candel

Preliminary report on the Apex and Paymaster mines, Washington County, Utah

by

A. R. Kinkel, Jr.

This report and accompanying illustrations are preliminary and have not been edited or reviewed for conformity with U. S. Geological Survey standards and nomenclature.

Illustrations

Preliminary report on the Apex and Paymaster mines Washington County, Utah

by

A. R. Kinkel, Jr.

October 1945

Abstract

The Apex and Paymaster mines in the Tetsagubet mining district, 25 miles southwest of St. George, Utah, are at an elevation of about 5,000 feet in the Beaver Dam Mountains. The ore was deposited in a steeply dipping fault zone which cuts a thick series of gently dipping limestones of Pennsylvanian age with minor interbedded shales and sandstones.

The ore now consists primarily of copper oxides, but is reported to contain small quantities of lead and zinc oxides. Complete oxidation extends to the 1,400 level of the Apex mine, the deepest level in this mine. Lead oxides are reported to have been more plentiful in the workings near surface, but the stoped area is now caved to the 1,330 level.

The ore bodies probably formed largely as a filling in the fault fissure, and in crushed zones along the fault, with only minor replacement extending for short distances along the bedding. The sulfides oxidized essentially in place and migration of the oxidized copper ores is believed to be limited to a few feet. Additional exploration below the known ore shoots in the Apex and Paymaster mines and along the fissure between the two mines may disclose new ore bodies.

Introduction

The Apex and Paymaster mines are located in the Tetsagubet mining district, in the Beaver Dam Mountains. The mine workings are in sec. 6, T. 43 S., R. 17 W., and sec. 1, T. 43 S., R. 18 W, Washington County, Utah. The dirt road to the mines branches south from the Arrowhead Trail 15 miles west of St. George, Utah. The mines are at an elevation of about 5,000 feet in barren desert mountains.

In 1943 all machinery at the Apex mine was operated electrically with power from a 33 kilovolt branch line of the Southern Utah Power Co. Housing for about 20 men was available at the mine, together with a cookhouse and the necessary shops. The mine was being operated by a crew of 10 men - 6 underground, 2 at the surface, and 2 truck drivers. The ore was hauled by truck to Cedar City, Utah. Production varied considerably but averaged about 50 tons a week at the time of the examination. Mr. Emerald Cox, of St. George, Utah, part owner of the mine, acted as General Superintendent and was most cooperative in this investigation.

The writer spent 20 days in the mine area. He was assisted for one week by A. R. Granger, and for one week by H. K. Erickson, both of the Geological Survey.

History

The Apex mine has had a varied history of production since 1900, and reached its peak production by 1905. At that time it was supplying ore for a smelter, which has long been dismantled, at St. George. According to old-timers in the district, the mine reached the 1,100-foot level by means of an inclined shaft from the upper tunnel, and most of the ore above the 1,100-foot level was mined out when the workings and shaft caved in 1905. About that time a fire destroyed most of the mine maps, and those included as a base for the illustrations in this report are the only records now available. Certain discrepancies lead the writer to discount the accuracy of these maps on details, but they probably are correct on the general location of stoped areas.

The mine was originally known as the Dixie, later as the Dixie Apex, and at present is called the Apex. As far as could be ascertained, the mine was not operated from 1905 to 1914, but was operated continuously from 1914 to 1921 when it again was shut down. It was reopened from 1929-32 and from 1936-38, most of the operation being by lessers. Mr. Cox and Mr. Paterson, the present owners, began work in October 1941, and the mine has operated continuously since that date, part of the time under lease and the rest of the time under the management of the owners.

Geology

The Apex and Paymaster mines are located in a thick series of rather thin-bedded limestones that Robbin[1] has called the Callville limestone of

1/ Robbin, C. R., Geology of the St. George district: U. S. Geological Survey. Released for publication by Dept. of Interior.

