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Tungsten Deposits in the Tem Piute District, Lincoln County, Nevada

By Donald G. Wyant and Dwight M. Lemmon

U. S. Geological Survey

This report is preliminary and has not been edited or reviewed for conformity with U. S. Geological Survey standards and nomenclature.

51-89

ILLUSTRATIONS

Tungsten Deposits in the Tem Piute District, Lincoln County, Nevada

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U. S. Geological Survey

Contact-metamorphic scheelite deposits occur at the north end of the Tem Piute Range in the west-central part of Lincoln County, Nevada, approximately 85 miles west of Caliente, 100 miles east of Tonopah, and 160 miles north of Las Vegas. The district is reached by 40 miles of desert road from U. S. Highway 93 at Crystal, near Hiko. The deposits are in Secs. 25 and 26, T. 3 S., R. 56 E.; Secs. 31 and 30, T. 3 S., R. 57 E.; and Sec. 1, T. 4 S., R. 56 E.

The range was prospected for silver in the 1860's, and small amounts of silver ore were mined at various times from 1868 to 1883, and again from 1935 to 1939. The scheelite deposits are several miles north of the silver prospects, and were first discovered in 1916. They were not mined or extensively prospected until 1934, when a number of claims were re-located by Wesley Koyen, in partnership with Mrs. W. Green, G. W. Thiriot, and D. P. Thiriot. The property was leased to Lincoln Mines, Inc., and a small mill was completed in June 1940. In 1945, the Atolia Mining Co. purchased Lincoln Mines, Inc. from D. B. Fegles, and took over the mining lease. The mine was idle in 1946, and was again operated in 1947. From 1940 to 1947 inclusive, Lincoln Mines, Inc., and its successor, the Atolia Mining Co., treated 81,872 tons of ore and recovered 43,390 units of WO_3. More than half this production

was made in 1941 and 1942.

The North Tem Piute Mining and Development Co. was organized in 1937 by the Schofield brothers, who had located claims in the district in 1928. In 1943, concentrate containing 32 units of WO_3 was made. The property was leased in 1946 to the Atolia Mining Co.

The U. S. Bureau of Mines explored the deposits in 1942 (E. O. Binyon in charge) and in 1944 (C. H. Holmes, Jr. in charge). In 1942, trenches were dug across the ore zones at intervals of 100 feet or less, samples were cut and assayed, and 5 diamond drill holes were completed. In 1944, 8 holes were drilled. The results of this work, with assay maps, were published by the Bureau of Mines. 1/

1/ Binyon, E. O., Holmes, C. H. Jr., and Johnson, A. C., Investigation of the Tem Piute tungsten deposit, Lincoln County, Nevada: U. S. Bureau of Mines, R. I. 4626, 16 pp., 23 figs., 1950.

Donald C. Wyant and M. P. Erickson of the Geological Survey prepared geologic maps of the tungsten deposits in 1942-43, and provided geologic guidance for the first Bureau of Mines project. In 1944, D. M. Lemmon spent 2 weeks revising the geologic maps and consulting with Holmes concerning the second drilling project.

Geology

The north end of the Tem Piute Range is composed largely of steeply dipping Paleozoic sedimentary rocks. They are invaded by two small granite

stocks and by several narrow, short basalt dikes. Volcanic tuffs and flows are found in the pediment at the north end of the range.

The Paleozoic sequence, the upper portion of which is mapped on figure 1, includes rocks of Ordovician, Devonian, and Carboniferous

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Figure 1. Geologic map of part of the Tem Piute Range, Lincoln County, Nevada.

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ages, and is more than 7,000 feet thick. The Ordovician rocks (not mapped) are exposed on the west side of the range where the Eureka quartzite forms prominent outcrops. They are succeeded eastward by Silurian and Devonian rocks, nearly a mile thick, consisting of dolomite, limestone, and a small amount of quartzite. The Carboniferous rocks are exposed on the east side of the range, and consist of a sequence of shale, sandstone, limestone, shale, and limestone.

Two granite stocks invade the sedimentary rocks near the Devonian-Carboniferous contact. The south granite stock is about a mile in diameter, the north stock about 4,000 feet. Both stocks are partly concordant with the invaded sedimentary rocks.

Structurally, the main part of the Tem Piute Range appears to be a homocline that strikes north, with older beds on the west side, younger ones on the east. Most of the beds dip east at steep angles. At the north end of the range, however, beginning in the southern part of the area shown in figure 1, the beds steepen and overturn along the strike. It is believed that this reversal in dip was brought about by overthrusting from southwest to northeast prior to the granite intrusion.

which cuts through the thrust plate. Although enough area has not been mapped to determine the character of the thrust, its presence is attested by anomalous stratigraphic relations, and by the overturn.

For a distance of 700 feet from the granite contacts, the limestone is bleached irregularly and recrystallized locally. The shaly beds are altered to hornfels, and the sandy ones to quartzite. On the west side of the south stock, part of the limestone is altered by contact metamorphism to thick bodies of tactite in bands parallel to bedding. Around the north stock, only a few narrow lenses of tactite have been found, principally on the northeast side, although the limestone is directly in contact with granite along other parts of the stock.

Tactite is present along the west half of the south stock for a distance of more than 6,000 feet (fig. 2). Directly at the contact is

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Figure 2. Map of the Tem Piute tungsten deposit, Nevada.

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a continuous band 15 to 110 feet thick, with occasional remnants of limestone along the west side. Adjoining this band is a fairly continuous belt of platy hornfels, ranging in width from 25 to 110 feet, and in part split into two beds separated by tactite. Before metamorphism, this hornfels was probably a limy shale. Large masses of tactite lie west of the hornfels, and extend as far as 450 feet from the granite contact. These more distant bands and lenses of tactite are less continuous than the one at the granite contact. No tactite is found farther than 450 feet from the granite, but farther away, in the outer contact aureole, is found a

bed of impure limestone irregularly altered to light-colored lime silicate minerals (mapped on fig. 2 as "silicated limestone"), and another continuous bed largely changed to hornfels.

A few hundred feet south of the south stock is an irregular granite mass about 400 feet wide by 600 feet long. This granite may be a tip of the south stock separated from it by faulting. It is bordered on the southwest side by tactite.

Along the south stock where the tactite is most plentiful, the contact between granite and sedimentary rocks is conformable both at the surface and in the deepest mine workings and drill holes (fig. 3). The

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Figure 3. Sections A-A', B-B', C-C', and D-D' through diamond drill holes 3A, 4A, 9, 10, and 11.

