

TRACE ELEMENT DISTRIBUTION NEAR JASPEROIDS IN THE WEEPAH  
SPRING WILDERNESS STUDY AREA, LINCOLN AND NYE COUNTIES, NEVADA

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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

ft	foot
mi	mile
ppb	parts per billion
ppm	parts per million
tr oz	troy ounce

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WILDERNESS STUDY AREA, LINCOLN AND NYE COUNTIES, NEVADA

By Diann D. Gese<sup>1</sup>

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ABSTRACT

In 1985, the Bureau of Mines conducted a site-specific investigation to further assess the possibility of gold occurring in the northwestern part of the Weepah Spring Wilderness Study Area, Lincoln and Nye Counties, Nevada. This area was identified in a previous study by the U.S. Geological Survey and the Bureau as having a "high potential" for undiscovered deposits of disseminated gold.

The study consisted of the Bureau collecting 64 rock-chip samples, 4 from unaltered carbonate rocks to establish a local background the rest from jasperoid outcrops, and 117 stream-sediment samples. Gold, silver, antimony, arsenic, barium, and mercury contents of the samples were evaluated statistically. All the antimony, arsenic, and barium concentrations of the stream-sediment samples were plotted and then contoured to determine if any areas of anomalously high element concentrations existed within the study area.

Some of the jasperoid samples contained low gold and silver concentrations and all contained anomalously high amounts of antimony, arsenic, barium, and mercury, elements commonly associated with disseminated gold and silver deposits in Nevada. Plotting and contouring the antimony, arsenic, and barium contents of the stream-sediment samples identified one area where all three elements were several times their background. Four other

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areas with anomalously high arsenic concentrations were also identified. The study identifies possible gold exploration targets in and near the wilderness study area.

#### INTRODUCTION

Site-specific studies are carried out by the Bureau on wilderness study areas when their initial study indicates that additional and more detailed field work may identify and quantify a resource with emphasis on critical and strategic minerals. The Weepah Spring Wilderness Study Area (WSA) is one such area (1).<sup>2</sup>

#### Location and Access

The Weepah Spring WSA is about 115 mi north of Las Vegas, Nevada, and 50 mi north of Alamo, Nevada. Access to the area is by Nevada State Route 38; the Timber Mountain Pass Road off Route 38 provides access to the northern part of the area while an unimproved dirt road up Seaman Wash provides access to the south end. Travel within the WSA is by dirt roads and foot trails (fig. 1).

The study area is along the northern part of Seaman Range. Terrain is rugged with elevations ranging from about 4,700 ft in the valleys on either side of the range to 8,587 ft at Black Cliff.

#### PREVIOUS WORK

The general geology of the northwest part of the WSA is included in Tschanz and Pampeyan's (2) Geology of Lincoln County and Kleinhampl and Ziony's (3) Geology of Northern Nye County. Wood's (4) thesis includes a

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<sup>2</sup>Underlined numbers in parentheses refer to items in the list of references at the end of this report.

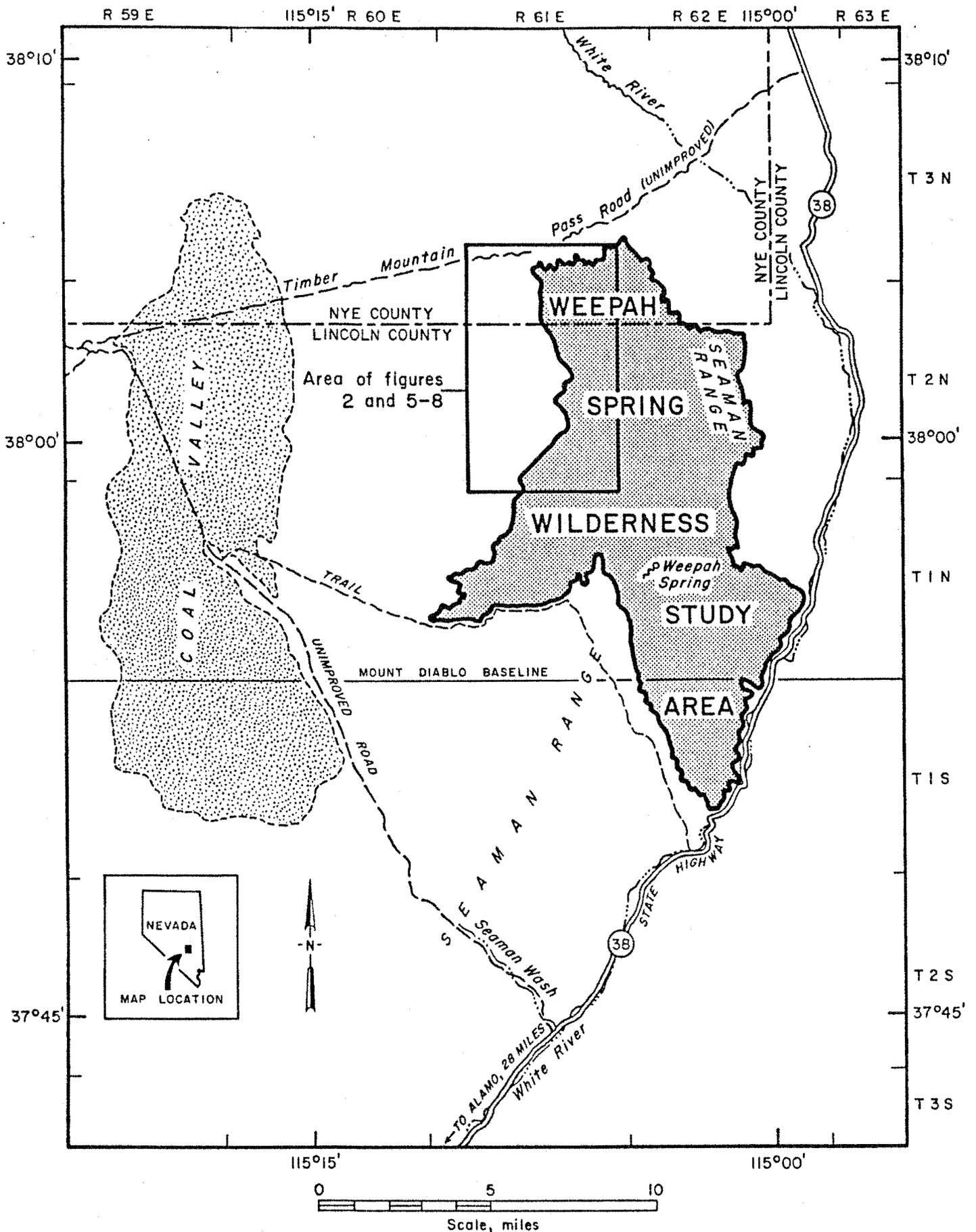


Figure 1.--Index map of the Weepah Spring Wilderness Study Area showing area studied.

detailed description and geologic map of the Timber Mountain Pass Area. The geology of the WSA was mapped in detail by du Bray (1) as part of the combined USGS-Bureau mineral resource study.

The Bureau conducted a mineral investigation of the WSA in 1985 (5). That study identified an area of mineralization along the northwest boundary of the study area. The geochemistry, host rock, and alteration products from this area are similar to those at the Alligator Ridge disseminated gold and silver deposit in White Pine County, Nevada (6). Samples from jasperoid outcrops in this part of the study area contained an average of 21 ppm antimony, 214 ppm arsenic, and 2 ppm mercury.

From the late 1960's to about 1981, Bear Creek Mining Company (Bear Creek), then the exploration subsidiary of Kennecott Copper Corporation, mapped, sampled, and drilled in the Timber Mountain Pass area on the northwest boundary of the WSA (5, p. 6). Soil samples taken by Bear Creek in 1979 defined several gold, arsenic, mercury, and antimony anomalies. These anomalies were best defined near the base of the Late Devonian and Early Mississippian Pilot Shale. Several holes drilled by rotary methods to shallow depths confirmed the presence of gold, especially near the barite-bearing jasperoids (7).

#### GEOLOGIC SETTING

The north-trending Seaman Range is a typical range of the Basin and Range physiographic province. Silurian through Mississippian-age carbonate and clastic rocks are overlain in the southern part of the WSA by Tertiary-age volcanic rocks. The volcanic rocks are mid-Tertiary ignimbrites, a sequence of intermediate to silicic ash-flow sheets, and basalt, trachyte, and rhyolite flows (fig. 2). Quarternary-age alluvium and colluvium flank the range on all

EXPLANATION OF SYMBOLS FOR FIGURE 2

 APPROXIMATE BOUNDARY OF THE WEEPAH SPRING WILDERNESS STUDY AREA

●<sup>146</sup> LOCALITY OF STREAM-SEDIMENT SAMPLE--Showing sample number

50-55  
○ LOCALITY OF SAMPLED OUTCROP--Showing sample number(s);  
symbol may represent more  
than one sample locality

x<sub>97</sub> PROSPECT PIT--Showing sample number

+++ JASPEROID OUTCROP

 FAULT--Bar and ball on downthrown side; dashed where  
inferred, dotted where concealed

 CONTACT

MAP UNITS

Qa	Quaternary alluvium
Tv	Tertiary volcanics
Mcs	Mississippian Chainman Shale
Mj	Lower Mississippian Joana Limestone
Mjj	Joana Limestone locally altered to jasper
Dw	Upper Devonian West Range Limestone
Dwj	West Range Limestone locally altered to jasper
Dg	Upper and Middle Devonian Guilmette Formation
Dsi	Middle Devonian Simonson Dolomite
Sl	Silurian Laketown Dolomite



sides. Numerous high-angle, normal faults cut both the sedimentary and volcanic rocks (8).

Of particular interest to this study are the Lower Mississippian-age Joana and Upper Devonian-age West Range Limestones, as they are lithologically equivalent to rock that hosts disseminated gold deposits elsewhere in Nevada. The West Range Limestone, a fine-grained silty limestone and calcareous siltstone, includes approximately 70 ft of section stratigraphically equivalent to the Pilot Shale, a Late Devonian- and Early Mississippian-age sequence of thinly bedded calcareous, carbonaceous siltstone and claystones. In the WSA, both the Joana and West Range Formations have been altered to jasper along faults that may have served as conduits for mineral-bearing fluids. The Pilot Shale is the primary host rock at the Alligator Ridge deposit, an epithermal disseminated gold deposit in White Pine County, Nevada. The original reserves at this deposit were 5 million tons of ore with an average grade of 0.12 tr oz gold per ton (6).

