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PRELIMINARY REPORT
ON
TUNGSTEN IN OREGON

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1951

State Governing Board

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FOREWORD

Small isolated occurrences of scheelite (calcium tungstate) have been known in Oregon for many years. They attracted little attention because they seemed too small to be worth exploring. In 1949 scheelite was found in two separate places near Ashland in deposits of possible economic interest and with geological associations that could be duplicated in other parts of southwestern Oregon. Later, scheelite was found, or at least examined, in other places where the same typical geological conditions obtain. Although there are exceptions, most of the occurrences follow the same general geological pattern - that is, they occur along with typical contact minerals in contact zones between calcareous and intrusive rocks. There are extensive areas of such contact rocks in southern Oregon and it is reasonable to assume that exploration in these areas will reveal additional deposits. This report is designed as a guide to tungsten prospecting in the State. To this end known deposits are described and the areas where geological conditions appear favorable are pointed out.

The Governing Board of the Department decided that a report on tungsten would be especially timely because of the Korean war which cut off to American industry one of the principal sources of tungsten supply, thereby creating a shortage of this vital material. It was felt that every effort should be made to focus attention on potential domestic supplies since in a crisis it might be necessary to depend on such supplies for survival. In addition to the national aspect concerned with tungsten, it is believed by the Board that the occurrences of scheelite in Oregon, together with the general pattern of geological relationships of these occurrences, should be publicized to the best of the Department's ability in order to encourage new exploration which might add to the value of the State's mineral production.

F. W. Libbey
Director

July 31, 1951

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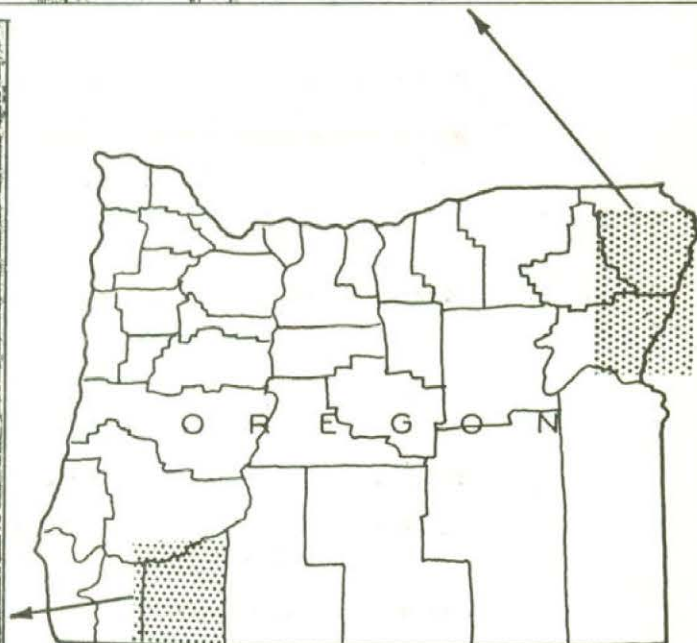
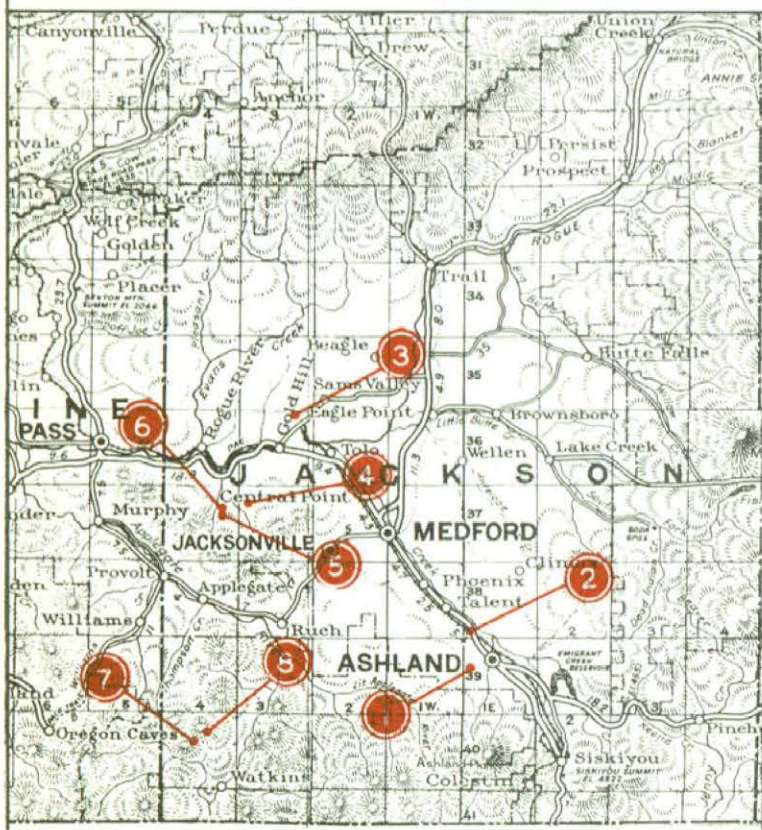
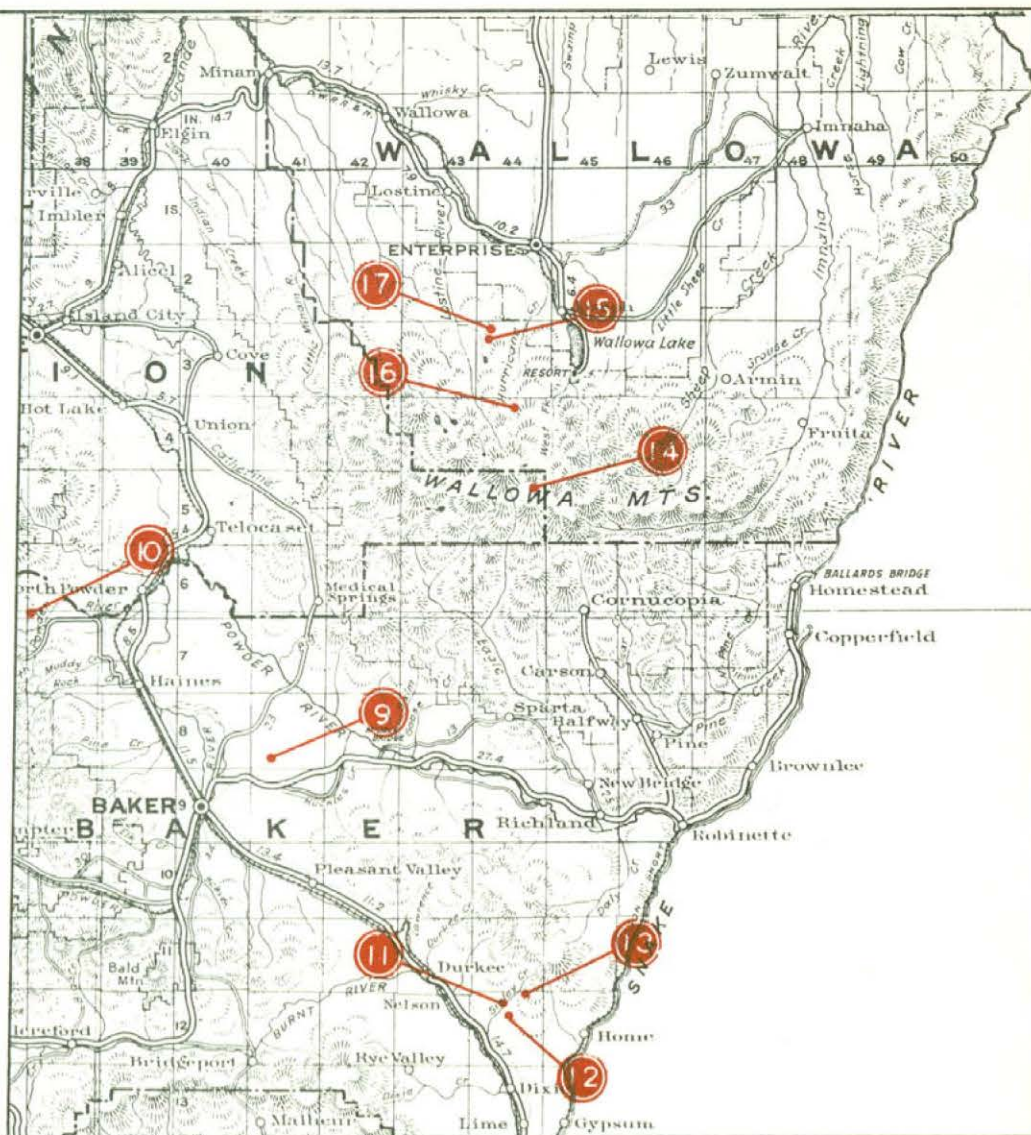
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KEY TO LOCALITIES

- 1 Bratcher
- 2 Mattern
- 3 Sylvanite
- 4 Lady Slipper
- 5 Blue Star
- 6 Lucky Strike
- 7 Mocks Gulch
- 8 Rattlesnake
- 9 Cliff
- 10 Davis
- 11 Scheelite
- 12 Tungsten
- 13 Chicken Creek
- 14 Frasier
- 15 Le Gore
- 16 Wilmot
- 17 Metzger

Scale of miles



Index map showing known tungsten localities in Oregon

PRELIMINARY REPORT ON TUNGSTEN IN OREGON

INTRODUCTION

Investigation by the Department of tungsten occurrences in southwestern Oregon was begun in April 1949 soon after the discovery of scheelite on the Bratcher property near Ashland in Jackson County. In the fall of 1949 a topographic and geologic map of a small area in the vicinity of this property was prepared. Subsequent exploration and mining at the Bratcher mine were closely followed and mapped by the authors. Most of the other tungsten occurrences in southwestern Oregon have been examined at various times in the past two years, largely in conjunction with other departmental field work.

The purpose of this report is to record and publish information pertaining to the known tungsten occurrences in southwestern Oregon, and to describe the typical geological relationships in order to encourage further prospecting in the area. A description of tungsten minerals and mineral associations as well as some suggestions concerning prospecting for tungsten have been included. Also included is a brief review of known occurrences in northeastern Oregon. It is hoped that this information will be of assistance to miners and prospectors and will accelerate the search for and exploration of tungsten ores in Oregon.

