Recent Development on the Black Bear[1] Vein, San Miguel County, Colorado

by

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[1]Published by permission of the Director of the Geological Survey, United States Department of the Interior, in cooperation with the State of Colorado through the Colorad State Geological Survey Board and the Colorado Metal Mining Fund.

[2]U. S. Geological Survey.

Illustrations

Abstract

Mining on the Black Bear vein in southwestern Colorado was resumed in 1944 after a lapse of about 20 years. The old Treasury tunnel, the portal of which is in Ouray County on the Ouray-Durango highway 13 miles south of Ouray, was extended westward into the mountain range between Telluride and the Uncompahgre drainage system. The vein was encountered in a crosscut 900 feet beneath the old workings in Ingram Basin high on the west side of the range. Drifts along the vein at the Treasury level have exposed ore of moderate grade containing lead, zinc, copper, gold, and silver. The width of vein and grade of ore have not changed materially with the increased depth.

Introduction

The Black Bear vein crops out near the eastern edge of San Miguel County, about four miles east of the town of Telluride in southwestern Colorado. The vein was formerly worked from an adit at an altitude of 12,318 feet in Ingram Basin on the west slope of the San Juan Mountains. The adit level is connected to five lower levels by a winze. Ore was taken by an aerial tram to a mill near Telluride, but snowslides at the mine and along the tramway, and difficulties encountered in milling the base-metal and gold-silver ore caused a cessation of operations in 1924.

The general geologic setting has been presented in detail by W. S. Burbank[1] and others[2] in earlier publications. The bedrock of this part of the San Juan Mountains is made up of a thick series of nearly flat-lying Tertiary volcanic breccias and flows which rest unconformably upon steeply dipping pre-Cambrian metamorphic rocks and gently dipping Paleozoic and Mesozoic sedimentary rocks. Glaciation has produced a very rugged topography.

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[1]Burbank, W. S., Structural control of ore deposition in the Red Mountain, Sneffels, and Telluride districts of the San Juan Mountains, Colo.. Colorado Sci. Soc. Proc., vol. 14, No. 5, 1941.

[2]Cross, W., and Purington, C. W., U.S. Geol. Survey Geol. Atlas, Telluride folio (No. 57), 1899.

The vein systems of this part of the San Juan Mountains are intimately related to a caldera of Tertiary age centering about three miles north of the town of Silverton. Its northwestern rim extended nearly to the portal of the Treasury tunnel. Fractures both radial and concentric to the caldera are prominent, but on the northwest side of the caldera the fractures trend radially away from the caldera for only a mile or two then curve toward an outlying intrusive mass at Stony Mountain, seven miles northwest of the caldera rim and four miles northeast of Telluride. These fractures, many of which were filled with dikes and later with vein material, thus are prominent in a roughly lens-shaped area extending nearly to Stony Mountain with a central axis on the line between the caldera rim and Stony Mountain. The dike-filled fractures, though steep, dip outward away from the axis. The central part of this lenticular area has sagged along the axis just mentioned and the long blocks between the dikes have tipped inward a few degrees toward the axis from both sides so that each block was downthrown slightly in relation to the adjacent block nearer the axis. This is the reverse of ordinary step-fault structure but the dips of the faults and the relative amounts of movement on them resulted in a sagging along the axis of the dike group. Tensional stresses resulting from this subsidence produced fractures within the blocks dipping at angles of 50 degrees to 70 degrees away from the axis. The Black Bear vein occupies one of these tension fractures within the block bounded on the southwest by the Argentine dike. The Black Bear vein strikes about N. 60° W., dips about 60 degrees to the southwest, and joins with the mineralization along the Argentine dike at the north end of the old Black Bear mine.

