Illustrations

Tungsten Deposits in the Minerva District, White Pine County, Nevada

by
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Abstract

The Minerva district covers a few square miles in the Snake Range, eastern Nevada, near the Utah border. Scheelite occurs in ore shoots in quartz veins that cut through limestone of Middle Cambrian age. The only igneous rocks in the area are dikes and sills of rhyolite, younger than the tungsten deposits. Of the 7 veins known, 5 have been productive, and 2 of these are responsible for most of the district yield. From the discovery of tungsten in 1915 up to 1944, the district yielded 82,000 units of WO_3, sold for approximately $1,726,565. Except for about $63,000 worth produced in 1916-1918, the major production has been since 1936. The average grade of ore has been nearly 1.0% of WO_3, with a range from 0.5% to 2.0% or more. The quartz veins range up to 30 feet in width, but the maximum width of ore has been only 10 feet, and the average nearer to 5 feet.

The veins, which strike easterly and dip north, are offset by many post-mineral normal faults with displacements as great as 400 feet. These faults disrupt ore shoots that were formerly continuous for pitch lengths of 900 feet or more.

On properties of Tungsten Metals Corporation, reserves with 0.5% or more of WO_3 were estimated in collaboration with the Bureau of Mines on December 1, 1943 at 1,200 tons of measurable ore containing 900 units of WO_3, 15,320 tons of indicated ore containing 11,705 units, and 53,900 tons of inferred ore containing 42,195 units. Reserves with a grade less than 0.5% of WO_3 amount to 9,000 tons of indicated ore containing 3,600 units. Reserves at other properties in the district were estimated at 400 tons of indicated ore containing 400 units, and 1,600 tons of inferred ore containing 1,600 units. In these estimates, no account is taken of entirely untested portions of veins that may be found, by future exploration, to contain additional tonnages perhaps equal to the total cited.

Introduction

Location

The Minerva district is near the Utah border in White Pine County, Nevada, 45 miles southeast of Ely, which is on the Standard gauge Nevada Northern Railroad (fig. 1). Minerva, the mill and townsite of Tungsten

Fig. 1. Index map of Nevada showing location of the Minerva district.

Metals Corporation at an elevation of 5,800 feet, is one mile south of Shoshone Post Office in Spring Valley, and is reached by a level dirt road extending 15 miles from surfaced highway U. S. 93. The mines, in the lower portion of the Snake Range at elevations of 6,300 to 7,500 feet, are 2 to 5 miles from the mill.

History and Production

Although silver ore was discovered in 1869 at the Indian Silver mine, now included in the east portion of the Scheelite Chief vein, operations here and at Bromide Flat, east of the Hilltop vein, were not extensive, silver production was meagre, and the district was abandoned by 1876.[1/] Scheelite

1/ Lincoln, F. C., Mining districts and mineral resources of Nevada, Nevada Newsletter Publishing Co., Reno, 1923. P. 254.

was found in the veins in 1915 by C. E. Millick, A. C. Millick, and Jasper M. Fox, and mined on a small scale in 1916. The Nevada Scheelite Co. held the property in 1917, the Minerva Tungsten Co. in 1918. A 150-ton mill, located below the Chief mine, was completed in 1918 shortly before collapse of the tungsten market. Production for this period is unknown to the writer, but is believed to be less than $100,000 worth of concentrate valued at the high prices then prevailing; Nevada bullion tax records show production only in 1916, amounting to $7,651.[2/] Except for a small-scale leasing operation in 1932,

2/ Couch, B. F., and J. A. Carpenter, Nevada's metal and mineral production, University of Nevada Bull., Geology and Mining Series No. 38, 1943, p. 148.

the property was idle until 1936 when Tungsten Metals Corporation was organized.

This company built the present 75-ton mill in 1938, and has developed the Scheelite Chief, Silver Bell, Oriole, West Everit, and East Everit mines (fig. 2). Production from these mines in the period 1937-1943 inclusive

Fig. 2. Index map of the Minerva district showing principal veins and faults.

was 101,467 tons yielding 77,889 units of WO_3 sold for approximately $1,615,275 (see table 1). Elsewhere in the district, the Hilltop, Tony,

Table 1. Production of tungsten ore and concentrates from mines of the Minerva district, Nevada, 1916-1943.

Canary Yellow, and Zigzag mines have yielded about 2,200 units, making a total district production of 82,000 units.

Field work by the Geological Survey

The writer, assisted by Donald Wyant, mapped most of the area during 3 months in the Fall of 1940, and has periodically revised maps as development progressed in the mines. In 1942, Paul C. Bateman of the Survey assisted in underground mapping; in 1943, Konrad B. Krauskopf, aided by Robert F. Stepper, of the Survey, made a surface map of the Hilltop mine area.

Work by the Bureau of Mines

In the winter and spring of 1941, the United States Bureau of Mines core-drilled 34 holes totalling 6932 feet on properties of Tungsten Metals Corporation, and located the ore mined since then. Again, in the fall of 1943, the Bureau drilled 8 holes totalling 2,898 feet and located the continuation of the ore body in the Silver Bell mine, now under development. In each instance, plans for the drilling were laid out jointly by the writer and the project engineer, E. W. Newman in 1941, R. W. Geehan in 1943, as part of a co-operative program of the Geological Survey and Bureau of Mines.

Acknowledgments

Tungsten Metals Corporation, through itsstaff consisting of Paul J. Sirkegian, W. L. Trent, A. J. O'Connell, and W. H. Dunham, has furnished

Table 1. Production of tungsten ore and concentrate from mines of the Minerva district, Nevada, 1916-1943.

	Tungsten Metals Corporation 1/			Hilltop mine 2/		
Year	Tons of ore	Units of WO_3	Value	Tons of ore	Units of WO_3	Value
1916	191 3/	191 3/	$ 7,651 3/			
1918	1,846 4/	1,846 4/	55,377 4/			
1937	6,400 5/	6,036 5/	158,916 5/			
1938	14,955	12,858	206,039			
1939	19,617	9,396	146,216			
1940	14,750	10,617 6/	196,090			
1941	10,160	13,599 7/	226,128 7/	1,126	1,677	$36,800
1942	19,867	16,876	428,008	450	429	11,462
1943	15,718	8,507	253,878	-	-	-
	103,504	79,926	$1,678,303	1,576	2,106	$48,262

1/ Data from Tungsten Metals Corporation except where noted. Includes production from Nevada Scheelite Co. (1916) and Minerva Tungsten Co. (1918)

2/ Data from Shoshone Mining Co.

3/ Value from Nevada tax records, University of Nevada Bulletin, Geology and Mining Series No. 38, p. 148, 1943. Units estimated from value, assuming $40 a unit price. Tonnage based on recovery of 1.0% WO_3.

4/ Value from Nevada tax records, op. cit., p. 148. Units estimated from value, assuming $30 a unit price. Tonnage based on recovery of 1.0% WO_3.

5/ Units from records of Tungsten Metals Corporation, value and tonnage from Nevada tax records, op. cit. p. 148.

6/ Includes production from retreatment of tailings.

7/ Includes production from retreatment of tailings, also 4521 units of WO_3 contained in 2,082 tons of slime tailings sold for $18,243, net.

records, surveys, board and lodging, and helpful assistance. Hadley R. Bramel contributed assays and other information about the Canary Yellow and Zigzag claims, has entered into many stimulating discussions, and has been a source of information about other mines in the region.

Geology

Regional Setting

The Snake Range extends nearly 60 miles in a north-south direction and rises to over 13,000 feet in elevation. It is composed of (1) a great thickness of Paleozoic sedimentary rocks ranging from Cambrian through Carboniferous, (2) a central intrusive mass of late Mesozoic granitic rock exposed in Snake Creek and south of Osceola, and (3) a volcanic capping at the south end of the range in the Murphy Wash area. All the ore deposits known to the writer occur in the Cambrian sedimentary rocks or in the granitic intrusive, and none have yet been identified in the higher Paleozoic section, perhaps largely because of the distance of the upper rocks from the intrusive to which the mineralization is probably related. Gold and tungsten, with minor amounts of lead and silver, have been produced profitably in the range. The Minerva district with its tungsten production has first place in gross yield; the Osceola district with its gold and minor tungsten production has second place; and the Hub district, a former tungsten producer, third place.

The tungsten occurrences in the range are in veins or stockworks with quartz or calcite or both as gangue. No deposits of the contact-metamorphic type have been found. In general, either scheelite or huebnerite or both occur in those deposits with quartzite or granitic wall rocks, but only scheelite occurs in the stratigraphically higher deposits with limestone wall rock. Narrow pegmatitic veins with quartz, feldspar, beryl, and scheelite have been found in the granite west of the old Bonita tungsten mine on Snake Creek. Minerva is the only tungsten district that made appreciable production between

1918 and 1944. Perhaps 6 other districts in the range were worked profitably in 1916-1918 at higher prices.

The sedimentary rocks on the west side of the Snake Range, from Osceola south past Minerva to the mouth of Murphy wash, consist from oldest to youngest of Lower Cambrian Prospect Mountain quartzite, Lower and Middle Cambrian Pioche shale, Middle Cambrian limestone, perhaps 2,000 feet thick, Middle or Upper Cambrian shale probably 300 to 1000 feet thick, cherty Ordovician Pogonip limestone, Ordovician Eureka quartzite, and overlying limestone, perhaps also Ordovician. The rocks are exposed in successively younger layers from Osceola southward: the Pioche shale appears at the mouth of Pole Creek 6 miles north of Minerva; the Middle Cambrian limestone forms the front of the range at Minerva; the Pogonip and Eureka quartzite are exposed south and east of Minerva. The veins at Minerva lie in the upper part of the Middle Cambrian limestone; so only this part of the stratigraphic section has been studied in detail. No attempt has been made to measure thicknesses outside of the map area; indeed, true thicknesses can be determined only by detailed mapping, for faulting is abundant and intricate.

Sedimentary rocks

At Minerva, the section mapped consists of about 1,000 feet of limestone overlain by at least 300 feet of thin, platy limestone and shale. The true thickness of the shale, not exposed because of faulting, may be as much as a thousand feet. The normal sequence above the shale is absent, for the shale is faulted against the middle part of the Pogonip cherty limestone of Ordovician age, probably many hundreds of feet above the base of the Pogonip. Below the Minerva section, massive, light and dark colored limestone beds with a total thickness estimated at 1,000 to 1,500 feet extend downward to the Pioche shale and Prospect Mountain quartzite. This part of the section is well-exposed on Mt. Washington, 5 miles north of Minerva; the saddle

between Mt. Washington and Mt. Lincoln represents the shale at the top of the Minerva Cambrian section.

For mapping purposes, the limestone has been divided by lithology into 3 units on the map of Tungsten Metals properties (fig. 3). The lowest of these units has been further subdivided into 4 units on the map of the Hilltop mine (fig. 4). Although it is possible to choose major units that

Fig. 3. Geologic map of a portion of the Minerva district.
Fig. 4. Surface map of the Hilltop mine, Minerva district.

maintain rather constant thicknesses over distances of miles, the small units mapped at Minerva are somewhat more variable. In the sequence of limestones that make up the Middle Cambrian, the units are light or dark, massive or thin-bedded, dense or granular, and these lithologic variations take place not only across the dip but along the strike of the beds as is well shown by tracing individual beds on the beautifully exposed west face of Mt. Washington north of Minerva. For an example from the Minerva district, the dense, massive unit mapped as "Upper White limestone" has a thickness of 80 feet at the Chief and Silver Bell mines, 180 feet in the east part of the Everit vein, 280 feet on the West Everit hill, and 180 feet at the Hilltop mine.

The following columnar section, starting with the youngest rocks, summarizes the units used in mapping the Minerva district:

Cherty limestone	Thickness not determined, but certainly several thousands of feet. Part of the Ordovician Pogonip. In fault contact with underlying shale.
Shale	Thickness at least 300 feet, perhaps 1,000. Thin, platy limestone beds with shale partings in the lower portion, argillaceous shale above.
Upper black limestone	Thickness 300 feet. Thin-bedded to flaggy, dark gray limestone, gradational contact upward. Abundant stylolites present in drill cores of Silver Bell area.

Upper white limestone	Thickness 75 feet at Chief mine, 180 feet at East Everit, 280 feet at West Everit, 180 feet at Hilltop. Massive, very fine-grained, light gray limestone with pinkish cast. Contains a few thin, lenticular beds of dark gray limestone. Cliff forming. Marked at top by a distinctive bed of thinly-banded, cross-bedded limestone 2 to 4 feet thick, a bed that is present throughout the district and elsewhere in the range at this position and serves as a stratigraphic marker.
Lower black limestone	Thickness at least 300 feet. Dark gray limestone with some lighter beds; variable, mottled, numerous algal beds. Bedding indistinct to good. At the Chief mine, 180 feet below the top of this unit, is a 30-foot bed of "Lower white limestone", lithologically similar to the "Upper white limestone". In the map area surrounding the Hilltop mine, these beds have been further subdivided into the following distinctive units: "Middle gray limestone", 50 feet thick; "Thin-bedded limestone", 40 feet thick; "Lower gray limestone", 100 feet thick; "Lower white limestone", over 50 feet thick, base not exposed.

Igneous rocks

Rhyolite is the only igneous rock exposed in the Minerva district. It occurs northwest of the Silver Bell mine in sills 2 to 20 feet thick near the base of the shale; elsewhere it forms dikes up to 25 feet thick that follow east-dipping faults. The dikes, which occasionally shift from one fault to another, are most abundant in a zone across the center of the district extending from the Silver Bell mine to the Hilltop mine. They were intruded after formation of the scheelite veins, for they cut through the veins at the portal of the 6,900-foot level in the East Everit mine and at the Tony prospect, and elsewhere occupy post-mineral faults that offset the veins. The silicification and iron-staining along some of the faults is probably connected with the rhyolite, which is probably allied to the flow rocks east of Murphy Wash at the south end of the Snake Range.