Acknowledgements

The authors wish to express appreciation to the owners of the various properties examined for their cooperation and helpful assistance. They are particularly indebted to Mr. L. A. Bratcher of the Bratcher Mining Company and to Messrs. C. B. and H. A. Harrison of the Blue Star prospect.

They also wish to acknowledge the assistance given by members of the Department in preparing this report. Miss Margaret L. Steere and Mr. F. W. Libbey reviewed the report and made numerous helpful additions. Messrs. T. C. Matthews and L. L. Hoagland, respectively, made the spectrographic and chemical analyses which are included. Mr. Ralph S. Mason prepared the maps for publication. Mr. Norman S. Wagner furnished information on tungsten occurrences in northeastern Oregon. Mr. Hollis M. Dole gave assistance in the petrographic determinations and contributed in many other ways to the preparation of the report. The final draft was carefully prepared by Mrs. Lillian F. Owen.

TUNGSTEN - GENERAL CONSIDERATIONS

Economics and uses

Tungsten is customarily marketed in the United States and Canada at so many dollars per short ton unit (20 pounds) on the basis of 60 percent tungsten trioxide (WO_3) concentrate or high-grade ore. The price paid for tungsten concentrates varies with the type of ore, grade, and impurities, and with the demands of the market at the time. According to Engineering and Mining Journal, February 1951, during 1950 the price of domestic scheelite, the most commonly produced tungsten ore in the United States, advanced from \$28.50 a unit delivered to \$47 a unit f.o.b. mines. On April 24, 1951, the press announced that the General Services Administration, Washington, D.C., had decided to buy tungsten ore at a price of \$63 a short ton unit. According to a regulation issued by GSA, May 10, 1951, the Government will buy all specification-grade tungsten concentrates produced from domestic ores which cannot be sold on the commercial market. The program does not apply to tungsten ore as was previously announced. E&MJ Metal and Mineral Markets, May 17, 1951, stated that a ceiling price of \$65 per short ton unit of WO_3 (basis 60 percent) for domestic tungsten concentrates had been established April 6, 1951.

The greatest consumption of tungsten is in alloys used for the manufacture of cutting tools and dies. Tungsten alloy tool steels retain their hardness and strength at high temperatures and can therefore take heavier cutting loads on harder material than carbon steels. The principal types of tungsten alloys used in dies and tools are ferrous alloys, tungsten carbide, and stellites. Tungsten carbide is an alloy of tungsten, carbon, and cobalt. Its extreme hardness and resistance to abrasion make it the best cutting-tool material known. Stellite is an alloy of tungsten, cobalt, and chromium. In addition to cutting tools, surgical instruments are manufactured from stellite because of its resistance to tarnish and corrosion.

Metallic tungsten is consumed in the manufacture of electric light and radio filaments. Some miscellaneous uses of tungsten compounds are as follows: tungstic acid as a mordant and coloring agent in the porcelain industry; various tungsten compounds as catalysts in the hydrogenation of carbonaceous material and the cracking of oil; and tungstic oxide as an adsorbent gel.

According to Li and Wang (1947:297)* the yearly consumption of tungsten in the United States may be roughly distributed as follows:

Ferrous alloys	90.00%
Tungsten carbide	5.0
Stellite	2.0
Electrical equipment	1.5
Miscellaneous	1.5

Tungsten minerals

There are many tungsten minerals, but only four - scheelite, ferberite, wolframite, and hübnerite - are of principal commercial importance. Some tungsten minerals and their compositions are listed in Table 1 on page 3. Most tungsten minerals have a high specific gravity. Few exhibit good crystal form. In general, the commercially important minerals can be divided into two groups: the scheelite group and the wolframite group.

* Bibliography at end of this report.

Table 1.

Composition of Tungsten Minerals

<u>Name</u>	<u>Composition</u>	<u>Approx. percent tungsten trioxide (WO₃)</u>	<u>Miscellaneous</u>
Scheelite	Calcium tungstate (CaWO ₄)	80.6	Only economically important mineral of scheelite group.
Ferberite	Iron tungstate (FeWO ₄)	76.3	Does not occur as pure mineral. Contains as much as 20 percent hübnerite molecule.
Wolframite	Iron-manganese tungstate [(Fe,Mn)WO ₄]	76.5	Variable iron and manganese.
Hübnerite	Manganese tungstate (MnWO ₄)	76.6	Not pure; may contain as much as 20 percent ferberite molecule.
Powellite	Calcium molybdate (CaMoO ₄)	as much as 10.0	Member of isomorphous scheelite-powellite group.
Chillagite	Lead tungstate-lead molybdate [Pb(W,Mo)O ₄]	21.7	Mixture of stolzite and wulfenite(PbMoO ₄); ratio of Mo:W = 3:1.
Stolzite and raspite	Lead tungstate (PbWO ₄)	51.0	
Tungstite	Hydrous tungstic oxide (WO ₃ ·H ₂ O)	92.8	
Cuprotungstite	Hydrous copper tungstate (Cu ₂ WO ₅ ·H ₂ O) ?	56.7	Formed by alteration of scheelite by copper sulphate.
Cuproscheelite	Impure mixture of cuprotungstite and scheelite [(Ca,Cu)WO ₄]		
Ferrotungstite	Hydrous ferric tungstate (Fe ₂ O ₃ ·WO ₃ ·6H ₂ O)	52.2	Oxidation product of wolframite.
Russellite	(BiO ₃ ·WO ₃)		Alteration product of native bismuth and wolframite.
Tungstenite	Tungsten sulphide (WS ₂)	94.0	

The scheelite group consists of the stony or vitreous-appearing minerals characterized by scheelite and powellite. Other important minerals in this group are cuproscheelite, cuprotungstite, stolzite, tungstite, and tungstehite.

Scheelite is a vitreous (glassy) to adamantine mineral. The color may be white, pale yellow, brownish, reddish, gray, or greenish. It rarely occurs as well-formed crystals, but usually as irregular granular masses or disseminated grains. In most crystalline specimens only a few well-formed triangular faces of an eight-sided pyramid can be observed. Since its hardness is 4.5 to 5, a knife blade will easily scratch it. The specific gravity (5.4 to 6.1) of scheelite is more than twice that of quartz (2.6). Scheelite has good cleavage in four directions.

Scheelite resembles quartz, feldspar, barite, calcite, and apatite and may be most readily distinguished from these minerals by observing the colors exhibited by scheelite under the short-wave fluorescent lamp (see page 5). Although the specific gravity of scheelite is higher than any of these minerals, the detection of scheelite in the field is often exceedingly difficult without the aid of an ultraviolet lamp.

The wolframite group consists of the metallic-appearing iron and manganese tungstates: ferberite, wolframite, and hübnerite. These three minerals form a continuous series of iron-manganese tungstates of which the iron end is ferberite and the manganese end is hübnerite. Pure ferberite and pure hübnerite do not occur as such in nature.

Wolframite, using it as a family name for iron-manganese tungstates whose exact composition is not known, is generally a black metallic-appearing mineral with a streak ranging from dark brown to reddish brown. Its specific gravity is from 7.1 to 7.5 and its hardness is about 5. Wolframite usually occurs in irregular aggregates of individuals with no outwardly visible crystal form and more rarely as radiating groups of bladed crystals.

Table 2.
Physical Properties of Scheelite, Ferberite, Wolframite, and Hübnerite

	<u>Scheelite</u>	<u>Ferberite</u>	<u>Wolframite</u>	<u>Hübnerite</u>
Crystallization	Tetragonal	Monoclinic	Monoclinic	Monoclinic
Cleavage	Good in 4 directions	Perfect in 1 direction	Perfect in 1 direction	Perfect in 1 direction
Specific gravity	5.4 - 6.1	7.5	7.1 - 7.5	7.2 - 7.3
Color	Pale yellow, brown, white	Black	Dark gray to black	Reddish brown to black
Tenacity	Very brittle	Very brittle	Very brittle	Very brittle
Luster	Vitreous to greasy adamantine	Submetallic to metallic	Submetallic to metallic	Submetallic to adamantine
Fracture	Uneven	Uneven	Uneven	Uneven
Hardness	4.5 - 5	5	5 - 5.5	5
Magnetism	Nonmagnetic	Sometimes feebly magnetic	Slightly magnetic	---
Streak	White	Dark brown	Dark brown	Brownish red to greenish yellow
Common form of occurrence	Massive and in small grains	Well-defined crystals, massive cryptocrystalline	Irregular masses, radiating groups of bladed crystals	Radiating groups of thin-bladed crystals

Common geologic occurrences and mineral associations

Tungsten minerals occur in igneous, metamorphic, and sedimentary rocks. Exclusive of placer deposits, tungsten deposits usually originate from a granitic magma. The literature indicates that most tungsten deposition is related to the "end stage" or the aftermath of the igneous intrusion. The types of deposits associated with igneous magmas are: magmatic segregations, pegmatites, high-temperature replacement (contact metamorphic) deposits, and veins.

Magmatic segregations are deposits formed by the concentration of ore minerals in the magma prior to its consolidation as an igneous rock. The ore minerals occur as knots or irregular segregations within the resultant igneous rock. Tungsten occurs in this type of deposit infrequently and in small amounts.

Pegmatites are veinlike masses (dikes) composed of coarsely crystalline minerals, mainly quartz, feldspar, and mica. Tungsten minerals occur in some pegmatites, but seldom in commercial quantities.

High-temperature replacement deposits are most commonly known as contact metamorphic deposits and are found in zones of intense metamorphism at or near granitic contacts. Scheelite deposits of this type are abundant in California, Nevada, and Utah. Oregon's tungsten deposits belong mainly to this classification. Contact metamorphic deposits containing tungsten are most common as replacements in limestones or other rocks of high-calcium content. According to Kerr (1946:58), pale-colored (pink or cream) garnet, fibrous wollastonite, and pale idocrase accompanied by recrystallization of calcite form an initial stage in contact metamorphism frequently found in association with tungsten deposits. He further states that the initial stage of metamorphism appears to be low in tungsten content. In the advanced stage of metamorphism, mixtures of garnet, diopside, epidote, quartz, and sometimes scheelite are formed. When the resulting rock is composed largely of dark silicates, it is called tectite. Although quartz-garnet-scheelite ores occur, and some are high grade, scheelite is generally more abundant in tectite consisting largely of epidote, quartz, and scheelite.

