FRONTISPIECE

Aerial view of the Three R Canyon area, showing the Three R mine, Patagonia Mountains, Santa Cruz County, Arizona.

GEOLOGY OF THE THREE R MINE, PALMETTO MINING DISTRICT, SANTA CRUZ COUNTY, ARIZONA

by

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A Thesis Submitted to the Faculty of the

DEPARTMENT OF GEOLOGY

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE

In the Graduate College

THE UNIVERSITY OF ARIZONA

1963

STATEMENT BY AUTHOR

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ABSTRACT

The Three R mine is located 75 miles southeast of Tucson in the Palmetto Mining District of the Patagonia Mountains, Santa Cruz County, Ariz. More than 2.5 million dollars of copper ore was mined around the time of World War I. This deposit consists of a large steeply dipping high-grade lens of secondary chalcocite deposited in an altered granite along a north-northwest fault zone where it is intersected by an east-northeast fracture zone. The only primary mineralization found in the area is very low grade cupriferous pyrite disseminated throughout a large portion of the altered granite phase of the Patagonia batholith. Supergene enrichment along the steeply dipping fault zone formed the orebody that produced about 10,000,000 pounds of copper.

The predominant rock in the Three R area is a granite phase of the Patagonia batholith intruded by small latite bodies. Hydrothermal

fluids have altered and mineralized the area, and post-mineralization andesite dikes are intrusive into the granite.

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INTRODUCTION

General Statement

The Three R mine is a geologic oddity among copper mines in southern Arizona. Situated in a mass of iron-stained, altered, sulfide-bearing granite, the chalcocite mineralization was limited to a narrow steeply dipping fracture zone instead of the typical flat blanket found in the southwestern porphyry copper bodies. In searching the literature, the unusual nature of this orebody becomes even more apparent with very few structurally similar types reported from anywhere else in the world. Only generalized and limited investigation into this mine and its geology have been conducted in the past.

The purpose of this investigation has been to make a detailed investigation of the geology and ore controls to explain the occurrence of this unusual economic mineralization. This study should clarify and contribute to the knowledge of the mining district and the mountain range and serve as an exploration guide for new economic possibilities in this district.

Methods in Investigation

Preliminary surface mapping was begun in the fall of 1961 on government aerial photographs at a scale of 1/4 mile to the inch. Approximately 35 days were spent in the field mapping surface and underground workings. The final surface map was compiled in the spring of 1962 on aerial photographs enlarged to a scale of 500 feet to the inch. Locally, some areas were mapped in greater detail on 200 feet to the inch aerial photographs taken by the author and transferred to the base map.

Underground mapping was accomplished using base maps at a scale of 50 feet to the inch compiled by Consolidated Coppermines and supplied by Sherwood Owens of Tucson. A check of certain portions revealed these maps as quite accurate. More than 40 thin sections and 9 polished sections were studied.

Location

The Three R mine is located in the Palmetto Mining District on the western flank of the Patagonia Mountains (fig. 1) in Santa Cruz County, Ariz., 5 miles south of Patagonia and 14 miles northeast of Nogales. The property, situated in the Coronado National Forest, is located in portions of sections 35, 36 of T. 22 S., R. 15 E. in the Nogales 15-minute quadrangle, and it consists of 21 contiguous patented claims (pl. V) covering 349.166 acres (Patent No. 922927 dated November 10, 1923, recorded in Book 7 of M. D., p. 129). Access to the property consists of a 3-1/2-mile dirt road leading east from Arizona

Highway 83 at a point 4 miles south of Patagonia. The closest rail point is at Nogales, Ariz., 20 road miles to the southeast.

Topography

The northwestward-trending Patagonia Mountains are situated in the Basin and Range physiographic province. About 2 square miles of steep terrain ranging in elevation from 4,000 feet to about 6,000 feet was mapped. The Three R mine is situated in a rugged canyon that rises to a bold narrow rim along the crest of the range with slopes averaging 30° to 34°. The steep slopes, which facilitate a rapid run-off, have eroded the canyon and formed the intermittent stream in Three R Canyon that drains westward to Sonoita Creek. Bedrock exposure is excellent in the higher portions of the canyon walls with alluvium increasing in the lower portions; however, outcrops are easy to locate throughout the mapped area. Hummocky ground and the crooked growth of trees indicate land creep is occurring locally throughout the canyon.

Vegetation

Chaparral, a complex vegetation type, is dominant in Three R Canyon. This type consists predominantly of scrub oak and manzanita with some interspersed pinon and juniper. The lower elevations produce grasses and mesquite. Locally, near the top of the canyon walls, the desert shrubs—such as cholla, ocotillo, amole, yucca, and others—are common. This apparent reversal in the usual vegetation sequences is probably due to the longer exposure of the sun near the top of the range and also to the shallow soil layer along the ridge lines, which limits the amount of moisture retention. In places, especially above 5,000 feet on the north-facing canyon walls, pine, juniper, and oak form small thick woodland areas. The lower elevations form excellent grazing land, which is the only use being made of this property at present.

Climate

The climate in the Patagonia area is influenced by the nearby mountains and a higher base level than the surrounding desert. This results in more pleasant weather than the typical Sonoran climate of southern Arizona. The mean annual temperature is 62.3°F, with the yearly average extremes ranging from 45° to 79°F. June is the hottest month with diurnal variations from 100° to 58°F. The average yearly rainfall in Patagonia since 1923 is 17.19 inches, with about 50 percent occurring in July and August thundershowers. Yearly extremes have ranged from 9.57 to 26.47 inches. Elevation is an influencing factor. As much as 4.45 inches of rain has fallen in one shower. About 3 percent of the total precipitation occurs as snow, which does not remain long on the ground except at higher elevations. The evaporation rate, which is high throughout southern Arizona, is about 99 inches.

Water Supply

There is no permanent water-supply development in the area mapped. The Three R mine levels are flooded to the 600-foot level. Rainwater remains in holes and pits on the surface and the small shafts in the area are flooded. The quality of surface water is poor, due to iron and copper contamination from the dumps and the mineralized rock. The nearest large source of water is located in the Sonoita Creek Valley 3 miles west.

Acknowledgments

The writer acknowledges Dr. S. R. Titley who supervised this study for his advice and criticism in the preparation of this manuscript. Dr. W. C. Lacy, Dr. R. L. DuBois, and Dr. E. B. Mayo of the Department of Geology, University of Arizona, also gave the author many helpful suggestions in field and laboratory techniques.

The West Range Co. employed the writer during the greater portion of this study, and special appreciation is given to Dr. C. P. Jenney, consulting geologist, Oakville, Ontario, Canada, who gave the author considerable aid in the field.

R. R. Reynolds of Indianapolis, Indiana, presented the author with various engineering reports on the Three R property. Robert Lenon of Patagonia made available many of the old maps, especially

some assay maps, which are included in this report. Sherwood Owens of Tucson, Ariz., who is currently managing the property for the owners, permitted the author access to the mine workings, as well as allowing free use of a rare set of underground maps for the purpose of this thesis.

Discussions with many graduate students of the University of Arizona—especially Barry Watson, who originally suggested this area, and Fred Graybeal and Dean Pilkington, were of considerable value in this study.

Final acknowledgment is made to my wife and coworker, Roberta, who aided me in the field and who supplied constant encouragement and help in completing this study.

Previous Work

The first complete published report of the Three R mine was made in 1914 by F. R. Probert (10). At about the same time, polished sections from the rich chalcocite ores were being studied by Graton in his classic study (7) on the processes of enrichment of copper ores. A U.S. Geological Survey bulletin covering the results of reconnaissance on the Patagonia and Santa Rita Mountains was published by Schrader (13) in 1915, with especially good coverage of the history of the Three R mine. Various reports in other U.S. Geological Survey bulletins and in Economic Geology by Schrader (11, 12, 14) either duplicated information in this bulletin or supplemented it to a slight degree.

Shortly after World War I, major mining efforts ceased in the Three R mine, and thereafter many companies studied the deposit looking for additional ore reserves. In about 1920 Magma mines did extensive mapping, sampling, and drilling on the property, and the use of some of their maps has been made in this study. The Kennecott Copper Corp. did a small amount of work sometime in the late forties. Due to the apparent limited potential size of the deposit, they recommended the property to the now defunct Consolidated Copper Co., who drilled and mapped the old workings. These mine maps were used in this study for base maps and the drill information is included in this report. Limited studies by various other engineers and geologists were made at various times.

Two Ph.D. dissertations on the Patagonia Mountains have been used for general reference. Kartchner (8) from the University of Arizona described a portion of the Harshaw district to the northeast of the Three R mine in 1946, and Baker (3) from the University of Michigan completed a study in 1961 of the sedimentary and volcanic rocks, as well as a portion of the Patagonia batholith, in the southeast portion of the Patagonia Mountains.

ROCK DESCRIPTION

Three R Granite

General

The Three R Granite forms only a small percentage of the total intrusive rock in the Patagonia batholith, which forms the core of the Patagonia Mountains from Alum Gulch on the north to the Mexican border and southward. The area of batholith covers more than 40 square miles of which the Three R Granite phase forms about 6 square miles. Many phases of the intrusive have been observed throughout the batholith, ranging from granodiorite to granite with diorite masses along the borders in the northern half.

The intrusive rocks form a rugged topography in the mapped area with steep canyons and prominent ridges with good outcrop exposure. The massive nature of the rock causes rapid runoff of the heavy rain showers causing rapid erosion.

Lack of primary structures in Three R Canyon—such as foliation, lineation, or the development of joints—does not permit any structural interpretation of the magma's intrusive history. Baker's description (3) of the rocks in the southern section of the Patagonia batholith suggests that the granitic rocks formed at a greater depth there than those in the Three R area, requiring uplift of the southern portion of the Patagonia Mountains since emplacement of the intrusion.

It is still to be determined how far north the batholith exists under the volcanics. The same type of intrusive rocks with similar age relations is evident in the Santa Rita Mountains northwestward.

Description

The Three R Granite is the principal rock unit in the mapped area and acts as the host rock for the Three R orebody. Southward in European Canyon no granite is present, and quartz monzonite and monzonite phases of the batholith form the predominant rock. The contact appears transitional. Northward the granite persists into Alum Gulch where the volcanic sequence of the Red Mountain area is in contact with the granite. The granite is bordered on the west near the mouth of Three R Canyon and the quartz monzonite phase makes up the pediment area westward. The eastern edge of the granite is located over the crestline in the upper portion of Flux Canyon.

The granite in outcrop is light-colored, medium- to coarse-grained, granitoid rock. The color of the rock depends upon the pyrite content and the amount of weathering. The granite, when fresh and relatively free of pyrite, is pink due to the potash feldspars, or is white if altered to sericite or clay. However, in the more common pyritized form of the granite, red iron stain is dominant and the entire mass of granite within the Three R Canyon area forms a region of brightly colored red rock, especially when viewed from afar, similar to that found near the porphyry copper deposits of Arizona.

Weathering of the granite is usually not deep, as evidenced by fresh pyrite inches below the surface, except near the Three R fault zone and other highly altered zones where surface oxidation is locally many feet. The pyrite usually occurs as veinlets 1/16 to 1/4 inch wide surrounded by pure sericite in a sericitized-argillized altered phase of the granite. The veins occur in clusters and trend approximately east-northeast. The most distinctive feature of the granite within Three R Canyon is the quartz phenocrysts, which make up as much as 50 percent of the rock. Differential weathering causes these irregular quartz grains to stand out in relief and gives the rock a very characteristic mottled appearance. Coarse potash feldspars are noticeable in certain areas; however, in much of the area along the Three R fault zone, the feldspars are intensely sericitized and argillized. Secondary silica is important locally within Three R Canyon.

Petrology

Microscopic examination of numerous thin sections reveals the following mineral composition:

	Percent		Percent
Quartz	15-50	Apatite	-1
Perthite	45-80	Zircon	-1
Oligoclase plagioclase (An_{28})	0-5	Pyrite	1-5
Microcline	0-1	Sphene	0-1
Mymekite	0-1	Biotite	0-1
		Muscovite	0-1

The average Three R Granite is xenomorphic granular and consists of 70 percent perthite with about 24 percent quartz and has a grain size of 2 to 3 mm. Secondary quartz and feldspar are quite abundant locally. Argillization and sericitization of the feldspar is prevalent with the argillization generally more common than the sericitization. The scattered plagioclase grains are more altered than the potash feldspar. In certain slides, albitization was noted around the perthite crystals. Tourmaline in a sunburst structure was observed in some areas. Microscopic examination of pyrite veinlets reveals a core of quartz and pyrite lined by solid sericite. Outside these small veined zones, which average about an inch, sericitization gradually gets weaker. In one thin section, two veinlets and their alteration sequences were observed, indicating the size of this microzoning.

This rock is quite featureless structurally, except for late shearing and faulting, and is inferred to be a shallow phase of the Patagonia batholith. Pendants of andesite flows in the granite have been noted on the crestline to the east, and blocks of quartzite are located on the ridges south of Three R Canyon, which indicate the near-surface formation of this intrusive. No contacts with other major rock groups of known geologic age were found in the mapped area. However, work accomplished in the southeastern Patagonia Mountains by Baker (3) shows that the Patagonia batholith intruded Paleozoic and Mesozoic age sediments and Tertiary volcanics, and the age is probably middle to late Tertiary.

