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Corrections made
& mailed Mr. May 13.
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to Koster with letter of May 24
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A REVIEW OF ORE RELATED TO THE MADONNA AND MAYFLOWER FAULTS MADONNA MINE, CHAFFEE COUNTY, COLO.

The Utze Lode Company
Corner Second and F Streets
Salida, Colorado

Wallace K. Howard
General Manager

March 12, 1947

by

John W. Vanderwilt
Midland Savings Building
Denver, Colorado

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SUMMARY AND RECOMMENDATION

The purpose of the study and report is to consider indicated extension of the ore formerly developed and mined: (a) on the 188-, 230-, and 305-foot levels; (b) the ore along the Mayflower fault on a level 85 feet below No. 6 level; and (c) to review the general possibilities.

The general text is intended to explain more fully the basis for the recommendations given. Close reference, as well as a careful study of accompanying figures 1 and 2, is necessary to clarify much of the written account. These figures show respectively the outlines of stopes of the Madonna ore shoot and the composite plan of the mine levels under consideration.

Records of production on 188-, 230-, and 305-foot levels (Madonna fault) justify further exploration. Diamond drilling is not believed satisfactory except for limited purposes, and it will be necessary to develop the levels by drifting, raising, and possibly sinking on the vein and fault. Deepening the shaft, as has been planned, is the best procedure for development and eventual mining below the 305-foot level. In view of the fact that the vein and the ore are changeable, it is recommended first to develop a level 50 feet below the 305-foot level; with the information

gained from this level a still lower level can be planned out to greater advantage.

In addition to work below the 305-foot level, exploratory work above the level is justified. Each level should be extended northwestward to locate and explore the granite-limestone contact on the southwest side of the fault. Exploration should be continued at least as far as the quartzite on the northeast side of the fault. In line with this, it would be well to explore, extending the margins of the old stops to the southeast and particularly to the northwest. Present high metal prices make it profitable to mine ore with a lower metal content than was possible twenty years or more ago. Work of this kind, considering the plan of stoping shown on figure 1, should be considered also above No. 6 level.

The ore exposed along the Mayflower fault in the winze level 85 feet below No. 6 level should be explored on the 230-foot level as planned or by raising from this level, if the ore is not found at this depth.

The general possibilities are regarded by the writer as excellent, but much work, including additional geologic studies, is required to evaluate properly the favorable indications, many of which have been described in a number of the earlier reports. This report summarizes only briefly

the more important features but specific recommendations cannot be made with safety due to limited information. It is important to determine if possible the level of the trough of the syncline, but the most critical data to be obtained is fault and fracture patterns, and particularly the nature and true character of the Madonna fault. In addition, reliable correlation of sedimentary formation is important and changes in strike and dip of sedimentary contacts, particularly the normal granite-limestone contact should be determined, as these probably bear on localization of ore bodies.

The changes of ore with depth, from oxidation types to sulfides are recognized and variations related to secondary enrichment can be expected. Fundamental changes in primary ore deposition related to depth, although a possibility, are likely to be less important than variations that can be related to controls dependent on structural conditions such as folding, faulting, and resulting changes in strike and dip of the rock formations.

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PHYSICAL FEATURES OF THE MINE

The Madonna mine is easily accessible to a railroad and surfaced highway. The lower part of the road connecting with the surfaced highway is a part of the limestone quarry operation maintained by the Colorado Fuel and Iron Company. The road, about a quarter of a mile long, connecting the quarry road with the mine, is well constructed. Occasional snowstorms will cause certain inconveniences, but continuous operation is possible without great difficulty.

Buildings at the mine are of substantial construction and efficient for office space, and what is equally or more important there is sufficient shop space with provision for reasonable comfort for the workmen.

The mine is well equipped for efficiently carrying on a program of exploration and development on the scale contemplated. The shaft is in good shape and in good rock. The flow of water is only moderate, although this can be expected to increase somewhat when the snow melts in the spring, and ordinary methods will suffice for sinking the shaft deeper and developing lower levels, as planned.

EXTENT OF INVESTIGATION

Three days were given at the Madonna mine, examining underground No. 6 and lower levels, and in study of geologic

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maps from No. 5 level down to the 305-foot level. The geologic maps consisted of two groups: one dated 1915, and earlier, of the No. 5 and lower levels for which the full authorship was not clear, and the other, No. 6 and lower levels prepared recently by the U. S. Bureau of Mines.

