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12/05/88

PREPARED BY: DIETZ AND ASSOCIATES, 4706 N. 31ST DRIVE
PHOENIX, AZ. 85017 PHONE (602)841-1744

PRIMARY NAME: HOOSIER GROUP

ALTERNATE NAMES:

PINAL COUNTY MILS NUMBER: 378C

LOCATION: TOWNSHIP 5 S RANGE 16 E SECTION 4 QUARTER W2
LATITUDE: N 33DEG 01MIN 32SEC LONGITUDE: W 110DEG 43MIN 22SEC
TOPO MAP NAME: CHRISTMAS - 7.5 MIN

CURRENT STATUS: PAST PRODUCER

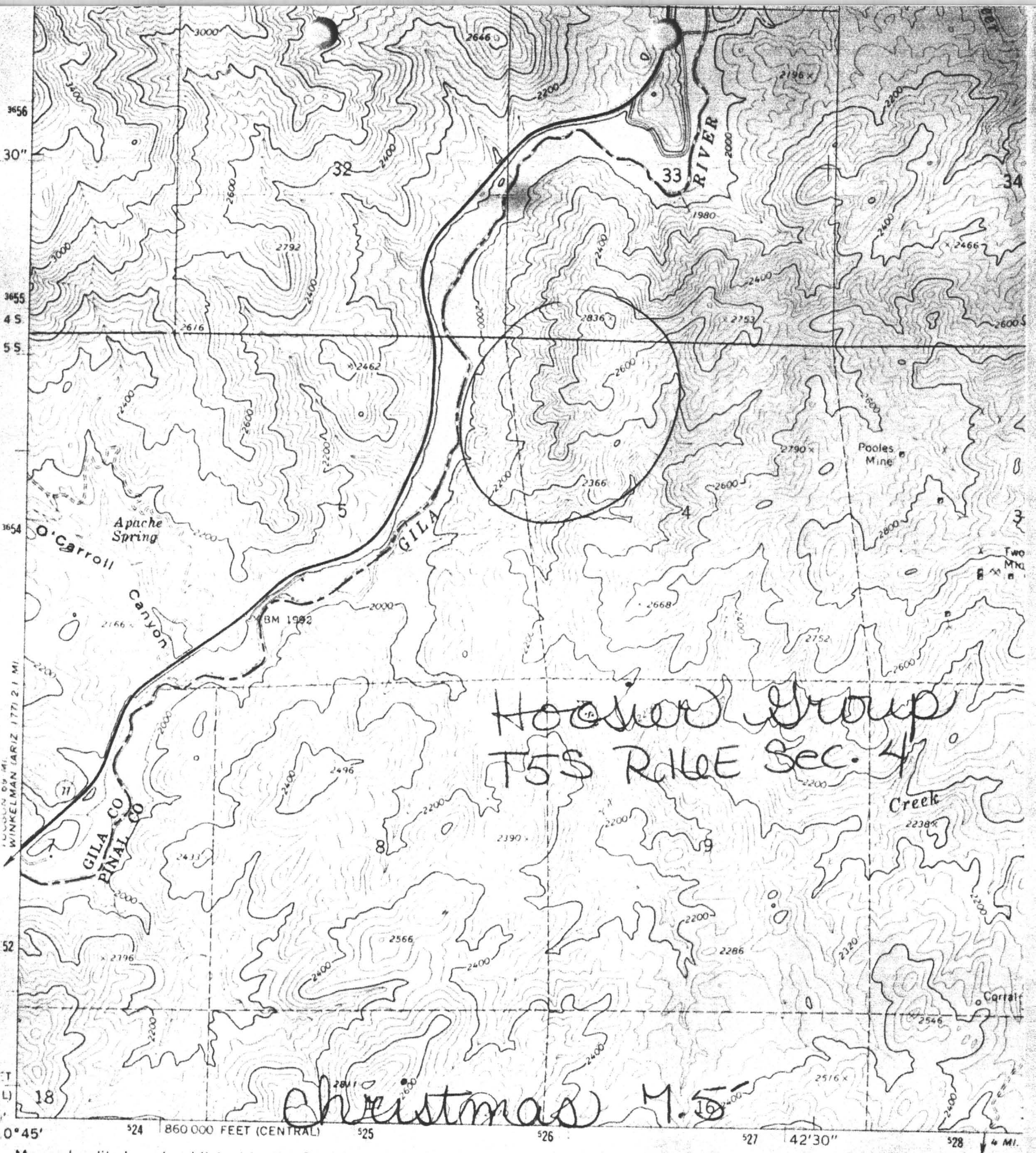
COMMODITY:
- GOLD
- SILVER
- COPPER

BIBLIOGRAPHY:

