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RECONNAISSANCE OF CERTAIN URANIUM  
DEPOSITS IN ARIZONA

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## ABSTRACT

Fourteen uranium-bearing mineral deposits in Arizona were investigated briefly. Three additional deposits received more extensive study. The deposits show a considerable range in geologic character but four general types can be recognized:

1. Vein deposits with associated base and precious metals,
2. Vein deposits in granite with minor metallic metals,
3. Deposits in sedimentary rocks near intrusive contacts,
4. Deposits within broad shear zones in volcanic rocks.

Several of the uranium-bearing deposits are localized in a comparatively limited area in Santa Cruz County and southern Pima County.

## INTRODUCTION

During the summer of 1950 field investigations of a number of uranium-bearing deposits were made in Arizona. This work grew from an attempt in 1949 to organize and evaluate all possible information about uranium mineral occurrences in the State<sup>1</sup>. In the 1949 report two possible approaches to the discovery of uranium ores were considered: first, geologic examination of areas from which radioactive material has been submitted; second, geologic and radiometric reconnaissance of areas which, from the standpoint of general geology, appear to provide favorable environments for uranium mineral concentrations.

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1. Wright, Robert J., Uranium possibilities in Arizona, exclusive of the Colorado Plateau: A.E.C., New York, December 1949.

During the summer of 1950 field work followed the first of these approaches. A list of some 80 localities in Arizona from which uranium-bearing samples had been submitted to the U. S. Atomic Energy Commission, the U. S. Bureau of Mines, and the U. S. Geological Survey was compiled. From this list, 36 localities were selected for field examination. Five additional occurrences of interest were added during the summer, making a total of 41, of which 17 were examined.

Since the investigation was essentially of reconnaissance nature, no detailed work on individual deposits was planned. For this reason only a single day was spent in examination of most prospects. However, it became advisable to give somewhat more attention to three properties. Hence approximately three weeks were spent in preparation of a radiometric survey of the Annie Laurie claim, Santa Cruz County <sup>2</sup>. This work was undertaken in order to provide a guide for exploration and sampling done there by American Smelting and Refining Company. Several days were spent at the Papago Chief mine, Pima County <sup>3</sup>, and in the examination of the Red Bluff prospect, Gila County.

Reconnaissance geologic reports are in the Commission's files for all 17 localities visited. Since these reports embody the details of each examination, those data are not repeated in the present report. Rather, an effort is made here to assemble and integrate the information.

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2. Wright, Robert J., Annie Laurie uranium prospect, Santa Cruz County, Arizona: A.E.C., New York, December 1950.
  3. Wright, Robert J., Papago Chief mine--report of preliminary investigation: A.E.C., New York, July 1950.

SELECTION OF DEPOSITS FOR EXAMINATION

In planning the field work an effort was made to focus first attention on what appeared to be the most significant samples. As a guide toward this objective, three criteria were applied:

1. Samples that were reported to contain more than 0.10%  $U_3O_8$  were chosen.
2. Samples which, from the mineralogic information available, appeared to be of pegmatitic origin were eliminated.
3. Areas within the Colorado Plateau were not examined; hence localities in Apache, Cocononino, and Navajo Counties were not visited.

Table 1 lists the properties which were visited. Table 3 (in Appendix) lists properties which furnished samples containing more than 0.1%  $U_3O_8$  but were not visited for one reason or another.

Table I

List of Localities Visited

<u>Name of Claim or Mine</u>	<u>Location</u>	<u>Owner</u>	<u>Date of Examination 1950</u>
<u>Cochise County</u>			
1. Valley View claims	15 mi. SW. of Bowie, Ariz.	Paul B. Lamb. Box 622 Bowie, Ariz.	June 29
2. Not known	Sec. 25, T18S, R19E	Not known; sample submitted by R. F. Howard, St. David, Ariz.	June 25
<u>Gila County</u>			
3. Red Bluff claims	Sec. 31, T5N, R14E	Ethel S. Larsen. Young Route, Globe, Ariz.	August 1
<u>Graham County</u>			
4. Golondrina claims	Sec. 13 (?) T11S, R25E	Matt V. Lee. Box 24 Dragoon, Ariz.	June 30
<u>Mohave County</u>			
5. Big Ledge claims	Cottonwood Mountains	Bert Gaylord. Box 204 Kingman, Ariz.	July 24
6. Jim Kane mine	Sec. 8, T22N, R17W	J. H. Kane. Gen. Del. Kingman, Ariz.	July 25
7. Red Hills claims	Sec. 7, T11N, R13W	E. W. Tate. Wenden, Ariz.	July 29
<u>Pima County</u>			
8. Lena claims	Sec. 7 T18S, R11E	Manuel Obregon. 515 S. Park Avenue Tucson, Ariz.	June 8
9. Papago Chief mine	Sec. 21, T20S, R7E	Arthur Kisdler, 2125 N. Treat, Tucson, Ariz.	June 4

