Chemical Composition of Selected Core Samples, Idaho National Engineering Laboratory, Idaho

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CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATED UNITS

Multiply	By	To obtain
foot (ft)	0.3048	meter
inch (in.)	25.4	millimeter
square mile (mi ²)	2.590	square kilometer

For temperature, degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) by using the equation:
 $^{\circ}\text{F} = (1.8)(^{\circ}\text{C}) + 32$.

Abbreviated units used in report: g (gram); mg (milligram); mL (milliliter); ppb (part per billion); ppm (part per million).

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Abstract

This report presents chemical compositions determined from 84 subsamples and 5 quality-assurance split subsamples of basalt core from the eastern Snake River Plain. The 84 subsamples were collected at selected depths from 5 coreholes located on the Idaho National Engineering Laboratory, Idaho. This report was jointly prepared by Lockheed Idaho Technologies Company and the U.S. Geological Survey, in cooperation with the U.S. Department of Energy, Idaho Operations Office.

Ten major elements and as many as 32 trace elements were determined for each subsample either by wavelength dispersive X-ray fluorescence spectrometry, inductively coupled plasma mass spectrometry, or by both methods. Descriptive statistics for each element were calculated and tabulated by analytical method for each corehole.

INTRODUCTION

The Idaho National Engineering Laboratory (INEL), which encompasses about 890 mi² of the eastern Snake River Plain in southeastern Idaho (fig. 1), is operated by the U.S. Department of Energy (DOE). INEL facilities are used in the development of peacetime atomic-energy applications, nuclear safety research, defense programs, and advanced energy concepts. Liquid radiochemical and chemical wastes generated at these facilities have been discharged to onsite infiltration ponds and disposal wells since 1952. Many of the waste constituents enter the Snake River Plain aquifer indirectly following percolation through

the unsaturated zone (Pittman and others, 1988, p. 2).

In 1949, the U.S. Atomic Energy Commission—now the U.S. DOE—requested that the U.S. Geological Survey (USGS) investigate the geohydrologic conditions at the INEL and adjacent areas before the beginning of reactor operations. Ongoing research by the USGS and Lockheed Idaho Technologies Company (LITCO) at the INEL involves investigation of the migration of radioactive elements contained in low-level radioactive waste, hydrologic and geologic factors affecting waste movement, and geochemical factors that influence the chemical composition of the waste. Identification of the chemistry of Snake River Plain aquifer materials is needed to aid in the study of the hydrology and geochemistry of subsurface waste disposal. This report was prepared jointly by LITCO and the USGS in cooperation with the DOE, Idaho Operations Office. Washington State University (WSU) provided analytical services under contract to EG&G Idaho, Inc.

Purpose and Scope

The purpose of this report is to provide a public record of archived information describing the chemical composition of geologic materials from the Snake River Plain aquifer. This report describes (1) the major- and trace-element composition of 84 subsamples and 5 quality-assurance split subsamples of basalt core from 5 sites (fig. 2) and (2) the methods used to analyze the samples. The subsamples were collected from continuous cores at the time of coring or shortly afterward. The remaining cores subsequently were archived at the U.S. Geological Survey's lithologic-core

Figure 1.—Location of the Idaho National Engineering Laboratory and selected facilities.

library at the INEL and are available for additional study

Previous Investigations

Geologic, hydrologic, and water-quality investigations have been conducted at the INEL since it was selected as a reactor-testing station in 1949. Nace and others (1956) and Nace and others (1975) reported major rock-forming element and selected trace-element chemistry of a basalt sample from Craters of the Moon National Monument and a nephelite basalt sample from the Fort Hall Indian Reservation. Jones (1961) reported the average composition of major rock-forming elements in 38 basalt samples from the Snake River Plain. The data of Nace and others (1956; 1975) and Jones (1961) were republished by Bartholomay and others (1989).

Kuntz and Dalrymple (1979) determined major rock-forming element chemistry for 17 basalt samples from large volcanoes in the eastern Snake River Plain and compared the average concentrations to those of various tholeiitic basalts from other locations. Fiesinger and others (1982) analyzed 26 basaltic lava samples from an area southeast of the eastern Snake River Plain for major rock-forming elements and compared results to basaltic lava compositions of samples from the Snake River Plain.

Leeman (1982a) provided major rock-forming element chemistry of 22 representative hybrid lava samples from the Snake River Plain. Leeman (1982b) also summarized major rock-forming element and selected trace-element chemistry for basalt samples from the Snake River Plain and discussed two major variants of basaltic lavas that are present on the Snake River Plain. Honjo and Leeman (1987) reported major- and trace-element chemistry for selected samples of hybrid ferrolatite lavas from the Snake River Plain. The chemical data were selected from a more detailed report about the petrology and geochemistry of the Magic Reservoir eruptive center in south-central Idaho (Honjo, 1986).

Wood and Low (1988) reported average compositions of major rock-forming elements for groups of 152 and 15 basalt samples from the

Snow River Plain. They also provided specific analytical results for 13 basalt samples from the Snake River Plain.

Shervais and others (1994) reported ranges of major-element oxide compositions and minor- and trace-element concentrations for 59 rock samples from 2 coreholes at the INEL. The rock samples represented 14 major flow groups that are part of the eastern Snake River Plain aquifer system.

Estimating Crustal Abundances of Major Rock-Forming Elements.

Historical estimates of average crustal abundances of major rock-forming elements by Clarke and Washington (1924) were computed from about 5,000 available analyses of igneous rocks that they felt were of superior quality; igneous rocks are the predominant rock type of the Earth's crust. Averages of geographically grouped rock analyses agreed fairly well with one another, which indicates regional similarity in the composition of the Earth's crust. The overall average composition computed by Clarke and Washington (1924) is intermediate between that of granite and basalt (Mason, 1966, p. 42).

Mason (1966) pointed out several objections to computing average compositions of igneous rocks by averaging analyses. The first objection was that the geographical distribution of analyses was uneven because the most intensive investigations had taken place in North America and Europe; therefore, results of averaging tended to downplay the importance of other continental areas and the oceanic basins. The second objection was that undue weight was given to rare and unusual rock types, which are studied more frequently than more common igneous rocks such as basalt and granite. The third objection was that all analyses were given equal weight regardless of the areas or volumes occupied by the respective rock types.

Goldschmidt (1954) minimized some of these objections by using representative samples of the Earth's crust to compute the average composition. The samples were mostly crystalline rocks derived from the widely distributed glacial clay in southern Norway. This clay was formed from a fine rock flour deposited by meltwater from the

Figure 2.—Location of selected corehole sites at the Idaho National Engineering Laboratory.

Fennoscandian ice sheet. Analyses from 77 samples were used to calculate an average composition similar to the one computed by Clarke and Washington (1924). Neither of these average compositions accounted for all the objections noted by Mason (1966), especially the one related to not sampling the oceanic basins.

Poldervaart (1955) resolved these objections more completely by computing averages by major geologic type: deep oceanic regions, continental shields, young folded belts, and continental platforms and slopes. The amount of the major rock types and their estimated compositions were used in computing final average crustal compositions. Because this technique gives adequate consideration to the oceanic crustal material, it more accurately reflects the true average composition of the crust (Mason, 1966). The average compositions of major rock-forming elements calculated by Poldervaart (1955) are the average crustal abundances reported in table 1.

Average crustal abundances of trace elements listed in table 3 are from Emsley (1989). The average crustal abundances in this report are for comparison purposes only and do not necessarily represent the average compositions of the aquifer materials from the Snake River Plain listed in this report. Additional information regarding crustal abundances of elements is provided by Clarke (1924), Clarke and Washington (1924), Goldschmidt (1954), Poldervaart (1955), Mason (1966), Fyfe (1974), and Greenwood and Earnshaw (1984).

Acknowledgments

The authors are grateful to Peter R. Hooper of WSU, David L. Naftz of the USGS, and Robert C. Starr of LITCO for technically reviewing the manuscript.

METHODS AND QUALITY ASSURANCE

The methods used for subsampling core samples, for analyzing the subsamples in the laboratory, and for quality assurance are outlined in the following sections.

Corehole Locations and Sample Collection

Core samples were collected by EG&G Idaho, Inc. at five sites (fig. 2): two near Test Area North (TAN CH 1 and TAN CH 2), two near the New Production Reactor site (NPR Test and NPR WO1), and one near the Test Reactors Area (TRA 5). Completion dates for the coreholes follow: TAN CH 1 (September 27, 1989), TAN CH 2 (September 6, 1990), NPR Test (May 6, 1984), NPR WO1 (August 30, 1990), and TRA 5 (September 18, 1990). Corehole TRA 5 subsequently was completed as a piezometer and currently is identified as PZ1.

Eighty-four subsamples of cores were collected from the 5 sites (at selected depths) distributed as follows: 35 subsamples from corehole TAN CH 2, 18 subsamples from corehole TAN CH 1, 21 subsamples from corehole NPR Test, 4 subsamples from corehole NPR WO1, and 6 subsamples from corehole TRA 5. The subsampling technique involved removing a 1- to 3-in.-long section of fresh core from a specific depth determined on the basis of representative lithology, labeling the subsample, and storing the subsample until shipment to the WSU GeoAnalytical Laboratory at Pullman, Wash., for analysis.

Analytical Methods

Two separate analytical methods were used to determine elemental compositions of the subsamples: wavelength dispersive X-ray fluorescence spectrometry (XRF) and inductively coupled plasma mass spectrometry (ICP/MS).

Wavelength Dispersive X-ray Fluorescence Spectrometry

XRF was used to analyze all 84 subsamples and 2 quality-assurance split subsamples for 10 major rock-forming elements and 17 trace elements. GeoAnalytical Laboratory staff handpicked about 28 g of fresh chips from each subsample with the largest dimension measuring about 0.4 in. The chips were processed for 2 minutes in a Tema swingmill with tungsten carbide surfaces. Part of the resulting powder (3.5 g) and 7 g of lithium tetraborate were mixed for 10 minutes in a plastic mixing jar with an enclosed plastic ball. The mixed

powder was emptied into graphite crucibles, which were loaded, 24 at a time, into a muffle furnace that was preheated to 1,000°C. The mixed powder was fused for 5 minutes after the temperature in the furnace returned to 1,000°C. The crucibles were removed from the furnace and allowed to cool for 10 minutes. Each resulting glass bead was reground in the Tema swingmill for 35 seconds. The resulting glass powder was returned to the crucible and refused for an additional 5 minutes at 1,000°C. The beads then were labeled with an engraver. The lower flat surface of each bead was ground on a 600-grit grinding wheel, finished on a glass plate (600 grit with alcohol) to remove metal residue from the grinding wheel, washed in an ultrasonic cleaner, rinsed in alcohol, and dried.

The glass beads were analyzed by XRF using a Rigaku 3370 automated wavelength spectrometer. Concentrations of 27 elements in the subsamples were measured by comparing X-ray intensities for each element in the subsample bead with intensities in duplicate beads for 8 international standards and the values recommended by Govindaraju (1989). Specific operating conditions at the WSU GeoAnalytical Laboratory, precision data, and estimates of accuracy for each element are provided by Hooper and others (1993, tables 4-6).

Hooper and others (1993) discussed method-related uncertainties for the GeoAnalytical Laboratory. Niobium concentrations less than 2 ppm can be affected by contamination from the tungsten carbide mills; however, because of the larger niobium concentrations in INEL samples, the effect should be minimal.

The subsample preparation process causes volatiles to be lost during fusing. Neither loss on ignition (LOI) nor the ferric/ferrous iron ratio was measured by the WSU laboratory. As a result, the totals listed in table 2 cannot be used as a measure of analytical accuracy, as is customary in gravimetric analyses. However, the divergence of any single subsample from 100 percent reflects the variation in volatile content relative to average values for the eight standards used. Thus, if the totals in table 2 are greater than 100 percent, the subsamples had less volatile content than the average for the standards. If the totals in table 2 are

less than 100 percent, the converse is true. The most common cause for volatile content less than 100 percent (more than the average value for standards) is that most rocks contain some ferric iron and the WSU laboratory reports all iron as ferrous iron.

Trace-element concentrations of barium, chromium, nickel, scandium, and vanadium that are less than 30 ppm are considered semiquantitative by the WSU laboratory. A few samples listed in table 3 contained concentrations of nickel and scandium less than 30 ppm and these values should be considered tentative. Similarly, trace element concentrations of niobium, rubidium, strontium, thorium, yttrium, and zirconium that are less than 3 ppm are considered semiquantitative. In table 3, 1 rubidium concentration and 65 thorium concentrations were less than 3 ppm. Lanthanum and cerium XRF concentrations are considered qualitative by the WSU laboratory and should not be compared to ICP/MS concentrations. Other trace-element concentrations measured by XRF are generally satisfactory, although there is some question about copper, gallium, lead, and zinc measurements. Additional information is available for XRF analytical precision and accuracy measurements in a report by Hooper and others (1993).