ADMMR HOOSIER GROUP FILE

ROSS, CLYDE P., ORE DEPOSITS OF THE SADDLE MTN AND BANNER MINING DISTRICTS, AZ., USGS 771, 1925, P. 50-51

USGS PP 450-D, P. 1-5

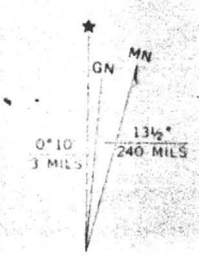


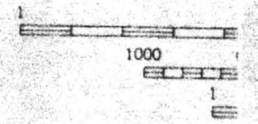
Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography by photogrammetric methods from aerial photographs taken 1967. Field checked 1968

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





NOOSIER GRP

*GENERAL REFERENCES

REFERENCE 1 F1 <USBM-ABGMT PRO(TION FILE DATA (

REFERENCE 2 F2 <USBM FILE DATA - CLUSTER #684

REFERENCE 3 F3 <ROSS, C.P. 1925, ORE DEPOSITS OF THE SADDLE MOUNTAIN AND BANNER MINING DISTRICTS, ARIZONA, USGS BULL. 771, P.50-51.

REFERENCE 4 F4 <CREASEY, S.C. AND KISTLER, R.W., 1962, USGS PP 450-D, P. D1-D5.

F5 <USGS BULL 1161-E, 1964>

N5 <STRIKES NW, DIPS 10 NE>

Mils 378C

U.S. CRIB-SITE FORM

RECORD IDENTIFICATION

*RECORD NUMBER B10 <> *RECORD TYPE B20 <X1M> DEPOSIT NUMBER B40 <

*REPORT DATE G1 <82 03> (YR. MO) *INFORMATION SOURCE B30 <12> *FILE LINK IDENT B50 <USBM-0040210533

*REPORTER(SUPERVISOR) G2 <LARABA, PETER (last, first, middle initial) (GEST DON (last, first, middle initial));

*REPORTER AFFILIATION G5 <ABGMT> SITE NAME A10 <HOOSIER MINE

*SYNONYMS A11 <

LOCATION

*MINING DISTRICT/AREA A30 <SADDLE MOUNTAIN DISTRICT>

*COUNTY A60 <PINAL> *STATE A50 <AZ> *COUNTRY A40 <U.S.>

PHYSIOGRAPHIC PROV A63 <12>

DRAINAGE AREA A62 <15050100> LAND STATUS A64 <49 (1978)>

QUADRANGLE NAME A90 <CHRISTMAS (1968)> QUADRANGLE SCALE A100 <24000>

SECOND QUAD NAME A92 <( )> SECOND QUAD SCALE A91 <>

ELEVATION A107 <2400 FT>

UTM

NORTHING A120 <3654400>

EASTING A130 <526200>

ZONE NUMBER A110 <+12>

ACCURACY

ACCURATE ACC (circle)

ESTIMATED (EST) <TO CENTER OF NW 1/4 SECTION 4.>

GEODETIC

LATITUDE A70 < - - N>

LONGITUDE A80 < - - W>

CADASTRAL

TOWNSHIP(S) A77 <005S> RANGE(S) A78 <016E>

SECTION(S) A79 <4

SECTION FRACTION(S) A76 <NW

MERIDIAN(S) A81 <GILA AND SALT RIVER>

POSITION FROM NEAREST PROMINENT LOCALITY A82 <3.1 MILES SW OF LEE MOUNTAIN (ELV. 3786)

LOCATION COMMENTS A83 <

* ESSENTIAL INFORMATION
+ ESSENTIAL SOMETIMES OR HIGHLY RECOMMENDED

COMMODITY INFORMATION

*COMMODITIES PRESENT C10 < CU, AG
*ORE MINERALS C30 < CHLORITE, MAGNETITE, SPECULARITE, PYRITE. BORNITE, CHALCOPYRITE IN NEARBY ADJUST MINE
COMMODITY SUBTYPES C41 <
GEN. ANALYTICAL DATA C43 <
COM. INFO. COMMENTS C50 <

* SIGNIFICANCE

PRODUCER		NON-PRODUCER	
MAJOR PRODUCTS MAJOR	AU	MAIN COMMODITIES PRESENT C11	
MINOR PRODUCTS MINOR	AG, CU	MINOR COMMODITIES PRESENT C12	
POTENTIAL PRODUCTS POTEN			
OCCURRENCES OCCUR		OCCURRENCES OCCUR	

