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A STATISTICAL ANALYSIS OF GEOCHEMICAL DATA FROM ROCKS AND STREAM DEPOSITS IN THE HIGHLAND MOUNTAINS SILVER BOW AND MADISON COUNTIES, MONTANA

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ABSTRACT

Factor analysis of stream-sediment geochemical data proved a useful technique for defining different lithologic units and characteristic trace-element suites resulting from various hydrothermal processes. The analysis showed similarities between rock types that may reflect source provenances for the sedimentary rocks (for example, Co-Cr-Ni in Proterozoic Y and Proterozoic X rocks). Finally, the analysis indicated that some of the characteristic "ore" elements (for example, Mo, Sn) occur in rock-forming minerals as well as in the sulfide-mineral deposits.

INTRODUCTION

The Highland Mountains, Silver Bow and Madison Counties, Montana (fig. 1), have been the site of frequent mining activity for over a century, for the most part concentrated in five districts: Rochester, Silver Star, Highland (Fish Creek), Moose Creek, and Upper Camp Creek. There are several types of mineral deposits in the Highland Mountains including complex-sulfide precious-metal and base-metal veins, contact metasomatic, stockwork, replacement, syngenetic(?) sulfide and oxide, and sedimentary phosphate. Commodities include gold, silver, copper, chlorite, chrome, tungsten, and phosphate.

The purpose of this paper is to report the results of a statistical analysis of trace-element data from rocks and stream sediments collected as part of the geochemical evaluation of the mineral resources in the Dillon, Montana-Idaho, 1° x 2° quadrangle. The Dillon 1° x 2° quadrangle is a part of the Conterminous United States Mineral Assessment Program (CUSMAP) of the U.S. Geological Survey.

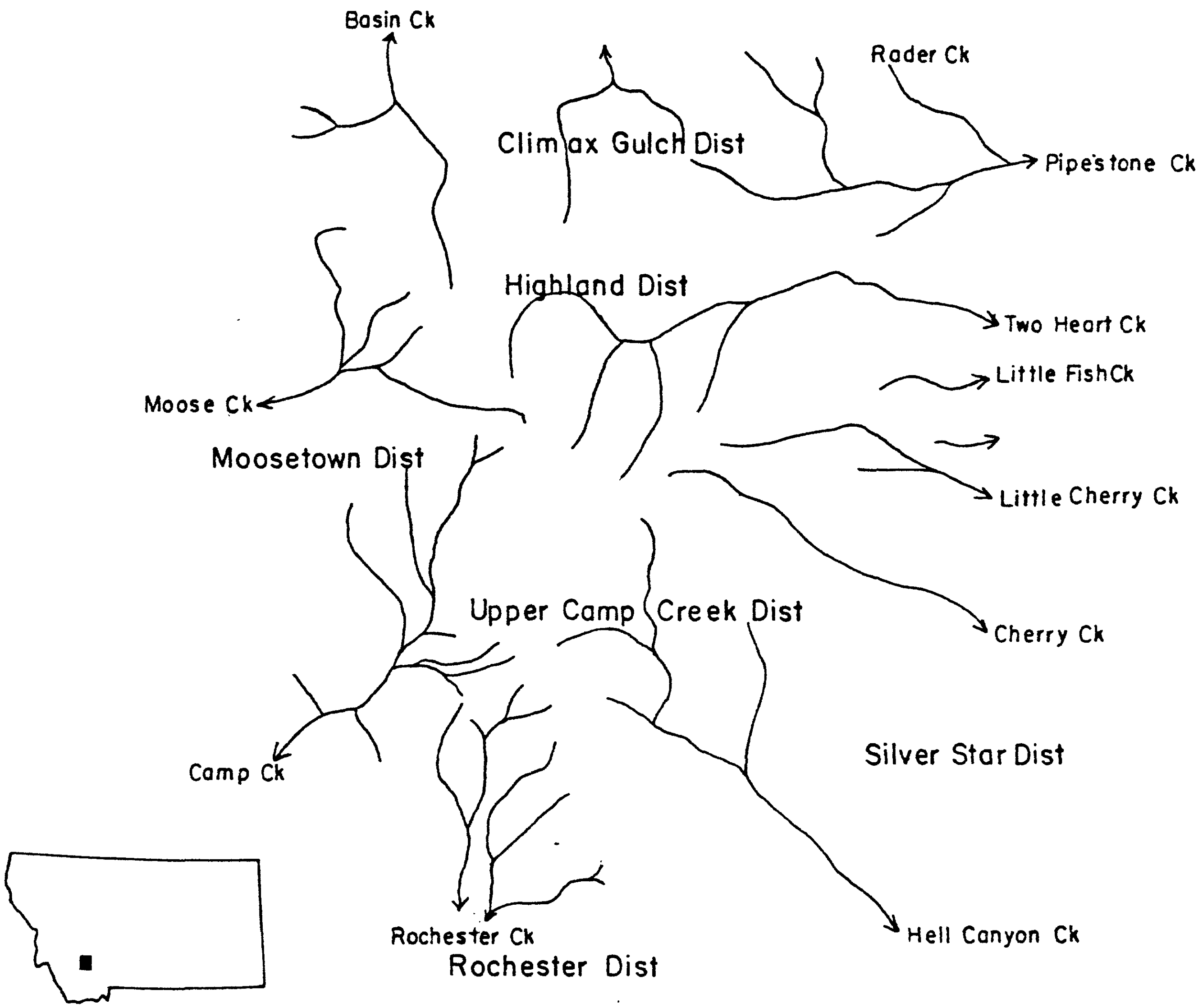


Figure 1. Index location map, major mining districts, and stream drainages in the Highland Mountains Silver Bow and Madison Counties, Montana.

GENERAL GEOLOGY

The Highland Mountains extend south from Butte and are bounded on the west by Divide Creek and the Big Hole River and on the east by the Jefferson River. The range consists mainly of complexly faulted sedimentary rocks ranging in age from Precambrian to late Paleozoic, and Archean or Proterozoic X gneisses and amphibolites (fig. 2). The Upper Cretaceous Boulder batholith intrudes the older rocks.

The Precambrian gneisses and amphibolites crop out in the southern part of the Highland Mountains, and are similar to the Precambrian crystalline complexes in the Tobacco Root Mountains and Ruby Range. The complexes consist of high-grade metasedimentary and metaigneous rocks with a mixture of calcium-magnesium silicate gneisses and schists, amphibolite, quartzite, and quartzo-feldspathic gneiss.

The Precambrian sedimentary rocks are part of the Proterozoic Y Belt Supergroup and occupy most of the central part of the range. The rocks are dominantly quartzite with associated conglomerate and argillite. Phanerozoic rocks of Cambrian through Mississippian age are dominantly carbonates, and those of Pennsylvanian through Permian age are mainly detrital.

Granitic plutons of the composite Boulder batholith make up the eastern and northern parts of the Highland Mountains (fig. 2). Tilling (1973) divided the batholith into two distinct magma series, the main and sodic series, based on whole-rock chemical characteristics. The main series consists of the Butte Quartz Monzonite and satellitic plutons in the Homestake Pass region. The granodiorite near Burton Park also shows strong chemical affinities to the main series plutons. The sodic series includes the Rader Creek, Moose Creek, Moosetown, Climax Gulch, Donald, and Hell Canyon stocks. The batholithic rocks range in age from 78 to 68 million years.

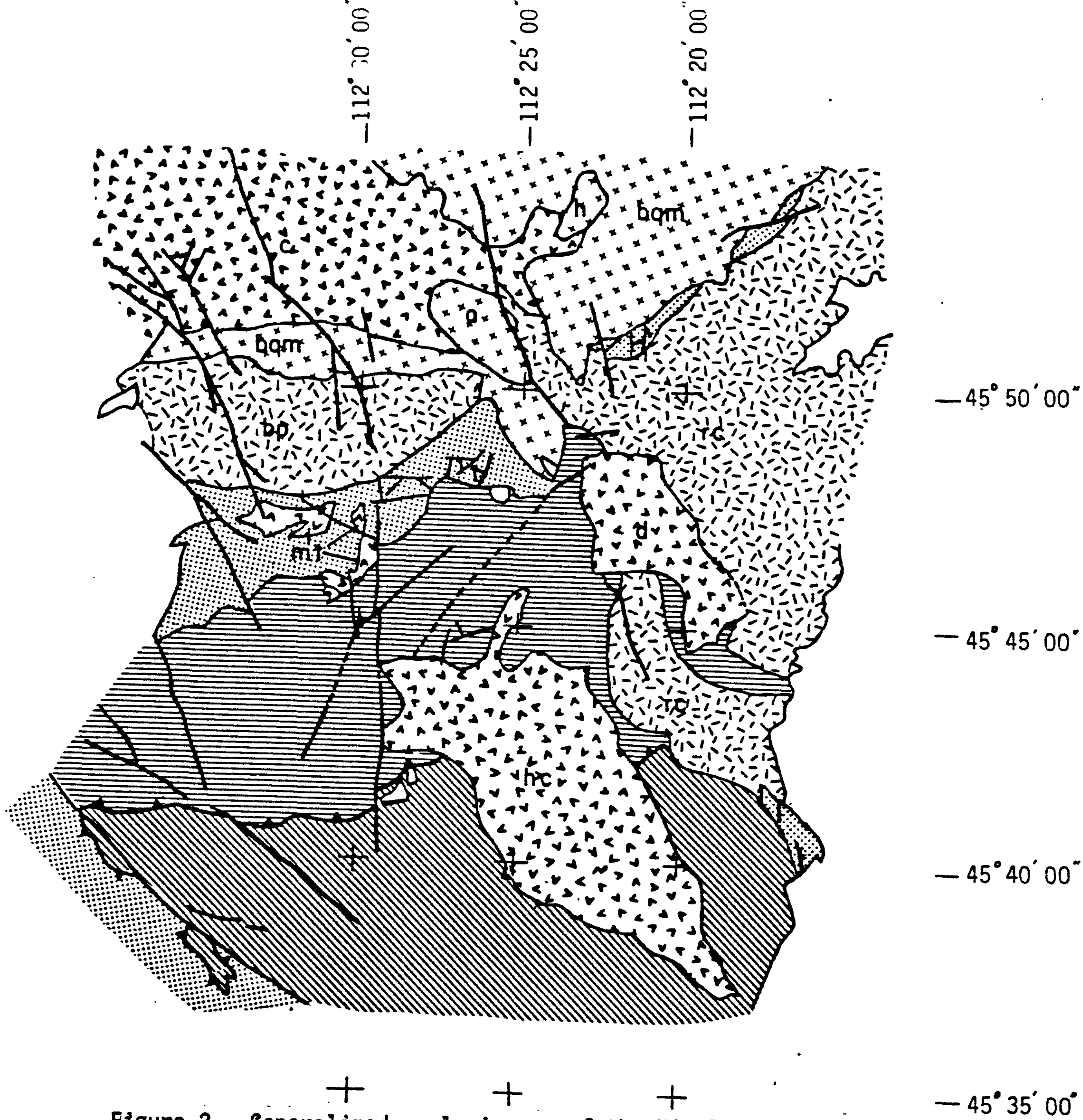


Figure 2. Generalized geologic map of the Highland Mountains, after H. W. Smedes (unpublished data, 1980).

- Cretaceous leucocratic rocks: hc, Hell Canyon pluton; mt, Moosetown pluton; c, Climax Gulch pluton; d, Donald pluton.
- Cretaceous Butte Quartz Monzonite and related silicic facies: a, alaskite, aplite, and pegmatite; h, Homestake pluton; bqm, Butte Quartz Monzonite.
- Cretaceous granodiorite: rc, Rader Creek pluton; bp, Burton Park pluton.
- Cretaceous(?) mafic rocks.
- Mesozoic and Paleozoic sedimentary rocks.
- Proterozoic Y Belt Supergroup.
- Archean or Proterozoic X gneiss and amphibolite.

Numerous small- to medium-sized mining districts are scattered throughout the range, most of which are in close proximity to the intrusive rocks. The principal exceptions to this relationship are in the Upper Camp Creek (Wickiup Creek) and Soap Gulch mining districts where disseminated to massive sulfide mineralization occurs in Belt Supergroup argillite. The deposits in association with intrusive rocks include quartz veins, contact skarns, replacements, and stockwork disseminations.

Previous geological investigations in the region include Winchell (1914), Sahinen (1950), Smedes and others (1968), Tilling and others (1968), Doe and others (1968), and Tilling (1973).

SAMPLING AND ANALYTICAL PROCEDURES

Rocks and stream sediments were chosen as the sample media to define the trace-element patterns in the Highland Mountains. Approximately 4.5 kg (10 lbs.) of composite stream sediment were collected at 78 sites (fig. 3). Each sample was panned with a gold pan to a concentrate of about 100 grams of 50% light-colored minerals and 50% darker, heavy minerals. Magnetite was removed with a hand magnet, and then the panned concentrate was passed through bromoform (specific gravity = 2.86 gm/cm^3). The heavy fraction was cleaned and dried and separated into "magnetic" and "non-magnetic" fractions using an isodynamic magnetic separator with settings of 0.6 amps, 15° forward tilt, and 25° side slope. One hundred forty-four rock samples were collected from mines and prospects throughout the range (fig. 4). Most of the samples were chosen to represent ore or altered host rock.

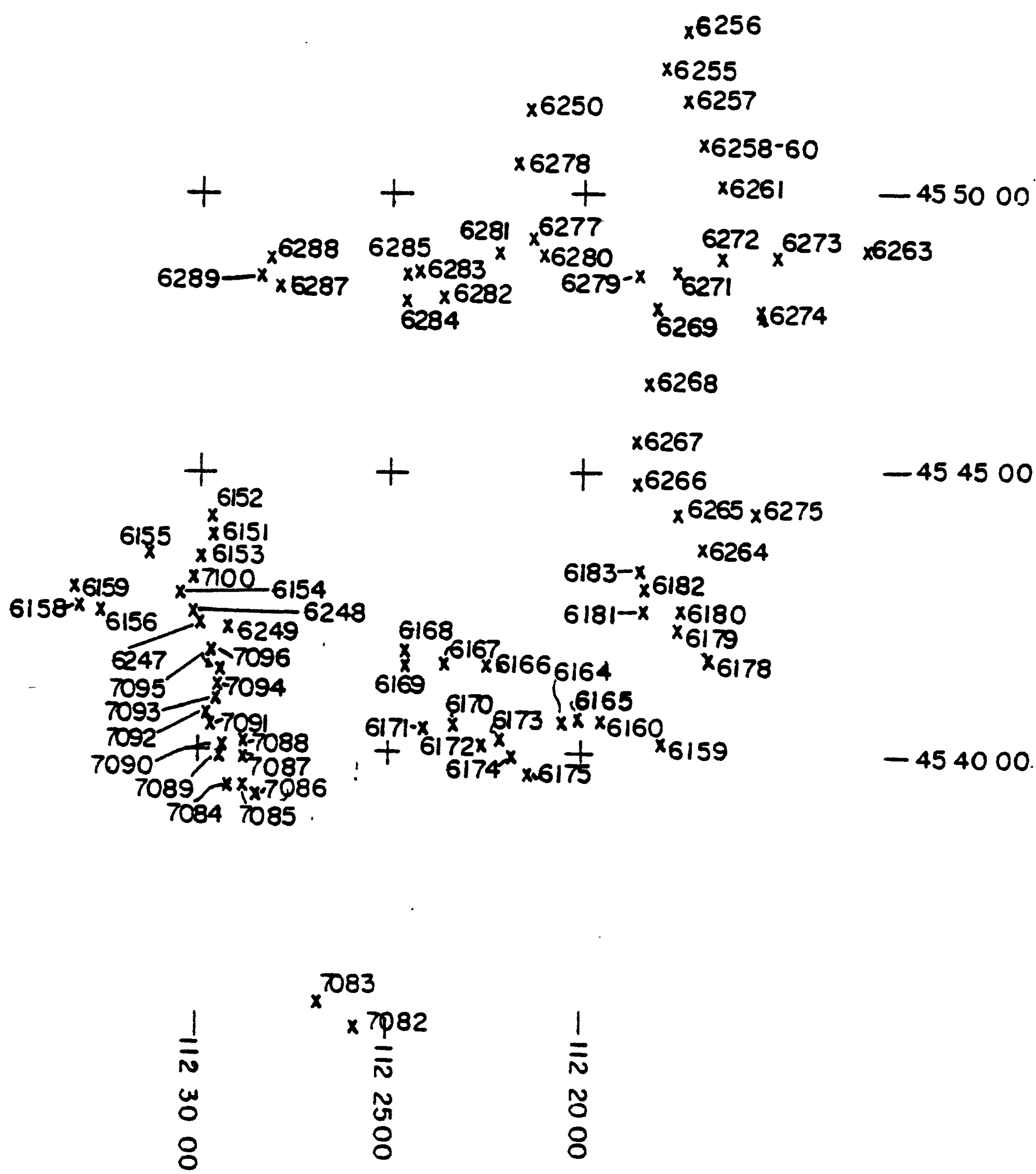


Figure 3. Composite stream-sediment sample sites, Highland Mountains Silver Bow and Madison Counties, Montana.

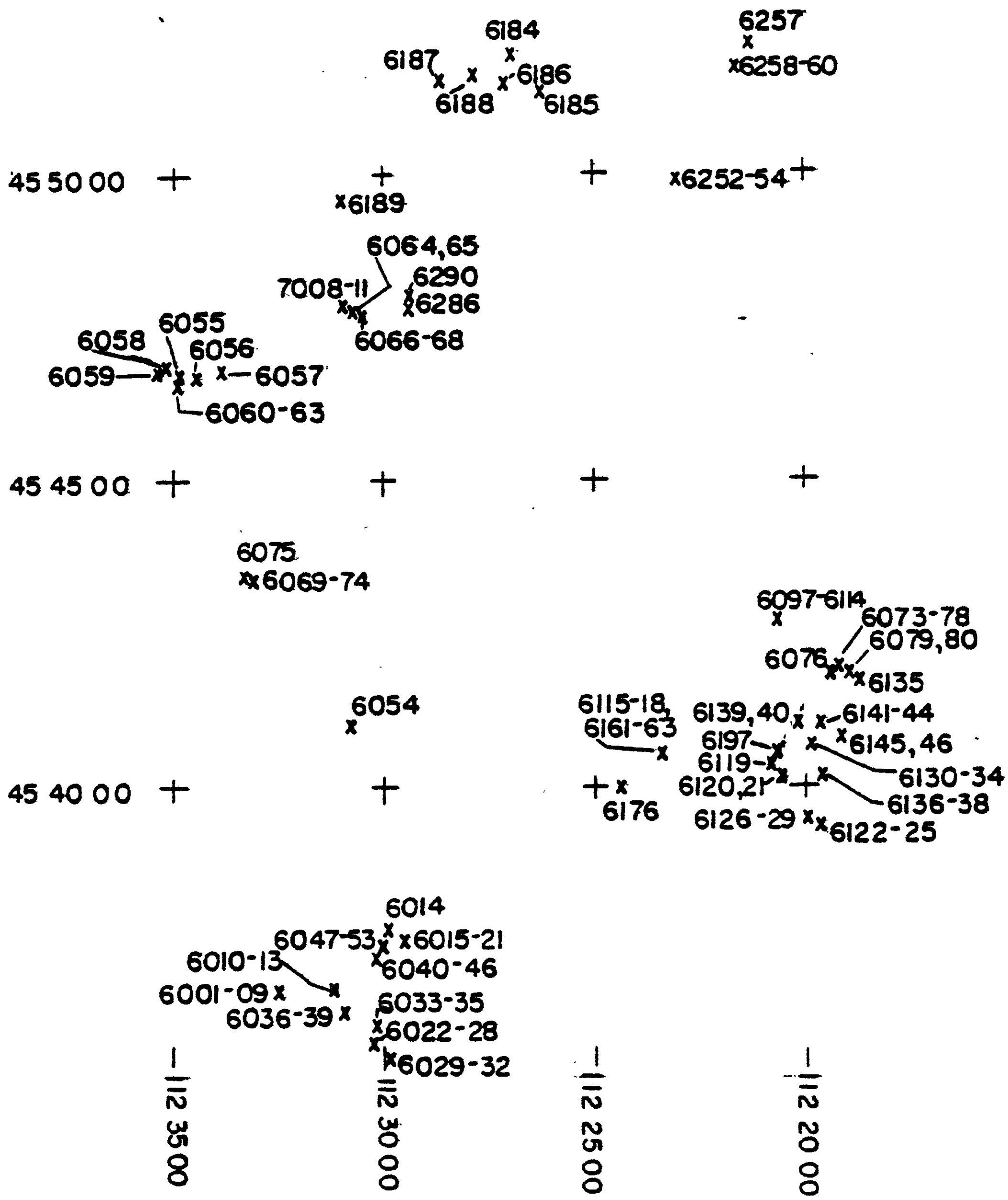


Figure 4. Rock sample sites, Highland Mountains Silver Bow and Madison Counties, Montana.

All of the samples collected were analyzed by David F. Siems of the U.S. Geological Survey for 31 elements using the six-step semiquantitative emission spectrographic method of Grimes and Marranzino (1968). Additional wet-chemical analyses was performed on the rock samples for zinc, arsenic, antimony, and tungsten by Eric Welsch of the U.S. Geological Survey using the methods of Ward and others (1969) for zinc, Almond (1953) for arsenic, Welsch and Chao (1976) for antimony, and Quin and Brooks (1972) for tungsten. The analytical data are presented in appendices 1 to 3.

GEOCHEMISTRY OF THE HIGHLAND MOUNTAIN REGION

A statistical summary of analytical data of samples from the Highland Mountains is shown in appendix 4. The correlation coefficients between the logarithms (base 10) of the concentration of the elements in the various sample media is given in tables 1 through 3. The measure of a linear relationship between elements is often determined with correlation coefficients. A correlation coefficient value of +1 indicates a perfect, direct (positive) linear relationship, a -1 value indicates a perfect, inverse (negative) linear relationship, and an 0 value indicates no linear relationship. The degree of direct or inverse relationship between two elements is indicated by values between +1 and -1. Tables 1 through 3 indicate numerous pairs of correlations significant at the 95 and 99 percent confidence levels (for example, Snedecor and Cochran, 1967). To better understand relationships between the elements, principal-component analysis (PCA) was done by D. R. Zimbelman with the assistance of W. S. Speckman of the U.S. Geological Survey. PCA has been previously used in both lithogeochemical (Garrett, 1973; Hesp and Rigby, 1975) and stream-sediment geochemistry surveys (Garrett and Nichol, 1969; Saager and Sinclair, 1974). Davis (1973) provides background information on the application of PCA to various geological studies. Generally, PCA is a mathematical technique used to calculate a group of principal components that approximate the variations within the data. The first principal component accounts for the most variation and each successive principal component accounts for (part) of the remaining variation. The interpretation of principal components is subjective, depending heavily on the geological and geochemical history of the samples.

