Vein Deposits Hosted By Plutonic Rocks in the Croesus Stock and Hailey Gold Belt Mineralized Areas, Blaine County, Idaho

By Ronald G. Worl *and* Reed S. Lewis

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Metric Conversion Factors

Multiply	By	To obtain
Miles	1.609	Kilometers
Feet	0.3048	Meters
Inches	2.54	Centimeters
Tons	1.016	Metric tons
Short tons	0.907	Metric tons
Troy ounces	31.103	Grams
Ounces	28.35	Grams

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Abstract

Mineral deposits in the Croesus and Hailey gold belt mineralized areas in Blaine County, south-central Idaho, are precious- and base-metal quartz veins that are part of a family of vein deposits spatially and temporally associated with the Idaho batholith. Historic production from these veins has been mainly gold and silver. Host rocks are older border phase plutons of the Idaho batholith that are characterized by more potassium and less sodium as compared to rocks from the main body of the batholith to the west. Host structures are reverse faults that have moderate to shallow dips to the northeast and high-angle normal faults that also strike northwest.

The veins are characterized by several generations of quartz and generally sparse sulfide minerals; gold is associated with late-stage comb quartz. The precious-metal ore bodies are in a series of shoots, each of which is as much as 8 ft in width, 400 ft in breadth, and 1,000 ft in pitch length.

Introduction

Numerous precious- and base-metal veins are in Cretaceous plutonic rocks in a belt that extends about 15 mi west-northwest from Bellevue, Idaho (figs. 1, 2). These veins are present in two mineralized areas, the Croesus stock and the Hailey gold belt (see Worl and Johnson, 1995 p. A2 for definition of mineralized areas). The Croesus stock mineralized area is defined by the outcrop of the Croesus stock (fig. 1) and is 1-5 mi west of Bellevue in the Mineral Hill mining district. The terrain is mountainous and is dissected by small drainages that flow north into Croy Creek and east into the Wood River. Elevations range from about 5,080 to 7,174 ft.

The Hailey gold belt mineralized area (fig. 2) is 5–15 mi west of Bellevue along both sides of the Croy Creek-Camp Creek road and essentially coincides with the Camas mining district. Most of the gold belt is in the Camp Creek and Rock Creek drainages, although some prospects are in the Croy Creek and Willow Creek drainages. The area is readily accessible along poorly maintained roads. The terrain is a dissected erosional surface of broad ridges, shallow valleys and gentle to moderately steep slopes. Elevations range from 5,200 to 6,400 ft.

Several mines in the Croesus mineralized area are described in Lindgren (1900). Umpleby and others (1930) described several mines and provided a geologic map of the Mineral Hill mining district, which includes the Croesus area. The first comprehensive study of the mines in this area was Anderson and others (1950). Most of the known information on the individual mines is from these reports.

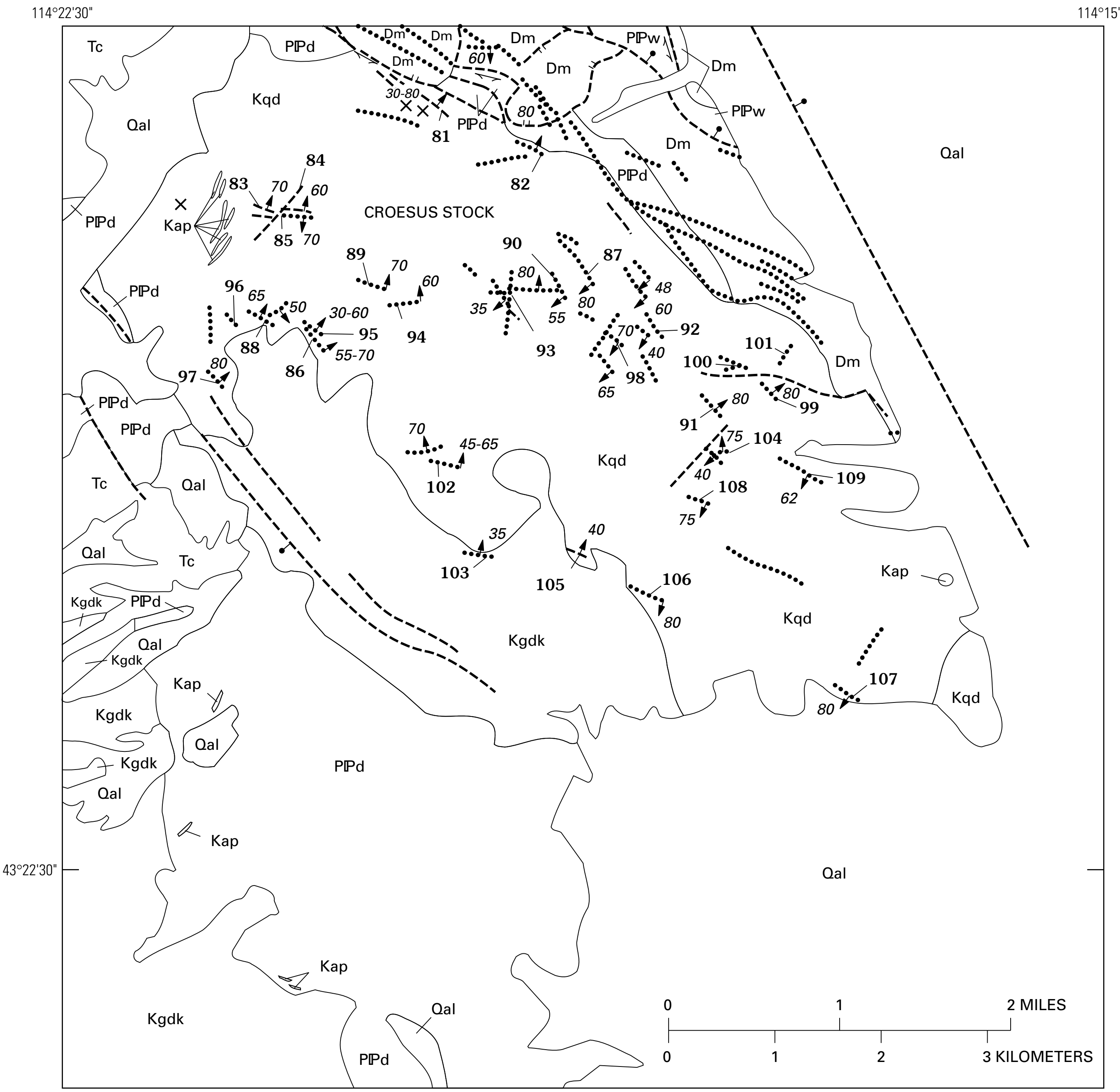
The Hailey gold belt mineralized area was briefly mentioned in Blake (1887), Eldridge (1895), and Lindgren (1900), but no comprehensive geologic study was conducted until Anderson and Wagner (1946). Schmidt (1961) mapped the Hailey gold belt and areas to the south and east. Most of the known geologic information on the area is contained in the latter two reports.

Historical Perspective

Past Production

Gold was first discovered in central Idaho in 1865 at the site of the Camas mine (fig. 2, site 63) in the Hailey gold belt, but there was very limited development until 1878 when high-grade silver ore was found near Hailey. Most of the mines in the two mineralized areas were discovered and developed during the next 10 years as targets for silver production. In the Wood River Valley, silver production has always been significantly greater than gold production. The year of greatest production for silver in Blaine County was 1885; 1,806,609 ounces of silver were produced and 4,129 ounces of gold. The year of greatest production of gold in Blaine County was 1888; 1,027,031 ounces of silver were produced and 18,789 ounces of gold (Lindgren, 1900, p. 207). Almost all gold production in the Wood River Valley has been from vein deposits hosted in Cretaceous plutonic rocks including those described in this report. Anderson and Wagner (1946) estimated that more than half of the recorded lode gold production of 178,278 ounces for Blaine County from 1874 to 1900 came from the Hailey gold belt.