According to Li and Wang (1947:18), most of the tungsten deposits of the world are the vein type. Quartz veins are the most common, and minerals of both the wolframite and scheelite groups are the tungsten-bearing constituents. Associated minerals in these veins consist of pyrite, arsenopyrite, chalcopyrite, molybdenite, bismuthinite, cassiterite, galena, sphalerite, stibnite, and cinnabar. Gangue minerals consist of quartz, calcite, muscovite, sericite, fluorite, topaz, tourmaline, chlorite, and chalcocite. Tungsten is usually irregularly distributed in the veins. Vein deposits occur in China, Malaya, Burma, Bolivia, Portugal, and Australia. In the United States vein deposits are found in California, Colorado, Nevada, South Dakota, Washington, and North Carolina.

Prospecting aids

Ultraviolet lamp

A short-wave ultraviolet lamp is one of the most useful aids in detection of scheelite. Such a lamp excites a very brilliant fluorescence in scheelite. Pure scheelite fluoresces a pale blue or bluish white. As the molybdenum content of the scheelite increases, the fluorescent color changes from white to yellow. Li and Wang (1947:9) state that according to R. S. Cannon and K. J. Murato scheelite that fluoresces white contains roughly from 0.35 to 1 percent of molybdenum, and scheelite that fluoresces distinctly yellow contains more than 1 percent of molybdenum. The fluorescent color of scheelite may be altered due to a coating of some other substance or alteration product. Comparison of the fluorescent color should not be attempted unless a fresh surface is exposed by scratching, breaking, or grinding to a powder.

Detection of scheelite, which often occurs in small grains or is intimately mixed with sulphides, as in some quartz veins, or in a variety of shades of colors of lime-silicate minerals, as in tectite, is relatively simple in ultraviolet light, but exceedingly difficult in ordinary light.

Best results in the use of an ultraviolet lamp in the field are obtained in the darkness of underground workings or at night. However, samples may be observed in the daytime in a room that has been darkened. Often it is worthwhile to examine surface workings or outcrops at night with a lamp to obtain an idea of the approximate area, extent, and trends of scheelite mineralization.

The detection of scheelite in any new occurrence should always be checked chemically because other minerals have fluorescent colors similar to those of scheelite. Calcite, hydrozincite, and powellite are the minerals most commonly mistaken for scheelite due to their similar color of fluorescence. Calcite commonly fluoresces red, but sometimes white. Calcite is softer than scheelite and effervesces when treated with hydrochloric acid. Hydrozincite, a hydrous zinc carbonate, usually occurs as a whitish or yellowish coating on sphalerite. Its fluorescent color is a brilliant white, but its manner of occurrence and its easy solubility in acids suffice to distinguish it from scheelite. Powellite, a calcium molybdate, is often associated with molybdenite in tactite or vein deposits. It is a soft yellowish-white mineral that fluoresces from yellowish-white to orange. Powellite may be distinguished from scheelite by its mode of occurrence as a crust on molybdenite. If powellite occurs as large grains that can be scratched easily with the fingernail, the powder will adhere to the skin. Scheelite cannot be scratched with the fingernail and, when powdered, will be easily rubbed off the skin. Tiny grains of powellite cannot be distinguished with certainty from scheelite except by chemical analyses.

Field chemical tests

An acid test may be used to check a preliminary identification of a tungsten-bearing mineral made on the basis of its fluorescence in ultraviolet light or other physical properties. Two somewhat similar methods are used depending on whether the tungsten-bearing mineral is scheelite or one of the wolframite group. Scheelite is attacked by acids and the simple acid test may be used, whereas the wolframites are relatively insoluble and must be fused before making the acid test. The test for the wolframites is described below as the fusion test.

Simple acid test: The following materials are needed for the acid test: hydrochloric (muriatic) acid, test tube or some acid-resisting vessel, short or thin sheets of zinc or tin, and a candle or alcohol lamp.

The mineral to be tested is ground to a fine powder and boiled in hydrochloric acid for a few minutes. A yellow powder, tungsten trioxide (WO_3), will separate from this solution if the mineral tested is a soluble tungsten compound such as scheelite. Add a few pieces of zinc or tin to the solution, boil gently for a few minutes, and if the tungsten oxide has been separated, the solution will turn an indigo blue. This blue color is probably due to the reduction of tungsten trioxide (WO_3) to tungsten hemipentoxide (W_2O_5) by the hydrogen liberated from the hydrochloric acid by the action of the zinc or tin.

Fusion test: This test is used for tungsten minerals of the wolframite group. In addition to the materials necessary for the acid test, the following materials are needed: sodium carbonate or bicarbonate (baking soda), a platinum or steel wire 2 to 4 inches long with a small loop in one end, and a blowpipe.

Make a soda bead with the platinum or steel wire by dipping the loop into a paste of soda and water, sinter this before a flame for a few minutes and then fuse it before a blowpipe. Crush the mineral to be tested to a fine powder and mix with 5 to 6 volumes of soda. Dip the soda bead into this mixture and again fuse the bead. Cool the fused mixture and grind to a powder. Using this powder, proceed as outlined above for the acid test.

Panning

Since tungsten minerals have a high specific gravity (5.4 to 6.1 for scheelite and 7.1 to 7.5 for wolframite), they are easily concentrated in a gold pan. Galena and cassiterite, which are two minerals often associated with wolframite, have specific gravities very similar to that of wolframite and, if present, will be concentrated with it in panning. Scheelite has a specific gravity higher than iron sulphides and the quartz, feldspars, garnet, and epidote commonly associated with it in tectite deposits and will tail behind these minerals in a pan.

Scheelite is very brittle and will not travel far except in sizes as fine as dust. The pan tailings should be examined with an ultraviolet light because even the smallest colors of scheelite will fluoresce. Zircon, a fluorescent mineral often retained in the pan with the scheelite, is distinguished by its orange fluorescence and greater hardness. A beginner should not try to pan too cleanly and should frequently examine the tails with an ultraviolet lamp.

TUNGSTEN OCCURRENCES OF SOUTHWESTERN OREGON

Introduction

Scheelite is the only tungsten mineral reported from southwestern Oregon. It occurs here principally in contact-metamorphic deposits but also has been found in quartz veins and in shear zones.

Prior to 1949 only four occurrences had been noted. Scheelite was detected by Ben Harrison as early as 1909 in the gold placers of Footh Creek in the Gold Hill area. It was also noticed there in later gold-dredging operations. Scheelite was identified in the gold-quartz veins at the Sylvanite mine in the Gold Hill area in 1916. In 1941 scheelite was found in a contact-metamorphic zone at the Lady Slipper prospect on the Left Fork of Footh Creek. At about the same time scheelite was discovered in shear zones with cinnabar at the Mooks Gulch prospect and Rattlesnake prospect near Steamboat located near the confluence of Brush and Carberry creeks in southwestern Jackson County.

In the past two years there have been several new discoveries of scheelite and a number of reported occurrences which have not yet been confirmed by field investigation. Subsequent to the discovery of scheelite in 1949 at the Bratcher tungsten mine near Ashland, discoveries have been made at the following properties: Mattern tungsten deposit in the Ashland district and at the Blue Star and Lucky Strike prospects on Footh Creek in the Gold Hill area.

General geology

Tungsten occurrences so far found in southwestern Oregon are limited geologically to a thick series of metamorphosed volcanic and sedimentary rocks which are exposed over a broad area in Jackson and Josephine counties. These rocks have been termed the Applegate group by Wells, Hotz, and Cater (1949:3). With few exceptions scheelite deposits are found in strongly metamorphosed portions of the Applegate group occurring marginal to granitic or dioritic intrusives.

As mapped by Wells and others (1939, 1940, 1949), the Applegate group is exposed over a wide area in southwestern Oregon, extending west about 34 miles from the overlap of Tertiary rocks in the Medford quadrangle to the contact with the Jurassic Galice formation in the northwestern part of the Grants Pass quadrangle. Based on fossil determinations by Reeside, the Applegate group has been assigned to the Mesozoic era, probably Upper Triassic, by Wells, Hotz, and Cater (1949:4).

Metavolcanics of the Applegate group consist largely of gray-green andesitic and basaltic lavas. Many of these layers contain abundant calcite, concerning which Wells and others (1939) state: "The abundance of calcite in many of the layers suggests that the lavas flowed into a basin and mixed with limy mud that was accumulating there, and finally consolidated as a vesicular breccia bound together by a calcareous matrix." Metasedimentary rocks, occurring as lenticular interbeds in the metavolcanics, include argillite, chert, quartzite, conglomerate, and marble.

Diller (1914:15) has placed the limestone or marble in four fairly well-defined northeast-trending belts. The first belt includes several lenses three miles east of Kerby and a number of very prominent bodies on Cheney Creek about ten miles southwest of Grants Pass. The second belt, forming prominent ledges at the Oregon Caves, passes northeast along the northwest side of Williams Creek valley and includes a number of small lenses in the Foots Creek area and several west of Gold Hill. The third belt includes the ledges west of Steamboat, others east of Applegate and on Kane Creek in the Gold Hill area. The fourth appears at Seattle Bar on the Applegate River near the Oregon-California boundary and also on the Little Applegate River above Buncom.

Numerous irregular masses of moderately to highly siliceous granitic rocks are intrusive into the Applegate group in both the Medford and Grants Pass quadrangles. According to Wells and others (1939,1940), quartz diorite is probably the most abundant type of intrusive rocks but both granodiorite and diorite are common in certain areas. Granite is also present but is comparatively rare. These masses are believed to have been intruded into the Applegate group during the general period of batholithic intrusion which occurred along the Pacific Coast in late Jurassic or early Cretaceous time.

Along contacts with the intrusives, the rocks of the Applegate group often show contact-metamorphism which has resulted in a variety of metamorphic types. Schist, gneiss, quartzite, amphibolite, marble, and lime-silicate rock may be present in these zones. Wells and others (1940) have mapped these more strongly metamorphosed areas in the Grants Pass quadrangle as contact aureoles. Similar rocks had been previously mapped in the Medford quadrangle by Wells and others (1939) as younger metamorphics and by Diller and Kay (1924) as May Creek schist in the Riddle quadrangle to the north. In the Kerby quadrangle Wells, Hotz, and Cater (1949) have mapped several areas of amphibole gneiss believed to have resulted from the metamorphism of sedimentary volcanic material. They have proposed that these may be the altered equivalent of sediments in the Applegate group.

