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"Some Mining Districts in Northeastern California and Northwestern Nev."
Item 1

EXCERPT FROM "SOME MINING DISTRICTS

IN

NORTHEASTERN CALIFORNIA AND NORTHWESTERN NEVADA"

5370 0001

Reference Card

Pine Grove District, Mineral County, Nev.

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Location and Accessibility

The Pine Grove district (No. 13, Pl. I, p. 19) is in the northwest part of Mineral County, Nev., about 17 miles in an air line south-southeast of Yerington, the largest town in Mason Valley. The settlement of Pine Grove is 4 miles east of the Mineral-Lyon county line, on the abandoned Lobdell Summit road between East and West Walker rivers, and is shown in the lower right-hand quarter of the Wellington topographic sheet of the United States Geological Survey. The district is most easily reached from Yerington, on the Nevada Copper Belt Railroad, which joins the Southern Pacific at Wabuska and is operated by the Mason Valley Copper Co. between its mines at Ludwig and Yerington and its smelter at Thompson.

Topography

Pine Grove is on the east flank of the Smith Valley Range, which is an irregularly shaped group of mountains separating Smith Valley on the west from Mason Valley on the east. The north end of this range, in the vicinity of the Yerington copper mines, is quite narrow, but south of the West Walker River canyon it spreads out to a maximum width of 12 miles. It is roughly separated from the Sweetwater Mountains at the south end by Dalzell Canyon.

The settlement of Pine Grove stands at an elevation of 6,700 feet in the canyon north of Pine Grove Summit, whose elevation above sea level is approximately 8,500 feet. Mount Etna, a mile and a half northwest of the town, has an elevation of 7,400 feet, and the Sugarloaf, a mile and a quarter east of the town, reaches a height of 6,900 feet.

Geology

Quartz monzonite.-- The town of Pine Grove is situated in an area of light-gray coarsely granular rock. In hand specimens it seems to be feldspathic, though a little quartz is visible, together with biotite and hornblende. Under the microscope the thin sections are seen to be composed largely of feldspar with some ferromagnesian minerals and minor quartz. The feldspar is about equally distributed between orthoclase and oligoclase-andesine, but in some thin sections the plagioclase is in excess of the orthoclase, whereas in others the reverse is true. Greenish biotite is the most common ferromagnesian mineral, but hornblende is sparingly present. Magnetite, titanite, and a little apatite are common accessory minerals. The biotite is altered, some of it being bleached to a nearly colorless mica and other fragments being largely changed to chlorite. The feldspars are kaolinized, the orthoclase being altered before the plagioclase feldspars. This rock is a quartz monzonite near granodiorite, and is typical of the late Mesozoic intrusives of the Pacific coast.

This formation is cut just north of Pine Grove by a strong fault that

strikes N. 60° W. and dips 40°-50° N. For 100 to 200 feet south of this fault there is a zone of more or less crushed and intensely altered quartz monzonite, which is a very dark gray to greenish-black rock. It is in this zone that the ore deposits are found.

Granite porphyry.-- About half a mile east of Pine Grove, in the canyon, the quartz monzonite is intruded by a dike of reddish-gray porphyry that contains small distinct pink orthoclase phenocrysts, together with white quartz blebs and flakes of greenish biotite. Thin sections of this rock show a medium coarse granular groundmass composed of orthoclase, oligoclase-andesine, microperthite, quartz, and biotite, in which are set small, fairly well developed phenocrysts of the same minerals. The quartz and orthoclase of the groundmass are intergrown in some s ides as in "graphic granite." Epidote and kaolin are secondary products from the biotite and feldspars. This rock, a granite porphyry, is probably a derivative of the quartz monzonite magma and was intruded into that rock at no great time after its formation.

Rhyolite.-- Above the quartz monzonite and granite porphyry lies a series of pink to gray rhyolites. These rocks form the "Sugar Loaf," 1½ miles east of Pine Grove. The contact lies at the west base of the peak, about 1 mile east of town. From this place it crosses the canyon at an elevation of about 5,900 feet and swings N. 73° W., forming the highest points along the summit of the ridge north of Pine Grove Canyon. These flows seem to dip to the north and northeast at low angles and are relatively thin. The lower flows are slightly porphyritic; the upper flows are more glassy. In the porphyritic flows the groundmass shows microscopic crystals of quartz and orthoclase, rather thickly scattered through the glass base. In this groundmass are a few small fragments of orthoclase, quartz, and biotite.