- |                       |                                 |   |              |
|-----------------------|---------------------------------|---|--------------|
| 10. Glen claims       | Sec. 30,<br>T17S, R11E          | Albert Ybarra.<br>Pima County Court<br>House, Tucson, Ariz.                         | September 23 |
| 11. Black Dike claims | Sec. 23, T17S,<br>R10E          | Albert Ybarra.<br>Pima County Court<br>House, Tucson, Ariz.                         | September 23 |
| 12. Iris claims       | Sec. 26, T21S<br>R11E           | Elmer Fernstrom.<br>648 W. Oro St.<br>Tucson, Ariz.                                 | July 1       |
| 13. St. Joe claims    | 9 mi. by road SW.<br>by Arivaca | Not known; sample<br>submitted by Arthur<br>Kister, 2125 N. Treat,<br>Tucson, Ariz. | August 21    |

Pinal County

- |                      |                       |                                     |         |
|----------------------|-----------------------|-------------------------------------|---------|
| 14. Kate No. 3 claim | Sec. 10, T4S,<br>R13E | Leo Wall.<br>Box 144,<br>Ray, Ariz. | June 23 |
|----------------------|-----------------------|-------------------------------------|---------|

Santa Cruz County

- |                         |                       |  |         |
|-------------------------|-----------------------|--|---------|
| 15. Annie Laurie claims | Sec. 8, T23S,<br>R11E | John H. Bright, Jr.<br>3914 S. United States<br>Ave., Tucson, Ariz.                    | June 12 |
| 16. Not known           | Sec. 3, T24S,<br>R12E | Not known; sample<br>submitted by Earnard<br>H. Spelbrink, Box 1263,<br>Nogales, Ariz. | June 28 |

Yavapai County

- |                   |                       |  |         |
|-------------------|-----------------------|--|---------|
| 17. Hillside mine | Sec. 21, T15N,<br>R9W | Sample submitted by<br>Charles H. Dunning,<br>State Dept. of Natural<br>Resources, Phoenix,<br>Ariz. | July 27 |
|-------------------|-----------------------|--|---------|

## TYPES OF URANIUM MINERALIZATION

A consideration of the localities examined suggests that the deposits may be classified into several general geologic types. Due to the reconnaissance nature of the work, and the limited amount of information in certain places, conclusions about the geology are of course preliminary; nevertheless, certain generalizations appear valid.

The deposits are grouped below according to geologic similarities. A description of each type follows later.

### Vein Types

a. Base and precious metals deposits:

1. Hillside mine
2. Papago Chief mine
3. Jim Kane mine
4. Iris mine
5. Red Hills claims
6. St. Joe claim
7. "Spelbrink" claim

b. Deposits in granite with minor metallic minerals:

1. Big Ledge claims
2. Glen claims
3. Kate claims
4. Lena claims
5. "R. F. Howard" claim

### Other Types

a. Deposits in sedimentary rocks near intrusive contacts:

1. Red Bluff claims
2. Valley View claims
3. Black Dike claims

b. Deposits within broad shear zones in volcanic rocks:

1. Annie Laurie claims
2. Golondrina claims



Base and precious metal vein deposits.

These are mesothermal deposits, carrying mixed sulphide ores with values in copper, lead, and (rarely) zinc, and commonly with trace amounts of gold and silver. Only one deposit, the Hillside, is worked at present.

Host rocks at five of the seven deposits in this group are volcanics. Commonly the rock is a felsic flow called, for field purposes, "rhyolite". The exceptions to this general rule are the Hillside mine in schist<sup>4</sup> and the Jim Kane mine in pre-Cambrian gneiss complex<sup>5</sup>. Structural relations between vein and wall rock are clear in only a few places. At the Hillside and the Papago Chief mines, fissure filling appears to have been the primary method of vein emplacement. The gangue material is largely quartz with minor calcite and chlorite. Mineralization at the Jim Kane, St. Joe, and Iris deposits has followed tabular shear zones, and the gangue material is primarily fault gouge.

