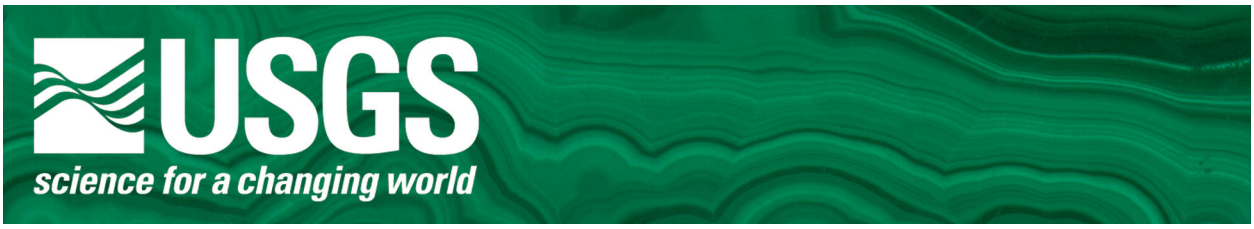

Geochemistry of Selected Mercury Mine-tailings in the Parkfield Mercury District, California

By James J. Rytuba[1], Boris B. Kotlyar[1], Gregg Wilkerson[2] *and* Jerry Olson[2]

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[1] U. S. Geological Survey, Menlo Park, California 94025
[2] U.S. Bureau of Land Management, Bakersfield, California

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Introduction

The Parkfield mercury district is located in the southern part of the California Coast Range mercury mineral belt and contains three silica-carbonate-type mercury deposits that have had significant mercury production (fig. 1). Mercury was first produced in the district in 1873, but the main period of production occurred from 1915–1922. Total production from the district is about 5,000 flasks of mercury (a flask equals 76 pounds of mercury) with most production coming from the Patriquin mine (1,875 flasks), and somewhat less from the King (1,600 flasks) and Dawson (1,470 flasks) mines. Several other small prospects and mines occur in the district but only minor production has come from them (U.S. Bureau of Mines, 1965). In 1969, Phelan Sulphur Company carried out mineral exploration at the King mine and announced the discovery of 55,000 tons of mercury ore with an average grade of 5.2 pounds per ton.

The King mine is located on federal land administered by the U.S. Bureau of Land Management. Several other parcels of federal land are present adjacent to other mines and prospects in the Parkfield district. An environmental assessment of mine sites on and adjacent to federal land was carried out to determine the amount of mercury and other trace metals present in mine wastes and in sediments from streams impacted by past mining.

Sampling and analytical procedures

Samples of mine wastes were collected and chemically analyzed to determine the concentration of mercury and other associated trace metals. Mine wastes that were sampled included calcines (mine tailings), waste rock, altered rock, and low-grade ore. Sediment samples were taken in streams impacted by the mercury deposits and past mining activity. Recent studies have shown that the formation and release of colloids from calcines is an important process, and that these fine-grained particles can be enriched in mercury (Shaw and others, 2001). In order to assess the importance of the release of fine-grained particles from calcines, sediment samples were selectively taken from dry pools where only very fine-grained sediment had accumulated.

Sample locations and description are listed in Table 1 and shown in figure 2. Stream sediments were dry sieved to minus 80 mesh. Trace and major elements in sediment, calcines, altered rock, and mercury ore were analyzed by ICP and ICP–MS. Mercury was analyzed by cold vapor atomic absorption after digestion by aqua regia. Gold was analyzed in selected samples by Atomic Absorption Spectroscopy (AAS) (table 1).

Geology

The mercury deposits in the Parkfield district formed when the American and Pacific plate margin changed from a convergent to a transform boundary at about 20 Ma in response to passage of the Mendocino triple juncture (fig. 1). The associated increase in the regional thermal anomaly resulted in the heating of carbon dioxide-rich connate fluids which migrated upward along regional faults and altered serpentinite to silica-carbonate rock (Rytuba, 1996). Silica-carbonate-mercury deposits formed early in the development of the regional thermal anomaly. The alteration mineral assemblage associated with these deposits is zoned and consists