Latite

Description

The latite intrusive masses, formerly called rhyolite (13) and trachyte (10), are localized within the granitic phase of the Patagonia batholith where they occur mostly as scattered small outcrops about 100 feet in diameter. However, southwest of the Three R area the latite occurs as bodies as much as 600 feet long and 200 feet wide. The largest outcrop is located near the mouth of Three R Canyon in proximity to a mass of altered tuffs. The latite is resistant to weathering, forming hilltops in the western portion of the mapped area and bold outcrops southwest of the Three R mine. The smaller bodies are too small to form bold outcrops; however, they are still noticeably more resistant.

No structural control of latite emplacement is apparent, except for the localization within the granitic phase of the batholith. Many small exposures are scattered throughout the 400- and 600-foot levels of the Three R mine without any obvious control. There seems to be an increase of this rock type along the zone of northwest faulting at the Three R mine and also along the stronger portions of the N. 65° E. shear direction southwest of the mine. However, the largest outcrop along the western edge of the granite near the mouth of Three R Canyon does not fit this structural pattern.

Within the Three R mine, the contact of the latite with the granite shows that the latite apparently intruded the granite as a rather viscous mass, since a well-developed foliation is found along every contact in a zone about 2 to 4 inches wide. It is believed that this foliation is due to flow structure within a viscous mass, which oriented the mineral grains parallel to the contact during intrusion. Intense silicification along the Three R fault zones destroys this feature locally. The latite was very susceptible to silica flooding, as shown by the underground exposures, with complete replacement by silica being the extreme example. The completely silicified latite is often quite strongly pyritized and may be the original rock type of some of the quartz-pyrite masses noted in the mapped area.

Megascopically, the rock ranges from light gray through pink with a splotchy distribution of iron oxides set in a dense to fine-grained matrix. Locally, phenocrysts of feldspar completely altered to sericite and phenocrysts of quartz are evident. The quantity of quartz sometimes increases enough to change the rock to a quartz latite. On weathered surfaces the rock becomes dark red. In the large exposure at the mouth of Three R Canyon, the northwestern end becomes more coarsely crystalline and resembles a mass of feldspar. In one outcrop a megascopic spherulitic texture was noted.

Petrology

Microscopic work reveals two main constituents, quartz in minor amounts varying from 3 to 8 percent and a devitrified glass locally spherulitic in nature. The incipient crystals average 0.2 to 0.3 mm in diameter and have a higher index of refraction than 1.54. An indication of albite twins on scattered grains in some thin sections together with the index of refraction suggest that the devitrifying material is probably an intermediate plagioclase feldspar. Zircon was visible in only one thin section. The crystallographic axes of the matrix material are revealed by sericite preferentially growing in two directions at right angles to each other. Sericitization is very strong in every thin section. Iron oxide is evident as scattered masses as well as along seams. Clay alteration is very weak considering most of the surrounding granite is argillized to some degree. Quartz occurs in the matrix of some of the rocks as well as in subangular to subrounded phenocrysts ranging from 2 mm in diameter to as much as one-eighth of an inch. The western area described above as a more crystallized form of the latite revealed oligoclase (An_{28}) phenocrysts with some green tourmaline localized in the phenocrysts. Clay alteration was extensive in this more crystallized portion of the latite, as in the granite around it.

That this rock type probably formed under shallow conditions is indicated by the spherulitic texture and the devitrified glass. It is younger than the granite and yet is prehydrothermal mineralization. Thus, it is probably the last phase of the magmatic activity of the Patagonia batholith occurring just before the hydrothermal phase. A rock of similar structure and texture has been observed on southwestern Red Mountain intruding the andesite and rhyolite sequences.

Andesite Porphyry

An andesite porphyry is located in two exposures within the granite of Three R Canyon. The first is a small surface outcrop approximately 500 feet north of the Three R portal, and the other exposure was observed in a caved drift in the 600-foot level of the Three R mine. On the surface the rock type is strongly altered, probably by supergene processes since it is quite fresh underground where it is in proximity to the strongest hydrothermal alteration.

The andesite porphyry is dark green with brownish-red phenocrysts of plagioclase up to 0.2 inch, which were apparently stained by supergene iron oxides. Small green patches of chlorite are visible, as is an abundance of pyrite which is disseminated throughout. The weathered surface exposure is bleached with masses of sericite forming from the plagioclase feldspars and scattered pale-green chlorite set in a buff matrix. Under the microscope, sharp ghosts of the former plagioclase and amphibole crystals are observed converted to sericite and chlorite, respectively. The fresh specimen in thin section reveals about 50 percent matrix material having an index of refraction above 1.54, which is probably an intermediate plagioclase feldspar. The phenocrysts consist of euhedral crystals of andesine (An_{32}), which make up 35 to 40 percent of the rock, and chlorite (10 to 15 percent) after amphibole. Epidote occurs in the chlorite and pyrite is the only opaque mineral.

Size or structural relations were not observable. However, due to the fresh nature of the rock underground and the small size of the exposures, this rock is considered to be a dike of material similar to the large exposures of andesite to the north and east of the Three R area around Red Mountain. The andesite porphyry is considered to be the last igneous activity in the mapped area, since it was not altered by the hydrothermal fluids that have affected all other rock types in and about the Three R area. Similar late andesite dikes are found on Red Mountain to the north and are also unaffected by the hydrothermal fluids in that area. This rock creates heavy ground in the mine, and it is the only rock that has caved extensively in more than 50 years.

Similar type, light-purple, porphyritic rocks were found along the Three R Canyon crestline east of the mine. Correlation is not possible since silicification and sericitization, which may be supergene, have destroyed the original constituents. No primary or secondary ferromagnesian minerals were found; however, small blotches of hematite may represent the former site of these minerals. The fine-grained matrix has an index of refraction greater than 1.54 and is probably plagioclase feldspar. No clear structural relations were observed. The southernmost exposure, which is the largest, appears to be a small flow lying above the main granitic mass. A thin section of this rock revealed alteration had converted it to a quartz sericite porphyry. Evidence of a weak banding was found in the central exposure suggesting flow lines. Since roof pendants of quartzite are found just south of Three R Canyon, the chance of volcanic flows lying on the crestline is a possibility in view of the fact that the granite has not been eroded deeply. The dikes noted in the Three R mine area may be feeder channels for these volcanic rocks.

Ferruginous Conglomerate

In the lower portion of Three R Canyon, along the present stream walls, masses of a ferruginous conglomerate form an irregular outcrop pattern on both sides of the stream for distances of as much as 150 feet above the present channel.

The conglomerate consists of angular and rounded fragments of the Three R Granite, ranging in size from half an inch to as much as 2 feet or more in diameter, and minor quantities of latite porphyry. The matrix consists of iron oxides and silica, which give an overall red-yellow color to the well-cemented rock. In places the formation has a limonitic soil matrix that forms poorly cemented conglomerate. This rock first formed as a typical alluvium deriving its materials from the downcutting action of stream erosion as well as slide material from the surrounding canyon walls. The iron oxide material that forms the matrix of this rock type precipitated in the alluvium from surface waters, which leached the iron from the pyritiferous granite around the Three R mine area.

The formation of the ferruginous conglomerate has been developing over a long time, as evidenced by its appearance 150 feet above the present channel where the stream originally existed. The conglomerate is still forming in places near the mouth of Three R Canyon where the most recent river gravels show a limonitic weakly cemented conglomerate along the present stream channels grading upward into well-cemented ferruginous conglomerate.

Various other canyons in the Patagonia Mountains as well as elsewhere in southern Arizona that have a high pyrite content in the surrounding rocks reveal similar type conglomerates immediately adjacent to the present-day streams.

STRUCTURE

Regional Structure

The Three R mine is situated within the north-northwest-trending Patagonia batholith within a granite phase of this intrusion (fig. 1). This trend is reflected northwestward into the Santa Rita Mountains and also in the nearby Canelo Hills. A southern continuation of this same trend was observed 35 miles southward in the Cananea Mining District, Sonora, Mexico, where a group of porphyritic intrusions are aligned in a north-northwest direction. The nearby Huachuca Mountains (1) and Whetstone Mountains also reflect the northwesterly trend. In the Patagonia Mountains the larger faults, including the Three R fault zone, that are within the intrusive and extrusive rocks follow this direction, and the major folds and faults in the sediments on the eastern flank of the range (3) also reflect the northwest trend. Kartchner (8), in his study of the Harshaw district just north of Three R Canyon, reports the major fault direction in that area is N. 25° W.

A second major structural direction noted in this area trends approximately east-west and has been described by Mayo (personal communication, 1962) as the Texas lineament. This zone was observed during aerial reconnaissance in a wide area between the south end of the

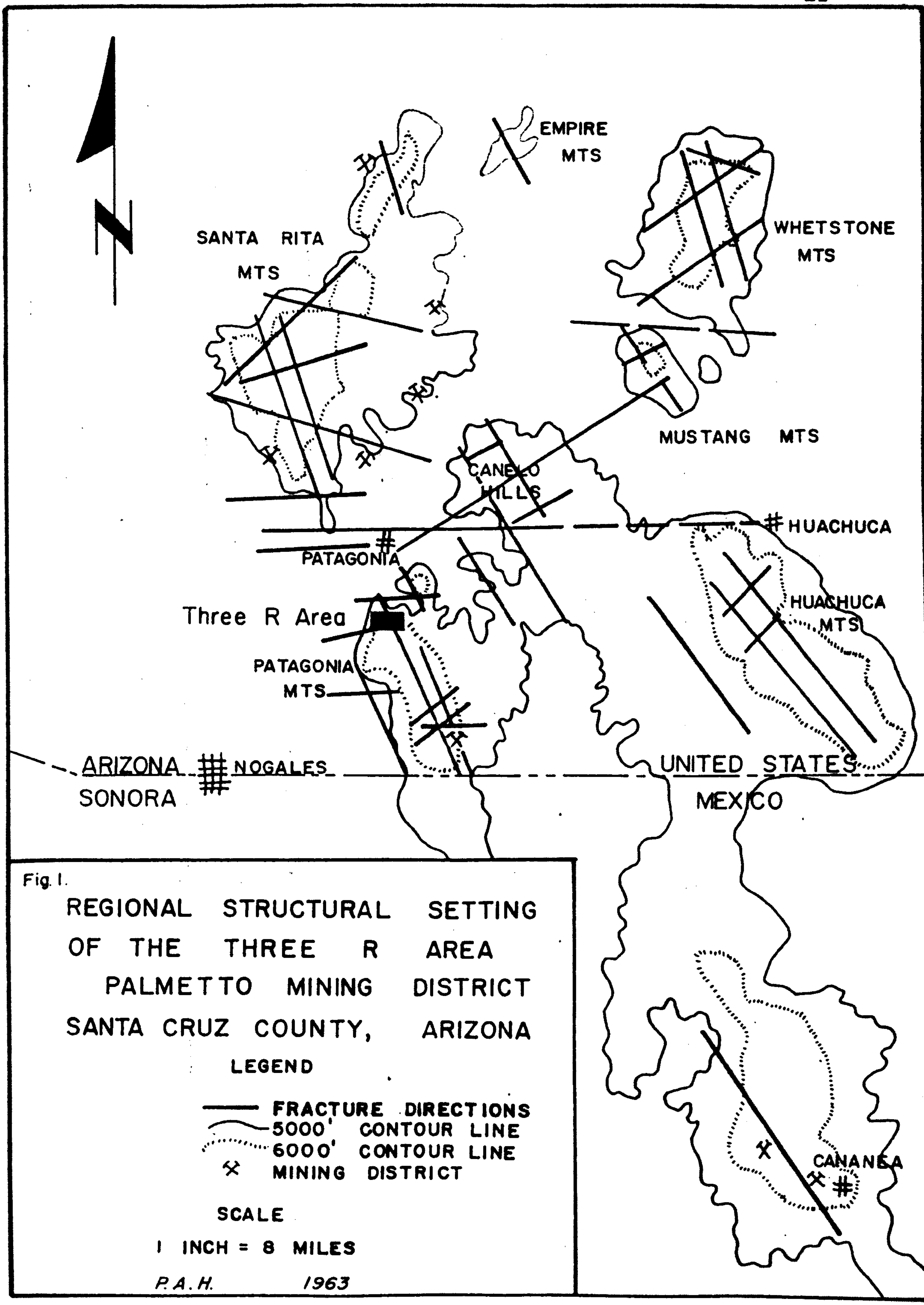


Fig. 1.
REGIONAL STRUCTURAL SETTING OF THE THREE R AREA
PALMETTO MINING DISTRICT
SANTA CRUZ COUNTY, ARIZONA

Santa Rita Mountains and north of the Patagonia range where it can be traced eastward to the north end of the Huachuca Mountains. A variation of this trend slightly north of west is apparent near the Flux mine along the contact between the Patagonia batholith and the volcanics to the north. An east-northeast trend normal to the major northwesterly grain was observed on aerial photographs in the Santa Rita Mountains centered near Mount Wrightson. This same direction is very important in localizing the hydrothermal mineralization in the Three R area and is described in the section on "Local Structure." The east-northeast direction is important in localizing orebodies in the Flux and Duquesne mining camps (personal communication, E. W. MacFarland, 1962). The northwestward-trending Canelo Hills consist of sediments that have been cut by north-south faults, which in turn have been cut by east-west faulting (6).

