UNIVERSITY OF NEVADA BULLETIN

VOL. XL JUNE 1946 No. 5

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By
S. W. HOBBS and S. E. CLABAUGH
Geologists, U. S. Geological Survey

PREPARED AND PUBLISHED BY NEVADA STATE BUREAU OF MINES
IN COOPERATION WITH UNITED STATES GEOLOGICAL SURVEY

PRICE ONE DOLLAR

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PUBLISHED QUARTERLY BY THE
UNIVERSITY OF NEVADA
RENO, NEVADA

Entered in the Post Office at Reno, Nevada, as second-class matter under Act of Congress, July 16, 1894. Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized April 21, 1919.

STATE PRINTING OFFICE OF NEVADA JACK McCARTHY, SUPERINTENDENT
CARSON CITY, NEVADA

PREFACE

There has always been a strong bond of friendship and mutual aid between the Nevada State Bureau of Mines and the U. S. Geological Survey. The Bureau has gladly furnished office, library, and laboratory facilities to visiting Survey geologists, along with technical advice and field trips. The Survey has often given the Bureau the privilege of promptly publishing and distributing to the citizens of Nevada the valuable work of its geologists pertaining to Nevada districts which might otherwise be long delayed in publication, if at all. This was particularly true during the war emergency with the field work of the Survey on strategic metals and minerals greatly expanded, and with write-up time and publication facilities sharply curtailed.

During 1942 and 1943 the Survey made a geological study of the quicksilver deposits of Nevada as companion work to sampling and exploration projects of the U. S. Bureau of Mines. This geological study was mainly the work of Edgar H. Bailey and David A. Phoenix, and was published by the Nevada State Bureau of Mines in cooperation with the U. S. Geological Survey as University of Nevada Bulletin Volume XXXVIII, No. 5, December 1944, Geology and Mining Series No. 41.

The Survey as a war measure also made an even more thorough study of the many producing and promising tungsten districts of the State. The results of this study would be too voluminous to be published in a single bulletin.

The Survey during the war period issued from time to time under the heading of "Strategic Minerals Investigations" preliminary maps covering several tungsten districts in Nevada, copies of which were placed on file in Washington and with the Nevada State Bureau of Mines. These maps covered the following districts: Mill City, Osgood Range, Cherry Creek, Star Tungsten, Rose Creek, and Minerva.

Presumably in time, if funds permit, geological reports will be prepared on these districts. There has been issued to date "Tungsten Deposits of the Nightingale District, Pershing County," by Ward C. Smith and Philip W. Gill, U. S. Geological Survey Bulletin 936–B and the "Rose Creek Tungsten Mine, Pershing County," by Ralph J. Roberts, U. S. Geological Survey Bulletin 940–A.

Due to the importance of the tungsten deposits of the Osgood

Range in Humboldt County a very thorough study of the district was continued after the preliminary maps were issued, and a report was completed early in 1946 by geologists S. W. Hobbs and S. E. Clabaugh.

Our Bureau has been favored by the Survey with permission to issue this report as a bulletin and thus make its many maps and its excellent exposition of this leading tungsten district available at this time to the general public.

During the war period the U. S. Bureau of Mines published as confidential "War Minerals Reports," reports on the:

Cherry Creek District, White Pine County, No. 216.

Tungstonia Property, Tungsten Minerals, Inc., White Pine County, No. 224.

Nevada Scheelite Inc., Mineral County, No. 362.

Tungsten Metals Corporation, Minerva Mining District, White Pine County, No. 424.

Tem Piute Tungsten District, Lincoln County, No. 430.

The geologic summaries in these reports are credited to unpublished reports of U. S. Geological Survey staff members.

The first bulletin I find of the U. S. Geological Survey on tungsten occurrence in Nevada is a short one-page description by F. B. Weeks in Bulletin 213, 1902, of a huebnerite bearing vein twelve miles south of Osceola.

In Bulletin 340, 1907, the same author described the "Tungsten Deposits in the Snake Range, White Pine County, Eastern Nevada." In Bulletin 725, 1922, Henry G. Ferguson relates the discovery of huebnerite in narrow veins in granite in the Round Mountain district in Nye County.

Dr. V. P. Gianella in his "Nevada's Common Minerals," University of Nevada Bulletin Volume XXXV, No. 6, states, "Huebnerite was named and first described from specimens from Ellsworth in the Paradise Range, Nye County." The description of this newly identified mineral first appeared in the columns of the Reese River Reveille of Austin, Nevada, in 1865. There was noted accompanying the huebnerite, both scheelite and wolframite.

The mining of tungsten ore in Nevada began soon after 1900 in the Snake Range. Small milling plants were erected as early as 1910 in the Snake Range and in 1911 in Round Mountain.

The advent of the World War in 1914 with its great demand for tungsten resulted in many new discoveries and development of mines, being almost entirely contact-metamorphic deposits of scheelite.

The U. S. Geological Survey Bulletin 725 of 1920, written by Frank L. Hess and Esper S. Larsen described deposits of this type in a dozen different districts in Nevada. Then after a lapse of many years, our Nevada State Bureau of Mines published two bulletins on tungsten districts both by Paul F. Kerr, being University of Nevada Bulletins Volume XXVIII, No. 2, "Geology of the Tungsten Deposits Near Mill City, Nevada," 1934, and Volume XXX, No. 5, "The Tungsten Mineralization at Silver Dyke, Nevada," 1936.

Beside the above enumeration of bulletins on Nevada tungsten deposits by Government agencies many special articles have appeared in geological and mining publications that are listed in U. S. Geological Survey bibliographies.

JAY A. CARPENTER,
Director Nevada State Bureau of Mines.

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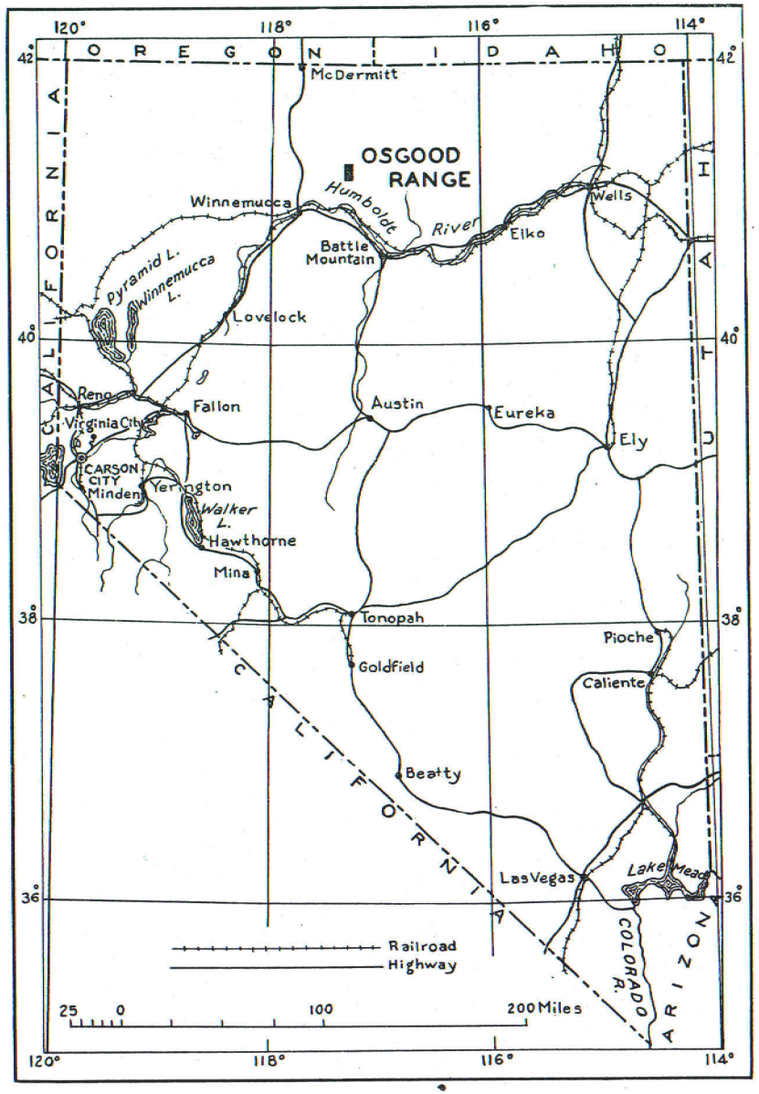

FIGURE 1. INDEX MAP OF NEVADA SHOWING LOCATION OF THE OSGOOD RANGE

TUNGSTEN DEPOSITS OF THE OSGOOD RANGE, HUMBOLDT COUNTY, NEVADA

By S. W. Hobbs and S. E. Clabaugh

ABSTRACT

Scheelite occurs in the northern half of the Osgood Range in tactite bodies formed by the metamorphism of limestone along the contacts of an intrusive granodiorite stock. Although the occurrence of scheelite in the area was known before 1917, very little tungsten ore was mined and milled until the fall of 1942 when a part of the Getchell gold mill was converted to tungsten production. By July 1945 nearly 250,000 tons of ore containing about 133,000 units of WO_3 had been mined from the Granite Creek, Kirby, Riley, Richmond, Porvenir, and Valley View mines. Several other properties in the area had been prospected, but no production had come as yet from them.

The mined ore contained an average of between 0.5 and 0.6 percent of WO_3, the grade ranging from 0.34 to over 0.8 percent. It was exploitable because of relatively low mining costs and favorable milling and stockpiling arrangements. Reserves of measured ore and indicated ore in the district were estimated in July 1945 at 573,750 tons containing 368,250 units of WO_3, but a portion of this occurs in small, undeveloped ore bodies.

INTRODUCTION

The Osgood Range is in eastern Humboldt County, Nevada (Fig. 1) northeast of the town of Golconda. Adam Peak, in the approximate center of the range, rises to an elevation of 8,400 feet, almost 3,500 feet above the desert flats on either side. The range is small and rugged with steep hillsides, but in many parts of the range exposures of bedrock are uncommon, and the surface extent of most of the ore bodies has been determined only by trenching.

The tungsten occurrences are in the Potosi mining district, and all are located within 10 miles of the Getchell mine, a large open pit gold mine 27 miles by road north of Golconda.

Although the occurrence of scheelite in this district was known before 1917, and a little selected ore was shipped in 1917, the only important activity prior to 1942 was the large-scale gold mining operation of the Getchell mine. 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 was recovered by flotation cells, and the low-grade concentrate produced, containing 12 to 15 percent of WO_3, was shipped to Salt Lake City, Utah, for retreatment in the chemical plant owned by Metals Reserve Co. The mill, with an initial capacity of 250 to 300 tons daily, later enlarged to 400 tons, was used to treat ore from the Richmond, Porvenir, Kirby, Granite Creek, and Riley mines. Operations were suspended June 20, 1944.

Between the summer of 1943 and June 30, 1944, Metals Reserve Co. purchased crude ore from the local producers and established a stockpile near the Getchell mill. About 80,000 tons of ore was purchased from the Riley mine, and small amounts from the Granite Creek and Valley View mines. In August 1945, the Getchell mill was reopened under contract with Metals Reserve Co. to treat the tungsten ore in this stockpile, and also that in stockpiles at Winnemucca and at Battle Mountain.

From March to July 1945, the U. S. Bureau of Mines explored the Riley mine with diamond drills. Mr. George H. Holmes was engineer in charge of the Bureau of Mines work.