Structure

The rocks and veins of the Minerva area are disrupted by numerous faults that follow at least 5 different systems. Nearly all of these faults, even the low-angle ones, are normal faults; that is, the hanging wall has dropped with respect to the footwall. The few that show reverse movement have relatively small displacements.

Most of the faults can be placed in one of the following groups, listed from oldest to youngest:

1. Faults now occupied by quartz veins that strike N. 70°W. to N. 70° E. and dip 40° to 70° N. Although the hanging wall appears to have moved downward 30 to 75 feet, the true displacement cannot be determined, and the apparent displacement cannot always be differentiated from post-mineral movement along the veins (group 4).

2. Faults that strike northerly, dip from 75° E. to 75° W., and have displacements up to 20 feet.

3. Faults that strike N. 15° W. to N. 30° E., dip 13° to 60° E., and have displacements up to hundreds of feet.

4. Faults that strike easterly, dip 45° to 60° N., and frequently follow vein segments. Displacements are up to 50feet.

5. Faults that strike northerly and dip 45° to 70° W. Displacements are up to 200 feet. Faults of this group are abundant at the front of the range west of the Everit vein, and also on the Zigzag claim.

The quartz veins occupy the oldest fault structures, and have been offset by most of the others. A few steep faults that cut across the vein structures are also pre-mineral, but they have had only small displacements, probably not more than a few feet, and have only locally affected ore deposition. That most of the faults are post-mineral is demonstrated by the lack of quartz and scheelite in them, and by the continuity of ore shoots prior to faulting.

True displacements on all the faults except the oldest can usually be determined from the offsets of veins and stratigraphic units. Knowledge of the true displacement of veins, rather than the horizontal offset, is essential in finding continuations of oreshoots. The displacements on some of the larger faults, such as the Everit fault, change along the strike and dip because of the cumulative effect of subsidiary faults in the footwall.

Most of the faults are well-exposed at the surface. The low-angle ones have topographic expression, for they repeat the massive, cliff-forming "Upper white" limestone; the faults lie at the tops of cliffs, and from a distance resemble bedding, which is much less apparent. All the faults contain calcite veins or cemented breccia, the carbonate material varying from an inch to 6 feet or more in width. Some contain reddish-stained material, usually calcareous but sometimes siliceous; the siliceous material, which is very fine-grained, and bears no resemblance to the quartz veins, is thought to be associated with the rhyolite.

The faults that dip east at angles of 50° or less can be contoured with fair accuracy from their surface exposures. The contours are curved, not straight, and in some instances appear to be "folded", with "fold axes" trending easterly. The Everit fault is a good example: it dips 13° east where it offsets the Everit vein, and steepens to 45° within 500 feet north and south of the vein; the dip of the fault at the vein intersection persists for at least 500 feet downward into the East Everit mine. The curves in the faults probably represent the original fracture pattern, rather than subsequent folding, for the limestone beds are not similarly folded.

In the map areas, the bedding in the limestone strikes north to northwesterly and dips 12° to 45° southwesterly. Folding within the different fault blocks is not pronounced, the attitudes within individual blocks being

essentially similar. The exception to this generalization is outside the detailed map areas on the Zigzag and Calico claims, between the West Everit and Hilltop mines. On parts of these claims, and for ½ mile in a northerly direction, the beds have been folded and complexly faulted so that most of the beds dip easterly.

The contact between "Upper black" limestone and overlying shale, in several exposures between the Chief and Everit veins, is marked by a red, silicified breccia 5 to 50 feet thick with limestone fragments up to ½ foot in size. One of the best exposures, north of the east limit of the Oriole vein, contains abundant fragments of vein quartz. Although this breccia is not yet adequately explained, it may represent an old bedding fault of unknown magnitude, perhaps one of the oldest faults in the district. The exposures of this contact are very poor except in these silicified areas.

The structure of the Snake Range is as yet too little known to permit fitting the detailed structural information from the Minerva district into a regional pattern.

Ore deposits

Extent and thickness of veins

Scheelite oreshoots occur in 7 roughly parallel quartz veins occupying normal faults that strike east, dip 45° to 70° north, and are spaced at intervals of approximately ½ mile. The Chief Extension, Scheelite Chief, Oriole, Everit, Lone Buck, and Canary Yellow veins are mapped on figure 3. The Hilltop and Tony veins, which lie farther north, are shown on figure 4. The Tony vein is anomalous in that it strikes north and dips east. Only the Scheelite Chief and Everit veins have been extensively worked; the west portion of the Chief and the east portion of the Everit have yielded the bulk of the district production.

The quartz veins vary in width from a few inches to 30 feet or more, and extend laterally 1,000 to 4,000 feet. The quartz changes in thickness in a short distance along strike or dip, and is sometimes distributed in a series of closely spaced, parallel fractures with horses of limestone. The vein outcrops are limited to the west by alluvium, and to the east by alluvium and by shale through which the veins do not penetrate. No major veins have been found on the surface at stratigraphic horizons above the shale; it may be possible to follow the veins underground eastward beneath the shale capping.

The Chief vein has been traced for 550 feet westward from the portal of the main adit, but none of the other veins have been explored beneath the alluvium. Frontal faults defining the range probably lie only a short distance west of the foothills; so the possibility of discovering large segments of veins buried beneath the alluvium seems remote.

Mineralogy and grade of ore

The veins consist mainly of quartz and calcite with some scheelite and, in spots, traces of tetrahedrite, galena, silver haloids, powellite, and cuprodescloisite. The scheelite concentrates are reported to contain as much as 4 ounces of silver to the ton, but this represents a high concentration ratio. The scarcity of associated minerals is indicated by the purity of the concentrates, as shown by analyses in table 2.

Table 2. Analyses of tungsten concentrates from the Minerva district.

The quartz in the veins is white or tinged with greenish yellow, is coarsely crystalline, and is usually massive, although a few small vugs can occasionally be found. The carbonate in the veins and faults ranges in color from white through flesh-color to light reddish-brown, suggesting several carbonate minerals, although calcite is dominant. The scheelite commonly occurs in coarse cleavages distributed through the quartz or aligned along

Table 2. Analyses of tungsten concentrates from the Minerva district.

	1.	2.	3.
WO_3	65.08	71.25	68.15
Cu	0.028	0.03	trace
P	0.018	0.032	0.151
S	0.005	0.137	0.11
Sn	0.968	trace	0.06
As	0.0003	trace	0.02
Mn	0.0002	0.21	0.20
Mo		0.06	trace
FeO	[illegible]	2.25	1.90
CaO		19.72	19.85
$Si\phi_2$	[illegible]	5.75	7.90
		99.439	98.341

1. Analysis by Smith-Emery Co., Los Angeles, for Goodman Tidball Mercantile Co., Ely, Nevada 1933.

2. and 3. Analyses for Tungsten Metals Corporation, 1937.

fractures in the quartz. In some parts of the veins, notably in the Oriole mine and Tony prospect, the scheelite is distributed in very fine grains.

The grade of ore mined in substantial quantities has ranged from 2.5% or more of WO_3 down to submarginal rock containing 0.3%. Local concentrations have contained as much as 10 or 20% of WO_3. All the ore milled by Tungsten Metals Corporation to the end of 1943 yielded an average of 0.76 units per ton, suggesting that the ore contained between 0.9 and 1.0% of WO_3.

Ore shoots

The tungsten ore all occurs in shoots of limited vertical extent but with remarkable lateral continuity, which has been disrupted by post-mineral faulting. Outside of shoots, which occupy only a small part of the veins, the quartz is nearly barren, as shown in surface outcrops, in underground workings, and in numerous drill holes. The ore shoots rake westerly, roughly parallel to the bedding in adjacent limestone, and frequently lie on the footwall side of the vein; the widest ore stoped has been about 10 feet, although the vein in which the ore occurred may have been 20 to 30 feet wide. In the smaller veins, ore shoots have been stoped as narrow as 1 to 3 feet.

Each of the main veins worked appears to have a single main ore shoot, although the Everit vein contains remnants of an upper oreshoot, and both it and the Chief vein may yet prove to contain lower ore shoots in ground that has never been prospected. In the East Everit mine, the main shoot has been mined for 80 to 130 feet along the dip of the vein, and for a pitch length of 650 feet; extensions to the east have not yet been found, but an extension to the west is known to continue another 240 to 400 feet, possibly more. In the Chief mine, the ore shoot has been mined for 80 to 140 feet along the dip and for a pitch length of 900 feet. Mine development may ultimately prove that the ore shoots before faulting were essentially continuous through most of the length of these veins. Little is known about the ore shoots in other

veins of the district, for they have not been extensively explored.

The main orebodies in the Chief, Everit, Canary Yellow, Zigzag, and Hilltop mines occur at about the same stratigraphic horizon in the "Upper white" limestone. The upper stope in the West Everit mine, and the surface stope in the East Everit mine east of the Everit fault, both lie higher stratigraphically in the upper black limestone. The ore shoot in the Silver Bell mine also lies at a higher horizon, but appears to be raking downward to join the shoot in the Chief mine.

The walls of the veins are frozen to the limestone in most instances, and post-mineral surfaces of breakage lie within the veins. The wall rocks are unaltered regardless of the presence or absence of ore in the adjoining vein.

The reason for ore shoots in these veins is not known. The occurrence of shoots and the brecciation in them show that the veins were formed by successive introductions of minerals, and that the ore bodies were probably deposited in more porous portions of the veins. The massiveness of the "UpperT white" limestone appears responsible for condtions favorable to scheelite mineralization. Perhaps slight changes in dip of veins, caused by crossing limestone beds of different competence, permitted development of crushed zones within the quartz, zones formed by continued shearing along the vein; these crushed zones became the loci for oreshoots. If this explanation be true, then other ore shoots may be discovered at greater depths in the vein wherever similar situations prevail. The conditions under which the veins were formed are too little known to anticipate the effect of additional depth on ore deposition.

Mines

The veins in the Minerva district known to contain tungsten are held by Tungsten Metals Corporation, Calico Tungsten Co., or Shoshone Mining Co. Of the many claims in the district, only 7 are patented, all part of the Tungsten Metals group. Companies formerly active on some of these properties include Nevada Scheelite Co. (1916-1917) (not to be confused with a different company now operating under this name at Rawhide, Nevada), Minerva Tungsten Co. (1918), New Deal Leasing Co. (1940-41), Scheelite Leasing Co. (1941), and Virdot Development Co. (1941-42. These companies have all disbanded.

Tungsten Metals Corporation

Tungsten Metals Corporation owns a 75-ton mill at Minerva and the southern 5 of the 7 known veins in the district. The district production since 1938 has been treated in this mill, which has accepted custom ore from the other properties. In addition to the 7 patented claims (surveys 4485-A, 4486, and 4487) shown on the map (fig. 3), the group includes about 40 unpatented claims.

Scheelite Chief mine

The Scheelite Chief mine (see figures 5 to 8) is in 2 major segments

Fig. 5. Map and vertical projection of the Scheelite Chief vein.
Fig. 6. Scheelite Chief mine, composite map.
Fig. 7. Scheelite Chief mine, vertical projection of west workings.
Fig. 8. Scheelite Chief mine, vertical projection of east workings.

of the Chief vein, separated by the Chief fault. Both segments are developed from the 6316-foot level, an adit 1,530 feet long. The west segment has 3 upper adits now largely stoped, a shaft near the portal of the main adit, and 2 short lower levels from the shaft. The east segment has a winze 30 feet deep below stope 1, with a sublevel from the bottom west to the Chief fault.

The west segment has been stoped from the portal of the adit to the

Chief fault. Two small blocks of ore probably still remain west of the fault that terminates the 6246 and 6276-foot levels. Of 7 holes drilled beneath the alluvium, only one, 550 feet west of the mine, found ore. The oreshoot in the intervening area may have been eroded away.

The east segment has been stoped above the main level for a length of 260 feet, and the level has been extended another 340 feet beneath the shoot. The quartz vein below the shoot is narrower, ranging from ½ to 4 feet, and contains sporadic traces of scheelite.

Silver Bell mine

The Silver Bell mine (see figures 9 to 12) in the east portion of the Chief vein is worked through a shaft 365 feet deep on the incline (238 feet

Fig. 9. Silver Bell mine, composite map.
Fig. 10. Silver Bell mine, vertical projection.
Fig. 11. Silver Bell mine, section A.
Fig. 12. Silver Bell mine, section B.

vertically). Except for 2 short upper levels, development is concentrated on the third level (265 feet on the incline) with 430 feet of workings that extend west from the shaft. A stope has been mined above this level for a length of 140 feet, a width of 3 to 5 feet, and a height of 60 feet along the dip. The ore shoot, offset by a fault on the third level, continues westward beneath the level; it was intersected by drill hole 53, 300 feet west of the shaft and 100 feet vertically below the third level. This same shoot continues eastward across the shaft above the third level, and warrants investigation by extending the third level east through the various fault segments.

Oriole mine

The Oriole vein is least developed of the major veins in the district. It is opened at the west end in the Oriole mine by 2 short adits at a vertical interval of 80 feet (see figures 13 and 14.). The ore stoped consisted of very

Fig. 13. Oriole mine, composite map.
Fig. 14. Oriole mine, vertical projection.

fine-grained scheelite in quartz, and averaged only 0.4% of WO_3. The width of ore ranged from 1½ to 5 feet. The stopes mined are in offset segments of a single ore shoot, which could probably be followed eastward readily by extending the upper adit.

The outcrop of the vein is mostly barren except for some coarsely crystalline scheelite on the crest of the hill above the mine, and for low-grade mineralization in the first segment east of Chief gulch. The only exploration east of the mine is by 3 shallow drill holes in 2 fault segments east of the gulch. Although the vein is not as strong at the surface as the Chief or Everit veins, still it shows impressive widths of quartz, and well may be productive in the future.