The primary uranium mineral in these vein deposits is presumed to be pitchblende. Unfortunately, present observations are limited largely to the near-surface zone of oxidation, and here the known uranium minerals are of secondary origin. Only in the Hillside, Jim Kane, and Papago Chief mines can samples be collected underground,

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4. Anderson, Chas. A., Lead-zinc deposits, Bagdad area, Yavapai County, Arizona (in Arizona zinc and lead deposits): Ariz. Bur. of Mines, Bull. No. 156, 1950, p. 123.
  5. Haury, P. S., Examination of zinc-lead mines in the Wallapai mining district, Mohave County, Arizona: U. S. Bur. of Mines Report of Invest. No. 4101, 1947.

and only in the Hillside and Jim Kane has pitchblende been identified. Sulphide ore from the S800 level of the Hillside mine yielded dark uranium-bearing fluorite which contains gray inclusions that may be pitchblende, according to tests in the Tucson laboratory of the U. S. Bureau of Mines. Material collected from the N400 level of the Hillside mine and submitted to the Geological Survey's Washington laboratory was found to contain pitchblende. Small grains of a dark mineral which has been identified as metamict uraninite have been separated by the A. E. C. laboratory in New York from galena ore collected at the Jim Kane mine.

Mineralogy of the secondary uranium minerals has received only limited attention except at the Hillside mine. Here, study by the Geological Survey resulted in the recognition of three new hydrous uranium carbonates--andersonite, bayleyite, and swartzite <sup>6</sup>. Recent work by the Survey reveals that other new hydrous uranium minerals may be present as well <sup>7</sup>. In other vein deposits the following secondary minerals have been identified:

Kasolite - St. Joe and Iris claims,

Uranophane - St. Joe claim,

Metatorbernite - Papago Chief mine,

Radioactive pyromorphite - "Spelbrink" claim.

In certain mines - notably the Jim Kane and Papago Chief - recent uranium-bearing salts coat some of the mine workings. The

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6. Axelrod, J. M., Grimaldi, F. S., Milton, C., and Murata, K. J., The Uranium Minerals from the Hillside Mine, Yavapai County, Arizona: American Mineralogist, Vol. 36 (1951) pp. 1-22.

7. Michael Fleisher, personal communication.

salts are usually identified by their radioactivity and yellow-green fluorescence. In the lower portion of the Papago Chief mine, the waterline is marked by fluorescent rings on mine walls and part submerged fill. Since the water level had been lowered by pumping a few months prior to examination, it is apparent that deposition must occur rapidly.

In general, it appears that uranium is most closely associated with the copper minerals. For example, the Papago Chief, Iris, and St. Joe deposits are primarily copper prospects with small (but possibly economically significant) amounts of gold and silver. In the Jim Kane mine and "Spelbrink" claim, however, copper minerals are mainly lacking and the ores are dominantly those of lead. Uranium is closely associated with galena at the Jim Kane mine and with pyromorphite at the "Spelbrink" claim.

Vein deposits in granite with minor metallic minerals.

The five deposits of this type have two characteristics which distinguish them from the veins described above. Otherwise, the deposits have little in common. The distinguishing characteristics are:

1. Minerals containing base and precious metals are sparse.
2. The host rock is granite.

The Big Ledge deposit consists of red jasper breccia which is marginal, on the hanging wall, to a wide and persistent silicified zone in granite. The red jasper cements fragments of gray quartz which is cut by veinlets of white quartz. Minor pyrite and galena are present.

Only the red jasper is radioactive and it contains up to 0.15%  $U_3O_8$ . Samples of the jasper studied in laboratories of the Atomic Energy Commission and the U. S. Bureau of Mines do not contain any recognizable uranium minerals.

The radioactive zone of the Glen claim, like the Big Ledge deposit, is marginal to a quartz-jasper breccia zone. The radioactive zone consists of weathered granite and gangue material containing iron oxides and scattered pyrite. One sample of this material assayed 0.008%  $U_3O_8$ .

On the Lena claim, a narrow fracture in granite is filled by clay gouge and red iron oxides. Minor pyrite and galena are found within the gouge and within the granite two inches on either side of the fracture. Pitchblende has been identified in samples submitted to the Atomic Energy Commission laboratory, and kasolite has been identified by the laboratory of the U. S. Bureau of Mines. One chip channel sample 4.5 feet long across the radioactive zone assayed 0.01%  $U_3O_8$ .