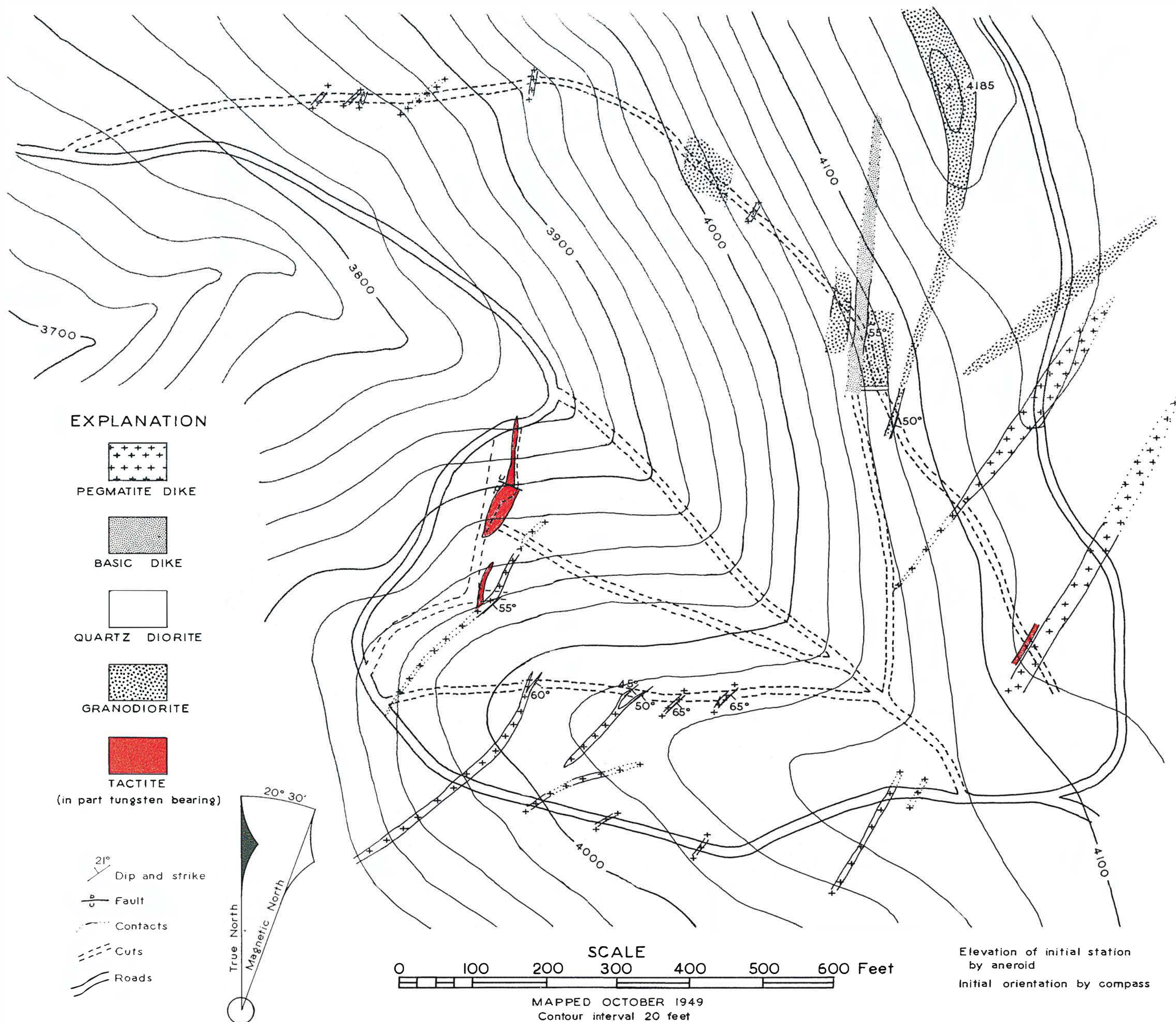


FIG. 2 GEOLOGIC MAP OF THE BRATCHER MINE AREA, JACKSON COUNTY, OREGON
Sec. 18, T. 39 S., R. 1 E.

Jackson County Properties

BRATCHER MINE (1)*

Location

The Bratcher mine is located $2\frac{1}{2}$ miles southwest of the city of Ashland at an elevation of approximately 3,900 feet. The mine is reached by 5 miles of dirt road extending southwestward from U.S. Highway 99 at the northwest limits of the city. The property consists of 482 acres located in sec. 18, T. 39 S., R. 1 E.

History and development

Scheelite was discovered at the Bratcher mine in 1949, and small-scale mining operations were undertaken immediately by the Bratcher Mining Company. An estimated 240 tons of ore was shipped to the Tulare County Tungsten Mines plant at Lindsey, California, yielding about 174 units of tungsten trioxide (WO_3). The initial shipment of about 100 tons yielded 109 units of WO_3 . Surface exploration work continued through 1949. Early in 1950 the property was leased to the Ashland Mining Company. An estimated 350 tons of low-grade scheelite bearing rock was mined and trucked to the Van Curler mill located a short distance below the Ashland mine. Milling of the ore was completed early in 1951, yielding about 35 units of WO_3 .

Development work consists of one main open cut 250 feet long averaging about 25 feet in width and from 10 to 15 feet in depth. In addition there are bulldozer cuts totaling more than 4,000 lineal feet.

Geology

The Bratcher mine is located within and near the western margin of a large intrusive granitic mass which lies south of Ashland, and in this report is called the Ashland stock. As described by Wells and others (1939), this stock is more than 18 miles long and 10 miles wide and comprises several granitic rock types of which quartz diorite is predominant and granodiorite is common. Mt. Ashland, which is near the center of the mass, is largely a perphyritic granite. Aplitic and pegmatitic dikes are numerous throughout. Many inclusions of metamorphic rocks, varying widely in size, occur within the intrusive.

On the west the stock is bounded by the metavolcanic-metasedimentary rocks of the Applegate group. Metavolcanics of this series consist largely of gray-green andesite and basaltic lavas. The metasedimentary rocks in this area, occurring as lenticular interbeds in the metavolcanics, consist largely of black, fine-grained argillite and numerous narrow lenses of marble. Most of the marble is impure and grades in places to limy argillite.

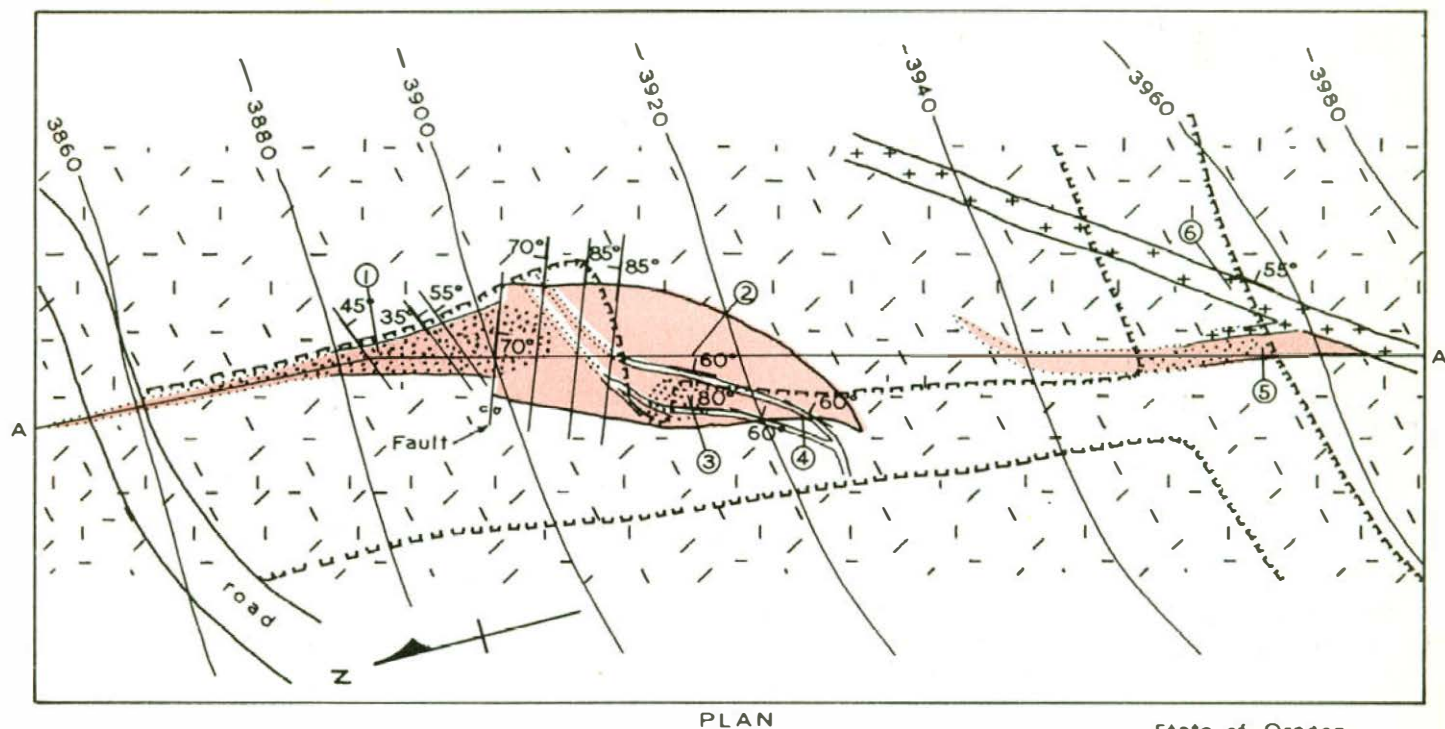
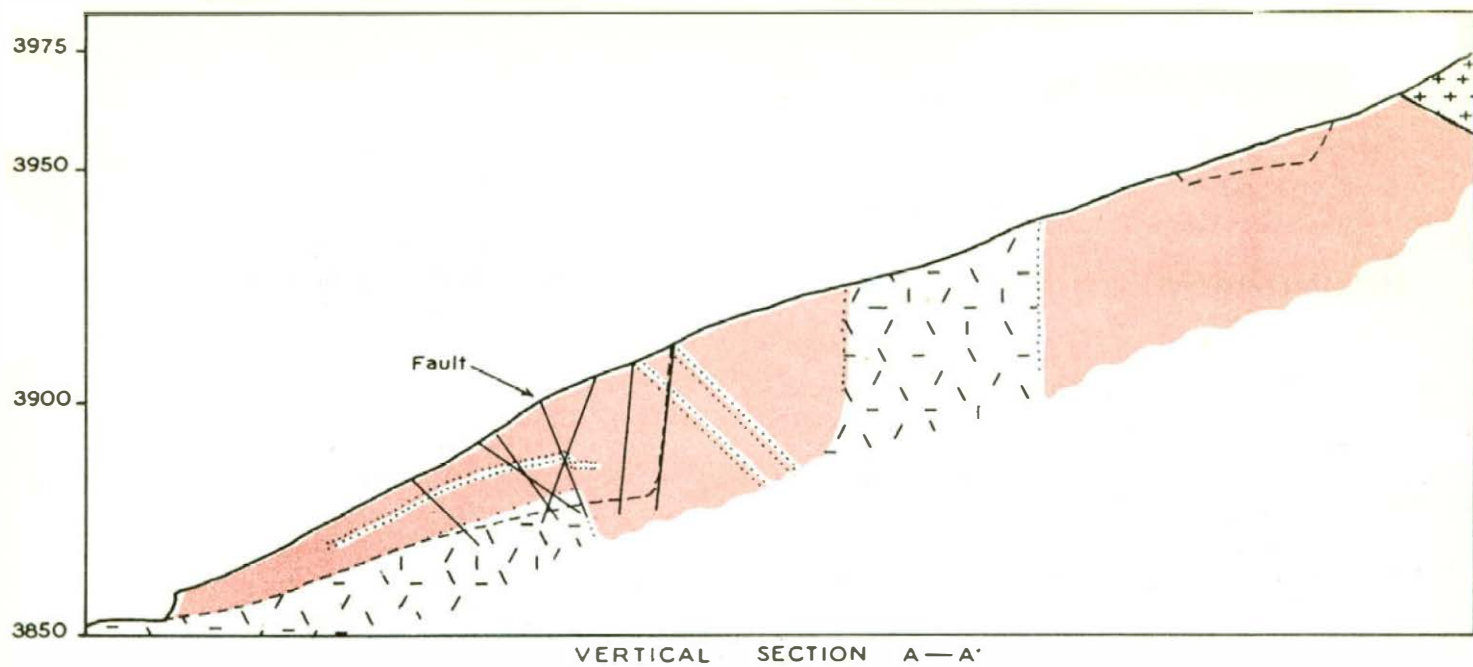
The rocks in the immediate area of the Bratcher mine are predominantly granitic types but also included are many small bodies of metamorphic rocks. Distribution of principal rock types in the mine area is shown on the geologic map (fig. 2). Descriptions of these rocks follow:

