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Quartzite with the basal Barnes Conglomerate, Mescal Limestone and Troy Quartzite. The thin basaltic layer on top of Mescal Limestone recognized in the Superior area is not exposed in this region. Generally, the Apache Group dips steeply to the east under Tertiary volcanic cover and its exposure is confined to a narrow north-south trending belt in Telegraph Canyon in the northeastern portion of the quadrangle.

The entire younger Precambrian sedimentary sequence and to some extent the Pinal Schist have been intruded extensively by diabase sills. These sills forced their way up along bedding surfaces, fault planes, and other zones of weakness especially in the Pioneer Shale, the upper portions of the Dripping Spring Quartzite and the Mescal Limestone. As a result the entire sedimentary sequence became dilated. The absolute age of the diabase intrusion is not known in this particular area; however, from the stratigraphic relationship it is evident, that the diabase must be post-Apache but probably pre-Devonian in age, as is indicated in the Magma mine at Superior (H. J. Steele, 1952). In the Sierra Ancha mountains the diabase is 1200 million years old (Damon, Livingston, and Erickson, 1962).

No Paleozoic and Mesozoic rocks are exposed in the Mineral Mountain quadrangle, but indirect field evidence indicates that they probably exist beneath the rhyolite-dacite flows to the east and southeast of the area. A number of Tertiary aplite, diorite porphyry and andesite porphyry dikes, and irregular masses of rhyolite are found intruding the Pinal Schist as well as a quartz monzonite stock of uncertain age in the western and southwestern portion of the area.

The latest volcanic event is manifested in the extrusion of felsic lava flows and tuffs which attain a thickness of about 800 feet. In the Superior area the dacite is up to 1200 feet thick. However, it remains to be determined whether the dacite near Superior and the rhyolite flows in the Mineral Mountain area are actually equivalent in age. Mrs. Nelson (oral communication) has good evidence that the rhyolite flows and tuffs in the Picketpost Mountain area are younger than the dacite.

A characteristic feature of the investigated area is a north-northwest trending epithermal vein system that occupies earlier-developed tension cracks and fault zones within the Pinal Schist. The gangue consists of quartz, calcite, barite, chalcedony, and altered schist fragments. Ore minerals include galena, manganese oxide, hematite, copper carbonates, and copper silicates, Locally, some fluorite is present. The veins have been mined in the past especially for their silver content. Limited mining operations are carried out at the present time in Martinez Canyon and at the Talley mine in Telegraph Canyon as a direct result of the favorable silver price situation.

The extensive vein system may have originated from a north-northwest or south-southeast stress direction which caused the development of a tensional force normal to this stress direction. The resulting tension gashes may then have served as channelways for the ascending mineralizing solutions.

OLDER PRECAMBRIAN PERIOD

Pinal Schist

In the investigated area the Pinal Schist is the most widely exposed unit. It is found especially in the western and central portion of the Mineral Mountain quadrangle and comprises about 60 per cent of the mapped area. To the south the schist is bounded by Precambrian intrusive and Tertiary extrusive rocks, to the east by younger Precambrian sedimentary rocks, but to the north and west the schist extends beyond the limits of the quadrangle and continues into the Iron Mountain area and dips under recent gravel cover.

The type locality for the Pinal Schist is in the Pinal Mountains south of Globe, Gila County, Arizona, where it was first described by Ransome in 1903. There the schist is fine grained, strongly foliated and consists mainly of muscovite and quartz. The foliation trends predominantly northeast and probably represents bedding of the older Precambrian sediments.

The Pinal Schist in southeastern Arizona is considered to be of older Precambrian age because of the presence of granitic intrusions that yielded an older Precambrian age through various radioactive dating methods.

The schist exposed in the Mineral Mountain quadrangle indicates the same characteristics that are present at the type locality, hence, it is also considered to be of older Precambrian age.

The schist is the only true metamorphic rock unit found in this area and reflects regional dynamometamorphic conditions during older Precambrian time. The rock varies in composition from a muscovite-albite-quartz schist, a cordierite?-muscovite-quartz schist, to an almost pure quartzose schist. Locally, bands of amphibolite are present within the schist that parallel the foliation.

In the northern and central portion of the mapped area the schist foliation has a definite northwest direction which changes into a more easterly trend as Telegraph Canyon is approached. In the southern portion of the map a north-easterly trend predominates. The schist has been intruded by many irregular masses of diabase and rhyolite along northwest trending fracture zones. Several quartz pegmatite veins are exposed south of Cottonwood Canyon, and a single massive quartz plug is present in the northwestern corner of the map. These quartz concentrations may represent remobilized silica at depth as a result of metamorphism and subsequent intrusion along fracture zones. On the other hand, they may be related to the later rhyolite intrusions comprising a silica rich phase. In any event, the quartz accumulations certainly do not represent original sedimentary features.

Small intrusive bodies of older Precambrian Madera Diorite are found in the northeast part of the mapped area where they are locally overlain by the younger Precambrian Apache Group. To the southwest a more massive quartz monzonite body of uncertain age intrudes the Pinal with a very irregular, discordant contact.

An extensive epithermal vein system dissects the Pinal Schist in a predominantly northwesterly direction regardless of the pre-established schistosity trend.

During the field investigation it became evident that varieties of schist types are present in this area which differ in composition, physical appearance and degree of foliation. With the exception of the amphibolite bands, which were mapped as individual units, it is beyond the scope of this investigation to delineate the different zones of the Pinal in detail. However, a general petrographic description of each zone will follow with a note on the general geographic extent.

The mineral assemblage assigns the zones to the quartz-albite-epidote-biotite subfacies of the greenschist facies which is characteristic of regional metamorphism. Four different types could be recognized:

1. a fine to medium grained quartz-muscovite schist with a sandy texture.
2. a very fine grained, extensively foliated spotted phyllite.

3. a quartzose schist with very little foliation.
4. the greenish black amphibolite bands.

Sandy Schist

The most common variety is a fine grained, friable, greenish gray to beige colored muscovite-quartz schist, displaying a somewhat sandy texture and an ill-defined foliation pattern. It is exposed mainly around Mineral Mountain proper and extends in a broad easterly trending belt across the area. The rock weathers readily on the outcrop and locally forms abundant iron and manganese oxide staining along fractures. At one place very fine quartz segregation bands are present that cut the general muscovite foliation with a 45^{o} angle, and may actually represent original bedding.

Under the microscope the rock has a holocrystalline, hypidiomorphic granoblastic, fine grained texture with an average grain size of 0.2 mm. An ill-defined foliation is apparent that results from the preferred orientation of muscovite and biotite. The average composition of the sandy variety as estimated from several thin sections is tabulated below:

quartz	70	75	60
muscovite	20	17	10
oligoclase	5	5	30
biotite	2	2	tr
chlorite	2	tr	tr
apatite	1	tr	tr
magnetite	tr	1	tr
epidote	--	--	tr
sericite	tr	tr	tr

In all these specimens quartz is the most abundant constituent. It occurs in small, anhedral grains and commonly is concentrated in segregation bands. Muscovite is always aligned to some extent in a subparallel manner. The individual mica flakes usually bend around larger quartz and magnetite grains indicating a yielding to the prevailing stress. With one exception, plagioclase is not very abundant. Locally, some poikilitic plagioclase porphyroblasts show a considerable amount of apatite inclusions. Plagioclase invariably indicates incipient sericite alteration. The latter usually prefers the crystallographic directions within the porphyroblast. Biotite is usually somewhat altered to chlorite along the edges. Small biotite aggregates commonly contain magnetite grains. In general, the magnetite occurs finely disseminated in small amounts throughout the rock. Judging from the mineral composition and the texture the sandy variety of the schist probably derived from a silty sandstone.

Spotted Phyllite

This variety is easily recognizable in the field by its strongly developed muscovite foliation, its fine grained texture, and bluish gray color. It is exposed primarily in the Cottonwood Canyon area where it trends in a narrow belt from northwest to southeast. Abundant greenish chloritized biotite porphyroblasts can be recognized in the hand specimen giving the rock a spotted texture. These porphyroblasts are always oriented obliquely to the main direction of muscovite foliation. Ptygmatic folding that even involves small quartz lenses is characteristic of this variety. Superimposed upon this folding is a secondary, much finer crenulation which measures only a few mm from crest to crest. Iron and manganese oxide occur frequently on weathered surfaces and along fractures.

Under the microscope the rock has a holocrystalline, but very fine grained texture and consists mainly of quartz, muscovite, magnetite and little feldspar. The well developed foliation is a result of the preferred orientation of muscovite. Locally, a fine train of magnetite grains developed parallel to the foliation pattern. The greenish porphyroblasts appear to be chloritized biotite crystals containing abundant magnetite inclusions. The flakes are subhedral and commonly measure 6 mm in diameter. Their orientation is almost at right angle to the foliation trend. A secondary strain-slip cleavage developed across the porphyroblast crystal and is also somewhat inclined to the main foliation trend. It probably represents additional deformation in the rock subsequent to the main metamorphic phase. Strain-slip cleavage or flexure folding was also observed elsewhere in the schist involving the entire rock rather than an individual crystal. Thus, the area has been subjected to at least two cycles of deformation.

The growth of the biotite porphyroblast across the general grain of the rock must have been aided by a stress direction that was superimposed upon the older foliation pattern. Also, the muscovite adjacent to the biotite porphyroblast begins to turn into the direction of least pressure together with a string of magnetite grains.

Throughout the rock, quartz occurs as fine, 0.2 mm wide segregation bands and very rarely as individual grains. Feldspar always indicates incipient sericite alteration. Locally, some small garnet blebs were observed that were always associated with magnetite clusters and some chlorite.

In one specimen cordierite was identified. The presence of cordierite is somewhat anomalous in this mineral assemblage, because it is considered to represent a higher grade of metamorphism than is indicated by the remaining minerals. It may reflect an abundance of MgO. According to Turner and Verhoogen (1960) abundant cordierite is commonly found in muscovite rich rocks.

In several different thin sections quartz comprises 20 to 65 per cent of the rock, muscovite ranges from 15 to 55 per cent, biotite from 2 to 5 per cent, and traces of chlorite, apatite, garnet, magnetite and sericite are always present. Locally, some K-feldspar was noted, but very little albite, if any, was recognized.

Quartzose Variety

This type is recognized in the field by its very fine grained quartz-rich texture. Fine alternating bands of pink feldspar and clear quartz can be recognized in the hand specimen. Very-fine-grained layers of biotite and magnetite follow the general foliation pattern. Along foliation planes silver gray muscovite can readily be observed. Minute specks of limonite are abundant on weathered surfaces.

Outcrops of this type are not widely distributed, but are restricted to narrow zones at certain localities. The field occurrence indicates that these quartzose bands represent an original higher concentration of siliceous material within the silty sediments rather than a secondary introduction of silica or even a different grade of metamorphism.

In thin sections the rock is holocrystalline, hypidioblastic granular, very fine grained and somewhat foliated on account of grain size segregations and limited preferred orientation of muscovite. A secondary strain slip cleavage developed obliquely to the main foliation trend which is especially emphasized by the folding of the muscovite foliation.

The mineral percentages within the quartzose rock vary from locality to locality. Quartz ranges from 65 to

95 per cent, muscovite from 4 to 6 per cent, albite from 20 to 40 per cent, and trace amounts of biotite, chlorite, sericite, apatite and magnetite are always present. Quartz and feldspar form an anhedral, inequigranular interlocking matrix with an average grain size of 0.2 mm. Locally, in coarser quartz segregations the grains may reach 0.6 mm in diameter. Apatite and muscovite commonly form inclusions in larger feldspar grains. Feldspar also frequently shows incipient sericite alteration.

Amphibolite

The amphibolite is a very distinct mappable unit within the Pinal Schist and occurs in relatively narrow discontinuous bands and lenses that follow the general trend of the schist foliation. In places the amphibolite may attain a thickness of up to 200 feet and a strike length of over one mile. As indicated on plate 1 the amphibolite bands crop out primarily in the northwestern portion of the quadrangle from where they swing eastward across the area toward Telegraph Canyon. Several isolated exposures occur also in the central portion of the quadrangle.

In the outcrop the amphibolite is dark greenish gray to black, fine grained and somewhat foliated as the result of a preferred orientation of hornblende needles. Iron oxide and epidote occur very commonly along fractures.

Under the microscope the rock appears holocrystalline, hypidioblastic granular and very fine grained with hornblende needles attaining a length of 0.5 mm. The latter show a fibrous development. A definite foliation pattern is indicated by the parallel alignment of hornblende and the elongation of epidote aggregates. Very seldom does the epidote occur as individual grains. In places, a closely packed cluster of epidote surrounds irregular blebs of pyrite and may replace the hornblende present. Elsewhere, small veinlets of calcite and epidote cut across the fabric of the rock and cause a calcite enrichment in the adjacent portions of the veinlet. Locally, plagioclase is extensively altered to sericite. Quartz forms a high percentage of the rock.

The effects of flexure folding are also evident in the amphibolite through the development of minute crenulations in the plagioclase segregation bands. Hornblende needles commonly grow into the folds of the plagioclase layers by taking advantage of the areas of least pressure.

The average composition of the amphibolite as estimated from thin sections is tabulated below (in per cent):

hornblende	45	50	50	45
plagioclase	20	35	30	35
epidote	20	2	6	5
quartz	14	10	10	12
apatite	1	1	1	1
sericite	tr	tr	tr	2
calcite	tr	1	1	tr
pyrite	tr	tr	tr	tr
biotite	--	--	2	--

This mineral assemblage seems to be diagnostic of the quartz-albite-epidote-almandine subfacies of the regional metamorphic greenschist facies and appears to be transitional between the latter and the true amphibolite facies. It is reasonable to assume, that the amphibolite bands are the result of the same grade of metamorphism which developed the surrounding pelitic schist. The alternative interpretation, that the amphibolite is the result of high grade metamorphism (almandine-amphibolite facies), is discarded here at least for the time being until more detailed petrographic work becomes available in this area. According to Turner and Verhoogen (1960), the mineral assemblage of the amphibolite and the greenschist subfacies mentioned above can be identical, namely hornblende, plagioclase and epidote, but the critical aspect is the composition of the plagioclase. Albite would indicate a lower grade of metamorphism, whereas the presence of oligoclase and andesine would reflect a high grade metamorphic condition. Unfortunately, the plagioclase in the amphibolite is usually strongly altered and very fine grained, making a definite identification very difficult. Twinning, where present, is always strained and distorted, and causes a wavy extinction.

The absence of diopside and almandine garnet, and the presence of relatively abundant granular quartz suggests, that the amphibolite represents an interbedded basic volcanic tuff layer rather than a calcareous sediment.

Madera Diorite

Several isolated exposures of an intermediate igneous intrusive rock that are found in the Pinal Schist in the northern portion of the investigated area are so similar in composition, texture and occurrence to the Precambrian Madera Diorite (Ransome, 1903) of the Pinal Mountains, Gila County, that the same name has also been given to these igneous bodies in the Mineral Mountain quadrangle. The Madera Diorite crops out in several semicircular to ellipsoidal shaped, medium-sized stocks especially east of the Reymert mine and in the vicinity of Telegraph Canyon. The long dimension of the stocks measures between 3000 and 4000 feet and the short dimension between 1500 and 2000 feet.

The Madera intrudes only the Pinal Schist. In the vicinity of Telegraph Canyon the Madera Diorite is overlain by the sediments of the younger Precambrian Apache Group with a smooth depositional contact. Thus, the Madera is older than the Apache Group, but younger than the Pinal Schist. An absolute K-Ar date (Damon, Livingston, and Erickson, 1962) was obtained for the Madera Diorite in the Pinal Mountains which amounted to 1660 m.y. Therefore, the Madera is even older than the Ruin Granite (1500 m.y., Damon, Livingston, and Erickson, 1962).

In the outcrop the Madera Diorite appears as a homogeneous, medium grained, greenish gray igneous mass that weathers readily into a granule soil. White to pink feldspar crystals alternate with greenish black mafic minerals giving rise to a typical "salt and pepper" texture. Locally, the mafic constituents form distinct dark segregation bands which are easily discernable within the lighter colored matrix. Small veinlets of epidote are common along fractures. On the weathered surfaces abundant iron oxide is present which is probably the result of oxidation of the mafic minerals.

Under the microscope the rock is holocrystalline, hypidiomorphic granular, medium grained, with a more or less equigranular non-foliated texture. The plagioclase measures on the average 2 mm in diameter, whereas the other major constituents range from 0.5 mm to 1 mm in size. The average composition of the Madera Diorite as determined from thin sections is given below (in percent):

andesine	35
hornblende	30
quartz	15
pennine	15
epidote	5
apatite	tr
biotite	tr
sericite	abundant in plagioclase as alteration product

The andesine is completely altered to sericite especially along crystallographic directions. Epidote occurs in individual crystals. Hornblende and biotite are moderately chloritized along the outer portions of the grains.

A small exposure of Madera Diorite in section 30, Township 2 South, Range 12 East, contains abundant epidote veinlets that measure up to 1 cm in diameter. In one specimen epidote comprises 50 per cent of the rock. No quartz is visible in the latter specimen and the pink plagioclase appears unaltered. Thus, with varying amounts of quartz, plagioclase and epidote the Madera may range in composition from a quartz diorite to a granodiorite.

Ruin Granite

In central Arizona the Ruin Granite was named by Ransome in 1903 after extensive exposures of a coarse grained, porphyritic igneous rock found within the Ruin Basin about 5 miles northwest of Miami, Arizona. In the southwestern portion of the Mineral Mountain quadrangle a porphyritic biotite granite or quartz monzonite is exposed which closely resembles in composition and texture Ransome's original Ruin Granite so that this name has been retained. Owing to its coarse grained habit the rock disintegrates easily into a granule soil. Abundant large K-feldspar phenocrysts can be observed that measure locally 4 cm in diameter.

Under the microscope the rock exhibits a holocrystalline, hypidiomorphic granular, porphyritic texture with an average grain size ranging from 0.5 mm to 6 mm. The general composition of the rock as determined from thin sections is given below (in per cent):

quartz	25
microcline	40
oligoclase	25
biotite	8
muscovite	1
magnetite	1
chlorite	tr
hornblende	tr
sericite	tr
apatite	tr

Quartz occurs in medium-grained, anhedral interlocking crystals which measure up to 2 mm in diameter. A stressed extinction pattern is common suggesting straining after solidification of the granite. Subhedral microcline is the predominant feldspar and displays distinct polysynthetic twinning. Locally, abundant apatite in microcline gives rise to a poikilitic texture. Incipient alteration of the microcline is less common and can only occasionally be observed. Subhedral oligoclase, on the other hand, with well developed albite twinning invariably shows extensive clay-sericite alteration especially in the center portion of the crystal. Usually, a 0.1 mm wide unaltered rim is preserved around each oligoclase crystal. This selectivity of alteration between the two feldspars creates a striking effect under the microscope. Biotite occurs either in large individual flakes measuring up to 3 mm in diameter or in clusters that commonly contain magnetite grains.

Some iron oxide and, locally, some chlorite can be seen forming along the edges of individual biotite flakes. Biotite is strongly pleochroic with colors ranging from olive green to dark yellowish brown. Fine-grained muscovite develops locally along fractures in microcline and oligoclase.

Throughout the exposed portion, the Ruin Granite is uniform in composition and is more a quartz monzonite than a granite. The Ruin Granite develops a gentle topography and readily disintegrates into a coarse granule soil on the weathered surface. The rock is usually so friable that it is difficult to obtain a solid hand - specimen.

The Ruin Granite intrudes with sharp contacts the older Precambrian Pinal Schist. No particular megascopic metamorphic effect could be observed in the Pinal Schist adjacent to the contact. A few schist inclusions occur in the eastern portion of the Ruin Granite stock which also seem to be unaffected by contact metamorphism. This relationship, at least, indicates a relative younger age for the Ruin Granite in respect to the Pinal Schist.

In the type locality the Ruin Granite is overlain by the sediments of the younger Precambrian Apache Group with a disconformity, thus establishing an older Precambrian age for the Ruin Granite on a stratigraphic basis.

No absolute age date has yet been obtained from the Ruin Granite in the immediate vicinity of the investigated area. However, a K-Ar date (Damon, Livingston, and Erickson, 1962) of the Ruin Granite from the south slope of the Sierra Ancha Mountains, about 25 miles northeast of Mineral Mountain, indicated an age of 1500 million years. This is in good agreement with a Rb-Sr date (Wasserburg and Lamphere, 1965) of Ruin Granite collected in northern Arizona which indicated 1450 million years.

