CONTACT INFORMATION
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Note: Field Exam. July 15-17, 1968.

Porphyry Flat Project:

Area 6. Groom Creek. Large basin of granodiorite with small color zones. No pervasive types noted. Diorite found as float but no outcrops noted: INTEREST.

Area 7. Lynx Creek. Small basin of granodiorite. Some color. INTEREST.

Area 8. Big Bug Prospect. See Beck-Sell files. Area of granodiorite with breccia zones. Some moderate pervasive alteration with minor pyrite-chalcopyrite-molybdenum. Some drill holes, low values. Apparently on south end of large granodiorite stock. INTEREST to check remaining portions of stock.

Area 11. Pine Flat Prospect. See Beck-Kennison files. Area of Tertiary intrusives but are small. Some drill holes (rotary are old holes, but several new ddh's) but values are probably low. Raymond Lasmanis located ddh's. NO FURTHER INTEREST.

Area 12. Mule Canyon. Total area in Texas Gulch formation with fault contact with Dion King Volcanics on east. No color zones or mineralization noted. NO FURTHER INTEREST.

Area 13. Bottle Flat. Northern area is highly gneissic but does have somewhat of a look of monzonite. A few colored areas noted as well as diorite float. J&P (folio 124) says basin is monzonite but Blacet (Open file) says it is dacitic member of Spud Mtn volcanics. FURTHER INTEREST as probably some intrusive material is present and my examination was short & confined to north end.

Area 14 Goodwin P.O. Mainly area of schist but minor granodiorite and diorite (?) found in stream fragments. Upper end (Dandrea Ranch cutoff) the schist is highly colored and deserves further work. Man-wife working gold bars at Turkey Creek where road crosses - have found few 1/4" flat flakes but most ~~are~~ is very fine flat particles. He says, new silver strike 1 mi above Dandrea Ranch. NO FURTHER INTEREST in main basin but area around Dandrea Ranch deserves check.

Area 16 Palace Station. Area of Bradshaw gr type within Crooks Complex. No further rock types noted. Some color along road to north, near Venezia, with dikes of granodiorite in Crooks Complex. INTEREST on north side.

Area 25. Copper Basin. Area of sufficient size containing numerous breccia pipes (Tertiary) cutting granodiorite et al complex. Has been drilled & examined several times. Rather low grade copper-moly values in limited tonnages. North area contains gold values of unknown extent as well as exposures of copper-moly. Gold in general associated with contacts along quartz latite porphyry dikes, however, all rocks visibly sheared & contain some oxidized veinlets. Sulfide mineralization generally 30-40 feet from surface. May have up to 30' of fill -

Mr. White estimates 2 million yds of gravel containing #2-#4 gold values. No estimate of gold content in sulfide zone (that is pannable). ASARCO files report #0.25 gold in pipe areas to south. INTEREST depends on gold content of submitted samples.

Examination:

8 areas

3 (Big Bug, Pine Flat, & Copper Basin) contain pervasive alteration & interesting mineralization.

1 (Mule Canyon) had no intrusive rock - No further interest.

4 show some possible intrusive material but only few color zones. Need further checking.

~~237 3.08~~

Not on any list

Copper Basin (Tiger Dist.) Sec. 2, 3, 10, 11 T9N, R1W.

(East of Fort Misery, Crown King Quad).

Fil Aa 25.20.3

Qtz monzonite intruded by diorite porphyry

2000 EW x 800' NS.

Mineralization localized in 400-800' zone periphery to dio. porp.

Py, cp & moly.

Ave of 9 holes 0.137% Cu & 0.017% Mo. {Cu 0.07 - 0.30; Mo. 0.004 - 0.028}

Center of area near E¼ corner of Sec. 10, T9N, R1W.

J. H. C.
JUN 9 1965

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona
June 8, 1965

TO: J. H. COURTRIGHT

FROM: D. B. BECK

PINE FLAT
TURKEY CREEK MINING DISTRICT
BRADSHAW MOUNTAINS
YAVAPAI COUNTY, ARIZONA

Pine Flat is a small porphyry copper deposit surrounded by unaltered schist which contains small quantities of disseminated pyrite. The flat consists of a western zone of generally unaltered diorite porphyry with disseminated pyrite plus minor amounts of other sulfides; and an eastern zone of altered porphyry with disseminated limonite after pyrite and some "live limonite." Reconnaissance mapping along with some geochemical sampling indicates that Pine Flat is too small and probably of too low grade to be of interest. John Kinnison visited the alteration zone with me one afternoon and agrees with the above conclusion.

Pine Flat is reached by taking a fair dirt road west out of Mayer (located on State Highway 69 between Prescott and the Black Canyon Highway) for approximately eight miles. A Mr. C. C. Woodburn of 1421 Woodland Avenue, Des Moines, Iowa owns most of the ground in Pine Flat.

The altered and/or mineralized rock occupies a pine-covered basin surrounded by ridges of schist striking in a north-northeast direction. The basin is composed of altered porphyry, at least two rhyolite porphyry dikes, granodiorite, diorite porphyry and alluvial fill. Some small brecciated areas, which might be pipes, are located west and northwest of Pine Creek which runs south through the basin (see attachment). The flat can be divided into two zones: (1) a west and northwest zone which consists of the brecciated areas along with fresh and weakly altered diorite porphyry and fresh granodiorite porphyry, and (2) a central and eastern zone which consists of moderate to well altered porphyry and rhyolite porphyry.

The west zone generally consists of fresh diorite porphyry and granodiorite porphyry which contains pyrite, chalcopyrite and minor amounts of disseminated molybdenite in seams and spots, especially near Pine Creek. About 500' north of the road to Mayer on the west bank of Pine Creek is a shaft about 25' deep in diorite. Selected samples collected from a nearby dump ran 0.4% to 2.35% Cu and 0.015% to 0.675% Mo. Some galena was also noted. Two rock samples a short distance from the shaft assayed 0.3% Cu and 0.01% Mo. The brecciated zones are cemented with limonite after pyrite, and some "live limonite." One sample from a breccia-tion zone near the road assayed 0.02% Cu and 0.006% Mo.

The central portion of the flat contains two hills trending north with an areal extent of 500' by 1500' and generally surrounded by alluvium. These hills consist of a well altered (sericite-clay) leached porphyry which once contained up to 5% sulfides (visual estimate). Much limonite after pyrite boxwork and lesser amounts of "live limonite" occur along with a few bright yellow spots which may be moly ocher. Within this zone were found three old air rotary holes with their cutting piles still visible. These cuttings were assayed for copper, molybdenum and silver, with the following results from Jacobs in Tucson:

Rotary Hole No.	Cu	Mo	Ag
1	0.09%	0.011%	0.3 oz.
2	0.14%	0.024%	0.3 oz.
3	0.02%	0.007%	0.1 oz.

Only in hole No. 2 was I sure that primary sulfides had been reached.

Another small hill located on the eastern edge of the basin consists of a moderately altered (sericite-clay) rhyolite(?) porphy-ry. This rock also contains disseminated cavities of limonite after pyrite with some "live limonite."

The basin, which measures about 3000' by 3000', is topographically surrounded by Yavapai schist which contains some pyrite, but no chalcopyrite. The schist seems to be altered in some areas, but is probably due to the original introduction of pyrite during Pre-Cambrian metamorphism and is not related to the Laramide(?) intrusives present in the basin. One-half mile north of Pine Flat is the older Cumber-land Mine located on a gold quartz vein in schist. The shaft is said to have been 350' deep and although much pyrite and some galena and chalcopyrite was found on the dump, no disseminated material was noted.

The following table summarizes the results from 32 rock chip samples taken in the Pine Flat area. Sample locations are shown on the attachment with the results given in parts per million.

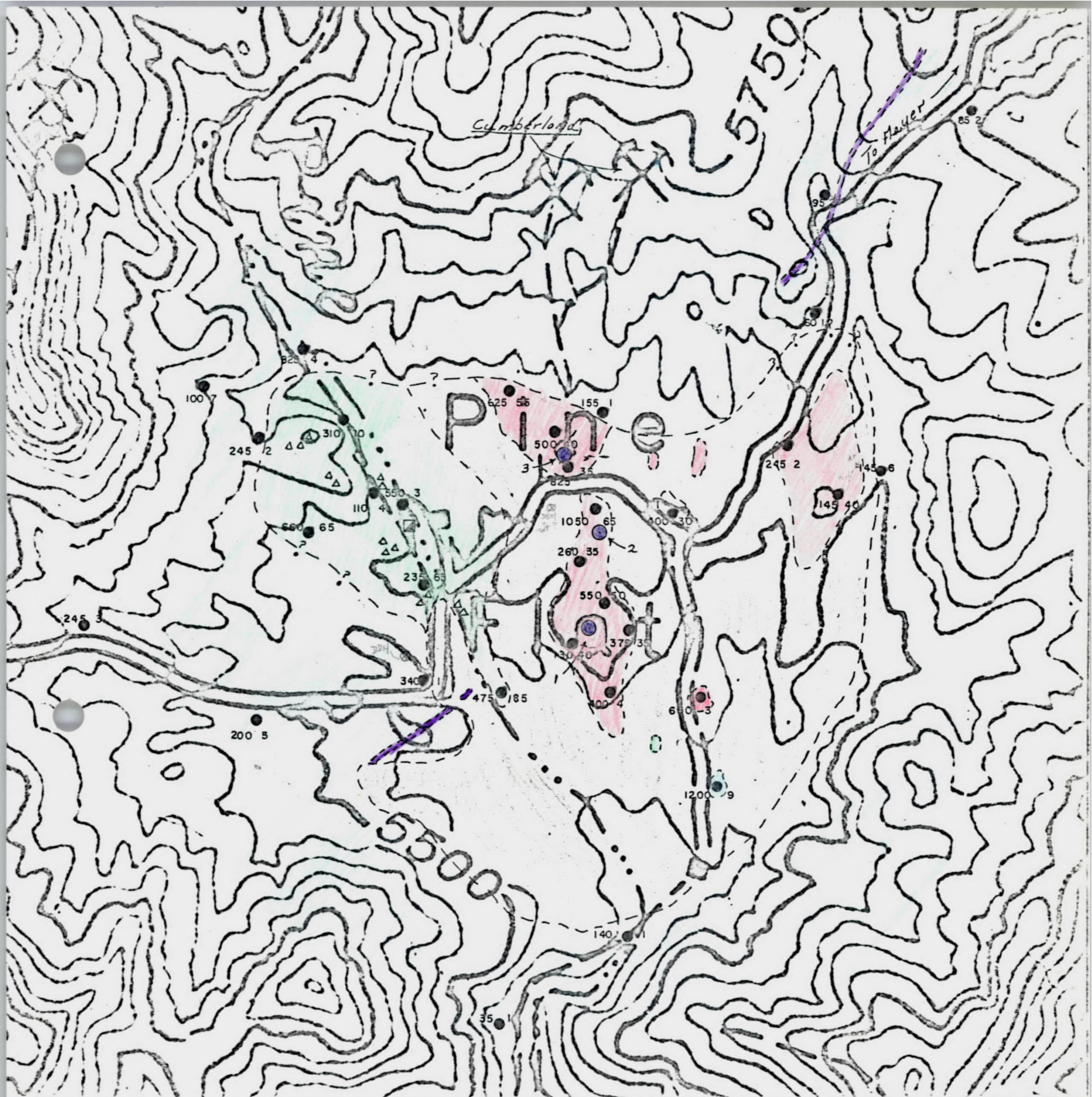
	Cu	Mo
Fresh Schist (average of 10 samples)	135	2
Altered Schist (average of 3 samples)	800	5
Altered Rhyolite(?) (average of 2 samples)	200	20
Fresh Diorite & Granodiorite (average of 6 samples)	400	40
Altered Porphyry (average of 11 samples)	525	40

Although the altered porphyry runs higher than the other rocks in the geochemical determinations, it was felt that due to the size of the area involved, and the assays from the rotary hole cuttings that no further work was necessary.

David B. Beck

DAVID B. BECK

DBB/jak
cc: JEKinnison



EXPLANATION

- Alluvium
- Rhyolite Porphyry Dikes
- Altered Porphyry (Includes Granodiorite, Rhyolite and Quartz Porphyry)
- Generally Unaltered Diorite Porphyry (Includes some Brecciation and Granodiorite)
- Yavapai Schist
- Air Rotary Hole

GEOLOGIC AND GEOCHEMICAL MAP

PINE CREEK FLAT

Turkey Creek Mining District
YAVAPAI COUNTY, ARIZONA
Scale 1" = 800' Approx.

Rock Chip Sample Location

100 25
Cu P.P.M. Mo P.P.M.

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

November 8, 1966

TO: J. H. COURTRIGHT

FROM: J. E. KINNISON

PINE FLAT
TURKEY CREEK MINING DISTRICT
PORPHYRY COPPER PROSPECT
YAVAPAI COUNTY, ARIZONA

I obtained the following new information on the subject heading from David Lowell, Consulting Geologist from Tucson, November 2, 1966.

As you may recall, Pine Flat is a small but typical porphyry copper altered zone located 8 miles west of Mayer. The leached capping is moderately to strongly sericitized, and contains principally limonite after pyrite with a small amount of "live" limonite. David Beck first noted and then mapped the altered zone about 1-1/2 years ago. I spent one day in the field with Beck, and concurred with his mapping and analysis of the prospective potential. In his memorandum to you (6/8/65) Mr. Beck concluded ". . . Pine Flat is too small and probably of too low-grade to be of interest."

Mr. Lowell had supervised exploration of Pine Flat two or three years ago, and he furnished me with data on the air rotary holes found by Mr. Beck. I don't know if Lowell was a consultant only, or whether he was a participating interest. He stated that the copper values obtained from the drill cuttings assayed .19% Cu as chalcopyrite. This was the average for each individual drill hole--an unusual situation. The presence of molybdenum was not mentioned in our conversation. Chalcocite is reportedly present in trace amounts only beneath the leached capping, and did not add significantly to the assays. Lowell is no longer associated with the property.

Lowell also stated that COMINCO is drilling on the south part of the altered zone and that they have "several" drill rigs operating. Reliable rumor suggests that COMINCO has developed a small tonnage of sub-marginal grade. Mr. Lowell surmises that they don't want to drop the property at this time, but also realize that they do not have an orebody.

I suppose the helicopter reconnaissance crew have seen these drills and have noted their approximate location.

COMMENTS

Mr. Beck's conclusions regarding the prospective value of Pine Flat are now verified. In his memorandum he stated that he could be sure that sulfides were contained in only one pile of the discarded cuttings. A sample of these cuttings assayed .14% Cu and .024% Mo.

As I recall the drill cuttings found near the drill sites appeared to have been tossed to the edge of the drill site. They were not layed out in an orderly fashion. It was not at all clear whether these were split rejects or merely portions of the hole which had not been samples. Possibly they represented a cleaning-out of the hole which had caved in.

The leached capping appeared to be derived mostly from pyrite, and that copper sulfides were minor. Tat these holes, as reported by Lowell, did contain as much as .19% Cu in the form of chalcopyrite; and that alteration in porphyry of a typical quartz-sericite type with 5% total sulfide leads to the following conclusion:

> Conditions in this area were 1) never favorable for the formation of chalcocite in any quantity, or 2) that the more common history during the Mid-Tertiary in the southwest prevailed and formed chalcocite during the time--during the most recent mountain up-life these secondary chalcocite zones have been eroded and/or leached. The second assumption above seems to me the most likely, and the high ridges should naturally receive the closest attention in exploration. Unfortunately, Mr. Beck has observed that the altered porphyry intrusives in the Bradshaw Mountains tend to form topographically low areas.

JOHN E. KINNISON

JEK:pjc
cc: WESaegart

3.0.0

AMERICAN SMELTING AND REFINING COMPANY
TUCSON ARIZONA

May 8, 1974

FILE MEMORANDUM

Pine Flat (Yavapai County)
East Johnson Camp (Cochise County)
Superior Oil Data

During the recent luncheon on the Copper Resources of the World Map, I chatted with Ben Dickerson of Superior Oil.

He stated that they drilled some 40 holes in the Pine Flat area and have some 20 million tons of 0.45% copper. They own several patented claims plus the unpatented claims. COMINCO has a 24% interest in the area. Ben states that they are interested in peddling the area to an interested party. He also feels that they have drilled out all the extension possibilities except in depth; no statement as to what their drilling depth had been. Very little chalcocite.

Ben also mentioned that at East Johnson Camp they were taking 8" diameter core hole samples for metallurgical work. He stated they had 50 million tons of 0.65% copper. The several cross-sections shown by Ted Eyde in several AIME Preprints suggest highly tilted blocks of mineralization with strong fault and lithological control.

He also stated that he knew of a deposit which has been drilled for the past several years that contains 350 million tons of 0.45% copper which was not on the World Copper Map. He would only suggest it was located between central Mexico and the Highland Valley area of Canada.

James D. Sell
James D. Sell

JDS:lb

October 28, 1968

To: Mr. J. H. Courtright
From: Mr J. W. Sell

Big Bug Mesa Examination
Mt. Union Quadrangle
Yavapai County, Arizona

Summary and Conclusions

Conclusive evidence for suspecting a hidden porphyry copper type ore body under the basalt cap of Big Bug Mesa was not found during a recent examination.

Only three of the nine outcrops shown as prevolcanic conglomerates (post-mineral) were visited. In the two western exposures one fragment of an quartz porphyry containing weak to moderate alteration with some limonite development was found. However, the bulk of the material noted is fresh and/or weathered

(1) 95% of material is granodiorite showing weathering characteristics & some iron stain / discoloration. Also noted in the qtz porphyry (rhy/qtz porph/qtz pegmatite?) which shows cobalt & py. Also qtz bx with py [illegible] filling. The material rest of dk-gabbro, [illegible] the material [illegible] same source as all is angular to very slightly rounded; in large pieces, fist size & up to several feet. In the saddle area the density of material suggests weathering in place. Only in the instance of large trees that have blown over is the tuffaceous material found suggestive of conglomerate matrix. The nearest gd outcrops are — miles in — direction. Giving a potential source direction but also possibly is an extreme distance for the blocky-poorly rounded material found.

(2) Very poorly exposed. Only a few pieces of rhy(qtz) porp, fresh; fine grain'd calc qtz diorite; ? clay alt w/ limonite. Also pieces of dk-gb. Did not see any granodiorite?!

(3) Abundant granodiorite, minor qtz diorite & rhy qtz porp. None altered — only weathered.

Geology and Origin of Mineralized Breccia Pipes in Copper Basin, Arizona
Econ. Geol. Vol 56, No. 5, Aug. 1961, p. 916-940 WP Johnston & J David Lowell.

Precambrian foliation
N-S to N30°E.
Precambrian fault-fissure system
N60°-75°W & N55°-70°E.
predating Copper Basin stock rocks (PE & Regional in magnitude ?).
N 30°-40°E (West side of Dist) & N 10°-20°E (East side of Dist).
Prominent minor fault trends observed within Copper Basin.
N 10-30°W; N10-30°E; N70-80°E; N60-80°W.
Some of which are occupied by late Tertiary (?) rhyolite dikes & have post-rhyolite displacement.
* "Movement along faults striking N 10-30°W & N 10-30°E appear to have been important in keeping critical channelways open and in fracturing the various types of quartz in the ore-bearing pipes" ... and thus allowing the passage of the copper-moly mineralization into the pipe area. p. 935.

Precambrian deposits (ore)
w/ qtz-tourmaline. fissure system N60°-75°W and N55°-70°E.
Laramide deposits (ore)
in bx pipes; but also controlled by N10°-30°E & N10°-30°W faults.
Late Tert (?) & Quat. dep.
Small amts of cinnabar, assoc w/ py, hem, olivine, have been found in and near rhyolite & rhyolite bx dikes.

Pine Flat, Turkey Creek Mining Dist. Aa-25. 20.17

by DB Beck. Comment by JEK.

altered area 1200 x 1500 ft (?).

"Basin is composed of altered porphyry, at least two rhyolite porphyry dikes, granodiorite, diorite porphyry, & alluvial fill. Some small brecciated areas. The altered rock occupies a pine-covered basin surrounded by ridges of schist striking in a North-northeast direction.

On his map: Rhyolite porphyry dikes trend: N30°E & N45°E.

JEK: ... "Unfortunately, Mr. Beck has observed that the altered porphyry intrusives in the Bradshaw Mountains tend to form topographically low areas".

Big Bug Creek Prospect Aa-25.2.0A.

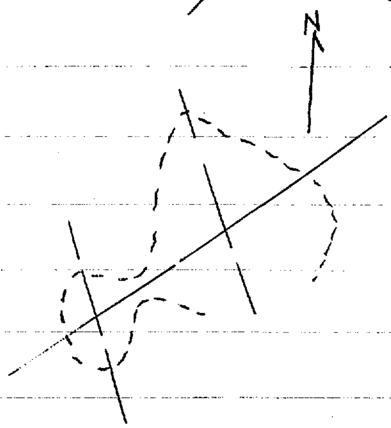
Beck & Sell (Nov. 10, 1966); Sell (Jan 31, 1967).

altered area 2000 x 2500 ft (NS x EW)

breccia zones (none greater than 200 ft diameter) generally show a Northeast trending lenticular shape.

From sketch map.

In general the alteration outline trends N45°E in long direction and is "dumbbell" shaped with the NW end being the largest. A secondary trend on the "bells" is N 40°W.



Quartz veins, inside & outside, trend N 35-45°E.

Trends:

~~Southeast~~ northwest:

Copper Basin 25.

Trap Corral Spring 26.

NE Glen Oaks 27.

Northeast

Big Bug (Beck) 8.

Pine flat 11.

Goodwin PO 14.

Northwest

Battle flat 13

Goodwin P.O. 14

Cellar Basin 17

Listings: Quadrangle

1) S. Jct. Turkey-Poland Creeks — Bumblebee

Sec 12-24, T10N, R1E

Bi-Metal Mine, Thunderbolt, Howard Silver Mine.

1) N. SE Cleator. — Mayer

Sec. 2-11, T10N, R1E

French Lilly, Gray Goose, St. Johns Mines

2). Mineral Draw — Mayer

Sec. 22-23, 26-27, T11N, R1E.

Jubilee Mine.

3) SE Roy Ranch — Mayer.

Sec. 11, 12, 13, 14, T12N R1E.

4) Cherry — Mingus Mtn.

Sec. 7-8, 16-17, 19-20, T14N, R3E

Leghorn, Sitting Bull, Federal, Bunker, Cherry King, Golden Idol, Black Hawk, Wombacker, Gold Bullion & Gunsight(?) Mine,

5). Kendall Camp — Mingus Mtn

Sec. 28, T15N, R2E.

6). Groom Creek basin. — Mt. Union

Sec. 22-23, 26-27, 34-35 T13N, R2W.

7) Walker-Lynx Creek — Mt Union

Sec. 33-34, T13N, R1W, & Sec. 5, T12N, R1W.

* 8). Big Bug Creek of Beck. — Mt. Union.

Sec 1, T12N, R1W.

9). Butternut Mine — Mt Union

Sec. 7-8, T12N, R1E.

Butternut Mine

10) Big Bug Mesa – Little Mesa. — Mt. Union

E 1/2, T12N, R1W.

Ck for possible Lowes cache exp.

* 11) Pine Flat — Mt. Union

Sec. 3, T11N, R1W.

12). Mule Canyon — Mt. Union

Sec. 6, T 11 1/2 N, R1E.

** 13). Battle Flat — Mt. Union

Sec. 9, T11N, R1W.

14). Goodwin P.O. — Mt. Union

Sec. 17, T 11 1/2 N, R1W.

** 15) Johnson Flat — Mt. Union

Sec. 3-4, T 11 1/2 N, R2W.

16) Palace Station — Mt. Union

Sec. 36, R12N, R1W.

** 17) Cellar Basin — Crown King

Sec. 3-4, 9-10, T10N, R2W.

** 18) Minnehaha Flat — Crown King

Sec. 19-30, T10N, R1W.

19) S Towers Mtn — Crown King

Sec. 9-10, T10N, R1W.

20). Crown King — Crown King

Sec. 14-15, T10N, R1W.

21). Horsethief Lookout — Crown King

Sec. 4-5, T9N, R1E, or in T9½N, R1E.

22). Oak Creek — Crown King

Sec. 2-3, 10, T9N, R2W.

23). Spring Creek — Wagoner

Sec. 29-30, T10N, R3W.

24). Wagoner — Wagoner

NE ¼, T10N, R3W

Large basin area along Hassayampa - Cherry Cks.

* 25). Copper Basin — Kirkland

Sec. 20-21, 28-29, T13N, R3W.

26). Trap Corral Spring — Kirkland

Sec. 34, T13N, R3W.

27) NE Glen Oaks. — Kirkland

Sec. 24, 25, 26, T12½N, R3W.

28). Whitehead Ranch — Kirkland

Sec. 19, 30, T11N, R3W.

29). Boulder Creek — Off Quad.

SE ¼, T9N, R1E.

30). South Silver Mtn — Off Quad.

SW ¼, T9N, R1W & SE ¼, T9N, R2W.

12). 1905. Jaggar & Palache, Bradshaw Mtns Folio 126.

49) 1922. Reber Geol & Ore Dep - Jerome Dist ADME Vol. 66.

61) 1926. Lindgren Ore Dep - Jerome-Bradshaw Mtn Quad. Bull 782.

Oct. 30, 1967

Telephone Call to Don Bulmer (N. Jersey Zinc Co - Tucson).

They had Fairchild Aerial fly the Bradshaw et al area.
More or less mapped for 8 years in Prescott-Jerome-Bradshaw Area
from 3 to 8 men at all times

Mapped very detailed (much probably much better than CA Anderson).
To look at map it is necessary to go thru the New York Office.
In the Agua Fria District, mapped in 1952-1953 at 1" = 400'.
Some geochemical-geophysical (?) work but NO DRILLING
Mainly interested in "Minor" property (east of Stoddard Mine). Joe Starnich of Mayer is owner. 250 & 460 Level drilled by US Bur. of Mines. Maps in War Minerals Report at 1" = 20'.

Throughout the Bradshaws their experience was that few holes reached +500 feet because of the hole deviation normal to the schistosity! and thus all holes flatten in depth.

Yavapai – Porphyry Flat Expl. – County Files

Yavapai General — Aa. 25.0.0

Lon Stringfield – American Ranches in Aa 25.0.0. — Aa. 0.0.7A

Company Report w/ USBM Drilling
Ballard Prospect 12 miles N of Aguila in Harcuvar Mtns. — Aa. 25.1.8

Includes Beck-Sell Report, Valuation of cont. work.
Porphyry Copper Big Bug District — Aa. 25.2.0A

Progress Report, Prescott area. Aa 25.2.0A, Aa 25.8.0, Aa 25.14.14B

Porphyry File: Recap of Lindgren – Jagger – Palache by Pepke — Aa. 25.2.0E

Turkey Creek area between Cleator & Bumblebee.
George Tobin Proposal – Black Cany. Dist. — Aa. 25.2.7A

Copper Stock Mine (Crown King Dist.) Recheck this! — Aa. 25.3.0

Copper Basin — Aa 25.3.0B

Crown King Mine area. Large file. — Aa. 25.3.3

East of Humboldt
Gossan-Capitan Group. Drilled by N J Zinc — Aa 25.3.7P

Large file.
Kay Copper Mine (Blk Canyon area) drilled by N.J. Zinc — Aa. 25.3.11

5 miles S of Cleator
Tip Top (Heath) Mine check for low grade possibilities?! — Aa. 25.3.20

Boulder Creek Ilmenite Prospect 200 million tons of 4.5% TiO_2! — Aa. 25.5.2

United Verde AIME Trip (April 1947) — Aa 25.10.21A

Bottoming of the United Verde Sulfide Pipe (Oct. 1946) — Aa 25.10.21A

Prescott Area Exploration Numerous Memos. — Aa 25.14.14B.