Quartz diorite



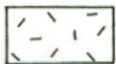
The quartz diorite is a massive, medium-grained, dark gray rock composed of approximately equal amounts of dark and light minerals. It weathers readily and to great depth. Under the microscope it is seen to consist of 45 percent plagioclase feldspar (andesine Ab_{64}), 30 percent hornblende, 18 percent biotite, 5 percent quartz, and 2 percent accessory minerals, including apatite, magnetite, pyrite, and zircon.

Metamorphic rocks occurring as inclusions within the quartz diorite, are chiefly schist but also include a few lenses of talcite which are described separately. The schist occurs as lenses or blocks ranging in size from a few inches to a few tens of feet across. The schist bodies weather easily and are too irregular and too poorly exposed to be segregated in mapping from the enclosing quartz diorite. With few exceptions the schistosity shows a dip to the northwest, usually at a low angle.

* Numbers are the same as key numbers on index map opposite page 1.



State of Oregon
Department of Geology and
Mineral Industries

-  PEGMATITE DIKE
-  QUARTZ DIORITE DIKE
-  QUARTZ DIORITE



Dotted portion indicates
principal scheelite
concentrations

 70° FAULT OR FRACTURE

① SPECTROGRAPHIC ANALYSES (SEE PAGE 13)

 APPROXIMATE LIMITS OF MINING AND
DEVELOPMENT WORK APRIL 1951

 DEPTH OF DEVELOPMENT WORK, APRIL, 1951

SCALE



FIG. 3

PLAN AND SECTION OF THE MAIN TACTITE LENS AT THE BRATCHER MINE

Granodiorite

Several granodiorite bodies crop out on the prominent ridge northeast of the main development out. The granodiorite is a fine-grained light-gray rock frequently showing notable lineation of biotite flakes. In places the granodiorite assumes a definite gneissic character. Its relationship to adjacent rocks is not known. Under the microscope it is seen to consist essentially of the following: 55 percent oligoclase (Ab_{84}), 34 percent quartz, 10 percent microcline, and 1 percent biotite.

Dikes

Pegmatite dikes are extremely common throughout the area and range from a few inches to 30 feet or more in width. The larger dikes, with few exceptions, strike northeast and dip 50° to 60° southeast cutting all other rocks in the area. These larger dikes are composed mainly of potash feldspars and quartz but sometimes contain a minor amount of biotite. Graphic texture is frequently well developed. A medium-grained, dark-green basaltic dike with a maximum width of 20 feet is exposed along the hillside northeast of the main workings. It strikes N. 10° E., dips 55° S.E., and directly overlies a small pegmatite dike of similar attitude.

A few small light-gray quartz-diorite dikes cut the main taotite lens (see fig. 3, p. 10). These dikes also cut the dark-gray quartz-diorite country rock which surrounds the taotite body and are closely associated with small pegmatite dikes. Under the microscope a thin section of a sample from one of these quartz-diorite dikes is seen to consist of 65 percent plagioclase feldspar (andesine Ab_{62}), 6 percent microcline, 8 percent quartz, 20 percent hornblende, and 1 percent zircon.

Taotite

Origin: The taotite was formed by complete metamorphism of small lenses of calcareous rocks, probably impure limestone, during the intrusion of the quartz diorite. It is believed that the main alteration was brought about at a very late stage, after partial solidification of the quartz diorite, by hot solutions which penetrated the calcareous lens. Scheelite, the only tungsten mineral noted, is believed to have been introduced very late in this stage. Three lenses of taotite or related rocks have been noted in the immediate mine area, and a fourth crops out a few hundred feet west of the area.

Main lens (mineralogy and structure): Mining has been confined to one main lens of contact metamorphic rocks 150 feet long and having a maximum width of 28 feet (see fig. 2, opposite p. 9).

This lens is composed largely of taotite but in places includes considerable amounts of dense, closely banded, green hornfels. A thin section from a hornfels sample is seen to be composed essentially of 65 percent diopside, 25 percent quartz, and 10 percent plagioclase feldspars (albite and andesine). In a few places light-colored lime silicates, largely wollastonite, are abundant. It was impractical to map and describe these portions separately, therefore they are included as taotite in this report. The taotite consists essentially of variable amounts of epidote, quartz, garnet, and diopside. Mineralization, including scheelite concentration, in the south half of the lens is somewhat different from that in the north half.

The south half of the lens is composed mainly of diopside, garnet, probably in the grossularite-almandine range, and wollastonite. Quartz and calcite are also present in lesser amounts. Along section B-B' (fig. 3) the lens shows a rough zoning or banding approximately parallel to its north strike. Here in an east-trending cut the lens consists essentially of three bands - (1) a narrow band of hornfels (diopside-quartz) along the eastern margin, (2) a band of taotite composed of diopside and garnet in the central part, and (3) a zone composed mainly of wollastonite and garnet along the west margin of the lens. Scheelite, occurring as local concentrations, is restricted to portions of the wollastonite-garnet zone. The lens here is cut by two prominent quartz-diorite dikes and numerous small pegmatite dikes.

Tactite in the north half of the lens, which contained the highest concentration of scheelite, is a medium- to coarse-grained rock composed of varying amounts of epidote, garnet, and quartz. In this part of the lens most of the scheelite occurred as finely disseminated grains, but within a few feet north and south of the fault, shown on figure 3 (p. 10), coarse subhedral to euhedral crystals of scheelite as much as an inch or more in diameter were abundant (now mined out) in a very coarse-grained garnet-epidote-quartz tactite.

The fault indicated on figure 3 strikes N. 70° W. and dips 70° SW. The exact displacement could not be determined but it is believed to be rather small, possibly only a few feet. Two sets of fractures are apparent in this portion of the lens. One set, which is found south of the fault, strikes N. 70° W. and dips to the northeast at high angles. A second set of fractures, north of the fault, strikes N. 70° E. and dips to the southeast at moderate angles. Both the fault and the fractures are believed to have been formed prior to introduction of solutions which produced the tactite.

Origin and localization of the scheelite: It is beyond the scope of this report to make a detailed study of the origin of the scheelite; however, certain generalizations may be made. The scheelite mineralization, accompanying the final stages of the granitic intrusion, is believed to have occurred as follows:

Tungsten-bearing solutions, originating at great depth in the granitic intrusive, ascended along fractures or pegmatitic conduits. When the solutions reached a calcareous inclusion, the limy material served as a precipitant, causing the tungsten to combine with calcium to form scheelite.

Localization of the scheelite was probably due in part to the favorable texture, porosity, and chemical composition of certain portions of the calcareous lens. The presence of fractures and cross fractures apparently has been responsible for the heavier concentrations of scheelite. Principal concentrations of scheelite occurred a few feet south and about 30 feet north of the fault shown on fig. 3. Fractures are common in this section, the more closely fractured zones being coincident with the heaviest concentrations of scheelite. Approximately 100 tons of ore from this fractured zone constituted the initial shipment to the Tulare tungsten mill mentioned on page 9.

Other tactite occurrences: A narrow lens of tactite occurs 50 feet south of the main tactite body. It is composed of epidote and quartz and shows local concentrations of scheelite in surface cuts. To the north the lens appears to pinch out and to the south it abuts against a prominent pegmatite dike.

Another small occurrence of tactite was noted adjacent to a large pegmatite dike 700 feet east of the main tactite body (see fig. 2, opposite p. 9). It is but a few feet in width and contains only occasional widely scattered grains of scheelite as exposed in shallow exploration cuts. The zone is composed in part of garnet, wollastonite, and quartz.

A barren zone of tactite composed essentially of epidote and quartz crops out 1,000 feet west of the main lens and beyond the limits of the area shown on the geologic map (fig. 2). This zone, which is several feet in width, can be traced northeast along the strike for at least 300 feet.

