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 Twin Peaks (CA-020-619A) Wilderness Study Area, Lassen County, California, and Washoe County, Nevada

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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, 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 Twin Peaks Wilderness Study Area, Lassen County, California, and Washoe County, Nevada.

INTRODUCTION

In 1985 the U.S. Geological Survey collected additional geochemical samples to augment a reconnaissance geochemical survey conducted previously by Barringer Inc. under contract to the Bureau of Land Management. The additional samples were collected within or adjacent to the Twin Peaks Wilderness Study Area, Lassen County, California, and Washoe County, Nevada.

The Twin Peaks Wilderness Study Area comprises about 143 mi^2 (370 km^2) (91,405 acres) in far east-central Lassen County, California, and far west-central Washoe County, Nevada, and lies about 20 mi (32 km) west of Gerlach, Nevada (fig. 1). Access to the study area is provided on the west by the Smoke Creek Reservoir Road; on the south by the Burro Mountain Road and an underground communication cable right-of-way; and on the southeast by the Sand Pass-Gerlach Road. The remaining boundaries are the Buffalo Meadow Road on the northeast, and the Parsnip Creek Road, the Mixie Flat Road and the Horne Springs-Painter Flat Road on the north. One dead end road penetrates the WSA 2.5 miles west from Mixie Flat.

The Twin Peaks WSA is on the western edge of the arid Great Basin, and is characterized by eroded volcanic peaks, ridges, and plateaus. The topography of this unit encompasses many landform types. In the northwest are flatlands and low rolling hills with small drainages. Al Shinn Creek and Smoke Creek form canyons with perennial streams. Toward the east the landscape becomes very rugged with numerous canyons, draws, hills, and mountain peaks. The most distinctive features on the eastern side are the canyons of Willow Creek, Buffalo Creek, a perennial stream, and Chimney Rock Creek. Plant life is mostly low sage, sparsely scattered juniper and grasses. In some drainages, riparian vegetation such as willow grows in meadow areas. Elevations vary from 3,900 ft (1,190 m) on the edge of the Smoke Creek Desert on the southeast side of the WSA to 6592 ft (2,010 m) on the highest summit of Twin Peaks which dominate the central portion of the unit. Other major peaks in the unit are Grass Mountain, Lone Mountain, and Chimney Rock Peak.

The oldest rocks in the area are a heterogeneous assemblage of Late Miocene age, belonging to the High Rock sequence, exposed in the northeast part of the area near the confluence of Parsnip Wash and Buffalo Creek, and also west of Buffalo Creek along the boundary between T.32 and T.33N. These are largely ash flow and ash fall and waterlaid tuffs full of pumice and lithic fragments and basalt bombs locally interbedded with diatomite, tuffaceous sandstone and siltstone, and also locally containing vertebrate fossils, plants and fossil wood. These rocks are unconformably overlain by Pliocene basalt flows which cover most of the northern 2/3 of the area east of Upper Smoke Creek valley and extend southward to the southern border south of Twin Peaks. This unit is predominantly dark gray aphanitic to medium-grained