Inductively Coupled Plasma Mass Spectrometry

ICP/MS was used to analyze 56 of the 84 subsamples and 3 quality assurance split subsamples for 22 trace elements. GeoAnalytical Laboratory staff completely dissolved the core subsamples prior to analysis. The subsamples were ground in an iron bowl in a shatterbox swing mill. A fraction of the powdered subsample weighing 2 g was mixed with an equal amount of lithium tetraborate flux and loaded into a muffle furnace that was preheated to 1,000°C. The mixture was fused for 5 minutes after the furnace returned to 1,000°C. The resulting bead was briefly ground in the shatterbox swing mill. Two hundred fifty mg of the resulting powder was dissolved in an open Teflon vial on a hotplate at 110°C with 6 mL of concentrated hydrofluoric acid (HF), 2 mL of concentrated nitric acid (HNO₃), and 2 mL of concentrated perchloric acid (HClO₄). The sub-

sample then was evaporated until dry, redissolved with 2 mL of concentrated HClO_4 , and evaporated again. This procedure converted insoluble fluorides to soluble perchlorates. An additional 3 mL of concentrated HNO_3 , 8 drops of concentrated hydrogen peroxide (H_2O_2), 10 drops of concentrated HF , an internal standard of indium and rhenium, and enough distilled water to make a final volume of 60 mL were added to the subsample. This procedure removed silica and boron matrix interferences by volatilizing them as gaseous fluorides and ensured complete dissolution of refractory phases such as zircon and garnet (Knaack and others, 1994).

The subsamples were analyzed by ICP/MS using a Sciex Elan model 250 inductively coupled plasma mass spectrometer equipped with a Babington nebulizer, a water cooled spray chamber, and Brooks mass flow controllers. Subsamples were introduced by peristaltic pump into an argon plasma at 1.0 mL per minute using an automatic sampler. Plasma power was 1,500 watts, which generates a plasma temperature of 7,000°C. These conditions minimize the formation of metal oxides. The instrument can measure many elements during each sample run. For each element, a count time of 0.5 seconds is repeated 10 times for a total integrated count time per element of 5 seconds. For elements with more than 1 isotope, target isotope selection is based on relative isotope abundance and freedom from interferences. The quadrupole mass spectrometer with an inductively coupled argon plasma ion source used by WSU's GeoAnalytical Laboratory is capable of quantitatively determining trace elements in liquids in the concentration range of fractions of a part per billion (Knaack and others, 1994). Duplicate subsamples from 3 laboratory rock standards, 1 acid blank sample, and 17 unknown subsamples were run together forming a total of 24 standard and unknown subsamples per batch. The 3 laboratory standards have been calibrated against 11 international standards by the GeoAnalytical Laboratory and elemental concentrations have been independently verified by other laboratories. Additional information for ICP/MS analytical precision and accuracy is available from the WSU GeoAnalytical Laboratory (Knaack and others, 1994).

Quality Assurance

Five quality-assurance subsamples were analyzed for elemental concentrations by the WSU GeoAnalytical Laboratory. The samples are identified in tables 1-3 by the letter "R" adjacent to the depth entry.

XRF.—Replicate beads were prepared by the GeoAnalytical Laboratory for splits of the 36-ft subsample from the NPR Test corehole and the 448-ft subsample from the NPR WO1 corehole. These replicate beads were analyzed for the same 27 elements as the reference sample beads. Percentage differences between pairs of analytical results were calculated for the 36- and 448-ft subsamples. For the 10 major rock-forming elements listed in tables 1 and 2, all analytical results for the replicate beads were within 10 percent difference of the reference sample beads. For the 17 trace elements listed in table 3 that were analyzed by XRF, analytical results for the replicate beads were within 10 percent difference of the reference sample beads for 9 elements. The other 8 elements (cerium, copper, gallium, lanthanum, lead, rubidium, thorium, and zinc) had percentage differences greater than 10 percent. Of these, Hooper and others (1993) identified cerium and lanthanum concentrations as being strictly qualitative measurements. Copper, gallium, lead, and zinc concentrations were identified as questionable in some cases. The calculated percentage differences for rubidium and thorium concentrations that exceed 10 percent were for subsample pairs that had concentrations near the 3 ppm cutoff where the XRF method becomes semiquantitative.

ICP/MS.—Replicate beads also were prepared by the GeoAnalytical Laboratory for splits of the 923-ft subsample from the TAN CH 2 corehole and the 195- and 593-ft subsamples from the TAN CH 1 corehole. These replicate beads were analyzed for the same 22 elements as the reference subsample beads. Percentage differences for all but one replicate subsample bead were within 10 percent of the reference subsample beads. The 923-ft replicate subsample bead for the TAN CH 2 corehole had a 12.2-percent difference from the reference subsample bead for uranium.

ICP/MS-XRF Comparison.—Because of overlap between analytical methods, 7 elements were determined by both analytical methods for 56 of the 84 subsamples. Percentage differences were calculated between analytical results from the two methods for concentrations of each element, by depth, using the ICP/MS concentration as the reference concentration. The percentage differences were calculated by subtracting the XRF value from the ICP/MS value, dividing by the ICP/MS value, and multiplying by one hundred. The seven elements determined using both methods and the ranges of percentage differences for each follow: barium (+1 to +20 percent), cerium (-50 to +40 percent), lanthanum (-47 to +100 percent), lead (-129 to +72 percent), niobium (-21 to +12 percent), thorium (-367 to +100 percent), and yttrium (0 to +14 percent). These data indicate that direct comparison of results from the two methods is not valid.

ANALYTICAL RESULTS

Major rock-forming element composition was determined by XRF analysis and trace element concentrations were determined by XRF and ICP/MS analysis for selected core subsamples. Descriptive statistics were calculated and are reported along with the data in tables 1 and 3. The errors associated with the mean and median values are standard errors and are an estimate of the uncertainty of the mean and median concentrations. Spiegel (1975, p. 162) published equations for calculation of the standard errors for the mean and median values. The standard errors of the mean and median values are valid if the distribution of a sample approximates a normal distribution. Spiegel (1975) indicated that for sample sizes greater than or equal to 30, the sampling distribution approximates a normal distribution, even if the population distribution is not normally distributed. Because the sample sizes for the TAN CH 1 and NPR Test coreholes are less than 30 and may not approximate a normal distribution, the standard errors associated with the mean and median values for those data sets should be used with caution.

Oxides of Major Rock-Forming Elements

Silicon, aluminum, titanium, iron, manganese, calcium, magnesium, potassium, sodium, and phosphorus were determined by XRF analysis for 84 subsamples of core taken from 5 locations. Chemical composition of the samples is reported in terms of elemental oxides in units of percent by weight. The results are reported in table 1 by elemental oxide, corehole from which subsample was collected, and subsample depth. In the solid phase, iron occurs in both ferrous and ferric form. In this report, all iron is assumed to be ferrous iron and is reported as FeO. Also included for each element in table 1 are average crustal abundances and descriptive statistics.

Table 2 is a listing of the 10 major rock-forming elements, in weight percent, by the corehole from which the subsample was collected, and by subsample depth. For each depth, the 10 weight percents were summed and the totals also are listed in table 2.

Trace Elements

As many as 32 trace-element concentrations were determined for 84 subsamples of core taken from 5 locations by either XRF analysis, ICP/MS analysis, or both methods. The results are reported in table 3 by element, corehole from which subsample was collected, subsample depth, and analytical method. Also included for each element in table 3 are average crustal abundances and descriptive statistics.

SUMMARY

This report presents chemical compositions determined from 84 subsamples and 5 quality-assurance split subsamples of basalt core from the eastern Snake River Plain. The 84 subsamples were collected at selected depths from 5 coreholes located on the Idaho National Engineering Laboratory, Idaho. This report was prepared jointly by LITCO and the USGS, in cooperation with the DOE, Idaho Operations Office. WSU provided analytical services under contract to EG&G Idaho, Inc.

Ten major elements and as many as 32 trace elements were determined for each subsample either by XRF analysis, ICP/MS analysis, or by both methods. Descriptive statistics for each element were calculated and tabulated by analytical method for each corehole.

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Table 1.—Chemical composition (percent by weight) of selected core subsamples, by major rock-forming element, Idaho National Engineering Laboratory, Idaho
 [Location of coreholes is shown on figure 2. Units for depth are feet below land surface. Abbreviations: TAN, Test Area North; CH, corehole; NPR, New Production Reactor; TRA, Test Reactors Area; XRF, wavelength-dispersive X-ray fluorescence spectrometry. Analyses by Washington State University. Depth: R indicates quality-assurance split subsample of the specified sample depth. Quality-assurance samples were not included in calculation of statistical parameters. Percent by weight data for oxides in this report were not normalized except for average crustal abundances, which were normalized to a water-free basis by Poldervaart (1955). In this report, total iron is expressed as simple ferrous iron oxide (FeO). Mason (1966) discussed the limitations of estimating crustal oxide abundances of major rock-forming elements and summarized the results of Poldervaart (1955)]

ELEMENTS

A:	Silicon	F:	Calcium
B:	Aluminum	G:	Magnesium
C:	Titanium	H:	Potassium
D:	Iron	I:	Sodium
E:	Manganese	J:	Phosphorus

A: Silicon oxide (SiO₂)—Average crustal abundance is 55.2 percent by weight (Mason, 1966)

[Oxide composition of core sample]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	45.56	61	46.29	36	46.35	418	47.43
154	45.63	91	45.76	36R	46.81	448	47.53
172	46.09	111	46.06	56	45.96	448R	47.78
201	45.33	130	45.51	98	46.95	476	47.02
215	46.56	150	46.78	121	47.90	522	47.06
238	45.33	195	48.18	127	47.50		
256	47.89	250	47.54	141	47.31		
277	46.61	300	46.77	156	47.26		
299	47.71	380	46.60	170	47.58		
309	46.77	421	47.23	232	47.16		
327	47.12	435	46.39	273	46.83		
352	46.96	460	46.88	291	46.64		
366	46.51	475	46.37	311	47.49		
413	46.22	491	45.91	379	47.43		
463	46.84	500	46.62	450	47.11		
477	45.89	521	46.23	461	47.01		
487	46.86	571	46.29	480	47.28		
490	46.84	593	45.95	489	47.72		
521	47.56			527	47.64		
545	46.10			538	47.74		
576	46.25			550	47.86		
592	46.04			608	46.67		
630	46.28						
659	46.38						
673	46.19						
730	46.48						
752	47.10						
785	46.20						
816	46.22						
832	47.97						
870	47.29						
886	46.89						
923	46.56						
961	47.09						
990	46.42						

[Descriptive statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	45.33	45.51	45.96	45.33
Maximum	47.97	48.18	47.90	48.18
Mean	46.56	46.52	47.21	46.78
Error	.11	.15	.11	.07
Median	46.51	46.38	47.28	46.805
Error	.14	.19	.14	.09
Sample size	35	18	21	84

B: Aluminum oxide (Al₂O₃)—Average crustal abundance is 15.3 percent by weight (Mason, 1966)

[Oxide composition of core sample]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	13.29	61	13.06	36	14.62	418	15.87
154	13.64	91	14.15	36R	14.66	448	16.27
172	13.80	111	14.27	56	14.55	448R	16.31
201	13.40	130	13.90	98	14.60	476	14.54
215	13.99	150	13.81	121	14.86	522	15.63
238	13.74	195	14.58	127	14.86		
256	14.99	250	14.96	141	14.55		
277	14.64	300	14.54	156	14.95		
299	13.87	380	14.82	170	14.93		
309	14.60	421	15.25	232	15.00		
327	14.65	435	15.09	273	14.34		
352	14.64	460	14.79	291	15.26		
366	14.83	475	14.84	311	15.31		
413	14.84	491	14.29	379	15.52		
463	15.26	500	14.52	450	16.26		
477	14.57	521	14.86	461	14.76		
487	14.27	571	14.85	480	11.80		
490	14.90	593	14.66	489	15.07		
521	13.71			527	15.37		
545	14.49			538	15.51		
576	15.08			550	15.47		
592	14.52			608	14.45		
630	14.85						
659	14.49						
673	14.67						
730	14.60						
752	13.59						
785	14.06						
816	13.88						
832	14.04						
870	13.95						
886	14.44						
923	14.51						
961	14.76						
990	14.46						

[Descriptive statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	13.29	13.06	11.80	11.80
Maximum	15.26	15.25	16.26	16.27
Mean	14.34	14.51	14.86	14.60
Error	.09	.13	.18	.07
Median	14.49	14.62	14.93	14.63
Error	.11	.16	.23	.09
Sample size	35	18	21	84

C: Titanium oxide (TiO₂)—Average crustal abundance is 1.6 percent by weight (Mason, 1966)

[Oxide composition of core sample]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	3.19	61	3.82	36	2.90	418	1.34
154	3.07	91	2.83	36R	2.97	448	1.17
172	3.21	111	3.25	56	2.84	448R	1.17
201	3.24	130	3.33	98	2.66	476	2.76
215	3.14	150	3.38	121	2.07	522	1.33
238	3.17	195	2.89	127	2.26		
256	2.57	250	2.45	141	3.05		
277	2.52	300	2.52	156	2.43		
299	3.07	380	2.02	170	2.40		
309	2.51	421	2.24	232	2.64		
327	2.54	435	2.23	273	3.25		
352	2.55	460	2.95	291	2.86		
366	2.40	475	2.87	311	1.95		
413	2.45	491	3.18	379	1.69		
463	1.68	500	3.04	450	1.32		
477	2.03	521	3.06	461	2.77		
487	3.15	571	2.87	480	4.59		
490	2.88	593	2.89	489	2.68		
521	3.53			527	1.35		
545	3.09			538	1.36		
576	2.86			550	1.33		
592	3.05			608	2.51		
630	2.88						
659	3.15						
673	2.87						
730	2.96						
752	3.10						
785	3.15						
816	3.15						
832	3.10						
870	2.96						
886	2.58						
923	2.45						
961	2.56						
990	2.93						