A north-trending diabase dike transects the Ruin Granite in the western portion of the outcrop area. The diabase in turn is cut by an east-trending diorite porphyry dike.

To the west and northwest the Ruin Granite is bounded by a finer-grained granitic intrusive rock of uncertain age that differs markedly from the Ruin Granite in texture and composition. It is believed that the finer grained granitic rock is younger than the Ruin Granite, but older than the diorite porphyry dike because it is cut by the latter.

YOUNGER PRECAMBRIAN PERIOD,

APACHE GROUP

Pioneer Shale

The Pioneer Shale was named by Ransome in 1903 from exposures in the Pioneer Mountains, about 20 miles east of the investigated area. The Pioneer is the lowermost unit of the Apache Group and usually develops at its base a coarse-grained pebbly layer, the Scanlan Conglomerate. In agreement with Shride (1961) it is felt that the Scanlan should merely be considered a basal portion of the Pioneer Shale rather than a separate unit because its thickness rarely exceeds 5 feet which is too small to indicate on a standard geologic map. Plate 1 shows the Scanlan Conglomerate as a dotted line at the base of the Pioneer Shale.

The Scanlan Conglomerate rests with an angular unconformity upon the older Precambrian Pinal Schist and Madera Diorite and represents the first reworked debris of the younger Precambrian transgressive sea (Wilson, 1962). Judging from the unusual straight contact line the depositional surface must have been relatively smooth and without any major topographic relief. Later faulting, however, has complicated this relationship considerably as can be seen in section 19 west of Telegraph Canyon.

The Scanlan Conglomerate is composed mainly of subrounded quartz and schist pebbles measuring up to 2 inches in diameter which are set in a fine grained matrix composed of silt, quartz and schist. Where the conglomerate overlies the Madera Diorite the composition becomes more arkosic. Generally, a certain amount of hematite is present in the matrix giving the unit its typical reddish-maroon color. The thickness of the conglomerate varies considerably from place to place ranging from several inches up to 5 feet. Even where the Pioneer Shale wedges out completely a thin veneer of pebbles is still present that separates the diabase from the underlying Madera Diorite or Pinal Schist.

The basal conglomerate gives way upward to the typical Pioneer Shale, a firmly indurated, dark-maroon to reddish siltstone or mudstone which contains abundant arkosic detrital material. Fragments of pink feldspar are common. Locally, some cross-lamination was recognized. In places the Pioneer becomes quite quartzitic and attains a more light gray color. The most conspicuous feature of this unit is the abundance of bleached reduction spots which are clearly recognizable within the dark maroon host rock.

The total thickness of the Pioneer Shale can not accurately be determined in this area because nowhere is there a complete stratigraphic section exposed on account of the presence of abundant diabase sills. Assuming that no assimilation took place and that the diabase merely dilated the sedimentary sequence, a maximum thickness of 450 feet is evident from the outcrop pattern.

The Pioneer Shale is overlain by the Dripping Spring Quartzite with an apparent conformable contact.

Dripping Spring Quartzite

The Dripping Spring Quartzite was described by F. L. Ransome in 1903 at Barnes Peak, which was the original type locality for the Apache Group. Here, the unit overlies with a conformable contact the Pioneer Shale and underlies the Mescal Limestone.

The lowermost unit of the Dripping Spring is the Barnes Conglomerate which serves as an excellent marker horizon to separate the Pioneer from the Dripping Spring. Again, the Barnes Conglomerate is considered an integral part of the Dripping Spring Quartzite and should not be separated from the main quartzite unit. On the geologic map (Plate 1) the Barnes Conglomerate is indicated by a dotted line at the base of the Dripping Spring Quartzite.

The conglomerate consists of very resistant, well rounded ellipsoidal quartz pebbles that are imbedded in a coarse-grained, arkosic matrix. The pebbles are less than 6 inches in diameter and commonly lie with their flattened faces parallel to the bedding. The unit is very well indurated and usually breaks across the fragments. In the outcrop the Barnes Conglomerate forms a resistant ledge and is always exposed along hill tops. In places, where the amount of matrix predominates over the pebble material the bed becomes more susceptible to weathering and the rounded fragments can easily be picked out of the unit.

The matrix is commonly somewhat iron stained and probably represents reworked material from the underlying Pioneer Shale.

The sudden increase of grain size from shale to conglomerate may indicate a new period of erosion and a renewed impetus of sedimentation; however, no definite unconformity was observed between the Barnes and Pioneer strata and the contact appears to be conformable. The Barnes Conglomerate is only 5 to 15 feet thick but the unit is very persistent in its occurrence.

The quartzite overlying the conglomerate bed is generally recognized as a massive, light reddish-brown, coarse- to medium-grained unit. It resists weathering and forms prominant cliffs and ridge tops. Locally, the unit is very arkosic showing abundant pink feldspar and fragmental quartz.

The upper portion of the Dripping Spring Quartzite is distinctively thinner bedded giving the rock a flaggy and laminated appearance. The individual beds measure from 2 to 12 inches in thickness and are of a deep reddish-brown to pale yellow and greenish-gray color. Alternating beds of arenaceous shale and quartzite are common. The shaly portions show a distinct dark maroon red discoloration especially along fractures. Minute specks of iron oxide are finely disseminated in the coarser portions of the shale. Commonly, a crust of yellowish brown limonite (mixture of goethite and jarosite?) is present within the wider fractures. It appears that the limonite specks within the rock are pseudomorphs after diagenetic pyrite or original magnetite, whereas the limonite along even the most minute fractures is of a transported rather than indigenous nature.

The actual thickness of the Dripping Spring Quartzite is difficult to determine because of the presence of extensive diabase intrusions and abundant fault displacements. From the outcrop pattern it is evident that the Dripping Spring Quartzite is at least 800 feet thick.

Throughout most of the exposed portion of the quartzite unit the beds dip steeply (75-85°) to the east. Farther south in Telegraph Canyon, however, the structural relationship becomes more complex as a result of the development of an anticline. At one place the Dripping Spring unit dips 75° west but flattens rapidly to 20°

closer to the crest of the anticline. As can be seen from section B" - B''', two portions of the Dripping Spring Quartzite dip steeply toward each other and are separated by a fault. Locally, this fault acted as a channelway for the intruding diabase.

The contact between the Dripping Spring Quartzite and the younger Mescal Limestone is very seldom observable. Heavy underbrush and quartzite talus tend to obscure this feature.

Mescal Limestone

The Mescal Limestone overlies the Dripping Spring Quartzite with an apparent conformable contact. However, a small exposure of Dripping Spring Quartzite and Mescal Limestone in Telegraph Canyon, section 29, adjacent to the Tertiary volcanic flow indicates a divergence in strike between the two formations. This suggests that the contact may actually be an unconformity.

Ransome (1923) named the Mescal Limestone from exposures found in the Mescal mountains, Ray quadrangle, about 20 miles east of the investigated area. He reported a thickness of 225 feet. In the Mineral Mountain quadrangle, however, it is impossible to give an accurate thickness of the formation because of intense folding, faulting, and dilation by the diabase. The only exposures of Mescal in this area are found in Telegraph Canyon where they crop out in a discontinuous, strongly faulted belt.

The Mescal Limestone is a thinly laminated silicified limestone containing abundant cherty layers that parallel the bedding. The cherty layers are more resistant to weathering and stand out in bold relief on the limestone outcrop. Through the microscope an aggregate of fine grained calcite and silica can usually be seen. No typical contact metamorphic minerals were observed.

The distinct chalky white appearance of the Mescal in the outcrop is in strong contrast to all adjacent rock types, especially the dark greenish gray diabase. This color difference may be used advantageously in tracing the unit on aerial photographs.

Shride (1961) was able to separate the Mescal Limestone into three members based on lithology and fossil assemblage. In the Mineral Mountain area, however, the exposures are too scanty and the stratigraphic section is too incomplete to distinguish a definite threefold separation. The maximum thickness of the unit approaches 250 feet as calculated from the outcrop pattern on the geologic map.

At the type locality the Mescal is overlain unconformably by a thin layer of basalt. In the investigated area no such feature could be recognized, and the limestone is directly overlain by Troy Quartzite.

Troy Quartzite

The Troy Quartzite is considered to be the uppermost unit of the younger Precambrian Apache Group. In the Mineral Mountain area only a few isolated blocks, that are believed to represent Troy Quartzite, are exposed stratigraphically above Mescal Limestone, immediately adjacent to the Tertiary volcanic flow complex in Telegraph Canyon. Locally, the Troy is overlain by Whitetail Conglomerate. In the Globe quadrangle (N. P. Peterson, 1962) and in the Dripping Spring range, the Troy Quartzite exhibits a distinct basal conglomerate unit measuring several tens of feet in thickness. Usually, the rock becomes more massive in the upper portions and shows abundant cross stratification. In Telegraph Canyon, however, the quartzite unit that overlies the Mescal Limestone lacks the typical basal conglomerate layer and indicates a more thinly-bedded development. The unit has an overall reddish appearance, the result of abundant iron oxide staining along fractures.

On the basis of its stratigraphic position, and in spite of the lack of some typical characteristics, it is believed that this fragmental unit represents the Troy Quartzite. If this unit, however, is actually uppermost Dripping Spring Quartzite, then the entire stratigraphic sequence has to have been overturned. No evidence for such a structural setting was observed in the field.

INTRUSIVE ROCKS OF UNCERTAIN AGE

Mineral Mountain Quartz Monzonite

It is the intention of the writer to assign the name Mineral Mountain Quartz Monzonite to an igneous intrusive rock which has hitherto not been recognized.[1] The name refers to Mineral Mountain, a prominent landmark in this area, after which the investigated quadrangle was also named.

The Mineral Mountain Quartz Monzonite is exposed in the southwestern corner of the area, about 1-1/2 miles south of Mineral Mountain proper, and covers portions of sections 20, 21, 22, 28, 29, 32, 33 of Township 3 South and Range 11 East.

The rock is medium grained, equigranular, greenish gray to yellowish gray in color, locally extensively iron stained and easily distinguishable from the adjacent coarser grained Ruin Granite in texture and composition. A moderate amount of dark, olive green biotite and hornblende can be recognized in the hand specimen.

The quartz monzonite is an irregular, discordant igneous mass that intrudes the older Precambrian Pinal Schist and Ruin Granite with a sharp contact. The exact

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1. Geologic map of Pinal County, Arizona Bureau of Mines, 1959 edition.

age of the rock, however, is not known. No obvious alteration effects were noted in the schist or in the granite. A few schist inclusions without any striking alteration features were observed in the northern and northeastern portion of the quartz monzonite. The northern contact of the rock is highly irregular and may indicate that the igneous body is plunging gently beneath the schist toward north. The most intense clay-sericite alteration and iron staining found within the quartz monzonite is confined to this contact. Several exploratory adits have been driven into the contact zone, but apparently no commercial mineralization was encountered. The fact that the quartz monzonite may underly the adjacent Pinal Schist is further substantiated by an isolated exposure of a similar intrusive rock in Box Canyon, section 22, Township 3 South, Range 11 East. This exposure undoubtedly connects at depth with the main mass. How far the quartz monzonite may extend further to the east beneath the Tertiary volcanic flow complex can not be determined with certainty because of the lack of surface exposures in this area. The moderate amount of iron staining in Pinal Schist and the presence of a little copper carbonate in a fault zone in the northern portion of section 23 may be indirect evidence of an igneous body at depth. To the west the quartz monzonite extends beneath recent gravel cover for an unknown distance.

A series of dikes, ranging in composition from aplite to diabase, transect the igneous mass in different directions. Diabase and trachy-andesite porphyry dikes trend northward, diorite and quartz diorite porphyry dikes trend eastward, and aplite dikes have a predominant north-east orientation. These hypabyssal rocks will be discussed in more detail in a subsequent chapter.

The Mineral Mountain Quartz Monzonite is not a homogeneous rock but varies in composition and physical appearance from quartz monzonite to granodiorite. The latter variety is confined to the exposure in Box Canyon. On the whole the rock appears unaltered in hand specimens in spite of some weathering on the surface.

Under the microscope the rock is holocrystalline, hypidiomorphic granular, fine to medium grained with a grain size ranging from 0.5 mm to 2 mm. The composition of the Mineral Mountain Quartz Monzonite as estimated from five thin sections is presented below (in percent):

plagioclase (oligoclase-andesine)	40	40	53	40	42
orthoclase	40	34	20	35	30
quartz	15	15	8	15	15
biotite	1	8	1	10	7
hornblende	1	--	15	tr	5
magnetite	1	2	--	tr	1
muscovite	2	--	--	tr	--
apatite	tr	1	1	tr	tr

Pyrite, chlorite, sphene, epidote and calcite occur in minor amounts. Sericite is a common alteration product of plagioclase. Andesine plagioclase (Ab_6An_4) is the predominant mineral present and usually forms subhedral crystals. Zoning is frequently developed; the outer rims increase in albite component. Strong sericite alteration is locally present following twin lamellae, fractures, and zoning patterns. Usually, the center portion of the plagioclase is extensively altered in contrast to the outer rim which rarely, if ever, shows any incipient alteration. Anhedral orthoclase and quartz form the general matrix of the rock. Orthoclase occurs in large crystals up to 6 mm in diameter, and inclusions of plagioclase, biotite and hornblende are very common. Very rarely is any alteration visible. The poikilitic texture of orthoclase suggests that potassium was secondarily introduced forming K-feldspar which subsequently engulfed earlier minerals present. Subhedral biotite and hornblende are commonly altered to chlorite along the edges of the crystals. Locally, calcite is present in hornblende. Magnetite occurs in minute grains, 0.15 mm in diameter, and is always associated with the mafic constituents of the rock. In places, the breakdown of magnetite causes extensive iron staining. The effects of stress are well displayed by the undulatory extinction of quartz, and by the curvature and faulting of the feldspar twinn lamellae.

The igneous intrusive rock in Box Canyon is very similar in mineral composition to the main quartz monzonite.

The amount of plagioclase, however, exceeds by far that of orthoclase so that the rock should be termed a granodiorite. Introduction of secondary K-feldspar is also evident. Instead of magnetite pyrite is here the metallic constituent. The rock is fine grained, dark greenish gray and has a general unaltered appearance in the outcrop. Under the microscope, however, the inner portions of the plagioclase are extensively altered to sericite.

The most pronounced iron staining in the quartz monzonite stock is developed in the small, northeast-trending neck-like extension. Here the rock shows considerable brecciation and development of iron oxide along fractures and narrow shear zones. The weathered surfaces are strongly coated by dark brown limonite (goethite) but no sulfide casts were observed. Viewed microscopically subhedral plagioclase is completely altered to sericite and is locally heavily iron stained. No pyrite was recognized in thin sections. Magnetite is relatively abundant and occurs with biotite. The rock is cut by many north-trending quartz hematite veins which may be the cause for the extensive iron staining in this area. These quartz-hematite structures are the extension of the more fully developed vein system to the northwest around Mineral Mountain. A genetic relationship between the quartz monzonite stock and the vein structures, however, is not apparent. The writer feels that the veins are related to the Tertiary volcanic activity in this area. Several of the east-trending, fault controlled vein structures in the quartz monzonite have been explored by prospecting pits for copper mineralization.

Dikes associated with the Mineral Mountain Quartz Monzonite

Four different dike rocks were recognized transecting the quartz monzonite in various directions. Their mutual age relationship can not readily be determined because only two dikes cross-cut one another. The dike rocks recognized are:

aplite

quartz diorite porphyry - diorite porphyry

trachy-andesite porphyry

diabase

Aplite

In hand specimen the rock has a typical phaneritic, sugary texture and contains a minor amount of fine-grained biotite. Cream- to rose-colored feldspar crystals and glassy quartz grains are very distinct on weathered surfaces. Generally, the rock has a pinkish gray color, is medium-grained and very hard.

The aplite forms narrow northeast-trending dikes which measure only a few feet in width. Their contacts with the quartz monzonite are sharp and even. Because the aplite is more resistant to erosion it stands out as narrow ribs in the general terrain.

Under the microscope the rock is seen to be holocrystalline, allotriomorphic granular with an average grain size of 1 mm. Occasionally, feldspar crystals may attain a diameter of 2 mm. The minerals form an anhedral, interlocking fabric with quartz predominating in the assemblage. The average composition of the aplite as determined from thin sections is tabulated below.

quartz	40
microcline	35
perthite-orthoclase	18
albite	5
biotite	2
apatite	tr
sericite	locally abundant as alteration product in albite

Microcline and orthoclase locally show a very distinct perthitic texture with plagioclase forming parallel oriented exsolution "flames" in the host mineral. Biotite occurs in very small corroded flakes 0.25 mm to 0.1 mm in diameter, and displays a very strong greenish pleochroism from chlorite alteration. Incipient clay alteration is present in all feldspars giving the minerals a general cloudy appearance in plane polarized light.

Quartz Diorite Porphyry - Diorite Porphyry

One major diorite porphyry dike is present transecting the quartz monzonite in an east-west direction. In the outcrop the rock is porphyritic, very hard and greenish gray as a result of abundant olive green hornblende needles that are randomly oriented throughout the rock. Irregular blebs of pink feldspar are common.

Under the microscope the rock is seen to be porphyritic with a microcrystalline matrix. About 25 per cent of the phenocrysts are plagioclase (oligoclase-andesine) and 20 per cent are hornblende and biotite. The matrix consists of microcrystalline plagioclase, hornblende, biotite, sericite and calcite. Plagioclase is strongly altered to sericite especially along crystallographic directions. The sericite occurs in fine individual flakes and shred-like aggregates. Hornblende is commonly altered to calcite; a thin chlorite border remains behind. Very fine-grained magnetite is crowded along the border zones of the altered hornblende. The rock is very resistant to weathering and forms narrow ridges above the low lying quartz monzonite terrain.

In the extreme southwestern corner of the quadrangle an east-trending porphyritic dike cuts both the Mineral Mountain Quartz Monzonite and the Ruin Granite. Because of the presence of abundant quartz phenocrysts the rock is a quartz diorite porphyry. It is pinkish gray, very hard and contains distinctly zoned feldspar phenocrysts that measure up to 10 mm in diameter. Phenocrysts comprise about 30 per cent of the rock. Quartz occurs as well rounded grains measuring 3 mm in diameter. It commonly develops a myrmekitic intergrowth in the form of a narrow halo zone around each grain. Micromyrmekitic texture is found throughout the rock in small blebs and aggregates wherever quartz is present. Epidote and calcite are common alteration products of hornblende. Plagioclase is always altered to sericite.

Trachy-Andesite Porphyry

The trachy-andesite is an orange-gray porphyritic rock with a very hard microcrystalline matrix. Small, unaltered black books of biotite are visible on the weathered surface. Well-rounded quartz grains comprise about 2 per cent of the phenocrysts, but angular anhedral quartz crystals are an important constituent of the matrix. On the weathered surface abundant chalky-white, subhedral to anhedral plagioclase crystals are visible which, as seen under the microscope, are completely replaced by calcite. Locally, magnetite accumulates as cluster-like aggregates in plagioclase and hornblende. A little iron oxide staining is usually developed around the magnetite grains. In a few cases magnetite forms small inclusions in unaltered biotite in association with calcite replacing plagioclase. In plane polarized light the matrix has an overall cloudy appearance, probably as the result of incipient clay alteration of the fine grained feldspar.

The name trachy-andesite has been tentatively applied to this rock on the basis of the plagioclase composition (oligoclase-andesine) and the abundance of biotite and quartz phenocrysts, as well as microcrystalline constituents of the ground mass. The north-trending trachy-andesite dike cuts the east-west trending diorite porphyry dike and thus is younger than the latter.