The main period of mining was from 1879 to 1907, and there have been intermittent periods of development and mining to the present. Although records are incomplete an indication of commodities and the amount of production can be obtained from Lindgren (1900), Umpleby and others (1930), Anderson and Wagner (1946), and records of the U.S. Geological Survey (Spokane, Washington). These data are summarized in table 1. Mines known to have produced more than 500 tons of ore include the Star (fig. 1, site 82). Camas (fig. 2, site 63), Tip Top (fig. 2, site 62), Princess Blue Ribbon (fig. 2, site 50), and Croesus (fig. 1, site 84); others that probably produced more than 500



EXPLANATION

Qal	Quarternary surficial deposits
Tv	Basalt lava (Miocene)
Tc	Challis Volcanic Group, undifferentiated (Eocene)

Late Cretaceous intrusive rocks associated with the Idaho batholith

Kap	Aplite
Kgdk	Potassium-rich hornblende-biotite grandodiorite
Kgd	Biotite granodiorite (Late Cretaceous)
Kqd	Quartz diorite
PPw	Wood River Formation (Lower Permian to Middle Pennsylvanian)
PPd	Dollarhide Formation (Lower Permian to Middle Pennsylvanian)
Dm	Milligen Formation (Devonian)

Contact—Dashed where approximately located

High-angle normal fault—Dashed were approximately located; bar and ball on hanging wall

70 **Mineralized vein**—Showing dip

83 **Site of mine or prospect**—See tables 1 and 2

× **Prospect**—Vein expression unknown

Figure 1 (facing page). Geologic map with mines and prospects of the Croesus mineralized area, Blaine County, Idaho. Mapping in the Hailey gold belt area by R.S. Lewis. Mapping in the Minnie Moore area by P.K. Link and R.S. Lewis, assisted by J.B. Mahoney. Mines and prospects described in tables 1 and 2: 81, Magdelena mine; 82, Star mine; 83, Assault prospect; 84, Croesus mine; 85, Eclipse prospect; 86, Fair View prospect; 87, Sunrise prospect; 88, Red Hornet prospect; 89, Keystone mine; 90, Peterlin prospect; 91, Lees Gulch prospect; 92, Little Giant prospect; 93, Heine mine; 94, Hard Times prospect; 95, Comet mine; 96, McCoy mine; 97, Babe prospect; 98, Overland mine; 99, Lees Gulch East prospect; 100, Modoc Chief prospect; 101, Legal Tender prospect; 102, Lees Gulch West prospect; 103, Edres mine; 104, Chicago mine; 105, Utah-Bellevue mine; 106, Broken Wheelbarrow prospect; 107, Lark mine; 108, South Chicago prospect; 109, Hillside prospect.

tons of ore include the Golden Star (fig. 2, site 65), and Jumbo (fig. 2, site 54). Numerous other mines produced less than 500 tons of ore.

There has been only sporadic production and development work in these mines since the main period of mining. The Croesus mine (fig. 1, site 84) was in intermittent production until 1951 (Mitchell and others, 1991) and remains in a state of development. The Star mine (fig. 1, site 82) was operated intermittently until 1968, the Lark mine (fig.1, site 107) until 1943, the Comet mine (fig. 1, site 95) until 1918, the Edres mine (fig. 1, site 103) until 1961, the Heine mine (fig. 1, site 93) until 1915, and the Utah Bellevue (fig. 1, site 105) until 1922 (Mitchell and others, 1991). The Magdalena mine (fig. 1, site 81) was in operation from 1985 to 1987. The Camas mine (fig. 2, site 63) was under development from 1924 to 1928 and from 1932 to 1934, recorded production in 1940 (probably from tailings), 1942, and 1943 (Anderson and Wagner, 1946), and was active in 1989. Production was recorded from the Jenny R. mine (fig. 2, site 67) in 1924 (Umpleby and others, 1930), Happy Day mine (fig. 2, site 52) in 1945, Jumbo mine (fig. 2, site 54) in 1939 and 1940 (Anderson and Wagner, 1946). The Princess Blue Ribbon mine (fig. 1, site 50) has been worked intermittently since the early days. This property was active in 1989, but recent production is unknown. Several other properties have obviously been worked since the turn of the century, but there is no record of production.

Exploration Activity

Most recent exploration and development work in the Croesus stock and Hailey gold belt mineralization areas has sought precious metals, mainly gold. In addition to gold, silver, lead, zinc, and copper, the quartz veins in the Hailey gold belt have been explored in the past for molybdenum, tungsten, and uranium. Scattered occurrences of molybdenite and uraninite in the vein systems indicated a potential for deposits of these commodities, but results of this exploration activity are not known.

Geologic Setting

Vein deposits in the Croesus stock mineralized area are present in rocks of the Croesus stock and in the Hailey gold belt in rocks of the informal Hailey granodiorite (Worl and others, 1991). These rocks comprise older plutons of the Idaho batholith. The Croesus stock, and perhaps much of the batholith, is thought to be a west-dipping sill-like body. The attitude of the intrusive contact in the Minnie Moore mine (Link and Worl, in press) supports this concept.

The Croesus stock is the oldest of the plutonic rock groups in the southeastern part of the Idaho batholith (Kiilsgaard and others, in press). The Hailey granodiorite, which intrudes the Croesus stock, is probably slightly older than the biotite granodiorite of the main batholith to the west. Two K-Ar dates of 84 Ma on biotite from the Hailey granodiorite (Berry and others 1976; Lewis and others, 1987) are at present the best estimates of the minimum age of this unit.

The Croesus stock and the Hailey granodiorite intrude limestone, argillite, and sandstone of the Devonian Milligen and Middle Pennsylvanian to Lower Permian Dollarhide Formations (fig. 1), and inclusions of these sedimentary rocks were found in the plutonic rocks at several locations. The sedimentary rocks that contain garnet and diopside occur near intrusive contacts but sedimentary rocks that contain tremolite occur over larger areas. Parts of both formations are carbonaceous and constitute part of the black shale terrane to the north and east (Hall, 1983).

Aplitic and pegmatitic felsic dikes are widely distributed throughout the area but are most abundant in the Paleozoic sedimentary rocks close to the contact with rocks of the Croesus stock or Hailey granodiorite. The dikes are conspicuous and form ridges due to their superior resistance to weathering and erosion. They are generally less than 100 ft long and a few feet

EXPLANATION FOR FIGURE 2

Qal	**Quarternary surficial deposits**
Tv	**Basalt lava (Miocene)**
Tc	**Challis Volcanic Group, undifferentiated (Eocene)**
	Late Cretaceous intrusive rocks associated with the Idaho batholith
Kap	**Aplite**
Kgdk	**Potassium-rich hornblende-biotite grandodiorite**
Kgd	**Biotite granodiorite (Late Cretaceous)**
Kqd	**Quartz diorite**
PIPw	**Wood River Formation (Lower Permian to Middle Pennsylvanian)**
PIPd	**Dollarhide Formation (Lower Permian to Middle Pennsylvanian)**
Dm	**Milligen Formation (Devonian)**
	Contact—Dashed where approximately located
	High-angle normal fault—Dashed were approximately located; bar and ball on hanging wall
70	**Mineralized vein—**Showing dip
83	**Site of mine or prospect—**See tables 1 and 2
×	**Prospect—**Vein expression unknown