Relatively little could have been accomplished in the allotted time without these maps and the assistance derived from Mr. Warren (Ware) K. Howard's personal knowledge, both of the existing maps and the mine workings. It is not considered an exaggeration to say that in this manner virtually all the factual information that is now available was reviewed, and in addition, the data relative to the No. 6 and lower levels was checked in the underground openings that are accessible.

Following the study of the mine and maps referred to above, a review was made of private reports as follows:

Richards, C.O., Early days of the Madonna Mine
April 24, 1923.

Clyde, H.J., The Madonna Mine, August 1, 1912.

Clyde H. Jay
CH JAY

Crawford, R.D., Letter report to Mr. A. Eilers
October 22, 1915.

Letter report to Mr. V.G. Hills
October 30, 1915.

Hills, V.G., Letter report to Mr. Karl Eilers
May 24, 1923.

Hills, V.G., Report on the Madonna Mine
December 1, 1924.

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to correct: 1 Warren K Howard to Wallace K H
2. H. J Clyde (2nd reference) to C.H. Jay.

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December 1, 1924.

Collins, George, Preliminary memorandum concerning results to be anticipated for development in the Madonna Mine. September 27, 1925.

Sayre, Robt. H., The Madonna Mine, Supplementary notes. July 21, 1926, July 26 and August 23, 1926.

McClain, H.G., Preliminary report on the Madonna Mine, Monarch, Colorado, 1928.

REVIEW OF EARLIER REPORTS

It is interesting to note that the reports agree as to many favorable possibilities of the Madonna Mine and adjoining areas. The reports also show differences of opinions as to control of the ore deposition and where future development and exploration should be planned.

The northerly plunging syncline cut by transverse faults, as described by Crawford in Colorado State Geological Survey bulletin 4, is accepted by everyone, but many puzzling questions concerning even major features recognized at an early date are still unanswered. The outstanding of these is the Madonna fault along which the large ore bodies were localized above No. 5 level. This fault offsets the granite-limestone contact for a distance of about 150 to 200 feet on certain mine levels, but its exact position where both walls are limestone on No. 5 level and below, remains

undetermined to this date. Notations on maps dated 1915 by R. D. Crawford are proof that he recognized the uncertainty on No. 5 and 6 levels, and considering the subsequent new drifts and crosscuts, it is surprising that this important relationship has not been definitely solved.

Hills and others call attention to the fact that for many years the mine was under lease, with numerous subleases, which no doubt is the reason for the lack of correlated information and explains the many mine openings, the original purpose of which is not clear. The lease system is seldom effective in building up the fund of information necessary for solving the problems related to the complex geologic conditions and mineralization found in the Madonna Mine and adjoining areas.

DIAMOND DRILLING

P 3 The advantages and disadvantages in using diamond drilling in the Madonna Mine were considered. The greatest 2 utility probably lies in drilling for geologic information, such as locating granite-limestone contacts, the quartzite-limestone relationship, and possibly the bottom of the syncline.

Ore occurrences are unfavorable for development with diamond drilling except under limited conditions. On

the whole the ore shoots are too irregular and small in cross section for safe projection, and therefore, they would be easily missed by a diamond drill hole. Also much of the ore is too friable and soft to produce good core, and the fractures in the rock will cause loss of drilling sludge, making the sludge that may be recovered unsatisfactory for either geologic study or for determining the metal content. In many parts of the mine the fractures are drained, and loss of drilling water would be a common occurrence to complicate and increase cost of drilling. Loss of drilling water would be least in down holes on lower levels where the most water is encountered.

As regards the 305-ft. level, the ore shoots have rather small dimensions, and the soft and friable ore is associated with low-grade bodies of pyrite with considerable clay and gouge both adjacent and in the ore. Under these conditions, core recovery will be poor, and if pyrite core is obtained, there is no proof that good values may not be present only a few feet away. For these reasons, the data that might be obtained by diamond drilling cannot be expected to be commensurate with the costs. The only sure way to prove the extent of the ore indicated by development on 230- and 305-ft. levels is by sinking, raising, and drifting on the vein.

LOCALIZATION OF ORE

It has long been recognized that ore bodies are related to cross faults, the Madonna fault having been the most important, and their intersection with sedimentary contacts, such as limestone on granite, and possibly a bed of quartzite in the limestone.

