TUNGSTEN RESOURCES OF MONTANA: DEPOSITS OF THE MOUNT TORREY BATHOLITH, BEAVERHEAD COUNTY

By Eldon C. Pattee
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TUNGSTEN RESOURCES OF MONTANA: DEPOSITS OF THE
MOUNT TORREY BATHOLITH, BEAVERHEAD COUNTY

By

Eldon C. Pattee

Summary and Introduction

THE BUREAU OF MINES began an investigation of tungsten resources of Montana in September 1953. This report presents information obtained from July 1955 to September 1957 on tungsten deposits in and near the Mount Torrey batholith. The batholith comprises part of the Pioneer Mountains of Beaverhead County in the southwest corner of Montana.

Included in the report are assays and preliminary-examination data on 22 properties. Tungsten minerals are known to occur in 19 of the properties. The major producer is the Brown's Lake mine which has produced more than 625,000 tons of ore.

Nearly all of the deposits are in the Lost Creek, Utopia, and Bald Mountain mining districts along the east and south margins of the Pioneer Mountains. The districts are less than 27 miles from Dillon, Mont.

In general, the deposits can be divided into two types: Contact metamorphic deposits and quartz-fissure-vein deposits. There also is one isolated occurrence of tungsten minerals intermixed with manganese oxides in mantle rock. The contact metamorphic deposits consist of tactite containing disseminated scheelite and powellite. These deposits generally are the most extensive; the average grade is less than 0.47 percent tungsten trioxide (WO₃). The largest deposit is about 4,470 feet long and a maximum of 160 feet wide; the tungsten minerals occur sporadically. The quartz-fissure veins occur in the batholith or in small stocks nearby and are limited in size.

Small, irregular areas within the sparsely mineralized tactite zones may contain to 2 percent WO₃, but they seldom can be mined separately because of their small size and irregular distribution.

ACKNOWLEDGMENTS

The cooperation and assistance of the property owners, especially the Minerals Engineering Company, Grand Junction, Colo., are gratefully acknowledged.

Project work was under the general supervision of Wing G. Agnew and under the direct supervision of J. A. Bowsher. G. T. Krempasky assisted in field work.

Acknowledgment is made for information obtained from previous work by C. C. Popoff and J. S. McNabb under a project in cooperation with the Bureau of Reclamation for the Missouri Basin Development Program.

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6 Glow Worm prospect and Greenhorn claim
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16 Elkhorn—Beaverhead mines
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18 Echo Lode
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20 Virginia claim
21 Little Hawk mine
22 T.D.6 prospect

Figure 1.—Tungsten Prospects and Mines of the Mount Torrey Batholith.
GEOGRAPHY

Physical Features

The Pioneer Mountains, covering an area of approximately 1,000 square miles, are bounded on the west, north, and partly on the east, by the Big Hole River, and on the east and south by the valleys of Beaverhead River and Grasshopper Creek. This report covers tungsten prospects in the east portion of the mountains (fig. 1).

The mountain range is topographically rugged and diverse, consisting of high glaciated mountains, glacial valleys, narrow canyons, and rolling foothills. Broad grass-covered uplands occur at about the 8,500-foot level. The highest mountains in the range are two peaks about 11,150 feet in altitude. Total relief of the range is about 6,000 feet, but locally relief usually is less than 3,000 feet. The Big Hole and Beaverhead Rivers and numerous tributaries form a radial drainage pattern. Wise River, a major tributary of the Big Hole, heads near the center of the mountains and flows northward.

The main valleys and foothills are sparsely forested with various species of conifer. The intermediate slopes are heavily forested, but higher slopes are bare. Various species of hardwood grow along streambeds and sides of some valleys. Sagebrush covers the untimbered areas, except for the higher rocky peaks. Underbrush is usually sparse, and soil mantle is thin, making prospecting relatively easy, though in several places there is deep glacial moraine.

TRANSPORTATION

A branch line of the Union Pacific Railroad that extends from Butte, Mont., to Salt Lake City, Utah, follows the valleys of the Big Hole and Beaverhead Rivers along the east side of the mountains. Highway transportation is by U.S. Highway 91 on the east margin of the mountains and State Highways 46, 43, and 36 on the north, west, and south, respectively. Several county and Forest Service roads provide only limited access to more rugged areas. One such road follows approximately the course of Wise River and Rattlesnake Creek through the mountains.

INDUSTRIES

The main industries of the area are ranching, farming, mining, and some logging. Mineral production from the area has consisted principally of ores of tungsten, lead, zinc, silver, and gold. The Brown's Lake tungsten deposit developed by Minerals Engineering Company, Grand Junction, Colo., has been the major mining activity in the mountains in recent years. The operation was discontinued in 1957, when the Federal stockpiling program was suspended.

The area is not heavily populated, but plenty of skilled mine labor is available because of the many mining activities nearby. Dillon, Mont., the county seat of Beaverhead County, has a population of 3,200, and a few other communities in the area have about 200 residents. Butte, Mont., 67 miles north of Dillon, is the nearest source of mining supplies; general supplies and some housing are available in small communities near the deposits.

CLIMATE

The climate is semiarid, with wide variations in daily and seasonal temperatures. The summer months usually are clear and warm, with temperatures seldom above 100° F. In winter the temperature occasionally drops to −30° F., with as many as 30 days of subzero weather during severe periods. The climate is modified occasionally by warm, moist winds from the Pacific coast.

Annual precipitation, mainly from winter snow and spring rains, averages 15 to 20 inches. Snow usually blankets the area from November through April. High elevations are covered with snow to depths of more than 3 feet for an additional 3 or 4 months.

GENERAL GEOLOGY

The geology of the area is described in various publications of the Federal Geological Survey and Montana Bureau of Mines and Geology. Reference is made to publications at appropriate places throughout the report.

The principal formations of the area are sedimentary and metamorphic rocks ranging in age from Precambrian to Tertiary (fig. 2). The sedimentary rocks on the east side of the mountains have been intruded by the Mount Torrey batholith and a few small stocks. The batholith, which is largely granodiorite and quartz monzonite, was emplaced during the erosion interval between deposition of Paleocene and Oligocene sediments. It is surrounded by sedimentary rocks from Precambrian to Upper
Figure 2.—Geologic Map of the Mount Torrey Batholith Area. (Adapted from Geologic Map of Montana by Federal Geological Survey and Montana Bureau of Mines and Geology.)
Cretaceous in age, except for Tertiary sediments in the valleys of Wise River and Grasshopper Creek. Portions of the intrusive are covered with glacial drift. Tertiary volcanics occur near the south margin of the mountains.

The sedimentary rocks on the east and south margins of the batholith have been complexly folded and faulted; they have a well-defined north to north-northeast trend, with predominately steep dips to the east. Numerous north-trending anticlines and synclines, some of which are overturned, have been mapped. The Kelley thrust, a major thrust fault with a 2-mile-wide zone containing lesser thrusts, trends north-northwest at the east edge of the batholith. It roughly parallels the strike of the formations. Steeply dipping normal faults occur at oblique angles to the thrusts.

The sedimentary rocks have been metamorphosed by the intruding rocks. On the east side of the batholith, metamorphism extends 1 to 1½ miles east from the contact. Additive metamorphism, produced partly by accessions from the intrusive, is limited to areas generally a few score to a few hundred feet from the intrusion.7

The contact metamorphic deposits, composed of tactite, have been formed by additive metamorphism of Carboniferous Amsden limestone and older calcareous rocks. The tactite is usually coarsely crystalline, but occasionally massive. It is generally composed of andradite garnet, with smaller amounts of quartz and calcite. Tungsten minerals in the tactite are scheelite and powellite. Various copper minerals occur locally. Epidote, diopside, magnetite, specular hematite, and limonite are found in places. The scheelite (CaWO₄) occurs as very small, disseminated crystals. Powellite (CaMoO₄) forms an isomorphous mixture with scheelite. The scheelite almost invariably fluoresces yellow. This property is nearly identical to that in powellite.

Quartz fissure veins occur within the intrusives at a considerable distance from the margin. The tungsten minerals in the veins are scheelite and wolframite, occurring as irregular masses and crystals scattered through the veins. Ferberite and hübnerite also have been tentatively identified.

**LOST CREEK MINING DISTRICT**

The Lost Creek or Brown’s Lake mining district is 9 to 12 miles by road northwest of Glen, Mont. (fig. 1). The northern part of the district is 9 miles west of U.S. Highway 91 by the Rock Creek road. The southern part, in the vicinity of Lost Creek, is accessible by a private graded dirt road from the Minerals Engineering Co. mill, 4 miles northwest of Glen, the nearest rail-shipping point. The dirt roads are adequate for ore hauling because of the high gravel content of the soil.