Pine Flat Porphyry Copper — Aa. 25.20.16

HA-25.2.0A

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

November 10, 1966

TO: J. H. COURTRIGHT

FROM: D. B. BECK

BIG BUG CREEK PROSPECT
BRADSHAW MOUNTAINS
YAVAPAI COUNTY, ARIZONA

Summary and Conclusion

The Big Bug Creek Prospect, initally inspected by Watson and Hoskins, is composed of small brecciated areas containing strong quartz-sericite alteration and pyritic limonite surrounded by weak to moderate altered granodiorite. Within the surrounding altered zone, which is approximately 2500 feet by 2000 feet, many small outcrops of fresh granodiorite are found. The lack of pervasive alteration, the small size of the brecciated areas, the fairly limited size of the over-all alteration zone and the scarcity of "live limonite" all indicate that ore values are not sufficient for continued Asarco interest.

Results from geochemical samples are shown on attached Table I.

Introduction

During the present helicopter program, Mr. Barry Watson and Mr. William Hoskins discovered an area of brecciation and alteration along Big Bug Creek in the Bradshaw Mountains. This prospect was examined by Mr. James Sell and the author during the latter part of October.

The big Bug Creek Prospect is located 2 miles west of Poland Junction at the confluence of Eugene Gulch and Big Bug Creek, about 25 miles southeast of Prescott by road (see map on Attachment A). The Iron King Mine is four airline miles in a north-northeast direction from the prospect.

Within the area mapped there are many different types of claims and many different ownerships. Along Big Bug Creek the ground is patented. The gravels north of the creek, (shown on Attachment A) are generally covered by recent placer claims. Mr. L. G. Carey of Dewey, Arizona and his associates control these claims. A number of lode claims, both valid and invalid are located throughout the altered zone. In August of 1964, Shattuck Denn located six claims, (Big Bug 1 through 6) generally over the gravels. These claims are probably not valid today, because of no assessment work. Drill results of the Shattuck Denn holes have not been available to date. However, Mr. Reed Welch is attempting to secure some information.

Geology

In 1953, Mr. Kenyon Richard visited Big Bug Prospect briefly. The following is taken from a report in the porphyry note file by Mr. Richards "...typical prophyry copper deposit (Laramide intrusive breccia pipes; quartz-sericite alteration; copper sulfide limonites) but probably too small to be commercial."

Within the area of interest there are three basic rock types; gravels and sands of Quaternary age, granodiorite and closily related rocks of Tertiary (?) age, and Yavapai schist of Precambrian age. To the west of the area mapped, Bradshaw granite of Precambrian age is found.

The alteration zone is approximately 2500 feet long in a E-W direction by 2000 feet in a N-S direction. Within this zone granodiorite cross cuts the Yavapai schist, which strikes in a northeast direction toward the Iron King Mine. The Big Bug Creek Prospect is at the southern end of the McCabe granodiorite intrusive that cuts schists for three miles in a northerly direction.

Within the altered zone, outcrops cover only about 1/3 of the ground, while the rest is covered by stream gravels. Moderate to strong quartz-sericite alteration with generally pyritic mineralization is found in the granodiorite outcrops, or similar rock types. Fresh granodiorite is also found within the altered zone, some times between well altered rock.

A number of breccia zones were noted in the altered area. None of them seemed to have a greater diameter than 200 feet. The breccia zones show a lenticular shape in a northeast direction, the same strike as the schist, which probably reflects the regional control of this stress direction. Within the breccia zones, the original rock type has been completely destroyed leaving only quartz and sericite. Some of the breccias zones are nearly free from limonites while others had up to 5% original sulfides. The limonites and boxwork indicate that most of the original sulfides were pyrite, but minor copper-limonites were also seen. No copper staining was noted in the breccia zones.

Many old workings are found in and around the Big Bug Creek Prospect. Most of these workings were placed along quartz veins in fresh to moderately altered granodiorite and schist. Some copper oxide is found on the old dumps, along with much pyrite, but gold was the principal mineral mined. Some of the fresh granodiorite on the dumps contained disseminated pyrite with a little chalcopyrite.

Seventeen geochemical rock-chip samples were collected and run for copper and molybdenum. The results are shown on Attachment B and on Table I. The samples indicate that the best copper values are in the fairly fresh granodiorite while the high molybdenum samples are in the well altered breccias zones. Sell and I feel that the geochemical results, taken as a whole, are not anomalous.

In 1964, Shattuck Denn put down at least thirteen diamond drill holes in the Big Bug Creek Prospect area. No information on the results of these holes has been learned to date. It is a well known fact that the Iron King Mine is running out of ore and it is our feeling that Shattuck Denn was not only testing the alteration zone itself, but the structual relationships between the schist and the granodiorite. The schist in the Big Bug Prospect area is the Spud Mountain Volcanics unit and is the same host unit for the ore at the Iron King. A line, projected along the strike of the schist, from the Big Bug Creek Prospect toward the northeast would come close to intersecting the Iron King ore body.

Another interesting feature of the Big Bug Creek Prospect is its similarity to the Pine Flat alteration zone, seven airline miles to the southwest. Again, if the strike direction of the Yavapai schist was followed along its extension, one would be in the Pine Flat alteration zone. The similarity between the two alteration zones continues with both having small but well altered breccia zones, some pervasive alteration and disseminated mineralization, and both being too small to interest the company.

Exploration Possibilities

Although the Big Bug Creek Prospect is of no interest in itself, the occurrence along with those at Pine Flat and Copper Basin lends encouragement to the possibility that other unrecognized porphyry copper type deposits might exist in the Bradshaw Mountains. There are two granodiorite stocks west of the McCabe stock which should be examined. They are called the Walker and Groom Creek granodiorite stocks. The county map does not show the location of these stocks, but the old Bradshaw Mountain Folio by Jaggar and Palache does.

DAVID B. BECK

DBB/mcg
Attachments

TABLE I GEOCHEMICAL RESULTS

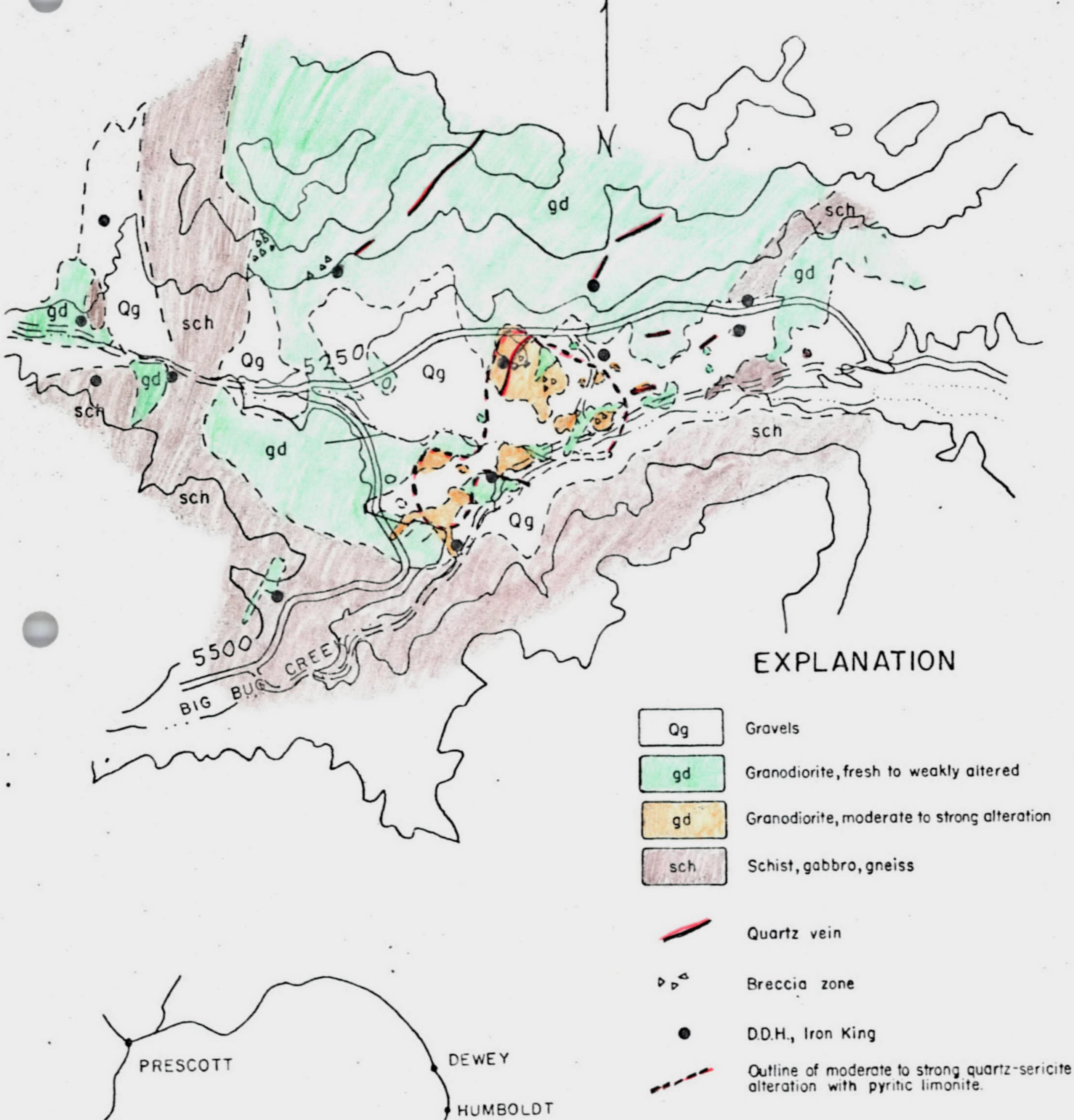
BIG BUG CREEK PROSPECT

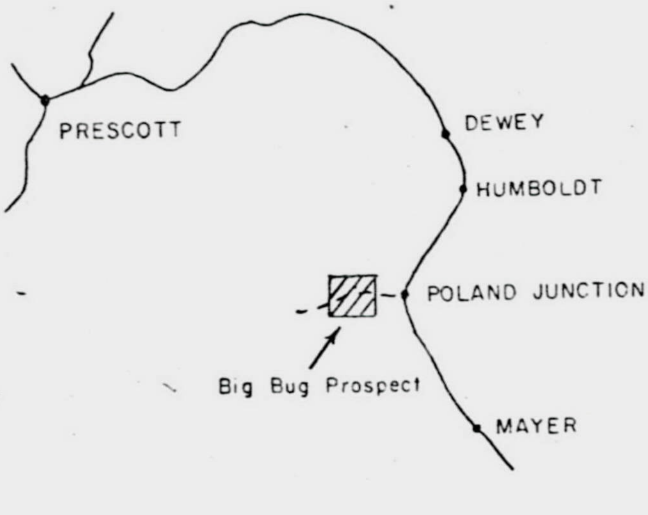
SAMPLE NO.	FRESH	SILICIF.	ARGILL.	SERCIT.	PYRITE	LIMONITE-HEMOTITE	PPM CU.	PPM MO.
GOC-BB1	X						135	2
-BB2						X	310	2
-BB3						X	90	-1
-BB4		?			X	X	220	-1
-BB5	X						315	-1
-BB6	(1)	X	X		X	X	450	6
-BB7						X	180	-1
-BB8					X	X	55	8
-BB9		X	X	X		X	40	12
-BB10						X	160	1
-BB11		X	X	X		X	115	7
-BB12		X		X	(casts)	X	90	11
-BB13						X	60	1
-BB14		X	X	X	X	X	105	2
-BB15		X		X		X	45	7
-BB16						X	210	3
-BB17	X				X		195	3

(1) Four-foot quartz-pyrite vein.

Note: All samples are granodiorite, except No. GOC-BB17 which was minor pyrite in schist.

Note: All values reported by Rochky Mountain Geochemical Laboratories. Copper by Atomic Absorption Method; Moly by Colorimetric Method.





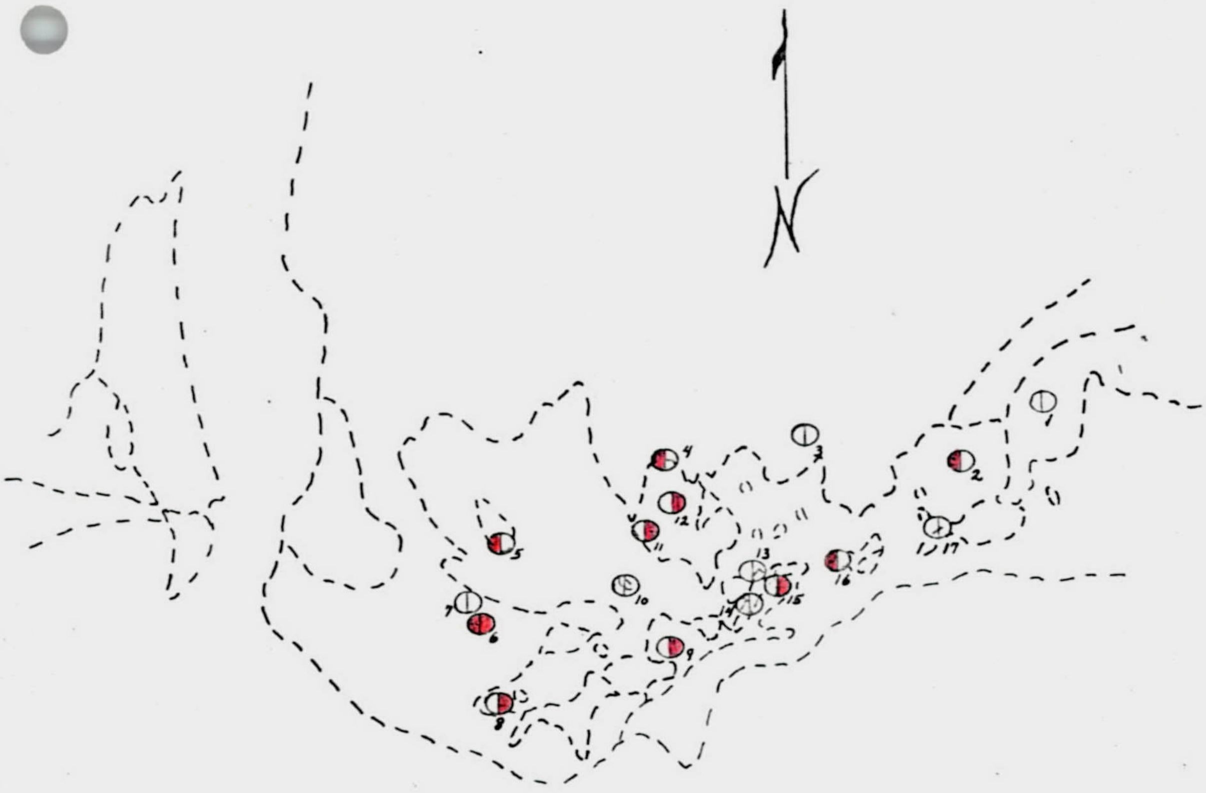
GEOLOGIC SKETCH MAP

BIG BUG CREEK PROSPECT

BRADSHAW MOUNTAINS

YAVAPAI COUNTY, ARIZONA

Scale: 1" = 1/2 mile



EXPLANATION

Copper

0-200

201 +

Molybdenum

0-5

6 +

COPPER - MOLY GEOCHEMICAL RESULTS

BIG BUG CREEK PROSPECT

BRADSHAW MOUNTAINS

YAVAPAI COUNTY, ARIZONA

Scale: 1" = 1/2 mile

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

January 31, 1967

TO: J. H. COURTRIGHT

FROM: J. D. SELL

BIG BUG CREEK PROSPECT
BRADSHAW MOUNTAINS
YAVAPAI COUNTY, ARIZONA

Mr. Reed F. Welch has kindly secured some additional information on the subject area, copies of which are submitted with this memorandum. Also see D. B. Beck's report of November 10, 1966.

As noted in the report dated December 11, 1965, Shattuck Denn staked and optioned the area "for the purpose of examining a possibility of a disseminated copper and molybdenum deposit within intrusive diorites and suspected breccia pipes within these diorites."

They also conducted induced polarization surveys and, later, an electro-magnetic survey. They consulted Dr. Harrison Schmitt for his opinions--apparently the opinions rendered were not favorable.

Two drill holes (BBII to 800.5 feet and BBIV to 785.5 feet) were drilled on the west side up Eugene Creek to test one of the better anomalous areas. Neither drill hole intercepted any significant mineralization--the average being less than 0.15% copper; and, the highest assay found being only 0.38% copper (See SD report of Dec. 11, 1965).

Apparently only these two deep holes were drilled specifically to test target areas. (This area is the far west side of Beck's Attachment A). However, eleven "Location Holes" from 60 feet to 135 feet deep were drilled, logged, and assayed, but none of these assays were submitted to Mr. Welch and probably none intercepted any outstanding values or they undoubtedly would have drilled deeper and/or additional holes nearby. See Beck's Attachment A showing the approximate location of the thirteen holes as found in the field.

The two "drill holes" located within the outline of moderate quartz-sericite alteration (Beck's Attachment A) were originally designated as proposed DDH BBI and BBIII; however, they were apparently only used as location holes. As the location holes were "logged and assayed" it is possible that renewed effort by Mr. Welch could secure the added information on these two holes in particular.

From the final report, dated June 16, 1966, it suggests that Shattuck Denn has found nothing in an encouraging way to further promote the area.

JDS/pjc
J. D. SELL
Attachments w/ original only

Comments on the:
Geologic Map of the SE¼ Mount Union Quadrangle Yavapai County, Arizona, by P.M. Blacet. Preliminary copy 1968.

Only one area of Tertiary intrusive activity is shown and this is the Pine Flat area complete with breccia pipes.
Rhyolite to granodiorite porphyry dikes of similar age follow the NE pЄ trend. No dikes were shown cutting the qtz latite porphyry intrusive.
See Beck's Pine Flat paper.
Zone 11. Pine Flat Sec. 3, T11N, R1W.

Zone 12. Mule Canyon Sec. 6, T11½N, R1E.
Southern part of zone on sheet. In Texas Gulch formation with basal cgl (basal members of Alder Group of Yavapai Schist) overlying Brady Butte Granodiorite. No anomalous structure noted.

Zone 13. Battle Flat Sec. 9, T11N, R1W.
No formations other than PЄ shown. Mainly alluvial cover with Spud Mountain Volcanics (massive bedded breccia crystal tuff member) on NW three sides. On SE side in fault contact with Brady Butte Granodiorite and to S both are intruded by porphyritic granodiorite of Tuscumbia Mountain (PЄ).
No Tert rhy dikes point to area.

Mayer Zone 2. Mineral Draw. Sec. 22-23, 26-27, T11N, R1E.
Western edge of zone on sheet. Mainly in Iron King Volcanics

and no anomalous structure noted except for an embayment or curl of the Ironking Volcanics (sedimentary breccia member) into the underlying Spud Mountain Volcanics (bedded rhyolitic tuff member). No Tertiary dikes in area.

Comments on difference between
PM Blacet's map & Folio 126 (Bradshaw Mtns).

Zone 11. Pine Flat.
Blacet shows quartz latite porphyry (Tertiary) intrusive but folio shows only acid dike in area.

Zone 12. Mule Canyon.
Nothing anomalous on either.

Zone 13. Battle Flat.
Blacet shows only Spud Mtn Volcanics with alluvial cover whereas folio shows large body of monzonite porphyry.

Zone 2. Mineral Draw.
Essentially nothing on either.

Comments on:
Bradshaw Mountains Folio, Arizona
Folio 126 , published 1905
by TA Jaggar, Jr., & Charles Palache.

youngest (all pЄ ?)
Quartz-diorite ← mineralization accompanied or followed...
Monzonite-porphyry
Diorite
Crooks Complex
Bradshaw Granite.
oldest.

Areas:
Quartz-diorite (qd):
Groom Creek basin area (Zone 6) (SE 1/4, T 13N, R2W.)
Walker area (Zone 7) (SW 1/4, T13N, R1W).
Big Bug (Back) area (Zone 8) (SE 1/4, T13N, R1W).
Poland Siding (Jct) area. (Sec. 5, T 12N, R1E).
S. Towers Mtn. (Zone 19) - Crown King (Zone 20) area. (T 10N, R1W).

Monzonite-porphyry (mp):
Bottle Flat (Zone 13) (N-central T11N, R1W).

Diorite (di):
NW Independent Spring (W central, T12N, R2W)
W Mt Tritle. (E Central, T12N, R2W).

(Diorite, di,) Continued.

W. Spruce Mtn (2 areas). (SE side line, T13N, R2W).

Poland (Sec. 9?, T12N, R1W).

N Peck & Drill (Sec. 19, T13N, R1½E).

Tower's Ranch [Del Pasco Mine] area (NC, T10N, R1W).

NS Cordes-Gillette zone.

Badger Spring (2 areas), (W End line T10N, R3E).

Notes on USGS Bull 782. Ore Deps of the Jerome & Bradshaw Mtns Quads, by W Lindgren (1926).

p. 21. Granodiorite (qtz diorite). Conceded to be the youngest intrusive masses. There are four: Groom Creek, Walker, McCabe and Crown King ..... all weather into spheroidal forms and the outcrops always occupy basins with sandy disintegrated soil. ...... The probability is strong that these masses were intruded in Cretaceous or early Tertiary time.

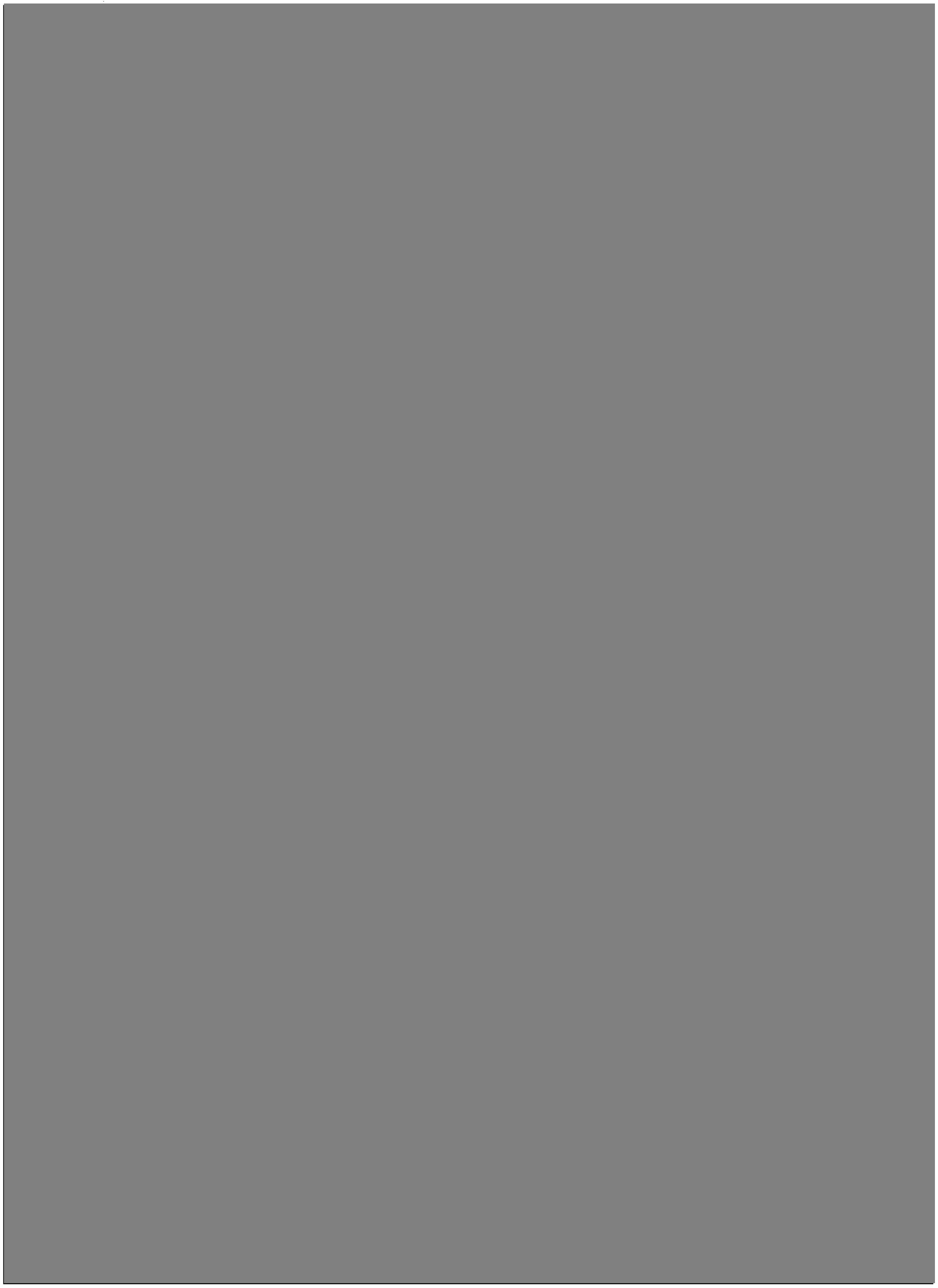
p. 48. The copper deposit at the Springfield mine (# 132) in the Crown King district (granodiorite), is contained in a mass of granite porphyry allied to the rhyolite porphyry. It contains only a small amount of gold. It is of interest because of its great similarity to the larger deposits at Copper Basin.

Economic Geology
Vol. 56, 1961, pp. 916–940

GEOLOGY AND ORIGIN OF MINERALIZED BRECCIA PIPES IN COPPER BASIN, ARIZONA

W. P. JOHNSTON AND J. DAVID LOWELL

CONTENTS



AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

January 5, 1972

TO: W. L. Kurtz

FROM: J. D. Sell

Massive Sulfide
Exploration Technique
Jerome-Prescott Area
Yavapai County, Arizona

This is to transmit Mr. Peter Walker's file memo on the subject. Peter reviewed the literature while in Tucson and noted the similarity of features and geology of the Jerome area to other areas of Precambrian geology elsewhere in the world. His original sketch on C. A. Anderson's Bulletin 1324-C, Figure 3, paper is included for reference, although the redrafted figure clearly shows Peter's subdivisions.

As pointed out verbally by Walker, prospecting for new Jeromes and Iron Kings would be primarily along the two main horizons, but the other favorable zones could contain good mineralization. All pyritic and chloritic zones would be sampled in looking for indicative trace mineralization or halo effects. The down dip projections would then need to be drilled in looking for the massive sulfide zone.