Considering the importance of these structural features, it is surprising that they have not been studied and recorded in greater detail or explored more completely. The records are incomplete and unsatisfactory regarding the principal structural features.

PRINCIPAL STRUCTURAL FEATURES

The syncline

The importance of the overturned syncline is emphasized in early reports. The axis of this syncline trends northerly, and its trough or deepest part lies at progressively greater depths on passing from southwest to northeast. The sedimentary beds in the southeast limb strike about N45°E and dip 30° to 60° NW. The northwest limb, as exposed in No. 6 tunnel, is overtuned with strike and dip approximately parallel to that of the southeast limb.

Not enough information could be obtained to modify or even criticize the conclusions to be found in the earlier

reports as to the syncline. Theoretically it would be a favorable locus for intense fracturing and by this token it is favorable for ore. The depth of the bottom of the syncline below the No. 6 level is highly conjectural because projections cannot be reliable, as faulting and changes in dip of the bedding are unpredictable. Diamond drilling could probably be used to advantage, but the best procedure would be to advance with caution from each level to a succeeding somewhat lower level. Above all, it is important to remember that conclusions as to the syncline are theories.

Faults

P2 As a regional feature, the Lake fault is an important structure, but it is not exposed in the mine. It lies to the southwest and probably is closely related to the folding that made the syncline.

toward some 3 NW; it should be westerly

The cross faults, such as the Madonna and the Mayflower, strike northwest, cutting the axis of the syncline, nearly at right angles.

Madonna fault

Stopes above No. 5 level on the Madonna fault dip 75° to 85° to the northeast. On No. 6 level, the dips are essentially vertical, and on the 305-ft. level, the dip is about 70° to the southwest. No one seems to have questioned

the apparent reversal in dip of the Madonna fault. However, it is not demonstrated to the writer's satisfaction that this change in dip cannot represent either a crossing or joining of two fracture systems. Mine workins are continuous it is true, but the intersection or junction of two veins at an acute angle could bring about the same relation so far as the mine workings are concerned.

The Madonna fault in No. 6 level offsets the granite-limestone contact about 225 feet, but position of the fault to the northwest, where both walls are limestone, is not definitely known. Dr. Crawford in 1915 and others have held to the view that the fault to the northwest swings farther west of north. Drift 602 subsequently completed along the top of the quartzite is against this belief. Drift 601 shows a continuous quartzite bed for 75 to 100 feet northeast of the No. 6 Adit, but beyond this the position of the quartzite is uncertain, but the maps show quartzite in 605 drift. Drift 607 is on a fault with a relative displacement opposite that of the Madonna fault. The evidence seems to point the Madonna fault being located about halfway between drift 607 and No. 6 Adit. It is entirely possible that the raise at the end of drift 603 is in the Madonna fault. If the fault is not in this vicinity, it must be suspected that the displacement decreases to the northwest of the granite-limestone contact. The drifts referred to are shown on figure 2.

The confusion that is apparent from the records as to the course of the Madonna fault where it intersects

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northeast was in error as northwest.

P1

the granite-limestone contact on the southeast side of the fault on the No. 5 and No. 6 levels and the course of the fault in the limestone is direct evidence that the true habit of this fault has not been worked out. It is important that the plan of this fault system be given continued close and careful attention. Otherwise it will be unreasonable to expect a proper understanding of the occurrence of the ore bodies.

Mayflower fault

P2

The Mayflower fault roughly parallels the Madonna fault on the lower levels and lies 250 to 300 feet to the northeast. It dips 65° to 70° southwest between the No. 6 level and the 85-ft. level. A number of early investigators have recommended this fault for extensive exploration, and ore is found at its intersection with the normal granite-limestone contact on the 85-ft. level. The plan to explore this intersection with drifts along the fault is warranted on the 230-ft. level. Even though ore is not found on the 230-ft. level, the extent of the ore on the 85-ft. level should be determined by sinking from above or preferably by raising from the 230-ft. level.

Other cross faults

A strong cross fault is indicated on old maps in

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the drift 607 and also in the new drift (see fig. 2) on the 230-ft. level. It is possible that these two drifts are on the same fault. On No. 6 level the fault on drift 607 extended to the southeast would intersect the Madonna fault in the vicinity of the granite-limestone contact on the southwest side of the latter fault. On 230-ft. level this fault offsets the normal granite-limestone contact and would intersect the Madonna fault in the granite to the southeast. This fault and any other cross fault that may be found should be studied and explored.

