques is shown in figure 2 for 70 samples. The DN analysis can be used to assess the U concentration data in Herring and others (1999), which were obtained using ICP-40 measurements with a lower detection limit of 100 ppm. For a common set of 12 samples where ICP-AES measurements for U concentrations are greater than the detection limit of 100 ppm, this technique shows that ICP-40 measurements average 12 percent greater than those of DN and have a relative standard deviation of 12 percent. Given this relative credibility in the ICP-40 technique as verified by DN analysis, the frequency of U concentrations >100 ppm among the set of all composited stratigraphic samples of the Meade Peak consequently can be estimated. For 182 channel samples of Section A, B, C, and D as measured by ICP-40, 18 percent of the U concentrations are >100 ppm, with 16 percent between 100 and 200 ppm and 2 percent >200 ppm. These channel samples average rock over intervals that range from 1 to 15 feet of true stratigraphic thickness. Clearly, each channel sample will have some U concentrations that are indeed higher, perhaps considerably so, than the interval average. Consequently, we believe that U concentrations in excess of 200 ppm are not as scarce as reported by Swanson (1970, and references therein) and that U concentration measurements from the gamma-ray spectrometers are reasonably accurate and should be reported as measured rather than scaling them against an assumed upper limit value.

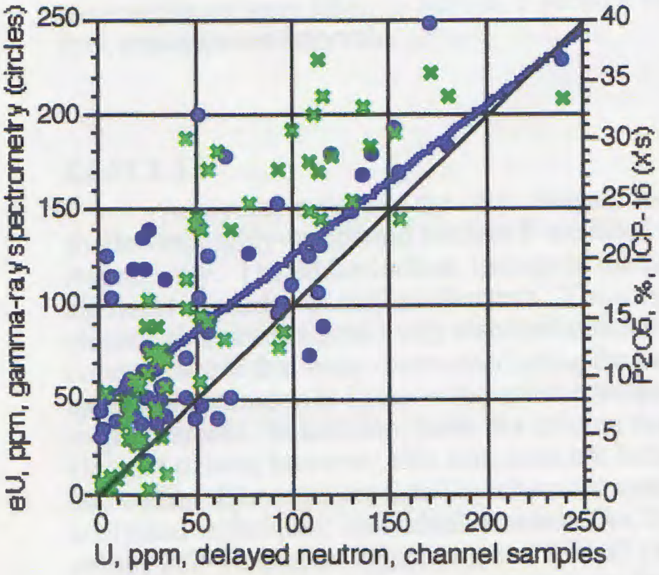

Figure 2. Comparison of measured uranium concentration by delayed neutron analysis in channel samples with gamma-ray spectroscopy measurements taken at 1-foot true-thickness stations through the same intervals and arithmetically averaged (circles). The 1:1 and least-squares regression (heavier line; $R^2 = 0.55$) lines are shown. Concentrations of P_2O_5 in percent are shown for the same samples (x's).

Previous studies of the Phosphoria Formation maintain that there is a consistent relationship between eU and total uranium contents and between total uranium and phosphate contents (McKelvey, 1956). Our measurements indicate considerable scatter in both relationships (fig. 2; Herring and others, 1999; Herring, unpublished data). Measured eU concentrations, even between adjoining 1 foot intervals of consistent lithologic character, often exhibit considerable variability. We expect that this results from: (1) fine-scale variability in the concentration of U; (2) the effect of the geometry of the dipping rocks; or (3) from lack of secular equilibrium. Scatter in the U to P_2O_5 relationship results from U removal or addition by syndepositional effects and (or) by post-depositional alteration, especially weathering. The U is mostly located in the phosphate mineral lattice as a substitute for Ca; location of the decay (daughter) products is uncertain. For the phosphatic rocks of the Phosphoria Formation, total gamma-ray counts are dominated by decay of U and its various daughter products. K_2O is generally <1 percent in the phosphorite and <3 percent in the middle waste shale; Th concentrations are generally <15 ppm in ore and waste shale (Altschuler and others, 1958; Swanson, 1970; Herring and others, 1999; Herring, unpublished data).

The measurements for eU were obtained on high-resolution, 1-foot (true-thickness) spacing across Section E. These concentration data are graphed in the preliminary report on the stratigraphic descriptions of Section E (Tysdal and others, 2000). The reported eU concentration for each channel-sampled interval in the data tables was obtained by averaging all measurements taken through that interval at 1-foot spacings. A recalibration of the GAD-6 instrument in April, 2000, indicates that eU concentrations in the previous reports should be reduced by 18 percent. This reduction is exactly proportional, thus all concentrations should be reduced by the same percentage. Relative changes among all reported concentrations for a measured section are accurate as depicted. No eU measurements were taken in Section F because the section was sampled over comparatively few, non-adjacent intervals.

RESULTS

Analytical results of the rock analyses for the deeper, less-weathered section E and shallower, highly-weathered Section F are listed in concentration data tables 1 and 2, respectively. The tables include listings of the concentrations of the major rock-forming elements as oxides as well as elements. The oxide concentrations are calculated from the elemental concentrations using standard stoichiometric conversions of the major element concentrations that were determined using the fusion technique. In the tables, the calculated oxide concentration is listed in the column adjacent to the reported concentration for each major element. In addition, there is a column that lists the sum of the calculated major element oxides; however, this sum does not include the contributions from oxides of carbon and sulfur. Elements are listed by chemical symbol in alphabetical order for each of the analytical techniques: individual elements (As, Hg, Sb, Se, Te, and Tl), carbon forms and sulfur, ICP-16 (fusion digestion), and ICP-40 (acid digestion). Interval base and top footages are specified relative to the stratigraphic base of the Meade Peak Phosphatic Shale Member. This base is defined specifically as the base of the Fish-scale stratum, a bioclastic marker phosphorite unit. Footage numbers increase upward through the measured sections. Section E samples represent the Meade Peak in its entirety as a series of contiguous channel samples from the uppermost Grandeur Tongue through and including the Upper Waste unit within the Phosphoria Formation. Section F was sampled as a set of non-contiguous intervals in various ore and waste zone strata of interest.

The concentration data in tables 1 and 2 are listed as reported by the contract laboratory. There has been no statistical manipulation of the data or consideration of qualified values. Qualified values of concentration result from detection of elements that are known to be present but at concentrations less than their lower detection limits (LDL) at or above which they can be quantified with confidence. They are listed in the data table with "<" preceding the LDL. No replacement values for these qualified concentrations, which is typically done for most traditional data summarization and analysis (for example, see Cohen, 1959), are included.

As an estimated measure of analytical accuracy, various analytical standard rock samples were included with the set of samples from the sections that were submitted to the contract laboratory. The reported analyses of these standards are included in table 3. We include analysis of three carefully prepared check standards of phosphatic shale (POW-1, POW-2, and POI-1) that are used as ongoing monitors of analytical accuracy for this project (Wilson and others, in preparation). These standards are finely ground splits of composite channel samples of two sections of middle waste rock and one of ore from Section B. This section was described by Tysdal and others (1999) and the analytical data were reported by Herring and others (1999). The preparation and use of these standards are intended to provide better analytical quality control for the project, especially because the standards have similar mineralogy and composition to the typical rocks being analyzed within the project. Table 3 also includes the concentrations obtained with the check standard splits that accompanied the samples for Section E and F, the mean concentration values of now 4 replicated analyses, and the relative standard difference between those standards and the means. The standards analyzed also included the standards SARL-1 and SARM-1 that are routinely submitted with rock samples as a part of the quality control monitoring of the contract laboratory. Table 3 lists the replicated analyses of these two standards, the mean of those replicated analyses, the accepted concentration values, and the relative standard difference in percent between those mean concentrations and the accepted values.

As a measure of analytical precision, the analytical sample set consists of 9 replicated sample pairs for Section E and one pair for Section F. These samples are identified in the data tables for Section E and F as duplicates. The listings in table 3 summarize for each element the average relative standard difference and average relative standard deviation of up to 10 duplicated pairs of samples. This summary only reports statistical comparisons for duplicated sample pairs without any qualified concentration data for individual elements.

The samples were submitted to the contract laboratory in a randomized sequence. This eliminated systematic errors from sources such as, for example, instrumental drift. The abbreviations for analytical techniques in the column headings of tables 1, 2, and 3 for analytical methodology are defined as follows:

XRD: X-ray diffraction
Hydr. AA: hydride generation followed by atomic absorption
CVAA: cold vapor atomic absorption
ICP-MS: inductively coupled plasma-mass spectrometry
ICP-16: inductively-coupled plasma spectrometry, fusion digestion
ICP-40: inductively-coupled plasma spectrometry, acid digestion.

Concentrations of various elements in the channel samples of the two sections are graphed in figure 3. The few "less-than" concentrations reported for some of these elements have been replaced with their lower detection limits for graphing. The figure includes a brief key to the general geology of major intervals within each section: Lower Ore Zone, Middle Waste, Upper Ore Zone, and Upper Waste. For Section E, the figure includes the data from the Grandeur Tongue limestone.

ACKNOWLEDGMENTS

The sections were measured within the Rasmussen Ridge mine, operated by the Agrium U.S. Inc. We thank Agrium U.S. Inc for providing access and we thank company personnel who freely discussed the geology of the area. P. Lamothe provided helpful insights into the quality of the analytical data. We appreciate help in sample preparation by D. Firewick and P. Wigton. D. Siems and J. Hein provided comments on the manuscript.

