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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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or incomplete and not included

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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)

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. Almost exactly coinciding with Schiefflin's discovery of rich silver mineralization at Tombstone, silver prices began a decline in 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, during which time 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. 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 subsidairy, in 1911. 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 aocurate 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.

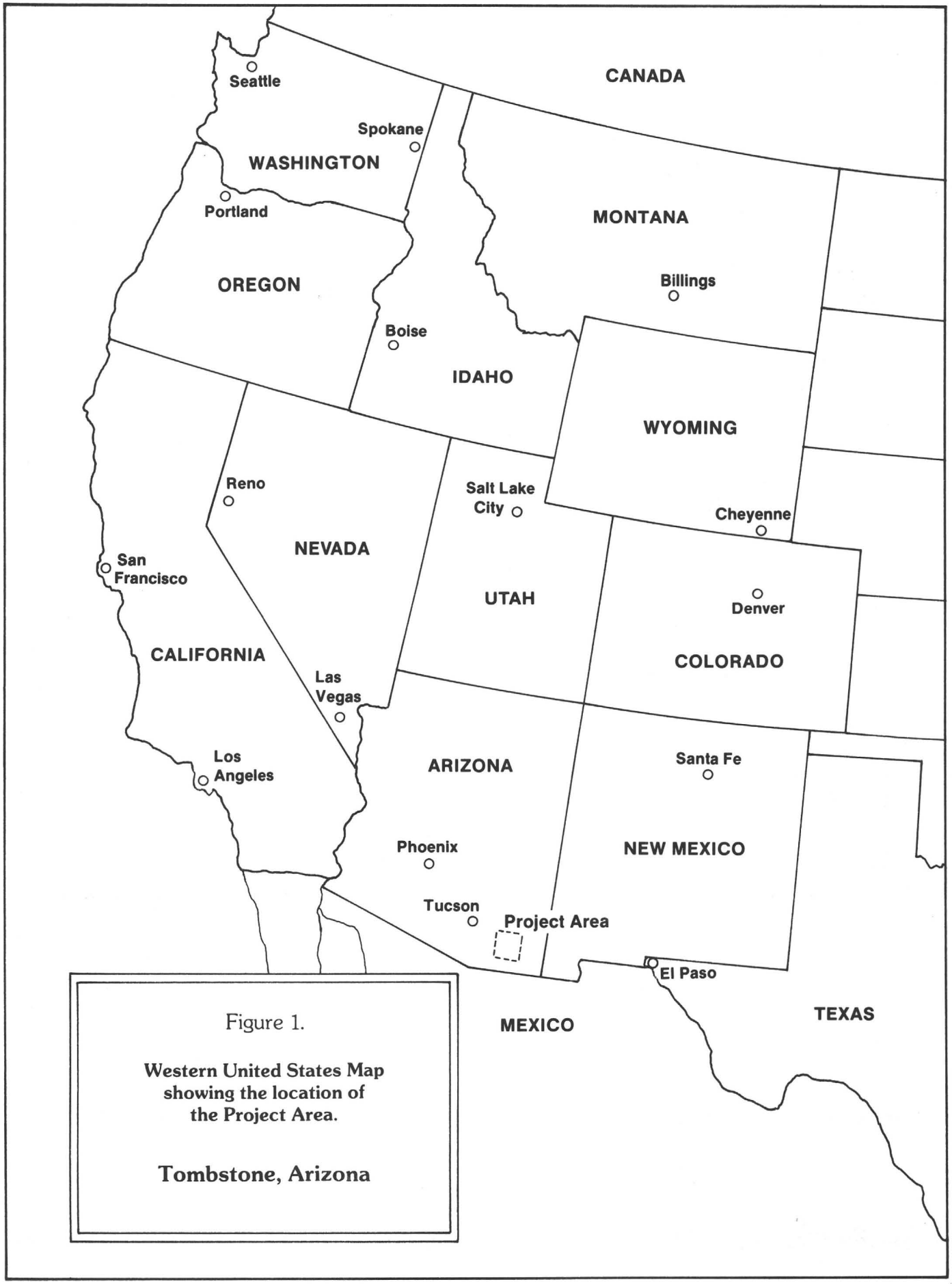


Figure 1.

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

Tombstone, Arizona

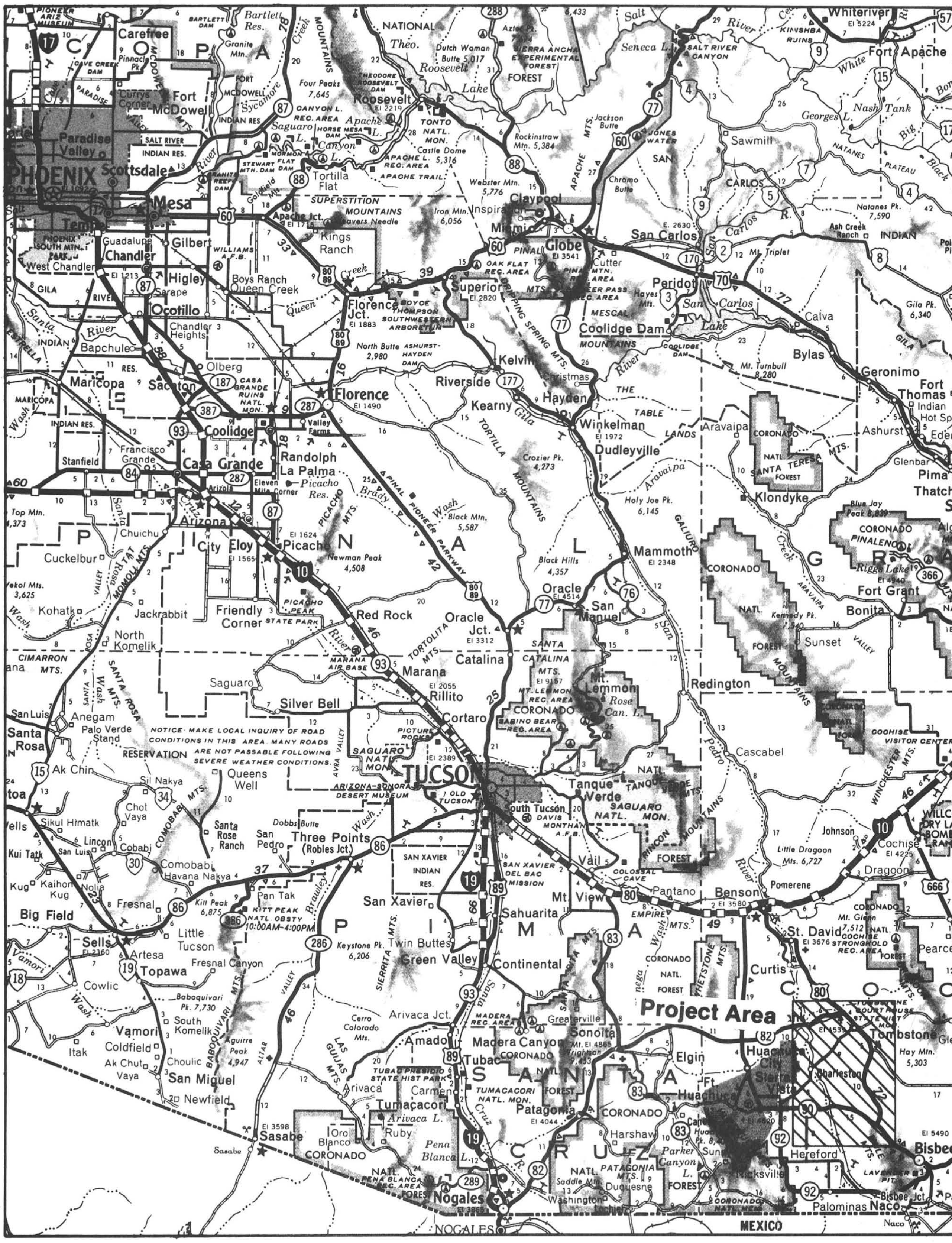
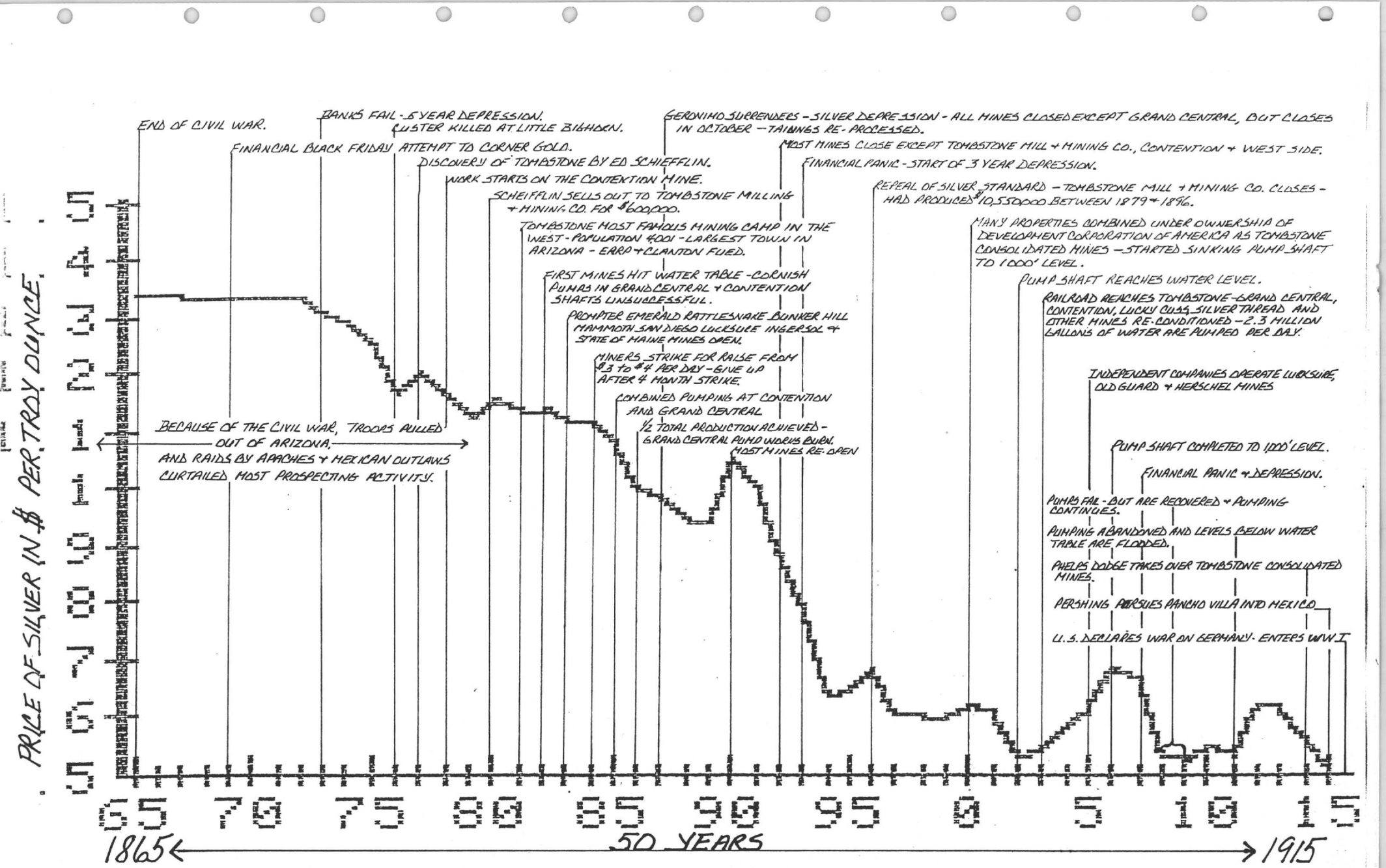