The wallrock of the Black Bear vein at the Treasury tunnel level is an andesitic and latitic breccia of the Miocene (?) San Juan tuff. The breccia is about 2,000 feet thick and is composed of angular fragments of volcanic rocks in a fine-grained matrix of air and water-laid tuff. It is well cemented, shows little tendency to cleave or part in any

single direction, and has behaved as a thick, uniform, and rather brittle plate under the action of stresses which produced the ore-bearing fractures. As a result, veins along the steep dike-filled fractures and along the flatter tension fractures of this district are remarkably continuous both in horizontal and vertical extent, and the bottoms of ore shoots in many mines have not been reached. It was therefore of considerable importance to study the Black Bear vein as exposed 900 feet below the old workings and to note any significant changes in the vein which might have a bearing on future deep level mining on other veins in the district. For this purpose the writer was assigned to the Treasury tunnel area and this paper is a report on the progress of the work up to the end of October 1944.

The Idarado Mining Company, Oscar Johnson, President, and C. W. Plumb, Resident Manager, operates the Treasury tunnel. The author wishes to express his thanks to the local company officials for their cooperation throughout the work, and to the Idarado and Newmont companies for their permission to publish.

Mine Workings

The portal of the Treasury tunnel is on the Ouray-Silverton highway about 13 miles south of Ouray at an altitude of 10,620 feet. This location has advantages over Ingram Basin in being readily accessible, in being much lower and fairly free from snowslides, and in having a good millsite and better tailings disposal facilities. The old Treasury tunnel, which went in 5,400 feet on a N. 86° W. course to work the Handicap and other veins, was extended in a straight line during 1943 and 1944 for the purpose of working the Black Bear vein. The vein was cut 8,668 feet from the portal. At this point the tunnel turns, follows the vein and shear zone on a winding northwesterly course for several hundred feet, then leaves the vein and goes in a straight N. 60° W. direction staying 50-100 feet into the hanging wall of the vein. At the time of visit the end of the tunnel was

about 11,900 feet from the portal. Crosscuts were driven at 600 foot intervals from the tunnel to the vein and diamond drill holes put out to the right and left of the tunnel. The crosscuts are to be connected by drifts along the vein. By the end of October 1944, approximately 990 feet of drifting had been finished and the raise to the old workings had been started. The raise will follow the vein and be about 1,100 feet long when completed. The relations of the new tunnel to the old workings, the surface and underground geologic features, and the topography of the area are shown on Plate 1. Drifting along the Black Bear vein is shown in more detail on Plate 2.

The Black Bear Vein

Although the strike of the vein, for short distances, may lie at any angle between N. 45° W. and west, the general trend at the Treasury tunnel level is about N. 63° W. For distances of a few hundred feet the vein may be nearly straight. The dip of the vein averages 60 degrees to the southwest, although in some places it may be as low as 45 degrees, and at others stringers of the vein are nearly vertical. The width of the vein varies from a few inches at the southeast end to about 15 feet at No. 7 crosscut, but the minable portion of the vein averages about 5½ feet wide. The vein is relatively weak where first crossed by the tunnel, and, from what may be seen on the surface and at limited underground exposures, it appears to split and die out to the southeast.

The successive mineralizations have, in general, followed the main fracture with some branching and braiding along the vein zone. In places, the several periods of mineralization are represented by one solid body of vein matter having a complex internal structure but bounded by sharp walls. At other places the vein consists of many interlocking stringers of quartz separated by sheets of country rock an inch to a foot in thickness. An inch to a foot of gouge separates the vein from the wall rock in many places.

Paragenesis and Mineralogy

The sequence of mineralization which becomes apparent from a study of the larger features of the Black Bear vein and from a few polished sections of the ore is given below. The various periods of mineralization are not all represented everywhere along the vein, and the various stages need not be thought of as separated by long periods of quiesence but may overlap in time as well as space.

1. The first stage of mineralization includes the silicification and pyritization of the wall rock, development of sericite, orthoclase feldspar, carbonates, and chlorite adjacent to the fracture, and introduction of pyrite and some vein quartz within the fracture. It is very likely that replacement of the wall rock was an important factor at this stage.