FIELD WORK AND ACKNOWLEDGMENTS

During the summer of 1940, Eugene Callaghan of the Geological Survey, assisted by C. J. Vitaliano, prepared plane table maps of the more important tungsten deposits. Hobbs and Clabaugh spent four weeks in the district during April and May 1943, and made maps on a larger scale of the producing mines and a reconnaissance map of the granodiorite stock (Plate 1). Hobbs spent one week in the district in 1944 and 3 weeks in July 1945 making a new map of the Riley mine and revising maps of other properties.

Officials of the Getchell Mine, Inc., supplied the writers with maps and information, and permitted use of the company's aerial photographs as a base for reconnaissance mapping. They also furnished living accommodations during the course of all the work. Mr. J. E. Riley provided maps and assay data of the Riley mine, and helped in many other ways. Other property owners in the district gave cordial assistance.

GEOLOGY

The north-central part of the Osgood range consists of a stock of granodiorite which has invaded sedimentary rocks (Pl. 1). The stock is six miles long in north-south direction and less than

two 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 andesite porphyry dikes are probably related to Tertiary volcanic rocks of the region, and possibly to the gold-arsenic mineralization. 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 (Pl. 1). 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.

A wide fault zone that strikes north-northwest and dips about 60° E. extends along the eastern front of the Osgood range, and contains the gold ore bodies of the Getchell mine. This fault is younger than the granodiorite, for it cuts across projections of

the igneous mass. It is exposed at the Riley mine, and in the Pacific tunnel near Granite Creek, where it is about 500 feet wide. The fault is probably one of several responsible for elevation of the Osgood range; movement on it alone may not have been sufficient to account for the total uplift, for the eastern margin of the fault zone, the downthrown side, contains limited exposures of limestone, argillite, and granodiorite.

ORE DEPOSITS

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 or 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 (Pl. 1) 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 percent of WO_3, to be considered ore. The ore mined prior to July 1945 contained an average tungsten content of 0.5 to 0.6 percent of WO_3, and ranged in grade from 0.34 to over 0.8 percent.

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 first described in the paragraphs which follow. U. S. Vanadium Corporation owns the Richmond mine, formerly leased to W. C. Rigg, and purchased the Riley mine in October 1945. The Riley mine contains the largest ore reserves in the district, and was the only property in operation in July 1945. The Valley View mine, the Alpine mine, and

the Markus claims are the most important of the other, independent properties.

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 (Pl. 1). 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 eight miles of good gravel road from the Getchell mill.

The occurrence of scheelite in the tactite of this area has been known for some time, but active mining of the ore was not started until the fall of 1942. From then until the mine was closed in the summer of 1944, production amounted to 88,000 tons of ore averaging 0.5 percent of WO_3, all of which came from the main tactite body at the east end of the ore zone.

The main Granite Creek mine workings (Pls. 3, 4) 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° SE. 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 (Pl. 2), 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. 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. They follow the bedding or cut across it at slight angles.

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 230 feet on the surface, where its width ranges from 5 to 25 feet, and a drift on the lower adit level follows the tactite for a distance of 200 feet (Pls. 3, 4). The average width of the tactite layer is between 15 and 20 feet, and the tungsten mineralization is rather uniform. The grade of the ore remaining is probably higher than the grade of the material mined, 0.5 percent of WO_3, for there was much unavoidable dilution with waste in mining from glory holes and open cuts.

Several of the tactite zones for 2,000 feet west of the main workings of the Granite Creek mine are possible ore bodies, but they need further exploration before definite conclusions can be reached as to their worth. In 1945 these tactite outcrops were accessible only by rough trail.

Production at the Granite Creek mine has come from the main ore zone between the lower adit level and the surface, and 22,000 tons of measured ore remains in this block, chiefly between the top of the large stope and the bottom of the open cuts and glory hole. About 8,000 tons of ore is estimated to occur between the southwest end of the stope and the end of the ore shoot formed by the intersection of granodiorite and a hornfels layer, and another 20,000 tons may be present northeast of the stope where the tactite makes a sharp bend. A block of inferred ore is computed to a depth of 115 feet below the main level, a distance equal to one-half the length of the surface exposure of this tactite layer. The ore developed 250 feet below the surface has about the same composition, thickness, and grade as that at the surface, and there is no reason to believe that it will not extend downward to considerable depth. However, production from below the haulage level may prove unprofitable because of increased mining costs.

Estimated ore reserves of the Granite Creek deposit are summarized in the following table:

	Measured		Indicated		Inferred	
	Tons	Units	Tons	Units	Tons	Units
Main ore body of Granite Creek mine	22,000	13,200	28,000	14,000	40,000	20,000
Other ore bodies in Granite Creek area	3,000	1,000	11,000	3,500	14,000	5,000
Totals	25,000	14,200	39,000	17,500	54,000	25,000

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. (Pl. 1). 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 4½ miles.

Hess and Larsen[1] present a brief description and reconnaissance map of the contact zone on claims held by Fayant and Blaine in 1917. This property was relocated by Mr. Kirby and sold to Getchell Mine, Inc. Operations ceased at the Kirby mine after exhaustion of the main ore body in the summer of 1943. Production amounted to about 32,000 tons of tungsten ore containing more than 12,000 units of WO_3. The average tungsten content of the ore was 0.43 percent WO_3.

Short adits, pits, and numerous trenches explore the contact zone of the Kirby deposit (Pl. 5). Ore was mined from two glory holes in a pendant-like mass of metamorphosed limestone and removed through a 315-foot adit in granodiorite below the glory holes. In the summer of 1943 the glory holes were connected to form a single open pit from which broken ore was loaded directly into trucks with 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, especially 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, pl. 6). In the mine area, the tactite and limestone nowhere extend more than 60 feet below the surface, and the workings of the haulage level below the ore body are entirely in granodiorite.

When the main ore body at the Kirby mine was exhausted in the summer of 1943, an attempt was made to strip and mine the tabular extension of tactite up the slope above the main ore body.

[1]Hess, Frank L., and Larsen, E. S., Contact-metamorphic tungsten deposits of the United States: U. S. Geol. Survey, Bull. 725, 1920.

This operation proved unprofitable, but at some future time it may be possible to mine the remainder of the tactite on a smaller scale. Reserves are estimated to be 1,500 tons of measured ore containing 600 units of WO_3, 2,000 tons of indicated ore containing 900 units of WO_3 and 2,000 tons of inferred ore containing 800 units of WO_3.

Other bodies of tactite occur northeast of the Kirby mine. Several of these are located near the point at which Kirby Creek crosses the contact zone, and one body north of the creek may be large, but its tungsten content is only about 0.2 percent WO_3.

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 (Pl. 1). The main road to the Granite Creek mine passes through the property.

West of the Pacific tunnel the granodiorite-limestone contact forms an irregular north-south line (Pl. 7). 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.

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. The Pacific tunnel intersects the contact zone 450 feet below the surface outcrop, but the tactite is only about 2 feet wide here and contains but a small amount of scheelite. However, no exploration has yet been done along the contact from the end of the tunnel, and it seems reasonable that larger masses of tactite, similar to those on the surface, will be found underground, especially north of the tunnel.

On the basis of the distribution of scheelite-bearing tactite in the outcrops above the Pacific tunnel it is estimated that about 40,000 tons of tactite containing 0.5 percent WO_3 occur 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 1945. It may be inferred that additional material of the same or slightly lower tungsten content is present above the adit level, and that scheelite-bearing tactite continues to considerable depth below the adit.

TONOPAH AND CHASE PROSPECTS

The Tonopah and Chase prospects are located on the igneous contact near the Getchell gold pits (Pl. 1), and both are easily accessible by short roads from the Getchell mill. Both prospects were prospected by open pits dug with a power shovel in the spring of 1943. The tungsten content of the ore, however, proved to be too low to encourage further development.

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, but only a few feet of ore containing 0.5 percent WO_3 has been exposed in the pit. No reserves of ore may be estimated from present exposures.

RICHMOND MINE AREA

The Richmond mine is located at the northwest corner of the granodiorite stock near the crest of the Osgood range, about two miles west of the Getchell mill (Pl. 1). It may be reached from the mill by five 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, was leased to W. C. Rigg of Winnemucca, Nevada, who operated the property until the fall of 1943. Active mining was begun in the summer of 1942, and 25,568 tons of ore were mined and hauled to the Getchell mill by November 1942, when work was discontinued for the winter. An additional 6,000 tons were mined in the spring and summer of 1943. Most of the ore was taken from an open cut on the east ore body, and after this open cut became dangerous for further operation, the remainder of the ore body was mined from underground.

The deposit includes two separate tactite bodies on opposite sides of a small valley (Pl. 8). 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 85

feet above the adit level. Workings in the west ore body comprise three adits and numerous surface trenches. The Richmond deposit has been described briefly by Hess and Larsen[2].

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.

Tactite of the Richmond area is characterized by the presence of a large amount of quartz, both in intimate association with garnet and epidote, and as large crystals in vugs at the immediate granodiorite contact. Some of the scheelite is reported to contain appreciable amounts of lead tungstate in isomorphous combination with the calcium tungstate.

The east ore body supplied all the ore mined from the deposit. This ore body was 210 feet long parallel to the granodiorite contact, and its average width was 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. The average tungsten content of the tactite was about 0.5 percent WO_3.

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 Plate 9, 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. Ore reserves are estimated to be about 10,000 tons of indicated ore

[2]Hess, Frank L., and Larsen, E. S., Contact-metamorphic tungsten deposits of the United States: U. S. Geol. Survey, Bull. 725, 1920.

containing 5,000 units of WO_3, and an equal amount of inferred ore.

RILEY MINE (DERNAN PROPERTY)

The Dernan property consists of 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, a short distance west of the main Getchell road (Pl. 1). This property, part of the Tom Dernan estate, was leased to Mr. J. E. Riley of Reno, Nevada, in the fall of 1942, and it has been developed and operated by him as the Riley mine. U. S. Vanadium Corporation purchased the property in October 1945.

Production began in May 1943, and by June 1944 approximately 80,000 tons of ore had been mined and sold to Metals Reserve Co. An additional 8,000 tons of ore have subsequently been mined and milled on the property in a plant completed in the winter of 1944–1945. All mining has been done in open cuts by stripping off the hanging-wall limestone and removing the ore with power shovels and trucks. In July 1945 the workings consisted of eight pits along about 1,700 feet of the ore zone (Pl. 10).

In the spring and summer of 1945 the United States Bureau of Mines explored the Riley mine by diamond drilling. Fifteen holes tested the ore zone to depths of 500 feet down dip from surface exposures. This exploration greatly enlarged the known ore reserves.

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. Bedding in the limestone is generally parallel to the contact, but locally the limestone is contorted. Thick-bedded, medium- to coarse-grained, blue-gray, pure limestone and thin-bedded, platy, fine-grained, impure limestone are shown by different patterns on the map (Pl. 10).

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. Topographic irregularities in combination with irregularities in the granodiorite contact give the tactite a sinuous outcrop pattern. The tactite is composed largely of red-brown garnet with some epidote, diopside, and locally abundant quartz. Scheelite occurs in most of the tactite. As a general rule the tactite was formed against the granodiorite or very close to the immediate contact. However, in the area of pits No. 1 and No. 1A there occur two

prominent tactite layers, one against the granodiorite and another about 30 feet from the contact and separated from the first by unaltered limestone. At several other places, also, bands of tactite occur in the limestone as much as 40 feet from the contact, but most of these are small and unimportant.

Between the granodiorite and tactite or limestone is a layer a few inches to 10 feet or more in thickness which varies in character from a hornfels or argillite to a fine-grained schist. This layer may have resulted from alteration and metamorphism of a zone of sheared material formed along the granodiorite-limestone contact before completion of the mineralization.

