UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Analytical results and sample locality map of heavy-mineral-concentrate and rock samples from the Mount Grafton Wilderness Study Area (NV-040-169), White Pine and Lincoln Counties, Nevada

By

Gordon W. Day and Harlan N. Barton

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STUDIES RELATED TO WILDERNESS

Bureau of Land Management Wilderness Study Areas

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976) requires the U.S. Geological Survey and the U.S. Bureau of Mines to conduct mineral surveys on certain areas to determine their mineral values, if any. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a geochemical survey of the Mount Grafton Wilderness Study Area, White Pine and Lincoln Counties, Nevada.

INTRODUCTION

In May 1984, the U.S. Geological Survey conducted a reconnaissance geochemical survey of the Mount Grafton Wilderness Study Area (NV-040-169), White Pine and Lincoln Counties, Nevada.

The U.S. Geological Survey studied 30,115 acres (47 mi^2) (122 km^2) of the 73,216-acre (114-mi^2) (295-km^2) Mount Grafton Wilderness Study Area in southeastern White Pine County, Nevada, and in northeastern Lincoln County, Nevada. Throughout this report, "Wilderness Study Area" and "study area" refer only to the area studied by the U.S. Geological Survey. The study area lies about 50 mi (80 km) south of Ely, Nevada (see fig. 1). Access to the study area is provided by roads and jeep trails branching from U.S. Highway 93. The study area consists principally of a high, structurally simple block of lower Paleozoic sedimentary rocks, composed largely of Prospect Mountain Quartzite, Piocha Shale, and Pole Canyon Limestone striking generally north and dipping moderately east.

The topographic relief in the study area is about 4,300 ft (1,310 m). The southern half of the study area consists of mountains forming a single north-south ridge; the northern half consists of scattered mountain peaks. The ground surface rises from about 6,700 ft (2,042 m) near the southeastern corner of the study area to the 10,990 ft (3,350 m) summit elevation of Mount Grafton near the center of the study area. There are conifers and aspen trees at the higher elevations and sagebrush at the lower flanks of the mountains. The climate is arid to semiarid.

METHODS OF STUDY

Sample Medium

Heavy-mineral-concentrate samples provide information about the chemistry of certain minerals in rock material eroded from the drainage basin upstream from each sample site. The selective concentration of minerals, many of which may be ore related, permits determination of some elements that are not easily detected in stream-sediment samples.

Analyses of unaltered or unmineralized rock samples provide background geochemical data for individual rock units. On the other hand, analyses of altered or mineralized rocks, where present, may provide useful geochemical information about the major- and trace-element assemblages associated with a mineralizing system.

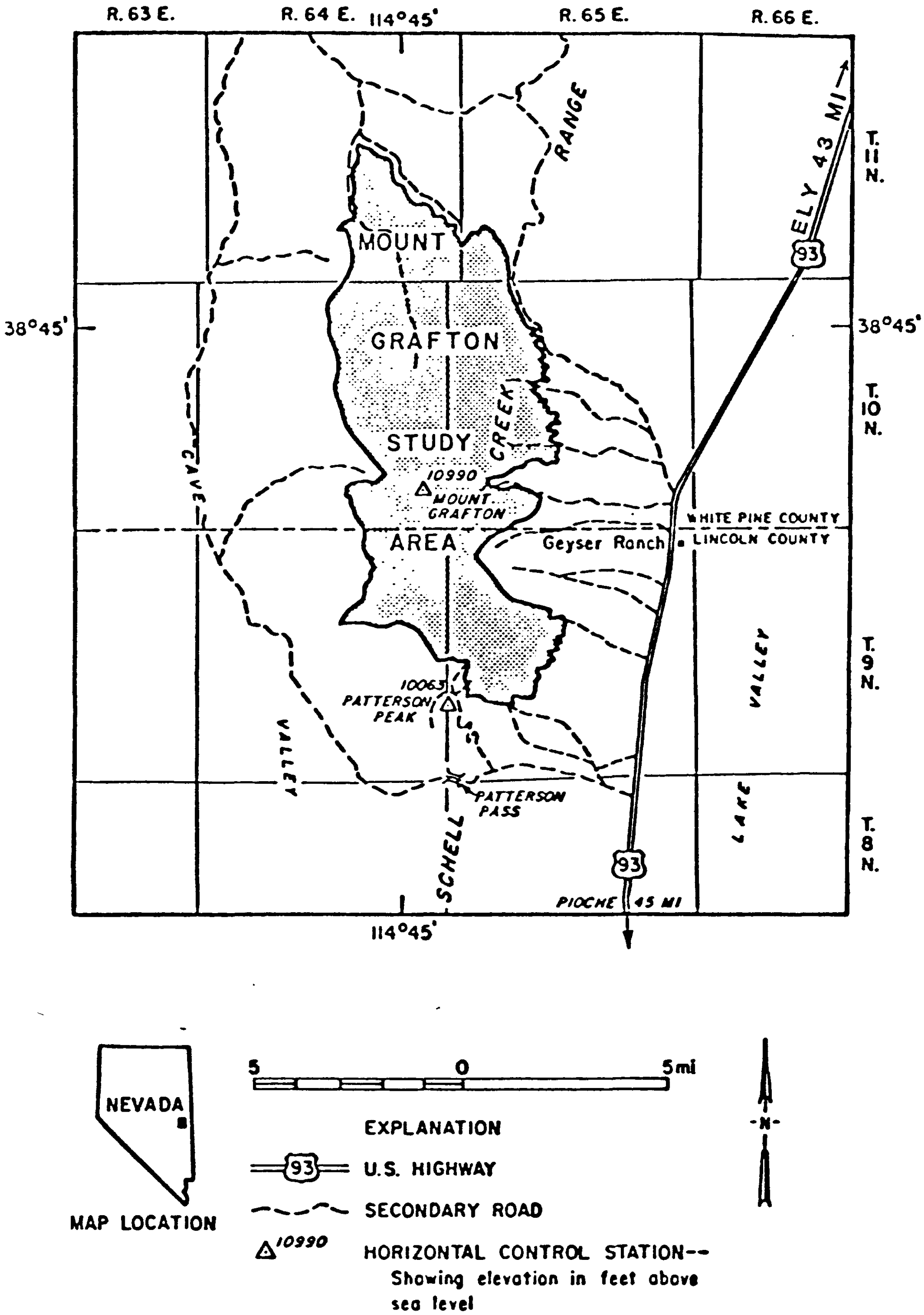

Figure 1. Location of the Mount Grafton Wilderness Study Area (NV-040-169), White Pine and Lincoln Counties, Nevada.

