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**BUREAU OF MINES  
Denver, Colorado**

**INVESTIGATION OF THE UNION ZINC-LEAD MINE  
WASHOE COUNTY, NEV.**

**BY ROBERT W. GEEHAN**

**United States Department of the Interior — January 1950**



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UNITED STATES DEPARTMENT OF THE INTERIOR  
Oscar L. Chapman, Secretary  
BUREAU OF MINES  
James Boyd, Director

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January 1950



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## INTRODUCTION AND SUMMARY

The Bureau of Mines has been developing deposits of critical and essential minerals in the United States since 1939. A preliminary examination of the Union lead mine was made in November 1944 and January 1945 by W. T. Benson, a Bureau of Mines engineer, who recommended development by diamond drilling. The Bureau conducted a drilling project at the mine from February 12 to May 16, 1947. The property is in sec. 12, T. 17 N., R. 19 E., Mount Diablo Base and Meridian, in southern Washoe County, Nev., about 15 miles south of Reno.

The Union lead mine, also known as the Commonwealth mine, has been an intermittent producer of zinc-lead-silver ore since 1860. During World War II, ore was shipped to smelters near Salt Lake City, Utah.

The Bureau drilled 21 diamond-drill holes having a total length of 1,549 feet and 20 long percussion-drill holes with a total length of 359 feet. The program was designed to test for horizontal and vertical extensions of the ore body and to prospect for parallel ore bodies. As a result of this program, extensions of the ore zone were established, but no parallel ore-bearing structures were found. The areas drilled were limited by drill sites available.

## ACKNOWLEDGMENT

Special acknowledgment is made to John Somers, manager of the mine, for cooperation in all phases of the drilling; to A. C. Johnson, chief, Reno Branch, Mining Division, for his aid and direction; and to A. C. Rice, acting supervising engineer, and his staff at the Rare and Precious Metals Experiment Station at Reno, for analytical work.

## OWNERSHIP

Patented land comprising the Union mining claim, Union millsite, the N. 1/2 of the N. E. 1/4 and the S.W. 1/4 of the N. E. 1/4 of sec. 13, T. 17 N., R. 19 E., M. D. B. & M., was owned by the Union Lead Mining & Smelter Co., a corporation, with John Somers, president, and W. E. Baldy, secretary.

## HISTORY

The Galena Mining District, in which the claims are situated, was established in 1860, and a short time thereafter a small smelting furnace and later a mill were erected. Both were unsuccessful, and the operation was abandoned. The Nevada Commonwealth Mining & Milling Co. operated the mine in 1906 and 1907, and later some developing was done on the property by the Treadwell, Yukon Corp. The present company acquired the mine in 1935. No



appreciable production was made until 1943, but since that date several thousand tons of ore has been shipped. At the time of the Bureau's project, the mine was not in production, but, according to Somers, the company subsequently planned to install a flotation-type mill.

#### PHYSICAL FEATURES

The Union lead mine is on a low hill a few miles east of the Sierra Nevada. Altitude of the mine workings ranges from 4,900 to 5,300 feet. As the claims cover an area of moderate relief, the upper workings are opened through adits, but the two lower levels are developed from a winze. Desert climatic conditions prevail; the summers are hot, and the annual precipitation is slight. Snow deep enough to hinder mine operations is infrequent. Vegetation is sparse and consists of the usual desert growths.

An ample water supply for mine and mill operations is available from a spring in Galena Creek and from the lower mine workings.

A short spur track from the Virginia & Truckee Railroad extends to the millsite at the property. No telephone facilities or transmitted electric power are available at the mine. A graveled road extends 0.5 mile from the mine to U. S. Highway 395; the junction is 15 miles south of Reno.

Housing accommodations for four families are provided at the mine; the remaining employees live in Reno and Carson City.

#### MINE WORKINGS AND PLANT

Underground development on the property consists of three adits, an inclined winze sunk from the lowest adit, and two levels, Nos. 4 and 5, which were driven from the winze. Surface workings are confined to a trench and a small open cut, from which some ore was mined. No. 5 level, the deepest in the mine, is 480 feet below the outcrop, measuring along the dip of the ore zone.

The mine is equipped for a production of about 60 tons per day. Following is a list of the more important items of equipment:

- 1 300-h.p. Diesel-electric plant.
- 1 Compressor, belt-driven from electric motor.
- 1 Small battery locomotive with charging equipment.
- 1 Shop, with gas and electric welding equipment.
- 1 Gravity-type mill, partly dismantled.
- Sundry mine cars, drills, and tuggers.