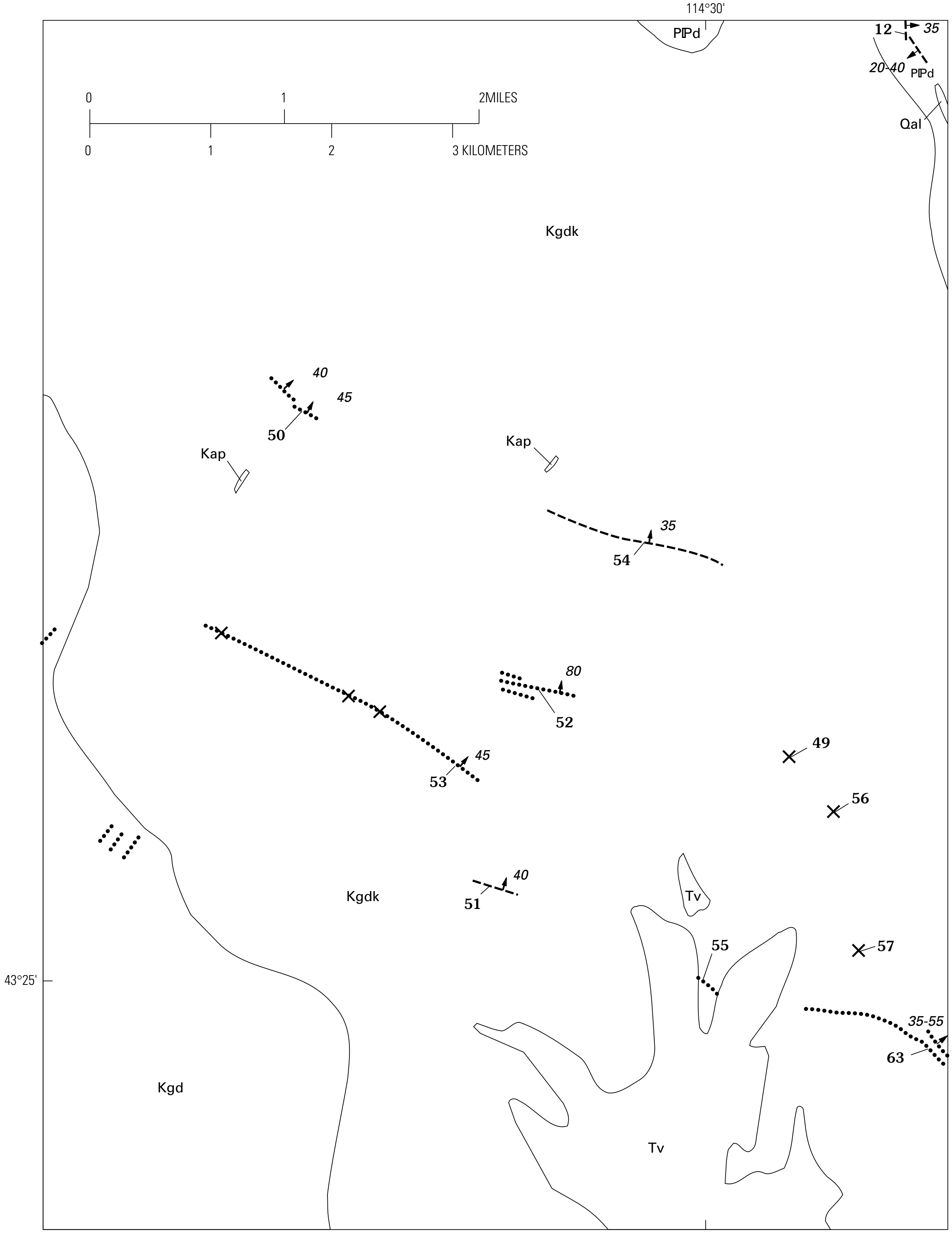
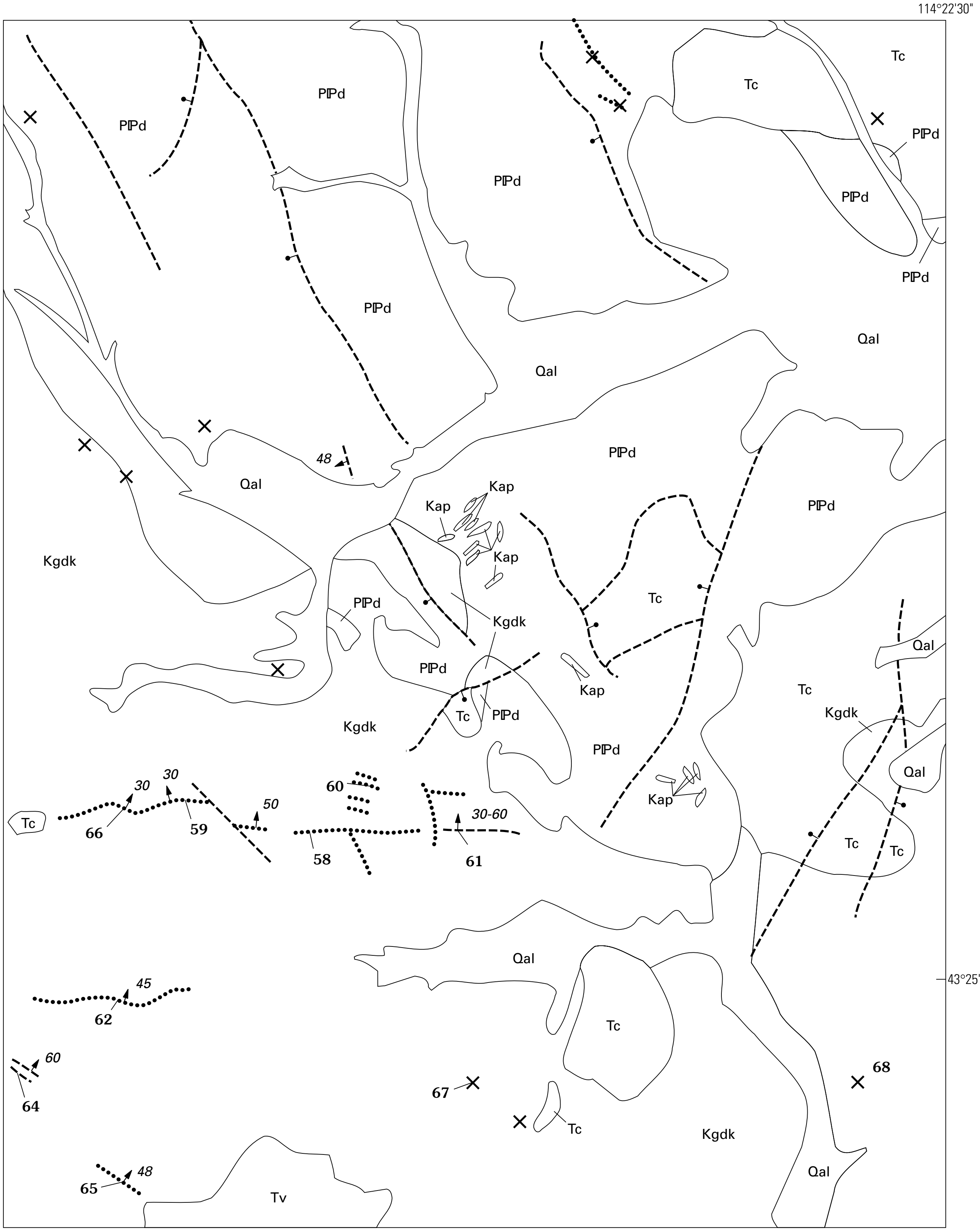


Figure 2 (above and facing page). Geologic map with mines and prospects of the Hailey gold belt mineralized area, Blaine County, Idaho. Mapping in the Hailey gold belt area by R.S. Lewis. Mapping in the Minnie Moore area by P.K. Link and R.S. Lewis, assisted by J.B. Mahoney. Mines and prospects described in tables 1 and 2: 49, Jackpot mine; 50, Princess Blue Ribbon mine; 51, Red Rock mine; 52, Happy Day mine; 53, Champlain mine; 54, Jumbo mine; 55, Burning Moscow - Fleming prospect; 56, Uranium Strike prospect; 57, Primitive Claims prospect; 58, Winner (Jennie Mae) prospect; 59, Rustler Claims (Donovan) mine; 60, Overlook prospect; 61, Oriental mine; 62, Tip Top mine; 63, Camas (Camas No. 2) mine; 64, Black Cinder mine; 65, Golden Star mine; 66, Treasure Vault (Hattie) mine; 67, Jenny R. (Montezuma) mine; 68, Diamond A mine.



thick. Most are aligned along northeast-trending fracture systems. These dikes are next to the quartz veins at several mine locations, but they probably are in different structural systems and, because in places they are cut by quartz veins, are older than the quartz veins.

Dark-gray to greenish-black lamprophyre dikes are along the same structures as the mineralized quartz veins and in places cut the quartz veins. The dikes are generally no more than 2 ft thick and tens of feet long. The age of these dikes is unknown but may be as old as Cretaceous.

Table 1. Production information for the Croesus stock and Hailey gold belt mineralized areas, Blaine County, Idaho.

[Sites are plotted by site numbers on figs. 1 and 2]

Site No.	Site Name	Latitude (N.), longitude (W.)	Production	Source of data[1]
49	Jackpot mine	43 26 4.13 114 29 31.3	Open cuts, pits	9
50	Princess Blue Ribbon mine	43 27 40.85 114 32 33.3	Property has a long history of production dating from the 1880's through 1988. Production in 1947–1949 was 285 ounces of gold, 3,421 ounces of silver, 2,017 in pounds of copper, 51,115 pounds of lead, and 44,366 pounds of zinc; in 1949–50 was 438 ounces of gold, 4,350 ounces of silver, 3,453 pounds of tungsten, 87,827 pounds of lead, and 55,540 pounds of zinc; and since 1902 has probably been several thousand tons of ore yielding silver, lead, zinc, copper, and gold	8, 4
51	Red Rock mine	43 25 28.52 114 31 22.2	Little if any production; shallow tunnels and a 60-foot shaft	2
52	Happy Day mine	43 26 20.59 114 31 6.19	Production of a few hundred ton yielded gold, silver, copper and lead. A new shaft was sunk in 1945. Tunnel, 60-ft long, 2 shafts, a 125-foot crosscut, and 90 ft of drift on the northern and middle of three vein systems	2, 4
53	Champlain mine	43 26 3.25 114 31 32.2	Reported to contain the highest grade gold ore in the Hailey gold belt. A few hundred tons of ore produced gold, silver and copper. Several tunnels and surface cuts	2, 4
54	Jumbo mine	43 27 5.95 114 30 20.0	Worked in the early days and also in 1939–40, extensive subsurface workings. No early production data but worked for both gold and lead. More recent production of a few hundred tons yielded gold, silver, copper, and lead	2, 4
55	Burning Moscow-Fleming prospect	43 24 57.33 114 29 58.3	Several caved tunnels, production unknown	2
56	Uranium Strike prospect	43 24 56.73 114 29 46.3	No data	5
57	Primitive Claims prospect	43 25 12.17 114 29 3.29	No data	6
58	Winner prospect	43 25 44.28 114 26 39.0	Several generations of trenches, shafts, and tunnels. Production unknown	2
59	Rustler Claims mine	43 25 50.80 114 27 18.1	100-foot deep shaft on west end and two tunnels on east end. A few hundred tons of ore yielded gold and silver	2, 13, 4
60	Overlook prospect	43 25 57.79 114 26 9.59	No data	12
61	Oriental mine	43 25 36.82 114 25 44.2	Workings caved. Known for silver rather than gold values, a few tens of tons of ore yielded silver, gold, and some lead and copper	2, 12
62	Tip Top mine	43 24 57.09 114 27 41.0	Active from 1887 to 1904 with values almost exclusively in gold; second in production in the Hailey gold belt only to the Camas mine; recorded production post-1904 was a few hundred tons yielding silver and lead. Two inclined shafts and several thousand feet of workings. Shaft on the west side of the ridge is 500 ft deep, and shaft on the east side is 1,000 ft deep	2, 3, 4