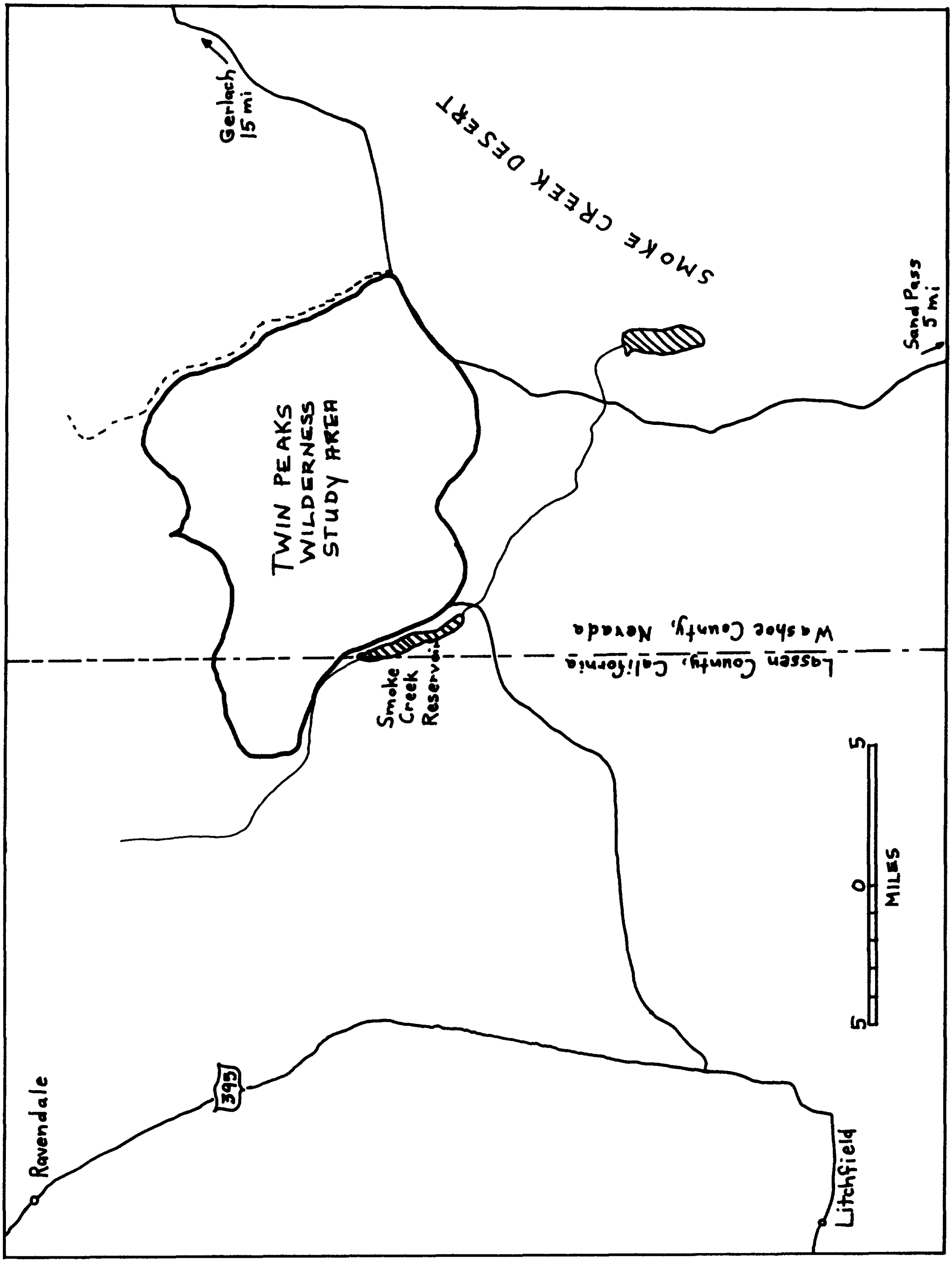

Figure 1. Location map of Twin Peaks (CA-020-619A) Wilderness Study Area, Lassen County, California, and Washoe County, Nevada.

olivine basalt, locally weathered to a red soil. A very small plug of late Tertiary flow-banded rhyolite of late Tertiary age is exposed in the valley of a south-flowing tributary of Smoke Creek about 4 miles east of the reservoir. In the southeast part of the area, north of Smoke Creek and east and southeast of the reservoir, is an extensive area covered by early Pleistocene alluvial deposits, which are locally covered by flat-lying flows of vesicular olivine basalt of Pleistocene age, near the reservoir. This basalt also covers upper Smoke Creek valley at the western edge of the area in California. The southeastern part of the area south of Buffalo Creek is covered by lake bed silt and clay of late Pleistocene (Lake Lahontan) age (Bonham and Papke, 1969; Lydon and others, 1960).

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.