#### PRESENT INVESTIGATION

Based on evidence in previous studies that suggested the possibility of gold occurring in the area (1), the Bureau conducted a site-specific investigation in the northwestern part of the Weepah Spring WSA in August 1985. This study was carried out to further assess the possibility of this part of the WSA hosting a disseminated gold and silver deposit.

Two Bureau geologists spent 17 days in the field and collected 64 rock-chip and 117 stream-sediment samples (fig. 2). Four unaltered carbonate rocks were sampled and analyzed to provide an estimate of local geochemical background concentrations for gold, silver, antimony, arsenic, barium, and mercury; the rest were jasperoid and silicified carbonate outcrops within and

near the area studied. Sediment samples were taken from all of the streams draining the Seaman Range, from the Timber Mountain Pass area to approximately 7 mi south where volcanics cover the sedimentary rocks. Stream-sediment samples were sieved, the minus-80-mesh fraction was used for chemical analyses. Wherever possible stream-sediments were taken at 200 ft intervals along the stream up to its source.

Gold, silver, antimony, arsenic, barium, and mercury contents of the samples were evaluated statistically. Arithmetic means, histograms, probability plots, correlation coefficients, and standard deviations were determined. All the antimony, arsenic, and barium concentrations of the stream-sediment samples were plotted and then contoured to determine if any areas of anomalously high element concentrations existed within the area studied. These elements are commonly associated with known sediment-hosted, disseminated gold and silver deposits in Nevada (9, 10). A statistical study by Harris and Radtke (11) of selected trace elements from unoxidized ore at the Carlin gold deposit, Nevada, found a high correlation between gold, arsenic, mercury, and antimony and a negative correlation between gold and barium.

#### ANALYTICAL METHODS

All rock-chip samples were analyzed for gold and silver by fire assay combined with inductively coupled plasma atomic emission spectrometry (ICP), for 33 elements by ICP, and for antimony and arsenic by atomic absorption spectrophotometry by the Bureau of Mines Reno Research Center, Nevada. The chip samples were also analyzed for mercury by cold-vapor atomic absorption and the stream-sediment samples were analyzed by direct irradiation/instrumental neutron-activation analysis for 26 elements by Bondar-Clegg Inc.,

Lakewood, CO. Analytical results for all samples are listed in Appendices A and B.

#### ANALYTICAL RESULTS

Four rock-chip samples from unaltered carbonates were taken within the area studied to provide an estimate of the local background concentrations. Background concentrations for the study area were: no detectable gold or silver, up to 8.1 ppm antimony, 3 ppm arsenic, 30 ppm barium, and 50 ppb mercury (table 1A). The local background for gold, silver, arsenic, barium, and mercury concentrations are comparable to those given by Parker (14) in an average crustal distribution of these same elements in carbonate rocks. The local background concentration for antimony (up to 8 ppm) was much higher than normal carbonate rocks (.2 ppm) (table 1B). By comparison, 12 of the 60 samples from the jasperoids and silicified carbonates contain from 0.01 ppm to 0.10 ppm gold and average 0.03 ppm. Twenty-seven of the samples contain from 0.35 ppm to 4.6 ppm silver and average 1.8 ppm. Forty-four of the 60 samples contain detectable amounts of antimony. Antimony concentrations range from 3 to 180 ppm and average 26 ppm. Fifty-nine of the samples contain detectable arsenic. Arsenic concentrations range from 3 ppm to 1,380 ppm and average 161 ppm. All 60 samples contain detectable amounts of barium and mercury. Barium concentrations range from 20 ppm to 940 ppm and average 205 ppm. Mercury concentrations range from 10 ppb to >5,000 ppb mercury and average 1,226 ppb (table 2). (For statistical analysis, where samples contained >5,000 ppb mercury, 5,000 ppb was used in determining the arithmetic mean.)

#### INTERPRETATION OF ANALYTICAL RESULTS

Analytical results from all samples were analyzed statistically to determine if a gold-silver exploration target exists within the study area.

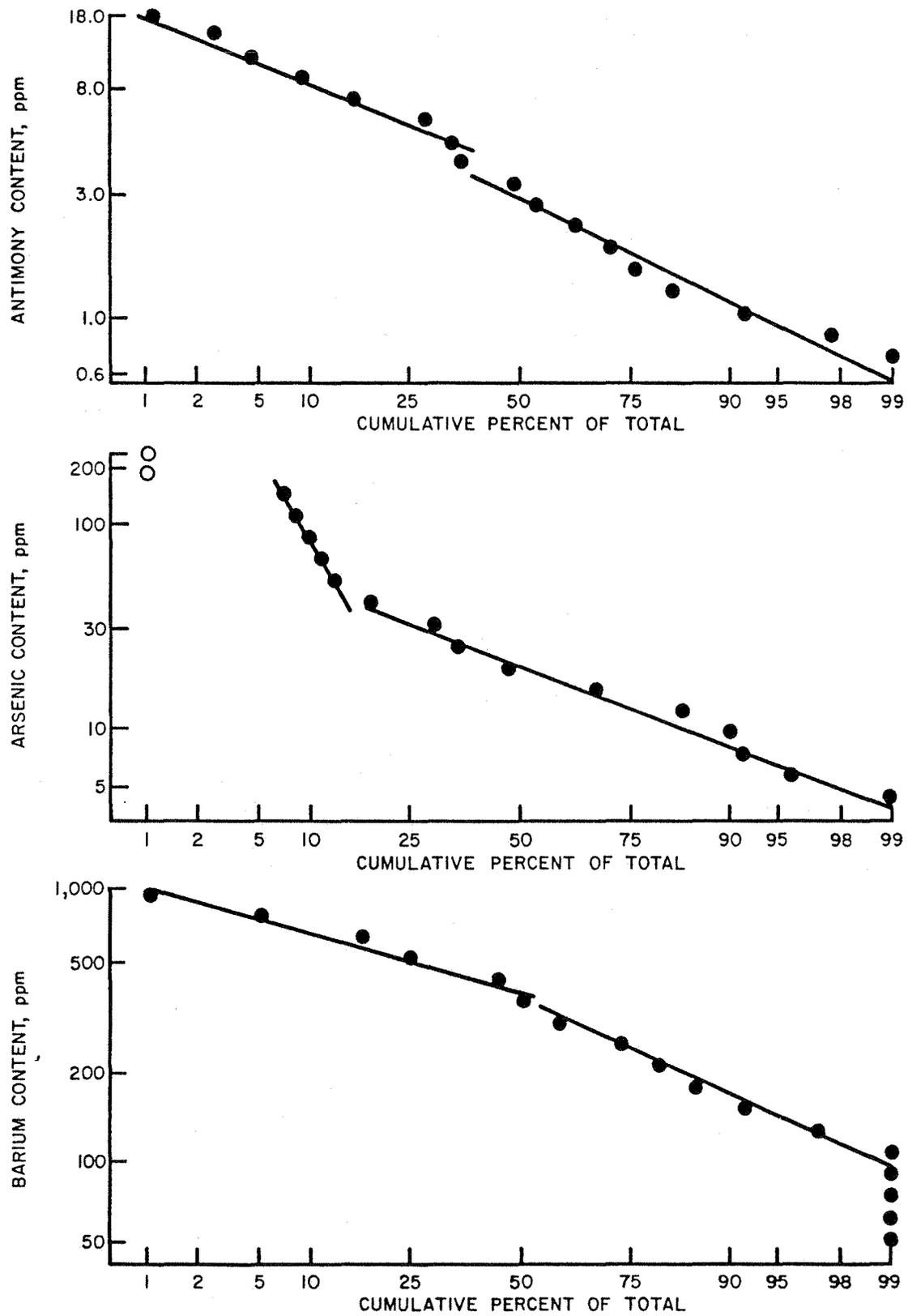


Figure 3.--Cumulative frequency plots for antimony, arsenic, and barium.

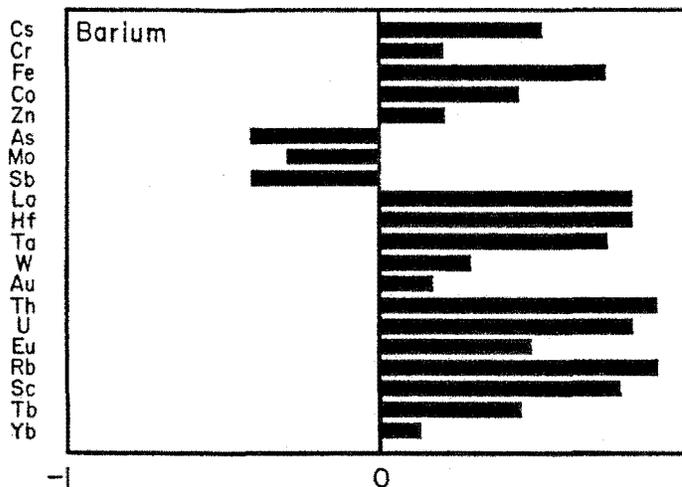
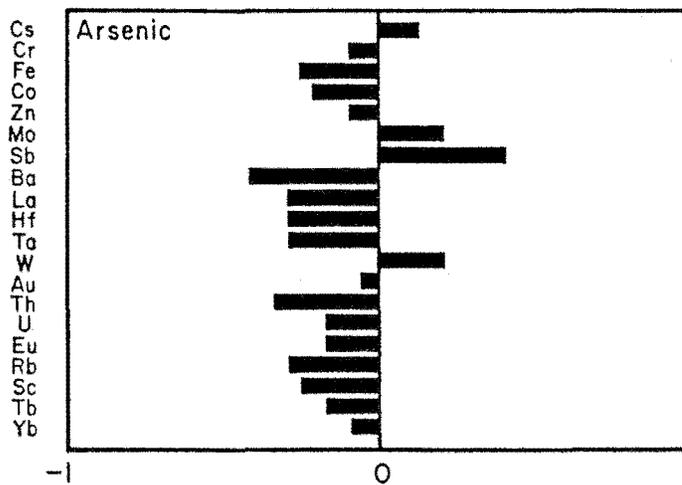
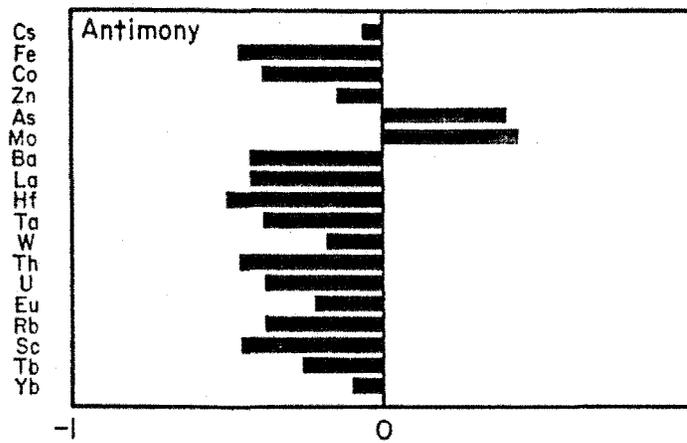


Figure 4.--Correlation matrices for antimony, arsenic, and barium.