	Fe	Mg	Ca	Ti	Mn	B	Ba	Be	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sc	Sn	V	W	Y	Th
Fe	Fe	0.39	-0.37	-0.07	0.44	0.42	0.15	0.36	0.41	0.31	0.33	-0.69	0.07	-0.33	0.10	0.30	0.19	-0.03	-0.44	-0.04	-0.69	0.31
Mg	78	Mg	0.01	-0.08	0.41	0.01	0.06	-0.01	0.24	0.39	0.20	-0.57	-0.12	-0.31	0.37	0.09	0.23	-0.07	-0.17	-0.37	-0.67	0.05
Ca	78	78	Ca	0.03	0.14	-0.10	-0.27	-0.51	-0.25	-0.10	-0.04	0.22	0.12	0.09	-0.18	-0.46	-0.14	-0.06	0.18	0.15	0.28	-0.28
Ti	23	23	23	Ti	0.29	0.44	0.08	0.05	-0.35	0.34	-0.05	0.45	0.71	0.36	0.20	0.12	0.42	-0.24	0.67	0.41	0.54	0.01
Mn	78	78	78	23	Mn	0.25	-0.08	0.12	-0.09	0.10	0.11	-0.14	0.20	-0.06	-0.08	0.11	0.14	-0.30	-0.09	0.21	-0.16	0.11
B	59	59	59	23	59	B	-0.13	-0.30	0.07	0.25	0.04	0.01	-0.05	-0.22	-0.11	-0.11	0.20	-0.18	-0.22	-0.08	-0.12	0.25
Ba	64	64	64	21	64	53	Ba	0.27	0.22	0.18	0.14	0.16	0.30	-0.21	0.34	0.31	0.19	-0.15	0.01	0.03	-0.19	0.09
Be	37	37	37	22	37	37	34	Be	-0.01	-0.03	0.20	-0.11	0.12	-0.02	-0.25	0.37	-0.36	-0.04	0.00	0.02	-0.43	-0.11
Co	59	59	59	17	59	46	51	29	Co	0.52	0.14	-0.35	0.10	-0.21	0.69	0.09	0.38	0.10	-0.25	-0.12	-0.27	0.47
Cr	74	74	74	22	74	58	62	36	56	Cr	0.13	-0.03	0.03	-0.34	0.79	0.18	0.48	0.14	-0.07	-0.36	-0.31	0.06
Cu	74	74	74	21	74	56	60	34	56	71	Cu	-0.15	0.21	-0.31	0.21	0.38	0.31	0.21	-0.06	-0.02	-0.22	-0.00
La	42	42	42	14	42	32	32	21	28	38	40	La	0.21	0.46	-0.02	-0.01	0.26	0.14	0.52	0.22	0.75	0.26
Mo	55	55	55	7	55	36	43	15	41	52	54	34	Mo	-0.18	0.14	0.34	0.30	-0.11	0.00	0.63	0.07	0.40
Nb	61	61	61	9	61	42	48	21	45	58	59	35	51	Nb	-0.19	-0.14	-0.28	-0.06	0.22	-0.11	0.62	-0.24
Ni	33	33	33	18	33	31	32	27	32	32	31	13	15	18	Ni	0.14	0.58	0.25	0.23	-0.18	-0.02	0.07
Pb	66	66	66	18	66	48	56	29	53	62	63	30	48	52	30	Pb	0.51	0.33	-0.27	-0.20	-0.37	0.41
Sc	74	74	74	21	74	55	62	33	58	70	70	38	53	58	33	65	Sc	0.13	-0.13	-0.13	-0.03	0.35
Sn	50	50	50	8	50	34	38	15	36	47	48	29	43	44	14	41	48	Sn	0.40	-0.23	0.17	-0.20
V	78	78	78	23	78	59	64	37	59	74	74	42	55	61	33	66	74	50	V	-0.24	0.43	-0.47
W	23	23	23	3	23	18	19	8	20	23	23	13	20	22	8	20	22	14	23	W	0.18	0.33
Y	78	78	78	23	78	59	64	37	59	74	74	42	55	61	33	66	74	50	78	23	Y	-0.22
Th	51	51	51	9	51	33	40	17	42	48	49	18	37	42	21	48	50	33	51	17	51	Th

Table 1. Matrix of correlation coefficients of the log-transformed originial data for nonmagnetic concentrates, Highland Mountains. Number of valid pairs are shown below diagonal.

	Fe	Mg	Ca	Ti	Mn	B	Ba	Be	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sc	Sr	V	Y	Zr
Fe	Fe	-0.61	-0.54	0.07	-0.08	0.12	0.27	0.43	-0.03	0.25	0.07	0.23	-.03	-0.18	0.07	0.21	-0.45	-0.22	0.40	0.12	-0.01
Mg	78	Mg	0.44	0.39	0.42	-0.13	-0.29	-0.64	0.06	-0.05	-0.39	-0.10	-0.01	0.05	-0.03	-0.28	0.72	-0.22	-0.09	0.06	0.03
Ca	78	78	Ca	0.07	0.11	0.04	-0.42	-0.63	0.03	-0.28	-0.21	-0.07	-0.15	0.43	-0.19	-0.27	0.42	0.06	-0.01	0.07	0.17
Ti	55	55	55	Ti	0.54	0.14	-0.01	-0.36	0.08	0.25	-0.46	0.38	-0.17	0.33	-0.06	-0.37	0.54	0.23	0.40	0.56	0.35
Mn	73	73	73	53	Mn	0.00	-0.11	-0.31	-0.21	-0.00	-0.55	0.26	-0.22	0.17	-0.32	-0.19	0.61	0.13	0.10	0.27	0.06
B	46	46	46	34	43	B	0.16	-0.09	-0.21	-0.04	-0.10	0.16	-0.25	0.21	-0.08	0.18	-0.05	-0.00	-0.16	0.05	0.33
Ba	59	59	59	44	54	38	Ba	0.31	0.28	0.32	0.56	0.27	0.30	0.17	0.37	0.19	-0.30	0.04	-0.01	0.01	-0.07
Be	46	46	46	35	44	34	35	Be	-0.09	0.14	0.13	0.09	0.26	-0.34	0.29	0.48	-0.59	-0.20	-0.49	-0.17	-0.24
Co	78	78	78	55	73	46	59	46	Co	0.24	0.20	0.19	0.21	-0.15	0.53	-0.14	0.11	-0.20	0.28	-0.04	0.16
Cr	78	78	78	55	73	46	59	46	78	Cr	-0.18	0.12	0.30	-0.54	0.63	-0.04	-0.12	-0.12	0.22	-0.03	-0.18
Cu	70	70	70	55	65	44	54	40	70	70	Cu	-0.03	0.24	-0.19	0.48	0.15	-0.48	-0.30	-0.19	-0.22	-0.27
La	54	54	54	44	49	32	41	30	54	54	54	La	0.09	0.31	0.01	-0.13	0.23	0.27	0.36	0.43	0.37
Mo	39	39	39	28	39	25	30	29	39	39	31	20	Mo	0.13	0.42	0.33	-0.28	-0.08	-0.06	-0.27	-0.34
Nb	48	48	48	27	47	29	33	27	48	48	40	25	24	Nb	-0.40	0.03	0.13	0.42	-0.06	0.39	0.29
Ni	78	78	78	55	73	46	59	46	78	78	70	54	39	48	Ni	0.12	-0.27	-0.14	-0.07	-0.30	-0.27
Pb	61	61	61	44	58	36	47	39	61	61	54	39	37	36	61	Pb	-0.47	0.21	-0.20	-0.06	-0.17
Sc	78	78	78	55	73	46	59	46	78	78	70	54	39	48	78	61	Sc	0.07	0.05	0.19	0.14
Sr	29	29	29	21	28	18	25	17	29	29	24	15	22	19	29	27	29	Sr	0.20	0.56	0.13
V	78	78	78	55	73	46	59	46	78	78	70	54	39	48	78	61	78	29	V	0.15	0.28
Y	78	78	78	55	73	46	59	46	78	78	70	54	39	48	78	61	78	29	78	Y	0.56
Zr	75	75	75	53	70	44	57	45	75	75	67	52	37	45	75	59	75	28	75	75	Zr

Table 2. Matrix of correlation coefficients of the log-transformed original data for magnetic concentrates, Highland Mountains. Number of valid pairs are shown below diagonal.

	Fe	Mg	Ca	Ti	Mn	Ag	B	Ba	Be	Co	Cr	Cu	La	Mo	Ni	Pb	Sc	Sr	V	Y	Zr	Zn	Sb	As
Fe	Fe	0.08	0.03	0.34	0.42	-0.15	0.04	-0.15	-0.26	0.28	0.30	0.14	0.20	-0.53	0.25	0.20	0.33	-0.05	0.47	0.32	0.21	0.15	0.18	0.05
Mg	141	Mg	0.42	0.34	0.29	-0.08	0.05	0.09	-0.21	0.17	0.26	0.09	0.12	0.02	0.25	-0.25	0.34	0.11	0.22	-.28	0.11	-0.14	-0.22	-0.22
Ca	140	144	Ca	0.06	0.35	0.03	-0.01	0.09	-0.07	-0.16	0.19	0.03	-0.12	-0.02	-0.06	-0.09	0.15	0.25	-0.08	0.03	-0.12	-0.07	-0.25	-0.13
Ti	144	147	146	Ti	0.28	-0.25	-0.03	0.19	-0.24	0.04	0.35	-0.11	0.39	-0.09	0.18	-0.07	0.58	.14	0.42	0.52	0.49	-0.00	-0.02	-0.01
Mn	140	143	142	146	Mn	-0.16	0.07	0.14	-0.03	0.10	0.29	0.06	0.12	-0.29	0.18	-0.08	0.37	0.16	0.36	0.32	0.18	0.04	-0.17	-0.13
Ag	84	86	85	89	86	Ag	-0.14	-0.22	-0.13	0.17	-0.11	0.29	-0.12	-0.14	0.05	0.50	-0.32	-0.32	-0.12	-0.10	-0.15	0.18	0.23	0.03
B	135	135	134	138	134	81	B	-0.08	0.31	0.03	-0.12	-0.15	0.11	-0.19	0.05	-0.06	-0.08	-0.07	0.07	-0.02	-0.05	-0.06	0.11	-0.07
Ba	129	129	128	132	129	81	128	Ba	0.14	-0.05	0.15	-0.21	0.32	0.03	0.07	-0.17	-0.11	0.07	0.02	-0.11	0.37	0.04	-0.10	-0.05
Be	107	108	107	111	107	69	107	106	Be	-0.12	-0.13	-0.02	0.15	0.02	-0.16	-0.13	-0.16	-0.02	-0.21	-0.12	0.04	-0.09	-0.05	-0.10
Co	111	116	113	116	113	70	105	102	83	Co	0.28	0.27	0.04	0.42	0.64	0.12	0.22	-0.07	0.56	0.13	-0.04	0.23	-0.04	-0.05
Cr	115	121	118	121	118	75	114	109	90	102	Cr	0.04	0.29	0.25	0.45	0.03	0.58	0.22	0.58	0.37	0.32	0.12	0.01	-0.09
Cu	122	125	124	128	124	85	119	116	94	100	111	Cu	-0.08	-0.10	0.01	0.32	-0.03	-0.07	0.17	0.02	-0.16	0.25	0.16	-0.06
La	108	108	106	109	108	64	107	106	89	82	90	93	La	-0.24	0.11	-0.14	0.05	-0.13	0.07	0.21	0.65	-0.09	0.07	0.09
Mo	45	45	45	48	46	41	43	44	36	36	40	44	31	Mo	-0.05	-0.04	0.06	-0.30	-0.00	-0.08	-0.25	0.56	0.09	0.18
Ni	128	132	130	134	130	85	123	119	100	112	115	117	95	43	Ni	0.10	0.37	-0.04	0.69	0.32	0.20	0.09	0.06	0.09
Pb	124	124	123	127	125	74	122	119	100	97	103	109	101	39	111	Pb	-0.13	-0.24	0.23	-0.10	-0.05	0.32	0.34	0.09
Sc	113	116	114	116	113	66	108	105	88	102	99	95	87	32	110	100	Sc	-0.07	0.45	0.59	0.29	-0.06	0.01	-0.07
Sr	86	87	87	87	84	48	83	83	65	69	77	76	69	23	80	79	72	Sr	0.07	-0.08	-0.08	-0.13	-0.28	-0.08
V	140	145	142	146	142	85	134	129	108	115	120	124	107	45	132	124	116	87	V	0.41	0.31	0.09	0.05	-0.12
Y	109	113	111	113	109	69	106	105	87	93	96	98	88	35	104	98	102	74	111	Y	0.38	0.04	0.09	0.01
Zr	130	131	130	134	132	78	127	123	105	104	111	115	104	42	119	118	108	82	131	105	Zr	-0.00	0.02	-0.03
Zn	139	144	141	145	141	84	133	127	107	114	119	123	106	44	131	122	114	85	143	110	129	Zn	0.45	0.12
Sb	78	79	78	82	79	64	77	77	65	63	68	74	58	37	75	74	60	42	80	60	72	78	Sb	0.36
As	89	94	91	94	91	65	86	85	67	78	82	85	66	39	89	78	77	53	92	77	83	92	64	As

Table 3. Matrix of correlation coefficients of the log-transformed original data for rock samples, Highland Mountains. Number of valid pairs are shown below diagonal.

INTERPRETATION OF THE STREAM-SEDIMENT DATA

The analytical data from the "nonmagnetic"1/ fraction of the panned concentrates were digitized and entered into an ER-mode factor analysis program (A. Miesch, USGS, unpub. program). The communalities of the recomputed data are listed in table 4 and graphically shown in figure 5. Those elements with communality values less than the square of the multiple correlation coefficient for that element (that is, not exceeding the total amount of variance explained by the analysis) are considered valid loadings in any particular factor. Those elements with the highest numerical loading in any particular factor are considered to be part of the "characteristic" elemental suite for that factor.

Factor 1 is characterized by Fe, Nb, Ni, Be, Y, B, Mg, Mo, Cr, and Sn with associated Ti, Co, Ba, and V. Figure 6 is a contour map of factor 1 using as the contour interval the percent of principal component scores in the total population. Those values in the upper 25th percentile show a close spatial association with the Precambrian Belt Supergroup rocks. The 50th-75th percentile contour outlines the sodic series intrusive rocks. This apparent relationship between the sodic intrusive rocks and the Belt rocks is due to the presence of Sn and Mo and to a lesser extent Ba and B in both rock groups. Geochemical studies in the Pioneer Mountains, Beaverhead County, Montana, indicate the Pioneer batholith is similar to the sodic series and that Proterozoic X rocks to the north of the batholith are chemically similar to the source rocks for the Pioneer batholith (E. Zen, USGS, oral commun., 1979).

1/The "nonmagnetic" fraction generally consists of sulfides and non-iron-bearing oxides and silicates with specific gravities greater than 2.86 gm/cm^3.

Table 4.--Communalities for the nonmagnetic fraction of panned concentrates.

(Dash where value not considered in text.)

Element	Factor			
	1	2	3	4
Fe	.786	.792	.816	.822
Mg	.468	.525	.601	.804
Ca	.196	.223	.334	.364
Ti	.372	.789	.819	.846
Mn	.084	.085	.268	.516
B	.462	.503	.611	.625
Ba	.201	.307	.478	---
Be	.581	.650	.654	.676
Co	.266	.616	.666	.705
Cr	.347	.559	.584	.700
Cu	.149	.152	.646	.652
La	.148	.775	.808	.810
Mo	.379	.398	.576	.674
Nb	.643	.643	.658	.666
Ni	.593	.822	.823	.826
Pb	.234	.607	.694	.698
Sc	.150	.677	---	---
Sn	.264	.271	.486	.540
V	.297	.342	.342	.720
W	.020	.097	.135	.256
Y	.475	.901	.902	.903
Th	.003	.453	.570	---

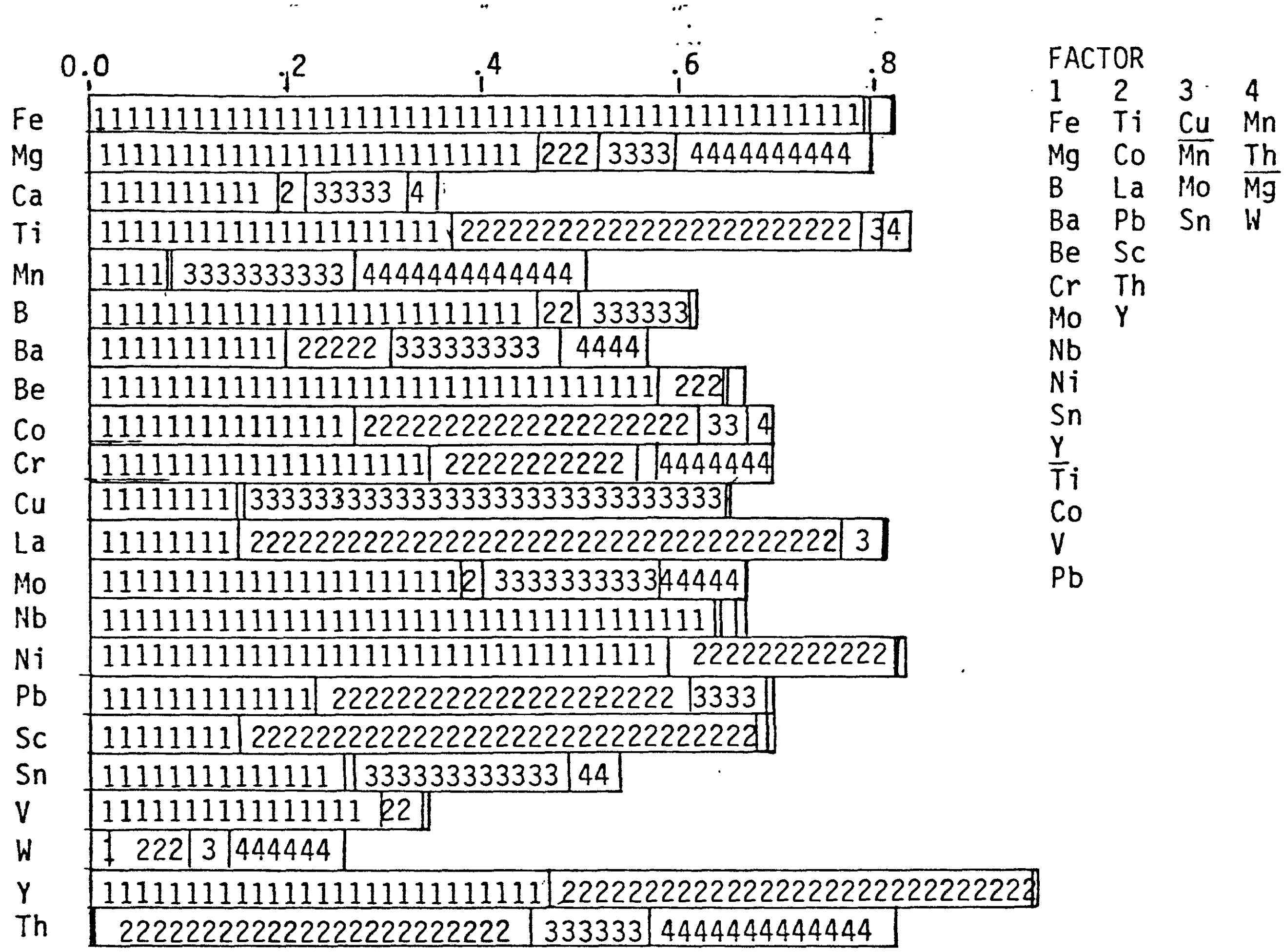
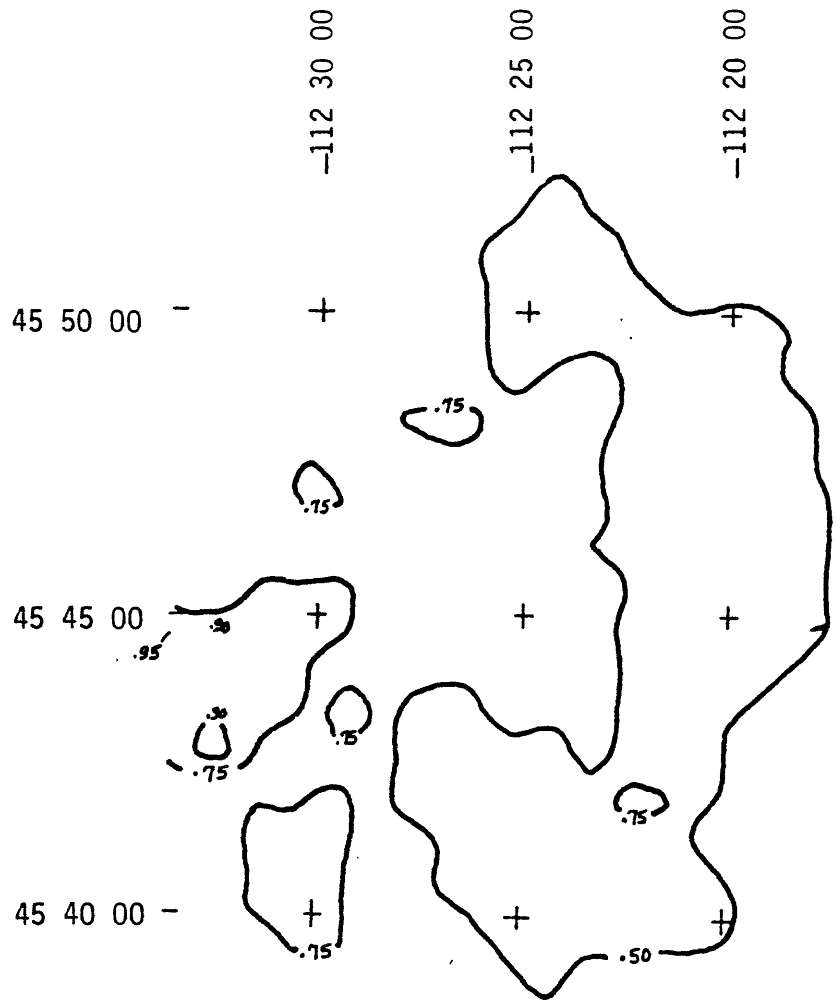


Figure 5. Graphical depiction of recomputed data from Table 4.



gure 6. Contour map of Factor 1, nonmagnetic concentrates. Contour intervals represent principal component percentiles, for example, .50 represents the 50th percentile.

Therefore, it is suggested that the Belt rocks in the Highland Mountains were receiving sediment from a source terrain enriched in Mo and Sn (and possibly W) and of similar composition to the source rocks for the sodic series rocks in the Boulder batholith. An alternative hypothesis is that the sodic rocks assimilated portions of the Belt Supergroup, although this seems an unlikely explanation for the elemental association in that the main series rocks do not show the same "contamination."

Factor 2 is characterized by the elemental suite La, Sc, Th, Y, Ti, Pb, and Co with associated Cr and Ni. Figure 7 shows the contour map of the percentiles. There is a good relationship between the highest factor loadings and the Proterozoic X crystalline rocks with the exception of a small anomalous area in the vicinity of the Rader Creek pluton. The relatively minor overlap of the suites for the Proterozoic X and the Belt Supergroup rocks suggests that the Belt rocks were receiving sediment from a compositionally different provenance than that represented by the Proterozoic X rocks in the Highland Mountains.

Factor 3 is characterized by the elemental suite Cu, Sn, Mo, Mn, and Ba. It outlines the mineralized areas of Rochester, Wickiup Creek, Moose Creek, Fish Creek, and upper Pipestone Creek (fig. 8). The central portion of the Hell Canyon stock also reflects the presence of this "mineralization" suite. Since the Rochester and Silver Star districts flank the Hell Canyon stock, the anomalous values in the center of the stock may reflect buried mineralization.