Baker (3) shows many northeast faults in the sediments and volcanics on the southeast flank of the Patagonia Mountains. One other major northeast trend is apparent on aerial photographs between the north end of the Patagonia Mountains and the south end of the Mustang Mountains.

Local Structure

Two structural trends are evident within Three R Canyon. One is north-northwest and the other is east-northeast (pl. I). The north-

northwest trend is that of a major fault zone, which is manifested by at least six parallel faults over a width of 2,000 feet in the mine area. The strike varies around N. 5° W. to N. 10° W. and dips 45° to 90° W. This fracture zone apparently coalesces to the south and forms into one fault, which is expressed on the surface by a general iron staining. Two miles to the southeast it forms a bold 200-foot escarpment that is the southernmost traceable limit of the fault. The fault trace is limited to the north and becomes progressively weaker until it is lost before entering Alum Gulch.

Immediately south of the 400-foot level portal, a large steep-walled mass of iron-stained granite forms a bold dikelike body (pl. VI A), which is centered along the fault. Close examination reveals a silicified ferruginous granite tightly sheared, compressed, and crushed, which gives a schistose appearance upon weathering. It shatters easily, when struck by a pick, along the numerous tiny planes that trend parallel to the fault. This intensely sheared area is limited to a few hundred feet surrounding the fault zone near the Three R mine and southward a few hundred feet.

Underground the widths of the faults are quite small, generally averaging 6 to 12 inches. Occasional extremes from 2 feet to as much as 30 feet in the main stope area can be observed. Locally, each fault in this fault system branches and horsetails over 5- to 25-foot portions, causing small brecciated zones that formed small pockets of ore away

PLATE VI

A

Bold resistant granite mass overlying main Three R fault south of the orebody. Another fault strand is shown at the right side of the photograph. The main shaft area is at the bottom of the picture.

B

Closeup of the smaller fault shown in plate VI A, showing iron oxides in the fault surrounded by silicified granite. This fracture carried little secondary copper mineralization.

from the main area. The dips vary from vertical to 45° W. with 60° the most common dip in the stoped area.

The entire zone of faulting is the most important control of the Three R orebodies, with the secondary chalcocite mineralization limited predominantly to particular fractures within the fault zone (fig. 2). Open spaces are evident within the fault zone, and pieces of root material are found 100 feet or more below the surface indicating the open nature of these fractures. An abundance of supergene iron and copper mineralization deposited locally over the entire width of the faults indicates the admission, channeling, and precipitation of mineralized surface waters down the fault zone. The Three R fracture zone in the vicinity of the mine is the only large area that was prepared structurally for entrance of the copper-bearing meteoric waters permitting large-scale secondary enrichment.

There was slight post-mineralization adjustment but no evidence of post-mineralization offsetting of orebodies was observed.

Neither the amount of displacement or the direction of relative displacement can be determined due to the homogeneity of the surrounding granite. Slickensides indicate the last movement was vertical down the plane of the fault. Southward, out of the mapped area within the upper portion of European Canyon, there is evidence that the Three R fault zone is normal with the volcanic rocks found on the mountaintop downfaulted many hundreds of feet below the crestline east of the

European mine.

It is inferred that the entire Three R fault zone is a tensional normal fault caused by a release of east-west forces. Strong east-west compressional forces, which were probably originally derived from the emplacement of the Patagonia batholith, are suggested by the north-south-trending folds in the sediments of the Washington-Duquesne (3) area to the southeast. The release of these forces after the intrusive cooled would develop longitudinal tension fractures along the axis of the intrusive, which is where the Three R fault zone apparently lies.

The other important structural direction is a fracture zone trending N. 65° E., which is normal to the north-northwest fault zone and intersects this zone in the vicinity of the Three R mine. This system consists of parallel quartz-pyrite-sericite veinlets, locally cupriferous, which can be traced from about a mile outside the mapped area into the Three R fault zone around the mine. This trend is cut off by the north-northwest fault zone with no apparent continuation eastward beyond the mine area.

Surface weathering of these mineralized fractures was intensive, and study of underground exposures of the veinlets reveals the widths of these fractures are hardly ever more than an inch and individually they are not persistent, but the extreme number of these mineralized shears over a zone half a mile long and more than 200 feet wide indicates that this was an important structure and probably is the major factor that helped localize the Three R primary mineralization. This north-northeast shear zone is inferred to be the main control of the cupriferous-pyrite solutions within the Three R Canyon area. This same cross trend is important in controlling the orebodies in the nearby Flux mine (personal communication, E. W. MacFarland, 1962). It is also apparent in the sediments along the eastern flank of the mountain range (3) from Harshaw southward to the Mexican border.

MINERALOGY

Native Elements

Native Copper

In 1917 Schrader (13) reported:

> Native copper, apparently derived from chalcocite, occurs in beads and films or thin sheets facing the sheeting or shear planes in the shaft and open cut above the tunnel, and a sample of it consisting of a thin sheet 1-1/2 feet in diameter, was presented, it is said, to the University of Arizona at Tucson.

This copper was found in the oxidized zone where it was probably derived from chalcocite and covellite oxidation.

Sulfur

Minor quantities of sulfur were observed on the dump and in the mine workings due to the complete oxidation of the sulfide minerals.

Gold

In 1927, a placer gold operation was instituted in lower Three R Canyon in the pediment area (15). Very little precious metal content was recovered from the Three R ores.

Silver

This is the only recorded precious metal production from the Three R mine. No silver minerals were observed or have been recorded. This silver (5) apparently occurs in trace-element quantity in the ore.

Sulfides

Chalcocite

The principal ore mineral of the Three R mine was chalcocite, which appeared as a sooty material coating and replacing pyrite. It was limited to the enriched wallrock of the Three R fault zone developing about 40 feet below the present surface and continuing in depth for about 400 feet with a gradual decrease in quantity. The sooty variety is the only form of this mineral observed and its origin is attributed to a supergene formation. Other small occurrences located along open fractures in the Three R Canyon are of no economic significance. Most of the primary copper was apparently derived by cupriferous pyrite rather than primary copper minerals.

Covellite

Probert (10) reported: "On the 500 foot level, 110 feet below the surface, stope No. 100, the pyrite was found coated with covellite of a purplish blue color . . ." This covellite was located in the top of the secondary sulfide zone. The usual formation of covellite is attributed to the first step in the oxidation and leaching of chalcocite. Since it is more resistant to weathering, it lags behind the downward migration of the chalcocite zone by solution and redeposition.

Bornite

On the Three R claim, north of the main workings, bornite is reported (10) to coat the crystal faces of pyrite. It was apparently rare and is of supergene origin. Graton (7) shows evidence of bornite forming from chalcopyrite as an intermediate step in the formation of chalcocite.

Chalcopyrite

Chalcopyrite is rare in this canyon and occurs widely disseminated throughout the granite with the pyrite in the quartz-sericite veinlets. In canyons to the south where erosion is proceeding faster than oxidation, chalcopyrite can be observed with pyrite in very small quantities. The large pyritiferous quartz masses reveal minor chalcopyrite. Schrader (13) reports the chalcopyrite occurs as small separated masses and not intergrown with the pyrite. However, the author feels the pyrite and chalcopyrite are essentially simultaneous or it formed very shortly after the pyrite. Graton (7) believed some of the chalcopyrite was secondary as a reverse oxidation from bornite.

Pyrite

Pyrite is the most abundant sulfide mineral in the Three R area. Most of the pyrite is cupriferous to some degree, since almost every assay within Three R Canyon (see Appendix A) of primary pyrite reveals a few hundredths of a percent copper. In general, it is well crystallized and crystals as much as 8 inches in diameter were noted by Schrader (13). It may occur as disseminations, as small veinlets, or in large veins and masses throughout the mine in all levels and in most of the surface rock. Striae are revealed on many crystals and twinning is noted. The pyrite is closely associated with quartz and sericite in the numerous shear veinlets. Pyritohedrons and cubes of pyrite were observed. Masses of quartz as much as 30 feet in diameter are found both underground and elsewhere in the canyon on the surface carrying abundant quantities of pyrite. The chalcocite ore precipitated as a thin film or coating on the pyrite and in the orebody, as the pyrite is only superficially altered being quite fresh internally. In polished section, the pyrite is strongly shattered.

Oxides

Hematite

Probert (10) reported the secondary chalcocite zone fades into an ocherous hematite, which is the surface expression of the main ore-body. Hematite is very common throughout Three R Canyon and imparts a red color to the entire area. Specular hematite has been found as small masses in local areas.

Limonite

Limonite is found on the surface rock within Three R Canyon generally associated with jarosite. Its origin is attributed to the oxidation of pyrite by meteoric solutions. Many limonite pseudomorphs after pyrite are evident. Some iron was transported as a colloid or in solution down the open faults and redeposited as botryoidal, cellular, sintery masses of black-brown limonite that often have a honeycombed texture.

Goethite

Goethite, derived from the oxidation of pyrite, is found locally in Three R Canyon. Turgite, distinguished by its red streak, is found around the mine area.

Melaconite

Melaconite was found both underground and on the surface developing from the oxidation of the cupriferous pyrite.

Carbonates

Malachite and Azurite

Earlier reports indicate malachite and azurite occurred locally as films on the walls near the mouth of the lower tunnels. The copper carbonates were found along the surface exposure of the Three R fault zone as well as other smaller shears within Three R Canyon. Malachite was associated with some of the ore in the mine tunnel. Much of the malachite observed occurred as the crystalline variety. The carbonates were derived as oxidation products of chalcocite and covellite and to some extent from other minerals. Azurite is always less abundant and may form from malachite. Small amounts of the oxide copper minerals coat the gravels of Three R stream along its course to Sonoita Creek. The preference of the copper in solution to precipitate on the more basic diorite rather than the acid granite along the stream channel is very apparent.

Calcite

Calcite has been found in very small quantities in Three R

Canyon in open fractures.

Sulfates

Chalcanthite

In the dry underground workings, chalcanthite crystals are found coating the walls locally. This mineral was especially noticeable in the 600-foot level near the stope at 50,750 E. - 47,450 N.

Jarosite

Jarosite derived from the oxidation of pyrite is very common throughout Three R Canyon.

Alunite

Alunite is considered to be primarily of hydrothermal origin in the Three R area. It occurs as pure masses in veins near and within the Three R fault zone, and as disseminations replacing the feldspar minerals. The vein form is crystalline in nature and is a very light pink white. It is porcelainlike and has a splintery fracture.

Gypsum

Small amounts of gypsum have formed along the mine walls and open fractures. It usually occurs in the crystalline varieties selenite and satin spar.

Silicates

Quartz

Quartz is one of the most abundant magmatic and hydrothermal minerals and secondary supergene quartz is common. The granite has large quartz blebs that give the rock a characteristic weathering effect. Quartz is associated with both the alunitic and the sericitic form of alteration and is associated with the pyrite. Pyritized quartz masses are observed underground along with silicified latite porphyry and granite. Minor phenocrysts of quartz were observed in the latite porphyry. On the surface, a thin veneer of silica has formed locally where it was deposited from meteoric silica solutions.

Feldspar

Most of the feldspar in the granite is perthitic with very minor oligoclase. These minerals were the primary targets of both the supergene and hydrothermal alteration phases.

Sericite

Sericite, which ranges in size from fine grained to coarse grained, formed in quartz-sericite-pyrite veinlets from the primary hydrothermal fluids. Sericite is ubiquitous throughout the area to a greater or lesser degree. It affects every form of rock in Three R Canyon except the andesite porphyry. It is believed to have been formed by hot mildly acidic fluids.

Tourmaline

Blue-black tiny radiating groups of tourmaline have been observed scattered throughout Three R Canyon, especially to the south and west. A small concentration was observed in the wash south of the loading shoots near the old power plant.

Chlorite

Very small amounts of the chlorite minerals were observed in the mapped area due to a lack of ferromagnesian minerals in the granite. South and west of the mapped area abundant chlorite mineralization was evident in the more intermediate rocks of the Patagonia batholith and the associated diorite.

Epidote

The only epidote observed in the mapped area was found in the diorite as an alteration of the ferromagnesian minerals as well as in fractures within the same rock type.

Clay

Undetermined varieties of clay minerals are common in the less mineralized rock of Three R Canyon replacing the feldspars. It is both supergene and hypogene in origin. Kaolinite, illite, and montmorillonite varieties have been observed.

Chrysocolla

Chrysocolla was found in local areas on the surface and in stream channels. Much of this mineral may be developed due to recent weathering of the dumps and the subsequent solution of copper in silica-rich meteoric solutions.

Zircon and Apatite

Minor quantities of zircon and apatite are found in the granite and diorite. Especially long slender crystals of apatite are formed in the diorite.

ALTERATION

Argillic, quartz-sericite, and quartz-alunite alteration are found in the Three R mine area. Minor tourmalinization occurs locally. In this study no attempt was made to outline the boundary of each type except in the most generalized manner.

Argillic Alteration

Argillic alteration, which consists of various clay minerals replacing the potash feldspars to variable degrees, is found within Three R Canyon. Distribution of this alteration type is irregular spatially and in intensity, and mapping the zones of this alteration phase is difficult. The strongest argillic alteration is located on the west side of the Three R fault zone.

