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A uranium occurrence in an altered volcanic flow near Essex, California

by

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A previously unreported uranium occurrence southeast of Essex, Calif., was discovered by the authors during a brief reconnaissance in early 1978 of Tertiary rocks in the Needles-Barstow area of southeastern California, The uranium is found in an altered rhyolite flow exposed on a low hill in sec. 33, T. 7 N., R. 17 E., San Bernadino Base and Meridian (fig. 1).

GEOLOGY

The only geologic map of the area is the Geologic Map of California: Needles Sheet (Bishop, 1964). This map shows 4 small areas of Tertiary basalt and rhyolite overlying Precambrian gneiss at the northern end of the Old Woman Mountains 6 mi (10 km) southeast of Essex. Our observations confirm the general relations shown on the map, although the distribution of the rocks is not quite as shown.

The Tertiary rocks are exposed in low hills generally isolated from one another and from outcrops of the older crystalline rocks of the Old Woman Mountains to the south by alluvium. Some volcaniclastic sediments are locally interbedded with the flows of rhyolite and basalt on some of the hills. These Tertiary units, which dip gently to the northwest, appear to be offset along northeast-trending faults.

An elliptical hill, underlain by rhyolite flow(?) rock, occurs in sec. 33, T. 7 N., R. 27 E. At its southern end a white, highly altered section of crypto-crystalline rhyolite a few thousand square feet (several hundred square meters) in area occurs. The surrounding slightly altered red-brown rhyolite contains abundant opaline silica veins and less abundant quartz-filled vugs.

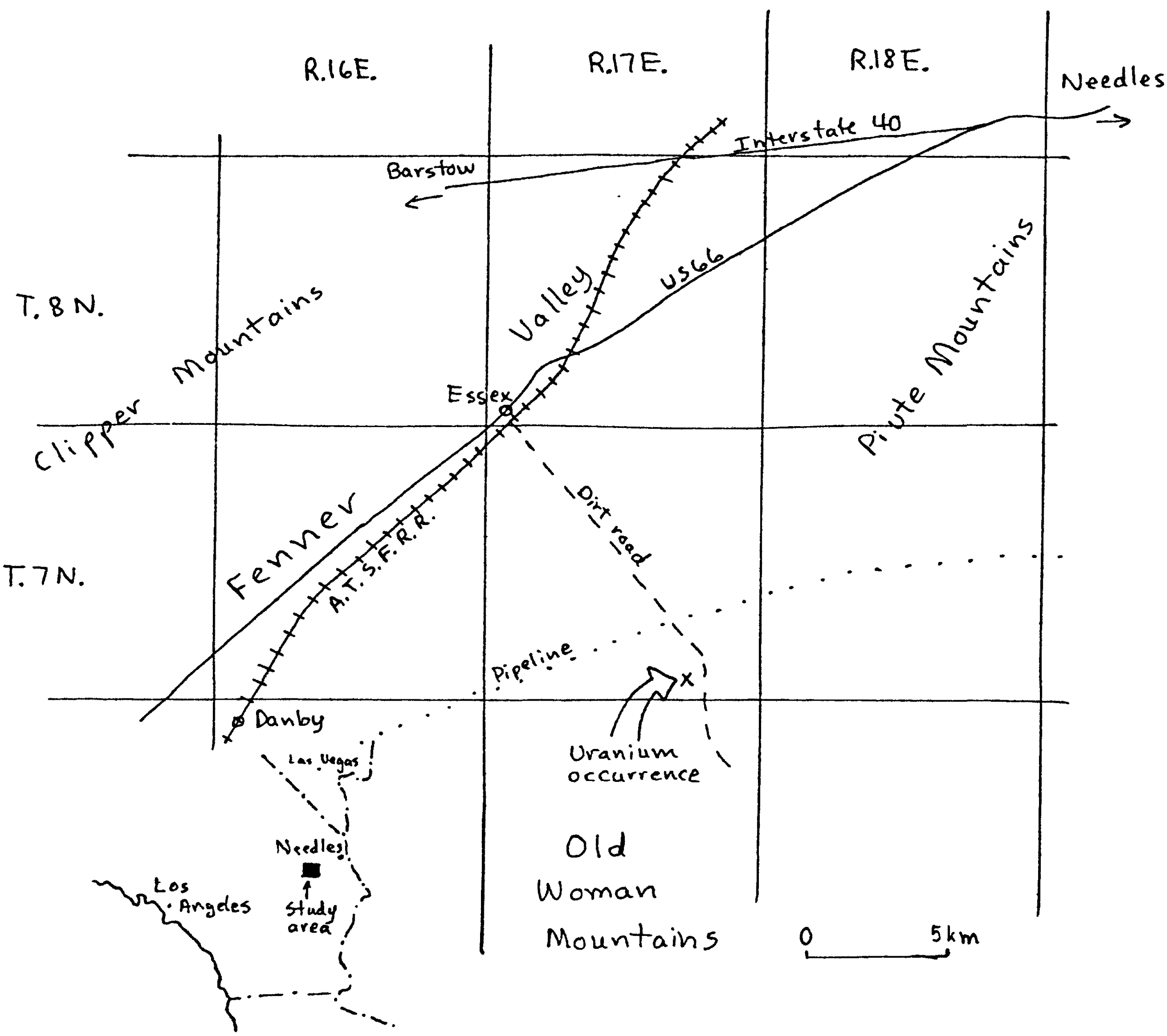

Figure 1.--Sketch map showing location of the uranium occurrence in the Essex, Calif. area.

RADIOACTIVITY, URANIUM AND TRACE METAL CONTENT

The rhyolite flow(?) rock on the hill averaged between 300 to 350 cps on a Mount Sopris Model SC-131A scintillometer[1]. Similar or slightly lower count rates were observed for rhyolite on other hills. Within the altered section, the count rate ranged from 300 to 7,000 cps.