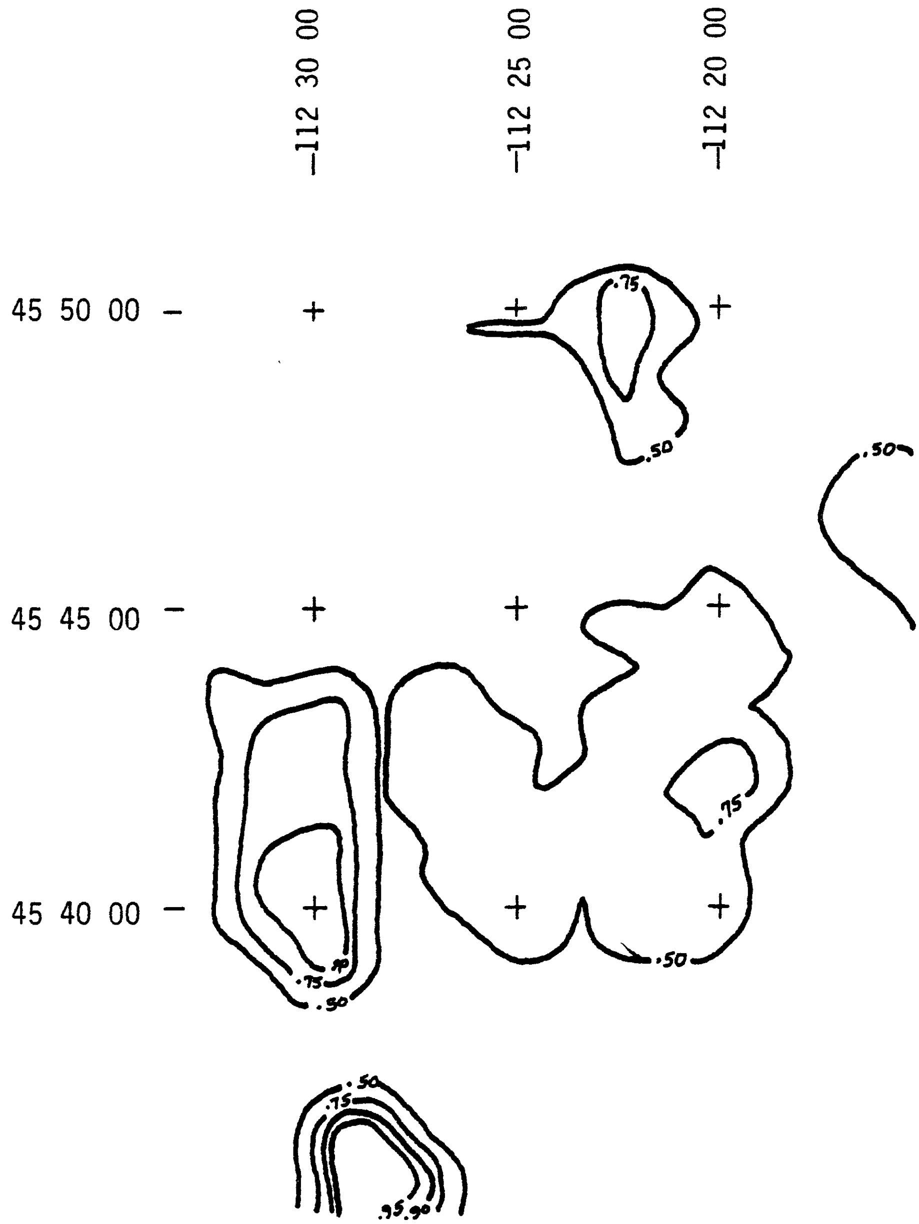


Figure 7. Contour map of Factor 2, nonmagnetic concentrates.
Contour intervals represent principal component percentiles,
for example, .50 represents the 50th percentile.

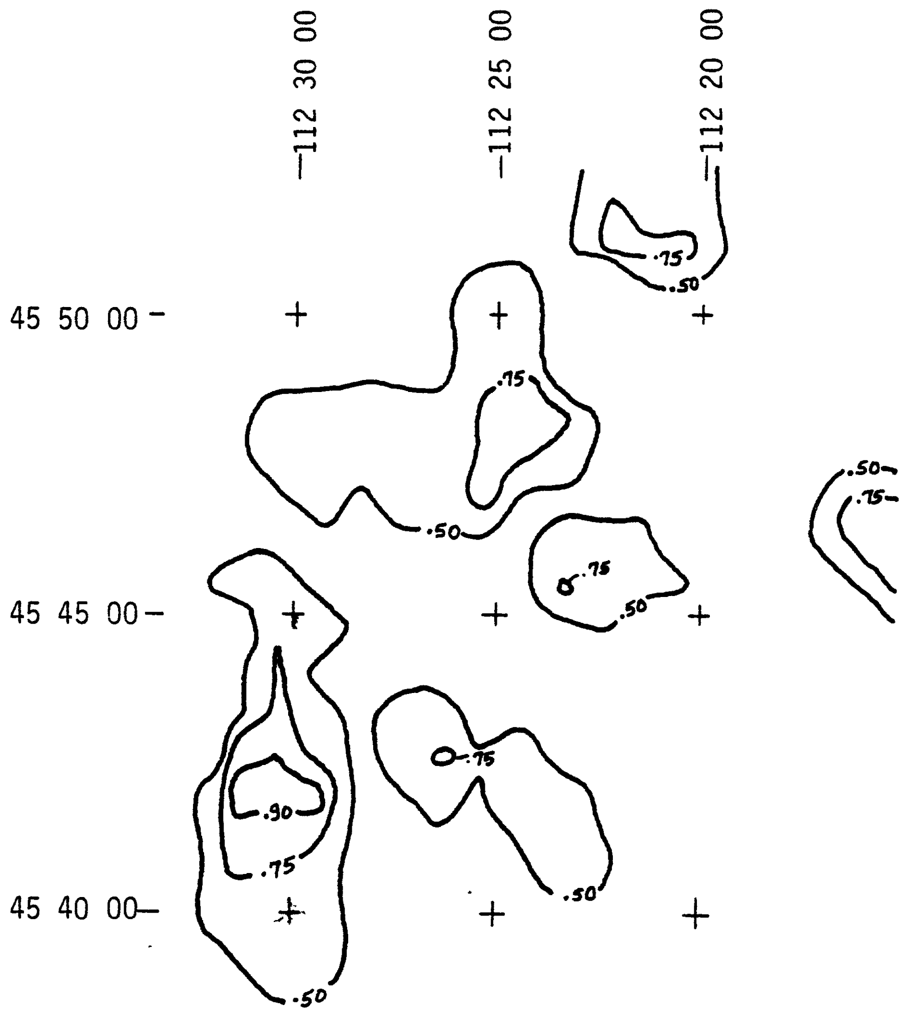


Figure 8. Contour map of Factor 3, nonmagnetic concentrates. Contour intervals represent principal component percentiles, for example, .50 represents the 50th percentile.

The results of an ER-mode factor analysis of the "magnetic"[2/] fraction of the panned concentrates are listed in table 5 and graphically shown in figure 9.

Factor 1 is characterized by the elemental suite Ti, Sc, Cu, Nb, Be, Mg, Mn, Ca, Zr, V, Pb, and Mo with associated Y and La. Figure 10 shows a percentile contour plot of the factor scores. The sodic plutons are generally outlined by the highest values with strong negative loadings over the Belt rocks on the west side of the area and in an isolated area in the Precambrian gneisses and amphibolites.

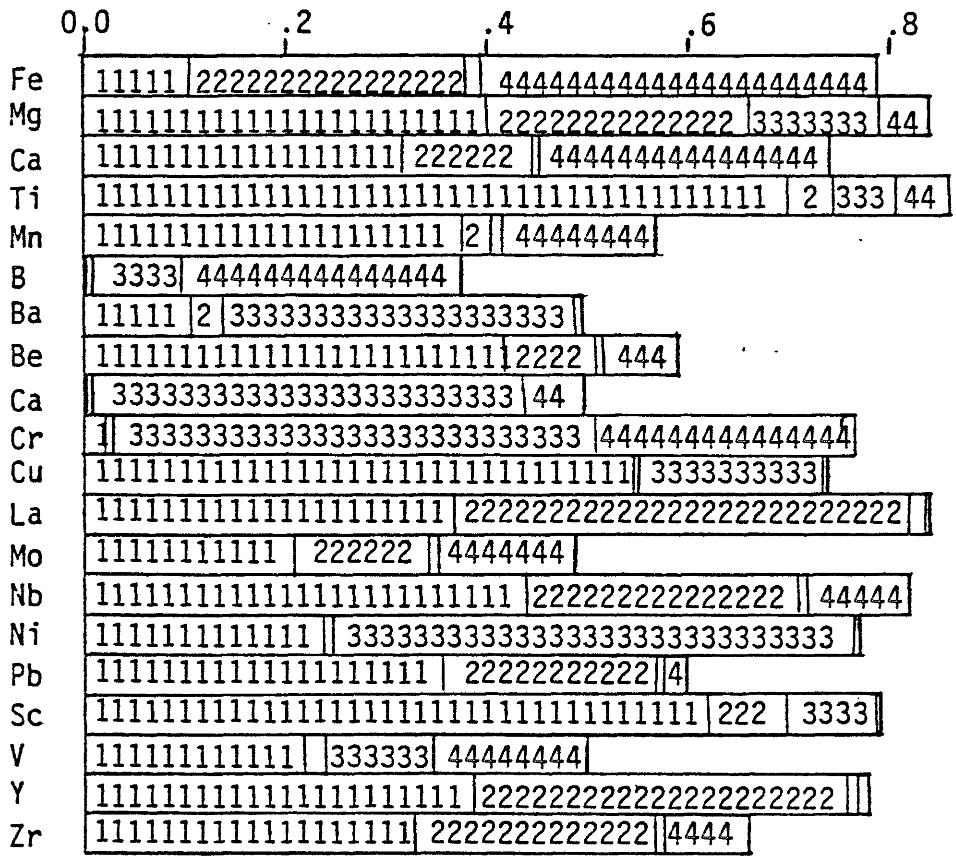
Factor 2 is characterized by Fe, La, and Y with associated Zr, Nb, Pb, and Mg. Figure 11 shows a contour map of the factor scores. High loadings are found over the Hell Canyon and Donald plutons and over the Belt rocks in the upper parts of Soap Gulch, Camp Creek, and Wickiup Creek. Otherwise, the sedimentary and metamorphic sequences are depleted in this suite.

Factor 3 is characterized by the elements Ba, Co, Cr, and Ni. Figure 12 shows a contour plot of the principal component scores. This suite of elements tends to reflect the areas of Proterozoic X rocks, although as with Factor 2, there is an anomalous high west of the Hell Canyon stock in Belt rocks. This anomalous area may reflect the different lithology found in the Belt in this area.

2/The "magnetic" fraction generally consists of iron and iron-manganese oxides and mafic silicate minerals with specific gravities greater than 2.86 gm/cm^3.

Table 5.--Communalities for the magnetic fraction of panned concentrates. (Dash where value not considered in text.)

Element	Factor			
	1	2	3	4
Fe	.110	.383	.397	---
Mg	.402	.661	.792	.835
Ca	.319	.446	.454	.746
Ti	.700	.754	.807	.855
Mn	.383	.407	.417	.572
B	.001	.008	.103	.378
Ba	.107	.143	.491	.498
Be	.426	.512	.515	.588
Co	.000	.010	.445	.504
Cr	.026	.028	.511	.767
Cu	.550	.551	.735	.736
La	.370	---	---	---
Mo	.210	.355	.355	.493
Nb	.424	.709	.724	---
Ni	.244	.253	.772	.773
Pb	.357	.573	.576	.604
Sc	.626	.703	.789	.792
V	.220	.240	.348	.504
Y	.388	.763	---	---
Zr	.330	.574	.577	.661



FACTOR

1	2	3	4
Ti	La	Ba	Fe
Mn	Y	Co	Ca
Be	Fe	Cr	B
Cu	Mg	Ni	
Nb	Nb	Cu	
Pb	Pb		
Sc	Zr		
Y			
Zr			
La			
V			
Ca			

Figure 9. Graphical depiction of recomputed data from table 5.

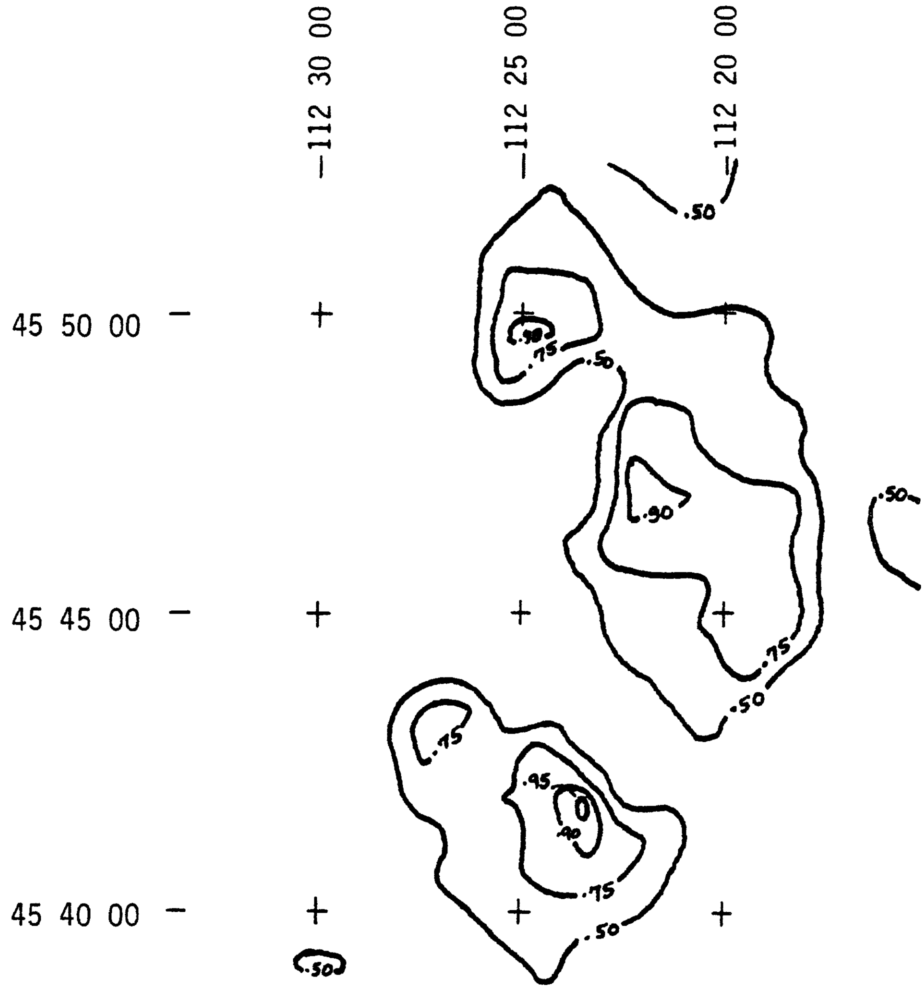


Figure 10. Contour map of Factor 1, magnetic concentrates. Contour intervals represent principal component percentiles, for example, .50 represents the 50th percentile.

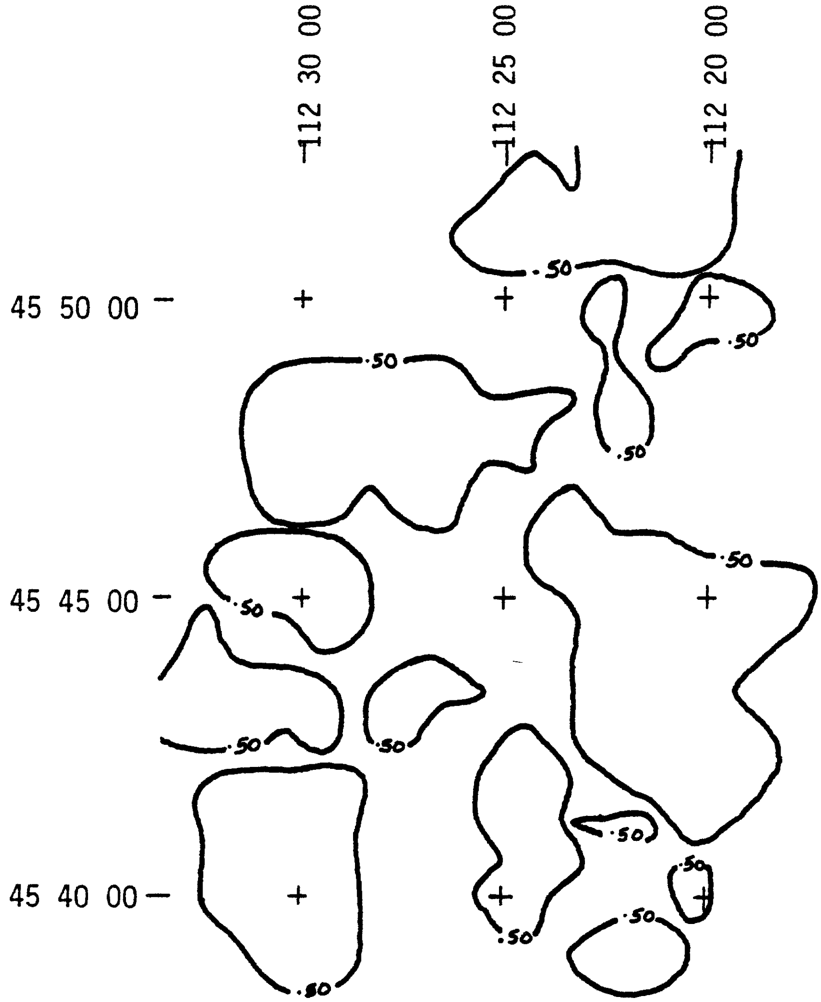


Figure 11. Contour map of Factor 2, magnetic concentrates. Contour intervals represent principal component percentiles, for example, .50 represents the 50th percentile.

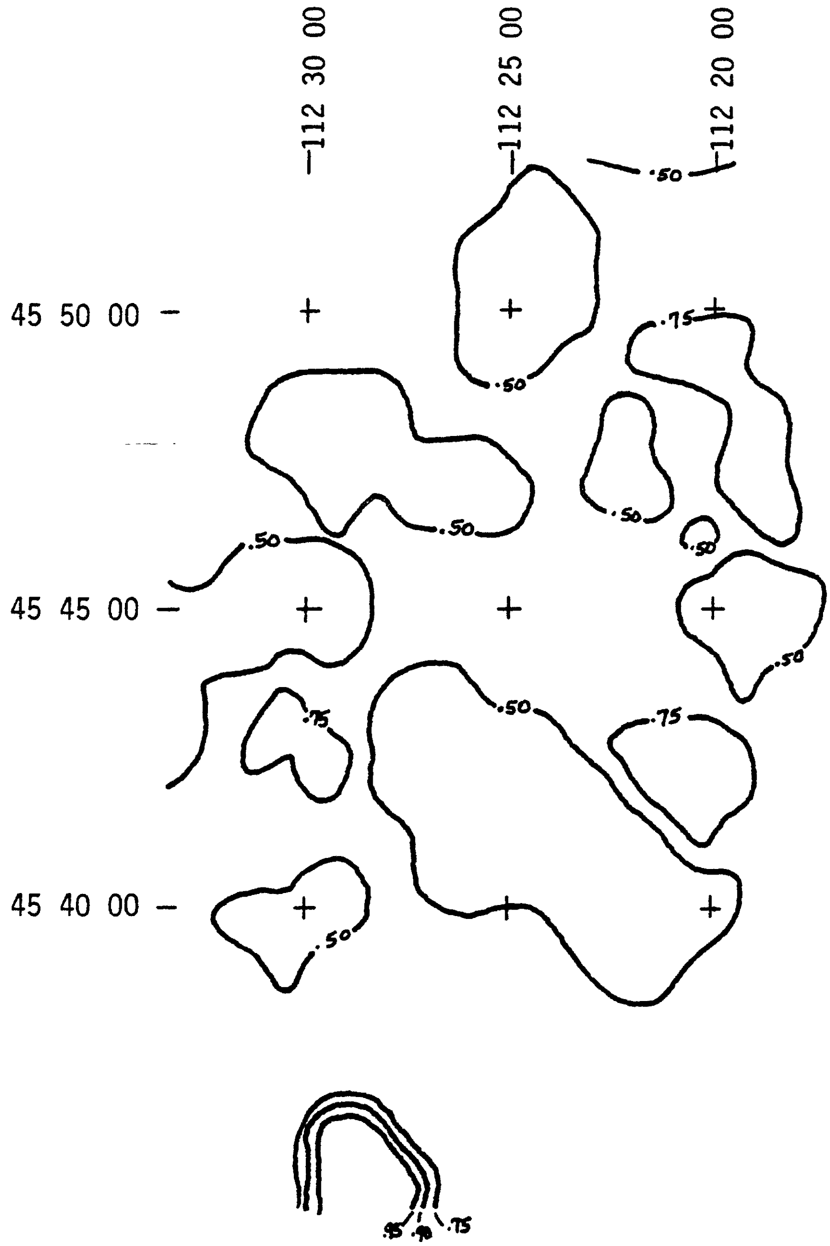


Figure 12. Contour map of Factor 3, magnetic concentrates. Contour intervals represent principal component percentiles, for example, .50 represents the 50th percentile.

INTERPRETATION OF THE ROCK DATA

The analytical data from the rock samples were entered into the same ER-mode factor analysis program as the stream-sediment data. The communalities of the recomputed data are listed in table 6, and graphically shown in figure 13.

Factor 1 reflects the mafic-rock constituents in the host rocks to the mineral deposits and is characterized by the elemental suite Fe, Mg, Ti, Mn, Co, Cr, Ni, Sc, V, and Y. Figure 14 shows these elements to occur mostly in the deposits in Proterozoic X rocks although there is an apparent concentration in the northeast part of the study area near the Butte Quartz Monzonite-Rader Creek pluton contact.

Factor 2 is characterized by the elemental suite Ag, Cu, Mo, Pb, Zn, Sb, and As. Figure 15 shows a contour map of the principal-component scores for this factor. This suite of elements represents hydrothermal mineralization related to the emplacement of the Boulder batholith. Those mining districts showing a similar suite are Rochester, Silver Star, Moosetown, Climax Gulch, and upper Pipestone Creek. All of these districts are associated with sodic-series intrusions.

Factor 3 is characterized by the elemental suite Ba, La, and Zr and is not readily interpretable (fig. 16). Factor 4 is characterized by Ca, Mn, and Sr with associated Ag, Cu, and Zn. Figure 17 shows the distribution of factor scores for this suite, which correlates roughly with the distribution of Phanerozoic sedimentary rocks in the Highland Mountains.

Table 6.--Communalities of rock data.

(Dash where data not considered in text.)

Element	Factor			
	1	2	3	4
Fe	.352	.568	.652	.652
Mg	.360	.490	.671	.707
Ca	.085	.210	.389	---
Ti	.554	.572	.761	.792
Mn	.475	.476	.518	.688
Ag	.022	.655	.656	.748
B	.004	.005	.151	.200
Ba	.021	.103	.608	---
Be	.100	.133	.378	.390
Co	.466	.547	.680	---
Cr	.650	.669	.676	.759
Cu	.028	.443	.499	.651
La	.051	.140	.594	.598
Mo	.069	.332	.356	.356
Ni	.597	.671	.698	.770
Pb	.009	.369	.597	.628
Sc	.704	.704	.775	.782
Sr	.069	.194	.205	---
V	.682	.748	.739	.774
Y	.411	.412	.624	.649
Zr	.177	.231	.716	.717
Zn	.066	.536	.595	.704
Sb	.034	.709	.749	.751
As	.050	.475	.586	.590
W	.012	.021	.214	.214

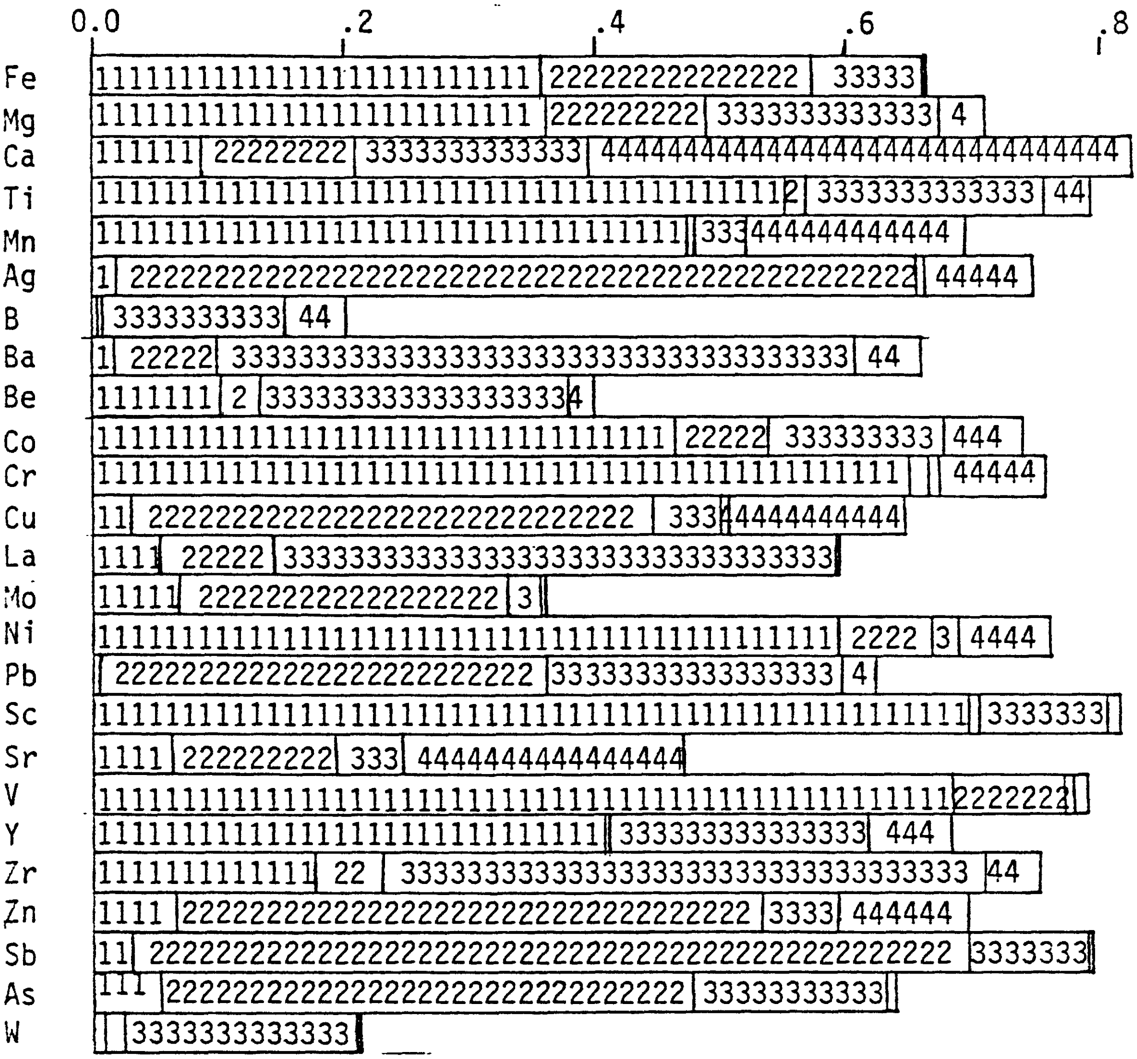


Figure 13. Graphical depiction of data in table 6.