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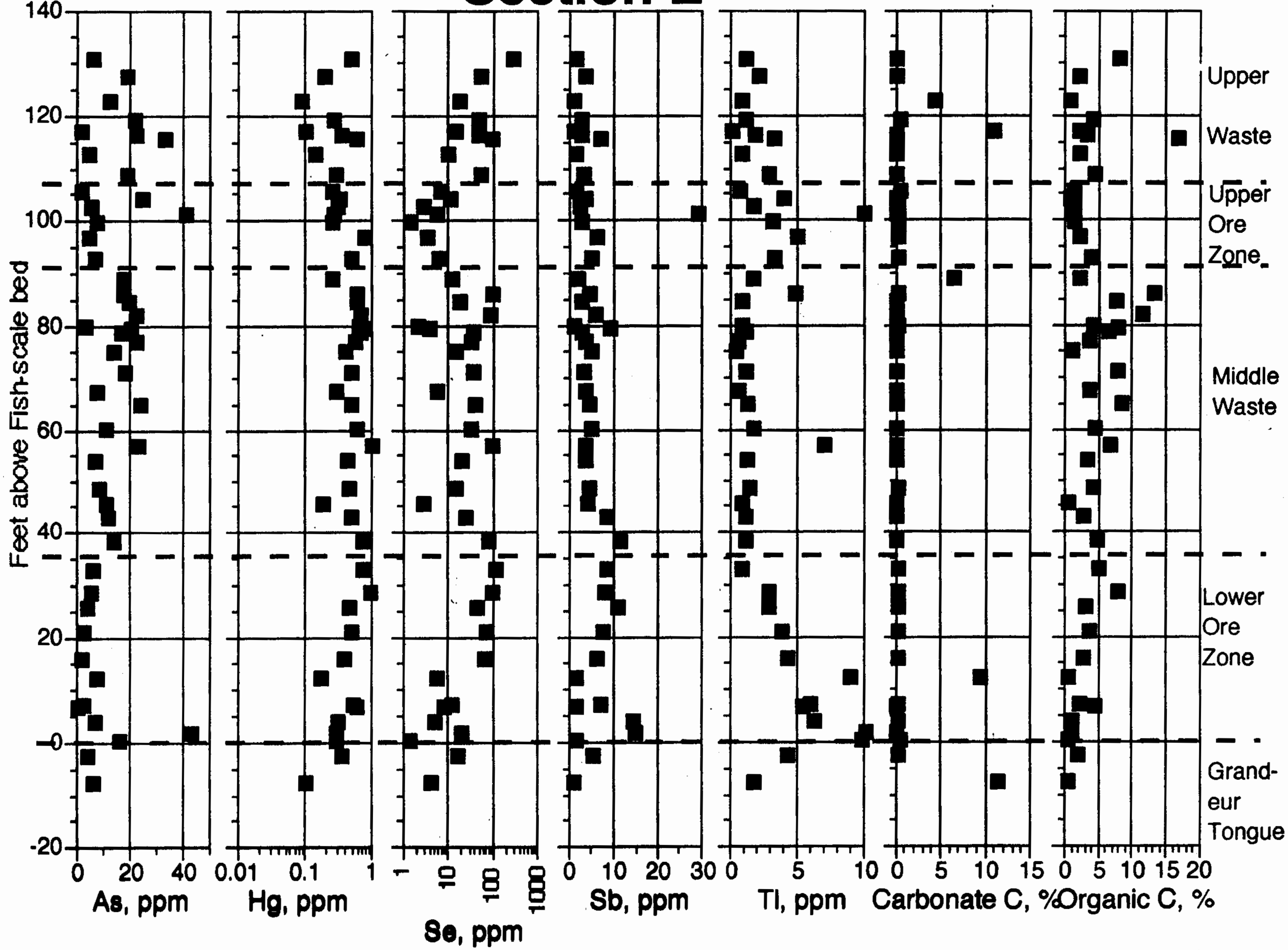
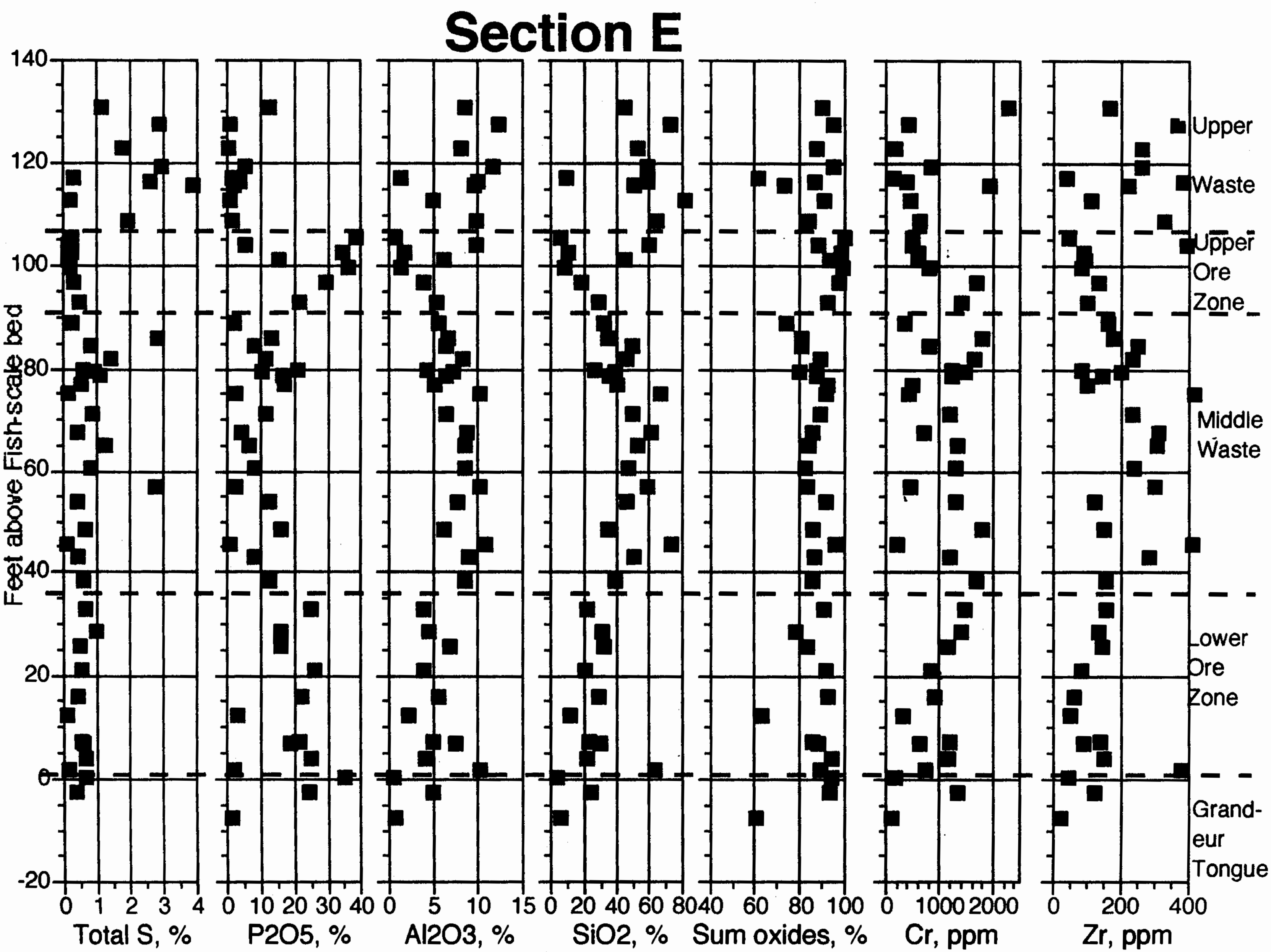
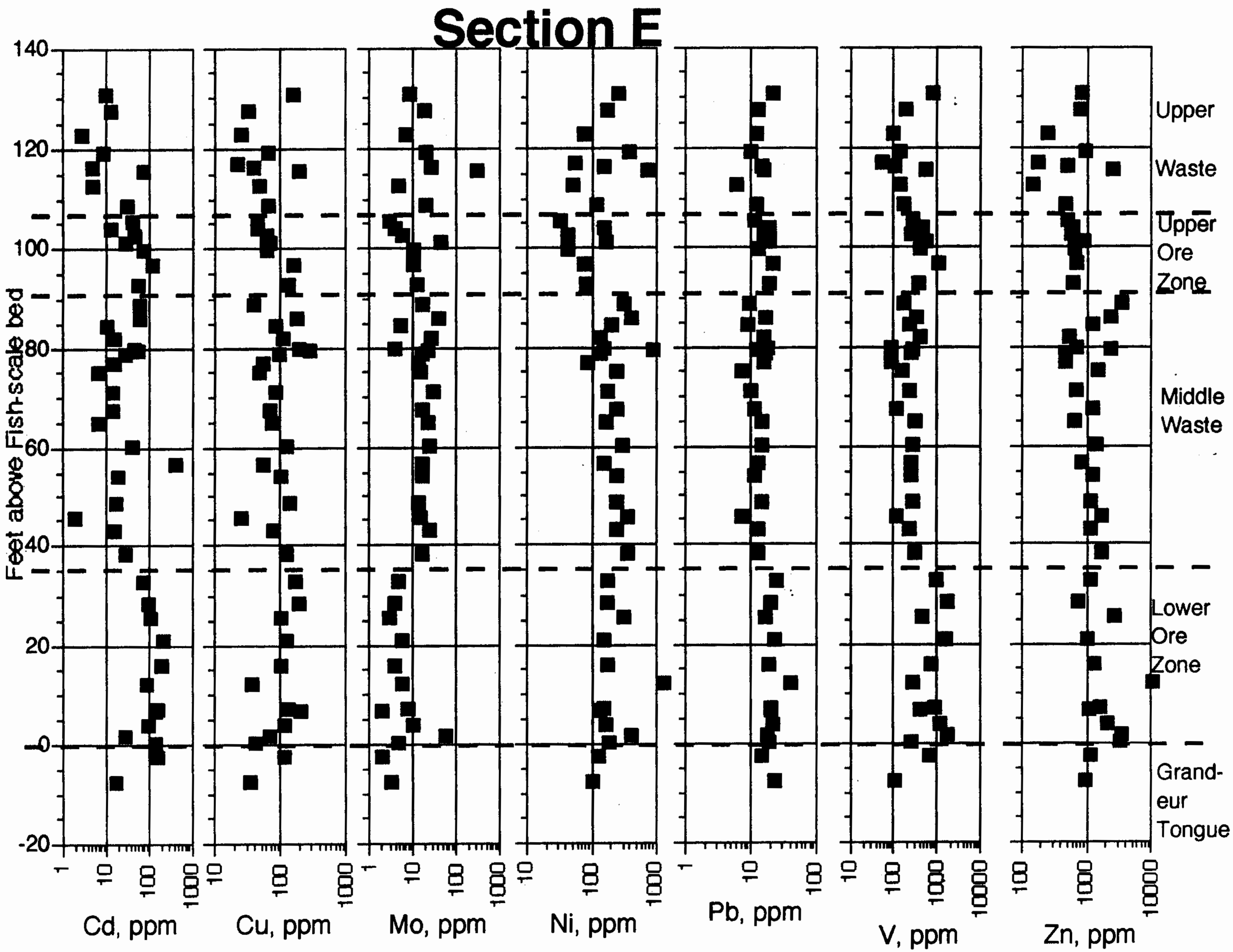
Section E



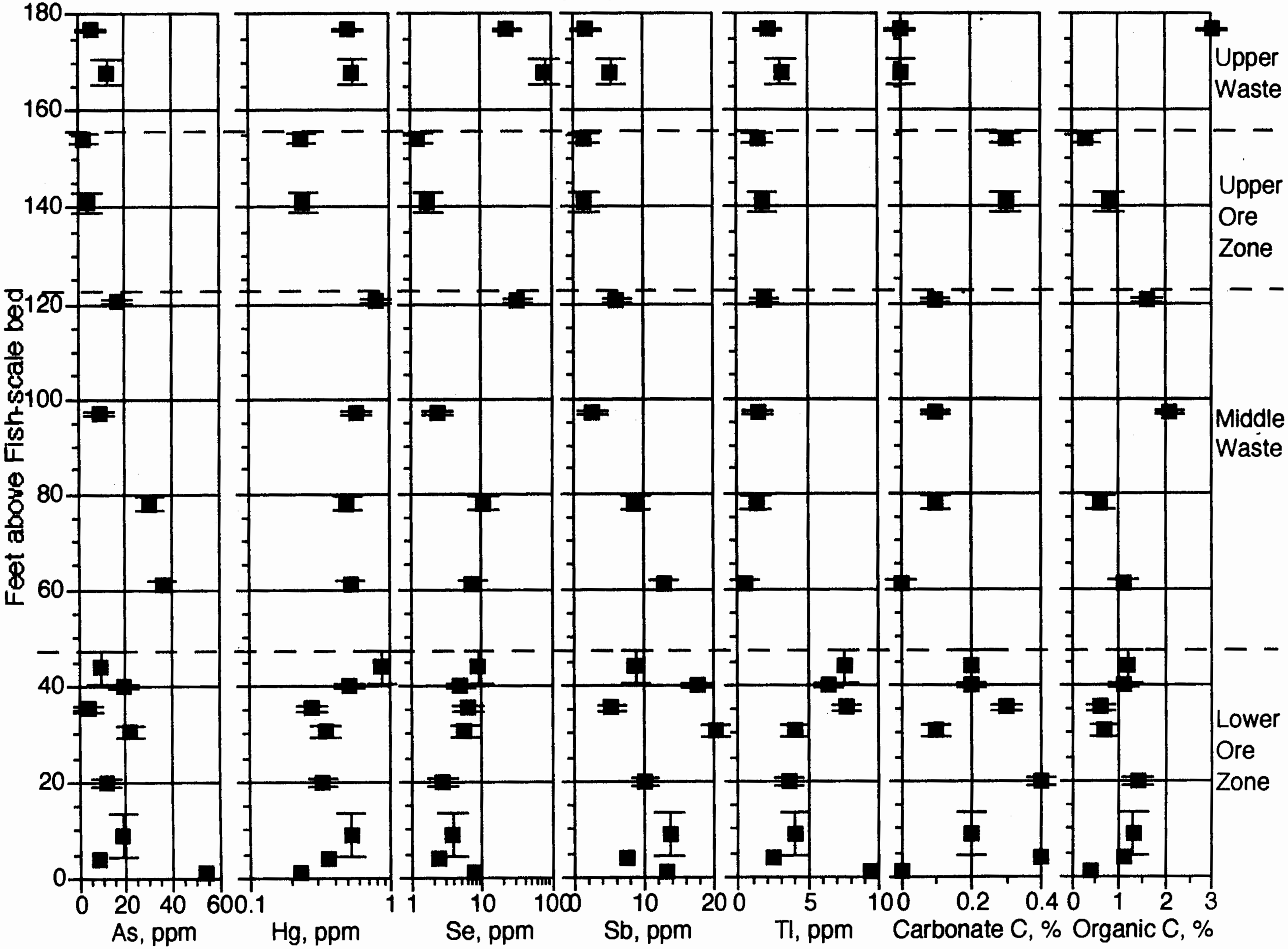
140
120
100
80
60
40
20
0
-20
Feet above Fish-scale bed
0 20 40
As, ppm
0.01 0.1 1
Hg, ppm
1 10 100 1000
Se, ppm
0 10 20 30
Sb, ppm
0 5 10
Tl, ppm
0 5 10 15
Carbonate C, %
0 5 10 15 20
Organic C, %
Upper Waste
Upper Ore Zone
Middle Waste
Lower Ore Zone
Grandeur Tongue


Section E
Feet above Fish-scale bed
140
120
100
80
60
40
20
0
-20
0 1 2 3 4
Total S, %
0 10 20 30 40
P2O5, %
0 5 10 15
Al2O3, %
0 20 40 60 80
SiO2, %
40 60 80 100
Sum oxides, %
0 1000 2000
Cr, ppm
0 200 400
Zr, ppm
Upper
Waste
Upper
Ore
Zone
Middle
Waste
Lower
Ore
Zone
Grand-
eur
Tongue

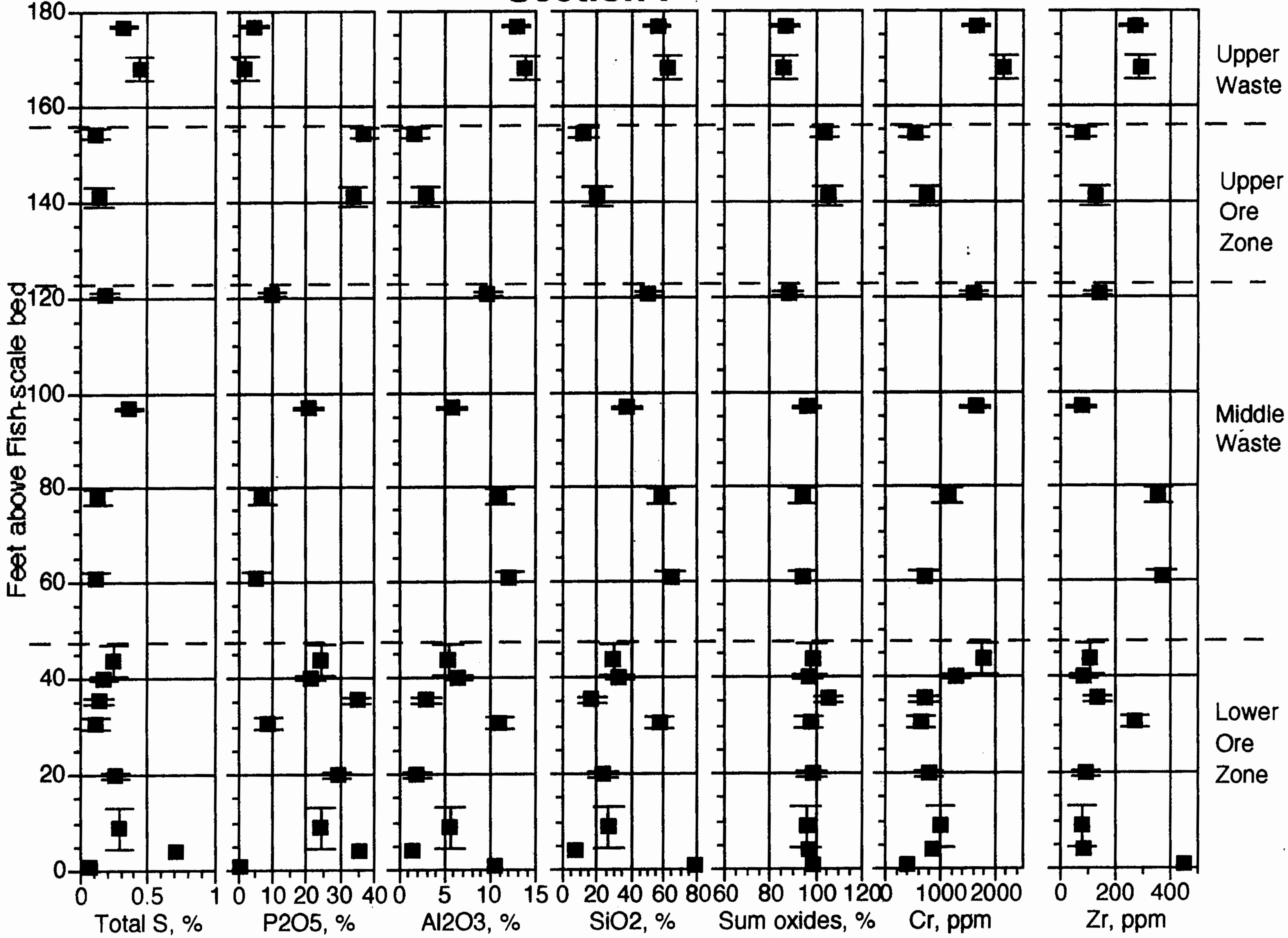


Section E
Feet above Fish-scale bed
Cd, ppm
Cu, ppm
Mo, ppm
Ni, ppm
Pb, ppm
V, ppm
Zn, ppm
Upper
Waste
Upper
Ore
Zone
Middle
Waste
Lower
Ore
Zone
Grand-
eur
Tongue

