UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Analytical results and sample locality map of stream-sediment and heavy-mineral-concentrate samples from the Sleeping Giant Wilderness Study Area (MT-075-111), Lewis and Clark County, Montana

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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 Sleeping Giant Wilderness Study Area (MT-075-111), Lewis and Clark County, Montana.

INTRODUCTION

In July 1987, the U.S. Geological Survey conducted a reconnaissance geochemical survey of the Sleeping Giant Wilderness Study Area (MT-075-111), Lewis and Clark County, Montana.

The Sleeping Giant Wilderness Study Area comprises about 24 mi^2 (61 km^2) (15,174 acres) in the southeast corner of Lewis and Clark County, Montana, and lies about 20 mi (32 km) north of the capitol city of Helena, and about 4 mi (6 km) south of the hamlet of Wolf Creek (fig. 1). Access to the western margin of the study area is provided by a jeep road that extends from an access road adjacent to Interstate Highway 15, 1-2 mi (1.5-3 km) west of the wilderness study area. The eastern part of the area is accessible by boat from Holter Lake, a man-made reservoir created by a dam on the Missouri River, which forms much of the eastern margin of the study area. Limited access is available from a maintenance road along a power line corridor between the two parts of the study area.

Siltite and argillite of the Middle Proterozoic Belt Supergroup make up most of the rocks exposed within the study area. Rocks that crop out in the easternmost part of the study area are mainly Cretaceous in age, composed of sandstone, siltstone, and shale; felsic to mafic sills; and interbedded welded tuff, lava, and clastic strata. These rocks dip generally westward at moderate angles. The Proterozoic strata have been displaced northeastward along a major low-angle thrust fault, the Eldorado thrust, and are juxtaposed over younger strata concealed beneath the study area. New geologic mapping was conducted in the western part of the study area, and locally within the eastern part by R.G. Tysdal and M.W. Reynolds to supplement unpublished mapping previously conducted by G.D. Robinson and M.R. McCallum.

The topographic relief in the study area is about 3,200 ft (975 m), with a maximum elevation of about 6,800 ft (2,100 m). The ground surface is steeply mountainous in all parts of the study area, and is most rugged in the easternmost portion of the area. Vegetation in the lower and middle elevations consists predominantly of conifers. At the higher elevations, ground covers and lichens predominate. The climate is semi-arid, with sparse vegetation on the ridges and slopes and more dense growth along the perennial and intermittent streams.

METHODS OF STUDY

Sample Media

Analyses of the stream-sediment samples represent the chemistry of the rock material eroded from the drainage basin upstream from each sample site. Such information is useful

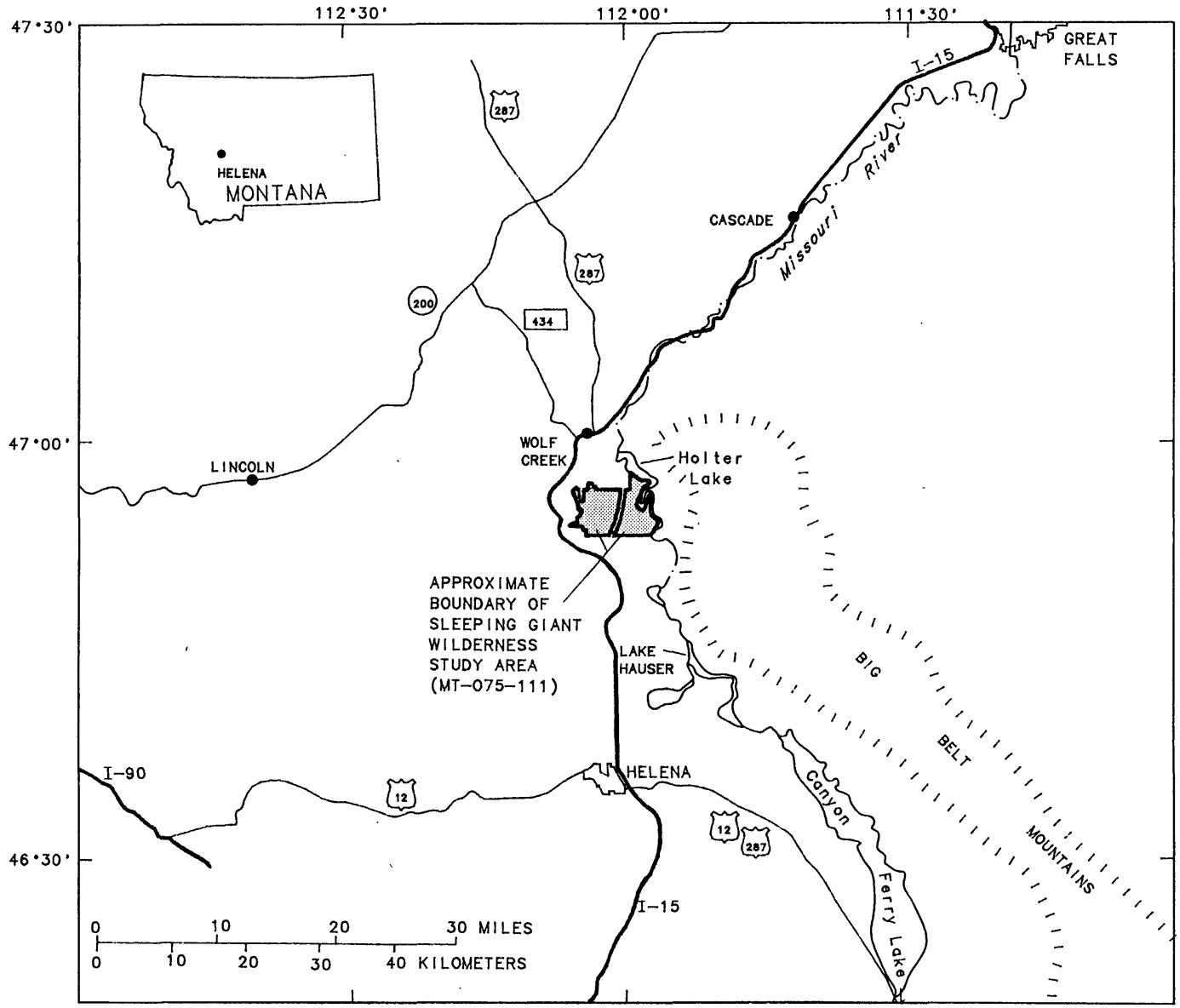

Figure 1. Location of the Sleeping Giant Wilderness Study Area (MT-075-111), Lewis and Clark County, Montana.

in identifying those basins that contain concentrations of elements that may be related to mineral deposits. 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.

Sample Collection

Heavy-mineral-concentrate and stream-sediment samples were collected at 58 sites (plate 1). Sampling density was about one sample site per 0.5 mi^2 (1.3 km^2) for the stream sediments and heavy-mineral concentrates. The area of the drainage basins sampled ranged from 0.04 mi^2 (0.1 km^2) to 1.5 mi^2 (3.9 km^2).

Stream-sediment samples

The stream-sediment samples consisted of active alluvium collected primarily from first-order (unbranched), second-order (below the junction of two first-order), and third-order (below the junction of two second-order) streams as shown on USGS topographic maps (scale = 1:24,000) (plate 1). Each sample was composited from several localities within an area that , for most sites, extended 10 ft (3 m) from the site plotted on the map, but for sites on the banks of Holter Lake may extend as much as 900 ft (275 m) from the site plotted on the map.

Heavy-mineral-concentrate samples

Heavy-mineral-concentrate samples were collected from the same active alluvium as the stream-sediment samples. 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

The stream-sediment samples were air dried, then sieved using 80-mesh (0.17-mm) stainless-steel sieves. The portion of the sediment passing through the sieve was saved for analysis.

Samples that had been panned in the field were air dried and sieved to -35 mesh; bromoform (specific gravity 2.85) was used to remove the remaining quartz and feldspar. 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 (removed at a setting of 0.25 ampere), primarily magnetite, was not analyzed. The second fraction (removed at a setting of 1.75 ampere), largely ferromagnesian silicates and iron oxides, and the third fraction (the nonmagnetic material which may include the nonmagnetic ore minerals, zircon, sphene, etc.) were split using a Jones splitter. One split each of the second and third fractions was hand ground for spectrographic analysis; the other split of these two fractions 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 0.2 ampere to remove the magnetite and ilmenite, and a current of 0.6 ampere to split the remainder of the sample into paramagnetic and nonmagnetic fractions.)