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

In the California portion of the Twin Peaks Wilderness Study Area, samples were collected at four sites (plate 1). At all of those sites, both a stream-sediment sample and a heavy-mineral-concentrate sample were collected. In the Nevada part of the WSA, 28 rock samples were collected from mafic dikes which are common in the area; these rock samples probably represent the geochemistry of most of the exposed surface rock units. Fifteen samples of tufa were also collected. Average sampling density was about one sample site per 3 mi^2 for the stream sediments and heavy-mineral concentrates in California (plus one sample per 1 mi^2 in Nevada = Barringer data, (Connors, R.A., and others, unpublished report)), and about one sample site per 5 mi^2 for the mafic dike rocks in Nevada. The area of the drainage basins sampled ranged from 1 mi^2 to 6 mi^2 in the California segment of the WSA. Table 7 lists six rock samples collected in conjunction with this study. These samples are outside of the map area and, consequently, do not appear on the sample locality map.

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 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 from outcrops or exposures in the vicinity of the plotted site location. Samples were not obviously altered or mineralized. Descriptions of rock samples are in 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 2.85) 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 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 0.2 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 of heavy-mineral-concentrate samples were performed by analysts in the Branch of Exploration Geochemistry using the method of Grimes and Marranzino (1968); analyses of 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 method (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 Twin Peaks Wilderness Study Area are listed in tables 3-5.

Chemical methods

Other methods of analysis used on samples from the Twin Peaks WSA are summarized in table 2. The analytical method used for determining As, Bi, Cd, Sb, and Zn is a modification of the method of O'Leary and Viets (1986) adapted to the inductively coupled plasma-atomic emission spectroscopy (ICP-AES) method of Crock and others (1983).

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 (plate 1). 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 activation; and "icp" indicates inductively coupled plasma-atomic emission spectroscopic 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 3-5 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.

ACKNOWLEDGMENTS

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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]

Element or constituent determined	Sample type	Method	Determination limit (micrograms/ gram or ppm)	Analyst	Reference
Mercury (Hg)	sediments	AA	.02	Kay Kennedy	Koirtyohann and Khalil, 1976.
Arsenic (As)	rocks	ICP	5	David Fey	Crock and others, 1983, and modification of O'Leary and Viets, 1986.
Antimony (Sb)	rocks	ICP	2		
Zinc (Zn)	rocks	ICP	2		
Bismuth (Bi)	rocks	ICP	2		
Cadmium (Cd)	rocks	ICP	.1		
Thorium (Th)	sediments	DN	--	R. B. Vaughn	Millard, 1976.
Uranium (U)	sediments	DN	--	R. B. Vaughn	Millard, 1976.

TABLE 3. RESULTS OF ANALYSES OF STREAM-SEDIMENT SAMPLES FROM THE TWIN PEAKS WILDERNESS STUDY AREA, LASSEN COUNTY, CALIFORNIA, AND WASHOE 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
TP025	40 40 6	120 2 24	10	1.5	2	>1.0	700	N	N	N	N
TP108	40 40 43	120 4 8	7	.7	2	.7	300	N	N	N	N
TP203	40 39 40	120 1 18	7	1.5	3	.5	700	N	N	N	10
TP204	40 41 30	120 2 0	7	1.5	2	.5	700	N	N	N	<10

TABLE 3. RESULTS OF ANALYSES OF STREAM-SEDIMENT SAMPLES FROM THE TWIN PEAKS WILDERNESS STUDY AREA, LASSEN COUNTY, CALIFORNIA, AND WASHOE COUNTY, NEVADA.--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
TP025	700	<1	N	N	20	200	70	70	N	<20	50	15
TP108	700	<1	N	N	15	150	70	N	N	<20	30	10
TP203	700	<1	N	N	15	150	70	N	N	N	30	10
TP204	700	<1	N	N	20	70	70	N	N	<20	70	15

TABLE 3. RESULTS OF ANALYSES OF STREAM-SEDIMENT SAMPLES FROM THE TWIN PEAKS WILDERNESS STUDY AREA, LASSEN COUNTY, CALIFORNIA, AND WASHOE COUNTY, NEVADA.--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	Th-ppm dn	U-ppm dn
TP025	N	30	N	300	500	N	15	N	200	N	<.02	4.1	1.53
TP108	N	20	N	300	200	N	10	N	100	N	<.02	3.8	1.85
TP203	N	20	N	500	150	N	10	N	70	N	<.02	3.9	1.40
TP204	N	30	N	500	200	N	10	N	100	N	<.02	4.5	1.36

TABLE 4. RESULTS OF ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE TWIN PEAKS WILDERNESS STUDY AREA, LASSEN COUNTY, CALIFORNIA, AND WASHOE CUNTY, NEVADA.

