UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Analytical results, mineralogical data, and sample locality map of stream-sediment, heavy-mineral-concentrate, and rock samples, from the Fremont Gorge (UT-050-221) and Fiddler Butte (UT-050-241) Wilderness Study Areas, Wayne and Garfield Counties, Utah

By

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

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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. 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 and mineralogical survey of the Fremont Gorge and Fiddler Butte Wilderness Study Areas, Wayne and Garfield Counties, Utah.

INTRODUCTION

In April 1982 the U.S. Geological Survey conducted a reconnaissance geochemical survey of the Fremont Gorge and Fiddler Butte Wilderness Study Areas, Wayne and Garfield Counties, Utah.

The Fremont Gorge and Fiddler Butte Wilderness Study Areas comprise about 265 mi^2 (686 km^2) in Wayne and Garfield Counties, Utah. Access to the study area is provided by unimproved dirt roads and jeep trails.

The study areas are located along the Dirty Devil River just north of Utah State Highway 95 and along Sulphur Creek five miles east of Torrey, Utah. The area is comprised of flat lying sediments of the Henry Basin section which are Triassic to Holocene in age. The individual formations have been described in detail by Larson and others (unpublished)

The topographic relief in the study area is about 3,000 ft (915 m) with a maximum elevation of 6,900 ft (2100 m). The ground surface is a flat lying plateau which has been eroded to steep walled canyons by intermittent streams and one third order river. The climate is arid.

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. Heavy-mineral-concentrate samples provide information about the chemistry of a limited number of minerals in rock material eroded from the drainage basin upstream from each sample site. The selective concentration of minerals, many of which are 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

Samples were collected at 39 sites (plate 1). At nearly all of those sites, both a stream-sediment sample and a heavy-mineral-concentrate sample were collected. Where suitable outcrop was available, rock samples were collected. Sampling density was about 1 sample site per 7 mi^2 for the stream sediments and heavy-mineral concentrates, and about 1 sample site per 66 mi^2 for the rocks. The area of the drainage basins sampled ranged from 5 mi^2 to 20 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 = 1:50,000). 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.

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 unaltered, altered, or mineralized rock outcrops.

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 analysis/archival storage. The third fraction (the least magnetic material including 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.

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 a semiquantitative, direct-current arc emission spectrographic method (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, and titanium) are given in weight percent; all others are given in parts per million (micrograms/gram). Analytical data for samples from the Fremont Gorge and Fiddler Butte Wilderness Study Areas are listed in tables 2-8.

In addition to the spectrographic analysis, all heavy-mineral-concentrate samples were mineralogically analyzed. Minerals reported include zircon (round and euhedral), sphene, rutile, anatase, barite, apatite, scheelite, epidote, pyrite, pyroxene, arsenopyrite, amphibole, and rock fragments. The relative abundance of these minerals was visually determined using a binocular microscope.

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, 1976).

DESCRIPTION OF DATA TABLES

Tables 2 and 3 list the analyses for the samples of stream sediment, and heavy-mineral concentrate, respectively for the Fiddler Butte Wilderness Study Area and tables 5-7 list the analyses for the samples of rock, stream sediment, and heavy-mineral concentrate, respectively for Fremont Gorge Wilderness Study Area. For the five 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 (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. If an element was not looked for in a sample, two dashes (--) are entered in tables 1-2 and 5-7 in place of an analytical value. Because of the formatting used in the computer program that produced tables 3-6, 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.

Tables 4 and 8 contain the mineralogical data for Fiddler Butte and Fremont Gorge Wilderness Study Areas, respectively. For the two tables, the data are arranged so that column 1 contains the USGS-assigned sample numbers. These numbers again correspond to the numbers shown on the site location map (plate 1). Columns headed with mineral names show the relative amount of that specific mineral found in a sample. Relative abundance is indicated by either two dashes (--) (meaning that the mineral was not observed), or a number from 1-6, where: 1 = trace present, <1%; 2 = present, >2%; 3 = common, >5%; 4 = major, >20%; 5 = dominant, >50%; 6 = ubiquitous, >85%.