Spectrographic analyses: Qualitative spectrographic analyses were made on six rock samples (see table 3, p. 13). This was done principally to determine if any important similarities in minor element content existed between the tactites and the associated granitic intrusives. All of the tactite and the granitic rocks showed a great similarity in minor element content; however, nothing particularly significant was disclosed. The elements present, both minor and essential, are shown in the table.

Table 3.

QUALITATIVE SPECTROGRAPHIC ANALYSES
(Quantities estimated to nearest power of ten)

<u>Sample</u>	<u>Description</u>	<u>+ 10%</u>	<u>10% - 1%</u>	<u>1% - 0.1%</u>	<u>0.1% - .01%</u>	<u>.01% - .001%</u>	<u>Below .001%</u>
No. 1 (P-8521)	Scheelite bearing- epidote-quartz tactite	Si	Al, Fe, Cu	Mg, Mn, W	Na, Pb, Ti, K, V, Sr	Ba, Cu, Cr, Mo, Ni	---
No. 2 (P-10164)	Diopside-garnet tactite	Si, Ca	Al, Fe, Mg	Ti, Na, K	Mn, Pb, Cr, V, Sr	Ba, Cu, W, Ni	B
No. 3 (P-10163)	Garnet-vollastonite tactite	Si, Ca	Al, Fe, Mg	Ti, Na, K	Mn, Pb, V, Sr	Ba, Cu, Cr, W, Ni	B
No. 4 (P-10159)	Quartz-diorite dike	Si	Al, Fe, Ca, Na	K	Mn, Pb, Ti, Cu, Ba, Sr	V, Cr, Ni	B, Mo
No. 5 (P-10165)	Epidote-quartz tactite	Si, Ca	Al, Fe, Mg	Ti, Na, K	Mn, Pb, Cr, V, Sr	Ba, Cu, W, Ni	B
No. 6 (P-10158)	Pegmatite dike	Si	Al, Fe, Ca, Na, K	---	Mn, Pb, Cr, Cu, Ba, Sr	V, Ti, Mo, Ni	B

MATTERN TUNGSTEN DEPOSIT (2)

General

The Mattern tungsten deposit is located in sec. 31, T. 38 S., R. 1 E., on the Southern Pacific Railroad right-of-way one mile northwest of Ashland and approximately an eighth of a mile southwest of the Jackson Hot Springs resort. For reference in this report it has been termed the Mattern tungsten deposit because of its proximity to the Mattern mine - one of the early gold quartz mines of the area, inactive for many years.

Attention was first directed to the deposit late in 1949 when a sample from the deposit, submitted to the Department by Mr. G. I. Maxwell, disclosed a small tungsten content. A field inspection of the deposit was made by the Department shortly thereafter.

Geology

The deposit occurs in a narrow fringe of metavolcanic rocks of the Applegate group which are exposed along the northern margin of the Ashland stock northwest of Ashland. Scheelite, the only tungsten mineral noted, occurs in a tactite body which has been exposed by a railroad cut about 300 feet northwest of the portal of the Mattern mine. The tactite occurs in strongly metamorphosed volcanic rocks of the Applegate group in an apparent interfingering of the metavolcanics with the granitic rocks along the margin of the stock. A vertical cross section of the tactite zone and other rocks exposed in the railroad cut is shown in fig. 4.

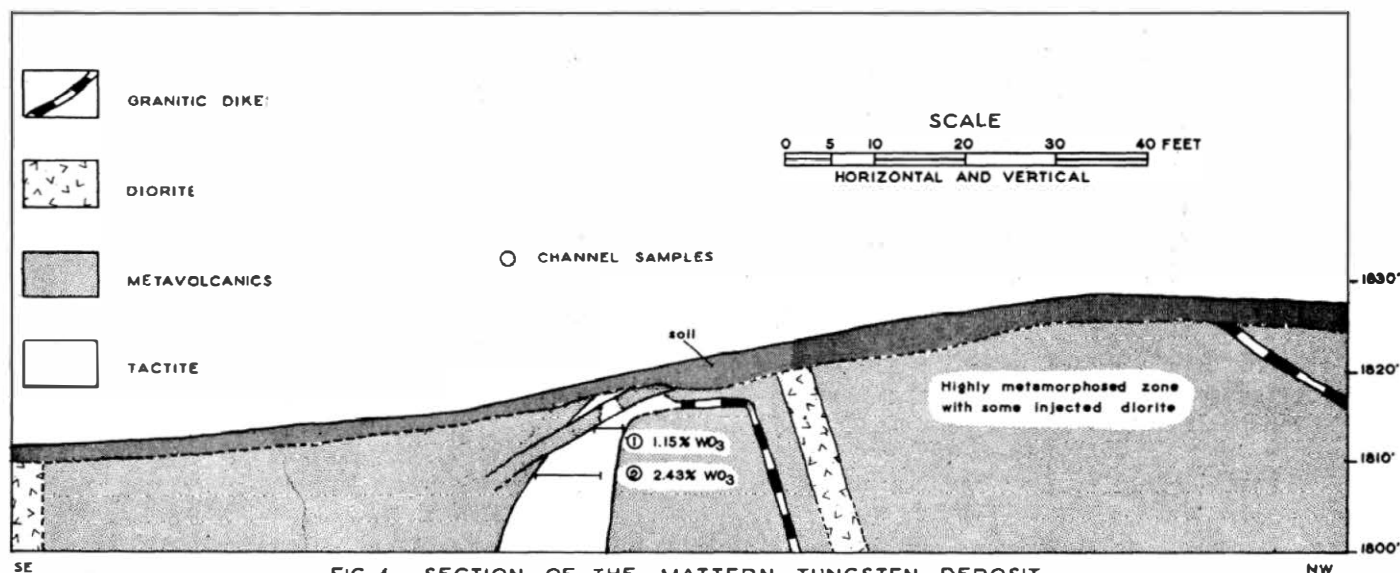


FIG 4. SECTION OF THE MATTERN TUNGSTEN DEPOSIT

Metavolcanics comprise the bulk of the rocks exposed in the section. Principal metavolcanic rock is a dark gray, porphyritic meta-andesite which is exposed on both sides of the tactite zone. To the northwest it passes into a zone of mixed types of rather strongly metamorphosed volcanic rock with some injected diorite. The meta-andesite extends southeast from the tactite body about 50 feet to the contact with diorite. The tactite zone and the adjoining porphyritic meta-andesite to the southeast are cut by a narrow meta-andesite dike which forms the southeast wall of the tactite zone for several feet.

The principal exposure of diorite in the immediate area is southeast of the tactite zone, where it is exposed along the railroad cut for about 100 feet. It is a massive, medium-grained, dark gray rock composed of about equal amounts of dark and light minerals.

Two narrow light-colored siliceous granitic dikes cutting the metavolcanics are exposed in the out northwest of the tactite body. One of these dikes cuts the metavolcanics about 20 feet northwest of the tactite zone and, a few feet below the top of the out, turns sharply to the southeast merging into the apex of the tactite body.

The tactite, which is exposed only in the railroad out, is 12 feet in width at the base of the out narrowing to possibly 2 feet in width at the top. It cannot be traced at the surface along its strike either to the northeast or southwest. The tactite is composed essentially of quartz, epidote, and calcite. Scheelite occurs finely disseminated throughout the zone but in places there are concentrations of coarse grains. Individual pieces in these concentrations are as much as 2 inches in diameter. Many of the heaviest concentrations occur around the margins of small masses of calcite which are irregularly distributed throughout the tactite. Scheelite was noted in particular abundance immediately below the meta-andesite dike which cuts the tactite. A 3-foot channel sample taken near the top of the tactite exposure contained 1.15 percent tungsten trioxide (WO_3) and a 7-foot channel sample taken near the middle of the exposure contained 2.43 percent tungsten trioxide.

A spectrographic analysis was made of representative material from the tactite zone with results as follows:

Sample No.	+ 10%	10% - 1%	1% - 0.1%	0.1% - .01%	.01% - .001%	Below .001%
(P-10156)	Si, Ca, Fe	Al	Mg, Na, Mn, W	K, Ti, Pb Cr, Mo, V, Cu Sr, Ni	Ba	B

The tactite zone has not been exposed sufficiently to permit other than a few general observations concerning the origin and localization of the scheelite. A genetic relationship is suggested between the tactite and the small siliceous granitic dike which cuts the metavolcanics about 20 feet northwest of the tactite zone. The meta-andesite dike which cuts the tactite zone appears to have been at least partially responsible for the heaviest concentrations of scheelite.

SYLVANITE MINE (3)

General

The Sylvanite mine is located about 3 miles northeast of Gold Hill in Jackson County in sec. 2, T. 36 S., R. 3 W. The property, owned by George Tulare, Route 2, Box 371, Gold Hill, Oregon, consists of 132 acres of patented ground which includes four full mining claims and two fractional claims.

This is primarily a gold property. Scheelite was discovered as a result of and incidental to the gold-mining operations. Parks and Swartley (1916:219) reported:

"... The vein strikes N. 22° E., and dips about 65° E. and the country rocks have the same attitude; they are argillite partly altered to chlorite and serpentine. The vein contains quartz carrying some pyrite. The workings, now badly caved, are reported to consist of a drift 1200 feet long at an elevation of 1360 feet by barometer and a crosscut to the vein at an elevation of 1650 feet, with a shaft to the lower level. According to W. A. Marvin, who was in charge of the mine at one time, the ore contained no telluride, but a little galena and much pyrite in quartz; the fault gouge contained about \$3 worth of gold and silver per ton; high-grade gold occurred in 'boulders' not in place at depths from 80 to 160 feet; sulphide ore began to appear at about 160 feet depth and was 5 feet wide at 225 feet depth; the hanging wall was slate and the footwall a limestone.

"Considerable interest has been attached to this property since the discovery in March 1916 of tungsten along with the gold ores in the form of scheelite. The mineral occurs in small stringers with quartz. Samples have been taken from those quartz ledges which run as high as 40 percent tungstic acid, but it is claimed by the management that the vein as a whole runs less than 2 percent. The veins carrying the best grade of tungsten have been developed to a small extent and the tungsten resources of the mine have not yet been determined."