On a claim called to the writer's attention by R. F. Howard, abnormal radioactivity was detected in quartz-wolframite veins in granite. Metatorbernite flakes are scattered along the plane of a minor fault in the wall rock. In addition, flakes of metatorbernite are found on freshly broken surfaces of the granite.

Deposits in sedimentary rocks near intrusive contacts.

As elsewhere, uranium-bearing deposits of this type are not common in Arizona. Reconnaissance of most contact deposits, especially replacements of limestone, suggests that their general radioactivity is relatively low. However, three of the deposits examined in Arizona are believed to belong in this class. They share few characteristics in common.

On the Red Bluff claims, Gila County, a radioactive zone is in siltstone of the Dripping Springs formation which here is nearly flat-lying. Stratigraphic control is significant, for most of the radioactive material is found within a preferred bed some 20 or 30 feet thick. Preliminary observations suggest that radioactivity in the siltstone decreases to the east and to the west away from a steeply dipping diabase dike, which has been emplaced along a fault. The diabase itself is only normally radioactive, and it may be questioned whether the diabase was the source of mineralizing solutions or was emplaced along a fault which earlier had provided a conduit for solutions. Preliminary mineralogic study has revealed no primary uranium mineral. The radioactivity originates in uranophane, metatorbernite and other secondary minerals which not only coat fractures but also

are intimately distributed through the siltstone. Picked specimens of siltstone submitted to the Bureau of Mines Tucson Laboratory analyzed more than 1%  $U_3O_8$ .

Geologic relationships at the Black Dike prospect are obscure because the only material available for study came from the dump of a vertical shaft, now filled. The shaft must have been sunk as a speculative venture, for no mineral concentration can be seen at the surface; in fact, the surface is largely covered by alluvium. Granite forms the bulk of the dump. The radioactive material consists of mineralized greenstone which is cut by stringers of granite and veinlets of uraninite, greenstone making 10 to 15% of the dump.

On the Valley View claim, granite surrounds a small xenolith of radioactive rock which appears to be metamorphosed limestone or dolomite carrying pyrite, chalcopyrite, galena, and chlorite. No uranium minerals have been identified, although picked samples containing as much as 0.19%  $U_3O_8$  have been collected for study.

Deposits in broad shear zones in volcanic rocks.

Two deposits of this type were examined, both within porphyritic rhyolitic flows.

The Annie Laurie deposit is in broadly sheared and strongly silicified rhyolite. The rock is resistant to weathering, as evidenced by the fact that pitchblende occurs within five feet of the surface. The pitchblende occurs primarily within fragments of the country rock, which is cemented by calcite and mineralized by fluorite, galena, sphalerite, and chalcopyrite. The sheared silicified rhyolite extends

over considerable area, but exploration by American Smelting and Refining Company indicates that the metallized, radioactive part is narrowly limited in extent <sup>8</sup>.

At the Golondrina claim secondary lead and copper minerals are distributed over a wide area on fracture surfaces in a sheared zone in volcanic flow rock. The only uranium-bearing mineral identified at present is powdery yellow pyromorphite. Samples of this material carry more than 0.5%  $U_3O_8$ .

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8. Wright, Robert J., Annie Laurie uranium prospect, Santa Cruz County, Arizona: A.E.C., New York, December 1950.

DEPOSITS IN SANTA CRUZ COUNTY AND SOUTHERN PIMA COUNTY

Of the deposits described in this report, a considerable number are within small portions of Santa Cruz County and Southern Pima County. Attention is called here to this apparent localization of uranium deposition.

The deposits concerned are located on the index map, Plate 2. Seven of these were examined and are described in the body of the present report. The now abandoned Happy Jack mine in the Patagonia area is also included in Plate 2 because pitchblende is reported as having been found here <sup>9</sup>. The eight deposits are:

1. Annie Laurie claims
2. Black Dike claims
3. Glen claims
4. Lena claims
5. Natalia claims
6. Papago Chief mine
7. "Spelbrink" claim
8. Happy Jack mine

In addition to these eight known occurrences of uranium, uranium-bearing samples have been received from several other localities listed in Table 2 that are thought to be within this area. Unfortunately, the exact location of these samples is not known.

