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A UNIQUE OCCURRENCE OF URANIUM MINERALS, MARSHALL PASS, SAGUACHE COUNTY, COLORADO

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ABSTRACT

In 1956 several unusual uranium deposits were uncovered in the Marshall Pass district, Saguache County, Colorado. Two of the ore bodies occurred in alluvium at an elevation of about 10,000 feet. The largest of these, on the Lookout No. 22 claim, produced about five tons of high-grade uranium ore. The bedrock at the deposit is a quartz-biotite-feldspar-schist which has been altered adjacent to a fault zone. Small areas of the schist have been completely replaced by uranium and sulfide minerals, producing "rich" ore bodies that have been found *in situ* in the alluvium above the fault.

Ore pieces are tabular to rounded yellow masses measuring from a few inches in diameter to large slabs 2′×1′×8″ thick and weighing as much as 140 pounds. Nearly all contained a yellow oxidized coating around a black interior of pitchblende and sulfides. Geochemical sampling of soils surrounding the deposit indicate that uranium has migrated less than 100 feet downslope from the ore body.

Radioactive minerals include pitchblende, schoepite, ianthinite, epi-ianthinite, becquerelite, soddyite, boltwoodite, uranophane, zeunerite, metazeunerite, and a hydrated autunite. Other minerals are tetrahedrite, chalcopyrite, sphalerite, chalcocite, covellite, galena, pyrite, and marcasite. Pitchblende occurs in concentrically banded and colloform masses showing fractures and microfaults rehealed by later pitchblende. Secondary uranium minerals and sulfides transect the pitchblende and occur interstitially between banded masses. The uranium deposit was probably formed under epithermal conditions during early Tertiary time.

INTRODUCTION

The Marshall Pass uranium district is about 12 miles southeast of Sargents in Gunnison and Saguache Counties, Colorado. Active uranium mining operations have developed near Indian Creek and on the west side of Harry Creek, tributaries of Marshall Creek at about 10,000 feet elevation.

In 1956 one of the first uranium discoveries of the area occurred on an alluvial slope. Further exploration by prospectors uncovered more pockets of high-grade uranium ore on mountain slopes beneath a thin soil cover. One such discovery on September 20, 1956, by Al Newman, surveyor for Monarch Exploration Company, Houston, Texas, initiated considerable excitement and stimulated intense prospecting in the Marshall Pass district. The Gibraltar Minerals Company of Dallas, Texas, took over control of mining operations and further development of the newly uncovered uranium property (Fig. 1).

The uranium deposit herein described, the Lookout 22 claim, is in a group of claims, 15 to 34 inclusive, in T. 48 N., R 6 E., N.M.P.M. It occurs

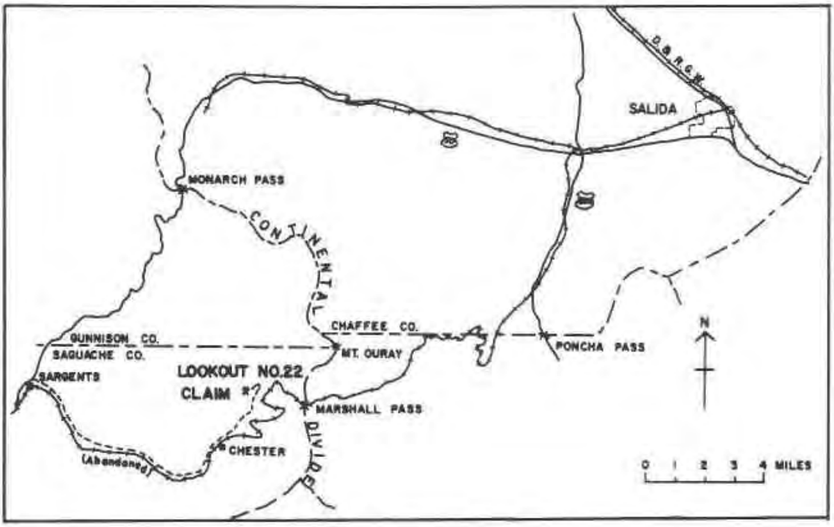


FIG. 1. Index map showing location of the Lookout No. 22 claim, near Marshall Pass, Saguache County, Colorado.

on the west slope of Harry Creek, a tributary of Marshall Creek, at 9600 feet in Saguache County, Colorado. The initial discovery was made by means of a scintillation counter used on float pieces of ore which were found about 50 feet downslope from the alluvial "pocket." An area 15 feet square in the alluvium produced 10,300 pounds of very rich uranium ore.