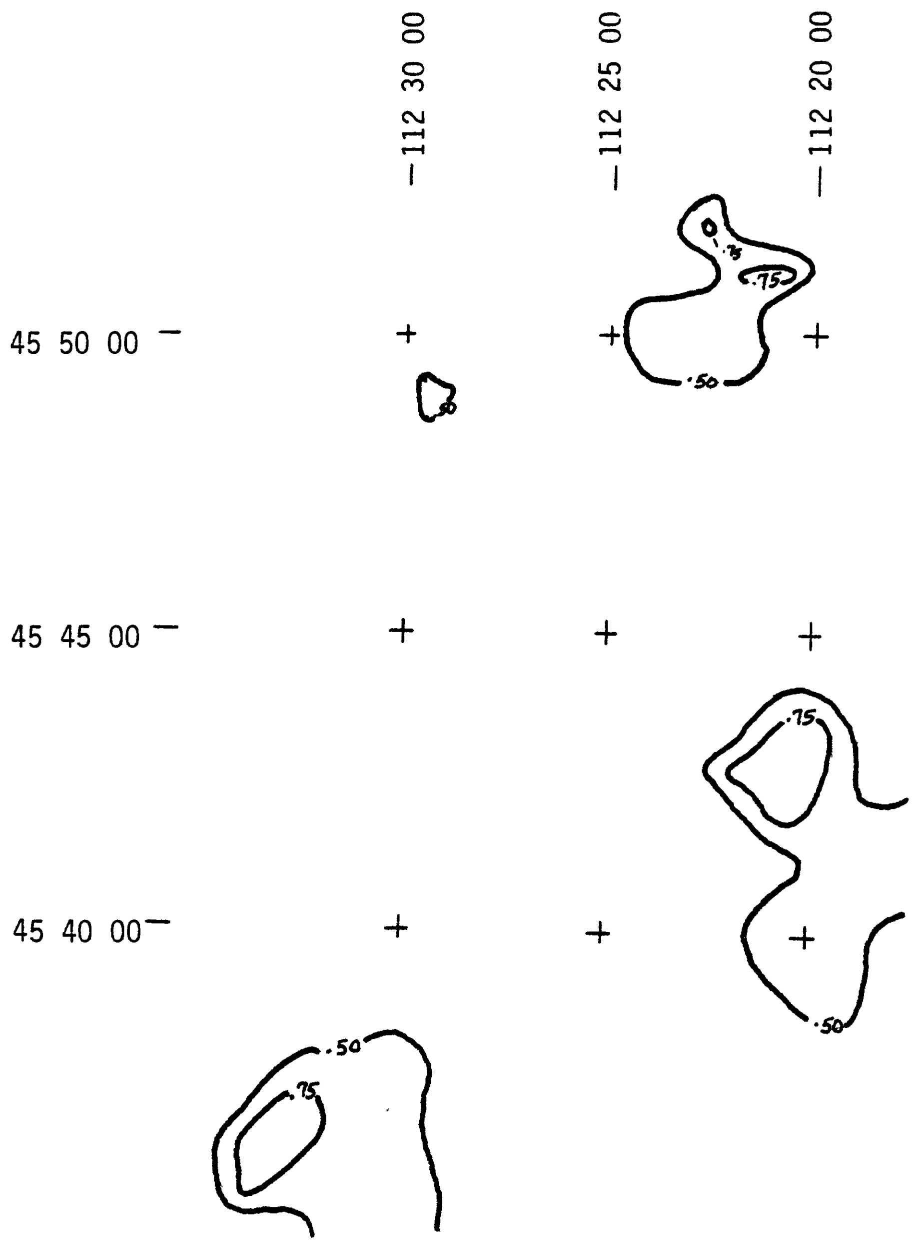


Figure 14. Contour map of Factor 1, rock samples. Contour intervals represent principal component percentiles, for example, .50 represents the 50th percentile.

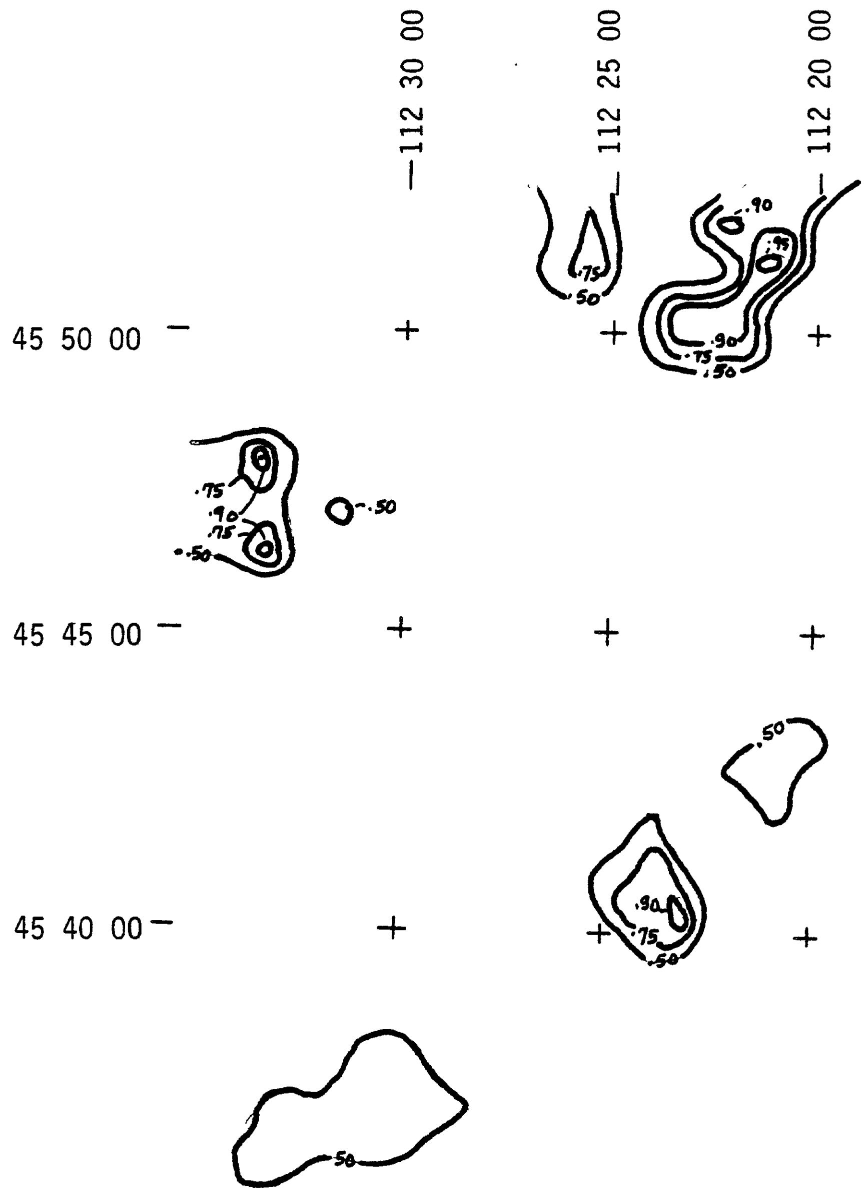


Figure 15. Contour map of Factor 2, rock samples. Contour intervals represent principal component percentiles, for example, .50 represents the 50th percentile.

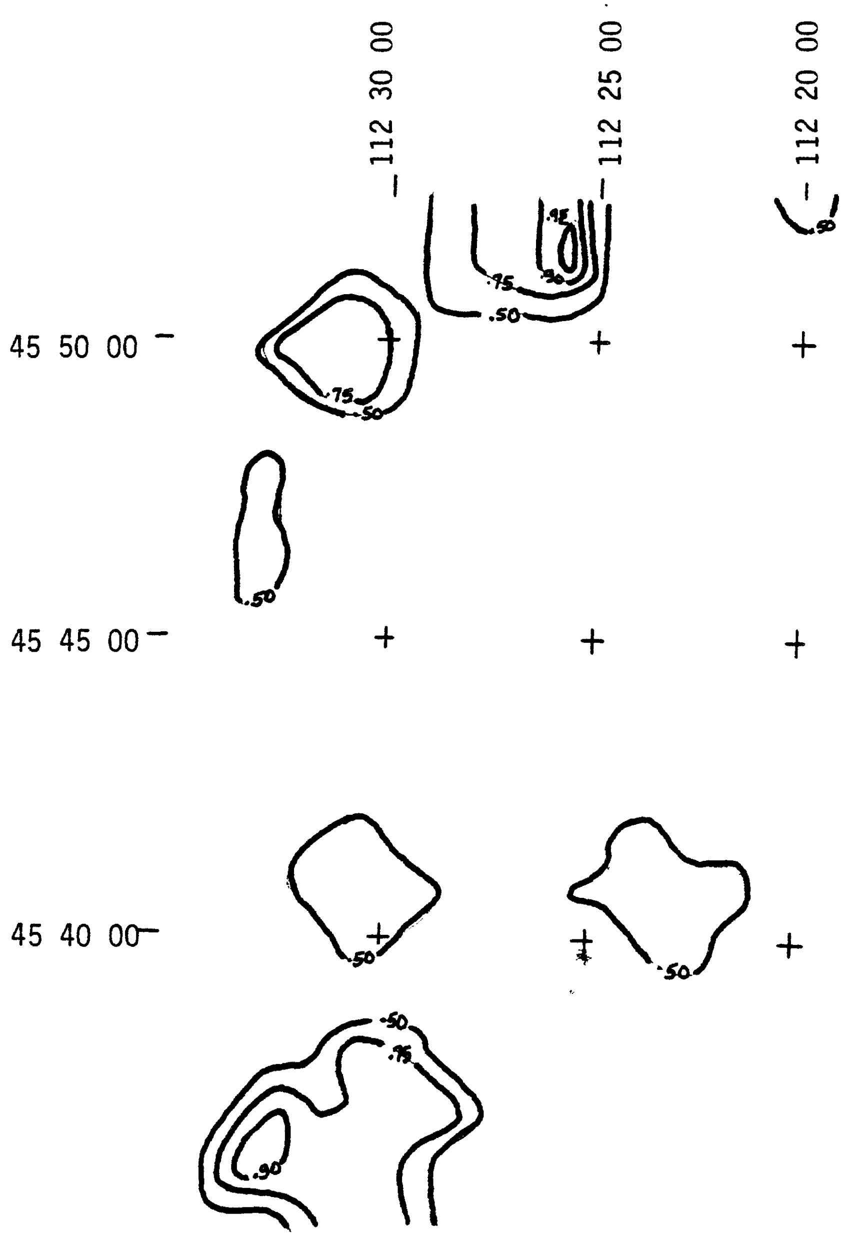


Figure 16. Contour map of Factor 3, rock samples. Contour intervals represent principal component percentiles, for example, .50 represents the 50th percentile.

Figure 17. Contour map of Factor 4, rock samples. Contour intervals represent principal component percentiles, for examples, .50 represents the 50th percentile.

DISCUSSION

Elements characteristic of mineralizing events and rock types are listed in table 7. As noted from the results of the ER-mode factor analysis, those mining districts near plutonic rocks carry a common suite. Figure 18 shows the anomalous elements found in ores from the various districts as discerned from a study of the raw data. The sampled Upper Camp Creek and Soap Gulch deposits show some similarities to the hydrothermal veins and replacements adjacent to igneous rocks, but are generally deficient in As, Sb, Pb, and Zn. The interesting similarity is in the presence of Sn and W.

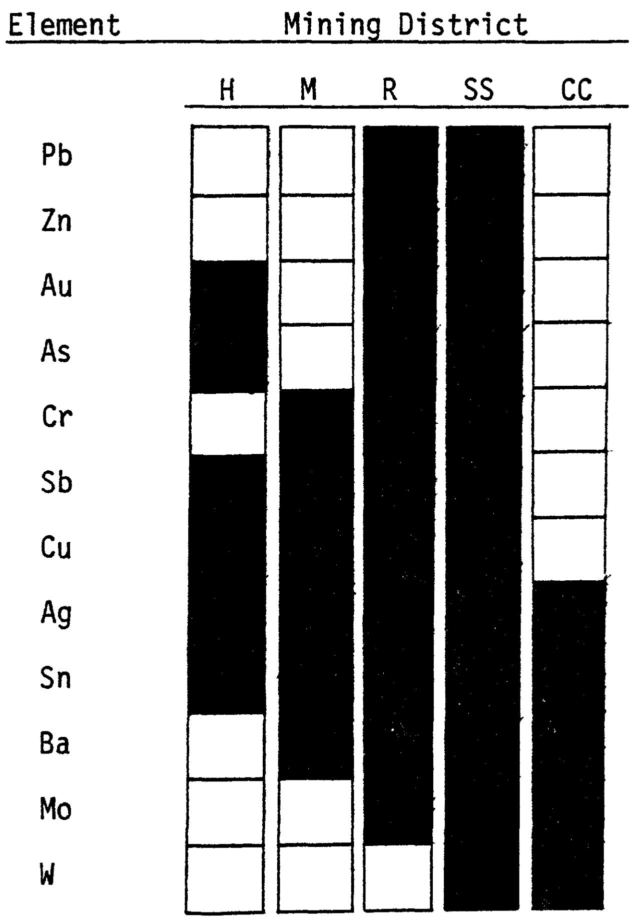
The magmatic-hydrothermal deposits are best developed peripheral to the sodic-series stocks. In particular, there appears to be a relationship between the more leucocratic or alaskitic phases of these stocks and the vein-type deposits. Age evidence from the Pioneer Mountains to the west of the Highland Mountains indicate that not all of the leucocratic rocks are genetically related to the plutons in which they occur (Lawrence Snee, USGS, unpub. data, 1980). Therefore, it is possible that a similar situation occurs in the Highland Mountains and that dike swarms (for example, Hell Canyon stock) may reflect the presence of an unexposed pluton of a younger age. If these hypothetical plutons exist, the trace elements in the dikes indicate a potential for buried mineral deposits.

The factor analysis of the stream-sediment data proved a useful technique for defining the different lithologic units. Additionally, the analysis showed similarities between rock types, that may reflect source provenances for the sedimentary rocks. Finally, the analysis indicated that some of the characterizing "ore" elements (for example, Mo, Sn) occur in rock-forming minerals as well as in the sulfide-mineral deposits. One ramification of this is that the Precambrian source terrains may have resource potential for such commodities as tin, molybdenum, and tungsten, and the form or character of these potential deposits may be quite different in appearance from "normal" exploration models.

Table 7.--Element suites characteristic of various mineralization and rock-types in the Highland Mountains.

Ore-related Veins	Skarns	Leucogranites	Proterozoic Y	Proterozoic X
Ag	Ca	B	Mg	Co
Cu	Mn	Be	Ca	Cr
Mo	Ag	W	Fe	Ni
Pb	Sr	Mo	Ti	La
Zn	Zn		B	Sc
Sb	W		Ba	Y
As			Be	
			Co	
			La	
			Pb	
			Sc	
			Y	
			Zr	
			Sb	
			As	
			W	

Figure 18.--Anomalous elements present in rock samples in five mining districts, Highland Mountains.
(Note similarity between Silver Star and Rochester districts.)



Key

H = Highland District

M = Moosetown

R = Rochester

SS = Silver Star

CC = Upper Camp Creek

Shading indicates presence of element in district.

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Appendix 1.--Rock geochemical data. All values are reported in parts per million (ppm) except Fe, Mg, Ca, and Ti which are reported in percent. "S" indicates analysis performed by emission spectrographic methods; "AA" indicates analysis by atomic absorption spectrophotometry methods; and "CM" indicates analysis by colorimetric methods. Latitude and longitude are reported in degrees, minutes, and seconds. "N" means the element was not detected for that sample.

Appendix 1. Rock geochemical data.

sample	LATITUDE	LONGITUD	S-FE%	S-MG%	S-CA%	S-TI%	S-MN	S-AG	S-AS	S-AU
8DL6001	45 36 39	112 32 30	3.0	.20	.70	.150	2,000	5.0	300	N
8DL6002	45 36 40	112 32 30	7.0	1.50	.50	.300	1,000	N	N	N
8DL6004	45 36 39	112 32 30	7.0	.50	.05	.300	5,000	2.0	N	N
8DL6005	45 36 39	112 32 30	7.0	1.00	.50	.300	700	N	N	N
8DL6006	45 36 39	112 32 30	.7	.10	.20	.150	200	N	N	N
8DL6007	45 36 39	112 32 30	10.0	2.00	3.00	1.000	3,000	N	N	N
8DL6008	45 36 39	112 32 30	3.0	1.00	1.00	.300	700	N	N	N
8DL6009	45 36 40	112 32 30	7.0	.07	.05	.100	5,000	N	N	N
8DL6010	45 36 44	112 31 16	10.0	.50	.05	1.000	500	1.5	N	N
8DL6011	45 36 44	112 31 16	7.0	.70	.20	.500	1,000	<.5	N	N
8DL6012	45 36 44	112 31 16	2.0	.10	.05	.500	70	2.0	200	N
8DL6013	45 36 44	112 31 16	7.0	2.00	2.00	.700	1,500	N	N	N
8DM6014	45 37 30	112 29 39	.7	.10	.20	.070	150	N	N	N
8DM6015	45 37 29	112 29 39	1.0	.10	.15	.100	200	N	N	N
8DM6016	45 37 42	112 29 58	5.0	.70	.50	.300	300	.5	N	N
8DM6017	45 37 30	112 29 40	15.0	.05	.20	.070	>5,000	150.0	10,000	<10
8DM6018	45 37 30	112 29 40	7.0	.20	.05	.150	100	10.0	300	N
8DM6019	45 37 30	112 29 40	20.0	.02	.05	.050	100	70.0	>10,000	N
8DM6020	45 37 30	112 29 40	5.0	.20	.05	.200	3,000	150.0	7,000	N
8DM6021	45 37 30	112 29 40	1.5	.15	.05	.100	700	2.0	<200	N
8DL6022	45 35 33	112 30 13	7.0	.03	.10	.100	700	70.0	>10,000	15
8DL6023	45 35 34	112 30 14	7.0	.70	.20	.300	700	N	N	N
8DL6024	45 35 33	112 30 13	.5	.10	.15	.030	200	N	N	N
8DL6025	45 35 33	112 30 13	.5	.20	.30	.050	500	N	N	N
8DL6026	45 35 33	112 30 13	2.0	.15	.05	.050	30	N	N	N
8DL6027	45 35 33	112 30 13	7.0	3.00	10.00	.500	1,000	N	N	N
8DL6028	45 35 33	112 30 13	5.0	.15	.05	.300	50	7.0	<200	N
8DL6029	45 35 47	112 30 20	7.0	.02	.05	.100	70	7.0	>10,000	<10
8DL6030	45 35 47	112 30 19	3.0	.70	.10	.500	150	3.0	500	N
8DL6031	45 35 47	112 30 19	1.5	.15	.15	.100	500	20.0	300	N
8DL6032	45 35 46	112 30 19	7.0	.30	.05	.300	150	2.0	1,000	N
8DL6033	45 36 6	112 30 17	1.0	.10	.10	.070	200	<.5	<200	N
8DL6034	45 35 6	112 30 16	5.0	1.00	.50	.500	300	N	N	N
8DL6035	45 36 5	112 30 16	7.0	1.00	.50	.500	700	N	N	N
8DL6036	45 36 25	112 30 57	1.0	.20	.15	.100	100	N	N	N
8DL6037	45 36 24	112 30 56	5.0	.70	.30	.200	200	1.5	>10,000	N
8DL6038	45 36 24	112 30 57	5.0	1.00	.50	.500	700	N	N	N
8DL6039	45 36 24	112 30 56	10.0	.10	.05	.100	1,000	1.0	200	N
8DL6040	45 37 12	112 30 19	7.0	.50	.07	.200	50	1.0	500	N
8DL6041	45 37 11	112 30 19	5.0	.30	.05	.100	500	3.0	500	N
8DL6042	45 37 12	112 30 19	>20.0	.50	1.00	.150	1,000	15.0	2,000	N
8DL6043	45 37 11	112 30 18	1.0	7.00	10.00	.020	200	N	N	N
8DL6044	45 37 12	112 30 19	5.0	.70	.07	.300	300	5.0	700	N
8DL6045	45 37 11	112 30 19	10.0	.07	.05	.030	70	<.5	N	10
8DL6046	45 37 11	112 30 19	10.0	1.00	1.00	1.000	1,500	2.0	N	N

Appendix 1.--Continued

sample	S-B	S-BA	S-BE	S-BI	S-CD	S-CO	S-CR	S-CU	S-LA	S-MO
80L6001	100	300	2.0	N	N	20.0	10	200	20	15
80L6002	15	500	<1.0	N	N	20.0	70	70	50	N
80L6004	100	500	1.5	N	N	30.0	150	100	70	20
80L6005	10	1,000	<1.0	N	N	20.0	150	20	100	N
80L6006	50	700	3.0	N	N	N	N	<5	50	N
80L6007	10	70	<1.0	N	N	50.0	200	200	20	N
80L6008	10	1,000	1.0	N	N	10.0	70	20	70	N
80L6009	10	200	1.0	N	N	10.0	20	<5	20	15
80L6010	150	150	1.5	N	N	30.0	150	15	<20	N
80L6011	200	200	2.0	N	N	30.0	100	100	150	5
80L6012	50	150	1.0	N	N	5.0	30	30	20	N
80L6013	20	150	1.0	N	N	30.0	100	100	20	N
80M6014	15	500	5.0	N	N	N	N	<5	30	N
80M6015	20	700	3.0	N	N	N	N	<5	50	N
80M6016	10	700	1.0	N	N	20.0	100	<5	50	N
80M6017	20	200	1.0	N	300	50.0	30	1,000	<20	30
80M6018	100	100	2.0	N	20	N	70	200	<20	50
80M6019	10	20	<1.0	N	150	5.0	20	1,000	<20	30
80M6020	30	150	1.5	N	200	30.0	100	1,000	30	10
80M6021	70	500	1.5	N	20	N	N	10	20	N
80L6022	20	150	<1.0	N	150	20.0	70	1,000	<20	20
80L6023	30	300	2.0	N	N	20.0	150	50	100	N
80L6024	15	150	5.0	N	N	N	N	<5	20	N
80L6025	15	300	1.5	N	N	N	N	<5	20	N
80L6026	20	150	1.5	N	N	N	10	15	20	N
80L6027	20	150	1.0	N	N	50.0	1,500	70	<20	N
80L6028	20	150	1.0	N	N	30.0	30	10	20	
80L6029	20	100	1.0	N	N	20.0	20	50	50	
80L6030	50	300	1.0	N	N	15.0	150	30	100	N
80L6031	30	500	3.0	N	N	N	10	70	100	N
80L6032	50	300	2.0	N	N	7.0	150	100	50	N
80L6033	20	200	5.0	N	N	5.0	10	10	20	N
80L6034	30	700	1.0	N	N	20.0	100	<5	150	N
80L6035	10	700	1.0	N	N	20.0	100	20	50	N
80L6036	20	500	2.0	N	N	N	N	15	30	N
80L6037	70	150	2.0	N	N	10.0	50	30	70	N
80L6038	50	300	2.0	N	N	15.0	70	15	70	N
80L6039	100	150	3.0	N	N	50.0	150	150	20	N
80L6040	30	500	2.0	N	N	10.0	N	30	30	N
80L6041	20	50	1.0	N	N	10.0	30	70	20	N
80L6042	10	700	1.0	N	30	700.0	500	10,000	20	1,000
80L6043	50	<20	<1.0	N	N	5.0	10	20	20	N
80L6044	20	500	1.5	N	N	20.0	100	200	150	15
80L6045	20	300	1.0	N	N	100.0	10	30	N	15
80L6046	70	200	1.0	N	N	50.0	200	200	30	N

