UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Analytical results and sample locality map of stream-sediment, heavy-mineral-concentrate, and rock samples from the Rough Hills Wilderness Study Area, Elko County, Nevada (NV-010-151)

By

B. M. Adrian[1], R. L. Turner[1], M. J. Malcolm[1], D. L. Fey[1], J. G. Crock[1], and T. A. Delaney[1]

Open-File Report 87-431

[1]DFC, Box 25046, MS 973, Denver, CO 80225

1987

CONTENTS

ILLUSTRATIONS

TABLES

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 Rough Hills Wilderness Study Area, Elko County, Nevada (NV-010-151).

INTRODUCTION

In May 1985, the U.S. Geological Survey conducted a reconnaissance geochemical survey of the Rough Hills Wilderness Study Area, Elko County, Nevada.

The Rough Hills Wilderness Study Area comprises about 10.45 mi^2 (27.05 km^2) (6,685 acres) in the north-central part of Elko County, Nevada, and lies about 85 mi (137 km) north of Elko, Nevada (see fig. 1). Access to the study area is provided on the south by State Highway 51 and on the periphery by dirt roads.

GEOLOGIC SUMMARY

Most of the study area is underlain by the Jarbidge Rhyolite, which erupted approximately 15.4 million years ago. This unit includes domes, ash-flow tuffs, flows, and interbedded volcaniclastic sedimentary rocks. The rhyolite contains large phenocrysts of quartz and potassium feldspar in a fine-grained reddish matrix. Colluvium and landslide deposits derived from the rhyolite flank the western and southern edges of the study area. Unrelated volcanic rocks are exposed along the southwestern and western edges of the area. Tuffaceous sedimentary rocks cover the Jarbidge Rhyolite along the eastern margins of the study area.

Paleozoic and Mesozoic sedimentary rocks are exposed in the extreme southwestern corner of the study area. Rock types include quartzite, siltstone, conglomerate, and minor limestone.

The massive-to-convoluted nature of the rhyolite obscures all but a few minor faults in that part of the study area underlain by rhyolite. The Paleozoic and Mesozoic sedimentary rocks have been moderately folded and metamorphosed, and are cut by several faults (Alan Wallace, unpublished data).

The topographic relief in the study area is about 1,879 ft (573 m), with a maximum elevation of 7,879 ft (2,401 m). The terrain in the study area is rugged with intermittent streams draining the area. The study area has a moderate coverage of conifers.