Sample Analysis

Spectrographic method

The stream-sediment samples were analyzed for 35 elements and the heavy-mineral-concentrate samples were analyzed for 37 elements using a semiquantitative, direct-current arc emission spectrographic method (modification of Grimes and Marranzino, 1968). The elements analyzed and their lower limits of determination are 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. The precision of the analytical method is approximately plus or minus one reporting interval at the 83 percent confidence level and plus or minus two reporting intervals at the 96 percent confidence level (Motooka and Grimes, 1976). Values determined for the major elements, iron, magnesium, calcium, titanium, sodium, and phosphorus are given in weight percent; all others are given in parts per million (micrograms/gram). Analytical data for samples from the Sleeping Giant Wilderness Study Area are listed in tables 2, 3, and 4.

DATA STORAGE SYSTEM

Upon completion of all analytical work, the analytical results were entered into the Branch of Geochemistry computer data base called PLUTO. 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

Tables 2-4 list the results of analyses for the samples of stream sediment, nonmagnetic heavy-mineral concentrate, and paramagnetic heavy-mineral concentrate, respectively. For the three tables, 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). 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. A "less than" symbol (<) entered in the tables in front of the lower limit of determination indicates that an element was observed but was below the lowest reporting value. 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. If an element was not looked for in a sample or if insufficient sample was available for analysis, two dashes (--) are entered in tables 2-4 in place of an analytical value. The inability to determine an analytical value for an element due to spectral interference is indicated by the lack of a numerical or symbol entry.

ACKNOWLEDGMENTS

The authors wish to thank C. Sanchez and R. Young for their efforts in preparing the samples for analysis.

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.

Motooka, J. M., and Grimes, D. J., 1976, Analytical precision of one-sixth order semiquantitative spectrographic analyses: U.S. Geological Survey Circular 738, 25 p.

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 rocks and stream sediments, based on a 10-mg sample

[The spectrographic limits of determination for heavy-mineral-concentrate samples are based on a 5-mg sample, and are therefore two reporting intervals higher than the limits given for rocks and stream sediments]

Elements	Lower determination limit	Upper determination limit
	Percent	
Calcium (Ca)	.05	20
Iron (Fe)	0.05	20
Magnesium (Mg)	.02	10
Sodium (Na)	0.2	5
Phosphorus (P)	0.2	10
Titanium (Ti)	.002	1
	Parts per million	
Silver (Ag)	0.5	5,000
Arsenic (As)	200	10,000
Gold (Au)	10	500
Boron (B)	10	2,000
Barium (Ba)	20	5,000
Beryllium (Be)	1	1,000
Bismuth (Bi)	10	1,000
Cadmium (Cd)	20	500
Cobalt (Co)	10	2,000
Chromium (Cr)	10	5,000
Copper (Cu)	5	20,000
Gallium (Ga)	5	500
Germanium (Ge)	10	100
Lanthanum (La)	50	1,000
Manganese (Mn)	10	5,000
Molybdenum (Mo)	5	2,000
Niobium (Nb)	20	2,000
Nickel (Ni)	5	5,000
Lead (Pb)	10	20,000
Antimony (Sb)	100	10,000
Scandium (Sc)	5	100
Tin (Sn)	10	1,000
Strontium (Sr)	100	5,000
Thorium (Th)	100	2,000
Vanadium (V)	10	10,000
Tungsten (W)	20	10,000
Yttrium (Y)	10	2,000
Zinc (Zn)	200	10,000
Zirconium (Zr)	10	1,000
Palladium (Pd)*	5	1,000
Platinum (Pt)*	20	1,000

*Determined in heavy-mineral-concentrate samples only. Limits are for heavy-mineral-concentrate samples.

Table 2. Results of analyses of stream-sediment samples from the Sleeping Giant Wilderness Study Area, Lewis and Clark County, Montana.

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

Sample	Latitude	Longtude	Fe %-s	Mg %-s	Ca %-s	Ti %-s	Mn ppm-s	Ag ppm-s	As ppm-s
SG-01S	46 57 12	112 0 8	3	2	2	.5	700	N	N
SG-02S	46 57 14	112 0 13	5	3	3	.3	1,500	N	N
SG-03S	46 56 50	112 0 20	3	1	.3	.3	1,000	N	N
SG-04S	46 56 52	112 0 21	3	1	.5	.3	1,500	N	N
SG-05S	46 56 18	112 0 37	3	1	.7	.5	1,500	N	N
SG-06S	46 56 27	111 59 14	3	2	1.5	.5	1,500	N	N
SG-07S	46 56 28	111 58 36	3	1.5	1.5	.3	700	N	N
SG-08S	46 55 3	112 2 13	3	.7	.7	.2	1,000	.5	N
SG-09S	46 55 5	112 2 15	2	.5	1	.15	700	N	N
SG-10S	46 57 42	112 3 34	3	1.5	.3	.5	700	N	N
SG-11S	46 57 42	112 3 36	3	1.5	.7	.3	500	N	N
SG-12S	46 56 45	112 4 33	3	2	.7	.3	700	N	N
SG-13S	46 55 19	112 4 57	3	1	.7	.3	1,000	N	N
SG-14S	46 53 57	112 5 12	3	1	.7	.3	1,000	N	N
SG-15S	46 55 41	112 3 17	1.5	.7	1	.15	700	N	N
SG-16S	46 55 56	112 2 42	2	.7	.5	.2	700	N	N
SG-17S	46 55 55	112 2 46	2	1	.7	.2	1,000	N	N
SG-18S	46 56 14	112 2 50	2	1	.5	.3	700	N	N
SG-19S	46 55 31	112 2 13	3	.7	.5	.15	1,500	N	N
SG-20S	46 54 27	112 4 39	3	1	.7	.3	1,500	N	N
SG-21S	46 53 54	112 4 24	2	.5	.7	.15	700	N	N
SG-22S	46 53 28	112 3 47	.7	.3	1	.07	700	N	N
SG-23S	46 53 10	112 3 16	3	.7	.7	.3	1,000	N	N
SG-24S	46 56 53	112 3 0	3	1.5	.3	.3	700	N	N
SG-25S	46 56 53	112 3 2	1.5	1	7	.15	700	N	N
SG-26S	46 54 45	111 59 46	3	.7	.5	.15	1,500	.7	N
SG-27S	46 54 40	111 57 7	1.5	1.5	2	.3	300	N	N
SG-28S	46 54 29	111 57 24	1.5	.7	2	.3	300	N	N
SG-29S	46 54 20	111 58 7	3	.7	2	.3	500	N	N
SG-30S	46 53 7	111 57 51	3	.7	.7	.3	300	N	N
SG-31S	46 53 4	111 58 20	3	1	3	.3	700	N	N
SG-32S	46 53 10	111 59 44	2	.7	.7	.3	300	N	N
SG-33S	46 54 56	112 0 45	3	.7	.7	.15	700	N	N
SG-34S	46 54 26	112 0 43	3	.7	.5	.3	1,000	N	N
SG-35S	46 54 28	112 0 46	3	.7	.5	.2	1,000	.5	N
SG-36S	46 54 17	112 0 57	3	.7	.5	.3	1,000	N	N
SG-37S	46 53 55	111 57 19	3	.7	1	.3	500	N	N
SG-38S	46 54 1	111 56 57	2	1.5	2	.3	200	N	N
SG-39S	46 54 26	111 56 19	3	1	2	.3	700	N	N
SG-40S	46 54 42	111 56 38	2	.7	.7	.2	300	N	N
SG-41S	46 54 54	111 57 3	1.5	1.5	2	.15	700	N	N
SG-42S	46 56 12	111 57 28	3	1	1	.3	1,500	N	N
SG-43S	46 55 49	111 57 36	3	1	1	.3	1,500	N	N
SG-44S	46 55 23	111 58 38	2	.7	1	.2	1,500	N	N
SG-45S	46 55 21	111 58 16	3	1.5	2	.3	700	N	N
SG-46S	46 56 37	111 58 36	5	3	3	.5	1,000	N	N
SG-47S	46 56 53	111 58 19	3	1	2	.3	1,500	N	N
SG-48S	46 57 26	111 57 39	3	1	1.5	.3	1,000	N	N
SG-49S	46 57 45	111 58 52	3	1.5	2	.3	1,000	N	N
SG-50S	46 54 9	112 1 0	3	.7	1	.15	1,500	.7	N
SG-51S	46 53 6	112 1 38	2	.7	1	.15	700	.5	N
SG-52S	46 53 53	112 1 17	3	.7	.7	.15	1,000	.5	N
SG-53S	46 53 34	112 1 23	3	1	.7	.3	1,500	.5	N
SG-54S	46 53 44	112 1 19	2	.7	.7	.15	1,000	N	N
SG-55S	46 57 14	111 57 15	3	1	2	.3	700	N	N
SG-56S	46 57 31	111 58 6	3	.7	1.5	.2	700	N	N
SG-57S	46 55 12	111 56 41	2	1	1.5	.2	700	N	N
SG-58S	46 56 51	111 57 43	3	1.5	2	.3	700	N	N

