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1

15 districts (not Jerome)

Ave. grade from prod. records, serially 1904–1933, not include low grade

red = this total production used for ave. = dollars

Jerome — Au+Ag = $49,559,000 (50/50 Au/Ag)
Cu+Pb + 438,211,000 (no Pb)
487,770,000

Big Bug — Au+Ag = $9,453,000 (~~50/50 Au/Ag~~) (3/4 Au) ✓
Cu+Pb = $12,467,000 (mostly Cu)
21,920,000 – $17,440,329

Ave. grade
.148 Au 2.28% Cu
2.02 Ag .121% Pb

Hassayampa — Au+Ag = $2,525,000 (3/4 Au) ✓
Cu+Pb = 75,000 (no Cu)
2,600,000 2,740,000 – $1,135,644

Hass – 2,600,000
Gron Crk – 140,000
2,740,000

Ave Grade
.33 Au, 1.20% Cu
5.19 Ag 1.23% Pb

lumped

Pine Grove — Au+Ag = $1,680,000 (90% Au) ✓
Cu+Pb 59,000 (no Pb)
$1,739,000
+ 1,780,000
3,519,000 $3,519,000 – $1,794,857

Ave Grade
lumped .35 Au .22 Cu
4.24 Ag .05 Pb

Tiger — Au+Ag = 1,745,000 (2/3 Ag) ✓
Cu+Pb = 35,000
1,780,000

Ave. Grade
.35 Au .22% Cu
4.24 Ag .05 Pb

Peck — Au+Ag = $2,325,000 (90% Ag) ✓
Cu+Pb $2865,000 (mostly all Cu)
5,190,000 – $3,986,610

Ave Grade
.06 Au 2.27 Cu
3.32 Ag .05 Pb

lumped

Black Cyn. — Au+Ag = $275,000 (80% Au) ✓
Cu+Pb = 5,000 (all Pb
$280,000 – $243,564

Ave. grade
.32 Au .06% Cu
4.93 Ag .74% Pb

Walker Dist. — Au+Ag = $1,140,000 (~60% Au) ✓
Cu+Pb = 535,000 (mostly Cu)
$1,675,000 – $1,303,430

Ave Grade
.19 oz Au 1.54 Cu
4.44 Ag .42 Pb

lumped

Groom Creek — Au+Ag = $140,000 (~50/50) ✓
no Cu, Pb

.33 Au 1.20 Cu
5.19 Ag 1.23 Pb

Cherry Creek — Au+Ag = $51,000 (98% Au) – $48,335 ✓
no Cu, Pb

Ave. Grade
.46 Au .11% Cu
.29 Ag

Black Hills — Au+Ag = $102,000 50/50 $1,500,000 ✓
Cu+Pb = $1,398,000 all Cu – $285,421

Ave. Grade
.005 Au, 3.30 Ag, 4.30% Cu, .086 Pb

~~25,757~~ 7

~~2,554,000~~

Minnehaha - not much noted by Lindgren
maybe check out

Agua Fria — Au+Ag - $400,000 - 2/3 Au ✓
Cu+Pb - 2,350,000 - all Cu
2,750,000

Ave grade
.34 Au 1.12% Cu
37.7 Ag 1.40% Pb

Turkey Creek — Au+Ag $295,000 - 3/4 Ag - $95,105 ✓
no Cu, Pb

Bradshaw — Au+Ag - 130,000 (80% Ag) ✓
no Cu, Pb

Humbug — Au+Ag $50,000 - all Au ✓
no Cu, Pb

Tiptop — Au+Ag 2,200,000 (90% Ag) ✓
no Cu, Pb.

Total — Au + Ag - from Bradshaw Mtns, the dists. (non Jerome)
= $22,511,000

Cu+Pb - non Jerome
- 19,739,000

P8-10 -
$4 Au ≈ .20 oz/T = $100
$4 Ag = 4 oz/T = 48
$148 } ~ $150/ton

Summary:

2 districts in Jerome Quad - Black Hills and Cherry Creek
- total of > 12 mines

13 districts in Bradshaw Mtns Quad. Aqua Fria Big Bug, Black Cyn., Black Hawk, ~~Black Hills~~,
Bradshaw, Little Creek Groom Creek, Hassayampa, Humbug, Peck, Tiger,
Tiptop, Turkey Creek, Walker, Weaver, White Rucicho, Minnehaha, Pine Grove
- total of > 80 mines

Most districts associated with "Later Gold and Silver Veins"
- all these in Bradshaw Mtns Quad, are, from S to N,
Tiptop, Humbug, Pine Grove, Tiger, Peck, Black Canyon, Turkey Creek, ~~Peck~~
Big Bug, Walker, Groom Creek, Hassayampa

Assume: Most all the ~~pr~~ secondary ore has been extracted - this was quite rich and at that time had to be worth ≥ ~ $50.00 - Oxidation level varies, ranges from 80 to 400', but erratic - Lindgren notes that these mines closed when oxidized ore exhausted, but notes that primary ore was close to economic + perhaps grades approximated by latest work which is:

240'

Henrietta - max. ore f/stope - 450-600' level = 3.2% Cu, 2 oz Au, 2.7 oz Ag
Silver Belt - ??
Tiptop - ??
Tiger - ore grade ~13 oz/T Ag
Crook - ??
Peck - ?? - very high grade oxidized ore

Some primary ore was profitable - according to Lindgren

quite deep - to 1200', - primary? - McCabe high grade - 1.6 oz/Au, 10.2 Ag 2.0% Cu, 2.1 Pb, 4.7 Zn
Senator - ? - $30/ton shipping ore - primary ??
Cash - ?
Crown King - Total prod. $1,840,000 - .5 oz Au, 4.0 oz Ag ? primary
total dist. prod = ~10,000 T. Shelldon - 1923 ore (prod. primary) ave. 2.76% Cu, 3.5% Pb, .25 oz Au, 8.5 Ag
Mudhole - $7-$15/ore - primary?

Based on ave. grade of ore mined for total dists.
for 1904 - 1937 -
say ave of these is ~ .30 oz/T Au - this should approximate
4.0 oz/T Ag good grade primary ore
no Cu, Pb credit

ave. thickness of ore is 3' - prob. ~ 50% ~~[illegible]~~ of vein is ore - ore restricted to shoots, .. so ave vein thickness for all ore mined is 1.5' - but ave. mining width is 5.0', so dilution ~ .3 or 30% of total ore value.

.30 Au @ 500 Au = $150 add 1.0% Cu : $17.00
.5% Pb $ 4.00
4.0 Ag @ 12.00 Ag = 48
198 × .3 (actual ore) = $59.40

$59.40 value / ton of rock moved

Shows average value not enough. Have to look for mines, ~~etc~~ or districts which characteristically had higher ~~[illegible]~~ grades (value / ton) or more continuous ore (less "shooty") and/or thicker veins (ave of ~ 5' or more), or a cheaper mining method.
~~Those districts which seem pref~~

- These not considered - too low grade, or low Au, Ag

- Black Hills District -
- Prescott District -
- Agua Fria -

Those districts with noted primary ore
Pine Grove, Hamburg
Tiger
Big Bug
Walker
Groom Creek - Hassayampa
Turkey Creek

Mazatzal - not really explored - maybe check
Peck
Tiptop
Turkey Creek
Bradshaw

Total - Yavapai = Lode =
3476,150 oz.
1,565,000 oz Jerome
1,911,150 non Jerome total

Red = total Prod. to 1959 for selected dists. from USGS PP 610 (Lode only)

Bull 782 - Ore Deposits - Jerome and Bradshaw Mtns Quad

only these vein-type deposits noted (ie. Verde Dist. not incl.)

Black Hills Dist -

Production totals	Tons	Copper #	Lead #	Au (oz)	Ag (oz)
1904-1923	12,656	1,455,219	19,430	87.13	55,548
		5.75%		.007 oz/T	4.39 oz/T

Yeager Mine
Shylock Mine
Mingus Mtn. Copper Co.
Bundle Pup Mine
Black Warrior Prospect

- See also USGS PP 308, p. 176-178

Cherry Creek Dist - see also Reed, 1906, Econ Geol. Vol, p. 417-436

no prod. records, but generally .3 to 1.0 oz/T Au and 3:1 Au:Ag (oz)
- no unoxidized ore mined - oxide out at 300'
- see also USGS PP 308 p. 174-176

see also Wilson, et al, 1934, p. 28-32

Monarch Mine and Vicinity
Golden Idol Mine
Conger and Inspiration Mines
Federal Mine
Leghorn Mine
Logan Mine

for USGS PP 308 & Az. Bur. Mines Bull 140
total Prod. - 1908-1933

3,524 Tons	1,640.4 oz Au	
	1,014 oz Ag	
	7,484 lbs Cu	

Prescott Dist - see Wilson et al, 1934, p. 28

no prod. records - but no lode, $1,000,000 placer prod.

Walker Dist - see also Wilson et al, 1934, p. 34-35

Prod. totals	Tons	Copper #	Lead #	Au (oz)	Ag (oz)
1905-1924	35,695	731,645	299,563	14,014.92	147,646
	[illegible]	1.02%		.393 oz/T	4.14 oz/T

in 1924 ore avg. 2.7% Cu, 3.5% Pb, .25 oz Au, 8.5 Ag - avg 4-5'

Production < $1,500,000 - mined quite a bit of unoxidized ore in dist

- Sheldon Mine - ≈ $1,075,000 - largest in Dist.
Mudhole Mine - $480,000, largest in Dist.
Amulet Mine 43,000 oz Au
Near Walker, North of Walker (Placer = 97,000 oz Au)

1934

Groom Creek Dist. and Hassayampa Dist. — See Wilson, et al, p. 32-34, p. 41-50

Prod. for both Dists, most from Hassayampa — 1904-1924 — Tons 44,840 — 108,300 oz Au

Big Pine Mine
Ruth Mine
N.C. 4 Mine
Jersey Lily Mine
Blue Dick ≈ $200,000
Mark Twain
Dr Orris Mine ≈ $216,000 to $440,000
Davis Mine ~ $200,000
Dunkirk Mine -
Tilkie Starbuck Mine
Senator Mine - ~ $530,000
Cash Mine
Storm Cloud Mine
Chicago Mill vicinity
Starlight Group (Venezia Area)
Crook Vein - ~ $250,000
Mount Union Mine - $200,000
Consolidated Bodie

Bighorn Dist. - see also Wilson et al, 1934, p. 35-44

Totals 1901-1924	Ore	Cu (lbs)	Au (oz)	Ag (oz)
	1,222,924	54,496,108	~~137,739~~	2,446,461
		2.23%	~182,802	2.0 oz/T
			.150 oz/T	584,300 oz Ag

Iron King - sulfide lenses - schist
Silver Belt
Arizona National
Lookout Mine
McCabe - Gladstone Mine - > $3,000,000 post prod - 5 ore shoots
New Gladstone.

