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 Tunnison Mountain Wilderness Study Area (CA-020-311), Lassen County, California

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Open-File Report 87-176

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1987

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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 Tunnison Mountain Wilderness Study Area (CA-020-311), Lassen County, California.

INTRODUCTION

In June 1985, the U.S. Geological Survey conducted a reconnaissance geochemical survey of the Tunnison Mountain Wilderness Study Area (CA-020-311), Lassen County, California. The Tunnison Mountain Wilderness Study area, located about 10 miles northeast of Susanville, covers 8,445 acres (13 mi^2) (34 km^2) in northeastern California at the southwestern edge of the Modoc Plateau (fig. 1) physiographic province. The area covers all of the several rounded peaks that form Tunnison Mountain. Elevations in the area range from 5,849 feet on the highest peak to around 4,500 feet in the valley to the east. An unimproved dirt road provides easy access to the north half of the area, but roads do not cross Willow Creek in the south and the creek can be crossed easily on foot in only a few places. Thus, the best access to the south half of the area is to climb over the ridge crest from the north. A few springs are present along the north boundary and Willow Creek is a perennial stream. An annual precipitation of approximately 10 inches allows the growth of sagebrush and grasses on slopes, ponderosa pine at low elevations, and some mountain mahogany along the ridge crest. The U.S. Geological Survey mapped the geology of the study area during a 2-week period in the summer of 1985 (Peterson and Goeldner, 1987) and collected additional rock samples for geochemical analyses. Reconnaissance mapping for regional geologic studies by Lydon and others (1960) and the California Division of Water Resources (1963) gives a broad overview of the area's geology. A recent report (Roberts, 1985) outlines in detail the geology north of Honey Lake, south of the study area. The study area is underlain by a pyroclastic sequence. Deposited on this is a series of basaltic-andesite flows. The southern part of the area has been covered by a younger basalt from a shield volcano east of the area. Ash-flow tuffs overlie the basalt and locally outcrop through alluvium.

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 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.

