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FREE ENTERPRISE URANIUM PROSPECT,
JEFFERSON COUNTY, MONTANA

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ABSTRACT

The Free Enterprise property is located in the Boulder mining district, Jefferson County, Montana. Secondary uranium minerals occur here in small irregular concentrations in and adjacent to a narrow silicified fracture zone in quartz monzonite. The zone has been prospected to a depth of 150 feet. Small amounts of a black to brownish uranium mineral, presumably pitchblende, have been observed, and the secondary minerals are characteristic of the alteration of pitchblende and uraninite. Indications are that a primary uranium mineral which was introduced with quartz and sulphides has been reconstituted by the action of surface and near-surface waters, reprecipitating uranium in secondary minerals. Below the present water level, where the vein is relatively unaltered and unenriched, only small amounts of uranium are present.

INTRODUCTION

The Free Enterprise property, in the Boulder mining district, Jefferson County, Montana, is in Section 19, T. 6 N., R. 4 W., Montana Principal Meridian, or about two miles northwest of the town of Boulder,

county seat of Jefferson County (Fig. 1). U. S. Highway No. 91 passes through Boulder, as also a branch of the Great Northern Railroad from Havre to Butte. Boulder is 30 miles from Helena and 36 miles from Butte.

The Free Enterprise and Boulder Mercury groups (Plate I) include 29 unpatented claims, owned by Edward C. Miles, Helena, Sanford Davis and Wade V. Lewis, Boulder, and are under lease and option to the Elkhorn Mining Co., of Boulder. The presence of radioactive material in the Boulder area was first brought to the attention of the Atomic Energy Commission's New York office when a sample was submitted for analysis by Mr. Lewis in June 1949. The Sunshine Mining Co., of Kellogg, Idaho, became interested in the property, and soon thereafter completed an operating agreement and began preparations for shaft sinking and other developments.

Geography

The Boulder mining district lies about 20 miles east of the Continental Divide in an area with a relief of about 2000 feet. Summits of the mountain peaks are rounded and attain elevations of nearly 7000 feet. Intermittent streams have dissected moderately steep canyons and valleys which drain into the Boulder River, a tributary of the Missouri. The town of Boulder, with a population of about 500, is at an elevation of 4900 feet. It is situated beside the Boulder River where the canyon begins to widen eastward into a broad valley.

**INDEX MAP OF MONTANA SHOWING LOCATION
OF JEFFERSON COUNTY**

JEFFERSON COUNTY, MONTANA

Fig. 1

North-facing slopes are covered with abundant evergreen timber, and bunchgrass abounds throughout the area. The climate is semi-arid, with an annual precipitation of from 15 to 20 inches. Summers are warm and pleasant and the winters are cold, annual mean temperatures ranging from 90° to 35° F.

The granitic country rock weathers into rounded slopes covered by a thin veneer of overburden and crossed by bold outcrops of quartz veins and aplite dikes. Rock exposures are large and numerous.

History

Silver Bell claim reportedly was staked as a silver prospect about 25 years ago. A few prospect holes were excavated before the Silver Bell shaft was started. The shaft was inclined on the dip of the vein and was sunk to a depth of 80 feet. At this point a cross-cut was driven about 20 feet into the hanging wall. Although a few spotty samples assaying as much as several hundred ounces of silver are said to have been obtained from the shaft, the project was abandoned.

Early in 1949, Mr. Sanford Davis found radioactive material on the old Silver Bell shaft dump. Mr. Lewis and Mr. Miles were invited to become partners in the venture. Investigation of the shaft disclosed that the air in the shaft was highly charged with radioactive particles; this radioactivity was quickly dispelled when ventilation was installed.