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

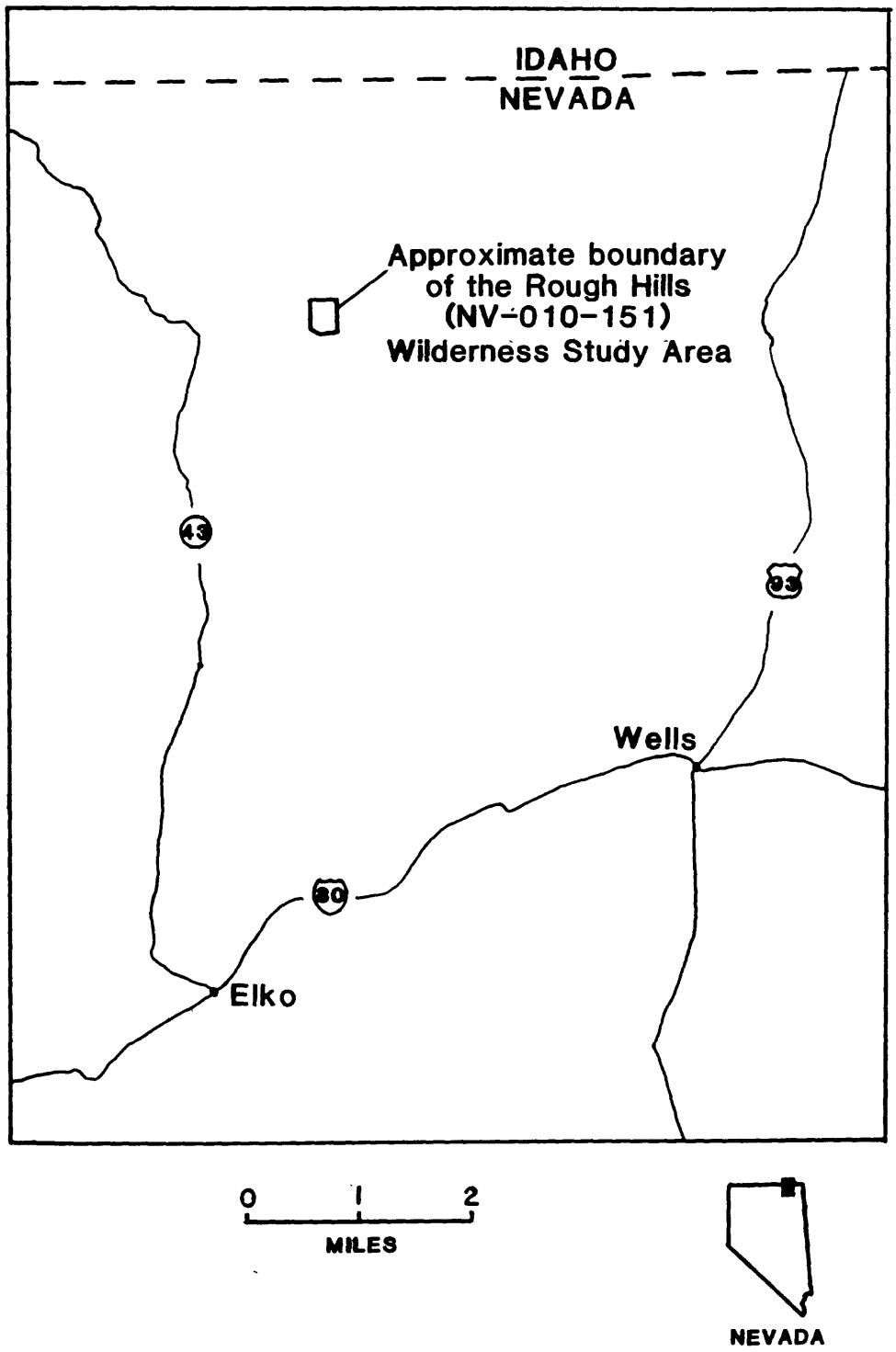

Figure 1. Location map of the Rough Hills Wilderness Study Area, Elko County, Nevada (NV-010-151).

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.

Sample Collection

Stream-sediment and heavy-mineral-concentrate samples were collected at 12 sites (fig. 2). Rock samples were collected at three sites. Average sampling density was about one sample site per 0.87 mi^2 for the stream sediments and heavy-mineral concentrates. The area of the drainage basins sampled ranged from 0.5 mi^2 to 2 mi^2.

Stream-sediment samples

The stream-sediment samples consisted of active alluvium collected primarily from first-order (unbranched) and second-order (below the junction of two first-order) streams as shown on USGS topographic maps (scale = 1:62,500). Each sample was composited from several localities within an area that may extend as much as 50 ft 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.

Rock samples

Rock samples were collected from outcrops or exposures in the vicinity of the plotted site location. Samples were collected from unmineralized and mineralized rocks. Table 6 gives a description of the rock samples.

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.