In outcrop the granite, which has been altered by argillization, generally retains its original color and texture. The characteristic quartz blebs are unaffected and the potash feldspar is converted to chalky appearing clays. Sericite is commonly associated with the clay to a minor degree. Occasionally, small zones of the granite are completely altered to clay minerals with a complete destruction of the original granitic texture.

In thin section, the feldspars show the variable intensity of the argillic alteration phase with some sections revealing most of the original feldspar while others show only quartz blebs remaining in a clay matrix. The clay minerals kaolinite, montmorillonite, and hydromuscovite have been observed.

There is overlap of the argillic and the quartz-sericite phases with all gradations between the two observed under the microscope.

Quartz-Sericite Alteration

The quartz-sericite phase reveals a close spatial relationship to structure and is found in proximity to the Three R fault zone and eastward to the crestline of the range. In this latter area, it is found along small fractures as well as disseminated throughout the granite. A second major area of quartz-sericite alteration is found along the east-northeast shear direction, which intersects the Three R fault zone from the west. The latite porphyry has been susceptible to this alteration and locally becomes so completely altered as to destroy its original texture and composition. Masses of silica-flooded rock that carry abundant sericite and pyrite are found within Three R Canyon and underground in the Three R mine in proximity to the major structural features and are apparently associated with the quartz-sericite alteration phase. This alteration type is typified by small quartz-sericite-pyrite veinlets, which parallel east-northeast structural directions within the granite.

Each veinlet can be traced only a few tens of feet at the most and rarely exceeds an inch in width.

In thin section, quartz-pyrite veinlets (1/8 to 1/4 inch wide) are surrounded by a zone of pure sericite (1/16 to 1/8 inch wide), which appears in outcrop as a white rim on each side of the veinlet. The sericite decreases in intensity within centimeters of the intense sericite rims, and remnants of the original feldspar minerals are apparent. The size of the sericite varies from very fine grained to very coarse grained. The original texture of the granite is not destroyed by the quartz-sericite phase of alteration except along the small mineralized veinlets. The altered rock reveals the distinctive quartz blebs surrounded by sericitized feldspar crystals. Pyrite is associated with the quartz-sericite veinlets, and in the strongly pyritized areas the granite is strongly sericitized. These larger areas of quartz-sericite alteration are made up of numerous veinlets that occur close together within inches of each other rather than a uniform flooding of the area. In this type of intensely altered area, the outcrop reveals little feldspar, but the microscope shows the alteration is rarely complete since the original potash feldspars are discernible.

Quartz-Alunite Alteration

The quartz-alunite phase, which is apparently located along the main structural intersection, is the most intense phase and is centered on the Three R fault zone. The alunite replaces the feldspar in the sheared and crushed rock next to individual fault zones where the granite appears to have a laminated or schistose structure with bands ranging from .1 to .3 mm in width. The total width of the quartz-alunite alteration is restricted to a few feet on either side of the main fracture. A second type of occurrence is veins of pure alunite several feet long and as much as 6 inches wide. These veins are either localized within and parallel to the main N. 5° W. Three R fracture zone or strike N. 30° to 35° W. and dip 60° E. In close proximity are small quartz veinlets that formed at the same time. The quartz-sericite phase is found along with the alunite alteration.

Chalcocite mineralization is commonly found in proximity to most of the alunite, and this has caused various authors to attribute the formation of the alunite to meteoric solutions since secondary chalcocite is formed by sulfate solutions generated by the destruction of pyrite forming sulfuric acid.

Schrader attributed the formation of alunite in the Three R area to metasomatic replacement of the potash feldspars (12). He considered the solutions to be sulfurous and acidic attended by some silicification.

Probert (10), on the other hand, believed the Three R alunite formed from sulfurous meteoric waters of the oxidized zone. He points out the close association between chalcotization and oxygenation of sulfides, suggesting a meteoric origin for the alunite.

The formation of alunite in the Three R area is attributed to a final stage of weak sulfuric acid hydrothermal activity, which leached the host rock of potassium and alumina in the lower portions of the channelways. Some of the disseminated alunite is probably a conversion of the feldspars in place. Alunite is not stable in strong free acid, which would suggest the original acid solutions were in the process of being neutralized by the liberation of hydrated silica and soluble bases along the hydrothermal channelways. This has occurred in other alunitized areas, as indicated by chemical comparisons of the fresh rock relative to the altered rock. Any alunite of meteoric origin is of minor importance in the Three R orebody.

THREE R MINE

History and Production[1/]

The Three R property was first located in 1897. Rollin R. Richardson was the first recorded owner, and thus the name "The Three R." Through 1908 little development work was conducted on the property, and Mr. Richardson's files became full of unfavorable engineers' reports concerning this property, due to the increasing interest at that time in locating large low-grade copper deposits rather than high-grade veins. During this period the property was bonded to W. R. Green of Cananea, Mexico, who did several hundred feet of development work. The property reverted back to Mr. Richardson when payments were forfeited. More development work was conducted by the Lewisohn group through H. S. McKay. Lewisohn left the property after opening up 1,600 feet of drifts in 4 months. Schrader (13) reports that by 1909 only 4 carloads of hand-sorted 20 percent copper amounted to the total production.

The Three R Syndicate, with offices in Patagonia, became the

1/ This section was compiled from various sources included in the references (4, 5, 10, 13, 17), as well as from some unpublished reports and personal communications.

owner in 1909. The original location and survey of the present town of Patagonia was made by R. R. Richardson. Several thousands of feet of development through 400 vertical feet was accomplished in the Three R, and by May 1911 Richardson had located a large body of chalcocite ore. Four carloads of 15 percent copper were shipped to the El Paso smelter. Through the remainder of the year, ore of 5 to 10 percent grade was stockpiled on the dumps and the orebody was developed through at least 200 vertical feet. The main adit was driven at this time to the orebody. It is believed that E. Bohlinger was responsible for opening up the major stope on the chalcocite body underground, and the stope bears his name. The Mexican miners called it "Cayman" or the Alligator stope for some obscure reason.

In April 1912, N. L. Amster of Boston, Massachusetts, took a lease and bond on the property totaling more than $500,000, and thus a third name, the "Amster stope," has been given to the rich interior of the mine. Careful geological investigations were now instituted, and for the first 6 months about 10 carloads a month were shipped with each averaging $1,000. The geologic mapping indicated that the orebody went deeper, and late in 1912, 2 carloads a day were being shipped while 5 to 10 percent ore was accumulated on the dump.

In April 1913, 100 tons of ore per day was shipped. By August 1914, 30,000 tons of 9 percent copper had been shipped. However, in October the property reverted back to the Three R Syndicate due to a dispute over payments. Net smelter returns during this period of 15- to 27-cent copper were about $18 per ton.

The Harrison interests of Houston, Texas, acquired the property and constructed a 60-ton semiflotation mill. Through 1918, three shifts operated the mine, handling 700 tons of 3 to 5 percent copper ore daily.

In 1919, Magma Copper Co.—under the name of the Patagonia-Superior Co.—optioned the property, mapped it, and did some diamond drilling that located 10,000 tons of 2 to 3 percent copper ore.

The property was dropped by Magma in November 1920 and various leasees attempted to find ore. In 1937 the property was sold by the sheriff of Santa Cruz County to C. A. Pierce. Dwane Bird became his partner. Scavenger-type operations by a number of leasees continued up through 1956, interrupted in the early fifties by a mapping, sampling, and drilling program instituted by Consolidated Coppermines upon the suggestion of the Kennecott Copper Corp. The last known production consisted of 15, 55-ton carloads of 3.5 to 6 percent hand-sorted copper ore shipped to the El Paso refinery. At present the property is in the hands of the descendants of Pierce and Bird and is again under option.

The total production of the Three R mine is in the neighborhood of $2,500,000 worth of copper and $65,000 worth of silver. Most of the copper was obtained from 40,000 tons of 9 percent copper ore.

In 1927 a placer gold operation was instituted (15) in the gravels of Three R stream about 2.5 miles northwest of the Three R mine. The project was abandoned after a month.

Description of the Orebody

The Three R chalcocite orebody, which averaged 10 percent copper, is tabular in shape and is restricted to the immediate vicinity of a north-northwest fault zone. Smaller tabular masses are localized in other parallel faults within the same fracture zone. The trend of the orebodies is north-northwest and the dips are about 60° paralleling the fault structures. The main orebody pitches southerly (fig. 2). The width of the high-grade ore is restricted to about 20 feet on either side of the main fault where the rock is strongly sheeted sympathetically with the fault. Lower grade ore averaging 3 to 4 percent is found up to 100 feet out from the actual fracture. Assay maps reveal the grade of copper gradually decreases outward into the protore, which averages only a few hundredths of a percent copper. Open spaces in the main fractures are evident underground, and the open nature of these fractures provided the inlet for copper-rich meteoric solutions to go down the fault and precipitate upon the abundant pyrite disseminated throughout the mine area. The solutions were distributed laterally by the sympathetic sheeting parallel to the fault forming the orebodies. The fault zones underground reveal 4- to 6-inch tabular masses of honeycombed and botryoidal

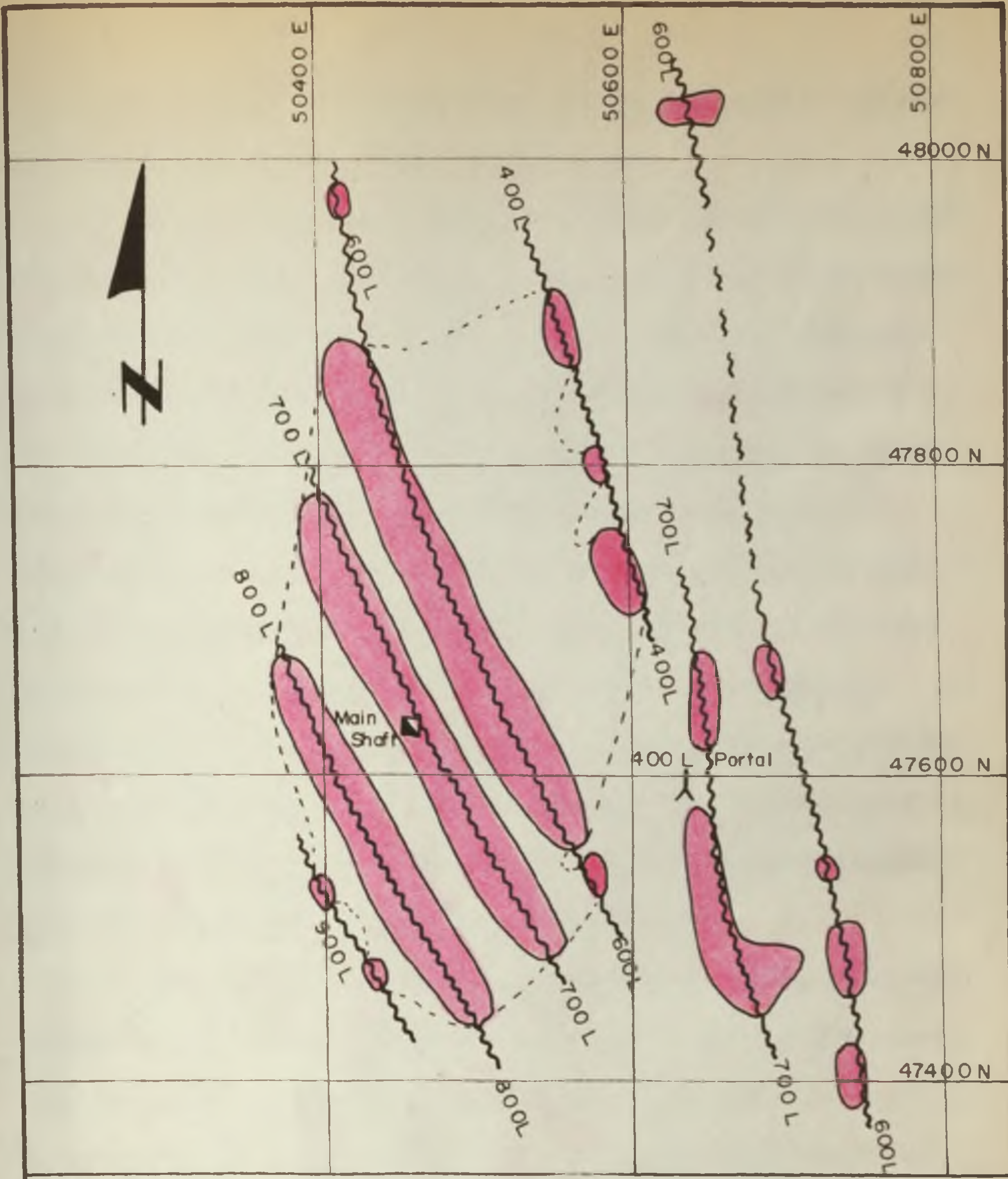


Fig. 2

GENERALIZED MAP SHOWING ZONES OF COPPER ASSAYING ABOVE 1.5 % IN THE THREE R MINE

FRACTURE ZONES ON DIFFERENT LEVELS SHOWN

Scale 1 in.= 100 ft.

P.A.H. 1963

iron oxide that was precipitated along the open fractures by the meteoric solutions as much as 250 feet below the surface.

