lbs. zinc.

References: Park and Cannon, 1943, p. 60; Jenkins, 1924, p. 104-105; Patty, 1921, p. 114-116.

KETTLE FALLS DISTRICT

The Kettle Falls district of west-central Stevens County is a gold mining district, with minor production. From 1903 through 1953, mines of the district produced 9,192 tons of ore that yielded 1,479 ounces of gold, 40,137 ounces of silver, 61,974 pounds of copper, 32,368 pounds of lead, and 200 pounds of zinc. Although the average silver content of the ore produced in the district was but 5.06 ounces per ton, gold ore from the Gold Ledge mine contained as much as 37 ounces per ton in silver. Twenty-three mines in the district have a record of production, but only at two mines (Big Silver and Gold Ledge) did the value of silver exceed that of any other metal. Currently (1975) no mines are operating in the district.

The ore deposits of the Kettle Falls district occur in quartz fissure veins and along shear zones. Paleozoic limestone, argillite, and quartzite, as well as minor Tertiary intrusives, are common host rocks for the deposits. The quartz veins are from several inches to as much as 6 feet in thickness, whereas some metallized shear zones are as much as 30 feet wide. Some shear zones contain numerous quartz veins, which contain ore minerals, while in other shear zones the ore minerals are scattered throughout the sheared rock. Common ore minerals of the quartz vein deposits and shear zones are chalcopyrite, galena, sphalerite, and pyrite. The less common minerals include native gold and silver, stibnite, bornite, covellite, boulangarite, cuprite, molybdenite, malachite, and azurite. In most deposits the ore minerals occur as small discontinuous lenses or as sparsely scattered grains in the quartz veins and shear zones. Most ore shoots seldom contain over 100 tons of ore.

Principal Silver Deposits of Kettle Falls District

Aguila (Eagle-Newport)

Location: SE¼ sec. 25, T. 35 N., R. 37 E.

Development: 580-foot adit with short crosscuts, 65-foot shaft.

Geology: Numerous quartz veins in a 25-foot-wide shear zone in argillite and quartzite; parts of the shear zone are almost entirely quartz.

Ore minerals: Chalcopyrite, malachite, azurite, galena, tetrahedrite, and pyrite; 4 feet of vein assayed 18.5 ozs. silver, 1.5 percent copper, 6.67 percent lead.

Production: 1938: 1½ tons yielded 30 ozs. silver, 38 lbs. copper, 264 lbs. lead.

References: Huntting, 1956, p. 236; Washington Division of Geology and Earth Resources files.

Ark (Silver Queen)

Location: Center N½ sec. 11, T. 35 N., R. 37 E.

Development: 100- and 150-foot shafts with drifts, 1,700-foot adit with 130-foot raise.

Geology: Quartz lenses up to 4 feet thick in argillite and limestone. Mineralized zone up to 30 feet wide.

Ore minerals: Galena, sphalerite, tetrahedrite, chalcopyrite, and pyrite. Some ore shoots contained up to 24 ozs. silver.

Production: 1915-1949: 1,925 tons produced

in 1937, and 1938 yielded 27,754 ozs. silver, 10,449 lbs. copper, 21,538 lbs. lead.

References: Huntting, 1956, p. 323; Patty, 1921, p. 143-144.

Gold Ledge

Location: SW¼ sec. 4, T. 36 N., R. 38 E.

Development: 140-foot shaft, 50-foot drift, and 160-foot adit.

Geology: Quartz vein along contact between argillite and porphyry.

Ore minerals: Free gold, silver sulfides, galena, and pyrite. Ore averaged 36 ozs. per ton in silver.

Production: 1933-1935: 36 tons yielded 15 ozs. gold, 1,322 ozs. silver, 54 lbs. lead.

References: Huntting, 1956, p. 169; Fulkerson, 1958, p. 33.

Gold Reef (Benvenue)

Location: SW¼SE¼ sec. 9, T. 36 N., R. 38 E.

Development: 80-foot shaft, 200-foot drift, and 700-foot adit.

Geology: 2- to 3-foot-thick quartz vein along contact between argillite and acidic dike.

Ore minerals: Free gold, silver sulfides, and chalcopyrite. High-grade ore shoots averaged 2.15 ozs. gold, and 8 ozs. silver.

Production: 1905-1950: 704 tons yielded 709 ozs. gold, 3,200 ozs. silver.

References: Huntting, 1956, p. 169; Fulkerson, 1958, p. 33.

Vanasse

Location: S½NE¼ sec. 10, T. 36 N., R. 38 E.

Development: 8 shafts, 7 to 20 feet deep; 1 shaft, 65 feet deep.

Geology: 1- to 6-foot-thick quartz vein in quartzite and arkose.

Ore minerals: Chalcopyrite, galena, sphalerite, tetrahedrite, stibnite, bornite, and pyrite. Select samples assayed as high as 14 percent lead, 6 percent copper, and 140 ozs. per ton in silver.

Production: Unknown.

References: Huntting, 1956, p. 333; Purdy, 1951, p. 145.

ORIENT DISTRICT

The Orient district of northwestern Stevens County is basically a gold district. From 1904 through 1942, 24 mines in the district produced 236,993 tons of ore that yielded 45,057 ounces of gold, 32,020 ounces of silver, 555,536 pounds of copper, and 23,115 pounds of lead. The bulk of the gold and silver came from the First Thought mine near Orient. From 1904 through 1942 the mine produced 38,436 ounces of gold and 16,699 ounces of silver from ore that averaged 0.47 ounce per ton in gold, and 0.24 ounce per ton in silver. Almost all the copper produced in the district came from the Napoleon mine near Boyds. Although several properties report up to 22 ounces per ton in silver, the average silver content of ore shipped from the district was less than 1 ounce per ton. Currently (1975) no properties are operating in the district.

Ore deposits in the Orient district occur mainly as replacement deposits in Paleozoic schist and amphibolite, and as metallized quartz veins and fracture zones in latite and andesite of Mesozoic and early Tertiary age. The deposits that are richest in silver

consist of quartz veins that range from 6 inches to 25 feet in thickness. Common ore minerals are pyrite, pyrrhotite, galena, sphalerite, and chalcopyrite. Bornite, tetrahedrite, and boulangerite are rarely present. The ore minerals are sparsely distributed or form narrow lenses and bands in most veins. To date, (1975), no large silver-rich ore shoots have been discovered in the district.

Principal Silver Deposits of Orient District

Comstock

Location: W½ sec. 25 and E½ sec. 26, T. 40 N., R. 36 E.

Development: Three shallow shafts and one adit.

Geology: Metallized shear zones and quartz veins 4 to 6 feet thick in quartzite and gneiss. One quartz vein contains up to 3.5 percent copper and 22 ozs. silver.

Ore minerals: Galena, chalcopyrite, and pyrite.

Production: Unknown.

Reference: Huntting, 1956, p. 95.

Easter Sunday

Location: Center E½ sec. 22, T. 40 N., R. 37 E.

Development: 130-foot inclined shaft, with levels at 70 and 100 feet.

Geology: 2- to 6-foot-thick quartz vein in cherty argillite.

Ore minerals: Pyrite, chalcopyrite, sphalerite, tetrahedrite, and boulangerite.

Production: 20 ton shipment in 1909 averaged 1.21 percent copper, 12.4 ozs. silver, and 0.44 oz. gold per ton.

References: Huntting, 1956, p. 168.

Iron Mask

Location: Sec. 25, T. 40 N., R. 36 E.

Development: 3 shafts and several open cuts.

Geology: 4- to 6-foot thick quartz vein in latite and limestone. Vein traceable for 3,000 feet. Select sample of vein assayed 7 ozs. silver, 0.08 oz. gold, 14 percent lead, and 28 percent zinc.

Ore minerals: Sphalerite, galena, chalcopyrite, pyrite, and pyrrhotite.

Production: None.

Reference: Huntting, 1956, p. 378.

McKinley

Location: Sec. 34, T. 39 N., R. 38 E.

Development: Unknown.

Geology: 4-foot "ledge" in andesite. Select samples assay up to 200 ozs. per ton in silver.

Ore minerals: Galena and pyrite.

Production: None.

Reference: Huntting, 1956, p. 244.

Montana and Washington

Location: Sec. 30, T. 40 N., R. 37 E.

Development: 215-foot adit.

Geology: Quartz veins 6 inches to 25 feet thick in gneiss. Select samples assayed 16 to 20 ounces per ton in silver.

Ore minerals: Chalcopyrite, bornite, galena, and pyrite.

Production: Unknown.

Reference: Huntting, 1956, p. 100.

FERRY COUNTY

Ferry County is Washington's leading silver-producing county, having produced 5,917,851 ounces of the metal from 1904 through 1956. Since 1956 the county has produced over 100,000 ounces of silver yearly, almost all of which came from gold-silver mining operations in the Republic district.

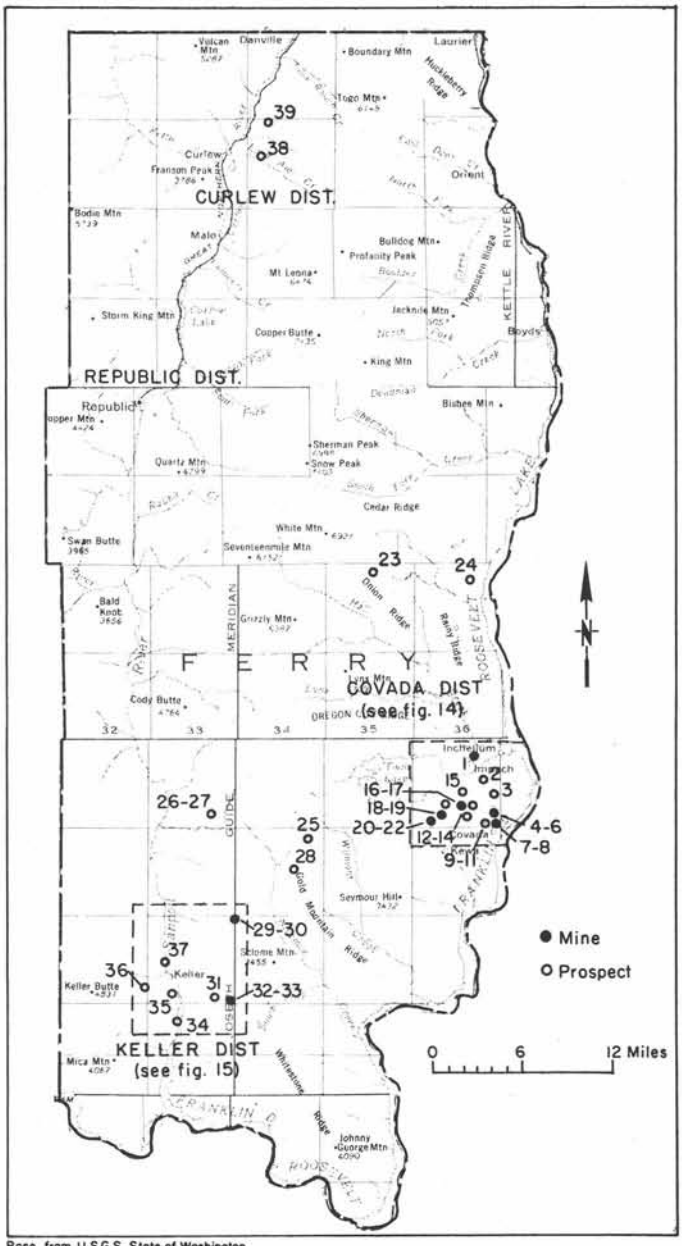
Silver has been reported at 49 mines, and at 134 prospects in the county. The distribution of silver according to the major metal at each property is shown in table 21.

TABLE 21.—Distribution of silver in Ferry County

Major metal at property	Mines	Prospects	No. of mines or prospects
Lead	3	53	56
Gold	28	24	52
Silver	12	38	50
Copper	5	16	21
Zinc	0	2	2
Nickel	1	1	2

Although 49 mines have produced silver along with other metals, 95 percent of the silver mined in Ferry County has come from gold mines of the Republic district. Production of silver from 12 silver mines in the county has been insignificant, and did not exceed 2,000 ounces.

Deposits that contain silver in Ferry County occur mainly in the Republic, Keller, and Covada districts (fig. 13). Silver in the Republic district is commonly associated with gold; in the Keller district, silver accompanies gold and copper; in the Covada district, silver is found in deposits of lead, zinc, copper and antimony. Silver is also present in the Belcher, Danville, Orient, and Sheridan districts where it is associated with gold and copper.



Base from U.S.G.S. State of Washington 1:500,000, 1962

Properties

1. Gwin
2. Dan Patch
3. Algonkian
4. Longstreet
5. Silver Leaf
6. Shoo Fly
7. Silver Crown
8. Ivanhoe
9. Butterfly
10. King Solomon
11. Plymouth Rock
12. Advance
13. Keystone
14. Royal Ann
15. Good Ore
16. Stray Dog
17. Oom Paul
18. Montana
19. Romulus
20. New York
21. Meteor
22. Reserve
23. Chief Barnaby
24. Big Lake
25. U.S.
26. McJunkin
27. Congress
28. Burlington and Delaware
29. Shamrock
30. Anderson
31. Summit
32. Addison
33. Golden Chord
34. Jumper
35. Rover Bonanza
36. Meadow Creek
37. Great Northern
38. Anchor
39. Panama

FIGURE 13.—Silver deposits of Ferry County.

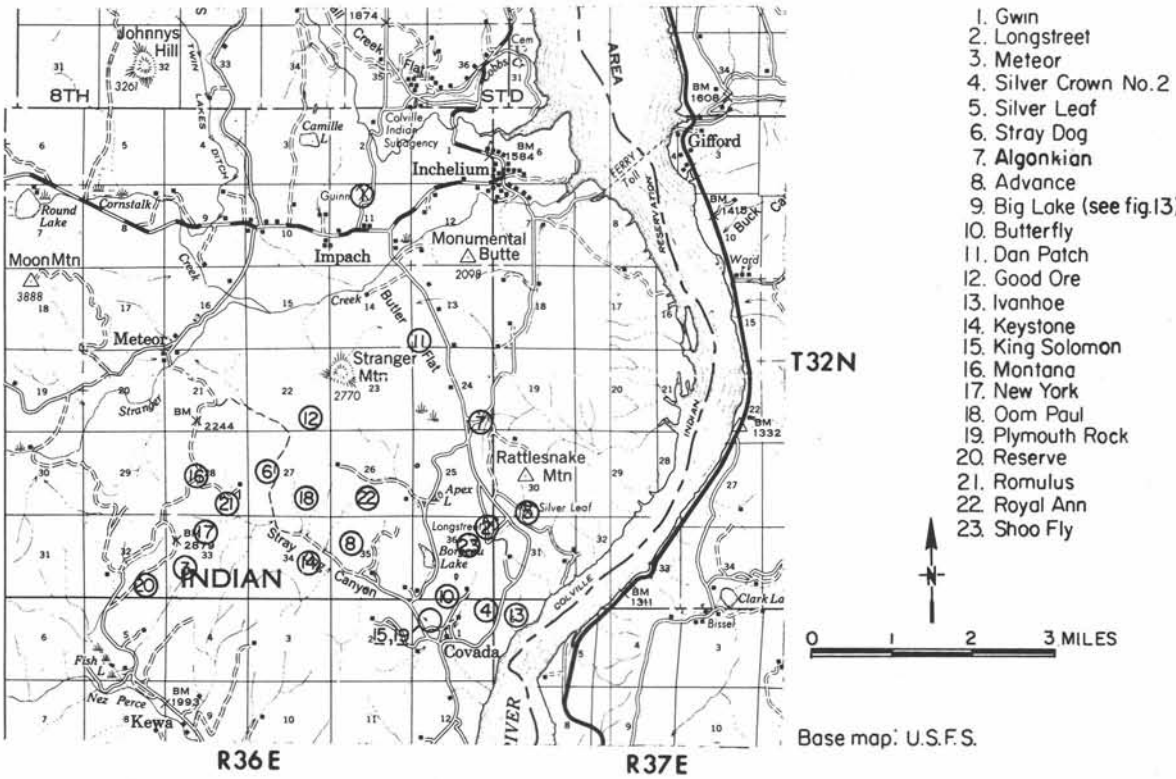


FIGURE 14.—Index map of the Covada district.

COVADA DISTRICT

Location

The Covada district is in southeastern Ferry County, immediately west of Lake Roosevelt. The district is entirely within the boundaries of the Colville Indian Reservation and centers about Twin Lakes. The district includes the old mining camps of Meteor, Impach, and Covada, and the present town of Inchelium. Elevations range from around 1,300 feet on the shores of Lake Roosevelt to around 6,000 feet on mountain peaks in the west part of the district. The silver-bearing deposits of the district occur mainly south of Inchelium in a northeast-trending area that is about 4 miles wide and 5 miles long (fig. 14).

Geology and Mineralization

Most ore deposits of the Covada district occur in quartz fissure veins, which have graywacke, argillite, and impure quartzite and limestone as their host rocks. All rocks are part of the Covada Group (Paleozoic), which are underlain by Cretaceous granodiorite. Along parts of the intrusive contact between the Covada Group and the granodiorite, hornfels has developed, some of which is sparsely metallized.

Common silver minerals of the quartz veins are argentiferous galena, pyrargyrite, cerargyrite, and argentite. Other minerals of the veins include galena, sphalerite, chalcopyrite, tetrahedrite, wolframite, scheelite, molybdenite, and stibnite. Pyrite is common in the veins; near the surface it has oxidized to limonite, which gives the veins a reddish-

brown color. In addition to pyrite, some veins contain pyrrhotite and minor arsenopyrite.

Most veins strike NW. and dip 45° to 70° NE. They vary from several inches to as much as 10 feet in thickness; however, the average thickness of 50 veins is only 2 feet. Shafts have been sunk on several veins to a depth of 150 feet, and some veins increase in thickness with depth. Most ore shoots are lenticular, and are only several inches thick. Around 100 tons of ore was extracted from the longest ore bodies. Weaver (1913, p. 44-84) reports that the average silver content of the veins is 2.21 ounces. The average ore shipped from the district contained 45 ounces per ton in silver, while one small shipment from the Silver Leaf mine contained 180 ounces per ton in silver.

Production

Twelve mines in the Covada district have a record of production; however, the combined silver production from the mines was only around 10,000 ounces. Silver was the major metal at nine mines, whereas, lead was the major metal at three mines. The average mine in the district only produced about 50 tons of ore. In addition to silver, the mines produced around 30 ounces of gold, 5,600 pounds of lead and 500 pounds of copper.

Principal Silver Deposits of Covada District

Advance

Location: Center NW¼ sec. 35, T. 32 N., R. 36 E.

