THE ORE RESERVES AT SOUTHWEST MINERALS INDUSTRIES SOCORRO DEPOSITS

BY

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The purpose of this report is to acquaint the officers of Southwest Minerals Industries with the ore reserves to be found on their properties at Socorro, New Mexico; to show some of the mining problems involved in producing an ore suitable for mining; and to give some basis so the economic value of the deposits may be calculated.

LOCATION

The main portion of the deposits are located about six miles southwest of Socorro, New Mexico and can be reached by car on highway 85 south for six miles then four to six miles west by improved dirt road. They are in Township four south and Range one west, sections 15, 16, 17, 18, 20, 21 and 22.

The Negro Head deposit is reached by traveling eight miles west on highway 60 to the Six mile Canyon turn off and then on this road for two and one-half more miles west.

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GENERAL GEOLOGY:

The Socorro Mountains form the western edge of the Rio Grade Valley in this district. The mountains are built up principally of Tertiary volcanic rocks and interlain sediments. This group of rocks rests upon a thick series of sedimentary rocks known as the Magdalena group. The Magdalena group in turn rests upon the pre-Cambrian argillite. The whole seqquence is apparently tilted toward the west.

The geology of the Tertiary period is rather complex. Some early flows were faulted and the resulting openings filled with later intrusions. Ultimately the entire series was faulted.

The formations found at the manganese deposits are almost entirely composed of igneous flows. They are light colored and fine grain. There is no doubt that they belong to the Tertiary volcanics. Some of the interlain conglomerates and sandstones are found to the south on the outer edges of the property.

The Tertiary Volcanics on the property vary in color from light red to tan, weathering to buff. They have a fine grain matrix with an occasional phenocryst of plagioclase of quartz. No perceptible phenocrysts of orthoclase or micas were found. The rocks are commonly called "rhyolites" in this area. Since no laboratory microscopic work has been done to prove otherwise the term will be used in this paper.

A thick bed of red clay overlays the volcanics at the northern end of the property. These red clays are probably late Tertiary or early Quaternery series.

Considerable structural disturbance occurred soon after the rhyolites were laid down and continued for sometime after the mineral deposition. These disturbances are represented by joining, faulting and minor folds.

The forces causing the structural disturbance reached their greatest intensity during the formation of the Rio Grande Basins Trough. This large regional fault system strikes almost due north and south. It was formed during the late Tertiary period when a general continental uplift occurred accompanied with additional volcanic activity. The faulting action placed heavy stresses on the surrounding formations and caused jointing and faulting in the points of weakness. Since the strike of the fault zones containing the manganese deposits parallel the Rio Grande Basin it is reasonable to think they were formed at the same time as the trough.

A study of the fault zones revealed that the broken material varies in size through out a cross-sectional area of the zone. The largest pieces are found in the central part of the fault. The cross-sectional area containing the smaller pieces is greater in size near the footwall than the hangingwall.

The width of the fault zones tends to increase with depth. It should be remembered, however, that the strength of the individual formations is the controlling factor and the zone may narrow or widen as the joint plane passes down through the different formations. All of the above factors tend to show movement along the planes but the absence of clay type gouge and the presence of original angular particles bears out the theory that little movement occurred. It is interesting to note that had a large movement occurred enough clay gouge probably could have been produced to prevent the penetration of the mineralizing solutions.

Some post-mineral jointing occurred. The cause of their formation has not been thoroughly studied but is believed to be caused by uneven settling of the rhyolite blocks. Since no evidence of mineralization outward from the regular zones along the cross joint planes was found they are assumed to be post-mineral. The jointing can be used, however, as indicators of highly mineralized zones. They trend east-west through zones of weakness in the rhyolitic flow blocks. Since these zones occurred where the crushing action was the greatest they passed through the highly mineralized zones.

Two other distinct eras of alteration affected the rhyolite flows. The first and most important economically was the penetration of the mineralizing solutions into the rhyolitic block. The second is the recent period of erosion which has reduced the area to its present sharp relief.

The penetration of the mineralizing solutions occurred sometime during the early Quaternary or very late Tertiary period. They may mark the last efforts of the magmatic activity which was present during these two periods.

It is evident that the ascending solutions contained large quantities of other elements. The zonal theory of deposition can readily be applied here although the extent and number of minerals involved is not entirely known. The last mineral to be deposited from these solutions was calcite. Two factors controlled its deposition. The temperature of the solution must be low enough to promote deposition at the calcium concentration and the cool descending surface waters containing carbon dioxide must contact the ascending solutions. These two factors prevented the calcite from forming until all of the other minerals had deposited. Below the calcite zone psilomelane was deposited. It is evident that the temperature-concentration factor for the deposition of psilomelane is larger than that of calcite.