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tactite bands are also parallel to bedding. Tactite exposures range in altitude from 6,325 feet to 7,075 feet, and the tactite is penetrated at an altitude of 5,760 feet by the deepest exploration. In this vertical range of 1,300 feet, mineralization appears to be relatively uniform, and the dip of beds fairly constant. It seems likely that the tactite zone extends to much greater depth, but no data exist upon which to base speculation as to the ultimate depth.

Ore deposits

Scheelite is the only mineral found in commercial amounts in the contact deposits. Although small amounts of gold and silver were formerly

produced from veins and replacement deposits farther south in the range, neither of these metals is known to occur near the tungsten mineralization.

The bulk of the scheelite occurs in garnet-tactite, but some rich deposits have been found in small masses of calcite-fluorite-sphalerite rock formed in marble remnants adjoining tactite bodies. Although the tactite masses around the south stock are very extensive and contain in the aggregate a large amount of tungsten, they are of low grade and had not been extensively exploited up to 1948. Most of the production was from the richer calcite-fluorite-sphalerite rock found in the relatively small Moody ore shoot of the Lincoln mine. Small amounts of fluorite and sphalerite, and possibly bismuth, are potential by-products from this type of ore.

Most of the tactite around the south stock contains some scheelite, but only part of it contains enough scheelite to be considered potential ore. The average grade of material that could be mined in large bodies is estimated at 0.2 to 0.4 percent of WO_3, determined from samples taken by the U. S. Bureau of Mines. On the surface map (fig. 2), rock containing 0.5 percent of WO_3 or more was distinguished from lower grade material on the basis of estimates made in ultraviolet light.

The tactite bodies exposed around the north stock are narrow and discontinuous, and contain too little scheelite to be economically significant; the largest body, on the northeast side of the stock, is composed of a series of lenses with a total length of 400 feet and average width of 1 to 2 feet.

Mineralogy.--The minerals observed in the tactite, listed in approximate order of abundance, are garnet, quartz, actinolite, calcite, fluorite, pyrite, pyrrhotite, diopside, sphalerite, scheelite, chlorite, hematite, clinozoisite, epidote, molybdenite, and powellite.

The bismuth mineral, shown to be present in concentrates, was not identified. Limonite is abundant in the surface gossan. Gypsum and manganosiderite occur as linings of solution cavities in the Lincoln mine.

The scheelite, which occurs for the most part in small grains, is white to buff in color. In ultraviolet light, it fluoresces white to pale yellow, indicating that some of it contains a small amount of molybdenum. The molybdenum content of concentrates rarely exceeded the tolerance of 0.4 percent.

Molybdenite is a rare mineral in the deposits. It is found sparingly in a small quartz lens at co-ordinates 4,800 N., 4,670 E. (fig. 2), where it is partially replaced by powellite. In the tungsten ores and associated bodies of sulfides, molybdenite is rare.

Sphalerite is found in very small amounts in the tactite. It is an abundant mineral in the calcite-fluorite-sphalerite-scheelite ore mined in the Moody ore shoot of the Lincoln mine. This ore averages about 3 to 4 percent of zinc.

The manganosiderite is dark green, scoriaceous-appearing material with a honeycomb framework. Jewell J. Glass of the Geological Survey examined the material microscopically and determined it to be a rhombohedral carbonate with an omega index of 1.830, that for the normal iron

carbonate, siderite, with some manganese. The material completely dissolved in hot hydrochloric acid with effervescence, and gave strong qualitative tests for iron and manganese, but none for tungsten.

Localization of ore.--Scheelite occurs in greater concentration on the limestone side of the tactite bands. The ore shoots present in the band of tactite that adjoins the granite (the "Moody" band) all have limestone remnants between them and the platy hornfels. It seems probable that the bulk of the calc-silicate minerals were introduced at an early stage, and that they were impermeable to subsequent introduction of tungsten-bearing solutions. The un-replaced limestone was a favorable host rock for these later solutions. In most instances, only part of the limestone was replaced.

In the Lincoln mine, fractures and joints that cut across the bedding in the limestone are now mineralized in part; they served as channelways for mineralizing solutions which penetrated out along them from the massive tactite. This relationship is particularly well shown in the Moody ore body; it is also evident in the Grubstake zone.

Scheelite mineralization in the tactite west of the platy hornfels is very erratic. In the Grubstake zone of the Lincoln mine, several stopes of high-grade ore were mined. Development beneath them showed that the ore bodies were not continuous downward. No information was gained whereby to predict the occurrence of ore.

Insofar as is known, the Moody ore shoot is unique in the district. There has been no recognition of surface evidence suggesting the occurrence of similar ore bodies.

Mines

The Lincoln mine and the Schofield mine are about 1.5 miles apart, on the northern and southern extremities respectively of the contact zone. The Lincoln mine has been the major producer in the district, whereas the Schofield mine, prospected sporadically for a number of years, had only produced about 32 units of WO_3 by the end of 1943.

Lincoln mine.--By 1944, the Lincoln mine was opened by an inclined shaft 220 feet deep, by an adit that intersects the shaft about 40 feet below the collar, and by several winzes (figs. 4, 5, 6, 7, 8, and 9).

Figure 4. Composite map of workings, Lincoln mine.

Figure 5. Level No. 1, Lincoln mine.

Figure 6. Level No. 2, Lincoln mine.

Figure 7. Level No. 3, Lincoln mine.

Figure 8. Level No. 4, Lincoln mine.

Figure 9. Vertical projection of Moody ore zone, Lincoln mine.

Workings in 1944 included four main levels, several sublevels, six stopes, connecting raises, winzes, and shafts. There were 5,200 feet of drifts and crosscuts, 1,700 feet of raises, winzes, and shafts. The fourth level, at a depth of 255 feet beneath the adit, was opened from a winze.

Two tactite zones were explored in the mine: the Moody zone, adjacent to the granite contact, and the Grubstake zone, from 60 to 200 feet northwest of the granite. The greater part of the ore mined came from the Moody ore shoot. The Grubstake zone was explored only on the first and

second levels, and the only important ore body found was at the north end of the mine above the adit.

In the Lincoln mine, the Moody tactite bed is about 45 feet thick. It consists of bands of different kinds of tactite associated with some residual limestone on the hanging wall. Along the granite contact is a sulfide-rich tactite 20 to 25 feet thick, which is succeeded outward by garnet tactite with little sulfide. The Moody ore shoot, which consists of calcite-chlorite-fluorite rock, with sphalerite and scheelite, lies between the tactite and the platy hornfels of the hanging wall. Irregular remnants of marble are in places present between the Moody ore and the hornfels.