The Brown’s Lake mine is the largest producer in the district. The tactite zone at the Lost Creek mine is of greater areal extent but of lower grade.

Tungsten was discovered in 1907 on Lost Creek and in 1942 on Rock Creek near Brown’s Lake. There are four tungsten mines and prospects in the district (table 1). In 1944 a mill was constructed on the Garnet claim near Brown’s Lake and has produced a few hundred pounds of concentrates. The Minerals Engineering Co. constructed a mill in 1953 near Glen to process ore from both the Lost Creek and Brown’s Lake areas. To February 1957 the district produced about 646,300 tons of ore (table 1), containing 0.18 to 0.48 percent WO₃.

The district is in a rugged, mountainous area on the east side of the Pioneer Mountains. Drainage is eastward into the Big Hole River by Storm Park, Rock, Lost, and Willow Creeks. The area ranges from 5,000 to 9,000 feet in altitude; higher elevations have been glaciated. Vegetation, glacial moraine, and heavy overburden in some places make prospecting and mining fairly difficult. Outcrops often stand out in bold relief and form cliffs a few hundred feet high.

The batholith is largely granodiorite in the Brown’s Lake area. Quartz monzonite occurring in the area is believed to be a facies of the intrusive.

In the area between Rock Creek and Lost Creek, the batholith contacts sedimentary rocks from Triassic to Mississippian in age. The formations strike northwesterly and dip gently eastward. South of Lost Creek the contact is south trending and roughly parallels the contacting Carboniferous Amsden and Quadrant formations.

Most faults in the district trend north to northeast. Major faults on Lost Creek have displaced formations to the northeast for nearly a mile.

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7 Myers, W. B., Geology and Mineral Deposits of the Northwest Quarter Willis Quadrangle and Adjacent Brown’s Lake Area, Beaverhead County, Mont.: Geol. Survey Open File Rept., 1952, p. 18.


9 Work cited in footnote 7, pl. 1.
In the district, scheelite and powellite occur in tactite that has been formed by additive metamorphism of marble and hornfels. The largest tactite body in the district is at the Lost Creek mine, and outcrops and exposures extend intermittently for 4,470 feet with a maximum horizontal width of 160 feet. The tungsten minerals occur sporadically.

**DEPOSITS**

**BROWN'S LAKE MINE**

The Brown's Lake mine, also known as the Ivanhoe mine, was the leading tungsten producer of Montana from 1954 through 1956 and ranked high among domestic producers. Mining was discontinued in February 1957.

One large and two small tactite bodies containing scheelite and powellite have been mined from a cut in metamorphosed sediments and glacial moraine on the property. The main ore body is from 60 to 80 feet thick and has been mined for an average length of 860 feet. It can be traced by outcrops for 490 feet beyond the mined area and appears to be covered by mine waste further west.

The deposit is about one-half mile southeast of the Rock Creek road and 8.9 miles west of U.S. Highway 91 at an elevation of 7,000 feet on the south wall of the easterly trending glaci-ated canyon in which Rock Creek and Brown's Lake lie. In places the canyon walls are nearly vertical, forming cliffs a few hundred feet high. The deposit (figs. 3 and 4) crops out in a cliff of this nature.

The American Alloy Metals, Inc., conducted underground and surface exploration at the deposit from 1951 to 1953 under a Defense Minerals Exploration Administration contract.

The Minerals Engineering Co., subleased the property in 1953, and mining began in October. The company mill for processing ore from this deposit and the Lost Creek mine was completed the following month. The property had produced 625,107 tons averaging 0.35 percent WO3, by 1957 when mining was discontinued.

The deposit is on the east margin of the Mount Torrey batholith, where the intrusive contacts metamorphosed sediments of the Amsden formation.10 The metamorphic rocks are covered on the east end of the cut by glacial moraine and are terminated on the west by granodiorite. Where exposed in the mine road, the contact with granodiorite is a fault that strikes N. 20° E. and dips 75° E. Quartz monzonite, with the upper surface approximately parallel to quartzite of the Amsden formation, outcrops in cliffs below the deposit. In the highwall of the cut alternating beds of marble, hornfels, and quartzite are exposed (fig. 5). Aplitic sills and two tactite bodies are intercalated between the alternating beds.

The tactite was formed by additive metamorphism of Amsden sediments. A sample of tactite submitted for ore dressing tests contained some biotite, chalcopyrite, limonite, malaclite, amphibole, magnetite, and traces of cerussite and bornite. The scheelte particles ranged in size to a maximum of 48-mesh and were not liberated from the copper minerals above 100-mesh. Scheelite crystals over 6 mm long are known to occur at places in the de-

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10 Work cited in footnote 7, pl. 2.
deposit. Samples of the tactite assayed from 0.104 to 0.358 percent WO₃.

The main ore body strikes N. 50° W. to N. 57° W. and dips southwesterly 30° to 37°. A bed of marble and four or more beds of hornfels, 2 to 3 feet thick, occur in the ore body. The marble is barren, but the hornfels which grades into tactite contains a small amount of scheelite. The footwall of the ore zone is a fault approximately parallel to the bedding. The zone is terminated down dip by granodiorite. The surface of the granodiorite, where exposed at the east end of the cut, strikes N. 70° W. and dips northeasterly about 80°.

At the west end of the mined area where samples 4 and 5 were taken, the horizontal, exposed width of the ore is 117 feet, and the exposed depth is 30 feet. Debris covers the footwall at this point. Most of the ore has been removed from the mined area; however, a block of ore 190 feet long remains where sample 6 was taken. The width and depth of the block are not known. Traces of tactite also were left along the footwall and along the granodiorite.

A scheelite-bearing tactite bed 9 feet thick occurs above the main ore body. The two ore bodies are separated by barren marble up to 16 feet thick. At the east end of the cut the two ore beds are in juxtaposition, caused by a fault nearly parallel to the bedding. The narrow tactite can be traced for 700 feet west from the convergence of the beds but appears to be covered by debris further west.

An isolated ore bed, a maximum of 13 feet thick, is about 90 feet stratigraphically above the main ore body. The ore can be traced westward for 420 feet from the overlying glacial moraine. The west end appears to pinch out, but it is in the highwall of the cut and is inaccessible.

Mining from the cut has been accomplished by advancing a series of benches. Most of the underground workings have been destroyed by excavation or have been covered with debris; however, at the east end of the cut a partly destroyed adit is in granodiorite. Another opening is visible near the center of the highwall but is inaccessible.

Overburden has been excavated with wagon drills, bulldozers, front-end loaders, and dumpers. Disposal of waste was relatively easy because of the steep slopes and cliffs below the deposit. After stripping overburden, the ore was mined by modified open-pit methods.
Most of the ore was broken by blasting vertical holes drilled from benches about 30 feet high; considerable secondary blasting was necessary. Broken ore was loaded into trucks by front-end loaders and power shovels and was transported 8.5 miles to the mill.

The mill produced a high-grade concentrate (fig. 6) averaging 55 percent tungsten, 0.25 percent copper, 0.25 percent lead, and varying amounts of phosphorus and sulfur. The concentrates were shipped to Salt Lake City and delivered to the General Services Administration after the impurities were leached to meet Government specifications. Middlings or low-grade concentrates were sent to the chemical upgrading plant of the Salt Lake Tungsten Company, where a 65 percent WO₃ concentrate was produced.¹¹

FLUORESCENT CLAIMS

The Fluorescent claims are principally on the north side of Rock Creek. The Garnet adit, one of two on the claims, is on the Rock Creek road, about 1 mile northwest of the Brown's Lake mine.

The largest exposure on the property is a 130-foot-long outcrop of mineralized tactite on the Mammoth claim, northeast from the Garnet adit. Scheelite and powellite also occur in small exposures of tactite and limestone near the Garnet adit and on the Star claims to the north (fig. 7).

The Bureau of Mines did some bulldozer trenching in 1942 on the Garnet claim under the wartime strategic minerals program. In 1944 a small mill was constructed near the Garnet adit, and a few hundred pounds of concentrates was produced.¹²

The contact of the Mount Torrey batholith and Amsden limestone trends northwestward across the property. The Amsden and overlying formations trend about N. 25° W. and dip about 25° northeasterly. Outcrops form cliffs a few hundred feet high at the west end of the property.

