UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CHEMICAL ANALYSES AND STATISTICAL SUMMARIES FOR SAMPLES OF ROCK, MINUS-60-MESH (0.25-MM) STREAM SEDIMENT, AND NONMAGNETIC HEAVY-MINERAL CONCENTRATE, FREEL AND DARDANELLES ROADLESS AREAS, ALPINE AND EL DORADO COUNTIES, CALIFORNIA

by

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STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral resource potential. 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 Freel and Dardanelles Roadless Areas in the Lake Tahoe Basin Management Unit and in Toiyabe National Forest, Alpine and El Dorado Counties, California. The Freel (5271) and Dardanelles (4982 and 5982) Roadless Areas were classified as further planning areas during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

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INTRODUCTION

Geochemical sampling was conducted in the Freel and Dardanelles Roadless Areas, Alpine and El Dorado Counties, California, during the summers of 1978 and 1979. This report includes a map showing the locations of all sites sampled in this program (plate 1), a tabulation of the lower limits of determination used in the various analytical methods (table 1), a tabulation of chemical analyses for samples of rock, minus-60-mesh (0.25-mm) stream sediment, and nonmagnetic heavy-mineral concentrate from stream sediment collected at each sample site (tables 2, 3, and 4, respectively), and summary statistics for the elements listed in tables 2-4 (tables 5-7). Tables 2-4 and 5-7 are based on data provided by computer programs in the U.S. Geological Survey RASS-STATPAC System (VanTrump and Miesch, 1977).

SAMPLE COLLECTION AND PREPARATION

A set of samples was collected at most sites shown on plate 1; a complete set consisted of a rock sample, a stream-sediment sample, and a bulk stream-sediment sample used for panning. At all sites, a stream-sediment sample and a bulk stream-sediment were collected, and where suitable outcrop was available, a rock sample was also collected. Analyses for a total of 21 rock samples, 35 stream-sediment samples, and 35 nonmagnetic heavy-mineral-concentrate samples are listed in this report (tables 2-4). The number of samples analyzed for each medium yields an approximate sample density of 1 sample/2.4 mi^2 (1 sample/6.3 km^2) for the rock samples and 1 sample/1.5 mi^2 (1 sample/3.8 km^2) for the other two.

Most of the rock samples are of unaltered material. These samples provide information on chemical abundances in rocks that have not been affected by hydrothermal alteration or mineralization. In addition, some altered and(or) mineralized rocks were collected to characterize anomalous areas and to test for ore-related elements that might not be identified by a visual examination. Although each sample was selected to be representative of the rocks exposed in the vicinity of its plotted site point, the actual areal extent of influence of the chemical information provided by a specific sample is not known; the sampling program was designed only to provide some general information of the geochemical nature of the rock units present.

The sediment samples provide information about the chemical elements present in rock material eroded from the drainage basin upstream from each sample site. Such information is useful in identifying those basins that contain unusually high concentrations of elements that may be related to mineral deposits.

Concentrate samples were processed from the same active alluvium used to make minus-60-mesh (0.25-mm) stream-sediment samples. The concentrate samples provide information about the chemistry of a limited number of minerals present in rock material eroded from the drainage basin upstream from each sample site. Removing most of the quartz, feldspars, clay minerals, and highly magnetic minerals concentrates a number of other minerals that are commonly associated with mineral deposits. The selective concentration of ore-related minerals permits determination of some elements that are not easily detected in stream-sediment samples. The analytical composition of a concentrate may also indicate specific minerals. For example, the barium content in a stream-sediment sample is predominantly the sum of barium in the mineral barite plus barium substituted in feldspars, clay minerals, and possibly other minerals, whereas the barium in a concentrate sample is essentially all in barite.

Rock samples

All rock samples were collected from outcrops that were considered to be representative of exposures in the vicinity of the plotted site location. Wherever possible the samples were hand cobbed to remove any obviously weathered material. All samples were crushed and pulverized to minus-100 mesh (0.149 mm) before analysis.

Minus-60-mesh (0.25-mm) stream-sediment samples

The material for the stream-sediment samples was collected primarily from first-order (unbranched) and second-order (below the junction of two first-order) streams as shown on 1:62,500-scale topographic maps. Each sample was composited from active alluvium collected from several locations within an area that may extend as much as 50 ft (15 m) from the site plotted on the map. The resulting sample was air dried and that portion passing a screen with 0.25-mm openings (a 60-mesh screen) was saved and pulverized before analysis.

Nonmagnetic heavy-mineral-concentrate samples

The bulk sample of active stream-sediment material was collected and composited in a manner similar to that used for the minus-60-mesh (0.25-mm) stream-sediment samples. Each bulk sample was passed through a 10-mesh (2.0-mm) screen to remove the coarsest material. The sediment passing through the screen was wet-panned until most of the quartz, feldspar, organic material, and clay-sized material was removed. The sample was air dried and passed through a 18-mesh (1.0-mm) sieve; the minus-18-mesh material was saved. Any light material remaining in the concentrate was then removed by allowing the heavier fraction of the sample to settle through bromoform (specific gravity 2.86). The highly magnetic material was next removed with a hand magnet from the heavy-mineral fraction. The remaining heavy-mineral material was then separated into a magnetic and a nonmagnetic fraction using a Frantz Isodynamic Separator set at 0.6 amperes, with a 15° forward setting and a 15° side setting. The resulting nonmagnetic sample was split into two equal fractions; one fraction was ground in an agate mortar prior to analysis and the other fraction was saved for future mineralogical studies.

