CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

TOMBSTONE
MINING DISTRICT
Cochise County, Arizona

State of Maine
Area of Interest

-Report-
State Mineral Locations
December, 1985

CERTIFIED MAIL #

December 5, 1985

Robert K. Lane, Commissioner
Arizona State Land Department
1624 W. Adams
Phoenix, AZ 85007

RE: Evidence of Mineral Location - Reporting to the Commissioner - Tombstone Silver Mines, Inc., State Mineral Claims

Dear Mr. Lane:

Pursuant to requirements for Proof of Mineral Location upon State lands, please find enclosed a detailed geological report for certain mineral claims (Attachment 1) located on State land in Section 16, Township 20 South, Range 22 East, G. & S.R.B.M., Tombstone Mining Distrct, Cochise County, Arizona, as claimed by Tombstone Silver Mines, Inc.

All claims were located on November 14, 1985, and recorded in the official records of Cochise County on the same date. Recorded copies of the Location Notices have been forwarded to your office, via the U. S. Mail's Certified Return Receipt, with acknowledgement of receipt having been received by myself after delivery..

As provided for in the "Official Compilation of Administrative Rules and Regulations", Title 12 (State Land Department), Tombstone Silver Mines, Inc. would request that you might act favorably on consolidating all located claims into one lease, as all claims are contiguous and will be unitized into one common mining plan. This requested consolidation should benefit both parties, and remove unnecessary administrative duplication. Your approval and notification of such will be appreciated.

Respectfully submitted,

Thomas E. Waldrip Jr.

Thomas E. Waldrip, Jr., Agent
Tombstone Silver Mines, Inc.

TEW/ms

Enclosure

GEOLOGIC REPORT

On The

TOMBSTONE MINING DISTRICT

Cochise County, Arizona

with Particular Emphasis on
Evidence of Mineral Location on State Mineral Claims

Section 16, Township 20 South, Range 22 East, G. & S.R.B.M.

Reference:

Type A Claims: T.S.M. 1A through 6A
Type B Claims: T.S.M. B1 through B6

Located on: November 14, 1985
Located by: Thomas E. Waldrip, Jr., Agent
Located for: Tombstone Silver Mines, Inc.

Submitted to:

Robert K. Lane, Commissioner
Arizona State Land Department
Phoenix, Arizona

Submitted By:

Thomas E. Waldrip, Jr.,
Land Consultant for Tombstone Silver Mines, Inc.

James A. Briscoe & Associates, Inc.
5701 E. Glenn St., #120
Tucson, Arizona 85712

December 11, 1985

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SUMMARY AND CONCLUSIONS

Sufficient information has been presented herein to demonstrate mineral location on the twelve State mineral claims under claim by Tombstone Silver Mines, reference the Location Notices on file with your office of T.S.M.'s #'s 1-A through 6-A and B-1 through B-6, located November 14, 1985. Substantial work remains to fully delineate all areas of economic mineralization contained therein. Tangible results of mineralization have been presented for each state claim to varying degrees and means, although hampered by soil cover, denuding of surface mineral values by leaching, complex structural setting, and nature of economic mineralization to the host veins (veinlets). Evidence for mineralization exists on all claims referenced by assayed, anamolous silver values, alteration, exposed leached veins, extralateral rights of veins, attendant manganese and iron oxides on fractures from oxidized sulphides, and past mining and exploration activities.

In light of the very positive and tangible results tendered herein for evidence of mineral location by Tombstone Silver Mines ,Inc., the author is optimistic that production will result on State lands under claim, with generation of mineral royalties to the State, should our leases be approved. Notwithstanding, strong argument also exists as to the intangible aspects of unitization via mineral lease of the lands under claim to Tombstone Silver Mines, Inc. by the state, especially in light of the extra lateral rights issues.

Mindful of these factors, the author respectfully requests the Land Commissioner to look favorably upon our evidence of mineral location, and approve our future filings with his office of mineral lease applications for each mineral claim covered herein.

INTRODUCTION

This report is being compiled and submitted as proof of valuable mineral location by Tombstone Silver Mines, Inc., for twelve (12) mineral locations, located on State grounds, on November 14, 1985, as detailed in Exhibit 1.

Evidence of mineral location ranges from surface vein exposures to assays of samples from underground workings. Results are herein compiled to demonstrate that Tombstone Silver Mines, Inc. has made a valuable mineral discovery upon each claim.

For convenience, efficiency, and to avoid unnecessary duplication, discussions of mineral location on all claims have been unitized into one report. However convenient, this format is utilized only to summarize generalities pertaining to geo-technical information for the claims as a whole. Specific and ample details of location are embodied in later sections of this report to prove scientifically that silver mineralization exists on each claim. That this mineralization is in place; has continuation; has metal value; and should prove economic to extract.

PROPERTY

Exhibit 1 lists claims under location. The outlined, as surveyed, claims boundaries are shown on Exhibit 2. Exhibit 3 illustrates, in addition to the claim illustrated in Exhibit 2, the additional components of interior, patented, mineral claims, in juxtaposition with our state mineral claims. As per the list of claims, Exhibit 1, the property position covered amounts to six (6) Type A mineral claims, enumerated as T.S.M. 1-A through 6-A, and six (6) Type B mineral claims, T.S.M. B-1 through B-6. In total, these claims cover 101.2 acres of State mineral grounds, located generally in the N1/2 of Section 16, Township 20 South, Range 22 East, G. & S.R.B.M., Cochise County, Arizona. Each is in overlap somewhere within its boundaries with either another claim of this group or a patented claim under Tombstone Silver Mines, Inc.'s control. As such, no claim has a full allotment of acreage. Careful attention was paid and efforts extended to prove mineral discovery outside the areas of overlap and within each identifiable open area of each mineral location on State lands.

EXHIBIT 1

MASTER CLAIM LIST, TYPE A & B MINERAL CLAIMS
TOMBSTONE SILVER MINES, INC.
LOCATED: NOVEMBER 14, 1985

Claim Name and Number	County Recording	Claim Type	Legal Description	Sect-ion	Town-ship	Range	Meridian
T.S.M. #1-A	851122739	A	M & B Lots 3 & 4	16	20S.	22E.	G.&S.R.B.M.
T.S.M. #2-A	851122740	A	M & B Lots 3 & 4	16	20S.	22E.	G.&S.R.B.M.
T.S.M. #3-A	851122741	A	M & B Lot 4	16	20S.	22E.	G.&S.R.B.M.
T.S.M. #4-A	851122742	A	M & B Lots 5 & 6	16	20S.	22E.	G.&S.R.B.M.
T.S.M. #5-A	851122743	A	M & B Lots 5 & 6	16	20S.	22E.	G.&S.R.B.M.
T.S.M. #6-A	851122744	A	M & B Lot 6	16	20S.	22E.	G.&S.R.B.M.
T.S.M. #B-1	851122745	B	W1/2 Lot 2	16	20S.	22E.	G.&S.R.B.M.
T.S.M. #B-2	851122746	B	E1/2 Lot 4	16	20S.	22E.	G.&S.R.B.M.
T.S.M. #B-3	851122747	B	W1/2 Lot 5	16	20S.	22E.	G.&S.R.B.M.
T.S.M. #B-4	851122748	B	M & B Lots 4 & 5	16	20S.	22E.	G.&S.R.B.M.
T.S.M. #B-5	851122749	B	E1/2 Lot 6	16	20S.	22E.	G.&S.R.B.M.
T.S.M. #B-6	851122750	B	W1/2 Lot 7	16	20S.	22E.	G.&S.R.B.M.

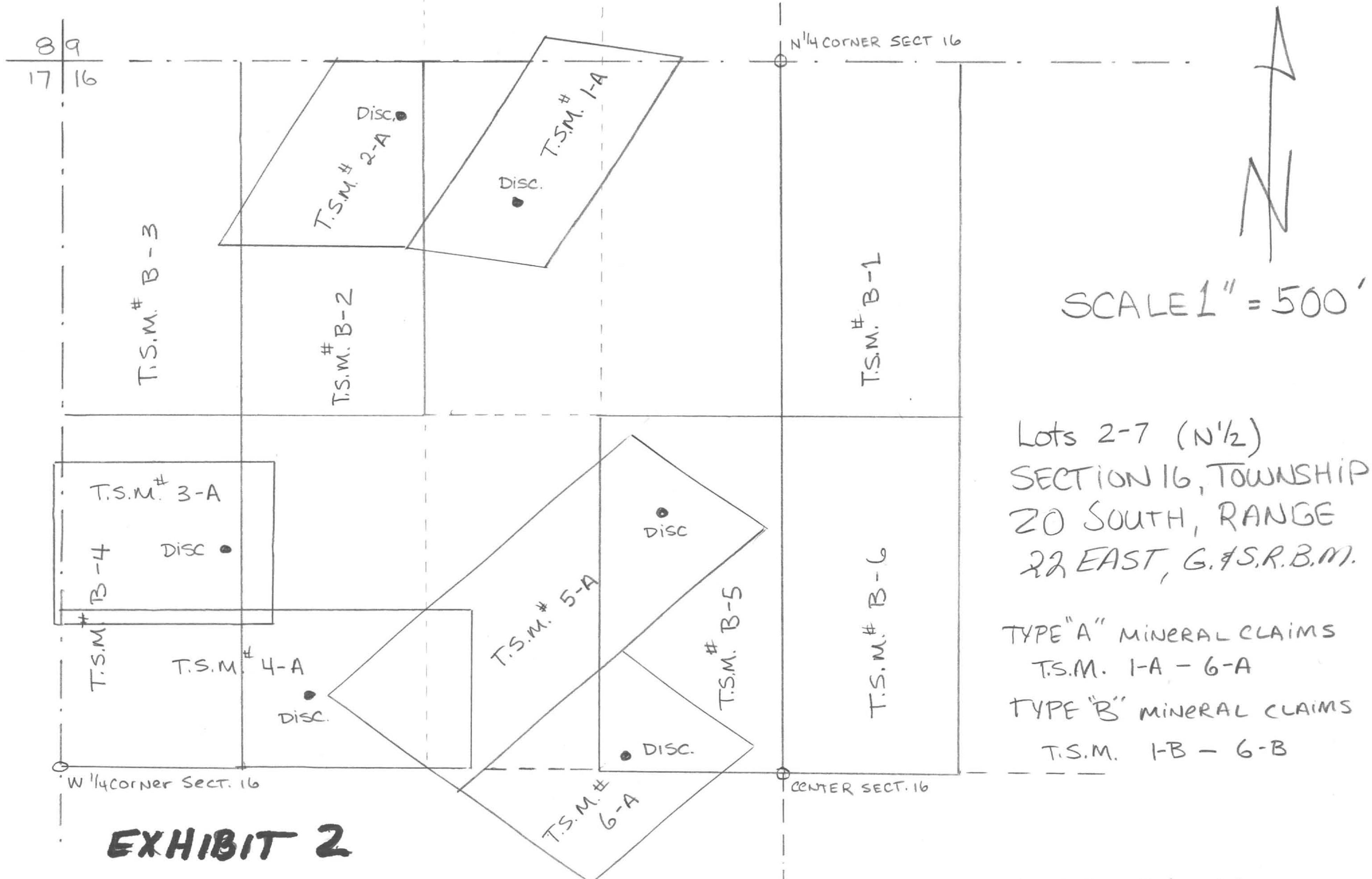
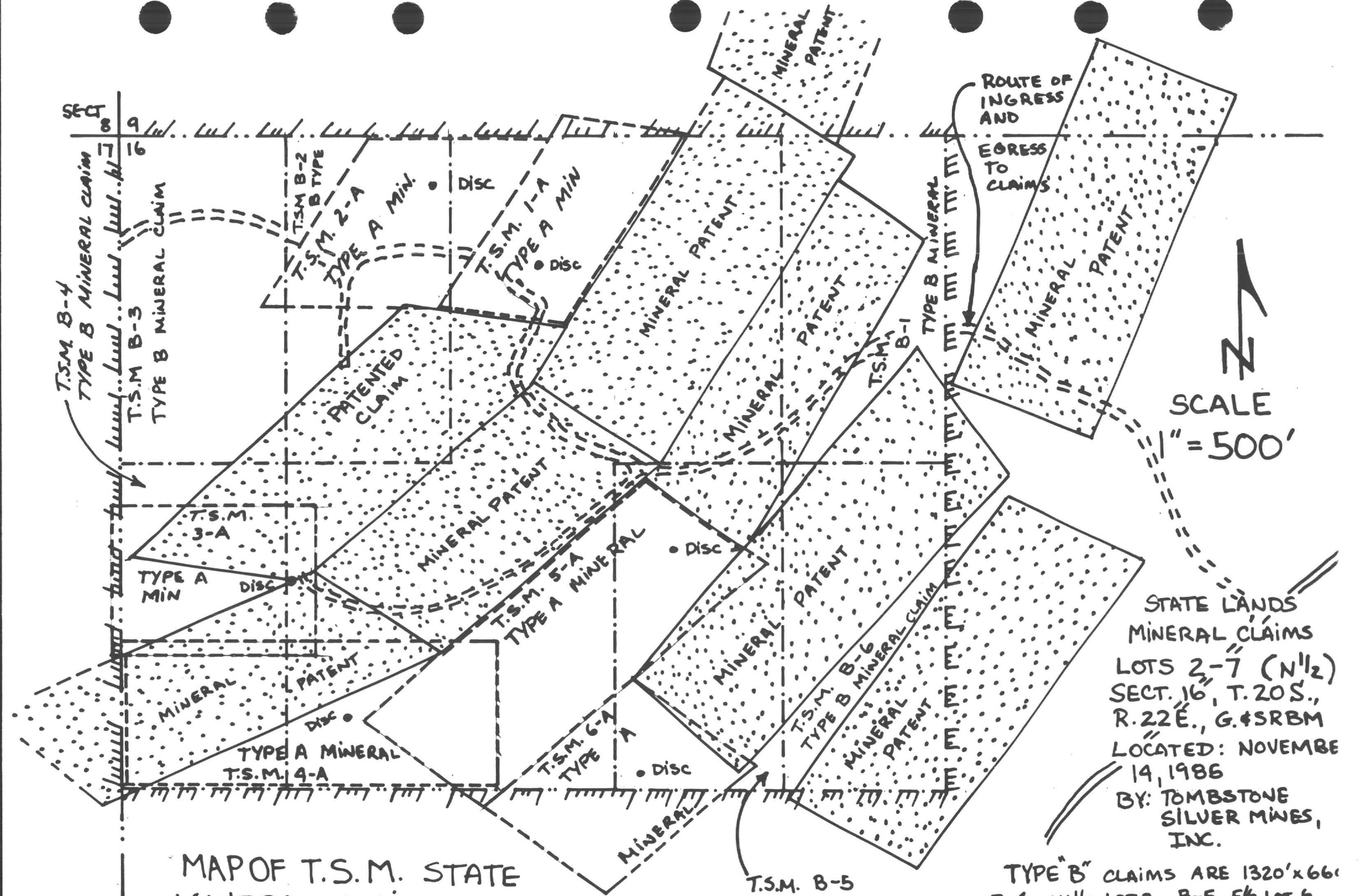


EXHIBIT 2

T.S.M STATE MINERAL CLAIMS – TOMBSTONE MINING DISTRICT,
COCHISE COUNTY, ARIZONA

CLAIM LOCATED NOVEMBER 14, 1985 BY TOMBSTONE SILVER MINES INC.



MAP OF T.S.M. STATE
MINERAL CLAIMS TOMBSTONE
MINING DISTRICT, COCHISE CO., ARIZONA

EXHIBIT 3

LOCATION, CULTURE, TRANSPORTATION, PHYSIOGRAPHY & GEOGRAPHY

The Tombstone Mining District lies in central Cochise County. The Tombstone townsite takes its proper name from the mines and incorporated mining district located there, and is the only population center within the U.S.G.S. 15 minute quadrangle map of its namesake. The approximate 1,500 inhabitants of Tombstone make their living from ranching, some mining, and a thriving tourist trade generated from Tombstone's rich, but vastly over commercialized, western and mining folklore. Enchanced topographic detail may be gleaned from the U.S.G.S. 7.5 minute series topographic map of the same name (please refer to the copied portion of the map surrounding the claims - Figure 2-A).

The mining district may be best reached via Interstate 10 and U. S. 80 to the municipality of Tombstone, some 60 miles southeast of Tucson (Figure 2). From Tombstone, one proceeds in a southwest direction on the paved Charleston Road, a distance of two miles (Figure 2-A). Access to the property is gained through a well maintained graveled road to the State of Maine Mine. Various poorly maintained ancillary trails branch off of the main road and give easy access to all areas of the property. Permission to use all roads should first be gained at the gate as most roads are on or lead across patented grounds.

The Tombstone district lies in the Tombstone Hills, a low, moderately scattered series of protrudences, primarily on the east side of the San Pedro River, some twenty-five (25) miles north along its course from its entrance at the International Boundary with Mexico. The property is near the northwest margin of the Tombstone Hills, some 4 miles due east of the Boquillas Ranch House on the river.

The claim group is situated at an elevation between 4,838 feet at Uncle Sam Hill on the west terminus of the claims, and 4,425 feet on the northeastern corner of T.S.M. B-1 claim. The San Pedro River channel, being the lowest elevation in the area, is at about 3,900 feet A.M.S.L., while Ajax Hill is the highest at 5,320 feet, 1 1/2 miles southeast of the area.

The area is on (if not transitional) the very northeastern margin of the Sonorian Desert physiographic provenance. The climate here is not indifferent to that of other desert regions of southwestern Arizona of similar elevations. Days are warm, often wet during summer, and cool but mild during winter. Rains are seasonal and sporatic, heaviest during summer thunder storms when the greatest majority of precipitation falls. Yearly recorded precipitation amounts are in the range of 15 inches.

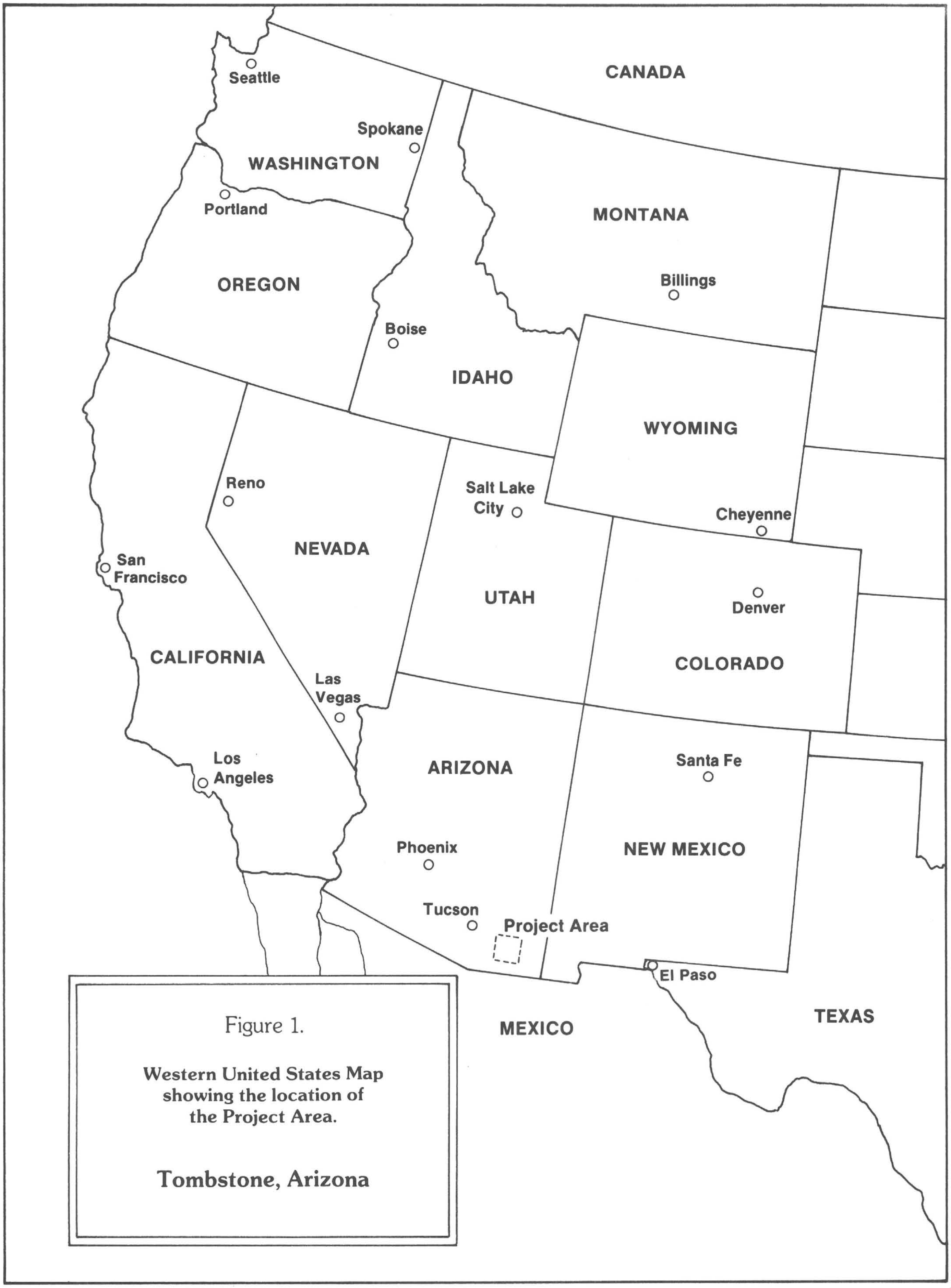


Figure 1.

Western United States Map showing the location of the Project Area.

Tombstone, Arizona

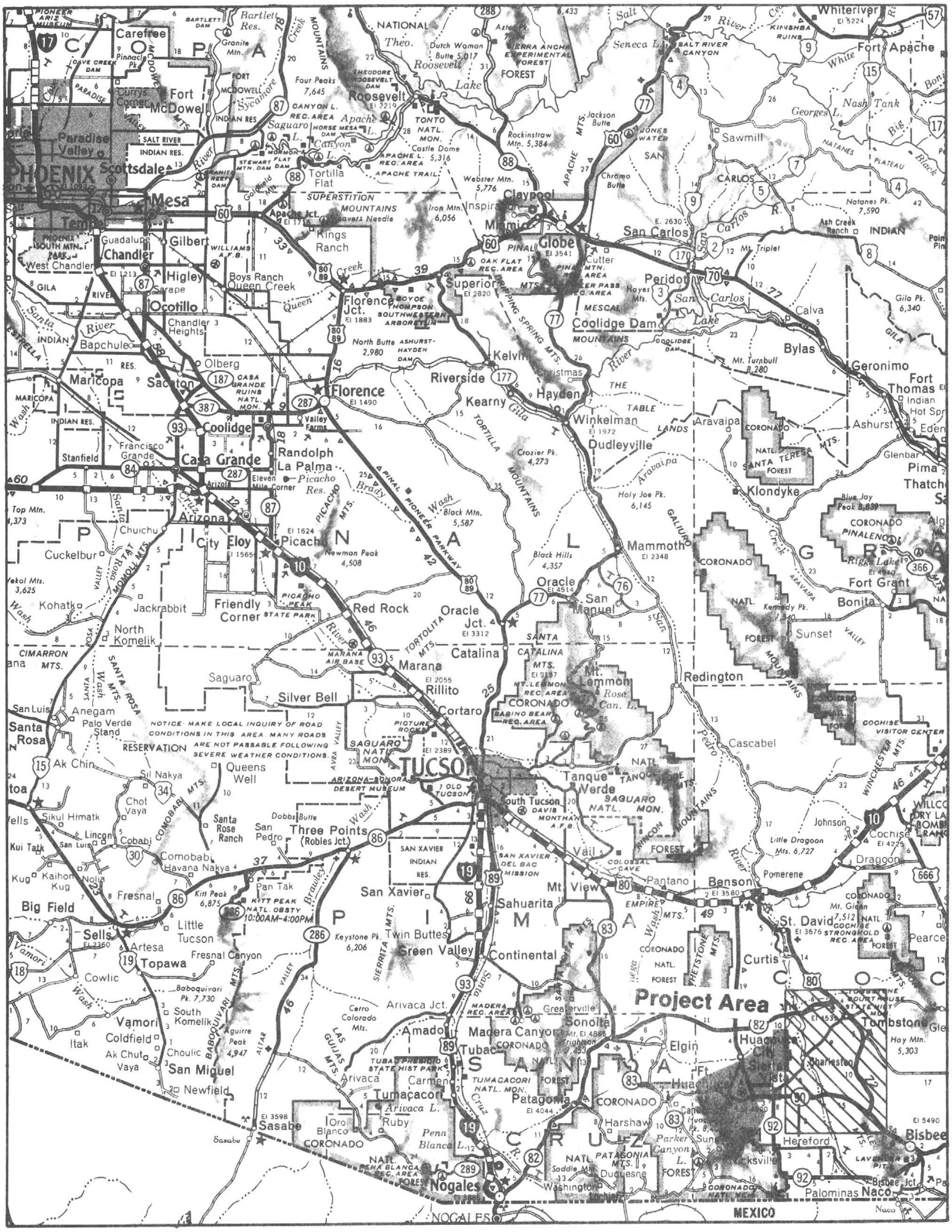
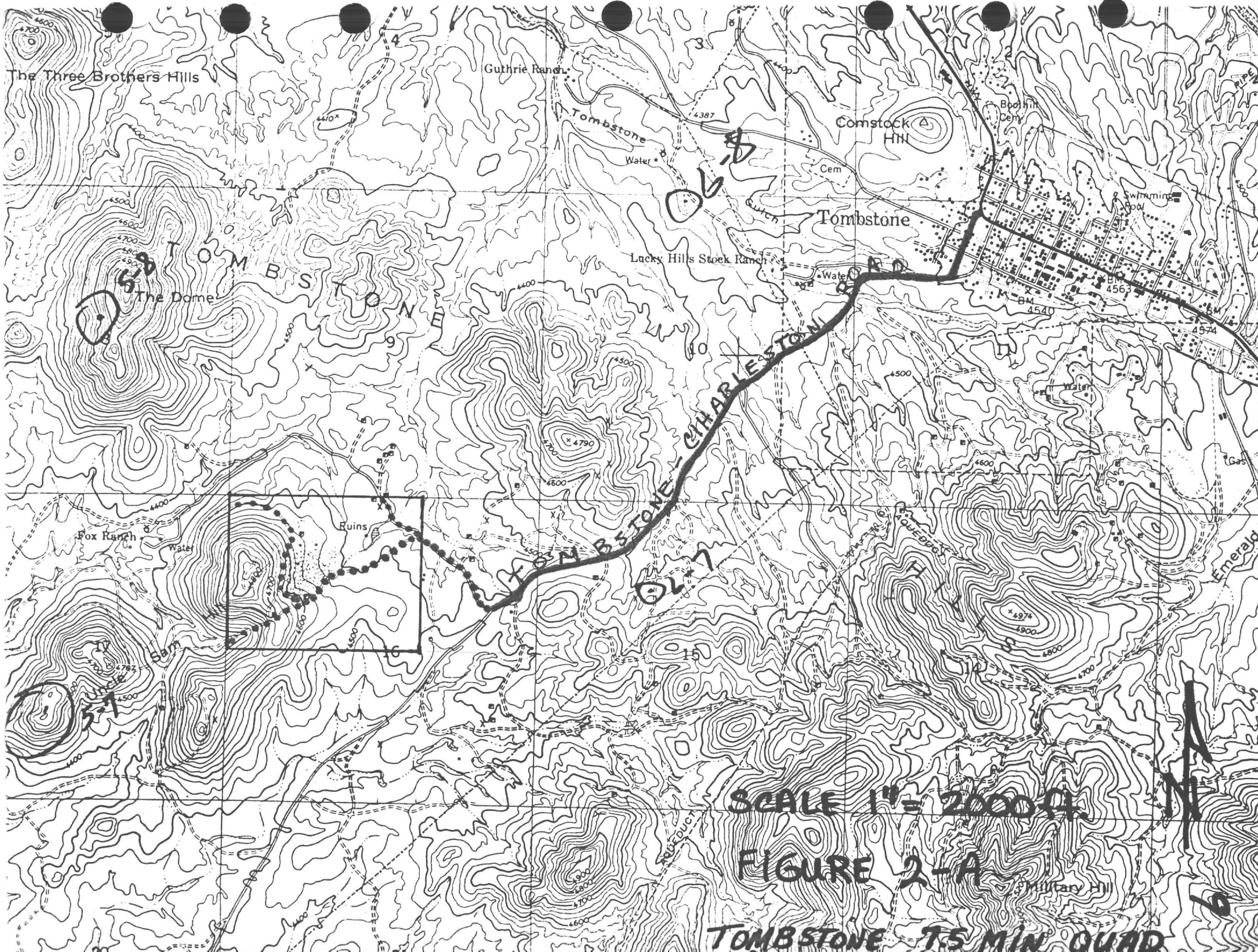


Figure 2. Highway map showing the location of the Project Area in relation to Tucson and Phoenix, Arizona



SCALE 1" = 2000 ft.

FIGURE 2-A

TOMBSTONE 7.5 MIN QUAD

Vegetation is an admixture of cat's claw and several cacti genera, Mammillaria and ocotillo being most common. There are also one or more species of Agave and some creosote. Some stunted mesquite trees and their thickets are found in arroyos and gulches crossing the claim area.

PREVIOUS WORK

Geotechnical information abounds with reference on the Tombstone district. One is directed to the bibliography section of this report. It must be pointed out, however, that many, if not most, of the cited works are of little but general geologic use. References used herein, for report preparation, are cited in an initial, separated reference section. Much of the data contained in this report is quoted directly from Tombstone Silver Mines, Inc.'s files and private, unpublished, confidential consultant reports. As such, it is requested that information contained herein be kept in confidence for as long as necessary or possible under State regulations.

REFERENCED INVESTIGATIONS

Although several authors mention details of the claim area, often as the "western area", "western group", "western basin" or "State of Maine Mine", little but historical generalities were gained from their reading. This period, circa 1880 to about 1925, seems to be the period during which most authors visited the "western group", but paid little attention to geological detail there. A ponderance of observations were authored in the "Tombstone Basin" further east, and we can only extrapolate references to general geological features, pertinent in the claim area.

Sarle and Melgren (1928), in unpublished private reports, are the first authors to report specifically on the area. Dr. Sarle relates in some detail, known underground workings on various cropping and blind veins, and charts many stopes as to their richness. Although promotional in nature, the report is very scientific in scope, valuable in a geotechnical sense, and verified by "old times" and our current exploration activities.

Butler, Wilson and Rasor (1938) further added to our knowledge of the claim area, in their Bulletin on the geology and mineralology on the Tombstone district. Invaluable underground illustrations, as studied and mapped by Ransome in earlier years, were also incorporated. Mineralization of the district was shown to be associated with north-south dike fissures, faults, anticlines, saddle reefs, and northeast-southwest fissures. Rasor's cited contribution was to recognize that hessite, tetrahedrite and galena were the hypogene silver bearing minerals. He believed these minerals, through oxidation, to have led to the supergene enriched silver ore minerals of bromyerite, embolite, cerargyrite, argentite (acanthite), stromyerite, native silver and argentojarosite found and mined in the oxide zone.

A hiatus of information for the area exists until the mid 1950's, when Gilluly (1956) published his studies on the Uncle Sam "porphyry". His studies of the Uncle Sam, combined with earlier published stratigraphic information, provide us with an exhaustive description of the geology of central Cochise County.

During the latter half of the 1960's and early 1970's, renewed copper and silver exploration activities lead to a flurry of activity and private reports related thereto. Of special interest within the scope of this report are Andreasen's (1965) aeromagnetic survey and map of Tombstone and vicinity; Austral Oil's (1968) cross-section and drilling results; Carouso's (1968) I.P. work over the area showing several moderately responsive zones; Lacy's (1968) report and detailed underground maps of the State of Maine and Uncle Sam mines; and King's (1973) logs and assays of deep porphyry copper exploration drilling. King's assay results indicated uneconomic deep copper mineralization was encountered. More importantly, through drilling logs, he conclusively demonstrated the relative shallow nature of the Uncle Sam porphyry underlain by the Mesozoic/Paleozoic sedimentary section seen outcroping in the central Tombstone district, all cut by several episodes of phases of intrusions of differing composition.

Briscoe (1973) mapped, in great detail, the area surrounding the State of Maine mine, and beyond a doubt, recognized the complex nature of mineralization found there and on surrounding State lands, now under claim (this report). An excellent outcrop, structural, and vein map was compiled to illustrate his field work. Numerous surface assays were taken, including some on State lands under claim and covered by this report. Briscoe recognized two important facts in relation to the general geology and mineralization. Namely:

1. The Uncle Sam porphyry was not an intrusive body but instead a quartz latite tuff.

2. Surface oxidation led to a marked increase in silver solubility and subsequent removal of silver halide mineralization in near surface rocks, deeper into the vein zone. This supergene enrichment phenomena has been recognized, documented and reported earlier for silver. Briscoe, however, showed conclusive evidence of accelerated leaching in waste dumps of + 7 feet in height and five ounce average ore, undergoing rapid depletion by leaching in a 70 year period. Resultant values were deposited in lower levels of the dumps and

the upper two feet of the soil horizon (supergene enrichment).

Around this same time, Roger A. Newell (1974) was completing a Stanford PhD. dissertation covering the Tombstone area. Interestingly, he recognized, as Briscoe did (1973), the tuffaceous nature of the Uncle Sam porphyry, and verified this with follow up petrographic work. Newell's contribution to the geology of the Tombstone district were several fold. His maps are still the most detailed, district-wide to date (Figure 3). Secondly, he presented geochemical data from regional sampling of mine dumps within the district which verified that mineralization there is correlative to a possible series of porphyry copper mineralization centers (Figures 6 through 15). This fact was demonstrated previous to the completion of the dissertation by drilling (reference King, 1973), but only afterwards was data supplied to corroborate Newell's hypothesis. Newell further formulated and presented a chronological summary of the evolution of the rock units, structure and ore deposits, on a whole, for the district.

Several other maps, unpublished private reports and memos have been authored since then. These have some bearing on the claims under discussion, in that geochemical data was presented, showing surface mineralization being present. Results will be presented accordingly later.

Briscoe and others (1982) and Briscoe (1985), with extensive use of illustrations, presented an excellent compilation of scientific and factual data accumulated to date for the Tombstone district. These reports forward arguments in favor of a hypothesized Laramide-aged caldera complex being present within the western district. The claims of this report lie astride the proposed eastern margin of this caldera complex. Further, in the 1985 report, evidence of a unique, arid climate method of oxidation-reduction reactions is presented to show hypothetically a means of removing silver mineralization in upper vein zones and then re-depositing these metal values at a lower vein zone elevation in or near the footwall as a type of supergene silver halide enrichment zone.

The following sections, consisting of 96 pages on the History, Geology, etc., and all illustrations, are included verbatim from Briscoe's (1985) unpublished report. It is noted that many references throughout the Briscoe report are related to the current land holdings of Tombstone Silver Mines, Inc., consisting primarily of patented claims. This fact, however, should have no bearing whatsoever as it will be clearly shown later that mineralization continues extralaterally down dip off the patented claims and generally throughout, across, and cross-cutting the State claims, under discussion. The important fact to remember is that although descriptions in the following sections by Briscoe are pertaining to mineralized, patented, claim veins, the environment is homogenous for the area, no matter the land ownership (veins have no ownership boundaries). This is the big picture, so to speak. Later specifics related to each claim will be covered.

Explanation

Geology

QTgu — OLDER OR UNDIFFERENTIATED SURFICAL DEPOSITS (HOLOCENE TO OLIGOCENE):—Gravel, sand, and silt (Pleistocene and Pliocene—Mainly alluvium of basins; includes some colluvium and landslide deposits. Generally light-pinkish gray, weakly indurated, and with poorly rounded clasts; locally well indurated. Thickness several meters to hundreds of meters.

QTb — Basalt (Pleistocene to Pliocene)—Lava flows, pyroclastic rocks, and some intercalated gravel. Thickness several meters to a few hundred meters in most places. Radiometrically dated at 0.25, 1.0, and 3.2 m.y. old

Tva — Extensive andesite and dacite (Miocene and Upper Oligocene)—Lava flows, pyroclastic rocks, some intercalated epiclastic rocks, and dikes. Mostly gray, fine-grained, porphyritic rocks; includes some very coarse feldspar porphyry andesite (Turkey track porphyry, an informal term of Cooper, 1961). Thickness mostly several meters to several tens of meters. Dated at 24, 25, 27, 33, and 39 m.y.

Tv — Extrusive rhyolite and rhyodacite (Miocene and Upper Oligocene—Lava flows, welded tuff, pyroclastic rocks, and some intercalated epiclastic rocks. Light-gray to grayish-pink, vitric to fine-grained, porphyritic. Commonly a few tens to a few thousand of meters thick. Dated at 23, 24, 25, 26, 26, 26, and 27 m.y. An additional date of 47 m.y., if substantiated, may indicate the presence of Eocene rocks in the lower member of the S O Volcanics of Cochise Co.

Tlc — Lower conglomerate, gravel, and sand (Oligocene and Eocene?)—Alluvium; commonly grayish-red deposits of small, well rounded, nonvolcanic clasts. Mostly several meters to a few tens of meters thick.

Tlv — UPPER CORDILLERAN (LARAMIDE) IGNEOUS ROCKS (LOWER PALEOCENE):—Lower volcanic rocks—Rhyolite to andesite lava flows, pyroclastic rocks, and some intercalated epiclastic rocks. Dated at 57 m.y. Possibly younger age to east.

TKp — MAIN CORDILLERAN (LARAMIDE) IGNEOUS ROCKS:—Porphyritic and aplitic intrusive rocks (Paleocene and Upper Cretaceous)—Mostly latitic porphyry to dacitic porphyry in small stocks and plugs and aplitic bodies not associated with other granitoid stocks. Dated at 61, 63, 63, 64, and 65 m.y.

Kib — Fluidized intrusive breccia—exact age unknown, but penetrates, and thus younger than Uncle Sam porphyry.

Kr — Rhyodacite tuff and welded tuff.—Includes parts of Salero Formation, Sugarloaf Quartz Latite, and Bronco Volcanics, and all of Red Bay Rhyolite, Cat Mountain Rhyolite of Brown (1939) and Uncle Sam Prophyry. Includes local intrusive bodies and locally contains fragments of exotic rocks. Thickness commonly several tens of meters to several hundreds of meters. Dated at 66(?), 70, 72, 73, and 73 m.y. The Uncle Sam, in the Tombstone area, is dated 72 m.y.

Ka — Andesitic to dacitic volcanic breccia.—Includes parts of Solero Formation, Sugarloaf Quartz Latite, and Bronco Volcanics, and all of Demetrie Volcanics and Silverbell Formation of Courtright (1958). Commonly contains large blocks of exotic rocks and locally includes some sedimentary rocks and intrusive rocks. Several tens of meters to several hundreds of meters thick in most places.

Klq — Lower quartz monzonite and graodiorite—Includes some quartz diorite; appears in small stocks. Locally associated with mineralization. Dated at 70, 71, 72, 73, 74, 74, 74, and 76 m.y. The Schiefflin granodorite at Tombstone is 72 m.y.

Kb — BISBEE FORMATION OR GROUP, UNDIFFERENTIATED (LOWER CRETACEOUS):—Upper part of Bisbee Formation or Group, undifferentiated, and related rocks.—Includes upper part of Bisbee Formation, Mural Limestone, Morita, Cintura, Willow Canyon, Apache Canyon, Shellenberger Canyon and Turney Ranch Formations (not listed in stratigraphic sequence) of the Bisbee Group, Amole Arkose of Bryant and Kinnison (1954), and Angelic Arkose. Consists of brownish- to reddish-arkose, gray siltstone, sandstone, conglomerate, and some fossiliferous gray limestone. Commonly several hundred meters thick

Jg — GRANITE AND QUARTZ MONZONITE (JURASSIC)—Stocks of pinkish-gray coarse-grained rock. Locally associated with mineralization. Dated at 140, 148, 149, 149, 150, 153, 160, 161, 167, 178, 185 m.y.

PIPs — Sedimentary rocks (Lower Permian and Upper Pennsylvanian)—consists of Epitaph Dolomite (Lower Permian), Colina Limestone (Lower Permian), and Earp Formation (Lower Permian and Upper Pennsylvanian), undifferentiated. Epitaph Dolomite is a dark- to light-gray slightly cherty dolomite, limestone, marl, siltstone, and gypsum, 120-280 meters thick. Colina Limestone is a medium gray, thick-bedded, sparsely cherty, and sparsely fossiliferous limestone 120-280 meters thick. Earp Formation is a pale-red siltstone, mudstone, shale, and limestone, 120-240 meters thick.

IPh — Horquilla Limestone (Upper and Middle Pennsylvanian)—Light-pinkish-gray, thick- to thin-bedded, cherty, fossiliferous limestone and intercalated pale-brown to pale-reddish-gray siltstone that increases in abundance upward. Typically 300-490 meters thick.

MDs — SEDIMENTARY ROCKS (MISSISSIPPIAN AND DEVONIAN)—Consists mainly of Escabrosa Limestone (Mississippian)—locally (Armstrong and Silberman, 1974) called Escabrosa Group—and Martin Formation (Upper Devonian), undifferentiated. In part of the Chiricahua Mountains also includes Paradise Formation (Upper Mississippian) and Portal Formation of Sabins, 1957a (Upper Devonian). In the Little Dragoon Mountains and some adjacent hills also includes Black Prince Limestone, whose fauna and correlation show strongest affinities with Mississippian rocks but which may include some Pennsylvanian rocks. Escabrosa Limestone is a medium-gray, massive to thick-bedded, commonly crinoidal, cherty, fossiliferous limestone 90-310 meters thick. Martin Formation is thick- to thin-bedded, gray to brown dolomite, gray sparsely fossiliferous, and some siltstone and sandstone, 90-120 meters thick. Paradise Formation is a brown, fossiliferous, shaly limestone. Portal Formation is a black shale and limestone 6-105 meters thick. Black Prince Limestone is pinkish-gray limestone with a basal shale and chert conglomerate, as much as 52 meters thick.

O€s — SEDIMENTARY ROCKS (LOWER ORDOVICIAN TO MIDDLE CAMBRIAN):—El Paso Limestone (Lower Ordovician and Upper Cambrian), Abrigo Formation (Upper and Middle Cambrian), and Bolsa Quartz (Middle Cambrian), undifferentiated.—El Paso Limestone is a gray, thin-bedded cherty limestone and dolomite 90 meters to about 220 meters thick. Abrigo Formation is a brown, thin-bedded fossiliferous limestone, sandstone, quartzite, and shale, 210-240 meters thick. Bolsa Quartzite is a brown to white or purplish-gray, thick-bedded, coarse-grained quartzite and sandstone with a basal conglomerate, 90-180 meters thick. To the east, equivalents of part of the Abrigo Formation and Bolsa Quartzite are known as the Coronado Sandstone.

€s — Sedimentary rocks (Upper and Middle Cambrian)—Abrigo Formation (Upper and Middle Cambrian), and Bolsa Quartzite (Middle Cambrian), undifferentiated.

Yg — GRANITOID ROCKS (PRECAMBRIAN Y):—Mainly granodiorite and quartz monsonite, unfoliated to foliated, in part metamorphosed. Generally in stocks, which ahve been little studied.

Xp — PINAL SCHIST (PRECAMBRIAN X)—Chlorite schist, phyllite, and some metavolcanic rocks, metavolcanic rocks, metaquartzite, metaquartzite conglomerate, and gneiss. One metavolcanic rock dated at 1715 m.y.

CONTACT—Dotted where concealed.

MARKER HORIZON—Dotted where concealed.

DIKES—Showing dip.

70 — FAULTS—Showing dip. Dotted where concealed or intruded; ball and bar on downthrown side.

45 — Normal

45 — Reverse

Strike-slip—Arrow couple shows relative displacement. Single arrow shows movement of active block.

Major thrust fault—Sawteeth on upper plate.

Thrust fault—Sawteeth on upper plate.

Anticline.

Syncline.

30 — Inclined strike and dip of beds.

EXOTIC-BLOCK BRECCIA—Rock contains chip or block inclusions of rock different from those of host or other blocks nearby. Typically of volcanic-tectonic or sedimentary-tectonic origin; excludes Tertiary megabreccia deposits.

(QTgu) 157 — Site of well or generalized site of several wells, showing unit penetrated, if known, and depth of well, in feet. 100 feet equals 30.5 meters.

72x — COLLECTION SITE—Radiogenically dated rock showing age in millions of years. Query before symbol where precise location uncertain.

Roads and Highways

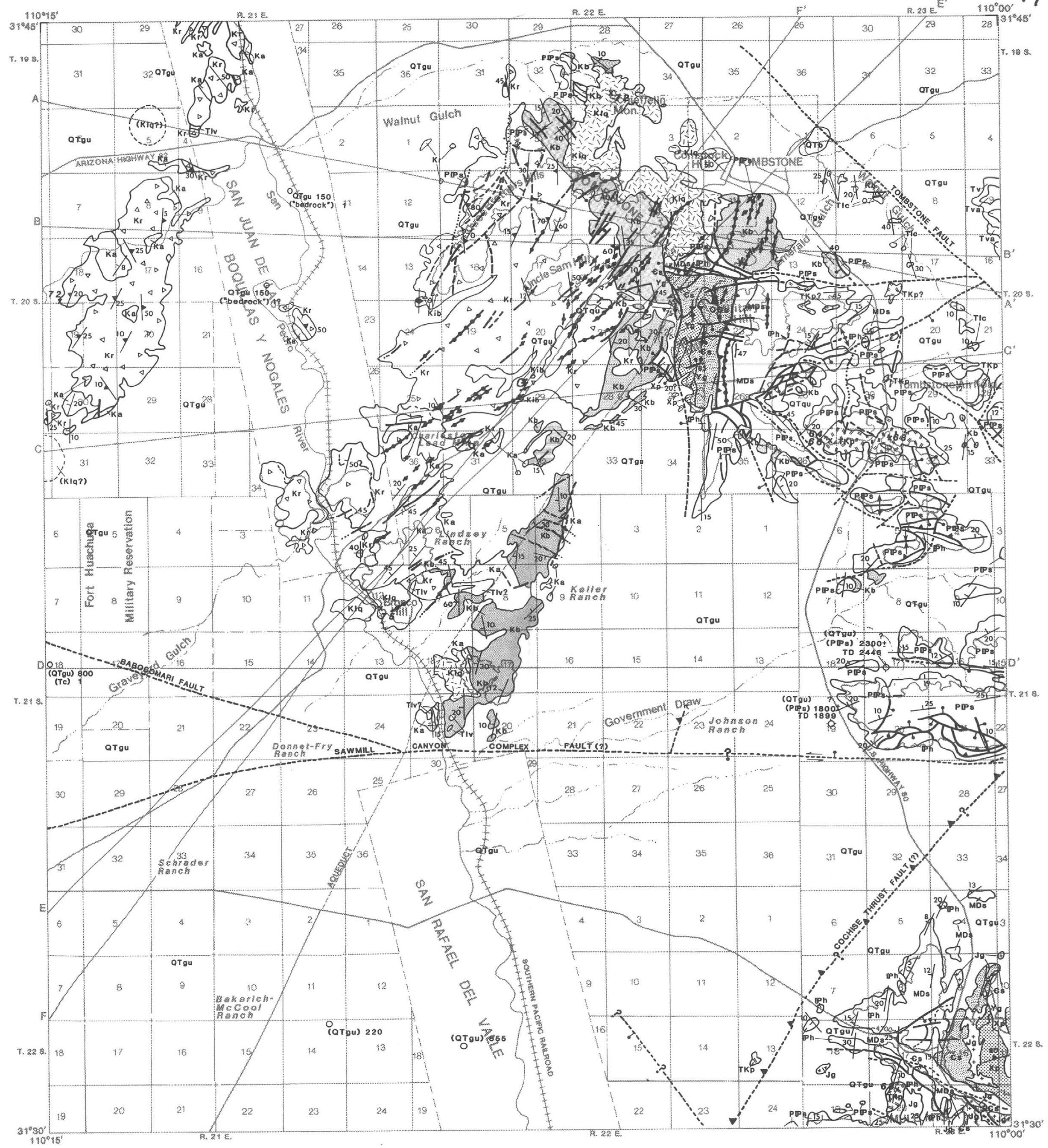
Dry wash

Southern Pacific Railroad

Government Reservation Boundary

Aqueduct

A——A' Cross section line



Tombstone Development Company, Inc.
Tombstone, Arizona

1 0 1 2 3 Miles

N

Geology adopted from Drewes, Harold, 1980, and Newell, R.A., 1973.