The sulfide-rich tactite is a dense, hard rock consisting predominantly of pyrite and pyrrhotite with lesser amounts of dark silicate minerals. It appears to fill the entire width of the Moody zone at the south end of the third level, but elsewhere takes up only half the bed or less. At the surface, the rock is oxidized to a limonite gossan which extends only 20 or 30 feet deep. Oxidation is much deeper in the adjoining tactite bands because of their higher porosity.

The rest of the tactite is low in sulfides and consists dominantly of garnet with lesser quartz and calcite. Some of this rock may contain as much as 1 percent of WO_3, but most of it is of lower grade.

Solution cavities as much as 5 feet across are present along part of the contact between ore and marble. They were formed by surface waters that seeped down along the porous contact, and extend to the lowest

workings, although the present water level, before pumping, is above the third level.

The Moody ore body consists of calcite-chlorite-sphalerite-fluorite-scheelite rock in an ore shoot with an average strike length of 200 feet and an average thickness of 10 feet. The thickness ranges from 5 to 15 feet. The shoot rakes 62° NE. (fig. 9). In 1944, it had been mined 300 feet along the rake, from the surface to the fourth level, and had been shown by drilling to continue another 380 feet deeper along the rake. The deepest hole penetrated 4.6 feet of ore containing 0.92 percent of WO_3 at an altitude of 5,755 feet, 615 feet vertical distance beneath the outcrop. The average content of WO_3 is probably about 1.0 percent. The lower limit of the ore shoot is not known.

Schofield mine.--The property of the North Tem Piute Mining and Development Co., known locally as the Schofield mine, consists of 40 unpatented claims, of which only four, the Phylis, Rae Ella, Rae Ella No. 2, and Rae Ella No. 3, are known to contain mineral deposits of potential value. These claims are at the south tip of the south stock. A single band of tactite, ranging in thickness from 20 to 110 feet, is present along the granite contact on the west side of the granite, and a narrower band on the east side. Scheelite is widespread in the tactite, but concentrations are found only in the west band along the limestone side of the tactite. From surface sampling and core drilling, it is believed that four shoots of scheelite ore are present in a distance of 850 feet; these shoots range in strike length from 95 to 280 feet, in width from 4 to 13 feet, and in grade from 0.4 to 0.65 percent of WO_3. Local en-

richments contain as much as 1.5 percent of WO_3, but they are too erratic in distribution to be mined separately. The tactite between ore shoots probably averages about 0.2 percent of WO_3, and much of the tactite from the ore shoots east to the granite contact ranges from 0.1 to 0.2 percent.

The four claims are partly prospected by nine short adits with a total length of 600 feet (fig. 10). At the surface, the tactite was

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Figure 10. Geologic map of workings, North Tem Piute Mining and Development Co.

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trenched and sampled, in 1942, at intervals of 50 to 100 feet. Three diamond drill holes, with an aggregate length of 944 feet, were drilled by the Bureau of Mines in 1944 to test the ore zone at depths up to 200 feet beneath the outcrop. The drill holes cored material similar in grade to that at the surface.

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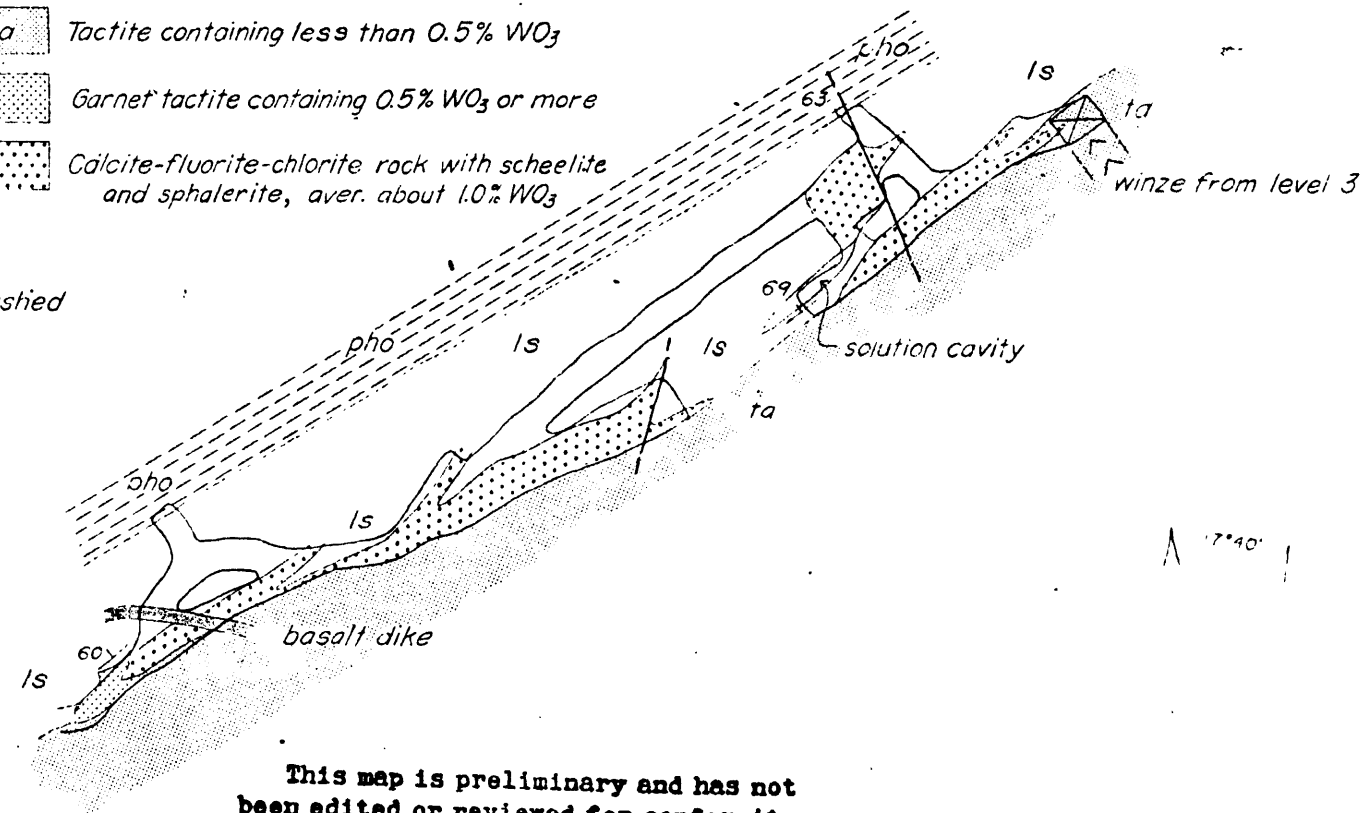
GEOLOGICAL SURVEY

STRATEGIC MINERALS INVESTIGATIONS
PRELIMINARY MAP FIGURE 8

EXPLANATION

- b — Basalt dike
- pho — Platy hornfels
- ls — Limestone
- 60 — Strike and dip of beds
- 63 — Contact, showing dip, dashed where inferred
- Fault
- ta — Tactite containing less than 0.5% WO_3
- Garnet tactite containing 0.5% WO_3 or more
- Calcite-fluorite-chlorite rock with scheelite and sphalerite, aver. about 1.0% WO_3



This map is preliminary and has not been edited or reviewed for conformity with U. S. Geological Survey standards and nomenclature.

