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3/24

FROM: F. T. GRAYBEAL

TO: JDSell

As we agreed please follow-up the Penny claims with further review of outcrops - core - etc.

J D S 3/8/77

Via W.T. Elsing 253-2191 *

Would you call Peter Marshall
Canadian Geologist
Phx AZ 966-4885

in Regard to: Perry Cls (55)
MAZATZAL Mtns.
15 miles W. of Payson

Did I give you a Report on this Prospect

Principal: Chas. Skinner
Vancouver, B.C.
604-936-2829

JBC

JDS Secretary Copy

PM called 4/7 to report he had requested maps be sent down
They have not arrived at this date.

also known as:
The Copper Penny Prospect
& formerly:
the Big Bear prospect
56 lode claims (320 of which are in Mazatzal Wilderness Area).
Sec. 29-30 & adjacent sections
of T 10N, R 9E. Gila County, Az
8-10 miles WSW of Pason.

Owners ?: (at various times)
Raymond Dudley
Samuel Dudley
C.C. Dudley
Early Chipley
Thomas Carr

Nick Carouso had lease for short period.

PROPERTY EVALUATION

FOR

GOLD-ANGEL RESOURCES INC.

ON THE

PENNEY COPPER PROSPECT

IN

GILA COUNTY

ARIZONA

U.S.A.

Five mineralized vein structures, approx parallel to one another, strike E-W (?) & dip 45° N into the ridge, with widths of 10-55 feet. The areas between these five structures proved to be mostly barren at the surface, however, diamond drilling shows mineralization below 20 feet. In the oxide & minor sulfide zone (below 20') the minimum copper content was 0.30%, which consisted of zones 15 to 20' thick between enriched zones (veins?) with a range of 1.5-2.0% copper over a thickness of 8-20 feet.

No [illegible]

29 holes on map. D { 2250' of diamond drilling (deepest hole 425') by Bayles (1956-57) for Viola Mac Co.
also drilling in 1967 (11 holes) for Phoenix Venture: deepest 365'.
" " " 1974 (3 holes?) for Gold-Angel Resources Inc.

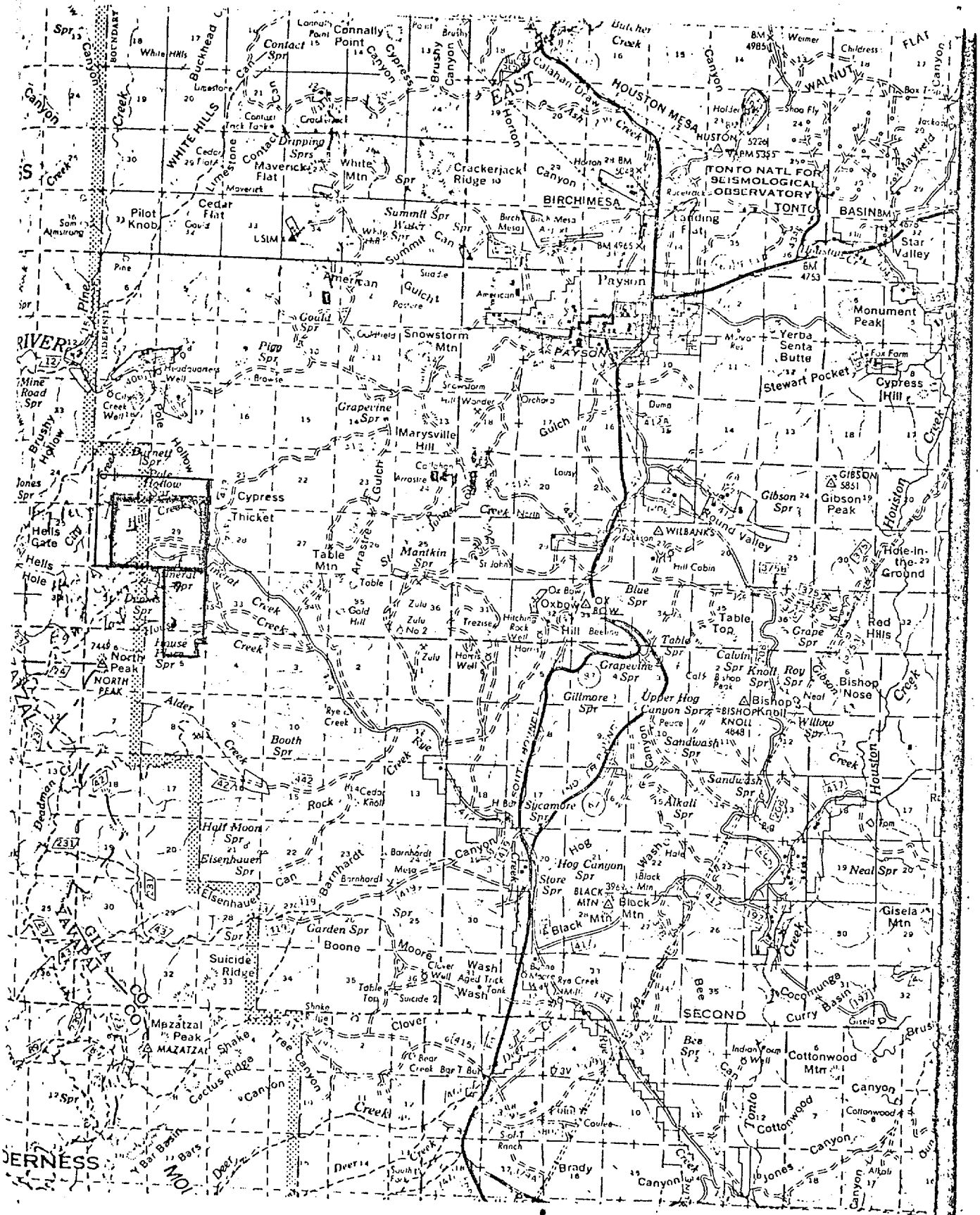
gossan float & oxide comes over area of 1800' EW x 800' NS
mineralization of malachite, azurite, chrysocolla, dioptase, bornite, & chalcopyrite
in greenstone & intrusive sr. overlain by tuffs.

July 12, 1976

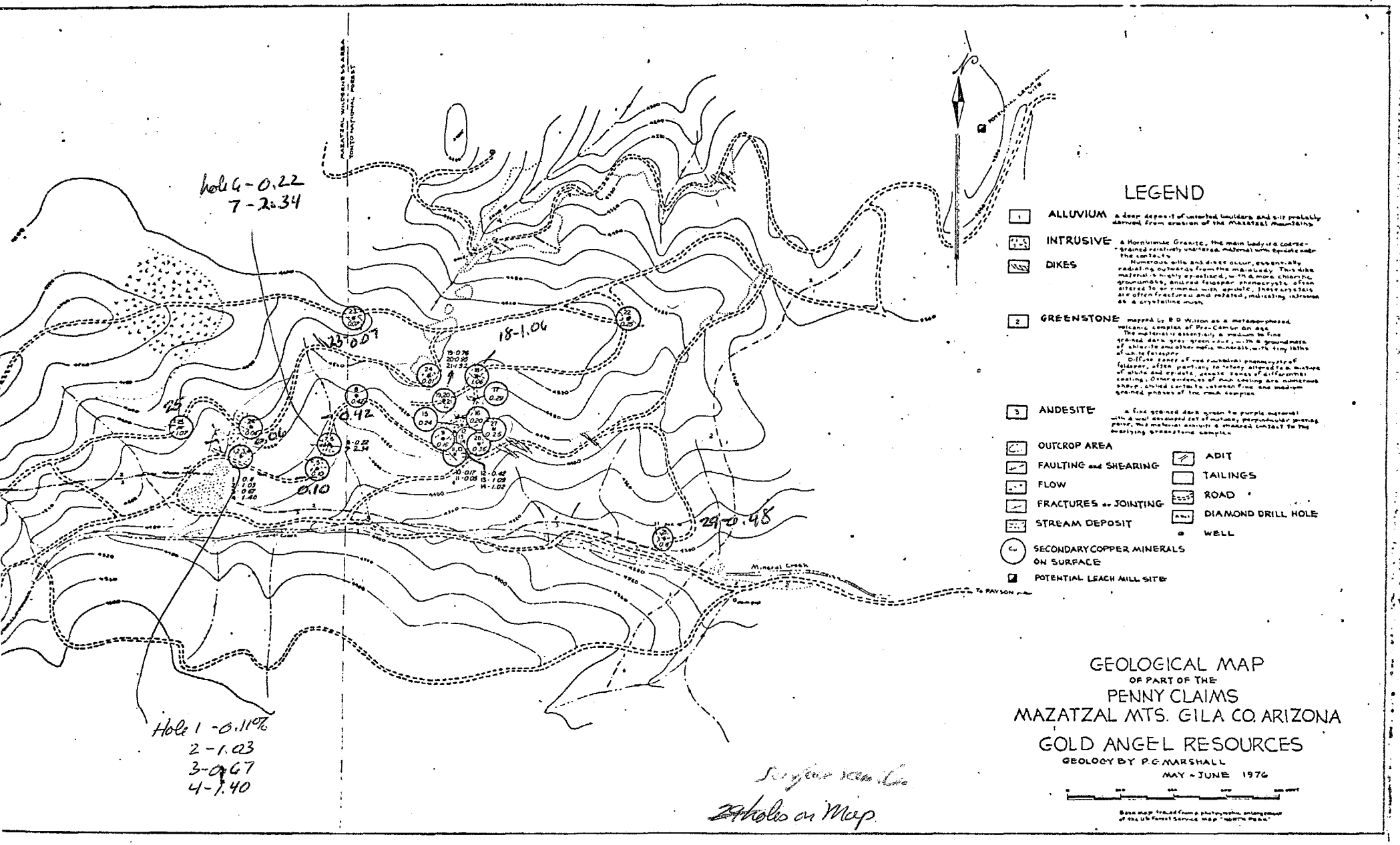
MANNY CONSULTANTS LTD.
EMANUEL AMENDOLAGINE, P. Eng.

APPENDIX 'B'

CLAIMS MAP



APPENDIX D


MAZATZAL WILDERNESS AREA
TONTO NATIONAL FOREST
Hole 4 - 0.22
7 - 2.34
23-0.07
18-1.06
25
0.42
0.06
0.10
29-0.48
Mineral Creek
To PAYSON
Hole 1 - 0.11%
2 - 1.03
3 - 0.67
4 - 1.40
Surface sampling
holes on Map
LEGEND
1 ALLUVIUM a deep deposit of unsorted boulders and silt probably derived from erosion of the Mazatzal Mountains
INTRUSIVE a Hornblende Granite, the main body is a coarse-grained relatively unaltered material with epidote near the contacts.
DIKES Numerous sills and dikes occur, essentially radiating outwards from the main body. This dike material is highly epidotized, with a more chloritic groundmass, and red feldspar phenocrysts, often altered to or rimmed with epidote. These crystals are often fractured and rotated, indicating intrusion as a crystalline mush.
2 GREENSTONE mapped by R.D. Wilson as a metamorphosed volcanic complex of Pre-Cambrian age. The material is essentially a medium to fine grained dark gray green rock with a groundmass of chlorite and other mafic minerals, with tiny laths of white feldspar. Diffuse zones of red rhombohedral phenocrysts of feldspar, often partially to totally altered to a mixture of albite and epidote, denote zones of differential cooling. Other evidences of rock cooling are numerous sharp, chilled contacts between fine and medium grained phases of the rock complex.
3 ANDESITE a fine grained dark green to purple material with a well developed set of mutually perpendicular jointing planes. This material exhibits a sheared contact to the underlying greenstone complex.
OUTCROP AREA
FAULTING and SHEARING
FLOW
FRACTURES or JOINTING
STREAM DEPOSIT
SECONDARY COPPER MINERALS ON SURFACE
POTENTIAL LEACH MILL SITE
ADIT
TAILINGS
ROAD
DIAMOND DRILL HOLE
WELL
GEOLOGICAL MAP
OF PART OF THE
PENNY CLAIMS
MAZATZAL MTS. GILA CO. ARIZONA
GOLD ANGEL RESOURCES
GEOLOGY BY P.G. MARSHALL
MAY - JUNE 1976

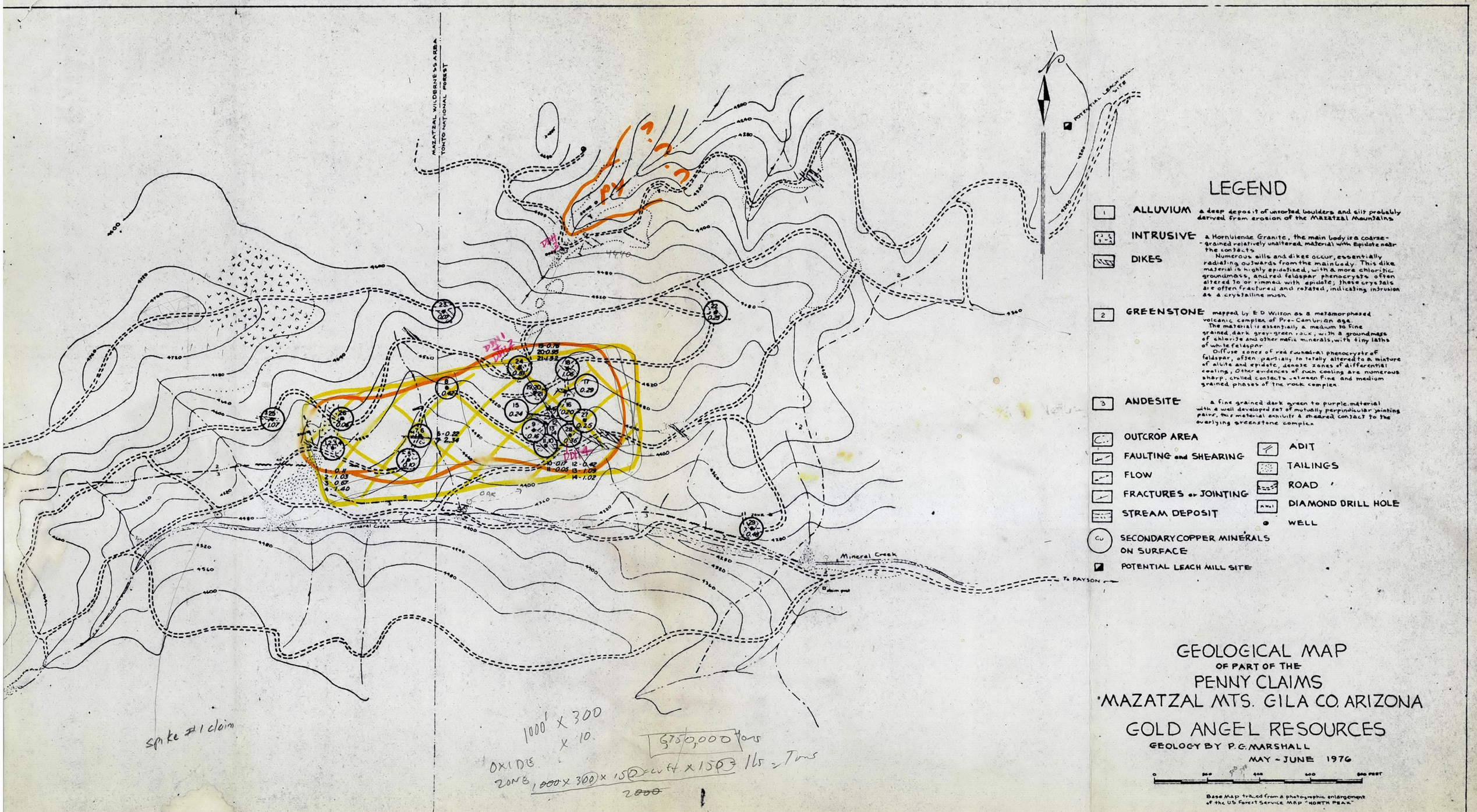
Hole - Recorded Assay - Map "D").

1 - 0.11
2 - 1.03
3 - 0.67
4 - 1.40
5 - 0.10
6 - 0.22
7 - 2.34
8 - 0.42
9 - 0.16
10 - 0.17
11 - 0.05
12 - 0.42
13 - 1.09
14 - 1.02
15 - 0.24
16 - 0.20
17 - 0.29
18 - 1.06
19 - 0.74
20 - 0.95
21 - 1.32
22 - 0.25
23 - 0.07
24 - 0.81
25 - 1.07
26 - 0.06
27 - 0.25
28 - 0.36
29 - 0.48

$$29 \overline{)17.37} = 0.60$$

{from same pad area

APPENDIX "D"


MAZATZAL WILDERNESS AREA
TONTO NATIONAL FOREST
POTENTIAL LEACH MILL SITE
Mineral Creek
To PAYSON
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DIAMOND DRILL HOLE
WELL
GEOLOGICAL MAP
OF PART OF THE
PENNY CLAIMS
MAZATZAL MTS. GILA CO. ARIZONA
GOLD ANGEL RESOURCES
GEOLOGY BY P.G. MARSHALL
MAY - JUNE 1976
Base Map traced from a photographic enlargement of the US Forest Service MAP "NORTH PEAK"
spike #1 claim
1000' x 300
x 10
$750,000 Tons
OXIDIS
ZONE
1,000 x 300 x 15 cu ft x 15 ft 165 = Tons
2000
15x15x3

~~Peter Marshall → Wednesday.~~

Peter Marshall
will call Miami Office Monday afternoon
or Tuesday to set up trip to Nassau
on Wednesday.

PROPERTY EVALUATION

FOR

GOLD-ANGEL RESOURCES INC.

ON THE

PENNEY COPPER PROSPECT

IN

GILA COUNTY

ARIZONA

U.S.A.

July 12, 1976

MANNY CONSULTANTS LTD.
EMANUEL AMENDOLAGINE, P. Eng.

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SUMMARY

The following is a progress report of the Gold-Angel Resources Inc. 'Penney Copper Prospect' near Payson, Arizona, U.S.A.

This report is based on my visit to the property during the period of May 31 to June 11, 1976, and also based upon the field work directed, performed and reported by Peter Marshall to Manny Consultants Inc.

The reported information consists of three (3) drill hole reports with some assays, and of twenty-nine (29) sporadic surface sample assays of the copper oxide mineralized areas of malachite, azurite, chrysocolla with minor chalcopyrite and bornite. The surface exposed copper mineralized area extends some 2,000 feet by 1,000 feet.

The purpose of the drill programme is mainly to substantiate the reports of copper sulphide mineralization at depths of $\pm$ 400 feet.

The drilling to date has confirmed the presence of chalcopyrite, the primary ore at depth. With this confirmation, it is recommended that a systematic drill program should be instigated on a predetermined drilling grid pattern to test and delineate the depth and extent of the primary copper mineralization.

The drill program should be carried out with core drilling for the copper sulphides at depth with at least one drill hole to a depth of some 1,500 feet vertically and the remaining drill holes to favourable depths based on information obtained from the 1,500 foot deep drill hole. The drill pattern should be at 200-foot centers for the primary sulphide ores.

The drilling should be programmed in phases with the first phase allowing for 7,000 feet of diamond drilling. The expenditures required for this program would be some $173,000.00.

PREVIOUS REPORTS OF COPPER PENNEY PROPERTY

The following three (3) reports by Willard D. Pye, J.W. Ambrose, and an unsigned report, describes the Penney Property and its potentialities.

Notes concerning

Big Bear Mining Claims

Payson, Arizona.

Toronto, Ontario,
May 15, 1958

J.W.Ambrose, Ph.D.
Consulting Geologist

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Notes concerning

Big Bear Mining Claims

Payson, Arizona.

SUMMARY

The Big Bear group of 20 claims, under option to G. A. MacMillan of Toronto, Ontario, lies on the east flank of the Matazal Mountains 12 miles north of Payson, Arizona. The claim group covers much of an area of gossan, roughly a mile in diameter; copper float has been found within the gossan over an area 4,000 feet square. Bedrock has been exposed in bulldozer cuts along the slopes of a canyon which crosses the northern side of the gossan. The cuts cover an area 1,800 feet long, 800 feet wide, extend over a vertical distance of about 300 feet, and expose oxidized copper ores in place throughout.

Previous work within the group consists of two short adits, a prospect shaft 30 feet or so deep and some shallow rock trenches. The area mentioned on the canyon slope was opened in May, 1956 by bulldozer cuts. Grab samples over this area give assays in copper ranging from 0.15 to 9.8 percent, but no overall grade has yet been established.

The bedrock consists of a series of volcanic rocks, intruded by several granitic sills, and overlain by quartzite.

Malachite, chrysocolla, azurite, chalcocite, bornite and chalcopyrite coat fracture faces and are disseminated through the solid rock.

Copper is widely distributed on the surface both in float and in place. The deposit is of the blanket type typical of many of the great copper deposits in this country. The overall grade probably will not be high but the tonnage potential is very large indeed. With these possibilities in mind, the property is certainly worthy of a thorough test.

RECOMMENDATIONS

Two objectives can be kept in mind:

(1) To establish average grade (a) in the oxidized zone (b) in the zone of secondary sulphides, and (c) in the protore.

(2) To establish the area and depth, i.e. the tonnage, of ore-bearing material.

The first objective requires that a limited amount of drilling be done. I therefore recommend that at least five vertical holes be drilled for a total of approximately 2,000 feet, at sites to be indicated.

To attain the second objective will require a large amount of systematic drilling. This will be undertaken only if a satisfactory grade is established by the preliminary drilling. In preparation for the larger drilling programme a geological examination of the claim group should be made.

INTRODUCTION

This report is based on visits to the claim group which I made on May 3 and May 12, 1956. The principal showings as exposed on the surface and as opened by recent bulldozer cuts were examined, and the property was viewed in a general way from points of vantage.

PREVIOUS WORK

Openings on the property consists of a few (at least two) adits, one 62 feet long, a shaft 30 feet deep, and a few shallow trenches. These workings were evidently opened several, perhaps many, years ago, and I have seen no record of either their purpose or their accomplishments. Hearsay states they were made by prospectors for gold and silver, a reasonable possibility. In 1955 the property was acquired by R. Dudley of Payson, Arizona, and associates, and surface prospecting and location work was done. In April, 1956 the properties were optioned by G. A. MacMillan, roads were bulldozed to various parts of the area, and in May, under my direction a number of bulldozer cuts were put in to bedrock.

OTHER MINING PROPERTIES IN THE AREA

Copper Mountain Mining Corporation (name uncertain) is developing a deposit of copper ore about 2½ miles north of the Big Bear claim group. In the Ox Bow Mine, about 5

J.M.A.

miles south of Payson a narrow copper-gold bearing vein is being developed by a group of partners. The great copper mines of Globe, Miami and Superior lie about 80 miles southeast and those at Jerome about the same distance northwest.

LOCATION

The Big Bear group of 20 mining claims, established by staking and now under option to G. A. MacMillan, lie on the east slope of the Mogollon Mountains, approximately 12 miles northwest by road of Payson, Arizona. The mountain range rises two thousand feet or more from the valley level to its highest point, North Peak, a mile or so south of the claim group. Local relief, developed by eastwardly-trending, V-shaped canyons, is of the order of 500 feet. The general elevation of the claim group is between 4,000 and 5,000 feet above sea level. The climate is arid and most of the streams are intermittent. A small stream, said to be permanent, follows the main canyon across the property. The East Verde River flows southwards some three miles to the east.

GENERAL GEOLOGY

The claim group is underlain by a series of volcanic rocks including tuffs, massive, amygdaloidal and pillowed (?) flows, intruded by sills of granitic rock. The volcanic

J.M.A.

series dips twenty degrees or so eastward or northeastward, and strikes northerly, parallel to the trend of the mountain range. This series is overlain, along the east flank of the range, by fine grained to cherty, grey to red, quartzite.

The valley which lies east of the Mogollon Range is here about 4 miles wide. It is floored with Tertiary and Recent alluvium. The Snowstorm Range which forms the east flank of the valley is composed of a medium grained granitoid rock, possibly monzonite or quartz monzonite.

STRUCTURE

The rock is covered nearly everywhere by a few feet of weathered material and accurate determinations of attitudes are difficult. The flows and intercalated sills dip 20 degrees or so eastward and strike north. They are cut off to the south along a fault (or faults) which follows the main canyon westward across the claim group. The fault is poorly exposed but at one place near the canyon mouth it strikes 20 degrees north of west and dips 70 degrees north. Although no evidence of movement was seen, it was probably normal, north side down. Movement on the fault was probably post-mineralization. Rocks south of the fault, i.e. those that form the footwall are, in part at least, barren purple slates, but these northern slopes are covered with thick vegetation and soil, so that little is known of details of character or structure of the bedrock.

MINERALIZED AREA

The mineralized area is marked by a gossan that extends over the hills for more than a mile northward from the fault mentioned above, and is limited on the east by the overlying quartzite. I was not able to visit its northern or western limits but it is roughly circular, and not less than a mile in diameter. "Float", or residual blocks of rock carrying copper-oxides have been picked up within the gossan over an area about 4,000 feet square.

The mineralized area is best exposed on the north flank of the main canyon. There, in old workings, and in bulldozer cuts made during the week May 5th to 12th, copper minerals can be seen in bedrock over an area 1,800 feet east to west, 800 feet north to south, and from creek level to the top of the ridge, over a vertical distance of about 300 feet. Thus within this block alone some three million tons of copper-bearing rock lie above creek level. If the area of copper float is likewise underlain by copper-bearing rock-and there is no reason to suppose it is not - this tonnage can be multiplied by a factor of a hundred.

MINERALS PRESENT

The rocks, on the surface, are leached and barren. On the recently formed erosion surface on the canyon slopes, the depth of the barren zone appears to depend on the character

of the rock: granitic rocks are barren for 2 to 6 inches, tuffs (?) for six feet or more. Below the superficial barren zone the rocks carry sparse to abundant oxidized copper minerals coating joint faces or, to a lesser extent, as impregnations. Malachite is most abundant, followed by chrysocolla and azurite, and possibly a very little cuprite. Where fresher surfaces can be broken bornite, chalcocite and chalcopyrite and perhaps other copper minerals occur in grains, tiny stringers, and as fillings of vesicles. Pyrite is extremely scarce.

The maximum depth of the barren zone so far exposed is about six feet. On the crest of the first ridge north of the creek oxidized ore lies within a foot of the surface, and similar oxidized ores are now exposed in cuts a few tens of feet apart down to creek level, i.e. to thecanyon fault. In one place a little oxidized copper was found in footwall rocks adjacent to the fault, but in general the footwall block is barren.

In this country the zone of oxidized ores commonly passes downwards into a zone, formed at and below a water table, which carries secondary copper sulphide minerals. This sulphide zone is characteristically richest near the top, and gradually becomes leaner with depth as the secondary sulphides decrease in amount. The lowermost zone, of protore, carries only the primary copper minerals; its copper content is generally low but may be of ore grade.

J.W.A.

It may be noted that the water table level which controlled the position of the enriched sulphide zone may have been - and in many places in Arizona has been - lowered by recent erosion and desiccation . Where this happens the sulphide zone is left perched, as it were, above the new water table, towards which it will move slowly with passage of downward-seeping groundwater. Depths to, and thicknesses of the several zones, the upper barren zone, the partially leached zone of oxidized ores, the enriched zone of secondary sulphides, and the protore can be established only by underground exploration.