Development: 1,861 feet of workings in crosscuts, drifts, raises, and winzes.

Geology: 2- to 3-foot-wide shear zone in schist contains quartz lenses up to 16 inches thick. Some quartz assays 0.05 to 333 ozs. silver, trace to 0.93 oz. gold, and up to 8 percent lead.

Ore minerals: Galena, pyrargyrite, native silver, chalcopyrite, sphalerite, and pyrite.

Production: Unknown.

Reference: Huntting, 1956, p. 288.

Algonkian

Location: SE¼ sec. 24, T. 32 N., R. 36 E.

Development: 8-foot shaft and open cut.

Geology: 6-inch-thick quartz vein in quartzite. Parts of the vein contain 6.25 to 8 ozs. silver and 0.03 to 0.06 oz. gold.

Ore minerals: Finely divided sulfides.

Production: Unknown.

Reference: Huntting, 1956, p. 288.

Big Lake

Location: Secs. 2 and 11, T. 36 N., R. 36 E.

Development: 793-foot adit; 20-, 30-, and 142-foot shafts.

Geology: 3-foot-wide shear zone in schistose grit and quartzite. Shear zone contains small quartz veins, parts of which assay up to 15 percent lead, 3 percent zinc, 40.32 ozs. silver, and 0.44 oz. gold.

Ore minerals: Galena, sphalerite, chalcopyrite, and pyrite.

Production: Unknown.

Reference: Huntting, 1956, p. 208.

Butterfly

Location: S¼ cor. sec. 36, T. 32 N., R. 36 E.

Development: 200-foot adit and 13-foot shaft.

Geology: 4- to 12-inch-thick quartz vein in granodiorite. Select sample of vein contained 30 ozs. per ton in silver.
Ore minerals: Argentiferous galena.
Production: Unknown.
Reference: Huntting, 1956, p. 209.

Chief Barnaby

Location: SW¼ sec. 35, T. 35 N., R. 35 E.
Development: 395-foot adit and a 35-foot shaft.
Geology: Shear zone in argillite, limestone, and granodiorite. Shear zone contains lenses of ore minerals. High-grade ore contained 21 percent lead and 205 ozs. of silver per ton.
Ore minerals: Galena, pyrite, and sphalerite.
Production: Unknown.
Reference: Huntting, 1956, p. 289.

Dan Patch

Location: Near center SW¼ sec. 13, T. 32 N., R. 36 E.
Development: 54-foot adit and a 30-foot shaft.
Geology: Quartz veins up to 16 inches thick in quartzite and slate. Vein assays 10.15 ozs. silver and 0.04 oz. gold.
Ore minerals: Sparse galena, sphalerite, and pyrite.
Production: Unknown.
Reference: Huntting, 1956, p. 289.

Good Ore

Location: SE¼ sec. 22, T. 32 N., R. 36 E.
Development: 140-foot crosscut adit and a 10-foot shaft.
Geology: 6- to 10-inch-thick quartz vein in granodiorite. Ore minerals occur in thin bands which assay 9 to 89 ozs. silver and 0.6 to 4.06 ozs. gold.
Ore minerals: Galena and pyrite.
Production: Unknown.
Reference: Huntting, 1956, p. 290.

Gwin

Location: NW¼ sec. 11, T. 32 N., R. 36 E.
Development: 750-foot adit and an inclined shaft.
Geology: Quartz veins up to 4 feet thick in quartzite and argillite. Vein averaged 27.7 ozs. in silver, 0.049 oz. in gold, and 3 percent copper.
Ore minerals: Tetrahedrite, galena, wolframite, tennantite or enargite, pyrite, and arsenopyrite.
Production: Mainly silver in the early 1900's, but some tungsten during World War I.
References: Culver and Broughton, 1945 p. 17-19; Pardee, 1918, p. 173-174; Weaver, 1913, p. 81-83.

Ivanhoe

Location: N½NW¼ sec. 6, T. 31 N., R. 37 E.
Development: 650-foot crosscut adit.
Geology: 3 quartz veins in calcareous shale. Veins average 10 inches in thickness and contain fair amounts of silver.
Ore minerals: Unknown.
Production: Unknown.
Reference: Huntting, 1956, p. 291.

Keystone

Location: Center E½ sec. 34, T. 32 N., R. 36 E.

Development: 550-foot adit.

Geology: 2- to 6-foot-wide metallized shear zone in schist and carbonaceous shale. Quartz veinlets in the shear zone assay up to 190 ozs. silver and 4 ozs. gold.

Ore minerals: Galena, native silver, pyrrhotite, sphalerite, chalcopyrite, and pyrite.

Production: Unknown.

Reference: Huntting, 1956, p. 291.

King Solomon

Location: NW¼ sec. 1, T. 31 N., R. 36 E.

Development: Several shafts and adits.

Geology: 3 quartz veins ranging from 4 to 12 inches thick in granodiorite. One vein averages 7.8 ozs. in silver per ton.

Ore minerals: Galena and pyrite.

Production: None.

Reference: Huntting, 1956, p. 211.

Longstreet

Location: NE. cor. sec. 36, T. 32 N., R. 36 E.

Development: 400- and 80-foot adits.

Geology: 8- to 30-foot-wide metallized granodiorite breccia. Ore contained 15 to 16 ozs. per ton in silver; high-grade ore contained 144 ozs. per ton in silver, and 24 percent antimony.

Ore minerals: Stibnite, argentite, galena, tetrahedrite, sphalerite, chalcopyrite, and pyrite.

Production: Several hundred tons in the early 1900's.

References: Purdy, 1951, p. 68-71; Pardee, 1918, p. 167-168.

Meteor

Location: SW¼ sec. 33, T. 32 N., R. 36 E.

Development: 700-foot crosscut with a 125-foot drift and several stopes; 160-foot inclined shaft.

Geology: 1- to 1½-foot-thick quartz vein in carbonaceous argillite, quartzite, and schist. High-grade ore shoots contained 65 to 178 ozs. per ton in silver, and ½ to 3½ percent lead.

Ore minerals: Galena, sphalerite, chalcopyrite, cerargyrite, pyrargyrite, argentite, tetrahedrite, native silver, pyrite, and rhodochrosite.

Production: 20 tons of ore by 1918.

References: Pardee, 1918, p. 155-156; Huntting, 1956, p. 292.

Montana

Location: Center of sec. 28, T. 32 N., R. 36 E.

Development: 3 shafts from 20 to 90 feet deep.

Geology: 1-foot-thick quartz vein in granodiorite. Select samples contained up to 47.6 percent lead and 224.8 ozs. of silver.

Ore minerals: Minor galena, sphalerite, pyrargyrite, and pyrite.

Production: Has produced, but amount unknown.

Reference: Huntting, 1956, p. 292.

New York

Location: Center N½ sec. 33, T. 32 N., R. 36 E.

Development: 40- and 60-foot shafts.

Geology: 12- to 16-inch-thick quartz vein in granodiorite. Parts of the vein contain 15 percent lead, 10 percent zinc, 7.8 ozs. silver, and 0.07 oz. gold.

Ore minerals: Galena, pyrargyrite, sphalerite, pyrite, and arsenopyrite.

Production: None.

Reference: Huntting, 1956, p. 212.

Oom Paul

Location: Center SE¼ sec. 27, T. 32 N., R. 36 E.

Development: 60-foot adit and a 50-foot shaft.

Geology: 4- to 12-inch-thick quartz vein in granodiorite. Ore minerals make up 50 percent of some parts of the vein. Select samples assay 69 percent lead and 25 ozs. silver.

Ore minerals: Galena and pyrite.

Production: None.

References: Huntting, 1956, p. 212.

Plymouth Rock

Location: N½NW¼ sec. 1, T. 31 N., R. 36 E.

Development: Unknown.

Geology: Quartz vein up to 2½ feet thick at contact between limestone and granodiorite. Vein assays up to 6 percent lead and 15 ozs. silver.

Ore minerals: Galena, sphalerite, and pyrite.

Production: None.

Reference: Huntting, 1956, p. 212.

Reserve

Location: SE¼ sec. 32, T. 32 N., R. 36 E.

Development: 48-foot shaft with 75-foot drift at bottom.

Geology: 3-foot-thick quartz vein in a 7-foot-wide shear zone in quartzite. Vein averages 7.8 ozs. silver and 0.04 oz. gold.

Ore minerals: Galena and pyrite.

Production: None.

Reference: Huntting, 1956, p. 293.

Silver Crown No. 2

Location: Near NE. cor sec. 1, T. 31 N., R. 36 E.

Development: 112-foot shaft with drifts on 50- and 100-foot levels; 125-foot crosscut.

Geology: 1½- to 4-feet-thick quartz vein in schistose quartzite and limy shale. Parts of vein containing fine-grained pyrite and unidentified sulfides assayed around 15 ozs. per ton in silver, and 0.05 oz. in gold.

Ore minerals: Unidentified sulfides and pyrite.

Production: 1,935 lbs. in 1905 netted $168.

References: Pardee, 1918, p. 166; Weaver, 1913, p. 57-58.

Silver Leaf

Location: Near S¼ cor. sec. 30, T. 32 N. R. 37 E.

Development: 50- and 240-foot adits; 40-foot shaft.

Geology: Quartz lenses in 50-foot-wide shear zone in limestone, schist, and argillite. Hand-sorted ore contained 180 ozs. per ton in silver, 3.6 percent lead, and 2.2 percent zinc.

Ore minerals: Tetrahedrite, chalcopyrite, sphalerite, galena, stibnite, scheelite, native silver, pyrargyrite, wolframite, and pyrite.

Production: 1911, 1912, 1915, 1916, and 1935. Total tonnage small; probably 2,000 ounces of silver produced.

References: Pardee, 1918, p. 170-171; Culver and Broughton, 1945, p. 19-21; Purdy, 1951, p. 71-74; Gage, 1941, p. 117-118.

Shoo Fly

Location: Center NE¼ sec. 36, T. 32 N., R. 36 E.

Development: 165-foot adit and a 6-foot shaft.

Geology: 1½- to 4-foot-thick quartz vein in granodiorite. Also an 80-foot zone of metallized aplite.

Ore minerals: Galena and pyrite.

Production: 12 tons mined in 1967 yielded 105 ozs. silver and 900 lbs. lead.

References: Huntting, 1956, p. 213.

Stray Dog

Location: Near center W½ sec. 27, T. 32 N. R. 36 E.

Development: 3 adits with 983 feet of workings, and a 100-foot shaft. Most work undertaken in lowest adit, which contains a drift, raise, and winze.

Geology: Quartz vein up to 2 feet thick in shear zone in quartz monzonite porphyry. Parts of vein contain 5 to 66 ozs. per ton in silver, and 0.3 to 0.6 oz. gold.

Ore minerals: Chalcopyrite, galena, sphalerite, tetrahedrite, pyrargyrite, argentite, native silver, pyrite, and arsenopyrite.

Production: 40 tons prior to 1910.

References: Gage, 1941, p. 123-124, Pardee, 1918, p. 159-160; Huntting, 1956, p. 294.

Romulus

Location: SE. cor. sec. 28. T. 32 N., R. 36 E.

Development: Caved incline shaft 110 feet deep.

Geology: Closely spaced quartz veinlets in a 5-foot-wide shear zone in granodiorite. Quartz assays up to 8 ozs. per ton in silver.

Ore minerals: Galena and pyrite.

Production: None.

Reference: Huntting, 1956, p. 213.

Royal Ann

Location: Center S½ sec. 26, T. 32 N., R. 36 E.

Development: 3 short adits and 2 shallow shafts.

Geology: Quartz veins up to 16 inches thick in granodiorite. Veins assay up to 12.5 ozs. silver.

Ore minerals: Galena, sphalerite, cerussite, and pyrite.
Production: None.
Reference: Huntting, 1956, p. 213.

U.S.

Location: Center W½ sec. 1, T. 31 N., R. 34 E.
Development: 50-foot crosscut adit with a 30-foot drift.
Geology: 6- to 10-inch quartz vein along a schist-limestone contact. Vein contains a 2-inch band of almost pure galena, which assays 49.5 percent lead and 59.96 ozs. of silver.
Ore minerals: Galena and pyrite.
Production: None.
Reference: Huntting, 1956, p. 214.

KELLER DISTRICT

Location

The Keller district is in southwestern Ferry County and falls within the boundaries of the Colville Indian Reservation. The San Poil River flows through the center of the district, and Lake Roosevelt forms the district's southern boundary. The predominant metal of the district is copper, but gold, silver, lead, zinc, nickel, tungsten, and molybdenum are also present. Silver has been reported at 5 mines and at 29 prospects; however, only at 3 mines and at 8 prospects is it present in significant amounts.

Geology and Mineralization

The ore deposits occur as metallized quartz veins and shear zones in schist, limestone, argillite,

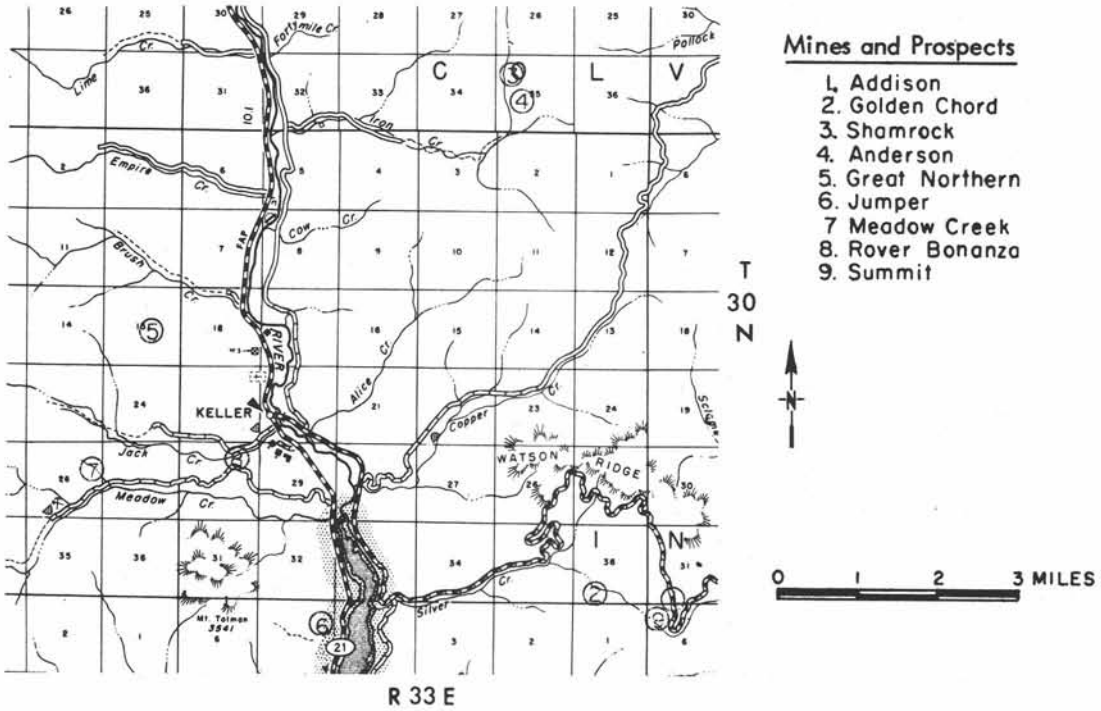


FIGURE 15.—Index map of the Keller district.

quartzite, and serpentine of the Covada Group (Paleozoic). The rocks occur as isolated roof pendants that are surrounded by Cretaceous granodiorite of the Colville batholith. The quartz veins are up to 6 feet thick, whereas, the shear zones are as much as 200 feet wide. In most veins and shear zones, ore minerals are sparse, but in parts of some veins, the ore minerals form pods and lenses up to several feet thick that are of ore grade.

The predominant ore minerals are chalcopyrite, galena, and sphalerite. Other ore minerals that are less common include chalcocite, scheelite, wolframite, cerussite, nickeliferous pyrite, and molybdenite. Pyrite, and occasionally arsenopyrite, almost always accompanies the ore minerals. Silver minerals have not been identified in any of the deposits, but some galena contains up to 100 ounces of silver per ton. Select samples from ore shoots at eight prospects are reported to contain 5.5 to 170 ounces per ton in silver. Small shipments of ore from three mines assayed from 20 to 64 ounces per ton. Based on past production and exposed ore at several properties most silver-bearing ore shoots in the Keller district appear to be small.

Production

To date (1975), the Keller district has produced around $12,000 in lead, silver, copper, and gold. This includes 13,800 ounces of silver, 51,000 pounds of lead, 4,300 pounds of copper, and 13 ounces of gold. Properties with a record of production include the Addison, Golden Chord, and Shamrock mines. The most productive mine has been the Addison, where currently small-scale mining operations are underway.

Principal Silver Deposits of Keller District

Addison (Pacific Mutual)

Location: SW¼ sec. 31, T. 30 N., R. 34 E.
Development: About 1,700 feet of underground workings in two adits and one shaft.
Geology: 4- to 6-foot-thick quartz veins in schist. Ore shoots up to 100-feet long assayed 1.4 to 33.8 ounces per ton in silver, up to 3.8 percent copper, and up to 19.6 percent lead.
Ore minerals: Galena, chalcopyrite, chalcocite, sphalerite, scheelite, wolframite, and pyrite.
Production: Minor production in 1923; 1,500 tons in 1973.
References: Culver and Broughton, 1945, p. 23-24; Gage, 1941, p. 142-143; Huntting, 1956, p. 51.

Anderson

Location: Sec. 35, T. 31 N., R. 33 N.
Development: Unknown.
Geology: 1-foot "vein" in limestone exposed for 150 feet. Vein averages 4 percent lead and 15 ozs. silver.
Ore mineral: Galena.
Production: None.
Reference: Huntting, 1956, p. 208.

Burlington and Delaware

Location: S½ sec. 15 and N½ sec. 22, T. 31 N., R. 34 E.
Development: 270-foot adit.

Geology: 5-foot-thick vein of quartz and limonite at contact between limestone and argillite. Parts of vein contain 16 ozs. silver and 5 percent lead.

Ore minerals: Galena, cerussite, and pyrite.

Production: None.

Reference: Huntting, 1956, p. 209.

Congress

Location: NW¼SE¼ sec. 35, T. 32 N., R. 33 E.

Development: 3 adits with a total of around 2,000 feet of workings.

Geology: Metallized shear zone up to 40 feet wide in serpentine at schist contact. Shear zone contains 0.17 to 5.17 percent nickel, 0.013 to 0.35 percent cobalt, and up to 5.5 ozs. silver.

Ore minerals: Nickeliferous pyrite, chalcopyrite, malachite, and garnierite in gangue of quartz, dolomite, barite, and epidote.

