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Kennecott Exploration, Inc.
Exploration Services Department

Geologic Research Division

March 9, 1976

MEMO TO: G. D. Van Voorhis

FROM: Richard L. Nielsen

SUBJECT: Exploration Application of the Southwest Structural Study: Gunsight Target Area, Pima County, Arizona by J. W. Allan and R. C. Fox

Jim Allan uses interpretation of the structural compilation to define exploration targets beneath postmineral cover. Two areas near Ajo have been outlined. Favorable features include major west-northwest-trending fractures and faults, dike swarms, and stocks of Laramide age, and copper mineralization near the target areas. Jim recommends a review of existing geophysical data and VIP survey in areas of appropriately thin cover to search for buried sulfide systems.

Dick Fox reviews existing geophysical data and recommends acquisition of additional gravity data in the Ajo Valley target area to determine gravel thickness throughout the area, even though part appears to be covered by gravels too thick for use of Vector IP.

The Why area may have an extensive pediment beneath gravels and additional gravity surveys are recommended followed by Vector IP if appropriate.

This work was done as part of our R-3 research on better techniques to explore covered areas of western U.S. We look forward in cooperating with your group in the application of results of the structural study.

Dick

Richard L. Nielsen

RLN:gp
Attachment

cc: H. L. Bauer
M. T. Pana w/o attach.
J. C. Wilson

2300 West 1700 South, Salt Lake City, Utah 84104 • Phone 801 - 486-6911 • TWX 910 - 925-5624

Kennecott Exploration, Inc.
Exploration Services

GEOLOGIC RESEARCH DIVISION

SOUTHWEST STRUCTURAL STUDY
GUNSIGHT TARGET AREA
PIMA COUNTY, ARIZONA

by

James W. Allan

Salt Lake City, Utah
March 9, 1976

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ILLUSTRATIONS

SOUTHWEST STRUCTURAL STUDY
GUNSIGHT TARGET AREA
PIMA COUNTY, ARIZONA

by
James W. Allan
March 9, 1976

INTRODUCTION

Location, Size, Access

The Gunsight target area comprises about 1,500 square miles in western Pima County, Arizona (Fig. 1 and Plate 1). The area, characterized by Basin and Range physiography and Sonoran Desert ecology, is practically everywhere accessible to four-wheel-drive vehicle except where restricted by law.

Reasons for Review and Evaluation

Structural interpretation of the region indicates that the first-order porphyry copper district at Ajo and the relatively small Gunsight district 15 miles to the southeast are emplaced along major west-northwest fractures (Plate 4). Of particular interest was the recognition of an east-northeast Laramide(?) porphyry dike swarm and associated copper veins* in the southwestern portion of the Gunsight district, a pattern common to many southwestern porphyry copper districts, including Ajo.

Land Status

With the exception of about 300 square miles around Ajo and northwest of Gunsight, all of the land in the Gunsight target area is either closed to mineral entry or regulated by severe surface restrictions which greatly hamper exploration activity (Fig. 2).

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*Tangential to the main west-northwest fracture zone.

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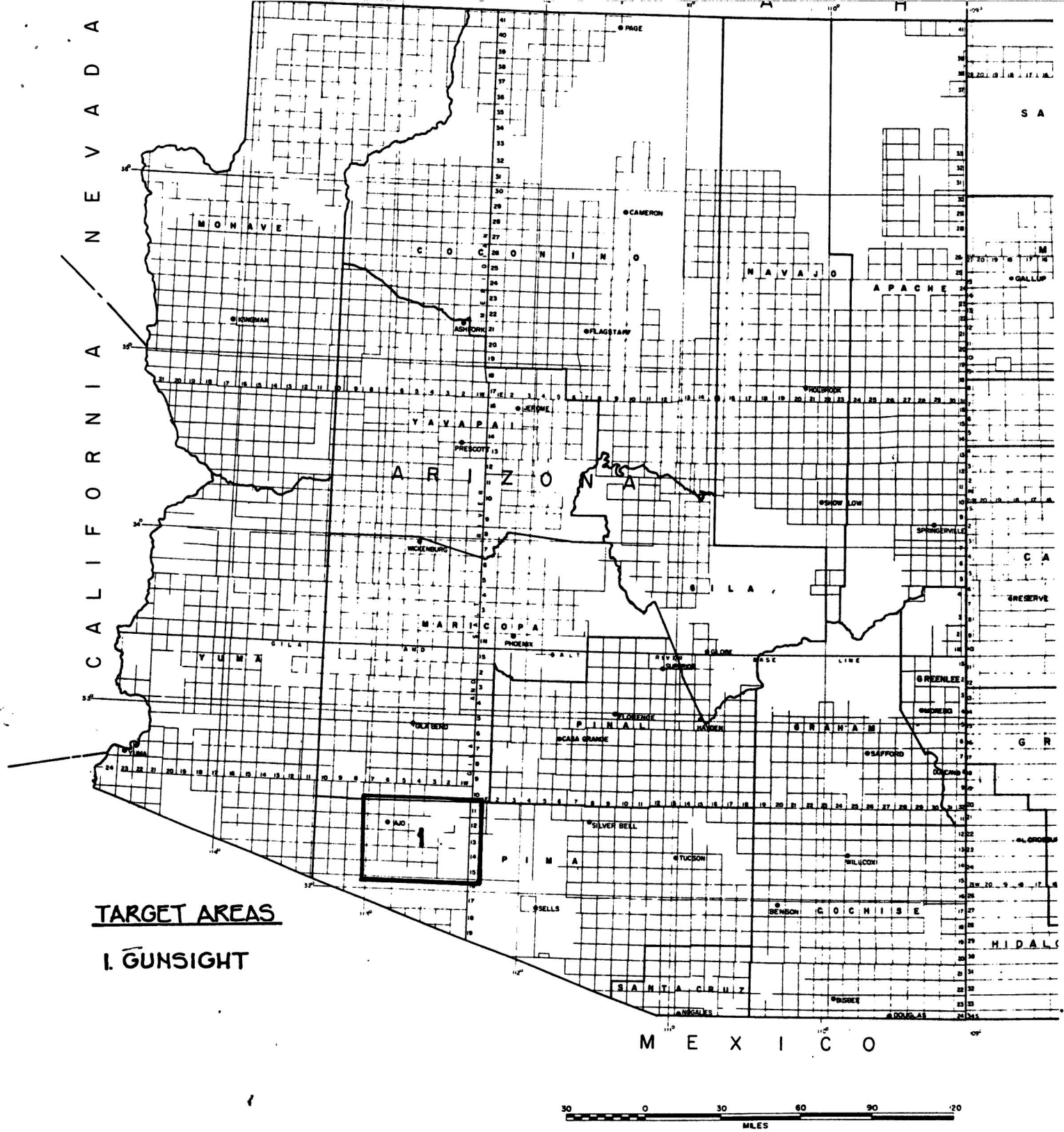

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Exploration Services Department

