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Geochemical analyses of rock samples collected at the Penn Mine,
Calaveras County, California

By

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This report is preliminary and
has not been reviewed for conformity
with U.S. Geological Survey editorial
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¹Menlo Park, California

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INTRODUCTION

This paper presents analytical data from spectrographic analyses of 124 rock samples collected from the Penn Mine area, located in the northwest corner of Calaveras County, Calif. This study was undertaken to examine the distribution of trace elements around the Penn Mine; this paper gives only the analytical results. The property lies in secs. 3 and 4, T. 4 N., R. 10 E., and sec. 33, T. 5 N., R. 10 E. The mine is adjacent to the Mokelumne River and parts of the mine property are now covered by the upper reaches of the Camanche Reservoir.

The Penn Mine is one of the deposits of the Foothill copper-zinc belt, a group of massive-sulfide deposits that extends about 400 km along the western Sierra Nevada (fig. 1). These deposits occur in a complex zone of metamorphic rocks that formed as part of a Jurassic island arc (Kemp, 1982). The Penn Mine lies midway from the ends of the Foothill copper-zinc belt (fig. 1).

Between 1861 and 1952 the mine produced an estimated 973,784 tons of ore containing 82,534,054 lbs Cu, 22,196,482 lbs Zn, 1,225,798 lbs Pb, 67,773 oz Au, and 2,150,304 oz Ag (Heyl and others, 1948; Clark and Lydon, 1962); the workings are now inaccessible. Early papers attributed the mineralization to a replacement origin, but recent studies (for example, Kemp, 1982) recognize that the deposits in the Foothill copper-zinc belt originated as massive-sulfide deposits that recrystallized and reequilibrated during regional metamorphism.

The Penn Mine is situated in the western block, as defined by Clark (1964), of the metamorphic rocks of the Sierra Nevada. The mine area contains rocks from the Gopher Ridge Volcanics and the Salt Spring Slate, the lower two units in the western block (Clark, 1964). Both units have been metamorphosed to greenschist facies. Additionally, some of the rocks near mineralization have been altered to what is now a quartz-sericite schist (patterned area, pl. 1). The Gopher Ridge Volcanics near the Penn Mine can be divided into five extrusive units and a contemporaneous intrusive unit (pl. 1). From east to west (youngest to oldest) the units are composed of siliceous tuff, basalt, mafic to intermediate tuff, heterogeneous tuff, and a vent complex (Peterson, in press). The intrusive unit is a felsic quartz porphyry, similar to rhyolitic domes and subvolcanic intrusives discussed by Solomon (1976), Sangster and Scott (1976), Horikoshi and Sato (1970), and Kuroda (1983), with which the massive-sulfide ore is associated. A finger of the Salt Spring Slate underlies the Gopher Ridge Volcanics. Although the Salt Spring Slate is younger than the Gopher Ridge Volcanics, the units overlap in time and interfinger such that locally, as at the Penn Mine, the time sequence appears to be reversed. Trondhjemite, presumably related genetically to the Sierra Nevada batholith, formed two small sills in the northeast part of the map area. All these units, including the trondhjemite sills, strike north-northwest and foliation in the metamorphosed units generally parallels the strike. Overlying the Mesozoic rocks are Tertiary conglomerates that have been extensively worked for gold.

SAMPLE COLLECTION AND ANALYTICAL PROCEDURE

All the samples were removed from outcrops, both natural and manmade. Plate 1 shows the sample locations as well as the simplified geology in the mine area. Except for two samples of the Salt Spring Slate (83JP005, 83JP059) and one sample of trondhjemite (83JP028), all those analyzed came from the Gopher Ridge Volcanics; no samples of Tertiary conglomerate were analyzed.

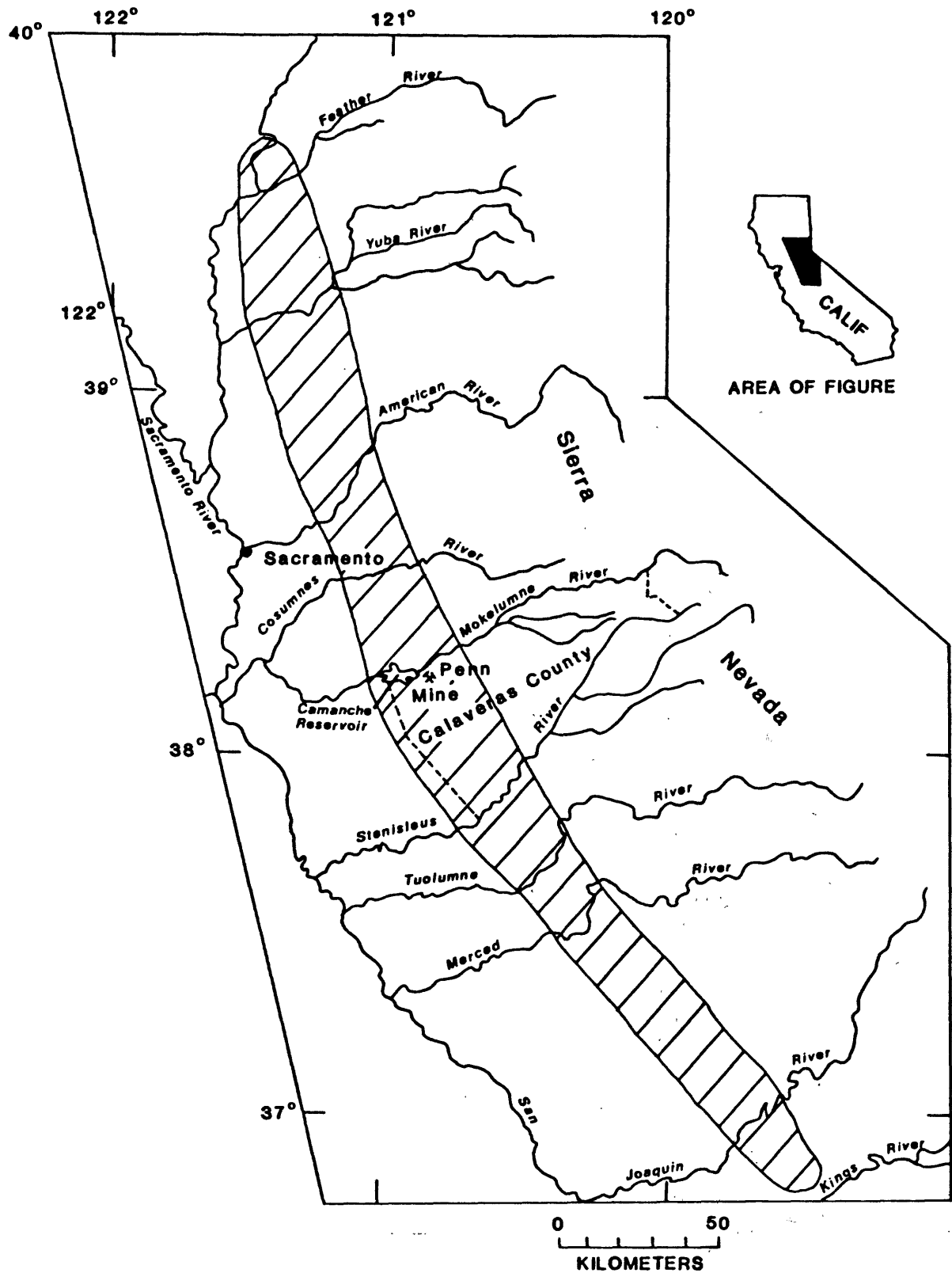


Figure 1. Index map showing location of the Penn Mine within the Foothill copper-zinc belt (lined area).