USGS geologic maps, mainly at 1:24,000, are available for the area and would greatly facilitate an exploration program in the district.

James D. Sell

James D. Sell

JDS:lad
Enc.

AMERICAN SMELTING AND REFINING COMPANY
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December 10, 1971

FILE MEMORANDUM

Jerome-Prescott Area

A brief examination of literature on the massive sulfide deposits in the area, particularly the United Verde and Iron King deposits, indicates that these deposits show many features typical of the socalled "volcanic exhalutive" deposits found in many parts of the world, particularly in Precambrian rocks. In particular, these deposits show very similar features both on a regional and local scale to the large producers of this type found in Archean rocks.

The stratigraphic column in this area shows the same features of cyclic volcanism found in these other areas. In particular, they show several cycles of basaltic-rhyolitic volcanism with each successive cycle becoming more acidic as a whole ascending the column. In general, mineralization appears at the top of the rhyolitic phase immediately before the change to a more basic phase of volcanism and is usually confined to rhyolite fragmentals, but often with associated pipe-like bodies in the underlying rhyolites.

These bodies typically show a halo of chloritic alteration in the underlying rocks and around the pipe-like stockwork deposits as is shown at United Verde. At one deposit in Australia, this chloritic alteration zone showed as a prominent colour anomaly. The mineralized horizons often are highly siliceous and show marked concentrations of hematite and pyrite features well displayed apparently at the Iron King deposit.

Both the Iron King and United Verde occur near the top of the cyclic sequence at the close of the last full recognizable cycle (see attachment). Two full cycles can be recognized in the Ash Creek Group and three in the Big Bug Group. The tops of the lower sequences; e.g., the Buzzard rhyolite, the top of the Green Gulch Volcanics rhyolitic member, and of the Spud Mountain rhyolitic members, are also favourable zones for mineralization. Deposits of this type tend to form clusters near vent zones and may show very large variations in size in one area and a copper-zinc tabular ore body may overlie a pipe-like copper ore body.

P. N. Walker

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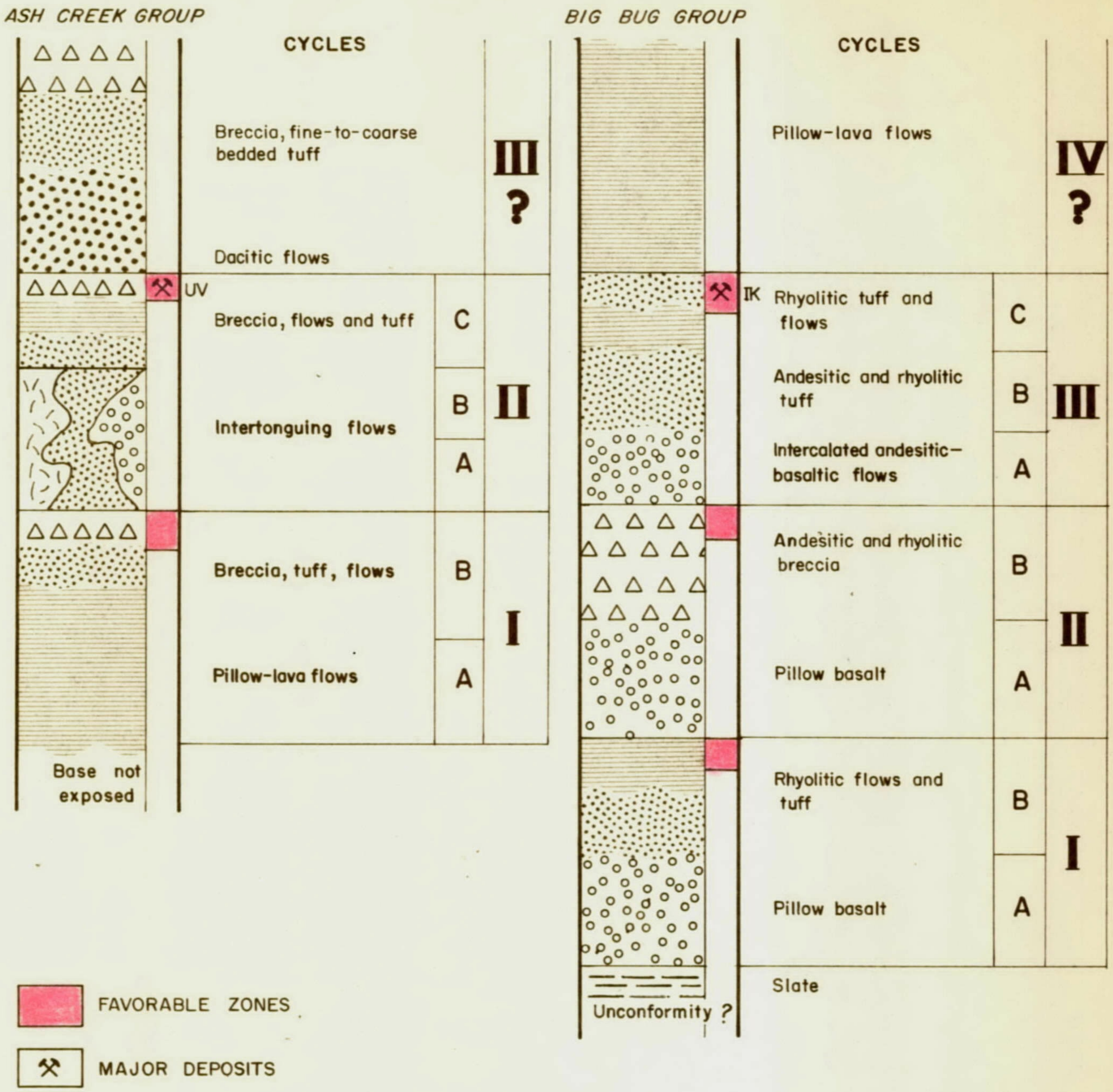
PNW:lad
Attach.

cc: JDSell



(Modified from Figure 3, U.S.G.S. bulletin 1324-C, p.C7) Revision of Precambrian Stratigraphy in the Prescott- Jerome area, Yavapai County, Arizona

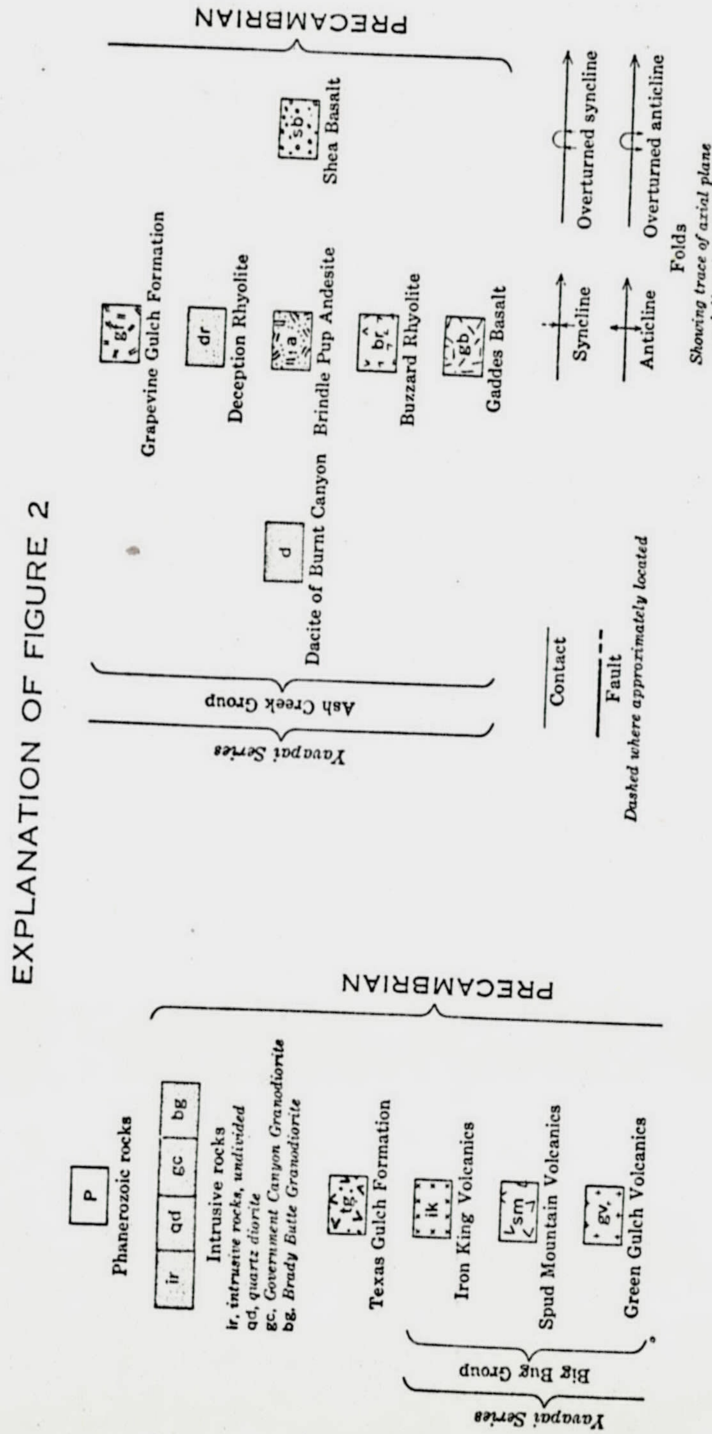


FIGURE 2.—Geologic map of the Prescott, Mingus Mountain, Mount Union, and Mayer quadrangles—Continued

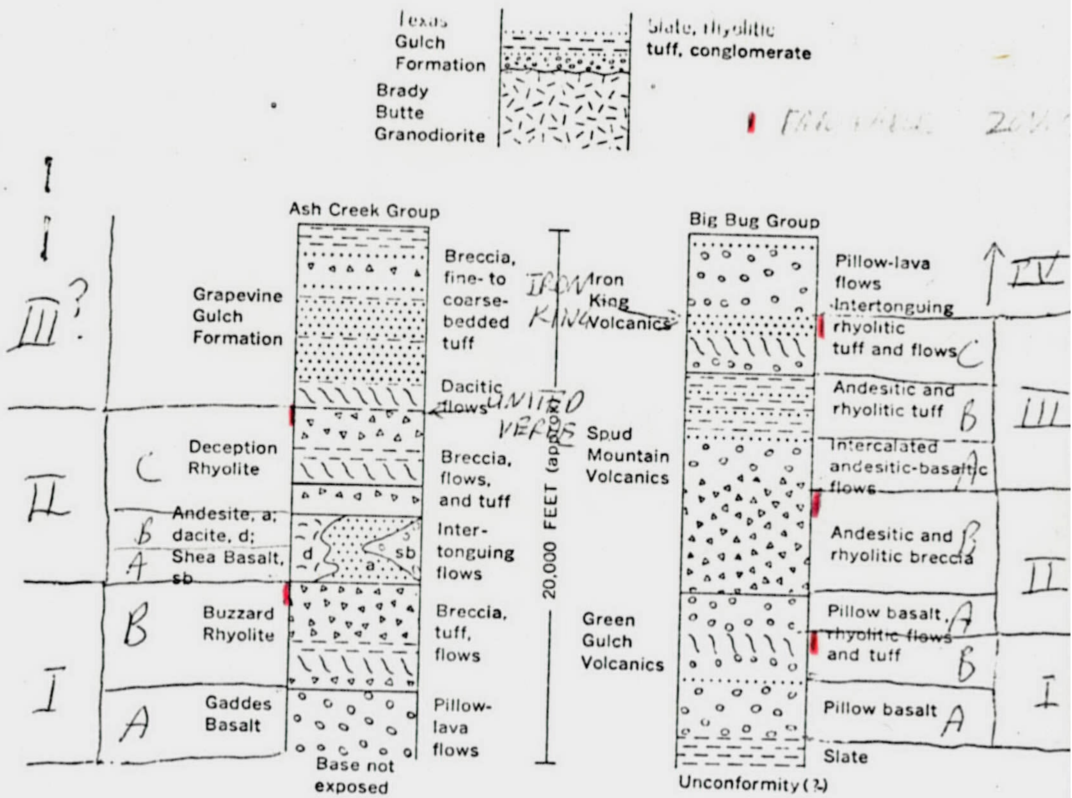


FIGURE 3.—Generalized sections of the Ash Creek and Big Bug Groups and of the Texas Gulch Formation.

BIG BUG GROUP

The Big Bug Group is exposed more or less continuously southward from the Prescott and Mingus Mountain quadrangles into the Mount Union quadrangle and western margin of the Mayer quadrangle (fig. 2). It is also exposed east of the Shylock fault zone and south of the younger pluton of quartz diorite in the Mayer quadrangle. The Big Bug Group is here named for its exposures along Big Bug Creek, originating west of Big Bug Mesa in the Mount Union quadrangle and joining the Agua Fria River in the Mayer quadrangle (fig. 2). This type locality cuts across a complete section of the Spud Mountain Volcanics and Iron King Volcanics. In the eastern half of the Mount Union quadrangle and the western part of the Mayer quadrangle, the Big Bug Group is isoclinally folded and, in general, well foliated. East of the Shylock fault zone and northwest of the

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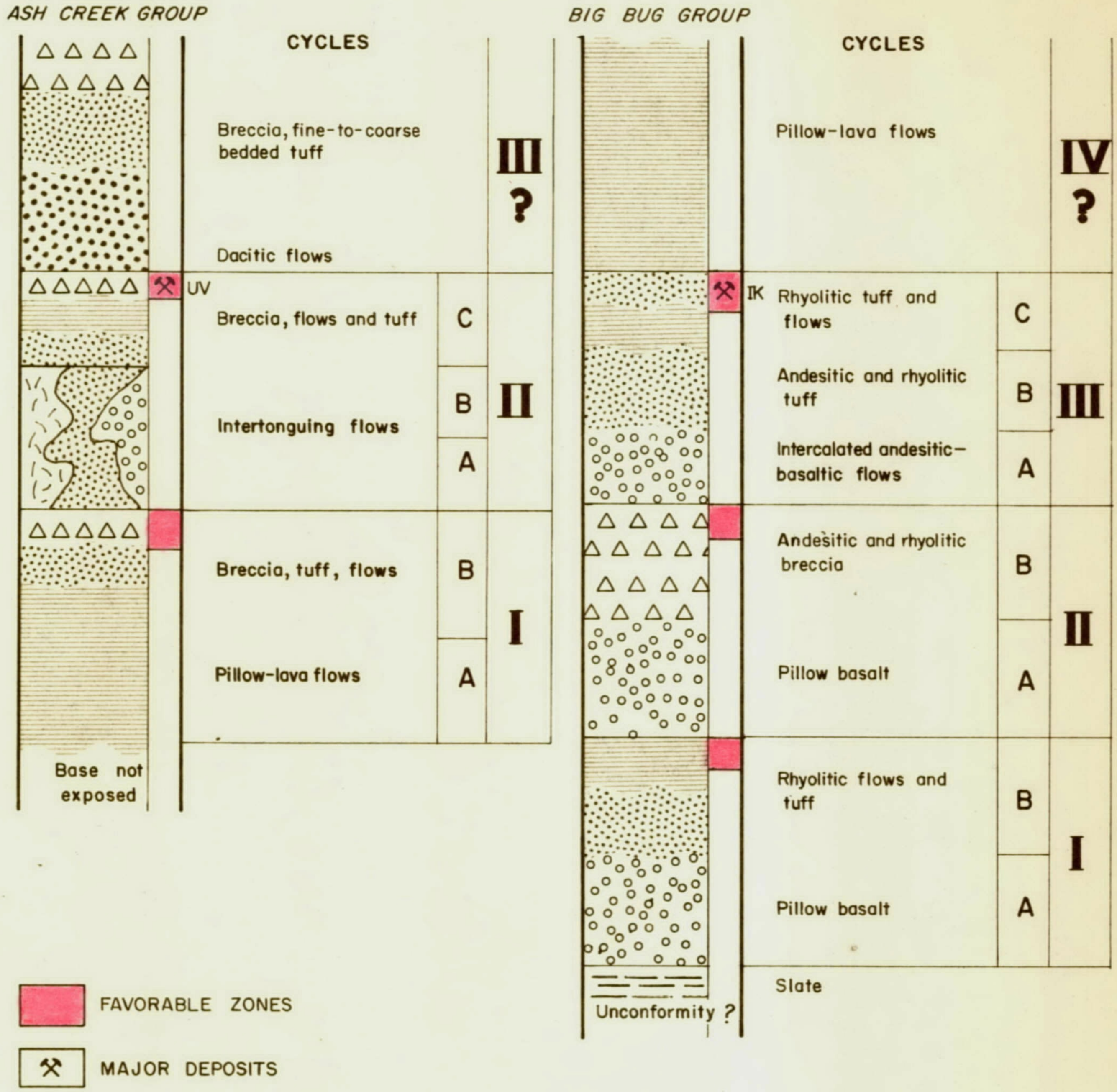

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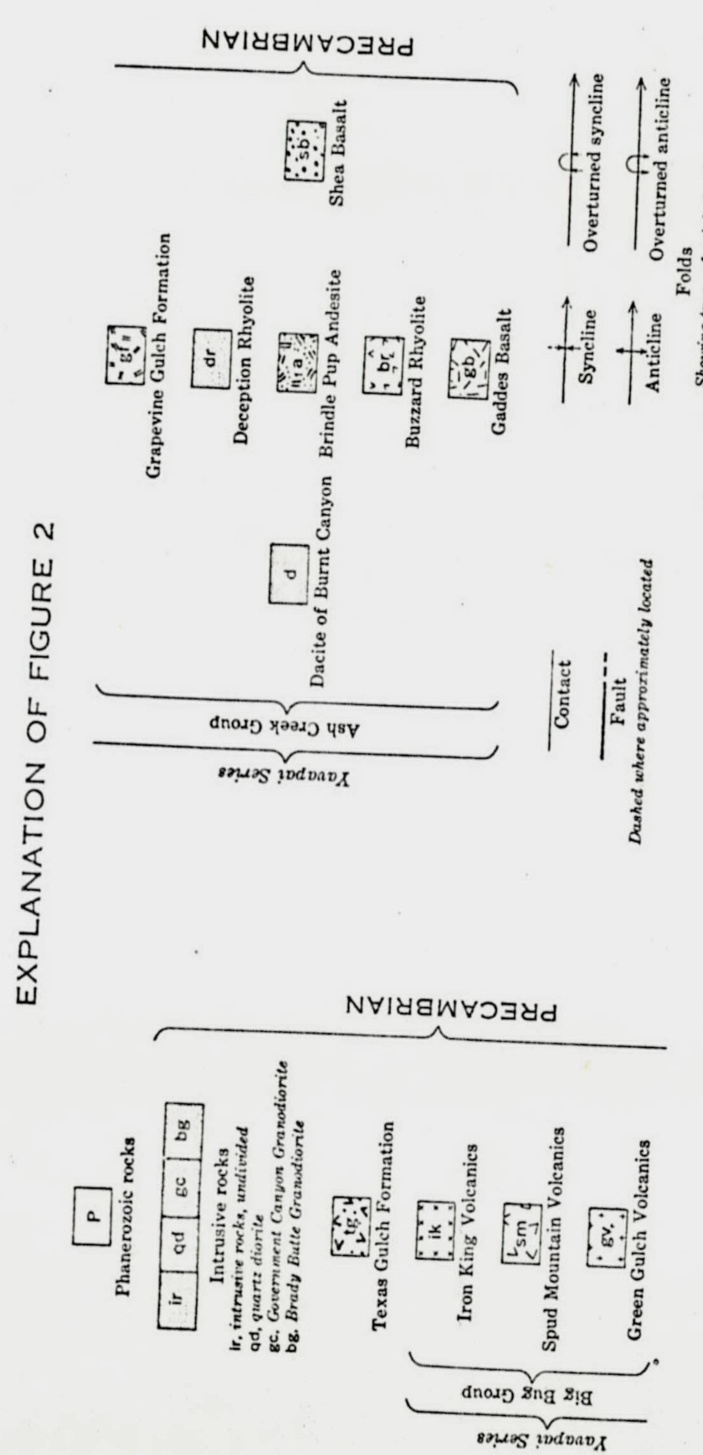

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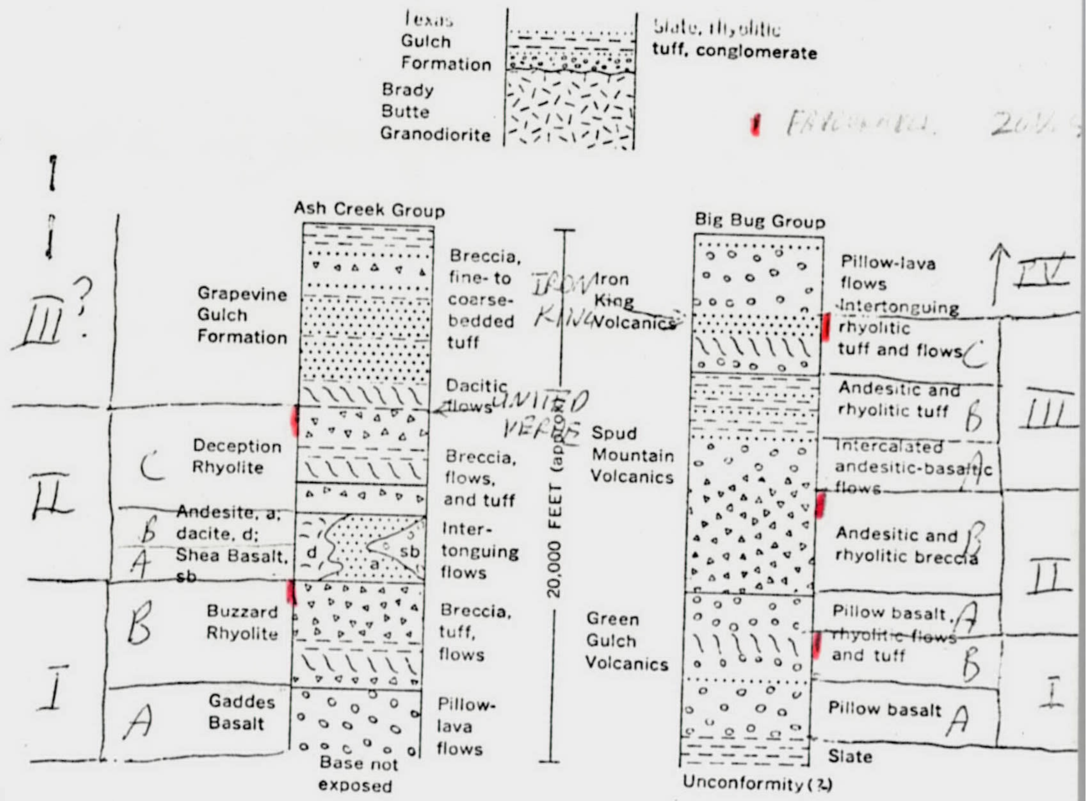

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WESTERN UNITED STATES 1:250,000

PRESCOTT

NI 12-4

• INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1966

Prepared by the Army Map Service (CGSX), Corps of Engineers, U.S. Army, Washington, D.C. Compiled in 1956 by U.S. Coast & Geodetic Survey by photogrammetric methods and from USGS quadrangles, 1:62,500, 1947-1950. Planimetric detail revised by photo-planimetric methods. Horizontal and vertical control by USGS, USC&GS and USCE. Photography field annotated 1954. Limited revision by U.S. Geological Survey 1962.

100,000-foot grid based on Arizona coordinate system, central and west zones

10,000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue

LEGEND

ROAD DATA 1954 PARTIALLY REVISED 1962

Figures in red denote approximate distances in miles between stars

POPULATED PLACES
- Over 500,000 — LOS ANGELES
- 100,000 to 500,000 — OMAHA
- 25,000 to 100,000 — GALVESTON
- 5,000 to 25,000 — Laramie
- 1,000 to 5,000 — Grand Coulee
- Less than 1,000 — Sun Valley

RAILROADS — Single track / Double or Multiple
- Standard gauge
- Narrow gauge

BOUNDARIES
- International
- State
- County
- Park or reservation

ROADS
- Hard surface, heavy duty
  - More than two lanes wide (3 LANES | 4 LANES)
  - Two lanes wide; Federal route marker
- Hard surface, medium duty
  - More than two lanes wide (3 LANES | 4 LANES)
  - Two lanes wide; State, Interstate route markers
- Improved light duty
- Unimproved dirt
- Trail

- Landplane airport
- Landing area
- Seaplane airport
- Seaplane anchorage
- Woods-brushwood
- Landmarks: School; Church; Other
- Horizontal control point; Windmill
- Spot elevation in feet .221
- Marsh or swamp
- Intermittent or dry stream
- Power line

Approximate road alinement

Scale 1:250,000

5 0 5 10 15 20 Statute Miles

5 0 5 10 15 20 25 30 Kilometers

5 0 5 10 15 Nautical Miles

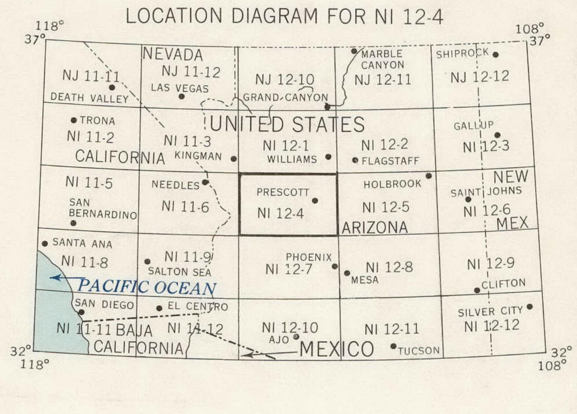
CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS

TRANSVERSE MERCATOR PROJECTION

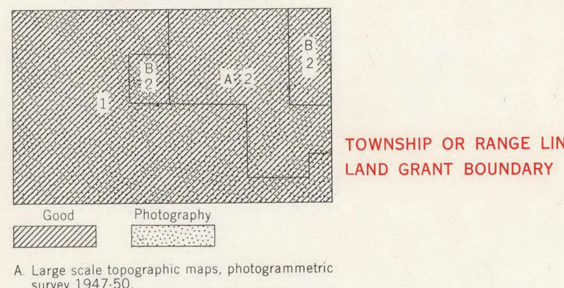
1960 MAGNETIC DECLINATION FOR THIS SHEET VARIES FROM 14°45' EASTERLY FOR THE CENTER OF THE WEST EDGE TO 14°15' EASTERLY FOR THE CENTER OF THE EAST EDGE. MEAN ANNUAL CHANGE IS 0°01' WESTERLY.

FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225 OR WASHINGTON, D. C. 20242

LOCATION DIAGRAM FOR NI 12-4



RELIABILITY DIAGRAM



A. Large scale topographic maps, photogrammetric survey 1947-50.
B. Large scale topographic maps, controlled ground survey 1947-50.
1. Stereo-compiled from 1954 aerial photography.
2. Planimetry revised from 1954 aerial photography.