Figure 3. Generalized geological and structural map on screened topographic base.

By James A. Briscoe
James A. Briscoe and Associates
Tucson, Arizona

Explanation

Geology

QTgu — OLDER OR UNDIFFERENTIATED SURFICAL DEPOSITS (HOLOCENE TO OLIGOCENE):—Gravel, sand, and silt (Pleistocene and Pliocene—Mainly alluvium of basins; includes some colluvium and landslide deposits. Generally light-pinkish gray, weakly indurated, and with poorly rounded clasts; locally well indurated. Thickness several meters to hundreds of meters.

QTb — Basalt (Pleistocene to Pliocene)—Lava flows, pyroclastic rocks, and some intercalated gravel. Thickness several meters to a few hundred meters in most places. Radiometrically dated at 0.25, 1.0, and 3.2 m.y. old

Tva — Extensive andesite and dacite (Miocene and Upper Oligocene)—Lava flows, pyroclastic rocks, some intercalated epiclastic rocks, and dikes. Mostly gray, fine-grained, porphyritic rocks; includes some very coarse feldspar porphyry andesite (Turkey track porphyry, an informal term of Cooper, 1961). Thickness mostly several meters to several tens of meters. Dated at 24, 25, 27, 33, and 39 m.y.

Tv — Extrusive rhyolite and rhyodacite (Miocene and Upper Oligocene—Lava flows, welded tuff, pyroclastic rocks, and some intercalated epiclastic rocks. Light-gray to grayish-pink, vitric to fine-grained, porphyritic. Commonly a few tens to a few thousand of meters thick. Dated at 23, 24, 25, 26, 26, 26, and 27 m.y. An additional date of 47 m.y., if substantiated, may indicate the presence of Eocene rocks in the lower member of the S O Volcanics of Cochise Co.

Tlc — Lower conglomerate, gravel, and sand (Oligocene and Eocene?)—Alluvium; commonly grayish-red deposits of small, well rounded, nonvolcanic clasts. Mostly several meters to a few tens of meters thick.

Tlv — UPPER CORDILLERAN (LARAMIDE) IGNEOUS ROCKS (LOWER PALEOCENE):—Lower volcanic rocks—Rhyolite to andesite lava flows, pyroclastic rocks, and some intercalated epiclastic rocks. Dated at 57 m.y. Possibly younger age to east.

TKp — MAIN CORDILLERAN (LARAMIDE) IGNEOUS ROCKS:—Porphyritic and aplitic intrusive rocks (Paleocene and Upper Cretaceous)—Mostly latitic porphyry to dacitic porphyry in small stocks and plugs and aplitic bodies not associated with other granitoid stocks. Dated at 61, 63, 63, 64, and 65 m.y.

Kib — Fluidized intrusive breccia – exact age unknown, but penetrates, and thus younger than Uncle Sam porphyry.

Kr — Rhyodacite tuff and welded tuff. –Includes parts of Salero Formation, Sugarloaf Quartz Latite, and Bronco Volcanics, and all of Red Bay Rhyolite, Cat Mountain Rhyolite of Brown (1939) and Uncle Sam Prophyry. Includes local intrusive bodies and locally contains fragments of exotic rocks. Thickness commonly several tens of meters to several hundreds of meters. Dated at 66(?), 70, 72, 73, and 73 m.y. The Uncle Sam, in the Tombstone area, is dated 72 m.y.

Ka — Andesitic to dacitic volcanic breccia.—Includes parts of Solero Formation, Sugarloaf Quartz Latite, and Bronco Volcanics, and all of Demetrie Volcanics and Silverbell Formation of Courtright (1958). Commonly contains large blocks of exotic rocks and locally includes some sedimentary rocks and intrusive rocks. Several tens of meters to several hundreds of meters thick in most places.

Klg — Lower quartz monzonite and graodiorite—Includes some quartz diorite; appears in small stocks. Locally associated with mineralization. Dated at 70, 71, 72, 73, 74, 74, 74, and 76 m.y. The Schiefflin granodorite at Tombstone is 72 m.y.

Kb — BISBEE FORMATION OR GROUP, UNDIFFERENTIATED (LOWER CRETACEOUS):—Upper part of Bisbee Formation or Group, undifferentiated, and related rocks.—Includes upper part of Bisbee Formation, Mural Limestone, Morita, Cintura, Willow Canyon, Apache Canyon, Shellenberger Canyon and Turney Ranch Formations (not listed in stratigraphic sequence) of the Bisbee Group, Amole Arkose of Bryant and Kinnison (1954), and Angelic Arkose. Consists of brownish- to reddish-arkose, gray siltstone, sandstone, conglomerate, and some fossiliferous gray limestone. Commonly several hundred meters thick

Jg — GRANITE AND QUARTZ MONZONITE (JURASSIC)—Stocks of pinkish-gray coarse-grained rock. Locally associated with mineralization. Dated at 140, 148, 149, 149, 150, 153, 160, 161, 167, 178, 185 m.y.

PIPs — Sedimentary rocks (Lower Permian and Upper Pennsylvanian)—consists of Epitaph Dolomite (Lower Permian), Colina Limestone (Lower Permian), and Earp Formation (Lower Permian and Upper Pennsylvanian), undifferentiated. Epitaph Dolomite is a dark- to light-gray slightly cherty dolomite, limestone, marl, siltstone, and gypsum, 120-280 meters thick. Colina Limestone is a medium gray, thick-bedded, sparsely cherty, and sparsely fossiliferous limestone 120-280 meters thick. Earp Formation is a pale-red siltstone, mudstone, shale, and limestone, 120-240 meters thick.

IPh — Horquilla Limestone (Upper and Middle Pennsylvanian)—Light-pinkish-gray, thick- to thin-bedded, cherty, fossiliferous limestone and intercalated pale-brown to pale-reddish-gray siltstone that increases in abundance upward. Typically 300-490 meters thick.

MDs — SEDIMENTARY ROCKS (MISSISSIPPIAN AND DEVONIAN)—Consists mainly of Escabrosa Limestone (Mississippian)—locally (Armstrong and Silberman, 1974) called Escabrosa Group—and Martin Formation (Upper Devonian), undifferentiated. In part of the Chiricahua Mountains also includes Paradise Formation (Upper Mississippian) and Portal Formation of Sabins, 1957a (Upper Devonian). In the Little Dragoon Mountains and some adjacent hills also includes Black Prince Limestone, whose fauna and correlation show strongest affinities with Mississippian rocks but which may include some Pennsylvanian rocks. Escabrosa Limestone is a medium-gray, massive to thick-bedded, commonly crinoidal, cherty, fossiliferous limestone 90-310 meters thick. Martin Formation is thick- to thin-bedded, gray to brown dolomite, gray sparsely fossiliferous, and some siltstone and sandstone, 90-120 meters thick. Paradise Formation is a brown, fossiliferous, shaly limestone. Portal Formation is a black shale and limestone 6-105 meters thick. Black Prince Limestone is pinkish-gray limestone with a basal shale and chert conglomerate, as much as 52 meters thick.

OЄs — SEDIMENTARY ROCKS (LOWER ORDOVICIAN TO MIDDLE CAMBRIAN):—El Paso Limestone (Lower Ordovician and Upper Cambrian), Abrigo Formation (Upper and Middle Cambrian), and Bolsa Quartz (Middle Cambrian), undifferentiated.—El Paso Limestone is a gray, thin-bedded cherty limestone and dolomite 90 meters to about 220 meters thick. Abrigo Formation is a brown, thin-bedded fossiliferous limestone, sandstone, quartzite, and shale, 210-240 meters thick. Bolsa Quartzite is a brown to white or purplish-gray, thick-bedded, coarse-grained quartzite and sandstone with a basal conglomerate, 90-180 meters thick. To the east, equivalents of part of the Abrigo Formation and Bolsa Quartzite are known as the Coronado Sandstone.

Єs — Sedimentary rocks (Upper and Middle Cambrian)—Abrigo Formation (Upper and Middle Cambrian), and Bolsa Quartzite (Middle Cambrian), undifferentiated.

Yg — GRANITOID ROCKS (PRECAMBRIAN Y)—Mainly granodiorite and quartz monzonite, unfoliated to foliated, in part metamorphosed. Generally in stocks, which ahve been little studied.

Xp — PINAL SCHIST (PRECAMBRIAN X)—Chlorite schist, phyllite, and some metavolcanic rocks, metavolcanic rocks, metaquartzite, metaquartzite conglomerate, and gneiss. One metavolcanic rock dated at 1715 m.y.

CONTACT—Dotted where concealed.

MARKER HORIZON—Dotted where concealed.

DIKES—Showing dip.

FAULTS—Showing dip. Dotted where concealed or intruded; ball and bar on downthrown side.

70 — Normal

45 — Reverse

Strike-slip—Arrow couple shows relative displacement. Single arrow shows movement of active block.

Major thrust fault—Sawteeth on upper plate.

Thrust fault—Sawteeth on upper plate.

Anticline.

Syncline.

30 — Inclined strike and dip of beds.

EXOTIC BLOCK BRECCIA—Rock contains chip or block inclusions of rock different from those of host or other blocks nearby. Typically of volcanic-tectonic or sedimentary-tectonic origin; excludes Tertiary megabreccia deposits.

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72x — COLLECTION SITE—Radiogenically dated rock showing age in millions of years. Query before symbol where precise location uncertain.

Roads and Highways

Dry wash

Southern Pacific Railroad

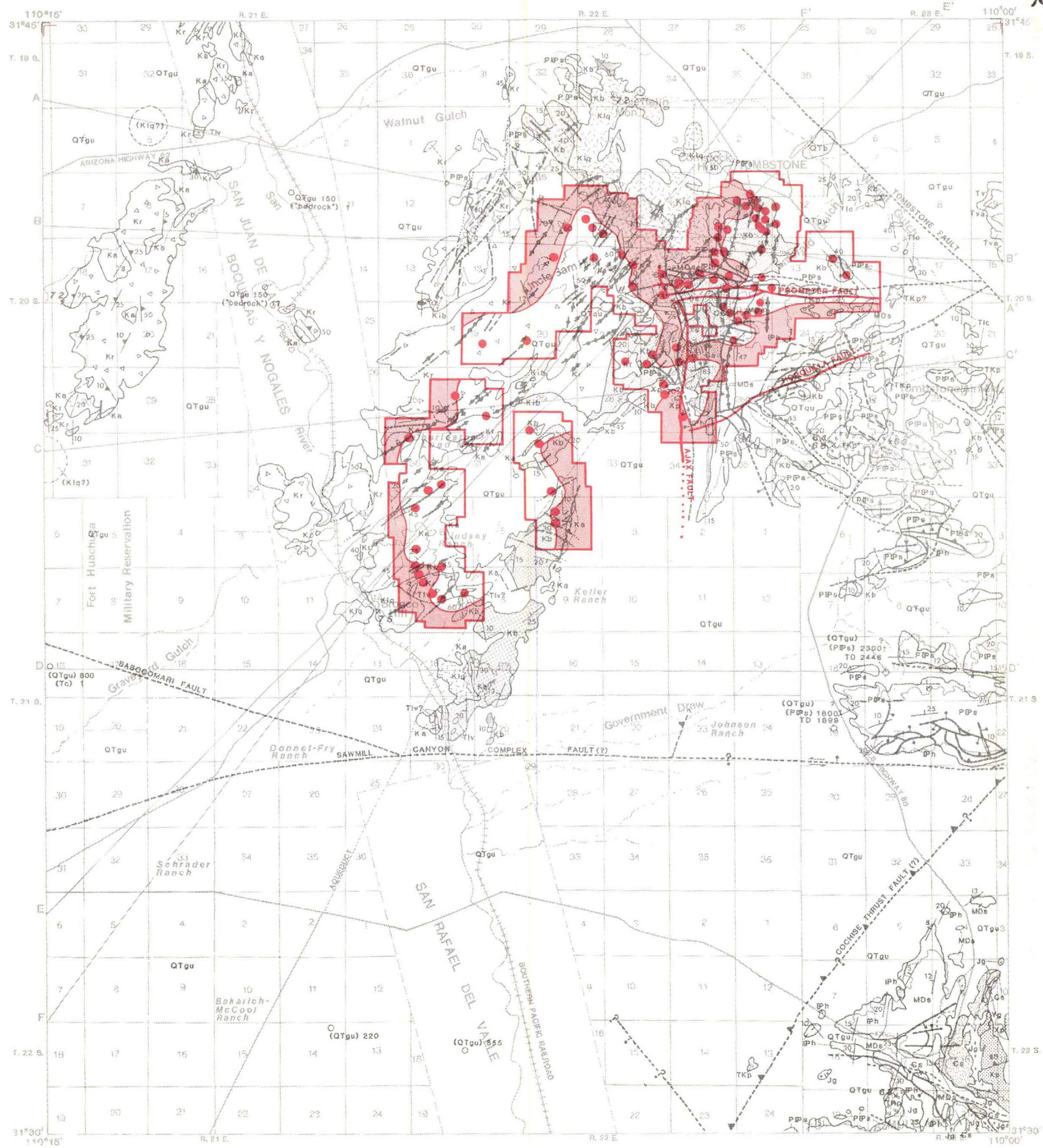
Government Reservation Boundary

Aqueduct

A—A' Cross section line

Dump sample location

Silver



Tombstone Development Company, Inc.
Tombstone, Arizona

Geology adopted from Drewes, Harold, 1980, and Newell, R.A., 1973.

By James A. Briscoe
James A. Briscoe and Associates
Tucson, Arizona

Figure 6. Dump sample location map showing area of influence boundaries and the Ajax, Prompter, and Horquilla faults, from Newell, R.A., 1973.

Distribution pattern for high silver ratios in dump samples (in red).

1 0 1 2 3 Miles

N

Explanation

Geology

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Reverse

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Roads and Highways

Dry wash

Southern Pacific Railroad

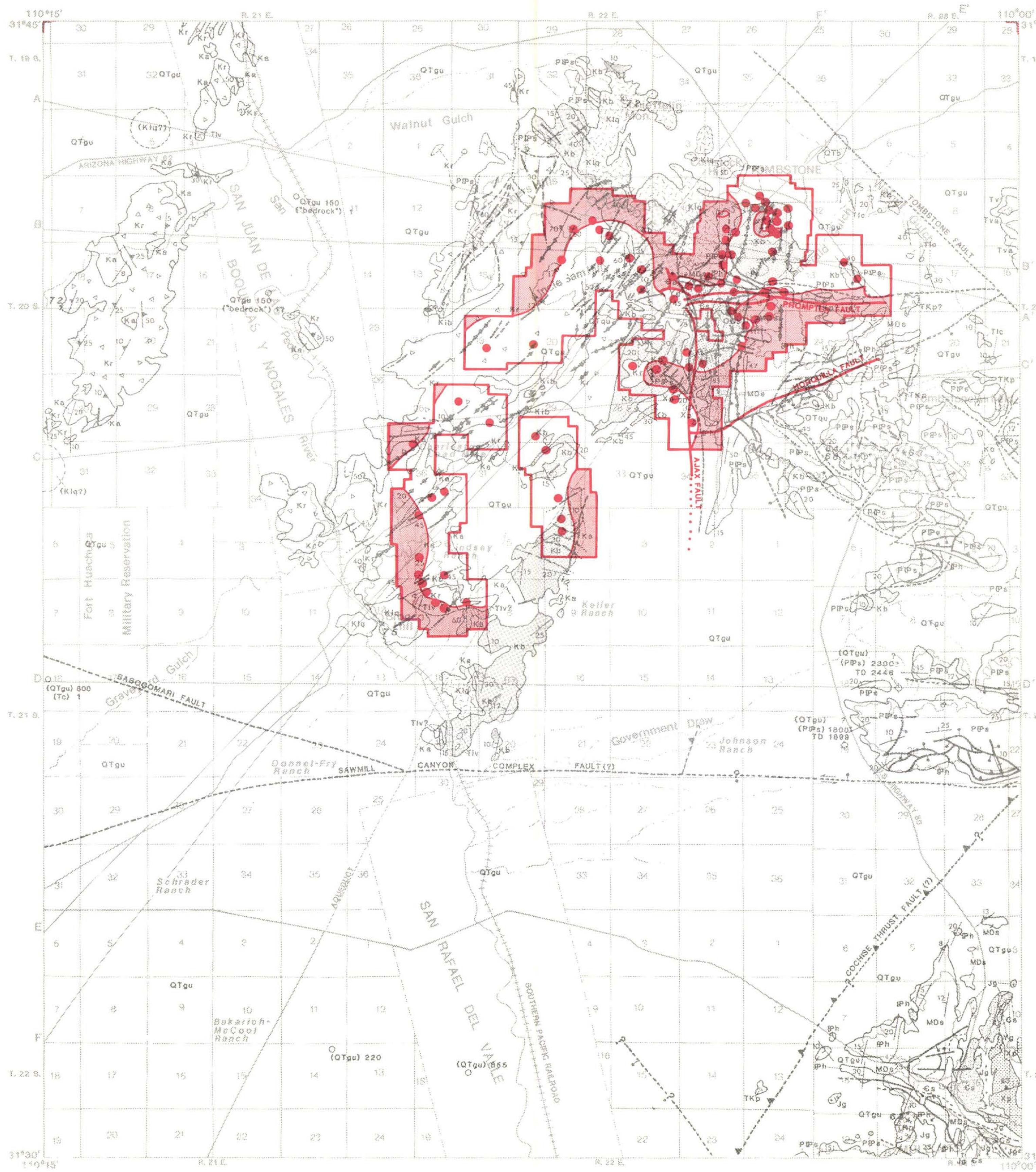
Government Reservation Boundary

Aqueduct

A—A' Cross section line

Dump sample location

Zinc



Tombstone Development Company, Inc.
Tombstone, Arizona

Geology adopted from Drewes, Harold, 1980, and Newell, R.A., 1973.

By James A. Briscoe
James A. Briscoe and Associates
Tucson, Arizona

Figure 7. Dump sample location map showing area of influence boundaries and the Ajax, Prompter, and Horquilla faults, from Newell, R.A., 1973.

Distribution pattern for high zinc ratio in dump samples (in red).

Explanation

Geology

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Roads and Highways

Dry wash

Southern Pacific Railroad

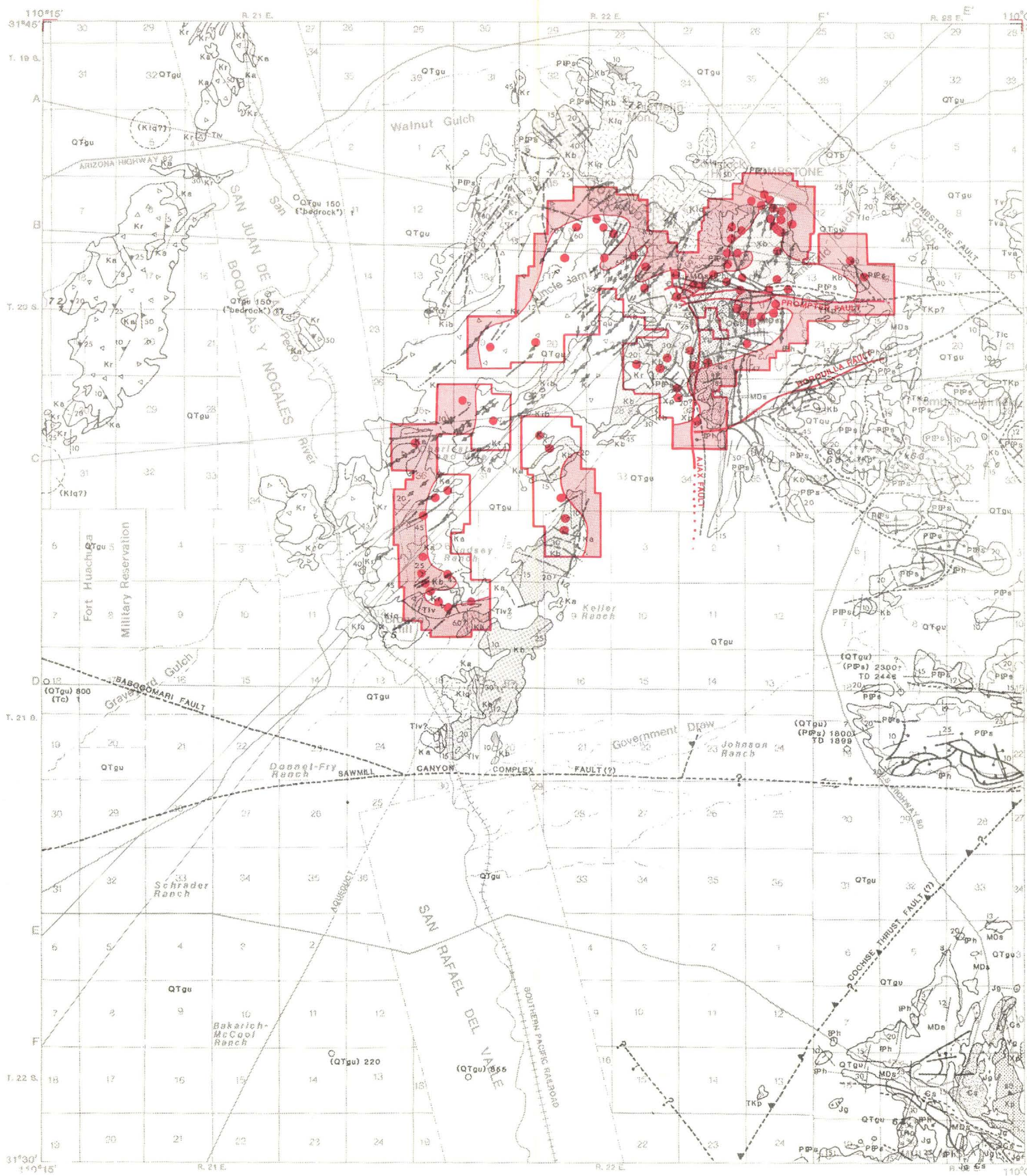
Government Reservation Boundary

Aqueduct

A——A' Cross section line

Dump sample location

Lead



Tombstone Development Company, Inc.
Tombstone, Arizona

1 0 1 2 3 Miles

N

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Figure 8. Dump sample location map showing area of influence boundaries and the Ajax, Prompter, and Horquilla faults, from Newell, R.A., 1973.

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Geology

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QTb — Basalt (Pleistocene to Pliocene)—Lava flows, pyroclastic rocks, and some intercalated gravel. Thickness several meters to a few hundred meters in most places. Radiometrically dated at 0.25, 1.0, and 3.2 m.y. old

Tva — Extensive andesite and dacite (Miocene and Upper Oligocene)—Lava flows, pyroclastic rocks, some intercalated epiclastic rocks, and dikes. Mostly gray, fine-grained, porphyritic rocks; includes some very coarse feldspar porphyry andesite (Turkey track porphyry, an informal term of Cooper, 1961). Thickness mostly several meters to several tens of meters. Dated at 24, 25, 27, 33, and 39 m.y.

Tv — Extrusive rhyolite and rhyodacite (Miocene and Upper Oligocene—Lava flows, welded tuff, pyroclastic rocks, and some intercalated epiclastic rocks. Light-gray to grayish-pink, vitric to fine-grained, porphyritic. Commonly a few tens to a few thousand of meters thick. Dated at 23, 24, 25, 26, 26, 26, and 27 m.y. An additional date of 47 m.y., if substantiated, may indicate the presence of Eocene rocks in the lower member of the S O Volcanics of Cochise Co.

Tlc — Lower conglomerate, gravel, and sand (Oligocene and Eocene?)—Alluvium; commonly grayish-red deposits of small, well rounded, nonvolcanic clasts. Mostly several meters to a few tens of meters thick.

Tlv — UPPER CORDILLERAN (LARAMIDE) IGNEOUS ROCKS (LOWER PALEOCENE)—Lower volcanic rocks—Rhyolite to andesite lava flows, pyroclastic rocks, and some intercalated epiclastic rocks. Dated at 57 m.y. Possibly younger age to east.

TKp — MAIN CORDILLERAN (LARAMIDE) IGNEOUS ROCKS:—Porphyritic and aplitic intrusive rocks (Paleocene and Upper Cretaceous)—Mostly latitic porphyry to dacitic porphyry in small stocks and plugs and aplitic bodies not associated with other granitoid stocks. Dated at 61, 63, 63, 64, and 65 m.y.

Kib — Fluidized intrusive breccia—exact age unknown, but penetrates, and thus younger than Uncle Sam porphyry.

Kr — Rhyodacite tuff and welded tuff.—Includes parts of Salero Formation, Sugarloaf Quartz Latite, and Bronco Volcanics, and all of Red Bay Rhyolite, Cat Mountain Rhyolite of Brown (1939) and Uncle Sam Prophyry. Includes local intrusive bodies and locally contains fragments of exotic rocks. Thickness commonly several tens of meters to several hundreds of meters thick. Dated at 66(?), 70, 72, 73, and 73 m.y. The Uncle Sam, in the Tombstone area, is dated 72 m.y.

Ka — Andesitic to dacitic volcanic breccia.—Includes parts of Salero Formation, Sugarloaf Quartz Latite, and Bronco Volcanics, and all of Demetrie Volcanics and Silverbell Formation of Courtright (1958). Commonly contains large blocks of exotic rocks and locally includes some sedimentary rocks and intrusive rocks. Several tens of meters to several hundreds of meters thick in most places.

Klq — Lower quartz monzonite and granodiorite—Includes some quartz diorite; appears in small stocks. Locally associated with mineralization. Dated at 70, 71, 72, 73, 74, 74, 74, and 76 m.y. The Schieffelin granodiorite at Tombstone is 72 m.y.

Kb — BISBEE FORMATION OR GROUP, UNDIFFERENTIATED (LOWER CRETACEOUS):—Upper part of Bisbee Formation or Group, undifferentiated, and related rocks.—Includes upper part of Bisbee Formation, Mural Limestone, Morita, Cintura, Willow Canyon, Apache Canyon, Shellenberger Canyon and Turney Ranch Formations (not listed in stratigraphic sequence) of the Bisbee Group, Amole Arkose of Bryant and Kinnison (1954), and Angelic Arkose. Consists of brownish- to reddish-arkose, gray siltstone, sandstone, conglomerate, and some fossiliferous gray limestone. Commonly several hundred meters thick

Jg — GRANITE AND QUARTZ MONZONITE (JURASSIC)—Stocks of pinkish-gray coarse-grained rock. Locally associated with mineralization. Dated at 140, 148, 149, 149, 150, 153, 160, 161, 167, 178, 185 m.y.

PIPs — Sedimentary rocks (Lower Permian and Upper Pennsylvanian)—consists of Epitaph Dolomite (Lower Permian), Colina Limestone (Lower Permian), and Earp Formation (Lower Permian and Upper Pennsylvanian), undifferentiated. Epitaph Dolomite is a dark- to light-gray slightly cherty dolomite, limestone, marl, siltstone, and gypsum, 120-280 meters thick. Colina Limestone is a medium gray, thick-bedded, sparsely cherty, and sparsely fossiliferous limestone 120-280 meters thick. Earp Formation is a pale-red siltstone, mudstone, shale, and limestone, 120-240 meters thick.

IPh — Horquilla Limestone (Upper and Middle Pennsylvanian)—Light-pinkish-gray, thick- to thin-bedded, cherty, fossiliferous limestone and intercalated pale-brown to pale-reddish-gray siltstone that increases in abundance upward. Typically 300-490 meters thick.

MDs — SEDIMENTARY ROCKS (MISSISSIPPIAN AND DEVONIAN)—Consists mainly of Escabrosa Limestone (Mississippian)—locally (Armstrong and Silberman, 1974) called Escabrosa Group—and Martin Formation (Upper Devonian), undifferentiated. In part of the Chiricahua Mountains also includes Paradise Formation (Upper Mississippian) and Portal Formation of Sabins, 1957a (Upper Devonian). In the Little Dragoon Mountains and some adjacent hills also includes Black Prince Limestone, whose fauna and correlation show strongest affinities with Mississippian rocks but which may include some Pennsylvanian rocks. Escabrosa Limestone is a medium-gray, massive to thick-bedded, commonly crinoidal, cherty, fossiliferous limestone 90-310 meters thick. Martin Formation is thick- to thin-bedded, gray to brown dolomite, gray sparsely fossiliferous, and some siltstone and sandstone, 90-120 meters thick. Paradise Formation is a brown, fossiliferous, shaly limestone. Portal Formation is a black shale and limestone 6-105 meters thick. Black Prince Limestone is pinkish-gray limestone with a basal shale and chert conglomerate, as much as 52 meters thick.

OCs — SEDIMENTARY ROCKS (LOWER ORDOVICIAN TO MIDDLE CAMBRIAN):—El Paso Limestone (Lower Ordovician and Upper Cambrian), Abrigo Formation (Upper and Middle Cambrian), and Bolsa Quartz (Middle Cambrian), undifferentiated.—El Paso Limestone is a gray, thin-bedded cherty limestone and dolomite 90 meters to about 220 meters thick. Abrigo Formation is a brown, thin-bedded fossiliferous limestone, sandstone, quartzite, and shale, 210-240 meters thick. Bolsa Quartzite is a brown to white or purplish-gray, thick-bedded, coarse-grained quartzite and sandstone with a basal conglomerate, 90-180 meters thick. To the east, equivalents of part of the Abrigo Formation and Bolsa Quartzite are known as the Coronado Sandstone.

Cs — Sedimentary rocks (Upper and Middle Cambrian)—Abrigo Formation (Upper and Middle Cambrian), and Bolsa Quartzite (Middle Cambrian), undifferentiated.

Yg — GRANITOID ROCKS (PRECAMBRIAN Y):—Mainly granodiorite and quartz monsonite, unfoliated to foliated, in part metamorphosed. Generally in stocks, which ahve been little studied.

Xp — PINAL SCHIST (PRECAMBRIAN X)—Chlorite schist, phyllite, and some metavolcanic rocks, metavolcanic rocks, metaquartzite, metaquartzite conglomerate, and gneiss. One metavolcanic rock dated at 1715 m.y.

CONTACT—Dotted where concealed.

MARKER HORIZON—Dotted where concealed.

DIKES—Showing dip.

70 — FAULTS—Showing dip. Dotted where concealed or intruded; ball and bar on downthrown side.

45 — Normal

45 — Reverse

Strike-slip—Arrow couple shows relative displacement. Single arrow shows movement of active block.

Major thrust fault—Sawteeth on upper plate.

Thrust fault—Sawteeth on upper plate.

Anticline.

Syncline.

30 — Inclined strike and dip of beds.

EXOTIC-BLOCK BRECCIA—Rock contains chip or block inclusions of rock different from those of host or other blocks nearby. Typically of volcanic-tectonic or sedimentary-tectonic origin; excludes Tertiary megabreccia deposits.

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Roads and Highways

Dry wash

Southern Pacific Railroad

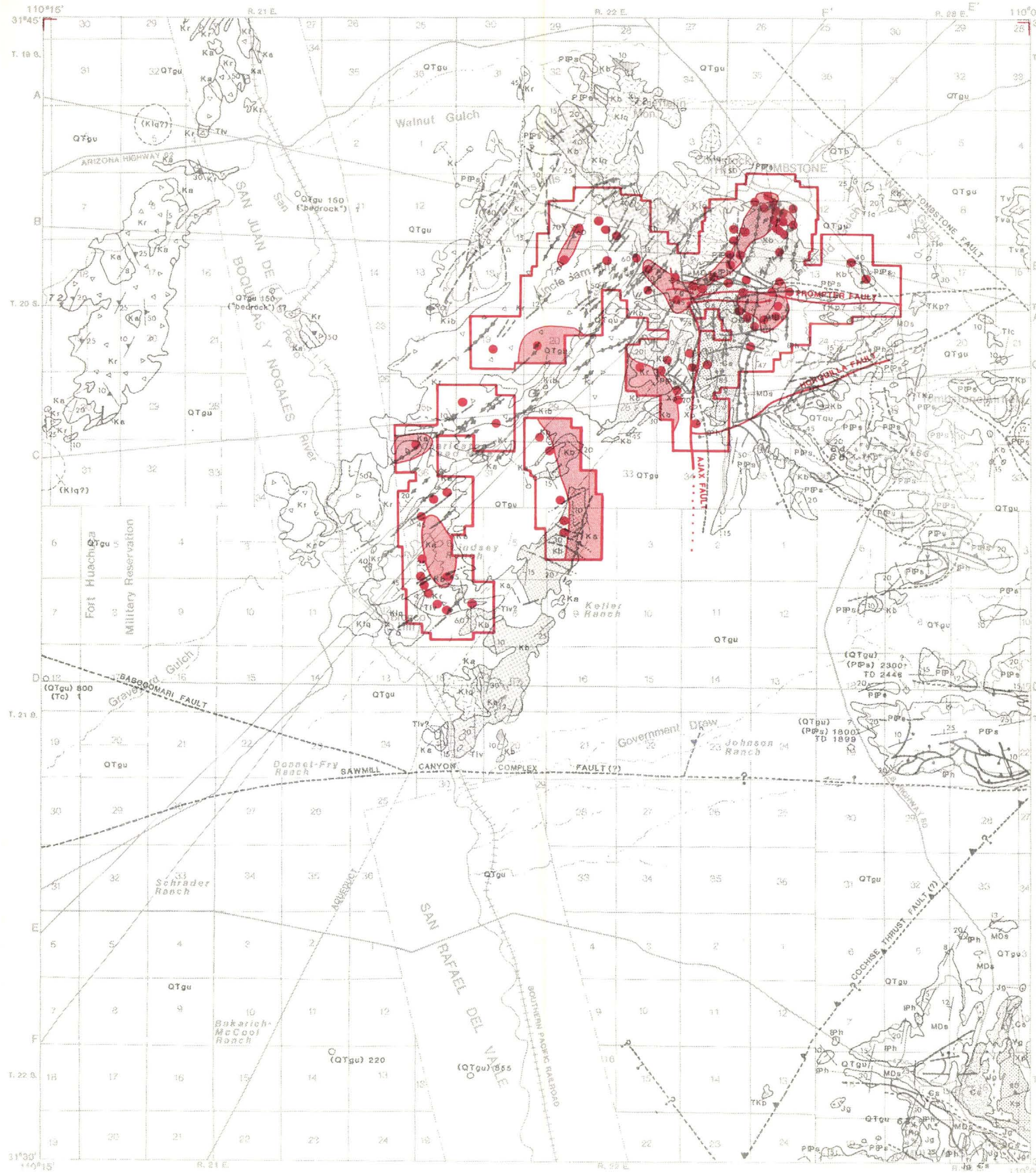
Government Reservation Boundary

Aqueduct

A———A' Cross section line

Dump sample location

Copper



Tombstone Development Company, Inc.
Tombstone, Arizona

1 0 1 2 3 Miles

N

Geology adopted from Drewes, Harold, 1980, and Newell, R.A., 1973.

By James A. Briscoe
James A. Briscoe and Associates
Tucson, Arizona

Figure 9. Dump sample location map showing area of influence boundaries and the Ajax, Prompter, and Horquilla faults, from Newell, R.A., 1973.

Distribution pattern for high copper ratios in dump samples (in red).

Explanation

Geology

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Roads and Highways

Dry wash

Southern Pacific Railroad

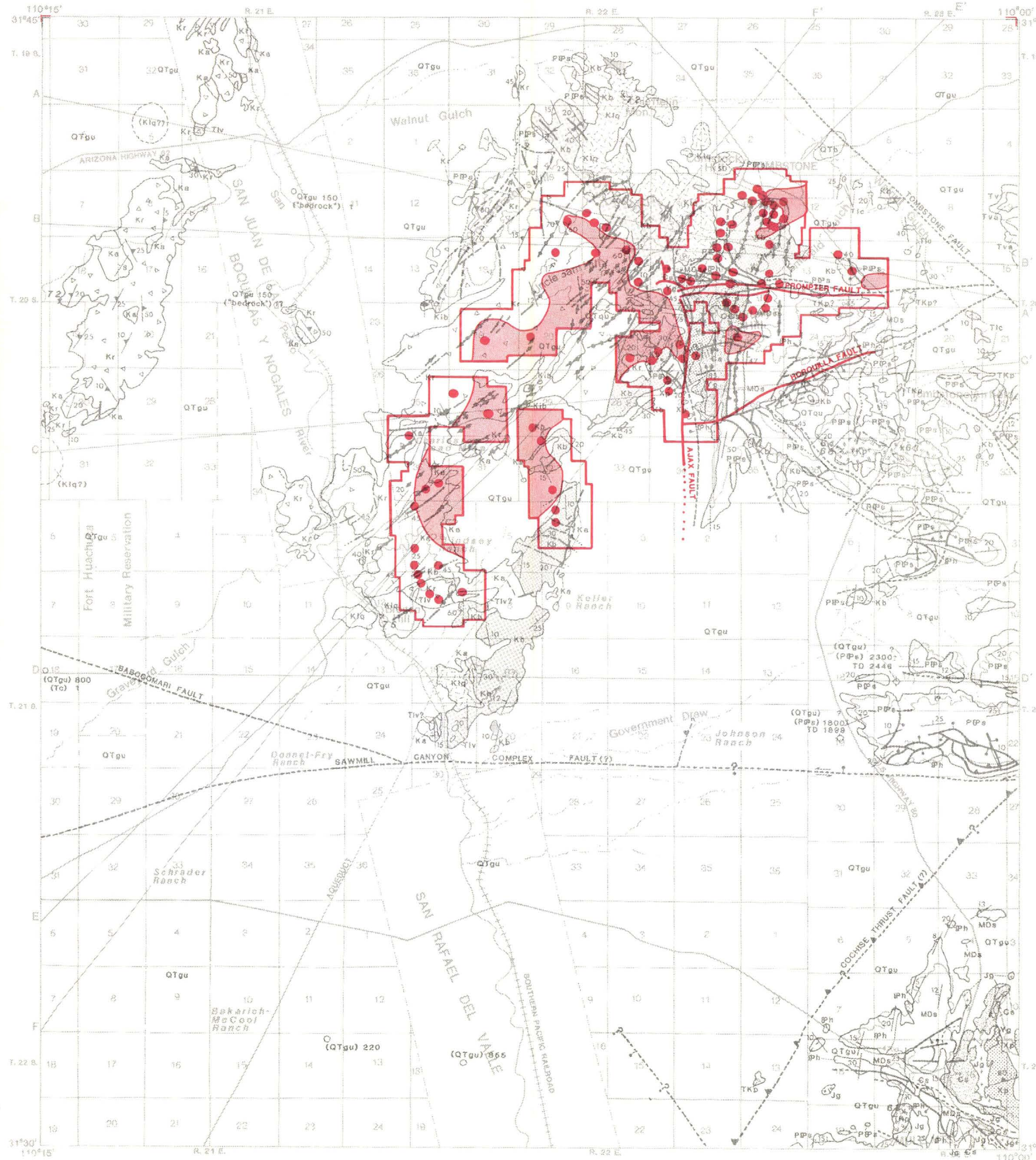
Government Reservation Boundary

Aqueduct

A—A' Cross section line

Dump sample location

Molybdenum



Tombstone Development Company, Inc.
Tombstone, Arizona

Geology adopted from Drewes, Harold, 1980, and Newell, R.A., 1973.

By James A. Briscoe
James A. Briscoe and Associates
Tucson, Arizona

1 0 1 2 3 Miles

Figure 10. Dump sample location map showing area of influence boundaries and the Ajax, Prompter, and Horquilla faults, from Newell, R.A., 1973.

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Explanation

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Roads and Highways

Dry wash

Southern Pacific Railroad

Government Reservation Boundary

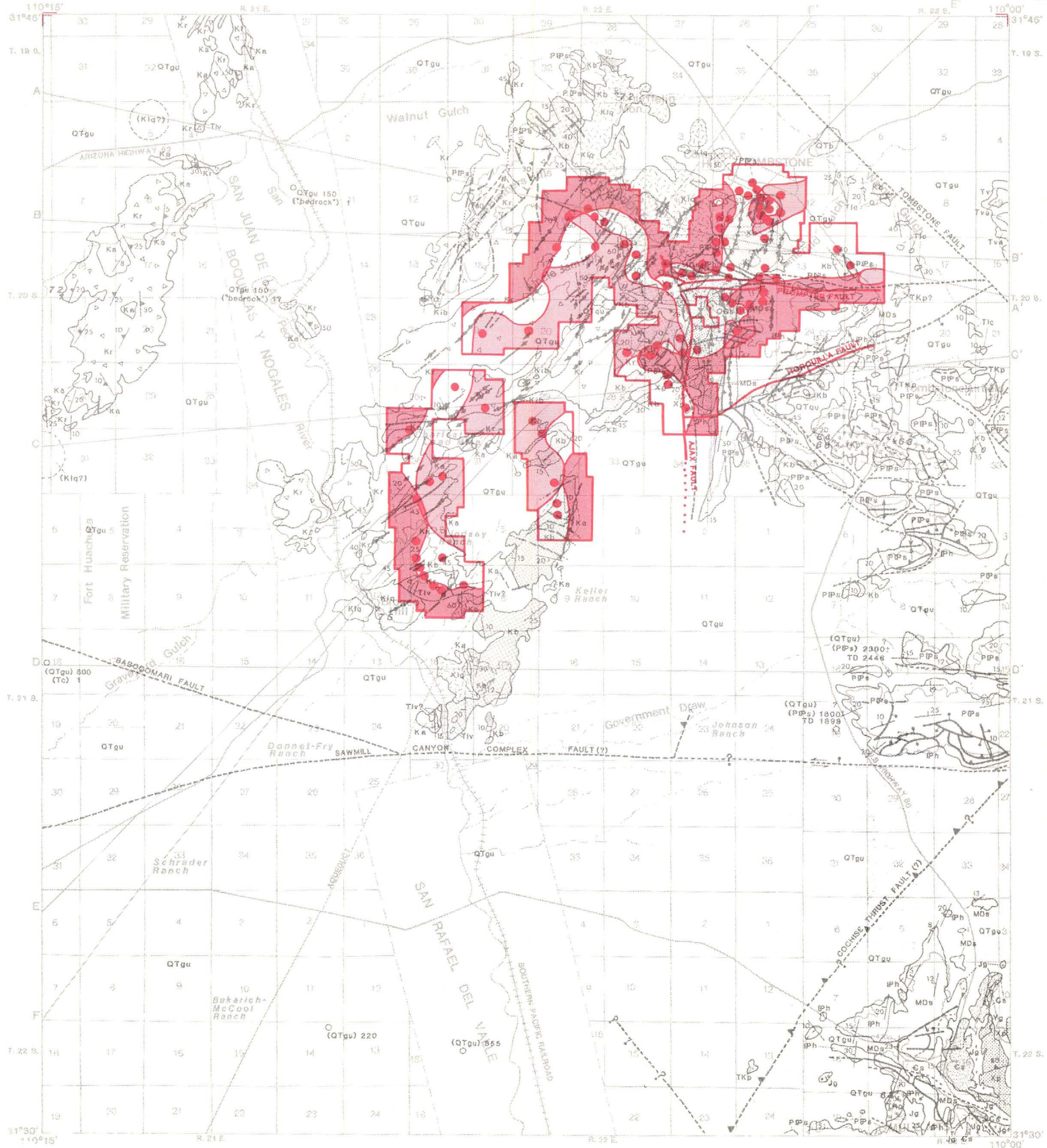
Aqueduct

A———A' Cross section line

Dump sample location

Molybdenum

Zinc



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QTb — Basalt (Pleistocene to Pliocene)—Lava flows, pyroclastic rocks, and some intercalated gravel. Thickness several meters to a few hundred meters in most places. Radiometrically dated at 0.25, 1.0, and 3.2 m.y. old

Tva — Extensive andesite and dacite (Miocene and Upper Oligocene)—Lava flows, pyroclastic rocks, some intercalated epiclastic rocks, and dikes. Mostly gray, fine-grained, porphyritic rocks; includes some very coarse feldspar porphyry andesite (Turkey track porphyry, an informal term of Cooper, 1961). Thickness mostly several meters to several tens of meters. Dated at 24, 25, 27, 33, and 39 m.y.

Tv — Extrusive rhyolite and rhyodacite (Miocene and Upper Oligocene—Lava flows, welded tuff, pyroclastic rocks, and some intercalated epiclastic rocks. Light-gray to grayish-pink, vitric to fine-grained, porphyritic. Commonly a few tens to a few thousand of meters thick. Dated at 23, 24, 25, 26, 26, 26, and 27 m.y. An additional date of 47 m.y., if substantiated, may indicate the presence of Eocene rocks in the lower member of the S O Volcanics of Cochise Co.

Tlc — Lower conglomerate, gravel, and sand (Oligocene and Eocene?)—Alluvium; commonly grayish-red deposits of small, well rounded, nonvolcanic clasts. Mostly several meters to a few tens of meters thick.

Tlv — UPPER CORDILLERAN (LARAMIDE) IGNEOUS ROCKS (LOWER PALEOCENE):—Lower volcanic rocks—Rhyolite to andesite lava flows, pyroclastic rocks, and some intercalated epiclastic rocks. Dated at 57 m.y. Possibly younger age to east.

TKp — MAIN CORDILLERAN (LARAMIDE) IGNEOUS ROCKS:—Porphyritic and aplitic intrusive rocks (Paleocene and Upper Cretaceous)—Mostly latitic porphyry to dacitic porphyry in small stocks and plugs and aplitic bodies not associated with other granitoid stocks. Dated at 61, 63, 63, 64, and 65 m.y.

Kib — Fluidized intrusive breccia – exact age unknown, but penetrates, and thus younger than Uncle Sam porphyry.

Kr — Rhyodacite tuff and welded tuff.—Includes parts of Salero Formation, Sugarloaf Quartz Latite, and Bronco Volcanics, and all of Red Bay Rhyolite, Cat Mountain Rhyolite of Brown (1939) and Uncle Sam Prophyry. Includes local intrusive bodies and locally contains fragments of exotic rocks. Thickness commonly several tens of meters to several hundreds of meters. Dated at 66(?), 70, 72, 73, and 73 m.y. The Uncle Sam, in the Tombstone area, is dated 72 m.y.

Ka — Andesitic to dacitic volcanic breccia.—Includes parts of Solero Formation, Sugarloaf Quartz Latite, and Bronco Volcanics, and all of Demetrie Volcanics and Silverbell Formation of Courtright (1958). Commonly contains large blocks of exotic rocks and locally includes some sedimentary rocks and intrusive rocks. Several tens of meters to several hundreds of meters thick in most places.