The 124 samples were crushed, split, and pulverized prior to analysis for 43 elements by semiquantitative emission spectroscopy (Golightly and others, unpub. report). Table 1 lists the lower limits of analytical determination for the 43 elements. Sample analyses were performed by T.L. Fries and R.W. Lerner at the U.S. Geological Survey in Menlo Park, Calif.

DATA

Table 2 lists the trace-element analyses of the 124 rock samples from the Penn Mine area. Analyses for most of the elements are reported in parts per million, but Al, Ca, Fe, K, Mg, Na, P, Si, and Ti are reported in percent. Several elements listed in table 1 (Au, Bi, Ce, Hg, Nb, Se, Sn, Te, Tl, and W) are not reported in table 2. None of the analytical values for these elements exceeded the respective lower limits of determination. Table 2 also lists location coordinates for each sample. Because the area covered by the sample sites is so small, conventional coordinates such as latitude and longitude or Universal Transverse Mercator coordinates could not be used. Therefore, the locations were determined by using a 0.1 in. grid arbitrarily placed on a 1:4,800 scale map of the area (the scale of pl. 1). For example, a sample located 1 in. from both the x and y axes would have x and y coordinates of 10 and 10. The axes of this grid are shown on plate 1 as a dashed line. The data were entered into a Lotus 1-2-3 file for data manipulation and presentation in tabular form.

Table 1.--Lower limits of determination for 43 elements analyzed by emission spectroscopy.

[All values are in parts per million unless otherwise stated.]

Element	Lower limit of determination	Element	Lower limit of determination
Al	0.25 pct.	Hg	500
Ca	0.05 pct.	La	20
Fe	0.05 pct.	Li	50
K	0.08 pct.	Mo	10
Mg	0.1 pct.	Mn	200
Na	0.15 pct.	Nb	25
P	0.02 pct.	Ni	1.0
Si	10. pct.	Pb	10
Ti	0.02 pct.	Re	50
Ag	1.0	Sb	100
As	200	Sc	10
Au	10	Se	200
B	10	Sn	10
Ba	20	Sr	15
Be	1.0	Te	50
Bi	10	Tl	10
Cd	2.0	V	10
Ce	100	W	100
Co	1.0	Y	10
Cr	10	Zn	50
Cu	1.0	Zr	20
Ga	10		

Table 2.--Results of rock geochemical analyses from the Penn Mine area, Calaveras County, Calif. "s" in heading indicates spectrographic analysis; "H" in data indicates interference in the analysis.

Sample number	X coord- inate	Y coord- inate	Al-pct. s	Ca-pct. s	Fe-pct. s	K-pct. s	Mg-pct. s	Na-pct. s	P-pct. s	Si-pct. s	Ti-pct. s	Ag-ppm s	As-ppm s
83JP005	9.00	36.00	6.7	1.70	3.70	1.10	0.97	2.10	0.13	31	0.32	<1.0	<200
83JP009	39.00	67.25	7.0	5.70	8.50	<0.08	3.70	0.30	<0.02	29	0.21	<1.0	<200
83JP010A	31.00	67.00	8.0	2.60	8.60	0.15	3.10	2.00	0.03	29	0.17	<1.0	<200
83JP010B	31.00	67.00	7.6	2.90	4.80	0.12	0.97	2.60	0.06	31	0.22	<1.0	<200
83JP011	31.75	78.75	7.4	4.00	9.30	0.16	4.40	1.30	0.03	26	0.26	<1.0	<200
83JP012	21.00	80.00	7.9	3.30	2.80	0.72	0.84	1.70	0.03	34	0.22	<1.0	<200
83JP013	33.00	84.00	7.2	6.60	6.00	0.35	2.70	0.69	<0.02	27	0.22	<1.0	<200
83JP014	36.00	85.00	8.3	6.60	4.60	0.15	1.50	0.40	<0.02	32	0.21	<1.0	<200
83JP015	41.00	58.00	3.9	0.38	>10.00	0.34	0.52	<0.15	0.03	30	0.05	<1.0	<200
83JP016	50.50	50.75	7.7	5.30	7.00	<0.08	2.90	0.28	<0.02	29	0.22	<1.0	<200
83JP017	53.00	46.50	8.2	4.40	7.80	0.14	2.90	1.90	0.03	25	0.23	<1.0	<200
83JP018	50.75	110.50	7.4	2.00	3.70	0.28	0.68	3.00	0.05	35	0.23	<1.0	<200
83JP019	49.25	107.50	8.4	<0.05	3.20	2.90	0.34	<0.15	0.03	39	0.20	<1.0	<200
83JP020	47.75	98.75	6.9	4.00	3.50	0.42	0.57	1.70	0.04	38	0.23	<1.0	<200
83JP021	40.00	96.00	7.7	2.20	6.70	0.83	2.70	1.80	<0.02	28	0.27	<1.0	<200
83JP022	34.50	120.00	8.2	3.00	7.80	0.27	3.00	3.40	<0.02	30	0.28	<1.0	<200
83JP023	33.00	158.00	7.9	2.00	4.80	2.60	2.40	0.15	0.10	34	0.30	<1.0	<200
83JP024	55.00	148.00	6.5	6.20	8.10	0.32	5.10	2.50	0.04	27	0.34	<1.0	<200
83JP025	52.25	146.00	6.0	0.46	0.78	0.30	0.19	3.00	<0.02	>40	0.21	<1.0	<200
83JP026	34.00	161.00	9.1	5.60	9.30	0.12	2.60	2.30	0.03	28	0.38	<1.0	<200
83JP027	78.50	136.50	5.8	0.45	1.70	0.66	0.16	2.60	<0.02	40	0.11	<1.0	<200
83JP028	70.00	141.75	6.8	0.15	1.10	0.66	0.22	3.80	0.02	37	0.15	<1.0	<200
83JP029	88.00	117.25	6.7	0.31	2.80	0.30	0.40	2.80	0.04	37	0.21	<1.0	<200
83JP030	74.00	121.00	7.2	6.50	8.00	0.14	3.10	1.30	<0.02	28	0.33	<1.0	<200
83JP031	76.50	118.50	6.0	0.21	2.60	0.56	0.21	2.70	<0.02	37	0.12	<1.0	<200
83JP032	85.25	81.50	7.0	3.10	5.10	0.34	1.20	1.90	0.04	33	0.33	<1.0	<200
83JP033	47.50	78.00	8.4	3.80	6.90	1.20	2.60	1.70	0.03	29	0.27	<1.0	<200
83JP034	68.00	73.00	5.9	0.08	0.21	1.10	<0.10	2.20	<0.02	37	0.24	2.4	<200
83JP035	67.25	73.00	4.6	<0.05	0.31	2.00	0.16	<0.15	<0.02	>40	0.10	2.2	<200
83JP036	61.00	74.50	9.1	4.20	8.90	0.17	2.80	<0.15	<0.02	29	0.37	10.0	<200
83JP037	52.50	77.00	7.5	2.70	1.80	2.00	0.83	0.30	0.03	34	0.18	<1.0	<200
83JP038	53.50	84.00	5.7	0.57	2.70	<0.08	0.33	2.20	<0.02	38	0.34	<1.0	<200
83JP039	54.25	80.00	1.2	<0.05	3.00	0.50	0.11	<0.15	<0.02	>40	0.17	8.4	440
83JP040	74.00	74.00	8.0	3.10	7.90	0.79	2.40	1.70	0.04	29	0.43	<1.0	<200
83JP041	75.00	62.25	5.2	0.19	2.10	0.36	0.59	2.20	<0.02	37	0.14	<1.0	<200