[Descriptive statistics]				
	TAN CH 2	TAN CH 1	NPR Test	All cores
Parameter	XRF	XRF	XRF	XRF
Minimum	1.68	2.02	1.32	1.17
Maximum	3.53	3.82	4.59	4.59
Mean	2.85	2.88	2.42	2.66
Error	.06	.11	.17	.07
Median	2.96	2.89	2.51	2.85
Error	.08	.13	.21	.08
Sample size	35	18	21	84

D: Iron oxide (FeO)—Average crustal abundance is 8.6 percent by weight (Mason, 1966)

[Oxide composition of core sample]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	14.70	61	15.44	36	13.89	418	10.66
154	14.49	91	13.93	36R	13.74	448	10.16
172	14.75	111	14.73	56	13.75	448R	10.14
201	14.62	130	14.92	98	13.14	476	13.72
215	14.62	150	14.90	121	11.71	522	10.81
238	14.58	195	13.42	127	11.69		
256	13.16	250	13.20	141	13.62		
277	13.10	300	13.08	156	12.48		
299	14.21	380	12.07	170	12.71		
309	13.32	421	13.06	232	13.22		
327	13.23	435	12.77	273	14.30		
352	13.16	460	13.99	291	13.78		
366	13.05	475	14.04	311	11.79		
413	13.54	491	14.73	379	11.39		
463	11.94	500	14.27	450	10.55		
477	12.35	521	14.06	461	13.33		
487	14.46	571	14.56	480	15.58		
490	13.79	593	14.31	489	13.07		
521	15.19			527	10.77		
545	14.96			538	10.55		
576	14.59			550	10.62		
592	14.80			608	13.23		
630	14.16						
659	14.99						
673	14.30						
730	14.25						
752	14.48						
785	14.72						
816	14.82						
832	14.09						
870	14.23						
886	13.25						
923	13.31						
961	12.83						
990	13.95						

[Descriptive statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	11.94	12.07	10.55	10.16
Maximum	15.19	15.44	15.58	15.58
Mean	14.00	13.97	12.63	13.44
Error	.14	.21	.30	.14
Median	14.23	14.05	13.07	13.70
Error	.17	.26	.38	.17
Sample size	35	18	21	84

E: Manganese oxide (MnO)—Average crustal abundance is 0.2 percent by weight (Mason, 1966)

[Oxide composition of core sample]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	0.22	61	0.23	36	0.20	418	0.18
154	.22	91	.21	36R	.20	448	.17
172	.21	111	.22	56	.20	448R	.17
201	.22	130	.22	98	.20	476	.20
215	.22	150	.22	121	.18	522	.18
238	.21	195	.21	127	.19		
256	.20	250	.20	141	.21		
277	.20	300	.19	156	.19		
299	.21	380	.19	170	.19		
309	.20	421	.20	232	.20		
327	.20	435	.19	273	.21		
352	.20	460	.20	291	.20		
366	.19	475	.20	311	.19		
413	.19	491	.21	379	.19		
463	.18	500	.21	450	.18		
477	.19	521	.21	461	.20		
487	.21	571	.21	480	.23		
490	.20	593	.20	489	.20		
521	.22			527	.17		
545	.21			538	.17		
576	.20			550	.18		
592	.21			608	.20		
630	.20						
659	.21						
673	.21						
730	.20						
752	.22						
785	.21						
816	.22						
832	.21						
870	.21						
886	.20						
923	.20						
961	.19						
990	.20						

[Descriptive statistics]				
	TAN CH 2	TAN CH 1	NPR Test	All cores
Parameter	XRF	XRF	XRF	XRF
Minimum	0.19	0.19	0.17	0.17
Maximum	.22	.23	.23	.23
Mean	.21	.21	.19	.20
Error	.002	.003	.003	.001
Median	.21	.21	.20	.20
Error	.002	.003	.004	.002
Sample size	35	18	21	84

F: Calcium oxide (CaO)—Average crustal abundance is 8.8 percent by weight (Mason, 1966)

[Oxide composition of core sample]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	9.58	61	10.18	36	9.45	418	11.51
154	9.53	91	9.50	36R	9.53	448	11.29
172	9.42	111	9.72	56	9.39	448R	11.32
201	9.38	130	9.63	98	9.46	476	9.52
215	9.36	150	9.59	121	9.94	522	10.48
238	9.48	195	9.41	127	10.09		
256	9.29	250	9.40	141	9.43		
277	9.34	300	9.41	156	9.33		
299	9.45	380	10.10	170	9.35		
309	9.35	421	10.48	232	9.54		
327	9.40	435	10.46	273	9.61		
352	9.65	460	9.31	291	9.66		
366	9.62	475	9.24	311	10.45		
413	9.74	491	9.39	379	10.81		
463	10.40	500	9.35	450	11.64		
477	9.95	521	9.67	461	9.61		
487	9.25	571	9.54	480	9.42		
490	9.24	593	9.52	489	9.68		
521	9.34			527	10.36		
545	9.38			538	10.54		
576	9.57			550	10.64		
592	9.61			608	10.16		
630	9.55						
659	9.78						
673	9.46						
730	9.57						
752	9.44						
785	9.62						
816	9.41						
832	9.36						
870	9.36						
886	9.82						
923	9.64						
961	10.15						
990	9.80						

[Descriptive statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	9.24	9.24	9.33	9.24
Maximum	10.40	10.48	11.64	11.64
Mean	9.55	9.66	9.93	9.75
Error	.04	.09	.13	.05
Median	9.48	9.53	9.66	9.585
Error	.05	.11	.17	.07
Sample size	35	18	21	84

G: Magnesium oxide (MgO)—Average crustal abundance is 5.2 percent by weight (Mason, 1966)

[Oxide composition of core sample]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	6.71	61	5.87	36	7.32	418	9.48
154	7.01	91	7.07	36R	7.37	448	10.46
172	7.00	111	7.04	56	7.45	448R	10.52
201	7.04	130	6.98	98	7.63	476	7.42
215	7.16	150	6.88	121	8.96	522	11.08
238	7.08	195	6.94	127	8.54		
256	6.92	250	7.49	141	6.98		
277	7.31	300	7.87	156	7.51		
299	6.72	380	9.38	170	7.88		
309	7.48	421	7.69	232	7.76		
327	7.70	435	7.75	273	6.61		
352	7.67	460	6.81	291	7.65		
366	8.12	475	6.73	311	9.02		
413	7.59	491	6.28	379	9.18		
463	9.08	500	6.81	450	10.12		
477	9.07	521	6.96	461	7.46		
487	6.32	571	7.31	480	4.69		
490	6.76	593	7.15	489	7.11		
521	6.05			527	10.96		
545	6.20			538	10.59		
576	7.01			550	10.39		
592	7.01			608	8.11		
630	7.40						
659	6.76						
673	6.99						
730	7.10						
752	7.24						
785	6.77						
816	6.93						
832	6.64						
870	6.80						
886	7.40						
923	7.63						
961	8.13						
990	7.03						

[Descriptive statistics]				
	TAN CH 2	TAN CH 1	NPR Test	All cores
Parameter	XRF	XRF	XRF	XRF
Minimum	6.05	5.87	4.69	4.69
Maximum	9.08	9.38	10.96	11.08
Mean	7.20	7.17	8.19	7.64
Error	.11	.17	.33	.13
Median	7.03	7.01	7.76	7.36
Error	.14	.22	.41	.16
Sample size	35	18	21	84

H: Potassium oxide (K₂O)—Average crustal abundance is 1.9 percent by weight (Mason, 1966)

[Oxide composition of core sample]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	0.70	61	0.64	36	0.61	418	0.24
154	.66	91	.58	36R	.61	448	.23
172	.69	111	.56	56	.59	448R	.22
201	.64	130	.58	98	.71	476	.68
215	.67	150	.68	121	.67	522	.29
238	.63	195	.71	127	.65		
256	.81	250	.56	141	.79		
277	.59	300	.57	156	.85		
299	.72	380	.43	170	.84		
309	.59	421	.37	232	.70		
327	.61	435	.34	273	.86		
352	.60	460	.62	291	.61		
366	.54	475	.60	311	.45		
413	.46	491	.59	379	.38		
463	.37	500	.61	450	.12		
477	.42	521	.45	461	.65		
487	.72	571	.49	480	1.06		
490	.66	593	.49	489	.69		
521	.74			527	.40		
545	.65			538	.40		
576	.46			550	.40		
592	.47			608	.55		
630	.44						
659	.46						
673	.49						
730	.55						
752	.62						
785	.48						
816	.54						
832	.65						
870	.66						
886	.68						
923	.60						
961	.61						
990	.66						

[Descriptive statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	0.37	0.34	0.12	0.12
Maximum	.81	.71	1.06	1.06
Mean	.60	.55	.62	.58
Error	.02	.02	.05	.02
Median	.61	.575	.65	.60
Error	.02	.03	.06	.02
Sample size	35	18	21	84

I: Sodium oxide (Na₂O)—Average crustal abundance is 2.9 percent by weight (Mason, 1966)

[Oxide composition of core sample]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	2.50	61	2.61	36	2.77	418	2.32
154	2.50	91	2.58	36R	2.78	448	2.29
172	2.56	111	2.57	56	2.71	448R	2.28
201	2.52	130	2.55	98	2.75	476	2.60
215	2.66	150	2.58	121	2.53	522	2.18
238	2.53	195	2.68	127	2.55		
256	2.71	250	2.70	141	2.75		
277	2.64	300	2.59	156	2.73		
299	2.76	380	2.48	170	2.67		
309	2.65	421	2.55	232	2.75		
327	2.61	435	2.50	273	2.68		
352	2.58	460	2.76	291	2.66		
366	2.64	475	2.80	311	2.42		
413	2.54	491	2.67	379	2.44		
463	2.31	500	2.74	450	2.25		
477	2.45	521	2.75	461	2.54		
487	2.81	571	2.78	480	2.73		
490	2.81	593	2.69	489	2.62		
521	2.93			527	2.26		
545	2.79			538	2.22		
576	2.78			550	2.25		
592	2.86			608	2.56		
630	2.80						
659	2.81						
673	2.88						
730	2.81						
752	2.45						
785	2.61						
816	2.52						
832	2.59						
870	2.49						
886	2.52						
923	2.61						
961	2.53						
990	2.64						

[Descriptive statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	2.31	2.48	2.22	2.18
Maximum	2.93	2.80	2.77	2.93
Mean	2.64	2.64	2.56	2.60
Error	.02	.02	.04	.02
Median	2.61	2.64	2.62	2.605
Error	.03	.03	.05	.02
Sample size	35	18	21	84

J: Phosphorus oxide (P₂O₅)—Average crustal abundance is 0.3 percent by weight (Mason, 1966)

[Oxide composition of core sample]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	1.02	61	1.37	36	0.66	418	0.22
154	.96	91	.91	36R	.67	448	.19
172	.81	111	.83	56	.64	448R	.19
201	.76	130	.86	98	.61	476	.59
215	.79	150	.84	121	.46	522	.23
238	.79	195	.74	127	.51		
256	.72	250	.58	141	.66		
277	.61	300	.53	156	.63		
299	.76	380	.38	170	.62		
309	.58	421	.47	232	.69		
327	.56	435	.39	273	.74		
352	.54	460	.50	291	.63		
366	.47	475	.50	311	.43		
413	.49	491	.53	379	.35		
463	.28	500	.50	450	.21		
477	.40	521	.38	461	.59		
487	.54	571	.46	480	.92		
490	.50	593	.44	489	.58		
521	.58			527	.23		
545	.51			538	.23		
576	.42			550	.22		
592	.48			608	.50		
630	.43						
659	.47						
673	.46						
730	.45						
752	.72						
785	.58						
816	.59						
832	.55						
870	.53						
886	.55						
923	.53						
961	.60						
990	.56						

[Descriptive statistics]				
	TAN CH 2	TAN CH 1	NPR Test	All cores
Parameter	XRF	XRF	XRF	XRF
Minimum	0.28	0.38	0.21	0.19
Maximum	1.03	1.37	.92	1.37
Mean	.59	.62	.53	.56
Error	.03	.06	.04	.02
Median	.55	.515	.59	.54
Error	.03	.08	.05	.03
Sample size	35	18	21	84

Table 2.—Chemical composition (percent by weight) of selected core subsamples, by corehole and depth, Idaho National Engineering Laboratory, Idaho

[Location of coreholes is shown on figure 2. Units for depth are feet below land surface.