West Everit mine

Workings in the West Everit mine consist of 2 adits, a sublevel above the upper adit, 2 stopes, and several connecting raises (see figures 16 to 18). An adit 50 feet long on the west face of the hill dates from 1917.

Fig. 16. West Everit mine, composite map.
Fig. 17. West Everit mine, vertical projection.
Fig. 18. West Everit mine, section along 11,350 E.

Two small orebodies have been mined, both of excellent grade: one on the crest of the hill, the other in the lower adit. Both ore bodies are in the hanging wall of the West Everit fault, and are cut off by it. Possible continuations of the upper ore shoot have been eroded away. Continuations of the lower ore shoot, however, might be found below the West Everit fault. Several hundred feet of exploratory work from the 6,800-foot level have not located the vein, but seem to have disproved the existence of any segment of appreciable size in the footwall of fault "A", which parallels the vein. Although the structure is complicated, and its solution not yet proved correct, the segment of vein exposed on the west side of the hill at 11,200 E., 9,400 N. is probably the same Everit vein. Future exploration in this segment may find ore below the 6,800-foot level.

The West Everit vein zone ranges in width from 5 to 50 feet, the vein branching into several parts with included bands of limestone. The maximum width of continuous quartz is 25 feet. Wherever drifts lie in the main vein, the full width of quartz is not exposed; so scheelite orebodies may be missed by failure to crosscut.

The only ore remaining in the mine is between the upper stope and the West Everit fault in a fault sliver estimated to contain 1,200 tons. The fault segments west of the mine are too little known to permit any inference as to quantity of ore. Because of extreme faulting, the vein westward beneath the alluvium probably does not justify underground exploration.

East Everit mine

The main development in the East Everit mine is from an adit 1,735 feet long at an elevation of 7050 feet (see figures 15 and 19 to 21). A raise

Fig. 15. Map and vertical projection of the Everit vein.
Fig. 19. East Everit mine, composite map.
Fig. 20. East Everit mine, vertical projection.
Fig. 21. East Everit mine, section along 24,674.

connects with the surface from a point 1,085 feet inside the portal. A shorter adit, 150 feet lower, is used for ore transfer, and also for development of another fault segment.

Two ore shoots have been mined, probably correlatives of the 2 in the West Everit mine. The upper ore shoot is eroded away except for a small segment stoped at the surface above the Everit fault. The lower shoot cropped out only west of the Everit fault, but has been stoped most extensively east of the fault. Although drill hole 8 and the westernmost stope in the mine, that from the 6,900-foot level, yielded ore containing only about 0.5% of WO_3, the ground has not been sufficiently tested to prove the absence of better ore. An adjoining segment of vein that crops south of the portal of the 6900-foot level is untested.

The portion of vein intersected near the face of the 7050-foot level (at 14,100 E.) contains low-grade scheelite mineralization at that point, but

has not been explored upward to the surface, which is masked by debris. Beyond the face, 5 holes drilled from the surface in 1943 failed to find ore, but proved that the ore horizon lies considerable lower in this fault block. The thickness of quartz and the presence of scheelite mineralization in this part of the vein are encouraging for the eventual discovery of an oreshoot at greater depth.

The small vein that lies 150 feet north of the Everit vein contains several exposures of narrow but high-grade scheelite ore. One outcrop (at 13,150 E.) was mined in an open cut. Drill hole 2 (at 13,240 E.) intersected 5 inches of vein that assayed 7.53% of WO_3. Eight inches of high-grade ore have not been touched in an exposure at the east end of the vein (at 13,580 E.). The widths and tonnages available are unfavorable for company exploration, but the grade of ore might make portions of the vein attractive to a lessee.

Lone Buck vein

The Lone Buck vein, entirely unexplored, crops out for a length of 1,200 feet and varies in width from a few inches to 4 feet. Two channel samples cut by the Bureau of Mines in 1941 indicate a block of ore (between 14,200 E. and 14,260 E.) 60 feet long 1.8 feet wide, and averaging 1.74% of WO_3; indicated ore along the rake west to the nearest fault amounts to 220 tons. The vein shows little promise of productivity, for the only ore exposed is in this block, which is small and inaccessible; possible extensions beyond faults are eroded away.

Calico Tungsten Co.

The Calico Tungsten Co., a partnership between Hadley R. Bramel and Stanley Feitler, owns 3 unpatented claims on a single vein: the Canary Yellow, Calico, and Zigzag claims. Except for surface cuts, work has been concentrated at the Canary Yellow mine.

Canary Yellow mine

The Canary Yellow mine is developed by an 85-foot crosscut adit with a 110-foot drift on the vein, and a raise to the surface 85 feet above (see figure 22). The vein in the drift shows 1 to 1½ feet of ore containing more than 1% of WO_3 for a drift length of 60 feet. On the surface directly over the portal of the adit, Bramel and Feitler sampled the vein at 10-foot intervals for a length of 130 feet over widths of 1½ to 6 feet, and obtained assays ranging from 0.39 to 4.20%, averaging over 1.0%. From the raise, 37½ tons milled by Tungsten Metals Corporation yielded only 27 units of WO_3, an average of 0.72 unit per ton. Although the ore in the drift and raise is poorer than that at the surface, better ore may lie west of the workings if the surface body is part of a shoot that rakes westward. The ore in the drift may represent a lower shoot. With this interpretation, the upper shoot, with an average width of 2 feet, is estimated to contain 400 tons of indicated ore that will average over 1.0% of WO_3; the lower shoot, 1½ feet wide and averaging 1.0%, may contain at least 600 tons of inferred ore if it continues 260 feet along the rake to the faults limiting this segment of vein. No estimate can be made of the possibilities of the vein eastward, for the vein is unexplored and ore is not exposed at the surface, although the vein croppings continue 1,000 feet east of the mine.

Zigzag and Calico claims

The Zigzag and Calico claims lie on the west end of the same vein as the Canary Yellow mine, but are separated from it by ½ mile of alluvial cover. The vein on these claims, faulted even more than is normal to the district, is broken into fragments 20 to 200 feet long, some of which contain ore at the surface. The only workings are a few open cuts from which Bramel and Feitler mined 18 tons of ore that yielded 20 units of WO_3. The width of vein ranges from 1 to 4 feet. Inasmuch as ore at the surface has not been profitable to mine because of the small size of fault segments, it is doubtful if ore present in other segments but not exposed could be mined profitably unless the price of tungsten exceeds $30 a unit.

Shoshone Mining Co.

The Shoshone Mining Co., a partnership among A. J. O'Connell, W. L. Trent, J. E. Brinton, and Horace Bath, owns the Hilltop group of 6 unpatented claims known as the Hilltop, Tony, Tony No. 1, Tony No. 2, Tony No. 3, and Tony No. 4. The claims were operated in 1940-41 by the New Deal Leasing Co., in 1941 by the Scheelite Leasing Co., and in 1942 by the Virdot Development Co. The Tony prospect was operated by Tungsten Metals Corporation for a short time in 1940-41. Most of the production has come from the Hilltop mine, which has yielded at least 2,106 units of WO_3.

Hilltop mine

The Hilltop mine is developed by a main adit at an elevation of 7,066 feet, by a short adit at 7,120 feet, and by several open cuts (see figures 23 and 24). The 7066-foot level has about 650 feet of drifts and crosscuts,

Fig. 23. Map and vertical projection of the Hilltop vein.
Fig. 24. Hilltop vein, map of main level with section.

3 stopes, and 3 raises to the surface. This level is connected with an orebin at the end of the road, 600 feet lower, by a single span, jig-back aerial tram 1,150 feet long.

The Hilltop vein is narrow, with surface widths of ½ to 3 feet. In the stope east of the crosscut adit, the vein flattened and widened to 8 feet of good ore between the level and the surface 35 feet above. Neither the drift level with 1½ feet of quartz nor the surface with 1 foot of quartz gave any indication of the intervening wide orebody. The stopes west of the adit were narrow, the ore being a foot or less in width although of high grade.

Hardly any ore remains in sight, although a few tons could still be underhanded beneath the level and stopes. The raise at the east end of the workings has some ore in the roof; so there may be ore in the 50 feet of unexplored ground up to the surface. The largest block of potential ore is in the vein segment beyond the west face of the 7,060 level, beneath the upper adit. All told, perhaps 1,000 tons of 1 to 2% ore might be found in these untested blocks with very little additional exploration.

Tony prospect

The Tony prospect is explored by a 225-foot adit, a raise to the surface, and several surface pits. The vein strikes north and dips east, and is in this respect unique among the tungsten-bearing veins of the district. The vein outcrop extends for nearly 200 feet along the strike; continuations of the same vein-fault to the north and south contain no quartz or scheelite, although calcite filling common to post-mineral faults of the district is present. Scheelite mineralization for widths of 1 to 3 feet extends for about 100 feet on the surface, but no comparable mineralization is present in the adit. The scheelite is extremely fine-grained. Only 32.5 units of WO_3 were recovered from 159 tons of ore milled in 1941, a yield of about 0.2%. No commercial ore is now exposed, and only a few tons that contain 0.2 to 0.5% are visible.

Two narrow veins on Tony No. 2 claim west of the section corner contain a few crystals of coarse scheelite, but the exposures are not encouraging enough to warrant exploration.

Reserves

The mines of the Minerva district rarely have more than a few tons of measurable ore, and seldom have more than a few thousand tons of indicated ore. As in many other tungsten mines, indicated, not measurable, ore is mined. Consequently, an estimate of ore reserves must be primarily an interpretation of unexplored areas based on past experience. The writer believes that the total reached in the following tabulation is conservative, and less than the expectable future production of the district. Individual blocks inferred, however, may vary materially from the estimate given.

The structural complexity of the orebodies necessitates considerable dead work in exploration. Development in the mines has never been far enough ahead to permit continuous milling at capacity. In the 6 years from 1938 to 1943, tonnage produced annually ranged from 10,160 to 19,867, and never approached the mill capacity of 27,000 tons. The added mining and milling cost involved in operating at capacity would be slight, and the net profit from such operation would be much greater.

Under operating conditions in 1943, the grade of ore mined (yield of 0.54% of WO_3) was the minimum that could be handled profitably at a market price of $30 a unit. Ore that would mill out at 0.75% (the average yield from past production) presumably could have been worked at $21.00 a unit. The cost of production in both instances could be reduced substantially by operating the mines at capacity.

The district reserves are summarized by mines in table 3. The reserve figures are broken down into blocks for individual mines in table 4. The only

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Table 3. Summary by mines of ore reserves in the Minerva district.
Table 4. Reserves within mines of the Minerva district, distributed into ore blocks.

---

measurable ore is blocked out in the east workings of the Chief mine by a winze, sublevel, and raise. The indicated ore is in blocks that have been tested by

drill holes or partially explored by drifts and raises. The inferred ore, which constitutes the bulk of the reserve, is inferred largely on geologic evidence as to continuity of oreshoots. Estimates of grade are based mainly on the yield from ore mined in the past.

In addition to the estimates enumerated, it is expected that future prospecting will discover other orebodies in the Oriole vein, unexplored for 2,600 feet east of the Oriole mine, and in the Chief vein, which extends at least 400 feet east of the Silver Bell shaft. Although these areas have not yet been tested by drilling or underground workings, they probably contain orebodies similar to those mined elsewhere in the veins, where production has amounted to about 23 tons per foot of vein explored along the strike. This additional tonnage might be in the order of 70,000 tons averaging 0.8% of WO_3.

Table 3. Summary by mines of ore reserves in the Minerva district. December 1, 1943.

Ore Commercial Under Present Conditions

Grade 0.5% WO_3 or higher

	Measurable		Indicated		Inferred*		Inferred**	
	Tons	Units	Tons	Units	Tons	Units	Tons	Units
Scheelite Chief	1,200	900	6,200	4,590	17,000	12,000		
Silver Bell			4,540	4,540	18,300	15,975		
East Everit			4,400	2,200	2,400	1,920	15,000	11,100
West Everit					1,200	1,200		
Lone Buck			220	375				
Canary Yellow			400	400	600	600		
Hilltop					1,000	1,000		
	1,200	900	15,760	12,105	40,500	32,695	15,000	11,100

Ore Marginal Under Present Conditions

Grade less than 0.5% WO_3

	Indicated	
	Tons	Units
East Everit	5,200	2,080
Oriole	3,800	1,520
	9,000	3,600

* Inferred with reasonable assurance on basis of nearby workings.

** Inferred by geologic reasoning unsupported by workings in the immediate vicinity.

Table 3. Summary by mines of ore reserves in the Minerva district. December 1, 1943.