TOWNSHIP OR RANGE LINE

LAND GRANT BOUNDARY

SECTIONIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

PRESCOTT, ARIZONA

1954

LIMITED REVISION 1962

AMERICAN SMELTING AND REFINING COMPANY
TUCSON ARIZONA

May 8, 1974

FILE MEMORANDUM

Pine Flat (Yavapai County)
East Johnson Camp (Cochise County)
Superior Oil Data

During the recent luncheon on the Copper Resources of the World Map, I chatted with Ben Dickerson of Superior Oil.

He stated that they drilled some 40 holes in the Pine Flat area and have some 20 million tons of 0.45% copper. They own several patented claims plus the unpatented claims. COMINCO has a 24% interest in the area. Ben states that they are interested in peddling the area to an interested party. He also feels that they have drilled out all the extension possibilities except in depth; no statement as to what their drilling depth had been. Very little chalcocite.

Ben also mentioned that at East Johnson Camp they were taking 8" diameter core hole samples for metallurgical work. He stated they had 50 million tons of 0.65% copper. The several cross-sections shown by Ted Eyde in several AIME Preprints suggest highly tilted blocks of mineralization with strong fault and lithological control.

He also stated that he knew of a deposit which has been drilled for the past several years that contains 350 million tons of 0.45% copper which was not on the World Copper Map. He would only suggest it was located between central Mexico and the Highland Valley area of Canada.

James D. Sell
James D. Sell

JDS:lb

Porphyry Flats Project Proposal.

Background information on previous Bradshaw Mtn Project proposals.

Letters or Memos:

Aa.25.16.16B.	WR Landwehr from LK Wilson.	Nov. 6, 1947.	1p.
	WR Landwehr from LK Wilson.	July 25, 1950.	2p.
	LK Wilson from FV Richard.	Aug. 8, 1951.	2p.
	WR Landwehr from LK Wilson.	Aug. 22, 1951.	1p.
	LK Wilson from WR Landwehr.	Aug. 25, 1951.	1p.
	DJ Pope from LK Wilson.	Dec. 19, 1951.	2p.
	LK Wilson from FM Stephens.	Jan. 10, 1952.	5p.
	LK Wilson from FM Stephens.	March 24, 1952	2p.
	WR Landwehr from LK Wilson.	March 26, 1952	3p.
	LK Wilson from FV Richard.	April 2, 1952.	1p.
	LK Wilson from WR Landwehr.	April 18, 1952.	2p.
Aa.25.2.0E	Porphyry file note by KE Richard.	Feb. 13, 1953.	1p.
Aa.25.2.0A	FV Richard from KE Richard.	June 14, 1956.	1p.
	KE Richard from FV Richard.	June 18, 1956.	1p.

Aa-25.16.16B

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

Nov. 6, 1947
(8th)

AIR MAIL

Mr. W.R.Landwehr, Chief Geologist,
Western Mining Department,
American Smelting and Refining Co.,
600 Pacific National Life Bldg.,
Salt Lake City, 1, Utah.

GEOLOGIC STUDIES NEAR PRESCOTT, ARIZONA

Dear Sir:

I am very pleased to note in the second paragraph of your letter of October 29 on Silver Plate, that you also think we should keep in close touch with the current activity of Dr. Charles Anderson of the U.S.G.S., near Prescott.

I have long felt that this was an important area for closer scrutiny than we have been able to provide heretofore, and that any field work in this area should be linked quite closely to the work which has been done by Dr. Anderson in the past two or three years. It was with this in mind that I had proposed in December, 1946 that we place a man in that area, and, since this at the time did not become possible, we used the Jerome survey and our consideration of Silver Plate as one expedient of cultivating Dr. Anderson and acquainting ourselves with his coverage of the Prescott area.

I am still hopeful that we may be able to place a man in that area for a period of at least several months, and would like to talk to you further about this when you come to Tucson in the near future. In this respect you may be interested in a copy of my Memorandum for Mr. Pope December 16, 1946, copy of which is attached hereto, in which I discussed a distribution of field geologists and proposed coverage in the Southwestern Division, and in addition a brief commentary on some of the basic principles of field coverage. The latter, I believe, recognized at that time and is now in complete accord with your recent discussion of a phase of exploration, in your letter of October 28, subject Irene Mine.

Yours very truly,

L. KENNETH WILSON

Enc. 1
LKW:W
CC: DJPope-no enc.

A. E. R.
NOV 8 - 1947

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

July 25, 1950

CONFIDENTIAL

Mr. W. R. Landwehr, Chief Geologist
Western Mining Department
Salt Lake City Office

GENERAL EXPLORATION
Southwest

Dear Sir:

In keeping with your telephone request of July 17th, following is an outline of broader exploration projects now under consideration.

1. Stanley District, north of Aravaipa, Arizona. Copper mineralization in Cretaceous volcanics probably represents leakage through underlying Carboniferous limestones. The Cretaceous may cover a broad syncline of Paleozoics, one flank of which outcrops in the productive Ag-Pb-Zn mines of Aravaipa to the south.

2. Hachita-Hatchet Area, Luna, Grant and Hidalgo Counties, New Mexico. Small mines in Cretaceous sediments and later flows may point to Pb-Zn replacement ore in deeper limestones comparable to the Central District.

3. Hillsboro area, New Mexico. Consideration of stratigraphy where covered sediments are intruded by Copper Flat monzonite, as suggested by Messrs. Hart and Richard.

4. Empire Mountains, east of Helvetia, Pima County, Arizona. Study of Pb-Zn prospects in Carboniferous intruded by stocks comparable to nearby Helvetia (Cu). Problem is structure and economic significance of thrust blocks.

5. Van Horn, Texas. In the Hazel Mine veins in sandstone have produced good silver and chalcocite orebodies. District stratigraphy will determine if the Carboniferous may be present below where no exploration for replacement ore has been undertaken.

6. Helmet Peak Area, Pima (Twin Buttes), Arizona. Subject to satisfactory assemblage of properties.

7. Copper Basin District, Yavapai County, Arizona. Subject to satisfactory assemblage of properties.

A study of exploration possibilities at Bagdad was proposed in my quarterly report of June 23rd, providing Mr. Dickie will permit the study. Of first interest: Examination of limonite-stained outcrops on Bagdad property and the vicinity.

The paper study of "Red Bed" possibilities - listed in my November 1948 and November 1949 memoranda - can still be undertaken if time and

July 25, 1950

Confidential

Mr. W. R. Landwehr

personnel permit, as also any study of old files as Mr. Loerpabel once initiated. The publication on Trench solicited by the Arizona State Bureau of Mines for some future bulletin should be prepared, if possible.

Very truly yours,

L. KENNETH WILSON

LK:ar

cc:DJPope

Aa.25.0.12

L.K.W.
AUG 22 1951

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

August 8, 1951

MEMORANDUM TO:
Mr.L.K.Wilson

LEAD-ZINC PROSPECTS
Bradshaw Mountain Quadrangle
Yavapai County, Arizona

It has always seemed odd to me that the Iron King Mine should be the only one among many mines in the adjacent area which has an economic lead-zinc content. I have over the past few months, as time permitted, been reading the files and the U.S.G.S.Bulletin 782, Ore Deposits of the Jerome and Bradshaw Mountains Quadrangles, Arizona, on the mines in this area, in hopes of finding further information on the subject.

The files, and the Government Bulletin (published in 1926) stress gold, silver and copper as the main economic minerals; however, in almost all cases they mention minor lead-zinc content. In the case of the Iron King Mine the Bulletin makes no point about the lead-zinc content being economic, even though the development of the mine then was little different from when Shattuck Denn took it over. Subsequent production, as you know, has proven this mine to be a substantial lead-zinc producer, having a crude ore content of about 2.5% lead and 7.5% zinc.

I am wondering whether this lack of stress in our files and in the Government Bulletin on the lead-zinc content of the ores in the various mines is not due to the fact that the majority of the production from this area was marketed at the Humboldt and other copper smelters where there was no pay for zinc content, and the average lead content was too low grade to justify shipment to El Paso or installation of lead smelting facilities at Humboldt.

We all know that the Iron King mine is continuing in depth with no change in metal values. I find also, in reading about the Blue Bell and McCabe-Gladstone Mines, that both were mined to over 1000 feet in depth, and were fairly large producers - (Blue Bell over a million tons) and there is little evidence of reduction of values or termination of the ore shoots in depth. It is noted also that both these mines appear to have the same sort of echelon pattern of ore shoots characteristic of Iron King.

It is interesting also to note in the Government Bulletin that an analysis of typical McCabe-Gladstone shipping ore shows the following:

Au	Ag	Pb	Cu	Zn
1.6 oz	10.2 oz	2.1%	2.0%	4.7%

In addition, our files indicate shipments from this mine to El Paso running as high as 5.0% Pb and 7.5% Zn. Likewise, although reported ore reserves of the Blue Bell Mine indicate about 250,000 tons of positive and probable ore, averaging .04 oz. Au, 1.5 oz. Ag, and 2.75% Cu, there are reports in the Government Bulletin of the presence of lead and zinc; however, no percentages are given. Since the Deming Mill started we have received several inquiries for schedules on good grade lead-zinc sulphide ores from mines in this area whose main production, from past records, seems to be gold, silver and copper. The Mt. Union Mine, which Mr. Welch is presently visiting, is a good example.

In view of the success of the Iron King in lead-zinc production, from a mine previously known for its precious metal production, and the characteristic remarkable persistence of the ore shoots in this general area, we cannot safely write this area off as not of interest until we are more certain that the lead-zinc content of the ore from the main past-producing mines is verified and adjudged not of interest in today's market. I would recommend, therefore, that someone be assigned in the very near future to follow this up. In citing the Blue Bell and McCabe-Gladstone Mines as examples, it is not my intention to recommend them as prospects which should be examined in preference to the many other mines in the area, but rather to show two typical past-producers of precious metals and copper about which there is some evidence of lead-zinc content the extent of which is not definitely known.

Ex. copy for file.

F V Richard
F. V. RICHARD

cc: WRLandwehr
FVR:blc

Aa-25.0.12

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

August 22, 1951

Mr. W. R. Landwehr, Chief Geologist
Western Mining Department
Salt Lake City Office

LEAD-ZINC PROSPECTS
Yavapai County, Ariz.

Dear Sir:

You probably have your copy of Mr. Richard's Memorandum to me August 8th which I now have upon my return to Tucson.

With reference to his recommendation in his closing paragraph, he has assigned Mr. Stephens to a compilation of published data to see what lead and zinc content can be found — or indicated — in the production records of old precious-metal producers. I will let you know if new information develops from this.

I haven't any plans for scheduling field work in this matter at present. If Stephens' review of the literature reveals possibilities that were not indicated to earlier operators of these gold-silver-copper mines, or say lead and zinc "by-products" which were not then marketable, we will follow through of course.

Very truly yours,

LKW:ar

L. KENNETH WILSON

AUG-23-1951
F.M.S.

L.K.W.
AUG 22 1951

Ca - 25.0.12

AMERICAN SMELTING AND REFINING COMPANY
WESTERN MINING DEPARTMENT

D. J. POPE, GENERAL MANAGER
L. H. HART, ASSISTANT MANAGER
W. R. LANDWEHR, CHIEF GEOLOGIST
J. FRED JOHNSON, MANAGER OF OPERATIONS
NORMAN WEISS, MILLING ENGINEER

600 PACIFIC NATIONAL LIFE BUILDING
SALT LAKE CITY, UTAH

August 25, 1951

Mr. L. K. Wilson, Chief Geologist
Southwestern Mining Division
American Smelting and Refining Company
813 Valley National Building
Tucson, Arizona

LEAD-ZINC PROSPECTS
YAVAPAI COUNTY, ARIZ.

Dear Sir:

Referring to Mr. Richard's memorandum to you of August 8th regarding the search for base-metal mines in the Jerome and Bradshaw Mountain Areas:

It seems to me that his suggestion is a good one. I assume, however, that you had already pretty well covered the area, nevertheless Mr. Stephens may be able to uncover something that will justify detailed field study.

Yours very truly,

W. R. Landwehr

W. R. Landwehr

WRL:bm
cc: E.V.Richard

L. K. W.
AUG 27 1951

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

December 19, 1951

FILE MEMORANDUM

PRESCOTT AREA EXPLORATION
ARIZONA

In the closing paragraph of Mr. Pope's memorandum to Mr. Landwehr of December 10th, he asks that I present any ideas or recommendations that I may have on the area near Prescott.

I have no recollection of any formal recommendations that are to be found in the files, other than the one mentioned by Mr. Pope (at that time, in 1946, exploration in the Southwest was being organized and I had proposed that a geologist be placed at Prescott to cover the nearby mining districts, including Eureka (Bagdad) and the areas where Mr. Richard has now revived the current interest. It had been planned to station Jim Pollock there while Entwistle was to continue on in New Mexico).

I believe it is true that this region, and particularly the Iron King area, has been discussed more or less by all of us on different occasions during the past few years, and I am quite sure that everyone has agreed that the development of the Iron King Mine into an important producer has drawn special attention to the possibility that other lead-zinc mines might be found in the vicinity.

At the present time, as we all know, New Jersey Zinc has had two geologists living at Prescott for about three years now, working the Iron King and adjacent areas and in close contact with Charlie Anderson of the U.S.Geological Survey. Anderson has been at Prescott since about 1947. George Fowler and his group have also spent a year or more in the same vicinity - in 1949 and the winter of '50-'51. In view of this, it is my feeling that if there were any favorable prospects of interest there for exploration, surely they would now be known to Mr. Fowler or the New Jersey people. It seems to me that the chances of men of this caliber overlooking something that we might like, are now pretty slim.

The new work on this area that Mr. Richard started Stephens on last August is a constructive approach, and it is of course possible that the published data might point to a lead-zinc content in some of the old gold-silver-copper producers that otherwise is not suggested by surface features. But to go into a general study of the region itself, behind Fowler and the other recent investigators, it is going to require some such originality of approach as Mr. Richard has suggested. As I see it, our geologic knowledge of the area is about three years behind these men and we would therefore find ourselves in something of an awkward position - if not an inadequate one - to compete with them now in the same area, and on the same footing.

Inasmuch as personnel with me is still limited to Reinhart - and, beginning today, Tom Mitcham will also be available - I believe that instead of tying up a geologist in Prescott at this time, that we should continue investigating those areas that have been established by our periodic group conferences and exchange of memoranda, areas where competition is not yet entrenched. (Summarized outlines of July 25, 1950, November 8, 1949, November 11, 1948).

enc: Current list (on this ~~file's~~ copy)
(July 25, 1950)

L. KENNETH WILSON

cc: D.J.Pope
W.R.Landwehr
F.V.Richard
2 ex.

LKW:blc

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

January 10, 1952

Mr. L. Kenneth Wilson, Chief Geologist
Southwestern Division
Tucson Office

PROGRESS REPORT
Prescott Area
Yavapai County, Arizona

Dear Sir:

Some time ago I started gathering data on the various mining districts and the mines in Yavapai County to see if I might turn up something of interest, now that metal prices are appreciably different from what they were years ago, when a great deal of the information in our files was obtained.

As you know, this work has been frequently interrupted by other more urgent matters requiring attention and has not progressed very far or to a conclusion although I have gotten some ideas about this Prescott Area which I think may be worth some thought.

In starting this work I picked out the two mining districts (Big Bug and Hassayampa) which have made the most lead production. I have tried to find out if the lead producing mines might not have also had an appreciable amount of zinc in their ores, but I find that hardly ever were there any records kept of the zinc content and very few records of the lead content, since past interest seems to have been in the gold-silver-copper values.

From a reading of the files and my general knowledge of these two districts it is my opinion that with the exception of a very few mines such as the Blue Bell, McCabe-Gladstone, possibly the Sheldon and recently the Iron King, there are none of the various deposits large enough as tonnage producers to support a mill of their own. Records show that numerous mills (gravity and later flotation) have been built from time to time and have failed, due no doubt to many causes, the chief of which, I am quite thoroughly convinced, was very likely the inability of the mine to supply a mill with sufficient ore for an economical operation. It is to be noted that of the $22,000,000 production from the Big Bug District up to 1936, that $17,000,000 or 77% came from the Blue Bell and McCabe-Gladstone mines. The production of the Hassayampa District up to 1936 was $2,600,000 of which $1,800,000 or 70% was in gold.

The majority of these deposits have narrow veins which contained enriched ore in the upper oxidized portions but when the sulphides were reached the metal values were found to be below the economic limit at the then prevailing metal prices. Conditions have now changed and vein matter which previously was not ore has, in a good many cases become of value. Of course many of the deposits are still too low grade to be of interest but I believe there are a number of properties which, if they were made accessible, would be productive of a small tonnage of mill ore.

The middle of October I started to visit the various accessible properties in the Big Bug and Hassayampa districts with the intent of gathering first-hand information regarding their productive possibilities, but I was called away on other matters after spending only two days in the area and visiting at three properties.

I visited with Mr. Jack Orr who is operating the old Senator property and is being financed by Mr. E. R. Dickie of Bagdad. They are producing some 200 tons of lead-zinc ore per month from one of the 4 or 5 veins developed by the drainage tunnel some 600 feet below the outcrop. These veins have heretofore been too low grade to mine but Mr. Orr thinks some of them might be made to pay if there were an efficient customs mill in the vicinity where the ore could be treated.

Mr. Orr is well acquainted with the area south of Prescott and is of the opinion that there are a goodly number of properties that would become producers and could ship from 100 to 300 tons per month to a custom mill in Prescott.

Aside from possibly the De Soto Mine, (Peck District) I know of no other properties in the Prescott area that singly would be of interest for Company operation. The De Soto has produced some 18,000,000 pounds of copper and is estimated by George M. Colvocoresses to have some 6,000,000 tons of 1.0% copper with .02 ozs. gold; 0.6 ozs. silver and small amounts of galena and sphalerite. This could be mined by open pit with a stripping ratio of approximately 2.5 to 1. To prove the existence of this ore would probably cost around $50,000.

Since Mr. Richard has suggested the possibility of there being enough added values in lead and zinc to make this a profitable mining venture, I therefore visited the sorting dump at the lower end of the old tramway and obtained some samples of various types of reject material. These were assayed with the following results:

Sample No.	Description	Cu%	Pb%	Zn%
2482	Selected pieces of well mineralized quartz showing good chalcopyrite with some lead and zinc	4.05	0.11	2.12
2483	Selected pieces of quartz with minor mineralization	1.15	0.07	0.27
2484	Selected pieces of well mineralized schist	1.52	0.10	2.85
2485	Selected pieces of poorly mineralized schist	0.16	0.16	0.43

The presence of zinc is indicated. Whether it is in profitably recoverable amounts in the low grade orebody is unknown.

The only other possibility of the Prescott area, so far as I can see, is that of getting together a number of small properties, making them accessible for lessee operation on a split-check basis, and establishing a custom mill at Prescott

Aa-25.16.16B
January 10, 195?

L. Kenneth Wilson

to treat their production. For such a scheme to be successful it would probably be necessary for the Company to have at least one property under its own management which would be capable of supplying ore for the mill if, at times, custom receipts should not be sufficient to keep the mill operating at capacity.

I do not know whether such an operation would be of interest to our Company but if so, then the first step would be to spend some time in the area gathering factual data on which to base a decision regarding such a venture. The data which I have gathered so far is insufficient to enable me to pick out and recommend any particular properties as possible prospective producers of mill ore.

Ore from the Senator and one or two other mines is now going to the Iron King mill. The excess capacity of this mill will shortly be needed for Iron King ore and no more custom ore will be received.

I understand that the Allison Steel Manufacturing Company has about completed a mill at the Sheldon Mine and will be in the market for custom ore. This may, in a way, solve the custom ore milling problem although concentrates would still have to be trucked to Prescott for shipment.

I feel, however, that only sporadic production will continue until such a time as some plan is put into effect whereby a group of properties are gotten together under one management and rehabilitated so that lessees can go in and mine the ore on a split-check basis similar to that which has been in effect in the Cripple Creek district for years.

The sources of information I have so far used are our own mine files, The Mines Handbook (Mines Register), the U. S. Bureau of Mines Minerals Yearbook and U. S. G. S. Bulletin 782. I am attaching some notes I have taken from the Minerals Yearbooks relating to the Big Bug and Hassayampa districts for the years 1915 through 1936. These give a little idea (not much) of the scope of operations and the grades of the ore produced.

I also have made up a sketch map showing the locations of the various properties in the Big Bug, Hassayampa and some neighboring districts. District boundaries shown thereon are approximate, only.

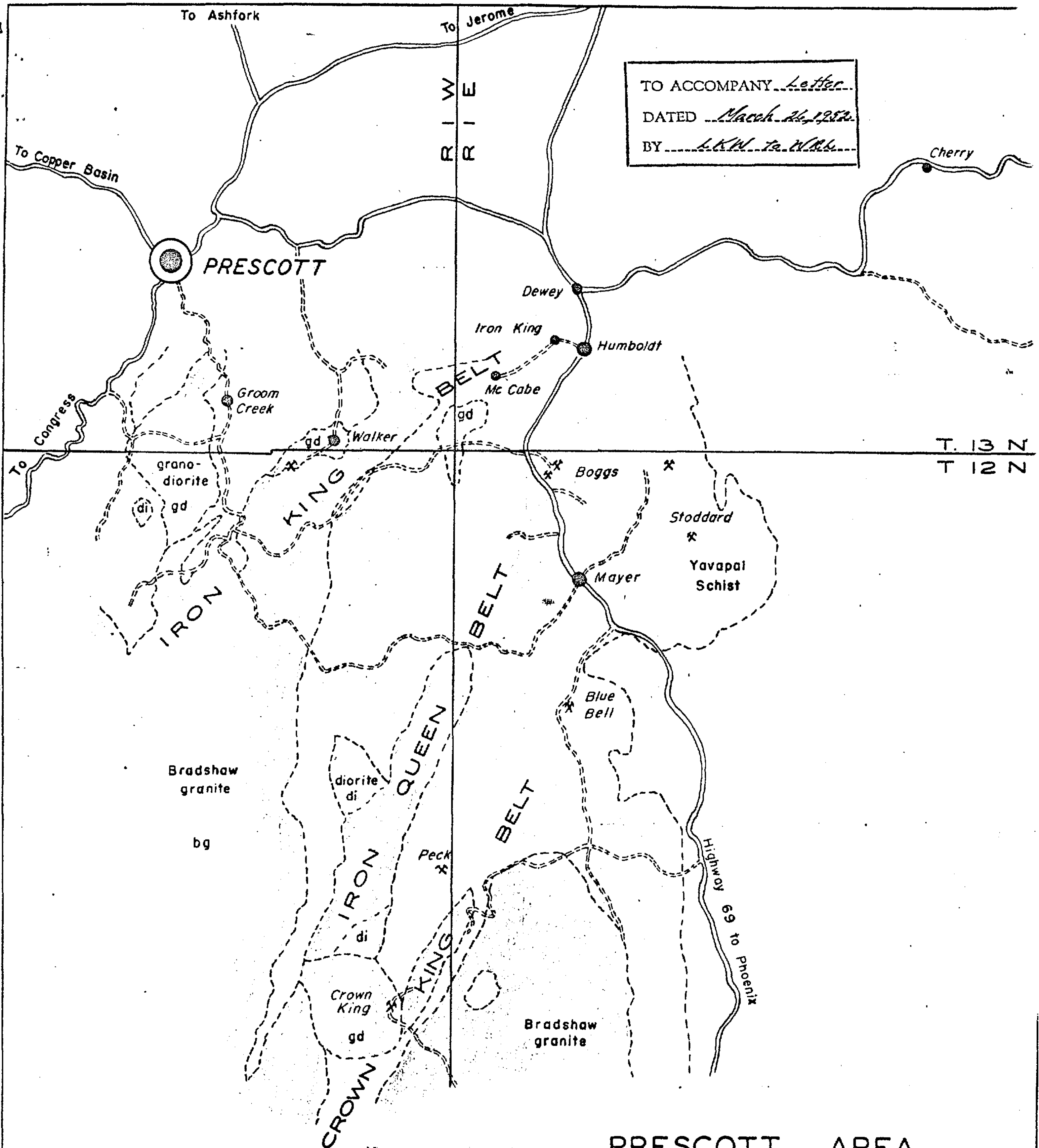
Yours very truly,

F. M. Stephens

F. M. STEPHENS

FMS:ar

Attachments:
Sketch Map
Notes on Mines - Filed w/ Big Bug & Hassayampa Districts



PRESCOTT AREA

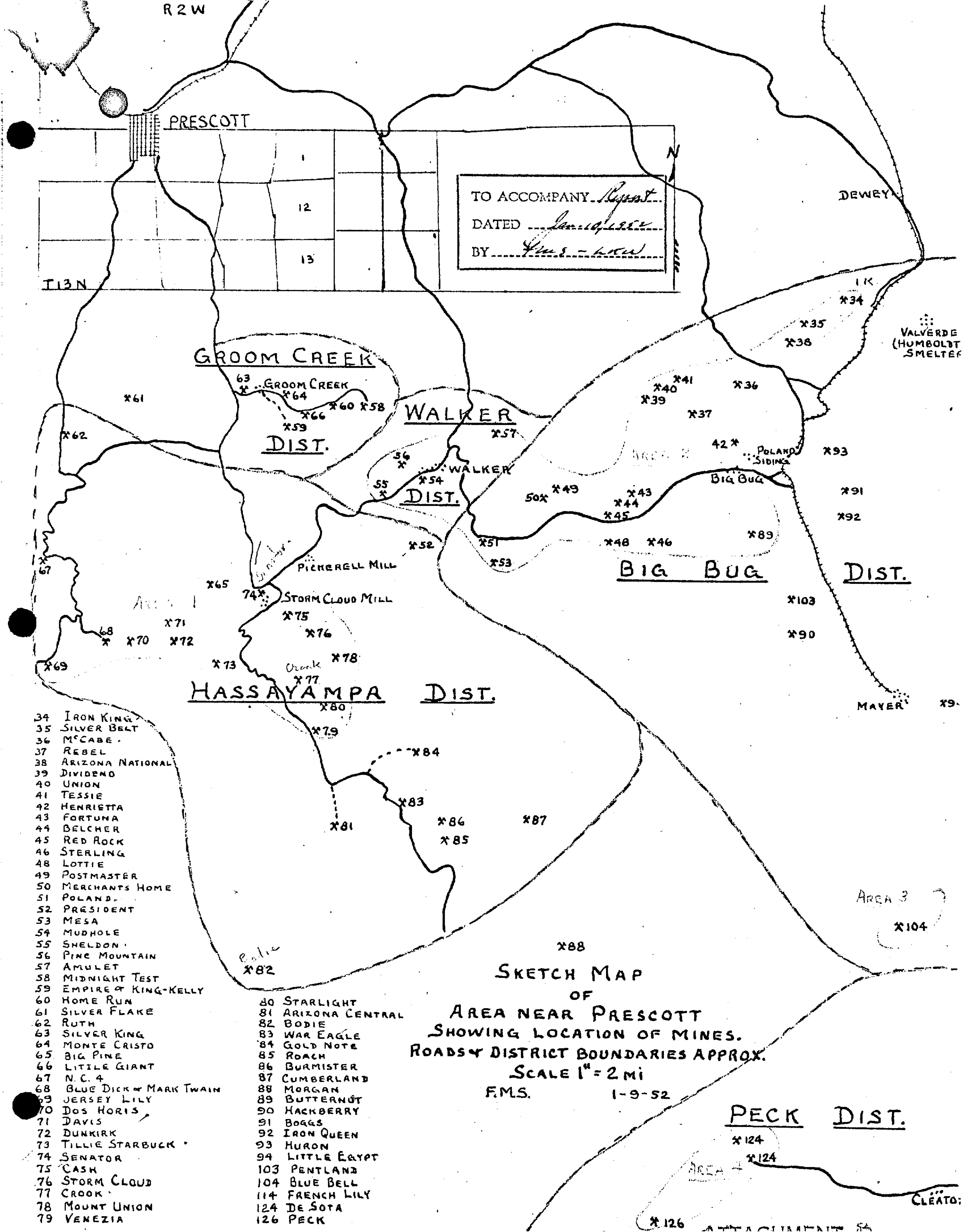
YAVAPAI COUNTY, ARIZONA

INDEX TO ROCK UNITS

SCALE 1" = 4 MILES

Modified after Lindgren
L. Kenneth Wilson

March, 1952
Map No. 1017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PRESCOTT
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TO ACCOMPANY
DATED
BY
N
DEWEY
I.K.
VALVERDE (HUMBOLDT SMELTER
GROOM CREEK
GROOM CREEK
DIST.
WALKER
DIST.
WALKER
PICKERELL MILL
STORM CLOUD MILL
POLAND SIDING
BIG BUG
BIG BUG DIST.
HASSAYAMPA DIST.
AREA 1
AREA 2
AREA 3
AREA 4
MAYER
PECK DIST.
CLEATO
ATTACHMENT
SKETCH MAP
OF
AREA NEAR PRESCOTT
SHOWING LOCATION OF MINES.
ROADS & DISTRICT BOUNDARIES APPROX.
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F.M.S.
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35 SILVER BELT
36 McCABE
37 REBEL
38 ARIZONA NATIONAL
39 DIVIDEND
40 UNION
41 TESSIE
42 HENRIETTA
43 FORTUNA
44 BELCHER
45 RED ROCK
46 STERLING
48 LOTTIE
49 POSTMASTER
50 MERCHANTS HOME
51 POLAND
52 PRESIDENT
53 MESA
54 MUDHOLE
55 SHELDON
56 PINE MOUNTAIN
57 AMULET
58 MIDNIGHT TEST
59 EMPIRE & KING-KELLY
60 HOME RUN
61 SILVER FLAKE
62 RUTH
63 SILVER KING
64 MONTE CRISTO
65 BIG PINE
66 LITTLE GIANT
67 N.C. 4
68 BLUE DICK & MARK TWAIN
69 JERSEY LILY
70 DOS HORIS
71 DAVIS
72 DUNKIRK
73 TILLIE STARBUCK
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84 GOLD NOTE
85 ROACH
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87 CUMBERLAND
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89 BUTTERNUT
90 HACKBERRY
91 BOGGS
92 IRON QUEEN
93 HURON
94 LITTLE EGYPT
103 PENTLAND
104 BLUE BELL
114 FRENCH LILY
124 DE SOTA
126 PECK

Aa-25.16.16B

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

March 24, 1952

MAR 27 1952

MEMORANDUM FOR MR. WILSON

PRESCOTT AREA
Yavapai County, Arizona

An area southeast of Prescott 14 miles square (196 square miles) would embrace four mining districts whose production through 1933 was as follows:

Big Bug District (north part		$8,485,000
Hassayampa "		2,600,000
Walker "		1,675,000
Groom Creek "		140,000
	Total	$12,900,000

The Crown King area (production $3,519,000) and Peck district (production $5,190,000) as well as the Blue Bell Mine (production $14,000,000) are outside the limits of this 196 square-mile-area and the production from them is not included in the above figures.