GRADE OF ORE

Spot samples of oxidized ores grade from 0.15 percent to 9.9 percent copper. Copper is found in all types of rock on the property; until more complete exposures or drill cores are available I find it impossible to say which, if any, rock is most favorable, or to estimate an average grade for any substantial thickness.

ORE POTENTIAL

Copper mineralization is well exposed in an area 1,800 by 800 feet, for a vertical distance of 300 feet and is known over an area 4,000 feet square. (All distances approximate only.) As noted above, the potential tonnage is very large indeed. The topography and climate lend themselves to an open

J.W.A.

cut operation, and thus to low mining costs. Providing sufficient tonnage is developed it is possible to consider as ore,material containing as little as 17 pounds of copper per ton. (Grade presently being mined by Inspiration Mining and Refining Corporation, Miami, Arizona.) Thus the present objective is to test this area for average grade within the oxidized zone, the secondary sulphide zone and the protore. Providing a mineable grade of ore is present the second objective would be to determine the tonnage, and so determine the type and size of mining operation to be undertaken.

Toronto, Ontario
May 15, 1955.

J. W. Ambrose
J. W. Ambrose, Ph.D.
Consulting Geologist.

DEVEX CORPORATION
3418 N. Forgeus Avenue
Tuscon, Arizona 85716
(602) 327-2956
October 6, 1972

COPPER PENNY PROSPECT

GILA COUNTY, ARIZONA

Location and Property

The Copper Penny prospect, formerly known as the Big Bear prospect, consists of 56 lode claims located in sections 29 and 30, but overlapping slightly into some of the adjacent sections, T. 10 N., R. 9 E., Gila County, Arizona, which location is about 10 miles west-southwest of Payson. The claims are connected by dirt road to paved Arizona Highway 73 at Payson. The property lies along the east flank of the Mazatzal Mountains at an elevation of about 4700 feet; the claims have a relief of about 1000 feet.

The western 32 claims lie in the Mazatzal Wilderness Area. They can be held by work on those claims lying outside of the Wilderness, but cannot be mined and no power equipment can be taken onto them. If mineralization can be developed on the claims outside the Wilderness and the mineralization leads into the claims in the Wilderness area, it may be possible to secure permission to develop them. Some of the better shows of mineralization were found within the Wilderness area.

Basis for Report

The report is based upon a few hours visit late in the afternoon to the Mineral Ridge and Mineral Creek portions of the claims. No detailed mapping or examination was undertaken. Observations were supplemented by the writer's personal knowledge of the area, information in his and other files and information derived from various people familiar with the property and its past history of exploration.

Geology

The property is underlain by steeply dipping Older Precambrian Yavapai schists, greenstones and related rocks, although some of the section may be composed of lesser metamorphosed sediments of the Younger Precambrian. The Precambrian rocks have been intruded by basic and acidic dikes, also of Precambrian age. Precambrian granitic intrusives are also present in the area.

Mineralization

Mineralization consists of oxides of copper exposed at the surface. In one of the shallow tunnels some chalcopyrite was found. Reportedly drilling has found copper and iron oxides extending for 100 feet or more of depth, and below this copper and iron sulfides. Mineralization is associated with greenstones and the basic intrusives, at least in some of the mineralized areas both on the claims and at a distance from them. Some quartz veins are present and show some mineralization. These may be related to the copper-gold bearing veins formerly mined southwest of Payson. Several veins or areas of mineralization are present which range from a foot or less wide to several feet wide. Most of them appear to be about 10 feet in width but may pinch and swell along strike. Reportedly some of the veins are 30 and up to 60 feet wide, but these were not observed.

Development, Assays and Production

Development consists of a number of shallow pits, trenches and short drifts along mineralized zones. There has been no production from the property.

There have been at least two periods of drilling, but records are unavailable. In 1957 Viola Mac Company drilled 7 diamond core holes (one report says 5) recovering about 30 percent of the core and keeping no record of the sludge. These holes averaged 350 feet and ranged from 275 feet to 425 feet in depth. Holes were both vertical and inclined. The deep hole apparently encountered bornite and chalcopyrite near its total depth and stopped in that mineralization. A report from the Arizona Department of Mineral Resources dated April 8, 1959, states "This drilling roughly indicated a mineralized zone which is 1800 feet in length and 900 feet wide, and averaged from 1% to 2% in copper with appreciable gold content." Another statement was that in the deep hole at 425 feet, the copper ore assayed 2.5%, and that higher in the section drilling had passed through "a section" which was as high as 7%.

An unsigned and undated report on this drilling states: ". . . The company immediately initiated an exploration program consisting of road building, landings for diamond drilling, 2250 feet of diamond drilling contracted by Boyles Brothers Drilling Co., Phoenix, Arizona, and limited stripping of mineralized structures for the purpose of obtaining assay data from unleached ore faces. Several hundred samples were collected and assayed by Arizona Testing Laboratories, Phoenix, Arizona, and it was found that the average copper content of mineralized vein material was 1.98 percent. Five (5) mineralized vein structures

were uncovered that were approximately parallel to each other and dipping approximately 45° into a ridge, with widths of from 10 to 55 feet. The area between these five structures proved to be mostly barren at the surface, however, after diamond drilling it was found that the barren zone only extended to an average depth of 20 feet. Below this depth, the minimum copper content was 0.30 percent, which consisted of zones 15 to 20 feet in thickness between enriched zones with the copper content ranging from 1.5 to 2.5 percent, and with thicknesses of 8 to 20 feet, averaging 2.5% copper. The deepest hole was 425 feet vertical, had an average copper content of 2.5 percent in the mineralized zones, and bottomed in 2.5 percent copper. Along with the copper content, the 405-410 foot and 415-420 foot core sections assayed $16.00 values in gold. To the depth of 400 feet, 80 percent of the copper mineralization of the ore bearing formations was Malachite and Azurite with the remainder mainly chalcopyrite. . . . .The silver potential of this property is minor as the average value was approximately 1 oz. per ton, however, occasional 5 foot core samples assayed up to 4 oz. per ton silver."

In 1967 Phoenix Ventures drilled 11 holes on the property. Most of these were for assessment or location work and were shallow being 100 feet or less in depth. However, 3 were drilled to depths between 100 and 200 feet and one to a depth of 365 feet. All were vertical. None were cored. Cuttings were collected on at least the 365 foot hole which showed considerable chalcopyrite.

Only one spectrographic analysis sheet was found and it gave copper between 1.5 and 4.0 percent, gold nil, silver .0005 to .001 percent with nothing else of importance. The sheet states: "This rock appears to be a quartz-gabbro schist with good secondary copper enrichment in the mineral forms of Malachite, Azurite and some Cuprite."

Other assay statements (but no sheets) are: "One tunnel goes back 58 feet and samples were taken every 5 feet and averaged 1.5% copper. Samples from the dump on this hole (tunnel) showed 0.5% copper and .05 silver with a trace of gold. At this site a sample taken from the outcropping near the entrance of the tunnel showed 3.1% copper, 0.2 silver and trace of gold. . . Five grab samples taken from the property averaged 1.48% copper, 0.16% silver and all a trace of gold." (an undated and unsigned typed statement.)

Conclusions

The property is mineralized and lies in a general region of

Precambrian rocks carrying appreciable Precambrian copper and gold mineralization. If problems can be worked out with the U.S. Forestry Service, the property deserves additional study as a possible copper leach operation. However, it will have to be drilled to determine the extent of copper oxides present in the apparently surficial "barren" zones between the copper mineralized bodies. It will be necessary to also determine the persistence of the exposed mineralized bodies, although in some areas outside of this prospect they have been found to be quite persistent. There is also the possibility of a larger sulfide body, but it will probably be at depths greater than 500 feet and will have to be found by drilling or geophysics.

Willard D. Pye

REGISTERED GEOLOGIST
GEOCHEMIST
4033
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Willard D. Pye
Consulting Geologist
Arizona State Board of
Technical Registration
#4033

THE BIG PENNY UNPATENTED MINING CLAIMS

GREEN VALLEY MINING DISTRICT, GILA COUNTY, ARIZONA

The "Big Penny" group of 56 unpatented mining claims situated in unsurveyed Sections 18, 20, 21, 28, 29, 30, 31, 32, 33, of unsurveyed Township 10 N., Range 9 E., G.& S.R.M., Green Valley Mining District, Gila County, Arizona, approximately 8 miles southwest of Payson, Arizona, is owned by Charles L. Dudley and Artie E. Dudley. Mr. Nicholas H. Carouso, Payson, Arizona, is the optionee and lessee of this group of claims.

The "Big Penny" group of claims was formerly known as the "Big Bear" group, and it was owned, at that time, by five partners whose names are as follows: Messrs. Raymond Dudley, Samuel Dudley, C. C. Dudley, Earl Chipley and Thomas Carr. This property was leased to the Viola Mac Mining Co., Toronto, Canada, during 1956-1957. The property was leased after Dr. J. Ambrose, Consulting Geologist for Viola Mac Mining Co., recommended its acquisition. The company immediately initiated an exploration program consisting of road building, landings for diamond drilling, 2250 feet of diamond drilling contracted by Boyles Bros. Drilling Co., Phoenix, Arizona, and limited stripping of mineralized structures for the purpose of obtaining assay data from unleached ore faces. Several hundred samples were collected and assayed by Arizona Testing Laboratories, Phoenix, Arizona, and it was found that the average copper content of mineralized vein material was 1.98 percent. Five (5) mineralized vein structures were uncovered that were approximately parallel to each other and dipping approximately 45° into a ridge, with widths of from 10 to 55 feet. The area between these five structures proved to be mostly barren at the surface, however, after diamond drilling it was found that the barren zone only extended to an average depth of 20 feet. Below this depth, the minimum copper content was 0.30 percent, which consisted of zones 15 to 20 feet in thickness between enriched zones with the copper content ranging from 1.5 to 2.8 percent, and with thicknesses of 8 to 20 feet, averaging 2.5 percent copper. The deepest hole was 425 feet vertical, had an average copper content of 2.8 percent in the mineralized zones, and bottomed in 2.5 percent copper. Along with the copper content, the 405-410 foot and 415-420 foot core sections assayed $16.00 values in gold. To the depth of 400 feet, 80 percent of the copper mineralization of the ore bearing formations was Malachite and Azurite with the remainder mainly Chalcopyrite.

It was the opinion of Dr. J. Ambrose, that preliminary stripping of surface structures should produce 250 to 300 tons per day of 1.98 percent copper ore for a period of from 6 to 8 months before extensive benching would be required. It was also the opinion and speculation of Dr. J. Ambrose and several other geologists who examined the property, that the major ore body lay from 800 to 1500 feet below the surface. Mr. L. E. Reber, Phelps Dodge Corp., Jerome, Arizona, spent approximately 3 months on the property and he believed that this property was very similar to the mine at Jerome, Arizona.

Upon the termination of the lease period, Viola Mac Mining Co., withdrew against the recommendation of Dr. J. Ambrose, with the statement that the property was not quite what they wanted. However, thirty

days after the termination of the lease, Mr. George McMillan contacted Mr. Raymond Dudley requesting a one year extension of the lease, and appeared distressed when the owners could not agree and subsequently denied the request. Several other major companies tried unsuccessfully to obtain leases, due mainly to disagreement among the owners during negotiations.

Pilot plant leaching of surface and drill hole core samples proved very successful.

The silver potential of this property is minor as the average value was approximately 1 oz. per ton, however, occassional 8 foot core samples assayed up to 4 oz. per ton silver.

The above information was obtained from Mr. Raymond Dudley, a part owner of this property during 1956 and 1957, who was employed by the Viola Mac Mining Co., to supervise the surface work and diamond drilling program, and who along with Dr. J. Ambrose prepared all drill core and surface samples for assay.

Recent examinations of this property substantiate the surface showings referred to in the above information furnished by Mr. Raymond Dudley. The mineralized structures are readily traced on the surface. Structural interpretation utilizing the reported copper value at the bottom of the 425 foot diamond drill hole, and the attitude of mineralized structures substantiates the opinion of Dr. J. Ambrose and others as to the probability of copper mineralization at depths of 800 to 1500 feet.

Laboratory leaching studies currently being conducted indicate that this ore has excellent leaching characteristics and certainly substantiates Mr. Raymond Dudley's statement that pilot plant leaching of the ore proved very successful.

The area affords favorable sites for reduction plant and tailings disposal. Two year around springs are available at this property and appear to produce sufficient water for a plant to handle at least 1000 tons per day of ore.

ASSAY REPORTS

The assays from the Iron King Assay Office in Humbolt, Arizona, are assays of the No. 2 Diamond Drill Hole and assays of surface samples taken by Peter Marshall. The assay sheets, dated July 8, 1976, are the surface samples taken. These are plotted on the Geologic map by Peter Marshall. The description of the surface samples are on the attached sheets.

The core assays dated June 19, 1976, represents sections of core from 345 feet to 498 feet. The remainder of the core will be sent out for assays.

IRON KING ASSAY OFFICE

ASSAY CERTIFICATE

BOX 14 — PHONE 602-7410

HUMBOLDT, ARIZONA 86329

WALTER G. STATLER

ASSAY MADE FOR GOLD ANGEL RESOURCES

June 19, 1976

Ref no.	SAMPLE DESCRIPTION	Gold oz/ton	Silver oz/ton		Copper %	
6-17-1	#1614	Tr	0.20		0.07	
6-17-2	#1645 379-385	Tr	0.26		0.23	
6-17-3	#1612 Gold A	.004	0.28		0.04	
6-17-4	#1615 (361)	Tr	0.20		0.55	
6-17-5	1646 Gold A	.004	0.24		0.25	
6-17-6	#1613	Tr	0.22		0.05	
6-17-7	#1642 361-364	.004	0.20		0.29	
6-17-8	#1643 364.5-372.1	Tr	0.20		0.11	
6-17-9	#1644 372.1-379	.004	0.28		0.16	
6-17-10	#1647 393.1-400	Tr	0.40		0.39	
6-17-11	P.M. 16.6.76.7	.016	0.24		1.85	
6-17-12	P.M. 16.6.76.14	Tr	0.20		0.98	
6-17-13	#1649 404-410	.006	0.26		0.62	
6-17-14	P.M. 16.6.76.15	Tr	0.52		1.56	
6-17-15	#1650 410-415	Tr	0.26		0.38	
6-17-16	P.M. 16.6.76.18	Tr	0.16		0.20	
6-17-17	P.M. 16.6.76.19	Tr	0.12		0.12	
6-17-18	#1654 435-443	Tr	0.20		0.25	
6-17-19	#1653 425-435	Tr	0.16		0.26	
6-17-20	#1655 443-446.6	Tr	0.32		0.34	
6-17-21	P.M. 16.6.76.12	Tr	0.60		0.15	
6-17-22	P.M. 16.6.76.8	Tr	0.24		0.21	
6-17-23	P.M. 16.6.76.9	Tr	0.10		0.15	
6-17-24	P.M. 16.6.76.5	Tr	0.18		0.15	

IRON KING ASSAY OFFICE

ASSAY CERTIFICATE

BOX 14 — PHONE 602-7410

HUMBOLDT, ARIZONA 86329

WALTER G. STATLER

ASSAY MADE FOR GOLD ANGEL RESOURCES

June 19, 1976

Ref no.	DESCRIPTION	oz/ton Au	oz/ton Ag		% Pb	% Zn	% Mo	% Cu
6-17-25	P.M. 16.6.76.6	Tr	0.18					0.15
6-17-26	P.M. 16.6.76.7	.056	6.86					0.16
6-17-27	P.M. 16.6.76.2	.008	0.60					0.05
6-17-28	P.M. 16.6.76.1	Tr	0.22					0.22
6-17-29	P.M. 16.6.76.3	.004	0.24					0.54
6-17-30	P.M. 16.6.76.4	Tr	0.10					0.23

$255.00

IRON KING ASSAY OFFICE

ASSAY CERTIFICATE

ASSAY MADE FOR

GOLD ANGEL RESOURCES
903-2033 Beach Ave.
Vancouver, B.C. Ca.

July 8, 1976

Bag No.	SAMPLE DESCRIPTION	Copper %
7-6-25	5.7.76-25	1.07
7-6-26	" -26	0.06
7-6-27	" -27	0.25
7-6-28	" -28	0.36
7-6-29	" -29	0.48
Charges $07.00		

IRON KING ASSAY OFFICE

ASSAY CERTIFICATE

ASSAY MADE FOR

GOLD ANGEL RESOURCES
903-2033 Beach Ave.
Vancouver, British Columbia, Ca.

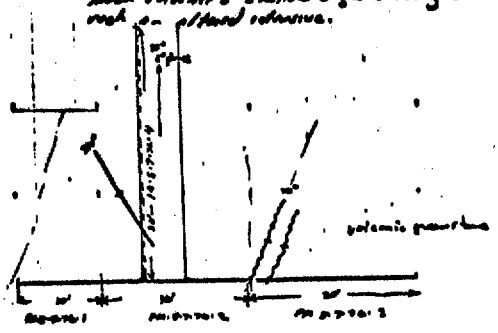
July 8, 1976

Bag No.	SAMPLE DESCRIPTION	Copper %
7-6-1	5.7.76-1	0.11
7-6-2	" -2	1.03
7-6-3	" -3	0.67
7-6-4	" -4	1.40
7-6-5	" -5	0.10
7-6-6	" -6	0.22
7-6-7	" -7	2.34
7-6-8	" -8	0.42
7-6-9	" -9	0.16
7-6-10	" -10	0.17
7-6-11	" -11	0.05
7-6-12	" -12	0.42
7-6-13	" -13	1.09
7-6-14	" -14	1.02
7-6-15	" -15	0.24
7-6-16	" -16	0.20
7-6-17	" -17	0.29
7-6-18	" -18	1.06
7-6-19	" -19	0.76
7-6-20	" -20	0.95
7-6-21	" -21	1.32
7-6-22	" -22	0.25
7-6-23	" -23	0.07
7-6-24	" -24	0.84

5-7-76-2 18' Sample altered intrusive - Hornblende - epidotized - mostly -- malachite - and rarely grains of chalcopyrite

5-7-76-3 20' Sample altered volcanic greenstone complex - several small lenses of intrusive material - red jasper phenocrysts. Scattered specks of malachite on fractures and shears

5-7-76-4 - 20' Sample - in old adit - along west wall - 8' above the floor - rock exposure of shallow angle showing - dark rock - altered intrusive.

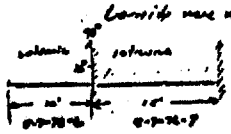


Scale 1" = 10' samples were each

5-7-76-5 with 10' Sample. with 8' of fill zone on roadway - badly fractured and sheared greenstone. no visible copper mineralization

5-7-76-6 with 10' Sample - volcanic rock, hanging wall side of an intrusive dike

5-7-76-7 " 15' Sample. sheared and fractured intrusive dike with malachite and azurite - some grains of bornite were noted.



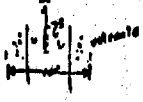
not measured

Scale 1" = 10'

5-7-76-8 10' Sample. Intrusive till - contains big sheared volcanic rock - sample taken along contact

5-7-76-15 PM-5-7-76-16 2' wide sample across intrusive dike - about 30' up shale from 15' - material outcrops in dozer trail - no map

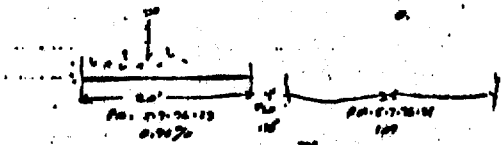
PM-5-7-76-17 10' sample



see map - 5' intrusive vein with 2.5' of volcanics on both sides 0.29%

PM-5-7-76-18 2' sample small intrusive dike - with malachite 1.08%

PM-5-7-76-19 20' sample Hornblende green intrusive with zones of the host volcanics - little visible mineralization



PM-5-7-76-20 9' sample - mineralized zone

0.05%

PM-5-7-76-21 25' zone - volcanic greenstone - very fractured and sheared with several small sills of intrusive material - some malachite staining

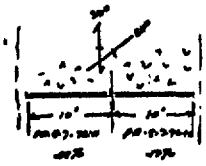
1.09%.

PM-5-7-76-22 10' sample

5' wide intrusive dike with 2.5' of volcanics on both sides.

PM-5-7-76-10 10' sample - Hornblende intrusive - with epidotization small amounts of malachite as stains on fracture surfaces.

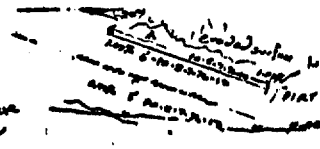
PM-5-7-76-11 10' sample - along zone intrusive - malachite with copper mineralization



see map for location

PM-5-7-76-12 5' sample. covers vertical width of intrusive dike - altered - some epidotization

PM-5-7-76-13 6' Sample. overlying volcanic material - malachite staining with grains of bornite



Scale 1" = 10'

This is the dike in the "BLACK COPPER" zone where the bornites were found

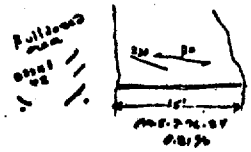
PM-5-7-76-14 20' sample - taken along the zone volcanic zone or where exists an 8' wide mineralized intrusive dike

PM-5-7-76-15 15' sample across two small intrusive dikes with a badly jointed and fractured volcanic zone between them. some shear zone.

PM-5-7-76-23 - 20' wide sample. across a 10' intrusive dike with 5' each side of the host volcanics

0.07%

PM-5-7-76-24 - 15' sample. at the open #102 location - mineralized zone to the east of the site - badly fractured volcanic material - with malachite stains.



Scale 1" = 10'

PM-5-7-76-25 10 sample. across a 5' vein - 2.5' of volcanics each side - vein with malachite 1.07%

PM-5-7-76-26 10' sample. badly fractured and weathered volcanic complex - strong surface coatings of opaque black to brown iron oxides 0.05%

PM-5-7-76-27 10 Sample. 5' intrusive vein. strike 330°.

PM-5-7-76-28 - vertical section taken on volcanics overlying an intrusive dike

0.10%

PETER MARSHALL'S REPORT:

The following twelve pages, compiled into a report, describing the drilling and geology on 'The Penney Group of Claims', was submitted by Peter Marshall.

LOCATION AND ACCESS

The Penney Claims, No. 1 through to 56 inclusive, are staked as a rectangular block in an east-west direction, over the north-eastern flank at the Mazatzal Mountains. The claims fall in an unsurveyed portion of north-western Gila County; the eastern two thirds are situated in the Tonto National Forest, and the western third falls in the Mazatzal Wilderness Area.

The claims straddle Mineral Creek, which flows north-easterly, and then easterly from the Mazatzal Range, the center of the claims lie about 2 miles north-east of "north Peak" the most northerly named mountain is the Mazatzal Range.

They are situated 8 miles in a straight line bearing 242° from the center cross roads in the town of Payson, Gila County, Arizona.

Access from Payson, a market center for surrounding ranches and a tourist center, is via a series of dirt surfaced roads - a distance of 10 miles - maintained by the U.S. Forest Services. These roads, well marked, go to 'Cypress Thicket' and end at the 'North Peak Trail', a fire access foot path to North Peak. To this point the roads are accessible by almost any vehicle, except after heavy rainstorms.

From here company built roads to the various sections of the claims are passable by almost any vehicle with high ground clearance.

PHYSIOGRAPHY AND VEGETATION

The Penney Group of Claims were staked in a westerly direction, across the north-eastern flank of the Mazatzal Mountains, the eastern two-thirds of the claims are situated in the Tonto National Forest, and the western third is in the Mazatzal Wilderness Area.

The general slope of the land tends downward, from an elevation slightly in excess of 5000' ASL, in a north-easterly direction to an elevation of about 4000' ASL.

As is typical of arid areas, where much of the rainfall occurs in summer thunder storms, the effects of water erosion are very pronounced.

An intermittent stream, known as Mineral Creek, has eroded an easterly trenching 'V' shaped valley, ranging in depth from 300' to about 100' across the general trend. The walls of this valley, except where modified by more resistent intrusive dikes, average about 25° down slope.

Numerous tributary streams, flowing only after rain storms have incised numerous smaller 'V' shaped valleys up to 50' deep. These small valleys generally trend normal to or at acute angles to the main valley of Mineral Creek.

By mid-June the flow of Mineral Creek has been much reduced, and the major portion of the flow occurs under the numerous soil and gravel deposits, surface water is found only where the stream has cut down to the bed rock.

Much of the area is mantled with residual soild, caused by weathering and mechanical break-down of the underlying rocks. Little

mass movement except down dill soil creep and some stream erosion has taken place.

The eastern third of the property is mantled by deep deposits of unsorted alluvium probably derived from the erosion of the Mazatzal Range proper.

Bed rock exposure occurs over about 10 - 15% of the property, and even where it is exposed, except in the cases of the more resistant intrusive dikes, it has undergone deep weathering and mechanical fracturing giving rise to an almost unconsolidated surface.

VEGETATION

Much of the hillsides and ridge tops, except over areas of outcrop, are covered with a dense tangle of manzanita, live oak, catspaw, and other forms of low prickly brush. At times these tangles form almost impenetrable thickets.

Scattered pygmy conifers such as pinon, junipon and cypress grow wherever there is sufficient soil and moisture, in places such as washes, near springs or seeps, and in moisture bearing fault and shear zones.

Along the ridge crests yuccas and century plants are common.

In the valley bottom of Mineral Creek, and in some of its tributaries, which contain sufficient water, deciduous trees such as cotton wood, oak, sycamore, walnut, and other species thrive. Here and there ponderosa pines, up to 60 feet high grow throughout the valley areas.

Poison Ivy is very common throughout the damp areas near the stream beds.

Various cacti such as the prickly pear, and hedge hogs, grow throughout the area from wet valley bottoms to the dry ridge crests.

CLIMATE

The area has a semi-arid climate averaging from 24 to 27 inches of rainfall per year. There are two peak rainfall peiods, a winter period peaking in March, and a summer period peaking in July.

The winter rains are associated with stratus-form clouds, and occur as relatively gentle rainfall with occasional snow. The snow usually melts within several days and only persists on mountain tops in excess of 7000'.

The summer rains take the form of thunder showers with very strong winds. The storm cells generally rise in the morning over the White Mountain area about 50 miles east, then move westward, gathering momentum, giving late afternoon storms over the area.

The annual temperature ranges from the mid 30's F. from November through until February, then rising about 10 ^{o}F per month to a summer average in the mid 60's from mid May through mid September, then it falls again at an average of about 10 ^{o}F per month.

Winter extremes show a night-time temperature rarely in excess of -10 ^{o}F, but generally rising above the freezing level during the day.

The summer extremes show temperatures in excess of 100 ^{o}F but cooling at night down to 60 ^{o}F, and sometimes as low as 50 ^{o}F.

GEOLOGY

GREENSTONE[1] - A metamorphic, epidotized volcanic flow and intrusive complex of Pre-Cambrian[1] Age. The material is essentially a dark grey-green, medium to fine grained textured rock with a groundmass of chlorite and other dark minerals, and tiny 'laths' of feldspar, much of which has been altered to a mixture of granular epitode and albite.