Ore Commercial Under Present Conditions

Grade 0.5% WO_3 or higher

	Measurable		Indicated		Inferred*		Inferred**	
	Tons	Units	Tons	Units	Tons	Units	Tons	Units
Scheelite Chief	1,200	900	6,200	4,590	17,000	12,000		
Silver Bell			4,540	4,540	18,300	15,975		
East Everit			4,400	2,200	2,400	1,920	15,000	11,100
West Everit					1,200	1,200		
Lone Buck			220	375				
Canary Yellow			400	400	600	600		
Hilltop					1,000	1,000		
	1,200	900	15,760	12,105	40,500	32,695	15,000	11,100

Ore Marginal Under Present Conditions

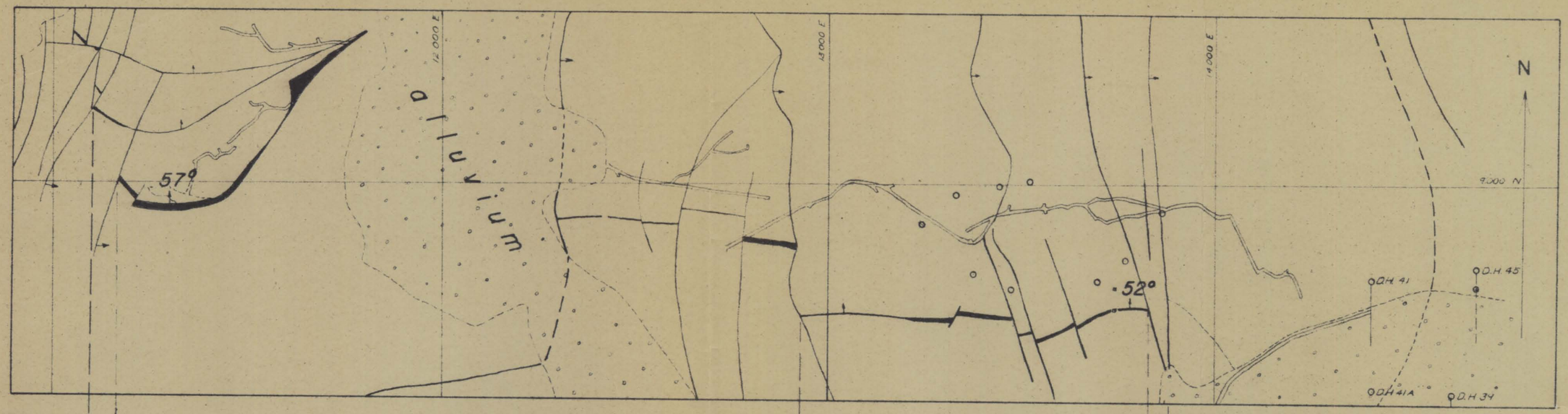
Grade less than 0.5% WO_3

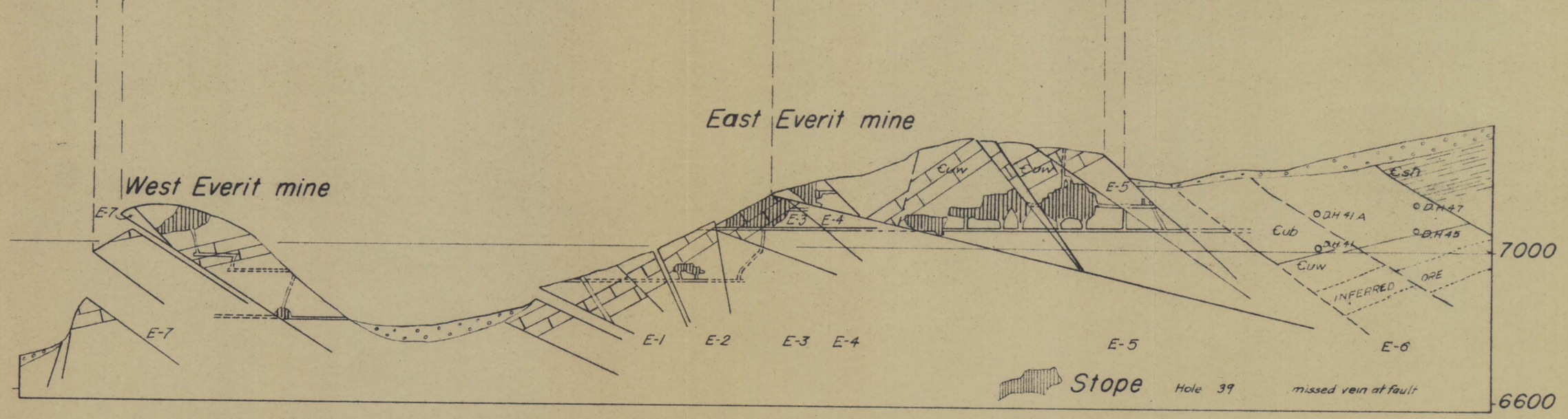
	Indicated	
	Tons	Units
East Everit	5,200	2,080
Oriole	3,800	1,520
	9,000	3,600

* Inferred with reasonable assurance on basis of nearby workings.

** Inferred by geologic reasoning unsupported by workings in the immediate vicinity.

Illustrations





MAP AND VERTICAL PROJECTION OF THE EVERIT VEIN

0 1000 2000 FEET

Numbers with E prefix identify ore blocks used in reserve estimates.

D.M. Lemmon, U.S. Geological Survey, 1940-43

14

VERTICAL PROJECTION OF THE ORIOLE MINE
MINERVA DISTRICT, NEVADA

0 — 50 — 100 — 150 FEET

← BEARING OF SECTION N. 75° W. —

GEOLOGY SHOWN ON HANGING WALL OF VEIN

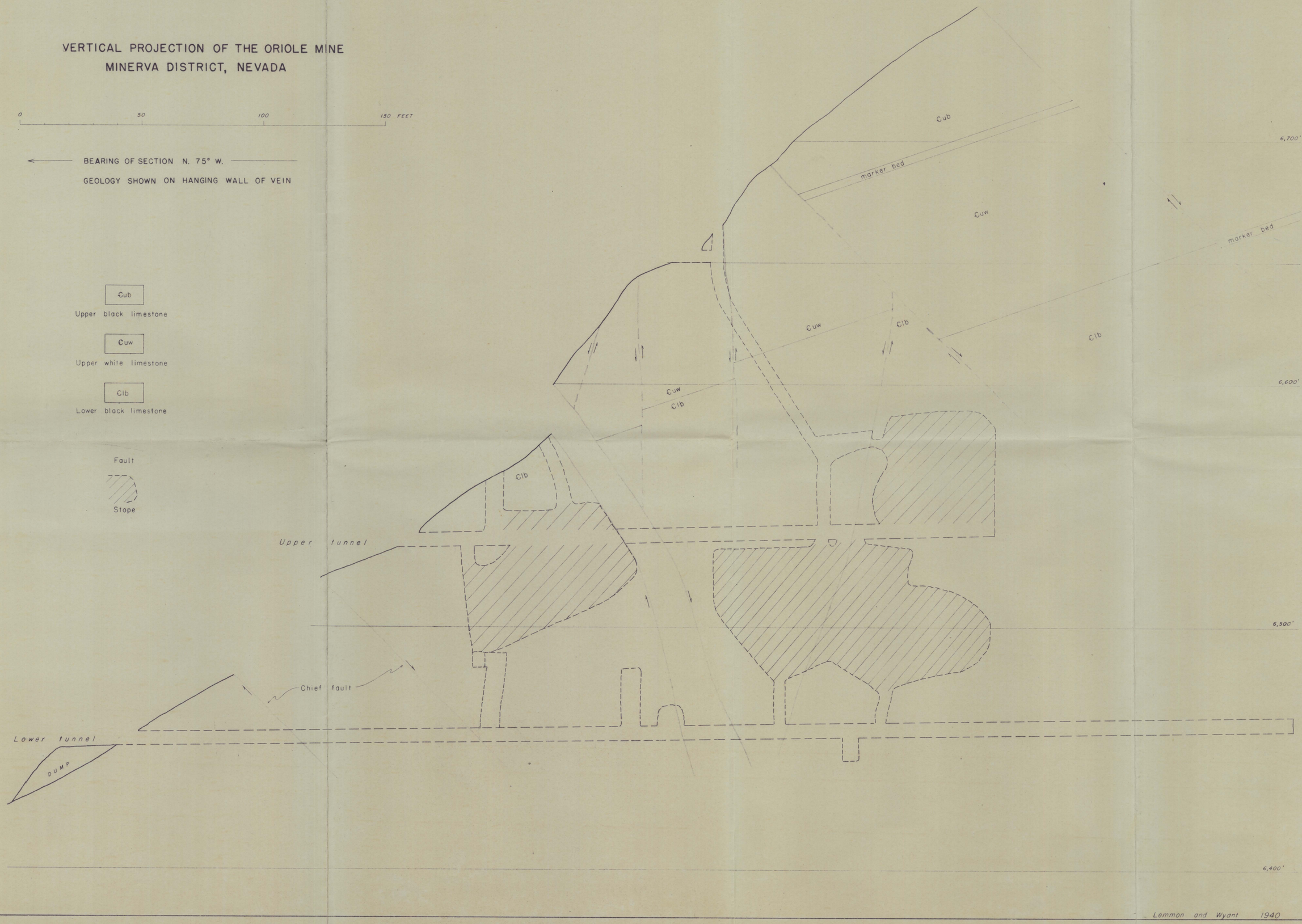
Cub — Upper black limestone

Cuw — Upper white limestone

Clb — Lower black limestone

Fault

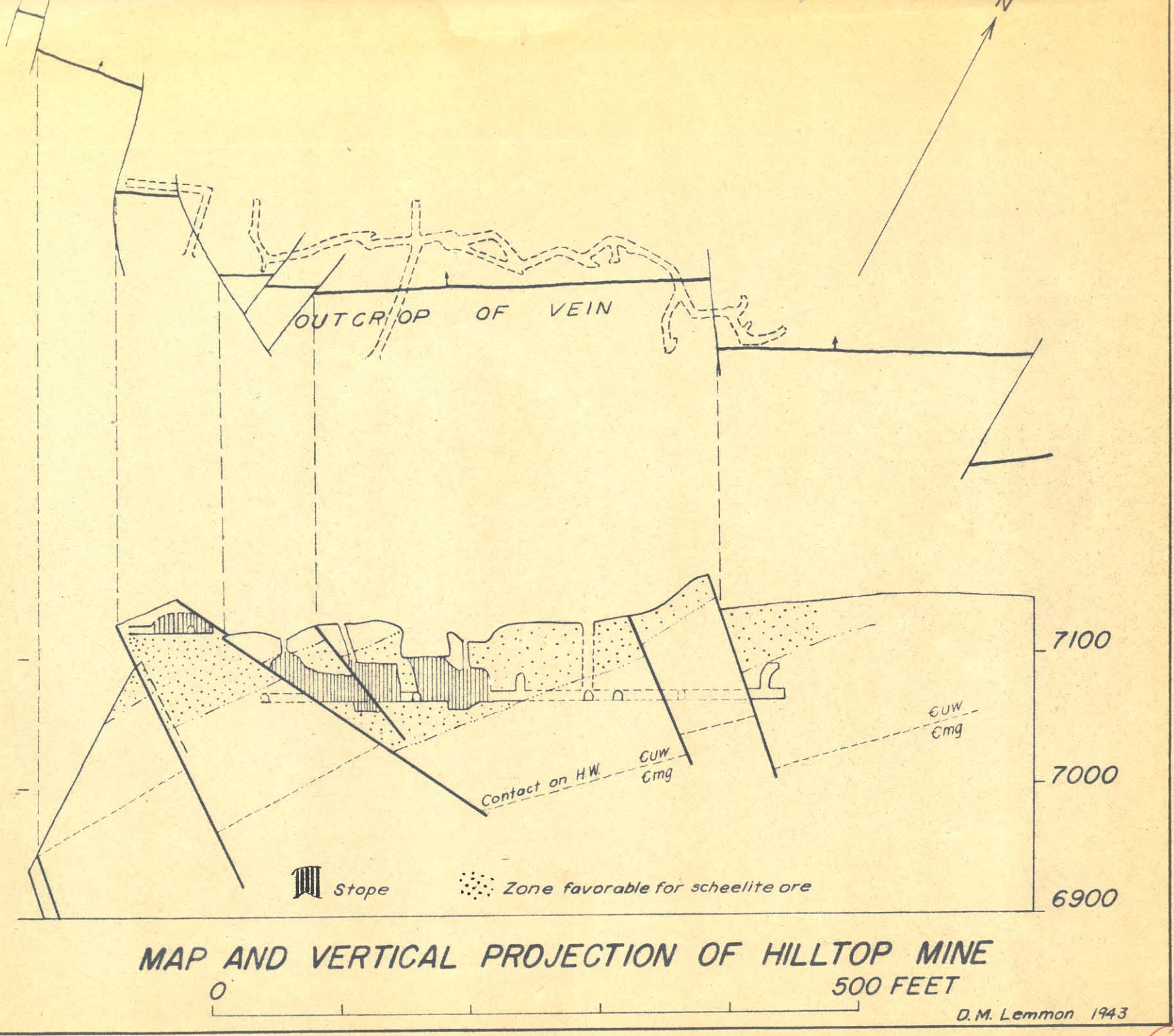
Stope



Lemmon and Wyant 1940

(332) A340 0018


7,300'
7,200'
7,100'
7,000'
6,900'
7050 LEVEL
6900 LEVEL
EAST EVERIT FAULT
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
EAST EVERIT MINE, MINERVA DISTRICT, NEVADA
VERTICAL E-W PROJECTION
0 40 80 120 FEET
D. M. LEMMON
1943