Sample Collection

Heavy-mineral-concentrate samples were collected at 69 sites (plate 1). At 7 of these sites, a duplicate sample was also collected as part of a general study to determine analytical and sampling variation. The duplicate samples are shown by a slashed line (/) between the sample numbers on plate. The average density was about one sample site per 1.5 mi^2. The area of the drainage basins sampled ranged from 0.3 mi^2 to 1.5 mi^2.

Heavy-mineral-concentrate samples

Heavy-mineral-concentrate samples were collected from active alluvium primarily from first-order (unbranched) and second-order (below the junction of two first-order) streams as shown on USGS topographic maps (scale = 1:24,000). Each sample was composited from several localities within an area that may extend as much as 100 ft from the site plotted on the map. Each bulk sample was screened with a 2.0-mm (10-mesh) screen to remove the coarse material. The less than 2.0-mm fraction was panned until most of the quartz, feldspar, organic material, and clay-sized material were removed.

Sample Preparation

After air drying, bromoform (specific gravity 2.8) was used to remove the remaining quartz and feldspar from the heavy-mineral-concentrate samples that had been panned in the field. The resultant heavy-mineral sample was separated into three fractions using a large electromagnet (in this case a modified Frantz Isodynamic Separator). The most magnetic material, primarily magnetite, was not analyzed. The second fraction, largely ferromagnesian silicates and iron oxides, was saved for archival storage. The third fraction (the least magnetic material which may include the nonmagnetic ore minerals, zircon, sphene, etc.) was split using a Jones splitter. One split was hand ground for spectrographic analysis; the other split was saved for mineralogical analysis. These magnetic separates are the same separates that would be produced by using a Frantz Isodynamic Separator set at a slope of 15° and a tilt of 10° with a current of 0.1 ampere to remove the magnetite and ilmenite, and a current of 1.0 ampere to split the remainder of the sample into paramagnetic and nonmagnetic fractions.

Sample Analysis

Spectrographic method

The heavy-mineral-concentrate and rock samples were both analyzed for 31 elements using a semiquantitative, direct-current arc emission spectrographic method (Grimes and Marranzino, 1968). The elements analyzed and their lower limits of determination for heavy-mineral-concentrate samples are listed in table 1. The lower limits of detection for rock samples are one-half the values listed in table 1. Spectrographic results were obtained by visual comparison of spectra derived from the sample against spectra obtained from standards made from pure oxides and carbonates. Standard concentrations are geometrically spaced over any given order of magnitude of concentration as follows: 100, 50, 20, 10, and so forth. Samples whose concentrations are estimated to fall between those values are assigned values of 70, 30, 15, and so forth. Values determined for the major elements (iron, magnesium, calcium, and titanium) are given in weight percent; all others are given in parts per million (micrograms/gram). Analytical data for heavy-mineral-concentrate samples from the Mount Grafton Wilderness Study Area are listed in table 2. Analytical data for rock samples are listed in table 3.

ROCK ANALYSIS STORAGE SYSTEM

Upon completion of all analytical work, the analytical results were entered into a computer-based file called Rock Analysis Storage System (RASS). This data base contains both descriptive geological information and analytical data. Any or all of this information may be retrieved and converted to a binary form (STATPAC) for computerized statistical analysis or publication (VanTrump and Miesch, 1977).

DESCRIPTION OF DATA TABLES

Table 2 lists the results of analyses for the samples of heavy-mineral concentrate. The data are arranged so that column 1 contains the USGS-assigned sample numbers. These numbers correspond to the numbers shown on the site location map (plate 1). Columns in which the element headings show the letter "s" below the element symbol are emission spectrographic analyses. A letter "N" in the tables indicates that a given element was looked for but not detected at the lower limit of determination shown for that element in table 1. If an element was observed but was below the lowest reporting value, a "less than" symbol (<) was entered in the tables in front of the lower limit of determination. If an element was observed but was above the highest reporting value, a "greater than" symbol (>) was entered in the tables in front of the upper limit of determination. Because of the formatting used in the computer program that produced the table, some of the elements listed in the table (Fe, Mg, Ca, Ti, Ag, and Be) carry one or more nonsignificant digits to the right of the significant digits. The analysts did not determine these elements to the accuracy suggested by the extra zeros.

REFERENCE TO MINERAL RESOURCES BULLETIN

An interpretative report on the mineral resource potential of the Mt. Grafton Wilderness Study Area (Van Loenen and others, 1987) uses a different sample identification system for the same heavy-mineral-concentrate samples than are identified by field numbers in this report. The correspondence between the two identification systems are presented in table 4.

REFERENCES CITED

Grimes, D. J., and Marranzino, A. P., 1968, Direct-current arc and alternating-current spark emission spectrographic field methods for the semiquantitative analysis of geologic materials: U.S. Geological Survey Circular 591, 6 p.

Van Loenen, R. E., Blank, H. R., Barton, Harlan N. (U.S. Geological Survey), and Chatman, Mark L. (U.S. Bureau of Mines), 1987, Mineral resources of the Mount Grafton Wilderness Study Area, Lincoln and White Pine Counties, Nevada: U.S. Geological Survey Bulletin 1728-F.

