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James Doyle Sell Mining Collection

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Geology Report JRK Sept 19, '73
Charleston West

Final Report JRK Oct 20, '75
Charleston West

do we want to show Burscat [?] maybe
The vertical zoning pictures if we kept
1 of them our skeleton core if we [illegible] the cover
over Can went back to Homme [?]

[signature]

WLK
comment

Without reviewing
I say the Bj Dawn [?]
work defined a target
but land situation never allowed
testing.

F. T. GRAYBEAL TOMBSTONE

TO: WL Kurtz / WD Payne

Any interest? Might be worth find out what he wants. I still think Devere Ims. repl. Pb-Zn-Au-Ag is good target and am not yet convinced Schleiffhn gd is source of metals.

1/26/82

Hand

Sent to CDP

Email — just as a confirmation that it is the report that we were looking for by Boisvert that we never found.

James A. Briscoe & Associates, Inc.

Exploration Consultants:
Base and Precious Metals/Geologic and Land Studies/Regional and Detail Projects

James A. Briscoe
Registered Professional Geologist

Thomas E. Waldrip, Jr.
Geologist/Landman

February 1, 1983

Jim Sell
Asarco, Inc.
P. O. Box 5747
Tucson, Arizona 85703

RE: Transmittal of the Tombstone area Summary Report

Dear Jim:

Enclosed is a copy of my report on Tombstone, which you expressed an interest in.

At some time, I would like to take a look at the report on the Asarco drilling, circa 1973, in the Charleston Lead Mine area, if that would be possible.

Best regards,

James A. Briscoe

JAB/ms

Enclosure

5701 East Glenn Street, Suite 120/Tucson, Arizona 85712/602•721-1375

A SUMMARY OF

THE TOMBSTONE DEVELOPMENT COMPANY LANDS

in the

TOMBSTONE CALDERA COMPLEX

COCHISE COUNTY, ARIZONA

A Geologic Appraisal and Estimate

of

Mineral Potential

By

James A. Briscoe
Registered Professional Geologist

Land Research and Property Maps

By

Thomas E. Waldrip, Jr.

November, 1982

Prepared by James A. Briscoe

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

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(Included Within This Report)

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either completed and available upon request,
or incomplete and not included

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SCALE 1:62,500

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Plate 2: Alteration and mineralization map, on a geologic base, of the Tombstone 15 min. quadrangle - 1" = 1 mile; 1:62,500 (Incomplete)

SCALE 1:24,000

Plate 3: Property map at 1" = 2,000' on a topographic base showing all patented and unpatented mining claims determined from research into county, B.L.M. and private records. No recent surveys have been used to create this map (Complete and available upon request)

SCALE 1:6,000

Plate 4: Property map at 1" = 500' on a topographic and geologic base of the Tombstone Basin-Military Hill area. Source as in Plate #3 (Complete and available upon request)

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Plate 7: Geologic cross section G-G', 1" = 500' vertical scale = horizontal scale (Incomplete)

Plate 8: Geologic cross section H-H' (Incomplete)

Plate 9: Geologic cross section I-I' (Incomplete)

Plate 10: Geologic cross section J-J' (Incomplete)

SCALE 1:2,400

Plate 11: Property map of the Tombstone Basin and Tombstone Extension areas, 1" = 200', on a topographic and geologic base (Complete and available upon request)

Plate 12: Geologic and structural map of the Tombstone Basin and Tombstone Extension areas, 1" = 200', on a topographic and geologic base (Completed and available upon request)

Plate 13: Alteration and mineralization map of the Tombstone Basin and Tombstone Extension areas on the same base as Plates #11 and #12 (Incomplete)

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Plate 15: Geologic cross section L-L' (Incomplete)

Plate 16: Geologic cross section M-M' (Incomplete)

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Plate 18: Geologic cross section O-O' (Incomplete)

Plate 19: Geologic cross section P-P' (Incomplete)

Plate 20: Geologic cross section Q-Q' (Incomplete)

Plate 21: Geologic cross section R-R' (Incomplete)

Plate 22: Geologic cross section S-S' (Incomplete)

Plate 23: Geologic cross section T-T' (Incomplete)

Plate 24: Geologic cross section U-U' (Incomplete)

SUMMARY

The Tombstone Mining District, then in Arizona Territory, was discovered by Ed Schiefflin, son of California 49er's, in 1877. Tombstone, though isolated and subject to maurading Indians and outlaws in its early days, was affected by world events through their effect on silver prices. With Schiefflin's discovery of rich silver mineralization at Tombstone, silver prices began a decline from which they would not see the same price of silver as in the year of discovery, for 86 years. During the 34 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 U. S. currency from the silver standard had immeasurably more affect on the mines than the Earp-Clanton feud, Apaches and bandits and underground waters. In 1911, prices of approximately $0.55 per ounce (less than half of that in effect when Schiefflin 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 operated the mines in a desultory fashion from 1914 through 1933, when the Tombstone Development Corporation, under Ed Holderness, was formed. The higher gold price instituted by Roosevelt in 1932, stimulated some development for a few years, as did World War II. However, production never came close to the halcyon years between 1877 and 1910. The Tombstone Development Company properties have been operated and explored only sporadically from the end of World War II to the present time.

Tombstone has primarily been a silver camp, though significant gold and lead, and subordinate copper, zinc and manganese has also been produced. Production has come mainly from mineralized vein fractures, cutting folded lower Cretaceous sediments of the Bisbee group within the Tombstone Basin. Ninety-five percent or more of the production is from 0 - 600 feet below the surface, and is primarily from oxide ore minerals.

The average grade for all of the recorded production within the District is 0.21 ounces gold, 25.89 ounces silver, 2.6% lead, 0.10% copper and small amounts of zinc and manganese. Approximately 1.25 million tons of ore was produced, though this is an estimate, since in the early most productive years, no accurate record of tonnage was maintained.

The Butler-Wilson volume, published by the Arizona Bureau of Mines in 1938, is the major professional treatise on the District. The 1956 U.S.G.S Professional Paper 281, "General geology of central Cochise County" by James Gilluly, included the Tombstone area. More recent important contributions include a

SUMMARY Cont.....

Stanford Doctoral thesis by Roger A. Newell in 1973, and a regional map by Harald Drewes, of the U.S.G.S., in 1980.

James Gilluly believed the mineralization at Tombstone to be of Mid-Tertiary age. More recent atomic age dates, show the intrusive rocks within the Tombstone area to range from 74 million to 63 million years in age, thus fixing the age of the District as Laramide.

In the early 70's, the large area of Uncle Sam porphyry, previously thought by Gilluley and others to be a sill-like mass, was recognized to be a welded tuff (ignimbrite). Recent work in this paper, by the author, has shown Tombstone to be a large Laramide caldera complex, indicated by the volcanic and intrusive rock assemblage, surface geology and regional aeromagnetic and gravity data. Mesothermal porphyry copper type alteration systems appear to be responsible for all metalization within the caldera complex, including the precious metal mineralization at Tombstone. Tombstone occupys the outer northeast rim of the caldera. Geologic and aeromagnetic projections along the caldera margin, suggest potential for additional mineral zones, such as Tombstone, around the periphery of the caldera. Some 45 square miles of pervasive, though variably altered rocks, are exposed in the eastern margin of the caldera. The western margin of the caldera falls primarily under cover, and is also inaccessible because of a military reservation. However, alteration appears to be present along the west margin of the caldera.

Total past production at Tombstone, in terms of $400 gold, $10 silver, $.50 lead, $1.00 copper and $.40 zinc, is approximately $463 million dollars. Geologic evaluation of ore bearing structures within the Tombstone Basin suggest that mineralization similar to that previously produced could aggregate approximately $3 billion, within the oxide zone, within 1,000 feet of the present surface. An open pitable ore body, in the range of 54 million tons of $25 per ton combined gold and silver, aggregating approximately $1 billion for the metal in place, is thought to be present along the Tranquility-Contention Zone, south of the town of Tombstone. An open pit mine is currently producing this grade of material on a lease from the Tombstone Development Company, at a rate of approximately 3,000 tons per day.

A geochemical anomaly with a signature similar to that of Tombstone exists along the caldera margin, but is completely hidden by alluvial cover. A similar precious metal occurence to that of Tombstone could be present below this geochemical anomaly.

SUMMARY Cont.....

Mesothermal replacement deposits, primarily of zinc and lead in the upper Paleozoic section, and copper in the lower Paleozoic section below Tombstone, are thought to exist. Though the lead-silver-zinc manto deposits probably begin within 1,000 feet of the present surface, copper replacements probably occur in the Cambrian Abrigo Formation and Devonian Martin Formation, as is characteristic in other Paleozoic hosted porphyry copper deposits in Arizona and southwestern New Mexico. In spite of the difference in age (180 m.y. vs. 65 to 75 m.y.), the replacement deposits in the Abrigo and Martin at Bisbee may be similar to those beneath Tombstone.

Multiple porphyry copper centers may occur, associated with Laramide granodioritic to quartz monzonitic plutons, within the caldera complex. One such center occurs at the Robbers Roost - Charleston Lead Mine area, where intense phyllic alteration and breccia pipe activity are exposed by erosion. Here too, the hydrothermal system is superimposed on the Paleozoic sedimentary sequence, hidden beneath the Uncle Sam quartz latite tuffs, Silver Bell type andesites and rhyolites. Zinc, lead and copper replacement bodies are to be expected in this area, rather than igneous hosted copper porphyrys.

The Tombstone Development Company controls essentially all of the significant past producing mines within the Tombstone Basin by ownership of some 91 patented mining claims. It has also consolidated other targets over the complex. These are being held by some 548 lode mining claims and 41 square miles of state leases.

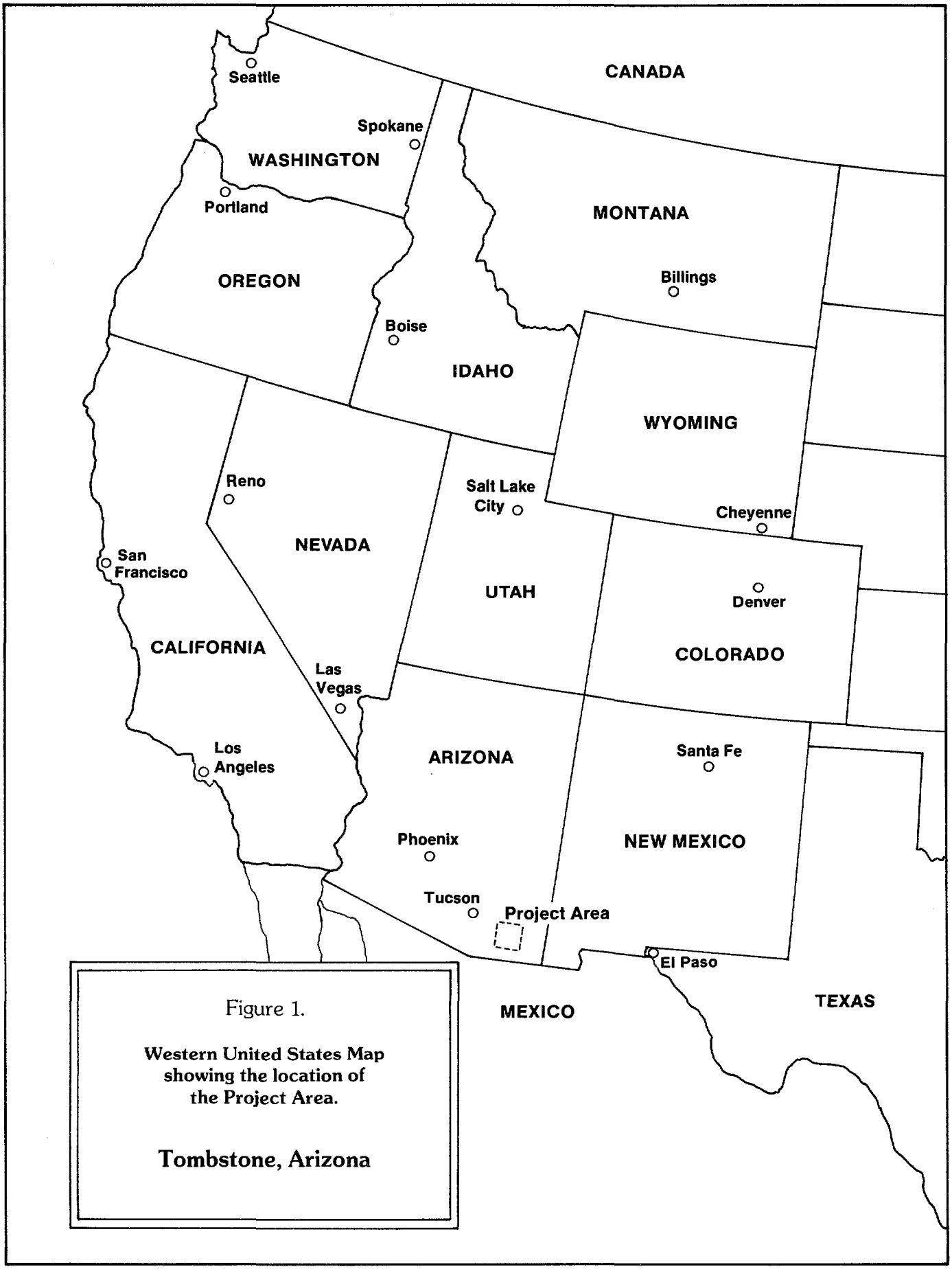


Figure 1.

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

Tombstone, Arizona

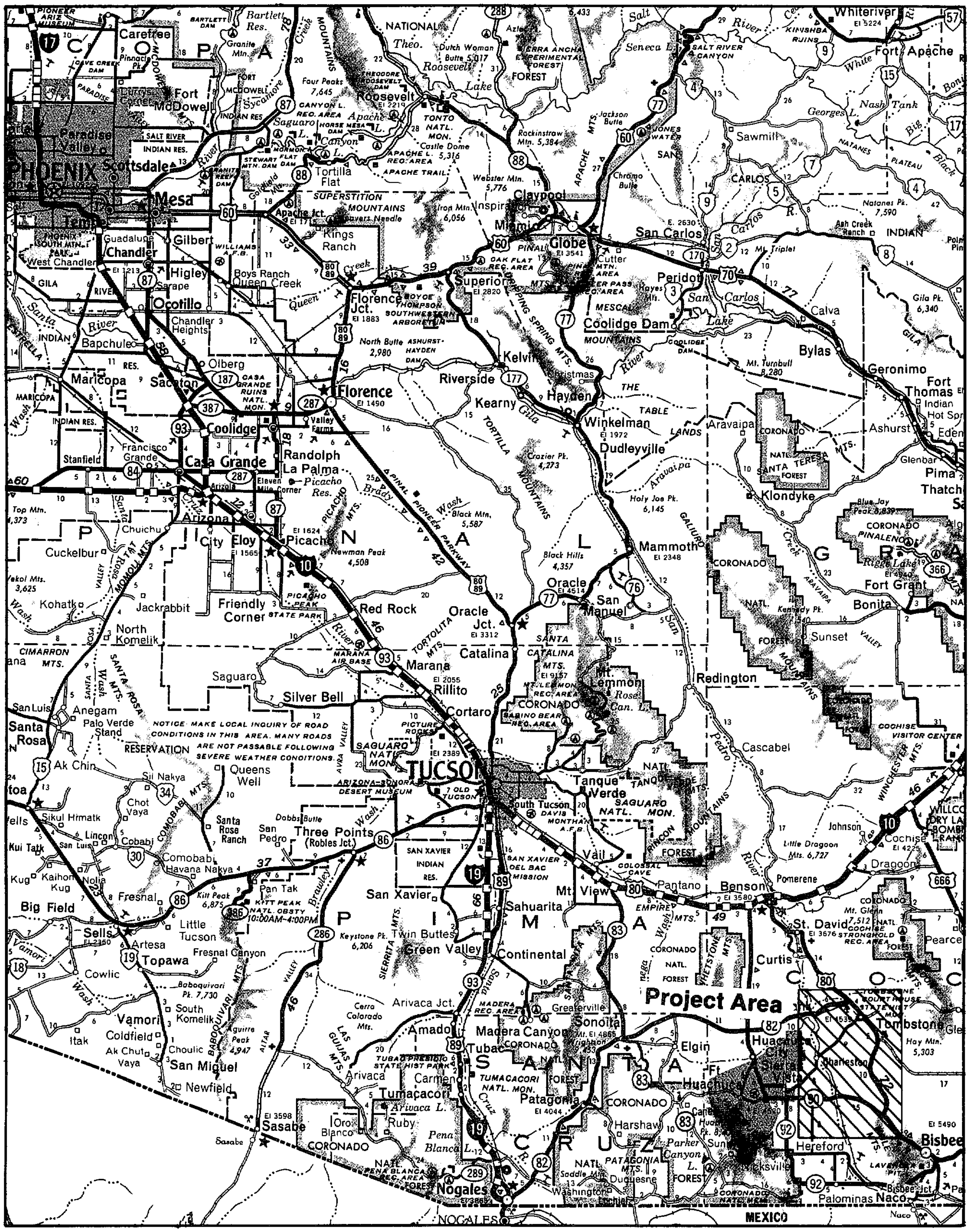
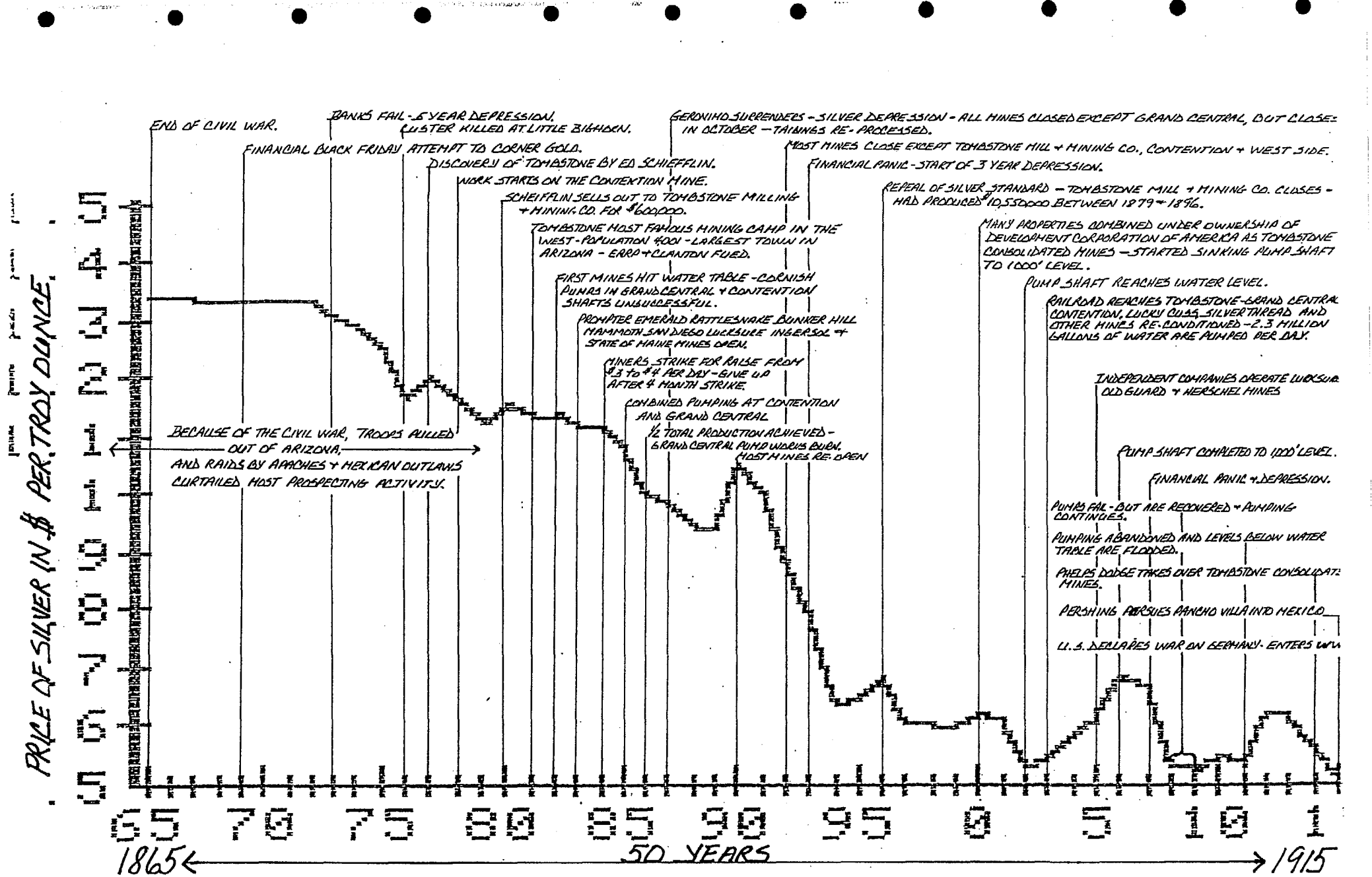


