UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey
Washington

TUNGSTEN DEPOSITS OF THE OSGOOD RANGE, HUMBOLDT COUNTY, NEVADA

Tungsten deposits in the Potosi mining district, in the northern part of the Osgood Range, Humboldt County, Nev. (fig. 1), were examined and mapped for the Geological Survey, United States Department of the Interior, in 1940 by Eugene Callaghan, assisted by C. J. Vitaliano, and in 1943 by S. E. Clabaugh and S. Warren Hobbs. A reconnaissance map of the area and detailed maps of the producing deposits were prepared and a study made of the ore deposits. Property owners and officials of companies operating in the district gave cordial assistance to the Survey geologists at all times.

Although scheelite was known to occur in this district before 1917, the only activity prior to the fall of 1942 was the large scale gold mining operation of the Getchell mines. In the fall of 1942 a part of the Getchell gold mill was converted to the treatment of the scheelite-bearing tactite ores which are unrelated to the gold ore bodies. Scheelite is recovered from the tungsten ore by flotation cells installed in a part of the mill which was formerly used for treating the oxidized part of the gold ore. Tungsten concentrates are hauled by truck to the Metals Reserve Co. chemical retreatment plant in Salt Lake City. During the summer of 1943 Metals Reserve Co. began purchasing crude ore from the local producers and established a stock pile near the Getchell mill.

The Osgood Range is in eastern Humboldt County northeast of the town of Golconda. Adam Peak, in the approximate center of the Osgood Range, rises to an altitude of 8,400 feet, almost 3,500 feet above the desert flats on either side of the range. The Osgood Range is small and rugged with steep hillsides, but in many parts of the range, exposures of bedrock are few, and the surface extent of most of the ore bodies has been defined only by means of trenches.

The north-central part of the range consists of a stock of granodiorite which has invaded sedimentary rocks (fig. 2). The stock is 6 miles long in a north-south direction and less than 2 miles wide, narrowing to less than 1,000 feet near the center. The granodiorite is a light-colored even-grained rock, composed chiefly of feldspar, quartz, biotite, and hornblende. Dikes of varied composition are numerous within the intrusive mass, as well as in the sedimentary rocks about the margin of the granodiorite stock. The dikes are composed of andesite porphyry, granodiorite aplite, and a minor amount of pegmatite. The contact of the stock with the surrounding sedimentary rocks dips generally from 40° to 60° E. on the eastern side of the stock; where it is exposed on the western side, it is nearly vertical.

The sedimentary rocks are interbedded argillite and limestone. The argillite, commonly called shale or hornfels in the district, varies widely in character, but most of it is dark gray or brown in color, platy to blocky, and fine-grained. The limestone, less abundant than the argillite, occurs as layers a few inches to several hundred feet thick in the argillite. Most of the limestone is thin - to medium-bedded. The sediments have been extensively folded and faulted.

Immediately adjacent to the main intrusive mass, the sedimentary rocks have been markedly metamorphosed. The argillite has been altered to hornfels and schist. The limestone has been altered in places to tactite, composed chiefly of garnet, in other places to a white wollastonite rock, or recrystallized to a coarse marble adjacent to the tactite or to the igneous contact where the tactite is absent.

The tungsten mineralization is almost entirely restricted to tactite formed by the alteration of limestone adjacent to the granodiorite. Tactite is present along about 60 to 70 percent of the total length of the contact between the limestone layers in the sediments and granodiorite (fig. 2). Larger tactite masses appear to have been localized by irregularities of the contact, particularly by projections of limestone into granodiorite. The tactite zone rarely extends for distances of more than 50 feet from the granodiorite contact, although exceptionally it may extend as far as 100 feet, and the main granodiorite stock forms one wall of each of the ore bodies developed by current mining operations.

Gold and tungsten are the only economically important metals in the district, although minerals containing zinc, copper, silver, molybdenum, lead, and bismuth also occur in the tactite bodies and in small veins of replacement bodies in the metamorphosed sedimentary rocks. The gold ore and the tungsten ore occur in separate deposits resulting from unrelated types and periods of mineralization. However, the presence of the large scale gold mining operation and mill has been an important factor in the rapid development of the tungsten deposits in the district.