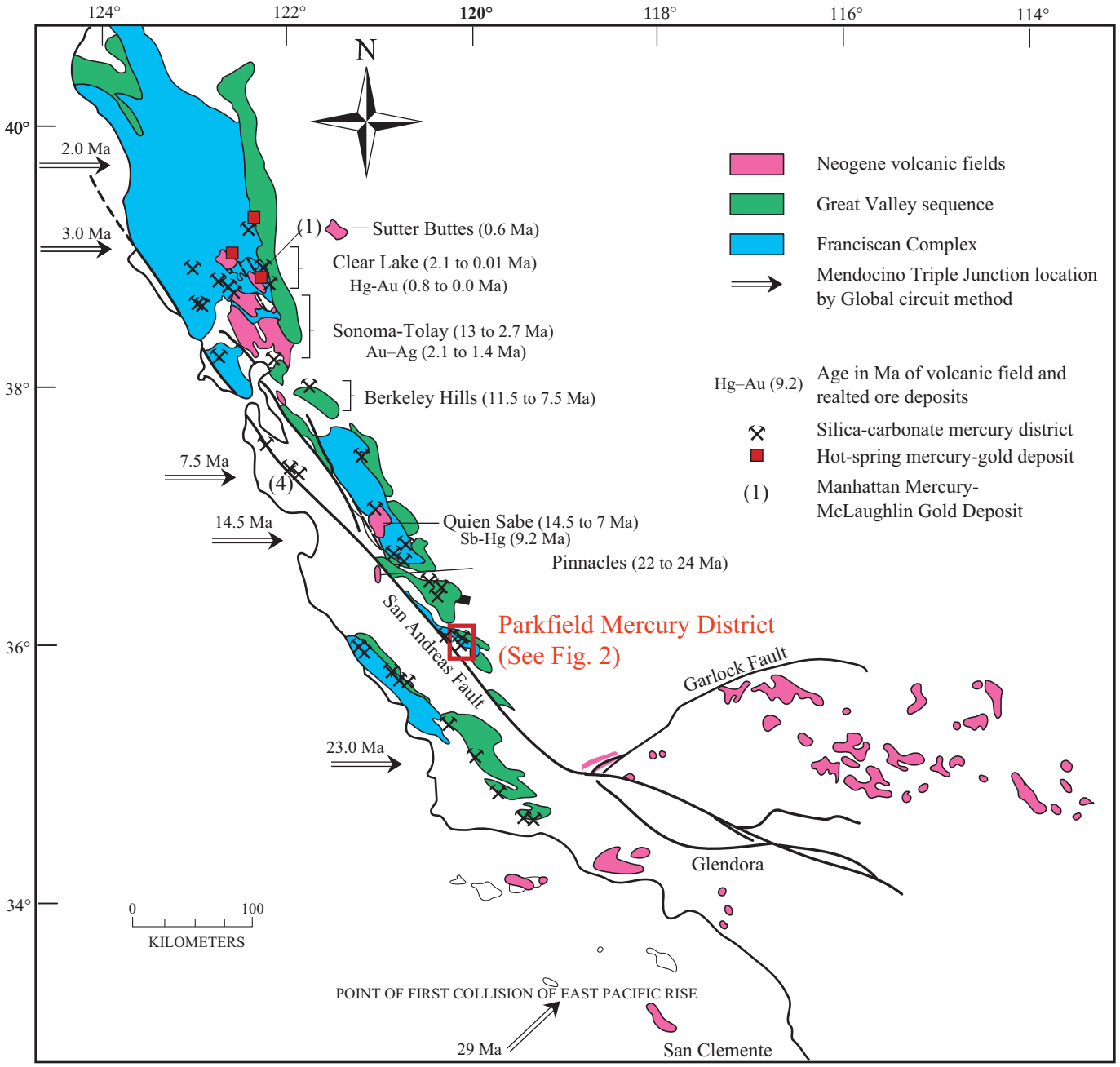

Figure 1—Location of the Parkfield mercury district in the California Coast Range mercury mineral belt. Modified from Rytuba (1996)

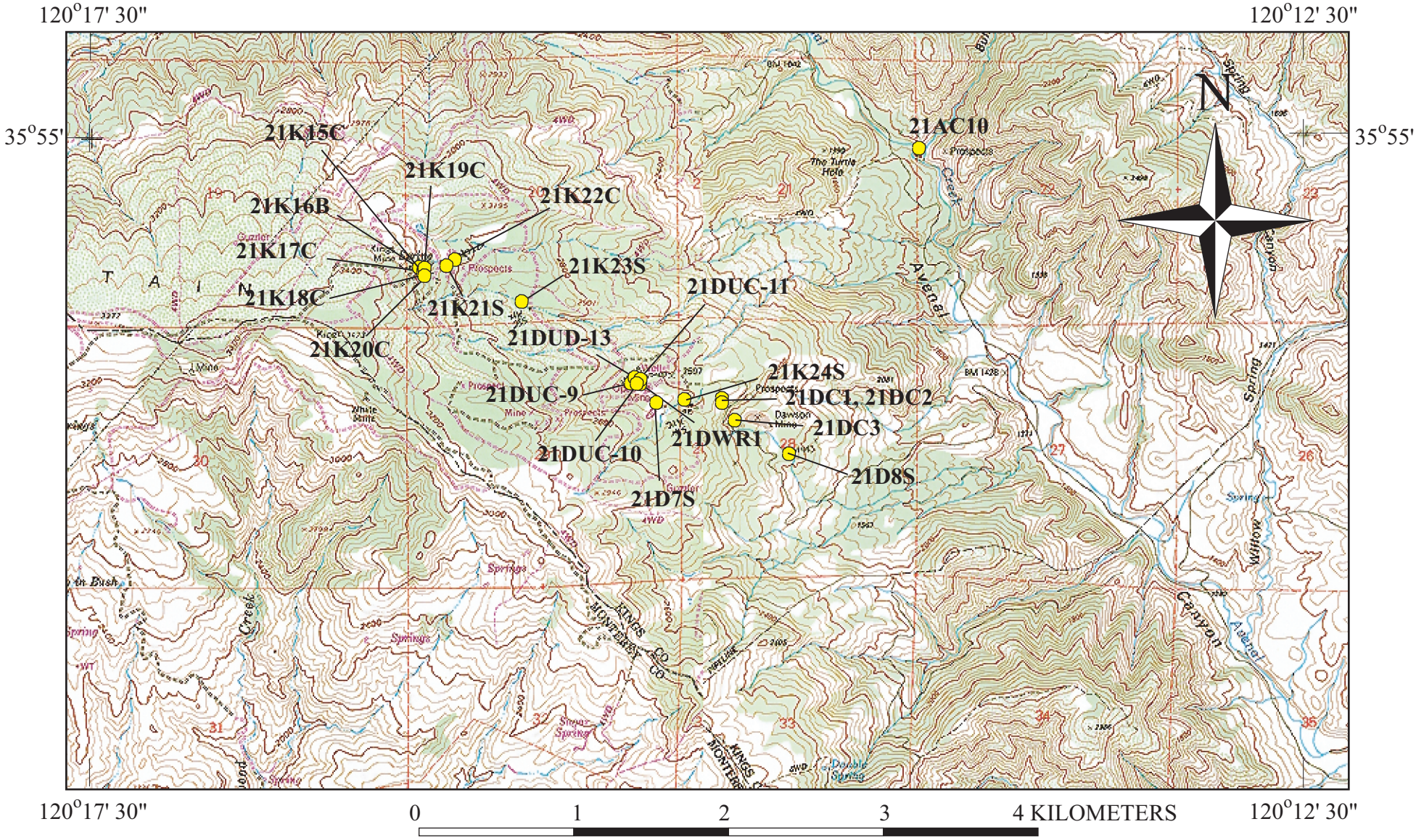

Figure 2—Locations of calcine, altered rock, and stream sediment samples at the King and Dawson mines, and Avenal Creek area, Parkfield mercury district

of a central core of quartz-chalcedony-magnesite-pyrite-marcasite that extends outward to a peripheral zone of magnesite-calcite-dolomite-magnetite. These deposits contain elevated levels of nickel, cobalt, chromium, and zinc that reflect their close association with serpentinite. Hot-spring-type mercury deposits formed late in the evolution of the regional thermal anomaly from low-temperature, meteoric-dominated, hydrothermal fluids. These mercury deposits formed at and in the near surface and have a trace metal association of lithium, boron, arsenic, antimony, gold, and tungsten. In some mercury districts the early formed silica-carbonate mineralization is cross-cut by later hot spring mercury gold mineralization (Rytuba, 1996). In the Parkfield district, hydrothermal fluid flow was focused along a fault zone that separates rocks of the Cretaceous Franciscan formation from sedimentary rocks of Cretaceous age (Bailey, 1942).