CHEMICAL ANALYSIS

All three types of samples were analyzed for 31 elements (Ag, As, Au, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, La, Mg, Mn, Mo, Nb, Ni, Pb, Sb, Sc, Sn, Sr, Th, Ti, V, W, Y, Zn, and Zr) using a six-step semiquantitative emission spectrographic method (Grimes and Marranzino, 1968). Because of the limited amount of sample material, the nonmagnetic heavy-mineral concentrates were only analyzed spectrographically. The rock and stream-sediment samples were also analyzed for As using a colorimetric method (Ward and others, 1963) and for Zn, Sb, Cd, and Bi by atomic absorption spectrometry (Ward and others, 1969; Welsch and Chao, 1975; Viets, 1978). Analysis for all three sample types was done partly in the field and partly in U.S. Geological Survey laboratories near Golden, Colorado.

The spectrographic analytical values are reported as the approximate geometric midpoints (0.15, 0.2, 0.3, 0.5, 0.7, and 1.0 or appropriate powers of ten of these values) of concentration ranges whose respective boundaries

are 0.12, 0.18, 0.26, 0.38, 0.56, 0.83, and 1.2 (or appropriate powers of ten of these values). In general, the precision of the spectrographic method is plus or minus one reporting value of the value given by the analyst approximately 83 percent of the time and plus or minus two reporting values of the value given by the analyst 96 percent of the time (Motooka and Grimes, 1976). Because all of the samples for this report were analyzed by the same analyst using the same spectrographic instrument, our experience indicates that better precision can be expected.

Each spectrographic film includes analytical spectra for up to 22 field samples and one reference standard sample. The reference standard sample is included with each set of field samples to monitor the quality of the analyses from film to film; however, the analyses for these samples have been omitted from tables 2-4.

For the five elements analyzed by colorimetric or atomic absorption methods the reporting values vary with the element and with the concentration level for any given element. Precision for these analytical methods is commonly reported as a percent relative standard deviation (% RSD), and is based on replicate analyses of samples selected to provide information at different concentration levels. In general, the precision for each method tends to be lowest for those samples containing a given element at or near its lower limit of determination. For the five elements discussed here, the reported ranges of percent relative standard deviation, as determined by replicate analysis of a limited sample set, are as follows:

Element	Range of % RSD	Source of data
As	0.0-48.9	Unpublished analyses by R. H. Hill, 1981
Zn	3.4-30.2	Ward and others, 1969, p. 21
Sb	3.7-10.7	Welsch and Chao, 1975
Cd	3.3-18.8	Viets, 1978
Bi	1.4- 4.0	Viets, 1978

As an example to use in interpreting these ranges one might consider antimony, whose range is shown as 3.7-10.7% RSD. This range indicates that a reported antimony value listed in tables 2 or 3 should be within $\pm$ 10.7% (usually much less) of the mean value for that sample. The mean value would be determined by repeating the analysis of that sample five or more times. As was the case for the spectrographic analyses, a reference standard sample was analyzed with each batch of field samples to monitor the quality of the analyses.

DESCRIPTION OF TABLES 1-4

Table 1 lists the lower limits of analytical determination for the three types of samples collected for this report. Because of matrix interference problems, the spectrographic technique was modified for the analysis of nonmagnetic heavy-mineral-concentrate samples. As a result, the lower limits of determination for the elements analyzed for this type of sample are all raised two reporting values above the normal lower-limit value.

Tables 2-4 list the chemical analyses for the samples of rock, minus-60-mesh (0.25-mm) stream sediment, and nonmagnetic heavy-mineral concentrate, respectively. For the three sample sets the data are arranged so that column 1 contains the USGS-assigned sample numbers. These numbers coincide with the numbers on the site location map (plate 1). In tables 2-4, rock samples are suffixed by RK, stream-sediment samples by SS, and concentrate samples by KN. Columns 2 and 3 list the latitudes (north) and longitudes (west) for the sample sites in degrees, minutes, and seconds. Columns in which the element headings show the letter "s" below the element symbol are emission spectrographic analyses. Columns in which the element headings show the letters "aa" below the element symbol are atomic absorption analyses. The last column of analyses in table 3 contains colorimetric determinations ("cm") for arsenic. All element concentrations are given in parts per million (ppm), except those for Fe, Mg, Ca, and Ti, which are given in percent (pct).

If a given element was looked for on the spectrographic film but not detected, then the letter "N" is entered in the tables in place of an analytical value. If an element was observed but was below the lowest reporting value, then 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, than 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 tables 2-4, some of the elements listed in these tables (Fe, Mg, Ca, Ti, and Be) carry one or more nonsignificant zeroes to the right of the significant digits. The analysts did not determine these elements to the accuracy suggested by the nonsignificant zeroes. The last column in table 2 gives the formation name for each rock sample. These names are taken from the units shown on the geologic map of the Freel and Dardanelles Roadless Areas (John and others, 1981).

For the semiquantitative spectrographic method used, the elements As, Bi, Cd, Sb, and Zn have lower limits of analytical determination that are usually above normal concentrations for these elements in natural materials. As a result, these elements were run by other, more sensitive methods on the rock and stream-sediment samples, and the spectrographic analyses for these five elements have been deleted from the rock and stream-sediment data sets (tables 2 and 3). The elements Ag, Au, Sn, W, and Th were not detected in any of the rock or stream-sediment samples; consequently, these elements were also deleted from tables 2 and 3. The element As-aa was deleted from the rock data set (table 2) and the elements Ag, Au, and Sb were deleted from the concentrate data set (table 4) for the same reason.

Table 1.--Lower limits of analytical determination for samples of rock, minus-60-mesh (0.25-mm) stream sediment, and nonmagnetic heavy-mineral concentrate, Freel and Dardanelles Roadless Areas, California

[(--) indicates not analyzed. "aa" following the element symbol indicates atomic absorption analysis; "cm" indicates colorimetric analysis; no suffix indicates spectrographic analysis. The values listed for Fe, Mg, Ca, and Ti are in percent; all others are in parts per million.]