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

Sample	Latituce	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
TP025	40 40 6	120 2 24	.5	.05	2	.7	70	N	N	N
TP203	40 39 40	120 1 18	.3	.05	3	.3	50	N	N	N

TABLE 4. RESULTS OF ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE TWIN PEAKS WILDERNESS STUDY AREA, LASSEN COUNTY, CALIFORNIA, AND WASHOE CUNTY, NEVADA.--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
TP025	20	500	N	N	N	<10	N	N	N	N	N
TP203	70	300	N	N	N	10	N	N	N	N	N

TABLE 4. RESULTS OF ANALYSES OF HEAVY-MINERAL-CONCENTRATE SAMPLES FROM THE TWIN PEAKS WILDERNESS STUDY AREA, LASSEN COUNTY, CALIFORNIA, AND WASHOE CUNTY, NEVADA.--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
TP025	10	N	N	N	N	700	50	N	100	N	>2,000	N
TP203	10	N	N	N	N	1,000	20	N	50	500	>2,000	N

TABLE 5. RESULTS OF ANALYSES OF ROCK SAMPLES FROM THE TWIN PEAKS STUDY AREA, LASSEN COUNTY, CALIFORNIA, AND WASHOE 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
85SN6A	40 41 24	119 49 3	.70	1.50	>20.0	.100	300	N	N	N	N	1,000
85SN50	40 40 27	119 48 28	.30	1.50	>20.0	.030	100	N	N	N	N	700
85SN63	40 38 59	119 46 0	.50	1.00	>20.0	.030	70	N	N	N	N	700
85VN11	40 40 19	119 48 41	.70	1.00	>20.0	.100	150	N	N	N	N	700
85VN26	40 35 51	119 46 48	.15	.50	>20.0	.010	30	N	N	N	N	150
85VN29	40 35 25	119 46 52	.70	1.00	>20.0	.070	150	N	N	N	N	1,500
85VN30	40 35 7	119 47 14	.20	1.50	>20.0	.015	50	N	N	N	N	700
85VN31	40 34 33	119 47 42	.15	.70	>20.0	.010	70	N	N	N	N	2,000
85VN32	40 34 11	119 47 52	.30	.70	>20.0	.020	50	N	N	N	N	700
85VN33	40 33 28	119 48 20	.10	.50	15.0	.005	30	N	N	N	N	1,000
85VN34	40 31 30	119 49 21	.15	.70	20.0	.010	100	N	N	N	N	1,500
85VN35	40 33 44	119 48 0	.30	1.50	>20.0	.030	50	N	N	N	N	1,000
85VN36	40 33 37	119 47 40	.15	.50	20.0	.010	50	N	N	N	N	1,000
85VN40	40 40 11	119 46 30	.30	.30	20.0	.030	30	N	N	N	N	300