#### DESCRIPTION OF THE DEPOSIT

The mineralized zone in which the zinc-lead-silver ore occurs strikes N. 40° E. and dips 55° S. This zone is limited on the hanging wall and foot-wall by faults that have slightly divergent strikes that cause a gradual widening to the southwest. The country rock is shale, hornfels, and altered igneous rocks intruded by andesite dikes and overlain in part by recent flow rocks and agglomerate.



The higher-grade ore occurs in irregular shoots, the mineralization of which apparently was controlled by cross faults striking northwest. Lower-grade ore was formed by mineralization of a network of small fractures that occur in the ore zone.

Widths and lengths of stopes are determined by sampling the walls when stoping is in progress, except where the ore extends to the limiting faults.

#### CHARACTER OF THE ORE

An oxidized type ore is found along the outcrop, and in some areas it extends downward to the No. 1 level. Lead is present as cerussite, zinc as smithsonite and calamine, and copper as malachite and chalcantite. This ore is stained by oxidized products of iron and arsenic.

Sulfide ore occurs below the oxidized ore. Lead is present as galena, the principal zinc minerals are sphalerite and marmatite, and copper occurs as chalcopryite. Pyrite is present in most ore, and arsenopyrite commonly occurs in irregular stringers. The gangue minerals are quartz, various silicates, and traces of calcite.

The higher-grade ore contains a high percentage of marmatite, and the ore minerals are relatively fine-grained. In the low-grade ore most of the zinc is present as sphalerite ranging in grain size from 1/16 to 1/4 inch.

Silver is associated with the galena, and the amount present increases when the percentage of lead increases; however, no definite ratio was determined.

The range of mineral content from ore shipments made in 1945 is as follows:

	<u>Ounces per ton</u>	
	<u>From-</u>	<u>To-</u>
Gold.....	0.0065	0.0275
Silver.....	0.78	4.8
	<u>Percent</u>	
Lead.....	0.25	10.45
Zinc.....	6.3	17.4
Copper.....	0.18	0.83
Insoluble.....	39.5	64.2
Iron.....	8.9	13.7
Sulfur.....	5.5	14.8
Limo.....	None	1.0
Arsenic.....	None	4.9

Two composite samples, one representing diamond-drill cores from all holes cutting the ore zone and one of cuttings from percussion drill holes in the ore zone, gave the following analyses:



	Composite of long drill hole samples, percent	Composite of diamond drill hole cores, percent
Lead.....	3.26	1.61
Zinc.....	2.62	2.96
Copper.....	0.06	0.04
Cadmium.....	1/0.04	1/0.03
Cobalt.....	1/0.01	1/0.01
Manganese.....	0.22	0.34
Iron.....	10.78	12.98
SiO <sub>2</sub> .....	50.19	50.85
Al <sub>2</sub> O <sub>3</sub> .....	16.29	16.00
CaO.....	0.37	0.23
MgO.....	2.24	2.92
Sulfur.....	5.81	4.71
Arsenic.....	1.60	0.75
Antimony.....	0.05	0.04
	<u>Ounces per ton</u>	<u>Ounces per ton</u>
Gold.....	Trace	Trace
Silver.....	1.45	2.90

1/ Less than.

#### MINING METHODS

The Union lead mine is worked through three adits and two levels driven off a winze sunk from the No. 3 adit. Levels are approximately 100 foot apart on the dip, some sublevels have been used, and the No. 4 level is only 40 foot below the No. 3. Raise spacing is irregular and is determined by the location of ore shoots. Much of the above development was completed before the present company started operations.

The No. 3 adit is the main haulageway. Ore from the upper levels is dropped to No. 3 through raises and open stopes; whereas ore from the lower levels is hoisted to it. A small battery locomotive is used to tram ore from storage pockets along this level to the mill or shipping bins.

The ore has been mined by square-set and shrinkage-stoping methods; the latter method has been employed for mining the larger part produced to date. The shrinkage stopes were empty, and although several months had passed since they were drawn, there has been no appreciable caving. It is reported that arched back stopes prevent the barren hanging-wall rock from caving into the broken ore.

Levels above the No. 3 adit are dry. About 350 gallons of water per hour is pumped from the No. 4 and 5 levels. It is reported that the flow of water is at a maximum just after an extension of the lowest level and gradually tapers off in periods when no new work is in progress. It was necessary to cap or plug all diamond-drill holes on the No. 5 level to prevent an excessive flow of water.



## ORE DRESSING

Several small mills have been in operation on this property, but no reliable records, except those of the present company are available concerning the type of mill or the flow sheet used. Tailings from the older mills contain 1.3 percent lead, 2.7 percent zinc, and 1.36 ounces of silver per ton, according to samples cut by an independent company.