Element	Lower limit of determination	
	Rock and stream sediment	Heavy-mineral concentrate
Fe	0.05	0.1
Mg	0.02	0.05
Ca	0.05	0.1
Ti	0.002	0.005
Mn	10	20
Ag	0.5	1.0
As	200	500
Au	10	20
B	10	20
Ba	20	50
Be	1	2
Bi	10	20
Cd	20	50
Co	5	10
Cr	10	20
Cu	5	10
La	20	50
Mo	5	10
Nb	20	50
Ni	5	10
Pb	10	20
Sb	100	200
Sc	5	10
Sn	10	20
Sr	100	200
V	10	20
W	50	100
Y	10	20
Zn	200	500
Zr	10	20
Th	200	500
Zn-aa	5	--
Cd-aa	0.05	--
Bi-aa	0.5	--
Sb-aa	1.0	--
As-cm	10	--

Table 2.--Data for rock samples, Freel and Dardanelles Roadless Areas, California

Sample	Latitude	Longitude	Fe-pct. s	Mg-pct. s	Ca-pct. s	Ti-pct. s	Mn-ppm s	B-ppm s	Ba-ppm s	Be-ppm s	Co-ppm s	Cr-ppm s
CC017RK	38 44 40	120 6 20	2.0	.70	1.5	.50	500	10	1,000	<1.0	7	15
DA004RK	38 44 5	119 57 47	1.0	.20	.3	.30	300	15	300	1.0	5	N
DA006RK	38 41 52	119 58 50	1.5	1.00	2.0	.50	300	<10	500	<1.0	15	15
DA403RK	38 46 2	120 1 43	3.0	1.00	2.0	.30	700	50	1,000	<1.0	10	15
DA404RK	38 45 59	120 1 15	7.0	1.50	2.0	.70	1,000	15	2,000	<1.0	20	50
DA405RK	38 48 6	120 1 11	2.0	.70	2.0	.50	500	20	1,000	<1.0	10	20
DA407RK	38 47 12	120 4 45	2.0	.70	2.0	.50	700	10	1,500	1.0	7	<10
DA408RK	38 46 53	120 5 16	2.0	.50	2.0	.30	500	10	2,000	<1.0	7	10
DA409RK	38 45 35	120 6 6	5.0	1.00	2.0	.50	1,000	10	1,000	1.0	10	10
DA500RK	38 44 20	120 1 20	5.0	1.00	2.0	.50	1,000	30	1,000	<1.0	20	50
FP304RK	38 49 33	119 58 24	3.0	1.00	2.0	.50	500	<10	1,000	<1.0	10	10
FP305RK	38 49 19	120 0 24	2.0	1.00	1.5	.50	500	10	1,000	<1.0	15	20
FP306RK	38 49 51	120 0 16	3.0	1.00	1.5	.50	700	10	2,000	<1.0	15	20
WL0033RK	38 43 55	119 56 0	2.0	.20	1.0	.15	500	20	700	2.0	5	<10
WL0037RK	38 47 39	119 57 17	5.0	1.50	3.0	.50	500	20	700	1.0	20	20
WL0440RK	38 48 33	119 54 3	2.0	1.00	1.0	.30	300	<10	1,000	1.5	<5	<10
WL0445RK	38 45 42	119 58 4	1.0	.50	2.0	.20	700	30	500	3.0	5	<10
WL0782RK	38 54 0	119 55 48	1.0	1.00	1.5	.20	700	N	700	1.0	7	<10
WL0785RK	38 52 8	119 58 52	1.5	1.00	1.5	.30	500	<10	1,000	<1.0	10	10
WL0787RK	38 51 46	119 57 25	1.0	1.00	1.5	.50	500	<10	700	<1.0	10	10
WL0789RK	38 52 19	119 57 46	.2	.05	.1	.05	100	N	100	1.5	N	N

Table 2.--Data for rock samples, Freel and Dardanelles Roadless Areas, California

Sample	Cu-ppm s	La-ppm s	Mo-ppm s	Nb-ppm s	Ni-ppm s	Pb-ppm s	Sc-ppm s	Sr-ppm s	V-ppm s	Y-ppm s	Zr-ppm s	Zn-ppm aa	Cd-ppm aa
CC017RK	7	30	N	N	5	30	5	500	100	10	50	40	N
DA004RK	5	20	20	N	5	20	5	100	30	15	50	20	.25
DA006RK	7	50	N	N	7	20	7	500	70	10	50	50	.25
DA403RK	5	100	N	N	5	50	5	500	70	<10	70	65	.05
DA404RK	20	30	N	N	20	30	7	500	150	10	70	65	<.05
DA405RK	10	30	N	N	5	30	5	500	100	10	50	50	<.05
DA407RK	7	30	N	N	5	30	5	700	100	<10	50	70	<.05
DA408RK	5	30	N	N	5	30	5	500	70	<10	30	45	<.05
DA409RK	10	30	N	N	5	30	5	700	100	10	15	75	<.05
DA500RK	20	50	N	N	20	30	10	1,000	150	20	10	45	.15
FP304RK	<5	50	N	N	<5	50	5	700	100	10	50	55	<.05
FP305RK	5	200	N	N	7	30	5	500	100	20	70	60	<.05
FP306RK	7	30	N	N	10	50	5	500	100	10	50	50	<.05
WL0033RK	<5	30	N	N	<5	50	5	300	70	20	70	20	<.05
WL0037RK	30	30	N	N	20	30	15	700	200	20	100	20	.05
WL0440RK	<5	30	N	N	N	20	5	200	70	20	150	50	.10
WL0446RK	N	20	N	<20	<5	20	7	200	70	20	100	25	.10
WL0782RK	5	20	N	N	5	50	5	700	150	<10	30	50	.10
WL0785RK	5	30	N	N	5	50	10	700	150	<10	150	40	.05
WL0787RK	<5	30	N	N	7	20	10	500	200	10	10	45	.05
WL0789RK	<5	100	N	N	N	100	<5	N	50	<10	30	<5	.10

