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GEOLOGICAL REPORT ON
RED HILLS DISSEMINATED COPPER
DEPOSIT ON PROPERTY OF
ARIZ CON GOLD & COPPER MINES CO.
FLORENCE-PINAL COUNTY-ARIZONA

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GEOLOGICAL REPORT ON
RED HILLS DISSEMINATED COPPER DEPOSIT
ON PROPERTY OF
ARIZONA CONSOLIDATED GOLD AND COPPER MINES COMPANY
FLORENCE-PINAL COUNTY-ARIZONA

The low chain of Red Hills buttes, rising out of surrounding Sahuara cactus-studded desert plain, lies about 12 miles east of Florence, Pinal County, Arizona, in the Red Hills Mining District.

The Red Hills mining rights are in possession of Arizona Consolidated Gold and Copper Mines Company by virtue of mining lode claim locations.

Eighty miles west by paved highway is the large supply center of Phoenix, capital of Arizona and Gila River is 7 miles north of the property. A good graded dirt highway from Florence passes through Red Hills. An electric power line from Coolidge Dam passes within 300 feet of Red Hills camp on the property.

Attention of miners was early attracted to the Red Hills area where red oxides of iron color the hills an attractive hue. An area 3600 feet long, from north to south, and averaging about 1800 feet wide has been highly fractured, faulted and soaked with mineral solutions. Today these processes are revealed in the gently rounded Red Hills, ribbed with parallel and closely repeated dikes; outcrops of silicified fracture zones, iron oxides and the copper silicate chrysocolla.

Water has been encountered in several shafts sunk in the Red Hills area at depths of 60 to 120 feet below the surface. Operating conditions for mining throughout the year are ideal. A minimum

of timber for support of mine workings is indicated by preservation of old workings without much support. Desert flora consists of a profuse growth of several varieties of cactus, a healthy carpet of desert grass and brush together with trees which furnish fodder for range cattle.

A small comfortable camp has been erected at the southern end of Red Hills. Elevation at the mine is about 2600 feet. Supplies are obtained from Florence and Phoenix.

During field examination of six days, investigations were confined to determination of geological conditions affecting deposition of copper ore bodies in Red Hills. Data on title, history, value and production of copper ores were not examined during field work, other than through statements of those associated with former operations. This information shows that the property consists of a compact, contiguous group of 90 mining lode claims, outlined on the accompanying map; 73 of which claims are held by right of location and 17 of which are partly owned or are in the process of acquisition. The entire Red Hills area is held under mining location rights by the Arizona Consolidated Gold and Copper Mines Company.

Fifteen miles northeast of Red Hills Copper deposit, across Gila river, is the major disseminated copper mine of Kennecott Copper, at Ray, Arizona, at about the same elevation as Red Hills. Thirty four miles across the desert to the southeast is a newly developed disseminated copper mine of the first magnitude. It is the great copper ore deposit of the San Manuel mine. References in literature describe San Manuel ranking with the leading Utah

Copper and Morenci, Arizona, disseminated copper deposits in tonnage of copper ore developed. So pronounced is the similarity of the Red Hills geological picture with that of San Manuel, that a comparison of the two properties will be outlined herein.

In this examination only 12 claims of the Arizona Consolidated Gold and Copper Mines Company were investigated. Copper ore deposits are indicated at other points on the property.

GEOLOGY

ROCKS:

Relatively few rock formations are exposed in the Red Hills. The oldest rock, forming the basement here and of a large area in this sector of Arizona, is pre-Cambrian quartz monzonite. It is a part of a granitic mass which is found fully 50 miles to the southeast as the oldest formation in the San Manuel copper mine and nearby Catalina Mountains.

The unaltered quartz monzonite is a light-pink coarse-grained porphyritic rock, characterized by coarseness of feldspar phenocrysts which often reach an inch or more in maximum measurement.

The quartz monzonite in the Red Hills area has been intensely affected by shattering, fracturing and hydrothermal alteration connected with ore deposition. It has been impregnated by solutions carrying iron and copper and silica, which were an aftermath of intrusion of monzonite porphyry dikes. These dikes form a ribbed, east-west grid of parallel low ridges, repeated every 10 to 50 feet or more from north to south, as minor projections above the altered quartz monzonite basal pediment.