VanTrump, George, Jr., and Miesch, A. T., 1977, The U.S. Geological Survey RASS-STATPAC system for management and statistical reduction of geochemical data: Computers and Geosciences, v. 3, p. 475-488.

TABLE 1.--Limits of determination for the spectrographic analysis of heavy-mineral concentrates based on a 5-mg sample

Elements	Lower determination limit	Upper determination limit
	Percent	
Iron (Fe)	.1	50
Magnesium (Mg)	.05	20
Calcium (Ca)	.1	50
Titanium (Ti)	.005	2
	Parts per million	
Manganese (Mn)	20	10,000
Silver (Ag)	1	10,000
Arsenic (As)	500	20,000
Gold (Au)	20	1,000
Boron (B)	20	5,000
Barium (Ba)	50	10,000
Beryllium (Be)	2	2,000
Bismuth (Bi)	20	2,000
Cadmium (Cd)	50	1,000
Cobalt (Co)	10	5,000
Chromium (Cr)	20	10,000
Copper (Cu)	10	50,000
Lanthanum (La)	50	2,000
Molybdenum (Mo)	10	5,000
Niobium (Nb)	50	5,000
Nickel (Ni)	10	10,000
Lead (Pb)	20	50,000
Antimony (Sb)	200	20,000
Tin (Sn)	20	2,000
Strontium (Sr)	200	10,000
Vanadium (V)	20	20,000
Tungsten (W)	100	20,000
Yttrium (Y)	20	5,000
Zinc (Zn)	500	20,000
Zirconium (Zr)	20	2,000
Thorium (Th)	200	5,000

TABLE 2.--Results of spectrographic analyses of heavy-mineral-concentrate samples from the Mount Grafton Wilderness Study Area, White and Lincoln Counties, Nevada

[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown.]

Sample	Latitude	Longitude	Fe-pct. s	Mg-pct. s	Ca-pct. s	Ti-pct. s	Mn-ppm s	Ag-ppm s	As-ppm s	Au-ppm s	B-ppm s	Ba-ppm s	Be-ppm s
MA001H	38 40 31	114 46 53	.20	.20	.1	2.00	20	N	N	N	20	300	5
MA002H	38 38 50	114 48 22	1.00	1.00	5.0	1.00	150	N	N	N	30	700	N
MA003H	38 45 39	114 46 41	.50	1.00	10.0	1.00	150	N	N	N	20	500	N
MA004H	38 45 42	114 46 38	.20	.20	.5	1.50	20	N	N	N	20	200	2
MA006H	38 46 26	114 46 52	.50	5.00	20.0	.20	200	N	N	N	20	5,000	N
MA008H	38 38 16	114 45 2	.20	.05	.2	2.00	20	N	N	N	20	N	30
MA009H	38 38 16	114 45 2	.15	.05	.1	.70	20	N	N	N	20	N	2
MA010H	38 37 43	114 44 52	.20	.10	.5	.70	20	N	N	N	20	200	30
MA011H	38 37 38	114 44 50	.20	.05	20.0	.50	70	N	N	N	<20	N	50
MA012H	38 37 5	114 45 13	.30	.05	.7	1.00	20	N	N	N	<20	2,000	5
MA013H	38 36 49	114 45 1	.30	2.00	5.0	1.00	100	N	N	N	20	N	50
MA014H	38 42 43	114 47 4	.20	.20	.5	2.00	20	N	N	N	<20	N	N
MA015H	38 43 36	114 48 35	.20	<.05	.1	1.50	50	N	N	N	20	N	2
MA016H	38 47 3	114 45 42	.50	.20	5.0	.50	150	N	N	N	50	N	2
MA017H	38 47 3	114 45 42	1.00	.10	2.0	.50	150	N	N	N	20	700	2
MA018H	38 47 20	114 46 10	.50	5.00	20.0	.20	100	N	N	N	20	N	15
MA019H	38 47 48	114 44 30	.50	10.00	10.0	.20	70	N	N	N	20	N	N
MA020H	38 47 43	114 44 37	.30	10.00	20.0	.20	50	N	N	N	20	N	N
MA021H	38 35 43	114 43 49	1.00	5.00	5.0	.70	200	N	N	N	<20	5,000	2
MA022H	38 36 8	114 43 33	.50	1.00	10.0	.70	150	N	N	N	20	1,500	2
MA023H	38 36 6	114 42 46	1.00	.20	1.0	1.50	150	N	N	N	20	200	7
MH001H	38 41 18	114 48 52	.30	1.00	1.0	1.50	50	N	N	N	20	N	N
MH002H	38 42 8	114 47 8	.15	.05	.1	2.00	20	N	N	N	20	N	2
MH003H	38 41 17	114 47 8	.30	.05	.1	1.00	20	N	N	N	<20	N	N
MH005H	38 44 23	114 47 6	.20	.10	.5	1.50	20	N	N	N	20	2,000	N
MH006H	38 44 28	114 47 4	.50	.20	1.0	1.00	50	3	N	100	20	N	2
MH007H	38 45 1	114 48 38	.20	2.00	5.0	.70	100	N	N	N	20	700	N
MH008H	38 45 7	114 48 36	.70	5.00	5.0	1.50	100	N	N	N	20	500	N
MH009H	38 45 7	114 48 36	.30	5.00	10.0	.50	100	N	N	N	<20	N	N
MH010H	38 45 12	114 49 17	.50	5.00	15.0	1.50	100	N	N	N	20	N	N
MH011H	38 38 43	114 45 31	.20	.05	.1	1.50	50	N	N	N	20	N	2
MH012H	38 38 37	114 45 28	.20	.05	.2	.70	20	N	N	N	20	700	15
MH013H	38 39 37	114 45 48	.30	.05	.1	1.00	20	N	N	N	20	500	2
MH014H	38 39 35	114 45 43	.20	.05	.1	.50	20	N	N	N	20	N	15
MJ001H	38 47 14	114 41 45	1.00	7.00	10.0	.20	200	N	N	N	20	N	N
MJ002H	38 46 18	114 42 7	.50	7.00	30.0	.20	100	N	N	N	20	700	N
MJ003H	38 45 13	114 43 27	.30	10.00	20.0	.10	50	N	N	N	20	N	N
MJ004H	38 45 34	114 42 22	.50	10.00	20.0	.05	100	N	N	N	20	N	N
MJ005H	38 44 36	114 42 11	.20	5.00	10.0	.50	100	N	N	N	20	N	N
MJ006H	38 44 4	114 43 43	1.00	5.00	20.0	.20	150	N	N	N	20	7,000	N
MJ007H	38 43 39	114 42 52	1.00	5.00	7.0	1.50	150	N	N	N	50	500	N
MJ008H	38 42 28	114 42 55	.10	.05	.2	1.00	20	N	N	N	<20	N	30
MJ009H	38 42 23	114 42 26	.20	.05	.5	1.00	20	N	N	N	<20	N	15
MJ010H	38 40 56	114 41 35	.30	.10	.5	1.00	50	7	N	N	20	3,000	100
MJ011H	38 41 12	114 41 36	.30	2.00	2.0	1.00	50	30	N	N	20	1,000	30