SOUTHWEST STRUCTURAL STUDY
INDEX TO TARGET AREAS-ARIZONA

SCALE	
ORIGINATOR J.W. ALLAN	
DRAFTING	

FIG. 1

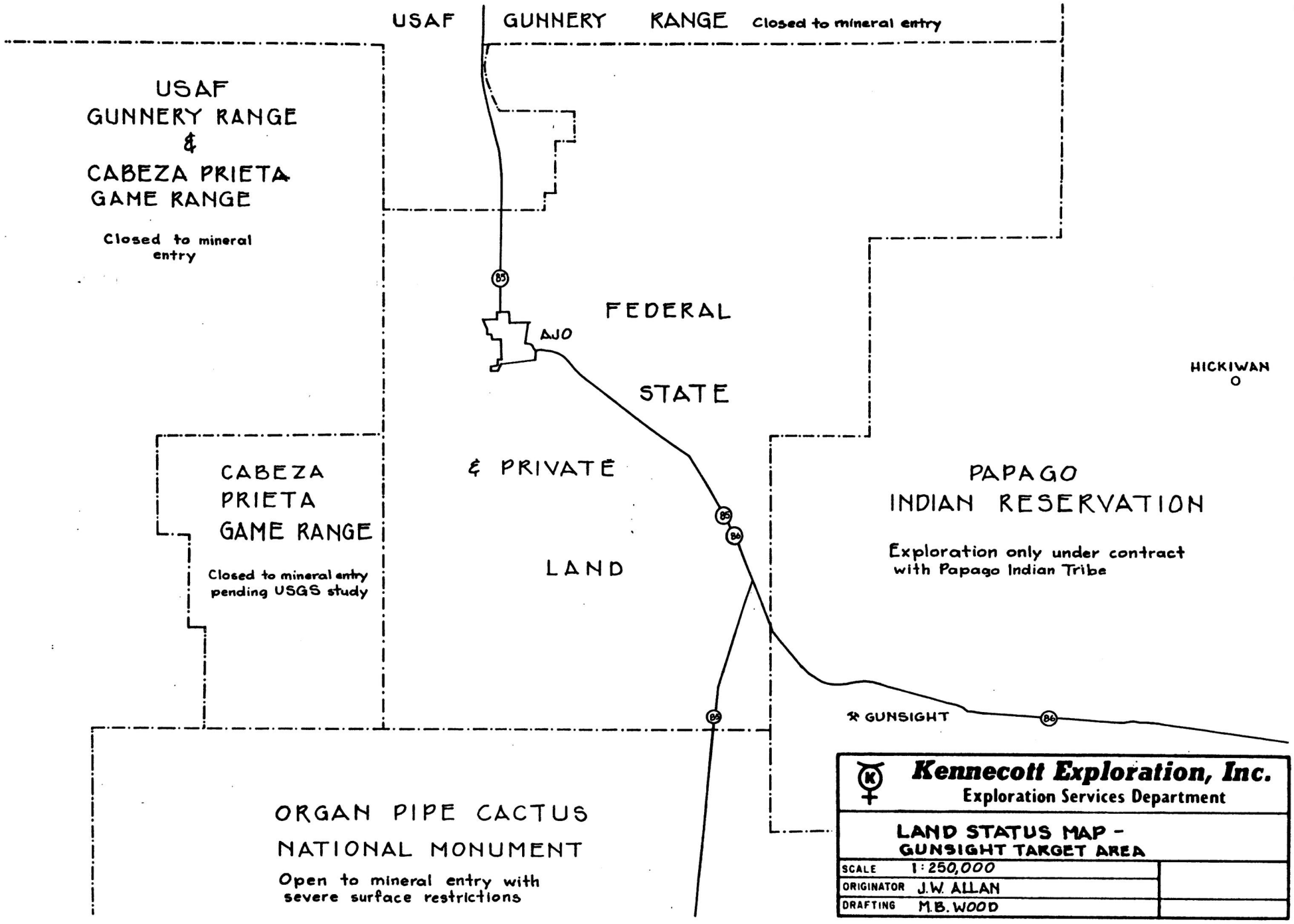
USAF GUNNERY RANGE Closed to mineral entry
USAF GUNNERY RANGE & CABEZA PRIETA GAME RANGE
Closed to mineral entry
FEDERAL
STATE
& PRIVATE
LAND
AJO
HICKIWAN
CABEZA PRIETA GAME RANGE
Closed to mineral entry pending USGS study
PAPAGO INDIAN RESERVATION
Exploration only under contract with Papago Indian Tribe
GUNSIGHT
ORGAN PIPE CACTUS NATIONAL MONUMENT
Open to mineral entry with severe surface restrictions
Kennecott Exploration, Inc.
Exploration Services Department
LAND STATUS MAP - GUNSIGHT TARGET AREA
SCALE 1:250,000
ORIGINATOR J.W. ALLAN
DRAFTING M.B. WOOD

FIG. 2

DATA SUMMARY AND REVIEW

Geology and Mineralization

All significant, known exposures of pre-Tertiary rocks in the Gunsight target area have been mapped, although some, like those south and east of Gunsight, are mapped only at reconnaissance scale and existing maps appear erroneous in many aspects. All available geologic mapping and literature, private and published, are indicated on Plate 2. A University of Arizona thesis covering the Gunsight area and including a couple of questionable K/Ar age dates is in preparation.

Geophysics

All BCM-KCC geophysical surveys are indicated on Plate 3. No published geophysical data are known to be available.

Gravity. -- A gravity survey conducted by Geophysics Division-Bear Creek Mining Company in the early 1960's is available for the region around Ajo and Gunsight.

Magnetics. -- Ground magnetic surveys are available for the Ajo-Childs and Gunsight-Copper Mountain areas. The Ajo (1961) and Copper Mountain (1970) aeromagnetic surveys cover relatively small but well-mineralized regions of the target area.

IP. -- Six IP surveys of pre-VIP vintage (1967) totaling about 93 line miles have been conducted in the target area. No VIP or RIP work has been done in the area.

Drilling

Outside of the bedrock areas of the Ajo and Gunsight districts, known exploratory drilling of significance in the target area is limited to the Copper Bell-Copper Giant prospect area south of Ajo and the Copper Mountain prospect southwest of Gunsight (Plate 3). Drilling in both these areas has been primarily for covered targets.

RESULTS OF CURRENT WORK

Data Review

Review of previous geologic work (Plate 2) in the Gunsight target area reveals only a couple of residual exploration targets which were recommended for further work which was not subsequently done. Caviness (1968) and Phillips (1968) recommended drilling the Bluestone-Copper Bell prospect about 1 mile

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south of the New Cornelia pit. The general area was subsequently drilled by Quintana; results of the drilling appear to have been discouraging.

More recently Welsh recommended RIP surveys in the Gunsight Hills vicinity (Welsh, 1974a) and south of Cimarron Peak (Welsh, 1974b), both on the Papago Indian Reservation. Jones recommended RIP and VIP surveys in the Snead embayment (Jones and Loucks, 1974) northwest of Ajo and the Growler district (Jones, 1974) south of Ajo.