Production: Unknown.

Reference: Huntting, 1956, p. 276.

Golden Chord

Location: SW¼SW¼ sec. 36, T. 30 N., R. 33 E.

Development: 125- and 400-foot adits, connected by raise.

Geology: Quartz veinlets in hornfels and quartz monazite porphyry. Ore, at shallow depth, contained 2 to 6 percent copper, and 2.4 to 64.2 ounces per ton in silver. Ore occurs in small pods and sparsely disseminated grains.

Ore minerals: Chalcopyrite, sphalerite, galena, and pyrite.

Production: Minor shipments in the early 1900's.

References: Pardee, 1918, p. 132-133; Huntting, 1956, p. 290.

Great Northern

Location: Near north line SE¼ sec. 13, T. 30 N., R. 32 E.

Development: Open cuts.

Geology: 1-foot-thick quartz vein in granodiorite. Select samples from vein contained 170 ozs. per ton in silver.

Ore minerals: Galena, sphalerite, and pyrite.

Production: None.

Reference: Huntting, 1956, p. 290.

Jumper

Location: Center NE¼ sec. 5, T. 29 N., R. 33 E.

Development: Open cut.

Geology: Closely spaced quartz veinlets in a 3-foot-wide shear zone in granodiorite. Select ore samples contained 7.5 percent copper, and 11.4 ozs. silver.

Ore minerals: Chalcopyrite, molybdenite, malachite, and pyrite.

Production: None.

Reference: Huntting, 1956, p. 53.

McJunkin

Location: Center NE¼ sec. 27, T. 32 N., R. 33 E.

Development: 45-foot adit with a 15-foot crosscut.

Geology: 4-foot-wide breccia zone between porphyry and limestone. Select samples from breccia contained 23.36 ozs. silver, 7.7 percent lead, and considerable zinc.

Ore minerals: Galena, sphalerite, garnierite, and pyrite.

Production: None.

Reference: Huntting, 1956, p. 291.

Meadow Creek

Location: Secs. 25 and 26, T. 30 N., R. 32 E.

Development: 8 adits with 2,103 feet of workings.

Geology: Quartz veins and stringers along shear zone in granodiorite. Parts of some veins contained 5 percent lead, 4 percent copper, and 27 ozs. silver.

Ore minerals: Chalcopyrite, chalcocite, molybdenite, sphalerite, and galena.

Production: Unknown.

Reference: Huntting, 1956, p. 54.

Rover Bonanza

Location: Center NE¼ sec. 30, T. 30 N., R. 33 E.

Development: 4 adits from 120 to 400 feet long.

Geology: Quartz veins up to 18 inches thick in sheared granodiorite. Parts of one vein contained 52.9 ozs. silver and 0.09 oz. gold; also high in lead and zinc.

Ore minerals: Galena, sphalerite, pyrite, and arsenopyrite.

Production: None.

Reference: Huntting, 1956, p. 293.

Shamrock (Iron Creek)

Location: SW¼NW¼ sec. 35, T. 31 N., R. 33 E.

Development: Over 4,000 feet of underground workings in 3 adits and 2 shafts.

Geology: Metallized shear zone in silicified limestone. Ore averaged 30 ozs. of silver per ton, and 5 percent lead. Select samples of ore contained 1,000 ozs. per ton in silver, and 75 percent lead.

Ore minerals: Galena, cerussite, chalcopyrite, and pyrite.

Production: 1914, 1922 and 1926: total silver production around 7,000 ounces.

References: Huntting, 1956, p. 276; Patty, 1921, p. 217-218.

Summit

Location: SW. cor. sec. 31, T. 30 N., R. 34 E.

Development: 2 shafts.

Geology: 1-foot-thick quartz vein in argillite and quartzite. Select dump samples assayed 14.2 percent zinc, 5.4 percent copper, and 17.7 ozs. silver.

Ore minerals: Sphalerite with minor galena, pyrite, chalcopyrite, and specularite.

Production: None.

Reference: Huntting, 1956, p. 362.

CURLEW DISTRICT

The Curlew district of northern Ferry County is basically a copper-gold district that produced around $450,000 of these metals from 1900 through 1935. In addition to copper and gold, the district produced around 10,000 ounces of silver, mainly as a byproduct of copper-gold mining operations at the Lone Star and Washington and Lucile Dreyfus mines. Although the ore from these mines averaged 1 ounce or less per ton in silver, some prospects in the district contain up to 42.9 ounces per ton. Currently (1975), metal production in the Curlew district is at a standstill; however, several properties are under investigation for copper and gold.

Principal Silver Deposits

Anchor

Location: T. 39 N., R. 34 E., (section unknown).
Development: Unknown.
Geology: Vein in dioritic rocks. Assays of 22 samples averaged 3.05 percent lead, 42.9 ozs. silver, and 0.89 oz. gold.
Ore minerals: Galena and pyrite.
Production: None.
Reference: Huntting, 1956, p. 288.

Panama

Location: Near N¼ cor. sec. 6, T. 39 N., R. 34 E.
Development: Unknown.
Geology: Vein in serpentine and diorite. Assays of 22 samples averaged 1.71 percent copper, 24.80 ozs. silver, and 0.98 oz. gold.
Ore minerals: Galena, sphalerite, chalcopyrite, and pyrite.
Production: None.
Reference: Huntting, 1956, p. 123.

REPUBLIC DISTRICT

The Republic district of northwestern Ferry County is the state's leading silver-producing district. Currently (1975) 97 percent of the silver mined in Washington is a byproduct of gold mining operations at the Knob Hill mine near Republic. Mining began in the district in 1897, and to date the gold mines of the district have produced around 2 million ounces of gold, and nearly 10 million ounces of silver. Although the Republic district is not classed as a silver district, the nature of the deposits is discussed briefly because of the large amount of silver produced.

Most gold-silver veins of the district occur in a north-trending belt that is up to 1 mile wide and 6 miles long. The belt extends 4 miles north of Republic and 2 miles south. The veins are moderately to steeply dipping, north to northwest-trending quartz fissure veins that average about 4 feet in thickness; some veins are as much as 50 feet thick. Host rocks for the veins are brecciated and altered andesitic lava flows of the Sanpoil Volcanics (Eocene-Oligocene). The most productive veins appear to be confined to the lower part of the Sanpoil Volcanics. As well as quartz, which is the most common gangue mineral, the veins contain lesser amounts of calcite, adularia, laumonite, and fluorite. In addition to the massive-banded quartz veins, some deposits consist of brecciated quartz that has been recemented by second generation quartz.

The ore minerals are extremely fine grained, and occur in thin, irregular black bands and stringers

that parallel the walls of the veins. A variety of ore minerals have been reported in the veins of the district. These include free gold, electrum, chalcopyrite, tetrahedrite, stibnite, realgar, pyrargyrite, argentite, umangite, stephanite, naumannite, and native silver. The ore minerals are almost always accompanied by pyrite, which is the most plentiful sulfide. According to Full and Grantham (1968, p. 1492) high-grade ore from the Knob Hill mine contains stephanite, naumannite, native silver, and electrum. Small light-red translucent crystal suggest the presence of pyrargyrite or proustite. Most veins in the mine also contain small amounts of chalcopyrite.

The ore shoots in the district vary considerably in size; the maximum stope length is around 350 feet, whereas, the maximum pitch length is 1,300 feet. The gold and silver content of the ore shoots varies within a given vein and from mine to mine; however, the silver content of the ore almost always exceeds gold. Ore mined in 1902 to 1951 from the district averaged about 0.34 ounces per ton in gold and 2.18 ounces in silver, with a gold-silver ratio of 1 to 6.4. However, in some mines of the district gold-silver ratio was as high as 1:12.

Silver in significant amounts has been reported at only one silver property in the Republic district—the Zalla M. mine, which is 10 miles northwest of Republic. Because of the mine's proximity to the Sheridan district of Okanogan County, and because the deposit is similar to silver deposits of the Sheridan district, the Zalla M. is discussed in the Sheridan district (Okanogan County) part of this report.

OKANOGAN COUNTY

Okanogan County ranks fourth in the production of silver in Washington, having produced 860,159 ounces of the metal from 1904 through 1969. Silver was produced in the county as early as 1889, but production figures are not available for individual counties prior to 1904. A conservative estimate of silver produced in Okanogan County from 1889 to 1904, is about 150,000 ounces.

Silver has been reported in all of the county's mining districts. It most commonly occurs at properties where gold, silver, copper, and lead are the predominant metals. A breakdown of silver occurrences according to the chief metal at each property is shown in table 22.

TABLE 22.—Distribution of silver in Okanogan County

Chief metal at property	Mines	Prospects	No. of mines or prospects
Gold	37	58	95
Silver	38	55	93
Lead	14	25	39
Copper	7	34	41
Zinc	1	4	5
Molybdenum.	1	1	2
Iron	1	1	2

Although silver occurs in most parts of Okanogan County, the most productive silver mines are in the Loomis, Conconully, Sheridan, and Nespelem districts (fig. 16). Mines that have produced over 100,000 ounces of silver are the Ruby and Kaaba-Texas in the Loomis district, and the Arlington mine in the Conconully district. Mines that have produced less than 100,000 ounces, but more than 50,000 ounces, are the First Thought in the Conconully district, Zalla M. and Sheridan in the Sheridan district, and Apache in the Nespelem district.

No major mining operations have been conducted in Okanogan County since 1950, at which

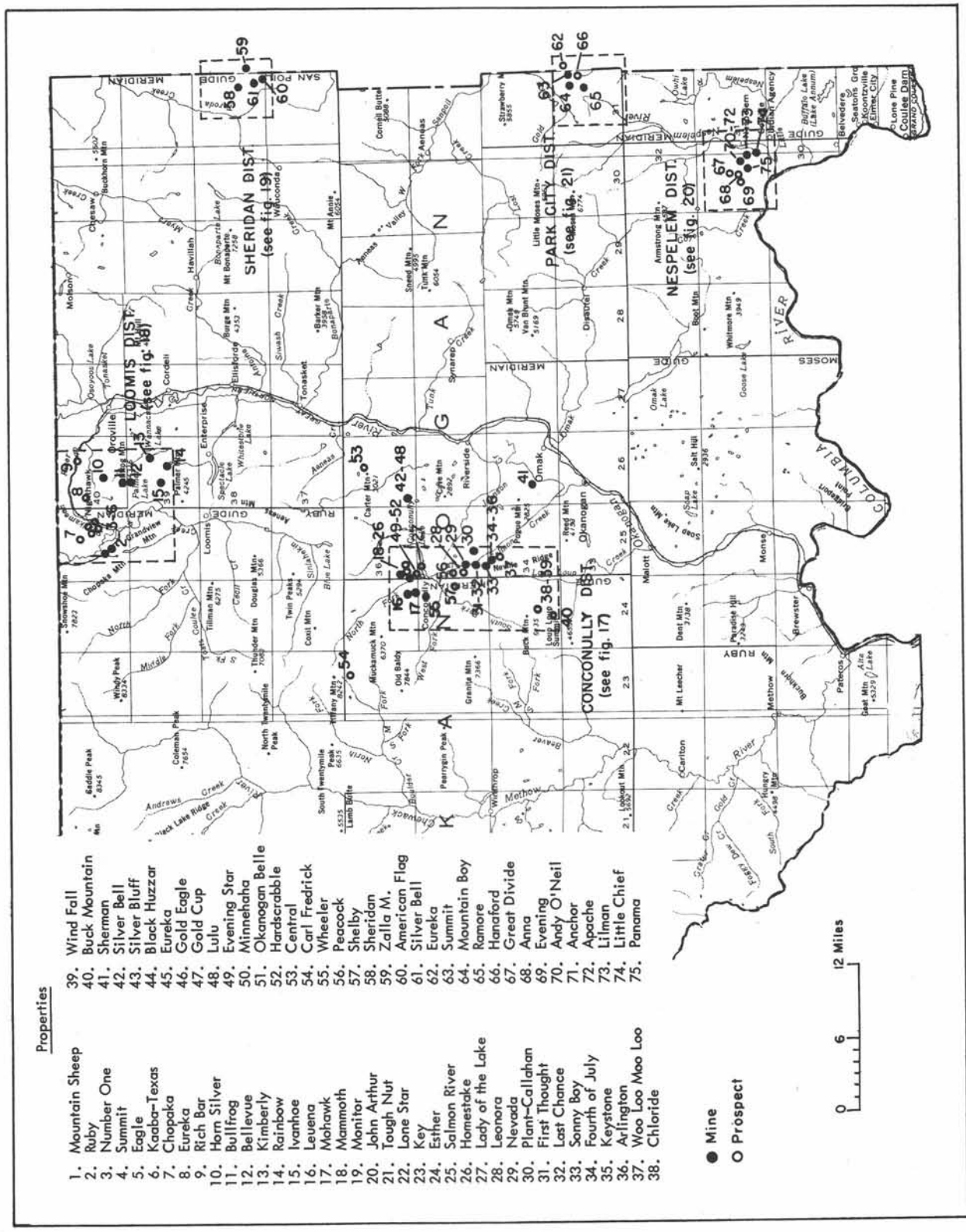


FIGURE 16.—Silver deposits of Okanogan County.

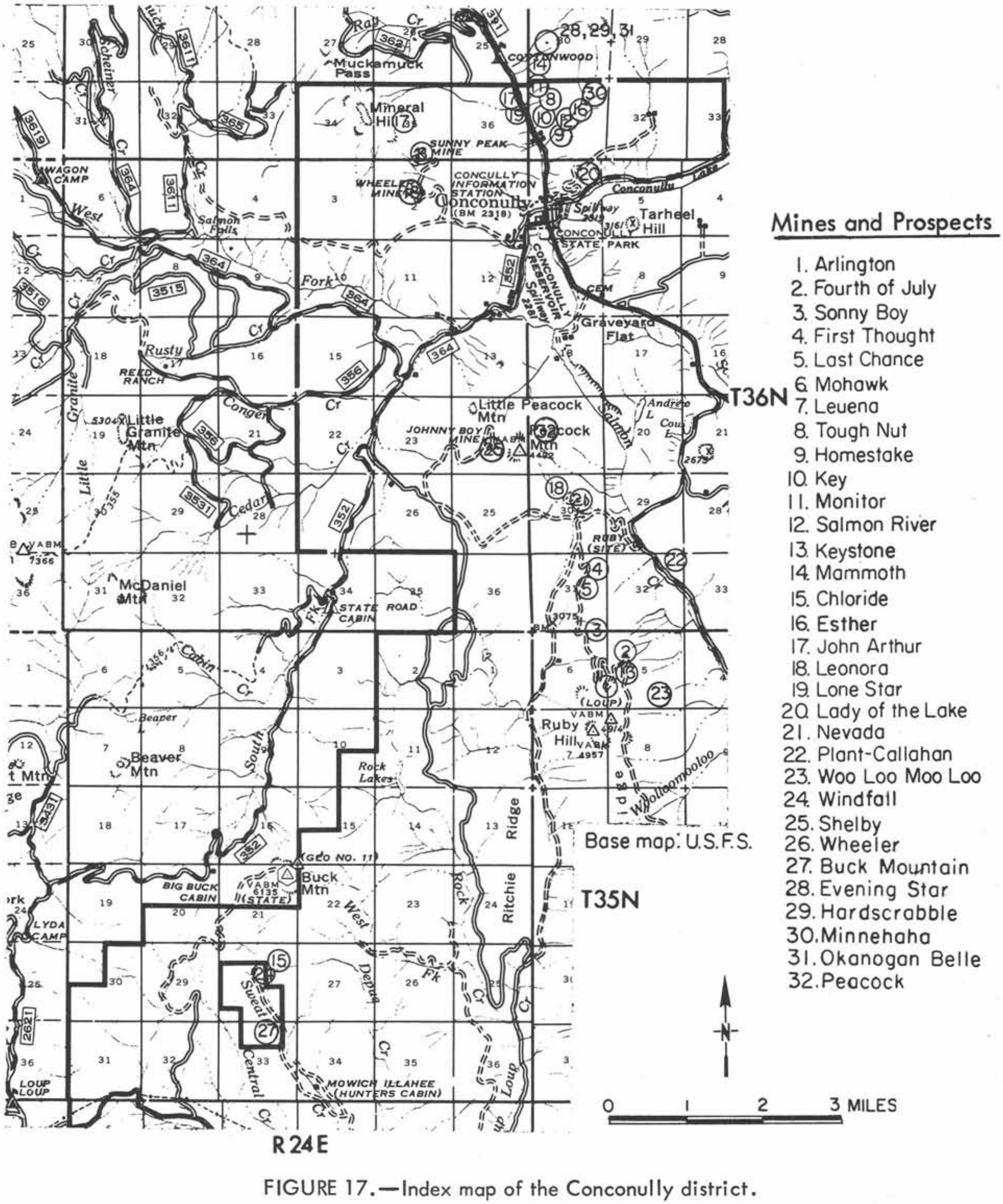


FIGURE 17.—Index map of the Conconully district.

time the Kaaba-Texas mine closed down. However, exploration work is undertaken almost yearly at mineral deposits throughout the county. Currently (1975) several silver mines in the Loomis, Conconully, and Nespelem districts are under investigation.

CONCONULLY DISTRICT

Location

The Conconully district of central Okanogan County encompasses 525 square miles of the Okanogan Highlands physiographic province of Washington. The district falls within T. 34 N. through T. 37 N., and extends westward from the Okanogan River to the middle of R. 23 E. (fig. 17). The topography of the district consists of gently rolling, grassy range lands in the east half, and moderately to heavily timbered mountainous lands in the west half; parts of the mountainous lands are steep and rocky. Elevations near the Okanogan River are around 875 feet; however, in the west half of the the district the summits of several peaks are in excess of 6,000 feet.

Geology and Mineralization

Most silver deposits of the Conconully district occur adjacent to a contact zone between granodiorite and metamorphic rocks. Granodiorite, which is mainly in the western part of the district, is part of the Similkameen batholith (late Mesozoic). Near Conconully, where the bulk of the silver deposits are, the batholith is composed of hornblende granodiorite, biotite granodiorite, porphyritic granodiorite, quartz diorite, and quartz monzonite. The metamorphic rocks in the Conconully area are predominantly gneiss, schist, and migmatite, which are separated from the granodiorite by sharp intrusive contacts, transitional zones of migmatitic rocks, and by the steeply dipping, northwest-trending Salmon Creek Fault. The schists and gneisses were derived from Paleozoic sediments and volcanics that were regionally metamorphosed during a Jurassic orogeny. Elsewhere in the district the predominant rocks are Triassic limestone, marble, and dolomite, and pre-Tertiary quartzite, metagraywacke, amphibolite, greenstone, and metavolcanics.