Figure 2. Highway map showing the location of the Project Area in relation to Tucson and Phoenix, Arizona



SILVER YEARS : 1865 - 1915

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

Prepared by James A. Briscoe

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	6659692	66596920	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

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	53716174
1883	2881900	19519	7807760	2122126	21221264	3351047	1675523	30704547
1884	1380788	9352	3740887	1016762	10167621	1865930	932965	14841472
1885	1320978	8947	3578842	999991	9999912	1651220	825610	14404363
1886	1050000	7112	2844702	859091	8590909	1141304	570652	12006264
1887	600000	4064	1625544	485818	4959184	666667	333333	6918061
1888	600000	4084	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	2771738	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

Prepared by James A. Briscoe

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

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	1770784	885392	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	8787	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	983883	491992	0	0	5638212
1917	57474	3373	1349220	444139	4441390	229488	229488	1278754	639377	0	0	6659475
1918	18507	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	928880	613700	6137000	196740	196740	744529	372265	0	0	7634885
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	421908	0	0	2171148
1930	8734	1875	749800	74937	749370	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) - $\frac{\$104,451,219}{608,345} = \$171.70/TON$

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	53862	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.

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

Prepared by James A. Briscoe

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	2910.78	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 & O'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	167849.24	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) - $\frac{\$5,405,829.42}{15,195.65} = \$355.75/TON$

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

Explanation

Geology

QTgu — OLDER OR UNDIF ERENTIATED SURFICAL DEPOSITS HOLOCENE TO OLIGOCENE): – Gra el sand a d s t Peis oc ne and Pliocene—Mainly alluvium of bas s inc udes some colluvium and l nd lide depo its. Gene ally light p nk sh gra , weakly m urat d, and with poor y rounded clasts ocally w l n urated Thickness several meter to hu d ed o meters

QTb — Basa t (Pe stoc ne to Pliocene) Lava flows, pyroclastic rocks and om nterca ated gravel. Thi kness several mete s to a few hundred meters i most places. Radiome rical y dated at 0 25, 1.0, and 3.2 m y old

Tva — Extensive andesite and dac t Miocene and Upper Oligocene;—Lava flows pyroclastic rocks some intercalated epic tic rocks and dikes. Mostly gray, fine-gra ned porphyri c ocks inc udes some very coarse fe dspar porphyry andesite (Turkey track porphyry an in ormal te m of Cooper, 961) Th ckne s mostly several meters to several tens o ete s Da ed at 24, 25, 27, 33, and 39 m y

Tv — Extrusive rhyolite and r yoda te (Miocene and Upper Oligocene—La a ws, welded tuff, pyroclastic rocks and som rca a ed epiclastic rocks Light-gray to gr yi h pink vitric to fine-grained, porphyritic. Comm n y a ew ens to a few thousand of me e th ck. Da ed at 23, 24, 25, 26, 26, 26, and 27 m y An add tional date of 47 m.y., if substantiated, ma d cat the presence of Eoc ne rocks n th lowe member of the S O Volcanics of Coch Co

Tlc — Lower co glome ate g a e , a sand (Oligocene an Eocene?)—All viu commonly grayish-red deposits of small, w ll rou ded nonvolcanic clasts. Mostly seve ete to a few tens of m ters thick.

Tlv — UPPER CORDILLERAN (LARAMIDE) IGNEOUS ROCKS (LOWER PALEOCENE)—Lower vol anic rocks—Rhyoli o ndes e lava flo s, pyroclastic rocks, an sc m ntercalated ep clast rocks. Dated at 57 y Poss bly younger age eas .

TKg — MAIN CORDILLERAN RAMIDE) IGNEOUS ROCKS:—Porphyriti a d ap t c intrusive rocks Paleocene and Uppe retac ous;—Mostly latitic porphyry to dacitic porph ry n small stocks and plugs and aplitic bodie no a sociated with other granito stocks Da e 63, 63, 64, and 65 m.y

Kib — Fluidized int us ve brecci e ac ge unknown, but penetrates, and hu u ge han Uncle Sam porphyry.

Kr — Rhyodaci e tuff and welded n udes parts of Salero Formation, S g r o Q rtz Latite, and Bronco Volcanics an R Bay Rhyolite, Cat Mountain Rhyolite of B 1939) and Uncle Sam Prophyry. Includes lo a s ve bodies and locally con ains fragmen s of ot o ks. Thickness commonly severa en eters to several hundreds of meters Da d at 66(?), 70, 72, 73, and 73 m.y. The Uncle Sa n 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 al of Demetrie Volcanics and Silverbell Formation of Courtright (1958). Commonly contains large blocks of exotic rocks and locally includes some sedimentary rocks and intru ive rocks. Severa tens of meters to several hundreds of meters thick in most places.

Klg — Lower qu rtz monzonite and graodiorite—Includes some quartz diorite; appe rs in small stocks. Locally assoc ated 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.

PIPe — 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 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.

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) 167 — 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

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, 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.

Tls — 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.

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Krg — 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 Schieffin granodorite at Tombstone is 72 m.y.

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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.

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

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MARKER HORIZON—Dotted where concealed.

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70 / 45 — Normal

Reverse — 45

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.

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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

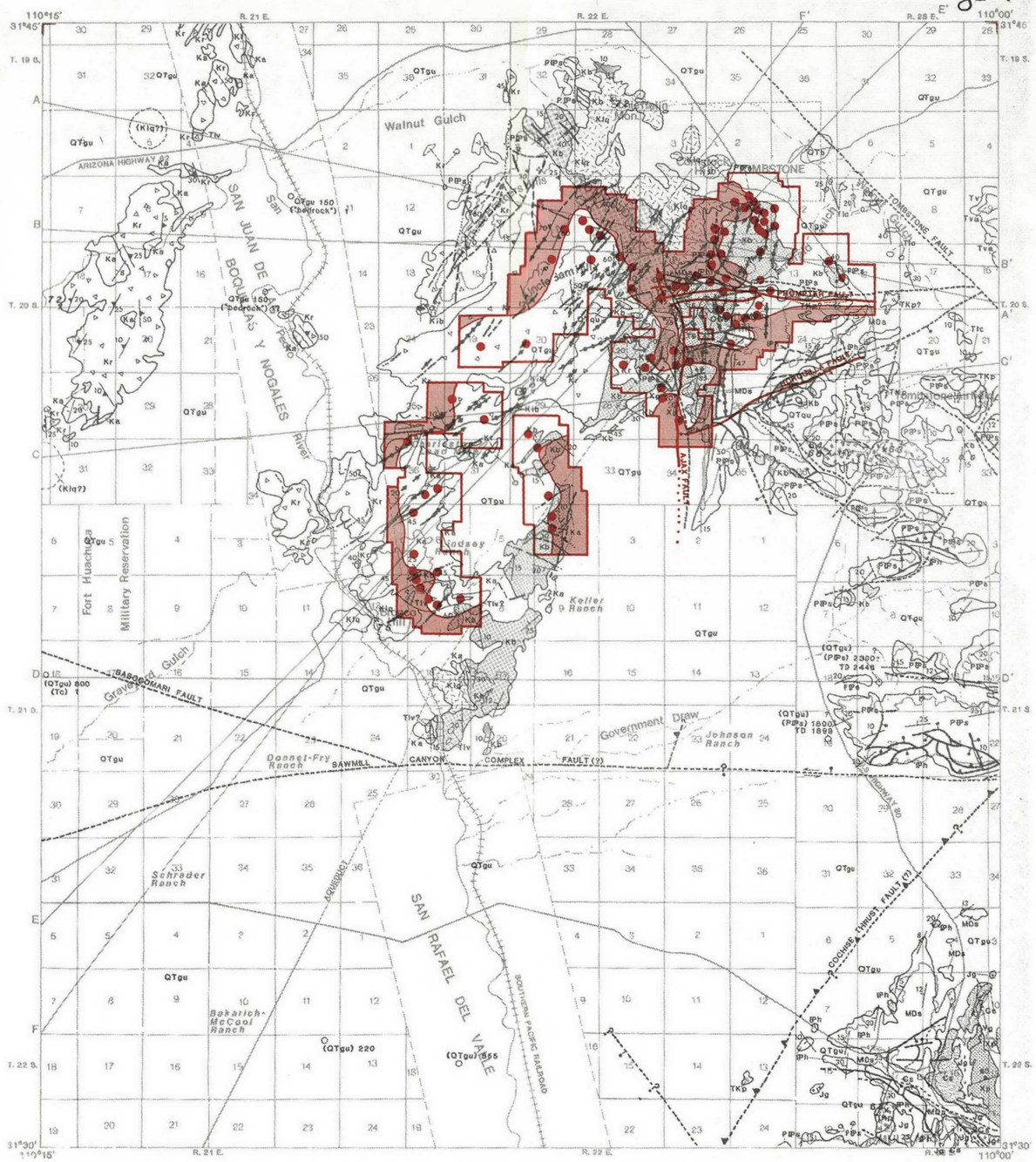
Government Reservation Boundary

Aqueduct

A—A' Cross section line

Dump sample location

Silver



Tombstone Development Company, Inc.
Tombstone, Arizona

1 0 1 2 3 Miles

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).

Explanation

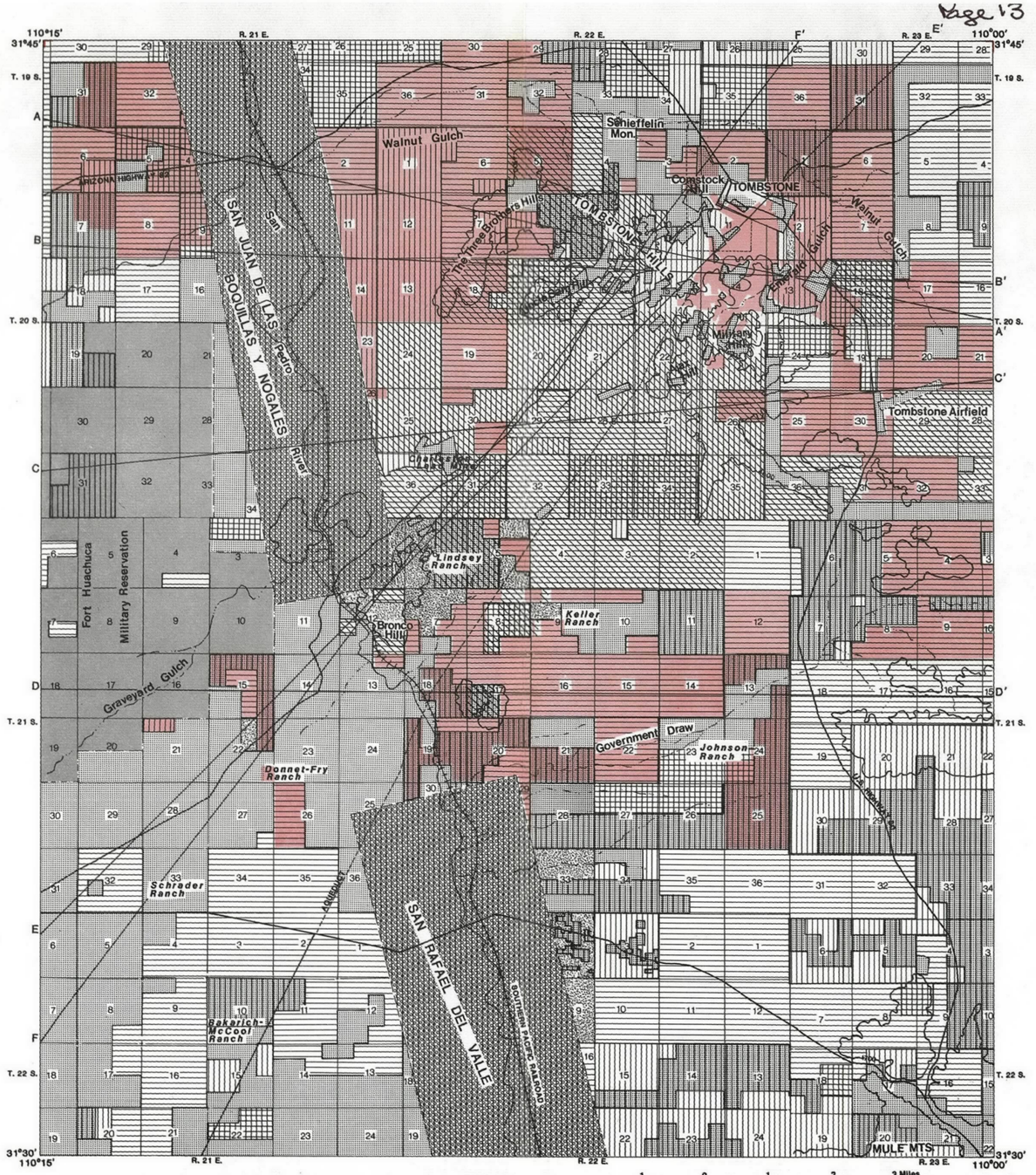
Land Status

- Public Domain - Mineral and Surface owned by Federal Government.
- State Domain - Mineral and Surface owned by State of Arizona.
- Public Domain Mineral and Surface. Mineral owned by Federal Government; Surface owned by State of Arizona.
- Fee Simple - Mineral and Surface privately owned.
- Fee Simple Surface and Public Domain Mineral Private Surface ownership Mineral owned by Federal Government.
- Spanish Land Grants - Fee Simple. Mineral and Surface privately owned; Reservation of Gold, Silver and Mercury to Federal Government.
- Military Reservation - Restricted Mineral Entry. Not open to Mining.
- Water & Power Resource Service & Various other Withdrawals - Not open to Mineral Entry or Mining.
- Mineral and Surface owned by Federal Government. Mineral Rights privately claimed.
- Mineral and Surface owned by State of Arizona. Mineral leases, prospecting permits or applications privately held.
- Public Domain Mineral and State of Arizona Surface. Mineral rights privately claimed.
- Public Domain Mineral and Fee Simple Surface. Mineral rights privately claimed.

- Roads and Highways
- Dry wash
- Southern Pacific Railroad
- Government Reservation Boundary
- Aqueduct
- A——A′ Cross section line

Tombstone Development Company, Inc. Lands

- Public Domain Mineral and Surface. Mineral rights claimed by Tombstone Development Company, Inc.
- Mineral and Surface owned by State of Arizona. Prospecting permits or applications held by Tombstone Development Company.
- Public Domain Mineral and Surface owned by State of Arizona. Mineral rights claimed by Tombstone Development Company, Inc.
- Patented Mining Claims owned by Tombstone Development Company, Inc.
- Public Domain Mineral and Fee Simple Surface. Mineral rights claimed by Tombstone Development Company, Inc.
- Fee Simple Surface and State of Arizona Mineral. Prospecting Permit held by Tombstone Development Company, Inc.



Tombstone Development Company, Inc.
Tombstone, Arizona

Land Status Map, Tombstone
15 min. Quadrangle

By Thomas E. Waldrip, Jr.
James A. Briscoe and Associates
Tucson, Arizona

Figure 5. Property map showing ownership of major holdings of mineral rights in the Tombstone area. Red overprint shows state, federal and private land and lands with mineral rights held by the Tombstone Development Company as of October 15, 1981.

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 informall 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.

Ti — 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.

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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.

OCa — 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.

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

Xg — GRANITOID ROCKS (PRECAMBRIAN V)—Mainly granodiorite and quartz monsonite, unfolated to folated, 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.