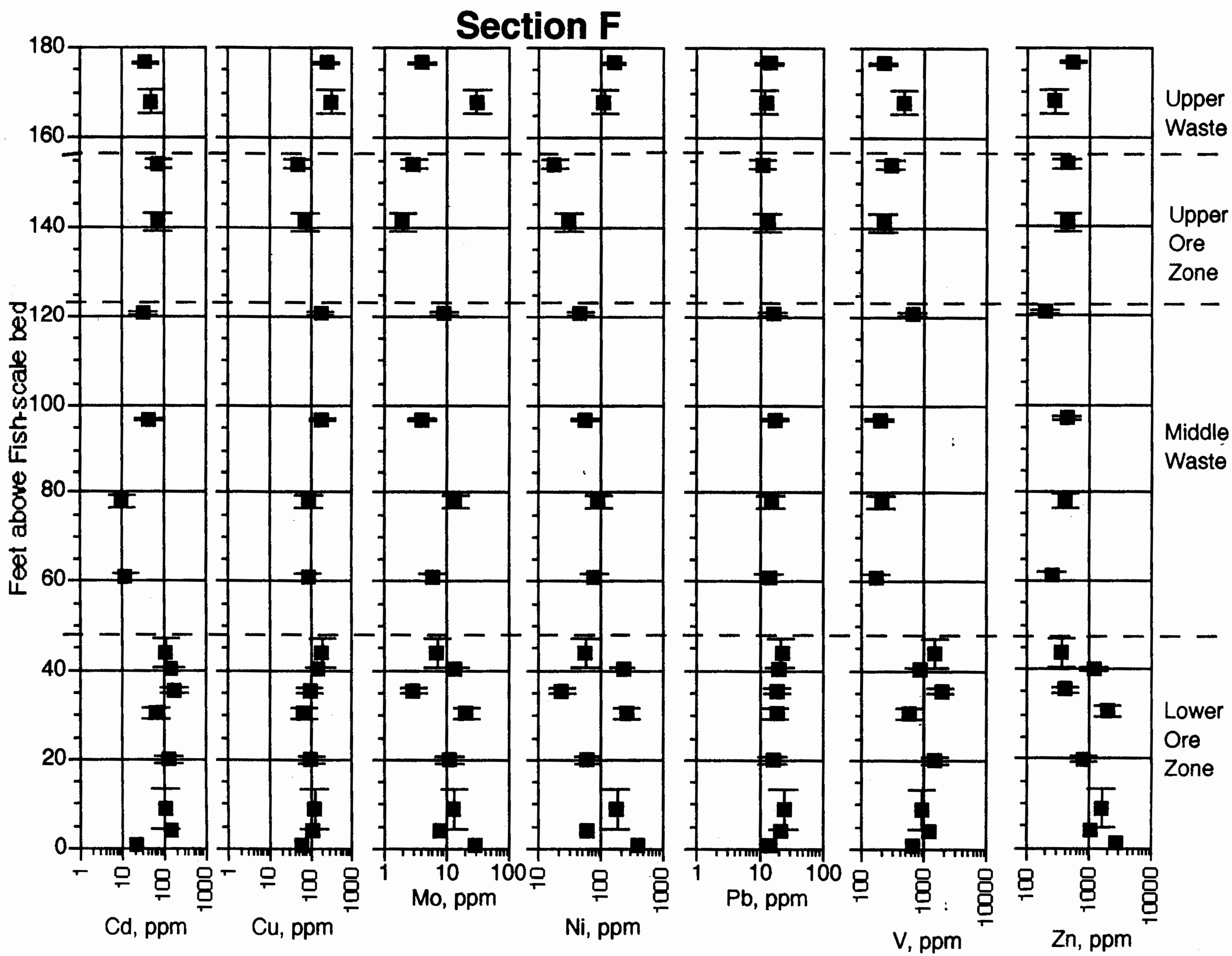
Section F


Feet above Fish-scale bed
180
160
140
120
100
80
60
40
20
0
0 20 40 60
As, ppm
0.1 1
Hg, ppm
1 10 100
Se, ppm
0 10 20
Sb, ppm
0 5 10
Tl, ppm
0 0.2 0.4
Carbonate C, %
0 1 2 3
Organic C, %
Upper Waste
Upper Ore Zone
Middle Waste
Lower Ore Zone

Section F



Feet above Fish-scale bed
180
160
140
120
100
80
60
40
20
0
0 0.5 1
Total S, %
0 10 20 30 40
P2O5, %
0 5 10 15
Al2O3, %
0 20 40 60 80
SiO2, %
60 80 100 120
Sum oxides, %
0 1000 2000
Cr, ppm
0 200 400
Zr, ppm
Upper Waste
Upper Ore Zone
Middle Waste
Lower Ore Zone


Section F
Feet above Fish-scale bed
180
160
140
120
100
80
60
40
20
0
Upper Waste
Upper Ore Zone
Middle Waste
Lower Ore Zone
Cd, ppm
Cu, ppm
Mo, ppm
Ni, ppm
Pb, ppm
V, ppm
Zn, ppm

Section E (wpsE) Sample Geochemistry

WUSP Sample	Unit w/in Phosphoria Formation	Lithology	Lab No.	Notes	Interval base, ft	Interval top, ft	Thickness, ft	Interval midpoint, ft	As, ppm, hydride	Hg, ppm, CVAA	Sb, ppm, hydride	Se, ppm, hydride	Tl, ppm, fusion-AA	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
WPSE-10C	Grandeur Member	Dolomite	C-141232		-10.0	-5.0	5.0	-7.5	5.8	0.06	1.2	3.5	1.5	11.8	42.3	11.5	0.3	<0.05	0.39	0.74	22.00	30.78	0.26
WPSE-10X	Grandeur Member	Dolomite	C-141235	duplicate of previous sample	-10.0	-5.0	5.0	-7.5	6.9	0.08	1.5	4.8	1.9	11.6	41.0	11.2	0.4	<0.05	0.49	0.93	21.70	30.36	0.32
WPSE-05C	Grandeur Member	Dolomite, altered	C-141256		-5.0	0.0	5.0	-2.5	4.0	0.35	5.5	16.5	4.3	2.0	0.8	0.2	1.8	0.33	2.65	5.01	25.70	35.95	0.47
WPSE0.5C	Fish-scale Bed	Phosphorite	C-141260		0.0	0.5	0.5	0.3	16.3	0.29	1.8	1.5	9.8	0.8	1.8	0.5	0.4	0.64	0.36	0.68	37.40	52.32	0.17
WPSE002C	Footwall Mudstone		C-141242		0.5	3.0	2.5	1.8	43.1	0.29	14.7	20.6	10.1	0.9	0.1	0.0	0.9	0.13	5.39	10.18	2.19	3.06	4.30
WPSE004C	Lower Ore zone	Phosphorite	C-141259		3.0	5.0	2.0	4.0	7.2	0.32	14.4	5.0	6.2	1.3	1.2	0.3	1.0	0.64	2.21	4.17	27.10	37.91	1.33
WPSE006C	Lower Ore zone	Mudstone	C-141252		6.5	7.0	0.5	6.8	0.8	0.59	1.8	8.4	5.4	4.4	0.5	0.1	4.3	0.6	3.98	7.52	19.90	27.84	0.19
WPSE008C	Lower Ore zone		C-141243		5.0	9.5	4.5	7.3	2.8	0.52	7.1	13.2	5.9	2.3	0.9	0.2	2.1	0.52	2.62	4.95	22.90	32.04	0.64
WPSE012C	Lower Ore zone	Phosphorite	C-141251		9.5	15.3	5.8	12.4	8.0	0.17	1.8	5.6	9.0	9.8	34.5	9.4	0.4	0.06	1.25	2.36	19.60	27.42	0.62
WPSE016C	Lower Ore zone	Phosphorite, Mudstone	C-141257		15.3	16.7	1.5	16.0	2.2	0.38	6.3	64.8	4.3	2.7	0.7	0.2	2.6	0.39	2.98	5.63	23.10	32.32	0.50
WPSE021C	Lower Ore zone	Phosphorite	C-141229		16.7	25.3	8.6	21.0	2.8	0.48	7.7	70.5	3.8	3.7	0.8	0.2	3.5	0.54	2.10	3.97	26.70	37.35	0.35
WPSE026C	False Cap	Mudstone	C-141238		25.3	26.3	1.0	25.8	4.3	0.46	11.0	45.3	2.8	3.3	0.6	0.2	3.1	0.45	3.67	6.93	17.00	23.78	1.17
WPSE029C	Lower Ore zone		C-141258		26.3	30.7	4.5	28.5	5.4	0.94	8.2	101.0	2.8	8.0	0.6	0.2	7.9	0.97	2.44	4.61	16.90	23.64	0.53
WPSE033C	Lower Ore zone	Phosphorite	C-141267		30.7	35.3	4.6	33.0	6.4	0.72	8.5	125.0	0.9	5.3	0.8	0.2	5.0	0.66	2.06	3.89	26.00	36.37	0.78
WPSE038C	Middle Waste		C-141265		35.3	41.0	5.7	38.2	14.1	0.73	11.6	85.0	1.2	4.7	0.4	0.1	4.6	0.58	4.58	8.65	13.50	18.89	1.90
WPSE043C	Middle Waste		C-141264		41.0	45.3	4.3	43.1	11.9	0.53	8.4	23.7	1.0	2.8	0.3	0.1	2.7	0.37	4.58	8.65	7.74	10.83	1.70
WPSE043X	Middle Waste		C-141266	duplicate of previous sample	41.0	45.3	4.3	43.1	11.5	0.50	8.8	24.3	1.1	2.8	0.3	0.1	2.7	0.37	4.92	9.29	9.48	13.26	1.84
WPSE046C	Middle Waste		C-141247		45.3	46.0	0.8	45.6	11.4	0.19	4.3	2.8	0.8	0.5	0.1	0.0	0.5	0.07	5.80	10.96	0.96	1.34	2.80
WPSE048C	Middle Waste		C-141250		46.0	51.0	5.0	48.5	8.4	0.45	4.5	15.0	1.4	4.3	0.6	0.2	4.1	0.62	3.27	6.18	17.30	24.20	1.43
WPSE055C	Middle Waste		C-141240		51.0	56.3	5.3	53.7	7.1	0.44	3.8	21.0	1.3	3.3	0.4	0.1	3.2	0.43	4.15	7.84	13.60	19.03	1.66
WPSE057C	Middle Waste		C-141230		56.3	57.0	0.7	56.7	23.0	1.02	3.8	99.0	7.0	6.8	0.1	0.0	6.7	2.77	5.41	10.22	3.00	4.20	2.13
WPSE061C	Middle Waste		C-141241		57.0	63.3	6.3	60.2	11.2	0.61	5.0	34.0	1.7	4.5	0.4	0.1	4.4	0.78	4.59	8.67	8.90	12.45	1.93
WPSE065C	Middle Waste		C-141249		63.3	67.0	3.7	65.2	23.7	0.49	4.6	41.0	1.3	8.5	0.2	0.1	8.4	1.26	4.57	8.63	6.61	9.25	2.09
WPSE067C	Middle Waste		C-141236		67.0	68.0	1.0	67.5	7.9	0.29	3.8	6.0	0.6	3.6	0.2	0.0	3.5	0.39	4.67	8.82	4.33	6.06	1.44
WPSE067X	Middle Waste	Phosphorite	C-141231	duplicate of previous sample	67.0	68.0	1.0	67.5	7.9	0.28	4.1	5.4	0.6	3.5	0.2	0.1	3.5	0.41	4.50	8.50	4.79	6.70	1.35
WPSE071C	Middle Waste		C-141263		68.0	74.5	6.5	71.3	18.5	0.49	3.4	35.6	1.1	7.8	0.3	0.1	7.7	0.88	3.38	6.38	11.30	15.81	1.98
WPSE075C	Middle Waste		C-141262		74.5	76.0	1.5	75.3	14.3	0.40	5.0	14.8	0.5	1.0	0.1	0.0	0.9	0.11	5.49	10.37	2.94	4.11	2.35
WPSE077C	Middle Waste	Phosphorite	C-141245		76.0	78.0	2.0	77.0	22.3	0.58	4.0	33.6	0.6	3.7	0.5	0.1	3.5	0.53	2.77	5.23	17.40	24.34	1.58
WPSE079C	Middle Waste	Phosphorite	C-141261		78.0	79.3	1.3	78.6	18.2	0.67	3.5	35.9	1.1	6.6	0.5	0.1	6.4	1.11	3.40	6.42	15.70	21.96	1.56
WPSE079X	Middle Waste	Phosphorite	C-141246	duplicate of previous sample	78.0	79.3	1.3	78.6	16.0	0.71	2.8	39.2	1.1	6.6	0.5	0.2	6.5	1.13	3.34	6.31	17.30	24.20	1.52
WPSE795C	Middle Waste	Carbon Seam	C-141244		79.3	79.8	0.5	79.5	18.6	0.80	9.6	4.2	0.9	8.0	0.4	0.1	7.9	0.92	4.00	7.56	11.70	16.37	1.89
WPSE795X	Middle Waste	Carbon Seam	C-141237	duplicate of previous sample	79.3	79.8	0.5	79.5	21.5	0.77	8.8	3.6	0.9	7.9	0.5	0.1	7.7	0.91	3.83	7.23	11.70	16.37	1.91
WPSE080C	Middle Waste	Phosphorite	C-141234		79.8	80.3	0.5	80.0	3.4	0.65	1.5	2.1	0.8	4.4	0.6	0.2	4.2	0.57	2.33	4.40	22.10	30.92	0.70
WPSE083C	Middle Waste		C-141239		80.3	84.1	3.8	82.2	22.3	0.70	6.0	87.0	<0.1	11.6	0.3	0.1	11.5	1.4	4.39	8.29	11.50	16.09	2.01
WPSE085C	Middle Waste		C-141255		84.1	85.0	0.9	84.6	17.9	0.55	2.8	17.5	1.0	7.7	0.2	0.1	7.6	0.78	3.34	6.31	8.57	11.99	1.39
WPSE085X	Middle Waste		C-141253	duplicate of previous sample	84.1	85.0	0.9	84.6	21.8	0.57	3.1	20.2	0.8	7.5	0.2	0.1	7.5	0.76	3.58	6.76	7.90	11.05	1.57
WPSE086C	Middle Waste		C-141233		85.0	87.0	2.0	86.0	17.8	0.61	4.9	102.0	4.8	13.2	0.6	0.2	13.1	2.85	3.59	6.78	13.90	19.45	1.54
WPSE089C	Middle Waste		C-141248		87.0	90.7	3.7	88.9	17.5	0.25	2.2	12.6	1.7	8.6	23.6	6.4	2.2	0.24	2.96	5.59	13.30	18.61	1.47
WPSE093C	Upper Ore zone	Phosphorite	C-141254		90.7	95.1	4.4	92.9	6.9	0.50	5.3	6.6	3.3	4.0	0.7	0.2	3.8	0.44	2.90	5.48	22.50	31.48	0.88
WPSE097C	Upper Ore zone	Phosphorite	C-141268		95.1	98.8	3.7	97.0	5.2	0.79	6.4	3.4	5.0	2.4	1.0	0.3	2.1	0.27	2.11	3.99	29.70	41.55	0.82
WPSE100C	Upper Ore zone		C-141272		98.8	101.0	2.2	99.9	7.9	0.25	3.0	1.5	3.1	1.6	1.2	0.3	1.3	0.21	0.78	1.47	36.50	51.06	0.44
WPSE101C	Upper Ore zone	Phosphorite	C-141275		101.0	101.5	0.5	101.3	41.1	0.27	29.1	6.0	9.9	1.1	0.4	0.1	0.9	0.13	3.30	6.23	14.70	20.57	2.63
WPSE103C	Upper Ore zone	Phosphorite	C-141294		101.5	103.8	2.3	102.7	5.3	0.32	2.5	2.9	1.7	1.7	1.0	0.3	1.4	0.22	0.92	1.74	34.70	48.55	0.42
WPSE104C	Upper Ore zone	Mudstone	C-141298		103.8	104.3	0.5	104.1	25.0	0.33	3.8	11.9	4.0	0.8	0.1	0.0	0.8	0.1	5.26	9.94	3.95	5.53	2.30
WPSE106C	Upper Ore zone	Phosphorite	C-141282		104.3	107.0	2.7	105.7	1.9	0.25	1.8	7.2	0.7	1.6	1.3	0.4	1.2	0.22	0.38	0.72	38.10	53.30	0.11
WPSE109C	Upper Waste		C-141297		107.0	110.5	3.5	108.8	19.5	0.31	3.1	57.8	3.0	4.4	0.0	0.0	4.4	1.89	4.90	9.26	1.18	1.65	1.76
WPSE109X	Upper Waste		C-141291	duplicate of previous sample	107.0	110.5	3.5	108.8	19.0	0.31	3.6	54.2	2.7	4.3	0.1	0.0	4.3	1.91	5.59	10.56	1.35	1.89	2.02
WPSE113C	Upper Waste		C-141283		110.5	115.3	4.8	112.9	4.7	0.14	1.7	10.2	0.9	2.0	0.0	0.0	2.0	0.19	2.62	4.95	0.96	1.34	0.48
WPSE116C	Upper Waste	Carbon Seam	C-141290		115.3	116.0	0.7	115.7	33.5	0.59	7.3	103.0	3.2	17.0	0.2	0.1	17.0	3.9	5.13	9.69	2.11	2.95	2.15
WPSE1165	Upper Waste		C-141295		116.0	116.5	0.5	116.3	22.7	0.35	2.9	48.6	1.8	3.4	0.5	0.1	3.3	2.6	5.27	9.96	4.05	5.67	2.33
WPSE117C	Upper Waste	Dolomite	C-141269		116.5	117.5	1.0	117.0	2.4	0.10	0.7	15.7	0.1	13.0	39.3	10.7	2.3	0.29	0.77	1.45	20.80	29.10	0.28
WPSE117X	Upper Waste	Dolomite	C-141278	duplicate of previous sample	116.5	117.5	1.0	117.0	1.7	0.10	1.9	14.9	0.2	12.5	39.5	10.8	1.7	0.24	0.80	1.51	21.80	30.50	0.30
WPSE120C	Upper Waste		C-141296		117.5	121.3	3.8	119.4	21.7	0.27	3.2	51.9	1.2	4.7	1.8	0.5	4.2	2.93	6.24	11.79	6.80	9.51	2.69
WPSE123C	Upper Waste		C-141305		121.3	124.5	3.2	122.9	12.9	0.09	1.4	17.9	0.8	5.0	16.0	4.4	0.7	1.73	4.32	8.16	10.20	14.27	1.89
WPSE126C	Upper Waste		C-141303		124.5	130.5	6.0	127.5	18.8	0.20	4.2	54.1	2.0	2.1	0.0	0.0	2.1	2.94	6.41	12.11	0.98	1.37	2.76
WPSE126X	Upper Waste		C-141302	duplicate of previous sample	124.6	130.5	5.9	127.6	19.0	0.21	3.3	55.6	2.1	2.0	0.0	0.0	2.0	2.86	6.70	12.66	1.07	1.50	2.88
WPSE131C	Upper Waste	Carbon Seam	C-141304		130.5	131.0	0.5	130.8	6.6	0.51	1.6	277.0	1.1	8.2	0.4	0.1	8.1	1.15	4.59	8.67	12.90	18.05	1.76