The Garnet adit is caved near the face. No mineralized tactite is exposed in the adit; how-


Figure 6.—Flowsheet of Minerals Engineering Company Mill.
Figure 7.—Rock Creek Area, Beaverhead County, Mont. (Modified from Defense Minerals Exploration Administration map by W. B. Myers)
ever, tactite 5 feet wide and 6 feet high is exposed in the north side of a bulldozer cut, 170 feet north of the portal. The tactite is in partly decomposed marble, which is bounded on the west by granodiorite. The broken nature of the rock in the cut indicates that the exposure is in landslide. A 5-foot chip sample across the thickness assayed 0.304 percent WO₃.

Broken and partly altered limestone, containing disseminated scheelite, is exposed for 40 feet along the side of a trench near the first switchback on the Storm Park trail approximately 700 feet north of the Garnet adit. The limestone strikes northwestward and dips about 39° to the southwest. It is covered beyond the trench. A 40-foot chip sample taken along the exposure assayed 0.162 percent WO₃ and 0.06 percent molybdenum (Mo).

A tactite bed 6 feet thick is exposed for 35 feet along the side of a bulldozer trench on the Star claims. The bed strikes N. 65° E. and dips at 21° to the southeast. A sample taken across the width assayed a trace of tungsten. Two small pits 160 feet to the northeast contain some mineralized tactite. A few hundred feet east of the bulldozer trench a tactite bed 6 feet thick is exposed by two small pits 40 feet apart.

The bed strikes northeasterly and dips northwesterly at about 29°. A grab sample contained a trace of tungsten.

On the Mammoth claim an adit has been driven into a tactite bed for 53 feet into the hillside. The bed is 9 feet thick, strikes N. 25° W. with a dip of 24° to the northeast, and is a few feet above the quartz-monzonite contact. The outcrop extends 130 feet west of the adit, and broken tactite is uncovered 270 feet farther west on the projected strike. It is covered to the east except for two small exposures less than 300 feet away. Two 9-foot chip samples taken 12 and 102 feet west of the adit assayed 0.122 and 0.026 percent WO₃, respectively.

**LOST CREEK MINE**

The Lost Creek mine (fig. 8) ranks second to Brown’s Lake in production from the district. It is 3 miles southeast of the Brown’s Lake mine, 8.8 miles by road northwest of Glen, and extends across the easterly flowing Lost Creek.

On the south slope of the canyon float and exposures of scheelite and powellite-bearing tactite occur for a slope distance of about 4,470 feet and a difference in elevation of 1,320 feet.
The mineralized zone is developed by the “B” adit near the north end of the zone, the “H” adit near the south end, and numerous bulldozer trenches. Small tactite bodies on the north side of the creek are intermittently exposed in a series of open pits and cuts 880 feet long and 170 feet wide. In general, the samples contained from a trace to 0.48 percent WO₃; a few ranged to 1.33 percent.

Tungsten minerals were first discovered on Lost Creek in 1907, and extensive exploration was conducted by the Minerals Engineering Company in 1952 and 1953 under a Defense Minerals Exploration Administration contract. Production from 1952 to August 1956 totaled 21,150 tons averaging 0.18 percent WO₃.

The deposit is in metamorphosed Amsden sediments near the contact with quartz monzonite of the Mount Torrey batholith. The contact trends in a northerly direction and dips easterly from 40° to vertical. Rocks on the north side of the canyon have been offset about 2,400 feet to the east by northeast-trending faults. Scheelite, occurring in crystals usually less than 2 mm. long, but occasionally as much as 2.5 cm. long, is disseminated sporadically in the tactite. Powellite and malachite occur in places.

Selected portions of tactite have been mined by raises from “B” adit and in two pits to the south. Overburden has been removed from the tactite zone for 855 feet south (figs. 9 and 10) of the portal, and the horizontal exposed width averages 87 feet. The south end of the stripped area is 315 feet higher than the adit. Lenses and beds of barren hornfels, marble, and quartzite in the zone contribute to dilution in mining. Faults, which roughly parallel the bedding but dip at a steeper angle, have broken the continuity and created areas of heavy ground. Possible extension of the zone north of the portal is obscured by overburden, but “A” trench to the north has exposed broken tactite. The zone is covered southward to “E-1” cut, except for “E” cut (fig. 11). Float in this area is quartz monzonite.

The zone is well exposed from “E-1” cut to 92 feet south of “F” cut (figs. 12 and 13). Bulldozer cuts between “F” cut and “H” cut to the south are sloughed. Some tactite with scheelite is in the debris of the cuts.

The tactite zone is also well-exposed from 70 feet north of “H” cut to 570 feet south of the portal. Underground workings and diamond-drill holes indicate that the horizontal width is a maximum of 157 feet. Ore has been mined from “I” pit at the south end of the area. At the pit, the zone strikes N. 9° W. to N. 6° E. and dips eastward at 53° to 55°.

About 4,000 feet north of Lost Creek narrow beds of tactite with sparse scheelite and powellite are exposed in bulldozer cuts (fig. 14). The tactite is interbedded with hornfels, quartzite, and marble. The best showings are in cut 6, where a 2.5-foot-wide bed is uncovered for 48 feet, and cut 7, where a bed extends for 58 feet with an average width of 4 feet. Approximately one-half mile to the northeast, a bulldozer cut on the east side of a ravine has exposed scheelite-bearing tactite, through a distance of 73 feet, an average width of 11 feet and an average depth of 7 feet. A grab sample assayed 0.02 percent WO₃.

**ADAMS PEAK**

The claims are on the south slope of the west peak of Twin Adams Mountain and are adjacent to the Lost Creek mine.

The east boundary of the Mount Torrey batholith extends southward through the property. The igneous mass intrudes Amsden limestone and Quadrant quartzite. Debris from two trenches contains a small amount of disseminated scheelite in tactite, but none is exposed in place. A grab sample from a trench at the north end of the claims assayed a trace of WO₃. Assays of two other samples from the same trench and one sample from a second trench showed no tungsten.

**UTOPIA MINING DISTRICT**

The Utopia or Birch Creek mining district is 20 miles northwest of Dillon, Mont., by way of U.S. Highway 91 and the Birch Creek road. The last 9 miles over the Birch Creek road is graveled and extends westward through the Apex siding. The east side of the district is accessible from the graveled Willow Creek road. Part of the Birch Creek road is maintained in the winter; other roads are impassable during periods of heavy snow. Several dirt roads provide access to the prospects. Apex, 6 miles from the district, is the nearest rail-shipping point.

The district, which was discovered about 1862, is noted principally for copper; however, nine deposits of tungsten minerals occur

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13 Myers, W. B., Geology and Mineral Deposits of the Northwest Quarter Willis Quadrangle and Adjacent Brown’s Lake Area, Beaverhead County, Mont.: Geol. Survey Open File Rept., 1952, p. 40.

14 Work cited in footnote 13, pl. 1.
FIGURE 10.—Lost Creek Mine, "B" Adit, Beaverhead County, Mont. (Modified from map by W. B. Meyers, Geological Survey, and J. S. McNabb, Bureau of Mines.)
Figure 11.—Lost Creek Mine, "E" Cut Area, Beaverhead County, Mont.
Figure 12.—Lost Creek Mine, "H" Adit Area, Beaverhead County, Mont.
**Sample Assays**

<table>
<thead>
<tr>
<th>No.</th>
<th>Type</th>
<th>WO3%</th>
<th>Mo%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chip</td>
<td>0.01</td>
<td>0.04</td>
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**DRILL HOLE No 1**

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**DRILL HOLE No 4**

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**DRILL HOLE No 5**

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**DRILL HOLE No 6**

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**DRILL HOLE No 8**

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**DRILL HOLE No 9**

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<td>0.11</td>
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**DRILL HOLE No 2**

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</tr>
<tr>
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<td>do</td>
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</tbody>
</table>

**Diagram Description**

- **Legend**
  - Tactite
  - Apilte
  - Marble
  - Hornfels
  - Contact
  - Inferred contact
  - Fault
  - Inferred fault
  - Drill hole

- **Sample Assays** table with detailed data for each sample.

- **DRILL HOLE No 1** data with length and WO3%.
- **DRILL HOLE No 4** data with length and WO3%.
- **DRILL HOLE No 5** data with length and WO3%.
- **DRILL HOLE No 6** data with length and WO3%.
- **DRILL HOLE No 8** data with length and WO3%.
- **DRILL HOLE No 9** data with length and WO3%.
- **DRILL HOLE No 2** data with length and WO3%.