Table 2.--Results of rock geochemical analyses from the Penn Mine area, Calaveras County, Calif.--continued

Sample number	X coor- dinate	Y coor- dinate	Al-pct. s	Ca-pct. s	Fe-pct. s	K-pct. s	Mg-pct. s	Na-pct. s	P-pct. s	Si-pct. s	Ti-pct. s	Ag-ppm s	As-ppm s
83JP042	84.00	62.00	8.7	3.40	7.90	0.19	2.40	2.00	0.04	32	0.43	<1.0	<200
83JP043	102.00	50.50	1.8	<0.05	2.30	0.64	0.10	<0.15	<0.02	>40	0.08	<1.0	<200
83JP044	73.50	20.50	8.0	3.40	5.30	0.62	2.40	1.50	0.14	29	0.30	<1.0	<200
83JP045	89.50	13.50	8.1	5.30	7.80	<0.08	4.00	<0.15	<0.02	26	0.25	<1.0	<200
83JP046	64.25	22.00	7.9	2.70	5.50	0.30	1.10	2.50	0.05	30	0.23	<1.0	<200
83JP047	88.00	2.00	8.7	4.80	6.90	<0.08	2.90	2.10	<0.02	23	0.23	<1.0	<200
83JP048	99.00	5.00	8.8	5.90	8.10	<0.08	3.60	1.20	0.02	24	0.34	<1.0	<200
83JP049	99.25	37.50	6.3	<0.05	3.30	3.00	0.20	0.22	0.03	34	0.14	<1.0	<200
83JP050	103.00	35.75	6.5	6.50	7.50	0.68	4.10	2.00	0.08	25	0.33	<1.0	<200
83JP051	79.00	53.50	6.6	>10.00	6.70	<0.08	4.10	1.50	0.03	22	0.32	<1.0	<200
83JP052	83.00	52.75	6.0	7.00	6.40	0.25	3.80	2.20	<0.02	24	0.27	<1.0	<200
83JP053	41.00	97.50	8.7	3.40	7.30	0.23	2.80	2.30	<0.02	26	0.33	<1.0	<200
83JP054	26.00	129.00	8.5	2.80	7.10	<0.08	2.50	2.70	<0.02	27	0.29	<1.0	<200
83JP055	25.75	108.50	7.9	3.80	7.80	0.96	3.30	1.00	<0.02	25	0.30	<1.0	<200
83JP056	95.00	43.00	6.7	<0.50	1.00	3.30	0.31	<0.15	0.02	38	0.18	4.3	<200
83JP059	21.00	71.50	9.0	0.18	5.60	2.60	1.40	0.84	0.11	29	0.51	<1.0	<200
83JP060	27.50	81.00	7.6	4.80	6.40	0.08	2.30	1.20	0.03	28	0.23	<1.0	<200
83JP061	49.50	43.50	8.7	6.10	6.60	0.08	2.50	0.70	0.02	28	0.16	<1.0	<200
83JP062	54.50	48.00	6.6	0.08	2.20	0.74	0.48	0.92	0.03	39	0.16	<1.0	<200
83JP063	60.00	48.00	8.6	3.50	7.30	0.10	3.70	1.30	<0.02	31	0.33	<1.0	<200
83JP064	58.50	60.00	9.4	0.14	7.90	0.72	2.10	1.10	0.04	30	0.26	<1.0	<200
83JP065	66.00	63.50	11.0	<0.05	>10.00	1.30	6.60	0.85	0.04	17	0.51	<1.0	<200
83JP066	63.25	64.00	11.0	0.06	8.70	1.00	3.10	1.40	0.05	26	0.33	<1.0	<200
83JP067	60.50	62.75	7.9	1.90	4.40	1.40	2.30	1.20	0.02	36	0.22	<1.0	<200
83JP069	65.00	61.00	7.0	<0.05	3.10	3.00	0.37	0.22	0.06	36	0.19	<1.0	<200
83JP070	68.00	61.00	6.8	<0.05	1.40	1.80	0.24	0.67	0.03	38	0.20	<1.0	<200
83JP072	33.50	89.50	9.2	5.00	8.30	0.11	3.70	0.94	<0.02	30	0.32	<1.0	<200
83JP073	33.00	97.50	8.4	4.70	8.00	0.41	4.00	0.40	<0.02	28	0.30	<1.0	<200
83JP074	44.00	94.50	8.7	5.50	9.00	0.24	2.20	1.10	0.02	26	0.38	<1.0	<200
83JP075	48.00	100.00	8.4	1.40	3.90	2.00	1.10	1.70	0.05	34	0.26	<1.0	<200
83JP076	49.00	105.00	6.3	<0.05	1.80	3.00	0.26	0.17	<0.02	39	0.46	6.3	<200
83JP077	50.00	91.50	8.2	0.08	>10.00	0.41	4.60	1.90	0.04	26	0.33	<1.0	<200
83JP078	53.50	93.25	6.9	<0.05	0.76	2.60	0.28	<0.15	<0.02	>40	0.12	<1.0	<200
83JP079	51.00	105.00	6.8	0.82	4.00	0.24	1.00	2.40	0.04	35	0.23	<1.0	<200
83JP080	56.00	105.50	7.3	1.30	4.10	1.20	0.89	2.20	0.04	37	0.21	<1.0	<200