Previous geophysical work (Plate 3) in the area includes relatively extensive gravity and ground magnetic surveys, two smaller aeromagnetic surveys, and several IP surveys, all of pre-VIP (1967) vintage. Although several aeromagnetic anomalies, highs and lows, were recommended for further consideration (MacDougall, 1961; Goldstein, 1971), none apparently was felt to be of any real exploration potential. Other than a relatively small and feeble anomaly at Copper Mountain (Longacre, 1963; Jinks, 1964), no sulfide responses were interpreted from any of the IP surveys.

Logs of the few, scattered drill holes in the target area are filed as indexed on Plate 3.

Geologic Mapping

Field mapping and prospect examinations were conducted in areas where previous work appeared to be inadequate and/or incorrect. Recent, good quality mapping by KEI-GRD in the Hickiwan (Welsh, 1974), Growler (Jones, 1974), and Ajo (Jones, 1974) areas greatly reduced the field work required for comprehensive evaluation of the target area.

Gunsight district. -- Mineralization in the Gunsight district was examined in detail, and the northern portion of the district was remapped at a reconnaissance scale. Results of this work are detailed elsewhere (Allan, 1975), the most significant being the mapping of a Laramide(?) porphyry dike swarm and associated copper mineralization in the southwestern portion of the mapped area. In addition, it was concluded that the Gunsight stock and associated silver- and copper-bearing quartz-barite-fluorite veins are of mid-Tertiary age and have little or no relation to porphyry copper-type mineralization. Also, the Laramide age previously assigned to the gneisses in the southern part of the district (Wilson, 1960) is questionable. It is concluded here they should be considered Precambrian until stratigraphically or radiometrically determined otherwise.

West Cardigan (Copper Canyon) area. -- Previously unreported (BCM-KCC files) copper occurrences in Copper Canyon, 4 miles west-southwest of Ajo, were examined and are considered to be of little or no exploration significance (Swan, 1976).

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RESULTS OF CURRENT WORK

Data Review

Review of previous geologic work (Plate 2) in the Gunsig only a couple of residual exploration targets which were further work which was not subsequently done. Cavines (1968) recommended drilling the Bluestone-Copper Bell

Structural Interpretation

The only known, significant mineral deposits in the target area, the Ajo and Gunsight districts, are located on major, pre-Laramide west-northwest fracture zones (Plates 1 and 4) which appear to have strongly influenced the emplacement of intrusions and mineralization. Both districts occur on or near intersections of the west-northwest zones with major fracture zones of north-south to north-northeast trend and undetermined age.

In the Ajo district, the reactivated Little Ajo Mountains fault and the southern contact of the Cornelia stock are interpreted as major, pre-Laramide (Precambrian?) transcurrent fault zones along which the stock was emplaced (Plate 4). The andesite porphyry and hornblende andesite dike swarms northwest of the New Cornelia pit and the aplite dikes farther west occupy fractures compatible with second-order or Riedel shear direction related to first-order left-lateral shear stress along west-northwest, transcurrent faults.

In the Gunsight district, evidence for large-scale, west-northwest faulting is more indirect. In the region east of the southern part of the district, west-northwest dikes up to 2 miles in length may represent elements of a poorly exposed, major fracture zone cutting through the northern part of the Gunsight district. The Laramide(?) Burro Burro and Stonehouse dike swarms, dominantly andesite and hornblende andesite porphyries, may be analogous to those at Ajo and, if so, may be related to a covered Laramide intrusion and porphyry copper deposit to the west.

CONCLUSIONS AND RECOMMENDATIONS

Results of structural interpretation indicate two preferred areas for exploration: (1) the Why area representing about 25 square miles south of the village of Why and (2) the Ajo Valley area, about 16 square miles, east of Ajo (Plate 4). Other equally favorable areas like those along the major, west-northwest fracture zones west of Ajo and east of Gunsight are on lands which are not presently available for exploration.

It is recommended that (1) land status within the areas be determined, (2) gravity and aeromagnetic data be reviewed to reach an estimate of gravel cover thickness, and (3) if feasible, conduct IP surveys over the recommended areas.

REVIEW OF GEOPHYSICAL DATA

by

R. C. Fox
February 1976

Gravity data over the Ajo Valley area show a steep gradient associated with the Black Mountain fault zone which indicates at least 2,000 feet of bedrock relief within the first mile east of outcrop in the northern half of the area. Additional data are necessary and recommended over the southern half of the area to properly delineate a possible pediment. This additional coverage is justified on the basis of the inherent exploration potential of this area.

Limited gravity data over the Why area indicate a pediment extending up to 1 mile west of outcrop within 1,000 feet of the surface and possibly an extensive pediment within 1,000 to 2,000 feet of the surface. Additional gravity coverage is necessary to better delineate the pediment in this area.

Aeromagnetic data over the Ajo Valley area show anomalies closely associated with the Tertiary volcanics along the western side of the area. A magnetic low occurs in sec. 32, T. 12 S., R. 5 W. which is surrounded by magnetic highs (RP-11, MacDougall, 1961). This anomalous area is most likely a reflection of buried volcanics, but it may be of exploration interest if additional gravity data indicate bedrock within exploration limits of VIP.

The Copper Mountain aeromagnetic survey (Goldstein, 1971) covers a small portion of the Why area. Anomalies RP-16, -17, and -18 along the eastern side of the area are related to Tertiary andesite which occurs as a ridge through this area. Coverage does not extend in the gravel-covered portion of the area.

Of the two areas of interest, the Why area appears to have the greatest potential for a pediment within the exploration limits of VIP. If additional gravity data support this conclusion, VIP follow-up should be in order.

Structural Interpretation

The only known, significant mineral deposits in the target ar and Gunsight districts, are located on major, pre-Laramide northwest fracture zones (Plates 1 and 4) which appear to ha influenced the emplacement of intrusions and mineralization. districts occur on or near intersections of the west-northwes with major fracture zones of north-south to north-northeast t undetermined age.