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.

Larson, M. J. Bromfield, C. S., Dubiel, R. F., Orkild, P. P., Patterson, C. G., and Peterson, Fred, 1984 Geologic map of the Fiddler Butte and Fremont Gorge Wilderness Study Areas, Garfield and Wayne Counties, Utah: U.S. Geological Survey Miscellaneous Field Study Map (unpublished).

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., 1976, 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	
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	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)	5	2,000
Chromium (Cr)	10	5,000
Copper (Cu)	5	20,000
Lanthanum (La)	20	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	2,000

TABLE 2.--Spectrographic analysis of stream-sediment samples from Fiddler Butte Wilderness Study Area, Utah
[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown.

SAMPLE	LATITUDE	LONGITUDE	S-FE%	S-MG%	S-CA%	S-TI%	S-MN	S-AG	S-AS	S-AU	S-B	S-BA	S-BE	S-BI	S-CD	S-CO	S-CR
HM412	38 3 29	110 22 42	1.0	1.0	3.0	.30	500	N	N	N	30	1,000	1	N	N	7	30
HM417	38 4 27	110 24 28	.7	.5	1.5	.20	100	N	N	N	70	500	1	N	N	5	20
HM418	38 4 25	110 24 0	.5	.3	.5	.10	50	N	N	N	70	150	1	N	N	5	10
HM419	38 2 57	110 25 16	.5	.5	1.0	.10	150	N	N	N	50	700	1	N	N	5	10
HM420	38 3 4	110 27 31	.7	.3	.7	.20	70	N	N	N	50	200	1	N	N	N	10
HM421	38 3 15	110 27 35	.5	.2	.7	.10	70	N	N	N	30	200	<1	N	N	N	15
HM422	38 1 45	110 29 6	.7	.3	.7	.15	150	N	N	N	50	200	<1	N	N	N	10
HM423	38 1 38	110 29 4	.5	.2	.3	.10	70	N	N	N	100	200	<1	N	N	N	10
HM424	38 1 9	110 29 54	.5	.2	.5	.15	100	N	N	N	70	300	<1	N	N	N	15
HM425	38 0 50	110 29 52	.5	.2	.5	.10	100	N	N	N	30	200	1	N	N	N	10
HM428	38 1 33	110 26 32	.5	.2	.5	.10	150	N	N	N	30	200	<1	N	N	N	20
HM429	38 1 37	110 26 40	.5	.2	.3	.15	100	N	N	N	50	300	<1	N	N	N	10
HM430	38 2 31	110 26 46	.3	.2	.5	.07	100	N	N	N	30	300	1	N	N	N	100
HM431	38 2 25	110 26 40	.5	.2	.2	.10	70	N	N	N	50	200	1	N	N	N	N
HM432	38 1 52	110 27 38	.5	.2	.2	.10	70	N	N	N	50	200	<1	N	N	N	N
HM433	38 1 15	110 28 1	.3	.2	.2	.10	100	N	N	N	20	300	1	N	N	N	10
HM434	38 1 12	110 28 0	.2	.2	.3	.10	100	N	N	N	20	150	N	N	N	N	N
HM435	38 0 13	110 28 50	.3	.3	.7	.07	100	N	N	N	10	500	1	N	N	N	N
HM436	37 59 35	110 29 50	.2	.2	.5	.07	50	N	N	N	10	300	1	N	N	N	150
HM438	37 59 26	110 29 59	.5	.5	2.0	.10	100	N	N	N	20	300	1	N	N	N	20
HM439	37 59 4	110 28 59	.3	.3	.2	.15	70	N	N	N	20	150	<1	N	N	N	200
HM440	37 58 58	110 28 50	.5	.2	.2	.15	70	N	N	N	30	200	<1	N	N	N	10
HM441	37 58 22	110 29 25	.7	.5	.5	.20	150	N	N	N	50	200	1	N	N	N	50
HM442	37 58 31	110 27 20	.7	.5	.5	.30	100	N	N	N	70	200	1	N	N	5	70
HM443	37 59 5	110 27 11	.3	.3	.2	.07	70	<.5	N	N	30	200	1	N	N	N	N
HM444	37 59 10	110 27 10	.5	.3	.5	.07	50	N	N	N	20	500	N	N	N	N	20
HM445	38 1 5	110 25 58	1.0	.3	.3	.50	150	N	N	N	200	300	1	N	N	5	20
HM446	37 59 35	110 26 3	.7	.7	.7	.20	200	N	N	N	70	200	1	N	N	N	30
HM447	37 59 23	110 25 50	.5	.5	.5	.20	150	N	N	N	100	500	1	N	N	N	20
HM554	38 7 56	110 29 50	.3	.2	.2	.07	100	N	N	N	30	200	1	N	N	N	N
HM555	38 7 3	110 28 55	.2	.3	.7	.05	100	N	N	N	50	200	1	N	N	N	N

