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Major, Minor, and Trace Elements in Samples from the Wheeler Wilderness Study Area, Colorado, as determined by Inductively Coupled Argon Plasma-Atomic Emission Spectrometry

By

J. G. Crock, W. H. Raymond, and F. E. Lichte

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INTRODUCTION

The mineral resource assessment of an area often requires a large number of samples from various origins be analyzed rapidly, accurately and precisely for a large number of elements. These requirements have been fulfilled using an acid digestion in sealed-container coupled with the multi-element analytical capacity of inductively coupled argon plasma-atomic emission spectrometry (ICAP-AES). On a single 10 mL solution, over 45 elements are determined in less than 2 minutes. The purpose of this investigation was the mineral resource evaluation of the area for consideration as a wilderness area designated by the Wilderness Act (Public Law 88-577, September 3, 1964). The purpose of this report is to present the data of this investigation and to describe a versatile analytical method in the analysis of geological materials.

INSTRUMENTATION

Samples from the Wheeler Geologic Area were analyzed using a 63-channel ICP emission spectrometer, Jarrell-Ash* model 1160 Atom Comp, with some in-house modifications (Taggart et al., 1981). These modifications include a Matheson mass flow controller, model 8249, for controlling the sample gas flow rate, a Gilson Minipulse II peristaltic pump to deliver the sample to a modified Babington nebulizer (Garbarino and Taylor, 1980), an autoprofiler, a water saturation system for the nebulizer gas flow, and a Perkin-Elmer model 100 auto sampler, and a modified quartz torch. A DEC PDP11-34 minicomputer controls the ICAP emission spectrometer is interfaced to a HP 1000 which is for data reporting. The operating conditions and parameters are listed in table 1. The wavelengths at which spectral measurements were made are given in table 2 for all 59 elements determined.

*The use of trade names is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

DIGESTION METHOD

The digestion procedure used was one modified from that described by Patchett and Tatsumoto (1980). This procedure is a low-temperature sealed-container digestion of the sample in a 30 mL teflon bottle. The procedure used is as follows:

Solutions Required:

Hydrochloric Acid: J. T. Baker "Instra-Analyzed" for trace element analysis grade, 37%.

Nitric Acid: J. T. Baker "Instra-Analyzed:" for trace element analysis grade, 70%.

Hydrofluoric Acid: J. T. Baker Reagent Grade, 48%.

Perchloric Acid: G. Frederick Smith Co., "Double Distilled," 70%.

Aqua Regia: 3 parts Hydrochloric Acid: 1 part Nitric Acid.

Lu internal standard, 500 mg/L: Dissolve in hydrochloric acid a sufficient amount (depends on manufacturer's assay) of 99.999% Lu_2O_3 (available from Spex Industries, Inc., Metucher, N.J.) to make 100 mL of a 10,000 mg/L solution. Make the 500 mg/L solution by serial dilution with 30% (v/v) hydrochloric acid.

Weigh 0.200 g of the -80 mesh sample into a 30 mL thick-walled teflon bottle (available from Savillex Corp., Minnetonka, MN). Wrap the bottle's threads with teflon tape to insure a good seal. Add to the sample 100 uL of the Lu internal standard solution. Slowly add 3 mL hydrochloric acid and 2 mL nitric acid and allow the reaction to subside, about 15 min. Add 2 mL hydrofluoric acid. Cap tightly and place in an aluminium heating block (24 in x 12 in x 1 in, with 50 holes drilled to slightly more than the outside diameter of each bottle) on a hotplate preset to 110°C. Heat for 30 min in the heating block. Remove, cool to room temperature, and carefully remove the caps. Add 0.2 mL perchloric acid and return to the heating block with the lids removed. Evaporate the solution to dryness at 160°C, usually overnight. Remove, cool to room temperature, and add 1 mL of aqua regia. Place the bottles, uncovered, on a steam bath for 15 min. Cool and transfer the solution to an empty pre-weighed 2 oz. polypropylene bottle and bring the final solution weighed to 10.00 g final solution weight with 1% (v/v) nitric acid.

This digestion procedure was applied to the three sample types used in this study: stream sediments, pan concentrates and rocks.

RESULTS

There were 54 sampling locations for this study. The sample sites are given in Raymond and Crock (1983). If multiple samples were taken at a given sample site, they were designated with sequential letters. The geology of this area has been previously mapped by (Steven and Ratte, 1973). Three sample types were collected for this mineral resource investigation: pan concentrates, stream sediments, and outcropping rocks. Table 4 lists the rock sample descriptions.

Table 5 lists the elements reported and their detection limits by ICAP-AES analysis. The results for the Wheeler Study Area samples are given in tables 6, 7, and 8 for the stream sediments, pan concentrates and rocks, respectively. The geologic evaluation of these results are discussed in Raymond and Crock (1983). Also given are the detection limits by 6-step spectroscophic analysis (Meyers et al., 1961). This is the most common specrographic technique used for this type of study in the past. Some elements cannot be determined analyzed by the ICAP-AES technique described due to an incompatible digestion, i.e., Si and B are volatilzed by the hydrofluoric acid or the low solubility of some resistant minerals, e.g., zircon, resulting in low values for some elements as Zr. Other elements, i.e., Pt, require preconcentration techniques to be applicable in geochemical studies. The results are reported as semi-quantitative; a relative standard deviation for this method for concentrations that were 5 times the detection limit was usually better than 10 percent as observed in replicate analyses. Accuracy was monitored by analysis of standard reference materials taken through the entire digestion procedure. The results of these standard reference materials are given in table 5. These results are acceptable and indicate acceptable accuracy for this rapid multi-element analysis of geological materials.

The digestion procedure prove to be a rapid and simple, yet very effective method for the dissolution of a wide variety of geological materials. The entire group of samples required less than 2 days for preparation and analysis. The teflon bottle digestion was very effective at dissolving even the pan concentrates which are usually difficult because they tend to have large amounts of resistant minerals such as magnitite or zircon. In all cases the stream sediments, rocks, and pan concentrates yielded clear solutions indicating a complete digestion. A closed vessel is more efficient at dissolving a sample because of the increase of the pressure at a given temperature. A closed vessel also will allow acid refluxing which then requires smaller amounts of acids. Another advantage of this digestion is the ability to dissolve and analyze a large number of samples in a single run, thus minimizing any daily instrumental or operator variations. The disadvantages of this technique are two-fold: incompatability with some elements due to loss, as in experienced with Si or B; and, the poor sensitivity of ICAP-AES for some important elements in a numerical assessment program, i.e., the precious metals.