GEOLOGY AND STRUCTURE

The Lookout 22 claim is on a steeply sloping mountain about 700 feet above Harry Creek. At the deposit the surface slopes about 32° southwest. Beneath about 6 feet of overburden in which the ore occurred, the country rock is a Precambrian quartz-orthoclase-biotite schist. Small outcrops of pegmatite project through the overburden near the deposit. The schistosity strikes northeast and dips 20 to 40 degrees northwest (Richter and Buel, 1958). Prior to stripping to bedrock, geologists proposed many theories for the source of the uranium deposit in unconsolidated sediments. However, bedrock exposures revealed a fault trending N. 30° W. and dipping about 65° southeast. This fault is believed to be an offshoot of the Chester fault, which is the major structural feature of the area. Uranium mineralization has also been found along the Chester fault a few miles northwest of the Lookout claim. Despite the steep slope, little soil creep has occurred and "float" ore consisted of only a few pieces.

GRADE

In the fall of 1956 the 15-foot-square high-grade area was mined by pick-and-shovel methods. Ore was sorted by weight into two types, oxidized yellow material and unoxidized black ore. In the early stages of the operation, little could be determined of the size and extent of the deposit. To the northwest another small mass of ore along what was believed to be the same fault line yielded an additional 500 pounds of uranium.

Subsequently, after all the ore had been removed from the unconsolidated sediments, the excavation exposed altered bedrock. The rock consisted of iron-stained and altered quartz-feldspar-biotite schist and blocks of iron-stained vein quartz within a fault zone. With increasing depth within the fault zone, mineralization diminished.

Assays of the various types of ore are listed in Table 1.

Following removal of the rich ore, 42 tons of "scrap" material and alluvium were shipped to Union Carbide Nuclear Company's mill. This ore averaged 4.39 percent U_3O_8. Lastly, about 360 tons of bedrock to a depth of 10 feet was shipped to a mill at Uravan, Colorado. It averaged 0.55 to 0.60 per cent U_3O_8.

GEOCHEMISTRY

Because of the unusual occurrence of highly radioactive ore in overburden, Vance Kennedy of the U. S. Geological Survey collected soil samples above the deposit and downslope to Harry Creek for geochemical studies. A fluorometric analysis for uranium in the soil samples, made by J. D. Crozier, National Lead Company, Grand Junction, Colorado, gave the following results:

		Uranium content	
		(1)	(2)
2046-SG-1)	160 feet above deposit	0.002	0.001
2)	12 feet below deposit	0.005	0.005
3)	100 feet below deposit	0.020	0.021
4)	700 feet below deposit	0.002	0.002
5)	0.7 mile below deposit	0.001	0.001

These results indicate that the highest concentration of uranium occurred a short distance downslope from the uranium deposit.

An attempt was also made to check the uranium content of plants in botanical prospecting by Cannon (1957). Samples of lodgepole pine needles collected by her gave the following results:

5 ppm uranium in barren ground

TABLE 1. URANIUM ORE ASSAYS AND CHEMICAL ANALYSIS

Material	U_3O_8 per cent[1]
Black "high grade" pitchblende ore	71.96
Yellow "high grade" oxidized ore	34.54
Coarse ore high in yellow content	31.72
Ore fines and scrap material	25.38
Alluvial material six feet south of deposit	2.31
Chips of brown altered schist	3.96

BULK ASSAY OF 16 BAGS OF MATERIAL

	Weight per cent[2]
U_3O_8	48.61
$FeO+Fe_2O_3$	2.82
As_2O_3	1.68
CuO	0.60
P_2O_5	0.33
SO_4	0.17
CaO	0.15
MoO_2	0.10
F	0.08
V_2O_5	0.06
CO_2	0.04

[1] Analyses by Brown Laboratory, Grand Junction, Colorado. R. Hinn, mine owner, personal communication.