The major north-south fault zone exposed along the eastern side of the Riley property 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. Because of the general convergence of the granodiorite contact and the fault, the ore zone is terminated at the south end against this fault. The fault dips to the east at slightly greater angles than the tactite zone, and consequently it may be expected to cut out the ore at progressively greater depths toward the north. Diamond drill holes indicate that the ore zone is present several hundred feet below the surface at distances of 500 to 600 feet east of the tactite outcrop in most of the area.

Four more or less distinct ore bodies occur in the deposit. These are localized by the lithology of the limestone and the structure of the limestone-granodiorite contact. Good tactite developed where the rather massive, granular, pure limestone adjoins the granodiorite; where the platy, thin-bedded, impure limestone is present at the contact, little or no tactite was formed. The granodiorite contact is nowhere precisely parallel with the bedding of the limestone for a great distance, therefore the tabular ore bodies play out laterally or down dip where unfavorable beds occupy the contact zone. The structural control which has localized ore bodies is the occurrence of right angle turns in the granodiorite contact, where the igneous rock cuts sharply across the limestone bedding for a short distance before resuming a course more nearly parallel to the bedding. The sharp bends or jogs of the contact are always in the same direction, such that the main granodiorite contact lies farther east, south of the offset. These offsets create trough-like features which plunge in the direction of the general dip of the contact, slightly north of east, at an angle of about 40°. Ore bodies localized by the troughs tend to be relatively small and limited in surface outcrop, but they extend down dip as elognate shoots.

The largest of the four ore bodies of the Riley mine extends from pit 1A northward to the end of surface exposures of tactite. The ore body is limited to the layer of tactite immediately against the contact. Diamond drilling indicated that this zone continues at least 450 feet and has an average thickness of about nine feet. The absence of tactite in the middle of the surface outcrop appears to be the local effect of an unfavorable platy limestone layer at the contact. The termination of the ore body to the north also appears to have resulted from the presence of unfavorable beds adjacent to the granodiorite.

The second ore body extends from pit 1C to pit 1A and includes the outer tactite layer in pits 1 and 1A, thus partly overlapping the first ore zone. This ore body has an average thickness of about 8½ feet and extends more than 450 feet down dip in the vicinity of pits 1 and 1A where the trough-like irregularity of the granodiorite contact favored more extensive and concentrated mineralization. In the area of pits 1B and 1C the ore averages only 3 feet in thickness, and it pinches out between 150 and 200 feet below the surface.

The third ore body is exposed by pits 2 and 3. The thickest and richest ore in this body occurs in two prominent angular troughs produced by sharp jogs in the gronodiorite contact. The narrower layer of tactite that connects the two has furnished some ore. The average thickness of ore in the troughs is 15 feet, the thickness in the area between is about 7 feet. Drilling indicated that ore extends 500 feet down dip from the surface and maintains a width comparable to that at the surface.

A fourth and much smaller ore body exposed by pit 4 is also localized for the most part in a trough-like irregularity of the contact zone. This ore body has an average width of about seven feet; it is limited on the south and west by the granodiorite and on the east by the large fault zone. The fault cuts across the ore body a short distance below the floor of the pit, and most of the ore has been mined out.

Ore reserves of the Riley mine are estimated from samples and measurements of surface exposures and from results of the diamond drilling program of the U. S. Bureau of Mines. Twenty surface samples from all parts of the tactite contained an average of 0.70 percent WO_3, and drill core samples from the eleven holes which cut appreciable thicknesses of tactite contained an average of 0.74 percent WO_3. The 80,000 tons of ore sold to Metals Reserve Co. contained 0.63 percent WO_3. None of the remaining ore is sufficiently well blocked out to be classed as measured ore. Indicated ore, outlined by surface exposures and diamond drill

holes, is calculated to be 412,500 tons containing 288,700 units of WO_3. Inferred ore is estimated to be 166,000 tons containing 116,000 units of WO_3.

VALLEY VIEW MINE (SAUNDERS PROPERTY)

The Saunders property, like the Dernan property, is in the low foothills on the east side of the Osgood range (Pl. 1). A dirt road 1.4 miles long 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. In 1943 the property was leased to the Harold's Club Mining Co. of Reno, Nevada, but in 1945 one of the chief operators was Mr. Don Bergner. The 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.

This property was prospected for silver and copper ore before scheelite was recognized in the district. In 1945 the workings included a 255-foot adit along the contact zone south from the small valley in which the camp is located and another adit 315 feet long that explores the contact north from the valley. An open cut on the surface above the north tunnel is connected by an ore pass with the tunnel. There are numerous pits, trenches, and small adits along the contact zone north of the open cut. Several small stopes were opened from the north tunnel, and about 1,500 tons of ore were sold to Metals Reserve Co. before June 30, 1945. Since that time some additional exploration has been done.

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 (Pl. 7). 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 315-foot north adit is gouge and sheared rock of the large fault zone along the east side of this part of the Osgood range. In the 315-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.

From the small valley in which the adits are located, a band of tactite extends southward along the igneous contact about 550 feet to the edge of sec. 29. The thickness of tactite varies between 1 foot and 10 feet, and the scheelite content is also quite variable, but it is estimated that a 3-foot width of tactite containing an average of 0.5 percent WO_3 occurs along at least half of this distance. On this basis it is calculated that 13,000 tons of indicated ore is present above the level of the main adit.

The tactite band which extends northward from the camp site is explored for over 300 feet by the main adit. Near the portal the tactite is very thin, but between 50 and 200 feet from the portal the average thickness is 2 to 3 feet and the WO_3 content is esitmated to be about 0.7 percent. The contact is barren from 200 feet to about 270 feet from the portal, but from 270 to 315 feet there is a 6- or 7-foot thickness of tactite that contains about 0.5 percent WO_3. On the surface a thin tactite band extends 325 feet northwest where it expands into an irregular area of mixed hornfels and tactite 200 feet long and 50 to 100 feet wide. An attempt was made to mine part of this, but the average tungsten content was too low. The adit and surface exposures for 500 feet north of the adit block out about 15,000 tons of indicated ore containing 0.5 percent WO_3.

Approximately 1,400 feet northwest of the camp a series of pits exposes a zone of tactite 3 to 10 feet wide and 250 feet long. The tungsten content is low, 0.3 to 0.4 percent WO_3, but it is estimated that this zone contains about 8,000 tons of ore carrying 0.4 percent WO_3. Other showings of tactite on the claims are too limited in thickness or extent to be of importance.

Below the level of the lowest exposed parts of the tactite bodies it is estimated that at least 20,000 tons of 0.5 percent WO_3 ore is present. However, it is doubtful that some of the narrow zones of ore containing about 0.5 percent WO_3 can be mined profitably.

ALPINE MINE

The Alpine mine, owned by Mr. Stanley O'Leary and Mr. Lee of Battle Mountain, Nevada, is on the crest of the Osgood range about 4,000 feet due south of the Richmond mine (Pl. 1). It is reached by a road which branches from the Richmond mine road at the crest of the range. This property was operated in the summer of 1943 as the Porvenir mine by Mr. W. C. Rigg of Winnemucca, Nevada. Mr. Rigg mined about 8,000 tons of tactite containing an average of 0.5 percent WO_3 from an open pit in the main ore zone at the south end of the deposit. The most accessible ore was removed, and the property was idle in July 1945.

A thick zone of laminated impure limestone is adjacent to the

granodiorite along the western margin of the igneous stock in the vicinity of the Alpine mine. Little or no tactite occurs at the contact where the bedding is nearly parallel to the margin of the granodiorite, 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. Mining activity was confined to the southernmost occurrences of tactite where the thickness of ore appears to be greatest. About 400 to 600 feet north of the main ore zone a series of pits and an old shaft expose 8 to 10 feet of tactite, parts of which contain more than 1 percent WO_3.

About 5,000 tons of indicated ore containing 0.4 to 0.5 percent WO_3 remains in the pit. The presence of several times as much ore in the deposit may reasonably be inferred, but outcrops of bedrock are poor in the vicinity of the mine, and no adequate picture of the structure of the ore body could be obtained, therefore no further estimate is offered.

MARKUS CLAIMS

The Markus claims are a group of five unpatented claims owned by John Etchart, Jr., and W. M. Pettit. The property is two miles northwest of the Granite Creek mine in the northeast corner of sec. 24 (Pl. 1). These claims are on the east side of the Osgood range near its crest and between 7,000 and 8,000 feet in altitude. A good road leads to the Granite Creek mine at an altitude of 5,500 feet. Beyond the end of the road a rough trail, 2½ to 3 miles long, follows the valley to the Markus claims at the head of the north fork of Granite Creek. In 1943 the property was leased to John H. Harden of Winnemucca, Nevada, but no new work was done, and in 1945 the claims were idle.

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 (Pl. 11). 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 which partly explore four tactite bodies. The lower adit cuts through granodiorite into a zone of garnet rock, and 20 feet of garnet rock is exposed in the trench above the adit. Traces of bedding in tactite in the adit indicate a nearly horizontal attitude, but the structure of the tactite in the trench is not apparent. In the lower adit scheelite was observed to be concentrated in a nearly horizontal layer about 1 foot wide, and a sample from the face of the adit is reported to have assayed 0.6 percent WO_3. The garnet rock in the trench contains only about 0.1 percent WO_3.

A second tactite body 120 feet north of the lower adit and trench is exposed by prominent surface outcrops and in the short upper adit. This zone of tactite is 2 to 10 feet wide, and it is exposed for a distance of about 75 feet. The tactite layer is much narrower in the adit than at the surface. On the west wall of the open cut in front of the upper adit the tactite layer is well exposed for about 30 feet, but its thickness does not exceed five feet. The richest ore observed on the claims occurs here, and samples from the open cut are said to have assayed 1.38 and 3.34 percent WO_3. The wider north end of the tactite layer contains very little scheelite.

About 300 to 350 tons of measured ore containing approximately 1.7 percent WO_3 is present at the upper adit, and 1,000 to 1,300 tons of indicated ore containing 0.5 percent WO_3 is estimated for the upper and lower adits. If the tactite layer exposed at the upper adit continues downward with comparable thickness and grade to join that in the lower adit, some 12,000 tons of tactite may be present above the level of the lower adit, but not more than half of this inferred tactite body may be expected to contain 0.3 percent or more WO_3.

The third and fourth tactite bodies occur about 600 and 1,000 feet north of the upper adit. These two bodies are obviously unrelated, and samples from them are reported to contain only about 0.1 percent WO_3.

MINOR TUNGSTEN OCCURRENCES OF THE DISTRICT

Tungsten ore occurs also on groups of claims held by Eyraud and Knight, and there are other occurrences on the extensive holdings of Getchell Mine, Inc. A small amount of scheelite occurs on the claims of Markus Durfee south of the granodiorite stock.

Alexander Eyraud holds a series of claims covering most of the contact zone between the Saunders property and the Kirby mine (Pl. 1). 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 Plate 1.

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. This layer is exposed again in a pit about 50 feet east of the shaft, but it does not continue farther. Indicated ore is estimated to be 100 tons containing 200 units of WO_3, plus 1,000 tons of 0.4 percent WO_3 ore, and an equal amount of inferred ore may reasonably be expected.

The only known occurrence 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.