Serpentinite emplaced within this fault zone acted as impermeable barrier to the flow of hydrothermal fluids and the margins of the serpentinite were altered to a silica-carbonate alteration assemblage consisting of quartz, chalcedony, calcite, magnesite, and pyrite. Silica-carbonate alteration is well developed at the Patriquin mine where it is an important host rock for the mercury ores. At the King and Dawson mines, the mercury ores were hosted primarily in sedimentary rocks of the Franciscan formation, which are altered to an argillic assemblage. At the Dawson mine mineralized blocks of silica-carbonate rock are present in landslides that have developed in the serpentinite and altered Franciscan sedimentary rocks. Mercury ores at the Dawson mine locally contain petroleum in the central portion of quartz-carbonate veins and in vugs within silica-carbonate altered serpentinite. The primary ore mineral in all deposits is cinnabar but elemental mercury was present in significant amounts in high-grade ore bodies at the King mine. Pyrite is the primary sulfide mineral. Minor sulfur and barite have been reported at the Patriquin mine and manganese oxide is common in the ore zones (Bailey, 1942).

Geochemistry of Calcines, Altered Rock and Stream Sediments

Mercury ores at the King and Dawson mines were processed within retorts or rotary furnaces and these two different processes generated distinctly different calcines. Retorts were used in small mining operations where the ores were commonly hand sorted. Calcines produced from retorts are coarse grained, poorly sorted, and have a relatively small volume. Rotary furnaces produced large amounts of calcines that are well sorted and typically finer grained than that produced from retorts. The small piles of calcines at the Dawson and King mines were produced from retorts and are older than the larger calcine piles that were produced from more recent rotary furnace operations.

Mercury concentration in the King Mine area

The largest pile of calcines at the King mine is located on a moderately steep slope at headwaters of an unnamed drainage (fig. 2, sample sites 21K17–20C). The caclines were generated from a rotary furnace and were moved from the furnace site using ore carts on rail track (fig. 3). Erosion has partially removed the calcines and the rail tracks used for calcine disposal are now partly unsupported (fig. 4). The maroon to red brown calcines are well sorted, massively bedded, and are locally coated by a white efflorescent salt (likely epsomite, magnesium sulfate) (fig. 4). Mercury content of the calcines is moderately high ranging from 26

Figure 3—Overview of King mine area. Remains of retort and calcines in foreground, locations of samples 21K15C and 21K16B. Main calcine pile in upper part of photo, location of samples 21K17–20C.

Figure 4—Calcine pile at King mine, location of samples 21K17–20C. Mine car track above calcines indicates the amount of calcines removed by erosion. White material that coats calcine are efflorescent salts (area above hammer).

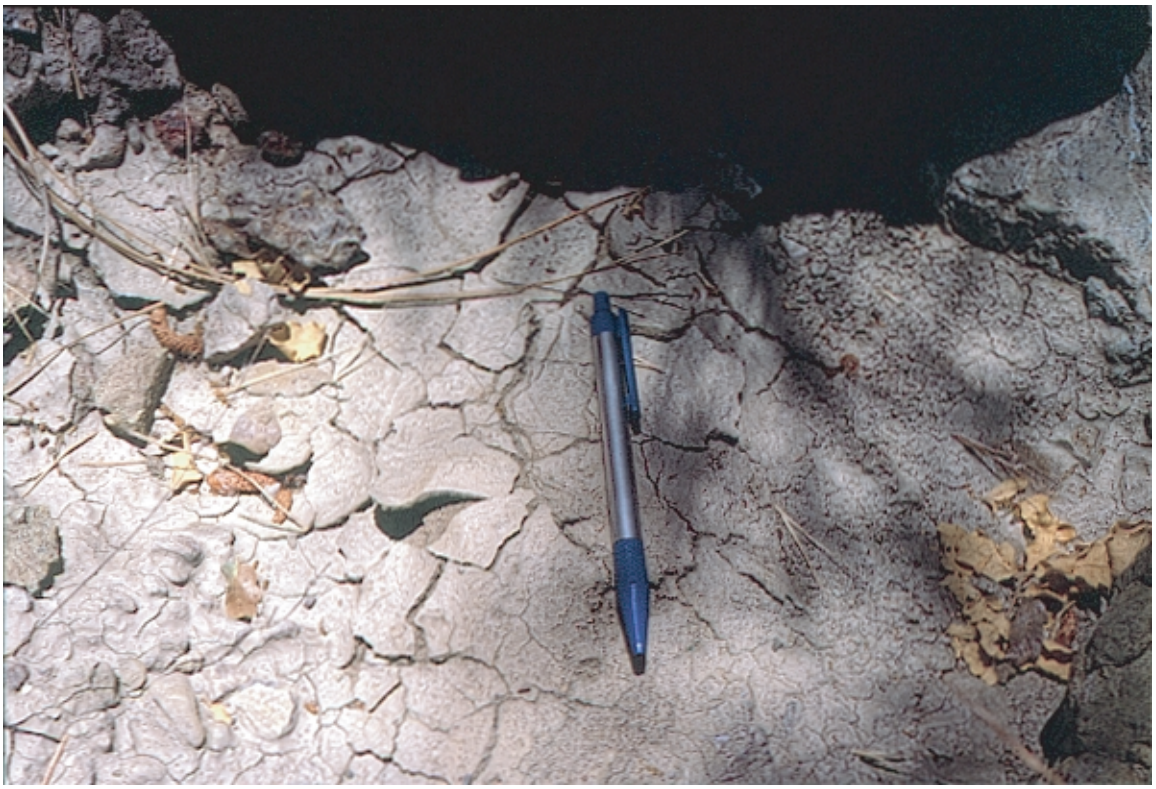

Figure 5—Fine-grained stream sediment accumulated in dry creek below main pile of calcines at King mine, sample location 21K21S. Sediment consists primarily of clay and colloidal size particles released from the calcine pile.

