

4590 0013
Granger, 1957

(77)
Item 13

Geology and Mineral Resources of Elko County

137

In a nearby prospect ~~chalc~~conyrite as well as galena and sphalerite is present, though the copper minerals do not seem to be particularly abundant.

SPRUCE MOUNTAIN (LATHAM, JOHNSON, STEPTOE) DISTRICT

Lead, silver, copper

Sources of information

White, A. F., 1871, Third biennial report of the State Mineralogist of Nevada for the years 1869 and 1870: Carson City, 128 p.

Raymond, R. W., 1873, Statistics of mines and mining in the States and Territories west of the Rocky Mountains for 1872: U. S. Treas. Dept., 5th Ann. Rept., p. 160-161.

Hill, J. M., 1916, Notes on some mining districts in eastern Nevada: U. S. Geol. Survey Bull. 648, p. 67-76.

Lincoln, F. C., 1923, Mining districts and mineral resources of Nevada: Nevada Newsletter Pub. Co., Reno, p. 55-57.

Schrader, F. C., 1931, Spruce Mountain district, Elko County: Nevada Univ. Bull., v. 25, No. 7, 24 p.

Granger, A. E., 1945: Unpublished report.

Wheeler, H. C., 1947: Unpublished report.

Location

The Spruce Mountain district covers the top of Spruce Mountain, T. 31 N., Rs. 63 and 64 E., about 45 miles south and a little east of Wells, the principal source of supplies. U. S. Highway 93 is about 7 miles west of the district, and Tobar, a shipping point on the Western Pacific Railroad is about 25 miles to the north. Most of the mines are above the 7,000-foot level, and the crest of the range reaches an altitude of 10,400 feet.

History and production

Lead-silver ore was discovered at the Killie (Latham) mine in 1869. Other early discoveries were the Juniper, Fourth of July, and Black Forest. In 1872-1873 the Ingot Mining Co. built a small smelter at Sprucemont to treat lead carbonate ores and for a short time smelted 35 tons of ore daily, but the plant was not a success. Just before the financial panic of 1907 the camp enjoyed a brief revival of activity, and it is said that for several years prior to 1910 a considerable tonnage of ore from the Black Forest mine was smelted in the C. M. Spence 50-ton furnace, in the valley northeast of Spruce Mountain.

There was only sporadic activity from 1910 to 1918. Higher lead prices in 1918 resulted in increased production, and the district continued to produce until 1949. The best years prior to World War II were 1924 (\$113,738), 1926 (\$243,043), and 1927 (\$116,190). Production from the district was small during the period 1930-1944. World War II resulted in a sharp rise in production as follows: 1944 (\$99,713), 1945 (\$329,051), 1946 (\$210,593), 1947 (\$153,734), and 1948 (\$40,814). Following the drop in metal prices, only minor ore shipments were made during 1949-1952. The district produced during the period 1869-1949 a total of 104,519 tons of ore with a metal content of 1,107 ounces of gold, 1,259,465 ounces of silver, 794,919 pounds of copper, 23,808,523 pounds of lead, and 3,148,490 pounds of zinc, valued in all at \$2,980,605.

During the period 1918-1930 some of the operating properties were worked out and others consolidated, so that in 1951 most of the district was controlled by three companies. All mines which are known to have produced are listed below.

Spruce Standard	Index
Black Forest	Valley
Monarch	Keystone
Parker (Humbug)	Hartley
Nevada Standard	Spence
Bullshead	Banner Hill
Killie	Juniper
Ada H	Fourth of July
Ohio No. 1	Paramount

Geology

According to Wheeler the oldest sedimentary rocks of the area consist of limestone and dolomite, light to dark-gray and light-buff in color. Ordovician fossils were found in the upper portion of this unit. Next in the sequence is a series of gray limestones with interbedded chert overlain by argillite, quartzite, and quartzitic conglomerate. Above these is another gray limestone with a few thin beds of shale; the limestone contains fossils of Mississippian age. Upper Pennsylvanian or lower Permian fossils were found in the youngest strata of the district, which are composed of buff-weathering gray limestone with a 200-foot sandstone bed, and some sandy limestone. The minimum thickness of the sedimentary sequence exceeds 7,000 feet. (See pl. 18.)