*PRODUCTION

PRODUCER: PRODUCTION (YES) (circle) PRODUCTION SIZE (SML) MED LGE (circle one)

NON-PRODUCER: PRODUCTION UND NO (circle one)

EXPLORATION OR DEVELOPMENT

*STATUS

PRODUCER: STATUS AND ACTIVITY A20 < H >

NON-PRODUCER: STATUS AND ACTIVITY A20 < >

*DISCOVERER L20 <
*YEAR OF DISCOVERY L10 < > *NATURE OF DISCOVERY L30 < B > *YEAR OF FIRST PRODUCTION L40 < 1913 > *YEAR OF LAST PRODUCTION L45 < 1938
*PRESENT/LAST OWNER A12 < J. MILES AND C.H. CROZIER (1925)
*PRESENT/LAST OPERATOR A13 < J. MILES, CROZIER AND CORDOZA, J. VAPPOS, F.D SMITH (1930)
*EXPL./DEV. COMMENTS L110 < EIGHT UNPATENTED CLAIMS

DESCRIPTION OF DEPOSIT

*DEPOSIT TYPE(S) C40 < VEIN / SHEAR ZONE
DEPOSIT FORM/SHAPE M10 < TABULAR
*DEPTH TO TOP M20 < > *UNITS M21 < > *MAXIMUM LENGTH M40 < 200 > *UNITS M41 < FT
*DEPTH TO BOTTOM M30 < > *UNITS M31 < > *MAXIMUM WIDTH M50 < 20 > *UNITS M51 < FT
*DEPOSIT SIZE M15 (SMALL) M15 < MEDIUM > M15 < LARGE > (circle one) *MAXIMUM THICKNESS M60 < > *UNITS M61 <
*STRIKE M70 < N65E > *DIP M80 < 80+
*DIRECTION OF PLUNGE M100 < > *PLUNGE M90 <
*DEP. DESC. COMMENTS M110 < ORE IS FOUND IN A MINERALIZED ZONE WITHIN A FAULT ZONE THAT STRIKES N75E AND DIPS 80S. >

DESCRIPTION OF WORKINGS

*Workings are: SURFACE M120 UNDERGROUND M130 BOTH M140 (circle one) *OVERALL LENGTH M190 < > *UNITS M191 <
*DEPTH BELOW SURFACE M160 < > *UNITS M161 < > *OVERALL WIDTH M200 < > *UNITS M201 <
*LENGTH OF WORKINGS M170 < > *UNITS M171 < > *OVERALL AREA M210 < > *UNITS M211 <
DESC. OF WORK. COM. M220 < 4 TO 5 SHALLOW SHAFTS AND TWO SHORT TUNNELS.

GEOLOGY

*AGE OF HOST ROCK(S) K1 < CRET - PALEO. ALSO SMALL BLOCK OF CARB TORNADO LIMESTONE
*HOST ROCK TYPE(S) K1A < ANDESITE
*AGE OF IGNEOUS ROCK(S) K2 < CRET - PALEO, 63 MY - QUARTZ DIORITE, CREASEY AND KISTLER, 1962
*IGNEOUS ROCK TYPE(S) K2A < ANDESITE, QUARTZ DIORITE
*AGE OF MINERALIZATION K3 < PALEO
*PERT. MINERALS (NOT ORE) K4 < QUARTZ, LIMONITE, BARITE, CALCITE
*ORE CONTROL/LOCUS K5 < IN BRECCIATED ZONES
*MAJ. REG. TRENDS/STRUCT. N6 < NE TRENDING QUARTZ MONZONITE AND HORNBLENDE ANDESITE INTRUSIONS, ANDESITE
*TECTONIC SETTING N15 <
*SIGNIFICANT LOCAL STRUCT. N70 < FAULT - STRIKES N75E AND DIPS 80S
*SIGNIFICANT ALTERATION N75 < LIMESTONE REPLACED BY QUARTZ, CHLORITE, MAGNETITE, SPECULARITE, PYRITE
*PROCESS OF CONC./ENRICH. N80 <
*FORMATION AGE N30 <
*FORMATION NAME N30A <
SECOND FM AGE N35 <
SECOND FM NAME N35A <
*IGNEOUS UNIT AGE N50 <
*IGNEOUS UNIT NAME N50A <
SECOND IG. UNIT AGE N55 <
SECOND IG. UNIT NAME N55A <
GEOLOGY COMMENTS N85 < RELATED IN AGE AND TYPE OF MINERALIZATION TO CHRISTMAS MINE, 3 MILES NW IN GILA COUNTY.

GENERAL COMMENTS

GENERAL COMMENTS GEN <

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Date November 17, 1939.