Areas of slower cooling are evidenced by rather diffuse bands of pink to red feldspar as subhedral phenocrysts up to ¼" in size, there phenocrysts are often altered to epidote, or in some cases are rimmed in epidote. Other evidence of differential cooling consists of numerous abrupt chilled contacts between extremely fine grained rock to a more coarse grained material. On surface outcrops this rock has undergone extreme weathering, leaching and mechanical breakdown, much of the broken surfaces are 'smeared' with ocherous iron oxides, and more rarely, near intrusives, secondary copper carbonates.

INTRUSIVE

Where outcropping in larger sills, dikes, or plugs this material is essentially a coarse grained HORNBLENDE GRANITE, generally the feldspar content has been more or less epidotized. Epidotization has also occurred along the contacts and in post emplacement sheared zones.

Moderate seritization occurs in en echelon zones with zonal lenses of epidotization. It is within these zones that, at depth, a large disseminated deposit has its greatest potential.

1 - Mapped 1959 by Eldred D. Wilson - Geologic Map of Gila County, Arizona.

Surface and upper sub-surface structures as evidenced by drilling tends to exhibit the intrusive body in the form of dikes and sills. At depth this plutonic intrusion would reveal larger bodies of zonal and diffused alteration.

In small scale dikes and sills the material tends to exhibit a finer grained groundmass, with fairly large pink to red feldspar subhedral to euhedral crystals, these crystals after show small scale fracturing and rotation indicating emplacement as a crystalline mush. Generally the smaller bodies show a higher degree of epidotization than the larger intrusives.

The intrusive material tends to withstand the effects of surface weathering better than the volcanic greenstone and forms small cliffs or ridges on the weathered side slopes.

ANDESITE

A siliceous, extremely fine grained material with either a dark green, or dark purple colour. Right angled jointing with relatively closely spaced pairs gives an almost slate-like appearance to much of the outcrop. A well developed sheared contact between this material and the overlying Greenstone Complex is exposed along the north side of Mineral Creek.

STRUCTURE

The host rock, a metamorphic greenstone complex, highly weathered and fractured on surface appears to trend roughly in an east-west direction, and dips to the north.

This material has been intruded by what appears to be a Hornblende Granite, which outcrops on two small knolls on the western portion of the property.

A series of dikes and sills have been intruded outwards from the main body, through zones of weakness in the host greenstones.

While the general trend of these dikes is again in an east-West direction, there are several exceptions where the intrusive bodies trend in a north-south direction, following major fractures across the general trend.

A well developed fault zone occurs just to the north of Mineral Creek, this fault appears to override the underlying andesites, and could represent a faulted or heavily sheared contact between the andesites and the overlying greenstone complex.

MINERALIZATION - (SURFACE)

Generally the surface manifestation of copper mineralization on this property consists of secondary copper carbonates coating the fracture and shear surfaces of the host greenstones. In most cases these areas of secondary mineralization are associated with intrusive dikes or sills. Therefore at depth, larger bodies of intrusive rock would show secondary mineralization.

The copper carbonates, mainly malachite and azurite occur generally as thin amorphus coatings on the fracture and shear surfaces of the host volcanics. Malachite also occurs interstially in the intrusive dikes, in these cases crystalling malachite usually occurs near the contacts, and lining fracture voids. Thin blue crusts of the hydrous copper silicate, chrysocolla also occurs in many of these mineralized cores.

Bornite also occurs in many of these surface mineral zones. This material, especially noted under an intrusive dike (marked 'A') is in the form of small grains and also rather large masses up to 1/2" thick and several inches long, filling what appears to be fracture voids.

Much of the bornite, especially in the granular form is closely associated with epidote, often an epidote grain or phenocryst has a bornite center.

This surface mineralization occurs over a wide area, with a general length of about 1800 feet, an average width of about 800 feet, and a vertical depth of 240 feet. A conservative estimate of the oxidation zone from surface down to 240 feet would indicate a body of approximately 32,000,000 tons of oxide copper.

Almost all fracture and shear surfaces have coatings of black to brown opaque oxides, in many cases these oxide coatings are in the form of well developed dendritic patterns. Another form of oxide coatings occurs in the form of small circular deposits over the fracture and shear surfaces of the rock.

While most of these oxide coatings are probably iron oxides, it is more than probable that copper oxides are also present throughout the area.

Primary mineralization takes the form of disseminated grains and crystalline aggregates of chalcopyrite. This disseminated material was found in an intrusive outcrop at a low elevation on the eastern end of the mineralized zone (marked zone 'B').

Grains and small aggregates of chalcopyrite were also found in the host volcanic greenstone complex near the adit on the western end of the mineralized zone (marked zone 'C').

Several small 1/2" - 1" white crystallized calcite veins exposed in a wash to the west of this adit also contained grains of chalcopyrite.

Several pieces of intrusive rock, picked from the tailings of this adit also contained minor amounts of disseminated chalcopyrite.

Pyrite occurs, as disseminated cubic crystals and crystalline aggregates associated with tensional fractures and calcite veins.

This material is exposed in a north trending creek bed, on the north slope of the property (marked zone 'D').

Studies of alteration products and oxidized copper mineralization are generally instrumental in tracing down large copper ore bodies. The copper oxidized surface area on the Penney Property is extensive.

In reference to Dr. K. W. Ambrose's report of 1956, on the 'Big Bear Mining Claims', there is a possibility of a large copper bearing mineralized zone. Quoting from his report on page 6 (see page 4 of my report), Dr. Ambrose states:

> "The mineralized area is best exposed on the north flank of the main canyon. There, in old workings, and in bulldozer cuts made during the week May 5th to 12th, copper minerals can be seen in bedrock over an area 1,800 feet east to west, 800 feet north to south, and from creek level to the top of the ridge, over a vertical distance of about 300 feet. Thus within this block alone some three million tons of copper-bearing rock lie above creek level. If the area of copper float is likewise underlain by copper-bearing rock - and there is no reason to suppose it is not - this tonnage can be multiplied by a factor of a hundred."

SURFACE EXPLORATION

A large amount of bulldozing has been carried out on the property using a D-8 Caterpillar with rippers.

At the southern end of the property, to the south of Mineral Creek, 4000 feet of road was put in along the ridge.

At the top of the ridge about 5,500 feet of stripping and roads were put in which exposed continuation of the zones exposed on the south side of the ridge.

At the north end of the property, about 3000 feet of roads and accompanying trenches were constructed.

Approximately six miles of Cat. work has been completed. This has exposed some new zones, confirmed the continuity of existing exposure zones and put in many access roads that would further facilitate and expedite more work on the property.

Diamond drilling exploration reveals that oxide copper is present on the south slope of the ridge from the surface down hole. Sulphide copper (chalcopyrite) was intersected at a depth of 300 feet and continued to the bottom of the No. 2 drill hole. The No. 3 drill hole, some 650 feet north of the No. 2 drill hole, on the north slope of the same ridge, was collared at a lower elevation than the No. 2 drill hole and has intersected sulphide copper (chalcopyrite) at a depth of 10 feet with chalcopyrite mineralization still present in the down hole at 280 feet. The drill hole will be continued as long as mineralization warrants.

Surface sampling on the south slope has returned very interesting copper assays. One chip sample returned an assay of 2.34% Copper. Twenty-nine chip samples were taken, all returning assays of copper in varying degrees.

The north slope of the ridge has several oxide copper showings, and on this slope some float was found containing chalcopyrite.

SUMMARY OF DIAMOND DRILL HOLE NO. 2

The hole, collared at an elevation of about 4560' A.S.L. was drilled vertically to a depth of 592 feet, casing was set to 11 feet, and recovery began at about 16 feet.

Initially the core return began in the altered greenstone complex, as described in the section of the report on the geology. Several intrusive zones ranging from a length of about 6 inches to over 40 feet were encountered throughout and the hole bottomed in several feet of a volcanic crystal tuff.

Most of the rock had undergone intensive fracturing and shearing, much of the shearing was vertical, with cross fracturing. Most of the fracture and shear surfaces were coated with smears of opaque brown to black oxides, these oxides often occured as dendritic granules.

Brecciation was common, with the small angular fragments cemented by white crystalline calcite.

While crystalline calcite also occured as hairline veins, and filling the numerous tensional fractures.

A major shear zone, 6 feet in thickness was encountered at 138'0".

Two large faults, the first 10 feet and the second 8 feet in thickness were encountered at 426'0" and 570'0". Recovery was poor in these faulted zones because much of the material was crushed to clay and sand sized particles.

MINERALIZATION - (DRILL CORE)

16'0" to 43'6" - an oxidized zone with secondary copper carbonate minerals, mainly malachite, and lesser amounts of azurite, coating shear and fracture surfaces, is the host volcanics. Several zones sheared visible grains of bornite.

64'0" to 164'0" - several diffuse zones of copper carbonates occured in both the greenstones and the intrusives throughout this section of the core. Again grains of bornite were seen.

326'4" to 330'0" - chalcopyrite as disseminated grains, and tiny veinlets occured in this zone.

358'0" to 393'10" - an oxidized zone in which secondary copper carbonates and the hydrous copper silicate, chrysocolla occured in both the volcanics and the intrusive. Small grains of bornite appeared to be concentrated on or near sheared and fractured zones.

393'1-" to 402'0" - an oxidized zone, again occured in both the volcanics and the intrusive rocks. Abundant iron oxide pseudomorphs, often rimmed with malachite or chrysocolla, after the primary sulphides occured. This zone ended in a small sheared band of secondary enrichment, a red powdery material, possibly cuprite contains small grains of native copper.

402'0" to 563'0" - a primary sulphide zone occured in a sheared and fractured greenstone complex. The sulphides mainly chalcopyrite were found in several nodes; disseminated grains; small granular aggregates filling tensional fractures; smears on fracture and shear surfaces; and as centers in epidote grains.

Visual chalcopyrite mineralization appears continuous in varying amounts throughout the first 90 feet. Past there it occurs in a series of diffuse bands - ranging from about 2 feet up to about 10 feet in thickness. These mineralized zones alternated with rock shows visible sulphides.

DIAMOND DRILL HOLE NO. 3

Diamond Drill Hole No. 3 collared at about 4420 feet A.S.L., approximately 650 feet from Diamond Drill Hole No. 2., measured in a north 20° east direction.

The first 200 feet recovered showed a medium grained, fractured and sheared dark greenstone complex material.

Fine grained sulphides were disseminated throughout, with some concentration near fracture fillings. Scattered 'clots' of chalcopyrite were seen associated with feldspar phenocrysts.

CONCLUSION

The aim of the current drill program (to test for the primary copper sulphide) at a depth of ± 400 feet has been successful!

Chalcopyrite has been present in the drill hole - mainly below the 400 foot depth. Oxide copper has also been present from the collar of the drill hole. With this information available, it is recommended that the property be completely explored to develop a major copper, gold and silver ore body.

The recommendations are to drill-off the mineralized zone in a systematic grid to facilitate the calculation of an ore body.

The program should be carried out in a series of phases. The first phase would be to core drill some 7,000 feet. The first drill hole should penetrate to some 1,500 feet or until mineralization warrants it. The depth of the remainder of the drilling will be determined by the results of the deep drill hole. The drill holes should be drilled at 200 foot centers.

The expenditures required for this program would be some $173,000.00.

Respectfully submitted,

MANNY CONSULTANTS LTD.,

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
E. AMENDOLAGINE

July 12, 1976

E. Amendolagine, P. Eng.

CERTIFICATE

I, EMANUEL AMENDOLAGINE, of the City of Vancouver, in the Province of British Columbia, hereby certify:

1. That I am a geologist and reside in Vancouver, British Columbia;

2. That I am a graudate of Hunter College, of the City of New York, and Columbia University, with a B.A. and M.A. respectively, and that I have been practising my profession as a geologist for 23 years;

3. That I am registered as a Professional Engineer in the Province of British Columbia;

4. That this report is based on visits to the property of GOLD-ANGEL RESOURCES, INC., during the period from May 31 to June 11, 1976, and on information obtained from geologic maps, reports of the area and on information from engineering reports of the Property;

5. That the writer does not have, nor does he expect to receive, either directly or indirectly, any interest in the named property and/or Company;

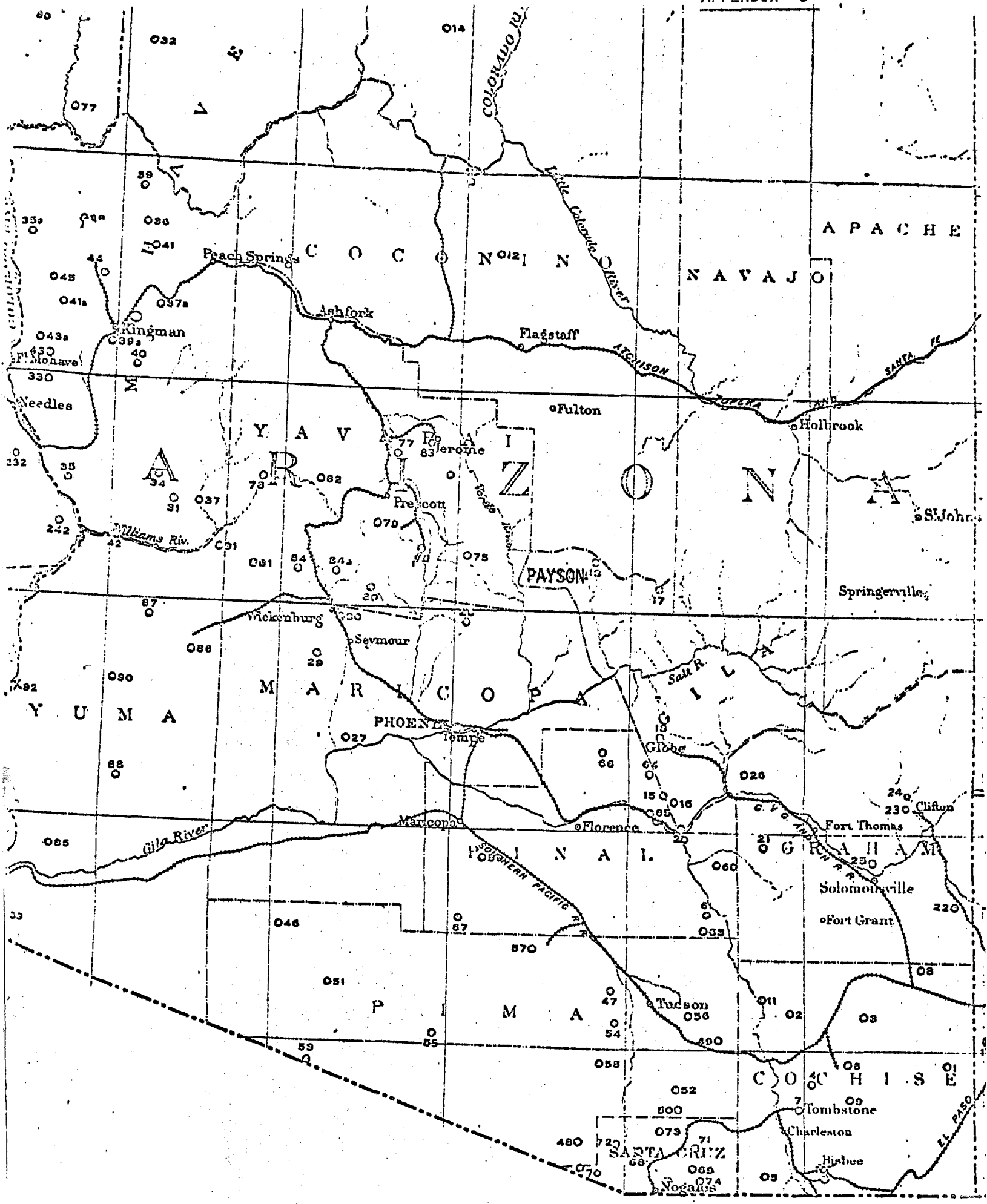
6. That this report may be used for the purpose of a Prospectus if so desired.

DATED at Vancouver, in the Province of British Columbia, on the 12th day of July, in the year 1976.

E. Amendolagine, P. Eng.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
E. AMENDOLAGINE

APPENDIX 'C'


COCONINO
NAVAJO
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YAVAPAI
ARIZONA
YUMA
MARICOPA
PINAL
PIMA
COCHISE
SANTA CRUZ
Peach Springs
Ashfork
Flagstaff
Kingman
Ft. Mohave
Needles
Fulton
Holbrook
St. Johns
Jerome
Prescott
PAYSON
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Wickenburg
Seymour
PHOENIX
Tempe
Globe
Clifton
Fort Thomas
Florence
Maricopa
Solomonville
Fort Grant
Tucson
Tombstone
Charleston
Bisbee
Nogales
Colorado River
Little Colorado River
Gila River
Salt R.
Verde R.
Williams Riv.
ATCHISON TOPEKA AND SANTA FE
SOUTHERN PACIFIC R.R.
G. V. G. AND N. R.R.
EL PASO

Penny

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120

Bulletin No. 120 *Geological Series No. 4*

University of Arizona

Bulletin

Arizona Bureau of Mines

G. M. Butler, *Director*

GOLD AND COPPER DEPOSITS NEAR PAYSON, ARIZONA

By Carl Lausen and E. D. Wilson

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GOLD AND COPPER DEPOSITS NEAR PAYSON, ARIZONA

By Carl Lausen and Eldred D. Wilson

INTRODUCTION AND ACKNOWLEDGMENTS

The following report is based upon an investigation made for the purpose of obtaining from the Payson region, or Green Valley mining district, geological data that might be of interest to mining men, prospectors, and investors. These data were obtained during a two weeks' visit in July, 1923, and a brief visit in March, 1924. The geologic base was for the most part prepared in 1920, during the course of the reconnaissance survey for the new geologic map of Arizona; and the topographic base map used for this region was the United States Geological Survey's Verde quadrangle topographic sheet, surveyed in 1885, on the scale of about four miles to the inch, with a 200-foot contour interval.

Grateful acknowledgments are due Mr. Wm. Craig, of Payson, for early historical information upon the district. To Mr. Arthur Boozer, Manager of the Atlantis Mining Company, Hon Jno. McCormack, of Gisela, Mr. E. B. Simanton, Mr. W. B. Collom, of Payson, and many other people of the region, acknowledgments are made for information, hospitality, and courtesy.

LOCATION AND ACCESSIBILITY

The region examined lies in the mountainous northern part of Gila County, in a portion of the area topographically mapped in 1885 by the United States Geological Survey as the Verde quadrangle, and is within the Tonto Basin and East Verde drainages.

Payson, which is known chiefly as a summer and hunting resort, is the principal town of the region. It was once a thriving mining center, but now depends for the support of its 214 inhabitants mainly upon the cattle industry, and only very slightly upon mining. It is located about ninety miles by road from the Arizona Eastern Railroad points, Globe and Miami, or about fifty-five miles north of Roosevelt Dam, and is reached from these places by a very good highway over which stages run three times a week. The new Apache Trail provides a good

The highest, the montane forest, occurs on the Mogollon rim, and to the north and east of Payson at elevations usually over 5600 feet above sea level. It constitutes part of the Tonto National Forest, which in turn is a unit of the so-called Mogollon Forest, said to be the largest forest in North America. It is here represented almost exclusively by yellow pine. Along streams are found aspens, alders, river-birch, and many other species, and in open places the Rocky Mountain oak. The economic trees are the yellow pine, and, to a lesser extent, the oak.

A sawmill, located about twelve miles east of Payson, is capable of furnishing almost any amount of timber that might be needed for use in mining operations.

Next below the montane forest is the oak-juniper zone, usually at elevations over 4600 feet. Its representatives are *(Juniperus monosperma* and other species of juniper); a tall oak bush *(Quercus undulata)*; hairy sumac *(Schmaltzia sp.)*; deerbush *(Ceanothus fendleri)*; barberry *(Berberis fremontii)* and other plants of lesser prominence.

Below the oak-juniper zone is the zone of desert shrubs and foothill grasses. The shrubs are largely catsclaws *(Acacia constricta, A. greggii, Mimosa biuncifera*, etc.) associated with more or less mesquite *(Prosopis juliflora velutina)*, palo-verde *(Parkinsonia microphylla* and *P. torreyana)*, garanbullo *(Condalia spathulata)*, and several species of *Lycium*. Many cacti are represented, such as chollas and prickly pears. In the canyons and washes of this zone, and extending into the zone above, are also found cottonwood, hackberry, black walnut, and sycamore. The foothill grasses are little redstems, Texas timothy, several kinds of grama, mesquite grass, needle grass, and many others.

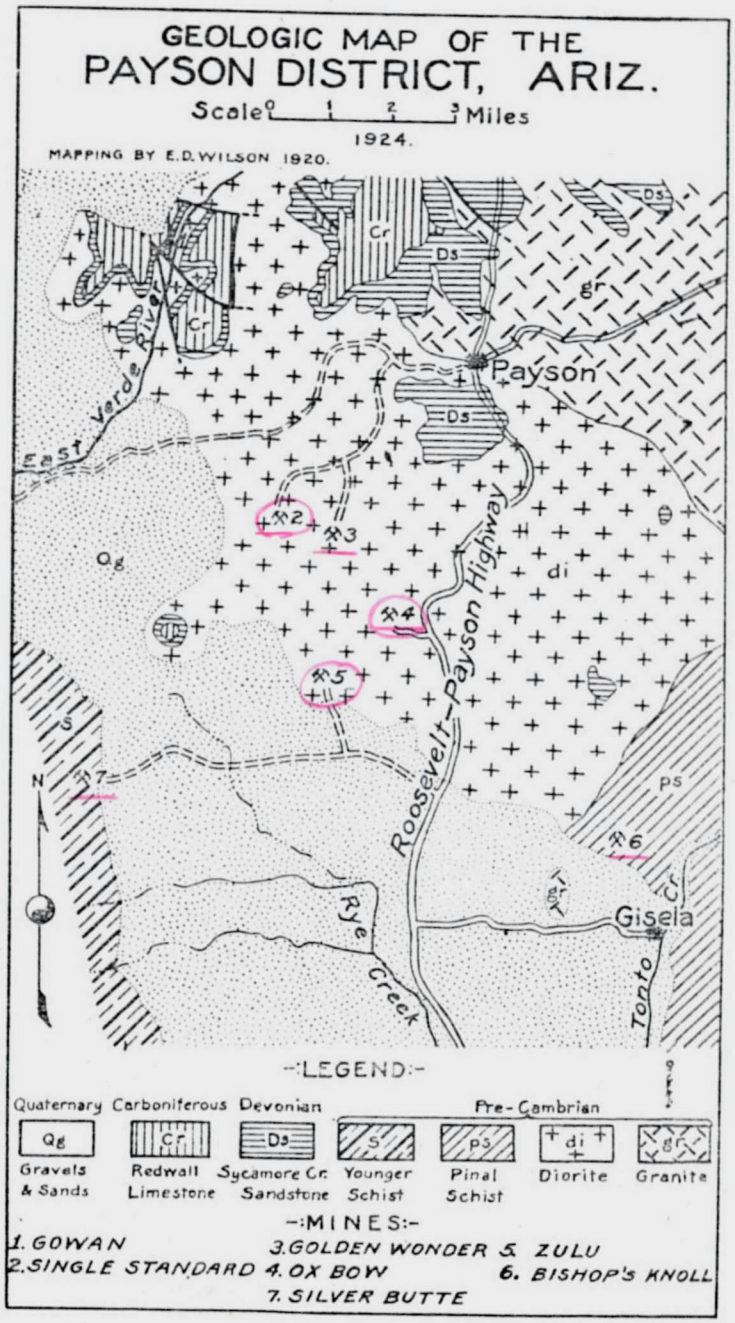

Plate I.

GENERAL GEOLOGY

PHYSIOGRAPHY

Physiographically, Arizona is divided into three major regions. These were first designated by Ransome* as the Desert Region on the southwest, the Plateau Region on the northeast, and the Mountain Region in between; or, more broadly, as the plateau province and the basin and range province.

The Payson district lies near the northern limit of the mountain belt or region, within a few miles of the great Mogollon Escarpment that here marks the southern border of the plateau region. The relief of the district varies considerably, both as to intensity and altitude; the precipitous Mogollon Escarpment, the rugged north end of the Mazatzal Range, and the deep canyons of East Verde River and Tonto Creek are in extreme contrast to the fairly even topography at Payson and the moderate contour of the floor of Tonto Basin.

The Mogollon Plateau rises gradually from the northwest towards the southeast. Some ten or twelve miles north of Payson, where it attains an elevation of about eight thousand feet above sea level, it suddenly breaks off with a bold escarpment two thousand feet high. This remarkable escarpment, which is locally known as the "rim" or the "mountain," and which is visible for many miles, is thought by some to be due to faulting; but closer examination clearly demonstrates that it is the result of erosion that has stripped back the plateau strata. Exposures reveal a complete, slightly northwestward-dipping section consisting here of the Permian Kaibab limestone at the top, underlain successively by the Permian Coconino sandstone, the Permian Supai sandstones and shales, the Devonian-Carboniferous Redwall limestone, and the Devonian Sycamore Creek sandstone. Erosional removal of the soft, Supai sandstones and shales faster than the more resistant, Coconino and Kaibab capping has brought about the cliff-like steepness of the escarpment. The Redwall limestone forms the pedestal of the cliff, and it, together with the Sycamore Creek sandstone, dips regularly under the Plateau.

Farther south towards Payson the Redwall and Sycamore Creek have been more or less completely stripped off from the pre-Cambrian granite and diorite basement, and the latter presents the form of a table-land dissected by the tributaries of East Verde River and Tonto Creek.

To the west of Payson is a rather sudden descent into the canyon of East Verde River. This stream, which runs during the whole year and

*Ransome, F. L., Bisbee Folio: U. S. Geol. Survey, Geologic Atlas of the U. S., Folio 112, (Reprint) 1914; Ray Folio, Folio 217, 1923.

is often a raging torrent during the rainy season, heads under the edge of the Plateau at an elevation of 6500 feet or more above sea level, and joins Verde River at an elevation of about 2700 feet. In consequence of its steep gradient and large drainage area, it has cut a canyon through the Redwall and Tapeats, and well down into the basement rocks, to an elevation, near the old Gowan Mine, of about 3500 feet.

Southeast of Payson is a fairly regular, but thoroughly dissected slope, extending into the canyon of Tonto Creek. This creek, like the East Verde, heads under the edge of the Plateau; but, because it has much larger drainage area, it has cut even more deeply into the hard, pre-Cambrian granites and schists. The wild rampages of this creek during the rainy seasons caused early settlers of the district to give it the Mexican title of "Tonto" (crazy).

South of Payson, beginning at a point a short distance above the Ox Bow Mine, is a regularly dissected slope extending into the valley of Rye Creek, which is a tributary of Tonto Creek. This valley, primarily of structural origin, owes its present broad, open character to a moderately dissected filling of Pliocene lake beds plus a mantle of Quaternary gravels. The same filling, together with its characteristic topography, continues northwestward over a low divide and occupies a portion of East Verde Valley between the mouth of Rock Creek and a point a few miles north of Simanton's ranch.