TABLE 2.--Continued

SAMPLE	S-CU	S-LA	S-MO	S-NB	S-NI	S-PB	S-SB	S-SC	S-SN	S-SR	S-V	S-W	S-Y	S-ZN	S-ZR	S-TH
HM412	10	30	N	N	10	10	N	--	N	150	30	N	20	N	--	N
HM417	7	N	N	N	7	15	N	--	N	100	20	N	10	N	--	N
HM418	5	N	N	N	10	10	N	--	N	N	10	N	N	N	--	N
HM419	5	N	N	N	7	10	N	--	N	100	20	N	N	N	--	N
HM420	5	N	N	N	7	10	N	--	N	N	20	N	10	N	--	N
HM421	5	N	N	N	N	15	N	--	N	N	15	N	N	N	--	N
HM422	5	N	N	N	N	15	N	--	N	N	20	N	10	N	--	N
HM423	5	20	N	N	N	10	N	--	N	N	15	N	N	N	--	N
HM424	<5	N	N	N	5	10	N	--	N	N	15	N	10	N	--	N
HM425	5	N	N	N	5	10	N	--	N	N	15	N	20	N	--	N
HM428	5	N	N	N	5	15	N	--	N	N	10	N	10	N	--	N
HM429	<5	N	N	N	5	15	N	--	N	N	20	N	10	N	--	N
HM430	5	N	N	N	5	10	N	--	N	N	15	N	N	N	--	N
HM431	<5	N	N	N	5	10	N	--	N	N	10	N	N	N	--	N
HM432	<5	N	N	N	5	10	N	--	N	N	10	N	N	N	--	N
HM433	5	N	N	N	5	15	N	--	N	N	15	N	N	N	--	N
HM434	5	N	N	N	5	10	N	--	N	N	15	N	N	N	--	N
HM435	5	N	N	N	5	15	N	--	N	N	15	N	N	N	--	N
HM436	<5	N	N	N	5	10	N	--	N	N	15	N	N	N	--	N
HM438	5	N	N	N	N	10	N	--	N	100	20	N	10	N	--	N
HM439	<5	N	N	N	5	10	N	--	N	N	10	N	N	N	--	N
HM440	<5	N	N	N	5	10	N	--	N	N	20	N	15	N	--	N
HM441	5	20	N	N	5	15	N	--	N	100	30	N	30	N	--	N
HM442	5	N	N	N	N	10	N	--	N	N	30	N	20	N	--	N
HM443	<5	N	N	N	N	10	N	--	N	N	10	N	N	N	--	N
HM444	5	N	N	N	N	10	N	--	N	N	10	N	N	N	--	N
HM445	<5	20	N	<20	5	15	N	--	N	N	30	N	20	N	--	N
HM446	5	50	N	N	N	15	N	--	N	N	20	N	10	N	--	N
HM447	5	100	N	N	5	15	N	--	N	N	15	N	20	N	--	N
HM554	<5	20	N	N	N	10	N	--	N	N	10	N	10	N	--	N
HM555	<5	N	N	N	N	15	N	--	N	N	10	N	N	N	--	N

TABLE 3.--Spectrographic analysis of heavy-mineral-concentrate samples from Fiddler Butte Wilderness Study Area, Utah
[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown.