Appendix 1.--Continued

sample	S-NB	S-NI	S-PB	S-SB	S-SC	S-SN	S-SR	S-V	S-W	S-Y
8DL6001	<20	20	2,000	N	15	N	<100	100	N	50
8DL6002	<20	50	100	N	15	N	150	150	N	20
8DL6004	<20	50	3,000	N	20	15	<100	500	N	50
8DL6005	<20	70	50	N	20	N	150	150	N	30
8DL6006	<20	5	70	N	5	<10	100	10	N	10
8DL6007	<20	70	15	N	50	N	100	200	N	100
8DL6008	<20	30	50	N	10	N	200	70	N	20
8DL6009	<20	20	100	N	7	N	<100	30	N	15
8DL6010	<20	70	15	N	30	N	150	200	N	70
8DL6011	<20	50	50	N	20	N	100	70	N	50
8DL6012	<20	10	15	N	15	N	<100	100	N	30
8DL6013	N	50	10	N	30	N	150	200	N	30
8DM6014	<20	<5	70	N	5	<10	<100	10	N	<10
8DM6015	<20	<5	100	N	5	<10	<100	10	N	20
8DM6016	<20	50	50	N	10	N	150	100	N	20
8DM6017	N	50	20,000	150	10	20	100	300	N	30
8DM6018	<20	15	3,000	<100	10	N	100	100	N	30
8DM6019	<20	20	>20,000	300	10	N	100	50	N	10
8DM6020	<20	20	>20,000	5,000	15	50	100	100	<50	20
8DM6021	<20	5	300	N	5	N	<100	10	N	<10
8DL6022	N	30	15,000	100	7	N	100	200	N	20
8DL6023	<20	70	50	N	15	N	100	150	N	30
8DL6024	<20	<5	150	N	5	<10	<100	10	N	1
8DL6025	<20	10	200	N	5	N	<100	10	N	20
8DL6026	<20	7	300	N	5	<10	<100	30	N	15
8DL6027	<20	300	150	N	30	<10	200	200	N	30
8DL6028	<20	30	5,000	N	10	N	<100	150	<50	10
8DL6029	<20	70	500	100	7	10	<100	20	N	30
8DL6030	<20	50	500	N	15	<10	100	150	N	30
8DL6031	<20	5	3,000	N	5	30	100	10	N	10
8DL6032	<20	30	1,500	200	15	N	<100	150	N	30
8DL6033	20	<5	150	N	7	10	<100	20	N	20
8DL6034	<20	70	20	N	15	N	100	150	N	30
8DL6035	<20	70	50	N	15	N	100	150	N	30
8DL6036	<20	<5	70	N	<5	<10	<100	10	N	15
8DL6037	<20	30	20	N	10	N	100	100	N	20
8DL6038	<20	50	30	N	15	N	100	150	N	20
8DL6039	<20	70	N	N	50	N	1,500	500	N	30
8DL6040	<20	5	30	N	7	N	<100	70	N	20
8DL6041	N	10	30	<100	5	N	<100	30	N	N
8DL6042	<20	150	2,000	1,000	7	500	150	200	100	30
8DL6043	<20	<5	15	N	<5	N	<100	10	N	N
8DL6044	<20	70	50	N	15	N	<100	150	N	30
8DL6045	<20	30	<10	N	N	N	<100	50	N	N

Appendix 1.--Continued

sample	S-ZN	S-ZR	S-TH	AA-ZN-P	AA-SB-P	CM-AS	CM-W	CM-W-P
8DL6001	2,000	50	N	2,000.0	10.0	400	--	<1
8DL6002	3,000	200	N	5,600.0	60.0	80,000	--	1
8DL6004	2,000	150	N	1,700.0	4.0	160	--	1
8DL6005	N	500	N	85.0	<1.0	10	--	N
8DL6006	N	70	N	20.0	<1.0	10	--	N
8DL6007	N	150	N	35.0	N	10	--	N
8DL6008	N	200	N	65.0	N	10	--	N
8DL6009	N	20	N	140.0	1.0	20	--	3
8DL6010	N	70	N	70.0	20.0	40	--	5
8DL6011	N	150	N	160.0	4.0	20	--	1
8DL6012	N	30	N	15.0	5.0	100	--	<1
8DL6013	N	70	N	35.0	<1.0	10	--	N
8DM6014	N	70	N	15.0	1.0	<10	--	2
8DM6015	N	70	N	20.0	2.0	<10	--	N
8DM6016	N	100	N	70.0	1.0	<10	--	<1
8DM6017	7,000	20	N	11,000.0	80.0	12,000	--	2
8DM6018	5,000	100	N	4,200.0	140.0	200	--	N
8DM6019	7,000	20	N	5,400.0	35.0	12,000	--	1
8DM6020	3,000	200	N	4,000.0	>200.0	4,000	--	1
8DM6021	5,000	70	N	5,400.0	5.0	80	--	1
8DL6022	500	30	N	70.0	4.0	20	--	N
8DL6023	N	300	N	60.0	2.0	<10	--	3
8DL6024	N	20	N	15.0	<1.0	<10	--	<1
8DL6025	200	15	N	360.0	1.0	10	--	N
8DL6026	500	30	N	500.0	2.0	20	--	<1
8DL6027	N	50	N	70.0	2.0	20	--	<1
8DL6028	1,000	30	N	840.0	5.0	40	--	10
8DL6029	N	30	N	70.0	80.0	160,000	--	3
8DL6030	200	200	N	130.0	4.0	200	--	5
8DL6031	1,000	70	N	1,300.0	4.0	1,200	--	1
8DL6032	2,000	100	N	2,800.0	200.0	800	--	2
8DL6033	N	20	N	80.0	2.0	20	--	3
8DL6034	N	200	N	55.0	<1.0	10	--	<1
8DL6035	N	300	N	80.0	1.0	10	--	N
8DL6036	N	70	N	10.0	<1.0	<10	--	N
8DL6037	N	200	N	30.0	5.0	8,000	--	1
8DL6038	N	200	N	60.0	<1.0	20	--	5
8DL6039	700	100	N	680.0	15.0	400	--	5
8DL6040	N	70	N	10.0	2.0	400	--	10
8DL6041	N	15	N	10.0	10.0	400	--	3
8DL6042	>10,000	70	N	34,000.0	35.0	1,600	--	1
8DL6043	N	10	N	20.0	N	<10	--	1
8DL6044	300	200	<100	320.0	5.0	800	--	2
8DL6045	N	20	N	70.0	5.0	80	--	10
8DL6046	N	100	N	220.0	2.0	[illegible]	--	3

Appendix 1.--continued

sample	LATITUDE	LONGITUD	S-FE%	S-MG%	S-CA%	S-TI%	S-MN	S-AG	S-AS	S-AU
8DL6047	45 37 22	112 30 8	10.0	.50	.07	.500	300	2.0	300	N
8DL6048	45 37 22	112 30 8	10.0	2.00	.50	.700	1,500	N	N	N
8DL6049	45 37 22	112 30 7	7.0	1.50	.30	.700	1,000	N	N	N
8DL6050	45 37 22	112 30 8	3.0	.70	.30	.300	300	N	N	N
8DL6051	45 37 22	112 30 8	5.0	1.00	.30	.300	500	N	N	N
8DL6052	45 37 22	112 30 8	.7	.10	.50	.030	100	.5	N	N
8DL6053	45 37 22	112 30 7	10.0	1.50	.07	.700	1,500	3.0	N	N
8DL6054	45 41 15	112 30 30	7.0	.10	.05	.100	100	1.0	500	<10
8DL6003	45 36 39	112 32 30	10.0	.02	.05	.070	70	500.0	>10,000	<10
8BL6055	45 46 43	112 34 29	.7	1.50	3.00	.020	500	200.0	N	N
8BL6056	45 46 42	112 34 27	2.0	.70	1.00	.200	700	N	N	N
8BL6057	45 46 47	112 33 50	1.5	.70	1.00	.200	500	N	N	N
8BL6058	45 46 41	112 34 47	.3	2.00	2.00	.007	150	.5	N	N
8BL6059	45 46 41	112 35 1	.3	7.00	10.00	.030	150	N	N	N
8BL6060	45 46 35	112 34 46	7.0	2.00	3.00	.500	1,500	.5	N	N
8BL6061	45 46 44	112 35 6	5.0	3.00	7.00	.300	1,500	N	N	N
8BL6062	45 46 37	112 34 49	.3	5.00	10.00	.020	300	N	N	N
8BL6063	45 46 42	112 34 48	20.0	.30	.50	.050	200	.7	300	N
8BL6064	45 47 41	112 30 28	5.0	1.00	15.00	.300	1,000	N	N	N
8BL6065	45 47 42	112 30 30	>20.0	.10	.10	.030	150	3.0	300	N
8BL6066	45 47 44	112 30 43	.3	.05	.10	.020	70	N	N	N
8BL6067	45 47 51	112 30 50	20.0	3.00	1.50	.010	700	1.5	N	10
8BL6068	45 47 51	112 30 50	10.0	5.00	10.00	.010	1,000	1.5	N	15
8CL6069	45 43 29	112 33 23	3.0	1.50	.10	.030	200	15.0	N	N
8CL6070	45 43 29	112 33 23	2.0	1.50	<.05	.500	150	.7	N	N
8BL6071	45 43 29	112 33 23	2.0	.05	.07	.020	30	2.0	N	N
8BL6072	45 43 29	112 33 23	.7	5.00	10.00	.005	300	N	N	N
8BL6073	45 43 29	112 33 22	.5	.70	1.00	.005	70	2,000.0	<200	N
8CL6074	45 43 29	112 33 23	1.5	.15	<.05	.150	20	20.0	N	N
8CL6075	45 43 23	112 33 16	7.0	1.00	.05	.300	300	1.5	N	N
8CN6076	45 41 51	112 18 59	15.0	1.50	7.00	.002	>5,000	2.0	N	N
8CN6077	45 42 3	112 19 8	15.0	1.00	3.00	.050	5,000	20.0	N	N
8CN6078	45 41 52	112 18 52	20.0	1.00	1.00	.007	150	10.0	N	10
8CN6079	45 41 47	112 18 54	5.0	1.50	1.50	.500	1,500	3.0	N	N
8CN6080	45 41 57	112 19 9	15.0	1.00	10.00	.100	3,000	70.0	N	N
8CN6097	45 42 43	112 20 32	20.0	7.00	7.00	.030	1,500	N	N	N
8CN6098	45 42 43	112 20 30	7.0	5.00	3.00	.500	1,500	.5	N	N
8CN6099	45 42 41	112 20 30	15.0	2.00	15.00	.150	2,000	1.0	N	N
8CN6100	45 42 43	112 20 31	1.5	5.00	20.00	.150	1,000	2.0	N	N
8CN6101	45 42 42	112 20 30	>20.0	1.50	1.50	.150	700	50.0	N	10
8CN6102	45 42 42	112 20 31	10.0	2.00	3.00	.500	1,500	N	N	N
8CN6103	45 42 43	112 20 31	15.0	5.00	1.00	.100	1,500	10.0	N	N
8CN6104	45 42 42	112 20 30	10.0	1.00	10.00	.300	5,000	N	N	N
8CN6105	45 42 43	112 20 31	7.0	2.00	2.00	.300	2,000	1.5	N	N

sample	S-B	S-BA	S-BE	S-BI	S-CD	S-CO	S-CR	S-CU	S-LA	S-MO
8DL6047	70	500	1.5	N	N	15.0	300	100	70	15
8DL6048	10	1,000	<1.0	N	N	30.0	500	70	100	N
8DL6049	15	1,000	<1.0	N	N	30.0	300	100	150	10
8DL6050	20	1,000	1.0	N	N	15.0	70	30	100	N
8DL6051	15	1,000	2.0	N	N	20.0	70	70	20	N
8DL6052	20	500	5.0	N	N	N	10	5	20	N
8DL6053	10	700	N	N	N	30.0	300	70	200	N
8DL6054	20	300	1.0	200	N	N	30	70	30	N
8DL6003	20	150	1.0	20	150	N	30	1,500	20	30
8BL6055	10	1,000	1.0	N	N	N	10	100	20	N
8BL6056	10	700	2.0	N	N	5.0	10	<5	70	N
8BL6057	15	1,000	2.0	N	N	5.0	15	<5	50	N
8BL6058	10	100	1.0	N	N	N	10	5	30	N
8BL6059	10	50	<1.0	N	N	N	20	5	30	N
8BL6060	20	700	1.0	N	N	30.0	100	150	50	N
8BL6061	20	150	1.5	N	N	20.0	500	70	30	N
8BL6062	15	<20	<1.0	N	N	N	10	10	20	N
8BL6063	10	70	1.0	N	N	100.0	10	1,500	<20	10
8BL6064	15	50	1.0	N	N	5.0	300	10	50	N
8BL6065	<10	<20	<1.0	N	N	150.0	20	5,000	<20	15
8BL6066	20	20	1.0	N	N	N	N	20	20	[illegible]
8BL6067	50	<20	<1.0	N	N	50.0	10	1,500	<20	[illegible]
8BL6068	N	<20	<1.0	50	N	30.0	10	1,000	<20	N
8CL6069	15	<20	1.0	N	N	10.0	20	20,000	<20	N
8CL6070	150	200	3.0	N	N	10.0	100	500	70	10
8BL6071	10	20	1.0	N	N	N	10	70	20	5
8BL6072	10	N	<1.0	N	N	N	10	70	20	[illegible]
8BL6073	20	20	1.0	N	70	N	10	2,000	20	N
8CL6074	100	70	1.0	N	N	30.0	20	50	50	N
8CL6075	200	200	3.0	N	N	15.0	100	100	50	7
8CN6076	50	500	3.0	<10	N	15.0	<10	20	<20	[illegible]
8CN6077	20	200	5.0	100	N	20.0	70	3,000	20	10
8CN6078	30	50	1.0	N	N	N	50	1,000	<20	10
8CN6079	30	200	1.0	N	N	30.0	70	70	20	N
8CN6080	<10	N	1.5	70	N	20.0	70	20,000	<20	20
8CN6097	500	20	<1.0	N	N	50.0	10	200	<20	N
8CN6098	15	1,000	1.0	N	N	30.0	1,000	100	30	N
8CN6099	<10	700	1.0	N	N	20.0	50	500	20	N
8CN6100	15	1,000	<1.0	N	N	5.0	50	200	50	N
8CN6101	<10	100	2.0	N	N	100.0	30	20,000	N	N
8CN6102	15	1,000	1.0	N	N	50.0	700	200	30	N
8CN6103	20	30	<1.0	N	N	50.0	300	10,000	<20	20
8CN6104	50	200	<1.0	N	N	20.0	70	100	70	N
8CN6105	15	700	1.0	N	N	100.0	1,000	15,000	30	N
8CN6106	50	500	1.0	N	N	15.0	20	70	20	N

Appendix 1.--continued

sample	S-NB	S-NI	S-PB	S-SB	S-SC	S-SN	S-SR	S-V	S-W	S-Y
8DL6047	<20	50	500	N	20	30	<100	200	N	50
8DL6048	<20	150	20	N	50	N	150	200	N	100
8DL6049	<20	100	20	N	20	N	150	200	N	70
8DL6050	<20	30	50	N	10	N	150	100	N	20
8DL6051	<20	50	50	N	10	N	150	150	N	20
8DL6052	N	5	100	N	<5	N	100	10	N	15
8DL6053	10	100	15	N	30	N	<100	300	N	70
8DL6054	N	5	150	N	7	10	500	150	N	10
8DL6003	N	20	>20,000	2,000	5	N	200	70	N	15
8BL6055	<20	15	200	<100	<5	N	100	50	N	<10
8BL6056	<20	5	15	N	15	N	300	70	N	30
8BL6057	<20	10	30	N	5	N	500	50	N	15
8BL6058	N	5	10	N	<5	N	<100	30	N	N
8BL6059	N	5	<10	N	<5	N	100	15	N	10
8BL6060	<20	30	20	N	30	N	1,000	200	N	30
8BL6061	<20	70	20	N	50	15	1,000	150	N	30
8BL6062	N	<5	10	N	N	N	100	20	N	N
8BL6063	<20	15	10	<100	N	N	<100	70	N	N
8BL6064	<20	7	10	N	20	70	200	150	N	100
8BL6065	<20	15	<10	N	<5	N	<100	70	N	10
8BL6066	<20	5	50	N	<5	N	<100	10	N	10
8BL6067	<20	10	<10	N	N	N	<100	<10	N	10
8BL6068	N	10	<10	N	5	N	100	70	N	10
8CL6069	<20	15	20	N	10	20	<100	30	N	20
8CL6070	<20	7	10	N	15	<10	<100	150	N	50
8BL6071	<20	7	<10	<100	<5	N	<100	30	N	N
8BL6072	<20	<5	10	N	<5	N	100	10	N	N
8BL6073	<20	10	1,000	2,000	N	N	100	20	N	N
8CL6074	<20	15	15	N	5	N	<100	70	N	20
8CL6075	<20	30	30	N	15	N	<100	150	N	50
8CN6076	N	30	<10	N	N	N	300	30	N	10
8CN6077	<20	30	10	N	5	N	150	70	70	30
8CN6078	N	10	10	N	5	N	150	150	70	10
8CN6079	<20	50	20	N	20	N	100	200	50	20
8CN6080	N	30	N	N	7	50	<100	100	N	30
8CN6097	20	20	10	N	N	300	200	100	N	N
8CN6098	<20	20	20	N	30	N	700	200	N	30
8CN6099	20	5	10	N	7	100	100	100	N	20
8CN6100	<20	150	20	N	5	N	500	50	N	20
8CN6101	<20	30	N	N	5	N	<100	100	N	10
8CN6102	<20	100	20	N	20	N	700	300	N	30
8CN6103	N	50	N	N	10	N	100	70	N	<10
8CN6104	<20	20	100	N	10	N	700	150	N	50
8CN6105	N	150	15	N	20	N	700	200	N	30

Appendix 1. --continued

sample	S-ZN	S-ZR	S-TH	AA-ZN-P	AA-SB-P	CM-AS	CM-W	CM-W-P
8DL6047	N	300	N	220.0	10.0	200	--	10
8DL6048	200	300	N	150.0	N	20	--	1
8DL6049	<200	500	N	90.0	<1.0	20	--	N
8DL6050	N	200	N	55.0	<1.0	10	--	N
8DL6051	N	70	N	60.0	N	<10	--	N
8DL6052	N	70	N	10.0	N	<10	--	N
8DL6053	200	700	N	140.0	N	<10	--	N
8DL6054	N	70	N	10.0	<1.0	100	--	2
8DL6003	5,000	30	N	3,800.0	>200.0	8,000	--	N
8DL6055	N	50	N	90.0	30.0	<10	3	--
8BL6056	N	150	N	55.0	<1.0	<10	2	--
8BL6057	N	100	N	35.0	<1.0	<10	2	--
8BL6058	N	10	N	20.0	1.0	<10	2	--
8BL6059	N	15	N	15.0	N	<10	1	--
8BL6060	N	70	N	40.0	<1.0	<10	1	--
8BL6061	N	50	N	40.0	1.0	<10	1	--
8BL6062	N	10	N	20.0	N	<10	2	--
8BL6063	200	20	N	110.0	20.0	300	2	--
8BL6064	N	50	N	15.0	<1.0	<10	2	--
8BL6065	N	15	N	120.0	10.0	200	N	--
8BL6066	N	N	N	10.0	<1.0	<10	1	--
8BL6067	N	<10	N	40.0	<1.0	20	1	--
8BL6068	N	<10	N	160.0	5.0	20	N	--
8CL6069	N	30	N	60.0	2.0	<10	N	--
8CL6070	N	200	N	20.0	1.0	20	N	--
8BL6071	N	10	N	40.0	15.0	40	5	--
8BL6072	N	10	N	25.0	<1.0	<10	<1	--
8BL6073	300	10	N	380.0	>200.0	60	N	--
8CL6074	N	100	N	15.0	15.0	20	5	--
8CL6075	N	50	N	25.0	3.0	20	<1	--
8CN6076	500	N	N	190.0	2.0	10	2	--
8CN6077	300	15	N	340.0	3.0	20	1	--
8CN6078	N	<10	N	45.0	10.0	10	1	--
8CN6079	N	70	N	110.0	<1.0	20	15	--
8CN6080	700	30	N	1,100.0	<1.0	5	N	--
8CN6097	N	15	N	25.0	3.0	10	--	10
8CN6098	N	70	N	65.0	N	10	--	<1
8CN6099	N	70	N	20.0	N	<10	--	1
8CN6100	N	30	N	45.0	N	<10	--	N
8CN6101	N	30	N	130.0	<1.0	<10	--	N
8CN6102	N	100	N	25.0	N	<10	--	N
8CN6103	N	15	N	65.0	<1.0	30	--	N
8CN6104	N	200	N	70.0	N	<10	--	<1
8CN6105	N	50	N	120.0	N	<10	--	N
8CN6106	N	70	N	35.0	N	<10	--	N