In the Conconully area the silver-bearing quartz veins vary from thin stringers less than 1 inch thick to massive quartz veins that are as much as 20 feet thick; the average quartz vein is 3 to 6 feet in thickness. The veins exhibit a wide variety of strikes ranging from N. 55° E. through N. 50° W.; the average strike is about N. 10° W. The dips of the veins are from 25° to 90°, both east and west, and average about 65°. Most veins have not been followed for much more than 500 to 600 feet along their strikes and dips.

The ore minerals of the veins, in order of decreasing abundance are galena, tetrahedrite, chalcopyrite, bornite, and sphalerite. Pyrite is almost always present in the veins; however, it appears to be more abundant in veins that contain ore minerals. The ore shoots in the veins consist of one or several of the above-mentioned minerals that occur as bands or lenses, 6 to 40 inches thick, and parallel the walls of the veins. The ore shoots are usually discontinuous, and vary in strike and pitch length from a few feet to as much as 200 feet. Sections of the veins between ore shoots usually consist of barren quartz, or quartz that contains sparsely disseminated fine-grained ore minerals.

Early reports on the mines of the Conconully area state that near-surface parts of some veins contained ore that assayed over 1,000 ounces per ton in silver, and hand-sorted ore assayed as much as 450 ounces per ton for carload lots that were shipped to smelters. However, ore that was concentrated at

mills in the district averaged around 50 ounces of silver per ton. The lead content of the ore ranged from 1 to 10 percent, copper averaged 1.5 percent, and the average gold content was 0.03 ounce per ton.

Silver is the most valuable metal in the veins and occurs in argentian tetrahedrite. Bethune (1892, p. 86) reports that select samples of tetrahedrite from the First Thought mine contained up to 1,926 ounces of silver per ton. Jones (1916, p. 23) states that minerals from the Key mine contained silver as follows:

Mineral	Silver (ozs/ton)
Tetrahedrite	347.6
Galena	71.1
Sphalerite	29.5
Pyrite	26.4
Quartz	None

The vertical extent of ore minerals in the Conconully area appears to be as much as 2,500 feet on Mineral Hill, and 1,500 feet on Ruby Hill. Near the surface, oxidation is only slight; for the most part, primary ore minerals extend to the surface. Secondary enrichment does not appear to be present at any mines in the district. Near-surface parts of the veins tend to be rich in tetrahedrite, and at increased depths, galena and sphalerite predominate. At deeper depths, these minerals give way to chalcopyrite and bornite, and finally to pyrrhotite.

Production

Silver mining began in the district in 1889; and by 1893, $200,000 mainly in silver had been produced from the Arlington, First Thought, Last Chance, and Fourth of July mines. The next most productive years were 1937 through 1939, at which time the Arlington produced $71,683 in silver and copper. The last production from the district was from 1958 through 1964, when about $12,000 in silver ore was mined at the Fourth of July. Because of incomplete production records, it is impossible to state with any accuracy the total value of metals mined in the Conconully district. A conservative estimate for the production of silver, lead, copper, and gold is around $350,000. The bulk of this production came from the silver mines that lie within 6 miles of the town of Conconully.

Major Mines

Arlington

This property, on the western slope of Ruby Hill, was the major producing metal mine of the Conconully district. Mining at the Arlington began in 1888; and by 1893, 1,000 tons of silver ore, having a net value of $25,000, had been mined. Between 1914 and 1921, several thousand tons of ore, which contained 66.6 ounces of silver per ton, returned a net profit of $31,000. In 1938 and 1939, a total of 5,700 tons of ore was mined that had a net value of $71,683. From 1888 to 1940, the mine produced $127,603 which was mainly in silver. In 1937, Arlington Mines, Inc. built a 50-ton flotation mill at the property. The mill operated in 1938 and 1939, and in 1958 it was destroyed by a fire.

The Arlington is developed by 4,500 feet of crosscuts, drifts, and shafts, as well as several stopes. The main haulage adit is 1,290 feet long and intersects the Arlington vein 972 feet from the adit's portal. The vein has been drifted upon for several hundred feet, and stoped overhead for at least 600 feet along the vein. A winze has been sunk on the vein for 100 feet beneath the main adit, and working levels are at 50 and 100 feet below the collar of the

winze. About 200 feet above the main adit, an upper adit intersects the vein 420 feet from its portal, and 200 feet beneath the outcrop of the vein. This adit contains over 700 feet of drifts, and a shaft that extends to the surface. The shaft contains several working levels from which ore has been extracted. Work thus far undertaken at the mine indicates that ore extends over a vertical distance of 540 feet on the vein, and possibly deeper.

The Arlington vein is a quartz fissure vein that follows a granodiorite-gneiss contact. The vein is 1 to 6 feet thick, strikes north, and dips 70° W. Argentian tetrahedrite, chalcopyrite, galena, and minor sphalerite form bands, pods, and lenses in the vein. Parts of the vein that were mined contained ore shoots up to 2 feet thick, and as much as 300 feet long. Steeply dipping transverse faults offset parts of the vein up to 10 feet, while steeply dipping faults parallel to the vein have brecciated the ore minerals, and drawn them out into thin dark bands.

Based on past production records, the average silver content of the Arlington vein was 60 ounces per ton. Some ore contained only 10 ounces per ton in silver, while as much as 1,000 ounces were present in high-grade ore. The gold content of average ore was only 0.02 ounce, and the copper content was 1.15 percent. The richest ore shoots in the Arlington appear to have been mined during the early history of the mine; however, all parts of the vein have yet to be explored. Huntting (1956, p. 300) reports that the 100-foot level of the winze in the main adit contains two ore shoots that total 350 feet in length, average 2.5 feet thick, and contain 18 ounces per ton in silver.

Fourth of July

This property was one of the first discoveries on Ruby Hill, and as early as 1889, high-grade silver ore was shipped to a Montana smelter. So favorable were the shipments, that in 1890, a Montana syndicate acquired the mine, and undertook extensive development work. After producing $36,000 in silver, the mine shut down during the silver panic of 1893. Except for small-scale mining operations from 1958 through 1964, the mine has remained idle.

Underground workings at the Fourth of July consist of a 500-foot, double-compartment vertical shaft, and a steeply inclined 200-foot, single-compartment shaft, both of which contain several working levels. The working levels, which are up to 300 feet beneath the surface and total 850 feet in length, contain several stopes. Currently, the 500-foot shaft is caved at its collar, but the 200-foot shaft is accessible to the 100-foot level.

The Fourth of July vein is a quartz fissure vein in biotite gneiss. It averages 6 feet in thickness, strikes N. 10° W. and dips 70° to 80° E. The ore minerals consist of argentian tetrahedrite, and galena, which are almost always accompanied by pyrite. These minerals appear to be confined mainly to a 2-foot-thick section of the vein that parallels the hanging wall. Parts of the vein have been intensely sheared by faults that parallel the walls. Based on past production records, the silver content of ore shoots in the Fourth of July vein average 50 to 150 ounces per ton in silver.

First Thought

This property, on the north end of Ruby Hill, was one of the first producing mines in the Conconully district. From October 1892 through May 1893, the mine produced silver ore valued at $66,000. A 1½-mile aerial tramline carried ore from the mine to First Thought Silver Mining Co's. concentrating mill at Ruby City. Mining at the property ceased during the silver panic of 1893. Several small shipments of ore

were made in the 1920's, but production was minor, and totaled only around 100 tons. Three adits and several drifts explore the vein over a vertical distance of 350 feet, and underground workings at the mine exceed 4,000 feet. In the two upper adits, drifts along the footwall and hanging wall of the vein follow it for a total strike length of about 1,000 feet. In addition to the adits, the First Thought vein has been explored by at least four shafts, which are caved at their collars.

Ore shoots at the mine contain galena, argentian tetrahedrite, sphalerite, chalcopyrite, and pyrite concentrated into lenses and bands in discontinuous lenticular masses of quartz. The lenses of quartz have general strikes of N. 10° E., dip 55° to 60° E., and occur in highly foliated feldspathic, quartzitic, and micaceous gneisses. One quartz lens is 90 feet thick at its maximum thickness, and is 600 to 700 feet in maximum breath. Individual ore shoots that were mined in the past were up to 5 feet thick, and had 75 to 100 ounces per ton in silver. Massive quartz between the ore shoots is reported to contain 6 to 8 ounces per ton in silver.

Principal Silver Deposits of Conconully District

Arlington

Location: NE¼SE¼ sec. 6, T. 34 N., R. 25 E.

Development: 4,500 feet of adits, drifts, shafts, and crosscuts. Four working levels over a vertical distance of 450 feet. Main haulage level is 1,290 feet long.

Geology: Quartz vein 1 to 6 feet thick in gneiss and granodiorite. Several ore shoots were 2 feet thick, and up to 300 feet long. Ore averaged 60 ozs. per ton in silver, 0.02 oz. gold, and 1.15 percent copper. High-grade ore shoots assayed up to 1,000 ozs. per ton in silver.

Ore minerals: Argentian tetrahedrite, galena, chalcopyrite, and minor sphalerite.

Production: 1888-1873: $25,000 mainly in silver. 1914-1921: $31,000 mainly in silver. 1938-1939: $71,683 in silver, copper, and gold.

References: Moen, 1973, p. 10-13; Patty, 1921, p. 250-253.

Black Huzzar

Location: NE¼ sec. 31, T. 36 N., R. 26 E.

Development: Unknown.

Geology: 3½-foot quartz vein, parts of which assay 90 ozs. silver, 3.5 percent copper, and trace of gold.

Ore minerals: Minor argentite and chalcocite.

Production: None.

Reference: Huntting, 1956, p. 301.

Buck Mountain

Location: NW¼NE¼ sec. 33, T. 34 N., R. 24 E.

Development: Two 100-foot adits. Several trenches and shallow prospect pits.

Geology: Quartz vein 2 to 36 inches thick in granodiorite.

Ore minerals: Sparsely scattered grains of of tetrahedrite, pyrite, and fine-grained scheelite.

Production: Minor production in the early 1900's.

References: Huntting, 1956, p. 344; Moen, 1973, p. 39-40.

Carl Frederick (Bernhardt)

Location: Near E¼ cor. sec. 3, T. 36 N., R. 23 E.
Development: 400-foot adit with 38-foot winze. Also a 270-foot adit.
Geology: 4- to 24-inch-thick quartz vein in granodiorite. Ore shoots up to 1 foot thick contain 20 ozs. of silver per ton.
Ore minerals: Galena and pyrite.
Production: Unknown.
References: Huntting, 1956, p. 301; Patty, 1921, p. 256-257.

Central

Location: Center of sec. 10, T. 36 N., R. 26 E.
Development: 50-foot shaft and several short adits.
Geology: Sparsely metallized zone up to 300 feet wide in aplite porphyry dike that intrudes argillite and hornblende porphyry. Parts of metallized zone contains 6 to 8 ozs. per ton in silver.
Ore minerals: Galena, sphalerite, chalcopyrite, and pyrite.
Production: None.
Reference: Huntting, 1956, p. 301.

Chloride

Location: NE¼ sec. 28, T. 34 N., R. 24 E.
Development: 100-foot adit.
Geology: 4-foot quartz vein in granodiorite. Select samples from vein contained 240 to 650 ozs. silver and 1.25 to 2.0 percent copper.
Ore minerals: Argentite, chalcocite, stephanite, malachite, and pyrite.
Production: None.
Reference: Huntting, 1956, p. 302.

Esther

Location: SW¼NE¼ sec. 31, T. 36 N., R. 25 E.
Development: 74-foot adit.
Geology: 1- to 3-foot-thick quartz vein in mica schist.
Ore minerals: Galena, sphalerite, chalcopyrite, and pyrite.
Production: None.
Reference: Huntting, 1956, p. 218.

Eureka

Location: NE¼ sec. 31, T. 36 N., R. 26 E.
Development: Unknown.
Geology: 4-foot quartz vein. Select samples assayed 370 ozs. silver, 0.10 oz. gold, and 3.9 percent copper.
Ore minerals: Argentite and chalcocite.
Production: None.
Reference: Huntting, 1956, p. 302.

Evening Star

Location: Sec. 31, T. 36 N., R. 25 E.
Development: 600-foot shaft.
Geology: 4-foot quartz vein.
Ore minerals: Chalcopyrite and native silver.
Production: None.
Reference: Huntting, 1956, p. 303.

First Thought

Location: Center NE¼ sec. 31, T. 35 N., R. 25 E.

Development: Three adits and several shafts, with combined underground workings in excess of 4,000 feet. Upper adit has around 2,000 feet of workings.

Geology: Quartz lenses up to 90 feet thick in gneiss. Maximum breadth of lenses, 700 feet. Ore shoots contained 75 to 100 ozs. per ton in silver, massive quartz between shoots contained 6 to 8 ozs. of silver.

Ore minerals: Argentian tetrahedrite, chalcopyrite, galena, sphalerite, and pyrite.

Production: 1892-1893: $66,000, mainly in silver.

References: Patty, 1921, p. 255; Jones, 1916, p. 31-32; Bethune, 1891, p. 49-50; Bethune, 1892, p. 79-80; Moen, 1973, p. 16-17.

Fourth of July

Location: Center NW¼ sec. 5, T. 34 N., R. 25 E.

Development: 500-foot, double-compartment shaft, and a 200-foot, single-compartment shaft with at least 850 feet of workings on five levels with stopes on most levels.

Geology: 6-foot quartz vein in biotite gneiss. Ore shoots up to 2 feet thick contained 50 to 150 ozs. per ton in silver. Ore mined from 1958 through 1964 averaged 60 ozs. per ton in silver.

Ore minerals: Argentian tetrahedrite, galena, and pyrite.

Production: 1890-1893, 1958-1964: total production around $50,000 mainly in silver.

References: Moen, 1973, p. 13-14; Bethune, 1891, 49-50; Bethune, 1892, p.79-80.

Gold Cup

Location: NE¼ sec. 31, T. 36 N., R. 26 E.

Development: Unknown.

Geology: Quartz vein, parts of which assay 80 ozs. per ton in silver.

Ore minerals: Unknown.

Production: Unknown.

Reference: Huntting, 1956, p. 303.

Gold Eagle

Location: NE¼ sec. 31, T. 36 N., R. 26 E.

Development: Unknown.

Geology: Quartz vein, parts of which assay 100 ozs. per ton in silver.

Ore minerals: Unknown.

Production: None.

Reference: Huntting, 1956, p. 303.

Hardscrabble

Location: Sec. 30, T. 36 N., R. 25 E.

Development: 30-foot drift.

Geology: 15-inch vein with 11-inch metallized zone. Assays of 178,335 and 605 ozs. per ton in silver reported.

Ore minerals: Stephanite and pyrite.

Production: None.

Reference: Huntting, 1956, p. 304.

Homestake

Location: E½SW¼ sec. 31, T. 36 N., R. 25 E.

Development: 29-foot shaft, and a 175-foot adit, with a 42-foot crosscut.

Geology: 11-foot-thick quartz vein in quartz-mica schist. Ore shoots contained 18 to 56 ozs. per ton in silver, and 32 to 36 percent lead.

Ore minerals: Galena and pyrite.

Production: 400 tons prior to 1902, of which 100 tons netted $1,500.

References: Huntting 1956, p. 220; Bethune, 1891, p. 56.

John Arthur

Location: SE¼NE¼ sec. 36, T. 36 N., R. 24 E.

Development: 70-foot inclined shaft.

Geology: 10-foot-thick quartz vein, 2 to 2½ feet of which is metallized. Parts of vein assay 30 to 116 ozs. per ton in silver, and traces to 5 ozs. gold.

Ore minerals: Argentite, native silver, and pyrite.

Production: Unknown.

Reference: Huntting, 1956, p. 305.

Key

Location: SW¼NW¼ sec. 31, T. 36 N., R. 25 E.

Development: 300-foot adit, 105-foot drift, and 80-foot shaft.

Geology: Sparsely metallized quartz vein 3 to 10 feet thick in mica schist and migmatite. Vein contained small, scattered ore shoots, with up to several hundred ozs. per ton in silver.

Ore minerals: Galena, sphalerite, and chalcopyrite.

Production: 1,500 tons prior to 1914.

References: Huntting, 1956, p. 304; Jones, 1916, p. 25; Gage, 1941, p. 207.

Keystone

Location: S½NW¼ sec. 5, T. 34 N., R. 25 E.

Development: 150-foot shaft.

Geology: 8-foot-thick quartz vein in biotite gneiss. Parts of vein contain up to 50 ozs. per ton in silver.

Ore minerals: Tetrahedrite and galena.

Production: Unknown.

References: Huntting, 1956, p. 305; Bethune, 1891, p. 52-53.

Lady of the Lake

Location: Center NE¼ sec. 6, T. 35 N., R. 25 E.

Development: 150-foot adit with 50 feet of drifts. Several open cuts.

Geology: Shear zones up to 20 feet wide in mica schist. Sparsely metallized but select samples contained 70 to 125 ozs. silver and 11 to 15 percent lead. Average sample contains less than 1 percent each of copper, lead, and zinc.

Ore minerals: Galena, pyrite, chalcopyrite, sphalerite, molybdenite, and scheelite.

Production: None.

Reference: Huntting, 1956, p. 305.

Last Chance

Location: Center sec. 31, T. 35 N., R. 25 E.

Development: 300-foot shaft with working levels at 100, 200, and 300 feet. 300-foot level contains 800 foot crosscut; 650 foot adit with stopes.

Geology: 12-foot-thick quartz vein in schist and granodiorite. Ore shoots 2 to 4 feet thick, and up to 200 feet long, averaged 30 ozs. of silver per ton, 17 percent lead, and 4 percent copper.

Ore minerals: Argentian tetrahedrite, galena, chalcopyrite, sphalerite and pyrite.

Production: Minor production in 1920, 1921, and 1924.

References: Patty, 1921, p. 254-255; Moen, 1973, p. 17-18.

Leonora

Location: Sec. 30, T. 35 N., R. 25 E.

Development: 80-foot shaft.

Geology: 5-foot-thick quartz vein with a 4-inch paystreak that assays up to 350 ozs. silver and 17 to 25 percent lead.

Ore minerals: Galena, stephanite, and pyrite.

Production: None.

Reference: Huntting, 1956, p. 220.

Leuena

Location: SE¼SW¼ sec. 35, T. 36 N., R. 24 E.

Development: 50- and 75-foot shafts, 60-foot adit, and 70-foot crosscut.

Geology: 7-foot-thick quartz vein in granodiorite. Ore shoots contained 200 to 800 ozs. per ton in silver.