There was a point, however, when all of the manganese had not been removed when the calcite started depositing. The calcite pulled the manganese from the solution and formed a dark colored mineral which has been given the name "Black Calcite".

Black calcite often causes some confusion in the mill as it seems to the layman to have all of the general properties of psilomelane but not the specific gravity to afford a good separation.

As the magmatic action supplying the mineralizing solutions died out the ascending solutions lost their heat faster and the deposition of calcite occurred at deeper and deeper levels. Black calcite was soon depositing on the pure psilomelane and finally pure calcite on the black calcite.

Silica, Barium and Water were pulled out of the solution when the psilomelane deposited, and are found in the analysis of the "pure" mineral. Some small crustations of chalcedony were found.

There are several other important factors which should be discussed while on the subject of mineralization. The deposition of psilomelane was a coating process with no evidence of replacement or chemical reaction with the host rock. The size or richness of deposition depended entirely on the cavities and quantity of solution available.

This means that the largest deposits of psilomelane occurred in areas of intense fracturing. In the fault zones the richer portion of the vein is found near the footwall, followed by the hangingwall area an d then the central part. As previously stated the presence of cross-joints indicates a richer zone. The vertical extend of the manganese horizon of deposition is not known. Veins examined in Red Gulch are similar to those at the top of Red Hill, a difference in elevation of two hundred feet (over). It is not too unreasonable to assume that the zone extends for another hundred feet below the lost visible elevation, since no change in vein properties was observed.

Recent weathering cut down the rhyolitic blocks into their present relief. Areas of cross-fracturing formed discharge canyons for rain water. The harder, less fractured, zones withstood the attack forming ridges and hills.

It is evident that although no new joints were made (parallel to the river basin) some post-mineral widing and movement along the existing joints did occur. Material from the decomposition of the rock formations filled the open joints. Some secondary calcite was formed. Psilomelane crusts were torn from the rock walls and deposited at the bottom of the cavities. The hills were covered with a ten foot coating of fractured rock which may or may not indicate the formations below.

A study of all of the manganese deposits within this area showed a constant strike parallel to the Rio Grande Basin. The extent of the mineralization is over fifteen miles and the intensity on all deposits varies with the cross-fracturing.

THE INDIVIDUAL ORE DEPOSITS

It is time now to discuss the individual deposits which are of economical interest. Each deposit has its own mining problems and a discussion of these problems will be given in detail.

A ratio of one foot horizontal to one foot vertical is considered the steepest mining slope possible from the standpoint of safety. Some open pit mines have attempted to establish steeper slopes than this but the result has been costly slides or cave-ins. There are many mines where even a one to one slope is too steep. The main factor which determines the slope ratio is the presence or absence of slip-joints which are nearly always found in igneous bodies. The slip-joints nearly always have a constant dip and strike. If the dig is steep, one side of the pit may be able to withstand a slope ratio of one to one while the other may have to be mined with a slope of one and one half feet horizontal to one foot vertical. Not enough mining has been done on our properties to determine the proper slope.

The Black Hill Ore Zone

The Black Hill ore zone has all of the general characteristics previously discussed. Although there are a few diagonal joints the general system of fissuring or jointing parallels the Rio Grande Basin. The east diagonal joint system presented a greater number of cavities and therefore supports some of the richer deposits. The strike of the diagonal system is about fifteen degrees west of north. The strike of the west diagonal system is about thirty degrees east of north. Mining on the upper levels has revealed a horizontal width of the fracture zone in the west area of over two hundred feet and the east area of over fifty feet. The overall strike of the veings within the diagonal system is almost due north and south.

Air drill holes drilled directly below the east area and due west of Red Hill indicated a good grade of ore for the entire depth of the hole after the ten foot debris mantel had been passed.

Using the tops of the holes as an assumed bottom of the deposit and the upper mining exposures to determine the widths and horizontal extent of the deposit a calculation of the ore reserves was made. Vertical cross-sections were taken at every one hundred feet of horizontal distance. Ore and waste limits, along with the contour of ground was plotted on these sections.

The Negro Head Ore Zone

The Negro Head ore zone is some ten miles distant by road from the present millsite. Under project 350 the United States Bureau of Mines did considerable mining and sampling to prove the extent of this deposit. The overall characteristics of this deposit is similar to the others. The mineralization however was not as great as that in the other ore zones. Cross-jointing is found here (as in the other deposits) at right angles to the strike of the veing. Six mile canyon which cuts the high grade ore zone is the result of recent erosion of one of these joint planes. The main fault zone strikes almost north and south and is about sixty feet wide. The breccia within the zone is finer than that found in the Black Hill and the resulting coating is thinner but the amount of mineral deposited is greater. The slopes into Six Mile Canyon are covered with a four foot mantel of debris. The tops of the rhyolite formation on the mesa above Six Mile Canyon are covered with a thirty foot layer of unconsolidated gravels.