Mine Hoosier Group

Engineer Newton Wolcott

District Saddle Mountain Mining District

Location 5 Miles North of Winkelman

Former name

Owner J. H. Miles

Address Winkelman, Arizona.

Operator

Address

President

Gen. Mgr.

Mine Supt.

Mill Supt.

Principal Metals Gold, silver, copper

Men Employed 6 Leasers

Production Rate No established rate.

Mill: Type & Cap.

Power: Amt. & Type

Operations: Present

Two groups of leasers mining and shipping ore.

Operations Planned

Deeper development work when able to finance.

Number Claims, Title, etc.

Nine unpatented claims.

Description: Topog. & Geog.

Very steep and fairly high hills along the Gila River to the north of the town of Winkelman. Vegetation very scanty except along river bottom.

Mine Workings: Amt. & Condition

One shaft approximately 90 feet in depth.
" " " 50 " " ".
" " " 15 " " "

Over 1600 feet of drifts and tunnels, as well as various shallow surface cuts. Practically all the workings are open.

(over)

Geology & Mineralization

This property shows two distinct types of ore deposits; one being irregular replacements along a contact between diorite and large included blocks of limestone, and the other made along fissure veins in the diorite. These deposits vary in width from a few inches to more than four feet, the fissure veins being as a rule the smaller of the two types. Vein minerals consist of quartz, limonite, specularite, pyrite and a little chalcopyrite. The gold and silver are associated with the sulphides, and the shallow depth of oxidation does not seem to have resulted in extensive enrichment. The sulphides themselves usually carry enough values to permit of direct shipment to the smelter.

Ore: Positive & Probable, Ore Dumps, Tailings

A small amount of ore is contained in various dumps, but the quantity is not great, and the grade is not known. Development is insufficient to permit any estimate of tonnage.

Mine, Mill Equipment & Flow Sheet

Leasers have rigged up a light jig-back tramway to drop their ore down to the truck loading point. There is no other mechanical equipment on the property.

Road Conditions, Route

The main workings lie only about a half-mile or less off State Highway 77. It is necessary however to ford the Gila River in this distance; and during any period of higher than normal water, it would be impossible to reach the property with truck or car.

Water Supply

Undeveloped on property, but the proximity of the river assures an ample quantity easily available.

Brief History

This property has been worked spasmodically over a period of a good many years, and considerable ore has been shipped from it. Old settlement sheets show that these shipments carried gold values of from 0.45 to 1 oz. ## in addition to varying amounts of silver and copper. Gold however, was the main value. The present owner netted over $1600 from small shipments made during 1938 and 39.

Special Problems, Reports Filed

The owner, as is usually the case, is unable to finance development work.

Remarks

This property is among those described in U.S.G.S. Bulletin No. 771

If property for sale: Price, terms and address to negotiate.

Property is for sale or lease. Communicate with owner for price and terms.

Signed ....

Use additional sheets if necessary. Separate sheets on each problem.

another inclined shaft. There are reported to be 600 feet of workings on the property.[a] At the prospect on Gila River there are several short tunnels and a shallow shaft. No work appears to have been done at either place for some time.

Character of the deposits.—The country rock at Pool's mine is a dark andesite. The deposit exposed in the cuts is a shear zone a few feet wide. The mineralized rock on the shaft dump is andesite in which chlorite, calcite, quartz, pyrite, and chalcopyrite have been introduced, cut by narrow stringers of quartz containing a little pyrite. The deposits were worked for copper and gold, but the ore found does not appear to have been of satisfactory grade. The shaft 1,500 feet farther east is at the contact between andesite and slate, both belonging to the Cretaceous bedded rocks. The slate is at the base of a considerable body of sedimentary beds which extends from the vicinity of the Two Queens mine through this place northward to Deer Creek. In the shaft is a zone of sheeted and brecciated altered andesite about 4 feet wide, with quartz stringers, calcite, and a little pyrite. The zone strikes N. 55° E. and dips steeply to the southeast. There is a small dike of quartz-mica diorite close to this shaft, and another just south of the shaft at the place marked "Pool's mine" on Plate I.

The prospect on Gila River is in a small fault block of Tornado limestone surrounded by Cretaceous andesitic strata and cut by a dike of hornblende porphyry 20 to 30 feet wide, with vertical dip, striking N. 20° E. The limestone dips gently northeast, and the andesitic strata above lie approximately parallel to the limestone beds. At one place on the contact is a mass of quartz-mica diorite cutting both andesite and limestone. The outcrop is so small that it could not be shown on Plate I. The west boundary of the limestone block appears to be a fault, the limestone being on the upthrown side.