Scheelite (calcium tungstate) is the only tungsten mineral which has been recognized in the district, although it has been reported that scheelite from the Richmond mine (fig. 2) contains lead tungstate in isomorphous combination with the calcium tungstate. Most of the scheelite has a moderate content of powellite, or calcium molybdate, in chemical combination with the calcium tungstate.

The scheelite-bearing bodies vary greatly in size and in tungsten content. Most of the tactite masses are small, and it is estimated that the average content of WO_3 is between 0.1 and 0.2 percent. Only a small part of the tactite contains sufficient scheelite, more than 0.3-0.4 percent WO_3, to be classed as ore. The average tungsten content of ore mined before May 1, 1943 ranged from 0.34 to 0.50 percent WO_3.

Total reserves of tungsten ore in the area are estimated to be several hundred thousand tons. Some of these reserves, however, are contained in small undeveloped ore bodies, and most of the ore is relatively low-grade.

The development of the low-grade tungsten deposits of the Osgood Range has been possible only because of relatively low mining costs and favorable milling arrangements. Other favorable factors include the size and accessibility of some of the ore bodies, the existence of the Metals Reserve Co. chemical retreatment plant in Salt Lake City which accepts the low-grade concentrates from these ores, and the arrangement by which Metals Reserve Co. purchases ore for local stock piling. Changes in any of these conditions may significantly affect the economic outlook of these tungsten deposits.

TUNGSTEN MINES AND PROSPECTS

Getchell Mine, Inc. owns several of the larger tungsten deposits of the district. The holdings of this company include the Granite Creek and Kirby mines and the Pacific, Chase, and Tonopah prospects. These are the properties described first in the paragraphs which follow. The Richmond mine, owned by U. S. Vanadium Corporation, is leased to W. C. Rigg. In May 1943 other important holdings in the district were the Dernan property leased to J. E. Riley, the Saunders property leased to the Harold's Club Mining Co., and the Markus claims leased to J. H. Harden.

Granite Creek mine area

The Granite Creek deposit is in the southern part of secs. 29 and 30, T. 38 N., R. 42 E., at the southernmost end of the granodiorite stock of the Osgood Range (fig. 2). The deposit is on the steep south side of Granite Creek canyon, about half a mile above its mouth, and it may be reached over 8 miles of good gravel road from the Getchell mill.

The occurrence of scheelite in the tactite of this area had been known for some time, but active mining of the ore was not started until the fall of 1942. Almost all of the ore mined to May 1943 was taken from two glory holes, but preparations had been completed for both underground and surface mining.

The main Granite Creek mine workings (figs. 4, 5) are at the eastern end of the deposit. These include adits at two levels connected with ore passes from the two glory holes higher on the hillside. Bodies of tactite in the central and western parts of the area are explored by short adits, pits, and trenches.

The principal sedimentary rock in the area is a body of limestone more than 1,000 feet thick, which includes several zones of calcareous argillite and mixed argillite and limestone. This limestone crops out prominently along the crest of the ridge south of Granite Creek. It strikes N. 40° E. to N. 55° E. and dips 45° to 70° S.E. and it is bordered on both sides by wide zones of argillite.

The contact between the granodiorite stock and the sedimentary rocks trends generally east and west (fig. 3), but minor irregularities are numerous. The strike of the sedimentary rocks makes an angle of approximately 40° with the general trend of the contact, although in places the contact is parallel to the bedding for distances of 350 feet or more. Many dikes extend from the granodiorite as much as 600 feet into the sedimentary rocks. The dikes range in composition from normal granodiorite to composite granodiorite-aplite-pegmatite dikes.

Irregular and discontinuous bodies of tactite occur along the granodiorite-limestone contact for a distance of more than 2,200 feet. No tactite occurs in argillite, and very little tactite occurs along the margins of the dikes where they extend more than 100 feet from the parent mass of igneous rock. Scheelite is irregularly distributed in the tactite, and it is entirely absent from much of the contact rock. Where the limestone-granodiorite contact and the strike of the limestone are essentially parallel, the tungsten mineralization is more nearly uniform throughout the whole mass of tactite. Where the contact forms an angle with the strike of the sedimentary rocks, the tactite bodies and the ore zones within them are more irregular and may pitch in the direction of the dip of the beds.