Table 2. Results of analyses of stream-sediment samples from the Sleeping Giant Wilderness Study Area, Lewis and Clark County, Montana.--Continued

Sample	Au ppm-s	B ppm-s	Ba ppm-s	Be ppm-s	Bi ppm-s	Cd ppm-s	Co ppm-s	Cr ppm-s	Cu ppm-s
SG-01S	N	<10	300	1.5	N	N	20	200	20
SG-02S	N	15	500	1.5	N	N	30	150	70
SG-03S	N	70	500	3	N	N	30	70	30
SG-04S	N	50	300	2	N	N	20	50	30
SG-05S	N	70	500	3	N	N	30	70	50
SG-06S	N	50	500	3	N	N	30	70	50
SG-07S	N	30	300	1.5	N	N	15	70	30
SG-08S	N	30	300	1.5	N	N	15	30	30
SG-09S	N	20	300	1.5	N	N	15	30	20
SG-10S	N	70	500	3	N	N	15	50	15
SG-11S	N	70	500	2	N	N	10	30	20
SG-12S	N	70	700	2	N	N	15	50	50
SG-13S	N	50	700	2	N	N	15	50	30
SG-14S	N	70	700	3	N	N	15	50	15
SG-15S	N	30	300	2	N	N	10	30	20
SG-16S	N	50	300	2	N	N	15	30	20
SG-17S	N	50	300	3	N	N	15	30	50
SG-18S	N	70	300	3	N	N	<10	30	15
SG-19S	N	20	300	2	N	N	20	30	70
SG-20S	N	70	700	3	N	N	20	70	30
SG-21S	N	20	300	2	N	N	<10	30	20
SG-22S	N	10	150	1.5	N	N	<10	15	15
SG-23S	N	70	700	2	N	N	15	30	50
SG-24S	N	70	500	3	N	N	15	50	20
SG-25S	N	30	150	1.5	N	N	<10	50	20
SG-26S	N	50	300	2	N	N	50	30	70
SG-27S	N	30	300	1.5	N	N	<10	20	10
SG-28S	N	15	300	1.5	N	N	<10	20	20
SG-29S	N	15	500	1.5	N	N	10	30	30
SG-30S	N	50	700	2	N	N	10	30	15
SG-31S	N	15	700	1.5	N	N	15	30	30
SG-32S	N	50	300	1.5	N	N	15	30	15
SG-33S	N	50	300	1.5	N	N	15	70	30
SG-34S	N	70	300	2	N	N	30	70	50
SG-35S	N	50	300	2	N	N	15	50	50
SG-36S	N	50	500	2	N	N	20	50	50
SG-37S	N	50	700	2	N	N	10	70	15
SG-38S	N	30	500	1.5	N	N	<10	30	5
SG-39S	N	15	700	1.5	N	N	10	50	15
SG-40S	N	20	300	1.5	N	N	<10	30	15
SG-41S	N	20	300	1.5	N	N	7	30	15
SG-42S	N	30	500	2	N	N	15	70	30
SG-43S	N	30	500	2	N	N	20	50	70
SG-44S	N	20	700	1.5	N	N	10	30	70
SG-45S	N	20	500	1.5	N	N	10	70	50
SG-46S	N	10	700	1.5	N	N	20	200	70
SG-47S	N	10	700	1.5	N	N	10	50	20
SG-48S	N	10	700	1.5	N	N	10	100	20
SG-49S	N	10	700	1.5	N	N	15	70	50
SG-50S	N	30	300	1.5	N	N	15	70	50
SG-51S	N	20	200	1.5	N	N	10	30	30
SG-52S	N	30	300	1.5	N	N	15	70	70
SG-53S	N	70	500	2	N	N	15	70	50
SG-54S	N	30	300	1.5	N	N	15	70	50
SG-55S	N	20	700	2	N	N	10	70	15
SG-56S	N	15	500	1.5	N	N	7	70	50
SG-57S	N	15	700	2	N	N	7	70	15
SG-58S	N	10	700	1.5	N	N	10	50	15

Table 2. Results of analyses of stream-sediment samples from the Sleeping Giant Wilderness Study Area, Lewis and Clark County, Montana.--Continued

Sample	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	V ppm-s
SG-01S	<50	N	<20	50	20	N	15	N	200	150
SG-02S	<50	N	<20	70	30	N	15	N	300	150
SG-03S	50	N	<20	30	30	N	7	N	<100	70
SG-04S	<50	N	<20	30	30	N	7	N	<100	70
SG-05S	50	N	<20	50	30	N	10	N	<100	70
SG-06S	N	N	<20	50	50	N	7	N	150	70
SG-07S	<50	N	<20	30	30	N	7	N	200	70
SG-08S	N	N	<20	30	30	N	7	N	<100	70
SG-09S	70	N	<20	10	20	N	7	N	<100	30
SG-10S	<50	N	<20	15	20	N	10	N	<100	70
SG-11S	<50	N	<20	15	20	N	7	10	<100	50
SG-12S	<50	N	<20	20	20	N	7	N	<100	70
SG-13S	<50	N	<20	20	30	N	7	N	<100	70
SG-14S	50	N	<20	20	30	N	7	N	<100	70
SG-15S	N	N	<20	10	20	N	7	N	<100	30
SG-16S	N	N	<20	15	20	N	7	N	<100	50
SG-17S	N	N	<20	15	30	N	7	N	<100	70
SG-18S	N	N	<20	10	30	N	7	N	<100	50
SG-19S	N	N	<20	20	30	N	7	N	<100	30
SG-20S	<50	N	<20	20	30	N	7	N	<100	70
SG-21S	50	N	<20	10	30	N	7	N	<100	15
SG-22S	50	N	<20	5	15	N	5	N	N	<10
SG-23S	50	N	<20	20	70	N	10	N	<100	70
SG-24S	<50	N	<20	20	30	N	10	N	<100	70
SG-25S	N	N	<20	15	15	N	7	N	100	30
SG-26S	70	N	<20	50	30	N	7	N	N	50
SG-27S	N	N	<20	5	15	N	5	N	<100	70
SG-28S	N	N	<20	7	15	N	5	N	150	70
SG-29S	N	N	<20	10	20	N	7	N	300	100
SG-30S	70	N	<20	20	20	N	10	N	100	100
SG-31S	<50	N	<20	15	20	N	10	N	300	100
SG-32S	N	N	<20	15	50	N	7	N	<100	70
SG-33S	N	N	<20	20	30	N	7	N	<100	70
SG-34S	<50	N	<20	50	30	N	7	N	<100	70
SG-35S	N	N	<20	30	20	N	7	N	<100	70
SG-36S	N	N	<20	30	30	N	7	N	<100	70
SG-37S	<50	N	<20	15	30	N	7	N	100	70
SG-38S	N	N	<20	10	15	N	5	N	100	70
SG-39S	N	N	<20	15	50	N	7	N	300	70
SG-40S	N	N	<20	7	30	N	5	N	<100	70
SG-41S	N	N	<20	10	15	N	5	N	100	50
SG-42S	<50	N	<20	20	20	N	7	N	100	70
SG-43S	70	N	<20	30	30	N	7	N	100	70
SG-44S	<50	N	<20	15	20	N	7	N	<100	50
SG-45S	<50	N	<20	15	20	N	10	N	300	150
SG-46S	<50	N	<20	70	20	N	20	N	300	150
SG-47S	<50	N	<20	5	10	N	15	N	300	100
SG-48S	<50	N	<20	15	15	N	15	N	300	70
SG-49S	<50	N	<20	20	10	N	15	N	700	150
SG-50S	N	N	<20	50	15	N	7	N	<100	50
SG-51S	N	N	<20	20	10	N	7	N	<100	50
SG-52S	<50	N	<20	30	15	N	7	N	<100	70
SG-53S	<50	N	<20	30	15	N	15	N	<100	70
SG-54S	N	N	<20	30	10	N	7	N	<100	30
SG-55S	<50	N	<20	15	15	N	7	N	150	70
SG-56S	<50	N	<20	15	15	N	7	N	150	70
SG-57S	<50	N	<20	20	20	N	7	N	100	70
SG-58S	<50	N	<20	10	15	N	15	N	300	100

Table 2. Results of analyses of stream-sediment samples from the Sleeping Giant Wilderness Study Area, Lewis and Clark County, Montana.--Continued