Section E (wpsE) Sample Geochemistry

WUSP Sample	Unit w/in Phosphoria Formation	Lithology	FeOx, %, ICP-16	K, %, ICP-16	KOx, %, ICP-16	Mg, %, ICP-16	MgOx, %, ICP-16	Na, %, ICP-16	NaOx, %, ICP-16	P, %, ICP-16	POx, %, ICP-16	Si, %, ICP-16	SiOx, %, ICP-16	Ti, %, ICP-16	TiOx, %, ICP-16	Sum Oxides, %	Ba, ppm, ICP-16	Cr, ppm, ICP-16	Mn, ppm, ICP-16	Nb, ppm, ICP-16	Sr, ppm, ICP-16	Y, ppm, ICP-16	Zr, ppm, ICP-16	Al, %, ICP-40	Ca, %, ICP-40	Fe, %, ICP-40	K, %, ICP-40
WPSE-10C	Grandeur Member	Dolomite	0.37	0.12	0.14	12.20	20.23	0.07	0.09	0.55	1.26	3.24	6.93	0.02	0.03	60.6	15	89	104	<10	116	16	16	0.40	20.00	0.24	0.12
WPSE-10X	Grandeur Member	Dolomite	0.46	0.13	0.16	11.80	19.56	0.07	0.09	0.64	1.47	3.36	7.19	0.03	0.05	60.3	18	117	127	<10	120	18	21	0.47	20.50	0.3	0.14
WPSE-05C	Grandeur Member	Dolomite, altered	0.67	1.04	1.25	0.18	0.30	0.21	0.28	10.60	24.29	11.60	24.81	0.17	0.28	92.9	138	1310	<100	<10	827	241	118	2.40	26.30	0.44	1.05
WPSE0.5C	Fish-scale Bed	Phosphorite	0.24	0.18	0.22	0.06	0.10	0.52	0.70	15.30	35.06	2.23	4.77	0.02	0.03	94.1	258	179	1450	<10	1090	344	40	0.35	34.30	0.16	0.19
WPSE002C	Footwall Mudstone		6.15	2.17	2.61	0.45	0.75	0.13	0.18	0.84	1.92	29.60	63.31	0.42	0.70	88.9	242	730	<100	<10	112	59	376	5.22	2.11	4.3	2.07
WPSE004C	Lower Ore zone	Phosphorite	1.90	0.84	1.01	0.21	0.35	0.47	0.63	11.00	25.21	10.50	22.46	0.15	0.25	93.9	134	1150	<100	<10	695	188	145	2.05	25.90	1.29	0.91
WPSE006C	Lower Ore zone	Mudstone	0.27	2.40	2.89	0.19	0.32	0.21	0.28	8.15	18.67	14.00	29.95	0.15	0.25	88.0	134	629	<100	<10	565	221	88	3.66	19.10	0.19	2.26
WPSE008C	Lower Ore zone		0.92	1.36	1.64	0.20	0.33	0.30	0.40	9.36	21.45	10.90	23.32	0.15	0.25	85.3	143	1200	<100	11	615	176	136	2.62	21.80	0.56	1.27
WPSE012C	Lower Ore zone	Phosphorite	0.89	0.34	0.41	9.46	15.68	0.06	0.11	1.32	3.02	5.85	12.51	0.06	0.10	62.5	78	324	897	<10	168	37	45	1.23	18.10	0.59	0.32
WPSE016C	Lower Ore zone	Phosphorite, Mudstone	0.72	1.28	1.54	0.16	0.27	0.28	0.38	9.70	22.23	13.50	28.88	0.20	0.33	92.3	141	914	<100	<10	758	159	59	2.71	22.90	0.47	1.28
WPSE021C	Lower Ore zone	Phosphorite	0.50	0.98	1.18	0.14	0.23	0.21	0.28	11.30	25.89	10.10	21.60	0.15	0.25	91.3	129	822	<100	<10	759	162	81	1.97	23.80	0.32	0.98
WPSE026C	False Cap	Mudstone	1.67	1.71	2.06	0.22	0.36	0.21	0.28	6.92	15.86	15.00	32.09	0.20	0.33	83.4	126	1160	<100	<10	607	221	142	3.71	16.30	1.19	1.64
WPSE029C	Lower Ore zone		0.76	1.25	1.51	0.18	0.30	0.20	0.27	6.89	15.79	14.40	30.80	0.17	0.28	78.0	183	1410	<100	<10	938	358	128	2.35	15.30	0.49	1.22
WPSE033C	Lower Ore zone	Phosphorite	1.12	0.88	1.06	0.16	0.27	0.27	0.36	11.00	25.21	10.40	22.25	0.14	0.23	90.8	165	1450	<100	<10	1000	515	151	1.95	26.70	0.71	0.96
WPSE036C	Middle Waste		2.72	1.84	2.22	0.25	0.41	0.26	0.35	5.52	12.65	18.40	39.36	0.26	0.43	85.7	188	1690	<100	<10	602	172	154	4.38	12.20	1.86	1.97
WPSE043C	Middle Waste		2.43	2.20	2.65	0.19	0.32	0.55	0.74	3.15	7.22	22.70	48.56	0.35	0.58	82.0	249	1130	<100	<10	395	129	289	4.76	7.83	1.84	2.17
WPSE043X	Middle Waste		2.63	2.03	2.45	0.21	0.35	0.58	0.78	3.89	8.91	24.50	52.41	0.38	0.63	90.7	254	1220	<100	<10	471	154	276	4.52	8.45	1.75	2.07
WPSE046C	Middle Waste		4.00	1.89	2.28	0.14	0.23	1.20	1.62	0.38	0.87	34.30	73.37	0.47	0.78	95.5	172	201	<100	17	81	35	412	5.10	0.90	2.58	1.91
WPSE048C	Middle Waste		2.04	1.35	1.63	0.25	0.41	0.35	0.47	6.95	15.93	16.10	34.44	0.23	0.38	85.7	190	1800	<100	<10	747	347	150	3.16	16.20	1.38	1.23
WPSE055C	Middle Waste		2.37	1.58	1.90	0.25	0.41	0.47	0.63	5.54	12.69	21.70	46.42	0.31	0.52	91.8	229	1300	<100	<10	551	243	122	3.78	12.10	1.54	1.59
WPSE057C	Middle Waste		3.05	1.87	2.25	0.20	0.33	1.15	1.55	1.19	2.73	27.10	57.97	0.41	0.68	83.0	264	455	<100	12	144	58	298	5.20	2.88	2.15	1.86
WPSE061C	Middle Waste		2.76	1.50	1.81	0.29	0.48	0.52	0.70	3.51	8.04	21.90	46.84	0.32	0.53	82.3	234	1290	<100	<10	365	146	235	4.44	8.94	1.93	1.49
WPSE065C	Middle Waste		2.99	1.85	2.23	0.20	0.33	0.77	1.04	2.77	6.35	24.70	52.83	0.35	0.58	84.2	246	1320	<100	<10	268	162	302	4.31	6.19	2.05	1.78
WPSE067C	Middle Waste		2.06	1.81	2.18	0.11	0.18	0.98	1.32	1.64	3.76	28.80	61.60	0.37	0.62	86.6	211	706	<100	<10	167	101	316	4.50	4.30	1.45	1.65
WPSE067X	Middle Waste	Phosphorite	1.93	1.75	2.11	0.10	0.17	0.95	1.28	1.82	4.17	27.80	59.46	0.36	0.60	84.9	225	696	<100	<10	186	117	303	4.42	4.65	1.41	1.61
WPSE071C	Middle Waste		2.83	1.24	1.49	0.17	0.28	0.53	0.71	4.95	11.34	23.10	49.41	0.25	0.42	88.7	206	1170	<100	<10	443	215	231	3.09	10.40	1.88	1.26
WPSE075C	Middle Waste		3.36	1.77	2.13	0.09	0.15	1.10	1.48	1.24	2.84	31.10	66.52	0.46	0.77	91.7	239	397	<100	<10	124	33	417	5.15	2.63	2.29	1.69
WPSE077C	Middle Waste	Phosphorite	2.26	1.14	1.37	0.09	0.15	0.64	0.86	7.57	17.35	18.70	40.00	0.24	0.40	92.0	187	473	<100	<10	679	179	96	2.67	16.10	1.45	1.13
WPSE079C	Middle Waste	Phosphorite	2.23	1.44	1.74	0.18	0.30	0.53	0.71	6.76	15.49	16.80	35.94	0.26	0.43	85.2	212	1210	<100	<10	542	286	115	3.25	14.90	1.46	1.44
WPSE079X	Middle Waste	Phosphorite	2.17	1.38	1.66	0.19	0.32	0.53	0.71	7.64	17.51	17.00	36.36	0.26	0.43	89.7	195	1200	<100	<10	601	325	170	3.13	17.00	1.42	1.38
WPSE795C	Middle Waste	Carbon Seam	2.70	1.34	1.61	0.23	0.38	0.58	0.78	4.66	10.68	18.90	40.43	0.26	0.43	80.9	170	1480	<100	<10	327	160	193	3.81	10.70	1.87	1.36
WPSE795X	Middle Waste	Carbon Seam	2.73	1.26	1.52	0.23	0.38	0.55	0.74	4.57	10.47	18.00	38.50	0.25	0.42	78.4	161	1460	<100	<10	327	159	204	3.63	11.10	1.88	1.27
WPSE080C	Middle Waste	Phosphorite	1.00	0.98	1.18	0.18	0.30	0.36	0.49	9.25	21.20	12.80	27.38	0.18	0.30	87.2	140	1210	104	<10	845	405	82	2.24	20.30	0.63	0.97
WPSE083C	Middle Waste		2.87	1.65	1.99	0.24	0.40	0.59	0.80	5.15	11.80	21.60	46.20	0.31	0.52	89.0	241	1650	<100	<10	436	169	233	3.83	10.90	1.85	1.65
WPSE085C	Middle Waste		1.99	1.43	1.72	0.15	0.25	0.58	0.78	3.64	8.34	22.30	47.70	0.26	0.43	79.5	182	785	<100	<10	436	186	237	3.25	8.22	1.38	1.44
WPSE085X	Middle Waste		2.25	1.64	1.98	0.17	0.28	0.61	0.82	3.32	7.61	23.70	50.69	0.28	0.47	81.9	194	847	<100	<10	412	172	265	3.41	7.48	1.56	1.5
WPSE086C	Middle Waste		2.20	1.42	1.71	0.28	0.46	0.50	0.67	5.87	13.45	16.40	35.08	0.22	0.37	80.2	197	1780	<100	<10	607	219	178	3.46	12.90	1.53	1.43
WPSE089C	Middle Waste		2.10	1.14	1.37	6.22	10.31	0.58	0.78	0.86	1.97	15.20	32.51	0.21	0.35	73.6	150	342	334	12	161	34	161	2.88	12.00	1.47	1.15
WPSE093C	Upper Ore zone	Phosphorite	1.26	1.08	1.30	0.24	0.40	0.34	0.46	9.51	21.79	13.80	29.52	0.20	0.33	92.0	173	1390	<100	<10	714	267	98	2.60	22.20	0.77	1.07
WPSE097C	Upper Ore zone	Phosphorite	1.17	0.77	0.93	0.25	0.41	0.16	0.22	13.00	29.79	8.93	19.10	0.16	0.27	97.4	145	1690	<100	<10	637	208	129	1.98	27.60	0.78	0.81
WPSE100C	Upper Ore zone		0.63	0.26	0.31	0.09	0.15	0.16	0.22	15.90	36.43	3.95	8.45	0.06	0.10	98.8	70	810	<100	<10	705	313	82	0.72	34.60	0.39	0.26
WPSE101C	Upper Ore zone	Phosphorite	3.76	0.94	1.13	0.16	0.27	0.59	0.80	6.85	15.70	20.80	44.49	0.28	0.47	93.4	542	583	<100	<10	2040	244	92	3.16	13.00	2.53	1
WPSE103C	Upper Ore zone	Phosphorite	0.60	0.32	0.39	0.08	0.13	0.19	0.26	15.20	34.83	5.38	11.51	0.07	0.12	98.1	66	600	<100	<10	676	394	83	0.88	33.20	0.38	0.31
WPSE104C	Upper Ore zone	Mudstone	3.29	1.62	1.95	0.20	0.33	0.71	0.96	2.28	5.22	27.90	59.68	0.48	0.80	87.7	324	478	<100	<10	122	78	392	5.13	3.72	2.31	1.57
WPSE106C	Upper Ore zone	Phosphorite	0.16	0.13	0.16	0.06	0.10	0.13	0.18	16.70	38.27	3.21	6.87	0.02	0.03	99.8	50	488	<100	<10	797	236	39	0.35	36.30	0.11	0.12
WPSE109C	Upper Waste		2.52	1.73	2.08	0.32	0.53	0.47	0.63	0.57	1.31	26.90	57.54	0.37	0.62	76.1	273	565	<100	<10	140	80	303	5.12	1.26	1.94	1.89
WPSE109X	Upper Waste		2.89	1.95	2.35	0.37	0.61	0.53	0.71	0.65	1.49	33.00	70.59	0.42	0.70	91.8	292	652	<100	13	158	89	350	5.04	1.24	1.94	1.86
WPSE113C	Upper Waste		0.69	0.77	0.93	0.18	0.30	0.11	0.15	0.37	0.85	38.00	81.28	0.12	0.20	90.7	101	448	<100	<10	73	55	110	2.42	0.92	0.44	0.74
WPSE116C	Upper Waste	Carbon Seam	3.07	1.87	2.25	0.56	0.93	0.42	0.57	0.84	1.92	23.70	50.69	0.33	0.55	72.6	251	1920	117	<10	85	102	220	5.01	2.02	2.19	1.89
WPSE1165	Upper Waste		3.33	1.82	2.19	0.44	0.73	0.67	1.17	1.68	3.85	27.50	58.82	0.42	0.70	86.4	268	395	109	<10	151	148	385	4.92	4.10	2.24	1.66
WPSE117C	Upper Waste	Dolomite	0.40	0.27	0.33	10.70	17.74	0.15	0.20	0.51	1.17	4.36	9.33	0.05	0.08	59.8	36	124	646	<10	182	42	35	0.77	19.30	0.27	0.25
WPSE117X	Upper Waste	Dolomite	0.43	0.23	0.28	11.00	18.24	0.16	0.22	0.57	1.31	4.75	10.16	0.05	0.08	62.7	36	132	674	<10	191	43	36	0.76	22.10	0.27	0.24
WPSE120C	Upper Waste		3.85	2.24	2.70	0.78	1.29	0.75	1.01	2.44	5.59	27.20	58.18	0.40	0.67	94.6	318	826	166	14	207	202	257	5.59	6.61	2.44	2.04
WPSE123C	Upper Waste		2.70	1.40	1.69	3.78	6.27	0.70	0.94	0.07	0.16	24.70	52.83	0.34	0.57	87.6	179	151	672	<10	129	25	261	4.04	9.15	1.79	1.32
WPSE126C	Upper Waste		3.95	2.09	2.52	0.44	0.73	0.33	0.44	0.42	0.96	32.50	69.52	0.49	0.82	92.4	272	394	127	14	63	48	366	5.87	0.90	2.65	1.91
WPSE126X	Upper Waste		4.12	2.21	2.66	0.46	0.76	0.31	0.42	0.47	1.08	34.20	73.15	0.51	0.85	97.2	284	408	129	<10	59	53	364	6.21	0.98	2.67	1.97
WPSE131C	Upper Waste	Carbon Seam	2.52	1.52	1.83	0.42	0.70	0.13	0.18	5.61	12.85	20.80	44.49	0.26	0.43	89.7	216	2260	<100	<10	306	396	165	4.17	12.00	1.6	1.38