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) 187 — 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

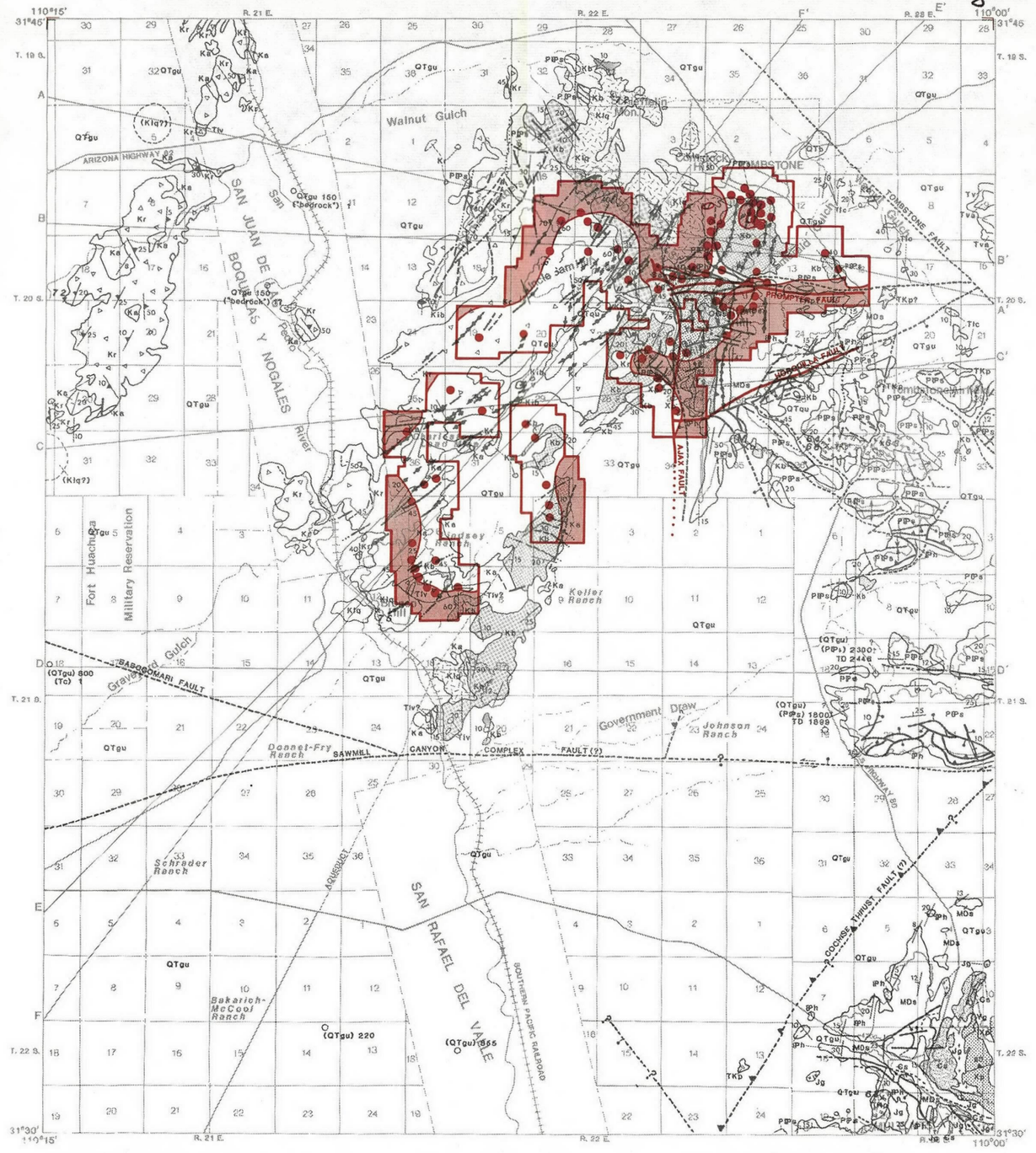
Government Reservation Boundary

Aqueduct

A—A' Cross section line

Dump sample location

Zinc



1 0 1 2 3 Miles

N

Tombstone Development Company, Inc.
Tombstone, Arizona

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

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).

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.

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 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 Schieffiin 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.

Ph — 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, 1976) 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.

Xs — PINAL SCHIST (PRECAMBRIAN X)—Chlorite schist, phyllite, and some metavolcanic rocks, metavolcanic rocks, metaquartzite, metasquartzite 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.

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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

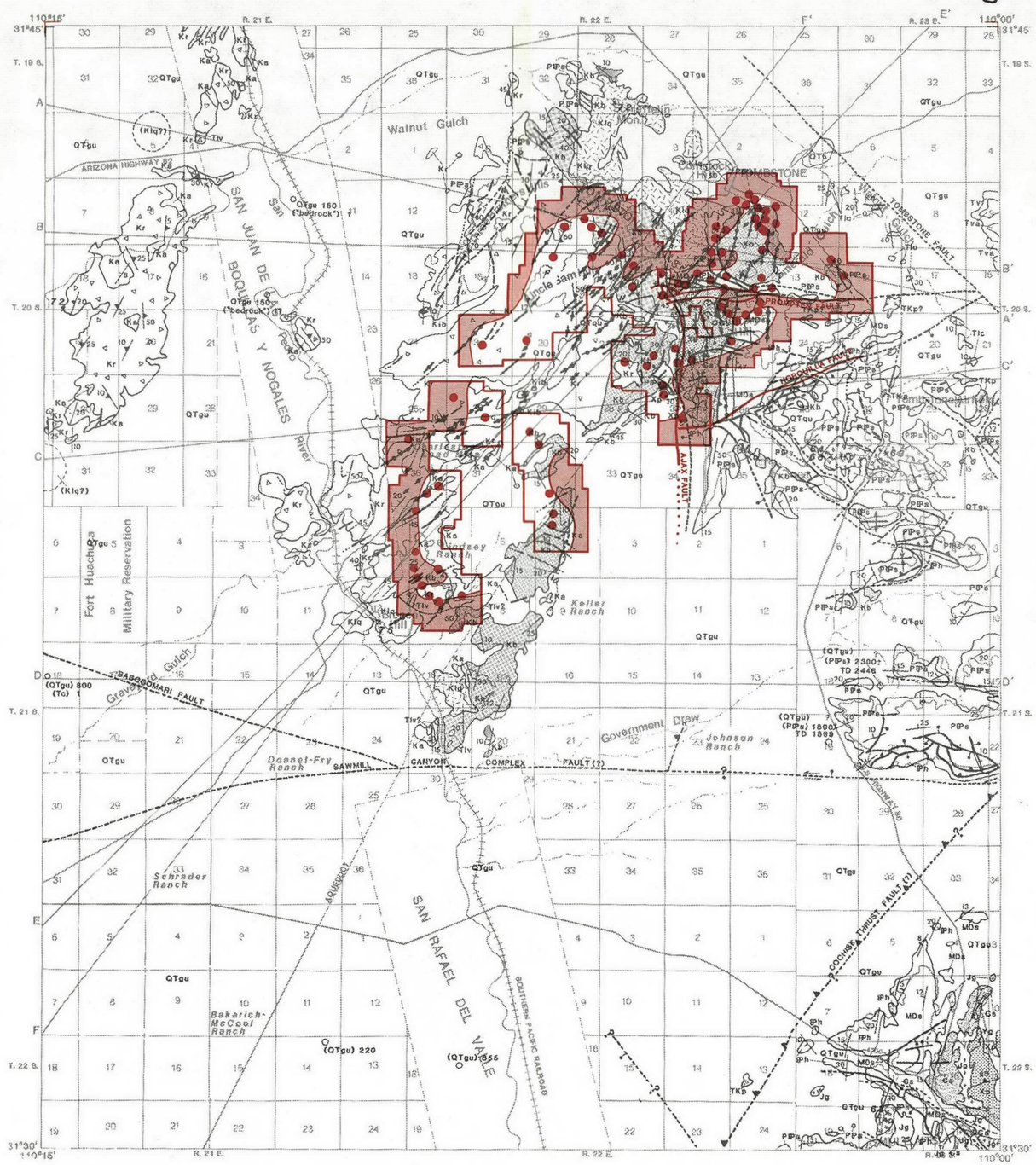
Government Reservation Boundary

Aqueduct

A——A' Cross section line

Dump sample location

Lead



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 8. 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 lead ratios in dump samples (in red).

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.

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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.

Tg — 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.

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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.

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Roads and Highways

Dry wash

Southern Pacific Railroad

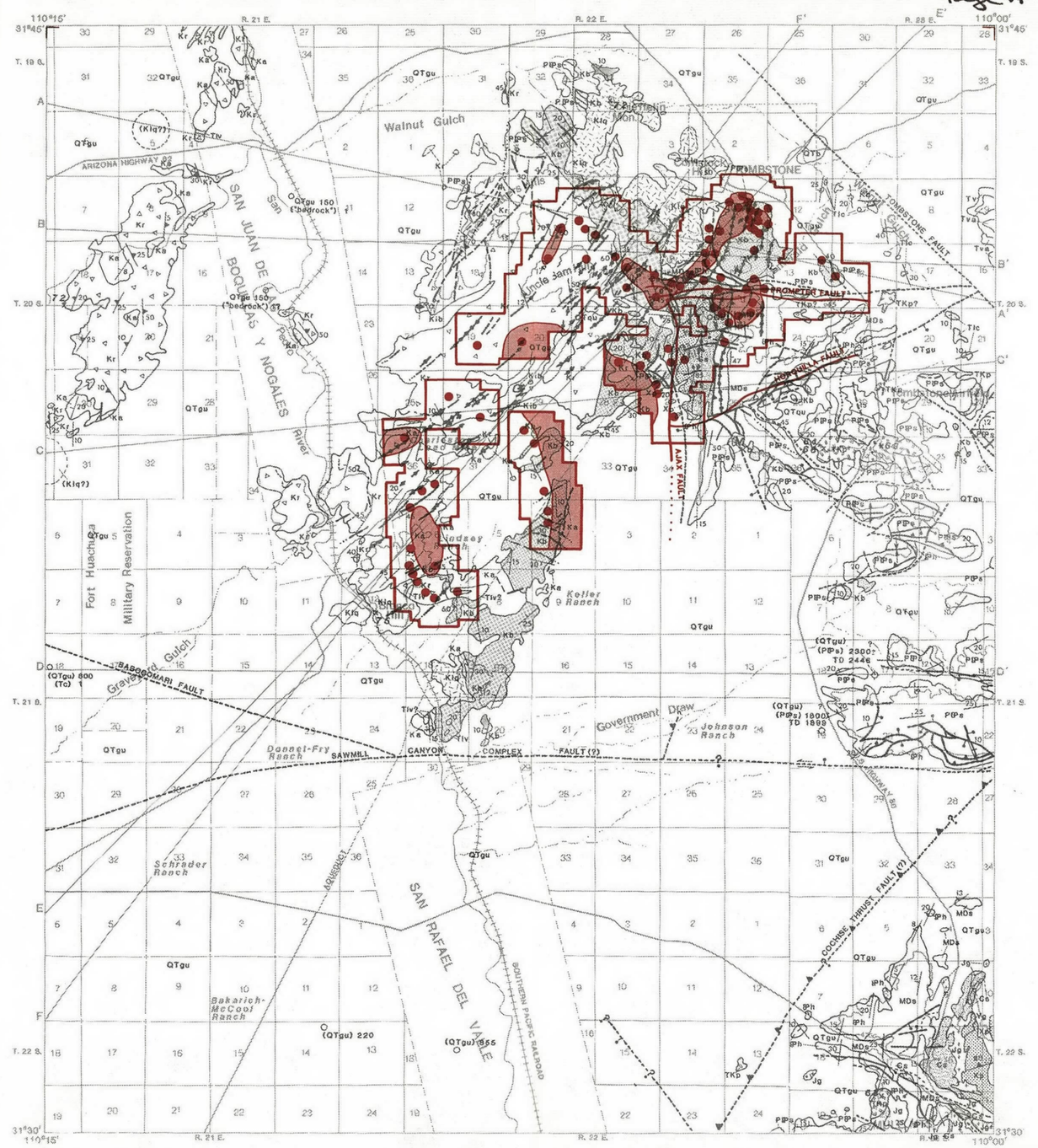
Government Reservation Boundary

Aqueduct

A——A' Cross section line

Dump sample location

Copper



1 0 1 2 3 Miles

N

Tombstone Development Company, Inc.
Tombstone, Arizona

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

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).

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

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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.

Cs — 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.

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

Xs — 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.

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

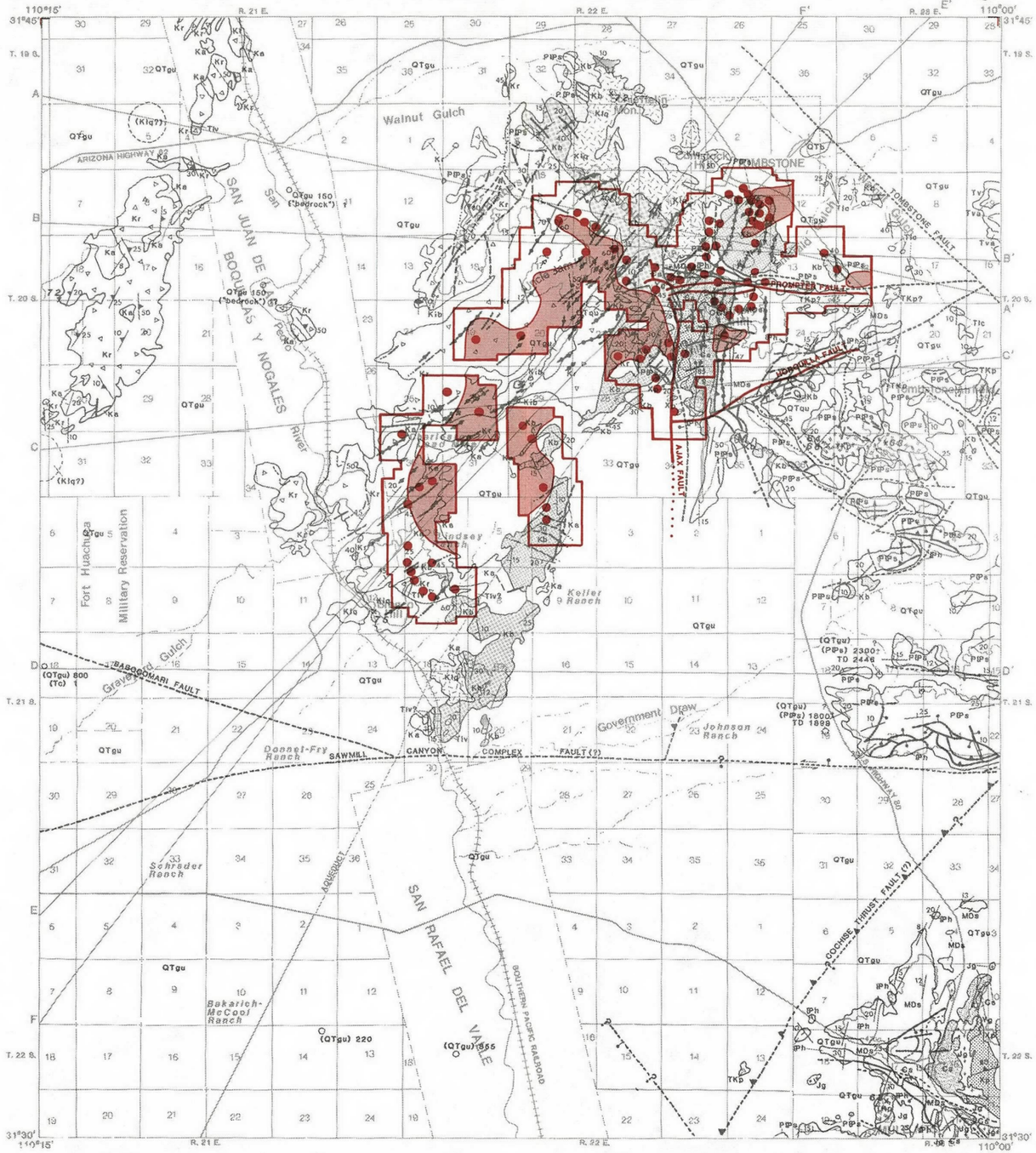
Government Reservation Boundary

Aqueduct

A—A' Cross section line

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

N

Figure 10. 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 molybdenum ratios in dump samples (in red).

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.

Tla — 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 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.

Klg — 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 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.

Mph — 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.

OCa — 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 alve been little studied.

Xs — 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.

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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

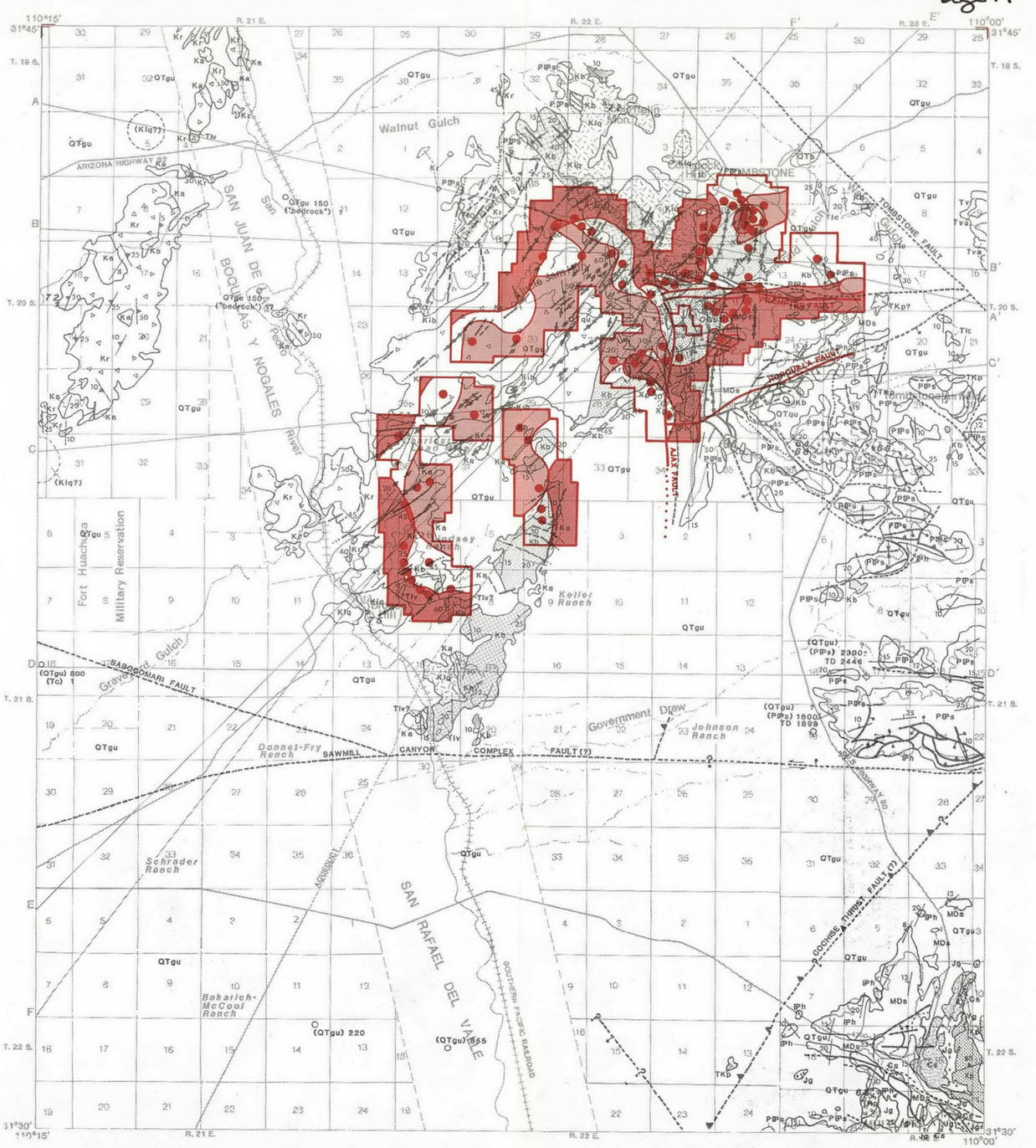
Aqueduct

A—A' Cross section line

Dump sample location

Molybdenum

Zinc



Tombstone Development Company, Inc.
Tombstone, Arizona

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

Figure 11. 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 molybdenum and zinc ratios in dump samples (in red).

