Mines and ore deposits near Ouray, Colorado

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sandstone was located near the Barker dome in sec. 13, T. 31 N., R. 14 W., by a Commission plane early in 1955. Weak radioactivity, associated with a poorly exposed outcrop of rust-brown sandstone, may result from a low concentration of heavy minerals.

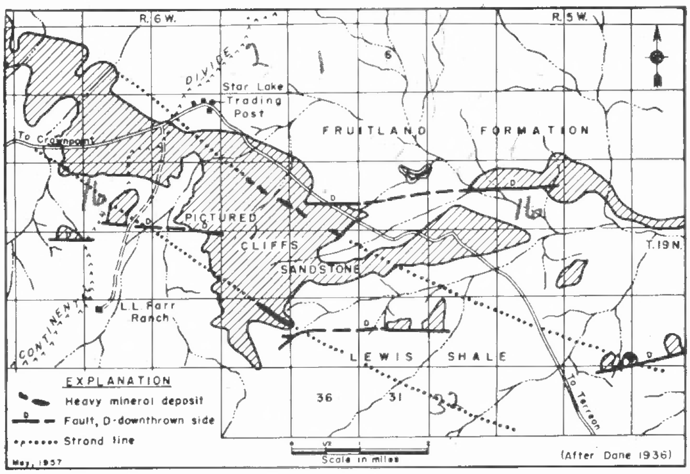

Figure 4. Geologic map of the Star Lake area showing the titaniferous sandstone deposits

Subsurface Occurrences

Of the numerous wells being drilled for natural gas in the San Juan Basin, it is likely that a few would penetrate black-sand deposits in the subsurface. Don W. Mitchell, of Pacific Northwest Pipeline Corp., noted strong radioactivity in the top of the Point Lookout sandstone in three wells drilled by his company near Gobernador (fig. 1). Gamma-ray logs indicate the SJU 30-6, No. 16-26 well, in sec. 26, T. 30 N., I R. 6. W., penetrated a radioactive zone between 5862-66 feet; the SJU 29-5, No. 35-34 well, in sec. 34, T. 29 N., R. 5 W., cut it between 5751-57 feet; and the SJU 29-4, No. 7-8 well, in sec. 8, T. 29 N., R. 4 W., encountered radioactivity between 6360-65 feet. Although no cuttings or cores were obtained, it is believed that the radioactivity is caused by a heavy-mineral concentration, since all other radioactivity in the top of the Point Lookout has been traced to such concentrations on the surface. Furthermore these wells fall within a northwest trend between the Stinking Lake deposits and those in the northern part of the southwest Mesa Verde area. Possibly heavy-mineral concentrations were formed near Gobernador along the same shoreline as the outcropping deposits.

Other Possible Deposits

The author believes that many more black-sand deposits may exist in the San Juan Basin and adjacent areas of Upper Cretaceous rocks. Undoubtedly many unreported deposits have been found by prospectors searching for uranium, who did not realize the actual significance of their find. A few deposits are known to exist in the Black Mesa Basin of northern Arizona and single deposits are known both in the Henry Mountains and Kaiparowits Plateau regions of southern Utah.

ECONOMIC POSSIBILITIES

Before complete evaluation of the deposits can be made it will be necessary to determine how the material will respond to current processing techniques. Alteration of the ilmenite and its freedom from intergrowths may make for ease of beneficiation while monazite or other minerals may be recovered as by-products.

The black-sand deposits have not been evaluated with respect to potential tonnage. Rough field estimates of the better exposed deposits indicate about 2-½ million tons of ore are exposed at Sanostee, about 2 million tons are in sight at Standing Rock, and about one-half million tons are in sight at Star Lake.

SUMMARY

(1) Upper Cretaceous rocks of the San Juan Basin contain titaniferous sandstone deposits as significant as any in the Rocky Mountains.

(2) Ilmenite in the deposits is highly altered, and as a result of iron leaching it contains an increased percentage of titanium dioxide. Also, most of the ilmenite is free from intergrowths with magnetite.

(3) Radioactivity, fluorescent zircon, and characteristic sedimentary environment aid in the recognition of new deposits.