From 1944 to 1946, the present company operated a gravity-type mill. Installed equipment comprised:

- 1 crusher, 8 by 12 inches.
- 1 elevator from crusher to fine-ore bin.
- 1 set of rolls 24 by 36 inches.
- 2 jigs.

Material from the crude ore bin was crushed to 1/2 inch and then elevated to the fine-ore bin. From this bin it was fed by a belt conveyor to rolls set at 1/4 inch and then sent directly to the jigs without sizing. This mill is said to have been unsatisfactory because the ore was not crushed sufficiently fine and sized before jigging. At present the mill is partly dismantled, and the manager states that the company is drawing up plans for the installation of a flotation mill. A sample of the tailings from the above mill contained 1.8 percent zinc, less than 0.1 percent lead, and 0.60 ounce silver per ton.

In 1944 the Bureau tested a sample of the higher-grade ore from the mine with the following results:<sup>2/</sup>

A representative head sample assayed 15.9 percent zinc, 0.3 percent lead, 0.23 percent copper, and 0.6 ounce silver. Mineralogically, this ore can be described as an intergrowth of quartz, sphalerite, pyrite, chlorite, galena, chalcopyrite, arsenopyrite, and iron oxide. The important mineral, sphalerite, occurs as grains ranging in size from 28- to 200-mesh. Chalcopyrite is finely disseminated in the sphalerite.

The sample, consisting of assay rejects, was crushed too finely for standard float-sink tests. However, the plus 10-mesh fraction was checked by heavy liquids. Of the fraction treated, 55 percent of the weight was rejected with a loss of only 3 1/2 percent of the zinc. The grade was raised from 0.22 percent lead and 10 percent zinc to 0.45 percent lead and 22 percent zinc. A jig and table test on minus 1/4-inch ore gave somewhat poorer results. Approximately 6 percent of the zinc was lost with a 35 percent weight rejection, or 12 percent of the zinc with a 50 percent weight rejection. In no case were the tailings from jig and table operation as low-grade as indicated by heavy liquid tests.

Selective flotation of ore batch ground to minus 200-mesh gave indicated recoveries of 96 percent of the zinc in a plus 50 percent zinc concentrate that contained 0.9 percent cadmium. Over 80 percent of the lead was recovered

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<sup>2/</sup> Metallurgical tests were made at the Rare and Precious Metals Station, U. S. Bureau of Mines, Reno, Nev.



in a low-grade product assaying 39 percent lead, 4.95 percent zinc, 4.8 percent copper, 37 ounces silver, and 0.2 ounce gold.

Both the gravity concentrate and middling also responded readily to selective flotation giving plus 90 percent recovery of zinc. Actually, gravity treatment would not be necessary for an ore of this grade except to raise the grade for direct shipment.

#### PLAN OF PROJECT

In November of 1944 and January of 1945, the mine was examined by W. T. Bonson, an engineer of the Bureau of Mines, and recommendations were made for a core-drilling program to test the horizontal and vertical extensions of the ore zone and to prospect the wall rocks for possible parallel occurrences. In preparation for the Bureau's core-drilling project, the mining company drove a crosscut and excavated a drill station on the No. 3 level. They also supplied compressed air for drilling. Near the end of the project a number of long percussion drill holes were used to sample areas where relatively short holes were needed.

