State Department of Geology and Mineral Industries

702 Woodlark Building
Portland, Oregon

REPORT ON THE OCCURRENCE OF URANIUM IN MUTTON MOUNTAIN, WASCO COUNTY, OREGON

by
Esther W. Miller
April 23, 1945

Abstract

The reported occurrence of uranium and radium ore in Mutton Mountain in central Oregon was investigated in the laboratories of the State Department of Geology and Mineral Industries. The samples submitted were studied by fluorescent, electroscopic, and spectrographic methods. No ore of commercial value was indicated.

TABLE OF CONTENTS

Page

Abstract

I. Introduction 1

II. Description of Samples 2

III. Experimental Procedure 6

IV. Discussion 9

V. Summary 10

VI. Appendix

A. Article in The Oregonian concerning the discovery of uranium in Oregon

B. Report of Howard and Joseph Davis to the State Department of Geology and Mineral Industries

REPORT ON URANIUM FROM MUTTON MOUNTAIN

I. Introduction

On March 13, 1945, the announcement was made in The Oregonian[1] by Jack A. DeMent of Portland, Oregon, that radium and uranium had been discovered in an ore specimen from Mutton Mountain on the Warm Springs Indian reservation in central Oregon.

The specimen was found by Mr. Joseph Davis of Tigard, Oregon. The specimen submitted to the State Department of Geology and Mineral Industries was mainly chalcedony with a partial coating of opaline material which exhibited pale yellow-green fluorescence.

On April 3rd and 4th, Mr. Davis made a field trip to the locality and brought nine specimens from the surrounding territory to the State Department of Geology and Mineral Industries to be examined for uranium and radium.

The following methods of testing were used:

1. Fluorescent light
2. Electroscope (aluminum leaf)
3. Spectrograph

---

1 See clipping in appendix of report.

II. Description of Samples

A description of the samples tested is given in Table I. Since a complete petrographic examination of all samples from Mutton Mountain was not warranted, a description reference is given, which indicates the source of the description of each sample.

Location sec. 28(3) T 6S; R. 13E (Dufur Quad)
Elev. approx. 3000 ft. (Davis estimate)

TABLE I

Ref. No.	General Lab. No.	Description	Description Reference
U-1	P-3499	A vein of grayish rock showing outcrop of about 50 x 100 ft. about 150' down slope directly under field of fluorescent material described under sample U-10.	Howard and Joseph Davis
U-2	P-3500	A visible 6-foot outcrop above and to right of field containing sample U-10.	Howard and Joseph Davis
U-3	P-3501	An outcrop of grayish pebbly material in center of field containing sample U-10, which runs for about 2 miles in a northwesterly direction.	Howard and Joseph Davis
U-4	P-3502	Right alongside of the U-3 material is a sizeable vein of soft rose-tinted rock or sandstone. About a 4-foot showing with a top covering of soil.	Howard and Joseph Davis
U-5	P-3503	Brownish-black dike of material on edge at vein of cliff in a locality about 5 miles to the east of the area described under U-4. However, this area also has some fluorescent agate of a different type from that of sample U-10 - same yellowish fluorescence but not so bright. Vein, or as much of it as is exposed, runs about 10 x 300 ft. Lies on edge.	Howard and Joseph Davis

TABLE I (cont.)