20 0 40 80 feet

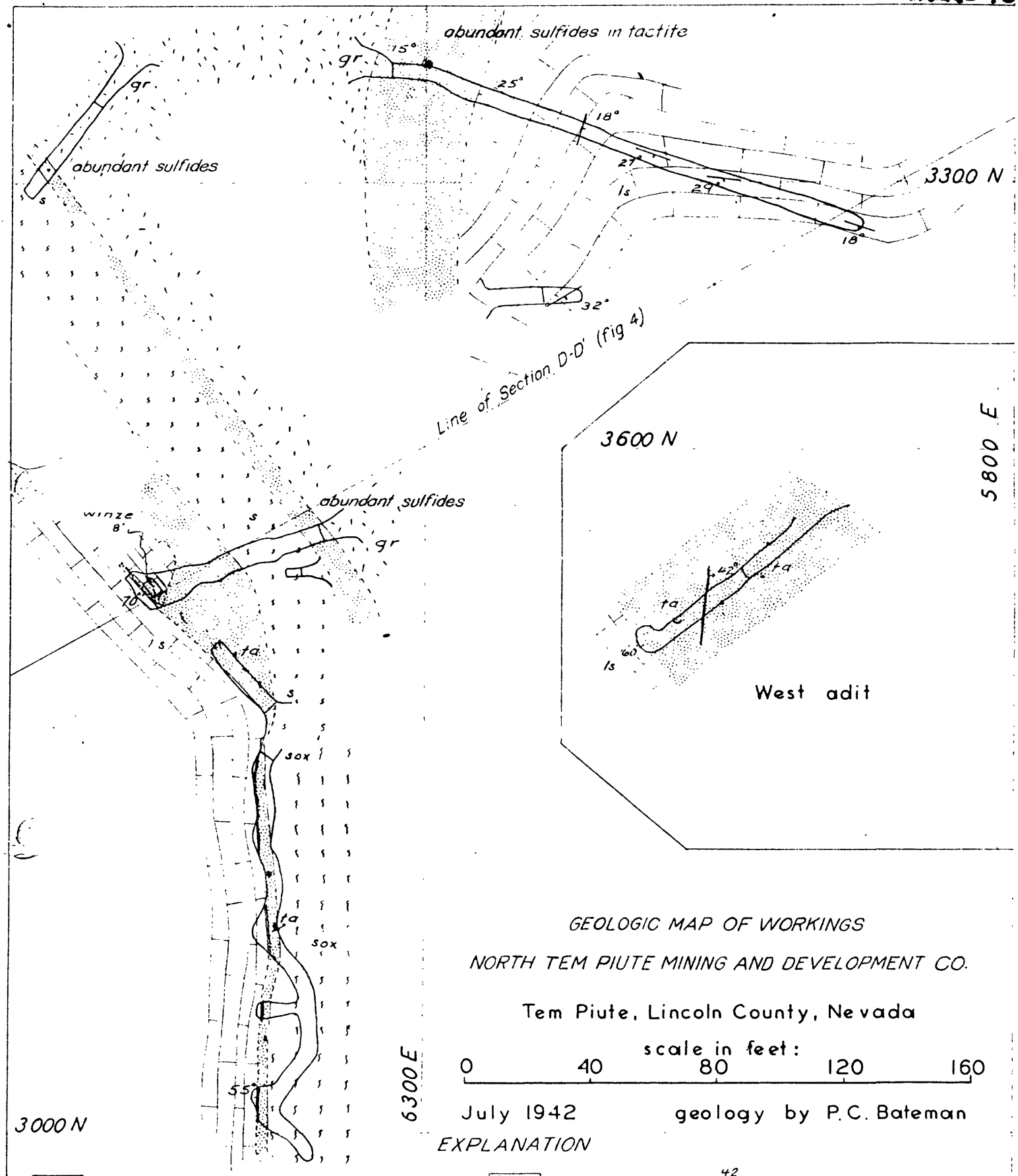
MAP OF LEVEL NO. 4, LINCOLN MINE, NEVADA

Compass-tape survey

Mapped by D.M. Lemmon 1944

TUNGSTEN DEPOSITS IN THE TEM PIUTE DISTRICT, LINCOLN COUNTY, NEVADA

FIGURE 10



TUNGSTEN DEPOSITS IN THE TEM PIUTE DISTRICT, LINCOLN COUNTY, NEVADA 50

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STRATEGIC MINERALS INVESTIGATIONS
PRELIMINARY MAP FIGURE 1

51-89

EXPLANATION

- al — Younger alluvium — QUATERNARY
- gal — Older alluvium — QUATERNARY
- t — Tactite — JURASSIC (?)
- gr — Granite — JURASSIC (?)
- ls — Limestone — UPPER PALEOZOIC
- sh — Shale, hornfels, and quartzite — UPPER PALEOZOIC
- lms — Limestone with beds of hornfels (hs) — UPPER PALEOZOIC

67 Strike and dip of beds

Strike of verticol beds

75 Strike and dip of overturned beds

80 Fault, showing dip, dashed where not accurately located

Contact, dashed where not accurately located

LINCOLN MINE

R. 56 E. R. 57 E.

T. 3 S. T. 4 S.

N 17°40'

Topography by multiplex from Aero Service photographs GSV I-48 and I-49; control by S.P. Hall, Lincoln Mines, Inc.