Before specific exploration can be recommended on cross faults, more information is necessary as to the reason why ore forms in some places where cross faults intersect the granite-limestone contact and not in others. This means a detailed study of the granite-limestone contact which is considered next.

Granite-limestone contact

A granite-limestone fault contact is produced where a cross fault (granite) displaces a normal granite-limestone contact. The stopes on 230-ft. and 305-ft. levels are on a fault contact of this type. The corresponding interval along the Mayflower fault on No. 6 level is not strongly mineralized. Neither has this interval along the cross fault followed by new drifting on the 230-ft. level been encouraging.

says this is not good psychology.

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The normal granite-limestone contact is along either limb of the syncline and it is described by Crawford and others as a depositional contact; that is the limestone was deposited on the granite. This contact has been offset by the cross faults (see fig. 1), and the intersections on either side of the fault have been characterized in places by ore. Sizable areas along this intersection have not yielded ore and the reasons for ore in some places and not in others is not clear.

Changes in dip

The normal granite-limestone contact on the southeast side of the syncline is partly exposed on No. 6 and lower levels in the vicinity of the Madonna and Mayflower faults. It is apparent that the dip varies from about 30° to over 60° to the northwest. The nature of the changes in dip are not known, as they are neither shown in detail on old maps nor described in earlier reports.

The stope map (fig. 1) shows the granite-limestone contact to have a much flatter dip on the upper levels where the larger ore bodies were mined than at lower levels where the ore has been less regular, but it is probably that the dip has been generalized. The ore along the Mayflower fault on the 85-ft. level along the granite-limestone has a dip of 30° to 40°. It is at once apparent that if the dipt of this contact influenced ore deposition, then the cross faults

will be correspondingly favorable or unfavorable at different levels. Possibly added information could be worked out by a careful analysis of the old maps, and this should be done as the changes in dip could readily be the place where ore bodies formed.

Quartzite bedding

Accounts of stopes on upper levels repeatedly mention the juxtaposition of quartzite and ore. However, ore did not seem to have formed in the quartzite, and on the whole more ore was found stratigraphically under than above it. Below No. 5 level (see fig. 1) the ore along the Madonna fault was progressively farther from the quartzite and closer to the normal granite-limestone contact.

Changes in dip of the bedding could be the cause of such a relationship if it really exists. Development work and the records thereof are not sufficient to demonstrate the facts, but the possible influence of changes in the dip of the bedding should be given more consideration.

CHARACTER OF THE ORE

The ore down to about level No. 6 was oxidized and only occasional boulder remnants of galena ore reported. Below No. 6 level considerable sulfide ore accompanied by some oxidation has been mined. The ore on the 85-ft. level

is oxidized. On 305-ft. level pyrite is plentiful.

On the upper levels the ore bodies are characterized by lead carbonate. Cross sections of stopes and descriptive accounts call attention to large quantities of iron ore adjacent the carbonate ore that was not mined. Reports also describe a zone of low-grade zinc carbonate and silicate ore that occurred as an envelope around the lead carbonate. The low-grade zinc ore was not mined, and if economical methods for treating these zinc carbonate ores could be worked out several hundred thousand tons are believed to be available. It would be well worthwhile to keep this possibility in mind.

Zinc carbonate ore is also reported in places away from lead ore, which is in line with the relatively ready transportation of zinc by circulating ground waters.

The changes with depth

Minor quantities of gold are reported from the upper levels but only below No. 6 has gold been of first importance. A rather consistent occurrence of gold is reported by Mr. Howard in assays of ore samples from the lower levels. More copper was found in one stope below No. 6 than elsewhere.

Attention is called to the fact that Mr. Hills' plate VI (fig. 1 of this report) shows a stope just below No. 5 level that is labelled "iron ore with gold only"

with the notation that this is not in the Madonna ore shoot.

The possible or probable changes in the character of the primary ore with depth is a natural question, but before a satisfactory answer can be hoped for, the original make-up of the ore must be established.