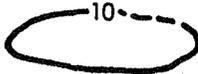
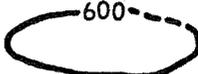
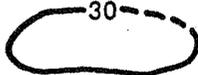
Elements evaluated were gold, silver, antimony, arsenic, barium, and mercury. (Mercury was determined and evaluated for the outcrop samples only.)

The antimony, arsenic, and barium contents of the stream-sediment samples were evaluated graphically and statistically using Bondar-Clegg Inc.'s, Lakewood, CO, computer programs. Cumulative frequency plots and correlation matrices were used to determine the number of populations for each element and the strength of the association between the elements (figs. 3 and 4). All three cumulative frequency curves were plotted using the logs of the elemental concentrations.

Antimony, arsenic, and barium contents from all the stream-sediment samples were plotted and contoured using the mean value as the reference contour and the standard deviation for each element as the contour interval (12, pp. 50-51) (figs. 5, 6, and 7). The gold and silver contents of the stream-sediment samples were not plotted on figure 10 because only four of the samples contained any detectable gold and none contained any detectable silver. The contour map shows one area with highly anomalous antimony, arsenic, and barium concentrations (fig. 8; Zone 1). In this zone arsenic and antimony concentrations exceed the mean plus two times the standard deviation. Arsenic concentrations are up to 50 times the local background, antimony is approximately twice the background, and barium is 18 times the background. Four other areas with 10 times the local background for arsenic were also identified (fig. 8; Zones 1, 2, 3, 4, and 5).

Zone 1, directly south of the Nye-Lincoln County Line, is an area of stream sediments with high antimony, arsenic, and barium concentrations. The antimony and barium anomalies appear to center two major normal faults while the arsenic is offset to the north. The three anomalies are spatially

EXPLANATION OF SYMBOLS FOR FIGURES 5-7

	APPROXIMATE BOUNDARY OF THE WEEPAH SPRING WILDERNESS STUDY AREA
● 146	LOCALITY OF STREAM-SEDIMENT SAMPLE--Showing sample number
50-55 ○	LOCALITY OF SAMPLED OUTCROP--Showing sample number(s); symbol may represent more than one sample locality
x 97	PROSPECT PIT--Showing sample number
+++	JASPEROID OUTCROP
	FAULT--Bar and ball on downthrown side; dashed where inferred, dotted where concealed
	CONTACT
MAP UNITS	
Qa	Quaternary alluvium
Tv	Tertiary volcanics
Mcs	Mississippian Chainman Shale
Mj	Lower Mississippian Joana Limestone
Mjj	Joana Limestone locally altered to jasper
Dw	Upper Devonian West Range Limestone
Dwj	West Range Limestone locally altered to jasper
Dg	Upper and Middle Devonian Guilmette Formation
Dsi	Middle Devonian Simonson Dolomite
Sl	Silurian Laketown Dolomite
	ANTIMONY--Contour interval 3 ppm, mean 4 ppm; short dashed where inferred
	BARIUM--Contour interval 200 ppm, mean 400 ppm; short dashed where inferred
	ARSENIC--Contour interval 40 ppm, mean 30 ppm; short dashed where inferred

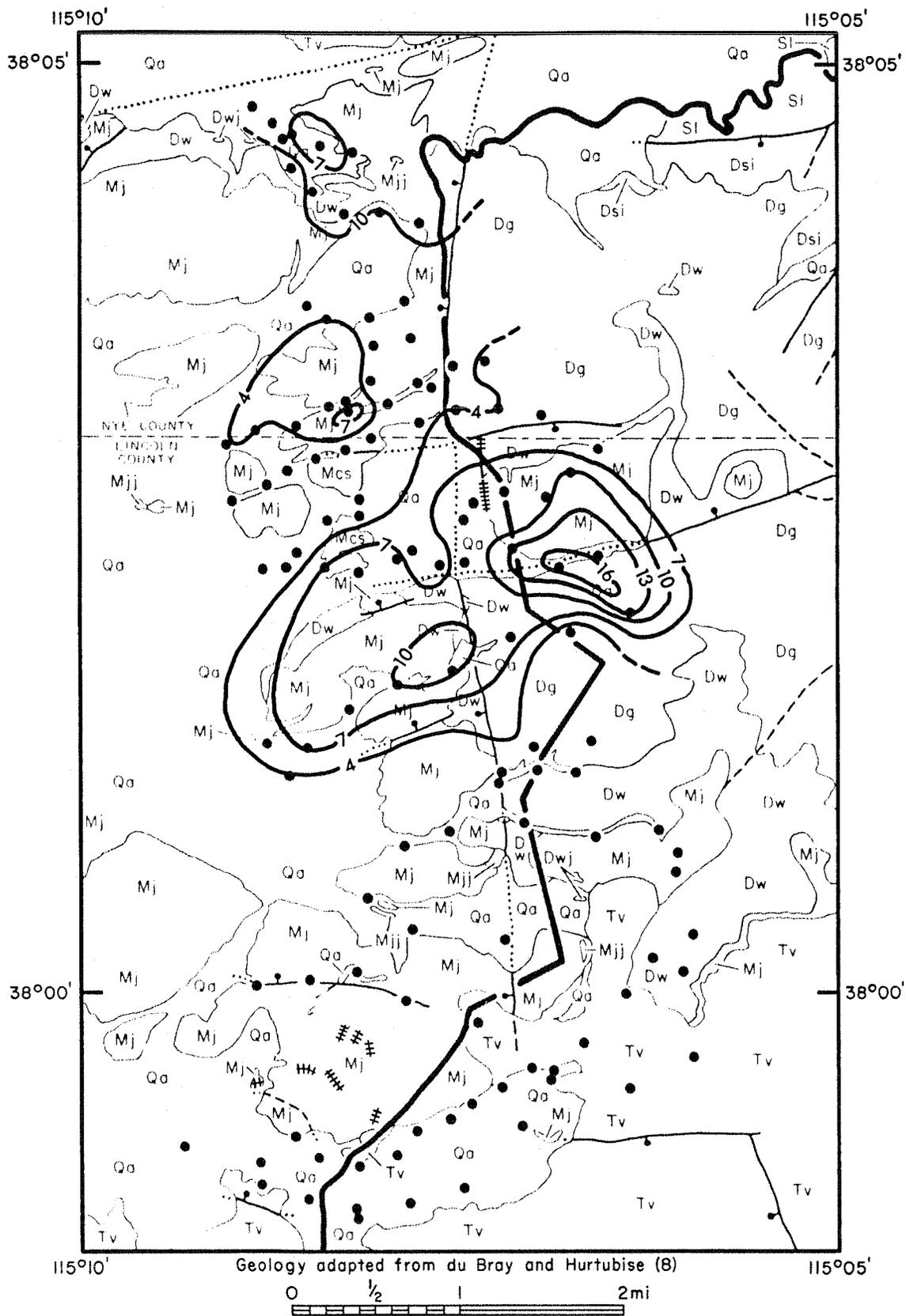


Figure 5.--Map showing contoured antimony concentrations in stream-sediment samples. (Explanation on p. 13.)