Section E (wpsE) Sample Geochemistry

WUSP Sample	Unit w/in Phosphoria Formation	Lithology	Mg, %, ICP-40	Na, %, ICP-40	P, %, ICP-40	Ti, %, ICP-40	Ag, ppm, ICP-40	As, ppm, ICP-40	Ba, ppm, ICP-40	Be, 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	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
WPSE-10C	Grandeur Member	Dolomite	12.70	0.06	0.53	0.01	<2	<10	16	<1	17	<5	3	82	44	<2	<4	<4	12	4	108	3	<4	<9	93	22	<2
WPSE-10X	Grandeur Member	Dolomite	12.30	0.07	0.65	0.02	<2	<10	19	<1	20	<5	3	93	25	<2	16	<4	15	4	134	4	<4	<9	123	24	<2
WPSE-05C	Grandeur Member	Dolomite, altered	0.17	0.22	9.59	0.05	7	<10	135	<1	156	47	<2	1250	119	4	12	<4	209	15	<4	2	<4	104	134	14	<2
WPSE0.5C	Fish-scale Bed	Phosphorite	0.06	0.51	15.60	0.01	<2	<10	272	<1	149	45	48	152	43	7	<4	<4	307	5	1440	5	<4	172	186	19	3
WPSE002C	Footwall Mudstone		0.42	0.12	0.77	0.26	<2	42	255	<1	29	46	9	656	69	2	18	<4	47	32	53	63	8	43	414	17	10
WPSE004C	Lower Ore zone	Phosphorite	0.19	0.47	10.20	0.05	6	<10	129	<1	101	31	3	1120	113	3	12	<4	156	16	8	11	<4	63	169	21	<2
WPSE006C	Lower Ore zone	Mudstone	0.18	0.19	7.47	0.07	5	<10	136	<1	155	39	2	620	214	2	11	5	168	7	<4	<2	<4	70	143	20	7
WPSE008C	Lower Ore zone		0.21	0.33	9.61	0.06	8	<10	148	<1	156	26	<2	1290	133	3	12	<4	165	16	<4	8	<4	59	157	20	<2
WPSE012C	Lower Ore zone	Phosphorite	9.73	0.08	1.32	0.05	<2	<10	82	<1	91	15	4	318	37	<2	17	<4	37	9	876	6	<4	18	1290	39	<2
WPSE016C	Lower Ore zone	Phosphorite, Mudstone	0.15	0.27	8.70	0.07	6	<10	140	<1	199	38	<2	951	101	2	11	<4	129	12	8	4	<4	59	180	18	3
WPSE021C	Lower Ore zone	Phosphorite	0.13	0.21	10.90	0.09	9	<10	132	<1	208	22	<2	764	128	3	8	<4	129	10	22	6	<4	53	155	23	5
WPSE026C	False Cap	Mudstone	0.21	0.22	6.89	0.09	9	<10	124	<1	113	53	<2	1040	105	4	15	<4	216	14	15	3	<4	99	323	16	10
WPSE029C	Lower Ore zone		0.19	0.21	6.82	0.08	26	<10	198	<1	98	57	<2	1370	198	6	11	<4	285	19	7	4	<4	136	180	20	5
WPSE033C	Lower Ore zone	Phosphorite	0.15	0.27	10.20	0.06	15	<10	155	<1	77	69	<2	1350	171	7	9	7	414	14	13	5	<4	193	184	24	8
WPSE038C	Middle Waste		0.24	0.27	5.29	0.13	10	<10	181	<1	28	53	3	1600	123	3	14	<4	158	20	12	18	4	93	371	13	11
WPSE043C	Middle Waste		0.20	0.60	3.28	0.15	5	<10	267	<1	16	60	4	1100	82	3	16	<4	136	18	16	25	<4	83	249	14	11
WPSE043X	Middle Waste		0.19	0.57	3.69	0.18	4	<10	263	<1	15	68	3	1180	81	3	15	<4	148	18	18	24	7	85	244	11	11
WPSE046C	Middle Waste		0.13	1.14	0.35	0.28	<2	<10	167	<1	<2	74	7	197	25	<2	8	<4	44	11	16	16	16	40	374	7	12
WPSE048C	Middle Waste		0.25	0.33	7.03	0.12	6	<10	195	<1	18	60	2	1760	141	6	14	5	273	20	17	14	<4	145	249	14	7
WPSE055C	Middle Waste		0.23	0.46	5.11	0.12	6	<10	221	<1	19	60	4	1220	104	4	13	5	171	18	16	18	5	103	250	11	10
WPSE057C	Middle Waste		0.20	1.17	1.16	0.28	4	19	270	<1	424	46	8	431	55	<2	13	<4	45	13	61	18	10	36	162	13	8
WPSE061C	Middle Waste		0.28	0.51	3.60	0.17	9	<10	245	<1	41	51	3	1180	122	3	14	<4	103	22	26	26	8	61	304	14	10
WPSE065C	Middle Waste		0.20	0.79	2.85	0.25	9	11	256	<1	7	70	<2	1310	75	3	15	<4	124	21	28	24	8	71	169	14	11
WPSE067C	Middle Waste		0.11	1.01	1.77	0.26	<2	<10	231	<1	15	47	4	688	71	2	9	<4	89	6	28	19	9	52	250	11	11
WPSE067X	Middle Waste	Phosphorite	0.10	0.99	1.83	0.24	4	<10	237	<1	15	55	4	670	65	3	10	<4	92	6	42	17	7	58	230	11	11
WPSE071C	Middle Waste		0.16	0.53	4.65	0.11	8	<10	198	<1	15	48	<2	1030	83	3	13	<4	138	16	16	32	5	75	184	10	9
WPSE075C	Middle Waste		0.09	1.12	1.14	0.28	<2	<10	246	<1	7	46	7	362	47	<2	9	<4	31	6	34	15	14	31	240	7	10
WPSE077C	Middle Waste	Phosphorite	0.09	0.66	7.33	0.06	4	<10	190	<1	17	59	2	440	53	3	9	<4	134	6	13	14	<4	88	86	15	2
WPSE079C	Middle Waste	Phosphorite	0.18	0.55	6.83	0.10	10	<10	199	<1	30	55	3	1190	93	4	12	<4	203	15	33	18	<4	99	144	16	9
WPSE079X	Middle Waste	Phosphorite	0.18	0.53	7.30	0.08	8	<10	176	<1	29	62	2	1190	97	4	14	<4	217	15	31	17	<4	108	131	17	7
WPSE795C	Middle Waste	Carbon Seam	0.23	0.59	4.60	0.14	8	<10	177	<1	57	30	4	1370	306	3	12	<4	98	10	34	24	5	52	881	10	10
WPSE795X	Middle Waste	Carbon Seam	0.21	0.56	4.55	0.12	8	<10	164	<1	54	44	4	1260	284	2	13	<4	98	9	32	23	4	48	867	14	9
WPSE080C	Middle Waste	Phosphorite	0.18	0.38	8.74	0.07	6	<10	141	1	45	45	4	1130	195	5	11	4	241	13	94	4	<4	113	156	17	<2
WPSE083C	Middle Waste		0.23	0.59	4.60	0.15	10	13	232	<1	16	40	<2	1610	106	2	14	<4	101	22	18	27	6	59	139	15	10
WPSE085C	Middle Waste		0.15	0.61	3.53	0.15	10	13	193	<1	11	44	<2	723	79	3	12	<4	126	11	11	5	5	80	194	9	8
WPSE085X	Middle Waste		0.16	0.64	3.30	0.14	10	12	193	<1	12	43	2	794	86	3	10	<4	116	12	12	6	5	65	223	8	8
WPSE086C	Middle Waste		0.27	0.50	5.60	0.11	13	<10	208	<1	60	36	3	1840	179	3	13	<4	135	27	50	42	<4	65	406	16	9
WPSE089C	Middle Waste		6.21	0.63	0.84	0.14	<2	18	148	<1	64	21	7	344	40	<2	18	<4	26	10	295	18	<4	17	319	9	5
WPSE093C	Upper Ore zone	Phosphorite	0.21	0.33	8.68	0.07	11	<10	160	<1	58	38	<2	1260	129	3	13	<4	158	16	10	13	<4	79	82	19	7
WPSE097C	Upper Ore zone	Phosphorite	0.23	0.15	12.30	0.07	8	<10	132	<1	120	30	<2	1720	161	2	12	<4	129	18	12	11	<4	60	76	21	<2
WPSE100C	Upper Ore zone		0.09	0.15	14.10	0.04	<2	<10	65	<1	76	29	<2	831	61	3	<4	<4	181	5	13	11	<4	81	45	13	4
WPSE101C	Upper Ore zone	Phosphorite	0.16	0.61	6.14	0.11	10	29	529	<1	30	57	2	549	72	3	8	<4	155	8	7	43	4	99	163	18	9
WPSE103C	Upper Ore zone	Phosphorite	0.08	0.19	15.20	0.03	5	<10	62	<1	48	31	2	574	62	5	5	<4	251	5	10	6	<4	122	45	15	<2
WPSE104C	Upper Ore zone	Mudstone	0.20	0.71	2.26	0.26	8	15	330	<1	14	49	2	478	44	<2	12	<4	59	12	12	4	8	49	162	18	9
WPSE106C	Upper Ore zone	Phosphorite	0.06	0.13	15.00	0.02	<2	<10	46	<1	44	19	<2	518	44	2	<4	<4	145	3	24	3	<4	62	34	11	<2
WPSE109C	Upper Waste		0.34	0.51	0.58	0.26	4	18	286	<1	31	67	5	536	64	2	15	<4	55	22	53	22	14	51	130	12	10
WPSE109X	Upper Waste		0.36	0.51	0.65	0.25	5	14	266	1	31	67	5	581	66	2	14	<4	58	23	55	21	14	56	121	12	11
WPSE113C	Upper Waste		0.18	0.10	0.35	0.08	<2	<10	107	<1	5	14	<2	403	47	<2	8	<4	31	10	6	5	<4	36	52	6	4
WPSE116C	Upper Waste	Carbon Seam	0.54	0.42	0.84	0.25	8	21	261	<1	73	58	7	1730	196	3	18	<4	67	48	96	308	9	58	752	15	11
WPSE1165	Upper Waste		0.40	0.84	1.53	0.27	<2	16	261	<1	5	75	8	350	39	3	14	<4	96	19	69	28	7	90	156	14	10
WPSE117C	Upper Waste	Dolomite	11.10	0.16	0.51	0.04	<2	<10	33	<1	<2	10	2	115	22	<2	7	<4	32	5	668	3	<4	21	57	7	<2
WPSE117X	Upper Waste	Dolomite	10.90	0.16	0.54	0.03	<2	<10	36	<1	2	5	3	115	22	<2	19	<4	33	5	656	<2	<4	17	58	<4	<2
WPSE120C	Upper Waste		0.72	0.70	2.35	0.26	<2	<10	297	1	9	80	8	783	64	4	18	<4	157	29	119	21	12	94	381	10	14
WPSE123C	Upper Waste		3.59	0.71	0.07	0.24	<2	11	183	<1	3	43	8	146	25	<2	28	<4	27	13	605	7	<4	20	78	12	8
WPSE126C	Upper Waste		0.43	0.31	0.40	0.37	<2	15	290	<1	14	48	11	399	32	<2	17	<4	44	20	82	21	9	37	188	14	12
WPSE126X	Upper Waste		0.42	0.33	0.48	0.37	<2	13	254	<1	13	69	10	394	31	4	16	<4	46	21	90	18	12	41	171	12	12
WPSE131C	Upper Waste	Carbon Seam	0.45	0.13	5.61	0.18	9	<10	195	<1	10	74	<2	2180	157	6	21	5	264	30	59	9	4	153	262	21	13