Table 1. Production information for the Croesus stock and Hailey gold belt mineralized areas, Blaine County, Idaho—*Continued.*

[Sites are plotted by site numbers on figs. 1 and 2]

63	Camas mine	43 24 45.86 114 28 34.4	Discovered in 1865 and recorded major production 1886–1898 and development work and some production in 1924–1928, 1932–1934, 1940–1946, and 1950–1951. Production prior to 1924 estimated at 1.24 million dollars. Tailings produced $78,000 in ore in 1940, and 3,200 tons of ore were shipped in 1942 and 1943. Production for 1886 as $45,168 in gold and $1,536 in silver and for 1888 as $13,224 in gold and $270 in silver (Lindgren, 1900). Recorded post-1902 production was several thousand tons of ore yielding significant gold, silver, copper, and some lead	2, 3, 4
64	Black Cinder mine	43 24 37.01 114 28 22.7	Prior to 1900 small bunches of oxidized ore were shipped; primarily sulfide-bearing ore did not yield to amalgamation. Inclined shaft 60º and drifts on unknown number of levels	2
65	Golden Star mine	43 24 3.11 114 27 43.1	Production data unavailable but one of the large mines in the area, probably ranking third in production behind the Camas and the Tip Top. 600-foot inclined shaft with about 200 ft of lateral workings on each level. Closed in 1907	2
66	Treasure Vault mine	43 25 48.26 114 27 39.5	Early production records unavailable; recorded post-1902 production of several hundred tons of ore yielded significant gold and silver and some copper, lead, and zinc. Several tunnels and 180-foot inclined shaft with 100-foot long drifts each direction on several levels	2, 4
67	Jenny R mine	43 25 3.91 114 26 9.11	Production from 1883 to 1908 tons yielded 1.45 ounces gold, 14,231.9 ounces silver, and 48,929 pounds lead. In 1924 a shipment of 10,934 pounds contained 0.14 ounces of gold per ton, 185.9 ounces of silver per ton, 19.5 percent lead, 14.5 percent zinc, and 0.9 percent copper	10, 4
68	Diamond A mine	43 24 33.93 114 23 4.55	Moderate-sized open pit and some older tunnels	4
81	Magdelena mine	43 28 56.91 114 19 41.7	Production data unavailable but was mainly gold. Mine was in operation 1985–1987	1
82	Star mine	43 28 48.27 114 18 59.0	Worked extensively in the early days then intermittently until 1968. Post-1902 production of several thousand tons yielded silver, lead, zinc, copper, and minor gold. 6-7 tunnels and 1 shaft	1, 4
83	Assault prospect	43 28 27.49 114 21 .21	Series of short tunnels	1
84	Croesus mine	43 28 27.03 114 20 48.8	Production 1906–1914, 1931–1934, and 1947–1951 of several thousand tons yielded significant gold and copper from the gold (Croesus) vein and significant silver and lead from the lead (galena) vein. This is the deepest mine in district at 860 ft; 8 levels and 10,000 ft of working	1, 4, 11
85	Eclipse prospect	43 23 23.85 114 20 55.4	No evidence that ore was encountered	16
86	Fair View prospect	43 27 47.27 114 20 39.1	Three tunnels and several cuts. May have taken some ore from a lens about 12 in. thick	1
87	Sunrise prospect	43 28 10.31 114 18 38.3	No data	1
88	Red Hornet prospect	43 27 55.22 114 21 1.04	No data	1

Table 1. Production information for the Croesus stock and Hailey gold belt mineralized areas, Blaine County, Idaho—*Continued.*

[Sites are plotted by site numbers on figs. 1 and 2]

89	Keystone mine	43 28 4.85 114 20 13.7	Recorded production (1883–1908) of 108.9 tons yielded 2.64 ounces gold, 5,115 ounces silver, 48,701 pounds lead, and 12,768 pounds copper	1
90	Peterlin prospect	43 28 6.68 114 18 52.7	Several cuts and caved tunnels	1
91	Lees Gulch prospect	43 27 31.76 114 17 42.1	No data	1
92	Little Giant prospect	43 27 50.45 114 18 13.6	Several cuts and old tunnels	1
93	Heine mine	43 28 1.05 114 19 12.3	Production (1911–1915) of 173 tons yielded 156 ounces gold, 182 ounces silver, and 3,340 pounds copper. Total production unknown but probably totaled several hundreds of ounces of gold and silver	1
94	Hard Times prospect	43 27 58.95 114 20 1.05	A few hundred tons of ore yielded silver, lead, zinc, and some gold and copper. Four tunnels and several open cuts	1, 4
95	Comet mine	43 27 52.14 114 20 36.9	Three main and several shorter tunnels. Production from 1883 to 1918 of 281.3 tons yielded 29.13 ounces gold, 11,912.20 ounces silver, 270,560 pounds lead, and 1,234 pounds copper	1
96	McCoy mine	43 27 51.30 114 21 14.1	A few tons of ore yielded gold, silver, copper, and some lead. Two tunnels: a lower tunnel 150 ft long and an upper tunnel 100 ft long	7, 4
97	Babe prospect	43 27 34.77 114 21 18.8	No data	1
98	Overland mine	43 27 48.24 114 18 28.5	180-foot shaft and a long crosscut. Reported to have produced from $30,000–125,000 worth of ore	1, 11
99	Lees Gulch East prospect	43 27 3.67 114 17 7.94	Numerous short tunnels and cuts	1
100	Modoc Chief prospect	43 27 41.05 114 17 38.9	A few tons of ore yielded silver, lead and zinc. Several tunnels	1, 4
101	Legal Tender prospect	43 27 44.49 114 17 14.8	No data	1
102	Lees Gulch West prospect	43 27 11.82 114 19 41.1	Several short tunnels	1
103	Edres mine	43 26 38.94 114 19 30.0	Intermittent production from 1902 to 1961 yielded silver, lead, zinc, and some copper and gold. Several hundred feet of crosscuts and drifts	1, 4
104	Chicago mine	43 27 13.21 114 17 46.4	A few tons of ore yielded silver, lead, zinc, and copper	1, 11, 4
105	Utah-Bellevue mine	43 26 39.48 114 18 35.9	Production in 1915, 1918, 1921, and 1922 of 207 tons of ore yielded 21.28 ounces gold, 9,384 ounces silver, 37,109 pounds lead, and 998 pounds copper	1, 11
106	Broken Wheelbarrow prospect	43 27 27.55 114 18 10.4	Several cuts and short tunnels	1
107	Lark mine	43 25 57.37 114 16 44.4	Intermittent production from the 1880s to 1943 of a few hundred tons of ore yielded silver, lead, zinc, and some copper and gold. Numerous cuts and several shafts	1, 11, 4

Table 1. Production information for the Croesus stock and Hailey gold belt mineralized areas, Blaine County, Idaho—*Continued.*

[Sites are plotted by site numbers on figs. 1 and 2]

108	South Chicago prospect	43 26 56.96 114 17 49.3	Several cuts and short tunnels	1
109	Hillside prospect	43 27 8.38 114 17 7.40	A few tens of tons of ore yielded silver, lead, and zinc. Several tunnels and two inclined shafts	1, 4

[1]Sources of data:
1, Anderson and others (1950)
2, Anderson and Wagner (1946)
3, Lindgren (1900)
4, Mitchell and others (1991)
5, Powers (1955a)
6, Powers (1955b,
7, Powers (1956)
8, Ross (1930)
9, Staley (1962)
10, Umpleby (1915)
11, Umpleby and others (1930)
12, U.S. Bureau of Mines (1977)
13, U.S. Geological Survey, Spokane Field Office, DMEA files

Scattered remnants of Eocene (Challis Volcanic Group) lava flows and volcaniclastic sedimentary rocks are present in the central and eastern parts of the Hailey gold belt and between the Hailey gold belt and the Cannonball area to the northwest. Miocene lava flows cover the Hailey granodiorite to the south, and a few erosional remnants of the flows are present throughout the area. In at least one area near the Golden Star mine (fig. 2, site 65), a mineralized zone extends beneath the Miocene lava flows.