Figure 6—Three pipe retort at Dawson mine, location of sample 21DC1.

to 50 ppm (samples 21K17C–20C, table 1). Fine-grained, brown to black beds of condenser soot are interbedded with the calcines. These have relatively low mercury content indicating that the condenser soot, which can have high mercury content, has been reprocessed to recover mercury. Two other calcines piles are present at the King mine and were generated from the processing of ores in retorts. The smallest of these is present below the ore feed area and contains numerous bricks from the remains of a retort (fig. 2, sample site 21K15C, and 16B, fig. 3 foreground). The mercury content of this cacline is the highest in the mine area, 1,225 ppm (table 1). The other calcine pile also contains high mercury, 374 ppm (sample site 21K22C, Fig. 1) and has no vegetation on it. Minimal erosion of this material has occurred because of its location in an area of low topographic relief.

Sediment samples from sites downstream from the King mine indicate that mercury is being released from the calcines and transported during the wet season. The highest mercury concentration in fine-grained sediment, 58 ppm (sample 21K21S, figs. 2 and 5), is present in a small stream about 0.5 km below the largest calcine pile at the King mine. Mercury released from calcines is associated with fine-grained particles of clay to colloidal size. At distances farther from the mine site, the mercury concentration decreases to 2.5 ppm at about 1 km, and then to 1.5 ppm at a distance of 2 km.

Mercury concentration in the Dawson mine area

In the eastern part of the Dawson mine area, the remains of a three-pipe retort (fig. 6) are present and calcines from this retort contain high mercury, 3,100 ppm (sample 21DC1, table 1). Silica-carbonate ore in the area of the ore feed bin adjacent to the retort contains 347 ppm mercury. The largest calcine pile below these mine workings consists of coarse grained and poorly sorted calcine that was processed in the retort. The calcines have moderately high mercury, 148 ppm (sample 21DC3). In the eastern part of the Dawson mine an open pit mine has been developed in argillically altered rock. The pit is partially filled with water and a white unidentified amorphous precipitate is forming on the floor of the pond. At a depth of 2- 3 cm, a black unidentified amorphous precipitate is present. Fine sediment that accumulated in the outflow area of this open pit contains 46 ppm mercury. About 1 km downstream from the open pit and calcines piles, fine grained (less than 200 mesh) dry stream sediment (surface sample site 21DS8) has high mercury concentrations, 234 ppm, indicating that mercury has been released from the Dawson mine area.

In the western part of the Dawson mine area, the largest pile of calcines is present. The calcines are well sorted and were produced from a rotary furnace operation. The calcines have moderate mercury content ranging from 24 to 78 ppm mercury. Beds of condenser soot within the calcine pile have been reprocessed (sample sites 21 DUC 9–11, fig. 1). Silica carbonate ore from the ore feed bin adjacent to this calcine pile contains relatively low mercury, 128 ppm.

Trace and major element geochemistry of the King and Dawson mine areas

Trace elements that are present at high concentrations in the calcines at the King and Dawson mines include cobalt, chrome, manganese, magnesium, nickel and iron. Silica-