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 (Turley 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.

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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.

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Normal

Reverse

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Roads and Highways

Dry wash

Southern Pacific Railroad

Government Reservation Boundary

Aqueduct

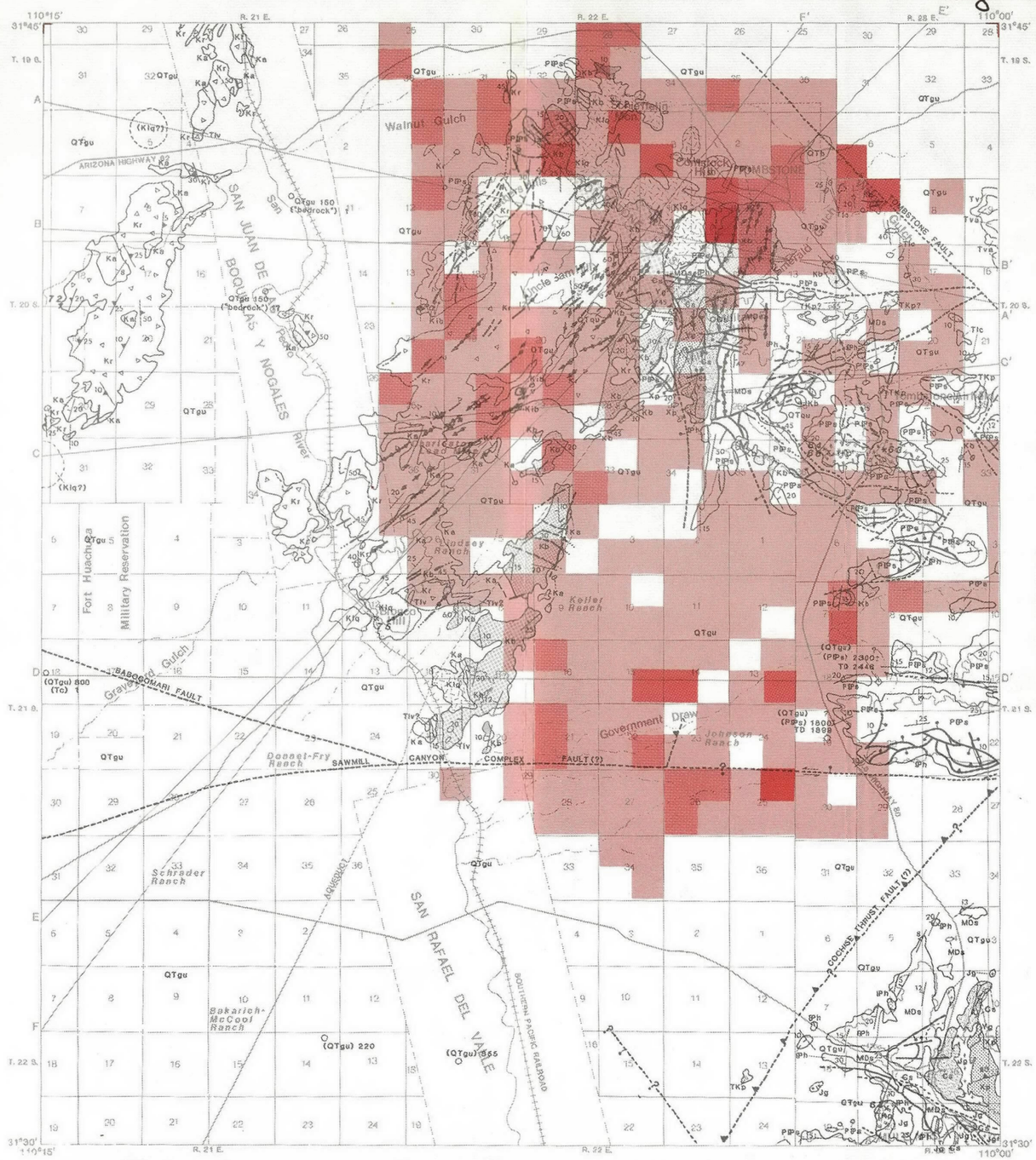
A——A' Cross section line

≤ 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.

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.

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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.

Klg — 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 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, Centura, 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.

Ph — 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.

Xg — 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.

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

70 — Normal

45 — Reverse

45

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

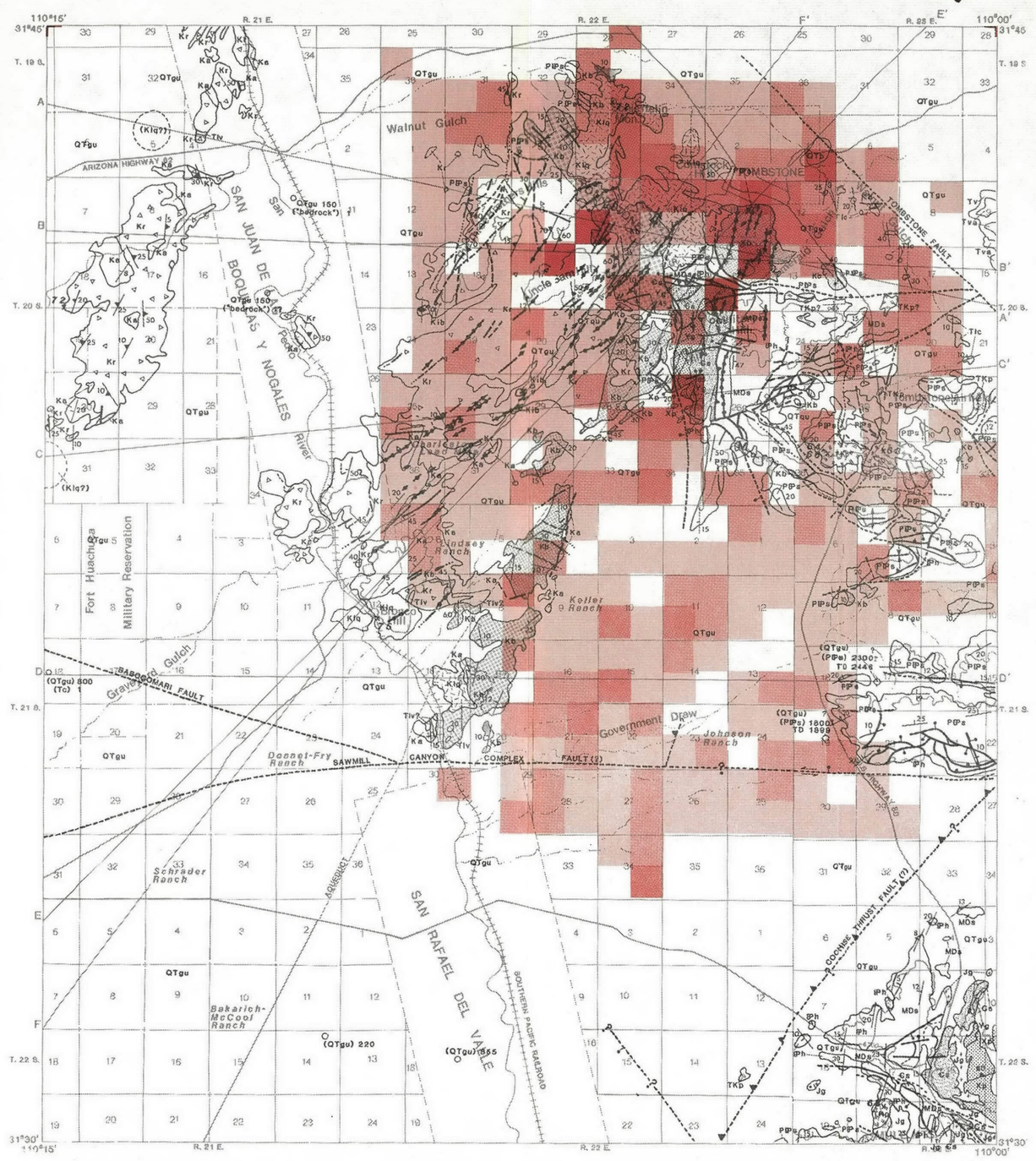
A—A' Cross section line

≤ 400 ppm

401 - 600 ppm

601 - 800 ppm

≥ 800 ppm



Tombstone Development Company, Inc.
Tombstone, Arizona

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

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

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 (Turley track porphyry, an informall 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 rocls 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 either 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 tuf 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 Schieflin 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.

Ph — 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.

Xs — 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

45

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.

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(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

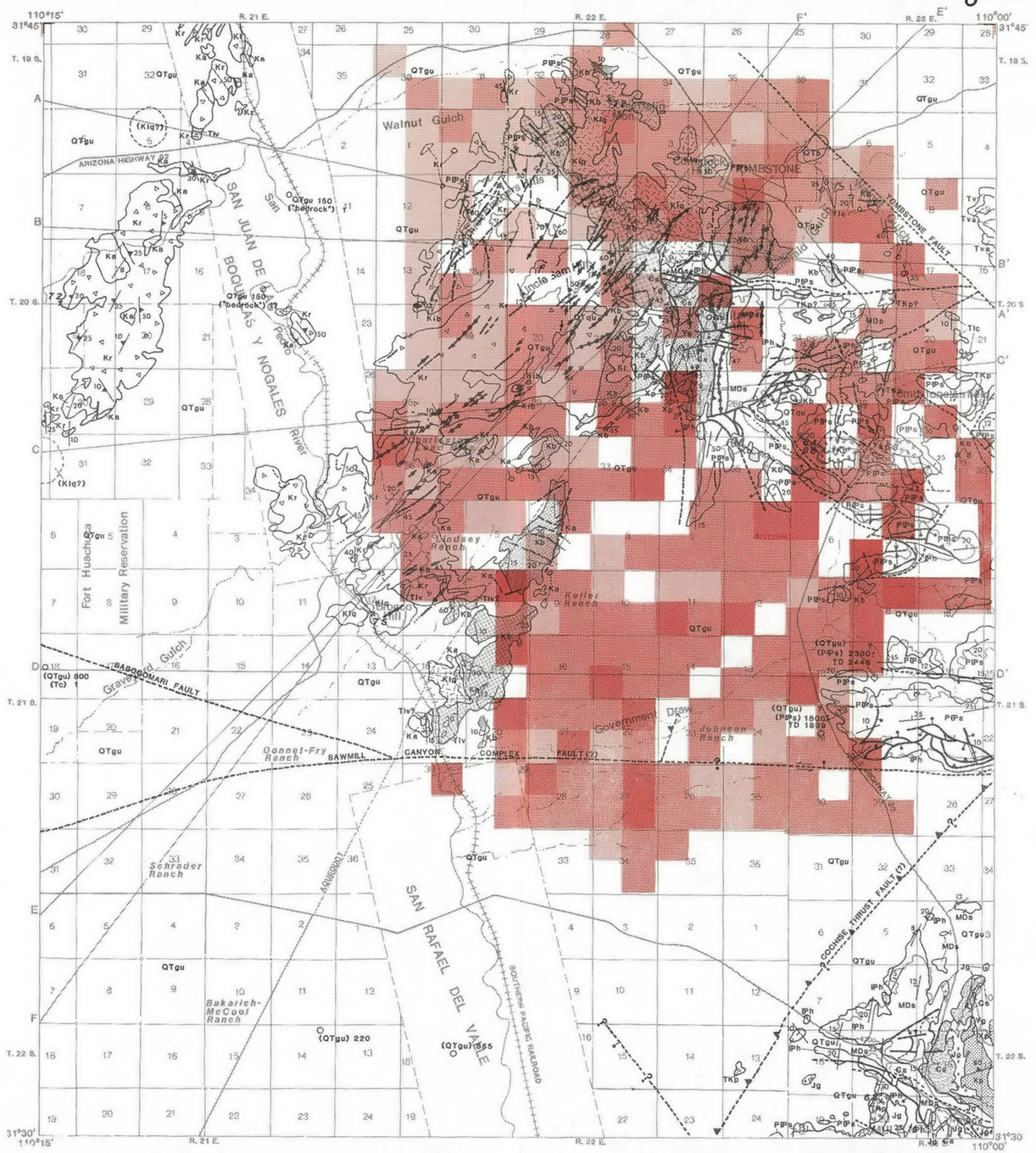
A——A' Cross section line

≤ 100 ppm

101 - 150 ppm

151 - 200 ppm

≥ 200 ppm



Tombstone Development Company, Inc.
Tombstone, Arizona

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

Figure 14. Distribution pattern of copper in mesquite trees (in red), from Newell, R.A., 1973.

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.

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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.

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.

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

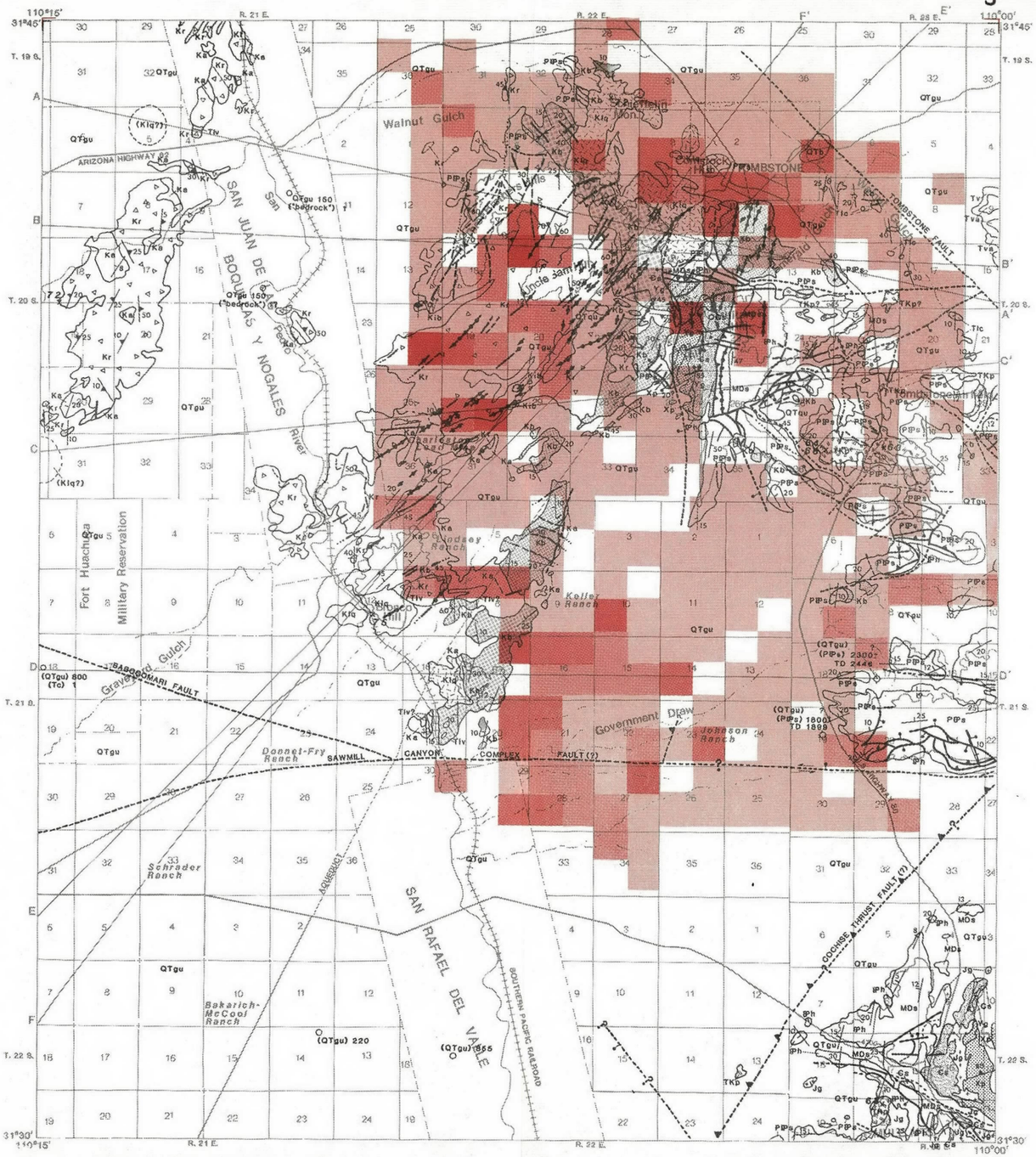
Cross section line

≤ 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.

1 0 1 2 3 Miles

N

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.

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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.

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Kt(g) — 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 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.

Ph — 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 Formtion 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.

Cs — SEDIMENTARY ROCKS (LOWER ORDOVICIAN TO MIDDLE CAMBRIAN).—El Paso Limestone (Lower Ordovician and Upper Cambrian), Abrigo Formation (Upper and Middle Cambrian), and Bolsa Quartzite (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.

Xs — 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

45

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.