TABLE 2.--Continued

Sample	Bi-ppm s	Cd-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	La-ppm s	Mo-ppm s	Nb-ppm s	Ni-ppm s	Pb-ppm s	Sb-ppm s	Sc-ppm s	Sn-ppm s	Sr-ppm s
MA001H	N	N	N	70	10	<50	N	N	N	50	N	70	N	500
MA002H	N	N	N	20	<10	50	N	N	N	N	N	30	N	200
MA003H	N	N	N	20	<10	100	N	N	N	N	N	70	N	1,000
MA004H	N	N	N	20	<10	<50	N	N	N	50	N	70	N	N
MA006H	N	N	N	20	<10	50	N	N	N	N	N	20	N	1,000
MA008H	N	N	N	50	<10	<50	N	N	N	150	N	70	N	200
MA009H	N	N	N	N	<10	<50	N	N	N	20	N	70	N	200
MA010H	N	N	N	N	<10	<50	N	N	N	50	N	15	N	200
MA011H	N	N	N	20	<10	<50	N	N	N	50	N	10	N	N
MA012H	N	N	N	N	<10	<50	N	N	N	500	N	50	N	N
MA013H	70	N	N	50	<10	<50	N	N	N	100	N	70	N	N
MA014H	N	N	N	70	<10	<50	N	N	N	20	N	70	N	N
MA015H	N	N	N	70	10	<50	N	N	N	200	N	100	N	N
MA016H	N	N	N	50	10	150	N	N	N	100	N	50	N	1,000
MA017H	N	N	N	20	<10	100	N	N	N	150	N	50	N	200
MA018H	N	N	N	N	<10	50	N	N	N	20	1,000	20	N	200
MA019H	N	N	N	50	<10	<50	N	N	N	70	N	10	100	N
MA020H	N	N	N	N	<10	<50	N	N	N	N	N	20	N	N
MA021H	N	N	N	N	<10	<50	N	N	N	100	300	50	N	N
MA022H	N	N	N	N	15	<50	15	N	N	500	N	50	N	200
MA023H	N	N	N	70	10	150	N	N	N	200	N	70	N	N
MH001H	N	N	N	50	<10	50	N	N	N	70	N	70	N	N
MH002H	N	N	N	50	10	<50	N	N	N	20	N	70	N	N
MH003H	N	N	N	N	50	<50	N	N	N	<20	N	50	N	N
MH005H	N	N	N	50	<10	<50	N	N	N	N	N	70	N	500
MH006H	N	N	N	20	<10	50	N	N	N	20	N	50	N	1,000
MH007H	N	N	N	N	<10	<50	N	N	N	N	1,500	50	N	200
MH008H	N	N	N	50	<10	100	N	N	N	N	500	30	N	200
MH009H	N	N	N	N	<10	<50	N	N	N	150	500	10	N	N
MH010H	N	N	N	50	<10	<50	N	N	N	20	N	30	N	N
MH011H	N	N	N	70	<10	<50	N	N	N	20	N	70	N	N
MH012H	N	N	N	N	<10	<50	N	N	N	20	N	70	N	200
MH013H	N	N	N	N	<10	<50	N	N	N	<20	N	50	N	200
MH014H	N	N	N	N	<10	<50	N	N	N	<20	N	50	N	200
MJ001H	N	N	N	N	<10	<50	N	N	N	N	N	10	N	N
MJ002H	N	N	N	N	<10	<50	N	N	N	20	N	20	N	N
MJ003H	N	N	N	N	<10	<50	N	N	N	50	N	10	N	N
MJ004H	N	N	N	N	<10	<50	N	N	N	<20	N	20	N	N
MJ005H	N	N	N	N	<10	<50	N	N	N	N	300	50	N	N
MJ006H	N	N	N	N	<10	50	N	N	N	N	200	10	N	500
MJ007H	N	N	N	70	15	300	N	N	N	150	N	70	N	N
MJ008H	N	N	N	N	<10	<50	N	N	N	50	N	70	50	N
MJ009H	N	N	N	N	<10	<50	N	N	N	20	N	70	20	200
MJ010H	N	N	N	50	<10	70	N	N	N	30	200	70	70	2,000
MJ011H	N	N	N	20	<10	50	N	N	N	N	7,000	50	N	500