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9. Schrader, Frank C., Mineral deposits of the Santa Rita and Patagonia mountains, U. S. Geol. Surv. Bull. 562, 1915, p. 232.

Schrader, F. C., Stove, R. W., and Sanford, S., Useful minerals of the United States: U. S. Geol. Surv. Bull. 624, 1917, p. 32.



Table 2

Deposits in Santa Cruz County and Southern Pima County

<u>Source</u>	<u>Location</u>	<u>Highest Analysis</u>
John H. Bright, Jr. 3914 So. United States Ave. Tucson, Arizona	Dry Springs, Ruby mining district	0.06% U <sub>3</sub> O <sub>8</sub> e
John H. Bright, Jr. 3914 So. United States Ave. Tucson, Arizona	West side of Frigita Peak, Oro Blanco mining district	0.28% U <sub>3</sub> O <sub>8</sub> c
Robert Fisher 549 North 6 Ave. Tucson, Arizona	Sierrita mountains	0.08% Ue
L. D. Poor Arivaca, Arizona	Old Gold No. 1 claim, reported to be south of Annie Laurie claim	0.25% U <sub>3</sub> O <sub>8</sub> 3.2 oz. Ag/ton tr. Au, 0.72% Cu
A. T. Starlings Tucson, Arizona	Banner mine, Papago mining district	0.04% U <sub>3</sub> O <sub>8</sub> c

General geology.

Most of the deposits for which geologic information is available are enclosed within the series of volcanic rocks that are described by the geologic map of Arizona (1924) as "older volcanic rocks" of Tertiary and Cretaceous age. However, the Lena, Glen, and Black Dike deposits are within and on the edge of the mass of granite that forms the core of the Sierrita Mountains. The Happy Jack deposit is within Mesozoic granite <sup>10</sup>. The associated base metals include primarily copper and lead.

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10. Schrader, loc. cit., p. 292.

Conclusions.

An appraisal of the geologic significance of these uranium occurrences is premature at the present stage of investigation, but two facts already appear relevant:

1. Uranium occurs in trace amounts in a number of mineral deposits located within a relatively limited area.
2. Uranium appears to have been deposited in rocks of two general ages: Mesozoic (probably Cretaceous) and Tertiary. It is not known whether more than one period of mineralization is represented.

APPENDIX

Table 3

Samples containing more than 0.1%  $U_3O_8$   
from localities mostly not visited

Arizona - General  
(county not designated)

<u>Originator</u>	<u>Highest analysis</u>	<u>Reported by</u>	<u>Remarks</u>
Fred W. Carlson 132 Chestnut Ave. Long Beach, Calif.	0.13% $U_3O_8$	USBM, Tucson	Letter to Mr. Carlson was returned by P.O. "present address unknown."
Charles H. Dunning Dept. of Mineral Reserves Phoenix, Ariz.	3.32% $U_3O_8$	USBM, Tucson	Samples originated at several localities in the Colorado Plateau.
D. E. Stewart P. O. Box 870 Joplin, Mo.	0.89% $U_3O_8$	USBM, Rolla	Sample believed to originate in the Colorado Plateau.
<u>Maricopa County</u>			
J. E. Busch 30 East 6 Street Tempe, Ariz.	0.73% $U_3O_8$ e	USBM, Tucson	Sample originated at Red Bluff claim which was visited.
E. F. George 919 McAllister Ave. Tempe, Ariz.	0.22% $U_3O_8$	USBM, Tucson	Micro. exam. by USBM shows quartz and microcline, apparently pegmatitic.
John Herr Wickenburg Ore Mkt. Wickenburg, Ariz.	0.26% $U_3O_8$	USBM, Tucson	According to Mr. Herr, the source of this sample is unknown.
Roland D. Ptak 738 E. Myrtle Ave. Phoenix, Ariz.	0.10% $U_3O_8$	USAEC, New York	Sample originated in the Colorado Plateau; locality examined by R. Nininger.

Mohave County

J. A. Carrara, Sr. Box 1005 Kingman, Ariz.	0.13% $U_3O_8$	USBM, Tucson	Sample from Big Ledge claim, which was examined.
L. W. Downs General Delivery Kingman, Ariz.	0.56% $U_3O_8$	USBM, Tucson	Radioactive mineral is allanite which suggests pegmatitic origin.
H. Thompson 715 South Third St. Las Vegas, Nev., and R. S. Schnure 231 N. Seventh St. Las Vegas, Nev.	0.30% $U_6$	USBM, Boulder City	Sample consists of pegmatitic granite containing "a radioactive iron titanate (ilmenite?)"