#### PROJECT WORK DONE BY THE BUREAU OF MINES

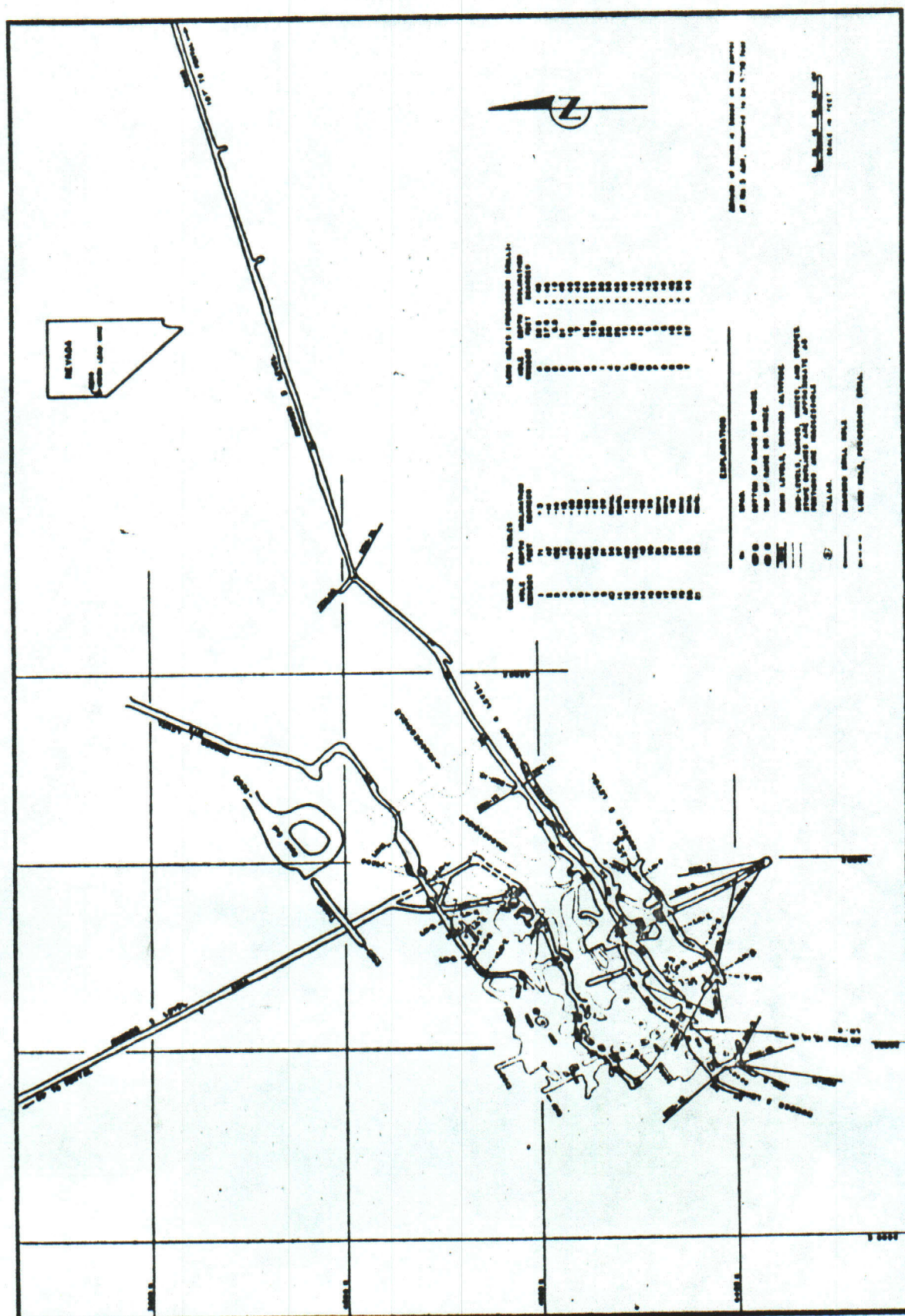
Twenty-one diamond-drill holes with a total length of 1,549 feet and 20 long holes with a total length of 359 feet were drilled. Figures 1 (mine map) shows the location of drill holes; figures 2 to 4 show locations and analyses of long holes; excepting long hole K, which is shown in figure 15; and figures 5 to 18 show the diamond-drill holes in section with the analyses of samples. Holes 1, 2, 4, 12, 17, 20, O, and Q were drilled to check for parallel ore structures on the footwall side of the main ore zone. Only traces of mineralization were cut by these holes. Hole 3 was drilled to determine the location of the hanging wall in order to help plan holes 5, 6, and 7.

Holes 5, 6, and 7 were drilled to test the ore zone below the deepest mine workings. The zone was cut by each hole, but no high-grade ore shoots were found. Holes 8, 9, 10, and 11 were used to check the southwestern extension of the ore-bearing structure. The hanging wall was located, and low-grade mineralization was found to extend as far to the southwest as it was practical to drill.

Holes 13, 14, 15, 16, and K were drilled to locate the hanging wall and footwall and to sample the ore zone in an area containing many small, transverse, ore-bearing fractures. These holes were designed to cut both the fracture system and the main ore zone. Holes 13 and 14 located the footwall, holes 16 and K the hanging wall. All five holes cut low-grade mineralization. Hole 16, which cut the fractures nearly at right angles, had a higher percentage core recovery than any of the other 20 core-drill holes.