85VN41	40 40 7	119 46 32	.30	.70	>20.0	.030	30	N	N	N	N	500
85SN8	40 41 9	119 49 44	7.00	1.50	7.0	.700	700	N	N	N	N	700
85SN81	40 40 54	119 49 46	7.00	2.00	7.0	.700	700	N	N	N	N	700
85SN12A	40 43 21	119 52 39	5.00	1.50	3.0	.500	1,000	N	N	N	N	2,000
85SN12C	40 43 21	119 52 39	5.00	.70	3.0	.500	1,000	N	N	N	N	3,000
85SN13	40 42 45	119 52 23	7.00	1.50	7.0	.700	700	N	N	N	<10	1,500
85SN14	40 43 4	119 53 11	7.00	1.50	7.0	.700	700	N	N	N	N	1,000
85SN16	40 44 28	119 51 32	7.00	5.00	7.0	.300	1,000	N	N	N	N	500
85SN17	40 42 53	119 52 45	7.00	1.50	5.0	.700	700	N	N	N	N	2,000
85SN19A	40 42 3	119 52 15	1.50	.20	1.0	.200	500	N	N	N	10	3,000
85SN19B	40 42 3	119 52 15	1.50	.30	2.0	.150	1,000	N	N	N	10	3,000
85SN25	40 41 40	119 51 20	7.00	3.00	7.0	.500	700	N	N	N	N	700
85SN49	40 42 20	119 49 31	7.00	1.00	7.0	.700	500	N	N	N	N	1,000
85SN55A	40 37 39	119 47 21	7.00	3.00	7.0	.700	700	100.0	N	N	N	500
85SN12B	40 43 21	119 52 39	7.00	1.00	3.0	.500	700	N	N	N	N	1,500
85VN1	40 41 10	119 49 50	7.00	1.50	5.0	.700	700	N	N	N	N	1,000
85VN5	40 42 33	119 42 1	5.00	1.00	3.0	.700	700	N	N	N	N	2,000
85VN8	40 41 16	119 52 49	7.00	3.00	7.0	.700	700	10.0	N	N	<10	1,000
85VN9	40 40 47	119 52 12	7.00	1.50	5.0	.700	500	N	N	N	<10	1,000
85VN12	40 40 45	119 55 20	7.00	1.00	3.0	.700	700	N	N	N	<10	2,000
85VN13	40 39 46	119 54 0	7.00	1.50	7.0	.700	700	N	N	N	N	1,000
85VN14	40 39 36	119 53 56	7.00	1.00	7.0	.700	700	N	N	N	N	700
85VN15	40 39 37	119 53 51	3.00	.70	3.0	.500	700	N	N	N	N	2,000
85VN19	40 40 58	119 54 42	7.00	.70	3.0	.700	700	N	N	N	N	1,500
85VN25	40 40 0	119 49 29	7.00	1.50	7.0	.700	700	N	N	N	N	700
85VN42	40 38 53	119 54 26	3.00	.70	3.0	.700	700	N	N	N	10	2,000
85VN43	40 38 53	119 54 26	7.00	1.50	3.0	.700	700	N	N	N	N	1,500
85VN45	40 38 34	119 54 9	3.00	1.00	5.0	.500	500	N	N	N	10	1,500
85VN6	40 42 20	119 52 58	1.50	.02	.1	.010	50	N	N	N	N	300