Twenty-nine properties lie in an east-west belt approximately 2 miles wide and 14 miles long (28 square miles) and their total production has been $11,845,000 or 92% of the whole 196 square-mile-area. These 29 properties are distributed as follows:

Area 1. Central part of Hassayampa district, 13 properties, area 10 square miles, production $2,360,000 (18% of total).

Area 2. Walker District and north part of Big Bug District, 16 properties, area 16 square miles, production $9,525,000 (74% of total).

If we were to consider also the Blue Bell Mine and the De Soto and Peck Mines in the Peck District, the result is about the same as above except we have added two small productive areas south of Mayer. The following tabulation shows the result of this analysis for 4 productive areas instead of the two considered above.

AREA	PRODUCTION
5 districts (Big Bug, Hassayampa, Walker, Groom Creek and Peck)	31,525,000
Area 1 (Hassayampa Dist. (13 properties, 10 sq. mi.)	2,360,000 (7½% of total)
" 2 Walker Dist. and N. part of Big Bug Dist., (13 properties, 16 sq. mi.)	8,960,000 (28½% " ")
" 3 Blue Bell Mine	14,000,000 (44% " ")
" 4 Peck Dist. (De Soto and Peck mines)	4,250,000 (13% " ")
	93%

Production since 1933 from these five districts has been as follows:

Aa-25.16.16B
March 24, 1952

Memorandum for Mr. Wilson

Big Bug District,	$21,874,000,	an increase of 100%.	Mostly Iron King production.
Hassayampa "	864,000,	" " " 33%.	
Peck District	229,000	" " " 4.4%	
Walker "	429,000	" " " 25%	

Groom Creek none. Probably small production reported Hassayampa District.

The total production of these five districts up to the end of 1949 is $54,921,000. That of the Big Bug is $43,794,000 or 80% of the total.

F. M. Stephens

FMS:ar

F. M. STEPHENS

Aa-25.16.16B

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

March 26, 1952

F. V. R.

MAR 27 1952

MEMORANDUM FOR MR. RICHARD

PRESCOTT AREA
Yavapai County, Ariz.

In Mr. Landwehr's letter to me January 10th he requests: "Please give me the names of the unexplored veins mentioned by Mr. Richard." He refers to Mr. Pope's memorandum of December 10th in which he says that you stated there are "numerous strong veins over 1000 feet long which have not been explored".

When you return to Tucson would you please advise me as soon as possible so that I may reply to Mr. Landwehr.

L. KENNETH WILSON

LKW:ar

cc: WRLandwehr

F. V. Richard

Aa-25.16.16B

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

March 26, 1952

Mr. W. R. Landwehr, Chief Geologist
Western Mining Department
Salt Lake City Office

F. V. R.

APR 1 1952

PRESCOTT AREA EXPLORATION

Dear Sir:

The following outlines my basic ideas on exploration of the Prescott area, Yavapai County, Arizona.

"PRESCOTT AREA" DEFINED

Expressed in round figures, the area here referred to as Prescott Area embraces 200 square miles in the Bradshaw Mountains southeast of Prescott. It includes the mining districts of Groom Creek, Hassayampa, Walker, Big Bug (Iron King Mine, Humboldt) and — furthest to the south — Peck and Pine Grove districts (Crown King Mine).

The region is rugged, heavily wooded and covered with thick underbrush. Rock units are further masked by soil. Elevations in the area under consideration range from 4,500 to 7,000 feet and it is at least partially covered by snow during the winter months.

Analyzing the production of the 200 square mile area, the greater part of important Au-Ag-Cu-Pb-Zn mineralization has been concentrated in about 10 per cent of the total area, or roughly about 20 square miles. The available records of this production show that this smaller area had produced over 90% of the total production of the Prescott area before the Iron King Mine was rehabilitated in 1937.

These same records show that, in this area of concentrated mineralization about 75% of the total production of the region came from 16 properties in the Walker and Big Bug (Iron King) districts. Again, the production of the Iron King Mine in the past 14 years is not included.

GEOLOGY

Waldemar Lindgren's U. S. G. S. Bulletin No. 782 has been the principal, published source of information on the area south of Prescott. Recently, S. C. Creasey published an article in Economic Geology on the Iron King Mine and the immediate vicinity. Geologically, the mines which have been responsible for the bulk of total production (in the smaller area described) are located in an area of Yavapai schist which has been invaded by various intrusives of granodiorite, diorite and Bradshaw granite. Attachment A. Intrusives are aligned northeasterly, and both the intrusives and schist alike are cut by fractures also aligned northeasterly and often in "en echelon" pattern. Foliation, schistosity and similar lineation in the pre-Cambrian rocks generally parallels these fracture systems.

The U. S. Geological Survey, under C. A. Anderson, concluded from their study of the Iron King Mine and vicinity that both lineation and shearing control the ore deposition, the length and width of orebodies, and the size and shape of rock alteration.

EXPLORATION POSSIBILITIES

The exploration or reconnaissance of any given region should always begin with an understanding of known mineralized areas nearby — a knowledge of apparent ore controls. There are usually in every mineralized district or region "thousands" of feet of veins which may be termed "unexplored". Justifying their exploration is quite another matter. Here, the approach to the Prescott area, as I have viewed it, begins with the area of greatest concentrated production — the Walker and Big Bug districts (Iron King, Blue Bell, McCabe-Gladstone, etc.) I feel sure that an understanding of this area, based upon field observations, is the key to Prescott Area exploration and that this will suggest or point to other exploration targets elsewhere in the Big Bug district. The possibility of lead-zinc mineralization greater than is mentioned in the literature is the objective, of course.

I should like to designate three structural units interpreted from the published information on this region. In review, we have noted above that where principal mineralization has been concentrated, there appears to be a uniform alignment of intrusives, mineralized fractures and rock lineation — the northeasterly belt shown on Lindgren's Plate 2, extending 15 miles through Mt. Tuttle to the Iron King and Humboldt. This belt is here referred to as the Iron King zone. (Attachment A).

In a planned program of regional exploration, I would follow the study of the "key" structure, the Iron King, with a reconnaissance of a similar and roughly parallel belt of northeasterly-aligned intrusives further to the south. It would begin with a projected extension of the belt at the old Boggs, Hackberry and Iron Queen Mines, investigating the zone southwesterly toward Towers Mountain and the old Peck Mine. This I designate the Iron Queen Belt. The reconnaissance would automatically expand into a third parallel belt of northeasterly-aligned intrusives which embrace the Crown King Mine, here called the Crown King Zone. (This zone is the one in which Lindgren shows an unbroken vein or mineralized fault, paralleling the belt for about 13 miles and most of it "unexplored").

With regard to other districts in the region, I feel that the Hassayampa (gold) and Groom Creek districts can be deferred for consideration later. The Walker District, geologically speaking, seems to represent a structural crossroads. North-south and north-northeast fractures cut across the major belt of intrusives, and as such, form a separate cluster, somewhat detached from the parallelism of Iron King lineation.

CONCLUSION

The role of the geologist in a reconnaissance of this scope will be difficult and tedious. Certainly, I feel it must be realized that it should be long-lasting and that it is not likely to prove fruitful quickly or within a few months. It is a matter for industrious — and preferably uninterrupted — study.

A geologist should be assigned to work this area from Prescott somewhat exclusively and with the expectation of at least several months in the region, possibly a year or more depending upon the results obtained. It is not at all unlikely that the reconnaissance will expand into localized detail mapping and even to geochemical and geophysical investigations. (The heavily wooded and soil-

Mr. W. R. Landwehr

covered region will hamper conventional studies).

I do not believe that we can meet competition in the same area, nor that we can match its three-year start on us unless we provide for full-time examination and by a well-qualified man. Therefore it is my recommendation that a geologist be assigned to Prescott more-or-less full time and that the program of geologic study discussed in this letter be started. In outline:

1. Learn by field observations, the geologic features and possible ore controls of the major producing area — the Iron King belt of structures. Stress lineation, fracture pattern and rock alteration.

2. Start a reconnaissance of the Iron Queen Zone, beginning near the Boggs Mine and to the southwest. Determine what areas appear somewhat promising by comparison with the key area, and which of them deserves further attention in more detail.

3. Continue with the Crown King zone.

I do not recommend that this program be initiated at the expense of our present work which involves more-detailed investigations in Aravaipa, Stanley, White Signal (uranium), Franco and other properties around Silver Bell, Hillsboro (New Mexico) and the miscellaneous mine examinations in progress and to be anticipated.

We have no knowledge of the property situation or of leases held by competitors. This would have to be determined by investigation.

Very truly yours,

L. KENNETH WILSON

LKW:ar

Attachments:

A. Geologic Index, Map No. 1017.

B. Mr. Stephens' Memorandum of 1/10/52 with attachments.

All separate in Memo of Jan 10/52

cc: DJPope with Attachment A
FVRichard with encs.

Aa-25-16-16B

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

L. K. W.
APR 7 1952

April 2, 1952

MEMORANDUM TO:
L. K. Wilson

PRESCOTT AREA
Yavapai Co., Arizona

In your memorandum to me of March 26th you advised that Mr. Landwehr had requested the names of the unexplored veins mentioned in Mr. Pope's memorandum of December 10, 1951.

I did not have in mind any particular vein or mineralized zone. My impression of the number and extent of the zones in this district was derived from flying over it, and later studying the Government bulletin.

I was also very much impressed by the Iron King ore which is such an intimate mixture of galena, sphalerite and pyrite that megascopically it looks like massive pyrite with no visible content of lead or zinc, even when the content of these metals is 10% or more combined. The oxidation product of such ore in an outcrop would probably have the same appearance as massive pyrite. In studying the area this factor should be considered.

The plan for exploring this district, as outlined in your letter of March 26, 1952, to Mr. Landwehr, seems to me the proper approach, and I sincerely hope it can be put into effect promptly.

cc: W.R.Landwehr
FVR:blc

F. V. RICHARD

WESTERN MINING DEPARTMENT
Salt Lake City, Utah

Aa-25.16.16B

April 18, 1952

AIR MAIL

F. V. R.
APR 21 1952

Mr. L. Kenneth Wilson, Chief Geologist
Southwestern Mining Division
American Smelting and Refining Company
813 Valley National Building
Tucson, Arizona

PRESCOTT AREA EXPLORATION

Dear Sir:

I have been studying your letter of March 26, and Mr. Stephens' letter to you of January 10, both relating to exploration possibilities in the Prescott area. Also to some extent I have read U.S.G.S. Bulletin 782. Frankly, I am not too impressed with the possibilities.

Mr. Stephens approached the problem from the standpoint of the known mines. According to Bulletin 782, these were of two age types, one presumably Pre-Cambrian, the principal metals being gold, silver and copper; the other, of Laramide age, in which the principal metals were gold and silver with minor base metals. Mr. Stephens, at the suggestion of Mr. Richard, studied our files, which must be rather comprehensive, and the literature, with the specific object of determining whether or not any of these deposits contain sufficient lead and zinc to make them attractive under present metal prices. Although many of them appear to contain appreciable amounts of lead and zinc, his conclusion was that in general none of them is large enough to singly be of interest.

He suggests, however, that a number of these, if operated on a split-check-leaser basis, might produce a sufficient tonnage to support a custom mill at Prescott.

You suggest a different approach, if I understand your recommendation correctly, which is a search for undiscovered ore bodies. This is to be initiated by careful study of the so-called Iron King zone in order to determine the geological features responsible for or associated with ore localization, such as fracture pattern, rock alteration, etc. With this geological basis you would then study the Iron King and Crown King belts, presumably, as I understand, with the hope that a new deposit might be discovered.

Although I consider this a proper approach to a district-wide study, in view of the generally small size of the deposits which characterize the Prescott area, and the amount of prospecting to which it no doubt has been subjected, I cannot feel that this has much chance of success. Certainly, we would not at this time want to station a man at Prescott for a year or more in order to carry out the program that you suggest. I, therefore, agree with you that we should not interrupt our present program.

PRESCOTT AREA EXPLORATION
April 18, 1952

Mr. C. A. Anderson has completed his study of the area, and I would suggest that if you have not already done so you discuss the district with him and determine whether or not he has found any areas which he thinks deserve the type of examination which you have recommended.

Very truly yours,

W. R. Landwehr

W. R. Landwehr

WRL:si

Ex 25. 2. 04.

NOTE FILE ON "PORPHYRX COPPER"

Yavapai Co., Ariz.; 25 mi. by road SE of Prescott; at confluence Property .
Gulch & Big Bug Creek, 2 mi. N of Poland Siding; 45 mi. airline District Bigbug
on King mine. See Index Map (p. ....) ~~Mtx Range~~ L. K. W.

Information	Explanation: FEB 24 1953
Observations	
Publications	Reconnaissance with K. Papke
Company Files	
Other	Date 1/19-20/53
Recommended Company Classification:	**Qualifying Remarks:** Typical porph. Cu deposit (Laramide intrusive; breccia pipes; qtz.-ser. alt.; Cu-sulph. lim.), but probably too small to be commercial. Detailed mapping warranted for purposes of record. This occurrence lends encouragement to the possibility that other unrecognized porph. Cu deposits exist in the region. The Walker & Groom Creek stocks particularly will be prospected carefully.
Active	
Possible	
None	
Scientific	(see p.....)

MINERALIZATION (See Sketch Map ....)

Alteration and Metallization: Altered zone ± 1/2 mi. diam. occupies basin mostly filled with stream gravels — outcrops wide-spaced. Granodiorite altered to qtz.-ser.-py. with probably argillic . Dump of a shaft near edge of alteration zone shows dissem. py. with a little cpy. (possibly to .10% Cu). Alteration locally is strong, particularly in and around breccias.

Leached Outcrops: (see p.....)

Outcrops show mostly pyrite-limonites, but occasional patches of sparse copper-limonites. Breccia pipe outcrop well-mineralized; no copper staining, but limonites and boxwork indicate at 1.0% Cu as cc. & cpy.

(see p.....)

Enrichment:

The region has been described as unfavorable for the accumulation of cc. This may be due to too-rapid erosion, and it probably applies to this deposit.

(see p.....)

Associated Metal Deposits:

Veins and replacement py.-Cu deposits in schist around the McCabe stock.
Placer Au workings in the gravels covering the porph. deposit.

(see p.....)

STRUCTURE (See Sketch Map p. ....)

Fissures:

(see p.....)

Intrusives:

The McCabe granodiorite is a Laramide stock about 3 miles long which crosscuts the Yavapai schist. The Bigbug altered zone is at the S end and apparently entirely within the stock. The N part of the stock has not yet been prospected for altered zones.

(see p.....)

Breccia Pipes:

One breccia pipe is outcropping. About 150' in diam.; comprised of angular fragments and vugs; obviously a sourseway of primary copper mineralization. Breccia float indicates there are other pipes buried by stream gravels.

(see p.....)

Cover Rocks:

Stream gravels cover most of the altered zone.

(see p.....)

DEVELOPMENT, PRODUCTION, FACILITIES, ECONOMIC POSITION, ETC.:

One shaft (flooded) with a few hundred feet of workings. Name unknown. Property ownership not investigated.

(see p.....)

cc: WPL(2)-TAS-LKW-JHC-KGP

Date 2/13/53 By KENYON RICHARD

2M-11-52-K

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

June 14, 1956

. F. V. Richard, Manager
stern Mining Department
lt Lake City Office

PORPHYRY COPPER
Big Bug District
Yavapai County, Arizona

ear Sir:

Reference is made to your memo of June 9.

Ever since the visit Papke and I made in that area in 1953, we have been planning to return and look the region over more thoroughly. We had expected to map this Big Bug area of breccia pipes and porphyry copper alteration just to obtain a better record of it -- and not necessarily because there are any commercial possibilities. My impression was that the exposed pipes were too small to be commercial. This mapping would still be a good idea, and we will get to it eventually.

Your suggestion that this Big Bug showing should be restudied in view of the Duval discovery south of Twin Buttes indicates to me that you are wondering if we have been misinterpreting some of these leached out-crop areas. To a limi- d extent you may be right -- but not because of the Duval discovery. That is a rather special problem, and I will not attempt to explain it here. However, you will probably recall that in some of our more formal reports on leached out-crops, for example the report on Red Hills prior to drilling, we have included rather long descriptions of those conditions of copper sulphide occurrence which <u>cannot</u> be predicted from observations of the leached out-crops.

Since you have always shown considerable interest in this type of work and are continuing to do so, in all seriousness I suggest that you should spend at least a day in the field with Mr. Courtright and me at Silverbell and other nearby localities, the next time you are in Tucson. In the field it will be much easier to point out the various types of occurrence and explain the uncertainties as well as the certainties of interpretation.

Yours very truly,

KENYON RICHARD

KR/ds
cc: WRLandwehr
JHCourtright

WESTERN MINING DEPARTMENT
Salt Lake City, Utah

June 18, 1956

K. R.
JUN 20 1956

AIR MAIL

Mr. K. E. Richard, Chief Geologist
Southwestern Mining Division
American Smelting and Refining Company
813 Valley National Building
Tucson, Arizona

PORPHYRY COPPER
BIG BUG DISTRICT
YAVAPAI COUNTY, ARIZ.

Dear Sir:

This will acknowledge your letter of June 14th on the above subject in answer to my pencil memorandum of June 9th.

If you think there may be additional porphyry copper possibilities in the various mining districts in the vicinity and particularly south of the Iron King mine, then it would seem to me that we had better look at these before somebody else beats us to the punch.

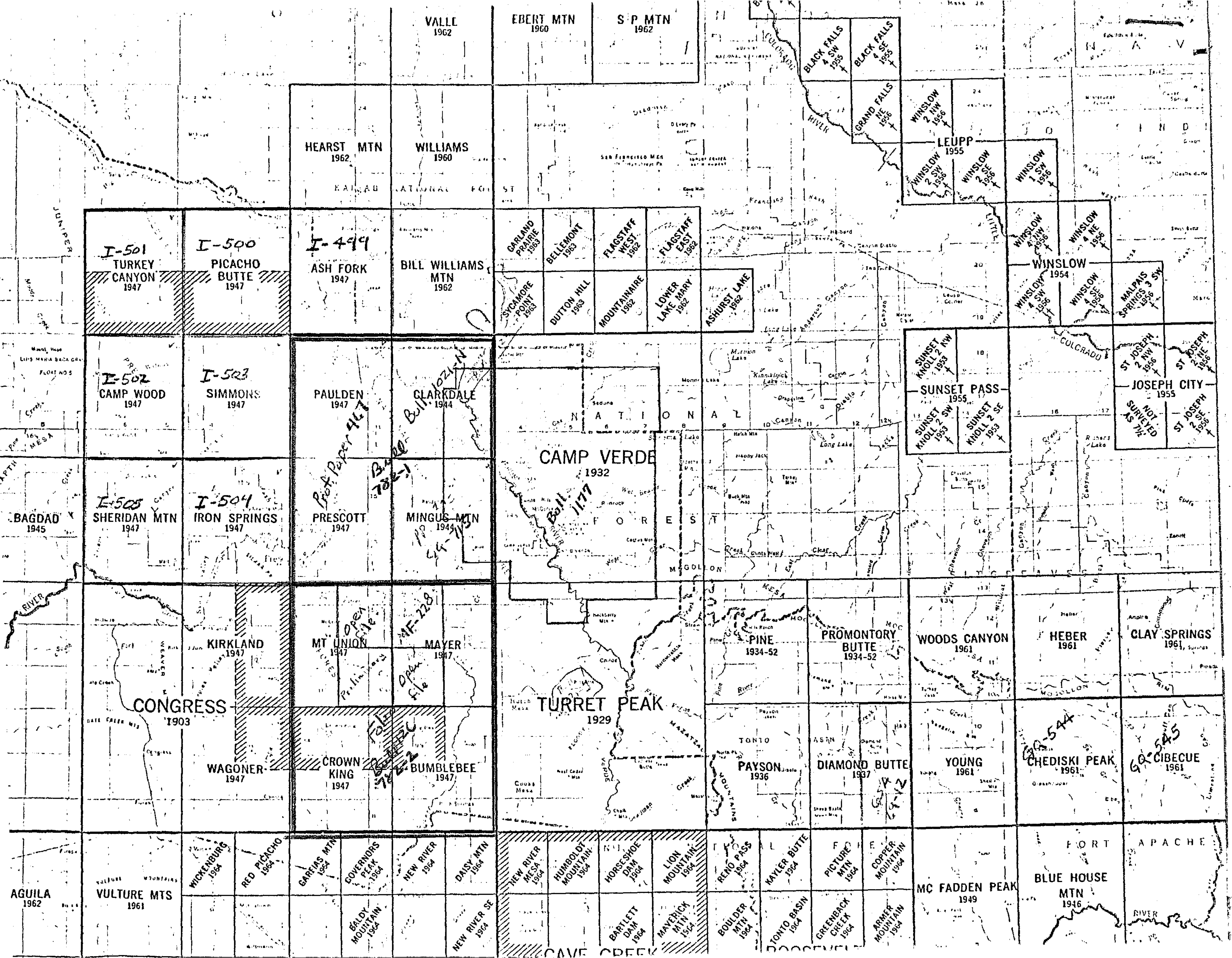
I would be very glad to take up your invitation to visit a number of porphyry outcrop areas with you and Mr. Courtright the next time I am in Tucson, if time will permit. I thought I had a pretty fair general appreciation of this problem; however, I would be more than happy to get some further instructions from experts.