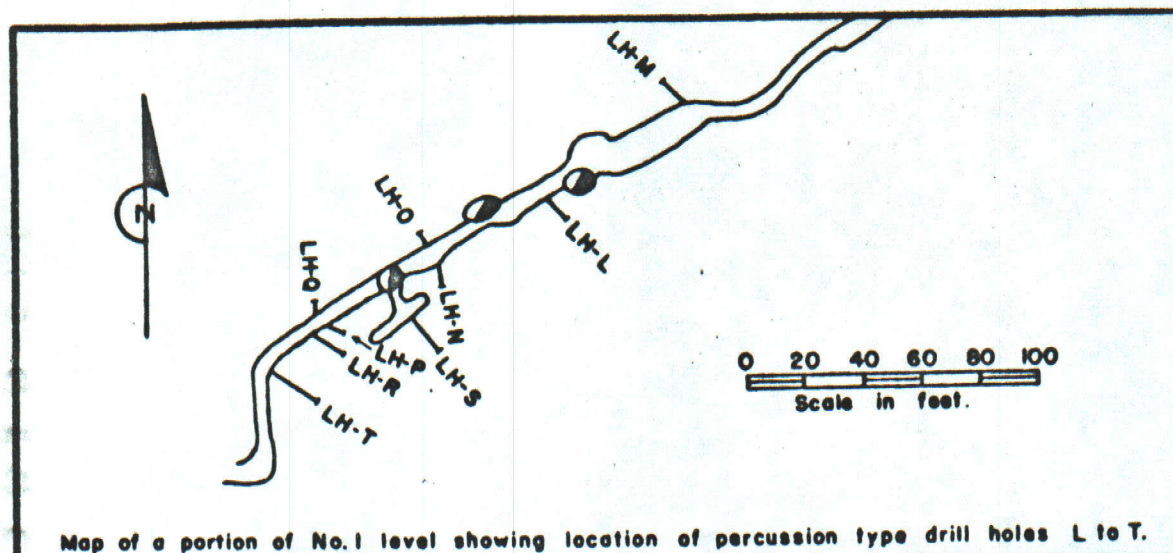
Hole 18 was drilled a short distance up-dip on an ore shoot to obtain a sample. Hole 19 was used to test for parallel structures on the hanging-wall side. Hole 21 was designed to locate and sample the ore zone near the dike on the No. 3 level.





**Figure 1. - Composite mine map.**





Analyses of samples from percussion type drill holes on No. 1 level.					
Feet	Length	Percent		Oz. per ton	
		Lead	Zinc	Gold	Silver
LONG-HOLE L. Inclination + 45°.					
0 - 6	6	x	2.7	0.005	1.25
6 - 10	4	3.4	5.5	0.01	3.50
10 - 15	5	0.5	0.2	T	0.95
LONG-HOLE M. Inclination + 10°.					
0 - 5	5	5.9	x	0.01	6.90
5 - 10	5	x	x	T	0.65
LONG-HOLE N. Inclination + 45°.					
0 - 5	5	x	1.7	T	0.60
5 - 10	5	6.6	3.0	0.005	5.60
10 - 13	3	x	1.0	T	0.30
LONG-HOLE O. Inclination + 10°.					
0 - 5	5	x	0.5	T	T
LONG-HOLE P. Inclination + 45°.					
0 - 5	5	2.2	1.4	T	1.95
5 - 9	4	0.1	6.0	T	0.40
LONG-HOLE Q. Inclination + 10°.					
0 - 6	6	x	1.0	T	T
LONG-HOLE R. Inclination + 45°.					
0 - 5	5	x	1.1	T	0.70
5 - 10	5	x	1.9	T	0.70
10 - 15	5	3.0	1.0	T	2.40
15 - 18	3	0.2	1.0	T	0.50
LONG-HOLE S. Inclination + 36°.					
0 - 4		x	1.1	T	0.20
4 - 10	6	x	1.1	T	0.55
LONG-HOLE T Inclination + 45°.					
5 - 10	5	3.5	1.1	T	2.20
10 - 15	5	7.0	1.5	0.005	5.10
15 - 19.5	4.5	2.3	0.8	T	1.55
x = less than 0.1 percent, T = trace.					

Figure 2. - Map showing locations of drill holes L to T, with log and analyses of samples.