TABLE 2.--Continued

Sample	V-ppm s	W-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s	Th-ppm s
MA001H	20	N	700	N	>2,000	N
MA002H	20	N	150	N	>2,000	N
MA003H	20	N	300	N	>2,000	N
MA004H	20	N	500	N	>2,000	N
MA006H	30	<100	100	N	>2,000	N
MA008H	50	N	700	N	>2,000	N
MA009H	20	N	700	N	>2,000	N
MA010H	<20	500	200	N	>2,000	N
MA011H	20	5,000	150	N	>2,000	N
MA012H	20	700	500	N	>2,000	N
MA013H	20	300	300	<500	>2,000	N
MA014H	50	N	1,500	N	>2,000	N
MA015H	50	N	1,500	N	>2,000	N
MA016H	<20	N	300	N	>2,000	N
MA017H	20	N	200	N	>2,000	N
MA018H	20	100	150	N	>2,000	N
MA019H	20	N	100	N	>2,000	N
MA020H	20	N	50	N	>2,000	N
MA021H	20	5,000	200	N	>2,000	N
MA022H	20	1,000	200	700	>2,000	N
MA023H	20	200	500	1,000	>2,000	N
MH001H	20	200	700	N	>2,000	N
MH002H	20	N	1,500	N	>2,000	N
MH003H	20	N	500	N	>2,000	N
MH005H	20	N	700	N	>2,000	N
MH006H	<20	N	500	N	>2,000	N
MH007H	20	<100	300	N	>2,000	N
MH008H	20	N	300	N	>2,000	N
MH009H	<20	100	200	N	>2,000	N
MH010H	20	100	300	N	>2,000	N
MH011H	20	N	500	N	>2,000	N
MH012H	20	N	500	N	>2,000	N
MH013H	20	N	700	N	>2,000	N
MH014H	<20	N	500	N	>2,000	N
MJ001H	20	N	100	N	>2,000	N
MJ002H	20	N	100	N	>2,000	N
MJ003H	<20	N	70	N	>2,000	N
MJ004H	20	N	70	N	>2,000	N
MJ005H	20	N	150	N	>2,000	N
MJ006H	<20	200	150	N	>2,000	N
MJ007H	100	500	500	N	>2,000	N
MJ008H	20	N	700	N	>2,000	N
MJ009H	20	700	700	N	>2,000	N
MJ010H	20	150	500	N	>2,000	N
MJ011H	20	1,000	300	N	>2,000	N

TABLE 2.--Continued [illegible]

Sample	Latitude	Longitude	Fe-pct. s	Mg-pct. s	Ca-pct. s	Ti-pct. s	Mn-ppm s	Ag-ppm s	As-ppm s	Au-ppm s	B-ppm s	Ba-ppm s	Be-ppm s
MJ012H	38 41 12	114 41 36	.50	2.00	10.0	.70	100	N	N	N	20	1,500	2
MJ013H	38 40 14	114 41 21	.30	1.00	20.0	.10	20	300	N	N	20	2,000	7
MJ014H	38 39 57	114 41 7	.20	10.00	10.0	.50	100	N	N	N	20	200	2
MJ015H	38 38 40	114 41 25	.30	.10	1.0	1.00	50	N	N	N	20	1,000	2
MJ016H	38 38 55	114 41 23	.20	.05	.2	1.00	20	N	N	N	20	700	N
MJ017H	38 39 42	114 41 18	.10	<.05	<.1	.50	20	N	N	N	20	200	5
MJ018H	38 39 42	114 41 18	.10	<.05	<.1	.70	20	10	N	100	20	500	5
MJ019H	38 37 52	114 41 45	.20	5.00	10.0	1.00	70	N	N	N	20	1,000	30
MJ020H	38 37 5	114 41 43	.30	.07	20.0	.20	100	N	N	N	20	N	30
MJ021H	38 37 0	114 42 12	.20	.05	.5	1.50	50	N	N	N	20	200	2
MJ022H	38 36 20	114 41 7	.20	5.00	7.0	1.00	100	N	N	N	20	N	20
MK001H	38 46 47	114 41 57	.30	5.00	20.0	.50	100	N	N	N	<20	N	N
MK002H	38 45 17	114 43 25	.30	10.00	20.0	.05	150	N	N	N	<20	200	N
MK003H	38 45 27	114 42 36	.20	10.00	20.0	.01	100	N	N	N	20	N	N
MK004H	38 44 41	114 42 27	.30	5.00	10.0	1.00	100	N	N	N	<20	N	N
MK005H	38 44 7	114 43 42	.50	2.00	20.0	.20	150	N	N	N	30	700	N
MK006H	38 43 56	114 43 45	.20	5.00	20.0	.15	100	N	N	N	<20	1,000	N
MK007H	38 42 25	114 42 29	.20	.50	1.0	1.50	20	N	N	N	20	700	100
MK008H	38 43 27	114 41 5	.20	5.00	5.0	1.00	100	N	N	N	20	N	20
MK009H	38 43 27	114 41 5	1.00	5.00	10.0	1.00	100	N	N	N	20	N	5
MK011H	38 41 26	114 41 36	.10	.05	.2	1.50	50	N	N	N	<20	N	5
MK012H	38 42 38	114 46 58	.10	2.00	2.0	.50	20	N	N	N	<20	7,000	N
MK013H	38 43 8	114 48 52	.20	.05	.1	2.00	20	2	N	100	20	700	5
MK014H	38 46 54	114 45 8	1.00	.20	2.0	.50	100	N	N	N	20	200	N
MK015H	38 46 56	114 45 4	2.00	1.00	10.0	.50	300	N	N	N	20	700	2
MK016H	38 47 9	114 44 47	.30	5.00	10.0	.50	100	N	N	N	<20	500	N
MK017H	38 47 10	114 44 40	.20	10.00	20.0	.05	100	N	N	N	20	N	N
MK018H	38 35 37	114 44 7	.50	5.00	1.5	1.00	100	N	N	N	20	N	2
MK019H	38 35 37	114 44 7	.20	10.00	20.0	.30	150	N	N	N	20	N	N
MK021H	38 36 4	114 42 49	.50	.05	.5	1.50	50	N	N	N	30	3,000	5
MK022H	38 36 16	114 42 27	.50	.05	.1	1.50	100	N	N	N	20	N	5