*Figure 12.—Lost Creek Mine, "H" Adit, Beaverhead County, Mont. (After map by W. B. Myers, Geological Survey, and J. S. McNabb, Bureau of Mines.)*
Figure 14.—Lost Creek Mine, North Area, Beaverhead County, Mont.
Copper mines, operating intermittently until 1949, produced ore valued at over a quarter million dollars. Tungsten minerals probably were discovered in the early 1940's. Production is limited to concentrates from mill tests.

The district is in the foothills of the Pioneer Mountains. Birch Creek flows southeastward through the area and could furnish water for mining and milling operations. Slopes are steep except on the east margin of the foothills and along Birch Creek. Overburden is several feet deep in places, but fairly shallow which makes prospecting relatively easy.

The east margin of the Mount Torrey batholith trends southward through the district (fig. 2). All but one of the deposits are along the contact. This portion of the batholith is predominantly quartz monzonite. A short distance north of Birch Creek the intruded formations are Carboniferous Amsden limestone and Quadrant quartzite, but southward the formations become progressively older from Mississippian Mission Canyon limestone to Precambrian Belt series. The formations strike northward and dip 20° to 55° east; however, several local north trending anticlines and synclines have been mapped. A few of the folds are overturned. Major faults in the district roughly parallel the contact and strike of the formations.15

The deposits in the district (fig. 15) are contact metamorphic, except for one, which is apparently a small quartz vein. In the metamorphic deposits, scheelite and powellite occur as scattered concentrations of small crystals disseminated through tactite. Exposures indicate that the tactite bodies range to 2,000 feet long and 140 feet wide.

DEPOSITS

GLOW WORM PROSPECT AND GREENHORN CLAIM

The Glow Worm prospect and Greenhorn claim are apparently overlapping properties on the steep north side of Greenstone Mountain at the north end of the district. The deposit is 8.6 miles from the Apex siding, by way of the Birch Creek, Willow Creek, and Barbour Gulch roads. The 3.1 miles of Barbour Gulch road is inadequate for heavy ore hauling. The south end of the property is accessible by way of Farlin Gulch on Birch Creek.

The deposit is composed of tactite containing disseminated scheelite and powellite. The tactite can be traced by exposures and float for

15 Myers, W. B., Geology and Minerals Deposits of the Northwest Quarter Willis Quadrangle and Adjacent Brown's Lake Area, Beaverhead County, Mont.: Geol. Survey Open File Rept., 1952, pl. 1.

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>(\text{WO}_3) production</th>
<th>Claim</th>
<th>Owner</th>
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<tr>
<td>Gold Nugget</td>
<td>Sec. 15, T. 5 S., R. 10 W.</td>
<td>None</td>
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<td>Charles Hein</td>
<td>Box 413, Dillon, Mont.</td>
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<td>Greenstone</td>
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<td>One ton, 1.2 percent (\text{WO}_3)</td>
<td>1 patented, 2 unpatented</td>
<td>Greenstone Exploration Co.</td>
<td>1914 Magnolia Blvd., Seattle, Wash.</td>
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<td>Haggerty</td>
<td>Secs. 15 and 22, T. 5 S., R. 10 W.</td>
<td>None</td>
<td>2 unpatented</td>
<td>Dewey Haggerty</td>
<td>909 S. Arizona, Butte, Mont.</td>
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<td>Indian Queen</td>
<td>Sec. 15, T. 5 S., R. 10 W.</td>
<td>None</td>
<td>1 patented</td>
<td>The Anaconda Co, Myrl Erwin Arley R. Jacobs, et al.</td>
<td>Butte, Mont.</td>
</tr>
<tr>
<td>Jumbo group</td>
<td>Secs. 16 and 21, T. 5 S., R. 10 W.</td>
<td>None</td>
<td>5 patented</td>
<td></td>
<td>1st Nat'l Bank, Missoula, Mont.</td>
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<td>Rockey Hueep</td>
<td>Sec. 16, T. 5 S., R. 10 W.</td>
<td>None</td>
<td>1 unpatented, Public land</td>
<td>R. J. Stanfield, Administered by U.S. Forest Service.</td>
<td>Dillon, Mont. Do.</td>
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<tr>
<td>Stanfield prospect</td>
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<td>Mill tests</td>
<td>6 unpatented</td>
<td>R. J. Stanfield, Roy Stanfield</td>
<td>Do.</td>
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</table>
a slope distance of approximately 2,230 feet. The estimated width of the tactite ranges from 30 to 140 feet. The north and south ends differ about 680 feet in elevation. Faulting in mine workings indicates that the body may not be continuous.

The property was first developed for copper in 1919. Development at that time is believed to have consisted of six adits and four shafts. Some work was completed at the south end of the deposit in later years. In 1952 and 1953, five bulldozer trenches and several small pits were excavated to explore for tungsten minerals.

The deposit (fig. 16), is on the east margin of the Mount Torrey batholith where tactite and marble were formed by metamorphism of Amsden limestone. Float indicates that the scheelite-bearing rock may extend north of the claims. Assays of samples range from a trace to 0.17 percent WO₃ and less than 0.02 percent Mo.

The north end of the tactite is well exposed in and near the main adit. Small amounts of malachite occur in the adit. West of the portal, the tactite crops out for 170 feet with a maximum width of 90 feet. The access road at the north end of the outcrop and three small pits north of the road reveal the tactite for 50 feet across the width.

Southwest of the portal, cut 1 has exposed a shear zone of tactite and quartz monzonite. The quartz monzonite crops out west of the cut and contains a finely disseminated mineral which appears to be scheelite. The tactite is not exposed from cut 1 to adit 3; however, sparse float and fragments in debris of trenches occur in this interval.

Adit 3 has been driven from tactite into quartz monzonite. The quartz monzonite is on the footwall side of a fault 48 feet from the portal. The fault strikes N. 74° E. and dips 31° W. Shoots of malachite-stained magnetite occur in the tactite. The two cuts south of the adit disclose tactite averaging 32 feet wide, striking N. 37° E. and dipping 70° E. The bedrocks are covered southward to adit 6, except for tactite in adit 5.

Near adit 6 and shaft 3 the tactite is well exposed. Stringers of quartz, calcite, and gyp-

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16 Work cited in footnote 15, p. 16.
Figure 16.—Glow Worm Prospect and Greenhorn Claim, Beaverhead County, Mont.
sum occur in altered tactite on the footwall of a narrow quartz vein near the face of the adit. Molybdenite and pyrite are disseminated through the rock in the footwall of the vein. Shaft 3 was collared at the contact of tactite and limestone. The contact appears to strike N. 20° E. and dip 30° easterly.

**GREENSTONE MINE**

The mine is a short distance south of the Glow Worm prospect and on the south slope of Greenstone Mountain. It is 8.8 miles from Apex by way of Farlin Gulch on Birch Creek. Scheelite and powellite in tactite are exposed south of Greenstone Gulch and in limestone and tactite north of the gulch.

The north area (figs. 17 and 18) was explored for copper before 1951 by 2 adits and a 235-foot shaft with 176 feet of drifting. In 1950, Minerals Engineering Company constructed an access road from the Willow Creek road and excavated 13 bulldozer cuts to explore for tungsten. One ton of sorted tungsten ore containing 1.2 percent WO₃ was shipped from the property.

The east margin of the Mount Torrey batholith extends southward through the claims. The intrusive is in contact with Amsden limestone at the mine and Quadrant quartzite 1,000 feet to the north. The limestone near the contact has metamorphosed to tactite. The tactite south of the gulch, a dip-slope exposure (fig. 19), strikes N. 6° to 22° E., dips 39° E., and crops out continuously for 480 feet. The known width along the dip varies from 25 to 180 feet and averages 140 feet. The known thickness varies from 3 to 9 feet, with an estimated maximum of 24 feet. A portion in the center of the exposure has eroded and exposed underlying quartz monzonite that contains scheelite and inclusions of garnet. The scheelite crystals are up to 6.3 mm. long. The south and west boundaries of the dip-slope exposure are difficult to follow because of quartz boulders, and the hanging wall is concealed by overburden. Debris from two trenches less than 470 feet south of the exposure contains fragments of tactite; sparse float occurs for 1,000 feet farther south.

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27 Work cited in footnote 15, p. 16.
FIGURE 18.—Greenstone Mine, North Area, Beaverhead County, Mont.
Figure 19.—Greenstone Mine, South Area, Beaverhead County, Mont.
North of the gulch a shaft is collared near the edge of a body of tactite containing some scheelite. There is a small exposure in a trench next to the shaft, but otherwise the rock in place is covered. Float can be traced for 115 feet N. 5° E. to a small exposure.