The west slope of the valley of Rye Creek breaks rather suddenly into the precipitous front of the Mazatzal Range. This range of mountains, structurally of the Basin and Range type, and one of the longest in Arizona, ends rather suddenly with North Peak, 7700 feet above sea level. From there it slopes rapidly, in a distance of about four miles, downward to the East Verde River, 3500 feet above sea level. Its bold northern and eastern fronts are due primarily to faulting and secondarily to erosion. Since its higher portions receive an unusually large amount of precipitation, torrential in the summer months, its slopes are deeply and intricately dissected into extremely rugged topography.

STRATIGRAPHY

METAMORPHIC ROCKS

The oldest rocks in this district consist of a series of sericitic and quartzitic schists, schistose grits, quartzites, and conglomerates. This series may be divided into two groups: One which has suffered intense deformation and which has been thoroughly recrystallized; and a younger group, consisting chiefly of quartzsites and greenstones which are relatively less deformed and have been only slightly altered by recrystallization.

Plate II.—Panoramic view of the north end of the Mazatzal Mountains.

The older of these two groups of rocks, the schists, extends in a northeast direction from the Mazatzal Mountains eastward to where it is covered by Paleozoic sediments. This belt of schists is over 10 miles wide in places, but only a small portion occurs on the map included with this report. The planes of schistosity strike northeast and usually dip at steep angles. Where seen along Tonto Creek the schists have considerable lithologic variety. They include sericite schist, greenstone schist, and hornblende schist. At the Bishop's Knoll Mine the hornblende schists are the most common variety. The sericite schists are pale to dark brown in color with a decidedly satiny luster. Parting faces of this type of schist are rather rough, due to the large grains of quartz, and to small pebbles. They are usually covered by thin foils of mica.

Under the microscope a thin section of the sericite schist is found to consist largely of quartz grains surrounded by foils of sericite. The rock also contains considerable magnetite, some chlorite, and a few grains of vermilion-red jasper. The greenstone schists consist of quartz, sericite, and chlorite, with some calcite, magnetite, and scattered crystals of rather acid plagioclase. The greenstone schist also contains small masses which seem to be the groundmass of a rather basic igneous rock, and which consist almost entirely of small plagioclase laths, a few shreds of chlorite, and considerable magnetite dust. The hornblende schist consists largely of green hornblende and quartz, together with some needles of apatite, a little magnetite, and epidote. The hornblende is largely altered to chlorite.

In part, these schists were derived from sedimentary rocks. The occurrence of small grains of jasper, pebbles of quartzite and chert, as well as vein quartz, suggests that the sericite schists were originally sediments that have since been deformed and recrystallized. The hornblende-quartz schist may have been derived from sediments, but the greenstone schists certainly were not. The finding of unaltered fragments of igneous rocks suggests that this type of schist was formed from moderately basic, perhaps andesitic, flows, breccias, and tuffs.

With regard to their age, but little can be said of these rocks other than that they are probably pre-Cambrian. They are not overlain by Cambrian sediments, but have been invaded by plutonic masses of granite and diorite which are themselves believed to be of pre-Cambrian age. Until more detailed work has been done in Arizona it will be impossible to assign these schists to any definite part of the pre-Cambrian. They are, therefore, tentatively correlated with the Pinal schists of the Globe district.*

*Ransome, F. L., Geology of the Globe Copper District, Ariz.: U. S. Geol. Survey Prof. Paper 12, p. 23, 1903.

The younger group of metamorphic rocks occurs along the east base of the Mazatzal Mountains from Deer Creek northward to the East Verde River. These rocks have been described by Ransome* as follows:

> "At the base of the sediments is a brick-red detrital rock made up of flakes of schist in an abundant matrix, apparently also composed of minute schist particles with an occasional grain of quartz. . . . Overlying it without any sharp line of demarcation is a conglomerate about 2 feet thick, with sparse pebbles of rhyolite and red jasper as much as 5 inches in diameter. The conglomerate in turn grades upward into quartzite. The quartzite is very hard and vitreous and is generally reddish or brown. Much of it is banded parallel with the bedding planes."

In another traverse up the North Fork of Deer Creek Ransome† describes these sediments again as follows:

> "The first rock to be seen in ascending the ravine is a large body of quartzite folded into a sharp anticline and apparently faulted against shales on the northwest. These shales resemble nothing I had previously seen in Arizona. They are gray-green, weathering yellow, fairly hard, and only moderately fissile . . . ."

On the south side of the East Verde River the writers observed a thick series of shales of a dark green to chocolate-brown color. These shales are uniformly fine-grained, showing no bedding planes, and are highly indurated. Apparently over these shales is a great thickness of greenstones which in turn is succeeded by massive feldspathic quartzite, conglomerate, and then by alternating gray and banded red-brown quartzite. The uppermost members of the series are beyond the limits of the area included in this report and were not studied. The total observed thickness including the greenstone is probably over two thousand feet.

These highly indurated sediments are cut by numerous dikes of granite porphyry, and by masses of hornblende diorite. This dioritic rock is probably the same as the hornblende diorite in the vicinity of the Ox Bow Mine, which is believed to be pre-Cambrian; and the sediments are therefore also thought to be of pre-Cambrian age.

SEDIMENTARY ROCKS

Sycamore Creek Sandstone: As is shown on Plate I, this formation occurs as isolated remnants south and southeast of Payson, while to the north is a large area partly overlain by the Redwall limestone.

The Sycamore Creek sandstone is generally dull, reddish-brown in color, although some buff colored beds are also present. The rock is made up of a coarse quartz sand cemented chiefly by oxides of iron and carbonate of lime. Cross-bedding is locally common and then the stratification is not well defined. The bedding planes are more apparent

*Ransome, F. L., Some Paleozoic Sections in Arizona and Their Correlation: U. S. Geol. Survey Prof. Paper 98, p. 158. 1916.

†Ransome, F. L., op. cit.

on weathered surfaces than in hand specimens. The rock is traversed by numerous joints, and weathers as steep bluffs. Pebbly layers are common, but the pebbles rarely exceed one inch in diameter, and consist of quartz, quartzite, and some jaspers. The upper part of this sandstone in the area covered by this report has been largely removed by erosion, and where the formation is overlain by the Redwall limestone the thickness is seldom over 150 feet.

When a reconnaissance survey of this region was made for the geologic map of Arizona this sandstone was correlated with the Upper Cambrian Tapeats sandstone of the Grand Canyon section. Within the last year, however, Drs. Chas. Schuchert and A. A. Stoyanow have found the layers of finer-grained material between the pebbly beds to contain bony plates of fresh-water fishes. These fossil fishes Dr. Stoyanow* states are undoubtedly of Upper Devonian age. A thorough examination of this material will probably lead to the correlation of the Sycamore Creek sandstone with the sandy beds at the base of the Temple Butte limestone in which Noble† found fragmentary remains of *Bothriolepsis*, an Upper Devonian fish.

A manuscript in which this horizon and its fossil remains will be described in detail, is now in course of preparation; and Dr. Stoyanow will propose the name Sycamore Creek sandstone for this formation.

Resting with apparent conformity on the Sycamore Creek sandstone are thin-bedded, flaggy limestones. A small area of this limestone is shown near the northern edge of Plate I. The lower members of this formation are somewhat sandy and argillaceous, and these impure beds grade upward into dense, light-gray and pink limestone. These lower beds, usually less than a foot thick, contain but little cherty material, and may in part be dolomitic. Above them the limestone is slightly darker gray, compact, and in beds two to three feet thick separated by thin partings of shale.

In these limestones Stoyanow found the following Upper Devonian fossils: *Spirifer whitneyi var. animasensis*, *Pachyphyllum woodmani*, *Cladopora sp.* The occurrence of this variety of Spirifer, according to Stoyanow, suggests a closer relationship of this horizon to the Ouray limestone of Colorado than to the Martin limestone of southern Arizona.

Redwall Limestone: Immediately above the thin-bedded Devonian limestones are rather pure limestones of Mississippian age, in which Stoyanow found a typical Madison fauna. The thickness of this formation in the area included in this report is approximately one hundred

*Personal communication.

†Noble, L. T., A Section of the Paleozoic Formations of the Grand Canyon at the Bass Trail: U. S. Geol. Survey Prof. Paper 131-B, p. 52, 1922.

Plate III. A.—Exposure of Sycamore Creek sandstone north of Payson.

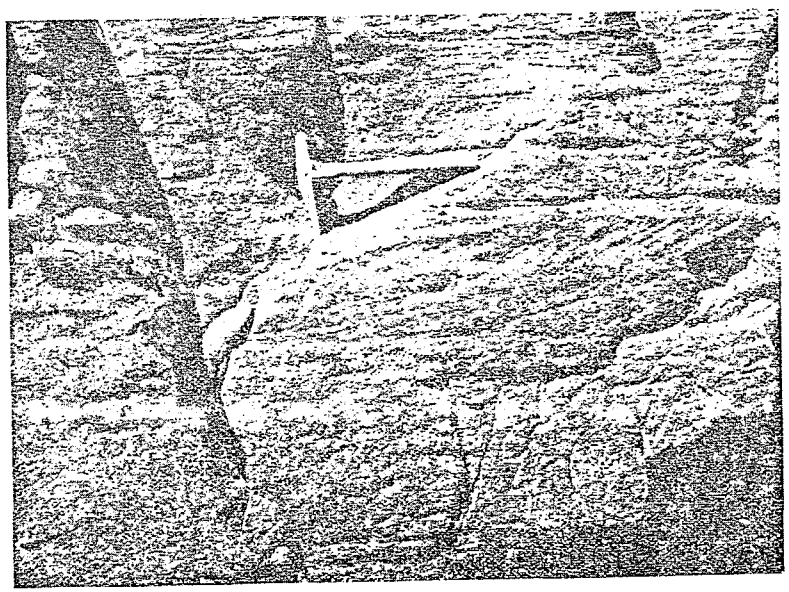

Plate III. B.—Sycamore Creek sandstone showing details of stratification.

feet, while in the Mogollon Escarpment the thickness is over 350 feet, showing that the major part of the formation near Payson has been removed by erosion.

This formation is correlated with the Redwall limestone of the Grand Canyon. The Redwall limestone as redefined by Noble* is assigned to the Mississippian by him, while the Temple Butte limestone and the Martin limestone are both Upper Devonian. The limestones near Payson are unfossiliferous, and, although traces of organic remains were found, they were too fragmentary for determination. It is the writers' belief that these limestones are the equivalent of the lower part of the Redwall limestone, and they are here correlated with that formation.

Tertiary Conglomerates and Silts: Filling the valley between Payson and the Mazatzal Mountains, and extending northward as a broad belt across the East Verde River, there are two distinct formations separated by an unconformity; but, as they are not of economic importance, they were not separated in mapping.

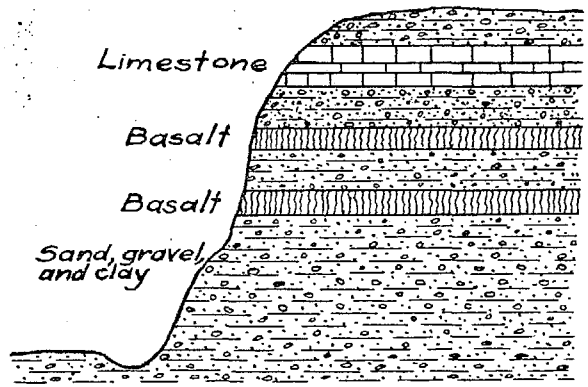

Fig. 2.—Section of Tertiary sediments on the East Verde River showing two flows of basalt intercalated in the conglomerate.

On the East Verde River a consolidated conglomerate is exposed in the cliffs which line the river. The pebbles and boulders making up this conglomerate are usually both subangular and rounded, and vary in size up to several feet in diameter. These pebbles consist of quartzite, limestone, basalt, and other igneous rocks occurring on the drainage area of the East Verde River. The interstices between the pebbles are filled with sand, and the whole cemented by carbonate of lime. Friable sandstones and sandy silts make up the largest part of this formation. Thin-bedded, fresh-water limestone occurs in the silty beds, and in the

*Noble, L. F., op. cit. p. 54.

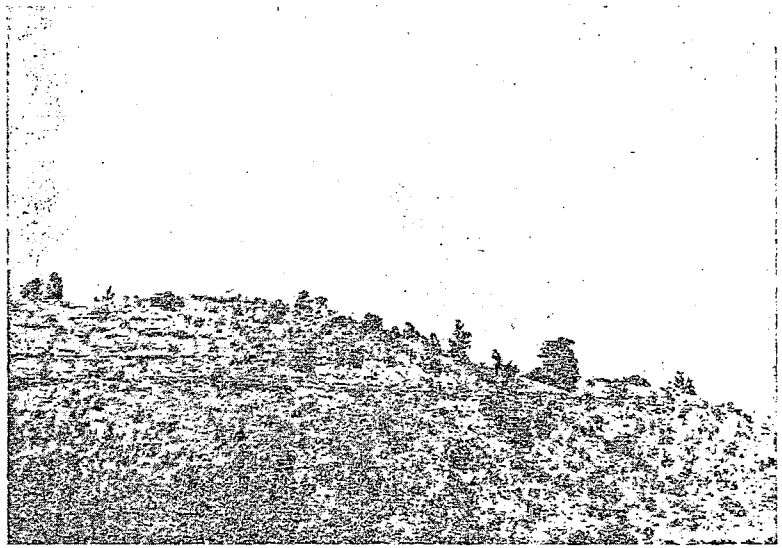

Plate IV. A.—Tertiary sediments southwest of Payson.

Plate IV. B.—Old stope at the Gowan Mine. These juniper stulls have been standing for over forty years. Photo by Chas F. Willis.

cliff sections along the East Verde River two basalt flows were intercalated in the conglomerates. A section illustrating these relations is shown in Fig. 2.

The material of which this formation is made up was deposited in a temporary lake formed by the damming of the East Verde River by extensive flows of basalt. These basalts appear to have come from some vent to the north or northwest of Payson, and were probably extruded during the first period of basalt eruption, which Robinson* has shown to be Pliocene. This formation is therefore probably Pliocene, and may in part be younger.

Quaternary Gravels: Resting on the fresh-water limestones, conglomerates, and silts described above are unconsolidated gravels and sands. The pebbles in this gravel are similar to the pebbles in the underlying conglomerate, both in rock composition and texture, and were probably derived from the same source. The two formations differ decidedly in the degree of induration; but on weathering resemble each other so closely that a separation in the field is impracticable. As neither of these formation is of economic importance, they were not separated on the map accompanying this report (See Plate I). That they were deposited at different times, however, and possibly with a decided time interval intervening, is clearly shown by their relative positions; the gravels occupy the ridges, while where the streams have cut through the gravels, the older formation is exposed in the bottoms of the gulches. In the deeper gulches the contact between the two formations is an irregular one, with many cuts in the underlying soft silts. These cuts are filled with gravel and sand, and the trenching in these silts suggests old stream channels. No fossils were found in this formation, but it is tentatively assigned to the Pleistocene.

IGNEOUS ROCKS

The igneous rocks in the vicinity of Payson consist of two pre-Cambrian plutonic masses, various basic and acidic dikes, and a greenstone (altered andesite) intercalated in the younger schist series. There are apparently no Paleozoic or Mesozoic igneous rocks in this district; but, in the late Tertiary conglomerates and silts are some flows of basalt and associated tuffs.

INTRUSIVE ROCKS

Granite: Plutonic masses of coarse-grained red granite occur to the southeast and east of Payson, extending for many miles to the east of the limits of the area included in Plate I. To the southeast the granite invades the pre-Cambrian schist series, while to the north and northeast

*Robinson, H. H., The San Franciscan Volcanic Field, Arizona: U. S. Geol. Survey, Prof. Paper 76, p. 92, 1913.

the granite is covered by the Paleozoic formations. The granite is cut by numerous fine-grained aplitic dikes of a pink color and containing essentially the same minerals as the granite. The rock weathers to a coarse, granitic soil consisting of quartz and feldspar, and exposures of the fresh rock were not seen.

Megascopically, the rock is pink in color, has a coarse, granitic texture, and a uniform grain, and consists essentially of potash feldspar and quartz. On a fresh fracture, sparkling, cleavage faces of the feldspar may be seen; and a few small flakes of a chloritic mineral, as well as occasional grains of magnetite, are evident.

Under the microscope, the rock is seen to consist essentially of microcline and quartz, together with a little orthoclase and albite. A few shreds of green hornblende and some muscovite are present, and as accessory minerals magnetite and zircon were identified. An elongated blue mineral occurs in a grain of quartz, but the optical properties could not readily be determined because of its small size. The quartz in this rock occurs as clear anhedral grains with irregular trains of inclusions like a string of beads. The microcline shows the typical, gridiron structure due to a combination of twinning in accord with the albite and pericline laws. Cleavage is sometimes seen, but usually the mineral is clouded with kaolinitic dust. A few small, subhedral grains of orthoclase with the typical Carlsbad twinning occur in the rock, and some albite was found. The small amount of hornblende present was of the green variety, and occurred as ragged shreds between other minerals. It is strongly pleochroic and alters readily to a chloritic substance. Muscovite is rare, as is also zircon. The alteration products consist of chlorite, kaolin, and sericite.

The texture is holocrystalline and hypidiomorphic, with a tendency towards equigranularity. The albite and orthoclase were among the earlier minerals to crystallize out, and therefore have their boundaries more or less well developed; but neither the microcline nor the quartz shows any well-defined crystal boundaries.

The granite, which intrudes the pre-Cambrian schists, and is therefore younger than them, is itself intruded by the hornblende diorite just west of Payson. It has the Sycamore Creek sandstone of Upper Devonian age resting upon its eroded surface. It is the oldest igneous rock in the district, and is probably the same as the Ruin granite of the Globe district described by Ransome.*

Hornblende Diorite: This intrusive rock is distributed in a northwest-southeast trending belt, immediately west of Payson, and extends from the Gowan Mine on the East Verde River to the Bishop's Knoll

*Ransome, F. L., Geology of the Globe Copper District, Ariz.: U. S. Geol. Survey Prof. Paper 12, pp. 73-75, 1903.

where it intrudes the schist. Along its east boundary it intrudes the granite described above, and to the southwestward is covered by the late Tertiary sediments. The rock weathers to an olive-drab soil which on close examination is found to consist of altered feldspar and hornblende. The rock is cut by numerous basic and acidic dikes, and near the Single Standard Mine by a dike of fine-grained hornblende diorite.

The rock is generally of a dark gray color, but locally, as at the Ox Bow shaft, is much lighter colored due to the local abundance of feldspar. In a hand specimen the rock is of a coarse-grained granitic texture and is composed chiefly of hornblende and feldspar. The hornblende is usually in larger crystals than the feldspar, but the constituent minerals seldom exceed a quarter of an inch in length. With the aid of a hand lens the feldspar is found to show abundant polysynthetic twinning, and is therefore plagioclase. The hornblende is nearly black and shows the perfect prismatic cleavage intersecting at 124°. Occasional grains of quartz and magnetite may also be seen.

Microscopically, the rock is composed essentially of plagioclase feldspar and hornblende, together with a little quartz and orthoclase and rarely a little biotite. As accessory minerals, magnetite, apatite, and zircon were observed. The plagioclase, determined by the statistical method, was found to be labradorite; but sections of the mineral parallel to the albite twinning plane show a zonal structure, so the outer portion of the mineral may be basic andesine. The mineral is usually cloudy due to minute inclusions of kaolin, an alteration product, especially along cleavage lines. The hornblende is of the dark green variety, and is strongly pleochroic. The prismatic cleavage is very pronounced. The hornblende often contains numerous grains of magnetite, especially near the center of the crystals, and is unusually free from alteration. The quartz occurs interstitially between the hornblende and labradorite, or between different grains of feldspar. The quartz is clear, and contains only a few minute crystals of apatite as inclusions. The magnetite occurs as irregular, more or less rounded grains, sometimes abundant in the hornblende. Apatite is present as short, stout, and well-formed crystals, occasionally partially enclosed by magnetite or by hornblende; and minute crystals were also found in both the quartz and labradorite. Biotite is rare, and the few sheds found were of the deep brown variety. The alteration products are not abundant, and consist chiefly of kaolin, a chloritic mineral with anomalous interference colors which may in part be antigorite, and a few grains of epidote.

The texture as seen under the microscope is holocrystalline, hypidiomorphic, and granular, with the plagioclase and hornblende showing partial crystallographic outlines. Very often the hornblende occurs with ragged outlines and partially enclosing other minerals, especially

magnetite and apatite. The quartz was undoubtedly the last mineral to crystallize, and occurs interstitially between other minerals.

This plutonic mass cuts the granite and the schist, and is therefore younger than either of these formations. Just west of Payson the Sycamore Creek sandstone rests unconformably on the diorite, which is clearly pre-Cambrian; but the time relation of the diorite to the greenstones intercalated in the younger schist series is not known, for the two rocks are nowhere in contact with each other. However, since this series of sediments does not show any contact effects, it is believed that the diorite is the older of the two.

Basic and Acidic Dikes: Cutting the granite and the hornblende diorite are numerous dikes, both basic and acidic in composition. In the vicinity of the Ox Bow Mine these dikes generally have an east-west or a northeast-southwest trend; but on the western part of the claims of the Bishop's Knoll Mining Company the basic dikes trend nearly north-south, while the acidic dikes have an east-west strike.

The basic dikes with a north-south strike may be divided into two groups, one of which is earlier than the acidic dikes and one of which is later. The members of the older group vary in composition from rocks containing about equal amounts of hornblende and plagioclase to rocks consisting almost entirely of coarse-grained, interlocking crystals of hornblende. The younger basic dikes are usually fine-grained, and consist largely of hornblende and plagioclase, with accessory apatite and magnetite. At the Ox Box Mine the basic dikes are hornblende porphyrites that consist of porphyritic crystals of green hornblende in a groundmass of hornblende and plagioclase feldspar, near andesine in composition, together with accessory apatite and magnetite. Acidic dikes of granite or granite porphyry cut the basic rocks. The dikes of granite porphyry are usually fine-grained, only slightly porphyritic, and consist of quartz, orthoclase, some acid plagioclase, and a little biotite and hornblende altering to chlorite. Acidic dikes of the same general composition also cut the greenstones on claims of the Silver Butte Mining Company.

Although these dikes occur within a short distance of exposures of Sycamore Creek sandstone, they were nowhere observed cutting this formation, and are probably of pre-Cambrian age. They are, however, definitely later than the hornblende diorite.

EXTRUSIVE ROCKS

Greenstone: The oldest extrusive rocks found in the area covered by this report occur as greenstones which form a rather continuous belt along the foot of the Mazatzal Mountains. The greenstones occur in the younger schist, underlain by highly indurated shale and overlain by quartzites. These greenstones were originally andesitic flows, breccias, and tuffs, and have a thickness of over one thousand feet; but in part this thickness may result from duplication due to faulting.

Examined microscopically, these rocks were found to consist largely of chlorite, epidote, and feldspar, together with a little kaolin, calcite, secondary quartz, and deep red scales of hematite. The larger porphyritic crystals of plagioclase are usually in part replaced by epidote, while the second generation of plagioclase in the groundmass surrounded by chlorite is only slightly altered. The small crystals of feldspar show distinct flow structure. No original ferromagnesian minerals were found, and the rocks were probably originally andesites.

These rocks are unconformably overlain by the Sycamore Creek sandstone of Upper Devonian age, and are considered by the writers to be pre-Cambrian.

Olivine Basalt: Flows of basalt occur along the East Verde River intercalated in the conglomerates and silts of the late Tertiary. The rock is dark colored and rather fine-grained; and with the aid of a hand lens olivine and striated plagioclase feldspar may be readily identified. These flows are unimportant economically, but have been discussed above in connection with the sedimentary rocks. They are shown diagramatically in Fig. 2.

STRUCTURE

Most of the area covered in this report consists of massive igneous rocks, such as the old granite and the hornblende diorite. In the southeast corner of the area, the schists which have been correlated with the Pinal schists of the Globe region consist of highly folded and contorted beds of sediments. The younger schists at the base of the Mazatzal Mountains, although highly indurated and partially recrystallized, show distinct bedding-planes, especially in the quartzites. On the North Fork of Deer Creek Ransome* found these quartzsites to have been folded into an anticline with steeply dipping limbs. These same beds along the East Verde River have a fairly uniform dip of about 20° to 25° to the northwest. The Paleozoic rocks lie nearly horizontal, and show little or no folding.

Faulting has been more important than folding in this region, and all the veins observed occupy fault fissures. These faults vary in strike from northeast to northwest. In the vicinity of the Bishop's Knoll there are a number of dikes trending generally north-south or east-west. Many of these dikes occupy fault fissures, and, along some of them, faulting has taken place after the intrusion of the dikes. This movement has often thoroughly crushed the rock of which the dikes are composed.

*Ransome, F. L., Some Paleozoic Sections in Arizona and their Correlation: U. S. Geol. Survey Prof. Paper 98, p. 158, 1916. See figure 13.

GEOLOGIC HISTORY

Pre-Cambrian: The oldest rocks of the district, namely the series of sericitic, greenstone, hornblende, and quartzitic schists, schistose grits, quartzites, and conglomerates, constitute a very interesting and intricate ancient record. Unfortunately, however, as is so often true of the older pre-Cambrian, this record is only dimly legible, and is generally so fragmentary that it is very difficult to read it.

Microscopic studies of these schists suggest that they were in part of sedimentary origin, and in part igneous. But, so far, nothing very definite is known of the still more ancient basement upon which they rested, or of the land mass from which the sediments were derived. Fluctuating cycles of long-continued continental and marine sedimentation, accompanied by igneous extrusions, appear to have obtained over widespread areas. How long deposition continued, or what the total amount of the great thickness of these older rocks was, is unknown; but they were ultimately subjected to deep burial, followed by dynamic metamorphism sufficient to bring about most of their present state of recrystallization and schistosity. This change was accompanied or closely followed by mountain-making movements and the batholithic intrusion of the granite. Next, there ensued a period of long-continued erosion, resulting, probably, in more or less peneplanation, followed by the resumption of the sedimentation cycle and the deposition of the younger pre-Cambrian series. This series seems to have been laid down during another long period of fluctuating cycles of continental and marine sedimentation. Uplift then again occurred; and mountain-making forces, accompanied or closely followed by the intrusion of the diorite and other dikes, acted to produce the second stage of dynamic metamorphism, which recrystallized this younger pre-Cambrian series.

Sometime before the dawn of the Cambrian period there occurred another extensive uplift during which the pre-Cambrian formations were extensively faulted and tilted. A long period of vast erosion then ensued, with the result that the strata were eroded into a peneplain marked here and there, however, with monadnocks of very resistant rocks.

Paleozoic: Whether erosion continued on through Cambrian time, or whether some sediments were deposited then and were comparatively soon removed, there is no evidence; but the oldest Paleozoic sediments found in the region consist of sandstones whose upper beds contain Devonian fossil fishes, as already mentioned. This sandstone seems to have been deposited in part along the shore of a steadily advancing sea, where much of the rounded, coarse, pebbly material was probably derived from the thorough reworking of loose material littered over the old land-surface; and part of it may have been deposited by rivers. The fact that both the sand and pebbles of the sandstones consist almost entirely of quartz and quartzose materials, very resistant to both oxidation and attrition, together with the lack of fresh feldspathic materials, indicates that the old land surface probably existed during a time of great aridity; and the characteristic red color of the sandstone is due to iron oxide probably derived from gossans of mineralized areas of the old land mass.