Ore minerals: Tetrahedrite, stephanite, and argentite.

Production: Several carloads prior to 1890.

References: Huntting, 1956, p. 305; Bethune, 1891, p. 59; Jones, 1916, p. 28-29.

Lone Star

Location: NE¼ sec. 36, T. 36 N., R. 24 E.

Development: 300-foot inclined shaft and 2 adits with total of 2,000 feet of workings.

Geology: 1½- to 20-foot-thick quartz vein in granodiorite. Select samples contained up to 65 percent lead, 140 ozs. silver, and 1.6 oz. gold. Samples of 1½- to 10-foot-thick vein assayed 1.85 to 7.35 ozs. silver, 0.1 to 1.1 percent zinc, and 0.1 to 0.6 percent lead.

Ore minerals: Sparse galena, sphalerite, chalcopyrite, pyrite, and stephanite.

Production: 40 tons in 1913.

References: Huntting, 1956, p. 221; Moen, 1973, p. 24-26.

Lulu

Location: NE¼ sec. 31, T. 36 N., R. 26 E.

Development: Unknown.

Geology: 4-foot thick quartz vein, parts of which contain up to 320 ozs. per ton in silver.

Ore minerals: Argentite and chalcocite.

Production: None.

Reference: Huntting, 1956, p. 306.

Mammoth

Location: SW¼ sec. 30, T. 36 N., R. 25 E.

Development: Two 30-foot crosscuts.

Geology: 5- and 6-foot quartz veins in mica schist. High-grade ore contained 87 to 330 ozs. per ton in silver, 1 to 3 ozs. of gold, and 7 percent copper.

Ore minerals: Galena, chalcopyrite and pyrite.

Production: Small shipment in 1889 netted $250 per ton.

Reference: Bethune, 1892, p. 95.

Minnehaha

Location: Sec. 31, T. 36 N., R. 25 E.

Development: 200-foot crosscut.

Geology: 17-foot-thick quartz vein. Select samples assay 12½ to 14 percent lead and 98 to 113 ozs. silver.

Ore minerals: Galena, tetrahedrite, and pyrite.

Production: None.

Reference: Huntting, 1956, p. 306.

Mohawk (Chief Sunshine)

Location: SW¼SE¼ sec. 35, T. 36 N., R. 24 E.

Development: 500- and 150-foot adits.

Geology: 1½- to 3-foot-thick quartz vein in porphyritic granodiorite. Ore shoots up to 1 foot wide contained up to 60 ozs. per ton in silver, 13 percent lead, and 3 percent copper.

Ore minerals: Galena, chalcopyrite, tetrahedrite, and pyrite.

Production: 1890-1893, 1951-1954, 1961 and 1967: total production probably less than 1,000 tons.

References: Moen, 1973, p. 24; Bethune, 1891, p. 60

Monitor

Location: NW¼NW¼ sec. 31, T. 36 N., R. 25 E.

Development: 200-foot adit and 50-foot shaft.

Geology: 2-foot-thick quartz vein in mica schist. Ore shoots contained up to 35 ozs. per ton in silver, and 10 percent lead.

Ore minerals: Galena, sphalerite, and chalcopyrite.

Production: Minor production prior to 1900. Shipment in 1889 netted $250 per ton in silver.

References: Huntting, 1956, p. 309; Jones, 1916, p. 26; Bethune, 1891, p. 56-58.

Nevada

Location: SW¼NE¼ sec. 30, T. 36 N., R. 25 E.

Development: 1,000-foot adit with drifts and crosscuts and 4 shafts up to 220 feet deep.

Geology: 3- to 5-foot-thick quartz vein in schist and gneiss. Ore minerals occur in pod and bands and ore shoots average 4.5 ozs. silver, 3.5 to 8.6 percent lead, 3.15 percent zinc, and 0.2 to 0.7 percent copper.

Ore minerals: Galena, tetrahedrite, pyrite, chalcopyrite, sphalerite, and stromeyerite.

Production: Minor production 1954-1957.

References: Huntting, 1956, p. 307; Moen, 1973, p. 18-20.

Okanogan Belle

Location: Sec. 30, T. 36 N., R. 25 E.
Development: 150-foot crosscut adit.
Geology: 13-foot-thick quartz vein. Select samples from vein and dump assay 92 to 95 ozs. silver and 10 percent lead.
Ore minerals: Minor galena, argentite, and pyrite.
Production: None.
Reference: Huntting, 1956, p. 307.

Peacock

Location: Sec. 19, T. 35 N., R. 25 E.
Development: 170-foot crosscut adit and shaft.
Geology: Quartz veins along contact between gneiss and granodiorite. Vein assays 10.4 to 19.2 ozs. silver, 0.5 to 0.8 percent copper, and 2.2 to 18 percent lead.
Ore minerals: Sparse galena, tetrahedrite, chalcopyrite, sphalerite, and pyrite.
Production: Minor production in the 1920's.
Reference: Huntting, 1956, p. 308.

Plant Callahan

Location: NE¼NE¼ sec. 32, T. 35 N., R. 25 E.
Development: 65- and 175-foot adits.
Geology: Narrow quartz veins in biotite gneiss. Select high-grade samples contained up to 1,000 ozs. per ton in silver.
Ore minerals: Tetrahedrite and pyrite.
Production: Minor prior to 1900.
Reference: Huntting, 1956, p. 308.

Salmon River

Location: NE¼SW¼ sec. 31, T. 36 N., R. 25 E.
Development: 150-foot crosscut adit with 500 feet of drifts. Also 20 and 30-foot adits and 20-foot crosscut.
Geology: Four quartz veins 1 to 5 feet thick in mica schist. Parts of some veins contained up to 4 ozs. per ton in gold, 83 ozs. per ton in silver, and 20 percent lead.
Ore minerals: Argentite, tetrahedrite, galena, sphalerite, and chalcopyrite.
Production: Unknown.
References: Huntting, 1956, p. 309; Jones, 1916, p. 26; Bethune, 1891, p. 56-58.

Shelby

Location: "West side of Peacock Hill." Possibly same as Johnny Boy mine in center sec. 24, T. 35 N., R. 24 E.
Development: 75-foot inclined shaft.
Geology: 6-foot-thick quartz vein in granodiorite. Select samples of vein assayed 29 to 140 ozs. silver and 0.5 to 5 percent lead.
Ore minerals: Galena, arsenopyrite, and pyrite.
Production: None.
Reference: Huntting, 1956, p. 309.

Sherman

Location: SW¼SE¼ sec. 20, T. 34 N., R. 26 E.
Development: 220-foot shaft with over 400 feet of drifts and crosscuts. Also

100- and 40-foot incline shafts.

Geology: 2- to 11-foot-wide metallized shear zones in granite and rhyolite. Parts of the shear zones contained 3.9 to 31 ozs. silver, traces to 0.08 oz. gold, 1.7 to 7.7 percent lead, and 0.67 to 8.1 percent zinc.

Ore minerals: Galena, sphalerite, chalcopyrite, arsenopyrite, and pyrite.

Production: Minor production in 1958.

References: Huntting, 1956, p. 223; Moen, 1973, p. 38-39.

Silver Belle

Location: NE¼ sec. 31, T. 36 N., R. 26 E.

Geology: Quartz vein, 2½ feet thick.

Ore minerals: Chalcocite, argentite, and stromeyerite.

Production: None.

References: Huntting, 1956, p. 310; Moen, 1973, p. 34.

Silver Bluff

Location: NE¼ sec. 31, T. 36 N., R. 26 E.

Development: 65-foot inclined shaft.

Geology: 2-foot-thick quartz vein, parts of which contained up to 110 ozs. per ton in silver, and 3.5 percent copper.

Ore minerals: Argentite and chalcocite.

Production: $80,000 to end of 1923.

References: Huntting, 1956, p. 310; Bethune, 1892, p. 112.

Sonny Boy

Location: S½SE¼ sec. 31, T. 35 N., R. 25 E.

Development: 600-foot main adit with several small stopes, crosscuts, and raises. Surface stope above adit.

Geology: ½- to 6-foot-thick quartz veins in granodiorite. High-grade ore shoots contained up to several hundred ozs. per ton in silver. Existing veins are only sparsely metallized.

Ore minerals: Tetrahedrite, galena, chalcopyrite, sphalerite, and pyrite.

Production: Minor production in 1937 and and 1939.

References: Moen, 1973, p. 14-16.

Sunrise

Location: "On Mineral Hill."

Development: 75-foot adit.

Geology: 4-foot-thick quartz vein with a 14-inch paystreak. High-grade samples assayed 379 ozs. silver per ton.

Ore minerals: Argentite, stephanite, and tetrahedrite.

Production: Unknown.

Reference: Huntting, 1956, p. 311.

Tough Nut

Location: Center NW¼ sec. 31, T. 36 N., R. 25 E.

Development: 50-foot inclined shaft, and a 250-foot adit, with a 40-foot winze.

Geology: 3- to 10-foot-thick quartz vein in quartz-mica schist. Ore shoots contained 47 to 86 ozs. per ton in silver, and 32 to 43 percent lead.

Ore minerals: Galena, sphalerite, and chalcopyrite.

Production: $9,000 prior to 1901.

References: Bethune, 1891, p. 55-56; Jones, 1916, p. 25; Gage, 1941, p. 209.

Wheeler (Mineral Hill)

Location: Center sec. 2, T. 35 N., R. 24 E.

Development: 3,000 feet of drifts, crosscuts, and shafts. Main adit consists of a 1,200-foot drift with a 1,400-foot crosscut. A 135-foot shaft from surface to main adit. Also several short adits.

Geology: Quartz veins from 1 to 36 inches thick in granodiorite. Columbia vein contained ore that averaged 34 ozs. per ton in silver, 0.22 oz. gold, and 10 percent lead. A 100-foot-thick molybdenite-bearing dike reported on property.

Ore minerals: Galena, chalcopyrite, sphalerite, tetrahedrite, and pyrite occur as disseminated grains in the quartz veins.

Production: Minor production in 1938 and 1939.

References: Moen, 1973, p. 20-24.

Windfall

Location: Sec. 28, T. 34 N., R. 24 E.

Development: 60-foot shaft.

Geology: 3-foot-thick quartz vein in granodiorite. Select samples of vein assayed 118 to 325 ozs. silver per ton.

Ore minerals: Stephanite and cerargyrite.

Production: None.

Reference: Huntting, 1956, p. 311.

Woo Loo Moo Loo

Location: NE$\frac{1}{4}$NE$\frac{1}{4}$ sec. 5, T. 34 N. R. 25 E.

Development: 150-foot shaft.

Geology: 8-foot-thick quartz vein in biotite-hornblende gneiss.

Ore minerals: Galena and tetrahedrite.

Production: None.

References: Huntting, 1956, p. 305; Moen, 1973, p. 27.

LOOMIS DISTRICT

Location

For the purpose of this report the Loomis district includes the Nighthawk, Oroville, Palmer Mountain, and Wannacut Lake districts of north-central Okanogan County. These combined districts extend from the Okanogan River westward to the west border of R. 23 E., and from the international border southward to the north border of T. 37 N. For the most part the district is mountainous, with several peaks in the west half of the district exceeding 6,000 feet in elevation. In the east half, the elevations of the main peaks are 3,000 to 5,000 feet. Near the central part of the district, elevations along the Sinlahekin Valley range from 1,200 to 1,700 feet; while along the Okanogan River, elevations are around 900 feet. Deposits of gold, lead, and silver predominate in the Loomis district, and several thousand ounces of silver have been produced from the mines of the area.

Geology and Mineralization

Most silver mines and prospects of the Loomis district are of the quartz fissure vein type. The veins, which are believed to be middle Cretaceous to early Tertiary age, occur in Jurassic or Cretaceous granodiorite, as well as in argillite, limestone, conglom-

erate, quartzite, and greenstone of Permian or Triassic age. The veins range from stringers less than 1 inch to massive quartz veins 20 feet thick. They display a wide variety of strikes and dips, and have a tendency to pinch and swell. One or several of the following ore minerals are present in the veins: pyrite, arsenopyrite, chalcopyrite, galena, sphalerite, scheelite, argentite, proustite, pyrargyrite, native silver, and free gold. In some veins the ore minerals are segregated into irregular bands that parallel the walls of the vein, while in other veins the ore minerals occur in pods or lenses. Most deposits exhibit little in the way of secondary enrichment. However, at the Ivanhoe mine, near-surface parts of the vein contained abundant silver oxides and native silver. The ore in most veins has not been mined for much more than 100 feet in stope and pitch lengths, which indicates that the majority of the deposits are small. However, at the Ruby the vein contained ore for as much as 800 feet along the strike of the vein, and for as much as 770 feet beneath the outcrop of the vein. At the Kaaba-Texas mine the vein has been mined for up to 800 feet along its strike, and to a depth of 360 feet beneath its outcrop. The maximum vertical extent of the ore minerals in the veins of the district has yet to be determined.

Some veins were extremely rich in silver, but the average silver content of the veins was only about 5 ounces per ton. Hand-sorted, near-surface ore from the Ivanhoe contained 572 ounces per ton in silver, whereas high-grade gold ore from the Rainbow mine assayed up to 200 ounces per ton in silver. The Ruby, which is a true silver mine, produced several thousand tons of ore that averaged 10 ounces per ton in silver; however, some parts of the vein contained several hundred ounces per ton in silver. The Kaaba-Texas, which was the major silver-producing mine in the district, produced 74,485 tons of lead-copper-zinc ore that averaged only 1.825 ounces per ton in silver.

Production

The major silver-producing mines were the Ruby, which produced around 100,000 ounces of silver from 1915 to 1926, and the Kaaba-Texas, which produced about 200,000 ounces from 1915 to 1951. At the Ruby, silver was the predominant metal, whereas at the Kaaba-Texas, lead, silver, zinc, and copper were the predominant metals. In addition to the Ruby and Kaaba-Texas mines, minor silver was produced during the early 1900's at the Horn Silver, Bullfrog, Golden Zone, Mountain Sheep, Number One, Bellevue, Ivanhoe, and Rainbow mines. Mining in the district ceased in 1951 with the closure of the Kaaba-Texas mine; however, minor exploration has been undertaken at several properties in the district over the past 20 years.

Major Mines

Ivanhoe mine

This mine near the summit of Palmer Mountain was for a short time a producer of some of the richest silver ore mined in Washington. Hand-sorted, near-surface ores mined from 1888 to 1897 contained up to 1,000 ounces per ton in silver, as well as several ounces of gold. Around 1,000 tons of ore was shipped to smelters in Washington and Montana; several shipments averaged 392 ounces per ton in silver and 1.20 ounces in gold.

The Ivanhoe vein was first developed by several shallow shafts, one of which was later sunk to a depth of 500 feet on the vein. Inasmuch as the richest

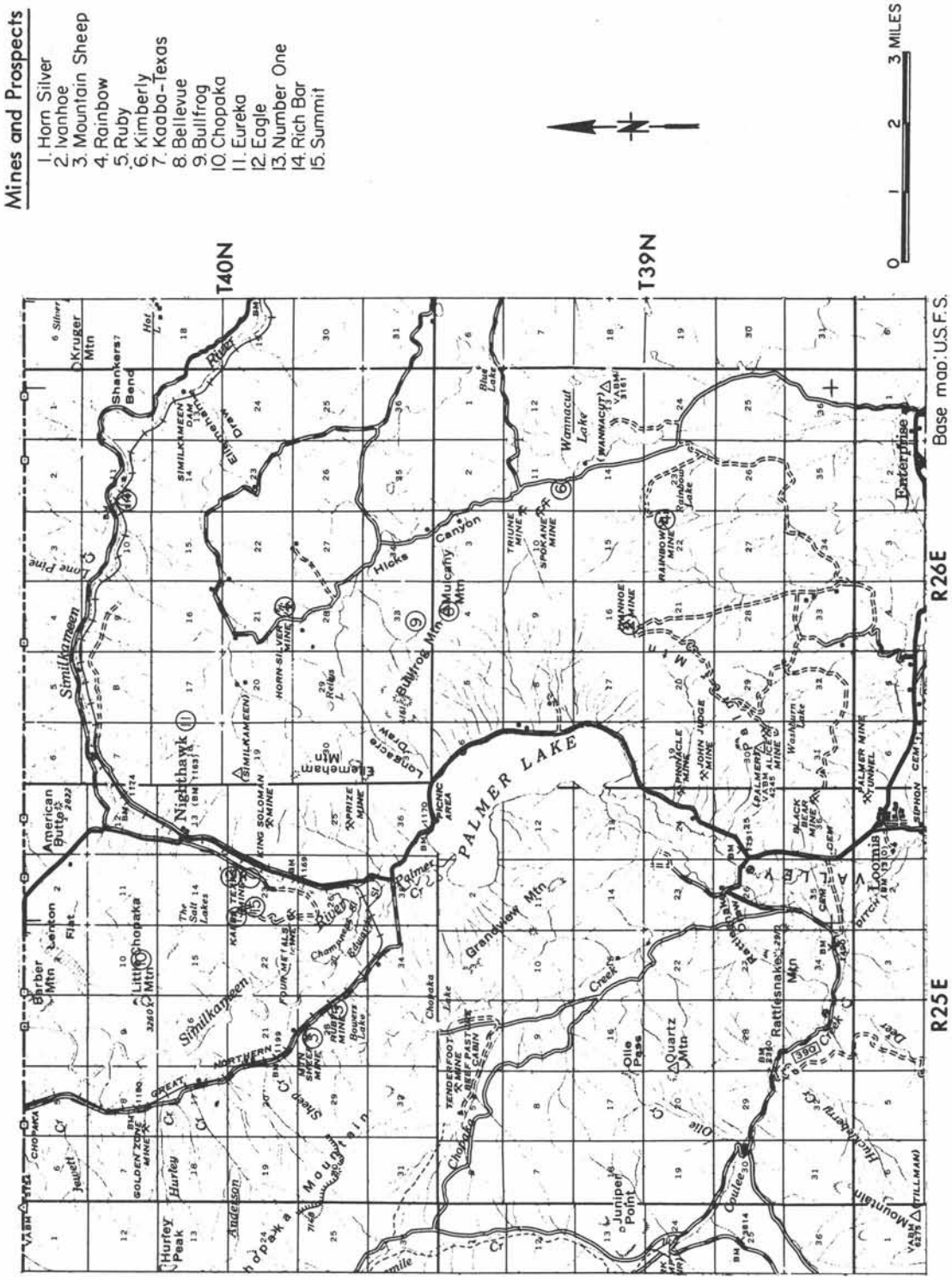


FIGURE 18.—Index map of the Loomis district.

silver ore proved to be near the surface, the ore was mined by stripping the hanging wall of the vein over an area of 70 by 120 feet, and to a maximum depth of around 30 feet. Around 1914, a 4,400-foot crosscut was driven from the west slope of Palmer Mountain to intersect the Ivanhoe vein at a depth of 1,560 feet. Although at least seven quartz veins were encountered, the average silver content of the veins proved to be less than 1 ounce per ton. Mining activity apparently ceased at the Ivanhoe around 1915. Currently (1975), only the 4,400-foot crosscut is accessible; other workings on the property are caved or full of water.