Diabase

A north-trending diabase dike is exposed in the southern portion of the quartz monzonite. Its composition and texture is almost identical to the diabase sills described in detail below. Of interest here is the age relationship between diabase and quartz monzonite. If the diabase is of Younger Precambrian age then the quartz monzonite must also be Younger Precambrian, if not older. The quartz monzonite, however, shows many characteristics of a Laramide intrusive body as far as composition, texture, and general appearance is concerned. Small intrusive rocks of Tertiary age and of similar composition as the quartz monzonite are exposed in the Dripping Spring Range and the Tortilla Mountains near Ray, Arizona, about 10 to 20 miles east of Mineral Mountain. In this case the diabase dike has to be also of Tertiary age. It may very well be that two ages of diabase intrusion exist in this part of Arizona; a Precambrian diabase found largely as sills associated with the sedimentary rocks of the Apache Group, and a Tertiary diabase occurring as isolated dikes mainly in other intrusive rocks.

Diabase

In the Mineral Mountain quadrangle the diabase appears in two modes of occurrence. The first is the extensive sill-like intrusion into the Apache Group in Telegraph Canyon, and the second is the formation of small, irregular intrusive bodies and narrow dikes within the Pinal Schist. Locally, the diabase also forms selvage zones along the northwest-trending tension fractures and vein structures.

In Telegraph Canyon the diabase intrudes the entire exposed sedimentary sequence of the younger Precambrian Apache Group. The diabase took advantage of bedding planes, formation boundaries and fault structures to form sills ranging in thickness from 100 to 1200 feet. The intrusion caused a dilation of the whole sedimentary section. The thinly bedded Pioneer Shale and Mescal Limestone were especially susceptible to the diabase intrusion, in contrast to the more massive Dripping Spring

Quartzite. Small apophyses of diabase are present in the quartzite, but they are very narrow and die out quickly. Heavy talus cover usually obscures these features. On the whole, the diabase sills are concordant to the sedimentary formations, but in detail, they locally transect the bedding along faults and fracture zones and follow more favorable horizons. It was primarily for this reason that no measured stratigraphic sections of the sedimentary units were obtained. The diabase restricted itself almost completely to the Apache Group and did not invade the adjacent Pinal Schist, at least not in this immediate area. Usually, a very narrow strip of Pioneer Shale separates the diabase from the Pinal Schist and Madera Diorite. In the central and southwestern portion of the area the diabase occurs as irregular intrusive masses and narrow dike-like features mainly within Pinal Schist. These discontinuous and discordant intrusive bodies have a general north-northwest orientation and probably follow a weak structural zone in the Pinal.

The age of the diabase in this area can only be determined on the basis of the following reasoning: Because the diabase intrudes the younger Precambrian Apache Group, it definitely has to be younger than these sedimentary rocks. An absolute K-Ar date of a similar diabase in the Sierra Ancha Mountains, Gila County, Arizona (Damon, Livingston and Erickson, 1962), indicates an age of 1140 million years, thus placing the diabase into late younger Precambrian time. If the diabase dike intruding the Mineral Mountain Quartz Monzonite is actually of Tertiary age, then two periods of diabase intrusion may very well be present in this area. Proof of this interpretation must await the age determination of the Mineral Mountain Quartz Monzonite. A Tertiary age for the diabase is postulated in the Globe-Miami and Superior area on the basis of stratigraphic evidence (N. P. Peterson, 1962).

The diabase is a holocrystalline, very fine to coarse grained, dark greenish gray intrusive rock displaying typical diabasic to ophitic texture. The coarse variety weathers readily into a dark green granule soil and usually forms topographic depressions adjacent to more resistant sedimentary units. Extensive talus cover is commonly present and locally obscures the contact relationships between diabase and adjacent rocks. A detailed survey will undoubtedly reveal more diabase than could be shown on this map.

Under the microscope the diabase is seen to be a holocrystalline, hypidiomorphic granular, medium- to coarse grained rock. Subhedral plagioclase laths are intergrown with augite and hornblende and may attain a length of 6.5 mm. Plagioclase is commonly altered to sericite in the coarse diabase. Since the rock is highly weathered in the outcrop it is difficult to determine whether the alteration is a result of supergene or deuteric processes. Secondary overgrowth of a more sodium-rich feldspar and/or orthoclase containing abundant hornblende inclusions is common around plagioclase. Pyroxene is almost completely recrystallized and shows a rim of small hornblende needles that extend outward from the original mineral into the adjacent plagioclase. Magnetite occurs in large inequidimensional grains filling open spaces or replacing mafic minerals. Locally, anomalous large apatite crystals can be observed.

In Telegraph Canyon the diabase is medium-grained with an average grain size of 1.5 mm, and the rock shows distinct signs of feldspathization. The diabase is very hard and almost black in color, and contains abundant conspicuous blebs and veinlets of pink feldspar. Under the microscope these blebs are revealed to be myrmekitic intergrowths of quartz and alkali feldspar. Secondary overgrowth on plagioclase is also present. Turner and Verhoogen (1960) observed a similar feature in the tholeitic quartz diabases and attributed it to differentiation of the magma upon cooling during intrusion. Another possibility for introducing silica and alkalies is limited assimilation of the host rock during diabase intrusion. The sedimentary units of the Apache Group could serve as a ready source for the needed constituents. The margins of the diabase sill, then, should indicate some changes in the mineral composition if conditions were favorable. Not nearly enough petrographic work has been carried out, however, to either support or disprove the validity of this hypothesis. J. W. Anthony (1960) pointed out, that because of the extreme differences in chemical composition of the host rock and the intruding diabase magma, one should not expect to find extensive assimilation of the sedimentary units (Dripping Spring Quartzite, Mescal Limestone) by the magma.

A narrow, very fine-grained diabase dike in Pinal Schist (section 12) indicates strong shearing which now is rehealed by calcite and chlorite (pennine). Abundant finely disseminated sulfide and magnetite grains are present. The mafic minerals are completely altered to calcite.

TERTIARY PERIOD

Whitetail Conglomerate

A deposit of detrital material directly beneath the Tertiary volcanic flow complex in the southern end of Telegraph Canyon is here termed Whitetail Conglomerate on the basis of its similarity in composition and stratigraphic position with the Whitetail exposed at Teapot Mountain near Ray, Arizona. A more extensive exposure of Whitetail Conglomerate is found in the extreme southeast corner of the quadrangle where it underlies thick rhyolite-dacite flows.

The Whitetail Conglomerate is composed mainly of schist and quartzite fragments imbedded in a clayey matrix. In Telegraph Canyon the conglomerate overlies Pinal Schist, Troy Quartzite and diabase, and partly obscures the trace of the Pinal thrust sheet. Here, the unit is about 100 feet thick and dips 5° to 18° east. Some stratification present may indicate a water-laid origin or perhaps local sorting.

The Whitetail Conglomerate represents a period of continued erosion that followed the middle Tertiary structural disturbance, and rapid deposition into shallow basins and stream valleys before the extensive extrusion of rhyolite and dacite flows.

Rhyolite-Dacite Extrusive Complex

Large portions of the Mineral Mountain quadrangle are covered by felsitic volcanic rocks of upper Miocene age. The eastern margin and southeastern portion of the mapped area are underlain by thick sequences of rhyolite tuffs, dacites, some vitrophyres, and a massive rhyolite intrusive rock centering in Martinez Canyon. No attempt was made to differentiate these individual volcanic rock units at this time, and for convenience they are indicated on the geologic map (plate 1) as the rhyolite-dacite extrusive complex of Tertiary age.

At the time of writing a thesis is being prepared by Eleanor Nelson, University of Arizona, which describes in detail the rhyolitic extrusive rock sequence in the vicinity of Picketpost Mountain, located just north of the Mineral Mountain quadrangle. According to Mrs. Nelson these rhyolitic tuffs are about 17 million years old and thus post-date the dacitic extrusive event near Superior. The dacite was dated by Damon (1965) to be about 20 million years old. The rhyolite tuffs in the investigated area are probably related in time and space to the extrusive activity around Picketpost Mountain. A doctoral dissertation presently being prepared by Mr. Donald Lamb, University of Cincinnati, discusses the Tertiary volcanic history of this general area (written communication). Mr. Lamb's interpretation agrees well with the one stated above.

Erosional remnants of rhyolitic flows are exposed south of Telegraph Canyon where they cap small hills and ridges of Pinal Schist. In the northeast corner of section 6 a black vitrophyre occurs which correlates with a similar rock overlying rhyolite tuff east of Telegraph Canyon. The black glassy matrix of the vitrophyre contains about 15 per cent subhedral to euhedral sanidine phenocrysts. In this area the volcanic sequence dips 15° to 30° east and indicates a basin-like configuration trending generally north-south to the east of the quadrangle. Some stratification within the tuff layers can be recognized. Generally, a creamy-white pumice breccia with foreign rock fragments occurs at the lower portion of the sequence and grades upward into a welded tuff. In certain areas the flow sheet attains a thickness of 800 to 1000 feet.

In thin sections the rhyolite flow contains 7 per cent quartz and plagioclase phenocrysts; the remainder is microcrystalline quartz and feldspar matrix. The phenocrysts are about 1 mm in diameter. Plagioclase is commonly fragmental and ranges from albite to andesine in composition. The quartz grains are always well rounded and show solution embayments. Corrosion halos around the quartz grains are locally present. In the matrix quartz occurs as very fine spiculite and longulite crystals. At places the rock attains a more reddish matrix because of abundant orthoclase phenocrysts. Fine-grained, brown biotite occurs in individual flakes with a preferred sub parallel orientation conformable with the predominant flow direction.

In places the rock has the texture and composition of a welded dacite flow containing about 15 per cent orthoclase, plagioclase and quartz phenocrysts. The remaining portion is microcrystalline matrix. Plagioclase is always fragmental and usually shows corrosion rims. The plagioclase ranges from albite to andesine in composition. Quartz, again, is well rounded and shows typical embayment features. Small quartz veinlets occur parallel to the general flow pattern.

Judging from the texture and distribution of the overall volcanic sequence it becomes apparent that the initial pyroclastic outburst in Miocene time was followed by the extrusion of siliceous lava flows which filled every basin-like feature in the pre-existing topography.

Rhyolite Intrusive Rocks

In the western half of the investigated quadrangle abundant elongated rhyolite masses intrude discordantly the older Precambrian Pinal Schist. These intrusive bodies trend predominantly in a northwesterly direction, subparallel to the epithermal fissure vein system. Because the rhyolite is very resistant to erosion it generally forms prominant ridge tops. Mineral Mountain proper is underlain by one of the more extensive intrusive masses.

In spite of their northwesterly elongation the rhyolite intrusive bodies seem to be arranged in a northeast-trending, en echelon pattern. This orientation may reflect the stress pattern which prevailed within the schist during the intrusion of the rhyolite. One tabular rhyolite body in Cottonwood Canyon dips concordantly 35° southwest with the schist foliation and appears to be a sill-like intrusive mass.

In the outcrop the rhyolite is a pinkish gray, very hard and somewhat porphyritic rock. Quartz phenocrysts are distinctively set in an aphanitic matrix and comprise about 5 to 10 per cent of the rock. Under the microscope quartz appears as clean, subhedral to euhedral grains about 1 mm in diameter. Commonly, a rim of dust-like material surrounds each crystal, and in places a narrow zone of recrystallized quartz can definitely be recognized. Feldspar occurs only occasionally as phenocrysts, but may be more abundantly present in the micro-crystalline matrix. Locally, minute opaque mineral grains measuring 0.2 mm in diameter are finely disseminated in the rhyolite and show a faint rim of iron oxide. The matrix of the rock has a general cloudy appearance and is composed mainly of quartz.

The age of the rhyolite intrusive rock is considered to be younger Tertiary because a similar but much larger rhyolite mass intrudes the volcanic flow complex of Miocene age in the Martinez Canyon area. The intrusive event, however, must have preceded the development of the fissure vein system because south of Mineral Mountain and in Martinez Canyon the rhyolite is transected by these mineralized structures. The rising magma has probably served as a source for the epithermal mineralization in this area.

Gila Conglomerate

The Gila Conglomerate is a coarse sedimentary unit of probable late Tertiary or early Quaternary age. It overlies stratigraphically the rhyolite-dacite extrusive complex and is restricted in its occurrence to the southern portion of the quadrangle.

The Gila Conglomerate was originally named by Gilbert in 1875 from exposures in the headwaters of the Gila River. Ransome, in 1903, applied the same name to sedimentary rocks exposed widely in the Globe-Miami-Ray area and which were younger than the dacite.

In the investigated area the conglomerate contains a high percentage of volcanic material, either as large, angular boulders, or as fine-grained matrix material cementing the larger fragments. Some stratification is present within the unit and may indicate that the conglomerate dips 25° to the southwest. Near Kearny, 15 miles to the southeast, the Gila Conglomerate dips very steeply to the east together with sedimentary units of the Apache Group. Thus, late Pliocene or early Pleistocene faulting must have been active in this area in order to produce such a structural relationship.

To differentiate the Gila Conglomerate from the Whitetail Conglomerate is a difficult task if the intervening dacite flow is not present. Usually, the Whitetail Conglomerate does not contain any volcanic fragments because it was deposited prior to the volcanic extrusive event. The Gila Conglomerate, however, contains abundant volcanic debris if it occurs near a volcanic terrain. Obviously, the composition of the conglomerate unit will vary accordingly with a change in the source material.

The boundary between the Gila Conglomerate and the underlying rocks is invariably an erosion surface of high relief. Therefore, the Gila Conglomerate represents a period of rapid erosion which was probably the result of considerable tectonic activity. The poorly-sorted texture of the unit and the presence of abundant angular fragments indicate that the conglomerate was deposited near its source into basin-like configurations.

Recent Gravel Cover

The Mineral Mountain Quadrangle is bounded in the west by a gently sloping alluvial plain that is composed mainly of flaggy schist fragments near the outcrop but which changes quickly to a granule soil further away from the bedrock exposures. Adjacent to the igneous terrain in the southwest corner of the map the gravel material is mainly decomposed granite.

Where Cottonwood Canyon enters the gravel covered area schist bedrock is still exposed in the wash for a considerable distance to the west. Thus, there is no visible evidence that a front fault separates the outcrop area from the gravel covered terrain as is commonly the case in this part of the state. Chances of finding a pediment here are very good. In the light of mineral exploration this pediment would provide an excellent target area. The mineralized fissure veins which may represent a fringe zone to a mineralized intrusive body presently buried under post-mineral gravel cover trend generally obliquely into the schist - gravel cover.

Geophysical surveys such as induced polarization, gravity or magnetometer conducted in this covered area should certainly prove or disprove the validity of this hypothesis.

STRUCTURE

Regional Structural Setting

The Mineral Mountain quadrangle lies within the Mountain Region of the Basin and Range Province and has a complex structural history from older Precambrian to Recent time. Present day topography is governed to some extent by structural events of the past. The general picture is complicated through the superposition of many younger tectonic events upon older, less discernible structural features. The structural history of this region will not be completely unraveled until more detailed information becomes available in the adjoining areas to the north and east.

Three major structural trends are evident from the geologic map (plate 1). The first is the Precambrian schistosity of the Pinal Schist, second is the north-trending belt of sediments of the Precambrian Apache Group, and third is the northwest-trending Tertiary fault and vein system developed extensively in Pinal Schist. The two different structural periods will be discussed in detail in the following chapters.

Precambrian Structures

The schistosity of the older Precambrian Pinal Schist has no consistent trend throughout the area. In the northern and central portion the direction is northwesterly but changes into a predominant east-west direction as Telegraph Canyon is approached. The interbedded amphibolite bands follow in minute detail the foliation trend of the schist. This is especially evident in the northwestern portion of the map. Here, the foliation dips predominantly to the southwest at angles ranging from 36° to 55°. Further to the south the dip steepens to 60° and 70°. South of Cottonwood Canyon the dip reverses to northeast, indicating a general northwest-trending synclinal structure in the schist. To the west of Mineral Mountain the foliation still strikes north-northwest but the dip is again reversed to the southwest outlining a small anticlinal configuration between Mineral Mountain and Cottonwood Canyon.

The foliation pattern becomes more complicated in the vicinity of Telegraph Canyon and near the Tertiary volcanic complex. West of Telegraph Canyon the schistosity trends east-northeast with a general dip (38° - 75°) to the north. Southwest of Telegraph Canyon the trend is less distinct as the result of the constant change in strike and dip. This irregular pattern may be the reflection of faulting and shearing which is very difficult to depict as such in the schistose terrain.

One major thrust fault occurs in the southern portion of Telegraph Canyon where Pinal Schist overrides younger Apache Group sediments; its trace is subsequently lost within the adjacent schist body. A careful and detailed mapping of the foliation pattern in this area should eventually delineate the extent of the thrust sheet.

Another conspicuous structural feature in Telegraph Canyon is the north-northwest-trending belt of the younger Precambrian sediments. The beds strike generally N 15° W and dip persistently to the east 50° to 83° with some local exceptions. It is believed that the sedimentary rocks are part of the northwest-trending, younger Precambrian geosyncline representing a transgressional period after the older Precambrian sediments were substantially metamorphosed, uplifted, and eroded as a result of the Mazatzal Revolution. This sequence may be correlated in time with the Grand Canyon Series in northern Arizona but apparently no direct connection existed between the two basins of deposition (Wilson, 1962).

The contact between the sedimentary rocks and the underlying schist and granitic rocks represents a regional disconformity which is recognized throughout Arizona and which was named by E. Wilson (1962) the ep-Archean unconformity. This old erosion surface shows very little relief and a tremendous time interval of no deposition or deposition and subsequent erosion is indicated. In the investigated area this surface is locally offset by later cross faulting, as can be seen in the northern portion of Telegraph Canyon.

The steep dip of the Apache Group can be interpreted in two ways: 1. After deposition of the sediments the general region was tilted during Nevadan, Laramide, or younger time; 2. the steep inclination is part of a north-trending monocline which has since been eroded. Monoclinal folding of regional extent is especially developed in the Plateau Province where entire sequences of Paleozoic strata are draped over deep-seated fault structures developed in underlying Precambrian rocks. This tectonic event apparently took place during Miocene time. However, no monoclinal folding has yet been recognized south of the Mogollon Rim involving only younger and older Precambrian rocks.

One aspect that may support a monoclinal origin is the presence of well-developed northwest-trending tension fractures within the Pinal Schist. These fractures could have formed during the folding process along the crest of the monocline which later on became the site of mineralization and intrusion of rhyolite and diabase. Much more work, however, remains to be done before a final answer can be given to this problem.

Abundant cross-faulting in the Apache Group probably developed before and simultaneous with the diabase intrusion because the diabase seems to have taken advantage of every weak structure available during its emplacement. Locally, lateral displacement or dilation amounts to 750 feet. For example, wherever the lower portion of the Dripping Spring Quartzite has been cross-faulted and laterally displaced the amount of separation can readily be determined from the position of the Barnes Conglomerate which serves as an excellent marker unit. It seems as if individual blocks of Apache sediments float in a sea of diabase like huge xenoliths. In the light of this concept it is actually surprising to find such a consistency in dip within a certain formation for a considerable strike length.

In the southern part of Telegraph Canyon, section 32, field evidence suggests a small anticlinal structure involving diabase in the core and Mescal Limestone and Troy Quartzite on the flanks. The orientation of the sediments suggests a tight, northward-plunging, asymmetrical fold whose western side is in fault contact with the easterly dipping Dripping Spring Quartzite but whose eastern flank dips gently under Tertiary volcanic cover. This small fold may have developed in front of an advancing thrust sheet from the southwest.

In southern Telegraph Canyon, along the dividing line between Township 2 South and Township 3 South, a completely overturned block of quartzite is exposed dipping 28^{o} to 48^{o} west. On the basis of two widely spaced conglomerate (Barnes?) layers and the similarity in lithology, the exposure is considered to be Dripping Spring Quartzite and some Pioneer Shale.

Tertiary Structures

Because no rocks of Paleozoic or Mesozoic age are present in this area, Tertiary tectonic events were superimposed directly upon the Precambrian terrain. The most prominant structural features are:

1. The north-northwest-trending fissure vein system in conjunction with elongated rhyolite intrusive bodies and irregular diabase masses.
2. The Pinal thrust sheet in Telegraph Canyon.
3. The volcanic flow complex with a rhyolite intrusive mass.

These structural features are discussed in the following paragraphs.

* Fissure Vein System

The Pinal Schist has been transected extensively by a N 15° - 20° W trending fissure system which subsequently became mineralized by ascending hydrothermal solutions forming shallow high grade manganese-lead-silver ore pockets. The Reymert, Oklahoma, Woodpecker, Ajax, and Martinez mines are located along one of these larger vein structures.