Klg — Lower quartz monzonite and graodiorite—Includes some quartz diorite; appears in small stocks. Locally associated with mineralization. Dated at 70, 71, 72, 73, 74, 74, 74, and 76 m.y. The Schiefflin granodorite at Tombstone is 72 m.y.

Kb — BISBEE FORMATION OR GROUP, UNDIFFERENTIATED (LOWER CRETACEOUS):—Upper part of Bisbee Formation or Group, undifferentiated, and related rocks.—Includes upper part of Bisbee Formation, Mural Limestone, Morita, Cintura, Willow Canyon, Apache Canyon, Shellenberger Canyon and Turney Ranch Formations (not listed in stratigraphic sequence) of the Bisbee Group, Amole Arkose of Bryant and Kinnison (1954), and Angelic Arkose. Consists of brownish- to reddish-arkose, gray siltstone, sandstone, conglomerate, and some fossiliferous gray limestone. Commonly several hundred meters thick

Jg — GRANITE AND QUARTZ MONZONITE (JURASSIC)—Stocks of pinkish-gray coarse-grained rock. Locally associated with mineralization. Dated at 140, 148, 149, 149, 150, 153, 160, 161, 167, 178, 185 m.y.

PIPs — Sedimentary rocks (Lower Permian and Upper Pennsylvanian)—consists of Epitaph Dolomite (Lower Permian), Colina Limestone (Lower Permian), and Earp Formation (Lower Permian and Upper Pennsylvanian), undifferentiated. Epitaph Dolomite is a dark- to light-gray slightly cherty dolomite, limestone, marl, siltstone, and gypsum, 120-280 meters thick. Colina Limestone is a medium gray, thick-bedded, sparsely cherty, and sparsely fossiliferous limestone 120-280 meters thick. Earp Formation is a pale-red siltstone, mudstone, shale, and limestone, 120-240 meters thick.

IPh — Horquilla Limestone (Upper and Middle Pennsylvanian)—Light-pinkish-gray, thick- to thin-bedded, cherty, fossiliferous limestone and intercalated pale-brown to pale-reddish-gray siltstone that increases in abundance upward. Typically 300-490 meters thick.

MDs — SEDIMENTARY ROCKS (MISSISSIPPIAN AND DEVONIAN)—Consists mainly of Escabrosa Limestone (Mississippian)—locally (Armstrong and Silberman, 1974) called Escabrosa Group—and Martin Formation (Upper Devonian), undifferentiated. In part of the Chiricahua Mountains also includes Paradise Formation (Upper Mississippian) and Portal Formation of Sabins, 1957a (Upper Devonian). In the Little Dragoon Mountains and some adjacent hills also includes Black Prince Limestone, whose fauna and correlation show strongest affinities with Mississippian rocks but which may include some Pennsylvanian rocks. Escabrosa Limestone is a medium-gray, massive to thick-bedded, commonly crinoidal, cherty, fossiliferous limestone 90-310 meters thick. Martin Formation is thick- to thin-bedded, gray to brown dolomite, gray sparsely fossiliferous, and some siltstone and sandstone, 90-120 meters thick. Paradise Formation is a brown, fossiliferous, shaly limestone. Portal Formation is a black shale and limestone 6-105 meters thick. Black Prince Limestone is pinkish-gray limestone with a basal shale and chert conglomerate, as much as 52 meters thick.

O€s — SEDIMENTARY ROCKS (LOWER ORDOVICIAN TO MIDDLE CAMBRIAN):—El Paso Limestone (Lower Ordovician and Upper Cambrian), Abrigo Formation (Upper and Middle Cambrian), and Bolsa Quartz (Middle Cambrian), undifferentiated.—El Paso Limestone is a gray, thin-bedded cherty limestone and dolomite 90 meters to about 220 meters thick. Abrigo Formation is a brown, thin-bedded fossiliferous limestone, sandstone, quartzite, and shale, 210-240 meters thick. Bolsa Quartzite is a brown to white or purplish-gray, thick-bedded, coarse-grained quartzite and sandstone with a basal conglomerate, 90-180 meters thick. To the east, equivalents of part of the Abrigo Formation and Bolsa Quartzite are known as the Coronado Sandstone.

€a — Sedimentary rocks (Upper and Middle Cambrian)—Abrigo Formation (Upper and Middle Cambrian), and Bolsa Quartzite (Middle Cambrian), undifferentiated.

Yg — GRANITOID ROCKS (PRECAMBRIAN Y)—Mainly granodiorite and quartz monzonite, unfoliated to foliated, in part metamorphosed. Generally in stocks, which have been little studied.

Xp — PINAL SCHIST (PRECAMBRIAN X)—Chlorite schist, phyllite, and some metavolcanic rocks, metavolcanic rocks, metaquartzite, metaquartzite conglomerate, and gneiss. One metavolcanic rock dated at 1715 m.y.

CONTACT—Dotted where concealed.

MARKER HORIZON—Dotted where concealed.

DIKES—Showing dip.

FAULTS—Showing dip. Dotted where concealed or intruded; ball and bar on downthrown side.

Normal

Reverse

Strike-slip—Arrow couple shows relative displacement. Single arrow shows movement of active block.

Major thrust fault—Sawteeth on upper plate.

Thrust fault—Sawteeth on upper plate.

Anticline.

Syncline.

Inclined strike and dip of beds.

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Roads and Highways

Dry wash

Southern Pacific Railroad

Government Reservation Boundary

Aqueduct

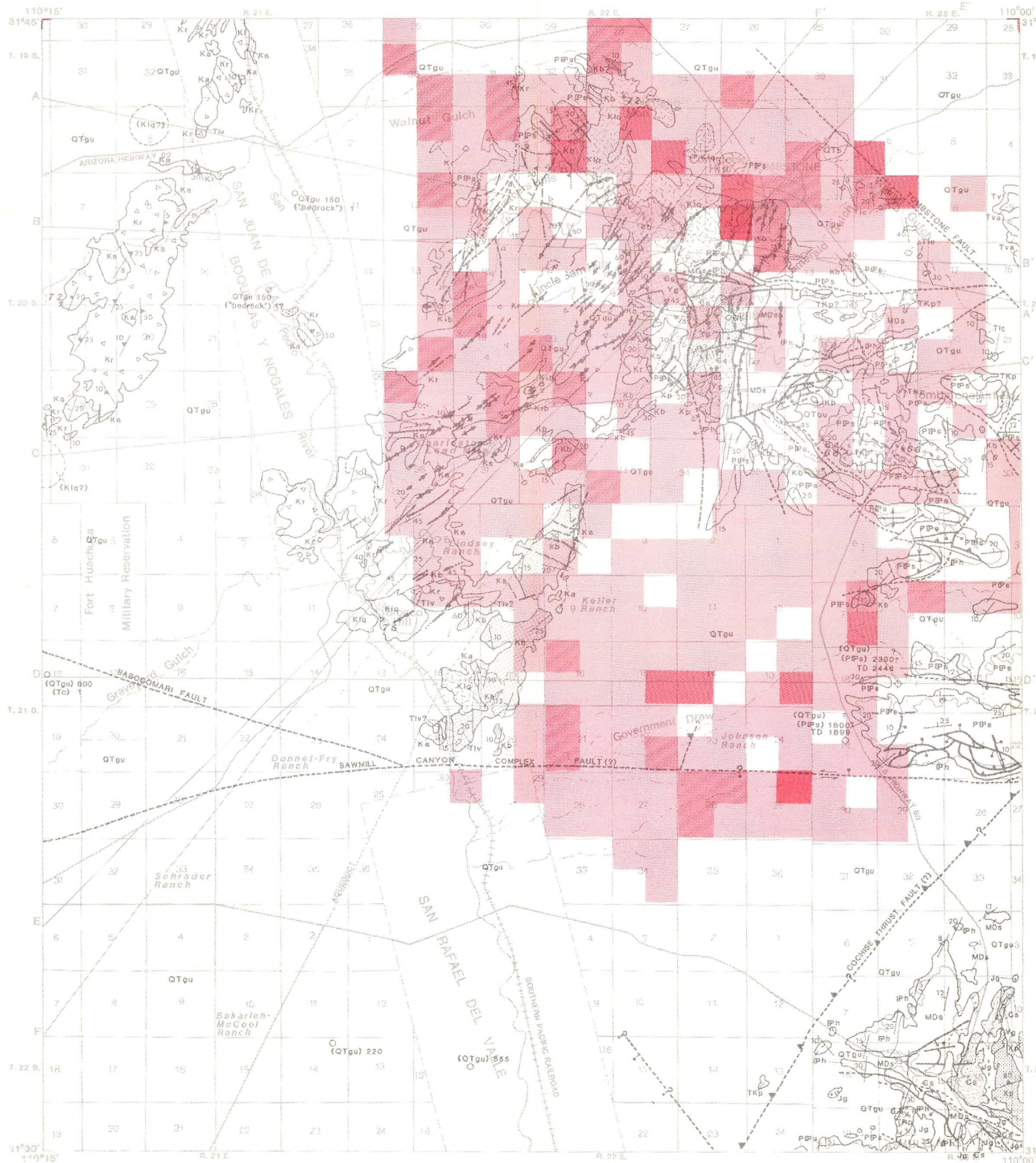
A——A' Cross section line

≤ 1 ppm

1.1 - 2 ppm

2.1 - 3 ppm

≥ 3 ppm



Tombstone Development Company, Inc.
Tombstone, Arizona

Geology adopted from Drewes, Harold, 1980, and Newell, R.A., 1973.

Figure 12. Distribution pattern of silver in mesquite trees (in red), from Newell, R.A., 1973.

1 0 1 2 3 Miles

N

By James A. Briscoe
James A. Briscoe and Associates
Tucson, Arizona

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Roads and Highways

Dry wash

Southern Pacific Railroad

Government Reservation Boundary

Aqueduct

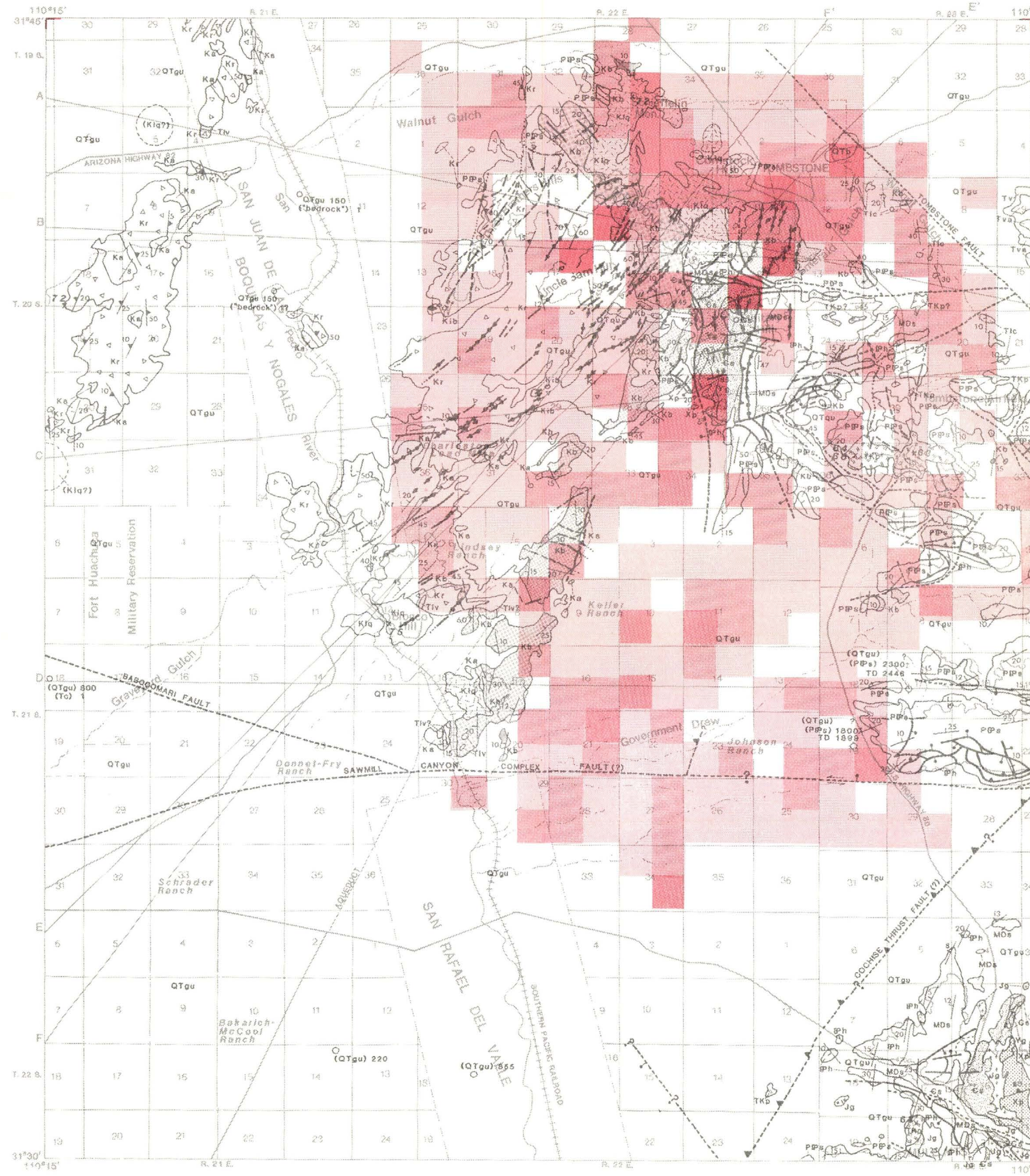
A———A' Cross section line

≤ 400 ppm

401 - 600 ppm

601 - 800 ppm

≥ 800 ppm



Tombstone Development Company, Inc.
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Figure 13. Distribution pattern of zinc in mesquite trees (in red), from Newell, R.A., 1973.

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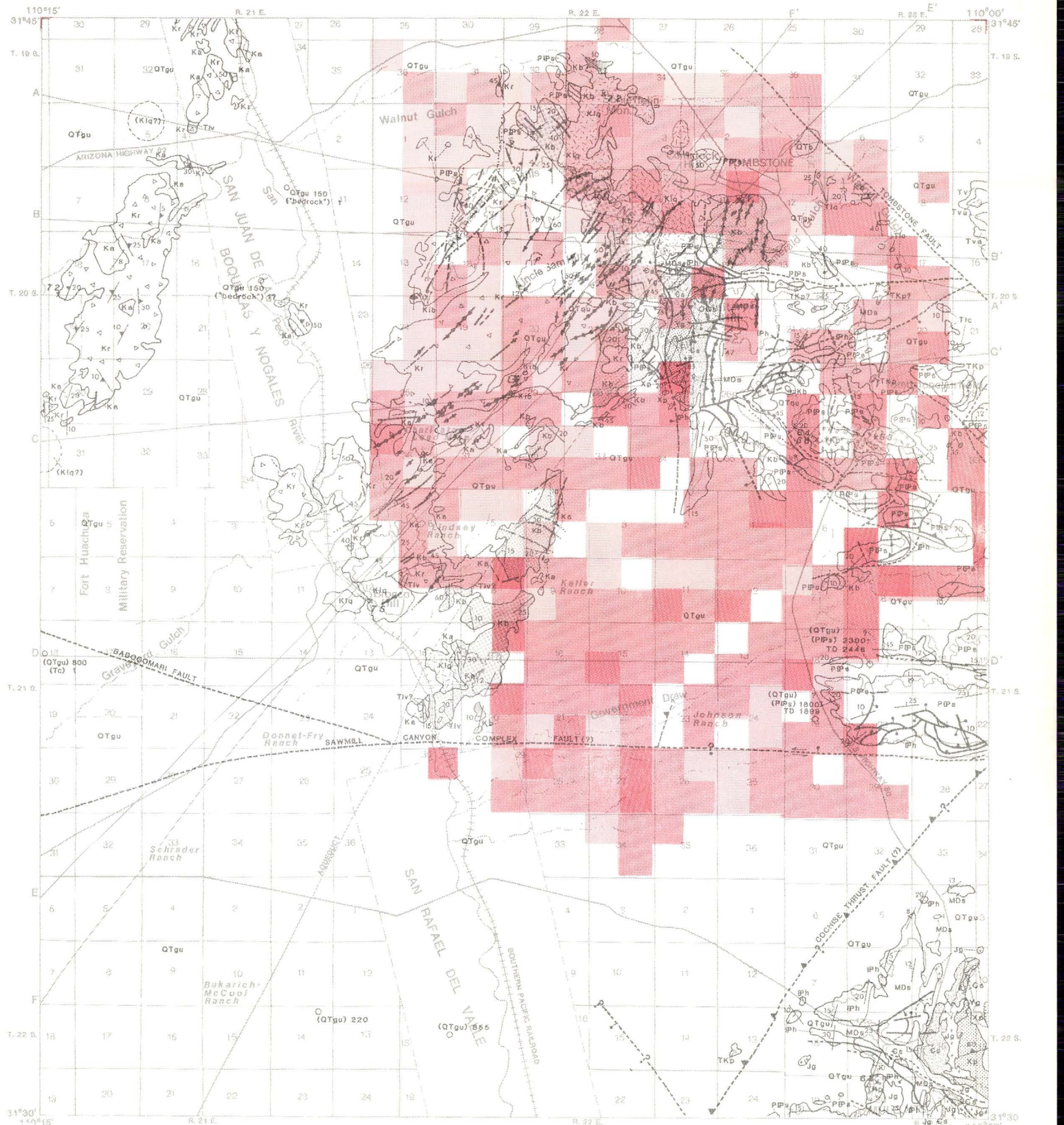

Tombstone Development Company, Inc.
Tombstone, Arizona

3 Miles

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QTb — Basalt (Pleistocene to Pliocene)—Lava flows, pyroclastic rocks, and some intercalated gravel. Thickness several meters to a few hundred meters in most places. Radiometrically dated at 0.25, 1.0, and 3.2 m.y. old

Tva — Extensive andesite and dacite (Miocene and Upper Oligocene)—Lava flows, pyroclastic rocks, some intercalated epiclastic rocks, and dikes. Mostly gray, fine-grained, porphyritic rocks; includes some very coarse feldspar porphyry andesite (Turkey track porphyry, an informal term of Cooper, 1961). Thickness mostly several meters to several tens of meters. Dated at 24, 25, 27, 33, and 39 m.y.

Tv — Extrusive rhyolite and rhyodacite (Miocene and Upper Oligocene)—Lava flows, welded tuff, pyroclastic rocks, and some intercalated epiclastic rocks. Light-gray to grayish-pink, vitric to fine-grained, porphyritic. Commonly a few tens to a few thousand of meters thick. Dated at 23, 24, 25, 26, 26, 26, and 27 m.y. An additional date of 47 m.y., if substantiated, may indicate the presence of Eocene rocks in the lower member of the S O Volcanics of Cochise Co.

Tlc — Lower conglomerate, gravel, and sand (Oligocene and Eocene?)—Alluvium; commonly grayish-red deposits of small, well rounded, nonvolcanic clasts. Mostly several meters to a few tens of meters thick.

Tlv — UPPER CORDILLERAN (LARAMIDE) IGNEOUS ROCKS (LOWER PALEOCENE):—Lower volcanic rocks—Rhyolite to andesite lava flows, pyroclastic rocks, and some intercalated epiclastic rocks. Dated at 57 m.y. Possibly younger age to east.

TKg — MAIN CORDILLERAN (LARAMIDE) IGNEOUS ROCKS:—Porphyritic and aplitic intrusive rocks (Paleocene and Upper Cretaceous)—Mostly latitic porphyry to dacitic porphyry in small stocks and plugs and aplitic bodies not associated with other granitoid stocks. Dated at 61, 63, 63, 64, and 65 m.y.

Kib — Fluidized intrusive breccia – exact age unknown, but penetrates, and thus younger than Uncle Sam porphyry.

Kr — Rhyodacite tuff and welded tuff. –Includes parts of Salero Formation, Sugarloaf Quartz Latite, and Bronco Volcanics, and all of Red Bay Rhyolite, Cat Mountain Rhyolite of Brown (1939) and Uncle Sam Prophyry. Includes local intrusive bodies and locally contains fragments of exotic rocks. Thickness commonly several tens of meters to several hundreds of meters. Dated at 66(?), 70, 72, 73, and 73 m.y. The Uncle Sam, in the Tombstone area, is dated 72 m.y.

Ka — Andesitic to dacitic volcanic breccia.—Includes parts of Solero Formation, Sugarloaf Quartz Latite, and Bronco Volcanics, and all of Demetrie Volcanics and Silverbell Formation of Courtright (1958). Commonly contains large blocks of exotic rocks and locally includes some sedimentary rocks and intrusive rocks. Several tens of meters to several hundreds of meters thick in most places.

Klg — Lower quartz monzonite and graodiorite—Includes some quartz diorite; appears in small stocks. Locally associated with mineralization. Dated at 70, 71, 72, 73, 74, 74, 74, and 76 m.y. The Schiefflin granodorite at Tombstone is 72 m.y.

Kb — BISBEE FORMATION OR GROUP, UNDIFFERENTIATED (LOWER CRETACEOUS):—Upper part of Bisbee Formation or Group, undifferentiated, and related rocks.—Includes upper part of Bisbee Formation, Mural Limestone, Morita, Cintura, Willow Canyon, Apache Canyon, Shellenberger Canyon and Turney Ranch Formations (not listed in stratigraphic sequence) of the Bisbee Group, Amole Arkose of Bryant and Kinnison (1954), and Angelic Arkose. Consists of brownish- to reddish-arkose, gray siltstone, sandstone, conglomerate, and some fossiliferous gray limestone. Commonly several hundred meters thick

Jg — GRANITE AND QUARTZ MONZONITE (JURASSIC)—Stocks of pinkish-gray coarse-grained rock. Locally associated with mineralization. Dated at 140, 148, 149, 149, 150, 153, 160, 161, 167, 178, 185 m.y.

PPs — Sedimentary rocks (Lower Permian and Upper Pennsylvanian)—consists of Epitaph Dolomite (Lower Permian), Colina Limestone (Lower Permian), and Earp Formation (Lower Permian and Upper Pennsylvanian), undifferentiated. Epitaph Dolomite is a dark- to light-gray slightly cherty dolomite, limestone, marl, siltstone, and gypsum, 120-280 meters thick. Colina Limestone is a medium gray, thick-bedded, sparsely cherty, and sparsely fossiliferous limestone 120-280 meters thick. Earp Formation is a pale-red siltstone, mudstone, shale, and limestone, 120-240 meters thick.

IPh — Horquilla Limestone (Upper and Middle Pennsylvanian)—Light-pinkish-gray, thick- to thin-bedded, cherty, fossiliferous limestone and intercalated pale-brown to pale-reddish-gray siltstone that increases in abundance upward. Typically 300-490 meters thick.

MDs — SEDIMENTARY ROCKS (MISSISSIPPIAN AND DEVONIAN)—Consists mainly of Escabrosa Limestone (Mississippian)—locally (Armstrong and Silberman, 1974) called Escabrosa Group—and Martin Formation (Upper Devonian), undifferentiated. In part of the Chiricahua Mountains also includes Paradise Formation (Upper Mississippian) and Portal Formation of Sabins, 1957a (Upper Devonian). In the Little Dragoon Mountains and some adjacent hills also includes Black Prince Limestone, whose fauna and correlation show strongest affinities with Mississippian rocks but which may include some Pennsylvanian rocks. Escabrosa Limestone is a medium-gray, massive to thick-bedded, commonly crinoidal, cherty, fossiliferous limestone 90-310 meters thick. Martin Formation is thick- to thin-bedded, gray to brown dolomite, gray sparsely fossiliferous, and some siltstone and sandstone, 90-120 meters thick. Paradise Formation is a brown, fossiliferous, shaly limestone. Portal Formation is a black shale and limestone 6-105 meters thick. Black Prince Limestone is pinkish-gray limestone with a basal shale and chert conglomerate, as much as 52 meters thick.

OCs — SEDIMENTARY ROCKS (LOWER ORDOVICIAN TO MIDDLE CAMBRIAN):—El Paso Limestone (Lower Ordovician and Upper Cambrian), Abrigo Formation (Upper and Middle Cambrian), and Bolsa Quartz (Middle Cambrian), undifferentiated.—El Paso Limestone is a gray, thin-bedded cherty limestone and dolomite 90 meters to about 220 meters thick. Abrigo Formation is a brown, thin-bedded fossiliferous limestone, sandstone, quartzite, and shale, 210-240 meters thick. Bolsa Quartzite is a brown to white or purplish-gray, thick-bedded, coarse-grained quartzite and sandstone with a basal conglomerate, 90-180 meters thick. To the east, equivalents of part of the Abrigo Formation and Bolsa Quartzite are known as the Coronado Sandstone.

Cs — Sedimentary rocks (Upper and Middle Cambrian)—Abrigo Formation (Upper and Middle Cambrian), and Bolsa Quartzite (Middle Cambrian), undifferentiated.

Yg — GRANITOID ROCKS (PRECAMBRIAN Y):—Mainly granodiorite and quartz monzonite, unfoliated to foliated, in part metamorphosed. Generally in stocks, which ahve been little studied.

Xp — PINAL SCHIST (PRECAMBRIAN X)—Chlorite schist, phyllite, and some metavolcanic rocks, metavolcanic rocks, metaquartzite, metaquartzite conglomerate, and gneiss. One metavolcanic rock dated at 1715 m.y.

CONTACT—Dotted where concealed.

MARKER HORIZON—Dotted where concealed.

DIKES—Showing dip.

FAULTS—Showing dip. Dotted where concealed or intruded; ball and bar on downthrown side.

Normal

Reverse

Strike slip—Arrow couple shows relative displacement. Single arrow shows movement of active block.

Major thrust fault—Sawteeth on upper plate.

Thrust fault—Sawteeth on upper plate.

Anticline.

Syncline.

Inclined strike and dip of beds.

EXOTIC-BLOCK BRECCIA—Rock contains chip or block inclusions of rock different from those of host or other blocks nearby. Typically of volcanic-tectonic or sedimentary-tectonic origin; excludes Tertiary megabreccia deposits.

(QTgu) 157 — Site of well or generalized site of several wells, showing unit penetrated, if known, and depth of well, in feet: 100 feet equals 30.5 meters.

72x — COLLECTION SITE—Radiogenically dated rock showing age in millions of years. Query before symbol where precise location uncertain.

Roads and Highways

Dry wash

Southern Pacific Railroad

Government Reservation Boundary

Aqueduct

A——A' Cross section line

≤ 5 ppm

5.1 - 9 ppm

9.1 - 14 ppm

≥ 14 ppm

Tombstone Development Company, Inc.
Tombstone, Arizona

Geology adopted from Drewes, Harold, 1980, and Newell, R.A., 1973.

By James A. Briscoe
James A. Briscoe and Associates
Tucson, Arizona

Figure 15. Distribution pattern of molybdenum in mesquite trees (in red), from Newell, R.A., 1973.

Explanation

Geology

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Roads and Highways

Dry wash

Southern Pacific Railroad

Government Reservation Boundary

Aqueduct

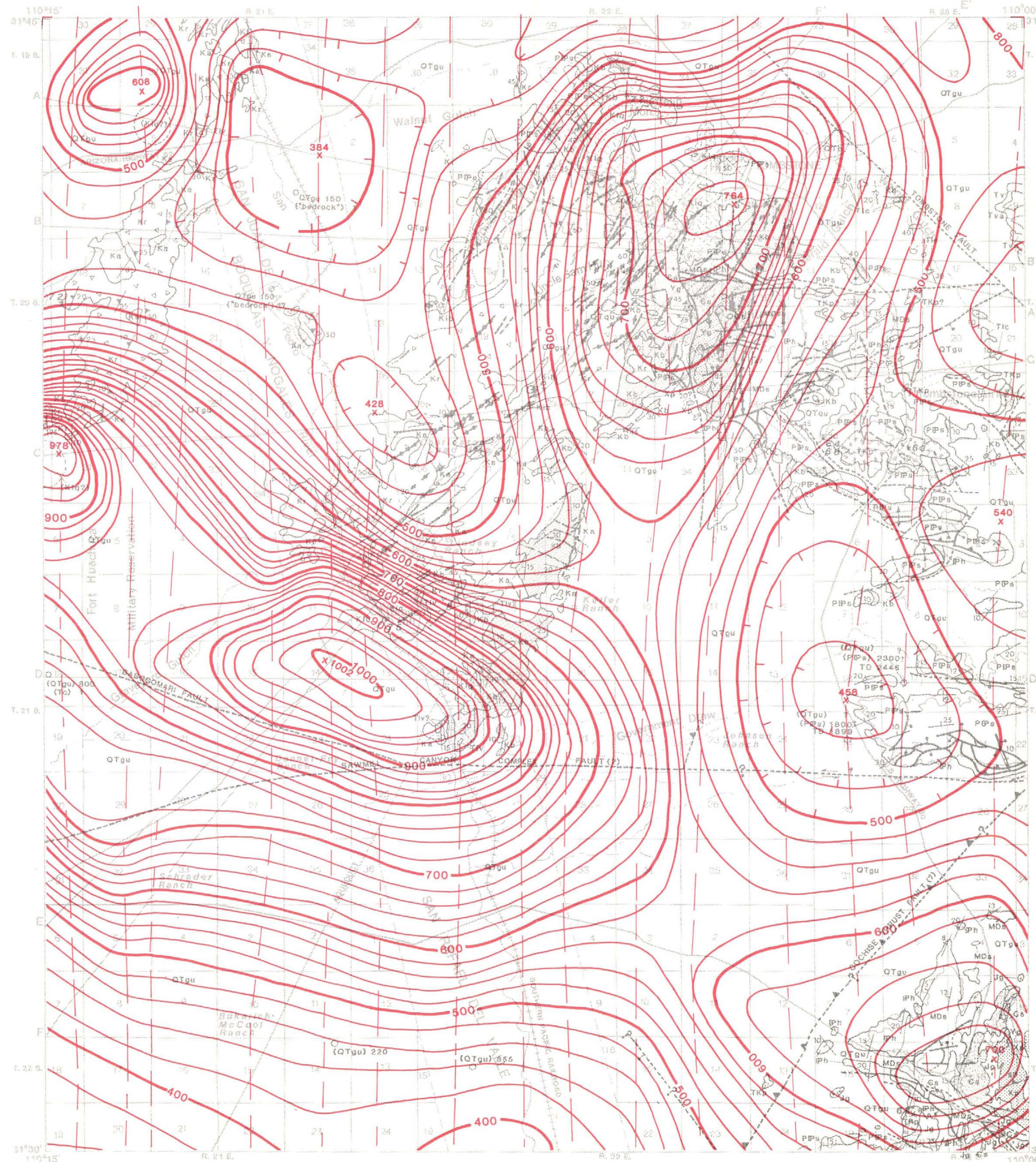
A———A' Cross section line

Flight line

Index contour line

Contour line

Contour interval: 25 gammas



Tombstone Development Company, Inc.
Tombstone, Arizona

1 0 1 2 3 Miles

N

Geology adopted from Drewes, Harold, 1980, and Newell, R.A., 1973.

By James A. Briscoe
James A. Briscoe and Associates
Tucson, Arizona

Figure 16. Aeromagnetic map of the Tombstone area.

From *Residual Aeromagnetic map of Southeastern Arizona*, Sauck, W.A., and Sumner, J.S., 1970. From Andreason, G.E., Mitchell, C.M., and Tyson, N.S., 1965

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Roads and Highways

Dry wash

Southern Pacific Railroad

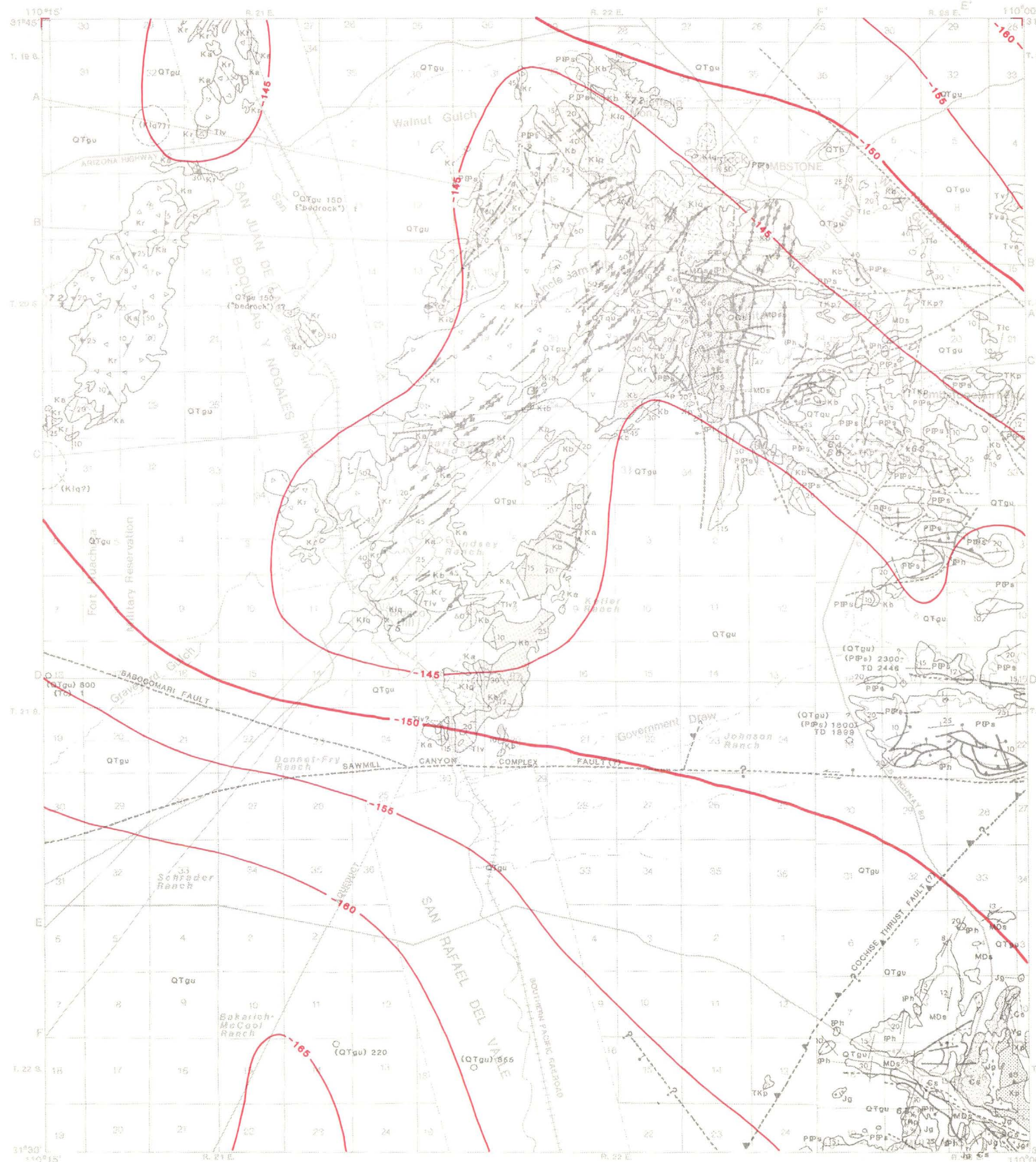
Government Reservation Boundary

Aqueduct

A———A′ Cross section line

-150 Gravity contour line

Contour interval: 5 milligals



Tombstone Development Company, Inc.
Tombstone, Arizona

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Figure 17. Gravity map of the Tombstone area.

From *Bouguer Gravity Anomaly map of Southeastern Arizona*, West, E.E., Sumner, J.S., Aiken, C.L.V., and Conley, J.N., 1973.

By James A. Briscoe
James A. Briscoe and Associates
Tucson, Arizona

1 0 1 2 3 Miles

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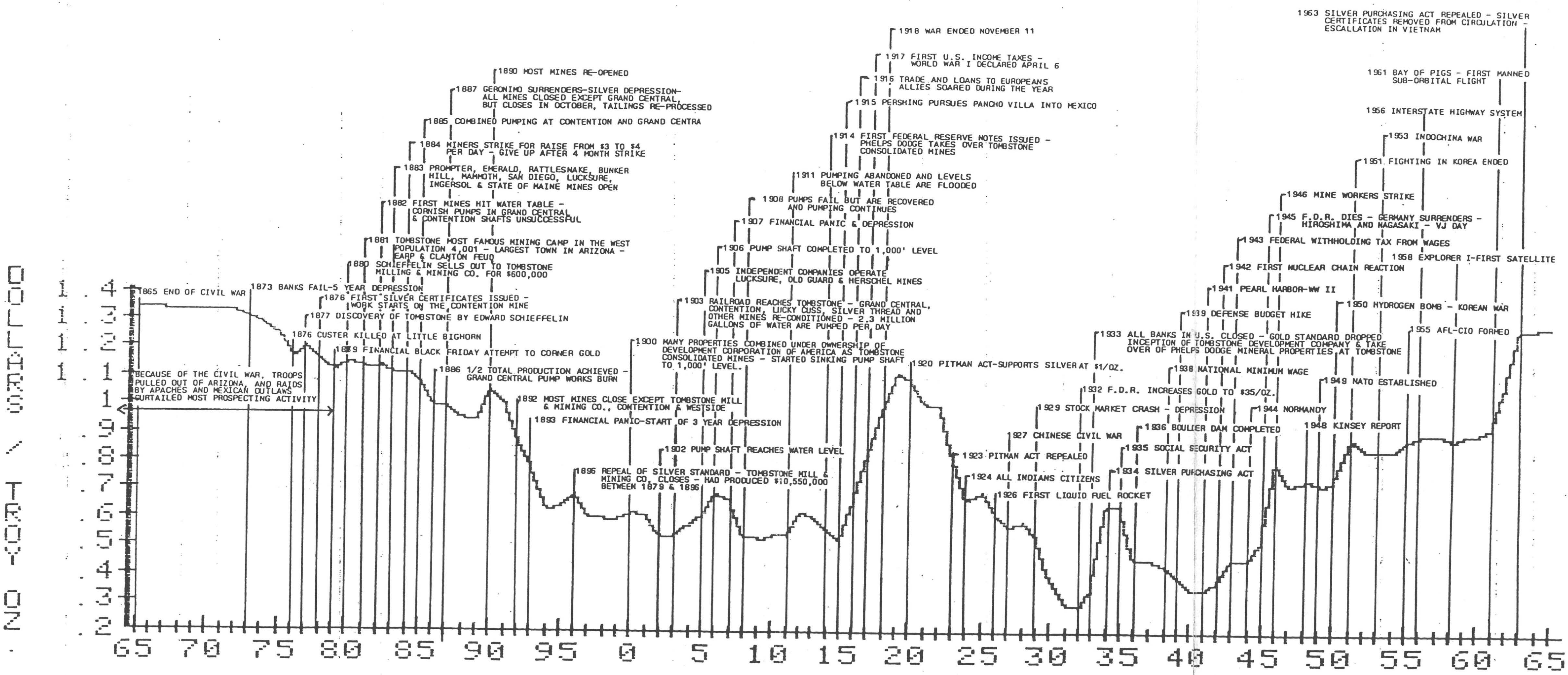
HISTORY

The Tombstone Mining District, then in Arizona Territory, was discovered by the son of a California 49ers, Edward L. Schieffelin in 1877. Tombstone, though isolated and subject to marauding Indians and outlaws in its early days, was affected by world events through their effect on silver prices. Ironically, with Schieffelin's discovery of rich silver mineralization at Tombstone, silver prices began a decline, and the price in 1877 would not be seen again for 86 years (Figure 18). During the thirty-four year period from 1877 to 1915, when most of the ore was produced at Tombstone, declining silver prices, financial panics and the removal of the United States currency from the silver standard, had immeasurably more affect on the mines than the Earp/Clanton fued, Apaches, bandits or underground waters.

The district has generally been divided into the main (eastern) portion and the western portion. The western portion is where the Tombstone Silver Mines, Inc. current property holdings lie. The State of Maine vein was discovered by John Escapule, who came to Tombstone as a photographer for the San Francisco Chronicle in 1878, to report on the silver rush. He caught "silver fever" and remained in Tombstone to prospect. In order to put the mine into operation, he approached financiers from the state of Maine, hence the mine and claim name (Bailey Escapule, 1985, pers. comm.). His decendents are operating his discovery, and are principals in Tombstone Silver Mines, Inc. The patented claims, now held by Tombstone Silver Mines, Inc., including the State of Maine, Brother Jonathan, Lowell, Merrimac, Red Top, Triple X, Clipper and May, were consolidated along with the main part of the district under the Tombstone Consolidated Mining Company.

In 1911, silver prices of approximately $0.55 per ounce (less than half that in effect when Schieffelin discovered Tombstone) brought the demise of efforts to unwater the mines, and the bankruptcy of the Development Corporation of America and its Tombstone Consolidated Mines subsidiary. The Phelps Dodge Corporation, who was a creditor of the Development Corporation of America, took over the Tombstone Consolidated Mines and operated them in a desultory fashion as the Bunker Hill Mining Company from 1914 through 1933. In 1915, the underground workings of the State of Maine mine were thoroughly sampled by Phelps Dodge (Butler, 1938, p. 101). Though 824 samples were taken, markings of which can still be seen on the walls of the State of Maine workings, the only information remaining concerning this sampling was published in the Butler Wilson volume, page 102, reproduced as Figure 34 in this report. In 1904, the Mellgren's, headed by Mr. V. G. Mellgren, a graduate mining and metallurgical engineer (Sarle, C. J., p. 8) began acquiring unpatented claims surrounding the patented ground later to be held by the Bunker Hill Company (Phelps Dodge Corporation subsidiary). The Pittman Act, supporting the price of silver at $1 per ounce between 1920 and 1923, stimulated some production in the main part of the district, primarily in the Bunker Hill mine, and a small amount of production in the western part of the district. During this time, surface mining on the Free Coinage vein and from the Bonanza dump was undertaken. In 1923, the Old Puebla Leasing Company cyanided part of the State of Maine dump and underground mine gob reportedly at a profit (Sarle, p. 8). Also, Chapman (later Dean and Dean Emertris of the College of Mines, University of Arizona, Tucson) undertook a Master's thesis (completed in 1924) to study the metallurgy of potential commercial leaching of the State of Maine mine dump. With the repeal of the Pittman Act in 1923, the price of silver plumeted (Figure 18), and no leaching of the dumps was ever accomplished. In 1933, when the price of silver averaged approximately $0.32 per ounce, the Tombstone Development Company, Inc., was formed by Ed Martin, owner of Tucson Ice, Dr. Roger Kline, founder of the Tucson Clinic, Mr. Moorehead, a retired banker from St. Louis, and Messrs. William Grace, Sr. and William Grace, Jr. (father and son). Lack of sufficient capital forced the Graces out of the deal at the time of incorporation. The purchase price from Phelps Dodge was $75,000 (Bill Grace, 1985, pers. comm.) for all of their patented mining claims in the district, which included essentially all of the producing mines. The company was headed by Ed Holderness, and acquired all the Bunker Hill (Phelps Dodge) properties in the Tombstone Mining District. It was the depths of the Great Depression, and miners were paid $3 per day and were happy to get the work

The higher gold price instituted by Franklin Roosevelt in 1932, stimulated some development, particularly in exploration in the main part of the district. The United States Smelting, Refining and Mining Company did considerable underground work in the northeastern part of the main district from early 1934 to May, 1937, on claims leased from the Tombstone Development Company, and shipped some ore. The Tombstone Extension mine was operated by the American Smelting and Refining Company during fifteen months in 1933 and 1934, and subsequently by its original owners, the Tombstone Mining Company and by lessees (Butler, p. 48). Except for some possible treatment of old stope fillings and dump leaching, there was no significant activity in the western part of the district. Sometime in the early 1940's, the State of Maine, Lowell, Brother Jonathan and the Triple X claims were purchased for back taxes by Mr. William Grace, and were subsequently transferred to Ernest Escapule, Senior. Joe Escapule, Sr., about the same time, acquired the True Blue, San Pedro, Santa Ana and the Free Coinage claims. During World War II, there was some study of the manganese deposits in the



100 YEAR SILVER PRICE CHART

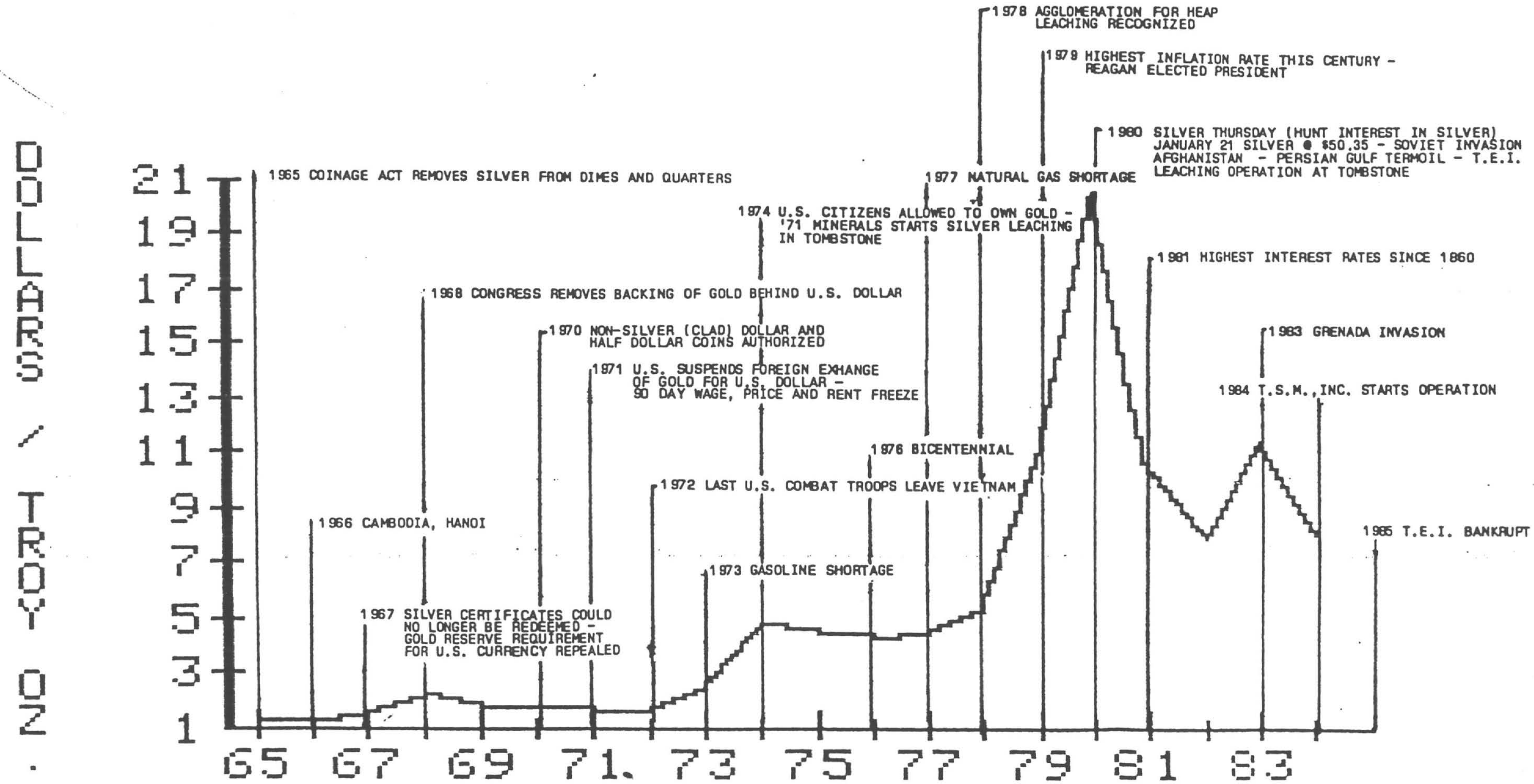
AVERAGE ANNUAL SILVER PRICE

YEARS: 1865 THROUGH 1965

FIGURE 18

district in relation to the war effort, and some manganese ores were produced, primarily from the Emerald and Bunker Hill mines, owned by the Tombstone Development Company. After World War II, in the late 1940's (the exact date is uncertain), a controlling interest in the Tombstone Development Company was acquired by the Newmont Mining Company. Fred Searls, then president, had great faith in the potential at Tombstone, and felt that after the war, precious metal prices would increase (William Hight, President, Tombstone Development Co., 1982, pers. comm.). Searls proved wrong, and after holding the property until the late 1950's, Newmont's controlling interest was sold to the current owners, a group of investors from Grand Island, Nebraska. Exploration work was done in the late 1950's by the Eagle Picher Company in the northeastern part of the main district, probably around the Silver Thread workings. Their drilling showed exciting values in lead and zinc (Burton DeVere, Billiton Exploration, 1983, pers. comm.). In 1965, the Duval Corporation drilled several rotary holes in the main part of the district probing for porphyry copper mineralization. Not much is known of the results of this exploration, though data is thought to be in the files of the Tombstone Development Company. In the period 1972-1973, the American Smelting & Refining Company obtained a lease on the Horne claims around the Robbers Roost breccia pipe. They drilled three holes to a maximum depth of 5,000 feet on the porphyry copper alteration zone in the vicinity of the breccia pipes. These holes intersected extensive but low grade mineralization, grading vertically downward from a lead-zinc phase of mineralization into porphyry copper type mineralization, including disseminated pyrite, chalcopyrite and molybdenite, as well as secondary feldspar and purple anhydrite. The Uncle Sam tuff was penetrated, intersecting Bisbee Formation, and at about 4,900 feet, the Bisbee was penetrated and the drill entered the Naco Limestone. Poor copper prices at the time and since have discouraged further exploration for copper at this depth.