On both sides of the hornblende porphyry dike the limestone shows irregular recrystallization and replacement with quartz, fluorite, pyrite, and chalcopyrite. The sulphides are partly oxidized to limonite, hematite, and a small amount of malachite. The porphyry is also in part altered and stained with limonite. The altered limestone exposed is small in amount. Locally the replacement spread out along bedding planes.

HOOSIER GROUP

Location.—The Hoosier group is on Sulphur Gulch in secs. 4 and 5, T. 5 S., R. 16 E. The principal workings are in the NW. ¼ sec. 4. Sulphur Gulch empties into Gila River about 1,000 feet above the mouth of Ash Creek and half a mile from the railroad siding of Finney.

[a] Weed, W. H., Mines Handbook, vol. 15, p. 219, 1922.

Property.—The Hoosier group comprises about eight unpatented claims owned by J. Miles and C. H. Crozier. About 1,500 feet from the mouth of Sulphur Gulch, in a side gulch, is a shaft on the vein. The same distance up the main gulch and some 50 feet vertically above it on the north side is another shaft, reported to be 48 feet deep, and a short tunnel. There are reported to be two or three shallow shafts on the vein between the two mentioned. In the main gulch a crosscut tunnel is being driven by Mr. Miles to intersect the vein exposed in the 48-foot shaft and the short tunnel. He has a tent house near the mouth of Sulphur Gulch.

Character of the deposits.—Most of the rock on this property is andesite of various types, including light-colored hornblende porphyry. At the shaft first mentioned above there is a small mass of Tornado limestone. (See Pl. I.) The block is bounded on the south by a slip that strikes N. 75° E. and dips 80° S. The shaft has been sunk on this slip, the rock along which is mineralized. The limestone block is about 200 feet long in a northwesterly direction and 100 feet wide. The southwest boundary appears also to be a fault with downthrow to the southwest. Beyond the limestone block to the northwest this fault is marked by a zone about 20 feet wide of fault breccia composed of hornblende porphyry, dark andesite, and limestone. The mineralized rock on the dump of the shaft here appears to be limestone almost completely replaced by quartz, chlorite, magnetite, specularite, and pyrite. The vein in the tunnel on the hillside 1,500 feet to the northeast is about 3 feet wide, stands nearly vertical, and strikes N. 65° E. The vein matter is thoroughly oxidized and consists essentially of limonite and quartz. In the lower part of the 48-foot shaft a small amount of pyrite is exposed in gangue consisting largely of chlorite and quartz. A little pyrite is exposed in the andesite in the tunnel below, but in May, 1923, the tunnel was not yet long enough to reach the vein exposed in the tunnel and shaft on the hillside above it.

RIEDER & BAILEY GROUP

Location.—The Rieder & Bailey group is on the south side of Ash Creek nearly a mile up the winding streamway from its mouth. The principal workings are in the NW. ¼ sec. 9, T. 5 S., R. 16 E.

Property.—This group comprises several unpatented claims, and Mr. Rieder has other claims covering much of the W. ½ sec. 5 and probably extending beyond. There are a number of workings in this area, but none are extensive. In May, 1922, Mr. Rieder was working on the south side of Ash Creek a short distance below the mouth of

SHORT PAPERS IN GEOLOGY, HYDROLOGY, AND TOPOGRAPHY, ARTICLES 120–179

GEOLOGIC STUDIES

ECONOMIC GEOLOGY

120. AGE OF SOME COPPER-BEARING PORPHYRIES AND OTHER IGNEOUS ROCKS IN SOUTHEASTERN ARIZONA

By S. C. Creasey and R. W. Kistler, Menlo Park, Calif.

Dating of the Mesozoic and early Cenozoic geologic events in southeastern Arizona is severely hampered by the scarcity of fossiliferous sedimentary rocks of these ages and by the isolation of individual mountain ranges. Isotopic age determinations, therefore, provide definite ages to replace permissive time intervals and aid in the correlation of geologic events from one range to another.