[2] Analysis by Lucius Pitkin Laboratory, Grand Junction, Colorado. R. Hinn, personal communication.

40 ppm uranium in ash of trees in undisturbed mineralized ground
240 ppm uranium in oxidized ground near discovery pit.

The five soil samples also were examined by semiquantitative spectrographic analysis (Table 2). The contents of Mn, Cr, Cu, Pb, Ni and V are higher in the soil nearer the uranium deposit, whereas Zn, although common in the deposit as sphalerite, does not occur in the soil. It has probably been removed in solution. Also uranium is not detectable by emission spectrograph methods in soil 12 feet below the high-grade deposit.

CHARACTER OF THE ORE

The ore occurred as tabular to rounded yellow boulders from a few inches in diameter to $2' \times 1' \times 8''$ in size. The largest piece, weighing 143 pounds, was purchased by the U. S. National Museum. Specimens weighing 10 to 30 pounds were common. Nearly all of the ore samples had a yellow oxidized coating $\frac{1}{4}$- to $\frac{1}{2}$-inch thick rimming a black interior of unoxidized pitchblende and sulfides. Many ore pieces exhibited com-

TABLE 2. SEMIQUANTITATIVE SPECTROGRAPHIC ANALYSES OF FIVE SOIL SAMPLES[1]

Element	Specimens 2046-SG				
	1	2	3	4	5
Si	M	M	M	M	M
Al	M	M	M	M	7.
Fe	3.	3.	3.	3.	3.
Mg	1.5	1.5	1.5	1.5	1.5
Ca	.7	.7	.7	.7	.7
Na	3.	3.	3.	3.	3.
K	3.	3.	3.	3.	3.
Ti	.3	.3	.3	.3	.3
Mn	.07	.15	.15	.07	.07
B	Tr	.003	Tr	Tr	Tr
Ba	.07	.07	.07	.07	.07
Be	.0003	.0003	.0003	.0003	.0003
Ce	0	Tr	0	Tr	0
Co	.0007	.0015	.0007	.0007	.0007
Cr	.003	.007	.003	.003	.003
Cu	.0015	.007	.003	.003	.007
Ga	.003	.003	.003	.0015	.0015
La	.003	.007	.003	.007	.003
Mo	.0007	.0015	.0015	.0007	0
Nb	.003	.003	.003	.0015	.0015
Nd	0	Tr	0	Tr	0
Ni	.0007	.0015	.0007	.0007	.0007
Pb	.007	.015	.015	.007	.003
Sc	.0015	.0015	.0015	.0015	.0015
Sr	.007	.015	.015	.015	.015
V	.003	.015	.007	.007	.007
Y	.03	.007	.007	.015	.007
Yb	.003	.0015	.0007	.003	.0015
Zr	.03	.03	.03	.03	.03
	160′ above deposit	12′ below deposit	100′ below deposit	700′ below deposit	0.7 mile on road

U. S. Geological Survey Laboratory, Denver, Colorado, TDS-8658 7-10-57, N. M. Conklin, Analyst.

[1] Permission to publish Tables 2, 3, and 4 is authorized by the Director, United States Geological Survey.

plete alteration to secondary uranium minerals. Some specimens consisted of pitchblende surrounding masses of brown fine-grained vein quartz. Other samples contained small brown inclusions in unoxidized ore which, on microscopic investigation, were found to consist of secondary uranium minerals. Within bedrock yellow veinlets of oxidized uranium minerals penetrated the brown schist near the fault zone. These veinlets diminished rapidly in size and number away from the fault.

MINERALOGY

Country rock. Most of the high-grade ore has been formed by complete replacement of quartz-feldspar-biotite schist in a small body along the fault zone adjacent to a pegmatite. The unaltered quartz-feldspar-biotite schist is composed of anhedral quartz grains, kaolinized and sericitized oligoclase and orthoclase, and biotite. Near the fault the quartz is fractured and filled with limonite veinlets, biotite is bleached, shredded, and largely altered to hematite and limonite along cleavages. The slightly altered schist shows fine-grained veins of chalcedony transecting the rock minerals. In the more severely altered schist, the biotite has been converted completely to hematite or limonite, feldspar has been altered to clay minerals, and the quartz grains are shattered. Veinlets of secondary uranium minerals commonly are present. A section of brown silicified rock from within the fault zone consists of hematite-stained quartz breccia composed of rock fragments and secondary uranium minerals in fine-grained chalcedony. Thin sections show that much of the feldspar is altered and replaced by silica and that the quartz grains are corroded. Fibrous secondary uranium minerals fill many of the fractures.