In 1973, 1971 Minerals, Ltd. - a limited partnership headed by general partners Richard F. Hewlett (operating as Sierra Mineral Management, Inc.) and Bruce Stevenson and James Bishop (operating as Stevenson, Bishop and McCready, Inc. of New York City, New York), optioned the various holdings of the Escapule family in the western part of the district, and later, the land of the Tombstone Mineral Reserve, Inc. (now ALANCO, Inc.) and the lands belonging to the Tombstone Development Company, Inc. In the spring of 1973, the writer was hired by Mr. Dick Hewlett to prepare a report on the State of Maine area. A topographic map of the State of Maine area was prepared at a scale of 1" = 200' with contour intervals at five feet, detailed mapping on black and white photos later to be transfered onto the topographic base, and geochemical sampling was performed. Previously unrecognized windows exposing sediments beneath the Uncle Sam



RECENT SILVER PRICE CHART

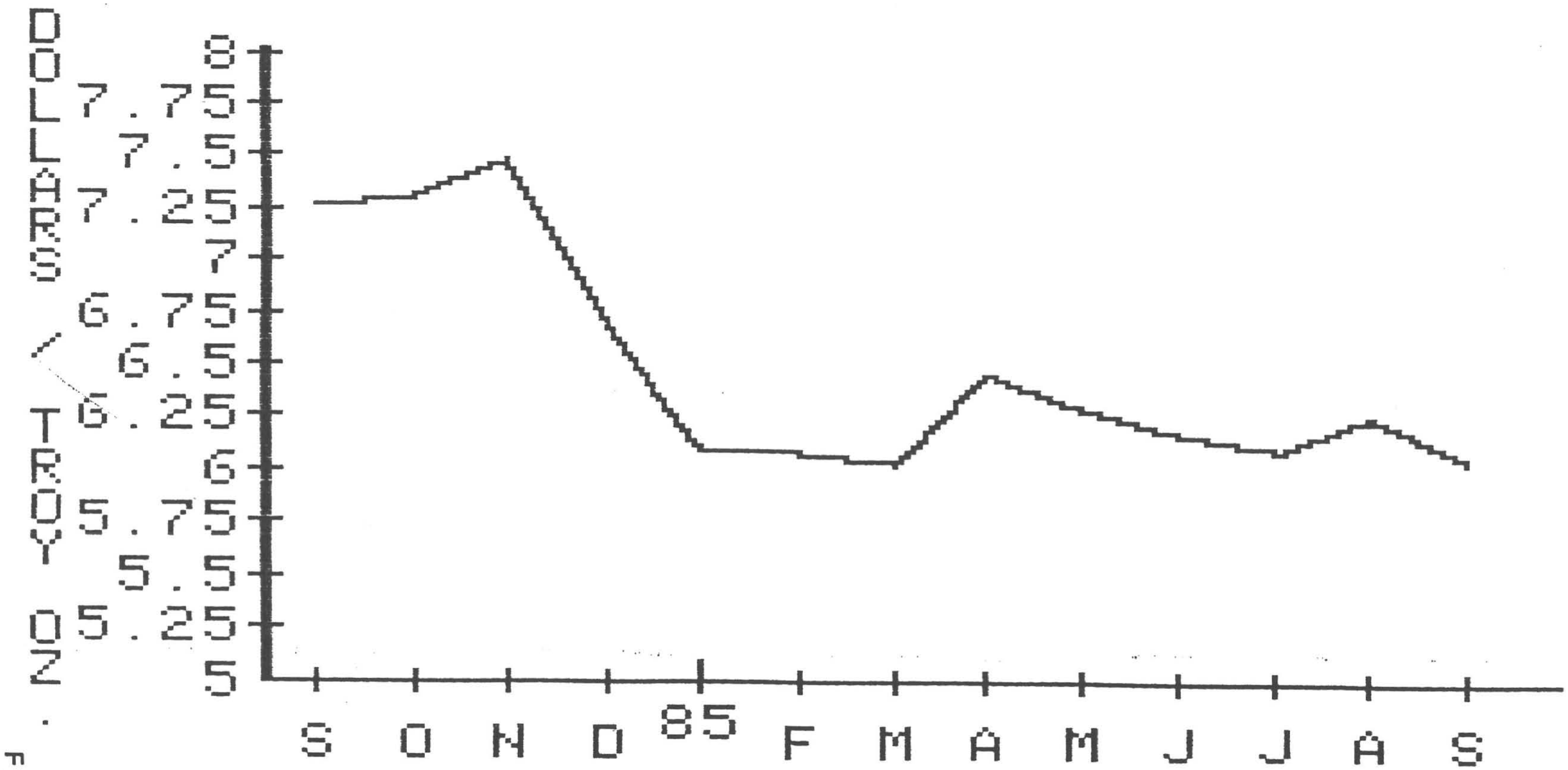
AVERAGE ANNUAL SILVER PRICE
YEARS: 1965 THROUGH 1984

Figure 19

tuff, as well as isoclinal folding in the sediments, were mapped. A comprehensive exporation program was planned and recommended. Also, in October of 1973, just before completion of the detailed report on the State of Maine area, the entire Tombstone District was flown in color aerial photography at a scale of 1" = 2,000' along north-south flight lines. In 1974, a counter-current decantation cyanide mill was moved from the Golden Sunlight mine in Montana, and installed at the State of Maine Mine, in order to treat ore from the State of Maine shaft. Also, the headframe from the #6 shaft at the Cordero mine in northern Nevada was set up on the State of Maine shaft over a newly poured concrete collar. Unfortunately the Golden Sunlight's cyanide mill never operated properly, probably due to underfinancing and poor management. It was later abandoned and the leases relinquished. 1971 Minerals, Ltd. went on to consolidate all of the old mine dumps in the main district on Tombstone Development Co. land into one large heap leach pad, which was operated until 1977, when the Tombstone Development Company lease was relinquished. They subsequently fell upon hard times, and are thought to no longer be a viable entity. None of the exploration program recommended by the writer was ever carried out.

About the same time, Roger A. Newell was completing a Stanford PhD. dissertation covering the area. Newell's maps covering the district as far west as the San Pedro River and as far south as the Bronco Hills, at a scale of 1:31,250 and 1:12,000 (Newell, 1974, Plates 1 & 2), are the most detailed and complete geologic coverage to date. Newell also presented geochemical data from regional sampling of mine dumps within the district (Figures 3 through 17 and Newell, 1974, p. 13-23), which verify mineralization in the district is related to a series of porphyry copper centers.

In 1980, Tombstone Exploration, Inc. (TEI) obtained a lease on the patented Tombstone Development Company lands in the main part of the district. Between 1980 and 1985, TEI operated an open pit mine on the Contention vein, and produced up to 3,000 tons per day of low grade ore averaging in the range of 1.25 ounces silver and .02 ounces gold, from which was recovered approximately 40% of the silver and 60% of the gold. Graves (1985) reports that 2 million ounces of silver and 10,000 ounces of gold were produced in the period from 1970 to 1985, mostly from the Tombstone Exploration, Inc. open pit operation and in a small part by the 1971 Minerals mine dump consolidation. No exploration drilling was ever done, and no ore reserves of significance were measured ahead of mining. Lowered silver and gold prices, poor management and a lack of reserves forced the company into bankruptcy in 1985, and its assets are currently being liquidated.



MONTHLY SILVER PRICE CHART
AVERAGE MONTHLY SILVER PRICE
SEPTEMBER, 1984 THROUGH SEPTEMBER, 1985

Figure 20

A regional map covering southeastern Arizona compiled by Harald Drewes of the United States Geological Survey was published in 1980. In 1982, the writer compiled data and maps from the work of Newell, Drewes and others (Figures 3 through 17). It is concluded from these various data that the volcanic geology and structure in the Tombstone area is related to a Laramide caldera, and mineralization in the district is also related to the caldera and attendant volcanic action and hydrothermal fluids.

Tombstone has primarily been a silver camp, though significant gold, lead, subordinate copper, zinc and manganese have also been produced. The silver to gold production ratio for documented production between 1877 and 1937, is 125.95:1. Production has come mainly from mineralized vein fractures, cutting folded Lower Cretaceous limestones and basal conglomerate of the Bisbee group within the Tombstone Basin (main part of the district). Ninety-five percent or more of the production is from the surface to six hundred feet below, and is primarily from oxide ore minerals.

Between 1879 and 1907, unpublished figures and estimates compiled by J. B. Tenny from old company reports and other sources (Butler, p. 48), indicate that $28,400,000 was produced. Unfortunately, this compilation is based only on dollar production and no information regarding tonnage, grades and ounces or pounds of which specific commodity was produced, is available. From 1908 through 1936, tonnages as well as amounts of gold in dollar value, silver in ounces, copper, lead and zinc in pounds (Butler, p. 49), as well as Tombstone Development Company records through the year 1936, showing the same units, give more specific information on the district. Using this more detailed later information as well as dump tonnages calculated during the period of dump leaching by 1971 Minerals, Ltd. (1972 through 1977 - private company reports for those years), the writer has estimated that 1.25 million tons of ore was produced. Using this estimated tonnage and the recorded production, it is calculated that the average grade for ore produced was 25.89 ounces silver, 0.21 ounces gold, 2.6% lead and 0.10% copper and smaller amounts of zinc and manganese. Not included in these figures are the substantial amounts produced between 1980 and 1985 by Tomstone Exploration, Inc. from its open pit mining operation along the Contention vein.

Total past production at Tombstone, not including that of 1971 Minerals Limited or Tombstone Exploration, Inc., in terms of $400 gold and $10 silver, $.50 lead, $1.00 copper, and $.40 zinc, is approximately $463 million (Figure 21).

SUMMARY OF TOTAL RECORDED PRODUCTION AT TOMBSTONE
1879 TO 1937
CALCULATED TO CURRENT VALUES - $400 GOLD, $10 SILVER, $1.00 COPPER, $.50 LEAD, $.40 ZINC

SOURCE & YEAR	TOTAL VALUE OF PRODUCTION IN YEAR PRODUCED	CALCULATED OUNCES OF GOLD PRODUCED	VALUE AT $400/OZ.	CALCULATED OUNCES OF SILVER PRODUCED	VALUE AT $10/OZ.	CALCULATED POUNDS OF LEAD PRODUCED	VALUE AT $.50/LB.	CALCULATED POUNDS OF COPPER PRODUCED	VALUE AT $1.00/LB.	CALCULATED POUNDS OF ZINC PRODUCED	VALUE AT $.40/LB.	TOTAL CURRENT VALUE OF PRODUCTION
J. B. TENNEY												
1879 TO 1907	28400000	192356	76942400	24338159	243381590	31805070	15902535	NRP*	NRP	NRP	NRP	336226525
MINERAL RESOURCES OF THE UNITED STATES												
1908 TO 1934	8138571	57971	23188400	665692	6659692O	23767829	11883915	2358495	2358495	1058234	423294	104451023
TOMBSTONE DEVELOPMENT TOMBSTONE MINING CO'S.												
1935 TO 1936	564437	6375	2550000	390305	3903050	3197305	1598653	157536	157536	NRP	NRP	8209239
TOMBSTONE EXTENSION												
1930 TO 1937	374972	1083	433056	1080491	10804907	6335734	3167867	NRP	NRP	NRP	NRP	14405829
TOTAL	37477980	257785	103113856	32468647	324686467	65105938	32552969	2516031	2516031	1058234	423294	463292616
AVERAGE/TON**		0.21	82.22	25.89	258.90	51.91	25.96	2.01	2.01	0.84	0.34	369.42

*NO RECORDED PRODUCTION

**TOTAL TONNAGE ASSUMED TO BE - 1254097

Figure 21

James A. Briscoe & Associates, Inc.
Tucson, Arizona

Prepared by James A. Briscoe

PRODUCTION OF THE TOMBSTONE MINING DISTRICT
1879 TO 1907*
CALCULATED TO CURRENT VALUES - $400 GOLD, $10 SILVER & $.50 LEAD

YEAR	TOTAL VALUE OF PRODUCTION IN YEAR PRODUCED	CALCULATED** OUNCES OF GOLD @14% OF TOTAL PRODUCED	VALUE AT $400/OZ.	CALCULATED** OUNCES OF SILVER @81% OF TOTAL PRODUCED	VALUE AT $10/OZ.	CALCULATED** POUNDS OF LEAD*** @5% OF TOTAL PRODUCED	VALUE AT $.50/LB.	TOTAL CURRENT VALUE OF PRODUCTION
1879-1880	2318567	15704	6281555	1633078	16330776	2318567	1159284	23771615
1881	5040633	34141	13656287	3613197	36131971	5250659	2625330	52413588
1882	5202876	35240	14095842	3696780	36967803	5309057	2654529	53718174
1883	2881900	19519	7807760	2122126	21221264	3351047	1675523	30704547
1884	1380788	9352	3740887	1016762	10167621	1865930	932965	14841472
1885	1320976	8947	3578842	999991	9999912	1651220	825610	14404363
1886	1050000	7112	2844702	859091	8590909	1141304	570652	12006264
1887	600000	4064	1625544	495918	4959184	666667	333333	6918061
1888	600000	4064	1625544	517021	5170213	681818	340909	7136666
1889	250000	1693	677310	215426	2154255	320513	160256	2991822
1890	600000	4064	1625544	462857	4628571	666667	333333	6587449
1891	674650	4569	1827789	551986	5519864	784477	392238	7739891
1892	490000	3319	1327528	456207	4562069	597561	298780	6188377
1893	450000	3048	1219158	467308	4673077	608108	304054	6196289
1894	300000	2032	812772	244890	2448900	454545	227273	3488945
1895	300000	2032	812772	373846	3738462	468750	234375	4785609
1896	300000	2032	812772	357353	3573529	500000	250000	4636302
1897-1901	1539610	10428	4171174	2078474	20784735	1877573	938787	25884695
1902-1906	2550000	17271	6908563	3500847	35008475	2771739	1385870	43302907
1907	550000	3725	1490082	675000	6750000	518868	259434	8499516
TOTAL	28400000	192356	76942429	24338159	243381589	31805070	15902535	336226552
AVERAGE/TON****		0.32	126.48	40.01	400.07	52.28	26.14	552.69

*"UNPUBLISHED FIGURES & ESTIMATES COMPILED BY J.B. TENNEY FROM OLD COMPANY REPORTS", ARIZONA BUREAU OF MINES, GEOLOGICAL SERIES, NO. 10, BULLETIN NO. 143 (BUTLER & WILSON)

**AS REPORTED BY BUTLER & WILSON, "THE PRODUCTION OF THE TOMBSTONE DISTRICT BY VALUE WAS ABOUT 81% SILVER, 14% GOLD AND 5% LEAD, WITH MINOR COPPER AND MANGANESE". THE METAL PRODUCTION IN THIS TABLE WAS CALCULATED BY MULTIPLYING THOSE PERCENTAGES BY TOTAL DOLLAR PRODUCTION, AND THEN DIVIDING THE RESULTING FIGURE BY THE METAL PRICE FOR THAT YEAR TO YIELD A CALCULATED PRODUCTION IN TROY OUNCES, OR POUNDS.

***INCLUDED ARE SOME TRACES OF COPPER, MANGANESE & ZINC PRODUCTION.

****ASSUME TONNAGE MINED FROM 1879 TO 1907 EQUAL TO THAT FROM 1908 TO 1934 - 608345 TONS

Figure 22

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PRODUCTION OF THE TOMBSTONE MINING DISTRICT
1908 TO 1934*
CALCULATED TO CURRENT VALUES - $400 GOLD, $10 SILVER, $1.00 COPPER, $.50 LEAD & $.40 ZINC

YEAR	TONS	GOLD (OUNCES)	VALUE AT $400/OZ.	SILVER (OUNCES)	VALUE AT $10/OZ.	COPPER (POUNDS)	VALUE AT $1.00/LB.	LEAD (POUNDS)	VALUE AT $.50/LB.	ZINC (POUNDS)	VALUE AT $.40/LB.	TOTAL CURRENT VALUE
1908	51266	4106	1642304	357414	3574140	7608	7608	177094	88597	173313	69325	6178774
1909	27123	2280	911832	201700	2017000	27706	27706	1535637	767819	713116	285246	4009603
1910	4619	1062	424712	116520	1165200	31163	31163	305876	152938	0	0	1774013
1911	8797	2155	862196	224098	2240980	68209	68209	982010	491005	0	0	3662390
1912	7405	1363	545272	158377	1583770	27723	27723	617820	308910	0	0	2465675
1913	5760	1230	491824	126392	1263920	10657	10657	334923	167462	36503	14601	1948464
1914	6063	1380	552144	108868	1088680	14217	14217	234345	117173	39324	15730	1787943
1915	9003	1216	486404	100115	1001150	36075	36075	164136	82068	63386	25354	1631051
1916	57200	3950	1580144	343453	3434530	131546	131546	983983	491992	0	0	5638212
1917	57474	3373	1349220	444139	4441390	229488	229488	1278754	639377	0	0	6659475
1918	19507	1389	555760	283412	2834120	41503	41503	457183	228592	0	0	3659975
1919	27445	1946	778328	450366	4503660	290182	290182	289424	144712	0	0	5716882
1920	28946	1788	715104	456855	4568550	144010	144010	243946	121973	0	0	5549637
1921	18594	1057	422632	423688	4236880	132688	132688	678946	339473	0	0	5131673
1922	44347	2322	928980	613700	6137000	196740	196740	744529	372265	0	0	7634985
1923	32770	3093	1237040	495943	4959430	195485	195485	465914	232957	0	0	6624912
1924	15448	2459	983456	247642	2476420	72836	72836	465323	232662	0	0	3765374
1925	27760	2677	1070692	241381	2413810	77340	77340	1527019	763510	32592	13037	4338388
1926	47708	2990	1195860	220579	2205790	113476	113476	1970986	985493	0	0	4500619
1927	31196	2459	983456	159944	1599440	68867	68867	900178	450089	0	0	3101852
1928	24172	2297	918644	164161	1641610	135643	135643	247316	123658	0	0	2819555
1929	15601	1671	668216	99423	994230	86793	86793	843817	421909	0	0	2171148
1930	8734	1875	749800	74837	748370	32903	32903	936862	468431	0	0	2000504
1931	15623	2204	881568	101504	1015040	62440	62440	476814	238407	0	0	2197455
1932	5067	485	194096	48021	480210	24810	24810	1166700	583350	0	0	1282466
1933	7016	1441	576464	100323	1003230	27875	27875	1744270	872135	0	0	2479704
1934	3701	3706	1482448	296737	2967370	70512	70512	2400324	1200162	0	0	5720492
TOTAL	608345	57971	23188596	6659692	66596920	2358495	2358495	23767829	11883915	1058234	423294	104451219
AVERAGE/TON		0.10	38.12	10.95	109.47	3.88	3.88	39.07	19.53	1.74	0.70	171.70

*AS RECORDED IN "THE MINERAL RESOURCES OF THE UNITED STATES"

AVERAGE VALUE PER TON AT CURRENT PRICES (SEE ABOVE) - $\frac{\$104,451,219}{608,345}$ = $171.70/TON

Figure 23

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James A. Briscoe & Associates, Inc.
Tucson, Arizona

Prepared by James A. Briscoe

PRODUCTION OF THE TOMBSTONE MINING DISTRICT
1935 TO 1936*
CALCULATED TO CURRENT VALUES - $400 GOLD, $10 SILVER, $1.00 COPPER, $.50 LEAD, $.40 ZINC

YEAR	TONS	GOLD (OUNCES)	VALUE AT $400/OZ.	SILVER (OUNCES)	VALUE AT $10/OZ.	COPPER (POUNDS)	VALUE AT $1.00/LB.	LEAD (POUNDS)	VALUE AT $.50/LB.	TOTAL CURRENT VALUE
1935	12907	3450	1380000	243087	2430870	103574	103574	2228288	1114144	5028588
1936	9305	2925	1170000	147218	1472180	53962	53962	969017	484509	3180651
TOTAL	22212	6375	2550000	390305	3903050	157536	157536	3197305	1598653	8209239
AVERAGE/TON		0.29	114.80	17.57	175.72	7.09	7.09	143.94	71.97	369.59

*AS STATED BY THE TOMBSTONE DEVELOPMENT CO. & THE TOMBSTONE MINING CO.

Figure 24

Prepared by James A. Briscoe

James A. Briscoe & Associates, Inc.
Tucson, Arizona

TOMBSTONE EXTENSION AREA
PRODUCTION STATISTICS OF THE TOMBSTONE MINING CO. FOR THE TOMBSTONE EXTENSION AREA - 1930 TO 1937
CALCULATED TO CURRENT VALUES - $400 GOLD, $10 SILVER & $.50 LEAD

OPERATOR	WET TONS	DRY TONS	GOLD (OUNCES)	VALUE AT $400/OZ.	SILVER (OUNCES)	VALUE AT $10/OZ.	LEAD (POUNDS)	VALUE AT $.50/LB.	TOTAL GROSS VALUE
TOMBSTONE MINING CO.									
1930	2810.78	2759.64	204.60	81840.00	21996.64	219966.40	887952.45	443976.23	745782.63
1931	311.66	299.69	44.21	17684.00	5800.71	58007.10	232098.67	116049.34	191740.44
1932	2482.88	2348.69	225.56	90224.00	32392.00	323920.00	1226722.00	613361.00	1027505.00
HAYWARD & RICHARDS									
1933	795.00	747.31	60.27	24108.00	9093.00	90930.00	336810.00	168405.00	283443.00
A. S. & R.									
1933	3041.00	2819.36	224.14	89656.00	37840.00	378400.00	1145565.00	572782.50	1040838.50
1934	2018.00	2006.20	116.38	46552.00	19836.00	198360.00	726559.00	363279.50	608191.50
HOLT & D'AUTREMONT									
1934	1195.01	1123.03	79.38	31752.00	15796.27	157962.70	553991.48	276995.74	466710.44
HASSELGREN & D'AUTREMONT									
1935	2308.64	2164.36	79.86	31944.00	27055.81	270558.10	842762.11	421381.06	723883.16
CARPER LEASE									
1935	196.71	183.35	8.14	3256.00	2421.26	24212.60	88951.82	44475.91	71944.51
TOMBSTONE MINING CO.									
1935	118.50	110.02	2.49	996.00	961.49	9614.90	39143.48	19571.74	30182.64
1936	80.78	75.93	2.36	944.00	648.74	6487.40	21970.27	10985.14	18416.54
1937	461.05	412.48	27.55	11020.00	4437.05	44370.50	167949.24	83974.62	139365.12
MACIA LEASE									
1936	96.48	88.96	3.56	1424.00	983.68	9836.80	36054.90	18027.45	29288.25
GALLAGHER LEASE									
1936	65.37	56.63	4.14	1656.00	1228.01	12280.10	29203.22	14601.61	28537.71
TOTAL	16081.86	15195.65	1082.64	433056.00	180490.66	1804906.60	6335733.64	3167866.82	5405829.42
AVERAGE/TON			0.07	28.50	11.88	118.78	416.94	208.47	355.75

AVERAGE VALUE PER TON AT CURRENT PRICES (SEE ABOVE) - $\frac{\$5,405,829.42}{15,195.65} = \$355.75/\text{TON}$

Figure 25

Prepared by James A. Briscoe

James A. Briscoe & Associates, Inc.
Tucson, Arizona

GENERAL GEOLOGY OF THE DISTRICT

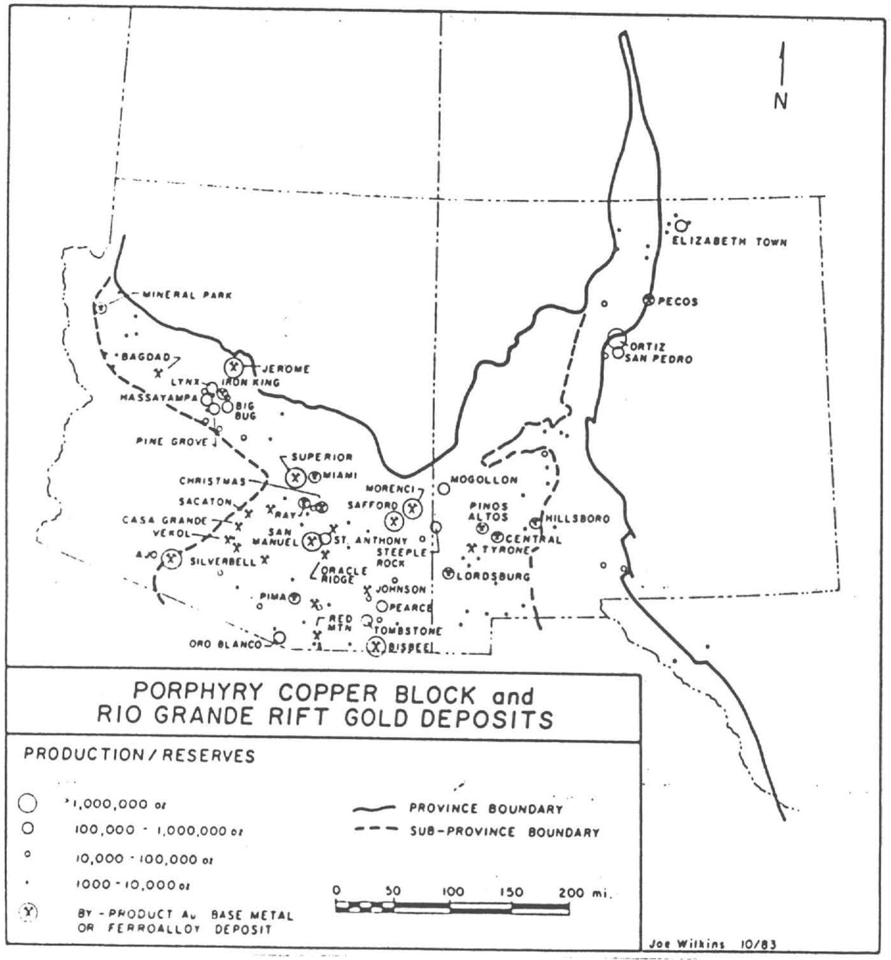
The Tombstone Mining District lies within the southwestern porphyry copper province (Figure 26). Nearby, large porphyry copper deposits are located at Bisbee, some twenty-five miles to the southeast, and the newly discovered deposits at Dragoon are some twenty-five miles to the north. Exploration drilling on a Jurasic porphyry copper system (the same age as Bisbee) at Gleeson, about fifteen miles northeast, was in progress in the early 1970's. However, the drilling disclosed that thrust faulting had broken the original deposit into sub-economic slivers.

The Tombstone area itself has had a complex geologic history, which includes sedimentation, folding, thrust faulting, explosive acid volcanism and caldera formation and resurgence, several stages of intrusion by igneous rocks and mineralization from hydrothermal solutions between 72 m.y. and 63 m.y.

Basement rocks are Precambrian granodiorite and Pinal schist. Over this are deposited approximately 5,000 feet of Paleozoic sediments consisting, for the most part, of limestone. Mesozoic sedimentation includes the Bisbee Formation consisting of plus 3,000 feet of sandstones, shales, mudstones and minor limestones near the base.

The post-Paleozoic tectonic history of the Tombstone area has been complex. At least two episodes of folding and thrust faulting have taken place (Gilluly, p. 122-130). It is apparent (Gilluly, p. 128) that an earlier period of deformation created eastward trending features, and later deformation formed north-trending and oblique features. During the first stage, north-south compression formed east trending folds and minor thrusts, with a north strike and northerly low angle dips. Later, the area underwent southwest-northeast compression, which produced thrust faults of northwesterly trend, and was probably responsible for large features visible in the district today, including the Empire anticline and the north 50 degree east fractures.

There must have been a profound structural weakness at the current location of the Tombstone Hills, because Laramide volcanism appears to form a focus at Tombstone, with relatively smaller effect on the surrounding terrain for a distance of 20 or more miles. Laramide surface volcanism began with the extrusion of the Bronco volcanics, comprised of lower andesite flows and breccias, overlain by rhyolitic tuffs and flows (Newell, R. A., 1974, p. 40-41). Examination by the writer suggests that these rhyolites, at least in part, may be a series of coalescing rhyolite domes, as they exhibit contorted flow, and in places, flow breccia structures. The Bronco andesites, which were


N
ELIZABETH TOWN
MINERAL PARK
PECOS
ORTIZ
SAN PEDRO
BAGDAD
JEROME
LYNX
IRON KING
HASSAYAMPA
BIG BUG
PINE GROVE
SUPERIOR
MIAMI
CHRISTMAS
MORENCI
MOGOLLON
SACATON
SAFFORD
PINOS ALTOS
CASA GRANDE
RAY
HILLSBORO
VEKOL
SAN MANUEL
ST. ANTHONY
CENTRAL
AJO
SILVERBELL
STEEPLE ROCK
TYRONE
ORACLE RIDGE
LORDSBURG
JOHNSON
PIMA
PEARCE
RED MTN
TOMBSTONE
ORO BLANCO
BISBEE
PORPHYRY COPPER BLOCK and
RIO GRANDE RIFT GOLD DEPOSITS
PRODUCTION / RESERVES
>1,000,000 oz
100,000 - 1,000,000 oz
10,000 - 100,000 oz
1000 - 10,000 oz
BY - PRODUCT Au BASE METAL OR FERROALLOY DEPOSIT
PROVINCE BOUNDARY
SUB-PROVINCE BOUNDARY
0 50 100 150 200 mi.
Joe Wilkins 10/83

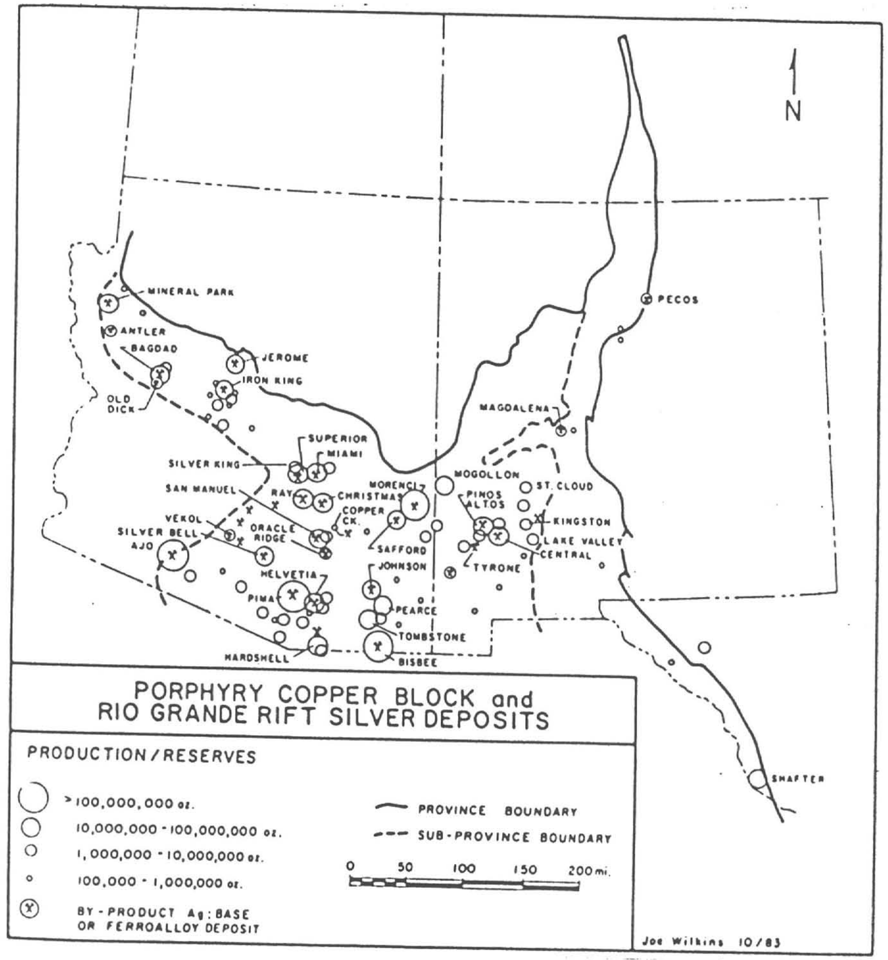

N
MINERAL PARK
PECOS
ANTLER
BAGDAD
JEROME
IRON KING
OLD DICK
MAGDALENA
SUPERIOR
MIAMI
SILVER KING
MOGOLLON
ST. CLOUD
SAN MANUEL
RAY
CHRISTMAS
MORENCI
PINOS ALTOS
COPPER CK.
KINGSTON
VEKOL
ORACLE RIDGE
LAKE VALLEY
SILVER BELL
SAFFORD
CENTRAL
AJO
JOHNSON
TYRONE
HELVETIA
PIMA
PEARCE
TOMBSTONE
HARDSHELL
BISBEE
SHAFTER
PORPHYRY COPPER BLOCK and
RIO GRANDE RIFT SILVER DEPOSITS
PRODUCTION / RESERVES
>100,000,000 oz.
10,000,000 - 100,000,000 oz.
1,000,000 - 10,000,000 oz.
100,000 - 1,000,000 oz.
BY - PRODUCT Ag: BASE OR FERROALLOY DEPOSIT
PROVINCE BOUNDARY
SUB-PROVINCE BOUNDARY
0 50 100 150 200 mi.
Joe Wilkins 10/83

Figure 26

extruded as flows, flow breccias and probable lahars, are of the Silverbell type. Extruded over the Bronco volcanics is the 71.9 ±2.4 m.y. (Drewes, 1971) old Uncle Sam quartz latite tuff. The extrusion of the tuff, which probably started issuing forth from the area of the Bronco Hills, resulted in partial evacuation of the underlying magma chamber and caldera collapse, with later resurgent exhalation of more quartz latite tuffs. The current Ajax fault, with some 5,000 feet of stratigraphic throw, formed the eastern margin of the caldera, and appears to localize some of the Uncle Sam vents, as well as later intrusives. Apophyses of the parent magma intruded along the northeasterly portion of the caldera, forming the present outcrops of Schieffelin Granodiorite southwest of Tombstone. Additional apophyses of Schieffelin Granodiorite intruded along the caldera margin at Bronco Hill; near Fairbank, and on the west side of the San Pedro River on the Ft. Huachuca Military Reservation. These probable intrusions are thought to be the source of aeromagnetic anomalies prominent on the aeromagnetic map in Figure 16. The Prompter and Horquilla faults may, in part, be radiating expansion fractures due to the initial doming before the extrusion of the Uncle Sam tuff and resurgence thereafter. Several episodes of explosive eruptions are indicated by multiple cooling units of Uncle Sam tuff, best exposed in the Charleston area. Geothermal convection cells circulating along fractures in the cooling volcanic and related plutonic rocks at depth, gave rise to the current copper, molybdenum, lead, zinc, silver and gold mineralization centers within and adjacent to the caldera. Phreatic (steam) explosions and venting probably gave rise to the breccia pipes in the Robbers Roost-Charleston Lead mine area. Deep exploration drill holes in this area confirm unexposed apophyses (cupolas) of porphyritic quartz monzonite below these altered areas - the probable driving mechanism for both hydrothermal fluidization of the breccia pipes as well as mineralization. Interestingly, Mr. David Sawyer, Stanford PhD. candidate, mapping the Silverbell mineral-volcanic complex for his dissertation, has found it to be a caldera complex (1984, pers. comm.). The sequence - Silverbell andesite, dacite, Mt. Lord ignimbrite, is the same type and sequence of extrusives as present at Tombstone, i.e., the Bronco andesites, Bronco rhyolite, and Uncle Sam tuff. At Silverbell, quartz monzonites intrude the cauldron fault, to be later mineralized by copper, molybdenum, silver, lead and zinc bearing hydrothermal solutions. At Silverbell, the volcanic complex is Laramide - approximately 65 m.y. old.

Age dating of samples of altered rock collected by Newell at the Charleston Lead mine (1974, p. 73), show potassium-argon age date of sericite of 74.5 ± 3 m.y., while a sample of the altered Contention dike material collected by Gustafson (Newell, 1974, p. 74) yield an age of about 72 m.y. The age date of 63 m.y. by Creasey, et al. (1962) for potassium-argon on rhyolite intimately associated with manganese south of the Emerald mine, suggests that the age of manganese mineralization (at least in the Military Hill-Emerald mine area south of the Prompter fault) is approximately 10 m.y. younger than mineralization on the Contention dike and at Charleston. The writer, in 1982, mapped a previously unnoticed apophysis of quartz monzonite porphyry in the Tombstone Extension area, and dikes of the same material in the Comstock Hill area, northwest of the Tombstone townsite. Drewes, in 1985, reported this rock had an age of 62.6 ± 2.8 m.y. (pers. comm.). This intrusive may be the source rock for the rhyolite dated by Creasey intruding the Prompter fault and as dikes south of the Prompter fault, as well as sill-like bodies southwest of Tombstone near the municipal airport. Further, they may be the source of rhyolite dikes associated with mineralization in the State of Maine area. Unfortunately, no age date on the mineralization on the State of Maine mine has been made.

As pointed out by Livingston et al. (1968, p. 30), "15 of the 16 known porphyry copper deposits in Arizona are intimately related to the late-Cretaceous or early-Tertiary plutons of the Laramide (75 to 55 m.y.)", and of these fifteen deposits, ten had dates between 55 and 65 m.y., and only two had dates greater than 70 m.y. The importance of determining the age of the Tombstone mineralization is thus clearly defined (Newell, 1974, p. 73). If the mineralization or at least some of the mineralization centers at Tombstone can be shown to be contemporaneous with other productive porphyry copper deposits in the surrounding area, then the long term potential for deeper mineralization would be enhanced. Confirmation that all or some mineral centers at Tombstone were related to the older 72 m.y. early Laramide phase of mineralization would suggest a lower copper, higher lead-zinc resource, and lower potential for intersecting a copper molybdenum deposit at depth (Keith, 1985). It is thus important that additional samples carefully collected from target mineral zones be taken and accurately age dated to determine the age of the mineralizing system. Additionally, key rock units such as the rhyolite dikes intruding the State of Maine area should also be age dated.

The following is a chronological summary extracted from Newell's 1974 dissertation on the district. The writer, as previously explained, believes that the extrusion of the Uncle Sam tuff through a series of vents, resulted in evacuation of the underlying magma chamber, and caldera collapse. The deepest collapse, documented by geologic mapping so far, is along the Ajax Hill fault, where some 5,000 feet of stratigraphic throw between the Precambrian on the upside and Cretaceous Bisbee on the downside, is also the loci of conduits for various extrusions and intrusions including; the Uncle Sam tuff, the Schieffelin Granodiorite, the quartz latite porphyry, the granophyre, and the rhyodacite. The reopening of the northeast trending fracture zones the prevalent fracture direction in Arizona since the Precambrian, allowed the circulation of geothermal convection cells altering the surrounding rock and emplacing base and precious metal mineralization. At specific weak spots, this hydrothermal activity appeared to be concentrated and the zones of concentration as known at this time would include the main part of the Tombstone district, the State of Maine area, the Robbers Roost breccia pipe area, the Charleston lead mine area, and possibly mesquite twig geochemical anomalies at Government Draw and Louis Springs (Newell, 1974, p.148-155), and possibly magnetic anomalies at the Charleston crossing, on the Huachuca Military Reservation, west of the San Pedro River, and at Fairbank. Following Newell's chronology, the writer has rearranged the chronology to support the evidence for caldera formation, and intrusion of the the Schieffelin Granodiorite after the extrusion of the Uncle Sam tuff and caldera collapse. The reader should note that the rearranged chronology is permissable within the sound chronologic evidence cited by Newell. The only major change is the timing of movement on the Ajax fault, extrusion of the Uncle Sam tuff, and intrusion of the Schieffelin Granodiorite along the caldera fracture zone - all of which are permissable under Newell's cited geochronologic evidence:

Chronological Summary--Igneous and Structural Activity (Newell, 1974, p. 67-72)

> The following chronological summary is based on field relations and age dates from selected igneous rocks. The summary is presented in a tabulated form to allow better separation and understanding of the complex structural history.
>
> 1. Pre-Cretaceous movement along the Prompter-Horquilla faults. Evidence: Total maximum offset on the Prompter fault is about 4,000 feet, and the Cretaceous Bisbee Formation is offset only about 2,800 feet.
>
> 2. Folding of the Bisbee Formation in the central portion of the Tombstone district. Evidence:
>
>   a. The Tombstone basin is bounded on the west by the Ajax Hill fault.
>
>   b. Fold trends are cut by the Schieffelin Granodiorite, which also cuts the Ajax Hill fault.
>
> 3. Movement along the Ajax Hill fault. Evidence:

a. The Ajax Hill fault cuts the Prompter fault.

b. The Ajax Hill fault is cut by the Schieffelin Granodiorite.

c. The Ajax Hill fault bounds the western margin of the Tombstone basin.

4. Extrusion of the Bronco Andesite, followed by extrusion of the Bronco Rhyolite. Evidence:

a. The Bronco Rhyolite cuts the andesite, immediately north of the Charleston lead mine.

b. The Uncle Sam Tuff cuts the Bronco Andesite (center sec. 28, T. 20 S., R. 22 E.).

c. The Uncle Sam Tuff intrudes the Ajax Hill fault. Note: The Ajax Hill fault is not in contact with the Bronco volcanics, and the possibility exists that these volcanics pre-date the Ajax Hill fault.

5. Intrusion of the north-trending andesite porphyry dikes. Evidence:

a. The dikes cut folds within the Bisbee Formation.

b. The dikes occur in sedimentary rocks which contain the Schieffelin Granodiorite at depth.

c. The dikes do not cut the Schieffelin Granodiorite.

6. Intrusion of the Schieffelin Granodiorite. Evidence:

a. The granodiorite cuts the Ajax Hill fault.

b. The Schieffelin is less siliceous than the Uncle Sam Tuff.

c. Creasey et al. (1962) dated the granodiorite at 72 m.y.

7. Renewed movement along the Prompter fault. Evidence:

a. The Prompter fault cuts andesite porphyry dikes.

b. The Prompter fault offsets the Ajax Hill fault.

8. Emplacement and extrusion of the Uncle Sam Tuff. Evidence:

a. The Uncle Sam Tuff cuts the Bronco volcanics (sec. 28, T. 20S., R. 22 E., and sec. 25, T. 20 S., R. 21 E.).

b. The Uncle Sam Tuff follows the Ajax Hill fault.

c. A hornblende andesite dike cuts the Schieffelin Granodiorite and the Uncle Sam Tuff north of Bronco Hill.

d. The Uncle Sam Tuff is more siliceous than the Schieffelin Granodiorite.

3. A potassium-argon date (71.9 ± 2.4 m.y., Drewes, 1971) from the Uncle Sam Tuff indicates the same age as the Schieffelin Granodiorite.

9. Emplacement of the quartz latite porphyry. Evidence:

a. The quartz latite porphyry cuts the Bronco Andesite.

b. The quartz latite porphyry is compositionally very similar to the Uncle Sam Tuff. Note: The quartz latite porphyry is probably an equivalent of the Uncle Sam Tuff, but textural evidence suggests the porphyry did not vent to the surface.

10. Emplacement of the granophyre. Evidence:

a. The granophyre intrudes the Ajax Hill fault.

b. The granophyre is intensely altered, and this may be due to the emplacement of the rhyodacite.

11. Emplacement of the rhyodacite. Evidence:

a. The rhyodacite intrudes the Ajax Hill fault.

b. The rhyodacite intrudes the Uncle Sam Tuff.

c. The rhyodacite probably altered the granophyre.

12. Earliest fracturing along the northeast-trending fissures. Evidence:

a. The fissures cut the Uncle Sam Tuff.

b. The fissures are intruded by hornblende andesite dikes.

13. Emplacement of the hornblende andesite dikes. Evidence: The dikes follow the northeast-trending fissures, in the Uncle Sam Tuff, and in the Schieffelin Granodiorite.

14. Introduction of hydrothermal solutions and formation of the base-metal and silver deposits at Charleston and at Tombstone. Evidence:

a. Hornblende andesite dikes are hydrothermally altered (Charleston lead mine; sericite date 74.5 ± 3 m.y., Appendix I).

b. The mineralization followed northeast-trending fractures at Tombstone (Butler and Wilson, 1942, p. 201).

c. Alteration along the Contention dike yielded a potassium-argon date of about 72 m.y. (Gustafson, pers. comm.).

15. Emplacement of the rhyolite porphyry, and associated dikes and sills. Evidence:

a. A rhyolite dike cuts an andesite porphyry dike immediately west of Military Hill.

b. The rhyolite intruded the Prompter fault zone.

c. Creasey et al. (1962) obtained a potassium-argon date of 63 m.y. for the rhyolite.

16. Renewed minor fracturing along the northeast-trending fissures. Evidence: A northeast-trending fissure cuts the rhyolite dike west of Military Hill.

17. Renewed movement along the Prompter fault. Evidence:

    a. A rhyolite porphyry dike is cut and offset left laterally about 200 ft. by the Prompter fault system.

    b. The northeast-trending fissures do not cross faults belonging to the Prompter system.