Abbreviations: TAN, Test Area North; CH, corehole; NPR, New Production Reactor; TRA, Test Reactors Area. Analyses by Washington State University using wavelength-dispersive X-ray fluorescence spectrometry. Depth: R indicates a quality-assurance split subsample of the specified sample depth. In this report, total iron is expressed as simple ferrous iron oxide (FeO). Total indicates the sum of unnormalized oxide chemical compositions by depth]

COREHOLES

A:	TAN CH 2	C:	NPR Test and NPR WO1
B:	TAN CH 1	D:	TRA 5

SYMBOLS FOR CHEMICAL NOTATIONS USED IN TABLE 2

SiO ₂	Silicon oxide	CaO	Calcium oxide
Al ₂ O ₃	Aluminum oxide	MgO	Magnesium oxide
TiO ₂	Titanium oxide	K ₂ O	Potassium oxide
FeO	Iron oxide	Na ₂ O	Sodium oxide
MnO	Manganese oxide	P ₂ O ₅	Phosphorus oxide

A: TAN CH 2

Oxide	Depth								
	138	154	172	201	215	238	256	277	299
SiO ₂	45.56	45.63	46.09	45.33	46.56	45.33	47.89	46.61	47.71
Al ₂ O ₃	13.29	13.64	13.80	13.40	13.99	13.74	14.99	14.64	13.87
TiO ₂	3.19	3.07	3.21	3.24	3.14	3.17	2.57	2.52	3.07
FeO	14.70	14.49	14.75	14.62	14.62	14.58	13.16	13.10	14.21
MnO	.22	.22	.21	.22	.22	.21	.20	.20	.21
CaO	9.58	9.53	9.42	9.38	9.36	9.48	9.29	9.34	9.45
MgO	6.71	7.01	7.00	7.04	7.16	7.08	6.92	7.31	6.72
K ₂ O	.70	.66	.69	.64	.67	.63	.81	.59	.72
Na ₂ O	2.50	2.50	2.56	2.52	2.66	2.53	2.71	2.64	2.76
P ₂ O ₅	1.02	.96	.81	.76	.79	.79	.72	.61	.76
Total	97.47	97.71	98.54	97.15	99.17	97.54	99.26	97.56	99.48
Oxide	309	327	352	366	413	463	477	487	490
SiO ₂	46.77	47.12	46.96	46.51	46.22	46.84	45.89	46.86	46.84
Al ₂ O ₃	14.60	14.65	14.64	14.83	14.84	15.26	14.57	14.27	14.90
TiO ₂	2.51	2.54	2.55	2.40	2.45	1.68	2.03	3.15	2.88
FeO	13.32	13.23	13.16	13.05	13.54	11.94	12.35	14.46	13.79
MnO	.20	.20	.20	.19	.19	.18	.19	.21	.20
CaO	9.35	9.40	9.65	9.62	9.74	10.40	9.95	9.25	9.24
MgO	7.48	7.70	7.67	8.12	7.59	9.08	9.07	6.32	6.76
K ₂ O	.59	.61	.60	.54	.46	.37	.42	.72	.66
Na ₂ O	2.65	2.61	2.58	2.64	2.54	2.31	2.45	2.81	2.81
P ₂ O ₅	.58	.56	.54	.47	.49	.28	.40	.54	.50
Total	98.05	98.62	98.55	98.37	98.06	98.34	97.32	98.59	98.58
Oxide	521	545	576	592	630	659	673	730	752
SiO ₂	47.56	46.10	46.25	46.04	46.28	46.38	46.19	46.48	47.10
Al ₂ O ₃	13.71	14.49	15.08	14.52	14.85	14.49	14.67	14.60	13.59
TiO ₂	3.53	3.09	2.86	3.05	2.88	3.15	2.87	2.96	3.10
FeO	15.19	14.96	14.59	14.80	14.16	14.99	14.30	14.25	14.48
MnO	.22	.21	.20	.21	.20	.21	.21	.20	.22
CaO	9.34	9.38	9.57	9.61	9.55	9.78	9.46	9.57	9.44
MgO	6.05	6.20	7.01	7.01	7.40	6.76	6.99	7.10	7.24
K ₂ O	.74	.65	.46	.47	.44	.46	.49	.55	.62
Na ₂ O	2.93	2.79	2.78	2.86	2.80	2.81	2.88	2.81	2.45
P ₂ O ₅	.58	.51	.42	.48	.43	.47	.46	.45	.72
Total	99.85	98.38	99.22	99.05	98.99	99.50	98.52	98.97	98.96
Oxide	785	816	832	870	886	923	961	990	
SiO ₂	46.20	46.22	47.97	47.29	46.89	46.56	47.09	46.42	
Al ₂ O ₃	14.06	13.88	14.04	13.95	14.44	14.51	14.76	14.46	
TiO ₂	3.15	3.15	3.10	2.96	2.58	2.45	2.56	2.93	
FeO	14.72	14.82	14.09	14.23	13.25	13.31	12.83	13.95	
MnO	.21	.22	.21	.21	.20	.20	.19	.20	
CaO	9.62	9.41	9.36	9.36	9.82	9.64	10.15	9.80	
MgO	6.77	6.93	6.64	6.80	7.40	7.63	8.13	7.03	
K ₂ O	.48	.54	.65	.66	.68	.60	.61	.66	
Na ₂ O	2.61	2.52	2.59	2.49	2.52	2.61	2.53	2.64	
P ₂ O ₅	.58	.59	.55	.53	.55	.53	.60	.56	
Total	98.40	98.28	99.20	98.48	98.33	98.04	99.45	98.65	

B: TAN CH 1

Oxide	Depth								
	61	91	111	130	150	195	250	300	380
SiO ₂	46.29	45.76	46.06	45.51	46.78	48.18	47.54	46.77	46.60
Al ₂ O ₃	13.06	14.15	14.27	13.90	13.81	14.58	14.96	14.54	14.82
TiO ₂	3.82	2.83	3.25	3.33	3.38	2.89	2.45	2.52	2.02
FeO	15.44	13.93	14.73	14.92	14.90	13.42	13.20	13.08	12.07
MnO	.23	.21	.22	.22	.22	.21	.20	.19	.19
CaO	10.18	9.50	9.72	9.63	9.59	9.41	9.40	9.41	10.10
MgO	5.87	7.07	7.04	6.98	6.88	6.94	7.49	7.87	9.38
K ₂ O	.64	.58	.56	.58	.68	.71	.56	.57	.43
Na ₂ O	2.61	2.58	2.57	2.55	2.58	2.68	2.70	2.59	2.48
P ₂ O ₅	1.37	.91	.83	.86	.84	.74	.58	.53	.38
Total	99.51	97.52	99.25	98.48	99.66	99.76	99.08	98.07	98.47

Oxide	421	435	460	475	491	500	521	571	593
SiO ₂	47.23	46.39	46.88	46.37	45.91	46.62	46.23	46.29	45.95
Al ₂ O ₃	15.25	15.09	14.79	14.84	14.29	14.52	14.86	14.85	14.66
TiO ₂	2.24	2.23	2.95	2.87	3.18	3.04	3.06	2.87	2.89
FeO	13.06	12.77	13.99	14.04	14.73	14.27	14.06	14.56	14.31
MnO	.20	.19	.20	.20	.21	.21	.21	.21	.20
CaO	10.48	10.46	9.31	9.24	9.39	9.35	9.67	9.54	9.52
MgO	7.69	7.75	6.81	6.73	6.28	6.81	6.96	7.31	7.15
K ₂ O	.37	.34	.62	.60	.59	.61	.45	.49	.49
Na ₂ O	2.55	2.50	2.76	2.80	2.67	2.74	2.75	2.78	2.69
P ₂ O ₅	.47	.39	.50	.50	.53	.50	.38	.46	.44
Total	99.54	98.11	98.81	98.19	97.78	98.67	98.63	99.36	98.30

C: NPR

[NPR Test]									
Oxide	Depth								
	36	36R	56	98	121	127	141	156	170
SiO ₂	46.35	46.81	45.96	46.95	47.90	47.50	47.31	47.26	47.58
Al ₂ O ₃	14.62	14.66	14.55	14.60	14.86	14.86	14.55	14.95	14.93
TiO ₂	2.90	2.97	2.84	2.66	2.07	2.26	3.05	2.43	2.40
FeO	13.89	13.74	13.75	13.14	11.71	11.69	13.62	12.48	12.71
MnO	.20	.20	.20	.20	.18	.19	.21	.19	.19
CaO	9.45	9.53	9.39	9.46	9.94	10.09	9.43	9.33	9.35
MgO	7.32	7.37	7.45	7.63	8.96	8.54	6.98	7.51	7.88
K ₂ O	.61	.61	.59	.71	.67	.65	.79	.85	.84
Na ₂ O	2.77	2.78	2.71	2.75	2.53	2.55	2.75	2.73	2.67
P ₂ O ₅	.66	.67	.64	.61	.46	.51	.66	.63	.62
Total	98.77	99.34	98.08	98.71	99.28	98.84	99.35	98.36	99.17
Oxide	232	273	291	311	379	450	461	480	489
SiO ₂	47.16	46.83	46.64	47.49	47.43	47.11	47.01	47.28	47.72
Al ₂ O ₃	15.00	14.34	15.26	15.31	15.52	16.26	14.76	11.80	15.07
TiO ₂	2.64	3.25	2.86	1.95	1.69	1.32	2.77	4.59	2.68
FeO	13.22	14.30	13.78	11.79	11.39	10.55	13.33	15.58	13.07
MnO	.20	.21	.20	.19	.19	.18	.20	.23	.20
CaO	9.54	9.61	9.66	10.45	10.81	11.64	9.61	9.42	9.68
MgO	7.76	6.61	7.65	9.02	9.18	10.12	7.46	4.69	7.11
K ₂ O	.70	.86	.61	.45	.38	.12	.65	1.06	.69
Na ₂ O	2.75	2.68	2.66	2.42	2.44	2.25	2.54	2.73	2.62
P ₂ O ₅	.69	.74	.63	.43	.35	.21	.59	.92	.58
Total	99.66	99.43	99.95	99.50	99.38	99.76	98.92	98.30	99.42
Oxide	527	538	550	608					
SiO ₂	47.64	47.74	47.86	46.67					
Al ₂ O ₃	15.37	15.51	15.47	14.45					
TiO ₂	1.35	1.36	1.33	2.51					
FeO	10.77	10.55	10.62	13.23					
MnO	.17	.17	.18	.20					
CaO	10.36	10.54	10.64	10.16					
MgO	10.96	10.59	10.39	8.11					
K ₂ O	.40	.40	.40	.55					
Na ₂ O	2.26	2.22	2.25	2.56					
P ₂ O ₅	.23	.23	.22	.50					
Total	99.51	99.31	99.36	98.94					
[NPR WO1]									
Oxide	418	448	448R	476	522				
SiO ₂	47.43	47.53	47.78	47.02	47.06				
Al ₂ O ₃	15.87	16.27	16.31	14.54	15.63				
TiO ₂	1.34	1.17	1.17	2.76	1.33				
FeO	10.66	10.16	10.14	13.72	10.81				
MnO	.18	.17	.17	.20	.18				
CaO	11.51	11.29	11.32	9.52	10.48				
MgO	9.48	10.46	10.52	7.42	11.08				
K ₂ O	.24	.23	.22	.68	.29				
Na ₂ O	2.32	2.29	2.28	2.60	2.18				
P ₂ O ₅	.22	.19	.19	.59	.23				
Total	99.25	99.76	100.10	99.05	99.27				

D: TRA 5

Oxide	Depth					
	100	139	162	170	192	202
SiO ₂	47.21	47.06	47.73	46.71	46.99	46.71
Al ₂ O ₃	15.34	15.11	15.10	15.06	14.25	13.67
TiO ₂	2.10	2.13	2.19	1.95	2.88	3.00
FeO	12.21	12.23	12.66	12.26	13.68	14.06
MnO	.19	.19	.19	.19	.21	.21
CaO	9.87	9.79	10.04	9.67	10.23	9.63
MgO	9.18	9.16	8.07	8.92	7.42	7.51
K ₂ O	.59	.60	.60	.54	.65	.82
Na ₂ O	2.54	2.56	2.59	2.58	2.60	2.64
P ₂ O ₅	.44	.41	.42	.39	.75	.79
Total	99.67	99.24	99.59	98.27	99.66	99.04

Table 3.—Trace-element concentrations of selected core subsamples, by corehole and analytical method, Idaho National Engineering Laboratory, Idaho

[Location of coreholes is shown on figure 2. Units are parts per million (ppm) except for depth, which is feet below land surface. Abbreviations: TAN, Test Area North; CH, corehole; NPR, New Production Reactor; TRA, Test Reactors Area; ICP/MS, inductively coupled plasma mass spectrometry; XRF, wavelength-dispersive X-ray fluorescence spectrometry. Analyses by Washington State University. Depth: R indicates quality-assurance split subsample of the specified sample depth. Quality-assurance samples were not included in calculation of statistical parameters. Symbol: ND indicates that analysis was not requested]

TRACE ELEMENTS

A:	Barium	Q:	Niobium
B:	Cerium	R:	Praseodymium
C:	Chromium	S:	Rubidium
D:	Copper	T:	Samarium
E:	Dysprosium	U:	Scandium
F:	Erbium	V:	Strontium
G:	Europium	W:	Tantalum
H:	Gadolinium	X:	Terbium
I:	Gallium	Y:	Thorium
J:	Hafnium	Z:	Thulium
K:	Holmium	AA:	Uranium
L:	Lanthanum	BB:	Vanadium
M:	Lead	CC:	Ytterbium
N:	Lutetium	DD:	Yttrium
O:	Neodymium	EE:	Zinc
P:	Nickel	FF:	Zirconium