Pennsylvanian age. The limestones had previously been called a part of the

Redwall limestone. They consist of massive beds up to 20 feet thick interbedded with many thinner beds of limestone and subordinate shale and sandy limestone members. The prevailing dip is 5° to 10° E. on the east side of the mines, and 10° to 30° E. on the west side of the mines. The dip gradually steepens westward until the beds are dipping 60° to 80° E at the Black Warrior mine, a mile and a half west of the Apex mine. No general change in dip was seen in crossing from the east to the west side of the vein fissure, although a local reversal of dip occurs in several places just east of the vein. Many local warps in bedding are present (fig. 1), and some of the mine levels in the Apex

Figure 1.--Geologic map of Apex mine and vicinity, Washington County, Utah.

show some crumpling of the limestone in the immediate vicinity of the vein fissure. No connection is obvious between the warps in the limestones and the location of ore in the vein, possibly because nothing is known of the position of pipelike enlargements of the vein.

Only one marker horizon was found in the area that was mapped. This is a forebedded sandstone which ranges in thickness from less than 1 foot, west of the mines, to more than 20 feet, east of the mines (fig. 1). The bedding in the sandstone is quite uniform, and is at a considerable angle to the bedding in the limestones. The overlying and underlying contacts of the sandstone show channeling, and the bed is believed to be of deltaic origin. This, together with the presence of a bed of pebbles on the 1,400 level of the Apex mine, and the occurrence of coral heads, would indicate deposition in relatively shallow water. The limestones are very little fractured, even near the vein and show no alteration except

for a small area northwest of the Paymaster shaft (fig. 1).

Some interbed movement has occurred, the movement being absorbed by the thin shale partings between some of the limestone beds. It was hoped that because of the favorable topographic situation (fig. 4),

Figure 4.—Apex mine, section along line of lower tunnel.

the mapping of the Apex mine would indicate which beds were replaced by ore away from the vein fissure, and that these beds could be studied in detail in surface exposures. When it was found that the mine maps were inadequate to show where, or even if, the ore extended out along certain beds, no attempt was made to study or map the limestones in detail.

The ore-bearing fissure probably represents a fault with a vertical displacement of roughly 250 feet. The only evidence of offset on the fault is the displacement of the forebedded sandstone (fig. 4). The correlation of the forebedded sandstone east of the ridge with that found west of the ridge is reasonably certain as the bed is distinctive in appearance, the forebedding has a persistent northeasterly strike at a considerable angle to that of the overlying and underlying limestones, and the sandstone bed is overlain by a persistent horizon of large corals.

The vein fissure lines up reasonably well with a prominent fault that has about the same vertical displacement as can be seen on a ridge about 3,000 feet south of the Paymaster mine. However, all slickensided surfaces seen in the Apex mine and on surface have horizontal striations, and the actual displacement on the fault could be determined only by mapping a larger area. The vein fissure disappears to the north in an

area of slope wash, and time was not available to map the continuation of the fissure to the north. The parallel fissure 350 feet to the west (fig. 1) may be a faulted continuation of the Apex fissure, but a larger area must be mapped to determine this. No offset is apparent in the fore-bedded sandstone on the western slope, but much of the area is covered with slope wash and was not mapped in detail. A reconnaissance down the main canyon to the west did not disclose any evidence of faulting.

Ore deposits

Two ore bodies are known on the Apex fissure, which is also called the Bulldog fissure by local residents. These are the Apex and Paymaster mines, which differ from each other in mineral content. The Paymaster mine is on a very sharply pulled portion of the fissure, and the primary ore apparently replaced fault gouge and sheeted limestone. No bedded ore was seen. The nature of the primary mineralization is unknown, and the "vein" now consists of a mixture of ground-up, altered, soft limestone, white clay, and irregular patches and streaks of yellow oxides that are said to contain lead and probably contain some zinc. Practically no copper is present.

In addition to the two tunnels shown in figure 3, several small dog

Figure 3.--Paymaster mine, lower and upper tunnels.

hole levels were driven below the upper tunnel, and a shaft, which varies by report from 85 to 125 feet in depth, was sunk at the portal of the upper tunnel. The ladders are now out of the shaft, but it is not caved. There is said to be a level at the bottom of the shaft, and a short winze from the north end of this level is reported to have been in high-grade lead ore when the mine was closed down. Although the writer has no information

on the grade of ore in the Paymaster mine, the mine is on a strong fissure with widths of oxidized material up to 6 feet, and seems to warrant deeper exploration. The lower tunnel (fig. 3) crossed the vein fissure but did not encounter ore, and surface exposures of the vein indicate the best possibilities lie in the vicinity of the Paymaster shaft and the area of strong alteration northwest of the shaft.