18. Introduction of the manganese mineralization, in the southern part of the district. Evidence:

    a. Manganese mineralization is intimately associated with the rhyolite porphyry in the Side Wheel mine west of Military Hill.

    b. Alteration related to silver mineralization along the Contention dike yielded an age of about 72 m.y. (Gustafson, pers. comm.).

    c. The age of the rhyolite porphyry is about 63 m.y. (Creasey et al., 1962).

    d. Manganese deposits are closely associated with the Prompter fault (Butler, Wilson and Rasor, 1938, p. 80), and the rhyolite porphyry has intruded along the Prompter fault.

    e. Quarts veinlets were observed paralleling the ore fissure which cuts the rhyolite dike west of Military Hill.

19. Partial district tilting to the northeast possibly associated with the northwest faulting. Evidence:

    a. Quaternary (?) conglomerate beds along Walnut Gulch dip 40 degrees NE.

    b. Northwest-trending faults (Grand Central, East Boundary, and Walnut Gulch) have progressively lowered the district to the northeast.

    c. Northwest-trending faults post-date the mineralization (Butler, Wilson and Rasor, 1938, p. 37).

20. Emplacement of the basalt and phonolite in Walnut Gulch. Evidence: The basalt cuts Tertiary and quaternary (?) gravels.

Chronological Summary -- Igneous and Structural Activity according to hypothesis by Briscoe that the Tombstone volcanics and mineral deposits are a Laramide caldera complex.

The following chronological summary is based on field relations and age dates from selected igneous rocks prepared by Newell, 1974. The summary is presented in a tabulated form to allow better separation and understanding of the complex structural history. Underlined words and phrases are those added by Briscoe. Chronology has been changed by Briscoe to relfect caldera hypothesis - see preceeding chronological summary for Newell's original order.

1. Pre-Cretaceous (Nevadan - 180 m.y. - contemporaneous with movement along Dividend fault at Bisbee) movement along the Prompter-Horquilla faults. Evidence: Total maximum offset on the Prompter fault is about 4,000 feet, and the Cretaceous Bisbee Formation is offset only about 2,800 feet.

2. Folding of the Bisbee Formation in the central portion of the Tombstone district - the folding is probably district-wide at least, and maybe regional. Evidence:

    a. The Tombstone basin is bounded on the west by the Ajax Hill fault.

    b. Fold trends are cut by the Schieffelin Granodiorite, which also cuts the Ajax Hill fault.

    c. Isoclinal folds in basal Bisbee group sediments, north of the Uncle Sam shaft.

3. Extrusion of the Bronco Andesite, followed by extrusion of the Bronco Rhyolite. Evidence:

    a. The Bronco Rhyolite cuts the andesite, immediately north of the Charleston lead mine.

    b. The Uncle Sam Tuff cuts the Bronco Andesite (center sec. 28, T. 20 S., R. 22 E.).

    c. The Uncle Sam Tuff intrudes the Ajax Hill fault. Note: The Ajax Hill fault is not in contact with the Bronco volcanics, and the possibility exists that these volcanics pre-date the Ajax Hill fault.

4. Intrusion of the north-trending andesite porphyry dikes. Evidence:

    a. The dikes cut folds within the Bisbee Formation.

b. The dikes occur in sedimentary rocks which contain the Schieffelin Granodiorite at depth.

c. The dikes do not cut the Schieffelin Granodiorite.

5. Explosive acid volcanism - extrusion of the Uncle Sam Tuff, followed by caldera collapse and resurgence.

a. The Uncle Sam Tuff cuts the Bronco volcanics (sec. 28, T. 20S., R. 22 E., and sec. 25, T. 20 S., R. 21 E.).

b. The Uncle Sam Tuff follows the Ajax Hill fault.

c. A hornblende andesite dike cuts the Schieffelin Granodiorite and the Uncle Sam Tuff north of Bronco Hill.

d. (?)The Uncle Sam Tuff is more siliceous than the Schieffelin Granodiorite(?).

e. A potassium-argon date (71.9 $\pm$ 2.4 m.y., Drewes, 1971) from the Uncle Sam Tuff indicates the same age as the Schieffelin Granodiorite.

6. Movement along the Ajax Hill fault <u>following caldera collapse - 5 above</u>. Evidence:

a. The Ajax Hill fault cuts the Prompter fault.

b. The Ajax Hill fault is cut by the Schieffelin Granodiorite.

c. The Ajax Hill fault bounds the western margin of the Tombstone basin.

7. Renewed movement along the Prompter fault. Evidence:

a. The Prompter fault cuts andesite porphyry dikes.

b. The Prompter fault offsets the Ajax Hill fault.

8. Emplacement of the quartz latite porphyry <u>after caldera resurgence above</u>. Evidence:

a. The quartz latite porphyry cuts the Bronco Andesite.

b. The quartz latite porphyry is compositionally very similar to the Uncle Sam Tuff. Note: The quartz latite porphyry is probably an equivalent of the Uncle Sam Tuff, but textural evidence suggests the porphyry did not vent to the surface.

9. Intrusion of the Schieffelin Granodiorite. Evidence:

a. The granodiorite cuts (intrudes) the Ajax Hill fault.

b. (?)The Schieffelin is less siliceous than the Uncle Sam Tuff(?).

c. Creasey et al. (1962) dated the granodiorite at 72 m.y.

10. Emplacement of the granophyre. Evidence:

a. The granophyre intrudes the Ajax Hill fault.

b. The granophyre is intensely altered, and this may be due to the emplacement of the rhyodacite.

11. Earliest fracturing along the northeast-trending fissures. Evidence:

a. The fissures cut the Uncle Sam Tuff.

b. The fissures are intruded by hornblende andesite dikes.

12. Emplacement of the hornblende andesite dikes. Evidence: The dikes follow the northeast-trending fissures, in the Uncle Sam Tuff, and in the Schieffelin Granodiorite.

13. Emplacement of the rhyodacite. Evidence:

a. The rhyodacite intrudes the Ajax Hill fault.

b. The rhyodacite intrudes the Uncle Sam Tuff.

c. The rhyodacite probably altered the granophyre (and related alteration of the hornblende andesite dikes above).

14. Introduction of hydrothermal solutions and formation of the base-metal and silver deposits at Charleston and at Tombstone. Phreatic (steam) explosive activity at the surface, and fluidized breccia pipe formation in the sub-surface at Robbers Roost and the Charleston Lead Mine area with attendant hydrothermal alteration and base and precious metal mineralization. Evidence:

    a. Hornblende andesite dikes are hydrothermally altered (Charleston lead mine; sericite date 74.5 + 3 m.y., Appendix I).

    b. The mineralization followed northeast-trending fractures at Tombstone (Butler and Wilson, 1942, p. 201).

    c. Alteration along the Contention dike yielded a potassium-argon date of about 72 m.y. (Gustafson, pers. comm.).

    d. Fluidized breccia pipes at Robbers Roost and Charleston Lead Mine.

    e. Cupola of quartz monzonite porphyry intersected in ASARCO drill holes in Robbers Roost area.

    f. Secondary K-spar, biotite, purple anhydrite, disseminated pyrite, chalcopyrite and molybdenite intersected in ASARCO drill holes in the Robbers Roost area.

    g. Sericite, sphalerite, galena, disseminated pyrite, and silver values intersected by Horne drilling in Charleston Lead Mine area.

15. Emplacement of Extension quartz monzonite porphyry. Evidence:

    a. Potassium-argon (hornblende) of 62.8 $\pm$ 2.6 m.y. by Briscoe/Drewes.

16. Emplacement of the rhyolite porphyry, and associated dikes and sills. Evidence:

    a. A rhyolite dike cuts an andesite porphyry dike immediately west of Military Hill.

    b. The rhyolite intruded the Prompter fault zone.

    c. Creasey et al. (1962) obtained a potassium- argon date of 63 m.y. for the rhyolite.

17. Renewed minor fracturing along the northeast- trending fissures. Evidence: A northeast- trending fissure cuts the rhyolite dike west of Military Hill.

18. Introduction of the manganese mineralization, in the southern part of the district. Evidence:

    a. Manganese mineralization is intimately associated with the rhyolite porphyry in the Side Wheel mine west of Military Hill.

    b. Alteration related to silver mineralization along the Contention dike yielded an age of about 72 m.y. (Gustafson, pers. comm.).

    c. The age of the rhyolite porphyry is about 63 m.y. (Creasey et al., 1962).

    d. Manganese deposits are closely associated with the Prompter fault (Butler, Wilson and Rasor, 1938, p. 80), and the rhyolite porphyry has intruded along the Prompter fault.

    e. Quarts veinlets were observed paralleling the ore fissure which cuts the rhyolite dike west of Military Hill.

19. Renewed movement along the Prompter fault. Evidence:

    a. A rhyolite porphyry dike is cut and offset left laterally about 200 ft. by the Prompter fault system. The Free Coinage vein in the State of Maine area is offset 200 feet left laterally by the northern bifrication of the Prompter fault

    b. The northeast-trending fissures do not cross faults belonging to the Prompter system.

20. Partial district tilting to the northeast possibly associated with the northwest faulting. Evidence:

    a. Quaternary (?) conglomerate beds along Walnut Gulch dip 40 degrees NE.

    b. Northwest-trending faults (Grand Central, East Boundary, and Walnut Gulch) have progressively lowered the district to the northeast.

    c. Northwest-trending faults post-date the mineralization (Butler, Wilson and Rasor, 1938, p. 37).

21. Emplacement of the basalt and phonolite in Walnut Gulch. Evidence: The basalt cuts Tertiary and quaternary (?) gravels.

Plio-Pleistocene(?) Gila Conglomerate is exposed along Walnut Gulch south and east of Tombstone. These gravels, which are well indurated by calcium carbonate, are faulted and tilted about 40 degrees to the northeast (Newell, 1974, p. 72), and probably occupy valley basins and pediment areas surrounding the Tombstone Hills. Quaternary alluvium lies both on the Gila Conglomerate as well as older rock units, and comprises thin cover in low lying areas within the Tombstone Hills, and thicker cover within the surrounding valley basins. A small basalt dome (Newell, 1974, p. 61) intrudes the Gila Conglomerate and Quaternary gravels along the east side of Walnut Gulch, approximately one mile northeast of Tombstone.

SURFACE GEOLOGY IN THE STATE OF MAINE AREA

General Background

Author's Previous Work in the Area

The author's first professional geologic work in the Tombstone District and the State of Maine area, took place in 1973, when he was engaged by 1971 Minerals, Ltd. to undertake a geologic evaluation of the State of Maine mine area, in order to delineate mineral targets that would relate to production anticipated from the State of Maine workings and processing of gob from the old stopes. Since it appeared that potential was for relatively small but rich bonanza-type ore bodies, it was felt that a detailed map would be required. The first order of business was to obtain an accurate topographic map at a scale of 1" = 200' with five foot contour intervals.

Base Map Preparation, 1973

The base triangulation survey for the 1973 base map was surveyed by Florian and Collins, civil engineers from Tucson, Arizona. Elevation control was tied to the state survey, using the bench mark at the Public Library at Tombstone. Primary control points were surveyed using theodolites and a Hewlett-Packard distance measuring device. The survey is first order in nature and adheres to minimum government specifications. In addition to the primary control points, all identifiable claim monuments and posts were targeted with white, 24 inch wide butcher paper, in the form of a "Y", with the monument in the center and legs extending outward 10 feet in length. In addition to claim monuments, fence corners, other property boundaries of interest, and some power poles were thus targeted. Probably at least 200 points were so identified. The area was then flown by Cooper Aerial Survey and photographed with black and white film using a Wild RC-10 mapping camera. The map was compiled using Kelsh plotters. Each of the targeted claim monuments and other points of interest were surveyed on the Kelsh with their location and elevation being noted to the nearest one-half foot. Thus, in addition to the topographic lines, there are numerous permanent points of reference scattered throughout the map area. Patent corners of the patented claims were thus accurately located, and claim lines were plotted on the map. Topographic features were scribed on mylar scribecoat and a screened mylar, right-reading base map sheet was then photographically reproduced from the scribecoat master. The scribecoat master remained on file at Cooper Aerial.

Base Map Update, 1985

When the author was engaged by Tombstone Silver Mines, Inc. to review the geology of the area, so many changes had taken place with regard to roads and other culture, particularly in the northwest quarter of Section 16, which covers the primary operatings of the State of Maine Mining Company, a new updated map was required. Unfortunately, the control points surveyed in 1973 by Florian and Collins were marked with wooden stakes and these could no longer be located. Thus, another triangulation control base tied to the state coordinate system was put in by Moria Surveying of Tombstone. Again, theodolites and distance measuring equipment was used for first order survey. Claim corners not targeted in 1973, were targeted again with white, 24 inch wide butcher paper, with legs fifteen feet long. All drill holes that could be located were targeted with butcher paper also. Where drill holes were closely spaced and lay in a line, the end drill holes were marked with a "T", and the intervening drill holes were marked with a twenty-four inch square sheet of butcher paper. Adits were also marked with a "Y" symbol, the "Y" aligned along the direction of the adit. The collars of shafts were also marked because in 1973, with the Kelch then in use, it was difficult, if not impossible, to determine black mine shafts from dark colored surrounding mesquite bushes. It turned out that with new color photography, which was used for mapping, combined with new optical plotters, vertical mine openings could be seen without difficulty, without the expense of targeting paper.

Cooper Aerial re-flew the area at two scales. One flight line which covered the desired width was flown at 1:12600 (1" = about 1,000'), while another set of photos was flown at the larger scale of 1:6,000 (1" = 500). This was done so that as the need might arise, a topographic map at a scale of 1" = 50' with a two foot contour interval could be prepared of any area within the over flight zone. Initially, the northwest quarter of Section 16, where all mining and exploration activity of significance in the previous decade had taken place, was to be mapped at this larger scale, as well as the smaller scale, wider coverage map at 1" = 200' with five foot contour intervals. Coordinates used on the 1973 vintage map were arbitrary, while on the 1985 vintage map, the state coordinate system was used so that it could be compared with other map data within the district. Cooper was able, using their sophisticated computerized equipment, to re-calculate their original photo control points and re-position the coordinate system to correspond to the state coordinate system. They then updated areas of change without the necessity of re-drafting the entire map, thus saving a substantial expenditure. The fifty-scale map of the northwest quarter of Section 16, was actually drawn from the plotting equipment at a scale of 1" = 100', and photographically enlarged two X, without loosing the required accuracy. Both topographic maps were scribed on mylar scribecoat material, from which photographic reproducible mylar copies were made. The topography and other data on the scribecoat master was screened 80% during printing so that annotations on the base map would not be confused or obscured by the base map information. The scribecoat mylar masters remain on permanent file at Cooper Aerial Survey, from which additional, right-reading photo mylar base maps can be produced.

With the voluminous drill hole data, including elevation control plotted on the fifty-scale map, it was determined that the map was too cluttered to be useable for presenting additional geologic information. Therefore, all of the elevation data for the drill holes and coordinates for the base triangulation survey were transfered onto an overlay called the Control Overlay. In this manner, the more simplified base map showing only the drill hole and triangulation point position could be used for geologic presentation purposes. However, by double burning the photographic mylar, a base map containing all information could also be reproduced. All three master sheets, that is the topographic map at a scale of 1" = 200', the topographic map of the northwest quarter of Section 16 at a scale of 1" = 50', and the Control Overlay (control point master overlay) for the fifty-scale map, can be upadted at any time as far as the position of new drill holes, roads, control points, etc.

The original presentation of the fifty-scale map of the northwest quarter of Section 16 came in four sheets, 30" x 30" square. Unfortunately, the joint of this four sheet composite map fell precisely in the middle of the most active mining area. Therefore, yet another composite map, thirty inches square, was constructed by combining the four sheets photographically to form one master original.

Once the topography was completed, two rectified color photo enlargements at a scale of 1" = 50' were matched as closely as possible to the fifty-scale topographic map. These enlargements, from negative 3-5, overlap in the center, but cover the active mining areas in the northwest quarter of Section 16. Although the match is not perfect because of distortion due to elevation differences, particularly over Uncle Sam Hill, the match is close enough so that data can readily be transferred from the color photo to the fifty-scale base map. The resolution on these color photo enlargements is excellent, both in clarity of surface features, as well as color rendition, particularly of alteration patterns and red earth tones due to oxidizing sulfides. Features as small as a two-foot clump of grass, telephone poles and even telephone lines, fences, as well as drill hole markers of the 24" X 24" sheets of butcher paper, can easily be seen. A rough count suggests that for each 30" x 30" photo, there are some 45,000 points of reference.

Geologic Mapping Methods, 1973

In 1973, black and white photos enlarged to a scale of 1" = 200', were used in field mapping. The geologic features were then transfered to the topographic base map. The technique of geologic outcrop mapping was employed. That is, only features that were actually seen in outcrop were plotted on the map. Little or no interpretive information has been added to the base geologic map. Further, actual rock outcrops were shown in the original 1973 colored map in a darker color, while talus-covered slopes on which bedrock was indicated by the presence of only one type of rock detritus, but in which no actual outcrops were present, are indicated by lighter colors. For the most part, it was impossible to trace small vein or dike features through areas of detrital cover. To aid in exploration, numerous bull-dozer roads and cuts were put in, an effort being made to anticipate future drill sites.

In addition to the surface geologic mapping, the black and white contact air photos were examined stereoscopically and linear features identified. These linear features were shown on the original map as heavy dashed blue lines. They probably represent fault or shear zones of substantial magnitude, although their presence can rarely be seen on the ground.

Geologic Mapping Methods in 1985

In 1985, updating of the 1973 vintage map began first by photo interpretation using a mirror stereoscope of the 1" = 1,000' and 1" = 500' scale color air photos, where in 1973, only black and white photos were used. Because of the color of alteration zones, which ranged from red to white, depending on the amount of limonite in outcrop, veins as well as large areas of alteration could be precisely mapped. This was not possible in 1973. Better stereo equipment, as well as transparent inkable mylar overlays and colored permanent marking pens, which were not available in 1973, also made photo interpretation easier and more efficient. Photo interpretation on this new photography had one at three different scales and two different ways. First, both the 1" = 1,000' and 1" = 500' photography was examined with a mirror stereoscope, both with 5X binoculars, and without binoculars. Rock types, alteration features, fault zones, vein zones, prospect pits and mine shafts, were annotated onto transparent overlays on the photo. Also, color photo enlargements at a scale of 1" = 50', matched to the topographic map of that area, were prepared. At this scale, the same type of features could be mapped much more precisely. A more detail-ed description follows:

Stereo Photo Interpretation of 1" = 2,000' and 1" = 1,000' photography

In addition to the new photography, a color photo mosaic of 1973 vintage photography at 1:24,000 scale covering approximately 345 square miles, was prepared by Cooper Aerial Photography, Inc. A second set of the mosaic photos was also printed so that the mosaic could actually be examined and annotated on it in stereoscopic view. This scale of photography is most valuable in mapping large, through going, structural or geologic features of district-wide proportions, i.e., features with a strike length of a minimum of several hundred feet, up to ten or more miles in length. Since the purpose of this report is not regional in scope, but pertains to the immediate State of Maine mine - Tombstone Silver Mines, Inc. property, this district-wide map was not studied in detail. However, it should be noted that the structural texture within the Tombstone Silver Mines, Inc. property is simply a continuation or part of the structural fabric prevalent within a ten mile radius. Northeastern fractures and drainages predominate while north-south and north-west fractures can also be identified. These north-south, north-east and north-west fracture patterns are reflected in the San Pedro River drainage, showing its response to the structural fabric of the district.

Aside from the caldera margin fault and its associated geologic complexities, the Prompter Fault, a major east-west feature, may have important structural influence on the Tombstone Silver Mines, Inc. property. The Prompter can be followed as a continuous feature from U. S. Highway 80 (the Jefferson Davis Memorial Highway), 9,000 feet southeast of the edge of Tombstone, almost due west some 15,000 feet to a point approximately 2,800 feet west of the old Prompter shaft. At this point, the fault splits, or bifricates, and appears to be broken into a west-south-west trending segment, and a northwest-trending segment. This bifrication takes place at the intersection of the Prompter with the Ajax fault, which is also the edge of the caldera margin. The west-southwesterly split can be followed as far west as the San Pedro River, where it causes an abrupt westerly-trending bend in the river drainage, 17,000 feet south of Fairbank. The northeasterly branch passes through the north slope of Mays Hill, and can, with difficulty, be followed also to the San Pedro River, where it appears to also cause a westerly-trending bend in the San Pedro, about 15,000 feet north of Fairbank. The northeasterly branch of the Prompter fault appears to cause the slight left-lateral offset in the Free Coinage-Merrimac vein, just north of the Merrimac end line. The Free Coinage West vein may also terminate to the southwest against this projection of the Prompter, and it also appears to have some effect on terminating the northern end of the San Pedro vein system. In fact, most significant mineralization appears to die out abruptly to the north of this feature. No such termination of mineralization appears to be caused by the southwestern branch of the Prompter, however. It is not clear whether all movement along this feature is post-mineral. However, its trace does not appear to be represented by vein zones (except in the Prompter mine area itself), so it is assumed that most of the movement in the Tombstone Silver Mines, Inc. area has taken place after the mineralizing episode. However, since the Prompter was also active prior to mineralization, it may have played a roll in localizing the silver mineralization that appears to be concentrated in the area of the State of Maine mine. The specifics of this relationship are not clear at present.

The plotting of prospects, fracture zones, alluvial bedrock contacts, and vegetation alignments and fault zones, reveal various important features of the economic geology within the Tombstone Silver Mines, Inc. property, only the highlights of which will be described here. As work progresses on Phase I of the proposed exploration program, these features will be plotted on the 200 scale topographic map.

From the photos it was noted that the Clipper-Free Coinage vein system appears to be one in the same, and it could be followed from the north end of the Free Coinage zone southward 6,000 feet where it intersects a slightly more northeasterly trending vein - drainage system, though there is some suggestion that it may be projected for another 2,000 feet south, giving it a possible length of 8,000 feet. The May vein can be seen to intersect with the Clipper, approximately 1,500 feet south of the Clipper claim end line, the intersection zone showing an increased intensity of limonite stain as well as a prospect pit. The Triple X and Merrimac #1 vein appear to form a four-way intersection with the Clipper vein and a possible post-mineral fault, partially under the Big Pond water retention dam. This area of intersection may localize mineralization, and, therefore, be an attractive drilling target.

Five-Hundred Scale Photography

On the 500 scale photography, the same features identified over a broader area are seen in sharper detail. A vegetation alignment passing through the Charlou office trailer was noted, although the same feature was overlooked on the smaller scale photography. Alteration patterns could be more closely defined so that their outcrop can be more precisely plotted.

1" = 50' Color Photography Matched to Topography

Two 30" X 30" blow ups were made from the 1:6,000 scale negatives, covering about 75% of the northwest quarter of Section 16 - the area of active mining. This photography could not be examined in stereo view (because of the lack of a stereo pair, though the scale would make it unwieldy), but was used for both office interpretation and for a field base map for in-field follow up. The photograph was securely stapled to a 1/4" plywood board with strap for carrying. A sheet of inkable Stabalene mylar was then stapled over the photograph. Itoya-Nikko fine point system permanent ink disposable drafting pen in black, and Stabilo (German) overhead projection waterproof (permanent) colored pens were used to annotate features onto the transparent overlay. These pens, I might add, were also used on the 9 x 9 photos. All cultural features, including fence lines, power poles, bushes and grass clumps more than a foot in diameter, as well as boulders and power lines were all visible to a greater or lesser degree, and could be used for navagational points. Further, since most drill holes had been targeted with two foot squares of white butcher paper, these could also be easily identified. Alteration patterns in both outcrop and as soil coloration in sub-outcrop, and by both color and reflectivity in trenches, could be closely identified and plotted. In fact, a rough count suggests approximately 45,000 such reference points on the 30 X 30 photograph. The fine color quality allowed the plotting of subtle tonal and color variations representing similar subtle variations in alteration, limonite (after pyrite), and it is assumed corresponding precious metal indicators. As a result, great detail on the delimitation of vein zones and alteration features, in addition to the cultural features, could be obtained. On completion of field mapping with this photo (though further work will probably reveal additional data), the geology was digitized on the CAD (Computer Assisted Drafting) system, and plotted on a mylar overlay at 1" = 50'. On overlaying this plot onto the topographic map, it was found that at this scale, there was about one inch of distortion across the photograph, primarily going upslope towards Uncle Sam Hill. On re-plotting at 1" = 200', it was found that errors at this scale were not significant. Since no optical lens, color air photo can be matched exactly to a planometric topographic map, this map distortion was not unexpected and the usefulness of the photography for this detailed geologic mapping can certainly not be negated.

After mappig on this photo base, it was found that one of the vegetation alignments noted on the 1,000 and 500 scale photos was an old wagon road and had no geologic significance. The vegetation alignment passing by the northwest corner of the Charlou office trailer was confirmed as being a vein by both surface mineral rubble - primarily limonite stained quartz, as well as two backhoe cuts across the vein. After the backhoe "excavator" was used to trench across the vein, it was found that the boundaries of the vein could be picked within approximately one foot accuracy. This vein has been termed the "Office Vein" and after confirmation by backhoe cutting and further examination of the photo, a second vein indicated by a vegetation alignment approximately 20 feet to the west, was identified. This was also confirmed by backhoe cutting. This vein is termed the "Office Vein West", and yet another vein which had already been cut obiquely by backhoe cuts made the preceding year, was identified and termed the "Office Vein 1 East". Further, sinuous veins extending from prospect pits on the May claim were mapped in detail. Though prospect pitting possibly dating back to the 1880's had been sunk on these veins, no recent exploration had been done. This identification of new veins approximating 3,000 feet in length, alone, justifies the expense of the color photo enlargement. Details of the width and length of other vein features in a way that would not have been impossible, but would have only been performed with great difficulty using black and white photos, or topographic map or without plane table, were identified. It is thus concluded that field mapping on the remainder of the Tombstone Silver Mines, Inc. property in the Tombstone Mining District, and elsewhere, should be performed either at the 1" = 50' scale where great detail is required, or perhaps at 1" = 200', where lesser detail is necessary.

After photo interpretation of the smaller scale color contact print stereo pairs at both scales, the 1" = 50' color enlargements matched to the topography in the northwest quarter of Section 16, were interpreted. By using all three scales of photography, large features crossing the district could be identified on the fifty-scale photography, which features visible on the fifty-scale photography could be cross referenced to the 500 and 1,000 scale photography.

Computer Assisted Drafting Equipment

Recent advances in micro-computer technology has reduced the cost of computer assisted drafting to make it affordable to relatively small companies. The author has been investigating various CAD (Computer Assisted Drafting) systems for the previous year, and when the project was presented for the Tombstone Silver Mines, Inc. properties in Tombstone, it was recommended that a CAD system be used to reduce the drafting and calculation requirements for ore reserve and geologic evaluation. Therefore, Charlou Corporation purchased a CAD system, consisting of a Tandy 2000 computer with a 20 megabyte hard disk, a Houston

Instrument CD size plotter, a Hewlett-Packard 17" X 24" digitizer, and an AUTO-CAD software system by AUTO DESK, Inc. This equipment, costing approximately $10,000, provides state-of-the-art micro-computer CAD drafting and calculating facilities. It is operated by geologist, Bailey Escapule. All geologic, survey and ore reserve data has or is in the process of being entered into this system. A substantial reduction in total drafting time, as well as a vastly more flexible method of manipulating map data is possible with this system. For example, maps can be entered at a very large scale, and reduced to a very small scale, or conversely, entered at small scale and enlarged to extremely large scale. A map can be printed at any scale desired. It s immediately obvious that original maps at different scales can be entered into the computer and then combined to form one composite map. Measurements can be entered into the computer accurately for four decimal places, and again printed out at any required scale. Measurement of the areas irregular areas can be accomplished within a few moments by the computer. It is anticipated that during the exploration and operating phases, all maps and cross sectional data can be entered into the computer, cataloged on its data base management system, and retrieved and manipulated at will. This will substantially reduce the engineering man power required, and thus, engineering management costs.

Both the 1973 geologic map data over the State of Maine area, and the more recent data on the fifty-scale photo enlargement base has been entered into the computer and combined to form the map presented in Figure 29. The cross section, Figure 30, has also been produced by the CAD system.

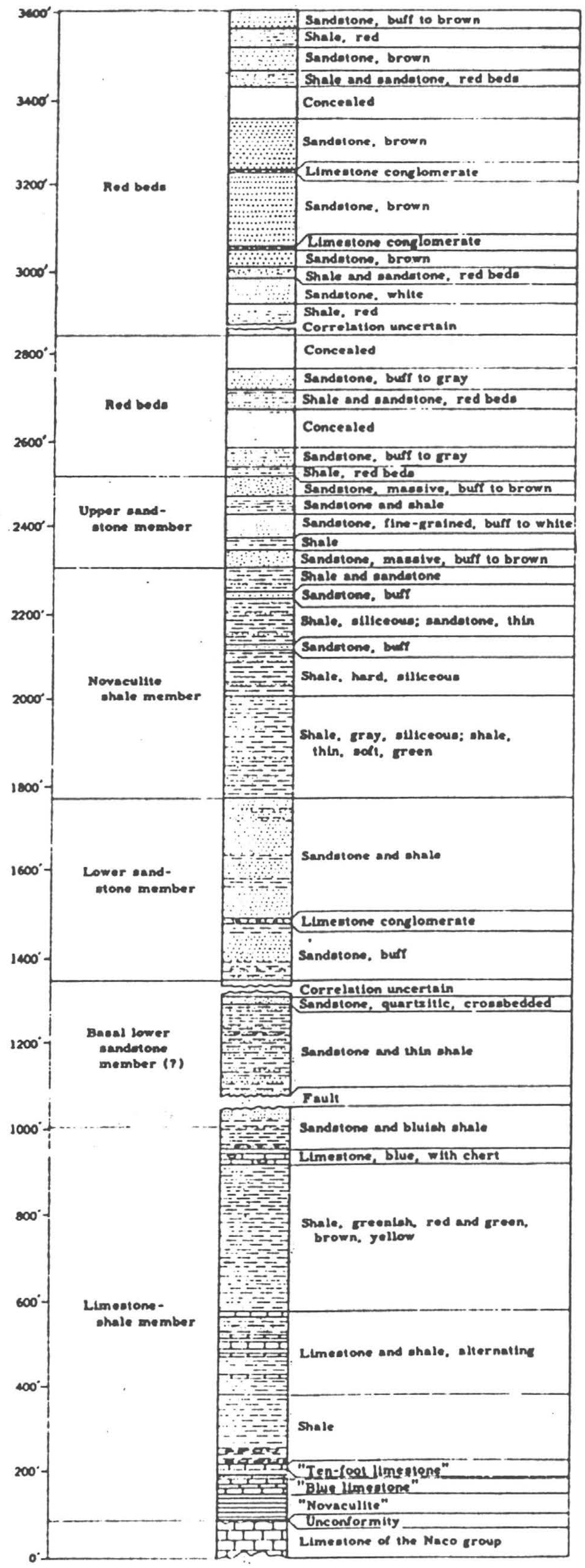
Sedimentary Rocks

Quaternary Alluvium

Quaternary alluvim consisting, for the most part, of stream wash, is located in valley bottoms. The thickest accumulations of Quaternary alluvium occurs in the north-trending drainage directly east of the Free Coinage claim where it is probably ten to a few tens of feet thick. In this area, it obscures the contact between Bisbee Group sediments and Uncle Sam tuff. It is locally up to 15 or more feet thick in the Fox Ranch area, as indicated by scraper cuts. However, in the remaining wash areas, it is probably 5 feet or less in thickness. The contact of the alluvium with bedrock is generally arbitrary and marked with a dashed line on the geologic map. There was insufficient time in this study to map in detail all of the small outcrops within the stream drainage areas marked Quaternary alluvium on the map. In the Fox Wash area in particular, there are numerous windows of bedrock sticking through alluvium.

Bisbee Group Sediments

The great preponderance of sedimentary outcrops within the bounds of the State of Maine geologic map are nondescript Bisbee Group sediments -- probably equivalent of the Morita and Cintura formations as described in the Bisbee area. The sediments can generally be characterized as red bed units consisting of sandstones, quartzites, and arkosic sandstones, shaley mudstones, and shales (Figure 27). Over most of their exposures within the map area, these sediments are soil covered, the rock type indicated only by detrital fragments. Because of this rapid weathering to soil, few exposures show sufficient bedding to determine strike and dip. Where seen, divergent attitude of bedding precludes meaningful comment regarding the detailed structure of Bisbee Group sediments in this area. It is suggested by regional aspects, however, that the beds are generally tilted to the east so that by progressing in a westerly direction, the base of the unit is approached. This idea is reinforced by the presence of limestones cropping out north-northwest of the Free Coinage claim (about 1,600 feet north of the Uncle Sam shaft), and also exposed in the window in the Fox Ranch area. These limestone units are probably corelative of either the Ten Foot or the Blue limestone ore horizons present in the main part of the district. Further evidence of this is suggested by the presence of a quartzite pebble conglomerate, exposed in the Fox Ranch window. This conglomerate is probably the Glance conglomerate. In most of the Tombstone area, the



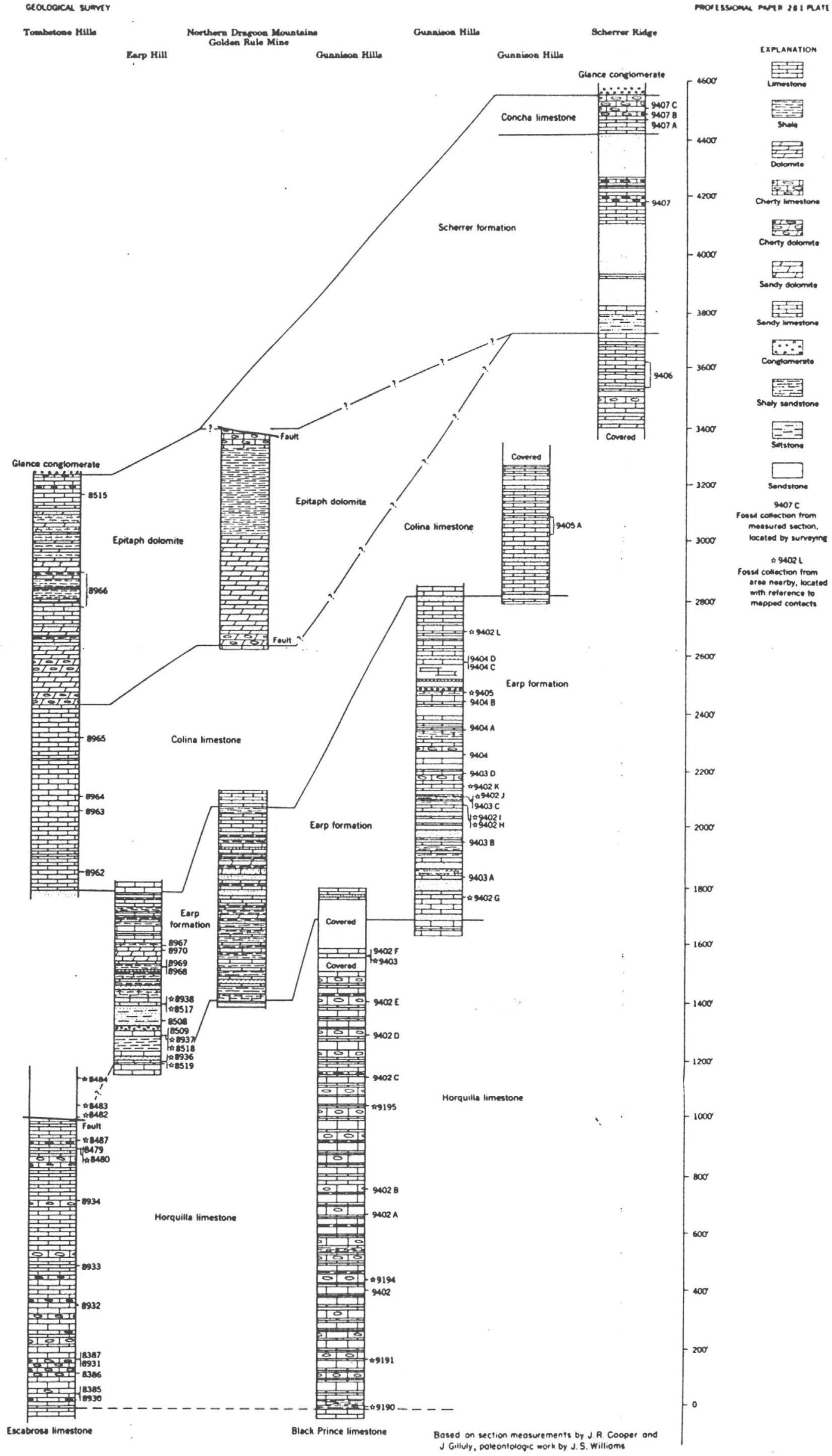
—Composite section of the Bisbee formation in the Tombstone mining district. After Lyden, O'Donnell, Hernon, and Higdon (unpublished mine rept., 1937).

Figure 27

Glance is not exposed; however, as shown in Figure 28, Gilluly and other workers in the district do show the Glance to be present, at least locally. Where intersected in mine workings, it is intensely silicified and has been termed the "Novaculite". In a small outcrop 2,000 feet north-northwest of the Uncle Sam shaft, there is exposed bleached quartzite breccia, which may be the equivalent of the Novaculite. Similar limestones and conglomerates appear to be absent in the Solstice Hill area, and thus, although not conclusive because of small outcrops and structural complexities, it is presumed that the limestones exposed north of the Uncle Sam shaft and in the Fox Wash window are basal Bisbee formation -- a critical point since this implies that Paleozoic Naco Limestone should be present within a short distance, either horizontally west below the Uncle Sam tuff, or vertically below.

Paleozoic Sediments

No Paleozoic sediments have been mapped within the State of Maine area geology map. Geologic relations indicating that lower Bisbee sediments are exposed in the central part of the mapped area (as discussed above) suggest that Paleozoic sediments should be located shallowly beneath the lower Bisbee in the Fox Ranch area. Futher, it is possible that Paleozoic limes may have been exposed in the pre-Uncle Sam erosion surface, and are now covered by that tuff layer.



CORRELATION OF THE PENNSYLVANIAN AND PERMIAN ROCKS WITH THOSE OF THE DRAGOON QUADRANGLE, ARIZONA

371235 O - 56 - 1 (In pocket)

Figure 28

Igneous Rocks

Uncle Sam Quartz Latite Tuff

Uncle Sam quartz latite tuff comprises the largest area of outcrop within the State of Maine area. The high peaks of Three Brothers Hill, the Dome, Uncle Sam Hill, and Buckman Hill, are all composed of the Uncle Sam tuff.

The tuff has an aphanetic ground mass with phenoclasts of quartz and plagioclase feldspar. A more detailed description can be found in Newell, 1974, p. 47-53. Drewes (1971) obtained a potassium-argon age of 71.9 ± 2.4 m.y. for the rock. Xenoliths of Bisbee Group sediments are prevalent throughout its exposures, and where it is in contact with the underlying Cretaceous Bisbee Group, the xenolith content increases and the rock appears to almost grade into the sediments. The tops of the higher hills appear to be composed of a more resistant, more strongly welded unit of the Uncle Sam. It is unclear whether this is a primary rock feature or a secondary alteration feature.

The Uncle Sam shows tabular relations in most of the State of Maine area (Figure 29). However, its contacts with the Bisbee Group, approximately 600 feet northeast of the northeast sideline of the Merrimac claim, appears to be steep, as indicated by its lack of deviation across the steep slope in the area. This contact could be a fault. At the northern exposure of the State of Maine vein, 1,100 feet north of the Uncle Sam shaft, indicated by topography, the exposure suggests a flat, tabular contact. About two hundred feet north, it again appears to dip steeply. In all probability, these areas may be feeder dikes, and as such, have continuity of the quartz latite in depth.

If it is remembered that the State of Maine area was at the interior edge of a blossoming caldera, and probably very active tectonically, it is easy to envision steep topography with active fault scarps. The Uncle Sam tuff was deposited over hills, valleys and fault scarp terrain. It is also possible there may be feeders for the Uncle Sam buried by the ash fall within the State of Maine area.

Schieffelin Granodiorite

The Schieffelin granodiorite is a holocrystalline rock. In hand specimen, it is light greenish-gray or pinkish-gray, and mildly porphyritic (Gilluly, p. 103), weathering to a buff color. Petrographically, it is intermediate between quartz monzonite and granodiorite, and could easily be called a quartz monzonite (Gilluly, p. 102). No outcrops of this rock were mapped within the State of Maine area. A complete petrographic description is given in Gilluly, p. 103.

Andesite Porphyry Dikes

Andesite porphyry dikes were mapped on the State of Maine map in only one area which is slightly south and west of the Gold Bug prospect. Dikes of the same type, however, were observed south of the southwest endline of the Chance claim. However, no detailed mapping was done in this area. Similar dikes are very prevalent in the Robbers Roost breccia pipe area. The dike rock consists of a dark-green chloritic-looking matrix, in which are set white feldspar phenocrysts. The dikes are pre-mineral in age and also predate the rhyolite porphyry. In the andesite dike mapped southwest of the Gold Bug area, rhyolite porphyry invades both the hanging wall and footwall of the dike and is younger in age as indicated by spherical xenoliths of andesite porphyry in the rhyolite.

Rhyolite Dikes

Several discontinuous rhyolite porphyry dikes crop out in the central part of the mapped area, and can be traced from the area of the Gold Bug prospect to the north end of the Clipper claim. These dikes were overlooked by previous writers, and mapped as Bisbee sediments by both Lee (1967, Figure 3) and Newell (1974, Plate 1 & 2). The dikes generally have a steep northwesterly dip, although in the Brother Jonathan area, one dip of 42 degrees is recorded. Flow structure generally parallels the walls of the dikes. However, a large dike on the Clipper claim shows turbulent flow structure. The dike outcrops are generally limonite-stained from disseminated pyrite content, are occasionally cut by vein structures, and are more resistant than the surrounding tuff. The spatial relationship of the rhyolite porphyry dikes to the productive part of the State of Maine vein suggests some basic relationship to mineralization. Numerous assays of dike material (though strongly altered) show only background amounts of base and precious metals. It is probable that the dikes and/or their plutonic source resevoir at depth provided the heat source to drive the hydrothermal fluids responsible for the nearby vein mineralization. Why the dikes themselves do not host ore mineralization is not clear. The State of Maine area rhyolite dikes may be of the same age and from the same source as the rhyolite dikes which intrude the

Prompter fault, the area west of Military Hill in the vicinity of the Emerald mine, and the sills of rhyolite which invade Paleozoic sediments near the Tombstone airport on either side of U. S. 80. Those rhyolites have been dated at 63 m.y. (Creasey, et al., 1962). The previously overlooked Extension quartz monzonite porphyry mapped in 1982 by the writer (see section on General Geology), is shown by Drewes (1985, pers. comm.) to be 62.6 ± 2.8 m.y. by potassium-argon (hornblende). This newly recognized plutonic rock may be the source for all of the 63 m.y. old rhyolites in the Tombstone district. The outcrop from which the age date sample was taken showed green copper oxide, suggesting this age intrusive may be more related to porphyry copper systems than the older 72 m.y. alteration in the main part of the district, which appears to have lead-zinc affinities (Keith, 1983).

GEOLOGY AND PROPERTY MAP
OF THE
TOMBSTONE SILVER MINES, INC. PROPERTY
IN THE VICINITY OF
THE STATE OF MAINE MINE
TOMBSTONE MINING DISTRICT
COCHISE COUNTY, ARIZONA

by: JAMES A. BRISCOE

EXPLANATION

Qal Quaternary Alluvium

Rhyolite Porphyry

Andesite Porphyry

Kut Cretateous Uncle Sam Tuff

Cretateous Bisbee Group Sediments

Kb Shale, Sandstone, Quartzite

Kbg Glance Conglomerate

Kbbl Blue Limestone

0 250 500

Scale: 1 in. = 500 ft.

Drawn by: Bailey Escapule
October 15, 1985

SYMBOLS

a. Anticline b. Syncline
Showing trace of axial plane

Contact
Dashed where approximately located
dotted where concealed

Fault

Vein

Photo Linear

Dashed where approximately located
dotted where concealed

a. 25 b. 30 c. 35

Strike and Dip

a. Bedding trends
b. Joint trends
c. Flow structure

Measured Veins
(length x width)
Precisely mapped at 1 in = 50 ft
on color photos

Property Boundaries

Surveyed Property

Boundaries from Metes and Bounds Desc. - Unsurveyed


Fox 11
12
13
14
15
16
21
Sect. 8
Sect. 9
Sect. 17
Sect. 16
Fox 4
TSM-B3
TSM-B2
TSM-2A
TSM-1A
TSM-B1
TSM-B4
TSM-3A
UNCLE SAM HILL
TSM-4A
TSM-5A
TSM-6A
TSM-B5
TSM-B6
SHOP
OFFICE
Mountain View 1
Solstice 3
FREE COINAGE
SAN PEDRO
TRUE BLUE
FOX WASH
BUCKMAN HILL
LOWELL
LOWELL RIDGE
BROTHER JONATHAN
TRIPLE EX
MERIDIAN
MAINE
CHANCE

Figure 29

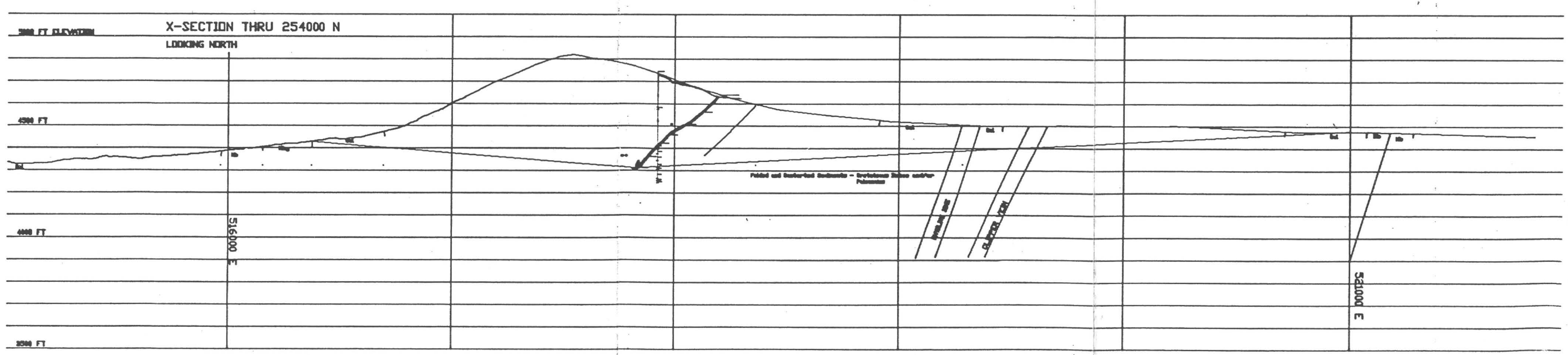

X-SECTION THRU 254000 N
LOOKING NORTH
4500 FT
4000 FT
3500 FT
516000 E
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Figure 30

STRUCTURAL FEATURES OF THE STATE OF MAINE AREA

General Statement

Structural features within the State of Maine area can be broken down into two broad categories -- steeply dipping features and horizontal and sub-horizontal features. Steeply dipping features which can be easily traced and mapped on the surface would include veins, vein zones, dikes, post-mineral faults, photo-linears, and vegetation alignments. Horizontal and sub-horizontal features would include thrust fault planes, bedding and fault planes with an angle of dip of less than 20 degrees and the basal contact of the Uncle Sam tuff. The horizontal and sub-horizontal features are either poorly exposed or not exposed at the surface, and can only be inferred from detailed surface geologic mapping or measured by drilling. Only the steeply dipping features will be discussed in this section, while the low angle features will be discussed under the heading Sub-Surface Geology, State of Maine Area.

