CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
3550 N. Central Ave, 2nd floor
Phoenix, AZ, 85012
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

Mike Fujita
601 W 22nd - Tucson, Az. 85713
624-5732

EVALUATION OF COPPER CLOUD
MINING PROPERTY

PAYSON, ARIZONA
GILA COUNTY

January, 1973

by

Donald J. Podesta
4747 North 16th Street
Phoenix, Arizona 85016

A- INTRODUCTION
LOCATION
C - CLAIMS
REG. GEOL.
- GEOL. CLAIMS
AMPLING
ECONOMICS

DONALD J. PODESTA
Mining and Petroleum Geologist
4747 NORTH 16TH STREET
PHOENIX, ARIZONA 85016

PHONE: (602) 277-7736

January 12, 1972

Mr. Dwight A. Sossaman
Route 1, Box 122 F
Chandler, Arizona 85224

Dear Mr. Sossaman:

Attached is my report on the Copper Cloud Mining Property.

If you have any questions or if I can help you in any way please do not hesitate to call on me.

Very truly yours,

Donald J. Podesta

DJP/pp
encl.

EVALUATION OF COPPER CLOUD MINING PROPERTY

PAYSON, ARIZONA
GILA COUNTY

January, 1973

by

Donald J. Podesta
4747 North 16th Street
Phoenix, Arizona 85016

INDEX

A INTRODUCTION

At the request of Mr. Dwight A. Sossaman, a director of the Copper Cloud Mining Company, Inc., of Payson, Arizona, a field examination was made of the Copper Cloud claims to determine whether the copper showings warranted the expenditure of funds to validate the claims already located and if it would be advisable to locate additional claims.

Several days were spent in a literature survey of the area and on photogeologic studies from air photos obtained from the Forest Service. Twelve days were spent in the field between October 28, 1972 and January 7, 1973 in surface geological mapping and sampling. During the course of the field work it was concluded that the geology of the area and the mineralization evident from surface outcrops warranted retaining 10 of the claims already located and locating an additional 40 claims, this has now been accomplished, as has the validation drilling for 20 of the claims.

B LOCATION, CLIMATE, ACCESSIBILITY, ETC.

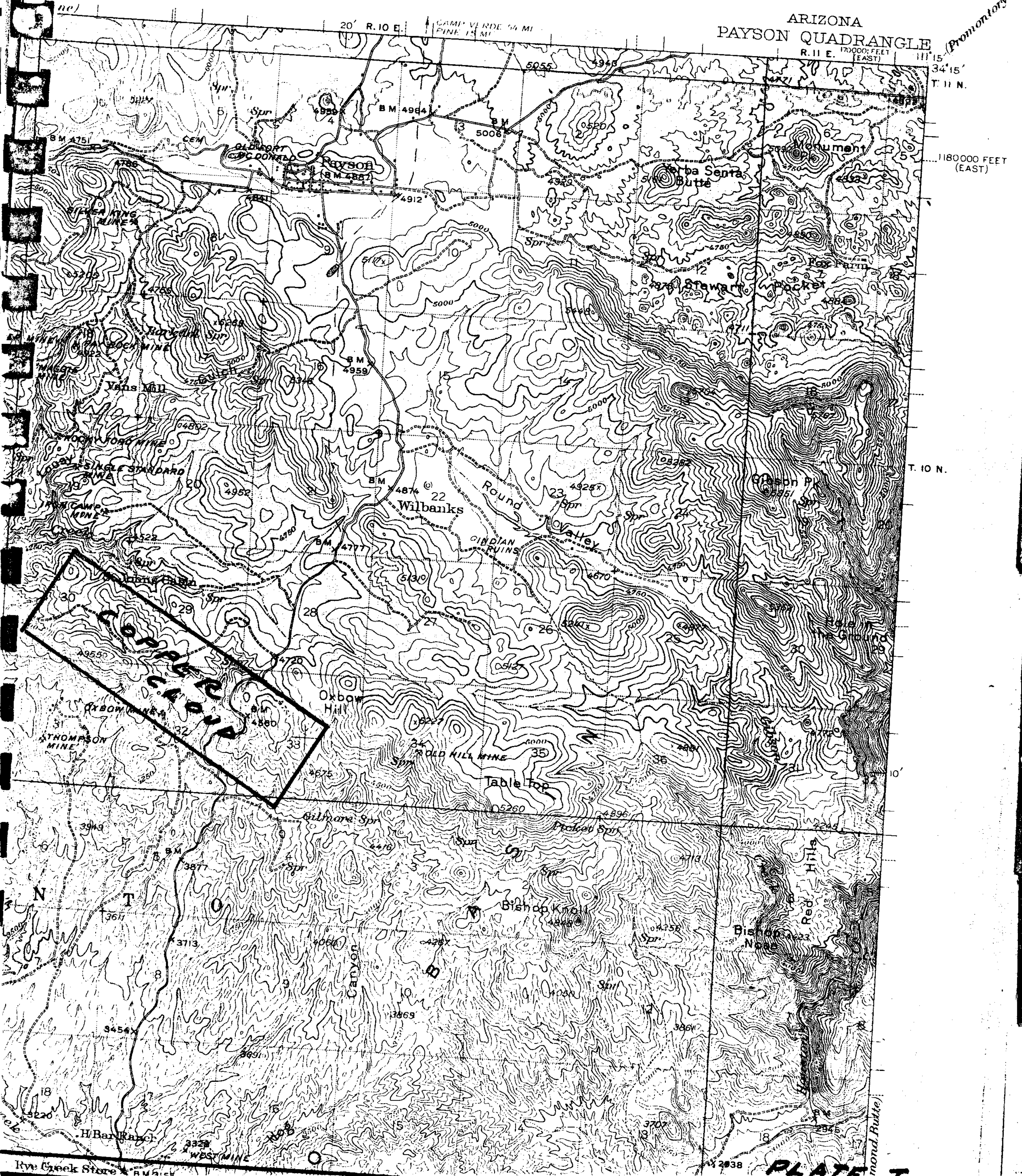
The Copper Cloud Mining claims are situated about 4 miles south and a little west of Payson in the Green Valley Mining District, Gila County, Arizona. (PLATE I)

The climate is favorable for year round mining although the temperature drops below freezing during the winter months with occasional snow which usually only covers the claim area for short periods.