A: Barium (Ba)—Average crustal abundance is 390 ppm (Emsley, 1989)

[Concentration]										
TAN CH 2			TAN CH 1			NPR Test			NPR WO1	
Depth	ICP/MS	XRF	Depth	ICP/MS	XRF	Depth	ICP/MS	XRF	Depth	XRF
138	483	452	61	595	553	36	ND	314	418	110
154	458	424	91	469	421	36R	ND	331	448	89
172	458	423	111	419	380	56	ND	304	448R	88
201	442	407	130	437	421	98	ND	363	476	411
215	473	434	150	461	441	121	ND	244	522	215
238	448	422	195	470	424	127	ND	277		
256	487	461	195R	464	ND	141	ND	398		
277	394	368	250	398	362	156	ND	446	TRA 5	
299	450	416	300	359	333	170	ND	421	Depth	XRF
309	360	345	380	254	218	232	ND	406	100	277
327	370	345	421	319	273	273	ND	488	139	277
352	392	330	435	272	233	291	374	345	162	257
366	344	313	460	395	379	311	ND	239	170	232
413	402	374	475	396	378	379	ND	197	192	454
463	224	197	491	446	432	450	170	146	202	440
477	265	226	500	387	357	461	ND	415		
487	451	424	521	306	276	480	ND	620		
490	484	445	571	311	290	489	ND	420		
521	481	454	593	308	287	527	202	162		
545	466	436	593R	308	ND	538	ND	174		
576	339	314				550	ND	167		
592	339	293				608	ND	257		
630	311	263								
659	337	330								
673	357	310								
730	327	293								
752	383	366								
785	369	344								
816	374	370								
832	412	377								
870	384	370								
886	390	346								
923	394	367								
923R	397	ND								
961	377	349								
990	414	370								

[Descriptive statistics]							
Parameter	TAN CH 2		TAN CH 1		NPR Test	All cores	
	ICP/MS	XRF	ICP/MS	XRF	XRF	ICP/MS	XRF
Minimum	224	197	254	218	146	170	89
Maximum	487	461	595	553	620	595	620
Mean	395	365	389	359	324	385	343
Error	11	11	20	20	27	11	11
Median	392	368	395.5	370	314	391	359.5
Error	13	14	25	25	34	13	13
Sample size	35	35	18	18	21	56	84

B: Cerium (Ce)—Average crustal abundance is 66 ppm (Emsley, 1989)
[Ce concentrations by XRF are qualitative estimates]

[Concentration]										
TAN CH 2			TAN CH 1			NPR Test			NPR WO1	
Depth	ICP/MS	XRF	Depth	ICP/MS	XRF	Depth	ICP/MS	XRF	Depth	XRF
138	102	105	61	140	146	36	ND	61	418	21
154	97	99	91	93	90	36R	ND	55	448	23
172	82	84	111	78	82	56	ND	64	448R	27
201	78	78	130	83	98	98	ND	68	476	53
215	83	85	150	83	88	121	ND	43	522	32
238	78	94	195	84	76	127	ND	46		
256	84	88	195R	82	ND	141	ND	51		
277	66	80	250	63	38	156	ND	66		
299	82	76	300	55	61	170	ND	77		
309	65	70	380	38	34	232	ND	79		
327	59	61	421	48	44	273	ND	66		
352	57	72	435	40	45	291	56	54		
366	51	39	460	49	57	311	ND	30		
413	50	52	475	50	54	379	ND	30		
463	29	32	491	51	60	450	21	23		
477	39	34	500	48	54	461	ND	43		
487	54	38	521	37	44	480	ND	94		
490	52	47	571	39	43	489	ND	61		
521	59	43	593	40	33	527	26	26		
545	50	44	593R	39	ND	538	ND	26		
576	38	44				550	ND	24		
592	42	46				608	ND	55		
630	38	46								
659	42	55								
673	44	53								
730	41	48								
752	64	62								
785	51	58								
816	53	51								
832	52	62								
870	50	75								
886	52	35								
923	50	49								
923R	49	ND								
961	54	48								
990	51	46								

TRA 5	
Depth	XRF
100	54
139	43
162	35
170	34
192	80
202	81

[Descriptive statistics]							
Parameter	TAN CH 2		TAN CH 1		NPR Test	All cores	
	ICP/MS	XRF	ICP/MS	XRF	XRF	ICP/MS	XRF
Minimum	29	32	37	33	23	21	21
Maximum	102	105	140	146	94	140	146
Mean	58	60	62	64	52	58	57
Error	3	3.3	6.3	6.8	4.4	2.9	2.5
Median	52	53	50.5	55.5	54	52	53.5
Error	3.7	4.2	7.9	8.5	5.5	3.6	3.1
Sample size	35	35	18	18	21	56	84

C: Chromium (Cr)—Average crustal abundance is 122 ppm (Emsley, 1989)

[Concentration]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	176	61	118	36	165	418	341
154	182	91	185	36R	167	448	374
172	180	111	163	56	167	448R	387
201	197	130	169	98	213	476	186
215	196	150	179	121	361	522	419
238	205	195	178	127	318		
256	137	250	212	141	155		
277	208	300	223	156	213		
299	156	380	380	170	235		
309	214	421	211	232	203		
327	210	435	213	273	127		
352	232	460	139	291	161		
366	247	475	143	311	303		
413	256	491	134	379	318		
463	297	500	145	450	380		
477	363	521	124	461	189		
487	131	571	177	480	61		
490	146	593	173	489	180		
521	107			527	406		
545	135			538	397		
576	132			550	393		
592	170			608	259		
630	186						
659	160						
673	168						
730	176						
752	183						
785	157						
816	159						
832	163						
870	182						
886	244						
923	267						
961	264						
990	173						

[Descriptive statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	107	118	61	61
Maximum	363	380	406	419
Mean	193	181	248	215
Error	8.9	14	22	8.5
Median	182	175	213	187.5
Error	11	17	28	11
Sample size	35	18	21	84

D: Copper (Cu)—Average crustal abundance is 68 ppm (Emsley, 1989)

[Concentration]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	27	61	38	36	19	418	46
154	33	91	30	36R	19	448	63
172	26	111	17	56	21	448R	49
201	40	130	15	98	34	476	29
215	47	150	26	121	31	522	71
238	39	195	23	127	32		
256	24	250	32	141	6		
277	29	300	31	156	24		
299	43	380	34	170	15		
309	35	421	23	232	18		
327	24	435	22	273	13		
352	39	460	1	291	24		
366	38	475	16	311	39		
413	43	491	22	379	52		
463	51	500	25	450	70		
477	43	521	17	461	29		
487	21	571	21	480	52		
490	19	593	30	489	22		
521	28			527	71		
545	25			538	75		
576	18			550	64		
592	31			608	38		
630	25						
659	25						
673	32						
730	21						
752	24						
785	55						
816	17						
832	34						
870	57						
886	32						
923	40						
961	36						
990	36						

[Descriptive statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	17	1.0	6.0	1.0
Maximum	57	38	75	110
Mean	33	24	36	34
Error	1.7	2.0	4.5	1.9
Median	32	23	31	31
Error	2.2	2.6	5.6	2.4
Sample size	35	18	21	84

E: Dysprosium (Dy)—Average crustal abundance is 4.5 ppm (Emsley, 1989)

TAN CH 2		[Concentration] TAN CH 1		NPR Test	
Depth	ICP/MS	Depth	ICP/MS	Depth	ICP/MS
138	9.6	61	12	291	6.1
154	9.2	91	8.8	450	4.1
172	8.5	111	8.3	527	4.1
201	8.3	130	8.7		
215	8.8	150	9.2		
238	8.4	195	8.1		
256	7.5	195R	7.8		
277	7.0	250	6.8		
299	8.6	300	6.4		
309	6.8	380	5.4		
327	6.7	421	6.2		
352	6.7	435	5.3		
366	6.0	460	6.2		
413	6.2	475	6.4		
463	4.5	491	6.9		
477	5.6	500	6.3		
487	6.6	521	6.0		
490	6.3	571	6.3		
521	7.4	593	6.1		
545	6.5	593R	6.2		
576	5.9				
592	6.3				
630	6.0				
659	6.5				
673	6.4				
730	6.1				
752	7.9				
785	7.2				
816	7.5				
832	7.4				
870	7.1				
886	7.1				
923	6.6				
923R	6.6				
961	7.4				
990	6.9				

Parameter	[Descriptive statistics]		
	TAN CH 2	TAN CH 1	All cores
	ICP/MS	ICP/MS	ICP/MS
Minimum	4.5	5.3	4.1
Maximum	9.6	12	12
Mean	6.9	7.2	6.9
Error	.18	.40	.18
Median	6.7	6.4	6.6
Error	.22	.50	.23
Sample size	35	18	56

F: Erbium (Er)—Average crustal abundance is 3.5 ppm (Emsley, 1989)

[Concentration]					
TAN CH 2		TAN CH 1		NPR Test	
Depth	ICP/MS	Depth	ICP/MS	Depth	ICP/MS
138	5.1	61	6.4	291	3.3
154	4.9	91	4.7	450	2.5
172	4.6	111	4.4	527	2.5
201	4.4	130	4.7		
215	4.7	150	4.9		
238	4.5	195	4.4		
256	4.0	195R	4.2		
277	3.6	250	3.7		
299	4.6	300	3.5		
309	3.6	380	3.1		
327	3.6	421	3.4		
352	3.6	435	2.9		
366	3.2	460	3.5		
413	3.4	475	3.5		
463	2.5	491	3.8		
477	3.1	500	3.4		
487	3.4	521	3.3		
490	3.4	571	3.4		
521	4.0	593	3.4		
545	3.5	593R	3.4		
576	3.3				
592	3.5				
630	3.3				
659	3.6				
673	3.7				
730	3.4				
752	4.3				
785	3.8				
816	4.0				
832	4.0				
870	3.8				
886	3.8				
923	3.6				
923R	3.7				
961	4.1				
990	3.8				

Parameter	[Descriptive statistics]		
	TAN CH 2	TAN CH 1	All cores
	ICP/MS	ICP/MS	ICP/MS
Minimum	2.5	2.9	2.5
Maximum	5.1	6.4	6.4
Mean	3.8	3.9	3.8
Error	.09	.20	.09
Median	3.7	3.5	3.6
Error	.12	.25	.12
Sample size	35	18	56

G: Europium (Eu)—Average crustal abundance is 2.1 ppm (Emsley, 1989)

[Concentration]					
TAN CH 2		TAN CH 1		NPR Test	
Depth	ICP/MS	Depth	ICP/MS	Depth	ICP/MS
138	3.6	61	4.5	291	2.4
154	3.4	91	3.4	450	1.3
172	3.3	111	3.3	527	1.3
201	3.2	130	3.4		
215	3.3	150	3.5		
238	3.2	195	3.1		
256	2.9	195R	3.0		
277	2.6	250	2.6		
299	3.1	300	2.4		
309	2.6	380	1.9		
327	2.6	421	2.3		
352	2.5	435	2.0		
366	2.2	460	2.5		
413	2.3	475	2.5		
463	1.5	491	2.7		
477	1.9	500	2.5		
487	2.7	521	2.2		
490	2.7	571	2.3		
521	2.9	593	2.3		
545	2.7	593R	2.3		
576	2.3				
592	2.4				
630	2.3				
659	2.5				
673	2.4				
730	2.4				
752	3.2				
785	2.9				
816	3.0				
832	2.9				
870	2.8				
886	2.7				
923	2.5				
923R	2.5				
961	2.7				
990	2.6				

[Descriptive statistics]			
Parameter	TAN CH 2	TAN CH 1	All cores
	ICP/MS	ICP/MS	ICP/MS
Minimum	1.5	1.9	1.3
Maximum	3.6	4.5	4.5
Mean	2.7	2.7	2.7
Error	.07	.16	.08
Median	2.7	2.5	2.6
Error	.09	.20	.10
Sample size	35	18	56

H: Gadolinium (Gd)—Average crustal abundance is 6.1 ppm (Emsley, 1989)

[Concentration]					
TAN CH 2		TAN CH 1		NPR Test	
Depth	ICP/MS	Depth	ICP/MS	Depth	ICP/MS
138	11	61	14	291	6.6
154	11	91	10	450	3.8
172	9.8	111	9.6	527	3.9
201	9.2	130	9.9		
215	9.8	150	11		
238	9.2	195	9.2		
256	8.4	195R	8.4		
277	7.6	250	7.6		
299	9.6	300	7.1		
309	7.6	380	5.6		
327	7.4	421	6.6		
352	7.2	435	5.5		
366	6.6	460	6.9		
413	6.7	475	7.2		
463	4.6	491	7.6		
477	5.8	500	6.9		
487	7.4	521	6.4		
490	7.0	571	6.6		
521	8.0	593	6.5		
545	7.2	593R	6.2		
576	6.3				
592	6.6				
630	6.1				
659	6.7				
673	7.0				
730	6.4				
752	8.9				
785	7.8				
816	8.1				
832	7.8				
870	7.6				
886	7.7				
923	7.3				
923R	7.0				
961	7.8				
990	7.6				