Appendix 1.--continued

sample	LATITUDE	LONGITUD	S-FE%	S-MG%	S-CA%	S-TI%	S-MN	S-AG	S-AS	S-AU
8CN6108	45 42 41	112 20 31	15.0	2.00	.20	.300	1,500	3.0	N	N
8CN6109	45 42 42	112 20 32	15.0	3.00	.30	1.000	1,500	7.0	N	N
8CN6110	45 42 42	112 20 31	2.0	.70	.50	.150	500	N	N	N
8CN6111	45 42 41	112 20 30	>20.0	.10	.07	.020	100	10.0	<200	N
8CN6112	45 42 42	112 20 31	>20.0	1.50	1.50	.005	1,000	15.0	N	N
8CN6113	45 42 42	112 20 30	5.0	2.00	1.50	.500	1,500	N	N	N
8CN6114	45 42 43	112 20 32	15.0	1.50	20.00	.150	>5,000	N	N	N
8CM6116	45 40 37	112 23 22	.7	.15	.10	.050	500	50.0	N	N
8CM6117	45 40 37	112 23 22	2.0	.70	1.00	.200	500	.7	N	N
8CM6118	45 40 36	112 23 21	2.0	.70	1.50	.200	1,000	N	N	N
8CN6119	45 40 12	112 20 37	5.0	3.00	5.00	.200	1,500	N	N	N
8CN6120	45 40 23	112 20 53	10.0	.70	.20	1.000	500	15.0	N	N
8CN6121	45 40 11	112 20 37	10.0	1.00	10.00	.020	>5,000	200.0	<200	N
8CN6122	45 39 23	112 19 42	3.0	1.50	1.00	.200	500	N	N	N
8CN6123	45 39 22	112 19 40	7.0	2.00	.30	.500	700	3.0	N	N
8CN6124	45 39 23	112 19 43	3.0	.20	<.05	.100	100	15.0	N	<10
8CN6125	45 39 23	112 19 42	10.0	5.00	.20	1.000	2,000	3.0	N	N
8CN6126	45 39 36	112 19 59	7.0	7.00	.07	.100	700	N	N	N
8CN6127	45 39 36	112 19 59	5.0	10.00	.07	.200	1,000	N	N	N
8CN6128	45 39 36	112 19 58	2.0	2.00	.15	.300	300	N	N	N
8CN6129	45 39 35	112 19 58	2.0	.70	1.00	.150	200	N	N	N
8CN6130	45 40 45	112 19 55	15.0	2.00	.07	.300	1,000	N	N	N
8CN6131	45 40 44	112 19 55	15.0	3.00	.10	.200	1,000	N	N	N
8CN6132	45 40 45	112 19 55	15.0	3.00	.15	.200	1,000	N	N	N
8CN6133	45 40 45	112 19 55	15.0	3.00	.07	.300	1,000	N	N	N
8CN6134	45 40 44	112 19 55	10.0	.20	.10	.300	100	700.0	500	<10
8CN6135	45 41 45	112 18 54	15.0	2.00	1.50	.300	2,000	10.0	N	N
8CM6115	45 40 37	112 23 22	2.0	.50	.30	.300	500	1.5	N	N
8CN6136	45 40 15	112 19 41	3.0	.05	.07	.020	100	20.0	N	50
8CN6137	45 40 15	112 19 40	7.0	2.00	1.50	.500	700	1.5	N	N
8CN6138	45 40 16	112 19 42	10.0	5.00	3.00	1.000	1,500	1.5	N	N
8CN6139	45 41 6	112 20 11	10.0	.15	1.00	.050	700	30.0	200	30
8CN6140	45 41 5	112 20 11	1.5	.70	2.00	.150	500	1.0	N	N
8CN6141	45 41 5	112 19 47	1.5	1.00	1.00	.150	300	.5	N	N
8CN6142	45 41 5	112 19 49	10.0	3.00	5.00	.700	3,000	.5	N	N
8CN6143	45 41 5	112 19 49	2.0	1.00	1.50	.070	1,000	1.0	N	N
8CN6144	45 41 5	112 19 49	10.0	2.00	5.00	.700	2,000	N	N	N
8CN6145	45 40 49	112 19 16	15.0	.70	1.50	.150	1,000	1.5	200	N
8CN6146	45 40 50	112 19 16	>20.0	1.00	1.00	.070	5,000	N	N	N
9BM6252	45 49 50	112 22 58	3.0	.70	2.00	.200	700	2.0	N	N
9BM6253	45 49 50	112 22 58	10.0	1.50	3.00	.300	2,000	1.5	N	N
9BM6254	45 49 50	112 22 58	5.0	1.00	2.00	.500	1,500	N	N	N
9BM6290	45 47 57	112 29 29	15.0	.70	7.00	.200	2,000	200.0	N	N
9BM6286	45 47 46	112 29 27	20.0	.30	.07	.015	70	200.0	700	N

Appendix 1.--continued

sample	S-B	S-BA	S-BE	S-BI	S-CD	S-CO	S-CR	S-CU	S-LA	S-MO
8CN6108	10	150	<1.0	N	N	70.0	1,000	500	30	5
8CN6109	10	50	<1.0	N	N	100.0	200	700	20	N
8CN6110	20	700	1.0	N	N	5.0	10	30	20	N
8CN6111	15	<20	<1.0	100	N	N	50	300	<20	20
8CN6112	<10	<20	5.0	50	N	10.0	10	2,000	<20	N
8CN6113	15	1,000	1.5	N	N	20.0	300	70	70	N
8CN6114	10	<20	1.0	N	N	N	70	70	<20	N
8CN6116	50	2,000	1.0	N	N	N	10	50	20	200
8CN6117	15	1,500	2.0	N	N	10.0	50	10	100	10
8CN6118	15	1,000	2.0	N	N	10.0	20	N	50	5
8CN6119	10	50	1.0	N	N	30.0	500	30	<20	N
8CN6120	20	200	1.0	N	N	20.0	50	200	20	20
8CN6121	10	70	1.0	100	20	50.0	20	500	20	10
8CN6122	15	300	1.0	N	N	10.0	70	10	<20	N
8CN6123	15	100	1.0	N	N	20.0	150	150	30	N
8CN6124	20	100	1.0	15	20	10.0	20	700	20	15
8CN6125	10	500	1.0	N	20	50.0	200	500	20	50
8CN6126	100	100	1.0	N	N	15.0	20	10	<20	N
8CN6127	10	<20	1.0	N	N	15.0	10	N	<20	N
8CN6128	20	150	1.0	N	N	10.0	50	N	20	N
8CN6129	15	300	1.0	N	N	7.0	30	10	20	N
8CN6130	N	N	N	N	N	1,500.0	>5,000	N	N	N
8CN6131	100	N	N	N	N	1,000.0	>5,000	<5	N	N
8CN6132	30	<20	N	N	N	1,500.0	>5,000	<5	N	N
8CN6133	N	<20	N	N	N	2,000.0	>5,000	N	N	N
8CN6134	15	70	<1.0	70	30	15.0	1,000	10,000	N	20
8CN6135	20	700	2.0	30	N	20.0	1,500	1,000	50	N
8CN6115	100	500	2.0	N	N	7.0	10	<5	70	7
8CN6136	10	100	<1.0	<10	N	15.0	10	20	20	N
8CN6137	15	500	1.0	N	N	20.0	70	50	30	N
8CN6138	15	500	<1.0	N	N	100.0	2,000	100	<20	N
8CN6139	20	150	<1.0	N	N	15.0	50	200	20	7
8CN6140	20	300	1.0	N	N	5.0	70	15	20	N
8CN6141	15	500	1.0	N	N	N	N	5	20	N
8CN6142	15	70	<1.0	N	N	50.0	300	150	20	N
8CN6143	1,000	200	5.0	N	N	15.0	10	20	20	N
8CN6144	10	150	N	N	N	50.0	300	150	<20	N
8CN6145	50	700	1.0	N	N	15.0	1,500	200	<20	N
8CN6146	10	150	1.5	N	N	30.0	150	100	<20	N
9BM6252	15	1,000	<1.0	<10	N	10.0	N	700	20	N
9BM6253	10	700	1.0	N	N	20.0	N	200	20	N
9BM6254	10	1,000	1.0	N	N	10.0	N	20	20	N
9BM6290	N	N	N	30	N	150.0	N	>20,000	N	N
9BM6286	N	30	N	50	20	100.0	N	3,000	N	15
9BN6257	50	150	2.0	N	N	N	N	30	30	7

Appendix 1.--continued

sample	S-NB	S-NI	S-PB	S-SB	S-SC	S-SN	S-SR	S-V	S-W	S-Y
8CN6108	<20	200	N	N	20	N	<100	200	N	20
8CN6109	<20	150	N	N	50	N	<100	200	N	100
8CN6110	<20	10	30	N	5	N	300	30	N	N
8CN6111	<20	5	10	N	N	N	<100	20	1,500	N
8CN6112	<20	10	N	N	N	N	<100	10	N	<10
8CN6113	20	50	50	N	15	N	1,000	150	N	50
8CN6114	N	10	N	N	10	100	<100	100	50	30
8CM6116	<20	5	500	100	<5	N	100	70	N	10
8CM6117	20	7	70	N	7	N	500	50	N	10
8CM6118	20	5	50	N	7	N	700	100	N	30
8CN6119	N	70	30	N	50	N	200	150	N	20
8CN6120	<20	20	7,000	N	20	N	200	150	100	70
8CN6121	N	70	20,000	<100	5	N	150	20	N	20
8CN6122	N	15	150	N	5	N	300	50	N	10
8CN6123	<20	50	200	N	10	N	100	100	N	30
8CN6124	<20	10	2,000	N	<5	N	<100	500	<50	<10
8CN6125	<20	70	2,000	N	50	N	<100	500	N	30
8CN6126	N	30	10	N	7	N	N	150	N	<10
8CN6127	<20	50	10	N	7	N	<100	50	N	N
8CN6128	<20	20	15	N	10	N	<100	50	N	N
8CN6129	N	500	20	N	5	N	500	50	N	N
8CN6130	N	1,000	N	N	5	N	<100	1,000	N	
8CN6131	N	1,500	N	N	15	N	<100	500	N	[illegible]
8CN6132	N	1,000	N	N	10	N	<100	500	N	N
8CN6133	N	500	N	N	7	N	<100	700	N	N
8CN6134	N	50	20,000	1,500	10	N	<100	300	70	20
8CN6135	N	50	200	N	15	N	300	200	N	30
8CM6115	<20	5	50	N	7	N	200	100	50	20
8CN6136	<20	10	300	N	N	N	<100	70	N	<10
8CN6137	<20	50	50	N	10	N	500	100	N	50
8CN6138	<20	500	20	N	50	N	150	500	N	30
8CN6139	<20	50	2,000	N	5	N	<100	500	N	15
8CN6140	<20	20	50	N	5	N	500	30	N	N
8CN6141	N	5	30	N	<5	N	300	20	N	N
8CN6142	N	70	30	N	50	N	150	500	N	30
8CN6143	<20	15	50	N	5	N	200	50	N	15
8CN6144	<20	70	10	N	50	N	200	500	N	30
8CN6145	N	100	1,000	N	10	N	N	200	N	10
8CN6146	N	70	10	N	10	N	<100	100	N	30
9BM6252	N	5	15	N	5	<10	1,000	50	<50	10
9BM6253	N	5	10	N	10	N	1,000	200	N	15
9BM6254	N	5	20	N	5	N	1,500	70	N	15
9BM6290	N	200	20	N	5	200	100	50	N	10
9BM6286	N	15	10	150	N	N	<100	15	N	<10

Appendix 1.--continued

sample	S-ZN	S-ZR	S-TH	AA-ZN-P	AA-SB-P	CM-AS	CM-W	CM-W-P
8CN6108	N	150	N	110.0	2.0	40	--	1
8CN6109	N	200	N	160.0	<1.0	10	--	2
8CN6110	N	100	N	20.0	N	<10	--	N
8CN6111	N	N	N	15.0	3.0	20	--	>200
8CN6112	N	N	N	20.0	<1.0	160	--	20
8CN6113	N	100	<100	45.0	<1.0	10	--	N
8CN6114	N	70	N	50.0	<1.0	<10	--	30
8CM6116	N	70	N	110.0	10.0	10	5	--
8CM6117	N	200	N	40.0	N	<10	1	--
8CM6118	N	100	N	30.0	N	<10	<1	--
8CN6119	N	10	N	20.0	N	<10	N	--
8CN6120	500	300	N	400.0	5.0	60	200	--
8CN6121	300	N	N	500.0	15.0	160	N	--
8CN6122	N	200	N	50.0	N	<10	N	--
8CN6123	500	70	N	600.0	N	<10	<1	--
8CN6124	200	30	N	190.0	5.0	40	5	--
8CN6125	1,000	70	N	1,200.0	<1.0	<10	N	--
8CN6126	N	30	N	60.0	<1.0	<10	N	--
8CN6127	N	70	N	60.0	N	<10	N	--
8CN6128	N	50	N	30.0	N	10	N	--
8CN6129	N	50	N	30.0	N	<10	N	--
8CN6130	500	50	N	10.0	<1.0	10	0	--
8CN6131	300	N	N	10.0	<1.0	<10	0	--
8CN6132	500	N	N	10.0	N	<10	0	--
8CN6133	500	N	N	10.0	N	<10	0	--
8CN6134	1,500	70	N	>2,000.0	>200.0	400	N	--
8CN6135	2,000	100	N	>2,000.0	4.0	40	10	--
8CM6115	N	150	N	25.0	1.0	20	10	--
8CN6136	N	N	N	15.0	3.0	30	1	--
8CN6137	N	200	N	60.0	2.0	<10	<1	--
8CN6138	N	70	N	40.0	2.0	10	1	--
8CN6139	300	N	N	240.0	10.0	160	1	--
8CN6140	N	30	N	20.0	2.0	<10	<1	--
8CN6141	N	50	N	20.0	1.0	<10	<1	--
8CN6142	N	50	N	50.0	2.0	10	<1	--
8CN6143	N	20	150	20.0	1.0	10	<1	--
8CN6144	N	50	N	30.0	1.0	10	<1	--
8CN6145	500	<10	N	200.0	8.0	160	2	--
8CN6146	N	10	N	70.0	1.0	10	<1	--
9BM6252	N	70	N	30.0	N	<10	--	--
9BM6253	N	70	N	30.0	<1.0	10	--	--
9BM6254	N	150	N	40.0	N	10	--	--
9BM6290	500	50	N	460.0	1.0	80	--	--
9BM6296	500	N	N	160.0	80.0	>1,600	--	--
9BN6257	N	200	N	.5	N	[illegible]	--	--

Appendix 1.--continued

sample	LATITUDE	LONGITUD	S-FE%	S-MG%	S-CA%	S-TI%	S-MN	S-AG	S-AS	S-AU
9BN6258	45 51 43	112 21 29	10.0	2.00	10.00	.300	3,000	100.0	N	N
9BN6259	45 51 43	112 21 23	1.0	2.00	20.00	.150	300	N	N	N
9BN6260	45 51 43	112 21 29	10.0	1.50	15.00	.300	3,000	N	N	N
9CM6176	45 40 8	112 24 22	15.0	.15	.70	.030	500	N	<200	N
9CL6158	45 43 32	112 33 23	5.0	2.00	.20	.030	200	20.0	N	N
9CM6161	45 40 37	112 23 23	2.0	.50	.70	.200	200	N	N	N
9CM6162	45 40 36	112 23 22	3.0	.70	1.00	.200	700	N	N	N
9CM6163	45 40 37	112 23 22	2.0	.30	.50	.100	500	150.0	N	N
9CN6177	45 40 37	112 20 39	7.0	.30	.05	.070	300	20.0	200	N
9BM6184	45 52 2	112 27 0	.7	.20	.07	.100	30	.5	N	N
9BM6185	45 51 24	112 26 15	5.0	.30	.50	.200	500	N	N	N
9BM6186	45 51 36	112 27 10	.7	<.02	.05	.020	10	.5	N	N
9BM6187	45 51 36	112 28 44	5.0	<.02	N	.100	100	.7	N	N
9BM6188	45 51 38	112 27 54	.2	<.02	.15	.070	20	3.0	N	N
9BL6189	45 42 39	112 30 57	3.0	.30	.05	.300	300	3.0	N	N

Appendix 1.--continued

sample	S-B	S-BA	S-BE	S-BI	S-CD	S-CO	S-CR	S-CU	S-LA	S-MO
9BN6258	10	100	1.5	10	20	300.0	30	>20,000	70	10
9BN6259	20	70	N	N	N	N	50	30	N	N
9BN6260	<10	N	N	N	N	15.0	N	70	N	15
9CM6176	N	700	<1.0	N	N	<5.0	10	20	20	50
9CL6158	10	20	<1.0	N	N	50.0	15	20,000	20	N
9CM6161	10	1,000	3.0	N	N	7.0	20	15	50	N
9CM6162	10	700	2.0	N	N	7.0	N	<5	30	N
9CM6163	70	700	1.0	N	N	5.0	N	200	20	150
9CN6177	100	200	1.5	20	N	10.0	20	500	<20	10
9BM6184	50	2,000	1.5	N	N	N	N	15	50	20
9BM6185	70	2,000	5.0	N	N	N	N	<5	100	N
9BM6186	15	150	2.0	N	N	N	N	70	N	500
9BM6187	15	20	1.5	N	N	N	N	700	<20	500
9BM6188	15	200	2.0	10	N	N	N	20	20	2,000
9BL6189	150	500	3.0	N	N	.5	20	20	30	10

Appendix 1. --continued

sample	S-NA	S-NI	S-PB	S-SB	S-SC	S-SN	S-SR	S-V	S-W	S-Y
9BN6258	N	300	30	N	15	10	1,000	70	<50	20
9BN6259	N	<5	15	N	5	N	3,000	15	N	10
9BN6260	N	15	10	N	10	15	<100	100	N	30
9CM6176	N	<5	15	N	N	N	200	50	N	<10
9CL6158	N	15	15	N	5	15	<100	20	N	50
9CM6161	<20	5	20	N	<5	N	200	30	N	<10
9CM6162	20	<5	15	N	5	N	500	50	N	15
9CM6163	N	<5	500	100	<5	N	<100	50	N	<10
9CN6177	N	70	1,000	<100	<5	N	100	70	N	<10
9BM6184	N	<5	30	N	<5	N	200	10	N	10
9BM6185	<20	<5	20	N	<5	N	300	50	N	15
9BM6186	<20	<5	15	N	<5	N	<100	<10	N	<10
9BM6187	20	5	10	N	<5	N	<100	30	N	N
9BM6188	<20	5	30	N	N	N	<100	<10	N	<10
9BL6189	N	20	50	100	7	N	700	100	<50	15

Appendix 1. --continued

sample	S-ZN	S-ZR	S-TH	AA-ZN-P	AA-SB-P	CM-AS	CM-W	CM-W-P
9BN6258	<200	70	N	200.0	1.0	120	--	--
9BN6259	N	20	N	20.0	N	15	--	--
9BN6260	N	200	N	20.0	N	10	--	--
9CM6176	N	<10	N	30.0	1.0	80	--	--
9CL6158	N	20	N	15.0	2.0	20	--	--
9CM6161	N	150	N	35.0	1.0	<10	--	--
9CM6162	N	200	N	30.0	<1.0	<10	--	--
9CM6163	N	20	N	40.0	40.0	20	--	--
9CN6177	200	30	N	120.0	80.0	300	--	--
9BM6184	N	70	N	<5.0	.5	--	--	2
9BM6185	N	100	N	15.0	<.5	--	--	2
9BM6186	N	70	N	<5.0	.5	--	--	N
9BM6137	N	10	N	10.0	4.0	--	--	1
9BM6188	N	50	N	<5.0	1.0	--	--	N
9BL6189	N	100	N	15.0	4.0	--	--	20

Appendix 2.--Magnetic stream-sediment geochemical data. All values are reported in parts per million (ppm) except Fe, Mg, Ca, and Ti which are reported in percent. "S" indicates analysis performed by emission spectrographic methods; "AA" indicates analysis by atomic absorption spectrophotometry methods; and "CM" indicates analysis by colorimetric methods. Latitude and longitude are reported in degrees, minutes, and seconds. "N" means the element was not detected for that sample.

Appendix 2.--Magnetic stream-sediment geochemical data.

sample	LATITUDE	LONGITUD	S-FE%	S-MG%	S-CA%	S-TI%	S-MN	S-AG	S-AS	S-AU	S-B
9BM6250M	45 50 52	112 24 11	10	5.0	5.0	1.00	5,000	N	N	N	20
9BM6251M	45 49 42	112 22 45	7	2.0	5.0	>2.00	5,000	N	N	N	100
9BM6255M	45 52 26	112 21 0	7	5.0	5.0	.70	5,000	N	N	N	50
9BM6256M	45 52 29	112 20 58	10	5.0	5.0	1.00	3,000	N	N	N	20
9BM6256M	45 52 29	112 20 58	10	5.0	7.0	1.00	5,000	N	N	N	70
9BM6261M	45 51 26	112 21 30	10	7.0	5.0	1.00	3,000	N	N	N	20
9BM6262M	45 49 18	112 20 19	10	7.0	5.0	1.50	7,000	N	N	N	20
9BM6263M	45 48 1	112 19 9	15	3.0	5.0	2.00	3,000	N	N	N	30
9CM6264M	45 44 20	112 20 37	10	5.0	3.0	2.00	5,000	N	N	N	20
9CM6265M	45 44 51	112 21 12	10	7.0	5.0	2.00	7,000	N	N	N	30
9BM6266M	45 45 48	112 21 56	10	7.0	5.0	1.00	5,000	N	N	N	30
9BM6267M	45 46 19	112 21 53	10	5.0	5.0	>2.00	7,000	N	N	N	20
9BM6268M	45 46 28	112 21 50	10	7.0	5.0	>2.00	7,000	N	N	N	50
9BM6269M	45 46 55	112 21 43	15	7.0	5.0	>2.00	7,000	N	N	N	30
9BM6270M	45 47 39	112 21 55	10	1.5	5.0	>2.00	7,000	N	N	N	30
9BM6271M	45 47 25	112 21 5	10	5.0	5.0	>2.00	7,000	N	N	N	<20
9BM7062M	45 34 53	112 27 57	15	5.0	3.0	.70	2,000	N	N	N	20
9BM7063M	45 35 29	112 26 38	15	2.0	2.0	1.00	2,000	N	N	N	20
9CL7084M	45 40 0	112 30 15	15	3.0	2.0	2.00	10,000	N	N	N	<20
9CL7085M	45 40 0	112 30 9	20	3.0	2.0	>2.00	>10,000	N	N	N	<20
9CM7086M	45 40 0	112 21 55	15	3.0	1.5	2.00	7,000	N	N	N	<20
9CL7087M	45 40 33	112 30 10	20	2.0	1.0	2.00	10,000	N	N	N	<20
9CL7088M	45 40 39	112 30 16	20	3.0	1.5	2.00	10,000	N	N	N	<20
9CL7089M	45 40 42	112 30 25	20	3.0	1.0	2.00	10,000	N	N	N	<20
9CL7090M	45 41 14	112 30 39	15	7.0	2.0	>2.00	>10,000	N	N	N	20
9CL7091M	45 41 24	112 30 40	15	7.0	3.0	1.50	10,000	N	N	N	<
9CL7092M	45 41 31	112 30 44	15	7.0	5.0	1.50	7,000	N	N	N	<20
9CL7093M	45 41 39	112 30 45	20	5.0	3.0	2.00	>10,000	N	N	N	50
9CL7094M	45 41 59	112 30 48	20	2.0	1.0	>2.00	>10,000	N	N	N	20
9CL7095M	45 42 27	112 30 38	30	2.0	1.0	2.00	10,000	N	N	N	20
9CL7096M	45 42 46	112 30 30	30	3.0	2.0	2.00	5,000	N	N	N	<20
9CL7097M	45 43 22	112 31 19	30	.3	.3	1.00	3,000	N	N	N	20
9CL7098M	45 43 25	112 31 24	30	1.0	1.0	2.00	5,000	N	N	N	50
9CL7099M	45 43 18	112 31 8	20	2.0	1.0	>2.00	7,000	N	N	N	50
9CL7100M	45 44 2	112 31 7	20	2.0	1.5	2.00	3,000	N	N	N	300
9CL6151M	45 44 41	112 30 41	30	1.0	1.0	.10	2,000	N	N	N	<20
9CL6152M	45 44 55	112 30 41	20	3.0	3.0	.50	5,000	N	N	N	<20
9CL6153M	45 44 23	112 30 52	20	2.0	3.0	1.00	7,000	N	N	N	<20
9CL6154M	45 44 5	112 31 54	30	.7	.7	.20	2,000	3	5,000	N	<20
9CL6155M	45 44 11	112 32 8	20	.5	.2	.15	3,000	1	1,000	N	<20
9CL6156M	45 43 28	112 33 16	20	.2	.7	.10	300	10	500	N	20
9CL6157M	45 43 34	112 33 23	20	2.0	1.5	1.50	3,000	N	N	N	20
9CM6159M	45 40 24	112 21 32	50	1.0	1.0	2.00	3,000	N	N	N	<20
9CM6160M	45 40 49	112 22 42	20	3.0	5.0	2.00	5,000	N	N	N	<20
9CM6164M	45 41 0	112 23 27	15	5.0	5.0	>2.00	5,000	N	N	N	<20