The mining problems in this deposit are rather complex. Two plans are studied and each plan mined ores which would average slightly over seven percent Mn. with a minimum grade of three percent over a ten foot area. Cross-sections were taken every fifty feet, and a mining slope angle of one to one was established.

The Negro Head Ore Zone (cont.)

Plan N1	153,000 long tons ore at 7.3% Mn.	330,000 tons of waste
Plan N2	110,000 " " " " " "	148,500 " " "

Ore to waste ratios

Plan N1	1 to 2.20
Plan N 2	1 to 1.35

Combined ore and waste for entire property based on mining with a one to one slope and as near a one to one ore to waste ratio as possible.

Black Hill	1,838,000	l.t.	ore	2,130,000	l.t.	waste
Big Basin	3,020,000	"	"	3,362,000	"	"
Red Hill	630,000	"	"	850,000	"	"
Negro Head	110,000	"	"	148,500	"	"
	5,628,000	"	"	6,490,500	"	"

Overall ore to waste ratio

1 to 1.15

The Big Basin Ore Zone:

The Big Basin deposit which lies about one half northwest of the Black Hill deposit is similar in general formation to the Black Hill zone.

The widths of the exposed veins in this area are not as great as those found in the Black Hill. The degree of fracturing seems to have not covered as widespread an area as the other deposit. The horizontal length, however, in most cases in greater. The author believes that these two deposits were one which have been separated by recent weathering along the cross-joint planes. If this theory is true, only the top exposures of the veins, not present in the Black Hill area, are shown. And the vein width will increase with depth until the deposit is similar to that found in the Black Hill area. No deep hole drilling has been done to substantiate or disprove this theory.

There are four distinct areax in the Big Basin ore zone where ore has been exposed. Vertical cross-sections were taken through all of these areas and calculations made on the total ore and the ore available with a mining slope of one to one.

The Big Basin Ore Zone (cont.)

Total Ore;

Switchback	326,000 long tons
Pinnacle	590,000 " "

Quarter Corner and No. 1

West Zone 2,890,000 long tons

Using a mining slope of one to one and making all of the ore that is estimated to be present:

Switchback	Plan B1	326,000 l.t. ore	372,000 l.t. waste
Pinnacle	" B2A	590,000 l.t. ore	1,187,900 l.t. "
Qut.Cor.&West	Plan B-3A	2,890,000 l.t. ore	5,280,000 l.t. waste

Using a mining slope of one to one and taking only that which will give an ore to waste ratio near one to one:

Switchback	Plan B1	326,000 l.t. ore	372,000 l.t. waste
Pinnacle	" B2B	500,000 l.t. ore	600,000 l.t. waste
Q.C. & W.	" B3B	1,840,000 l.t. ore	2,430,000 l.t. waste
	Total	2,666,000 l.t. ore	3,402,000 l.t. waste

Over all ore to waste ratio under the above plans 1 to 1.28

This ore deposit has excellent possibilities and may prove to be as large as eight to ten million tons. Deep hole drilling should be done to help in obtaining a true picture of the ore reserves.

Red Hill Ore Zone.

This ore zone is found on the east slope of Red Hill. The fractures are similar to those found in the other districts but the exposed mineralization is not so intense. Not enough work has been done in this area to give a fair estimate of the tonnage. Cross-sections through the area established four areas. The results are given below:

Pit A	243,000	l.t. ore	390,000	l.t. waste
Pit B	290,000	l.t. ore	338,000	l.t. waste
Pit C	40,400	l.t. ore	64,200	l.t. waste
Pit D	58,200	l.t. ore	57,800	l.t. waste
	632,200	l.t. ore	850,600	l.t. waste

Over all ore to waste ratio 1 to 1.34

Using the areas found on these cross-sections the following volumes or tonnage of ore and waste were calculated:

Total ore present:

1,390,000 long tons of ore in the east zone

500,000 long tons of ore in the west zone

Using a 1::1 slope mining ratio;

1,390,000 long tons of ore in the east zone (called 1,400,000)

1,400,000 long tons of waste in the east zone

468,000 long tons of ore in the west zone

730,000 long tons of waste in the west zone

Totals:

1,868,000 long tons of ore

2,130,000 long tons of waste

Ore to waste ratio of one to 1.12

The above figures are subject to adjustment as the mining processes. Insufficient deep hole drilling has been done to outline the ore deposit. The correct mining slope has not been determined. Enough data is present however to show the amount of investment which should be made.