An adit southwest of the shaft has been driven northward in a second body of tactite. This body can be traced by exposures and float for 340 feet north from the bank of the road south of the portal. The horizontal width varies from 44 to 105 feet. The body trends a few degrees west of north and dips eastward. Deep overburden obscures a possible extension to the south.

A stope has been excavated to the surface on a mineralized portion of a shear zone from an adit northwest of the shaft. The walls of the stope contain finely disseminated scheelite and shoots of magnetite. Malachite stain and secondary powellite occur along shear planes which trend in a southeast direction.

A small pit has been dug to expose a shear zone at a point 84 feet north of the stope. The zone strikes N. 24° E. and dips 69° to the southeast. Malachite stain, finely disseminated scheelite, and shoots of magnetite were observed in the pit. Barren tactite has been uncovered in a bulldozer trench 135 feet northeast of the pit.

**Copper Contact Claim**

The claim, ½ mile south of the Greenstone mine, extends across Lime Gulch at a point ½ mile north of the Birch Creek road.

Fine, sparsely disseminated scheelite is contained in partly decomposed friable tactite which strikes N. 79° E. and dips 80° E. It is exposed in a small pit for 4 feet along the strike and 3 feet along the dip, with an average width of 2.5 feet. A 4-foot chip sample taken diagonally across the width assayed no tungsten. Quartz monzonite and Mission Canyon limestone bound the north and south sides, respectively. Possible extensions are obscured by overburden. Underground workings are caved, and no tungsten minerals are on the dumps.

**Indian Queen Mine**

The claim is 6.5 miles west of the Apex siding via the Birch Creek road at the south end of a ridge between Lime and Farlin gulches. The end of the ridge slopes about 25° south toward Birch Creek.

The deposit probably was discovered in the 1860's, when the area was prospected for gold and copper. A blast furnace for smelting copper was installed in 1903 at the property. The mine is the main producer of copper. Copper production in the district was valued at more than a quarter of a million dollars. No tungsten has been produced from the claim.

According to Stevens, the underground workings totaled about 1,600 feet in 1906. Three adits totaling 321 feet long are accessible at present. Two shafts averaging 38 feet in depth are open, but unsafe.

The deposit is on the east margin of the Mount Torrey batholith. Two tactite bodies containing scheelite occur along the contact of quartz monzonite and Mississippian Mission Canyon limestone (figs. 20 and 21). At the south end of the property, the contact trends in a north-south direction, but near the north end of the claim it turns to the east. Tactite continues about 400 feet northward from the turn into the quartz monzonite. The rocks along the contact have been intensely faulted and sheared. Scheelite is generally finely disseminated, but crystals to 25 millimeters occur. Malachite and azurite were observed, and Winchell reports several other copper minerals.

A dip-slope exposure of tactite, containing a negligible amount of scheelite, extends westward for 144 feet from near the inaccessible main adit. It strikes N. 70° W. to S. 80° W. and dips 51° to 65° southward. The body is exposed up to 92 feet along the dip. The thickness is estimated by projection to be less than 30 feet.

A large body of tactite, which is mostly barren, can be traced by float and exposures for 1,030 feet northeastward from a point 44 feet north of the main adit. The width ranges from 6 to 370 feet and is estimated to average 160 feet. The depth is unknown, but exposures differ in elevation by about 290 feet. The only portion of the body that contains enough tungsten to show in the assay is at a small pit 885 feet northeast of the main adit. The rock contains some scheelite, magnetite, and malachite. It is gray and banded. This showing extends to a small pit 24 feet to the northwest. A grab sample assayed 0.14 percent WO₃. Negligible amounts of scheelite shown by fluorescence and qualitative tests occur in the body in outcrops at sample 3, in outcrops at the west end of sample 5, in adit 2, and in adit 3 (fig. 20).

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*W* Myers, W. B., Geology and Mineral Deposits of the Northwest Quarter Willis Quadrangle and Adjacent Brown's Lake Area, Beaverhead County, Mont.: Geol. Survey Open File Rept., 1922, pl. 1.  
FIGURE 20.—Indian Queen Mine, Beaverhead County, Mont.
GOLD NUGGET CLAIM

This claim is adjacent to the south side of the Indian Queen mine.

The workings consist of an adit and lateral totaling 122 feet in length. At the face of the adit a 7-by-9-by-10-inch inclusion of hornfels contains scheelite, powellite, magnetite, and some chlorite. A grab sample assayed 0.026 percent WO₃ and 0.046 percent Mo₃.

HAGGERTY PROSPECT

The property (fig. 22) is adjacent to and south of the Indian Queen mine. It extends from Birch Creek southward along a ridge between Sheep Creek and Bridge Gulch.

Scheelite and powellite occur in gravel and tactite on the property. The tactite was formed at the contact of the Mount Torrey batholith and Mission Canyon limestone. Faulting makes it difficult to trace the exact contact. Assays ranged from 0.012 to 0.022 percent WO₃ (fig. 23).

The gravel is an irregular body with boundaries obscured by soil mantle. It is poorly bedded and loosely cemented with sandy caliche; pebbles and boulders of limestone pre-dominant. Scheelite occurs finely disseminated in the sand. The main adit with 250 feet accessible has been driven southward in gravel from the floor of Birch Creek valley. An outcrop of limestone 50 feet east of the main adit and a caved adit in quartz monzonite 225 feet west of the portal delimit the gravel in these directions. Soil mantle obscures the south boundary. Myer’s map²² shows similar bodies occurring elsewhere in the area.

Adit 2 has exposed tactite, limestone, and gravel containing a small amount of scheelite. A sloughed shaft above the adit has no scheelite at the collar. Tactite exposed in adit 3, southwest of adit 2, is barren.

On the crest of the ridge, three shafts have been sunk along faulted segments of tactite. The segments contain scattered scheelite and are from 3 to 12 feet wide.

STANFIELD PROSPECT

The prospect is south of the Haggerty prospect and 7 miles west of the Apex siding via

²² Work cited in footnote 20, p. 22.
Figure 22.—General View of Haggerty Prospect. Limestone (lms); gravel (g); quartz monzonite (qm).
Figure 23.—Haggerty Prospect, Beaverhead County, Mont.
the Birch Creek and mine roads. The 0.8 mile of mine road is graded dirt and impassable during periods of heavy snow.

The deposit (figs. 24 and 25) is mineralized tactite, which is intermittently exposed over an area 1,850 feet long and averaging 120 feet wide.

The property was located about 1903, and two adits were driven about that time to explore for copper. In 1954 and 1955 a small amount of exploration work and a 50-to-100-ton-capacity tungsten mill were completed. Tungsten production from the mill was limited to test runs. Later in 1955 a pit and several bulldozer trenches were excavated. Several drill holes were also put down. The mill was partly dismantled in July 1956.

The deposit is on the east margin of the Mount Torrey batholith where the intrusive contacts Mission Canyon limestone. Scheelite generally occurs as fine crystals disseminated through the deposit; however, crystals to 12 mm. long occur. Small lenses of limestone or marble are scattered through the tactite. Samples contained from less than 0.02 to 0.21 percent WO3. The tactite can be traced for a length of 520 feet from the pit at the west end of the property to a small cliff and outcrop to the east. The known width averages 170 feet. It is exposed to a depth of 25 feet in the cliff and 16 feet in the pit. Quartz veinlets in the walls of the pit are parallel to joints that strike N. 47° W. and dip 67° northeastward. Altered limestone containing a small amount of scheelite is uncovered in a trench 100 feet west of the cliff and apparently grades into limestone to the east.

The tactite body is obscured by overburden east of the cliff but can be traced by float for 460 feet to a trench. Exposures and debris indicate that the body ranges between 100 and 220 feet wide in this area. The lack of float and the presence of quartz monzonite outcrops indicate that the tactite may not continue east of the trench; however, mine workings have explored tactite 400 feet farther east. In this area, tactite averages 50 feet wide and is exposed intermittently for 360 feet.

*Work cited in footnote 20, p. 22.*

Figure 24.—General View of Stanfield Prospect. Tactite (ta); limestone (lms); quartz monzonite (qm).
Scheelite-bearing rock may extend to the east and west of mine workings, but overburden obscures it.

**JUMBO GROUP**

The Jumbo group is accessible by mine road extending 1.8 miles southward from the Birch Creek road through the Stanfield prospect. The road is not adequate for ore hauling. The claims trend northwest-southeast across Sheep Creek (fig. 26).

Tactite float and exposures are scattered over an area approximately 1,600 feet long and averaging 113 feet wide. Some mineralization also occurs at isolated points in quartzite and other metasedimentary rocks near the tactite.