Table 2.--Results of rock geochemical analyses from the Penn Mine area, Calaveras County, Calif.--continued

Sample number	X coordinate	Y coordinate	Al-pct. s	Ca-pct. s	Fe-pct. s	K-pct. s	Mg-pct. s	Na-pct. s	P-pct. s	Si-pct. s	Ti-pct. s	Ag-ppm s	As-ppm s
83JP081	54.00	111.00	7.4	0.21	4.00	0.17	1.00	3.30	0.06	36	0.27	<1.0	<200
83JP082	67.00	112.00	6.5	0.07	1.40	<0.08	0.10	3.70	<0.02	39	0.16	<1.0	<200
83JP083	64.00	115.50	7.8	3.20	5.90	0.63	3.50	2.20	0.02	32	0.38	<1.0	<200
83JP084	115.25	98.50	8.2	2.60	5.00	0.14	0.86	2.40	0.12	35	0.44	<1.0	<200
83JP086	94.50	114.50	5.2	0.20	1.70	<0.08	0.18	2.70	<0.02	39	0.14	<1.0	<200
83JP087	81.50	118.00	5.8	0.32	1.60	0.53	0.22	2.50	<0.02	39	0.13	<1.0	<200
83JP088	74.00	113.50	6.5	5.10	7.90	0.34	4.10	1.70	<0.02	24	0.20	<1.0	<200
83JP089	67.00	118.00	8.1	6.80	7.40	0.28	2.60	2.40	0.12	24	0.53	<1.0	<200
83JP090	49.50	116.50	8.0	4.30	6.80	0.23	2.10	1.90	0.04	31	0.43	<1.0	<200
83JP091	35.50	118.50	8.4	1.50	1.90	1.80	0.53	2.30	0.03	36	0.17	<1.0	<200
83JP092	34.50	123.00	7.7	2.30	4.20	0.50	0.86	2.40	0.10	34	0.37	<1.0	<200
83JP093	34.00	115.00	8.2	2.40	2.50	1.20	0.79	2.20	0.03	36	0.18	<1.0	<200
83JP094	31.75	109.50	9.2	5.70	7.60	1.20	3.30	0.59	<0.02	27	0.32	<1.0	<200
83JP095	34.50	105.50	8.2	3.10	6.50	0.54	3.90	0.86	<0.02	29	0.24	<1.0	<200
83JP096	33.00	103.00	9.1	5.40	7.80	0.83	3.40	1.70	<0.02	26	0.28	<1.0	<200
83JP097	24.50	140.50	7.9	2.60	4.30	0.93	1.10	2.20	0.08	32	0.30	<1.0	<200
83JP098	25.00	136.00	7.7	6.70	6.70	0.16	1.90	1.90	<0.02	28	0.26	<1.0	<200
83JP099	29.00	121.50	7.9	2.50	3.20	1.10	1.20	1.40	0.03	35	0.18	<1.0	<200
83JP100	27.00	113.00	9.1	6.10	7.30	1.30	2.60	0.37	<0.02	20	0.29	<1.0	<200
83JP101	33.00	131.00	7.5	2.90	5.50	0.71	1.40	1.70	0.07	34	0.38	<1.0	<200
83JP102	29.00	144.00	6.3	1.10	1.40	0.19	0.12	3.00	0.06	39	0.28	<1.0	<200
83JP103	25.00	146.00	8.2	<0.05	0.97	3.10	0.30	1.90	0.04	35	0.14	3.6	<200
83JP104	27.00	137.00	6.7	0.69	4.50	1.90	1.70	1.50	0.05	33	0.22	<1.0	<200
83JP105	30.50	129.00	6.9	1.40	3.30	0.44	0.85	2.50	0.05	35	0.24	<1.0	<200
83JP106	44.75	148.75	8.3	4.30	>10.00	0.88	4.10	1.30	0.10	23	0.64	<1.0	<200
83JP107	30.00	153.75	9.2	4.10	9.40	0.14	2.50	3.40	0.09	25	0.50	<1.0	<200
83JP108	26.00	150.00	5.7	0.18	1.10	0.18	<0.10	3.00	<0.02	38	0.12	3.4	<200
83JP109	67.00	71.00	8.3	0.89	5.10	0.11	1.50	2.60	0.08	30	0.45	<1.0	<200
83JP110	66.00	69.00	3.3	<0.05	1.10	1.20	0.12	<0.15	<0.02	>40	0.10	6.6	<200
83JP111	79.50	60.75	7.5	5.20	6.40	0.94	5.60	2.30	0.02	30	0.37	<1.0	<200
83JP113	77.00	54.75	6.3	<0.05	0.42	3.00	0.27	<0.15	<0.02	>40	0.11	1.1	<200
83JP114	75.00	58.50	8.4	2.70	7.80	<0.08	3.90	1.40	0.08	28	0.55	<1.0	<200
83JP115	73.00	60.50	9.3	1.70	8.60	0.08	4.90	2.30	0.10	22	0.64	<1.0	<200
83JP116	69.00	62.50	8.8	3.10	9.10	0.14	6.00	<0.15	0.12	24	0.71	<1.0	<200
83JP117	105.50	61.75	7.7	1.90	5.10	0.13	1.10	2.10	0.09	34	0.54	<1.0	<200

Table 2.--Results of rock geochemical analyses from the Penn Mine area, Calaveras County, Calif.--continued