2. Movement with brecciation of the early pyrite followed the first mineralization.

3. In the third stage, a large part of the quartz now seen in the vein was introduced, closely followed by the major part of the sphalerite which invariably carries considerable amounts of chalcopyrite and some galena as minute blebs with a diameter of about 0.01 mm. The blebs are believed to be contemporaneous in age with the sphalerite, and in some specimens they are banded along growth lines of the sphalerite crystals.

4. After the deposition of the sphalerite of stage 3, there followed the introduction of more quartz, almost all of the galena, the larger part of the chalcopyrite, and small amounts of tetrahedrite and argentite (?).

5. In stage 5 further movement may have occurred, accompanied by the entrance of more quartz together with small amounts of base metal sulfides, hematite, and bornite. The quartz of this late stage commonly forms large pyramidal crystals showing prominent zoning as bands of a milky white, gray, or rose color. In many places the crystals line the walls of large vugs or "watercourses" and are very

similar to those in the Camp Bird vein 1½ miles to the northeast. Along many parts of the vein this type of quartz forms a separate band in the footwall.

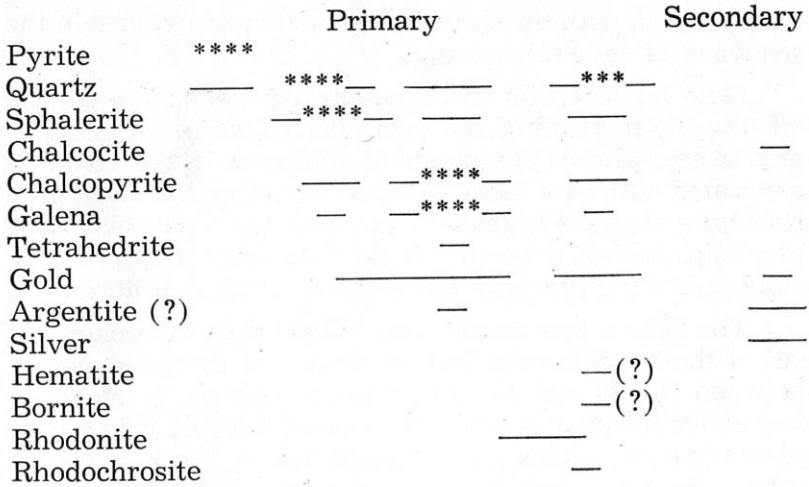
6. More movement followed the last period of primary mineralization. As mentioned above and shown on Plate 2, the ore is commonly bounded by clay and gouge. Striations indicate that most of the movement was normal and down the dip of the vein. No information is available on the amount of the movement, but it is probably not more than a few feet.

One crosscutting fault (the Iron vein) offsets the Black Bear vein about 25 feet (see pl. 2). All other faults in the area are more nearly at right angles to the Black Bear vein than the Iron vein and apparently are earlier in age than the vein matter within the Black Bear fracture.

7. Lastly, in and near the post-ore fractures small amounts of gold, native silver, and argentite have been deposited from descending solutions. Oxidation has, in general, been very slight within the vein at the Treasury level, and secondary enrichment at this depth is probably of no economic importance. However, it would be worthwhile to assay samples collected in and near fissures to be sure that local concentrations of finely divided gold or silver are not being missed.

The paragenesis of the ores is summarized in the table below, in which the left or right position of the horizontal lines indicates deposition of the minerals at respectively early or late stages, and the asterisks mark the main surges of deposition.

Specimens were collected from dumps at the small mines on the north side of Ingram Basin at an altitude of 12,700 feet, from the first level of the Black Bear mine at about 12,325 feet, and from the Treasury tunnel at 10,700 feet altitude. Mineral relationships remained unchanged throughout this range in altitude. It should be remembered that specimens of ore and polished sections represent but a minute part of the ore body and that the sequence shown



in the table should not be applied too closely to any particular piece of ore.

Other minerals found in the vein are calcite, much of which is manganiferous, chlorite in the wall rock and as bands within vein quartz, halloysite, a kaolin mineral, and various other undifferentiated clay minerals and iron oxides in the gouge seams. Rhodonite and other manganese silicates of a pink, brown, or green color are abundant but not conspicuous due to their somber colors. Adularia, a variety of orthoclase, is present in the altered rock wall close to the vein.