The property was developed for iron ore, which has been produced intermittently since about 1908, when the claims were patented. No production records are available.

The deposit is at the contact of the Mount Torrey batholith with dolomite and limestone of the Cambrian Wolsey and Pilgrim formations.* The tactite is on the west side of a south-trending tongue of the intrusive. A dike or branch of the tongue extends across the canyon and lies west of the tactite.

Tactite containing scheelite and powellite is exposed in and around an adit on the northwest side of the canyon and can be traced by float and exposures for 700 feet to the northwest. It cannot be traced southwest toward the creek because of heavy overburden.

Near the adit the tactite is gray and banded and contains some magnetite stringers parallel to the banding. Sparse amounts of scheelite and powellite or both occur along fractures. At this point, the tactite is about 24 feet wide. The tactite-quartzite contact on the northeast is masked by overburden. The southwest contact strikes N. 45° W. and dips 66° northwesterly.

About 310 feet north of the adit and near the common corner of the U.S. Treasure Lode and Phyllis claims, a 25-foot adit has been driven in the northwest wall of a bulldozer cut. The wall of the cut has slumped, but the adit is accessible. The wallrock appears to be decomposed tactite. Two caved adits near the common corner were started in quartzite. Traces of scheelite were found on the dumps.

A small outcrop of tactite occurs approximately 310 feet northwest of the common corner. The absence of float to the northwest indicates that extension of the outcrop is limited.

Tactite float extends for 630 feet southeast from an adit near the creek to an outcrop near the access road. The adit is accessible for 55 feet, but the walls and back are concealed by tight lagging. The tactite crops out from the access road south-southeast for 272 feet with an average width of 63 feet; however, heavy float indicates a maximum width of 250 feet. The height from the road to the top of the outcrop is 27 feet.

The metasedimentary rocks and dolomite have been sheared, folded, and altered in an area west of the outcrops. The area of deformation probably extends westward beyond three adits at the southwest side of unaltered dolomite. The adits were driven for iron ore and are open, but unsafe to enter. Four magnetite shoots or lenses occur in this area. The largest lens is exposed for 14 feet along the strike, 11 feet along the dip, and is a maximum of 15 feet wide.

Assays of five samples of tactite from the northwest side of Sheep Creek range from 0.013 to 0.042 percent WO₃. Assays of four samples of tactite on the southeast side of the canyon showed no tungsten.

**ROCKEY HUEEP PROSPECT**

This prospect, on the ridge between Spring and Armstrong gulches, is approximately 1,000 feet northwesterly from the Jumbo group.

The deposit is in quartz monzonite (fig. 27) of the Mount Torrey batholith. Approximately one-fourth mile to the southwest the quartz monzonite contacts gray quartzite of the Precambrian Belt series.†

Dumps of two small pits and a smaller pit 288 feet to the northwest contain white to grayish-green quartz, with small amounts of disseminated scheelite. Some quartz float between the pits contain scheelite. Debris conceals the quartz in the pits. An adit in barren quartz monzonite has been driven southwest toward the two small pits, but not far enough to intersect the mineralization.

Scheelite occurs in irregular masses to 12 mm. in diameter; however, most of it is finely disseminated. Some of the quartz contains magnetite seams as much as 38 mm. wide. The magnetite is partly altered to limonite and hematite.

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* Work cited in footnote 20, p. 22.
† Myers, W. B., Geology and Mineral Deposits of the Northwest Quarter Willits Quadrangle and Adjacent Brown's Lake Area, Beaverhead County, Mont.: Geol. Survey Open File Rept., 1952, pl. 1.
SAMPLE ASSAYS

<table>
<thead>
<tr>
<th>Sample No</th>
<th>Length</th>
<th>Type</th>
<th>WO₃ %</th>
<th>Mo %</th>
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</thead>
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<tr>
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<td>Chip</td>
<td>0.21</td>
<td>&lt;0.02</td>
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<tr>
<td>2</td>
<td>Bulk</td>
<td>.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>54'</td>
<td>Chip</td>
<td>&lt;0.02</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>95'</td>
<td>do</td>
<td>&lt;0.02</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Grab</td>
<td>&lt;0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>do</td>
<td>&lt;0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>do</td>
<td>&lt;0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>do</td>
<td>&lt;0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>87'</td>
<td>Chip</td>
<td>&lt;0.02</td>
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<tr>
<td>10</td>
<td>6'</td>
<td>do</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

< less than
Sampled locations are indicated by circled numbers

LEGEND

- Tactite
- Quartz monzonite
- Limestone
○ Location notice
- Contact
- Inferred contact

Facet 25.—Stanfield Prospect, Beaverhead County, Mont.
<table>
<thead>
<tr>
<th>Sample Assays</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No.</strong></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
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</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

Sampled locations are indicated by circled numbers.

**Legend**

- **+++**: Tactite
- **+++**: Quartz monzonite
- *******: Dolomite
- **+++**: Quartzite
- **+-**: Metasediments
- **---**: Inferred contact
- **---**: Inferred fault
- **M**: Magnetite shoot

**Figure 26**—Jumbo Group and Phyllis Claim, Beaverhead County, Mont.
Figure 27.—Rockey Huep Prospect, Beaverhead County, Mont
**Legend**

- **Tactite (b)***
- **Granodiorite (g)***
- **Limestone**
- **Contact**
- **Inferred contact**
- **Fault**
- **Inferred fault**

**Sample Assays**

<table>
<thead>
<tr>
<th>No.</th>
<th>Length</th>
<th>Type</th>
<th>WOx%</th>
<th>Mo%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>0.11</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>128.0'</td>
<td>do.</td>
<td>0.046</td>
<td>0.011</td>
</tr>
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<td>3</td>
<td>125'</td>
<td>do.</td>
<td>nil</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>44.0'</td>
<td>do.</td>
<td>0.084</td>
<td>0.019</td>
</tr>
<tr>
<td>5</td>
<td>85'</td>
<td>do.</td>
<td>nil</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>37'</td>
<td>do.</td>
<td>nil</td>
<td>-</td>
</tr>
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<td>7</td>
<td>680'</td>
<td>do.</td>
<td>0.03</td>
<td>-</td>
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<tr>
<td>8</td>
<td>210'</td>
<td>do.</td>
<td>nil</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>480'</td>
<td>Grab</td>
<td>nil</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>360'</td>
<td>do.</td>
<td>0.02</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td>685'</td>
<td>Chip</td>
<td>0.024</td>
<td>-</td>
</tr>
</tbody>
</table>

Sampled locations are indicated by circled numbers.

**Figure 28.** Hanel Prospect, Beaverhead County, Mont.
Bald Mountain Mining District

The Bald Mountain mining district is about 27 miles west-northwest of Dillon via U.S. Highway 91, State Highway 36, and the Dyce Creek roads. The latter are graded dirt and will need improving for hauling in wet weather. The nearest rail-shipping point, source of supplies, and living quarters are at Dillon.

A moderate production, principally silver, has been made since discovery of the district about 1869. Tungsten minerals were found about 1951, but production has been limited to concentrates from mill tests. Five reported tungsten deposits were examined (table 3).

The district is at the south end of the Pioneer Mountains. Most of the area is rolling country, with high points of 7,900 feet elevation. Drainage is by Scudder Creek, Taylor Creek, and Dyce Creek, which could furnish water for milling. Overburden is usually limited to a few feet, and in several places the rocks crop out or are thinly covered, making prospecting relatively easy. The Geologic Map of Montana shows that the Mount Torrey batholith extends into the area. The rock associated with the tungsten deposits is a granodiorite phase of the intrusive. The granodiorite is bound on the south, east, and west by Carboniferous Madison limestone and Quadrant quartzite. Lava occurs in the southeast and lake beds in the west portions of the district.

Several dikes, sills and a few remnants or root pendants of limestone also occur in the district. Portions of the rocks are complexly folded, faulted, and sheared.

Tungsten mineralization is confined to bodies of tactite formed at or near the contact of granodiorite and limestone. Exposed dimensions of the largest deposit are 215 feet long, 105 feet wide, and 3 to 33 feet deep.

Deposits

Hazel Prospect

The prospect is at the north end of the district, 7.9 miles north of State Highway 36 via the East Fork of Dyce Creek road. It extends across the West Fork of Dyce Creek.