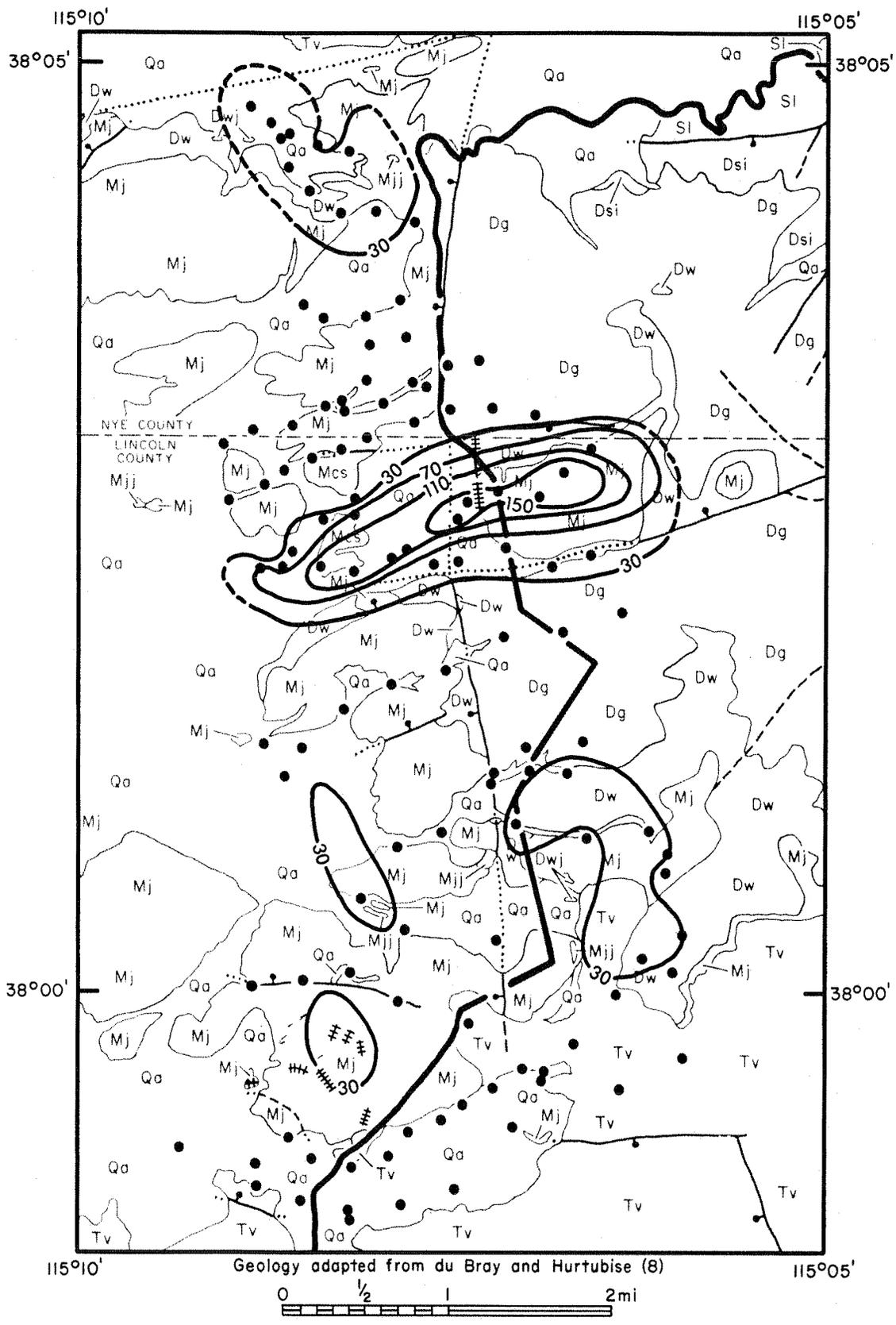


Figure 6.--Map showing contoured arsenic concentrations in stream-sediment samples. (Explanation on p. 13.)

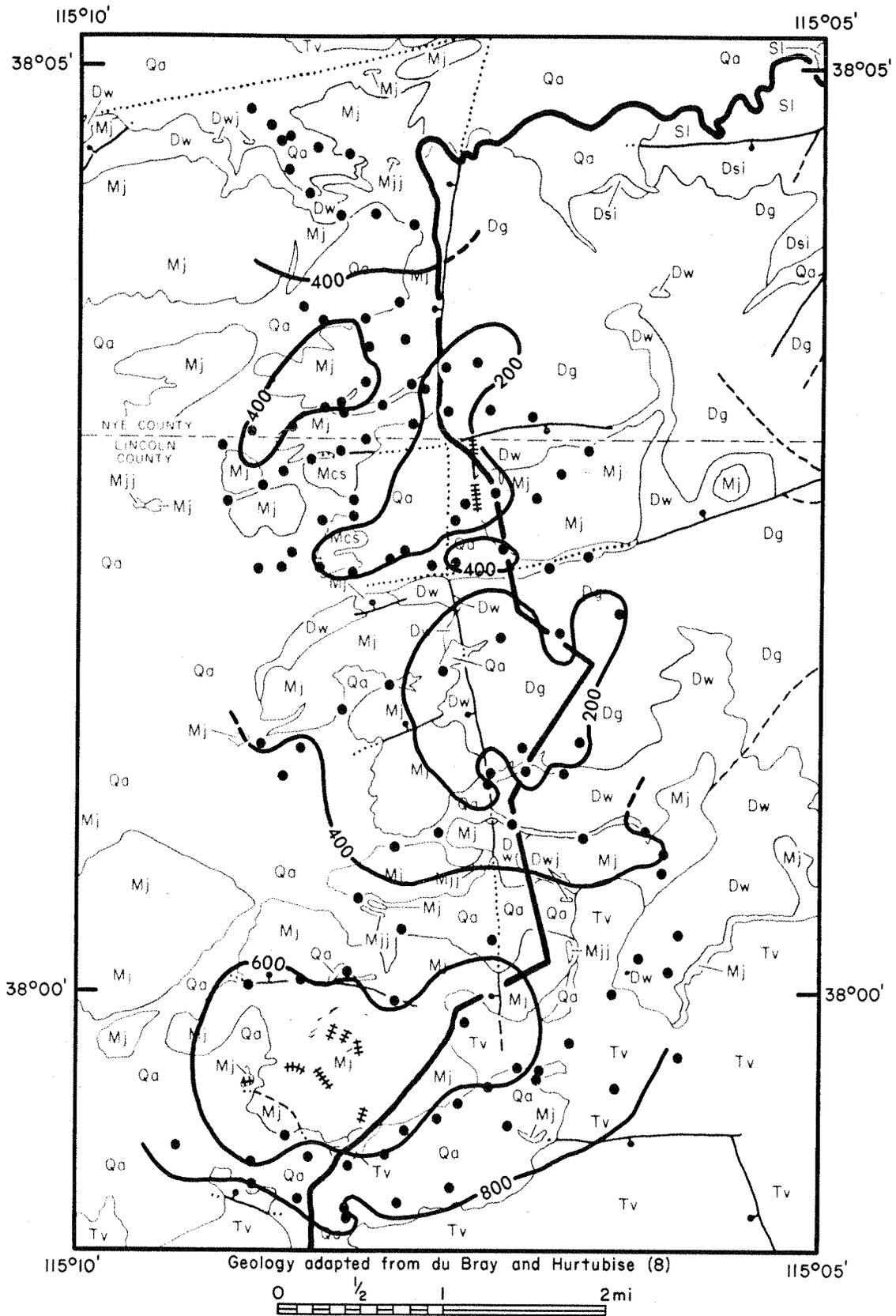
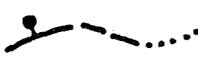
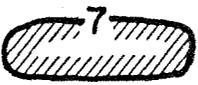


Figure 7.--Map showing contoured barium concentrations in stream-sediment samples. (Explanation on p. 13.)

EXPLANATION OF SYMBOLS FOR FIGURE 8

	APPROXIMATE BOUNDARY OF THE WEEPAH SPRING WILDERNESS STUDY AREA
	LOCALITY OF STREAM-SEDIMENT SAMPLE-- Showing sample number
	JASPEROID OUTCROP
	FAULT-- Bar and ball on downthrown side; dashed where inferred; dotted where concealed
	CONTACT
MAP UNITS	
Qa	Quaternary alluvium
Tv	Tertiary volcanics
Mcs	Mississippian Chainman Shale
Mj	Lower Mississippian Joana Limestone
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Dg	Upper and Middle Devonian Guilmette Formation
Dsi	Middle Devonian Simonson Dolomite
Sl	Silurian Laketown Dolomite
	ANTIMONY--Contour interval 3ppm, mean 4ppm
	ARSENIC--Contour interval 40ppm, mean 30ppm; short dashed where inferred
	BARIUM--Contour interval 200ppm, mean 400ppm



associated with the Joana and West Range Limestones, especially where jasperoid crops out along the north-south normal fault in the center of this zone. Three of the 20 samples taken from jasperoid outcrops in this area contained gold (0.010 ppm and 0.101 ppm) and four samples contained from 0.38 ppm to 2.15 ppm silver (table 2; samples 47, 53, 58, 66, 76, 84, and 99).

Zone 2, in the northern part of the area studied, has overlapping arsenic and antimony anomalies. These anomalies are associated mainly with Joana Limestone in an area of numerous jasperoid outcrops and is directly west of a major fault. Three of the five samples of jasperoids in this area contained from 0.035 ppm to 0.042 ppm gold and from 0.35 ppm to 1.21 ppm silver (table 2; samples 7-9). Bear Creek drilled in this area in 1981 confirming the presence of gold, especially near the barite-bearing jasperoids (5, p. 6).

Two areas with anomalously high concentrations of arsenic and 1 area with anomalously high concentrations of arsenic and barium lie near the southern part of the area studied (fig. 8; Zones 3, 4, and 5). All three areas, are underlain mainly by Joana and West Range Limestones with jasperoid outcrops. Jasperoid outcrops are especially concentrated in Zone 3. Twenty-two chip samples were taken from these jasperoids; 2 contained low (0.018 ppm and 0.023 ppm) gold concentrations and 15 contained silver, ranging from 0.430 ppm to 4.132 ppm (table 2; samples 131, 132, 135, 136, 154-164, and 170).

The cumulative frequency plot for arsenic show two populations (fig. 3); one population corresponds with those at Zone 1 on figure 8 while the other population corresponds to the four smaller arsenic anomalies. Similar plots for antimony also show two populations (fig. 3), but unlike arsenic, the distribution of these populations are not as evident on figure 8. One population may represent a local background while the other represents the

anomalously high area at Zone 1. The graphs for barium also show two populations (fig. 3), but this element shows a high background with a second, anomalously low population at Zone 1.

The correlation matrices show a positive correlation between antimony and arsenic (0.39) and a negative correlation with barium (-0.386) (fig. 4). As the amount of arsenic increases in a sample, the amount of antimony increases while the amount of barium decreases.

In addition to the antimony, arsenic, and barium anomalies, the area studied has other geologic features often associated with disseminated gold deposits in Nevada, particularly at Alligator Ridge (13, p. 110). These features include: presence of jasperoids, high angle faults, favorable host rocks, a heat source, the gangue minerals barite, quartz, pyrite, calcite, and hematite, and anomalous concentrations of the pathfinder elements antimony, arsenic, barium, and mercury.

#### CONCLUSIONS

Geochemical data from jasperoids and stream-sediment samples identify areas of high gold, silver, arsenic, antimony, mercury, and barium concentrations in the northwest part of the Weepah Spring WSA. Statistical analysis and contouring the arsenic, antimony, and barium concentrations in the stream-sediment samples reveal strong concentrations of the three elements in one area and four other areas of high arsenic concentrations. Zone 1, an area where a broad east-northeast-trending arsenic anomaly (up to 50 times the local background) overlaps antimony and barium anomalies, is centered over a major north-south trending normal fault and offset to the north of an east-northeast-trending fault. This area appears to be most promising, as a gold and/or silver exploration target, of the five anomalous zones identified

in this study. In addition to its anomalous concentrations of arsenic, antimony, and barium, the area studied is also very similar in geology, host rocks, and rock alteration products to other areas in Nevada that host disseminated gold deposits.