Appendix 2.--Continued

sample	S-BA	S-BE	S-BI	S-CD	S-CO	S-CR	S-CU	S-LA	S-MO	S-NB	S-NI	S-PB
9BM6250M	50	2	N	N	50	50	20	300	N	50	20	<20
9BM6251M	200	<2	N	N	70	70	200	2,000	20	500	20	200
9BN6255M	150	3	N	N	70	30	50	200	N	<50	20	20
9BN6256M	N	2	N	N	70	20	10	1,000	N	50	20	<20
9BN6256M	100	2	N	N	50	50	15	500	N	<50	20	<20
9BN6261M	70	2	N	N	70	200	50	50	N	<50	150	<20
9BN6262M	150	<2	N	N	70	200	50	2,000	10	150	70	30
9BN6263M	100	3	N	N	70	200	70	>2,000	10	200	70	20
9CN6264M	50	<2	N	N	70	50	20	1,500	<10	150	30	<20
9CN6265M	50	2	N	N	50	150	20	700	N	70	100	<20
9BN6266M	<50	2	N	N	70	150	50	500	N	50	100	<20
9BN6267M	50	<2	N	N	50	300	10	>2,000	<10	200	70	<20
9BN6268M	150	2	N	N	50	50	N	>2,000	10	500	20	50
9BN6269M	150	2	N	N	70	30	N	>2,000	15	500	20	30
9BN6270M	100	<2	N	N	30	70	15	>2,000	15	700	20	150
9BN6271M	100	<2	N	N	50	30	N	>2,000	15	300	30	<20
9DM7082M	200	2	N	N	100	500	300	2,000	100	N	200	100
9DM7083M	200	<2	N	N	200	700	500	700	100	N	200	50
9CL7084M	70	<2	N	N	30	150	50	500	N	<50	30	N
9CL7085M	70	<2	N	N	50	150	70	700	N	<50	30	30
9CM7086M	150	<2	N	N	30	100	70	200	N	<50	30	50
9CL7087M	50	<2	N	N	30	100	50	1,000	N	<50	20	20
9CL7088M	200	<2	N	N	50	150	70	1,000	N	<50	50	30
9CL7089M	50	<2	N	N	50	150	20	700	N	50	20	20
9CL7090M	100	2	N	N	30	300	20	300	N	<50	70	20
9CL7091M	150	2	N	N	50	500	50	500	N	N	100	30
9CL7092M	70	<2	N	N	30	500	20	300	N	N	100	<20
9CL7093M	150	2	N	N	30	500	100	150	N	N	70	30
9CL7094M	50	<2	N	N	20	500	50	700	N	50	20	<20
9CL7095M	300	3	N	N	200	700	300	1,500	10	50	200	50
9CL7096M	<50	<2	N	N	50	200	50	>2,000	N	100	50	150
9CL7097M	200	7	N	N	30	1,000	200	500	15	<50	150	70
9CL7098M	300	5	N	N	50	500	200	2,000	15	<50	100	200
9CL7099M	200	7	N	N	50	700	200	2,000	N	50	100	200
9CL7100M	300	5	N	N	30	500	100	>2,000	20	70	100	100
9CL6151M	50	1	N	N	20	30	70	<50	15	N	50	100
9CL6152M	100	5	N	N	30	150	100	50	30	N	50	50
9CL6153M	200	5	N	N	30	100	100	2,000	100	<50	50	50
9CL6154M	200	20	N	N	30	100	150	200	70	N	100	3,000
9CL6155M	200	15	N	N	20	70	70	100	15	N	70	200
9CL6156M	<50	5	N	N	100	30	10,000	70	10	N	100	200
9CL6157M	200	10	N	N	70	100	200	>2,000	10	150	150	70
9CN6159M	N	N	N	N	70	500	20	700	N	50	50	20
9CM6160M	<50	2	N	N	70	100	10	>2,000	10	500	70	20
9CM6164M	N	2	N	N	50	30	<10	>2,000	15	500	20	20

Appendix 2.--Continued

sample	S-SB	S-SC	S-SN	S-SR	S-V	S-W	S-Y	S-ZN	S-ZR	S-TH
9BM6250M	N	100	N	<200	500	N	150	N	1,000	N
9BM6251M	N	100	200	<200	300	N	100	N	>2,000	N
9BN6255M	N	100	N	<200	300	N	150	N	700	N
9BN6256M	N	150	N	<200	500	N	200	N	>2,000	<200
9BN6256M	N	100	20	200	500	N	150	N	500	N
9BN6261M	N	70	N	<200	300	N	150	N	700	N
9BN6262M	N	100	N	200	300	N	300	N	500	N
9BN6263M	N	70	N	200	500	N	300	N	1,500	N
9CN6264M	N	100	N	<200	500	N	300	N	2,000	N
9CN6265M	N	100	N	<200	300	N	200	N	500	N
9BN6266M	N	100	N	<200	300	N	200	N	300	N
9BN6267M	N	100	<20	<200	300	N	700	N	500	200
9BN6268M	N	100	20	300	300	N	700	N	1,000	300
9BN6269M	N	100	<20	500	500	N	1,000	N	1,000	500
9BN6270M	N	70	20	3,000	500	N	1,000	N	700	300
9BN6271M	N	70	<20	<200	300	N	500	N	500	N
9BN7082M	N	50	N	200	700	N	150	N	100	N
9BM7083M	N	50	N	<200	700	N	300	N	700	N
9CL7084M	N	100	N	<200	500	N	200	N	70	N
9CL7085M	N	100	N	<200	500	N	200	N	100	N
9CM7086M	N	70	N	<200	500	N	150	N	100	N
9CL7087M	N	100	N	<200	300	N	300	N	100	N
9CL7088M	N	100	N	<200	500	N	200	N	200	
9CL7089M	N	100	N	<200	200	N	200	N	150	
9CL7090M	N	100	N	<200	500	N	150	N	100	N
9CL7091M	N	100	N	<200	500	N	150	N	300	N
9CL7092M	N	70	N	<200	500	N	150	N	70	N
9CL7093M	N	70	N	<200	500	N	200	N	100	N
9CL7094M	N	70	N	<200	200	N	1,000	N	300	N
9CL7095M	N	50	N	<200	700	N	500	N	700	200
9CL7096M	N	50	N	200	700	N	500	N	1,000	300
9CL7097M	N	20	N	<200	300	N	150	200	150	N
9CL7098M	N	50	N	<200	500	N	300	700	700	<200
9CL7099M	N	70	N	<200	300	N	1,000	500	700	N
9CL7100M	N	50	N	<200	300	N	500	N	1,500	200
9CL6151M	N	20	N	<200	200	N	20	1,000	50	N
9CL6152M	N	70	N	200	300	N	50	N	70	N
9CL6153M	N	50	N	<200	300	150	150	N	200	N
9CL6154M	N	15	N	200	150	N	100	1,000	100	N
9CL6155M	N	15	N	<200	150	N	50	500	100	N
9CL6156M	200	10	50	N	70	N	200	500	50	N
9CL6157M	N	50	N	<200	200	N	300	N	500	<200
9CN6159M	N	30	N	<200	1,000	N	700	N	1,000	<200
9CM6160M	N	100	N	<200	500	N	700	N	700	1,000
9CM6164M	N	100	N	<200	300	N	700	N	2,000	1,000

Appendix 2. --continued

sample	LATITUDE	LONGITUD	S-FE%	S-MG%	S-CA%	S-TI%	S-MN	S-AG	S-AS	S-AU	S-B
9CM6165M	45 41 0	112 23 19	10	3.0	3.0	>2.00	5,000	N	N	N	N
9CM6166M	45 41 57	112 25 12	15	3.0	7.0	>2.00	5,000	N	N	N	20
9CM6167M	45 42 3	112 25 58	50	.2	1.0	1.00	3,000	N	N	N	N
9CM6168M	45 42 25	112 26 42	15	5.0	7.0	>2.00	10,000	N	N	N	N
9CM6169M	45 42 22	112 26 47	20	3.0	2.0	2.00	>10,000	N	N	N	<20
9CM6170M	45 41 3	112 25 48	15	5.0	7.0	2.00	10,000	N	N	N	20
9CM6171M	45 40 54	112 25 51	20	2.0	1.5	>2.00	10,000	N	N	N	N
9CM6172M	45 40 31	112 25 7	20	5.0	5.0	2.00	5,000	N	N	N	N
9CM6173M	45 40 39	112 24 54	30	.7	2.0	2.00	2,000	N	N	N	<20
9CM6174M	45 40 15	112 24 42	30	1.5	3.0	>2.00	3,000	N	N	N	<20
9CM6175M	45 39 59	112 24 13	15	2.0	2.0	>2.00	3,000	N	N	N	<20
9CM6178M	45 42 12	112 20 32	10	5.0	5.0	2.00	5,000	N	N	N	<20
9CM6179M	45 42 46	112 20 48	10	7.0	3.0	2.00	7,000	N	N	N	<20
9CM6180M	45 42 50	112 21 6	10	7.0	5.0	2.00	7,000	N	N	N	20
9CM6181M	45 43 13	112 21 50	10	5.0	3.0	2.00	3,000	N	N	N	<20
9CM6182M	45 43 37	112 21 46	10	5.0	5.0	>2.00	5,000	N	N	N	<20
9CM6183M	45 43 44	112 21 46	7	5.0	5.0	1.00	5,000	N	N	N	20
9BM6272M	45 47 57	112 20 8	15	5.0	3.0	2.00	5,000	N	N	N	20
9BM6273M	45 47 53	112 20 7	20	5.0	5.0	2.00	5,000	N	N	N	20
9BM6274M	45 46 46	112 19 30	20	5.0	5.0	>2.00	7,000	N	N	N	20
9BM6275M	45 45 10	112 19 33	15	3.0	2.0	>2.00	7,000	N	N	N	20
9BM6276M	45 46 24	112 15 27	30	2.0	2.0	>2.00	7,000	N	N	N	<20
9BM6277M	45 49 44	112 24 24	20	2.0	5.0	>2.00	10,000	N	N	N	200
9BM6278M	45 49 45	112 24 28	15	5.0	7.0	>2.00	10,000	N	N	N	<20
9BM6279M	45 48 1	112 23 57	15	3.0	5.0	1.50	3,000	N	N	N	150
9BM6280M	45 48 8	112 24 13	15	1.5	7.0	.70	2,000	N	N	N	100
9BM6281M	45 47 58	112 24 55	15	5.0	10.0	1.50	7,000	N	N	N	70
9BM6282M	45 47 13	112 26 2	20	.7	1.5	1.00	2,000	N	N	N	20
9BM6283M	45 47 24	112 26 34	10	3.0	10.0	.70	2,000	N	N	N	50
9BM6284M	45 47 19	112 26 51	15	2.0	2.0	.50	1,500	N	N	N	20
9BM6285M	45 47 26	112 26 48	15	3.0	10.0	.70	5,000	N	N	N	30
9BM6287M	45 47 36	112 29 41	15	3.0	7.0	.70	2,000	N	N	N	70
9BM6289M	45 47 53	112 29 29	10	2.0	15.0	.70	2,000	N	N	N	20

Appendix 2.--continued

sample	S-BA	S-BE	S-BI	S-CD	S-CO	S-CR	S-CU	S-LA	S-MO	S-NB	S-NI	S-PB
9CM6165M	N	2	N	N	30	20	N	>2,000	15	500	10	20
9CM6166M	N	2	N	N	30	20	15	>2,000	20	500	10	30
9CM6167M	N	<2	N	N	30	100	20	2,000	10	70	10	<20
9CM6168M	<50	2	N	N	20	200	<10	>2,000	15	150	10	50
9CM6169M	70	N	N	N	20	150	20	1,000	N	<50	10	<20
9CM6170M	50	<2	N	N	30	70	20	>2,000	10	200	15	30
9CM6171M	N	<2	N	N	30	150	10	2,000	N	50	20	20
9CM6172M	70	<2	N	N	100	1,000	30	2,000	N	50	200	30
9CM6173M	50	<2	N	N	70	50	20	>2,000	15	200	10	50
9CM6174M	50	<2	N	N	50	150	<10	>2,000	10	300	15	30
9CM6175M	N	N	N	N	70	300	70	2,000	N	70	100	30
9CM6178M	150	<2	N	N	70	300	100	500	N	<50	100	30
9CM6179M	70	<2	N	N	70	300	70	1,000	N	70	100	30
9CM6180M	100	2	N	N	100	500	200	1,000	N	70	100	50
9CM6181M	N	2	N	N	50	150	50	700	N	50	100	20
9CM6182M	50	2	N	N	50	200	50	700	N	100	100	<20
9CM6183M	50	3	N	N	50	200	50	200	<10	50	70	30
9BM6272M	200	2	N	N	70	100	100	>2,000	10	300	50	30
9BM6273M	150	2	N	N	70	100	50	>2,000	N	300	50	20
9BM6274M	150	2	N	N	70	200	100	>2,000	N	300	50	30
9BM6275M	<50	<2	N	N	50	50	15	1,000	N	150	30	<20
9BM6276M	<50	<2	N	N	70	300	100	2,000	N	150	100	<20
9BM6277M	50	<2	N	N	50	50	20	>2,000	N	500	15	50
9BM6278M	50	2	N	N	30	30	<10	>2,000	10	300	20	30
9BM6279M	100	3	N	N	50	300	70	>2,000	15	200	200	30
9BM6280M	<50	2	N	N	70	100	70	700	10	<50	100	20
9BM6281M	70	2	N	N	50	100	50	2,000	10	100	20	50
9BM6282M	100	20	N	N	50	20	150	2,000	30	70	70	50
9BM6283M	N	2	N	N	50	300	30	1,000	10	N	50	20
9BM6284M	100	5	N	N	100	300	70	150	70	N	200	20
9BM6285M	70	<2	N	N	70	70	100	100	10	N	50	50
9BM6287M	70	3	N	N	70	150	300	50	20	N	70	30
9BM6289M	N	<2	N	N	20	100	50	70	N	N	15	30

Appendix 2.--continued

sample	S-SB	S-SC	S-SN	S-SR	S-V	S-W	S-Y	S-ZN	S-ZR	S-TH
9CM6165M	N	70	N	<200	300	N	700	N	1,500	700
9CM6166M	N	50	20	200	300	N	1,000	N	1,000	500
9CM6167M	N	20	N	<200	1,500	N	300	N	1,500	N
9CM6168M	N	70	N	300	300	N	1,000	N	700	500
9CM6169M	N	100	N	200	300	N	300	N	100	N
9CM6170M	N	100	N	200	300	N	500	N	700	N
9CM6171M	N	100	N	<200	200	N	300	N	700	200
9CM6172M	N	100	N	200	700	N	500	N	700	500
9CM6173M	N	50	N	500	1,000	N	500	N	>2,000	500
9CM6174M	N	70	N	300	700	N	500	N	1,500	500
9CM6175M	N	50	N	N	500	N	1,000	N	2,000	<200
9CN6176M	N	70	N	200	500	N	150	N	100	N
9CN6179M	N	70	N	200	500	N	200	N	500	N
9CN6180M	N	70	N	<200	500	N	200	N	500	N
9CN6181M	N	70	N	<200	300	N	200	N	700	N
9CN6182M	N	100	N	<200	500	N	200	N	700	N
9CN6183M	N	70	N	<200	500	N	150	N	200	N
9BN6272M	N	100	<20	300	500	N	500	N	700	N
9BN6273M	N	100	N	<200	700	N	500	N	700	N
9BN6274M	N	100	N	<200	700	N	700	N	500	<200
9BN6275M	N	100	N	<200	500	N	300	N	700	N
9BN6276M	N	50	N	<200	1,000	N	200	N	200	N
9BM6277M	N	70	<20	200	500	N	700	N	2,000	1,C
9BM6278M	N	70	<20	200	500	N	300	N	300	
9BM6279M	N	70	N	700	300	N	500	N	700	
9BM6280M	N	50	N	<200	300	N	100	N	100	N
9BM6281M	N	100	N	300	500	N	300	N	300	N
9BM6282M	N	20	N	200	150	N	200	N	300	N
9BM6283M	N	30	N	200	300	N	100	N	1,000	N
9BM6284M	N	50	N	200	300	N	70	N	70	N
9BM6285M	N	70	N	200	300	N	100	N	700	N
9BM6287M	N	50	N	200	200	N	70	N	150	N
9BM6289M	N	20	50	<200	300	N	50	N	150	N

Appendix 3.--Nonmagnetic stream-sediment geochemical data. All values are reported in parts per million (ppm) except Fe, Mg, Ca, and Ti which are reported in percent. "S" indicates analysis performed by emission spectrographic methods; "AA" indicates analysis by atomic absorption spectrophotometry methods; and "CM" indicates analysis by colorimetric methods. Latitude and longtitude are reported in degrees, minutes, and seconds. "N" means the element was not detected for that sample.

Appendix 3.--Nonmagnetic stream-sediment geochemical data.

sample	LATITUDE	LONGITUD	S-FE%	S-MG%	S-CA%	S-TI%	S-MN	S-AG	S-AS	S-AU	S-B
9BM6250N	45 50 52	112 24 11	.3	.05	10.0	>2.0	500	N	N	N	<20
9BM6251N	45 49 42	112 22 45	.5	.30	15.0	>2.0	1,000	N	N	N	150
9BM6255N	45 52 27	112 21 2	.5	.70	15.0	>2.0	1,000	N	N	N	20
9BM6256A	45 52 29	112 20 59	.3	.15	10.0	>2.0	500	N	N	N	<20
9BM6256B	45 52 29	112 20 59	3.0	7.00	20.0	.7	3,000	N	N	N	100
9BN6261N	45 51 26	112 21 30	1.0	3.00	10.0	1.5	500	N	N	N	100
9BN6262N	45 49 18	112 20 19	.5	.50	10.0	>2.0	700	N	N	N	<20
9BN6263N	45 48 1	112 19 9	.7	5.00	15.0	>2.0	1,500	N	N	N	70
9CN6264N	45 44 20	112 20 37	.5	.30	10.0	>2.0	700	N	N	N	30
9CN6265N	45 44 51	112 21 12	.7	1.50	15.0	>2.0	1,000	N	N	N	150
9BN6266N	45 45 48	112 21 56	2.0	5.00	10.0	>2.0	1,000	N	N	N	500
9BN6267N	45 46 19	112 21 53	1.0	.30	10.0	>2.0	1,000	N	N	N	300
9BN6268N	45 46 28	112 21 50	.7	.30	15.0	>2.0	1,500	N	N	N	70
9BN6269N	45 46 55	112 21 43	.5	.05	10.0	>2.0	700	N	N	N	<20
9BN6270N	45 47 39	112 21 55	.7	.20	10.0	>2.0	1,000	N	N	N	<20
9BN6271N	45 47 25	112 21 5	.5	.15	10.0	>2.0	1,000	N	N	N	<20
9BN6272N	45 47 57	112 20 8	.5	.15	7.0	>2.0	1,000	N	N	N	<20
9BN6273N	45 47 53	112 20 7	.5	.10	10.0	>2.0	1,000	N	N	N	<20
9BN6274N	45 46 46	112 19 30	.5	.15	10.0	>2.0	700	N	N	N	50
9BN6275N	45 45 10	112 19 33	.5	.30	10.0	>2.0	1,000	N	N	N	100
9BN6276N	45 46 24	112 15 27	.7	3.00	10.0	>2.0	1,000	N	N	N	70
9BM6277N	45 49 44	112 24 24	.5	1.50	7.0	>2.0	1,000	N	N	N	70
9BM6278N	45 49 45	112 24 28	.5	1.50	15.0	>2.0	2,000	N	N	N	30
9BM6279N	45 48 1	112 23 57	1.0	1.00	5.0	>2.0	700	N	N	N	500
9BM6280N	45 48 8	112 24 13	3.0	10.00	20.0	1.5	2,000	N	N	N	200
9BM6281N	45 47 58	112 24 55	1.5	3.00	10.0	>2.0	1,000	N	N	N	70
9BM6282N	45 47 13	112 26 2	1.5	.30	7.0	>2.0	1,500	N	N	N	100
9BM6283N	45 47 24	112 26 34	2.0	5.00	10.0	1.0	1,500	N	N	N	[illegible]
9BM6284N	45 47 19	112 26 51	5.0	5.00	5.0	1.0	2,000	N	N	N	[illegible]
9BM6285N	45 47 26	112 26 48	1.5	5.00	15.0	.3	700	N	N	N	[illegible]
9BM6287N	45 47 36	112 29 41	3.0	7.00	15.0	.7	1,500	N	N	N	150
9BM6289N	45 47 53	112 29 29	2.0	7.00	15.0	.7	1,000	N	N	N	70
9DM7082N	45 34 53	112 27 57	5.0	2.00	10.0	>2.0	1,500	N	N	N	30
9DM7083N	45 35 29	112 26 38	3.0	2.00	5.0	>2.0	1,500	N	N	N	50
9CL7084N	45 40 0	112 30 15	1.0	1.00	10.0	2.0	1,000	N	N	N	200
9CL7085N	45 40 0	112 30 9	1.0	1.00	10.0	>2.0	700	5	N	N	150
9CM7086N	45 40 0	112 29 55	3.0	1.00	10.0	>2.0	700	N	N	N	700
9CL7087N	45 40 33	112 30 10	1.5	1.00	7.0	>2.0	1,500	N	N	N	200
9CL7088N	45 40 39	112 30 16	2.0	1.00	10.0	2.0	1,000	N	N	N	500
9CL7089N	45 40 42	112 30 25	1.5	.70	2.0	>2.0	700	N	N	N	150
9CL7090N	45 41 14	112 30 39	3.0	3.00	7.0	>2.0	1,000	N	N	N	700
9CL7091N	45 41 24	112 30 40	2.0	3.00	5.0	1.0	1,000	N	N	N	70
9CL7092N	45 41 31	112 30 44	5.0	10.00	15.0	2.0	2,000	10	N	N	500
9CL7093N	45 41 39	112 30 45	5.0	2.00	7.0	2.0	2,000	N	N	N	1,500
9CL7094N	45 41 59	112 30 48	1.5	.70	10.0	>2.0	2,000	N	N	N	1,500

Appendix 3.--Continued

sample	S-BA	S-BE	S-BI	S-CD	S-CO	S-CR	S-CU	S-LA	S-MO	S-NB	S-NI	S-PB
9BM6250N	N	N	N	N	N	20	20	1,500	20	100	N	N
9BM6251N	300	N	100	N	15	150	300	2,000	50	150	N	2,000
9BM6255N	150	N	N	N	<10	30	30	1,500	20	100	N	100
9BM6256A	N	N	N	N	<10	20	20	2,000	20	150	N	70
9BM6256B	150	5	N	N	10	100	20	700	N	<50	10	<20
9BN6261N	N	2	N	N	<10	100	30	500	N	70	N	<20
9BN6262N	100	N	N	N	10	200	30	2,000	20	500	N	50
9BN6263N	1,000	N	N	N	<10	100	30	2,000	15	500	N	30
9CN6264N	50	N	N	N	10	70	30	2,000	20	200	N	500
9CN6265N	150	N	N	N	15	200	30	2,000	30	200	N	20
9BN6266N	70	3	N	N	10	100	30	1,500	10	100	N	<20
9BN6267N	100	N	N	N	<10	50	20	>2,000	20	300	N	20
9BN6268N	150	N	N	N	<10	70	20	2,000	20	500	N	20
9BN6269N	N	N	N	N	<10	<20	15	2,000	15	300	N	20
9BN6270N	50	N	500	N	10	70	10	2,000	20	300	N	100
9BN6271N	100	N	N	N	<10	20	30	>2,000	20	500	N	20
9BN6272N	100	N	N	N	<10	30	30	>2,000	20	300	N	20
9BN6273N	70	N	N	N	<10	30	30	>2,000	20	500	N	20
9BN6274N	100	N	N	N	<10	20	30	>2,000	20	500	N	20
9BN6275N	70	N	N	N	10	20	30	2,000	15	500	N	30
9BN6276N	50	N	70	N	15	100	20	2,000	15	500	50	<20
9BM6277N	70	2	N	N	<10	20	20	2,000	15	700	N	50
9BM6278N	50	N	N	N	10	30	30	>2,000	20	500	N	30
9BM6279N	70	N	N	N	15	200	10	1,000	10	700	50	<20
9BM6280N	70	5	N	N	10	100	10	200	N	70	20	100
9BM6281N	N	10	N	N	<10	20	10	1,000	15	300	N	N
9BM6282N	70	3	N	N	10	50	10	1,500	20	500	N	[illegible]
9BM6283N	50	7	N	N	<10	70	<10	500	N	70	N	<20
9BM6284N	100	7	N	N	100	150	30	100	10	<50	100	50
9BM6285N	100	2	N	N	N	50	15	100	N	<50	N	<20
9BM6287N	50	5	N	N	<10	50	500	200	N	50	N	30
9BM6289N	<50	5	100	N	<10	30	20	150	N	<50	N	<20
9DM7082N	700	3	200	N	30	300	150	2,000	70	300	100	500
9DM7083N	700	2	500	N	30	300	100	>2,000	30	70	150	200
9CL7084N	700	3	N	N	20	150	10	>2,000	N	N	30	300
9CL7085N	150	3	N	N	50	200	20	>2,000	N	50	70	700
9CM7086N	300	2	N	N	20	200	70	>2,000	N	50	50	500
9CL7087N	200	2	1,000	N	30	150	100	>2,000	N	N	100	1,500
9CL7088N	200	7	N	N	20	200	70	>2,000	N	N	50	700
9CL7089N	200	7	N	N	30	200	20	>2,000	N	100	50	700
9CL7090N	150	2	N	N	30	700	20	>2,000	N	<50	100	200
9CL7091N	70	N	N	N	30	700	20	>2,000	N	N	100	300
9CL7092N	200	7	1,000	N	50	1,500	100	>2,000	N	N	150	200
9CL7093N	50	2	N	N	20	300	50	>2,000	N	50	50	200
9CL7094N	70	2	N	N	20	150	N	>2,000	N	<50	30	500