There is a suggestion that fault irregularities control the grade of copper enrichment with the higher grade ore occurring on the steeper portions of the fault and lower grade mineralization on the flatter sections. Since the raises were inaccessible during this study, this control can only be inferred from the assay map. Along one of the raises from the 700- to the 600-foot level (718 to 625), the variation in inclination of the raise is considered to reflect dip irregularities of the main ore-bearing fault. The grade of ore ranges from 4 to 13 percent on the steeper portions and only 0 to 4 percent along the flat areas. This suggests that the action of the Three R normal fault intensified the brecciation and open spaces along the steeper portions of the fault while the flatter portions were sealed up by the recurrent movement making these flat areas impermeable to the meteoric waters.

This ore did not occur as one massive chalcocite lens but consisted of small masses and veinlets of chalcocite coating pyrite with the intervening areas consisting of bleached alunitized granite with pinpoints of chalcocite coating pyrite. The limits of ore have been tested and outlined by drifts and flat drill holes. The vertical range of the orebody is about 450 feet with the richest ores concentrated between the 470- and 700-foot levels. Assay maps reveal enrichment occurred in all levels of the mine, but the assays of the 900-foot level are above 1 percent copper over a very few feet (pl. IV), and a winze sunk to about the 940-foot level revealed only traces of copper similar in grade to the protore of the entire pyritized area. Schrader (13) reported 700 to 800 feet of vertical range to the ore, but he must have erred since there is only about 600 feet of vertical development in the entire mine, the deeper levels of which were completed after Schrader's visit.

The orebody came to within 40 feet of the surface where it graded into an ocherous hematite with abundant silica. The outcrops of the various fractures in the Three R fault zone are bold iron-stained silicified masses (pl. VI B) that appear dikelike varying in width from a few feet to 50 feet. The fault itself is filled with botryoidal and honey-combed cellular masses of reddish-brown iron oxides. The main mass of rich ore started about 200 feet below the surface. Close investigation on the surface reveals the rock in proximity to the fault is highly sheared and almost schistose parallel to the north-northwest faults. This zone is the only highly fractured and brecciated zone within the area mapped in this report. Shallow pits along the fractures reveal malachite locally, and very spotty chalcocite was noted in one pit.

Within the mine most of the chalcocite and all of the mined ore was limited to only two fractures, as shown in figure 2.

Diamond-Drilling Results

Two programs of exploratory diamond drilling (fig. 3) have

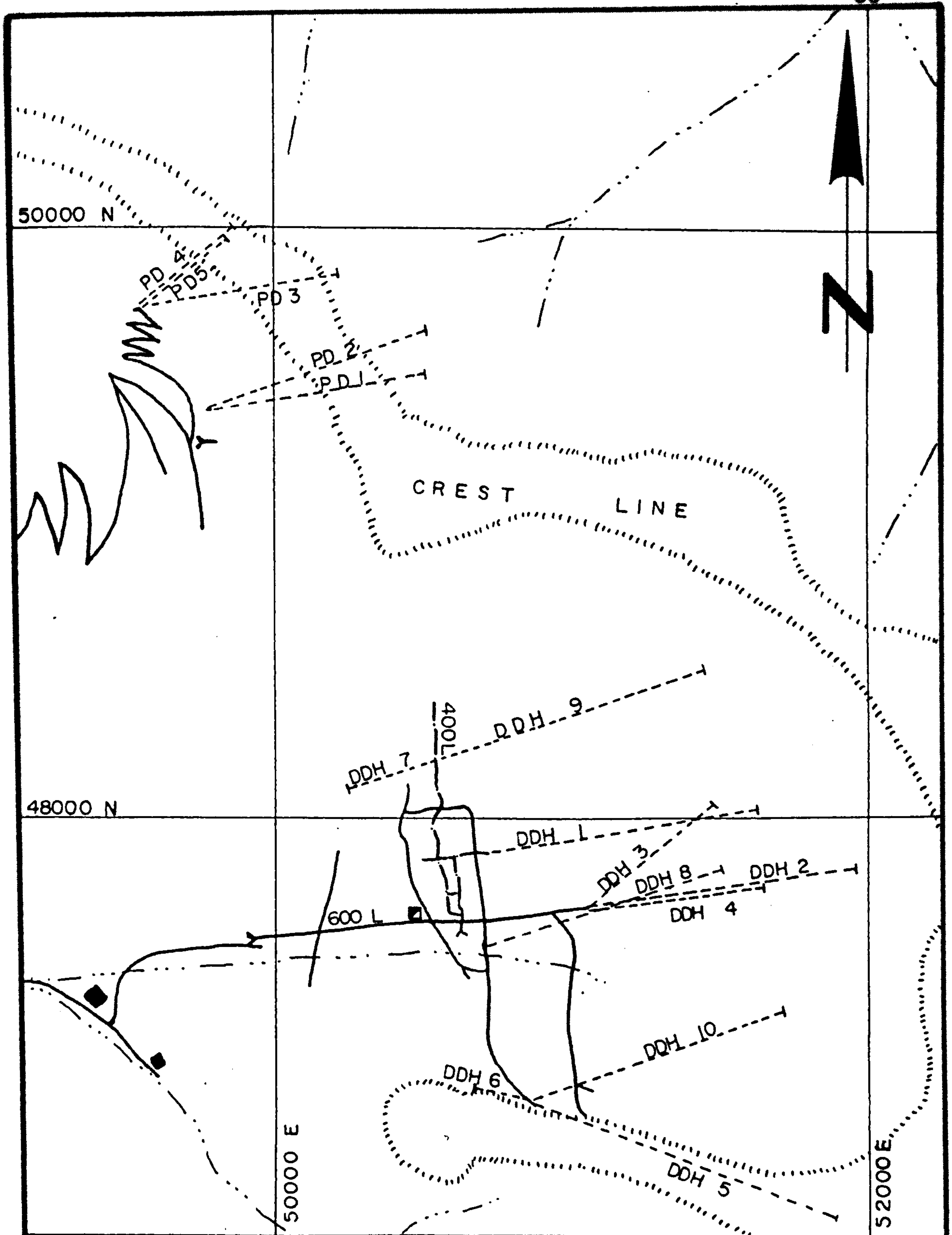


Fig. 3.

THREE R MINE AREA
SANTA CRUZ COUNTY, ARIZONA
MAP SHOWING DIAMOND DRILL HOLE LOCATIONS
ACCESSIBLE MINE WORKINGS AND GENERALIZED
TOPOGRAPHY

I inch = 500 feet

P.A.H. 1963

been conducted in the Three R mine area (see Appendix A). Ten holes were drilled by Magma Copper Co. shortly after World War I. Most of the holes were drilled eastward from stations set up on the 400- and 600-foot levels at flat or low angles. This direction was chosen to crosscut the Three R shear zone for possible orebodies in the parallel faults east of the main orebody. This zone is well fractured and consists mainly of altered pyritized granite. Small pockets of chalcocite were crosscut along shears, but nothing of significance was discovered. This program eliminated much of the favorable ground.

The second program of drilling was conducted in the early fifties by Consolidated Copper. Five low-angle holes were drilled to the north of the Three R mine crosscutting the main fault zone. Nothing significant was found. One of the holes was reported to have gone through the entire mountain, emphasizing the steep topography of the narrow ridge-line east of the fault zone and the lack of area within Three R Canyon for outlining a favorably large zone of low-grade copper mineralization.

Drilling has indicated rather conclusively that little chance of a recurrence of chalcocite orebodies can be found northward or eastward of the Three R mine.

Geochemical Test Results

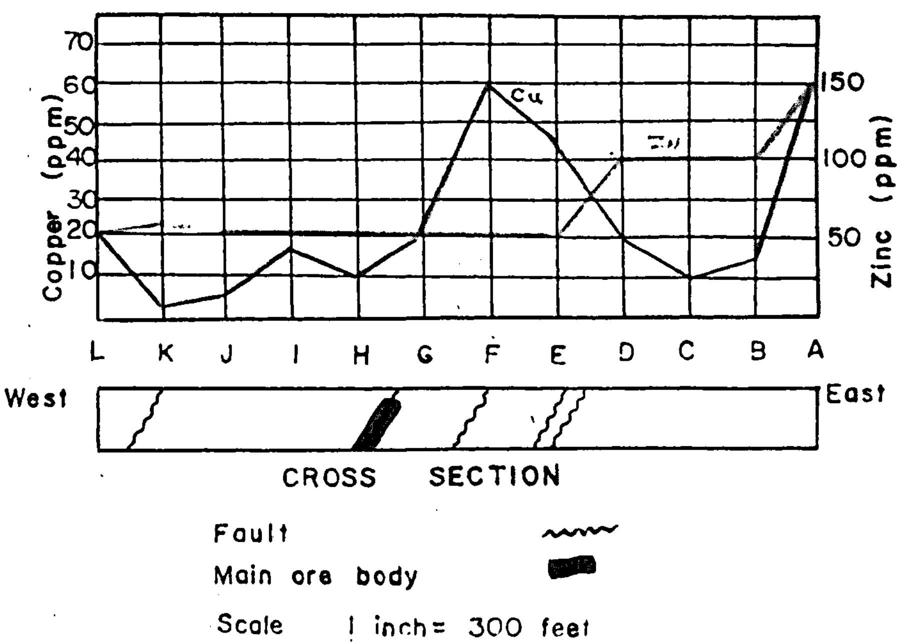
A limited geochemical sampling test was conducted in order to evaluate the possibility of discovering similar type orebodies using these techniques. A 1,100-foot east-west line was located about 200 feet north of the 400-foot level portal and 150 feet north of the main shaft (pl. I). Bedrock samples were collected every 100 feet. The main orebodies are located about half way from each end of the sampling line. This line crosscuts the Three R fault zone and the strike of the orebodies. Any contamination from waste material was avoided since the mine dumps are topographically below any portion of the sampled rocks.

The results are shown in table 1 and figure 4. No significant copper anomaly is apparent updip from the main ore body. Since the average acidic igneous rock carries 30 ppm copper and in this area the rock is impregnated with cupriferous pyrite, leaching of the surface rock has occurred and little trace of the copper-bearing meteoric solutions is evident in this limited test. A slight increase in ppm copper is noted above the main ore-bearing fault zone with a decrease below the fault zone itself. Higher zinc values are located at the topographically higher east end of the traverse associated with a higher copper reading. If this trend continues, it is probably a reflection of the erosion rate proceeding faster than the oxidation rate in the higher portions of Three R Canyon, and the primary sulfide minerals have not been completely leached near the surface. No zinc minerals are reported from the Three R area; however, there must be traces of the element in the pyrite along with the copper since 150 ppm zinc was found in sample A.

Table I. Geochemical Analyses By Fusion Method

SAMPLE	COPPER (ppm)	ZINC (ppm)
A	60	150
B	15	100
C	10	100
D	20	100
E	45	50
F	60	50
G	20	50
H	10	50
I	15	50
J	5	50
K	2.5	60
L	20	50

Fig. 4. Graph showing geochemical sample values in relation to the main ore body and faults.



Facilities

The mine consists of six levels of which two, the 400 and the 600, are accessible at present. The total development work along these levels amounts to more than 2 miles. There is one 2-compartment shaft more than 600 feet deep with additional raises and winzes connecting individual levels. The present water table is at the 600-foot level with the remaining four bottom levels completely flooded. Minimum slabbing and little caving has occurred in the present accessible workings, except in one drift of the 600-foot level where the andesite porphyry was intersected. All the loading chutes appear in satisfactory condition as are the raises and winzes in the accessible portion of the mine. Three small buildings on the property are useless due to neglect; one large building, the former power plant, which was built of galvanized iron on wooden beams, is rundown but probably could be satisfactorily repaired. This latter building is in the stream channel and would have to be protected from flooding. Most of the ore came from one large stope, which was mined by shrinkage-stope and open-stope methods.

Milling

The ore shipped from this mine has been direct-smelting grade. The high aluminum content has always been an economic handicap in these rich ores and prohibited the exploitation of the lower grade reserves. The fine nature of the chalcocite makes milling the remaining low-grade material economically unprofitable, since they must be ground to at least 30 percent below 300 mesh. This has discouraged modern lessors from removing the remaining known reserves.

Genesis and Classification of the Orebody

The rich chalcocite orebody occurs just below the completely leached zone of oxidation with the grade of copper decreasing with depth into the protore, which conclusively indicates that the Three R orebody was formed by secondary processes. The source of the original primary copper is attributed to the cupriferous pyrite and rare chalcopyrite found in the Three R Granite.

Meteoric solutions carried the copper to its present location. No steely chalcocite has been observed discounting the possibility of primary chalcocite mineralization. Sooty chalcocite ore is localized along open faults and shears within otherwise unsheared granite. Gross mineralogic zoning (<u>see</u> Mineralogy) as well as evidence of secondary replacement observed in the microscope confirm the supergene origin of this orebody.

The location of the ore is found at the intersection of the north-northwest Three R fault zone with an east-northeast shear zone. Strong hydrothermal alteration has been observed along the latter shear zone that goes westerly from the mine.