Sample	W ppm-s	Y ppm-s	Zn ppm-s	Zr ppm-s	Ga ppm-s	Ge ppm-s	Na %-s	P %-s	Th ppm-s
SG-01S	N	20	N	150	15	N	1.5	N	N
SG-02S	N	30	N	150	15	N	1.5	N	N
SG-03S	N	30	N	200	15	N	1.5	N	N
SG-04S	N	30	N	200	15	N	1.5	N	N
SG-05S	N	50	N	300	15	N	1.5	N	N
SG-06S	N	30	N	200	15	N	1.5	N	N
SG-07S	N	30	N	150	15	N	1.5	N	N
SG-08S	N	30	N	100	15	N	1.5	N	N
SG-09S	N	50	N	100	1	N	1	N	N
SG-10S	N	30	N	200	2	N	1.5	N	N
SG-11S	N	30	N	150	15	N	1.5	N	N
SG-12S	N	30	N	150	15	N	1	N	N
SG-13S	N	30	N	200	15	N	1.5	N	N
SG-14S	N	50	N	300	15	N	1.5	N	N
SG-15S	N	30	N	100	1	N	.7	N	N
SG-16S	N	30	N	150	15	N	1.5	N	N
SG-17S	N	30	N	150	15	N	.7	N	N
SG-18S	N	30	N	150	15	N	1.5	N	N
SG-19S	N	50	N	100	1	N	1.5	N	N
SG-20S	N	50	N	200	15	N	1.5	N	N
SG-21S	N	50	N	100	1	N	.7	N	N
SG-22S	N	30	N	50	5	N	.5	N	N
SG-23S	N	30	N	150	2	N	1.5	N	N
SG-24S	N	30	N	150	15	N	1.5	N	N
SG-25S	N	30	N	100	1	N	1	N	N
SG-26S	N	70	N	150	15	N	1.5	N	N
SG-27S	N	15	N	150	15	N	1	N	N
SG-28S	N	15	N	100	1	N	1.5	N	N
SG-29S	N	20	N	150	15	N	1.5	N	N
SG-30S	N	30	N	200	15	N	1.5	N	N
SG-31S	N	20	N	150	15	N	1.5	N	N
SG-32S	N	30	N	200	15	N	1.5	N	N
SG-33S	N	30	N	150	15	N	1.5	N	N
SG-34S	N	70	N	200	15	N	1.5	N	N
SG-35S	N	50	N	200	15	N	1.5	N	N
SG-36S	N	30	N	200	15	N	1.5	N	N
SG-37S	N	30	N	150	15	N	1.5	N	N
SG-38S	N	15	N	150	15	N	1.5	N	N
SG-39S	N	20	N	150	15	N	1.5	N	N
SG-40S	N	15	N	150	10	N	1.5	N	N
SG-41S	N	20	N	200	15	N	1	N	N
SG-42S	N	30	N	300	15	N	1.5	N	N
SG-43S	N	50	N	150	15	N	1.5	N	N
SG-44S	N	30	N	150	10	N	1.5	N	N
SG-45S	N	20	N	150	15	N	1.5	N	N
SG-46S	N	30	N	300	15	N	1.5	N	N
SG-47S	N	20	N	150	15	N	1.5	N	N
SG-48S	N	30	N	150	15	N	1.5	N	N
SG-49S	N	20	N	100	15	N	1.5	N	N
SG-50S	N	70	N	150	15	N	1	N	N
SG-51S	N	30	N	100	10	N	1	N	N
SG-52S	N	50	N	150	15	N	1.5	N	N
SG-53S	N	50	N	300	15	N	1	N	N
SG-54S	N	50	N	150	15	N	1	N	N
SG-55S	N	30	N	200	15	N	1.5	N	N
SG-56S	N	30	N	150	15	N	1.5	N	N
SG-57S	N	30	N	200	15	N	1.5	N	N
SG-58S	N	30	N	150	15	N	1.5	N	N

Table 3. Results of analyses of nonmagnetic heavy-mineral-concentrate samples from the Sleeping Giant Wilderness Study Area, Lewis and Clark County, Montana.

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

Sample	Latitude	Longtude	Ca	%-s	Fe	%-s	Mg	%-s	Na	%-s	P	%-s	Ti	%-s	Ag ppm-s	As ppm-s
SG-01-C3	46 57 12	112 0 8	7		3		2		1.5		2		1.5		N	N
SG-02-C3	46 57 14	112 0 13	7		5		1.5		1.5		3		1		N	N
SG-03-C3	46 56 50	112 0 20	2		5		1		1		1		1.5		N	300
SG-04-C3	46 56 52	112 0 21	2		7		1		.7		1.5		>1		N	200
SG-05-C3	46 56 18	112 0 37	.7		5		.5		1.5		.5		1		N	N
SG-06-C3	46 56 27	111 59 14	5		2		1		.3		2		>.7		N	N
SG-07-C3	46 56 28	111 58 36	7		3		1		.7		5		1.5		N	N
SG-08-C3	46 55 3	112 2 13	1.5		5		.7		1.5		.7		1.5		N	N
SG-09-C3	46 55 5	112 2 15	1.5		3		.7		.7		.7		>1		N	200
SG-10-C3	46 57 42	112 3 34	1.5		2		.7		.7		1		2		N	N
SG-11-C3	46 57 42	112 3 36	.7		1		.5		.7		.5		.5		N	N
SG-12-C3	46 56 45	112 4 33	1		1		.7		.5		1		>2		1	N
SG-13-C3	46 55 19	112 4 57	2		5		1.5		1.5		.5		.7		N	N
SG-14-C3	46 53 57	112 5 12	5		7		3		1		<.5		.5		<1	N
SG-15-C3	46 55 41	112 3 17	.5		5		1		1		<.5		.7		N	N
SG-16-C3	46 55 56	112 2 42	3		3		.5		1.5		1		>2		N	N
SG-17-C3	46 55 55	112 2 46	.7		1.5		.7		1.5		N		.7		<2	N
SG-18-C3	46 56 14	112 2 50	5		7		.7		.7		3		2		N	N
SG-19-C3	46 55 31	112 2 13	3		7		<.5		<5		N		2		N	N
SG-20-C3	46 54 27	112 4 39	2		5		1.5		1.5		.5		.7		N	N
SG-21-C3	46 53 54	112 4 24	.7		2		.5		2		N		.5		N	N
SG-22-C3	46 53 28	112 3 47	1.5		5		.5		1.5		1		1.5		N	N
SG-23-C3	46 53 10	112 3 16	5		2		.2		1		.5		>2		N	N
SG-24-C3	46 56 53	112 3 0	1		1		.5		1		<.7		1		N	N
SG-25-C3	46 56 53	112 3 2	1		1.5		.5		.3		.7		>1.5		N	N
SG-26-C3	46 54 45	111 59 46	1		7		.5		1.5		<.5		1		N	N
SG-27-C3	46 54 40	111 57 7	5		2		.3		.7		2		1		N	N
SG-28-C3	46 54 29	111 57 24	15		3		.1		<.5		1		.1		N	N
SG-29-C3	46 54 20	111 58 7	15		3		.3		.5		2		.15		3	N
SG-30-C3	46 53 7	111 57 51	7		5		.3		.3		3		>.7			<200
SG-31-C3	46 53 4	111 58 20	15		2		.1		<.5		2		.2		1	N
SG-32-C3	46 53 10	111 59 44	5		2		.2		1.5		1.5		>2		N	N
SG-33-C3	46 54 56	112 0 45	2		10		.7		.7		1.5		>1.5		N	<300
SG-34-C3	46 54 26	112 0 43	.7		5		.2		.3		.5		>.7		N	<150
SG-35-C3	46 54 28	112 0 46	1		5		.2		.5		1		1.5		N	N
SG-36-C3	46 54 17	112 0 57	1		10		.3		1		.7		1		N	N
SG-37-C3	46 53 55	111 57 19	10		3		.2		.5		7		.7		N	N
SG-38-C3	46 54 1	111 56 57	10		1		.2		.5		5		2		N	N
SG-39-C3	46 54 26	111 56 19	15		1.5		.5		.7		5		2		N	N
SG-40-C3	46 54 42	111 56 38	20		1.5		.3		.5		10		>2		N	N
SG-41-C3	46 54 54	111 57 3	15		1		1		.5		7		1.5		N	N
SG-42-C3	46 56 12	111 57 28	7		.5		.3		.7		3		>2		N	N
SG-43-C3	46 55 49	111 57 36	5		.5		.3		<.5		3		>2		N	N
SG-44-C3	46 55 23	111 58 38	--		--		--		--		--		--		--	--
SG-45-C3	46 55 21	111 58 16	30		2		.2		.5		5		.7		N	N
SG-46-C3	46 56 37	111 58 36	5		1		.3		1.5		3		1.5		N	N
SG-47-C3	46 56 53	111 58 19	10		2		.7		1.5		2		2		N	<500
SG-48-C3	46 57 26	111 57 39	15		.7		.5		.7		7		>2		N	N
SG-49-C3	46 57 45	111 58 52	20		.5		.1		1.5		20		.3		N	N
SG-50-C3	46 54 9	112 1 0	--		--		--		--		--		--		--	--
SG-51-C3	46 53 6	112 1 38	--		--		--		--		--		--		--	--
SG-52-C3	46 53 53	112 1 17	--		--		--		--		--		--		--	--
SG-53-C3	46 53 34	112 1 23	--		--		--		--		--		--		--	--
SG-54-C3	46 53 44	112 1 19	--		--		--		--		--		--		--	--
SG-55-C3	46 57 14	111 57 15	7		.7		.7		.5		5		>2		N	<500
SG-56-C3	46 57 31	111 58 6	10		.5		.5		.7		5		>2		N	N
SG-57-C3	46 55 12	111 56 41	7		.7		.5		.7		3		>2		N	N
SG-58-C3	46 56 51	111 57 43	7		.7		.5		1		5		2		N	N