The Ivanhoe vein is a 3½- to 4½-foot-thick quartz fissure vein, which has for host rocks Permian carboniferous phyllite and slaty argillite. Near the surface the vein is greatly fractured and contorted. It has a general north-northwest strike, and dips 60° W. At one time the vein was stripped of its overburden for around 1,200 feet; however, very little of the vein is presently visible. The ore minerals consist of pyrite, tetrahedrite, galena, stephanite, cerargyrite, native silver, and free gold. Ore that was mined occurred in a 2½-foot-wide ore shoot that contained dark streaks and blotches of very fine-grained ore minerals. Currently (1975), only a small part of the vein is visible at the collar of the inclined shaft on the Ivanhoe claim. Select samples from this part of the vein assayed 91.70 ounces per ton in silver. Because the 500-foot inclined shaft is caved near its collar and full of water, the silver content of other parts of the vein remains unknown. The silver content of seven quartz veins exposed in the 4,400-foot crosscut ranges from 0.34 to 1.82 ounces per ton; the gold content averages less than 0.02 ounce per ton.

Ruby Mine

This mine, which is 3 miles southwest of Nighthawk, was an important silver mine of the Loomis area, having produced around 100,000 ounces of silver from 1915 to 1922. High-grade ore contained as much as several hundred ounces per ton in silver, but mill-run ore averaged only 10 ounces per ton in silver. In 1920, Pyrargyrite Mining Company built a 75-ton flotation mill at the mine, and from 1920 to 1923, the company produced silver concentrates. Prior to 1920, only crude ore was shipped to smelters. Except for small-scale development work, the mine is currently inactive.

The mine, which is 2½ miles northwest of Palmer Lake, is developed by at least 5,000 feet of underground workings, and several stopes. The main adit intersects the Ruby vein 950 feet from the adit's portal, and 550 feet beneath the outcrop of the vein. At the adit level the vein has been drifted upon for 600 feet, and near the face of the northwest drift a winze was sunk 210 feet on the vein. Raises follow the vein upward from the adit level to the surface, and connect with four intermediate levels.

The Ruby vein is a quartz fissure vein in a shear zone in granodiorite of Cretaceous age. The vein averages 3 feet in thickness, strikes N. 45° W., and dips 42° SW. The ore minerals, which occur as sparsely scattered grains in the vein, consist of pyrite, arsenopyrite, chalcopyrite, galena, sphalerite, pyrargyrite, proustite, and argentite. The vein contains at least two ore shoots, parts of which have been mined; all parts of the vein have yet to be explored.

Principal Silver Deposits of Loomis District

Bellevue

Location: SE¼NW¼ sec. 4, T. 39 N., R. 26 E.

Development: Shallow shaft and several open cuts.

Geology: 1- to 3-foot-thick quartz vein in slate. Hand-sorted ore contained 60 ozs. silver and 2 ozs. gold per ton.

Ore minerals: Chalcopyrite, pyrargyrite, native silver, free gold, pyrite, and arsenopyrite.

Production: Minor.

References: Huntting, 1956, p. 136; Rinehart and Fox, 1972, p. 78-79.

Bullfrog

Location: S½SW¼ sec. 33, T. 40 N., R. 26 E.

Development: 140- and 160-foot shafts and 1 adit.

Geology: 7-foot-thick quartz vein in quartzite and schist. Vein traceable for 3,000 feet and assays up to 10 ozs. silver and 0.5 oz. gold.

Ore minerals: Pyrite and fine-grained black sulfides.

Production: Minor production in early 1900's.

Reference: Huntting, 1956, p. 63.

Chopaka

Location: S½ sec. 10, T. 40 N., R. 25 E.

Development: 30-foot adit.

Geology: 10-foot-thick quartz vein in granodiorite. Select samples of vein assayed 0.80 to 1.10 ozs. gold, 75 to 125 ozs. silver, and 1.5 to 1.9 percent copper.

Ore minerals: Chalcopyrite and pyrite.

Production: None.

Reference: Huntting, 1956, p. 38.

Eagle

Location: NE¼ sec. 23, T. 40 N., R. 25 E.

Development: 110-foot adit.

Geology: 12-foot-thick quartz vein. Select samples from vein assayed 18 to 310 ozs. silver, and 10 to 12 percent lead.

Ore minerals: Galena and pyrite.

Production: None.

Reference: Huntting, 1956, p. 218.

Eureka

Location: Secs. 17 and 18, T. 40 N., R. 26 E.

Development: 7 shafts with a total of 360 feet of workings.

Geology: 3- to 7-foot-thick quartz veins in granodiorite. Average of eight assays of the veins showed 17.71 ozs. silver and 7.15 percent lead.

Ore minerals: Galena and pyrite.

Production: None.

Reference: Huntting, 1956, p. 218.

Horn Silver

Location: S½ sec. 21, T. 40 N., R. 26 E.

Development: 750-foot adit and a 100-foot shaft.

Geology: Quartz veins up to 4 feet thick in argillite and granodiorite. Ore shoots averaged around 110 ounces per ton in silver.

Ore minerals: Stephanite, cerargyrite, proustite, galena, chalcopyrite, sphalerite, and pyrite.

Production: Several carloads prior to 1910.

References: Umpleby, 1911b, p. 100; Huntting, 1956, p. 304.

Ivanhoe

Location: SW¼ sec. 16, T. 39 N., R. 26 E.

Development: 4,400-foot crosscut adit, 500-foot inclined shaft, and a 70-foot vertical shaft.

Geology: 3½- to 4½-foot-thick quartz vein in calcareous argillite. Near the surface the vein contained a 2½-foot-thick ore shoot that carried from 36 to 572 ounces of silver per ton. Select samples of the vein assays up to 50 ounces per ton in silver.

Ore minerals: Pyrargyrite, cerargyrite, stephanite, native silver, free gold, galena, and pyrite.

Production: 1888 to 1897, around 1,000 tons of hand-sorted, high-grade ore.

References: Bethune 1891, p. 63-64; Bethune 1892, p. 99.

Kaaba-Texas

Location: Center NE¼ sec. 23, T. 40 N., R. 25 E.

Development: 300-foot inclined shaft, with 1,100 feet of drifts on four levels.

Geology: 6- to 12-foot-thick quartz vein along lamprophyre-granodiorite contact. Ore averaged 2.25 ozs. per ton in silver, 1.2 percent lead, ½ percent zinc, and 0.1 percent copper. Ore minerals occur as bands along footwall, and as lenses and pods along hanging wall.

Ore minerals: Galena, chalcopyrite, sphalerite, molybdenite, scheelite, and pyrite.

Production: 1918, 1943-1951: around 205,000 ozs. of silver. 1943-1946: 135,973 ozs. silver, 1,357,185 lbs. lead, 506,050 lbs. zinc, 99,410 lbs. copper.

References: Patty, 1921, p. 228-231; Gage, 1941, p. 216-219; Culver and Broughton, 1945, p. 34-35.

Kimberly

Location: Near center SW¼ sec. 11, T. 39 N., R. 26 E.

Development: 140-foot inclined shaft, with drifts on the 60-, 80-, and 100-foot levels.

Geology: En echelon quartz lenses along contact between diorite and slaty argillite. Ore shoots, 1 to 5 feet wide and 40 to 50 feet long, containing 60 to 70 ozs. per ton in silver, 10 to 20 percent lead, and up to 1 oz. of gold.

Ore minerals: Galena, sphalerite, chalcopyrite, and pyrite.

Production: Amount not known.

References: Umpleby, 1911b, p. 96-97.

Mountain Sheep

Location: NE¼NW¼ sec. 28, T. 40 N., R. 25 E.

Development: Three adits totaling 2,000 feet.

Geology: Quartz vein up to 6 feet thick in granodiorite. Select ore samples assayed up to 100 ozs. per ton in silver.

Ore minerals: Unknown.
Production: Few carloads prior to 1911.
References: Huntting, 1956, p. 307.

Number One

Location: NW¼NW¼ sec. 23, T. 40 N., R. 25 E.
Development: 200-foot adit and several shafts, one of which connects with the adit.
Geology: 3- to 12-foot-thick quartz vein along fault between granodiorite, and slate and conglomerate. Parts of vein assays up to 50 ozs. silver and 20 percent lead.
Ore minerals: Galena.
Production: None.
Reference: Huntting, 1956, p. 221.

Rainbow

Location: Center NE¼ sec. 22, T. 39 N., R. 26 E.
Development: Three adits, with a total of 850 feet of workings.
Geology: Quartz lenses in limestone, schist, and quartzite. Ore shoots contained up to 200 ozs. per ton in silver, two percent copper, and up to 3½ percent lead.
Ore minerals: Chalcopyrite, galena, native gold, malachite, arsenopyrite, and pyrite.
Production: Has produced, but amount unknown.
References: Rinehart and Fox, 1972, p.100-101; Huntting, 1956, p. 147.

Rich Bar

Location: SW¼NW¼ sec. 11, T. 40 N., R. 26 E.
Development: 2 shafts, deepest one 150 feet, with drifts at 50- and 150-foot levels.
Geology: Quartz veins up to 6 feet thick in quartzitic slate.
Ore minerals: Chalcopyrite, sphalerite, galena, stephanite, argentite, and pyrite.
Production: None.
Reference: Huntting, 1956, p. 70.

Ruby

Location: NE¼SE¼ sec. 28, T. 40 N., R. 25 E.
Development: 950-foot adit, with 5,000 feet of drifts and raises.
Geology: Metallized shear zone in granodiorite averages around 3 feet in thickness. Gangue consists of quartz, calcite, and gouge. High-grade ore averaged several hundred ounces per ton in silver; mill-run ore averaged around 10 ozs. per ton.
Ore minerals: Pyrargyrite, proustite, argentite, galena, chalcopyrite, sphalerite, native gold, arsenopyrite, and pyrite.
Production: 1915-1923: around 100,000 ozs. of silver.
References: Huntting, 1956, p. 309; Patty, 1921, p. 237-240; Umpleby, 1911b, p. 94-95; Gage, 1941, p. 224-225.

Summit

Location: NE¼NW¼ sec. 23, T. 40 N., R. 25 E.

Development: 70-foot inclined shaft.

Geology: $3\frac{1}{2}$- to 4-foot-thick quartz vein in granodiorite. Vein assays 5 to 7 ozs. per ton in silver.

Ore minerals: Galena, sphalerite, chalcopyrite, molybdenite, and pyrite.

Production: None.

References: Huntting, 1956, p. 310; Rinehart and Fox, 1972, p. 104-105.

SHERIDAN DISTRICT

Location

The Sheridan district is about 10 miles northwest of Republic, in northeastern Okanogan County. Most silver occurrences are immediately west of the Ferry-Okanogan county line, and in sections 23, 24, 25, and 26, T. 38 N., R. 31 E. The Zalla M. mine, which produced rich silver ore, is 0.2 miles east of the district's eastern border, but because of its proximity and similarity to silver deposits of the Sheridan district, it is included in this discussion.

Geology and Mineralization

The silver deposits of the Sheridan district occur in quartz fissure veins, and in narrow shear zones in phonolite of the Klondike Mountain Formation of Oligocene and Miocene(?) age. Although granitic rocks do not crop out at the silver mines, they form extensive outcrops $\frac{1}{2}$ to $1\frac{1}{2}$ miles east of the mines. High-angle north-trending faults separate the granitic rocks (Cretaceous or older) from the Klondike Mountain Formation.

At the Sheridan and American Flag mines, unidentified silver minerals occur in 1- to 8-foot-wide

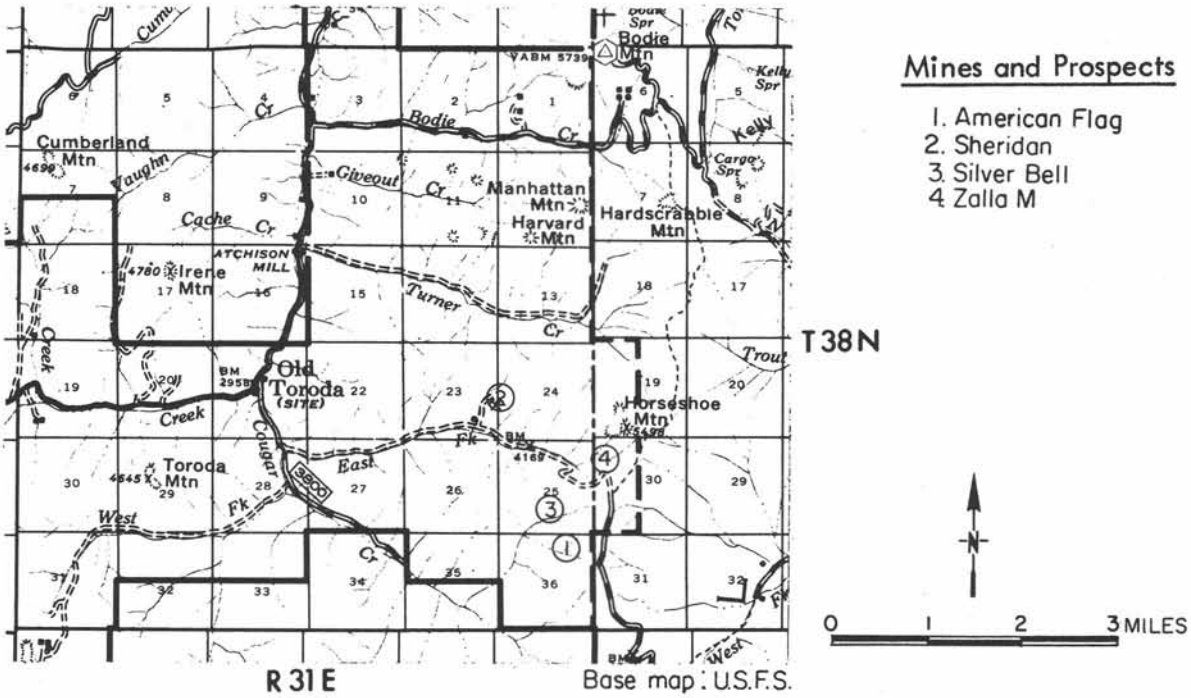


FIGURE 19.—Index map of the Sheridan district.

shear zones in phonolite. The brecciated rocks of the shear zones have been altered and silicified; common alteration products are kaolin and sericite. Ore shoots at the Sheridan mine averaged 15 ounces per ton in silver. The ore minerals are not visible, and assays were necessary to determine ore-grade material.

At the American Flag mine, the silicified shear zones contained ore shoots composed of bornite, chalcopyrite, sphalerite, pyrite, and unidentified minute sulfides believed to be a silver mineral. At the Zalla M. and Silver Bell mines, silver is found in ore shoots of galena, chalcopyrite, and pyrite that occur in fissure veins composed of quartz, fluorite, and calcite. The veins range from 1 to 6 feet in thickness, are north trending, and steeply dipping. Although silver ore from the veins averaged around 15 ounces per ton in silver, and hand-sorted ore contained up to 118 ounces per ton, the main silver mineral of the district is unknown. Much of the silver appears to be contained in dark-gray streaks composed of minute opaque particles that might possibly be tetrahedrite or argentite. Some silver occurs in argentiferous galena, and Pearson (1967, p. 3) reports the presence of hessite (silver telluride) and krennerite (gold-silver telluride) in the Zalla M. vein.

Numerous prospect pits and short adits in the district expose quartz veins and pyritized shear zones; however, the veins and shear zones contain only traces of silver.

Production

Shipments of high-grade silver ore were made from the district as early as 1898; by 1919, the combined production from the Zalla M., Sheridan, Silver Bell, and American Flag mines reached $100,000. Except for small shipments in 1935, 1940, and 1968, mines of the district have been idle.

Principal Silver Deposits of Sheridan District

American Flag

Location: NE¼ sec. 36, T. 38 N., R. 31 E.
Development: 97-foot drift with a 97-foot winze.
Geology: 2- to 8-foot-wide silicified shear zone in phonolite. Ore shoots up to 16 feet long average 16 ozs. per ton in silver, and 36 percent copper.
Ore minerals: Chalcopyrite, bornite, sphalerite, argentite and pyrite.
Production: 60 tons around 1918.
References: Patty, 1921, p. 196-198; Gage 1941, p. 172-173.

Sheridan

Location: SW¼ sec. 24, T. 38 N., R. 31 E.
Development: Several adits with a total of around 900 feet of underground workings. Also a 300-foot shaft.
Geology: 1- to 7-foot-wide silicified shear zone in phonolite. Mill feed averaged 15 ozs. per ton in silver.
Ore minerals: Unidentified minute sulfides.
Production: 1910-1919: total production estimated between $60,000 and $100,000.
Reference: Patty, 1921, p. 194-196.

Silver Bell

Location: NW¼SE¼ sec. 25, T. 38 N., R. 31 E.
Development: 340-foot adit and a 600-foot drift.

Geology: Silicified shear zone in phonolite. Two ore shoots contained up to 30 ozs. per ton in silver.

Ore minerals: Unidentified minute sulfides.

Production: Early 1900's and 1940: minor production

References: Huntting, 1956, p. 148.

Zalla M.

Location: NW¼ sec. 30, T. 38 N., R. 32 E.

Development: Two adits with 1,000 feet of underground workings. Main crosscut adit 470 feet long with 300-foot drift on vein.

Geology: 1- to 6-foot-thick quartz vein in phonolite. Secondary enrichment from surface to depth of 150 feet. Hand-sorted ore contained 86 to 118 ozs. per ton in silver, and 0.17 to 0.25 ozs. gold.

Ore minerals: Chalcopyrite, silver sulfides, and pyrite.

Production: $40,000 prior to 1903. 1968: 300 tons.

Reference: Patty, 1921, p. 198-200.

NESPELEM DISTRICT

Location

The Nespelem district is in southeastern Okanogan County, and extends from the Ferry County border westward to the Okanogan River, and from the north line of T. 32 N. to the Columbia River. Most silver deposits of the district are in T. 31 N., R. 30 E., where elevations range from 1,815 feet at Nespelem to 3,440 feet on the summit of Squaw Mountain. The area is sparsely vegetated with sagebrush and bunchgrass, and the northern slopes of most mountains are covered by pine forests. Many parts of the district, especially adjacent to the Columbia River, are steep and rocky and have very little soil cover.