The most important, and in many ways the most difficult mineralogic problem presented by the vein is the distribution of the gold. So far as is now known the gold is free, although it is possible that some gold may occur as inclusions in sulfides. The writer has seen very little gold in place, and specimens collected from miners and from broken ore give little information as to their location within the vein. Although it is probable that the gold is not confined to one part of the vein or to a definite type of quartz, available data indicate that most of the gold may

have come in with the second stage of quartz (stage 4 in the sequence of mineralization).

Gold has been found in small quartz stringers cutting off into the footwall of the vein. It also occurs in greenish quartz near altered fragments of wall rock in the vein and associated with base metal sulfides. Some specimens of pink rhodonite show free gold. It has also been reported from clay slips where it occurs as delicate spidery wires, possibly indicating precipitation from descending waters.

The richest specimens were collected from broken ore out of the knuckle raise just northwest of the main station between No. 16 and No. 13 crosscuts (see pl. 2) about 15 feet above the main level. At this point the gold is in a very distinctive cavernous white quartz which forms a pocket within the vein, and which grades into quartz of normal texture on all sides. The gold is in fine mossy aggregates in the quartz and in the cavities and is accompanied by calcite and very finely divided galena. The cavities have been produced by the removal of a mineral which was intergrown with the quartz. They are rectangular in outline and contain thin lamellae of quartz oriented in such a way as to suggest that the mineral had three mutually perpendicular cleavage planes in which some of the quartz deposited. Dr. W. T. Schaller, who has done much work on crystal cavities, believes the mineral was anhydrite, $CaSO_4$, which was hydrated to gypsum and removed by solution. Anhydrite is known in veins of this region. Barite, $BaSO_4$, generally a more common sulfate, has not been found in the vein.

Reserves

A sufficient quantity of ore had been left in the mine to justify plans for the extension of the Treasury tunnel and the driving of an 1,100 foot raise to reach the ore. The continuity of the vein to this lower level has been proved by driving drifts along the Black Bear vein at the level of the Treasury tunnel, and additional reserves may now be in-

ferred with reasonable assurance. Total reserves in measured, indicated, and inferred ore are substantial and have an estimated average grade of approximately 0.1 oz. gold, 3.4 oz. silver, 3.2 percent lead, 1.1 percent copper, and 6 percent zinc.

A comparison of the results of sampling in the old workings with sampling at the Treasury tunnel level shows that the grade of ore and width of vein are not greatly different even though the new drifts are nearly 1,100 feet down the dip of the vein from the upper workings. The content of gold, lead, and zinc appears to be somewhat lower, and the amount of copper and silver somewhat higher at the Treasury tunnel level, but these small differences may be in part the result of unlike sampling procedures rather than zoning of ore with depth. The most important fact presented by the assays is that the metal content of the vein has not changed greatly for a distance of 1,500 feet along the dip, and this alone should encourage further development on this vein and on similar veins in the district.

The Black Bear vein apparently will cease to be of minable width to the southeast of the present development. The fissure was relatively weak where first intersected by the crosscut, its angle of dip rather low, and the occurrence of sulfides within the fracture irregular. Surface study as well as the presence of numerous stringers crossing the crosscut portalward from the main vein suggest that the vein breaks into numerous splits and dies out to the southeast. The prospects are good for some hundreds of feet at greater depth although, as Burbank[3] points out, the dip may decrease still more and the vein feather as it approaches the Argentine fissure, or extends into the sedimentary rocks beneath the San Juan tuff. The ore will almost certainly continue to the northwest until the Argentine dike is encountered. At this point the main mineralization will probably swing off and follow the Argentine dike as observed on the surface (see pl. 1). Although, at the surface, vein mate-

[3]Burbank, W S., op. cit., pp. 222, 228-229.

rial on the Black Bear fracture continues to the northwest beyond the Argentine dike at least several hundred feet there is as yet no assurance that this part of the vein will be productive at depth. In all probability the steeper fissuring along the Argentine dike and vein was the feeder channel for the Black Bear vein.