TABLE 2.--Continued

Sample	Bi-ppm s	Cd-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	La-ppm s	Mo-ppm s	Nb-ppm s	Ni-ppm s	Pb-ppm s	Sb-ppm s	Sc-ppm s	Sn-ppm s	Sr-ppm s
MJ012H	N	N	N	20	10	50	N	N	N	20	5,000	30	N	200
MJ013H	N	N	N	N	<10	<50	N	N	N	150	1,000	20	N	5,000
MJ014H	N	N	N	20	<10	<50	N	N	N	70	5,000	70	N	200
MJ015H	N	N	N	20	<10	<50	N	N	N	150	N	50	N	2,000
MJ016H	N	N	N	N	<10	<50	N	N	N	N	N	50	N	500
MJ017H	N	N	N	N	<10	<50	N	N	N	20	N	70	N	300
MJ018H	N	N	N	N	<10	<50	N	N	N	50	N	70	N	1,500
MJ019H	N	N	N	N	<10	<50	N	N	N	N	<200	50	N	700
MJ020H	500	N	N	N	<10	<50	50	N	N	150	N	10	N	200
MJ021H	N	N	N	50	<10	<50	N	N	N	100	N	70	N	N
MJ022H	100	N	N	20	<10	<50	N	N	N	30	N	50	30	N
MK001H	N	N	N	N	<10	<50	N	N	N	N	N	10	N	200
MK002H	N	N	N	N	<10	<50	N	N	N	20	1,500	10	N	N
MK003H	N	N	N	N	<10	<50	N	N	N	N	N	N	N	N
MK004H	N	N	N	20	<10	<50	N	N	N	N	<200	50	N	N
MK005H	N	N	N	20	<10	70	N	N	N	50	N	20	N	1,000
MK006H	N	N	N	N	10	<50	N	N	N	100	200	10	N	200
MK007H	N	N	N	70	10	<50	N	N	N	200	N	70	50	200
MK008H	N	N	N	N	<10	<50	30	N	N	N	N	20	N	N
MK009H	N	N	N	70	<10	<50	N	N	N	20	N	50	N	N
MK011H	N	N	N	50	<10	<50	N	N	N	50	N	70	N	300
MK012H	N	N	N	N	<10	<50	N	N	N	N	N	30	N	N
MK013H	N	N	N	70	10	<50	N	N	N	20	N	70	N	N
MK014H	N	N	N	20	<10	100	N	N	N	N	N	50	N	200
MK015H	N	N	N	N	10	150	N	N	N	50	N	50	N	500
MK016H	N	N	N	N	<10	50	N	N	N	N	N	50	50	500
MK017H	N	N	N	N	<10	<50	N	N	N	70	N	20	N	200
MK018H	N	N	N	20	<10	<50	N	N	N	150	500	50	N	N
MK019H	N	N	N	N	<10	<50	N	N	N	50	<200	10	N	N
MK021H	N	N	N	20	<10	50	N	N	N	<20	2,000	70	N	200
MK022H	N	N	N	N	<10	50	N	N	N	20	N	100	N	N

TABLE 2.--Continued

Sample	V-ppm s	W-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s	Th-ppm s
MJ012H	20	700	200	N	>2,000	N
MJ013H	<20	500	70	N	>2,000	N
MJ014H	20	5,000	150	N	>2,000	N
MJ015H	20	N	500	N	>2,000	N
MJ016H	20	100	300	N	>2,000	N
MJ017H	20	N	700	N	>2,000	N
MJ018H	20	N	700	N	>2,000	N
MJ019H	20	500	200	N	>2,000	N
MJ020H	20	5,000	70	N	>2,000	N
MJ021H	20	150	500	N	>2,000	N
MJ022H	20	150	300	N	>2,000	N
MK001H	20	100	100	N	>2,000	N
MK002H	<20	100	50	N	>2,000	N
MK003H	<20	N	N	N	700	N
MK004H	20	N	200	N	>2,000	N
MK005H	20	N	150	N	>2,000	N
MK006H	<20	500	100	N	>2,000	N
MK007H	20	N	1,000	N	>2,000	N
MK008H	<20	N	150	N	>2,000	N
MK009H	20	100	500	N	>2,000	N
MK011H	20	150	500	N	>2,000	N
MK012H	<20	N	300	N	>2,000	N
MK013H	30	N	500	N	>2,000	N
MK014H	20	N	500	N	>2,000	N
MK015H	20	N	200	N	>2,000	N
MK016H	20	N	150	N	>2,000	N
MK017H	20	N	50	N	>2,000	N
MK018H	20	300	200	N	>2,000	N
MK019H	20	300	100	N	>2,000	N
MK021H	20	100	500	N	>2,000	N
MK022H	20	N	700	N	>2,000	N

TABLE 3.--SPECTROGRAPHIC ANALYSIS OF ROCK SAMPLES

[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown.]