Ref. No.	General Lab. No.	Description	Description Reference
U-6	P-3504	Grayish to green outcrop approximately 100 x 200 ft. Some fluorescent agate on either side.	Howard and Joseph Davis
U-7	P-3505	Resembles obsidian. Outcrops approximately 15 x 100 feet up and down hill. About 50 feet higher up, there occurs a 20-foot caprock composed of what seems to be an unusually yellow lava rock. No fluorescent matter in vicinity.	Howard and Joseph Davis
U-8	P-3506	Found at an elevation of about 3000 ft. Outcrops seem to continue for miles showing same material.	Howard and Joseph Davis
U-9	P-3507	Coal-like material outcrops at a 2000 ft. level on same mountain.	Howard and Joseph Davis
U-10	P-3521	First sample submitted by Joseph Davis. This sample was a geode from the Clarno formation and probably of upper Eocene age. The geode is of chalcedonic material which has a botryoidal structure. The sample possessed a partial coating of material (described under U-11) which fluoresced a pale yellow-green color.	W. D. Lowry
U-11	P-3521-a	Fluorescent coating found on sample U-10. The coating is nearly all opaline material.	W. D. Lowry
		Uraninite (pitchblende) from standard mineral collection of the State Department of Geology and Mineral Industries. Specimen is from Bohemia.	Descriptive list in standard collection.
		Carnotite - Moab district, Utah.	Descriptive list in standard collection.
		Torbernite - Mt. Painter, S. Australia.	Descriptive list in standard collection.
		Opal - semi opal - fluorescent. Nevada	Descriptive list in standard collection.

Uraninite, carnotite, and torbernite are known sources of uranium. Schoeller and Powell[2] describe them as follows:

(1) "Uraninite is a complex mixture of oxides, described by Dana as a 'uranate of uranyl, lead, usually thorium (or zirconium) often the metals of the lanthanum and yttrium groups; also contains nitrogen in varying amounts up to 2.6 percent'. A black, pitch-like heavy mineral; sp. gr. 9.5; H. 5.5 Non-magnetic; brittle; conchoidal fracture. Cubic, sometimes found as octahedra. Streak brown black to olive-green and shining. There are several varieties of this mineral. Cleveite contains about 10 percent of yttria earths; broggerite shows a ratio of UO_3 to other bases of about 1:1; Uraniobite contains much thoria and the maximum observed amount of nitrogen."

(2) "Pitchblende is a black, amorphous, hydrated oxide containing only traces of thoria and rare earths; sp. gr. 6.5. It is found in veins with sulfide minerals, while uraninite occurs in pegmatites."

(3) "Torbernite (copper uranite) copper uranyl phosphate (H. 2.5; sp. gr. 3.5), is a brittle emerald green mineral with pearly to adamantine luster and micaceous cleavage. It is tetragonal, occurring in thin, transparent tables or in micaceous aggregates."

(4) "Carnotite, hydrous potassium uranyl vanadate, consists of a yellow crystalline powder or incrustations on sandstone and quarts and in crevices of rocks."

---

2 The Analysis of Minerals and Ores of the Rarer Elements (J.B. Lippincott Co., 1940. pp. 129, 220-222.)

Fluorescent opal was studied because it is believed that its fluorescence is caused by small amounts of uranium[3].

---

3 Deco Trefoil, Denver Equipment Company publication, vol. 8, no. 3, March, 1944, p. 10.

III. Experimental Procedure

Standard samples containing 10%, 1%, 0.1% and 0.01% uranium as uranium nitrate ($UO_2(NO_3)_2 \cdot 6H_2O$) in a silica base were prepared for comparison with the unknown samples.

A. Fluorescent Light -

All the samples described in Table 1, as well as the prepared uranium standards, were observed under fluorescent light. The 2537 A mercury radiation was filtered by a plate of purple glass. Both crushed and uncrushed samples were examined. The results are given in Table II.

B. Electroscope -

The nine samples collected on the field trip of April 3rd and 4th were tested with the electroscope at Reed College. Small pieces rather than crushed samples were used. Dr. Knowlton of the physics department tested samples U-1, U-2 and U-10.

The electroscope of the Department of Geology and Mineral Industries was set up and minus-100 mesh samples of the specimens from Mutton Mountain, the 10% and 1% uranium standards, and solid specimens of uraninite, carnotite, torbernite and fluorescent opal were tested. The natural leakage of the instrument was 0.5 divisions per minute. The testing period for each sample was 4 minutes. This was sufficient for a qualitative determination of the presence of radioactive material. The results are given in Table II.

C. Spectrograph -

Spectrograms of the standard samples were prepared and the following

lines were sensitive to 0.1% uranium when a 50 mg sample was used:

	Arc Intensity
4244.4	25
4246.3	30

The 4241.7 A line was eliminated because of the interference of zirconium at the same wavelength.