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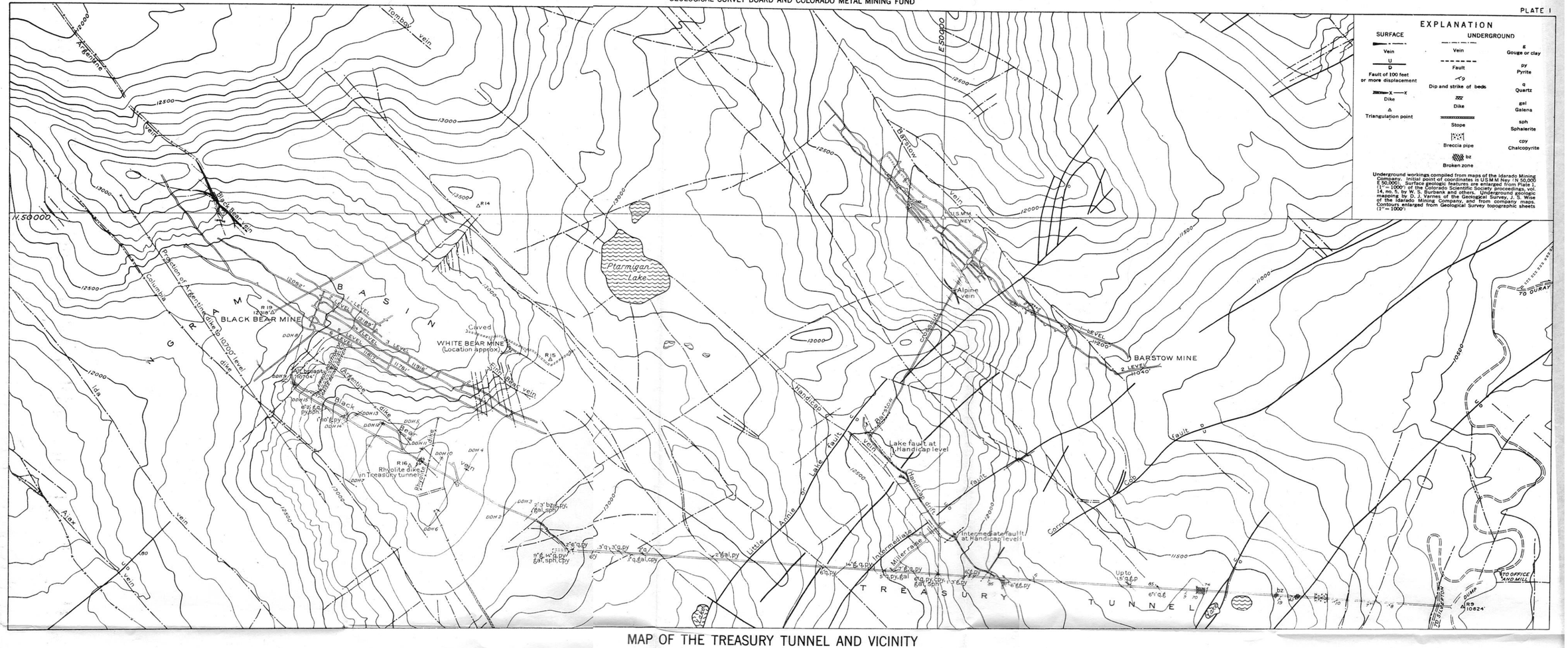
PLATE I