~~841-2318~~ ~~841-2318?~~

~~2 bad photos Bc~~.

~~360.~~

3

~~3 [illegible]~~

Union Mine - >$800,000 production
Along Bighorn Creek
Henrietta Mine - much past prod., mostly oxide ore, last prod'g = 3.22% Cu, .2 oz/T Au, 2.7 oz/T Ag
Boggs Mine
Iron Queen - pyritic schist
Hackberry Mine - pyritic schist
Butternut Mine - pyritic schist
Pocahontas Mine
Blue Bell Mine - large producer, mostly Cu, low Au, Ag - massive sulfide?

Agua Fria District -

Stoddard Mine - shallow oxidation, mostly all ~~Copper~~ 12,170 oz Au

Turkey Creek District - see also Wilson et al, 1934, p. 50

Prod. Totals	Tons	Au (oz)	Ag (oz)	Cu (lbs)	Pb (lbs)
	3,369	756	90,067	53,667	67,024

Cumberland Mine -
Copper Deposit
War Eagle Mine -
Gold Note Group -
Goodwin Properties -
Morgan Mine - ~$100,000 prod.

Black Canyon District - also Wilson, et al, 1934, p. 51-55

Totals	Tons	Au (oz)	Ag (oz)	Large product. 1934-1941
10,065		3,440	59,049	46,700 oz Au
		.342 oz/T	5.87 oz/T	

Rainbow Lode - contact - metamorphic deposit?
Pyritic deposits E of Turkey Crk Station - pyritic schist
Howard Copper Co. - in pyritic schist
Kay Copper Co. - in pyritic schist

Magnetite Deposits - Magnetite diser. - Yavapai schist
Precambrian Quartz Veins -
Richinbar Mine - large producer, near Bumblebee
Placers
"Gold Belt" near Turkey Crk. Station - Flat veins
~~Ba~~ - Silver Cord Vein - vein dips SSE at ~20°
- Thunderbolt Mine - vein dips N20W
- Howard Silver Co. - vein dips 25°NE
- French Lady Mine - vein dips 30°N

Peck District -

		Cu lbs	Au (oz)	Ag
Prod. Totals - 1904-1924	248,853 tons	10,867,753	15,080	827,253
	Limited by 180,000 tons - Desoto mine which ave. .02 Au 1 oz/T Ag	2.18%	.061 oz/T	3.32 oz/T
			15,550 oz Au	

no sulfide ore produced, mining grade - maybe mining ore possible??

~~Prescott South of~~
~~Properties S. of Peck Mine -~~
Peck Mine - >$1,500,000 prod, mostly all oxide Ag
Swastika Mine - ~1,000,000 oz Ag production, mostly all oxide
De Soto Mine - pyritic schist, mostly Cu

Pine Grove District - see also Wilson, 1934, p. 55-59
- partly oxidized ore generally - deep H_2O level
- prob. ~$3,000,000 tot. prod.
Springfield Group - all Cu
Wildflower Mine - large producer
Del Pasco Group -
Crown King Group - >$1,200,000 production, ~$40.00/ton ore
Vein 2' in width - .50 oz/T Au, 4.0 oz/T Ag
Philadelphia Mine - large producer - vein 2-5' wide
Fairview Tunnel -
Lincoln Mine - high grade ore
Other Properties -

Pine Grove - Tiger
130,275 oz Au

Tiger District - see also Wilson, p. 59

Production 1901-1924 - Tiger and Pine Grove Dists.

Tons	Au (oz)	Ag (oz)
148,955	52,209	631,792
	.35 oz/T	4.24 oz/T

Tiger Mine - > $750,000 prod., ave. grade of ~ 13 oz/T Ag, or .07 oz Au, 22 oz Ag - little ore left.

M&M vein -

Oro Belle and Gray Eagle Mine - ~ $700,000 total prod.

- vein 2-15' wide

Northward Ext. of Gray Eagle Lode -

Bradshaw District. - see Wilson, p. 55

Minnehaha Flat and Silver Mtn. - see Wilson, p. 59

Humbug District - see Wilson, p. 60

- good grade ore, veins continuous for long distances.

Tiptop District - ~ $4,000,000 total production, most all from Tiptop Mine 10,000 oz, Au

Tiptop Mine - most oxidized ore produced, mostly for Ag

Yavapai Cty Production - from Ariz. Bull 140 - Major Mines - Major Dists

Jerome Dist - Au-Ag = $49,559,000

Cu+Pb 438,211,000 (no Pb prod.)

$ 487,770,000

Others - Lode production - incl. Big Bug, Hassayampa, Pine Grove, Tiger, Peck, Black Cyn., Walker, Brown Creek, Cherry Creek, Black Hills, Agua Fria, Turkey Creek, Bradshaw, Humbug, Tiptop

Westmont Mining Inc.

2341 S. Friebus Ave., #12

Tucson, AZ 85713

We, the undersigned, have several valid mining claims with low grade gold values which may be suitable for open pit operations. The claims are located in sections 35 and 36, T13N, R10W and section 2, T12N, R10W, Yavapai County, Arizona. All claims are covered by current State Mineral Permits or BLM Permits and are immediately availabe for Lease or Sale.

At this time, interested individuals may contact H. Mason Coggin to view the property. He may be contacted as follows:

H. Mason Coggin, Mining Engineer

317 East Griswold

Phoenix, Arizona 85020

(602) 944-3763

If Mr. Coggin is not available, we also have in our possesion reports, assays, maps and other records extending over the past 10 years for these claims. Appointments to study these records may be made by contacting us at the address shown below.

Sincerly,

Melvin Jones

Melvin and Ana Maria Jones

74 Megan Dr.

Henderson, Nevada 89014

(702) 458-1802 or

(702) 361-2261

c.c. Mr. H. Mason Coggin

UNIVERSITY OF ARIZONA
ARIZONA BUREAU OF MINES
J. D. FORRESTER, DIRECTOR

GEOLOGIC MAP OF YAVAPAI COUNTY, ARIZONA

PREPARED BY THE
ARIZONA BUREAU OF MINES
UNIVERSITY OF ARIZONA
TUCSON, ARIZONA

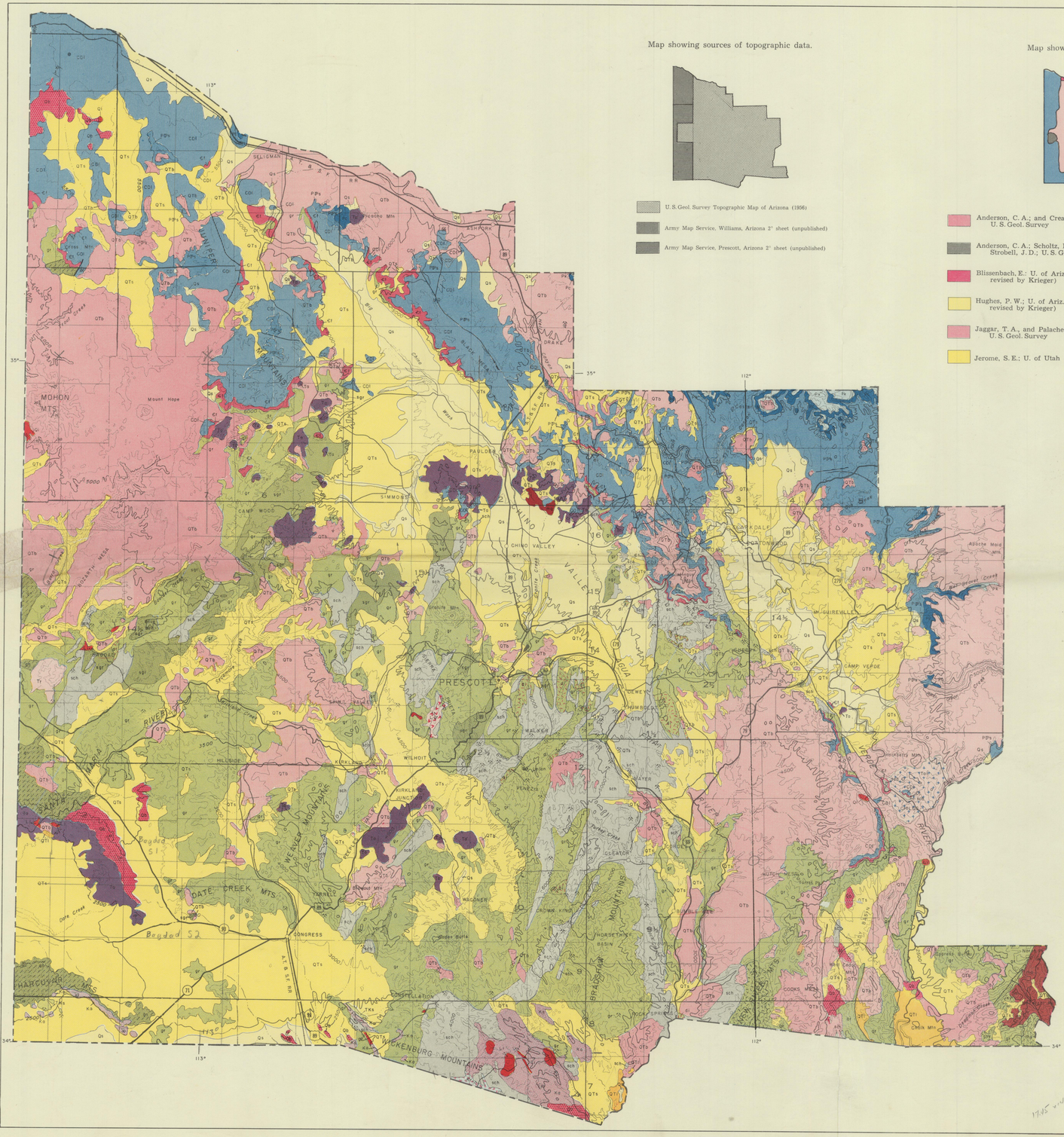
Scale $\frac{1}{375,000}$

10 0 10 20 30 Miles

10 0 10 20 30 Kilometers

Contour interval 500 feet
datum is mean sea level

1958



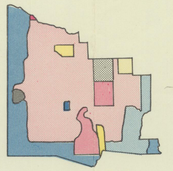
Map showing sources of topographic data.

U. S. Geol. Survey Topographic Map of Arizona (1956)

Army Map Service, Williams, Arizona 2° sheet (unpublished)

Army Map Service, Prescott, Arizona 2° sheet (unpublished)

Map showing sources of geologic data.