SAMPLE	LATITUDE	LONGITUDE	S-FE%	S-MG%	S-CA%	S-TI%	S-MN	S-AG	S-AS	S-AU	S-B	S-BA	S-BE	S-BI	S-CD	S-CU	S-CR
HM412	38 3 27	110 22 42	.50	.10	1.00	>2.0	100	N	N	N	150	>10,000	2	N	N	N	70
HM417	38 4 27	110 24 28	.70	.20	1.00	2.0	150	<1	N	N	150	>10,000	<2	N	N	N	100
HM418	38 4 25	110 24 0	.30	.05	.50	1.5	70	<1	N	N	100	>10,000	2	N	N	N	100
HM419	38 2 57	110 25 18	1.50	.15	.50	2.0	150	<1	N	N	150	>10,000	<2	N	N	N	200
HM420	38 3 4	110 27 31	.50	<.05	.10	>2.0	100	<1	N	N	100	>10,000	<2	N	N	N	150
HM421	38 3 15	110 27 35	1.00	<.05	.10	>2.0	100	<1	N	N	200	>10,000	<2	N	N	N	200
HM422	38 1 45	110 29 6	1.00	<.05	.10	>2.0	100	<1	N	N	100	>10,000	<2	N	N	N	200
HM423	38 1 38	110 29 4	.50	<.05	.20	>2.0	100	<1	N	N	150	>10,000	<2	N	N	N	150
HM424	38 1 9	110 29 54	.50	<.05	.15	>2.0	70	<1	N	N	200	>10,000	<2	N	N	N	150
HM425	38 0 50	110 29 52	.70	.05	.30	>2.0	100	<1	N	N	300	>10,000	<2	N	N	N	200
HM428	38 1 33	110 26 32	.70	.05	.20	>2.0	100	N	N	N	100	>10,000	2	N	N	N	300
HM429	38 1 39	110 26 40	1.00	.05	.20	>2.0	150	N	N	N	200	>10,000	<2	N	N	N	500
HM430	38 2 31	110 26 40	1.00	.05	.15	>2.0	200	N	N	N	100	>10,000	<2	N	N	N	700
HM431	38 2 25	110 26 40	.50	.07	.20	>2.0	50	N	N	N	70	>10,000	<2	N	N	N	70
HM432	38 1 52	110 27 38	1.00	.05	.30	>2.0	150	N	N	N	200	>10,000	<2	N	N	N	200
HM433	38 1 15	110 28 1	.50	.07	.20	>2.0	100	N	N	N	500	>10,000	2	N	N	N	200
HM434	38 1 12	110 28 0	.50	.07	.20	>2.0	100	N	N	N	200	>10,000	<2	N	N	N	100
HM435	38 0 13	110 28 50	.30	.05	.30	>2.0	70	N	N	N	150	>10,000	2	N	N	N	100
HM436	37 59 3[illegible]	110 29 50	1.00	.15	.50	>2.0	150	N	N	N	500	>10,000	2	N	N	N	500
HM438	37 59 26	110 29 59	.15	<.05	.30	.7	50	N	N	N	100	>10,000	2	N	N	N	20
HM439	37 59 4	110 28 59	.20	.10	.30	>2.0	100	N	N	N	100	>10,000	<2	N	N	N	150
HM440	37 58 58	110 28 50	.70	<.05	.20	>2.0	150	N	N	N	100	>10,000	<2	N	N	N	200
HM441	37 58 22	110 29 25	.70	.20	.30	2.0	100	N	N	N	100	>10,000	<2	N	N	N	200
HM442	37 58 31	110 27 20	.50	.05	.20	>2.0	100	N	N	N	100	>10,000	<2	N	N	N	150
HM443	37 59 5	110 27 11	.50	.07	.50	>2.0	100	N	N	N	100	>10,000	2	N	N	N	150
HM444	37 59 10	110 27 10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HM445	38 1 5	110 25 58	--	--	--	--	--	--	--	--	--	--	--	--	--	-	--
HM446	37 59 35	110 26 3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HM447	37 59 23	110 25 50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HM554	38 7 56	110 29 58	.70	.05	.20	>2.0	70	N	N	N	100	>10,000	<2	N	N	N	100