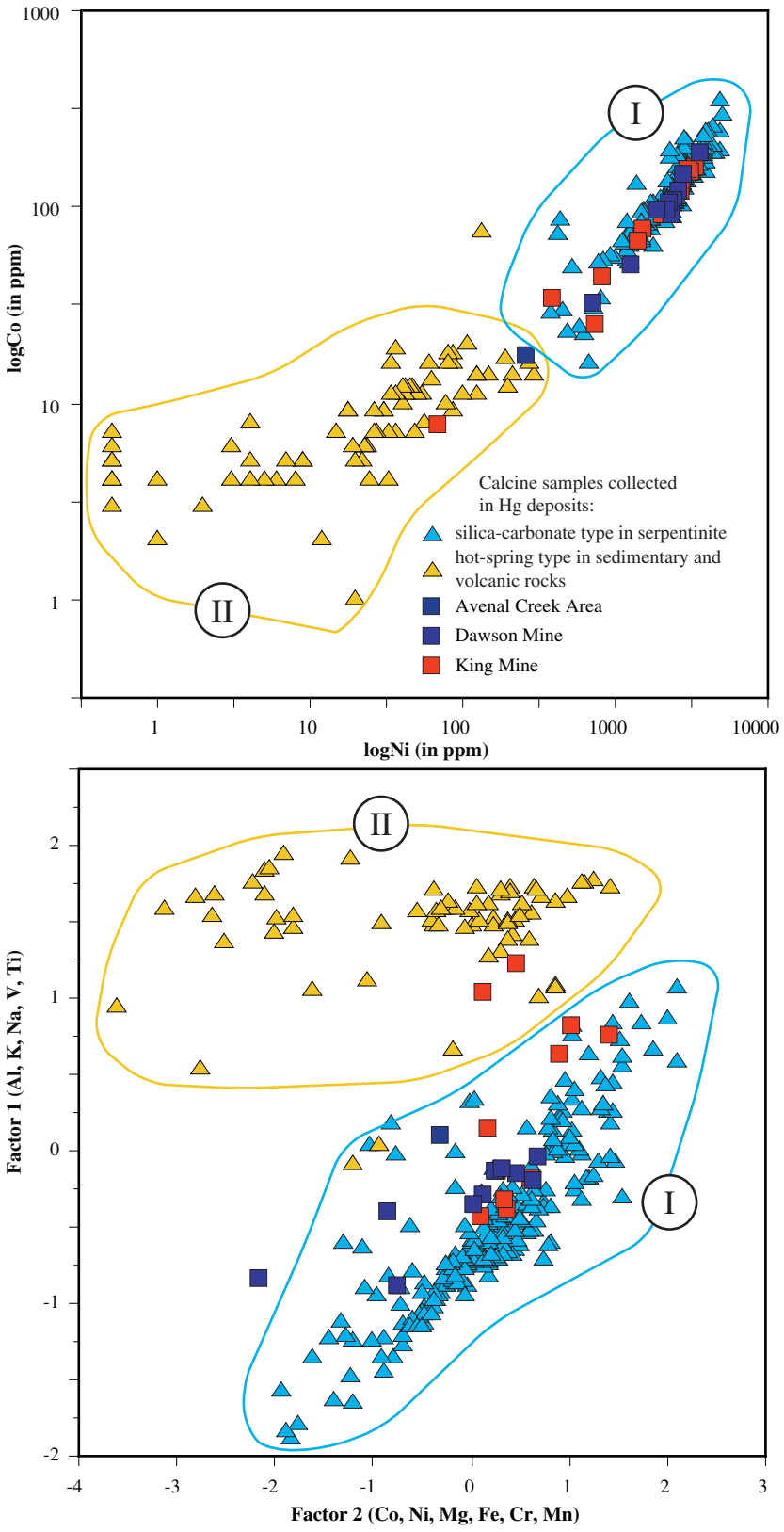

Figure 7—Silica-carbonate (SC) type mercury deposits associated with serpentinite have high nickel and cobalt concentration, field I, as compared to hot-spring (HS) type mercury deposits, field II. Other trace elements enriched in SC deposits define Factor 2 (Co, Ni, Mg, Fe, Cr, Mn) and discriminate these deposits from HS deposits which are enriched in Factor 1 elements (Al, K, Na, V, Ti). Samples from the Dawson and King and Avenal Creek areas plot in the field of silica-carbonate-type deposits but some samples from the King mine plot in the hot-spring-type field.

carbonate-type mercury deposits typically have high concentrations of nickel and cobalt that reflect the serpentinite associated with these deposits (field I in fig. 7). Nickel and cobalt concentrations of samples from the King and Dawson mines primarily plot in the field defined by other silica-carbonate-type mercury deposits from the Coast Range mercury mineral belt (field I, fig.7). Silica-carbonate-type mercury deposits also can be distinguished from hot-spring-type mercury deposits hosted in sedimentary and volcanic rocks with principal components Q–mode type of factor analysis (Davis, 191986). The analysis was based on 20 selected minor and major elements in 320 calcine samples from mercury deposits in the California mercury mineral belt and calcine chemical analyses from Parkfield mercury district listed in this report. Two of four major factors (78% of the variances of all elements) discriminate silica-carbonate-type from hot-spring-type mercury deposits. Silica-carbonate-type deposits plot in a field where cobalt, nickel, magnesium, iron, chrome and manganese are elevated as compared to hot-spring-type mercury deposits which have elevated levels of aluminum, potassium, sodium, vanadium, and titanium. Samples from the King and Dawson mines plot mostly in the field of silica-carbonate-type deposits (field I, fig. 7). However, some samples from the King mine plot in the field of hot-spring-type mercury deposits and many samples from both mines plot toward the hot-spring-field II (fig. 7). This suggests that both hot-spring-type mercury and silica-carbonate-type mineralized rocks are present. This type of relationship is present in other mercury districts such as the Knoxville and Sulphur Creek districts, where earlier formed silica carbonate mercury deposits are overprinted by later hot-spring-type mercury-gold mineralization (Rytuba, 1996). Other trace elements present at elevated concentrations in calcines at the King mine include antimony (180–350 ppm), tungsten (27–44 ppm), lithium (82–88 ppm) and thallium (22–60 ppm). At the Dawson mine these elements also are anomalous and the highest tungsten concentration, 312 ppm, is present in calcine from the eastern area (sample 21DC1). This suite of elements is characteristic of hot-spring-type mercury deposits. Of these elements, thallium is of most environmental concern because it is particularly toxic at relatively low concentrations, and can be present as phases that are highly soluble at ambient conditions.

Gold concentrations are consistently anomalous for all samples analyzed at the King and Dawson mine areas. Gold concentration ranges from 200 to 1,050 ppb in the King mine area (fig. 8, table 1). The largest calcine pile at the King mine (figs. 2 and 4, sample sites 21K17–21C) contains gold concentrations that are sufficiently high to be of possible economic interest, ranging from 400 to 1,050 ppb. The gold concentration of the calcines at the Dawson mine are lower than those at the King mine, (40 to 365 ppb) but are still highly anomalous. Presence of anomalous gold concentrations in the waste rock pile at the Dawson mine indicates that anomalous gold concentrations are not restricted to the mercury ore bodies. Further sampling would be required to delineate the amount of gold present in the calcines and to evaluate the extent of gold mineralization in the King and Dawson mine areas.

Avenal Creek Prospect

The remains of a mercury retort are present in Avenal Creek (fig. 2 sample 21AC10) and several prospects are located on the slopes of Avenal Creek. Calcines from this small mining operation have been eroded downstream. Large blocks of brecciated and silicified sedimentary