Neither the Bright Angel shale nor the Muav limestone of the Grand Canyon region appears to be represented in the Payson district. Whether they pinch out before reaching this far south, or were removed by pre-Devonian erosion, has not yet been determined.

No Ordovician or Silurian was found in the Payson region, nor does there seem to be evidence that any sediments of those periods were ever deposited there.

The next formation present, younger than the sandstones, is the Devonian limestone. Above it is another limestone series correlated with the Redwall limestone of northern Arizona and consisting here of Mississippian and Pennsylvanian strata. These beds are definitely of marine origin, and were deposited in quiet waters upon the Cambrian continental shelf.

Sedimentation probably continued in the region throughout Permian time, for Permian beds are well represented a few miles north of Payson, along the Mogollon Escarpment, and on the Plateau; but erosion has since stripped them from the area considered in this report.

Mesozoic and Cenozoic: Deposition probably progressed on through the Triassic, Jurassic, and Cretaceous, and to some extent into the Tertiary, for representatives of these periods are present in the Plateau Region farther north. However, Tertiary and Quaternary erosion has completely stripped them from the Payson region. Some Tertiary sediments are present as local, detrital conglomerates beneath the lava flows, and probably also as part of the valley filling.

The Tertiary period in this region, as in many others of the Southwest, was marked by vigorous erosion, great volcanic activity, and faulting; and it is quite probable that continuations of the lava flows that still remain northwest of Payson, west of Pine Creek, and on much of the Plateau, once also covered the whole region. Such flows so obstructed the drainage of the East Verde River and Tonto Creek in Pliocene time that lakes were formed which are evidenced today in the calcareous and gypsiferous lower beds of the valleys of these streams.

The early Quaternary of the region probably witnessed some basaltic extrusions; but, on the whole, the period has been marked by intense erosion and considerable consequent deposition of detritus in the valleys.

ECONOMIC GEOLOGY

MINERALOGY

A considerable number of distinct mineral species occur in this district. Some of them, such as the feldspars and hornblende, are confined to the igneous rocks, and have already been described. Others, such as epidote or chlorite, occur as alteration products of pre-existing rock minerals, but because of their close association with the ore deposits may be included in this list. Sulphide minerals like pyrite, chalcopyrite, bornite, or galena are of primary character, and were deposited when the veins were formed. These primary minerals were later altered by oxidation processes to the oxides and carbonates. The minerals in this list will be described in groups, such as the minerals containing copper, or silver, or lead; and they will be followed by species that are of no economic value, but which are usually found associated with the ores.

GOLD MINERALS

Native Gold (Au): Metallic bright yellow flakes in rusty, porous quartz. The gold of quartz veins contains a variable amount of silver, and is always of a lighter color if considerable silver is present. Small flakes of gold were seen in the oxidized ores from the Gowan, the Ox Bow (Atlantis Mining Company), the Golden Wonder, and the Zulu mines. Assays of samples of gold ore from the Payson district show only small quantities of silver. The placer gold on the slopes of Ox Bow Hill varies in size from minute flakes to small, flat nuggets up to a quarter of an inch in length. The nuggets are of a deeper color than the vein gold, and probably contain little or no silver. The gold in the oxidized portions of the veins was probably derived from auriferous pyrite, and this mineral will be more fully described under the iron minerals.

SILVER MINERALS

Native Silver (Ag): Metallic silver-white flakes or wire, but may be tarnished brown or gray. Wire silver is reported to have been found near the surface in the oxidized portion of the ore-shoot at the Silver Butte mine. This metal was not seen in specimens collected during this examination, and apparently is relatively rare in the district. Small, but variable, amounts of silver occur with gold in the quartz veins, and it is an important constituent of the galena and tetrahedrite ores at the Silver Butte Mine.

Cerargyrite (AgCl): Usually massive and resembling wax; often in crusts; also known as hornsilver. Color variable, usually grayish green; upon exposure to light, turns violet-brown. The mineral was reported

to have been found associated with native silver in the open-cut workings of the Silver Butte Mine. The mineral is rare in this district, and none was seen by the writers.

LEAD MINERALS

Galena (PbS): Metallic; color lead-gray; usually as crystalline masses with good, cubic cleavage; intergrown with other sulphides. The mineral was found only at the Silver Butte Mine, associated with pyrite, chalcopyrite, and the oxidation products of lead and iron minerals. This mineral probably carries some silver.

Anglesite ($PbSO_4$): The color of the mineral in specimens from this district is light to dark gray, and it occurs as a dull-lustered, crystalline mass surrounding galena. It alters to cerussite, the carbonate of lead. The mineral is not common in the district, and was found only at the Silver Butte Mine.

Cerussite ($PbCO_3$): Colorless to white or gray, sometimes blue or green due to copper salts. The mineral occurs in crystalline masses surrounding anglesite, the sulphate of lead, from which it was derived. It also occurs as colorless crystals in cavities. The crystals are glassy with a faint, silvery sheen on the surface. It is rare in the district, and was found only at the Silver Butte Mine.

Massicot (PbO): The mineral occurs as an earthy, yellow powder associated with other oxidized lead minerals; it is sometimes greenish due to the presence of copper, or reddish when it contains oxides of iron. The mineral, rare in the district and not an important constituent of the ores, was found only at the Silver Butte Mine.

Cuprodescloizite ($4RO.V_2O_5.H_2O$, R=Pb, Zn, Cu): Color dark brown to black. Occurs as velvety crusts. Copper replaces some of the lead and zinc in the molecule. The mineral was found associated with copper ore in the Ox Bow Mine and also at the Zulu Mine. It is rare, and not of economic importance.

Wulfenite ($PbMoO_4$): Color orange-yellow. This mineral usually occurs as glassy crystals, but the only specimen found in this district occurred as scales on a fracture plane associated with cuprodescloizite. The chemical and physical properties correspond to the mineral wulfenite. It was found only at the Ox Bow Mine.

COPPER MINERALS

Chalcopyrite ($CuFeS_2$): Metallic, color brass-yellow; usually massive. This is the chief sulphide in the copper deposits. It occurs associated with bornite on the claims of C. Harrington and also on claims of W. A. Cain. Chalcopyrite was also seen with pyrite and galena, in the ore from the Silver Butte Mine. A little chalcopyrite was found with

pyrite at the Bishop's Knoll. The copper minerals of many of the gold veins were probably derived from chalcopyrite by oxidation processes.

Bornite (Cu_5FeS_4): Metallic; color pinchbeck-brown on fresh fracture; tarnishes readily to peacock colors. The mineral was found only on claims of W. A. Cain. Here it surrounds grains of chalcopyrite. The mineral is probably primary, but may have been deposited by descending acid solutions.

Tetrahedrite ($Cu_3Sb_2S_7$): Metallic. Color lead-gray; usually massive. This mineral is the chief constituent of the ore in the Silver Butte Mine, and is reported to carry considerable silver. The tetrahedrite occurs in a gangue of calcite and quartz. In polished surfaces, the mineral was found as irregular grains in galena.

Covellite (CuS)): Metallic; crystals usually are thin, hexagonal plates; color indigo-blue. Turns purple when moistened. Covellite occurs as a microscopic constituent of the ores in specimens from the Silver Butte Mine, in specimens from W. A. Cain's claims, and probably elsewhere. At the Silver Butte Mine it replaces galena, chalcopyrite, and tetrahedrite. At Cain's claims the mineral replaces bornite. The covellite in these specimens was formed by supergene enrichment.*

Chalcocite (Cu_2S): Metallic; dull when tarnished; color dark lead-gray to black when earthy or tarnished; usually massive. The mineral occurs in a vein at the Bishop's Knoll. In other parts of the district it is found as a microscopic constituent of the ores, especially in the ore from the claims of W. A. Cain. The mineral is supergene in origin, and is not important economically in the Payson district.

Malachite ($CuCO_3Cu(OH)_2$): Dull to glassy; color bright green; usually radiating-fibrous. This green basic carbonate of copper was found in practically all the deposits examined. At the Silver Butte Mine it occurs as stout, prismatic crystals embedded in porous quartz. In the gold-quartz veins it occurs in small, radiating-fibrous masses associated with limonite and chrysocolla, and occasionally with azurite.

Azurite ($2CuCO_3.Cu(OH)_2$): Glassy to dull; color deep azure blue. Crystals are rare in this district and the mineral occurs only as crystalline masses at the Silver Butte Mine, at the Golden Wonder, and at the Bishop's Knoll. Like malachite, it is associated chiefly with earthy limonite.

Chrysocolla ($CuSiO_3.2H_2O$): Dull or waxy to glassy; color bluish-green to sky-blue. Chrysocolla was found at all the properties containing copper minerals, and is usually associated with limonite, quartz, and malachite. It is not an important constituent of the ores.

*A term applied to ores or ore minerals that have been formed by generally descending waters. (Ransome, F. L., Prof. Paper 115, U. S. Geol. Survey).

Dioptase (H_2CuSiO_4): Glassy. Color emerald green; usually as crystals. This mineral was found at the Ox Bow Mine as small, prismatic crystals on limonite, and associated with malachite and chrysocolla.

IRON MINERALS

Pyrite (FeS_2): Metallic; color pale brass-yellow; usually as crystals in the quartz veins; but also as crystalline masses in the lead and copper ores. May tarnish to brass-yellow, but is harder than chalcopyrite. In those quartz veins that have been mined to the ground-water level, pyrite is the most important constituent of the ore, and, since the ore is not free milling, the gold probably occurs in this mineral. It is usually found in the quartz veins with chlorite. In the lead and copper deposits it occurs with the sulphides of those metals.

Hematite (Fe_2O_3): Dull (usually) to metallic; color brick-red to dark-red; dark gray when metallic; usually earthy in this district. The mineral occurs at all the deposits examined and is especially important in the gold veins, where it is associated with limonite and quartz and often carries flakes of free gold. This is one of the most important minerals in the district, as where this mineral is abundant the gold values are higher.

Limonite ($2Fe_2O_3.3H_2O$): Dull; color varies from ocher-yellow to dark brown. Limonite is one of the most important constituents of the oxidized portions of the gold veins. Gold occurs in this limonite in small flakes; and the more abundant the limonite, the higher is the gold content of these veins. In the Ox Bow Mine, limonite occurs as a pseudomorphic replacement of pyrite. At the Silver Butte Mine, the limonite in the oxidized ore is associated with the oxidized minerals of lead and copper.

GANGUE MINERALS

Quartz (SiO_2): Glassy; colorless to white; six-sided crystals and crystalline masses. The primary ore of the gold veins consists of white quartz with scattered grains of pyrite and occasional grains of chalcopyrite. Near the borders of the veins the quartz often contains considerable dark green chlorite. In the oxidized portions of these veins the pyrite has been changed to limonite and hematite, and, where some of these constituents of the pyrite have been carried away by solutions, the quartz is rusty, porous, and open-textured. Quartz also occurs with the lead ore, and to a lesser extent with the tetrahedrite ore. At the Ox Bow Mine, some barren quartz in the hanging-wall is unusually clear and occurs as inward-projecting crystals up to an inch in length.

Calcite ($CaCO_3$): Glassy; colorless to white, with a flesh tint; in crystalline masses. Calcite of a flesh-colored tint occurs with barren quartz in the Ox Bow Mine. Here it fills the center of the vein be-

tween the crystals of quartz projecting from both walls. In the ore from W. A. Cain's claims it is associated with quartz, epidote, and garnet.

Ankerite ($2CaCO_3.MgCO_3.FeCO_3$): Glassy to stony; color white; crystalline masses. This mineral occurs only at the Silver Butte Mine, where it is associated with the tetrahedrite ore. Specimens of this mineral, lying on the dump for a few years, have turned brown because of the oxidation of the iron in the ankerite molecule.

Fluorite (CaF_2): Glassy; color violet-blue; crystalline masses. The mineral was found associated with epidote as a vein in a fine-grained diorite dike. The specimen in which this mineral was found came from the shaft of the Ox Bow Mine.

Garnet (Ca_3Fe_2 $(SiO_1)_3$, variety andradite): Glassy; color yellowish brown; commonly as crystals. Garnet was found intergrown with epidote, calcite, and chalcopyrite in Harrington's claims near the East Verde River.

Epidote (HCa_2 $(Al, Fe)_3$ Si_3O_{13}): Glassy to dull; color yellowish green; prismatic crystals and crystalline masses. Epidote occurs with garnet, as mentioned above. At the Ox Bow Mine, the mineral lines a veinlet of fluorite. It also occurs in the schist at the Bishop's Knoll, and is a common constituent of the dike rocks, especially where they have been altered by hydrothermal solutions.

Chlorite (Complex hydrous silicate of magnesia, iron, and alumina): Usually dull; sometimes pearly; color dark green; usually as foils of cleavage flakes. The mineral is commonly associated with the gold-quartz veins. It also occurs in the greenstones at the Silver Butte Mine.

Sericite (H_2KAl_3 $(SiO_4)_3$): Pearly to dull; colorless to white; usually as small micaceous flakes. The mineral is a common constituent of practically all the deposits examined, except those on the East Verde River. It occurs as an alteration product of the wall-rock, especially at the Ox Bow and the Silver Butte mines.

Kaolinite ($H_4Al_2Si_2O_9$): Dull; color white; earthy to scaly. Kaolin is a common constituent of most of the deposits examined, and was probably formed from sericite during the oxidation of the ores.

Barite ($BaSO_4$): Glassy; color white to flesh; heavy; crystalline masses. A vein of barite was seen a few hundred yards south of the Zulu claim; and another vein occurs in schist at the Bishop's Knoll. These veins are only a few inches wide, and are not commercially valuable.

ORE DEPOSITS

HISTORY OF MINING

Much of the early mining history contained in this report was furnished the writers by Mr. Wm. Craig, a pioneer of the early days when

the gold properties were most active, who has been a resident of Payson for the past forty-five years.

According to Mr. Craig, the earliest locations in the district were made about 1875-76 by Al Sieber, an early-day scout. Associated with Sieber were Wm. Moore and a man known as St. John. These men located the Ox Bow Mine. During the year 1877 the Golden Wonder Claim was located by Nash and Moore, and during the latter part of this year these men also located the Soldier Boy Claim. The Gowan vein was located in 1878 by Messrs. Gowan, Samuels, Rouse, Bacon, and Snow. This property now consists of eleven claims.

About 1877 or 1878 two men, House and Rouse, located some silver claims on an iron-stained gossan in the foot-hills of the Mazatzal Mountains. This property is now owned by the Silver Butte Mining Company. The Zulu Claim was located by Sam Hill and a man named Smith in 1878. These locations covered practically all the prominent outcrops of quartz veins in the district.

With free gold visible in abundance, and an ore readily amenable to treatment by amalgamation, the fame of the district spread rapidly. In 1881, over three hundred men were employed in the various mines of the district, and new settlers were arriving daily. These men came chiefly from California and Nevada where they had worked the gold gravels and quartz veins.

To the southwest of Payson are the rough Mazatzal Mountains; and to the south and east are the deep canyons of the Tonto Basin. This rough country was a natural rendezvous for the Apache Indians, who were more or less a source of annoyance; but, although lonely ranches were frequently raided and the ranchers murdered, the miners were never actually molested. These early settlers, however, lived in constant fear of a raid until the Indians were finally subdued by Major Chaffee who drove them northward over the Mogollon Escarpment.

Many of the quartz veins occur in a coarse-grained diorite which weathers readily and leaves the veins outcropping prominently. In the early days, the surface ore was collected, hauled on burros to the East Verde River, and worked in arrastras. No fire assays were made, but the grade of the ore was determined by grinding it in a mortar, washing the material in a miner's pan, and then noting the length of the string of colors. No records of production from the different mines were kept, and it is not known how much gold was produced.

In the early days machinery for the mines and mills of the district was purchased in San Francisco, shipped to Guaymas, Mexico, and thence up the Gulf of California and the Colorado River on lighters to Yuma. From Yuma the machinery was hauled across the desert to Phoenix, and over the Mazatzal Mountains by way of Reno Pass to Payson.

Activity in the district gradually died out, and by 1886 practically all the properties were shut down. Operations were more or less sporadic, depending on new or rich strikes, until about 1895, when renewed efforts were made to work the closed or abandoned mines. This active work continued for over two years, but since then very little productive work has been done. In recent years, especially since 1918, the Atlantis Mining Company has been working the Ox Bow property. Small-scale operations have been carried out in a few other parts of the district, and they are described later in this bulletin.

Thus far, the mining operations have been confined entirely to the gold veins; but, with the discovery of disseminated copper ores near Globe, a number of locations were made in the schist belt south of Payson and near the Bishop's Knoll. These locations were chiefly on small stringer veins in the schist, showing stains of copper salts at the surface. In 1916, several claims were located on this schist belt by Ed. Simanton, W. A. Cain, and Wm. Brown. Others also located claims there, and out of the consolidation of all these holdings the Bishop's Knoll Mining Company was incorporated.

GOLD VEINS

The gold veins are by far the most important mineral deposits of the district. The metal production, except for a comparatively small amount of silver and lead from the foot-hills of the Mazatzal Mountains and a little placer gold from Ox Bow Hill, has been from this type of deposit. So far as the writers were able to determine, no copper ores have been shipped from this district; but the concentrates from the quartz veins carried a little copper, chiefly as chalcopyrite, and the oxidized silver and lead ore carried copper carbonates.

The quartz veins vary in strike from N. 15° W. to N. 65° W., and the dip is usually to the northeast. An exception is the Ox Bow vein, which will be described more fully later. The veins occupy fault fissures, and the movement has produced a crushed zone from a few inches to several feet in width on both sides of the vein. There has also been renewed movement on these fault fissures, in part later than the oxidation of the ore. It was these exposed portions of the veins, together with the float which occurred near them, that were collected by the early settlers and hauled by burros to the rivers, there to be worked in arrastras. The veins vary in width from a few inches to six feet in the Ox Bow Mine, and a maximum width of twelve feet has been reported for the Gowan vein. Most of the veins are two feet or under in width, especially the Zulu, Golden Wonder, and Single Standard. Near some of the gold veins, notably the Ox Bow, Gowan, and Zulu, are dikes of granite porphyry which may bear some relation to the genesis of these ores.

The oxidized portions of the veins are rather porous, and consist of quartz with considerable hematite and limonite. Cavities with a cubical outline and with striations on the wall suggest that they were originally occupied by cubes of pyrite. Other cavities in this porous ore contain nests of small radiating crystals of quartz, and were probably never originally occupied by sulphides. Some portions of the veins are more massive quartz with only a small amount of hematite and limonite, and are of lower grade than the honey-combed variety. Locally the veins carry oxidized copper minerals, usually chrysocolla and some malachite, and massive dark brown limonite is then abundant. The oxidized copper minerals occur as irregular bunches, and are localized chiefly in the wider portions of the veins. They are reported to carry good gold values. The gold occurs free in the oxidized portions of the veins, and is often visible to the naked eye. A vial of placer gold panned by Mr. Boozer contained small flat nuggets up to a quarter of an inch in width.

The oxidized ore from the Ox Bow Mine carries from $5 to $80 per ton in gold and silver, and will average between $35 and $45. In the Gowan vein values up to $100 or more per ton were reported. The ratio of gold to silver is unknown; but, from the information given the writers, the silver is believed to be low.

In this district the water-table is close to the surface, and some of the mines which are now idle have standing water in the lower workings. Some ore from below the water-level was found on the dump at the Golden Wonder Mine. This consisted of rather massive quartz with considerable pyrite and a little chalcopyrite; and that portion of the vein which was near the wall-rock contained considerable dark green chlorite. This is undoubtedly primary ore, and is said to carry less than $20 in gold and silver per ton.

The wall-rock, which is generally diorite, is altered for a distance of several feet on either side of the veins to chlorite, sericite, and secondary quartz. In the Ox Bow Mine some of the kaolin found was probably derived from the sericite. A number of mines have been shut down for some time and are inaccessible. At these mines only the surface could be studied, and the alteration produced by the mineralizing solutions was masked more or less by surface weathering.

COPPER DEPOSITS

The deposits in which copper is the most important constituent consist of lenticular masses of tetrahedrite in greenstone; disseminations of chalcopyrite and bornite in greenstone; and disseminated pyrite, chalcopyrite, and chalcocite in schist and along basic dikes.

The deposit containing tetrahedrite is in the foothills of the Mazatzal Mountains, on claims held by the Silver Butte Mining Company. The

ore occurs as irregular masses usually lenticular in shape, and along a fault in the greenstone. This fault strikes nearly east-west, and dips steeply to the north. A drift has been driven for about sixty feet along this fault, and the vein has pinched down to a few inches of ankerite with no tetrahedrite visible. The ore-shoot is apparently confined to a length of sixty feet on the fault, and was reported to have had a maximum width of seven feet. The ore consists of tetrahedrite in a gangue of quartz and ankerite. No analysis of this carbonate is available, but qualitative tests show it to contain considerable ferrous iron and magnesium. The tetrahedrite is reported to carry good values in silver. The ore in the discovery shaft consisted of oxidized lead, silver, and copper minerals, with occasional kernels of unaltered galena. This oxidized ore was largely limonite and quartz with a little manganese oxide, and was mined for its silver content. No galena was found with the tetrahedrite, and that portion of the mine where galena and tetrahedrite might occur associated is inaccessible.

A little copper occurs on the claims located by Mr. C. Harrington near the East Verde River. Here a vertical fault with a N. 43° E. strike cuts the greenstone. The copper mineralization is found in the fault breccia and in the wall-rock, and consists of a little pyrite and chalcopyrite in a gangue of quartz. The wall-rock has been altered to garnet, epidote, calcite, and quartz. A little specularite was also found, and chalcocite was seen in a thin section; but the enrichment of copper has been slight.

Adjoining Harrington's claims on the southwest is a prospect located by Mr. W. A. Cain. Chalcopyrite and bornite with a little chalcocite occur both in greenstone and in quartzite, but not along any well-defined fissure. The mineralization has been slight, and the wall-rock is altered to epidote, chlorite, and quartz.

At the Bishop's Knoll, copper carbonates are common along the borders of some of the basic dikes. A little pyrite, chalcopyrite, and chalcocite were also seen. The gangue is chiefly quartz and calcite with a little limonite. Pyrite and chalcopyrite were also found in a fault fissure in the schist, but the mineralization has been slight. Most of the fissures carrying copper carbonates have an east-west trend.

PLACERS

Although the quartz veins show free gold at the surface, placers are not common. One short tributary of the East Verde River drains the region in which most of the gold veins occur; yet the prospectors of this district state that no placer gold has been found in it. Placers, however, have been worked in a small way for a number of years below Ox Bow Hill, but only during the rainy season when water is available.

These gravels are only worked sporadically, and yield but a few dollars per day. On the slopes of Ox Bow Hill immediately below the outcrop of the vein, Mr. Boozer panned about an ounce of gold. Some of this consisted of rather coarse particles, and was washed from the thin layer of soil covering the hillside. He states that any pan of this dirt from the slope below the vein will show a few colors.

ENRICHMENT

As has been stated, few, if any, assays were made of the ores during the early days when mining activity was at its height. The oxidized ores, according to all reports, carried considerable free gold. The old pioneers who have been in this district since the early days all agree that the ore often ran over $100 per ton in gold and silver; and at the Ox Bow Mine the ore assayed as high as $80 per ton. The fact that a number of the mines now idle had reached the water-level is suggestive, and the general absence of placers is also important. At the water-level the tenor of the ore dropped to less than $20 per ton, sulphides became more abundant, and, finally, the gold and silver could not be recovered by amalgamation. This last mentioned fact would suggest that the gold in the unoxidized ores is in the mineral pyrite. Unfortunately the mines that have reached the water-level are now inaccessible, and the reported decrease in values could not be checked by samples and assays.

No manganese minerals were found in the gold veins of the Payson region, although manganese dioxide may be present in small quantities. Generally, deposits which have given rise to placers, or whose outcrops are rich in gold, are not likely to be manganiferous; and consequently they are not extensively enriched. It is not impossible that reagents other than manganese may take gold in solution; and Ransome* has noted the occurrence of wire gold on oxidized copper ores in the original Old Dominion Mine, about four miles north of Globe, with apparently no manganese minerals present.

Some enrichment may also have taken place by the removal of valueless material, as suggested by Rickard.† The oxidized ores are generally rather porous and cellular, and contain considerable limonite and hematite. How much of this pore-space is original in the vein, and how much is due to the removal of sulphides by solutions is unknown. However, it is not believed that much enrichment of the gold has taken place by this process.

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*Personal communication.

†Rickard, T. A., The Formation of Bonanzas in the Upper Portions of Gold Veins: Am. Inst. Min. Eng., Trans., vol. 31, pp. 198-220, 1902.

It is difficult to reconcile the idea of rich gold in quartz at the surface, in part as float, with the absence of placers. It would seem that this float would eventually reach the stream-beds, and, on disintegration by geologic processes, liberate the gold to form placers. From the reported absence of placers other than below the Ox Bow Mine, it may be inferred that the tenor of the gravels was too low to be worked profitably. In the general absence of positive evidence to the contrary, it is the writers' belief that the enrichment of gold in these veins has been slight; and the high values reported may be due to the localization of gold in definite ore-shoots.

The occurrence of veinlets of chalcocite and covellite traversing bornite and chalcopyrite in specimens of ore from the claims of W. A. Cain, suggests a supergene origin of these minerals by downward enrichment. The chalcocite at the Bishop's Knoll Mine occurs only near the surface, and, where workings extend deeper on these deposits, only pyrite and a small amount of chalcopyrite are found. This chalcocite was probably also formed by supergene enrichment. The increase in grade of the ore in the copper deposits by enrichment, however, has been slight; and, so far as the writers know, has produced no large or workable orebodies.

AGE AND PROBABLE ORIGIN

Areas of the Upper Devonian Sycamore Creek sandstone in the vicinity of Payson are small and scattered, and quartz veins were nowhere observed cutting it, nor was the sandstone stained by the salts of copper. Here, as in the vicinity of Jerome, this sandstone is generally heavily stained by iron oxide. At Jerome, the gossans of the great copper deposits may have furnished much of the iron coloring this sandstone, and this may be true to some extent for the Payson district.

The hanging-wall of the Gowan Mine consists of blocky and brecciated Sycamore Creek sandstone which has been displaced by a fault for at least one hundred feet. Nowhere in the hanging-wall were stringers of quartz from the main vein found, and the alteration was too slight to suggest the action of hot, primary solutions.

On the basis of the observations cited above, and in the absence of any definite evidence to the contrary, the deposits are tentatively believed to have been formed during pre-Cambrian time. Very likely they were formed when the large orebodies of copper at Jerome were deposited.

The complex of basic and acidic dikes in the hornblende diorite at the Ox Bow Mine and at the Bishop's Knoll has been described above. Dikes of granite porphyry were also seen at the Zulu and Gowan mines, and the greenstones of the Mazatzal Mountains are cut by a number of dikes of this type of rock. The intrusion of these dikes was probably

the last phase of igneous activity preceding the formation of the veins. As these dikes have been altered by the mineralizing solutions, and as they often occupy faults or planes of weakness in the surrounding rocks, they may have acted as channels along which the hot, ascending water rose and deposited their load of mineral matter. The source of these solutions was undoubtedly deep-seated; but until more exploratory work has been done in the district it will be impossible to assign the origin of these solutions to any definite phase of igneous activity.