Table 2.--Data for rock samples, Freel and Dardanelles Roadless Areas, California

Sample	Bi-ppm aa	Sb-ppm aa	FORMATION NAME
CC017RK	<.5	3	LOVERS LEAP GRANODIORITE OF LOOMIS (1981)
DA004RK	<.5	1	BURNSIDE LAKE ADAMELLITE OF PARKER (1961)
DA006RK	N	1	CARSON PASS TONALITE OF PARKER (1961)
DA403RK	<.5	2	BRYAN MEADOW GRANODIORITE
DA404RK	N	2	BRYAN MEADOW GRANODIORITE
DA405RK	N	2	BRYAN MEADOW GRANODIORITE
DA407RK	N	2	BRYAN MEADOW GRANODIORITE
DA408RK	<.5	2	LOVERS LEAP GRANODIORITE OF LOOMIS (1981)
DA409RK	N	2	LOVERS LEAP GRANODIORITE OF LOOMIS (1981)
DA500RK	N	1	BRYAN MEADOW GRANODIORITE
FP304RK	N	2	BRYAN MEADOW GRANODIORITE
FP305RK	N	<1	BRYAN MEADOW GRANODIORITE
FP306RK	<.5	2	BRYAN MEADOW GRANODIORITE
WL0033RK	N	<1	BURNSIDE LAKE ADAMELLITE OF PARKER (1961)
WL0037RK	<.5	<1	BRYAN MEADOW GRANODIORITE
WL0440RK	<.5	2	GRANODIORITE OF FREEL PEAK
WL0446RK	<.5	2	BURNSIDE LAKE ADAMELLITE OF PARKER (1961)
WL0782RK	N	2	BRYAN MEADOW GRANODIORITE
WL0785RK	N	2	BRYAN MEADOW GRANODIORITE
WL0787RK	<.5	2	BRYAN MEADOW GRANODIORITE
WL0789RK	.5	2	BRYAN MEADOW GRANODIORITE

Table 3.--Data for stream-sediment samples, Freel and Dardanelles Roadless Areas, California

Sample	Latitude	Longitude	Fe-pct. s	Mg-pct. s	Ca-pct. s	Ti-pct. s	Mn-ppm s	B-ppm s	Ba-ppm s
CC016SS	38 44 42	120 6 2	5.0	1.00	1.5	.5	1,000	20	500
DA004SS	38 44 5	119 57 47	5.0	1.50	3.0	.5	1,500	10	1,000
DA005SS	38 43 38	119 57 50	5.0	.70	1.5	.5	1,500	20	1,000
DA006SS	38 41 52	119 58 50	5.0	1.00	2.0	.5	1,000	15	1,000
DA401SS	38 46 26	119 59 45	5.0	2.00	2.0	.5	2,000	<10	500
DA402SS	38 46 32	119 59 36	5.0	.30	.7	.2	1,000	10	300
DA403SS	38 46 2	120 1 43	5.0	1.50	1.5	.7	2,000	10	700
DA404SS	38 45 59	120 1 15	5.0	1.00	2.0	.5	1,500	15	700
DA405SS	38 48 6	120 1 11	7.0	.50	1.5	.5	1,000	15	300
DA406SS	38 49 21	120 3 15	2.0	.50	1.5	.5	700	15	500
DA407SS	38 47 12	120 4 45	7.0	.50	1.0	.5	1,000	10	500
DA408SS	38 46 53	120 5 16	2.0	.30	1.5	.5	500	10	500
DA409SS	38 45 35	120 6 6	10.0	.70	1.5	.5	700	10	500
DA410SS	38 44 33	120 0 21	7.0	1.50	2.0	.5	1,500	10	1,000
DA500SS	38 44 20	120 1 20	5.0	2.00	2.0	.7	1,500	10	1,000
FP301SS	38 53 35	119 54 24	2.0	.30	1.0	.3	1,000	10	500
FP302SS	38 53 38	119 54 11	5.0	.20	1.0	.5	1,500	10	300
FP303SS	38 53 47	119 54 3	5.0	.15	1.5	.7	2,000	<10	300
FP304SS	38 49 33	119 58 24	7.0	1.00	1.5	.7	1,500	10	500
FP305SS	38 49 19	120 0 24	3.0	1.00	2.0	.7	1,000	15	300
FP306SS	38 49 51	120 0 16	5.0	.50	1.5	.5	2,000	<10	300
WL0033SS	38 43 55	119 56 0	2.0	1.50	2.0	.5	700	50	1,000
WL0035SS	38 44 50	119 56 22	2.0	2.00	3.0	.5	1,000	50	1,000
WL0038SS	38 47 55	119 58 43	2.0	1.50	2.0	.3	700	15	700
WL0037SS	38 47 39	119 57 17	2.0	1.00	1.5	.5	700	20	1,000
WL0440SS	38 48 33	119 54 3	5.0	1.00	2.0	.5	1,000	30	500
WL0441SS	38 48 32	119 53 50	7.0	.70	2.0	.5	1,000	20	700
WL0445SS	38 45 50	119 57 42	5.0	1.00	3.0	.7	2,000	100	700
WL0782SS	38 54 0	119 55 48	1.0	.70	1.5	.3	700	20	300
WL0783SS	38 53 54	119 55 51	1.5	1.00	1.5	.5	700	<10	300
WL0785SS	38 52 8	119 58 52	1.0	1.00	1.5	.3	500	20	500
WL0786SS	38 52 12	119 58 44	1.0	1.50	1.5	.7	500	10	500
WL0787SS	38 51 46	119 57 25	2.0	1.00	1.5	.5	1,000	10	500
WL0788SS	38 51 48	119 57 31	1.0	1.00	1.5	.5	700	10	500
WL0789SS	38 52 19	119 57 46	2.0	.70	1.0	.5	700	10	300