Geology and Mineralization

Silver deposits of the Nespelem district occur along shear zones, and in quartz fissure veins in granodioritic rocks of the Colville batholith (Cretaceous). The shear zones and quartz veins have general northwest strikes, and dip 40° to 70° northeast. They vary from several inches to as much as 10 feet in thickness; however, ore shoots in the shear zones average not much more than 1 foot in thickness. The main silver minerals of the shear zone deposits are sooty argentite, stephanite, pyrargyrite, proustite, and native silver. In unoxidized parts of the shear zones, stephanite, galena, and sphalerite are the principal ore minerals. In addition to the ore minerals, the shear zones contain sericitized granodiorite, quartz, calcite, fluorite, rhodochrosite, and pyrite.

The ore shoots occur as tabular and lenticular bodies that are separated from other parts of the shear zones by black gouge. The size of the ore shoots is generally small. The largest ore shoot at the Apache mine was 12 to 18 inches thick, had a stope length of 40 feet, and a pitch length of 70 feet. At the Little Chief mine, the most productive ore shoot had an average thickness of 2 feet, a stope length of 60 feet, and a pitch length of 100 feet. In both of these mines the richest ore occurred where minor cross fractures intersected the main shear zones.

Crude ore from the district contained 14 to 25 ounces of silver per ton. Hand-sorted shipments of ore from the Apache mine contained 560 ounces of silver and 0.8 ounce of gold per ton. Ore from the Little Chief contained 124 ounces per ton in silver,

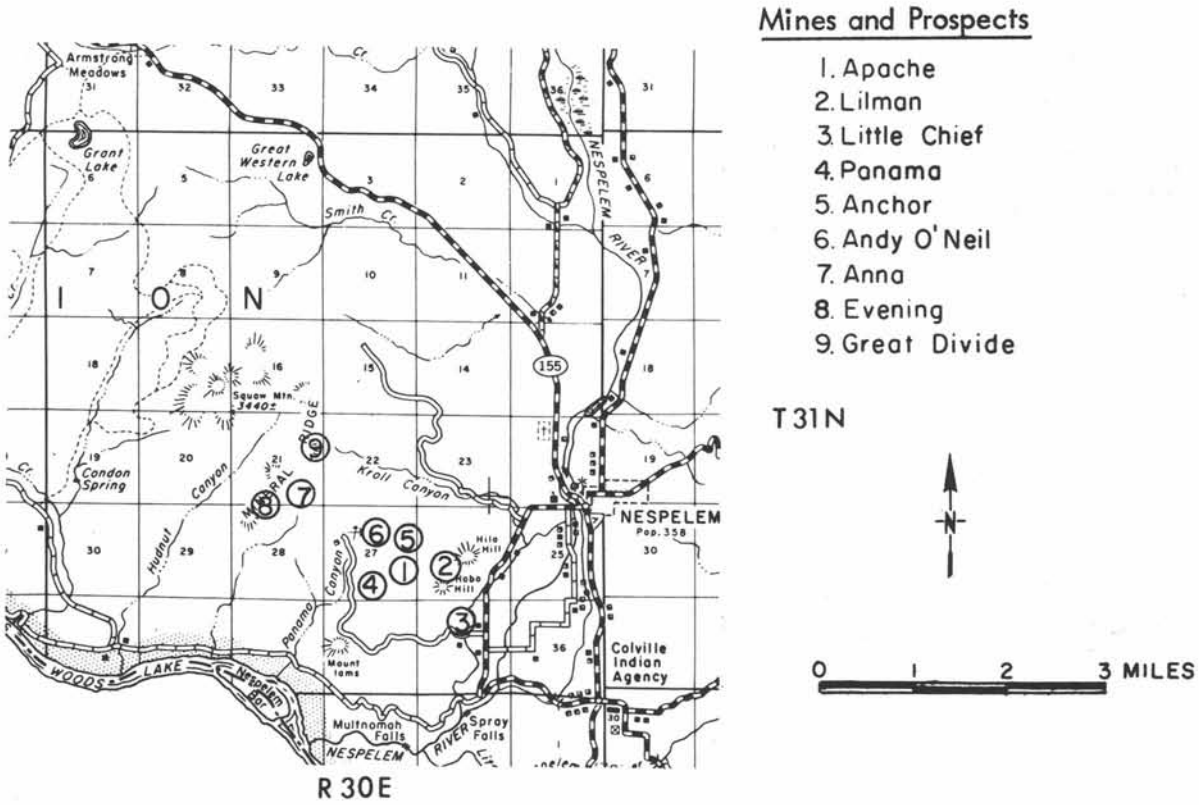


FIGURE 20.—Index map of the Nespelem district.

and 0.2 ounce in gold; however, some shipments assayed as much as 590 ounces per ton in silver. The richest ore shoots at producing mines in the district occurred beneath the leached zone, and for depths of 150 to 200 feet beneath the surface. From 15 to 40 feet beneath the surface most shear zones are leached and barren of ore minerals.

The quartz veins of the district have yielded only minor amounts of silver. The veins, which range from 1 to 4 feet in thickness, contain galena, sphalerite, tetrahedrite, chalcopyrite, and pyrite. For the most part the ore minerals are only sparsely disseminated in the quartz veins. In some veins, pods and lenses of ore minerals comprise up to 25 percent of the veins. Shipments of galena-rich ore from several quartz veins contained 1.2 to 10.3 ounces of silver per ton, which indicates the low silver content of galena from the district.

In summary, some very rich silver ore has been mined in the Nespelem district; however, ore shoots are small and sporadically distributed in shear zones, which are the main metallized structures.

Production

Silver mining began in the Nespelem district in 1911, and by 1920 over 150,000 ounces of silver had been mined from high grade, near-surface deposits. The bulk of the production came from the Apache and Little Chief mines, which are 2 miles west of Nespelem. The total silver production for

the district from 1911 through 1968, is estimated at 172,659 ounces. In addition to silver, mines of the district produced around 9,000 pounds of lead, 400 ounces of gold, and 300 pounds of copper. Currently (1975) there are no producing mines in the district.

Major Mines

Apache

This property, which is 1½ miles southwest of Nespelem, was the richest and most productive silver mine in the Nespelen district. The estimated production from 1911 to 1940 is around $250,000 in silver, and $20,000 in gold. Shipments to the Tacoma smelter in 1911, contained around $350 per ton in gold and silver. Small hand-sorted, high-grade shipments contained up to 2,444 ounces of silver to the ton. The bulk of the ore averaged 10 to 20 ounces of silver, and was concentrated at the Great Metals mill near Nespelem Falls, prior to shipment to the Tacoma smelter.

The mine is developed by a main haulage adit that is 700 feet long, and by 2,500 feet of underground workings on three levels. Most of the vein between the third level and the main adit has been stoped, and at least one stope extends from the main level to the surface. In addition to the main adit, the mine contains two shafts and three short adits, all of which follow a metallized shear zone.

The ore bodies occur along a shear zone, which strikes N. 50° E., and dips 50° NE., in granodiorite. In places the shear zone is displaced a foot or more by cross fractures. Some of the richest ore appears to have been deposited at the intersection of cross fractures and the main shear zone. The upper 25 feet of the deposit is oxidized, and leached of its metals. Below the oxidized zone, stephanite is the most important primary mineral, while argentite and native silver are the most important secondary minerals. Other ore minerals include galena, tetrahedrite, sphalerite, pyrargyrite, chalcopyrite, and pyrite. Common gangue minerals are quartz and rhodochrosite. The ore minerals occur in pods and lenses that pinch and swell along the strike and dip of the lode. The principal high-grade ore shoot, which has been mined out, had a maximum thickness of 2 feet, a stope length of 100 feet, and a pitch length of 150 feet. Other ore shoots had stope lengths of 30 to 40 feet. Much of this ore contained around 300 ounces of silver per ton, and almost 0.75 ounce of gold. In levels below the main adit, the gold and silver content of the ore decreased, whereas the copper and zinc content increased. Other parts of the lode are reported to have contained 16 to 20 ounces of silver per ton, over widths of 4 to 5 feet. Although the main ore shoots appear to have been mined out, further exploration of the shear zone below the zone of oxidation might possibly uncover additional shoots.

Little Chief

This property is three-quarters of a mile southeast of the Apache mine, and was the second most productive silver mine in the Nespelem district. Mining began in 1911, and by 1921 around $60,000 in silver had been produced from ore that contained 77 to 590 ounces of silver per ton, and 0.09 to 0.31 ounce of gold. The mine reportedly produced small amounts of ore in 1937 and 1954, which was concentrated at a 50-ton flotation mill near the portal of the main adit.

The main adit of the mine is around 560 feet long, and contains 640 feet of crosscuts and drifts.

Near the face of the adit a raise follows the lode for 200 feet to the surface. From near the surface to a depth of about 130 feet the lode has been mined for 60 feet on both sides of the raise. Ore was also mined from several small stopes in the main adit; however, the bulk of the production came from stopes in the raise.

Ore shoots occur in a well-defined shear zone that strikes N. 60° W. and dips 38° NE. The shear zone, in granodiorite, ranges from 2 to 10 feet in width, and consists of fragments of granodiorite, clay, sericite, quartz, and calcite. Ore minerals consist of argentite, pyrargyrite, stephanite, native silver, chalcopyrite, and pyrite. These minerals occur in small stringers, pods, and lenses along the shear zone. Within 100 feet of the surface, one lens of pyrargyrite, which was mined over a thickness of 2 feet and over a stope length of 30 feet, yielded around 1,000 ounces of silver. Although parts of the Little Chief workings contain sparsely disseminated ore minerals, no ore shoots appear to be present in the accessible mine workings. The owners of the mine report that ore is present in parts of the mine that are now inaccessible because of caved ground.

Principal Silver Deposits of Nespelem District

Anchor

Location: NE¼ sec. 27, T. 31 N., R. 30 E.
Development: Several caved adits and shafts.
Geology: Metallized shear zones in granodiorite. Select samples from the shear zones assayed up to 149.5 ozs. silver and 0.22 oz. gold.
Ore minerals: Argentiferous galena, sphalerite, and minor chalcopyrite.
Production: None.
Reference: Huntting, 1956, p. 300.

Andy O'Neil

Location: N¼ cor. sec. 27, T. 31 N., R. 30 E.
Development: 2 adits connected by a raise. Total underground workings about 800 feet.
Geology: 1- to 4-foot-thick quartz-calcite veins in granodiorite. Ore assays up to 30 ozs. silver and 20 percent lead.
Ore minerals: Galena, chalcopyrite, tetrahedrite, bornite, and pyrite.
Production: Minor production in 1965 and 1968.
Reference: Huntting, 1956, p. 300.

Anna

Location: SE¼ sec. 21, T. 31 N., R. 30 E.
Development: 140-foot adit and a 60-foot shaft.
Geology: 4-foot-thick shear zone in granodiorite contains metallized quartz veins, which assay up to 43 ozs. per ton in silver.
Ore minerals: Galena and pyrite with minor sphalerite and chalcopyrite.
Production: None.
Reference: Huntting, 1956, p. 300.

Apache

Location: Center E½ sec. 27, T. 31 N., R. 30 E.
Development: 2,500 feet of underground workings on three levels, including

three adits and three shafts. Main adit 560 feet long.

Geology: Tabular lenses and veinlets of ore along an 8- to 10-foot-wide shear zone in granodiorite. Ore shoots contained up to 300 ozs. per ton in silver and 3/4 oz. of gold; select high-grade ore contained up to 2,444 ozs. per ton in silver, and bulk of ore averaged 10 to 20 ozs. per ton in silver.

Ore minerals: Stephanite, argentite, pyrargyrite, galena, tetrahedrite, sphalerite, chalcopyrite, and pyrite.

Production: 1911-1940: $250,000 in silver and $20,000 in gold.

References: Pardee, 1918, p. 72-74, 68-70; Patty 1921, p. 207-209; Huntting, 1956, p. 300.

Evening

Location: S½SE¼ sec. 21, T. 31 N., R. 30 E.

Development: Several small pits.

Geology: Lime-silicate bands in argillite and schist. Bands assay up to 20.2 ozs. per ton in silver.

Ore minerals: Galena, sphalerite, chalcopyrite, and pyrite.

Production: None.

Reference: Huntting, 1956, p. 302.

Great Divide

Location: E½NE¼ sec. 21, T. 31 N., R. 30 E.

Development: 300-foot adit with 100 feet of crosscuts. Also several short adits.

Geology: Shear zone up to 50 feet wide in granodiorite contains metallized quartz veinlets. Ore minerals also occur in pods up to 2 feet in diameter, which assay up to 100 ozs. per ton in silver.

Ore minerals: Galena, chalcopyrite, chalcocite, and pyrite.

Production: Unknown.

Reference: Huntting, 1956, p. 303.

Lilman

Location: SE¼SE¼ sec. 27, T. 31 N., R. 30 E.

Development: 35- and 50-foot shafts; 150-foot adit.

Geology: Lenses and veinlets of ore along a 1½- to 20-foot-wide shear zone in granodiorite. 3 inches of ore along hanging wall contained 80 ozs. per ton in silver and 0.20 oz. of gold.

Ore minerals: Tetrahedrite, chalcopyrite, pyrite, and pyrrhotite.

Production: 16 tons prior to 1940.

References: Huntting, 1956, p. 306.

Little Chief

Location: NE¼NW¼ sec. 35, T. 31 N., R. 30 E.

Development: 560-foot adit with 640 feet of drifts and crosscuts; 200-foot shaft with stopes.

Geology: 2- to 10-foot-wide shear zone in granodiorite containing stringers, pods, and lenses of ore minerals. Near-surface ore shoots were up to 2 feet thick and 30 feet long, and contained 77 to 590 ozs. of silver per ton, and 0.09 to 0.31 ozs. of gold.

Ore minerals: Argentite, pyrargyrite, steph-

anite, native silver, chalcopyrite, and pyrite.

Production: 1911 to 1921: $60,000 in silver. 1937 and 1954: small amount of concentrates.

References: Patty, 1921, p. 213-214; Pardee, 1918, p. 74; Huntting, 1956, p. 306.

Panama

Location: Center S½ sec. 27, T. 31 N., R. 30 E.

Development: 30-foot crosscut adit with short drift and small stope; 170-foot crosscut adit with 100-foot drift.

Geology: Quartz lenses and veins along 4-foot-wide shear zone in granodiorite. High-grade ore shoots contained 57 ozs. per ton in silver, and several ozs. per ton in gold.

Ore minerals: Argentite, stephanite, native silver, minor chalcopyrite, and pyrite.

Production: 1919, 1921, and 1936: 26 tons total.

References: Patty, 1921, p. 209-211; Huntting, 1956, p. 308.

PARK CITY DISTRICT

The Park City district is in east-central Okanogan County and about 15 miles southwest of Republic. Lead-silver deposits were discovered in the district in 1898, and from 1905 to 1920 mining was undertaken at several properties; however, total production from the district has not exceeded $10,000.

The lead-silver veins of the district occur along and near the contact between quartz monzonite of the Colville batholith (Cretaceous) and Triassic black shale, phyllite, and limestone. The veins are of the quartz fissure type and have diverse strikes and dips. They vary in thickness from less than 1 inch to as much as 7 feet, and pinch and swell along their strikes and dips. Most veins cannot be followed for much more than 50 feet, but several veins are over a hundred feet in length. Common sulfide minerals of the veins include pyrite, galena, and sphalerite; chalcopyrite and tetrahedrite are present only rarely. Quartz is the chief gangue mineral and is accompanied by minor calcite, fluorite, and sericite. Most commonly the sulfides are sparsely disseminated in the quartz veins, but in some veins the sulfides are concentrated into small lenses, pods, and stringers. According to Pardee (1918, p. 95-102) the veins contain up to 182 ounces per ton in silver, traces to 0.10 ounce in gold, 2.7 to 40.3 percent lead, 0.05 to 0.3 percent copper, and 3.2 to 6 percent zinc. Although small shipments of ore, containing 30 percent lead and 20 ounces of silver per ton, were made years ago, exploration has failed to discover any large silver ore shoots in the district. Most lead-silver ore shoots appear to be small and isolated.

Principal Silver Deposits of Park City District

Eureka

Location: NW¼NW¼ sec. 7 and SW¼SW¼ sec. 6, T. 33 N., R. 32 E.

Development: 200-foot adit.

Geology: 1½-foot-thick quartz vein in black shale. Select samples assayed up to 150.6 ozs. silver and 41.4 percent lead.

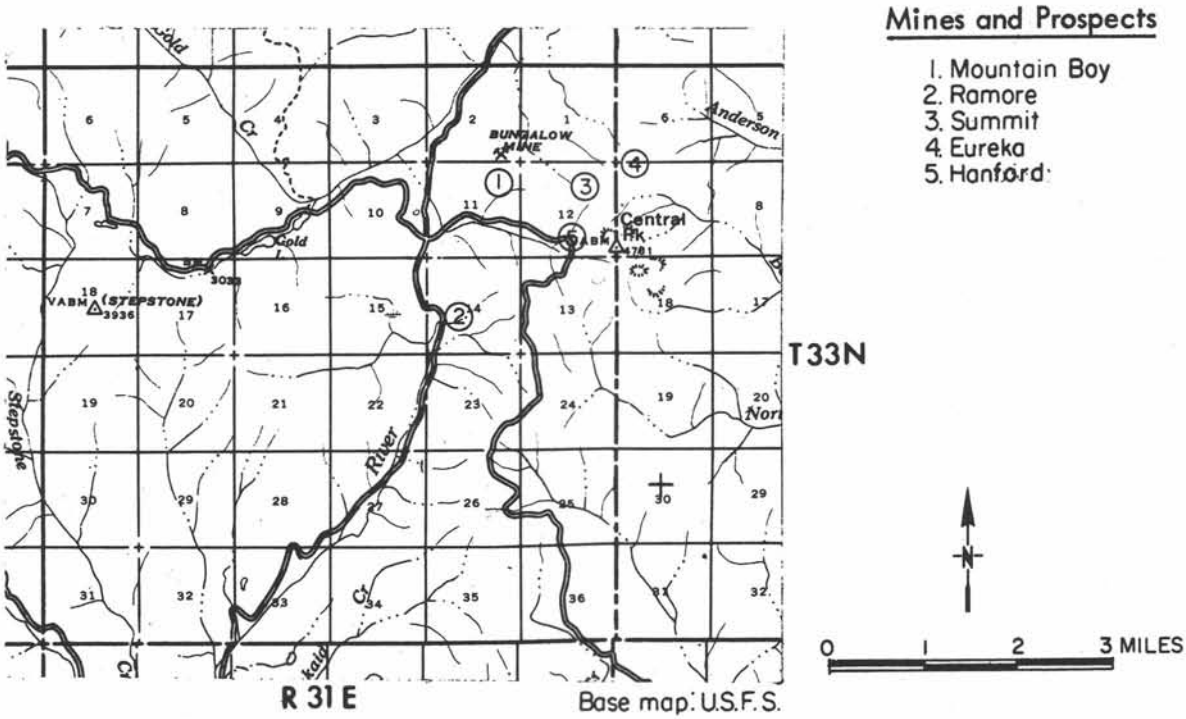


FIGURE 21.—Index map of the Park City district.