TABLE 3.--Continued

SAMPLE	S-LU	S-LA	S-MO	S-NB	S-NI	S-PB	S-SB	S-SC	S-SN	S-SR	S-V	S-W	S-Y	S-ZN	S-ZR	S-TH
HM412	15	100	N	50	<10	30	N	200	N	10,000	50	N	500	N	>2,000	N
HM41[illegible]	10	70	N	<50	<10	20	N	200	N	5,000	70	N	500	N	>2,000	N
HM416	<10	N	N	<50	<10	<20	N	>200	20	3,000	50	N	1,000	N	>2,000	N
HM41[illegible]	10	N	N	<50	<10	<20	N	200	N	5,000	50	N	500	N	>2,000	N
HM420	N	N	N	<50	<10	<20	N	>200	N	500	50	N	1,000	N	>2,000	N
HM421	N	N	N	<50	<10	<20	N	>200	N	500	70	<100	1,000	N	>2,000	<200
HM422	N	N	N	<50	<10	20	N	>200	N	500	50	<100	1,500	N	>2,000	<200
HM423	N	N	N	50	<10	<20	N	>200	<20	1,000	70	<100	1,500	N	>2,000	<200
HM424	N	N	N	N	<10	<20	N	>200	N	500	50	<100	700	N	>2,000	<200
HM425	N	100	N	50	<10	<20	N	>200	<20	500	70	<100	700	N	>2,000	<200
HM428	N	N	N	N	<10	<20	N	200	N	1,500	70	N	500	N	>2,000	N
HM429	N	N	N	<50	<10	20	N	>200	N	1,000	70	<100	1,500	N	>2,000	N
HM430	N	N	N	N	<10	20	N	200	N	1,000	70	N	700	N	>2,000	N
HM431	N	N	N	N	<10	<20	N	200	20	500	50	<100	500	N	>2,000	N
HM432	N	N	N	N	<10	20	N	>200	N	700	100	N	1,000	N	>2,000	N
HM433	N	N	N	<50	<10	20	N	>200	<20	1,000	100	<100	1,000	N	>2,000	N
HM434	N	70	N	<50	<10	N	N	150	N	1,000	50	N	300	N	>2,000	N
HM435	N	50	N	<50	<10	N	N	100	N	2,000	70	<100	200	N	>2,000	N
HM436	N	70	N	N	<10	20	N	>200	N	2,000	100	<100	1,000	N	>2,000	N
HM43[illegible]	N	N	N	N	<10	<20	N	20	N	3,000	20	N	70	N	>2,000	N
HM439	N	N	N	50	<10	20	N	150	<20	1,000	70	<100	500	N	>2,000	N
HM440	N	70	N	<50	<10	30	N	>200	30	700	100	<100	1,500	N	>2,000	<200
HM441	N	150	N	N	<10	20	N	100	N	500	50	<100	300	N	>2,000	N
HM442	N	70	N	50	<10	20	N	200	<20	1,500	70	<100	500	N	>2,000	N
HM443	N	50	N	<50	<10	30	N	200	N	1,500	100	<100	500	N	>2,000	N
HM444	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HM445	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HM446	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HM447	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HM554	10	N	N	N	<10	20	N	>200	N	1,000	70	N	700	N	>2,000	N