GENERAL GEOLOGY

Regional

The Free Enterprise deposit lies wholly within the Boulder batholith, an elongate granitic mass which outcrops over a length of 60 miles, and averages about 18 miles in width. The Boulder batholith, so named by Weed ¹ from the mountains throughout which it is exposed, extends from the Highland Mountains 16 miles south of Butte, to Mallan pass, a few miles north of Helena. Although locally referred to as granite, or Butte granite, the rock of the batholith is predominantly quartz monzonite. Typically it is sheeted and weathers to huge boulders. Locally the quartz monzonite is broken by pronounced systems of jointing. The rock has been quarried for building stone in at least two localities near Helena.

Aplite is common within the Boulder batholith and around its margins. The aplite forms dikes and irregular masses, some of which cover several square miles. Although aplite is abundant, pegmatite is rare ². The nearest contact with other rocks is about three miles southeast of Boulder, where the batholith is intrusive into andesites which overlie Paleozoic and Mesozoic sediments (Fig. 2).

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1. Weed, W. H., Granitic rock of Butte, Montana, and vicinity: Jour. Geol., vol. 7, 1899, p. 737.
 2. Knoph, Adolph, Ore deposits of the Helena mining region, Montana: U. S. Geol. Surv. Bull. 527, 1913, p. 34.

**GEOLOGIC MAP OF BOULDER MINING DISTRICT
AND VICINITY
JEFFERSON COUNTY, MONTANA**

0 10 20 MILES

Fig. 2

LEGEND

Qa	Recent
ALLUVIUM	
Tib	Tertiary
LAKE BEDS	
TKi	Late Cretaceous and
INTRUSIVES	
TKv	Early Tertiary
VOLCANICS	
KJe	Jurassic
SH & SS	
PC	Permian and Carboniferous
QTZITE & SH	
Cm	Carboniferous
LS	
Dc	Devonian through Cambrian
SH & LS	
pCb	Pre-Cambrian
BELT SERIES	

From Geologic Map of Montana by
Andrews, Lambert, and Stose
1944

Plate I

Local

The radioactive vein occupies a fracture zone in quartz monzonite and aplite. The aplite occurs as two distinct, nearly horizontal sheets having sharp contacts with the enclosing quartz monzonite. Nature of the contact indicates that, although the two rock types are genetically related, the aplite is younger than the main igneous body. Pockets of coarse-grained pegmatite are not uncommon in the aplite. The quartz monzonite is granoblastic in texture, probably as a result of recrystallization near the quartz monzonite-aplite contact.

The deposit is near the periphery of the Boulder batholith. There are no major faults or veins in the immediate vicinity, although a number of small structures reflect a pattern of northeasterly trending veins and shear zones intersected by slips and small faults nearly at right angles to them.

ECONOMIC GEOLOGY

Boulder mining district

Economic ore deposits within the Boulder mining district are few, small, and scattered. The deposits in general occupy short irregular veins enclosed in quartz monzonite and aplite. The mineralogy is simple and usually consists of quartz, pyrite, sphalerite, galena, and chalcopryrite. Silver, lead, and copper are the principal ore metals, although gold is also present in small amounts³. Mercury has been reported in trace amounts from a few small veins.

3. Knopf, Adolph, op. cit., p. 120.

Free Enterprise prospect

This deposit is essentially a siliceous filling of a steeply dipping fracture zone in quartz monzonite and aplite. The zone of silicification varies in width from a few inches to about 2 feet, though the central sulphide-bearing portion is 6 inches or less in width. The mineral assemblage and general character of the vein indicate that it should be classed as mesothermal.

Mineralogy. Principal sulphide minerals in the Free Enterprise vein are galena and pyrite. Ruby silver has been observed, and native silver is present in small amounts. Molybdenite, pyrite, and chalcopyrite, are disseminated in the wall rock adjacent to the vein, particularly in the aplite. Arsenopyrite is reportedly present in microscopic amounts. Quartz is the only non-metallic gangue mineral observed; it occurs in a variety of forms, including white vein quartz, smoky quartz, black and brownish cherty quartz, and tan opal. From megascopic examination it appears that the vein quartz accompanied the early sulphides and was later brecciated and recemented by black cryptocrystalline silica which also contains sulphides. The opal apparently is a later phase and fills cracks and forms the lining of vugs. Quartz having a smoky appearance occurs as grains in the vein material and granitic wall rock. It is not known whether the smoky appearance is related to radioactivity.