Monzonite porphyry, of Tertiary age, occurs chiefly as narrow parallel dikes which penetrated the older quartz monzonite along parallel fissures to form the east-west striking structural dike pattern. The porphyry is much finer-grained than the quartz monzonite and is easily distinguished from it in outcrops. Little difference in mineral or chemical composition exists between these two granitic rocks, although the porphyry has less quartz. Hydrothermal alteration and mineralization by iron and copper solutions and deformation by closely spaced east-west fractures in monzonite porphyry is similar to that in the quartz monzonite host rock.

Irregular fine-grained diabase dikes cut the quartz monzonite and monzonite porphyry. They are small and numberous and contain no ore minerals, although it is probable they have had in places some relation to localization of ore deposition.

A persistent fine-grained east-west striking aplite dike, up to 100 feet in width, with near-vertical dip, cuts through the Red hills copper area and also clear across the Arizona Consolidated Gold and Copper Mines estate for more than one mile. Along the north side of the aplite dike, in places, heavy deposition of vein quartz, iron oxides and copper ore minerals can be seen. This mineralization is pronounced in a fissure parallel to and about 10 to 20 feet north of the dike and can be detected in a fractured zone as much as 100 feet wide along the north side of the dike.

Because the aplite dike fills a persistent major crustal fracture in the quartz monzonite, deposition of copper minerals along its course indicates connection with deep-seated fissuring

and sources of ore depositing solutions. Other smaller aplite dikes are present in Red Hills but pale in comparison to the giant heretofore described.

Felsite dikes are frequent throughout Red Hills and conform to the east-west grid pattern for dikes and fractures. They are generally narrow and appear to have a close connection with formation of vein quartz, iron and copper minerals.

The felsite dikes cut the preceding rocks and present a cream-colored very fine grained rock seamed often with fractures saturated with iron oxide solutions. Often oxidation of pyrite in the felsite dikes gives the outcrop a light pink color.

At the surface therefore, over the designated Red Hills area, mineralization is indicated by oxidation products; iron oxides, principally hematite and limonite resulting from oxidation of pyrite; chrysocolla, resulting from oxidation of chalcocite and chalcopyrite; and by quartz veins and jasper, colored red by hematite, by quartz stringers and seams dispersed in all directions where fracturing and mineralization has been intense. The prevailing red color of Red Hills is due to hematite released by oxidation of pyrite.

STRUCTURE:

The most prominent structural feature of Red Hills copper area is the north-south-striking West fault cutting clear through the center of the 3600-foot-long ridge of red buttes.

Parallel to the West fault and 600 feet easterly is the similar major East fault which forms an eastern boundary to Red Hills ridge and to the area under investigation. These two faults, the West and East faults, include within their walls the eastern

pediment of Red Hills ridge.

It is apparent on the surface that the 600-foot wide fault zone formed by these two major lines of movement in Red Hills ridge has had a pronounced influence on deposition of ore minerals. Reference to the accompanying map will illustrate the wide swath cut through the eastern half of Red Hills ridge by these two major fault planes. It is apparent in the field too, that minor parallel fault planes on the west side of the West fault have extended influence of this structure up the red eastern slopes of Red Hills ridge and exert a similar beneficial influence on concentration of mineral deposition.

The major structural feature of this 600 to 1000-foot wide north-south fault zone is an anticlinal flexure developed at about the center, north to south, of Red Hills ridge. Interpretation of this fault anticline in the quartz monzonite and monzonite porphyry mass of Red Hills ridge suggests the structural influence that has concentrated intrusion of dikes and deposition of disseminated copper and iron minerals in Red Hills.

In spite of large areas of disseminated copper and iron mineralization in east-west fracture zones from the south to the north tip of Red Hills, a distinct increase in surface indications of ore deposition is evident along the strike of the West and East faults. This influence for richer ore deposition appears strongest in a 600-foot wide zone along the west side of the West fault and between the West and East faults. It appears as though these eastward dipping faults have acted as walls directing circulation of mineralizing solutions which formed the quartz, iron and copper deposits.