Altitudes on the property range from 4000 feet to a maximum of 4800 feet. The black topped state highway 87 runs through the eastern portion of the claims and there are several rough gravel roads through the area. At the present time these are in poor condition and can only be traversed by a 4-wheel drive vehicle but grading, filling, and maintaining these roads presents no serious problem nor excessive expenditures.

A well at the old Ox Bow mine just south of the claim area and one about 1½ miles farther south both produced water from depths of 70 feet, so a water supply for mining operations apparently will present no problems.

In the event that it might prove economically advantageous to produce only cement copper, the smelter at Inspiration is conveniently located only 80 miles by road from the property.


ARIZONA
PAYSON QUADRANGLE
(Promontory Butte)
R. 10 E.
R. 11 E.
CAMP VERDE 54 MI
PINE 15 MI
170000 FEET (EAST)
34°15'
T. 11 N.
1180000 FEET (EAST)
T. 10 N.
10'
111°15'
Payson
(BM 4887)
OLD FORT MC DONALD
CEM
BM 4964
BM 5006
BM 4751
BM 4959
BM 4874
BM 4777
BM 4880
BM 3877
Yerba Senta Butte
Monument Pk
Fox Farm
Stewart Pocket
SILVER KING MINE
Vans Mill
ROCKY FORD MINE
SINGLE STANDARD MINE
IRON CAMP MINE
Gulch
Wilbanks
Round Valley
INDIAN RUINS
Gibson Pk
Hole in the Ground
Oxbow Hill
OXBOW MINE
THOMPSON MINE
OLD HILL MINE
Table Top
Gilmore Spr
Pocket Spr
Bishop Knoll
Bishop Nose
Red Hills
Canyon
H Bar Ranch
WEST MINE
Rye Creek Store
Spr
COPPER CLOUD
PLATE I

C CLAIM STATUS

The following tabulation shows the status of claims as of 1/ /73. (PLATE II)

NAME OF CLAIM	LOCATED	RECORDED	DOCKET	PAGE
Copper Cloud #7	9/11/72	9/15/72	327	932
Copper Cloud #8	9/11/72	9/15/72	327	933
Copper Cloud #9	9/11/72	9/15/72	327	934
Copper Cloud #10	9/11/72	9/15/72	327	935
Copper Cloud #11	9/11/72	9/15/72	327	936
Copper Cloud #12	9/11/72	9/15/72	327	937
Copper Cloud #13	9/11/72	9/15/72	327	938
Copper Cloud #14	9/11/72	9/15/72	327	939
Copper Cloud #15	9/11/72	9/15/72	327	940
Copper Cloud #16	9/11/72	9/15/72	327	941
Copper Cloud #33	12/21/72	12/22/72	333	363
Copper Cloud #34	12/21/72	12/22/72	333	364
Copper Cloud #35	12/21/72	12/22/72	333	365
Copper Cloud #36	12/21/72	12/22/72	333	366
Copper Cloud #37	12/18/72	12/19/72	333	204
Copper Cloud #38	12/18/72	12/19/72	333	205
Copper Cloud #39	12/18/72	12/19/72	333	206
Copper Cloud #40	12/18/72	12/19/72	333	207
Copper Cloud #41	12/18/72	12/19/72	333	208
Copper Cloud #42	12/18/72	12/19/72	333	209
Copper Cloud #43	12/18/72	12/19/72	333	210
Copper Cloud #44	12/18/72	12/19/72	333	211
Copper Cloud #45	12/21/72	12/22/72	333	367
Copper Cloud #46	12/21/72	12/22/72	333	368
Copper Cloud #47	12/21/72	12/22/72	333	369
Copper Cloud #48	12/21/72	12/22/72	333	370
Copper Cloud #49	12/21/72	12/22/72	333	371
Copper Cloud #50	12/21/72	12/22/72	333	372
Copper Cloud #51	12/26/72	12/29/72	333	553
Copper Cloud #52	1/02/73			
Copper Cloud #53	1/02/73			
Copper Cloud #54	1/02/73			
Copper Cloud #55	1/02/73			
Copper Cloud #56	1/02/73			
Copper Cloud #57	1/02/73			
Copper Cloud #58	1/02/73			
Copper Cloud #59	1/02/73			
Copper Cloud #60	1/02/73			

NAME OF CLAIM	LOCATED	RECORDED	DOCKET	PAGE
Copper Cloud Extension #7	11/27/72	11/29/72	332	268
Copper Cloud Extension #8	12/07/72	12/14/72	332	921
Copper Cloud Extension #9	11/27/72	11/29/72	332	269
Copper Cloud Extension #10	12/07/72	12/14/72	332	922
Copper Cloud Extension #11	11/28/72	11/29/72	332	270
Copper Cloud Extension #12	12/07/72	11/29/72	332	271
Copper Cloud Extension #13	11/27/72	12/14/72	332	923
Copper Cloud Extension #14	12/13/72	11/29/72	332	272
Copper Cloud Extension #15	11/28/72	12/14/72	332	924
Copper Cloud Extension #16	11/28/72	11/29/72	332	273
Copper Cloud Extension #18	11/28/72	11/29/72	332	274
Copper Cloud Extension #20	11/28/72	11/29/72	332	275

50

DONALD J. PODESTA
Mining and Petroleum Geologist
4747 NORTH 16TH STREET
PHOENIX, ARIZONA 85016

PHONE: (602) 277-7736

AFFIDAVIT

I, Donald J. Podesta, Registered Geologist No. 7785 in Arizona, do hereby certify that holes designated Location 1 and Location 2 (see accompanying Plat), were drilled and completed to depths of 100 feet and 60 feet respectively by the Unzicker and Wells Drilling Company of Kirkland, Arizona on December 14, 1972, at a cost of $1080.00 to comply with the required location work for the following lode claims located in Gila County, Arizona:

Name of Claim	Located	Recorded	Docket	Page
Copper Cloud #7	9-11-72	9-15-72	327	932
Copper Cloud #9	9-11-72	9-15-72	327	934
Copper Cloud #11	9-11-72	9-15-72	327	936
Copper Cloud #13	9-11-72	9-15-72	327	938
Copper Cloud #15	9-11-72	9-15-72	327	940
Copper Cloud Extension #7	11-27-72	11-29-72	332	268
Copper Cloud Extension #9	11-27-72	11-29-72	332	269
Copper Cloud Extension #11	11-28-72	11-29-72	332	270
Copper Cloud Extension #13	12-07-72	12-14-72	332	923
Copper Cloud Extension #15	12-07-72	12-14-72	332	924

In addition, holes designated as Location 3 and Location 4 (see accompanying Plat), were drilled and completed by the Unzicker and Wells Drilling Company of Kirkland, Arizona to depths of 110 feet and 40 feet respectively on December 15, 1972, at a cost of $1025.50 to comply with the required location work for the following lode claims also located in Gila County, Arizona:

Name of Claim	Located	Recorded	Docket	Page
Copper Cloud #8	9-11-72	9-15-72	327	933
Copper Cloud #10	9-11-72	9-15-72	327	935
Copper Cloud #12	9-11-72	9-15-72	327	937

DONALD J. PODESTA
Mining and Petroleum Geologist
4747 NORTH 16TH STREET
PHOENIX, ARIZONA 85016

PHONE: (602) 277-7736

Name of Claim	Located	Recorded	Docket	Page
Copper Cloud #14	9-11-72	9-15-72	327	939
Copper Cloud #16	9-11-72	9-15-72	327	941
Copper Cloud Extension #8	12-07-72	12-14-72	332	921
Copper Cloud Extension #10	12-07-72	12-14-72	332	923
Copper Cloud Extension #12	11-28-72	11-29-72	332	271
Copper Cloud Extension #14	11-28-72	11-29-72	332	272
Copper Cloud Extension #16	11-28-72	11-29-72	332	273

All of the 20 above listed claims have been posted with 4" x 4" wooden posts or rock monuments in compliance with the Mining Regulations of the State of Arizona within the prescribed 90 day limitation from the date of location and the drill holes have been capped and a 4" x 4" wooden post placed at each location with notices as attached securely fixed to each post.

Dated: January 5, 1973

Donald J. Podesta

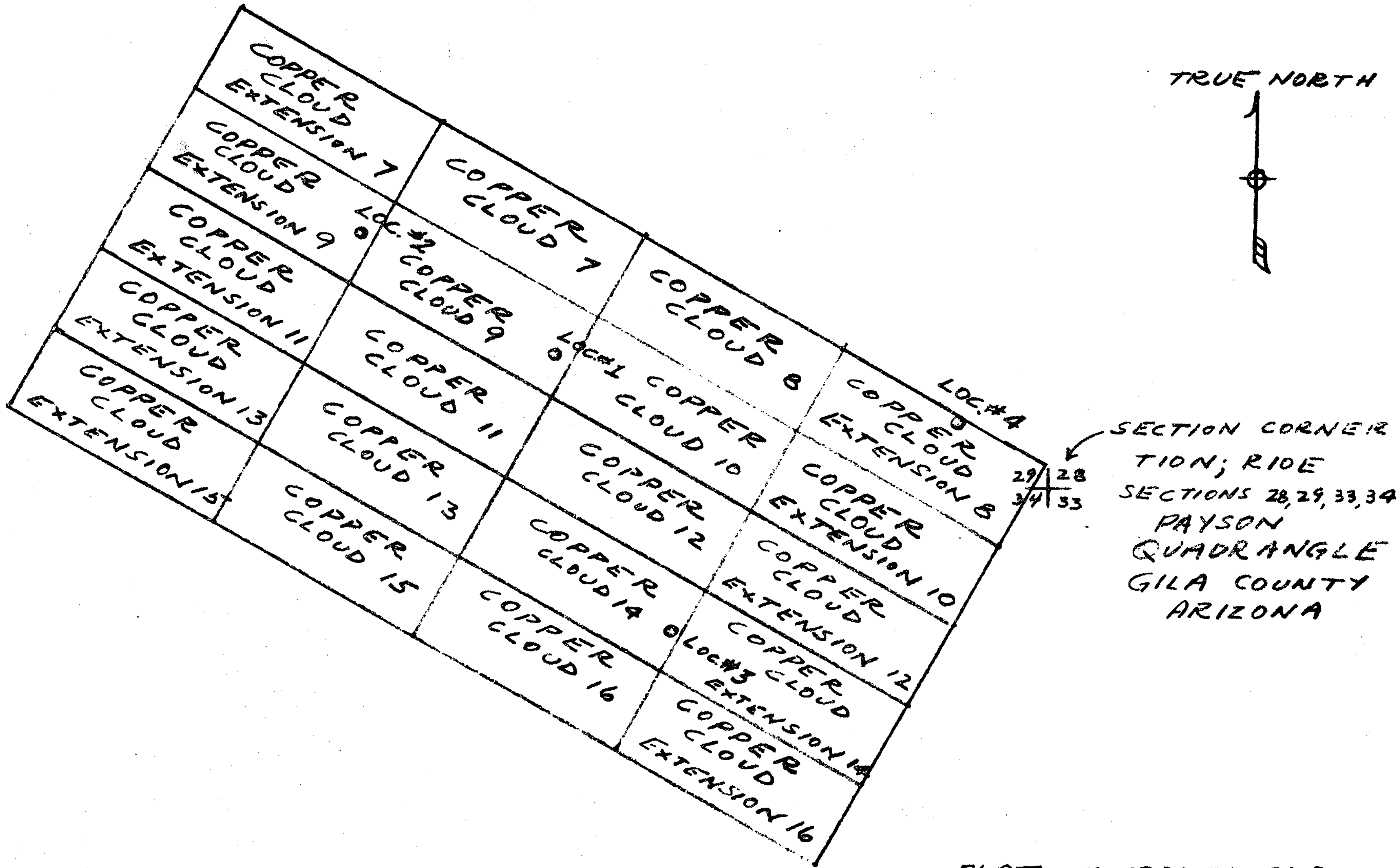
REGISTERED GEOLOGIST CERTIFICATE No. DONALD J. PODESTA Date Signed 1/5/73 ARIZONA, U.S.A.

STATE OF ARIZONA)
)ss.
County of Maricopa)

Subscribed and sworn to before me this 5th day of January, 1973.