TABLE 5. RESULTS OF ANALYSES OF ROCK SAMPLES FROM THE TWIN PEAKS STUDY AREA, LASSEN COUNTY, CALIFORNIA, AND WASHOE COUNTY, NEVADA.--Continued

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
85SN6A	<1.0	N	N	5	15	20	N	N	N	10	N	N	7
85SN50	<1.0	N	N	<5	10	7	N	N	N	5	N	N	N
85SN63	<1.0	N	N	<5	15	10	N	N	N	5	N	N	<5
85VN11	<1.0	N	N	5	15	10	N	N	N	5	N	N	5
85VN26	<1.0	N	N	N	<10	<5	N	N	N	N	N	N	N
85VN29	<1.0	N	N	<5	15	7	N	N	N	5	N	N	5
85VN30	<1.0	N	N	N	<10	7	N	N	N	<5	N	N	N
85VN31	<1.0	N	N	N	<10	7	N	N	N	<5	N	N	N
85VN32	<1.0	N	N	N	<10	7	N	N	N	<5	N	N	N
85VN33	<1.0	N	N	N	<10	10	N	N	N	<5	N	N	N
85VN34	<1.0	N	N	N	<10	5	N	N	N	<5	N	N	N
85VN35	<1.0	N	N	N	<10	7	N	N	N	<5	N	N	N
85VN36	<1.0	N	N	N	<10	7	N	N	N	<5	N	N	N
85VN40	<1.0	N	N	<5	10	7	N	N	N	<5	N	N	<5
85VN41	<1.0	N	N	N	10	7	N	N	N	<5	N	N	<5
85SN8	1.0	N	N	15	N	50	30	N	<20	<5	10	N	30
85SN81	1.5	N	N	15	15	70	30	N	<20	N	10	N	30
85SN12A	1.5	N	N	5	N	<5	30	N	<20	<5	10	N	10
85SN12C	1.5	N	N	5	<10	<5	30	N	<20	<5	10	N	10
85SN13	1.5	N	N	15	<10	30	30	N	<20	5	10	N	20
85SN14	1.5	N	N	15	15	30	30	N	<20	5	10	N	30
85SN16	N	N	N	30	300	50	N	N	N	70	N	N	30
85SN17	1.5	N	N	15	10	30	30	N	<20	7	10	N	20
85SN19A	1.5	N	N	N	<10	<5	30	<5	<20	N	15	N	<5
85SN19B	1.5	N	N	N	<10	<5	50	<5	<20	N	15	N	5
85SN25	<1.0	N	N	20	70	50	N	N	N	50	N	N	30
85SN49	1.5	N	N	15	<10	50	30	N	<20	15	<10	N	30
85SN55A	N	N	N	20	150	50	N	N	N	50	N	N	30
85SN12B	1.0	N	N	7	<10	<5	N	N	N	N	<10	N	15
85VN1	1.0	N	N	15	N	7	N	N	<20	N	<10	N	30
85VN5	1.5	N	N	7	N	7	30	<5	<20	<5	10	N	15
85VN8	1.5	N	N	20	30	70	30	N	<20	30	10	N	30
85VN9	1.5	N	N	15	20	30	30	N	<20	10	10	N	20
85VN12	1.5	N	N	15	15	300	30	N	<20	15	10	N	20
85VN13	1.0	N	N	15	15	50	N	N	<20	20	<10	N	20
85VN14	1.0	N	N	15	15	30	N	N	<20	15	<10	N	20
85VN15	1.5	N	N	10	<10	20	30	N	<20	N	15	N	15
85VN19	1.5	N	N	15	<10	7	50	N	<20	N	10	N	15
85VN25	1.0	N	N	20	70	70	<30	N	<20	30	<10	N	30
85VN42	1.5	N	N	5	N	5	N	N	<20	N	10	N	15
85VN43	1.5	N	N	15	<10	20	30	N	<20	<5	10	N	20
85VN45	1.5	N	N	15	15	30	30	N	<20	15	10	N	15
85VN6	N	N	N	N	N	7	N	N	N	<5	N	N	N

TABLE 5. RESULTS OF ANALYSES OF ROCK SAMPLES FROM THE TWIN PEAKS STUDY AREA, LASSEN COUNTY, CALIFORNIA, AND WASHOE COUNTY, NEVADA.--Continued