Vein Zones

The strongest direction of structural fracturing within the Tombstone Mining District is approximately north 55 degrees east. This is the typical northeast fracturing direction, which is invariably seen in Arizona porphyry copper deposits. The fracture direction is represented by topographic alignments of ridges and stream drainages, by rhyolite dikes, andesite dikes, and by the vein system which is responsible for most of the mineralization within the district. In the main Tombstone district, northeast of the north-trending Ajax fault, these northeast trending fractures dip to the southeast, while in the State of Maine area, west of the Ajax fault, most of the veins dip to the northwest. The exception to this observation is the Fox vein which dips southeasterly at about 50 degrees. Right lateral movement along the northeast trending veins is suggested by synthetic faults occurring along the shallowly dipping State of Maine structure and the Clipper vein zone. The strongest synthetic structure is the Triple X vein which appears to be continuous between the State of Maine vein and the Clipper vein zone. Similar synthetic structures along the San Pedro vein also suggest right lateral movement.

An offsetting vein structure identified during the recent mining of the Merrimac #1 pit and other "post mineral" structures identified by Joe Graves during the spring of 1985 along the State of Maine vein trend, may be antithetic faulting related to the same right lateral strike-slip movement.

One fracture zone within the Tombstone Silver Mines, Inc. property area trends almost north-south with a vertical dip. This is the San Pedro vein just north of the Fox Ranch. The vein appears to bend to the northeast where it intersects the Fox vein and continues in a northeasterly-trending arc through the San Pedro workings and is lost in the alluvium to the east.

Dikes

Two types of dike rock crop out within the State of Maine area. The most predominant type is rhyolite with only a few exposures of subordinate andesite being seen. The dikes are related to the igneous events that formed the caldera complex, and are both pre-mineral. The andesite predates the rhyolite as is indicated southwest of the Gold Bug area where a composite rhyolite-andesite dike shows spherical xenoliths of andesite in rhyolite. Discontinuous and irregular outcrop patterns of the rhyolite suggest intrusion into tension fractures, which may have been synthetic to the State of Maine right lateral strike-slip movement. Proximity of the rhyolite to productive veins, as well as their pervasively pyritized and altered character may suggest a genetic relationship to the veins. However, no significant metal values have been discovered in the rhyolite to date.

Post-Mineral Faults and Photolinears and Topographic Alignments

Surface evidence of significant post-mineral faulting has only been seen in a few areas. A possible fault was noted in the southwest corner of the May claim, apparently being responsible for a bold ridge of Uncle Sam porphyry a few hundred feet long. One small probable left lateral fault was noted a few feet southwest of the Triple X shaft. This fault appears to offset the adjacent rhyolite dike about 10 feet. However, normal movement in the fault would give the same apparent movement. A few small strike-slip faults were noted in the window in the Fox Ranch area, offsetting limestone beds in the Bisbee sediments. The most significant fault could not be identified in the field, yet is indicated by its left lateral offset of the composite andesite-rhyolite dike southwest of the Gold Bug prospect. This linear appears to correspond with a poorly defined structure visible on aerial photographs. The structure can be traced on the color air photos approximately 4,000' to the south, but apparently terminates against another photolinear northwest of the Gold Bug area (Figure 29).

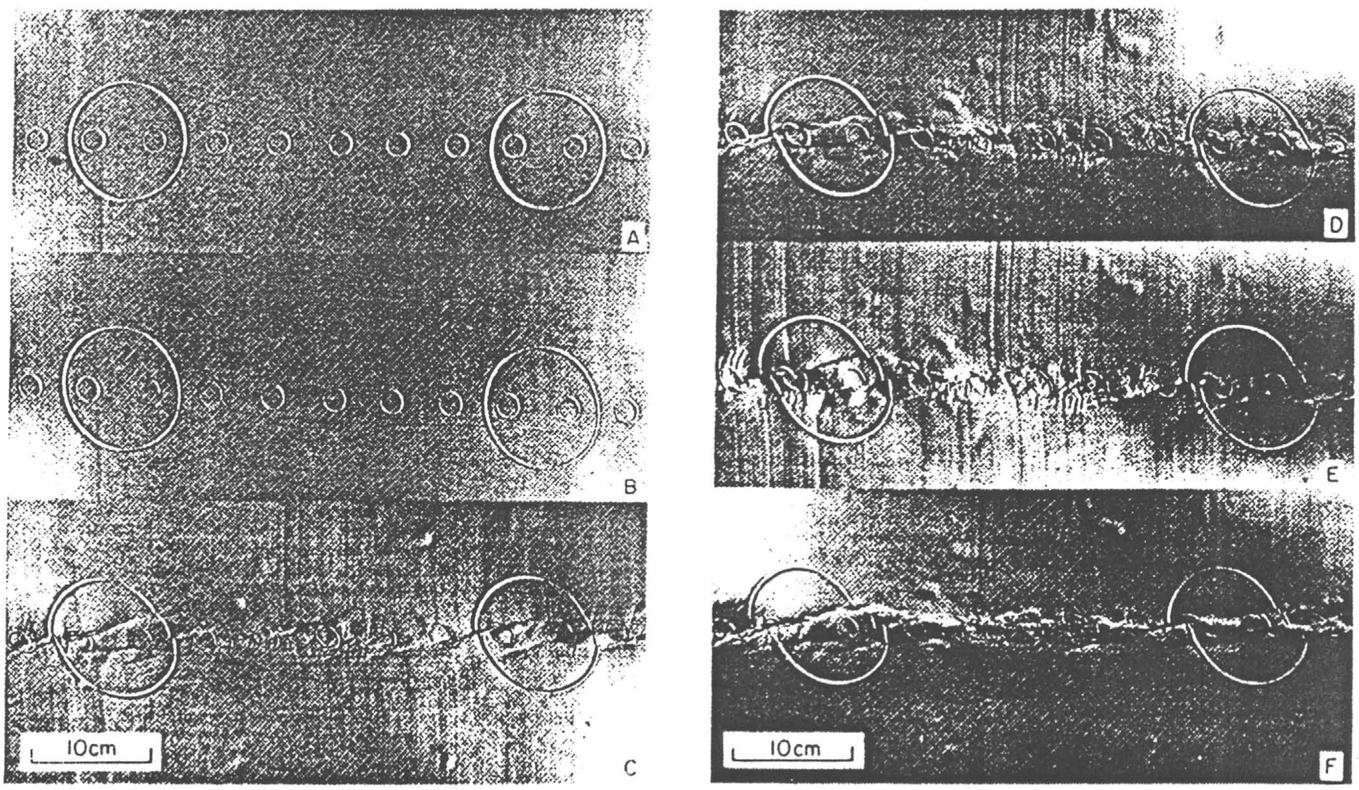
Examination of the 1" = 2,000' color photo mosaic of the district shows the Prompter fault splits at its intersection of the Ajax fault - the caldera margin. The northerly split passes just north of the south end line of the Free Coinage claim, and offsets the Free Coinage vein 200 feet in a left-lateral manner. This offset corresponds to the same offset in a rhyolite dike east of the Prompter mine (Newell, 1974, p. 71).

Topographic alignments, which have not been specifically delineated on the geologic map of the area as faults or veins, probably also represent structural features. The washes probably represent vein zones. At any rate, they are the least resistant areas of rock exposure, and alteration generally appears stronger along their trend. This is corroborated by examination of the color air photos which show red coloration localized along the drainages while absence of this coloration on the ridge tops suggests fresh resistant rock.

In 1973, examination of the 1" = 200' enlargements of the black and white photographs revealed linears, which were shown on the geologic map of the area as heavy dashed blue lines. The linears are for the most part topographic, vegetation or small drainage alignments, and cannot generally be seen from the ground. They appear to be post-mineral, and one of the most prominent, a north-trending feature traceable for in excess of a mile north of Fox Wash, appears to make a right lateral offset in the Fox Wash vein zone. The photolinear which trends east-west and cuts through the top of the Uncle Sam hill (Figure 27), projects through the State of Maine shaft and partially parallels the State of Maine wash, which is alluvial covered. Dump rock on old caved prospect shafts along this wash show fragments of strongly altered Uncle Sam porphyry. The intersection of the structure with the State of Maine shaft suggests that it may be pre-mineral and may have had some influence on mineralization. For the most part, however, it still appears most of these features are post-mineral and may be mid-Tertiary or Quaternary in age. Except in the case of the fracture which offsets the Gold Bug area dike, there is no way at present to measure their dynamic effect on the rocks in the area. It may be, however, that these features bound structural blocks which have been displaced in a vertical sense, either up or down in relation to each other. For this reason, they may have an important bearing on the spatial positions of ore bodies within the area, and thus, their correct interpretation may be of economic significance. Knowledge of their location may be critical in correct interpretation of drill hole data.

SYNTHETIC AND ANTITHETIC FAULTS. Both right-handed and left-handed strike–slip faults emerge in clay deformed in this way (Wilcox, Harding, and Seely, 1973). The faults combine to form conjugate sets marked by an initial conjugate angle of intersection of about 60° (see Figure 9.53*C*). Of the two conjugate fault sets, the one whose sense of slip is identical to that of the main zone of faulting is called **synthetic**. The one whose sense of slip is opposite to that of the main zone is called **antithetic**. The synthetic faults are typically oriented at a small acute angle to the trace of the main fault zone; the antithetic faults are oriented at a very high angle to the main zone (see Figure 9.53*E*).

Figure 9.53 Clay cake deformation experiments simulating strike-slip faulting. Clay cake is placed on adjoining panels of sheet metal. Strike-slip faulting is achieved by shifting the panels horizontally past one another. (*A*) Starting configuration. (*B*) Initial distortion of clay. (*C*) Onset of faulting and the formation of synthetic and antithetic faults. (*D*) to (*F*) Continued faulting. Folds that develop become oriented parallel to the direction of greatest extension (*X*). [From Wilcox, Harding, and Seely (1973). Published with permission of American Association of Petroleum Geologists.]



SUBSURFACE GEOLOGY STATE OF MAINE AREA

General Statement

As mentioned previously under General Geology of the District, low angle structures caused by two episodes of thrust faulting are responsible for some of the complexities of the sub-surface geology within the Tombstone Mining District. The Uncle Sam tuff, which comprises the major portion of the outcrops in the western part of the Tombstone Mining District, is a quartz latite tuff deposited within the Tombstone Caldera. The tuff in the northeastern portion of the caldera (the Tombstone Silver Mines, Inc. properties) is thinner than in the southeast portion (area of the Charleston Mine) and western portions (west of the San Pedro River). The relative thinness is verified by several windows of sediments peeking from beneath the tuff in the vicinity of Uncle Sam Hill, and also the intersection of Bisbee Group sediments in the bottom of the State of Maine shaft. The low angle of this structure is also attested to by its semi-circular outcrop on its eastern edge of the caldera caused by topographic effects. One outcrop of Permian Colina limestone on the northwest edge of May's Hill and the pre-tuff erosion surface developed on Bisbee sediments in the north side of Fox Wash, one mile from the San Pedro River, also indicates the relative thinness of the Uncle Sam in the northern portion of the caldera. The Bronco volcanics which underly the Uncle Sam in the Charleston area have not been identified north of Robbers Roost, but may be present in pre-Uncle Sam topographic lows. All of the sedimentary formations which underly the Uncle Sam tuff (including the the Bisbee Group and Paleozoic sediments) have been involved in thrust faulting (Drewes, 1980). How many layers of thrust sheets are present is not known. Thus, good ore horizons which would include basal Paleozoics and basal Bisbee Group sediments, could lie either near the surface or at great depth depending on wehther they have been repeated by low angle faulting. The only method of determining what the true layer cake nature of the district is, will be by the careful logging of deep exploratory drill holes and perhaps the application of detailed magnetic or possibly even seismic surveys.

Thickness of the Uncle Sam Quartz Latite Tuff

In his 1973 report, Briscoe constructed eight cross sections from surface geologic data, as well as information from the State of Maine workings, through the State of Maine area. The purpose was to determine the approximate thickness of the Uncle Sam tuff, as well as areas of intersections of veins with each other and with sedimentary horizons beneath the Uncle Sam tuff. In about 1980, several diamond drill holes were sunk in the Fox Ranch area by Oxidental Minerals Corp. The Uncle Sam tuff was penetrated at about 90 feet, near the Fox Ranch windmill. Drill logs as well as core will be available from this drilling during the first part of the proposed exploration program, so that additional details regarding the thickness of the Uncle Sam will be compiled.

At present, using the above mentioned data, it is apparent that the thickness of the Uncle Sam ranges from several hundred feet from the tops of the highest hills to a few tens of feet in the bottoms of the washes. The thin areas would be exemplified by the San Pedro mine area, where the tuff appears to be 300 feet or less in thickness. It must be remembered, however, that since the Uncle Sam was extruded onto a tectonically active surface within a resurgent caldera, the thickness can be expected to vary abruptly, and be quite irregular. Further, photolinears identified by Briscoe in 1973, could represent post-mineral faults, which may define structural blocks that have been randomly jumbled up and down, and changing the apparent thickness of the Uncle Sam. Accurate projections of the thickness of the Uncle Sam will have to await numerous drill hole penetrations.

Structure of Sedimentary Rocks Beneath the Uncle Sam Tuff

The Bisbee Group sediments are rather massive nondescript sandstones, siltstones and mudstones over most of their exposure with the State of Maine area. However, north and east of the Free Coinage claim, and in the Fox Ranch area, marker horizons which show structure are exposed. These marker horizons are limestone beds which may be the equivalent of either the Blue Limestone occurring near the base of the Bisbee, or the so-called Ten-Foot Limestone occurring slightly above the Blue Limestone. Mapping of the sediments exposed in the window on the north end of the State of Maine vein show they are warped into a tight anticline plunging to the east. The type of fold and direction of plunge appears to be the equivalent of folds within the Tombstone Basin. It is assumed they were due to the same tectonic forces. In the Fox Ranch window there are exposed two limestone beds and one bed of conglomerate. It is assumed the conglomerate is the Glance Conglomerate, and thus the limestones appear to be overturned in a recumbent fold. Several other fold structures might be proposed to explain the geometry of the exposed features. However, until more data are acquired by drilling, the recumbent fold seems to fit the general geologic environment as well as any. Since at least two events of folding and thrust faulting occurred in this area (Gilluly, 1953), it is quite probable that folds developed during the first episode were again folded during the second episode, thus creating extremely complex fold surfaces (Figure 30). It is assumed that folds are generally northwest trending, as they are in the main Tombstone district.

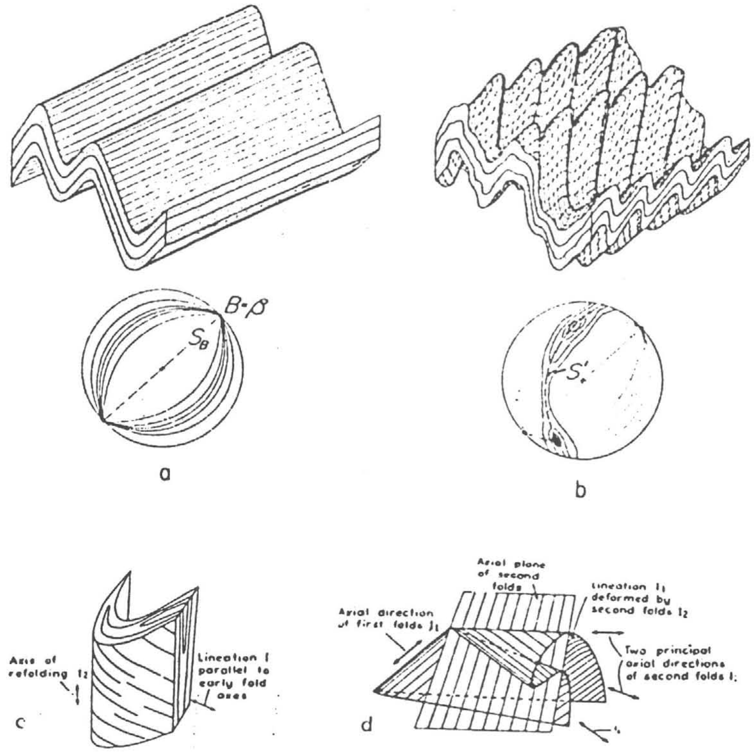


Figure 32A

Figs. 16a and 16b.—Superposed cylindroidal folding with oblique axes, as drawn by Weiss, showing stereographic projections of the bedding and fold axes (from Weiss, 1959, Fig. 5). 16c and 16d.—Superposed deformation of early lineated folds (from Ramsay, 1960, Figs. 1 and 2). Axes and directrices are oblique.

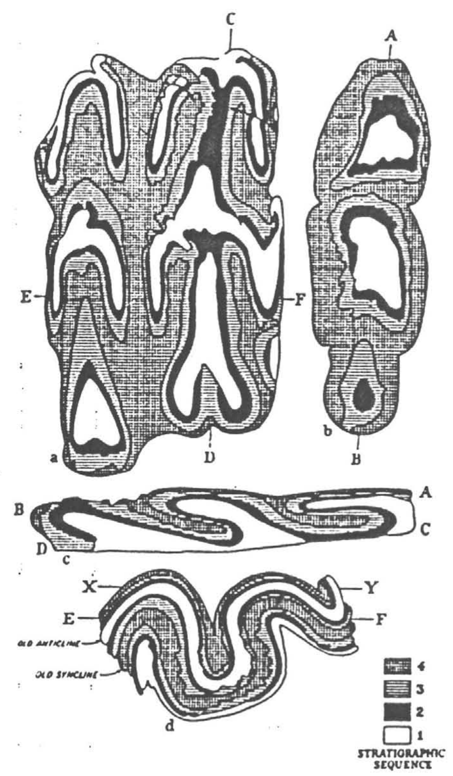


Figure 32B

.—Superposition of similar folds with orthogonal strikes and divergent directrices (from Reynolds and Holmes, 1954, Text-fig. 13). EF is the axial direction of the first folding and CD (or AB) that of the second. (a) Surface outcrops after slicing. (b) Surface outcrops on the right-hand side only, as seen at a higher level than that of (a). (c) Section of the model, before slicing off its top, cut along CD of (a) and AB of (b). AB and CD represent the levels at which (b) and (a) were respectively sliced. (d) Section of the model, before slicing off its top, cut along EF of (a). XY and EF represent the levels at which (b) and (a) were respectively sliced.

Figure 32 A & B

MINERALIZATION

General Description of Silver Mineralization, and Vein Alteration Within the Uncle Sam Tuff

As mentioned under the heading "Structural Features of the State of Maine Area - Vein Zones", the average strike of the veins bearing silver within the State of Maine area is approximately north 55 degrees east with a dip of from 30 to 80 degrees westerly. The exceptions to this are the San Pedro, Gold Bug and Fox Wash veins which strike more easterly. The Fox Wash vein also has a southwesterly dip (Figure 29).

The only silver mineral, which is documented to have been identified within the area, is bromyrite (AgBr). It is a pistachio green, waxy mineral which occurs in the oxide zone on fracture planes, and is termed horn silver (horn) by the operators within the area. It is the equivalent of cerargyrite (AgCl) and can only be differentiated by chemical or x-ray analysis. It is quite possible that cerargyrite as well as iodyrite (AgI) are present in addition to bromyrite, but no careful analytical work that would differentiate these mineral sub-species has been done. The probable source of silver halides is argentiferous galena, and/or tetrahedrite (Butler & Wilson, p. 52). Numerous assays, taken in 1973, showed a strong geochemical presence of lead, ranging up to multiple thousands of parts per million. The lead is probably present as cerussite or anglesite, but no specimens of these minerals have yet been identified. Open pit operations in the last two years have exposed thin seams of galena along vein structures, associated with higher grade silver, lending credence to the idea that galena is one of the major sources of the silver. Newell did electron microprobe analysis on hessite (Ag2Te) blebs in galena and found them to be composed of (weight percent) 60.9% silver, 38.6% telluride and 0.2% gold (1974, p. 167). Adjacent galena showed only 0.1 weight percent silver. Hessite is probably the primary hypogene silver mineral at Tombstone (Newell, p. 169). The temperature of formation of the hessite was probably about 205 degrees centigrade (Newell, 1974, p. 167). Silver is probably also tied up as argentojarosite or plumbojarosite, and possibly in the manganese oxide minerals. Although operators Charlie and Louis Escapule have developed an eye for rock which contains ore grade silver mineralization, to the casual observer, there appears to be no way of easily judging silver content by eyeballing the rock, unless horn silver is visible, in which case high assays can be anticipated. Traces of copper oxide were seen in the San Pedro area, the dump of the Brother Jonathan shaft, and in the State of Maine workings below the second level, but no copper sulfides have been noted. It is concluded that the copper may have come from the oxidation of tetrahedrite and probably some chalcopyrite occuring as ex-solution blebs in sphalerite as it does in the main part of the district (Newell, 1974, p. 160, 162). Sarle (1928, p. 33) reports that chalcocite was encountered in the lowest level of the San Pedro mine.

Hydrothermal alteration associated with the silver mineralization in the area appears to be mesothermal in character, and this is corroborated by fluid inclusion temperatures measured by Newell (1974, p. 169) in the main district of 205 degrees to 279 degrees (±5 degrees) and 243 degrees to 318 degrees centigrade (±5 degrees) at Charleston. Alteration along the veins in the Uncle Sam tuff consists of emplacement of (as judged by leached capping interpretation, as well as inferences cited in the preceding paragraph) pyrite, minor galena, possibly some sphalerite, tetrahedrite, chalcopyrite and possibly alabandite (manganese sulfide-MnS). All of these sulfide minerals (with the exception of minor remnant galena) have been oxidized above the water table, and are represented by limonite after their respective parent sulfide, or in the case of alabandite(?), black manganese oxide minerals. The silver, represented primarily by bromyrite was probably originally contained in hessite blebs in the galena and in tetrahedrite, before oxidation. Wall rock has been silicified to varying, but generally minor degrees, and alteration to clay and sericite has taken place in the reactive feldspar and aphanetic matrix of the Uncle Sam tuff. Where alteration and vein intensity is greatest, sericite is dominate, while in poorly altered vein areas, argillization is the primary effect. Pyrite is represented at the surface by jarosite and red and yellow limonites. In the most strongly altered veins, maroon and red, "relief" or "live limonite" is present on fractures. In the most poorly altered areas, occasional suggestions of pseudomorphs of limonite after pyrite are seen. All of the dumps in the area with the exception of the San Pedro dump show only oxidized material. Examination of the sulfide bearing fragments on the San Pedro dump show them to be intensely bleached and altered Uncle Sam tuff, with finely disseminated white pyrite along silicious fractures, and disseminated through the rock. Accessory gangue minerals in the San Pedro veins consist of silica and some manganese oxide. Barite is seen only in the Gold Bug area. Manganese appears to be more prevalent in the San Pedro area with lower amounts seen in the Gold Bug, Lowell, Merrimac, and the State of Maine areas. The State of Maine, May and Clipper veins are primarily wide zones of sericitic and argillic alteration with little, if any silicification. They represent the most typical pattern of alteration within the State of Maine area. Traces of amythestine quartz along with a small amount of native gold with horn silver has been seen in the Triple X open pit workings. No primary (sulfide) manganese minerals have been identified on the Tombstone Silver Mines, Inc. properties, to the knowledge of the writer.

Detailed mapping on a 1" = 50' color air photo base map in the Clipper-May area shows that, in detail, the veins are sinuous with varying width (Figure 29). This attests to the saturation of the surrounding Uncle Sam tuff by hydrothermal solutions, probably controlled by micro-fractures and/or inherent porosity within the tuff.

Total vein length mapped in the State of Maine area to date is about 30,000 feet. Detailed mapping in the northwest 1/4 of Section 16 at 1" = 50' in August, documented an additional 3,000 feet. Additional detailed mapping is expected to delineate additonal vein length. Vein length in the main district depicted on the Butler, Wilson, Rasor map (1938, Plate IV), approximates about 63,000 feet.

General Description of Silver Mineralization and Vein Alteration Within the Bisbee Sediments

Bisbee sediments which crop out within the State of Maine area consist of non-descript red beds of quartzite to siltstone, probably the equivalent of the Cintura and Morita formations, in the Chance area, and a small outcrop of what may be basal Blue Limestone warped into a tight isoclinal anticline north of the Uncle Sam shaft. There is also some conglomeratic units (possibly Glance?) intercalated with greenish shales exposed in a window in the Uncle Sam tuff, just east of the Fox Ranch. These exposures, with the exception of the limestone north of the Uncle Sam shaft, are chemically very similar to the Uncle Sam tuff, and the alteration effects on them is quite similar to that seen in the Uncle Sam tuff. Thus, in the sandstones, quartzites and argillites in the eastern part of the property, and noteably on the Red Top claim, pyrite appears to have been disseminated in large areas of the porous rock, and the red stain is primarily due to hematite after pyrite. This same coloration of similar sediments can be seen in the main part of the Tombstone District and in the Tombstone Extension area. In the sediments where there is a high lime content, hydrothermal alteration has silicated the lime to hornfels attended by weak disseminated pyrite. Because of the lime content, pyrite oxidation is minimal.

Vein Widths

The most significant feature of the veins in the State of Maine area is their width. The State of Maine vein itself varies between 100 and 200 feet true thickness (Figure 30) between the hanging wall and footwall ore zones. The Gold Bug vein zone is silicified and strongly altered over a width of about 100 feet, and shows moderate to strong alteration over a width of approximately 300 feet. The Fox Wash vein zone is approximately 100 feet wide, and sub-parallel fracture zones associated with the Fox Wash vein zone appear to be up to 300 feet in maximum dimension. The north trending San Pedro vein in the area of the Fox Ranch windmill is intensely altered over a width of 30 feet, and shows moderate to strong alteration over a width of approximately 20 to 30 feet on either side of the central zone, for a total width of 50 to 60 feet. A parallel structure, which is intensely silicified but has not been mined, shows a width of 10 to 25 feet. A zone southeast from the San Pedro shaft shows disseminated sub-parallel fracture zones over a width of approximately 400 feet. This zone apparently continues across alluvial cover to intersect the north trending San Pedro vein.

In the Three Brothers shaft area, altered rock containing sub-parallel fractures is approximately 300 feet wide. Throughout the general area of the True Blue claim, the Three Brothers shaft, and the San Pedro and Fox veins, the Uncle Sam tuff shows sub-parallel and intersecting veining, the rock being pervasively though weakly altered over an area of approximately 400 feet to 700 feet in width, and about 1,500 feet in length. In the area of the Lowell claim, a vein zone which may be the extension of the State of Maine vein, alters rock over a width of up to 200 feet, and a length of 300 or more feet. The Clipper and Free Coinage claims are located on what the writer has termed the "Clipper Zone". This zone consists of sub-parallel fractures showing weak to strong hydrothermal alteration over a width of 20 feet to about 200 feet, averaging approximately 89 feet wide in the center portion, and a length of at least 3,500 feet.

The width and intensity of mineralization of these veins suggests greater volume and intensity of mineralization than that present in the Tombstone Basin area, from which most of the production of the mining district has come. Further, when it is considered that these vein structures are underlain by reactive limestone units which would have the effect of precipitating metals and silica from ascending hydrothermal solutions, as well as from decending supergene solutions, their apparent strength, and we assume potential, is further emphasized. The best targets for ore bodies, of course, would occur where hydrothermal vein zones intersect the chemically and structurally reactive host rocks - the tightly folded lower Bisbee and upper Paleozoic sediments. More details on these targets will follow below.

Proposed Mechanism for Supergene Leaching of Silver in the State of Maine Area, and its Probable Effect on Near Surface Vein Configuration and Enrichment of Veins at Depth

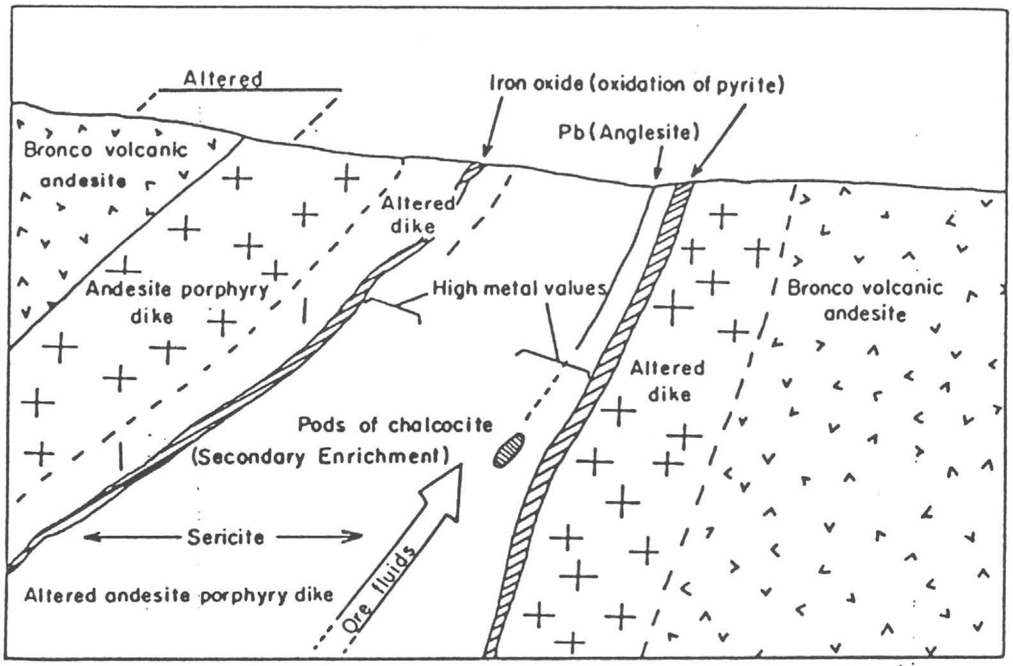
The Confusing Geometry of the State of Maine Area Veins

The silver veins cutting the Uncle Sam tuff appear to all have a similar configuration. In all exposures within the accessible State of Maine workings, the Brother Jonathan workings, and Clipper and Merrimac zones, the veins appear to be composed of a narrow, high grade ore shoot in the hanging wall, immediately adjacent to, or sometimes within poorly altered tuff, consisting of bromyrite along fractures, then a wide zone (largely barren of silver, or, at best, low grade) of argillized and sericitized rock containing abundant limonite after pyrite and assumed other sulfides, and then a lower grade of silver as bromyrite immediately adjacent to or within the poorly altered Uncle Sam tuff in the footwall. During the writer's association with the area, of about twelve years, it seemed incongruous that the best silver mineralization appeared adjacent to the poorest appearing rock adjacent to strong to intensely altered limonite rich vein material which contained little or no silver. Indeed, recent UNC Silver MAP tool work in the Charleston area showed poorly altered wall rock adjacent to wide vein zones carried more silver than did the strongly altered material itself.

The Hypothesis for Supergene Leaching

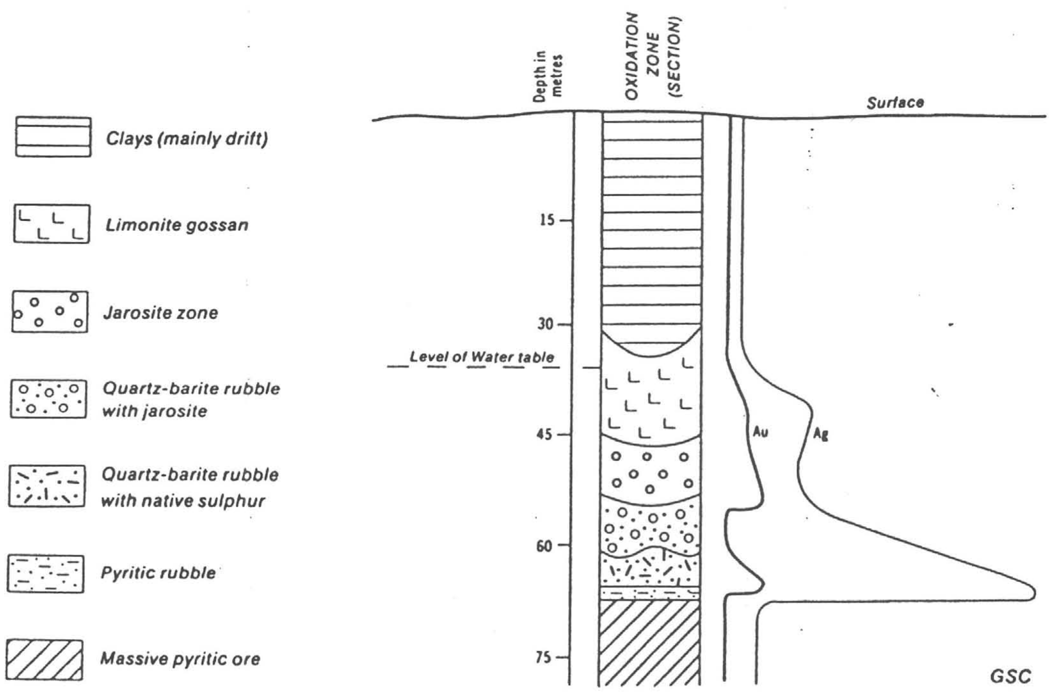
The current understanding of the genesis of the Tombstone District, as part of a caldera feature, and the proper identification of the Uncle Sam as a tuff rather than a porphyry sill, and a review of the solubility of silver in the oxide environment has lead the writer to a hypothesis which appears to well explain the geometry of the veins, as well as having important impact on what the configuration of silver mineralization at depth might be. This hypothesis will be described in the following discussion.

As explained in the discussion of the general geology, the Tombstone District lies within and adjacent to the 72 million year old Tombstone resurgent caldera. The main district lies just outside of the caldera ring fracture (the Ajax fault) which has been intruded by the Schefflin granodiorite. The State of Maine mine area falls just within the caldera ring fracture.



Schematic diagram of the west face of the Charleston Lead mine in the Charleston area.

Figure 33A

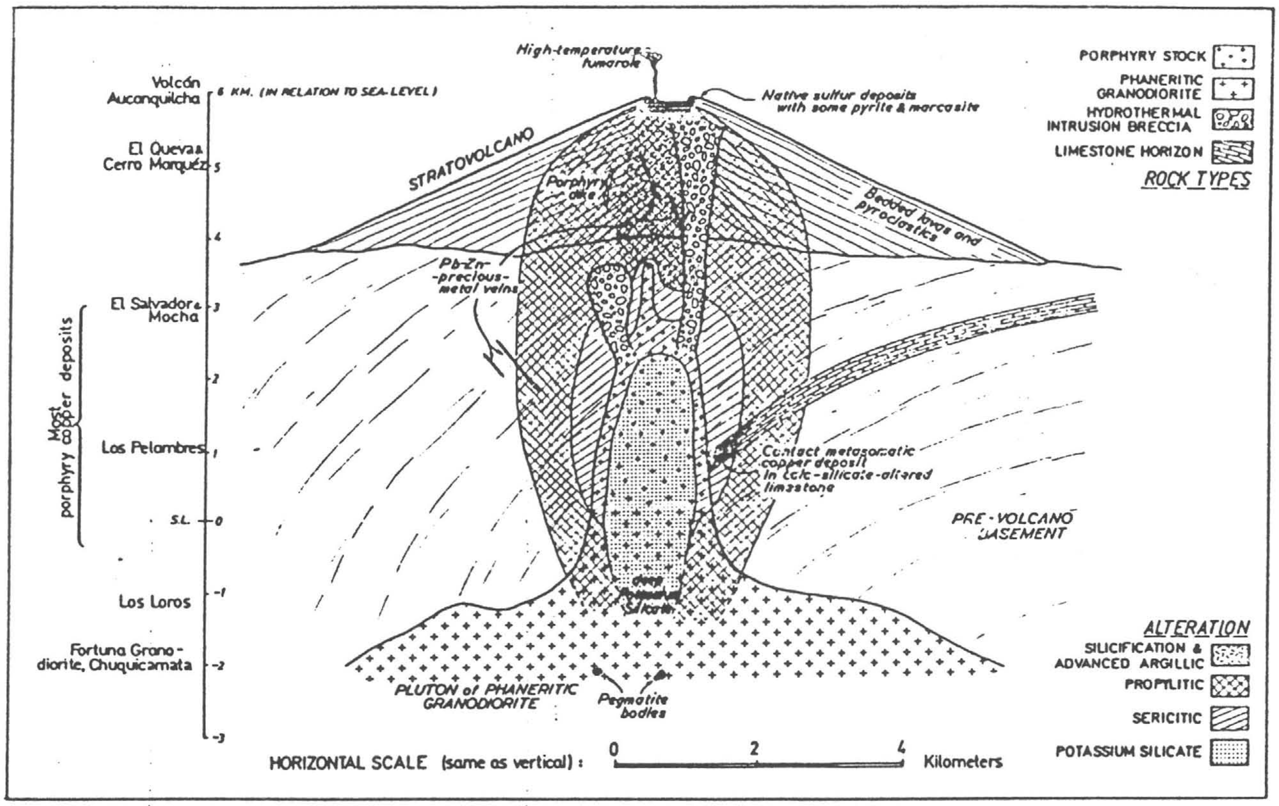


Localization of gold and silver in the oxidized zone of the Maikain 'S' deposit, northern Kazakhstan, U.S.S.R. (after Borodaevskaya and Rozhkov, 1974).

Figure 33B

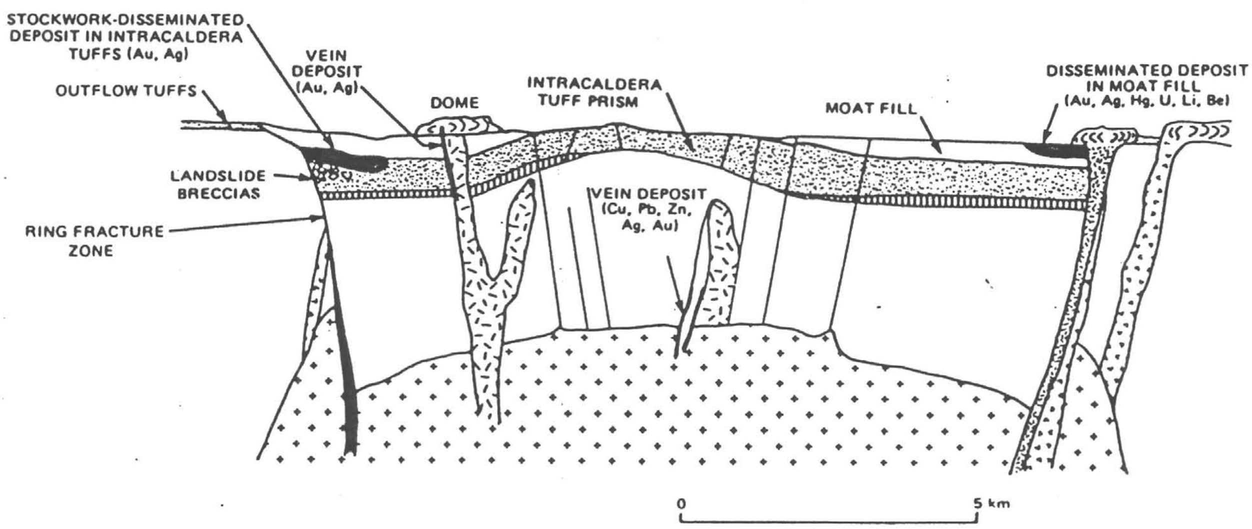
The Uncle Sam tuff was probably extruded as multiple nuee ardentes before, and subsequent to, caldera collapse. Distal portions of the tuff undoubtedly covered the terrain around the caldera, including the main part of the district. Subsequent erosion, however, has removed all of the tuff, except that which lies within the caldera. Extrusive rhyolitic volcanics are a prime source for halides (Vinogradou, 1959) which occur as fluid inclusions entrapped within the extrusives.

After development of the resurgent caldera, culminating in the accumulation of possibly as much as 1,000 feet of Uncle Sam tuff within the State of Maine mine area, typical late stage magmatism occurred. This included the intrusion of the Schefflin Granodiorite into the caldera ring fracture shortly after the caldera formation, and subsequent intrusion of the 62.6 $\pm$ 2.8 m.y. old (Harald Drewes, 1985, pers. comm.) Extension quartz monzonite. Intrusion of, first, andesite porphyry dikes and subsequently rhyolite dikes, occurred in the State of Maine area. Subsequent fracturing occurred sub-parallel to the fractures occupied by the rhyolite dikes, and these fractures were invaded by hydrothermal solutions, which in their lower extremeties probably tap a porphyry copper type environment, but in their upper extremities, grade to mesothermal to possibly epithermal lead, zinc, silver, gold, and manganese veins (Sillitoe, 1973, p. 800 and 1984, p. 1287, 1291 & 1294). During the mid-Tertiary orogeny, the Tombstone area was tilted, like all the surrounding mountains, to the northeast. However, the tilting and deformation was relatively moderate and resulted in no substantial dislocation or destruction by erosion of the mineral deposits, except their surface expressions. After quiescence of the Laramide mineral activity, oxidation of the veins, and erosion of the surrounding Uncle Sam tuff proceeded up to the present time, resulting in the present topographic expression. We know from experimental data (Lingren, 1938, p. 862 & Park & McDiramide, 1985, p. 465) that silver readily dissolves in ferric sulfate solutions. Thus, as the Clipper, State of Maine, and other veins in the area, which are composed of up to 10 percent pyrite as well as galena, sphalerite and tetrahedrite, began to weather and oxidize, the zinc, copper and silver would go into solution, as would the lead and gold more slowly, and move towards the water table where they would encounter reducing conditions. Under reducing conditions at and below the water table, copper would precipitate as chalcocite, while silver would probably precipitate as argentite, stromyrite, and native silver. However, on the journey from their original position in the sulfide minerals of galena (as blebs of hessite?) and tetrahedrite to their position of future re-deposition below the water table, those silver ions near the hanging wall and the footwall zones of the veins would encounter halides, which are present as weathering products of the fresh Uncle Sam volcanic wall rock. The continual decrepitation by



Idealized cross section of a typical, simple porphyry copper deposit showing its position at the boundary between plutonic and volcanic environments. Vertical and horizontal dimensions are meant to be only approximate.

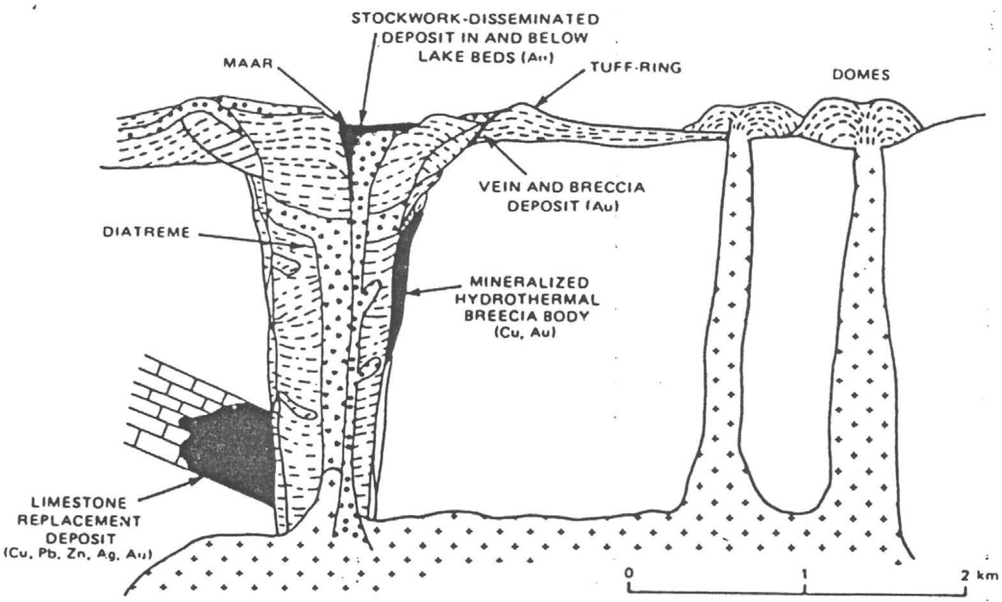
Figure 34A



Idealized model of possible ore deposit types related to a Valles-type caldera.

Figure 34B

Figure 34 A & B



Idealized model of possible ore deposit types related to a maar-diatreme system.

Figure 35

weathering and mechanical destruction of inclusions within the fresh Uncle Sam tuff provides a continuous supply of bromine, iodine and chlorine to react with the mobile silver in the ferric sulfate solution. Of course when the silver ions encounter halides, they immediately form insoluble silver halides that are precipitated in and immediately adjacent to the fresh Uncle Sam tuff - the source of the halide ions. Since the solubility of the halides is in decreasing solubility order of chlorine-bromine-iodine, after substantial weathering, bromyrite is the predominate halide left in the near surface enviornment.

As erosion progressed downwards through the blanket of Uncle Sam tuff deposited in the current State of Maine mine area, previously enriched zones of silver were exposed to oxidation and sequentially were oxidized only to re-precipitate at a lower level as a continuous oxidation and reduction front, proceeding ahead of the erosion surface; just as the chalcocite blanket in porphyry copper deposits have been developed through sequential stages of leaching precipitation, re-leaching, re-preciitation, etc. Thus, most, if not all, of the silver contained in the column of rock which was once present in the now eroded veins above the current surface, has been precipitated at or below the permanent water table.

This scenario appears to adequately explain why in all the wide vein zones within the State of Maine area (the State of Maine vein, the Clipper vein zone, etc. etc.) there is always a zone of "horn" (bromyrite or other halides) in the hanging wall and in the footwall, but the center portion of the vein, though strongly altered, is barren or relatively so. In all probability, silver values were distributed evenly or relatively so within the vein, but in the central portions where no halides were available to precipitate silver, the silver migrated down the dip of the vein to be precipitated in the reducing zone below the permanent water table. The same mechanism was observed by Lee (1967) at Charleston, as shown in his Figure 7A (p.24), reproduced herein as Figure 33A.

We can therefore expect to always find an enriched zone on the hanging and footwall sides of wide phyllic zones such as the State of Maine and Clipper veins, which carried relatively disseminated silver sulfides. For more narrow veins without a wide zone of phyllic alteration and attendant pyrite, the supply of halides from leaching of the surrounding fresh Uncle Sam tuff may have been sufficient to have precipitated all silver as silver halides. But in the wide vein zones, we can predict that significant enrichment should be found below the water table, much as a chalcocite blanket is typical beneath leached porphyry copper zones. Further, we can expect that most, if not all, of the silver from the vein material which is now completely eroded away will be located within the enrichment zone.

Using this hypothesis, we can predict and anticipate other conditions which will be helpful in maintaining accurate ore control. For example, since silver ions probably migrated into poorly altered or unaltered rock where they were precipitated along micro fractures by halides in the fresh rock, it will not be perplexing to find silver of economic proportions in what appears to be uninteresting rock adjacent to veins. Further, crushing and screening of such silver bearing rock, will probably yield silver in the fine fractions and an oversized product with little or no silver content. Also, where the veins flatten in dip, perculation of halide bearing surface water into a greater thickness of the vein hanging wall in the flattened part of the veins will precipitate additional silver yielding hot spots of more voluminous silver halide mineralization. This is exemplified in the State of Maine mine between the 3rd and 4th levels, where the vein flattens. In fact, any hydrologic traps in the plane of the vein, which would tend to channel surface originated waters carrying higher than normal volumes of halides into the vein, would tend to precipitate a larger volume of silver halides. Thus, careful mapping and structural contouring along the vein surface could be used as ore guides to silver halide mineralization within the oxide portion of the veins. Recognition of the genesis of these halide ore bodies and attention to the factors which might cause their formation may be an important ore guide in profitable exploitation and ore control in surface and underground mining operations within the State of Maine area.