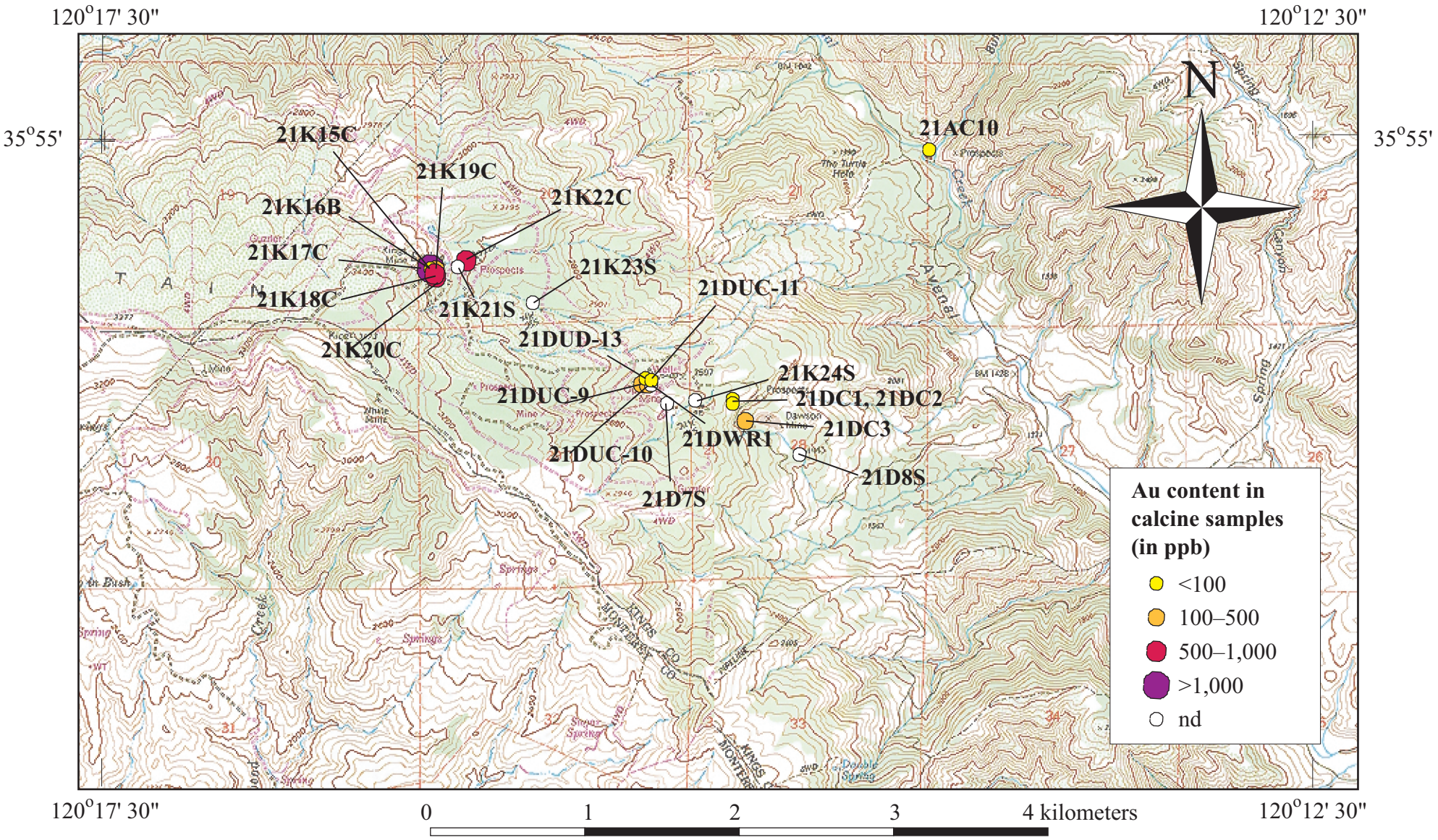

Figure 8—Gold distribution in calcine and altered rock samples at the King and Dawson mines, and Avenal Creek area

rocks are present in the creek and contain high concentrations of mercury, as much as 1,470 ppm. Other trace metals present at elevated levels include barium, manganese, and tungsten.

Conclusion

Mine wastes and altered rocks at the King and Dawson mines have moderate to high concentrations of mercury and other trace metals such as cobalt, chrome, nickel, and manganese that are typical of other silica-carbonate-type mercury deposits in the California Coast Range mercury mineral belt. In addition to mercury, the concentration of thallium in the calcines at the King mine is sufficiently high to pose an environmental concern. Mercury concentration in streams impacted by the King and Dawson mines indicate that mercury is being released from the calcines as fine-grained particles and transported from the mine sites during the wet season by intermittent streams. Mercury has accumulated in the bed load of the streams as fine-grained sediment that would be resuspended during high stream flow events.

The presence of anomalous to ore grade concentrations of gold and other trace metals such as antimony and tungsten indicate that the silica-carbonate mercury deposits at the King and Dawson mines have been overprinted by a hot spring mercury-gold hydrothermal system. Other mercury districts in the California Coast Range mercury mineral belt, such as the Knoxville and Sulphur Creek districts, have hot spring type gold-mercury deposits associated with silica-carbonate type mercury mineralization. In these mercury districts, early formed silica-carbonate-type mercury deposits are overprinted by later hot-spring-type gold-mercury mineralization (Rytuba, 1996). Further sampling at the King and Dawson deposits would be required to establish the extent and possible economic significance of the gold present in the calcines and the mercury deposits.

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Table 1 Location and geochemistry of mine wastes, bedrock, and stream sediment samples at the King and Dawson mercury mines, and Avenal Creek mercury prospect, Parkfield district, California