TABLE 4.--Mineralogical analysis of heavy-mineral-concentrate samples from Fiddler Butte Wilderness Study Area, Utah
[Abundance of minerals tentatively identified in the non-magnetic heavy-mineral fraction: -- = none observed; 1 = trace present, <1%; 2 = present, 5 = dominant, >50%; 6 = ubiquitous, >85%. Observed crystal shape of zircon is denoted in column header by an R or E indicating round and euhedral, respectively.]

SAMPLE	LATITUDE	LONGITUD	ZIRCON-R	ZIRCON-E	SPHENE	RUTILE	ANATASE	BARITE	APATITE	SCHEELIT	EPIDOTE	PYRITE
HM412C	38 3 29	110 22 42	5	1	--	2	--	4	1	--	--	--
HM413C	38 5 45	110 20 44	3	1	--	2	2	5	--	--	--	--
HM414C	39 5 23	110 20 22	4	2	--	2	2	4	--	--	--	--
HM415C	38 5 33	110 20 26	4	2	--	2	2	5	--	--	--	2
HM416C	38 5 40	110 23 50	4	3	--	2	--	5	--	--	--	2
HM417C	38 4 27	110 24 28	4	2	--	2	--	5	--	--	1	2
HM418C	38 4 25	110 24 0	5	1	--	--	--	4	--	--	--	--
HM419C	38 2 57	110 25 18	4	1	--	1	--	5	--	--	--	3
HM420C	38 3 4	110 27 31	6	1	--	1	--	1	--	--	--	--
HM421C	38 3 15	110 27 35	6	1	--	1	--	2	--	--	--	--
HM422C	38 1 45	110 29 6	6	--	--	2	--	2	--	--	--	--
HM423C	38 1 38	110 29 4	5	--	--	2	--	3	--	--	--	--
HM424C	38 1 9	110 29 54	6	--	--	1	--	--	--	--	--	--
HM425C	38 0 50	110 29 52	5	2	--	2	--	3	--	--	--	2
HM428C	38 1 33	110 26 32	5	2	--	2	--	4	--	--	--	--
HM429C	38 1 39	110 26 40	5	1	1	2	--	3	--	--	--	--
HM430C	38 2 31	110 26 40	5	1	--	2	--	3	--	--	1	--
HM431C	38 2 25	110 26 40	5	1	--	2	--	3	--	--	--	--
HM432C	38 1 52	110 27 38	5	1	--	2	--	3	--	--	--	--
HM433C	38 1 15	110 28 1	5	1	--	2	--	3	--	--	--	--
HM434C	38 1 12	110 28 0	5	1	--	2	--	3	--	--	--	--
HM435C	38 0 13	110 28 50	3	1	--	3	--	5	--	--	--	--
HM436C	37 59 35	110 29 50	5	2	--	2	--	3	--	--	--	--
HM438C	37 59 26	110 29 59	4	1	2	2	--	5	--	--	--	--
HM439C	37 59 4	110 28 59	5	1	--	2	--	3	--	--	--	--
HM440C	37 58 58	110 28 50	5	1	--	2	--	3	--	--	--	--
HM441C	37 58 22	110 29 25	5	1	--	3	--	2	--	--	--	--
HM442C	37 58 31	110 27 20	5	2	--	3	--	3	--	--	--	--
HM443C	37 59 5	110 27 11	4	1	--	3	--	4	--	--	--	--
HM444C	37 59 10	110 27 10	5	1	--	3	--	3	--	--	--	--
HM445C	38 1 5	110 25 58	5	1	--	3	--	3	--	--	--	--
HM446C	37 59 35	110 26 3	5	1	--	3	--	3	--	--	--	--
HM447C	37 59 23	110 25 50	5	1	--	3	--	3	--	--	--	2
HM554C	38 7 56	110 29 58	5	2	--	2	--	2	2	--	--	--