Gold, though substantially less soluble than silver, may also be solubilized in some portions of the typical State of Maine vein environment. Lingren (p. 858) states that where the manganese content is high (as in the Merrimac #2 pit area and along the San Pedro and Fox veins), it may be possible to carry gold downward to be precipitated below the water table. Since, except where noted, the MnO_2 content of the State of Maine area veins is relatively low, we might expect gold to be left substantially untouched. Interestingly, however, the gold content in the State of Maine vein in the various levels, indicated by the 1915 Phelps Dodge assays (Figure 36), is relatively uniform. Since a substantial column of rock (possibly as much as 1,000 feet), has been eroded from above the current surface, we might question what has become of the contained gold. If it were simply mechanically enriched by the dissolution and erosion and removal of lighter and less inert vein and rock constituents, it would be expected to find rich pockets of native gold at or near the surface within the State of Maine area veins. Since no such accumulation has ever been found, it is concluded that either (1) there was not much vein removed from over the current erosion surface, or (2) the vein material carried essentially no gold, or (3) the gold was solublized and has migrated to the permanent water table where it has been precipitated. To the

1915 PHELPS DODGE CORPORATION
ASSAY RECORDS, STATE OF MAINE MINE
BUTLER, WILSON & RASOR, 1938, P.102

LEVEL	NUMBER OF SAMPLES	AVERAGE WIDTH IN FEET	AVERAGE GOLD IN OUNCES	SUM OF SAMPLE WIDTH X GOLD ASSAY	AVERAGE SILVER IN OUNCES	SUM OF SAMPLE WIDTH X SILVER ASSAY	RATIO OF SILVER TO GOLD
1ST AND 2ND........	251	2.73	.017	.04641	1.98	5.4054	116.47:1
3RD................	196	2.06	.023	.04738	3.50	7.21	152.17:1
4TH................	199	1.80	.019	.0342	4.35	7.83	228.95:1
7TH................	178	1.29	.012	.01548	3.27	4.2183	272.50:1
TOTAL->	824	7.88		.14		24.66	
	WEIGHTED	AVERAGE->	GOLD .018		SILVER 3.12		171.9 :1
3RD (HIGH-GRADE SAMPLES)......	4				465.30		

Figure 36

writer, it seems like alternative #3 is more likely. It is also worthy of note that where supergene halides from weathering of the fresh Uncle Sam are encountered, an environment of gold solubility would be present since gold is soluble in halides as adverse to silver, which is insoluble. Thus, within the halide zone, we might find silver halides, but gold would be solublized and removed. No data has been collected within the State of Maine area to test this hypothesis, but because of its importance in mining operations, evidence for or against should be developed in the course of mining.

Bisbee group sediments lie at shallow depth beneath the Uncle Sam tuff and the current erosion surface (Cross Section, Figure 30). Thus, there is a geochemical layer cake in which supergene enrichment will react differently, depending on the chemistry of encountered rock units and whether they are encountered above or below the oxidation zone. The different potential rock types encountered above or below the oxidation zone create a relatively large number of environments, all of which would react somewhat differently in precipitating supergene solutions. For example, if the Clipper vein were to encounter the water table while the vein was still in the Uncle Sam tuff, then supergene solutions would probably precipitate copper and silver (and possibly gold) as chalcocite, argentite, stromeyerite, native gold and possibly native silver, as well as ruby silvers, depending on the content of arsenic and antimony. If, however, the vein intersects the Blue Limestone, the Glance Conglomerate or the Naco Limestone while still above the permanent water table, the ferric sulfate solutions mobilizing copper, silver, zinc and lead (and MnO_2 mobilizing gold?) would pobably be neutralized by reacting with the calcium carbonate of the limestone to precipitate copper carbonates, native silver, silver chlorides, smithsonite, and native gold. If Bisbee red beds were intersected prior to the interception of the water table, and no significant limestone beds were present, an oxide environment similar to that in the Uncle Sam tuff would be maintained, assuming a low lime (calcium carbonate) content. If a pre-tuff erosion surface with coarse clastic material is encountered, the vein may splay out along this more porous zone, possibly developing a significantly wider ore zone at this point. If this erosion surface should contain pebbles or cobbles of carbonate material, then selective replacement as well as supergene enrichment in these cobbles could be present. If limestone units are intersected by the vein below the current water table, then secondary sulfide deposition would occur in a manner similar to that if the vein remained in the Uncle Sam tuff immediately below the water table. However, the enrichment zone may be compressed by the neutralizing character of the surrounding limestone wall rock.

Obviously, a relatively large number of permutations of environments and resulting mineral deposition may be present in the State of Maine area. The geologic exploration staff must be familiar with, and able to interpret and evaluate the various possibilities in order to comprehend the drill data and to make geologic and economic projections.

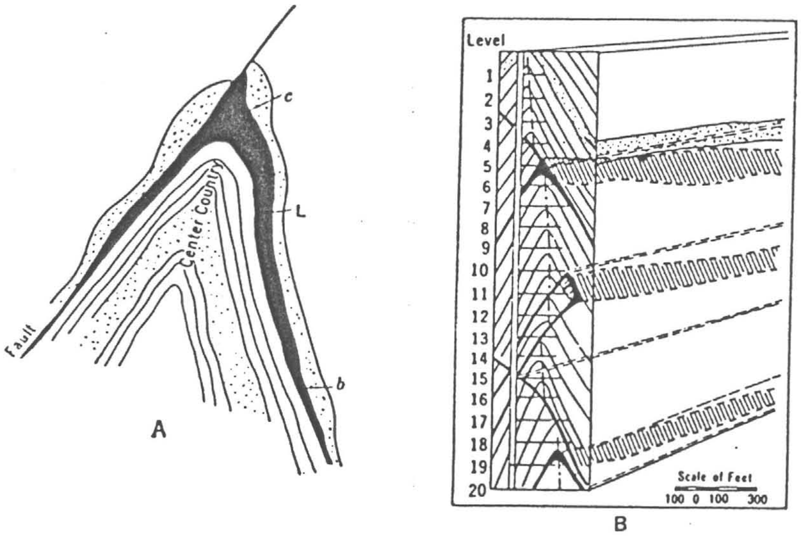
Potential for Enriched Silver Ore Bodies at the Uncle Sam Tuff - Bisbee Sediment Interface and Below

Because of the layer cake nature of the geologic environment within the State of Maine area, we must be alert to the various environments of potential ore deposition, and how the chemistry and structure of this layer cake will effect the position and geometry of potential ore bodies. Failure to understand these multiple environments for ore deposition will result in a lowered, if not completely lacking, success ratio. In the previous section, the writer has discussed the hypogene and subsequent supergene environment of mesothermal veins within the Uncle Sam tuff. In this section, observations will be made concerning the hypogene and perhaps supergene environment of these same veins within folded sediments of the Bisbee and various subsequent Paleozoic formations.

Fold Structures Within the Sediments

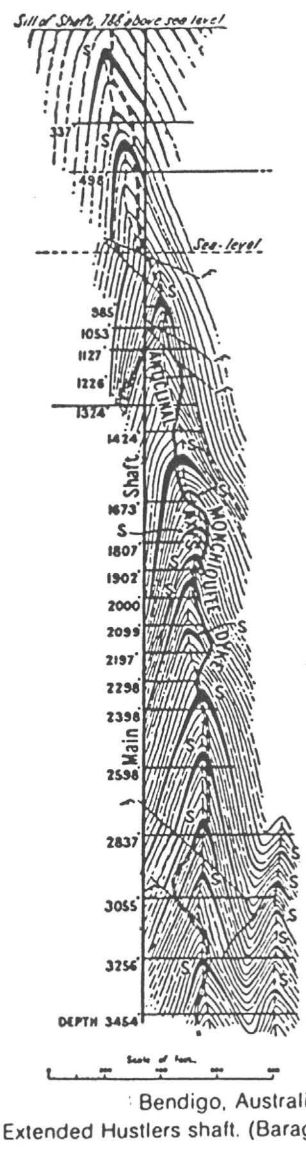
We know from previous mining activity in the main part of the district (Butler, Wilson, et al., Bulletin 143, 1938), and in the surrounding area (Galully, James, 1951 & Drewes, Harald, 1980), that tectonic forces have resulted in the thrust faulting and folding of the Bisbee sediments and underlying Paleozoic formations. In the main part of the district, the axial planes of drag folds along northwest trending anticlines and synclines, when intersected by the northeast trending veins, formed saddle reef type replacement zones of bonanza grade silver deposits. Further, these ore bodies appear to have continuity along the strike of the axial planes outwards from the vein conduits. Since these folds are apparently regional in nature, it is logical to conclude that the same types of drag folds would form similar saddle reef type bonanza ore bodies where the Clipper, State of Maine and other veins of the State of Maine area intersect these features at depth. Geologic mapping by the writer has confirmed that one such isoclinal fold exists in the exposure of sediments north of the Uncle Sam shaft. Thus, the same type of mineralization can be expected in the State of Maine area that formed the high grade bonanzas along the various rolls (saddle reefs) in the main district, such as the Visina roll, the Toughnut, the Silver Thread and others. The geologic task is how to predict in three dimensional space not only where these folds in the sediments might occur (and in which horizons - i.e., the Glance Conglomerate ((the Novaculite)), the Blue Limestone, the Twelve Foot or Six Foot Limestone, or the Naco Formation), and where the veins or vein intersection zones may intersect these favorable structures. Obviously, this is a very

Figure 37A



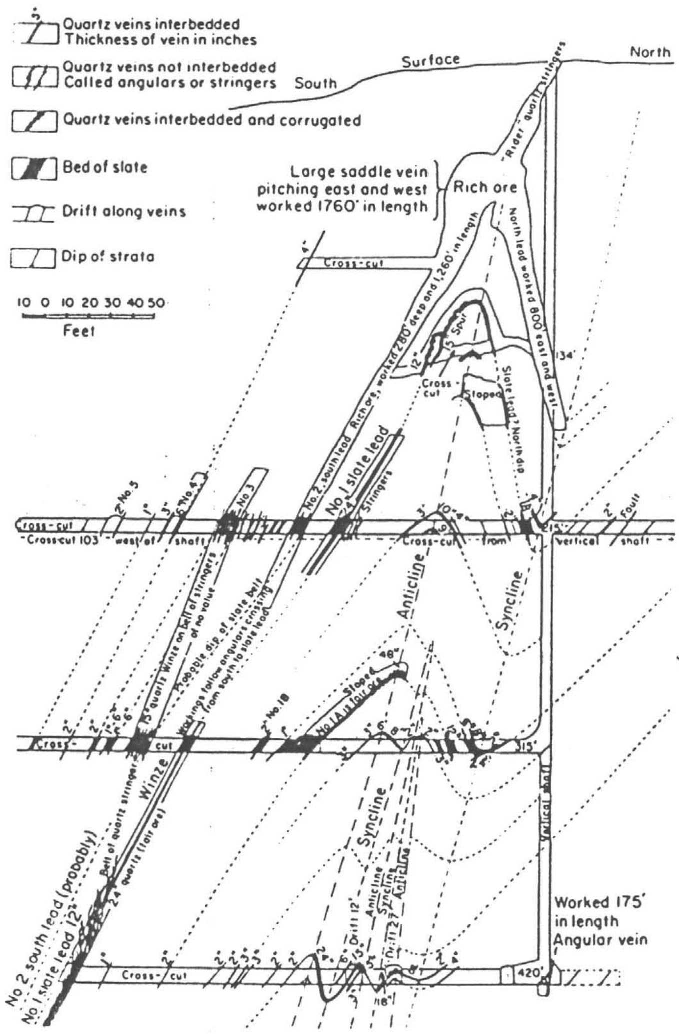
A. Typical saddle reefs of Bendigo, Australia. c, cap; *L*, leg. *b*, back; black is gold quartz ore. B. Three types of bendigo reefs and methods of mining them. (After Report by Bendigo Mines, Ltd.)

Figure 37B



Bendigo, Australia. Saddle reefs shown in Great Extended Hustlers shaft. (Baragwanath, Gold Res. World.)

Figure 37C



Saddle rocks in the Dufferin mine, Salmon River gold district, Nova Scotia. (After Faribault as quoted by Malcolm 1912, from Park and MacDiarmid, *Ore Deposits*, W. H. Freeman, 1964.)

Figure 37 A, B & C

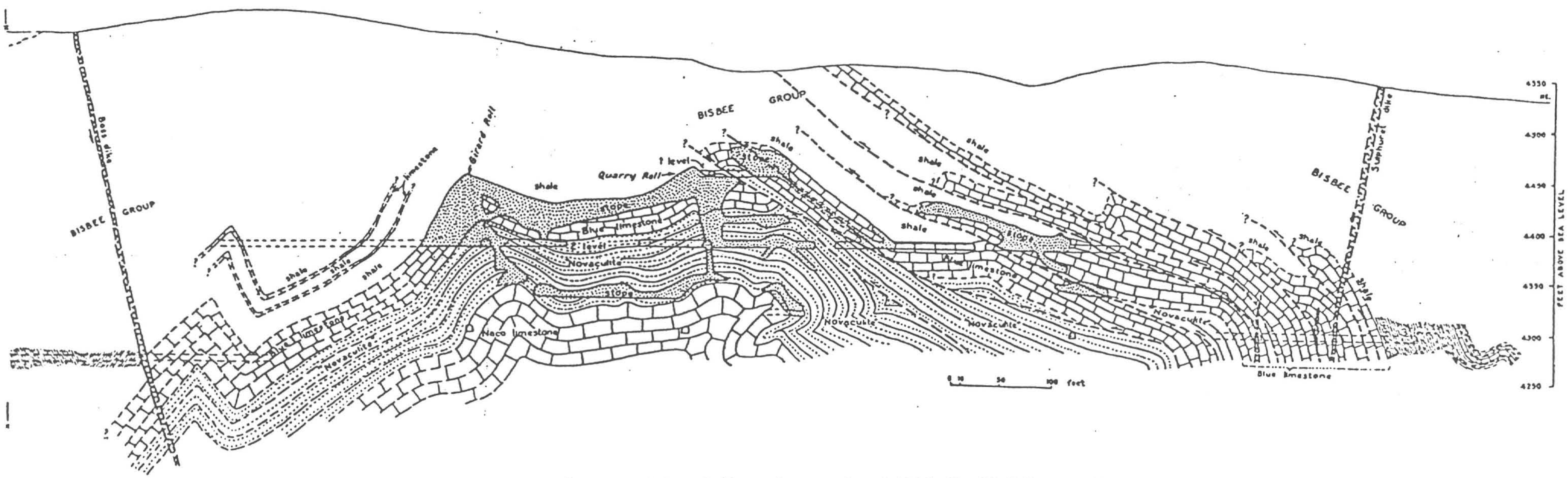


Plate XXIV, A.—Section along West Side fissure, looking northwest (northeast half; joins Plate XXIV, B at line X-X).

Figure 38

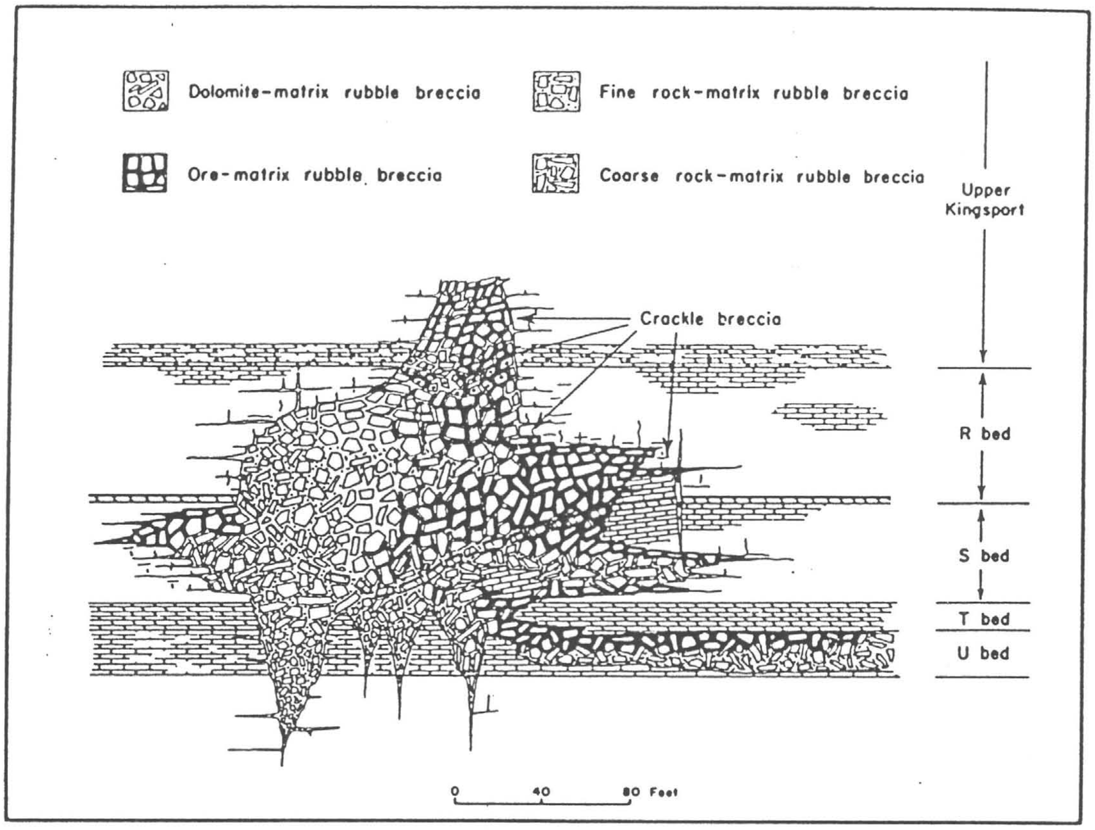
complex three dimensional problem, which is not amenable to easy solutions. However, by ardent, thorough geologic work, including the careful structural, geologic, mineralogic, and geochemical logging of exploration holes, this three dimensional geologic ore puzzle can probably be solved with commensurate economic rewards. Individual ore bodies within the main part of the district were of exceptional grade yielding, at current prices, several millions of dollars of ore, grading over $1,000 per ton. Thus, the writer feels that the reward is probably worth the difficulties of the search.

In addition to the chemical, structural traps offered by drag folds and saddle reefs in lime beds within the Bisbee group, there are some additional targets which should not be overlooked.

Karst Targets

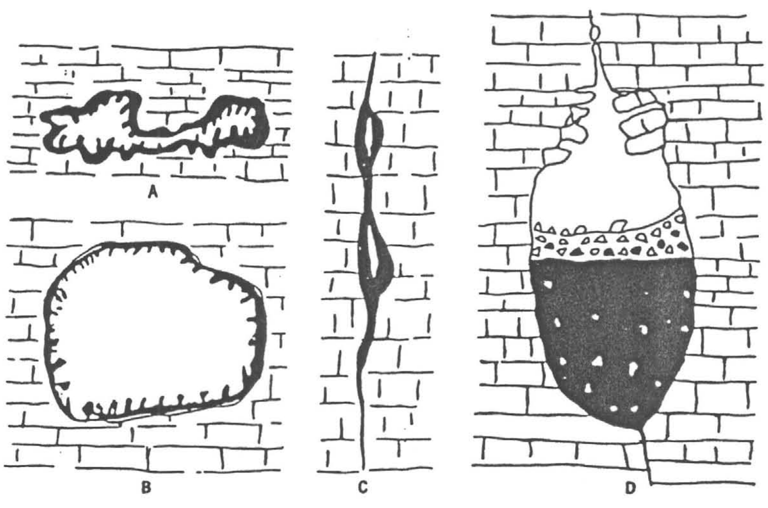
Whenever there are any subaerial erosion surfaces developed on limestone bedrock, there is potential for development of karst topography - that is the development of caves or caverns in the limestone. When these karst (cavern) topography limestones are subsequently covered and then subject to hydrothermal mineralization, the caverns or karsts form ideal targets for the localization of hydrothermal solutions, and deposition of massive sulfide deposits. This mineral deposition in karsts is a possible origin of the Tri-State lead-zinc deposits, though the source of mineralizing solutions is open to much debate. However, in the Leadville Mining District of Colorado, the environment appears to be similar, if not equivalent to that at Tombstone (oral communication Roland C. McEldowney, September, 1985). Here the Leadville Limestone, which has karst development on its erosion surface with overlying formations, has been cut by a caldera with subsequent lead-zinc-silver mineralization. Where the veins have intersected caverns in the Leadville Limestone, massive deposition of silver bearing galena with subordinate zinc and copper has resulted. These exceedingly large and rich ore bodies are currently exploited by the ASARCO-Newmont joint venture - the Black Cloud Mine.

Prior to the deposition of the Bisbee Formation, the Naco Formation was exposed to sub-aerial erosion and potential development of karst topography. During the Cretaceous, it was subsequently covered by the Glance Conglomerate and other units of the Bisbee Formation. During the development of the Tombstone vein system, if karsts were indeed present in the Naco Limestone, they may have well been invaded by the veins, and massive lead-silver-zinc deposition may have occured. In fact, some of the ore bodies in the main part of the district within the Naco Limestone may be such karst replacement zones.



Generalized section through a portion of the Jefferson City Mine showing breccia. (From Crawford and Hoagland, J. Ridge, ed., 1968, Ore deposits of the U.S., p. 253.)

Figure 39A



Solution caves and cavities in limestone. A, B, Open solution cavities lined with crusts of crystals, Wisconsin lead-zinc region (after Chamberlin); C, gash vein or solution enlargement along joint (after Whitney); D, solution cave occupied by ore (black) and cave breccia on bottom, overlain by later breccia and ore, and by breccia fragments (after Walker).

Figure 39B

If such an environment was present in the Naco Formation, then these karst replacements should be considered potential targets in any deep exploration work within the State of Maine mine area.

Since the northeast fracture direction appears to have been the prevalent one since the Precambrian, such karsts may have been aligned along the same northeasterly trend, as have been occupied by the later Laramide silver-lead-zinc-gold veins, which are the subject of the current exploration.

In addition to the Naco Formation, the question remains were there other karst developments lower in the Paleozoic limestone sequence? Any where there was a hiatus in Paleozoic limestone deposition and where that limestone was subject to sub-aerial erosion, there was potential for karst development. An examination of the geologic column (AAPG, 1967) suggests that the Escabrosa limestone (equivalent to the Leadville limestone) underwent a period of sub-aerial erosion as did the Devonian-Martin Limestone. Thus, potential for very deep karst targets in these horizons would be a possibility, as would replacement porphyry copper mineralization, particularly in the Martin, which was very productive at Bisbee.

Possible Changes in Alteration and Mineralization With Depth

The writer has previously described the Tombstone District as being the surface expression of multiple nested porphyry copper systems. Thus, as exploration proceeds more deeply below the State of Maine Mine area, mineralization should grade downwards into a more copper rich and less lead-zinc-silver rich environment, until true porphyry copper mineralization might be encountered at an unknown depth. Increasing grade of contact metamorphic calcsilicate minerals would be expected as would an increasing copper to zinc and lead ratio. Molybdenum might also be expected to increase, and it is conceivable that the rhyolite dikes exposed at the current surface might expand into or be rooted into a granitic pluton, the Extension quartz monzonite or its equivalent. Such a gradation was reported by Ransome in 1914, in the main part of the district, where he mapped complete silicification and calcsilicate alteration on the six hundred foot level of the Pump Shaft workings (Ransome, personal field note summaries, 1914). Further, in Section 36, at the Robbers Roost breccia pipe, drill holes to a 5,000 foot depth by ASARCO in the early 1970's, intersected typical porphyry copper alteration, including disseminated chalcopyrite, secondary K-spar, and purple anhydrite. Such a deep seated porphyry copper target, should it lie below the Tombstone Silver Mines, Inc. property at the State of Maine Mine, is not economically attractive with the currently poor state of the copper industry in the United States. However fluctuating copper prices are the rule, not the exception, and a decade or two in the future may see high copper/moly prices, which would make this an attractive target. Since the size of such a potential porphyry could be substantial, though probably very deep, the economic potential in the future could be significant.

Potential of the State of Maine Area Compared With Known Economic Silver Deposits of Similar Character

In the evaluation of any mineral deposit, without extensive drilling, the geologist must rely on comparisons with known deposits in similar geologic environments. Thus, the geologic model is the primary tool in comparing a potential exploration target to determine whether the costly exploration program might be rewarded sufficiently to justify itself. Other silver deposits geologically comparable to the State of Maine area include the following:

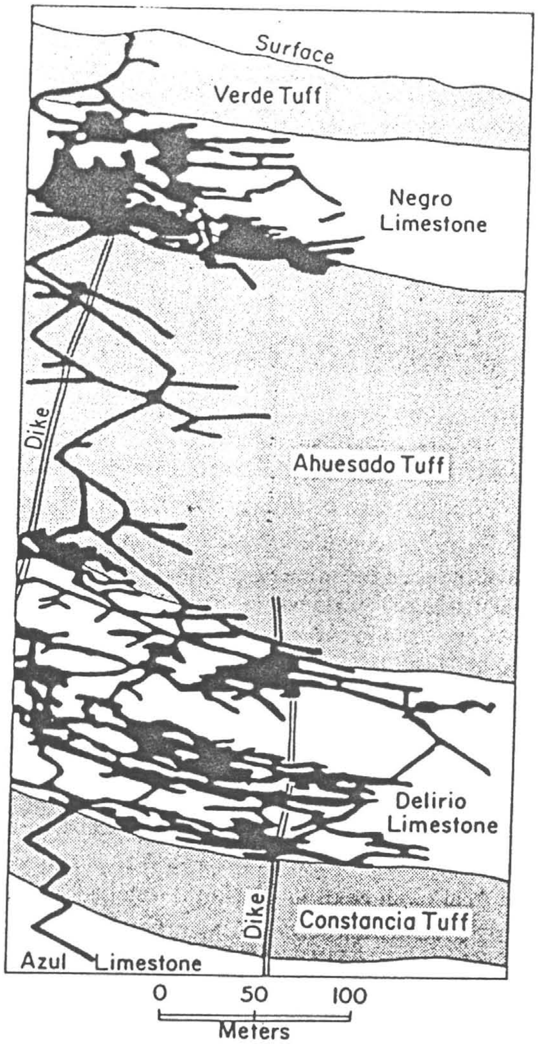
The Constancia Mine, Chanarcillo, Chile

The Constancia Mine, Chanarcillo Chile (see Figure 20-4, (Park & McDieramid, 1975, p. 489, Figure 39, this report), which is hosted by intercalated Cretaceous limestone and tuff, had a zone of supergene enrichment that was a minimum of 130 feet thick to a maximum 500 feet thick below the water table. It produced an approximate total of 100 million ounces of silver, 33 million ounces produced between 1860 and 1885. The production averaged 100 to 240 ounces of silver per ton in the supergene enriched zone. Because of its isolation, only the highest grade material was mined and shipped. Almost all production was from the limestone units. "In places the oxidized (silver) ores cropped out, but elsewhere they were overlain by tuff" (Park & McDiramid, p. 490).

Because none of the underlying limy sedimentary rocks within the State of Maine mine area have been penetrated by either drill holes or mine workings beneath the water table, we could conceivably intersect bonanza type silver mineralization similar to that located at Chanarcillo.

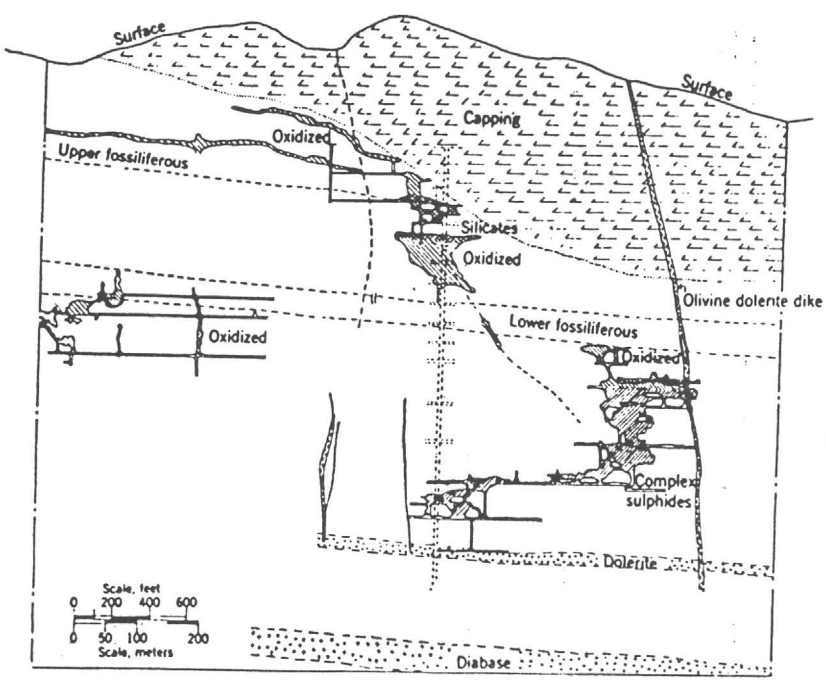
The El Potosi Mine, Santa Eulalia, Hildalgo, Mexico

At the El Potosi Mine, andesite and dacite flows and flow breccias overlie Cretaceous limestone. Veins form mantos, chimneys and irregular replacements in Cretaceous limestones, which are folded into a gentle anticline along which ore bodies are concentrated. This environment is quite similar to the main part of the Tombstone District, and similar to that for which we projected below the State of Maine area. Apparently both low and high temperature environments are present at the El Potosi mine, as indicated by the presence of garnet and other calcsilicates.



Cross section through the Constancia mine, Chañarcillo, Chile, showing the concentration of ore in limestones and the extensions of ore parallel to the bedding. (From Whitehead, 1919, Fig. 2.)

Figure 40A



Cross section of part of the ore bodies of the Potosi mine, Santa Eulalia, Mexico, showing mantos and pipes in limestone (white). The ore is shaded. (From Walker, U.S. Bur. Mines.)

Figure 40B

Figure 40 A & B

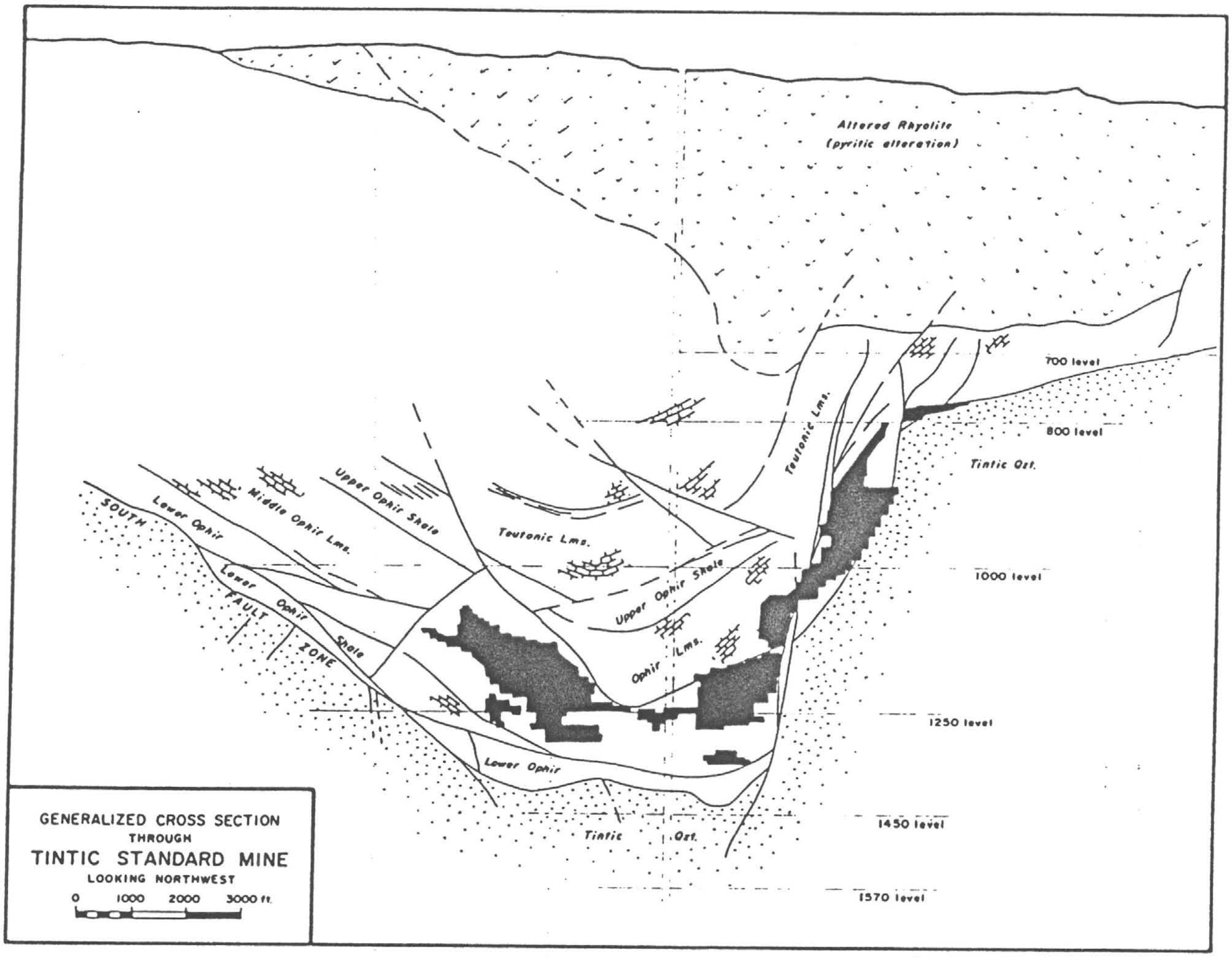
There is garnet and calcsilicate alteration at Tombstone, so here again the environment is similar. The production at the El Potosi mine has been $600 million since 1703, in silver, lead and zinc. This production figure does not represent the current price of silver, but probably silver at $1 or less and similarly low prices for lead and zinc. If we could extrapolate that price to the current price of silver at say $10 per ounce, then the mine may have produced as much as $6 billion in silver.

The Tintic Standard Mine, East Tintic District, Utah

The Tintic Standard Mine is overlain by rhyolite, and the ore is deposited in eugeosynclinal Paleozoics along a synclinal axis, accompanied by much faulting. Major thrust faults have been mapped, which have lead to the discovery of blind ore deposits. Careful geologic and geochemical mapping of the alteration of the surface volcanics lead to the discovery of the Bergin Mine, a blind ore deposit within the same area, in the 1950's. The district has produced silver, lead, zinc, copper and gold mineralization amounting to about $425 million to 1952. These figures do not include any production from the Bergin Mine operated by Kennecott Copper Corp. Further, the values were all at low metal prices in relation to today's prices - gold in the range of $20 to $35 per ounce and silver in the range of $.50 per ounce. The geologic environment, both in host rocks and overlying volcanics, is very similar to the State of Maine area.

The Main Part of the Tombstone District

As a close to this section on comments on the mineral potential of the State of Maine area, a comparison to the main part of the district is worthwhile. In size, they are very similar. Most production has come from a block approximately 6,000 feet square in the main part of the district, where as in the State of Maine area, the greatest intensity of mineralization appears to occupy a block 5,000 feet X 6,000 feet. Perhaps the best comparison might be the area of vein mineralization - that is, length of vein X average width between the two. Since we know, with some degree of accuracy, the production from the main part of the district between 1879 and 1937 (Figure 21), comparing the area of the veins in the two areas and multiplying the vein factor in the State of Maine area X the production in the main district, should give us an estimate of the potential for the State of Maine area. This is shown in the table on the following page:



Generalized cross section through Tintic Standard mine looking northwest.

Figure 41

PRODUCTION POTENTIAL

STATE OF MAINE AREA vs. THE MAIN TOMBSTONE DISTRICT

East edge of Section 16 to W edge of the True Blue claim & N end of the Free Coinage vein to S end of the Clipper vein	Eastern edge of the Contention - Silver thread W to the Scheiffelin Granodiorite & from the Vizina shaft to the Prompter fault
PHYSICAL SIZE: 6,000' X 5,000'	PHYSICAL SIZE: 6,000' X 6,000'
TOTAL VEIN LENGTH: 29,000'	TOTAL VEIN LENGTH: 63,000'
TOTAL AVERAGE VEIN WIDTH: 28'	TOTAL AVERAGE VEIN WIDTH: 5-15' (not clearly reported)
TOTAL PRODUCTION: 338,000 oz. Ag 787 oz. Au	TOTAL PRODUCTION: 33,468,647 oz. Ag 257,785 oz. Au

Using vein (fissure) length X width of the main district veins vs. the same for the State of Maine area to calculate potential for the State of Maine area;

Area of vein (fissures) for main district = 63,000' in length
X 10' average width
630,000 sq. ft.

Area of vein (fissures) for SOM area = 29,000' in length
X 28' average width
812,000 sq. ft.

812,000 State of Maine sq. ft. / 630,000 Main district sq. ft. = 1.29% of the main district is the State of Maine area potential

34 million oz. Ag produced X 1.29% = 43 million oz. Ag potential for the State of Maine area

258 thousand oz. Au produced X 1.29% = 333 thousand oz. Au potential for the State of Maine area

Figure 42

When compared in this way, it appears that because the State of Maine veins seem to have a greater average width even though the length so far identified is not as great as the main district, the total production in the State of Maine area might be larger than that in the main part of the district. Since production in the district ceased because of lowered silver prices rather than exhaustion of ore (Figure 18), it is quite likely that the main part of the district is far from exhausted, suggesting the potential for the State of Maine area is greater also.

The only difference the writer can discern on concluding this study between the two areas, is that within the State of Maine alteration zone, the strongest parts of the veins are contained within the non-reactive Uncle Sam tuff, which chemically allows the leaching of silver and gold values out of the surface, to be precipitated below the water table, out of site, and where they were beyond the reach of miners in the 1880's. In the main part of the district, reactive limestone neutralized supergene solutions, resulting in bonanza grade precious metal ore bodies now exposed at or near the surface.

Using a price of $10 silver and $400 gold, estimated potential dollar value of precious metals in the State of Maine area appears to be $563 million.

GEOTECHNICAL EVALUATION OF STATE MINERAL CLAIMS

GENERAL

The explorationist must have a firm grasp not only of the regional geologic settings, but also the character of attendant alteration, coupled with post-mineral structural disruption, weathering, and leaching which has occurred. Attention to these facts is critical. Understanding the nuances can lead to economical recovery of ores in the area. Generally speaking, many other factors must also be considered. Some of these are found in the following outline, without reference to author's work:

1. The sinuous nature of the veins (Briscoe).
2. Width and nature of through-going alteration zones (Sarle, Briscoe, Escapule).
3. The sporatic, stringer, or pod-like nature of the ore zones (many authors).
4. The apparent lack of surface expression of vein values (Sarle, Briscoe).
5. The complex structural environment exhibited in calderas (Briscoe).
6. Pre-mineralization environment and vein forming mechanisms (Briscoe).
7. Post-mineralization, oxidation and leaching of vein zones (Briscoe).
8. Erosion of altered vein zones (Sarle, Briscoe).

Accounting for these facts, a re-investigation of office records, maps and photographs was performed within and adjacent to the area, and interestingly, subtle extensions to known vein zones became apparent. Washes and soil covered zones became immediately suspect. Field investigations have followed, over several years, periodically mapping prospect pits, trenches and bulldozer cuts.

Recent investigations were undertaken by professional graduates of the geological, earth or geological engineering sciences and included:

1. James A. Briscoe, University of Arizona, Registered Professional Geologist, Arizona #9424, 21 years experience.

2. Arthur J. Graves, Colorado School of Mines, Registered Professional Geologist, Colorado, 31 years experience.

3. C. Bailey Escapule, Jr., University of Arizona, Geologist, 5 years experience.

4. Thomas E. Waldrip, Jr., University of Arizona, Geologist/Landman, 10 years experience.

Other data used herein was limited to that collected in a scientific manner by professionally educated consultants, and is believed to be accurate and representative. Assays are substantiated by attched reports, as all were done by certified assayers or reputable assay firms.

GEOPHYSICS

Within the immediate claim area, only one reported and documented geophysical I.P. survey is known (Figure 43). Three lines were within the limits of the claim area. According to Carouso (1968), a 500 foot station spacing was used, identifying two moderately weak, anomalous zones in the claim area. Carouso suggested in his summary that a closer dipole spacing be used to better define the anomalous zones, but this survey was never performed.

DRILLING

Several episodes of drilling have been performed through the years on or adjacent to the claims in question. Unfortunately, data related to assays has either been lost or is proprietary to other companies.

In 1968, Austral Oil Company had a drilling program of 36 holes of which 33 were on patented claims. Three holes, H-19, H-24 and H-27, were located on claims now under consideration, and are plotted on Figure 44. Each hole and its importance will be discussed later in the section pertaining to each mineral claim now under consideration.

A summary of Austral Oil's drilling results are as follows:

1. Total drilled footage: 10,580 feet.

2. Total drilled footage in the area of current State mineral claims (rotary/hammer): 960 feet.

3. Drilling type:

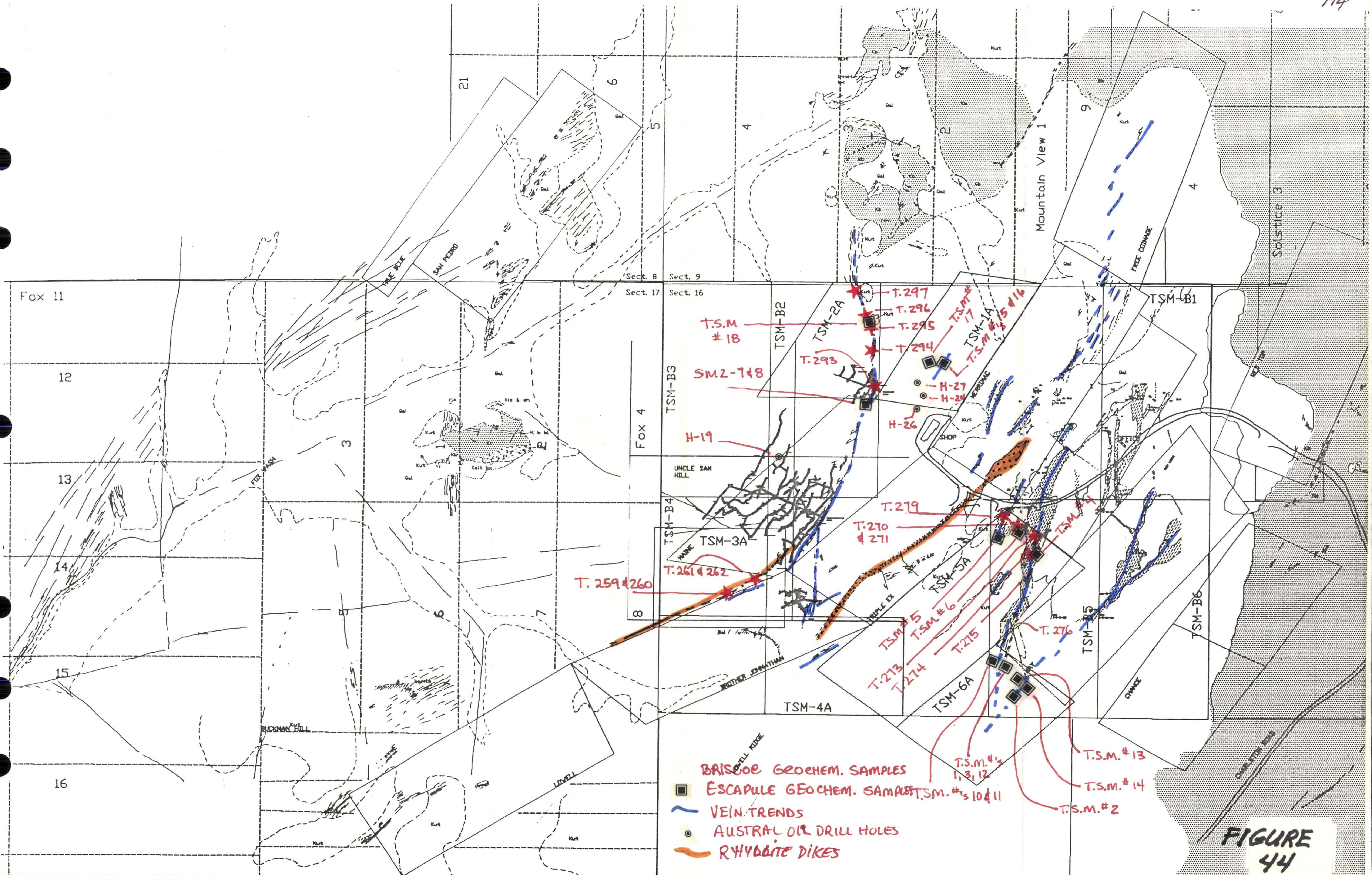

Fox 11
12
13
14
15
16
21
6
5
4
3
2
Mountain View 1
Solstice 3
Sect. 8
Sect. 9
Sect. 17
Sect. 16
Fox 4
TSM-B1
TSM-B2
TSM-B3
TSM-B4
TSM-B5
TSM-B6
TSM-1A
TSM-2A
TSM-3A
TSM-4A
TSM-5A
TSM-6A
UNCLE SAM HILL
SHOP
FOX WASH
T.297
T.296
T.295
T.294
T.293
T.S.M #18
T.S.M #17
T.S.M #15 & 16
SM2-7&8
H-27
H-24
H-26
H-19
T.279
T.270 & 271
T.S.M #4
T.261 & 262
T. 259 & 260
T.S.M #5
T.S.M #6
T.275
T.273
T.274
T.276
T.S.M. #'s 1, 3, 12
T.S.M. #13
T.S.M. #14
T.S.M. #2
T.S.M. #'s 10 & 11
BRISCOE GEOCHEM. SAMPLES
ESCAPULE GEOCHEM. SAMPLES
VEIN TRENDS
AUSTRAL OIL DRILL HOLES
RHYOLITE DIKES

FIGURE 44

a. Conventional vertical down the hole hammer: 8,398 feet.

b. Diamond, sub-horizontal -45 degrees to -60 degrees to the east or southeast direction: 2,560 feet.

4. Sample assay intervals generally were 10 feet. Most samples were assayed for silver. Anomalous sample intervals of +1/2 ounce silver were also assayed for gold. Copper was assayed in deeper holes at or below 450 feet in depth. No lead, zinc or trace element assays were performed. All assays were performed by the Atomic Absorption (AA) method by Southwestern Assayers and Chemists, Inc., Registered Assayers (Wilbur D. Wright, Certificate #5875), with offices at P. O. Box 7517, Tucson, Arizona 85713.

5. Silver assays included 863 assays (AA), ranging from a trace to a high of 10.06 troy ounces per ton.

6. Gold assays included 78 (AA) assays ranging from a trace to a high of 0.52 troy ounces per ton.

7. Copper assays included 93 (AA) assays ranging from less than 100 ppm (parts per million) to a high of 0.05 percent.

Drilling results failed to indicate sufficient reserves to justify mining at the then current averaged yearly precious metal pirce of $2.14 per troy ounce for silver and $35.00 per troy ounce of gold.