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 metallic minerals,

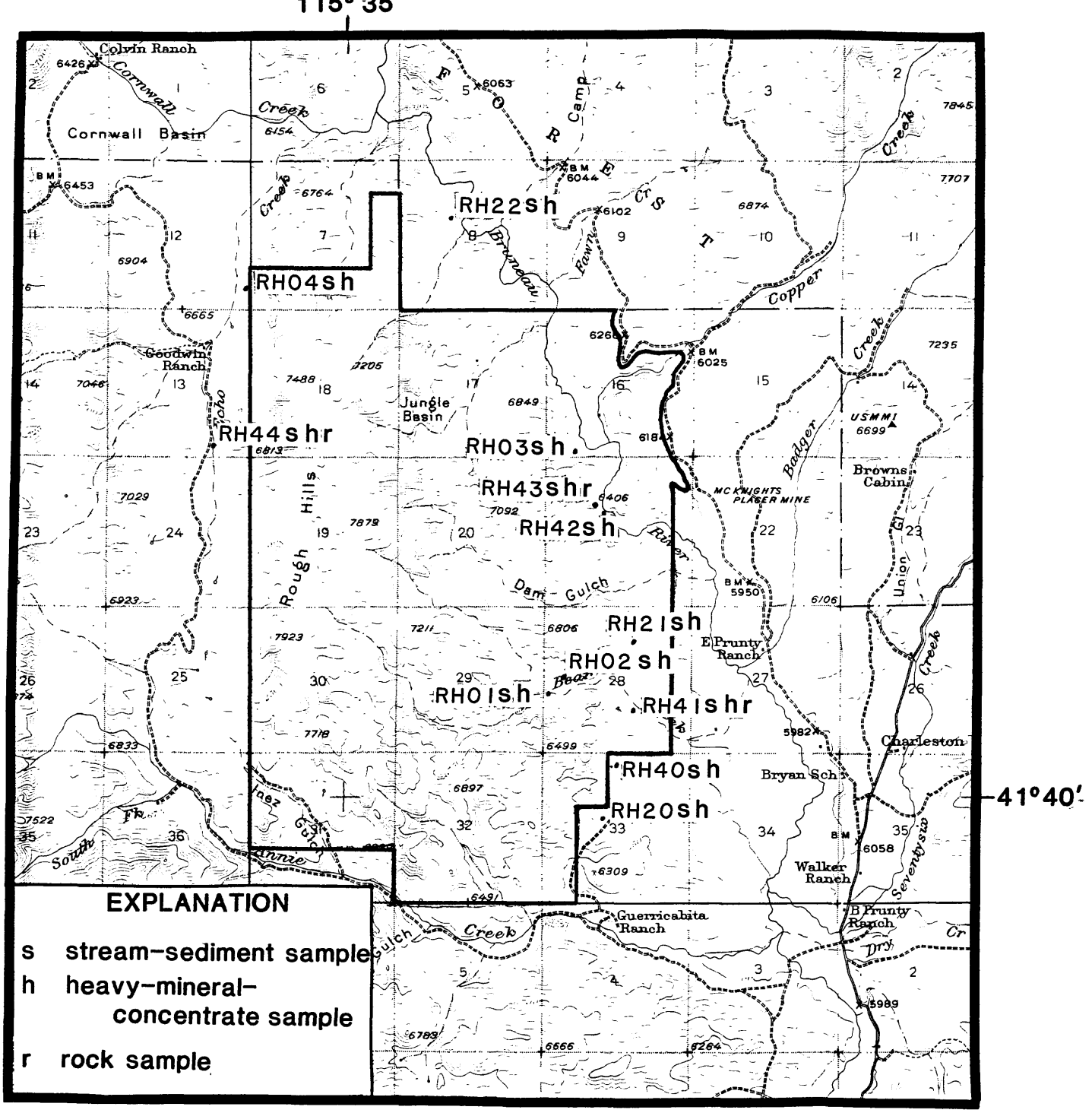

Figure 2. Localities of stream-sediment, heavy-mineral-concentrate, and rock samples from the Rough Hills Wilderness Study Area, Elko County, Nevada (NV-010-151).

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 0.2 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.

Rock samples were crushed and then pulverized to minus 0.15 mm with ceramic plates.

Sample Analysis

Spectrographic method

The stream-sediment, heavy-mineral-concentrate, and rock samples were analyzed for 31 elements using semiquantitative, direct-current arc emission spectrographic methods. The analyses for heavy-mineral-concentrate samples were performed by analysts in the Branch of Exploration Geochemistry using the method of Grimes and Marranzino (1968); analyses for stream-sediment and rock samples were performed by analysts in the Branch of Analytical Chemistry using the method of Myers and others (1961) as modified by Crock and others, (1987). The elements analyzed and their lower limits of determination are listed in table 1. For arsenic (As), gold (Au), cadmium (Cd), lanthanum (La), and thorium (Th), the lower limits of determination of the two analytical methods vary. The values in the parentheses are the limits of determination for Myers and others (1961). 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, and titanium, are given in weight percent; all others are given in parts per million (micrograms/gram). Analytical data for samples from the Rough Hills Wilderness Study Area are listed in tables 3-5.

Chemical methods

Other methods of analysis used on samples from the Rough Hills Wilderness Study Area are summarized in table 2.

Analytical results for stream-sediment, heavy-mineral-concentrate, and rock samples are listed in tables 3, 4, and 5, respectively.