SUMMARY OF ORE RESERVES OF THE DISTRICT

Estimates of ore reserves of the tungsten deposits in the Osgood range are summarized in the following table. The amount of ore is expressed in short tons, and the tungsten content in units of tungsten trioxide. In the calculation of reserves the minimum grade included has generally been between 0.3 and 0.4 percent WO_3. Ore containing 0.34 percent WO_3 has been mined profitably by open pit methods in the district. In all calculations it was assumed that 10 cubic feet of tactite equals one ton.

The amount of inferred ore is small as compared with the total measured and indicated ore, and in most of the ore bodies it is restricted to continuations of known ore bodies to shallow depth. In some cases, the downward extension of the tactite zone is known to be limited, in others, the tungsten content is so low that the mining of tactite at any great depth is not considered economically feasible.

TUNGSTEN ORE RESERVES, OSGOOD RANGE, POTOSI MINING DISTRICT, HUMBOLDT COUNTY, NEVADA

Property	Measured		Indicated		Inferred		Total	
	Tons	Units	Tons	Units	Tons	Units	Tons	Units
Getchell Mine, Inc.—								
Granite Creek deposit	25,000	14,200	39,000	17,500	54,000	25,000	118,000	56,700
Kirby deposit	1,500	600	2,000	900	2,000	800	5,500	2,300
Pacific prospect	.....	.....	40,000	20,000	.....	.....	40,000	20,000
Tonopah and Chase prospects	No estimate							
Subtotal	26,500	14,800	81,000	38,400	56,000	25,800	163,500	79,000
Richmond deposit	.....	.....	10,000	5,000	10,000	5,000	20,000	10,000
Riley mine	.....	.....	412,500	288,700	166,000	116,000	578,500	404,700
Valley view mine	.....	.....	36,000	17,200	20,000	10,000	56,000	27,200
Alpine mine	.....	.....	5,000	2,250	5,000	2,500	10,000	4,750
Markus claims	350	600	1,300	700	6,000	1,800	7,650	3,100
Eyraud's claims	No estimate		1,100	600	1,000	500	2,100	1,100
Knight's claims	.....	.....						
Durfee's claims	No estimate							
Grand totals	26,850	15,400	546,900	352,850	264,000	161,600	837,750	529,850

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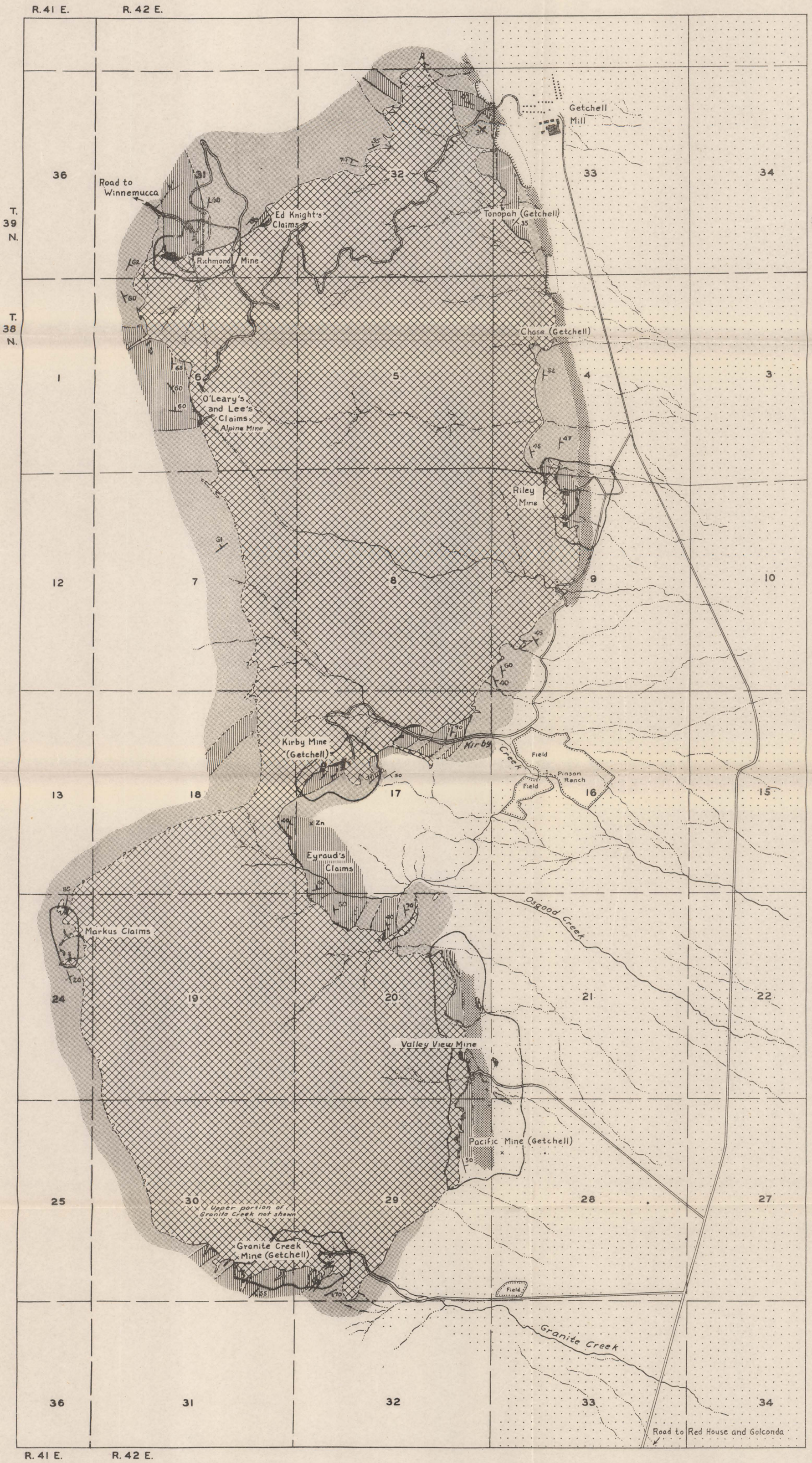

EXPLANATION

- ALLUVIUM
- TACTITE, CHIEFLY SCHEELITE-BEARING
- GRANODIORITE
- LIMESTONE
- HORNFELS AND ARGILLITE
- FAULT ZONE
- STRIKE AND DIP OF BEDS
- OPEN PITS OF GETCHELL MINE (GOLD AND ARSENIC)
- ADIT, SHAFT, OR PIT
- AREAS MAPPED IN DETAIL

SCALE

0 1000' 2000' 3000' 4000'

BASE IN PART FROM AERIAL PHOTOGRAPHS MADE AVAILABLE BY GETCHELL MINE, INC.

GEOLOGY BY S. E. CLABAUGH AND S. W. HOBBS, APRIL, 1943

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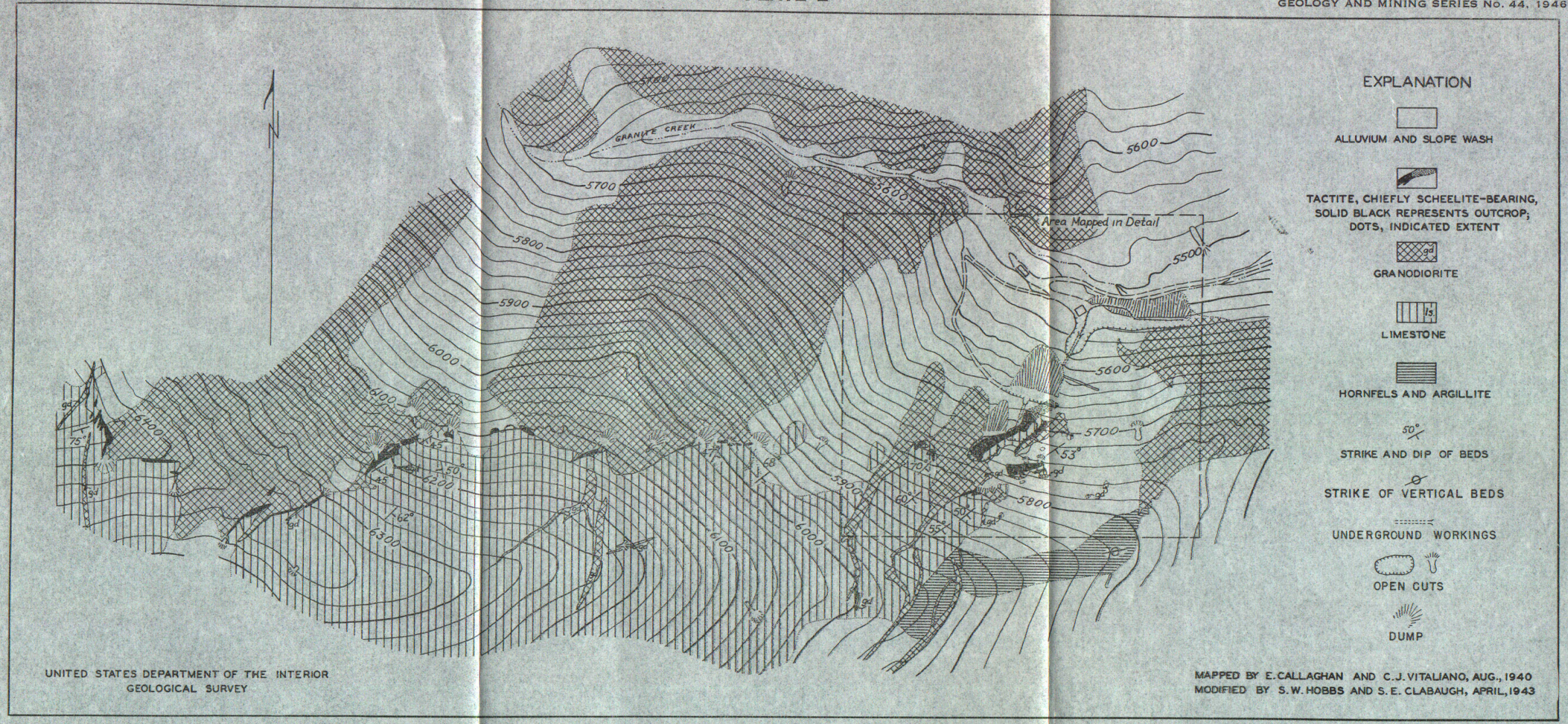
RECONNAISSANCE GEOLOGIC MAP OF THE OSGOOD RANGE INTRUSIVE

POTOSI MINING DISTRICT, HUMBOLDT COUNTY, NEVADA



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MAPPED BY E. CALLAGHAN AND C. J. VITALIANO, AUG., 1940
MODIFIED BY S. W. HOBBS AND S. E. CLABAUGH, APRIL, 1943

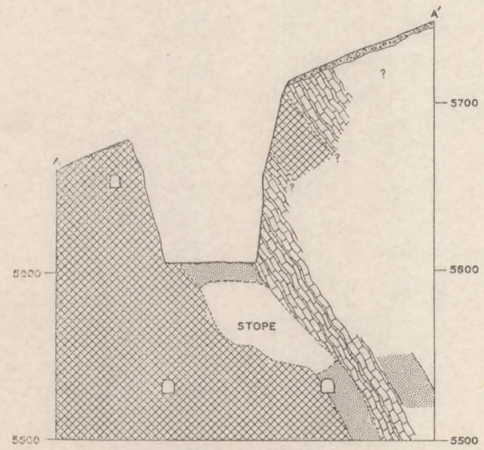
GEOLOGIC MAP OF THE GRANITE CREEK TUNGSTEN DEPOSIT

POTOSI MINING DISTRICT, HUMBOLDT COUNTY, NEVADA

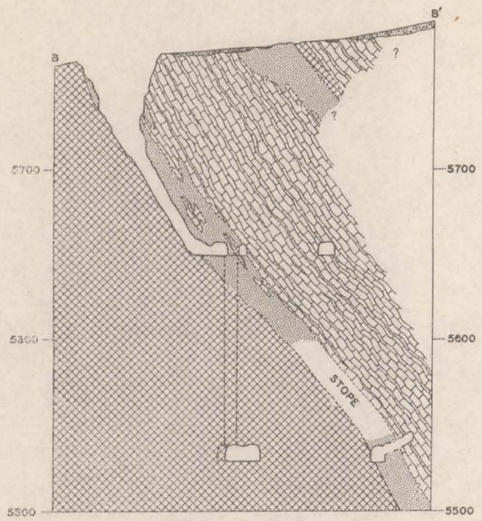
200 0 200 400 600 800 FEET

CONTOUR INTERVAL 20 FEET. DATUM ASSUMED

PLATE 3



SECTION ALONG LINE A-A'