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(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

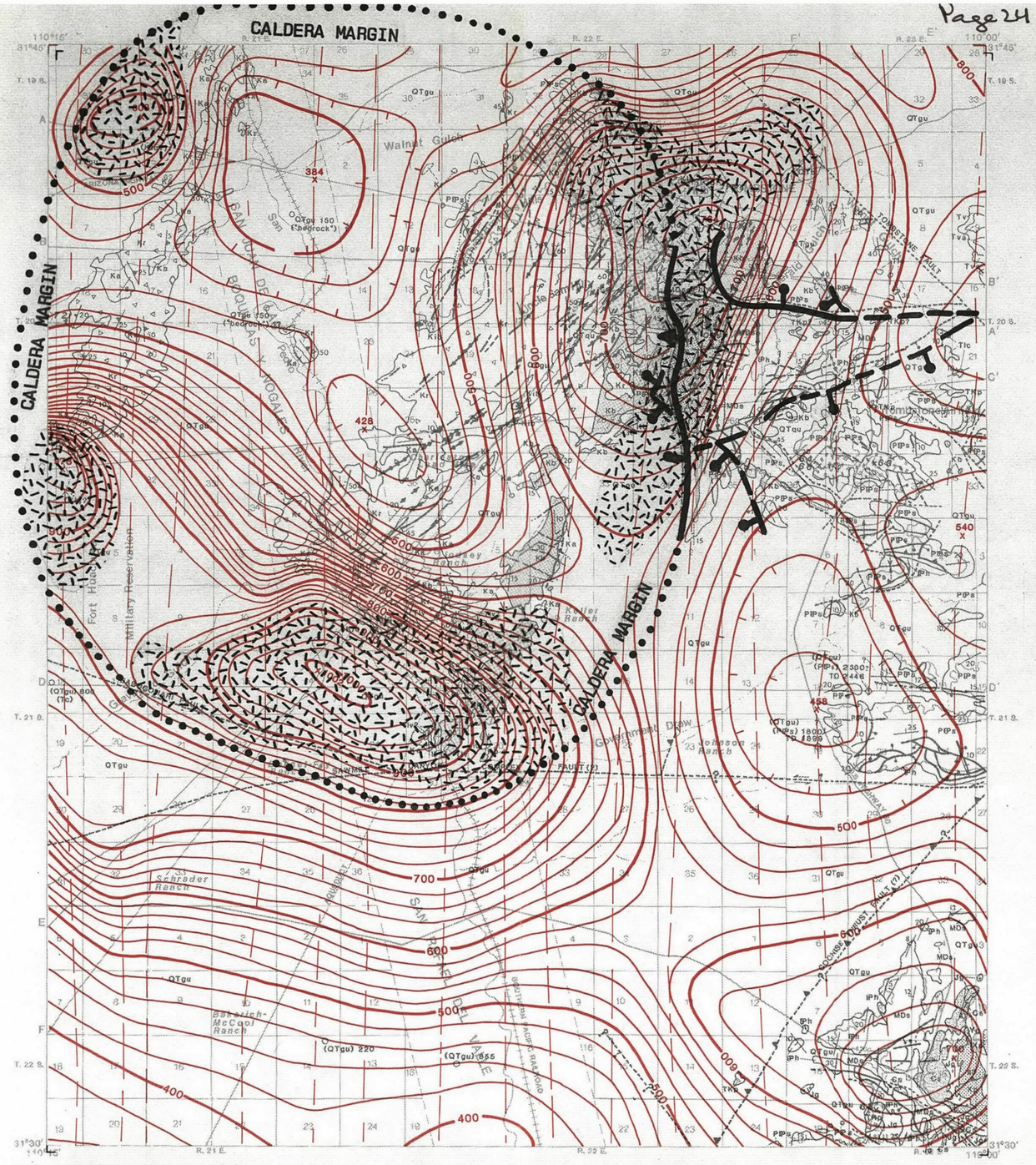
A—A' Cross section line

Flight line

Index contour line

Contour line

Contour interval: 25 gammas



Tombstone Development Company, Inc.
Tombstone, Arizona

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

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

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.

Tli — 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.

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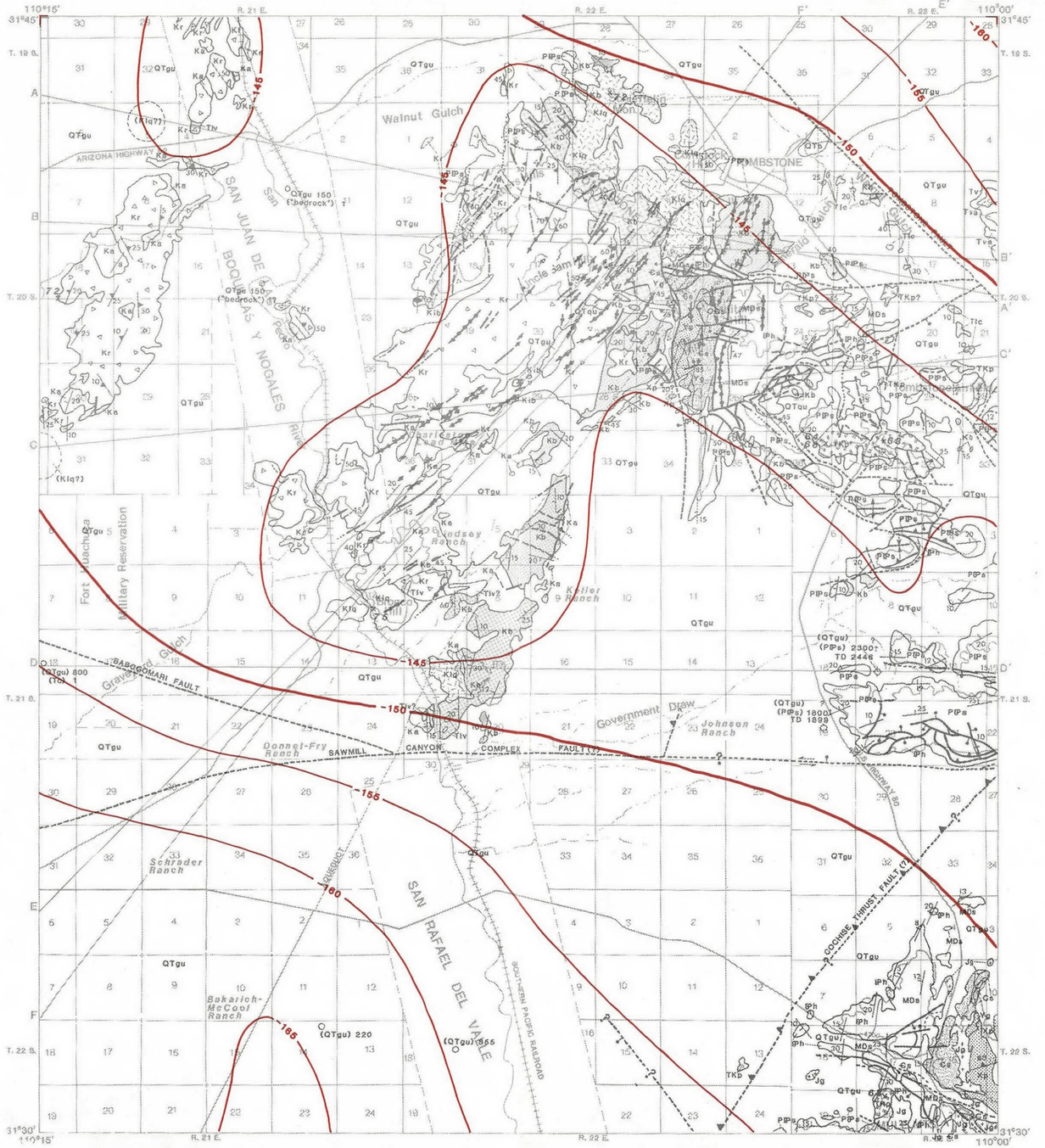
A——A' Cross section line

-150 Gravity contour line

Contour interval: 5 milligals



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 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.

SUMMARY OF GEOLOGICALLY "INDICATED" ORE IN THE TOMBSTONE BASIN
BETWEEN 0 - 1,000 FEET BELOW CURRENT SURFACE

	TONS OF ORE	AVERAGE GRADE OF GOLD	TOTAL OUNCES OF GOLD	TOTAL DOLLAR VALUE AT $400 GOLD	AVERAGE GRADE OF SILVER	TOTAL OUNCES OF SILVER	TOTAL DOLLAR VALUE AT $10 SILVER	AVERAGE GRADE OF COPPER	TOTAL POUNDS OF COPPER	TOTAL DOLLAR VALUE AT $1 COPPER	AVERAGE GRADE OF LEAD	TOTAL POUNDS OF LEAD	TOTAL DOLLAR VALUE AT $.50 LEAD	AVERAGE GRADE OF ZINC	TOTAL POUNDS OF ZINC	TOTAL DOLLAR VALUE AT $.40 ZINC	GROSS METAL VALUE (GMV) IN $	AVERAGE VALUE PER TON
LOW GRADE OPEN PIT ORE																		
1. TRANQUILITY-CONTENTION GRAND CENTRAL AREA OPEN PIT (CONSERVATIVE EST.)	52840000	.021	1109640	443856000	1.65	87186000	871860000	0	0	0	0	0	0	0	0	0	1315716000	24.9
TOTAL LOW GRADE	52840000	.021	1109640	443856000	1.65	87186000	871860000	0	0	0	0	0	0	0	0	0	1315716000	24.9
HIGH GRADE UNDERGROUND ORE																		
2. EMPIRE ANTICLINE & ITS PROJECTIONS	1570000	.21	329700	131880000	25.89	40647300	406473000	2.01	3155700	3155700	51.91	81498700	40749350	.84	1318800	527520	582705570	371.201
3. ROLLS & FISSURES SOUTHWEST OF AXIAL PLANE OF EMPIRE ANTICLINE	2650000	.21	556500	222600000	25.89	68608500	686085000	2.01	5326500	5326500	51.91	137561500	68780750	.84	2226000	890400	983682650	371.201
4. TOMBSTONE EXTENSION BLOCK = EMPIRE ANTICLINE + ROLLS & FISSURES	4220000	.21	886200	354480000	25.89	109255800	1092558000	2.01	8482200	8482200	51.91	218960200	109530100	.84	3544800	1417920	1566468220	371.201
TOTAL HIGH GRADE ORE	8440000		1772400	708960000		218511600	2185116000		16964400	16964400		438120400	219060200		7089600	2835840	3132936440	371.201
GRAND TOTAL GROSS CONTAINED METAL IN THE TOMBSTONE BASIN BETWEEN 0-1,000 FT. BELOW CURRENT SURFACE			2882040	1152816000		305607600	3056976000		16964400	16964400		438120400	219060200		7089600	2835840	4448652440	

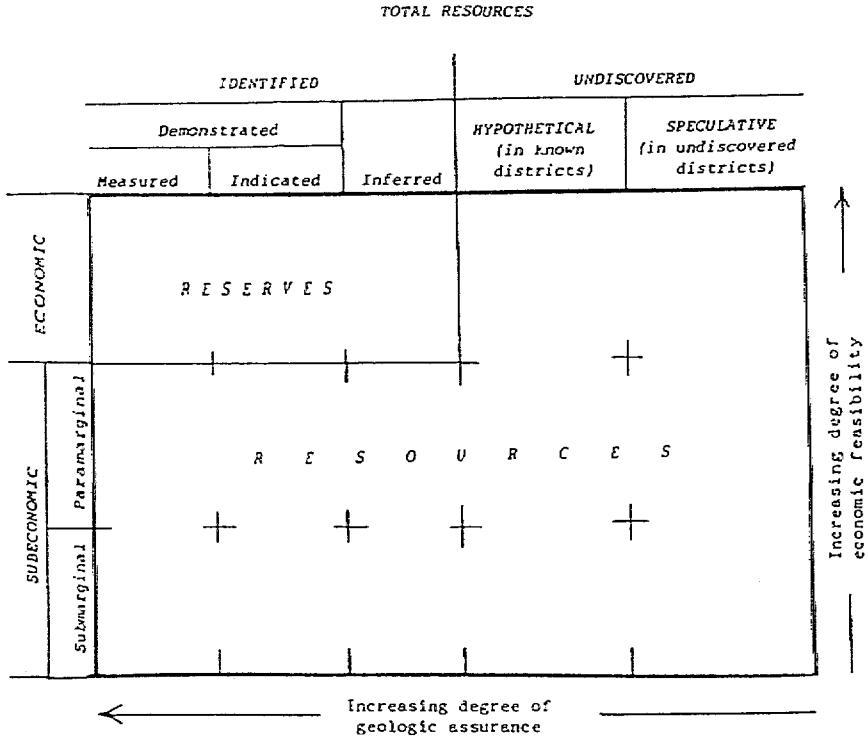


FIGURE 4.—Classification of Mineral Resources. From U.S. Bureau of Mines and U.S. Geological Survey (1967a, p. A2).

Measured: Material whose quality and quantity have been estimated, within a margin of error of less than 20 percent, from analyses and measurements from closely spaced and geologically well-known sample sites.

Indicated: Material whose quality and quantity have been estimated partly from sample analyses and measurements and partly from reasonable geologic projections.

Demonstrated: A collective term for the sum of materials in both measured and indicated resources.

Inferred: Material in unexplored but identified deposits whose quality and size have been estimated on the basis of geologic evidence and projection.

Identified-subeconomic resources: Known deposits not now economically minable.

Paramarginal: The portion of subeconomic resources that (a) is almost economically producible or (b) is not commercially available solely because of legal or political circumstances.

Submarginal: The portion of subeconomic resources which would require a substantially higher price (more than 1.5 times the price at the time of determination) or a major cost-reducing advance in technology to become economic.

Hypothetical resources: Undiscovered materials that may reasonably be expected to exist in a known mining district under known geologic conditions. Exploration that confirms their existence and reveals quantity and quality will permit their reclassification as a reserve or identified-subeconomic resource.

Speculative resources: Undiscovered materials that may occur either in known types of deposits in a favorable geologic setting where no discoveries have been made or in as-yet-unknown types of deposits that remain to be recognized. Exploration that confirms their existence and reveals quantity and quality will permit their reclassification as reserves or identified-subeconomic resources.

DEFINITION OF ORE RESERVE TERMS

as used by James A. Briscoe & Associates, Inc.

Measured Identified resources for which tonnage is computed from dimensions revealed in outcrops, trenches, workings and drill holes, and for which grade is computed from the results of detailed sampling. The sites for inspection, sampling and measurement are spaced so closely, and the geologic character is so well defined that size, shape and mineral content are well established. The computed tonnage and grade are judged to be accurate within limits which are stated, and no such limit is judged to be different from the computed tonnage or grade by more than 20 percent.

Indicated Identified resources for which tonnage and grade are computed partly from specific measurements, samples or production data, and partly from projection for a reasonable distance on the basis of geologic evidence. The sites available for inspection, measurement and sampling are too widely or otherwise inappropriately spaced to permit the mineral bodies to be outlined completely or the grade to be established throughout.

Inferred Identified resources for which quantitative estimates are based largely on broad knowledge of the geologic character of the deposit, and for which there are few, if any, samples or measurements. Continuity or repetition is assumed on the basis of geologic evidence, which may include comparison with deposits of similar type. Bodies that are completely concealed may be included if there is specific geologic evidence of their presence. Estimates of inferred reserves or resources should include a statement of the specific limits within which the inferred material may lie.

Hypothetical Identified resources for which tonnage and grade are poorly known. The sites available for inspection, measurement and sampling are inaccessible or have not been thoroughly examined in the field. Generally, all of the parameters necessary for calculating reserves (i.e. volume and grade) are based on geologic projections or assumptions.

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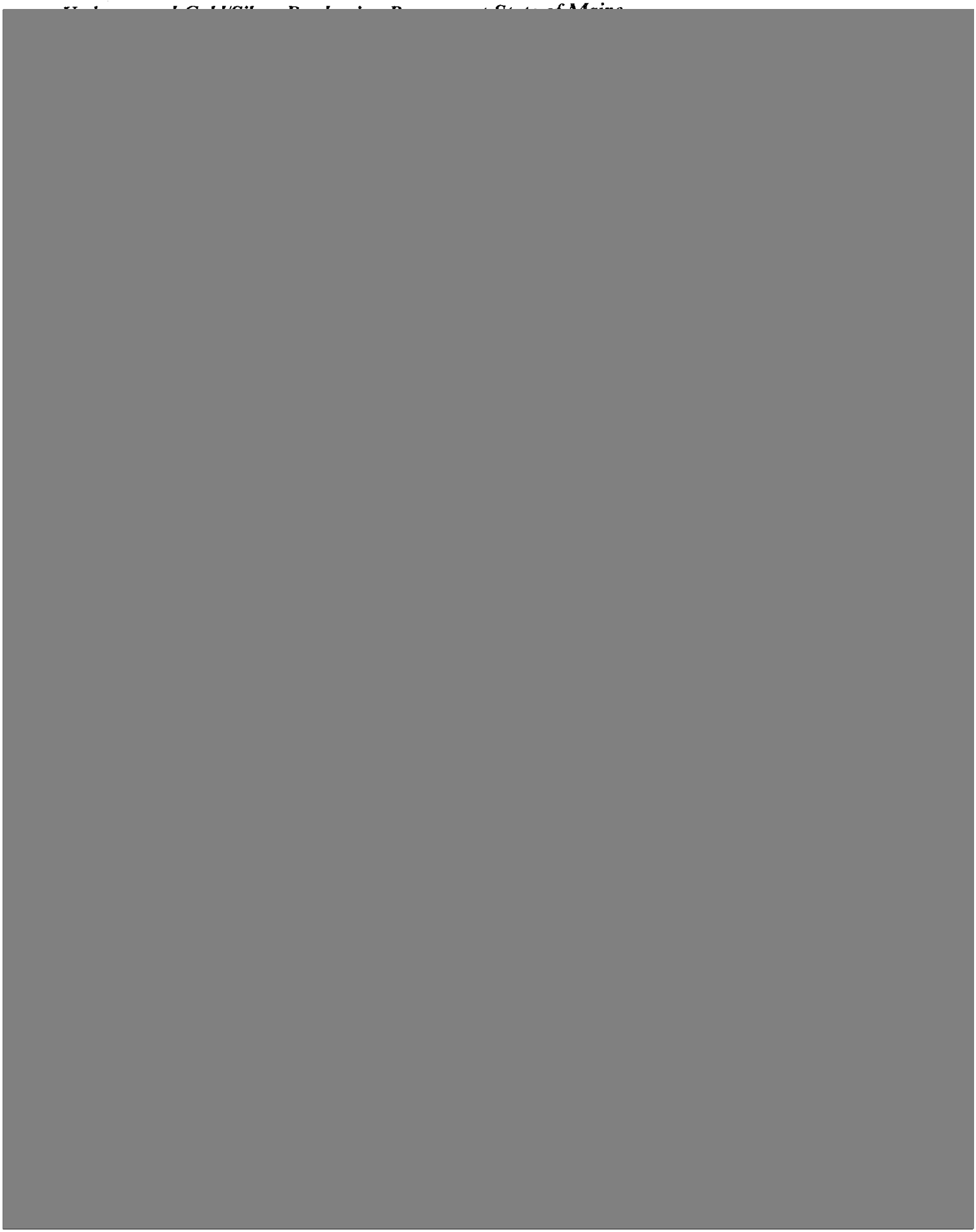
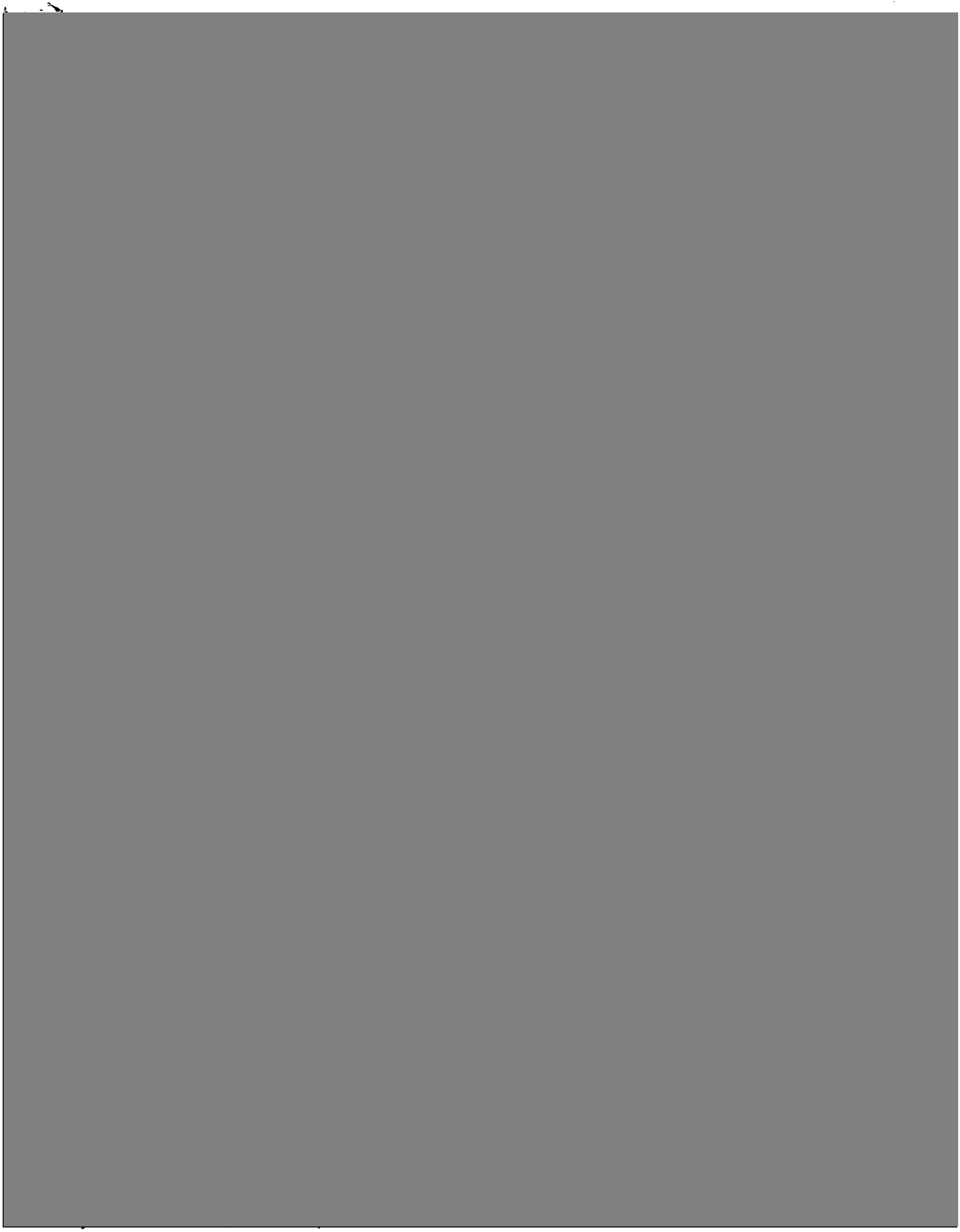