Sample number	X coordinate	Y coordinate	Al-pct. s	Ca-pct. s	Fe-pct. s	K-pct. s	Mg-pct. s	Na-pct. s	P-pct. s	Si-pct. s	Ti-pct. s	Ag-ppm s	As-ppm s
83JP118	90.00	49.50	6.7	0.10	3.60	2.30	2.30	<0.15	0.02	33	0.21	<1.0	<200
83JP119	100.75	44.00	7.6	8.80	8.10	0.19	3.80	1.80	0.06	25	0.41	<1.0	<200
83JP120	108.00	41.50	7.6	1.50	5.50	1.20	0.89	2.30	0.13	32	0.52	<1.0	<200
83JP121	110.00	27.75	8.8	6.60	8.20	0.24	2.50	2.30	0.10	26	0.41	<1.0	<200
83JP122	114.00	21.00	6.9	<0.05	1.30	3.00	0.35	0.42	0.05	38	0.14	<1.0	<200
83JP123	104.00	13.00	6.6	1.80	2.60	0.90	0.65	1.50	0.03	37	0.20	<1.0	<200
83JP124	106.50	22.50	7.4	>10.00	9.30	<0.08	3.50	1.30	0.05	25	0.46	<1.0	<200
83JP125	103.50	27.50	9.1	>10.00	8.40	<0.08	3.20	1.90	0.06	23	0.47	<1.0	<200
83JP127B	91.50	43.00	4.4	<0.05	0.55	1.50	0.25	<0.15	<0.02	>40	0.08	<1.0	<200
83JP129	73.00	43.75	7.3	<0.05	1.30	1.40	1.90	0.63	<0.02	34	0.21	1.4	<200
83JP130	75.75	41.00	7.8	0.05	5.00	<0.08	0.22	<0.15	0.05	34	0.23	<1.0	<200
83JP131	79.00	38.50	5.4	<0.05	>10.00	1.50	0.39	0.17	0.02	35	0.17	H	>1,000
83JP132	66.25	28.00	8.0	3.70	3.60	0.38	0.99	1.00	0.04	34	0.23	<1.0	<200
83JP133	67.50	14.50	7.3	0.58	4.50	0.16	2.00	2.60	0.10	32	0.38	<1.0	<200
83JP134	72.50	13.25	8.5	3.80	9.60	0.08	4.30	1.20	0.04	20	0.27	<1.0	<200
83JP135	80.00	26.50	9.7	5.80	9.80	0.25	4.60	0.48	0.03	24	0.51	<1.0	<200
83JP137	49.25	103.25	9.2	2.70	9.20	<0.08	5.00	1.80	0.05	25	0.36	<1.0	<200
83JP138A	55.75	94.00	2.9	<0.05	0.52	1.20	0.10	<0.15	<0.02	>40	0.07	<1.0	<200
83JP139	56.00	95.00	7.9	<0.05	8.20	0.74	7.20	<0.15	<0.02	24	0.53	<1.0	<200

Table 2.--Results of rock geochemical analyses from the Penn Mine area, Calaveras County, Calif.--continued

Sample number	B-ppm s	Ba-ppm s	Be-ppm s	Cd-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	Ga-ppm s	La-ppm s	Li-ppm s	Mo-ppm s	Mn-ppm s	Ni-ppm s
83JP005	<10	430	1.5	<2.0	12.0	200	28.0	12	<20	<50	<10	640	55.0
83JP009	<10	81	1.3	<2.0	29.0	66	130.0	13	<20	<50	<10	1,200	14.0
83JP010A	<10	250	1.2	<2.0	32.0	20	110.0	11	<20	<50	<10	1,600	8.5
83JP010B	<10	190	<1.0	<2.0	18.0	<10	90.0	11	<20	<50	<10	1,200	4.3
83JP011	12	190	1.3	3.4	41.0	140	300.0	10	<20	<50	<10	1,600	18.0
83JP012	<10	1,100	1.4	<2.0	9.3	<10	54.0	<10	<20	<50	<10	690	3.1
83JP013	<10	300	1.0	<2.0	25.0	27	100.0	11	<20	<50	<10	890	9.5
83JP014	<10	57	1.2	<2.0	12.0	<10	25.0	13	<20	<50	<10	900	4.4
83JP015	H	240	2.6	<2.0	25.0	<10	39.0	H	<20	<50	H	2,100	9.1
83JP016	<10	69	1.2	<2.0	31.0	29	79.0	11	<20	<50	<10	1,100	9.3
83JP017	<10	390	<1.0	<2.0	29.0	32	140.0	11	<20	<50	<10	1,500	9.8
83JP018	<10	120	<1.0	<2.0	7.9	<10	6.5	10	<20	<50	<10	490	3.1
83JP019	<10	660	1.7	<2.0	5.2	<10	190.0	15	<20	<50	<10	<200	4.8
83JP020	<10	180	2.0	<2.0	9.0	<10	8.1	15	<20	<50	<10	1,100	4.1
83JP021	<10	140	<1.0	<2.0	17.0	10	65.0	13	<20	<50	<10	1,500	6.1
83JP022	<10	250	1.2	<2.0	27.0	16	74.0	14	<20	<50	<10	1,700	8.1
83JP023	<10	920	1.7	<2.0	13.0	<10	17.0	21	<20	<50	<10	650	8.6
83JP024	<10	130	1.2	<2.0	42.0	98	160.0	12	<20	<50	<10	1,700	38.0
83JP025	<10	270	1.2	<2.0	5.1	<10	8.8	<10	<20	<50	<10	230	2.7
83JP026	10	49	1.4	<2.0	26.0	<10	130.0	19	<20	<50	<10	1,400	6.8
83JP027	<10	140	1.9	<2.0	4.5	<10	5.4	<10	<20	<50	<10	<200	3.5
83JP028	<10	200	<1.0	<2.0	2.6	<10	19.0	<10	<20	<50	<10	<200	3.4
83JP029	<10	120	<1.0	<2.0	2.4	<10	8.4	<10	<20	<50	<10	500	3.0
83JP030	<10	34	1.4	<2.0	30.0	170	51.0	19	<20	<50	<10	1,400	50.0
83JP031	<10	110	1.4	<2.0	4.4	<10	11.0	10	<20	<50	<10	<200	4.5
83JP032	<10	81	1.2	<2.0	17.0	<10	12.0	12	<20	<50	<10	980	4.8
83JP033	21	250	<1.0	<2.0	25.0	20	90.0	13	<20	<50	<10	1,600	7.5
83JP034	<10	2,600	<1.0	<2.0	3.1	<10	8.5	<10	<20	<50	<10	<200	1.6
83JP035	<10	980	1.1	<2.0	3.7	<10	2.7	<10	<20	<50	<10	<200	1.7
83JP036	55	77	1.3	3.2	29.0	<10	780.0	20	<20	<50	<10	990	7.4
83JP037	15	310	<1.0	<2.0	4.5	<10	7.4	12	<20	<50	<10	690	3.7
83JP038	<10	260	1.2	<2.0	6.7	<10	260.0	<10	<20	<50	<10	720	3.6
83JP039	48	3,900	<1.0	4.2	2.0	<10	79.0	<10	<20	<50	28	<200	2.0
83JP040	<10	110	1.0	<2.0	23.0	<10	23.0	13	<20	<50	<10	1,400	4.8
83JP041	<10	110	1.1	<2.0	5.8	<10	16.0	<10	<20	<50	<10	430	6.4

Table 2.--Results of rock geochemical analyses from the Penn Mine area, Calaveras County, Calif.--continued