The K-Ar and Rb-Sr ages of biotites from some intrusive and extrusive rocks in southeastern Arizona are listed in table 120.1, and the location of the rocks sampled is shown on figure 120.1. Potassium was determined by flame photometer using lithium as an internal standard. Argon was extracted from the specimens using the technique described by Lipson (1958). Argon was analyzed with a Reynolds-type

Table 120.1.—*Analytical data and isotopic ages of biotites from Arizona*

K–Ar age determinations

No. on fig. 120.1	Rock	Location	K (weight percent) [1]	$K^{40}\times10^{-7}$ (moles per g)	$^*Ar^{40}\times10^{-11}$ (moles per g)	Ar^{40}/K^{40}	Age (m. y.)
1	Juniper Flat Granite [2]	Northern Mule Mountains, Warren district.	5. 49	1. 71	171. 0	0. 01	163
2	Intrusive rhyolite	Tombstone district	7. 44	2. 32	87. 0	. 00375	63
3	Schieffelin Granodiorite	do	3. 33	1. 04	44. 6	. 00429	72
4	Equigranular granodiorite	Pima district	7. 28	2. 27	81. 0	. 00357	60
5	Quartz monzonite porphyry	do	5. 98	1. 87	61. 5	. 00329	56
6	Rhyolite tuff	do	7. 16	2. 23	74. 7	. 00335	57
7	Andesite dikes	do	3. 87	1. 21	16. 9	. 0014	24
8	Lost Gulch Quartz Monzonite	Globe-Miami district	7. 24	2. 26	83. 6	. 0037	62
9	Schultze Granite	do	7. 32	2. 28	77. 7	. 00341	58
10	Vitrophyre (dacite ash flow)	do	5. 67	1. 77	20. 4	. 00115	20
11	Granite Mountain Porphyry	Mineral Creek district	6. 86	2. 14	79. 6	. 00372	63
12	Quartz diorite porphyry	Banner district	6. 49	2. 02	73. 9	. 00366	62
13	Copper Creek granodiorite	Bunker Hill district	6. 27	1. 96	78. 8	. 00402	68

Rb–Sr age determinations

No. on fig. 120.1	Rock	Location	Rb^{87} (ppm)	Normal Sr (ppm)	$^*Sr^{87}$ (ppm)	Sr^{87}/Rb^{87}	Age (m. y.)
	Juniper Flat Granite [2]	Warren district	384	22. 2	0. 994	0. 00259	176
	do [2]	do	388	21. 3	1. 017	. 00262	178

[1] Frank Walthall analyst.
[2] Same sample used for Rb–Sr and K–Ar age determinations.
*Radiogenic.
Decay constants:
K^{40}: $\lambda_e=0.584\times10^{-10}$ yr^{-1}, $\lambda_\beta=4.72\times10^{-10}$ yr^{-1}; $K^{40}=1.22\times10^{-4}$ g K^{40} per g K.
Rb^{87}: $\lambda=1.47\times10^{-11}$ yr^{-1}; $Rb^{87}=0.283$ g Rb^{87} per g Rb.

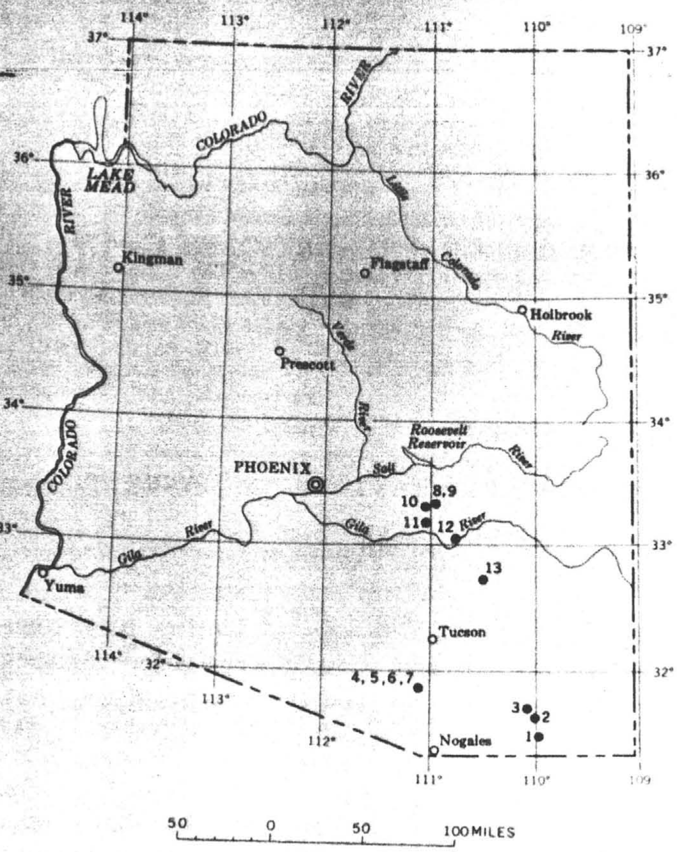


FIGURE 120.1.—Index map of Arizona showing location of igneous rocks sampled for the isotopic age determinations listed in table 120.1.

mass spectrometer by the geochronology group of the University of California, Berkeley. Rubidium and strontium were determined by isotope dilution techniques described by Goldich and others (1961, p. 8–35). The analytical determination of potassium and the mass spectrometric measurements of Ar, Rb, and Sr are accurate to about 2 percent. The probable error of an individual mineral age is about ±4 percent.