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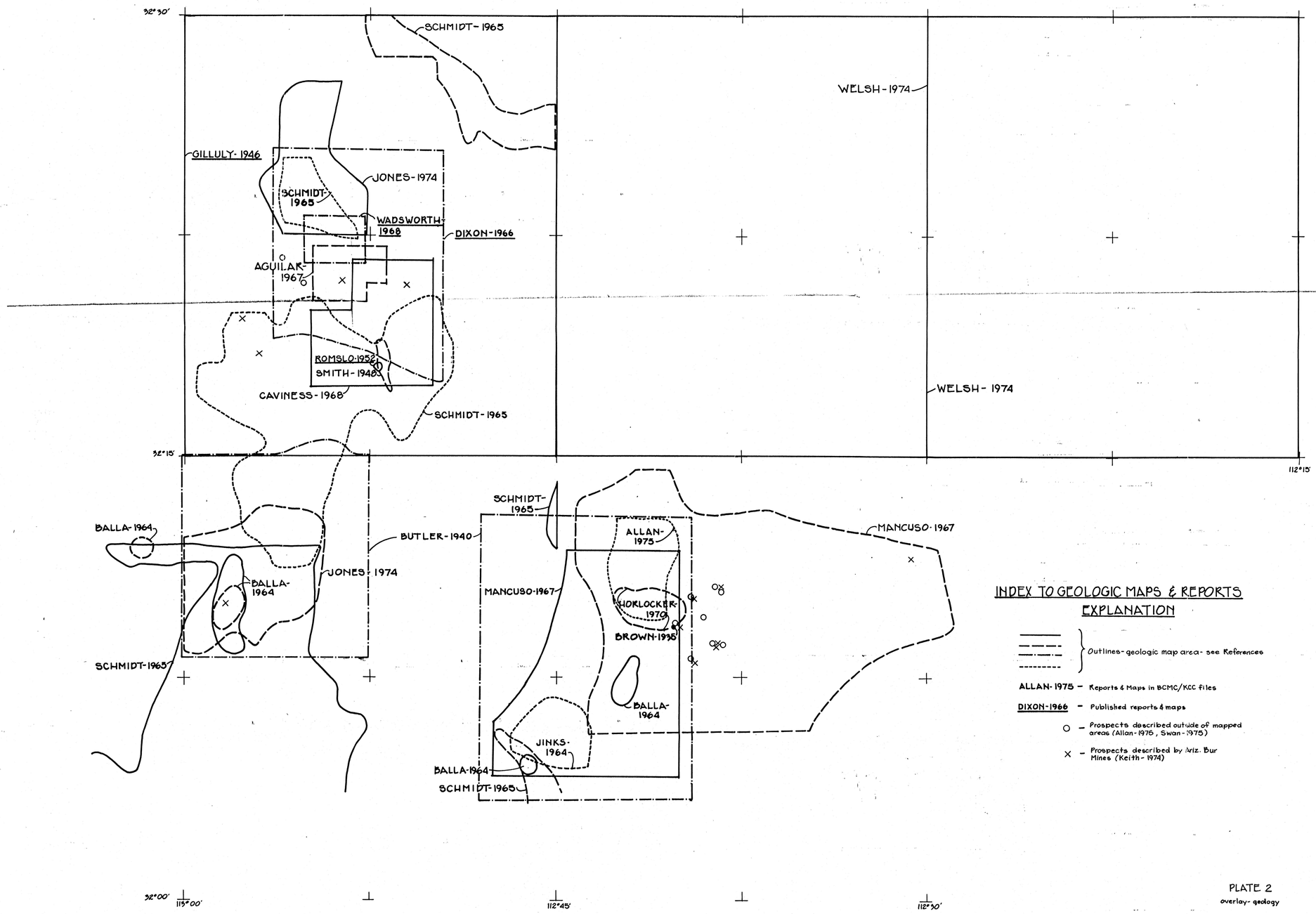


INDEX TO GEOLOGIC MAPS & REPORTS

EXPLANATION

Outlines- geologic map area- see References

ALLAN-1975 – Reports & Maps in BCMC/KCC files

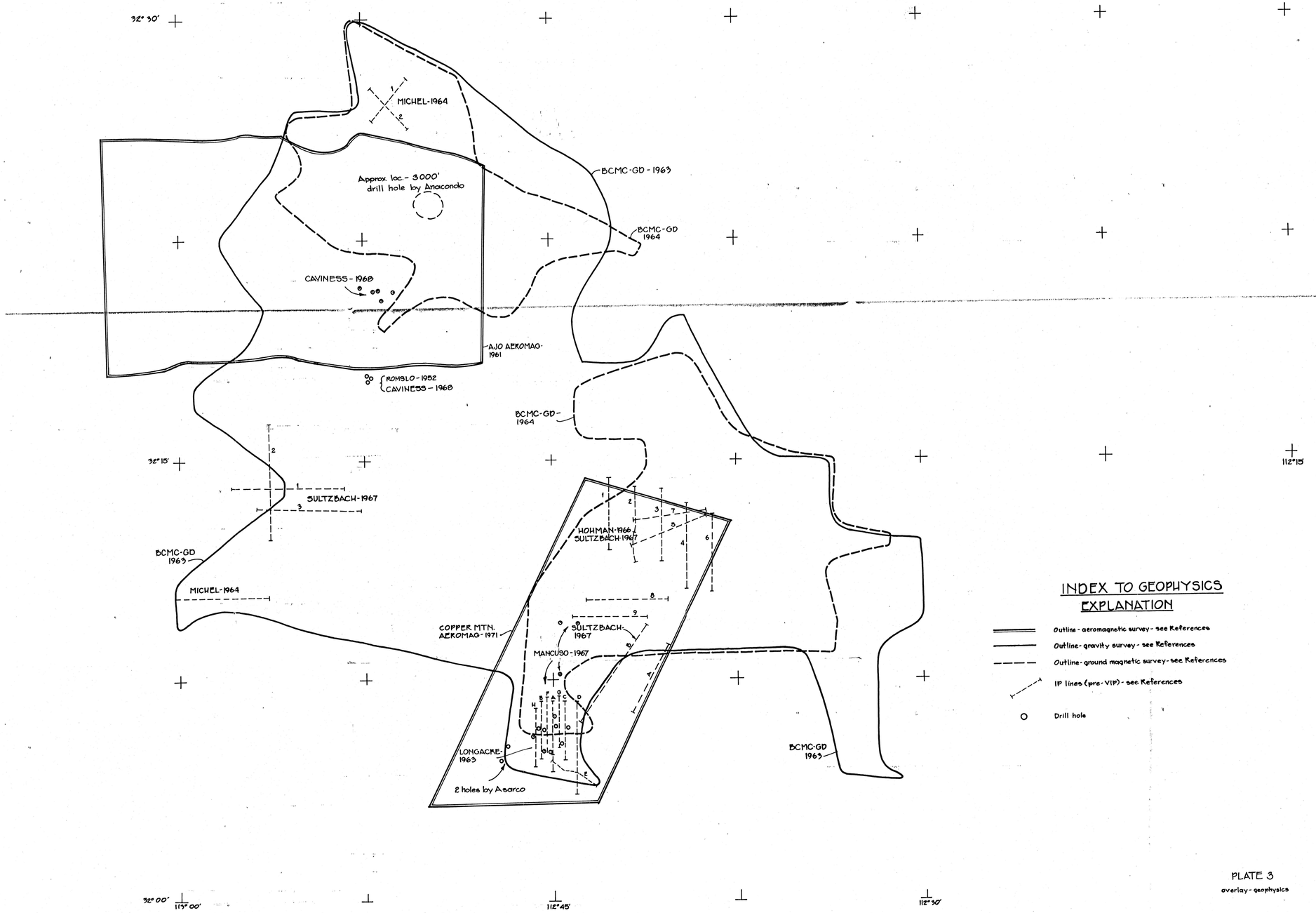
DIXON-1966 – Published reports & maps

○ – Prospects described outside of mapped areas (Allan-1975, Swan-1975)