Section E (wpsE) Sample Geochemistry

WUSP Sample	Unit w/in Phosphoria Formation	Lithology	Sr, 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	eU, ppm
WPSE-10C	Grandeur Member	Dolomite	118	<6	<100	95	15	<1	815	20
WPSE-10X	Grandeur Member	Dolomite	120	<6	<100	117	18	1	1070	
WPSE-05C	Grandeur Member	Dolomite, altered	769	<6	<100	617	232	11	1160	35
WPSE0.5C	Fish-scale Bed	Phosphorite	1090	<6	106	250	361	14	3180	78
WPSE002C	Footwall Mudstone		109	16	<100	1670	47	5	3500	181
WPSE004C	Lower Ore zone	Phosphorite	641	10	<100	1160	184	9	2040	117
WPSE006C	Lower Ore zone	Mudstone	515	9	<100	406	215	10	1050	112
WPSE008C	Lower Ore zone		611	<6	<100	853	186	9	1610	116
WPSE012C	Lower Ore zone	Phosphorite	169	<6	<100	272	38	2	10140	13
WPSE016C	Lower Ore zone	Phosphorite, Mudstone	679	9	<100	703	154	8	1350	68
WPSE021C	Lower Ore zone	Phosphorite	711	12	<100	1460	161	9	1030	151
WPSE026C	False Cap	Mudstone	609	<6	<100	429	240	11	2620	96
WPSE029C	Lower Ore zone		925	10	<100	1670	364	19	753	102
WPSE033C	Lower Ore zone	Phosphorite	945	6	<100	932	518	23	1180	95
WPSE038C	Middle Waste		575	7	<100	297	178	9	1670	49
WPSE043C	Middle Waste		410	12	<100	236	138	7	1150	40
WPSE043X	Middle Waste		432	12	<100	227	147	8	1120	
WPSE046C	Middle Waste		74	15	<100	117	31	3	1640	46
WPSE048C	Middle Waste		739	12	<100	275	365	15	1150	54
WPSE055C	Middle Waste		514	14	<100	238	239	11	1200	45
WPSE057C	Middle Waste		138	11	<100	241	53	4	854	50
WPSE061C	Middle Waste		379	10	<100	260	157	8	1380	55
WPSE065C	Middle Waste		258	12	<100	298	164	9	635	48
WPSE067C	Middle Waste		169	9	<100	121	112	6	1320	38
WPSE067X	Middle Waste	Phosphorite	184	15	<100	114	117	6	1210	
WPSE071C	Middle Waste		421	8	<100	220	213	11	700	41
WPSE075C	Middle Waste		115	14	<100	144	31	3	1460	23
WPSE077C	Middle Waste	Phosphorite	661	6	<100	85	184	10	476	46
WPSE079C	Middle Waste	Phosphorite	530	10	<100	240	303	15	480	52
WPSE079X	Middle Waste	Phosphorite	562	6	<100	238	325	16	486	52
WPSE795C	Middle Waste	Carbon Seam	307	9	<100	274	159	8	2420	54
WPSE795X	Middle Waste	Carbon Seam	319	<6	<100	260	165	8	2300	
WPSE080C	Middle Waste	Phosphorite	819	<6	<100	82	405	19	691	54
WPSE083C	Middle Waste		399	<6	<100	403	159	9	521	58
WPSE085C	Middle Waste		444	<6	<100	207	194	10	1160	65
WPSE085X	Middle Waste		406	<6	<100	219	174	9	1310	
WPSE086C	Middle Waste		580	7	<100	328	215	11	2290	65
WPSE089C	Middle Waste		159	<6	<100	172	32	3	3510	36
WPSE093C	Upper Ore zone	Phosphorite	646	<6	<100	367	256	12	614	86
WPSE097C	Upper Ore zone	Phosphorite	586	<6	<100	1050	204	10	669	173
WPSE100C	Upper Ore zone		644	<6	<100	389	300	15	641	158
WPSE101C	Upper Ore zone	Phosphorite	1960	8	<100	542	244	13	909	142
WPSE103C	Upper Ore zone	Phosphorite	635	<6	<100	233	384	18	560	129
WPSE104C	Upper Ore zone	Mudstone	121	11	<100	437	79	5	591	103
WPSE106C	Upper Ore zone	Phosphorite	731	<6	<100	271	228	9	512	130
WPSE109C	Upper Waste		148	<6	<100	163	81	5	437	60
WPSE109X	Upper Waste		144	11	<100	168	83	6	495	
WPSE113C	Upper Waste		69	7	<100	140	55	3	147	38
WPSE116C	Upper Waste	Carbon Seam	84	9	<100	527	95	7	2500	35
WPSE1165	Upper Waste		138	10	<100	107	135	7	488	29
WPSE117C	Upper Waste	Dolomite	189	<6	<100	51	42	2	180	33
WPSE117X	Upper Waste	Dolomite	186	<6	<100	50	43	2	183	
WPSE120C	Upper Waste		186	9	<100	143	185	11	965	35
WPSE123C	Upper Waste		120	<6	<100	91	19	2	243	15
WPSE126C	Upper Waste		57	15	<100	177	41	4	784	23
WPSE126X	Upper Waste		59	13	<100	177	44	4	738	
WPSE131C	Upper Waste	Carbon Seam	285	12	<100	778	386	21	816	64

Section F (wpsF) Sample Geochemistry

WUSP Sample	Unit w/in Phosphoria Formation	Lithology	Lab No.	Notes	Interval base, ft	Interval top, ft	Thickness, ft	Interval midpoint, ft	As, ppm, hydride	Hg, ppm, CVAA	Sb, ppm, hydride	Se, ppm, hydride	Tl, ppm, fusion-AA	C, %, combustion	CO2, %, acidification	Carbonate C, %, acidification
WPSF001C	Footwall Mudstone?		C-141287		1			1	54.4	0.23	13.3	8	9.3	0.4	0.0	0.0
WPSF004C	Lower Ore zone		C-141289		4			4	8.1	0.37	7.5	2.5	2.4	1.6	1.5	0.4
WPSF015C	Lower Ore zor	Mudstone	C-141280		4.5	13.2	8.7	8.9	18.8	0.53	13.7	3.8	4	1.5	0.8	0.2
WPSF020C	Lower Ore zor	Phosphorite	C-141270		19.2	20.5	1.3	19.9	11.6	0.33	10.1	2.7	3.6	1.8	1.4	0.4
WPSF031C	Lower Ore zor	Mudstone	C-141281		29.25	31.9	2.65	30.6	22	0.35	20.4	5.8	4	0.8	0.3	0.1
WPSF035C	Lower Ore zor	Phosphorite	C-141288		34.8	36	1.2	35.4	3.9	0.28	5.3	6.3	7.7	0.8	0.9	0.3
WPSF040C	False Cap	Mudstone	C-141276		39.6	40.5	0.9	40.1	19.1	0.52	17.7	5	6.4	1.3	0.6	0.2
WPSF045C	Lower Ore zone		C-141271		40.5	47	6.5	43.8	9.6	0.89	8.8	9.1	7.5	1.4	0.7	0.2
WPSF061C	Middle Waste		C-141301		60	62	2	61.0	36	0.53	12.9	7.5	0.5	1.2	0.2	0.0
WPSF078C	Middle Waste	Siltstone	C-141300		76.4	79.4	3	77.9	30.6	0.61	8.8	10.7	1.3	0.7	0.2	0.1
WPSF097C	Middle Waste	Phosphorite	C-141285		96.6	97.2	0.6	96.9	9.2	0.59	2.7	2.4	1.4	2.3	0.5	0.1
WPSF121C	Middle Waste	Phosphorite	C-141299		120.4	121.2	0.8	120.8	16.8	0.81	6.3	33.2	1.8	1.6	0.2	0.1
WPSF121X	Middle Waste	Phosphorite	C-141286	duplicate of previous sample	120.4	121.2	0.8	120.8	16.6	0.82	6.1	32.7	2	1.7	0.2	0.1
WPSF141C	Upper Ore zor	Phosphorite	C-141284		139	142.9	3.9	141.0	4	0.25	1.5	1.8	1.8	1.0	1.0	0.3
WPSF154C	Upper Ore zor	Phosphorite	C-141277		153.2	155.2	2	154.2	2.5	0.24	1.5	1.3	1.4	0.6	1.0	0.3
WPSF167C	Upper Waste	Carbon Seam	C-141274		165.4	170.6	5.2	168.0	12.6	0.56	5.4	81.3	3.1	4.7	0.0	<0.003
WPSF177C	Upper Waste	Carbon Seam	C-141279		176.5	176.9	0.4	176.7	5.5	0.52	1.8	24	2.2	3.0	0.1	0.0

Section F (wpsF) Sample Geochemistry

WUSP Sample	Unit w/in Phosphoria Formation	Lithology	Organic C, %, difference	S, %, combustion	Al, %, ICP-16	AlOx, %, ICP-16	Ca, %, ICP-16	CaOx, %, ICP-16	Fe, %, ICP-16	FeOx, %, ICP-16	K, %, ICP-16	KOx, %, ICP-16	Mg, %, ICP-16	MgOx, %, ICP-16	Na, %, ICP-16	NaOx, %, ICP-16
WPSF001C	Footwall Mudstone?		0.4	0.07	5.61	10.60	0.79	1.11	2.77	3.96	2.32	2.80	0.48	0.80	0.12	0.16
WPSF004C	Lower Ore zone		1.1	0.71	0.81	1.53	35.80	50.08	0.45	0.64	0.30	0.36	0.12	0.20	0.53	0.71
WPSF015C	Lower Ore zor	Mudstone	1.3	0.29	2.96	5.59	24.60	34.42	1.31	1.87	1.43	1.72	0.14	0.23	0.17	0.23
WPSF020C	Lower Ore zor	Phosphorite	1.4	0.26	1.06	2.00	29.50	41.27	0.51	0.73	0.50	0.60	0.22	0.36	0.14	0.19
WPSF031C	Lower Ore zor	Mudstone	0.7	0.12	5.85	11.05	8.93	12.49	2.30	3.29	2.69	3.24	0.16	0.27	0.24	0.32
WPSF036C	Lower Ore zor	Phosphorite	0.6	0.14	1.57	2.97	34.30	47.99	0.65	0.93	0.78	0.94	0.10	0.17	0.15	0.20
WPSF040C	False Cap	Mudstone	1.1	0.18	3.48	6.57	21.40	29.94	1.75	2.50	1.63	1.96	0.20	0.33	0.11	0.15
WPSF045C	Lower Ore zone		1.2	0.25	2.86	5.40	24.50	34.28	1.46	2.09	1.17	1.41	0.19	0.32	0.17	0.23
WPSF061C	Middle Waste		1.1	0.12	6.41	12.11	3.82	5.34	2.16	3.09	2.20	2.65	0.06	0.10	0.63	0.85
WPSF078C	Middle Waste	Siltstone	0.6	0.13	5.87	11.09	6.70	9.37	2.48	3.55	2.39	2.88	0.19	0.32	0.86	1.16
WPSF097C	Middle Waste	Phosphorite	2.1	0.36	3.08	5.82	19.50	27.28	1.62	2.32	1.29	1.55	0.18	0.30	0.29	0.39
WPSF121C	Middle Waste	Phosphorite	1.5	0.18	5.25	9.92	7.03	9.83	2.41	3.45	2.08	2.51	0.28	0.46	0.38	0.51
WPSF121X	Middle Waste	Phosphorite	1.6	0.19	5.15	9.73	7.03	9.83	2.48	3.55	1.91	2.30	0.28	0.46	0.37	0.50
WPSF141C	Upper Ore zor	Phosphorite	0.8	0.14	1.55	2.93	33.30	46.59	0.46	0.66	0.54	0.65	0.12	0.20	0.11	0.15
WPSF154C	Upper Ore zor	Phosphorite	0.3	0.11	0.93	1.76	37.00	51.76	0.32	0.46	0.30	0.36	0.08	0.13	0.10	0.13
WPSF167C	Upper Waste	Carbon Seam	4.7	0.44	7.30	13.79	1.14	1.59	1.47	2.10	2.10	2.53	0.75	1.24	0.08	0.11
WPSF177C	Upper Waste	Carbon Seam	3.0	0.32	6.81	12.86	4.76	6.66	1.57	2.25	1.82	2.19	0.62	1.03	0.10	0.13