Parameter	[Descriptive statistics]		
	TAN CH 2	TAN CH 1	All cores
	ICP/MS	ICP/MS	ICP/MS
Minimum	4.6	5.5	3.8
Maximum	11	14	14
Mean	7.7	8.0	7.7
Error	.24	.52	.24
Median	7.6	7.15	7.4
Error	.30	.65	.30
Sample size	35	18	56

I: Gallium (Ga)—Average crustal abundance is 19 ppm (Emsley, 1989)

[Concentration]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	20	61	23	36	18	418	21
154	19	91	21	36R	20	448	15
172	20	111	22	56	21	448R	15
201	22	130	23	98	20	476	21
215	20	150	21	121	19	522	16
238	26	195	19	127	17		
256	21	250	23	141	20		
277	18	300	21	156	20		
299	21	380	16	170	18		
309	19	421	20	232	19		
327	17	435	14	273	20		
352	21	460	18	291	19		
366	19	475	16	311	20		
413	18	491	20	379	17		
463	18	500	24	450	18		
477	17	521	20	461	20		
487	24	571	22	480	24		
490	20	593	22	489	18		
521	23			527	16		
545	20			538	17		
576	22			550	15		
592	22			608	17		
630	24						
659	21						
673	21						
730	21						
752	17						
785	21						
816	20						
832	19						
870	20						
886	19						
923	17						
961	21						
990	18						

[Descriptive statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	17	14	15	14
Maximum	26	24	24	26
Mean	20	20	19	20
Error	.36	.65	.43	.26
Median	20	21	19	20
Error	.45	.82	.54	.32
Sample size	35	18	21	84

J: Hafnium (Hf)—Average crustal abundance is 2.8 ppm (Emsley, 1989)

[Concentration]					
TAN CH 2		TAN CH 1		NPR Test	
Depth	ICP/MS	Depth	ICP/MS	Depth	ICP/MS
138	7.6	61	9.0	291	5.0
154	6.2	91	6.0	450	2.5
172	6.8	111	6.9	527	2.7
201	6.8	130	7.4		
215	7.3	150	7.8		
238	6.5	195	6.6		
256	6.1	195R	6.4		
277	5.3	250	5.3		
299	6.5	300	5.3		
309	5.3	380	4.0		
327	5.0	421	4.6		
352	5.4	435	3.9		
366	4.8	460	5.1		
413	4.8	475	5.2		
463	3.1	491	5.5		
477	4.0	500	5.0		
487	5.3	521	3.5		
490	4.9	571	4.7		
521	6.1	593	4.6		
545	5.2	593R	4.5		
576	4.3				
592	4.6				
630	4.4				
659	4.9				
673	5.0				
730	4.7				
752	6.7				
785	5.6				
816	6.1				
832	6.2				
870	5.8				
886	6.1				
923	5.9				
923R	5.8				
961	6.6				
990	5.3				

Parameter	[Descriptive statistics]		
	TAN CH 2	TAN CH 1	All cores
	ICP/MS	ICP/MS	ICP/MS
Minimum	3.1	3.5	2.5
Maximum	7.6	9.0	9.0
Mean	5.6	5.6	5.5
Error	.17	.34	.17
Median	5.4	5.25	5.3
Error	.21	.43	.21
Sample size	35	18	56

K: Holmium (Ho)—Average crustal abundance is 1.3 ppm (Emsley, 1989)

[Concentration]					
TAN CH 2		TAN CH 1		NPR Test	
Depth	ICP/MS	Depth	ICP/MS	Depth	ICP/MS
138	1.8	61	2.2	291	1.2
154	1.7	91	1.7	450	.83
172	1.6	111	1.6	527	.84
201	1.6	130	1.7		
215	1.6	150	1.7		
238	1.6	195	1.5		
256	1.4	195R	1.4		
277	1.3	250	1.3		
299	1.6	300	1.2		
309	1.3	380	1.0		
327	1.2	421	1.2		
352	1.2	435	1.0		
366	1.1	460	1.2		
413	1.2	475	1.2		
463	.85	491	1.3		
477	1.1	500	1.2		
487	1.2	521	1.2		
490	1.2	571	1.2		
521	1.4	593	1.2		
545	1.3	593R	1.2		
576	1.2				
592	1.2				
630	1.2				
659	1.3				
673	1.2				
730	1.2				
752	1.6				
785	1.4				
816	1.4				
832	1.4				
870	1.4				
886	1.4				
923	1.3				
923R	1.3				
961	1.4				
990	1.4				

Parameter	[Descriptive Statistics]		
	TAN CH 2	TAN CH 1	All cores
	ICP/MS	ICP/MS	ICP/MS
Minimum	0.85	1.0	0.83
Maximum	1.8	2.3	2.3
Mean	1.4	1.4	1.3
Error	.03	.08	.03
Median	1.3	1.2	1.3
Error	.04	.10	.04
Sample size	35	18	56

L: Lanthanum (La)—Average crustal abundance is 35 ppm (Emsley, 1989)
[La concentrations by XRF are qualitative estimates]

[Concentration]										
TAN CH 2			TAN CH 1			NPR Test			NPR WO1	
Depth	ICP/MS	XRF	Depth	ICP/MS	XRF	Depth	ICP/MS	XRF	Depth	XRF
138	50	50	61	68	69	36	ND	27	418	8.0
154	47	50	91	45	34	36R	ND	31	448	0
172	39	40	111	37	49	56	ND	28	448R	8.0
201	37	30	130	39	31	98	ND	30	476	31
215	39	38	150	39	39	121	ND	20	522	0
238	36	47	195	41	27	127	ND	21		
256	42	55	195R	40	ND	141	ND	32		
277	32	30	250	31	21	156	ND	26		
299	39	51	300	26	33	170	ND	23		
309	31	40	380	18	26	232	ND	20		
327	28	24	421	22	23	273	ND	53		
352	27	24	435	19	0	291	26	34		
366	24	30	460	23	17	311	ND	20		
413	23	27	475	23	27	379	ND	30		
463	13	4.0	491	24	27	450	10	0		
477	18	9.0	500	22	20	461	ND	32		
487	25	25	521	17	0	480	ND	28		
490	24	21	571	18	12	489	ND	23		
521	27	23	593	18	19	527	12	7.0		
545	23	0	593R	18	ND	538	ND	21		
576	18	15				550	ND	27		
592	19	7.0				608	ND	28		
630	18	10								
659	19	28								
673	20	29								
730	19	13								
752	29	33								
785	23	10								
816	24	19								
832	24	21								
870	23	29								
886	24	18								
923	23	26								
923R	23	ND								
961	25	14								
990	24	26								

[Descriptive Statistics]							
Parameter	TAN CH 2		TAN CH 1		NPR Test	All cores	
	ICP/MS	XRF	ICP/MS	XRF	XRF	ICP/MS	XRF
Minimum	13	0	17	0	0	10	0
Maximum	50	55	68	69	53	68	69
Mean	27	26	29	26	25	27	25
Error	1.5	2.4	3.1	3.8	2.2	1.4	1.6
Median	24	26	23.5	26.5	27	24	26
Error	1.9	3.0	3.9	4.8	2.8	1.8	1.9
Sample size	35	35	18	18	21	56	84

M: Lead (Pb)—Average crustal abundance is 13 ppm (Emsley, 1989)

[Concentration]										
TAN CH 2			TAN CH 1			NPR Test			NPR WO1	
Depth	ICP/MS	XRF	Depth	ICP/MS	XRF	Depth	ICP/MS	XRF	Depth	XRF
138	6.4	4	61	7.5	8	36	ND	4	418	4
154	6.0	6	91	5.1	5	36R	ND	6	448	5
172	5.3	3	111	4.6	7	56	ND	7	448R	4
201	5.2	2	130	4.7	6	98	ND	6	476	5
215	5.6	9	150	5.3	6	121	ND	2	522	4
238	4.9	6	195	5.8	5	127	ND	5		
256	6.3	6	195R	5.9	ND	141	ND	6		
277	4.8	7	250	4.5	7	156	ND	4		
299	6.1	4	300	4.0	5	170	ND	6		
309	4.2	6	380	2.9	3	232	ND	6		
327	4.4	4	421	3.4	4	273	ND	6		
352	4.3	5	435	3.2	2	291	3.9	5		
366	3.8	2	460	3.9	3	311	ND	3		
413	4.3	2	475	3.9	6	379	ND	3		
463	3.5	1	491	4.3	4	450	1.9	2		
477	3.0	3	500	3.9	5	461	ND	5		
487	4.3	6	521	3.5	6	480	ND	6		
490	4.2	3	571	3.5	8	489	ND	4		
521	5.1	7	593	3.3	5	527	2.1	2		
545	3.8	4	593R	3.4	ND	538	ND	4		
576	3.6	8				550	ND	3		
592	3.4	5				608	ND	5		
630	3.4	1								
659	3.5	4								
673	5.5	6								
730	3.8	2								
752	4.4	6								
785	3.7	5								
816	3.7	4								
832	4.1	6								
870	5.0	3								
886	4.1	5								
923	4.2	3								
923R	4.2	ND								
961	4.3	5								
990	3.8	7								

[Descriptive Statistics]							
Parameter	TAN CH 2		TAN CH 1		NPR Test	All cores	
	ICP/MS	XRF	ICP/MS	XRF	XRF	ICP/MS	XRF
Minimum	3.0	1.0	2.9	2.0	2.0	1.9	1.0
Maximum	6.4	9.0	7.5	8.0	7.0	7.5	9.0
Mean	4.5	4.6	4.3	5.3	4.5	4.3	4.8
Error	.15	.33	.26	.39	.34	.14	.19
Median	4.3	5.0	3.95	5.0	5.0	4.2	5.0
Error	.19	.42	.33	.49	.42	.18	.24
Sample size	35	35	18	18	21	56	84

N: Lutetium (Lu)—Average crustal abundance is 0.8 ppm (Emsley, 1989)

[Concentration]					
TAN CH 2		TAN CH 1		NPR Test	
Depth	ICP/MS	Depth	ICP/MS	Depth	ICP/MS
138	0.71	61	0.87	291	0.47
154	.66	91	.63	450	.41
172	.63	111	.60	527	.39
201	.62	130	.65		
215	.64	150	.67		
238	.61	195	.59		
256	.55	195R	.57		
277	.50	250	.51		
299	.62	300	.50		
309	.51	380	.45		
327	.48	421	.47		
352	.51	435	.40		
366	.45	460	.48		
413	.48	475	.48		
463	.35	491	.52		
477	.45	500	.48		
487	.47	521	.47		
490	.45	571	.49		
521	.54	593	.48		
545	.49	593R	.48		
576	.45				
592	.49				
630	.45				
659	.50				
673	.50				
730	.47				
752	.58				
785	.52				
816	.55				
832	.54				
870	.52				
886	.55				
923	.53				
923R	.52				
961	.56				
990	.53				

[Descriptive Statistics]			
Parameter	TAN CH 2	TAN CH 1	All cores
	ICP/MS	ICP/MS	ICP/MS
Minimum	0.35	0.40	0.35
Maximum	.71	.87	.87
Mean	.53	.54	.53
Error	.01	.03	.01
Median	.52	.495	.505
Error	.02	.03	.01
Sample size	35	18	56

O: Neodymium (Nd)—Average crustal abundance is 40 ppm (Emsley, 1989)

[Concentration]					
TAN CH 2		TAN CH 1		NPR Test	
Depth	ICP/MS	Depth	ICP/MS	Depth	ICP/MS
138	54	61	72	291	30
154	51	91	48	450	13
172	45	111	43	527	15
201	43	130	46		
215	46	150	47		
238	43	195	45		
256	42	195R	43		
277	35	250	35		
299	44	300	31		
309	35	380	22		
327	33	421	28		
352	32	435	23		
366	28	460	29		
413	29	475	29		
463	17	491	31		
477	23	500	29		
487	32	521	24		
490	31	571	25		
521	35	593	25		
545	30	593R	25		
576	24				
592	27				
630	25				
659	27				
673	27				
730	26				
752	39				
785	33				
816	34				
832	33				
870	32				
886	32				
923	30				
923R	30				
961	32				
990	31				

[Descriptive Statistics]			
Parameter	TAN CH 2	TAN CH 1	All cores
	ICP/MS	ICP/MS	ICP/MS
Minimum	17	22	13
Maximum	54	72	72
Mean	34	35	33
Error	1.4	3.0	1.4
Median	32	30	31.5
Error	1.7	3.8	1.7
Sample size	35	18	56

P: Nickel (Ni)—Average crustal abundance is 99 ppm (Emsley, 1989)
[Ni concentrations less than 30 ppm are semiquantitative]

[Concentration]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	60	61	36	36	53	418	108
154	64	91	69	36R	52	448	131
172	76	111	72	56	55	448R	131
201	80	130	67	98	81	476	85
215	84	150	74	121	101	522	246
238	88	195	50	127	98		
256	50	250	66	141	45		
277	68	300	102	156	55		
299	46	380	105	170	59		
309	67	421	73	232	40		
327	76	435	71	273	32		
352	90	460	39	291	53		
366	101	475	39	311	120		
413	100	491	38	379	124		
463	125	500	40	450	124		
477	106	521	37	461	87		
487	35	571	38	480	22		
490	48	593	38	489	74		
521	28			527	240		
545	39			538	233		
576	38			550	216		
592	37			608	60		
630	39						
659	32						
673	41						
730	42						
752	73						
785	65						
816	65						
832	61						
870	67						
886	80						
923	99						
961	92						
990	66						

