Geochemical Data and Airborne Radioactivity From Parts of West-central Ventura County, California

by

Kendell A. Dickinson[1]

Virgil A. Frizzell, Jr.[2]

John F. Morrone[1]

Open-File Report 82-818C

This report has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

1. U.S. Geological Survey, Golden, Colorado

2. U.S. Geological Survey, Menlo Park, California

CONTENTS

Page

Introduction.....1
Elemental associations.....1
Airborne radiometric measurements.....7
List of References.....10

PLATES

1. Uranium occurrences, sample localities, and geology for west-central Ventura County, California.....in pocket
2. Sample occurrences, sample localities and airborne radiometric measurements (based on detection of bismuth 214) for west-central Ventura County, California.....in pocket

TABLES

1. Summary of uranium claims.....2
2. Sample data.....3
3. Spectrochemical analysis.....4-6
4. Geologic units summarized from Moser and Frizzell (1982).....9

INTRODUCTION

The purpose of this report is to relate uranium occurrences and geochemical data to geologic and airborne radiometric maps (Tables 1, 2, and 3; Plates 1 and 2). The data was collected to aid in evaluating the potential uranium resources in part of the Los Padres National Forest. In addition to the data presented here, a geologic map for this area was compiled by Moser and Frizzell (1982), a study of the helium content of soil gas was carried out by Bowles and Reimer (unpublished study, 1983), and a model for uranium mineralization was prepared by Dickinson (1982).

The geochemical data consists of six-step semi-quantitative analysis for 28 elements and of uranium-thorium data by delayed neutron (Myers and others, 1961; Millard, 1976). The summary of uranium occurrences (Table 1) is based mostly on claim reports compiled by the Atomic Energy Commission during 1954 thru 1960 and from Bowes and Myerson, (1957). Data in Tables 2 and 3 are from samples that were collected by K. A. Dickinson (1982) during 1981 and 1982. The airborne radiometrics data were collected under the direction of Richard Godson of the U.S. Geological Survey in Denver, Colorado.

ELEMENTAL ASSOCIATIONS

Studies of uranium mineralization are difficult because determination of uranium content of a given rock sample may not by itself indicate whether or not the sample has been mineralized. This is especially true for slightly mineralized samples. There is a strong correlation, though, between uranium and vanadium and between uranium and molybdenum in rocks that have been mineralized, and for this reason higher vanadium and molybdenum values in a particular sample are evidence that it has been mineralized. In addition, the Th/U ratio is low, perhaps about one or lower, for mineralized rocks, and generally if the rock is mineralized only an upper limit for thorium can be determined by the delayed neutron method (Millard, 1976). Examination of the data in Tables 2 and 3, suggests that samples with over 10 ppm uranium have been mineralized. Some samples with between 5 and 10 ppm uranium may also been slightly mineralized.

The correlation coefficient for uranium and vanadium in samples containing more than 10 ppm uranium is +.86 which establishes a correlation at above the 99 percent confidence level for 10 samples. The correlation between uranium and vanadium in samples containing less than 10 ppm uranium is -.03 which is insignificant for 25 samples. In all the samples listed in tables 2 and 3 the coefficient of correlation between uranium and thorium is +.38 which is significant at the 95 percent confidence level for 35 samples (Dickinson, 1982). A correlation also apparently exists between uranium and molybdenum. Only one sample with over 10 ppm uranium shows undetectable molybdenum and only one sample with less than 10 ppm uranium shows detectable molybdenum. The correlation between both uranium and vanadium and uranium and molybdenum is common in epigenetic uranium deposits (Shoemaker and others, 1959).

Correlations between uranium and other elements may exists, for instance the two uranium mineralized samples of Monterey Formation contain more than ten times the amount of copper found in the other mineralized samples, but too little data is available to establish a link between copper and uranium in the Monterey samples.