My Commission Expires:
My Commission Expires Mar. 4, 1975

C. Patricia Parsons
Notary Public



PLAT OF COPPER CLOUD
CLAIMS SHOWING HOLES
DRILLED FOR LOCATION
WORK DEC. 14-15, 1972

0 500' 1000'

REGISTERED GEOLOGIST
CERTIFICATE NO.
7785
DONALD
ARIZONA

Donald Podesta
1/5/73

UNZICKER & WELLS DRILLING CO.

P. O. BOX 77

KIRKLAND, ARIZONA 86332

DAILY DRILL REPORT

Date DEC. 14, 1972 Shift

Client PONDEROSA MINING CO. (COPPER CLOUD)

	DEPTH	HOURS	HOLE NUMBER	DEPTH
Drilled With Tri-Cone Bit			No. 2	60'
Drilled With ~~Drag Bit~~ TRI-CONE			No. 1	100'
Drilled With Down Hole Hammer				
Cored				
Move Time				
Standby Time				
TOTAL				160'

BITS	MAKE	SIZE	SERIAL NO.	TYPE	FOOTAGE
Bit No.	W-M	5 1/8		H-1	160'
Bit No.					
Bit No.					
Bit No.					

Driller FRED MOORE

Helper MARK STEWART

Verified E. A. Unzicker / Donald J Podesta

(18)

UNZICKER & WELLS DRILLING CO.

P. O. BOX 77

KIRKLAND, ARIZONA 86332

DAILY DRILL REPORT

Date DEC. 15, 1972 Shift

Client PONDEROSA MINING CO. (COPPER CLOUD)

	DEPTH	HOURS	HOLE NUMBER	DEPTH
Drilled With Tri-Cone Bit			No. 3	110'
Drilled With ~~Drag Bit~~ TRICONE			No. 4	40'
Drilled With Down Hole Hammer				
Cored				
Move Time				
Standby Time				
TOTAL				150'

BITS	MAKE	SIZE	SERIAL NO.	TYPE	FOOTAGE
Bit No.	W-M	5 1/8		H-1	150'
Bit No.					
Bit No.					
Bit No.					

Driller FRED MOORE

Helper MARK STEWART

Verified E. A. Unzicker / Donald J Podesta

(18)

LOCATION 1 DRILLED 12/14/1972

LOCATED ON CLAIM COPPER CLOUD #9

DEPTH 100 ft

SIZE HOLE 5 1/8" 0-75 ft

4 3/4" 75-100 ft.

NAME OF LOCATOR - RAYMOND F. LE ROY JR.

FOR COPPER CLOUD MINING CO.

THIS HOLE IN CONJUNCTION WITH LOCATION 2 DRILLED ON CLAIM COPPER CLOUD EXTENSION 9 IS CLAIMED FOR LOCATION WORK ON THE FOLLOWING CONTIGUOUS CLAIMS:

COPPER CLOUD # 7
" " # 9 (9)
" " # 11
" " # 13
" " # 15

COPPER CLOUD EXTENSION # 7
" " " # 9
" " " # 11
" " " # 13
" " " # 15

REGISTERED GEOLOGIST
CERTIFICATE NO.
7785
DONALD ACESTA
Date Signed 1/5/73
ARIZONA, U.S.A.

[signature] Acesta

LOCATION 2 DRILLED 12/14/72

LOCATED ON CLAIM COPPER CLOUD EXTENSION 9

DEPTH 60 ft.

SIZE HOLE 5 1/8" 0-60 ft.

NAME OF LOCATOR THOMAS SACCUCI
FOR COPPER CLOUD MINING CO.

THIS HOLE IN CONJUNCTION WITH LOCATION 1 DRILLED ON CLAIM COPPER CLOUD 9 IS CLAIMED AS LOCATION WORK ON THE FOLLOWING CONTIGUOUS CLAIMS

COPPER	CLOUD	#7
"	"	#9
"	"	#11
"	"	#13
"	"	#15

COPPER	CLOUD	EXTENSION	#7
"	"	"	#9
"	"	"	#13
"	"	"	#11
"	"	"	#15

REGISTERED GEO[illegible] CERTIFICATE 77[illegible]

Donald J. Podesta
1/5/73

LOCATION 3 DRILLED 12/15/1972

LOCATED ON CLAIM COPPER CLOUD EXTENSION 14

DEPTH 110 ft.

SIZE HOLE 5 1/8" 0-110 ft

NAME OF LOCATOR THOMAS SACCUCI

FOR COPPER CLOUD MINING CO.

THIS HOLE IN CONJUNCTION WITH LOCATION 4 DRILLED ON COPPER CLOUD EXTENSION 8 IS CLAIMED AS LOCATION WORK ON THE FOLLOWING CONTIGUOUS CLAIMS:

COPPER	CLOUD		# 8
"	"		# 10
"	"		# 14
"	"		# 12
"	"		# 16
COPPER	CLOUD	EXTENSION	# 8
"	"	"	# 10
"	"	"	# 12
"	"	"	# 14
"	"	"	# 16