Figure 2. Highway map showing the location of the Project Area in relation to Tucson and Phoenix, Arizona



SILVER
YEARS : 1865-1915

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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

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Prepared by James A. Briscoe

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

YEAR	TOTAL VALUE OF PRODUCTION IN YEAR PRODUCED	CALCULATED** OUNCES OF GOLD @14% OF TOTAL PRODUCED	VALUE AT $400/OZ.	CALCULATED** OUNCES OF SILVER @81% OF TOTAL PRODUCED	VALUE AT $10/OZ.	CALCULATED** POUNDS OF LEAD*** @5% OF TOTAL PRODUCED	VALUE AT $.50/LB.	TOTAL CURRENT VALUE OF PRODUCTION
1879-1880	2318567	15704	6281555	1633078	16330776	2318567	1159284	23771615
1881	5040633	34141	13656287	3613197	36131971	5250659	2625330	52413588
1882	5202876	35240	14095842	3696780	36967803	5309057	2654529	53718174
1883	2881900	19519	7807760	2122126	21221264	3351047	1675523	30704547
1884	1380788	9352	3740887	1016762	10167621	1865930	932965	14841472
1885	1320976	8947	3578842	999991	9999912	1651220	825610	14404363
1886	1050000	7112	2844702	859091	8590909	1141304	570652	12006264
1887	600000	4064	1625544	495918	4959184	666667	333333	6918061
1888	600000	4064	1625544	517021	5170213	681818	340909	7136666
1889	250000	1693	677310	215426	2154255	320513	160256	2991822
1890	600000	4064	1625544	462857	4628571	666667	333333	6587449
1891	674650	4569	1827789	551986	5519864	784477	392238	7739891
1892	490000	3319	1327528	456207	4562069	597561	298780	6188377
1893	450000	3048	1219158	467308	4673077	608108	304054	6196289
1894	300000	2032	812772	244890	2448900	454545	227273	3488945
1895	300000	2032	812772	373846	3738462	468750	234375	4785609
1896	300000	2032	812772	357353	3573529	500000	250000	4636302
1897-1901	1539610	10428	4171174	2078474	20784735	1877573	938787	25894695
1902-1906	2550000	17271	6908563	3500847	35008475	2771739	1385870	43302907
1907	550000	3725	1490082	675000	6750000	518868	259434	8499516
TOTAL	28400000	192356	76942429	24338159	243381589	31805070	15902535	336226552
AVERAGE/TON****		0.32	126.48	40.01	400.07	52.28	26.14	552.69

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

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

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

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

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

Prepared by James A. Briscoe

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	1770794	885397	173313	69325	6178774
1909	27123	2280	911832	201700	2017000	27706	27706	1535637	767819	713116	285246	4009603
1910	4619	1062	424712	116520	1165200	31163	31163	305876	152938	0	0	1774013
1911	8797	2155	862196	224098	2240980	68209	68209	982010	491005	0	0	3662390
1912	7405	1363	545272	158377	1583770	27723	27723	617820	308910	0	0	2465675
1913	5760	1230	491824	126392	1263920	10657	10657	334923	167462	36503	14601	1948464
1914	6063	1380	552144	108868	1088680	14217	14217	234345	117173	39324	15730	1787943
1915	9003	1216	486404	100115	1001150	36075	36075	164136	82068	63386	25354	1631051
1916	57200	3950	1580144	343453	3434530	131546	131546	983983	491992	0	0	5638212
1917	57474	3373	1349220	444139	4441390	229488	229488	1278754	639377	0	0	6659475
1918	19507	1389	555760	283412	2834120	41503	41503	457183	228592	0	0	3659975
1919	27445	1946	778328	450366	4503660	290182	290182	289424	144712	0	0	5716882
1920	28946	1788	715104	456855	4568550	144010	144010	243946	121973	0	0	5549637
1921	18594	1057	422632	423688	4236880	132688	132688	678946	339473	0	0	5131673
1922	44347	2322	928980	613700	6137000	196740	196740	744529	372265	0	0	7634985
1923	32770	3093	1237040	495943	4959430	195485	195485	465914	232957	0	0	6624912
1924	15448	2459	983456	247642	2476420	72836	72836	465323	232662	0	0	3765374
1925	27760	2677	1070692	241381	2413810	77340	77340	1527019	763510	32592	13037	4338388
1926	47708	2990	1195860	220579	2205790	113476	113476	1970986	985493	0	0	4500619
1927	31196	2459	983456	159944	1599440	68867	68867	900178	450089	0	0	3101852
1928	24172	2297	918644	164161	1641610	135643	135643	247316	123658	0	0	2819555
1929	15601	1671	668216	99423	994230	86793	86793	843817	421909	0	0	2171148
1930	8734	1875	749800	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	53962	53962	969017	484509	3180651
TOTAL	22212	6375	2550000	390305	3903050	157536	157536	3197305	1598653	8209239
AVERAGE/TON		0.29	114.80	17.57	175.72	7.09	7.09	143.94	71.97	369.59

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

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

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

OPERATOR	WET TONS	DRY TONS	GOLD (OUNCES)	VALUE AT $400/OZ.	SILVER (OUNCES)	VALUE AT $10/OZ.	LEAD (POUNDS)	VALUE AT $.50/LB.	TOTAL GROSS VALUE
TOMBSTONE MINING CO.									
1930	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 & D'AUTREMONT									
1935	2308.64	2164.36	79.86	31944.00	27055.81	270558.10	842762.11	421381.06	723883.16
CARPER LEASE									
1935	196.71	183.35	8.14	3256.00	2421.26	24212.60	88951.82	44475.91	71944.51
TOMBSTONE MINING CO.									
1935	118.50	110.02	2.49	996.00	961.49	9614.90	39143.48	19571.74	30182.64
1936	80.78	75.93	2.36	944.00	648.74	6487.40	21970.27	10985.14	18416.54
1937	461.05	412.48	27.55	11020.00	4437.05	44370.50	167949.24	83974.62	139365.12
MACIA LEASE									
1936	96.48	88.96	3.56	1424.00	983.68	9836.80	36054.90	18027.45	29288.25
GALLAGHER LEASE									
1936	65.37	56.63	4.14	1656.00	1228.01	12280.10	29203.22	14601.61	28537.71
TOTAL	16081.86	15195.65	1082.64	433056.00	180490.66	1804906.60	6335733.64	3167866.82	5405829.42
AVERAGE/TON			0.07	28.50	11.88	118.78	416.94	208.47	355.75

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

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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 in areas.

TKp — MAIN CORDILLERAN (LARAMIDE) IGNEOUS ROCKS:—Porphyritic and aplitic intrusive rocks (Paleocene and Upper Cretaceous.—Mostly latitic porphyry to dacitic porphyry in small stocks and plugs and aplitic bodies not associated with other granitoid stocks. Dated at 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 Red Boy Rhyolite, Cat Mountain Rhyolite of Brown (1939) and Uncle Sam Prophyry. Includes local intrusive bodies and locally contains fragments of other rocks. Thickness commonly several tens of meters to several hundreds of meters. Dated at 66(?), 70, 72, 73, and 73 m.y. The Uncle Sam in the Tombstone area, is dated 72 m.y.

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

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

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

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

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

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

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

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

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

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

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

CONTACT—Dotted where concealed.

MARKER HORIZON—Dotted where concealed

DIKES—Showing dip.

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

45 — Normal

45 — Reverse

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

Major thrust fault—Sawteeth on upper plate

Thrust fault—Sawteeth on upper plate.

Anticline.

Syncline.

30 — Inclined strike and dip of beds.