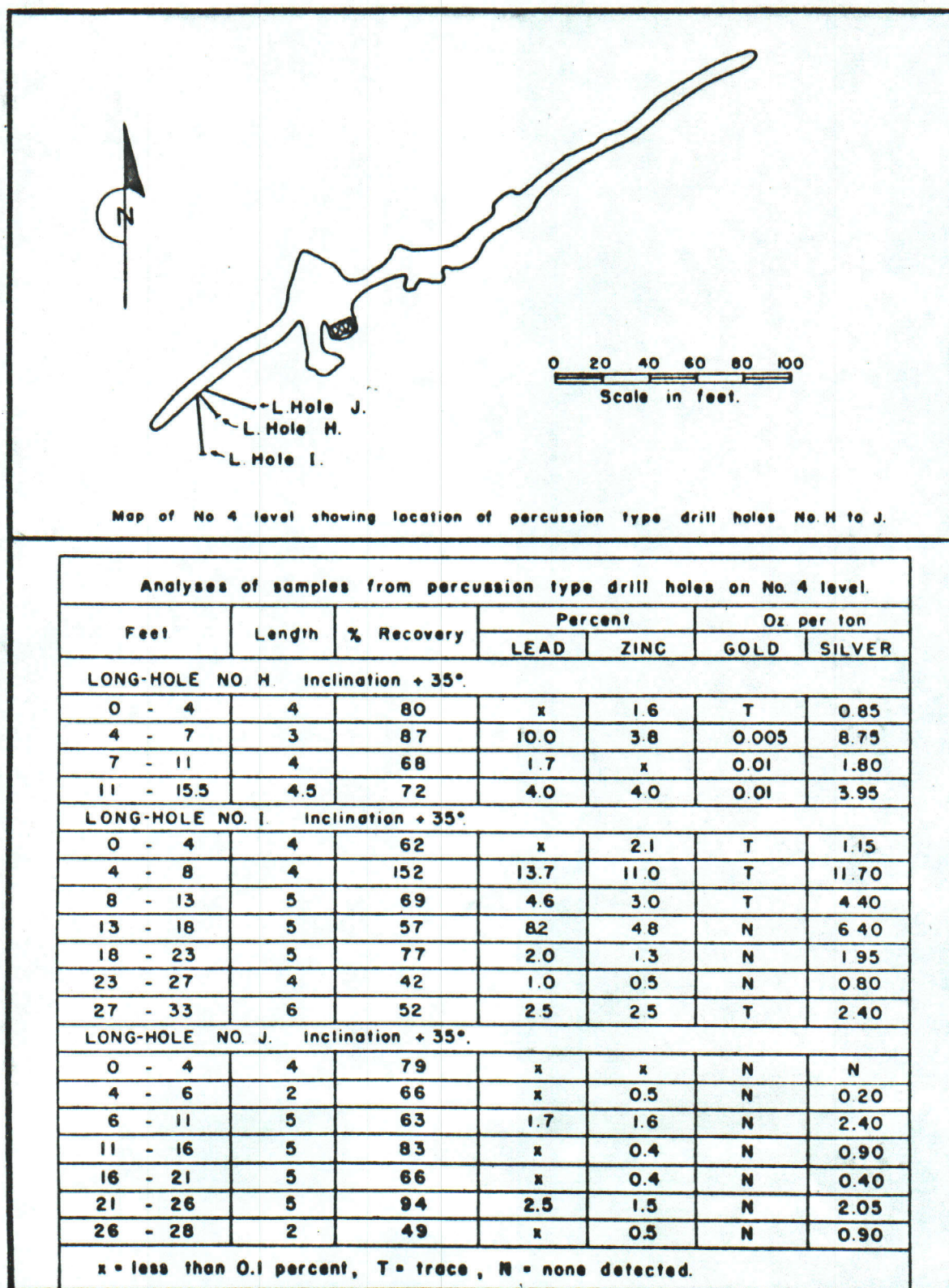


Figure 3. - Map showing locations of drill holes H to J, with log and analyses of samples.