An intense silica and alunite alteration is centered in the mine area at this intersection, and thus it is postulated that more intensive primary sulfide mineralization may have occurred in this area, which is verified by megascopic examination. This may be a factor in the location of the richest ore at this structural intersection with little else of economic value found elsewhere along the Three R fault zone. This in no way detracts, however, from the secondary origin of the chalcocite, but only suggests more primary sulfide may have been deposited in this area compared to the remainder of the altered pyritized granite.

The thickness of overlying granite that has been eroded away is not considered greater than a few hundreds of feet since volcanics are found along the crestline southeast of the mapped area. Since the pyritic granite carries .01 to .05 percent copper and covers a large area, sufficient copper could have been leached from a few hundred feet of eroded rock, and if additional primary copper was deposited at the structural intersection described earlier, the area and thickness of leached and eroded material required for the development of the orebody are substantially reduced.

The development of high-grade chalcocite from such a low-grade protore was encouraged by the permeable fault zone and the abundant pyrite, which developed the necessary acids to put the copper into solution and transport it, as well as to cause precipitation of the copper-rich meteoric solutions at depth.

The lack of pervious granite over most of the mineralized zone as well as the rapid rate of erosion in Three R Canyon prohibited the development of an enriched chalcocite blanket and show how fortuitous it was that the permeable Three R fault zone was available to trap the copper-rich solution before it went into the valley. Small shears on the surface and other shears cut by diamond drilling revealed limited chalcocite enrichment wherever a permeable zone existed within Three R Canyon, but nothing of mining size.

The present-day water table is quite a bit lower than the main orebody. At present the mine is flooded up to the lower tunnel level, but this is not a reflection of the true water table. The bottom of the orebody is quite irregular and is not related to the topography or the water table, suggesting that the secondary enrichment processes occurred above the permanent water table, and thus enrichment took place in a zone of transient saturation. The depth to which surface water penetrated depended upon the permeability of the fault zone, and the only true saturation would occur during periods of heavy rainfall following the dry periods in this arid environment. Thus, most of the time the rock would be moist and not saturated. Most of the oxygen probably was supplied from air circulating through the rocks as a form of "earth breathing" as suggested by Lovering (2, p. 328).

Using Locke's nomenclature (2, p. 333), most of the iron oxide is transported with some contiguous limonite, both of which are yellow brown to brown. Very little indigenous limonite was observed in the Three R mine area. Some favorable copper boxworks with relief limonite were observed on the dump. Jarosite is extremely common.

In conclusion, the Three R orebody was formed by the processes of secondary enrichment that converted .01 to .05 percent cupriferous pyrite protore into mineable chalcocite ore, which ran up to 40 to 50 percent copper locally. The primary ore occurred sometime after the latite consolidated and may have been associated with it.

Fig. 5

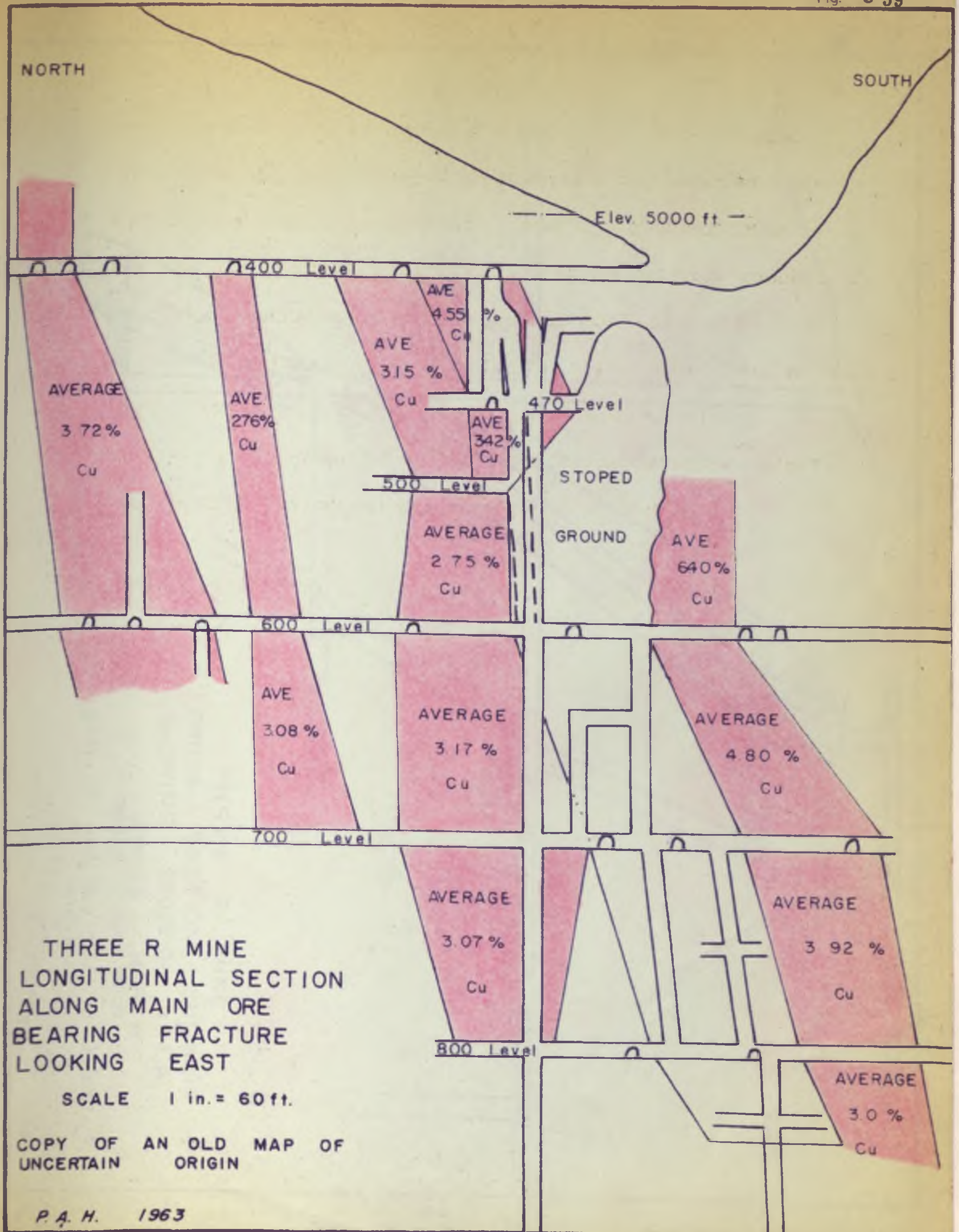
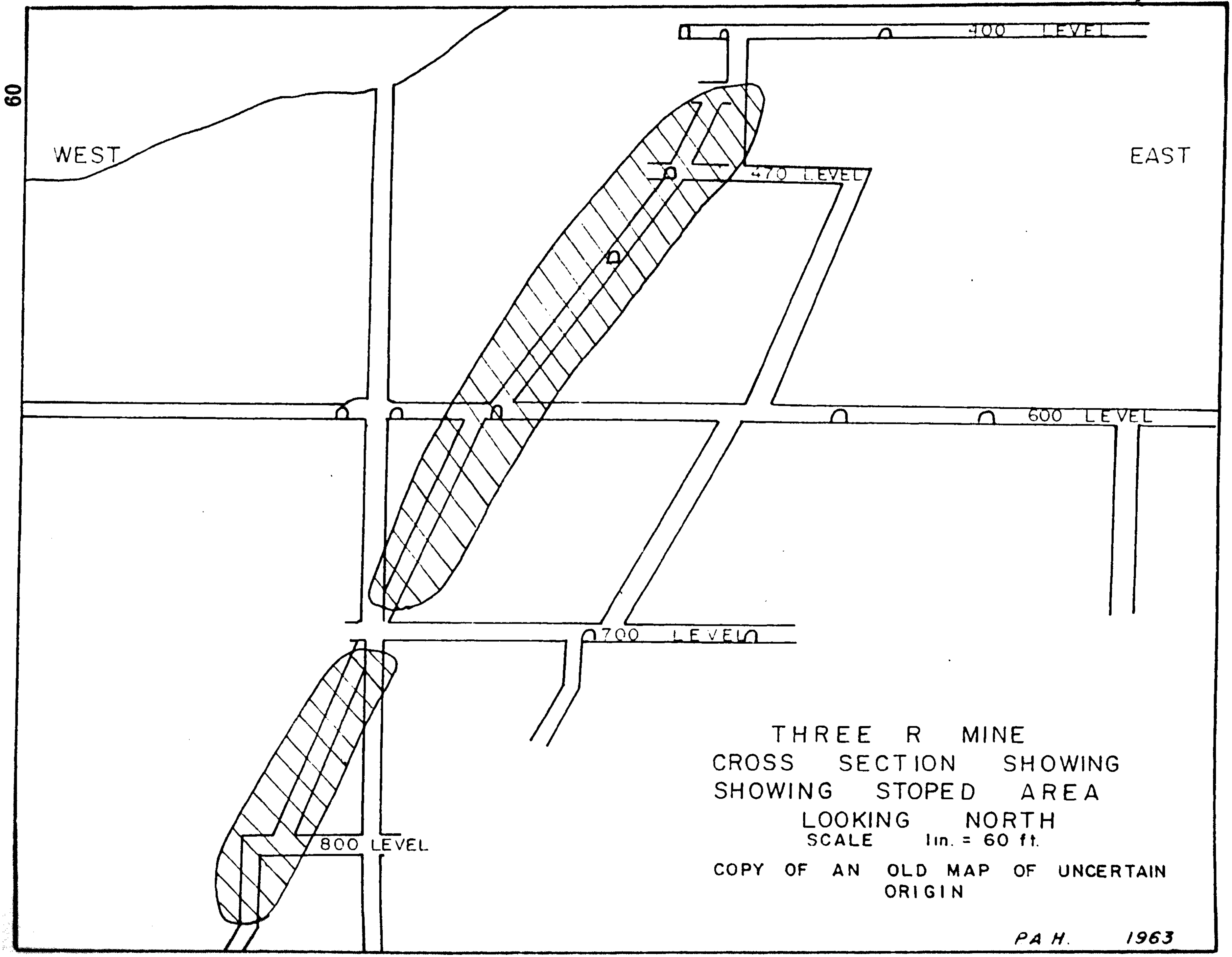

NORTH
SOUTH
Elev. 5000 ft.
400 Level
470 Level
500 Level
600 Level
700 Level
800 Level
AVERAGE
3.72%
Cu
AVE.
2.76%
Cu
AVE
3.15 %
Cu
AVE
4.55 %
Cu
AVE
3.42%
Cu
AVERAGE
2.75 %
Cu
STOPED
GROUND
AVE.
6.40%
Cu
AVE
3.08 %
Cu
AVERAGE
3.17 %
Cu
AVERAGE
4.80 %
Cu
AVERAGE
3.07 %
Cu
AVERAGE
3.92 %
Cu
AVERAGE
3.0 %
Cu
THREE R MINE
LONGITUDINAL SECTION
ALONG MAIN ORE
BEARING FRACTURE
LOOKING EAST
SCALE 1 in. = 60 ft.
COPY OF AN OLD MAP OF
UNCERTAIN ORIGIN
P. A. H. 1963

Fig. 6



THREE R MINE
CROSS SECTION SHOWING
SHOWING STOPED AREA
LOOKING NORTH
SCALE 1in. = 60 ft.

COPY OF AN OLD MAP OF UNCERTAIN
ORIGIN

PA H. 1963

GEOLOGIC HISTORY

The earliest geologic event in the Three R area is inferred to be the formation of a quartzite of unknown age. Only very small blocks are found within the mapped area, but large masses of fine-grained quartzite are located just to the south a few hundred yards. The Patagonia batholith in middle to late Tertiary time intruded the area, with its many granitic rock types reflecting a complex intrusive history. This was followed by the masses of latite that are found throughout the Three R area.

The east-northeast shearing and the north-northwest Three R faulting occurred next, probably as a result of stresses developed by the intrusion of the Patagonia batholith. Hydrothermal solutions deposited sulfides along these structures and are inferred to be the last phase of the magmatic history of the Patagonia batholith.

The final igneous activity in Three R Canyon was the intrusion of andesite dikes that are found in the mine area and other volcanic activity. Uplift, probably of the Basin and Range type, followed and erosion proceeded up to the present time. The formation of the secondary chalcocite orebodies occurred and the ferruginous conglomerate formed.

APPENDIX A

DIAMOND-DRILL DATA

Diamond-Drill Data from 10 Exploratory Holes Drilled About 1920. Location Shown on Figure 3 and Plates II and III.