SUMMARY

The given digestion procedure coupled with analysis by ICAP-AES has shown itself to be a rapid, accurate, precise and sensitive method for the analysis of geoloigcal material required in a Wilderness area study. Not only does this method apply to Wilderness area study problems as the data in tables 6-8 indicate, but is useful in exploration problems in general due to the rapid multi-element analytical power of the ICAP-AES and the sealed-container digestion. This is also enforced by the lower detection limits for some key elements in exploration problems, e.g., As, Cd, REE, U, and Zn, as shown in table 5. Also although the major elements by ICAP-AES analysis have less of a detection capability, this is not a problem for many geological material have these major elements well above the detection limits of ICAP-AES analysis.

REFERENCES CITED

Abbey, Syndey, 1980, Studies in "Standard Samples" for use in the general analysis of silicate rocks and minerals: Part 6, 1979 Edition of "Usable" values: Canadian Geological Survey Paper 80-14, 30 pp.

Garbarino, J. R., and Taylor, H. E., 1980, A Babington type nebulizer for use in the analysis of natural water samples by inductively coupled plasma spectrometry: Applied Spectroscopy, v. 34, pp. 584-590.

Gladney, E. S., and Goode, W. E., 1981, Elemental concentration in eight new United States Geological Survey rock standards: A review: Geostandards Newsletters, 5, pp. 31-64.

Myers, A. T., Havens, R. G., and Dunton, P. J., 1961, A spectrochemical method for the semiquantitative analysis of rocks, minerals, and ores: U.S. Geological Survey Bulletin 1084-I, pp. 207-229.

Patchett, P. J., and Tatsumoto, M., 1980, A routine high-precision method for Lu-Hf isotope geochemistry and chronology: Contrib. Mineral Petrol., v. 75, pp. 263-267.

Raymond, W.H., and Crock, J.G., 1983, Geology and Mineral Resource Potential of the Wheeler Geologic Study Area, Mineral County, Colorado: U.S. Geological Survey Map Folio, MF--, in press.

Steven, T. A., and Ratte, J. C., 1973, Geological Map of the Creede quadrangle, Mineral and Saguache Counties, Colorado: U.S. Geological Survey Geol. Quad. Map GQ-1053.

Taggart, J. E., Lichte, F. E., and Wahlberg, J. S., 1981, Methods of analysis of samples using X-ray fluorescence and inductively coupled plasma, U.S. Geological Survey Prof. Paper 1250, pp. 683-687.

Table 1. Operating conditions and parameters

Power	1250 W
Argon flow rate	18 L/min, coolant
	0.50 L/min, sample
Sample pump rate to nebulizer	0.70 mL/min
Observation height	23 mm above the load coil
	2 mm above the top of the torch
Reciprocal linear Dispersion	0.54 nm/mm
Nebulizer	modified Babington
Optics	1:3 magnification at entrance slit
Slits	25 µm x 3 mm, entrance
	50 µm x 3 mm, exit
Internal Standard	5.0 mg/L Lu, 261.5 nm

Table 2.--Wavelengths used for analysis

Element	Wavelength (nm)	Element	Wavelength (nm)	Element	Wavelength (nm)
Ag	328.0	Gd	303.2	Sc	424.6
Al	309.2	Ge	265.1	Se	196.0
As	189.0	Hf	241.6	Si	251.6
Au	242.7	Ho	345.6	Sm	442.4
B	249.7	K	766.4	Sn	189.9
Ba	455.4	La	398.8	Sr	421.5
Be	313.0	Li	670.7	Ta	240.0
Bi	223.0	Lu	261.5	Tb	367.6
Ca	317.9	Mg	285.2	Te	238.5
Cd	226.5	Mn	257.6	Th	401.9
Ce	418.6	Mo	202.0	Ti	334.9
Co	228.6	Na	588.9	Tl	190.7
Cr	267.7	Nb	309.4	Tm	313.1
Cu	324.7	Nd	430.3	U	409.0
Dy	340.7	Ni	231.6	V	292.4
Er	369.2	P	213.6	W	207.9
Eu	381.9	Pb	220.3	Y	321.6
Fe	259.9	Pr	422.2	Yb	328.9
Fe	271.4	Pt	203.6	Zn	213.8
Ga	294.3	Sb	217.5	Zr	339.1

Table 3.--Selected standard reference materials analyzed by the described ICAP-AES procedure

	USGS Basalt BCR-1		USGS Granodiorite GSP-1		Canadian Syenite Sy-2		USGS Basalt BHVO-1		USGS Shale SCO-1		Canadian Soil SO-1	
	Found	Lit. (1)	Found	Lit.(1)	Found	Lit.(1)	Found	Lit.(2)	Found	Lit.(2)	Found	Lit.(1)
Al(%)	7.3	7.26	8.0	8.08	6.6	6.41	7.3	7.30	7.3	7.21	9.5	9.38
Fe	9.3	9.38	3.2	3.01	4.5	4.39	8.2	8.49	3.5	3.59	6.7	5.99
Mg	1.7	2.10	0.6	0.59	1.6	1.63	4.1	4.30	1.6	1.61	2.3	2.31
Ca	5.0	4.98	1.5	1.45	5.7	5.70	8.1	8.18	1.9	1.87	1.8	1.80
Na	2.4	2.45	2.1	2.08	3.2	3.22	1.7	1.64	0.7	0.64	2.1	1.90
K	1.4	1.41	4.7	4.57	3.8	3.72	0.4	0.46	2.1	2.28	2.8	2.68
Ti	1.4	1.35	0.4	0.40	0.1	0.08	1.7	1.60	0.3	0.40	0.5	.53
P	0.17	0.16	0.14	0.12	0.20	0.19	0.12	0.12	0.09	0.10	0.07	0.06
Ag (ppm)	<2	0.04	<2	0.08	<2		<2		<2		<2	
As	<10	0.8	<10	0.1	10	18	<10	1.5	10		<10	1.9
Au	<4		<4		<4		<4		<4		<4	
Ba	660	680	1300	1300	430	460	130	142	550	580	970	900
Be	2	1.6	1	1	22	23	1	0.9	2	1.7	2	
Bi	<10	0.05	<10	0.04	<10		<10	0.01	<10	0.4	<10	
Cd	<2	0.09	<2	0.06	<2		<2	0.12	<2	0.15	<2	0.15
Ce	50	53	400	360	180	210	39	41	57	62	120	
Co	36	36	7	7.8	9	11	43	45	10	10	32	33
Cr	12	15	12	12	7	12	290	300	68	67	200	160
Cu	19	16	33	33	3	5	138	137	26	30	71	61
Ga	21	22	23	23	26	28	19	22	18	12	27	
Ge	<10	1.5	<10	0.9	<10		<10	1.6	<10	<1	<10	
La	30	27	160	195	70	88	20	17	30	35	58	56
Li	*	14	*	30	*	93	*	5	*	43	*	40
Mn	1400	1400	310	300	2300	2500	1300	1270	320	420	900	850
Mo	<2	1.5	<2	1.5	<2	3	<2	1	<2	1.3	<2	
Nb	20	19	30	23	24	23	25	19	10	9	11	

1) Abbey (1980)
2) Gladney and Goode (1981)
* Li not determined on these standards.