The important structures in the mineralized areas are the low- to moderate-angle reverse faults and high-angle normal faults that host the quartz veins. This is in contrast to the area west and north in which shear zones containing large areas of highly fractured and altered rock are found in rocks of the Idaho batholith. To the east and north mineralized structures common in the black shale belt are similar to those in the Croesus and Hailey gold belt mineralized areas. The emplacement of the Croesus stock and Hailey granodiorite may have been guided by the low-angle west-dipping structures. Numerous small post mineralization faults offset the quartz veins a few inches to a few feet.

Host-Rock Characteristics

The Croesus stock comprises medium-grained quartz diorite containing zoned plagioclase and conspicuous biotite grains. The Hailey granodiorite is medium- to coarse-grained hornblende-biotite granodiorite that locally contains small phenocrysts of potassium feldspar. The granodiorite is characterized by large books of biotite, in contrast to the disseminated anhedral biotite that typifies the biotite granodiorite of the main batholith to the west. Quartz veins are common in both the quartz diorite and the hornblende-biotite granodiorite but not in the biotite granodiorite of the main phase of the Idaho batholith.

Lewis (1989) subdivided the plutonic rocks of the southeastern part of the Idaho batholith into a potassic suite and a sodic suite. Most mineral deposits in the Croesus stock and Hailey gold belt mineralized areas are in rocks of the potassic suite or in Paleozoic sedimentary rocks intruded by rocks of the potassic suite. Rocks of the Croesus stock and Hailey granodiorite belong to the potassic suite, and rocks of the biotite granodiorite are part of the sodic suite. Compared to the biotite granodiorite, the quartz diorite and hornblende-biotite granodiorite contain more potassium and less sodium.

Alteration

Alteration is generally restricted to zones a few inches to a few feet wide along the edges of quartz veins, quartz veinlets, and fractures. Feldspars and biotite are altered to an aggregate of sericite, chlorite, and calcite, but the original phaneritic texture of the rock remains. Locally the host rock is silicified and pyritized for an unknown distance away from the veins. There are a few locations in the western part of the Hailey gold belt mineralized area near the western contact with the Hailey granodiorite where the biotite granodiorite is sericitized, silicified, and iron stained. Narrow veins of chalcedonic quartz are present, but prospects are lacking. Three samples of this vein material (fig. 2, RSL 484, RSL 485, and RSL 486) contain less than 0.3 ppm Au.

Host Structures

Vein deposits in the mineralized areas are associated with quartz veins and pods hosted by large faults (figs. 1, 2). The zone of fracturing generally is 2–15 ft wide and locally is as wide as 40 ft (Anderson and Wagner, 1946, p. 8). Movement during vein formation is evidenced by several generations of brecciated and healed quartz in many of the veins. Some movement occurred after emplacement of the quartz veins and the lamprophyre dikes that are also hosted by the faults.

Two sets of faults host these veins. One set strikes N. 50°–80° W. and dips 30°–70° NE., showing considerable local variation in strike and dip. This set is prevalent in the Hailey gold belt and the western part of the Croesus stock. Slickensides indicating reverse movement with the hanging wall (northeast side) moving upward toward the southwest over the footwall are common. The other fault set strikes N. 0°–50° W. and dips 80° NE. to 40° SW. and is most common in the sedimentary rocks of the Minnie Moore and Bullion Gulch mineralized areas (Link and Worl, in press). Some faults of this set are present in the eastern part of the Croesus stock. Normal movement with a horizontal component is indicated for the N. 0°-50° W. set. Faults of both sets are poorly exposed except where they host the quartz veins that are cut by many post mineralization faults.

Weathering

Throughout the study area exposures of igneous rocks are very poor. Vein outcrops consist of large masses of iron-stained quartz with local malachite staining and small massive gossans after sulfide-rich zones. The only fresh samples of granodiorite are on some of the larger mine dumps. The zone of oxidation at the Tip Top mine (fig. 2, site 62) extends to 75 ft (Lindgren, 1900).

Mineral Deposits

Two types of plutonic rock-hosted vein deposits have been historically recognized in the Croesus stock and Hailey gold belt mineralized areas: gold-quartz veins and silver-lead veins (Lindgren, 1900; Umpleby and others, 1930; Anderson and others, 1950). These deposits correspond, respectively, to the gold and base-metal subtypes of the descriptive polymetallic quartz vein and lode mineral deposit model of Worl and Johnson (1995); all gradations between the two subtypes are present. Polymetallic quartz veins and lodes are the dominant vein type throughout the exposure of the Idaho batholith; most are of the gold subtype. The base-metal subtype is similar to and gradational with the polymetallic veins that are the dominant deposit type in the black shale terrane (Worl and Johnson, 1995).

Most veins in the Croesus mineralized area are more similar to characteristics of base-metal subtype end-member; those in the Hailey gold belt mineralized area are more similar to the gold subtype end-member (table 2). Deposits of both subtypes are present in several mines, sometimes in the same structure; the base-metal ores were introduced after the gold ores (Anderson and others, 1950, p. 10).

Polymetallic Quartz Veins and Lodes—Gold Subtype

Description

Deposits of the gold subtype in the study area are fissure fillings quartz veins aligned along two sets of faults: low- to moderate-angle reverse faults and steep- to moderate-angle normal faults. The veins are present as a series of lenses 1–15 ft wide and as long as 1,000 ft and in places are present almost continuously along the fault. In the reverse faults most quartz veins are present where the fault systems dip less than 50°; the widest bulges are where the dip is close to 30°, and, as the dip increases to 60°, the veins pinch out completely (Anderson and Wagner, 1946, p.11). In the normal faults the quartz veins are in the steeper sections and pinch as the dip flattens (Anderson and others, 1950, p. 12).

These gold subtype veins were mined in the past mainly for silver and gold (Ag/Au about 3:1) and for copper. Although they locally contain galena and sphalerite, they probably are not a potential source for lead and zinc.

Mineralogy and Texture

Quartz forms the great bulk of the veins, and in most deposits more than one depositional phase is represented. Most of the quartz is a early formed, coarsely granular variety. The youngest quartz phase is a coarsely crystalline comb variety that is present as fillings in fractures and breccias in the early formed quartz.

Sulfide minerals are generally scarce and consist mainly of pyrite, pyrrhotite, arsenopyrite, chalcopyrite, and locally galena and sphalerite. A few veins contain molybdenite (Anderson and Wagner, 1946) and others uraninite (Powers, 1955a), but apparently not in sufficient quantity to be considered a resource. Most of the disseminated sulfides are either in the early formed, coarsely granular quartz or in the altered host rock, and gold was apparently introduced with the late-stage comb quartz (Anderson and Wagner, 1946, p. 12). Siderite, galena, and sphalerite were deposited locally in openings in the late-stage comb quartz.

Orebodies

Gold-bearing zones are related to the distribution of the late-stage comb quartz and constitute only a small part of the quartz veins. The ore shoots are 200–400 ft long and 3–8 ft wide. “They appear to lie in or along the thicker parts of the quartz lenses, particularly along or close to the hangingwall” (Anderson and Wagner, 1946, p. 12). The vertical extent of the veins is unknown; the Camas mine (fig. 2, site 63) was worked below the 400-foot level and the Tip Top mine (fig. 2, site 62) to the 1000-foot level with no mention of a bottoming of the ore. The only reliable indication of the grade of the primary ore is some assay values for the 200-, 300-, and 400- foot levels of the

Camas No. 2 (fig. 2, site 63) mine given in Anderson and Wagner (1946, p. 17). Values of 0.23–0.6 ounces per ton gold and 0.8–2 ounces per ton silver were reported for bodies 2.5–5 ft wide and 45–195 ft long. Umpleby and others (1930, p. 128) reported values from the Croesus mine (fig. 1, site 84) ranging from about 0.15 to almost 10 ounces of gold per ton with shipping ore averaging 2–2.5 ounces of gold per ton and milling ore about 0.5 ounces of gold per ton. Most of the early production was from oxidized ore, and the reported high values were probably for oxidized ore. Much ore that was not amenable to concentration by the early stamp mills was apparently left in the mines.

The known deposits form a series of small ore shoots of a few thousand to a few tens of thousands of tons. The aggregate tonnage in the larger deposits may be less than 150,000 tons.

Polymetallic Quartz Veins and Lodes—Base-Metal Subtype

Description

The base-metal subtype comprises quartz-siderite-sulfide veins that are a combination of fissure filling and replacement of altered country rock. They are in the same sets of faults as the gold subtype but seem to be best developed in the steeper parts of the normal faults. Vein material is irregularly banded with alternating bands of sulfides and crushed quartz and siderite. Calcite fills interstices and later small fractures.

These veins were mined in the past mainly for silver, lead, and zinc but also produced some gold and, in one location, tungsten.

Mineralogy and Texture

Deposits of the base-metal subtype contain variable amounts of quartz, calcite, siderite, pyrite, and arsenopyrite gangue. Primary ore minerals are sphalerite, galena, tetrahedrite, and chalcopyrite. Native silver and hornsilver are also present, probably in the oxidized supergene ore. The veins are similar to and gradational with the lead-silver (polymetallic) veins of the Wood River Valley to the east and north. Relative to these lead-silver veins, they contain more sphalerite and pyrite (Lindgren, 1900, p. 206.)