MAP OF THE TREASURY TUNNEL AND VICINITY

SHOWING VEINS, FAULTS, AND UNDERGROUND WORKINGS

OURAY, COLORADO

0 200 400 600 800 1000 FEET

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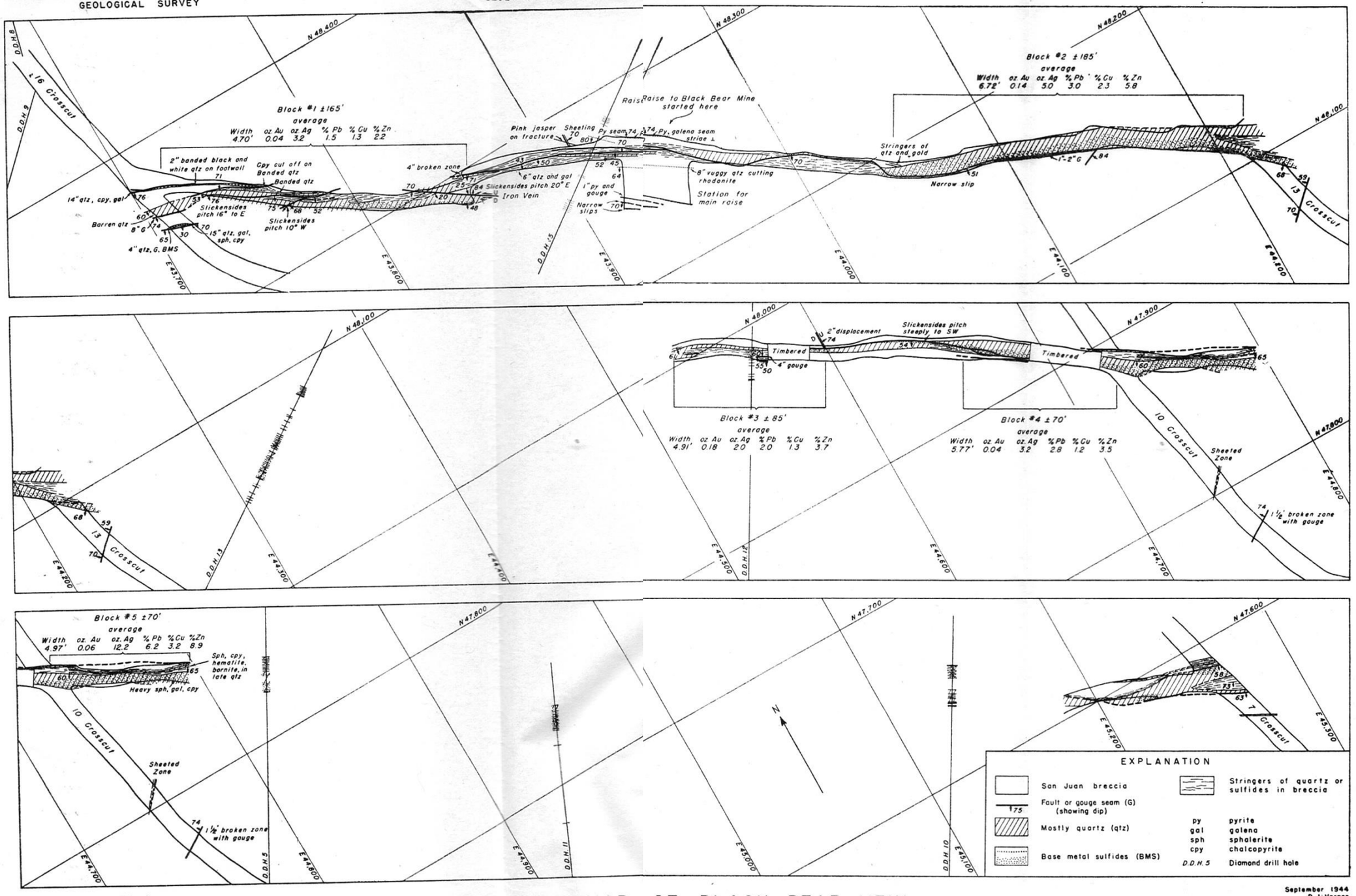
PLATE 2



Base map from Idorado Mining Co.

GEOLOGIC MAP OF BLACK BEAR VEIN
TREASURY TUNNEL
Ouray, Colorado

SCALE
50 0 50 100 150 Feet

September 1944
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Geological Survey