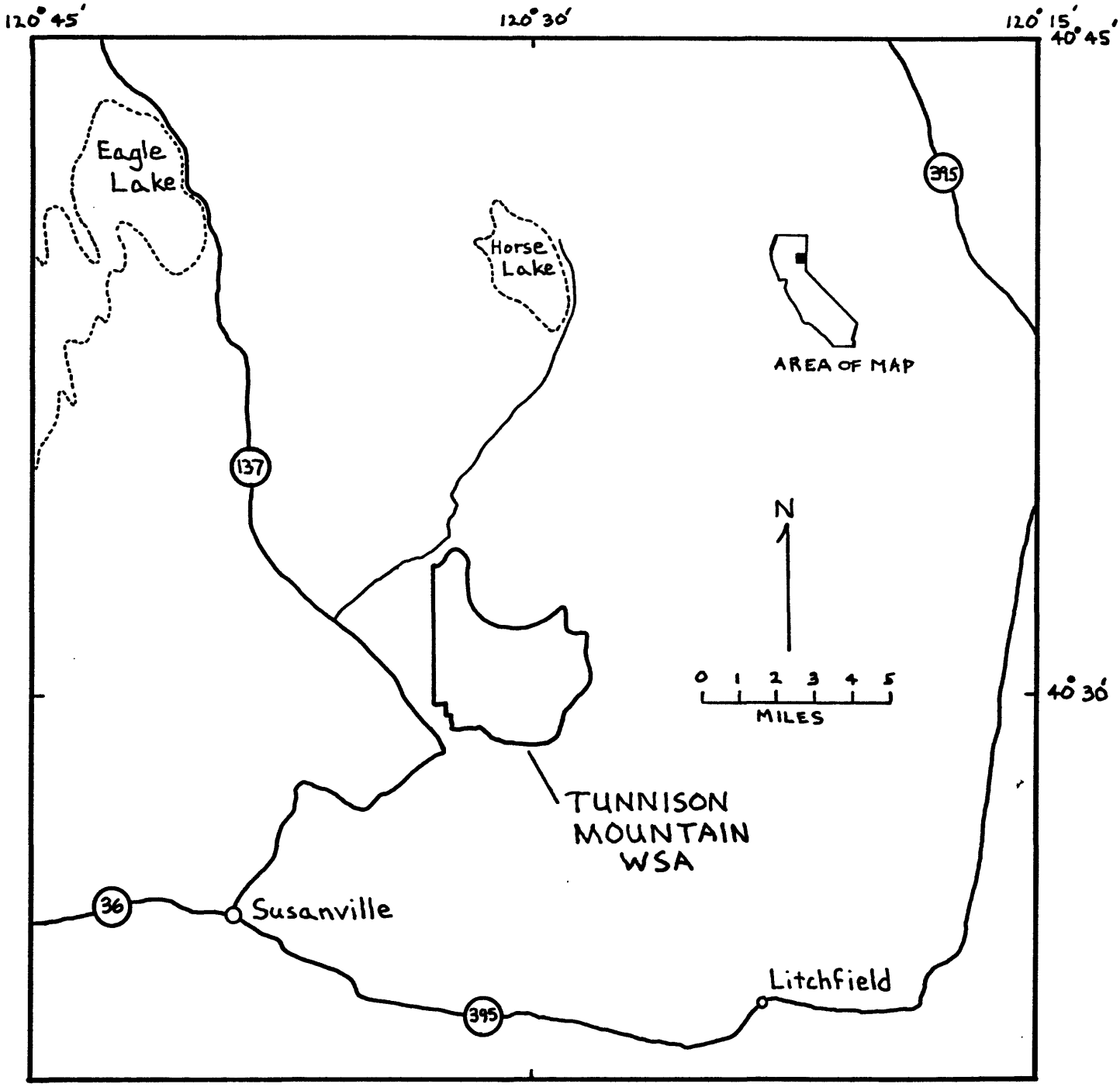

Figure 1. Location map of Tunnison Mountain Wilderness Study Area (CA-020-311), Lassen County, California.

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

Heavy-mineral-concentrate and stream-sediment samples were collected at 13 sites and rock samples were collected at 36 sites (fig. 2). Average sampling density was about one sample site per 1 mi^2 for the stream sediments and heavy-mineral concentrates, and about one sample site per 0.3 mi^2 for the rocks. Typical areas of drainage basins sampled ranged from 0.25 mi^2 to 1 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. Each sample was composited from several localities within an area that may extend as much as 20 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 as stream cobbles (TM) or from outcrops or exposures in the vicinity of the plotted site location. Samples collected were unaltered and unmineralized (see table 6).

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 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°