Seven samples, four of highly altered rhyolite, two of opaline silica, and one of rhyolite with silicia veinlets, were taken for analysis. The altered rhyolite samples were principally of broken clayey bedrock taken from near the center of the altered zone and 6 in. to 1 ft beneath thin surface material. These samples were analyzed for eU by total beta-gamma activity, for U and Th by delayed neutron activation and for other trace metals by semi-quantitative 6-step emission spectrography; the data are given in table 1.

The highly altered rock showed a uranium content that averagd 328 ppm and ranged from 19.4 ppm to 863 ppm. The mineralized opal showed uranium content of 94.3 and 275 ppm, whereas the rhyolite with opaline silica veining showed a uranium content of 8.1 ppm. The four samples from the altered zone (A, B, C, F of table 1) appear to be enriched in uranium, calcium, magnesium, phosphorous, manganese, chromium, copper, strontium, vanadium, yttrium, lithium, and ytterbium when compared with the single rhyolite sample (E). Boron appears to be enriched in the rhyolite and the opaline silica (D, G) with respect to the altered zone. Phosphorous content is greatest in the sample with the highest uranium content.

X-ray mineralogy

Analyses of the samples by X-ray diffraction shows that the rhyolite (E) consists essentially of quartz and potassium feldspar. The opaline silica (D,

[1]Use of a brand name does not necessarily constitute endorsement of the product by the U.S. Geological Survey.

Table 1.--Radiometric, delayed neutron and spectrographic data

[All analyses in ppm except Fe, Mg, Ca, Ti, Al, Na, K, and P, which are in percent.
< = The Th/U ratio is less than one, no value can be reported]

Sample no.	Sample type	eU[1]	U[2]	Th[2]	Fe[3]	Mg	Ca	Ti	Al	Na	K	P	Mn	B	Ba	Be
A	Altered rock	800	863	<	0.7	0.3	G	0.07	3	0.7	2	1.	1000	L	150	Z
B	Altered rock	160	126	<	.5	.15	7	.05	1	.3	.7	.5	700	L	50	N
C	Altered rock	310	303	<	.7	.3	G	.07	3	.5	3	N	700	L	70	2
D	Opaline silica	110	94.3	<	.15	.05	7	.007	.2	.1	N	N	1500	30	70	N
E	Rhyolite/opaline/ silica veining	30	8.1	12.6	.2	.03	.5	.05	1.5	.7	1.5	N	100	100	30	1.5
F	Altered rock	30	19.4	<	.3	.15	10	.03	.7	.3	N	N	1500	L	100	N
G	Opaline silica	290	275	<	.15	.07	10	.007	.5	.15	N	.7	5000	20	150	3

Sample no.	Sample type	Co	Cr	Cr	La	Mo	Nb	Ni	Pb	Sc	Sr	V	Y	Zr	Ga	Li	Yb
A	Altered rock	L	15	15	L	5	10	10	15	5	1000	30	70	50	15	L	15
B	Altered rock	L	15	7	N	N	10	15	N	N	300	70	70	30	7	L	7
C	Altered rock	L	15	10	L	N	15	7	N	7	200	30	150	70	15	L	15
D	Opaline silica	N	3	7	N	N	L	L	N	N	70	7	N	N	N	N	L
E	Rhyolite/silica veining	N	3	3	N	N	15	L	15	N	15	N	10	70	7	N	L
F	Altered rock	N	15	7	N	N	L	7	10	L	200	70	15	30	7	150	1.5
G	Opaline silica	L	3	10	N	5	L	10	N	N	200	15	L	30	N	N	1.5

[1]Determined by beta-gamma scaler by Harriet Neuman.
[2]Determined by delayed neutron activation by H. Millard, Jr., C. McFee, and C. Bliss.
[3]This and other analyses following in table determined by semiquantitative 6-step spectrography by Leon Bradley.

G) consist mostly of quartz but sample D also contains abundant calcite, a trace of potassium feldspar and an unidentified mineral with an 8.8 A° peak. Sample G, in addition to quartz, has abundant potassium feldspar, a trace of calcite, and an unidentified mineral with a 10 A° peak. Sample G had a fair amount of rhyolite country rock still attached to the vein material which probably explains the abundant potassium feldspar. What was identified in the field as opaline silica is clearly fine grained quartz.

Samples within the altered zone (A, B, C, F) have both quartz and calcite as the most abundant minerals. They contain about half the potassium feldspar present in the relatively unaltered rhyolite (E). The two altered samples that contain the most uranium (A and C show 863 and 303 ppm, respectively) have higher potassium feldspar content than the other altered samples (B and F show 126 and 19 ppm, respectively). Samples A and C also contain a trioctahedral smectite clay as a principal mineral. Sample A also has an unidentified peak at 8.8 A°. Considering the high calcium content and the enrichment in phosphorous, uranium probably occurs as a calcium uranyl phosphate mineral, but additional work will be required to define the uranium mineralogy of this occurrence.

DISCUSSION

It appears that uranium occurs here in a hydrothermally altered rhyolite. The major element changes, the trace metal assemblage, the apparent zonation of boron around the altered zone, and the alteration of the rhyolite to quartz, calcite, and smectite all support this conclusion. The data suggest that the uranium content increases with the degree of alteration.

This occurrence cannot be further evaluated without trenching or drilling. The uranium contents obtained for these near surface samples probably do not reflect the uranium content of deeper rocks. Other altered mineralized zones within the rhyolite flows may be present beneath the thin alluvial cover in the valley.

REFERENCE

Bishop, C. C., 1963, Compiler, Geologic map of California, Needles sheet: California Division of Mines, San Francisco, 2 pl.