According to Schrader, the igneous rocks are granite porphyry, diorite porphyry, and lamprophyre. They intrude the sedimentary rocks, and in general are highly altered and not well exposed.

A 500-foot wide dike of granite porphyry extends across the mountain range. In the Porphyry tunnel, opposite the Black Forest mine, this rock is light-gray and medium-grained with abundant phenocrysts of quartz and orthoclase as much as 0.2 inch in diameter in a fine-grained groundmass of the same minerals. Pyrite, a little biotite, and traces of hornblende are also present. In places the increase in the amount of plagioclase marks a gradation toward quartz monzonite porphyry. The granite porphyry has been hydrothermally altered and is much weathered. The feldspar is largely kaolinized and the biotite changed to chlorite and iron oxides. Bands of fine-grained siliceous limonite about an inch thick and dipping about 30° SW. occur in the granite porphyry. The rock between these bands is traversed by numerous parallel veinlets or seams of aphanitic, greasy-lustered secondary quartz. These features denote that after having been closely sheared the rock was later altered and sealed by silica. Near the face of the tunnel the limestone has been metamorphosed and mineralized for a distance of 30 feet from the dike. The granite porphyry is cut by veinlets composed of quartz, sericite, and calcite.

The diorite porphyry is a fine-grained dark brownish-gray rock, which occurs as small irregular bodies and dikes. It is composed mainly of plagioclase and hornblende, both largely altered to kaolin, sericite, chlorite, and epidote.

A lamprophyric dike in the upper tunnel of the Black Forest mine is a dark greenish-gray speckled medium- to fine-grained porphyritic rock, characterized by abundant small phenocrysts of biotite together with hornblende and olivine. Considerable orthoclase and plagioclase are also present. Much of the biotite is altered to greenish chlorite, the hornblende to actinolite and other products, and the feldspars to epidote, sericite, and kaolin.

The porphyry dikes have, in general, had a very slight metamorphic effect on the intruded rocks. Metamorphism of the sedimentary rocks has in most places extended for a maximum distance of about 30 feet from the contact with the dikes. One notable exception is a mass of green lime-silicate rock 500 feet wide by about one-half mile long, which lies just east of the Spruce Standard mine, and is at least 500 feet from any known igneous rock.

The structure of Spruce Mountain, according to Hill, is an anticlinal fold which has been greatly modified in the vicinity of the mines by normal faulting and igneous intrusion. Two prominent faults in the district strike approximately N. 20 E. Both have steep dips; the eastern fault dipping to the east and the western fault dipping to the west. The granite porphyry dikes are localized near the fault zones.

Ore deposits (from Schrader, 1931)

The ore deposits chiefly contain lead, silver, and copper; but some contain zinc. They occur as replacement deposits in limestone, mainly as bedded deposits in or between certain limestone beds, as in the Killie mine, and as fissure vein deposits. In the limestone they also follow seams and irregular fractures. In the Porphyry tunnel ore deposits occur on the contact between the limestone and igneous rocks. The bedded deposits have been the most productive. The ores thus far mined have been mostly oxidized and consist chiefly of carbonates, of which the lead carbonates have been more profitable than the copper.

The lead-silver ores contain abundant limonite, together with cerussite, anglesite, and wulfenite as alteration products of galena, which is still present in some of the ore. The copper ores contain malachite, chrysocolla, and chalcopyrite, with subordinate quantities of bornite and chalcocite.

Smithsonite and calamine are the only zinc minerals that have been identified. Some of the brownish lead-zinc ore, as in the Killie mine, is cut by veinlets of white smithsonite. In some of the yellowish-gray sandy carbonate ore the structure of the limestone has been preserved in great detail by the replacement ore minerals. In general, there is a marked decrease in the zinc content of the ores with nearness to the granite porphyry, as in the eastern part of the Killie mine.