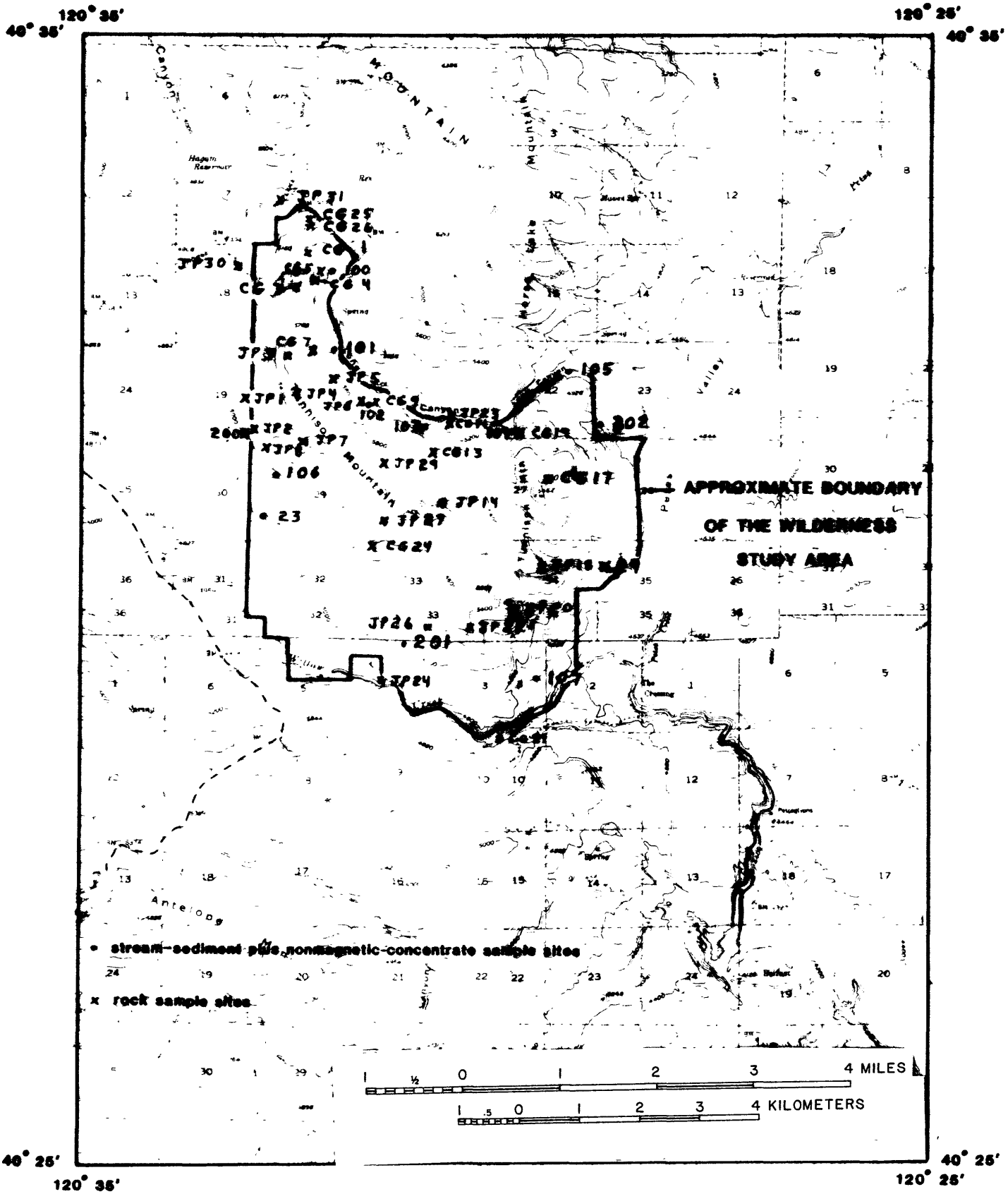

Figure 2. Localities of stream-sediment, heavy-mineral-concentrate, and rock samples from the Tunnison Mountain Wilderness Study Area (CA-020-311), Lassen County, California.

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 rock samples were performed by analysts in the Branch of Analytical Chemistry using the method of Myers and others (1961). 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 differ. 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 Tunnison Mountain Wilderness Study Area are listed in tables 3-5.

Chemical methods

Other methods of analysis used on samples from the Tunnison Mountain 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 map (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; "dn" indicates delayed neutron activiation 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.

ACKNOWLEDGEMENTS

Three additional colleagues participated in the collection and preparation of these samples: collection, J. L. Jones and T. A. Delaney; and preparation, Robin Sanchez.

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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; DN = delayed neutron activation]

Element or constituent determined	Sample type	Method	Determination limit (micrograms/gram or ppm)	Analyst	Reference
Gold (Au)	rock	AA	0.05	J.G. Frisken	Thompson and others, 1968.
Mercury (Hg)	rock stream-sediment	AA	.02	K.R. Kennedy	Koirtyohann and Khalil, 1976.
Arsenic (As)	rock	ICP	5	D.L. Fey	Crock and others, 1983, and modification of O'Leary and Viets, 1986.
Antimony (Sb)	rock	ICP	2	Paul Briggs	
Zinc (Zn)	rock	ICP	2		
Bismuth (Bi)	rock	ICP	2		
Cadmium (Cd)	rock	ICP	.1		
Thorium (Th)	rock stream-sediment	DN		R.B. Vaughn	Millard, 1976.
Uranium (U)	rock stream-sediment	DN		R.B. Vaughn	Millard, 1976.

TABLE 3. RESULTS OF ANALYSES OF STREAM-SEDIMENT SAMPLES FROM THE TUNNISON MOUNTAIN WILDERNESS STUDY AREA, LASSEN COUNTY, CALIFORNIA.