Pima County

L. E. Elgart Route 2, Box 870 Tucson, Ariz.	0.23% $U_3O_8$	USBM, Tucson	Sample contains quartz, microcline, and muscovite and appears to be pegmatitic.
R. M. Vanover Route 2, Box 905 Tucson, Ariz.	0.27% $U_6$	USBM, Tucson	Sample from locality which furnished sample submitted by L. E. Elgart, above.
F. L. P. Gonia 3236 Harrison St. Chicago, Ill.	0.22% $U_6$	USGS, Washington	Sample from Kids Sample pegmatite near Ajo, Ariz.

Pinal County

John A. Rose 511 Cherokee Tucson, Ariz.	0.42% $U_3O_8$	USBM, Tucson	After submitting the sample, Mr. Rose learned that it had been salted with carnotite.
W. W. Simon	0.14% $U_3O_8$	USAEC, New York USBM, Tucson USGS, Washington (Leo Wall)	Samples from the Kane claim, which was examined.

Santa Cruz County

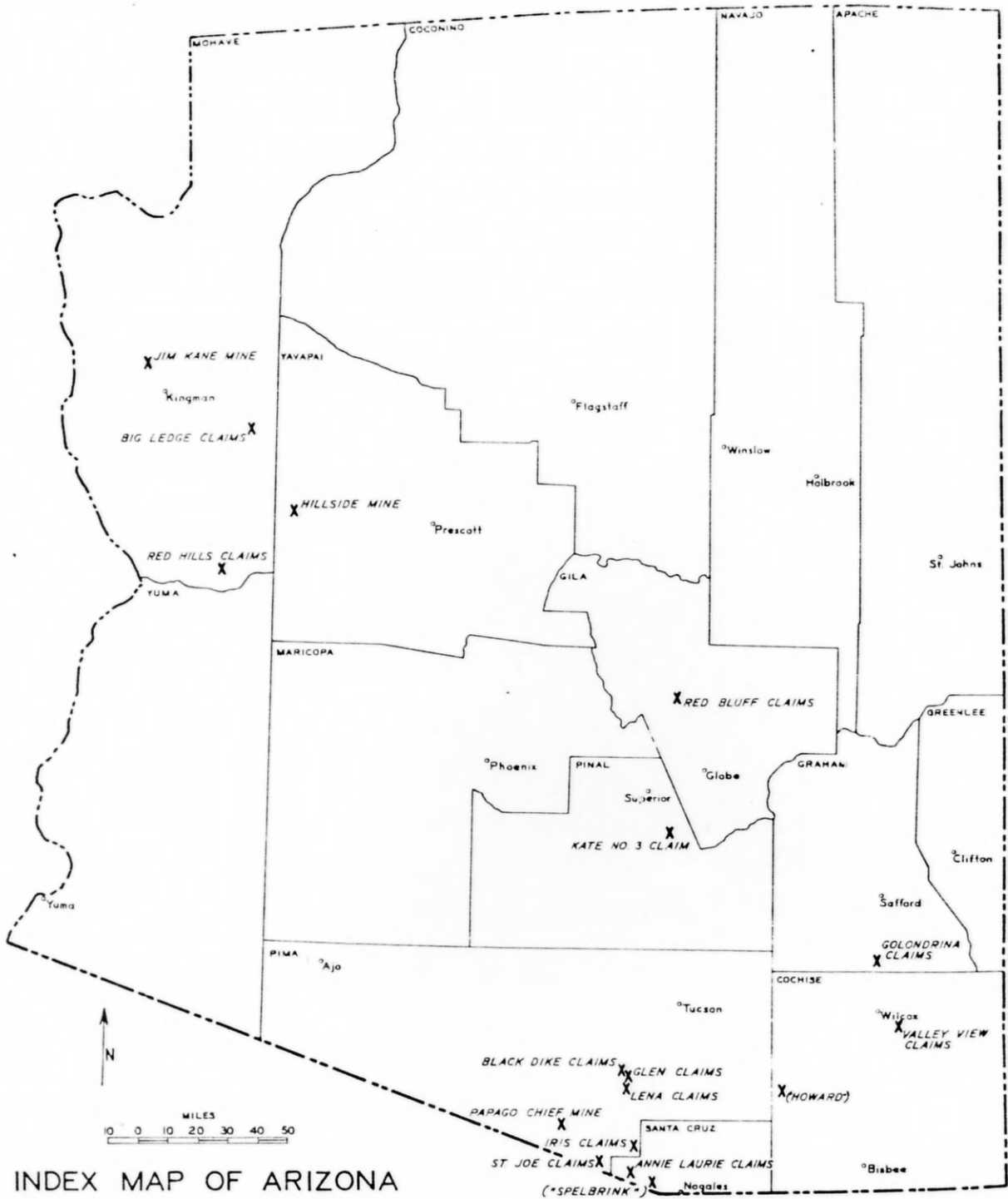
John A. Richards Mammoth-St. Anthony Mining & Developing Co. Tiger, Ariz.	0.13% $U_3O_8$	USBM, Tucson	No reply from Mr. Richards in response to a request for further information.
John H. Bright, Jr. 3914 S. United States Avenue Tucson, Ariz.	0.28% $U_3O_8$	USBM, Tucson	Not examined, at suggestion of Mr. Bright, holder of the Annie Laurie claim.