TABLE 4.--Continued

SAMPLE	PYROXENE	ARSENOPY	AMPHIBOL	ROCK FRA
HM412C	--	--	2	2
HM413C	--	--	2	2
HM414C	--	--	--	2
HM415C	--	--	2	2
HM416C	--	--	--	2
HM417C	--	--	2	2
HM418C	--	--	2	2
HM419C	--	--	--	2
HM420C	--	--	--	--
HM421C	--	--	--	2
HM422C	--	--	--	--
HM423C	--	--	--	1
HM424C	--	--	1	1
HM425C	--	--	1	2
HM428C	--	--	--	2
HM429C	--	--	1	2
HM430C	--	--	--	2
HM431C	--	--	--	2
HM432C	--	--	--	2
HM433C	--	--	--	2
HM434C	--	--	--	2
HM435C	--	--	--	2
HM436C	--	--	--	2
HM438C	--	--	--	2
HM439C	--	--	--	2
HM440C	--	--	--	2
HM441C	--	--	--	2
HM442C	--	--	--	2
HM443C	--	--	--	2
HM444C	--	--	--	2
HM445C	--	--	--	2
HM446C	--	--	1	2
HM447C	--	--	--	2
HM554C	--	--	--	--

TABLE 5.--Spectrographic analysis of rock samples from Fremont Gorge Wilderness Study Area, Utah
[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown.]

SAMPLE	LATITUDE	LONGITUDE	S-FE%	S-MG%	S-CA%	S-TI%	S-MN	S-AG	S-AS	S-AU	S-B	S-BA	S-BE	S-BI	S-CD	S-CU	S-CR
HM910A	38 18 0	111 21 29	20.0	.7	1.0	.003	200	N	N	N	N	700	N	N	N	N	<10
HM919A	38 18 0	111 21 29	1.5	1.0	.2	.100	150	N	N	N	70	150	<1	N	N	70	30
HM919B	38 18 0	111 21 29	.7	.5	.3	.050	30	N	N	N	20	200	<1	N	N	<5	10
HM919C	38 18 0	111 21 29	2.0	1.5	.5	.300	150	N	N	N	100	200	1	N	N	30	70

TABLE 5.--Continued

SAMPLE	S-CU	S-LA	S-MO	S-NB	S-NI	S-PB	S-SB	S-SC	S-SN	S-SR	S-V	S-W	S-Y	S-ZN	S-ZR	S-TH
HM910A	20	20	N	N	7	10	N	<5	N	N	30	N	<10	N	N	N
HM919A	15	<20	15	N	50	200	N	20	N	<100	>10,000	N	20	N	70	N
HM919B	5	20	N	N	<5	150	N	<5	N	<100	>10,000	N	N	N	50	N
HM919C	30	20	15	<20	30	50	N	10	N	300	2,000	N	20	N	100	N

TABLE 6.--Spectrographic analysis of stream-sediment samples from Fremont Gorge Wilderness Study Area, Utah
[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown.]

SAMPLE	LATITUDE	LONGITUDE	S-FE%	S-MG%	S-CA%	S-TI%	S-MN	S-AG	S-AS	S-AU	S-B	S-BA	S-BE	S-BI	S-CD	S-CO	S-CR
HM376	38 16 7	111 19 45	.5	.5	2	.15	100	N	N	N	50	300	1	N	N	N	N
HM377	38 18 8	111 21 0	.5	.5	2	.20	100	N	N	N	70	700	1	N	N	N	15
HM378	36 17 40	111 20 29	.5	.5	1	.20	100	N	N	N	70	200	<1	N	N	N	20
HM379	38 17 44	111 20 32	.5	1.0	3	.20	200	N	N	N	30	200	1	N	N	5	<10
HM911S	36 17 47	111 19 43	.7	1.5	3	.15	700	N	N	N	30	300	<1	N	N	7	15