Table 3.--Data for stream-sediment samples, Freel and Dardanelles Roadless Areas, California

Sample	Be-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
CC016SS	1.0	10	50	10	50	5	<20	5	30
DA004SS	<1.0	30	100	30	50	<5	N	50	30
DA005SS	1.0	20	50	70	30	10	N	30	50
DA006SS	<1.0	20	150	20	30	N	N	50	50
DA401SS	<1.0	20	100	20	30	N	N	30	30
DA402SS	1.0	5	20	<5	20	<5	N	5	30
DA403SS	<1.0	20	70	20	30	N	N	20	20
DA404SS	<1.0	20	70	15	30	N	N	20	30
DA405SS	<1.0	10	50	10	30	N	N	<5	30
DA406SS	<1.0	7	30	7	50	5	<20	<5	50
DA407SS	<1.0	10	30	7	50	N	N	<5	30
DA408SS	<1.0	<5	10	15	100	N	<20	N	30
DA409SS	<1.0	15	70	20	20	N	N	10	20
DA410SS	<1.0	20	100	30	30	N	N	30	30
DA500SS	<1.0	20	100	30	30	N	N	50	30
FP301SS	1.0	5	<10	30	30	10	N	<5	50
FP302SS	1.0	5	10	30	30	10	<20	N	30
FP303SS	1.0	5	10	30	70	15	<20	N	30
FP304SS	<1.0	15	50	15	50	15	N	5	20
FP305SS	<1.0	20	30	20	50	<5	N	15	30
FP306SS	1.0	7	15	7	50	N	N	N	30
WL0033SS	1.0	20	150	30	30	5	N	50	30
WL0035SS	1.0	20	50	30	20	5	N	30	30
WL0038SS	1.5	20	<10	10	20	N	N	10	30
WL0037SS	1.5	30	100	30	50	N	N	30	30
WL0440SS	2.0	7	10	50	50	20	<20	<5	30
WL0441SS	3.0	7	10	30	50	N	<20	N	20
WL0445SS	2.0	15	50	30	50	10	N	20	20
WL0782SS	1.5	5	<10	10	30	7	N	<5	30
WL0783SS	1.0	10	10	<5	70	<5	N	<5	30
WL0785SS	1.0	7	10	7	30	N	N	7	30
WL0786SS	1.0	7	15	5	50	5	N	5	30
WL0787SS	1.0	10	50	7	30	N	N	5	50
WL0788SS	<1.0	10	10	5	50	<5	N	5	50
WL0789SS	1.0	5	15	10	50	N	N	<5	30

Table 3.--Data for stream-sediment samples, Freel and Dardanelles Roadless Areas, California

Sample	Sc-ppm s	Sr-ppm s	V-ppm s	Y-ppm s	Zr-ppm s	Zn-ppm aa	Cd-ppm aa	Bi-ppm aa	Sb-ppm aa	As-ppm cm
CC016SS	10	500	150	20	300	40	N	1.0	2	N
DA004SS	20	1,000	200	20	70	40	.05	N	2	N
DA005SS	10	700	150	15	100	700	4.50	1.5	3	20
DA006SS	15	1,000	200	20	70	80	.20	N	2	N
DA401SS	20	700	150	15	70	35	.10	N	2	N
DA402SS	5	300	100	15	100	30	.20	<.5	2	N
DA403SS	20	1,000	300	15	150	35	.10	N	2	N
DA404SS	20	700	150	15	150	30	.10	<.5	2	N
DA405SS	10	500	150	20	200	40	N	<.5	3	N
DA406SS	10	500	100	30	200	30	.10	<.5	2	N
DA407SS	7	500	200	20	100	20	.10	N	2	N
DA408SS	5	500	100	20	70	20	<.05	<.5	2	N
DA409SS	10	700	300	20	150	30	.10	N	2	N
DA410SS	20	1,000	200	15	100	40	.10	N	2	N
DA500SS	20	1,000	200	15	150	45	<.05	N	2	N
FP301SS	7	500	70	20	70	45	.25	<.5	2	N
FP302SS	7	300	100	50	150	40	.20	1.5	2	N
FP303SS	7	500	100	70	150	20	.20	<.5	1	N
FP304SS	15	700	150	20	200	35	.10	<.5	2	N
FP305SS	20	500	150	20	70	45	N	<.5	2	N
FP306SS	10	500	100	30	150	25	.10	<.5	2	N
WL0033SS	10	700	100	15	100	75	.50	2.0	2	20
WL0035SS	15	1,000	150	10	100	50	.20	2.0	<1	N
WL0038SS	10	700	70	10	200	30	.50	1.0	1	N
WL0037SS	15	500	100	15	200	65	.15	2.5	1	N
WL0440SS	15	300	100	30	1,000	50	.15	1.0	2	N
WL0441SS	7	500	500	50	>1,000	50	.15	.5	2	N
WL0445SS	15	300	500	30	700	100	.70	N	3	10
WL0782SS	10	500	100	30	100	20	<.05	<.5	2	N
WL0783SS	15	500	200	30	200	15	N	<.5	2	N
WL0785SS	10	700	150	10	70	30	N	.5	2	N
WL0786SS	15	700	200	20	100	15	N	N	2	N
WL0787SS	20	500	200	30	300	40	<.05	.5	2	N
WL0788SS	15	700	200	20	150	20	N	<.5	2	N
WL0789SS	15	500	200	30	200	30	.05	.5	2	N

Table 4.--Data for concentrate samples, Freel and Dardanelles Roadless Areas, California