Yavapai County

David Fulton Box 1268 Jerome, Ariz.	0.46% $U_3O_8$	USBM, Tucson	Radioactivity in this sample is due to car- notite; presumed to have originated in the Colorado Plateau.
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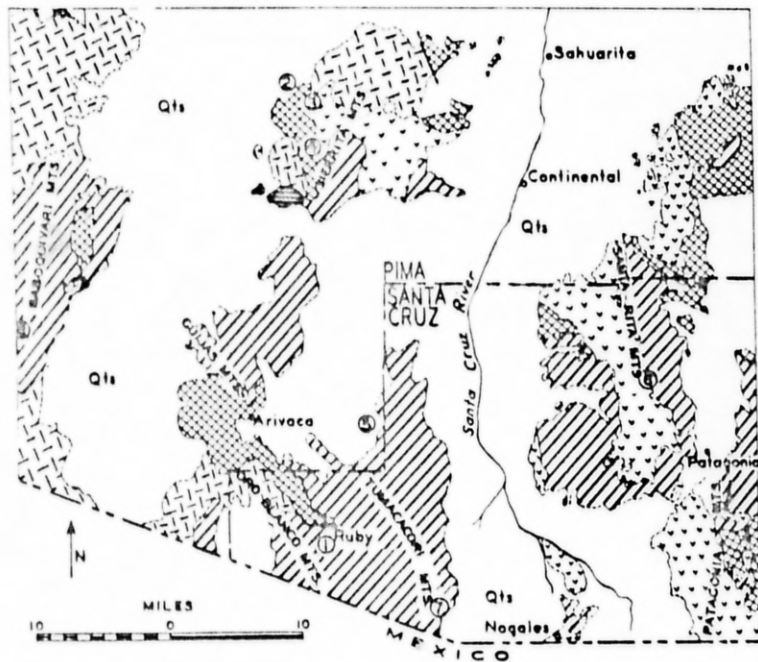
Yuma County

George M. Robbins 352 Madison Ave. Yuma, Ariz.	0.29% $U_3O_8$	USGS, Washington	Material appears to be pegmatitic.
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INDEX MAP OF ARIZONA

PLATE 1



**GEOLOGIC LEGEND**

Quaternary and Tertiary	Qts	sand, gravel, and conglomerate
<u>Igneous Rocks</u>		
Quaternary		younger volcanic rocks
Tertiary and Cretaceous		older volcanic rocks
Tertiary		granite and porphyry
Cretaceous		granite, qtz. monzonite porphyry and diorite
Mostly Pre-Cambrian		granite and related crystalline rocks
<u>Sedimentary Rocks</u>		
Cretaceous ← Cambrian		undifferentiated rocks

**DEPOSIT LOCATIONS**

1. Annie Laurie claims
2. Black Dike claims
3. Glen claims
4. Lena claims
5. Natalia claims
6. Papago Chief mine
7. "Spelbrink" claim
8. Happy Jack mine

INDEX MAP OF SANTA CRUZ AND SOUTHERN PIMA COUNTIES - ARIZONA

AFTER U. S. G. S. GEOLOGIC MAP OF THE STATE OF ARIZONA

AEC, DEC. 1950, RMG-590