Diamond-Drill Hole No. 1
0° to -10° Inclination

Copper (percent)	Footage From	Footage To
0.21	0	113
.35	113	186
.23	186	239
1.60	239	250
.15	250	279
.1-.2	279	910

Diamond-Drill Hole No. 2
0°-14° Inclination

Copper (percent)	Footage From	Footage To
?	0	101
1.10	101	107
.15	107	143
.41	143	179
.14	179	349
.23	349	406
.49	406	421
2.61	421	428
.35	428	462
.08	462	470

Copper (percent)	Footage From	Footage To
1.08	470	477
.09	477	492
.45	492	552
.18	552	664
.29	664	704
.46	704	733
.15	733	795
.28	795	814
.09	814	882
.87	882	893
.16	893	936

Diamond-Drill Hole No. 3
0° to -2° Inclination

.13	0	140
.33	140	181
.06	181	230
.25	230	271
.10	271	377
.35	377	422
.60	422	458
.06	458	497

Copper (percent)	Footage From	To
.39	497	507
.12	507	523
.58	523	528
.21	528	559

Diamond-Drill Hole No. 4
-23° to -33° Inclination

Copper (percent)	Footage From	To
.18	0	23
1.16	23	31
.18	31	79
.56	79	94
?	94	99
.21	99	157
.81	157	163
.18	163	174
.99	174	185
.20	185	231
.55	231	237
.20	237	272
.50	272	290
.11	290	315
.26	315	347

Copper (percent)	Footage From	Footage To
.15	347	396
.50	396	403
.15	403	435
.28	435	456
.19	456	488
.05	488	511
.33	511	523
.53	523	529
.30	529	556
.12	556	610

Diamond-Drill Hole No. 5
0^{o} to -20^{o} Inclination

.08	0	41
1.04	41	51
.27	51	70
.69	70	90
.25	90	174
.68	174	189
.29	189	198
1.08	198	205
.19	205	245

Copper (percent)	Footage From	Footage To
1.39	245	348
.13	348	811
.94	811	817
.21	817	832
1.21	832	838
.09	838	1,110

Diamond-Drill Hole No. 6
0° Inclination

Copper (percent)	Footage From	Footage To
.08	0	195

Diamond-Drill Hole No. 7
$+1\text{-}1/2^{\circ}$ to -2° Inclination

Copper (percent)	Footage From	Footage To
.10	0	16
.43	16	37
.15	37	359
.82	359	370
.09	370	638
.60	638	658
.05	658	940

Diamond-Drill Hole No. 8
? to -52° Inclination

Copper (percent)	Footage From	Footage To
.16	0	344

Copper (percent)	Footage From	To
.28	344	373
.14	373	456
.21	456	476
.93	476	481
.17	481	546
.37	546	551
.17	551	810

Diamond-Drill Hole No. 9
0° Inclination

Copper (percent)	Footage From	To
.13	0	310

Diamond-Drill Hole No. 10
$-31\text{-}1/2^{\circ}$? Inclination

Copper (percent)	Footage From	To
.11	0	55
.33	55	136
.65	136	216
.16	216	309
.28(?)	309	366
.11	366	808
.24	808	821
8.50	821	828
.08	828	928

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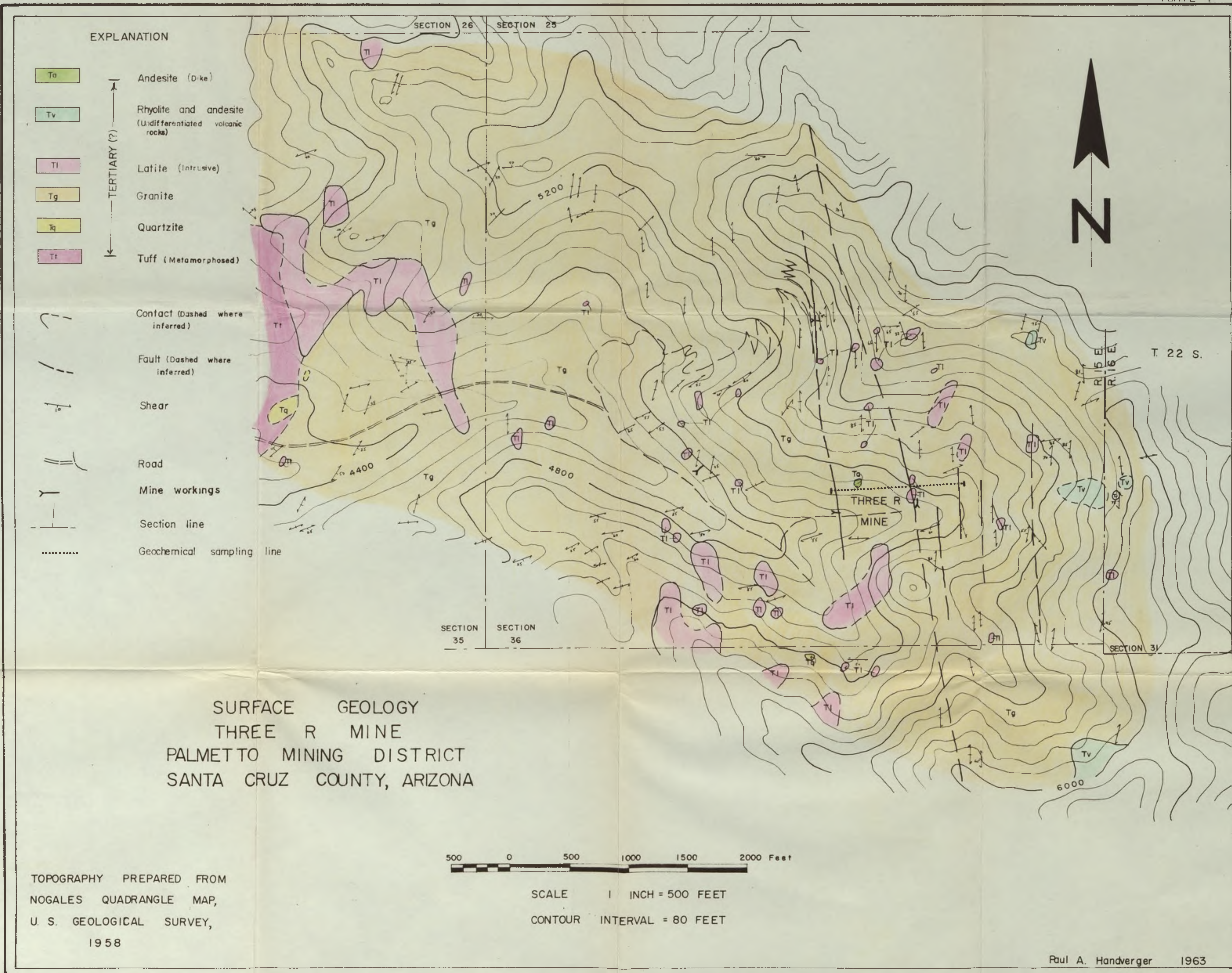
7 Plates

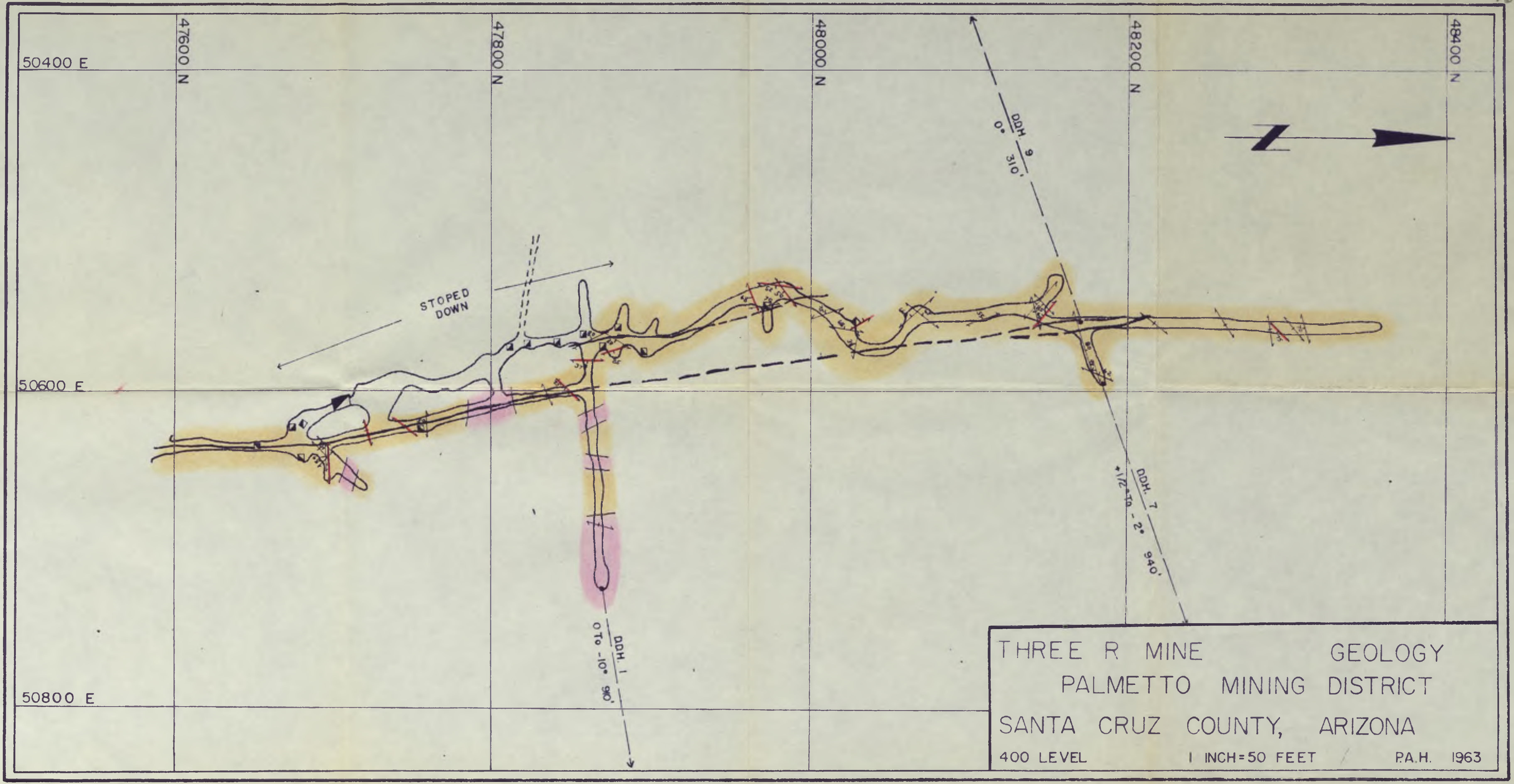
E9791
1963
163
PLATE 1




50000 E
50200 E
50400 E
50600 E
50800 E
51000 E
48000 N
47800 N
47600 N
47400 N
47200 N
47000 N
STOPED UP & DOWN
STOPED UP
CAVED
D.D.H. 3 0 To -2° 559'
D.D.H. 4 -23 To -33° 610'
D.D.H. 2 0 To -14° 936'
D.D.H. 8 -52°? 810'
D.D.H. 10 -31°? 928'
D.D.H. 6 0° 195'
D.D.H. 5 0 To -20° 1110'
EXPLANATION FOR PLATES II AND III
Quaternary alluvium
Tertiary (?) andesite
Tertiary (?) latite
Tertiary (?) granite
Contact
Dashed where inferred
Fault showing dip
Dashed where inferred
Shear
Shear mineralized with chalcocite
Raises and winzes
Diamond drill hole showing inclination and footage
THREE R MINE GEOLOGY
PALMETTO MINING DISTRICT
SANTA CRUZ COUNTY, ARIZONA
600 LEVEL
1 INCH = 50 FEET
P.A.H. 1963

E9791
1963
163

PLATE III



THREE R MINE GEOLOGY
PALMETTO MINING DISTRICT
SANTA CRUZ COUNTY, ARIZONA
400 LEVEL | 1 INCH=50 FEET | P.A.H. 1963

PLATE IV

ASSAY MAP
THREE R MINE
PALMETTO MINING DISTRICT
SANTA CRUZ COUNTY
ARIZONA
COPY OF AN OLD MAP OF UNCERTAIN ORIGIN
SCALE
20 0 20 40 60 80 100 Feet
P.A.H. 1963
CROSS SECTIONS
400 Level
600 Level
700 Level
800 Level
68 SAMPLES NO VALUES
NO VALUES 101 SAMPLES
575 feet
N

PLATE V


SURVEY Nº 3689
ARIZONA LAND DISTRICT
HARSHAW MINING DISTRICT
SANTA CRUZ COUNTY
ARIZONA
Scale: 1 Inch = 200 Feet · Surveyed July 15 - August 1, 1910
By FRANK ANDERSON
U.S. Mineral Surveyor
N
WHITE TAIL DEER 3689
THREE R. Nº4 3689
MAY FLOWER 3689
HATTIE R. Nº3 3689
3R. 3689
COLOSSUS 3689
THREE R Nº5 3689
SALT LAKE FRACTION 3689
BLUE ROCK Nº9 3689
EVENING STAR 3689
BLUE ROCK Nº6 3689
BLUE ROCK Nº7 3689
FRACTION 3689
BLUE ROCK Nº8 3689
THREE R Nº6 3689
THREE R Nº7 3689
BLUE ROCK
BLUE ROCK Nº5 3689
BLUE ROCK Nº4 3689
BLUE ROCK Nº3 3689
BLUE ROCK Nº2 3689
Unsurveyed Part of T.22S.R15E.G.&S.R.M.
Unsurveyed Part of T.23S.R15E.G.&S.R.M.
T.22S.R16E.G.&S.R.M.
T.23S.R16E.G.&S.R.M.
Sec.6 Unsurveyed
¼ Sec. Cor. 36 31
POWER LINE
COLOSSUS TUNNEL
Gulch

E9791
1969
163

PLATE VII.