Sample Number	Longitude	Latitude	Description	Au, ppb	Hg, ppm	Ag, ppm	Al, %	As, ppm	Ba, ppm	Be, ppm	Bi, ppm	Ca, %	Cd, ppm
Dawson Mine Area													
21 DC-1	35 54.12'	120 15.48'	Calcine from 3 pipe retort	40	3100	0.08	0.53	4.8	89.5	0.9	0.01	0.21	0.22
21 DC-2	35 54.12'	120 15.4'8	Ore in sandstone	40	347	0.02	0.31	3	69.5	0.65	0.02	0.17	0.02
21 DC-3	35 54.12'	120 15.49'	Calcine	290	158	0.04	0.47	2.6	51	0.95	0.02	0.8	0.08
21D7S	35 54.08'	120 14.792	Fine sediment from open pit	Na	46.9	0.08	0.15	1.4	18	<0.05	<0.01	0.42	<0.02
21D8S	35 54.08'	120 14.792	Fine stream sediment	Na	234	0.02	0.52	2	148.5	0.2	0.05	0.46	0.12
21 DUC-9	35 54.186'	120 15.391'	Calcine	365	56	0.3	0.49	1.2	48	0.9	0.01	3	<0.02
21 DWR 1	35 54.186'	120 15.35'	Waste rock	5	59.7	0.12	0.29	<0.2	818	<0.05	<0.01	0.13	0.02
21 DUD-13	35 54.207'	120 15.376'	Ore silica-carbonate	10	128	0.02	0.1	0.6	11	0.2	0.01	0.61	<0.02
21 DUC 11	35 54.202'	120 15.35'	Calcine	90	23.9	0.12	1.14	2	84.5	0.2	0.04	1.55	0.08
21 DUC 10	35 54.186'	120 15.365'	Calcine	130	77.9	0.24	0.79	3	68.5	0.2	0.01	3.9	<0.02
King Mine													
21 K 15C	35 54.547'	120 16.251'	Calcine	205	1225	0.14	0.89	2.2	110	2	0.05	3.3	<0.02
21 K 16 B	35 54.547'	120 16.251'	Furnace brick	15	4.37	0.46	10.5	2	354	1.4	0.28	0.24	<0.02
21 K 17 C	35 54.535'	120 16.231'	Calcine	1050	38	0.56	0.63	1.6	29	0.85	0.02	3.5	<0.02
21 K 18C	35 54.528'	120 16.232'	Calcine	565	50.3	0.42	0.45	1.2	31.5	1.6	0.01	4.3	<0.02
21 K19C	35 54.546'	120 16.227'	Calcine	405	43	0.72	0.81	4.2	90	1.25	0.01	2	0.08
21 K 20C	35 54.518'	120 16.226'	Calcine	715	26.8	0.74	0.6	4.8	37	2	<0.01	4.2	0.02
21 K 22C	35 54.583'	120 16.097'	Calcine	590	374	0.14	0.46	3	47	2.5	0.01	1.35	0.1
21K21S	35 54.56'	120 16.132'	Fine stream sediment	Na	58.2	0.26	2.43	7	2080	0.65	0.14	1.15	0.1
21K23S	35 54.451'	120 15.801'	Fine stream sediment	Na	2.5	0.24	3.8	7.2	347	0.95	0.15	0.76	<0.02
21K24S	35 54.125'	120 15.154'	Fine stream sediment	Na	1.5	0.1	5.56	5.8	419	0.7	0.16	0.93	0.02
Avenal Creek Prospect													
21 AC 10	35 55.1'	120 14.1'	Brecciated ore	<5	1470	0.12	0.66	<0.2	366	0.2	0.19	6	0.22

All sample locations based on GPS measurements except those at Dawson mine area which are based on topographic map projection.

Table 1 cont'd

Sample Number	Ce, ppm	Co, ppm	Cr, ppm	Cs, ppm	Cu, ppm	Fe, %	Ga, ppm	Ge, ppm	Hf, ppm	In, ppm	K, %	La, ppm	Li, ppm	Mg, %
Dawson Mine Area														
21 DC-1	0.3	194	3870	3.85	50.7	15.4	1.9	0.45	1.2	0.015	0.05	<0.5	267	6.58
21 DC-2	0.38	98.2	1760	2.95	28.2	10.65	1.2	0.4	0.7	0.015	0.04	<0.5	459	4.42
21 DC-3	1.66	149.2	1340	2.15	16.6	7.11	2.25	0.25	0.3	0.005	0.06	0.5	233	9.27
21D7S	0.75	51.2	590	1.1	7.6	2.39	0.6	0.6	0.2	<0.005	0.05	<0.5	293	13.5
21D8S	7.53	110.3	1155	3.15	18.6	6.08	4.05	0.35	0.4	0.02	0.4	4	193.5	9.9
21 DUC-9	1.07	108.1	1625	2.3	14.2	5.28	7.45	0.25	0.1	0.015	0.08	0.5	154	9.46
21 DWR 1	0.26	93.6	1475	1.95	7.2	4.48	0.65	0.35	<0.1	<0.005	0.01	<0.5	168	>15.00
21 DUD-13	0.18	32.7	569	0.8	4.4	1.78	0.3	0.2	<0.1	<0.005	0.01	<0.5	17.8	4.5
21 DUC 11	5.87	121.9	1815	4.95	17.4	6.41	4	0.35	0.3	0.005	0.1	3.5	68.4	6.06
21 DUC 10	3.08	98.6	1550	3.1	14.8	5	4.55	0.2	0.2	0.01	0.11	2	111	10.25
King Mine														
21 K 15C	4.37	67.2	699	1.55	12.6	4.03	7.6	0.15	0.4	0.02	0.49	2	48.8	3.67
21 K 16 B	58.3	25.7	238	4.35	37.4	1.51	32.95	0.2	4.9	0.115	0.42	32.5	78.6	0.45
21 K 17 C	0.62	92.3	3030	2.7	20.4	7.96	11.95	0.25	0.1	0.01	0.07	<0.5	85.2	1.7
21 K 18C	0.49	123.9	1900	2.05	14.8	6.13	14.65	0.35	0.1	0.015	0.04	<0.5	82	4.48
21 K19C	1.79	153	2690	2.8	18.8	8.84	17.3	0.7	0.2	<0.005	0.09	1.5	86	4.11
21 K 20C	0.32	160.9	3060	3.05	21.6	7.61	18.65	0.4	0.1	0.01	0.03	<0.5	88.4	4.3
21 K 22C	1.03	156.4	1860	2.05	15.4	8.11	11.2	0.55	0.1	<0.005	0.06	0.5	105	2.88
21K21S	22.3	77.8	895	3.3	39.2	5.36	11.9	0.25	1.7	0.04	1.43	10.5	68.4	4.72
21K23S	26.9	45.1	518	0.65	33.8	3.92	8.7	0.25	1.9	0.045	1.03	12.5	41	3.7
21K24S	21.2	35	268	1.45	50.1	4.41	11.65	0.25	1.8	0.06	0.84	9	50.8	3.08
Avenal Creek Prospect														
21 AC 10	7.63	17.8	406	1.25	51.6	2.71	1.55	0.25	0.3	0.025	0.17	4	22.8	2.98