Table 3.--Selected standard reference materials analyzed by the described ICAP-AES procedure (continued)

	USGS Basalt BCR-1		USGS Granodiorite GSP-1		Canadian Syenite Sy-2		USGS Basalt BHVO-1		USGS Shale SCO-1		Canadian Soil SO-1	
	Found	Lit. (1)	Found	Lit.(1)	Found	Lit.(1)	Found	Lit.(2)	Found	Lit.(2)	Found	Lit.(1)
Ni	12	10	8	9	8	10	120	117	27	28	102	94
Pb	8	14	52	54	70	80	<4	4	22	29	23	20
Sc	36	33	8	6.6	8	7	32	30	13	11	22	
Sn	<4	2.5	<4	5	<4	4	<4	2	<4	4.1	5	
Sr	330	330	230	240	270	275	400	440	170	188	360	300
Ta	<40	0.8	<40	1	<40		<40	1	<40	1	<40	
Th	4	6.1	90	105	200	380	<4	1	8	10	10	
U	<40	1.7	<40	2.1	290	290	<40	0.4	<40	3	<40	
V	430	420	57	54	52	52	330	314	130	122	150	140
Y	37	40	21	29	120	130	28	28	25	26	23	24
Zn	130	125	110	105	260	250	110	102	100	106	160	145
Pr	<10	7	45	50	20		<10	5.6	<10	5.4	15	
Nd	27	26	190	190	72	71	25	24	28	26	38	
Sm	<50	6.5	<50	25	<50	15	<50	6.1	<50	5.3	<50	
Eu	2	2.0	2	2.4	2	2.4	2	2.0	<2	1.2	2	
Gd	<10	6.6	10	15	<10	2.6	<10	7	<10	5	<10	
Tb	<20	1.0	<20	1.4	<20	2	<20	1.0	<20	0.8	<20	
Dy	6	7	6	5.7	16	20	4	4.8	5	3.8	8	
Ho	<4	1.2	<4		5		<4	0.94	<4	0.93	<4	
Er	<4	3.5	<4	3	13	12	<4	2.0	<4	2.5	<4	
Yb	4	3.4	2	1.9	18	17	3	2.1	3	2.6		

1) Abbey (1980)
2) Gladney and Goode (1981)

Table 4.--Rock sample descriptions

Lab Number	Field Number	Sample Description
D-245568	W-1-82	Tuff
D-245569	W-2-82	Tuff
D-245570	W-5A-82	Gray Tuff
D-245571	W-5B-82	Buff Tuff
D-245572	W-6-82	Buff Tuff
D-245573	W-8-82	Buff Tuff
D-245574	W-10-82	Porphyry
D-245575	W-13-82	Porphyry
D-245576	W-15-82	Red Porphyry
D-245577	W-28C-82	Red Porphyry
D-245578	W-31-82	Rhyolite
D-245579	W-33-82	Gray Porphyry
D-245580	W-35-83	Buff Tuff
D-245581	W-36-82	Gray Tuff
D-245582	W-37-82	Dark Brittle Tuff With Obsidian
D-245583	W-38-82	Tuff
D-245584	W-39-82	Tuff
D-245585	W-40-82	Tuff
D-245586	W-41-82	Tuff
D-245587	W-42-82	Dark Porphyry
D-245588	W-43-82	Dark Porphyry
D-245589	W-50-82	Dark Porphyry
D-245590	W-52-82	Buff Tuff

Table 5.--ICAP-AES detection limits

Elements and detection limits reported for ICP-AES semi-quantitative analysis* from an acid digestion and the detection limit by the 6-step visual spectrographic method (1)

Element	ICP-AES Detection Limit	6-Step Detection Limit	Element	Detection Limit	6-Step Detection Limit
Al%	.05	.01	Mn µg/g	4	1
Fe	.05	.001	Mo	2	3
Mg	.05	.002	Nb	4	10
Ca	.05	.002	Ni	2	5
Na	.1	.05	Pb	4	10
K	.1	.7	Sc	2	5
Ti	.01	.0002	Sn	4	10
P	.01	.2	Sr	2	5
Ag µg/g	2	0.5	Th	4	200
As	10	1000	U	40	500
Au	4	20	V	1	7
Ba	1	2	Y	2	10
Be	1	1.5	Yb	1	1
Bi	10	10	Zn	2	300
Cd	2	50	Pr	10	100
Ce	4	200	Nd	4	70
Co	1	5	Sm	50	100
Cr	1	1	Eu	2	100
Cu	1	1	Gd	10	50
Ga	4	5	Tb	20	300
Ge	10	10	Dy	4	50
La	2	50	Ho	4	20
Li	2	100	Er	4	50

*For granites and a dilution factor of 50 (0.200 g sample dissolved in 10.00 g solution). Elements and/or detection limits may change for non-silicates or highly mineralized samples.

(1) Revised in 1972 from Myers et al., 1961.