[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
TM023	40 30 45	120 32 55	10	2.0	3.0	1.0	700	N	N	N	N
TM024	40 30 17	120 28 53	7	1.5	3.0	.7	700	N	N	N	N
TM100	40 32 56	120 32 3	7	2.0	2.0	.7	1,000	N	N	N	N
TM101	40 32 14	120 32 3	7	1.5	1.5	.7	700	N	N	N	N
TM102	40 31 44	120 31 40	7	2.0	2.0	.5	700	N	N	N	<10
TM103	40 31 32	120 31 0	7	1.5	2.0	.5	500	N	N	N	<10
TM104	40 31 32	120 29 58	7	1.0	1.5	.3	500	N	N	N	N
TM105	40 32 1	120 29 17	5	.7	1.5	.5	500	N	N	N	<10
TM106	40 31 7	120 32 46	7	1.5	3.0	.5	700	N	N	N	<10
TM107	40 29 17	120 29 37	7	2.0	3.0	.7	700	N	N	N	N
TM200	40 31 29	120 33 9	7	2.0	3.0	.7	700	N	N	N	<10
TM201	40 29 22	120 31 16	7	1.5	3.0	.5	500	N	N	N	<10
TM202	40 31 35	120 28 55	7	.7	1.5	.7	500	N	N	N	<10

TABLE 3. RESULTS OF ANALYSES OF STREAM-SEDIMENT SAMPLES FROM THE TUNNISON MOUNTAIN WILDERNESS STUDY AREA, LASSEN COUNTY, CALIFORNIA.--Continued

Sample	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	Ni-ppm s	Pb-ppm s
TM023	500	<1	N	N	30	300	70	N	N	N	70	10
TM024	700	<1	N	N	20	200	70	N	N	N	50	15
TM100	300	N	N	N	30	200	70	N	N	N	50	10
TM101	300	N	N	N	20	150	70	N	N	N	30	10
TM102	500	N	N	N	20	150	50	N	N	N	30	15
TM103	500	N	N	N	20	50	70	N	N	N	30	10
TM104	300	N	N	N	15	70	70	N	N	N	20	10
TM105	500	N	N	N	20	70	70	N	N	N	30	10
TM106	700	N	N	N	20	200	50	N	N	N	50	10
TM107	700	<1	N	N	20	200	50	N	N	N	70	10
TM200	700	N	N	N	20	200	70	N	N	N	30	10
TM201	700	N	N	N	20	200	70	N	N	N	50	10
TM202	500	<1	N	N	15	100	70	N	N	N	30	15

TABLE 3. RESULTS OF ANALYSES OF STREAM-SEDIMENT SAMPLES FROM THE TUNNISON MOUNTAIN WILDERNESS STUDY AREA, LASSEN COUNTY, CALIFORNIA.--Continued

Sample	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	Hg-ppm aa	U-ppm dn	Th-ppm dn
TM023	N	30	N	700	500	N	10	N	70	N	<.02	1.99	3.4
TM024	N	30	N	700	300	N	10	N	100	N	<.02	2.02	6.1
TM100	N	30	N	300	300	N	10	N	150	N	<.02	1.69	3.2
TM101	N	30	N	200	300	N	10	N	150	N	<.02	1.72	4.4
TM102	N	20	N	300	200	N	<10	N	70	N	<.02	1.76	4.4
TM103	N	30	N	300	200	N	10	N	70	N	<.02	1.57	3.2
TM104	N	30	N	300	200	N	10	N	70	N	<.02	2.35	4.2
TM105	N	30	N	300	200	N	15	N	70	N	.02	2.47	6.2
TM106	N	30	N	500	200	N	15	N	100	N	<.02	1.67	3.8
TM107	N	30	N	700	300	N	15	N	100	N	<.02	1.75	5.0
TM200	N	30	N	500	300	N	10	N	70	N	.02	1.69	3.4
TM201	N	30	N	700	300	N	15	N	150	N	<.02	2.13	5.1
TM202	N	20	N	300	300	N	15	N	100	N	<.02	2.90	5.5

TABLE 4. RESULTS OF ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE TUNNISON MOUNTAIN WILDERNESS STUDY AREA, LASSEN COUNTY, CALIFORNIA.