× – Prospects described by Ariz. Bur Mines (Keith-1974)

PLATE 2

overlay- geology

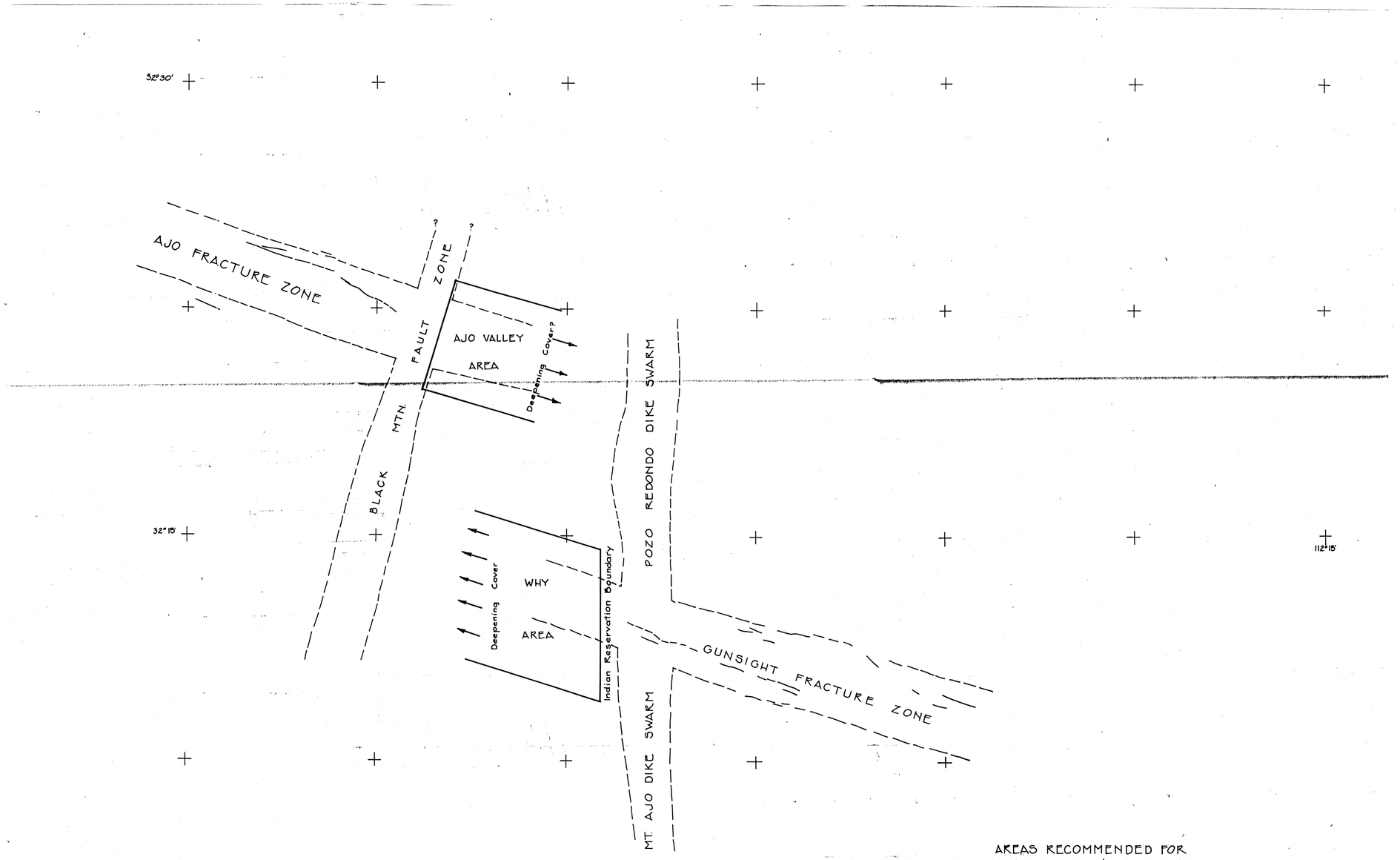


INDEX TO GEOPHYSICS EXPLANATION

- Outline - aeromagnetic survey - see References
- Outline - gravity survey - see References
- Outline - ground magnetic survey - see References
- IP lines (pre-VIP) - see References
- Drill hole