Plate V. A.—General view of the Ox Bow Mine.

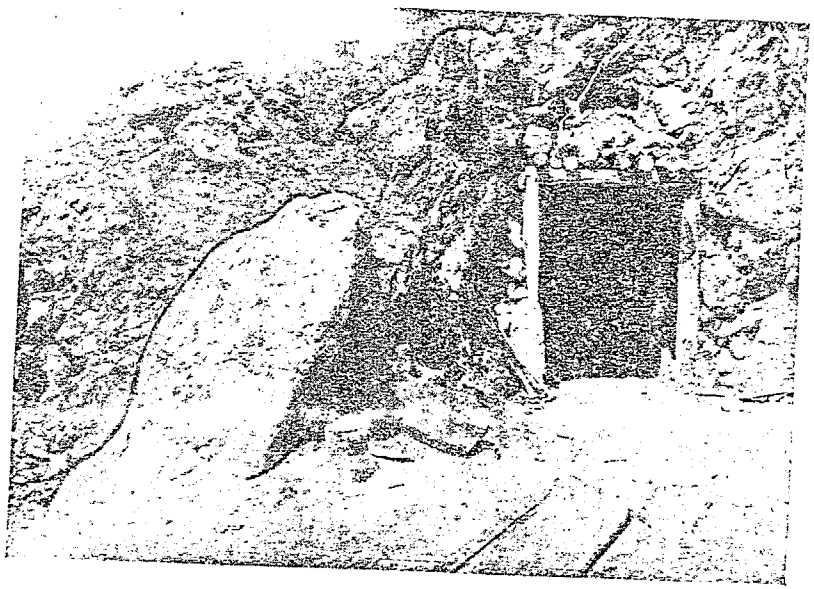


Plate V. B.—Outcrop of the Ox Bow vein.

MINES AND PROSPECTS

OX BOW MINE

This mine is owned by the Atlantis Mining Company, whose holdings here consist of two patented claims, the Golden Wreath and the Ox Bow, and fourteen unpatented claims. The company was incorporated in the State of Rhode Island in 1917. The property is seven miles south of Payson and within a few hundred yards of the Roosevelt-Payson Highway. The Ox Bow Claim was located about 1876 by Al Sieber and associates; but no real attempt was made to develop the property until it was taken over by the present company. No record of production is available. Supplies, except timber, are hauled from Globe, timber is purchased from the sawmills east of Payson, and in 1918 cost $48 per thousand feet B.M., delivered to the mine.

The surface rock in the vicinity of the mine is a rather uniform-textured, coarse-grained hornblende diorite. The diorite has been cut by a complex of dikes, usually with an east or northeast trend, and varying in width from a few inches to fifteen feet. They consist of fine-grained, occasionally slightly porphyritic hornblende diorites, and a large dike of rhyolite, highly altered.

The vein occupies a fault fissure, and takes an unusually curved course resembling an oxbow, from which the name of the mine originated. Its shape is shown in Fig. 3. At the portal of the main adit the vein has a width of about four feet which increases to a maximum of six feet. The wider portions are more porous, contain more hematite and limonite, and carry higher values in gold and silver. Where the vein narrows down to a width of only a few inches, the fracture is occupied by quartz crystals which have grown inward from each wall. The center of the vein is sometimes occupied by coarsely crystalline calcite, and these narrow portions of the vein are too low-grade to mine. Narrow stringers from the main vein extend into the hanging-wall, and, average about two inches in width. These veinlets are also barren. About two hundred feet from the portal of the adit, the vein splits; but the two portions join again, fifty or sixty feet farther on. The water-table in the shaft is about 175 feet below the collar, or about one hundred feet below the adit level. A considerable tonnage of free milling ore averaging between $35 and $45 per ton has been developed.

At the time of the writers' visit the property had been partially developed by a 2-compartment shaft sunk to a depth of 176 feet, and an adit driven somewhat over five hundred feet along the vein. A lower adit has a length of forty feet. Three raises have been put up from the main adit to the surface, and some stoping has been done

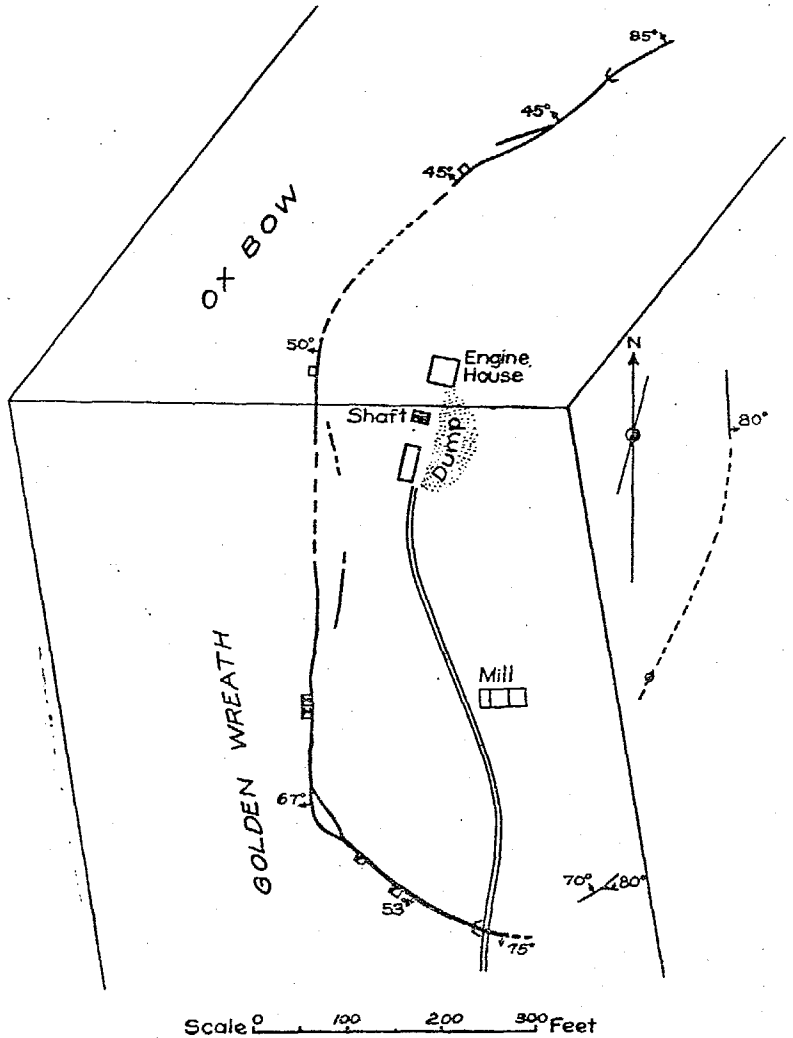


Fig. 3.—Plan of the Ox Bow vein as exposed on the Ox Bow and Golden Wreath claims.

from these raises. On the surface, numerous pits and trenches have been dug to expose the outcrop of the vein.

In the shaft house is a 12 x 7¾ x 12 Chicago Pneumatic Tool Company compressor, run at three hundred revolutions per minute, and a Fairbanks-Morse 9 x 12 hoist. The water in the shaft is lifted by a 2-stage centrifugal pump. South of the shaft is a well-equipped blacksmith shop.

The remodeling of the mill had been started, and when completed the flow-sheet will be as follows:

Orebin
↓
Dodge crusher (to 1¼")
↓
Challenge Feeder
↓
Gibson Mill (25 ton cap.)
↓
Gibson amalgamator
↓
Gibson concentrator

GOWAN MINE

During the early days this was the most famous mine in the district and the largest producer. It was located in the late seventies and worked steadily during the years 1880, 1881, and 1882. After this time the mill was run chiefly on custom ores.

The property consists of eleven patented claims, and is located on the west side of the East Verde River. The foot-wall of the vein consists of altered hornblende diorite invaded by granite porphyry. Resting on these igneous rocks is the Sycamore Creek sandstone, which in the hanging-wall has been dropped a maximum vertical distance of one hundred feet. This faulting is believed to be later than the formation of the ore. The vein strikes N. 15° W., dips 32° to the northeast, and has a maximum width of twelve feet. The ore lying on the dump consists of more or less cellular quartz heavily stained with iron and occasionally with copper; some free gold is also visible. Specimens containing pyrite and chalcopyrite probably came from below the water level.

The flat-dipping vein was stoped for a distance of a hundred feet along the dip of the vein, with the lower twenty-five feet of this work extending below the present water-level. Old round timbers placed in the mine forty years ago still support their load. The distance that the property has been developed along the vein is unknown, for these workings are now inaccessible. The mine has been idle for a number of years.

An old stamp mill, now in a dilapidated condition, treated custom ores long after the Gowan Mine was shut down, and stands today as a relic of the pioneer days.

GOLDEN WONDER MINE

At one time an active rival of the Gowan both in production and richness of the ore, the Golden Wonder today is also idle and has been shut down for a number of years. The Golden Wonder Claim was located by Nash and Moore about 1877. This claim and two additional ones are now owned by the Chilson brothers.

The property is situated on the southwest side of a ridge separating Payson from the East Verde River, and is about six miles from the town. The surface rock is highly altered hornblende diorite, and no exposures of the vein were visible. The vein between the two shafts strikes northwest and has a nearly vertical dip. It is reported to have a maximum width of four feet. The material on the dump resembles the ore from the Gowan, but contains considerably more copper carbonate. When mining operations reached the water-level, sulphides became a more abundant constituent of the ore and the gold could not be extracted by amalgamation.

The mine was developed by two shafts several hundred feet apart. These shafts are filled with water to within about eighty feet of the surface, but are reported to have been sunk to a depth of three hundred feet. Considerable drifting along the vein was done, and also much stoping.

An old mill is still standing on the property. The ore was fed from a Dodge crusher to a battery of two stamps; from the plates it passed to a vanner. The concentrates from the vanner were sacked and shipped to a smelter.

SINGLE STANDARD MINE

About a mile west of the Golden Wonder is the Single Standard Mine. This mine is also idle and the workings are inaccessible.

Both walls of the vein are hornblende diorite, and this rock is cut by later dikes of fine-grained diorite. The strike of the vein is N. 65° W. and the dip is 55° to the northeast. Where exposed at the surface the vein has a width of twelve inches, and consists of more or less massive quartz with some hematite and limonite.

An inclined shaft was sunk on the vein, but is now entirely caved in; an adit driven from a point on the hillside below the shaft is also caved.

ZULU MINE

The Zulu Claim was located by Sam Hill in 1878, and is now owned by Wm. Craig of Payson. The mine is about two miles southwest of the Ox Bow and is reached by a branch road about four miles long from the main Roosevelt-Payson Highway.

Hornblende diorite is the surface rock on this claim, and has been intruded by dikes of fine-grained diorite and granite-porphyry. The vein at the collar of the shaft is about twelve inches wide with numerous stringer veins extending into both walls. At the surface the vein consists of rather massive quartz containing some hematite and limonite, but ore on the dump is much more cellular and is heavily iron-stained. Some copper carbonates and a few small specks of free gold were also seen.

The property has been developed by a 2-compartment shaft, but the depth of this shaft is unknown. The size of the dump would suggest that some stoping or drifting has been done on the vein.

BISHOP'S KNOLL MINE

This property is located a few miles north of Gisela, a small settlement and farming community on the west bank of Tonto Creek, about fifteen miles south of Payson. In 1916 Ed. Simonton, W. A. Cain, and Wm. Brown located twenty-four claims, hoping to develop a copper mine. Adjoining them were claims located by other individuals. All these holdings, consisting of fifty-one claims, were consolidated, and the Bishop's Knoll Mining Company was incorporated in 1917.

The batholithic intrusion of hornblende diorite occurring at Payson also occurs here and intrudes biotite and sericite schist. Both of these formations are cut by basic dikes, usually somewhat porphyritic, but essentially hornblende diorites. Dikes of granite-porphyry and aplite cut the basic dikes. Many of them are brecciated, and faulting later than the intrusion of the dikes has taken place along them.

The mineralization consists of small specks and veinlets of pyrite, chalcopyrite, and chalcocite in the fractured portions of the hornblende porphyry dikes, and along fractures in the schist. As all the development on this property is within a short distance of the surface, very little pyrite and chalcopyrite were observed. A 50-foot shaft was sunk on the Storm Cloud Claim, and the bottom of the shaft is on a level with a small stream nearby. The rock from the bottom of the shaft is a sericite schist impregnated with pyrite and a little chalcopyrite. This material is too low-grade to be mined profitably today, and shows no enrichment whatever. On the Ella Claim a little pyrite and chalcopyrite was found when doing the location work. A 70-foot adit driven in one of the basic dikes contains some carbonates of copper and a little chrysocolla in a gangue consisting of quartz and calcite. There are no well-defined veins, and exposures of mineral have been found chiefly in the crushed basic dikes.

Very little development work has been done on the property. A 50-foot shaft, a 70-foot adit, several short adits, and the original location and assessment work make up the total development.

SILVER BUTTE MINE

About forty-five years ago when this part of Arizona was included in Yavapai County, the O'Dougherty brothers located some claims on the lower east slopes of the Mazatzal Mountains. The claims were located for silver, on a heavily iron-stained gossan. The property consists of ten unpatented claims, and the present company was incorporated in 1914.

The geology is simple, and consists of a series of andesitic flows, tuffs, and breccias that have been altered to greenstones. These greenstones were intruded by dikes of hornblende diorite and granite porphyry. These rocks have been cut by several faults and numerous minor fractures. The ore-shoot occurs at the intersection of two faults, one of which trends nearly east-west and dips 70° to the north on the second level, and the other strikes N. 45° E. and is vertical. The ore occurs as a vein with a maximum width of seven feet filling the east-west fracture, and consists of tetrahedrite in a gangue of quartz and ankerite. This tetrahedrite is reported to carry good values in silver. No galena was found with the tetrahedrite, but the ore from the upper level contains some oxidized lead minerals, chiefly as the carbonate and sulphate of lead. A little galena also occurs in this oxidized ore; but no pyrite was seen, and much of the limonite in the outcrop was probably derived from the breaking down of ankerite.

In the Thompson adit a quartz vein about twelve inches wide carries pyrite, chalcopyrite, and galena. Copper carbonates occur as alteration products of the chalcopyrite, but the galena shows little or no alteration, and no tetrahedrite was found in this ore.

The development on this property consists of three adits; the upper one, with a length of about 125 feet; the middle adit, with a length of 510 feet; and the lower adit, which at the time of the visit was in about 270 feet. An old inclined shaft, sunk to a depth of ninety feet on the outcrop of the orebody, is now caved.

PROSPECTS

Along the East Verde River and just off the west edge of the map (Plate I) are two prospects, located by Harrington and Cain. These claims were located for copper, and the district is locally known as the Copperas District.

Greenstone and highly indurated quartzsites and shale have been mineralized along fractures by pyrite, chalcopyrite, and bornite. These sulphides have been slightly enriched by chalcocite and covellite.

Only location and assessment work have been done.

PRACTICAL DEDUCTIONS

The study of this district has led the writers to draw certain conclusions which have a practical bearing on future operations. These deductions, based on geologic observations, should prove useful both in connection with the mining and the treatment of the ore.

Although these quartz veins throughout their entire length carry some values in gold and silver, only certain portions are rich enough to mine under present economic conditions. These richer portions, or ore-shoots, occur where the veins widen. This is clearly shown in the Ox Bow vein, and these portions are reported also to have occurred in the Gowan vein. As many of the properties were closed down at the time the district was visited, no definite information could be collected that might throw light on the occurrence and distribution of these ore-shoots. As enrichment in these veins is believed to have been slight, a good grade of milling ore may be expected in depth in these ore-shoots; but a decided change in the character of the ore has taken place at the water-level. The change from oxidized vein material carrying free gold and readily amenable to treatment by simple amalgamation, to an ore in which the gold is probably largely, if not entirely, in the pyrite, may have been an important factor in the closing down of the mines on reaching the water-level. In the design of a mill to treat these ores, this fact must be taken into consideration.

Payson is about ninety miles from Globe, the nearest railway point, and about an equal distance from Flagstaff. Supplies are hauled from Globe in motor-trucks and the freight charge is about $50 per ton. A new highway from Payson to Camp Verde is now in the course of construction; and, should the proposed railway be built down the Verde River, it would place the mines within fifty miles of a railway shipping point. The highway, however, will cross a plateau slightly over six thousand feet in elevation; and, since this region is in the winter months often subject to heavy snowfalls, the transportation of freight over this highway is likely to be impossible for days at a time.

The Arizona Power Company has a hydro-electric plant on Fossil Creek, about twenty-five miles in a westerly direction from Payson, from which cheap power could probably be obtained; but the cost of installing a transmission line across this rugged country would be greater than a small company could stand. Similarly, power-sites are available both on the East Verde River and on Tonto Creek, but the initial outlay to develop hydro-electric power would be great, and would not be justifiable until a considerable tonnage of good milling ore had been developed.

Fuel-oil, hauled from Globe at $50 per ton freight charge, is expensive for the generation of power; and although some wood, such as juniper, occurs in the valley to the west of Payson, the supply is limited. There is a large stand of timber to the north and east of Payson, and scrap lumber from the sawmills east of Payson may be a cheaper source of fuel.

The cost of labor and supplies is considerably higher today than when the gold mines of this district were closed down, but, with sufficient capital to develop the veins and build an adequate plant, and with careful management, these veins should again become profitable producers of gold.

MAPS OF ARIZONA

The Arizona Bureau of Mines now has available for distribution four different maps of the State, as follows:

1. Base map of Arizona in two sheets on a scale of about eight miles to the inch. This map is strictly geographic, with the positions of all towns, railroads, rivers, surveyed lands, national forests, national parks and monuments, etc., indicated in black, and the location of mountains and other topographic features shown in brown. It also indicates where the various mining districts are situated, and is accompanied by a complete index. It was issued in 1919 and is sold, unmounted, for 35c, or mounted on cloth with rollers at top and bottom for $2.50.

2. A topographic map of Arizona in one sheet, on the same scale as the base map. It shows 100-meter contours, and there is a meter-foot conversion table on the map. It was issued in 1923, and is sold, unmounted, for 50c, or mounted on cloth with rollers at top and bottom for $2.50.

3. A geologic map of Arizona on the same scale as the base map, printed in many colors. It was issued in 1925, and is sold both mounted and unmounted for the same prices as the topographic map.

4. A relief map of Arizona on the same scale as the base map, printed in various shades of brown, black, and blue. It was issued in 1925, and looks exactly like a photograph of a relief model of the State. This map was prepared by the U. S. Geological Survey, and is sold by the Survey for $1.00. Unmounted copies may be obtained from the Arizona Bureau of Mines at the same price. The same map mounted on cloth with rollers at the top and bottom is sold by the Bureau for $3.00.

POSTAGE IS PREPAID ON ALL MAPS.

SERVICE OFFERED BY THE BUREAU

The Arizona Bureau of Mines will classify free of charge all rocks and minerals submitted to it, provided it can do so without making elaborate chemical tests. Assaying and analytical work is done at rates fixed by law, which may be secured on application.

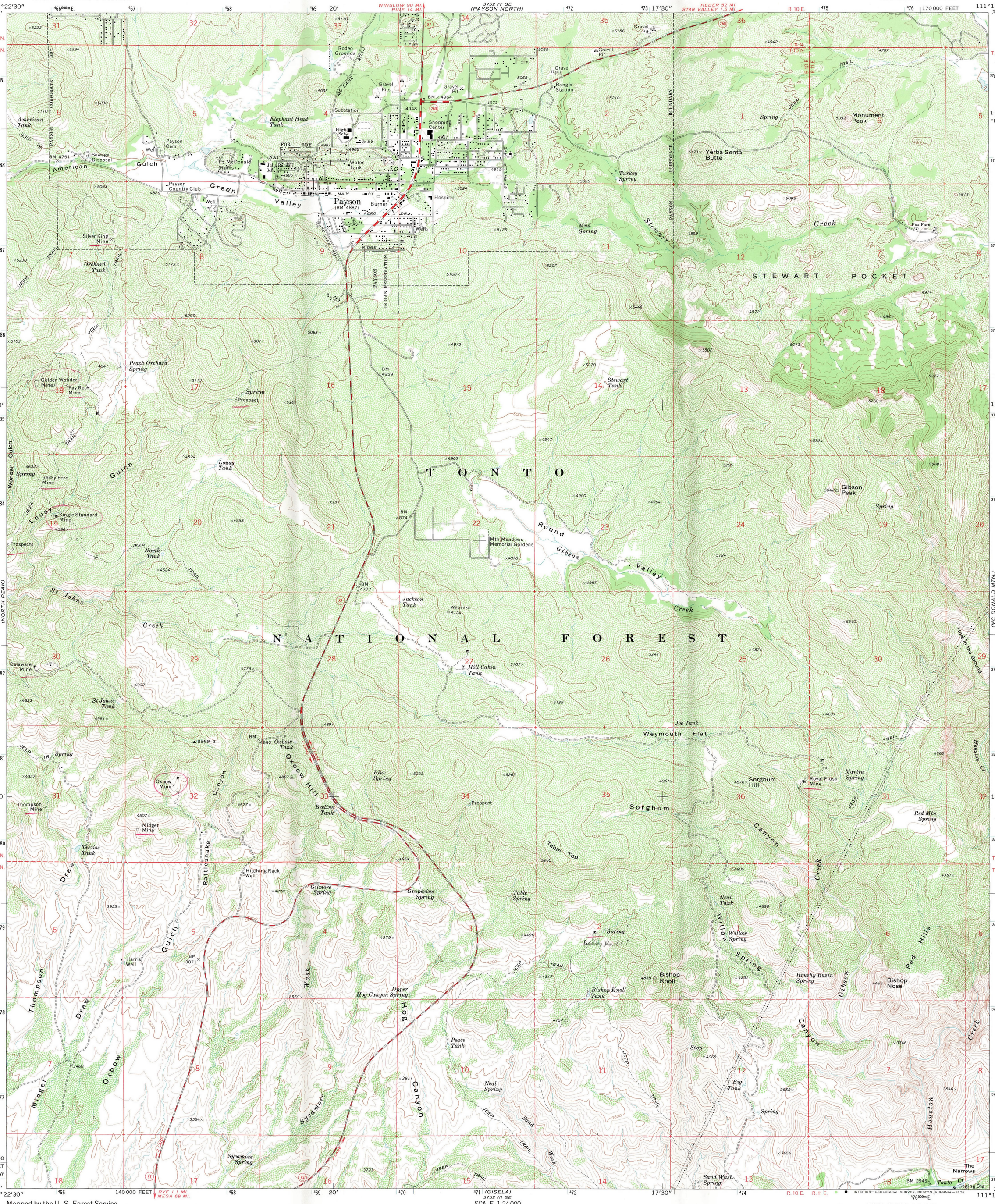
The Bureau is always glad to answer to the best of its ability inquiries on mining, metallurgical, and geological subjects; and takes pride in the fact that its replies are always as complete and authoritative as it is possible to make them.

All communications should be addressed and remittances made payable to "The Arizona Bureau of Mines, University Station, Tucson, Arizona."

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PAYSON SOUTH QUADRANGLE

ARIZONA—GILA CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NE/4 PAYSON 15' QUADRANGLE



Mapped by the U. S. Forest Service
Edited and published by the Geological Survey

Control by USGS, NOS/NOAA, and USFS

Topography by photogrammetric methods from aerial photographs taken 1965. Field checked by USGS 1973

Projection and 10,000-foot grid ticks: Arizona coordinate system, east zone (transverse Mercator)
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue. 1927 North American datum

Fine red dashed lines indicate selected fence lines

Where omitted, land lines have not been established

UTM GRID AND 1973 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 20-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Primary highway, hard surface
Light-duty road, hard or improved surface
Secondary highway, hard surface
Unimproved road
Interstate Route
U. S. Route
State Route

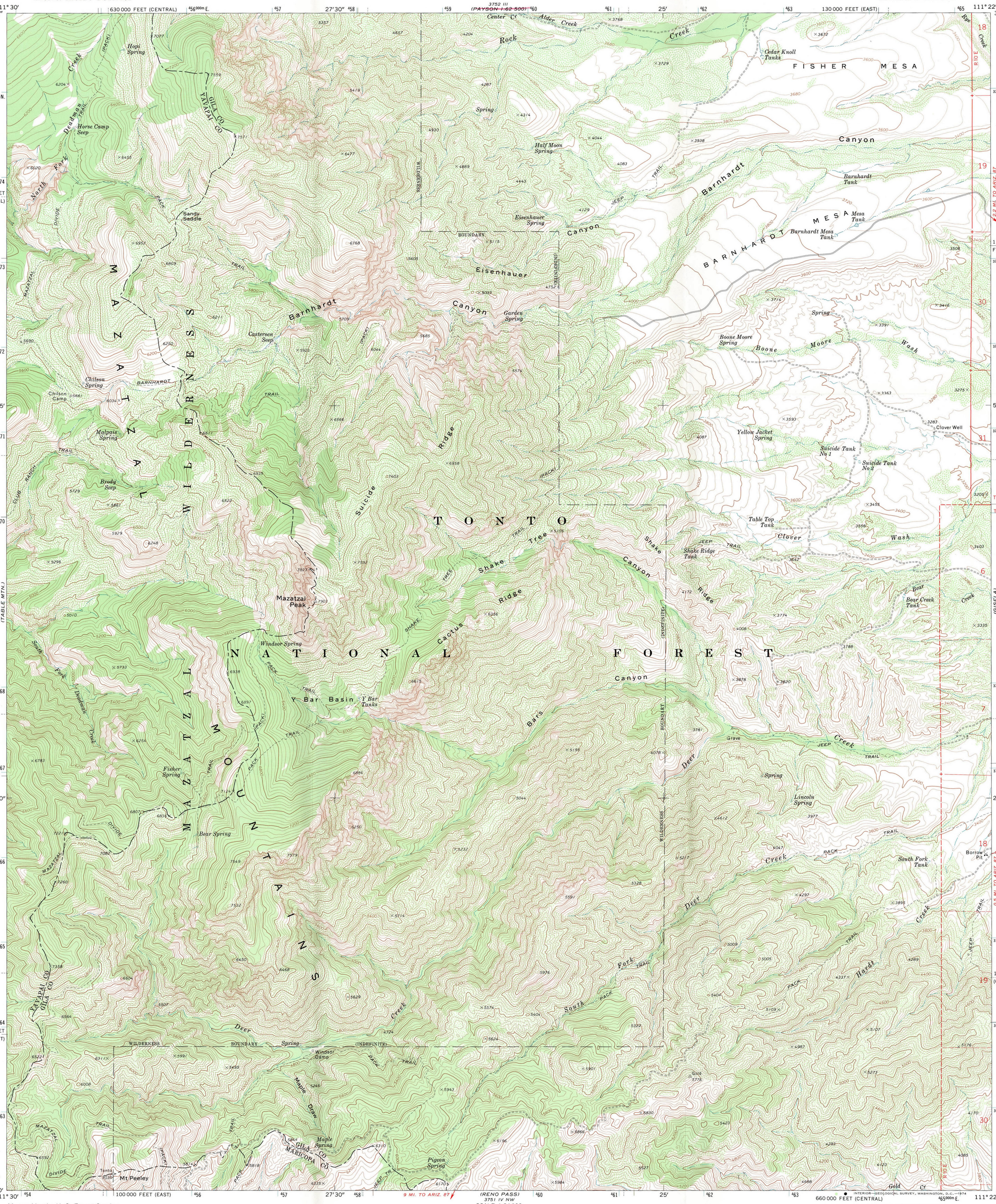
PAYSON SOUTH, ARIZ.
NE/4 PAYSON 15' QUADRANGLE
N3407.5—W11115/7.5