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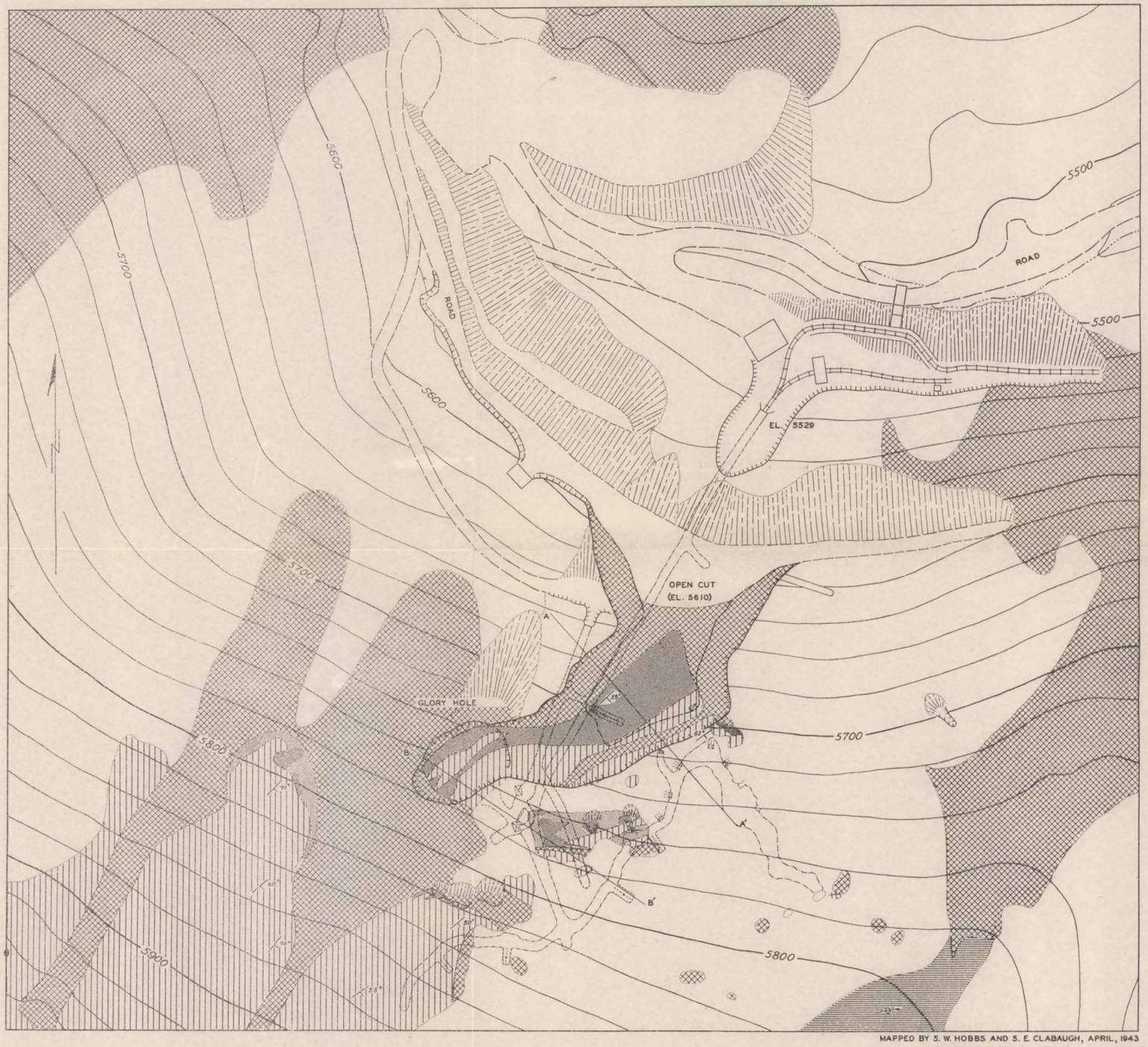

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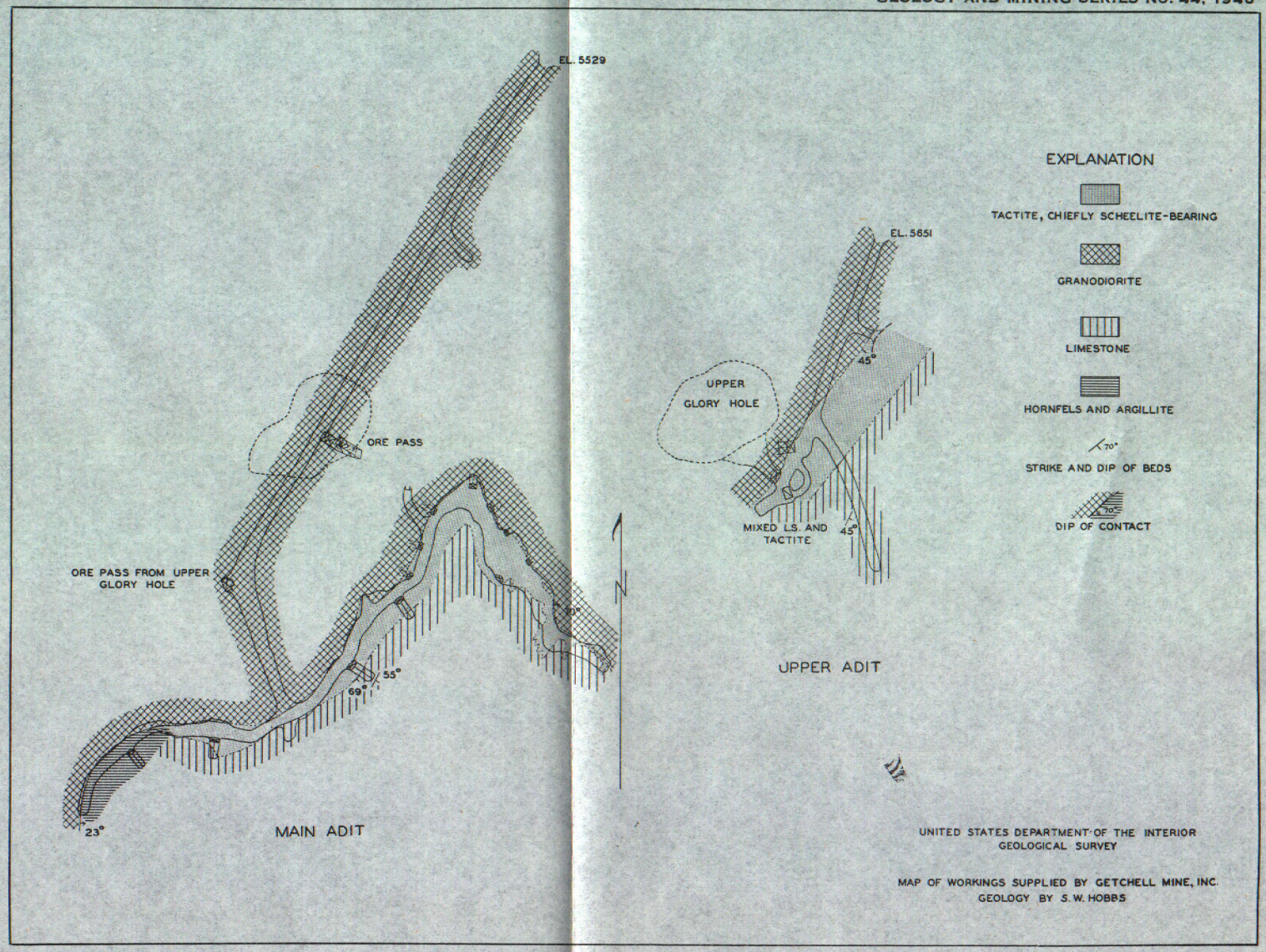
REVISED BY S. W. HOBBS, JUNE, 1944

