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LITHIUM RECONNAISSANCE OF ARIZONA

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Introduction

Reconnaissance geochemical sampling in Arizona was undertaken by members of the U.S. Geological Survey during 1973-1976. This report is one of several which compile the data collected in this and similar reconnaissance studies. While the data have been helpful in understanding the regional lithium distribution in Arizona, the reconnaissance was limited primarily to sedimentary basins which accumulated thick sequences of fine-grained alluvium and evaporite minerals during Cenozoic time, and therefore the data should not be considered as an ultimate statement of the lithium potential. Figure 1 is a map showing the locations of the samples.

All lithium analyses listed in Tables 1-3 were determined by atomic absorption, as described by Meier (1976). Mineralogy was determined by X-ray diffraction of whole rock samples. The term "feldspar" was assigned to minerals with diffraction patterns indicative of orthoclase, microcline or the albite-anorthite series. No clay separations were made to accurately determine the clay mineralogy; the term "mica" was assigned to any mineral with a sharp diffraction peak at 10 Å, and "mixed-layer clay" was assigned to minerals with diffraction peaks, whether sharp or diffuse, between 11 Å and 15 Å.

Most samples of well cuttings and cores were made available through the Arizona Bureau of Mines and Geology. However, the 124 samples of cuttings from Red Lake playa and the core from near the town of Bowie were obtained by the U.S. Geological Survey, and the core from Willcox Playa was made available through Professor Paul Martin of the University of Arizona.

MAP INDEX FOR FIGURE 1

Town or geographic feature and nearest town

	locality number
Bagdad	1
Bowie	2
Camel Canyon (near San Manuel)	3
Casa Grande	4
Castle Hot Springs	5
Coolidge	6
Fisher Hills (west of Bowie)	7
Frye Mesa (near Safford)	8
Kirkland	9
Kirkland Jct.	10
Klondyke	11
Litchfield Park	12
Mammoth	13
Maricopa	14
Murray Springs (near Fort Huachuca)	15
Oatman	16
Peach Springs	17
Pierce Ferry	18
Picacho	19
Post Ranch (near Tombstone)	20
Red Lake (playa near Kingman)	21

	locality number
Salt Banks (near Seneca)	22
Santa Rosa Valley (near Gu Komelik)	23
San Simon	24
Skull Valley	25
Verde River Valley (near Camp Verde)	26
Wellton	27
Wikieup	28
Willcox Playa (near Willcox)	29