MINES AND ORE DEPOSITS NEAR OURAY, COLORADO

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INTRODUCTION

Numerous mines and ore deposits occur within a radius of 2-3 miles of Ouray. Only a few of the more typical deposits will be described here. They are both diverse as to types and variable within individual deposits. Several of the deposits are more or less unique for the San Juan Mountains. Irving (1904, p. 55) long ago recognized the presence of both fissure veins and bedded replacement deposits and noted that some deposits were principally auriferous, others argentiferous. Many of the ore bodies are found along fissures in sandstone just below shale and the deposits commonly spread as replacements into quartzitic sandstone or into limestone. Irving also noted the presence of high-temperature replacement (pyrometasomatic) deposits near the intrusives, and (1904, p. 75) further concluded that the Ouray deposits were formed in post-San Juan tuff time, which he supposed to be Eocene in age, and hence curiously postulated a Miocene or younger age for the deposits. At that time it was thought that the laccolithic intrusives were younger than the San Juan tuff. In 1930 Burbank (p. 201) determined the laccolithic intrusives to be pre-Telluride conglomerate which he appears to have thought to be Oligocene or Eocene in age. He further concluded that in the Ouray area there were two principal ages of deposits, the more important ones of early Tertiary age and genetically related to the laccolithic center, and later ones of late Tertiary age and related to the fissure vein types in the Silverton quadrangle to the south. Burbank (1947, p. 410; 1930, p. 217-218) postulated that the Ouray deposits were structurally controlled by the near coincidence of the intrusives and a sharp turn in the Paleozoic monoclinal flex. He further deduced from metal zoning, shape of ore shoots, and lineation in the breccia dikes that the principal ore solutions rose upward toward the west along intersections of bedding rolls and fissures from source channels east of the laccolithic center.

The deposits of the Ouray area may be divided into four groups that are more or less zoned outward from the intrusive center (Burbank, 1940, p. 200):

(1) Pyrometasomatic magnetite-pyrite ore containing little copper and gold, Bright Diamond and Iron Clad.
(2) Pyritic ores containing copper and gold.
(3) Pyritic base-metal ores containing native gold and gold and silver tellurides.
(4) Siliceous and baritic ores containing silver, lead, and zinc.

The silver-lead-zinc deposits have been the most productive of the above groups, but the entire production has been less than one percent of that of the San Juan districts as a whole. The principal values in the deposits have been from either local concentrations of gold or from the more widely distributed argentiferous gray copper minerals, the brittle silver minerals, or the ruby silver minerals. The principal stratigraphic horizons for ore have ranged from Dolores to Dakota, but most especially were the Dakota sandstone and the Pony Express beds (Todilto and Wanakah formations). Some silver-lead ore of group 4 has come from near the top of the Leadville limestone and in the overlying Molas formation at the Mineral Farm deposits south of Ouray.

MINES

The location and names of mines around Ouray may be found on Figure 1 accompanying the article in this guidebook on the "Geology of Ouray and environs." Only the Bachelor, American Nettie, and Mineral Farm mines are described below. These are representative, and others reveal only minor variations from the features illustrated by these three.

Bachelor Mine

The Bachelor vein is about two miles north of Ouray along Dexter Creek. The vein strikes about N. 85° E. and is nearly vertical. The wall rocks are Morrison, Dakota, and Mancos, but the vein is poorly or not at all developed in the Mancos shale. The fissure is a small fault along which movement has been mostly horizontal although a downthrow of the south side about seven feet has been observed in places (Irving, 1904, p. 61). The fissure was early injected by a breccia dike 3-4 feet wide and was subsequently reopened before, during, and after ore deposition.

The vein is thought to have formed largely by cavity filling as banded and crustified structures are prevalent; however, some replacement is evident. The principal gangue of the vein consists of quartz, barite, and country rock fragments and locally, especially with the ore, there may be rhodochrosite. The hypogene ore minerals are argentiferous galena, tetrahedrite, pearceite (Bastin, 1923, p. 70), sphalerite, and chalcopyrite. Although supergene enrichment and alteration have not been great, they involved both silver and copper to form argentite, pearceite, native silver, bornite, chalcocite, chrysocolla, and tenorite.

The Bachelor vein has been entered in three places: (1) the Bachelor tunnel, a 720-foot crosscut, (2) the Wedge shaft, and (3) the Neodesha tunnel. Drifts from the Bachelor crosscut have opened the vein for more than 1,000 feet eastward where it becomes barren. The principal ore body of the Bachelor, in the Dakota sandstone section, was discovered in 1892 (Burbank, 1947, p. 410), however the vein was mined and prospected for many years before this. By 1895 the mine became the principal producer in the Ouray district and its output has been one of the greatest of the district, probably amounting to nearly $3,500,000. During the early mining high-grade pockets of ruby silver ore were reported to contain as much as 15,000 ounces of silver per ton (Irving and Cross, 1905, p. 17).