Section F (wpsF) Sample Geochemistry

WUSP Sample	Unit w/in Phosphoria Formation	Lithology	P, %, ICP-16	POx, %, ICP-16	Si, %, ICP-16	SiOx, %, ICP-16	Ti, %, ICP-16	TiOx, %, ICP-16	Sum Oxides, %	Ba, ppm, ICP-16	Cr, ppm, ICP-16	Mn, ppm, ICP-16	Nb, ppm, ICP-16	Sr, ppm, ICP-16	Y, ppm, ICP-16	Zr, ppm, ICP-16
WPSF001C	Footwall Mudstone?		0.25	0.57	36.30	77.65	0.47	0.78	98.4	332	365	417	<10	53	34	454
WPSF004C	Lower Ore zone		15.70	35.97	3.45	7.38	0.05	0.08	97.0	105	857	<100	<10	717	193	83
WPSF015C	Lower Ore zor	Mudstone	10.60	24.29	12.60	26.95	0.17	0.28	95.6	190	993	<100	<10	567	212	80
WPSF020C	Lower Ore zor	Phosphorite	12.70	29.10	11.10	23.74	0.07	0.12	98.1	121	786	<100	<10	653	126	94
WPSF031C	Lower Ore zor	Mudstone	3.85	8.82	26.60	56.90	0.41	0.68	97.1	253	645	<100	11	274	73	272
WPSF035C	Lower Ore zor	Phosphorite	15.20	34.83	8.12	17.37	0.12	0.20	105.6	183	693	<100	<10	1010	131	136
WPSF040C	False Cap	Mudstone	9.24	21.17	15.60	33.37	0.21	0.35	96.4	129	1290	<100	<10	766	288	85
WPSF045C	Lower Ore zone		10.60	24.29	13.90	29.73	0.18	0.30	98.0	186	1770	<100	<10	936	442	109
WPSF061C	Middle Waste		2.34	5.36	29.90	63.96	0.52	0.87	94.3	284	696	<100	16	1670	59	369
WPSF078C	Middle Waste	Siltstone	3.09	7.08	27.10	57.97	0.45	0.75	94.2	302	1130	<100	15	444	97	361
WPSF097C	Middle Waste	Phosphorite	8.94	20.49	17.40	37.22	0.26	0.43	95.8	235	1630	<100	<10	726	590	74
WPSF121C	Middle Waste	Phosphorite	4.29	9.83	24.20	51.76	0.41	0.68	89.0	299	1640	<100	<10	309	150	85
WPSF121X	Middle Waste	Phosphorite	4.28	9.81	23.30	49.84	0.39	0.65	86.7	288	1580	<100	<10	311	146	192
WPSF141C	Upper Ore zor	Phosphorite	14.70	33.68	9.39	20.09	0.11	0.18	105.1	113	719	<100	<10	717	370	127
WPSF154C	Upper Ore zor	Phosphorite	16.20	37.12	5.61	12.00	0.07	0.12	103.8	71	514	<100	<10	691	215	76
WPSF167C	Upper Waste	Carbon Seam	0.84	1.92	28.90	61.82	0.43	0.72	85.8	286	2150	<100	<10	49	94	291
WPSF177C	Upper Waste	Carbon Seam	2.09	4.79	26.00	55.61	0.39	0.65	86.2	249	1650	<100	<10	133	260	268

Section F (wpsF) Sample Geochemistry

WUSP Sample	Unit w/in Phosphoria Formation	Lithology	Al, %, ICP-40	Ca, %, ICP-40	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	Ba, ppm, ICP-40	Be, ppm, ICP-40	Cd, ppm, ICP-40	Ce, ppm, ICP-40
WPSF001C	Footwall Mudstone?		4.93	0.72	2.58	2.11	0.44	0.13	0.22	0.29	<2	48	317	<1	22	53
WPSF004C	Lower Ore zone		0.79	33.20	0.45	0.3	0.11	0.55	15.70	0.05	7	<10	106	<1	142	23
WPSF015C	Lower Ore zor	Mudstone	2.76	23.90	1.29	1.5	0.14	0.17	10.00	0.04	9	<10	173	<1	107	45
WPSF020C	Lower Ore zor	Phosphorite	0.94	29.10	0.49	0.5	0.21	0.14	12.00	0.05	13	<10	116	<1	132	18
WPSF031C	Lower Ore zor	Mudstone	5.47	8.38	2.15	2.64	0.16	0.22	3.57	0.22	9	14	232	<1	66	59
WPSF035C	Lower Ore zor	Phosphorite	1.38	33.10	0.58	0.73	0.10	0.16	14.10	0.06	4	<10	171	<1	175	25
WPSF040C	False Cap	Mudstone	3.30	20.20	1.58	1.71	0.20	0.11	8.94	0.07	21	<10	135	<1	146	50
WPSF045C	Lower Ore zone		2.62	23.80	1.39	1.19	0.18	0.16	9.89	0.03	22	<10	169	<1	110	64
WPSF061C	Middle Waste		5.84	3.57	2.03	2	0.05	0.59	2.30	0.27	14	28	256	<1	12	61
WPSF078C	Middle Waste	Siltstone	5.49	5.96	2.32	2.33	0.18	0.83	2.99	0.27	4	22	295	<1	10	79
WPSF097C	Middle Waste	Phosphorite	2.76	19.10	1.42	1.25	0.17	0.26	8.31	0.05	7	<10	215	1	44	97
WPSF121C	Middle Waste	Phosphorite	5.03	6.47	2.36	2.07	0.28	0.37	4.28	0.21	17	<10	301	<1	32	62
WPSF121X	Middle Waste	Phosphorite	5.01	7.08	2.42	2.02	0.26	0.37	3.90	0.19	16	<10	293	<1	32	63
WPSF141C	Upper Ore zor	Phosphorite	1.37	31.20	0.44	0.54	0.12	0.11	13.90	0.06	4	<10	97	<1	71	36
WPSF154C	Upper Ore zor	Phosphorite	0.82	34.90	0.27	0.29	0.08	0.10	15.10	0.04	<2	<10	63	<1	76	22
WPSF167C	Upper Waste	Carbon Seam	6.36	1.02	1.34	2	0.69	0.08	0.81	0.26	7	<10	300	<1	49	40
WPSF177C	Upper Waste	Carbon Seam	6.41	4.46	1.53	1.86	0.60	0.10	2.03	0.30	<2	<10	262	2	37	87

Section F (wpsF) Sample Geochemistry

WUSP Sample	Unit w/in Phosphoria Formation	Lithology	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	Mn, ppm, ICP-40	Mo, ppm, ICP-40	Nb, ppm, ICP-40	Nd, ppm, ICP-40	Ni, ppm, ICP-40	Pb, ppm, ICP-40
WPSF001C	Footwall Mudstone?		6	354	62	<2	14	<4	32	27	371	28	7	33	385	14
WPSF004C	Lower Ore zone		<2	812	108	2	6	<4	153	9	20	8	<4	54	59	21
WPSF015C	Lower Ore zor	Mudstone	<2	1050	123	3	12	<4	168	12	11	13	<4	71	172	24
WPSF020C	Lower Ore zor	Phosphorite	2	784	102	<2	5	<4	92	7	14	11	<4	40	61	16
WPSF031C	Lower Ore zor	Mudstone	3	639	69	<2	12	<4	64	14	49	21	6	45	257	18
WPSF035C	Lower Ore zor	Phosphorite	<2	640	96	<2	8	<4	93	7	7	3	<4	41	23	19
WPSF040C	False Cap	Mudstone	<2	1250	159	5	14	<4	232	19	10	14	<4	108	222	20
WPSF045C	Lower Ore zone		<2	1690	187	6	9	7	338	19	13	7	<4	78	55	22
WPSF061C	Middle Waste		<2	690	87	<2	7	<4	61	8	<4	6	12	43	77	14
WPSF078C	Middle Waste	Siltstone	3	1130	88	3	15	<4	100	18	56	14	9	70	91	15
WPSF097C	Middle Waste	Phosphorite	<2	1510	187	7	14	7	408	16	13	4	<4	202	55	17
WPSF121C	Middle Waste	Phosphorite	<2	1730	174	<2	17	<4	102	24	12	9	8	57	47	17
WPSF121X	Middle Waste	Phosphorite	<2	1500	180	2	17	<4	97	22	10	9	7	60	46	15
WPSF141C	Upper Ore zor	Phosphorite	5	770	74	4	6	<4	210	8	50	2	<4	97	30	13
WPSF154C	Upper Ore zor	Phosphorite	6	449	49	2	<4	<4	129	5	58	3	<4	53	18	11
WPSF167C	Upper Waste	Carbon Seam	<2	2180	303	<2	25	<4	45	47	16	30	8	40	110	12
WPSF177C	Upper Waste	Carbon Seam	<2	1440	240	5	21	<4	175	40	19	4	8	121	158	14

Section F (wpsF) Sample Geochemistry

WUSP Sample	Unit w/in Phosphoria Formation	Lithology	Sc, ppm, ICP-40	Sr, 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
WPSF001C	Footwall Mudstone?		10	46	16	<100	642	29	4	2750
WPSF004C	Lower Ore zone		2	694	<6	<100	1200	189	9	1050
WPSF015C	Lower Ore zor	Mudstone	<2	530	<6	<100	925	209	10	1550
WPSF020C	Lower Ore zor	Phosphorite	<2	591	7	<100	1460	119	7	809
WPSF031C	Lower Ore zor	Mudstone	10	252	11	<100	574	67	5	1970
WPSF035C	Lower Ore zor	Phosphorite	<2	937	<6	<100	1820	122	8	415
WPSF040C	False Cap	Mudstone	5	710	6	<100	824	283	14	1180
WPSF045C	Lower Ore zone		<2	842	<6	<100	1450	428	20	364
WPSF061C	Middle Waste		11	1550	12	<100	167	47	4	245
WPSF078C	Middle Waste	Siltstone	13	426	14	<100	201	94	6	406
WPSF097C	Middle Waste	Phosphorite	6	669	7	<100	187	552	23	426
WPSF121C	Middle Waste	Phosphorite	12	289	11	<100	613	142	9	186
WPSF121X	Middle Waste	Phosphorite	11	288	7	<100	636	143	9	189
WPSF141C	Upper Ore zor	Phosphorite	5	672	<6	<100	215	340	16	443
WPSF154C	Upper Ore zor	Phosphorite	3	611	<6	<100	283	199	9	429
WPSF167C	Upper Waste	Carbon Seam	13	44	14	<100	459	82	6	268
WPSF177C	Upper Waste	Carbon Seam	15	130	15	<100	215	263	14	537

Section E and F: Accuracy and Precision

Project Check Standards	Lab No.	As, ppm, hydride	Hg, ppm, CVAA	Sb, ppm, hydride	Se, ppm, hydride	Tl, ppm, fusion-AA	C, %, combustion	CO2, %, acidification	Carbonate C, %, acidification	Organic C, %, difference	S, %, combustion	Al, %, ICP-16	Ca, %, ICP-16	Fe, %, ICP-16	K, %, ICP-16	Mg, %, ICP-16	Na, %, ICP-16	P, %, ICP-16
POW-1	C-141293	12.4	0.24	2.4	47.3	2.2	3.09	0.14	0.04	3.05	1.28	2.1	3.07	1.01	0.59	0.19	0.08	1.33
4-Sample Mean		10.9	0.2	1.5	52.1	2.1	3.07	0.14	0.04	3.03	1.3	2.12	2.85	1.10	0.60	0.20	0.08	1.31
4-sample Relative Std. Dev., %		10%	7%	41%	7%	8%	1%	7%	0%	1%	3%	4%	8%	13%	6%	7%	6%	5%
Relative Std. Diff., %, sample-mean		14%	5%	57%	-9%	4%	1%	2%	0%	1%	-2%	-1%	8%	-8%	-2%	-3%	3%	2%
POW-2	C-141292	30.4	0.52	8.0	128	2.2	7.71	4.38	1.20	6.51	0.94	3.60	16.4	1.58	1.39	1.15	0.60	6.09
4-Sample Mean		31.8	0.51	6.9	140	2.4	7.66	4.42	1.21	6.45	0.90	3.56	14.7	1.57	1.41	1.12	0.59	5.80
4-sample Relative Std. Dev., %		8%	6%	13%	8%	7%	1%	1%	1%	2%	4%	2%	9%	6%	5%	6%	3%	6%
Relative Std. Diff., %, sample-mean		-4%	3%	17%	-9%	-9%	1%	-1%	-1%	1%	4%	1%	12%	0%	-1%	3%	3%	5%
POI-1	C-141273	18.6	0.25	2.4	47.5	1.4	3.88	2.51	0.69	3.19	2.75	5.63	4.10	2.51	1.92	1.08	0.57	1.16
4-Sample Mean		18.5	0.23	1.9	44.5	1.4	3.81	2.50	0.68	3.13	2.70	5.73	3.88	2.46	1.97	1.04	0.56	1.11
4-sample Relative Std. Dev., %		2%	8%	22%	5%	7%	2%	0%	1%	2%	4%	2%	9%	2%	4%	4%	1%	4%
Relative Std. Diff., %, sample-mean		0%	11%	26%	7%	-2%	2%	0%	1%	2%	2%	-2%	6%	2%	-3%	4%	2%	5%
Analyzed Reference Material SARL-1	Lab No.	As, ppm, hydride	Hg, ppm, CVAA	Sb, ppm, hydride	Se, ppm, hydride	Tl, ppm, fusion-AA	C, %, combustion	CO2, %, acidification	Carbonate C, %, acidification	Organic C, %, difference	S, %, combustion	Al, %, ICP-16	Ca, %, ICP-16	Fe, %, ICP-16	K, %, ICP-16	Mg, %, ICP-16	Na, %, ICP-16	P, %, ICP-16
	C-141306	19.8	0.19	5.6	1.1	1.2	1.09	0.37	0.10	0.99	0.07	6.26	1.11	2.83	3.25	0.55	1.55	0.08
	C-141308	18.3	0.18	5.1	0.9	1.1	1.10	0.39	0.11	0.99	0.07	5.75	1.02	2.59	2.99	0.51	1.44	0.07
	C-141310	18.2	0.19	5.7	0.9	1.1	1.09	0.39	0.11	0.98	0.08	5.88	1.06	2.63	3.15	0.52	1.48	0.08
	C-141312	20.1	0.17	6.0	0.9	1.2	1.10	0.39	0.11	0.99	0.07	6.43	1.16	2.88	2.98	0.56	1.60	0.09
Average		19.1	0.18	5.6	1.0	1.2	1.10	0.39	0.11	0.99	0.07	6.08	1.09	2.73	3.09	0.54	1.52	0.08
Accepted Value		16.5	0.16	5.1	0.9	1.4	0.97	0.40	0.11	0.86	0.07	5.79	1.06	2.67	2.98	0.55	1.53	0.09
Rel. Std. Diff.		16%	14%	10%	6%	-18%	13%	-4%	-2%	15%	4%	5%	3%	2%	4%	-3%	-1%	-11%
Analyzed Reference Material SARM-1	Lab No.	As, ppm, hydride	Hg, ppm, CVAA	Sb, ppm, hydride	Se, ppm, hydride	Tl, ppm, fusion-AA	C, %, combustion	CO2, %, acidification	Carbonate C, %, acidification	Organic C, %, difference	S, %, combustion	Al, %, ICP-16	Ca, %, ICP-16	Fe, %, ICP-16	K, %, ICP-16	Mg, %, ICP-16	Na, %, ICP-16	P, %, ICP-16
	C-141307	38.6	0.11	6.5	0.5	2.1	0.31	0.08	0.02	0.29	0.12	6.20	0.55	3.11	3.09	0.45	1.16	0.07
	C-141309	37.5	0.11	7.1	0.4	2.3	0.29	0.08	0.02	0.27	0.12	6.37	0.56	3.16	3.13	0.48	1.18	0.08
	C-141311	36.6	0.11	7.0	0.3	2.4	0.30	0.08	0.02	0.28	0.12	6.46	0.58	3.28	3.19	0.48	1.19	0.07
Average		37.6	0.11	6.9	0.4	2.3	0.30	0.08	0.02	0.28	0.12	6.34	0.56	3.18	3.14	0.47	1.18	0.07
Accepted Value		37.0	0.12	5.6	0.3	2.8	0.30	0.07	0.02	0.28	0.13	6.09	0.58	3.22	2.92	0.50	1.19	0.08
Rel. Std. Diff.		2%	-6%	23%	21%	-19%	0%	14%	0%	0%	-8%	4%	-3%	-1%	7%	-6%	-1%	-8%
Section E and F Precision																		
Number of duplicate pairs		10	10	10	10	10	10	10	10	10	9	10	10	10	10	10	10	10
Avg. Rel. Std. Diff.		11%	6%	21%	10%	15%	2%	12%	13%	9%	4%	7%	8%	8%	9%	6%	5%	11%
Avg. Rel. Std. Dev.		8%	4%	15%	7%	10%	2%	9%	9%	6%	3%	5%	5%	6%	6%	4%	3%	7%