The largest and most continuous tactite body is at the eastern end of the deposit. The main tactite layer has been traced for more than 300 feet on the surface, and a drift on the lower adit level follows the tactite for a distance of about 250 feet (figs. 4, 5). The average width of the tactite layer is between 15 and 20 feet, and the tungsten mineralization is rather uniform.

More than 10,000 tons of ore containing 0.3 to 0.5 percent WO_3 had been mined from this tactite body prior to May 1, 1943. At that time it was estimated that reserves of material of the same grade in this tactite body amount to more than 100,000 tons.

Several of the tactite zones west of the main workings of the Granite Creek mine are possible ore bodies, but they need further exploration and sampling before definite conclusions can be reached as to their worth. These bodies are not accessible by road at the present time.

The Granite Creek deposit is both the largest and the lowest grade producing deposit in the Osgood Range, as well as one of the lowest grade tungsten deposits of its type in the country to yield a significant production. The ore bodies show little tendency to change in character with increasing depth, and a considerable downward extent may be expected. However, the low tungsten content of the tactite makes it unlikely either that profitable mining can be carried on below creek level or that the more inaccessible ore bodies of the area can be developed profitably.

Kirby mine area

The Kirby mine is near the narrow central part of the Osgood Range stock, in sec. 17, T. 38 N., R. 42 E. (fig. 2). The main workings are south of the upper valley of Kirby Creek (also called Ranch Creek), at an altitude of about 6,300 feet. A dirt road leads from the deposit to the Getchell mill, a distance of about 5 miles.

The contact zone of the Kirby deposit is explored by means of short adits, pits, and numercus trenches (fig. 6). The mine workings include two glory holes in a pendantlike mass of tactite, a 375-foot adit in granodiorite below the glory holes, and several short exploratory adits (fig. 7). Plans were being made in May 1943 to eliminate underground haulage by converting the two glory holes into a single open pit from which broken ore could be loaded directly into trucks by means of a power shovel.

The structure of the sedimentary rocks in this area is complex and the limestone and argillite are locally tightly folded and contorted, expecially where they are metamorphosed next to the contact. Dikes of granodiorite extend from the main igneous body into the sedimentary rocks, and aplite and andesite porphyry dikes cut both the sedimentary rocks and granodiorite. The main contact between the granodiorite and the sedimentary rocks is irregular. Tactite occurs on the contact in roughly tabular bodies which are nearly parallel to the slope of the hillside, and most of the wide, prominent outcrops therefore represent only small volumes of ore.

The large tactite ore body in which the glory holes were opened is a tapered, pendant like mass of replaced limestone which projects downward into granodiorite (sec. A-D, B-D, C-D, fig. 7). In the mine area, the tactite and limestone are nowhere more than 60 feet thick, and the workings of the haulage level below the ore body are entirely in granodiorite.

Ore mined from the Kirby deposit during the fall of 1942 had an average tungsten content of slightly less than 0.5 percent WO_3. Reserves of ore were estimated in May 1943 to be in excess of 15,000 tons. It was anticipated at that time that most of the ore remaining in the main tactite body would be mined out before the following winter. Other bodies of tactite occur in the vicinity of the Kirby mine, but they either contain too little tungsten or are too small to encourage more thorough prospecting.

Pacific prospect

The zone of scheelite-bearing tactite of the Pacific prospect extends through the northeast corner of sec. 29 and continues into the Saunders property in sec. 20, T. 38 N., R. 42 E. An adit, called the Pacific tunnel, extends westward from sec. 28 almost to the tactite zone. The adit is located at the base of the east side of the Osgood range 5 miles due south of the Getchell mill (fig. 2). It may be reached by unimproved roads from either the Granite Creek property or the Saunders property.

West of the Pacific tunnel the granodiorite-limestone contact forms an irregular north-south line (fig. 8). The contact dips beneath the limestone to the east at an angle of about 60°. The Pacific tunnel cuts through more than 600 feet of crushed rock, part of the wide fault zone along the eastern base of the Osgood Range, before it reaches solid limestone. It had not been driven to the contact in May, 1943.