The fissures are mainly concentrated around Mineral Mountain proper and the north central portion of the quadrangle. The more strongly developed fissures can be traced for several miles along their strike length, whereas the smaller structures are very discontinuous and irregular in their orientation. West of Mineral Mountain the fissures dip consistently 58^{o} to 86^{o} southwest. North of here the dip (45^{o} - 60^{o}) reverses to the northeast. At the Woodpecker mine the dip is again to the southwest (32^{o} - 60^{o}) but at the Reymert mine further to the north the dip is steeply (75^{o}) to the northeast. Vertical slickensides within the fissures indicate considerable movement.

The northwest-trending fissure system represents tensional release in the crust which could either be due to large scale folding with compressional forces acting from northeast-southwest, or to a northwest directed stress pattern which would cause the formation of tension fractures similar to Q joints in granitic rocks.

Generally, the fissures are confined to the Pinal Schist and only locally do they extend into Mineral Mountain Quartz Monzonite (section 21). The age of the fissures is difficult to determine. They may represent Precambrian structures that became rejuvinated during later structural disturbances. In part, at least, they have to be post-rhyolite intrusions because at Mineral Mountain and in Martinez Canyon the mineralized veins cut and border the intrusive rocks.

Similar northwest-trending fissures were mapped by Nelson on the west side of Picketpost Mountain.

Pinal Thrust Sheet

In the southern portion of Telegraph Canyon, sections 32 and 5, the edge of a thrust fault is exposed that dips 20° - 30° east beneath the Tertiary volcanic complex. The upper plate consists of highly brecciated Pinal Schist which overlies diabase and the sedimentary rocks of the Apache Group. The thrust fault could not be traced further southwest into Pinal Schist primarily because of the similarity of rock types involved. However, as pointed out before, detailed mapping of the foliation pattern on a large scale should aid in delineating this structure.

The thrust could have originated either by gravity gliding from an adjacent highland, or from regional compression acting in an east-west direction. Major thrusting was described by E. Wilson (1952) in the Ray area where high angle reverse faults and completely overturned strata are common. Wilson also recognized an eastward dipping, low angle thrust fault west of the Concentrator fault where Pinal Schist is thrust over Paleozoic limestone. Wilson could not trace this fault further to the northwest because the structure is concealed by dacite. The writer feels very strongly, that the thrust fault exposed in Telegraph

Canyon connects with Wilson's thrust fault 3 miles to the east beneath the Tertiary volcanic cover.

If the thrust in Telegraph Canyon represents a gravity glide sheet then uplift must have occurred in the north central portion of the quadrangle which caused the gliding process to originate. In any event, the thrusting occurred before the deposition of the Whitetail Conglomerate because the latter overlaps the fault with a depositional contact. The thrusting is probably the result of the early phase of the Laramide orogeny.

The Volcanic Flow Complex

The extensive felsitic extrusive material completely covers the southeastern and eastern portion of the quadrangle and extends for 6 miles further southeast into the vicinity of Copper Butte. Lamb (1962) recognized at least 30 rhyolitic necks in this area.

The volcanic flows outline several small synclines which may be an expression of the pre-volcanic topography. One shallow, west-northwest-trending syncline is transected at almost right angles by Box Canyon. A somewhat larger, basin-like structure is outlined by the north-northeast-trending lobe of volcanic rock that includes the Martinez mine area. This synclinal structure was then intruded by an elongated north-trending rhyolite mass, perhaps along a weak structural zone in the crust. A third synclinal configuration is indicated by the gentle eastward dip of the volcanic strata in Telegraph Canyon. The center of this basin probably lies several miles east of the mapped area.

MINERAL DEPOSITS

General Statement

The Mineral Mountain quadrangle is characterized by an extensive northwest-trending mineralized fissure system that occurs exclusively in older Precambrian Pinal Schist. In some instances individual veins attain a strike length of several miles and a width of up to 20 feet, whereas at other places the mineralized structures are very narrow and discontinuous. The vein system follows a steady northwest trend regardless of the orientation of the predominant schist foliation. Locally, the foliation is parallel with the fissure structure, however, this is more the exception than the rule. Usually, the vein system trends at right angles to the prevailing foliation pattern.

Abundant small prospecting shafts and surface diggings neatly follow each individual vein structure and give evidence of extensive mining at one time in this area. Exploitation of the metals was primarily confined to near surface high grade ore pockets, probably because of the rapid decrease of metals with depth.

Mining activity in this general area started with the discovery of the Magma vein at Superior in 1874 and the Silver King ore body in 1875. In the Mineral Mountain area only the Reymert and Martinez mine, aside from several smaller workings, became somewhat famous; the first for its silver content and the second for its massive galena mineralization. Owing to the unfavorable price situation, however, these mines could not maintain a continuous operation and had to close down in the early thirties. The recent upsurge in the silver price created quite an interest among mining companies in this area again. At the present time small mining groups undertake the difficult task to reopen and deepen old adits and shafts in the search for additional high grade ore pockets. Some diamond drilling has been carried out on the surface to explore for ore at depth.

The individual veins are usually 500 to 1000 feet apart and their mineral assemblage, texture, and regional occurrence clearly suggest an epithermal origin for these deposits. Open space filling is the predominant form of emplacement resulting in the formation of conspicuous drusy cavities, comb structures, crustification, and symmetrical banding. Brecciation and extensive slickensiding along the footwall of the fissures indicates post-mineral movement. A six- to ten-inch-wide zone of intense mylonitization is commonly developed and the fault plane is usually straight and smooth. Brecciated Pinal Schist is almost always present within the vein structure.

Alteration adjacent to individual fissures is very inconspicuous. Because the host rock is already a muscovite-chlorite-quartz schist any superimposed propylitization as the result of ascending mineralizing solutions is difficult to recognize in the outcrop. A small zone of bleaching is usually developed in the schist ranging outward from the vein for several feet into the host rock. The emplacement of diabase into the fissure veins must have occurred before the mineralizing event because fragments of diabase are present in the mineralized breccia.

The veins form distinct iron stained exposures and stand out as narrow, elongated ridges because of the high amount of silica present. Quartz is the predominant gangue mineral forming typical crustification bands. Calcite and dolomite are next in abundance followed by barite and locally some fluorite. Visible ore minerals are sparse and include galena, malachite, specularite, manganese and possibly some sulfarsenides, although none were definitely identified megascopically.

The only extensive galena mineralization occurs in the Martinez mine. Reportedly, the galena does not contain any silver. Another small occurrence of galena, sphalerite and very little chalcopyrite is found 2500 feet southeast of Mineral Mountain in the vicinity of a rhyolite intrusive body. Minor amounts of small euhedral limonite pseudomorphs after pyrite are always visible in the deposits.

Epithermal deposits are considered to be the result of near surface, low temperature (200° C) precipitation of ascending hydrothermal solutions circulating freely through the fractured rock as they are being expelled from a magmatic source at depth. Because the mineralized veins in this area are found in close proximity to volcanic necks and vents (Picketpost Mountain) an association of mineralization with Tertiary volcanic activity seems to be evident rather than an association with deepseated intrusive bodies.

In the following paragraphs a more detailed discussion of the larger mining properties is given.

Reymert Mine

The Reymert mine is located in the E 1/2 of section 22, T2S, R11E along a N 15° W trending fissure vein system. On the surface the veins are 10 to 20 feet wide and dip 75° W in the northern portion and 75° E in the southern portion.

The mineralized structures transect the schist foliation almost at right angles. Because of the strong silicification the veins form prominant narrow ridges within the general schist terrain. Abundant shafts and trenches (Alaska, Australia) have been dug along these structures in the search for high-grade silver mineralization.

Between 1887 and 1930 the Reymert mine produced $575,000 worth of silver but the mine is inactive at the present time. Two years ago the Phelps Dodge Corporation undertook some surface exploration in this area and bored three diamond drill holes in an attempt to intersect the mineralized structures at depth. Drilling in the schist proved to be very difficult and the veins were never intersected at depth to the extent as they appear on the surface. DDH RI-1 (fig. 2), an inclined hole, indicates some sulfide mineralization and a little fluorite in Madera Diorite about 400 feet deep. The mineralization is usually confined to 1/2 to 4 inch veinlets which may indicate that the massive vein structures exposed on the surface thin out rapidly with depth. DDH R-2 and DDH R-3 (fig. 3 and 4 respectively) show a similar mineral assemblage.

From the drill logs it is also evident that the Madera Diorite is much more extensive at depth than can be seen from surface exposures. The Alaska shaft, for instance, intercepted diorite at 260 feet and bottomed in the same rock at 420 feet.

Mineralization at depth appears to be mainly confined to Madera Diorite, rather than the overlying and

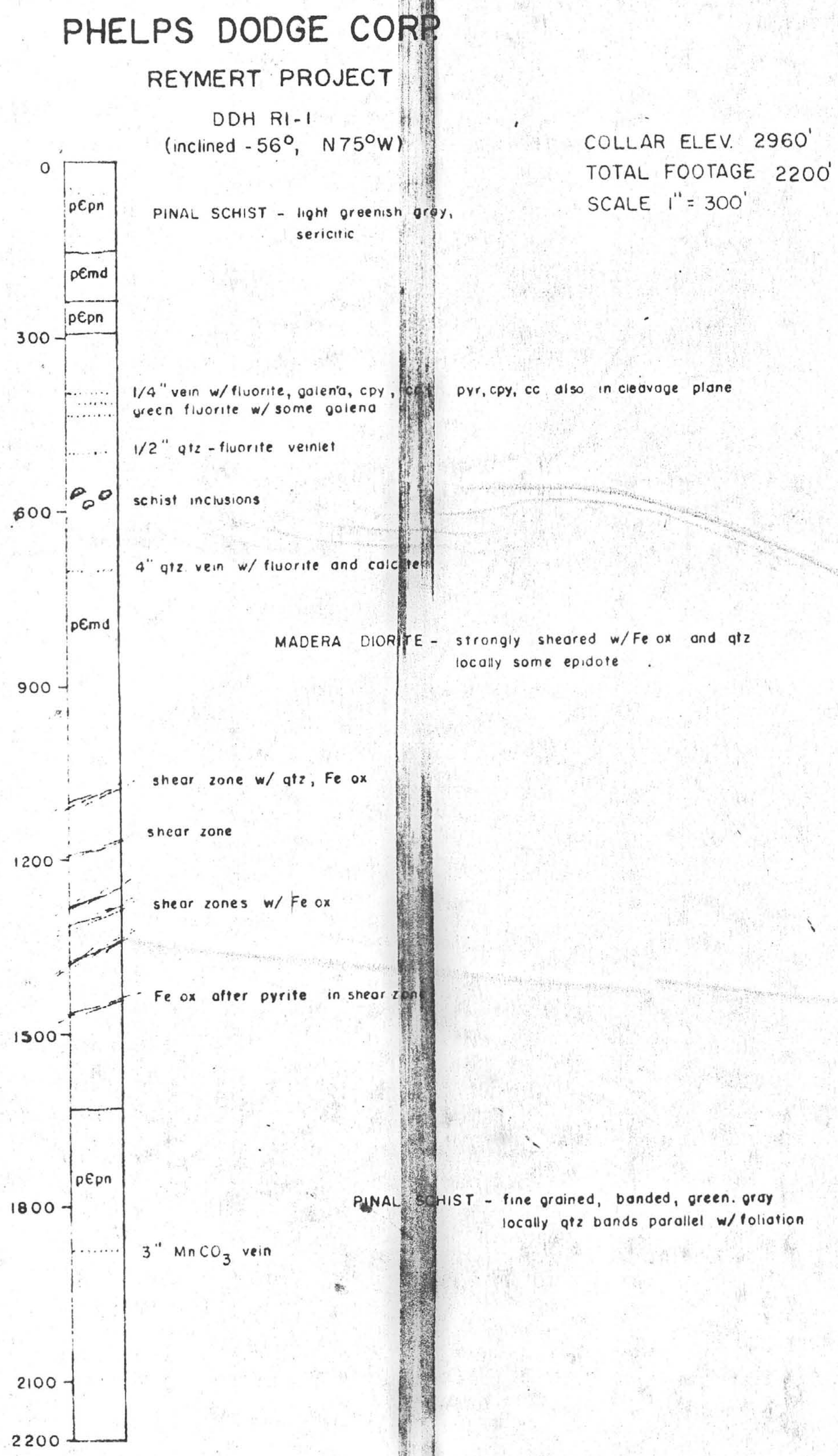

Fig 2 Log of Diamond Drill Hole RI-1 (modified by E. Schmidt)

PHELPS DODGE CORP.

REYMERT PROJECT

DDH R-2

COLLAR ELEV. 3400'
TOTAL FOOTAGE 1800'
SCALE 1= 300'

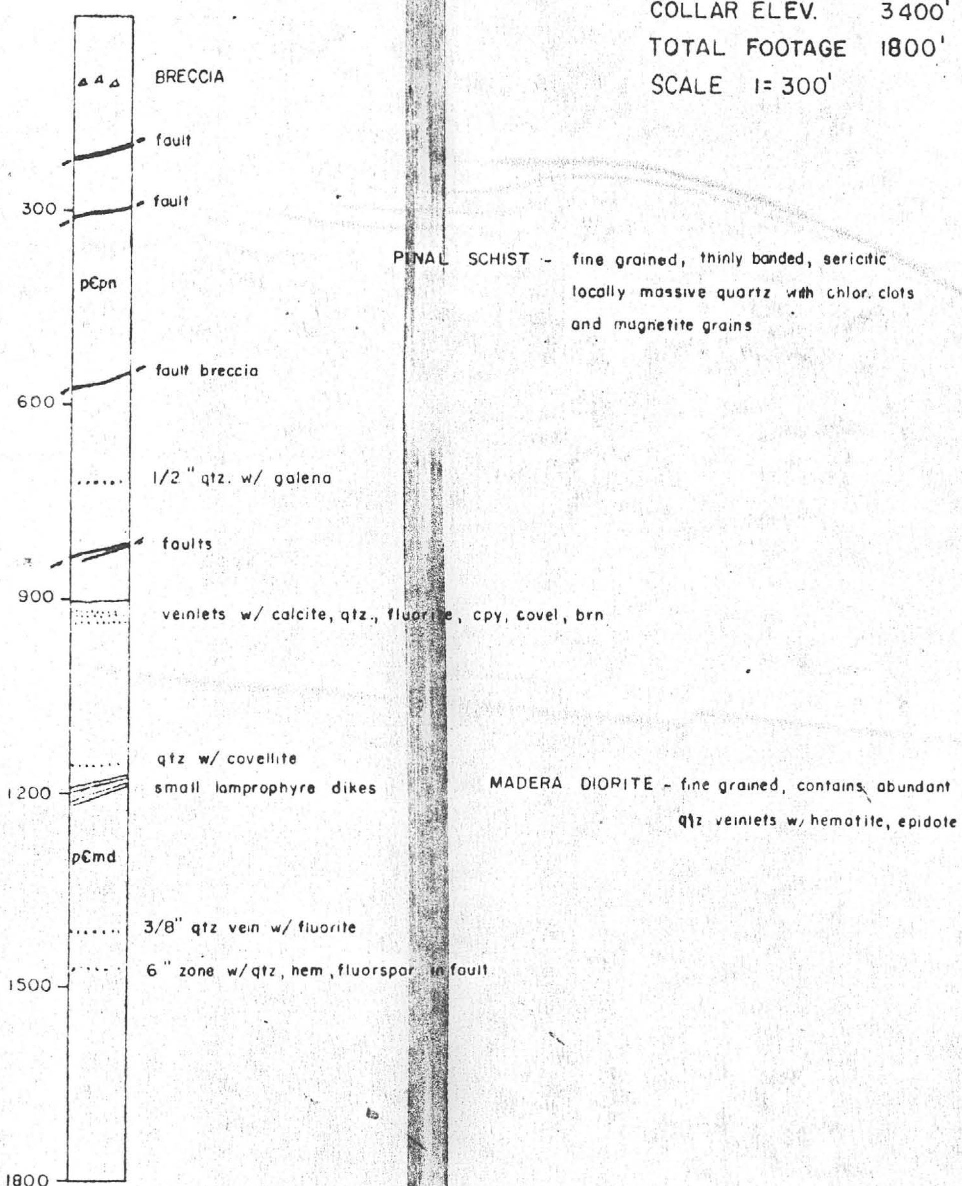

Fig. 3 Log of Diamond Drill Hole R-2 (modified by E. Schmidt)

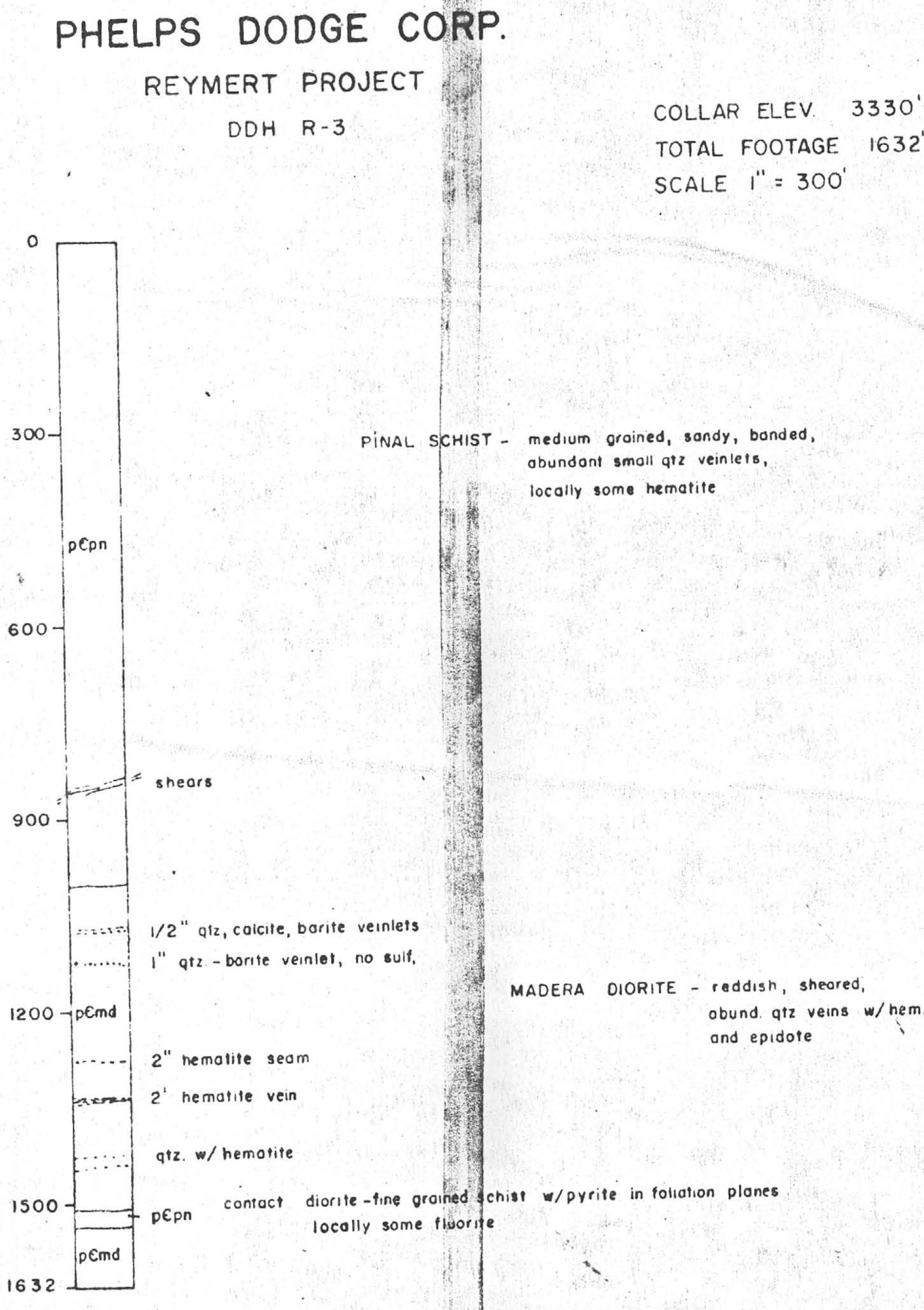

Fig. 4 Log of Diamond Drill Hole R-3 (modified by E. Schmidt)

underlying Pinal Schist. Additional exploration may prove that the diorite is actually a better host rock for sulfide mineralization than the Pinal Schist.