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

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

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

Roads and Highways

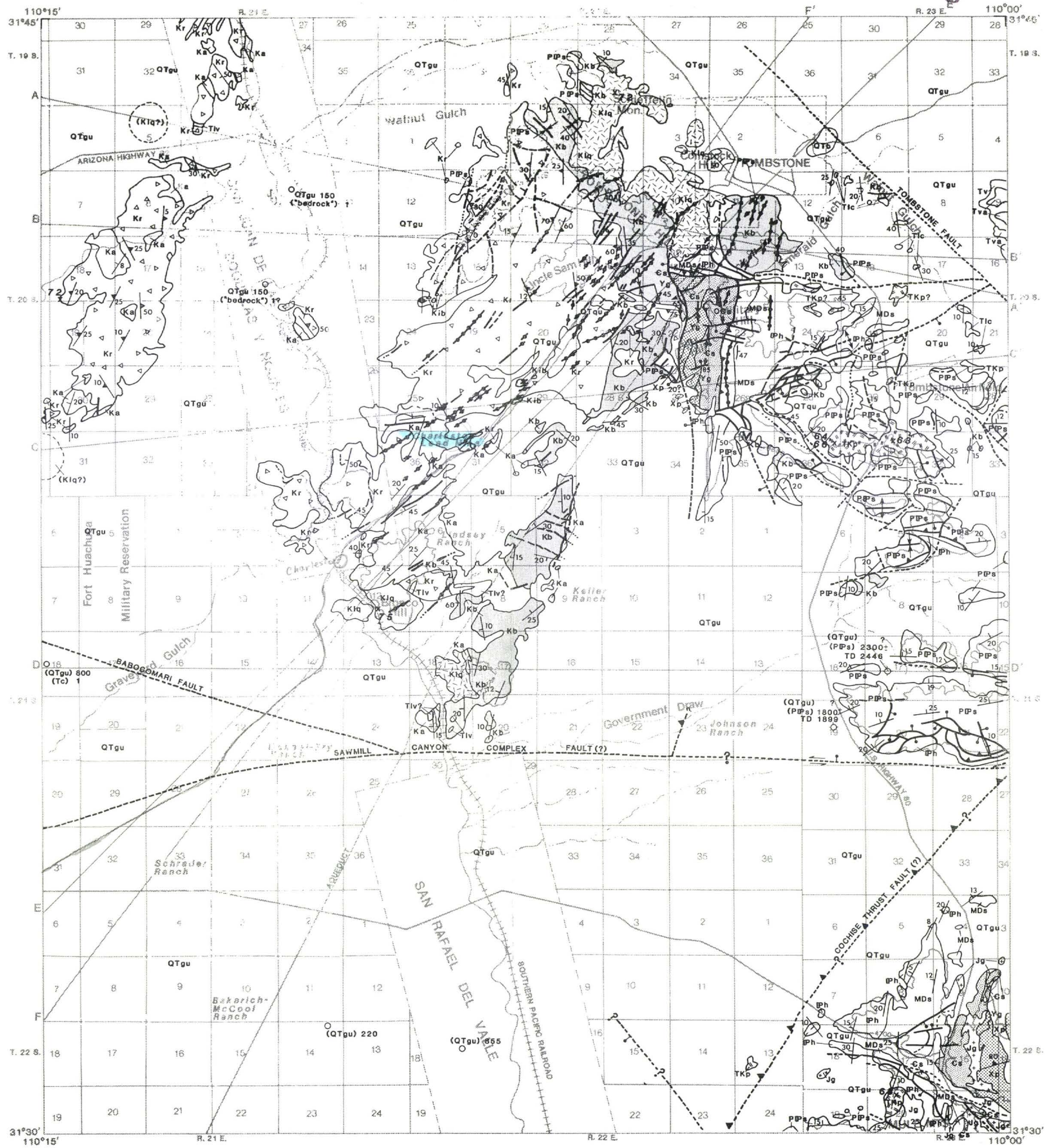
Dry wash

Southern Pacific Railroad

Government Reservation Boundary

Aqueduct

A—A' Cross section line



Tombstone Development Company, Inc.
Tombstone, Arizona

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

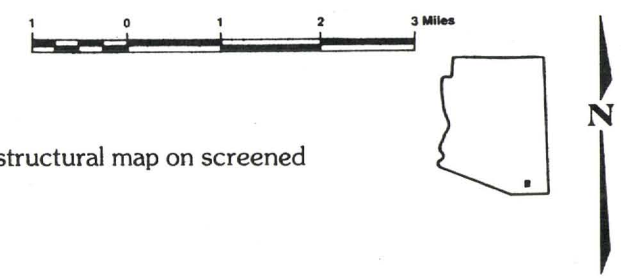


Figure 3. Generalized geological and structural map on screened topographic base.

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

Explanation

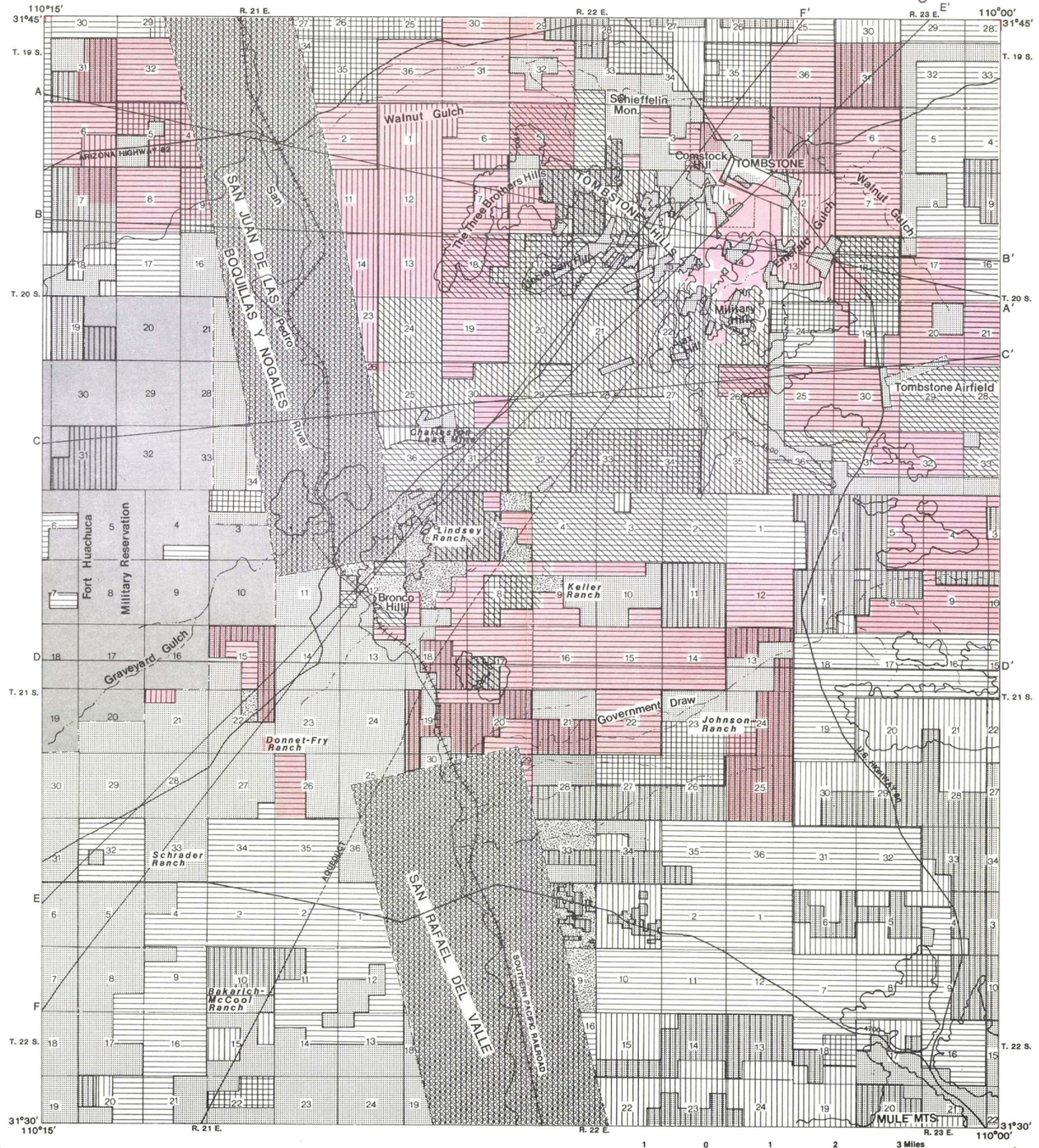
Land Status

- 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.

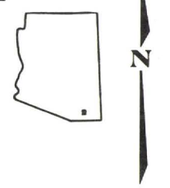


Tombstone Development Company, Inc.
Tombstone, Arizona

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 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 Schaefflin 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 300-690 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.

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

CONTACT—Dotted where concealed.

MARKER HORIZON—Dotted where concealed.

DIKES—Showing dip.

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

Normal

Reverse

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

Major thrust fault—Sawteeth on upper plate.

Thrust fault—Sawteeth on upper plate.

Anticline.

Syncline.

Inclined strike and dip of beds.