[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
TM023	40 30 45	120 32 55	.2	.05	2.0	.10	50	N	N	N
TM024	40 30 17	120 28 53	.3	.05	2.0	.15	70	N	N	N
TM100	40 32 56	120 32 3	.3	.05	3.0	.10	50	N	N	N
TM101	40 32 14	120 32 3	.3	.05	3.0	.20	50	N	N	N
TM102	40 31 30	120 31 40	.5	.05	2.0	1.00	100	N	N	N
TM103	40 31 32	120 31 0	.5	.05	2.0	.20	70	N	N	N
TM104	40 31 32	120 29 58	.3	.05	2.0	.20	50	N	N	N
TM105	40 32 1	120 29 17	.3	.05	1.5	.30	30	N	N	N
TM106	40 31 7	120 32 46	.3	.05	3.0	.30	50	N	N	N
TM107	40 29 17	120 29 37	.3	.05	3.0	.07	70	N	N	N
TM200	40 31 29	120 33 9	.2	.05	2.0	.07	30	N	N	N
TM201	40 29 22	120 31 16	.2	.05	3.0	.05	50	N	N	N
TM202	40 31 35	120 28 55	.3	.05	3.0	.20	30	N	N	N

TABLE 4. RESULTS OF ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE TUNNISON MOUNTAIN WILDERNESS STUDY AREA, LASSEN COUNTY, CALIFORNIA.--Continued

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
TM023	20	500	N	N	N	<10	N	N	N	N	N
TM024	<20	700	N	N	N	<10	N	N	N	N	N
TM100	<20	500	N	N	N	<10	N	N	N	N	N
TM101	<20	500	N	N	N	10	N	N	N	N	N
TM102	20	500	<0	N	N	N	<0	15	100	N	N
TM103	<20	500	N	N	N	<10	N	N	N	N	N
TM104	<20	700	N	N	N	<10	N	N	N	N	N
TM105	<20	500	N	N	N	<10	N	N	N	N	N
TM106	<20	500	N	N	N	<10	N	N	N	N	N
TM107	<20	700	N	N	N	<10	N	N	N	N	N
TM200	<20	300	N	N	N	<10	N	N	N	N	N
TM201	<20	500	N	N	N	<10	N	N	N	N	N
TM202	<20	700	N	N	N	<10	N	N	N	N	N

TABLE 4. RESULTS OF ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE TUNNISON MOUNTAIN WILDERNESS STUDY AREA, LASSEN COUNTY, CALIFORNIA.--Continued

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
TM023	<10	N	N	N	N	700	<20	N	30	N	>2,000	N
TM024	<10	N	N	N	N	700	20	N	<20	N	>2,000	N
TM100	10	N	N	N	N	700	<20	N	20	N	>2,000	N
TM101	<10	N	N	N	N	500	20	N	20	N	>2,000	N
TM102	20	N	N	30	N	1,000	30	N	300	N	>2,000	N
TM103	<10	100	N	N	N	700	20	N	50	N	>2,000	N
TM104	15	N	N	N	N	700	20	N	70	N	>2,000	N
TM105	15	N	N	20	N	500	20	N	100	N	>2,000	N
TM106	10	N	N	N	N	1,000	20	N	70	N	>2,000	N
TM107	<10	<20	N	N	N	700	<20	N	<20	N	2,000	N
TM200	<10	20	N	20	N	700	<20	N	70	N	>2,000	N
TM201	<10	N	N	<10	N	700	<20	N	30	N	>2,000	N
TM202	10	N	N	<10	N	700	20	N	30	N	>2,000	N

TABLE 5. RESULTS OF ANALYSES OF ROCK SAMPLES FROM THE TUNNISON MOUNTAIN WILDERNESS STUDY AREA, LASSEN COUNTY, CALIFORNIA.