Table 3. Results of analyses of nonmagnetic heavy-mineral-concentrate samples from the Sleeping Giant Wilderness Study Area, Lewis and Clark County, Montana.--Continued

Sample	Au ppm-s	B ppm-s	Ba ppm-s	Be ppm-s	Bi ppm-s	Cd ppm-s	Co ppm-s	Cr ppm-s	Cu ppm-s
SG-01-C3	N	20	1,500	3	N	N	20	200	30
SG-02-C3	N	20	700	2	N	N	30	300	30
SG-03-C3	N	100	700	7	N	N	20	300	70
SG-04-C3	N	100	>5,000	7	N	N	30	500	70
SG-05-C3	N	100	1,000	5	N	N	30	30	50
SG-06-C3	N	10	>3,000	1.5	N	N	10	100	30
SG-07-C3	N	50	7,000	3	N	N	<20	70	30
SG-08-C3	N	100	3,000	7	N	N	<20	30	30
SG-09-C3	N	150	1,500	7	N	N	15	70	30
SG-10-C3	N	70	>10,000	3	N	N	<20	70	500
SG-11-C3	N	20	>10,000	N	N	N	<20	100	1,000
SG-12-C3	N	50	>10,000	2	N	N	<20	100	200
SG-13-C3	N	100	>10,000	3	N	N	20	500	300
SG-14-C3	N	70	7,000	5	<20	N	30	1,500	50
SG-15-C3	N	100	>10,000	5	N	N	30	30	30
SG-16-C3	N	100	10,000	7	N	N	<20	70	150
SG-17-C3	N	100	7,000	N	N	N	N	<50	100
SG-18-C3	N	150	700	7	N	N	N	70	20
SG-19-C3	N	<300	700	N	N	N	N	<300	200
SG-20-C3	N	70	>10,000	3	N	N	20	700	100
SG-21-C3	N	100	1,000	5	N	N	N	<50	70
SG-22-C3	N	100	700	5	N	N	<20	70	50
SG-23-C3	N	50	500	3	N		N	20	30
SG-24-C3	N	70	>20,000	3	N	N	N	<30	30
SG-25-C3	N	15	>7,000	1.5	N	N	<15	150	20
SG-26-C3	N	100	1,000	5	N	N	20	30	100
SG-27-C3	N	50	>10,000	2	N	N	N	20	30
SG-28-C3	N	50	700	10	N	N	N	<20	15
SG-29-C3	N	50	300	7	N	N	N	50	15
SG-30-C3	N	70	>3,000	5	N		20	500	50
SG-31-C3	N	30	3,000	7	N	N	N	<20	15
SG-32-C3	N	20	7,000	10	N	N	<20	70	30
SG-33-C3	N	150	1,000	10	N	N	50	70	150
SG-34-C3	N	30	200	7	N	N	10	15	70
SG-35-C3	N	70	500	3	N	N	15	20	100
SG-36-C3	N	20	700	5	N	N	30	30	200
SG-37-C3	N	<20	>10,000	3	N	N	N	50	30
SG-38-C3	N	20	>10,000	2	N	N	N	50	20
SG-39-C3	N	30	2,000	2	N	N	<20	300	15
SG-40-C3	N	20	>10,000	3	N	N	<20	50	20
SG-41-C3	N	30	>10,000	N	N	N	<20	50	15
SG-42-C3	N	20	1,000	5	N	N	N	70	<10
SG-43-C3	N	<20	>10,000	5	N	N	N	70	<10
SG-44-C3	--	--	--	--	--	--	--	--	--
SG-45-C3	N	150	5,000	7	N	N	<20	<20	20
SG-46-C3	N	20	700	3	N	N	<20	30	15
SG-47-C3	N	20	1,000	3	N	N	<20	70	70
SG-48-C3	N	20	300	3	N	N	N	70	10
SG-49-C3	N	<20	>10,000	N	N	N	N	<20	15
SG-50-C3	--	--	--	--	--	--	--	--	--
SG-51-C3	--	--	--	--	--	--	--	--	--
SG-52-C3	--	--	--	--	--	--	--	--	--
SG-53-C3	--	--	--	--	--	--	--	--	--
SG-54-C3	--	--	--	--	--	--	--	--	--
SG-55-C3	N	50	500	7	N	N	N	100	20
SG-56-C3	N	20	700	5	N	N	N	100	<10
SG-57-C3	N	70	700	10	N	N	N	150	<10
SG-58-C3	N	20	>10,000	7	N	N	N	50	<10

Table 3. Results of analyses of nonmagnetic heavy-mineral-concentrate samples from the Sleeping Giant Wilderness Study Area, Lewis and Clark County, Montana.--Continued

Sample	Ga ppm-s	Ge ppm-s	La ppm-s	Mn ppm-s	Mo ppm-s	Nb ppm-s	Ni ppm-s	Pb ppm-s	Sb ppm-s	Sc ppm-s
SG-01-C3	10	N	200	700	N	50	50	<20	N	30
SG-02-C3	10	N	300	500	N	<50	30	20	N	30
SG-03-C3	20	N	1,000	700	N	70	50	70	N	50
SG-04-C3	20	N	1,000	1,500	5	70	70	700	N	70
SG-05-C3	15	N	700	500	N	50	30	50	N	15
SG-06-C3	10	N	500	300	5	50	15	50	N	15
SG-07-C3	10	N	300	300	N	70	10	70	N	10
SG-08-C3	15	N	700	200	N	50	20	50	N	15
SG-09-C3	30	N	500	200	N	30	15	700	150	30
SG-10-C3	10	N	300	150	N	100	10	1,000	N	10
SG-11-C3	<10	N	N	150	N	<50	<10	15,000	<200	<10
SG-12-C3	<10	N	100	150	N	100	10	5,000	N	15
SG-13-C3	15	N	150	500	N	<50	30	1,500	N	20
SG-14-C3	10	N	200	500	N	<50	70	5,000	N	30
SG-15-C3	10	N	N	200	N	<50	20	150	N	10
SG-16-C3	15	N	1,500	150	N	100	10	1,000	<200	30
SG-17-C3	<20	N	N	100	N	<100	<20	7,000	1,500	N
SG-18-C3	20	N	700	300	N	70	<20	50	N	30
SG-19-C3	N	N	N	500	N	<500	<150	N	N	N
SG-20-C3	10	N	N	500	N	<50	30	70	N	20
SG-21-C3	<20	N	<200	150	N	<100	<20	1,500	N	<20
SG-22-C3	20	N	300	200	N	50	10	700	N	15
SG-23-C3	10	N	1,000	150	N	100	<10	500	<200	50
SG-24-C3	<20	N	N	300	N	<70	<20	300	N	20
SG-25-C3	<7	N	200	150	N	70	7	20	N	10
SG-26-C3	10	N	300	500	N	50	30	500	N	15
SG-27-C3	<10	N	150	200	N	50	<10	30	N	<10
SG-28-C3	50	N	N	200	N	<50	<10	150	N	N
SG-29-C3	50	N	100	200	N	<50	<10	20	N	<10
SG-30-C3	10	N	700	300	10	30	20	200	N	30
SG-31-C3	30	N	150	200	N	<50	<10	<20	N	<10
SG-32-C3	15	N	300	500	N	70	20	30	N	20
SG-33-C3	20	N	700	1,000	10	100	50	100	N	30
SG-34-C3	10	N	>700	150	N	30	10	30	N	30
SG-35-C3	7	N	1,000	200	N	50	15	50	N	10
SG-36-C3	15	N	300	1,000	N	<50	30	100	N	10
SG-37-C3	15	N	300	200	N	<50	<10	70	N	10
SG-38-C3	<10	N	700	150	N	50	<10	50	N	15
SG-39-C3	<10	N	700	300	N	100	10	1,500	N	10
SG-40-C3	10	N	700	500	N	70	<10	50	N	15
SG-41-C3	<10	N	300	150	N	50	<10	150	N	15
SG-42-C3	10	N	200	200	N	70	<10	1,000	N	20
SG-43-C3	10	N	150	150	N	70	<10	70	N	20
SG-44-C3	--	--	--	--	--	--	--	--	--	--
SG-45-C3	50	N	300	500	N	<50	<10	50	N	<10
SG-46-C3	10	N	200	150	N	50	<10	70	<200	15
SG-47-C3	30	N	150	500	N	100	<10	10,000	N	10
SG-48-C3	10	N	300	300	N	100	<10	150	N	15
SG-49-C3	<10	N	700	500	20	<50	<10	20	N	N
SG-50-C3	--	--	--	--	--	--	--	--	--	--
SG-51-C3	--	--	--	--	--	--	--	--	--	--
SG-52-C3	--	--	--	--	--	--	--	--	--	--
SG-53-C3	--	--	--	--	--	--	--	--	--	--
SG-54-C3	--	--	--	--	--	--	--	--	--	--
SG-55-C3	10	N	300	500	N	70	<10	200	N	30
SG-56-C3	15	N	300	300	N	70	<10	70	N	15
SG-57-C3	<10	N	300	300	N	100	<10	70	N	30
SG-58-C3	10	N	150	300	N	50	<10	50	N	15