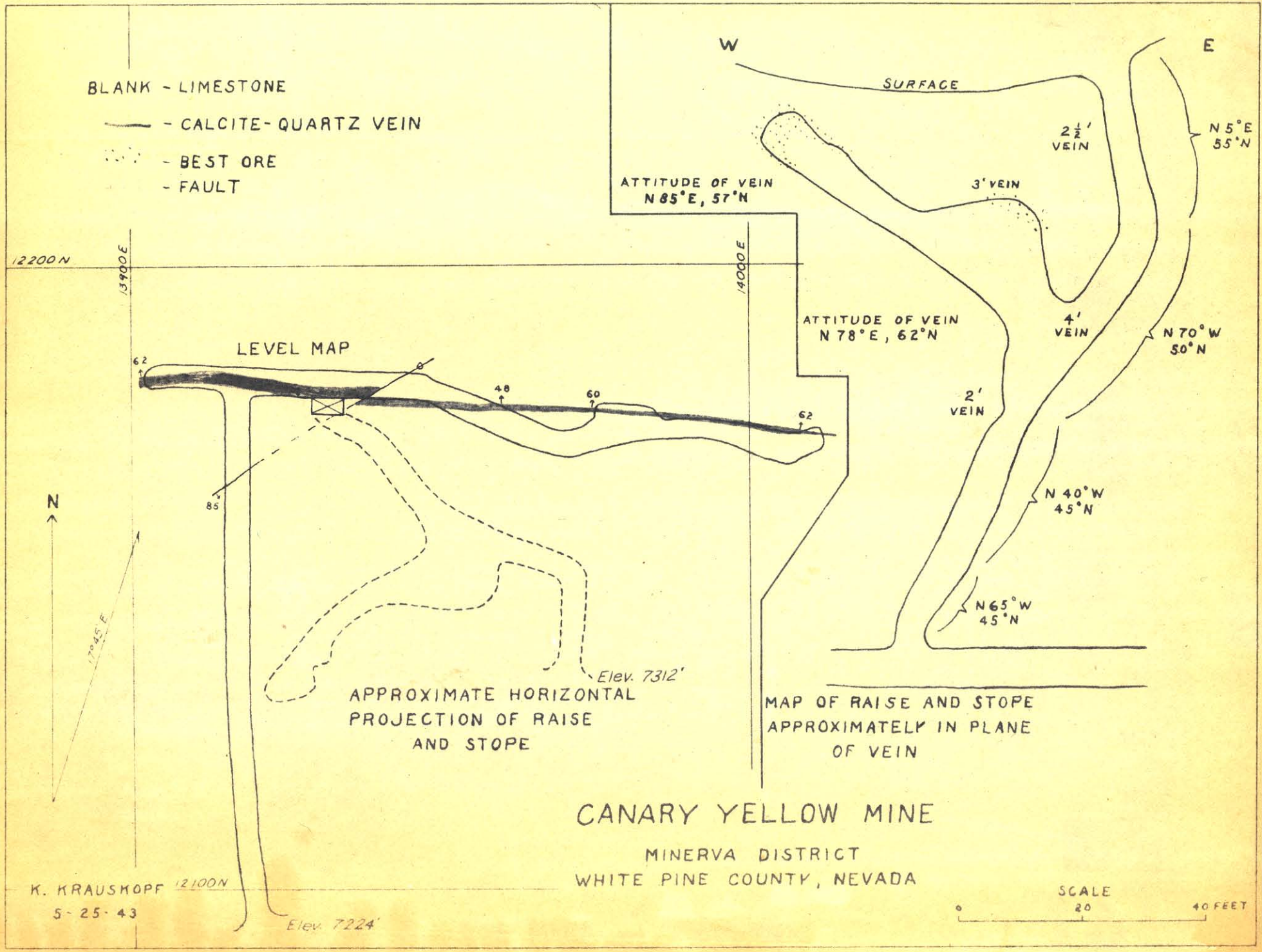
MAP AND VERTICAL PROJECTION OF HILLTOP MINE

0 500 FEET

D. M. Lemmon 1943

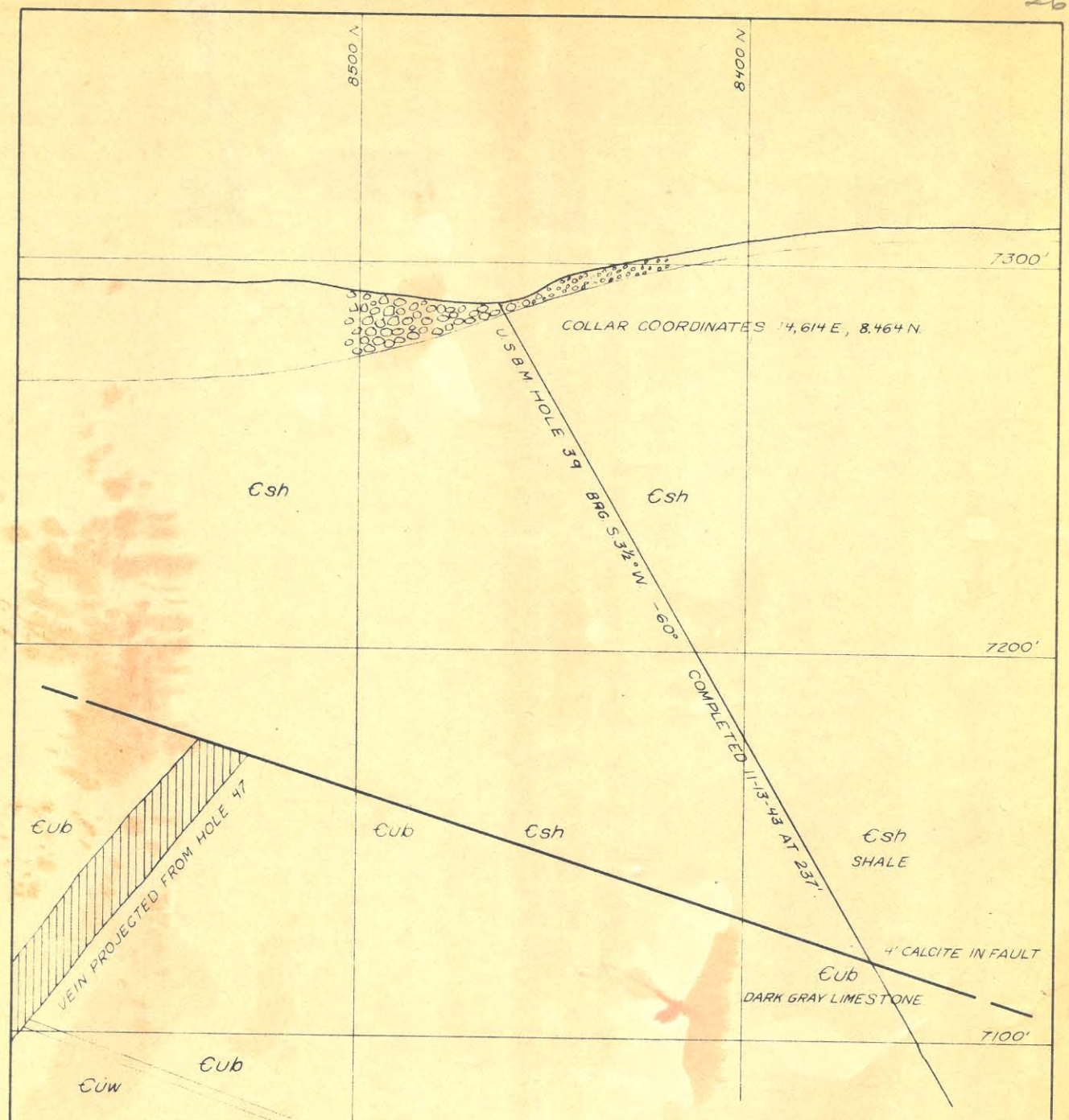
1340 0018

332


BLANK - LIMESTONE
- CALCITE-QUARTZ VEIN
- BEST ORE
- FAULT
W
E
SURFACE
2½' VEIN
N 5° E
55° N
3' VEIN
ATTITUDE OF VEIN
N 85° E, 57° N
12200 N
13900 E
14000 E
ATTITUDE OF VEIN
N 78° E, 62° N
4' VEIN
N 70° W
50° N
LEVEL MAP
62
48
60
62
2' VEIN
N 40° W
45° N
85
N
17° 45' E
N 65° W
45° N
Elev. 7312'
APPROXIMATE HORIZONTAL
PROJECTION OF RAISE
AND STOPE
MAP OF RAISE AND STOPE
APPROXIMATELY IN PLANE
OF VEIN
CANARY YELLOW MINE
MINERVA DISTRICT
WHITE PINE COUNTY, NEVADA
K. KRAUSKOPF
5-25-43
12100 N
Elev. 7224'
SCALE
0
20
40 FEET

(332)

4340 018



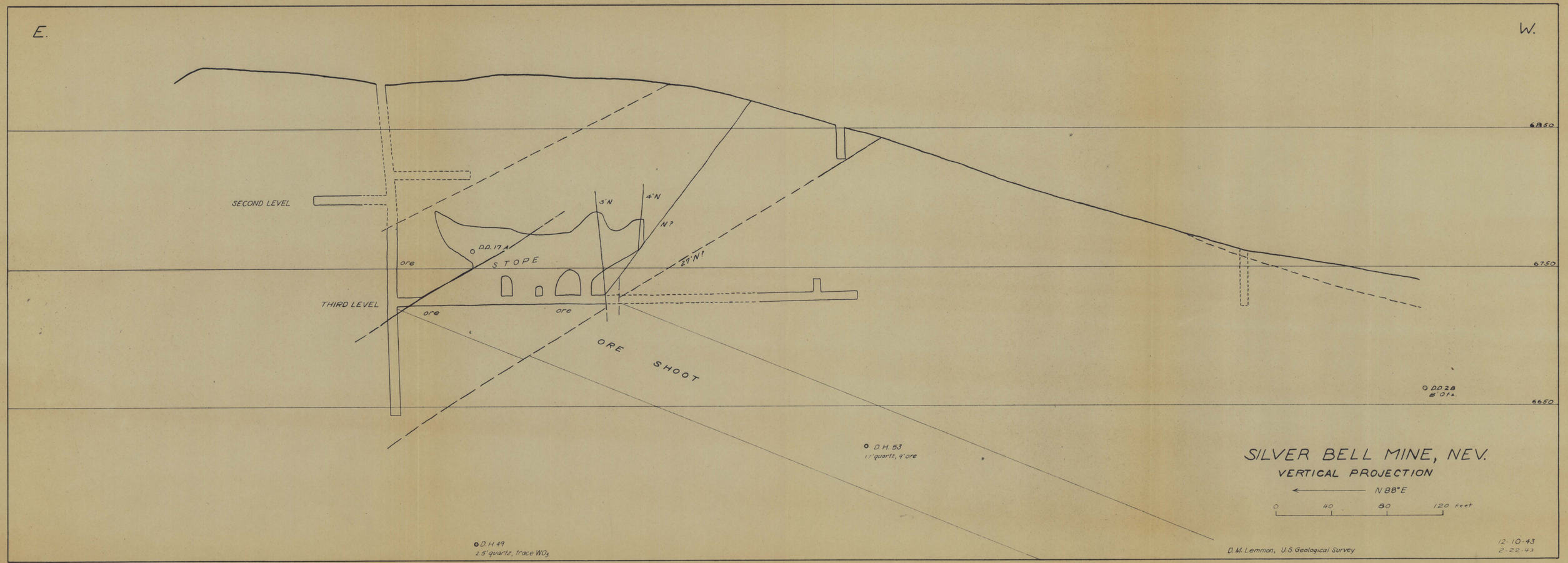
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
BUREAU OF MINES PROJECT 705 A

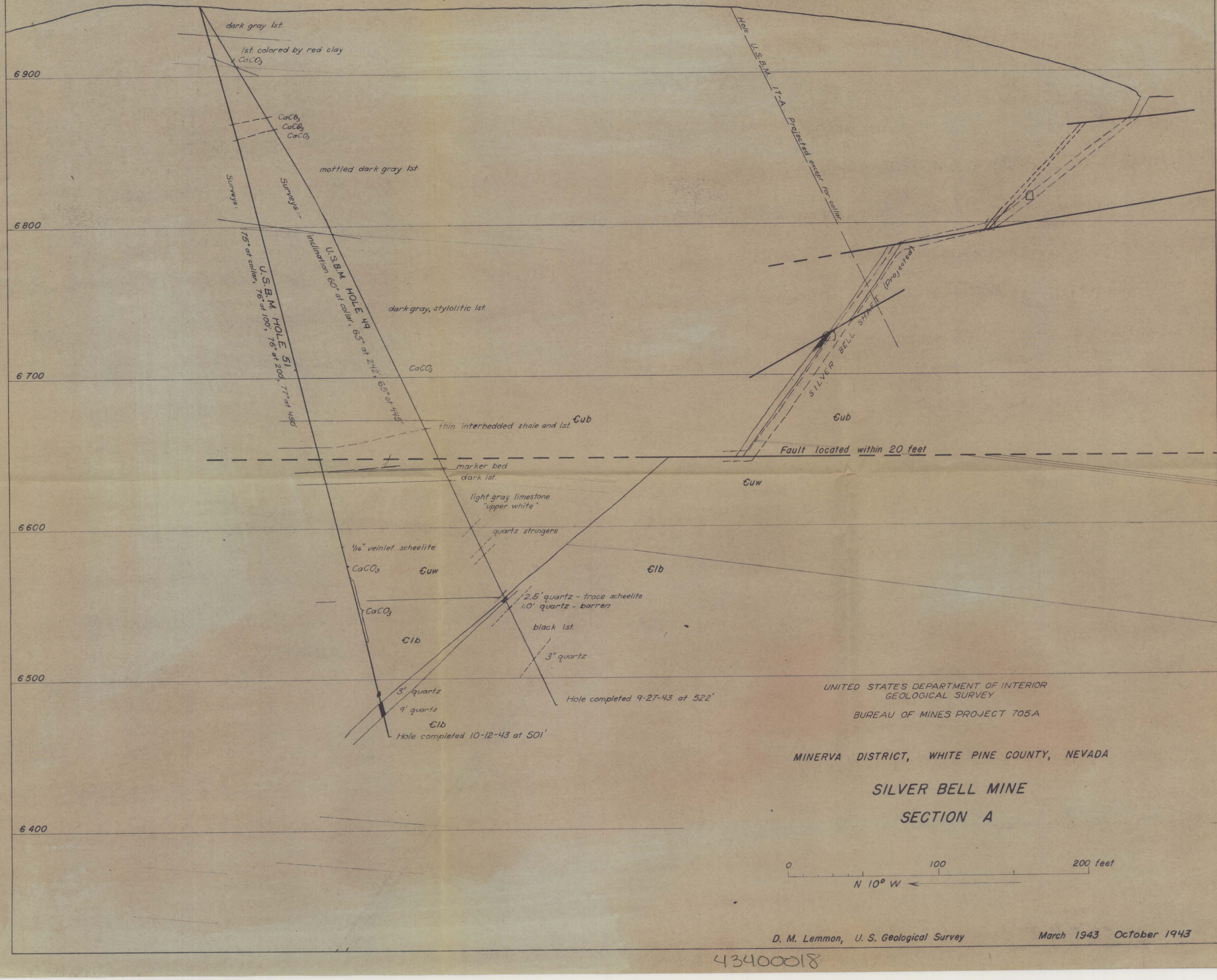
EAST EVERIT VEIN, MINERVA DISTRICT, NEVADA

SECTION THROUGH HOLE 39

0 40 80 120 FEET

D. M. LEMMON DECEMBER 1943





UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

BUREAU OF MINES PROJECT 705A

MINERVA DISTRICT, WHITE PINE COUNTY, NEVADA

SILVER BELL MINE

SECTION A

0 — 100 — 200 feet

N 10° W

D. M. Lemmon, U. S. Geological Survey

March 1943 October 1943

43400018

HILLTOP

TONY

SECTION 17

ZIGZAG

CANARY YELLOW

LONE BUCK

U M

A L L U V I

SECTION 20

EVERIT

N

ORIOLE

MINERVA DISTRICT

WHITE PINE COUNTY, NEVADA

SHOWING PRINCIPAL

VEINS AND FAULTS

SCHEELITE CHIEF

SILVER BELL

0 1000 2000 FEET

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

ORIOLE MINE, MINERVA DISTRICT, NEVADA

COMPOSITE MAP

0 40 80 120 FEET

After maps by K. E. Richard and J. D. Burgess for Tungsten Metals Corporation 1940 with slight modifications by D. M. Lemmon.