Spectrographic analyses of black ore, yellow ore, and altered brown schist are given in Table 3. The analyses suggest that the rock-forming mineral elements Si, Al, Fe, Ca, Mg, Sr, Ba and Ti decrease from brown schist to black ore. Substituting for these are the ore elements Ag, Cu, Pb and Sb. Apparently Mo, Y, Yb and Ni occur only in the black ore (pitchblende); the As, Sb and Ag are from tetrahedrite. Tetrahedrite and the copper sulfides account for the copper content of the ores. The elements Nb and Zr, are present in the black and yellow ores. In Table 4, the pitchblende analysis 2046W does not contain Nb. The Nb, if present, may have its original source in the pegmatites which are in the immediate vicinity of the deposit. The Zr probably occurs in isomorphous substitution in the uranium U^{4+} (Heinrich, 1958). Unusually high concentrations of zirconium in vein-type uranium deposits have been noted for the Central City district, Joe Reynolds mine, and Walnut Mountain, Tennessee (Walker and Adams, 1963). These deposits, which also have notable amounts of Mo, W and Y, have similar metal content to the uranium vein of the Lookout claim.

Ore Minerals. Ore specimens were examined in polished and thin sections. Individual minerals were identified by the *x*-ray powder diffraction method, and where this proved inconclusive, a spectrographic analysis was made. Radioactive minerals occurring in the high-grade uranium samples include: pitchblende, schoepite, ianthinite, "epiianthinite," becquerelite, oddyite, uranophane, boltwoodite, zeunerite, metazeunerite

Table 3. Semiquantitative Spectrographic Analyses of Black and Yellow Ores and Brown Schist

Element	2046S1 Black Ore	2046S3 Yellow Ore	2046S2 Brown Schist
Si	.7	7.	M
Al	.15	3.	7.
Fe	.15	.3	3.
Mg	.015	.03	.07
Ca	1.5	.7	1.5
Na	.3	.3	.3
K	0	0	M
Ti	.03	.7	.7
Mn	.03	.03	.015
Ag	.007	.015	0
As	0	7.	0
Ba	.007	.015	.07
Co	.001	.001	.001
Cr	0	0	.003
Cu	.3	.7	.07
Mo	.03	0	0
Nb	.3	.3	0
Ni	.007	0	0
Pb	.7	1.5	.3
Sb	.3	.3	0
Sr	.003	.03	0
U	M	M	M
V	0	.07	.015
Y	.07	0	0
Yb	.007	0	0
Zr	.3	.15	.03

0 looked for but not detected.
M maximum.
U. S. Geological Survey Laboratory, Denver, Colorado.
TDS-8256, 11-16-56, P. J. Dunton, Analyst.

and a hydrated autunite. One sulfosalt is present—tetrahedrite. Sulfides include chalcopyrite, sphalerite, galena, chalcocite, covellite, pyrite and marcasite. Also present is an unidentified radioactive red-banded to granular material.

Pitchblende of the Lookout claim appears in several distinct forms. The earliest developed unoxidized ore type occurs in massive irregular-shaped to rounded grains which range in diameter from a few tenths of a millimeter to 10 mm. Most of these grains are fractured and rimmed by a wide zone of concentrically banded pitchblende of lower reflectivity (Fig. 2). Under high magnification some of the massive grains show tapering, discontinuous veins that are characteristic of exsolution textures. However, these vein features were probably the result of filling of desiccation cracks that developed during hardening of gel-pitchblende (Fig. 3a). Another type includes micro-vein replacement of the massive grains, producing scalloped, isolated "island" remnants (Fig. 3b). Some of the massive pitchblende was partially redissolved along the micro-fractures before re-healing by later vein material, and prior to precipitation of the banded overgrowths of second generation pitchblende. The vein material does not extend into the concentrically banded rims of the overgrowths.