Mines (data from Schrader, 1931)

The mines that have a recorded production are listed on page 138, and only the major mines are described in the following pages.

Monarch mine.—The Monarch mine is about $1\frac{3}{4}$ miles east of Sprucemont, on the middle of the steep western slope of Spruce Mountain, with the main tunnel at an altitude of 8,455 feet. It is the deepest and one of the oldest mines in the district and contains more than 3,000 feet of workings along three major veins, the Monarch, Thelma, and Big Fault.

The early history of the mine is unknown. In 1917 the Monarch Consolidated Mining Co. began work. The Monarch tunnel was driven to connect with the old workings, and shipments of ore began in 1919. Between 1919 and 1922 the production was about 21,000 tons of ore that contained about 17 percent of lead and 20 ounces of silver to the ton. The bulk of this production was made in 1920. In 1922 the mine was the largest producer in the district. Some of the ore shipped contained as much as 22 percent of lead and 24 ounces of silver to the ton. In 1926, 2,000 tons of lead-silver ore, chiefly oxidized, was shipped. Production from the mine continued until February 1930. The Bronco tunnel, 1,800 feet north of the Monarch tunnel and about 50 feet higher, was driven at about that time. Operations practically ceased in June 1931. Sporadic production has continued since that time.

Nearly all the Monarch production came from the 300-, 400-, and 500-foot levels. Extensive developments on the 600-foot level have not thus far been encouraging. The work done during 1918-1928 followed the Fordna-Hardy ore shoot down to the 520-foot level. This shoot raked to the southeast and on the 400-foot level was 360 feet long. To the southeast of it three ore bodies were developed on the Monarch fissure, which here strikes N. 20° W. and dips 60° E.

Black Forest Mine.—The Black Forest mine is in the northeastern part of the district at an altitude of about 8,500 feet (pl. 18).

After a period of operation by lessees, the Black Forest Mining & Smelting Co. began operating the mine on its own account in the spring of 1924 and made its first shipment in June of that year. During 1926, 3,000 tons of lead-silver ore, chiefly oxidized ore, was shipped for smelting and 1,000 feet of development work was done. By 1927 the company had shipped 8,800 tons of ore that contained about 20 percent of lead and 20 ounces of silver to the ton. Most of the oxidized ore came from a series of interlacing pipes or chimneys and chambers in the white limestone above the 150-foot level. The ore was shipped to the American Smelting & Refining Co. at Murray, Utah. Transportation costs amounted to 50 percent of the value of the ore. The production included 770 tons of ore that ran 20 percent of lead, 18 percent of iron, and 22 ounces of silver to the ton.

The mine is opened by four tunnels, the chief of which are

the upper and lower tunnels, spaced about 70 feet apart vertically. It contains more than 7,000 feet of workings. The lower tunnel trends S. 60° W. and is about 3,000 feet long. The Black Forest and Monarch mines are connected by the Bronco tunnel through the heart of the mountain at an altitude of about 8,500 feet. This connecting tunnel has a combined length of nearly 7,000 feet and a maximum depth of 800 feet. Much of the ground in the Bronco tunnel is broken, soft, and wet and requires good timbering. The tunnel was designed primarily to facilitate movement of ore from either mine.

The mine is near the eastern of the two main faults in the district and, as shown in plate 18, is bordered on the north and west by the large dike of intrusive granite porphyry. Granite porphyry dikes also occur southeast of the mine, and granite porphyry, diorite, and lamprophyric dikes occur in the mine. A diorite dike cuts across the lower tunnel about 600 feet from the portal. There are also several cross faults, and the most favorable places for ore are the junctions of the cross faults with the main fault.