[Descriptive Statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	28	36	22	22
Maximum	125	105	240	246
Mean	67	59	94	78
Error	4.1	5.3	14	5.1
Median	66	58	74	67
Error	5.2	6.6	17	6.4
Sample size	35	18	21	84

Q: Niobium (Nb)—Average crustal abundance is 20 ppm (Emsley, 1989)

[Concentration]										
TAN CH 2			TAN CH 1			NPR Test			NPR WO1	
Depth	ICP/MS	XRF	Depth	ICP/MS	XRF	Depth	ICP/MS	XRF	Depth	XRF
138	48	46	61	63	58	36	ND	29	418	11
154	42	42	91	43	38	36R	ND	28	448	9.6
172	39	35	111	37	37	56	ND	28	448R	9.1
201	38	36	130	40	37	98	ND	30	476	25
215	40	37	150	41	37	121	ND	23	522	14
238	37	34	195	42	38	127	ND	23		
256	41	37	195R	39	ND	141	ND	31		
277	32	31	250	30	31	156	ND	34		
299	39	36	300	26	25	170	ND	34		
309	31	30	380	18	16	232	ND	32		
327	27	27	421	22	22	273	ND	34		
352	26	27	435	20	18	291	27	26		
366	23	25	460	23	23	311	ND	19		
413	22	24	475	23	21	379	ND	17		
463	13	14	491	24	23	450	9.6	9.0		
477	18	18	500	23	23	461	ND	26		
487	26	27	521	14	17	480	ND	42		
490	24	24	571	18	18	489	ND	26		
521	28	26	593	18	20	527	12	13		
545	22	23	593R	17	ND	538	ND	13		
576	18	18				550	ND	10		
592	20	20				608	ND	22		
630	18	19								
659	20	20								
673	19	20								
730	19	19								
752	26	27								
785	21	22								
816	22	22								
832	21	22								
870	20	20								
886	22	22								
923	22	22								
923R	21	ND								
961	24	22								
990	27	28								

TRA 5	
Depth	XRF
100	21
139	21
162	18
170	16
192	36
202	40

[Descriptive Statistics]							
Parameter	TAN CH 2		TAN CH 1		NPR Test	All cores	
	ICP/MS	XRF	ICP/MS	XRF	XRF	ICP/MS	XRF
Minimum	13	14	14	16	9.0	10	9.0
Maximum	48	46	63	58	42	63	58
Mean	27	26	29	28	25	27	26
Error	1.5	1.3	3.0	2.6	1.9	1.4	.99
Median	24	24	23.5	23	26	23.5	23.5
Error	1.8	1.6	3.7	3.3	2.4	1.7	1.2
Sample size	35	35	18	18	21	56	84

R: Praseodymium (Pr)—Average crustal abundance is 9.1 ppm (Emsley, 1989)

[Concentration]					
TAN CH 2		TAN CH 1		NPR Test	
Depth	ICP/MS	Depth	ICP/MS	Depth	ICP/MS
138	13	61	18	291	7.3
154	12	91	12	450	2.9
172	11	111	10	527	3.6
201	10	130	11		
215	11	150	11		
238	10	195	11		
256	10	195R	10		
277	8.6	250	8.2		
299	10	300	7.3		
309	8.2	380	5.1		
327	7.8	421	6.3		
352	7.5	435	5.4		
366	6.7	460	6.7		
413	6.6	475	6.7		
463	4.0	491	7.0		
477	5.3	500	6.5		
487	7.3	521	5.2		
490	7.0	571	5.6		
521	7.9	593	5.6		
545	6.9	593R	5.5		
576	5.4				
592	5.9				
630	5.4				
659	6.0				
673	6.1				
730	5.7				
752	8.7				
785	7.2				
816	7.5				
832	7.2				
870	7.1				
886	7.1				
923	6.8				
923R	6.8				
961	7.3				
990	6.9				

Parameter	[Descriptive Statistics]		
	TAN CH 2	TAN CH 1	All cores
	ICP/MS	ICP/MS	ICP/MS
Minimum	4.0	5.1	2.9
Maximum	13	17	17
Mean	7.7	8.2	7.7
Error	.34	.75	.34
Median	7.2	6.85	7.15
Error	.43	.94	.43
Sample size	35	18	56

S: Rubidium (Rb)—Average crustal abundance is 78 ppm (Emsley, 1989)
[Rb concentrations less than 3 ppm are semiquantitative]

[Concentration]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	13	61	8	36	11	418	5
154	11	91	9	36R	11	448	5
172	12	111	6	56	10	448R	4
201	11	130	7	98	13	476	10
215	10	150	12	121	16	522	6
238	10	195	10	127	16		
256	13	250	9	141	15		
277	8	300	8	156	19		
299	13	380	7	170	18		
309	10	421	4	232	15		
327	9	435	5	273	16		
352	11	460	9	291	12		
366	9	475	8	311	9		
413	7	491	8	379	7		
463	6	500	9	450	1		
477	8	521	6	461	12		
487	11	571	6	480	19		
490	10	593	6	489	12		
521	11			527	9		
545	9			538	8		
576	6			550	10		
592	6			608	10		
630	4						
659	5						
673	5						
730	8						
752	10						
785	6						
816	6						
832	10						
870	11						
886	10						
923	10						
961	10						
990	11						

[Descriptive Statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	4.0	4.0	1.0	1.0
Maximum	13	12	19	19
Mean	9.1	7.6	12	9.7
Error	.41	.46	1.0	.38
Median	10	8.0	12	10
Error	.52	.57	1.2	.48
Sample size	35	18	21	84

T: Samarium (Sm)—Average crustal abundance is 7.0 ppm (Emsley, 1989)

[Concentration]					
TAN CH 2		TAN CH 1		NPR Test	
Depth	ICP/MS	Depth	ICP/MS	Depth	ICP/MS
138	11	61	15	291	6.7
154	11	91	10	450	3.2
172	9.8	111	9.5	527	3.6
201	9.2	130	10		
215	9.8	150	10		
238	9.4	195	9.4		
256	8.6	195R	9.0		
277	7.6	250	7.7		
299	9.6	300	7.0		
309	7.5	380	5.2		
327	7.3	421	6.4		
352	7.1	435	5.3		
366	6.4	460	6.8		
413	6.5	475	6.8		
463	4.2	491	7.2		
477	5.4	500	6.6		
487	7.4	521	5.8		
490	7.0	571	6.2		
521	8.3	593	6.1		
545	7.2	593R	5.9		
576	6.0				
592	6.4				
630	6.0				
659	6.6				
673	6.5				
730	6.2				
752	8.9				
785	7.7				
816	8.0				
832	7.8				
870	7.5				
886	7.4				
923	6.9				
923R	7.0				
961	7.6				
990	7.2				

[Descriptive Statistics]			
Parameter	TAN CH 2	TAN CH 1	All cores
	ICP/MS	ICP/MS	ICP/MS
Minimum	4.2	5.2	3.2
Maximum	11	15	15
Mean	7.6	7.8	7.5
Error	.26	.57	.26
Median	7.4	6.9	7.2
Error	.32	.72	.33
Sample size	35	18	56

U: Scandium (Sc)—Average crustal abundance is 25 ppm (Emsley, 1989)
[Sc concentrations less than 30 ppm are semiquantitative]

[Concentration]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	31	61	36	36	35	418	40
154	31	91	42	36R	34	448	34
172	34	111	42	56	26	448R	36
201	31	130	41	98	30	476	31
215	26	150	43	121	30	522	33
238	31	195	35	127	32		
256	24	250	35	141	34		
277	27	300	30	156	31		
299	40	380	29	170	30		
309	28	421	31	232	33		
327	30	435	31	273	33		
352	28	460	32	291	29		
366	26	475	26	311	37		
413	31	491	28	379	38		
463	37	500	27	450	37		
477	34	521	27	461	32		
487	28	571	27	480	43		
490	25	593	32	489	32		
521	35			527	41		
545	31			538	38		
576	30			550	38		
592	33			608	35		
630	30						
659	33						
673	35						
730	35						
752	33						
785	27						
816	32						
832	31						
870	32						
886	34						
923	33						
961	35						
990	29						

TRA 5	
Depth	XRF
100	36
139	34
162	34
170	28
192	37
202	43

[Descriptive Statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	24	26	26	24
Maximum	40	43	43	43
Mean	31	33	34	33
Error	.60	1.4	.92	.49
Median	31	31.5	33	32
Error	.75	1.7	1.2	.62
Sample size	35	18	21	84

V: Strontium (Sr)—Average crustal abundance is 384 ppm (Emsley, 1989)

[Concentration]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	300	61	306	36	313	418	187
154	301	91	313	36R	308	448	188
172	315	111	329	56	311	448R	185
201	312	130	330	98	287	476	340
215	317	150	319	121	258	522	203
238	319	195	320	127	260		
256	327	250	332	141	304		
277	330	300	298	156	299		
299	315	380	241	170	297		
309	325	421	270	232	295		
327	315	435	268	273	292		
352	292	460	362	291	311		
366	292	475	366	311	226		
413	289	491	349	379	205		
463	226	500	348	450	190		
477	241	521	315	461	342		
487	381	571	315	480	300		
490	392	593	316	489	341		
521	363			527	197		
545	357			538	199		
576	324			550	196		
592	308			608	249		
630	310						
659	308						
673	312						
730	311						
752	304						
785	329						
816	322						
832	319						
870	319						
886	293						
923	294						
961	292						
990	362						

TRA 5	
Depth	XRF
100	269
139	264
162	251
170	249
192	279
202	273

[Descriptive Statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	226	241	190	187
Maximum	392	366	342	392
Mean	315	316	270	296
Error	5.4	7.6	11	5.0
Median	315	317.5	292	308
Error	6.8	9.6	14	6.3
Sample size	35	18	21	84

W: Tantalum (Ta)—Average crustal abundance is 1.7 ppm (Emsley, 1989)

[Concentration]					
TAN CH 2		TAN CH 1		NPR Test	
Depth	ICP/MS	Depth	ICP/MS	Depth	ICP/MS
138	2.8	61	3.3	291	2.1
154	2.0	91	2.0	450	.87
172	2.4	111	2.4	527	1.3
201	2.0	130	2.2		
215	2.5	150	2.5		
238	2.0	195	2.3		
256	2.5	195R	2.3		
277	1.7	250	2.0		
299	2.2	300	1.6		
309	1.8	380	1.3		
327	1.7	421	1.4		
352	1.6	435	1.6		
366	1.8	460	1.4		
413	1.5	475	1.8		
463	1.6	491	1.6		
477	1.4	500	1.7		
487	1.7	521	.94		
490	1.7	571	1.4		
521	1.7	593	1.2		
545	1.5	593R	1.2		
576	1.7				
592	1.7				
630	1.4				
659	1.7				
673	1.3				
730	1.6				
752	1.7				
785	1.6				
816	1.4				
832	1.6				
870	1.4				
886	1.6				
923	1.3				
923R	1.2				
961	1.6				
990	1.7				

Parameter	[Descriptive Statistics]		
	TAN CH 2	TAN CH 1	All cores
	ICP/MS	ICP/MS	ICP/MS
Minimum	1.3	0.94	0.87
Maximum	2.8	3.3	3.3
Mean	1.8	1.8	1.8
Error	.06	.13	.06
Median	1.7	1.65	1.7
Error	.07	.17	.07
Sample size	35	18	56

X: Terbium (Tb)—Average crustal abundance is 1.2 ppm (Emsley, 1989)

[Concentration]					
TAN CH 2		TAN CH 1		NPR Test	
Depth	ICP/MS	Depth	ICP/MS	Depth	ICP/MS
138	1.6	61	2.0	291	0.99
154	1.5	91	1.5	450	.62
172	1.4	111	1.4	527	.62
201	1.4	130	1.4		
215	1.4	150	1.5		
238	1.4	195	1.4		
256	1.2	195R	1.3		
277	1.1	250	1.1		
299	1.4	300	1.1		
309	1.1	380	.85		
327	1.1	421	.99		
352	1.1	435	.84		
366	.97	460	.99		
413	1.0	475	1.0		
463	.69	491	1.1		
477	.88	500	1.0		
487	1.1	521	.96		
490	1.0	571	1.0		
521	1.2	593	1.0		
545	1.1	593R	.98		
576	.94				
592	1.0				
630	.97				
659	1.0				
673	1.1				
730	.99				
752	1.3				
785	1.2				
816	1.2				
832	1.2				
870	1.1				
886	1.2				
923	1.1				
923R	1.1				
961	1.2				
990	1.1				

[Descriptive Statistics]			
Parameter	TAN CH 2	TAN CH 1	All cores
	ICP/MS	ICP/MS	ICP/MS
Minimum	0.69	0.84	0.62
Maximum	1.6	2.0	2.0
Mean	1.1	1.2	1.1
Error	.03	.07	.03
Median	1.1	1.05	1.1
Error	.04	.09	.04
Sample size	35	18	56

Y: Thorium (Th)—Average crustal abundance is 8.1 ppm (Emsley, 1989)
 [Th XRF concentrations less than 3 ppm are semiquantitative]