Geology by M.P. Erickson and D.G. Wyant, 1943, with additions by D.M. Lemman, 1944

1000 0 1000 2000 3000 Feet

Contour interval 25 feet

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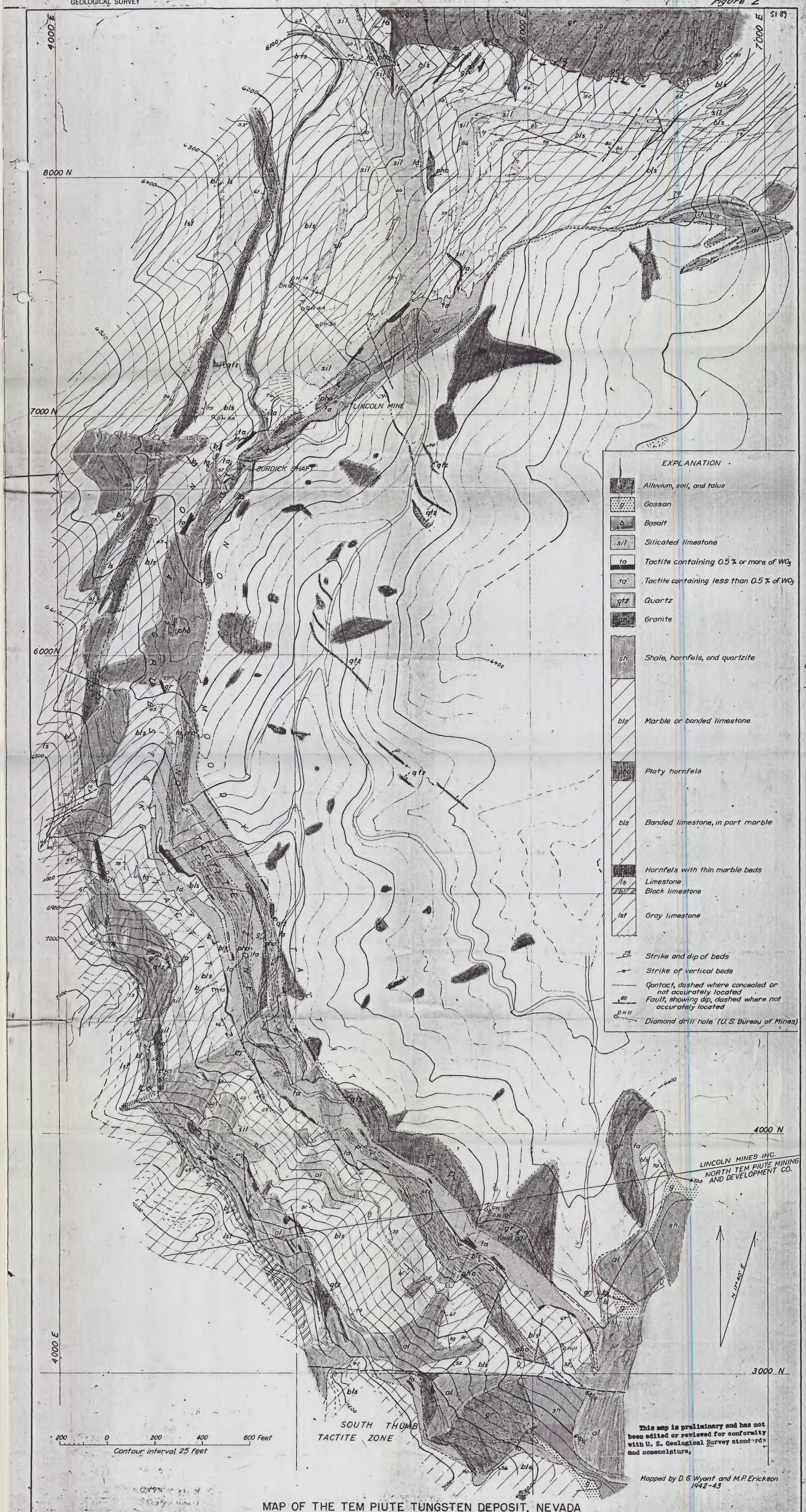
GEOLOGIC MAP OF PART OF THE TEM PIUTE RANGE, LINCOLN COUNTY, NEVADA

TUNGSTEN DEPOSITS IN THE TEM PIUTE DISTRICT, LINCOLN COUNTY, NEVADA

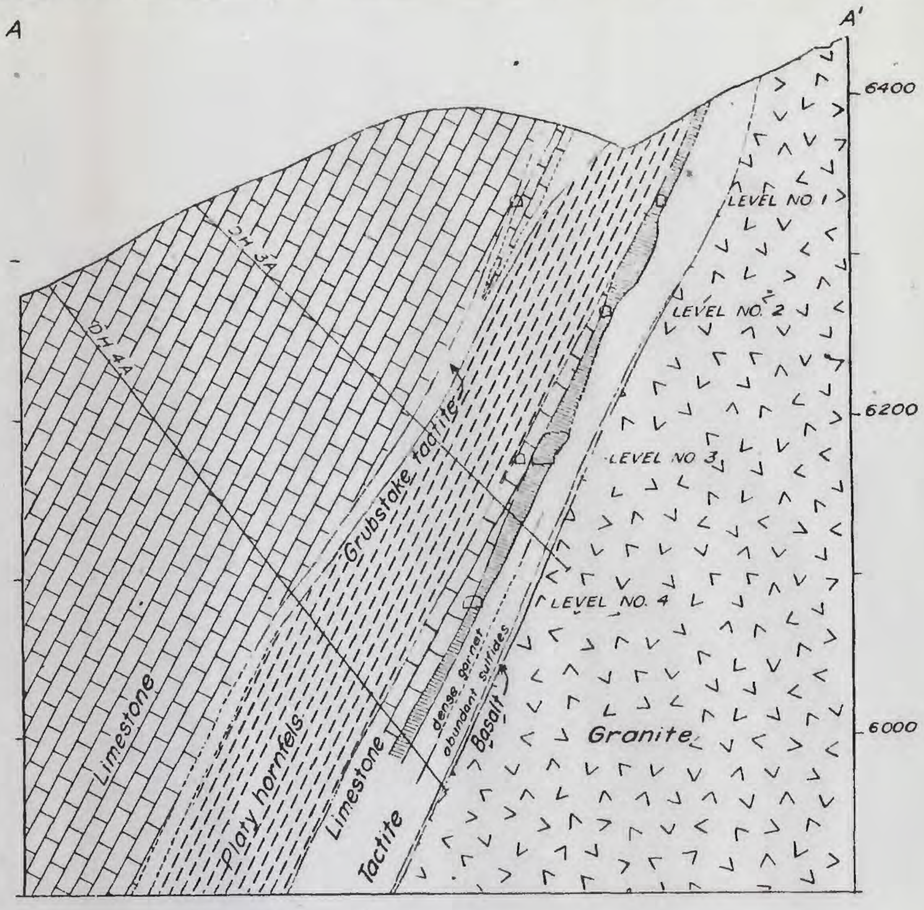
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