AMERICAN SMELTING AND REFINING COMPANY
TUCSON ARIZONA

June 24, 1974

TO: W. L. Kurtz

FROM: J. R. King

Review of Newmont Deep Exploration
Tombstone District
Cochise County, Arizona

In January 1974, Sierra Mineral Management brought to ASARCO's attention the data Newmont obtained in their exploration of the Tombstone district. In the early 1950's Newmont had leased from the Tombstone Development Co. (as Sierra M. M. has now) the major portion of the Tombstone mining district and conducted exploration of the central district by using underground diamond drilling, some drifting, and surface drilling.

Attached are copies of their geologic logs and cross-section maps of the two diamond drill holes which tested for mineralization at depth (≃2000' below ground surface). Core from four drill holes (#6, 7, 8, & 9) were casually inspected. Drill hole #8 was also logged by J. D. Sell and myself and our brief log is attached.

It is provisionally interpreted that drill holes 6, 7, 8, & 9 encountered and were bottomed in Mississippian limestone (probably Escabrosa limestone) as the limestone is massive, without shaley interbeds, and uniform in grain size, rather than the Pennsylvanian-Permian Naco group limestones. If this interpretation is correct, only the Devonian Martin Limestone and/or the Cambrian Abrigo Limestone remain as favorable horizons for replacement mineralization.

All of these drill holes showed only weak, very sporadic calc-silicate alteration and associated, spotty sulfide mineralization. The alteration and mineralization is controlled by the andesite-granodiorite dikes. There is no evidence for pervasive or intensity increase in either alteration or mineralization with depth.

It is reasonable to conclude, therefore, that economic replacement mineralization at depth in more favorable limestones is possible but not likely and the presence of a deep porphyry copper center (as suggested by J. C. Balla) is not indicated.

At this time the Tombstone district does not warrant exploration drilling and John Beeder (geologist-Sierra Mineral Management) has been notified of ASARCO's feelings.

John R. King

JRK:lb
Attachs.
cc: JDSell

ASARCO EXPLORATION RECORD

[X] FIELD EXAMINATION [ ] LITERATURE SEARCH [ ] ASARCO FILE [ ] _____

Section I General Indexing

① Name(s) of Property or Area: TOMBSTONE DISTRICT - Newmont's Exploration Drilling					② Country: U.S.A.		③ State or Province: Arizona	
					④ Co. or Map Sheet: Cochise Co.		⑤ File or Core No.: 3.20.0B	
⑥ Latitude: 31°42'	⑦ Longitude: 110°05'	⑧ Mer.: GSBM	Tws.: 22E	Rng.: 20S	Sec.: 11	⑨ Examined by: J.D. Sell & J.R. King	⑩ Date: June '74	
						⑪ Office: Tucson	⑫ Field Days: 2	

Section II Sources of Information

⑬ References

Author	Date	Title	Publications	Vol. No.
Gilluly	1956	Geol. of Central Cochise Co., Arizona	USGS PP 281	

Section III Appraisal

⑭ Recommendations
- [ ] Action Now
- [X] Too Low Grade
- [ ] Too Small
- [ ] Ownership Problem
- [ ] Access Problem
- [X] Depth

⑮
- [X] Past Producer
- [ ] Producer
- [ ] Mineral Deposit
- [ ] Prospect
- [ ]
- [ ]
- [ ] Geologic Concept
- [ ] Geochem Anomaly
- [ ] Geophy. Anomaly
- [ ]

⑯ Production

Commodity	Tons	Grade
1902 Ag/Au/Pb	≃$40,000,000	

⑰ Reserves [ ] Measured [ ] Estimated

Commodity	Tons	Grade

⑱ Num. Drill Holes: 9
Approx. Total Footage: 5,000

⑲ Excavations: numerous underground workings

⑳ Spectro. Analysis Attached

㉑ Assays Attached

㉒ Geochem Results Attached

Section IV Geologic Data

㉓ Commodity or Contained Metals: Ag/Au/Pb/Zn/Cp

㉔ Ore Minerals - Major: Galena, Sphalerite, Pyrite — Minor: Chalcopy.

㉕ Host Rocks - Major: — Minor:

㉖ Age of Host Rocks: Miss. Escabrosa Lm ?

㉗ Environment:

㉘ Alteration: weak - spotty calc-silicates

㉙ Total Extent: Very intermittent

㉚ Structure:

㉛ Ore Occurrence:

㉜ Age of Mineralization: Laramide

㉝ Conclusions and Recommendations: This is a review of Newmont's deep exploration of the 1950's; too deep - too weakly altered and mineralized. No recommendations now; review 5 yrs. hence.

(For additional space use extra sheets)

ASARCO

Southwestern Exploration Division

February 4, 1985

To: J.D. Sell/W.L. Kurtz

From: F.R. Koutz

Burt Devere Data
Tombstone Mining District
Cochise County, AZ

W.D. Gay has turned up a number of geologic and assay worksheets, property maps, air photo enlargements with mylar geologic overlays in map file drawers from B.J. Devere's old office. I have inventoried these for D.A. Melhado who will file them in dead-storage in the hall closet in case the property/environmental/PR situation improves and additional work is justified in the district. Many of the sheets were drafted to figures for B. Devere's 1977-80 Tombstone reports.

- Tombstone & Charleston Mining District - Property Map. 1:24,000 (mn 2738 dam). Claims numbered, colored + state P.P.
- Coloring guide, above map
- Old claim plat photo ∿1"= 2000'
- Claim plat - worksheet 1" = 2000'
- Claims - Charleston-Fairbank Area 1" = 1000' + topography
- Generalized Stratigraphic Column 1" = 500'
- Contention - Empire dike - Fault Fissure zone 1" = 200' + assays
- X-Section thru Newmont DDH-8 & across Tranquility Fault zone 1" = 200'
- X-Section thru Contention Pump Shaft (E-W) 1" = 200'
- X-Section thru DDH-7 1" = 200'
- Geologic map 1" = 2000', colored, topo.
- Geologic map: Central Portion, Tombstone 1" = 500'
- Alteration map, overlay: 1" = 500'
- Diagrammatic cross section A-A' 1" = 500' N42E
- Diagrammatic cross section X-X' 1" = 500' N62W
- Geologic overlay - compiled from photos - 1" = 458.4'
- SW-NE Assay Profile 1" = 1000' (Fig. 3)
- W-E Assay Profile 1" = 1000' (Fig. 5)
- W-E Hirshel Assay Profile (Fig. 4)
- S-N Assay Profile (Fig. 6)
- S-N Assay Profile (Fig. 7)
- S-N Assay Profile - Bunker Hill (Fig. 8)
- Mineral Zoning 1" = 500'
- Overlay: Assays - Zoning 1" = 500' (3 sheets)
- Long section along Ariz. Queen - Skip Shaft (D-D') 1" = 200'
- Start of Section thru Oregon-Prompter Fault 1" = 200'
- PMT - of Geology ∿ 1" = 500'
- Overlay - plot of high-grade Dump Samples (1" = 500'?)
- Overlay Geology
- Generalized Section thru Tombstone Mining Dist. N30E 1" = 2000' 12/77
- Structure Map: 1" = 2000' overlay
- Tombstone 7½' Quad Sample + Alt. overlay

- Geologic overlay 7½'
- Fox Prospect 1" = 300' BJD June '78 (MVK 4049)
- Fox Prospect 1" = 300' overlay (samples)
- Fox Prospect 1" = 300' Geology
- Fox Prospect: Mylar Geol. overlay (to Air photos)
  Photos: 1/76 1:31680 Tombstone + Vicinity
  9 Air photo enlargements, 3 with Geologic mylar overlays ∿1" = 500'

F. R. Koutz

FRK:mek

cc: D.A. Melhado

ASARCO

Southwestern Exploration Division

April 25, 1985

F. T. Graybeal
New York Office

Tombstone District, Arizona

Jim Sell asked us to run down the publicity concerning the cyanide leach solution leak at the Tombstone Exploration Inc. mine plant. We couldn't find all of the references, but the four enclosed clips detail most of the circumstances.

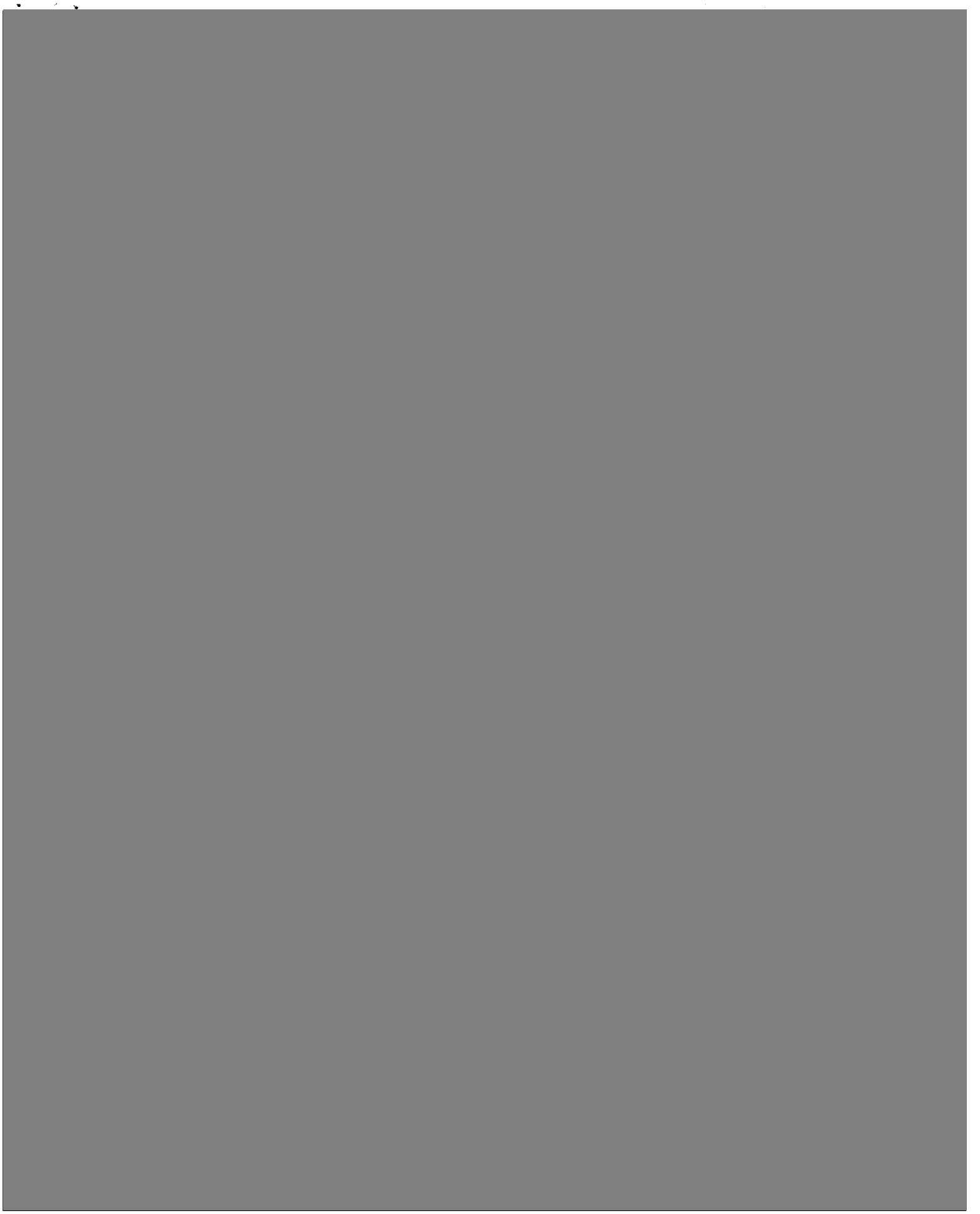
Within the last few weeks, short television and newspaper articles have questioned the Arizona Department of Health Services' inaction in the case. Apparently, no one from ADHS has been around to check the town wells since the first alarm last July, and someone in Tombstone alerted one of the newspapers.

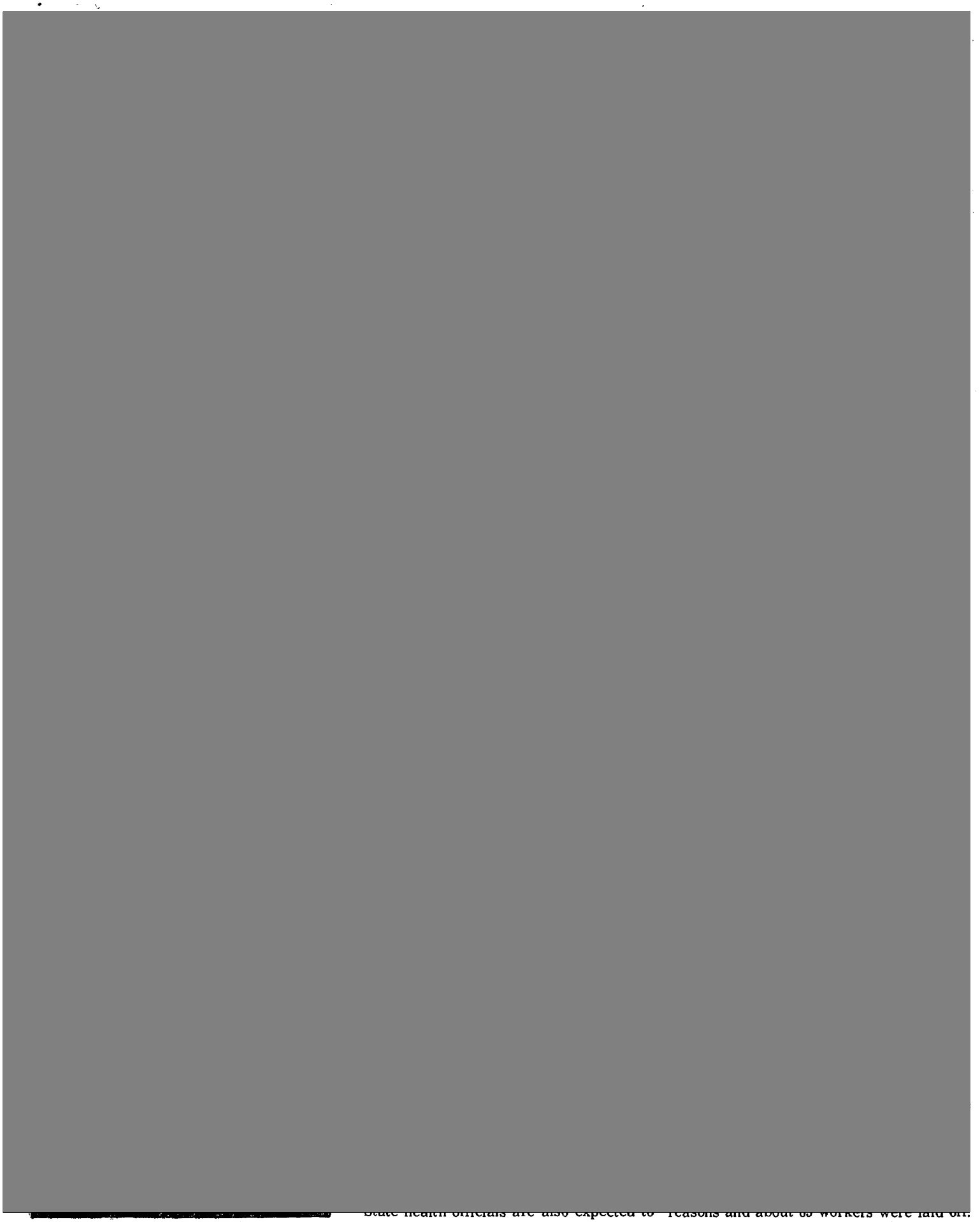
Asarco would undoubtedly provide a more inviting target than a nearly bankrupt small firm -- the Mission Mine is number six on ADHS's priority list for a waste water discharge permit. The new groundwater quality regulations have just gone into effect and Asarco is considered to be a major polluter in spite of our educational efforts. A plant with TEI's record would be hard to defend.

J. R. Stringham

JRS:mek
encs.

cc: J. D. Sell





State health officials are also expected to [illegible] reasons and about 85 workers were laid off.