Donald J Podesta
1/5/73

LOCATION 4 DRILLED 12/15/1972

LOCATED ON CLAIM COPPER CLOUD EXTENSION 8

SIZE HOLE 5 1/8" 0 - 40 ft

DEPTH 40 ft

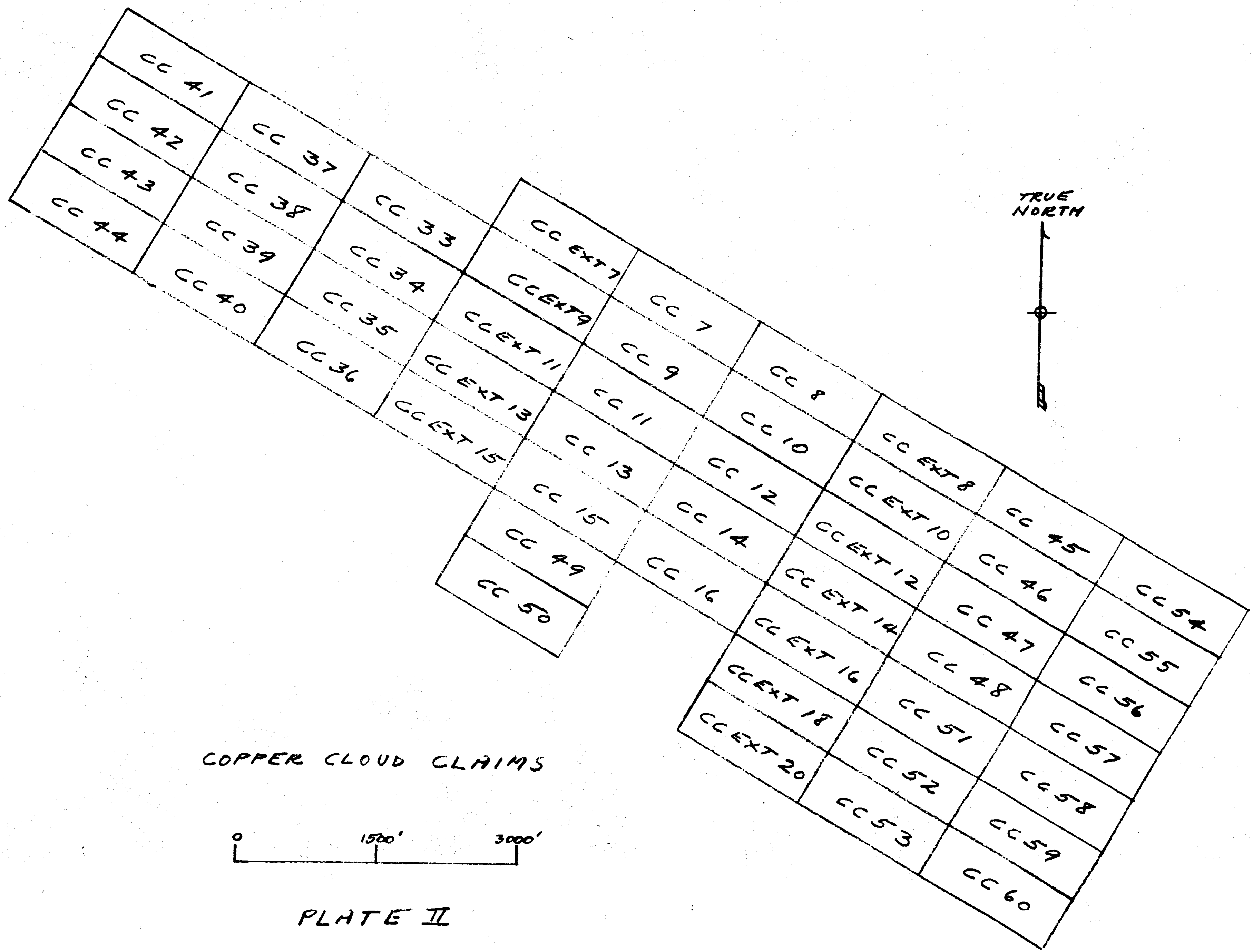
NAME OF LOCATOR THOMAS SACCUCI
FOR COPPER CLOUD MINING CO.

THIS HOLE IN CONJUNCTION WITH LOCATION 3 DRILLED ON COPPER CLOUD EXTENSION 14 IS CLAIMED AS LOCATION WORK ON THE FOLLOWING CONTIGUOUS CLAIMS:

COPPER CLOUD # 8
10
12
14
16

COPPER CLOUD EXTENSION # 8
" " " # 10
" " " # 12
" " " # 14
" " " # 16

Donald J Podesta
1/5/73



COPPER CLOUD CLAIMS

PLATE II

D REGIONAL GEOLOGY OF THE AREA

The following report "Gold and Copper Deposits near Payson, Arizona" by E. D. Wilson, Arizona Bureau of Mines Bulletin 120 is included to provide an understanding of the regional geology of the area.

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.

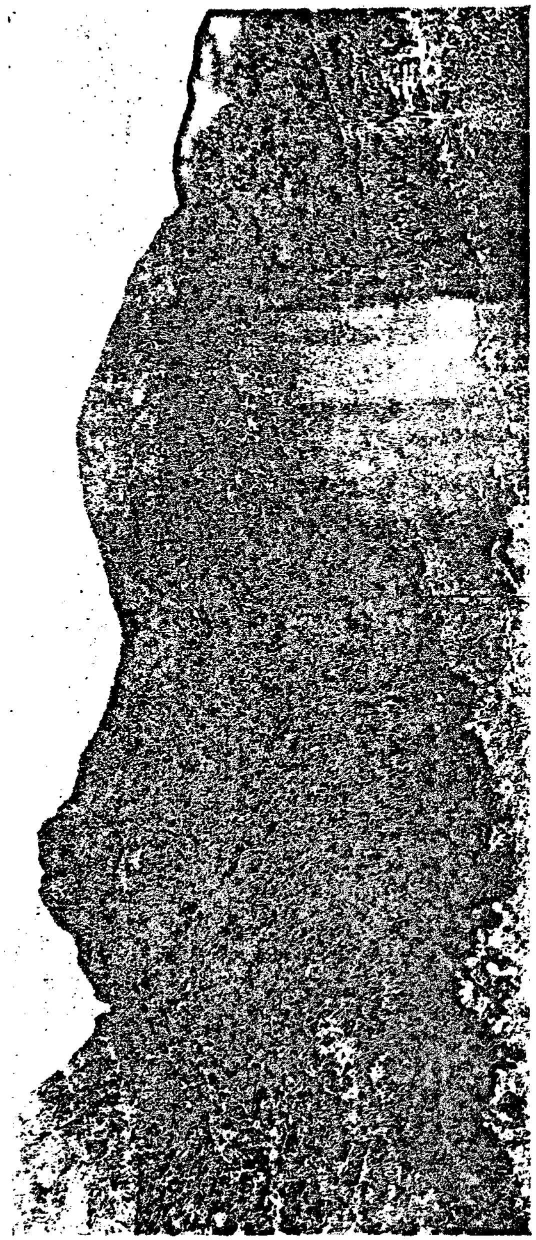


Plate II.—Panoramic view of the north end of the Mazatzal Mountains.

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.