Orebodies

Base-metal subtype ore bodies are apparently small, and the total amount of base-metal ore taken from most of these veins amounts to only a few hundred tons; the Croesus mine (fig. 2, site 84) recorded several thousand tons of production. Much of the recorded production was probably from secondarily enriched oxide zones. Assay values of supergene enrichment ore from the Jenny R. mine (fig. 2, site 67) were 258.6–1,062.7 ounces of silver (Umpleby and others, 1930). Grade of primary ore is unknown, but several mines recorded production averaging 42–47 ounces of silver and 0.02–0.10 ounces of gold (Anderson and others, 1950).

Nearby Vein Deposits in Plutonic Host Rocks

The Liberal mine and the Cannonball mine, northwest of the Hailey gold belt mineralized area, were also visited during this study. Both are hosted by Cretaceous biotite granodiorite of the Idaho batholith. The Liberal mine is near the headwaters of Liberal Creek in the SE1/4 sec. 20, T. 2 N., R. 15 E. A northwest-trending quartz vein 6–8 ft wide explored by underground workings, which are now caved. Based on the size of the dumps, underground workings were probably on the order of a few thousand feet. The amount of production is unknown. The vein was emplaced along, or immediately north of, a northwest-trending fault that continues 1.5 mi to the southeast.

The Cannonball mine, also known as the Bluebird mine, is along Cannonball Creek in the NE1/4 sec. 30, T. 2 N., R. 15 E. A quartz vein 3-6 ft thick trends north-south and dips about 60 to the east. The vein contains siderite, pyrite, galena, and sphalerite.

Genesis and Ore Controls

Plutonic-rock-hosted vein deposits in the Croesus and Hailey gold belt mineralized areas are part of a family of veins in this region that developed during the late stages of emplacement of the Idaho batholith (Worl and Johnson, 1995). They are similar in chemistry, mineralogy, form, and metal content and generally occupy similar structures. Although they are of about the same age, crosscutting relationships were observed.

The polymetallic quartz veins and lodes, both gold and base-metal subtypes, in these mineralized areas are thought to be mesothermal because of their physical character, although there are no fluid inclusion or other temperature data to support this assumption. The age of these veins was thought to be Tertiary by Anderson and Wagner (1946) because of the association of the veins with what they assumed were Tertiary lamprophyric dikes. Recent work suggests, however, that the lamprophyric dikes may be Cretaceous and related to the emplacement of the Idaho batholith. Eocene plutons and dikes are notably absent in these areas. Snee and Kunk (1989) reported Cretaceous to Paleocene ages for polymetallic quartz veins and lodes from the Atlanta and Rocky Bar districts, and the related lead-silver (polymetallic) veins of the Wood River Valley are thought to be Cretaceous (Hall, 1983). Biotite from the selvage zone of a mineralized quartz vein at the Diamond A mine (fig. 1, site 68) gave an $^{40}Ar/^{39}Ar$ age of 79.5 Ma (Larry Snee, written commun., 1991).

The differences between the gold and base-metal subtypes may reflect the source of the metal, source of the ore-forming fluids, host rock, or a combination of these factors. The base-metal subtype veins probably were deposited from solutions that had traversed through the Paleozoic black shale terrane, and the

Table 2. Description of mines and prospects of the Croesus stock and Hailey gold belt mineralized areas, Blaine County, Idaho.

[Mines and prospects are plotted by site numbers on figs. 1 and 2. First synonym is map number from Hustedde and others (1981) (for example 813), second synonym is the USGS Mineral Resources Data System record number (for example WO13678). Commodities are listed in approximate decreasing order of importance. Mineral deposit types 22C, polymetallic quartz veins and lodes, base-metal subtype; 22CX, polymetallic quartz veins and lodes, gold subtype. Locations and information sources are given in table 1]

Site No.	Site name (synonyms)	Deposit type	Commodities	Description
48	Croy Creek deposit 893 W013678	22CX	Ag, Cu, Au	Poorly exposed quartz vein containing chalcopyrite and locally stained with malachite. Analysis of a high-grade dump sample (RSL 459) yielded 0.01 ounces of gold per ton, 10 ounces of silver per ton, 14 percent copper, 5,400 ppm bismuth, and trace amounts of lead and zinc.
49	Jackpot mine 750	22CX	Au, Ag, Cu	Gossany quartz vein in sheared granodiorite.
50	Princess Blue Rib-bon mine 764 W013815	22C,22CX	Pb, Au, Ag, Cu, Zn	Prominent 1-10 foot-wide iron-stained quartz vein strikes N. 40º W. and dips 39º NE. Vein contains an abundance of pyrite as well as coarse-textured galena, chalcopyrite, and sphalerite. Siderite is a common gangue mineral. Granodiorite host rock is sericitized near the vein. Gold content is reported to increase with the amount of pyrite. Analysis of a high-grade dump sample (RSL 455) gave 1.4 ounces of gold per ton, 3.7 ounces of silver per ton, 4.2 percent lead, 0.016 percent zinc, and 0.075 percent copper.
51	Red Rock mine 775 W013896	22CX		Large 8-12 foot-wide quartz vein with bold outcrop strikes N. 70º–80º W. and dips 40º NE.
52	Happy Day mine 776 W013814	22CX	Au, Cu, Pb, Mo	Three parallel quartz veins generally strike west-northwest and dip steeply northeast. The northern vein, 8-10 ft wide, is mainly coarse-grained quartz that contains minor amounts of chalcopyrite and molybdenite. The middle vein, about 8 ft wide, strikes N. 80º W., dips steeply northeast, changing at depth to steeply southwest, and is within a 20-foot-side fracture zone. Analysis of a high-grade dump sample (RSL 469 yielded 1.6 ounces of gold per ton, 16 ounces of silver per ton, 1.9 percent lead, 0.13 percent zinc, 0.29 percent copper, and 110 ppm molybdenum.
53	Champlain mine 777 W013892	22CX	Au, Ag, Cu	A large poorly exposed quartz vein, as wide as 14 ft, strikes N. 60º W. and dips about 45º NE. The vein is cut by post-mineralization faults of unknown attitude. Ore contains an abundance of coarsely crystalline comb quartz and subordinate granular quartz and some disseminated sulfide minerals. Ore grade is reported to have been 0.5 ounces of gold per ton with some zones as high as 3.0 ounces of silver per ton.
54	Jumbo mine 778 W0130166	22CX	Au, Ag, Cu, Pb	Similar to other vein deposits in the gold belt in general west trend and low northeast dip; vein 3–4 ft wide.
55	Burning Moscow-Fleming prospect 781 W013890	22CX	Au	May be a westward continuation of the camas zone. The Burning Moscow vein (west of Camp Creek) is apparently 30 ft wide, trends N. 30º–50º W. and dips 30º NE. Composed mostly of early coarse-grained iron-stained quartz and later comb quartz on the hanging wall (NE). The Fleming vein (east of Camp Creek) is 3–4 ft wide and dips 40º NE.

Table 2. Description of mines and prospects of the Croesus stock and Hailey gold belt mineralized areas, Blaine County, Idaho—*Continued.*

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56	Uranium Strike prospect 786	22CX	U	Vein of limonite and manganese oxides, strikes east, highly radioactive, count 0.3 MR/Hr.
57	Primitive Claims prospect 787 W013797	22CX	U, Cu	No information.
58	Winner prospect 788 W013810 Jennie May	22CX	Au, Ag, Cu, Pb	Several parallel veins trend west-northwest. Vein west of gully is about 5 ft wide, strikes N. 80º W., and dips 40–50º NE. This vein is cut by a post-mineral fault trending N. 50º W. and dipping 30º NE. Vein is mostly coarsely crystalline second-stage quartz, heavily stained by reddish oxides of iron and lead. Galena and pyrite are present as disseminations in the vein and altered wallrock. Veins east of the gully are 1–5 inch-wide fracture fillings of drusy comb quartz with a little galena and chalcopyrite.
59	Rustler Claims mine 790 W013795 Donovan mine	22CX	Au, Ag, Pb, Zn, Cu, U	Vein composed of coarse granular and younger comb quartz is probably a continuation of the Hattie vein; trends west-northwest and averages 8 ft wide. One outcrop at the portal oxidized and contains reddish lead oxides and galena casts. Uraninite is present in parts of the vein, analyses of three channel samples, 2–2.5 ft long, gave 3.44 percent, 3.35 percent, and 1.62 percent.
60	Overlook prospect 792	22CX	W, Mo	No information.
61	Oriental mine 793 W013809	22C, 22CX	Ag, Au, Cu, Pb	Two vein systems about 800–1,000 ft apart. The northern system is a series of small veins or mineralized fractures containing seams and bunches of ore. One 6-inch-wide vein in this system strikes N. 60º W., dips 30º–65º NE. and contains a little galena, sphalerite, and tetrahedrite, and locally pyrite, and scattered malachite and azurite. Ore was apparently small high-grade oxidized pods enriched in silver. The southern vein strikes about N. 65º W. Quartz is coarse comb variety with some chalcedony.
62	Tip top mine 795 W013813	22C, 22CX	Au, Ag, Pb, Zn, Cu	Large conspicuous vein strikes N. 70º W. and dips 40º–50º NE. and can be traced for 1,800 ft. The vein is locally as much a s 40 ft thick of quartz, gouge, and altered wallrock, but productive part is 5–8 ft wide. Lamprophyric dike parallels vein. Vein is massive granular quartz cut by at least three overlapping stages of comb quartz in veinlets and veins as thick as 16 in. Late-stage comb quartz veinlets and veins are mainly in the hanging wall. Sporadic disseminations and masses of sulfides and in the massive granular quartz. The zone of oxidation extends to 75 ft. The amount of siderite increases downward, and some siderite ore contains as much as 0.5 ounce of gold per ton. In the lower levels siderite forms a filling between quartz crystals and in fractures and is cut by veinlets and disseminated grains of pyrite.