SURFACE GEOCHEMISTRY

Throughout the years, many geochemical samples have been collected over the claims in question. Suffice to say, some are currently proprietary. Others were assayed by questionable assay labs. Still others are questionable as to sampling methods involved. Therefore, any reference to these questionable samples has been dismissed, and only those results known to have been collected by professional geologists, using scientific sampling methods, and certified assay labs, are used in this report.

A few words are in order as to what a scientific sample collection method is. The following general specifications have been followed by the author for this report:

1. A described sample, i.e., grab, high-grade, vein, soil, etc.

2. A minimum of a four pound sample.

3. A sample from in place bed rock. Otherwise a soil sample is indicated.

4. A known sample position verified to a map or map coordinates.

5. A fresh sample, uncontaminated by soil or biological debris or mineral matter.

6. A sample, generally, as best as possible representing an admix of all representative rock types, alteration or particular vein, etc., in porportion to that in the field (a true representatie statistical sample of the population being sampled).

As pointed out earlier, many samples did not fit these categories and were dismissed. Many others did, but were collected on private lands. These are likewise left unreported, herein, but are open to private review during normal business hours, with prior appointment. The resultant geochemical samples are thus few, but representative of outcrop.

OTHER WORK

In the immediate State lands covered by mineral claims, numerous surface disturbances are noted. They range from bulldozer cuts estimated to be from 6 feet in depth to 100 feet in length, to backhoe trenches of various depths and lengths. It is assumed that they have been dug in prior years for work obligations or exploration activities, as they are now overgrown and appear several years old.

Numerous old prospect pits are scattered throughout the area along vein trends, off patented mineral claims. Only one mine, the Uncle Sam, of any consequence on the northward arcuate extension of the Maine Vein is known. It is estimated that an approximate tonnage of 1,500 tons of rock has been removed in total from all prospect pits, several tons being of shipping or milling quality ore. Of the figure mined, 75 to 80 percent was derived in the Uncle Sam mine area, with the remainder being from scatterd workings on State grounds.

The main observable value gained from these various endeavors, sampling and drilling in relation to the veins are:

1. Veins or their indications are continuing from workings on patented mineral claims onto and across State lands under claims.

2. Individual veins are narrow, less than 1 foot generally, and are difficult to identify on the surface, often because of soil cover.

3. Characteristically, workings in the area of mineral claims were in argillically altered county rock up to 100 feet in width on either side of the vein zone.

4. Veins are best described as vein zones, and generally characterized as strongly fractured and oxidized, shattered zones of Uncle Sam tuff, with associated manganese and iron oxides, with possible silica enrichment of wall rock.

5. Surface silver values seem to be denuded by surface leaching (no noticeable, observable silver mineralization was evident).

6. Generally, workings were in zones where junctions of veins were indicated or structures would change, such as strike (possible also dip, as noted in workings on patented claims).

7. Vein dips are variable, but generally appear to be moderate - 40 to 70 degrees in the west to northwest direction.

8. Surface and drilling indications are that vein mineralization is sporadic, generally low grade over undefined widths, with possible high grade zones. Silver values can vary from ore to anomalous values within a one foot distance. Vein zones identified to date on State grounds and sampled are all anomalously high in precious metals, minor areas and tonnage possible being able to be mined currently.

9. Assay indications are that veins are strongly silver in nature with minor gold values. Silver to gold ratios vary considerably, as seen in assays. In the Uncle Sam dumps (unpublished results), results range from 400:1 to (rarely) 23:1 in Austral Oil's drill hole #13.

DISCOVERY EVIDENCE BY CLAIM

Type A Mineral Claims

T.S.M. 1-A

Altered vein zone(s) evident in dump cuttings of three prospect shafts and three backhoe cuts, and possibly more veins noted, all with northeasterly strike and north-northwest dips in the 60 to 83 degree range, according to Escapule (1981). Fire assays were performed on samples labled T.S.M. 15, 16, and 17, collected in the area in 1981, by Arizona Assayers, P. O. Box 672, Tombstone Arizona, invoice #6199 (Figure 45). Sample descriptions and results are as follows:

Sample Number	Type of Sample	Ounces/Ton Silver	Ounces/Ton Gold
T.S.M.#15	Channel - highgrade - 1"	220.07	0.0980
T.S.M.#16	Channel - 25 feet	1.53	0.010
T.S.M.#17	Channel - 7 feet	0.24	0.005

Indications are that veins cropping on the Merrimac patented mining claims could transect the north side line of the Merrimac and proceed onto (under) State grounds of this claim at 300 to 900 feet in depth. Extralateral rights off the Merrimac veins, as granted by patent recorded 06/16/1882, Cochise County Deeds of Mine Book 9, Page 413, to Merrimac Silver Mining Company, and assigned to present owners, Tombstone Silver Mines, Inc., would take precedence over those portions of the vein(s) continuing through State lands, as covered by this claim. Indications are, as yet proven, that mineralization cropping and identified on this claim at the surface, as only spurs traced to the Merrimac vein zone at depth, and thus, belong to it by extralateral rights.

Two Austral Oil Company drill holes were drilled to the southwest of the above samples in 1968. Hole numbers 24 and 27 (Figure 44), which show little evidence of economic mineralization (Figures 46 & 47), attributed to cropping veins on the claim. Regretably, these holes were not drilled to a depth sufficient to accurately determine the issue of extralateral rights off the Merrimac. However, approximately 250 feet further south (just south of the northend-line of the Maine claim), a drill hole, number 25, Figure 44, intersects 30 feet of averaged 2.0 troy ounces silver mineralization between 400 and 430 feet in depth, which would be the anticipated depth to mineralization, 500 feet distant from the Merrimac veins, at a dip angle of 40 degrees. Author's note: A 40 degree dip is a very compatible dip for veins within the area.

6185

MAY 30, 1981

ARIZONA ASSAYERS

SOLD TO Tombstone Silver Mines Inc.

STREET & NO.

CITY

SHIPPED TO

STREET & NO.

CITY

CUSTOMER'S ORDER	SALESMAN	TERMS	VIA	F.O.B.	DATE
quantity	test	code	price	Ag.	Au.
9	fire assays	TSM1	@ $8.00	.82	.040
	"	TSM 2		.40	tr
	"	TSM 3		.21	.002
	"	TSM 4		5.11	.095
	"	TSM 5		.81	.005
	"	TSM 6		2.02	.020
	"	TSM 7		tr	nil
	"	TSM 8		3.66	tr
	"	TSM 9		2.12	tr

FIGURE 45

REDIFORM®

7H 736

INVOICE

June 3, 1981

120

6199

ARIZONA ASSAYERS,
P. O. Box 672
TOMBSTONE, AZ 85638

SOLD TO Tombstone Silver Mines Inc.
STREET & NO. 8238 E. Indian School Rd.
CITY Scottsdale, Az. 85251

SHIPPED TO
STREET & NO.
CITY

CUSTOMER'S ORDER quantity	SALESMAN test	TERMS Code#	VIA price	F.O.B. Ag	DATE Au
11	fire assays T.S.M.	#10	@$8.00	.08	tr
	" "	#11		.74	tr
	" "	#12		.13	tr
	" "	#13		.12	tr
	" "	#14		.07	tr
	" "	#15		220.07	0.980
	" "	#16		1.53	.010
	" "	#17		.24	.005
	" "	#18		.29	tr
	" "	#19		.36	tr
	" "	#20		1.74	tr
			balance due $88.00		

FIGURE 45 cont'd

REDIFORM®
7H 736

INVOICE

SOUTHWESTERN ASSAYERS & CHEMISTS, Inc.

REGISTERED ASSAYERS

FELIX K. DURAZO
WIL WRIGHT
ARIZONA REG. NO. 5875

P. O. BOX 7517
TUCSON, ARIZONA 85713

710 E. EV IS BLVD.
PHONE 602 94-5811

Austral Oil Company
2700 Humble Building
Houston, Texas

JOB # 002791
RECEIVED 7-12-68
REPORTED 7-17-68

SAMPLE NUMBER	GOLD OZ.*	SILVER OZ.*	LEAD %	COPPER %	ZINC %		MOLYBDENUM %
H-24:							
0-10		Trace					
10-20		Trace					
20-30		Trace					
30-40		Trace					
40-50		Trace					
50-60		Trace					
60-70		Trace					
70-80		Trace					
80-90		Trace					
90-100		Trace					
100-110		Trace					
110-120		Trace					
120-130		Trace					
130-140		Trace					
140-150		.20					
150-160		.18					
160-170		Trace					
170-180		Trace					
180-190		Trace					
190-200		.10					
200-210		.12					
210-220		.08					
220-230		.08					
230-240		.16					
240-250		.10					
250-260		.08					
260-270		.12					

REGISTERED ASSAYER CERTIFICATE NO. 5875 WILBUR D. WRIGHT Date Signed Arizona U. S. A.

FIGURE 46

CHARGE $ 54.00

INVOICE

* Gold and Silver reported in troy oz. per 2,000 lb. ton.

SOUTHWESTERN ASSAYERS & CHEMISTS, Inc.

REGISTERED ASSAYERS

FELIX K. DURAZO
WIL WRIGHT
ARIZONA REG. NO. 5875

P. O. BOX 7517
TUCSON, ARIZONA 85713

710 E. EVANS BLVD.
PHONE 602-294-5811

Austral Oil Company
2700 Humble Building
Houston, Texas

JOB # 002811
RECEIVED 7-15-68
REPORTED 7-17-68

SAMPLE NUMBER	GOLD OZ.*	SILVER OZ.*	LEAD %	COPPER %	ZINC %		MOLYBDENUM %
H-27:							
0-10		Trace					
10-20		Trace					
20-30		.04					
30-40		.06					
40-50		.32					
50-60		.24					
60-70	Nil	.68					
70-80		.30					
80-90		.24					
90-100		.18					
100-110		.16					
110-120		.08					
120-130		.20					
130-140	Nil (Tr)	.72	(0.60)				
140-150		.36					
150-160		.30					
160-170		.04					
170-180		Trace					
180-190		Trace					
190-200		.04					

REGISTERED ASSAYER
CERTIFICATE NO.
5875
WILBUR D.
WRIGHT
Date Signed
Arizona U. S. A.

FIGURE 4.7

CHARGE $ 40.00

* Gold and Silver reported in troy oz. per 2,000 lb. ton:

INVOICE

T.S.M. 2-A:

Altered vein zone evident in dump cuttings from four prospect pits and bulldozer cuts. Vein appears to be the arcuate northward component of the Maine vein, with ample evidence of workings. Immediately north of the northend-line of the Maine claim lies the Uncle Sam Mine (State lands this claim). Extensive development work exists in the mine (see underground level map, Lacy, 1968, Figure 48).

A private correspondence to Austral Oil (believed authored by Lacy), dated 3/11/68, indicated three mine dumps (at the time comprising the total of the Uncle Sam Mine waste), amounted to 341.6 cubic yards or approximately 700 tons, all on State land of this claim. A subsequent composite backhoe channel sample was cut and assayed at 1.60 troy ounces silver per ton (Figure 49), a reasonable figure, considering dilution from mining. These mine workings have yet to be fully investigated as to their potential.

Grab sampls of mine dumps and prospect pits associated with this claim were collected by both Briscoe (1973, samples 293A & B, and 294 throuh 297) and Escapule (1981, T.S.M. #18) (Figure 44), with results presented in figure 50 for respective samplers. Two samples collected by Escapule (1981) on the Maine patented claim, just south of the north end-line of this claim in a bulldozer cut (samples SM2-7 and SM2-8, Figure 44), indicate a representative sample of ore mineralization in the area. These two samples are high graded vein samples, from narrow (1/2 foot or less) vein structures and have respective values of 0.80 troy ounces per ton of gold, and 33.28 troy ounces per ton silver, and a trace of gold, and 44.64 troy ounces per ton silver.

T.S.M. 3-A:

Altered Uncle Sam tuff associated with rhyolite dikes dipping 42 degrees to the northwest. Several prospect pits and workings are noted along the dike with associated iron and manganese oxides being apparent.

Briscoe (1973) collected four samples in this area. Samples 259 and 260 (Figure 44), were high grade vein zone samples from a shaft collared in the footwall side of the rhyolite dike. This shaft is just outside the north side-line of the Brother Jonathan patented mining claim, showing the vein dipping to the northwest at 55 degrees. The northeastward trend of the vein is onto the Brother Jonathan patented claim, where it has been mapped by Briscoe (1973). Two other grab samples, Numbers 261 and 262, were collected off prospect pits immediately to the north (Figure 44), showing negative results. Assays for this claim are highlighted on Figure 51.

125 ~~660~~

SOUTHWESTERN ASSAYERS & CHEMISTS, Inc.

REGISTERED ASSAYERS

FELIX K. DURAZO
WIL WRIGHT
ARIZONA REG. NO. 5875

P. O. BOX 7517
TUCSON, ARIZONA 85713

710 E. EVANS BLVD.
PHONE 602-294-5811

Austral Oil Company Inc.
2700 Humble Building
Houston, Texas 77002

JOB # 002618
RECEIVED 6-11-68
REPORTED 6-13-68

SAMPLE NUMBER	GOLD OZ.*	SILVER OZ.*	LEAD %	COPPER %	ZINC %		MOLYBDENUM %
Dump #6	Nil	1.60					

Lincoln Sm

REGISTERED ASSAYER CERTIFICATE NO. 5875 WILBUR D. WRIGHT Date Signed 6/13 Arizona U. S. A.

FIGURE 49

CHARGE 3.75

* Gold and Silver reported in troy oz. per 2,000 lb. ton.

INVOICE

SKYLINE LABS, INC.
Hawley & Hawley, Assayers and Chemists Division
P.O. Box 50106, 1700 W. Grant Rd., Tucson, Arizona 85703

HAWLEY & HAWLEY SINCE 1914

CERTIFICATE OF ANALYSIS

ITEM NO.	SAMPLE IDENTIFICATION	Au ppm	Ag ppm	Pb ppm	Cu ppm	Oz Ag				
1	T - 276	<0.02	4.0	125	20	—				
2	277	<0.02	0.2	85	15	—				
3	281A	0.18	28.	6,800	75	0.82				
4	281B	0.23	26.	3,800	40	0.76				
5	282	0.11	165.	8,900	1,300	4.81				
6	283	<0.02	6.6	8,100	50	0.19				
7	287	<0.02	8.2	4,000	45	0.24				
8	288	<0.02	11.	3,600	30	0.32				
9	289	0.11	36.	1,400	30	1.05				
10	290	<0.02	165.	4,400	180	4.81				
11	291	0.06	3.6	30	30	—				
12	292	<0.02	2.8	1,100	20	—				
13	293A	<0.02	18.	1,400	75	0.52				
14	293B	0.19	13.	1,300	85	0.38				
15	294	<0.02	1.4	125	20	—				
16	295	<0.02	4.2	3,200	45	—				
17	296	<0.02	0.8	55	20	—				
18	297	<0.02	1.0	425	25	—				
19	298	0.03	13.	1,500	90	0.38				
20	299	0.06	62.	16,000	260	1.81				
21	332	0.06	4.2	850	20	—				
22	333	<0.02	4.0	1,300	15	—				
23	334	<0.02	6.6	1,900	15	—				
24	335	<0.02	1.0	110	25	—				
25	T - 336	<0.02	4.4	4,100	100	—				

TO:
James A. Briscoe DBA
Sierra Mineral Management
4741 East Sunrise Drive
Tucson, Arizona 85718
Attn: Mr. R. Hewlett

REMARKS:
Trace analysis

Page 1 of 2

CERTIFIED BY:

FIGURE 50

ACCT.:	DATE REC'D:	DATE COMPL.:	
SIERRA MINERAL MANAGEMENT	6/26/73	6/29/73	347509

SKYLINE LABS, INC.
Hawley & Hawley, Assayers and Chemists Division
P.O. Box 50106, 1700 W. Grant Rd., Tucson, Arizona 85703

CERTIFICATE OF ANALYSIS

ITEM NO.	SAMPLE IDENTIFICATION	Gold ppm	Silver ppm	Lead ppm	Copper ppm	Oz Ag				
1	T - 232	0.08	8.1	4,900	30	0.24				
2	240	<0.02	8.1	2,800	60	0.24				
3	241	0.23	220.	25,000	120	6.42				
4	242	<0.02	5.7	4,200	600	0.17				
5	243	<0.02	1.4	40	25	—				
6	244	<0.02	1.8	280	25	—				
7	245 } 9.97 ppm	<0.02	9.7	1,200	30	0.28				
8	246 } or 0.3 oz	<0.02	11.4	1,100	30	0.33				
9	247 }	<0.02	8.8	525	25	0.26				
10	248	0.06	31.	2,300	40	0.90				
11	249	0.11	14.	1,900	55	0.41				
12	2 250	<0.02	13.	65	70	0.38				
13	251	<0.02	0.8	80	15	—				
14	252	<0.02	9.4	2,500	100	0.27				
15	253	<0.02	2.4	470	15	—				
16	254	<0.02	2.6	535	20	—				
17	where 255	<0.02	2.2	435	30	—				
18	256	<0.02	2.0	540	30	—				
19	257	<0.02	39.	4,000	110	1.14				
20	258	<0.02	9.8	630	50	0.29				
21	259	0.32	39.	33,000	320	1.14				
22	260	1.20	240.	4,500	55	7.00				
23	261	<0.02	< 0.2	50	15	—				
24	262	<0.02	0.6	25	15	—				
25	263	<0.02	31.	1,900	55	0.90				
26	264	<0.02	6.2	2,500	30	0.18				
27	265	<0.02	2.6	165	35	—				
28	266	<0.02	2.8	150	30	—				
29	T - 305	<0.02	2.0	35	10	—				

TO: J. A. Briscoe DBA
Sierra Mineral Management
1971 Minerals Ltd., 4741 E. Sunrise Dr.,
Tucson, Arizona 85718
cc: Mr. R. Hewlett

REMARKS: Trace analysis

CERTIFIED BY: [signature]

REGISTERED ASSAYER CERTIFICATE NO. 6704 H. E. RICHARD Arizona

ACCT.: J. A. BRISCOE, DBA, SIERRA MINERAL MGNT., 1971 MINERALS LTD

DATE REC'D: 6/14/73

DATE COMPL.: 6/21/73

347451

FIGURE 51

Again, it must be pointed out that existing veins on the Brother Jonathan patented mining claims appear to be dipping under State grounds on which this claim is located. Tombstone Silver Mines, Inc. has extralateral rights to such mineralization, if shown to be contiguous with vein cropping on the Brother Jonathan, as acquired by chain of title per patent issued to C. W. Leach, as recorded on 1/12/1885, in Cochise County, Deeds of Mine Book 8, Page 530.

T.S.M. 4-A:

Four prospect pits exist on altered Uncle Sam tuff on the footwall side of the projected rhyolite dike in the area. Waste rock and float indicate abundant manganese and iron oxide staining, with possible minor silicification in the area. Samples have yet to be assayed, but indications are they will run in lead and silver, although low grade.

T.S.M. 5-A:

Abundance of evidence exists for the southward projection (continuation) of the Clipper vein zone, past the south end-line of the Clipper patented claim into and across the claim in question. Other alteration (vein?) zones enter the corner of the State claim from the Merrimac and/or Triple X (XXX) patented claims. Bulldozer cuts and waste rock surrounding prospect shafts indicate a moderately altered zone of Uncle Sam tuff on these trends. Argillic alteration predominates with noticeable amounts of manganese and iron oxides on fractures.

Both Briscoe (1973) and Escapule (1981) have mapped and sampled this area. A compilation of their work appears on Figure 44 with samples, location sites noted. Results are as follows:

Briscoe Samples - A.A. Assay (Figure 52)

Sample Number	Description	Type of Sample	Oz/Ton Silver	Oz/Ton Gold
T-270	Prospect pit	Grab	1.08	0.03ppm
T-271	Prospect pit	Grab	0.40ppm	Trace
T-272	Prospect pit	Grab	4.40ppm	0.03ppm
T-273	Prospect pit	Grab	0.25	Trace
T-274	Prospect pit	Grab	0.44	0.04ppm
T-275	Surface vein	Linear surface chip 15'	1.46	0.12ppm
T-278	Surface vein	Linear surface chip 25'	2.00ppm	Trace
T-279	Surface vein	Linear surface chip 50'	2.20ppm	0.02ppm

SKYLINE LABS, INC.
Hawley & Hawley, Assayers and Chemists Division
P.O. Box 50106, 1700 W. Grant Rd., Tucson, Arizona 85703

CERTIFICATE OF ANALYSIS

ITEM NO.	SAMPLE IDENTIFICATION	Au ppm	Ag ppm	Pb ppm	Cu ppm	Ag (oz)				
1	T - 267	0.03	6.8	2,500	30	0.20				
2	268	<0.02	1.6	360	25	—				
3	? 269	<0.02	1.0	135	20	—				
4	270	0.03	37.	6,100	175	1.08				
5	? 271	<0.02	0.40	120	15	—				
6	272	0.03	4.4	540	20	—				
7	273	<0.02	8.6	400	20	0.25				
8	274	0.04	15.	980	85	0.44				
9	275	0.12	50.	2,300	195	1.46				
10	278	<0.02	2.0	335	10	—				
11	279	0.02	2.2	360	10	—				
12	280	0.06	79.	17,000	215	2.30				
13	? 284	<0.02	31.	1,100	45	0.90				
14	285	0.02	34.	850	95	0.99				
15	T - 286	0.03	95.	2,200	220	2.77				

TO: J. A. Briscoe DBA
Sierra Minerals Management
4741 East Sunrise Drive
Tucson, Arizona 85718
Attn: Mr. R. Hewlett

REMARKS:

CERTIFIED BY:

FIGURE 52

ACCT.:	DATE REC'D:	DATE COMPL.:	
SIERRA MINERALS MANAGEMENT	6/20/73	6/26/73	347483

Escaule Samples - Fire Assay (Figure 45)

Sample Number	Description	Type of Sample	Oz/Ton Silver	Oz/Ton Gold
TSM #4	Prospect pit	Grab - 5'	0.82	0.04
TSM #5	Prospect pit	Grab - 2'	0.40	Trace
TSM #6	Prospect pit	Grab - 5'	0.21	0.002

Surface samples are highly erratic, but in all cases, strongly anomalous if not ore grade considering strong surface leaching. Soil cover prevents adequate sampling without large surface disturbances by trenching or bulldozer cuts.

T.S.M. #6-A:

Evidence on this claim exists for showing the continued southward trend of the Clipper vein after its crossing the southwest corner of the May patented claim. Some evidence also exists to show the southward trend of the May veins could cross into the claim, and possibly intersect with the Clipper vein (Figure 44). This evidence has been generated by past backhoe cuts, cut normal to the proposed vein structures and their trend. These cuts, plus prospect pits, indicate moderately altered Uncle Sam tuff being present in the area, with strongly anomalous silver mineralization, as indicated below (for sample locations, see Figure 44):

Sample Number	Description	Type of Sample	Oz/Ton Silver	Oz/Ton Gold
TSM #1	Prospect Pit	Grab-channel 5'	0.82	0.04
TSM #2	Prospect Pit	Grab-channel 2'	0.40	Trace
TSM #3	Prospect Pit	Grab-channel 5'	0.21	0.002
TSM #10	Backhoe cut	Channel-2.5'	0.08	Trace
TSM #11	Backhoe cut	Channel-10.0'	0.74	Trace
TSM #12	Backhoe cut	Channel-12.0'	0.13	Trace
TSM #13	Backhoe cut	Channel-10.0'	0.12	Trace
TSM #14	Backhoe cut	Channel-4.0'	0.07	Trace

Type B Mineral Claims

T.S.M. #'s B-1, B-5 and B-6:

Evidence for discovery upon these claims is limited to observable continuation of vein structures from the Clipper vein onto and across the common corners (SW corner T.S.M. #B-1, NE corner T.S.M. #B-5, and NW corner T.S.M. #B-6) of these claims. Details of the veins and backhoe cuts cut on the Clipper patented claim are detailed by Briscoe (1985) under his section 1" = 50' Color Photography Matched to Topography, this report, Page --. The three veins named by Briscoe have been identified from east to west as the Office Vein 1 East, Office Vein and Office Vein West. Adequate sampling on State lands has yet to be performed due to soil cover in the area and the necessary disturbances needed to perform such scientific sampling surveys. Briscoe (1985) has identified surface mineral rubble on the State claims in question in trend with the above referenced vein zones.

T.S.M. #'s B-2, B-3 and B-4:

Evidence for discovery on these three claims is taken directly from the State of Maine mine workings on the Maine vein. No direct assays are available to present here for individual samples collected within the mine on levels 5, 6, and 7 workings. These levels cross into and are driven upon State lands, Figures 53 & 54. However, during various investigations through the years, several surveys have been performed.

The earliest sampling of record was performed by the Phelps Dodge Corporation in 1915. Sampling of the 7th level of the mine consisted of 178 samples giving the following results: an average sample width of 1.29 feet; and averaged assay values of 0.12 and 3.27 troy ounce(s) per ton gold and silver, respectively (Butler, et al., 1938, Page 102, Briscoe, 1985, Figure 36, this report). Although Phelps Dodge sampling stations are still visible in the mine today, results have been lost or are filed and misplaced in the company archives.

Recent sampling in underground workings has been limited to spot checking various structures with a UNC Silver MAP unit. Sampling stations and results therefrom have been spray painted on mining workings, and have yet to be transferred to hard copy. Results of the survey indicate similar results to Phelps Dodge's work (author's observation). Results were sporatic and vary highly from station to station. Assays from no detectable silver to a reading of several tens of ounces were noted. By use of the UNC Silver MAP unit, a quick, cost effective, quantitative and reliable method of taking silver assays is at hand, with the instrument to be used in the future as an assaying guide to open pit selective mining of silver veins.

An Austral Oil drill hole, Number 19 (Figures 44, 53 & 54), is projected to near an area of the common corners of the above claims. This drill hole tends to be quite dead, for silver mineralization above 350 feet, but silver values pick up from there to a total depth to be strongly anomalous in the expected dip slope trend of the drilled Maine vein. Figure 55 lists assay values of various intervals for Austral Hole #19.

Ground reconnaissance and review of aerial photography of the slopes of Uncle Sam Hill failed to locate any visible evidence of mineralization, other than that exposed in the Maine vein system. The Uncle Sam tuff, as exposed on the west and north slopes (claim area of T.S.M. #'s B-2, B-3 and B4), is unaltered and save for weathering, quite fresh in broken exposure where sampled. The inference the author would draw from this observation would be to strongly suspect that the only economic silver mineralization to be devleoped on State lands would be that directly associated with the Maine vein, extralaterally off the patented claim. Any other mineralization found extralaterally to the west side-line of the Maine patented claim will then, in all likelihood, ultimately pass to Tombstone Silver Mines. It is the author's opinion that in order to avoid further complications, the State should grant Tombstone Silver Mines a preferred right to lease the States mineral rights to all three of the claims, on this basis.

SOUTHWESTERN ASSAYERS & CHEMISTS, Inc.

REGISTERED ASSAYERS

FELIX K. DURAZO
WIL WRIGHT
ARIZONA REG. NO. 5875

P. O. BOX 7517
TUCSON, ARIZONA 85713

710 E. EVANS BLVD.
PHONE 602-294-5811

Austral Oil Company
2700 Humble Building
Houston, Texas

JOB # 002781
RECEIVED 7-11-68
REPORTED 7-16-68

SAMPLE NUMBER	GOLD OZ.*	SILVER OZ.*	LEAD %	COPPER %	ZINC %		MOLYBDENUM %
H-19:							
0-10		Trace					
10-20		Trace					
20-30		Trace					
30-40		Trace					
40-50		Trace					
50-60		Trace					
60-70		Trace					
70-80		Trace					
80-90		Trace					
90-100		Trace					
100-110		Trace					
110-120		Trace					
120-130		Trace					
130-140		Trace					
140-150		Trace					
150-160	Nil	.80					
160-170		Trace					
170-180		Trace					
180-190		Trace					
190-200		Trace					
200-210		Trace					
210-220		Trace					
220-230		Trace					
230-240		Trace					
240-250		Trace					
250-260		Trace					
260-270		Trace					
270-280		Trace					
280-290		Trace					
290-300		Trace					

FIGURE 55

CHARGE ______

* Gold and Silver reported in troy oz. per 2,000 lb. ton.

INVOICE

SOUTHWESTERN ASSAYERS & CHEMISTS, Inc.

REGISTERED ASSAYERS

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Austral Oil Company

Page # 2

JOB # 002781 Continued
RECEIVED
REPORTED

SAMPLE NUMBER	GOLD OZ.*	SILVER OZ.*	LEAD %	COPPER ppm	ZINC %		MOLYBDENUM %
H-19:							
300-310		Trace					
310-320		Trace					
320-330		.14					
330-340		Trace					
340-350		.12 } 0.17					
350-360		.22					
360-370		.04 } 0.05					
370-380		.08					
380-390		.04	0.45				
390-400	Tr	.32		60			
400-410		.22 } 0.30		40			
410-420		.34		32			
420-430		.30		20			
430-440	No Sample						
440-450		.08		20			
450-460		.06		24			
460-470		.06		16			
470-480		.20		16			
480-490		.08		12			

REGISTERED ASSAYER
CERTIFICATE No. 5875
WILBUR D. WRIGHT
Date Signed
Arizona U. S. A.

FIGURE 55
Cont'd

CHARGE $ 116.00

* Gold and Silver reported in troy oz. per 2,000 lb. ton.

INVOICE

GENERAL COMMENTS:

Within the general environment of the North 1/2 of Section 16, Township 20 South, Range 22 East, G. & S.R.B.M., Tombstone Silver Mines, Inc. or its predecessors have expended large sums in exploration capital, doing a complete and scientific survey of mineral occurrences located there. These parties have established reserves, substantially all located on patented claims, extending to the end-line boundaries with State lands.

During 1984, Tombstone Silver Mines, Inc. drilled 170 vertical 4 1/2 inch diameter developmental drill holes. A total of 10,159 feet of drilling, to a maximum depth of 120 feet, was performed. Mining commenced shortly thereafter on ore reserves in 1985, with termination later in the year, due to weakening commodity prices. During this hiatus, work has continued to delineate additional reserves and re-evaluate results to date, conceptualizing various mining and developmental plans. What has become clear from this work is that:

1. A consolidation of all lands within the NW1/4 and W1/2W1/2NE1/4 of Section 16 will be necessary in order to formulate a viable and economic mining plan.

2. Most, if not all, past production of high grade mineralization has been generated off of patented claims in the outlined area.

3. Little, if any, mining of economic results has been done on State grounds in the outline area.

4. Mineralization and reserves exist on patented land currently awaiting development.

5. Some mineralization of probable development grade exists on state grounds under claim by Tombstone Silver Mines, Inc., if developed in conjunction with that located to date on patented claims.

6. Evidence is substantially in favor of Tombstone Silver Mines proving ownership to most any ore developed extralaterally to their claim, on State lands, as being associated to outcropping veins on patented claims (emphasized by the Maine and Merrimac veins, this report).

7. Tombstone Silver Mines, Inc. and its personnel has and continues to demonstrate superior ability to prospect, develop and mine low grade silver mineralization found in the area, at a profit.

8. Tombstone Silver Mines, Inc. and its consultants have developed a unique method of selective mining in order to mine the lower grade dispersed mineral reserves in the area at a profit by open cut design.

9. Tombstone Silver Mines, Inc. is in the unique position to have a mining and processing infrastructure in place to mine, extract and process ore.

10. Future mining on patented claims may prove it necessary to limit easy ingress and egress to future mineable areas on State lands in the area. Resulting exploration, development and mining of State lands will become more difficult

Further, some intangibles in our conceptualizing have caused concern to Tombstone Silver Mines, as they should be to the Commissioner. The author does not wish to harbor or imply any misunderstanding by the following points, but feels it proper to point them out to the Commmissioner.

Tombstone Silver Mines exploration acitivities indicates:

1. The strong possibility of conflicts resulting over the extralateral rights issue, should mineral rights be subsequently leased to other parties.

2. The distinct possibility that should State lands under claim by Tombstone Silver Mines, Inc. not be leased to them, that development will not result thereon, both because of low grade nature of mineralization contained therein, and the removal of the mining and processing infrastructure. Obvious royalty losses to the State will probably, therefore, result.

3. Unitization of all grounds (veins) will be necessary in order to obtain necessary tonnages and lands to fulfill comprehensive and economical mining objectives. Without consolidation, large scale mining will probably be impossible in the future. Dilution of higher grade near surface reserves by small scale mining on patented claims will result, removing the future possibility of large scale open cut mining in the area on the State lands.

4. Due to the complex and broken-up nature of State land parcels in the area, it will be extremely difficult for any party other than Tombstone Silver Mines, Inc. to put forward a mining plan capable of extracting what mineralization is known to exist on State lands.

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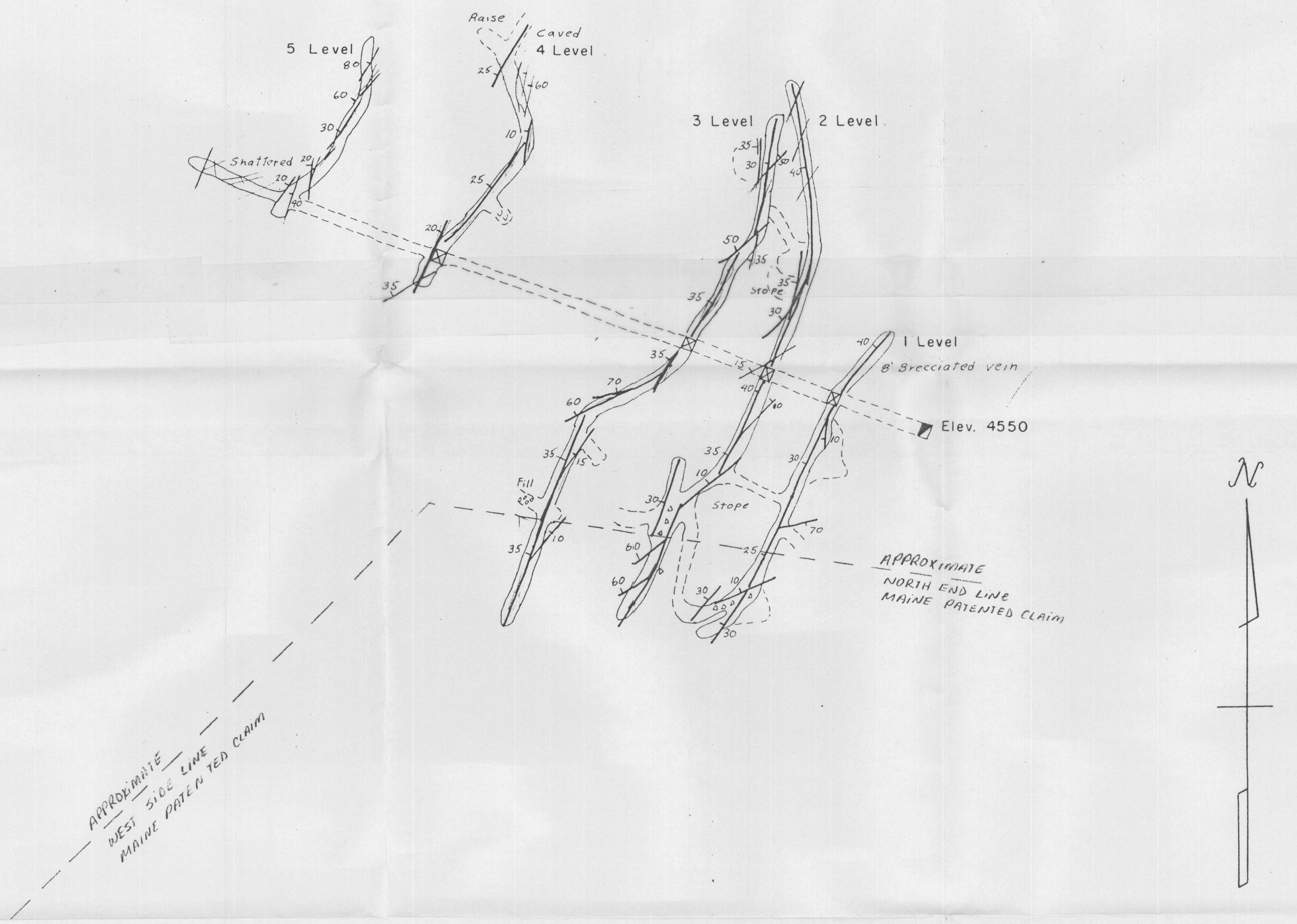
INDUCED POLARIZATION AND RESISTIVITY SURVEY
COMPOSITE OF CAB AND AUSTRAL SURVEYS
TOMBSTONE AREA, COCHISE COUNTY, ARIZONA
SCALE 1:24000

SUFACE PROJECTION OF ANOMALOUS ZONES
DEFINITE
PROBABLE
POSSIBLE

I. P. LINES
A = AUSTRAL
C = CAB

STATE LEASE

FIGURE 43
NOV. 1968



AUSTRAL OIL COMPANY INC.

TOMBSTONE AREA

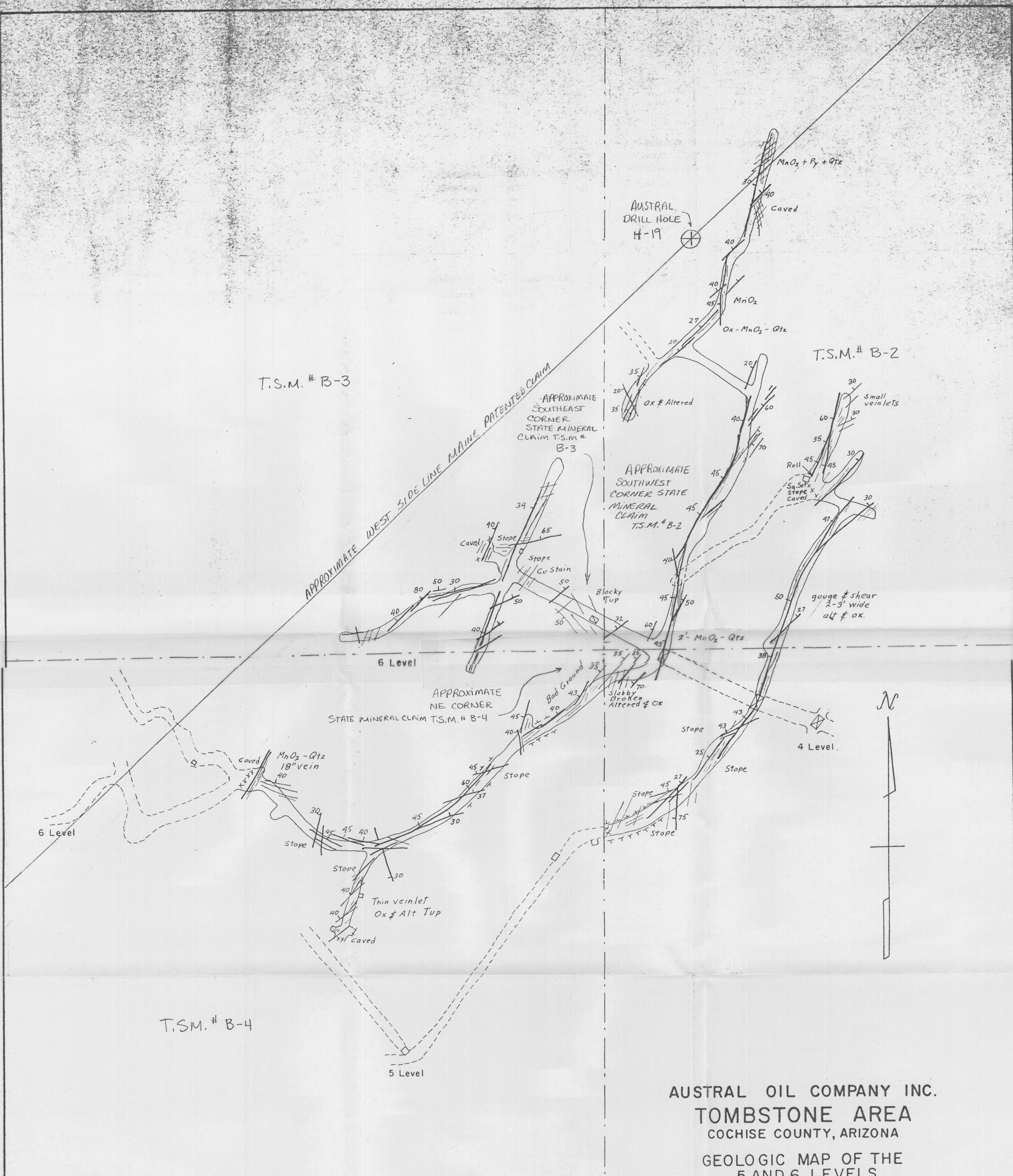
COCHISE COUNTY, ARIZONA

GEOLOGIC MAP OF THE COMPOSITE LEVELS UNCLE SAM MINE

0 10 50 100 Feet

W.L. July, 1968

FIGURE 48



T.S.M. # B-3
T.S.M. # B-2
T.S.M. # B-4
APPROXIMATE WEST SIDE LINE MAINE PATENTED CLAIM
AUSTRAL DRILL HOLE H-19
MnO_2 + Py + Qtz
Caved
MnO_2
Ox - MnO_2 - Qtz
Ox & Altered
APPROXIMATE SOUTHEAST CORNER STATE MINERAL CLAIM T.S.M. # B-3
APPROXIMATE SOUTHWEST CORNER STATE MINERAL CLAIM T.S.M. # B-2
Small veinlets
Roll
Square Set Stope Caved
Stope
Cu Stain
Blocky Tup
2' - MnO_2 - Qtz
gouge & shear 2-3' wide alt & ox.
6 Level
APPROXIMATE NE CORNER STATE MINERAL CLAIM T.S.M. # B-4
Bad Ground
Slabby Broken Altered & Ox
4 Level
MnO_2 - Qtz 18" vein
Thin veinlet Ox & Alt Tup
5 Level
N
AUSTRAL OIL COMPANY INC.
TOMBSTONE AREA
COCHISE COUNTY, ARIZONA
GEOLOGIC MAP OF THE 5 AND 6 LEVELS STATE OF MAINE MINE
0 10 50 100 Feet
W.L. July, 1968

FIGURE 53

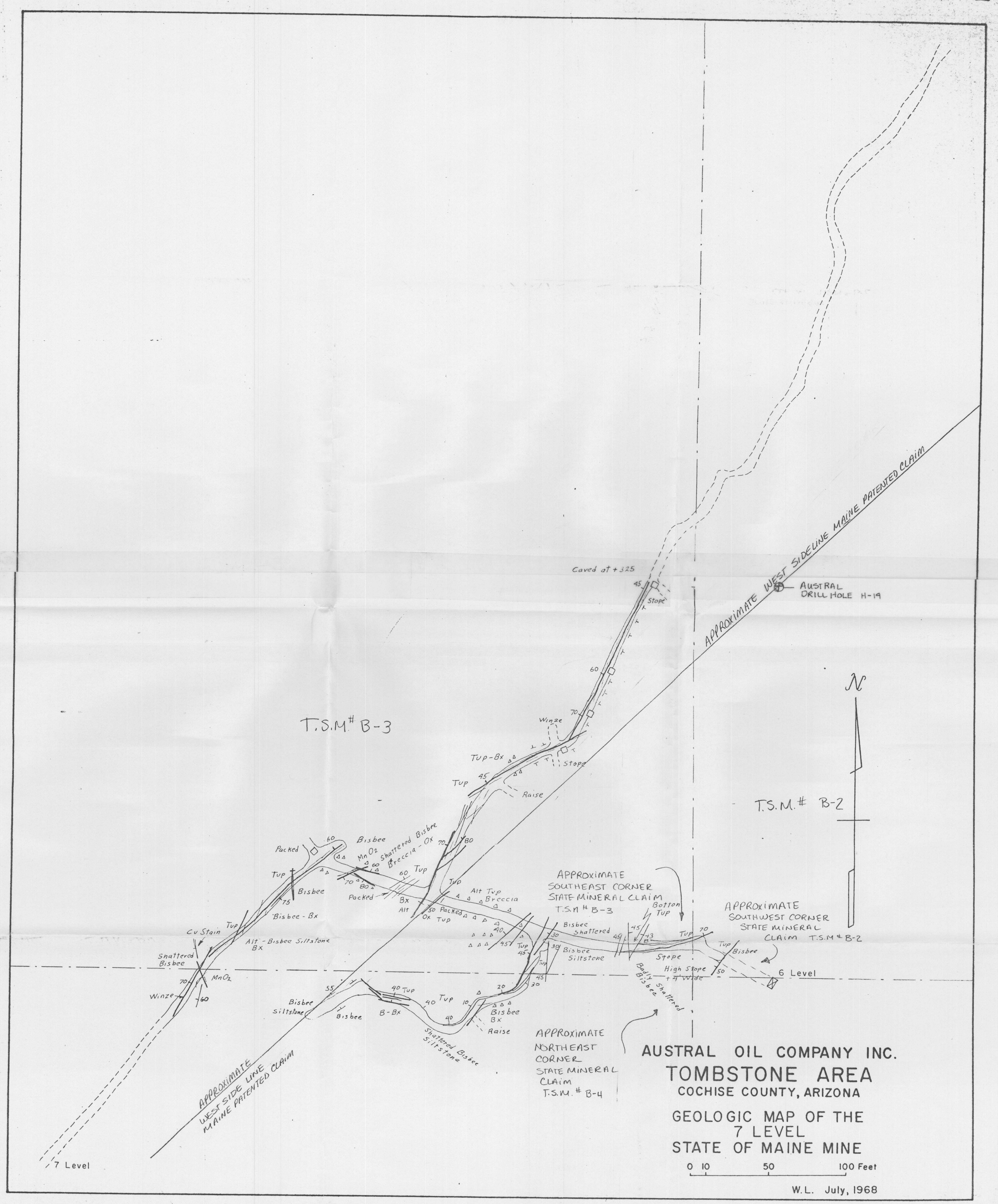

AUSTRAL OIL COMPANY INC.
TOMBSTONE AREA
COCHISE COUNTY, ARIZONA
GEOLOGIC MAP OF THE
7 LEVEL
STATE OF MAINE MINE
0 10 50 100 Feet
W.L. July, 1968
N
T.S.M.# B-3
T.S.M.# B-2
APPROXIMATE WEST SIDELINE MAINE PATENTED CLAIM
APPROXIMATE WEST SIDE LINE MAINE PATENTED CLAIM
AUSTRAL DRILL HOLE H-19
Caved at +325
Stope
Winze
Raise
Tup-Bx
Tup
APPROXIMATE SOUTHEAST CORNER STATE MINERAL CLAIM T.S.M.# B-3
APPROXIMATE SOUTHWEST CORNER STATE MINERAL CLAIM T.S.M.# B-2
APPROXIMATE NORTHEAST CORNER STATE MINERAL CLAIM T.S.M.# B-4
Bottom Tup
Bisbee Shattered
Bisbee Siltstone
High Stope +4' Wide
Badly Shattered Bisbee
6 Level
7 Level
Alt Tup Breccia
Packed
Bisbee
MnO2
Shattered Bisbee Breccia - Ox
Bisbee - Bx
Alt - Bisbee Siltstone Bx
Cu Stain
Shattered Bisbee
Bx
Alt
Ox Tup
B-Bx
Bisbee Bx
Shattered Bisbee Siltstone

FIGURE 54