DETAILED GEOLOGIC MAP AND SECTIONS OF THE GRANITE CREEK MINE AREA

POTOSI MINING DISTRICT, HUMBOLDT COUNTY, NEVADA

50 0 100 200 FEET

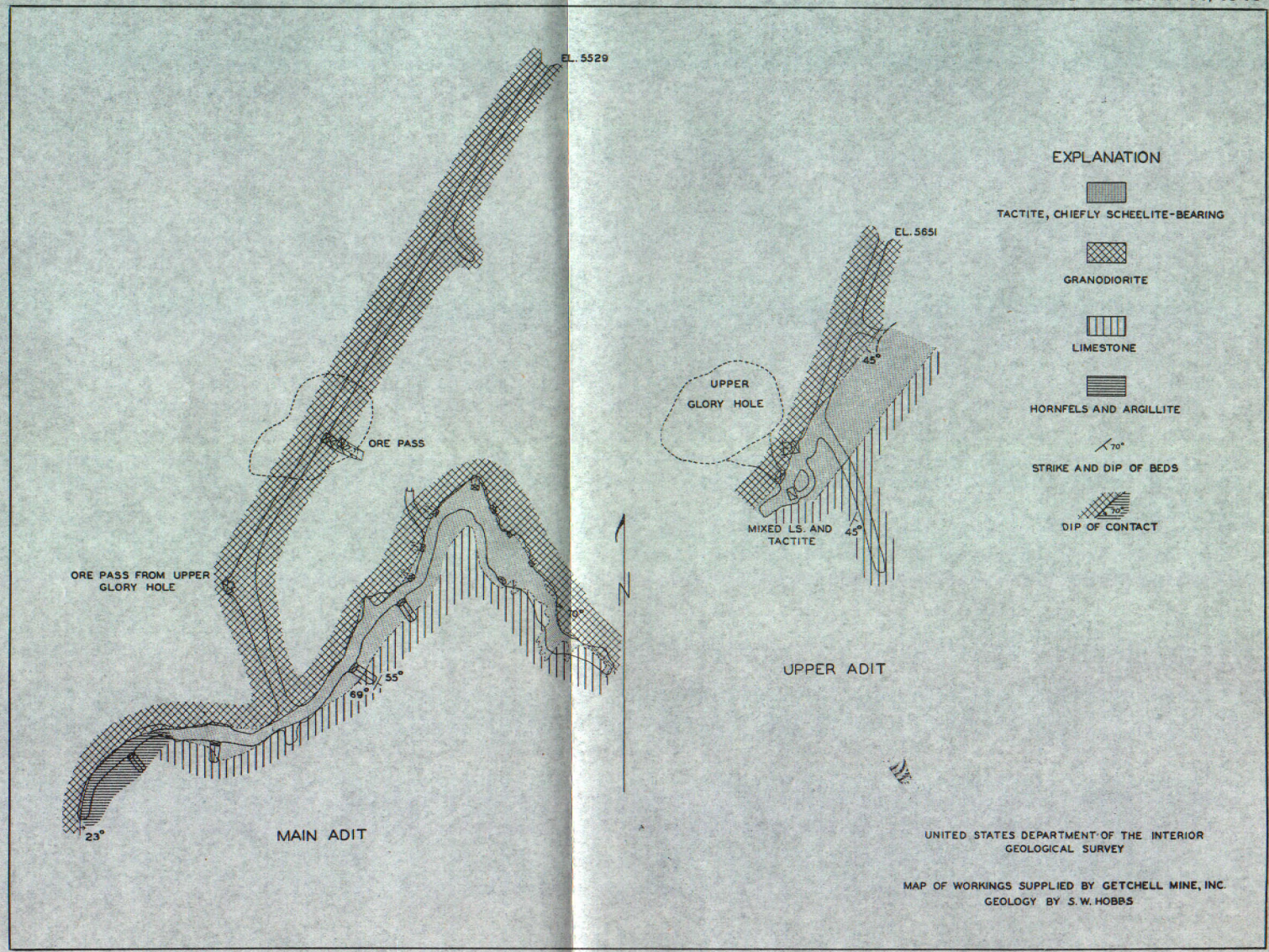
CONTOUR INTERVAL 20 FEET, DATUM ASSUMED



UNDERGROUND WORKINGS OF THE GRANITE CREEK MINE

POTOSI MINING DISTRICT, HUMBOLDT COUNTY, NEVADA

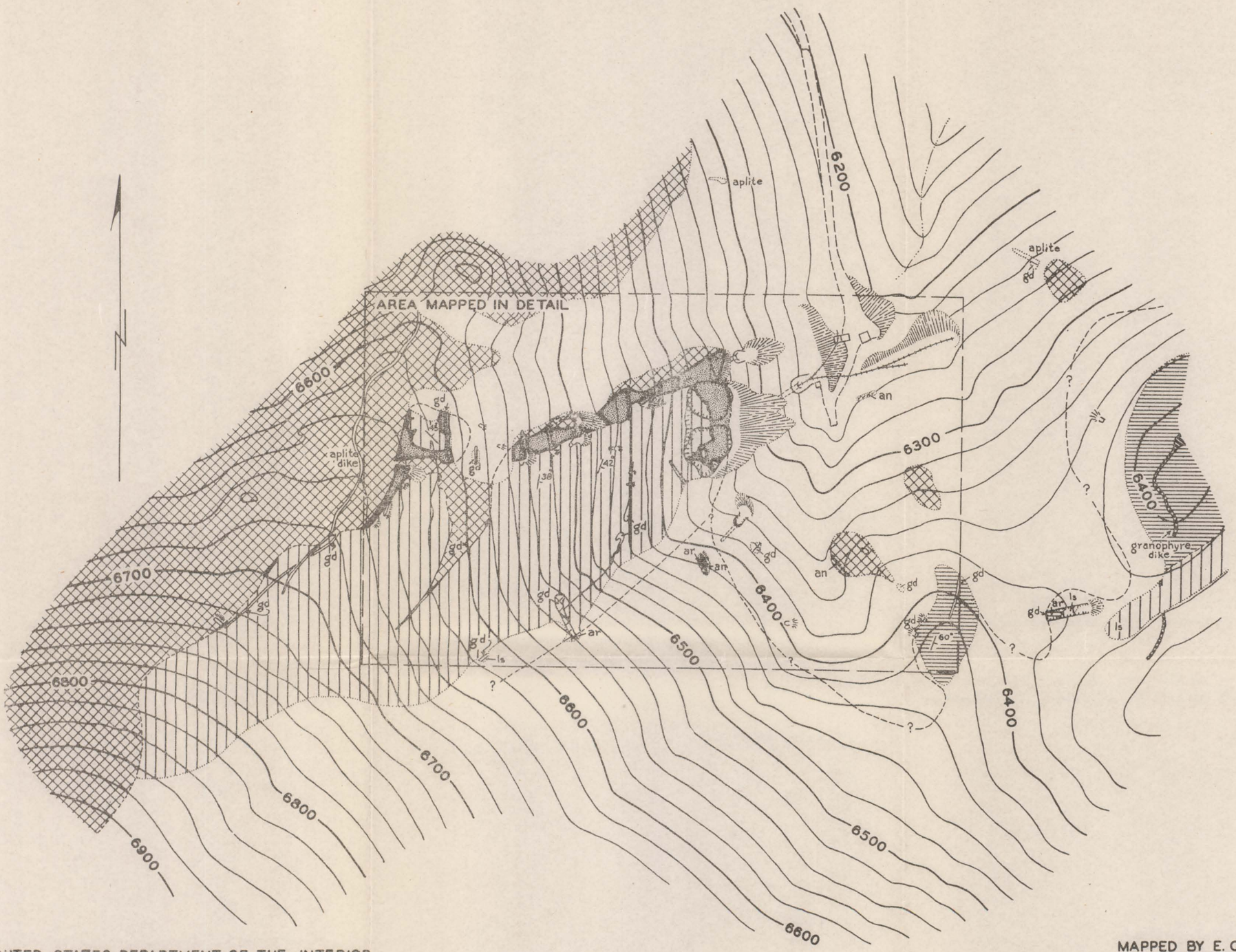
50 0 100 200 FEET



UNDERGROUND WORKINGS OF THE GRANITE CREEK MINE

POTOSI MINING DISTRICT, HUMBOLDT COUNTY, NEVADA

50 0 100 200 FEET



EXPLANATION

ALLUVIUM AND SLOPE WASH

ANDESITE PORPHYRY DIKES

TACTITE, CHIEFLY SCHEELITE-BEARING

GRANODIORITE

LIMESTONE

HORNFELS AND ARGILLITE

STRIKE AND DIP OF BEDS

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

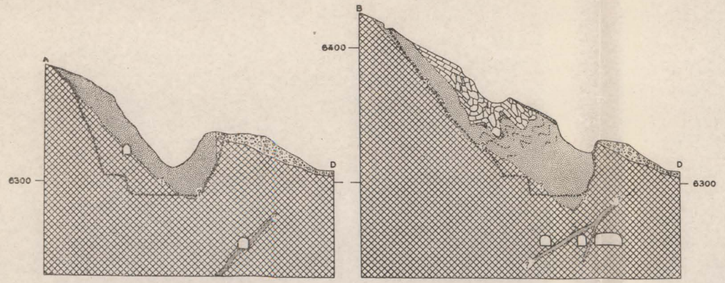
MAPPED BY E. CALLAGHAN AND C. J. VITALIANO, AUG., 1940
MODIFIED BY S. E. CLABAUGH, APRIL, 1943

GEOLOGIC MAP OF THE KIRBY TUNGSTEN DEPOSIT

POTOSI MINING DISTRICT, HUMBOLDT COUNTY, NEVADA

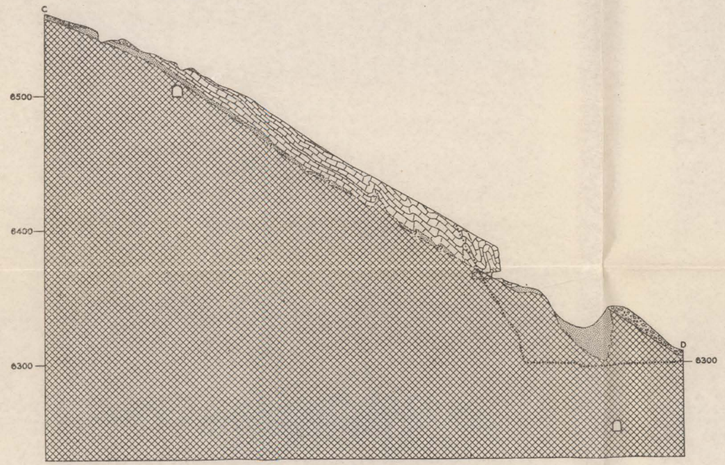
200 0 400 800 FEET

CONTOUR INTERVAL 20 FEET, DATUM ASSUMED



SECTION ALONG LINE A–D

SECTION ALONG LINE B–D



SECTION ALONG LINE C–D

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

MAPPED BY S. E. CLABAUGH AND S. W. HOBBS, APRIL, 1943

EXPLANATION

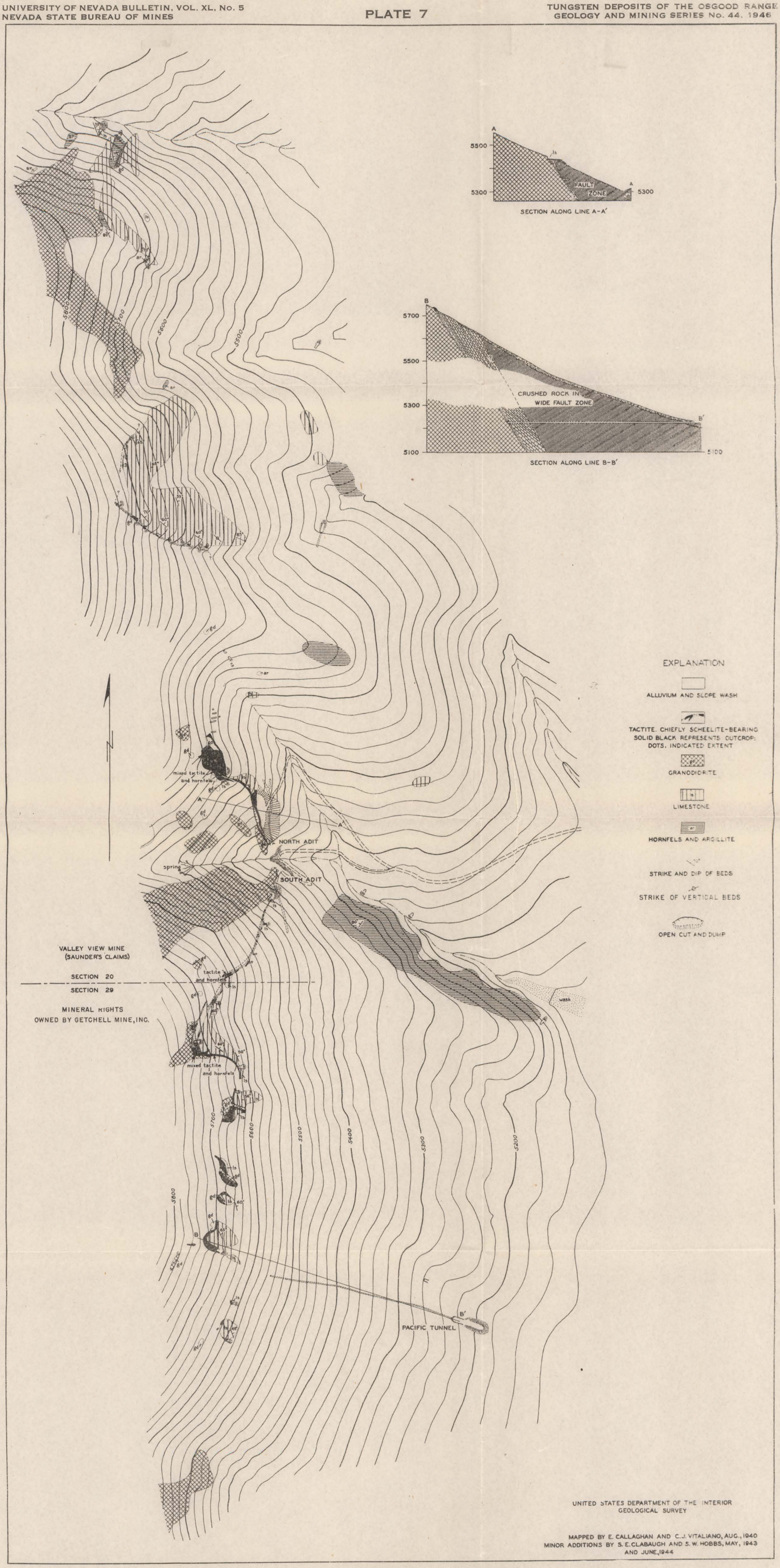
- ALLUVIUM AND SLOPE WASH
- ANDESITE PORPHYRY DIKES
- TACTITE, CHIEFLY SCHEELITE-BEARING, HEAVY DOTS REPRESENT OUTCROP; LIGHT DOTS, INDICATED EXTENT.
- GRANODIORITE
- LIMESTONE
- HORNFELS AND ARGILLITE
- 36° STRIKE AND DIP OF BEDS
- UNDERGROUND WORKINGS
- TRENCH
- CONCEALED CONTACT LOCATION APPROXIMATE
- OPEN CUT
- PIT PROFILE, JUNE, 1944 SHOWN ON SECTIONS