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

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

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

Roads and Highways

Dry wash

Southern Pacific Railroad

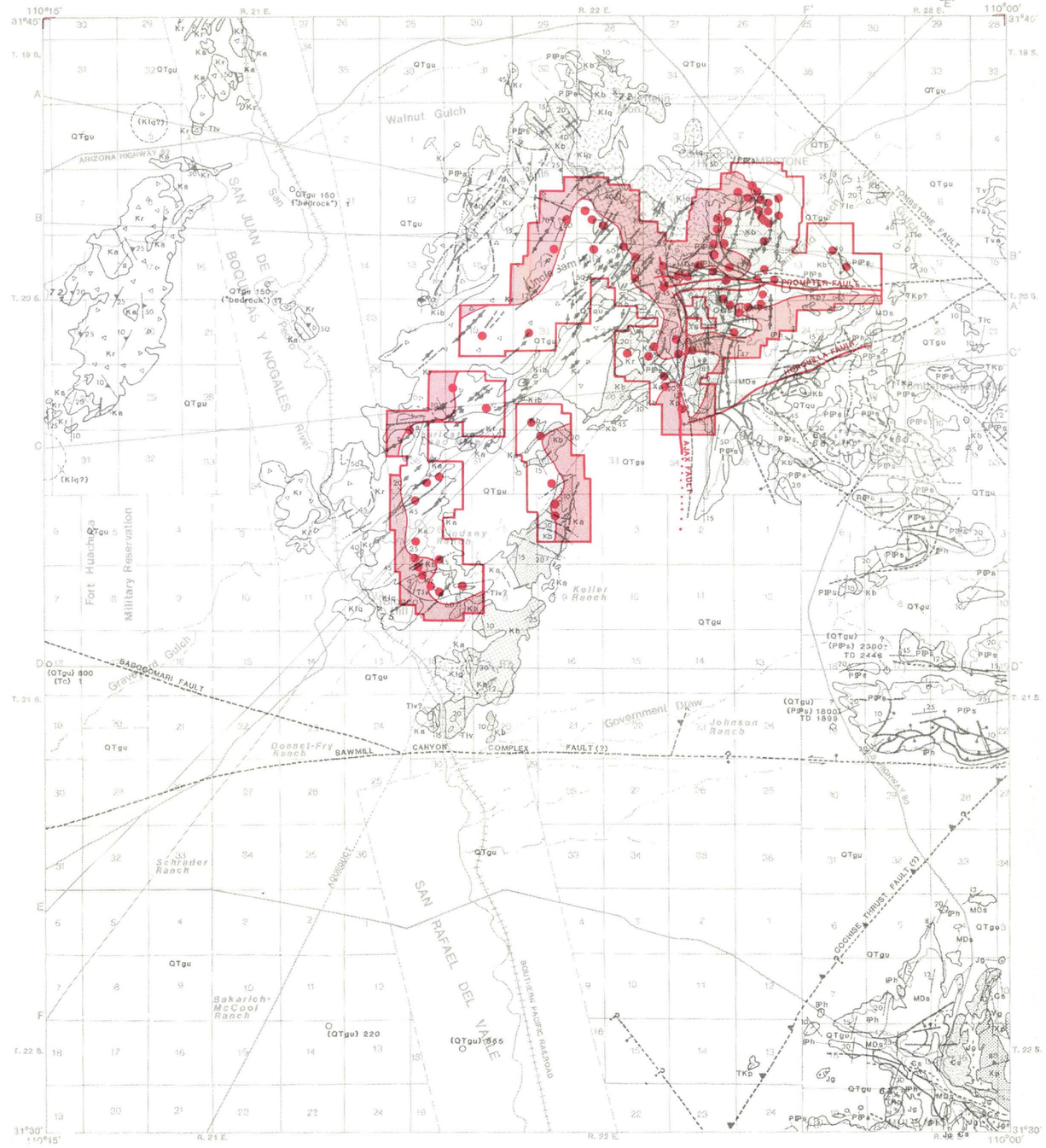
Government Reservation Boundary

Aqueduct

A——A' Cross section line

Dump sample location

Silver



Tombstone Development Company, Inc.
Tombstone, Arizona

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

By James A. Briscoe

James A. Briscoe and Associates
Tucson, Arizona

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

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

Explanation

Geology

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

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

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

CONTACT—Dotted where concealed.

MARKER HORIZON—Dotted where concealed.

DIKES—Showing dip.

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

Normal

Reverse

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

Major thrust fault—Sawteeth on upper plate.

Thrust fault—Sawteeth on upper plate.

Anticline.

Syncline.

Inclined strike and dip of beds.

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

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

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

Roads and Highways

Dry wash

Southern Pacific Railroad

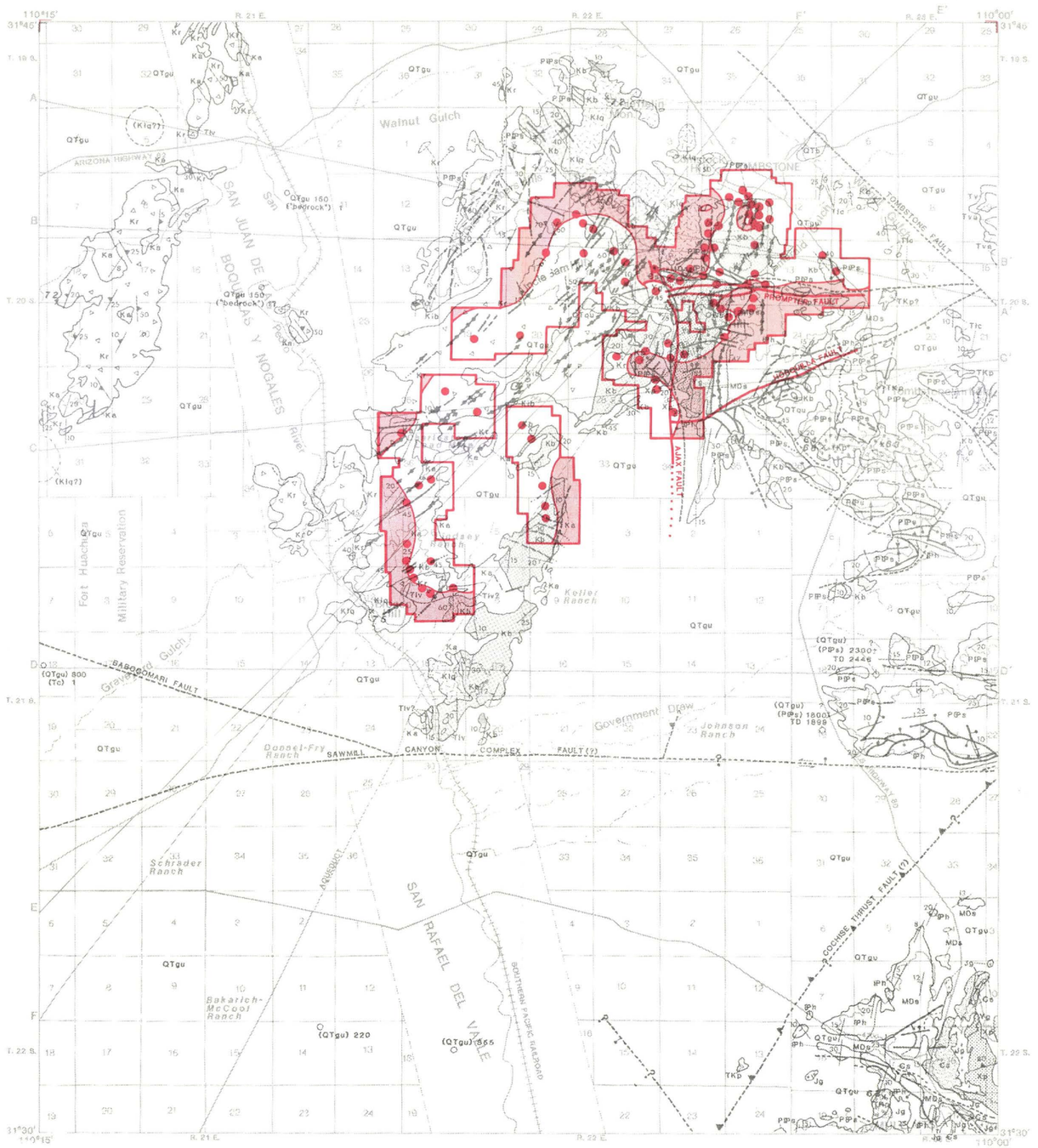
Government Reservation Boundary

Aqueduct

A — A' Cross section line

Dump sample location

Zinc



Tombstone Development Company, Inc.
Tombstone, Arizona

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

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

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

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

Explanation

Geology

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.

Kd — 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.

Kqg — 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.

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 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.

Ca — 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

70 — Normal

45 — Reverse

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

Major thrust fault—Sawteeth on upper plate.

Thrust fault—Sawteeth on upper plate.

Anticline.

Syncline.

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

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Roads and Highways

Dry wash

Southern Pacific Railroad

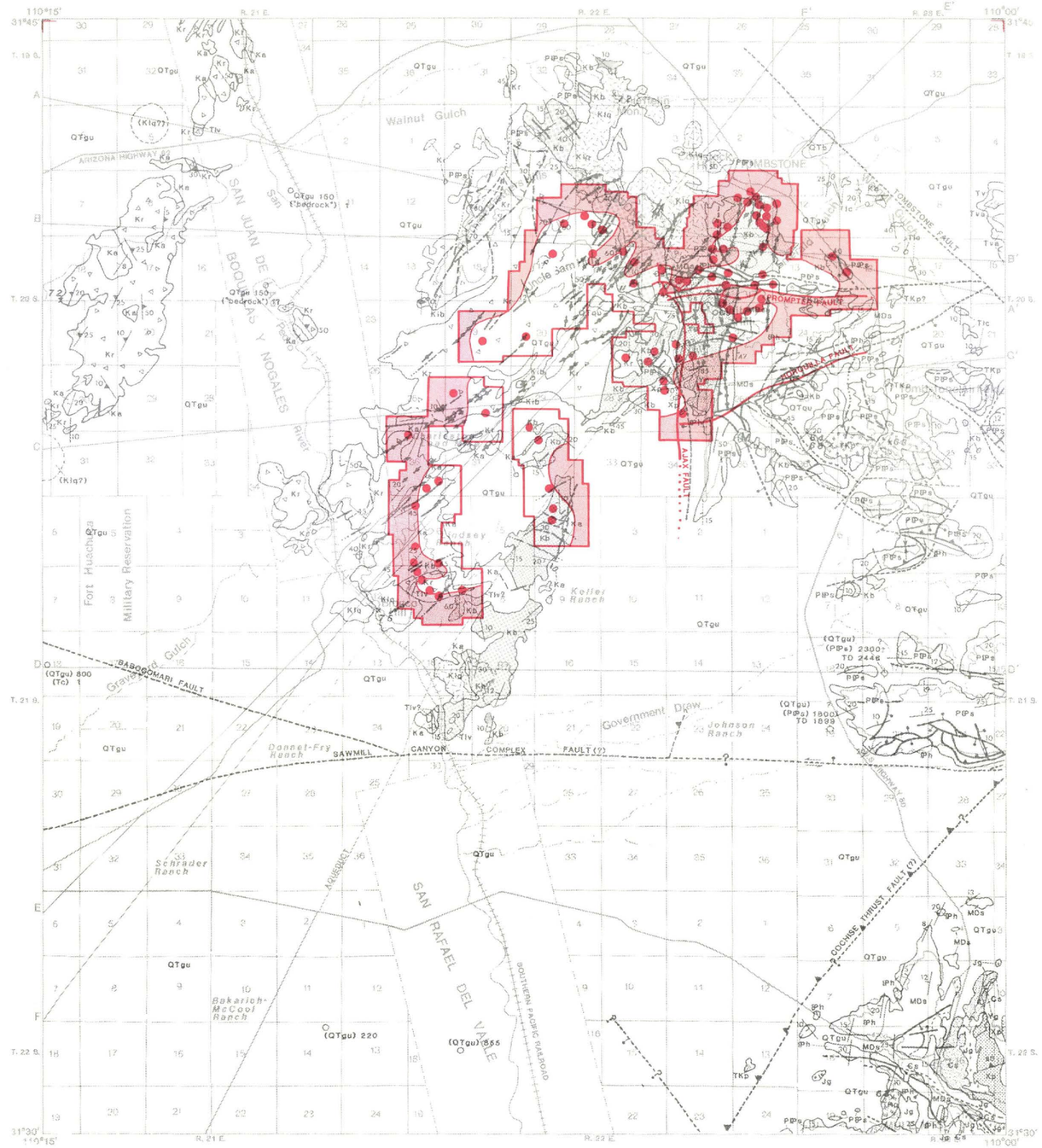
Government Reservation Boundary

Aqueduct

A—A' Cross section line

Dump sample location

Lead



1 0 1 2 3 Miles

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).