Sample	Latitude	Longitude	Smpl.des[1]	Fe-pct. s	Mg-pct. s	Ca-pct. s	Ti-pct. s	Mn-ppm s	Ag-ppm s	As-ppm s	Au-ppm s	B-ppm s	Ba-ppm s
MG01	38 41 26	114 42 59	1	5.00	.70	.03	.500	100	<.5	<700	<15	20	700
MG02	38 41 34	114 43 0	1	.50	.07	.02	.070	3,000	20.0	<700	<15	10	500
MG03	38 40 58	114 44 9	1	5.00	.70	.07	.300	150	<.5	<700	<15	50	1,000
MG04	38 40 11	114 42 42	1	5.00	.70	.05	.300	150	<.5	<700	<15	30	700
MG05	38 40 18	114 42 12	7	.15	.05	15.00	.007	50	150.0	<700	<15	<10	700
MG06	38 39 28	114 42 15	7	>20.00	.05	.15	.030	150	7.0	<700	<15	<10	100
MG07	38 41 35	114 44 29	7	.15	<.02	<.05	.050	<10	<.5	<700	<15	<10	70
MG08	38 36 54	114 45 18	8	5.00	.05	<.05	.030	300	200.0	700	<15	<10	1,000
MG09	38 36 50	114 44 37	1	5.00	1.50	.20	.500	500	<.5	<700	<15	10	1,500
MG10	38 37 46	114 42 9	7	<.05	<.02	<.05	.030	15	<.5	<700	<15	<10	30
MG11	38 36 27	114 44 28	7	.70	.10	<.05	.100	15	<.5	<700	<15	<10	150
MG12	38 38 38	114 44 28	2	10.00	5.00	3.00	>1.000	2,000	<.5	<700	<15	<10	200
MG13	38 39 3	114 44 34	3	.70	.70	.15	.070	300	<.5	<700	<15	<10	70
MG14	38 36 33	114 42 18	6	3.00	.15	15.00	<.002	200	200.0	700	<15	<10	50
MG15	38 36 31	114 42 14	6	.70	1.50	20.00	.030	150	<.5	<700	<15	<10	200
MG16	38 37 35	114 43 42	1	7.00	1.50	.20	.300	200	<.5	<700	<15	20	1,000
MG17	38 37 35	114 43 42	8	15.00	.50	15.00	.070	1,500	5.0	<700	<15	<10	300
MG18	38 37 38	114 43 37	1	20.00	1.00	20.00	.150	1,500	<.5	<700	<15	<10	200
MG19	38 37 28	114 43 44	1	10.00	.70	2.00	.070	>5,000	7.0	<700	<15	<10	300
MG20	38 46 28	114 47 11	6	.70	.15	10.00	.100	200	5.0	<700	<15	<10	500
MG21	38 46 30	114 47 13	8	.20	.05	1.00	.030	30	7.0	<700	<15	<10	150
MG22	38 45 30	114 44 2	7	<.05	<.02	<.05	.005	<10	<.5	<700	<15	<10	50
MG23	38 45 21	114 42 54	5	<.05	7.00	7.00	<.002	30	<.5	<700	<15	<10	<20
MG24	38 45 5	114 46 2	6	.05	.20	>20.00	.003	200	<.5	<700	<15	<10	<20
MG25	38 37 21	114 41 29	5	<.05	7.00	10.00	<.002	10	<.5	<700	<15	<10	<20
MG26	38 37 11	114 41 39	7	.10	.05	.15	.007	30	<.5	<700	<15	<10	70
MG27	38 36 20	114 41 18	4	3.00	1.50	3.00	.300	700	<.5	<700	<15	<10	1,000
MG28	38 38 33	114 47 49	1	.15	.02	.05	.020	30	1,500.0	<700	<15	<10	70

[1]Sample description codes are: (1) argillite, (2) basalt, (3) conglomerate, (4) dacite, (5) dolomite, (6) limestone, (7) quartzite, and (8) vein quartz.

TABLE 3.--SPECTROGRAPHIC ANALYSIS OF ROCK SAMPLES--Continued

Sample	Be-ppm s	Bi-ppm s	Cd-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	La-ppm s	Mo-ppm s	Nb-ppm s	Ni-ppm s	Pb-ppm s	Sb-ppm s	Sc-ppm s	Sn-ppm s
MG01	30.0	<10	<30	10	70	15	50	<5	<20	70	<10	<100	15	<10
MG02	2.0	<10	<30	10	10	100	<30	<5	2,564	7	150	<100	<5	<10
MG03	3.0	<10	<30	7	50	10	70	<5	<20	30	10	<100	15	<10
MG04	1.5	<10	<30	5	70	30	70	<5	<20	30	20	<100	15	<10
MG05	<1.0	<10	<30	<5	<10	20	<30	<5	<20	<5	200	100	<5	<10
MG06	2.0	<10	<30	15	<10	200	<30	2,564	<20	20	100	200	<5	<10
MG07	<1.0	<10	<30	<5	<10	<5	<30	<5	<20	<5	<10	<100	<5	<10
MG08	<1.0	<10	<30	<5	<10	700	<30	<5	2,564	7	200	500	<5	20
MG09	2.0	<10	<30	10	70	15	100	<5	<20	20	10	<100	15	<10
MG10	<1.0	<10	<30	<5	<10	<5	<30	<5	<20	<5	<10	<100	<5	<10
MG11	<1.0	<10	<30	<5	<10	30	<30	<5	<20	10	<10	<100	<5	<10
MG12	1.0	<10	<30	50	70	300	<30	<5	<20	70	30	<100	50	<10
MG13	<1.0	<10	<30	5	<10	200	<30	<5	<20	5	<10	<100	<5	<10
MG14	3.0	<10	<30	5	<10	20,000	<30	<5	<20	5	2,000	500	<5	100
MG15	<1.0	<10	<30	<5	15	7	<30	<5	<20	5	<10	<100	<5	<10
MG16	5.0	<10	<30	15	70	30	70	<5	<20	50	<10	<100	20	<10
MG17	30.0	<10	<30	15	10	700	<30	<5	<20	5	15	<100	5	15
MG18	100.0	<10	<30	15	20	300	50	<5	<20	15	50	<100	7	50
MG19	100.0	150	70	15	7	700	<30	<5	<20	7	70	<100	<5	150
MG20	1.0	<10	<30	5	20	70	<30	<5	<20	10	20	<100	<5	<10
MG21	<1.0	<10	<30	<5	<10	70	<30	<5	<20	7	70	200	<5	<10
MG22	<1.0	<10	<30	<5	<10	<5	<30	<5	<20	<5	<10	<100	<5	<10
MG23	<1.0	<10	<30	<5	<10	<5	<30	<5	<20	<5	<10	<100	<5	<10
MG24	<1.0	<10	<30	<5	<10	<5	<30	<5	<20	<5	<10	<100	<5	<10
MG25	<1.0	<10	<30	<5	<10	<5	<30	<5	<20	<5	<10	<100	<5	<10
MG26	<1.0	<10	<30	<5	<10	<5	<30	<5	<20	<5	<10	<100	<5	<10
MG27	1.0	<10	<30	15	15	20	70	<5	<20	15	20	<100	15	<10
MG28	<1.0	<10	100	<5	<10	7,000	<30	<5	<20	<5	>20,000	3,000	<5	<10