Table 1.--Summary of uranium claims

Area Claim Sec./T./R./	Map location Number	Maximum Uranium Values eU_3O_8**	Uranium Minerals	V_2O_5	Petrology of Host Rock	Stratigraphy	Strike/dip
Superior Ridge Beer Can #12 2 4 N. 24 W.	1	0.19	Carnotite	0.67	Sandstone, gray, light-brown, arkosic cross bedded fluvial, black carbonaceous pod and veinlets	Lower Sespe Formation	40' S. dipping beds
Payoff** 10 4 N. 24 W.	2	2.18	Carnotite	NA*	Sandstone, gray, light-brown, micaceous, poorly sorted fluvial, with carbonaceous trash	Lower Sespe Formation	Strike northeast
Chismahoo East #1 10 4 N. 24 W.	3	.23	Carnotite	NA*	Sandstone, gray to light-brown, poorly sorted, contains conglomerate lenses and carbonized wood	Lower Sespe Formation	N. 70' E., 40' N.
Coyote #1 4 4 N. 24 W.	4	.16	Carnotite	NA*	Sandstone, gray, coarse-grained, micaceous, fluvial	Lower Sespe Formation	N. 45-70' E., 30-40' S.
Gamma Queen 6 4 N. 24 W.	5	.07	Autunite	.09	Sandstone, buff-colored, fine-grained micaceous, contains pockets of carbonaceous material and interbedded conglomerate, sed siltstone and red and green shsle	Lower Sespe Formation	N. 85' W., 45-50' SW.
Lamar 7 4 N. 24 W.	6	.03			Sandstone containing carbon trash	Lower Sespe Formation	NA*
Laguna Ranch Hoot Mon #4 20 4 N. 24 W.	7	NA*	Carnotite	NA*	Sandstone, buff to light gray containing carbon trash fluvial	Lower Sespe Formation	NA*
Sespe Creek Area Bertram lode 2 5 N. 23 W.	8	.64	NA	NA*	Sandstone, containing uraniferous concretions and interbedded shale	Upper Eocene	N. 60-70' E., 30' S.
Lucky Saddle 31 6 N. 22 W.	9	.51	NA	NA*	Sandstone, gray, micaceous, carbonaceous material long-bedding planes, fluvial	Lower Sespe Formation	