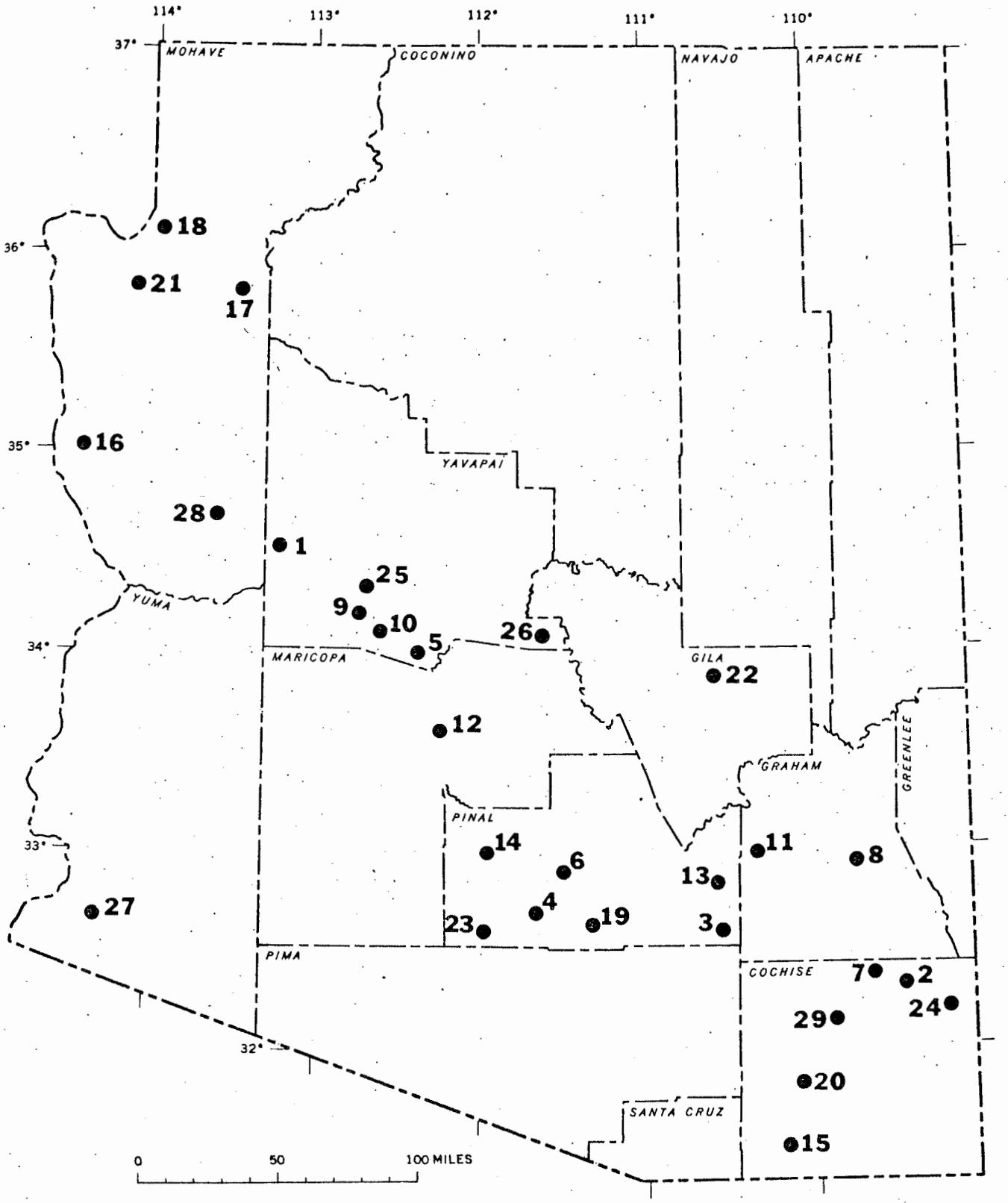

Figure 1. Index map showing sample localities in Arizona.

TABLE 1.-- ROCK AND SEDIMENT SAMPLES

	LOCALITY	NUMBER OF SAMPLES	LITHIUM (PPM)	MINERALOGY	REMARKS
1.	Bagdad	4	46-140 (average = 81)	not determined	altered Tertiary ash
3.	Camel Canyon	5	65-200 (average = 112)	not determined	Pliocene ash and clay (Scarborough, 1974)
5.	Castle Hot Springs	8	<1-70 (average = 19)	mica , feldspar, quartz	pegmatite in the Wickenburg Mountains
7.	Fisher Hills	1	16	not determined	granite weathering product
8.	Frye Mesa	1	105	not determined	altered tuff Plio-Pleistocene alluvium (Melton, 1965, p. 11)
9.	Kirkland	11	820-3400 (average = 2150)	not determined	clay deposit described in Norton (1965)
10.	Kirkland Junction	9	42-230 (average = 114)	not determined	Tertiary ash and clay southwest of Kirkland Junction
	" "	6	21-58 (average = 38)	not determined	Tertiary ash and clay southeast of Kirkland Junction

TABLE 1.--ROCK AND SEDIMENT SAMPLES (CONTINUED)

	LOCALITY	NUMBER OF SAMPLES	LITHIUM (PPM)	MINERALOGY	REMARKS
11.	Klondyke	1	132	not determined	altered yellow rock from mine dump
13.	Mammoth	1	4	gypsum	Tertiary
15.	Murray Springs	2	43; 12	quartz, feldspar, mixed-layer clay; calcite, quartz, feldspar, mixed-layer clay	Units D and F_3 (Haynes, 1968)
	" "	6	7-71 (average = 39)	not determined	lacustrine clays and marls correlative with the Wolfe Ranch fauna (Johnson and others, 1975)
16.	Oatman	10	4-200 (average = 60)	not determined	country rock and mineralized veins in the Oatman Mining District
17.	Peach Springs	6	2-50 (average = 23)	not determined	alluvium and tuff
18.	Pierce Ferry	1	340	not determined	light gray volcanic ash
19.	Picacho	2	94; 36	not determined	caliche and gray soil; sandy brown soil