DETAILED GEOLOGIC MAP AND SECTIONS OF THE KIRBY MINE AREA

POTOSI MINING DISTRICT, HUMBOLDT COUNTY, NEVADA

50 0 100 200 FEET

CONTOUR INTERVAL 20 FEET. DATUM ASSUMED

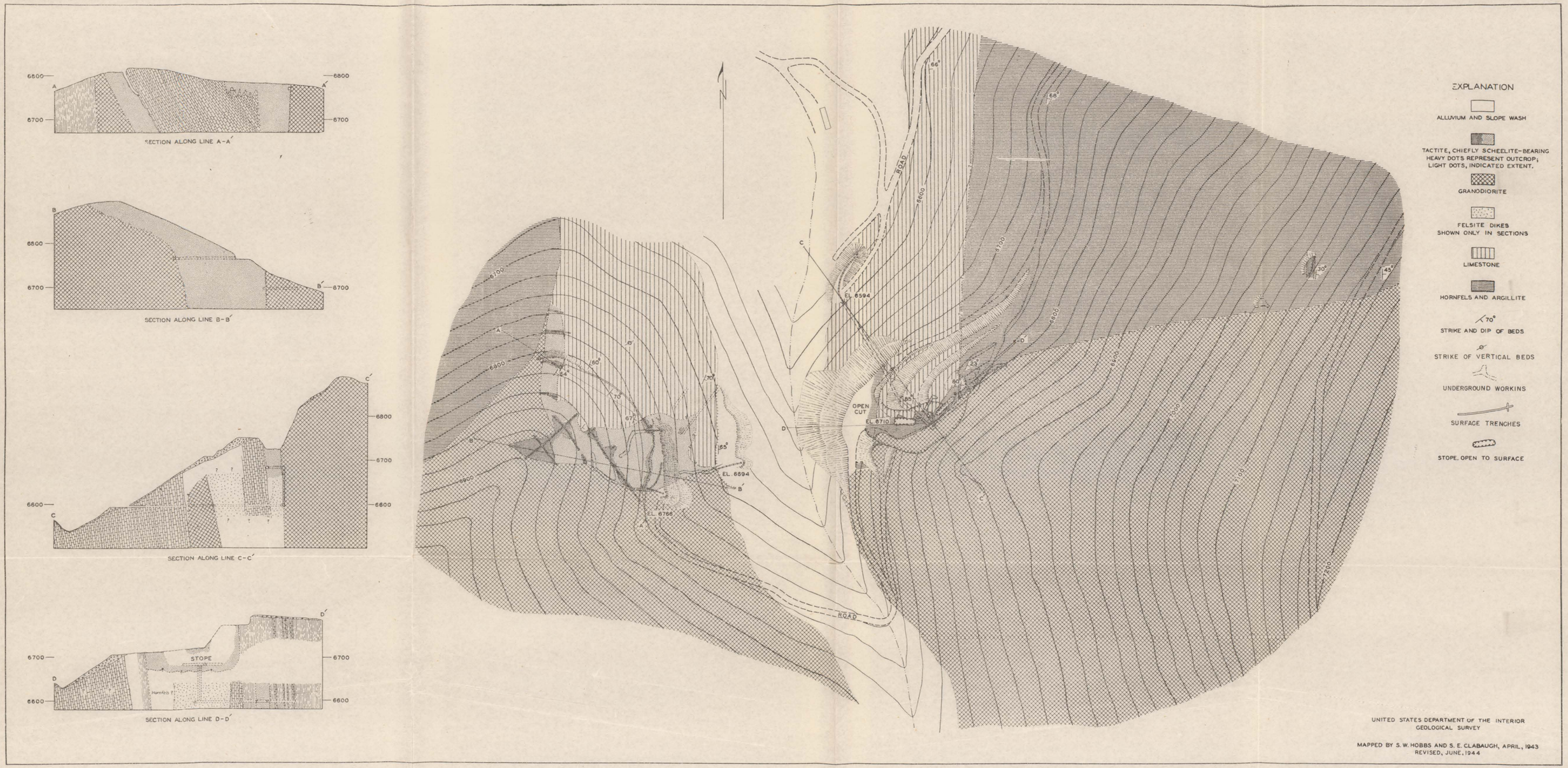


GEOLOGIC MAP AND SECTIONS OF THE VALLEY VIEW MINE AND PACIFIC PROSPECT

POTOSI MINING DISTRICT, HUMBOLDT COUNTY, NEVADA

200 0 400 800 FEET

CONTOUR INTERVAL 20 FEET, DATUM ASSUMED

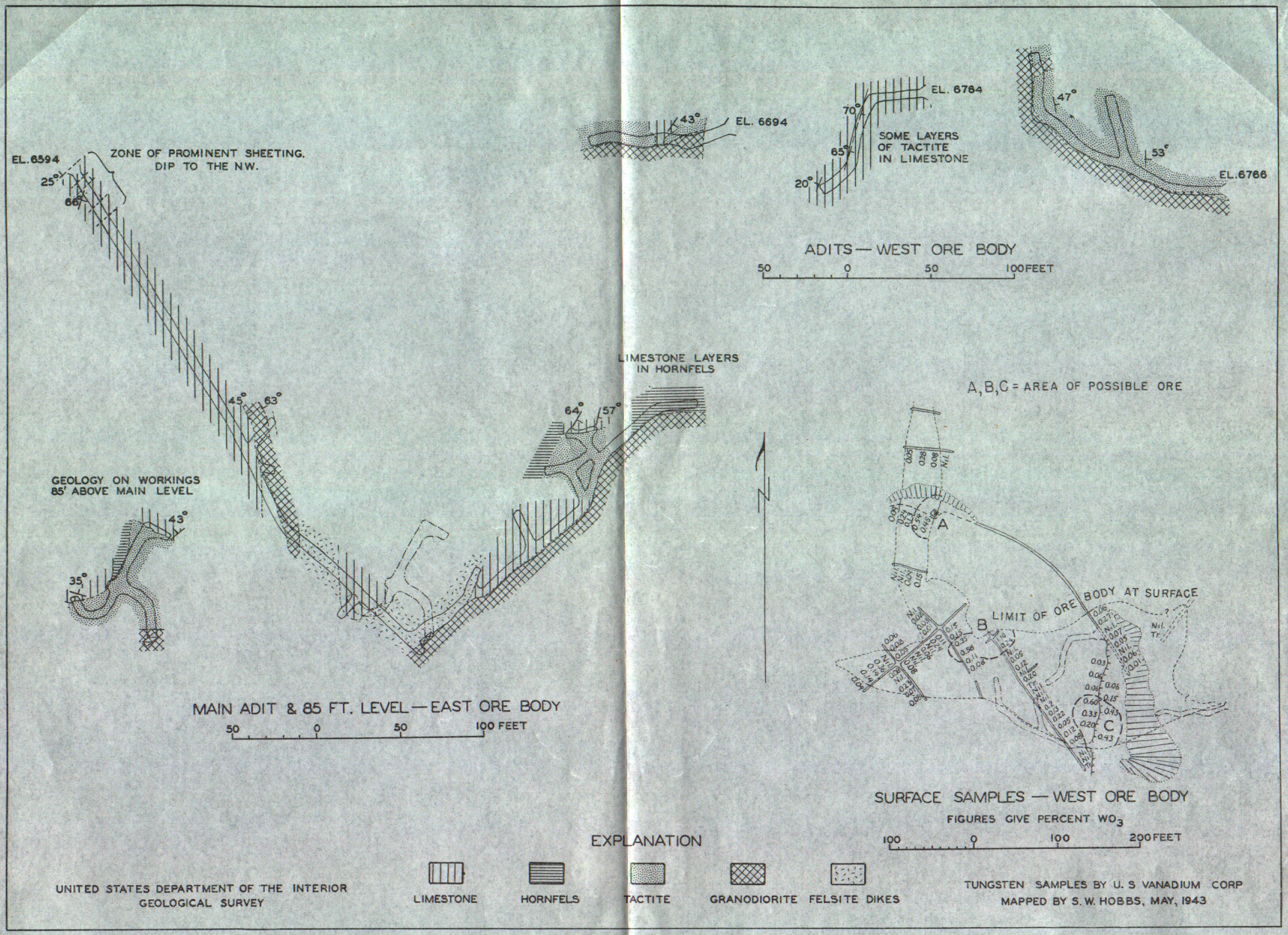


DETAILED GEOLOGIC MAP AND SECTIONS OF THE RICHMOND MINE AREA

POTOSI MINING DISTRICT, HUMBOLDT COUNTY, NEVADA

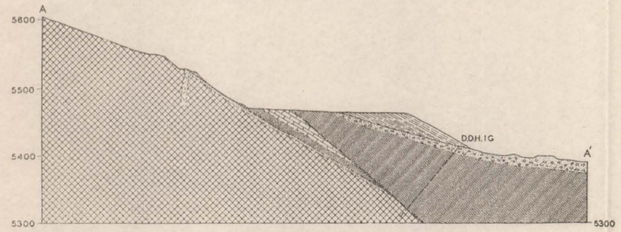
100 0 100 200 300 400 FEET

CONTOUR INTERVAL 20 FEET, DATUM ASSUMED

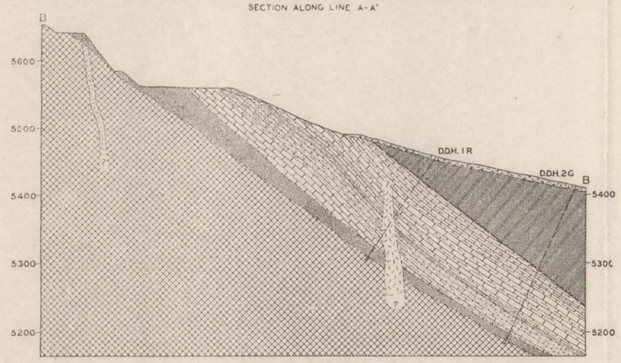


UNDERGROUND WORKINGS AND SURFACE SAMPLES — RICHMOND MINE

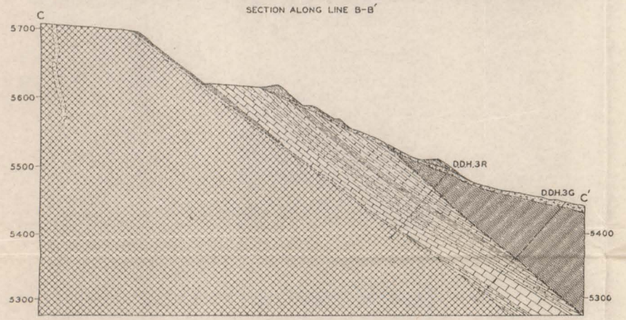
POTOSI MINING DISTRICT, HUMBOLDT COUNTY, NEVADA



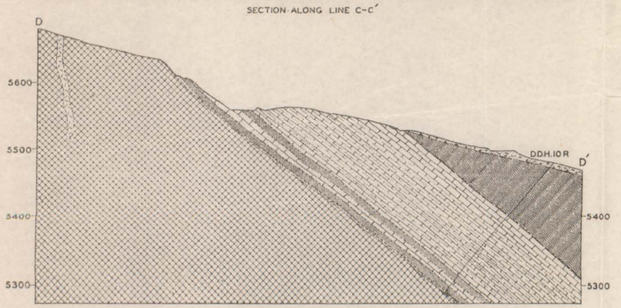
SECTION ALONG LINE A-A'