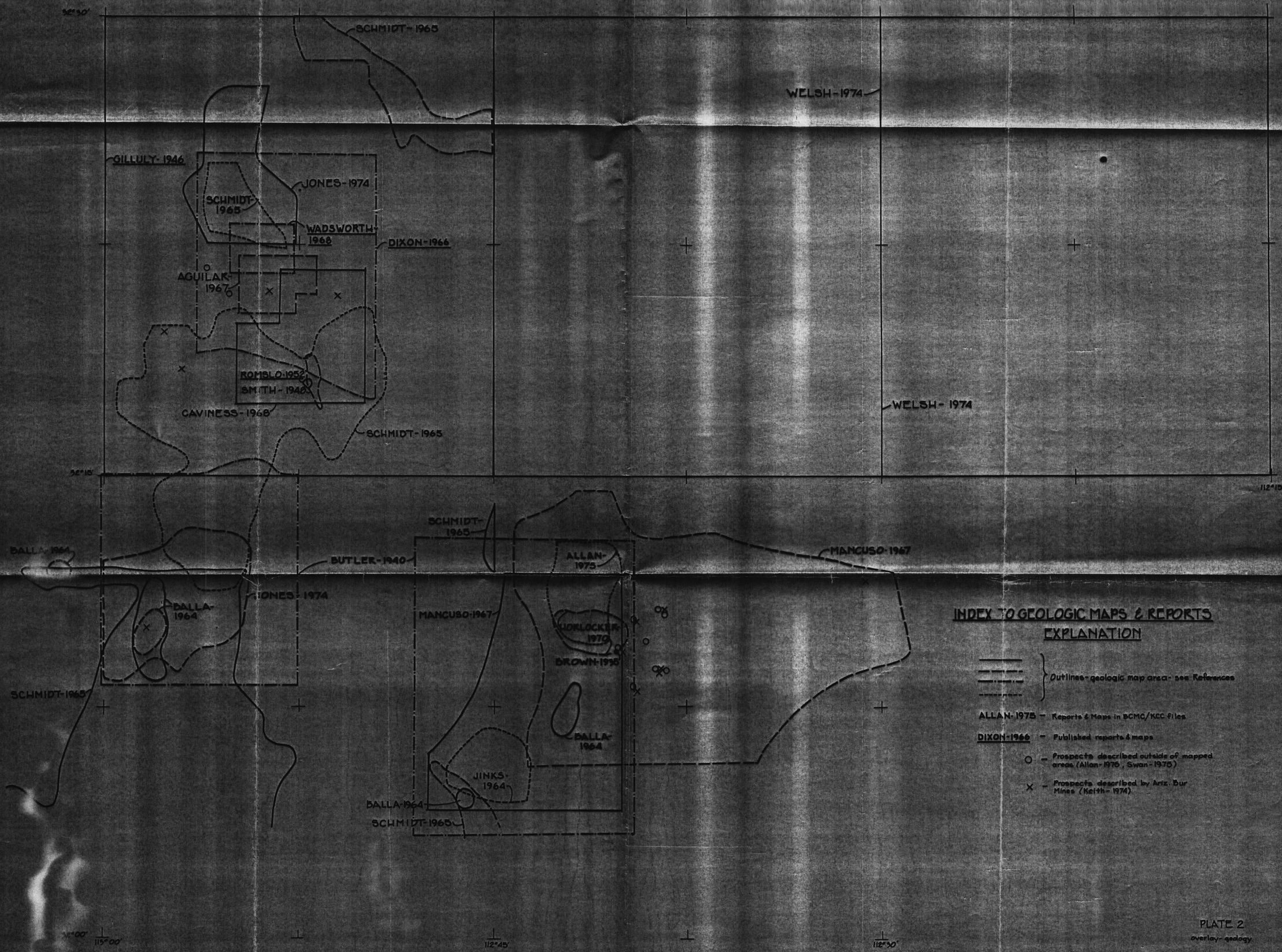
PLATE 3

overlay - geophysics



AREAS RECOMMENDED FOR
GEOPHYSICAL REVIEW & IP SURVEYS

PLATE 4



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× – Prospects described by Ariz. Bur Mines (Keith-1974)

PLATE 2

overlay - geology

32° 30'

USAF

GUILDS MTN FAULT

GUNNERY RANGE

LITTLE AJO MTS FAULT

AJO

GIBSON

New Cornelia Pit

AJO DISTRICT

CHICO SHUNTE

AJO PEAK

BLACK MTN FAULT

CABEZA PRIETA

32° 15'

GAME REFUGE

GROWLER DISTRICT

ORGAN PIPE CACTUS

NATIONAL MONUMENT

Batamote Mts.

SAUCEDA FAULT

WHY

GUNSIGHT DISTRICT

GUNSIGHT (SITE)

KUAKATCH

COPPER MTN

112° 45'

112° 30'

Cimarron Pk

HICKIWAN

PAPAGO INDIAN RESERVATION

112° 15'

32° 00'

113° 00'

EXPLANATION

- Post-Laramide Cover — Includes Tertiary & Quaternary volcanic rock, bolson gravels, & alluvium.
- Mid-Tertiary/Quaternary Dike and Plug
- Other Volcanic Features: 1. Shield or strato-volcano 2. Crater 3. Caldera
- gd — Mid-Tertiary Stock at Gunsight
- qm gr — Laramide Intrusive & Dikes — Age questionable in Gunsight Dist.
- vc / ls — Pre-Laramide Volcanic (vc) & Sedimentary (ls) Rocks
- gn sch — Older Crystalline Rocks, Mainly Gneisses (gn) & Schists (sch) Pre-Laramide (?) dikes
- Fault
- Laramide (?) qtz-sulfide vein
- Mid-Tertiary epithermal vein

SCALE: 1:125,000

5 0 5 MILES

N

Kennecott Exploration, Inc.

Exploration Services Department

SOUTHWEST STRUCTURAL STUDY

GUNSIGHT TARGET AREA

PIMA COUNTY, ARIZONA

SCALE 1:125,000	DATE 6-27-75	NO.
ORIGINATOR J.W. ALLAN		
DRAFTING M.B. WOOD		REVISED

PLATE 1

32°30'

USAF

GUNNERY RANGE

CABEZA PRIETA GAME REFUGE

ORGAN PIPE CACTUS NATIONAL MONUMENT

32°15'

32°00'

113°00'

CHILDS MTN FAULT

LITTLE AJO MTS FAULT

AJO

GIBSON

New Cornelia Pit

AJO DISTRICT

CHICO SHUNIE

AJO PEAK

BLACK MTN FAULT

Batamote Mts.

SAUCEDA FAULT

Cimarron Pk

HICKIWAN

PAPAGO INDIAN RESERVATION

WHY

GROWLER DISTRICT

GUNSIGHT (SITE)

NORTH GUNSIGHT DISTRICT

KUAKATCH

COPPER MTN

112°45'

112°30'

112°15'

EXPLANATION

- Post-Laramide Cover — Includes Tertiary & Quaternary volcanic rock, bolson gravels, & alluvium
- Mid-Tertiary/Quaternary Dike and Plug
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- Fault
- Laramide (?) qtz-sulfide vein
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SCALE: 1:125,000

5 0 5 MILES

N

Kennecott Exploration, Inc.

Exploration Services Department

SOUTHWEST STRUCTURAL STUDY

GUNSIGHT TARGET AREA

PIMA COUNTY, ARIZONA

SCALE 1:125,000	DATE 6-27-75	NO.
ORIGINATOR J.W. ALLAN		
DRAFTING M.B. WOOD		REVISED

PLATE 1

32°15'

112°45'

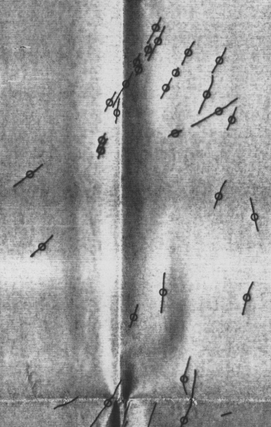
112°37'30"

32°15'

PLATE 1- Mineralization Overlay

Epithermal veins

Quartz-sulfide veins



32°07'30"

112°45'

32°07'30"

112°37'30"

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Advance Sheet
Subject to correction
To be published at 1:62 500 scale

PLATE 1

TONOCA NW., ARIZ.
PIMA CO.

GUNSIGHT (MEYER) MINING DISTRICT
PAPAGO INDIAN RESERVATION
PIMA COUNTY, ARIZONA

Reconnaissance Geologic Map

Scale 1:24,000

J.W. Allan — Feb, 1976

EXPLANATION

Post-Laramide cover
- Qal - alluvium & bolson gravels
- QTb - mesa capping basalt flows
- Tv - mid Tertiary(?) volcanic rocks and dikes

Mid Tertiary(?) Gunsight stock
- Tgc - coarse grained, leuco-quartz monzonite
- Tgf - fine grained, aplitic quartz monzonite
- gm - biotite quartz monzonite (may be Laramide or Precambrian)

Laramide (?) porphyry dikes

Precambrian (?) crystalline rocks
- gn - medium grained, gneissic granodiorite
- gr - coarse grained granodiorite with abundant aplite dikes

Fault

Epithermal veins

Cu, Au, & Sn, W bearing quartz-sulfide veins

K-Ar date
46 my (Damon)

K-Ar date
39 my (Jones-1974)
(location probably in error - rock was granitic intrusive)

Mapped by Pacific Area, Geological Survey

This is an unedited copy of an original manuscript including field additions made in 1963

APPROXIMATE MEAN DECLINATION, 1963
TRUE NORTH
MAGNETIC NORTH
13½°

SCALE 1:24000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

CONTOUR INTERVAL 20 FEET
DASHED LINES REPRESENT 10-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

Gunsight Mining District - Papago Indian Reservation, Pima County, Arizona
J.W Allan 5-12-75

TONOCA NW., ARIZ.
PIMA CO.