Table 1 cont'd

Sample Number	Mn, ppm	Mo, ppm	Na, %	Nb, ppm	Ni, ppm	P, ppm	Pb, ppm	Rb, ppm	Re, ppm	S, %	Sb, ppm	Se, ppm	Sn, ppm	Sr, ppm
Dawson Mine Area														
21 DC-1	930	64.93	<0.01	0.4	3510	120	4.5	3.9	<0.002	0.45	8.05	5	1.2	116
21 DC-2	355	2.35	<0.01	0.1	1820	70	11	3.1	0.002	0.63	6.05	1	2.4	78.2
21 DC-3	855	37.65	0.03	0.3	2710	100	5	3.6	0.006	0.12	56.8	1	0.4	107
21D7S	425	0.95	0.19	0.6	1230	100	10.5	2.1	<0.002	2.63	4	<1	0.2	61.8
21D8S	930	0.7	0.28	2.2	2400	190	6	18.2	<0.002	0.15	6.2	2	0.2	82.8
21 DUC-9	660	2.25	0.01	0.1	2240	60	2.5	4.2	<0.002	0.42	128.9	3	0.6	458
21 DWR 1	595	0.45	<0.01	<0.1	2280	20	0.5	0.9	<0.002	0.04	2.05	<1	<0.2	28
21 DUD-13	205	0.95	0.01	<0.1	690	<10	0.5	1.1	0.002	0.3	1.05	<1	<0.2	33.8
21 DUC 11	740	1.1	0.05	0.6	2530	70	2.5	7.6	<0.002	0.08	26.35	4	0.4	160.5
21 DUC 10	685	1.45	0.04	0.6	2160	70	3	6.1	<0.002	0.23	56.8	1	0.2	323
King Mine														
21 K 15C	670	1.35	0.09	0.7	1375	70	3	15.5	0.006	0.64	54.85	8	0.6	305
21 K 16 B	220	2.4	0.74	17.3	711	170	27.5	26.6	0.002	0.09	4.05	1	4.6	55.3
21 K 17 C	465	5.55	0.02	<0.1	1950	10	1.5	3.6	0.002	2.5	325.6	7	1	404
21 K 18C	850	2.2	0.01	<0.1	2630	30	1	2.7	0.008	1.83	183.35	15	1	450
21 K19C	855	2.05	0.02	0.3	3070	120	1.5	5.3	<0.002	0.1	199.6	17	0.6	143
21 K 20C	950	2.65	<0.01	<0.1	3280	30	1	3.3	0.002	0.63	340	11	1	505
21 K 22C	895	1.05	0.02	<0.1	2930	160	2.5	3.4	<0.002	0.08	166.95	14	1	136
21K21S	885	1.25	0.72	4.6	1480	290	10	46.9	0.002	0.13	70.45	1	0.8	124
21K23S	720	0.55	0.69	6	812	360	9.5	12.5	0.002	0.02	1.7	<1	0.8	62.3
21K24S	1055	0.7	0.75	4	372	270	10	17.2	<0.002	<0.01	1	<1	1	154.5
Avenal Creek Prospect														
21 AC 10	1150	0.65	0.03	0.5	251	250	5.5	9.5	<0.002	0.11	1.25	1	0.6	129.5

Table 1 cont'd

Sample Number	Ta, ppm	Te, ppm	Th, ppm	Ti, %	Tl, ppm	U, ppm	V, ppm	W, ppm	Y, ppm	Zn, ppm	Zr, ppm
Dawson Mine Area											
21 DC-1	<0.05	0.1	<0.2	0.01	4.54	<0.1	67	312	0.2	84	2
21 DC-2	<0.05	0.1	<0.2	<0.01	3.38	<0.1	38	200	0.2	64	1
21 DC-3	<0.05	0.2	<0.2	0.01	15.3	0.1	30	54	0.7	54	3
21D7S	0.95	<0.05	<0.2	0.01	1.5	<0.1	15	6.8	0.3	16	2
21D8S	0.55	<0.05	0.6	0.08	2.68	0.5	48	17	2.5	44	11.5
21 DUC-9	<0.05	<0.05	<0.2	0.01	25	<0.1	30	34.5	0.8	36	2
21 DWR 1	<0.05	<0.05	<0.2	<0.01	1.2	<0.1	25	6	0.3	26	0.5
21 DUD-13	<0.05	0.05	<0.2	<0.01	0.68	<0.1	8	8	0.1	8	0.5
21 DUC 11	<0.05	<0.05	1.2	0.04	5.72	0.3	43	21.8	3.1	36	7.5
21 DUC 10	<0.05	0.15	0.6	0.03	10.35	0.1	34	27	1.6	30	5
King Mine											
21 K 15C	<0.05	0.05	0.6	0.04	22.4	0.2	25	22.9	2	24	10
21 K 16 B	2.05	<0.05	26.4	0.63	0.46	4.7	635	4.5	31.2	82	161
21 K 17 C	<0.05	<0.05	<0.2	0.01	55.6	<0.1	48	44	0.4	38	2
21 K 18C	<0.05	0.15	<0.2	<0.01	46	<0.1	33	33.5	0.5	36	1.5
21 K19C	<0.05	0.15	0.2	0.02	20.3	0.1	57	27.6	1.5	48	3.5
21 K 20C	<0.05	<0.05	<0.2	<0.01	59.8	<0.1	45	38	0.5	48	1.5
21 K 22C	<0.05	<0.05	<0.2	0.01	24.5	<0.1	43	43.2	0.5	48	3.5
21K21S	0.85	<0.05	2.2	0.22	6.86	1.1	96	17.3	9	64	51.5
21K23S	0.85	<0.05	3.4	0.28	0.28	1.4	97	3	8.1	58	66
21K24S	0.75	0.25	3	0.37	0.28	0.9	140	2.1	12.7	66	54.5
Avenal Creek Prospect											
21 AC 10	<0.05	0.3	0.4	0.02	0.84	0.4	31	36.4	6.7	22	9