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

Tables 3-5 list the results of analyses for the samples of stream sediment, heavy-mineral concentrate, and rock, 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 maps (fig. 2). Columns in which the element headings show the letter "s" below the element symbol are emission spectrographic analyses; "aa" indicates atomic absorption analyses; and "icp" indicates inductively coupled plasma-atomic emission spectroscopy. 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. If an element was not looked for in a sample, two dashes (--) are entered in tables 3-5 in place of an analytical value. Because of the formatting used in the computer program that produced tables 3-5, some of the elements listed in these tables (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.

ACKNOWLEDGMENTS

A number of our colleagues also participated in the collection, preparation, and analyses of these samples: collection, Kim Greene, Judy Lewis, and Randy Baker; preparation, Robin Sanchez; and analyses, Carol Gent and Janet Jones.

REFERENCES CITED

Crock, J. G., Briggs, P. H., Jackson, L. L., and Lichte, F. E., 1987, Analytical methods for the analysis of stream sediments and rocks from wilderness study areas: U.S. Geological Survey Open-File Report 87-84, 35 p.

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.

Koirtyohann, S. R., and Khalil, Moheb, 1976, Variables in the determination of mercury by cold vapor atomic absorption: Analytical Chemistry, 48, p. 136-139.

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.

Myers, A. T., Havens, R. G., and Dunton, P. J., 1961, A spectrochemical method for the semiquantitative analyses of rocks, minerals, and ores: U.S. Geological Survey Bulletin 1084-I, p. 1207-1229.

Thompson, C. E., Nakagawa, H. M., and Van Sickle, G. H., 1968, Rapid analysis for gold in geologic materials, in Geological Survey research 1968: U.S. Geological Survey Professional Paper 600-B, p. B130-B132.

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 values shown are the lower limits of determination assigned by the Grimes and Marranzino method, except for those values in parentheses, which are the lower values assigned by the Myers and others method. 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.]

Elements	Lower determination limit		Upper determination limit
	Percent		
Iron (Fe)	0.05		20
Magnesium (Mg)	.02		10
Calcium (Ca)	.05		20
Titanium (Ti)	.002		1
	Parts per million		
Manganese (Mn)	10		5,000
Silver (Ag)	0.5		5,000
Arsenic (As)	200	(700)	10,000
Gold (Au)	10	(15)	500
Boron (B)	10		2,000
Barium (Ba)	20		5,000
Beryllium (Be)	1		1,000
Bismuth (Bi)	10		1,000
Cadmium (Cd)	20	(30)	500
Cobalt (Co)	5		2,000
Chromium (Cr)	10		5,000
Copper (Cu)	5		20,000
Lanthanum (La)	20	(30)	1,000
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
Vanadium (V)	10		10,000
Tungsten (W)	50		10,000
Yttrium (Y)	10		2,000
Zinc (Zn)	200		10,000
Zirconium (Zr)	10		1,000
Thorium (Th)	100	(200)	2,000

TABLE 2.--Chemical methods used

[AA = atomic absorption; ICP = inductively coupled plasma spectroscopy]

Element or constituent determined	Sample type	Method	Determination limit (micrograms/gram or ppm)	Reference
Gold (Au)	Rocks and sediments	AA	0.01	Modification of Thompson and others, 1968, by Crock and others, 1987.
Mercury (Hg)	Rocks and sediments	AA	.02	Koirtyohann and Khalil, 1976.
Arsenic (As)	Rocks and sediments	ICP	5	Crock and others, 1987.
Antimony (Sb)		ICP	2	
Zinc (Zn)		ICP	2	
Bismuth (Bi)		ICP	2	
Cadmium (Cd)		ICP	.1	