* Not available
** From unpublished claim reports

Table 2.--Sample data

Locality	Formation	Sample Number	Uranium[2] (ppm)	Thorium[2] (ppm)	Th/U	Field Description	Mineralogy as determined by whole-rock X-ray diffraction in general order of decreasing proportion[1]
Superior Ridge	Sespe	6381-1A	162.0	<27.0		Sandstone, light-yellow-brown, medium-grained; contains carbonaceous fragements	Q, P, O, S, I
Do---	---do---	6381-1C	84.5	<16.0		Sandstone, light-yellow-brown, medium-grained	No data
Do---	---do---	6381-1E	93.8	<17.0		Sandstone, light-yellow-brown, medium-grained	No data
Do---	---do---	6381-2	8.8	13.2	1.5	Sandstone, pink, fine- to medium-grained, friable	No data
Do---	---do---	6381-3	2.8	6.2	2.2	Sandstone, light-yellow-brown, fine-grained, hard, slightly calcareous	Q, P, O, S, I, Ch
Do---	---do---	6581-1	10.7	<3.9		Sandstone, gray, fine- to coarse-grained, conglomeratic, cross bedded	Q, P, O, S, I, Ch
Do---	---do---	6581-2	6.4	<3.2		Siltstone, light-yellow-brown, hard	Q, P, O, S(?), I, Ch
Do---	---do---	6581-3	2870.0	<640.0		Sandstone, light-yellow-brown, medium- to coarse-grained, contains carbonaceous fragments	Q, O, P, S(?), I, Ch
Do---	---do---	6581-4	6.2	8.2	1.3	Sandstone, light-yellow-brown, medium- to coarse-grained, thin-bedded	Q, O, P, S(?), I, Ch
Do---	---do---	6581-5	5.2	>2.7		Sandstone, tan, medium- to coarse-grained, poorly sorted, calcareous	Q, C, P, S
Do---	---do---	61381-3	1.8	7.3	4.0	Conglomerate, reddish-brown, argillaceous; contains seashell fragments	C, Q, P, Ch, S
Do---	---do---	61381-4	1.0	3.9	3.9	Sandstone, red, coarse-grained, conglomeratic, crumbly	Q, P, O, Ch, S
Do---	---do---	61381-6	19.2	<5.3		Sandstone, buff, medium-grained, hard, contorted bedding	Q, O, P, I, S,
Wilsie Canyon	---do---	6881-1	7.9	10.9	1.4	Sandstone, reddish-brown, conglomeratic, weathered	Q, O, P, S
Hartman Ranch	---do---	6981-1A	15.7	<6.1		Sandstone, reddish-gray, medium-grained; contains carbonaceous fragments	O, P, Q, I, Ch
Do---	---do---	6981-1B	3.9	13.0	3.4	Sandstone, reddish-gray, medium-grained; contains carbonaceous fragments	Q, P, O, S, I
Dennison Hill	---do---	61181-1	2.3	9.2	3.9	Siltstone and very fine-grained sandstone, red, laminated, calcareous	Q, P, O, G, S, I
Do---	---do---	61181-2	1.5	5.3	3.6	Sandstone, pink, evenly bedded, calcareous, micaceous	Q, P, O, G, S, Ch
Do---	---do---	61181-3	2.0	8.4	4.2	Sandstone, red, medium-grained, medium- to thick-bedded	Q, P, O, C
Do---	---do---	61181-4	2.5	9.5	3.7	Sandstone, reddish-brown to buff, fine- to medium-grained cross bedded	Q, P, O, I, Ch
Laguna Ridge	---do---	61281-1	1.7	9.1	5.4	Sandstone, light-tan, hard, evenly thin to thick bedded	Q, P, O, S
West Casitas Pass	---do---	61281-4	2.6	11.0	4.2	Sandstone, buff, medium-grained, evenly thin to thick bedded	Q, P, O, S, I
Do---	---do---	61281-5	2.1	8.1	3.9	Sandstone, light-reddish-brown, evenly thin to thick bedded	Q, P, O, S, Ch, I
Upper Sespe Creek	Rincon	63082-1	2.9	5.3	1.8	Sandstone, light-brown, fine- to coarse-grained, friable	Q, P, O, I, S
Divide Peak	Coldwater	6781-1	2.5	6.6	2.6	Sandstone, light-buff, fine- to medium-grained, poorly sorted	Q, O, P, I
Matilija Hot Springs	Matilija	6481-1	19.1	<5.4		Sandstone, gray, fine-grained, hard; contains carbonaceous fragments and Fe-O stain	Q, O, P, S, Ch
Do---	---do---	6481-2	2.5	9.5	3.75	Sandstone, gray, fine-grained, hard	Q, P, O, S, Ch

[1]Q = Quartz, P = Plagioclase, O = Orthoclase, S = Smectite, I = Illite, Ch = Chlorite, G = Gypsum, C = Calcite.
[2]Determined by neutron-activation (Millard, H. T., Jr., 1976).

Table 3.--Spectrochemical analysis

[Detection limits are given by Myers, Havens, and Dunton (1961);
L=detected at detection limit, but not determined;
N=Not detected at detection limit]