The record since 1916 is incomplete. In 1928 the Oregon-Pittsburg Company worked the mine, and in 1930 the Discon Mining Company developed the high-grade ore shoot along the Cox-Lyman vein. Western United Gold Properties had the mine for a short period, and from 1935 to 1937, the Sylvanite Mining Company worked it during the summer months. In 1939 the property was re-opened by the Imperial Gold Mines, Inc., but operations were discontinued in 1940. A limited amount of development work has been carried on since that time by the present owner. There apparently has been little, if any, development work aimed at exploring the tungsten-bearing veins during this period.

Geology

The general area in which the Sylvanite mine is located has been mapped by Wells and others (1940) largely as metavolcanic and metasedimentary rocks of the Applegate group. A prominent band of metasedimentary rock more than a mile in width occurs immediately to the northwest of the mine. This band strikes southwest through Gold Hill to the Foote's Creek area. In the mine area the metasedimentary rocks consist largely of argillite. Further to the southwest in the Gold Hill-Foote's Creek area a considerable number of small lenses of limestone are included. A prominent granitic intrusive composed largely of gabbro and granodiorite occurs about 1 mile southeast of the mine.

The gold ore deposits are related to complex shearing and faulting. One of the more persistent of these shear zones is the so-called Sylvanite vein which trends slightly east of north and dips southeastward at about 45°. Generally speaking rocks west of this shear zone are metasedimentary and those east of the zone are metavolcanic.

One quartz vein containing the scheelite is exposed in a crosscut to the northeast from the so-called Half-Tunnel which trends N. 34° W. on the Hammersley vein. At a point 80 feet from the portal of the Half-Tunnel a crosscut extends N. 48° E. cutting two quartz veins which parallel the Hammersley vein. The second vein which contains scheelite is intersected at 113 feet. It is 10 inches in width, striking N. 30° W. and dipping 72° NE. Scheelite appears spottily along a 2-inch band in the quartz vein. The scheelite vein is reported to have been traced by panning at the surface for about 200 feet along the strike to the northwest.

LADY SLIPPER PROSPECT (4)

General

The Lady Slipper mine is located on the Left Fork of Foote's Creek in Jackson County in sec. 7, T. 37 S., R. 3 W. The principal workings are on patented land owned by George E. Murphy and Harry B. Murphy, 302 Lumbermens Building, Portland, Oregon. The prospect was discovered by Ben Harrison in 1941. Previously scheelite had been noted in the gold cleanups of the Black Gold Channel placer on the Left Fork of Foote's Creek and in cleanups of the Ferry dredge on Foote's Creek.

Geology

Metavolcanic rocks of the Applegate group are predominant in the mine area. The metavolcanics here include tuffs and some amygdaloidal lavas containing an abundance of calcite. Scheelite occurs as disseminated grains in strongly metamorphosed volcanics along the contact with a small intrusive dioritic mass. Overburden obscures the extent of the intrusive; however, it appears to be less than 50 feet in width. The length is indeterminate. The contact zone has been prospected by a short adit about 28 feet long and a 24-foot winze

at the end of the adit. Short drifts were driven east and west from the bottom of the winze. The winze is now badly caved but is partially accessible. A crosscut about 45 feet lower in elevation than the adit has been driven 80 feet to explore the contact zone but is about 30 feet short of the contact.

The contact zone has not had sufficient exploration to allow a satisfactory estimate of quantity and concentration of scheelite present.

BLUE STAR PROSPECT (5)

General

The Blue Star tungsten prospect is located on a ridge between the Middle and Right forks of Foote Creek in Jackson County. The property consists of 3 lode claims located in the SE $\frac{1}{4}$ sec. 14, T. 37 S., R. 4 W. The claims were located in December 1950 by C.B. Harrison, H.A. Harrison, and Leo Thompson, Gold Hill, Oregon. The principal occurrences are at about 1,900 feet elevation.

Scheelite was detected in drainages of the area in the fall of 1950 by the owners, who later succeeded in locating several widely dispersed scheelite occurrences mainly by "pocket-hunting" prospecting methods. A shaft 20 feet deep was sunk in addition to several pits.

The property was leased for a short time early in 1951 by the Cordero Mining Company who did about 2,000 lineal feet of trenching with a bulldozer.

Geology

The scheelite occurrences are in rocks of the Applegate group, predominantly metavolcanics, marginal to a granitic intrusive. This intrusive, which has been mapped as quartz diorite by Wells and others (1940), is half a mile in diameter and apparently has a very irregular contact. In places blocks of pale lime-silicate rocks occur well within the margins of the intrusive.

Scheelite in metavolcanic rocks occurring near the contact with the granitic intrusive has been noted at one point on the Blue Star No. 1 claim. These metavolcanics may represent either an inclusion or a small body which projects into the granitic intrusive along the contact. The occurrence has been explored by surface pits and a 20-foot location shaft. Decomposed granitic rock is exposed in outs within 50 to 100 feet to the east, south, and west of the location shaft. The rocks exposed in the shaft consist of gray metamorphosed basaltic or andesitic lavas containing a considerable amount of calcite. Scheelite occurs as scattered grains as large as half an inch in diameter in the more altered portions of the metavolcanics. The zone has been traced by surface panning for possibly 20 to 30 feet to the northeast.

One point of scheelite mineralization has been noted on the Blue Star No. 2 claim about 500 feet south of the location shaft on the Blue Star No. 1 claim. This is exposed in one shallow surface out only.

The Blue Star No. 3 claim contains several discontinuous points of scheelite mineralization in the contact zone along the east margin of the granitic intrusive. These have been exposed in shallow trenches and bulldozer cuts. The most southerly of these points is at the location out and in a bulldozer cut a few feet to the south. Scheelite occurs here in a dense, gray-green, very siliceous contact rock, presumably a lime-silicate rock, which might properly be termed a taotite. Megascopically, garnet is the only mineral easily identified. Scheelite occurs as small indistinct "spots" or areas in the more dense, siliceous contact rocks. The extent or nature of this zone cannot be determined from the present limited development work.

Approximately 200 feet north of the location out, three points of mineralization are exposed in the two bulldozer outs and one small trench. The most northerly of these points has been explored by a broad east-west bulldozer out which exposes the contact between the

intrusive on the west and rocks of the Applegate group, presumably metavolcanics, on the east. On the south side of this out the contact rocks consist of several feet of a dense, fine-grained, white rock, possibly lime-silicate. Outward from the contact this white rock grades into dense, dark gray, siliceous material. Scheelite occurs as disseminated grains and as narrow stringers in parts of the latter zone. Scheelite mineralization extends to the northeast from the south side of the out for about 10 feet. The exact width of the scheelite-bearing zone cannot be determined from present exposures but is reported to range from 2 to 4 feet. In the upper portion of the out a very high-grade "pocket" of scheelite was encountered.

Several hundred feet to the southeast of the location out on Blue Star No. 3, scheelite has been reported from a contact zone exposed on Moore Gulch. A zone of tectite composed largely of garnet was noted immediately east of the Blue Star No. 2 claim on private land. This zone, which is exposed in an irrigation ditch, appears to be several feet in width but no scheelite was found.

LUCKY STRIKE PROSPECT (6)

General

The Lucky Strike tungsten prospect is on a ridge between the Middle and Right forks of Footh Creek in Jackson County and immediately north of the Blue Star tungsten prospect. The property consists of three lode claims located in March 1951 in the NE $\frac{1}{4}$ sec. 14, T. 37 S., R. 4 W., by Stuart S. Hatch, Gordon L. Hatch, and William C. Tingle, Rogue River, Oregon. The discovery shaft is at an elevation of about 1,650 feet.

Geology

The geology is essentially the same as at the Blue Star prospect to the south. Scheelite occurrences are in rocks of the Applegate group along the north margin of the same small granitic intrusive which is responsible for the scheelite mineralization at the Blue Star prospect.

Principal occurrences thus far noted are on the Lucky Strike No. 3 claim and were found by "pocket-hunting" prospecting methods. Development work consists of a location shaft 10 feet in depth entirely in weathered contact rocks and several small outs. Scheelite occurs as sparsely disseminated grains and small stringers on all four walls of the shaft. Granitic rocks crop out at several places in the immediate area. On the hillside a few hundred feet northeast of the shaft a second prospect has been exposed by a small out. The out exposes an 18-inch zone of weathered rock and clay containing disseminated scheelite adjacent to a limestone body. Intrusive granitic rocks are exposed to the north and east of the out.

Scheelite is also reported to have been found in a quartz vein half a mile northwest of the Lucky Strike prospect.

MOCKS GULCH PROSPECT (7)

General

The Mocks Gulch prospect is located at an elevation of 3,400 feet in the SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 17, T. 40 S., R. 4 W., Jackson County. The prospect is west of Brush Creek, a tributary of Carberry Creek in the Upper Applegate area.

The property has been prospected for both cinnabar and scheelite. Development work consists of 5 small open outs. The largest of these is 50 feet in length. The only occurrence of scheelite is in a small out which was opened in 1917.

Geology

The prospect is located in deeply weathered metavolcanic rocks of the Applegate Group. No granitic intrusives are exposed in the immediate area; however, there is a small diorite intrusive approximately 2 miles to the southeast near Steamboat. The large Grayback Mountain granitic stock is located about 4 miles west of the prospect. Scheelite occurs in a well-defined shear zone in the metavolcanic rocks striking east and dipping about 70° S. The zone is 3 feet wide and has been opened for only 5 feet along the strike. Cinnabar occurs in the wall rock of the zone and has been noted in small amounts elsewhere on the property, occurring along fracture planes in the metavolcanic rocks.

RATTLESNAKE PROSPECT (8)

General

The Rattlesnake prospect is in the SW $\frac{1}{4}$ sec. 9 and the SE $\frac{1}{4}$ sec. 8, T. 40 S., R. 4 W., east of Brush Creek, a tributary of Carberry Creek, in the Upper Applegate area of Jackson County. It has been considered principally as a mercury prospect. Cinnabar was discovered here in 1935. In 1942 the property, consisting of 11 unpatented lode claims, was owned by Milton Murphy, Applegate, Oregon, and E. S. Nee, Jacksonville, Oregon, and was under lease to the Horse Heaven Mines, Inc. Present ownership is not known.

Geology

The prospect is in metavolcanic rocks of the Applegate group and the geological relationships are similar to those at the Mocks Gulch prospect to the west across Brush Creek. Probably the nearest granitic intrusive - a small diorite mass - is about 2 miles to the southeast near Steamboat. The large Grayback Mountain granitic stock is about 4 miles west of the prospect.