12° 45' E

FAULT

VEIN

CHIEF FAULT

STOPE

6453' LEVEL

6533' LEVEL

Pocket high grade ore 3' in diam.

Brecciated limestone and quartz

quartz 2' thick

7100 N

7000 N

6900 N

10,500 E

10,600 E

10,700 E

10,900 E

6900

6800

6700

6600

6500

6400

6300

OLD SHAFT

U. S. B. M. HOLE 53
Inclination 60° at collar.

Cub

Cub

Cub

Cub

West face Silver Bell, Second Level

4' quartz, little scheelite

17' quartz, lower 14' scheelite-bearing. Assays:

233.5-235	0.13 % WO_3
235-236	*0.01
236-240'	4.70 % WO_3
240-243'	0.03 "
243-245'	1.35 "
248-250'	0.04 "
245-248	*0.01 "

* Less than

Light-gray limestone "upper white"

Projected position upper oreshoot

Hole completed 10-23-43 at 290'.

Cuw

Cuw

Clb

Clb

Clb

East dipping fault. Exact position unknown. May lie 100 feet higher.

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

BUREAU OF MINES PROJECT 705 A

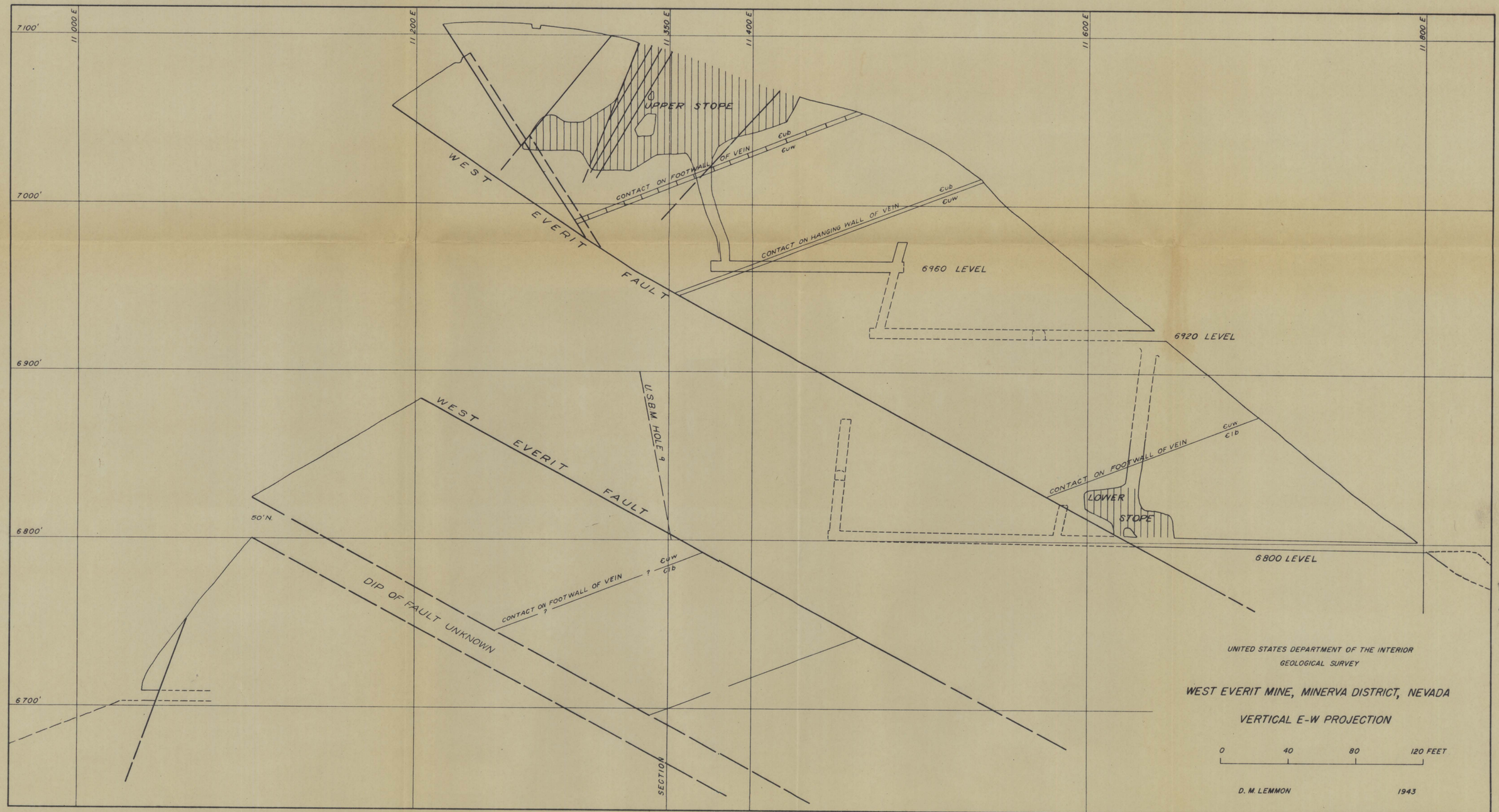
MINERVA DISTRICT, WHITE PINE COUNTY, NEVADA

SILVER BELL MINE
SECTION B

0 100 200 feet

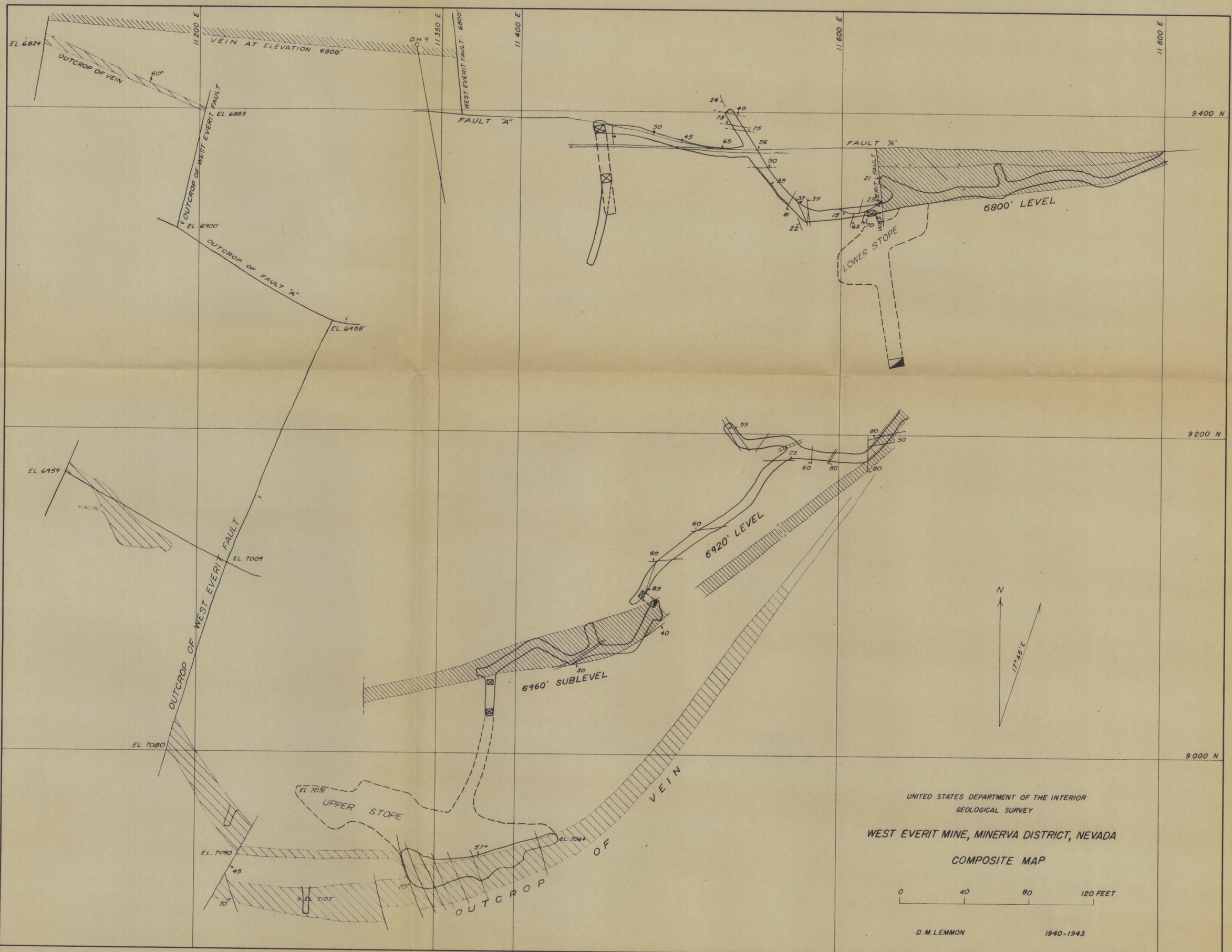
N. 10° E.

D. M. Lemmon, U. S. Geological Survey March 1943


7100'
7000'
6900'
6800'
6700'
11 000 E
11 200 E
11 350 E
11 400 E
11 600 E
11 800 E
UPPER STOPE
WEST EVERIT FAULT
CONTACT ON FOOTWALL OF VEIN
CONTACT ON HANGING WALL OF VEIN
€ub
€uw
6960 LEVEL
6920 LEVEL
U.S.B.M. HOLE 9
50' N.
LOWER STOPE
CONTACT ON FOOTWALL OF VEIN ?
€lw
€lb
DIP OF FAULT UNKNOWN
6800 LEVEL
SECTION
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WEST EVERIT MINE, MINERVA DISTRICT, NEVADA
VERTICAL E-W PROJECTION
0 40 80 120 FEET
D. M. LEMMON
1943

4340018

332



UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WEST EVERIT MINE, MINERVA DISTRICT, NEVADA

COMPOSITE MAP

0 40 80 120 FEET

D. M. LEMMON 1940-1943

4340 0018

(332)

4340 0018 (332) 18

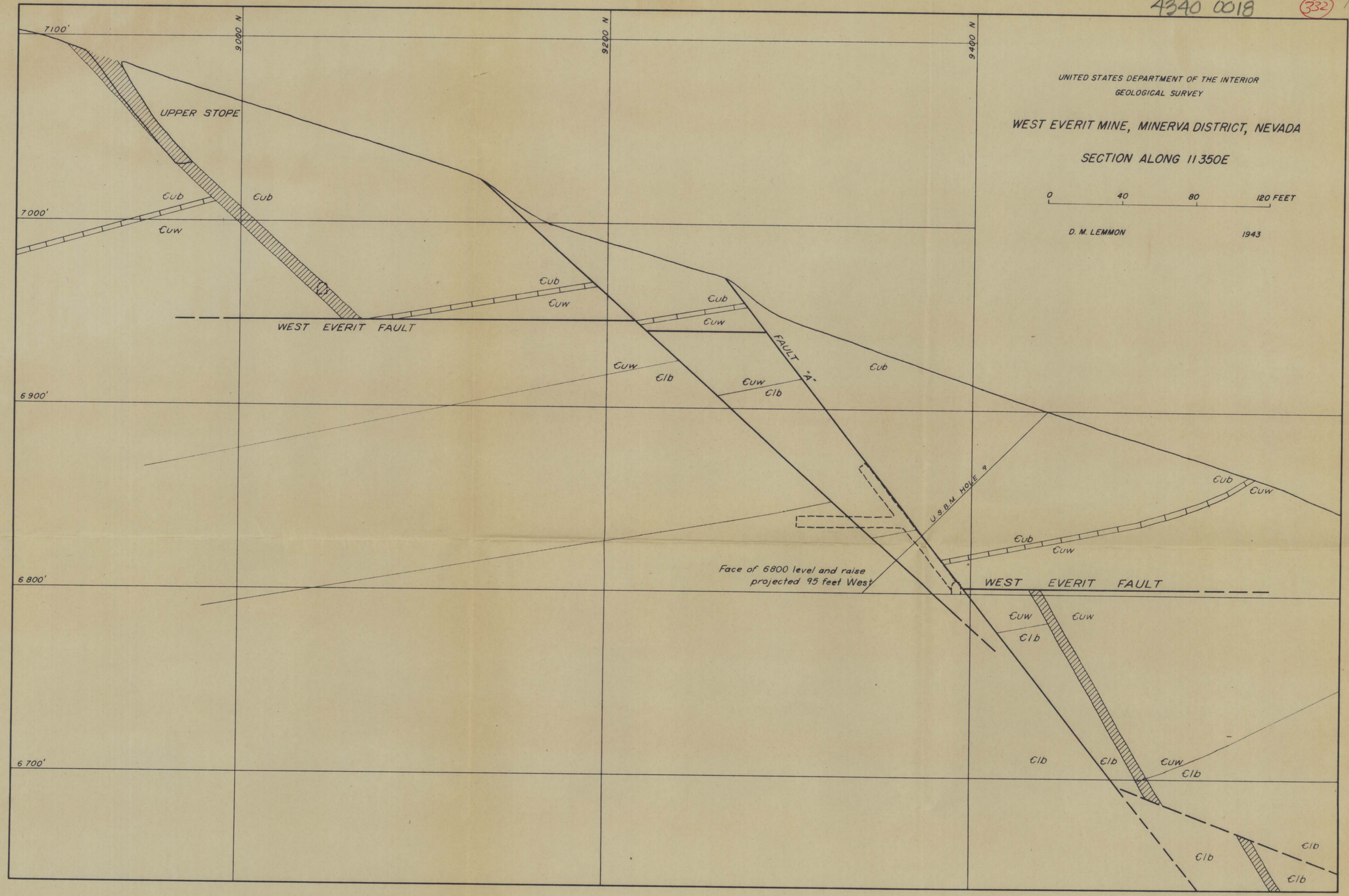
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