Like the great tabular ore zone of the San Manuel mine, where the ore lies upon the eastward dipping pyritic zone of Red Hill, this structure on the claims of Arizona Consolidated Gold and Copper Mines Company appears to concentrate the best copper mineral zone of Red Hills on the red core of the ridge as a footwall.

Dips of the West and East faults are hard to obtain for nowhere has surface digging unearthed a satisfactory exposure of the fault plane. Its course and dip have been estimated from surface indications and occasional contacts of quartz monzonite and monzonite porphyry along its course. Dips estimated for the West fault vary from 65 degrees to 85 degrees east. Dips of the East fault are estimated at 35 degrees east to vertical.

It is thus apparent that Red Hills ridge is a core of pyritic quartz monzonite, sliced into thin vertical layers by east-west striking monzonite porphyry dikes and vertical east-west fracturing. And into this mass of fractured rock, with a hood of impervious fault clay entered the mineralizing solutions that formed the disseminated copper deposits indicated by widespread chrysocolla outcrops which extend from the south limit of Red Hills ridge to the northern limit, 3600 feet distant.

MINERALIZATION:

A significant exhibit of copper ore deposition is present at the south end of the Red Hills as this mineralized area is approached. Opencut and tunnel workings for 200 feet west of the West fault have been dug on an east-west-striking fracture zone from which chrysocolla ore has been mined and shipped. A 100-foot deep shaft, now filled, is reported dug right at the west contact of

this mineralized zone and the West fault. It appears that, in this initially considered working alone, as much evidence of copper mineralization is present as can be found in the entire outcrop visible at the San Manuel mine, 34 miles southeast.

Chrysocolla, hydrous silicate of copper, and vein quartz and hematite, red oxide of iron, are the chief minerals in these workings. Still further west along this same zone, outcrops indicate a continuation of mineralization.

Going further north on the west side of the West fault, outcrops of east-west-striking silicified fracture zones, soaked with iron oxide and containing chrysocolla films along fracture planes and permeating the monzonite in places, continue for 3600 feet through the Red Hills ridge.

The basal and ancient quartz monzonite foundation of the region is here ribbed with small and large east-west striking monzonite porphyry dikes; some a few feet wide, others more than 100 feet wide. In both of these monzonite formations, east-west striking, vertical fracture zones have sheeted the entire ridge into a permeable mass that has been favorable for entrance of mineralizing solutions believed to be genetically connected with the Tertiary monzonite porphyry intrusion.

Silicification of the dikes and host rock along the vertical east-west fracture planes has formed indurated zones of most intense silicification and these project, several feet high, as ridges above the surrounding rock, repeated one after another, every few feet to over 100 feet or so, along the entire ridge, from south to north. They cut the north-south Red Hills ridge into

vertical east-west standing slices from the south end to the northern extremity.

At the north end of Red Hills ridge singularly enough, another 120-foot deep shaft was sunk on an iron-copper zone of vertical sheeting and fault movement, thus completing a picture of Red Hills with deepest shafts sunk at southern and northern extremities.

At about the center of the ridge, from south to north, where an anticlinal arch is apparent in the West fault, surface diggings have exposed chrysocolla concentrations along many east-west fracture zones. A concentration both of silica and chrysocolla outcrops also occurs along the west side of the West fault zone.

The evidence is unmistakable that throughout Red Hills ridge, iron and copper sulphide minerals were deposited in the quartz monzonite and monzonite porphyry east-west fracture zones which shatter the entire red ridge. Red and brown iron oxides and chrysocolla outcrops seen today are remnants of oxidized sulphides, the surface trace of sulphide mineralization to be expected in these rocks at depths where oxygen has not attacked and destroyed the sulphide minerals.

Another distinctive channel for uprising mineralizing solutions is found on the north side of the mile long 70-100-foot wide, east-west aplite dike which paints a white path clear across the northern third of Red Hills at right angles to its strike. A prominent quartz-iron-copper cropping, standing 10 feet above the surface can be seen marking a mineral zone solution channel about 15 feet north of and parallel to the dike on the Copper #20 claim.