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Hughes, P. W.; U. of Ariz. (partially revised by Krieger)

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Jerome, S. E.: U. of Utah

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Krieger, M. H.; U. S. Geol. Survey

Lehner, R. E.; U. S. Geol. Survey

Metzger, D. G. and Twenter, F. R.; U. S. Geol. Survey

Wilson, E. D.; Ariz. Bur. Mines

Wilson, E. D. and Moore, R. T.; Ariz. Bur. Mines.

INDEX MAP OF ARIZONA
Showing Location of Yavapai County.

EXPLANATION

SEDIMENTARY ROCKS

Gravel, sand, and silt (Qs)

Silt, sand, and gravel (QTs)

Lake Deposits (QTl)
Siltstone, sandstone, and limestone.

Sandstone, shale, and conglomerate (TKs)
Includes some volcanic rocks.

Kaibab limestone (Pk)
Includes Toroweap formation

Coconino sandstone (Pc)

Supai formation (PPs)
Includes Hermit shale near Seligman

Redwall and Martin limestones (CDl)

Tonto group (Ct)

IGNEOUS ROCKS

QUATERNARY

Basalt (Qb)
Locally includes tuff and agglomerate.

Dikes and plugs (Qi)
Mainly basaltic in composition.

TERTIARY

Basalt (QTb)
Locally includes tuff and agglomerate.

Rhyolite (Tr)
Includes tuff and agglomerate.

Intrusive Andesite (Tia)

Andesite (Ta)
Includes tuff and agglomerate

LARAMIDE

Granite and related crystalline intrusive rocks (Kg)

Dikes and plugs (Li)

CRETACEOUS

Rhyolite (Kr)

Andesite (Ka)
Flows, tuff, and agglomerate

SYMBOLS

Contact, showing dip

Fault, showing dip
Dashed where approximately located
U, *upthrown side*, D, *downthrown side*

Thrust fault
(T, upper plate)

Strike and dip of beds

Strike of vertical beds

Horizontal beds

Mine

Quarry

METAMORPHIC ROCKS

Mazatzal quartzite (Pmz)
Includes Deadman quartzite and Maverick shale

Schist (sch)
Locally includes diorite, rhyolite, and greenstone.

Granite and senist undifferentiated (sgr)

Granite gneiss (gg)

Granite (gr)

Diorite porphyry (di)

Red Rock rhyolite (Prr)

PERMIAN

PENNSYLVANIAN

MISSISSIPPIAN AND DEVONIAN

CAMBRIAN

OLDER PRECAMBRIAN

Yavapai

WEST CLEAR CREEK ROADLESS AREA, ARIZONA

By GEORGE E. ULRICH, U.S. GEOLOGICAL SURVEY, and

ALAN M. BIELSKI, U.S. BUREAU OF MINES

SUMMARY

Results of USGS geologic, geochemical, and aeromagnetic studies and USBM review of mineral records and prospect examination for the West Clear Creek Roadless Area, Arizona, indicate that there is little likelihood of the occurrence of mineral or energy resources. No concentrations of minerals were identified within the boundary of the area. A small manganese deposit occurs 1–3 mi east of the area but does not extend into the area. Slightly anomalous values for certain trace metals were found in samples taken within the area, but do not indicate the presence of metallic resources. Gypsum, basaltic cinders, and sandstone occur in the area, but similar materials are available and have been quarried outside the area where they are much more readily accessible.

CHARACTER AND SETTING

The West Clear Creek Roadless Area includes approximately 53 sq mi in Yavapai and Coconino Counties in central Arizona, about 70 mi north of Phoenix. The area lies on the southwestern margin of the Colorado Plateau and includes part of the Verde valley, one of several northwest-linear basins in the Arizona transition zone separating the Basin and Range and Colorado Plateaus physiographic provinces. Interstate 17 connecting Phoenix and Flagstaff crosses Verde Valley 10 mi west of the roadless area and affords a view of the west-facing escarpment of the plateau margin notched by the prominent canyon of West Clear Creek.

The roadless area boundary closely follows the rim of the steep-walled canyon of West Clear Creek and its tributaries. The perennial stream within the canyon drops 3000 ft over a distance of 36 mi from its head at the juncture of Willow and Clover Creeks to its confluence with the Verde River. Together with its tributaries, it drains an area of about 240 sq mi. The maximum altitude of the area, approximately 7000 ft above sea level, occurs at the eastern end, on the top of the plateau. The topographic relief increases about 100 ft at the eastern end, to a maximum of 1800 ft toward the west as the canyon deepens across the Plateau margin. The relief decreases abruptly at the western boundary where West Clear Creek flows onto the broad open floor of the Verde River valley.

Paleozoic and Mesozoic rocks are exposed in the precipitous walls of the canyon and include upper Paleozoic sedimentary strata having a cumulative thickness of about 1700 ft and remnants of Triassic rocks in the northeastern corner of the roadless area. The Paleozoic formations, in ascending order, are the impressive "red rocks" of the Supai Formation (650 ft of siltstone, sandstone, and minor limestone), the light-gray crossbedded Coconino Sandstone (700 ft), and the ledgy limestones of the Kaibab Formation (as much as 350 ft). In the middle part of the canyon, west of the Cash Tank fault, these rocks were deeply eroded more than 10 million years ago, creating an old valley at least 1300 ft deep which crossed the direction of the modern westerly course of West Clear Creek. This paleovalley was partly filled by as much as 300 ft of coarse conglomerate chiefly derived from the valley walls. Beginning about 11 million years ago (Pierce and others, 1979), extensive volcanic eruptions, primarily basaltic, produced pyroclastic deposits and lava flows that filled and overtopped the remaining space within the old valley, reaching a maximum thickness of about 1500 ft. Basin-filling sediments of the Tertiary Verde Formation were deposited in the western part of the roadless area during and following the volcanic activity. After deposition of the Verde Formation had ceased, extensive erosion by the present river system began; it has cut as much as 1500 ft into the plateau.

The structural setting is one of gentle westward dips in the sedimentary rocks and steeply dipping normal faults. Most of the faults trend north to northwest, but

two of them, the Cash Tank and Toms Creek faults, are unusual in that they strike northeasterly and can be traced for more than 3 mi. The Cash Tank fault is also notable for its large throw, 240–360 ft, and is reflected in both the gravity and aeromagnetic data. The Toms Creek fault parallels the aeromagnetic contours in the area and lies on a trend which, if extended to the northeast, would coincide with the breccia zone described by Jones and Ransome (1920) in the Long Valley manganese district.

MINERAL RESOURCES

On the basis of geologic mapping, geochemical sampling, an aeromagnetic survey, and review of the county and federal land records, the roadless area is considered to have little likelihood for the occurrence of hidden mineral resources. No metallic mineral occurrences are known within the area.

Mineralized areas, mining claims, and mining activities are limited to the Long Valley manganese district 1–3 mi east of the roadless area. The Last Chance mine near the head of Iron Mine Draw, is within the Long Valley district but mineralization does not appear to extend into the roadless area.

The Verde Formation occurs at the western extremity of the roadless area and is quarried for gypsum al 2 mi west of the area; however, this formation does contain evaporite deposits within the roadless a Basalt and basaltic cinder deposits along the can rim have uses for road metal, concrete aggreg riprap, and cinder blocks, and the Coconino Sandst exposed in the canyon can be used as building- flagstone but similar construction materials are n readily available outside the area.

SUGGESTIONS FOR FURTHER STUDIE

Further study of the roadless area offers little prom for the identification of hidden mineral deposits.

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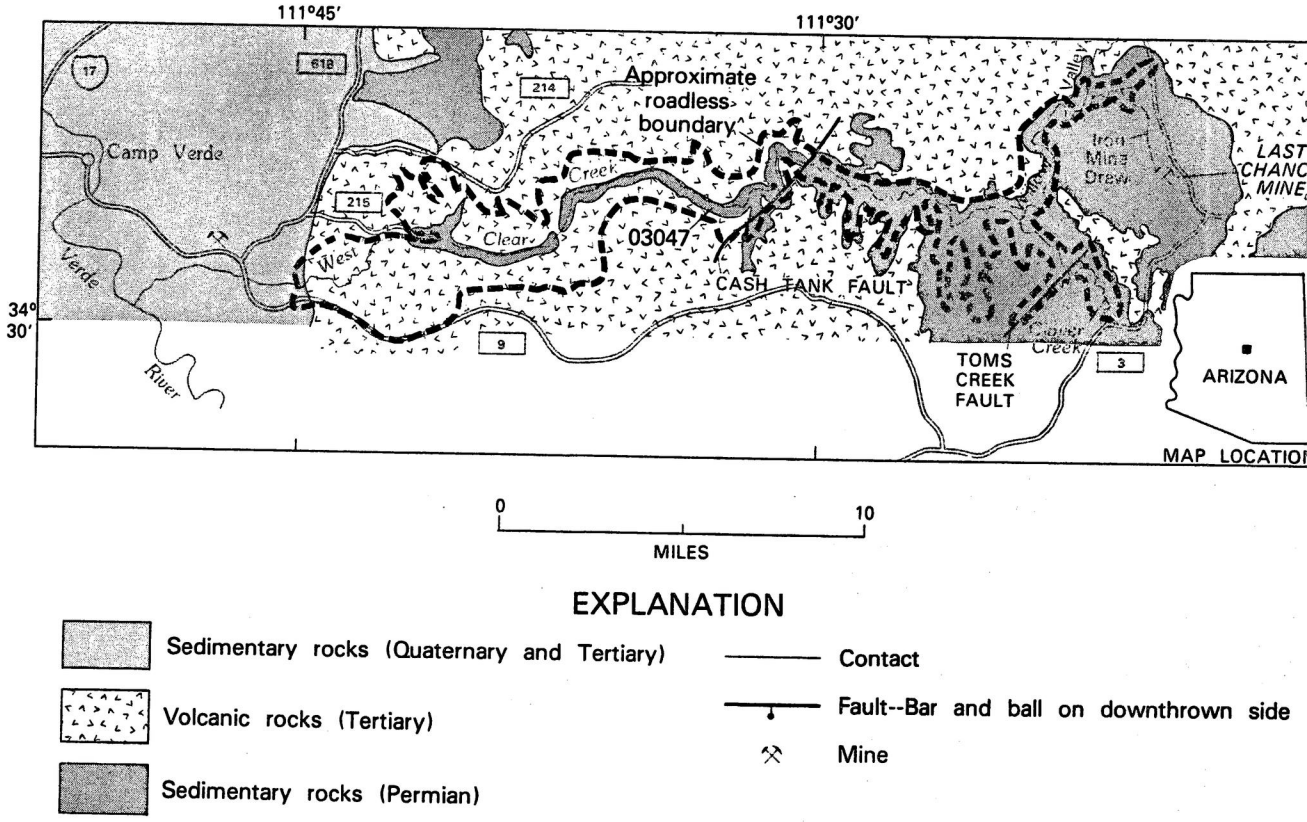

Figure 33.—West Clear Creek Roadless Area, Arizona.