The botryoidal masses of second stage pitchblende range in size from a few millimeters to 10 mm wide to 50 mm in length. These bands are usually discontinuous around the massive grains. Some colloform blebs associated with massive grains show syneresis effects, with fractures filled with sulfides or secondary uranium minerals. The pitchblende usually alters to schoepite, but locally it has been transformed to a reddish-orange mineral (unidentified) which still retains the banded appearance of the colloform pitchblende.

X-ray diffraction measurements of cell edges in order to determine the

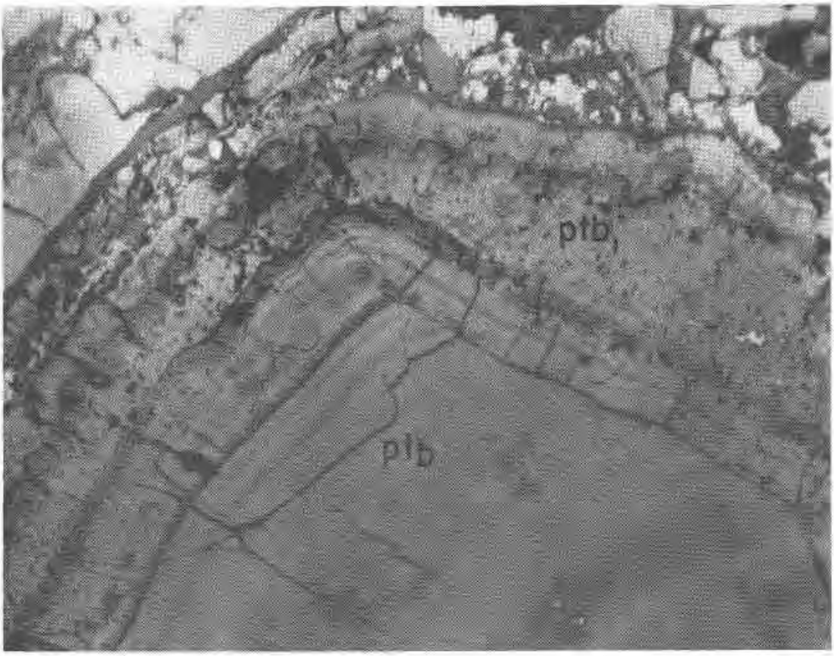
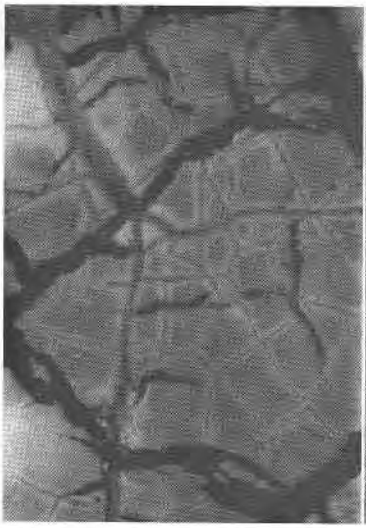


FIG. 2. Massive pitchblende (ptb) showing overgrowth of later banded colloform pitchblende (ptb$_1$) and brecciated fragments in matrix of oxidized uranium minerals and sulfides (white). Polished section, ×80.



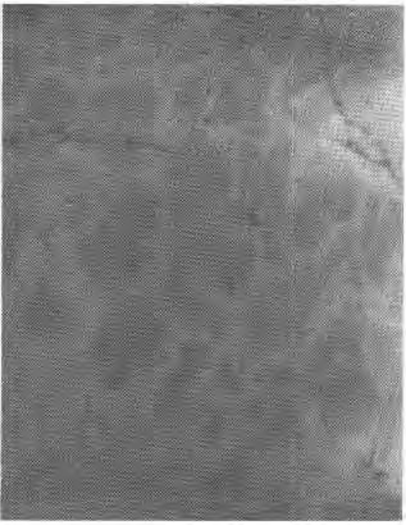


FIG. 3a. Pitchblende filling desiccation fractures in massive gel-pitchblende showing pseudo-exsolution texture. Polished section, ×400.