Table 6.--Stream sediment sample results

LAB NO.		D-245601	D-245602	D-245603	D-245604	D-245605	D-245606	D-245607	D-245608
FIELD NO.		W-3-82	W-4A-82	W-7-82	W-9-82	W-10-82	W-12A-82	W-14-82	W-16-82
AL	%-S	9.2	10.	6.9	7.6	7.6	8.3	9.9	8.3
FE	%-S	7.6	6.5	2.4	1.7	11.	3.7	2.5	2.6
MG	%-S	1.1	1.2	0.50	0.48	0.55	0.61	0.95	0.54
CA	%-S	3.7	4.2	1.2	1.1	1.8	2.0	3.5	1.3
NA	%-S	2.4	2.7	1.4	1.8	2.3	2.1	2.7	2.3
K	%-S	1.9	1.6	2.4	3.3	2.5	2.5	2.3	3.5
TI	%-S	0.55	0.53	0.23	0.16	0.70	0.34	0.29	0.31
P	%-S	0.15	0.15	0.09	0.03	0.07	0.06	0.1	0.06
AG	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.
AS	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
AU	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
B	PPM-S	-	-	-	-	-	-	-	-
BA	PPM-S	1000.	970.	560.	500.	970.	1200.	1400.	1300.
BE	PPM-S	2.	2.	3.	3.	2.	3.	2.	2.
BI	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
CD	PPM-S	<2.	2.	<2.	<2.	<2.	<2.	<2.	<2.
CE	PPM-S	93.	81.	67.	75.	100.	85.	82.	80.
CO	PPM-S	19.	18.	8.	5.	21.	10.	9.	9.
CR	PPM-S	13.	11.	11.	4.	20.	9.	4.	9.
CU	PPM-S	14.	12.	11.	7.	11.	8.	9.	12.
GA	PPM-S	25.	24.	18.	18.	27.	23.	19.	19.
GE	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
LA	PPM-S	50.	47.	36.	44.	59.	51.	49.	46.
LI	PPM-S	17.	16.	23.	25.	23.	20.	17.	20.
MN	PPM-S	1600.	1500.	1300.	980.	2700.	930.	860.	980.
MO	PPM-S	<2.	<2.	3.	3.	4.	<2.	<2.	<2.
NB	PPM-S	14.	13.	20.	23.	26.	18.	11.	19.
NI	PPM-S	5.	4.	6.	2.	8.	3.	3.	5.
PB	PPM-S	24.	21.	31.	34.	32.	27.	19.	30.
SC	PPM-S	11.	12.	6.	3.	8.	7.	8.	8.
SN	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
SR	PPM-S	810.	950.	240.	240.	450.	500.	850.	320.
TA	PPM-S	<40.	<40.	<40.	<40.	<40.	<40.	<40.	<40.
TH	PPM-S	12.	9.	15.	14.	15.	13.	8.	15.
U	PPM-S	<40.	<40.	<40.	<40.	<40.	<40.	<40.	<40.
V	PPM-S	180.	170.	41.	29.	240.	83.	50.	52.
W	PPM-S	-	-	-	-	-	-	-	-
Y	PPM-S	27.	26.	22.	25.	31.	26.	23.	26.
ZN	PPM-S	99.	88.	45.	42.	200.	67.	33.	50.
ZR	PPM-S	-	-	-	-	-	-	-	-
PR	PPM-S	10.	10.	<10.	<10.	10.	10.	<10.	10.
ND	PPM-S	47.	42.	32.	28.	50.	41.	38.	39.
SM	PPM-S	10.	10.	<10.	<10.	10.	10.	<10.	<10.
EU	PPM-S	2.	2.	<2.	<2.	<2.	<2.	2.	<2.
GD	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
TB	PPM-S	<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
DY	PPM-S	8.	9.	6.	<4.	9.	7.	5.	6.
HO	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
ER	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
TM	PPM-S	-	-	-	-	-	-	-	-
YB	PPM-S	2.	2.	2.	2.	3.	2.	2.	3.
LU	PPM-S	-	-	-	-	-	-	-	-

Table 6.--Stream sediment samples results (continued)

LAB NO. / FIELD NO.		D-245609 W-17A-82	D-245610 W-18-82	D-245611 W-19A-82	D-245612 W-20A-82	D-245613 W-21-82	D-245614 W-22-82	D-245615 W-23-82	D-245616 W-24-82
AL	%-S	9.4	8.8	7.9	8.0	7.1	7.7	7.8	6.7
FE	%-S	5.2	3.9	3.7	2.2	2.4	5.6	3.1	1.5
MG	%-S	0.86	1.1	0.45	0.40	0.68	0.61	0.53	0.47
CA	%-S	3.7	2.8	1.6	1.5	1.8	1.8	1.8	1.3
NA	%-S	2.9	2.2	2.3	2.8	1.3	2.2	1.9	0.88
K	%-S	2.1	2.6	3.6	4.2	2.6	3.2	3.1	3.2
TI	%-S	0.46	0.40	0.35	0.28	0.25	0.50	0.34	0.16
P	%-S	0.1	0.10	0.07	0.05	0.05	0.09	0.07	0.04
AG	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.
AS	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	10.	20.
AU	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	4.	<4.
B	PPM-S	-	-	-	-	-	-	-	-
BA	PPM-S	1600.	1300.	1200.	1600.	950.	1300.	1200.	1200.
BE	PPM-S	2.	2.	2.	2.	2.	2.	2.	2.
BI	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
CD	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.
CE	PPM-S	60.	85.	83.	72.	80.	94.	82.	73.
CO	PPM-S	15.	13.	11.	8.	9.	14.	12.	6.
CR	PPM-S	8.	6.	7.	4.	11.	11.	14.	5.
CU	PPM-S	10.	12.	11.	9.	18.	11.	18.	10.
GA	PPM-S	23.	20.	20.	19.	17.	21.	18.	16.
GE	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
LA	PPM-S	39.	49.	45.	41.	48.	55.	48.	44.
LI	PPM-S	15.	21.	16.	22.	43.	19.	26.	43.
MN	PPM-S	1200.	1200.	1200.	770.	900.	1300.	1100.	490.
MO	PPM-S	<2.	<2.	<2.	<2.	2.	<2.	<2.	4.
NB	PPM-S	12.	15.	20.	19.	16.	20.	15.	13.
NI	PPM-S	4.	3.	5.	3.	5.	4.	9.	4.
PB	PPM-S	21.	23.	28.	24.	29.	24.	27.	21.
SC	PPM-S	8.	11.	6.	5.	7.	8.	8.	5.
SN	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
SR	PPM-S	860.	630.	390.	420.	420.	430.	430.	390.
TA	PPM-S	<40.	<40.	<40.	<40.	<40.	<40.	<40.	<40.
TH	PPM-S	8.	10.	15.	16.	16.	13.	13.	17.
U	PPM-S	<40.	<40.	<40.	<40.	<40.	<40.	<40.	40.
V	PPM-S	120.	87.	66.	39.	48.	120.	74.	32.
W	PPM-S	-	-	-	-	-	-	-	-
Y	PPM-S	20.	26.	25.	20.	29.	26.	25.	21.
ZN	PPM-S	73.	57.	47.	36.	43.	93.	34.	30.
ZR	PPM-S	-	-	-	-	-	-	-	-
PR	PPM-S	<10.	10.	10.	<10.	<10.	<10.	10.	<10.
ND	PPM-S	33.	41.	44.	36.	33.	45.	37.	31.
SM	PPM-S	<10.	10.	10.	<10.	<10.	<10.	<10.	<10.
EU	PPM-S	2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.
GD	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
TB	PPM-S	<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
DY	PPM-S	6.	8.	8.	5.	6.	8.	7.	5.
HO	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
ER	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
TM	PPM-S	-	-	-	-	-	-	-	-
YB	PPM-S	2.	2.	2.	2.	3.	2.	2.	2.
LU	PPM-S	-	-	-	-	-	-	-	-

Table 6.--Stream sediment samples results (continued)