Yavapai

ARNOLD MESA ROADLESS AREA, ARIZONA

By EDWARD W. WOLFE, U.S. GEOLOGICAL SURVEY, and

ROBERT A. MCCOLLY, U.S. BUREAU OF MINES

SUMMARY

Geologic, geochemical, and aeromagnetic investigations and a survey of mines and prospects in 1980 in the Arnold Mesa Roadless Area, Arizona, provide little evidence for the occurrence of mineral or energy resources. Buried Proterozoic basement rocks are possible hosts for porphyry-type copper and massive sulfide deposits but the thick cover of Paleozoic sedimentary rocks and upper Cenozoic volcanic rocks precluded assessment of this possibility. Chemistry and temperature of spring and well waters suggest that a geothermal resource may exist near the eastern margin of the roadless area, but the anomaly has not been tested by drilling and this resource remains unverified. No other energy resources were identified.

CHARACTER AND SETTING

The Arnold Mesa Roadless Area comprises about 44 sq mi in and along the flanks of the Black Hills south of Camp Verde, Arizona. The crest and southwest flank of the Black Hills within the roadless area are moderately dissected rolling uplands. The northeast flank, which is steep terrain that forms the western wall of the Verde River Valley, has a total relief within the roadless area of almost 4000 ft and is deeply incised by canyons such as those of Gap and Chasm Creeks.

The roadless area is within the transition zone between the Colorado Plateaus and the Basin and Range Province. The zone is underlain by Precambrian rocks and gently dipping Paleozoic strata that are similar to Precambrian and Paleozoic rocks in the southern part of the Colorado Plateau in the Grand Canyon.

Proterozoic rocks just north of the roadless area, in the vicinity of Squaw Peak Canyon, include foliated mafic and, locally, intermediate volcanic rocks of greenschist facies that are intruded by a Proterozoic pluton composed mainly of tonalite. The tonalite is locally exposed in the northern and central parts of the roadless area. In the southern part of the roadless area, Proterozoic rocks exposed along Gap Creek, in Chalk Tank Canyon, and locally along the Verde River are dominantly relatively unmetamorphosed dacite and rhyolite with subordinate mafic volcanic or volcaniclastic rocks.

Gently dipping Paleozoic dolomite and limestone with subordinate sandstone and siltstone rest unconformably on the Proterozoic rocks. These strata, Cambrian to Pennsylvanian or Permian in age, have an aggregate maximum thickness of 730 to 910 ft, but they pinch out locally between the Proterozoic tonalite and the upper Cenozoic Hickey Formation.

The transition zone in central Arizona was the locus of voluminous eruptions of basaltic lava and pyroclastic deposits that rest on the eroded surface of the Paleozoic and Precambrian rocks. Dacitic to rhyolitic lava flows and pyroclastic deposits, also of late Miocene age, occur locally within the roadless area.

Northwest-trending linear basins of late Cenozoic age characterize the transition zone and indicate extension and basin subsidence. The roadless area includes the southernmost part of one of these basins, the 30 mi-long Verde basin alined approximately along the Verde River, that contains late Cenozoic basin-fill deposits more than 3100-ft thick (Nations, 1974) of the Verde Formation.

The Verde basin and its sedimentary fill are bounded on the southwest by the Verde fault, which, in the northern part of the roadless area, is a conspicuous, single, steep, normal fault. Near Chasm Creek, however, the single fault splays southward into several high-angle faults that can be traced only a short distance southeast of Chasm Creek. Another fault system, similar to the Verde fault in trend and sense of movement but offset en echelon from it, extends from the upper part of Gap Creek to the southern boundary of the roadless area.

MINERAL RESOURCES

Prospecting and claim staking have occurred intermittently from about the mid-1800's to the present. No mine production is known from within the roadless area and at the time of field examination, no mining or exploration work was occurring within the roadless area.

At the Squaw Peak mine, just north of the Arnold Mesa Roadless Area, the Proterozoic tonalite pluton is the host for a porphyry-type copper deposit (Roe, 1976). The Squaw Peak mine is not currently active, and the only recorded production was from 1944 to 1946. During that period, 1000 tons of ore produced 5.4 tons of 98.82 percent molybdenite (MoS_2) and 36 tons of concentrate averaging 22.85 percent copper, 1.92 oz silver/ton, and 0.016 oz gold/ton (Hill, 1949). Roe has shown that the deposit does not extend into the roadless area, and no outcrop evidence of similar occurrences exists in the roadless area. There is a small possibility that similar porphyry-type mineral deposits may occur in the subsurface throughout the roadless area; however, overlying Paleozoic sedimentary and Cenozoic volcanic rocks as much as 1500 ft thick cover any such porphyry-type copper deposits.

A minor amount of gold with an estimated value of a few hundred to a few thousand dollars has been produced north of the roadless area at the Chicken Wire gold mine from brecciated tonalite adjacent to quartz veins. Although quartz veins do occur in the roadless area, they are relatively scarce in the outcrop areas of tonalite and no resource potential for the occurrence of small vein- or fracture-related deposits of silver or gold was identified.

The Proterozoic volcanic rocks of Gap Creek underlie the southern part of the roadless area. They are broadly like the host rocks for the massive sulfide deposit of Jerome, Arizona (Anderson and Creasey, 1958; Donnelly and Hahn, 1981), and there may be a possibility for the occurrence of similar ores of copper, silver, and gold. The unit is largely buried by younger sedimentary and volcanic rocks as much as 2500 ft thick and because direct evidence of a massive sulfide deposit has not been found. However, this does not preclude the occurrence of massive sulfide deposits under the cover of younger rocks within the volcanic rocks of Gap Creek. Therefore, the possibility exists for such deposits in the southern part of the roadless area, but due to the lack of conclusive data, no resource potential was identified.

Rock suitable for crushing into aggregate occurs throughout the roadless area, and tonalite has been quarried locally for use in flood-control construction on the Verde River. However, deposits of potential aggregate material outside the roadless area are more accessible and closer to markets. No potential was identified for the occurrence of resources in the Paleozoic an Cenozoic rocks that cover most of the roadless area.

Evidence gathered by Ross and Farrar (1980) ind cates that ground water near the eastern boundary c the roadless area has been in contact with reservoi rocks of elevated temperature. The sampled springs an wells all lie within and east of the Verde fault zone an its projection to the southeast. Their modestly elevate temperatures suggest a possible geothermal resourc but this resource remains untested.

The results of geologic, geochemical, and aeromag netic investigations and a survey of mines and pros pects (McColly and Korzeb, 1981) in 1980 indicate littl likelihood that the Arnold Mesa Roadless Area has oc currences of metallic mineral resources in porphyr copper-type settings, but a greater likelihood in the are for massive sulfide-type deposits (Wolfe and others 1983).

SUGGESTIONS FOR FURTHER STUDIES

Additional detailed examination and geochemica sampling of the exposed Proterozoic rocks represent th most direct approach to identifying geochemical pat terns that might offer further evidence on the presenc or absence of mineral deposits. Geophysical studies and ultimately, drilling are the most likely techniques fo additional evaluation of the weak geothermal anomaly.

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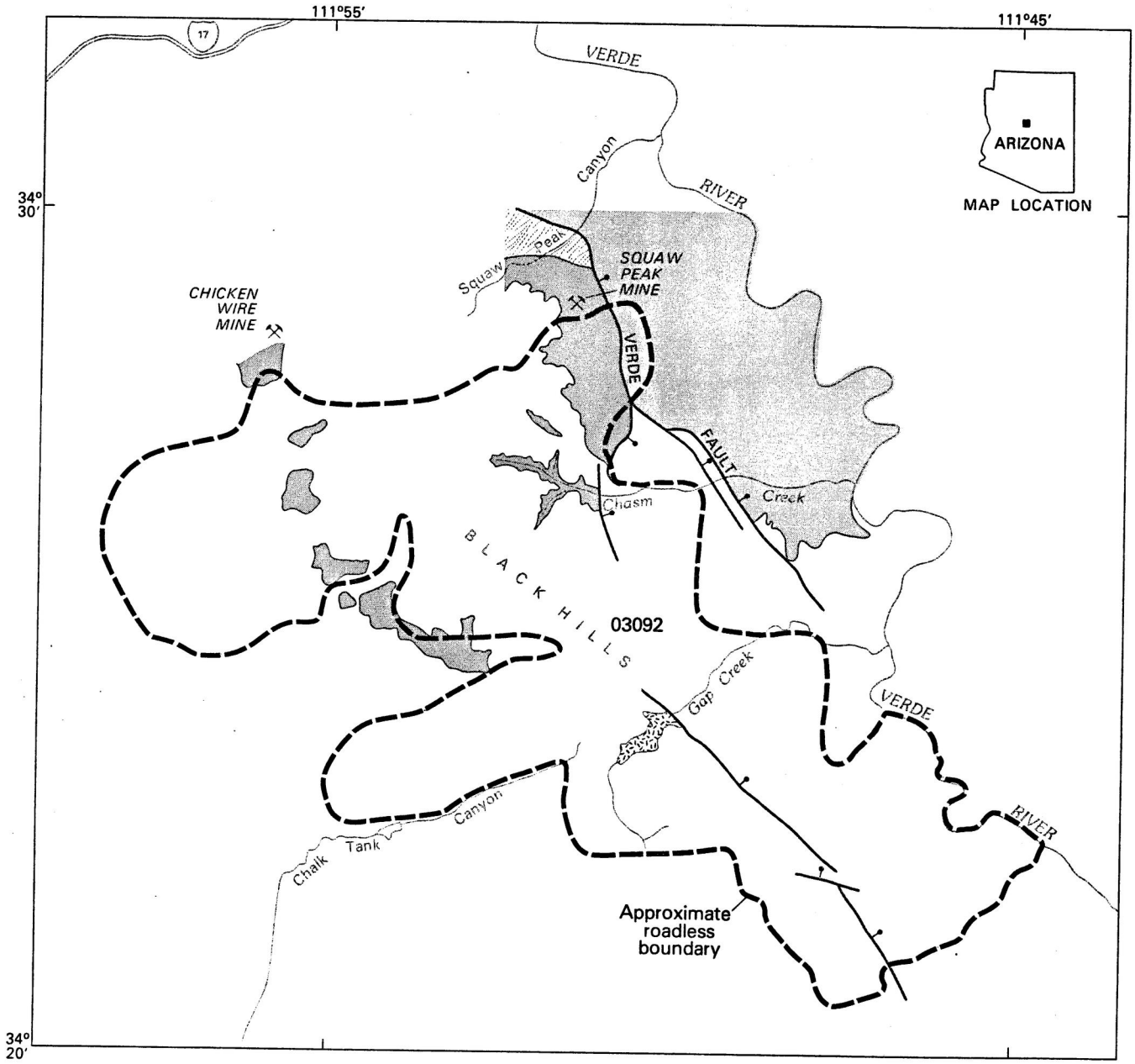

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MILES

EXPLANATION

- Verde Formation (Cenozoic)
- Volcanic and sedimentary rocks, undifferentiated (Cenozoic and Paleozoic)
- Tonalite (Proterozoic)
- Metamorphic rocks of Squaw Peak Canyon (Proterozoic)
- Volcanic rocks of Gap Creek (Proterozoic)
- Contact
- Fault--Bar and ball on downthrown side

Figure 12.—Arnold Mesa Roadless Area, Arizona.