Sample	Sn-ppm s	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
85SN6A	N	3,000	50	N	10	N	30	N	7	<2	.4	3	23
85SN50	N	3,000	10	N	<10	N	15	N	8	<2	.2	4	22
85SN63	N	3,000	15	N	<10	N	15	N	9	<2	.2	<2	14
85VN11	N	3,000	30	N	<10	N	30	N	8	<2	.4	3	14
85VN26	N	1,000	<10	N	N	N	15	N	6	<2	.1	<2	<2
85VN29	N	3,000	30	N	10	N	20	N	6	<2	.4	<2	11
85VN30	N	3,000	10	N	<10	N	10	N	10	<2	.2	4	3
85VN31	N	3,000	10	N	15	N	10	N	9	<2	.2	<2	<2
85VN32	N	3,000	10	N	<10	N	15	N	13	<2	.3	3	5
85VN33	N	2,000	<10	N	<10	N	N	N	10	<2	.2	<2	3
85VN34	N	3,000	10	N	10	N	N	N	12	2	.4	<2	3
85VN35	N	3,000	15	N	10	N	15	N	10	<2	.3	3	4
85VN36	N	3,000	10	N	10	N	10	N	11	<2	.2	<2	5
85VN40	N	700	15	N	N	N	10	N	11	<2	.2	<2	7
85VN41	N	1,500	15	N	<10	N	10	N	16	<2	.2	<2	4
85SN8	N	500	300	N	30	N	100	N	<5	<2	.5	<2	67
85SN81	N	500	300	N	30	N	150	N	<5	<2	.8	<2	77
85SN12A	N	1,000	50	N	30	N	150	N	<5	<2	.6	<2	84
85SN12C	N	1,000	30	N	30	N	150	N	<5	<2	.7	<2	87
85SN13	N	500	150	N	20	N	150	N	<5	<2	.9	<2	83
85SN14	N	500	150	N	30	N	150	N	<5	<2	.7	<2	67
85SN16	N	500	200	N	10	N	50	N	<5	<2	.9	2	51
85SN17	N	1,000	150	N	30	N	150	N	<5	<2	.9	<2	78
85SN19A	N	300	10	N	15	N	200	N	<5	<2	.1	<2	28
85SN19B	N	300	10	N	15	N	200	N	<5	<2	.2	<2	33
85SN25	N	500	200	N	10	N	70	N	<5	<2	1.0	<2	76
85SN49	N	500	200	N	30	N	150	N	<5	<2	.5	<2	36
85SN55A	N	500	300	N	15	N	70	N	<5	<2	1.0	<2	63
85SN12B	N	700	70	N	30	N	150	N	<5	<2	.9	<2	66
85VN1	N	1,000	150	N	30	N	100	N	<5	<2	.8	<2	84
85VN5	N	700	100	N	30	N	150	N	<5	<2	.4	<2	55
85VN8	N	500	200	N	20	N	150	N	<5	<2	1.0	<2	88
85VN9	N	700	150	N	30	N	150	N	<5	<2	.7	<2	71
85VN12	N	700	150	N	20	N	150	N	<5	<2	.6	<2	62
85VN13	N	700	200	N	15	N	100	N	<5	2	.8	<2	63
85VN14	N	500	150	N	20	N	100	N	<5	<2	.6	<2	63
85VN15	N	700	100	N	30	N	200	N	<5	3	.4	<2	70
85VN19	N	1,000	150	N	30	N	200	N	<5	<2	.5	<2	52
85VN25	N	500	150	N	15	N	100	N	<5	3	.6	<2	60
85VN42	N	700	100	N	20	N	150	N	<5	<2	.5	<2	78
85VN43	N	700	150	N	20	N	150	N	<5	<2	.5	<2	60
85VN45	N	1,000	150	N	15	N	150	N	<5	<2	.6	<2	70
85VN6	N	<100	20	N	<10	N	10	N	<5	<2	.3	<2	9

TABLE 6.--Descriptions of rock samples

85 SN 8	Mafic dike	85 SN 6A	Calcareous tufa
8.1	Mafic dike	85 SN 50	Calcareous tufa
12A	Mafic dike	85 VN 63	Calcareous tufa
12C	Mafic dike	11	Calcareous tufa
13	Mafic dike	26	Calcareous tufa
14	Mafic dike	29	Calcareous tufa
16	Mafic dike	30	Calcareous tufa
17	Mafic dike	31	Calcareous tufa
19A	Mafic dike	32	Calcareous tufa
19B	Mafic dike	33	Calcareous tufa
25	Mafic dike	34	Calcareous tufa
49	Mafic dike	35	Calcareous tufa
55A	Mafic dike	36	Calcareous tufa
12B	Mafic dike	40	Calcareous tufa
85 VN 1	Mafic dike	41	Calcareous tufa
5	Mafic dike		
8	Mafic dike		
9	Mafic dike		
12	Mafic dike		
13	Mafic dike		
14	Mafic dike		
15	Mafic dike		
19	Mafic dike		
25	Mafic dike		
42	Mafic dike		
43	Mafic dike		
45	Mafic dike		
6	Mafic dike		

TABLE 7.--Latitudes and longitudes of rock samples not appearing on Plate 1

Sample	Latitude	Longitude
VN31	40 34 33	119 47 42
VN32	40 34 11	119 47 52
VN33	40 33 28	119 48 20
VN34	40 31 30	119 49 21
VN35	40 33 44	119 48 00
VN36	40 33 37	119 47 40