1973

AMS 3752 III NE—SERIES V898

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

MAZATZAL PEAK QUADRANGLE
ARIZONA
7.5 MINUTE SERIES (TOPOGRAPHIC)
SW/4 PAYSON 15' QUADRANGLE



Mapped by the U. S. Forest Service
Edited and published by the Geological Survey

Control by USGS, USC&GS, and USFS

Topography by photogrammetric methods from aerial photographs taken 1965. Field checked by USGS 1972

Projection: Arizona coordinate system, east zone (transverse Mercator)
10,000-foot grid ticks based on Arizona coordinate system, east and central zones
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue. 1927 North American datum

Where omitted, land lines have not been established

UTM GRID AND 1972 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET
GN MN 0° 15′ 4 MILS 13½° 240 MILS

SCALE 1:24 000
1 ½ 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR WASHINGTON, D. C. 20242
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

ARIZONA
QUADRANGLE LOCATION

ROAD CLASSIFICATION
Primary highway, hard surface — Light-duty road, hard or improved surface
Secondary highway, hard surface — Unimproved road
Interstate Route — U. S. Route — State Route

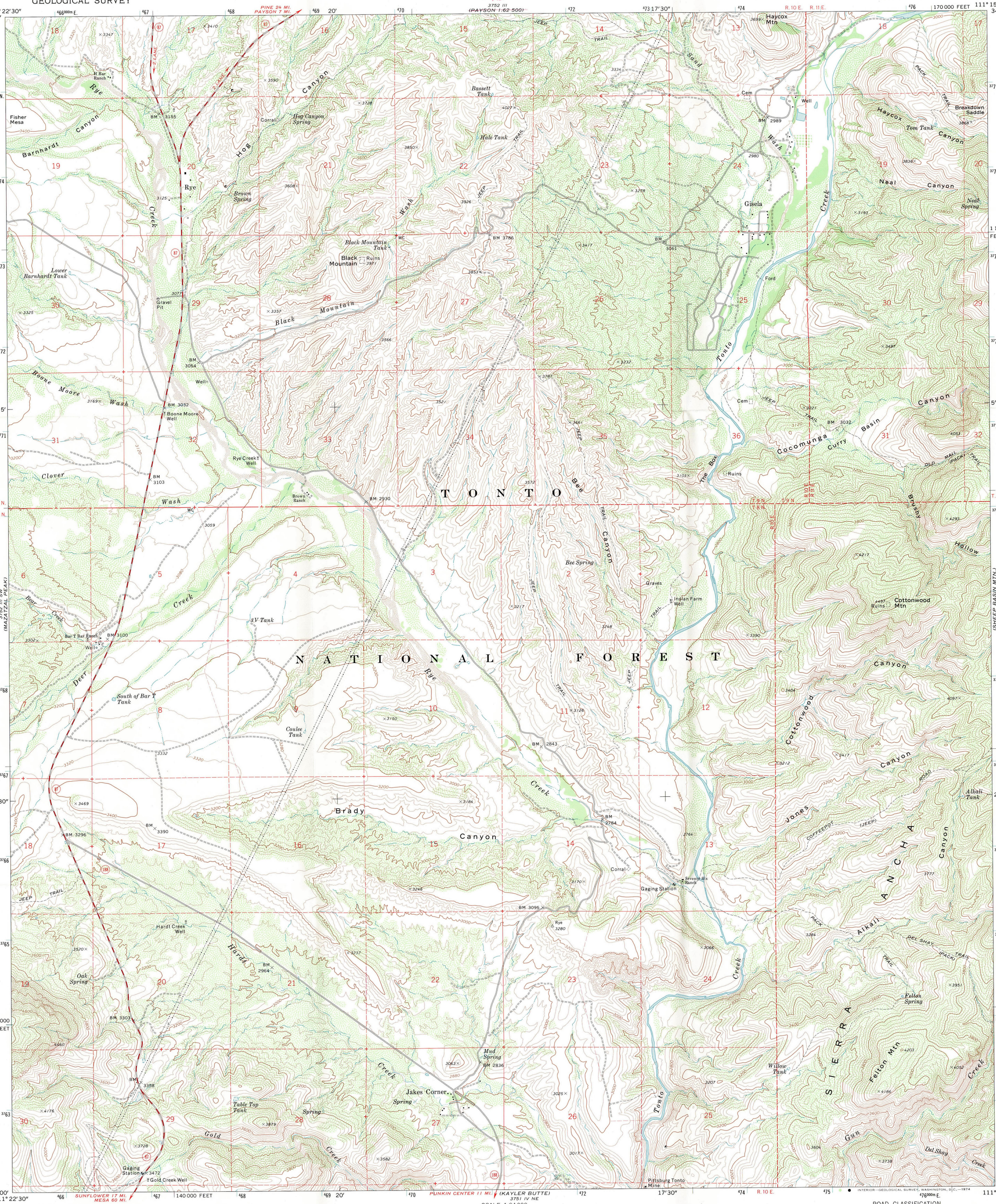
MAZATZAL PEAK, ARIZ.
SW/4 PAYSON 15' QUADRANGLE
N3400—W11122.5/7.5

1972

AMS 3752 III SW—SERIES V898

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

GISELA QUADRANGLE
ARIZONA—GILA CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 PAYSON 15' QUADRANGLE



Mapped by the U.S. Forest Service
Edited and published by the Geological Survey

Control by USGS, USC&GS, and USFS

Topography by photogrammetric methods from aerial photographs taken 1965. Field checked by USGS 1972

Projection and 10,000-foot grid ticks: Arizona coordinate system, east zone (transverse Mercator)
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue. 1927 North American datum

Fine red dashed lines indicate selected fence lines

Where omitted, land lines have not been established

UTM GRID AND 1972 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR WASHINGTON, D. C. 20242
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Primary highway, hard surface
Light-duty road, hard or improved surface
Secondary highway, hard surface
Unimproved road
Interstate Route
U. S. Route
State Route

GISELA, ARIZ.
SE/4 PAYSON 15' QUADRANGLE
N3400—W11115/7.5

1972

AMS 3752 III SE—SERIES V898

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

NORTH PEAK QUADRANGLE
ARIZONA
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 PAYSON 15' QUADRANGLE

Mapped by the U. S. Forest Service
Edited and published by the Geological Survey

Control by USGS, USC&GS, and USFS

Topography by photogrammetric methods from aerial photographs taken 1965. Field checked by USGS 1973

Projection: Arizona coordinate system, east zone (transverse Mercator)
10,000-foot grid ticks based on Arizona coordinate system, east and central zones
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue. 1927 North American datum

Where omitted, land lines have not been established

UTM GRID AND 1973 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

1 ½ 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

ARIZONA
QUADRANGLE LOCATION

ROAD CLASSIFICATION

Primary highway, hard surface	Light-duty road, hard or improved surface
Secondary highway, hard surface	Unimproved road
Interstate Route	U. S. Route
State Route	

NORTH PEAK, ARIZ.
NW/4 PAYSON 15' QUADRANGLE
N3407.5—W11122.5/7.5

1973

AMS 3752 III NW—SERIES V898

ASARCO

Southwestern Exploration Division

March 22, 1977

TO: F. T. Graybeal

FROM: J. D. Sell

Penny Claims
Gold Angel Resources
Gila County, Arizona

I visited the Gold Angel Resources property located southwest of Payson on March 16, 1977. Mr. Peter G. Marshall, consultant geologist, was also along and we looked over a portion of the property.

The location is shown on the attached map, a portion of the North Peak 7-1/2' quad., and is within Eldred Wilson's greenstone belt of the Payson-Mazatzal Mountains area. Gold Angel surface sampled outcrops and the Iron King assay office reported values ranging from 0.05% to 2.34% copper. The arithmetic value of the 29 samples reported was 0.60% copper. Gold Angel drilled four holes as follows (and shown on the attached map):

Same Site: #1, angle hole @ 45° to south; 185 feet
#2, vertical; 685 feet — polished thin section @ 401'
#3, vertical; 982 feet - polished thin sections @ 720' & 840'.
#4, vertical; 252 feet, stopped by lack of drilling funds

Marshall verbally reported that they intercepted a north-dipping zone of chalcopyrite-bornite averaging 80-150 feet thick with a grade of between 0.3 and 0.5% copper with minor lengths of 1+% copper. Visual inspection of some core indicates that hole #3 is the most intriguing with perhaps 10% pyrite scattered through much of the hole. Within the mineral intercept, as at 445 feet, the greenstone host has ±1/8" epidote eyes with centers of pinhead-size bornite blebs or a spiderweb splash of bornite.

The surface is intensely oxidized and contains a muddy brown leached cast. Former sulfides sites are difficult to pick out in most of the outcrop. Sulfides of pyrite, chalcopyrite(?), and bornite can be found in a few quartz masses. Oxide copper is scattered in the areas of the quartz masses and other dike-like masses of intrusive granitoid materal.

Marshall has asked his principals to send the drill hole and cross-section data to us.

The drill hole mineral and assays are anomalous from my interpretation of what I saw on the surface. No quartz veins apparently cut the core altho' a few of the granitoid dikes do. Mineral is associated with some of the dikes, but not all of the dikes.

It is recommended that additional time be spent in the area and relooking at the total core available (in Payson).

Rec 4/20

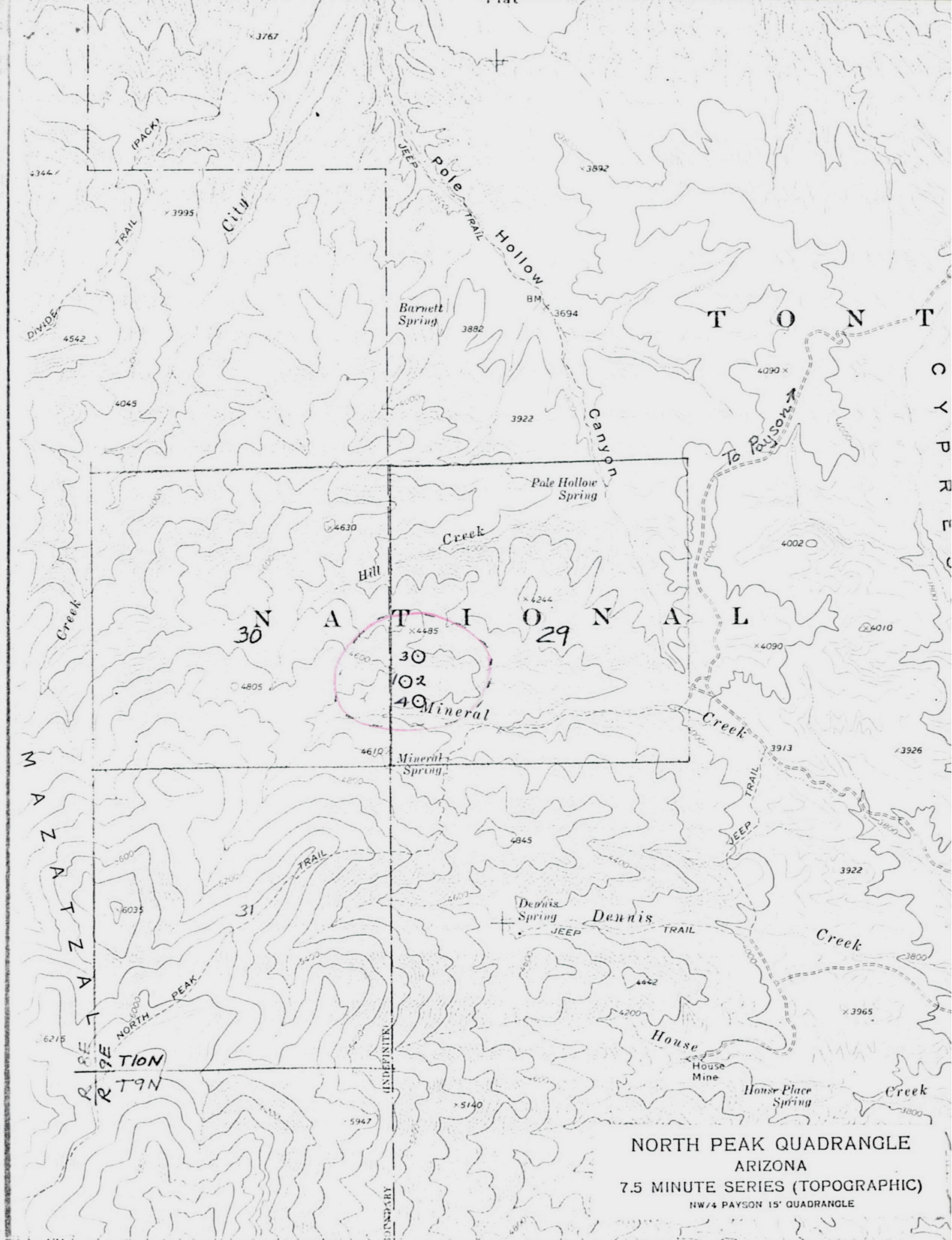
Three core specimens are at Western Petrographics for a polished thin-section slab.

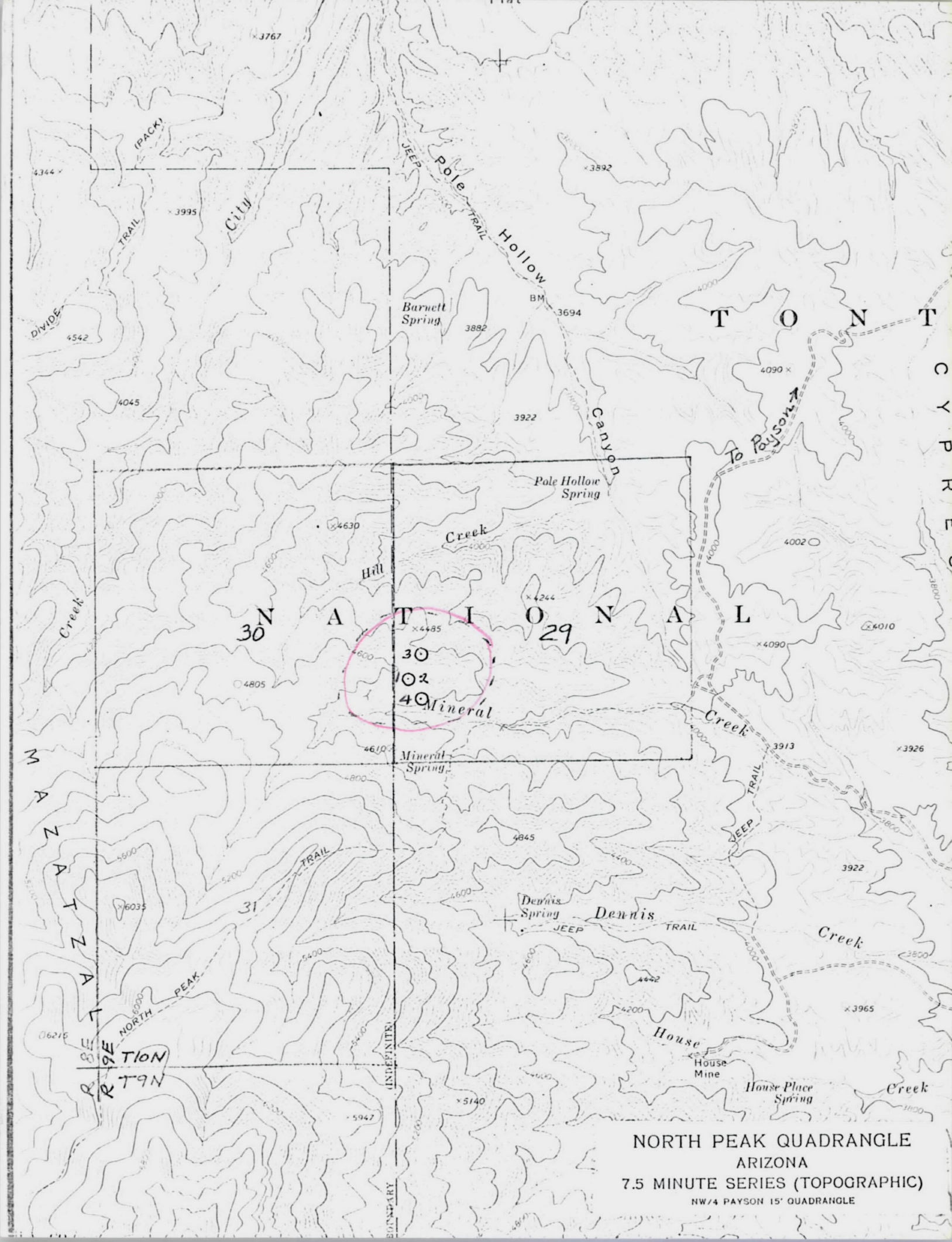
The 56 lode claim group includes 32 which are inside the Mazatzal Wilderness Area.

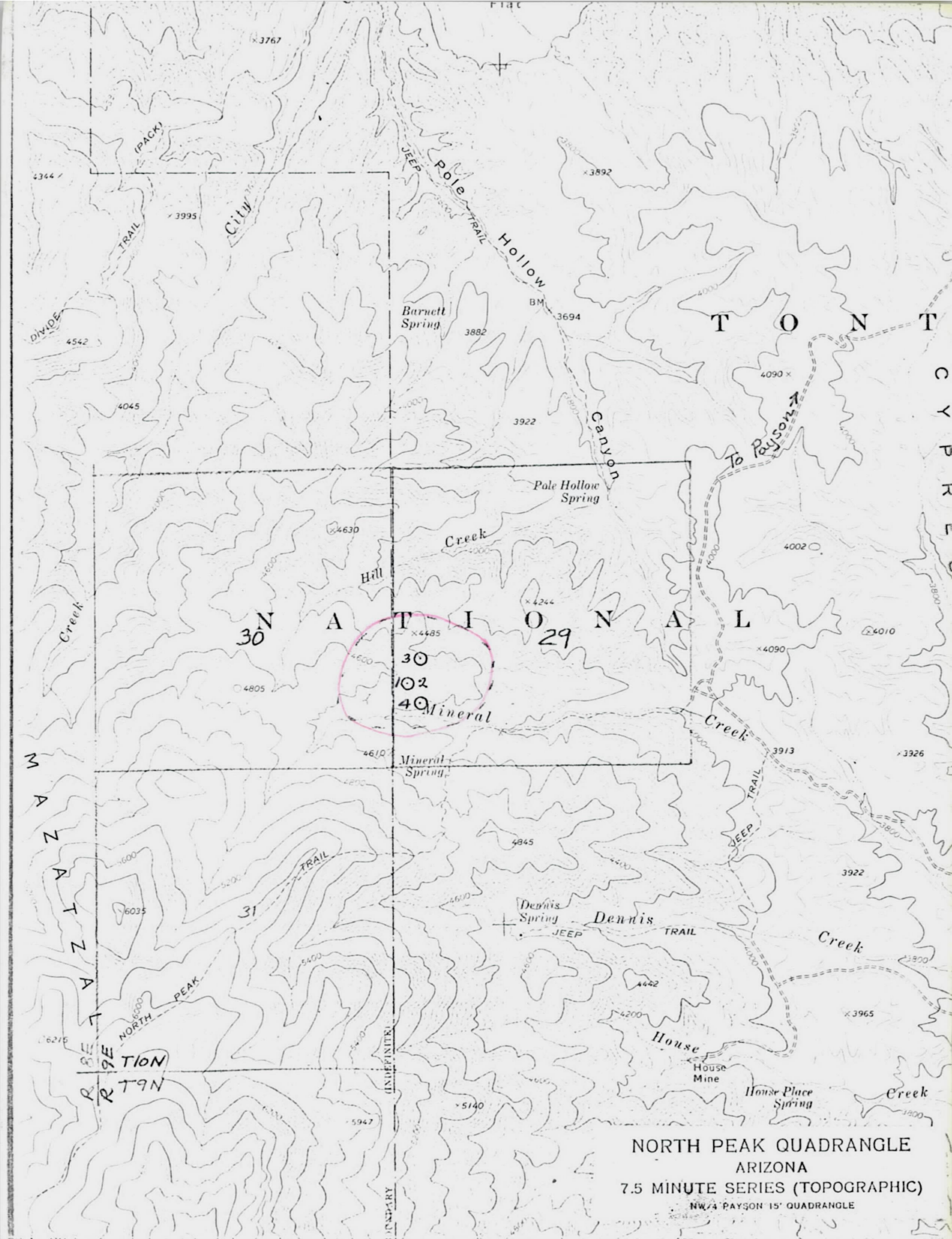
James D. Sell

James D. Sell

JDS:lb


NORTH PEAK QUADRANGLE
ARIZONA
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 PAYSON 15' QUADRANGLE
T O N T
N A T I O N A L
M A N Z A N I T A
Pole Hollow
Canyon
Pole Hollow Spring
Barnett Spring
City Creek
Hill Creek
Mineral Creek
Mineral Spring
Dennis Spring
Dennis Creek
House Creek
House Mine
House Place Spring
North Peak
To Payson
JEEP TRAIL
(PACK) TRAIL
DIVIDE TRAIL
(INDEFINITE)
30
29
31
30
102
40
T10N
R9E
T9N
R9E


NORTH PEAK QUADRANGLE
ARIZONA
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 PAYSON 15' QUADRANGLE
Pole Hollow
Canyon
Barnett Spring
Pole Hollow Spring
Creek
Hill
Mineral
Mineral Spring
Dennis Spring
Dennis
Creek
House
House Mine
House Place Spring
Creek
City
DIVIDE
TRAIL
(PACK)
JEEP
TRAIL
NORTH PEAK
(INDEFINITE)
BOUNDARY
To Payson
T O N T
C Y P R E
N A T I O N A L
M A N Z A N I T A
30
29
31
R 9E
R 10E
T 10N
T 9N
BM 3694
3767
3995
4344
4542
4045
3882
3892
3922
4090
4002
4010
4630
4244
4485
4805
4610
4845
4442
3913
3926
3965
6035
6215
5947
5140


NORTH PEAK QUADRANGLE
ARIZONA
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 PAYSON 15' QUADRANGLE
Pole Hollow
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Mineral Spring
Dennis Spring
Dennis
Creek
House
House Mine
House Place Spring
Creek
City
Creek
JEEP TRAIL
(PACK) TRAIL
DIVIDE
NORTH PEAK
TRAIL
To Payson
T O N T
N A T I O N A L
M A N Z A N I T A
30
29
31
R 9E
R 10E
T 9N
T 10N
(INDEFINITE)
3767
3892
3995
4344
4542
4045
3694
3882
3922
4090
4630
4244
4485
4805
4610
4845
4002
4010
4090
3913
3326
3922
6035
4442
3965
6216
5140
5947

INVOICE

WESTERN PETROGRAPHIC

20 West Flores
Tucson, Arizona 85705

INVOICE NO. 77290

INVOICE DATE April 11, 1977

SOLD TO
ASARCO, INCORPORATED
P. O. Box 5747
Tucson, Arizona 85706

SHIPPED TO J. D. Sell

W. G. K.

APR 13 1977

OUR ORDER NO.	YOUR ORDER NO.	TERMS	SHIPPED VIA	SURPLUS MATERIA
77290		net 30 days	picked up	returned

QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	AMOUNT
3	ea	Polished thin sections (27 x 46 mm)	8.00	24.00
3	ea	K-feldspar stain	.75	2.25
		TOTAL		$26.25

APPROVED FOR PAYMENT

By: James D Sell
(Signature)

Inc. General
(Copper Penny Claims)

JDS - care to have another fling in this area?
F.T.G.

PERFECT PRODUCTS

8360 EAST SOLANO • SCOTTSDALE, ARIZONA 85253 • (602) 948-4591
CABLE: PERFECPRO

6 May, 1977

RECEIVED
MAY 9 - 1977
EXPLORATION DEPT.

Exploration Division
ASARCO
1150 N. 7th Ave.
Tucson, Arizona

Re: Uranium, copper, silver

Gentlemen:

Please consider the Copper Mountain Mines property for your inspection.

As of today, access had not officially been granted although evidence of internal acceptance of the request by the Forest Service is in our possession.

Of course, access by horseback (14 miles) is feasable anytime.

Please let me know of your interest.

Sincerely,

Don W. Jones

Don W. Jones
Perfect Products

PERFECT PRODUCTS

8360 EAST SOLANO • SCOTTSDALE, ARIZONA 85253 • (602) 948-4591

CABLE: PERFECPRO

Claims available

Uranium - Copper - Silver

Available now are various minerals and metals in an area of 3200 acres known as Copper Mountain Mines near Payson, Arizona. The area was originally explored and production (copper) was initiated in the 20's when a Canadian company built $3 million in roads throughout the property. The backer died and the deal collapsed.

Various operators have mined it on a small scale, tested it and offered it for sale but the biggest obstacle was placed in the way in 1964 when it was declared a Wilderness Area. The present owner set out to unscramble the restrictions this placed on development. He has over the past year developed an excellent working rapport with the Forest Service and has accomplished the following:

1) Drilling approval is expected momentarily.
2) Access permission will be concurrent.
3) He has been assured mining will be approved.
4) Entire area is quite well developed (for a forest) and it should not be classified as a Wilderness Area. Forest Service is aware of this and moves are underway to correct this status.

As desired, values can be divided into three primary areas of interest and are geographically separate, namely, copper, silver and uranium as follows:

1) Copper
   a. Indications are that half the property will yield over 1.25% copper.
   b. Two carload shipments smelted out at 11.1% and 16.9% copper.
   c. One square mile of indicated 1.5% to 7.5% copper.
   d. Known vein of solid bornite.
   e. Estimated to be the largest and richest copper deposit in Arizona.

2) Silver
   a. A 67,000# shipment produced 12.64 oz. per ton silver and 1.25% copper. There are millions of tons of this.
   b. A rich known vein rumored to run as high as 2,000 oz.

3) Uranium
   a. A recent fly-over indicated an extremely high reading over a particular area.

4) Other
   a. Three veins of turquoise.
   b. A 30' vein of 87.82% silicone.
   c. An area of 2 to 4 oz. gold.

Needless to say, the barriers placed by the Wilderness Area status has previously cramped development. It has only been in recent weeks that the barriers have been dropped to make mining feasable so this is one of the first offerings made under the new status.

If you have any interest in uranium, silver or copper either together or separately, please contact the undersigned for an appointment to see and test the property. There are NO assays or samples available other than those enclosed.

Sincerely,

Don W. Jones
Perfect Products

Form 13 9c

INSPIRATION CONSOLIDATED COPPER CO.

SMELTING DEPARTMENT

Smelter Lot 7410 Shipper Lot 1 DATE August 23 1964

BOUGHT OF Copper Mountain Mines, Inc. Date Received August 18, 1964

Street Box 512 City Globe, Arizona

Initial	CAR Number	WET WEIGHT	Moisture %	DRY WEIGHT	
ICC	920	67,780	6.20	63,578	

N. Y. QUOTATIONS

Copper (per lb.) 35.929 ¢

Less 4.85¢ = 31.079 ¢

Silver (per oz.) 128.900 ¢

Gold (per oz.)