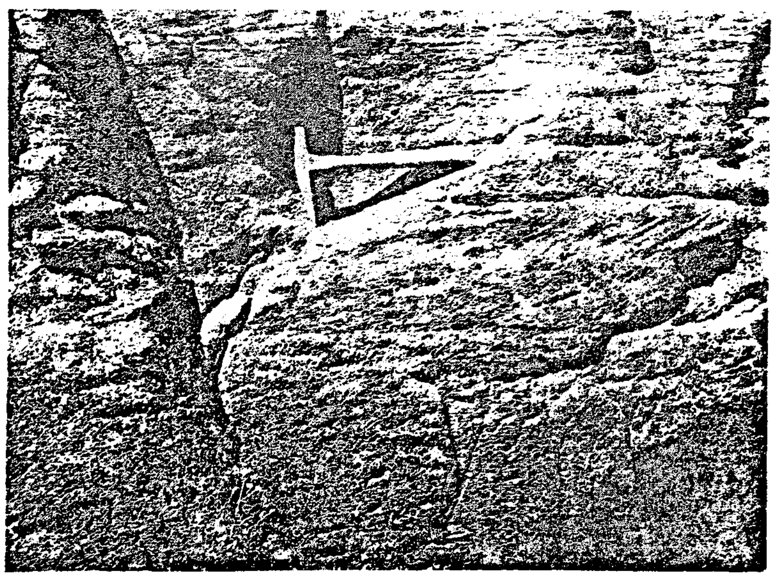


Plate III. B.—Sycamore Creek sandstone showing details of stratification.

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.

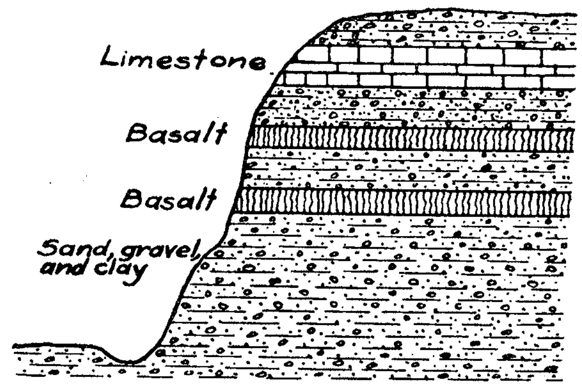


Fig. 2.—Section of Tertiary sediments on the East Verde River showing two flows of basalt intercalated in the conglomerate.

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.

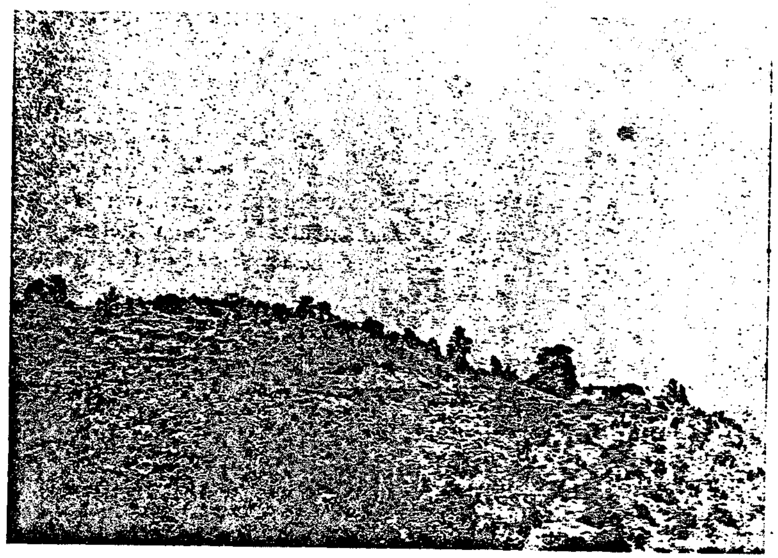


Plate IV. A.—Tertiary sediments southwest of Payson.

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 ($Cu_8Sb_2S_7$): 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 ($CuCO_3.Cu(OH)_2$): 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 between 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 ($Ca_3Fe_2\ (SiO_4)_3$, *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

[illegible] deposits in which copper is the most important constituent con-[illegible] lenticular masses of tetrahedrite in greenstone; disseminations [illegible]copyrite and bornite in greenstone; and disseminated pyrite, [illegible]yrite, and chalcocite in schist and along basic dikes.

[illegible] deposit containing tetrahedrite is in the foothills of the Mazatzal [illegible]ains, 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.

* 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.

E GEOLOGY OF THE CLAIM AREA

ROCKS ENCOUNTERED

Plutonic, medium to coarsely crystalline granodiorite to diorite outcrops over much of the area. It is usually black and white speckled, giving an overall tone of light gray which upon weathering becomes soft and crumbly and changes to a brownish shade due to alteration of the iron from the ferromags to limonite. Occasionally, pink feldspars, orthoclase or microcline, are plentiful enough to give the rock a pink and black color and these outcrops probably should be classed as a true granite. The granite-granodiorite appears to be the oldest rock on the claims and, according to Wilson, is of pre-Cambrian age.

Thin intrusions of a crypto- crystalline, hard, light to apple green, silicic "greenstone" cut the granodiorite and appear to be a mixture of epidote and chlorite. Occasional veinlets ¼" to ½" of epidote occur throughout the area. The "Greenstone" and epidote are also classified as pre-Cambrian.

Dark greenish gray to black, hard, andesite dikes which weather to a very soft light tan and dark, chocolate brown also intrude the granodiorite. In places the andesite becomes less aphanitic and small crystals of pink and white feldspars and greenish black hornblende are visible. This change in texture is attributed to magmatic segregation and slower cooling rates for certain portions of the dikes. Occasional blocks and large sections of granodiorite occur within the dikes and are either due to having been caught up in the intrusive andesite or represent "braiding" of the dike. Contacts between the dikes and the granodiorite are sharp and show only very minor contact metamorphism of the granodiorite. Although obviously younger than the granodiorite, the age of the andesite has not been definitely established. It may be pre-Cambrian as suggested by Wilson, or even as late as Tertiary to Quaternary.

STRUCTURE

The aerial photograph with overlay (PLATE III) clearly portrays the major N60°W trending dike with subsidiary N20°W and N50°E trends. It is not known whether these various trends represent separate systems with different ages or are all the same system. Drainage patterns indicate faulting throughout the area and several of these faults are shown striking haphazardly from N40°E to N40°W. Some of these (not on this photo) cause off-setting of the east-west dike so are definitely later, but others are difficult to date as off-setting is not obvious.