FIG. 3b. Vein replacement texture in massive pitchblende of first generation. Polished section, ×400.

approximate composition of dull and shiny reflective pitchblende gave values of $a = 5.424$ Å, $UO_{2.34}$ and $a = 5.406$ Å, $UO_{2.475}$ according to the chart of Brooker and Nuffield (1952). Spectrographic analyses of dull and shiny pitchblendes, including one that was submitted for chemical determination of UO_2, are given in Table 4. Impurities in the samples account for the iron, magnesium, calcium, bismuth, cobalt, and copper. The niobium, yttrium, molybdenum, zirconium, and tungsten occur within the pitchblende. The Lookout claim pitchblende contains metals similar to those given for the Central City district, Colorado (Table 2, p. 75, Walker and Adams, 1963). Most of the lead can be accounted for by the presence of tetrahedrite. Radiogenic lead will be discussed under age determinations in the Conclusions.

A red-orange granular mineral (?) occurring in black ore appears to retain the banded character of the pitchblende. In some specimens megascopic brown spots are actually the red-orange material rimmed by yellow-green "epi-ianthinite" and violet ianthinite. Repeated attempts to identify the material have failed. *X*-ray diffraction patterns produced only diffuse lines. The material was submitted for spectrographic analysis (Table 4). The red-orange material may be (1) a new potassium-aluminium-uranium oxide mineral, or more probably (2) a finely divided clay alteration of orthoclase, which has become saturated with uranium and stained red by iron oxide. In some polished sections, white granular material surrounded by pitchblende proved to be orthoclase.

Schoepite ($2UO_2 \cdot 5H_2O$) is the most abundant supergene alteration

TABLE 4. SEMIQUANTITATIVE SPECTROGRAPHIC ANALYSES OF PITCHBLENDES AND RED-ORANGE MATERIAL

Element	2046S4[1] Shiny Pitchblende	2046S6[1] Dull Pitchblende	2046AW[2] Pitchblende	Red-orange[3] Material
Si	—	—	1.0	—
Al	0	0	.3	3.
Fe	.15	.15	.3	1.5
Mg	.015	.015	.03	.015
Ca	1.5	3.	1.	.3
Ti	.7	.3	.03	.15
Mn	0	0	.03	.015
Ba	.007	.007	.1	.07
Be	0	0	.0003	—
Bi	<.2	<.2	0	—
Co	<.1	<.1	0	—
Cu	.07	.7	1.	.07
Mo	.7	.7	.3	1.5
Nb	.7	.7	0	.015
Pb	.3	.3	.1	.15
Sr	0	0	.03	.007
U	M	M	M	M
W	.7	1.5	0	—
Y	.07	.15	.1	.007
Zr	.7	.7	.1	.03
K	0	0	0	M
As	0	0	0	1.5
Cr	—	—	—	.003
Ag	—	—	—	.0007

— not looked for

0 looked for but not detected

Chemical Analysis of Pitchblende (2046AW) for U content[4]

% total U	% U^{4+}
65.9, 65.6	33.6, 33.3

[1] U. S. Geological Survey Laboratory, Denver, Colorado. TDS-8658, 7-10-57, N. M. Conklin, Analyst.

[2] U. S. Geological Survey Laboratory, Washington, D. C. TWS-3042, 3-1-57, C. Annell, Analyst.

[3] U. S. Geological Survey Laboratory, Denver, Colorado. TDS-9218, 1-20-58, J. C. Hamilton, Analyst.

[4] U. S. Geological Survey Laboratory, Washington, D. C. TWC-5540, 7-1-57, I. Barlow, Analyst.

product of the pitchblende. Its color ranges from deep yellow or greenish yellow to brownish orange. Schoepite appears in granular to bladed grains which replace pitchblende along curved boundaries between the two and along fracture surfaces in the primary ore. Occasionally it retains the banded character of the pitchblende. Schoepite veins pitchblende and also rock fragments.

Ianthinite occurs in red-violet to purple blades and fine-granular masses in the matrix and in narrow bands filling cavities. It has been difficult to identify because of its rapid oxidation to "epi-ianthinite." Ianthinite has also been identified by E. J. Young (Walker, p. 94, 1963).