N

Explanation

Geology

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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.

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Roads and Highways

Dry wash

Southern Pacific Railroad

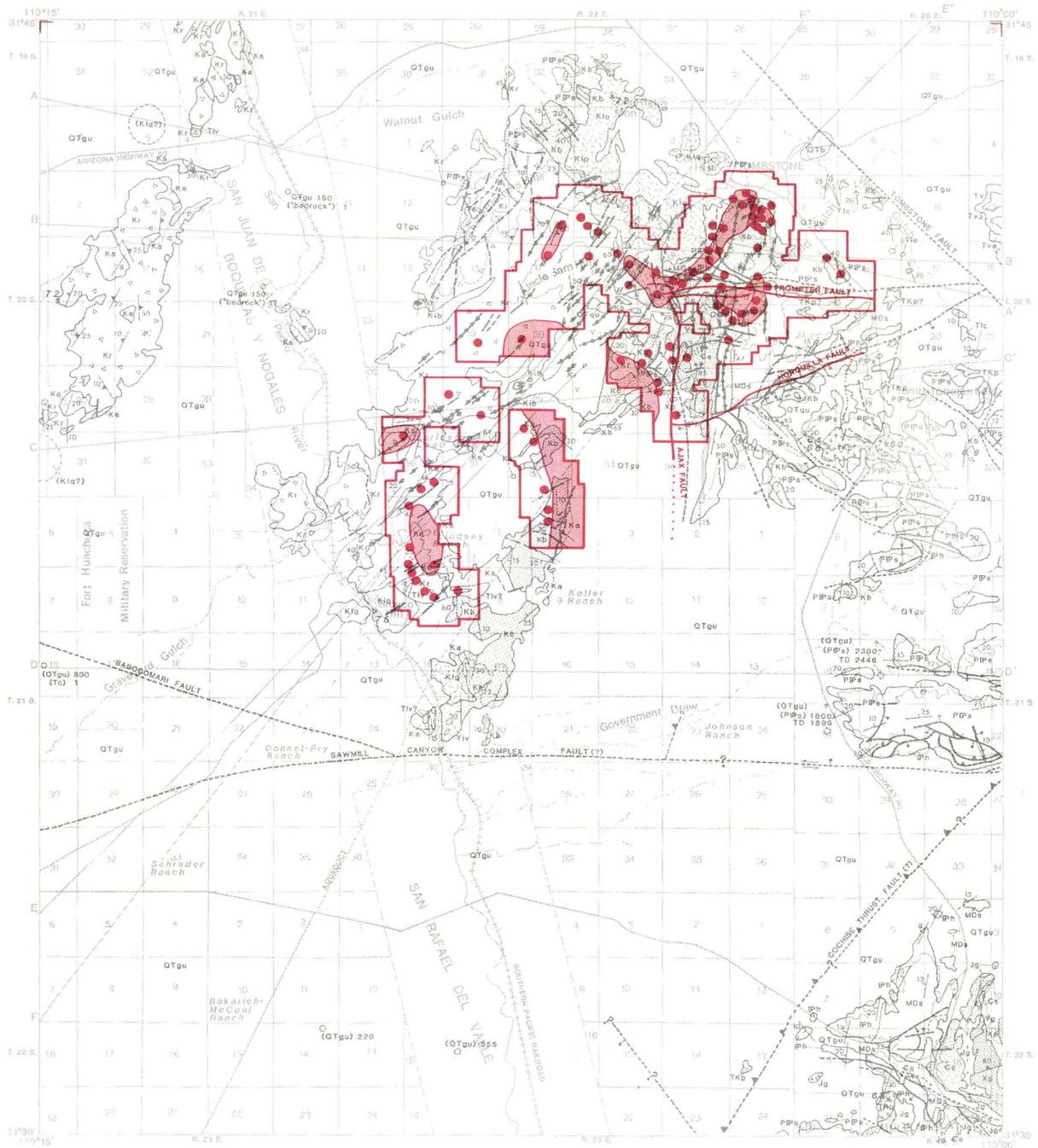
Government Reservation Boundary

Aqueduct

A—A' Cross section line

Dump sample location

Copper



Tombstone Development Company, Inc.
Tombstone, Arizona

1 0 1 2 3 Miles

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

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

N

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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.

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

CONTACT—Dotted where concealed.

MARKER HORIZON—Dotted where concealed.

DIKES—Showing dip.

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

Normal

Reverse

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

Major thrust fault—Sawteeth on upper plate.

Thrust fault—Sawteeth on upper plate.

Anticline.

Syncline.

Inclined strike and dip of beds.

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

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

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

Roads and Highways

Dry wash

Southern Pacific Railroad

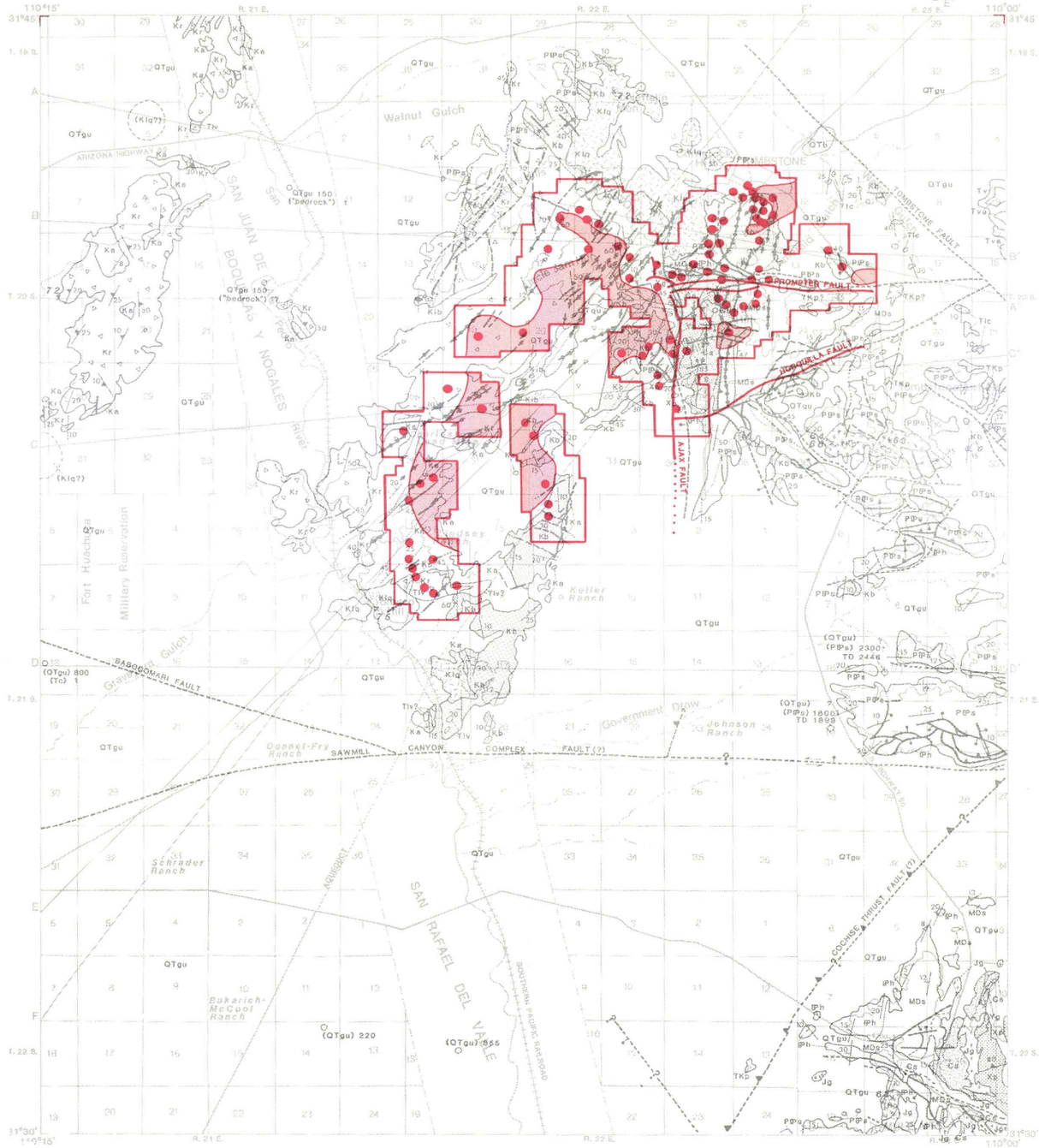
Government Reservation Boundary

Aqueduct

A—A' Cross section line

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.

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 Solero 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 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 Schefflin granodiorite at Tombstone is 72 m.y.

Kb — BISBEE FORMATION OR GROUP, UNDIFFERENTIATED (LOWER CRETACEOUS)—Upper part of Bisbee Formation or Group, undifferentiated, and related rocks.—Includes upper part of Bisbee Formation, Mural Limestone, Morita, Cintura, Willow Canyon, Apache Canyon, Shellenberger Canyon and Turney Ranch Formations (not listed in stratigraphic sequence) of the Bisbee Group, Amole Arkose of Bryant and Kinnison (1964), 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, 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.