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

Sample	Latitude	Longitude	Fe-pct. s	Mg-pct. s	Ca-pct. s	Ti-pct. s	Mn-ppm s	Ag-ppm s	As-ppm s	Au-ppm s	B-ppm s	Ba-ppm s	Be-ppm s
85JP1	40 31 46	120 33 8	5.0	1.50	7.00	.30	700	N	N	N	10	700	1.0
85JP2	40 31 30	120 33 0	5.0	1.50	7.00	.30	700	N	N	N	15	700	1.0
85JP3	40 32 9	120 32 8	5.0	3.00	7.00	.30	700	N	N	N	<10	500	N
85JP4	40 31 50	120 32 28	7.0	5.00	7.00	.30	700	N	N	N	<10	300	N
85JP5	40 31 59	120 32 4	5.0	5.00	7.00	.30	700	N	N	N	<10	700	<1.0
85JP6	40 31 45	120 31 43	5.0	3.00	7.00	.30	700	N	N	N	<10	500	1.0
85JP7	40 31 24	120 32 25	5.0	5.00	7.00	.30	700	N	N	N	<10	300	1.0
85JP8	40 31 21	120 32 51	1.5	.70	1.50	.15	300	N	N	N	15	700	1.0
85JP14	40 30 52	120 30 47	5.0	3.00	7.00	.30	700	N	N	N	10	700	<1.0
85JP18	40 30 17	120 29 37	5.0	2.00	7.00	.30	700	N	N	N	<10	500	<1.0
85JP20	40 29 56	120 29 57	5.0	2.00	7.00	.30	700	N	N	N	<10	700	<1.0
85JP22	40 30 25	120 29 45	5.0	2.00	7.00	.30	500	N	N	N	<10	700	1.0
85JP23	40 31 37	120 30 38	7.0	.70	7.00	.50	700	N	N	N	10	700	<1.0
85JP24	40 29 19	120 31 26	5.0	3.00	7.00	.30	700	N	N	N	<10	300	<1.0
85JP26	40 29 46	120 30 57	7.0	3.00	7.00	.30	700	N	N	N	<10	300	<1.0
85JP27	40 30 40	120 31 30	7.0	3.00	5.00	.30	700	N	N	N	<10	700	<1.0
85JP29	40 31 14	120 31 26	5.0	1.50	7.00	.30	500	N	N	N	<10	700	<1.0
85JP30	40 32 56	120 33 15	1.5	.50	1.50	.15	700	N	N	N	20	700	1.0
85JP31	40 33 31	120 32 43	3.0	.70	1.00	.30	300	N	N	N	15	700	1.0
85CG1	40 33 3	120 32 22	5.0	1.50	7.00	.30	500	N	N	N	<10	700	<1.0
85CG3	40 32 45	120 32 30	3.0	1.50	5.00	.30	300	N	N	N	<10	500	<1.0
85CG4	40 32 50	120 32 21	7.0	3.00	5.00	.20	500	N	N	N	<10	700	<1.0
85CG5	40 32 53	120 32 15	5.0	3.00	5.00	.20	500	N	N	N	<10	300	<1.0
85CG7	40 32 13	120 32 20	5.0	3.00	7.00	.20	500	N	N	N	<10	300	<1.0
85CG9	40 31 45	120 31 37	5.0	3.00	7.00	.30	500	N	N	N	<10	500	<1.0
85CG13	40 31 20	120 30 51	7.0	3.00	7.00	.30	500	N	N	N	<10	500	<1.0
85CG14	40 31 33	120 30 39	7.0	3.00	7.00	.50	500	N	N	N	<10	700	1.0
85CG17	40 31 7	120 29 36	3.0	.70	3.00	.30	300	N	N	N	30	700	1.0
85CG19	40 31 30	120 29 53	5.0	1.50	5.00	.30	300	N	N	N	<10	700	<1.0
85CG21	40 28 47	120 30 5	1.5	.50	1.50	.10	300	N	N	N	15	700	<1.0
85CG24	40 30 30	120 31 37	7.0	5.00	7.00	.30	700	N	N	N	<10	300	N
85CG25	40 33 22	120 32 23	2.0	.30	1.50	.30	500	N	N	N	15	700	1.0
85CG26	40 33 16	120 32 24	3.0	.20	1.50	.30	300	N	N	N	<10	700	<1.0
TM024A	40 30 17	120 28 53	7.0	3.00	3.00	.50	1,000	N	N	N	N	3,000	1.0
TM024B	40 30 17	120 28 54	7.0	1.50	3.00	.50	700	N	N	N	<10	2,000	1.0
TM200	40 31 29	120 33 9	7.0	5.00	3.00	.30	1,500	N	N	N	N	700	<1.0
TM102	40 31 30	120 31 40	.2	.07	.15	.50	1,000	N	N	N	20	70	1.5

TABLE 5. RESULTS OF ANALYSES OF ROCK SAMPLES FROM THE TUNNISON MOUNTAIN WILDERNESS STUDY AREA, LASSEN COUNTY, CALIFORNIA.--Continued