"Epi-ianthinite" is associated with the red-orange material and purple ianthinite in the interstitial brown spots and in the matrix between botryoidal pitchblende grains. The mineral forms readily from breakdown of ianthinite and in turn alters to schoepite. The writer noted that some purple areas changed to yellow over a period of six months. An *x*-ray powder pattern for epi-ianthinite-type mineral altered from ianthinite is given by Frondel (1958, p. 61). The lines for this pattern are similar to powder patterns of the Lookout claim material. According to Guillenium and Protos (1959), epi-ianthinite is probably schoepite. In the Lookout ore the mineral is closely associated with yellow-green schoepite.

Becquerelite ($7UO_3 \cdot 11H_2O$) is an early alteration product of the unoxidized ore. Yellow veinlets of becquerelite transect schoepite and pitchblende. It fluoresces a weak yellow-green.

Soddyite $[(UO_2)(SiO_4)_2(OH)_2 \cdot 5H_2O]$ occurs in blocky, fibrous, deep-yellow to yellow-green crystals which vein other uranyl minerals in the matrix. The veinlets in turn are cut by later uranophane.

Uranophane $[(H_3O)_2(UO_2)_2(SiO_4)_2 \cdot H_2O]$ is found in radial fibrous aggregates in veins transecting pitchblende, soddyite, and sulfides. It occurs commonly in the altered biotite schist.

Boltwoodite $[K_2(UO_2)_2(SiO_3)_2(OH)_2 \cdot 5H_2O]$ has been identified by Honea (1961) from samples of the Lookout 22 claim. The mineral occurs in yellow fibrous clusters similar in association to uranophane.

Zeunerite and metazeunerite $[Cu(UO_2)_2(AsO_4)_2 \cdot 10\text{–}16H_2O]$ are in green square-shaped crystals. The zeunerite veins are found in brown altered schist, and a few veinlets transect high-grade yellow ore.

A hydrated autunite-like mineral has also been examined by *x*-ray diffraction methods, but results are inconclusive since most of the material dehydrated before *x*-ray examination.

The sulfide minerals fill fractures in pitchblende and occur in interstitial areas between botryoidal grains of pitchblende. In order of decreasing abundance, they consist of tetrahedrite, chalcopyrite, sphalerite, covellite, chalcocite, pyrite, marcasite, and galena.

Tetrahedrite is the most abundant base-metal mineral present. It occurs in discontinuous veins as well as fills syneresis fractures in pitchblende (Fig. 4). Some grains include blebs of chalcopyrite and veinlets of covellite. Grains range in size from less than a millimeter to 1.2×3.5 mm.

Chalcopyrite occurs in irregular masses and blebs in interstitial areas bordering pitchblende. Much of the chalcopyrite is rimmed by chalcocite or covellite.

Sphalerite is found in groups of euhedral, corroded and pitted crystals in the matrix with secondary uranyl minerals. The crystals range in size from 0.20 to 0.40 mm.

Chalcocite shows alteration rims of covellite.

Covellite occurs in anhedral masses in the matrix. The mineral veins tetrahedrite and chalcopyrite and replaces chalcopyrite and chalcocite along grain edges.

Galena, pyrite, and marcasite are rare; only a few grains were found in the polished sections studied. Their paragenetic relations to other minerals were not observed.

Hematite and limonite are abundant in altered wall rock and in the fault zone. Locally iron oxides have stained secondary uranium minerals of ore samples.