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

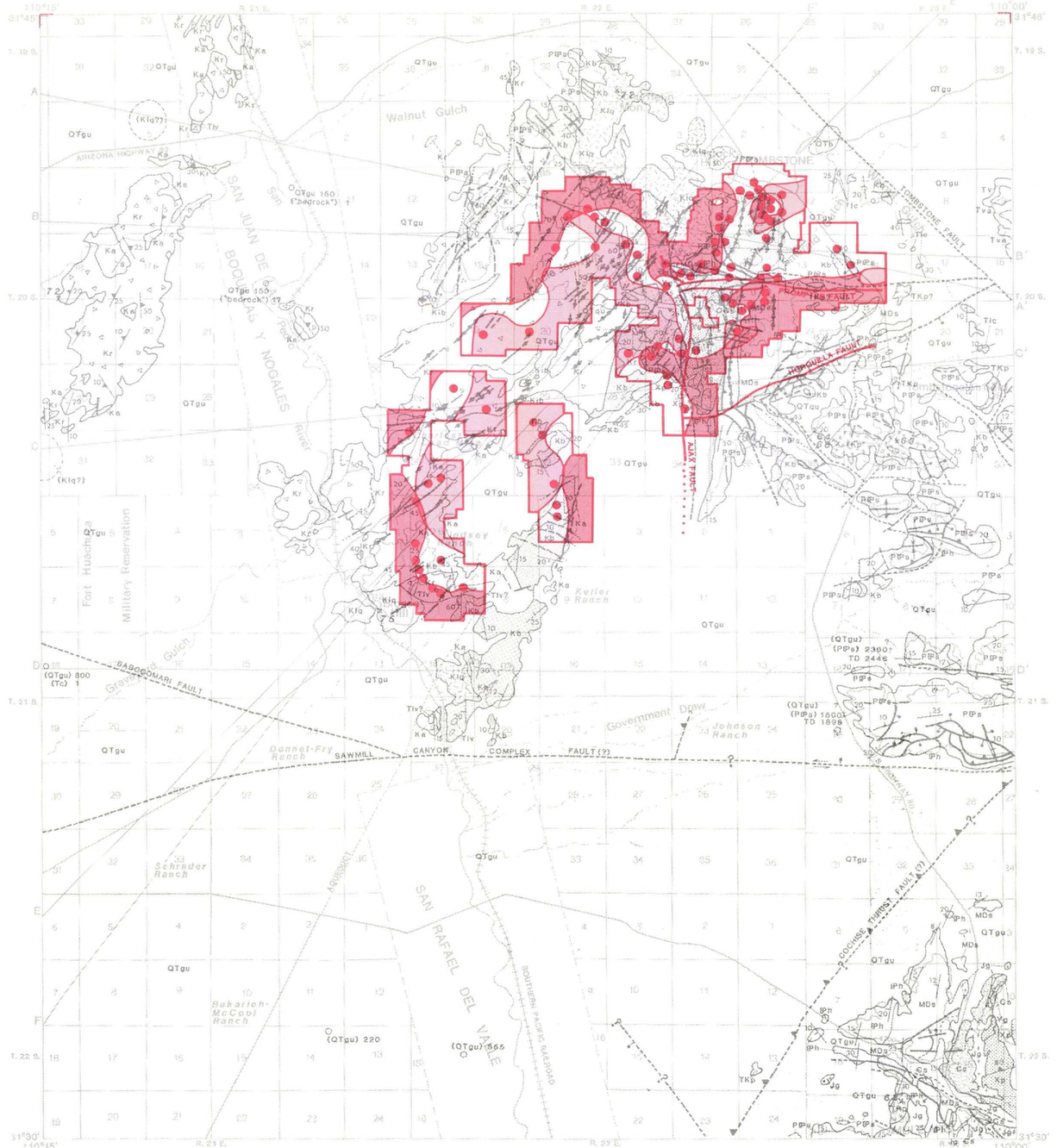
Aqueduct

A——A' Cross section line

Dump sample location

Molybdenum

Zinc



Tombstone Development Company, Inc.
Tombstone, Arizona

1 0 1 2 3 Miles

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

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.

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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Kla — 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.

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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.

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.

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CONTACT—Dotted where concealed.

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DIKES—Showing dip.

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

70 — Normal

45 — Reverse

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

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Anticline.

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

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Roads and Highways

Dry wash

Southern Pacific Railroad

Government Reservation Boundary

Aqueduct

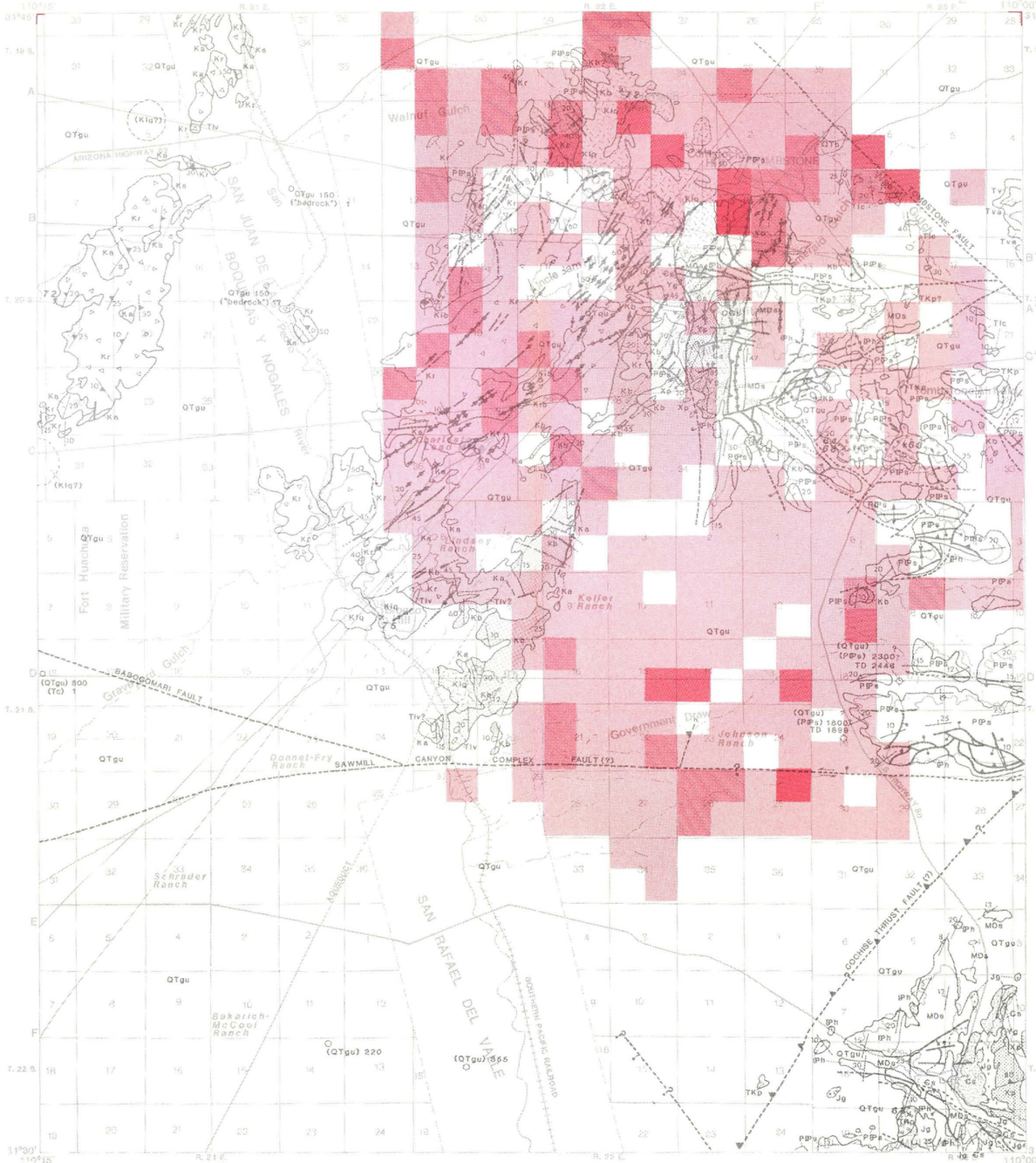
A——A' Cross section line

≤ 1 ppm

1.1 - 2 ppm

2.1 - 3 ppm

≥ 3 ppm



Tombstone Development Company, Inc.
Tombstone, Arizona

1 0 1 2 3 Miles

N

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

Figure 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

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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.

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OCs — 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 alwe 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.