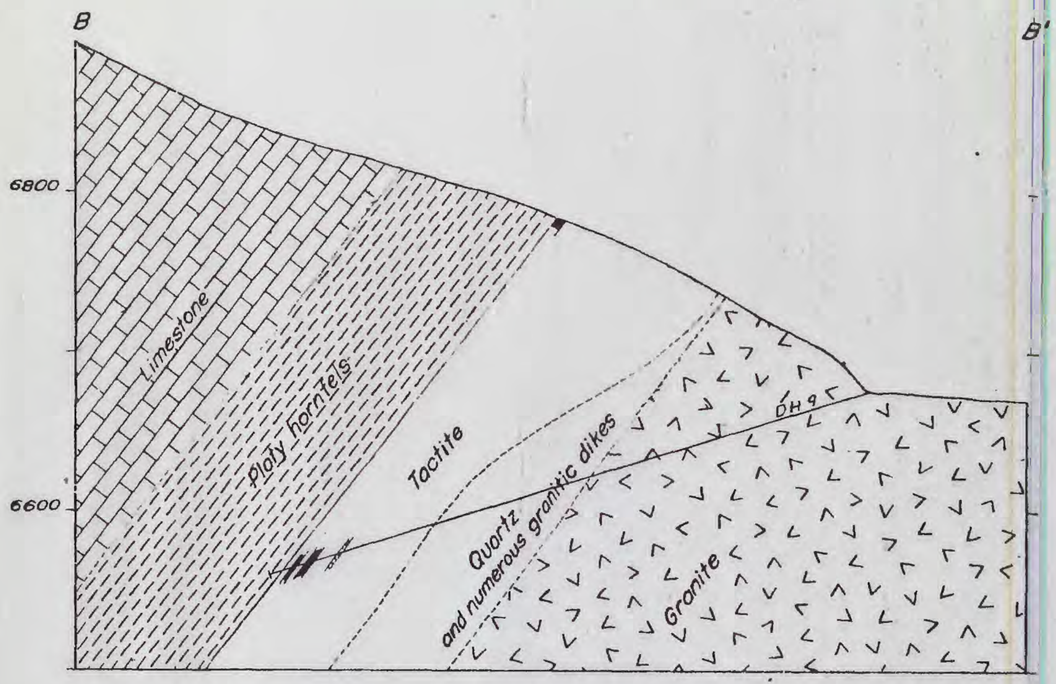
Figure 2

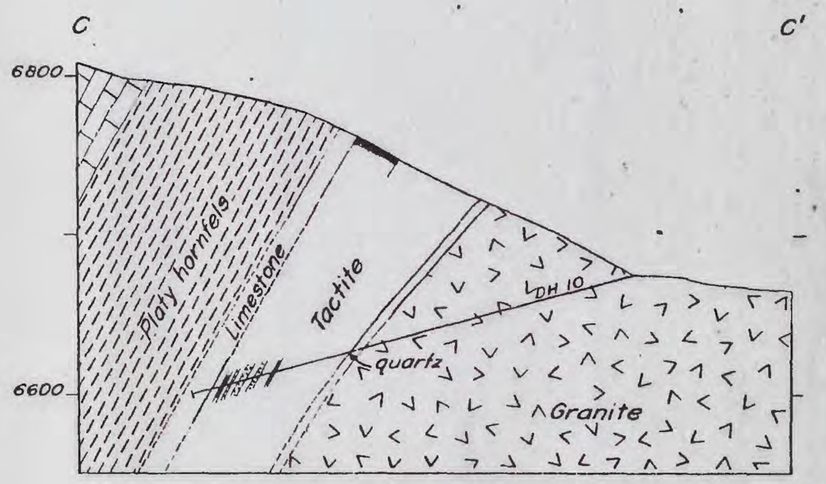


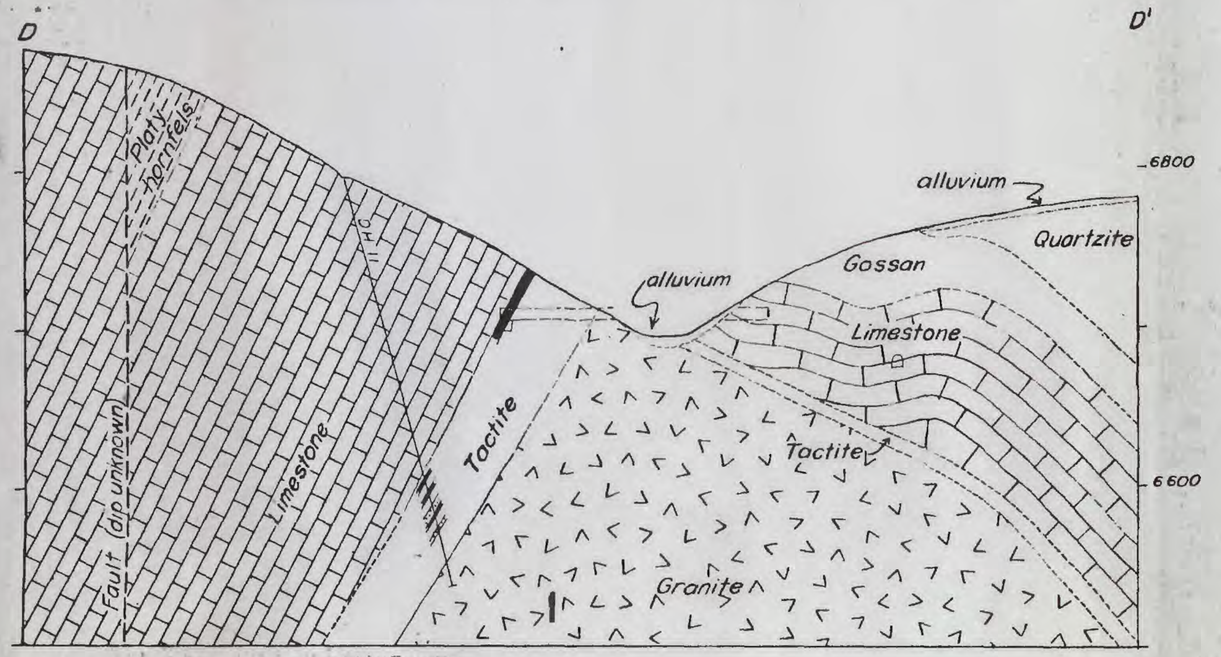
MAP OF THE TEM PIUTE TUNGSTEN DEPOSIT, NEVADA

TUNGSTEN DEPOSITS IN THE TEM PIUTE DISTRICT, LINCOLN COUNTY, NEVADA









Tactite containing more than 0.5 % of WO_3

Tactite containing 0.3 to 0.5 % of WO_3

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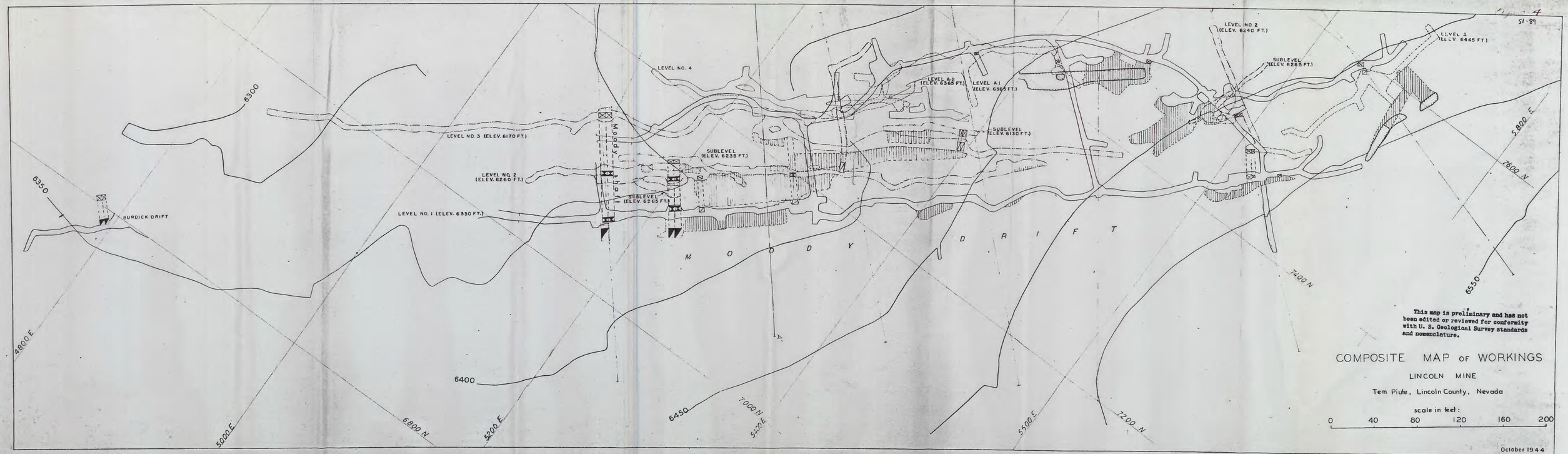
SECTIONS A-A', B-B', C-C', AND D-D' THROUGH DIAMOND DRILL HOLES 3A, 4A, 9, 10, AND 11

100 0 100 200 300 feet

See fig. 3 for lines of sections

Geology by D. M. Lemmon 1944



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COMPOSITE MAP OF WORKINGS