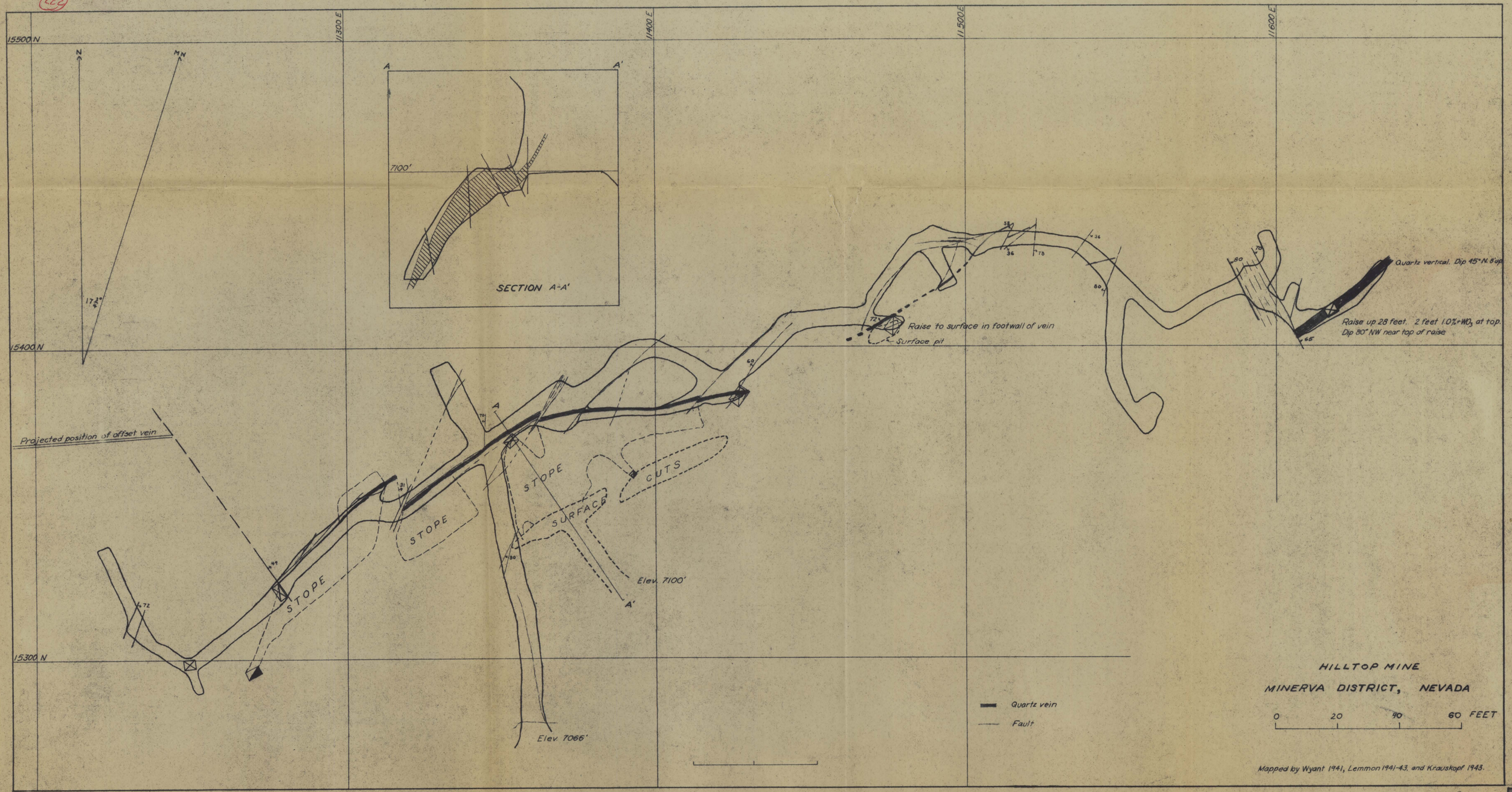
WEST EVERIT MINE, MINERVA DISTRICT, NEVADA

SECTION ALONG 11350E

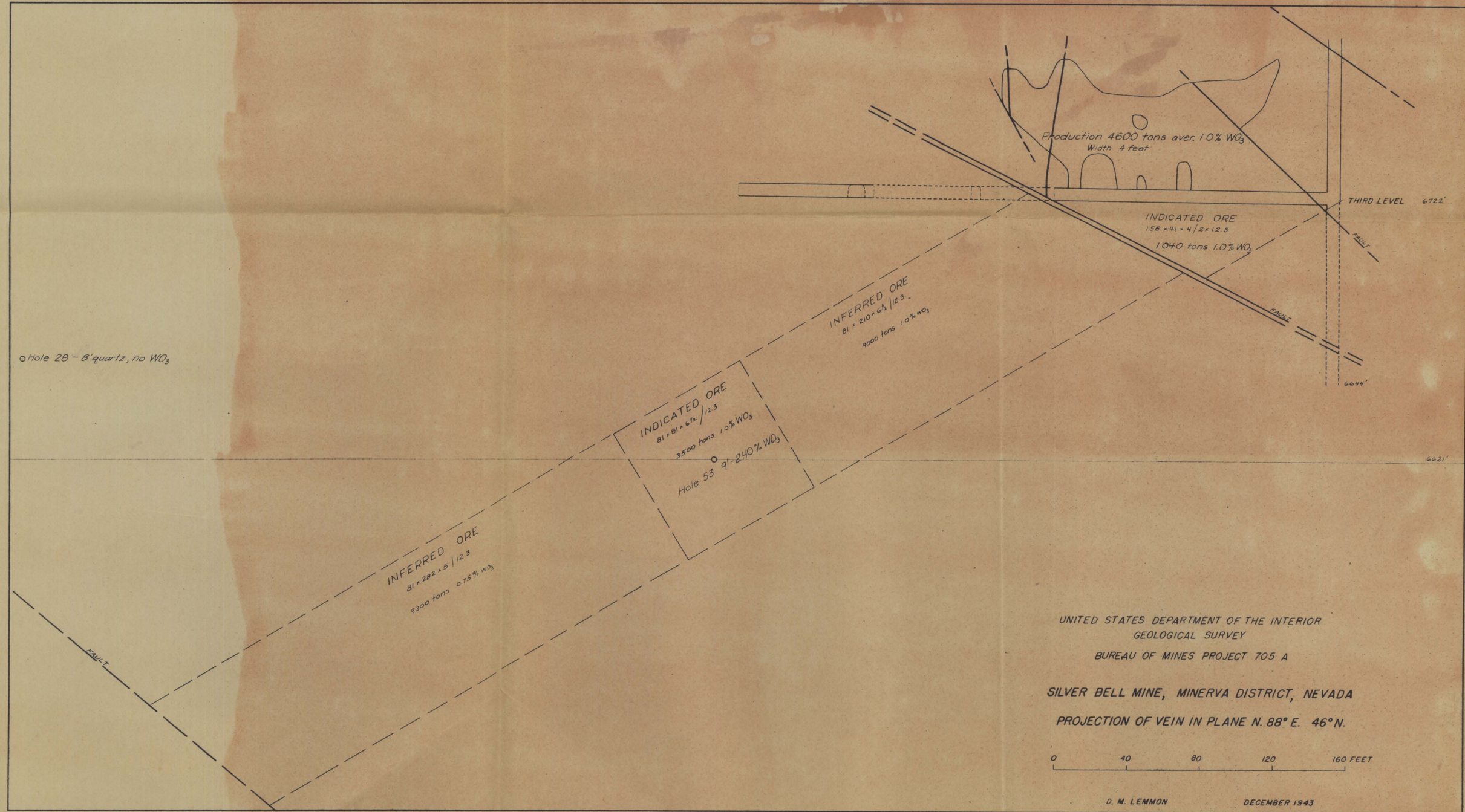
0 40 80 120 FEET

D. M. LEMMON 1943




11300 E
11400 E
11500 E
11600 E
15500 N
15400 N
15300 N
N
MN
17½°
A
A'
7100'
SECTION A-A'
Projected position of offset vein
STOPE
STOPE
STOPE
SURFACE
CUTS
Elev. 7100'
Elev. 7066'
Raise to surface in footwall of vein
Surface pit
Quartz vertical. Dip 45° N. 8' up.
Raise up 28 feet. 2 feet 1.0% + WO3 at top.
Dip 80° NW near top of raise
Quartz vein
Fault
HILLTOP MINE
MINERVA DISTRICT, NEVADA
0 20 40 60 FEET
Mapped by Wyant 1941, Lemmon 1941-43, and Krauskopf 1943.

4340 0018



UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

BUREAU OF MINES PROJECT 705 A

SILVER BELL MINE, MINERVA DISTRICT, NEVADA

PROJECTION OF VEIN IN PLANE N. 88° E. 46° N.

0 40 80 120 160 FEET

D. M. LEMMON DECEMBER 1943

8 800 N

8 600 N

8 400 N

14 000 E

14 200 E

14 400 E

14 600 E

Face 7050 Level, East Everit Mine
Approx elev 7058'

Hole 41

3' quartz, tr WO₃ at 7011'

Everit vein - elev 7075'

Footwall of Everit vein - Elev 7075'

Hole 41A
16' quartz at 7103

Hole 45

Fault €sh/€ub elev 7225
Hole 47

15' quartz, tr WO₃ elev 7055'

Fault €sh/€ub elev 7205

15' quartz, barren, elev 7115'
MARKER BED - Elev 7111

Hole 39

FAULT €sh/€ub 7116

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

BUREAU OF MINES PROJECT 705 A

MINERVA DISTRICT, NEVADA

EAST EVERIT VEIN

0 40 80 120 160 FEET

D. M. LEMMON DECEMBER 1943

(332)

4340 0018 (33)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SCHEELITE CHIEF MINE, MINERVA DISTRICT, NEVADA

COMPOSITE MAP

0 40 80 120 FEET

D.M. Lemmon 1940-43. West workings from maps by K.E. Richard and J.D. Burgess 1940 for Tungsten Metals Corporation.

Quartz vein
Fault
Cuw "Upper white" limestone
Clb "Lower black" limestone

W

E

10800 E

11000 E

11200 E

11400 E

11600 E

6800'

6600'

6400'

SILVER WORKINGS

D.H. 14-A
0 44'qtz tr WO3

D.H. 15
0 18'qtz tr WO3

D.H. 12
0 22'qtz tr WO3

CHIEF FAULT

Eub

CONTACT ON HANGING WALL OF VEIN

Euw

PROBABLE ORESHOOT

waste

ore

STOPE 1 and 2

D.H. 13
0 3'qtz - 1% 0.5% WO3 sludge 0.38%

STOPE 1A and 2A

1A

2A

ore

D.H. 15A
0 2'

vein narrow

STOPE 3

3

Elb

No ore at draft level. Occasional scheelite, vein narrow.

CROSSCUT TO ADIT
6316' LEVEL

Elev 6325 approx.