Very truly yours,

F. V. Richard

F. V. RICHARD

FVR:bm
cc: J.H.Courtright



VALLE 1962
EBERT MTN 1960
S P MTN 1962
BLACK FALLS 4 SW 1955
BLACK FALLS 4 SE 1955
GRAND FALLS NE 1956
WINSLOW 2 NW 1956
LEUPP 1955
WINSLOW 2 SW 1956
WINSLOW 2 SE 1956
WINSLOW 1 SW 1956
HEARST MTN 1962
WILLIAMS 1960
KAIBAB NATIONAL FOREST
I-501
TURKEY CANYON 1947
I-500
PICACHO BUTTE 1947
I-499
ASH FORK 1947
BILL WILLIAMS MTN 1962
GARLAND PRAIRIE 1963
BELLEMONT 1963
FLAGSTAFF WEST 1962
FLAGSTAFF EAST 1962
WINSLOW 4 NW 1956
WINSLOW 4 NE 1956
WINSLOW 1954
SYCAMORE POINT 1963
DUTTON HILL 1963
MOUNTAINAIRE 1962
LOWER LAKE MARY 1962
ASHURST LAKE 1962
WINSLOW 4 SW 1956
WINSLOW 4 SE 1956
MALPAIS SPRINGS 3 SW 1956
I-502
CAMP WOOD 1947
I-503
SIMMONS 1947
PAULDEN 1947
CLARKDALE 1944
Prof Paper 467
Bull Bull 1021-N
SUNSET KNOLL 2 NW 1953
SUNSET PASS 1955
SUNSET KNOLL 2 SW 1953
SUNSET KNOLL 2 SE 1953
ST JOSEPH 2 NW 1956
ST JOSEPH 2 NE 1956
JOSEPH CITY 1955
NOT SURVEYED
ST JOSEPH 2 SE 1956
NATIONAL FOREST
CAMP VERDE 1932
Bull 782-1
Bull 1177
BAGDAD 1945
I-505
SHERIDAN MTN 1947
I-504
IRON SPRINGS 1947
PRESCOTT 1947
MINGUS MTN 1944
PP
MOGOLLON
MOGOLLON RIM
KIRKLAND 1947
MT UNION 1947
Open file
Preliminary
MF-228
MAYER 1947
Open file
PINE 1934-52
PROMONTORY BUTTE 1934-52
WOODS CANYON 1961
HEBER 1961
CLAY SPRINGS 1961
CONGRESS 1903
TURRET PEAK 1929
WAGONER 1947
CROWN KING 1947
BUMBLEBEE 1947
Bull
TONTO BASIN
PAYSON 1936
DIAMOND BUTTE 1937
YOUNG 1961
GQ-544
CHEDISKI PEAK 1961
GQ-545
CIBECUE 1961
AGUILA 1962
VULTURE MTS 1961
WICKENBURG 1964
RED PICACHO 1964
GARFIAS MTN 1964
GOVERNORS PEAK 1964
NEW RIVER 1964
DAISY MTN 1964
NEW RIVER MESA 1964
HUMBOLDT MOUNTAIN 1964
HORSESHOE DAM 1964
LION MOUNTAIN 1964
RENO PASS 1964
KAYLER BUTTE 1964
PICTURE MTN 1964
COPPER MOUNTAIN 1964
MC FADDEN PEAK 1949
FORT APACHE
BLUE HOUSE MTN 1946
BALDY MOUNTAIN 1964
NEW RIVER SE 1964
BARTLETT DAM 1964
MAVERICK MTN 1964
BOULDER MTN 1964
TONTO BASIN 1964
GREENBACK CREEK 1964
ARMER MOUNTAIN 1964
CAVE CREEK
ROOSEVELT
COLORADO RIVER
LITTLE COLORADO
VERDE RIVER

Recent Coverage

Bull. 1021-N. Geol. of the Clarkdale Quad. (Lehner, 1958).
Bull. 1177. Geol. in the Verde Valley (Twenter, 1962).
Bull. 1230-F. Mineral Resources — Sycamore Canyon (Hoff, 1966)
Bull. 1230-I. Mineral Resources — Pine Mountain (Canney, 1967)
P.P. 308. Geol. of the Jerome Dist. (Anderson, 1958).
P.P. 467. Geol. of the Bagdad-Prescott Quad. (Krieger, 1965).
GQ-544. Geol. of the Chalcedony Peak Quad. (Fennell, 1966).
GQ-545. Geol. of the Cibecue Quad. (Fennell, 1966).
MF-228. Prelim. Geol. of the NW 1/4 Mayer Quad. (Anderson, 1959).
I-501. Prelim. Geol. of the Turkey Canyon Quad. (Krieger, 1967).
I-502. Prelim. Geol. of the Gray Wood Quad. (Krieger, 1967)
I-503. Prelim. Geol. of the Simmons Quad. (Krieger, 1967)
I-504. Prelim. Geol. of the Iron Springs Quad. (Krieger, 1967)
I-505. Prelim. Geol. of the Sheridan Mtn. Quad. (Krieger, 1967)
Open File. Prelim. Geol. of the NE 1/4 Mt. Union Quad. (Anderson, 1967).
GSA 69-12. Geol. (E 1/2) of the Diamond Butte Quad. (Bull. v. 69 no. 12, p. 495- (Gastil, 1958).
I-499. Prelim. Geol. of the Ash Fork Quad. (Krieger, 1967)
I-500. Prelim. Geol. of the Picacho Butte Quad. (Krieger, 1967)
Open File. Prelim. Geol. of the SW 1/4 Mayer Quad. (Anderson, 1967).
GQ-715. Geol. of the Mingus Mtn. Quad. (Anderson & Creasey, 1967).
Preliminary Geol. (SE 1/4) Mount Union Quad. (P.M. Blacet, 1968) (Copy in ASARCO files)

✓ Bull 782. Ore dep. of Jerome (Plate 1) & Bradshaw Mtns. (Plate 2) Quads (Lindgren, 1926).
✓ Folio 126. Bradshaw Mtns. (Jaggar & Palache, 1905).

PRECAMBRIAN WRENCH FAULT IN CENTRAL ARIZONA

By C. A. ANDERSON, Menlo Park, Calif.

Abstract.—The major north-trending high-angle Shylock fault zone, 17 miles east of Prescott, Ariz., displaces Precambrian rocks. It is interpreted as a wrench fault with a minimum right-lateral slip of 5 miles. A piercement structure in the fault zone is implied by a fault slice of tightly folded and highly deformed incompetent rhyolitic tuff and slate that is in contact with younger andesitic breccia and tuff. The fault zone is covered by unbroken Cambrian Tapeats Sandstone at its north end.

The Shylock fault in the Mingus Mountain quadrangle in central Arizona is a straight high-angle fault separating diverse rocks of Precambrian age (Anderson and Creasey, 1958, p. 77). New data added by geologic mapping to the south in the Mayer quadrangle indicate that the Shylock fault is a major wrench fault, following E. M. Anderson's terminology (1951, p. 15). Evidence in the Mingus Mountain quadrangle indicates a right-lateral slip.

Acknowledgments.—Much of the detailed mapping of the Shylock fault zone in the Mingus Mountain quadrangle was done by my associate S. C. Creasey, and I am indebted to him for many helpful suggestions in the structural interpretation of this Precambrian terrane. I am most appreciative of the encouragement and helpful comments of Mason L. Hill in the preparation of the manuscript; I should state, however, that he does not agree with all of my terminology.

GENERAL GEOLOGY OF THE AREA

The geologic setting is shown in figure 1. Originally the Shylock fault was limited to the sharp break along the eastern margin of a complex faulted zone (Anderson and Creasey, 1958, p. 77). Following Noble's distinction (1926, p. 416–17) between "fault" and "fault zone," "Shylock fault zone" is used for the belt of branching, interlacing, and roughly parallel faults to the west of the Shylock fault. The Shylock fault zone is approximately 1 mile wide at the exposed north end and somewhat wider at the south margin of figure 1. Where the fault zone contains rocks of diverse lithology and age, its branching and interlacing pattern is apparent on geologic maps (figs. 2, 3, 4). This pattern is obscure in the area (central part, fig. 1) where only the Spud Mountain Volcanics are exposed along and within the fault zone.

The Yavapai Series (fig. 1) consists largely of volcanic rocks that are metamorphosed to the greenschist facies. Relict textures and structures permit the identification of the original character of the volcanic rocks ranging from basalt to rhyolite, and the distinction between flows and pyroclastics. The Yavapai Series is divided into the Alder and Ash Creek Groups. The Alder Group is exposed on both sides of the Shylock fault, and in the southern half of the area (fig. 1) and east of the fault, the Spud Mountain Volcanics of this group are intruded by a quartz diorite pluton. The Ash Creek Group is exposed only east of the Shylock fault and north of the quartz diorite pluton which cuts southeasterly plunging folds developed in the Ash Creek (fig. 1). The Ash Creek Group is typically nonfoliated, whereas the Alder Group is isoclinally folded and is foliated parallel to the overturned folds.

The oldest formation in the Alder Group, the Texas Gulch Formation, is unconformable above the Brady Butte Granodiorite (Blacet, 1966). Elsewhere various types of plutonic rocks intrude the Alder Group (fig. 1). At present, no evidence is available to determine the age relationships of the Alder and Ash Creek Groups because they are separated either by the Shylock fault or by the quartz diorite which intrudes both groups.

SHYLOCK FAULT ZONE

Because of its width of approximately 1 mile, its known length of more than 30 miles, and its separation in part of dissimilar rocks, the Shylock fault zone is a major structural feature of the region. The Cambrian Tapeats Sandstone and Devonian Martin Formation were deposited on a widespread surface of low

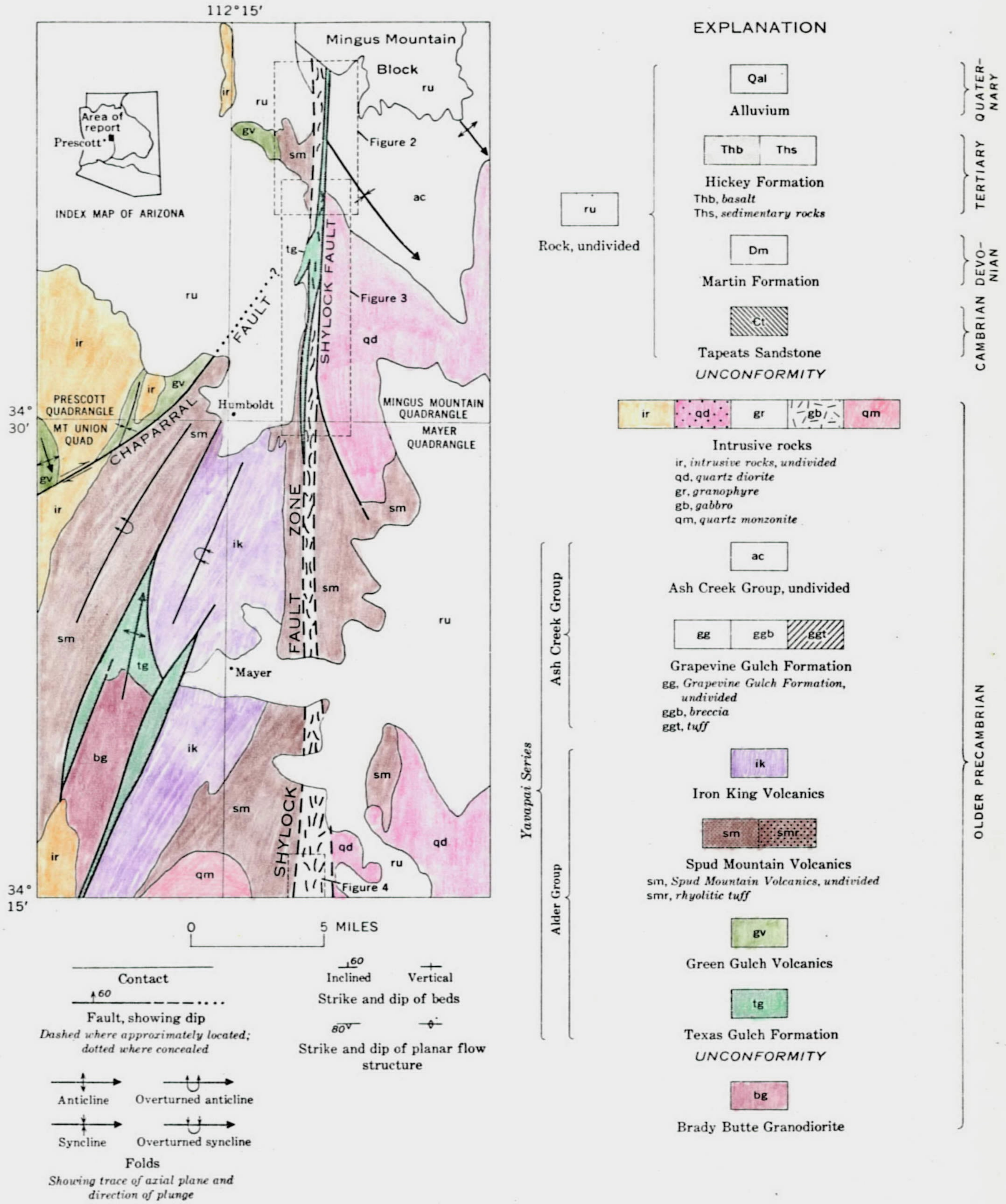


FIGURE 1.—Generalized geologic map of parts of the Mingus Mountain, Prescott, Mount Union, and Mayer quadrangles, Yavapai County, central Arizona, showing the geologic setting of the Shylock fault zone and Chaparral fault. Explanation applies to figures 1, 2, and 3. Only the pattern for the Texas Gulch Formation is shown on figure 1.

relief. The northern end of the exposed Shylock fault zone is covered by the Tapeats Sandstone, and therefore the faulting is of Precambrian age (fig. 2). Three narrow slices of quartz diorite and one of the Spud Mountain Volcanics illustrate the exotic character of some of the fault slices within the fault zone (fig. 2). These fault slices have schistose margins, and only in their exposed cores are relict minerals and textures preserved.

The best key to the displacement along the Shylock fault is provided by the quartz diorite fault slices within the fault zone north of the crudely planar,

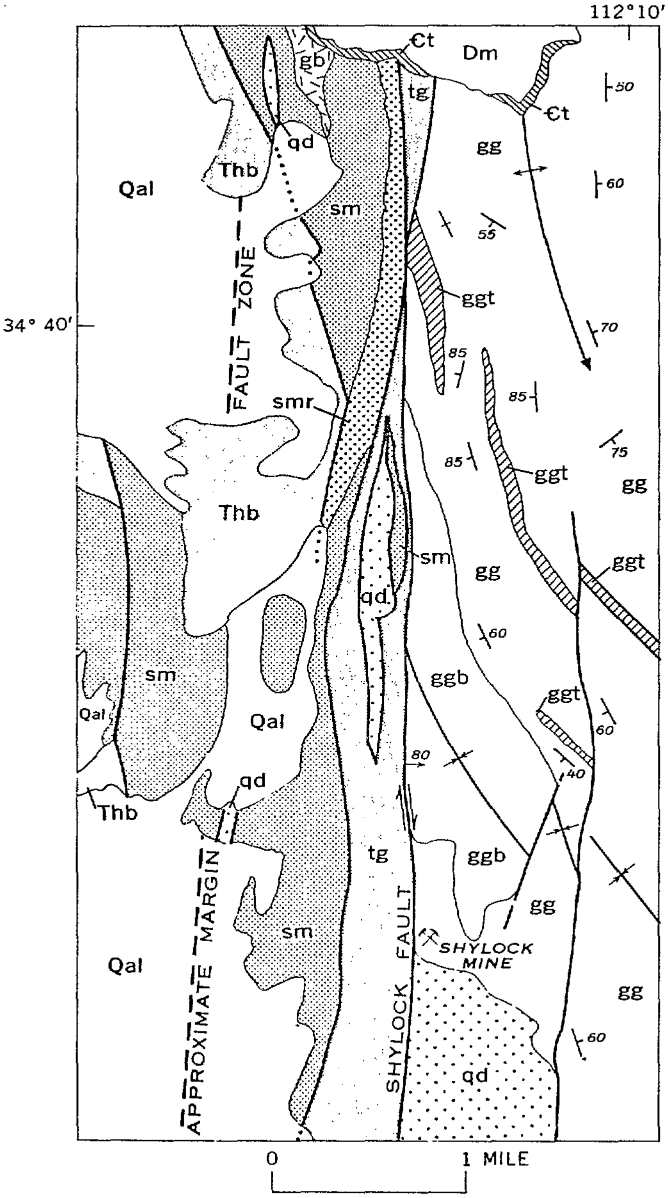


FIGURE 2.—Geologic map of the northern part of the Shylock fault zone. Patterns and map units are explained in figure 1.

steeply dipping contact of the quartz diorite pluton that extends southeastward from the Shylock fault for a distance of 7 miles (figs. 1, 2). A minimum of 5 miles of right-lateral slip is indicated, measured in the fault zone from the steeply dipping planar quartz diorite contact southeast of the Shylock fault to the most northerly quartz diorite fault slice (fig. 2). The total displacement is not known because no faulted segment of the pluton has been found west of the fault zone; it may be buried by Phanerozoic rocks to the north. The quartz diorite pluton east of the Shylock fault clearly is truncated by the fault, as shown by the sharp discordance between the fault and the planar flow structures within the quartz diorite (fig. 3). The bending northward of the synclinal axial trace (outlined by the tuff beds in the Grapevine Gulch Formation) next to the Shylock fault also is consistent with right-lateral slip.

The Texas Gulch Formation is the dominant unit in the northern part of the Shylock fault zone (figs. 2, 3). This formation consists of intertonguing rhyolitic tuff and slate, and within the fault zone these two lithologic units are, in general, separated by faults. The formation is tightly folded and shows reversals of plunge (fig. 3). In places, slaty cleavage (S2) is folded and cut by a younger cleavage (S3) that has axial-plane symmetry with the folded slate. Fault slices of the Spud Mountain Volcanics appear within the larger fault slice of the Texas Gulch Formation (fig. 3); those on the west are largely andesitic tuff and those on the east are andesitic breccia. The most southerly exposures of the Texas Gulch Formation in the Shylock fault zone end abruptly about a mile south of the area shown in figure 3 (fig. 1).

Faults of north and northwest trends displace basalts of the Tertiary Hickey Formation (fig. 2), and northward they bound the Mingus Mountain block (fig. 1). In the area shown in figure 2, these young faults converge with the Shylock fault zone, and some late movement may have occurred along the westerly faults in the Shylock fault zone. Several miles south of the Shylock mine (fig. 3), the Hickey Formation covers the entire Shylock fault zone, but farther south this formation is in fault contact with the Spud Mountain Volcanics. Presumably the fault contact represents small activation along an older fault.

A splay fault off the Shylock fault dies out southeastward in the Spud Mountain Volcanics (fig. 1), diverging from the main fault by an acute angle, typical of splay faults associated with wrench faults (Anderson, 1951, p. 167).

In the Mayer quadrangle (fig. 1), much of the Shylock fault zone is in the Spud Mountain Volcanics;

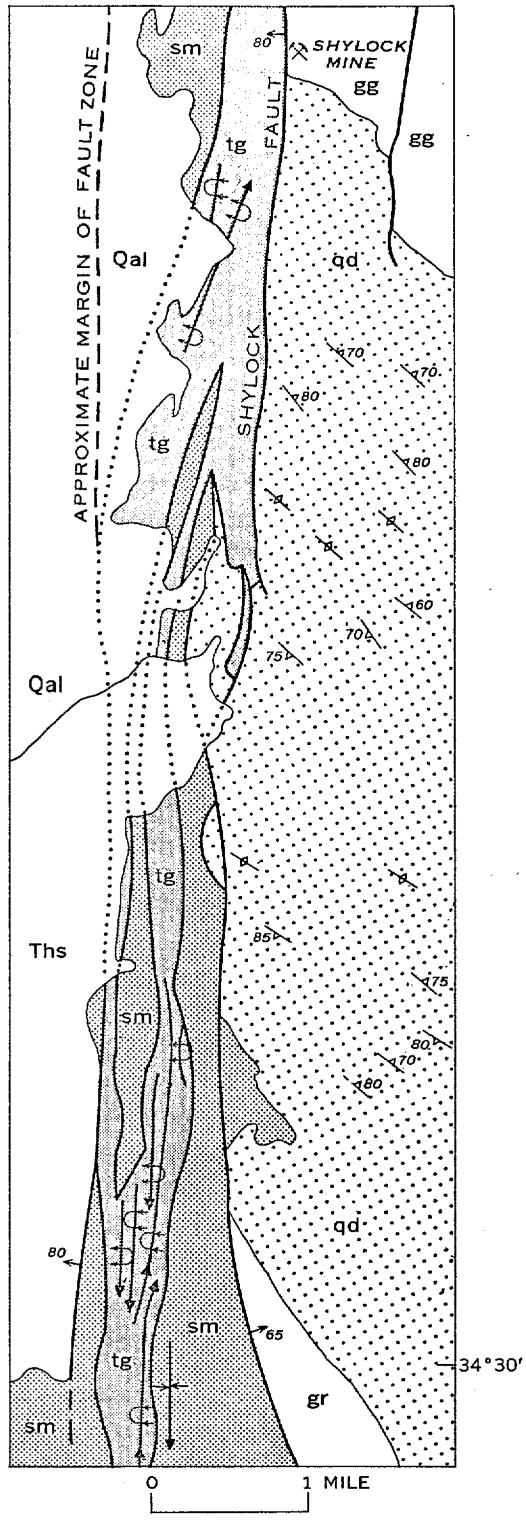


FIGURE 3.—Geologic map of elongate area along the Shylock fault zone, south of area shown in figure 2. Patterns and map units are explained in figure 1.

the bedded units of this formation are almost parallel to the fault zone, as revealed by the north-trending contact between the Spud Mountain Volcanics and Iron King Volcanics north of Mayer and west of the fault zone (fig. 1). In this segment of the fault zone, some minor folds have been mapped, and one north-trending fault can be traced for 2½ miles.

At the southern margin of the Mayer quadrangle (fig. 4), the Spud Mountain Volcanics are in fault contact with a pluton of coarse-grained quartz diorite. Near the fault, this quartz diorite is appreciably granulated and cut by subparallel veinlets of sericite and chlorite, whereas at the fault, the rock is highly foliated. West of the Shylock fault (fig. 4), the Spud Mountain rocks are largely mixed andesitic and rhyolitic tuff, recrystallized to well-foliated chlorite schist, quartz-sericite schist, and quartz-chlorite-sericite schist. Amygdaloidal basalt in part crops out in very irregular outlines that contrast with the regular and continuous pattern of intertonguing flows exposed elsewhere distant from the Shylock fault zone. Alteration and foliation mask the amygdaloids in the margins of the basalt. Small fault slices of the coarse-grained quartz diorite and gabbro also appear in the foliated andesitic-rhyolitic tuff.

Masses of quartz porphyry crop out in the Shylock fault zone south of the area shown in figure 3 (fig. 1). Three elongate masses mapped northeast of Mayer (Anderson, 1959) have their long dimensions almost north. The margins of these masses are highly foliated quartz-sericite schist, but relict textures are present throughout most of the masses. The general concordance of these quartz porphyry masses with the bedded tuffs and breccias of the Spud Mountain Volcanics and their strongly foliated margins suggest that they are fault slices, particularly because elsewhere in the Yavapai Series, other quartz porphyry masses are largely discordant with their host rocks and presumably had an intrusive origin.

As shown in the western part of figure 4, at the southern margin of the Mayer quadrangle (fig. 1) rhyolitic flows and breccias are associated with quartz porphyry and other amygdaloidal basalt. Whether or not these quartz porphyry and basalt masses are fault slices is debatable, particularly because the pattern of the quartz porphyry outcrops in part can be interpreted as normal intrusive relations (fig. 4). However, all these rocks are foliated and contain zones of chlorite schist and quartz-sericite schist. It may be

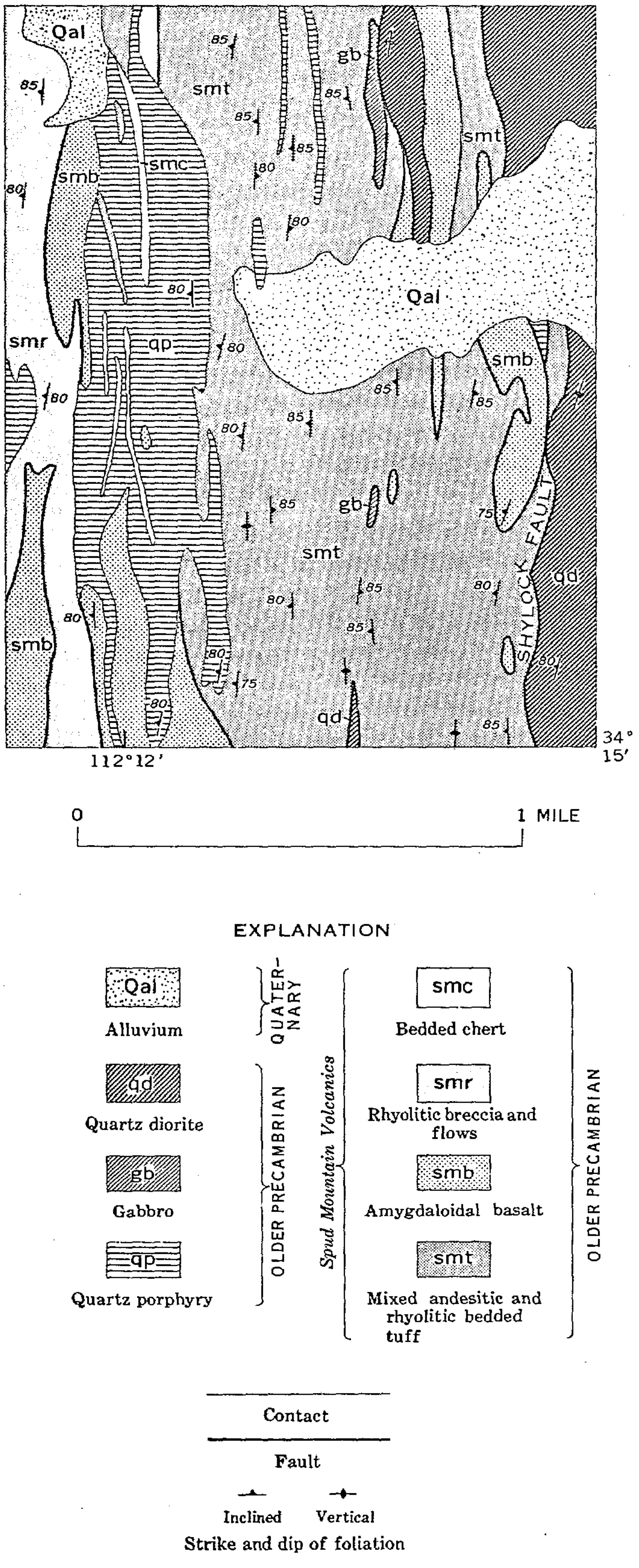


FIGURE 4.—Geologic map of the Shylock fault zone at the southern margin of the Mayer quadrangle.

that all the contacts shown in figure 4, except those of the alluvium, are faults.

PIERCEMENT STRUCTURE

The Texas Gulch Formation in the Shylock fault zone forms a long narrow fault slice in contact with the younger Spud Mountain Volcanics. To the west, where the regional stratigraphic relations can be established, the Green Gulch Volcanics, about 6,000 feet thick, separate the older Texas Gulch Formation from the younger Spud Mountain Volcanics. Therefore, formation of the fault slice of Texas Gulch Formation required an appreciable component of upward displacement. The large displacement justifies the interpretation that the fault slice is a piercement structure in the Shylock fault zone.

Upward squeezing of rocks appears to be a common feature in wrench faults. Kingma (1959, p. 15) reported such small-scale piercement structures in wrench faults in New Zealand. Crowell (1962, p. 48) noted that in the San Andreas fault zone the shape and orientation of phacoids and rare minor structural features suggest upward squeezing. Wallace (1949, p. 796, 805) related ridges of sedimentary rocks in the San Andreas fault zone to upward squeezing of plastic fault gouge and breccia; this squeezing raised the covering sedimentary rocks above the rift zone.

Because of the incompetent character of the Texas Gulch Formation, it is not surprising to find the elongated fault slice in the Shylock fault zone. To the west (fig. 1) the Texas Gulch Formation is in a north-plunging anticline where it rests on the Brady Butte Granodiorite. The margins of this fold are in fault contact with the Spud Mountain Volcanics to the west and with the Iron King Volcanics to the east. The single fault line shown extending northward toward Humboldt from the outcrop area of the Texas Gulch Formation on figure 1 represents a narrow fault slice of Texas Gulch Formation, another piercement structure but one related to the underlying anticline.