TABLE 3 -- RESULTS OF ANALYSES OF STREAM-SEDIMENT SAMPLES COLLECTED FROM THE ROUGH HILLS BLM WILDERNESS STUDY AREA, ELKO COUNTY, 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
85RH01S	41 40 37	115 33 25	7.0	.15	1.5	>1.0	700	N	N	N	N	3,000
85RH02S	41 40 42	115 33 20	3.0	.15	1.5	.3	300	N	N	N	<10	3,000
85RH03S	41 42 2	115 33 14	7.0	.20	1.5	.7	500	N	N	N	<10	3,000
85RH04S	41 43 0	115 35 46	5.0	.30	1.5	.3	500	N	N	N	10	2,000
85RH20S	41 39 52	115 32 59	1.5	1.50	1.5	.2	150	N	N	N	10	1,000
85RH21S	41 40 55	115 32 43	5.0	.15	1.5	.5	500	N	N	N	<10	3,000
85RH22S	41 43 24	115 34 11	7.0	.20	1.5	1.0	500	N	N	N	<10	3,000
85RH40S	41 41 10	115 32 52	5.0	.15	1.5	.7	300	N	N	N	<10	3,000
85RH41S	41 40 30	115 32 45	7.0	.15	1.5	>1.0	700	.5	N	N	<10	3,000
85RH42S	41 41 39	115 33 0	7.0	.20	1.5	.7	500	N	N	N	10	3,000
85RH43S	41 41 43	115 33 3	7.0	.20	1.5	1.0	700	N	N	N	<10	3,000
85RH44S	41 42 5	115 36 1	5.0	.30	3.0	.7	1,000	N	N	N	10	2,000

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
85RH01S	1.5	N	N	7	10	7	70	5	50	<5	30	N	10	N
85RH02S	1.5	N	N	<5	10	7	70	N	20	<5	30	N	7	N
85RH03S	1.5	N	N	5	10	7	100	<5	20	5	30	N	10	N
85RH04S	1.5	N	N	7	20	15	100	N	<20	7	30	N	15	N
85RH20S	1.5	N	N	<5	20	10	70	N	<20	5	15	N	7	N
85RH21S	1.5	N	N	5	15	10	100	N	20	5	30	N	10	N
85RH22S	1.5	N	N	7	20	10	100	<5	30	7	20	N	15	N
85RH40S	2.0	N	N	5	10	10	100	N	30	5	30	N	10	N
85RH41S	1.5	N	N	5	15	10	100	<5	30	10	20	N	10	N
85RH42S	1.5	N	N	7	15	10	100	<5	30	7	30	N	10	N
85RH43S	1.5	N	N	7	10	10	70	<5	30	5	30	N	10	N
85RH44S	1.5	N	N	10	15	10	150	N	20	7	20	N	10	N

Sample	Sr-ppm s	V-ppm s	W-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s	Th-ppm s	As-ppm icp	Bi-ppm icp	Cd-ppm icp	Sb-ppm icp	Zn-ppm icp	Au-ppm aa	Hg-ppm aa
85RH01S	500	70	N	50	H	1,500	N	<5	<2	.6	<2	190	<.1	<.02
85RH02S	500	30	N	50	N	300	N	<5	<2	.2	<2	55	<.1	<.02
85RH03S	500	30	N	50	N	500	N	<5	<2	.4	<2	120	<.1	<.02
85RH04S	300	50	N	70	N	300	N	<5	<2	.3	<2	87	<.1	.03
85RH20S	300	30	N	30	N	200	N	<5	<2	.2	<2	28	<.1	.05
85RH21S	500	30	N	50	N	500	N	<5	<2	.2	<2	77	<.1	<.02
85RH22S	500	70	N	70	N	700	N	<5	<2	1.6	<2	140	<.2	.03
85RH40S	500	30	N	50	N	500	N	<5	<2	.3	<2	73	<.1	<.02
85RH41S	500	70	N	70	N	1,000	N	<5	<2	.3	<2	130	<.2	.03
85RH42S	300	50	N	50	N	700	N	<5	<2	.3	<2	98	<.1	<.02
85RH43S	300	30	N	50	N	500	N	<5	<2	.4	<2	150	--	.03
85RH44S	700	100	N	30	N	300	N	<5	<2	.4	<2	62	<.1	.05

TABLE 4 -- RESULTS OF ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES COLLECTED FROM THE ROUGH HILLS BLM WILDERNESS STUDY AREA, ELKO COUNTY, 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
85RH01H	41 40 37	115 33 25	.30	<.05	.5	.02	50	N	N	N
85RH02H	41 40 42	115 33 20	.30	<.05	1.5	.03	70	N	N	N
85RH03H	41 42 2	115 33 14	.20	<.05	1.0	.02	70	N	N	N
85RH04H	41 43 0	115 35 46	.15	<.05	.5	.05	70	N	N	N
85RH20H	41 39 52	115 32 59	.10	<.05	<.1	.03	50	N	N	N
85RH21H	41 40 55	115 32 43	.20	<.05	.3	.05	70	N	N	N
85RH22H	41 43 24	115 34 11	.20	<.05	.3	.03	50	N	N	N
85RH40H	41 41 10	115 32 52	.20	<.05	.3	.02	50	N	N	N
85RH41H	41 40 30	115 32 45	.20	<.05	.7	.03	50	N	N	N
85RH42H	41 41 39	115 33 0	.20	<.05	.3	.03	50	N	N	N
85RH43H	41 41 43	115 33 3	.20	<.05	.5	.02	70	N	N	N
85RH44H	41 42 5	115 36 1	.15	<.05	.2	.07	70	N	N	N