The ore occurs chiefly along the northwest fault fissures, in part as large replacement ore bodies extending well out into the limestone. It also occurs as chimneys, pipes, and globular bodies 3 feet or more in diameter enclosed in crustified ferruginous casings or shells 1 to 3 inches thick. A tabular body mined in the lower tunnel about 2,000 feet from the portal averaged about 2 feet in thickness. The productive area was developed in 1930 over a horizontal distance of about 1,800 feet and through a vertical range of 400 feet by eight levels spaced about 60 feet apart vertically. The mine contains more than 10,000 feet of underground workings.

The ore consists chiefly of a fine-grained mixture of carbonates and oxides of lead and copper containing about 20 percent of lead and 20 ounces of silver to the ton. In the deep part of the mine, however, the workings seem to be nearing the sulfide zone, to judge from the sulfide ore found on the C level.

Killie mine.—After being idle nine years the Killie (Latham) mine, in Killie Pass at an altitude of 8,900 feet, was reopened in May 1926 and operated by the Spruce Consolidated Mines Co., which was succeeded at the end of the year by the Nevada Lead & Zinc Mining Co.

During 1926-1930 the mine shipped about 100 tons of ore a month, for a total of about 4,800 tons of \$15 ore that contained

22 percent of lead, 13 percent of zinc, 5 percent of iron, 6 percent of manganese, 4 ounces of silver, and 0.005 ounce of gold to the ton. The net profit was reported to have been \$3.40 a ton. No payment was made by the smelter for the zinc content, and a penalty was exacted if the zinc content was above 15 percent.

The mine was developed in 1950 to a vertical depth of 250 feet, or 450 feet on the dip of the ore zone, by several thousand feet of workings, mostly on the 70-, 85-, 120-, 160-, 210-, and 220-foot levels. The 70- and 160-foot levels are the most extensively developed. The Killie shaft has a vertical depth of 220 feet. During the early period of operation most of the mining was done between the surface and the 70-foot level, and most of the stopes in the mine are above the 120-foot level. Ore was developed in 1930 on and above the 120-foot level and on the 160-foot level. The Jackson stope, in 1930, had a very good showing of ore reported to contain 45 percent of lead and 12 ounces of silver to the ton. Both the Killie mine and the camp are supplied by a rather scanty amount of water piped from the Spartan tunnel on the adjoining west slope of the mountain.

The Killie mine is chiefly in limestone about 800 feet northwest of the granite porphyry dike. The ore bodies now being developed extend from the glory hole northeastward down the dip of the lode for a distance of 450 feet. The lode seems to be on, or just east of, a north-south fault or shear zone; immediately to the west and northwest the rocks dip west, whereas in the mine the average dip is about 40° ENE. A portion of the tentative section in descending order is as follows:

	Feet
Grayish-blue limestone, ore-bearing.....	60
White limestone.....	50
Quartzite or silicified limestone.....	40

The Killie lode or ore zone, beginning at the glory hole, has a known extent of 450 feet down a 28° dip, a length of 100 feet along the strike, and a thickness of 40 feet or more measured at right angles to the dip. It is estimated to contain about 50,000 tons of mill-grade ore with a probable tenor of 10 percent of lead, 10 percent of zinc, 3 ounces of silver to the ton, and a little gold.

The ore is in part localized by the intersections of the lode and many fissures or slips, which strike and dip in various directions, some being curved in both strike and dip, so that it is very difficult to follow any given ore body. The largest is the "big fissure," which strikes about N. 70° E., parallel with the dip of the lode, and dips steeply north-northwest.

The Killie glory hole is about 80 feet long, 60 feet wide, and 60 feet deep and the ore body has also been worked underground to a vertical depth of 80 feet, or 120 feet on the dip, below which mineralization ceased. It has produced much good ore, some of it very high in lead and zinc. The ore has replaced limestone and contains streaks of residual galena.

The Latham tunnel is on the 70-foot level and extends 700 feet east to the Killie shaft. The western part of the tunnel passes through the barren white limestone and about 350 feet from the portal it is overlain by blue limestone. Both formations dip very gently east. The rocks are crushed and shattered. The white limestone is marbled and the blue limestone, in part ore bearing, is stained brown with lead and iron carbonates or oxides. Ore has been stoped in places for a distance of 100 feet south from the tunnel.