Ajo Project

SOUTHWEST STRUCTURAL STUDY
GUNSIGHT TARGET AREA
PIMA COUNTY, ARIZONA

by

James W. Allan

1976

CONTENTS

ILLUSTRATIONS

mylars on file
BCMC - Tucson

originals at KEI

SOUTHWEST STRUCTURAL STUDY
GUNSIGHT TARGET AREA
PIMA COUNTY, ARIZONA

Introduction

Location, Size and Access

The Gunsight target area comprises about 1,500 square mile in western Pima County, Arizona (Figure 1 & Plate 1). The area, characterized by Basin and Range physiography and Sonoran Desert ecology, is practically everywhere accessible to 4-wheel drive vehicle except where restricted by law.

Reasons for Review and Evaluation

Structural interpretation of the region indicates that the first order porphyry copper district at Ajo and the Gunsight district 15 miles to the southeast are emplaced along major west-northwest fractures (Plate 4). Of particular interest was the recognition of an east-northeast Laramide(?) porphyry dike swarm and associated copper veins* in the southwestern portion of the Gunsight district, a pattern common to many Southwestern porphyry copper districts, including Ajo.

* tangential to the main WNW fracture zone

Land Status

With the exception of about 300 square miles around Ajo and northwest of Gunsight, all of the land in the Gunsight target area is either closed to mineral entry or regulated by severe surface restrictions which greatly hamper exploration activity (Figure 2).

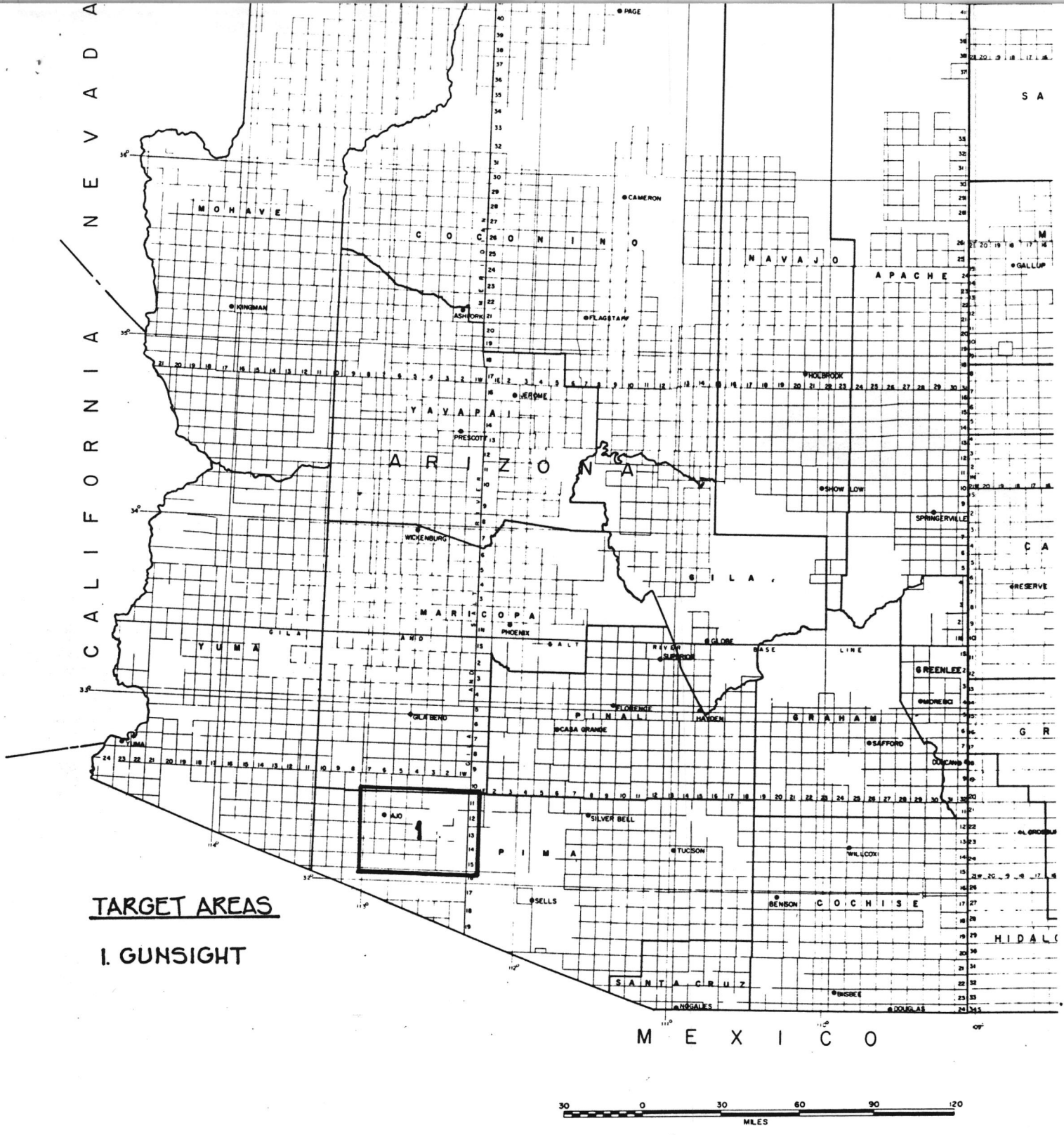
Data Summary & Review

Geology and Mineralization

All significant, known exposures of pre-Tertiary rocks in the Gunsight target area have been mapped although some, like those south and east of Gunsight, are mapped only at reconnaissance scale and existing maps appear erroneous in many aspects. All available geologic mapping and literature, private and published, are indicated on Plate 2. A University of Arizona thesis covering the Gunsight area and including a couple of questionable K/Ar age dates is in preparation.

Geophysics

All BCMC/KCC geophysical surveys are indicated on Plate 3. No published geophysical data are known to be available.