Additional geologic mapping, bulk sampling, and drilling, especially in the area of Zone 1, would be needed to identify a deposit.

## REFERENCES

1. du Bray, E. A., Blank, H. R., Jr., Turner, R. L., Gese, D. D., and Harris, A. D. Mineral Resources of the Weepah Spring Wilderness Study Area, Lincoln and Nye Counties, Nevada. U.S. Geol. Surv. Bull. 1728-E, 1987, E1-E-11 pp.
2. Tschanz, C. M. and Pampeyan, E. H. Geology and Mineral Deposits of Lincoln County, Nevada. NV Bureau of Mines and Geol. Bull. 73, 1970, 187 pp.
3. Kleinhampl, F. J. and Ziony, J. I. Geology of Northern Nye County, Nevada. NV Bureau of Mines and Geol. Bull. 99A, 1985, 172 p. scale 1:250,000.
4. Wood, D. R., II. Geology at Timber Mountain Pass, Northern Seaman Range, Nye County, Nevada. Univ. M.S. Thesis, TX, El Paso, TX, 1986, 79 pp.
5. Gese, D. D. and Harris, A. D. Mineral Resources of the Weepah Spring Wilderness Study Area (NV-040-246), Nye and Lincoln Counties, Nevada. BuMines OFR MLA 40-85, 1985, 52 pp.
6. Klessig, P. J. History and Geology of the Alligator Ridge Gold Mine, White Pine County, Nevada, Field Trip 2: Paper in Exploration for ore deposits of the North American Cordillera. Assoc. of Expl. Geochemists 1984 Regional Symp., 1984, pp. 27-35.
7. Wilcox, R. E. Private communication. Expl. Mgr. Bear Creek Mining Co., Spokane, WN, 1984, 2 pp; available from D. D. Gese, BuMines, Denver, CO.
8. du Bray, E. A., Hurtubise, D. O., and Bannister, C. A. Geologic map of the Weepah Spring Wilderness Study Area, Lincoln and Nye Counties. U.S. Geol. Surv. Misc. Field Studies Map, MF-1922, 1987, scale 1:50,000.
9. Overstreet, W. C. and Marsh, S. P. Some concepts and techniques in geochemical exploration. Econ. Geol., 75th Anniv. V., 1981, 775-805 pp.
10. Bagby, W. C. and Berger, B. R. Geologic characteristics of sediment-hosted, disseminated precious-metal deposits in the western United States in Berger, B. R. and others (eds.) Geology and geochemistry of epithermal systems: Society of Economic Geologists, 1985, pp. 169-202.
11. Harris, Michael and Radtke, A. S. Statistical study of selected trace elements with reference to geology and genesis of the Carlin deposit, Nevada. U.S. Geol. Surv. Prof. Paper 960, 1976, 21 pp.

REFERENCES--Continued

12. Sinclair, A. J. Applications of probability graphs in mineral exploration. Assoc. of Expl. Geochemists, Special V. No. 4, 1976, 95 pp.
13. Tooker, E. W. Discussion of the Disseminated-Gold-Ore-Occurrence Model, Paper in Geologic Characteristics of Sediment-Volcanic-Hosted Disseminated Gold Deposits--Search for an occurrence model, ed. by E. W. Tooker: U.S. Geol. Surv. Bull. 1646, 1985, pp. 107-149.
14. Parker, R. L., Composition of the earth's crust, in Fleischer, Michael, ed., Chapter D., Date of geochemistry (6th ed.). U.S. Geological Survey Professional Paper 440-D, 1967, 19 p.

Table 1A.--Analyses of chip samples taken for local background.

[Parts per million, unless otherwise specified.]

Sample	As	Ba	Sb	Hg, ppb
78	ND	12	8.1	50
93	ND	21	ND	30
105	ND	25	ND	50
142	3	30	4	45

ND--Assayed for, but not detected.

NOTE.--Assayed for, but not detected in any of the samples: Au and Ag.

Table 1B.--Average crustal abundance of carbonate rocks (14).

[Parts per million, unless otherwise specified.]

Sample	As	Ba	Sb	Hg, ppb
13	1	10	0.2	40

ND--Assayed for, but not detected.

NOTE.--Assayed for, but not detected in any of the samples: Au and Ag.

Table 2.--Analytical results of chip samples from jasperoids.

[Parts per million, unless otherwise specified.]

Sample	Au	Ag	As	Ba	Sb	Hg, ppb
7	0.036	0.350	79	63	27.6	1,750
8	.042	1.214	100	30	27.6	>5,000
9	.035	.991	140	40	62	>5,000
10	ND	ND	17.3	67	13.4	1,450
11	ND	ND	19.1	58	27.6	2,050
24	.022	3.317	3	20	ND	70
47	.101	ND	34	680	ND	80
50	ND	ND	180	84	74	1,650
51	ND	ND	230	54	9	4,100
52	ND	ND	130	370	33	>5,000
53	ND	.380	170	190	15.1	1,850
54	ND	ND	45	200	13.4	395
55	ND	ND	160	36	72	2,700
56	ND	ND	250	97	9	1,550
57	ND	ND	240	130	12.5	1,750
58	ND	2.150	610	150	180	1,700
59	ND	ND	1,130	220	42	2,400
60	ND	ND	180	150	9	1,300
62	ND	ND	190	180	11.6	350
63	ND	ND	100	160	19.6	1,800
64	ND	ND	58	250	22.2	>5,000
65	ND	ND	320	170	20.5	2,050
66	ND	.480	200	230	29.3	>5,000
76	ND	1.786	4	22	5	30
83	ND	ND	79	430	15.1	3,550
84	.010	ND	200	520	36	1,550
86	ND	ND	310	58	37	1,650
96	ND	ND	20.9	62	ND	50
97	ND	ND	ND	35	ND	600
98	ND	ND	130	97	16	450

ND--Assayed for, but not detected.

Table 2.--Analytical results of chip samples from jasperoids--Continued

Sample	Au	Ag	As	Ba	Sb	Hg, ppb
99	0.014	ND	360	97	24	280
117	ND	ND	17.3	120	ND	70
119	ND	ND	180	180	5	100
120	.019	3.809	280	390	4	440
121	ND	.560	86	170	7.2	380
122	ND	ND	440	140	41	2,100
124	ND	ND	43	110	12.5	150
126	.024	3.822	160	80	40	1,100
127	.026	4.592	50	110	4	115
130	ND	ND	7	16	15.1	45
131	ND	4.132	220	760	81	130
132	ND	.440	22.7	350	ND	100
134	ND	ND	10.1	190	ND	35
135	ND	.790	25.4	93	ND	25
136	ND	1.005	1,380	180	8.1	220
138	ND	ND	29.9	140	ND	40
154	.018	.945	40	940	4	>5,000
155	ND	2.770	6	310	5	70
156	ND	3.397	26.3	280	3	110
157	ND	3.311	24.5	250	ND	100
159	ND	1.263	70	270	8.1	180
160	ND	.862	270	250	ND	80
161	ND	2.607	170	300	ND	50
162	ND	.470	53	270	5	70
163	ND	.430	36	230	ND	385
164	.023	.510	67	420	3	100
169	ND	ND	7	140	ND	40
170	ND	.923	260	480	20.5	125
179	ND	ND	5	73	ND	10
180	ND	ND	12.5	120	ND	30

ND--Assayed for, but not detected.

Table 3.--Analytical results of stream-sediment samples from a part of the Weepah Spring WSA.

[Parts per million, unless otherwise specified.]

Sample	Au, ppb	As	Ba	Sb	Sample	Au, ppb	As	Ba	Sb
1	ND	40	500	8.2	67	ND	158	180	7.3
2	ND	36	470	7.7	68	ND	173	160	8.3
3	8	32	490	5.4	69	ND	11	420	1.9
4	ND	33	450	8.1	70	ND	72	300	2.4
5	ND	28	480	6.0	71	ND	37	300	2.6
6	ND	33	580	9.0	72	ND	63	310	3.9
12	ND	40	460	13.0	73	ND	71	290	2.9
13	ND	33	420	7.5	74	ND	31	420	2.6
14	ND	36	480	7.9	75	ND	139	200	7.4
15	9	35	530	10.0	77	ND	140	200	7.2
16	ND	23	490	7.0	79	ND	133	140	7.1
17	ND	17	350	4.6	80	ND	140	160	6.4
18	ND	15	400	4.0	81	ND	110	260	6.1
19	ND	18	320	4.9	82	ND	33	470	8.5
20	ND	17	340	6.3	85	ND	43	490	13.0
21	5	24	360	6.5	87	ND	51	280	18.0
22	ND	22	330	8.4	88	ND	33	420	15.0
23	ND	15	160	4.2	89	ND	16	140	15.0
25	ND	11	120	3.2	90	ND	11	ND	7.4
26	ND	10	550	2.9	91	ND	12	120	7.8
27	ND	10	170	3.3	92	ND	18	130	11.0
28	ND	12	260	3.7	94	ND	20	210	10.0
29	ND	13	510	3.4	95	ND	20	270	9.1
30	ND	14	530	5.1	100	ND	28	530	7.2
31	ND	12	220	3.8	101	ND	18	270	6.6
32	ND	12	340	4.1	102	ND	16	500	3.2
33	ND	14	370	4.8	103	ND	23	270	2.0
34	ND	13	430	3.9	104	ND	23	340	1.7
35	ND	14	290	4.0	106	ND	23	150	2.4
36	ND	15	260	1.9	107	ND	16	260	2.0
37	ND	16	310	2.6	108	ND	16	150	3.9
38	ND	17	290	2.9	109	ND	26	150	2.2
39	ND	16	250	2.4	110	ND	10	120	1.2
40	ND	12	380	2.2	111	5	50	280	3.2
41	ND	18	250	3.9	112	ND	31	370	1.6
42	ND	15	350	2.8	113	ND	26	250	1.2
43	ND	20	190	4.3	114	ND	35	470	2.5
44	ND	23	230	4.0	115	ND	50	370	2.6
45	ND	22	210	4.1	116	ND	10	540	1.0
46	ND	97	200	4.8	118	ND	12	560	.8
48	ND	228	230	10.0	123	ND	21	570	1.6
49	ND	175	210	9.0	125	ND	34	530	2.2
61	ND	151	180	7.2	128	ND	20	550	2.2

ND--Assayed for, but not detected.