Most of the intrusive rocks are related spatially either to ore deposits or to structures. These dates are a start toward establishing the age of mineralization of the porphyry copper and other deposits. In the following, the ages of the igneous rock will be discussed briefly in relation to the ore deposits of four general areas, each including one or more mining districts.

WARREN (BISBEE) AND TOMBSTONE DISTRICTS

Three intrusive rocks from the Warren and Tombstone districts were dated: The Juniper Flat Granite from the northern end of the Mule Mountains, intrusive rhyolite from south of Tombstone, and the Schieffelin Granodiorite from Tombstone. Gilluly (1956, p. 55) determined the age of the Juniper Flat Granite to be post-Pennsylvanian (Horquilla Limestone) and pre-Lower Cretaceous (Bisbee Group). He also assigned a tentative Tertiary age to the intrusive rhyolite south of Tombstone on indirect geologic evidence (Gilluly, 1956, p. 106) and correlated it with the granite porphyry mapped by Ransome (1904) in the Warren district. The similarity in chemical composition of the intrusive rhyolite and the granite porphyry supports this correlation: both have an unusually high K_2O content. This correlation could not be tested by isotopic dating, however, for we were not able to obtain granite porphyry with fresh biotite.

Ransome (1904, p. 84) thought that the granite porphyry, the Juniper Flat Granite, and the Sacramento Porphyry (which is the host for disseminated copper ore at Bisbee) were comagmatic. Because the Juniper Flat Granite and the granite porphyry apparently had supplied pebbles to the basal conglomerate of the Bisbee Group of Early Cretaceous age, he assigned the entire rock suite and the ore deposits to the pre-Lower Cretaceous. Others, however, such as Tenney (1935, p. 225–227), believed that the Sacramento Porphyry and the spatially related ore deposits at Bisbee are Late Cretaceous or early Tertiary (Laramide).

The isotopic dating of the Juniper Flat Granite and the intrusive rhyolite do not establish the age of the Bisbee ore deposits. However, they do support Gilluly's conclusions that both Cenozoic and Mesozoic granitic rocks occur in the Bisbee area, that the apparent time interval between them is about 100 m.y. (million years), and that the deposits at Bisbee probably are related in time to only one of these.

Bain (1952), using the Pb^{207}/Pb^{206} ratio of uraninite from veins in the Bisbee district, suggested that the age of the Bisbee ore is 85 to 112 m.y. The radiogenic components of lead in the uraninites were small, however, and isotopic analyses of lead in the samples were not internally consistent. Under such conditions an unequivocal age determination is most difficult. Our data neither confirm nor contradict Bain's determinations.

The Schieffelin Granodiorite is the rock unit most closely related in time and space to the ore deposits at Tombstone (Gilluly, 1956, p. 160). The geologic age of the Schieffelin Granodiorite is post-Bronco Volcanics, which rests on the eroded surface of the Bisbee Group (Gilluly, 1956, p. 87). The isotopic age seems compatible with the position of the Schieffelin Granodiorite in the geologic sequence, and, as a working hypothesis, 72 m.y. can be used as the maximum age of the ore deposits at Tombstone.

The Schieffelin Granodiorite is younger than three faults in the Tombstone Hills. The age of the Schieflying rocks. The K-Ar age of the vitrophyre at the base of the dacite is 20 m.y. This age for the "cover rocks" is a minimum for the copper mineralization in the Globe-Miami district. Secondary enrichment in the Miami-Inspiration ore body is related to topography that antedates the Whitetail Conglomerate (Ransome, 1919, p. 173–174), which suggests that the ore is considerably older than the dacite.

MINERAL CREEK, BANNER, AND BUNKER HILL DISTRICTS

The Granite Mountain Porphyry from Ray (Mineral Creek district), the quartz diorite porphyry from Christmas (Banner district), and the granodiorite from Copper Creek (Bunker Hill district) were dated by the K-Ar method. These three districts are separated by about 40 airline miles, Christmas being roughly 15 airline miles southeast of Ray, and Copper Creek roughly 25 airline miles southeast of Christmas (fig. 120.1).

At Ray, the Granite Mountain Porphyry forms part of the disseminated copper deposit. At Christmas, pyrometasomatic copper deposits formed along the intrusive contacts of the quartz diorite porphyry and certain carbonate beds in the Paleozoic section, and at Copper Creek, the granodiorite is the host rock for perhaps 25 to 50 breccia pipes, many of which are mineralized.