The main cinnabar tunnel is about 600 feet above Brush Creek and extends into the hill S. 70° E. for a distance of 52 feet. Scheelite occurs here as a narrow stringer about an eighth of an inch wide extending along the northeast side of the tunnel for 15 feet.

TUNGSTEN OCCURRENCES OF NORTHEASTERN OREGON

Introduction

In order to present a more complete picture of tungsten in Oregon, a brief review of occurrences in northeastern Oregon is included. No field work on these deposits has been done by the writers, and the information below is summarized from the literature available.

Descriptions of tungsten deposits in this part of the State are sketchy. Very little exploration work has been done on any of these occurrences, many of which consist merely of the identification of scheelite in small amounts in quartz veins or in taconite zones between granodiorite or quartz diorite and limestone lenses.

Tungsten has been reported by Lindgren (1901:725) at the Cliff mine near the southwestern edge of the Farley Hills northeast of Baker. In addition, scheelite has been identified at the Davis tungsten deposit on the eastern slope of the Elkhorn Mountains; at three properties in the Chicken Creek district in the Lower Burnt River area; and at four properties in the Wallowa Mountains along the northeastern edge of the Wallowa batholith. Descriptions of these properties follow:

Baker County Properties

CLIFF MINE (9)

The Cliff mine, formerly mined for gold, is in the Virtue district in sec. 32, T. 8 S., R. 41 E., Baker County. It is about 5 miles northeast of Baker at an elevation of about 3,600 feet on the north side of a small gulch draining into Baker valley. The mine is owned by Alma Williams, 2458 N. Maxson Road, El Monte, California, and J. T. Taylor, 2149-5th Street, Bremerton, Washington.

The Cliff vein, containing quartz and calcite, is from 1 to 3 feet wide in a country rock of altered gabbro. The strike is north. Development work consists mainly of a 300-foot shaft now inaccessible. The mine has been inactive since the late 1930's when a small amount of mining was done by Kenneth Grabner of Ironsides, Oregon.

Lindgren (1901:725) reported that scheelite was identified in the quartz by C.L. King of Baker. In 1916 and later, because of war prices of tungsten, attempts, largely unsuccessful, were made to produce scheelite.

DAVIS TUNGSTEN DEPOSIT (10)

The deposit is on the eastern slope of the Elkhorn Mountains in the S $\frac{1}{2}$ sec. 31, T. 6 S., R. 38 E., at about 4,500 feet in elevation. Richards (1942) reported that the owner was Jack Brown, Route 1, North Powder, Oregon.

Country rock at the outcrop consists of a coarsely crystalline white limestone which is in contact with altered greenstone on the east. Development work consisted of five shallow open cuts in 1942. An 18-inch gouge and quartz seam was noted in the limestone in one cut, but it did not carry any scheelite. Within 35 feet of the greenstone contact, scheelite was found in minute fractures in the limestone, and also at one place in a fracture in the greenstone within 2 feet of the limestone contact. Of two samples which were taken by Richards, only one, a picked sample, showed a trace of tungsten trioxide (WO₃).

The scheelite mineralization as indicated by the exposures in the pits is too weak to be of any economic importance.

CHICKEN CREEK PROSPECTS (11, 12, 13)

The Chicken Creek prospects are in the Lower Burnt River area in the central part of T. 12 S., R. 44 E., approximately 14 miles north of Huntington and about 4 miles northeast of Weatherby along the headwaters of Chicken Creek. Narrow quartz veins and seams from 1 to 16 inches in width occur here in quartz diorite and have been worked for their gold content for many years; also, several localities have been placered. Scheelite has been found in the quartz veins and in the placer gravels. According to Fitzsimmons (1949:139) the scheelite occurs as incrustations on quartz, in fractures in the quartz, and like a powder on vein walls. Apparently scheelite mineralization is widespread but extremely meager.

Scheelite has been reported* from the following properties (all in T. 12 S., R. 44 E.) in this district: the Scheelite Property (11) 4 miles northeast of Weatherby in about sec. 9; the Tungsten Claim (12) on the east side of Chicken Creek in NW $\frac{1}{4}$ sec. 15; and the Chicken Creek (Hallowell) Mine (13) in the NW $\frac{1}{4}$ sec. 2 at an approximate elevation of 5,200 feet. No assays of samples from these properties for tungsten trioxide have been recorded.

*Oregon metal mines handbook - Baker, Union, and Wallowa counties: Oregon Dept. Geology and Min. Industries Bull. 14-A, 1939.

Wallowa Mountains Properties

Introduction

Tungsten in small amounts has been detected in taciite formed along contact metamorphic zones between granodiorite and limestone in the Wallowa Mountains. The taciite consists of garnet, epidote, calcite, and quartz. Many of these contact zones contain chalcopyrite, pyrite, and molybdenite, as well as scheelite. Some high-grade picked samples of scheelite have been obtained, but there has been no accurate sampling to determine the tungsten content at any of the properties. The continuity of the ore zones and extent of the deposit have not been proved. Scheelite has been found at four properties which are discussed below.

FRASIER PROPERTY (14)

This property is in the center of the NW $\frac{1}{4}$ sec. 12, T. 5 S., R. 44 E., on a high ridge which separates the headwaters of the Imnaha River and the West Fork of the Wallowa River. It is about 18 miles south of Joseph. Six miles are by road and 12 miles are by trail along the West Fork of the Wallowa River.

According to Rees and Larsen (1921:308) a taciite zone from a few feet to 20 feet wide lies between a semicircular block of marble a few hundred feet across and a quartz-diorite body nearly surrounding it. The taciite has abundant brown garnet with lesser amounts of green epidote, quartz, and calcite. The accompanying minerals, titanite, apatite, scheelite, pyrite, chalcopyrite, and molybdenite, are associated with fractures in the taciite. There are some quartz lenses rich in scheelite along the borders. A picked sample from quartz lenses from the west side of the ridge panned 17 percent WO₃, but two grab samples from the taciite panned only a trace of WO₃.

LE GORE PROSPECT (15)

The Le Gore prospect is near the head of Falls Creek in E $\frac{1}{2}$ SW $\frac{1}{4}$ sec. 8, T. 3 S., R. 44 E., at an elevation of about 7,900 feet. A good road extends 5 miles from Joseph up Hurricane Creek almost to the mouth of Falls Creek and from this point a trail 2 miles long leads up Falls Creek to the property.

Claims on the property cover a contact zone of taciite between granodiorite and limestone. Molybdenite, pyrite, chalcopyrite, minor amounts of sphalerite, and traces of scheelite are sparsely disseminated in the taciite. The contact zone is from a few inches to about 20 feet in width. According to Smith and Allen (1941:45-46) no molybdenite or scheelite ore bodies of economic importance have been discovered, and only two out of nine channel samples contained even a trace of tungsten.

WILMOT PROPERTY (Matterhorn Group) (16)

The Wilmot is primarily a molybdenum prospect near the base of the western slope of Matterhorn Peak on the east side of Hurricane Creek in the SW $\frac{1}{4}$ sec. 10, T. 4 S., R. 44 E. The prospect is about 10 miles by trail up Hurricane Creek from the terminus of the Forest Service road that extends about 2 miles up Hurricane Canyon.

Granodiorite intrudes gray to black shale or hornfels and crystalline limestone. Basalt dikes intrude these rocks. Mineralization in taciite zones along the metamorphic-granodiorite contacts in this area is poorly developed and spotty. Three open cuts explore taciite zones 2 to 3 feet thick. The taciite zones contain sparsely disseminated molybdenite, pyrite, chalcopyrite, and scheelite in a gangue of garnet, epidote, calcite, and quartz. According to Smith and Allen (1941:49-50), the largest taciite zone exposed is in one of these cuts and is 10 feet by 3 feet by 15 feet.

METZGER PROPERTY (17)

The Metzger property is in sec. 5, T. 3 S., R. 44 E., on Little Granite Creek which flows into Hurricane Creek at a point about 4 miles by road west of Joseph. It is about $1\frac{1}{2}$ miles up Little Granite Creek from Hurricane Creek at an approximate elevation of 7,600 feet.

An open cut exposes a tantalite zone lying between marble and granodiorite. The tantalite zone contains sparsely disseminated molybdenite and some scheelite.

FAVORABLE PROSPECTING AREAS

Tungsten ores are deposited from solutions derived from granite magmas, and the known occurrences of scheelite in southwestern and northeastern Oregon consist of contact replacement deposits and vein deposits closely associated with siliceous (granitic or dioritic) masses believed to have intruded existing volcanic flows and sedimentary rocks during the Mesozoic era. That geological conditions favorable to tungsten deposition existed at this time has been previously demonstrated. Besides the information on known deposits of tungsten presented in this report, general statements regarding areas favorable for prospecting may be made.

In southwestern Oregon, scheelite has been noted only in rocks of the Applegate group. It is suggested that prospectors direct their attention in particular to contact zones or aureoles surrounding siliceous intrusives in areas where limestone or other highly calcareous rocks are abundant in the Applegate group.

The major areal distribution of rocks of the Applegate group, as well as of the siliceous intrusive rocks, is shown on the following published geologic maps: Preliminary geologic map of the Medford quadrangle, Oregon, (Wells and others, 1939); Preliminary geologic map of the Grants Pass quadrangle, Oregon, (Wells and others, 1940); and Preliminary geologic map of the Kerby quadrangle, Oregon, (Wells, Hotz, and Cater, 1949).

In northeastern Oregon favorable areas would be along margins of the numerous granitic and dioritic intrusive masses, for example, the Wallowa batholith, occurring in the Blue and Wallowa mountains. The following literature, some of which contain geological maps, should be of interest to anyone prospecting for tungsten in this area: The gold belt of the Blue Mountains of Oregon (Lindgren, 1901); Geology and physiography of the northern Wallowa Mountains (Smith, Allen, and others, 1941); Geology and mineral resources of the Baker quadrangle (Gilluly, 1937); Preliminary geologic map of the Sumpter quadrangle (Pardee and others, 1941); Some mining districts of eastern Oregon (Gilluly, Reed, and Parks, 1933); and Petrology of the southwest quarter of the Pine quadrangle (Fitzsimmons, 1949).

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2. Progress report on Coos Bay coal field, 1938: F. W. Libbey	0.10
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