Tactite crops out along the hill surface as irregular lenticular and tabular bodies separated by areas in which exposures are poor and tactite probably absent. The distribution of scheelite in the tactite bodies is erratic. Only a small fraction of the material contains more than 0.5 percent WO_3, and much of it contains less than 0.2 percent WO_3. The curved band of tactite about 375 feet south of the section line includes a layer of garnet-rock from 3 to 5 feet wide which contains about 1 percent WO_3 throughout a length of 100 feet. A diamond drill hole from the face of the Pacific tunnel cut through 10 feet of tactite of which 3 feet assayed about 1 percent WO_3, and the remainder was of much lower grade.

On the basis of the distribution of scheelite-bearing tactite in the outcrops above the Pacific tunnel it was estimated that about 40,000 tons of tactite containing 0.5 percent WO_3 occurs above the tunnel level. However, it is unlikely that more than a fraction of this material can be mined profitably under conditions comparable to those prevailing in the district in the spring of 1943. It is improbable that tactite will be mined from this deposit until the more completely developed properties of Getchell Mine, Inc. are exhausted.

Tonopah and Chase prospects

The Tonopah and Chase prospects are located on the igneous contact near the Getchell gold pits (fig. 2), and both are easily accessible by short roads from the Getchell mill. Both prospects were being explored by means of a power shovel in the spring of 1943.

The Tonopah pit is at the north end of an ill-defined tactite zone which extends south for a distance of about 1,000 feet. Only locally does the WO_3 content exceed a few tenths of one percent. Both scheelite and powellite occur in sheared argillite at the Chase prospect. In May 1943 exploration was insufficient to indicate the extent of the mineralized body.

Both of these prospects are experiments in mining near-surface, low-grade tungsten ore by methods similar to those used in the adjacent open-pit gold mining operations. Until the two deposits are better explored and the methods tried out, no estimates of reserves and possible production can be made.

Richmond mine area

The Richmond mine is located at the northwest corner of the granodiorite stock near the crest of the Osgood Range, about 2 miles west of the Getchell mill (fig. 2). It may be reached from the mill by 5 miles of well-graded private road which crosses the crest of the range at an altitude of approximately 7,300 feet.

The Richmond property, owned by U. S. Vanadium Corporation, is leased to W. C. Rigg of Winnemucca, Nevada. Active mining was begun in the summer of 1942, and about 25,000 tons of ore was mined by November when work was discontinued for the winter. Most of the ore mined in the fall of 1942 was taken from an open cut, but underground mining was in progress in April and May 1943.

The deposit includes two separate tactite bodies on oppsoite sides of a small valley (fig. 9). Workings in the east ore body consist of an open cut, an adit approximately 120 feet lower than the floor of the cut, and a sublevel below the open cut and above the adit level. Workings in the west ore body comprise 3 adits and numerous surface trenches.

This deposit, like others in the district, consists of tactite bodies immediately adjacent to the main granodiorite intrusive. The sedimentary rocks consist of a central zone of limestone more than 900 feet in outcrop width, bordered on the east and on the west by thick series of argillite. These rocks have an average dip of 70° to the east, and they strike south

into the granodiorite contact, which extends generally N. 75° E. and is nearly vertical. Tactite has been formed where limestone abuts granodiorite. A small stream has cut a steep valley across the contact and down the center of the limestone zone, leaving the tactite bodies separated by a strip of alluvium. The two bodies may be connected beneath the valley bottom, but there is no evidence to support the possibility.

The east ore body is 210 feet long parallel to the granodiorite contact, and its average width is nearly 35 feet. The tactite is terminated on the east by hornfels and argillite and on the west by a fine-grained, dense, light-colored rock, either a siliceous hornfels or a felsitic dike rock. Most of the ore body is cut out on the main adit level by fine-grained dike rock which takes the place of limestone at the contact, and little ore is indicated below the sublevel 30 feet under the floor of the open cut.

Most of the tactite of the east ore body contains about 0.5 percent WO_3. It was estimated in May 1943 that about 10,000 to 20,000 tons of tactite remained in this ore body, but the more accessible portion had already been mined from the surface. The cost of underground mining may allow removal of only the higher grade portions of the remainder of this body.