CHAPARRAL FAULT

The Chaparral fault (fig. 1) is another wrench fault with right-lateral slip, as shown by the pattern of deformation in the Green Gulch Volcanics along the fault. Vertical separation is indicated by the older Green Gulch Volcanics in fault relationship with the younger Spud Mountain Volcanics, but vertical slip cannot be proven. The terrane north of the Chaparral fault includes a large volume of rock intrusive into the Alder Group, implying an appreciable right-lateral separation as these rocks are common to the southwest on the south side of the Chaparral fault. The fault itself does not have any of the spectacular fault slices typical of the Shylock fault zone, and much of the fault is a narrow mylonite zone in which cataclasis is dominant. The relation of the Chaparral fault to the Shylock fault is unknown because of the cover of Phanerozoic rocks in the critical area.

AGE OF THE SHYLOCK FAULT

The evidence is clear that the Shylock fault is older than the Cambrian Tapeats Sandstone and is therefore Precambrian. The faulting is later than the intrusion of the two quartz diorite plutons, and the northerly pluton was clearly intruded after the folding of the Ash Creek Group. West of the Shylock fault zone at the south end of the area (fig. 1), the northern end of a quartz monzonite pluton is exposed. This pluton has many associated pegmatite dikes, and the grade of metamorphism is high around the nose of the pluton in Spud Mountain Volcanics west of the Shylock fault zone. Coarse muscovite-biotite schist, locally containing abundant garnet and staurolite, indicates the high rank. In the Shylock fault zone to the east, chlorite, albite, and sericite are common metamorphic minerals and imply either retrograde metamorphism at the time of faulting or the southward displacement of green-schist facies in juxtaposition with high-rank metamorphic Spud Mountain Volcanics. Thus the wrench fault is younger than the quartz monzonite pluton. No evidence is available to establish the time interval between the folding of the Yavapai Series and intrusion of the plutons and the later deformation creating the Shylock wrench fault.

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No Text but apparently now have proof on formational sequence

EXPLANATION

Geologic Map of the SE 1/4 Mount Union Quadrangle, Yavapai County, Arizona by P.M. Blacet Preliminary Edition, 1968

PLIOCENE (?) QUATERNARY

Qg	Reddish gravels and alluvium
	HICKEY FORMATION
Ths / Thv	Ths, poorly consolidated conglomerate and sandstone Thv, basaltic flows and isolated plugs

MESOZOIC (?) EARLY TERTIARY

qlp / rp	Rhyolite to granodiorite porphyry dikes, and quartz latite porphyry
md	Alkalic mafic and lamprophyre dikes

PRECAMBRIAN

peg	Granite pegmatite and aplite dikes
qm	Quartz monzonite south of Crazy Basin Creek, medium- to coarse-grained with porphyritic facies, some granite.
grd	Porphyritic granodiorite of Tuscumbia Mountain, coarse-grained, except for medium-grained nonporphyritic marginal facies.
qd	Medium-grained biotite quartz diorite
al	Medium-grained alaskite
di	Fine- to medium-grained diorite, intensely altered or recrystallized

PRECAMBRIAN

qm — Quartz monzonite south of Crazy Basin Creek, medium- to coarse-grained with porphyritic facies, some granite.

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qd — Medium-grained biotite quartz diorite

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di — Fine- to medium-grained diorite, intensely altered or recrystallized

gb — Medium-grained gabbro, recrystallized

hbl — Coarse-grained hornblendite, recrystallized

ap — Albititic porphyry, recrystallized

qp — Fine-grained quartz porphyry, variably sheared and altered to a schistose quartz-sericite rock with quartz phenocrysts

Alder Group of the Yavapai Series

IRON KING VOLCANICS

ikc, ikr, ika, ikab

ika, pillow and amygdaloidal basalt and andesite, with intercalated mafic tuff, recrystallized to amphibolitic schist.
ikc, thinly interlayered chert, ferruginous chert, magnetite-hematite and phyllite, locally constituting itabirite.
ikr, schistose metarhyolite and rhyolitic tuff.
ikab, sedimentary breccia of mixed volcanic and non-volcanic debris, with intermixed pillow basalt and mafic tuff.

SPUD MOUNTAIN VOLCANICS

smr, smt, smu, smrh, smb, smct

smr, bedded rhyolitic tuff and volcaniclastic rocks, recrystallized to staurolite schist and quartzo-feldspathic semischist
smt, bedded fine-grained andesitic tuff and tuffaceous sediment
smu, undifferentiated hornfelsed andesitic tuff, complexly mixed with mafic flows and intrusive diorite or gabbro.
smb, andesitic breccia and interbedded tuffaceous sedimentary rock
smct, massive bedded dacitic crystal tuff
smrh, massive rhyolitic flows or shallow intrusives, some tuff(?)

PRECAMBRIAN

Alder Group of the Yavapai Series

hbl	Coarse-grained hornblendite, recrystallized
ap	Albititic porphyry, recrystallized
qp	Fine-grained quartz porphyry, variably sheared and altered to a schistose quartz-sericite rock with quartz phenocrysts

IRON KING VOLCANICS

ikc ikr ika ikab	ika, pillow and amygdaloidal basalt and andesite, with intercalated mafic tuff, recrystallized to amphibolitic schist. ikc, thinly interlayered chert, ferruginous chert, magnetite-hematite and phyllite, locally constituting itabirite. ikr, schistose metarhyolite and rhyolitic tuff. ikab, sedimentary breccia of mixed volcanic and non-volcanic debris, with intermixed pillow basalt and mafic tuff.

SPUD MOUNTAIN VOLCANICS

smr smt smu smrh smb smct	smr, bedded rhyolitic tuff and volcaniclastic rocks, recrystallized to staurolite schist and quartzo-feldspathic semischist smt, bedded fine-grained andesitic tuff and tuffaceous sediment smu, undifferentiated hornfelsed andesitic tuff, complexly mixed with mafic flows and intrusive diorite or gabbro. smb, andesitic breccia and interbedded tuffaceous sedimentary rock smct, massive bedded dacitic crystal tuff smrh, massive rhyolitic flows or shallow intrusives, some tuff(?)

TEXAS GULCH FORMATION

tg tgcl	tg, arkosic sandstone, slate and phyllite, and bedded rhyolitic tuff tgcl, pebble-cobble conglomerate, and a basal boulder conglomerate (dots)

BRADY BUTTE GRANODIORITE

bbg	Medium- to coarse-grained gneissic granodiorite, with recrystallized biotite and plagioclase.
si	Quartz lenses and pods, mostly jaspery, includes recrystallized chert and hydrothermal silica.
ss	Silicified and sericitized, hydrothermally altered rock.

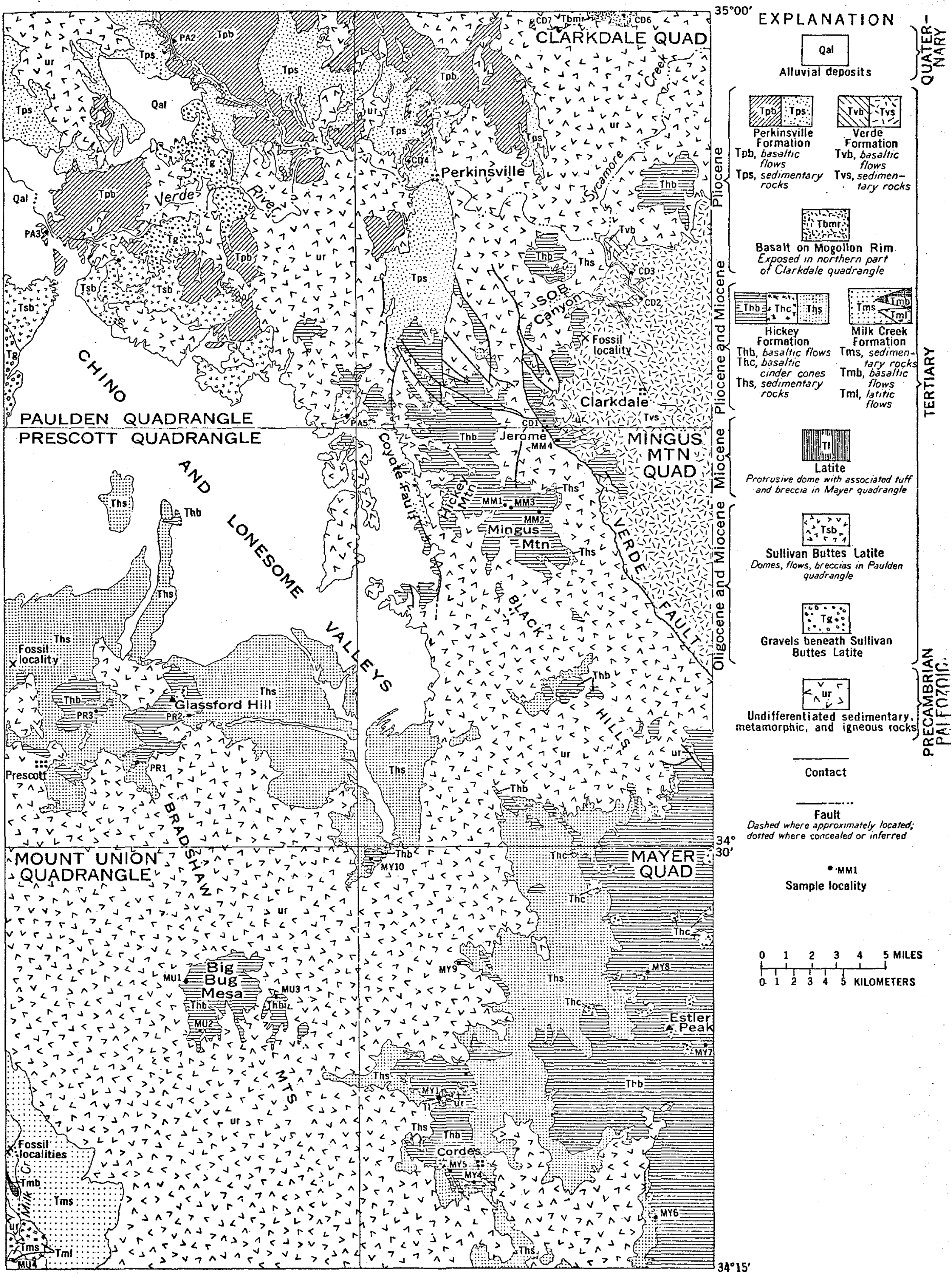

Figure 3. Geologic map and section of the type locality of the Milk Creek Formation.

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

April 20, 1971

FILE MEMORANDUM

Re: YAVAPAI SERIES (PRECAMBRIAN)
BRADSHAW MOUNTAINS
YAVAPAI COUNTY, ARIZONA

Recently reported age dating of units has clarified some aspects of the Precambrian Yavapai Series rocks in northern Arizona. C. A. Anderson and others (PP550-B, p. 1-5; PP575-C, p. 60-65; Open File of SE$\frac{1}{4}$ Mount Union) have long worked in the area and the new dates now suggest a revision of the entire sequence than that suggested in the previous publications.

Riverside G.S.A. Meeting, March 27. Abstract, p. 84.

P. M. Blacet, L. T. Silver, T. W. Stern and C. A. Anderson: Precambrian evolution of the Big Bug group (Yavapai Series) and associated rocks in the northern Bradshaw Mountains, central Arizona.

Younger Precambrian

	Crazy Basin Quartz Monzonite	1720 my.
	Texas Gulch Formation	

	Other Plutions (quartz diorite, etc.)	1760-1770 my.
	Brady Gutte Granodiorite	1770 my.
Big Bug Group	Iron King Volcanics Spud Mtn. Volcanics Green Gulch Vol. $\cong$ Grapevine Gulch Vol.	1775 my. date in parts of all three units

--?--?--?--?--?--?--?--?--?--?--?--?--?--

Ash Creek Group (Deception Rhyolite $\cong$ 1820 my.)

James D. Sell

James D. Sell

JDS:sh

UNCONFORMITY BETWEEN GNEISSIC GRANODIORITE AND OVERLYING YAVAPAI SERIES (OLDER PRECAMBRIAN), CENTRAL ARIZONA

By P. M. BLACET, Beltsville, Md.

Abstract.—Granodiorite older than isoclinally folded schists of the Yavapai Series is uniquely exposed in the core of an upfaulted anticline at Brady Butte southeast of Prescott, Ariz. A folded unconformity at the base of the Alder Group of the Yavapai Series is well exposed in an area of about 3 square miles, providing the only known exposure of the depositional contact between the older Precambrian Yavapai Series and a still older basement. The herein named Brady Butte Granodiorite predates the Mazatzal revolution, during which the overlying Alder Group was metamorphosed, and represents a plutonic event older than any previously recognized in Arizona.

Detailed geologic mapping has revealed the occurrence of gneissic granodiorite unconformably below the older Precambrian [1] Yavapai Series (Yavapai Schist of former usage) in the Bradshaw Mountains, Yavapai County, central Arizona. The granodiorite is exposed along a high ridge approximately 15 airline miles southeast of Prescott and 6 miles southwest of Mayer (fig. 1). This gneissic granodiorite is well exposed at Brady Butte, the most prominent geographic feature in the area, and the name Brady Butte Granodiorite is here introduced for this unit. A continuous section through the granodiorite is provided by the canyon of Wolf Creek immediately northeast of Brady Butte; this area serves as the type locality of the formation.

The unconformity between the gneissic granodiorite and basal arkosic metasedimentary rocks of the Yavapai Series represents a major break in the stratigraphic record of the older Precambrian in Arizona. This unconformity is marked by a coarse basal conglomerate that contains large subangular blocks of gneiss indistinguishable from the underlying Brady Butte Granodiorite. The unconformity is exposed in an area of less than 3 square miles, and is the only known exposure of the depositional contact at the base of the Yavapai Series. The Brady Butte Granodiorite represents part of an ancient basement upon which the older Precambrian schists of central Arizona were deposited.

The Yavapai Series consists of metamorphosed sedimentary, pyroclastic, and other volcanic rocks, which are largely included within the greenschist facies. In the Jerome area, Anderson and Creasey (1958, p. 9) have divided the Yavapai Series into the Ash Creek Group and the Alder Group, and have recognized about a dozen formations on the basis of relict textures and structures. In keeping with their usage, the prefix "meta" has been omitted from descriptive terminology used for these older Precambrian rocks.

STRUCTURAL SETTING

The Brady Butte Granodiorite is exposed in the core of a major faulted anticline that plunges gently north-northeast, and that trends approximately parallel to the strike of foliation in the granodiorite and in the overlying Alder Group (fig. 1). The surface trace of the unconformity between the granodiorite and the Alder Group has a general northwest trend, where it is well exposed along the northeastern wall of the canyon of Wolf Creek for a distance of about 2 miles downstream from the confluence with Little Wolf Creek. North of Brady Butte, along Wolf Creek, the unconformity has been tightly folded, with attenuation of the fold limbs evidenced by flattening and elongation of cobbles in the basal conglomerate. The Brady Butte Granodiorite was mylonitized in the area of tight folding.

Southeastward from locality 46, about 0.8 mile north-northeast of Brady Butte, the folds rapidly diminish in amplitude, and relict sedimentary textures and structures are remarkably preserved in the conglomerate and arkose above the unconformity; the granodiorite beneath is only slightly foliated. The intensity of deformation increases rapidly northeastward away from

[1] The age designation "older Precambrian" has only local significance, and is used in Arizona to distinguish older metamorphic and plutonic rocks from the overlying, unmetamorphosed "younger Precambrian" sedimentary rocks of the Apache Group and the Grand Canyon Series.

U.S. GEOL. SURVEY PROF. PAPER 550-B, PAGES B1-B5

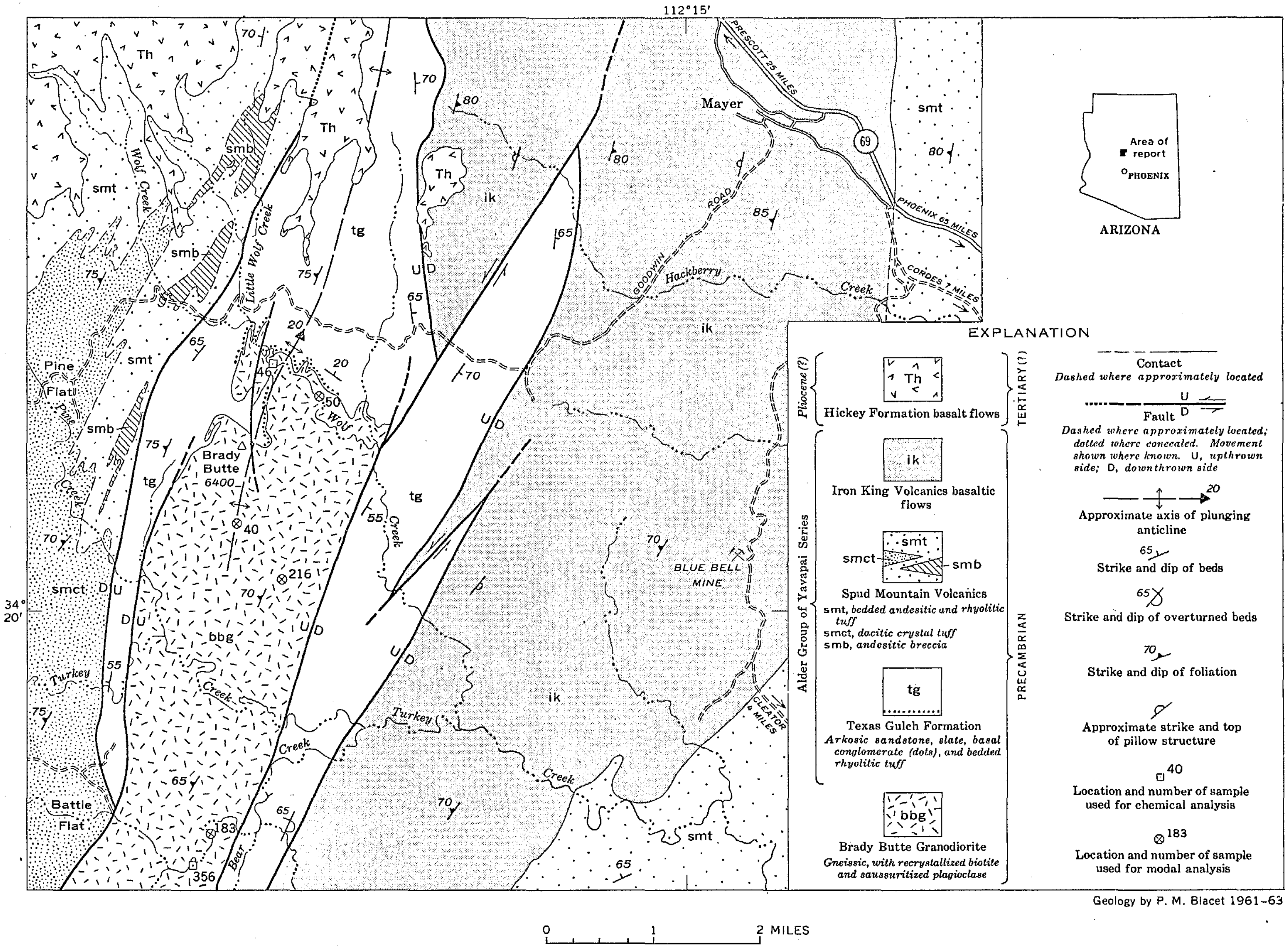

FIGURE 1.—Generalized geologic map of the Brady Butte area, Yavapai County, central Arizona, illustrating the unconformity between the gneissic Brady Butte Granodiorite and the overlying Texas Gulch Formation. Distribution of the deformed basal conglomerate is indicated by stippling along the folded unconformity.

this segment of the unconformity. The remarkable preservation of the rocks near this part of the unconformity indicates that this small area was shielded from the stresses that intensely deformed the adjacent rocks. This small region of low strain directly overlies the relatively undeformed interior of the granodiorite core, which apparently acted as a rigid block deflecting tectonic stresses during metamorphism.

Except where the unconformity is exposed north and northeast of Brady Butte, the contacts between the Brady Butte Granodiorite and the overlying Texas Gulch Formation of the Alder Group are steeply dipping, north-northeast-trending faults. The fault bounding the granodiorite on the west either dies out northward, west of Brady Butte, or diverges from the contact and is undetected within the schists of the Texas Gulch Formation. The fault east of the granodiorite has a left-lateral separation of about 1½ miles, where it offsets the shear zone constituting the contact between the Texas Gulch Formation and the Iron King Volcanics.

The anticlinal block, consisting of the granodiorite and overlying sedimentary rocks, has apparently been squeezed upward along two shear zones which bound the Texas Gulch Formation on the east and west. The displacements on these two major faults are unknown, but the minimum stratigraphic throw along the eastern fault probably exceeds 10,000 feet. Structural and stratigraphic relationships within the isoclinally folded Alder Group suggest that the upfaulted anticline has been elevated several miles with respect to the adjacent volcanic rocks. Erosion has breached the anticlinal core at Brady Butte, providing a unique exposure of the ancient basement beneath schists of the Yavapai Series.

South of the map area (fig. 1), the Brady Butte Granodiorite is truncated by large plutons which are intrusive into the Alder Group. Northward, the Texas Gulch Formation, crudely defining the anticlinal axis, narrows to form a schistose belt several hundred feet wide and disappears beneath Tertiary sedimentary rocks about 10 miles north of Brady Butte (C. A. Anderson and Blacet, unpub. data).

The summit of Brady Butte lies approximately along the axis of the anticline, and a thin cover of arkosic sandstone and the basal conglomerate is draped over the northern shoulder of the butte, between the summit and locality 46 (fig. 1). The unconformity near the summit of Brady Butte is 1,100 feet above its altitude in the canyon of Wolf Creek, indicating that here the anticline plunges approximately 28° north-northeast. Axes of the minor folds in the overlying Texas Gulch Formation generally plunge approximately parallel to the main anticlinal axis.

BASAL CONGLOMERATE

A remarkable exposure of boulder conglomerate lying directly on the Brady Butte Granodiorite is found 1,000 feet east of the summit of Brady Butte, at an elevation of 6,000 feet. In most places the conglomerate above the unconformity is less than 10 feet thick, but here its thickness is more than 30 feet. Well-rounded cobbles and boulders of leucocratic granophyre as much as 18 inches in diameter are abundant and are mixed with even larger subangular gneissic blocks indistinguishable from the underlying granodiorite (fig. 2). Clasts of chert, argillite, siltstone, and quartzite are also abundant and are commonly flattened or elongated, contrasting with the tough nearly spherical granophyre clasts, which have apparently escaped shear deformation by rotation within the schistose matrix. In the attenuated limbs of the tight folds, north of Brady Butte, the length-to-width ratios of the deformed clasts are commonly as high as 8:1, with the granophyre clasts retaining their original sphericity.

The matrix of the basal conglomerate is poorly sorted arkosic sandstone with angular to subrounded relict grains of quartz, plagioclase, and microcline. Muscovite is the predominant metamorphic mineral, but green biotite is abundant. Foliation is generally apparent and is nearly parallel to the long dimension of deformed clasts, to the foliation in the gneissic blocks, and to the foliation in the Brady Butte Granodiorite.

The basal conglomerate, although widespread, is not evenly distributed along the unconformity, and may have been deposited in channels and depressions on the

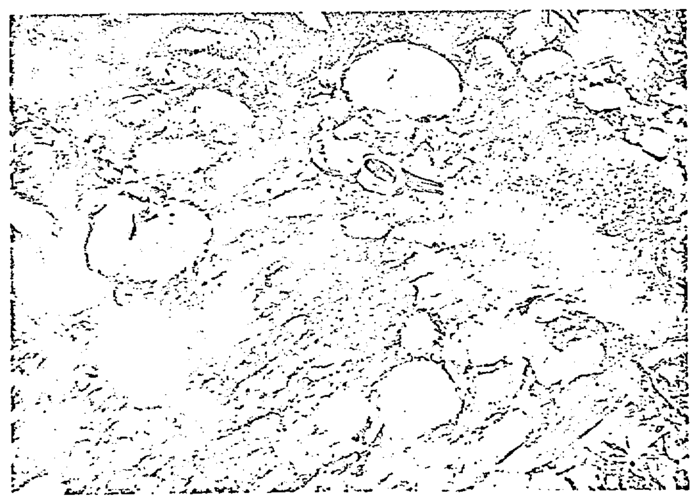

FIGURE 2.—Boulder conglomerate at the base of the Texas Gulch Formation exposed on a high spur 1,000 feet east of Brady Butte. The compass rests about 5 feet stratigraphically above the Brady Butte Granodiorite. Light-colored, well-rounded granophyre and felsite clasts are in a schistose matrix of poorly sorted arkose. The compass points to a large angular block of gneissic granodiorite indistinguishable from the Brady Butte Granodiorite.

ancient erosion surface beneath the Alder Group. Southeastward along the main trace of the unconformity, north of Wolf Creek, the basal conglomerate gradually diminishes in thickness and clast size. North of locality 50 (fig. 1) it is a pebble conglomerate 3 feet thick, which grades southeastward into coarse-grained arkose. East-southeast of locality 50 there are a few probable remnants of a Precambrian weathered zone several feet thick at the top of the Brady Butte Granodiorite.

BRADY BUTTE GRANODIORITE

The granitoid basement beneath the Yavapai Series in the vicinity of Brady Butte has undergone varying degrees of alteration and deformation. On the west flank and north of Brady Butte, the granodiorite has been mylonitized, with intense granulation of the altered plagioclase and preferential preservation of quartz augen. In general, the Brady Butte Granodiorite is somewhat gneissic with a medium- to coarse-grained hypidiomorphic-granular texture. In the field it is characterized by the fine-grained granular biotite, which occurs in crudely oriented patches, and by turbid plagioclase, which is sometimes difficult to distinguish from granulated quartz. The freshest and least deformed rocks are found along watercourses in the interior of the anticlinal core. Recrystallization of the original plutonic mafic minerals is thorough, so that ragged crudely lenticular patches of olive-green biotite, with lesser amounts of epidote, sphene, magnetite, and muscovite constitute the present mafic and accessory constituents. Quartz occurs as large, strained or recrystallized patches which, like microcline, are interstitial to subhedral plagioclase. The plagioclase is invariably altered to a turbid aggregate of clinozoisite and sericite in an albite base; some calcite is present. Twinning is largely obscured by saussuritization and it is impossible to determine the original composition of the plagioclase. Modal analyses of four relatively fresh and undeformed samples of the Brady Butte Granodiorite plot near the center of the granodiorite field on a triangular diagram (fig. 3). Modal analyses were made by point counting polished slabs which were stained for both plagioclase (albite) and potassium feldspar. The average mode of these 4 rocks is as follows: quartz, 27.2 percent; microcline, 15.6 percent; saussuritized plagioclase, 44 percent; and total mafic and accessory minerals (largely biotite), 13.2 percent.