Martinez Mine

The Martinez mine is located in the SW 1/4 of section 18, T3S, R12E along a northwest-trending fissure vein that dips 50° W. The workings consist of two inclined shafts, one adit, and a small concentrating plant. The Martinez mine is inactive at the present time. It is owned by the Ball, Owen and Wingfield Mining Company of Phoenix, Arizona.

The host rock is a pink, very dense, somewhat porphyritic rhyolite which intruded the Tertiary volcanic flow complex. On the surface the vein is 5 to 10 feet wide and contains predominantly massive galena. Reportedly no silver is associated with the galena. No other sulfide minerals were recognized in the outcrop.

Generally, the galena occurs as solid nodules measuring up to 6 inches in diameter. The unoxidized core is usually engulfed by concentric layers of cerussite, anglesite(?), and some hematite. The galena nodules are found in the sheared and brecciated gangue of volcanic material. Some silicification was also noted. As seen in polished sections quartz penetrates every available fracture in the massive galena and locally forms drusy cavities. Under the microscope no solid solution phase of argentite could be recognized in the galena. The strong plastic deformation of the galena is probably the result of tectonic stresses developed after crystallization.

Silver Bell Mine

The Silver Bell mine is located in the N 1/2 of section 18, T3S, R12E about 3000 feet northwest of the Martinez mine and apparently lies along the same northwest-trending mineralized structure. The mine is owned and operated at the present time by the Ball, Owen and Wingfield Mining Company.

The Silver Bell structure strikes N 8° W, dips 67° W, and cuts the rhyolite intrusive body described above. The vein is about 20 feet wide and is bordered on both sides by a fault. Slicken-sides along the faults indicate a normal down-dip, post-mineral movement. A 5 foot gouge zone is developed along the hanging wall containing abundant galena nodules. The latter show concentric oxidation layers of cerussite and anglesite. Some hematite, azurite and chrysocolla was also noted. In polished sections some covellite was seen replacing galena along incipient fractures. Quartz fills open spaces and forms drusy cavities. Galena again shows a strongly deformed texture.

The gangue material in the vein is a rhyolite breccia recemented mainly by quartz and chalcedony. A few specks of chrysocolla were noted locally. According to the field personnel of the B. O. W. Mining Company (oral communication) the silver tends to be concentrated near the footwall of the vein. In hand specimens fine veinlets of cerargyrite can be recognized filling fractures in the brecciated rhyolite. No native silver and/or argentite could be seen.

Long hole exploratory drilling in the footwall of the vein confirmed silver mineralization for 40 feet to the east.

Woodpecker Mine

The Woodpecker mine is located along a series of fissure veins in the W 1/2 of section 35, T2S, R11E. The structures strike generally N 20° W, dip 32 - 72° SW and cut the foliation of the Pinal Schist with an oblique angle. Post-mineral faulting along these veins is indicated by the presence of abundant slicken-sides on the footwall. Numerous shafts, trenches, and adits have been dug in the vein to explore for metals but the mine is inactive at the present time.

The main portion of the vein consists of quartz, chalcedony and hematite showing characteristic colloform banding and crustification. Generally, the vein material is a brecciated mixture of quartz and schist with a dark greenish gray siliceous matrix. Here and there, a few specks of galena are visible.

A vein located near the center of section 35 contains galena, chalcopyrite, malachite, hematite and abundant drusy quartz. Galena occurs in blebs up to 2 cm in diameter and is replaced in part by anglesite. The latter penetrates the host along fractures and crystallographic boundaries, and locally completely encloses small portions of galena. Chalcopyrite is present in minor amounts as small isolated grains. Specular hematite forms conspiceous fine bands outlining in minute detail the colloform texture of the rock. Quartz is the latest mineral in this assemblage filling open spaces and giving rise to typical comb structure and crustification. No silver minerals were definitely identified in hand specimens and polished sections.

Talley Mine

The Talley mine is located in the N 1/2 NW 1/4 of section 5, near the dividing line between T2S and T3S, R12E. In August 1965 the mine was operated by Dick Heros who developed a 300 foot drift and a 100 foot shaft. Reportedly, the property had been worked from 1935 to 1937 and produced 4000 tons of ore averaging 15 oz. silver per ton. Present plans are to deepen the shaft at least 400 more feet.

The mine is located along an 8 feet wide fault zone that trends N 70° W and dips 55° S. The fault separates a block of Pinal Schist from Madera Diorite. A one foot wide gouge zone is developed along the footwall of the structure and forms a uniformly inclined smooth surface.

The vein material consists mainly of a brecciated and mylonitized greenish-gray mixture of diorite and schist which is recemented by calcite. Locally, quartz forms open space fillings. Individual grains of galena are finely disseminated throughout the dark-green matrix. A brown, earthy manganese coating is common along fractures. No definite silver mineralization was recognized in hand specimens collected from the shaft.

Other Prospects

Each one of the indicated vein structures in the Mineral Mountain quadrangle (plate 1) has invariably been explored extensively for precious and base metals. However, the mines are too numerous to be described here individually in detail. The Oklahoma mine, Ajax mine, Coronado mine, just to mention a few, are all similar in occurrence to and show the same mineral assemblage as the Reymert and Woodpecker mine. Needless to say, none of these mines are active today.

A drilling program initiated by the B. O. W. Mining Company in 1964 attempted to confirm disseminated copper mineralization in Pinal Schist about one-half mile northeast of the isolated Mineral Mountain Quartz Monzonite exposure in Box Canyon. The schist in this particular area is somewhat iron stained on the surface, and at one place a gently eastward dipping shear zone exposes considerable amounts of copper carbonates. The company drilled several AX holes down to 537 feet and reportedly intercepted copper oxide mineralization from the surface to the bottom. No sulfide mineralization or an enriched zone were encountered. According to the field personnel (oral communication) silver averaged 2 to 8 oz. per ton.

As pointed out elsewhere in this manuscript, the writer believes that the Mineral Mountain Quartz Monzonite extends further to the east beneath Pinal Schist. The observed iron staining in the overlying schist and the sparse copper mineralization may be intricately associated with the monzonite intrusion. However, the amount of mineralization appears to be insufficient for an economic metal deposit at the present time.

GEOLOGIC HISTORY

The older Precambrian Pinal Schist is the product of widespread regional metamorphism of sedimentary rocks and interbedded basic volcanic rocks that accumulated in a major northeast-trending geosyncline across the State of Arizona. Time equivalent units are the Yavapai Schist in the Bradshaw Mountains and the Vishnu Schist in the Grand Canyon area (Wilson, 1962). The original sedimentary rocks were largely mudstones, sandstones and arkoses with some basic volcanic tuff layers. During the Mazatzal Revolution, at the end of older Precambrian time, these rocks underwent extensive metamorphism and folding and were intruded by a wide range of igneous rocks as evidenced by the presence of Ruin Granite and Madera Diorite. The clastic sediments were converted into quartz-muscovite schist and the mafic tuff layers to amphibolites. The developed schistosity coincides in general with the original bedding of the sediments. The foliation indicates a predominant northeast trend over large portions of Arizona. In the Mineral Mountain quadrangle, however, the schistosity trends predominantly northwest and east-west.

Following the Mazatzal Revolution the area was uplifted and subjected to extensive erosion which carried on long enough to produce an essentially flat surface of regional extent, the ep-Archean erosion surface. Upon this flat surface were deposited the sediments of the younger Precambrian Apache Group in a northwest-trending, steadily sinking trough. The rocks were mainly sandstone, shale, and limestone. The presence of a basal conglomerate unit in the clastic sediments indicates repeated uplift and subsidence during the cycle of sedimentation. Locally, submarine volcanism spread a basaltic layer over Mescal Limestone.

At the end of younger Precambrian time the Grand Canyon Disturbance was accompanied by a widespread diabase intrusive activity which thoroughly penetrated the sediments along bedding planes and fracture zones and caused a dilation of the entire sedimentary sequence. The Grand Canyon Disturbance was followed by another erosion cycle which produced the ep-Algonkian surface. Although no Paleozoic rocks are exposed in the Mineral Mountain quadrangle they may have been deposited and since then eroded again because thick Paleozoic sections crop out in the vicinity of Superior, only 4 miles to the east.

The next tectonic event recognized in this area is the tilting and folding of the older and younger Precambrian rocks reflecting the onset of the Laramide Revolution. This event lasted until middle and late

Tertiary time. The steeply dipping beds of the Apache Group, the small scale folding of the Mescal Limestone, and the Pinal overthrust are evidence for this movement.

Igneous intrusions were plentiful during this tectonic period and the Mineral Mountain Quartz Monzonite may be such an intrusion. Throughout southern Arizona extensive mineralization accompanied these intrusions and formed the large porphyry copper deposits which are being mined today.

The vein-type mineralization in the quadrangle is certainly of similar, if not younger, age. The fissure system in the schist probably originated during this time either as a result of directed compressional stress in a northwest direction, or as a result of regional monoclinal folding. In the latter case the axis of the fold would lie somewhere near Mineral Mountain trending parallel to the present fissure system. Ascending solutions rich in silica, lead, silver, and manganese readily penetrated the structurally prepared ground and deposited near surface ore pockets.

Uplift must have been vigorous enough to cause tremendous erosion and the deposition of abundant coarse material as indicated by the Whitetail Conglomerate. Regional studies have shown that the Whitetail was deposited in isolated structural basins and stream channels, the material having been derived from adjacent high mountain areas.

Contemporaneous with and following the Whitetail deposition volcanic activity was initiated which resulted in the formation of a regional dacitic ash sheet. A later volcanic eruption produced the extensive deposits of rhyolite flows and tuffs seen in the Picketpost Mountain and Copper Butte areas. This material filled structural basins previously formed through block faulting. The volcanic complex exposed in the southern and eastern portion of the quadrangle is a typical example of the later volcanic event. Also, the rhyolite intrusions that comprise Mineral Mountain proper and which are exposed in Martinez Canyon were formed during this time.

Crustal unrest must have continued until Pliocene time because Gila Conglomerate is involved in regional tilting. Gila Conglomerate, similar to the Whitetail Conglomerate, represents a period of rapid erosion following the rhyolitic eruptions. The present day topography is a result of large-scale block faulting, thrust faulting, and regional tilting in association with continuous erosion which is wearing down the mountainous areas and depositing the debris into the surrounding basins.

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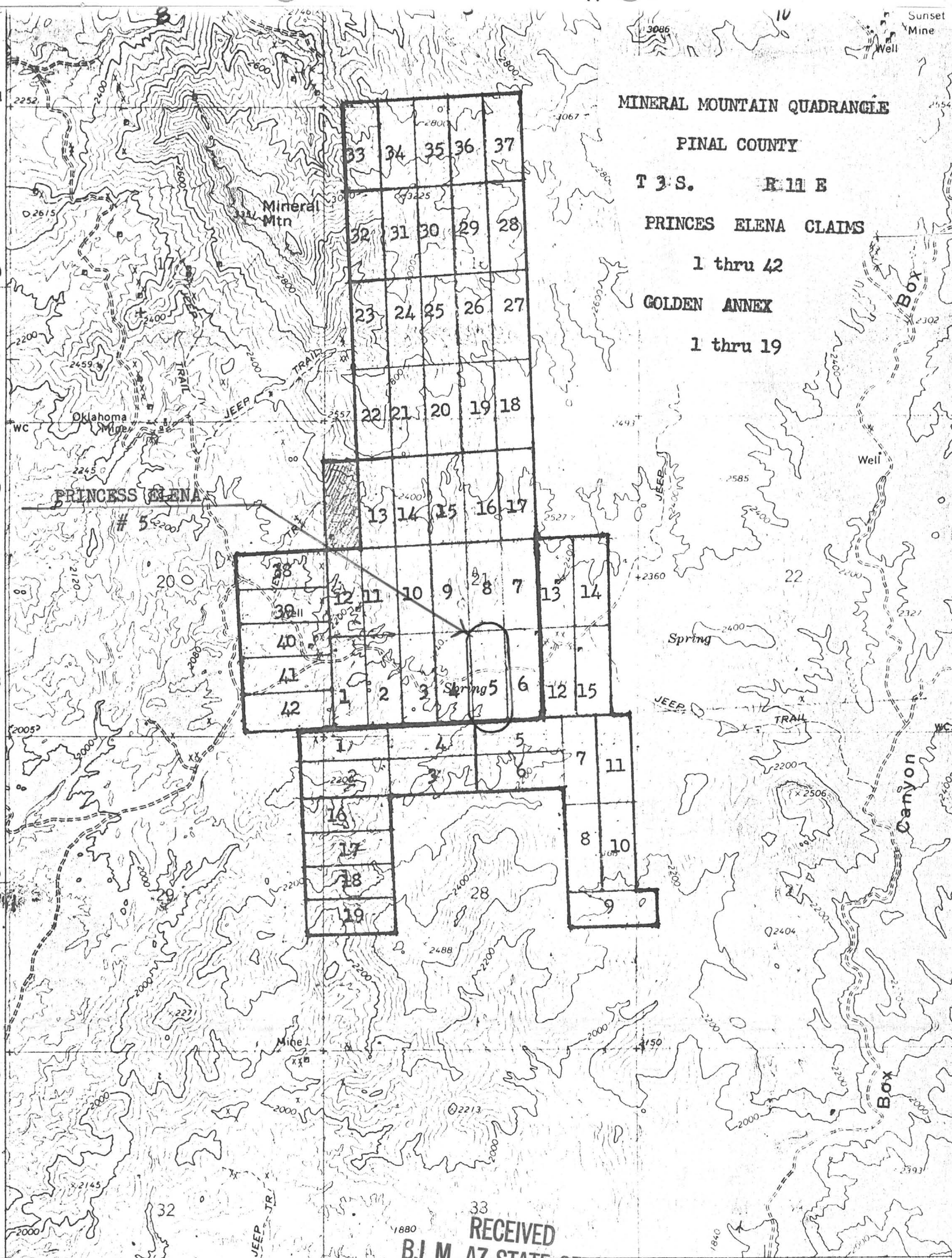


Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography by photogrammetric methods from aerial photographs taken 1962. Field checked 1964

Polyconic projection. 1927 North American datum
10,000-foot grid based on Arizona coordinate system, central zone
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue

GN MN 0°06' 2 MILS 14° 249 MILS

UTM GRID AND 1964 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

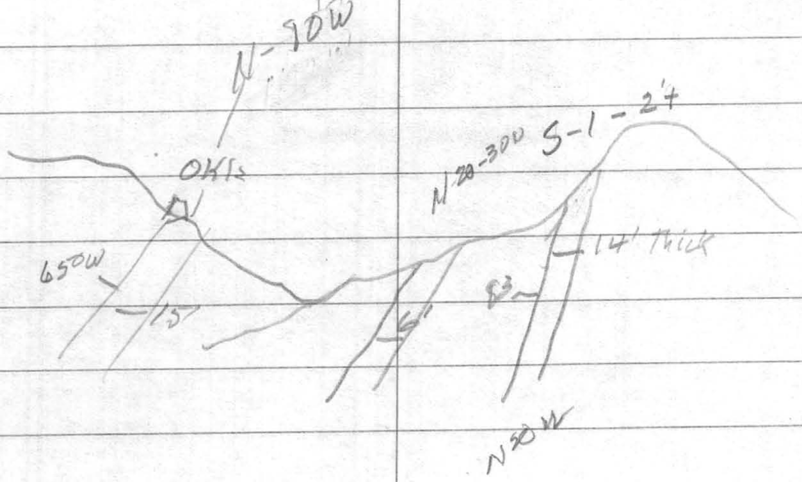
FOR SALE BY U.S. GE
A FOLDER DE

Mineral Mtn Quad
Florence NE Quad

Quad Florence NE

~~Quad~~ Mineral Mbr

N20W - N Extension

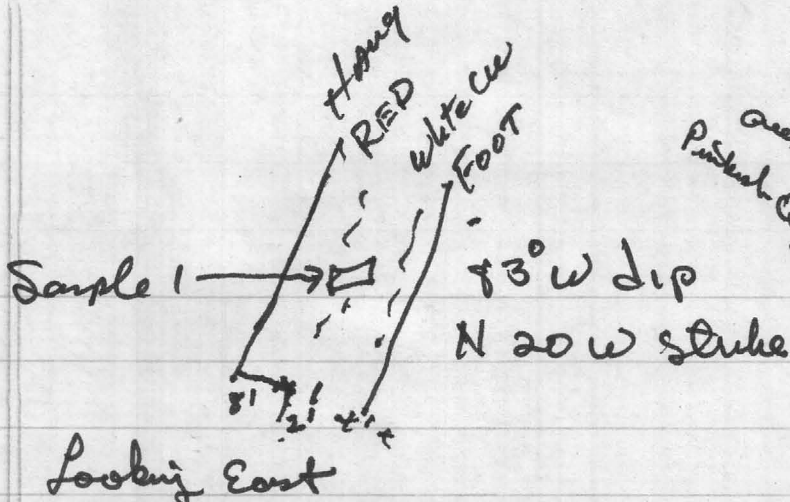


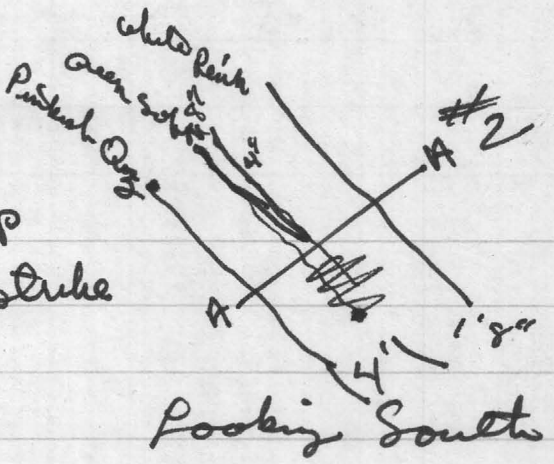
Mile Marker 145
MM Flame Jct - Florence
Turn E.

MS | 37/52

Ore at MS - N20W, Dip 53W.

Sylvester Dimmer
Doug Martin
Buzz Brown

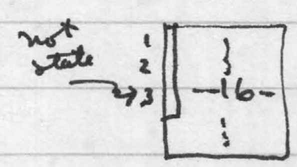




3S 11E
~~T11E R3S~~

7, 8
18, 17
19, 20

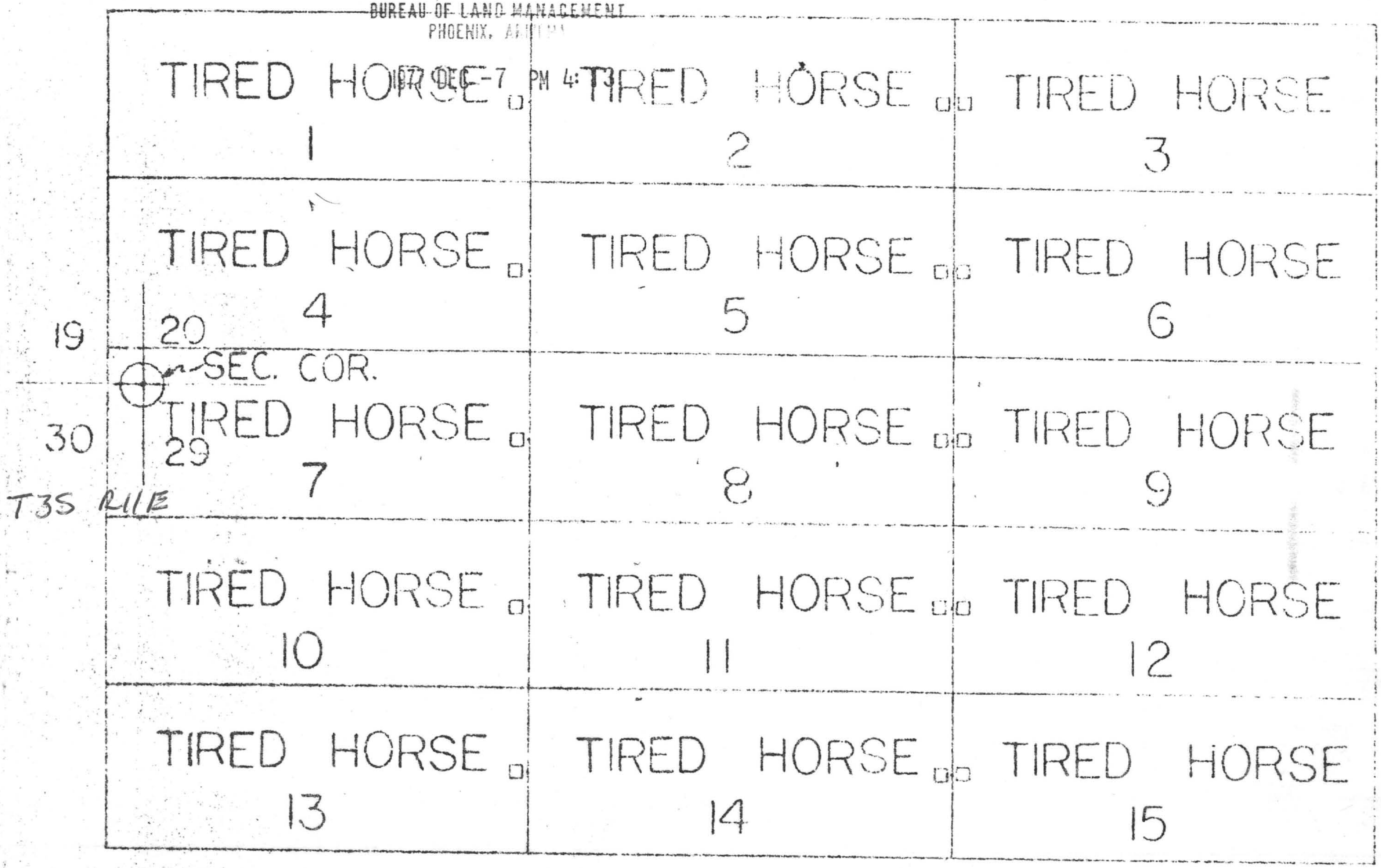
Sect 16 - State



all open except Pate

Paul 939 6214 after 3 PM
Re Serial # Cat Loader
DH8 tractor info

Fred Gorchess
meeting monday



T.3 S.
R.11E.