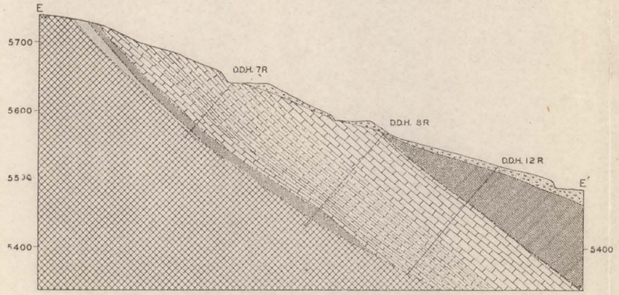
SECTION ALONG LINE B-B'



SECTION ALONG LINE C-C'

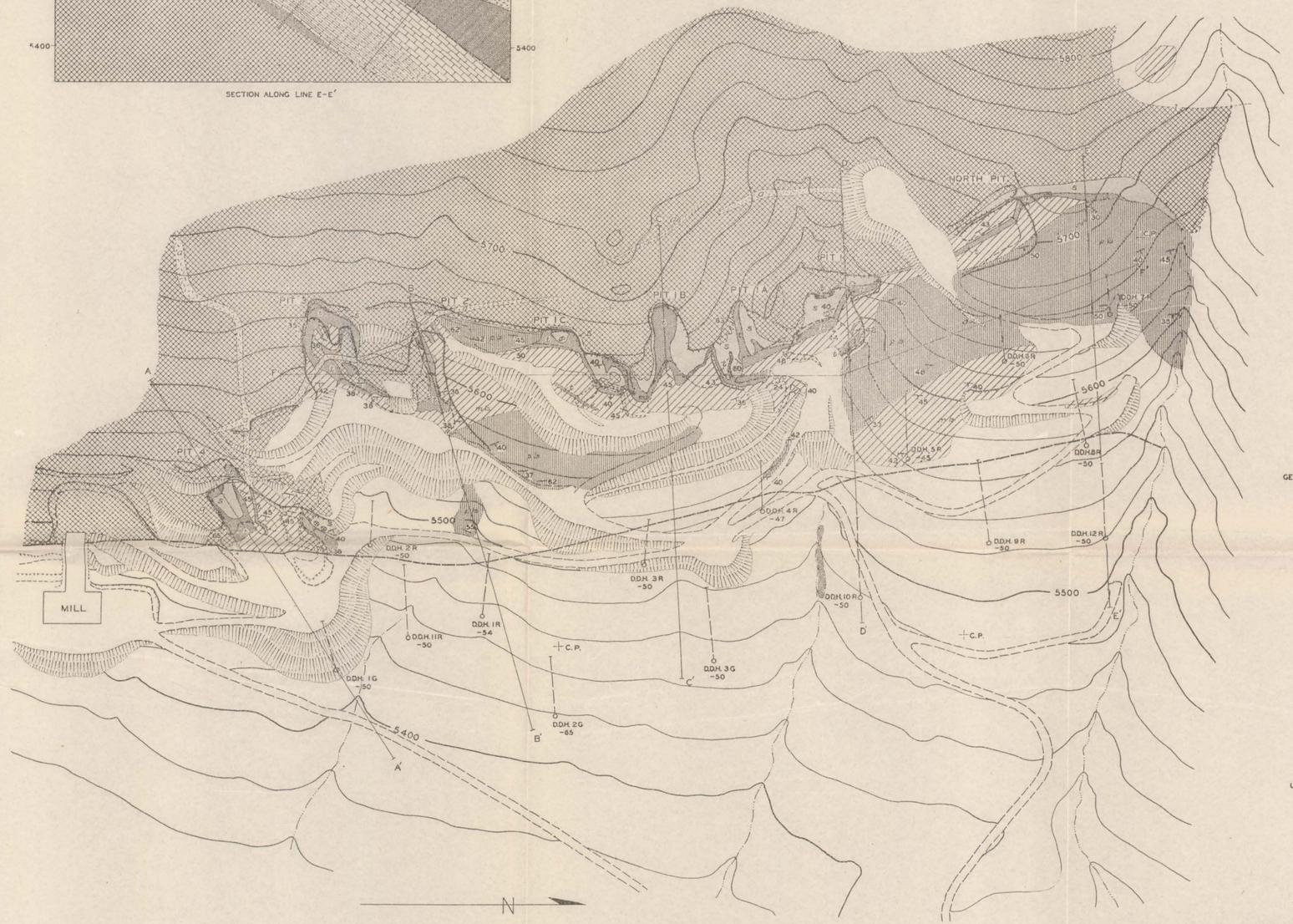


SECTION ALONG LINE D-D'



SECTION ALONG LINE E-E'

SECTION ALONG LINE F-F'



EXPLANATION

- ALLUVIUM AND SLOPE WASH — ON PLAN, ON SECTION
- CRUSHED ROCK IN FAULT ZONE
- ANDESITE PORPHYRY DIKES
- TACTITE, CHIEFLY SCHEELITE BEARING
- SCHIST AND HORNFELS
- GRANODIORITE
- LIMESTONE — MASSIVE LIMESTONE – *mls*; PLATY LIMESTONE – *pls*
- FOOTWALL OF FAULT ZONE
- 50 — STRIKE AND DIP OF BEDS
- 24 — GENERALIZED STRIKE AND DIP OF CRUMPLED BEDS
- 65 — GEOLOGIC CONTACTS SHOWING DIP, DASHED WHERE CONCEALED
- CONTACT OF ALLUVIUM AND BEDROCK
- OPEN CUT OR LARGE PIT
- WASTE DUMP — ON PLAN AND ON SECTION
- OUTER EDGE OF CUT TERRACE
- C.P. — CLAIM LINE POST
- DDH.7R -50 — U.S. BUREAU OF MINES DIAMOND DRILL HOLE SHOWING INCLINATION

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

GEOLOGY BY S. W. HOBBS, JULY, 1945
BASE IN PART FROM MAP BY E. CALLAGHAN AND C. J. VITALIANO, AUG., 1940

GEOLOGIC MAP AND SECTIONS OF THE RILEY MINE

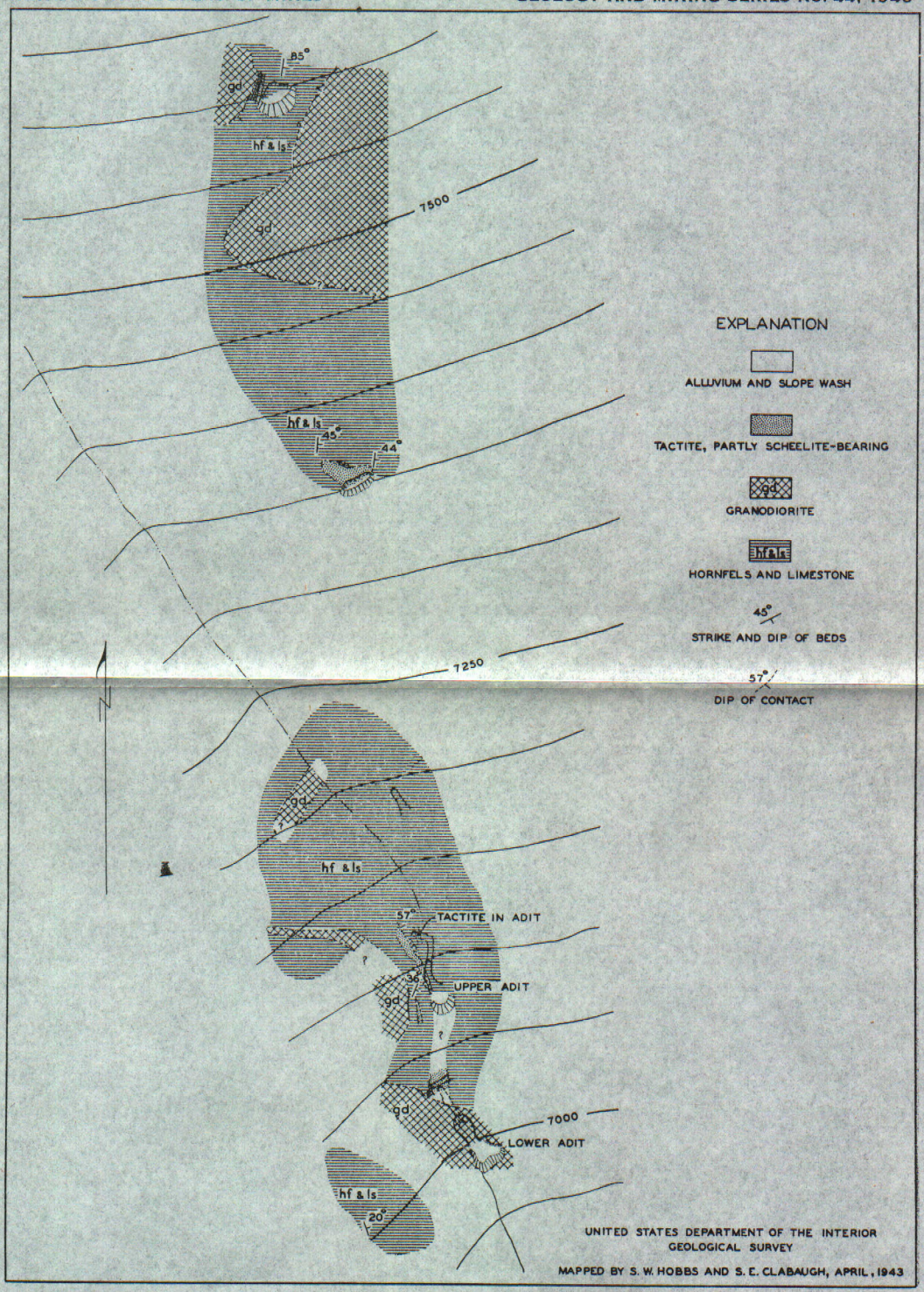
POTOSI MINING DISTRICT, HUMBOLDT COUNTY, NEVADA

100 0 200 400 FEET

CONTOUR INTERVAL 20 FEET, DATUM ASSUMED

3680 0061

PLATE 11



SKETCH MAP OF THE MARKUS CLAIMS

POTOSI MINING DISTRICT, HUMBOLDT COUNTY, NEVADA

100 0 100 200 300 400 FEET

CONTOUR INTERVAL 50 FEET, DATUM ASSUMED