Sample number	B-ppm s	Ba-ppm s	Be-ppm s	Cd-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	Ga-ppm s	La-ppm s	Li-ppm s	Mo-ppm s	Mn-ppm s	Ni-ppm s
83JP042	<10	88	1.4	<2.0	26.0	<10	20.0	14	<20	<50	<10	1,300	5.9
83JP043	13	1,700	2.0	<2.0	5.3	48	50.0	<10	27	<50	<10	<200	4.4
83JP044	<10	250	<1.0	8.2	20.0	22	76.0	11	<20	<50	<10	600	5.7
83JP045	<10	36	1.1	<2.0	36.0	39	120.0	13	<20	<50	<10	1,200	14.0
83JP046	<10	110	<1.0	<2.0	19.0	<10	73.0	<10	<20	<50	<10	860	3.8
83JP047	<10	40	<1.0	<2.0	23.0	19	140.0	16	<20	<50	<10	1,500	8.2
83JP048	12	62	<1.0	<2.0	24.0	17	81.0	17	<20	<50	<10	1,100	8.6
83JP049	<10	960	1.6	<2.0	3.8	<10	140.0	16	<20	<50	<10	<200	2.9
83JP050	12	190	1.1	<2.0	53.0	140	25.0	<10	<20	<50	<10	1,500	73.0
83JP051	<10	28	<1.0	<2.0	43.0	160	150.0	13	<20	<50	<10	1,200	50.0
83JP052	<10	85	<1.0	<2.0	37.0	110	73.0	<10	<20	<50	<10	1,200	38.0
83JP053	<10	110	<1.0	11.0	28.0	24	430.0	15	<20	<50	<10	1,400	11.0
83JP054	<10	51	1.0	<2.0	25.0	14	66.0	13	<20	<50	<10	1,600	7.3
83JP055	<10	150	1.0	<2.0	30.0	15	77.0	16	<20	<50	<10	1,500	7.9
83JP056	44	2,600	<1.0	<2.0	1.1	<10	24.0	17	<20	<50	<10	<200	2.4
83JP059	100	950	2.2	7.1	11.0	120	510.0	21	24	67	<10	320	51.0
83JP060	22	72	<1.0	<2.0	20.0	22	79.0	12	<20	<50	<10	980	8.2
83JP061	10	94	1.1	<2.0	22.0	14	130.0	12	<20	<50	<10	1,200	6.6
83JP062	82	280	<1.0	<2.0	8.7	<10	56.0	10	<20	<50	<10	890	4.1
83JP063	<10	2,400	1.2	<2.0	27.0	13	47.0	14	<20	<50	<10	870	7.3
83JP064	81	170	<1.0	<2.0	28.0	30	86.0	15	<20	89	<10	520	12.0
83JP065	H	870	1.6	3.3	53.0	120	550.0	33	<20	110	H	710	35.0
83JP066	120	1,000	<1.0	<2.0	29.0	<10	500.0	23	<20	<50	<10	530	7.8
83JP067	<10	460	1.2	<2.0	13.0	<10	19.0	10	<20	<50	<10	1,100	3.6
83JP069	44	5,000	1.9	8.2	5.4	<10	260.0	12	<20	<50	<10	280	5.1
83JP070	43	990	1.0	<2.0	2.6	<10	100.0	14	<20	<50	<10	<200	2.7
83JP072	<10	31	1.2	<2.0	28.0	11	140.0	16	<20	<50	<10	1,100	8.6
83JP073	<10	61	1.1	<2.0	31.0	20	120.0	12	<20	<50	<10	910	8.8
83JP074	<10	40	1.3	<2.0	17.0	<10	140.0	19	<20	<50	<10	1,600	5.9
83JP075	<10	660	1.5	<2.0	10.0	<10	13.0	14	<20	<50	<10	530	6.6
83JP076	23	1,500	<1.0	<2.0	5.5	140	15.0	12	<20	<50	12	<200	2.4
83JP077	H	77	1.8	<2.0	48.0	150	1,400.0	H	<20	<50	H	940	37.0
83JP078	<10	850	1.8	6.4	5.1	<10	150.0	19	<20	<50	<10	<200	3.7
83JP079	<10	100	1.0	<2.0	11.0	<10	13.0	<10	<20	<50	<10	840	2.4
83JP080	<10	180	1.3	<2.0	12.0	<10	43.0	<10	<20	<50	<10	800	3.0

Table 2.--Results of rock geochemical analyses from the Penn Mine area, Calaveras County, Calif.--continued

Sample number	B-ppm s	Ba-ppm s	Be-ppm s	Cd-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	Ga-ppm s	La-ppm s	Li-ppm s	Mo-ppm s	Mn-ppm s	Ni-ppm s
83JP081	<10	100	1.2	<2.0	11.0	<10	41.0	<10	<20	<50	<10	470	2.8
83JP082	<10	79	1.1	<2.0	6.2	<10	19.0	<10	<20	<50	<10	<200	6.0
83JP083	<10	340	1.1	<2.0	32.0	430	76.0	11	<20	<50	<10	1,100	99.0
83JP084	<10	180	1.6	<2.0	10.0	<10	8.3	12	<20	<50	<10	960	4.5
83JP086	<10	47	<1.0	<2.0	2.9	<10	8.2	<10	<20	<50	<10	<200	3.7
83JP087	<10	170	1.5	<2.0	7.0	<10	9.9	<10	<20	<50	<10	<200	4.2
83JP088	<10	56	1.0	<2.0	43.0	700	78.0	10	<20	<50	<10	920	160.0
83JP089	11	75	<1.0	<2.0	28.0	170	77.0	14	<20	<50	<10	1,400	51.0
83JP090	<10	88	1.4	<2.0	25.0	<10	9.7	14	<20	<50	<10	1,200	5.1
83JP091	<10	670	1.2	<2.0	7.4	<10	120.0	12	<20	<50	<10	530	4.0
83JP092	<10	230	1.4	<2.0	11.0	<10	8.9	15	<20	<50	<10	1,100	4.3
83JP093	<10	370	1.3	<2.0	8.1	<10	17.0	10	<20	<50	<10	860	3.6
83JP094	<10	250	1.1	<2.0	21.0	12	83.0	17	<20	<50	<10	1,100	7.6
83JP095	13	190	<1.0	2.8	22.0	37	78.0	14	<20	<50	<10	1,900	14.0
83JP096	<10	100	1.1	<2.0	30.0	29	110.0	15	<20	<50	<10	1,500	9.4
83JP097	<10	170	<1.0	<2.0	6.8	14	23.0	12	<20	<50	<10	900	5.4
83JP098	<10	74	<1.0	<2.0	24.0	13	72.0	13	<20	<50	<10	1,200	7.6
83JP099	<10	310	1.1	<2.0	8.2	<10	36.0	10	<20	<50	<10	530	2.7
83JP100	26	160	<1.0	<2.0	24.0	24	130.0	14	<20	<50	<10	1,100	11.0
83JP101	<10	620	1.5	<2.0	15.0	<10	12.0	12	<20	<50	<10	1,100	5.1
83JP102	<10	93	1.4	<2.0	5.9	<10	6.6	<10	<20	<50	<10	350	3.0
83JP103	30	1,600	1.1	<2.0	2.0	<10	16.0	22	<20	<50	<10	<200	3.7
83JP104	<10	1,300	1.4	<2.0	6.5	<10	16.0	20	<20	<50	<10	450	4.7
83JP105	<10	130	1.1	<2.0	8.3	<10	11.0	<10	<20	<50	<10	680	3.5
83JP106	H	99	1.7	<2.0	30.0	<10	41.0	17	<20	<50	H	650	13.0
83JP107	<10	28	1.2	<2.0	22.0	<10	27.0	18	<20	<50	<10	1,700	6.7
83JP108	<10	210	<1.0	<2.0	3.7	<10	6.2	<10	<20	<50	<10	<200	2.6
83JP109	<10	87	1.2	<2.0	12.0	<10	31.0	12	<20	<50	<10	1,100	6.0
83JP110	<10	>5,000	<1.0	<2.0	3.3	<10	16.0	<10	<20	<50	<10	<200	1.5
83JP111	<10	150	1.2	<2.0	40.0	110	42.0	<10	<20	<50	<10	1,200	32.0
83JP113	<10	1,100	1.5	<2.0	3.9	<10	7.9	13	<20	<50	<10	<200	2.4
83JP114	18	110	1.2	<2.0	20.0	190	60.0	14	<20	<50	<10	990	57.0
83JP115	23	37	1.1	<2.0	29.0	200	54.0	20	<20	<50	<10	1,700	72.0
83JP116	23	81	1.4	4.9	40.0	220	230.0	22	<20	<50	<10	1,100	53.0
83JP117	10	120	<1.0	<2.0	9.1	<10	7.0	12	<20	<50	<10	690	4.7