The iron ore (limonite) associated with the lead carbonate on the upper level is strong evidence that pyrite was formerly present. Galena and sphalerite also were present. Malachite is indicative of a copper mineral, probably chalcopyrite. Silver may have occurred as a sulfide. Thus the ore was the complex type composed of Galina-silver, sphalerite, pyrite, and a little chalcopyrite.

Circulating ground waters oxidized the pyrite to limonite (iron ore); changed galena to cerussite (lead carbonate); and sphalerite to zinc carbonate and silicate.

Zinc and copper and some silver would be transported to lower levels to form a zone of secondary enrichment. The quantities of pyrite found below are not out of line quantitatively with limonite found above and thus not an indication of changes related to depth in the primary ore.

The occurrence of gold below No. 6 level, probably beginning as high as No. 5 level, does suggest a change with depth, but such changes are gradatorial so that an occurrence of lead-silver, gold, zinc, and pyrite ores over a vertical range of several hundred feet would not be unusual.

Some secondary enrichment is indicated, but a

well-defined zone has not been recognized and additional enrichment could well lie at a still lower level. Moreover, as circulating waters are controlled by irregular fractures, secondary enrichment can be expected to be correspondingly complex.

Fundamental changes in the character of the ore are more likely to be limited to the change from oxide to sulfide. The increase in gold content is favorable and will tend to offset the decrease in carbonate ore that is to be expected.

More important than mineralogical changes are the structural changes related to faulting, dips of contacts, and the influence of the bottom trough of the syncline.

Ore on 188-, 230- and 305-ft. levels.

P 4 Logical reasoning and theorizing has been presented in earlier reports both in favor of and against the continuation of the mineralization with depth. In the final analysis it will require additional sinking and drifting and raising to develop the area, and in the writer's opinion the extent of the stopes and the character of the ore that has been mined justifies exploratory work of this scope.

The present shaft is well located and equipped, so that it is the logical place to start from for development at greater depth. More work should be done to determine the variations in dip along normal granite-limestone contact,

P1

and the probable position of the trough of the syncline before too great a depth is planned. A new level, say 50 feet below the 305-ft. level, would be preferred as against a 100-ft. lift, unless material savings can be made by sinking the shaft 100 feet in a single operation as compared with two 50-foot intervals. On the new level, exploratory work should be done along the fault to the southeast, to the granite-limestone contact and to the northwest to the quartzite. 6

The drifts on 230-ft. and 305-ft. levels should be extended to the northwest at least as far as the quartzite on the northeast side of the fault.

On each level, regardless of the mineralization that may be found, particular attention should be given to the details of structure in the areas where the normal granite-limestone contact butts against the fault. A close watch should be kept for branch fractures and faults. In other words, detailed geologic mapping should be done as fast as mine openings are advanced. Otherwise much will be lost behind timber.

P4

A raise from 188- or 230-ft. levels in the vicinity of the northwest end of the 188-ft. level (see fig. 1) also should be considered. Existing workings shown on the maps do not prove the limits of the commercial mineralization. The chances are that ore, noncommercial at the time the stopes were made, now with present high metal prices could be mined

at a profit. Areas immediately above No. 6 level also are deserving of consideration with the possibility of extending old stopes along recognized mineralized zones.

Mayflower Fault

P2 This fault has been considered a favorable zone by early investigators and considerable work was done along this fault about 1926 or 1927 on No. 5 level. It was not possible to examine the work on No. 5 level, and the results are not known except that either they were not favorable or the work was not conclusive. However, as stated previously, the changes in dip of the granite-limestone contact may be of greater consequence than the intersecting fault, and therefore the Mayflower and other faults remain favorable zones for prospecting.

The ore developed on the 85-ft. level at the intersection of the granite-limestone contact and the Mayflower fault, on its own merits and apart from any other consideration, warrants careful exploration to determine extent down the dip and northwestward along the contact.