Yavapai

PINE MOUNTAIN WILDERNESS, ARIZONA

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SUMMARY

A geologic study and geochemical survey were made of the Pine Mountain Wilderness in 1966. Only slight traces of mineralization of no apparent significance were found and the results of the geochemical survey were negative. The presence of important near-surface mineral deposits in the area is considered unlikely. No evidence of nonmetallic or energy resources was identified during the course of this study.

CHARACTER AND SETTING

The Pine Mountain Wilderness comprises an area of about 31 sq mi in southeastern Yavapai County near the center of Arizona. The wilderness is between the Black Canyon Highway (Arizona State Route 69 and Interstate Highway 17) and the Verde River. It is about 40 mi east-southeast of Prescott, the county seat of Yavapai County, and about 20 mi south of Camp Verde. The northwestern part of the area is in the Prescott National Forest, and the southeastern part is in the Tonto National Forest. The Pine Mountain Primitive Area was studied in 1966 (Canney and others, 1967). Because the boundaries of the proposed wilderness were known in 1966, all the additional tracts of land outside the existing primitive area proposed for inclusion in the wilderness were also examined. The Pine Mountain Wilderness was formally established in 1973.

The Pine Mountain Wilderness is characterized by rather diverse types of topography and vegetation, but in general it is rugged and mountainous. It forms the southeast end of the Black Hills, a northwest-trending range that bounds Verde Valley on the southwest, and extends northwestward to the famous Verde mining district. The wilderness is divided into two parts roughly equal in size but different in character. The part west and northwest of the Prescott-Tonto National Forest boundary is generally mesalike because of the nearly horizontal attitude of the Tertiary lava flows and moderately deep canyons have been cut into it by Bishop and Sycamore Creeks. Within the Prescott National Forest area a good network of horse and foot trails permits relatively easy access to much of the area. The part of the wilderness southeast and east of the Prescott-Tonto National Forest boundary is extremely rugged and is dissected by many moderately deep canyons. In the Tonto National Forest area travel is generally difficult owing to complete lack of trails and the vegetative cover is often so dense that to travel any distance is an extremely difficult, painful, and time-consuming operation.

Altitudes in the wilderness range from 6814 ft on Pine Mountain to slightly less than 4000 ft at several points on the southeast border. Turret Peak (alt. 5840 ft) and 1 M Peak (alt. 5998 ft) are prominent and easily recognizable landmarks on the southwest edge of the area. The vegetation is extremely varied, both in type and amount, as would be expected from the rather large differences in altitude between various parts of the area. It ranges from plant communities composed of various species of shrubs and cacti characteristic of the Sonoran Desert to relatively open stands of ponderosa pine.

The rocks in the Pine Mountain Wilderness vary greatly both in age and type. The Tonto National Forest section is underlain principally by very old (Precambrian) rocks, mostly granites and closely related types, although there are small areas of highly metamorphosed volcanic and sedimentary rocks. The metamorphic rocks are also well exposed in the deeper canyons in the Prescott National Forest section. Overlying Precambrian rocks, principally in the western part of the wilderness (Prescott National Forest section), are nearly flat-lying strata of sandstone and limestone of early to middle Paleozoic age (about 350–550 million years old). These sedimentary rocks are covered nearly everywhere by basalt lava flows of Tertiary age, so are generally exposed only in the walls of the deeper canyons in the western part of the wilderness and in the east-facing cliffs along the Pine Mountain escarpment

[1]With contributions by William L. Lehmbeck, USGS.

The Paleozoic rocks are missing from large areas in the southwestern part of the wilderness; presumably they were eroded before the advent of volcanic activity, for basalt flows rest directly on the old igneous rocks in those areas. The basalt flows that are widespread in the wilderness, and compose much of the exposed bedrock in the Prescott National Forest area, were deposited during an episode of extensive volcanic activity that occurred in north-central Arizona only a few million years ago.

Strong tectonic forces elevated the Black Hills at least 3000 ft a few million years ago. Vigorous stream erosion since that time has shaped the landscape of the Pine Mountain Wilderness that we see today. The rocks in the wilderness responded to the stresses during the period of Cenozoic deformation principally by simple uplift and minor tilting; no folds have been recognized, and the principal structural features are vertical to high-angle faults.

MINERAL RESOURCES

The 1966 mineral survey (Canney and others, 1967) found no evidence of any significant near-surface mineral deposits in the Pine Mountain Wilderness. This was not unexpected, because much prospecting has been done during the past 75–100 years in this part of Arizona in the hopes of finding large and rich deposits of gold, silver, copper, and zinc like those mined in the Verde mining district, 30–40 mi to the northwest. Certainly any surface indications of important mineralization would have been detected by these early prospectors. And considering how thoroughly this area must have been prospected, diggings are surprisingly scarce; only three prospects were noted during the 1966 survey.

Precambrian massive sulfide deposits and Precambrian fissure veins are the principal types of ore deposits in the Black Hills and in the Bradshaw Mountains to the southwest. Although most of the important known Precambrian ore deposits are found in a belt extending south and southwest of the Verde district, the geology of the wilderness is permissive for the occurrence of such deposits, because Precambrian igneous and metamorphic rocks are exposed in more than 50 percent of the area.

Very few mineral claims have apparently been staked in the wilderness. In 1966, only the Frances Young group of 18 claims were believed to be in the wilderness, but fragmentary and incomplete land records prevented finding their precise location. Since the 1966 survey, additional claims were staked in 1972, 1979, and 198 cording to the USFS, but they have no recor knowledge of any physical exploration on these cla

Geochemical prospecting, using active-stream ments and heavy-mineral concentrates, was the cipal method employed to evaluate the mineral p tial of the area. No anomalies that might be consid indicative of the presence of near-surface met mineral deposits were found.

Iron-stained zones, bleached areas, quartz-ja stringers and veins, minor shear zones, and other cellaneous types of altered rock are common in metamorphic rocks of the wilderness. These occurre were examined, and samples were collected for anal from many of them. Only insignificant traces of met minerals were revealed by the analytical data and studies. The presence of significant near-surface min deposits in the area therefore is considered unlikely.

No nonmetallic or energy resources were identifie the wilderness in the course of this study.

SUGGESTIONS FOR FURTHER STUDIE

Additional studies do not appear warranted at time. Ore deposits, if present, are probably of massive sulfide type, and buried deeply beneath ground surface, beyond the range of the various chemical and geophysical techniques used in routine ploration. Some of the newer geophysical meth might possibly be capable of detecting such hidden bodies if not buried too deeply, but this would requ blanketing the entire wilderness with expens surveys; such techniques are usually used in limi areas where it is possible to define restricted tar areas by other means, for example geochemical surve and such target areas were not defined by the 19 study. Future development of a geochemical meth that could detect mineralization beneath a cover younger barren rocks would, of course, be am justification for conducting such a survey in the wild ness, especially the western part (Prescott Natio Forest section) where the Precambrian rocks are nea everywhere covered by much younger sedimentary a volcanic rocks.

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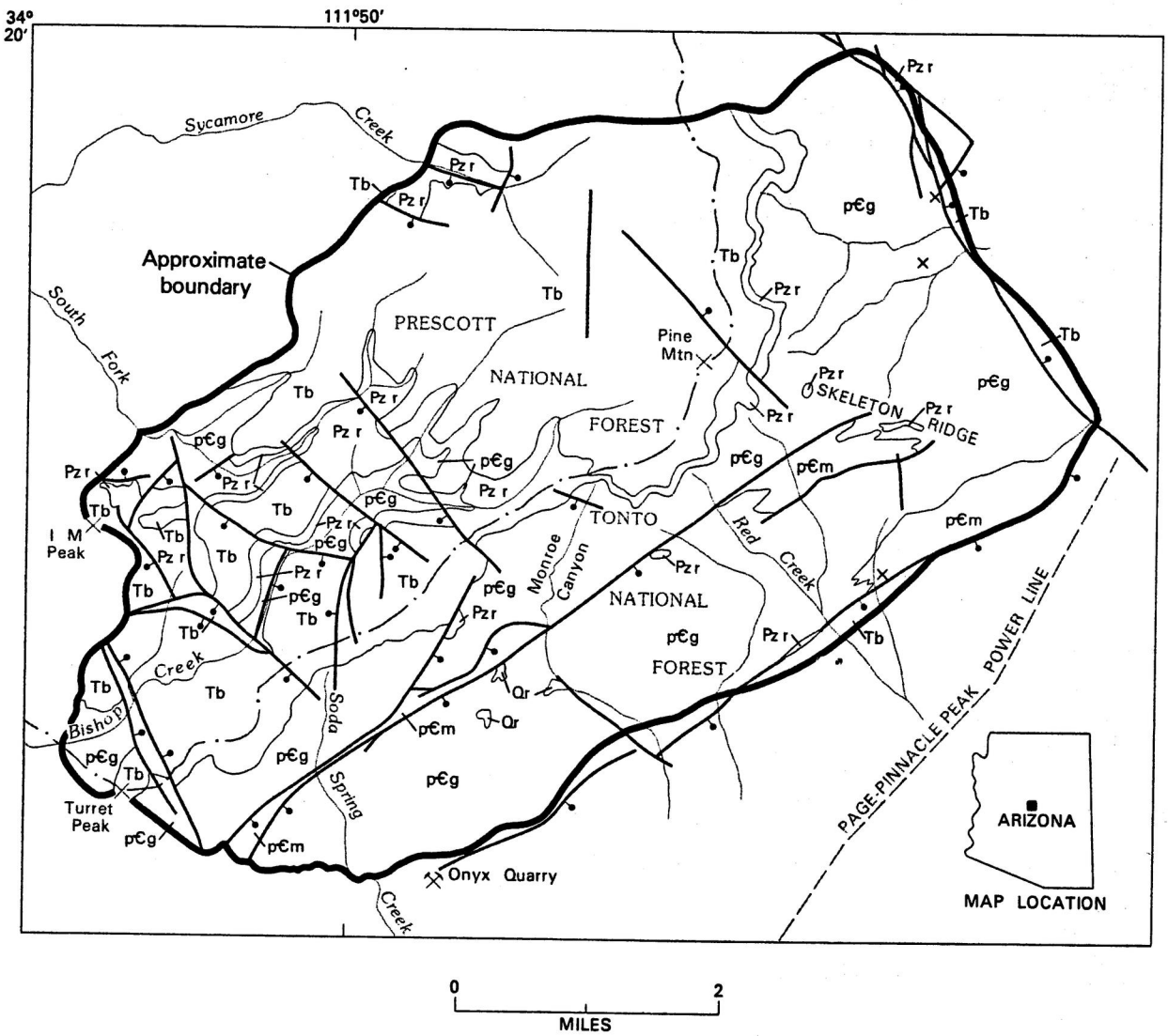

EXPLANATION

Qr	Rhyolite plugs (Quaternary)
Tb	Basalt (Tertiary)
Pzr	Limestone and sandstone (Paleozoic)
pЄg	Granitic rocks (Precambrian)
pЄm	Metamorphic rocks (Precambrian)

Contact

Fault--Bar and ball on downthrown side

× Mineral occurrence

Figure 25.—Pine Mountain Wilderness, Arizona.

from U.S.G.S. PP. 610

The Magma deposits are a series of disconnected ore shoots in replaced shattered country rock between two east-trending shear zones. The richest ore bodies are found along the Magma fault, where it intersects diabase. The principal ore minerals are pyrite, bornite, chalcopyrite, and enargite, with subordinate tennantite and hypogene chalcocite. In places sphalerite is the predominant sulfide; small amounts of galena accompany the sphalerite. Most of the ore bodies were enriched by supergene copper sulfides (Short and others, 1943, p. 74–78).