(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

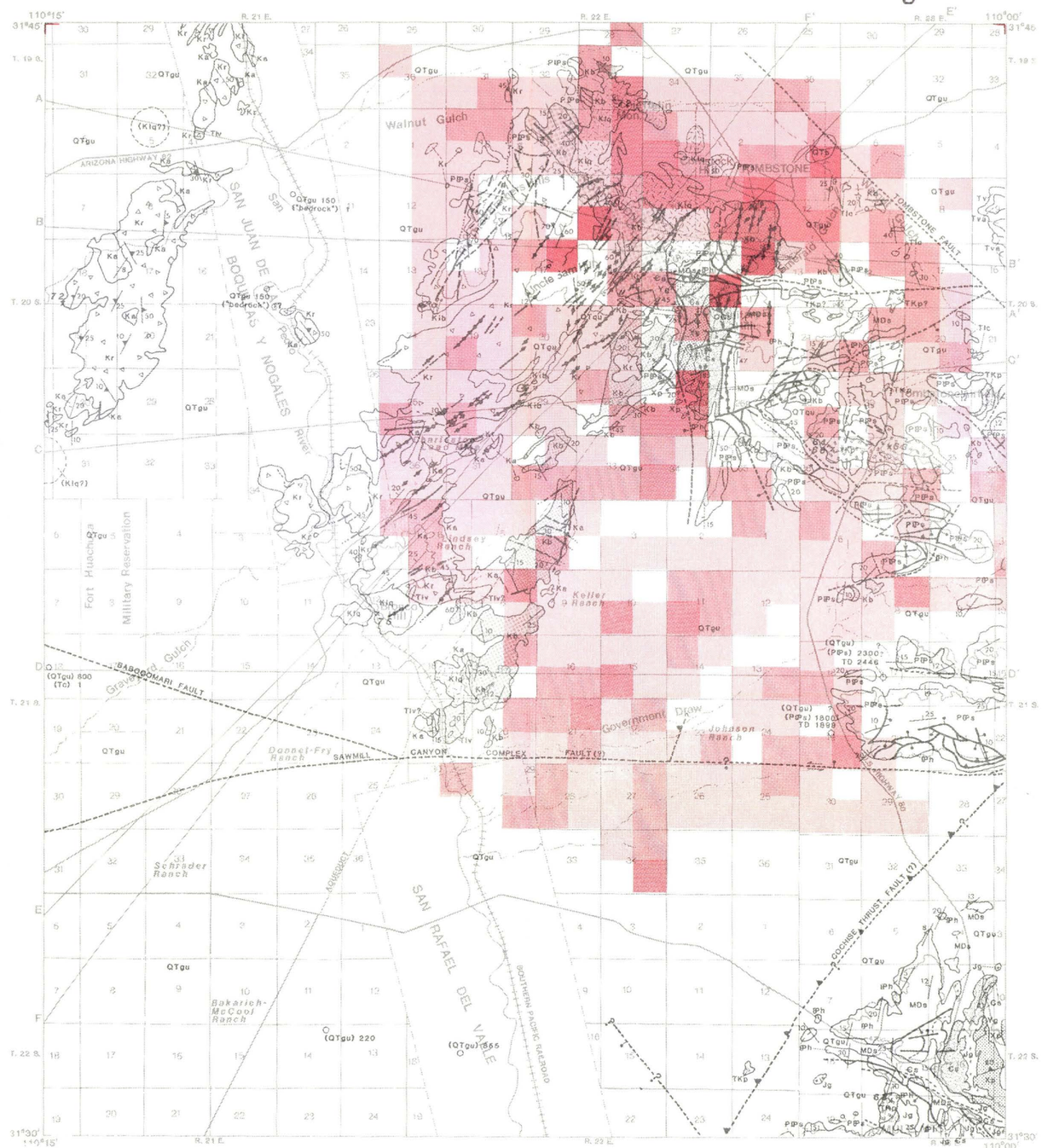
A——A' Cross section line

≤ 400 ppm

401 - 600 ppm

601 - 800 ppm

≥ 800 ppm



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 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 (Turkey track porphyry, an informal term of Cooper, 1961). Thickness mostly several meters to several tens of meters. Dated at 24, 25, 27, 33, and 39 m.y.

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

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

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

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

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

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

Ka — Andesitic to dacitic volcanic breccia.—Includes parts of 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 Schieffin 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, 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.

Normal

Reverse

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

Major thrust fault—Sawteeth on upper plate.

Thrust fault—Sawteeth on upper plate.

Anticline.

Syncline.

Inclined strike and dip of beds.

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

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

72_K — 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

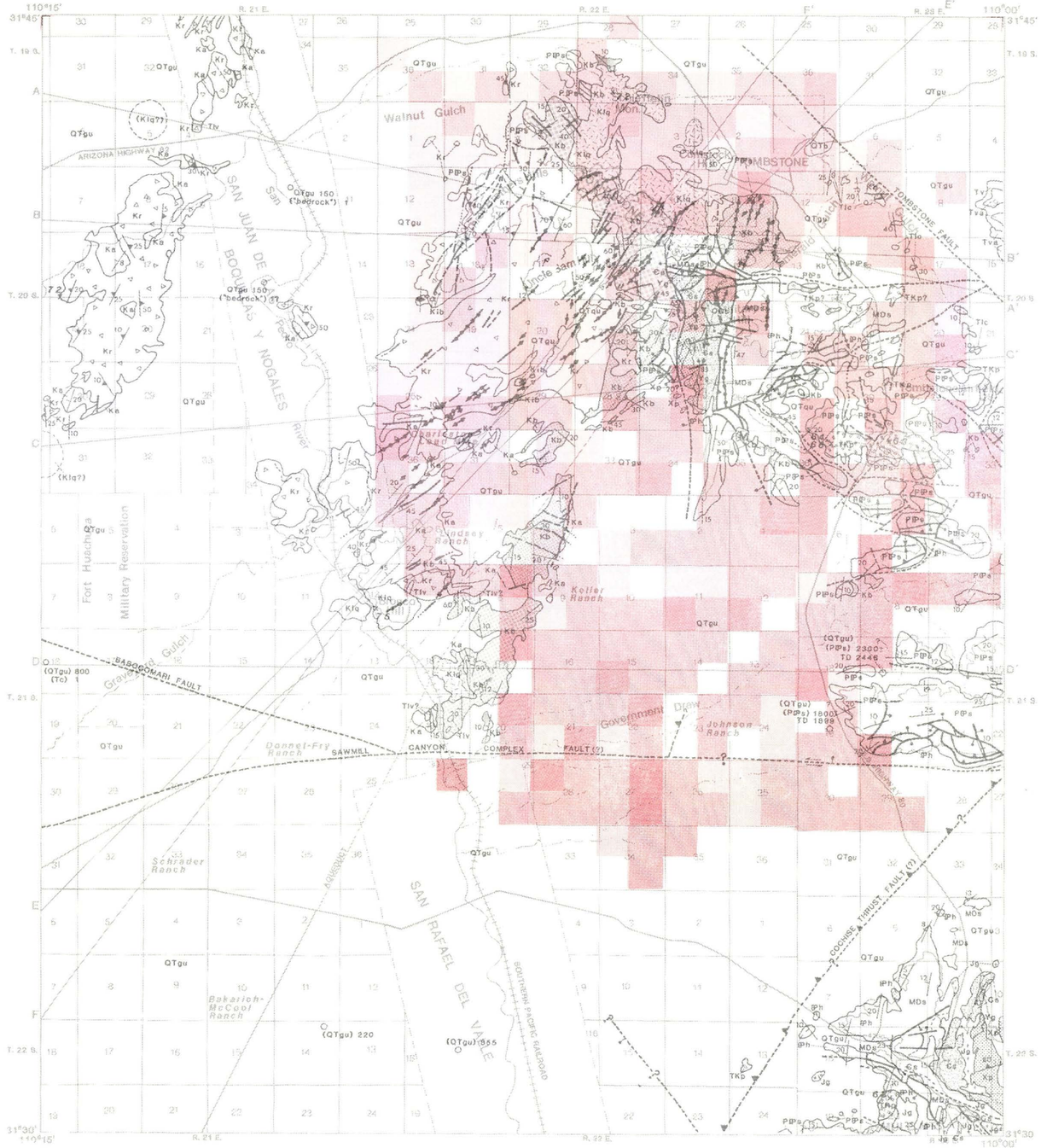
A——A' Cross section line

≤ 100 ppm

101 - 150 ppm

151 - 200 ppm

≥ 200 ppm



Tombstone Development Company, Inc.
Tombstone, Arizona

1 0 1 2 3 Miles

N

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.

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

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

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

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

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

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

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

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

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

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

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

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

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OCa — 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.

Ca — 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.

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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.

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

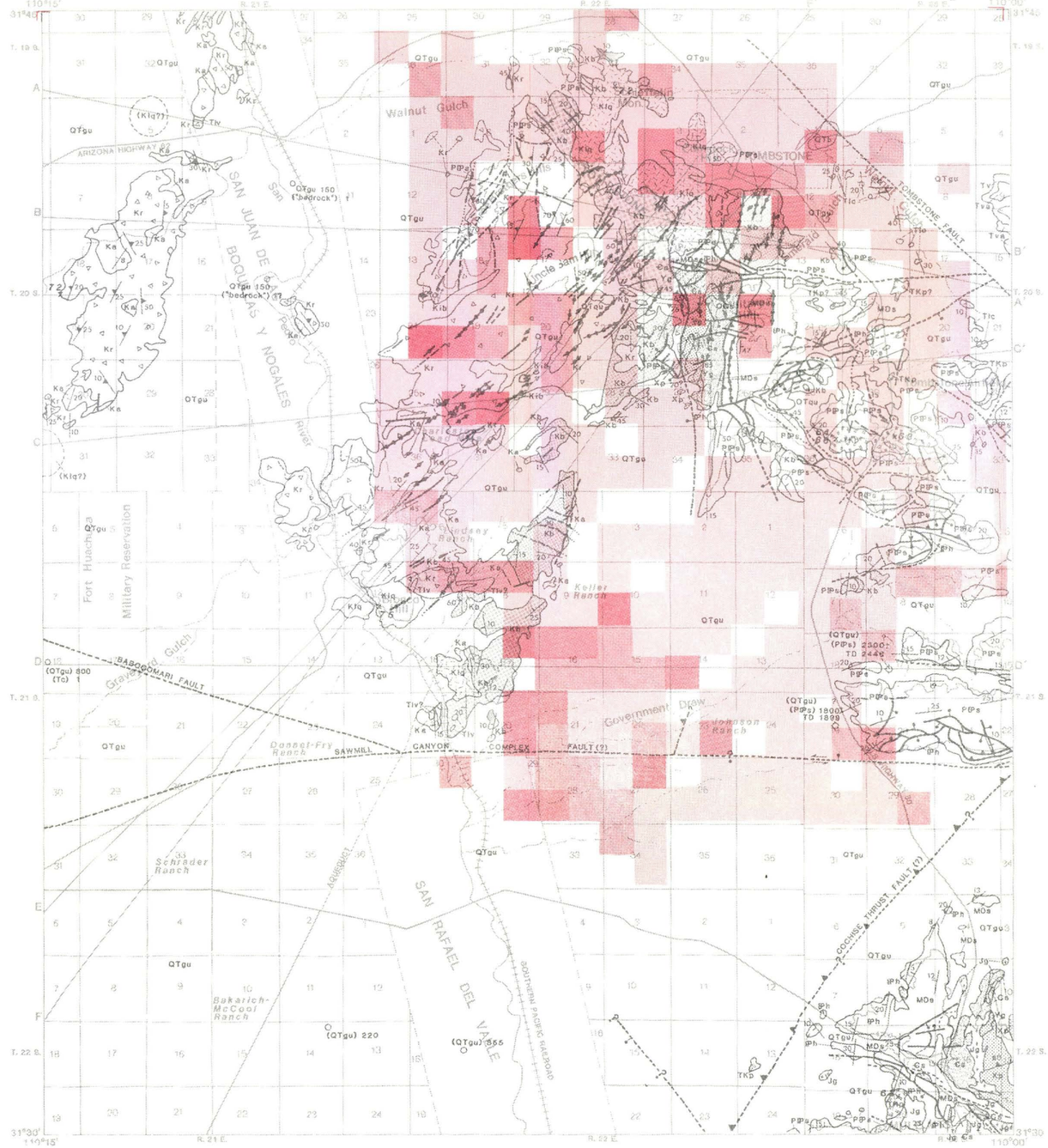
Cross section line

≤ 5 ppm

5.1 - 9 ppm

9.1 - 14 ppm

≥ 14 ppm



Tombstone Development Company, Inc.
Tombstone, Arizona

1 0 1 2 3 Miles

N

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

Figure 15. Distribution pattern of molybdenum 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 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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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 (1964), and Angelic Arkose. Consists of brownish- to reddish-arkose, gray siltstone, sandstone, conglomerate, and some fossiliferous gray limestone. Commonly several hundred meters thick.