Table 3. Results of analyses of nonmagnetic heavy-mineral-concentrate samples from the Sleeping Giant Wilderness Study Area, Lewis and Clark County, Montana.--Continued

Sample	Sn ppm-s	Sr ppm-s	Th ppm-s	V ppm-s	W ppm-s	Y ppm-s	Zn ppm-s	Zr ppm-s	Pd ppm-s	Pt ppm-s
SG-01-C3	20	300	N	100	N	200	N	>2,000	N	N
SG-02-C3	N	300	N	150	N	200	N	>2,000	N	N
SG-03-C3	70	200	N	200	N	500	N	>1,500	N	N
SG-04-C3	70	700	N	300	N	500	N	>1,000	N	N
SG-05-C3	N	<200	N	70	N	150	N	>2,000	N	N
SG-06-C3	15	>3,000	N	200	N	200	N	>700	N	N
SG-07-C3	N	300	N	150	N	300	N	>2,000	N	N
SG-08-C3	N	<200	N	70	N	200	N	2,000	N	N
SG-09-C3	N	200	N	100	N	300	300	>1,000	N	N
SG-10-C3	N	1,500	N	50	N	100	1,000	>2,000	N	N
SG-11-C3	500	7,000	N	50	N	70	N	>2,000	N	N
SG-12-C3	1,500	2,000	N	70	N	100	1,500	>2,000	N	N
SG-13-C3	1,500	200	N	150	N	70	N	2,000	N	N
SG-14-C3	30	<200	N	100	N	70	N	2,000	N	N
SG-15-C3	N	300	N	70	N	70	N	>2,000	N	N
SG-16-C3	300	200	N	70	N	700	N	>2,000	N	N
SG-17-C3	1,000	<500	N	<50	N	100	N	500	N	N
SG-18-C3	N	<500	N	150	N	500	2,000	5,000	N	N
SG-19-C3	N	N	N	N	N	700	N	7,000	N	N
SG-20-C3	N	200	N	70	N	70	N	>2,000	N	N
SG-21-C3	3,000	N	N	50	N	70	N	500	N	N
SG-22-C3	1,500	<200	N	70	N	300	N	1,500	N	N
SG-23-C3	100	<200	N	70	N	1,500	N	>2,000	N	N
SG-24-C3	N	500	N	70	N	300	N	>3,000	N	N
SG-25-C3	N	3,000	N	50	N	150	N	>1,500	N	N
SG-26-C3	N	<200	N	70	N	300	N	1,500	N	N
SG-27-C3	N	1,000	N	70	N	200	N	>2,000	N	N
SG-28-C3	N	<200	N	300	N	50	N	300	N	N
SG-29-C3	N	200	N	200	N	70	N	500	N	N
SG-30-C3	20	>3,000	N	300	N	500	N	>700	N	N
SG-31-C3	N	200	N	300	N	70	N	700	N	N
SG-32-C3	N	700	N	300	N	200	500	>2,000	N	N
SG-33-C3	150	300	N	200	N	500	1,500	>1,500	N	N
SG-34-C3	7	150	N	50	N	200	N	>700	N	N
SG-35-C3	N	<150	N	50	N	500	N	>1,500	N	N
SG-36-C3	N	N	N	70	N	200	700	2,000	N	N
SG-37-C3	N	1,500	N	70	N	200	N	>2,000	N	N
SG-38-C3	N	2,000	<200	70	N	500	N	>2,000	N	N
SG-39-C3	50	300	N	150	N	500	N	>2,000	N	N
SG-40-C3	20	1,500	<200	200	N	700	N	>2,000	N	N
SG-41-C3	N	3,000	<200	70	N	300	N	1,500	N	N
SG-42-C3	150	<200	300	100	N	300	N	>2,000	N	N
SG-43-C3	30	200	700	150	N	300	N	>2,000	N	N
SG-44-C3	--	--	--	--	--	--	--	--	--	--
SG-45-C3	N	700	N	150	N	200	N	700	N	N
SG-46-C3	70	300	200	70	N	300	N	>2,000	N	N
SG-47-C3	70	700	<200	100	N	300	1,000	>2,000	N	N
SG-48-C3	30	300	<200	150	N	500	N	>2,000	N	N
SG-49-C3	N	2,000	N	100	N	300	N	>2,000	N	N
SG-50-C3	--	--	--	--	--	--	--	--	--	--
SG-51-C3	--	--	--	--	--	--	--	--	--	--
SG-52-C3	--	--	--	--	--	--	--	--	--	--
SG-53-C3	--	--	--	--	--	--	--	--	--	--
SG-54-C3	--	--	--	--	--	--	--	--	--	--
SG-55-C3	200	200	700	150	N	700	N	>2,000	N	N
SG-56-C3	20	300	<200	150	N	500	N	>2,000	N	N
SG-57-C3	30	<200	500	150	N	500	N	>2,000	N	N
SG-58-C3	N	700	<200	70	N	300	N	>2,000	N	N

Table 4. Results of analyses of paramagnetic heavy-mineral-concentrate samples from the Sleeping Giant Wilderness Study Area, Lewis and Clark County, Montana.