Table 3.--Analytical results of stream-sediment samples from a part of the Weepah Spring WSA--Continued

Sample	Au, ppb	As	Ba	Sb
129	ND	18	650	1.9
133	ND	20	690	1.8
137	ND	18	670	1.6
139	ND	16	750	1.3
140	ND	20	290	1.6
141	ND	37	560	2.8
143	ND	47	620	3.1
144	ND	19	380	1.5
145	ND	5	890	.8
146	ND	5	670	.9
147	ND	21	530	1.6
148	ND	18	540	1.4
149	ND	8	740	1.1
150	ND	18	500	1.4
151	ND	14	650	1.2
152	ND	15	660	1.4
153	ND	14	690	1.2
158	ND	12	780	1.1
165	ND	14	780	1.2
166	ND	13	690	1.2
167	ND	13	790	1.2
168	ND	41	560	3.0
171	ND	11	720	1.1
172	ND	17	570	1.4
173	ND	6	800	.8
174	ND	6	830	1.0
175	ND	6	690	1.2
176	ND	7	990	1.2
177	ND	6	770	.9
178	ND	7	750	.9
181	ND	5	830	.7

ND--Assayed for, but not detected.

Appendix A.--Analytical results of chip samples not listed in table 2.

[Parts per million, unless otherwise detected.]

Element	Sample Numbers									
	7	8	9	10	11	24	47	50	51	52
Al	1.3%	0.33%	0.31%	0.20%	0.24%	480	0.21%	0.22%	0.14%	2.0%
Be	ND	ND	ND	ND	ND	2.5	na	1.3	ND	ND
Bi	ND	ND	ND	ND	ND	93	na	ND	ND	ND
Ca	0.21%	840	0.21%	0.24%	0.16%	32.6	47.9	0.66%	0.48%	0.32%
Cd	ND	ND	0.65	0.40	ND	6.2	17	1.9	ND	1.1
Co	ND	ND	ND	ND	ND	12	32	ND	ND	ND
Cr	130	220	200	240	220	51	110	210	160	93
Cu	ND	8.9	7.3	18	11	12	40	ND	ND	ND
Fe	0.60%	0.47%	0.53%	0.37%	0.38%	410	0.17%	1.5%	0.34%	1.3%
K	0.48%	690	650	500	610	590	0.21%	420	210	0.55%
La	8.8	5.5	6.5	ND	ND	43	100	4.0	ND	11
Li	38	31	28	32	26	3.3	27	20	23	61
Mg	940	170	190	220	170	0.27%	0.18%	240	230	0.12%
Mn	72	70	98	160	110	310	810	130	99	50
Mo	ND	ND	ND	ND	ND	15	43	18	12	ND
Na	120	47	56	49	60	160	320	74	43	260
Nb	ND	ND	ND	ND	ND	28	84	ND	ND	ND
Ni	ND	12	11	7.0	4.6	24	62	21	5.0	8.3
P	120	ND	ND	110	ND	310	750	ND	260	400
Pb	ND	ND	11	46	21	75	200	ND	ND	ND
Sn	ND	ND	ND	ND	ND	40	78	ND	ND	ND
Sr	160	39	31	36	28	110	94	47	18	270
Te	ND	ND	ND	ND	ND	160	380	ND	ND	ND
Ti	580	82	78	65	91	38	160	110	76	790
V	32	8.3	10	5.6	6.1	27	71	12	ND	47
W	ND	ND	ND	ND	ND	56	180	40	ND	ND
Y	2.7	ND	ND	ND	ND	7.5	18	1.3	ND	3.5
Zn	ND	100	110	32	12	110	260	120	16	26
Zr	20	ND	ND	ND	ND	13	46	ND	ND	18

ND, not detected  
na, not analysed

Appendix A.--Analytical results of chip samples not listed in table 2--Continued

Element	Sample Numbers									
	53	54	55	56	57	58	59	60	62	63
Al	3.4%	1.3%	0.20%	3.7%	3.8%	2.5%	2.0%	1.3%	2.5%	1.6%
Be	ND	0.12	ND	0.18	0.11	ND	ND	ND	ND	ND
Bi	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ca	0.37%	0.73%	0.30%	22.0	234	0.53%	0.32%	0.28%	0.55%	0.35%
Cd	1.7	0.90	0.74	2.7	3.5	3.5	6.1	1.8	1.8	0.92%
Co	ND	ND	ND	9.5	11	ND	ND	ND	5.9	1.0
Cr	120	110	250	47	48	130	130	150	160	120
Cu	ND	ND	ND	8.7	11	9.6	0.9	7.0	22	13
Fe	1.4%	0.48%	1.2%	1.4%	1.8%	3.3%	5.8%	1.9%	1.1%	0.85%
K	0.56%	0.35%	230	0.75%	0.69%	0.50%	0.79%	0.37%	0.44%	0.31%
La	17	18	7.4	29	33	20	27	13	15	13
Li	40	49	38	13	13	40	20	39	24	28
Mg	980	0.11%	130	1.8%	0.82%	0.10%	0.14%	740	690	550
Mn	94	200	130	410	340	66	64	90	80	62
Mo	ND	ND	72	ND	14	17	6.4	ND	11	11
Na	430	440	42	230	250	210	710	660	280	140
Nb	ND	2.3	ND	ND	5.8	ND	3.2	ND	3.0	ND
Ni	17	7.6	15	38	69	36	11	6.3	56	15
P	240	350	150	380	430	0.14%	0.14%	310	0.15%	470
Pb	11	11	ND	19	29	ND	ND	ND	13	ND
Sn	ND	ND	ND	8.7	11	ND	ND	ND	ND	ND
Sr	270	230	150	170	180	490	600	110	480	260
Te	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ti	0.17%	550	85	0.15%	0.15%	640	0.11%	550	400	310
V	72	28	7.9	45	47	61	100	41	32	23
W	ND	ND	ND	31	36	ND	ND	ND	ND	ND
Y	5.1	2.9	ND	16	17	8.2	5.7	2.6	17	4.6
Zn	47	12	89	120	250	130	43	11	87	30
Zr	40	15	ND	73	74	28	46	17	18	ND

ND, not detected  
na, not analysed

Appendix A.--Analytical results of chip samples not listed in table 2--Continued

Element	Sample Numbers									
	64	65	66	76	83	84	86	96	97	98
Al	1.1%	1.4%	2.8%	1.2%	2.0%	1.8%	0.46%	0.30%	0.91%	0.49%
Be	ND	ND	ND	ND	0.24	ND	ND	ND	na	ND
Bi	ND	ND	ND	ND	ND	ND	ND	ND	na	ND
Ca	0.36%	0.31%	0.41%	0.50%	0.16%	0.56%	7.4%	0.59%	406	0.58%
Cd	1.5	2.4	1.2	2.2	ND	1.3	2.4	0.96	6.5	4.5
Co	ND	ND	1.7	6.6	ND	ND	3.0	ND	13	ND
Cr	140	160	180	140	160	180	130	230	65	510
Cu	38	15	12	6.8	8.2	14	6.2	ND	16	ND
Fe	2.3%	2.2%	0.98%	1.1%	0.47%	1.6%	1.6%	0.87%	0.25%	4.8%
K	0.21%	0.36%	0.19%	340	0.37%	0.23%	0.15%	590	0.35%	0.27%
La	9.6	17	18	12	14	25	14	14	42	36
Li	55	43	46	ND	42	38	25	23	11	29
Mg	600	0.11%	440	560	480	590	680	240	0.35%	400
Mn	120	100	89	200	20	130	57	87	120	120
Mo	ND	5.6	5.6	ND	8.4	5.3	11	ND	16	9.4
Na	100	230	170	81	900	170	150	280	270	0.22%
Nb	ND	2.0	3.1	4.9	ND	ND	ND	ND	25	ND
Ni	20	47	15	21	5.3	37	34	8.5	42	29
P	540	910	900	460	740	0.28%	700	510	310	0.24%
Pb	ND	ND	ND	17	ND	ND	ND	ND	71	ND
Sn	ND	ND	ND	4.1	ND	ND	ND	ND	28	ND
Sr	220	320	310	26	290	560	180	110	460	370
Te	ND	ND	ND	ND	ND	ND	ND	ND	140	ND
Ti	400	400	600	360	570	430	170	130	290	250
V	34	82	50	23	43	36	20	46	39	250
W	ND	ND	ND	ND	ND	ND	83	ND	73	ND
Y	2.7	4.9	10	8.6	3.1	17	8.8	1.9	7.2	4.3
Zn	92	90	28	41	12	170	150	10	170	75
Zr	15	20	27	25	25	20	ND	ND	16	12

ND, not detected  
na, not analysed

Appendix A.--Analytical results of chip samples not listed in table 2--Continued

Element	Sample Numbers									
	99	117	119	120	121	122	124	126	127	131
Al	0.46%	0.97%	2.4%	1.3%	0.92%	2.0%	1.6%	0.71%	1.0%	3.9%
Be	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.0
Bi	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ca	0.90%	0.11%	0.36%	0.75%	1.0%	0.92%	0.35%	0.51%	0.45%	1.3%
Cd	3.6	0.93	3.5	5.6	1.8	7.4	4.1	5.6	2.6	4.2
Co	ND	ND	ND	7.6	ND	ND	ND	ND	1.6	24
Cr	220	150	120	390	320	540	170	160	240	900
Cu	ND	8.2	30	64	14	30	19	11	14	94
Fe	4.2%	1.1%	3.6%	5.4%	1.7%	7.9%	4.6%	5.9%	1.8%	4.5%
K	0.16%	0.33%	0.56%	0.27%	0.16%	0.83%	540	950	740	0.26%
La	27	6.4	9.8	37	30	53	40	29	47	480
Li	19	14	9.9	7.8	12	29	22	25	29	ND
Mg	490	590	0.11%	0.10%	470	0.13%	460	350	300	680
Mn	45	41	70	160	53	46	160	100	120	170
Mo	8.8	6.0	11	27	6.2	15	9.6	9.8	6.7	7.0
Na	0.15%	140	230	160	130	910	70	100	150	230
Nb	ND	ND	ND	2.5	2.3	3.9	ND	ND	ND	ND
Ni	44	7.6	33	110	49	210	14	57	23	82
P	0.20%	120	0.12%	0.48%	0.38%	0.71%	0.14%	0.14%	0.20%	1.7%
Pb	ND	ND	ND	ND	ND	ND	ND	ND	17	ND
Sn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sr	290	32	140	360	280	750	380	610	0.26%	0.11%
Te	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ti	390	300	590	480	250	510	290	280	360	500
V	180	26	170	220	89	560	84	30	42	280
W	350	ND								
Y	3.0	1.7	3.5	58	9.1	27	4.9	6.9	9.6	780
Zn	380	24	120	540	130	650	40	290	100	220
Zr	15	ND	31	20	ND	26	13	12	15	29