Ore from part of the Jackson lode is roughly banded, locally stained with malachite, and consists mainly of brownish-gray cerussite and perhaps other oxidized lead minerals, replacing limestone. Minute specks of the dark copper oxide melanconite are also present. The silver seems to be associated with the cerussite and other oxidized lead minerals.

The argentiferous cerussite ore from the footwall side of the Killie lode is brownish-green fine-grained, very closely banded, and preserves in detail the structure of the replaced limestone. This ore is friable and is said to contain about 40 percent of lead and 20 ounces of silver to the ton. The ore body is highly oxidized throughout, and the upper part is capped by half an inch or more of a yellowish and yellowish-green mineral, possibly lead oxy-chloride.

The brown ore that occurs generally throughout the mine is composed of a mixture of partly oxidized sphalerite and cerussite, and is cut by seams and veinlets of smithsonite. It contains about 30 percent of lead and an equal amount of zinc. A lighter-brown and more compact variety of the ore, also common in the mine, contains considerable cerussite and is said to average 25 percent of lead and 10 percent of zinc.

Residual nodules of coarsely crystalline galena a few inches in diameter, said to contain about 65 percent of lead and a little silver, occur sporadically in most of the oxidized ore.

Bullshead mine.—The Bullshead mine is on the northeast slope of Spruce Mountain about half a mile south of Black Forest

Canyon, at an altitude of about 7,900 feet. It has been a large producer and consists of about 6,000 feet of underground workings, mostly drifts, on both sides of the canyon.

A 50-ton smelter was built in 1917 and a trial run made with ore from the Bullshead and Black Forest mines. The plant has since been idle. The Bullshead was one of the two principal producers in 1918, when the total value of the district's output was nearly \$24,000. It was also a large contributor to the district's output of \$53,428 in 1922 and was then said to have in reserve 10,000 tons of ore averaging 3 percent of lead and 10 ounces of silver to the ton. In 1926, 150 tons of lead ore was shipped from the mine by lessees.

The main vein, which reaches 4 feet in width, strikes N. 30° E. and dips 30° ESE. in blue limestone. It seems to be down-faulted 15 to 20 feet on the west.

Spence mine.—In 1917–1918 sinking done in the Spence copper mine is said to have disclosed 15 feet of low-grade copper ore on the south contact between the granite porphyry dike and limestone, and small stringers of good-grade ore in the dike. Work was discontinued in the fall of 1918, and no further record was obtained.

Parker mine.—The Parker or Humbug mine is in the northeastern part of the district below the Spence mine, in a low flat-topped foothill at an altitude of about 6,950 feet. The claims are known as the Humbug group. In 1929 and 1930, 250 tons of ore with a tenor of 22 percent of lead and 9 ounces of silver to the ton was shipped. The principal vein is in limestone. It is 3 feet or more wide, with vertical dip, and strikes N. 10° W. It has several branch veins.

The ore is mostly gray lead carbonate replacing altered limestone, much of which is stained reddish and yellowish-brown with iron oxides, and in places contains disseminated cubes and grains of pyrite. The ore occurs chiefly in the vein and as replacement deposits in the limestone. Some ore is found as replacement bodies in a fine-grained gray calcareous rock that is locally called porphyry but is actually an impure lime-silicate rock composed mainly of quartz and calcite with a little diopside and other silicates. This rock contains remnants of crinoid stems of probable Mississippian age. Besides the ore of the main lode, good ore is reported to occur in a fissure east of the main shaft.

Spruce Standard mine.—The Spruce Standard mine is at Spruceмонт, on the lower west slope of the mountain, at an altitude of about 7,000 feet. It was formerly a part of the Ada H. property.