No primary uranium mineral has been positively identified, although a few black grains that may be uraninite or pitchblende have been observed. It is not known at what stage the primary mineral was introduced. The black, cherty quartz exhibits slight radioactivity which may also derive from a primary uranium mineral. Secondary

uranium minerals which include metatorbernite, torbernite (?), autunite, and an unidentified yellow mineral of the gummite type are present. Some of these secondary minerals are found as much as two feet from the vein in the altered granitic wall where they are readily observed under ultra-violet light. The oxidized minerals occur in small, irregular concentrations in and along the vein above the present water level. Below the water level (120 feet from collar), radioactivity is slight, but even here it is largely attributed to secondary minerals which have been observed along cracks and in vugs. In general, relatively fresh vein material containing abundant sulphides exhibits low radioactivity. Silver values roughly parallel the variations in uranium content, and specimens showing enriched concentrations may yield high assays for each.

Considerable limonite, manganese oxide, and traces of secondary copper minerals occur throughout the deposit. These extend at least to the lowest level (141 feet), although the present water level is at 120 feet.

Structural features. The Free Enterprise vein occupies a steeply dipping fracture zone in granitic country rock. Striking N. 60° E., the vein dips 80° to the northwest. Well developed slickensides indicate some horizontal movement in the plane of the vein. The pronounced brecciation can also be explained by this movement. A number of small steeply dipping cross-faults intersect the vein, and offsets a few inches to a foot or more are common. The structure can be followed on the surface for nearly 400 feet.

The two flat-lying aplite bodies appear to have a structural effect on the vein. Within the aplite the vein is noticeably narrower and tighter than it is in the quartz monzonite. The occurrence of the vein within aplite on the 141-foot level may, in some measure account for the very poor showing at this elevation.

EXPLORATION

In 1949 the Sunshine Mining Company entered an agreement with Mr. Lewis and Elkhorn Mining Company to explore the property. The shaft was re-timbered and deepened to about 150 feet from the collar. At 141 feet the vein was drifted on for a total of 90 feet. The results of this work were discouraging. The next move was to prospect the vein higher in the shaft at the elevation of the bottom of the original 80-foot shaft. The east drift was advanced 57 feet and stopped in extremely hard silicified aplite. The west-side drift was then advanced to 62 feet from the shaft, exposing irregular spots of radioactive material. At 40 feet from the shaft, on the west side, the most radioactive disseminated zone in wall rock (foot wall) was encountered. Fluorescent radioactive minerals occurred disseminated in the altered quartz monzonite for a distance of about 2 feet from the vein. The strike length of this zone was about 15 feet. A raise was started in this material and it was exposed to a height of 15 feet above the drift.

Sunshine Mining Company discontinued exploration work in April, 1950, but developments were continued by the Elkhorn company. Since the shaft was flooded to within 120 feet below collar, all new work

was confined to the 80-foot level (Plate II). This included: (a) advancing the northeast drift to 105 feet from shaft; (b) advancing the southwest drift to 128 feet from shaft; (c) mining two small overhand stopes 20 and 40 feet east of the shaft; (d) sinking a 16-foot winze in the southwest drift at 110 feet from shaft. All of these workings were on the main vein, except the interval 72 to 107 feet in the southwest drift, where the vein deviated and became weak. The vein was re-encountered after passing an aplite dike crossing the drift, and a small but rich silver-uranium shoot then exposed was the reason for the winze; at a depth of 16 feet, the vein is deficient in values. In the northeast drift, the vein is slightly offset by a series of cross-fractures, but retains fair radioactivity for 80 feet from shaft, beyond which point it becomes narrower and less radioactive. Plate II records (in counts per second) a radioactivity traverse along the 80-foot level.

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