The Granite Mountain Porphyry cuts only the Precambrian Pinal Schist, so that its age relative to younger rocks is indeterminate. Both the quartz diorite porphyry at Christmas and the granodiorite at Copper Creek intrude andesitic volcanic rocks. According to Frank Simons (written communication, 1962), the andesites intruded by the granodiorite appear to overlie unconformably a sequence of conglomerate and shale that he has correlated tentatively with the Pinkard Formation of Late Cretaceous age. Holmes (1960) dates the end of the Cretaceous at 70±2 m.y. The isotopic ages of the quartz diorite porphyry at Christmas and the granodiorite at Copper Creek do not conflict with their ages as determined by their relation to other rocks, some of which have been dated by fossils, and until further information is available 62 and 68 m.y. are reasonable assumptions for the maximum age of the ore deposits at Christmas and Copper Creek respectively.

The K-Ar age of 63 m.y. for the Granite Mountain Porphyry is close to that of the quartz diorite porphyry at Christmas, the Schultze Granite, and the Lost Gulch Quartz Monzonite. Ransome's (1919, p. 67) geologic studies indicated a close genetic relation between the quartzose granitic rocks in the Globe-Miami, Ray, and Christmas areas. A close genetic

TABLE 120.2.—*Apparent maximum and minimum age of ore de- posits in six mining districts in Arizona, based on K–Ar d... of biotites in associated intrusive rocks*

Mining district	Rock	Maximum age (million years)	Minimu[m] age [(m]ill[ion yea]rs)
Tombstone	Schieffelin Granodiorite	72	
Pima	Quartz monzonite porphyry.	56	
Globe-Miami	Schultze Granite	58	
Mineral Creek	Granite Mountain Porphyry.	63	----
Bunker Hill	Granodiorite at Copper Creek.	68	----
Banner	Quartz diorite porphyry at Christmas.	62	----
Average			62-
Mean			
Range			

relation implies a close time relation. On this ba[sis] the K-Ar age of the Granite Mountain Porphyry compatible with Ransome's geologic interpretations

The apparent maximum and minimum age of deposits in the six mining districts based on the K- age of biotites in the associated intrusive igneous ro ("porphyries") are summarized in table 120.2. T significance that one attributes to the ages in t ta depends on the extent to which one accepts c time and genetic relation between the "porphyr and the ore. In writing about the deposits at Ray Miami 43 years ago, Ransome (1919, p. 166) luc stated the position of those of us who accept a c tie, but not a direct one:

Had no previous study been made of the copper deposi the western United States and were observation restricte one only of the two districts here described, the obse might well inquire whether the association of the ores granitic or monzonitic porphyry is merely accidenta illustration of cause and effect. The present state ou formation, however, leaves little room for this doubt. only at Ray and Miami but at Clifton, Bisbee, and A Arizona, at Ely in Nevada, at Santa Rita in New Mexico at Bingham in Utah, not to mention occurrences outsid this country, copper ores generally similar to those of and Miami are closely associated with monzonite porp or with porphyry intermediate in character between m nite porphyry and granite porphyry. In some of these tricts the evidence for an essential genetic relationshi tween ore and porphyry is plain; in others it is more o equivocal to anyone who permits himself to realize at ores, even ores of copper, may occur in localities where is nothing to suggest any connection between them ar neous activity. Taken collectively, however, the dissemi copper deposits of the southwestern United States presen vincing evidence that the monzonitic porphyries, by which are invariably accompanied, had something to do with origin.

It is not to be supposed, however, that the now visible of these bodies of porphyry contributed in any active w ore deposition. They, like the neighboring schist, have themselves been altered by the ore-bearing solutions, and, where favorably situated, have been changed into protore just as the schist was changed under similar circumstances. Their significance lies in their testimony to the probable presence of much larger masses of similar igneous material below any depths likely to be reached in mining, and it is from these larger and deeper masses, which must have taken far longer to solidify and cool than the bodies now exposed by natural erosion and in the mines, that most of the energy and at least a part of the materials were derived to form the protore.

Following Ransome's beliefs, the data presented here suggest that the range in age of the ore deposits is essentially the range in K-Ar age of the "porphyries," that is, 56 to 72 m.y. On the Holmes (1960) time scale, the Cretaceous period ended 70±2 m.y. ago and the Eocene 40 m.y. ago. Using these terminal dates, the ore deposits are early Tertiary, and the range in time of 16 m.y. seems small to us. We find considerable support in the data for the concept of a Laramide period of mineralization in southeastern Arizona.

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