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

Sample	Latitude	Longtude	Ca	%-s	Fe	%-s	Mg	%-s	Na	%-s	P	%-s	Ti	%-s	Ag ppm-s	As ppm-s
SG-01-C2	46 57 12	112 0 8	5		10		10		.7		N		.3		N	N
SG-02-C2	46 57 14	112 0 13	5		10		7		.7		N		.3		N	N
SG-03-C2	46 56 50	112 0 20	.2		15		.2		.5		.7		.07		N	N
SG-04-C2	46 56 52	112 0 21	1		15		.7		.7		.7		.2		N	N
SG-05-C2	46 56 18	112 0 37	.2		15		.3		.7		.7		.1		N	N
SG-06-C2	46 56 27	111 59 14	5		10		3		.7		N		1		N	N
SG-07-C2	46 56 28	111 58 36	3		10		3		.7		N		1.5		N	N
SG-08-C2	46 55 3	112 2 13	7		7		5		.7		N		.7		N	<500
SG-09-C2	46 55 5	112 2 15	.7		15		.5		.7		N		.1		N	<500
SG-10-C2	46 57 42	112 3 34	.7		30		.7		.5		N		.3		N	1,500
SG-11-C2	46 57 42	112 3 36	.3		20		.3		.7		1		.15		N	N
SG-12-C2	46 56 45	112 4 33	5		15		5		.7		N		1.5		N	N
SG-13-C2	46 55 19	112 4 57	7		7		7		.7		N		1.5		N	N
SG-14-C2	46 53 57	112 5 12	1.5		20		.7		.7		N		.2		5	N
SG-15-C2	46 55 41	112 3 17	--		--		--		--		--		--		--	--
SG-16-C2	46 55 56	112 2 42	.3		15		.3		.7		.7		.15		N	N
SG-17-C2	46 55 55	112 2 46	.3		15		.5		1		<.5		.15		N	N
SG-18-C2	46 56 14	112 2 50	.3		15		.3		.7		<.5		.2		N	N
SG-19-C2	46 55 31	112 2 13	.15		20		.2		.5		1		.07		N	N
SG-20-C2	46 54 27	112 4 39	3		15		2		.7		N		.3		N	700
SG-21-C2	46 53 54	112 4 24	.5		15		.7		.7		.5		.3		N	N
SG-22-C2	46 53 28	112 3 47	.5		15		.5		.7		<.5		.5		N	N
SG-23-C2	46 53 10	112 3 16	.2		15		.3		.7		.7		.3		N	N
SG-24-C2	46 56 53	112 3 0	.5		15		.5		.7		.5		.07		N	N
SG-25-C2	46 56 53	112 3 2	1.5		20		1		.7		.5		.3		N	<500
SG-26-C2	46 54 45	111 59 46	.15		30		.2		<.5		1.5		.05		N	N
SG-27-C2	46 54 40	111 57 7	3		20		1.5		.7		N		2		N	N
SG-28-C2	46 54 29	111 57 24	10		10		1.5		.7		N		.7		N	N
SG-29-C2	46 54 20	111 58 7	7		10		5		.7		N		.7		N	N
SG-30-C2	46 53 7	111 57 51	1		20		1		.5		.5		1		3	<500
SG-31-C2	46 53 4	111 58 20	7		7		2		.7		N		.7		N	N
SG-32-C2	46 53 10	111 59 44	5		7		.7		1.5		N		.3		N	N
SG-33-C2	46 54 56	112 0 45	.2		30		.2		.5		1		.07		N	N
SG-34-C2	46 54 26	112 0 43	.15		20		.3		.7		1		.1		N	N
SG-35-C2	46 54 28	112 0 46	.2		30		.2		.5		1		.07		N	N
SG-36-C2	46 54 17	112 0 57	.15		20		.2		.5		1		.15		N	N
SG-37-C2	46 53 55	111 57 19	5		15		3		.7		N		.7		3	N
SG-38-C2	46 54 1	111 56 57	2		15		1		.7		N		.7		2	N
SG-39-C2	46 54 26	111 56 19	3		15		2		.7		N		1		N	N
SG-40-C2	46 54 42	111 56 38	3		15		2		.7		N		1		N	N
SG-41-C2	46 54 54	111 57 3	3		15		2		.7		.5		1.5		1	<500
SG-42-C2	46 56 12	111 57 28	3		15		2		.7		<.5		>2		N	N
SG-43-C2	46 55 49	111 57 36	3		20		3		.7		N		>2		N	N
SG-44-C2	46 55 23	111 58 38	3		15		2		.7		.5		.5		N	N
SG-45-C2	46 55 21	111 58 16	5		15		2		.7		<.5		1.5		N	N
SG-46-C2	46 56 37	111 58 36	7		15		7		.5		<.5		.7		N	N
SG-47-C2	46 56 53	111 58 19	5		15		7		.7		N		1		N	N
SG-48-C2	46 57 26	111 57 39	5		15		3		.7		.5		2		N	N
SG-49-C2	46 57 45	111 58 52	5		15		7		.7		.5		.7		N	N
SG-50-C2	46 54 9	112 1 0	.3		30		.5		.7		1.5		.1		N	N
SG-51-C2	46 53 6	112 1 38	.5		30		.3		.5		1.5		.15		N	N
SG-52-C2	46 53 53	112 1 17	.7		20		.5		.5		1		.15		N	N
SG-53-C2	46 53 34	112 1 23	1.5		30		1.5		<.5		1		.15		N	N
SG-54-C2	46 53 44	112 1 19	.3		30		.3		.5		1.5		.1		N	N
SG-55-C2	46 57 14	111 57 15	5		15		3		.7		<.5		>2		N	N
SG-56-C2	46 57 31	111 58 6	7		15		5		.7		<.5		1.5		N	N
SG-57-C2	46 55 12	111 56 41	5		15		3		.7		N		2		N	N
SG-58-C2	46 56 51	111 57 43	10		15		7		.7		N		1.5		N	N

Table 4. Results of analyses of paramagnetic heavy-mineral-concentrate samples from the Sleeping Giant Wilderness Study Area, Lewis and Clark County, Montana.--Continued

Sample	Au ppm-s	B ppm-s	Ba ppm-s	Be ppm-s	Bi ppm-s	Cd ppm-s	Co ppm-s	Cr ppm-s	Cu ppm-s
SG-01-C2	N	N	70	N	N	N	70	500	20
SG-02-C2	N	N	100	N	N	N	70	500	20
SG-03-C2	N	<20	700	10	N	N	70	30	200
SG-04-C2	N	N	700	10	N	N	70	200	200
SG-05-C2	N	N	700	10	N	N	100	50	300
SG-06-C2	N	70	700	2	N	N	70	1,000	100
SG-07-C2	N	50	200	N	N	N	30	1,000	100
SG-08-C2	N	20	700	N	N	N	50	1,500	50
SG-09-C2	N	N	500	10	<20	N	70	70	150
SG-10-C2	N	70	300	10	30	N	200	20	300
SG-11-C2	N	20	500	15	N	N	50	30	200
SG-12-C2	N	100	500	3	N	N	30	1,000	70
SG-13-C2	N	30	300	3	N	N	50	1,500	50
SG-14-C2	20	<20	500	15	N	N	70	500	150
SG-15-C2	--	--	--	--	--	--	--	--	--
SG-16-C2	N	<20	300	10	N	N	50	50	200
SG-17-C2	N	20	300	7	N	N	70	20	150
SG-18-C2	N	30	300	5	N	N	30	30	100
SG-19-C2	N	N	300	15	N	N	70	30	300
SG-20-C2	N	<20	500	7	<20	N	100	1,000	200
SG-21-C2	N	70	500	10	N	N	50	70	150
SG-22-C2	N	70	700	10	N	N	30	70	100
SG-23-C2	N	<20	300	10	N	N	30	20	150
SG-24-C2	N	<20	300	10	N	N	70	30	200
SG-25-C2	N	20	500	10	N	N	150	200	300
SG-26-C2	N	N	500	10	N	N	100	20	300
SG-27-C2	N	100	1,000	2	N	N	70	200	150
SG-28-C2	N	20	150	10	N	N	30	100	50
SG-29-C2	N	20	150	5	N	N	50	300	70
SG-30-C2	N	100	700	3	<20	N	70	200	200
SG-31-C2	N	<20	150	7	N	N	30	200	100
SG-32-C2	N	30	300	5	N	N	30	30	50
SG-33-C2	N	N	700	15	N	N	150	30	300
SG-34-C2	N	20	300	10	N	N	70	30	300
SG-35-C2	N	<20	500	10	N	N	70	30	300
SG-36-C2	N	N	300	10	N	N	100	20	300
SG-37-C2	N	<20	1,000	3	N	N	30	500	150
SG-38-C2	N	100	1,000	2	N	N	30	100	150
SG-39-C2	N	N	150	N	N	N	50	300	100
SG-40-C2	N	30	150	N	N	N	50	500	70
SG-41-C2	N	100	1,500	3	N	N	70	200	150
SG-42-C2	N	70	200	2	N	N	70	300	30
SG-43-C2	N	70	300	3	N	N	70	700	70
SG-44-C2	N	70	300	5	N	N	70	100	150
SG-45-C2	N	<20	300	5	N	N	50	100	150
SG-46-C2	N	20	150	N	N	N	100	700	50
SG-47-C2	N	<20	150	N	N	N	70	150	20
SG-48-C2	N	70	150	2	N	N	70	300	30
SG-49-C2	N	20	700	N	N	N	100	300	150
SG-50-C2	N	30	300	15	N	N	100	30	300
SG-51-C2	N	20	300	15	N	N	70	30	300
SG-52-C2	N	20	700	15	N	N	100	70	300
SG-53-C2	N	N	300	15	N	N	70	300	200
SG-54-C2	N	20	700	15	N	N	100	30	300
SG-55-C2	N	70	200	N	N	N	70	500	50
SG-56-C2	N	50	200	2	N	N	100	700	50
SG-57-C2	N	100	150	N	N	N	70	500	50
SG-58-C2	N	20	150	N	N	N	70	700	30

Table 4. Results of analyses of paramagnetic heavy-mineral-concentrate samples from the Sleeping Giant Wilderness Study Area, Lewis and Clark County, Montana.--Continued