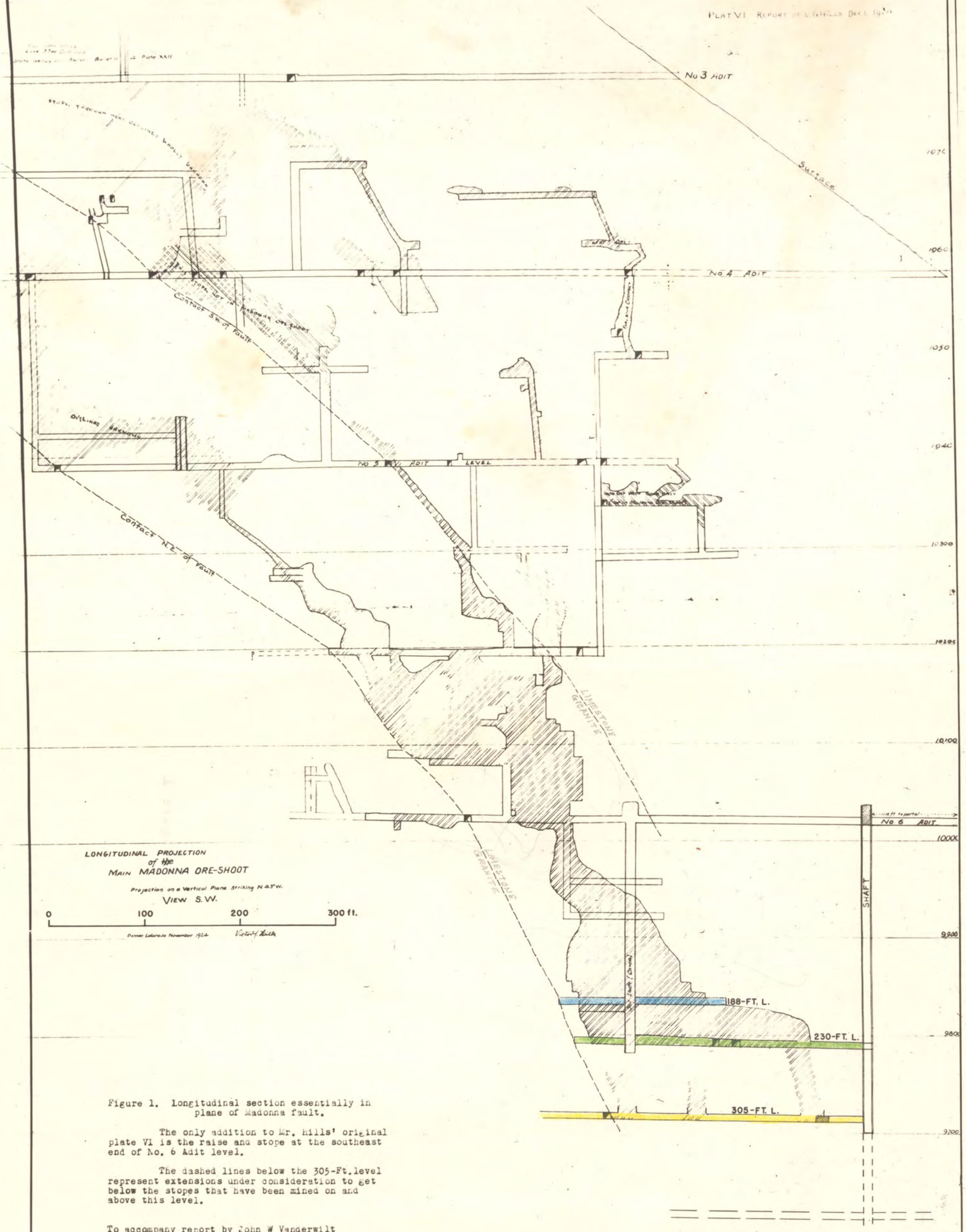
SOURCE OF THE ORE SOLUTIONS

P4 The source and channels followed by the solutions have not been left until last to discuss because they are least important but because the least is known about ultimate

ore channels. No attempt is made to analyze the possibilities because of their highly theoretical and controversial nature. It is generally accepted that the solutions originated somewhere at depth. In their course upward they probably moved along an irregular route before reaching the particular fracture or broken rock where concentrations of the metal finally made ore. For all practical purposes it is sufficient at this stage to concentrate studies in the particular places where ore has occurred in order to find any and all possible extensions that may be present.

John W. Vanderwilt
March 12, 1947.

PLAT VI REPORT OF V. HILLS DEC. 1924



LONGITUDINAL PROJECTION
of the
MAIN MADONNA ORE-SHOOT

Projection on a Vertical Plane Striking N 43° W.
VIEW S.W.

0 100 200 300 ft.

Denver Colorado November 1924 Victor F. Hills

Figure 1. Longitudinal section essentially in plane of Madonna fault.