A relatively large tactite body occurs at the southeast end of the property (fig. 28). Several small tactite bodies are along a north-west trending remnant of limestone which has been explored for 1,700 feet (fig. 29). The bodies occur at the contact of limestone and granodiorite. According to A. V. Corry the limestone is the Mississippian Madison formation. The tactite containing scheelite is friable and partly decomposed at the southeast end of the deposit, but it is fresh and more compact at the northwest end. Scheelite crystals are disseminated in the tactite and average less than 3 mm. in length; however, crystals to 15 mm. in length occur. Samples range from nil to 0.11 percent WO₃ and 0.011 to 0.019 percent Mo.

The large tactite body is exposed by mine workings at the northeast end of a rectangular remnant of limestone, which appears to be surrounded by granodiorite (fig. 30). The tactite is exposed for an average length of 215 feet, an average width of 105 feet and from 3 to 33 feet in depth. A portion at the southeast

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27 Correy, A. V., Some Gold Deposits of Broadwater, Beaverhead, Philips, and Fergus Counties, Mont.: Montana Bureau of Mines and Geology, Memoir 10, 1933, pl. 5.
28 Work cited in footnote 27.

Table 3.—Location, production, and ownership of properties in the Bald Mountain mining district

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>WO₃ production</th>
<th>Claims</th>
<th>Owner</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agnes lode</td>
<td>Sec. 14, T. 6 S., R. 12 W.</td>
<td>None</td>
<td>4 unpatented</td>
<td>Pete Piazzola</td>
<td>Dillon, Mont.</td>
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<tr>
<td>Echo lode</td>
<td>Secs. 11 and 14 T. 6 S., R. 12 W.</td>
<td>None</td>
<td>1 patented</td>
<td>J. H. Judge</td>
<td>Polaris, Mont.</td>
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<tr>
<td>Hazel prospect</td>
<td>Sec. 11, T. 6 S., R. 12 W.</td>
<td>None</td>
<td>11 unpatented</td>
<td>W. E. Talent</td>
<td>Dillon, Mont.</td>
</tr>
<tr>
<td>Little Hawk mine</td>
<td>Secs. 10, 11, 14 and 15, T. 6 S., R. 12 W.</td>
<td>Mill tests</td>
<td>1 patented, 6 unpatented</td>
<td>Beck Estate Little Hawk Mining Co. Patent claim is leased.</td>
<td>Do. 2317 Choteau, St. Louis, Mo.</td>
</tr>
<tr>
<td>Virginia claim</td>
<td>Sec. 14, T. 6 S., R. 11 W.</td>
<td>None</td>
<td>1 unpatented</td>
<td>C. O. Schleicher</td>
<td>Dillon, Mont.</td>
</tr>
</tbody>
</table>
corner has been faulted eastward and can be traced a few feet before being obscured by debris. The southwest and northwest sides are covered. The elongated remnant of limestone with small bodies of tectite has been explored northwestward for 1,700 feet from cut 7, and tectite probably extends an additional 730 feet to the northwest. The limestone can be traced for several hundred feet to the southeast, but it has not been explored in that direction.

A tectite body containing scheelite and powellite is exposed in cut 6, at the southeast end of the explored area. It strikes N. 31° W. to N. 55° W. and dips 67° northeasterly. It is uncovered for 104 feet along the strike and is 2 to 8.5 feet wide. The body is barren in cut 7.

Float and exposures indicate that the limestone extending from the creek north to cut 4 is surrounded by granodiorite with barren tectite at points along the contacts.

Tectite in cut 3 contains a small amount of scheelite and is exposed for a length of 17 feet with an average width of 10 feet. The west side is a fault striking N. 2° W. and dipping 52° eastward.

Tectite containing scheelite and powellite is exposed for 113 feet in cut 2. The revealed width is 44 feet but averages about 60 feet. The contact at the southwest side strikes N. 32° W. and dips 65° to 75° NE. The northeast side is covered by debris.

A faulted body which appears to be an extension of the segment in cut 2 is exposed in cut 1. It is uncovered for 150 feet with an average width of 36 feet.

LITTLE HAWK MINE

The property is two-thirds mile south of the Hazel prospect and 7.9 miles north of State Highway 36 via the West Fork of Dyce Creek road. The company mill is near the creek, and an open pit is on a ridge crest 500 feet west (fig. 31). In the vicinity of the pit, the crest is relatively flat. A tectite body 190 feet long and averaging 70 feet wide in the pit is the main showing (fig. 32).

Copper was discovered at the property in the early 1890's, and some exploration work was completed; tungsten minerals were discovered
at the deposit in 1951. In 1955 the Little Hawk Mining Company constructed a 150-ton mill (fig. 33) and two earth dams for water storage. Mining and stockpiling of the ore were started at that time. A small amount of concentrates was produced during mill tests.

Tactite, containing scheelite and powellite in places, has been formed at the contact of Mississippian Madison limestone and granodiorite. Remnants or roof pendants of limestone occur in places. Scheelite and powellite crystals to 1.2 mm. in length occur disseminated through the tactite: the average crystal is 0.3 to 0.6 mm. long. Samples contained from 0.1 to 0.188 percent WO₃.

The main tactite body is at the northwest end of the pit in a roof pendant or remnant of limestone. It has been mined to a depth of 15 feet and grades into limestone or marble, except at the southeast end, where it terminates at a fault striking N. 65° E. and dipping 60° southeast. Some magnetite with malachite stain occurs along the fault. Three small granodiorite bodies, two of which appear to be sills, are in the scheelite-bearing rock.

A 30-foot inclined shaft bears westward in tactite at the southeast end of the pit. Near the bottom the scheelite-bearing rock ends at a fault that strikes N. 2° E. and dips 40° W. The tactite grades into granodiorite 8 feet from the collar and extends 54 feet southwest and 64 feet northeast along the contact. A small amount of magnetite, malachite, and azurite occurs near the contact.

Three masses of tactite that appear to be faulted segments of one body extend northwestward into limestone from the contact at a point south of the shaft. The first segment strikes N. 39° W. and dips southwesterly 31°. A small amount of malachite was observed along fractures of the tactite. The second segment appears to be faulted 26 feet to the southwest. Some chalcopyrite occurs at the northwest end of the third segment.

A stringer of tactite can be traced for 64 feet in limestone northeast of the shaft. The width was not apparent because of debris, but it is estimated from 1 to 3 feet.

Disseminated scheelite in tactite is exposed in the discovery cut of Little Hawk No. 6 claim, 760 yards northeast of the open pit. It is uncovered for 28 feet along a limestone-granodi-
orite contact, strikes N. 65° E., and dips 50° northwesterly. An assay of a sample taken across the 5-foot width showed no tungsten, but qualitative tests of hand specimens confirmed its presence.

Traces of a mineral that fluoresces like scheelite are in a bank near the stockpile and in the discovery cut of Little Hawk No. 3 claim.

**ECHO LODE**

The prospect, one-third mile east of the Little Hawk mine, is on the crest of the ridge between the East and West Forks of Dyce Creek. It is 7 miles north of State Highway 36 by the East Fork road.

Tactite on the property is associated with a granodiorite dike in limestone. At the portal of the caved lower adit, a tactite body strikes N. 76° E. and dips 58° northwesterly. The exposed dimensions are 3 by 3 by 3.5 feet. No tungsten minerals were identified, but a 3-foot chip sample taken at the portal assayed 0.005 percent WO₃. Muscovite, magnetite, limonite, malachite, and azurite occur in two upper adits, but no tungsten minerals were identified and assays showed no tungsten.

**AGNES LODE**

The Agnes lode is immediately west of the Echo lode. The property has been explored by a few bulldozer trenches. Traces of a mineral that fluoresces similarly to scheelite occur in tactite and partly altered limestone along a granodiorite dike, which may extend to the Echo lode claim. The mineral is too fine to make qualitative tests for tungsten. A chip sample assayed no tungsten.

**VIRGINIA CLAIM**

The deposit is south of the Agnes lode claim and approximately 240 feet east of the East Fork of Dyce Creek road 5 miles north of State Highway 36.

Two faulted segments of tactite and tactite fragments in a shear zone occur in granodiorite on the property. The tactite contains a finely
Figure 32.—Little Hawk Mine, Beaverhead County, Mont.
disseminated mineral that fluoresces much like scheelite or powellite, but the mineral is disseminated too finely to prevent making qualitative tests for tungsten. A chip sample across the shear zone and one from a tactite segment assayed no tungsten.

OTHER PROPERTIES

Four isolated occurrences of tungsten minerals have been reported in the Mount Torrey, Elkhorn, and Vipond mining districts (table 4). Three of the deposits are quartz veins, and the fourth is a deposit of mantle rock containing tungsten mineralization.