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63	Camas mine 796 W013794 Camas No. 2	22CX	Au, Ag, Pb, Cu, U	Two parallel vein systems, the Camas to the north and the Treasure Trove to the south, both with conspicuous outcrop. A third vein southwest of the Treasure Trove does not outcrop. The Camas vein is about 900 ft long, strikes N. 50º W., and dips 35º–55º NE. The Treasure Trove is 3,000 ft long, strikes N. 50º–70º W. and dips 35º–55º NE. The Camas vein is a single lens, whereas the Treasure Trove is composed of three almost continuous lenticular bodies. The veins are composed of early granular and late comb quartz and in places contain scant sulfides. Lamprophyric dikes generally parallel but cut the quartz veins. There has been extensive post-mineralization faulting along structures that generally parallel, but cut the veins. Ore bodies, restricted to the younger comb quartz, are 2.5–5 ft thick and are throughout the system along both the foot and hanging walls. Examples of ore bodies in the Camas vein are a 105 foot length and 4 foot thickness on the 200 foot level averaging 0.33 ounces of gold per ton and 1.39 ounces of silver per ton; a 195 foot length and 5 foot thickness on the 300 foot level with values as high as 0.45 ounces of gold per ton; and a 110 foot length and 3 foot thickness on the 400 foot level averaging 0.60 ounces of gold per ton and 2 ounces of silver per ton. In the Treasure Trove vein system examples of ore bodies are a 60 foot length and 2.5 foot thickness on the 400 foot level averaging 0.23 ounces of gold per ton and 0.8 ounces of silver per ton; 70 foot length and 2 foot thickness on the 400 foot level averaging 0.48 ounces of gold per ton and 1.91 ounces of silver per ton; and a 185 foot section 4.5 foot in thickness averaging 0.3 ounces of gold per ton and 1.09 ounces of silver per ton. Lead and silver ore is only present within one of the lamprophyre dikes as small lenses and bunches of galena.
64	Black Cinder mine 797 W013812	22C, 22CX	Au, Ag, Pb, Zn, Cu	Two veins about 40 ft apart strike west-northwest and dip 60º NE. Outcrop of one vein is 1–5 ft in width of rusty quartz. Ore pile on the dump is galena, sphalerite, and chalcopyrite in a siderite gangue. This ore is reported to average 0.40 ounces of gold per ton.
65	Gold Star mine 798 W013811	22CX	Au, Cu	Quartz vein strikes N. 57º W., dips 48º NE. and shallows with depth. Vein can be traced for several hundred feet on each side of the shaft before it passes under basalt. Width is about 5 ft at the surface and thickens with depth. There were two ore shoots each about 4 ft wide and 100 and 120 ft long. Ore is reported to have averaged 0.5 ounces of gold per ton. Quartz is mainly the coarse granular variety cut by seams of coarsely crystalline comb quartz.
66	Treasure Vault mine 832 W013680 Hattie	22CX	Au, Ag, Pb, Cu, Zn	Series of quartz lenses or thick wedges along low-angle fault system that strikes west and dips about 30º NE. The fault and quartz lenses can be traced for more than a mile. The lenses, 6–10 ft or more thick, are composed mainly of older coarse quartz cut by younger comb quartz veins as thick as 1 ft. The older quartz contains pods and lenses of galena and sphalerite, whereas the younger quartz contains disseminated pyrite. One ore body is reported to be about 200 ft long. Two small mineralized fracture zones that are parallel to the Treasure Vault vein are about 1,200 ft to the north.

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67	Jenny R. mine 801 W013683 Montezuma	22C	Ag, Pb, Zn, Au	Vein material is composed of irregularly alternating bands of sulfides and cursed quartz. Calcite fills interstices and coats open surfaces. Wallrocks are silicified and sericitized, and the ore is partly a replacement of the altered intrusive rock. Five assay samples of oxide ore contained trace to 0.29 ounces of gold per ton, 285–1,062.7 ounces of silver per ton, and 0.4–21.6 percent lead.
68	Diamond A mine 803	22CX	Au, Ag, Cu	Numerous small (0.5–8 in.) Quartz veins strike N. 50º–80º W. and dip steeply southwest. Host granodiorite has 0.5-3.0-inch alteration selvages of course secondary muscovite and quartz. Veins contain rare tenorite (?) after chalcopyrite and are locally stained with malachite. Subhorizontal faults displace the veins. Analysis of a 6-inch chip sample (RSL 451) across high-grade part of one vein yielded 0.01 ounces of gold per ton, 2.3 ounces of silver per ton, 5.6 percent copper, and trace amounts of lead and zinc.
81	Kagdelena mine 202 W013661	22CX	Au, Cu, Ag, Pb, Zn	A persistent vein several thousand feet long is hosted in a 6-foot wide fault zone that trends N. 45º–58º W. and dips 70º–80º NE. The vein, composed mainly of white quartz, some coarsely crystalline pyrite and arsenopyrite and locally minor chalcopyrite, is generally 1–2 ft wide and locally 3–4 ft wide.
82	Star mine 203 W013659	22C	Ag, Pb, Zn, Cu, Au	Two veins 90 ft apart, each in a fissure also occupied by a highly bleached lamprophyric or silicic porphyritic dike. Ore is on either side of the dikes but not within. Veins strike N. 70º–80º NE. at surface and 45º NE. in 6th and 7th levels. Southern (footwall) vein was the most productive; ore zone was as wide as 6 ft and mostly galena and lesser amounts of sphalerite, chalcopyrite, tetrahedrite an d pyrite. Ore shipments in 1928 contained 12– 65 percent lead, 0.13–0.65 percent copper, 3–13 percent zinc, and 44–140 ounces of gold per ton. Veins were mainly in quartz diorite, although some ore was reported from a quartz-siderite vein in argillite.
83	Assault prospect 206 W013549	22C	Ag, Pb	Workings aligned along a vein trending N. 70º–80º W. and dipping 60º–70º NE. Vein is 4–7 ft of white quartz.
84	Croesus mine 207 W013668	22C, 22CX	Au, Pb, Ag, Cu	The first 600 ft of mine was mined for gold and the lowest 200 ft for silver and lead. Mine contains two distinctly different types of veins. The two vein types trend about west; the gold (Croesus) vein dips near vertical at the surface and curves in 200 ft of depth to 70 S, and the galena vein dips about 68º N. The gold vein (Croesus) contains ore lenses of varied sizes and shapes with the long axes usually included steeply east. The largest shoots, 100–187 ft long and 4–5 ft wide, are composed of quartz, pyrite, chalcopyrite, arsenopyrite, and pyrrhotite and minor siderite and galena. Direct shipping ore was $40–50 ton and milling ore $10–12 ton. The lead (galena) vein is composed of galena, some sphalerite, quartz, pyrite, chalcopyrite, and tetrahedrite in a siderite gangue and contained 5–20 percent lead with 1 ounce of gold for each 1 percent of lead, and 0.25–0.35 ounces of gold per ton.