A considerable amount of gold ore has been mined from the Lake Superior and Arizona property and lesser amounts from similar gold lodes in the Belmont-Queen Creek area. The gold occurs in small lenticular ore bodies 10 to 20 feet above the base of the Martin Limestone (Devonian) and adjacent to faults. Gold, malachite, and chrysocolla occur in a gangue of iron and manganese oxides and quartz. Silver is associated with the copper minerals and gold (Short and others, 1943, p. 138).

SANTA CRUZ COUNTY

Santa Cruz County is in south-central Arizona along the Mexican boundary. Both lode and placer gold have been produced, but the placer output has been small. From 1900 through 1959, the county produced about 108,200 ounces of gold, mostly from the Oro Blanco district. From 1942 through 1959 gold production was very low.

ORO BLANCO DISTRICT

The Oro Blanco district is in western Santa Cruz County near Ruby, about 32 miles by road northwest of Nogales and about 70 miles by road south-southwest of Tucson. Deposits of gold and silver have attracted the most attention. Some of the gold deposits probably were worked by the Indians and early Spanish explorers. Placers and rich outcrops attracted early American prospectors who made their first locations in 1873 (Wilson and others, 1934, p. 188–189; Milton, 1913, p. 1005). The deposits were successfully exploited through the middle 1880's. Most of the mines were inactive from 1887 to 1893; thereafter mining was intermittent, and production in general was small. Production rose rapidly in 1934 but declined again in the early 1940's. From 1942 through 1959 the district was almost dormant. The gold mined in the district from 1873 through 1957 has been estimated as worth $2,626,000, which is equivalent to about [illegible] ounces (Wilson, 1962, p. 109). About [illegible] worth of placer gold was produced between 1896 and 1904. Production was not recorded for 1957–59.

Not much is known about the geology of the district. According to Wilson (Wilson and others, 1934, p. 189), metamorphosed sandstones, conglomerates, shales, and interlayered volcanic rocks of probable Cretaceous age overlie altered diorite, are intruded by dikes of basic to acid composition, and are complexly faulted.

The deposits are of three types: gold-bearing quartz veins, mineralized shear zones, and mineralized country rock. Pyrite, chalcopyrite, galena, and sphalerite are the common ore minerals, and the tellurides have been reported (Milton, 1913, p. 1006).

YAVAPAI COUNTY

Yavapai County, in the central part of Arizona, ranks first in the State in gold production through 1959.

The production by ounces is as follows:

	Lode	*Placer*
Prior to 1900 [1]	477,703	193,500
1900 to 1934 [1]	1,934,447	33,204
1935 to 1959 [2]	1,064,000	40,100
Total	3,476,150	266,804

[1] Elsing and Heineman (1936, p. 60).
[2] U.S. Bureau of Mines (1936–60). Includes 28,137 ounces for 1958 undifferentiated as to source.

The Jerome (Verde) district is the largest gold producer, having contributed about 1,565,000 ounces to the total lode production.

Though mineral deposits were known in this area long before the Civil War, the first prospectors were Union soldiers with mining experience from California (Wilson and others, 1934, p. 23). Placers at Rich Hill were discovered in 1862 and those along Hassayampa and Lynx Creeks were discovered in 1863 (Lindgren, 1926, p. 2–5). Silver ore, first discovered in the Big Bug district in 1870, was found at other localities in Yavapai County in the 1870's. Claims were located in the Jerome district in 1876.

The northern part of Yavapai County is in the plateau region, and the southern part is in the mountain region, which consists of a series of short mountain ranges of the fault-block type that trend north-northwest and are separated by broad valleys filled with fluvial and lacustrine deposits. The mountains consist chiefly of Precambrian metamorphic and igneous rocks, which are intruded locally by stocks, plugs, and dikes of granitic rocks of Late Cretaceous or early Tertiary age. Large areas are covered by volcanic rocks of Tertiary and Quaternary age.

The ore deposits, which are in the mountain region, consist of veins and replacement deposits of Precambrian age and veins of Mesozoic or early Tertiary age. Placer deposits have also been important.

AGUA FRIA DISTRICT

The Agua Fria district is southeast of Prescott along the headwaters of the Agua Fria River about 4½ miles northeast of Mayer. Both gold and silver are byproducts of copper ore.

The Stoddard mine in this district is one of the earliest locations in Arizona but no dates of discovery or location are known (Lindgren, 1926, p. 148). The district was active during World War I and into the early 1920's—probably its period of greatest production. From 1936 through 1957 the mines were operated intermittently. Total gold production through 1959 was about 12,710 ounces.

The rocks exposed in the district are chiefly schists of the Precambrian Yavapai Series, which are intruded by the Precambrian Bradshaw Granite. The Yavapai Series includes many quartz lenses and bodies of fissile quartz porphyry. The Precambrian rocks are capped locally by volcanic flows and tuffs of Tertiary age (Lindgren, 1926, p. 146–147).

The ore deposits are replacement bodies of quartz, pyrite, and chalcopyrite, and tetrahedrite in the schists.

BIG BUG DISTRICT

The Big Bug district, on the northeast slope of the Bradshaw Mountains, is about 12 miles east-southeast of Prescott. Copper, gold, silver, lead, and zinc are obtained from a variety of ore deposits in the district.

Wilson, Cunningham, and Butler (1934, p. 39) referred to activity at the Big Bug mine as early as 1866, and other properties were producing gold and silver from oxidized ores before 1870. After a period of decline, some mines were reopened in the late 1890's and maintained a small sporadic annual output through 1933. The tempo of mining increased from 1934 through 1959 mainly because of expanded operation of the Iron King mine. Gold placers were highly productive during the 1880's (Wilson, 1952, p. 48–50) and from 1933 through 1942, after which they declined in importance.

Total gold production from 1867 through 1959 was about 627,000 ounces, of which about 42,700 ounces was from placers.

The Yavapai Series, which here consists of interlayered sedimentary rocks and volcanic tuffs and breccias, was intruded by a variety of Precambrian granitic rocks—gabbro, diorite, granodiorite, and granite—and by dikes of rhyolite porphyry (Lindgren, 1926, p. 126–127; Anderson and Creasey, 1958, pl. 1). Tertiary volcanic rocks younger than the ore deposits locally form a cover.

Lindgren (1926, p. 127) recognized four classes of ore deposits in the district; however, the lead-zinc-silver veins of the Irón King mine have yielded the most gold, and the gold vein of the McCabe-Gladstone property has probably been the second largest gold producer.

The Iron King deposit is a system of 12 massive sulfide veins oriented en echelon in a mylonitized shear zone in the Spud Mountain Volcanics of the Precambrian Yavapai Series (Creasey, in Anderson and Creasey, 1958, p. 156–169). The wallrock is so intensely altered by hydrothermal introduction of quartz, sericite, and pyrite that in places the nature of the original rock cannot be determined. Two groups of veins are recognized in the deposit: well-defined massive sulfide veins, from which all but a few tons of the total ore has been mined, and poorly defined veins, chiefly of pyrite, ankerite, and quartz. The massive sulfide veins comprise thin layers of fine-grained pyrite, sphalerite, chalcopyrite, arsenopyrite, galena, and tennantite. Quartz and ankerite are the major gangue minerals. Gold is in the pyrite, and silver is probably in the tennantite.

The McCabe-Gladstone is one of several mines on the 14,000-foot-long Silver Belt-McCabe vein, a mineralized shear zone in the breccia facies of the Spud Mountain Volcanics. Ore occurs as discontinuous lenses or pods of coarsely crystalline drusy masses of sulfides, with numerous open vugs. The mineralogy of the ore is variable. Silver and lead are abundant in the ores at the north end of the vein. Toward the south end the ores are more complex and contain lead, zinc, iron, silver, copper, and gold. The McCabe-Gladstone mine, which is at the south end of the vein, is in ore composed of arsenopyrite, pyrite, chalcopyrite, and quartz. The gold and silver are in the sulfides (Creasey, in Anderson and Creasey, 1958, p. 169–171).

BLACK CANYON DISTRICT

The Black Canyon district is in southeastern Yavapai County between the eastern foothills of the Bradshaw Mountains and the Agua Fria River, at Bumblebee.

The first locations were made probably as early as 1873, but the first record of mineral production was in 1904. The district was active through 1956, with the highest output from 1934 through 1941. Total gold production from 1904 through 1959 was about 46,700 ounces.

A belt about 2 miles wide of Yavapai schist trends northward through the district and is flanked on the east by a narrow mass of diorite and Bradshaw Granite and on the west by Bradshaw Granite. These rocks, which are all of Precambrian age, are overlain in the eastern part of the district by volcanic rocks of Tertiary age (Lindgren, 1926, p. 153).

The gold ore is in Precambrian high-angle veins and in flat veins of a younger age (Lindgren, 1926, p. 156–159).

The Precambrian veins contain coarse glassy quartz and small amounts of chalcopyrite, pyrite, galena, sphalerite, and native gold. Aggregates of minute prisms of blue, brown, or colorless tourmaline are associated with the sulfides. The flat veins, which are also found in the Precambrian rocks, consist of quartz with a little pyrite, galena, chalcopyrite, and locally contain sphalerite and proustite. The gold in these veins is probably in the sulfides.