DEPOSITS

SHEEP MOUNTAIN PROSPECT

This prospect is in the Vipond mining district north of the batholith and 22.8 miles southwest of Divide, Mont. The route to the property from Divide is west on State Highway 43 for 7.7 miles, south on the Vipond Park road for 11.9 miles, southwest on the Cannivan Gulch road for 2.0 miles, and southwest by foot trail for about 0.7 miles. The Vipond Park and Cannivan Gulch roads are impassable because of snow from November to the last of June. The deposit is also accessible from Melrose, Mont., during the summer.

Mine workings indicate that a mineralized quartz vein at least 195 feet long occurs on the property; quartz boulders can be traced for an additional 1,900 feet. Float indicates that other quartz veins or stringers may occur.

The claims are on an easterly trending ridge between Cannivan and Buffalo Head Gulches. The crest of the ridge is relatively flat near the prospect, but slopes in the area are steep. The north side of the ridge is heavily forested with fir and pine, but portions of the south slope
TABLE 4.—Location, production, and ownership of properties in other mining districts

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>WO₃ production</th>
<th>Claims</th>
<th>Owner</th>
<th>Address</th>
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<td>Blackmore.</td>
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<td>C. P. MacKenzie</td>
<td>Dillon, Mont.</td>
</tr>
<tr>
<td>Elkhorn-Beaverhead mines</td>
<td>Sec. 14, T. 4 S., R. 12 W.</td>
<td>Mill tests</td>
<td></td>
<td>Bruce Risley, et al.</td>
<td>Do</td>
</tr>
<tr>
<td>Sheep Mountain prospect</td>
<td>Secs. 15 and 16, T. 2 S., R. 11 W.</td>
<td>None</td>
<td>2 unpatented</td>
<td>Arthur Semsak, Miles Tuttle</td>
<td>2221 Latherwood, Butte, Mont., Divide, Mont.</td>
</tr>
</tbody>
</table>

are bare. Workings are at an elevation of 8,650 feet.

The deposit was probably discovered before 1900, when the area was prospected for silver and gold. It was relocated for tungsten in 1951.

The country rocks are quartz monzonite and Cambrian limestone. The quartz monzonite appears to be a small stock from ¼ to ½ mile wide and about 1 mile long.

The white quartz fissure vein (fig. 34), explored by the workings, contains scheelite, wolframite, and powellite. Hübnerite has also been reported. The float can be traced from quartz monzonite into the surrounding limestone. A small pit has exposed the footwall and 9 feet across the width of the vein. A caved adit extends toward the pit from the northeast (fig. 35), but the absence of quartz on the dump indicates that the vein is not intersected. A mass of white quartz, 10 feet wide and 10 feet long, containing scheelite is exposed 72 feet east of the pit. It could not be traced on the surface.

The scheelite, wolframite, and powellite apparently occur disseminated through the vein. The tungsten minerals were not observed in place, but vugs at the surface indicate that the minerals may have been leached. The vein material on the dump of the shafts and some of the pits contain irregular masses of wolframite a maximum of 6 by 30 mm. in size, scheelite in crystals to 3 mm. in diameter and 12 mm. in length, and finely disseminated powellite. Traces of limonite and malachite stain occur along fractures. A random grab sample from the dumps assayed no tungsten, but a select grab sample from one of the shafts contained 2.88 percent WO₃.

Quartz float indicates that a second vein striking N. 3° W. may intersect the first vein about 30 feet southwest of the workings; however, this float may have come from several small stringers or pods. The float can be traced for 480 feet to the northwest. Traces of molybdenite and powellite occur in the float.

Stringers of quartz occur intermittently in the quartz monzonite. Some of these stringers contain a small amount of disseminated scheelite and powellite and probably assay a trace of tungsten.

ELKHORN-BEAVERHEAD MINES

The property is near the west edge of the Mount Torrey batholith and 27 miles from the Wise River by the Wise River and mine roads. The mine is inaccessible when snow is deep.

Tungsten minerals have been reported from the Bluejay vein and in ore from the Park claim; however, most of the workings are caved, and the occurrence was not verified.

Quartz fissure veins occur in quartz monzonite at the property. The veins contain clahcodyrite, galena, sphalerite, chalcocite, pyrite, tetrahedrite, and bornite. A vein on the Park group has a maximum thickness of 20 to 30 feet.²¹

BLACKMORE PROSPECT

The prospect is near the center of the batholith approximately 1,500 feet northwest of Pear Lake dam and 16 miles northwest of Apex by the Birch Creek road.

Tungsten minerals have been reported to occur at the property, but none were observed. Float and three quartz veins in a small pit contain blebs of molybdenite. The veins are less than five inches wide. The deposit is in quartz monzonite. Most of the area is covered with glacial moraine.


Figure 34.—Main Pit on Sheep Mountain Prospect. Vein quartz (qtz); quartz monzonite (qm).
T. D. 6 PROSPECT

The prospect is 6 miles south of the batholith, 1 mile north of the Dillon-Jackson road, and 20.7 miles by road west of Dillon. A graded dirt road extends from the Dillon-Jackson road through the prospect.

The deposit is on the west slope of a ridge one-half mile west of Taylor Creek. The slope averages 18°, but the surface is relatively flat west of the mined area. Sagebrush and grass are the main vegetation.

The claims were located for manganese in 1948 or 1949. Production since that time is estimated to be a few truckloads of manganese ore, but no records are available. There has been no production of tungsten ore.

Oxides of manganese containing tungstite and an unidentified tungsten mineral have been exposed in mantle rock above Mississippian Lodgepole limestone at three points on the property. The gray limestone contains small, irregular, fissure veinlets of a light orange granular mineral tentatively identified as calcite. The limestone has been brecciated in places and cemented with calcite. The north trending Kelly thrust has been mapped less than 1 mile north of the prospect and apparently occurs a short distance to the west where it is obscured by Tertiary sediments.

Petrographic examination showed that the manganese oxide material was predominantly psilomelane with a small amount of pyrolusite, a tungsten mineral, magnesian-bearing calcite, quartz, claylike material, and chloride. Optical data indicate that at least part of the tungsten is present as tungstite. Some may be colloidal in the manganese minerals. Minute amounts of a finely disseminated mineral that fluoresces like scheelite occur in the oxides.

Oxides of manganese are exposed at the intersection of bulldozer cut 2 and a small bulldozer trench extending to cut 3 (fig. 36). The oxide body strikes due north and dips 17° W. It is exposed for 27 feet along the strike and 27 feet down the dip. Maximum thickness is 2.5 feet with an average of 1.5 feet. The body pinches out to the north and has been mined to the south, west, and east. Pieces of chert, a maximum of 14 inches in diameter but averaging about 4 inches, occur through the body. The footwall is irregular, and limonite underlies the northern half. Sample 1 was taken across the thickness at 5-foot intervals. Minor amounts of manganese oxides mixed with soil mantle, limestone, and chert occur in a bank 20 feet east of the oxide body.

A pit in cut 3 has exposed a second manganese body in the mantle where sample 2 was taken. The second body, containing pieces of chert, strikes N. 25° E. and dips 20° northwesterly. It averages 2 feet in thickness and is exposed for 18 feet along the strike and 15 feet along the dip. Overburden and debris obscure extension to the north. The body has been mined to the south, west, and east. Sample 2 was taken across the thickness at 4-foot intervals.

A small pit 57 feet to the south has exposed layers of manganese oxides. The layers strike eastward and dip southward at a low angle. They are exposed for 7 feet along the strike and 15 feet along the dip. Maximum combined thickness is 3 feet. Sample 4 was taken across the thickness. A grab sample from a 2.5-ton pile of oxides near the pit assayed 5.38 percent manganese, 0.12 percent WO₃, 0.14 percent Cu, 84 percent SiO₂, and no P₂O₅.

Appreciable amounts of manganese oxides in the debris of cut 3 cover an area 105 feet in length and average 31 feet in width. The depth is estimated to average 5 feet. Other areas in the debris contain some manganese oxides.

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Meyers, W. B., Geology and Mineral Deposits of the Northwest Quarter, Willis Quadrangle, and Adjacent Brown’s Lake Area, Beaverhead County, Mont.: Geol. Survey Open File Rept., 1952, pl. 1.
LEGEND

//---------- Manganese oxide

**SAMPLE ASSAYS**

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<tr>
<th>No.</th>
<th>Type</th>
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<th>Mn.%</th>
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<td>Chip</td>
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Figure 36.—T. D. 6 Prospect, Beaverhead County, Mont.