Sample	Bi-ppm s	Cd-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	La-ppm s	Mo-ppm s	Nb-ppm s	Ni-ppm s	Pb-ppm s	Sb-ppm s	Sc-ppm s	Sn-ppm s	Sr-ppm s
85JP1	N	N	15	<10	30	<30	N	<20	15	15	N	20	N	300
85JP2	N	N	15	15	30	<30	N	<20	15	15	N	20	N	300
85JP3	N	N	20	70	50	<30	N	N	20	10	N	50	N	300
85JP4	N	N	20	70	15	<30	N	<20	20	<10	N	30	N	300
85JP5	N	N	15	100	70	30	N	<20	20	10	N	30	N	500
85JP6	N	N	15	100	70	<30	N	<20	20	10	N	30	N	300
85JP7	N	N	15	300	30	<30	N	<20	50	<10	N	30	N	300
85JP8	N	N	7	30	10	30	N	<20	10	15	N	7	N	300
85JP14	N	N	15	150	30	30	N	<20	30	10	N	30	N	300
85JP18	N	N	15	30	30	<30	N	<20	15	10	N	30	N	300
85JP20	N	N	15	20	30	30	N	<20	15	10	N	20	N	500
85JP22	N	N	15	30	30	30	N	<20	15	10	N	20	N	500
85JP23	N	N	20	70	30	30	N	<20	30	10	N	30	N	300
85JP24	N	N	20	150	70	N	N	<20	70	<10	N	30	N	150
85JP26	N	N	20	300	30	N	N	<20	70	<10	N	30	N	300
85JP27	N	N	20	150	30	30	N	<20	30	<10	N	30	N	300
85JP29	N	N	15	50	30	30	N	<20	20	15	N	20	N	300
85JP30	N	N	<5	<10	<5	30	<5	<20	<5	15	N	7	N	200
85JP31	N	N	10	15	10	30	N	<20	5	15	N	20	N	200
85CG1	N	N	15	<10	30	N	N	<20	10	<10	N	15	N	300
85CG3	N	N	15	30	30	N	N	<20	15	<10	N	15	N	300
85CG4	N	N	20	100	30	N	N	<20	70	<10	N	30	N	500
85CG5	N	N	15	70	30	N	<5	<20	30	<10	N	30	N	300
85CG7	N	N	15	70	30	N	N	<20	30	<10	N	30	N	200
85CG9	N	N	15	150	30	<30	N	<20	30	<10	N	30	N	300
85CG13	N	N	15	70	30	30	N	<20	30	<10	N	30	N	300
85CG14	N	N	15	100	30	<30	N	<20	50	<10	N	30	N	300
85CG17	N	N	15	<10	50	30	<5	<20	5	15	N	15	N	300
85CG19	N	N	15	10	30	<30	N	<20	20	10	N	20	N	500
85CG21	N	N	<5	<10	<5	30	<5	<20	<5	15	N	7	N	200
85CG24	N	N	20	150	30	N	N	<20	70	<10	N	30	N	200
85CG25	N	N	<5	<10	<5	30	N	<20	<5	15	N	15	N	300
85CG26	N	N	<5	<10	<5	30	N	<20	<5	15	N	15	N	300
TM024A	N	N	15	70	100	70	N	N	30	10	N	30	N	2,000
TM024B	N	N	15	30	70	70	<5	N	20	10	N	20	N	1,500
TM200	N	N	30	300	70	<30	N	N	100	<10	N	30	N	1,000
TM102	N	N	7	50	5	N	N	N	5	<10	N	5	N	100

TABLE 5. RESULTS OF ANALYSES OF ROCK SAMPLES FROM THE TUNNISON MOUNTAIN WILDERNESS STUDY AREA, LASSEN COUNTY, CALIFORNIA.--Continued