Chemical analyses of mylonitized and of relatively undeformed Brady Butte Granodiorite are presented in table 1. The mylonitized sample (No. 46, fig. 1) was obtained from a fresh exposure along Wolf Creek, approximately 200 feet stratigraphically below the unconformity. Sample 356 represents relatively fresh,

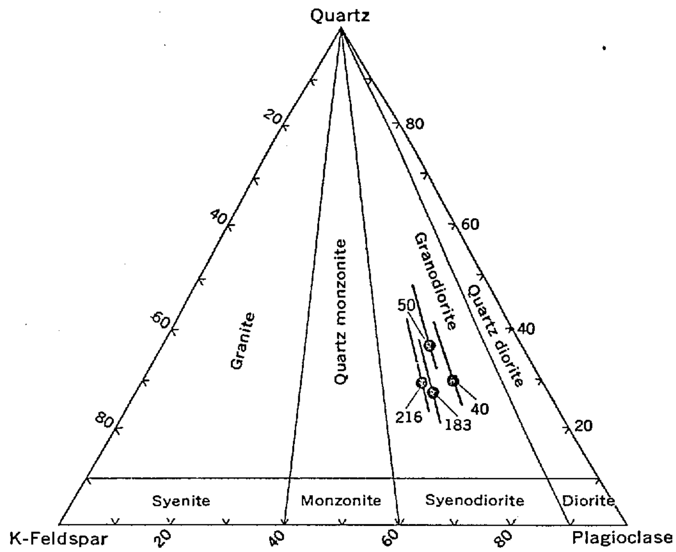

FIGURE 3.—Diagram of modal analyses of the Brady Butte Granodiorite. Length of the inclined lines represents percentage of essential constituents (mostly biotite) not otherwise indicated on the diagram. Numbers refer to sample locations plotted on figure 1.

TABLE 1.—*Chemical analyses and molecular norms of Brady Butte Granodiorite*

[Analyzed by X-ray fluorescence supplemented by methods described by Shapiro and Brannock (1962). Analysts: Paul Elmore, Sam Botts, Gillison Chloe, Lowell Artis, and H. Smith]

Constituent or normative mineral	Sample (field No.)	
	46	356
Chemical analyses		
SiO_2	70.5	70.8
Al_2O_3	14.4	15.1
Fe_2O_3	.84	1.0
FeO	1.6	1.6
MgO	1.2	.75
CaO	2.0	1.7
Na_2O	4.0	3.7
K_2O	3.2	3.3
H_2O^-	.06	.13
H_2O^+	.79	.78
TiO_2	.21	.24
P_2O_5	.09	.31
MnO	.07	.06
CO_2	1.0	.12
Molecular norms		
Quartz	29.7	31.6
Orthoclase	19.1	18.8
Albite	36.2	34.0
Anorthite	3.1	5.3
Corundum	3.5	4.1
Magnetite	.88	1.0
Ferrosilite	1.6	1.5
Enstatite	3.3	2.1
Ilmenite	.30	.34
Apatite	.18	.67
Calcite	2.5	.50

46. Mylonitized granodiorite, on Wolf Creek 1 mile north of Brady Butte; lab. No. 163347.
356. Undeformed granodiorite, on Tuscumbia Creek 4 miles south of Brady Butte; lab. No. 163348.

undeformed granodiorite collected 5 miles south of locality 46 (fig. 1). Molecular norms, calculated by Barth's (1962) modification of the Niggli method, accompany the chemical analyses. The chemical analyses of these two contrasting samples of Brady Butte Granodiorite are similar, indicating that mylonitization was not accompanied by significant changes in bulk composition. Addition of CO_2 in the mylonitized phase is the most apparent chemical variation and reflects the abundance of calcite, commonly occurring as granular fringes along the boundaries of albitized plagioclase augen.

AGE OF THE BRADY BUTTE GRANODIORITE

Geologic mapping demonstrates that the gneissic granodiorite at Brady Butte lies unconformably below the Texas Gulch Formation, which is the oldest formation in the Alder Group of the Yavapai Series. The bulk of geologic and radiometric data on the older Precambrian of Arizona suggests a widespread regional metamorphic and plutonic episode about 1,700 million years ago. This orogeny, named the Mazatzal revolution by Wilson (1939), is the most intense and widespread metamorphic event recorded in the geologic history of Arizona. The type locality of the Alder Group is in the Mazatzal Mountains about 60 miles east of Brady Butte (Anderson and Creasey, 1958, p. 20). Recent U-Pb isotopic work on zircon from the older Precambrian complex of the Mazatzal Mountains gives the age of rhyolite in the Yavapai Series as $1,715 \pm 15$ m.y., and that of postdeformational granite as $1,660 \pm 15$ m.y. (Silver, 1965). These ages place the date of the type-Mazatzal orogeny within the interval 1,660 to 1,715 m.y., which corresponds to the age of metamorphism of the Pinal Schist in southeastern Arizona (Silver and Deutsch, 1963). The stratigraphic relations, combined with radiometric dating of the Mazatzal orogeny, indicate that the Brady Butte Granodiorite is older than 1,700 m.y. Isotopic lead dating of zircon from the Brady Butte Granodiorite has confirmed its minimum age as 1,700 m.y. (Anderson, 1963, p. 180).

DISCUSSION

The occurrence of granodiorite unconformably beneath older Precambrian schists of the Yavapai Series has two principal implications: (1) that a crust of continental character has underlain central Arizona for more than 1,700 m.y.; and (2) that direct evidence now exists in Arizona for a plutonic, and probably orogenic, event predating the Mazatzal revolution. The existence of large volumes of quartzofeldspathic sedimentary and silicic igneous rocks within the older Precambrian of Arizona has long suggested the presence of older granitoid rocks, but the granodiorite at Brady Butte constitutes the first known exposure of this ancient basement.

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Aa-25.3.0B

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona
August 7, 1968

TO: Mr. J.H. Courtright

FROM: Mr. J.D. Sell

White Property
Copper Basin District
Yavapai County, Arizona

Summary and Conclusions

A brief examination was conducted in the north side of Copper Basin where free gold has been placered for many years. Free gold was also reported in cuttings from rotary drill holes bottoming in sulfides.

Fifteen samples were taken from surface samples and rotary cuttings. These samples have been analyzed for copper, lead, moly, silver, and gold. The silver and gold results are low (less than $0.40 combined) but anomalous copper and moly values were reported.

Published mapping shows the sampled area to include a prong of Tertiary quartz monzonite. A half dozen or more conical hills were noted in the northern area and they may represent the breccia-pipe development as known to the south. If so, this suggests more widespread Tertiary intrusive activity than is indicated by the maps.

The occurrence of anomalous copper-moly geochem values, general alteration of all rock types, quartz-sericite development, high pyrite content, and the probable occurrence of additional breccia-pipes in the northern area suggests that additional rock sample studies be conducted in the northern area. Further reconnaissance is intended within the next several weeks.

General

The Copper Basin district was visited during reconnaissance studies of basin areas of the Bradshaw Mountain region.

A "General Minerals Corporation" of Texas presently (July 17) has a diamond drill rig in the central part of the main mining area but reportedly does not have signed agreements with all the private land holders. Phelps Dodge had also been in the area the previous week contacting the private land holders for possible lease-options.

The northern area (Attachment A) is controlled by Mr. L.B. White who is a long time resident of the area and presently lives there. Attachment C shows the claim group as submitted by Mr. White. Attachment B is the general geology of the entire basin area.

During the visit no attempt was made to study the various rock types, but conical hills were noted in the northern area, and they show a slight color anomaly. Such hills, to the south, represent Tertiary breccia-pipe development. In the sampled area the rocks are generally altered and some contain abundant quartz, sericite, jarosite, and pyrite. The general surface rocks exposed are highly oxidized and leached but the oxidation, according to Mr. White, rarely exceeds fourty feet in depth. In a few of the deeper canyons sulfides were noted which supports his observation.

Table 1 and 2 are the descriptions and geochemical results of fifteen samples collected in the area. Eight samples are oxide, one a mixed oxide-sulfide, another a sulfide outcrop, while the remaining five were grab samples (mostly sulfide) from rotary drill hole sludge piles.

Mr. White has made several very good gold finds in the basin and is presently looking for another pocket of free gold. He collects mainly residual alluvium and disintegrated bedrock and collects the heavy particles by a modified sluice box and then pans the concentrate. Conversation with him suggested that low-grade values of gold might be present in sufficient quantities to warrant open-pit operations. A clear to cloudy heavy mineral was noted to lag in the sluice concentrate and pan. Unable to identify it and hopeful that it might possibly be an economic mineral such as monazite, a sluice concentrate sample was submitted to the Arizona Bureau of Mines. They identified the lag mineral as being prismatic crystals of wulfenite.

The geochemical results (Table 2) show low silver and gold values in the samples taken. Apparently, little precious metal value is found in the abundance of veinlets and rocks sampled. The copper and moly values are anomalous and, coupled with the alteration effects and the limonite and jarosite development, further work is intended to be conducted in the northern part of the basin area.

A discerning note, however, is the apparent fact that most of the highest anomalous copper values came from rotary cuttings samples. The five rotary samples average 0.12% copper whereas, the surface oxidized samples show less than 0.06% (discounting the one high oxide sample of 0.36%). How close the result of 0.12% (or the range of 0.02-0.23%) approximates the protore of the northern end is unknown, but apparently there is little chance that chalcocite enriched ore will be found in any abundance.

As shown in Table 2-b, two sets of samples were taken showing the oxide zone and its probable underlying sulfide zone. CBW-11 and CBW-12 were taken in a deep wash and are essentially a long vertical cut. CBW-14 and CBW-15 are from the same location with the sludge pile representing the sulfide zone. In both cases a slight increase in copper values is shown for the sulfide zone sample.

Mr. White has been rotary drilling (maximum depth 300 feet) the past several years for claim assessment work. However, he does not systematically sample the cuttings, but only pans zones (generally near the surface) which he thinks might carry free gold. I suggested to Mr. White that ASARCO might be interested, in exchange for the information, in placing a sampler on any deep hole he might drill in the future.

A Mr. Neil Gambell is presently working on a MS degree in geology in Flagstaff. He is studying the heavy mineral content of an area of 1,000' x 1,200' using a 100' sample grid. The study area is essentially centered on the Golden Treasure claim. A study of the sluice concentrate by the Arizona Bureau of Mines shows hematite-magnetite, zircon, wulfenite, pyrite, chalcopyrite and gold plus minor amounts of an unidentified black opaque mineral.

James D. Sell

James D. Sell

JDS:ir

TABLE 1

SAMPLE IDENTIFICATION

Sample Number	Material	Claim Area
CBW-1	Surface, Oxide	Silver Queen 10, Central
-2	RDH (110') Cuttings	Silver Queen 10, Central
-3	Surface, Oxide	Silver Queen 10, Central
-4	RDH (100') Cuttings	Golden Treasure #1, N. Central
-5	Surface, Oxide	Golden Treasure, NE Sideline
-6	Surface, Oxide	Golden Treasure, SE Sideline
-7	Surface, Oxide-Sulfide	Hazel, east side
-8	RDH (300') Cuttings (West)	Golden Treasure, SW Sideline
-9	RDH (100') Cuttings (Central)	Golden Treasure, SW Sideline
-10	Surface, Oxide	Queen of Sheba, SE Sideline
-11	Surface, Oxide	Queen of Sheba, SW Corner
-12	Surface, Sulfide	Queen of Sheba, SW Corner
-13	Surface, Oxide	Hard Luck
-14	Surface, Oxide	Queen of Sheba, N Endline
CBW-15	RDH (100') Cuttings	Queen of Sheba, N Endline

NOTES:

1). Rotary drill hole (RDH) cuttings contain py, cp, moly, and often galena. Gold has been panned from the cuttings. All samples are grab samples from dug pits in cuttings pile.
2). In areas of RDH, depth of oxidation rarely exceeded 40 feet.
3). Samples #11 and #12 are from vertical cut in large wash.
4). Sample #14 is surface above Sample #15/

ROCKY MOUNTAIN GEOCHEMICAL LABORATORIES

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PRESCOTT, ARIZONA 86301

CHEMICAL ANALYSIS CERTIFICATE

Date July 27, 1968 **Page** 1 of 2

Client Mr. James D. Sell
American Smelting & Refining Co.
P.O. Box 5795
Tucson, Arizona 85703

Submitted by J. Sell

Date Letter 7/18/68

Report on 15 Rock & Drill Cuttings Samples

Analysis COPPER, LEAD, MOLYBDENUM, SILVER, GOLD

Remarks Cu, Ag. Au, done by Atomic Absorption methods.
Pb. Mo, done by Colorimetric methods.
All results given in parts per million.
The minus (-) sign is read "less than".
Precision is about + or - 10% of the given value.
Sample pulps to be returned.

cc: encl.
file

REGISTERED ASSAYER
CERTIFICATE NO. 6847
EDWIN ADAM JOHNSON
Date Signed 7/27
ARIZONA, U.S.A.

All values are reported in parts per million unless specified otherwise. A minus sign (—) is to be read "less than" and a plus sign (+) "greater than." Values in parenthesis are estimates. This analytical report is the confidential property of the above mentioned client and for the protection of this client and ourselves we reserve the right to forbid publication or reproduction of this report or any part thereof without written permission.

North Side, Copper Basin District
Rock & Drill Cuttings Samples
(All results given in parts per million.)

SAMPLE NO.		COPPER	LEAD	MOLYBDENUM	SILVER	GOLD
CBW-1	ox	3600	15	75	2	0.3
CBW-2	Sludge	1200	15	27	$\frac{1}{2}$	-0.1
CBW-3	ox	550	5	1	$-\frac{1}{4}$	-0.1
CBW-4	Sludge	250	5	2	$-\frac{1}{4}$	0.2
CBW-5	ox	120	5	190	$\frac{1}{4}$	-0.1
CBW-6	ox	700	5	21	$-\frac{1}{4}$	-0.1
CBW-7	ox-sulf	675	5	300	$-\frac{1}{4}$	0.1
CBW-8	Sludge	1400	5	50	$-\frac{1}{4}$	-0.1
CBW-9	Sludge	2300	5	85	3/4	-0.1
CBW-10	ox	115	30	150	$2\frac{1}{4}$	-0.1
CBW-11	ox	500	10	40	$\frac{1}{4}$	-0.1
CBW-12	Sulf	700	5	26	$-\frac{1}{4}$	-0.1
CBW-13	ox	1150	15	27	$\frac{1}{4}$	0.1
CBW-14	ox	925	15	6	$-\frac{1}{4}$	-0.1
CBW-15	Sludge	975	320	20	$\frac{1}{4}$	-0.1

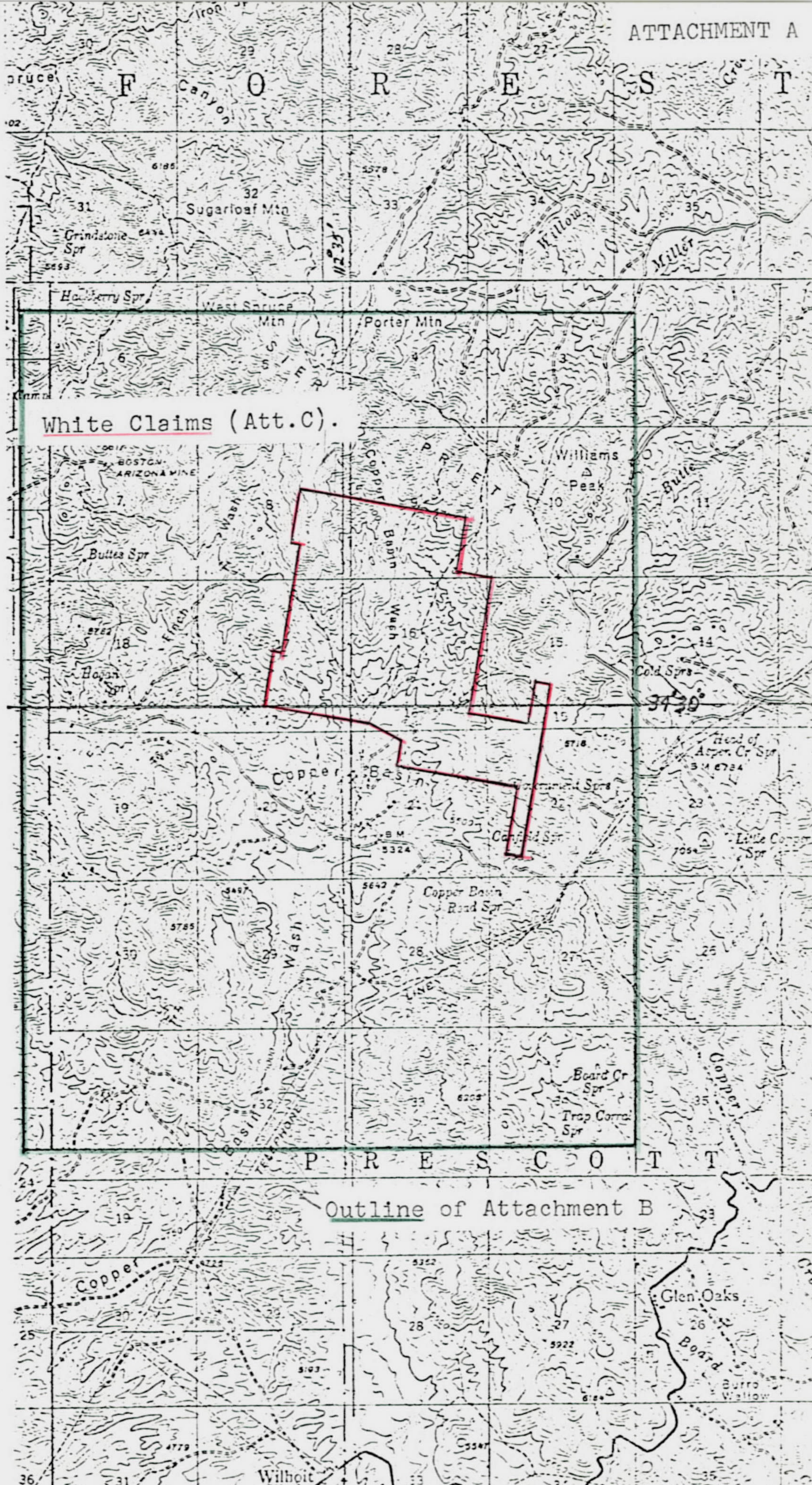
ox- Oxide zone

Sulf-Sulfide zone

Sludge- RDH Cuttings

ATTACHMENT A

Copper Basin
Area
T13N, R3W.



Copper Basin
Kirkland-Iron Springs Quads.
Yavapai County, Arizona

ATTACHMENT B

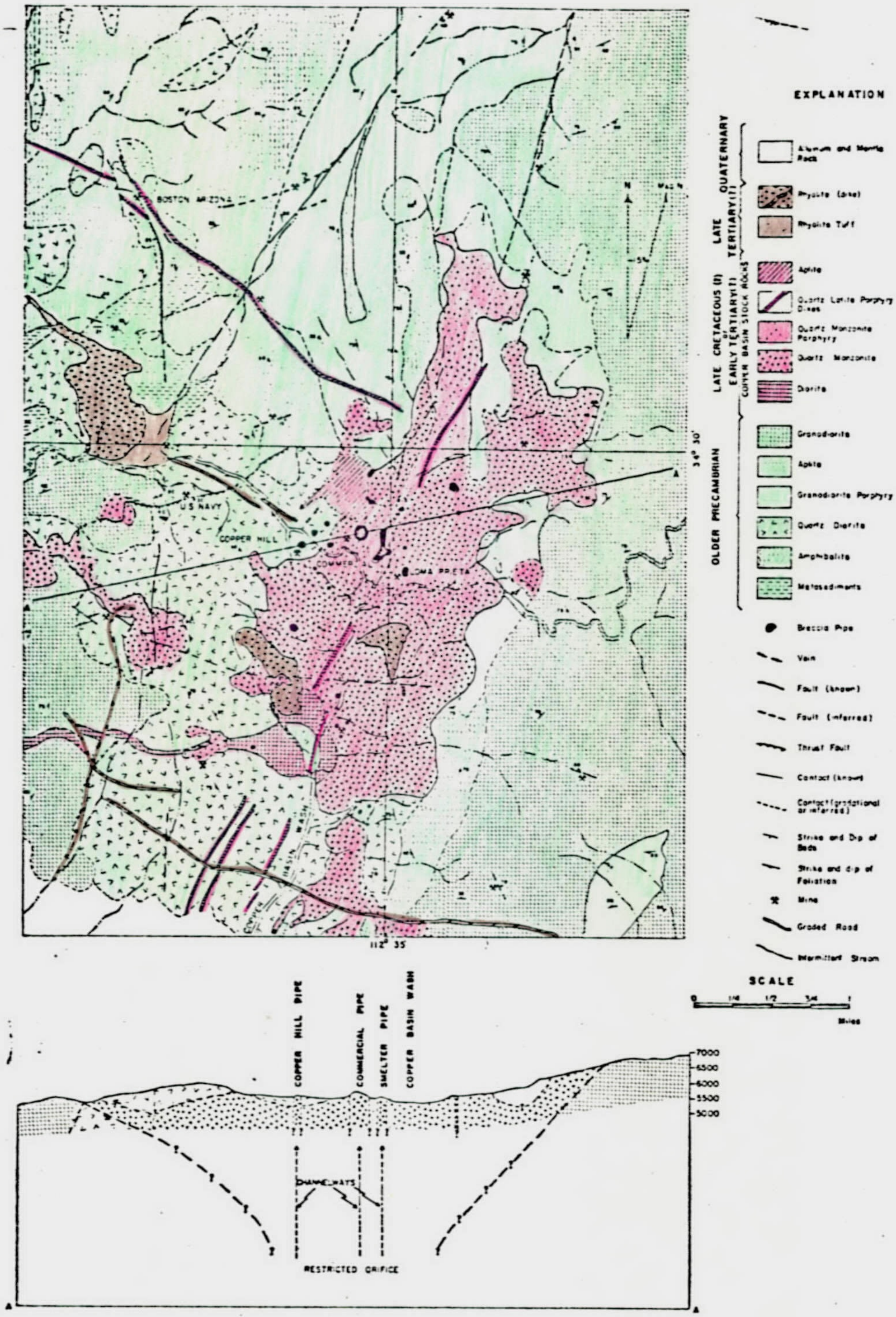


FIG. 3. Geologic map and cross section of the Copper Basin mining district, Yavapai County, Arizona.

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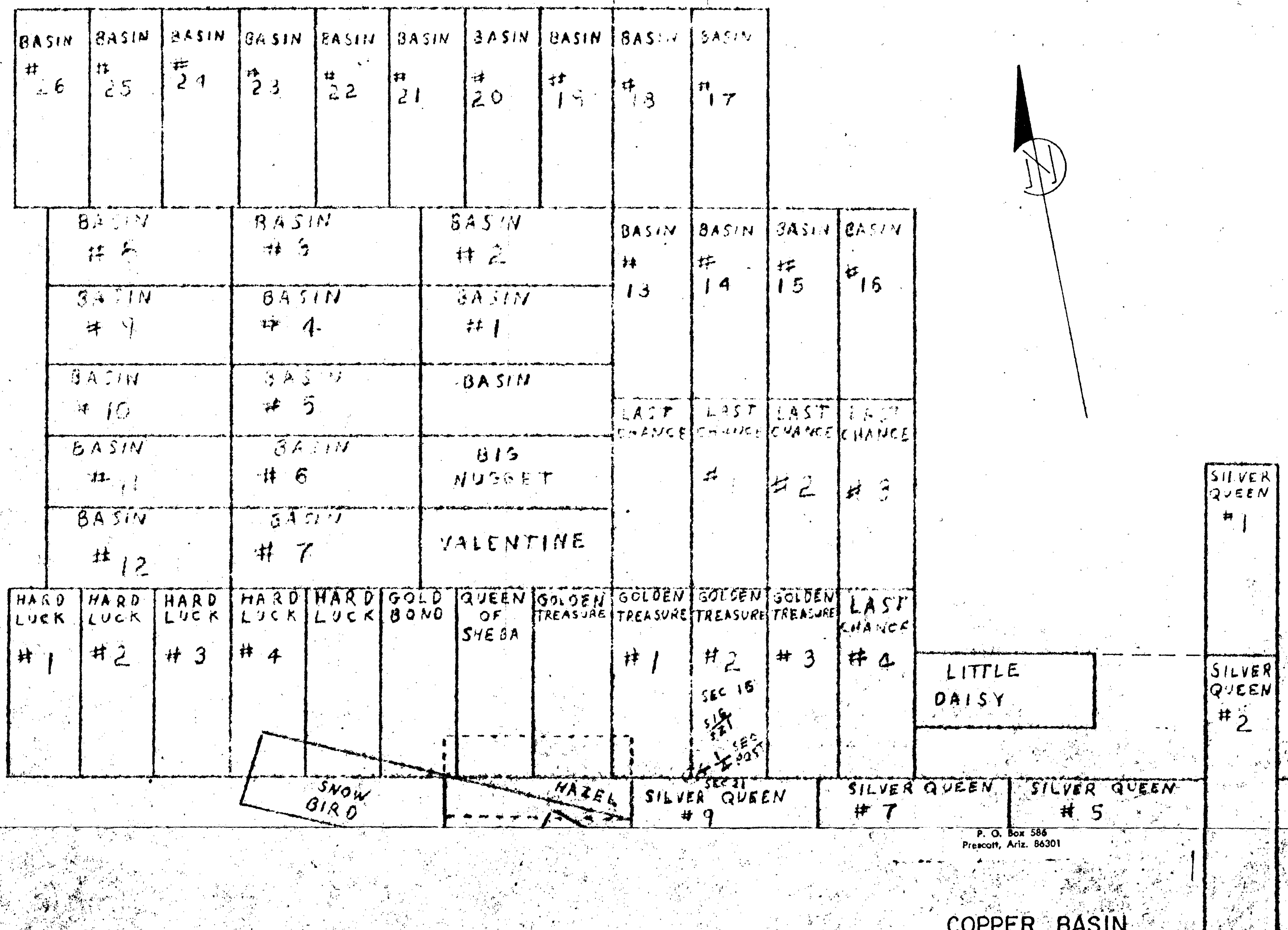
ATTACHMENT C



P. O. Box 586
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COPPER BASIN

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E A Johnson

Rock & Drill Cuttings Samples
(All results given in parts per million.)

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CBW-1	3600	15	75	2	0.3
CBW-2	1200	15	27	½	-0.1
CBW-3	550	5	1	-¼	-0.1
CBW-4	250	5	2	-¼	0.2
CBW-5	120	5	190	¼	-0.1
CBW-6	700	5	21	-¼	-0.1
CBW-7	675	5	300	-¼	0.1
CBW-8	1400	5	50	-¼	-0.1
CBW-9	2300	5	85	3/4	-0.1
CBW-10	115	30	150	2¼	-0.1
CBW-11	500	10	40	¼	-0.1
CBW-12	700	5	26	-¼	-0.1
CBW-13	1150	15	27	¼	0.1
CBW-14	925	15	6	-¼	-0.1
CBW-15	975	320	20	¼	-0.1