TARGET AREAS

1. GUNSIGHT

30 0 30 60 90 120
MILES

FIG. 1

Kennecott Exploration, Inc.
Exploration Services Department

SOUTHWEST STRUCTURAL STUDY
INDEX TO TARGET AREAS-ARIZONA

SCALE	
ORIGINATOR J.W. ALLAN	
DRAFTING	

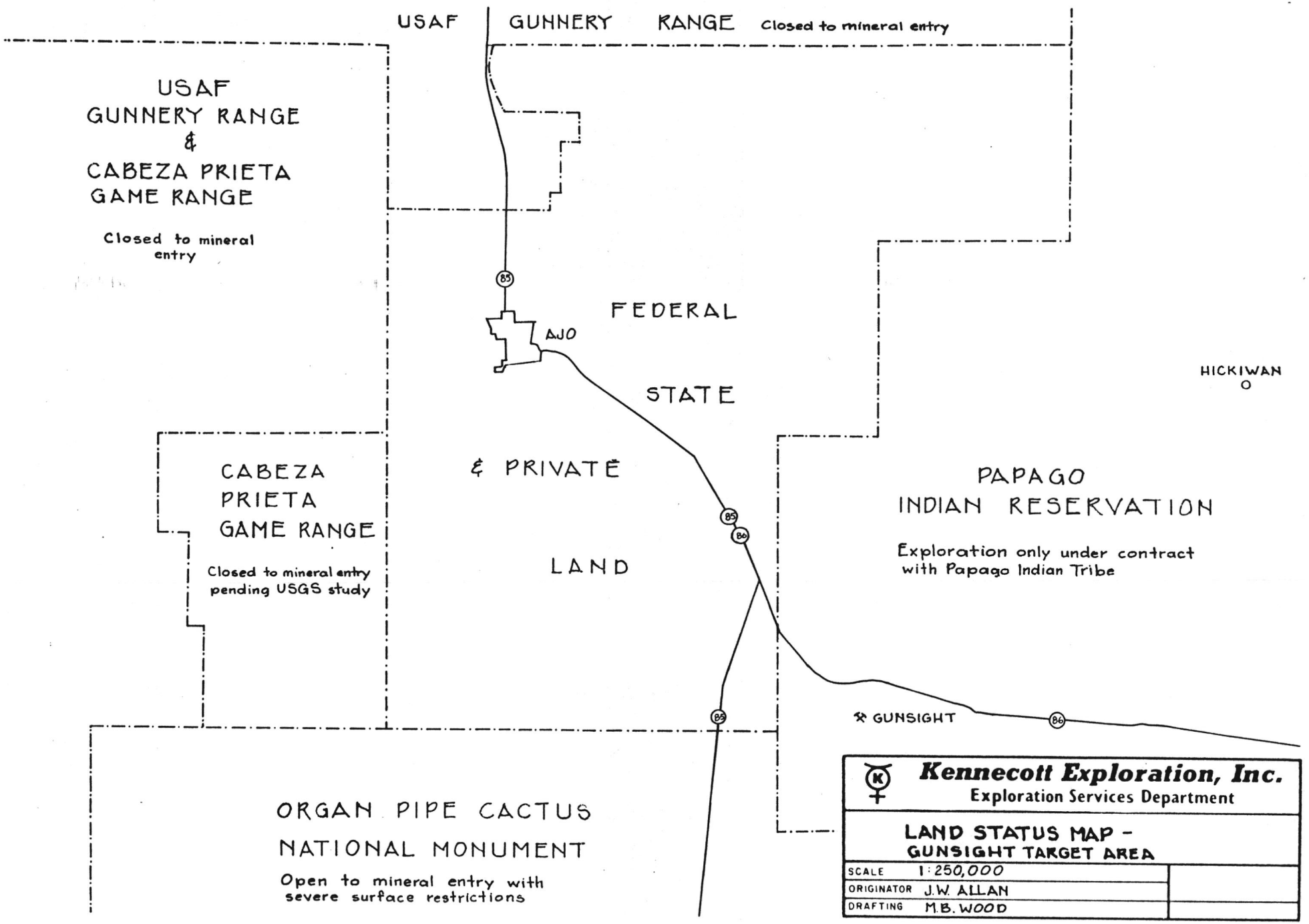

USAF GUNNERY RANGE Closed to mineral entry
USAF
GUNNERY RANGE
&
CABEZA PRIETA
GAME RANGE
Closed to mineral entry
85
AJO
FEDERAL
STATE
& PRIVATE
LAND
HICKIWAN
O
CABEZA
PRIETA
GAME RANGE
Closed to mineral entry
pending USGS study
85
86
PAPAGO
INDIAN RESERVATION
Exploration only under contract
with Papago Indian Tribe
85
GUNSIGHT
86
ORGAN PIPE CACTUS
NATIONAL MONUMENT
Open to mineral entry with
severe surface restrictions
Kennecott Exploration, Inc.
Exploration Services Department
LAND STATUS MAP -
GUNSIGHT TARGET AREA
SCALE 1:250,000
ORIGINATOR J.W. ALLAN
DRAFTING M.B. WOOD

FIG. 2

→ inset – outcrop

Gravity. A gravity survey conducted by Geophysics Division-Bear Creek Mining Co. in the early 1960's is available for the region around Ajo and Gunsight.

Magnetics. Ground magnetic surveys are available for the Ajo-Childs and Gunsight-Copper Mtn areas. The Ajo (1961) and Copper Mtn (1970) aeromagnetic surveys cover relatively small but well mineralized regions of the Target Area.

IP. Six IP surveys of pre-VIP vintage (1967) totaling about 93 line miles have been conducted in the Target Area. No VIP or RIP work has been done in the area.

Drilling

Outside of the bedrock areas of the Ajo and Gunsight districts, known exploratory drilling of significance in the Target Area is limited to the Copper Bell-Copper Giant prospect area south of Ajo and the Copper Mtn prospect southwest of Gunsight (Plate 3). Drilling in both these areas has been primarily for covered targets.

Results of Current Work

Data Review

Review of previous geologic work (Plate 2) in the Gunsight Target Area reveals only a couple of residual exploration targets which were recommended for further work which was not subsequently done. Caviness (Caviness-1968) and Phillips (Phillips-1968) recommended drilling the Bluestone-Copper Bell prospect about one mile south of the New Cornelia pit. The general area was subsequently drilled by Quintana; results of the drilling appear to have been discouraging.

More recently Welsh recommended RIP surveys in the Gunsight Hills vicinity (Welsh-1974A) and south of Cimarron Peak (Welsh-1974B), both on the Papago Indian Reservation. Jones recommended RIP and VIP surveys in the Snead embayment (Jones and Loucks-1974) northwest of Ajo and the Growler district (Jones-1974) south of Ajo.

Previous geophysical work (Plate 3) in the area includes relatively extensive gravity and ground magnetic surveys, two smaller aeromagnetic surveys, and several IP surveys, all of pre-VIP (1967) vintage. Although several aeromagnetic anomalies, highs and lows, were recommended for further consideration (McDougall-1961 and Goldstein-1971) none apparently was felt to be of any real exploration potential. Other than a relatively small and feeble anomaly at Copper Mtn (Longacre-1963 and Jinks-1964), no sulfide responses were interpreted from any of the IP surveys.

Logs of the few, scattered drill holes in the Target Area are filed as indexed on Plate 3.