The west ore body is larger than the east ore body, but the tungsten mineralization is weaker and more erratic. Results of extensive surface sampling of the trenches are shown on figure 10, where three areas of possible ore (A, B, C) are thus outlined. In the adits the greatest concentration of scheelite appears to be at the tactite-granodiorite contact. The distribution of scheelite in the west ore body is such that there appear to be no large blocks suitable for mining by inexpensive open pit methods.

Riley's lease (Dernan property)

The Dernan property comprises 60 acres of patented ground in the northern part of sec. 9, T. 38 N., R. 42 E. It is in the low foothills on the east side of the Osgood Range two miles south of the Getchell mill (fig. 2). This property, part of the Tom Dernan estate, is leased to J. E. Riley of Bishop, California.

In May 1943 there had been little production from the property, but two open pits had been started in ore, and rapid production was anticipated.

Limestone with interbedded argillite adjoins the eastern margin of the granodiorite stock in this area. The strike of the limestone-granodiorite contact is generally north-south, and the dip is from 30° to 60° to the east (fig. 11). Bedding in the limestone is generally parallel to the contact. A band of tactite from 3 to 20 feet thick is present against the granodiorite in many places. The hillsides slope gently in the same direction as the dip of the contact, and the outcrop width of the tactite zone is much greater than its true thickness. Irregularities of topography combine with "rolls" or large-scale corrugations of the contact zone to give the outcrop of the tactite a sinuous pattern.

The richest and largest bodies of ore occur in and adjacent to the two small valleys in which the open pits are located. Most of the tactite which crops out on the hill between the two valleys is either barren of scheelite or has a very low tungsten content.

The north-south fault zone exposed about 300 feet east of the tactite outcrops is probably the same as that to the north in which the Getchell gold ore occurs and that to the south exposed by the Pacific adit. Where the fault is well exposed it dips about 60° to the east. Therefore it may cut the tactite zone at depth in the area of the Dernan property, for the average dip of the tactite is less than 60°.

In the spring of 1943, 10,000 to 20,000 tons of ore was exposed at the surface on the Riley lease. Several times the exposed amount may be expected if the ore bodies continue a few hundred feet below the shallow cover of limestone and alluvium. The average tungsten content of the larger ore bodies is between 0.4 and 0.8 percent WO_3.

Harold's Club Mining Co. lease (Saunders property).

The Saunders property, like the Dernan property, is in the low foothills on the east side of the Osgood Range (fig. 2). A short dirt road connects the property with the Getchell-Golconda road about 5½ miles south of the Getchell mill. The property consists of the Valley View claim and Toby claims, owned by Mr. Saunders of Winnemucca, and leased to the Harold's Club Mining Co. of Reno, Nevada. These claims extend along the margin of the granodiorite intrusive in the eastern third of sec. 20, T. 38 N., R. 42 E. They are joined on the south by the Pacific property of Getchell Mine, Inc.

Workings on the property include an adit about 170 feet long and a caved adit said to be 60 feet long, both of which were driven in search of silver and copper ore before scheelite was recognized in the district. Surface trenches have been cut across the tactite bodies to check their tungsten content. In May 1943 the old adits were being put in shape for mining, and a limited amount of mining equipment had been moved to the property.

Limestone and a minor amount of argillite lie adjacent to the granodiorite contact which in this area trends generally north-south and dips from 45° to 80° to the east (fig. 8). The zone of tactite along the limestone-granodiorite contact is usually only a few feet thick, and where the zone is wider the tactite contains considerable barren hornfels derived from argillite layers in the limestone.

The east wall of the tactite layer exposed in the 170 foot adit is gouge and sheared rock of the large fault zone along the east side of this part of the Osgood Range. In the 170 foot adit tactite is sealed tightly against the granodiorite and the two together serve locally as a footwall for the wide fault zone. Elsewhere the fault zone may cut through projections of tactite and granodiorite, and it probably cuts across gently dipping portions of the contact zone at depth, thus limiting the downward extent of part of the ore zone.