6300' SUBLEVEL

D.H. 37
22'qtz 5' - 1.08%

MINERVA DISTRICT, NEVADA

SCHEELITE CHIEF MINE
VERTICAL E-W PROJECTION
EAST WORKINGS

0 40 80 120 FEET

D.M. Lemmon, U.S. Geological Survey

12-10-43
2-22-43

4340 0018

(332)

EAST EVERIT MINE

MINERVA DISTRICT, NEVADA

Transit survey by R.W. Gerhon September 1943
Geology by D. M. Lemmon 1940-1943

R. 68 E.

T. 11 N.

CANARY YELLOW MINE

WEST EVERIT MINE

EAST EVERIT MINE

ORIOLE MINE

SCHEELITE CHIEF MINE

SILVER BELL MINE

Everit canyon

Chief canyon

SECTION 17

SECTION 20

SECTION 29

17

20

29

EXPLANATION

TERTIARY QUATERNARY

- Qal — Alluvium
- Trh — Rhyolite dikes and sills

CAMBRIAN

- Cc — Cherty limestone
- Csh — Shale and shaly limestone
- Cub — Upper black limestone
- Cuw — Upper white limestone
- Clb Clw — Lower black limestone with lower white limestone member

Quartz vein

Fault

Strike and dip of bedding

Prospect pit

Adit

Shaft

6 787 Triangulation pole

MAP OF A PORTION OF THE MINERVA DISTRICT, NEVADA

500 0 500 1000 Feet

CONTOUR INTERVAL 25 FEET

N 17° 45' E

Geology and topography by Dwight M. Lemmon and Donald Wyant

Assumed sea level datum

1940

ASAO 0018

(332)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

BUREAU OF MINES PROJECT 705 A

SCHEELITE CHIEF VEIN, MINERVA DISTRICT, NEVADA

COMPOSITE MAP OF THE SILVER BELL MINE

0 40 80 120 160 FEET

D. M. LEMMON DECEMBER 7, 1943

4400 N

4200 N

4000 N

12400 E

12600 E

12800 E

13000 E

13200 E

HOLES 49 AND 51

vein elev. 6476' 10' quartz

vein elev. 6551' - 2.5' quartz, tr WO_3

HOLE 53

vein elev. 6621' - 17' quartz, 9' aver 2.410% WO_3

HOLE 28

vein elev. 6664' - 8' quartz, no WO_3

VEIN FOOTWALL elev. 6644'

Intersection fault and vein - large offset north

ORE SHOOT

46°

elev. 6761'

elev. 6850'

HOLE 17 A

Fourth level elev. 6644'

Intersection fault and vein

Third level elev. 6722'

53°

57°

54°

45°

SECOND LEVEL elev. 6796

First level elev. 6814'

Collar elev. 6882'

8800 N

8600 N

8400 N

7300'

7200'

7100'

7000'

6900'

Charty, gray limestone – "Pogonip"

Cc

Csh

Csh

Csh

Fissile shale

Dark gray limestone

1.0' calcite with scheelite

U.S.B.M. HOLE 43 INCLINATION 65° AT COLLAR, 100 AT 500'. COMPLETED 11-26-43 AT 531'

U.S.B.M. HOLE 47 INCLINATION 55° AT COLLAR, 60° AT 306 FEET. COMPLETED 12-7-43 AT 491'

Cub

Cub

Dark limestone – shale partings

Dark limestone with shale beds ¼" thick

15' quartz – barren

Cuw

Cuw

Massive light gray limestone

1.5' quartz – trace WO_3

Massive light gray limestone

Red, shaley breccia – White Calcite breccia

Dark limestone – red clay bands

Dark limestone with stylolites

Clb

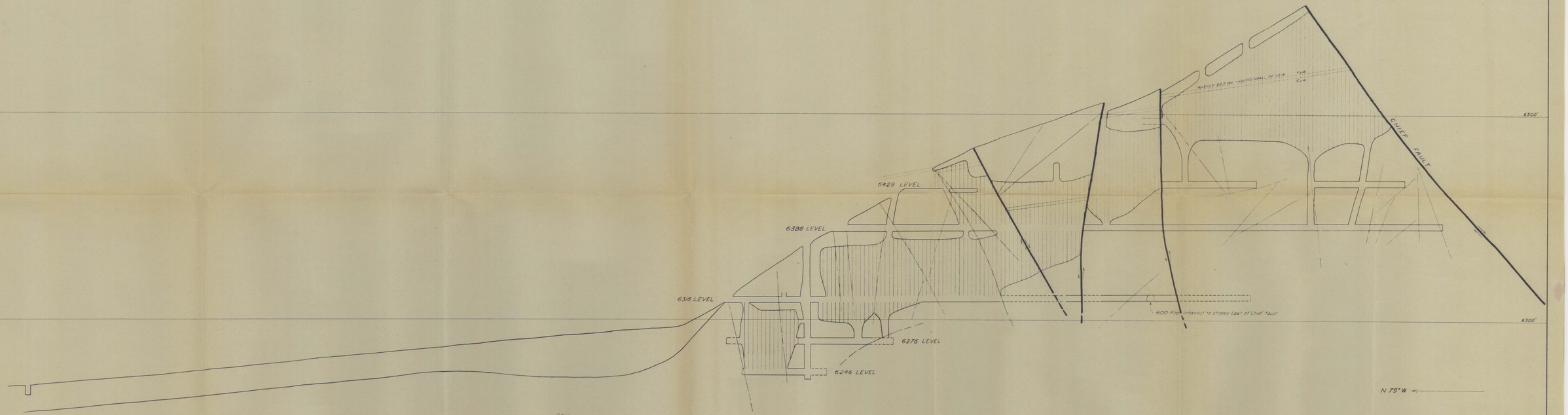
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
BUREAU OF MINES PROJECT 705 A

EAST EVERIT VEIN, MINERVA DISTRICT, NEVADA
SECTION ALONG 14,674 E

0 40 80 120 FEET

D. M. LEMMON

DECEMBER 7, 1943


6500'
6300'
6100'
6428 LEVEL
6386 LEVEL
6316 LEVEL
6276 LEVEL
6246 LEVEL
CHIEF FAULT
600-Foot crosscut to stopes East of Chief fault
N. 75° W
D.H.-32
NO QUARTZ
D.H.-31
5' QUARTZ, TRACE WO3
2' ASSAY 0.06 % WO3
D.H.-26
3' QUARTZ, 0.72 % WO3
D.H.-25
12' QUARTZ, BARREN
7' ASSAY 3.3 OZ Ag, 0.01 OZ Au
D.H.-1
1½' QUARTZ, TRACE WO3
ASSAY 0.13 % WO3
D.H.-0
2' QTZ, TR WO3
Major fault
Minor fault
Stope
Workings out of vein
HOLES DRILLED BY U. S. BUREAU OF MINES IN 1941
Point platted is intersection of hole with footwall of vein
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
SCHEELITE CHIEF MINE, MINERVA DISTRICT, NEVADA
VERTICAL PROJECTION OF WEST WORKINGS
0 40 80 120 FEET
D. M. Lemmon, 1940-1943. Partially adapted from maps by K. E. Richard and J. D. Burgess for Tungsten Metals Corp., 1940.

7200'

7100'

7000'

8800 N

8600 N

1" QUARTZ

2" QUARTZ TRACE SCHEELITE

¼" QUARTZ AND SCHEELITE

½" QUARTZ TRACE SCHEELITE

1' QUARTZ AND LST. TRACE SCHEELITE

1/16" QUARTZ TRACE SCHEELITE

USBM HOLE 41

-60°

USBM HOLE 41-A

ALLUVIUM

FAULT?

LIMESTONE PARTIALLY SILICIFIED BELOW 51'

1" QUARTZ

½" QUARTZ

1' QUARTZ

NARROW QUARTZ STRINGERS IN LST. TR. WO_3.

3' QUARTZ TR. WO_3

24' QUARTZ TR. WO_3

DARK GRAY LST. €ub

Hole completed 11-8-43 at 166'

€ub

PROBABLE FAULT

?

€uw

?

€uw

6" QUARTZ TR. WO_3

3' QUARTZ TR. WO_3

LIGHT GRAY LIMESTONE "UPPER WHITE"

Hole completed 10-31-43 at 326'

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
BUREAU OF MINES PROJECT 705-A

EAST EVERIT VEIN, MINERVA DISTRICT, NEVADA

SECTION ALONG 14408 E

0 40 80 120 FEET

NOVEMBER 10, 1943

D.M.L.

332

4340 0018

(332) Item 20

10000 E

11000 E

16000 N

15000 N

SECTION 8

SECTION 17

T 11 N R 68 E

A

A'

B

B'

HILLTOP MINE

TONY MINE

AERIAL TRAM

6485

6700

6600

6500

6400

6900

7000

7100

7200

6800

6700

EXPLANATION

al Alluvium	Fault
rh Rhyolite	Strike and dip of bedding
€ug Upper dark-gray limestone	Trail
€uw Upper "white", massive limestone	Road
€mg Middle dark-gray limestone	Mine dump
€tb Thin-bedded limestone	Mine workings
€lg Lower dark-gray limestone	Quartz vein
€lw Lower "white" massive limestone	

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

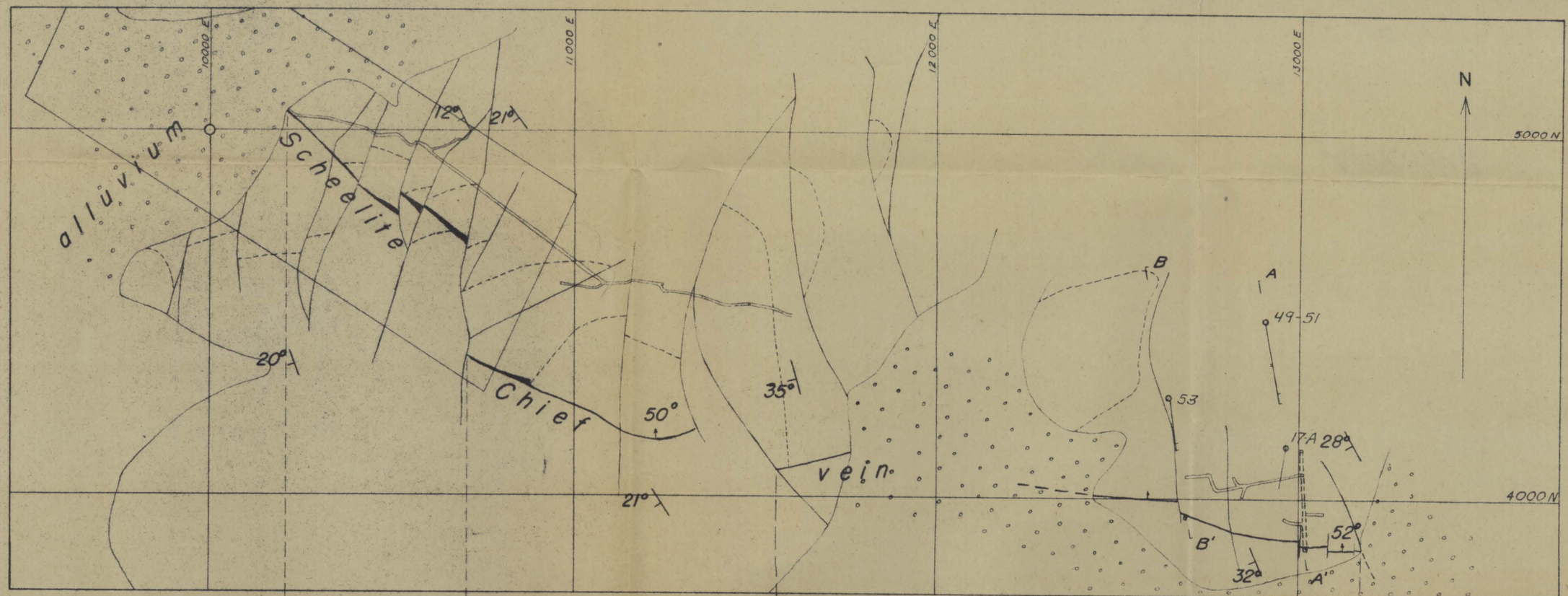
SURFACE MAP OF THE HILLTOP MINE, MINERVA DISTRICT, NEVADA

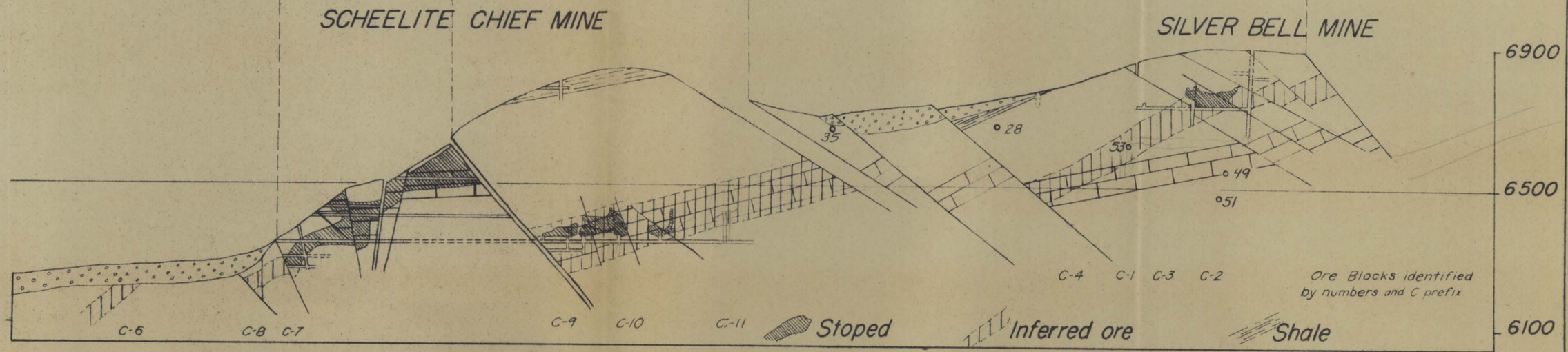
0 200 400 600 FEET

CONTOUR INTERVAL 25 FEET

K.B. Krauskopf assisted by R.F. Stopper June 1943

DMR





MAP AND VERTICAL PROJECTION OF THE SCHEELITE CHIEF VEIN

0 1000' 2000 FEET

43400018

D.M. Lemmon 1943

W

E

10800 E

11000 E

11200 E

11400 E

11600 E

6800'

6600'

6400'

SILVER WORKINGS

D.H. 14-A
0 44'qtz tr WO3

D.H. 15
0 18'qtz tr WO3

D.H. 12
0 22'qtz tr WO3

CHIEF FAULT

Eub

CONTACT ON HANGING WALL OF VEIN

Euw

PROBABLE ORESHOOT

waste

ore

STOPE 1 and 2

D.H. 13
0 3'qtz - 1% 0.5% WO3 sludge 0.38%

STOPE 1A and 2A

1A

2A

ore

D.H. 15A
0 2'

vein narrow

STOPE 3

3

Elb

No ore at draft level. Occasional scheelite, vein narrow.

CROSSCUT TO ADIT
6316' LEVEL

Elev 6325 approx.

6300' SUBLEVEL

D.H. 37
22'qtz 5' - 1.08%

MINERVA DISTRICT, NEVADA

SCHEELITE CHIEF MINE
VERTICAL E-W PROJECTION
EAST WORKINGS

0 40 80 120 FEET

D.M. Lemmon, U.S. Geological Survey

12-10-43
2-22-43

4340 0018

(332)