TABLE 6.--Continued

SAMPLE	S-CU	S-LA	S-MO	S-NB	S-NI	S-PB	S-SB	S-SC	S-SN	S-SR	S-V	S-W	S-Y	S-ZN	S-ZR	S-TH
HM376	<5	20	N	N	5	10	N	--	N	100	15	N	10	N	--	N
HM377	5	N	N	N	5	15	N	--	N	150	20	N	20	N	--	N
HM378	<5	N	N	N	5	10	N	--	N	100	15	N	10	N	--	<100
HM379	7	20	N	N	7	10	N	--	N	700	20	N	15	N	--	N
HM911S	20	<20	N	N	10	30	N	<5	N	150	50	N	15	N	70	N

TABLE 7.--Spectrographic analysis of heavy-mineral concentrate samples from Fremont Gorge Wilderness Study Area, Utah
[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown.]

SAMPLE	LATITUDE	LONGITUDE	S-FE%	S-MG%	S-CA%	S-TI%	S-MN	S-AG	S-AS	S-AU	S-B	S-BA	S-BE	S-BI	S-CD	S-CO	S-CR
HM376C	38 18 7	111 19 45	1.0	.2	.5	1.0	70	7	N	30	70	>10,000	<2	N	N	<10	70
HM378C	38 17 40	111 20 29	2.0	.5	1.5	1.0	100	N	N	N	100	>10,000	N	N	N	10	30
HM379C	38 17 44	111 20 32	.5	.3	.7	1.5	70	N	N	N	50	>10,000	<2	N	N	<10	100
HM911C	38 17 47	111 19 43	.7	.3	.7	.7	200	N	N	N	20	>10,000	N	N	N	N	50

TABLE 7.--Continued

SAMPLE	S-CU	S-LA	S-MO	S-NB	S-NI	S-PB	S-SB	S-SC	S-SN	S-SR	S-V	S-W	S-Y	S-ZN	S-ZR	S-TH
HM376C	50	70	N	N	10	1,500	N	20	N	3,000	50	N	200	N	>2,000	N
HM378C	50	50	N	<50	20	200	N	10	N	2,000	70	N	150	N	>2,000	N
HM379C	30	50	N	<50	<10	20	N	20	50	2,000	50	N	200	N	>2,000	N
HMY11C	50	50	N	N	<10	70	N	10	50	1,500	70	N	150	N	>2,000	N

TABLE 8.--Mineralogical analysis of heavy-mineral-concentrate samples from Fremont Gorge Wilderness Study Area, Utah
[Abundance of minerals tentatively identified in the non-magnetic heavy-mineral fraction: -- = none observed; 1 = trace present, <1%; 2 = present, 5 = dominant, >50%; 6 = ubiquitous, >85%. Observed crystal shape of zircon is denoted in column header by an R or E indicating round and euhedral, respectively.]

SAMPLE	LATITUDE	LONGITUD	ZIRCON-R	ZIRCON-E	SPHENE	RUTILE	ANATASE	BARITE	APATITE	SCHEELIT	EPIDOTE	PYRITE
HM376C	38 18 7	111 19 45	3	1	2	2	--	5	2	--	1	1
HM378C	38 17 40	111 20 29	2	1	1	2	--	5	1	--	1	1
HM379C	38 17 44	111 20 32	4	--	1	1	--	5	1	--	1	--
HM911C	38 17 47	111 19 43	--	--	--	--	--	--	--	--	--	--

TABLE 8.--Continued

SAMPLE	PYROXENE	ARSENOPY	AMPHIBOL	ROCK FRA
HM376C	--	--	--	1
HM378C	--	--	--	--
HM379C	--	--	--	--
HM911C	--	--	--	--