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85	Eclipse prospect 209 W013548	22C, 22CX	Ag, Pb	Vein/fracture zone trends easterly, dips 70º N., and is cut off by a fault that strikes N. 40º E. and dips 60 º SE.
86	Fair View prospect 210	22C	Pb, Ag, Au	Workings follow a N. 30º–50º W. trending fracture system that dips 55º–70º NE. Quartz and siderite veins 6–12 in. wide in the fracture system contain a little pyrite and coarse cubic galena.
87	Sunrise prospect 211 W013652	22C, 22CX	Pb, Ag, Au	Two small lodes strike N. 30º W. The western vein is a siderite lode about 2 ft wide that dips 80º SW and eastern vein is composed of quartz, pyrite, and arsenopyrite.
88	Red Hornet pros- pect 214 W013550	22C	Pb	Several quartz veins in fracture zones strike northeast or northwest and dip southeast or northeast. The fracture zones are about 4 ft wide, and the quartz veins are generally less than 12 in. wide. Comb quartz was found in one northeast-trending vein. A younger basic dike crosscuts one of the veins.
89	Keystone mine 215 W013671 E.N. Stone property	22C	Pb, Ag, Cu, Au	Vein strikes N. 69º W. and dips 70º NE. Ranges from a few inches to 4 ft in width. Ore was in pockets that decreased in size and number with depth.
90	Peterlin prospect 216 W013651	22C	Pb	Vein strikes N. 87º E., dips 80º N., and is approximately 12–14 in. wide. This consistent vein is younger than, and crosscuts, the Heine vein. Only oxidized material is exposed. A second vein strikes N. 30º W and dips 75º SW.
91	Lees Gulch prospect 217 W013568	22C	Ag, Pb	Several veins may be present, but only one was exposed in 1950. It contained about 12 in. of oxidized siderite. The fissure zone strikes N. 50º W. and dips 60º NE.
92	Little Giant pros- pect 220 W013649	22C	Pb	Several fissure zones strike N. 35º–55º W. and dip 40º–60º SW. Zones about 4 ft wide and contain lenses and bunches of siderite. Galena was found on the dump.
93	Heine mine 222 W013650 Golden Bel	22C, 22CX	Au, Ag, Cu	Vein as wide as 20 in. composed of quartz, pyrite, and some arsenopyrite and chalcopyrite follows a 4–6 foot wide fracture zone that strikes N. 30º–80º W. and dips 35º–60º SW. The vein has local minor offsets by northeast-trending faults. Gold is reported to be present with the sulfides and to average about 0.9 ounces of gold per ton. Gold values apparently decrease with depth.
94	Hard Times pros- pect 223 W013547	22C	Ag, Pb, Zn, Cu, Au	Siderite vein with quartz and galena strikes N. 80º E., dips 60º N., and follows a 4–5 foot wide fracture zone. Quartz-pyrite vein material on the dump suggests the presence of a quartz-pyrite vein.
95	Comet mine 224 W013547	22C	Pb, Cu, Ag, Au, Zn	Sulfide-bearing quartz-siderite vein follows a N. 50º–60º W.-trending fracture system that dips 30º–60º NE. Post-mineralization lamprophyre dikes both follow and crosscut the fracture zone. The ore consists of a cemented breccia of galena, sphalerite, pyrite, and chalcopyrite. Gangue is mainly quartz and some siderite.

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96	McCoy mine 225 W013832	22CX	Au, Ag, Cu, Pb	A small, 1 in.–1 ft wide, gold-quartz vein in diorite strikes N. 50º W. and is almost vertical. Considerable limonite stain and some copper stain is associated with the vein.
97	Babe prospect 226 W013551	22C	Pb, Ag, Cu	A N. 30º W.-trending almost vertical fracture-fissure zone in a body of aplite-pegmatite hosts quartz lenses. The 6-foot wide zone has 10 in. of quartz on one wall and 4 in. on the other. The quartz contains scattered galena, tetrahedrite, pyrite, and chalcopyrite.
98	Overland mine 227 W013648	22C	Cu, Zn, Pb, Ag, Au	Three lodes strike northwest and dip steeply southwest (two lodes or northeast (one lode). Main lode strikes N. 55º W., dips 70º SW., is 30 in. wide and has well-defined walls. Northeast-trending faults cut off two of the lodes. Ore is composes of sphalerite, galena, chalcopyrite, and tetrahedrite in a gangue of siderite and minor calcite. The ore shoot pitched southeast.
99	Lees Gulch East prospect 228 W013566	22C	Zn, Pb	Vein that trends about N. 45º W. and dips steeply northeast has a surface expression of considerable iron oxide that probably comes from weathering siderite.
100	Modoc Chief pros-pect 229 W013565	22C	Ag, Pb, Zn	Seams and stringers of siderite and sulfides are in a fracture zone that strikes N. 70º W. and dips 62º SW.
101	Legal Tender pros-pect 230 W013564	22C	Pb, Zn, Au, Ag	Three veins in sheared diorite strike N. 30º E. and are almost vertical. Each contains a few sulfides. Anderson and Wagner said the light-colored sphalerite suggests mid-Tertiary mineralization.
102	Lees Gulch West prospect 809 W013567	22C	Pb, Zn	Shear zone as wide as 8 ft strikes N. 70º W., dips 45º–65º NE., and contains lamprophyric dike as well as seams and lenses as much as 12 in. thick of quartz, locally with sulfides.
103	Edres mine 810 W013557	22C	Ag, Pb, Zn, Cu, Au	Ore is on either side of a lamprophyre dike that follows a thrust that strikes east and dips 30º–38º N. in the granodiorite. Lenses are as thick as 8 in. Ore is confined to the flatter parts of the fault zone, especially under the dike.
104	Chicago mine 817 W013563	22C	Ag, Pb, Zn, Cu	Major ore body is in a 5-foot wide fault that strikes N. 45º W. and dips 40º SW. and contains several 1–5 in. wide veinlets of siderite with patches of tetrahedrite and chalcopyrite. Another vein strikes westerly and dips 75º N. This 1–4 inch wide vein contains siderite and disseminated pyrite, arsenopyrite, and chalcopyrite.
105	Utah-Bellevue mine 818 W013560	22C, 22CX	Pb, Ag, Zn, Au	Deposits consist of calcite, quartz, galena, sphalerite, and pyrite in altered and sheared quartz diorite and lamprophyre dikes. Many of the individual shear slips in the quartz diorite are lined with chloritic material. Shear zone strikes N. 70º W. and dips northeast. Ore shipped on September 12, 1922, contained 9.8 percent lead, 0.13 ounces of gold per ton, 66.85 ounces of silver per ton, 17.7 percent zinc, and 7.7 percent iron.

[Mines and prospects are plotted by site numbers on figs. 1 and 2. First synonym is map number from Hustedde and others (1981) (for example 813), second synonym is the USGS Mineral Resources Data System record number (for example WO13678). Commodities are listed in approximate decreasing order of importance. Mineral deposit types 22C, polymetallic quartz veins and lodes, base-metal subtype; 22CX, polymetallic quartz veins and lodes, gold subtype. Locations and information sources are given in table 1]

106	Broken Wheelbar-row prospect 819 W013559	22C	Pb, Ag, Zn	Fractures in a west-northwest-trending fracture zone locally contain siderite, galena, pyrite, and minor quartz.
107	Lark mine 820 W013558	22C	Pb, Ag, Zn, Cu, Au	Vein zone as wide as 4 ft is composed of lenses of altered wallrock and lenses of quartz, galena, sphalerite, and siderite. The sulfide minerals are associated with the quartz, not with siderite. Sulfide-bearing lenses are from a few inches to 20 in. in width and as an aggregate form an ore shoot about 50 ft in stope length. Cerussite was common to the 80-foot level, and sphalerite was found only below the 80-foot level. Selected ore contained 35 percent lead and 100 ounces of gold per ton.
108	South Chicago pros-pect 821 W013561	22C	Cu, Mn	Deposits consist of lenses, seams, and stringers of siderite and scattered chalcopyrite in shear zones. One 6-foot wide zone trends about N. 70º W. and dips 70º–80º SW. and another 8-foot wide zone trends about N. 20º W. and dips 68º SW. Outcrops have abundant black manganese oxides.
109	Hillside prospect 822 W103562	22C	Pb, Ag, Zn	The deposit is a vein, about 1 ft wide in a fault zone that strikes about N. 60º W. and dips 60º SW. The vein is in fractured diorite with seams of siderite containing scattered grains and masses of galena, tetrahedrite, pyrite, and sphalerite.

source of the contained metals was the black shale. The solutions that formed the gold subtype veins traversed only plutonic rocks, and the source of the precious-metals may have been igneous fluids.

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The gold-subtype vein orebodies known to exist in the Croesus and Hailey gold belt mineralized areas are generally small isolated pods associated with the late-stage comb quartz in zones of major quartz veins along a few low-angle fault systems. There are probably many orebodies of this type in which the quartz vein has little if any surface expression. Descriptions of several of the old workings mention quartz veins that did not extend to the surface. A combination of detailed mapping to delineate the low-angle fault systems and detailed selective geochemistry, along with considerable luck, will be needed to find these orebodies. The presence of late-stage comb quartz is an indication that gold-mineralized rock might be present.

A related type of gold deposit should be considered, large stockwork veinlet zones in the hanging wall of some of the low-angle faults. A few small high-angle quartz veins in these areas might represent feeder zones that had broken through the rock of the hanging wall. If the area of brecciation and veining was large enough and gold was deposited, an orebody of significant size might have formed. One of the best places for formation of this type of deposit would be beneath a cap of impermeable sedimentary rocks.

Although higher grade pods of lead-silver-zinc ore were mined from some of the base-metal subtype veins, they do not constitute a significant resource. These types of deposits are much more significant in the Paleozoic sedimentary rocks.

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