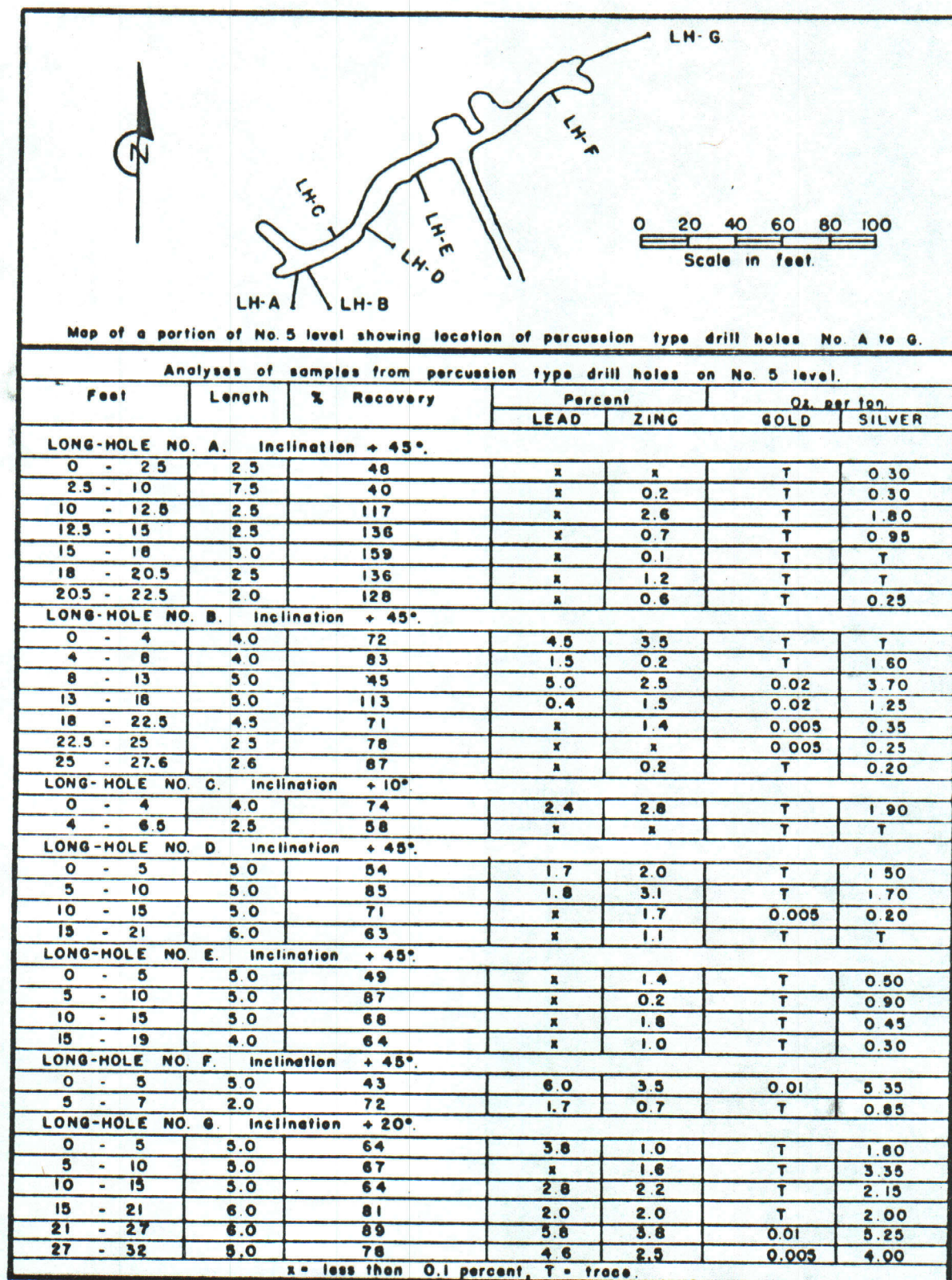
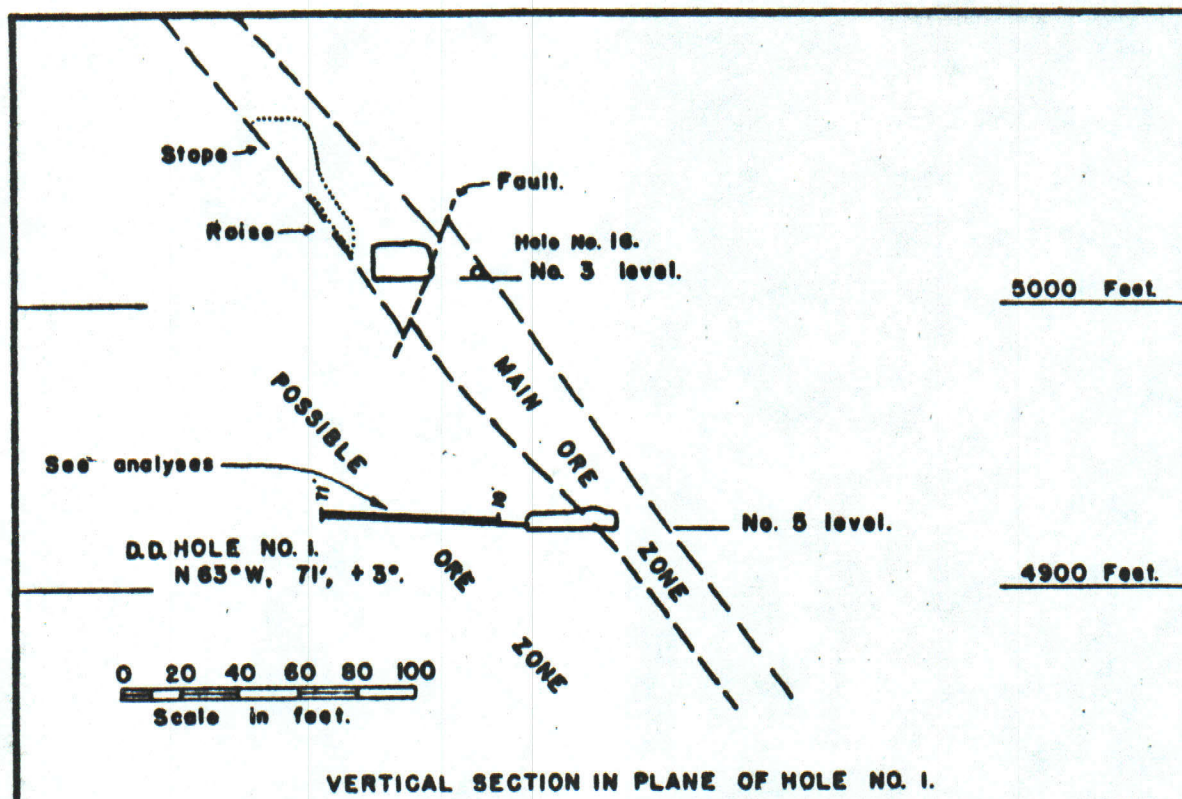