Appendix 3.--Continued

sample	S-SB	S-SC	S-SN	S-SR	S-V	S-W	S-Y	S-ZN	S-ZR	S-TH
9BM6250N	N	10	50	N	500	N	1,000	N	>2,000	300
9BM6251N	N	50	>2,000	N	500	300	1,500	N	>2,000	N
9BM6255N	N	10	100	N	500	N	1,000	N	>2,000	N
9BM6256A	N	10	70	N	500	N	1,500	N	>2,000	700
9BM6256B	N	10	20	200	300	N	200	N	2,000	N
9BN6261N	N	<10	N	N	300	N	200	N	>2,000	N
9BN6262N	N	10	70	N	500	N	1,500	N	>2,000	<200
9BN6263N	N	10	50	N	500	100	1,500	N	>2,000	200
9CN6264N	N	30	300	N	500	150	1,500	N	>2,000	200
9CN6265N	N	20	50	<200	500	100	1,500	N	>2,000	300
9BN6266N	N	10	30	<200	300	N	700	N	>2,000	N
9BN6267N	N	10	70	N	500	N	2,000	N	>2,000	N
9BN6268N	N	10	70	N	500	N	2,000	N	2,000	N
9BN6269N	N	10	50	N	500	N	2,000	N	>2,000	500
9BN6270N	N	20	70	N	500	1,000	3,000	N	>2,000	1,000
9BN6271N	N	10	50	N	500	N	2,000	N	2,000	1,000
9BN6272N	N	10	50	N	500	200	2,000	N	>2,000	500
9BN6273N	N	10	50	N	500	<100	2,000	N	>2,000	500
9BN6274N	N	10	50	N	500	N	2,000	N	>2,000	200
9BN6275N	N	10	70	N	500	N	2,000	N	>2,000	700
9BN6276N	N	30	30	N	300	<100	1,500	N	>2,000	300
9BM6277N	N	15	70	N	300	N	2,000	N	>2,000	2,000
9BM6278N	N	20	70	N	300	N	2,000	N	>2,000	2,000
9BM6279N	N	20	50	N	300	100	1,500	N	>2,000	200
9BM6280N	N	10	30	200	300	<100	200	N	1,000	N
9BM6281N	N	<10	30	N	500	100	500	N	1,500	<200
9BM6282N	N	15	50	N	300	<100	700	N	700	<200
9BM6283N	N	10	N	200	200	<100	50	N	1,000	N
9BM6284N	N	10	N	200	300	200	150	N	1,000	N
9BM6285N	N	N	N	<200	70	N	50	N	300	N
9BM6287N	N	10	N	<200	200	N	150	N	700	N
9BM6289N	N	10	20	<200	150	N	30	N	500	N
9BM7082N	N	50	<20	300	500	200	1,000	N	>2,000	N
9BM7083N	N	50	N	200	500	1,000	700	N	>2,000	500
9CL7084N	N	20	N	200	200	N	500	N	>2,000	1,500
9CL7085N	N	50	N	<200	200	200	1,500	N	>2,000	5,000
9CM7086N	N	20	N	<200	200	100	1,000	700	>2,000	3,000
9CL7087N	N	150	20	N	200	N	2,000	500	>2,000	>5,000
9CL7088N	N	20	50	<200	300	N	700	N	>2,000	1,500
9CL7089N	N	50	N	<200	200	N	500	N	>2,000	5,000
9CL7090N	N	50	N	<200	300	N	500	N	>2,000	2,000
9CL7091N	N	50	N	<200	150	N	500	N	>2,000	2,000
9CL7092N	N	70	100	200	300	<100	500	N	>2,000	700
9CL7093N	N	20	N	<200	300	100	700	N	>2,000	1,000
9CL7094N	N	50	N	<200	200	N	2,000	N	>2,000	1,500

Appendix 3.--continued

sample	LATITUDE	LONGITUD	S-FE%	S-MG%	S-CA%	S-TI%	S-MN	S-AG	S-AS	S-AU	S-B
9CL7095N	45 42 27	112 30 38	7.0	.50	7.0	>2.0	2,000	N	N	N	2,000
9CL7096N	45 42 46	112 30 30	1.0	.15	15.0	>2.0	1,500	N	N	N	<20
9CL7097N	45 43 22	112 31 19	15.0	1.00	5.0	1.5	2,000	N	N	N	5,000
9CL7098N	45 43 25	112 31 24	7.0	1.00	5.0	2.0	1,500	N	N	N	5,000
9CL7099N	45 43 18	112 31 8	7.0	1.00	7.0	2.0	1,000	N	N	N	5,000
9CL7100N	45 44 2	112 31 7	3.0	1.00	15.0	1.5	2,000	N	N	N	5,000
9CL6151N	45 44 41	112 30 41	5.0	3.00	7.0	.5	2,000	N	N	N	100
9CL6152N	45 44 55	112 30 41	5.0	3.00	10.0	.7	3,000	N	N	N	70
9CL6153N	45 44 23	112 30 52	5.0	5.00	15.0	2.0	5,000	N	N	N	1,000
9CL6154N	45 44 5	112 31 54	15.0	1.00	1.5	1.5	2,000	10	7,000	N	30
9CL6155N	45 44 11	112 32 8	15.0	.50	1.0	.7	1,000	N	700	N	50
9CL6156N	45 43 28	112 33 16	20.0	.20	7.0	.2	200	100	<500	N	50
9CL6157N	45 43 34	112 33 23	7.0	.30	5.0	>2.0	500	2	N	N	150
9CN6159N	45 40 24	112 21 32	.5	.15	10.0	>2.0	700	N	N	N	30
9CM6160N	45 40 49	112 22 42	.5	.20	15.0	>2.0	1,000	N	N	N	<20
9CM6164N	45 41 0	112 23 27	.7	.15	20.0	>2.0	2,000	N	N	N	<20
9CM6165	45 41 0	112 23 22	.3	.07	15.0	>2.0	700	N	N	N	<20
9CM6166N	45 41 57	112 25 12	.5	.05	15.0	>2.0	1,000	N	N	N	<20
9CM6167N	45 42 3	112 25 56	.5	.05	15.0	>2.0	1,500	N	N	N	<20
9CM6168N	45 42 25	112 26 42	.5	.15	10.0	>2.0	1,000	N	N	N	<20
9CM6169N	45 42 22	112 26 47	.5	.20	15.0	>2.0	1,500	N	N	N	50
9CM6170N	45 41 3	112 25 48	.5	.05	10.0	>2.0	1,000	N	N	N	[illegible]
9CM6171N	45 40 54	112 25 51	.5	.20	10.0	>2.0	1,000	N	N	N	[illegible]
9CM6172N	45 40 31	112 25 7	.7	.50	15.0	>2.0	1,500	N	N	N	30
9CM6173N	45 40 39	112 24 54	.5	.05	15.0	>2.0	1,000	20	N	N	<20
9CM6174N	45 40 15	112 24 42	.5	.07	15.0	>2.0	1,000	N	N	N	<20
9CM6175N	45 39 59	112 24 13	.5	.20	10.0	>2.0	1,000	N	N	N	<20
9CN6178N	45 42 12	112 20 32	1.0	1.50	20.0	>2.0	1,000	N	N	N	200
9CN6179N	45 42 46	112 20 48	.5	1.00	10.0	>2.0	700	N	N	N	<20
9CN6180N	45 42 50	112 21 6	.3	.50	10.0	>2.0	500	N	N	N	50
9CN6181N	45 43 13	112 21 50	.5	.30	10.0	>2.0	500	N	N	N	20
9CN6182N	45 43 37	112 21 46	.3	.30	7.0	>2.0	500	N	N	N	200
9CN6183N	45 43 44	112 21 46	.7	.70	7.0	>2.0	500	N	N	N	150

Appendix 3, --continued

sample	S-BA	S-BE	S-BI	S-CD	S-CO	S-CR	S-CU	S-LA	S-MO	S-NB	S-NI	S-PB
9CL7095N	150	3	N	N	20	70	70	>2,000	N	100	30	150
9CL7096N	N	N	N	N	20	20	20	>2,000	50	300	N	70
9CL7097N	200	5	N	N	30	300	50	>2,000	10	N	50	300
9CL7098N	150	2	N	N	30	200	70	>2,000	N	N	50	300
9CL7099N	200	3	N	N	20	200	70	>2,000	N	N	50	200
9CL7100N	70	5	N	N	15	70	20	>2,000	N	50	20	150
9CL6151N	70	5	N	N	N	30	10	1,000	10	<50	10	20
9CL6152N	70	5	N	N	10	50	100	150	15	<50	10	20
9CL6153N	200	7	N	N	10	100	100	2,000	70	100	15	70
9CL6154N	500	15	N	N	20	150	200	1,000	70	150	50	7,000
9CL6155N	700	15	N	N	15	70	70	300	10	50	30	500
9CL6156N	300	3	N	N	70	<20	>50,000	300	<10	N	50	150
9CL6157N	200	7	N	N	20	30	300	1,000	15	500	20	500
9CN6159N	50	N	N	N	15	20	100	>2,000	15	200	10	500
9CM6160N	<50	N	N	N	15	70	15	>2,000	50	500	10	20
9CM6164N	50	N	N	N	15	20	20	>2,000	20	500	10	50
9CM6165	<50	N	N	N	15	20	20	2,000	20	500	<10	20
9CM6166N	N	N	N	N	15	50	20	2,000	30	500	N	2.
9CM6167N	50	N	150	N	20	30	30	>2,000	20	300	<10	50
9CM6168N	N	N	N	N	20	<20	20	2,000	30	700	<10	20
9CM6169N	100	N	100	N	10	50	20	>2,000	20	150	<10	70
9CM6170N	N	N	N	N	10	20	20	2,000	20	500	N	20
9CM6171N	<50	N	N	N	15	30	15	>2,000	20	100	N	70
9CM6172N	<50	N	70	N	20	70	20	>2,000	20	200	<10	3
9CM6173N	200	N	150	N	20	20	20	2,000	150	150	N	
9CM6174N	300	N	N	N	20	<20	20	2,000	20	500	N	20
9CM6175N	100	N	N	N	10	30	N	>2,000	30	100	<10	100
9CN6178N	150	N	N	N	20	200	300	>2,000	20	70	<10	100
9CN6179N	100	N	N	N	20	300	30	>2,000	20	100	<10	300
9CN6180N	200	N	N	N	20	300	30	>2,000	20	100	<10	70
9CN6181N	50	N	N	N	10	100	15	>2,000	20	150	<10	50
9CN6182N	1,000	N	N	N	15	70	20	2,000	15	70	<10	<20
9CN6183N	100	7	N	N	15	150	20	2,000	30	500	<10	70

Appendix 3.--continued

sample	S-SB	S-SC	S-SN	S-SR	S-V	S-W	S-Y	S-ZN	S-ZR	S-TH
9CL7095N	N	50	N	<200	200	N	1,500	N	>2,000	1,000
9CL7096N	N	50	30	<200	300	500	2,000	N	>2,000	5,000
9CL7097N	N	20	N	<200	200	N	1,500	N	>2,000	2,000
9CL7098N	N	30	N	<200	200	N	500	N	>2,000	5,000
9CL7099N	N	30	N	<200	200	N	500	N	>2,000	1,500
9CL7100N	N	20	N	200	200	<100	300	N	>2,000	1,000
9CL6151N	N	10	N	200	200	N	50	N	150	N
9CL6152N	N	15	N	200	200	<100	100	N	200	N
9CL6153N	N	15	20	200	300	1,000	300	N	>2,000	<200
9CL6154N	N	15	N	200	200	<100	200	700	1,000	N
9CL6155N	N	15	30	<200	200	N	150	500	700	N
9CL6156N	N	10	100	N	70	N	100	<500	100	N
9CL6157N	N	10	150	<200	200	<100	700	N	2,000	<200
9CN6159N	N	10	50	<200	200	N	1,500	N	>2,000	2,000
9CM6160N	N	10	20	N	300	N	2,000	N	2,000	700
9CM6164N	N	10	50	<200	300	N	2,000	N	>2,000	2,000
9CM6165	N	15	<20	<200	200	N	2,000	N	>2,000	1,000
9CM6166N	N	10	30	<200	200	<100	2,000	N	>2,000	2,000
9CM6167N	N	10	50	<200	300	500	2,000	N	>2,000	1,500
9CM6168N	N	10	70	N	300	N	2,000	N	>2,000	1,000
9CM6169N	N	20	<20	200	300	100	1,500	N	>2,000	500
9CM6170N	N	15	20	<200	200	<100	1,500	N	>2,000	700
9CM6171N	N	10	30	<200	200	1,000	1,500	N	>2,000	2,000
9CM6172N	N	10	20	<200	200	100	1,500	N	>2,000	700
9CM6173N	N	10	<20	<200	200	2,000	1,500	N	>2,000	3,000
9CM6174N	N	10	<20	<200	200	<100	2,000	N	>2,000	700
9CM6175N	N	10	70	<200	200	<100	1,500	N	>2,000	500
9CN6178N	N	50	70	500	300	<100	1,500	N	>2,000	300
9CN6179N	N	20	200	<200	500	N	1,500	N	>2,000	500
9CN6180N	N	10	70	<200	500	200	1,500	N	>2,000	700
9CN6181N	N	15	70	<200	300	N	1,500	N	>2,000	<200
9CN6182N	N	20	30	200	300	200	1,500	N	>2,000	N
9CN6183N	N	N	20	<200	200	N	1,000	N	>2,000	300

Appendix 4.--Statistical summary of chemical analyses for panned concentrates and rock samples, Highland Mountains.

Appendix 4.--Statistical summary of chemical analyses for panned concentrates and rock samples, Highland Mountains.

"Nonmagnetic" stream sediments

	Minimum	Maximum	Mean	Deviation	Valid	B	L	N	G	Other
Latitude	45.58139	45.87472	45.73963	0.062625	78	0	0	0	0	0
Longitude	112.2575	112.5564	112.4273	0.065300	78	0	0	0	0	0
S-Fe%	0.300000	20.00000	2.494872	3.735783	78	0	0	0	0	0
S-Mg%	0.050000	10.00000	1.627436	2.253102	78	0	0	0	0	0
S-Ca%	1.000000	20.00000	10.62179	4.256535	78	0	0	0	0	0
S-Ti%	0.200000	2.000000	1.260870	0.622122	23	0	0	0	55	0
S-Mn	200.0000	5000.000	1232.051	709.5807	78	0	0	0	0	0
S-Ag	2.000000	100.0000	24.50000	37.49000	6	0	0	72	0	0
S-As	700.0000	7000.000	3850.000	4454.773	2	0	1	75	0	0
S-Au					0	0	0	78	0	0
S-B	20.00000	5000.000	570.6780	1265.313	59	0	19	0	0	0
S-Ba	50.00000	1000.000	192.8125	217.8354	64	0	5	9	0	0
S-Be	2.000000	15.00000	4.864865	3.241760	37	0	0	41	0	0
S-Bi	70.00000	1000.000	328.3333	347.8723	12	0	0	66	0	0
S-Cd					0	0	0	78	0	0
S-Co	10.00000	100.0000	20.84746	15.14734	59	0	16	3	0	0
S-Cr	20.00000	1500.000	137.2973	205.8480	74	0	4	0	0	0
S-Cu	10.00000	500.0000	54.39189	81.51793	74	0	1	2	1	0
S-La	100.0000	2000.000	1385.714	743.5319	42	0	0	0	36	0
S-Mo	10.00000	150.0000	25.81818	22.23118	55	0	1	22	0	0
S-Nb	50.00000	700.0000	277.3770	201.5019	61	0	8	9	0	0
S-Ni	10.00000	150.0000	50.75758	38.73228	33	0	12	33	0	0
S-Pb	20.00000	7000.000	319.8485	899.8778	66	0	9	3	0	0
S-Sb					0	0	0	78	0	0
S-Sc	10.00000	150.0000	22.09459	21.29388	74	0	2	2	0	0
S-Sn	20.00000	300.0000	59.80000	48.17019	50	0	5	22	1	0
S-Sr	200.0000	500.0000	225.0000	77.45967	16	0	35	27	0	0
S-V	70.00000	500.0000	310.7692	130.0227	78	0	0	0	0	0
S-W	100.0000	2000.000	410.8696	479.0987	23	0	15	40	0	0
S-Y	30.00000	3000.000	1191.410	724.4178	78	0	0	0	0	0
S-Zn	500.0000	700.0000	600.0000	115.4701	4	0	1	73	0	0
S-Zr	100.0000	2000.000	1047.222	702.6153	18	0	0	0	60	0
S-Th	200.0000	5000.000	1370.588	1286.281	51	0	6	20	1	0

"Magnetic" stream sediments

	Minimum	Maximum	Mean	Deviation	Valid	B	L	N	G	Other
Latitude	45.58139	45.874472	45.73963	0.061683	78	0	0	0	0	0
Longitude	112.2575	112.5564	112.4255	0.065917	78	0	0	0	0	0
S-Fe%	7.000000	50.00000	17.38462	8.256018	78	0	0	0	0	0
S-Mg%	0.200000	7.000000	3.574359	2.029358	78	0	0	0	0	0
S-Ca%	0.200000	15.00000	3.832051	2.646266	78	0	0	0	0	0
S-Ti%	0.100000	2.000000	1.390000	0.641858	55	0	0	0	23	0
S-Mn	300.0000	10000.00	5339.726	2663.839	73	0	0	0	5	0
S-Ag	1.000000	10.00000	4.666667	4.725816	3	0	0	75	0	0
S-As	500.0000	5000.000	2166.667	2466.441	3	0	0	75	0	0
S-Au					0	0	0	78	0	0
S-B	20.00000	300.0000	44.78261	52.86205	46	0	27	5	0	0
S-Ba	50.00000	300.0000	119.4915	69.36718	59	0	8	11	0	0
S-Be	1.000000	20.00000	3.956522	4.258098	46	0	29	3	0	0
S-Bi					0	0	0	78	0	0
S-Cd					0	0	0	78	0	0
S-Co	20.00000	200.0000	56.02564	31.51333	78	0	0	0	0	0
S-Cr	20.00000	1000.000	216.5385	217.2008	78	0	0	0	0	0
S-Cu	10.00000	10000.00	224.5714	1188.496	70	0	4	4	0	0
S-La	50.00000	2000.000	903.5185	711.6236	54	0	1	0	23	0
S-Mo	10.00000	100.0000	23.58974	26.05532	39	0	3	36	0	0
S-Nb	50.00000	700.0000	203.9583	176.4031	48	0	15	15	0	0
S-Ni	10.00000	200.0000	66.66667	53.48059	78	0	0	0	0	0
S-Pb	20.00000	3000.000	103.1148	380.6290	61	0	16	1	0	0
S-Sb	200.0000	200.0000	200.0000		1	0	0	77	0	0
S-Sc	10.00000	150.0000	72.30769	28.90527	78	0	0	0	0	0
S-Sn	20.00000	200.0000	54.28571	65.79188	7	0	6	65	0	0
S-Sr	200.0000	3000.000	351.7241	522.7815	29	0	47	2	0	0
S-V	70.00000	1500.000	438.7179	227.6210	78	0	0	0	0	0
S-W	150.0000	150.0000	150.0000		1	0	0	77	0	0
S-Y	20.00000	1000.000	355.8974	277.2895	78	0	0	0	0	0
S-Zn	200.0000	1000.000	628.5714	292.7700	7	0	0	71	0	0
S-Zr	50.00000	2000.000	599.7333	516.7282	75	0	0	0	3	0
S-Th	200.0000	1000.000	494.1176	281.6704	17	0	6	55	0	0

Appendix 4.--Continued

	Minimum	Maximum	Mean	Deviation	Valid	B	L	N	G	Other
						Rock Samples				
Latitude	45.59250	45.86917	45.68720	0.077087	150	0	0	0	0	0
Longitude	112.3144	112.5850	112.4421	0.098734	150	0	0	0	0	0
S-Fe%	0.200000	20.00000	6.656250	5.290217	144	0	0	0	6	0
S-Mg%	0.020000	10.00000	1.413265	1.704238	147	0	3	0	0	0
S-Ca%	0.050000	20.00000	2.262740	4.183636	146	0	3	1	0	0
S-Ti%	0.002000	1.000000	0.245173	0.244194	150	0	0	0	0	0
S-Mn	10.00000	5000.000	902.4658	1059.001	146	0	0	0	4	0
S-Ag	0.500000	2000.000	59.95281	230.9362	89	0	3	58	0	0
S-As	200.0000	10000.00	1213.636	2435.510	22	0	7	116	5	0
S-Au	10.00000	50.00000	18.75000	14.33029	8	0	6	136	0	0
S-B	10.00000	1000.000	43.55072	98.15116	138	0	6	6	0	0
S-Ba	20.00000	2000.000	424.9242	408.6834	132	0	12	6	0	0
S-Be	1.000000	5.000000	1.711712	1.098655	111	0	29	10	0	0
S-Bi	10.00000	200.0000	57.81250	49.56372	16	0	3	131	0	0
S-Cd	20.00000	300.0000	81.33333	87.73879	15	0	0	135	0	0
S-Co	0.500000	2000.000	87.63362	285.4859	116	0	1	33	0	0
S-Cr	10.00000	2000.000	174.8760	339.5803	121	0	1	24	4	0
S-Cu	5.000000	20000.00	1283.945	3951.632	128	0	15	5	2	0
S-La	20.00000	200.0000	43.66972	35.32024	109	0	29	12	0	0
S-Mo	5.000000	2000.000	105.0625	327.7743	48	0	0	102	0	0
S-Nb	10.00000	20.00000	18.88889	3.333333	9	0	94	47	0	0
S-Ni	5.000000	1500.000	78.43284	189.0089	134	0	16	0	0	0
S-Pb	10.00000	20000.00	932.5591	3383.868	127	0	7	13	3	0
S-Sb	100.0000	5000.000	914.2857	1380.416	14	0	7	129	0	0
S-Sc	5.000000	50.00000	14.77586	13.13216	116	0	20	14	0	0
S-Sn	10.00000	500.0000	78.50000	123.6623	20	0	10	120	0	0
S-Sr	100.0000	3000.000	345.4023	429.1441	87	0	61	2	0	0
S-V	10.00000	1000.000	136.2671	153.8593	146	0	4	0	0	0
S-W	50.00000	1500.000	228.8889	477.0599	9	0	6	135	0	0
S-Y	10.00000	100.0000	27.74336	19.98874	113	0	15	22	0	0
S-Zn	200.0000	7000.000	1404.878	1843.089	41	0	2	106	1	0
S-Zr	10.00000	700.0000	97.64925	102.8260	134	0	5	11	0	0
S-Th	150.0000	150.0000	150.0000		1	0	2	147	0	0
AA-Zn-P	0.500000	34000.00	661.9690	3088.907	145	0	3	0	2	0
AA-Sb-P	0.500000	200.0000	14.37805	31.37562	82	0	32	32	4	0
CM-As	5.000000	160000.0	3132.447	18408.83	94	6	49	0	1	0
CM-W	1.000000	200.0000	10.88462	38.72707	26	92	11	15	0	6
CM-W-F	.000000	30.00000	4.794872	6.287747	39	73	9	27	1	1