Sample	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	Th-ppm dn	U-ppm dn
85JP1	150	N	15	N	100	N	<5	<2	.5	<2	36	--	--	--	--
85JP2	150	N	15	N	70	N	<5	<2	1.3	<2	42	--	--	--	--
85JP3	150	N	15	N	70	N	<5	<2	1.2	<2	25	--	--	--	--
85JP4	300	N	15	N	70	N	<5	<2	1.2	<2	40	--	--	--	--
85JP5	200	N	15	N	100	N	<5	<2	1.6	<2	48	--	--	--	--
85JP6	200	N	15	N	70	N	<5	<2	1.8	<2	43	--	--	--	--
85JP7	200	N	15	N	70	N	<5	<2	1.4	<2	41	--	--	--	--
85JP8	30	N	10	N	70	N	<5	<2	.5	<2	24	--	--	--	--
85JP14	150	N	20	N	70	N	<5	<2	1.0	<2	37	--	--	--	--
85JP18	150	N	15	N	70	N	<5	2	1.0	<2	46	--	--	--	--
85JP20	150	N	15	N	100	N	<5	3	1.3	<2	50	--	--	--	--
85JP22	150	N	15	N	100	N	<5	2	1.4	<2	47	--	--	--	--
85JP23	150	N	20	N	70	N	<5	<2	2.4	<2	57	--	--	--	--
85JP24	150	N	20	N	30	N	<5	<2	2.3	2	49	--	--	--	--
85JP26	150	N	15	N	30	N	<5	<2	1.3	<2	40	--	--	--	--
85JP27	200	N	15	N	30	N	<5	<2	1.5	<2	46	--	--	--	--
85JP29	150	N	20	N	70	N	<5	<2	1.1	<2	49	--	--	--	--
85JP30	30	N	15	N	70	N	<5	<2	.6	<2	21	--	--	--	--
85JP31	70	N	20	N	70	N	<5	<2	1.1	<2	85	--	--	--	--
85CG1	150	N	20	N	100	N	<5	<2	.7	<2	31	--	--	--	--
85CG3	100	N	15	N	70	N	<5	3	.9	<2	37	--	--	--	--
85CG4	150	N	20	N	70	N	<5	<2	1.1	<2	32	--	--	--	--
85CG5	150	N	15	N	70	N	<5	<2	.9	<2	26	--	--	--	--
85CG7	150	N	15	N	70	N	<5	<2	.9	<2	30	--	--	--	--
85CG9	300	N	20	N	70	N	<5	<2	1.2	<2	38	--	--	--	--
85CG13	200	N	15	N	70	N	<5	<2	1.4	<2	47	--	--	--	--
85CG14	200	N	30	N	100	N	<5	<2	1.4	<2	30	--	--	--	--
85CG17	150	N	30	N	150	N	<5	4	1.1	<2	46	--	--	--	--
85CG19	150	N	15	N	70	N	<5	<2	.8	<2	37	--	--	--	--
85CG21	30	N	10	N	70	N	<5	<2	.3	<2	15	--	--	--	--
85CG24	150	N	10	N	70	N	<5	<2	1.1	<2	37	--	--	--	--
85CG25	30	N	20	N	150	N	<5	<2	.7	<2	74	--	--	--	--
85CG26	30	N	15	N	150	N	<5	<2	1.0	<2	66	--	--	--	--
TM024A	300	N	15	N	150	N	<5	<2	.6	<2	44	--	<.02	10.70	1.52
TM024B	300	N	20	N	200	N	<5	<2	.5	<2	60	--	<.02	11.60	3.53
TM200	300	N	10	N	70	N	<5	<2	.7	<2	44	--	<.02	4.99	1.52
TM102	70	N	<10	N	<10	N	--	--	--	--	--	N	--	--	--

TABLE 6.--Description of rock samples.

TM 024A	basaltic andesite
TM 024B	basaltic andesite
TM 200	basaltic andesite
85JP1	platy basaltic andesite
JP2	lapilli tuff
JP3	coarsely porphyritic basaltic andesite
JP4	coarsely porphyritic basaltic andesite
JP5	basal basaltic andesite
JP6	basal basaltic andesite
JP7	platy basaltic andesite
JP8	ash fall tuff
JP14	coarsely porphyritic basaltic andesite
JP18	basal basaltic andesite
JP20	basal basaltic andesite
JP22	basal basaltic andesite
JP23	cinder cone basaltic andesite
JP24	basalt of Willow Creek
JP26	platy basaltic andesite
JP27	coarsely porphyritic basaltic andesite
JP29	coarsely porphyritic basaltic andesite
JP30	ash fall tuff
JP31	ash fall tuff
CG1	basal basaltic andesite
CG3	lapilli tuff
CG4	coarsely porphyritic basaltic andesite
CG5	coarsely porphyritic basaltic andesite
CG7	coarsely porphyritic basaltic andesite
CG9	platy basaltic andesite
CG13	coarsely porphyritic basaltic andesite
CG14	platy basaltic andesite
CG17	coarsely porphyritic basaltic andesite
CG19	basal basaltic andesite
CG21	ash fall tuff
CG24	welded tuff
CG26	welded tuff