Sample	B-ppm s	Ba-ppm s	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
85RH01H	20	3,000	N	N	N	N	N	N	<50	N	N
85RH02H	20	500	N	N	N	<10	N	N	100	N	N
85RH03H	20	3,000	<2	N	N	N	N	N	150	N	N
85RH04H	20	700	2	N	N	N	N	N	150	N	N
85RH20H	20	200	<2	N	N	N	N	10	N	N	N
85RH21H	20	1,500	<2	N	N	N	N	N	<50	N	N
85RH22H	20	3,000	N	N	N	N	N	N	N	N	N
85RH40H	20	2,000	N	N	N	N	N	N	<50	N	N
85RH41H	20	2,000	<2	N	N	N	N	N	100	N	N
85RH42H	20	1,000	2	N	N	N	N	N	150	N	N
85RH43H	20	2,000	N	N	N	N	N	N	150	N	N
85RH44H	30	500	2	N	N	N	N	N	100	N	N

Sample	Ni-ppm s	Pb-ppm s	Sb-ppm s	Sc-ppm s	Sn-ppm s	Sr-ppm s	V-ppm s	W-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s	Th-ppm s
85RH01H	<10	N	N	N	N	300	<20	N	100	N	>2,000	N
85RH02H	<10	N	N	N	N	500	<20	N	150	N	>2,000	N
85RH03H	<10	N	N	N	N	200	<20	N	200	N	>2,000	N
85RH04H	20	N	N	50	N	200	<20	N	1,000	N	>2,000	N
85RH20H	30	N	N	50	N	200	<20	N	1,000	N	>2,000	N
85RH21H	10	N	N	<10	N	200	<20	N	500	N	>2,000	N
85RH22H	<10	N	N	N	100	200	<20	N	200	N	>2,000	N
85RH40H	10	N	N	N	N	200	<20	N	300	N	>2,000	N
85RH41H	<10	N	N	N	N	200	<20	N	300	N	>2,000	N
85RH42H	20	N	N	50	N	200	<20	N	700	N	>2,000	N
85RH43H	<10	N	N	N	N	200	<20	N	150	N	>2,000	N
85RH44H	20	N	N	100	N	200	<20	N	1,000	N	>2,000	N

TABLE 5 -- RESULTS OF ANALYSES OF ROCK SAMPLES COLLECTED FROM THE ROUGH HILLS BLM WILDERNESS STUDY AREA, ELKO COUNTY, 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
85RH41R1	41 40 30	115 32 45	1	<.02	1.5	.2	200	N	N	N	N	3,000
85RH43R1	41 41 43	115 33 3	3	.15	1.5	.3	300	N	N	N	N	5,000
85RH44R1	41 42 5	115 36 1	5	1.00	3.0	.3	300	N	N	N	N	1,500

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
85RH41R1	1.5	N	N	<5	<10	<5	150	N	20	<5	30	N	7	<10
85RH43R1	2.0	N	N	<5	<10	5	150	N	20	<5	30	N	7	N
85RH44R1	1.5	N	N	10	30	7	50	N	<20	5	15	N	15	N

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	Hg-ppm aa	As-ppm icp	Bi-ppm icp	Cd-ppm icp	Sb-ppm icp	Zn-ppm icp
85RH41R1	300	<10	N	50	N	300	N	<.02	<.1	<5	<2	.1	<2	55
85RH43R1	300	<10	N	30	N	300	N	<.02	<.1	<5	<2	.1	<2	67
85RH44R1	700	150	N	20	N	100	N	<.02	<.1	<5	<2	.2	<2	37

TABLE 6.--Description of rock samples from the Rough Hills Wilderness Study Area

85RH43R	volcanic rock
85RH43R	rhyolite
85RH44R	andesite