LAB NO.		D-245617	D-245618	D-245619	D-245620	D-245621	D-245622	D-245623	D-245624
FIELD NO.		W-25-82	W-26A-82	W-27A-82	W-28A-82	W-29-82	W-30-82	W-32-82	W-34-82
AL	%-S	9.3	7.5	7.9	8.2	7.8	7.2	6.1	8.1
FE	%-S	7.8	2.0	4.2	2.5	3.1	5.9	17.	11.
MG	%-S	1.6	0.61	0.48	0.43	0.41	0.31	0.62	1.2
CA	%-S	4.2	1.8	2.0	1.7	1.2	1.0	0.85	3.1
NA	%-S	2.5	1.7	2.3	2.4	2.4	2.5	0.59	2.1
K	%-S	1.5	2.4	3.2	3.7	4.3	4.2	0.99	2.0
TI	%-S	0.62	0.22	0.35	0.27	0.29	0.40	0.28	0.78
P	%-S	0.13	0.09	0.07	0.05	0.07	0.08	0.19	0.16
AG	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.
AS	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	20.	<10.
AU	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
B	PPM-S	-	-	-	-	-	-	-	-
BA	PPM-S	810.	1100.	1000.	1400.	1600.	1500.	730.	1100.
BE	PPM-S	2.	2.	2.	2.	2.	2.	3.	2.
BI	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
CD	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.
CE	PPM-S	75.	85.	68.	58.	68.	77.	100.	120.
CO	PPM-S	20.	8.	13.	9.	11.	17.	130.	25.
CR	PPM-S	14.	7.	8.	6.	5.	13.	28.	18.
CU	PPM-S	15.	10.	12.	10.	8.	10.	25.	16.
GA	PPM-S	25.	16.	21.	19.	19.	23.	24.	26.
GE	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
LA	PPM-S	40.	52.	37.	35.	41.	45.	26.	65.
LI	PPM-S	17.	21.	16.	17.	17.	15.	22.	16.
MN	PPM-S	1700.	890.	1000.	800.	1600.	1600.	9400.	2300.
MO	PPM-S	3.	<2.	<2.	<2.	<2.	2.	4.	4.
NB	PPM-S	17.	14.	19.	17.	19.	21.	12.	21.
NI	PPM-S	9.	3.	6.	4.	<2.	7.	12.	8.
PB	PPM-S	21.	26.	24.	24.	23.	29.	31.	27.
SC	PPM-S	17.	8.	6.	4.	4.	5.	10.	14.
SN	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
SR	PPM-S	850.	390.	440.	440.	350.	280.	170.	660.
TA	PPM-S	<40.	<40.	<40.	<40.	<40.	<40.	<40.	<40.
TH	PPM-S	8.	12.	14.	11.	15.	15.	17.	9.
U	PPM-S	<40.	40.	<40.	<40.	<40.	<40.	40.	<40.
V	PPM-S	190.	35.	66.	45.	46.	100.	190.	260.
W	PPM-S	-	-	-	-	-	-	-	-
Y	PPM-S	32.	22.	23.	18.	19.	22.	14.	31.
ZN	PPM-S	99.	32.	47.	33.	45.	79.	12.	150.
ZR	PPM-S	-	-	-	-	-	-	-	-
PR	PPM-S	10.	<10.	<10.	<10.	<10.	<10.	<10.	20.
ND	PPM-S	43.	36.	31.	26.	32.	41.	26.	54.
SM	PPM-S	10.	<10.	<10.	<10.	<10.	10.	<10.	10.
EU	PPM-S	2.	<2.	<2.	<2.	<2.	<2.	<2.	2.
GD	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
TB	PPM-S	<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
DY	PPM-S	11.	5.	8.	5.	<4.	8.	10.	10.
HO	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
ER	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
TM	PPM-S	-	-	-	-	-	-	-	-
YB	PPM-S	3.	2.	2.	2.	2.	2.	2.	3.
LU	PPM-S	-	-	-	-	-	-	-	-

Table 6.--Stream sediment samples results (continued)

LAB NO. / FIELD NO.		D-245625 W-44-82	D-245626 W-45-82	D-245627 W-46-82	D-245628 W-47-82	D-245629 W-48A-82	D-245630 W-49-82	D-245631 W-51-82	D-245632 W-53-82
AL	%-S	7.9	7.9	8.2	7.3	7.7	7.2	8.6	8.2
FE	%-S	2.7	3.7	3.2	2.9	3.1	3.5	2.5	2.3
MG	%-S	0.59	0.63	0.55	0.47	0.46	0.63	0.44	0.47
CA	%-S	1.8	1.9	2.1	1.4	2.1	1.7	1.8	1.6
NA	%-S	2.0	2.0	2.4	1.9	2.5	1.6	2.7	2.4
K	%-S	2.8	3.1	3.0	3.1	3.3	2.0	3.1	2.6
TI	%-S	0.26	0.33	0.29	0.24	0.30	0.34	0.28	0.24
P	%-S	0.08	0.08	0.07	0.09	0.06	0.09	0.03	0.04
AG	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.
AS	PPM-S	10.	10.	<10.	<10.	<10.	<10.	<10.	<10.
AU	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
B	PPM-S	-	-	-	-	-	-	-	-
BA	PPM-S	860.	890.	930.	1100.	1000.	800.	4000.	1400.
BE	PPM-S	2.	2.	2.	2.	2.	2.	2.	3.
BI	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
CD	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.
CE	PPM-S	66.	92.	56.	72.	53.	70.	88.	62.
CO	PPM-S	11.	12.	10.	11.	11.	11.	15.	11.
CR	PPM-S	7.	6.	7.	6.	5.	13.	7.	9.
CU	PPM-S	14.	12.	11.	11.	11.	15.	7.	9.
GA	PPM-S	18.	19.	18.	17.	21.	17.	23.	22.
GE	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
LA	PPM-S	40.	51.	35.	42.	30.	40.	46.	34.
LI	PPM-S	17.	17.	17.	18.	16.	22.	19.	27.
MN	PPM-S	790.	840.	720.	1800.	690.	980.	2300.	1700.
MO	PPM-S	<2.	<2.	<2.	3.	2.	<2.	2.	<2.
NB	PPM-S	10.	19.	15.	16.	17.	16.	17.	19.
NI	PPM-S	6.	5.	8.	5.	3.	6.	5.	6.
PB	PPM-S	31.	23.	22.	26.	25.	25.	37.	34.
SC	PPM-S	7.	8.	6.	6.	5.	7.	6.	6.
SN	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
SR	PPM-S	410.	430.	470.	320.	460.	370.	630.	420.
TA	PPM-S	<40.	<40.	<40.	<40.	<40.	<40.	<40.	<40.
TH	PPM-S	14.	15.	10.	12.	12.	12.	11.	13.
U	PPM-S	<40.	<40.	<40.	50.	<40.	<40.	50.	<40.
V	PPM-S	55.	72.	61.	47.	60.	71.	45.	49.
W	PPM-S	-	-	-	-	-	-	-	-
Y	PPM-S	20.	28.	20.	23.	20.	24.	16.	16.
ZN	PPM-S	42.	43.	39.	40.	31.	50.	47.	45.
ZR	PPM-S	-	-	-	-	-	-	-	-
PR	PPM-S	<10.	10.	<10.	<10.	<10.	10.	10.	<10.
ND	PPM-S	28.	43.	28.	29.	27.	34.	35.	27.
SM	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	10.	<10.
EU	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	3.	<2.
GD	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
TB	PPM-S	<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
DY	PPM-S	6.	9.	4.	5.	5.	8.	6.	5.
HO	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
ER	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
TM	PPM-S	-	-	-	-	-	-	-	-
YB	PPM-S	2.	3.	2.	2.	2.	2.	2.	2.
LU	PPM-S	-	-	-	-	-	-	-	-