It is estimated that a considerable reserve of tactite containing about 0.5 percent WO_3 occurs in the narrow tactite zones and large irregular tactite-hornfels bodies of the Saunders property. It has not been demonstrated, however, that ore bodies 3 to 5 feet wide containing 0.4 to 0.6 percent WO_3 can be mined profitably in this area, although lower grade ore is being taken from glory holes and open pits on nearby properties. It is probable that a small amount of ore of appreciably higher grade than the average of 0.5 percent WO_3 can be mined after development work is completed.

Harden's lease (Markus property)

The Markus claims are on the east side of the Osgood Range near its crest (fig. 2). The main workings are two miles northwest of the Granite Creek mine between 7,000 and 8,000 feet in altitude. A good road leads to the Granite Creek mine, and beyond this point a rough trail follows the valley of the north fork of Granite Creek to the claims.

The group of 5 claims is owned by John Etchart, Jr. and W. M. Pettit and leased to John H. Harden of Winnemucca, Nevada. The property was inactive in the spring of 1943.

Slide rock covers much of the surface in the vicinity of the Markus claims, and exposures of bedrock are poor. The contact between granodiorite and sedimentary rocks is highly irregular. The invaded rock is predominantly argillite and hornfels. Limestone occurs as occasional layers in the sedimentary rocks, and tactite bodies are present only where the limestone is truncated by the main granodiorite body or its irregular apophyses (fig. 12). The tactite bodies are, therefore, discontinuous, irregular, and limited in extent.

Workings on the claims include two short adits and a number of trenches and open cuts. The open cut at the portal of the upper adit (fig. 12) exposes a tactite layer several feet thick which contains more than one percent WO_3. Other portions of this layer are exposed at the surface and in the adit, but they contain very little scheelite. Part of the tactite exposed in the lower adit contains more than 0.5 percent WO_3. Most of the other tactite bodies have a low tungsten content, and the presence of only a few thousand tons of tactite containing more than 0.3 percent WO_3 can be inferred. Further trenching and underground work may indicate the existence of a greater volume of ore, but no ore can be removed without the construction of a rather expensive access road.

Other properties of the District

Tungsten ore occurs on three groups of claims held by Knight, Eyraud, and O'Leary and Lee, respectively. There are other minor occurrences on the extensive holdings of Getchell Mine, Inc., and scheelite occurs in small amount on the claims of Markus Durfee south of the grandoiorite stock.

Alexander Eyaud holds a series of claims covering most of the contact zone between the Saunders property and the Kirby mine (fig. 2). Although limestone adjoins the granodiorite along most of the contact zone, only narrow and discontinuous tactite bodies were developed there, and most of these contain little scheelite. A few of the tactite bodies are probably of minable grade and size, but they are not developed and are relatively inaccessible. A small replacement body of sphalerite occurs in limestone at the point marked Zn on figure 2.

Several claims along the northern margin of the intrusive are held by Ed Knight. Tungsten ore occurs on one of these claims on the crest of the Osgood Range east of the Richmond mine. A small salient of limestone and calcareous hornfels contains irregular bodies of tactite and disseminations of scheelite and altered sulfides. Several pits and trenches explore the mineralized zones, and a short inclined shaft exposes a gossan layer one to three feet wide which contains about two percent WO_3. The existence of large ore bodies in this deposit is considered unlikely.

Poorly exposed tactite bodies occur south of the Richmond mine in the upper parts of two gentle valleys. Claims covering this area are held by Stanley O'Leary and "Smokey" Lee of Battle Mountain, Nevada. The few scattered outcrops and pits indicate the possibility of an ore body comparable in size and grade to the producing deposits of the district. A thick zone of laminated, impure limestone is present along the contact. Little or no tactite occurs at the contact where the bedding is nearly parallel to the margin of the igneous mass, but near the ridge crest the limestone is folded sharply eastward, and tactite is present where contorted limestone beds strike directly into the igneous mass. Although this property is located near the crest of the mountain range at an altitude of about 7,800 feet, the Richmond road is less than a mile distant where it crosses the range crest at an altitude of about 7,300 feet. W. C. Rigg of Winnemucca had made arrangements in May 1943 to explore this property.