Where the northerly striking West fault cuts through the east-

west striking aplite dike and moves the east side of the fault about 165 feet north, a concentration of mineralization has occurred on the west side of the fault, resulting in the prominent outcrop mentioned. Such a prominent outcrop is reminiscent of quartz croppings over some of the best copper deposits of the state. It appears advisable to explore this bold quartz cropping at depth, for it is highly saturated with iron oxides and shows chrysocolla films.

The above description of mineralization on the west side of the West fault applies also to the east side, where a 600-foot wide north-south strip of mineralized Red Hills lies between the West and East faults. Because of greater east-west shattering between these faults, an increase in the number of silicified ridges is apparent in this inter-fault zone. These are concentrated particularly in the northern half of the zone where anticlinal structure creates an arch.

For this reason it appears best to start preliminary exploration at seemingly favorable points in this anticlinal structure.

Between the West and East faults, in the northern half of Red Hills, four hills stand out, ribbed with silicified mineralized dikes and fractures. They represent the ultimate in mineral deposition in the ridge. Chrysocolla is evident as films in the fractures and rocks exposed by opencuts, shallow shafts and outcrops.

Visible mineralization of Red Hills therefore consists of an oxide zone of unknown depth containing the copper silicate chrysocolla. It is undoubltedly certain that chrysocolla results from

oxidation of either Chalcophyrite or Chalcocite, primary and secondary sulphides of copper, which are thus indicated at some unknown depth beneath the surface.

Alteration of the quartz monzonite and monzonite porphyry has resulted in decomposition of the feldspar of the rock in zones of intense fracturing and mineralization, and in silicification along fractures. Near the West and East fault zones alteration of the rocks has proceeded further, and a bleached mass of kaolinite and various alteration products outcrop in the most intensely mineralized fracture zones intersecting the faults.

Surface evidence therefore indicates a disseminated copper sulphide zone beneath the chrysocolla and hematite-limonite deposits on Red Hills eastern flank.

COMPARISON WITH OTHER DISSEMINATED COPPER DEPOSITS

Red Hills copper area lies in the Basin and Range province of southern Arizona. Geologic history similar to that of proven major copper mines nearby, can reasonably be expected from similarity of rocks, structure and mineralization. Within a radius of 120 miles lie such rich and well known Arizona mining districts as San Manuel, Globe, Morenci, Bisbee, Miami, Superior, Jerome, Bagdad, Ajo and Ray.

So near are the Ray and San Manuel copper deposits, with a patently identical geologic history, that comparison of these deposits with Red Hills will serve to portray what may be expected in exploration at Red Hills.

Since San Manuel rock occurrences and associations are identical with those of Red Hills, it is interesting to note that

chrysocolla and iron oxide surface evidence of the immense copper ore body developed by churn drilling at San Manuel, is similar to the chrysocolla and iron oxide outcrops at Red Hills.

One hundred and twenty two churn drill holes were drilled to outline San Manuel ore deposit, and the mineralized rock was found to be remarkably uniform in copper content. A comparatively regular tabular zone of enriched copper sulphide ore was found dipping from 50 degrees to 60 degrees southeast. The ore zone averages about 400 feet in thickness. The footwall of this zone is highly pyritic monzonite and is represented at the surface by the red iron-stained rocks of Red Hill. The ore zone, on its dip, extends to depths of over 3000 feet.

The hangingwall of the copper ore body is gradational and indefinite, due to its determination by means of copper content. Oxidation of the hangingwall rock, from the sulphide ore body to the surface has resulted in a great mass of low-grade chrysocolla-bearing monzonite that varies in depth from 300 to 1600 feet. Many holes drilled through this hangingwall of the main copper sulphide zone show an horizon of very lean oxidized rock.

No relation between sulphide enrichment and the underground water table at San Manuel is apparent. Deep oxidation is no doubt due to tilting of the copper deposit formations to the southeast after leaching of the overlying oxide zone by surface waters and enrichment of the sulphide zone below.

The greater part of the copper in the secondarily enriched sulphide zone, lying just beneath the oxide zone is in the form of the secondary copper sulphide chalcocite, which is usually a

replacement, by downward percolating copper-bearing waters, of chalcoprite, primary copper-iron sulphide, and secondarily of pyrite.