Table 6.--Stream sediment samples results (continued)

LAB NO.		D-245633
FIELD NO.		W-54-82
AL	%-S	7.8
FE	%-S	2.6
MG	%-S	0.64
CA	%-S	1.5
NA	%-S	1.8
K	%-S	2.3
TI	%-S	0.26
P	%-S	0.08
AG	PPM-S	<2.
AS	PPM-S	<10.
AU	PPM-S	<4.
B	PPM-S	-
BA	PPM-S	720.
BE	PPM-S	3.
BI	PPM-S	<10.
CD	PPM-S	<2.
CE	PPM-S	74.
CO	PPM-S	10.
CR	PPM-S	11.
CU	PPM-S	11.
GA	PPM-S	20.
GE	PPM-S	<10.
LA	PPM-S	40.
LI	PPM-S	29.
MN	PPM-S	1400.
MO	PPM-S	<2.
NB	PPM-S	18.
NI	PPM-S	8.
PB	PPM-S	30.
SC	PPM-S	7.
SN	PPM-S	<4.
SR	PPM-S	320.
TA	PPM-S	<40.
TH	PPM-S	17.
U	PPM-S	<40.
V	PPM-S	55.
W	PPM-S	-
Y	PPM-S	26.
ZN	PPM-S	54.
ZR	PPM-S	-
PR	PPM-S	10.
ND	PPM-S	34.
SM	PPM-S	10.
EU	PPM-S	<2.
GD	PPM-S	<10.
TB	PPM-S	<20.
DY	PPM-S	9.
HO	PPM-S	<4.
ER	PPM-S	<4.
TM	PPM-S	-
YB	PPM-S	3.
LU	PPM-S	-

Table 7.--Pan concentrated samples results

LAB NO. / FIELD NO.		D-245591 W-4B-82	D-245592 W-12B-82	D-245593 W-16B-82	D-245594 W-17B-82	D-245595 W-19B-82	D-245596 W-20B-82	D-245597 W-26B-82	D-245598 W-27B-82
AL	%-S	7.2	5.2	7.9	5.2	5.2	4.6	8.3	4.4
FE	%-S	19.	33.	5.6	33.	29.	32.	11.	33.
MG	%-S	1.9	1.0	0.59	1.0	0.62	0.58	0.65	0.77
CA	%-S	4.0	2.2	1.3	2.2	1.9	1.8	2.7	2.1
NA	%-S	1.9	1.4	2.5	1.5	1.5	1.4	2.6	1.2
K	%-S	1.2	0.89	4.0	0.90	1.4	1.4	2.1	0.86
TI	%-S	1.3	2.2	0.59	2.1	2.0	2.6	0.83	1.8
P	%-S	0.30	0.13	0.07	0.13	0.16	0.23	0.09	0.21
AG	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.
AS	PPM-S	<10.	<10.	<10.	10.	<10.	10.	<10.	<10.
AU	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
B	PPM-S	-	-	-	-	-	-	-	-
BA	PPM-S	700.	600.	1400.	610.	730.	940.	1400.	390.
BE	PPM-S	2.	2.	2.	2.	2.	2.	2.	1.
BI	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
CD	PPM-S	<2.	2.	<2.	<2.	<2.	<2.	<2.	2.
CE	PPM-S	150.	140.	83.	160.	160.	130.	210.	240.
CO	PPM-S	40.	55.	16.	53.	50.	52.	22.	63.
CR	PPM-S	33.	72.	16.	70.	48.	54.	21.	55.
CU	PPM-S	20.	22.	13.	23.	29.	32.	15.	32.
GA	PPM-S	34.	44.	23.	46.	39.	38.	25.	44.
GE	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
LA	PPM-S	73.	73.	46.	89.	78.	65.	110.	100.
LI	PPM-S	14.	9.	16.	8.	13.	13.	11.	10.
MN	PPM-S	3600.	5300.	1400.	5200.	4000.	5300.	1600.	3700.
MO	PPM-S	<2.	<2.	<2.	<2.	6.	4.	4.	6.
NB	PPM-S	25.	40.	23.	39.	60.	66.	30.	61.
NI	PPM-S	12.	14.	6.	16.	19.	17.	7.	24.
PB	PPM-S	28.	40.	27.	39.	35.	50.	26.	29.
SC	PPM-S	25.	20.	8.	20.	15.	19.	14.	14.
SN	PPM-S	<4.	10.	<4.	8.	12.	14.	<4.	9.
SR	PPM-S	650.	440.	330.	430.	350.	340.	630.	290.
TA	PPM-S	<40.	<40.	<40.	<40.	<40.	<40.	<40.	<40.
TH	PPM-S	9.	14.	14.	18.	14.	17.	14.	17.
U	PPM-S	<40.	<40.	<40.	<40.	<40.	<40.	<40.	<40.
V	PPM-S	510.	820.	150.	810.	530.	660.	220.	460.
W	PPM-S	-	-	-	-	-	-	-	-
Y	PPM-S	47.	40.	23.	38.	55.	43.	39.	88.
ZN	PPM-S	280.	510.	110.	500.	400.	500.	140.	320.
ZR	PPM-S	-	-	-	-	-	-	-	-
PR	PPM-S	20.	10.	<10.	20.	10.	20.	30.	30.
ND	PPM-S	79.	78.	35.	89.	87.	69.	94.	130.
SM	PPM-S	20.	20.	<10.	20.	20.	20.	20.	30.
EU	PPM-S	3.	3.	<2.	3.	3.	2.	3.	4.
GD	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
TB	PPM-S	<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
DY	PPM-S	15.	19.	5.	20.	19.	17.	10.	29.
HO	PPM-S	4.	6.	<4.	5.	5.	6.	<4.	7.
ER	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
TM	PPM-S	-	-	-	-	-	-	-	-
YB	PPM-S	4.	4.	2.	4.	5.	4.	4.	8.
LU	PPM-S	-	-	-	-	-	-	-	-

Table 7.--Pan concentrated samples results (continued)