American Nettie Mine

The American Nettie is about two miles north of Ouray and nearly 1,800 feet above the Uncompahgre River along the steep eastern ciffs of the canyon. The ore is near the top of the Dakota sandstone and occurs as irregular replacements and cavity fillings whose positions and orientations are generally related to irregular branching fissures. Two breccia dikes and one latite dike occur at the mine and although the localization of the deposits may be structurally controlled by these dikes the ore does not as a rule directly follow them. The solutions which deposited the hypogene ore were preceded by corrosive fluids that dissolved cavities in the Dakota sandstone along and outward from the fissures. The latter ore-bearing fluids entered the cavities and permeable parts of the sandstone from the

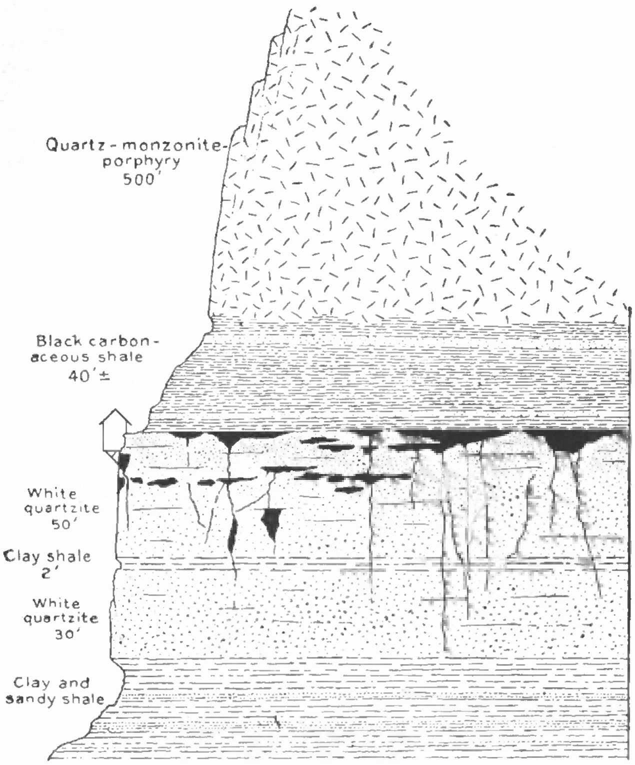

Figure 1. East-west section along the American Nettie deposit. From Irving, 1904.

fissures, and the mineralization in general has converted the sandstone to a quartzite. According to Irving (1904, p. 68):

> Along the course of the fissures ore bodies or shoots extend outward for sometimes as much as 20 feet. In the most typical cases these shoots are irregular bodies, ranging from a few inches to 15 feet in thickness, longer in the direction of the fissure than across it, and with their larger dimensions in a horizontal position. They are often exceedingly irregular, wandering through the quartzite in all directions, but generally being concentrated along a definite bed, usually just under a very fine shale band, which is sometimes so thin that it can be detected only when the rock is broken parallel to it. In the vicinity of the supplying fissures the shoots are at times pear-shaped, with their longer axes in a vertical position and with the fissure passing down through the small end, but away from the fissures they are flat and have their longer axes parallel to the planes of stratification of the quartzite, the ore solutions having seemingly passed laterally along the bedding. The largest shoots lie immediately beneath the black shale at the top of the quartzite. Several tiers of shoots sometimes occur along a single fissure.
>
> The ore in these masses is located chiefly near the supplying fissures, where it forms a solid mass, but outward along the strata it but partially fills open cavities, often merely lining the interior of the open space. On the extreme outer limit of the shoots nothing but empty cavities lined with quartz crystals are to be seen. These contain no ore whatever, and frequently extended for 30 feet beyond the ore shoot.

As evident as cavity filling is, it appears that replacement accompanying the ore deposition probably greatly exceeded the filling (Burbank, 1940, p. 206).

The hypogene gangue minerals of the deposit are principally quartz, pyrite, and barite. The hypogene ore minerals in their probably paragenetic sequence are molybdenite, chalcopyrite, sphalerite, tetrahedrite, galena, hessite, ruby silver, and gold. Much gold was found with limonite near the outcrop in the bottoms of the cavities, and elsewhere the ruby silver was locally so abundant as to cause the mine water on the floors of the stopes and from the drill cuttings to be "bloody red".

The American Nettie bonanza gold ores were discovered in 1889 and in the period to 1905 ore averaging six ounces of gold per ton and valued at $1,464,923 was produced. Over all it is reported to have produced several million dollars in ore.