MINERALIZATION

Copper mineralization, except for one narrow rhyolite dike in the eastern tier of claims, is confined solely to the andesite dikes and occasionally in the 2" to 4" zone of contact metamorphism along their edges. It is not restricted to the major N60°W trend, as it occurs also on the other trends. Also, to the north of the claim area, relatively narrow northwest striking dikes exhibit copper oxide mineralization.

Malachite and chrysocolla are the principle oxide minerals and outcrop throughout the claims. Traces of turquoise are evident and one or two specimens showed a green copper mineral which might be either antlerite or brochantite. Small erratically distributed brick red spots of cuprite are also present.

The copper oxides occur mainly along fracture planes and in veinlets, alone and with sulphides, and at times surround grains of chalcopyrite. They are plainly of secondary origin derived from sulphides.

The sulphide copper is primarily chalcopyrite with associated bornite in places and some chalcocite. A shiny, soft, silvery mineral was observed but the grains were too small to make a definite determination. It may be molybdenite, galena or native silver. Pyrite is associated with the chalcopyrite as is limonite and hematite. A platy, dark brownish mineral, also too small to be identified, could be siderite or sphalerite.

The copper sulphides occur along thin, hairline $\frac{1}{4}$" to $\frac{1}{2}$" veinlets and also disseminated sporadically throughout the andesite. It is believed that the chalcopyrite is primary as is possibly some or all of the chalcocite.

The sulphide mineralization, in general, appears more plentiful in the eastern portion of the claim area but it is also present in some of the samples from the central portion.


5-16-57
ESA 3-209

F - SAMPLING - ECONOMICS

F SAMPLING

METHOD

A total of 29 chip samples (PLATE IV) were taken of outcrops containing visible copper mineralization. 23 of these were within the claim limits and 3 (Nos. 1, 6 and 7) were located about 1500 feet north from a relatively narrow northwest trending dike. One sample (No. 31) was taken of vein material from the old Delaware mine; one (No. 32) from the Sylvan mine stock-pile east of the claim area; and one from a cut on highway 87 also east of the claims. As evident from PLATE IV the sample locations are primarily clustered around the claim boundaries. This is because the majority of them were taken at the same time the claims were being surveyed. There is little doubt that when the dikes are walked many more copper bearing outcrops will be found.

The following tabulation lists the samples taken with the assay results and the lithologic descriptions:

No.	% Cu	Sample Description
CC-1	0.70	Dk. gry. andesite. Brnsh limonite on fracture planes. Occas. milky qtz. Little malachite and chrysocolla.
CC-2	0.90	Dk. gry. andesite. Much dk. red limonite along fracture planes. Little malachite and chrysocolla.
CC-3	0.60	Dk. gry. andesite. Some brn. limonite. Little malachite and chrysocolla.
CC-4	19.60	Dk. red andesite. Much red limonite. Considerable malachite and chrysocolla.
CC-5	9.20	Same as above
CC-6	1.90	Light grnsh. buff alt. andesite. Much brn. limonite. Some malachite and chrysocolla.

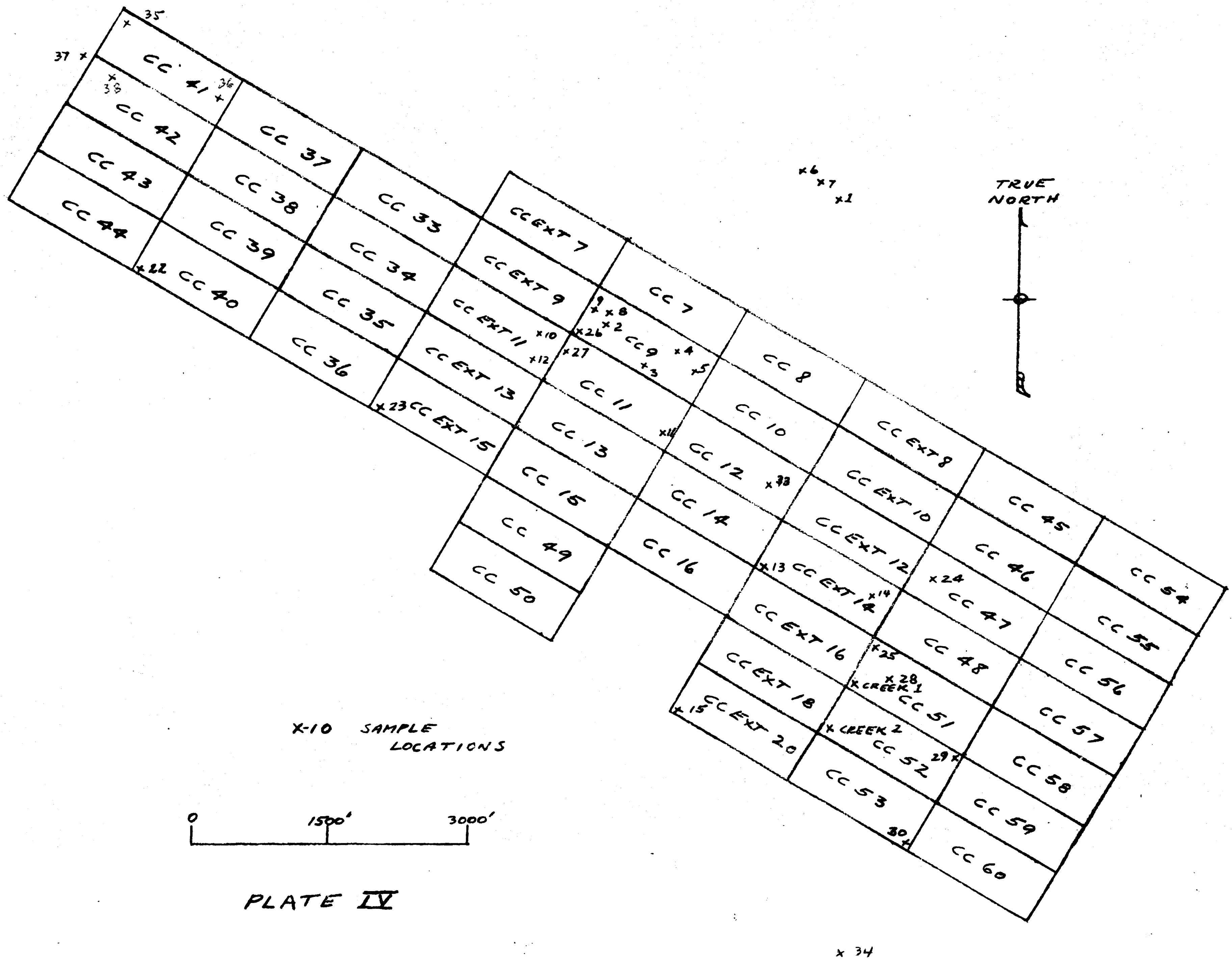
No.	% Cu	Sample Description
CC-7	0.50	Dk. gry. andesite. Some brn limonite. Little malachite.
CC-8	0.65	Dk. gry. andesite. Some chrysocolla, little malachite.
CC-9	0.85	Same as above.
CC-10	0.35	Dk. gry. andesite. Little malachite and traces diss. chalcopyrite and possibly little cuprite.
CC-11	0.75	Dk. gry. andesite. Little malachite and chrysocolla.
CC-12	0.55	Dk. gry. andesite. Little malachite and diss. chalcopyrite.
CC-13	0.80	Dk. gry. andesite. Little chalcocite and possibly cuprite.
CC-14	0.65	Dk. gry. andesite. Little chalcopyrite and bornite.
CC-15	1.60	Dk. gry. andesite. Some malachite, chrysocolla, and poss. cuprite.
CC-22	0.40	Dk. gry. andesite. Little malachite, chrysocolla, and poss. cuprite.
CC-23	0.25	Same as above.
CC-24	2.10	Dk. gry. andesite. Some malachite and chrysocolla.
CC-25	2.60	Light pink rhyolite. Some malachite, chrysocolla and turquoise.
CC-26	0.85	Dk. gry. andesite. Little malachite and chrysocolla.
CC-27	0.30	Dk. gry. andesite. Little malachite and chrysocolla.
CC-28	0.45	Dk. gry. andesite. Little malachite and chrysocolla. Traces diss. chalcopyrite.