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

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

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

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 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.

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

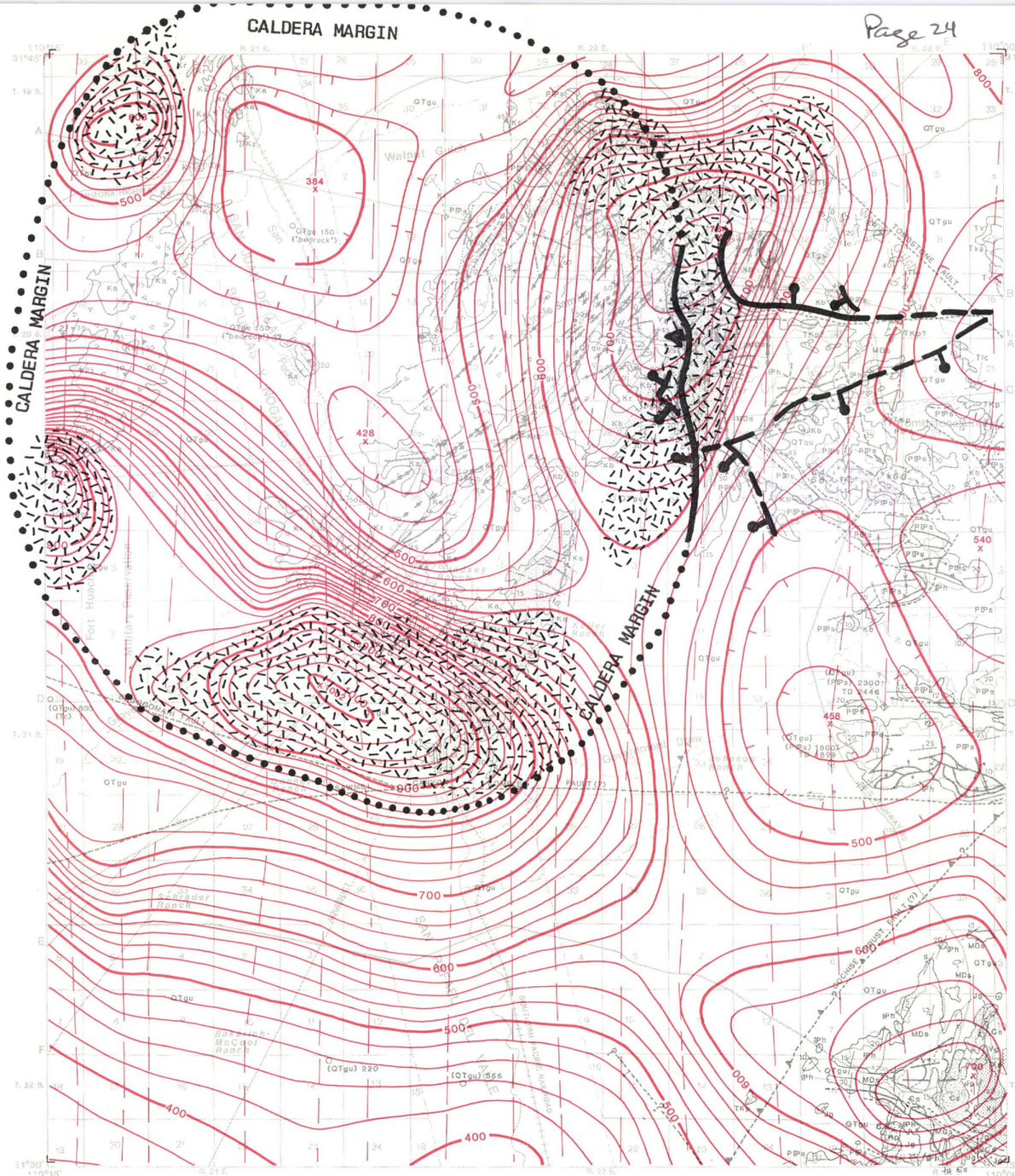
A—A' Cross section line

Flight line

Index contour line

Contour line

Contour interval: 25 gammas



Tombstone Development Company, Inc.
Tombstone, Arizona

1 0 1 2 3 Miles

N

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

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.

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

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

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

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

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

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

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

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

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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

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.

Anticline.

Syncline.

30

Inclined strike and dip of beds.

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

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Roads and Highways

Dry wash

Southern Pacific Railroad

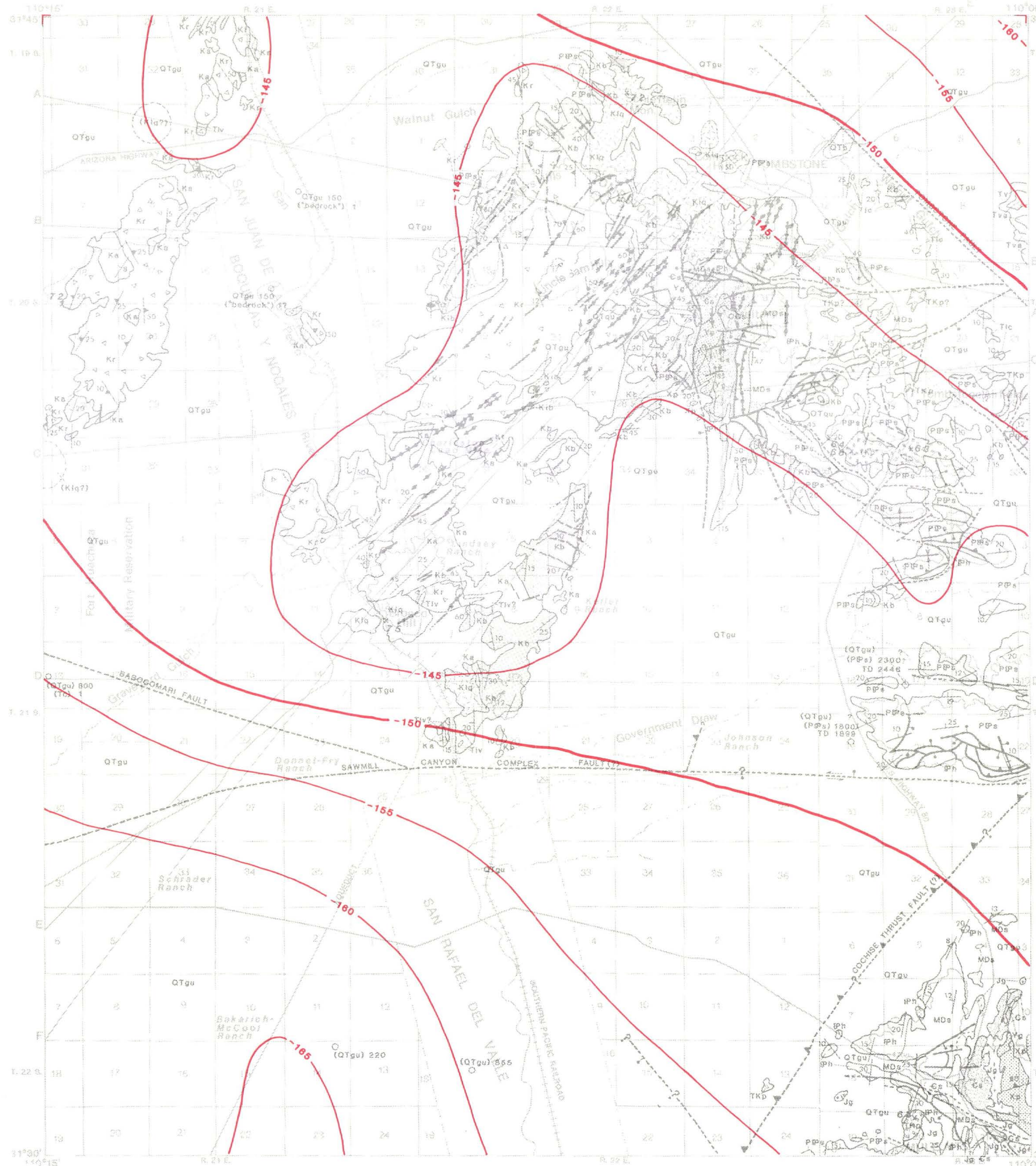
Government Reservation Boundary

Aqueduct

A——A' Cross section line

-150 Gravity contour line

Contour interval: 5 milligals



Tombstone Development Company, Inc.
Tombstone, Arizona

1 0 1 2 3 Miles

N

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

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

Figure 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 OF GOLD	TOTAL DOLLAR VALUE AT $400 GOLD	AVERAGE GRADE OF SILVER	TOTAL OUNCES OF OF SILVER	TOTAL DOLLAR VALUE AT $10 SILVER	AVERAGE GRADE OF COPPER	TOTAL POUNDS OF 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	582785570	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	219060200	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		305697600	3056976000		16964400	16964400		438120400	219060200		7089600	2835840	4448652440	

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Prepared by James A. Briscoe

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

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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