Mineral Farm Mine

The Mineral Farm deposits lies on an erosional bench about 3/4 of a mile south of Ouray at an altitude of about 9,000 feet. The deposit is along or near the low-dipping contact between the Leadville limestone and

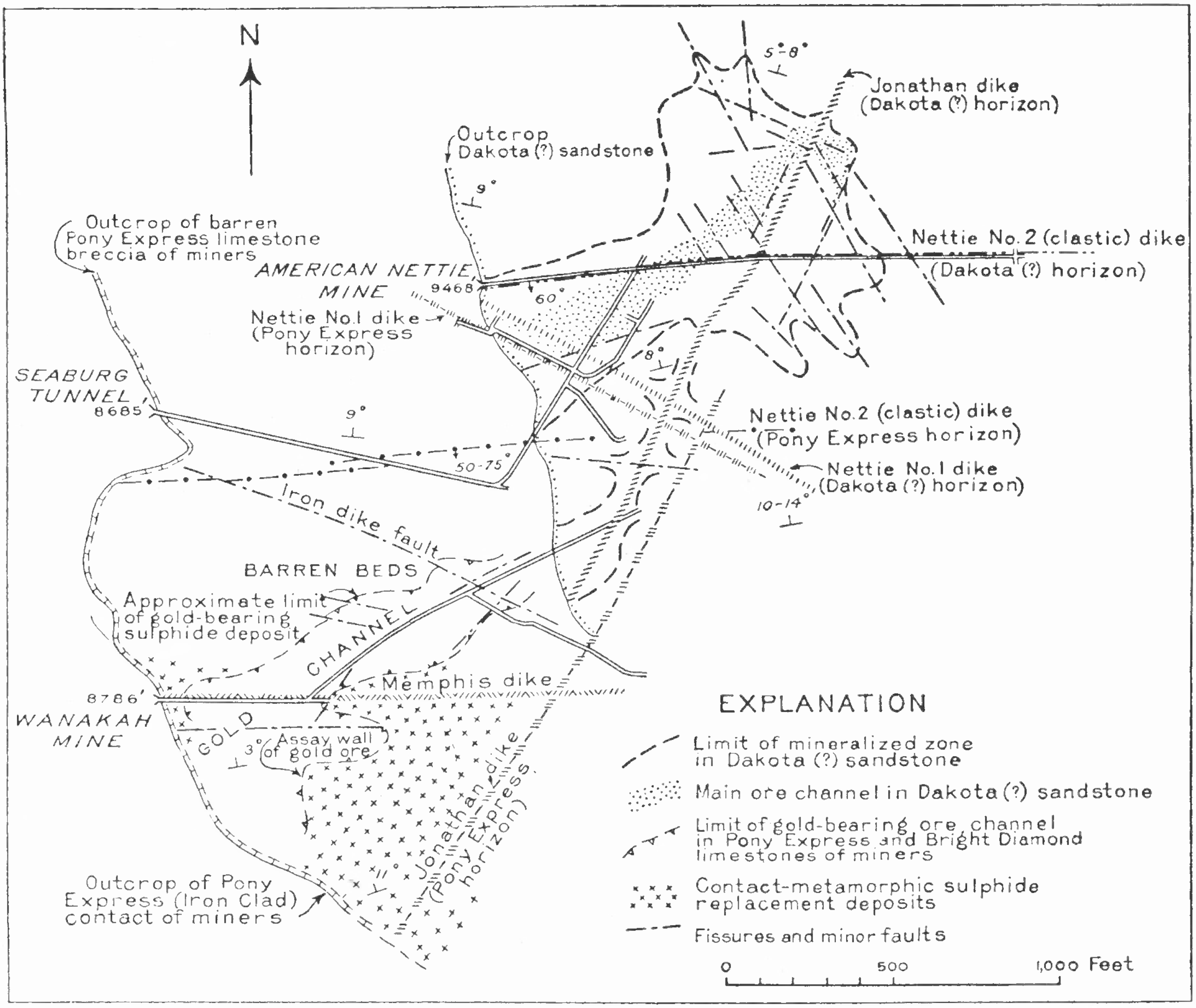

Figure 2. Plan of ore channels, fissures, and workings of the American Nettie and Wanakah mines. From Burbank, 1940

overlying Molas formation. The ore is distributed in a series of caves dissolved in a coarse-textured and clastic member at the top of the Leadville formation. The top of the Leadville was eroded during late Mississippian time and karst structures are common throughout the region into which the Molas beds were either deposited or collapsed before deep burial. Burbank (1940, p. 209-210) concluded that many of the caverns were the result of hydrothermal leaching during Laramide time and points out also that some leaching and collapse even occurred after the deposition of the early Tertiary ore, probably in Recent time by either hot springs or descending surface water. Obscure fissures in the limestone appear to have guided the Mississippian and later periods of leaching and as a result the deposits are shoots generally aligned about N. 63° E. Typical shoots were 8-10 feet thick, 6-50 feet wide, and as much as 600 feet long (Irving, 1904, p. 72).