LAB NO.		D-245599	D-245600
FIELD NO.		W-28B-82	W-48B-82
AL	%-S	6.9	7.8
FE	%-S	18.	11.
MG	%-S	0.64	0.61
CA	%-S	2.4	2.6
NA	%-S	2.1	2.4
K	%-S	1.7	2.1
TI	%-S	1.3	0.73
P	%-S	0.11	0.09
AG	PPM-S	<2.	<2.
AS	PPM-S	<10.	<10.
AU	PPM-S	<4.	<4.
B	PPM-S	-	-
BA	PPM-S	870.	850.
BE	PPM-S	2.	2.
BI	PPM-S	<10.	<10.
CD	PPM-S	<2.	<2.
CE	PPM-S	170.	150.
CO	PPM-S	32.	22.
CR	PPM-S	28.	17.
CU	PPM-S	18.	13.
GA	PPM-S	30.	27.
GE	PPM-S	<10.	<10.
LA	PPM-S	73.	67.
LI	PPM-S	15.	16.
MN	PPM-S	2400.	1200.
MO	PPM-S	3.	<2.
NB	PPM-S	48.	34.
NI	PPM-S	10.	9.
PB	PPM-S	28.	20.
SC	PPM-S	11.	9.
SN	PPM-S	6.	<4.
SR	PPM-S	490.	550.
TA	PPM-S	<40.	<40.
TH	PPM-S	15.	13.
U	PPM-S	<40.	<40.
V	PPM-S	330.	210.
W	PPM-S	-	-
Y	PPM-S	60.	55.
ZN	PPM-S	230.	99.
ZR	PPM-S	-	-
PR	PPM-S	20.	20.
ND	PPM-S	90.	83.
SM	PPM-S	20.	20.
EU	PPM-S	3.	3.
GD	PPM-S	<10.	<10.
TB	PPM-S	<20.	<20.
DY	PPM-S	18.	16.
HO	PPM-S	<4.	<4.
ER	PPM-S	<4.	4.
TM	PPM-S	-	-
YB	PPM-S	5.	5.
LU	PPM-S	-	-

Table 8.--Rock samples results

LAB NO. FIELD NO.		D-245568 W-1-82	D-245569 W-2-82	D-245570 W-5A-82	D-245571 W-5B-82	D-245572 W-6-82	D-245573 W-8-82	D-245574 W-10-82	D-245575 W-13-82
AL	%-S	7.8	7.6	9.3	7.2	7.6	7.1	8.5	8.5
FE	%-S	1.4	1.2	3.7	1.3	1.3	1.0	3.9	3.9
MG	%-S	0.41	0.44	1.3	0.63	0.61	0.41	0.98	1.3
CA	%-S	1.1	1.1	3.3	1.4	1.2	0.85	3.0	3.0
NA	%-S	1.9	1.9	2.1	1.5	1.5	1.8	2.4	2.3
K	%-S	4.3	4.4	2.6	4.1	3.9	4.5	3.3	3.5
TI	%-S	0.18	0.16	0.36	0.14	0.13	0.11	0.42	0.44
P	%-S	0.12	0.06	0.17	0.05	0.05	0.04	0.15	0.14
AG	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.
AS	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
AU	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
B	PPM-S	--	--	--	--	--	--	--	--
BA	PPM-S	2000.	1300.	750.	450.	350.	280.	1000.	1000.
BE	PPM-S	3.	2.	2.	3.	4.	4.	2.	2.
BI	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
CD	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.
CE	PPM-S	110.	110.	84.	75.	76.	75.	84.	90.
CO	PPM-S	6.	4.	13.	4.	4.	3.	17.	16.
CR	PPM-S	3.	2.	5.	2.	2.	<1.	14.	19.
CU	PPM-S	5.	4.	22.	6.	5.	6.	58.	16.
GA	PPM-S	16.	18.	20.	17.	21.	18.	20.	19.
GE	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
LA	PPM-S	62.	64.	46.	41.	41.	40.	48.	53.
LI	PPM-S	19.	19.	24.	25.	19.	24.	12.	10.
MN	PPM-S	790.	730.	930.	750.	800.	820.	990.	930.
MO	PPM-S	3.	5.	<2.	<2.	3.	5.	<2.	2.
NB	PPM-S	18.	19.	15.	22.	25.	26.	15.	15.
NI	PPM-S	4.	<2.	3.	4.	<2.	5.	13.	11.
PB	PPM-S	27.	25.	21.	27.	33.	34.	19.	21.
SC	PPM-S	7.	7.	10.	4.	4.	3.	11.	11.
SN	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
SR	PPM-S	270.	240.	660.	320.	300.	160.	610.	610.
TA	PPM-S	<40.	<40.	<40.	<40.	<40.	<40.	<40.	<40.
TH	PPM-S	17.	16.	11.	13.	18.	23.	12.	15.
U	PPM-S	<40.	<40.	<40.	<40.	<40.	<40.	<40.	<40.
V	PPM-S	15.	11.	80.	22.	20.	14.	110.	110.
W	PPM-S	--	--	--	--	--	--	--	--
Y	PPM-S	28.	28.	27.	25.	25.	25.	23.	23.
ZN	PPM-S	35.	31.	45.	29.	35.	32.	42.	44.
ZR	PPM-S	--	--	--	--	--	--	--	--
PR	PPM-S	10.	10.	<10.	<10.	10.	10.	<10.	10.
ND	PPM-S	51.	49.	38.	30.	32.	27.	38.	43.
SM	PPM-S	10.	10.	<10.	<10.	10.	<10.	<10.	10.
EU	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.
GD	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
TB	PPM-S	<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
DY	PPM-S	5.	6.	6.	<4.	5.	<4.	4.	7.
HO	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
ER	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
TM	PPM-S	--	--	--	--	--	--	--	--
YB	PPM-S	2.	2.	2.	2.	2.	3.	2.	2.
LU	PPM-S	--	--	--	--	--	--	--	--

Table 8.--Rock samples results (continued)