Sample	Ga ppm-s	Ge ppm-s	La ppm-s	Mn ppm-s	Mo ppm-s	Nb ppm-s	Ni ppm-s	Pb ppm-s	Sb ppm-s	Sc ppm-s
SG-01-C2	<10	N	N	3,000	N	<50	150	N	N	100
SG-02-C2	<10	N	N	2,000	N	<50	150	N	N	150
SG-03-C2	10	N	150	3,000	15	<50	100	150	N	<10
SG-04-C2	10	N	150	3,000	10	<50	70	150	N	15
SG-05-C2	10	N	100	3,000	15	<50	100	150	N	<10
SG-06-C2	10	N	200	1,500	N	<50	50	200	N	70
SG-07-C2	10	N	100	1,500	N	<50	50	50	N	70
SG-08-C2	10	N	N	1,500	N	<50	70	70	N	70
SG-09-C2	15	N	300	1,500	10	<50	50	300	N	15
SG-10-C2	15	N	N	500	20	<50	70	500	N	10
SG-11-C2	15	N	700	2,000	15	<50	70	150	N	10
SG-12-C2	10	N	N	1,500	N	<50	50	70	N	70
SG-13-C2	10	N	100	1,500	N	<50	100	70	N	100
SG-14-C2	15	N	200	1,000	10	<50	70	500	N	20
SG-15-C2	--	--	--	--	--	--	--	--	--	--
SG-16-C2	15	N	1,000	2,000	15	<50	70	150	N	10
SG-17-C2	15	N	N	700	10	<50	50	200	N	10
SG-18-C2	20	N	100	700	N	<50	30	150	N	15
SG-19-C2	15	N	150	3,000	15	<50	70	150	N	<10
SG-20-C2	10	N	N	1,500	30	<50	150	500	N	30
SG-21-C2	20	N	700	500	10	<50	50	200	N	15
SG-22-C2	15	N	1,500	500	10	<50	50	150	N	20
SG-23-C2	15	N	700	700	10	<50	50	200	N	10
SG-24-C2	15	N	500	2,000	10	<50	70	200	N	N
SG-25-C2	15	N	500	700	10	<50	70	150	N	15
SG-26-C2		N	300	2,000	10	<50	150	100	N	N
SG-27-C2	15	N	1,000	3,000	15	50	70	150	N	50
SG-28-C2	30	N	100	700	10	<50	30	70	N	30
SG-29-C2	20	N	100	1,500	10	<50	70	70	N	70
SG-30-C2	15	N	1,000	2,000	50	<50	150	500	N	15
SG-31-C2	30	N	150	700	15	<50	50	70	N	30
SG-32-C2	30	N	150	1,000	N	<50	30	100	N	20
SG-33-C2	10	N	200	5,000	20	<50	150	150	N	<10
SG-34-C2	15	N	300	1,500	10	<50	100	100	N	<10
SG-35-C2	15	N	N	3,000	15	<50	100	150	N	<10
SG-36-C2	15	N	100	3,000	10	<50	100	150	N	<10
SG-37-C2	15	N	300	1,000	15	<50	50	150	N	50
SG-38-C2	15	N	700	1,500	15	<50	70	200	N	15
SG-39-C2	15	N	300	3,000	N	50	50	50	N	30
SG-40-C2	15	N	700	3,000	N	50	70	70	N	70
SG-41-C2	15	N	500	2,000	70	50	100	200	N	30
SG-42-C2	20	N	500	3,000	N	50	70	30	N	50
SG-43-C2	20	N	500	3,000	N	70	70	70	N	70
SG-44-C2	15	N	700	1,500	15	<50	70	100	N	30
SG-45-C2	20	N	200	2,000	50	<50	50	100	N	50
SG-46-C2	10	N	100	2,000	N	<50	150	<20	N	100
SG-47-C2	10	N	N	3,000	N	<50	70	20	N	70
SG-48-C2	15	N	500	3,000	N	70	100	200	N	70
SG-49-C2	10	N	100	3,000	N	<50	100	<20	N	70
SG-50-C2		N	300	1,500	20	<50	150	150	N	10
SG-51-C2		N	300	1,000	15	<50	150	200	N	10
SG-52-C2		N	100	3,000	15	<50	150	150	N	15
SG-53-C2		N	200	1,000	10	<50	150	100	N	15
SG-54-C2		N	700	3,000	20	<50	200	150	N	10
SG-55-C2	15	N	700	3,000	N	70	100	100	N	70
SG-56-C2	20	N	500	3,000	N	70	150	50	N	70
SG-57-C2	15	N	700	3,000	N	70	70	50	N	70
SG-58-C2	10	N	150	3,000	N	<50	50	20	N	150

Table 4. Results of analyses of paramagnetic heavy-mineral-concentrate samples from the Sleeping Giant Wilderness Study Area, Lewis and Clark County, Montana.--Continued

Sample	Sn ppm-s	Sr ppm-s	Th ppm-s	V ppm-s	W ppm-s	Y ppm-s	Zn ppm-s	Zr ppm-s	Pd ppm-s	Pt ppm-s
SG-01-C2	N	N	N	300	N	70	N	300	N	N
SG-02-C2	N	N	N	300	N	50	N	200	N	N
SG-03-C2	N	N	N	100	N	70	1,500	100	N	N
SG-04-C2	N	N	N	100	N	150	700	150	N	N
SG-05-C2	N	N	N	70	N	70	700	70	N	N
SG-06-C2	100	N	N	300	N	100	N	150	N	N
SG-07-C2	N	N	N	300	N	100	N	150	N	N
SG-08-C2	150	<200	N	300	N	50	N	200	N	N
SG-09-C2	N	N	N	100	N	70	500	100	N	N
SG-10-C2	N	N	N	150	N	70	700	150	N	N
SG-11-C2	N	N	N	150	N	100	1,000	70	N	N
SG-12-C2	N	N	N	300	N	100	N	500	N	N
SG-13-C2	70	<200	N	300	N	50	N	150	N	N
SG-14-C2	300	N	N	150	N	70	700	150	N	N
SG-15-C2	--	--	--	--	--	--	--	--	--	--
SG-16-C2	N	N	N	100	N	100	1,000	70	N	N
SG-17-C2	70	N	N	70	N	100	N	300	N	N
SG-18-C2	N	N	N	150	N	70	N	150	N	N
SG-19-C2	N	N	N	100	N	150	1,500	50	N	N
SG-20-C2	N	<200	N	150	N	50	N	150	N	N
SG-21-C2	300	<200	N	100	N	100	700	300	N	N
SG-22-C2	N	N	N	150	N	200	700	300	N	N
SG-23-C2	N	N	N	100	N	150	1,000	70	N	N
SG-24-C2	N	N	N	70	N	100	1,000	100	N	N
SG-25-C2	N	N	N	150	N	200	700	150	N	N
SG-26-C2	N	<200	N	100	N	150	1,500	50	N	N
SG-27-C2	N	<200	N	300	N	200	N	500	N	N
SG-28-C2	N	<200	N	300	N	50	N	150	N	N
SG-29-C2	N	<200	N	300	N	70	N	150	N	N
SG-30-C2	N	<200	N	150	N	500	500	200	N	N
SG-31-C2	N	<200	N	300	N	70	N	150	N	N
SG-32-C2	N	2,000	N	200	N	70	N	100	N	N
SG-33-C2	N	<200	N	100	N	150	1,500	70	N	N
SG-34-C2	N	<200	N	100	N	150	1,500	100	N	N
SG-35-C2	N	N	N	100	N	100	1,500	70	N	N
SG-36-C2	N	<200	N	150	N	100	1,500	70	N	N
SG-37-C2	N	<200	N	200	N	150	N	100	N	N
SG-38-C2	N	<200	N	150	N	100	N	500	N	N
SG-39-C2	N	<200	N	300	N	70	N	500	N	N
SG-40-C2	20	<200	N	300	N	100	N	700	N	N
SG-41-C2	N	N	N	200	N	150	500	1,500	N	N
SG-42-C2	N	N	N	300	N	200	N	>2,000	N	N
SG-43-C2	<20	N	N	500	N	150	500	>2,000	N	N
SG-44-C2	N	N	N	150	N	150	700	500	N	N
SG-45-C2	N	N	N	300	N	70	N	1,500	N	N
SG-46-C2	N	N	N	300	N	70	N	500	N	N
SG-47-C2	N	N	N	300	N	70	N	1,000	N	N
SG-48-C2	<20	N	N	300	N	200	N	1,500	N	N
SG-49-C2	N	N	N	300	N	70	N	700	N	N
SG-50-C2	N	N	N	150	N	150	1,500	100	N	N
SG-51-C2	N	N	N	150	N	150	1,500	150	N	N
SG-52-C2	N	N	N	100	N	200	1,500	150	N	N
SG-53-C2	N	N	N	100	N	150	1,500	150	N	N
SG-54-C2	N	N	N	100	N	200	2,000	150	N	N
SG-55-C2	<20	N	200	300	N	300	N	>2,000	N	N
SG-56-C2	<20	N	N	500	N	200	N	2,000	N	N
SG-57-C2	<20	N	N	300	N	200	N	>2,000	N	N
SG-58-C2	N	N	N	300	N	200	N	1,500	N	N