The Apex mine is the largest mine in the Tetsagubet mining district, and a series of ore shoots have been mined from the surface to the 1,400 level. Stope lengths of several hundred feet are shown on old maps. In 1945 no mine workings on the vein were accessible above the 1,330 level, but all accessible crosscuts to the vein zone were mapped (figs. 2-B to 2-J). The ore mined in 1945 from the 1,330 to 1,400 levels is reported

---

Figures 2-B - 2-J.—Apex mine

---

to have been of the same grade and character as most of the ore mined above these levels.

The mine is in a district that contains many natural caves of large size, generally oriented along fissures. In the Black Warrior and Surprise mines to the west of the Apex mine, the lead and copper ore occurs as a filling of preexisting caves and shows little tendency to replace the walls of the cave. In the Apex mine, in spite of numerous small caves and one very large open cave, no ore was deposited as a cave filling away from the Apex fissure. The fissure itself was locally enlarged by solution to form small cave areas, but the fissure was apparently the only channelway for ore-depositing solutions. Only the caves directly connected with the fissure are ore bearing.

The ore consists of malachite, azurite, and other copper oxides in cemented but very porous masses. Much white and brown clay is present in the ore, together with angular fragments of altered limestone and shale. Ore boundaries are extremely irregular because of original irregularities in the open parts of the fissure and because of replacement and penetration of the shattered material along the walls of the fissure. No sharp wall similar to that in the Paymaster mine was seen, but such a limited area of the vein is now accessible that its major physical characteristics can only be guessed at.

The ore is believed to have been a sulfide deposit that oxidized in place. Massive black and yellow iron oxides are plentiful and a few small patches of lead oxide that still contain specks of galena can be found in the vein zone. On the old maps the ore shoots appear to be continuous pipelike enlargements of the fissure, and at least two separate ore shoots were mined for a number of levels. The writer has the impression, based on very limited evidence, that the enlargements on the Apex fissure occur where it is crossed by a fissure or series of fissures bearing N. 30° to 65° W. Many fractures exposed underground are alined about N. 60° W., and this set of fractures is a persistent one on surface. These fissures, together with crumpled areas in the bedding, and more massive beds which fractured easily, may have accounted for the large ore bodies reportedly found above the 1,100-foot level.

The ore-bearing rock on the 1,400 level is of much less extent than the stoped areas shown on the old maps of upper levels. That the old maps cannot be accepted without question, however, is shown by such details as an unraved drift in limestone on the 750 level (fig. 2-Y) in an area shown

as stoped. In general, the limestones above the 1,100 level contain only a very minor proportion of shale members compared with those below the 1,100 level. On the 1,330 level and below, mottled green and red shales make up as much as 30 percent of the rock. Fissures are not persistent and do not remain open where so much shale is present, and it is the writer's belief that this accounts for the smaller quantity of ore on these horizons. Reconnaissance to the west suggests that the large proportion of shale is limited to a stratigraphic band a few hundred feet thick, and should be underlain by more massive limestones similar to those above the 1,100 level. On this basis, deeper exploration along the Apex fissure is suggested, preferably preceded by detailed mapping of the stratigraphic section exposed to the west. The Apex fissure should also be explored to the south toward the Paymaster mine above the 1,100 level in the limestones believed to be more favorable for open fractures than those below the 1,100 level.

The problem of dolomitization was studied briefly as time was not available to map the dolomitized rock in detail. Hydrothermal dolomitization is present along the Apex fissure, near all the known ore bodies. Fragments of altered limestone in the ore have been completely dolomitized, but dolomitized rock seldom extends as much as 20 feet from the walls of the fissure, even in shattered zones. The pink alteration of the limestone sometimes seen in the ore zone is in part dolomite that seems to be closely related to the ore in space, if not in origin. It is doubtful, however, if underground exposures are sufficient to permit a study of the relationship between ore deposition and dolomitization.