TIRED HORSE CLAIM GROUP

PINAL CO., ARIZ. SCALE: 1"=500 FT. NOV. '77

Custom Smelting
Chemical Analysis
Flow Sheet Design

GOLD DOME
MINING CORPORATION
Refining Division

4329 East Magnolia
Phoenix, Arizona 85034
(602) 243-5226

ASSAY RESULTS

TO: Syl Dimmer

4-29-83

SAMPLE ID NO.	PROCESS USED	AU(GOLD) OZ/TON	AG(SILVER) OZ/TON
Oklahoma Vein 3ft.	Fire Assay	.61	1.49
#2 Vein Left of center shaft	Fire Assay	.6	2.4
Rock from tunnel of Oklahoma	Fire Assay	.3	1.4
Bank of Washington	Fire Assay	.51	3.4
Tunnel Oklahoma	Fire Assay	.4	2.3

The above assay results are for the sole use of Gold Dome Mining Corp. and the above named party. They are not intended for public distribution or for the public solicitation of funds. These results are provided as a result of Gold Domes interest in the above property.

Gene Stowe

Florence NE Quad
Mineral Mtn Quad

REPORT ON

AN INDUCED POLARIZATION SURVEY
GORILLA PROPERTY
PINAL COUNTY, ARIZONA

Owned by

MARGUERITE LAKE MINES LTD (N. P. L.)

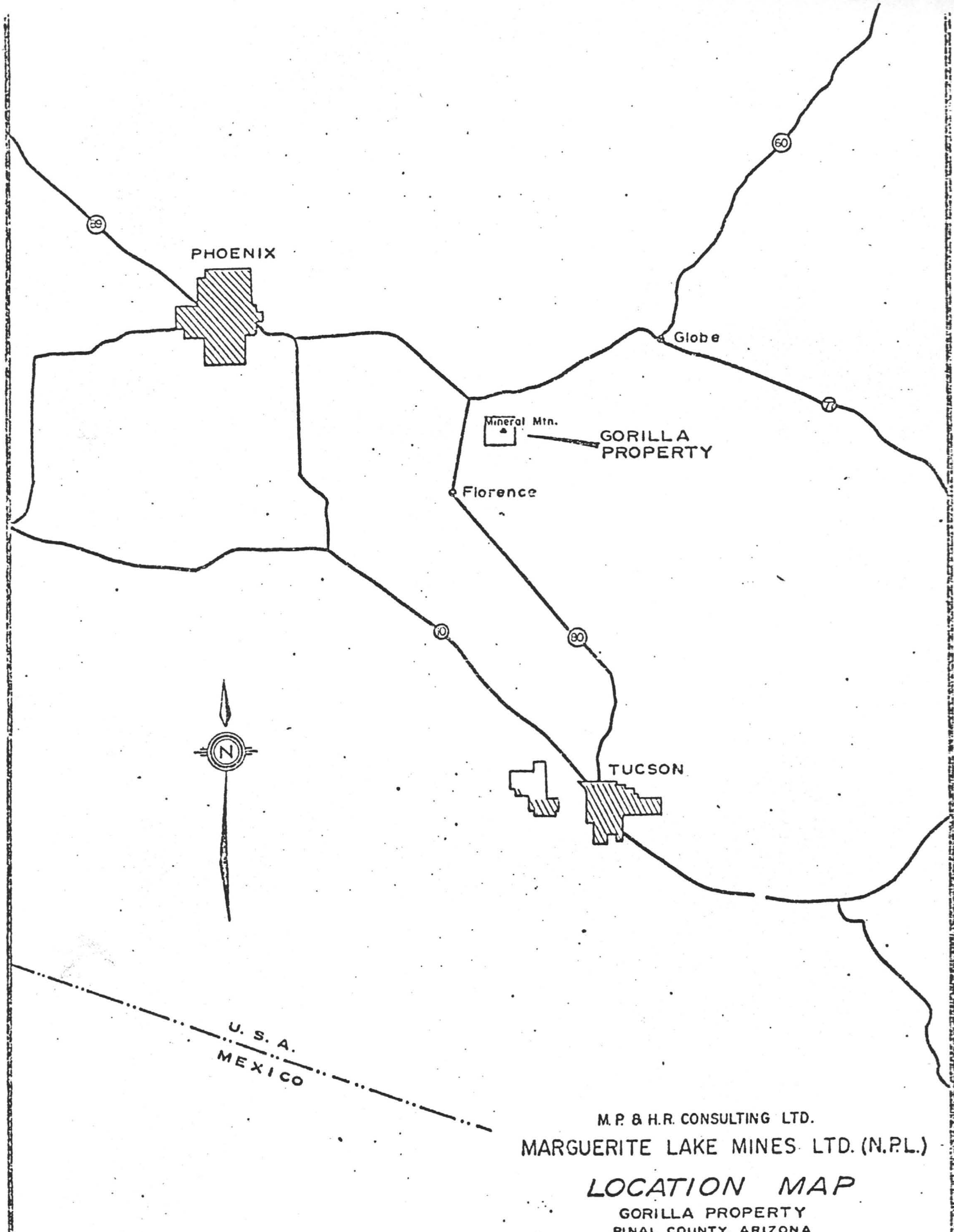
for

METALS PETROLEUM & HYDRAULIC RESOURCES
CONSULTING LTD

by

FRED J. SYBERG, B. Sc.,

November 15, 1970



M.P. & H.R. CONSULTING LTD.

MARGUERITE LAKE MINES LTD. (N.P.L.)

LOCATION MAP

GORILLA PROPERTY

PINAL COUNTY, ARIZONA

SCALE: 1" = 21 mi. Approx.

Nov. 1970 J.R.G.

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APPENDICES

Report on Induced Polarization Survey by
Fred Syberg, Geophysicist

Map of Geochemical Results - Scale 1" = 500 feet

Map of Induced Polarization Results - Scale 1" = 500 feet

SUMMARY

Marguerite Lake Mines Ltd (N.P.L.) holds the rights to 50 contiguous mining claims, located about ten miles north-east of Florence, Arizona.

Kennecott's 23,000 ton per day open pit mine at Ray, is seventeen miles east of the Marguerite property. Newmont's 1,500 ton per day underground mine at Superior is fourteen miles to the north-west and the Miami copper camp with a combined production of some 36,000 tons per day is thirty miles to the north-west.

The rock formations underlying the claim group are Precambrian Pinal schist and Precambrian quartz monzonite. Pinal schist is host rocks for copper mineralization at the Ray Mine and at the Miami mining camp. The Precambrian monzonite is host rock for the copper mineralization in other mines in Arizona.

Three parallel veins containing gold, silver and copper cut the Pinal schist. A small amount of mining has been done on these veins, although no shipments have been recorded.

Copper mineralization has been found over a wide area in the Precambrian granite and subsequent geochemical soil surveys and induced polarization surveys have indicated coincidental anomalous conditions.

It is recommended that an exploration programme be initiated on this property which should include the following:

1. Reconnaissance geochemical soil sampling
2. Reconnaissance induced polarization survey
3. Diamond drilling *or hammer*

It is anticipated that the budget for this programme would be $86,000.00 divided into two phases.

CONCLUSIONS

1. Sporadic copper mineralization has been found in Precambrian quartz monzonite over an area approximately 3,000 feet by 2,000 feet. This copper occurs mainly as a chrysacolla stain on fracture planes but it is also disseminated through the rock at times. One vein containing chalcocite has been noted and minor amounts of molybdenum have been seen.

2. Three veins containing copper, gold and silver cut the Pinal schist. Samples of these veins as reported by Dr. A. C. Skerl returned the following assays:

Vein	Cu	Au	Ag	Width
No. 1	1.24	0.17	0.10	4'
Dump of vein material	not assayed	0.14	0.10	

The extension of one of the veins can be seen for many hundreds of feet with the vein swelling to a width of 20 feet in places.

3. Anomalous amounts of copper are found in the soil in five separate zones in the vicinity of the known copper mineralization. Two of these zones are "open" to the west.

4. An induced polarization survey performed over part of the property shows an area of high chargeability near the contact between Pinal schist and the Precambrian quartz monzonite and an area of moderate chargeability over the main geochemical anomaly.

RECOMMENDATIONS

PHASE I

1. Perform a geochemical soil survey along the southern and western extensions of the present survey.

2. Perform an induced polarization survey to the north of the present survey and extend the coverage on lines No. 2 and No. 3 to the east.

3. Sample the bedrock under the present induced polarization anomaly by drilling holes to a depth of 700 feet. Sample the bedrock under the geochemical anomaly-moderate induced polarization anomaly by drilling one hole to a depth of 700 feet.

PHASE II

4. Diamond drill any subsequent induced polarization anomalies found in the proposed survey. It is anticipated that 3, 400 feet of drilling would adequately explore and sample any bedrock source.

BUDGET FOR PROPOSED PROGRAMME

PHASE I

Geochemical Survey	$ 2,000.00
Induced Polarization Survey	$ 3,500.00
Surveying and geological mapping	$ 1,000.00
Vehicles	$ 1,000.00
Travel and living expenses	$ 1,500.00
Diamond drilling 1,400' @ $10.00/ft	$14,000.00
Engineering-assaying, drafting etc	$ 2,000.00
Administration	$ 1,000.00
Contingency	$ 3,000.00
TOTAL	$29,000.00

TOPOGRAPHY

The topography is gently rolling with elevations from 2,000 feet to 2,300 feet. Intermittent streams flow in the sand-filled gulleys during the rainy seasons.

CLIMATE AND VEGETATION

The climate is desert-type. Winter temperatures seldom reach freezing point and summer temperatures peak around 110°F. Rainfall annually is less than eight inches. Vegetation includes many kinds of cactus, mesquite bushes and palo verde trees.

HISTORY

There is no history of significant mining from the Gorilla property. Limited mining was done on one of the copper, silver, gold veins cutting the Pinal schist, but no shipment records exist.

An exploration shaft was sunk at least 60 feet which is located south of the main area of showings. No mineralization was observed in the dump of this shaft.

Arcan Mining & Smelting Ltd (N.P.L.) acquired an option to the property by an Agreement dated June 11, 1969, and Marguerite acquired an option from Arcan in July, 1970. Dr. A. C. Skerl (P. Eng.,) of Vancouver, Canada, visited the property in April of 1969, sampled two of the veins and made a brief geological examination and recommended that further work be done. To date Marguerite has performed a geochemical survey and Metals Petroleum and Hydraulic Resources Consulting Ltd has carried out an induced polarization survey and an extremely cursory geological examination.

INTRODUCTION

This report contains the results of an Induced Polarization Survey which was carried out by Mr. Carlos Aiken, a geophysicist, employed by Metals, Petroleum & Hydraulic Resources Consulting Ltd. This report was prepared in Vancouver, B. C. in November, 1970.

PROPERTY

The property consists of 50 continguous claims which are located on the south-west side of Mineral Mountain, about ten miles north-east of Florence, Arizona.

The claims which are recorded in the Court House, Florence, Arizona are listed as follows:

Claim Name	County	Docket	Page
Lost Gorilla 1	Pinal	522	451
Lost Gorilla 2	Pinal	522	452
Lost Gorilla 3	Pinal	522	453
Lost Gorilla 4	Pinal	522	454
Lost Gorilla 5	Pinal	522	454
Lost Gorilla 6	Pinal	522	456
Lost Gorilla 7	Pinal	536	20
Lost Gorilla 8	Pinal	536	21
Lost Gorilla 9	Pinal	536	22
Lost Gorilla 10	Pinal	536	23
Lost Gorilla 11	Pinal	536	24
Lost Gorilla 12	Pinal	536	25
Lost Gorilla 13	Pinal	536	26
Lost Gorilla 14	Pinal	536	27
Lost Gorilla 15	Pinal	536	28
Lost Gorilla 16	Pinal	558	113
Lost Gorilla 17	Pinal	558	115
Lost Gorilla 18	Pinal	558	116
Lost Gorilla 19	Pinal	558	117
Lost Gorilla 20	Pinal	558	118
LEW 1 to 20 Incl.	Pinal	571	442-441

PROPERTY AND LOCATION

Marguerite Lake Mines Ltd (N.P.L.) holds an option on 50 contiguous mining claims which are located some ten miles north-east of Florence, Arizona on the south-west side of Mineral Mountain. The claims are recorded in the Court House, Florence, Arizona, as follows:

Claim Name	County	Docket No.	Page
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Lost Gorilla 6	Pinal	522	456
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Lost Gorilla 8	Pinal	536	21
Lost Gorilla 9	Pinal	536	22
Lost Gorilla 10	Pinal	536	23
Lost Gorilla 11	Pinal	536	24
Lost Gorilla 12	Pinal	536	25
Lost Gorilla 13	Pinal	536	26
Lost Gorilla 14	Pinal	536	27
Lost Gorilla 15	Pinal	536	28
Lost Gorilla 16	Pinal	558	113
Lost Gorilla 17	Pinal	558	115
Lost Gorilla 18	Pinal	558	116
Lost Gorilla 19	Pinal	558	117
Lost Gorilla 20	Pinal	558	118
LEW 1 to 20 Incl.	Pinal	571	442-461
Big Bonanza 1	Pinal	560	854
Big Bonanza 2	Pinal	562	802
Big Bonanza 3	Pinal	562	803
Big Bonanza 4	Pinal	562	804
Big Bonanza 5	Pinal	562	805
Big Bonanza 6	Pinal	568	533
Big Bonanza 7	Pinal	568	534
Big Bonanza 8	Pinal	568	535
Big Bonanza 9	Pinal	568	536
Big Bonanza 10	Pinal	568	537

The 50 claims make up an area of approximately 1,050 acres.

The property can be reached by a fairly good gravel road maintained by local ranchers.

REGIONAL GEOLOGY

The Gorilla property is on the western portion of the Tortilla Mountains, part of the basin and range province. These mountains consist of Precambrian granite, quartz monzonite, granodiorite and quartz diorite; locally there are other igneous rocks of post Paleozoic age. The granitic rocks intrude Precambrian Pinal schist and are overlain by Tertiary volcanics and sedimentary rocks.

LOCAL GEOLOGY

The rocks underlying the property consist of Precambrian Pinal schist intruded by Precambrian quartz monzonite.

Schistosity is approximately N 15° W, dipping steeply to the west.

The quartz monzonite is altered somewhat, and is cut by aphanitic acidic dykes which are classified as rhyolite.

North of the schist monzonite contact is a prominent ridge of highly altered limestone which is overlying the Pinal Schist. The exact relationship however, is unknown at this time.

MINERALIZATION

Three veins of widths from less than two feet to over twenty feet, are found in the Pinal Schist, in the northern portion of the property. These veins are in large shear zones, strike approximately N 15° W, and dip to the west at 65°. They are conformable with the schistosity.

Vein material consists of vuggy quartz, specular hematite with secondary limonite and jasper. Copper stain is noted in the material although no copper sulphides were seen. A band of altered limestone is associated with one of the veins.

Assays taken by Dr. A. C. Skerl returned the following:

Vein No.	Au oz/ton	Ag oz/ton	Cu %	Width
No. 1	0.17	0.10	1.24	4'
No. 2	0.14	0.14	Not assayed	dump
No. 3	0.11	0. 3	Not assayed	4'

An assay taken by Marguerite returned the following:

No. 2	0.11	0.13	1.84	3'

The surface expression of one of the veins can be seen extending to the north for many hundreds of feet.

There are some old workings in the ridge of altered limestone, but no economic mineralization was seen.

Small patches and stringers of "oxide" copper mineralization are seen in the quartz monzonite over an area approximately 3,000 feet by 2,000 feet. Some fairly local concentrations of copper are included in this area. With one exception the copper is found in the "oxide" form, i.e. chrysacolla, chalcanthite. One vein of chalcocite was noted.

Molybdenite was seen disseminated in the granite in one location.

An old exploration shaft was sunk in the monzonite south of the main zone of mineralization. No copper mineralization was seen in this old working.

GEOCHEMICAL SURVEY

During the year 1969, Arcan Mining & Smelting Ltd (N. P. L.) carried out a geochemical soil survey over the property. The results of this survey are plotted on map of scale 1" = 500 feet included with this report.

Background in the area is considered to be 30 parts per million of copper. Any value over 100 parts per million is considered to be anomalous. There are five areas on the survey that are anomalous, as well as a number of single "highs."

The main anomaly is of dimensions roughly 1, 500' x 1, 200' with an individual high of 23, 500 ppm. This anomaly coincides fairly well with the main surface mineralization. Patches of mineralization however, are seen outside the anomalous area.

One lense-shaped anomaly is associated with the schist-monzonite contact. It has dimensions roughly 2, 500'x 200' with an individual high of 290 ppm.

One anomaly is associated with the mineralized veins in the schist. It has dimensions roughly 1, 500' x 200' with an high of 1, 250 ppm.

Two anomalous zones exist on the west side of the property. Both these are "open" to the west so the ultimate size is unknown at this time. In the smaller anomaly the individual high is 198 ppm and the other peaks at 205 ppm.

GEOPHYSICAL SURVEY

In 1970 an induced polarization survey was carried out by Metals, Petroleum & Hydraulic Resources Consulting Ltd on behalf of Marguerite Lake Mines Ltd (N. P. L.). The survey was carried out along six lines spaced 1,000 feet apart with an electrode separation of 800 feet using a dipole-dipole configuration and searching to a theoretical depth of approximately 1,600 feet.

The results of this survey and the report prepared by Mr. Fred Syberg, geophysicist, are included with this report.

Mr. Syberg states that there is a definite high chargeability zone near the schist granite contact which may be caused by massive sulphides. He further states that a rather subtle anomaly with readings slightly above background is found over the area containing the surface mineralization. Mr. Syberg recommends that diamond (or Hammer) drilling be used to sample the bedrock under these two areas.