LINCOLN MINE

Tem Piute, Lincoln County, Nevada

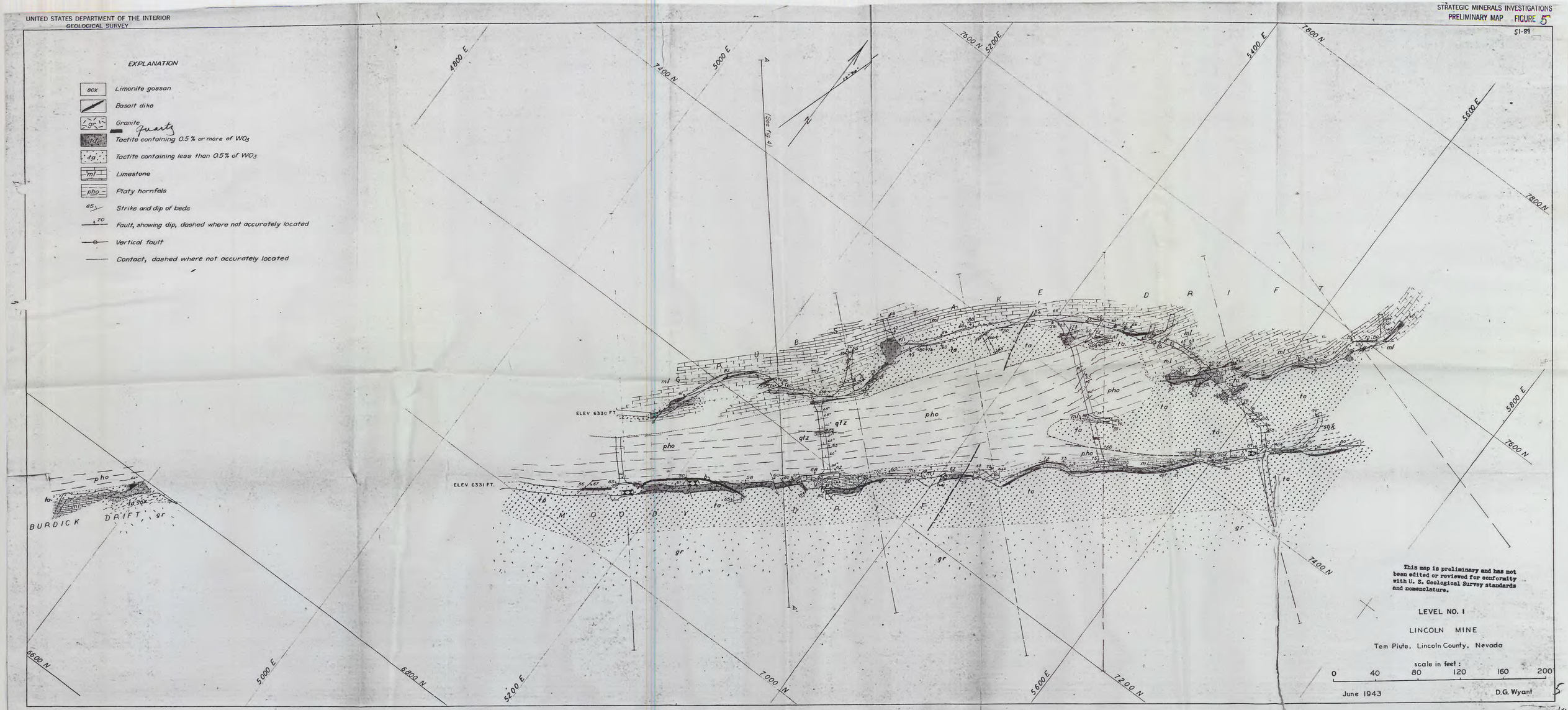
scale in feet:

0 40 80 120 160 200

October 1944

EXPLANATION

- box — Limonite gossan
- Basalt dike
- gr — Granite
- Tactite containing 0.5% or more of WO_3
- ta — Tactite containing less than 0.5% of WO_3
- ml — Limestone
- pho — Platy hornfels
- 65 — Strike and dip of beds
- 70 — Fault, showing dip, dashed where not accurately located
- Vertical fault
- Contact, dashed where not accurately located



This map is preliminary and has not been edited or reviewed for conformity with U. S. Geological Survey standards and nomenclature.