Sample	Latitude	Longitude	Fe-pct. s	Mg-pct. s	Ca-pct. s	Ti-pct. s	Mn-ppm s	As-ppm s	B-ppm s	Ba-ppm s	Be-ppm s
CC016KN	38 44 42	120 6 2	.5	.30	7	>2.0	1,000	N	<20	1,000	N
DA004KN	38 44 5	119 57 47	2.0	2.00	7	.7	1,000	N	30	50	N
DA005KN	38 43 38	119 57 50	2.0	1.00	10	1.0	5,000	500	150	<50	N
DA006KN	38 41 52	119 58 50	2.0	3.00	7	2.0	1,500	N	100	70	N
DA401KN	38 46 26	119 59 45	1.0	7.00	15	1.5	1,000	N	N	70	N
DA402KN	38 46 32	119 59 36	.7	1.00	15	1.5	2,000	N	100	50	<2
DA403KN	38 46 2	120 1 43	1.0	5.00	10	>2.0	1,000	N	20	100	<2
DA404KN	38 45 59	120 1 15	.5	5.00	15	>2.0	1,500	N	100	100	<2
DA405KN	38 48 6	120 1 11	.2	.20	15	>2.0	1,000	N	20	50	N
DA406KN	38 49 21	120 3 15	.1	.05	15	>2.0	1,000	N	<20	N	N
DA407KN	38 47 12	120 4 45	.2	.10	15	>2.0	1,000	N	20	<50	N
DA408KN	38 46 53	120 5 16	.2	.10	15	>2.0	700	N	20	<50	N
DA409KN	38 45 35	120 6 6	.5	.30	15	>2.0	1,000	N	20	50	N
DA410KN	38 44 33	120 0 21	3.0	10.00	15	1.0	1,500	N	<20	50	N
DA500KN	38 44 20	120 1 20	3.0	3.00	10	1.0	1,500	N	N	50	N
FP301KN	38 53 35	119 54 24	.2	.15	10	>2.0	1,500	N	<20	70	<2
FP302KN	38 53 38	119 54 11	.2	<.05	2	>2.0	700	N	N	100	<2
FP303KN	38 53 47	119 54 3	.2	.10	15	>2.0	2,000	N	N	50	<2
FP304KN	38 49 33	119 58 24	.2	.15	15	>2.0	1,000	N	N	50	N
FP305KN	38 49 19	120 0 24	.5	.50	15	>2.0	1,000	N	150	100	<2
FP306KN	38 49 51	120 0 16	.2	.10	10	>2.0	1,500	N	N	70	<2
WL0033KN	38 43 55	119 56 0	2.0	3.00	10	>2.0	2,000	N	500	500	2
WL0035KN	38 44 50	119 56 22	3.0	5.00	15	2.0	2,000	N	500	300	2
WL0038KN	38 47 55	119 58 43	.2	.20	10	>2.0	1,500	N	<20	150	<2
WL0037KN	38 47 39	119 57 17	2.0	5.00	10	>2.0	1,500	N	200	500	2
WL0440KN	38 48 33	119 54 3	.5	.10	5	>2.0	1,000	N	N	70	N
WL0441KN	38 48 32	119 53 50	.5	.05	5	>2.0	2,000	N	N	70	N
WL0445KN	38 45 50	119 57 42	2.0	1.50	10	2.0	3,000	N	300	150	<2
WL0782KN	38 54 0	119 55 48	.2	.15	3	>2.0	1,000	N	N	100	N
WL0783KN	38 53 54	119 55 51	.5	<.05	2	>2.0	700	N	30	100	N
WL0785KN	38 52 8	119 58 52	.5	.10	5	>2.0	1,000	N	N	100	<2
WL0786KN	38 52 12	119 58 44	.5	.05	5	>2.0	700	N	N	100	N
WL0787KN	38 51 46	119 57 25	.7	.30	5	>2.0	1,000	N	N	50	N
WL0788KN	38 51 48	119 57 31	.5	.05	5	>2.0	700	N	N	<50	N
WL0789KN	38 52 19	119 57 46	.5	.05	5	>2.0	1,000	N	N	100	N

Table 4.--Data for concentrate samples, Freel and Dardanelles Roadless Areas, California

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
CC016KN	N	N	10	70	10	1,000	50	70	N	50
DA004KN	200	N	20	1,000	10	1,500	300	50	70	<20
DA005KN	70	<50	30	200	200	1,000	5,000	70	50	20
DA006KN	N	N	30	2,000	20	500	70	100	150	N
DA401KN	N	N	30	1,000	<10	500	10	50	100	<20
DA402KN	N	N	<10	150	<10	2,000	30	100	15	30
DA403KN	N	N	30	500	<10	700	20	70	50	N
DA404KN	N	N	20	300	<10	700	30	100	20	20
DA405KN	N	N	<10	50	N	1,500	50	150	N	30
DA406KN	N	N	<10	30	N	1,500	50	150	10	20
DA407KN	N	N	N	20	<10	1,000	50	100	N	50
DA408KN	N	N	N	20	N	1,000	50	150	N	20
DA409KN	N	N	<10	70	N	1,000	30	100	N	150
DA410KN	N	N	50	1,500	20	100	<10	N	150	30
DA500KN	N	N	30	1,500	N	100	N	N	100	N
FP301KN	N	N	15	30	10	1,000	50	150	N	200
FP302KN	N	N	15	<20	10	700	30	100	N	70
FP303KN	200	N	15	20	30	2,000	50	100	20	100
FP304KN	N	N	15	30	<10	1,500	50	100	N	20
FP305KN	N	N	20	30	<10	1,000	50	200	N	20
FP306KN	N	N	15	20	<10	1,000	50	150	<10	50
WL0033KN	N	N	20	200	<10	500	N	100	50	20
WL0035KN	N	N	15	500	50	150	N	50	70	N
WL0038KN	N	N	10	<20	N	1,000	50	200	<10	20
WL0037KN	<20	N	20	200	10	700	N	150	100	20
WL0440KN	N	N	<10	N	<10	700	15	100	20	30
WL0441KN	N	N	<10	20	<10	1,000	20	70	20	20
WL0445KN	N	N	N	150	10	300	50	50	N	70
WL0782KN	N	N	10	20	N	500	15	100	20	50
WL0783KN	N	N	<10	20	N	500	20	70	20	N
WL0785KN	N	N	10	30	N	700	20	100	20	20
WL0786KN	N	N	10	<20	<10	500	20	50	<10	<20
WL0787KN	N	N	<10	100	<10	500	15	100	20	20
WL0788KN	N	N	10	<20	<10	700	20	100	20	50
WL0789KN	N	N	10	20	<10	500	20	100	20	70