Respectfully submitted,

James R. Glass

James R. Glass, B.Sc.,
Consulting Geologist

APPENDIX "A"

Report on Induced
Polarization Survey by
Fred Syberg, Geophysicist

TABLE OF CONTENTS

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INTRODUCTION	1
PROPERTY	1
SURVEY SPECIFICATIONS	2
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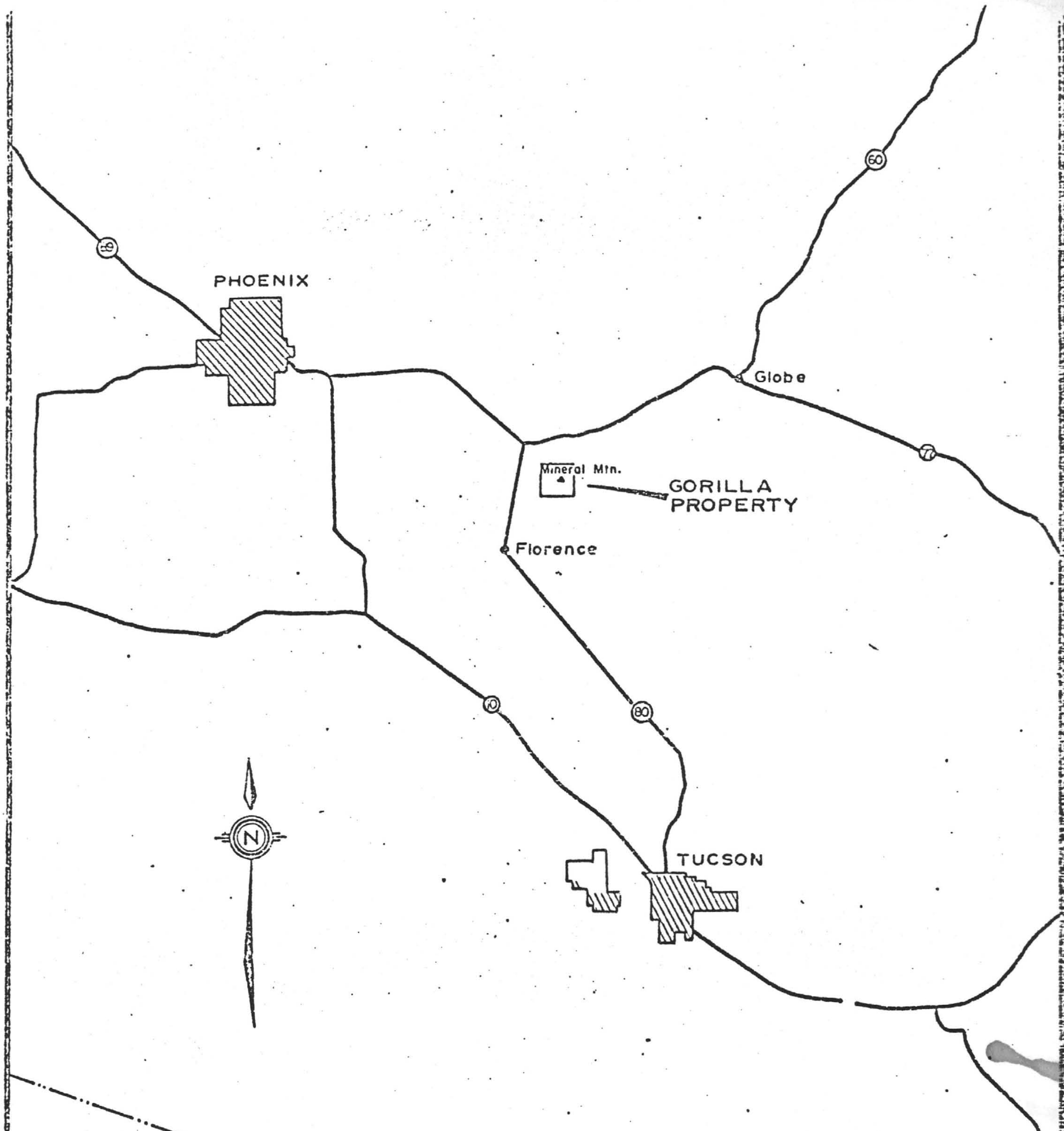
Presentation of Data	3
INTERPRETATION	4
CONTOUR PLANS	6
CONCLUSIONS AND RECOMMENDATIONS	7

APPENDICES

Map of apparent chargeability

n = 2 Scale 1" = 500 feet

Author's certificate



M. P. & H.R. CONSULTING LTD.

MARGUERITE LAKE MINES LTD. (N.P.L.)

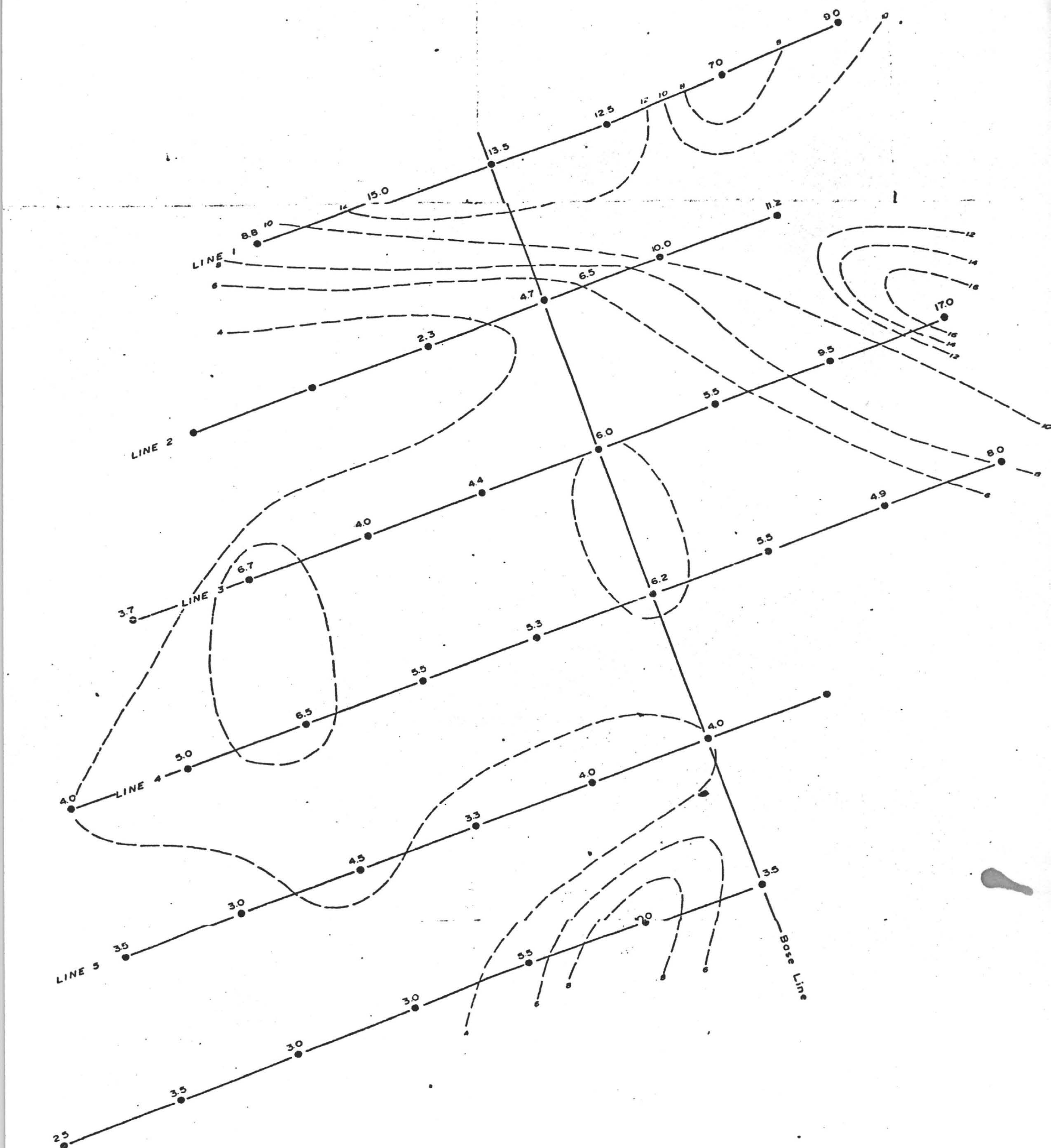
LOCATION MAP

GORILLA PROPERTY

PINAL COUNTY, ARIZONA

SCALE: 1" = 21 mi. Approx.

Nov. 1970 J.R.G.


LINE 1
LINE 2
LINE 3
LINE 4
LINE 5
Base Line
9.0
7.0
12.5
13.5
15.0
8.8
11.2
10.0
6.5
4.7
2.3
17.0
9.5
5.5
6.0
4.4
4.0
6.7
3.7
8.0
4.9
5.5
6.2
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3.5
3.5
10.0
5.5
3.0
3.0
3.5
2.5

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Big Bonanza 9	Pinal	568	536
Big Bonanza 10	Pinal	568	537

The 50 claims make up an area of approximately 1,050 acres.

The property can be reached by a fairly good gravel road maintained by local ranchers.

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Big Bonanza 5	Pinal	562	805
Big Bonanza 6	Pinal	568	533
Big Bonanza 7	Pinal	568	534
Big Bonanza 8	Pinal	568	535
Big Bonanza 9	Pinal	568	536
Big Bonanza 10	Pinal	568	537

SURVEY SPECIFICATIONS

Instrumentation:

The Induced Polarization equipment used was 2.5 kw. pulse-type transmitter manufactured by Sharp Instruments combined with a Scintrex Newmont type MKVII receiver.

Type of Current	-	Direct current broken at periodic intervals
Pulse duration	-	2 seconds "current on" 2 seconds "current off" Alternate pulses have reverse polarity
Integrating time	-	650 milliseconds
Delay time	-	450 milliseconds
Maximum available current	-	5.0 amps

Measurements taken in the field were:

1. Current flowing through current electrodes C_1 and C_2.

2. Primary voltage, V_p, between measuring electrodes during "current off" time. V_s divided by V_p gives the apparent chargeability (Ma) in milliseconds.

The apparent resistivity is calculated by dividing V_p by the current and multiplying by the geometrical factor appropriate to the electrode array being used.

Electrode Configuration:

The entire survey was carried out using the dipole-dipole configuration or array. The current electrodes C_1 and C_2 and the potential electrodes, P_1 and P_2 are moved in unison along the survey line. Current is applied to the ground at two points a distance (a) feet apart. The potentials are measured at two points (a) feet apart, in line with the current electrodes. The distance between the nearest current and potential is an integral number (n) times the basic distance (a). For this survey "a" was chosen to be 800 feet and "n" values of 1, 2, 3 and sometimes 4 were used.

The product of "n" and "a" is a rough approximation of the maximum depth of penetration. Covering the survey area using multiple separations provides more information as to depth, dip, location and metallic distribution of sources than does a single profile.

Presentation of Data:

The survey results are plotted in the two-dimensional "pseudo-section" manner with apparent resistivity in ohm-feet being plotted above the survey line and chargeability (Ma) in milliseconds below. This method of display is not to be taken as the vertical section of the electrical properties of the ground surveyed. The electrode separation is only one factor that determines the depth to which the ground affects a measurement. It is rather a convenient way of plotting all the data, especially lines of limited length.

The reading for any given set up is the mid-point between the centre point of the current electrodes and the centre point of the potential electrodes.

Contour plan maps of the apparent resistivity and chargeability were also plotted for n= 2.

The data received by the author of this report is believed to be accurate and the survey appears to have been well executed.

INTERPRETATION

The interpretation was based on a study of the existing chargeability and resistivity data both in "pseudo-section" as well as in contour form. Generally, highest priorities were given to anomalous areas having high chargeabilities and low apparent restivities along with greatest lateral and depth extent.

The two-dimensional "pseudo-sections" were mainly used to obtain information regarding apparent dip, depth determinations, and vertical distribution of metallically conducting material along the lines surveyed.

The contour plans provide information concerning strike, true dip, lateral distribution between survey lines and were used to correlate chargeability and resistivity with geological and geochemical data.

SECTIONS

Line No. 1 — The maximum apparent chargeability was 15 milliseconds which is considered above a variable background chargeability across the property of an estimated maximum of 6 milliseconds in the area of this line. The shape of the profile suggests a good anomalous condition due to an I. P. source with an easterly dip in the direction of the line. It is suggested that the vertical extent of the I. P. source is greater than 800 feet since no "double peaking" is evident. There appears to be some correlation between low resistivity and high chargeability.

Line No. 2

This line should be extended beyond the 11.2 millisecond reading, for n = 2, at the eastern end of the line in attempt to show a similar condition to that along Line No. 1. There is a good correlation between low resistivity and high chargeability. along this line.

Line No. 3

The background chargeability appears to charge from 4 milliseconds in the western area covered by this line to about 7 milliseconds at the eastern end. Therefore, an anomalous condition exists at the eastern end of this line which is open to the east. The correlation between resistivity and chargeability is not significant.

Line No. 4

No apparent anomalous conditions seem to appear along this line.

Line No. 5

No apparent anomalous conditions seem to appear along this line.

Line No. 6

The background chargeability of the area covered by this line appears to be of the order of 3 milliseconds suggesting an anomalous area in the neighbourhood of station 8 W.

Since only the reading at 16 W may be suggesting a continuous anomaly, some detail surveying should be done in this area in order to verify the high value. There appears to be no correlation between low resistivity and high chargeability.

CONTOUR PLANS

The contour map for n = 2 suggests a high chargeability trend across lines No. 1, No. 2 and No. 3. In the neighbourhood of station 8 E along line No. 3 this trend coincides with a granite-schist contact. Along Line No. 2 this coincidence is fair, and along line No. 1 there exists no coincidence. Consequently, it is believed that the I. P. sources may not necessarily be related to the contact. The pattern of the contours in this area suggests an I. P. source which dips in a N. N. easterly direction and has a W. N. westerly strike. Along Lines No. 1 and No. 2 the anomalous pattern coincides with four geochemical anomalies striking in approximately the same direction.

A rather subtle anomaly may be suggested along the baseline and between Lines No. 3 and No. 4. The relief of this pattern is only slightly above background; however, it coincides with an anomalous geochemical condition. Since an electrode spacing as large as 800 feet was used it is possible, when using a 2.5 kw. transmitter, that anomalies due to interesting mineralization could be subtle due to averaging over very large volumes. The author of this report has in a number of surveys made such observations.

CONCLUSIONS AND RECOMMENDATIONS

The background chargeability appears to vary across the granite-schist contact with the background being estimated at about 3 to 4 milliseconds throughout the granitic rocks and as high as 7 milliseconds in the contact area or in the schist.

The anomalous areas vary from two times background to slightly above background. Then highly anomalous areas would suggest mineralization well in excess of 1% sulphides or equivalent oxides. This rule could be varied in light of the large electrode spacing such that a much smaller anomaly relative to background may be indicative of commercially interesting mineralization. The coincident geochemical anomalies and favourable rock units seem to support this suggestion.

Mineralization in the anomalous area could be massive in the area of the granite-schist contact. In the granitic rock units the mineralization is most likely disseminated as is suggested by the history of the Arizona metallogenic province.

It is recommended that further surveying be done along the eastern extensions of Lines No. 2 and No. 3.

It is further recommended that a [or hammer] diamond drill programme be undertaken to investigate the sources of the I. P. anomalies and the geochemical anomalies. At least three [or hammer] diamond drill holes should be spotted to investigate the I. P. anomaly crossing lines No. 1 and No. 2. Also, a drill hole should

NOTE-OF-IMPORTANCE
also- SEE-NEXT-PG

PHASE II

Diamond drilling, 3,400' @ $10.00/ft	$34,000.00
Drill pad preparation and bulldozer work	$ 5,000.00
Engineering and Supervision	$ 6,000.00
Living and accommodation	$ 1,000.00
Administration and Communication	$ 4,000.00
Sampling and Mapping	$ 1,000.00
Vehicles	$ 1,000.00
Contingencies	$ 5,000.00
PHASE II TOTAL	$57,000.00
PHASE I TOTAL	$29,000.00
GRAND TOTAL	$86,000.00

be spotted on the baseline and between lines No. 3 and No. 4. All core holes should be drilled to a minimum of 800 feet vertical.

Respectfully submitted,

F. J. R. Syberg.

Fred J. Syberg, B.Sc.,
Consulting Geophysicist

November 15, 1970

Dup

PRELIMINARY REPORT ON

MINERAL HILL INVESTMENT ASSOCIATION'S GROUP OF CLAIMS - PINAL COUNTY, ARIZ.
FRED H. PERKINS, MINING ENGINEER, REGISTERED, NO. 368
STATE OF ARIZONA, No. 918 North 2nd St., PHOENIX, ARIZ.

8-1-1928

SITUATION:

The twenty-four lode mining claims this report covers are about fourteen miles in a northeasterly direction from Florence, Arizona, a station on the Southern Pacific R.R. and in Mineral Hill Mining District of Pinal County, Arizona.

When surveyed by the Government, these claims will be located in Township 3 South, Range 11 East, Gila and Salt River Base and Meridian, Sections 16,17,21,22. See Topographical Map which accompanies and is a part of this report.

CLAIMS:

The claims comprising these holdings consist of twenty-four lode mining claims and cover a total area of five hundred and twenty acres.

JONES KNOB, MARYLAND, LITTLE JOY, IRONWOOD SPRING, TERESA, OLD CROW, YUKON, INDIO, PEACOCK, ROCK HILL, NEW ORLEANS, PAPAGO, RAIN BOW, APEX, MISSOUFA, LUCKY BOY, DODGE, SUN RISE, POP EYE, ATLAS, BLUE EAGLE, FRANCES, UNCLE TEED, ST. ANTHONY.

Prospecting for high grade ore production has been carried on for the last 35 years on this ground, there having been several owners during this time.

TITLES:

The titles are held by the performance of annual assessment work. So far as could be determined on the ground, there are no adverse claims. No abstract of title has been made for this report, but an abstract should be made in the future and before much money is spent.

ROADS:

A fair wagon road 14 miles long connects this group of claims and Florence, the nearest supply point. Munns siding, the nearest railroad point, and is only 1200 yards from the ground and has a daily passenger train service each way. A good highway to within six miles of this property makes the property easily accessible. The hauling costs from Phoenix, would probably be as cheap as hauling from Florence and especially while the hauling is only one way. Carload lots will only require a haul of 3½ to 4 miles haul to the mines and less than a half mile to the mill from Munns siding on the S.P.R.R.

CLIMATE:

The claims are from 2000 to 3000 feet above sea level. At this elevation the desert climate is very mild with but three warm months during the year. During these months the weather is not hot enough to interfere with the work and the nights are usually cool. There is no snow in the winter and the average rainfall during the year is about three inches. The climatical conditions are exceptionally favorable and the work need never be interrupted by unfavorable weather.

WOOD AND WATER:

These claims and surrounding area will furnish wood in limited quantities for domestic purposes only. Water furnished by two shallow wells on the ground will take care of the camp needs for the present. The Gila River, south of the property a short distance, will furnish all the water the property in its operations will ever need.

LABOR:

The wages for miners have been reduced in some districts of the state, often resulting in strikes and delays, thereby increasing the net costs. Good steady miners can be obtained and kept satisfied on $5.00 per day. This price can be used as a basis for estimates of mining costs. After the camp is well established and outfitted it might be possible to reduce labor costs, but in a new camp good wages will have to be paid in order to get competent miners. Muckers, laborers and car men will command $3.00 to $4.50 per day.

EQUIPMENT:

With the exception of a few hand tools and living quarters for a very small force of men, the property will have to be entirely reoutfitted. The present roads are in fair shape and before it is necessary to move large loads some work must be done on the road system.

TOPOGRAPHY:

These claims cover an area of about 520 acres on the Southwesterly slope of Mineral Mountain and drainage is southerly into the Gila River, about 3 miles away. There is an approximate difference of 800 feet in elevation between the highest and lowest points on the property. This area is in the nature of a aloping plain or basin cut by numerous gulches and an occasional small butte standing up two or three hundred feet above the surrounding country.

GEOLOGY AND COMMERCIAL CONDITIONS:

Accepting the classification of the general formation as made by Clyde P. Ross of the U.S.Geological Survey of the Lower Gila River Region, the formations are Pre-Cambrian and Paleozoic age and as a whole is called "A Basal Complex".