TABLE 1.--ROCK AND SEDIMENT SAMPLES (CONTINUED)

	LOCALITY	NUMBER OF SAMPLES	LITHIUM (PPM)	MINERALOGY	REMARKS
20.	Post Ranch	2	190; 360	calcite, quartz, feldspar, mica, mixed-layer clay	clay beds in the St. David Formation (Gray, 1967)
	" "	2	600; 630	mixed-layer clay	ash altered to clay in the St. David Formation (Gray, 1967)
21.	Red Lake playa	10	42-94 (average = 63)	not determined	samples collected from auger holes on playa surface to a maximum depth of 135 cm
22.	Salt Banks	3	15; 46; 65	not determined	halite and alluvium collected near the confluence of Salt Creek Draw and the Salt River
24.	San Simon	1	58	not determined	Holocene alluvium on the floodplain of the San Simon River
25.	Skull Valley	3	150; 160; 180	not determined	tuffaceous Tertiary alluvium
26.	Verde River Valley	19	19-200 (average = 90)	not determined	ash , clay , marl , and evaporites of Tertiary age

TABLE 1.--ROCK AND SEDIMENT SAMPLES (CONTINUED)

	LOCALITY	NUMBER OF SAMPLES	LITHIUM (PPM)	MINERALOGY	REMARKS
27.	Wellton	1	710	not determined	pink bentonitic claystone
28.	Wikieup	34	45-1830 (average = 600)	not determined	Big Sandy Formation (Sheppard and Gude, 1973)
29.	Willcox Playa	2	61, 70	not determined	sandy soil
	" "	1	150	not determined	green clay at 30 cm

TABLE 2.--WATER SAMPLES

	LOCALITY	LITHIUM (PPM)	REMARKS
5.	Castle Hot Springs	0.40	48° C
17.	Peach Springs	0.08	Resting Spring
21.	Red Lake playa	0.012	well water, south of Red Lake playa
	" "	0.013	" " " " " " "
26.	Verde River Valley	0.19	spring
28.	Wikieup	0.54	Cafer Hot Spring
	"	0.61	" " "
29.	Willcox Playa	0.07	well sample at southern margin of playa

TABLE 3.--WELL CUTTINGS AND CORES

	LOCALITY	WELL NAME	NUMBER OF SAMPLES	DEPTH (METERS)	LITHIUM PPM	LITHOLOGY OR MINERALOGY
2.	Bowie	U.S. Geological Survey zeolite core	2	14-16	50; 110	zeolitic mudstone
	"	"	1	56	92	dolomitic claystone
	"	"	5	15-60	95-650 (average = 250)	mudstone and claystone
4.	Casa Grande	U.S. Bureau of Reclamation Well #3	1	47	170	quartz, mixed-layer clay, feldspar, mica, kaolinite
12.	Litchfield Park	Arizona Salt Co. Test #1	2	760; 915	1; 15	halite; chert(?)
	"	U.S. Bureau of Reclamation Well #5	5	160-610	20-52	calcite, quartz, feldspar, mixed-layer clay, mica
14.	Maricopa	U.S. Bureau of Reclamation	2	80; 185	130; 200	quartz, feldspar, mixed-layer clay, mica
	"	"	1	336	160	quartz, feldspar, gypsum, mica, mixed-layer clay
	"	"	1	398	12	anhydrite, gypsum, quartz, feldspar, mica

TABLE 3.--WELL CUTTINGS AND CORES (CONTINUED)