One drill hole at San Manuel showed 390 feet of oxide zone averaging 0.1% copper. The secondarily enriched sulphide zone, just beneath the oxide zone, had a thickness of 40 feet and averaged 1.793% copper. The primary sulphide zone, below the secondary zone, averaged 0.877% copper.

The first 17 churn drill holes drilled by the United States Bureau of Mines in the San Manuel Copper deposit are described in Report of Investigations 4108, where assay returns from samples taken every five feet down the holes are recorded, along with notations on the character of rock and of copper mineralization present. Four more holes drilled by Magma Copper Co. are similarly described.

It is apparent that, for the first 400 to 700 feet on the average, the drills passed through an oxidized zone in quartz monzonite and monzonite porphyry which contained around 0.25% to 1% copper in the form of chrysocolla.

Below this oxide zone, an enriched sulphide zone was entered by the drills, where chalcocite and chalcopyrite were the main copper sulphide minerals. Copper content of the formation increased in this sulphide ore zone to around 1% copper or more; sometimes however only 0.75% copper was found. This was the copper ore body of the San Manuel mine. A thickness of 400 feet of this ore might be used as an illustration of the magnitude of the deposit which has a length, in one ore body of 3800 feet.

Below the enriched chalcocite-chalcopyrite zone lies the primary sulphide zone which may have any width until the underlying pyritic zone of Red Hill is reached. Some rock, containing primary metallization is as rich in copper as the secondary chalcocite zone-showing that little enrichment of copper is sometimes present in the San Manuel disseminated copper deposit. This is illustrated by one drill hole wherein primary ore extended from 705 to 2,160 feet. The average copper content for the 1,455 feet was just over 0.9% copper, most assays returning between 0.75 and 1.1% copper.

Altho Magma Copper Co., in its annual report for 1946 states that there are 66,000,000 tons of oxide ore averaging 0.7% copper in the deposit, this oxide mineralization is not relied upon for copper production. The slightly enriched secondary sulphide and primary sulphide ore zones below the oxide zone are relied on to furnish profitable copper ore.

This story has great import for Red Hills exploration on property of the Arizona Consolidated Gold and Copper Mines Company, with identical geological setting among quartz monzonite basement and monzonite porphyry dike rocks; with a pyritic footwall in evidence and fracturing and widespread chrysocolla outcrops, Red Hills exploration should disclose a somewhat similar arrangement of oxide, secondary sulphide and primary sulphide copper ore zones as San Manuel. It is quite probable that copper deposition of both ore deposits came from the same deep regional source of mineralization, that is, the parent magma of the intrusive monzonite porphyry.

A somewhat less complicated picture of copper ore enrichment is presented by the disseminated copper deposit at Ray, 15 miles northeast of Red Hills. Here the deposit is a secondary enrichment of disseminated chalcocite associated with and partly replacing primary pyrite in the pre-Cambrian Pinal schist, and to a slight extent in the monzonite porphyry responsible for the mineralization. The ore body is a flat-lying mass, irregular in outline and of variable thickness. The long axis of this copper deposit extends roughly east and west for about 7000 feet. It ranges in width from about 200 feet in the center to over 2000 feet at the ends. The thickness of the ore ranges from 15 to 400 feet and averages around 150 feet. An average depth of 225 feet of oxide zone overlies the ore body; chrysocolla is the main copper mineral of the oxide zone. The concentration of secondary copper was greatly influenced by fault barriers which confined the descending enriching solutions to well defined areas. Value of copper produced in the Ray district to date approach the grand total of $400,000,000.00.

EXPLORATION AT RED HILLS

It can readily be seen, by comparing Red Hills mineralized outcrops and rock varieties and structural pattern, that great resemblance exists with the San Manuel copper deposit. The formation of disseminated copper deposits at Ray also sheds light on expectations of copper enrichment at Red Hills.

Apparently the churn drill program followed at the San Manuel copper mine in exploring for the copper ore body at depth, should be emulated at Red Hills. As shown heretofore, the anticlinal

structure formed by the West and East faults along the eastern half of Red Hills ridge may be the guide to copper ore deposits at Red Hills. It therefore seems best to churn drill Red Hills eastern flank at selected spots to determine the presence of secondary copper sulphide ore bodies beneath outcrops which indicate copper enrichment below.