The mine is credited with an early-day production of more than \$100,000 in lead-silver-copper ore, in part very rich. It is opened by a shaft inclined at 65° , from which levels have been driven at depths of 165 to 265 feet. In 1926, several hundred tons of oxidized lead ore containing silver and 100 tons of old slag from the Spruce Standard dump were shipped by way of Tobar. In September 1928, the mine was reconditioned and the shaft sunk from the 165-foot to the 265-foot level, on which extensive development work was done and a little ore mined, but no ore was shipped. The mine made about 40 gallons of water a day.

The main lode strikes N. 35° E. and dips 60° SE. in limestone. It ranges from a few feet to 5 or 6 feet in width. It is opened for about 700 feet on the 165-foot level and 300 feet on the 265-foot level. On the 165-foot level south of the shaft there is a large body of medium-grade oxidized and leached lead-silver ore, and north of the shaft there are two good stopes of lead-silver-copper ore. The oxidized ore, much of which is friable, is generally stained reddish or yellowish-brown with iron oxides and is sparingly speckled with copper carbonates, particularly malachite. On the 265-foot level the ore is mainly sulfide ore containing lead, silver, and copper and may represent the top of the sulfide zone.

The ore occurs chiefly as replacement deposits in the limestone and the granite porphyry, and along the contact of these two rocks in a quartz-pyrite gangue, and it is generally crudely banded and speckled. The ore minerals are chiefly galena, which is probably argentiferous, chalcopyrite, pyrite, and a little arsenopyrite. Some of the ore is relatively pure fine-grained or dense chalcopyrite, and some is stained black with manganese oxide. The lead-silver ore contains 12 percent or more of lead and is high in iron.

From a point near the south end of the drift on the 265-foot level, a 1,400-foot crosscut has been driven southeastward to an eastward striking granite porphyry dike. The rock in the crosscut is highly crushed and in part mineralized. In places a little copper ore, mostly chalcopyrite, has been found. The dike is about 200 feet wide and seems to be a branch of the main dike.

The rock is granite porphyry and contains sparingly disseminated fine-grained pyrite, which also coats the joint planes.

A metamorphic zone, 500 feet or more wide, in which the limestone has been completely changed to a grayish olive-green rock, locally has been called a diabase dike. Thin section study shows that it is composed chiefly of diopside, greenish garnet, and fluorite. The diopside may be accompanied by other pyroxenes, tremolite, and actinolite. In places the rock also contains a little secondary calcite and quartz.

A dike of the granite porphyry also occurs about 200 feet northwest of the Spruce Standard mine. It strikes N. 40° E., about parallel with the Spruce Standard vein, and is probably connected with the ore deposits in that vicinity. About 150 feet north of the dike a 250-foot branch turns off from the crosscut and runs east nearly parallel with the dike. About 100 feet from the crosscut the branch cuts a zone of closely spaced parallel mineralized fissures that are 20 feet wide and dip 80° NE. Sphalerite is the principal ore mineral in this fissure zone. The branch crosscut offset 70 feet to the southeast beyond this fissure zone resumes its northeasterly course for about 150 feet and follows a fissure of vertical to steep southerly dip that contains some lead and silver. The crosscut ends beneath the center of a large quartz breccia mass or "blowout."

Paramount mine.—The Paramount mine is one of a group of mines in the foothill belt on the west front of Spruce Mountain. Limestone in the foothill belt is mineralized for a width of about 3,000 feet for a distance of 8 miles north to 2 miles south of Sprucemont.

The old Paramount shaft is located on Paramount claim No. 7 about 1 mile northwest of Sprucemont. It is 200 feet deep and is on the intersection of two veins, one dipping 60° N. and the other 80° NW. Considerable ore has been produced, reported to have run about 40 percent lead, 15 ounces of silver, and \$5.00 in gold to the ton.

Other properties in the foothill belt include the Chicago, Ohio, and Cedar groups.

TECOMA DISTRICT
Lead, silver

Sources of information

Hill, J. M., 1916, Notes on some mining districts in eastern Nevada: U. S. Geol. Survey Bull. 648, p. 102-105.