LAB NO. / FIELD NO.		D-245576 W-15-82	D-245577 W-28C-82	D-245578 W-31-82	D-245579 W-33-82	D-245580 W-35-82	D-245581 W-36-82	D-245582 W-37-82	D-245583 W-38-82
AL	%-S	8.3	8.2	7.1	8.4	7.9	7.8	8.4	8.8
FE	%-S	1.6	1.8	1.5	4.3	1.4	1.3	3.0	3.9
MG	%-S	0.35	0.42	0.22	1.2	0.81	0.58	0.85	1.1
CA	%-S	1.3	1.4	0.70	3.1	1.2	1.2	2.5	3.2
NA	%-S	2.9	3.0	3.1	2.4	1.8	1.9	2.3	2.2
K	%-S	4.9	5.1	5.6	3.4	4.0	4.3	3.3	2.5
TI	%-S	0.23	0.24	0.23	0.47	0.18	0.18	0.30	0.35
P	%-S	0.05	0.06	0.04	0.15	0.04	0.03	0.12	0.14
AG	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.
AS	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
AU	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
B	PPM-S	-	-	-	-	-	-	-	-
BA	PPM-S	1400.	1500.	850.	1100.	1600.	1600.	900.	860.
BE	PPM-S	2.	2.	3.	2.	2.	2.	2.	2.
BI	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
CD	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.
CE	PPM-S	84.	80.	79.	81.	110.	110.	84.	74.
CO	PPM-S	5.	6.	5.	18.	5.	4.	11.	13.
CR	PPM-S	1.	2.	1.	17.	3.	2.	4.	6.
CU	PPM-S	5.	8.	6.	33.	7.	5.	17.	19.
GA	PPM-S	18.	22.	20.	18.	19.	18.	19.	21.
GE	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
LA	PPM-S	47.	40.	40.	49.	65.	62.	47.	43.
LI	PPM-S	16.	16.	18.	16.	25.	20.	11.	21.
MN	PPM-S	710.	470.	700.	1100.	780.	740.	910.	980.
MO	PPM-S	3.	<2.	4.	<2.	3.	4.	2.	2.
NB	PPM-S	19.	19.	27.	13.	18.	18.	15.	13.
NI	PPM-S	<2.	<2.	<2.	11.	2.	<2.	5.	6.
PB	PPM-S	24.	24.	35.	17.	28.	26.	23.	17.
SC	PPM-S	5.	6.	4.	12.	7.	7.	7.	9.
SN	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
SR	PPM-S	350.	390.	170.	600.	320.	310.	530.	660.
TA	PPM-S	<40.	<40.	<40.	<40.	<40.	<40.	<40.	<40.
TH	PPM-S	17.	19.	20.	11.	17.	14.	13.	15.
U	PPM-S	<40.	<40.	<40.	<40.	<40.	<40.	<40.	<40.
V	PPM-S	23.	26.	18.	120.	18.	14.	67.	91.
W	PPM-S	-	-	9.	-	-	-	-	-
Y	PPM-S	21.	19.	19.	24.	28.	28.	24.	24.
ZN	PPM-S	34.	39.	45.	50.	32.	32.	43.	52.
ZR	PPM-S	-	-	-	-	-	-	-	-
PR	PPM-S	10.	10.	10.	10.	10.	20.	<10.	<10.
ND	PPM-S	38.	41.	37.	42.	48.	49.	38.	37.
SM	PPM-S	10.	10.	10.	10.	10.	10.	<10.	<10.
EU	PPM-S	<2.	<2.	<2.	<2.	2.	<2.	<2.	<2.
GD	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
TB	PPM-S	<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
DY	PPM-S	6.	7.	<4.	6.	7.	6.	6.	5.
HO	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
ER	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.	<4.
TM	PPM-S	-	-	-	-	-	-	-	-
YB	PPM-S	2.	2.	2.	2.	2.	2.	2.	2.
LU	PPM-S	-	-	-	-	-	-	-	-

Table 8.--Rock samples results (continued)

LAB NO. FIELD NO.		D-245584 W-39-82	D-245585 W-40-82	D-245586 W-41-82	D-245587 W-42-82	D-245588 W-43-82	D-245589 W-50-82	D-245590 W-52-82
AL	%-S	7.0	6.9	7.8	7.6	7.5	8.6	7.5
FE	%-S	1.3	1.0	1.4	1.6	1.6	4.0	1.2
MG	%-S	0.48	0.59	0.43	0.28	0.28	0.92	0.57
CA	%-S	1.2	0.93	1.2	1.1	1.2	2.9	1.1
NA	%-S	2.0	1.5	2.2	3.0	2.8	2.4	1.8
K	%-S	3.9	3.8	4.3	4.4	4.6	3.3	4.2
TI	%-S	0.13	0.12	0.17	0.19	0.20	0.43	0.16
P	%-S	0.03	0.03	0.05	0.05	0.04	0.15	0.03
AG	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.
AS	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.
AU	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.
B	PPM-S	-	-	-	-	-	-	-
BA	PPM-S	310.	280.	850.	1200.	1300.	1000.	1400.
BE	PPM-S	3.	3.	3.	3.	3.	2.	3.
BI	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.
CD	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.
CE	PPM-S	70.	74.	94.	80.	80.	98.	110.
CO	PPM-S	4.	4.	5.	4.	5.	18.	4.
CR	PPM-S	3.	2.	1.	2.	1.	16.	2.
CU	PPM-S	6.	5.	5.	5.	4.	38.	5.
GA	PPM-S	20.	17.	18.	20.	18.	21.	15.
GE	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.
LA	PPM-S	39.	40.	51.	42.	42.	63.	61.
LI	PPM-S	24.	33.	32.	26.	23.	12.	29.
MN	PPM-S	850.	850.	760.	750.	800.	1000.	720.
MO	PPM-S	4.	2.	<2.	4.	5.	<2.	2.
NB	PPM-S	24.	23.	20.	23.	22.	14.	17.
NI	PPM-S	4.	<2.	<2.	2.	<2.	12.	<2.
PB	PPM-S	32.	29.	26.	33.	29.	20.	24.
SC	PPM-S	4.	3.	4.	5.	4.	12.	7.
SN	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.
SR	PPM-S	200.	130.	240.	260.	290.	630.	270.
TA	PPM-S	<40.	<40.	<40.	<40.	<40.	<40.	<40.
TH	PPM-S	16.	17.	21.	16.	32.	16.	17.
U	PPM-S	<40.	<40.	<40.	<40.	<40.	<40.	<40.
V	PPM-S	20.	13.	20.	21.	20.	110.	16.
W	PPM-S	9.	-	-	-	-	-	-
Y	PPM-S	24.	24.	28.	25.	25.	26.	29.
ZN	PPM-S	38.	35.	37.	45.	60.	51.	35.
ZR	PPM-S	-	-	-	-	-	-	-
PR	PPM-S	<10.	10.	10.	10.	10.	10.	10.
ND	PPM-S	28.	28.	42.	38.	40.	52.	50.
SM	PPM-S	<10.	<10.	<10.	10.	10.	10.	10.
EU	PPM-S	<2.	<2.	<2.	<2.	<2.	<2.	<2.
GD	PPM-S	<10.	<10.	<10.	<10.	<10.	<10.	<10.
TB	PPM-S	<20.	<20.	<20.	<20.	<20.	<20.	<20.
DY	PPM-S	4.	4.	6.	6.	7.	6.	7.
HO	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.
ER	PPM-S	<4.	<4.	<4.	<4.	<4.	<4.	<4.
TM	PPM-S	-	-	-	-	-	-	-
YB	PPM-S	3.	2.	3.	2.	3.	2.	3.
LU	PPM-S	-	-	-	-	-	-	-