TABLE 3.--SPECTROGRAPHIC ANALYSIS OF ROCK SAMPLES--Continued

Sample	Sr-ppm s	V-ppm s	W-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s	Th-ppm s	Au-ppm aa	As-ppm aa	Bi-ppm aa	Cd-ppm aa	Sb-ppm aa	Zn-ppm aa	W-ppm cm
MG01	<100	70	<50	30	<200	300	<200	--	<5	<2	.2	<2	20	--
MG02	200	10	5,000	<10	<200	50	<200	<.1	127	--	2.3	--	<2	3,800.00
MG03	<100	100	<50	50	<200	300	<200	--	<5	<2	.2	<2	42	--
MG04	<100	70	<50	30	<200	300	<200	--	8	<2	.3	<2	60	--
MG05	150	<10	<50	30	<200	20	<200	<.1	36	--	2.8	--	10	3.80
MG06	<100	70	200	<10	500	30	<200	<.1	652	--	3.3	--	97	280.00
MG07	<100	<10	<50	<10	<200	70	<200	--	<5	<2	<.1	<2	<2	--
MG08	<100	10	2,000	10	1,000	50	<200	<.1	595	--	6.9	--	370	6,100.00
MG09	100	100	<50	50	<200	500	<200	--	<5	<2	.2	<2	39	--
MG10	<100	<10	<50	<10	<200	50	<200	--	<5	<2	<.1	<2	<2	--
MG11	<100	15	<50	<10	<200	300	<200	--	<5	<2	<.1	<2	2	--
MG12	700	500	<50	50	<200	150	<200	--	<5	<2	1.0	<2	103	--
MG13	<100	15	<50	<10	<200	200	<200	--	<5	<2	<.1	<2	16	--
MG14	100	150	<50	<10	2,000	<10	<200	<.1	1,680	--	33.8	--	2,290	24.00
MG15	1,000	15	<50	10	<200	20	<200	--	<5	<2	.3	<2	12	--
MG16	<100	100	<50	50	<200	200	<200	--	41	<2	.4	<2	57	--
MG17	<100	15	300	20	3,000	150	<200	<.1	849	--	29.9	--	3,500	530.00
MG18	100	30	70	30	700	150	<200	<.1	8	--	4.1	--	652	260.00
MG19	<100	15	70	15	>10,000	70	<200	<.1	255	--	77.6	--	>40,000	400.00
MG20	<100	100	<50	<10	300	20	<200	<.1	28	--	1.4	--	77	3.00
MG21	<100	10	<50	<10	200	15	<200	<.1	36	--	.3	--	38	2.00
MG22	<100	<10	<50	<10	<200	15	<200	--	<5	<2	<.1	<2	<2	--
MG23	<100	<10	<50	<10	<200	<10	<200	--	7	<2	<.1	12	<2	--
MG24	500	<10	<50	<10	<200	<10	<200	--	<5	<2	<.1	<2	<2	--
MG25	<100	<10	<50	<10	<200	<10	<200	--	<5	<2	<.1	12	<2	--
MG26	<100	<10	<50	<10	<200	20	<200	--	10	<2	<.1	<2	4	--
MG27	500	150	<50	15	<200	100	<200	--	<5	<2	.3	<2	28	--
MG28	100	<10	<50	<10	>10,000	10	<200	<.1	262	--	114.0	--	20,200	.81

TABLE 4.--Correspondence of sample identification numbers of Mineral Resources Bulletin (MR no.) and field numbers (Field no.) of this report, for heavy-mineral-concentrate samples

MR no.	Field no.	MR no.	Field no.	MR no.	Field no.
01	MA018	24	MK007	47	MA010
02	MA016	25	MJ009	48	MA008
--	MA017	26	MK011	48	MA009
03	MK014	27	MJ011	49	MH012
04	MK015	27	MJ012	50	MH011
05	MK016	28	MJ010	51	MA002
06	MK017	29	MJ013	52	MH014
07	MA020	30	MJ014	53	MH013
08	MA019	31	MJ017	54	MA001
09	MJ001	--	MJ018	55	MH003
10	MK001	32	MJ016	56	MH001
11	MJ002	33	MJ015	57	MH002
12	MJ004	34	MJ019	58	MK012
13	MK003	35	MJ021	59	MA014
14	MK002	36	MJ020	60	MK013
15	MJ003	37	MJ022	61	MA015
16	MK004	38	MK022	62	MH005
17	MJ005	39	MA023	63	MH006
18	MK005	40	MK021	64	MH007
19	MJ006	41	MA022	65	MH008
20	MK006	42	MA021	65	MH009
21	MJ007	43	MK018	66	MH010
22	MK008	43	MK019	67	MA003
22	MK009	44	MA013	68	MA004
23	MJ008	45	MA012	69	MA006
		46	MA011		