ND, not detected  
na, not analysed

Appendix A.--Analytical results of chip samples not listed in table 2--Continued

Element	Sample Numbers									
	130	132	134	135	136	138	154	155	156	157
Al	800	0.15%	0.67%	0.57%	1.6%	1.1%	2.6%	0.85%	2.7%	2.0%
Be	2.2	0.29	ND	ND	ND	ND	0.45	0.20	0.43	0.36
Bi	260	ND								
Ca	476	0.46%	0.61%	0.85%	2.9%	0.48%	0.48%	1.00%	2.6%	1.4%
Cd	16	0.63	0.89	2.2	2.1	0.98	2.3	ND	1.6	2.5
Co	30	ND	ND	1.1	ND	ND	ND	ND	ND	1.3
Cr	120	240	160	180	280	120	800	350	690	730
Cu	87	ND	21	16	25	6.7	48	49	89	86
Fe	0.31%	0.47%	0.80%	1.7%	2.9%	1.1%	2.5%	0.48%	1.9%	2.1%
K	0.14%	490	0.19%	0.15%	0.40%	0.42%	0.65%	0.18%	0.70%	0.54%
La	99	4.7	15	13	66	31	40	42	180	100
Li	24	ND	ND	ND	13	30	ND	ND	ND	ND
Mg	0.31%	200	500	400	0.12%	650	0.17%	610	0.22%	0.20%
Mn	51	0.13%	38	44	77	29	33	38	31	41
Mo	38	6.5	ND	ND	41	ND	ND	ND	ND	ND
Na	360	41	160	110	260	150	180	130	310	240
Nb	79	ND	3.7							
Ni	54	18	23	33	5.7	3.7	19	9	34	34
P	690	0.14%	0.20%	0.26%	1.1%	0.20%	0.44%	0.39%	1.1%	0.58%
Pb	310	ND	15							
Sn	82	ND	2.8							
Sr	520	27	70	46	0.12%	330	0.13%	400	630	430
Te	340	ND								
Ti	70	51	240	210	370	230	680	260	0.10%	640
V	66	26	44	79	130	28	320	61	170	190
W	160	ND								
Y	17	13	26	18	48	28	76	67	340	130
Zn	340	50	110	100	ND	21	94	28	73	91
Zr	43	ND	ND	ND	16	ND	19	ND	31	19

ND, not detected  
na, not analysed

Appendix A.--Analytical results of chip samples not listed in table 2--Continued

Element	Sample Numbers									
	159	160	161	162	163	164	169	170	179	180
Al	2.2%	2.2%	0.75%	3.2%	3.0%	3.0%	1.3%	1.3%	8.9%	9.4%
Be	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bi	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ca	1.6%	1.6%	0.72%	0.19%	0.19%	0.29%	0.16%	0.25%	0.28%	0.25%
Cd	3.8	10	12	0.89	2.0	10	ND	5.0	3.6	4.5
Co	3.9	ND	4.2	7.5						
Cr	490	930	990	130	180	440	170	430	41	44
Cu	52	39	51	25	18	40	7.8	11	56	65
Fe	2.8%	10.4%	12.6%	1.6%	3.4%	9.7%	0.40%	5.0%	3.6%	4.2%
K	0.60%	0.64%	0.60%	0.95%	0.99%	0.94%	0.46%	0.58%	770	660
La	45	71	110	21	13	14	13	36	13	12
Li	4.2	6.8	ND	6.6	ND	11	19	ND	ND	ND
Mg	0.15%	0.14%	370	0.20%	0.27%	0.25%	920	950	0.16%	0.11%
Mn	170	53	30	170	39	720	34	250	30	18
Mo	5.6	23	27	ND	ND	15	ND	9.5	ND	ND
Na	240	290	630	320	370	310	140	200	490	490
Nb	4.4	5.9	6.2	ND	ND	2.1	ND	5.9	11	12
Ni	63	50	15	4.4	5.1	34	ND	12	8.9	14
P	0.62%	0.80%	0.60%	330	270	680	200	0.14%	180	210
Pb	12	ND	ND	ND	ND	12	ND	10	30	26
Sn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sr	460	740	730	170	150	83	150	320	66	72
Te	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ti	600	780	820	0.16%	0.12%	0.15%	380	0.18%	0.40%	0.38%
V	200	360	330	120	270	610	38	270	130	120
W	ND	ND	ND	ND	ND	ND	ND	ND	49	61
Y	64	45	110	9	7.2	20	6.1	9.7	2.8	3.1
Zn	230	160	31	9.3	9.4	84	12	38	20	20
Zr	25	39	38	62	51	53	11	67	59	62

ND, not detected  
na, not analysed

Appendix B.--Analytical results not listed in table 3 for stream-sediment samples.

[Parts per million.]

Element	Sample Numbers													
	1	2	3	4	5	6	12	13	14	15	16	17	18	
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cr	53	56	ND	ND	72	ND	58	87	70	77	ND	ND	ND	ND
Cs	4	5	4	6	5	5	6	7	6	8	6	4	4	4
Eu	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fe	1.9	2.1	2.5	2.0	2.3	2.7	2.1	2.1	2.2	2.3	1.8	1.4	1.9	1.9
Hf	7	6	8	6	7	9	6	5	5	5	5	4	4	4
In	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
La	42	41	43	37	38	47	40	37	37	40	29	27	28	28
Mo	ND	3	ND	2	ND	ND	3	4	3	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Rb	66	75	ND	81	82	92	81	89	78	78	99	68	76	76
Sc	4.9	5.6	6.4	4.6	6.4	6.7	5.9	5.5	5.7	5.8	4.8	4.2	5.0	5.0
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ta	ND	ND	1	ND	ND	1	ND	ND	ND	1	ND	ND	ND	ND
Tb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Th	9.2	11.0	12.0	9.3	11.0	13.0	10.0	10.0	10.0	11.0	10.0	7.9	9.0	9.0
U	2.9	2.3	2.8	2.9	2.6	3.0	3.3	3.0	2.9	3.1	2.6	1.7	2.1	2.1
W	2	3	ND	ND	3	3	3	3	3	3	2	ND	3	3
Yb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND, not detected

Appendix B.--Analytical results not listed in table 3 for stream-sediment samples--Continued

Element	Sample Numbers												
	19	20	21	22	23	25	26	27	28	29	30	31	32
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cr	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cs	5	4	5	4	2	1	6	2	3	6	6	3	4
Eu	ND	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	ND	ND
Fe	1.6	1.3	1.7	0.6	0.7	ND	2.0	0.7	1.1	2.1	2.2	0.5	1.3
Hf	4	3	4	4	ND	ND	5	ND	3	5	5	2	3
In	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
La	27	20	25	19	10	9	35	12	16	35	36	18	21
Mo	2	ND	ND	3	3	2	ND	ND	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Rb	62	59	65	59	30	17	86	28	36	88	97	32	50
Sc	4.2	3.8	4.4	3.3	2.1	1.4	5.8	1.9	2.8	6.2	6.2	2.6	3.8
Se	ND	ND	24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ta	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	ND	ND	ND
Tb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Th	8.1	7.0	7.8	6.7	3.5	2.4	11.0	3.5	4.9	11.0	11.0	5.1	6.8
U	2.0	1.8	1.9	1.9	1.5	1.0	2.4	1.3	1.5	2.3	2.5	1.4	1.8
W	3	2	2	4	ND	ND	3	ND	ND	ND	3	ND	ND
Yb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND, not detected

Appendix B.--Analytical results not listed in table 3 for stream-sediment samples--Continued

Element	Sample Numbers												
	33	34	35	36	37	38	39	40	41	42	43	44	45
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	11	ND	11	ND						
Cr	ND	ND	ND	63	57	ND	58	ND	ND	ND	ND	ND	ND
Cs	4	4	3	3	4	4	4	5	3	4	2	2	2
Eu	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fe	1.6	1.8	1.2	2.8	2.3	2.4	2.1	1.6	1.1	1.6	0.7	0.9	1.0
Hf	3	5	3	5	5	5	5	5	4	4	2	3	3
In	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
La	26	27	21	38	33	31	32	25	16	23	13	15	16
Mo	ND	ND	3	4	7	3	ND	ND	ND	ND	2	ND	2
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Rb	62	70	55	58	39	50	55	66	37	74	36	37	35
Sc	4.2	4.5	3.2	7.2	6.5	6.7	6.5	4.4	2.7	4.3	2.2	2.6	2.6
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ta	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Th	7.7	7.9	6.8	9.4	9.2	8.8	9.0	8.0	5.2	7.9	4.1	4.7	5.0
U	1.8	2.0	2.0	3.7	4.1	2.9	2.4	1.8	1.7	1.8	1.5	1.5	1.6
W	ND	ND	ND	ND	ND	ND	ND	ND	ND	2	ND	ND	ND
Yb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND, not detected

Appendix B.--Analytical results not listed in table 3 for stream-sediment samples--Continued