DIAMOND DRILL HOLE PD-1

THREE R CLAIM
49,332.92 N
49,823.61 E
COLLAR ELEV. 5,376.5
BEARING N80°E
INCLINATION +25°

CORE % CU	SLUDGE % CU	DEPTH
002		1.9
005		3.5
021		6.9
005		10.6
003		13.7
007		17.1
004		20.4
0.11	013	22.5
007	009	27.4
003	006	32.5
004		34.7
004	004	37.7
008	008	40.0
006	008	45.9
006	009	60.6
006	006	68.7
0.11	007	79.7
006	005	89.8
004	006	99.6
004	019	109.6
005	005	119.8
003	003	129.8
005	006	140.0
005	005	150.0
006	017	157.4
005	0.11	160.0
004	007	170.0
006	007	180.4
023	021	190.4
4.38	3.02	200.5
0.10	033	210.5
006	0.12	213.5
004		220.5
003	005	231.2
0.23	036	236.2
008		241.2
0.14	0.11	246.1
008		251.1
009	018	251.9
0.81		259.1
004		261.4
005	009	266.1
007		271.6
003	015	276.6
002		281.6
001	006	286.6
003		292.0
004	007	297.1
004		302.2
004	005	307.2
004		312.7
002	004	317.7
002		322.8
004	005	327.9
003		333.0
004	007	342.0
002		343.0
002		343.4
Tr	002	348.0
Tr		353.0
Tr.	0.01	357.0
Tr		362.3
Tr.	007	368.3
006		372.3
003		374.5
003	003	378.3
002		381.9
008		382.5
002	004	387.9
001	005	390.5
001	003	394.7
002		399.0
001		400.5
006	006	405.5
		408.0
008		409.0
006		415.1
001	004	418.1
003		419.1
017		421.1
003	008	425.1
004		429.3
002	003	434.2
003		439.5
002	004	444.5
002		450.0
003	008	455.0
004		460.0
001	002	465.7
008		470.0
003		472.5
009	002	475.0
005		477.0
003		480.5
001	004	486.5

GEOLOGY:
Mod Silic · Heav Silic · Mod Lim · Sp. Limonite
Sparse Silic · Sparse Limonite
Sp. Silic · V.Sp. Limonite
Moderate Silicification · Sp. Lim · Very Sparse Limonite
Heav Silic · Sp. Lim
M. Silic · V.Sp. Lim.
Sp. Silic · Mod Lim.
Strong Silic · V.Sp. Limonite
Granite
Sparse Silicification · Sp. Lim
Mod.-Strong Silic · Mod. Sp. Lim.
Mod Silic · V.Sp. Lim
St.-Mod Silic · Sp. Lim
Mod Lim
Moderate Silicification · Sparse - Very Sparse Limonite
Mod Lim

CORE % CU	SLUDGE % CU	DEPTH
002	006	493.3
006	009	498.4
038		503.4
003	004	508.4
003		513.9
005	003	517.0
0.01		524.0
0.01		526.4
005	0.10	530.7
013		534.7
0.10	007	540.0
006		545.6
003	002	550.0
001		554.0
0.01	001	558.3
0.01	002	563.6
0.01		569.0
002		571.0
008	004	576.0
001		580.0
001	001	585.0
0.01		590.0
002	002	599.0
002		599.5
078	003	601.5
0.01		609.1
009	008	615.1
001		619.6
002	001	624.0
001	002	629.4
0.01		634.8
020	001	639.9
002		645.0
001	0.01	650.1
001		655.2
001	002	659.6
001		664.0
001	0.01	669.0
0.01		674.0
001	002	683.0
0.01	003	684.6
001	003	690.2
001		695.7
Tr.	002	700.8
001		706.0
Tr.	0.01	711.0
001		716.0
001	0.01	720.0
Tr.		724.0
001	0.01	728.0
0.01	0.01	733.0
0.01		736.6
001	0.01	743.8
0.01		749.0
001	001	754.1
0.01		759.3
001	Tr	764.1
001		769.0

GEOLOGY:
Mod.-St. Silic. · Sp. Silic · Mod Lim
Moderate - Strong Silicification · V.Sp. Lim · Mod. Lim · Mod. Lim
Granite
St. Silicification · Strong Limonite
Mod Sil. · St. Silic
Moderate Silicification · Moderate Limonite

DIAMOND DRILL HOLE PD-2

THREE R CLAIM
49,333.88 N
49,823.33 E
COLLAR ELEV. 5373.72
BEARING N70°E
INCLINATION -5°

CORE % CU	SLUDGE % CU	DEPTH
004		10.0
005	005	15.0
009	009	17.4
005	002	22.0
003	002	27.0
007	004	29.6
002	004	34.0
007	005	39.0
003	003	44.0
004	005	49.0
0.02		54.3
009	006	59.7
031		63.0
002		65.0
006	004	70.0
008	008	75.0
0.12	006	80.0
003	009	85.3
003	005	91.0
004	005	97.0
005	005	102.6
007	005	107.9
003	004	113.0
	006	123.0
	001	133.8
	003	143.0
	003	153.0
	004	163.6
065	064	174.0
	016	184.0
	006	194.0
	004	204.0
	002	211.0
	003	214.0
	004	221.0
	007	231.0
	003	241.0
	007	252.0
	002	262.0
	006	272.0
	006	282.5
	005	292.5
	003	303.0
	002	313.0
	002	324.0
	003	334.0
	002	344.0
	002	354.0
	001	364.3
	003	374.0
	003	383.0
	003	393.0
	005	404.0
	006	414.0
	006	424.0
	009	433.0
	005	443.0
	006	452.0
		455.0
	004	465.0
	007	475.0
	003	486.0
	0.19	496.0
	005	506.0
	0.12	518.0
	022	529.0
	006	539.0
	004	550.0
	004	560.0
	005	570.0
	005	581.0
	005	591.0
	009	602.0
	007	615.0
	004	625.0
	005	635.0
	003	640.0
	008	650.0
	005	656.0
	013	665.0
	008	673.0
	004	683.0
	003	694.0
001		706.0
001		717.0
001		726.0
001		732.0
004		742.0
001		752.0
001		762.0
001		773.0
002		782.0
004		792.0
004		801.0
003		810.0

GEOLOGY:
Heav.-Mod Silic. · Sp. Mod Limonite
H. Silic. · Sp. Lim
Granite
Strong to Moderate Silicification · Mod Limon · Sp-V.Sp. Limon
Tr. Por. · H. Silic · Sp. Lim.
H. Silic · Mod. Silic · Sp-V.Sp. Lim
Mod Silic · Mod Lim
Granite
Heav. Silic · V.Sp. Lim. · Mod Lim
V. Sp. Limonite
Moderate Silicification
St. to Heav. Silic. · Sp. - V.Sp. Limonite · Tr. Lim.

DIAMOND DRILL HOLE PD-3

THREE R CLAIM
49,769.61 N
49,662.22 E
COLLAR ELEV. 5,506.96
BEARING N80°E
INCLINATION -10°

CORE % CU	SLUDGE % CU	DEPTH
001		6.6
001		10.5
001		16.5
001		18.5
001		22.0
	0.01	24.5
	0.02	29.6
	0.05	34.8
0.02		43.0
0.01		48.6
002		53.6
002		59.0
0.02		64.0
0.02		69.7
	0.02	74.8
	0.02	84.9
0.03		95.1
0.02		104.1
0.04		114.3
004		124.3
0.08		134.1
	0.10	144.1
	0.03	150.2
0.04	0.03	154.5
	0.03	165.0
	0.05	175.2
	0.33	181.5
0.43	0.33	185.5
	0.10	196.0
	0.06	206.3
	0.08	216.8
	0.07	226.6
	0.04	236.7
	0.08	246.8
	0.10	257.0
	0.05	267.2
0.15		270.6
0.85		273.7
9.66	1.71	277.2
3.51		279.1
0.03	1.01	286.5
	0.05	296.9
	0.03	307.6
	0.05	318.1
0.05		328.3
0.01		337.0
0.01		347.4
0.02		357.7
0.03	0.03	367.8
		381.0
0.03	0.05	391.1
0.03	0.03	401.2
0.04	0.10	411.3
0.05		421.3
0.07		421.8
0.10	0.04	431.8
0.21		441.8
0.21		446.4
0.17		454.7
0.02		465.2
0.02		475.2
0.01		485.5
0.14		494.0
0.10		499.0
0.01		511.0
0.01		521.1
Tr		531.2
0.01		541.5
0.01		552.3
0.01		562.3
0.01		572.1
Tr.		582.3
Tr.		592.2
0.01		602.3
0.01		612.3
Tr		622.4
Tr.		627.5
0.01		637.2
0.01		647.3
0.02		657.9
0.01		669.2
0.01		679.8

GEOLOGY:
Gr. · Tr. Por · Gr. · St. Silic · V.Sp.-Mod Lim
St. Silic · V.Sp.-Mod Limonite
Heavy-Strong Silicification · Tr. Lim
Granite · Mod Silic · Tr. Lim.
H. Silic · V.H. · St. Silic · V.Sp.-Mod Limon
H. Silic · H. Limon
No Samples
St.-H Silic · V.Sp.-St. Limon
Tr. Porph. · Gr. · Tr. Por.
Granite · Moderate Silicification · Moderate-Sparse Limonite

W.A. Handwerger

E9791
1963
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PLATE VIII

DIAMOND DRILL HOLE PD-4

THREE R CLAIM
49770.61 N.
49665.22 E.

COLLAR ELEV: 5,506.96
BEARING N50°E
INCLINATION -10°

ASSAYS

CORE % CU.	SLUDGE % CU.	DEPTH
.011		2.0
.010		7.2
.011		11.4
.010		16.4
.015		19.1
.011		20.1
.065		25.4
.021		30.8
		35.5
	.018	40.9
		45.5
	.028	50.7
		55.5
	.028	61.2
		66.2
	.028	71.0
		75.8
	.026	81.1
		86.4
	.039	91.1
		96.0
	.121	101.0
		106.0
	.049	111.0
		116.3
	.034	121.3
		126.3
	.028	131.3
		136.3
	.034	141.3
		146.5
	.052	151.5
		156.5
		161.2
	.078	166.2
		170.3
		175.4
	.062	178.4
		183.8
	.124	189.0
		194.0
	.099	199.2
		204.4
	.194	209.5
		214.5
	.111	215.3
		219.2
	.299	229.2
	.216	239.2
	.141	249.4
	.120	259.4
	.171	269.4
	.139	279.5
	.139	288.9
.020		291.4
	.088	301.3
.012		311.3
	.022	320.4
.010		331.5
	.024	341.2
	.030	351.1
	.032	361.2
	.089	371.2
	.031	381.3
	.024	391.6
	.016	401.3
	.031	411.5

GEOLOGY

Granite; Tr. Pr.; Granite; Tr. Pr.; Granite; Tr. Pr.; Granite

Str. Silic.; Hea Si.; Moderate Silic.; Str. Sil.; Hea Silic.; V. Hea; Str. — Mod Silicification; Hea Mod Sil.; V.H. Sil.; Str. Sil.; Mod St. Sil.

Sp. Lim.; Tr. Lim.; V. Sp. Lim.; tr. Limonite; Sp. Limonite; V. Sp.; Tr. Lim.; V. Sp. Lim.; Sp.-V.Sp. Lim.; M.H. Lim.; Sp.-V.Sp. Lim.

DIAMOND DRILL HOLE PD-5

THREE R CLAIM
49767.98 N.
49664.26 E.

COLLAR ELEV: 5,505.66
BEARING N50°E
INCLINATION -31°

ASSAYS

CORE % CU.	SLUDGE % CU.	DEPTH
.036		2.0
.007		10.0
.010		15.3
.017		20.3
.020		25.3
.063		30.3
.055		35.3
	.024	39.8
	.063	44.8
	.045	49.9
	.045	54.3
	.037	59.3
	.063	64.5
	.030	69.7
	.034	74.7
	.035	79.7
	.052	84.8
	.025	89.5
	.025	94.4
	.025	99.3
	.027	104.4
	[illegible]	109.4
	.052	114.5
	.048	119.3
	.073	124.7
	.222	129.6
	.290	133.8
	.121	138.8
.250		141.5
	.060	146.8
	.081	151.9
	.051	157.0
	.065	162.4
	.057	167.7
	.052	172.7
	.068	178.1
	.050	183.5
	.044	188.4
	.065	194.2
	.066	200.2
	.079	205.1
	.099	215.8
	.066	222.9
	.068	232.0
.059	.050	242.9
.065		251.3
.940	.740	261.4
.209	.430	271.5
.460	.460	277.9
.211	.390	298.2
.136	.270	298.4
	.076	309.0
	.118	319.3
	.078	330.7
	.060	340.9
	.216	351.3
.067		353.5
.057		364.0
.049		374.3

GEOLOGY

Granite; Tr. Por.; Granite

St. Mod. Sil.; Strong Silicification; Heavy; Sp. Si.; Heavy Silic.; Heavy Silic.; Str. - Hea Silic.; Hea Si.; V Hea Sil.; V.H.Sil.; H.; Str.-Hea Silic.

Sp. Lim.; V. Sp. Lim.; Sp. Lim.; H-V.Sp. L.; V. Sp. Limonite; V. Sp. Lim.; V.Sp. Lim.; Sp.-V.Sp. Lim.; Sp. Lim.; Sp. Lim.; Mod.-V.Sp. Lim.