Analyses were then made of the following samples:

U-1	U-8
U-2	U-9
U-3	U-10
U-4	U-11
U-5	Carnotite
U-6	Torbernite
U-7	Fluorescent opal

Following are the conditions under which the spectra of the samples were recorded:

1. Plate Nos.: 837 and 839
2. Range: 3650-5000 A
3. E-33 plate
4. 220 volts - 5 amps for 30 secs. then 13 amps to completion
5. 5% light
6. Iron standard - 5 amps for 30 secs.
7. New uppers
8. 50 mg sample
9. Carriage at 10
10. Develop 5 min. at 70° F.

The results are given in Table II.

TABLE II

Sample No.	Fluorescent Light	Electroscope	Spectrograph
10% uranium	Bright yellow	7.75 div./min	Strong
1% uranium	Bright yellow, but less than 10%	0.75 div./min	Medium
0.1% uranium	None	Not tested	Weak
0.01% uranium	None	Not tested	Not detected
U-1	None	No radioactivity	Not detected
U-2	None	No radioactivity	Not detected
U-3	None	No radioactivity	Not detected
U-4	None	No radioactivity	Not detected
U-5	None	No radioactivity	Not detected
U-6	None	No radioactivity	Not detected
U-7	None	No radioactivity	Not detected
U-8	None	No radioactivity	Not detected
U-9	None	No radioactivity	Not detected
U-10	Pale yellow in parts, but none when crushed	No radioactivity	Not detected
U-11	Pale yellow, but none when crushed	No radioactivity	Not detected
Pitchblende	None	14.5 div./min	Not tested - insufficient sample
Carnotite	None	15 div./min	10-1% uranium
Torbernite	None	3.3 div./min	10-1% uranium
Fluorescent opal	Bright yellow	No radioactivity	1-0.1% uranium

IV. Discussion

The results obtained by each of the three methods when the standard samples were tested for each sample are in agreement. The same sample was used in each method and the results are as would be expected.

It is evident that there is no detectable uranium and hence no radium in samples U-1 to U-9.

The fluorescence of the coating of sample U-10 and the coating itself, sample U-11, is undoubtedly due to a surface or particle size effect or to activation by a minor constituent and the uranium content, if such is the cause of the fluorescence, is much less than might be supposed. This fact is supported by spectrographic results.

Since crushed samples of uraninite (pitchblende), carnotite, and torbernite were not available in sufficient quantity for electroscopic determinations, the indication of radioactivity in these specimens is qualitative only. Thus it is not expected that electroscopic and spectrographic results should be correlative for these materials.

The fluorescence of the opal is undoubtedly due to the uranium content,* but the ratio of radium to uranium is so low as to render the sample incapable of affecting the electroscope.

---

* Ibid. P. 10.

V. SUMMARY

1. The uranium standards (10% and 1%) and specimens known to contain uranium (pitchblende, carnotite, torbernite, and fluorescent opal) varied in their reaction to fluorescent light. All of the above-mentioned materials except the fluorescent opal reacted to the electroscope, and all except uraninite, which was not tested, contains some uranium, according to spectrographic results. Therefore, the fluorescent light cannot be considered a specific test, the electroscope provides a measure of radioactivity, while the spectrograph determines uranium only.
2. None of the samples from Mutton Mountain were indicative of uranium ore of commercial value. That the fluorescent coating of the chalcedony is an indication of a nearby uranium deposit is a possibility, but until samples are obtained which indicate some radioactivity, the report of the discovery of uranium in Mutton Mountain must remain of academic interest only.

THE OREGONIAN
March 13, 1945

ORE SPECIMEN HAS RADIUM

Discovery of radium and uranium in an ore specimen from Mutton Mountain on the Warm Springs Indian reservation in central Oregon was announced Saturday by Jack A. Dement, Portland research chemist.

Dement said the radioactive elements were found in a fragment of chalcedony, which he described as "an agate-like silica material." Presence of the elements was indicated by an electroscope, ultra-violet light, spectroscope, peracid reaction and the fluoride bead test.