[Concentration]											
TAN CH 2			TAN CH 1			NPR Test			NPR WO1		
Depth	ICP/MS	XRF	Depth	ICP/MS	XRF	Depth	ICP/MS	XRF	Depth	XRF	
138	2.1	4	61	2.1	2	36	ND	2	418	0	
154	1.9	3	91	1.8	4	36R	ND	2	448	2	
172	1.6	1	111	1.1	0	56	ND	0	448R	3	
201	1.5	7	130	1.2	0	98	ND	3	476	0	
215	1.6	4	150	1.6	3	121	ND	3	522	0	
238	1.4	1	195	1.7	1	127	ND	1			
256	1.9	2	195R	1.6	ND	141	ND	4			
277	1.3	0	250	1.2	3	156	ND	2			
299	1.6	1	300	1.1	3	170	ND	3			
309	1.2	1	380	.85	0	232	ND	3			
327	1.2	1	421	.87	2	273	ND	2			
352	1.1	2	435	.78	0	291	1.2	0			
366	.98	0	460	1.1	0	311	ND	0			
413	.99	1	475	1.0	1	379	ND	0			
463	.68	0	491	1.2	0	450	.60	2			
477	.85	2	500	1.0	1	461	ND	4			
487	1.1	0	521	.82	0	480	ND	0			
490	1.0	3	571	.75	0	489	ND	3			
521	1.2	1	593	.75	0	527	.90	2			
545	1.0	1	593R	.69	ND	538	ND	0			
576	.80	1				550	ND	1			
592	.70	2				608	ND	0			
630	.73	0									
659	.77	1									
673	.86	3									
730	.86	3									
752	1.0	2									
785	.64	1									
816	.75	2									
832	.95	1									
870	1.0	1									
886	1.3	0									
923	1.4	1									
923R	1.3	ND									
961	1.2	0									
990	1.4	1									

[Descriptive Statistics]							
Parameter	TAN CH 2		TAN CH 1		NPR Test	All cores	
	ICP/MS	XRF	ICP/MS	XRF	XRF	ICP/MS	XRF
Minimum	0.64	0	0.75	0	0	0.60	0
Maximum	2.1	7.0	2.1	4.0	4.0	2.1	7.0
Mean	1.2	1.5	1.2	1.1	1.7	1.2	1.5
Error	.06	.25	.09	.32	.31	.05	.16
Median	1.1	1.0	1.1	.50	2.0	1.1	1.0
Error	.08	.31	.12	.40	.39	.06	.20
Sample size	35	35	18	18	21	56	84

Z: Thulium (Tm)—Average crustal abundance is 0.5 ppm (Emsley, 1989)

TAN CH 2		[Concentration] TAN CH 1		NPR Test	
Depth	ICP/MS	Depth	ICP/MS	Depth	ICP/MS
138	0.75	61	0.89	291	0.48
154	.72	91	.67	450	.37
172	.67	111	.63	527	.38
201	.66	130	.66		
215	.69	150	.70		
238	.65	195	.61		
256	.57	195R	.60		
277	.52	250	.53		
299	.67	300	.51		
309	.53	380	.44		
327	.53	421	.47		
352	.54	435	.40		
366	.47	460	.48		
413	.50	475	.49		
463	.36	491	.53		
477	.46	500	.49		
487	.50	521	.48		
490	.49	571	.50		
521	.59	593	.50		
545	.52	593R	.48		
576	.48				
592	.52				
630	.50				
659	.52				
673	.53				
730	.50				
752	.62				
785	.56				
816	.59				
832	.57				
870	.56				
886	.57				
923	.53				
923R	.53				
961	.57				
990	.54				

Parameter	[Descriptive Statistics]		
	TAN CH 2 ICP/MS	TAN CH 1 ICP/MS	All cores ICP/MS
Minimum	0.36	0.40	0.36
Maximum	.75	.89	.89
Mean	.56	.55	.55
Error	.01	.03	.01
Median	.54	.505	.53
Error	.02	.04	.02
Sample size	35	18	56

AA: Uranium (U)—Average crustal abundance is 2.3 ppm (Emsley, 1989)

TAN CH 2		[Concentration]		NPR Test	
Depth	ICP/MS	Depth	ICP/MS	Depth	ICP/MS
138	0.71	61	0.69	291	0.38
154	.67	91	.57	450	.10
172	.55	111	.38	527	.24
201	.51	130	.37		
215	.56	150	.52		
238	.45	195	.49		
256	.58	195R	.46		
277	.39	250	.38		
299	.53	300	.33		
309	.38	380	.25		
327	.37	421	.26		
352	.37	435	.23		
366	.30	460	.34		
413	.30	475	.32		
463	.19	491	.35		
477	.25	500	.31		
487	.35	521	.24		
490	.32	571	.25		
521	.39	593	.25		
545	.33	593R	.23		
576	.25				
592	.23				
630	.23				
659	.25				
673	.26				
730	.28				
752	.34				
785	.22				
816	.25				
832	.29				
870	.29				
886	.38				
923	.41				
923R	.36				
961	.76				
990	.37				

Parameter	[Descriptive Statistics]		
	TAN CH 2	TAN CH 1	All cores
	ICP/MS	ICP/MS	ICP/MS
Minimum	0.19	0.23	0.10
Maximum	.76	.69	.76
Mean	.38	.36	.37
Error	.02	.03	.02
Median	.35	.335	.34
Error	.03	.04	.02
Sample size	35	18	56

BB: Vanadium (V)—Average crustal abundance is 136 ppm (Emsley, 1989)

[Concentration]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	306	61	362	36	296	418	269
154	291	91	263	36R	311	448	229
172	304	111	304	56	303	448R	230
201	322	130	326	98	267	476	275
215	289	150	322	121	265	522	224
238	316	195	292	127	289		
256	259	250	245	141	309		
277	255	300	274	156	265		
299	307	380	253	170	249		
309	254	421	267	232	284		
327	250	435	284	273	347		
352	262	460	297	291	316		
366	266	475	271	311	256		
413	263	491	315	379	245		
463	225	500	287	450	248		
477	249	521	332	461	267		
487	306	571	301	480	410		
490	268	593	300	489	279		
521	273			527	222		
545	291			538	234		
576	298			550	232		
592	297			608	303		
630	295						
659	315						
673	299						
730	303						
752	308						
785	321						
816	307						
832	317						
870	296						
886	275						
923	262						
961	278						
990	285						

[Descriptive Statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	225	245	222	222
Maximum	322	362	410	410
Mean	286	294	280	285
Error	4.2	7.1	9.4	3.5
Median	291	294.5	267	286
Error	5.2	8.9	12	4.4
Sample size	35	18	21	84

CC: Ytterbium (Yb)—Average crustal abundance is 3.1 ppm (Emsley, 1989)

[Concentration]					
TAN CH 2		TAN CH 1		NPR Test	
Depth	ICP/MS	Depth	ICP/MS	Depth	ICP/MS
138	4.5	61	5.7	291	3.0
154	4.3	91	4.3	450	2.5
172	4.2	111	3.9	527	2.4
201	4.0	130	4.1		
215	4.1	150	4.4		
238	4.0	195	3.8		
256	3.5	195R	3.7		
277	3.2	250	3.3		
299	4.0	300	3.2		
309	3.3	380	2.8		
327	3.2	421	3.0		
352	3.3	435	2.6		
366	3.0	460	3.1		
413	3.1	475	3.1		
463	2.3	491	3.4		
477	2.9	500	3.1		
487	3.2	521	3.1		
490	3.0	571	3.2		
521	3.6	593	3.1		
545	3.2	593R	3.0		
576	3.0				
592	3.2				
630	3.0				
659	3.2				
673	3.4				
730	3.1				
752	3.8				
785	3.5				
816	3.6				
832	3.6				
870	3.4				
886	3.5				
923	3.3				
923R	3.3				
961	3.7				
990	3.5				

[Descriptive Statistics]			
Parameter	TAN CH 2	TAN CH 1	All cores
	ICP/MS	ICP/MS	ICP/MS
Minimum	2.3	2.6	2.3
Maximum	4.5	5.7	5.7
Mean	3.5	3.5	3.4
Error	.08	.18	.08
Median	3.4	3.2	3.3
Error	.10	.22	.10
Sample size	35	18	56

DD: Yttrium (Y)—Average crustal abundance is 31 ppm (Emsley, 1989)

[Concentration]										
TAN CH 2			TAN CH 1			NPR Test			NPR WO1	
Depth	ICP/MS	XRF	Depth	ICP/MS	XRF	Depth	ICP/MS	XRF	Depth	XRF
138	59	52	61	71	64	36	ND	40	418	26
154	56	48	91	52	49	36R	ND	41	448	23
172	52	47	111	48	45	56	ND	40	448R	23
201	51	44	130	52	46	98	ND	41	476	41
215	52	47	150	54	48	121	ND	34	522	23
238	50	46	195	48	42	127	ND	34		
256	44	41	195R	46	ND	141	ND	42		
277	41	38	250	40	36	156	ND	40		
299	49	46	300	39	35	170	ND	39		
309	39	37	380	33	30	232	ND	40		
327	39	35	421	36	33	273	ND	44		
352	38	38	435	32	29	291	37	35		
366	35	33	460	38	35	311	ND	32		
413	36	36	475	39	36	379	ND	31		
463	26	25	491	41	39	450	27	25		
477	32	32	500	39	35	461	ND	39		
487	39	37	521	36	33	480	ND	62		
490	38	36	571	37	36	489	ND	40		
521	45	41	593	37	34	527	27	24		
545	40	38	593R	36	ND	538	ND	27		
576	36	34				550	ND	25		
592	40	36				608	ND	35		
630	36	34								
659	39	36								
673	38	37								
730	37	35								
752	46	45								
785	43	39								
816	45	40								
832	44	41								
870	41	38								
886	43	40								
923	41	37								
923R	40	ND								
961	45	40								
990	42	39								

[Descriptive Statistics]							
Parameter	TAN CH 2		TAN CH 1		NPR Test	All cores	
	ICP/MS	XRF	ICP/MS	XRF	XRF	ICP/MS	XRF
Minimum	26	25	32	29	24	26	23
Maximum	59	52	71	64	62	71	64
Mean	42	39	43	39	37	42	38
Error	1.1	0.9	2.3	2	1.8	1.1	0.83
Median	41	38	39	36	39	40	37
Error	1.4	1.1	2.9	2.5	2.3	1.4	1.0
Sample size	35	35	18	18	21	56	84

EE: Zinc (Zn)—Average crustal abundance is 76 ppm (Emsley, 1989)

[Concentration]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	150	61	158	36	123	418	75
154	145	91	139	36R	124	448	76
172	143	111	141	56	121	448R	68
201	142	130	145	98	117	476	125
215	141	150	140	121	98	522	77
238	141	195	133	127	104		
256	126	250	122	141	126		
277	125	300	119	156	112		
299	141	380	104	170	115		
309	126	421	110	232	120		
327	121	435	103	273	129		
352	113	460	129	291	115		
366	117	475	125	311	100		
413	114	491	132	379	90		
463	95	500	130	450	74		
477	100	521	126	461	129		
487	136	571	124	480	155		
490	128	593	123	489	127		
521	151			527	77		
545	134			538	74		
576	128			550	76		
592	127			608	107		
630	126						
659	129						
673	125						
730	129						
752	140						
785	140						
816	142						
832	139						
870	136						
886	126						
923	121						
961	127						
990	129						

TRA 5	
Depth	XRF
100	96
139	98
162	98
170	98
192	126
202	131

[Descriptive Statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	95	103	74	74
Maximum	151	158	155	158
Mean	130	128	109	121
Error	2.1	3.3	4.7	2.2
Median	129	127.5	115	126
Error	2.7	4.2	5.9	2.7
Sample size	35	18	21	84

FF: Zirconium (Zr)—Average crustal abundance is 162 ppm (Emsley, 1989)

[Concentration]							
TAN CH 2		TAN CH 1		NPR Test		NPR WO1	
Depth	XRF	Depth	XRF	Depth	XRF	Depth	XRF
138	327	61	409	36	240	418	108
154	308	91	293	36R	239	448	94
172	294	111	285	56	232	448R	95
201	286	130	299	98	247	476	237
215	309	150	305	121	178	522	109
238	287	195	263	127	183		
256	256	250	214	141	252		
277	222	300	211	156	257		
299	272	380	155	170	252		
309	218	421	183	232	261		
327	204	435	162	273	270		
352	213	460	211	291	211		
366	194	475	215	311	175		
413	197	491	226	379	151		
463	124	500	214	450	104		
477	161	521	173	461	237		
487	226	571	186	480	375		
490	211	593	183	489	236		
521	247			527	109		
545	221			538	109		
576	182			550	107		
592	195			608	189		
630	181						
659	194						
673	204						
730	191						
752	270						
785	228						
816	240						
832	239						
870	234						
886	248						
923	240						
961	259						
990	207						

TRA 5	
Depth	XRF
100	169
139	164
162	157
170	144
192	285
202	297

[Descriptive Statistics]				
Parameter	TAN CH 2	TAN CH 1	NPR Test	All cores
	XRF	XRF	XRF	XRF
Minimum	124	155	104	94
Maximum	327	409	375	409
Mean	231	233	208	219
Error	7.6	15	15	6.7
Median	226	214	232	216.5
Error	9.5	19	19	8.3
Sample size	35	18	21	84