BLACK ROCK DISTRICT

The Black Rock district, about 12 to 15 miles northeast of Wickenburg, was prospected for copper and silver in the 1870's, but according to meager records the deposits were not developed until 1900 or later (Wilson and others, 1934, p. 62–65). Through about 1932 the district is credited with a gold production of $195,000 (9,438 ounces), most of which came from the Gold Bar (O'Brien) mine (Elsing and Heineman, 1936, p. 103). From 1932 through 1955 the district produced 2,754 ounces of gold, of which at least 99 ounces was placer gold. The total through 1959 was about 12,190 ounces.

The principal rocks of the region are schist and granite of Precambrian age, volcanic rocks (chiefly andesite) of Cretaceous(?) and Tertiary age, and local remnants of basalt of Quaternary age (Arizona Bureau of Mines, 1958).

The ore deposit in the Gold Bar mine is a fissure vein consisting of coarse glassy quartz with pyrite and free gold. In the oxidized zone the quartz is cellular; its cavities are filled with hematite and limonite formed from pyrite, which is common in the deeper zones. Gold occurs as fine to medium-coarse particles, both in the quartz and with the iron minerals (Wilson and others, 1934, p. 63–64).

EUREKA DISTRICT

The Eureka (Bagdad) district is in western Yavapai County, 42 miles west of Prescott. Most of the mines are near Bagdad in the southwestern part of the district.

Although the district is noted mainly for copper, its deposits were mined originally for silver, gold, and lead. The first claims were located in 1880, and mining began in 1887. Until 1917 most production was from ores rich in gold and silver, with subordinate lead and zinc, from the Hillside mine. Copper minerals were known in the district as early as 1882; however, sporadic exploration through the early 1900's failed to disclose any significant copper ore bodies until 1929 when the Bagdad mine began operations. Gold and silver production from the Hillside mine and several smaller properties continued until 1942, when the Hillside mine was closed. Meanwhile the Bagdad mine expanded due to the demand for copper during World War II. Large-scale activity continued after the war. The Hillside mine was reopened during 1948–51; open-pit mining increased the Bagdad mine production after 1947; and other properties were developed to mine tungsten and zinc. Copper output at the Bagdad mine continued to be significant through the 1950's, and in 1959 it was the largest copper producer in the county.

Total gold output of the district from 1887 through 1951 was 59,787 ounces, of which 58,748 ounces is attributed to the Hillside mine (Anderson and others, 1956, p. 46, 84). From 1952 through 1959 the district produced only 179 ounces of gold. The copper ores at the Bagdad mine yielded insignificant amounts of gold.

Most of the bedrock in the Eureka district is of Precambrian age and consists of metamorphosed volcanic and tuffaceous sedimentary rocks and intrusive masses of rhyolite, gabbro, anorthosite, quartz diorite, diabase, alaskite, granodiorite, and granite. Rhyolite tuff of Cretaceous(?) or Tertiary (?) age unconformably overlies the Precambrian rocks in the southwestern corner of the area, and small stocks, plugs, and dikes of quartz monzonite, quartz monzonite porphyry, and diorite porphyry, slightly younger than the rhyolite tuff, are scattered throughout the older terrain. A thick section of Tertiary and Quaternary clastic sedimentary rocks intercalated with basalt and rhyolite flows and tuffs caps the mesas and overlaps the older rocks (Anderson and others, 1956, p. 6–29). The Precambrian rocks show effects of folding, dynamic and thermal metamorphism, and several periods of faulting. Faulting continued during at least three periods in post-Precambrian time, when some of the major faults related to the mineral deposits were formed (Anderson and others, 1956, p. 29–39).

The gold-silver-zinc-lead deposit at the Hillside mine is a fissure vein in the Hillside fault, which

trends N. 10° W. to N. 25° E. and dips steeply to the west in the mine vicinity. The mineralization was related to the quartz monzonite intrusions and occurred during Cretaceous or early Tertiary time. Postmineral faulting, resulting in gaps and overlaps of ore, is a factor to be considered in exploiting these deposits. The hypogene vein minerals are pyrite, arsenopyrite, galena, sphalerite, argentite, chalcopyrite, freibergite, and tetrahedrite in a gangue of quartz. Most of the gold is associated with pyrite and arsenopyrite. The upper part of the vein is oxidized to limonite-stained quartz and variable amounts of gold, silver, cerargyrite, cerussite, malachite, chalcanthite, and goslarite (Anderson and others, 1956, p. 77–79).

HASSAYAMPA-GROOM CREEK DISTRICT

The Hassayampa-Groom Creek district is on the western slopes of the Bradshaw Mountains, 6 miles south of Prescott.

Gold placers were discovered in 1864 along the Hassayampa River, and shortly afterward many quartz veins were found. Considerable gold and silver was extracted from the shallow oxidized parts of these veins, and after 1895 the primary sulfide ore was mined for gold, silver, copper, lead, and zinc (Wilson and others, 1934, p. 41). The placers were worked most intensively between 1885 and 1890; thereafter, operations were carried out on a small scale (Wilson, 1952, p. 52). From 1953 through 1959 the district produced only a few ounces of gold per year from lodes and placers.

Total gold production through 1959 was about 127,000 ounces—18,700 ounces from placers and 108,300 ounces from lodes. Schists of the Yavapai Series and the Bradshaw Granite, the oldest rocks of the district, were intruded by several small masses of diorite and granodiorite and dikes of rhyolite porphyry, all of Precambrian age (Lindgren, 1926, p. 114–115, pl. 2).

Most of the ore deposits are in fissure veins in the schist, a few are in the granite and diorite. The ore consists of pyrite, arsenopyrite, sphalerite, galena, chalcopyrite, and local tetrahedrite, in a gangue of quartz and a little carbonate. Gold is associated with quartz and sulfides, and in some deposits, with specularite. Some veins are of Precambrian age, others are of probable Tertiary age (Lindgren, 1926, p. 114–126).

JEROME DISTRICT

The Jerome (Verde) district is on the eastern slope of the Black Hills in northeast Yavapai County just west of the Verde River. Both gold and silver have been produced as byproducts of copper mining from the two major mines in this district—the United Verde and the United Verde Extension.

Centuries ago the copper ores at Jerome were utilized by Indians for jewelry and dyes. In 1582 and 1598 Spanish explorers visited the deposits and located claims, though they did not work them. The deposits remained unnoticed and undeveloped until their rediscovery in 1875 by U.S. Army troops. In 1876 prospectors entered the area, and by 1882 the newly organized United Verde Copper Co. began consolidating the numerous claims and later became the largest producer of the district. Oxidized ores rich in gold, silver, and copper were mined in 1883–84, but by the end of 1884 the ore was exhausted and the price of copper dropped, so that work was suspended at the United Verde property until 1888. Prospecting elsewhere in the district in the early 1900's was successful, and for a time several small mines were active. The United Verde Extension Gold, Silver, and Copper Mining Co. was organized in 1899, and under its successors it became the second largest mine of the district. In the early 1900's the United Verde Extension Co. explored extensively, first to the southwest and later east of the prospering United Verde property. Most of these efforts were fruitless; nevertheless, work continued until the company was on the verge of collapse. Finally in 1914, a rich chalcocite ore body was found on the 1,200 level, and in 1916 a much larger ore body was found. The company operated on a large scale until 1938 when the deposit was mined out and the mine was closed.

The United Verde mine continued its underground operations until 1931, after which open-pit mining was the chief activity. Depletion of reserves finally forced the mine to close in 1953 (Anderson and Creasey, 1958, p. 84–90).

The large-scale copper mining yielded a total of about 1,565,000 ounces of byproduct gold from 1883 through 1951 (Anderson and Creasey, 1958, p. 101). Total gold production from 1883 through 1959 was about 1,571,000 ounces.

Most of the central and southern parts of the Jerome district are underlain by slate, phyllite, schist, gneiss, and granulite that make up the Yavapai Series of Precambrian age. These rocks are intruded by numerous irregular bodies of quartz porphyry, gabbro, quartz diorite, and granodiorite, also of Precambrian age. Paleozoic sedimentary rocks, which cover parts of the northern half of the district, overlie the Precambrian rocks unconformably and range in age from Cambrian to Pennsylvanian or Permian. Rocks of Mesozoic age do

not occur in the district; a thick section of lava flows and intercalated sedimentary rocks of Pliocene(?) age and lake deposits of late Pliocene and Pleistocene age overlap the older rocks (Anderson and Creasey, 1958, p. 8–61).

The Precambrian rocks were deformed during several periods of faulting and folding. Later faulting, accompanied by tilting, displaced the Paleozoic and Cenozoic rocks (Anderson and Creasey, 1958, p. 62–83). The important ore deposits of the district are massive sulfide deposits of Precambrian age. At the United Verde mine the main ore body was a pipelike mass of pyrite, chalcopyrite, sphalerite, quartz, and carbonates that replaced quartz porphyry and tuffaceous sedimentary rocks. The deposits of the United Verde Extension mine were buried beneath a cover of Paleozoic and Tertiary sedimentary rocks. Ore consisted of elliptical masses of chalcocite in Precambrian rocks. Massive sulfide, similar in composition to the United Verde ore body, underlies the chalcocite. In both mines the sulfide ore bodies were overlain by oxidized zones containing iron oxides, malachite, azurite, chrysocolla, gold, silver, and native copper (Anderson and Creasey, 1958, p. 103–145).

LYNX CREEK-WALKER DISTRICT

The Lynx Creek-Walker district is about 7 miles southeast of Prescott. Lynx Creek is one of the most productive placer streams in the State; moreover, lode mines in the Walker camp have yielded considerable gold, silver, copper, and lead.

The placers were discovered by a party of California miners in 1863, and as they worked upstream they found the gold-bearing veins of the Walker camp (Lindgren, 1926, p. 108–109). The richest placers were depleted in the early days, but small and intermittent placer operations continued for many years. From 1927 through 1941 large-scale dredging operations were successful, but from 1942 through 1959 the placer mining was desultory and was carried out on a small scale. In the Walker camp only oxidized ore was mined in the early years and was worked in arrastres. Deep mining into the sulfide zone presumably was begun some time before 1910. Lode production probably was never very large, and it fluctuated considerably but was almost continuous from 1905 through 1952.

According to Lindgren (1926, p. 109) the placer output through 1924 was about $1 million, most of which was extracted in the early years. Wilson (1952, p. 39, 42) reported that production before 1881 was estimated at $1 million (48,379 ounces), and from 1900 to 1949 it was about $1 million, mostly during 1933–42. Total gold output of the district through 1959 was about 140,000 ounces: 97,000 ounces from placers and 43,000 ounces from lodes.