The Mineral Hill Investment Association's ground parallels and partially covers a wide, much brecciated zone composed of a liminated formation of granite, gneissic granite, schist, dolomite, lime quartz, quartzite and diorite. This zone is bounded on the west with a large body of granite and on the east by schist. The two large principal dikes or veins cut the lime beds northerly and southerly and parallel the granite and schist contacts to this zone, one of and parallel the granite and schist contacts of this zone. One of these dikes stands up some 100 to 150 feet high above the surrounding country and dry washes, and presents a bold outcropping for a distance, north and south of over 6000 feet on this ground or group of claims. Several other veins or dikes are strong and continuous, and range from eight to seventy feet in width, with fair values in lead, gold and silver uniformly disseminated throughout the entire width. The outcrop of the large vein shows good values, not only its entire width but for a length of over 6000 feet. All indications point to the permanency of ore values for great depths. The large quantities of ore, both length and width and because of no overburden, can be handled by steam shovel operations. By operating in one or more open cuts no difficulty will be encountered in furnishing ore for a 50 ton plant or even more for a considerable time to come.

DEVELOPMENTS:

The ore body which is 61 feet wide in the luba Lode Claim is particularly developed by means of an open cut 28 feet long, 16 feet deep and 10 feet wide. At the south end of this deposit is a shaft about 50 feet deep bottoming in ore, also a cross tunnel driven across the vein at the wash level. These developments combined, expose ore for more than 100 feet in depth, and 61 feet wide. The above described vein continues on north across the independent Lode, Oriental Lode, across the northeast corner of Tip Top Lode, across Strip Lode, Philadelphia Lode, Australia

Lode, Blue Front and Good Enough Lode Claims. Openings consisting of open cuts, tunnels and shafts of various sizes prove this a vein of continuous commercial ore body. On the west side of this group is a large vein or dike, called the Jones Lead and is continuous across the length of the claims, San Francisco, Silver Spray, Malacon and the Malabon Lode Claims. A 100 foot shaft at the extreme south end of the San Francisco Claim shows ore continuously to its bottom, and surface showings indicate a vein from 60 to 70 ft. wide. At or near the south end of the Claim San Francisco is a tunnel driven 60 feet long in a northeast course partially crosscutting the vein showing ore all the way, but not yet reaching the west limit of the ore body. Surface croppings above the face of this tunnel show the vein to be 70 feet wide. The openings on the Silver Spray show good values, and of vein width of about 60 feet. A shaft about 200 feet deep on the Malacon Lode Claim, this shaft is fitted with a steam boiler hoist and compressor. A tunnel on this claim driven 75 feet long, driven parallel with and in the vein on an enriched seal of steele galena about 2 feet wide, which gave the surprising value of $98.00 per ton.

A little north of the 200 foot shaft is a slightly inclined shaft exposing 5 ft. of high grade ore, and still six feet of high grade ore on the footwall side. The quantity of mill ore of this inclined shaft indicates it is at least 50 feet deep, or perhaps deeper, In addition to the above mentioned openings on the Iuba and Jones veins are numerous open cuts, a shaft 100 feet deep and tunnel 75 feet long, all of which are important in developing a property, but these are all developing a mass of cross breaks of more or less unimportant parallel ledges.

ASSAYS:

No attempt was made by the author to thoroughly sample this property at this time, but sufficient samples were taken across the larger ore bodies where the low cost mining operations could be carried on, such as open cut or steam shovel operations. One sample of several tons made up from samples from 20 dumps on the property was taken for general purposes; one split sent to Phelps Dodge Company for them to base a contract on; onesplit was for concentration, etc.

Name	Width	Lead%	Gold Ozs.	Silver Ozs.	Cu.	Zu.	Values per ton.
Iuba Cut	26 ft.	3.85	0.01	1.08	0.2	5.4	$12.25
Iuba Dump	28½ ft.	8.8	0.01	0.2			12.45
Lead Hill	8 "	10.55	0.02	13.44			21.50
Long Chance	8 "	8.00	0.05	1.80	4.19		23.75
San Francisco	25 "	3.8	0.01	0.5			4.46
Silver Shaft	20 "	6.8	0.02	1.0			9.45
Silver Spray	14 "	5.8	0.01	1.0			8.00
Jones Lead #1	30 "	3.3	0.02	4.5			12.35
" " #2	18 "	5.0	0.02	2.4	2.	4.5	8.10
" " #3	30 "	6.6	0.01	0.2		4.5	13.90
Phelps Dodge Av.Sample		10.3	0.02	3.2			15.55
Concentrates from 20 samples 7 to 1		67.40	9.54				88.90

APPROXIMATE COSTS:

Concentrating and sampling plant (50) Tons	$22,000.00
Mine equipment complete	$11,000.00
Laboratory equipment, roads, etc.	2,500.00
Cost reserve operating fund	12,500.00
Total - - - - - - - - - -	$48,000.00

Basing further costs on a sample, gravity flow, 50 ton concentrator and ore whose values as mined is $12.00 per ton (a safe estimated average).

	Per ton		Per day
Cost of mining and hauling	1.50 per ton	or	$75.00
Cost of milling	2.00 "	" "	100.00
Cost of shipping and smelting	1.15 "	" "	57.50
20% loss of value in concentrating	2.40 "	" "	120.00
Royalties based on net receipts	0.366 "		18.30
Depreciation based on 10% net basis	.33		16.47
Total costs	$ 7.746		$387.27 per day
Gross value 50 tons ore at	$12.00		$600.00 per day
Total cost less royalties and depreciation			$352.50
Net profit per day			$247.50
Net profit per year operation			$89,000.00

CONCLUSION:

The prospects of developing a large deposit of commercial ore are more than favorable. The surface indications, the character of the veins and its Geologic relations indicate a deep mineralized zone whose value will increase with depth, and whose surface croppings now indicate it to be 6000 feet,or over, long and 20 feet wide. No change in the character of the need be feared with depth, as the final form, sulphides, crop on the surface.

The ore presents no complicated metallurgical or ore dressing problems, and even higher extraction of values than 80% should be easily obtained after construction and operation of plant, allowing management to become thoroughly acquanited with the ore. A profit of $4.94 per ton may be expected after all charges have been made. A half million tons of ore above lowest present workings may be assumed as available, and many times this tonnage available through shaft work. The price of the mine and cost of mill is small considering the extent of the deposit and the uniform value of the ore, and the probability of developing a very large mine operation. It is unusual to find a mining property that will return profits from the beginning. A large investment ordinarily is required to prospect the ground, and much time consumed. In this case these problems are already solved and profits may be expected just as soon as milling operations are started. For the reasons just given, this group of claims recommends itself as a legitimate mining investment, worthy of the necessary expenditure to place it in the dividend earning class of mine operations.

Signed Fred H. Perkins
Consulting Mining Engineer ,
Registered Mining Engineer, #368
State of Arizona

Date - Phoenix, Arizona
August 1st, 1928.

Dwg

R E P O R T   O N

THE OKLAHOMA COPPER COMPANY'S PROPERTY, PINAL COUNTY, ARIZONA.

MADE AT THE REQUEST OF MR. E. V. REISS,
120 Liberty St., New York City

12-11-1906

LOCATION

Is on the west slope of Mineral Hill, 14 miles N. E. of Florence, and 4½ miles north of the Phoenix & Eastern Railroad, a branch of the Santa Fe Railroad, which follows along the Gila River. Wagon haul to Price R.R. Station 6 miles distant, would not exceed one dollar, and freight rate to the Humboldt Copper Smelter near Prescott, Arizona, about two dollars per ton. There is talk also of another smelter being installed at Florence by the Superior Mining Company, which is now shipping ore. Ores from the Oklahoma property would find a ready outlet to the Gila River over the present wagon road or by the installation of a tramroad.

PROPERTY

Embraces ~~30~~ 18 mining claims, in the form shown of Figure 1, covering ~~400~~ 300 acres of ground, held under location title of record at Florence, the County Seat of Pinal County, Arizona.

GEOLOGY

The rock formation of the district is shown in Figure 2. An extensive granite area to the west is succeeded by a width of about 4,000 feet of mica schist, lying on the west flank of Mineral Hill, this schist being the rock on which the veins occur and valuable portion of the same is all covered by the Oklahoma Company's claim.

This hill itself is a porphyritic rock (rhyolite), and to the west are found successive dikes of the same rock, 10 to 50 feet in width, having a trend of about N. 20 deg. W.

The porphyry uplift has tilted the schist beds to an angle of some 30 degrees to the west, and also resulted in several very strong fault fissures parallel with the dikes, and with a quite uniform dip of about 70 deg. to the west.

The fissures form the present veins of the property, and are characterized by a hard quartz filling, which has replaced the schist and from the hardness of the quartz as well as the dikes, compared with the soft schist, has resulted in a bold vein and dike outcrop, which I myself have traced on the surface for 2½ miles, and they were still going ahead in a northerly direction.

The quartz vein filling is largely of the typical vein "ribbon structure" and slickenside walls indicate extent of the fissures to great depths. The veins are from 2 to 20 feet in width, and sometimes have a parallel vein at a distance of 50 feet or less distant, and on one hill, locally known as Jone's Knob, an outcrop of vein 150 feet in width is disclosed, consisting of alternately bands of quartz, lime and schist.

In addition to the quartz, there is also a large amount of hematite and calcite in the vein filling, and to the west of the Mallacon vein and separated therefrom by

20 feet of schist, are two parallel 5 feet veins of almost pure calcite, which the 85 ft. vertical shaft has penetrated for the last 20 feet, giving rise to the impression at the mine that the underlying country was limestone, but it is evident the shaft will soon pass through this lime and again enter the schist.

DEVELOPMENT

Consists principally of two shafts 100 feet each on the two most prominent veins, to-wit: the Mallacon and the Australia, with some drifting and crosscutting as shown on Figures 3 and 4. A vertical shaft on the former was and still is dry down to 85 feet depth, at which point water was encountered so that further sinking has been discontinued until a pump and hoisting plant can be installed. Whether this is the present permanent water level is uncertain, but the original water level which demarks the sulphide from the oxides zone is probably some moderate distance below this. There are also numerous shafts, tunnels, etc., varying from 10 to 40 feet in depth, which show more or less mineralization.

The Australia shaft is sunk on the vein but just under the heavy quartz body, the entire vein being cross-cutted at the bottom.

The Mallacon shaft is sunk in the schist just under the vein into which it breaks at intervals, as shown in Figure 4, the red portion showing vein matter, while the shaft, drifts and other workings are yellow, both drifts being driven on the vein.

No water has yet been encountered in either the Australia or Mallacon incline shafts.

ORE

No ore in commercial quantity has been yet opened up upon the property, and is not likely to be until the workings are carried below water level, for the reason stated hereafter.

What ore is at present disclosed consists of the rich high grade copper carbonates and glance, which is found near the surface in most of the shafts shown on Figure 1, and supplied a few tons here and there, which was shipped at profit.

Assays of any value up to 50% copper could now be obtained from a large number of the various holes and cuts, but such assays would mean nothing commercially on account of the very limited quantity of this ore at the surface, its presence, however, being indications of copper mineralization which may be reasonably expected below the oxidized region.

Associated with this copper there is also an appreciable quantity of gold and silver, and in several places on the property there has been found a heavy galena ore carrying some silver. I am informed that one small shipment of 2 tons from the Iuba claim showed 64% lead and 13 oz. silver per ton from a 6 inch streak at 30 feet depth, but this is now under water.

My sampling of the two 100 ft. shafts embraced the full veins widths, and in the case of the Australia, took in only the mineralized quartz, which alternates with schist as shown in Figure 3.

The sampling was done mainly as a matter of precaution, and not with an expectation of commercial values, for it is clear that most of the copper originally in the veins above the water level, had been leached and carried below, a small quantity being reprecipitated as high grade carbonate and glance near the surface, as previously stated.

On the map are marked the sample numbers, followed by the width of material sampled, then the value of the gold and silver contents in red figures, in addition to which there is a small copper percentage, samples 4, 5, 6 and 7, averaging 0.5%, samples 15 to 18 0.3%, and samples 19 to 21 ---%. These samples show an average gross value of about $4.00 per ton, with present price copper (24¢) not pay ore to be sure for, as previously stated, any pay values in copper must be looked for in the sulphide zone below water level, but the samples do indicate this, namely, a general mineralization of the vein, which with other features hereafter mentioned, gives promise of a mine with deeper development.

VALUE OF PROPERTY

It is evident, then, that the value of this property depends upon how much copper has been leached from the upper portions of the veins, and from portions long since eroded and carried below the water level from the action of the surface waters, and this fact can be ascertained at moderate expense by sinking the two 100 ft. shafts, for I do not anticipate it is far down to this secondary enrichment.

In order to see whether any information could be obtained from other properties in the vicinity, I visited the Alto M. & S. Co. workings shown on the map. An adit 600 feet in length has been driven along the vein in one place, but its greatest depth below the surface at no point exceeds 150 feet, and shows nothing but a strong vein with evidence of leached copper contents. A 100 ft. shaft on the Alto property farther north, has just reached what is the present water level, and as this vein is a continuation of the Mallacon vein and shows great strength and unique filling, I have shown a sketch of same in Figure 5. The vein filling is mostly manganese and calcite. Galena ore carrying silver is found in bunches, and adjoining this is a band of Wolframite ore (tungsten) from 2 to 10 inches thick. The vein itself has a striking appearance from its black color due to the manganese and shows intense mineralization. Their east vein looks the most promising for copper, but, as everywhere else, has been leached in the upper workings.

CONCLUSIONS

The value of the Oklahoma property then, cannot be predicted from anything now in sight, no more than could the valuable copper veins of Butte, Montana, which are usually leached of all copper contents in the upper 50 to 300 feet, leaving only a quartz filling carrying some gold and silver.

In a limestone formation, leached copper values are often indicated by an iron capping. In a granite or schist formation, however, when such leaching occurs, nothing is often shown but the quartz filling, and in this respect the veins on the Oklahoma property closely resemble those at Butte.

My examination of the property gave me a strong impression of unusual confidence in the ultimate success of the property, based largely on the following facts:

1st: The unusually strong, healthy looking and large size of the veins, as now disclosed at the surface, and down to a depth of 100 feet.

2nd: This strength being augmented by the fact that the vein fissures cut across the schist stratification and are not interbedded with it.

3rd: The pressure of so many porphyry dikes, of various ages and varieties, from rhyolite to diabase, the more prominent ones only being shown on the map.

4th: The numerous deep crusts of carbonate of lime found in many places on the property at the surface, indication of the existence of old springs and a once active water circulation.

5th: The quite general mineralization of the veins throughout their length, as shown by the high grade secondary copper in small quantities near the surface, and by the values obtained in the sampling.

6th: All of the above facts go to show strong veins which will, without any question, be persistent in depth, and the evidence of copper leaching in the upper regions, now shown by that peculiar reddish stain common to such occurrences, gives much assurance that it will be concentrated at lower depths in commercial bodies.

No one can help being impressed with the general bold and strong features which present development discloses, which is more borne out on the ground than any description can convey.

For a mine not actually producing ore it is the best looking thing I have seen in many years, and I believe the property has the making of a paying mine.

Respectfully,

EDWIN E. CHASE,

Mining Engineer.

Denver, Colo., Dec. 11, 1906.

6/23/75

GEOCHEMICAL ANALYSIS

Date Received JUN 9 1975

Location Grayback Quad, 341 Ariz.

Em. Spec. [illegible] X-Ray 17 [illegible] 75 CST Chem.

Geologist R. S. Lapoint

Pulp No.	SAMPLE NUMBER / T. R. S. IDENT.	Mo P.P.M.	Pb P.P.M.	Zn P.P.M.	Cu P.P.M.	Ag OZ/TON	Au OZ/TON		
	Hudgins Prop.		609 459 150	4009 1274 2735	183989 1274 182715				
R-3175	Large Rock #1		255	300	4.4%				
	Small Rock		300 410 390	4584 1044 3540	128194 1044 127150			[illegible]	[illegible]
R-3176	#2		950	500	3.5%				205
	Fines	[illegible] 1788 1352	1661 616 935	5884 1519 4365	158999 1519 157480	[illegible] 2332 1788			[illegible]
R-3177	#3	50	1045	405	3.2%	.64			115

1 Troy Oz / Ton = 34.28 PPM: ES = Em. Spectrograph X = X-Ray A = Atomic Absorption C = Colorometric O = Other

SPECTROGRAPHIC ANALYSIS

DATE RECEIVED June 9 '75 LOCATION Greyback Dd [illegible] Az GEOLOGIST LaPoint

6-12-75 LAT Hudgins Property

NO.	PULP #	LOCATION	Ni	B	Pb	V	Cu	Zn
	R3175	Large Rock #1		56	5	10	VS	S
	3176	Small Rock #2	15		.5		VS	VS
	3177	Fines #3	18		VS	19	VS	S

ALSO CHECKED FOR: Be As Te P Hg Sb Ge Pt Au Ti Sn Th Ds Ba Ir Li In Cd Ta Pd Rh Ru Re Co

F = Faint
M = Medium

S = Strong
VS = Very Strong

Not Marked = Not Detected

☐ Complete Spec
☒ Short Spec

6-24-75

GEOCHEMICAL ANALYSIS

Location: Grayback Qd. 341 AZ

Geologist: Lapoint

Date Received: 6-9-75

Em. Spec.: 6-12-75 X-Ray: 6-17-75 Chem.:

Pulp No.	SAMPLE NUMBER T. R. S. IDENT.	Mo P.P.M.	Pb P.P.M.	Zn P.P.M.	Cu P.P.M.	Ag OZ/TON	Au OZ/TON	Bi	W ppm
3175	Hudgins Prop Large Rock #1	ES 3	X 255	X 300	X 4.4%	ES .04	0.71	ES 9	ES 530
3176	Small rock #2	ES 3	X 950	X 550	X 3.5%	ES .20	1.8	X 245	ES 610
3177	Fines #3	ES 50	X 1045	X 405	X 3.2%	X .64	3.2	X 115	ES 500

1 Troy Oz / Ton = 34.28 PPM: ES = Em. Spectrograph X = X-Ray A = Atomic Absorption C = Colorometric O = Other

S = Strong M = Medium F = Faint ND = Not Detected

SLEEPING ANGEL CLAIMS
PINAL CO, AZ
RSL 6/12/75

APPENDIX — SAMPLE DESCRIPTIONS

Number	Type	Geochem (PPM) or Assay							Rock and Description
		Mo	Pb	Zn	Cu	oz Ag		W	
3-11-7		345	1.01%	8460	1460	3.5		ND	Sleeping Angel #3. NW trending quartz vein cutting Pinal schist. Some chrysocolla.

△ = Hand Lens Description, □ = Binocular Microscope, ○ = Thin Section; Solid for Geochem or Assay

3-11-7 (T, R, Sec) ND = Not Detected

SLEEPING ANGEL CLAIMS
PINAL CO, AZ
RSL 6/12/75

APPENDIX — SAMPLE DESCRIPTIONS

Number	Type	Mo	Pb	Zn	Cu	oz Ag	oz Au	W	Rock and Description
		Geochem (PPM) or Assay							
3-11-17		42	690	518	4.01%	1.05		620	Sleeping Angel #19. Pinal schist cut by FeOx-stained fractures.
		12	1562	860	1254	0.08		70	" " ". Vein in Pinal schist. Qtz, hematite, fluorite, chrysocolla.
		<35	530	122	1.53%	0.02	0.02		Sleeping Angel #25 (Oklahoma Mine) Fault breccia of sericitized Pinal schist with quartz specularite, minor chrysocolla, traces of pyrite. up to 20' wide
		<35	760	465	2.0%	0.02	0.06		" " ", Same structure near shaft.
		<35	570	268	1.9%	0.03	0.34		Sleeping Angel # 27. Vein along northerly trending fault, Quartz calcite, specularite and chrysocolla.
		35	1954	6627	4348	0.13		310	Sleeping Angel # 28. Vein - qtz chalcedony, hematite and chrysocolla w/ much FeOx, Dips 40° W in Pinal schist.
		60	2020	1.04%	820	0.03	0.12		Sleeping Angel #29. Vein along northerly trending fault, 75° W Quartz, specularite.
		42	2.14%	960	333	0.12	0.34		Sleeping Angel # 30. Vein along 65° W dipping fault. qtz fluorite w/ FeOx cement. Adit. Mostly brecciated Pinal schist.

△ = Hand Lens Description, □ = Binocular Microscope, ○ = Thin Section; Solid for Geochem or Assay

Sleeping Angel Mines

1 thru 26 over file of Sec. 8, May 15, 1973

27 thru 42 filed Aug. 30, 1973

43 thru 56 June 17, 1974

56 thru 70 Oct. 1974

Re-location of claims # 41 & 42