G - ECONOMICS

No.	% Cu	Sample Description
CC-29	4.90	Dk. gry. andesite. Some malachite, chrysocolla, diss. chalcopyrite. Silver to gray, soft, shiny metallic specks. Molybdenite? Galena? Silver?
CC-30	0.90	Dk. gry. andesite. Little malachite. diss. chalcopyrite and traces of torquoise. Brnsh. to pplsh. black mineral. Sphalerite? Siderite?
CREEK-1	0.30	Dk. gry. andesite. Veinlets and diss. chalcopyrite.
CREEK-2	0.75	Dk. gry. andesite. Little malachite and chrysocolla.
Hiway-1	1.25	Dk. gry. andesite. 1/8"-1/4" veinlet of pyrite, chalcopyrite and limonite.
Sylvan Mine	0.70	Dk. gry. andesite. Little diss. chalcopyrite and some limonite. Soft, shinny, silvery mineral. Galena? Molybdenite? Silver?
Delaware* Mine	0.70	Qtz. vein material. Limonite, chalcopyrite, malachite, chrysocolla.

*Also ran 1.30 oz. gold and 1.30 oz. silver

G - ECONOMICS



X-10 SAMPLE LOCATIONS

PLATE IV

G ECONOMICS

Until the ore body has been finally delineated as to size, shape, grade and depth to plan efficient mining operations and plant size, and pilot tests run to determine the most favorable extraction process, meaningful economic studies can not be made. However, using generalized industry average figures for open pit mining operations a global idea of economics follows:

<u>PARAMETERS ASSUMED</u>

Length of ore body	13,500 feet
Average width	400 feet
Average thickness	500 feet
Weight per cu. ft.	160 lbs.
Possible ore reserves	200,000,000 Tons
Average grade	0.70% copper
Recovery factor	85%-12 lbs/Ton
Price of copper	$0.53 lb.
Value per ton	6.46 Ton
Operating costs	
Mining	$0.75 Ton
Crushing and grinding	1.50 Ton
Extraction	1.75 Ton

Calculations based on these numbers show a profit of $2.46 per ton of ore for a total profit for the life of the mine of $492,000,000 excluding development and plant costs, royalty payments, taxes and depletion allowance.

UP-DATED ECONOMICS

OF

COPPER CLOUD MINING PROPERTY

PARAMETERS ASSUMED

Length of ore body	13,500 feet
Average width	400 feet
Average thickness	500 feet
Weight per cu. ft.	160 lbs.
Possible ore reserves	200,000,000 tons
Average grade copper (est.)	.70%
Recovery factor copper	85% - 12 lbs/ton
Price of copper	$0.60 lb.
Average grade gold (est.)	0.01 oz/ton
Price of gold	$100.00 oz.
Average grade silver (est.)	0.50 oz/ton
Price of silver	$2.00 oz.
Value - copper	$7.20 ton
Value - gold	1.00 ton
Value - silver	1.00 ton
Total value per ton ore	$9.20 ton

Operating costs

Mining	$0.75 ton
Crushing and grinding	$1.50 ton
Extraction	$1.75 ton
Total cost	$4.00 ton

Calculations based on these numbers show a profit of $5.20 per ton of ore for a total net profit over the life of the mine of approximately $1,000,000,000 (one billion) excluding development and plant costs, royalty payments, taxes and depletion allowance.

H CONCLUSIONS

The extent and grade of the mineralization, plus the potential of exceedingly large reserves warrant further exploration of the property.

RECOMMENDATIONS

1) Obtain new aerial photographic coverage and construct a 10 foot interval contour map of the area.

2) Map the surface geology of the area in detail.

3) Perform an IP survey of the property.

4) Drill at least 20 exploratory holes to depths of 500 ft.

5) Deepen at least 4 of the more promising holes until mineralization is bottomed but no less than 1500 ft.

REGISTERED GEOLOGIST CERTIFICATE
ARIZONA
Date Signed 1/12/73