Table 2.--Results of rock geochemical analyses from the Penn Mine area, Calaveras County, Calif.--continued

Sample number	B-ppm s	Ba-ppm s	Be-ppm s	Cd-ppm s	Co-ppm s	Cr-ppm s	Cu-ppm s	Ga-ppm s	La-ppm s	Li-ppm s	Mo-ppm s	Mn-ppm s	Ni-ppm s
83JP118	<10	730	1.5	4.4	19.0	21	180.0	16	<20	<50	<10	540	43.0
83JP119	<10	46	1.3	<2.0	41.0	110	100.0	13	<20	<50	<10	1,300	40.0
83JP120	22	230	1.1	<2.0	11.0	<10	7.4	15	<20	<50	<10	810	4.3
83JP121	29	410	<1.0	<2.0	26.0	94	41.0	11	<20	<50	<10	950	21.0
83JP122	35	940	1.3	<2.0	2.2	<10	28.0	16	<20	<50	<10	<200	3.1
83JP123	<10	250	1.5	<2.0	6.2	<10	7.7	11	<20	<50	<10	820	3.0
83JP124	29	22	<1.0	<2.0	38.0	290	89.0	<10	<20	<50	<10	1,400	54.0
83JP125	16	39	<1.0	<2.0	35.0	120	74.0	15	<20	<50	<10	1,100	40.0
83JP127B	30	1,500	<1.0	<2.0	1.5	14	40.0	<10	<20	<50	<10	<200	3.7
83JP129	40	2,000	<1.0	9.4	1.3	<10	110.0	14	<20	<50	<10	220	3.0
83JP130	60	140	<1.0	7.5	6.7	14	96.0	15	<20	51	<10	490	6.9
83JP131	H	4,100	1.6	H	5.9	<10	250.0	<10	<20	<50	H	<200	5.9
83JP132	33	500	<1.0	<2.0	7.1	<10	36.0	11	<20	<50	<10	620	5.1
83JP133	11	210	<1.0	<2.0	12.0	<10	130.0	<10	<20	<50	<10	800	7.0
83JP134	29	38	<1.0	<2.0	37.0	44	150.0	<10	<20	<50	<10	1,800	12.0
83JP135	19	100	<1.0	<2.0	37.0	10	220.0	13	<20	<50	<10	1,500	9.3
83JP137	18	42	<1.0	<2.0	43.0	52	170.0	13	<20	<50	<10	1,700	22.0
83JP138A	12	810	<1.0	2.0	2.4	<10	8.6	<10	<20	<50	<10	<200	3.3
83JP139	42	160	<1.0	<2.0	33.0	230	61.0	21	<20	<50	<10	2,300	87.0

Table 2.--Results of rock geochemical analyses from the Penn Mine area, Calaveras County, Calif.--continued

Sample number	Pb-ppm s	Re-ppm s	Sb-ppm s	Sc-ppm s	Sr-ppm s	V-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s
83JP005	<10	<50	<100	13	300	110	16	170	130
83JP009	<10	<50	<100	47	170	250	11	110	31
83JP010A	<10	<50	<100	46	350	300	<10	130	21
83JP010B	22	<50	<100	36	680	170	12	160	32
83JP011	63	<50	<100	57	92	300	14	230	52
83JP012	<10	<50	<100	16	110	35	19	230	99
83JP013	12	<50	<100	34	110	230	11	99	30
83JP014	12	<50	<100	26	720	49	21	72	61
83JP015	30	H	<100	38	17	130	17	130	27
83JP016	<10	<50	<100	41	140	260	13	110	28
83JP017	<10	<50	<100	52	280	320	11	120	30
83JP018	<10	<50	<100	20	100	40	26	56	50
83JP019	<10	<50	<100	19	110	<10	36	<50	210
83JP020	<10	<50	<100	17	200	24	35	96	120
83JP021	10	<50	<100	41	160	290	11	120	23
83JP022	<10	<50	<100	46	530	230	11	110	27
83JP023	13	<50	<100	26	250	<10	39	160	180
83JP024	<10	<50	<100	44	49	240	14	91	45
83JP025	<10	<50	<100	<10	34	<10	25	<50	110
83JP026	<10	<50	<100	53	190	320	12	84	24
83JP027	<10	<50	<100	<10	50	<10	53	<50	150
83JP028	<10	<50	<100	<10	48	<10	51	51	140
83JP029	<10	<50	<100	13	33	<10	33	96	150
83JP030	<10	<50	<100	33	500	190	27	120	120
83JP031	<10	<50	<100	10	<15	<10	38	67	150
83JP032	<10	<50	<100	26	110	92	21	97	81
83JP033	<10	<50	<100	37	230	270	12	200	27
83JP034	28	<50	<100	<10	67	42	<10	<50	110
83JP035	<10	<50	<100	<10	<15	<10	24	<50	92
83JP036	210	<50	<100	54	380	360	<10	340	22
83JP037	13	<50	<100	19	130	23	21	86	56
83JP038	14	<50	<100	16	52	<10	57	290	96
83JP039	290	<50	310	<10	21	35	<10	<50	34
83JP040	12	<50	<100	36	180	170	22	130	96
83JP041	11	<50	<100	<10	18	20	29	200	110