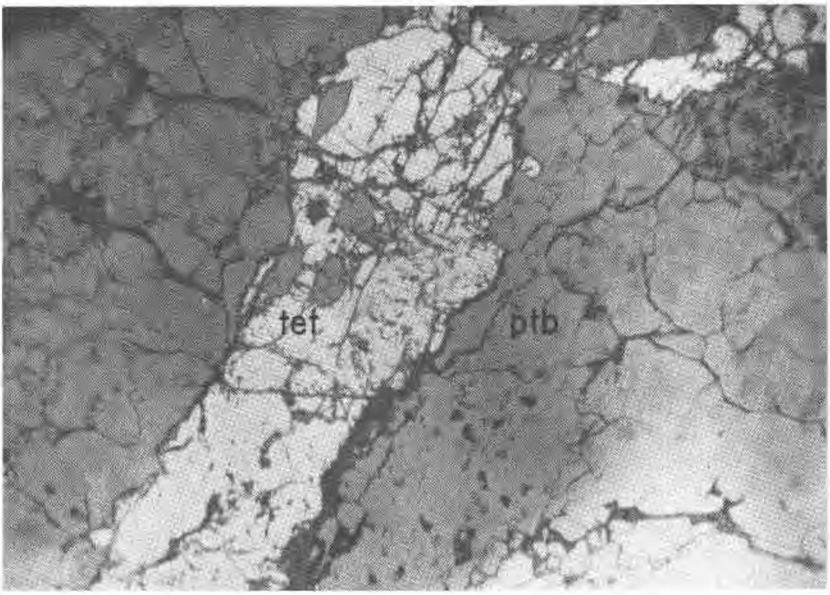


FIG. 4. Tetrahedrite (tet) filling fractures in pitchblende (ptb). Polished section, ×80.

PARAGENESIS

A paragenetic sequence of the ore minerals is given in Table 5. Early ore solutions precipitated within the fault zone colloform pitchblende along with fine-grained vein quartz. Nearly complete alteration and replacement of the quartz-orthoclase-biotite schist occurred in the fault zone. Subsequent movement in the vein brecciated and fractured the massive pitchblende. More uranium bearing solutions accompanied by sulfides precipitated pitchblende as banded overgrowths on earlier formed grains and tetrahedrite and sulfides filled fractures in the pitchblende and matrix between botryoidal masses.

TABLE 5. PARAGENETIC SEQUENCE OF MINERALS, LOOKOUT CLAIM

Vein quartz	XXXXXXXX		
Pitchblende	XXXXXXX		
Tetrahedrite		and BRECCIATION	XXXXX
Chalcopyrite			xxxxxx
Sphalerite			xxxxx
Chalcocite			xxxxx
Covellite			xxxxx
Pyrite			x?x
Galena			x?x
Marcasite			x?x
Hematite	XX?X		XXXXXXXXXXXXXXX
Ianthinite			xxxx
"Epi-ianthinite"		FRACTURING	xxxx
Schoepite			XXXXX
Becquerelite			xxxx
Soddyite			xxxx
Uranophane			xxxx
Boltwoodite			xxxx
Zeunerite			xxxx
Autunite?			xxxx

Supergene alteration of the vein pitchblende produced hydrated uranyl oxides and uranyl silicates and arsenates. The tetrahedrite and chalcopyrite altered to chalcocite and covellite, and sphalerite was corroded.

Hematitic alteration which is widespread in the vein and immediately adjacent wall rock may have acted as a reducing agent for precipitation of the colloform pitchblende as well as permeating in part the secondary uranium minerals and quartz within the vein and wall rocks during later supergene alteration.

CONCLUSIONS

A specimen of the pitchblende from the Lookout claim has been submitted for age determination. The results from this ore sample give discordant uranium-lead ages (T. W. Stern, pers. comm.)—namely, $Pb^{202}/U^{238} = 94$my, $Pb^{207}/U^{235} = 99$my, $Pb^{207}/Pb^{206} = 203$my.

$U = 65.61\%$ $Pb^{204} = 0.655\%$ $Pb^{207} = 12.75\%$
$Pb = 1.70\%$ $Pb^{206} = 60.39\%$ $Pb^{208} = 26.20\%$

The following factors may account for the age discrepancies:

1) Results are based on inadequate sampling. More specimens of pitchblende from the Marshall Pass district should be used for age determinations to obtain an average age.
2) The large amount of nonradiogenic lead present (Pb^{204}) may be due to impurities, namely tetrahedrite, which transects the uraninite in minute veinlets.
3) Microfaulting in the pitchblende and near-surface conditions of the deposit which was subjected to weathering could result in leaching of the lead isotopes.
4) Russell and Ahrens (1957) noted that apparent alteration at each stage during mineralization increased with increasing values of the "true age."

Thus the microbrecciation, the possibility of more than one period of mineralization, the contamination of tetrahedrite, and lastly the alteration of the near-surface deposit all contribute to the age discrepancies.

In conclusion, the deposit may be classified as a dominantly uranium vein, low in sulfides of epithermal character. The deposit was exposed *in situ* in alluvium by weathering of the bedrock.

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