The specimen examined by Dement was found by Joe Davis, Tigard, who turned it over to Dr. H. C. Dake, editor of "The Mineralogist." Davis said the material is to be found in abundance in the locality where he picked up the specimen.

Uranium Amount Vital

Dement said the quantity of radioactive material in the specimen had not been determined, since the richest part of the fragment was in the nature of a coating over material which showed less radioactivity.

Fay W. Libbey, acting director of the Oregon State department of geology and mineral industries, points out that chalcedony is not ordinarily found with uranium. The radioactive substance would be expected to be an accidental coating or deposit over the core of chalcedony.

In that case the abundance of chalcedony in the area would be no indication of the amount of uranium to be found.

If the uranium is abundant, or relatively abundant, Dement's discovery is of supreme importance, he indicated; but if it is found only in minute quantities, it is merely one more interesting item to add to Oregon's geological wonders.

COPY

"ASTRALITE" FLUORESCENT AGATE

Explanatory Notes

"Astralite", so named because of its vivid fluorescent qualities was discovered in August 1944 by Joseph and Howard Davis in the Mutton Mountain district adjacent to the Deschutes River, Wasco County, central Oregon.

Material is black agate in nodule and geode form found only in one area covering about fifty acres. Occurs on surface and under soil - some specimens measuring two or three feet across. All of it is highly fluorescent (uranium yellow and a dark green - the latter wherever black inclusions show.)

No claim is made by discoverers that this material contains radium - this report being an independent observation by party unknown to writer.

Finders would have preferred to keep location secret and feel that newspaper publicity was unfortunate, for the reason that if the location goes onto public record it would result in an influx of amateur rock collectors to the area who would destroy much of the rare material out of curiosity.

Due to publicity of the radium report and the stimulus of official interest, the undersigned decided to make a field trip to the locality for the purpose of finding pitchblende and to bring back samples of same if possible - or if no pitchblende to be found, to bring in any other samples of outcrop occurring along with the fluorescent agate. Field trip was made on April 3rd and 4th and the following specimens brought back:

#1 - A vein of grayish rock showing outcrop of about 50 x 100 ft. about 150" down slope directly under field of fluorescent material described above.

#2 - A visible six foot outcrop above and to right of same field.

#3 - An outcrop of grayish pebbly material in center of same field which runs for about two miles in a northwesterly direction.

#4 - Right alongside of the foregoing grayish material, is a sizable vein of soft rose tinted rock or sandstone. About a four foot showing with a top covering of soil.

#5 - Brownish black dike of material on edge at rim of cliff in a locality about 5 miles to the east of the area mentioned above. However this area also has some fluorescent agate of a different type from the above described - same yellowish fluorescence but not so bright. Vein, or as much of it as is exposed, runs about 10 x 300 feet. Lies on edge.

#6 - Grayish to green outcrop approximately 100 x 200. Some fluorescent agate on either side.

#7 - Resembles obsidian. Outcrops approximately 15 x 100 feet up and down hill. About fifty feet higher up there occurs a twenty foot caprock composed of what seems to be an unusually yellow lava rock. No fluorescent matter in vicinity.

#8 - Found at an elevation of about 3000 feet. Outcrops seem to continue for miles showing same material.

#9 - Coal-like material outcrops at a 2000 ft. level on same mountain.

Note: Special attention should be given to specimens 1 to 5 as these were taken from heaviest fluorescing area. An odd fact noted was the constant occurrence of all kinds of rocks in the creek running below for a distance of several miles - or all the way to the Deschutes. This seemed to be a coating left by water or possibly a molten substance which covered not only agates, but common basalt rocks with a thin veneer of uranium salts. One specimen noted seemed to be a conglomerate shot through with bright kernels of fluorescing matter about the size of almonds. A specimen of this rock was turned over to Smith's Agate Shop about two months ago and they may still have it on hand.

Howard S. Davis
Joseph Davis

Rt. 1, Box 501
Tigard, Oregon