Table 2.--Results of rock geochemical analyses from the Penn Mine area, Calaveras County, Calif.--continued

Sample number	Pb-ppm s	Re-ppm s	Sb-ppm s	Sc-ppm s	Sr-ppm s	V-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s
83JP042	<10	<50	<100	34	230	130	22	120	100
83JP043	43	<50	<100	<10	130	100	26	<50	60
83JP044	13	<50	<100	48	100	280	45	230	21
83JP045	<10	<50	<100	49	77	340	<10	120	<20
83JP046	15	59	<100	32	1600	96	<10	100	24
83JP047	<10	<50	<100	36	150	290	<10	120	22
83JP048	<10	<50	<100	55	180	290	12	110	27
83JP049	<10	<50	<100	15	21	<10	28	97	160
83JP050	<10	<50	<100	47	130	260	13	77	39
83JP051	14	<50	<100	48	90	270	16	H	43
83JP052	<10	<50	<100	39	79	220	15	79	34
83JP053	25	<50	<100	48	190	310	13	370	20
83JP054	12	<50	<100	44	140	210	12	110	26
83JP055	<10	<50	<100	47	180	250	<10	120	23
83JP056	110	<50	<100	13	38	<10	43	<50	180
83JP059	45	<50	<100	21	95	210	25	550	180
83JP060	11	<50	<100	34	96	300	12	92	31
83JP061	11	<50	<100	40	71	220	10	130	26
83JP062	<10	<50	<100	17	120	62	16	87	36
83JP063	<10	<50	<100	47	200	240	15	100	33
83JP064	<10	<50	<100	38	120	310	<10	120	<20
83JP065	H	<50	<100	67	62	330	H	H	74
83JP066	870	<50	<100	50	170	470	<10	650	21
83JP067	<10	<50	<100	27	200	65	20	95	46
83JP069	>1,000	<50	<100	13	40	77	21	970	120
83JP070	150	<50	<100	15	130	<10	29	140	100
83JP072	<10	<50	<100	49	110	300	10	110	22
83JP073	<10	<50	<100	46	260	310	<10	82	21
83JP074	<10	<50	<100	53	560	380	12	170	22
83JP075	<10	<50	<100	18	230	42	32	67	140
83JP076	42	<50	<100	34	<15	260	<10	<50	34
83JP077	<10	<50	<100	63	50	330	H	H	48
83JP078	<10	<50	<100	11	<15	<10	49	300	200
83JP079	<10	<50	<100	19	150	35	23	91	47
83JP080	12	<50	<100	17	120	40	23	82	46

Table 2.--Results of rock geochemical analyses from the Penn Mine area, Calaveras County, Calif.--continued

Sample number	Pb-ppm s	Re-ppm s	Sb-ppm s	Sc-ppm s	Sr-ppm s	V-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s
83JP081	<10	<50	<100	18	39	38	23	100	45
83JP082	13	<50	<100	<10	<15	<10	11	56	110
83JP083	20	<50	<100	34	110	210	15	110	32
83JP084	<10	<50	<100	23	180	<10	43	110	120
83JP086	<10	<50	<100	<10	42	<10	45	61	120
83JP087	<10	<50	<100	<10	26	<10	36	50	150
83JP088	11	<50	<100	33	34	240	11	94	28
83JP089	<10	<50	<100	38	230	240	25	110	60
83JP090	<10	<50	<100	33	410	190	24	83	89
83JP091	<10	<50	<100	18	770	19	31	200	47
83JP092	<10	<50	<100	21	280	<10	31	98	110
83JP093	20	<50	<100	19	500	25	21	70	52
83JP094	<10	<50	<100	51	140	290	14	120	29
83JP095	27	<50	<100	38	260	280	13	180	34
83JP096	<10	<50	<100	45	110	280	<10	120	21
83JP097	11	<50	<100	20	140	17	25	140	92
83JP098	<10	<50	<100	43	210	230	10	76	22
83JP099	29	<50	<100	23	290	22	19	110	49
83JP100	17	<50	<100	43	120	350	10	170	<20
83JP101	11	<50	<100	27	310	76	29	150	110
83JP102	<10	<50	<100	12	63	<10	27	60	120
83JP103	180	<50	<100	11	47	<10	20	91	230
83JP104	<10	<50	<100	18	94	<10	49	210	140
83JP105	12	<50	<100	18	120	31	23	120	50
83JP106	<10	<50	<100	36	140	340	H	H	62
83JP107	14	<50	<100	46	110	220	32	140	130
83JP108	11	<50	<100	<10	40	<10	28	57	140
83JP109	<10	<50	<100	21	82	15	31	430	130
83JP110	110	<50	<100	<10	230	27	<10	<50	54
83JP111	<10	<50	<100	42	32	180	14	100	35
83JP113	51	<50	<100	<10	<15	<10	32	<50	150
83JP114	<10	<50	<100	36	100	310	17	250	44
83JP115	<10	<50	<100	40	110	370	23	190	52
83JP116	17	<50	<100	47	160	350	25	>1,000	62
83JP117	<10	<50	<100	23	170	13	34	110	120

Table 2.--Results of rock geochemical analyses from the Penn Mine area, Calaveras County, Calif.--continued

Sample number	Pb-ppm s	Re-ppm s	Sb-ppm s	Sc-ppm s	Sr-ppm s	V-ppm s	Y-ppm s	Zn-ppm s	Zr-ppm s
83JP118	21	<50	<100	16	<15	50	52	710	120
83JP119	<10	<50	<100	50	110	270	25	72	52
83JP120	<10	<50	<100	22	120	12	29	130	120
83JP121	15	<50	<100	49	130	360	23	65	48
83JP122	800	<50	<100	13	29	<10	41	96	150
83JP123	<10	<50	<100	15	210	<10	42	86	130
83JP124	<10	<50	<100	51	85	250	25	H	74
83JP125	<10	<50	<100	59	60	350	29	H	79
83JP127B	110	<50	<100	11	25	30	12	<50	110
83JP129	92	<50	<100	12	62	58	20	470	110
83JP130	<10	<50	<100	30	24	88	11	530	57
83JP131	H	<50	<100	17	42	56	14	H	150
83JP132	25	<50	<100	24	260	64	20	110	54
83JP133	<10	<50	<100	22	180	74	30	200	94
83JP134	<10	<50	<100	60	140	370	16	130	37
83JP135	<10	<50	<100	67	280	420	11	150	42
83JP137	<10	<50	<100	57	110	380	19	260	62
83JP138A	<10	<50	<100	<10	21	15	30	<50	160
83JP139	25	<50	<100	29	100	300	<10	230	44

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