	6381-1A	6381-1C	6381-1E	6381-2	6381-3	6581-1	6581-2	6581-3	6581-4	6581-5	61381-3
Fe	3.0	3.0	0.7	1.5	1.5	1.0	2.0	1.5	1.5	2.0	1.0
Mg	.15	.15	.3	.2	.3	.5	.5	.3	.3	1.0	.7
Ca	.2	.2	.2	.5	.5	.3	.5	.15	.3	5.0	7.0
Ti	.15	.15	.07	.2	.15	.1	.15	.15	.1	.15	.07
Si	G	G	G	G	G	G	G	G	G	G	G
Al	5.0	3.0	5.0	5.0	7.0	7.0	7.0	3.0	7.0	3.0	2.0
Na	1.0	1.0	1.0	1.0	1.5	1.5	1.5	.7	1.5	1.0	.7
K	2.0	1.5	2.0	1.5	1.5	1.5	1.5	1.5	2.0	1.0	1.5
Mn	70	150	70	200	200	200	200	70	150	1,000	1,000
B	L	L	L	L	L	L	L	L	L	L	L
Bu	700	700	700	700	7,000	700	700	500	700	500	500
Be	N	N	L	N	L	L	L	L	L	N	N
Co	L	L	L	L	7.0	5.0	7.0	5.0	L	15	7
Cr	30	30	15	20	30	15	20	30	20	700	200
Cu	15	7.0	7.0	5.0	15	7.0	7.0	15	7.0	30	15
La	N	N	L	50	L	L	L	L	L	L	N
Mo	30	30	50	N	N	L	N	50	N	N	N
Nb	10	10	L	10	N	L	L	L	L	L	L
Ni	L	L	7	7	15	10	15	7.0	5.0	70	70
Pb	20	30	15	15	15	15	15	30	10	15	N
Sc	L	L	L	5.0	5.0	L	7.0	L	L	7.0	5
Sr	150	150	150	150	200	50	200	150	200	150	150
V	1,500	1,000	500	50	30	50	50	5,000	30	70	30
Y	L	N	10	20	15	15	20	20	15	15	15
Zr	150	100	100	150	150	150	150	100	100	70	70
Ce	N	N	N	L	L	N	N	L	N	N	N
Ga	10	7.0	7.0	10	10	15	15	10	15	10	7
Yb			1.5	2.0	1.5	1.5	1.5		1.5	1.5	1.5

Table 3.--Spectrochemical analysis--continued

	61381-4	61381-6	6981-1A	6981-1B	61181-1	61181-2	61181-3	61181-4
Fe	0.7	1.5	0.7	0.7	1.5	0.7	0.7	1.5
Mg	.5	.2	.2	.2	.7	.15	.3	.7
Ca	.2	.3	.7	.3	3.0	3.0	3.0	.7
Ti	.07	.15	.15	.15	.1	.07	.1	.15
Si	G	G	G	G	G	G	G	G
Al	2.0	7.0	5.0	5.0	3.0	2.0	5.0	7.0
Na	.7	1.0	.7	.7	1.5	1.5	1.5	1.5
K	1.5	1.5	3	1.5	1.5	3	3	1.5
Mn	500	150	700	300	200	100	700	150
B	L	L	L	L	L	L	L	L
Ba	300	700	700	700	700	500	700	700
Be	N	L	L	L	N	N	N	L
Co	5.0	7.0	7.0	7.0	7.0	L	L	7.0
Cr	150	20	7.0	7.0	70	30	30	30
Cu	15	7.0	10	7.0	30	20	20	15
La	N	L	L	L	N	N	L	L
Mo	N	L	N	N	N	N	L	N
Nb	L	L	L	L	N	N	N	N
Ni	30	.7	7.0	7.0	30	7.0	7.0	10
Pb	N	15	15	15	10	10	15	15
Sc	L	5	5.0	5.0	7.0	L	L	7.0
Sr	100	300	150	150	300	500	200	300
V	30	70	50	30	70	30	30	70
Y	L	15	20	15	15	L	20	20
Zr	100	150	150	150	70	70	200	150
Ce	N	N	L	L	N	N	L	L
Ga	7.0	10	7.0	7.0	7.0	7.0	7.0	15
Yb	1.0	1.5	2.0	1.5	1.5	L	1.5	2.0