Basalt.-- Some of the low hills in the valley 5 miles east of Pine Grove are composed of black vesicular augite basalt, which overlies the rhyolite unconformably.

Ore Deposits

History and production.-- The first discoveries of gold were made on some outcroppings on the north side of the canyon at the town of Pine Grove in 1866 by William Wilson, a resident of Mason Valley. The Wilson mine covers the original location, and also about 80 acres of ground in the vicinity. For some years the district was called the Wilson, after its discoverer, but the name of Pine Grove was finally adopted from a grove of pinon trees, which the Indians visit annually to gather nuts.

In 1869, according to Raymond, there were several arrastres and a 10-stamp mill in operation on oxidized ore, which ran from $30 to $90 a ton. The bullion produced at that time was said to be 0.917 fine.

The Wheeler mine, on the south side of the canyon, about three-fourths of a mile east of town, was discovered shortly after the Wilson.

In 1882 Burchard reports that both the Wheeler and Wilson mines were working ores between $50 and $60 in grade in amalgamating mills. The Wheeler mill had 15 stamps and the Wilson mill 10 stamps.

Prior to 1896 none of the ore was concentrated, and as only about 33 per cent in value of the precious metals in the sulphide ore is free milling the tailing piles contained considerable quantities of those metals. A small

cyanide mill not in use in 1912 was still standing in the canyon just north of Sugar Loaf Peak. It is said that a large quantity of the tailings from the Wheeler mine had been re-treated in this mill with considerable success.

During the later years of development in the mine the low-grade material averaged 0.28 ounce in gold to the ton and the high-grade sulphide ore 3.4 ounces gold, 0.3 ounce silver, and 0.24 per cent copper to the ton. It is estimated by Mr. Deleray, superintendent of the Wilson mine, that the production from that property between its discovery and 1893 amounted to about $5,000,000 and that about $3,000,000 was taken from the Wheeler mine during the same period. Since 1893 the mines have not been worked continuously, but in 1909 the Wilson mine was purchased by the Pine Grove Nevada Gold Mining Co., so there is some hope that the camp may again become active. According to the mining journals the Wilson mine has been reopened and equipped with electrically driven machines.

The following table of production of the Pine Grove district is taken from the mineral resources reports of the United States Geological Survey for the years 1902 to 1911, inclusive. The value of ore a ton according to these figures ranges from $6 to $22, the average being $8.65.

Production of gold and silver from the Pine Grove district, Mineral County, Nev., from 1902 to 1911, inclusive.

Year	Crude Ore Treated	Gold	Silver	Total Value
	Tons		Ounces	
1902	1,105	$ 11,270	5,917	$ 14,164
1903	2,675	63,000	28,584	75,000
1904	2,300	14,238	1,882	15,310
1905	150	1,230	242	1,376
1906	1,231	11,090	1,821	12,310
1907	9,735	12,393	3,264	14,547
1908	632	14,143	277	14,310
1909	.....	.....	.....	.....
1910	273	3,246	2,817	4,767
1911	1,024	11,914	81	11,957
	19,125	142,524	44,885	163,741

Development.-- The Wilson mine is developed by a series of tunnels that join and cross one another in a most intricate manner. From the tunnels there are many long-filled stopes, shoots, and galleries, making a network of openings in the ore zone which are estimated to total about 3 miles of workings. All this work reaches a maximum depth of 140 feet below the outcrop. A 300-foot incline shaft is located near the mouth of the main working tunnel, but its mouth was caved and water was standing within 100 feet of the surface, so it could not be entered. Most of this work was done by lessees, as the mine was largely worked under that system. The lessees paid the company a royalty of 50 per cent of the net returns on all ore produced.

The ground is heavy, necessitating the use of large timbers, and a great many of the old stopes are either partly or completely filled with waste, many of them being caved.

A long crosscut tunnel has been started to cut the ore body 500 feet below the outcrop, but as yet has been driven only through the overlying rhyolites. This tunnel has its mouth in the first canyon north of Pine Grove Canyon, about 1½ miles north-northeast of town. It is said that there are about 4 miner's inches of water a minute developed by this tunnel, which would be an adequate supply for a mill located at the tunnel mouth.