The Arizona Daily Star

Metro/State

C

Tucson, Sunday, July 29, 1984

Page One

JDS

ASARCO

Southwestern Exploration Division

May 15, 1985

Mr. F. T. Graybeal
New York Office

Tombstone District
Arizona

The Asarco files contain little information on the potential of the near surface values in the Tombstone District. Most of our work was toward the enriched ores at the water table and sulfides. Whether sufficient tonnage out of the surface narrow vein expressions could be secured as an aggregate for nominal production is questionable. The use of a large bit cable tool rig (or Becker drill type) might sample the area of the present open pit, and adjacent extensions, to a satisfactory degree to indicate tonnage-grade sufficient for a continued operation. Thus the district does contain some present exploration possibilities for continued open pit operations. As noted in JRS's newspaper article, the open pit produced 5,262,271 tons of ore in 1981 through 1983.

I agree with J.R. Stringham (April 25, 1985) that the cyanide leakage problem has not been resolved and that the liability may be more than Asarco cares to take on at this time. Of course, this pad could be moved to a new properly prepared site.

I also believe that the Mining Department should evaluate the stripping and mining characteristics as, in the present Contention open pit, the easily accessable material has probably been mined and placed on the leach pads which are involved in the cyanide leakage problem.

Whether the projected increase in grade with depth would compensate for the increased stripping needs to be evaluated, as will the question of old open stopes under the pit which produced about half the ore value, according to J.A. Williams, and their effect on mining activities.

In Wednesday's Arizona Daily Star, copy attached, is an article on the Haber, Inc. and Houston Mining and Resources Inc.'s tentative work in the Tombstone District. Mr. Stringham's sources say that Houston-Haber are not part of the TEI ground.

James D. Sell

JDS:mek
Atts.

cc: W. L. Kurtz
J. R. Stringham

ASARCO Southwestern Exploration Division JDS

October 24, 1988

SWED Staff

AGS Fall Field Trip, 1988
Tombstone-Bisbee-Commonwealth

The Guidebook for the 1988 Fall Field Trip of the Arizona Geological Society (149 pages, spiral bound) of October 22-23 has been placed in the Asarco Library.

The trip covers the Tombstone-Bisbee-Commonwealth areas of Cochise County.

Santa Fe Minerals has now tied up much of the patented and unpatented claims in the main Tombstone area and has three rigs busy. They are testing, by 3000 foot drill holes, for replacement deposits in the Abrigo and Martin limestones; Peter Megaw, project geologist.

At Bisbee, the PD group has five geologists working on the drilling, interpretation, and engineering studies coupled with the economic analysis. Reserves have been announced in the range of 170 million tons at 0.45% copper in this Cochise deposit (north of the Dividend Fault). They have announced that all the copper will be recovered in a Solvent Extraction plant.

In the Gleeson area, Santa Fe has several core rigs busy. One "wag" said he wouldn't touch that area with a ten-foot pole and was glad his name would not be attached to the project. Apparently Jim Loghry is one of four consultants to the Santa Fe Gleeson project (he was not on the trip).

The Commonwealth Mine at Pearce is now being prepared for drilling (and fund-raising) by Westland Minerals Corporation. The cyanide tailings (±½ million tons at 2 oz./ton silver and 0.01 oz./ton gold, very high silica) are presently being shipped to the PD Hidalgo smelter.

H. Drewes, R. Newell, S. Eade, and J. Guilbert all combined to expound on the geology, mineralization, and on their thoughts to the group during the excellent days for an outing.

James D. Sell

JDS:mek

cc: W.L. Kurtz

Santa Fe Pacific Mining, Inc.

Tombstone, AZ

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Fred J. Jenkins
Manager Mineral Exploration
S.W. Region

A Santa Fe Southern Pacific Company

November 2, 1989

Santa Fe Pacific Mining, Inc. is undergoing some organizational changes that will focus exploration activity around our land base in northern Nevada. As a result, a number of mature exploration projects are available for sale, lease or preferably joint venture. Many of the projects have discoveries with some short term production potential. What follows are executive summaries on properties which are furthest along. Others which are not summarized herein are in the very grassroots stage with the exception of three industrial mineral properties which are in the delineation and marketing phase. These include ceramic grade feldspar, clay and limestone. Large blocks of grant land minerals will also be available for lease in southern and northern California and Arizona. A 150,000 acre parcel of fee surface and minerals is for sale in the Hualapai mountain area of Mohave County, southeast of Kingman, Arizona.

Confidentiality agreements are enclosed for the six properties described should you wish to examine any of these in detail. Please note the Gunnison Gold Belt and Hahn's Peak has some area of interest which are shown on attached maps. Negotiations concerning sale, lease or joint venture will be coordinated through Dale Trubey - Director of Land or Ken Sageser - Vice President Exploration in Albuquerque. Fred Jenkins should be contacted to set up appointments for data review, field visits or further discussion regarding the technical aspects of the projects.

TOMBSTONE PROJECT,
COCHISE COUNTY, ARIZONA

Santa Fe Pacific Mining's Tombstone project is located 65 miles southeast of Tucson, and 20 miles northwest of Bisbee, in central Cochise County, Arizona. Patented mining claims, leased from Tombstone Development Company in 1987, cover the bulk of the historic mining district which lies immediately south of the town of Tombstone (Figure 1). Production is estimated to have been 2.9 MMT of ore which yielded, with poor recovery methods, 29.8 MM oz of silver, 248 M oz of gold, 35.7 MM lbs of lead, as well as considerable quantities of copper, zinc, and manganese. Since 1911, exploration in the district has been very limited; the small drilling programs that were undertaken were largely confined to areas above the water table, approximately 500 feet below the surface.

The ores exploited in the district occurred primarily in the Cretaceous Bisbee formation which blankets the entire basin to a depth of 500 to 600 feet. Within the Tombstone basin, the Bisbee is underlain by in excess of 4000 feet of Paleozoic carbonate rocks ranging in age from Cambrian to Permian. Production records verify an increasing gold to silver ratio with depth in several parts of the district.

The style, geometry, mineralogy, and geochemical zoning of the known mineralization in the Tombstone district are typical of the upper or outer fringes of a large CRD system. That the bulk of known mineralization occurs in the thin limestone units of the Bisbee formation, suggests that larger CRD orebodies may have been developed in the thick Paleozoic carbonate section known to underlie the Cretaceous in the Tombstone basin. These carbonates host substantial CRD ore elsewhere in southeastern Arizona, most notably in the Bisbee-Warren district.

CRD - Carbonate Replacement Deposit

The results of surface and underground mapping and sampling, as well as a review of the records and literature, established several types of drill targets: fissure-replacement veins, chimney and manto replacements, and breccia pipe-related ore. These targets are schematically illustrated in figure 2. To date, only a very minimal amount of drilling has been completed in an attempt to evaluate a few of the above target classes. Seven core holes have been completed, with an aggregate footage of 19,041 feet. Basic results demonstrate the presence of ore grade mineralization and general viability of the exploration concept. The best thick intercept to-date is 23.5 feet @ 6.5% Pb, 2.6% Zn, 0.6% Cu and 1.1 oz/T Ag on a replacement vein while a high grade thin, shear bounded intercept on a chimney target assayed 17.3% Zn, 3.2% Pb, 0.8% Cu and 31.0 oz/T Ag over 0.5 feet.

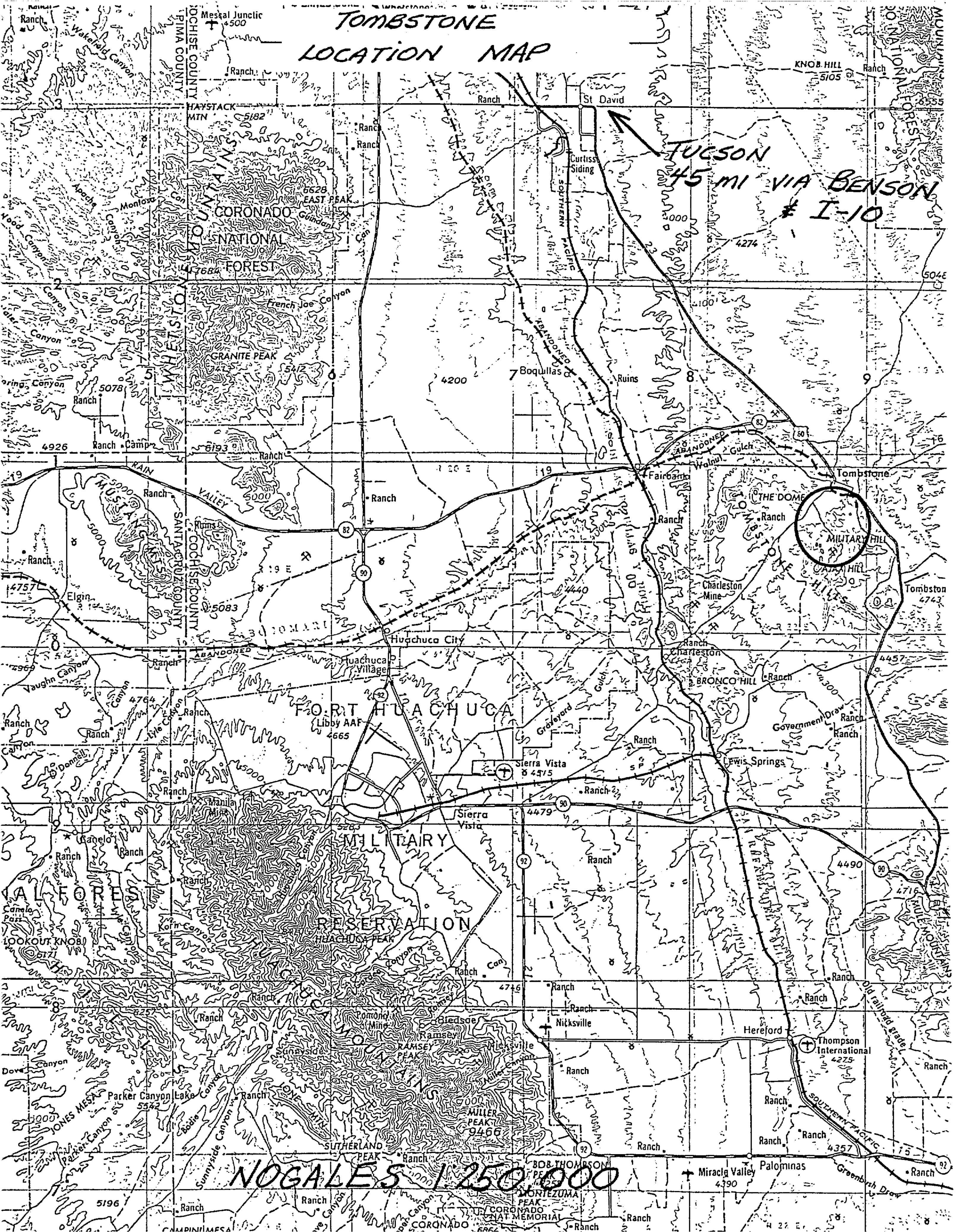
Some potential for shallow high grade mineralization still occurs. A breccia pipe at the 300 level of the Empire Mine appears undeveloped below and exposures suggest a 75 foot diameter. Grab samples of the breccia assayed up to .15 oz/T Au and 21.7 oz/T Ag while proximal CRD mineralization assayed up to .36 oz/T Au and 8.6 oz/T Ag. There is a reasonable chance a mill will be constructed in the next two years at Courtland, 15 miles to the east, on SFPM's Star Hill orebody, thereby providing potential for a short term opportunity while continuing exploration for the deeper Paleozoic hosted mantos or chimneys.

SFPM is looking for a joint venture partner who will continue to explore the property by putting money into the ground, looking at both shallow resources and completing drill holes that offset mineralized intercepts or target other stratigraphic/structural plays. Holding costs for the core of the Tombstone district is around $50,000. In order to earn a 50% interest, the prospective partner should be prepared to spend $2 million over a several year period with the right to back out at the end of any approved program.

GUNNISON GOLD BELT
GUNNISON COUNTY, COLORADO

Santa Fe controls or owns over 100 unpatented mining claims in three target areas within the Gunnison Gold Belt, a 30X15 mile belt of Precambrian volcanosedimendary rocks and intrusives that lie just south of Gunnison, Colorado. During the mid to late 1970's the area was well explored for massive sulfide deposits but not much attention was given to the gold occurrences largely due to their vein-like style. In the late 1980's Santa Fe reexamined the gold potential of the district and has confirmed the presence of mineralization which typifies a model concept that allows for the presence of a world class gold deposit. Very shallow reverse circulation drilling (± 100 feet) and trenching results support this innovative idea. Gold values range from 73 feet of .015 oz/T to 4 feet of 0.7 oz/T in drill holes and 180 feet of .033 oz/T with five foot intervals over 0.2 oz/T in trenches. Mineralization is not vein related and is atypical of previously mined gold.

The property potential is suited to any company who wishes to capitalize early on into a newly proven exploration concept that could result in discovery of a major new gold camp. In addition a small amount of open pittable material (200,000 tons @ .05 oz/T Au) may be available on one property.



TOMBSTONE
LOCATION MAP
TUCSON
45 MI VIA BENSON
& I-10
NOGALES 1:250,000
St David
Curtiss Siding
SOUTHERN PACIFIC
CORONADO NATIONAL FOREST
EAST PEAK
GRANITE PEAK
HAYSTACK MTN
KNOB HILL
Boquillas
Ruins
Fairbank
Tombstone
THE DOME
MILITARY HILL
TOMBSTONE HILLS
Charleston Mine
Charleston
BRONCO HILL
Walnut Gulch
RAIN VALLEY
Elgin
Huachuca City
Huachuca Village
FORT HUACHUCA
Libby AAF
Sierra Vista
Lewis Springs
MILITARY
RESERVATION
HUACHUCA PEAK
HUACHUCA MOUNTAINS
Government Draw
Ramsey Peak
MILLER PEAK
9466
Nicksville
Hereford
Thompson International
Palominas
Miracle Valley
Parker Canyon Lake
Canelo
LOOKOUT KNOB
SUTHERLAND PEAK
MONTEZUMA PEAK
CORONADO NAT MEMORIAL
MULE MOUNTAINS
Greenbush Draw

TOMBSTONE PROJECT,
COCHISE COUNTY, ARIZONA

Santa Fe Pacific Mining's Tombstone project is located 65 miles southeast of Tucson, and 20 miles northwest of Bisbee, in central Cochise County, Arizona. Patented mining claims, leased from Tombstone Development Company in 1987, cover the bulk of the historic mining district which lies immediately south of the town of Tombstone (Figure 1). Production is estimated to have been 2.9 MMT of ore which yielded, with poor recovery methods, 29.8 MM oz of silver, 248 M oz of gold, 35.7 MM lbs of lead, as well as considerable quantities of copper, zinc, and manganese. Since 1911, exploration in the district has been very limited; the small drilling programs that were undertaken were largely confined to areas above the water table, approximately 500 feet below the surface.

The ores exploited in the district occurred primarily in the Cretaceous Bisbee formation which blankets the entire basin to a depth of 500 to 600 feet. Within the Tombstone basin, the Bisbee is underlain by in excess of 4000 feet of Paleozoic carbonate rocks ranging in age from Cambrian to Permian. Production records verify an increasing gold to silver ratio with depth in several parts of the district.

The style, geometry, mineralogy, and geochemical zoning of the known mineralization in the Tombstone district are typical of the upper or outer fringes of a large CRD system. That the bulk of known mineralization occurs in the thin limestone units of the Bisbee formation, suggests that larger CRD orebodies may have been developed in the thick Paleozoic carbonate section known to underlie the Cretaceous in the Tombstone basin. These carbonates host substantial CRD ore elsewhere in southeastern Arizona, most notably in the Bisbee-Warren district.

CRD = Carbonate Replacement Deposit

The results of surface and underground mapping and sampling, as well as a review of the records and literature, established several types of drill targets: fissure-replacement veins, chimney and manto replacements, and breccia pipe-related ore. These targets are schematically illustrated in figure 2. To date, only a very minimal amount of drilling has been completed in an attempt to evaluate a few of the above target classes. Seven core holes have been completed, with an aggregate footage of 19,041 feet. Basic results demonstrate the presence of ore grade mineralization and general viability of the exploration concept. The best thick intercept to-date is 23.5 feet @ 6.5% Pb, 2.6% Zn, 0.6% Cu and 1.1 oz/T Ag on a replacement vein while a high grade thin, shear bounded intercept on a chimney target assayed 17.3% Zn, 3.2% Pb, 0.8% Cu and 31.0 oz/T Ag over 0.5 feet.

Some potential for shallow high grade mineralization still occurs. A breccia pipe at the 300 level of the Empire Mine appears undeveloped below and exposures suggest a 75 foot diameter. Grab samples of the breccia assayed up to .15 oz/T Au and 21.7 oz/T Ag while proximal CRD mineralization assayed up to .36 oz/T Au and 8.6 oz/T Ag. There is a reasonable chance a mill will be constructed in the next two years at Courtland, 15 miles to the east, on SFPM's Star Hill orebody, thereby providing potential for a short term opportunity while continuing exploration for the deeper Paleozoic hosted mantos or chimneys.

SFPM is looking for a joint venture partner who will continue to explore the property by putting money into the ground, looking at both shallow resources and completing drill holes that offset mineralized intercepts or target other stratigraphic/structural plays. Holding costs for the core of the Tombstone district is around $50,000. In order to earn a 50% interest, the prospective partner should be prepared to spend $2 million over a several year period with the right to back out at the end of any approved program.

GUNNISON GOLD BELT
GUNNISON COUNTY, COLORADO

Santa Fe controls or owns over 100 unpatented mining claims in three target areas within the Gunnison Gold Belt, a 30X15 mile belt of Precambrian volcanosedimendary rocks and intrusives that lie just south of Gunnison, Colorado. During the mid to late 1970's the area was well explored for massive sulfide deposits but not much attention was given to the gold occurrences largely due to their vein-like style. In the late 1980's Santa Fe reexamined the gold potential of the district and has confirmed the presence of mineralization which typifies a model concept that allows for the presence of a world class gold deposit. Very shallow reverse circulation drilling ($\pm$ 100 feet) and trenching results support this innovative idea. Gold values range from 73 feet of .015 oz/T to 4 feet of 0.7 oz/T in drill holes and 180 feet of .033 oz/T with five foot intervals over 0.2 oz/T in trenches. Mineralization is not vein related and is atypical of previously mined gold.