The gangue of the deposits consists of silicified limestone and fine-grained quartz in which much barite is commonly intergrown. Also present are pyrite, ankerite, and sericite. The ore minerals are chiefly argentiferous gray copper, brittle silver, and galena (Henderson,

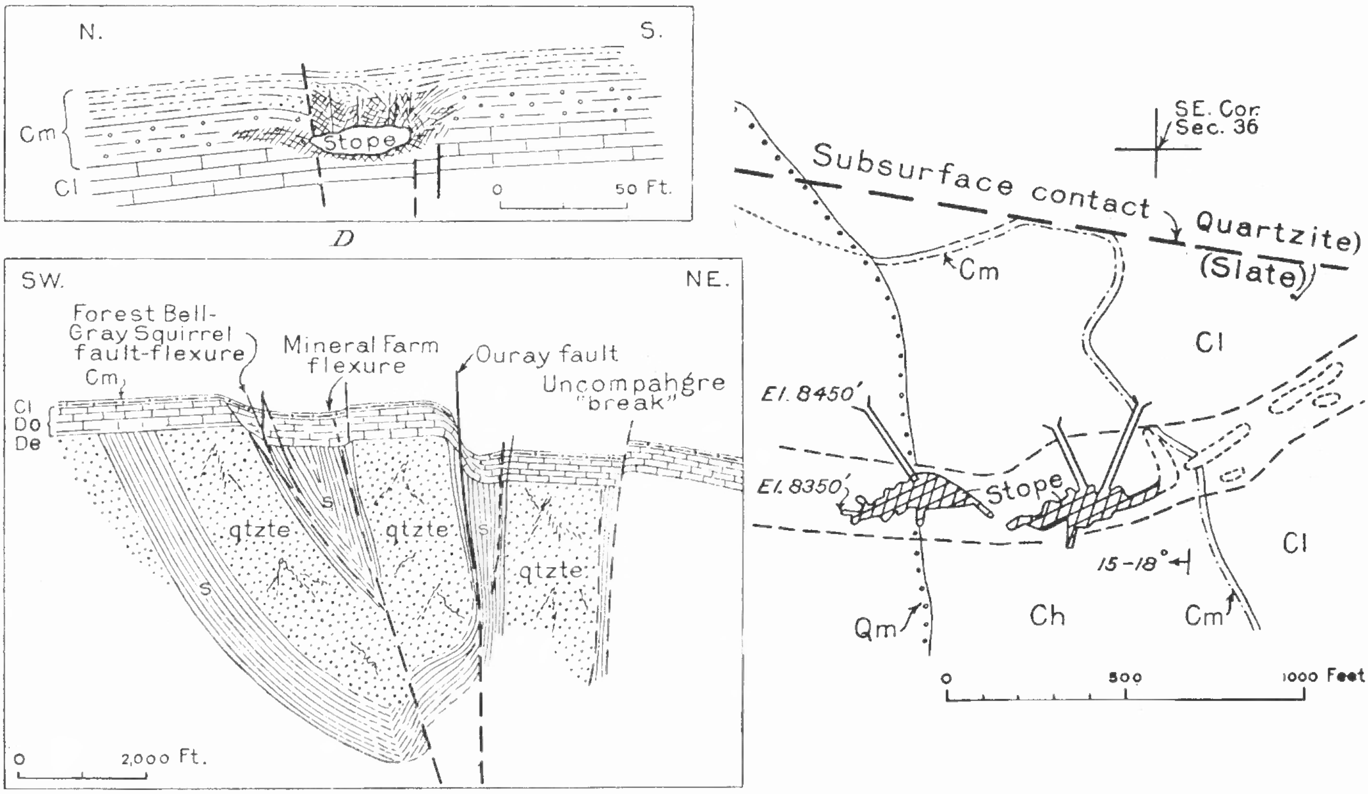

Figure 3. Plan and sections of the Mineral Farm deposits. Elbert formation, De; Ouray limestone, Do; Leadville limestone, Cl; Molas formation, Cm; Hermosa formation, Ch; and slate, s. Adapted from Burbank, 1940.

1926, p. 183) with minor amounts of chalcopyrite, sphalerite, and rarer minerals. The values were mainly in silver with gold only occasionally present in significant amounts. The average grade of the ore, however, has been low and higher grade pockets were very irregular. Output probably has amounted to less than $1,000,000