The Wheeler mine is developed by three irregular tunnels and connecting stopes, raises, and chutes, through a vertical distance of about 120 feet. The work is in rather bad condition, owing to its long idleness. Most of the stopes are filled, but the ore is visible at many places in drifts.

Occurrence of the ore.— The ore bodies in the Wilson and Wheeler mines lie in a zone of intense crushing and alteration immediately south of the well-marked fault, striking N. 60° W., that cuts the quartz monzonite. This fault dips 40°-45° N. and is marked by a heavy clay gouge. Rounded pebbles of the altered rock are present in this gouge, which seems to be largely iron-stained clay, together with much sericite. Calcite crystals are developed in it, some ofthem 2 inches across. The gouge ranges from 4 to 6 feet in thickness and slickensides in it are all about parallel to the dip of the vein. The direction of movement was not entirely clear, but the faulting appears to have been normal.

The quartz monzonite for 150 to 160 feet south of the fault has been crushed and altered to a high degree. In this zone there is a considerable quantity of disseminated pyrite and a large number of small interlacing quartz stringers carrying pyrite that range from one-eighth inch to 3 inches in width. There are also lenses of quartz and pyrite that may be 2 or 3 feet thick extending along the strike for 10 to 150 feet. These lenses of sulphides constitute the good ore, which is said to have been of better grade in those portions from 8 to 10 inches thick. They have a very flat dip to the north, between 10° and 15°, so that many pillars were left in the mining operations. The lenses overlap both in strike and dip, and there was apparently no indication to direct new drifting at the end of a lens. There are a few post-mineral faults about parallel to the main fracture that are vertical and have moved the rock on the north side downward from 6 to 8 feet.

Character of the ore.— The small streaks and large lenses of quartz and sulphides constitute the ore. The sulphide is 95 per cent pyrite, though a little chalcopyrite occurs in places, particularly in narrow veinlets branching off from the lenses. The ores are all somewhat oxidized to a depth of 170 feet. Limonite is common and locally there are small areas of copper-stained ore where the chalcopyrite was most abundant.

The valuable constituents of the ore are gold and silver, and it is said that at the Wilson mine, at the west end of the mineralized area, the ratio of gold to silver was higher than at the Wheeler mine ease of Pine Grove. The bullion from the Wilson mine is said to have sold for $18.75 an ounce, whereas that from the Wheeler mine was worth only $15 an ounce. Above the 170-foot level about 50 per cent of the gold was free in the semioxidized ores and at the surface very rich free-milling ore bodies were found. It is said that at a depth of 250 feet in the Wilson mine there is practically no oxidation of the sulphides, which have a value of about $10 a ton.

Alteration of the quartz monzonite.— For about 200 feet south of the main fault, and for an unknown distance north of it, the normal light-gray coarsely crystalline quartz monzonite is crushed and altered to a dark-

gray, almost black rock. The alteration is progressing, becoming less and less intense as the fault is left. The beginning of the alteration is shown in the slightly changed rock by a sericitization of the oligoclase-albite and by a partial alteration of the original green hornblende to brownish-green biotite. A small amount of epidote is also seen. In the ore zone most of the plagioclase feldspar is replaced by greenish-brown biotite and sericite, and all the original hornblende is changed to the dark mica. In this rock there is widely disseminated pyrite and numerous interlacing quartz stringers cut the formation in all directions.

At the fault the rock is completely altered to an aggregate of quartz and brownish-green biotite, together with a little orthoclase, apparently left from the original rock. All the plagioclase and hornblende are gone, but the magnetite seen appears to have escaped alteration. This rock contains abundant grains of disseminated pyrite as well as veinlets of quartz and pyrite. Calcite is developed to a small extent in veinlets in the ore zone and forms thin crusts coating the joint planes of the rock.

This alteration must have been accomplished at depth by hot ascending solutions rich in potassium. The ores were formed as replacements of the crushed and altered rock by the same solutions that caused the alteration.

Biotitization of the wall rock by vein-forming solutions, though not of wide occurrence, has been noted at a number of places. Lindgren found biotite--

replacing hornblende and feldspars --- in veins carrying tourmaline (Meadow Lake, Cal.); replacing the same minerals it appears abundantly in the gold-copper veins of Rossland, B. C. A greenish mica, probably biotite, occurs, replacing quartz, in small veinlets, associated with quartz, garnet, tourmaline, actinolite, and zinc blende, in the Bunker Hill and Sullivan mine, Idaho.