Table 3.--Spectrochemical analysis--continued

	61281-1	61281-4	61281-5	6881-1	63082-1	6781-1	6481-1	6481-2
Fe	1.5	1.5	1.5	1.0	No data	0.7	1.5	1.5
Mg	.3	.3	.7	.15		.15	.15	.5
Ca	.3	.3	1.0	.15		.3	.3	.3
Ti	.15	.15	.15	.1		.07	.2	.15
Si	G	G	G	G		G	G	G
Al	3.0	5.0	5.0	3.0		5.0	7.0	7.0
Na	.7	1.5	1.5	.7		1.0	1.5	1.5
K	1.5	2.0	2.0	3.0		3.0	2.0	2.0
Mn	300.0	300.0	300.0	100.0		100.0	100.0	200.0
B	L	L	L	L		L	L	L
Ba	1,500.0	700.0	700.0	700.0		700	3,000.0	700.0
Be	N	L	L	N		L	L	L
Co	5.0	5.0	7.0	L		N	N	L
Cr	300.0	15.0	100.0	300.0		300.0	7.0	7.0
Cu	15.0	15.0	15	3.0		3.0	3.0	5.0
Lu	L	L	L	N		L	50.0	L
Mo	N	N	N	N		N	5.0	N
Nb	L	L	L	L		L	15.0	10.0
Ni	30.0	7.0	30.0	L		L	N	7.0
Pb	15	15.0	15.0	10.0		10.0	30.0	10.0
Sc	L	L	7.0	L		L	5.0	7.0
Sr	150.0	150.0	200.0	150.0		150.0	300.0	200.0
V	50.0	30.0	50.0	20.0		20.0	70.0	30.0
Y	15.0	15.0	15.0	10		20.0	20.0	20.0
Zr	150.0	150.0	150.0	150.0		150.0	200.0	150.0
Ce	L	L	N	N		N	L	L
Ga	7.0	10.0	10	10.0		10.0	15.0	15.0
Yb	1.5	1.5	1.5	1.0		2.0	3.0	1.5

The following elements were not detected: P, Ag, As, Bi, Cd, Pd, Pt, Sb, Sn, Te, W, Zn

AIRBORNE RADIOMETRIC MEASUREMENTS

The airborne radiometrics are shown on Plate 2. Areas over which the equivalent of 4 ppm uranium were recorded are shaded on this plate. The 4 ppm valve was arbitrarily chosen to designate areas of higher radioactivity. The prominent radiometric highs are numbered on the map. Only 2 of these highs, numbers I and IV are known to be related to uranium occurrences. Number I signals the Payoff Claim near the eastern end of Superior Ridge along the western border of Matilija Quadrangle where small amounts of uranium mineralized rock is present at the surface in the lower transitional unit of the Upper Eocene to Miocene Sespe Formation (Dickinson, 1982). Other uranium occurrences along Superior Ridge west of the Payoff Claim are not represented by prominent radiometric highs.

Radiometric high number II is located in the west central part of the Ojai Quadrangle. It is mostly over the Miocene Monterey Formation and it is the most pronounced airborne radiometric high in the survey area. A uranium occurrence was found in the Monterey near Simi Valley about 20 (32 km) east of this radiometric high (Dickinson, 1982), but no evidence is available to suggest that a similar uranium occurrence is related to radiometric high number II.

Radiometric high number III is a rather broad anomaly in the north-central part of the Ojai Quadrangle extending over several geologic formations including some of Eocene and Quaternary ages. This anomaly probably does not represent a uranium deposit because it is not related to a single geologic formation or contact. It may be a fugitive anomaly associated with the accumulation of radon gas in Senior Canyon a topographic feature around which the high seems to be centered.

Anomaly number IV was recorded over an area which includes uranium occurrences at the Lucky Saddle and Bertram Lode (Dickinson, 1982). The anomaly, which is over the Coldwater-Sespe contact, probably does not represent a uranium deposit of commercial size because it is small compared to anomaly V which apparently is over non-uraniferous Eocene rock in the same general area. Anomaly V, in the northeastern part of the Wheeler Springs Quadrangle, is a linear high about 3 miles (5 km) long, which is primarily over the Eocene Matilija Sandstone and areas where the Matilija is covered by Holocene sediment. Uranium occurrences, except for slight mineralization (19 ppm uranium, see Table 2) near Matilija Hot Springs (Maps 1 and 2), are not known in the Matilija and it is unlikely that this anomaly represents a significant uranium deposit.