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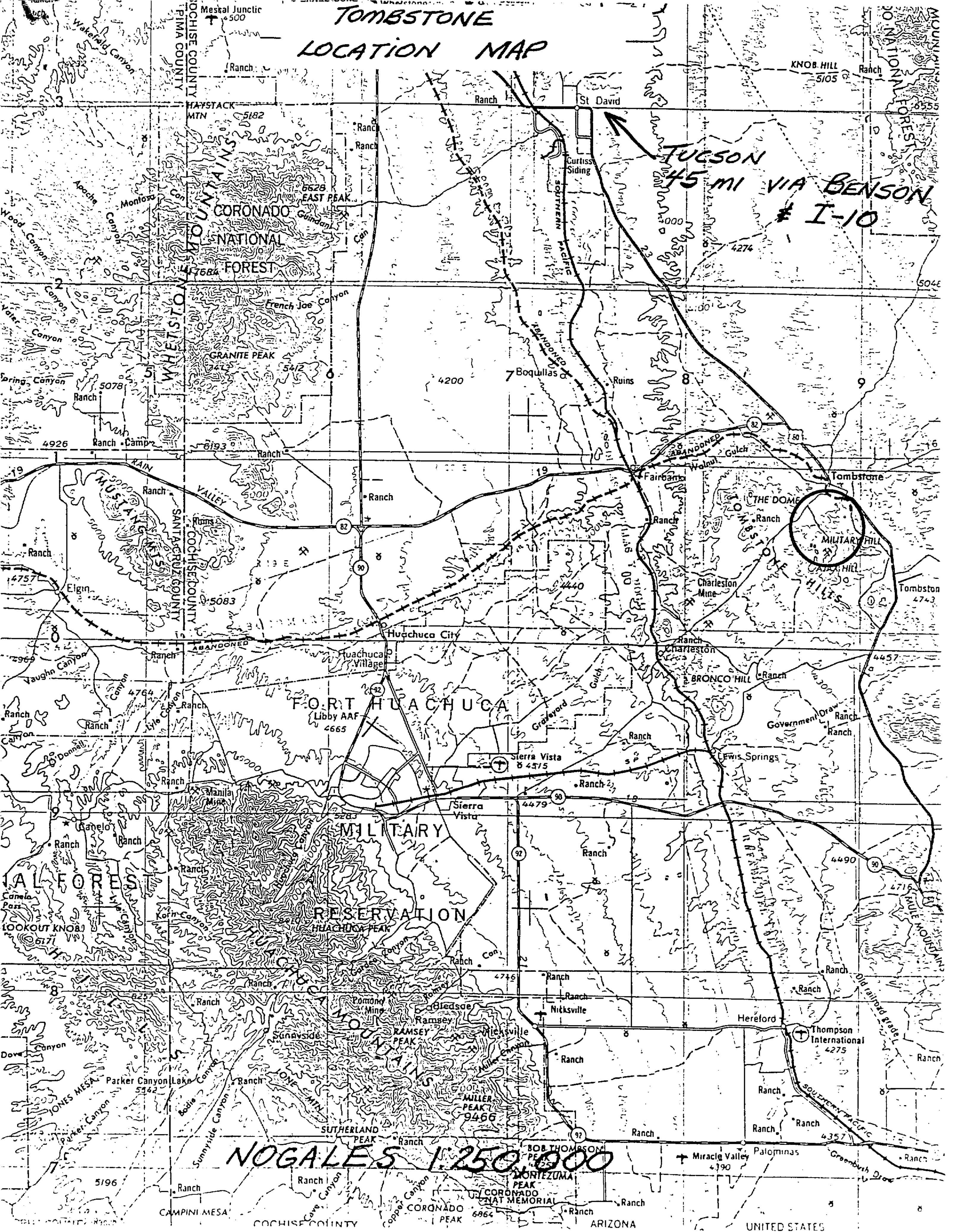

TOMBSTONE LOCATION MAP
TUCSON 45 MI VIA BENSON & I-10
NOGALES 1:250,000
St David
Curtiss Siding
Tombstone
Fairbank
THE DOME
MILITARY HILL
TOMBSTONE HILLS
Charleston
Charleston Mine
BRONCO HILL
Huachuca City
Huachuca Village
FORT HUACHUCA
MILITARY
RESERVATION
Sierra Vista
Lewis Springs
Hereford
Palominas
Miracle Valley
Nicksville
Thompson International
CORONADO NATIONAL FOREST
WHETSTONE MOUNTAINS
MUSTANG MTS
Elgin
HUACHUCA MOUNTAINS
HUACHUCA PEAK
MILLER PEAK 9466
RAMSEY PEAK
CORONADO NAT MEMORIAL
Parker Canyon Lake
SOUTHERN PACIFIC
MULE MOUNTAINS
Mescal Junction
KNOB HILL
COCHISE COUNTY
PIMA COUNTY
SANTA CRUZ COUNTY
ARIZONA
UNITED STATES

ASARCO

Great Basin Exploration Division

February 8, 1994

TO: J.D. Sell
Tucson Office

Tombstone, AZ
Properties

Attached is a description of several Tombstone (AZ) properties being offered by Excellon Resources. It is your decision whether these properties are worth pursuing. Also attached is the requested claim map for the Courtland-Gleeson property. Please note that this map is confidential and not for public information.

Thanks for faxing your schedule of future activities and status of present investigations.

Yours truly,

Peter G. Vikre, KS

Peter G. Vikre

PGV:ks
Attachments

Rex E. Loesby, P.E.

19288 East Hickock Dr., Parker, CO 80134
Tel: (303) 840-7812 Fax: (303) 840-7816

January 31, 1994

Mr. Peter Vikre
Asarco
510 East Plum Lane
Reno, NV 89502

Dear Peter:

Enclosed is a Properties Summary for the Tombstone District Projects near Tombstone, Arizona. The package includes six projects in the Tombstone area, one of which is a surface mineable gold target in more advanced stages of development. The other five properties are earlier stage targets with significant indications of mineralization and merit further investigation.

As usual, I have a finder agreement with the owner that calls for my fee to be paid by the owner. Please let me know if you would like to investigate any or all of the properties. Thank you.

Sincerely,

Rex E. Loesby

Peter 702/826-7007

TOMBSTONE DISTRICT PROJECTS

PROPERTIES SUMMARY

Prepared by Rex E. Loesby, P. E.

January 1994

For information, contact Rex E. Loesby at 19288 E. Hickock Dr., Parker, CO 80134, Tel: 303-840-7812, Fax: 303-840-7816

I. INTRODUCTION

The Tombstone District Projects, controlled by Excellon Resources of Toronto, consist of six separate mineral properties, all near the town of Tombstone, Cochise County, Arizona (please see the attached map). A seventh, the Robbers Roost Project, was recently optioned by a major mining company. The properties are shown on the attached map. Tombstone is located approximately 70 miles southeast of Tucson, Arizona on US Highway 80. The properties are held by Excellon subject to the terms of a number of lease agreements with the underlying owners. Details of the leases are available to interested parties from Excellon.

The TDC Lease area has had the most significant exploration and mining activity and is in the most advanced stage of development of all of the projects described in this report. Excellon has held the property for a number of years, during which time it and joint venturers have performed extensive geologic evaluations including substantial drilling programs.

The Tombstone district was previously thought to be a mid-Tertiary aged epithermal silver-lead-zinc district of limited size and potential. More recent work shows it to be of Laramide age. Mineralization is associated with volcanism and related caldera formation, and alteration assemblages are characteristic of porphyry copper deposits. Five such potential porphyry copper centers in the Tombstone area have been acquired by Excellon in addition to the core TDC Lease area. Excellon's consultants are Dr. John M. Guilbert, Professor Emeritus, The University of Arizona, and James A. Briscoe, President, JABA, Inc., both recognized authorities on ore deposit geology. A very detailed report on the Tombstone District and Guilbert's/Briscoe's recommendations for development programs on all of Excellon's holdings is available to interested parties from Excellon.

Excellon offers each property separately, or will consider combining some or all of the properties in a single package. Excellon offers these properties to a joint venture partner or purchaser under terms which might include an initial cash payment with minimum spending requirements for development. On full development of any of the properties, Excellon offers a direct interest which could ultimately amount to majority control of that property.

The following two sections describe the properties. The first section concentrates on the TDC Lease Project area as it has had significant past mining activity and the data available from drilling and geologic evaluations are quite extensive. The second section describes each of the outlying properties.

II. TDC LEASES

Property Description: The TDC Leases project area includes the original gold/silver discoveries and mines that were the reason for the building of the town of Tombstone, Arizona in 1877. The property consists of 89 patented and 59 unpatented lode claims just south and immediately adjacent to the town of Tombstone.

Reserves: During the first half of 1993, 86 reverse circulation holes were drilled. Approximately 50 percent of this drilling was adjacent to and within a previously mined open pit area. This drilling suggested a geologic resource of 1.2 million tons grading 0.063 opt gold equivalent. An additional deeper geologic resource of 289,000 tons grading 0.098 opt gold equivalent was also identified. Excellon's partner in the drilling became discouraged when the most prolific gold zone appeared to fade abruptly to the west and

chose to abandon their interest in the area. Subsequent analysis by Briscoe revealed there was a failure to take into account a major strike slip fault which offset the gold zone some 400 feet to the south. Further examination of this data plus data from previous work suggest there is the potential to develop in excess of 600,000 ounces of gold equivalent within the disturbed ground in and around the old open pit area. Furthermore, the potential exists on other partially tested and untested ground which, according to Briscoe, could contain more than 1.5 million ounces of gold equivalent.

Metallurgy: Based on prior operators' experience, the gold ores of the project are known to respond favorably to heap leaching with high recovery rates.

History: Initial gold discoveries of gold and silver were made in 1877. From 1877 to 1907, gold production was 194,000 ounces and silver production was 24 million ounces. During the past 20 years, numerous attempts have been made to re-develop mines in the district. The property was developed in 1980 by Tombstone Exploration Inc. (TEI) and it produced an estimated 100,000 ounces of gold equivalent from 1980 to 1984. In 1989 a Merrill Crowe processing plant was installed on the property by Cowichan Resources, Inc., but under-capitalization resulted in a closing of operations late in 1989. Excellon acquired an option on the property in 1990.

Planned Development Work: An exploration program has been recommended by Briscoe. The program is estimated to cost approximately $200,000 and would consist of geochemistry, geophysics, and 10,000 feet of scout drilling to broadly outline ore zones. A follow-up definition drilling program totalling approximately 20,000 feet is estimated to cost $260,000.

Infrastructure: Mine utilities, services and skilled labor are readily available in the area. A 3,000 tpd Merrill-Crowe processing plant was installed on the property in 1989 by a previous owner. The plant remains and could be made operational with minimal expenditures.

Permitting: All permits are in place for both the mining and leaching operation. The people of the town of Tombstone seem very supportive of a mining operation at the sight.

III. OTHER PROPERTIES

The other five properties held by Excellon in the Tombstone area include the Walnut Creek Porphyry Centre, the State of Maine Porphyry Centre, the Johnson Ranch Property, the Zebra Property, and the Prompter Ridge Property. With respect to these five properties, Guilbert writes:

> "Potential in the district is for carbonate-hosted replacement-type porphyry copper mineralization at intermediate to moderate depth and perhaps great depth; shallow chalcocite blanket porphyry type mineralization; statigraphically and structurally controlled carbonate replacement lead-zinc-silver mineralization; similarly controlled gold of low grade to high grade; volcanic-hosted disseminated precious metal mineralization; supergene enriched volcanic and sediment hosted intermediate to high grade precious metal mineralization; and porphyry-copper-associated distal sediment or volcanic hosted gold mineralization."

All of the five properties are early stage exploration targets where there are significant indications of mineralization that merit further investigation. Guilbert and Briscoe have designed integrated exploration programs for all of the properties including geophysics, geochemistry, biogeochemistry, and drilling to test the areas.

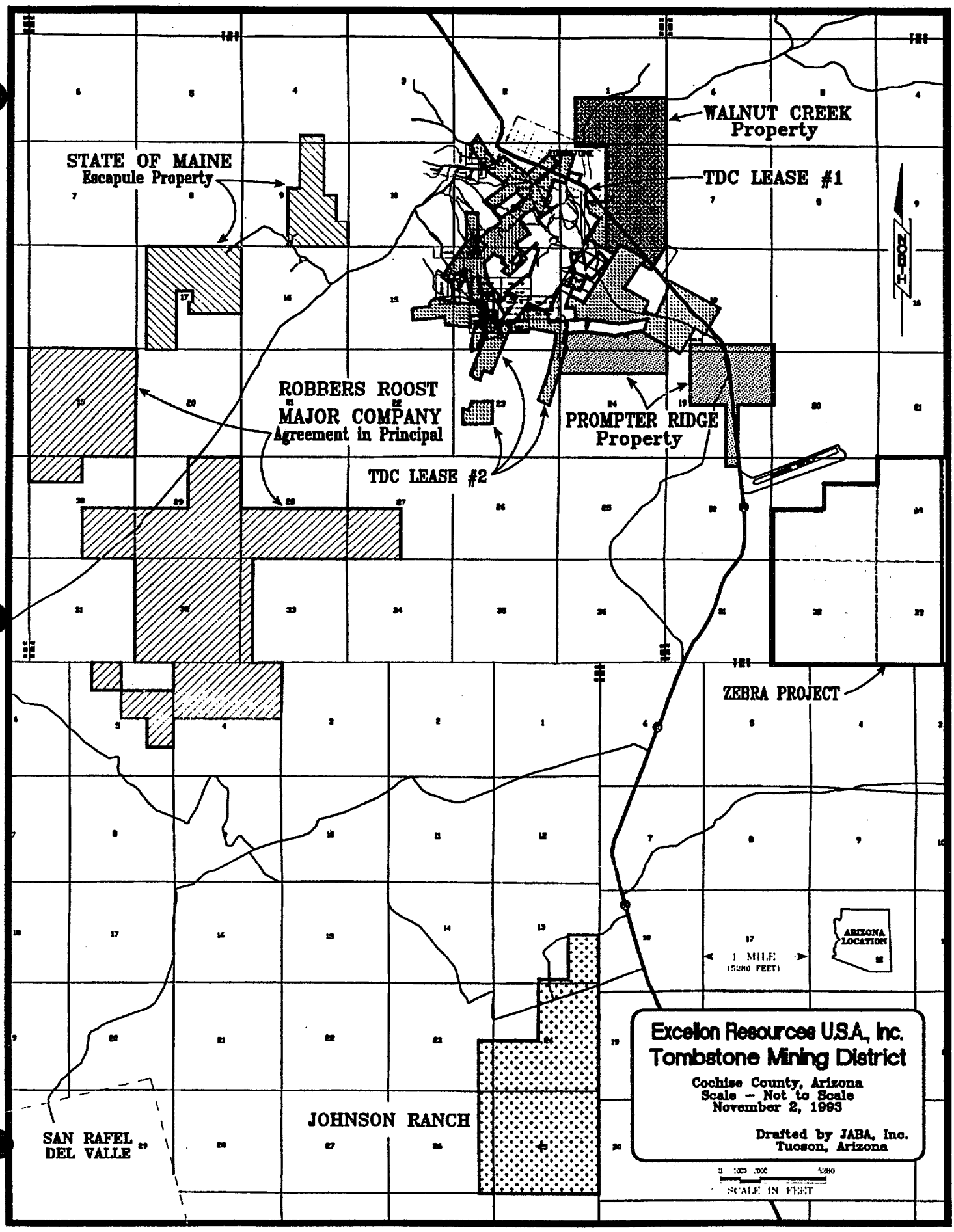
Walnut Creek Porphyry Centre, Prompter Ridge Distal Gold Target: The Walnut Creek property is located east of and immediately adjacent to the town of Tombstone, while the Prompter Ridge property is located southeast of the TDC Lease property. Guilbert writes:

> "Although (the Walnut Creek) suspected porphyry center is under alluvium cover, zonation of precious metals in exposed rocks around the projected center is similar to recently recognized haloes around better exposed porphyries... new orthophotography showed that the Prompter fault is not straight as it has been mapped previously, but rather is concave to the north. It lines up with the north to northeast concave Lucky Cuss fault system. The combination of the two faults describes an arcuate structure, the centroid of which is the projected Walnut Creek Porphyry Center. These faults localize manganese-silver mineralization that may reasonably be interpreted as the outer part of a porphyry alteration zonation. Recent gold discoveries at Chimney Creek, Bingham Canyon, and the adjacent Barney's Canyon, and studies on these and other areas by Osterberg and Guilbert (1989), Sillitoe and Bonham (1990), and Schuh and Guilbert (1993), show that there can be a distal gold zone around porphyry systems hosted by carbonate and pelitic sedimentary rocks. According to Sillitoe and Bonham (1990), these gold halos occur up to a radius of 5 km away from the porphyry center... Such an outer gold center appears to have been discovered by Santa Fe Pacific Mining in the spring of 1992 in the area south of the Prompter Ridge Mine.

State of Maine Mine Porphyry Centre: Located two to three mile west of the town of Tombstone, just north of the Robbers Roost Project Area. Geochemical sampling by Newell (1974) showed a significant molybdenum anomaly over this area and mapping shows wide hydrothermal veins in Uncle Sam tuff. Vein area is greater than in the Tombstone center. The property has a thin veneer of intracaldera tuffs that are mineralized with silver and gold. Copper values increase at shallow depths. A full section of folded Paleozoic and cretaceous sediments is known to underlie the volcanics. Guilbert and Briscoe believe this mineral zone may be the upper portion of a porphyry copper centre. Enriched gold and silver mineralization in broad zones, perhaps of bonanza grades, perhaps underlain at significant depth by porphyry copper mineralization, comprises the potential of the area. Successful exploration could define shallow depth surface mineable silver-gold zones, underlain by polymetallic underground mineable replacement deposits of significant size.

Johnson Ranch Porphyry Anomaly: Located eight to ten miles directly south of the town of Tombstone. The block is comprised of 66 unpatented lode mining claims totalling 1,366 acres. The claims are staked over a silver-molybdenum anomaly defined by Newell (1974) in his mesquite twig geochemical sampling, a pattern similar to that over the main Tombstone porphyry center. This suggests another Tombstone-like porphyry system on the property. If so, it is hidden beneath Quaternary soil and alluvium.

Zebra Property: Located three to four miles southeast of the TDC Lease property. Guilbert writes: "Another significant occurrence of the distal Tombstone gold zone is at the Zebra Property... There, disseminated invisible (Carlin style?) gold of up to an ounce per ton on the surface is disseminated in the Upper Paleozoic Naco formation." Minor jasperoid is associated with gold apparently disseminated in silty limestone along structural features. Anomalous gold in surface samples occurs over several square miles in the Zebra project area. Some geophysics has been done and limited near surface drilling has indicated 100,000 tons of material at 0.09 opt gold in one small area.


WALNUT CREEK
Property
STATE OF MAINE
Escapule Property
TDC LEASE #1
ROBRERS ROOST
MAJOR COMPANY
Agreement in Principal
PROMPTER RIDGE
Property
TDC LEASE #2
ZEBRA PROJECT
JOHNSON RANCH
SAN RAFEL
DEL VALLE
ARIZONA
LOCATION
1 MILE
(5280 FEET)
Excelon Resources U.S.A., Inc.
Tombstone Mining District
Cochise County, Arizona
Scale – Not to Scale
November 2, 1993
Drafted by JABA, Inc.
Tucson, Arizona
SCALE IN FEET