ASSAY and ANALYSES	Copper %	Silver Oz.	Gold Oz.	Silica %	Alumina %	Iron %	Lime %	Sulphur %
	1.25	12.64	Tr.	29.0	11.2	12.3	.7	—

PAYMENTS PER TON

						DEBITS	CREDITS	Valuation For Freight
Copper	25.00 Lbs. per ton, less	10 %	15.00 Lbs. at	31.079 ¢	per Lb.	$	$ 4.66	$
Silver	12.64 Ozs. per ton, less	5 %	12.01 Ozs. at	128.900 ¢	per Oz.		15.48	
Gold	Ozs. per ton, less	%	Ozs. at		per Oz.			
Excess Metal Values	$20.14 - 15.00 = $5.14 @ 10%					.51		
Treatment Charge						9.50		
TOTALS						10.01	20.14	
Net Value per ton							10.13	

Net Value for Freight Charges, per wet ton $

Trucking paid to: ~~Royalty, tonnage paid to:~~	31.789	Dry tons at $ 10.13	$ 322.02
Joe W. Clark	Sampling	tons at	
Box 460, Globe, Arizona	Freight		
	Trucking 33.89 wet tons @ $10.00/ton = $338.90		322.02*
* Note: Total proceeds of $322.02 paid	AMOUNT DUE SHIPPER		—
to trucker, leaving a balance due	Less 10 % Royalty	Smelter Net after Trucking	—
trucker of $16.88.	NET AMOUNT DUE SHIPPER		$ —

Correct [signature] Approved [signature]

Mr Gamble
Copper Mt Mines
one car in May 1966
16.9 Copper
1.34 Silver
.005 of Gold
In June 66 one car at 11.1 copper
run at Copper Mt Mfg Co.

MAGMA COPPER COMPANY
Superior Division

ASSAY CERTIFICATE 'A'

DATE 11/2 19 [illegible]

NO.	LOCATION AND REMARKS	CU %	AG OZ.	AU OZ.				
45[illegible]	Clay Thorne (Old Polk lodes)	1.40	0.20	0.01				
	13 mi W of Payson in							
	Wilderness							

[illegible] to Hugh Steele
Tucson

[illegible]
CHIEF CHEMIST

SC-1005

This is an assay on all Claims combined

SKYLINE LABS, INC.
Hawley & Hawley, Assayers and Chemists Division
1700 W. Grant Rd., P.O. Box 50106, Tucson, Arizona 85703
(602) 622-4836

Charles E. Thompson
Arizona Registered Assayer No. 9427

William L. Lehmbeck
Arizona Registered Assayer No. 9425

CERTIFICATE OF ANALYSIS

ITEM NO.	SAMPLE IDENTIFICATION	Au ppm	Ag ppm	Ag** oz/ton	Cu ppm	Cu* %	Pb ppm	Pb* %		
1	7202	< 0.02	0.6		1000		240			
2	7203	< 0.02	0.6		740		120			
3	7204	< 0.02	19.0			1.58	1000			
4	7205	< 0.02	0.4			0.69	350			
5	7206	< 0.02	>450.0	17.40		1.48	335			
6	7207	< 0.02	125.0	3.26	1450		145			
7	7208	< 0.02	22.0			5.85		0.32		
8	7209	< 0.02	6.4			3.05	65			
9	7210	< 0.02	0.6		300		45			

TO:
NEWMONT EXPLORATION LTD.
200 W. Desert Sky Rd.
Tucson, Arizona 85704

Attn: M. M. Swan

REMARKS:

Trace Analysis
* Single Analysis
** Analysis by Fire Assay

CERTIFIED BY:

DATE REC'D: | DATE COMPL.: | JOB NUMBER:

SKYLINE LABS, INC.
Hawley & Hawley, Assayers and Chemists Division
1700 W. Grant Rd., P.O. Box 50106, Tucson, Arizona 85703
(602) 622-4836

Charles E. Thompson
Arizona Registered Assayer No. 9427

William L. Lehmbeck
Arizona Registered Assayer No. 9425

CERTIFICATE OF ANALYSIS

ITEM NO.	SAMPLE IDENTIFICATION	Zn ppm	Mo ppm	As ppm	Sb ppm					
1	7202	110	2							
2	7203	85	2							
3	7204	125	2							
4	7205	50	2	20	14					
5	7206	220	2							
6	7207	155	2							
7	7208	100	42							
8	7209	120	4							
9	7210	105	2	40	13					

12 oz
~~240~~ 0 oz
1/2 240 oz

TO:
NEWMONT EXPLORATION LTD.
200 West Desert Sky Rd.
Tucson, Arizona 85704

Attn: M. M. Swan

REMARKS:
Trace Analysis

CERTIFIED BY:

DATE REC'D: | DATE COMPL.: | JOB NUMBER:

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Tonto National Forest

REPLY TO: 8410 Environmental Analysis and Report 24 MAY 1977

SUBJECT: Copper Mountain Claims, Mazatzal Wilderness -EAR

TO: District Ranger, Payson R.D.

We have carefully reviewed your EAR. This is one of the better Reports we have seen and you are commended for your efforts.

The Report is approved, subject to the following constraints:

1. All Phase I work must be completed by primitive means, as you have suggested. Further, it seems reasonable that when hole sites are finally determined by geologic work, the drill site and access thereto should be further examined and a decision made, on a case basis, as to what is best for each site. An I.D. Team would function well on this effort.

by who

2. The claimant be required to show his reasoning and evidence for selection of particular drill sites to our mining engineer, who would confirm or alter the location. Road work or other vehicular access would not be allowed until that process is complete.

3. Phase II would begin after the following:

   a. Review of each drill site on the ground.

   b. Compare helicopter access impacts with ground vehicle access, in other than cost terms.

   c. Landing pads and/or roads be individually reviewed and approved before use.

4. Phase III would require analysis of findings from the drilling program. It's most probable that an EIS would be required, as you have implied.

5. A fire plan must be developed for Phase II.

6. Archeological survey of drilling sites, landing pads/access roads will be accomplished by our archeologist prior to disturbance of any kind.

prior to drilling?

MAY 24 1977
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(2320)

ENVIRONMENTAL ANALYSIS REPORT

FOR

MINERAL EXPLORATION AND MINING

COPPER MOUNTAIN CLAIM GROUP

MAZATZAL WILDERNESS

R-3

PAYSON RANGER DISTRICT

TONTO NATIONAL FOREST

Prepared by Michael L. Boyle Date 4/25/7
ACTING RECREATION AND LANDS STAFF

Recommended by Hugh C. Thompson Date 4/25/77
DISTRICT FOREST RANGER

Recommended by Bruce B. Jack Date 5/18/7
FOREST SUPERVISOR

SUMMARY

This proposal to perform exploratory drilling and active mining within an existing open pit within the Mazatzal Wilderness was evaluated to determine the economic and environmental impacts concerned. Consideration was primarily given to the exploratory drilling phase of the operation since a full scale mining operation is dependent on the findings of the exploration, and evaluation of associated impacts is beyond the scope of this report.

Certainly the economic potential of such a proposal is obvious; however, there are no positive associated environmental effects. Air quality, natural beauty, wildlife, wilderness values, and outdoor recreation are a few of the factors which will be negatively affected by the proposed exploratory drilling operation.

The Wilderness Preservation Act of 1964 provides for mineral exploration within the Wilderness and for reasonable ingress and egress to mining claims within the wilderness. In light of current legislation,approval of the proposed drilling operation is recommended subject to management contraints as delineated later in this report. Approval of an active mining operation is not recommended pending the results of the exploratory drilling. If indeed the drilling suggests a full scale mining operation will commence, an environmental impact statement will be necessary to evaluate the impacts of such a project.

DESCRIPTION

The proposal involves copper and silver ore production and removal, as well as drilling and other forms of exploration within the Mazatzal Wilderness.

The applicant has submitted an Operating Plan which makes application for permission to upgrade existing roads for removing ore and moving in a drill rig. The plan specifies the use of a drilling rig, crawler tractor, front end loader, and two (2) three yard dump trucks.

The claim block encompasses an area of approximately 2,900 acres. The area is located in parts of Section 8-11, 14-17, 20-22, Township 10 North, Range 8 East, G&SRBM. Initial operations will commence in the S½, Section 9, Township 10 North, Range 8 East. The Operating Plan calls for drilling, and ore removal from this area.

The proposal area was heavily explored and roaded in the 1950's and 1960's. Wilderness access permits have been issued to at least two different individuals. Existing aerial photos of the area show the degree to which it has been disturbed.

The claim block lies south of the East Verde River. The area is broken by several canyons and the topography varies from flat, and gently rolling terrain to very precipitous slopes, and narrow ridge tops.

Vegetation is typical of the chaparral type being primarily perennial grasses, shrub species, and pinyon-juniper.

The Operating Plan as submitted can essentially be broken down into three phases:

1. Geologic sampling to determine exact locations of drill holes.

2. Exploratory deep drilling to determine mineral potential of claims.

3. If mineral potential is significant, ore removal from claims.

Phase I can be accomplished without mechanized equipment, either on foot or via horseback. Phase III would most likely require an environmental impact statement if such an operation proves feasible. This report will be primarily concerned with the impacts involved with Phase II, the exploratory drilling phase.

Some sites already picked

The first hole will be drilled near the open pit in the Polk #11 claim. Other drill sites have not been exactly located, but will commence approximately 2,000 yards southwest of the open pit. Additional drill hole locations will be adjacent to existing roads and are subject to Forest Service approval. Phase I of the Operation (as listed above) will have to be completed to determine the exact drill hole locations.

ENVIRONMENTAL EFFECTS AND ECONOMIC ANALYSIS

Renewable Resources

nots

Air - Air quality at the area is very good since it is within the Wilderness. The proposal will create a marked decrease in air quality due to dust, equipment, smoke and noise. This condition will exist as long as the project is in operation.

Human Resource

The proposal will create a paradox in relation to this resource. If a drilling operation shows the mineral potential to be positive, activation of the mining venture would be benefical for the economy of Payson and Northern Gila County. It would create more jobs and pump added money into the economy of the area. On the other hand, a full scale mining operation will result in the degradation of a portion of the Mazatzal Wilderness. Restoration measures can help lessen the impacts but any true wilderness character will be lost from the area.

already lost due to prior prospecting

Natural Beauty

The natural beauty resource in this area has suffered over the past two (2) decades due to mineral exploration. The area is heavily roaded and there are many open shafts, pits and tractor cuts. Some of this disturbance has begun to heal but evidence of past mining activity is very apparent.

Implementation of the proposal will necessitate the re-opening of existing roads. It will also cause the enlargement of the exisiting ore pit in Section 9, Township 10 North, Range 8 East. All of this activity will cause an added loss in the natural beauty resource.

Open Space

The proposal will create a loss in open space through the re-opening of existing roads and enlargement of the existing pit.

The impact on this resource will be caused by reopened roads and increased disturbance at the ore pit.

Vegetation

The project area is within the chaparral vegetative type. Vegetation present are those shrub species customarily found in zone along with some perennial grasses, and forbs, and scattered pinyon-junipers. Areas previously disturbed have some native vegetation on them although the disturbance is still evident.

The proposal will re-open these areas plus create new disturbance as mining and exploration operations increase in size.

Water

The proposal area involves several steep, intermittent drainages, all of which are tributaries of the East Verde River. The southwestern portion of the claim block lies in the head of Houston Creek, which is a tributary of the Verde River.

Soils in the area have a high erosion hazard with moderate run-off and gully potential. Storm intensity is high and the area has slopes ranging up to 90%. The area is subject to mass soil erosion, slides and dry creep.

Increased mining and exploration activity with attendant removal of vegetation and soil disturbance will increase soil erosion which will result in an increased silt load in the Verde and East Verde Rivers.

Leaching of water through ore and tailing piles could create a source of water pollution that could affect water quality in the Verde and East Verde Rivers.

Oil and fuel spills from mining and exploration equipment could be a source of water pollution but would probably be quite localized.

Wildlife

The proposal area provides habitat for a variety of wildlife and game species. Apparently wildlife populations are not as high as the area could support because of a lack of permanent water. Species found include white-tail and mule deer, black bear, cougar, javelina, coyote, bobcat, quail, rabbit, and squirrel. Numerous other non-game forms include species of reptiles, rodents, and birds.

There have been unsubstantiated sightings of both bald and golden eagles in the general area of the proposal. At this time, it isn't known if these birds are resident in the area, or have come to the area for the winter.

Mining exploration activities will decrease the quality and quantity of wildlife habitat in the area. Nuts

The East Verde and Verde Rivers support a warm water fishery of both native and introduced species. Included are brown and rainbow trout, catfish, bass and several species of rough fish. Increased siltation and reduced water quality could adversely affect this resource.

Non-renewable Resources

Antiquities - There has apparently been some archeological inventory work done in the past within the proposal area. This data is not available to the District at this time.

Disturbance and activity associated with an active mining operation could damage or destroy archeological values in the area.

Minerals

As was previously stated in the Description, the proposal area has a long history of mineral exploration and sporadic mining. The area has existing roads, shafts, and tractor cuts.

According to District records, there have been Wilderness access permits issued for this area on two(2) or three(3) occasions. when?

There are existing mineral examination reports which appear to establish the validity of the claims. where?

Soils

There are several soil types present within the claim block, and that are traversed by the haul road. However, the soil mapping unit at the ore and drill site is 653 (McFadden extremely stony sandy loam). This is a moderately deep, stony, soil over quartzite or sandstone bedrock.

Erosion hazard is high. Soil erodibility, gully potential, and surface run-off are moderate. Slopes range from 50% to 90%. This is subject to mass soil erosion, occasional slides, and moderate dry creep.

Revegetation potential is low for grass and moderate for browse.

This soil is rated fair for road construction. Active mining would undoubtedly create more areas of disturbed soil with resultant increase in surface run-off and soil erosion.

Wilderness

As was stated earlier, the proposal is entirely within the Mazatzal Wilderness. It also shows signs of past mining and exploration. The area is heavily roaded from this activity as is eveident on 1967 aerial photo, ESA17-154, Quad 249, Line 22.

As a result of the above, wilderness values have been severely impacted by the above activities.

The proposal will further decrease the quality of wilderness in the area through physical disturbance plus the presence of mechanized equipment with attendant noise, smoke, etc.

Uses

Forage - The proposal area is entirely within the Bull Springs Allotment. The proposed deep drilling operation would not affect the grazing to any appreciable degree. Mining would begin in an existing open pit where there is presently no forage on site. What little perennial grass that exists on adjacent claims is found along old cat roads. Increased traffic on these roads will be to the detriment of the range resource. Overall, the grazing capacity of the Bull Springs Allotment will not be materially affected.

Land Uses

Since the entire claims area lies within the Mazatzal Wilderness, the primary management direction is oriented towards dispersed recreation and scenic values. The claims area receives very little additional use other than token grazing. By opening up existing roads which have partially healed, the exploratory drilling phase of the operation will detract from the primary management objectives. Certainly a full scale mining operation would destroy much of the wilderness value of the claims area.

Outdoor Recreation

Although visitor use in the Mazatzals is light, especially compared with the Superstition Wilderness, it is estimated that it has increased nearly 100% in the past five (5) years. During 1976, an estimated 16,000 visitor days were recorded as compared to 8,500 in 1971. Population trends in Arizona, together with a developing appreciation of wilderness, indicate that the use will continue to increase.

Much of the use is by big game hunters who hunt primarily deer and bear. If big game are scared away from the claims area, it would only be while the project is in operation. It is not anticipated the drilling project will appreciably affect the present recreation activity of the Mazatzal Wilderness. In event a full scale mining operation is begun, the impact could be substantial.

Timber

Since there is no timber in the claims area, none would be affected by the proposed project.

Transportation

The initial drill site location and proposed site of the mining operation is approximately five (5) miles inside the Wilderness boundary. There is an existing road (partially healed) which leads directly to the drill site. No new road construction will be necessary. Heavy machinery will be necessary to transport the drilling rig to the drill site for exploratory drilling.

Pack animals can carry the majority of other equipment and supplies. In event of active mining, truck, tractors and front end loaders will be driven over existing roads.

The LF Ranch has an access permit to private land immediately north of the Copper Mountain claim block. Part of this route will have to serve for permitted access to the claim area.

Activities

Economics - The initial exploratory drilling will enable the applicant to determine if there is a sufficient ore body present to develop a mining operation in the Copper Mountain claim block. If the results of the exploratory drilling are positive, the claims eventually could be patented. The value of the wilderness would be decreased, while the mineral resource would be utilized.

The development would create jobs and enhance the economic environment of Northern Gila County.

Fire Management

The proposed drilling and/or mining operation would create an additional fire risk in the claims area which is highly inflammable. With a fire plan, proper fire-fighting tools, and approved spark arrestors on all internal combustion engines, the danger of fire can be kept to a minimum.

Information and Education

The unique quality of the wilderness resource in the claims area will be lost in event of a full scale mining operation. On the other hand a valuable ore body would help to produce a necessary product. The ultimate question will be whether the mineral resource or the wilderness resource will have the greatest long-term benefit.

Critical Areas

Archeological Sites - The proposed exploratory drilling/mining in the Polk 11 claim will not disturb a potential archeological site since the area is already an existing open pit which was actively mined in the mid 1960's. If further exploratory drilling/mining is eventually planned for other claims within the block, archeological clearance will be necessary. Archeological site potential on adjacent claims varies from low to high depending on location on the terrain.

Riparian Sites

There are several riparian sites located within this claims block. None are located in the immediate vicinity of the proposed drilling/mining activity with the Polk #11 claim. In event adjacent claims are actively mined, the riparian resource within these claims will likely be disturbed or perhaps destroyed.

FAVORABLE ENVIRONMENTAL EFFECTS

There are no favorable effects to the physical environment to be realized from the proposed mineral exploration. However, should a marketable body of ore be discovered as a result of the proposed exploration, many Americans will benefit from the resultant mineral products.

ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

Any mechancial encroachment into the wilderness will create an adverse effect. It would be in direct conflict with the basic philsoophy of wilderness. In addition to the noise pollution, the motorized equipment will also create temporary pollution through the creation of dust and smoke in the vicinity of the drill site and access road.

Any extensive earth work in leveling drill pads or wasting sludge down hill-sides would also cause lasting contrast on the landscape and could adversely affect water quality, as well as some aquatic life. Man's imprint in the Wilderness would then be more evident.

Resident populations of wildlife species would be temporaily displaced by drill site construction and operation.

The adverse effects involving the exploratory phase of this proposal would be compounded many times if active mining is commenced. In addition, natural beauty, vegetation, water, antiquities, soils and outdoor recreation would all be adversely affected. These items will be spoken to in more detail in a future Environmental Analysis if the exploratory drilling substantiates the presence of a valuable mineral deposit.

ALTERNATIVES TO PROPOSED ACTION

One alternative is to deny the applicant entry into the wilderness to do mineral exploratory work. This alternative would have the least impact on the environment, but is not consistent with existing legislation. The Wilderness Preservation Act of 1964 is explicit in that under existing mining laws, the use of the land for mineral location within the wilderness may continue until December 31, 1983. This use is subject to reasonable regulations concerning ingress and egress as may be prescribed by the Secretary of Agriculture. It is for this reason that this alternative is unacceptable.

Acknowledging the applicant has legal right to develop a claim which has a good potential for mineralization, the next step is to develop a sound methodology which the applicant can use to develop his claims in a manner most compatible with the environment. Since there are existing roads leading directly to the proposed drilling/mining location, the only workable alternative is to use these existing roads to haul in any mechanized equipment which is essential to the operation. The important point is that the mechanized equipment must be essential to the operation (i.e., work which absolutely could not be accomplished on foot or on horseback).

The history of these claims shows that preliminary sampling indicates a good mineral potential to be present on several of the claims. Mining Geologist Raj H. Daniel inspected the claim in August of 1976 and his mineral report included a recommendation to drill two (2) deep wildcat holes to a depth of 2,000 feet plus, to enlighten the mineralization potential. Certainly this operation would be considered essential and would justify moving in a drill rig on existing roads.

One alternative to using existing roads is to move in the drill rig via helicopter. This would certainly be a viable alternative if existing roads were not already in place; however, since an extensive road system is already in existence, it is most practical to utilize this existing system.

The alternative which is most compatible both with the environment and with the applicant's desire to develop this claim block is a modification of the Operating Plan (enclosed) as submitted. As stated before, it involves three phases:

A. Phase 1. - Preliminary geology, location of drilling sites. This phase must be accomplished via horseback since use of mechanized equipment (such as a jeep) is not necessary to the operation (i. e., certainly use of a jeep would be more convenient and economical but it is possible to accomplish this work by horseback; therefore a jeep is not essential).

B. Phase 2. - Exploratory drilling using deep drilling equipment. This phase will be accomplished using mechanized equipment to be moved in on existing roads. No new road construction will be allowed, but a cat may be necessary to repair the existing grade in some places.

might be necessary for proper drilling

C. Phase 3 - Active mining if the exploratory drilling shows the presence of a valuable mineral deposit. It is felt that this phase, while being the next logical step in the operation, is beyond the scope of this environmental analysis. The environmental impacts of such an operation have been alluded to in this report, but would have to more fully investigated in a separate analysis. If the results of the drilling are positive, suggesting a full scale mining operation, an Environmental Impact Statement will be required for this phase of the operation. No active mining will be allowed until the associated impacts can be more fully investigated.

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

While a mining operation is a short-term use, a wilderness must be considered a resource for long-term use. If the proposed exploration work is done in such a way as to minimize man's imprint on the Wilderness, the effect on long-term productivity will also be minimized. Certainly the existing roads are already a significant imprint on man's presence. Opening up these same roads will not be creating a significant additional imprint.

The use of mechanized drilling equipment to be moved in over the existing roads will have the least environmental impact while still providing the reasonable ingress and egress as specified by the Wilderness Preservation Act of 1964.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The use of existing roads to move in deep drill equipment to test the mineral potential of these claims does not represent an irreversible and irretrievable commitment of resources. If the proposed drilling revealed a mineral resource of great enough economic potential, it is conceivable that a full scale mining operation would result. In that case, a portion of the wilderness resource would be lost.

On the other hand, if the exploratory drilling showed that the mineral resource was not of great enough economic potential, there would be significant evidence to discourage further exploratory work. That particular area of Wilderness would then be safeguarded for its intended long-term use.

CONSULTATION WITH APPROPRIATE FEDERAL AGENCIES AND REVIEW BY STATE AND LOCAL AGENCIES DEVELOPING AND ENFORCING ENVIRONMENTAL STANDARDS

A total of ninety-six (96) letters were sent to various Federal and State agencies, environmental groups, newspapers and publications, mining associations, universities and other groups who may have an interest in the proposal. In addition, a request for public response was solicited in local news publications. Copies of all letters of response are included in the Appendix.

Most of the received correspondence indicated the group/individual concerned was not totally opposed to the proposal provided certain operating constraints were adhered to. A few responses, primarily from mining concerns, indicated blanket approval of the proposal under any circumstances. There were also several responses from environmentalists which indicated blanket disapproval of the proposal under any circumstances.

There were actually more parties who expressed approval with certain restraints than those who would not favor the project under any circumstances. The types of restraints varied depending on the type of organization responding, but most expressed concern that only existing roads be used and properly closed following use.

MANAGEMENT REQUIRMENTS AND CONSTRAINTS

1. All geologic work associated with locating drill hole sites will be accomplished either on foot or via horseback.

2. The location of drill-hole sites will be approved by the Forest Service prior to drilling.

3. Drill hole sites will be located adjacent to existing roads, so that no new road construction will be necessary to complete mineral exploration.

4. Existing roads will be opened to move in the deep-drill rig. Only the minimum earth work will be accomplished as necessary to make the road passable to the drill rig.

5. Other mechanized equipment will not be used to transport personnel or supplies to the drill site except where essential to the maintenance/operation of the drill rig. For example, it will be necessary to truck in fuel and water for the operation of the drill rig, but it is not essential to provide a truck specifically for the transport of personnel. If various supplies can be moved in via pack animal, they will be moved in this fashion unless they can be transported in the same truck which is being used to transport essential fuel and water to the drill rig.

6. At no time will light rigs such as jeeps or pickups be used to enter the wilderness in conjunction with this project. Anything that can be moved in by jeep can be moved in by pack animal.

7. Only the minimum disturbance will be allowed in preparing the site for set up of the drill rig. Following drilling, the drill site location will be revegetated as prescribed by the Forest Service.

8. All water used in conjunction with the drill rig will be trucked in from a source outside the wilderness in drums. These drums could later be utilized as settling ponds.

9. The sludge contained in these drums will be returned to the holes once the drilling is completed.

For your information, we are enclosing a xerox of all Staff review notes. These may further assist you.

BRUCE B. HRONEK
Forest Supervisor

Enclosures

10. Drilling holes will be plugged so they will not present a safety hazard to the public or become a trap for wildlife.

11. A support camp could be established outside the wilderness to act as a staging and supply area. The applicant orginally applied to use existing buildings in Boardinghouse Canyon as a support camp. This is unacceptable due to lack of adequate sanitary facilities and the distance from the Polk claims which will be initially explored. It is felt that since the buildings are located some distance from the operation, it would not be that much further to stage the operation from outside the wilderness with much less impact on the resource.

12. It will be acceptable to camp personnel in the vicinity of the drill rig providing proper sanitary facilities are provided and campers conduct their affairs so as to minimize impact on the land.

13. Following drilling operations, all supplies, garbage, tools will be removed from the drill site so as to return the site to the same condition in which it was found as much as feasible.

14. Following drilling operations, all roads will be closed out, water-barred and seeded as necessary to minimize erosion.

15. The Arizona Commission of Agriculture and Horticulture will be notified if any plants to be removed or destroyed are on the Protected Native Plants list. This allows the Commission to salvage these plants to be planted in other area.

16. The recommended seed mixture for revegetation work connected with the proposal will be side-oats grama, sand dropseed, weeping lovegrass and yellow blossom sweetclover in a mixture ratio of 5:1:1:1 applied at a at a rate of ten (10) pounds per acre.

17. I and E signs will be placed at Wilderness boundary to explain the exploration/mining activity.

18. A gate security system will be agreed upon so that any mining activity will not allow other members of the public to enter the wilderness.

ENVIRONMENTAL STATEMENT

As stated above, this project is essentially a three-phase operation. The first phase involves geologic sampling and mapping to determine drill site locations. This phase can be accomplished without motorized equipment in such a manner that is compatible with the wilderness concept. Phase two involves sample drilling to evaluate the minerals potential of the claims. The use of mechanized equipment will be essential to this phase of the operation Due to the existence of roads leading directly to and extending through the claims area, the impact on the wilderness could be minimized for this phase of the operation.

For this reason, it is felt that an Environmental Statement is not necessary for these first two phases of the operation.

If the drilling operation shows the location of a valuable mineral deposit, a full scale mining operation will likely be Phase 3 of the proposed operation. If such an operation materilazes it is recommended an Environmental Impact Statement be prepared in advance of mining.