With this exploration in view, it is interesting to note that color of outcrop at San Manuel distinguished the zone in which the copper deposit lay. This shade is a dark brownish red, from a sericitized rock commonly seamed with chrysocolla, indicating copper and iron sulphides at depth.

RECOMMENDATIONS:

Five proposed churn drill holes have been spotted on croppings of dark brownish red monzonite near the footwalls of the West and East faults. It is recommended that eight-inch churn drill holes be drilled at these points to explore for secondary copper sulphide ore bodies at depth in Red Hills ridge.

It is probable that the depth of secondary sulphide ore at San Manuel is the most likely information applicable to Red Hills. It is unlikely that present water level is related to depth of oxidized zone or secondary sulphide enrichment. Using San Manuel as a guide therefore, sulphide enrichment at Red Hills should be encountered above the 600-foot depth in drill holes. It is possible that a much shallower depth will obtain. In advance of drilling however, certain forecast is impossible and drill holes should continue to greater depth if necessary to pass through the oxidized zone; pass through the secondarily enriched sulphide zone and into the primary ore zone.

PROPOSED CHURN DRILL HOLES:

#1 Hole: proposed to be drilled in the footwall of the West fault near the southwest corner of the copper #1 claim, will penetrate a brownish-red highly fractured outcrop, containing brown iron oxides and seams of chrysocolla, which appears to indicate deposition of copper sulphides at depth.

#2 Hole: near the Mexican shaft, on Copper #1 claim, likewise is located on croppings of brown oxides of iron and chrysocolla-seamed monzonite. The hole also will descend in the footwall of the West fault near the center of the anticlinal arch in the strong structural zone of movement. The brownish iron-stained appearance of rock on the dump of the nearby Mexican shaft furnishes strong support to expectation of good results from this hole.

#3 Hole: is located on the east side of the Red Hills, in the footwall of the East fault and at about the center of Chango #7 claim, 480 feet east of its westerly endline. Here, the hole will penetrate a ridge characterized by brownish red outcrops of sericitized monzonite porphyry seamed with chrysocolla. The ridge lies at the top of the east-west anticlinal arch exhibited by the East fault and appears to contain the most attractive outcrop of any ridge east of the West fault.

#4 Hole: is a deviation from the policy followed in locating the first three holes. It is located near the center of Copper #20 claim, 360 feet west of the east endline. It is also about 30 feet north of the large east-west aplite dike which cuts clear across Red Hills ridge. The hole will go down in the vicinity of a quartz specular hematite-chrysocolla outcrop that could well be part of the United Verde ore body outcrop at Jerome. There may

be a copper ore shoot along the aplite dike at this point. Only exploration can settle that question.

#5 Hole: is located near the north end of Red Hills, where strong outcrops of quartz, iron oxides and chrysocolla filling fracture zones project to a position in the footwall of the West fault.

These five holes all lie in the north half of Red Hills. They are all predicated on the hypothesis that a combination of favorable outcrops, structural anticline due to faulting and apparent position overlying the red core of Red Hills will bring to them the optimum of good results.

Depth to which these holes should be drilled can only be determined when the drills penetrate the oxide, secondary sulphide and primary sulphide zones of copper deposition. Possibly more than 1000 feet depth will be advisable, as at San Manuel. Possibly less than 1,000 feet depth will tell the story, as at Ray.

CONCLUSIONS

The Red Hills mineralized outcrops and rock formations resembling so closely those of the noted, major San Manuel copper deposit 34 miles southeast of Red Hills, warrant exploration by churn drilling to determine the presence of disseminated copper ore bodies at depth.

The anticlinal fault structures of the West and East faults in Red Hills indicate a concentration of copper mineralization beneath the 3600-foot long ridge.

It is therefore a sound exploration endeavor to churn drill as recommended above in a search for copper ore bodies. Red Hill ridge certainly contains mineral indications at the surface

of a magnitude comparable to those of the closely related San Manuel mine, and should be carefully explored with the expectation of major copper ore discoveries.

Respectfully submitted,

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June 21, 1950

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