The only addition to Mr. Hills' original plate VI is the raise and stope at the southeast end of No. 6 Adit level.

The dashed lines below the 305-Ft. level represent extensions under consideration to get below the stopes that have been mined on and above this level.

To accompany report by John W Vanderwilt
March 12, 1947

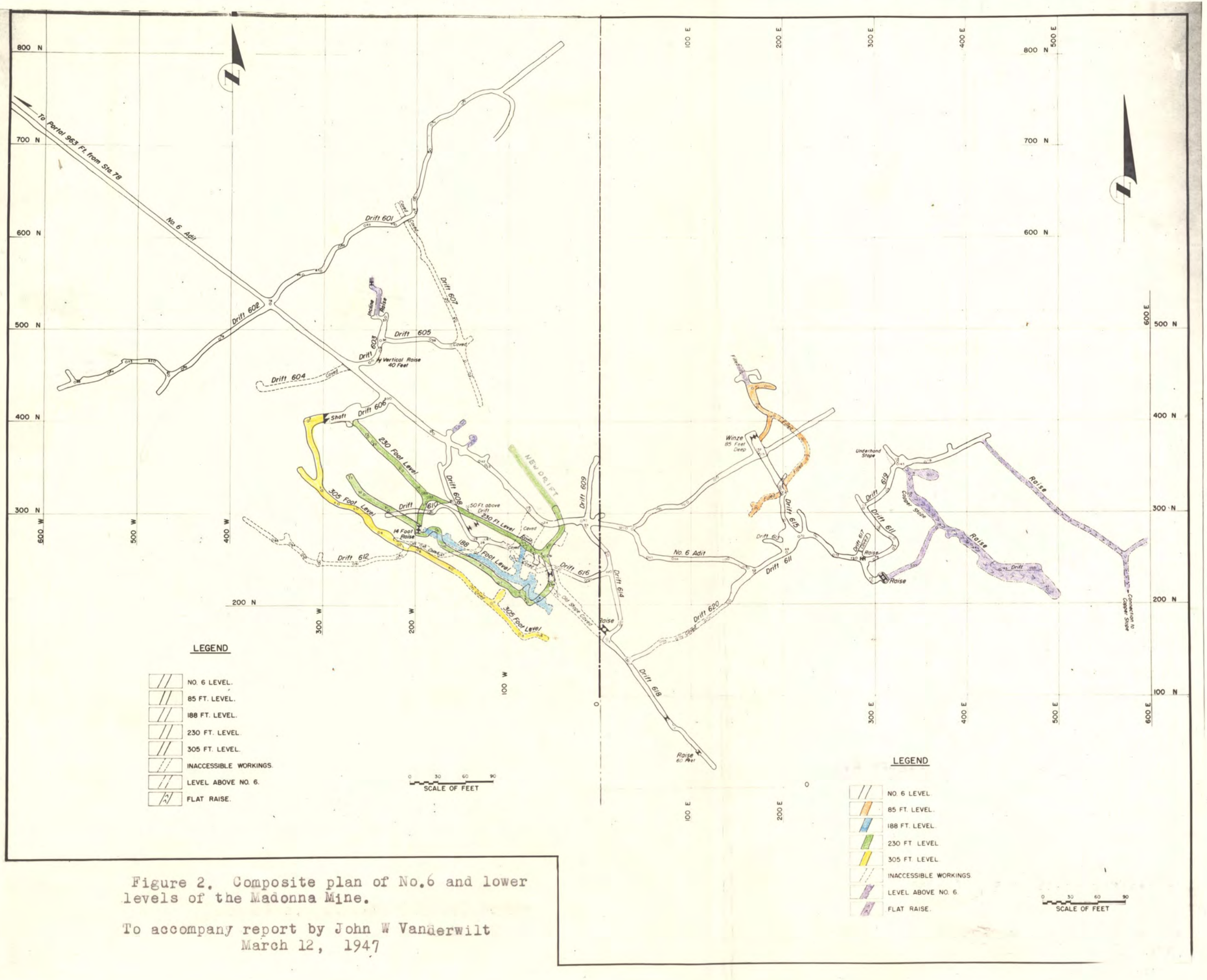


Figure 2. Composite plan of No.6 and lower levels of the Madonna Mine.

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