Section E and F: Accuracy and Precision

Project Check Standards	Si, %, ICP-16	Ti, %, ICP-16	Ba, ppm, ICP-16	Cr, ppm, ICP-16	Mn, ppm, ICP-16	Nb, ppm, ICP-16	Sr, ppm, ICP-16	Y, ppm, ICP-16	Zr, ppm, ICP-16	Al, %, ICP-40	Ca, %, ICP-40	Fe, %, ICP-40	K, %, ICP-40	Mg, %, ICP-40	Na, %, ICP-40	P, %, ICP-40	Ti, %, ICP-40	Ag, ppm, ICP-40
POW-1	36.0	0.10	176	577	<100	<10	131	122	65	1.80	2.94	1.01	0.56	0.18	0.07	1.35	0.08	<2
4-Sample Mean	36.5	0.10	173	601	<100	<10	132	122	70	1.86	2.81	1.01	0.57	0.18	0.07	1.24	0.08	<2
4-sample Relative Std. Dev., %	3%	5%	2%	5%	<100		3%	1%	11%	5%	7%	1%	2%	3%	2%	9%	9%	
Relative Std. Diff., %, sample-mean	-1%	-2%	2%	-4%			-1%	0%	-7%	-3%	4%	0%	-1%	3%	0%	9%	1%	
POW-2	16.8	0.24	268	1300	<100	11	610	173	180	3.20	16.3	1.48	1.38	1.04	0.59	5.87	0.11	8
4-Sample Mean	16.6	0.23	258	1300			592	169	183	3.32	14.2	1.49	1.37	1.03	0.57	5.47	0.11	9
4-sample Relative Std. Dev., %	5%	4%	4%	7%			3%	2%	2%	6%	11%	2%	4%	3%	3%	8%	16%	20%
Relative Std. Diff., %, sample-mean	1%	3%	4%	0%			3%	3%	-2%	-4%	15%	-1%	1%	1%	3%	7%	-1%	
POI-1	26.80	0.39	276	503	221	<10	128	91	270	5.34	3.87	2.47	2.02	1.09	0.57	1.14	0.26	<2
4-Sample Mean	26.40	0.39	261	493	213		128	88	264	5.70	3.87	2.48	2.04	1.04	0.56	1.13	0.26	
4-sample Relative Std. Dev., %	2%	5%	4%	3%	7%		2%	4%	10%	5%	7%	1%	3%	6%	3%	6%	6%	
Relative Std. Diff., %, sample-mean	2%	1%	6%	2%			0%	3%	2%	-6%	0%	0%	-1%	4%	1%	1%	-3%	
Analyzed Reference Material SARL-1	Si, %, ICP-16	Ti, %, ICP-16	Ba, ppm, ICP-16	Cr, ppm, ICP-16	Mn, ppm, ICP-16	Nb, ppm, ICP-16	Sr, ppm, ICP-16	Y, ppm, ICP-16	Zr, ppm, ICP-16	Al, %, ICP-40	Ca, %, ICP-40	Fe, %, ICP-40	K, %, ICP-40	Mg, %, ICP-40	Na, %, ICP-40	P, %, ICP-40	Ti, %, ICP-40	Ag, ppm, ICP-40
	34.4	0.31	981	107	2080	35	153	53	380	5.76	1.03	2.67	2.99	0.54	1.49	0.08	0.32	2
	31.2	0.29	893	108	1920	36	141	48	366	5.64	1.02	2.60	2.94	0.50	1.48	0.08	0.30	2
	33.1	0.30	903	110	1910	35	144	40	391	5.69	1.03	2.63	2.96	0.53	1.49	0.07	0.29	2
	36.3	0.33	992	119	2160	43	159	43	357	5.68	1.14	2.62	2.97	0.51	1.49	0.08	0.32	3
Average	33.8	0.31	942	111	2018	37	149	46	374	5.69	1.06	2.63	2.97	0.52	1.49	0.08	0.31	2
Accepted Valu	33.6	0.25	879	110	2094	35	158	44	408	5.79	1.06	2.67	2.98	0.55	1.53	0.09	0.25	3
Rel. Std. Diff.	0%	23%	7%	1%	-4%	6%	-6%	5%	-8%	-2%	0%	-1%	-1%	-5%	-3%	-15%	22%	-13%
Analyzed Reference Material SARM-1	Si, %, ICP-16	Ti, %, ICP-16	Ba, ppm, ICP-16	Cr, ppm, ICP-16	Mn, ppm, ICP-16	Nb, ppm, ICP-16	Sr, ppm, ICP-16	Y, ppm, ICP-16	Zr, ppm, ICP-16	Al, %, ICP-40	Ca, %, ICP-40	Fe, %, ICP-40	K, %, ICP-40	Mg, %, ICP-40	Na, %, ICP-40	P, %, ICP-40	Ti, %, ICP-40	Ag, ppm, ICP-40
	32.5	0.36	788	95	4950	44	147	35	359	6.03	0.55	3.14	2.96	0.46	1.16	0.07	0.38	3
	33.7	0.36	811	95	5070	39	148	27	345	6.11	0.56	3.19	3.02	0.49	1.18	0.07	0.37	4
	34.0	0.36	826	97	5100	31	153	27	315	6.12	0.56	3.18	3.01	0.49	1.18	0.08	0.38	4
Average	33.4	0.36	808	96	5040	38	149	30	340	6.08	0.55	3.17	3.00	0.48	1.17	0.07	0.38	4
Accepted Valu	33.5	0.35	764	101	5200	31	156	33	370	6.09	0.58	3.22	2.92	0.5	1.19	0.08	0.35	3
Rel. Std. Diff.	0%	3%	6%	-5%	-3%	23%	-4%	-10%	-8%	0%	-5%	-2%	3%	-4%	-1%	-11%	7%	18%
Section E and F Precision																		
Number of duplicate pairs	10	10	10	10	3	0	10	10	10	10	10	10	10	10	10	10	10	6
Avg. Rel. Std. Diff.	6%	8%	6%	7%	9%		7%	9%	19%	4%	8%	5%	5%	5%	4%	9%	12%	12%
Avg. Rel. Std. Dev.	5%	6%	4%	5%	6%		5%	6%	13%	3%	5%	3%	3%	3%	3%	7%	9%	9%

Section E and F: Accuracy and Precision

Project Check Standards	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	Mn, ppm, ICP-40	Mo, ppm, ICP-40	Nb, ppm, ICP-40
POW-1	<10	<8	180	<1	<50	11	21	3	510	55	2	9	<4	75	16	28	21	<4
4-Sample Mean	<10	<8	171	<1	<50	11	22	4	421	55	2	7	<4	70	17	36	21	<4
4-sample Relative Std. Dev., %			5%			5%	28%	26%	52%	2%	0%	23%		5%	6%	18%	6%	
Relative Std. Diff., %, sample-mean			6%			2%	-2%	-20%	21%	1%	0%	29%		7%	-7%	-21%	1%	
POW-2	18	<8	255	<1	<50	49	46	4	1240	103	3	14	<4	132	17	64	29	<4
4-Sample Mean	20	<8	240	<1	<50	50	44	4	1185	101	3	13	<4	123	18	66	30	<4
4-sample Relative Std. Dev., %	13%		7%			3%	3%	54%	9%	2%	0%	10%		6%	5%	2%	6%	
Relative Std. Diff., %, sample-mean			6%			-2%	5%	0%	5%	2%	0%	10%		8%	-4%	-3%	-2%	
POI-1	11		289	<1		8	49	11	505	42	3	19	<4	67	22	205	18	9
4-Sample Mean	16		269			8	51	11	406	41	3	17		65	23	202	18	8
4-sample Relative Std. Dev., %	41%		6%			10%	9%	9%	40%	9%	22%	14%		4%	7%	5%	0%	35%
Relative Std. Diff., %, sample-mean			8%			0%	-4%	2%	24%	4%	13%	12%		3%	-3%	2%	0%	

Analyzed Reference Material SARL-1	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	Mn, ppm, ICP-40	Mo, ppm, ICP-40	Nb, ppm, ICP-40
	15	<8	976	3	<50	2	166	8	110	374	<2	17	<4	83	26	1980	14	36
	16	<8	893	3	<50	2	151	7	71	352	<2	15	<4	74	26	2000	13	33
	17	<8	937	3	<50	2	151	8	97	349	<2	16	<4	77	27	2020	14	36
	19	<8	922	3	<50	4	160	7	88	358	<2	16	<4	76	29	2030	14	30
Average	17		932	3		3	157	8	92	358		16		78	27	2008	14	34
Accepted Valu	17	0	879	3	1	3	150	8	110	370	2	17	2	75	28	2094	13	35
Rel. Std. Diff.	2%		6%	-6%		0%	5%	0%	-17%	-3%		-6%		3%	-4%	-4%	6%	-4%

Analyzed Reference Material SARM-1	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	Mn, ppm, ICP-40	Mo, ppm, ICP-40	Nb, ppm, ICP-40
	35	<8	793	2	<50	5	108	12	102	302	<2	17	<4	56	32	4740	13	32
	35	<8	850	2	<50	5	113	12	49	318	<2	21	<4	59	29	5100	12	33
	36	<8	869	2	<50	5	125	12	31	325	<2	17	<4	66	31	5060	12	31
Average	35		837	2		5	115	12	61	315		18		60	31	4967	12	32
Accepted Valu	37	0	764	2	1	5	120	11	101	320	1	20	2	61	30	5200	12	31
Rel. Std. Diff.	-5%		10%	-17%		5%	-4%	9%	-40%	-2%		-8%		-1%	2%	-4%	3%	3%
Section E and F Precision																		
Number of duplicate pairs	3		10	0		9	9	8	10	10	6	9	0	10	10	10	9	6
Avg. Rel. Std. Diff.	16%		7%			5%	20%	15%	6%	9%	13%	18%		7%	4%	13%	10%	15%
Avg. Rel. Std. Dev.	11%		5%			4%	14%	10%	4%	7%	9%	13%		5%	3%	9%	7%	11%

Project Check Standards	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
POW-1	58	186	6	5	<50	125	<40	<6	<100	171	117	7	836
4-Sample Mean	57	187	10	5	<50	126	<40	<6	<100	175	119	6	849
4-sample Relative Std. Dev., %	7%	4%	56%	13%		1%				4%	5%	8%	2%
Relative Std. Diff., %, sample-mean	2%	-1%	-41%	11%		-1%				-2%	-1%	12%	-2%
POW-2	75	200	12	8	<50	545	<40	8	<100	635	166	9	1080
4-Sample Mean	74	203	18	8	<50	553	<40	9	<100	664	168	9	1125
4-sample Relative Std. Dev., %	16%	6%	51%	8%		2%		29%		3%	4%	7%	3%
Relative Std. Diff., %, sample-mean	1%	-1%	-32%	7%		-1%				-4%	-1%	6%	-4%
POI-1	47	396	14	11		119		11	<100	149	89	6	1330
4-Sample Mean	54	396	18	11		122		10		150	87	6	1318
4-sample Relative Std. Dev., %	15%	5%	31%	5%		2%		22%		5%	7%	9%	4%
Relative Std. Diff., %, sample-mean	-13%	0%	-23%	2%		-3%				-1%	3%	4%	1%
Analyzed Reference Material SARL-1	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
	69	51	627	9	<50	147	<40	21	<100	135	42	5	442
	64	47	544	8	<50	144	<40	25	<100	127	39	5	420
	63	51	603	8	<50	144	<40	25	<100	130	39	5	428
	67	49	560	9	<50	145	<40	22	<100	130	40	5	421
Average	66	50	584	9		145		23		131	40	5	428
Accepted Valu	66	52	578	8	6	158	3	19	5	140	44	5	420
Rel. Std. Diff.	0%	-5%	1%	9%		-8%		22%		-7%	-9%	9%	2%
Analyzed Reference Material SARM-1	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
	48	39	1020	8	<50	146	<40	20	<100	68	25	3	907
	47	41	1070	9	<50	147	<40	24	<100	72	27	4	967
	48	43	1130	9	<50	147	<40	19	<100	71	27	3	1010
Average	48	41	1073	9		147		21		70	26	3	961
Accepted Valu	51	41	960	8	9	156	1	18	3	66	33	3	888
Rel. Std. Diff.	-7%	0%	12%	4%		-6%		17%		7%	-20%	4%	8%
Section E and F Precision													
Number of duplicate pairs	9	10	9	8		10		5	0	10	10	9	10
Avg. Rel. Std. Diff.	11%	8%	12%	7%		4%		32%		5%	6%	5%	8%
Avg. Rel. Std. Dev.	8%	6%	9%	5%		3%		22%		4%	4%	4%	6%