Radiometric high number VI, which occurs in west-central Lion Canyon Quadrangle, is a rather small, but distinct high over the Lower Miocene Rincon Shale and the Piedra Blanca Sandstone of Badger (1957), a facies of the Rincon. This high is not believed to represent a uranium deposit because no uranium occurrences have been found in the Rincon Shale or Piedra Blanca Sandstone. A sample associated with one of the small radioactive highs east of anomaly VI contained only 2.9 ppm U (Table 2). However, two samples collected from the Rincon Shale about 1 1/2 miles (2 km) east of high VI, but not on map 2 contained an average of 8.8 ppm uranium (Dickinson, 1982). These two samples were also collected near a small radiometric high. The radiometric highs recorded over the Rincon and Piedra Blanca may be related to

minor variations in uranium content, but no occurrences suggestive of epigenetic mineralization have been found there and nothing suggests the presence of commercial deposits.

Table 4

Geologic units summarized from
Moser and Frizzell (1983)

Qa, Qg, Qls	SURFICIAL SEDIMENTS (holocene)
Qoa, Qog, Qvs	OLDER SURFICIAL SEDIMENTS (Pleistocene)
Qsb	SANTA BARBARA FORMATION (Pleistocene)
Tp	PICO FORMATION (Pliocene)
Tsq	SISQUOC FORMATION (upper Miocene and [or] Pliocene)
Tsm, Tsmp	SANTA MARGARITA (upper Miocene)
Tm, Tms	MONTEREY FORMATION (lower to upper Miocene)
Tr	RINCON SHALE (lower Miocene)
Trb	Piedra Blanca Sandstone of Badger (1957)
Tv	VAQUEROS SANDSTONE (upper Oligocene to lower Miocene)
Tsp, Tsl	SESPE FORMATION (late Eocene and early Oliocene)
Tcw, Tcws	COLDWATER SANDSTONE (late Eocene)
Tcd, Tcds	COZY DELL SHALE (middle and upper Eocene)
Tma, Tmas	MATILIJA SANDSTONE (middle and upper Eocene)
Tj, Tjs	JUNCAL FORMATION (lower(?) middle, and upper Eocene)
Ku	UNNAMED MARINE STRATA (late Cretaceous)
Kuc	Howard Conglomerate of Badger (1957)

LIST OF REFERENCES

Badger, R. L., 1957, Geology of the western Lion Canyon Quadrangle, Ventura County, California: California State University, Los Angeles, M.S. thesis, 84 p.

Bowes, W. A. and Myerson, B. L., 1957, Sandstone-type uranium occurrences in White Ledge Peak area, Ventura County, California: U.S. Atomic Energy Commission, RME 2073 20 p.

Dickinson, K. A., 1982, Epigenetic uranium deposits in Tertiary sedimentary rocks in Ventura County, California: a preliminary report: U.S. Geological Survey Open-File Report 82-818B 26 p.

Millard, H. T., Jr., 1976, Determinations of uranium and thorium in U.S.G.S. standard rocks by the delayed neutron technique: U.S. Geological Survey Professional Paper 840, p. 61-65.

Moser, F. C. and Frizzell, V. A., Jr. (1982), Geologic Map of the Lion Canyon, Matilija, Ojai, Wheeler Springs, and White Ledge Peak Quadrangles, California: U.S. Geological Survey Open-File Map 82-818A.

Myers, A. T., Havens, R. G., and Dunton, P. J., 1961, A spectrochemical method for the analysis of rocks, minerals, and ores: U.S. Geological Survey Bulletin 1084-I, p. 1207-1229.

Shoemaker, E. M., Miesch, A. T., Newman, W. L. and Riley, L. B., 1959, Part 3. Elemental composition of the sandstone-type deposits in Garrels and Larsen: U.S. Geological Survey Professional Paper 320, p. 25-54.