Element	Sample Numbers												
	46	48	49	61	67	68	69	70	71	72	73	74	75
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cr	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	59	ND
Cs	7	4	9	3	4	4	3	4	3	5	5	4	5
Eu	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fe	1.4	1.4	1.6	1.2	1.4	1.5	1.6	1.6	1.7	1.9	1.8	2.3	1.5
Hf	8	2	3	3	3	3	4	4	5	4	3	7	3
In	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
La	19	18	22	15	17	18	29	25	25	27	27	35	23
Mo	2	ND	3	ND	ND	3	ND	3	ND	ND	ND	ND	3
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Rb	60	48	70	30	36	34	69	54	51	49	57	59	51
Sc	4.4	4.0	5.0	3.3	3.7	3.4	4.3	4.4	3.3	5.1	4.5	6.0	4.1
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ta	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Th	5.9	4.9	6.3	4.3	5.0	4.9	8.7	6.8	7.1	7.9	7.7	9.3	6.4
U	2.4	2.2	2.5	2.0	2.1	2.2	1.9	2.1	1.8	2.2	2.1	2.1	2.6
W	2	3	4	3	3	3	ND	3	ND	ND	3	ND	2
Yb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND, not detected

Appendix B.--Analytical results not listed in table 3 for stream-sediment samples--Continued

Element	Sample Numbers												
	77	79	80	81	82	85	87	88	89	90	91	92	94
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cr	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cs	4	4	4	5	7	7	5	7	2	1	2	2	3
Eu	2	ND	ND	ND	3	ND	ND	3	ND	ND	ND	ND	ND
Fe	1.4	1.5	1.2	1.8	2.0	2.3	1.5	1.9	0.6	ND	0.5	0.7	0.4
Hf	3	3	3	5	6	5	3	4	ND	ND	ND	ND	2
In	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
La	22	21	16	27	31	32	23	29	10	8	8	11	15
Mo	2	3	2	2	ND	3	3	4	3	ND	ND	3	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Rb	53	48	47	53	93	87	51	83	20	17	18	24	41
Sc	4.0	3.9	3.3	5.6	6.2	5.6	3.8	5.8	1.8	1.1	1.3	2.2	2.5
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ta	ND	ND	ND	ND	ND	ND	ND	1	ND	ND	ND	ND	ND
Tb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Th	6.0	6.3	4.9	7.3	10.0	10.0	6.4	8.9	3.0	2.2	2.4	3.9	5.0
U	2.4	2.3	2.4	2.4	2.4	2.5	2.2	2.2	1.3	.9	.9	1.8	1.6
W	3	3	ND	3	ND	ND	ND	2	ND	ND	ND	ND	ND
Yb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND, not detected

Appendix B.--Analytical results not listed in table 3 for stream-sediment samples--Continued

Element	Sample Numbers												
	95	100	101	102	103	104	106	107	108	109	110	111	112
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cr	ND	72	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cs	4	5	3	6	4	4	3	3	2	3	2	3	5
Eu	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2
Fe	0.6	1.6	1.1	2.4	2.0	2.1	ND	1.2	0.7	0.7	0.6	1.4	2.3
Hf	3	6	4	5	4	6	ND	4	2	ND	2	3	ND
In	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
La	18	31	20	35	22	30	11	21	11	12	10	19	32
Mo	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Rb	52	73	52	91	52	53	27	49	23	30	20	41	60
Sc	3.1	4.3	3.2	6.3	4.4	6.4	2.3	3.6	2.0	2.3	1.4	3.1	5.3
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ta	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Th	6.6	9.3	6.1	11.0	6.2	8.1	8.3	6.2	3.3	3.3	3.0	4.9	8.3
U	1.8	2.4	1.6	2.6	1.8	2.3	1.3	1.7	1.8	1.8	1.1	1.7	2.1
W	ND	ND	ND	ND	3	3	ND	ND	ND	ND	ND	ND	4
Yb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND, not detected

Appendix B.--Analytical results not listed in table 3 for stream-sediment samples--Continued

Element	Sample Numbers												
	113	114	115	116	118	123	125	128	129	133	137	139	140
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	10	ND	22	17	11	13	12	13	12	13	ND	ND
Cr	ND	65	ND	110	78	ND	ND	56	ND	ND	57	ND	ND
Cs	5	6	8	4	4	5	5	6	7	6	4	7	5
Eu	ND	ND	ND	ND	2	ND	ND	3	2	ND	3	ND	ND
Fe	2.1	4.3	1.7	8.7	6.0	3.5	5.1	4.8	3.7	5.1	4.3	3.2	1.5
Hf	4	11	5	19	16	10	12	14	8	12	11	8	3
In	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
La	30	44	30	53	52	42	46	55	51	64	69	48	24
Mo	ND	ND	ND	ND	ND	ND	ND	ND	ND	2	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Rb	57	71	68	94	95	97	88	100	120	120	99	150	62
Sc	5.5	11.0	4.8	17.0	12.0	8.7	11.0	8.7	10.0	12.0	12.0	7.2	3.9
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ta	ND	ND	ND	2	ND	ND	ND	1	2	1	ND	1	ND
Tb	ND	ND	ND	ND	ND	ND	1	1	ND	ND	1	ND	ND
Th	7.2	12.0	7.4	17.0	20.0	16.0	15.0	17.0	17.0	18.0	19.0	19.0	7.5
U	2.2	2.7	1.9	3.4	4.7	3.7	4.0	4.6	4.5	4.7	4.5	3.9	1.7
W	3	7	10	ND	ND	ND	ND	3	2	3	ND	ND	4
Yb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND, not detected

Appendix B.--Analytical results not listed in table 3 for stream-sediment samples--Continued

Element	Sample Numbers													
	141	143	144	145	146	147	148	149	150	151	152	153	158	
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Co	ND	ND	ND	ND	24	ND	12	ND	ND	12	ND	ND	ND	
Cr	ND	ND	ND	ND	ND	ND	56	ND	ND	ND	ND	ND	ND	
Cs	7	10	9	4	4	6	5	6	5	4	5	5	5	
Eu	ND	ND	ND	3	5	ND	4	ND	ND	3	ND	ND	4	
Fe	2.0	2.4	1.8	6.1	16.0	2.8	5.4	3.8	3.0	3.9	4.7	2.8	3.8	
Hf	6	6	4	16	27	7	12	10	8	11	10	7	11	
In	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
La	39	52	30	100	180	42	62	63	48	60	67	50	80	
Mo	2	ND												
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Rb	99	120	98	120	110	79	64	140	87	100	96	95	110	
Sc	4.8	5.9	5.4	7.2	11.0	9.3	9.2	8.6	8.0	8.3	7.9	6.9	7.3	
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Ta	ND	1	ND	2	3	ND	ND	2	1	ND	1	ND	2	
Tb	ND	ND	ND	1	2	ND	1	ND	ND	ND	ND	ND	ND	
Th	14.0	16.0	10.0	28.0	37.0	12.0	15.0	19.0	13.0	17.0	18.1	14.0	20.0	
U	2.9	2.7	2.6	4.2	5.1	2.7	3.0	3.9	2.7	3.1	3.3	2.8	2.7	
W	6	6	3	3	3	4	4	3	5	2	4	3	4	
Yb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Zn	ND	ND	ND	ND	230	ND								

ND, not detected

Appendix B.--Analytical results not listed in table 3 for stream-sediment samples--Continued

Element	Sample Numbers												
	165	166	167	168	171	172	173	174	175	176	177	178	181
Ag	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Co	ND	12	12	14	ND	12	ND	18	16	13	ND	ND	16
Cr	ND	ND	ND	120	ND	ND	ND	ND	52	67	ND	ND	ND
Cs	4	5	5	6	5	7	9	5	5	6	7	8	3
Eu	3	ND	ND	2	ND	ND	ND	4	8	ND	ND	ND	4
Fe	3.0	5.6	6.1	4.7	3.5	3.5	4.7	8.6	10.0	6.8	3.1	4.3	11.0
Hf	11	15	14	16	10	7	13	20	26	20	9	14	22
In	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
La	75	91	96	61	66	55	71	110	170	110	60	80	210
Mo	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Rb	94	100	98	70	110	110	150	130	110	120	170	170	67
Sc	7.5	7.9	9.0	8.4	7.4	8.3	8.6	10.0	11.0	11.0	7.8	7.4	7.5
Se	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ta	2	2	2	1	1	2	2	2	3	2	2	2	3
Tb	ND	ND	ND	1	ND	ND	ND	1	1	1	ND	ND	2
Th	19.0	21.0	23.0	15.0	19.0	16.0	23.0	29.0	39.0	29.0	21.0	25.0	40.0
U	3.3	3.5	3.9	4.8	3.8	3.2	6.1	5.7	6.5	4.8	5.2	6.8	4.9
W	3	3	3	4	2	5	3	4	3	3	2	ND	ND
Yb	ND	ND	ND	ND	ND	ND	ND	ND	5	ND	ND	ND	ND
Zn	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	320

ND, not detected

Appendix C.--Direct irradiation/instrumental neutron activation analysis and cold vapor atomic absorption detection limits.

Element	Detection limit, ppm	Element	Detection limit, ppm
Ag	5	Mo	2
Au	<sup>1</sup> 5	Ni	50
As	1	Rb	10
Ba	100	Sb	0.2
Cd	10	Sc	.5
Co	10	Se	10
Cr	50	Ta	1
Cs	1	Tb	1
Eu	2	Th	.5
Fe	<sup>2</sup> 0.5	U	.5
Hf	2	W	2
Hg	<sup>1</sup> 5	Yb	5
In	<sup>1</sup> 100	Zn	200
La	5		

<sup>1</sup>Parts per billion.

<sup>2</sup>Percent.

Source: Bondar-Clegg, Inc.

Appendix D.--Fire assay, inductively coupled plasma atomic-emission spectrometry and atomic absorption spectrophotometry detection limits.

Element	Detection limit, ppm	Element	Detection limit, ppm
Ag	0.3	Mn	0.5
Al	10	Mo	5
As	2	Na	300
Au	.007	Nb	2
Ba	5	Ni	3
Be	.1	P	100
Bi	30	Pb	10
Ca	200	Sb	2
Cd	.4	Sn	2
Co	1	Sr	.5
Cr	4	Te	20
Cu	6	Ti	5
Fe	5	V	.005
K	200	W	30
La	4	Y	1
Li	3	Zn	3
Mg	100	Zr	10

NOTE.--These detection limits represent an ideal situation. In actual analyses, the detection limits vary with the composition of the material analyzed. These numbers are to be used only as a guide.

SOURCE: Bureau of Mines