LEVEL NO. 1

LINCOLN MINE

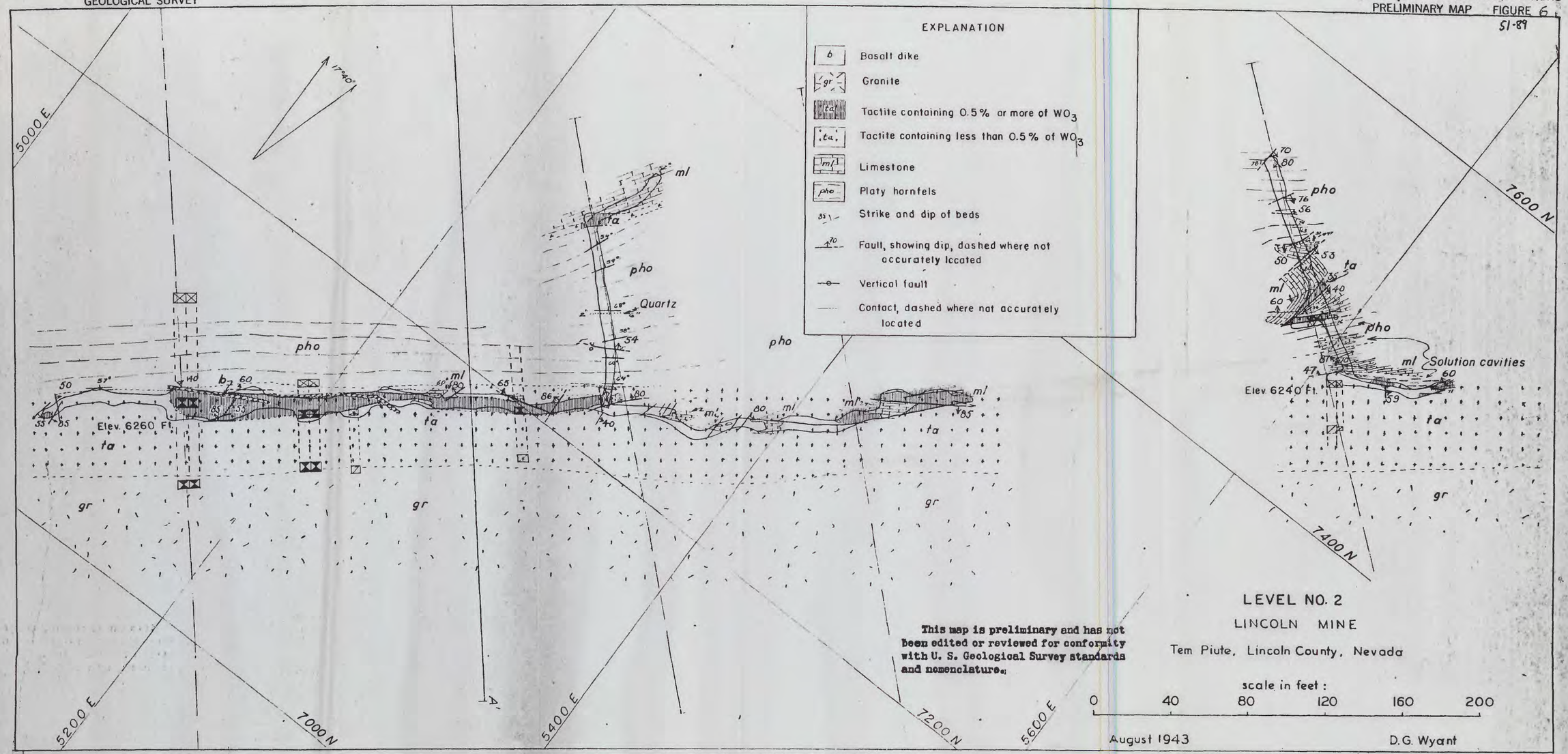
Tem Piute, Lincoln County, Nevada

scale in feet: 0 40 80 120 160 200

June 1943 D.G. Wyant

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STRATEGIC MINERALS INVESTIGATIONS
PRELIMINARY MAP FIGURE 6
51-89



This map is preliminary and has not been edited or reviewed for conformity with U. S. Geological Survey standards and nomenclature.

LEVEL NO. 2

LINCOLN MINE

Tem Piute, Lincoln County, Nevada

scale in feet :

0 40 80 120 160 200

August 1943

D.G. Wyant

TUNGSTEN DEPOSITS IN THE TEM PIUTE DISTRICT, LINCOLN COUNTY, NEVADA

118-2

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UNITED STATES DEPARTMENT OF THE INTERIOR
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STRATEGIC MINERALS INVESTIGATIONS
PRELIMINARY MAP FIGURE 7
51-89

4800 E
7200 N
5000 E
B.M. DD 3A
7400 N
5200 E
5400 E
7000 N
7200 N

N
17°40'

ml
ta
pho
gr
drag fold
Elev. 6170 Ft.
Moody shaft

EXPLANATION

- b — Basalt dike
- gr — Granite
- tc — Tactite containing 0.5% or more of WO_3
- ta — Tactite containing less than 0.5% of WO_3
- ml — Limestone
- pho — Platy hornfels
- 65 — Strike and dip of beds
- 70 — Fault, showing dip, dashed where not accurately located
- Vertical fault
- Contact, dashed where not accurately located

This map is preliminary and has not been edited or reviewed for conformity with U. S. Geological Survey standards and nomenclature.

LEVEL NO. 3
LINCOLN MINE
Tem Piute, Lincoln County, Nevada

scale in feet:
0 40 80 120 160 200

June 1943

D.G. Wyant

TUNGSTEN DEPOSITS IN THE TEM PIUTE DISTRICT, LINCOLN COUNTY, NEVADA

116 - 3 47

SI-89

6400

6200

6000

LEVEL NO. 1

LEVEL NO. 2

LEVEL NO. 3

LEVEL NO. 4

Fault

Moody dike

BURDICK WORKINGS

MOODY ORE SHOOT

DH 3A
2 Ft. 1.16% WO_3

DH 4A
5.5 ft. 1.05% WO_3

DH 12
11.0 Ft. 0.65% WO_3

DH 14
4.6 Ft. 0.92% WO_3

Reference line (Section A-A')

EXPLANATION

2 to 5 feet
5 to 15 feet
more than 15 feet
} Thickness of ore (more than 0.5 % WO_3)

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VERTICAL PROJECTION OF MOODY ORE ZONE
LINCOLN MINE

40 0 40 80 120 feet

N 50° E

Workings as of November 1944. Drawn by D. M. Lemmon after D. G. Wyant