Ore minerals: Galena, chalcopyrite, and pyrite.

Production: None.

Reference: Huntting, 1956, p. 218.

Hanford

Location: S¼ cor. sec. 12, T. 33 N., R. 31 E.

Development: Inclined shaft.

Geology: 2- to 3-foot-thick quartz vein in argillite. Select samples contained 25.9 percent lead and 20.48 ozs. silver per ton.

Ore minerals: Galena and pyrite.

Production: None.

Reference: Huntting, 1956, p. 219.

Mountain Boy

Location: NE¼ sec. 11, T. 33 N., R. 31 E.

Development: Four adits, one of which is 155 feet long.

Geology: Quartz lenses up to 1½ feet thick along shear zones in argillite and limestone. Select samples of ore contained 7 to 182 ozs. per ton in silver.

Ore minerals: Galena, sphalerite, chalcopyrite, tetrahedrite, chalcocite, covellite, and pyrite.

Production: Four to five carloads prior to 1918 averaged $60 per ton in lead and silver.

References: Pardee, 1918, p. 94-95; Gage, 1941, p. 183-185; Patty, 1921, p. 192.

Ramore

Location: NE¼SW¼ sec. 14, T. 33 N., R. 31 E.

Development: 440-foot adit with a 600-foot crosscut and a 45-foot winze.

Geology: Five-foot quartz vein with disseminated sulfides along shear zone in granodiorite. Assays of ore show up to 59 ozs. per ton in silver, 9.6 percent lead, and 0.07 oz. gold.

Ore minerals: Galena, sphalerite, tetrahedrite, chalcopyrite, pyrite, and pyrrhotite.

Production: Small shipments in the early 1900's.

References: Pardee, 1918, p. 98-99, Gage, 1941, p. 188-190; Bancroft, 1914, p. 207-209.

Summit

Location: NE¼ sec. 12, T. 33 N., R. 31 E.

Development: 1,000-, 350-, 150-, and 100-foot adits.

Geology: Quartz lenses along a 1½-foot-wide shear zone in granodiorite. Ore shoots contained up to 90 ounces of silver per ton, 0.12 ounce gold, and 40 percent lead.

Ore minerals: Galena, sphalerite, chalcopyrite, tetrahedrite, arsenopyrite, and pyrite.

Production: 50 tons of galena around 1910.

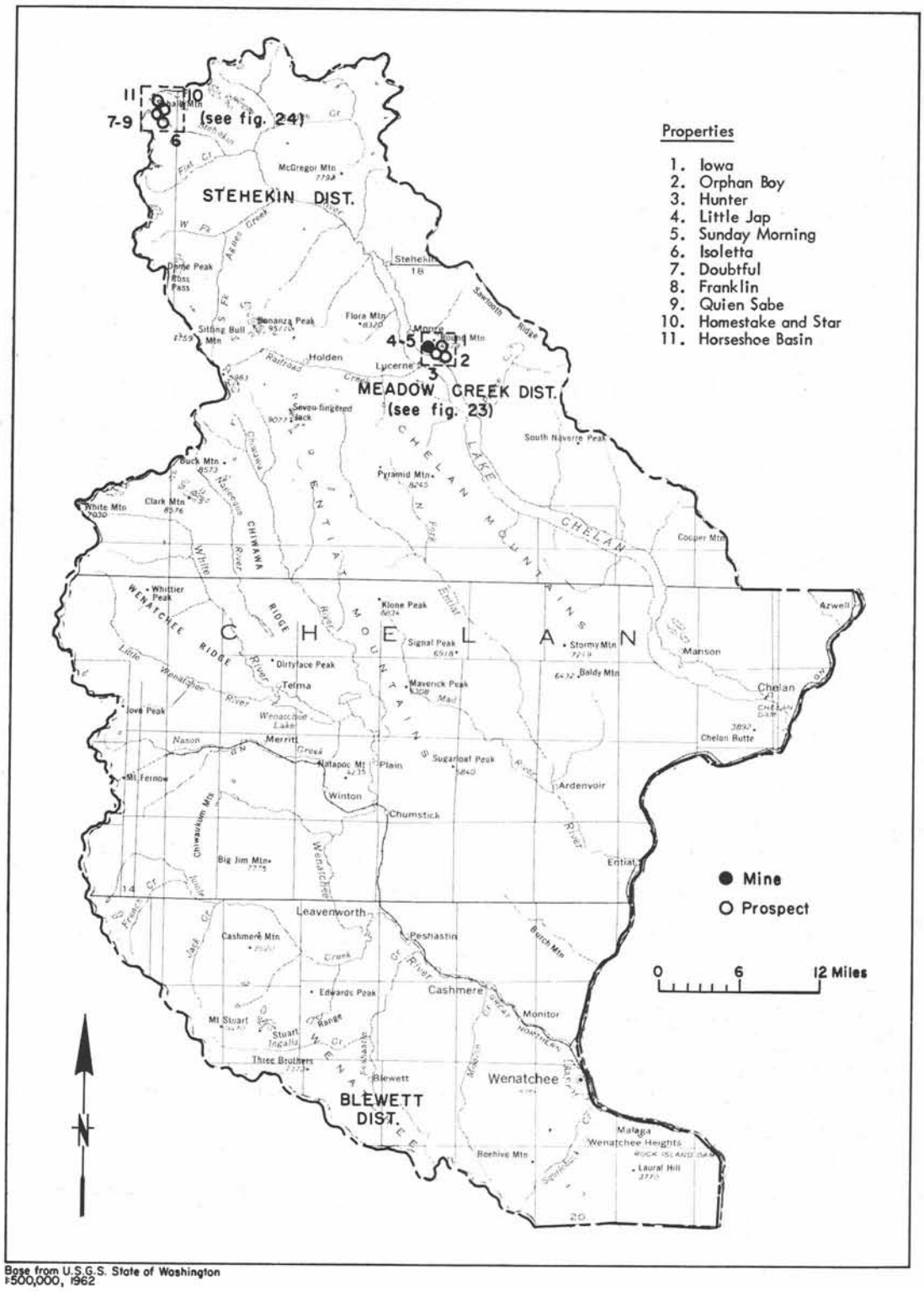
References: Pardee, 1918, p. 94; Gage, 1941, p. 183-185; Patty, 1921, p. 190-191.

OTHER SILVER DISTRICTS OF EASTERN WASHINGTON

Thus far the discussion of the silver districts of eastern Washington has been confined to the Okanogan Highlands of northeastern Washington. Elsewhere in eastern Washington, silver deposits occur in the Cascade Mountains. Although silver is known to occur at several hundred mines and prospects east of the crest of the Cascades, only a few deposits contain silver in notable amounts. These deposits are in the Meadow Creek and Stehekin districts of Chelan County and the Cle Elum and Gold Creek districts of Kittitas County. In other mining districts silver appears to be minor and accompanies gold, lead, zinc, and copper.

CHELAN COUNTY

Chelan County ranks third in the production of silver by counties; however, the bulk of the silver has come from copper mining operations. From 1904 through 1969, the county produced 2,822,225 ounces of silver valued at $2,364,048. The largest silver producer was the Holden mine that produced 2,147,744 ounces of silver from 1938 through 1957. In addition to silver, the mine produced around 216 million pounds of copper from a total of 10.6 million tons of ore. The second largest silver producer was the Gold King mine, which from 1949 to 1967 produced 420,000



Base from U.S.G.S. State of Washington
1:500,000, 1962

FIGURE 22.—Silver deposits of Chelan County.

ounces of silver from around 1 million tons of ore. In addition to silver the mine produced 367,500 ounces of gold. An additional 14,860 ounces of silver came from copper mining operations at the Red Mountain mine, which operated from 1935 through 1937. Prior to 1935, the production of silver in Chelan County was insignificant. Almost yearly since 1890, several hundred ounces of silver have come from small gold mining operations, mainly through the refining of gold bullion.

Aside from the silver that occurs in the copper and gold ores, only two districts of Chelan County appear to have anomalous concentrations of silver. Quartz veins in the Meadow Creek district are sparsely metallized with silver minerals, whereas in the Stehekin district silver occurs in argentiferous galena. The production of silver, as well as other metals from these districts, has been insignificant.

MEADOW CREEK DISTRICT

This district is near the head of Lake Chelan and lies northeast of the lake. The terrain is steep and rocky and elevations range from 1,096 feet on the shores of the lake to 8,500 feet on the highest peaks above the lake. The district is not yet accessible by roads.

The ore minerals occur in lenticular quartz veins that have as their host rocks pre-Upper Cretaceous biotite gneiss. The veins, which are up to 4 feet thick, occur in hydrothermally altered shear zones as much as 7 feet thick. The ore minerals of the veins are galena, sphalerite, chalcopyrite, tetrahedrite, pyrargyrite, and native silver. These ore minerals are almost always accompanied by pyrite, pyrrhotite, and arsenopyrite. Deposits that are richest in silver occur near the shore of Lake Chelan; at least

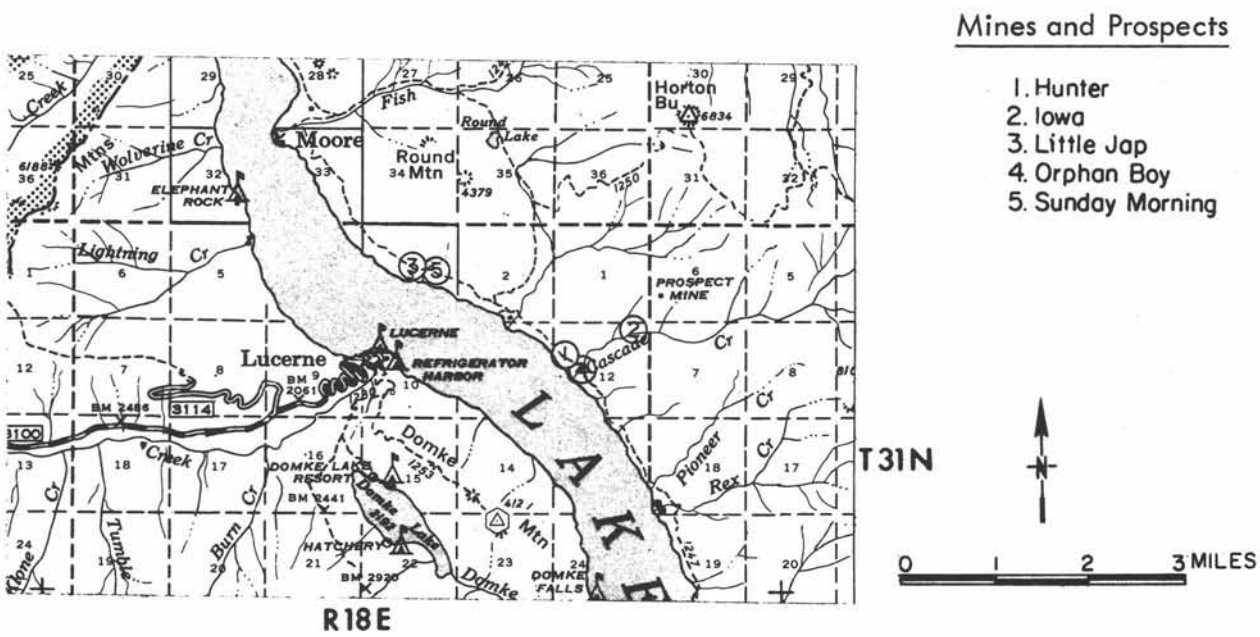


FIGURE 23.—Index map of the Meadow Creek district.

one deposit is now under water, due to the raising of the lake level by the dam at Chelan. Deposits near the lake consist of narrow quartz veins that contain rich seams of pyrargyrite, tetrahedrite, and galena. As much as 140 ounces of silver per ton has been reported for some seams. Although early reports mention the presence of silver minerals, Webb (1957, p. 33-47) did not observe any silver minerals in the veins of the district. Sulfides noted by Webb were arsenopyrite, pyrrhotite, marcasite, chalcopyrite, and sphalerite.

In addition to silver-bearing quartz veins, several of the district's copper-metallized quartz-feldspar dikes carry silver. Up to 21 ounces of silver per ton have been reported in seams as irregular masses of solid sulfides that occur along the walls of the dikes. Common sulfide minerals include chalcopyrite, pyrrhotite, and pyrite, which when oxidized, impart a distinct yellowish-brown color to the surface parts of the dikes. Most dikes crop out on the mountainside several thousand feet above the lake level.

Principal Silver Deposits of Meadow Creek District

Hunter

Location: NW¼ sec. 12, T. 31 N., R. 18 E.
Development: 15-foot adit.
Geology: Quartz vein with 4-inch paystreak containing up to 140 ozs. silver and 1 oz. gold per ton.
Ore minerals: Pyrargyrite and tetrahedrite.
Production: None.
Reference: Huntting, 1956, p. 206.

Iowa

Location: NE¼ sec. 12, T. 31 N., R. 18 E.
Development: 40-foot adit.
Geology: Quartz vein with 1-foot paystreak that contains up to 200 ozs. silver and 3 ozs. gold per ton.
Ore minerals: Unknown.
Production: None.
Reference: Huntting, 1956, p. 113.

Little Jap

Location: NW¼SE¼ sec. 3, T. 31 N., R. 18 E.
Development: Main adit below lake level; 30-foot adit 200 feet above lake level.
Geology: Quartz veinlets in granite gneiss.
Ore minerals: Pyrargyrite, chalcopyrite, pyrite, and pyrrhotite.
Production: None.
Reference: Huntting, 1956, p. 286.

Orphan Boy

Location: SW¼ sec. 12, T. 31 N., R. 18 E.
Development: 50-foot adit and a 10-foot inclined shaft.
Geology: Quartz veins up to 3 inches thick in a 7-foot-wide altered shear zone. Sample of footwall assayed 28.64 ozs. silver, 0.02 oz. gold, and 0.11 oz. zinc. Sample of hanging wall assayed 4.64 ozs. silver, 0.13 percent lead, and 0.16 percent zinc.
Ore minerals: Pyrite, pyrrhotite, galena, sphalerite, arsenopyrite, and minor pyrargyrite.
Production: None.
Reference: Huntting, 1956, p. 286.

Sunday Morning

Location: NW¼SE¼ sec. 3, T. 31 N., R. 18 E.

Development: 70-foot adit near lake level.

Geology: 4-foot-wide altered shear zone in granite gneiss contains sparsely metallized quartz veinlet.

Ore minerals: Galena, pyrargyrite, and pyrite.

Production: 2-ton shipment prior to 1897 grossed $250 per ton.

Reference: Huntting, 1956, p. 287.

STEHEKIN DISTRICT

The Stehekin district is in the northwestern corner of Chelan County, and much of the district is in the North Cascades National Park, which is closed to mineral entry. In the 1890's, work was undertaken on several small high-grade argentiferous galena deposits, which resulted in the production of 2,200 pounds of ore that had a net value of $60 per ton. To date (1975) most work in the district has been undertaken on the Horseshoe Basin property; however, the property has been idle since 1952.

The richest argentiferous galena deposits are in Horseshoe Basin near the crest of the Cascades. Elevations in the basin range from 3,200 to 7,200 feet. Quartz fissure veins predominate and have as their host rocks pre-Jurassic biotite, quartz diorite, and hornblende gneisses, many of which are migmatitic. The veins occupy well-developed shear zones in the gneiss, and have general east to northeast strikes and near-vertical dips. The veins range from several inches to 7 feet in thickness; most are only sparsely metallized with argentiferous galena, sphalerite, pyrite, and minor chalcopyrite. Parts of some veins contain lenses of solid galena up to 3 feet in thickness, and assay as much as several hundred ounces per ton in silver. In general, the ore minerals occur only as small isolated pods and lenses. Sphalerite appears to be more abundant than galena and chalcopyrite, while pyrite, pyrrhotite, and arsenopyrite, in order of decreasing abundance, make up the bulk of the sulfide in the veins. The Davenport vein,

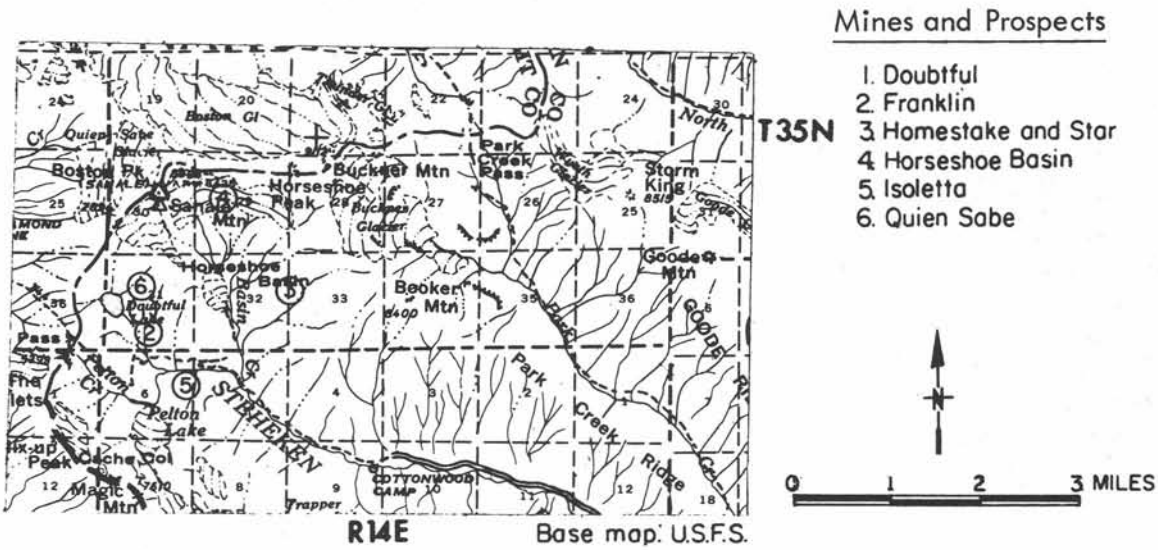


FIGURE 24.—Index map of the Stehekin district (Horseshoe Basin area).