The only known occurence of scheelite in the district outside the narrow contact zone about the granodiorite stock is on the claims owned by Markus Durfee. The Durfee claims are from one to two miles southeast of the Granite Creek mine. Small quantities of copper ore have been mined and shipped from narrow veins on the property. Scheelite occurs as scattered crystals of moderate size, generally with quartz, throughout a wide zone of broken and contorted limestone. Copper ore and scheelite do not occur together. The average tungsten content of the rock is far less than 0.1 percent WO_3, and there are no local concentrations of scheelite rich enough to permit selective mining.

UNITED STATES
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STRATEGIC MINERALS
INVESTIGATIONS
PRELIMINARY MAP FIG. 1

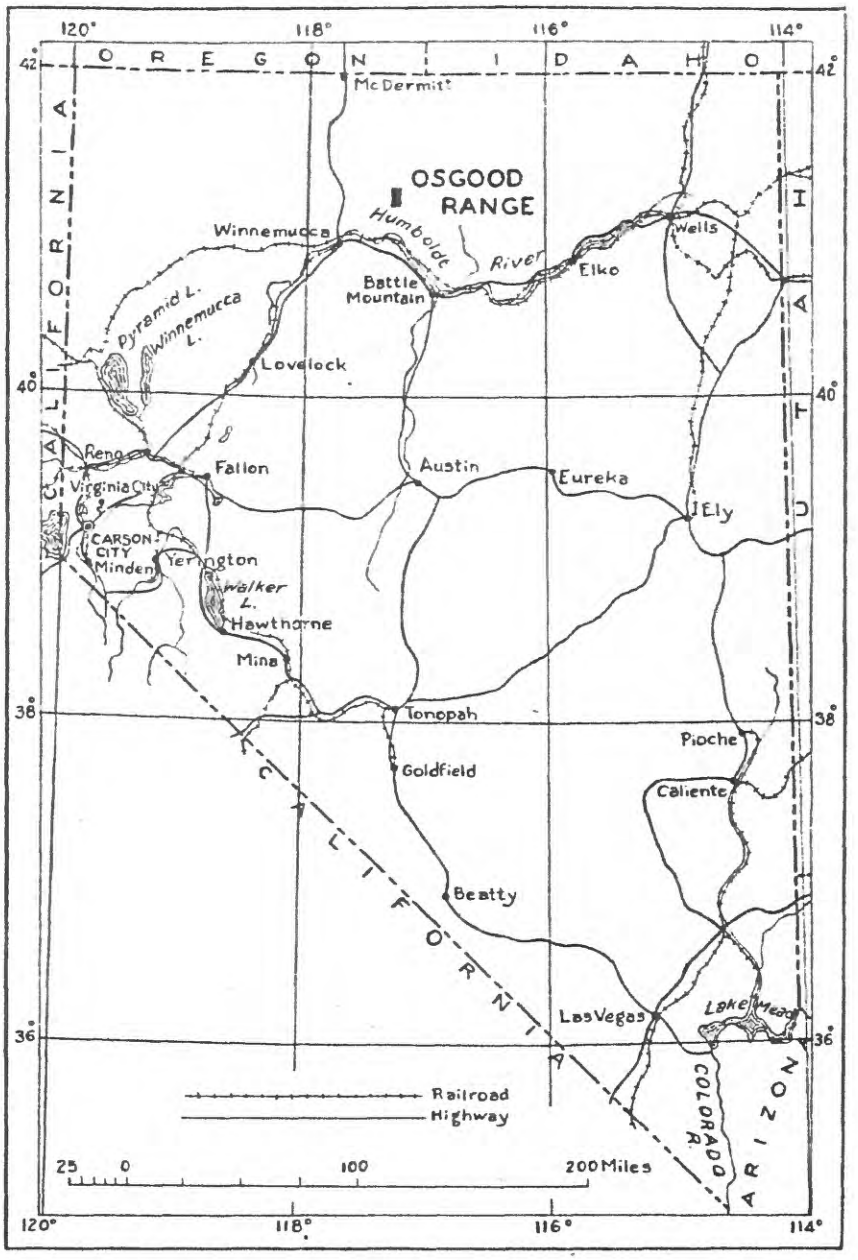

FIG. 1 INDEX MAP OF NEVADA SHOWING LOCATION OF THE OSGOOD RANGE