LOCALITY	WELL NAME	NUMBER OF SAMPLES	DEPTH (METERS)	LITHIUM PPM	LITHOLOGY OR MINERALOGY
19. Picacho	U.S. Bureau of Reclamation Well #1	2	82; 189	53; 82	quartz, feldspar, mixed-layer clay, mica, calcite
"	U.S. Bureau of Reclamation Well #6	2	275; 277	10; 30	sand: quartz and feldspar
"	U.S. Bureau of Reclamation Wells #7 & #8	2	110; 112	13; 17	sandstone: quartz, feldspar, calcite, and mixed-layer clay
"	"	5	90-250	50-100 (average = 80)	siltstone: quartz, feldspar, mixed-layer clay, mica
"	"	1	237	390	altered ash: mixed-layer clay, feldspar, quartz
"	Humble Oil and Refining #1	5	400-1300	140-560 (average = 340)	siltstone
"	"	2	730; 1615	54; 70	anhydrite
"	"	3	1540-1615	140; 325; 360	shale and evaporites

TABLE 3.--WELL CUTTINGS AND CORES (CONTINUED)

	LOCALITY	WELL NAME	NUMBER OF SAMPLES	DEPTH (METERS)	LITHIUM PPM	LITHOLOGY OR MINERALOGY
21.	Red Lake	U.S. Geological Survey	124	0-175	average = 34	fine sand and silt
	"	Kerr McGee Red Lake #1	1	415	14	anhydrite
	"	"	1	480	210	siltstone
	"	"	2	525	26; 540	halite; siltstone
23.	Santa Rosa Valley	U.S. Bureau of Reclamation Well #2	1	80	140	siltstone: quartz, feldspar, mica, and mixed-layer clay
29.	Willcox Playa	University of Arizona	10	0-42	87-390 (average = 170)	clay: quartz, calcite, analcime, feldspar, mica (Schreiber and others, 1970; Martin, 1963)

References cited

Gray, R. S., 1967, Petrography of the Upper Cenozoic non-marine sediments in the San Pedro Valley, Arizona: Jour. Sed. Petrol., v. 37, no. 3, p. 774-789.

Haynes, C. V., 1968, Preliminary report on the late Quaternary geology of the San Pedro Valley, Arizona, in Southern Arizona Guidebook III: Arizona Geological Society, p. 79-96.

Johnson, N. M., Opdyke, N. D., and Lindsay, E. H., 1975, Magnetic polarity stratigraphy of Pliocene-Pleistocene terrestrial deposits and vertebrate faunas, San Pedro Valley, Arizona: Geol. Soc. America Bull., v. 86, no. 1, p. 5-12.

Martin, P. S., 1963, Geochronology of pluvial Lake Cochise, southern Arizona. II Pollen analysis of a 42-meter core: Ecology, v. 44, p. 436-444.

Meier, A. L., 1976, Analytical methods and problems of lithium determination in rocks, sediments, and brines, in Vine, J. D., ed., Lithium resources and requirements by the year 2000: U.S. Geol. Survey Prof. Paper 1005 (in press).

Melton, M. A., 1965, The geomorphic and paleoclimatic significance of alluvial deposits in southern Arizona: Jour. Geology, v. 73, no. 1, p. 1-38.

Norton, J. J., 1965, Lithium-bearing bentonite deposit, Yavapai County, Arizona: U.S. Geol. Survey Prof. Paper 525-D, p. 163-166.

Scarborough, R. B., 1974, Geochronology of Pliocene vitric ash falls in southern Arizona: Geol. Soc. America Abstracts with Programs, v. 6, no. 3, p. 249-250.

Schreiber, J. F., Pine, G. L., Pipkin, B. W., Robinson, R. C., and Wilt, J. C., 1970, Sedimentologic studies in the Willcox Playa area, Cochise County, Arizona: Tucson, University of Arizona, Department of Geosciences, Contribution #12, p. 133-184.

Sheppard, R. A., and Gude, A. J., 1973, Zeolites and associated authigenic silicate minerals in tuffaceous rocks of the Big Sandy Formation, Mohave County, Arizona: U.S. Geol. Survey Prof. Paper 830, 36 p.