Hatch reports that--

in the near neighborhood of the quartz lodes (at Kolar, India) a characteristic brown mica is abundantly developed --- genetically connected with the mineralization of the lodes, whether by vapors from below or by ascending mineralizing solutions.

In a footnote he further suggests that the "brown mica has been produced by deep-seated vapors attacking the hornblende and supplying the requisite amount of water and alkalies.

At Bingham, Utah, Boutwell notes the alteration of quartz monzonite in the vicinity of zones of strong shattering. He says:

Conspicuous areas of granular quartz are numerous, the orthoclase is highly sericitized, and the femic minerals are represented by numerous irregular patches of small individuals or flakes of dense brown biotite. The quartz and sericite are clearly secondary, and though no direct proof of the age of the biotite has been found it resembles secondary biotite and may be secondary also. Magnetite, excepting occasional grains, has disappeared, and large amounts of chalcopyrite and pyrite are present in the form of rounded grains, chains, and veinlets embedded in secondary quartz, flaky biotite, and sericitized feldspar.

In the gold veins of Dahlonega, Ga., which "lie on the contact of either mica schist and amphibolite or of mica schist and granite," Lindgren mentions garnet, apatite, ilmenite, muscovite, dark-green mica, and green hornblende in the altered wall rocks of the veins, which contain very few striated feldspar grains, though much feldspar is present, and most of it, as indicated by its optical properties, is an oligoclase, although some of it may be albite. In the same veins garnet, hornblende, apatite, and a green mica may develop along the quartz veins. He concludes that "In the prevailing class of Dahlonega mines the products of alteration are such minerals as occur in areas of regional metamorphism or in contact zones."

In his report on the Juneau gold belt of Alaska, Spencer has described the alteration of the diorite, particularly where this rock contains the greatest number of quartz veins, into a fine-grained substance, composed mainly of quartz, calcite, brown mica, and chlorite, by the addition of potash.

Knopf has noted a similar alteration of the igneous rocks in the northern end of the Juneau belt by a large introduction of albite, the conversion of the hornblende and other amphiboles into biotite, and the introduction of apatite. This alteration shows a large addition of soda and potash demanded by the formation of albite and biotite, and a heavy loss of magnesia, lime, and iron. Knopf concludes that the mineralizing solutions were rich in soda and potash and that they were hot, ascending waters of deep-seated origin.

Spencer has recently found a similar alteration of quartz monzonite in the Ely district, Nev. He finds the most intense alteration along zones of crushing and concludes that the alteration was produced by hot aqueous solutions carrying soda and potash which have changed the hornblende, plagioclase, and magnetite of the original rock into sericite and biotite and have deposited pyrite, chalcopyrite, calcite, and possibly quartz.

Rockland Mine.-- The Rockland mine, situated about 3 miles southeast of Pine Grove, though not visited, is presumably of the same type of ore deposits as the Wheeler and Wilson mines and may be on a continuation of the same fault zone, though it seems more probable that it lies in another zone of fracture. The "vein" is said to strike northwest and to dip 45°-55° NE. The footwall is the dark altered quartz monzonite and the hanging wall a "light-colored porphyry," presumably the intrusive granite porphyry, though it may be the rhyolite. The property is developed by three drift tunnels. The ore is said to contain very little copper, the value being chiefly gold and silver, the bullion having a value of $15 an ounce.

There is said to be a 20-stamp amalgamation mill on the property, lately installed to replace a dry process mill, which was unsuccessful on account of the large quantity of clay in the ore.

Future of the District

This type of ore has probably been formed at considerable depth, for the accompanying alteration, as pointed out by Lindgren, is such as to preclude the theory of shallow deposition. It seems probable, therefore, that the mineralization along the fault zone will continue for a considerable distance below the surface. It is to be expected, and is already shown in the lower workings of the Wilson, that the grade of the ore will not be as high as at the surface, but the unaltered sulphides at a depth of 250 feet carry

$10 a ton, and ore of even lower grade has been successfully worked at numerous places. This pyritic ore, with such a small proportion of copper minerals, is amenable to cyanide treatment, and it seems entirely possible that if a sufficient quantity of ore can be treated the properties could again be producers. In fact, reports in the mining journals indicate that these mines are to resume production in the near future.