Table 4.--Data for concentrate samples, Freel and Dardanelles Roadless Areas, California

Sample	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
CC016KN	50	100	N	300	N	1,000	N	>2,000	2,000
DA004KN	50	N	200	300	2,000	500	N	>2,000	2,000
DA005KN	30	70	200	300	5,000	150	1,500	>2,000	<500
DA006KN	70	20	200	300	500	300	N	>2,000	500
DA401KN	100	N	<200	200	<100	200	N	2,000	<500
DA402KN	50	30	N	200	150	1,000	N	>2,000	2,000
DA403KN	100	70	N	300	N	500	N	>2,000	<500
DA404KN	70	50	<200	200	N	500	N	2,000	<500
DA405KN	30	70	N	300	N	1,000	N	1,000	500
DA406KN	50	70	N	500	N	1,000	N	1,500	<500
DA407KN	50	50	N	300	N	700	N	1,500	2,000
DA408KN	30	70	N	300	N	700	N	500	<500
DA409KN	30	70	N	300	N	700	N	1,500	<500
DA410KN	150	N	200	300	N	100	N	>2,000	<500
DA500KN	70	N	<200	300	N	150	N	>2,000	<500
FP301KN	50	100	N	300	N	2,000	N	>2,000	1,000
FP302KN	50	70	N	150	100	1,500	N	>2,000	5,000
FP303KN	70	100	N	200	<100	1,500	N	>2,000	2,000
FP304KN	30	50	N	500	N	500	N	2,000	1,000
FP305KN	30	70	N	500	N	700	N	2,000	500
FP306KN	50	100	N	300	N	1,000	N	>2,000	700
WL0033KN	50	20	N	700	100	500	N	>2,000	1,000
WL0035KN	50	20	200	700	500	200	N	>2,000	500
WL0038KN	30	70	N	1,000	<100	700	N	>2,000	1,000
WL0037KN	100	50	500	1,000	N	500	N	>2,000	500
WL0440KN	50	100	N	300	N	1,000	N	>2,000	2,000
WL0441KN	50	100	<200	300	N	500	N	>2,000	1,000
WL0445KN	30	<20	500	500	700	150	N	1,500	1,000
WL0782KN	50	100	N	500	N	500	N	>2,000	1,000
WL0783KN	30	20	<200	300	100	200	N	2,000	1,500
WL0785KN	30	70	N	500	N	500	N	2,000	500
WL0786KN	20	50	200	300	N	200	N	>2,000	2,000
WL0787KN	20	100	N	300	N	700	N	>2,000	1,500
WL0788KN	20	70	N	300	N	300	N	2,000	2,000
WL0789KN	20	100	N	300	100	500	N	>2,000	2,000

DESCRIPTION OF TABLES 5-7

Tables 5, 6, and 7 give summary statistics for the analyses of the samples of rock, minus-60-mesh (0.25-mm) stream sediment, and nonmagnetic heavy-mineral concentrate listed in tables 2, 3, and 4, respectively. All values in the Range of values and Percentiles columns are significant to the number of digits shown. For uniformity, the values in the Geometric mean and Geometric deviation columns are all listed to two significant digits even though it is recognized that the second digit may not be truly significant for some elements. The geometric mean and geometric deviation for each element are calculated from the analyses remaining after all the "not detected," (N), "less than," (<), and "greater than" (>) values have been deleted for that element.

Table 5.--Summary statistics for the analyses of the 21 rock samples in table 3, Freel and Dardanelles Roadless Areas, California

[All concentrations are in parts per million except those for Fe, Mg, Ca, and Ti, which are in percent. "aa" following the element symbol indicates atomic absorption analysis; no element prefix indicates emission spectrographic analysis. "N" means not detected at the lower limit of determination shown in parentheses. Dashes (--) indicate insufficient reported values not qualified by N, <, or > to derive meaningful information]

Element	Range of values	Geometric mean	Geometric deviation	Percentiles				
				50	75	90	95	98
Fe	0.2 - 7	2.0	2.2	2.	3	5	5	7
Mg	0.05 - 1.5	0.69	2.2	1	1	1	1.5	1.5
Ca	0.1 - 3	1.4	2.1	2	2	2	2	3
Ti	0.05 - 0.7	0.35	1.8	0.5	0.5	0.5	0.5	0.7
Mn	100 -1000	520	1.7	500	700	1000	1000	1000
B	N(10)- 50	16	1.7	10	20	30	30	50
Ba	100 -2000	830	1.9	1000	1000	2000	2000	2000
Be	<1 - 3	--	--	<1	1	1.5	2	3
Co	N(5) - 20	10	1.6	10	15	20	20	20
Cr	N(10)- 50	17	1.7	10	20	20	50	50
Cu	N(5) - 30	8.1	1.8	5	7	20	20	30
La	20 - 200	37	1.8	30	50	100	100	150
Mo	N(5) - 20	--	--	N(5)	N(5)	N(5)	N(5)	15
Nb	N(20)- <20	--	--	N(20)	N(20)	N(20)	<20	<20
Ni	N(5) - 20	7.2	1.7	5	7	20	20	20
Pb	20 - 100	33	1.5	30	50	50	50	100
Sc	<5 - 15	6.2	1.4	5	7	10	10	15
Sr	N(100) -1000	470	1.7	500	700	700	700	1000
V	30 - 200	95	1.6	100	150	150	200	200
Y	<10 - 20	14	1.4	10	20	20	20	20
Zr	10 - 150	47	2.1	50	70	100	150	150
Zn-aa	<5 - 75	44	1.5	50	55	65	70	75
Cd-aa	N(0.05)- 0.25	0.09	1.8	0.05	0.1	0.15	0.25	0.25
Bi-aa	N(0.5)- 0.5	--	--	N(0.5)	<0.5	<0.5	0.5	0.5
Sb-aa	<1 - 3	1.8	1.3	2	2	2	2	3