Underlying the district are schists of the Yavapai Series and the Bradshaw Granite intruded first by a granodiorite stock and later by a number of rhyolite porphyry dikes. The ore deposits are in sulfide-bearing quartz veins that transect the granodiorite. Ore minerals are pyrite, sphalerite, chalcopyrite, galena, and tetahedrite. Gold is contained in chalcopyrite, and gold and silver seem to be associated with galena and tetrahedrite. The ores were mined mainly for gold (Lindgren, 1926, p. 111).

MARTINEZ DISTRICT

The Martinez district is in southwestern Yavapai County in the southeastern Date Creek Mountains a few miles northwest of Congress.

Gold was produced almost entirely from quartz veins and mostly from the Congress mine. The first discoveries were made in 1870, but the ore was not free milling and thus progress was impeded until a cyanide plant was built in 1895. High production was maintained until 1910 (Wilson and others, 1934, p. 69–71). Except for a span of intensive operation by lessees during 1938–42, the mine was virtually idle from 1910 through 1959. The total minimum gold production of the Congress mine from 1887 through 1959 was about 396,300 ounces.

The eastern Date Creek Mountains consist of coarse-grained granite, intruded by pegmatites, aplites, and basic dikes. The gold deposits are along low-dipping faults in veins that consist of coarse-textured quartz with pyrite and some galena (Wilson and others, 1934, p. 69). At the Congress mine the most productive veins are within the basic dikes, mostly near their footwalls. Veins in the granite are of lower grade; they carry small amounts of galena and larger amounts of silver (Staunton, 1926, p. 769). Ore has been mined to a depth of 4,000 feet.

PECK DISTRICT

The Peck district is in the drainage area of Peck Canyon and Bear Creek, about 20 miles south-southeast of Prescott.

Rich silver ore was discovered in the Peck mine in 1875, and in the following 10 years $1 to $1½ million worth of silver was mined. Other silver deposits were found in the late 1870's. By 1885 the rich ore of the Peck mine was depleted, and work in the succeeding years was mainly by lessees. In the

early 1900's copper-silver properties were developed which yielded considerable byproduct gold. From 1932 through 1959 the district was for the most part inactive. Total gold production from 1890 through 1959 was about 15,550 ounces.

The area is underlain by Precambrian rocks, chiefly the Yavapai Series, which here includes quartzite and layers of amphibolite, chlorite, and sericite schist. The belt of schist, about 2 miles wide, lies between areas of Precambrian Bradshaw Granite. Porphyry dikes intruded the schist parallel to its strike (Lindgren, 1926, p. 160).

The veins, found in the quartzite and schist, are parallel to the foliation. The rich silver-bearing veins contain a gangue of siderite or ankerite, which near the surface is almost wholly oxidized to limonite. The principal ore minerals are bromyrite and subordinate native silver, but locally the veins contain chalcopyrite and silver-rich tetrahedrite. The copper-rich ore bodies found in the De Soto mine are overlapping lenses of fine-grained quartz in the chloritic schist of the Yavapai Series. They contain pyrite, chalcopyrite, some sphalerite and galena, and sparse tetrahedrite and arsenopyrite (Lindgren, 1926, p. 161–163). Gold occurs as microscopic grains in the sulfides.

PINE GROVE-TIGER DISTRICT

The Pine Grove-Tiger (Crown King) district is in the heart of the Bradshaw Mountains 40 miles by road southeast of Prescott; the Tiger camp lies immediately south of the Pine Grove camp. The ores, which were very rich in silver and gold near the surface, also contained significant amounts of copper, lead, and zinc.

A few mines in this district were worked as early as 1874, but there is little indication of any significant development until after 1890. The Crown King mine, the most important gold property of the district, was most active between 1893 and 1900 (Lindgren, 1926, p. 168). More recent productive flurries occurred during 1903–23 and 1934–51. The total gold production through 1959 was about 130,275 ounces.

Bedrock in the district consists of Precambrian Yavapai Series and Bradshaw Granite which are intruded by a stock and dikes of granodiorite of Mesozoic or Tertiary age and by younger dikes of rhyolite porphyry and granite porphyry (Lindgren, 1926, p. 21–23, 164–176).

The ore is in veins which are most abundant in the granodiorite; a few extend into the surrounding rocks. The vein minerals are pyrite, chalcopyrite, sphalerite, galena, and some tetrahedrite in a gangue of quartz with a little ankerite and calcite. In some of the sulfide ore, native gold is present. Much of the mined ore was partly oxidized and rich in gold and silver (Lindgren, 1926, p. 164–165).

TIPTOP DISTRICT

The Tiptop district is in the southern foothills of the Bradshaw Mountains in southeastern Yavapai County, about 45 miles north-northwest of Phoenix.

The history and production of the district is mainly that of the Tiptop mine (Lindgren, 1926, p. 180). This mine, located in 1875, yielded about $2 million probably all in silver and gold, before 1883, when it was closed. The mine was reopened from 1886 to 1888, but apparently it has been closed since that time. A small amount of tungsten ore was mined, probably during World War I. Since then the district has been dormant, except for minor activity during the 1930's and early 1950's. Lindgren (1926, p. 180) considered the estimated total production of $4 million somewhat high. Total gold production through 1959 was about 10,000 ounces.

The host rock is the Bradshaw Granite which intruded a north-trending belt of Yavapai Series, exposed just east of the district. The granite is cut by dikes of rhyolite porphyry and is overlain by a remnant of Tertiary lava flows at the south end of the district (Lindgren, 1926, p. 179–180).

The ore deposits are fissure veins in the granite. The principal gangue mineral is fine to coarse quartz, and some druses are coated with chalcedony. The ore minerals, in paragenetic order, are wolframite, arsenopyrite, pyrite, sphalerite, bornite, and galena. Cerargyrite and ruby silver were common in the oxidized ore; antimonial silver minerals and native silver were probably also present. Some veins rich in galena contained gold and some silver (Lindgren, 1926, p. 181–182).

WEAVER-RICH HILL DISTRICT

The Weaver-Rich Hill district is in southwestern Yavapai County along the southwestern front of the Weaver Mountains, 5 to 8 miles east of Congress. Both lodes and placers have been important sources of gold in this district.

An accidental discovery of gold nuggets on top of Rich Hill in the early 1860's kindled interest in the area and before long gold placers along Weaver and Antelope Creeks and the lode deposit at the Octave mine were found (Wilson, 1952, p. 43). By 1883 the placers had yielded $1 million in gold, but thereafter the deposits were worked sporadically and were idle from 1952 through 1959.

Little development of the Octave mine was attempted until the perfection of the cyanide process in the 1890's. Between 1900 and 1905 gold and silver ore worth $1,900,000 was mined. Activity declined after 1905, and the mine was closed in 1930. Under new ownership of the American Smelting and Refining Co., the mine was reopened in 1934 (E. D. Wilson, in Arizona Bureau of Mines, 1938, p. 131) and was worked until December 1942 (Woodward and Luff, 1943, p. 258). Lode production of the district declined sharply in 1943 and was negligible through 1959.

Placers in the district are credited through 1959 with about 104,000 ounces of gold and lodes with about 204,000 ounces, a total of 308,000 ounces. All but about 1,500 ounces of the lode gold came from the Octave mine.

The country rock of the district is mainly granite and quartz diorite with lenses and septa of schist. These rocks are cut by dikes of pegmatite, aplite, and diabase (Wilson and others, 1934, p. 66–68).

The veins in the district occur along low-angle fault zones that are chiefly in the granite, but some are in the schist. The main Octave vein, which is in granitic rocks (Nevius, 1921, p. 123), consists of coarse white quartz that carries irregular masses, disseminations, and layers of fine-grained pyrite, galena, and sparse sphalerite and chalcopyrite and a little native gold. Most of the gold is contained in the galena (Wilson and others, 1934, p. 67, 68).

YUMA COUNTY

Yuma County, in the southwest corner of Arizona, ranks fourth among the gold-producing counties of the State. The terrain includes many mountains of the fault-block type that trend north-northwest and are separated by broad desert plains. The bedrock of the mountains consists of schist, gneiss, and granite of Precambrian age, sedimentary and metamorphic rocks of Paleozoic, Mesozoic, and Tertiary age, granite of Tertiary age, and volcanic rocks of Cretaceous to Quaternary age (Wilson and others, 1934, p. 124). Nine mining districts, mainly in the central and western parts of the county, have had a total output of more than 10,000 ounces of gold each.

The mines of Yuma County produced a total of about 771,000 ounces of gold through 1959.

CASTLE DOME DISTRICT

The Castle Dome district is in south-central Yuma County in the southern Castle Dome Mountains, about 20 to 25 miles north of Wellton.

Organized in 1863, the Castle Dome district has produced about equal amounts of placer and lode gold. The first discoveries were of silver-bearing lead ore; gold placers were found in 1884, and gold-quartz veins, although known for some time, received little attention until 1912 (Wilson, 1933, p. 85, 87; 1952, p. 23). Activity in the district has been sporadic, and from 1942 through 1959 the mines were dormant. Total gold production through 1959 was between 9,500 and 10,500 ounces.

In the Castle Dome district gneiss, schist, and granite, all probably Precambrian in age, are unconformably overlain by thick-bedded shales and impure cherty limestones of Cretaceous(?) age. These rocks were intruded by numerous dikes of diorite porphyry. Broad areas of the older rocks are capped by volcanic rocks and cut by dikes of rhyolite porphyry (Wilson, 1933, p. 78–81).

The mineral deposits in the district are argentiferous galena-fluorite veins, gold-quartz veins, and some veins that carry copper, gold, and silver. The deposit of the Big Eye mine, one of the major gold producers, occurs in a sheared zone in volcanic rocks. The vein consists of brecciated yellow quartz interlaced with veinlets of calcite. The gold was probably free milling and did not continue in minable quantities below depths of 30 feet (Wilson, 1933, p. 102–103).

CIENEGA DISTRICT

The Cienega district is in northwestern Yuma County, 5 to 8 miles northeast of Parker.

Some mining was done as early as 1870 (Wilson and others, 1934, p. 126). Gold-copper lodes developed during 1909–20 had small sporadic yields. Intermittent activity continued through 1957.

Nolan (in Hewett and others, 1936, p. 31) estimated that the district produced ore worth $80,000 (chiefly in gold) before 1908, but Elsing and Heineman (1936, p. 104) credited the district with $415,000 (about 20,000 ounces), from 1870 to 1933, most of which must have been mined before 1908 because recorded production from 1908 to 1933 was only 4,271 ounces. Total gold production through 1959 was at least 10,000 ounces.

A thick section of Paleozoic metamorphosed sedimentary rocks, consisting of limestone, shale, and quartzite, is the predominant bedrock in the district. These rocks are cut by intrusive bodies of granite and are overlain locally by basalt. Gold, chrysocolla, malachite, limonite, and specularite occur in brecciated pockets of sedimentary rock along shear zones.

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