Table 6.--Summary statistics for the analyses of the 35 minus-60-mesh (0.25-mm) stream-sediment samples in table 3, Freel and Dardanelles Roadless Areas, California

[All concentrations are in parts per million except those for Fe, Mg, Ca, and Ti, which are in percent. "aa" following the element symbol indicates atomic absorption anaysis; "cm" indicates colorimetric analysis; no element prefix indicates emission spectrography analysis. "N" means not detected at the lower limit of determination shown in parentheses. Dashes (--) indicate insufficient reported values not qualified with N, <, or > to derive meaningful information]

Element	Range of values	Geometric mean	Geometric deviation	Percentiles				
				50	75	90	95	98
Fe	1 - 10	3.3	1.9	5	5	7	7	7
Mg	0.15- 2	0.81	1.9	1	1	1.5	2	2
Ca	0.7 - 3	1.6	1.4	1.5	2	2	3	3
Ti	0.2 - 0.7	0.49	1.3	0.5	0.5	0.7	0.7	0.7
Mn	500 - 2000	1000	1.5	1000	1500	2000	2000	2000
B	<10 - 100	15	1.8	10	20	30	50	70
Ba	300 - 1000	540	1.6	500	700	1000	1000	1000
Be	<1 - 3	1.2	1.4	1	1	1.5	2	2
Co	<5 - 30	11	1.8	10	20	20	20	30
Cr	<10 - 150	34	2.6	30	70	100	100	150
Cu	<5 - 50	16	2.0	20	30	30	30	50
La	20 - 100	38	1.5	30	50	50	70	70
Mo	N(5)- 20	8.4	1.6	<5	5	10	15	15
Nb	N(20)- <20	--	--	N(20)	N(20)	<20	<20	<20
Ni	N(5)- 50	16	2.4	5	20	50	50	50
Pb	20 - 50	31	1.3	30	30	50	50	50
Sc	5 - 20	12	1.5	15	15	20	20	20
Sr	300 - 1000	580	1.4	500	700	1000	1000	1000
V	70 - 500	150	1.6	150	200	300	300	500
Y	10 - 70	20	1.6	20	30	30	50	50
Zr	70 ->1000	140	1.9	150	200	300	700	>1000
Zn-aa	15 - 700	38	2.0	35	45	70	80	100
Cd-aa	<0.05 - 4.5	0.17	2.6	0.10	0.20	0.50	0.50	0.70
Bi-aa	N(0.5)- 2.0	1.0	1.8	<0.5	0.5	1.5	2.0	2.0
Sb-aa	<1 - 3	1.9	1.3	2	2	2	3	3
As-cm	N(10)- 20	--	--	N(10)	N(10)	N(10)	10	20

Table 7.--Summary statistics for the analyses of the 35 nonmagnetic heavy-mineral-concentrate samples in table 4, Freel and Dardanelles Roadless Areas, California

[All concentrations are in parts per million except those for Fe, Mg, Ca, and Ti, which are in percent. All analyses are by emission spectrography. "N" means not detected at the lower limit of determination shown in parentheses. Dashes (--) indicate insufficient reported values not qualified by N, <, or > to derive meaningful information]

Element	Range of values	Geometric mean	Geometric deviation	Percentiles				
				50	75	90	95	98
Fe	0.1 - 3	0.58	2.7	0.5	1.5	2	3	3
Mg	<0.05- 10	0.44	5.8	0.2	2	5	5	7
Ca	2 - 15	8.6	1.8	10	15	15	15	15
Ti	0.7 - >2	1.3	1.5	>2	>2	>2	>2	>2
Mn	700 - 5000	1200	1.6	1000	1500	2000	2000	3000
As	N(500) - 500	--	--	N(500)	N(500)	N(500)	N(500)	500
B	N(20) - 500	74	3.3	<20	50	200	300	500
Ba	N(50) - 1000	100	2.3	70	100	500	500	700
Bi	N(20) - 200	140	1.8	N(20)	N(20)	<20	100	200
Cd	N(50) - <50	--	--	N(50)	N(50)	N(50)	N(50)	<50
Co	N(10) - 50	17	1.6	10	20	30	30	30
Cr	N(20) - 2000	100	4.8	30	200	1000	1500	1500
Cu	N(10)- 200	19	2.6	<10	10	20	30	100
La	100 - 2000	700	2.0	700	1000	1500	1500	2000
Mo	N(10)- 5000	39	3.1	30	50	50	150	2000
Nb	N(50)- 200	96	1.5	100	100	150	150	200
Ni	N(10)- 150	36	2.3	20	50	100	100	150
Pb	N(20)- 200	36	2.0	20	50	70	100	150
Sc	20 - 150	44	1.7	50	50	100	100	100
Sn	N(20)- 100	61	1.7	70	70	100	100	100
Sr	N(200)- 500	250	1.5	N(200)	<200	200	200	500
V	150 - 1000	350	1.5	300	500	700	700	1000
W	N(100)- 5000	350	4.1	N(100)	100	500	1000	3000
Y	100 - 2000	500	2.1	500	700	1000	1500	1500
Zn	N(500)- 1500	--	--	N(500)	N(500)	N(500)	N(500)	1000
Zr	500 - >2000	1600	1.5	>2000	>2000	>2000	>2000	>2000
Th	<500 - >5000	1200	1.9	1000	2000	2000	2000	3000

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