Figure 4. - Map showing locations of drill holes A to G, with log and analyses of samples.



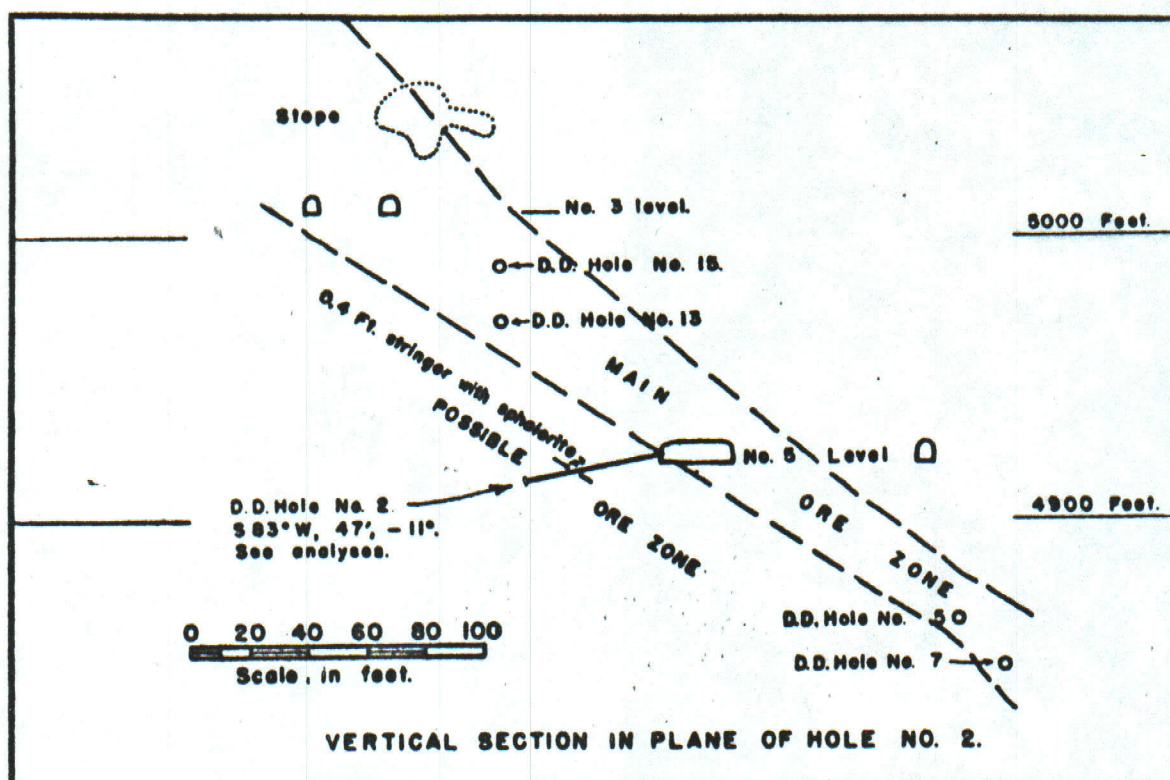


VERTICAL SECTION IN PLANE OF HOLE NO. 1.

ANALYSES OF SAMPLES FROM HOLE NO. 1.						
FEET	LENGTH	PERCENT LEAD	PERCENT ZINC	Oz./ton GOLD	Oz./ton SILVER	
10-15 S	5	0.4	0.3	T	0.20	
15-24 S	9	0.4	0.3	T	0.70	
24-36 S	12	0.4	0.3	N	T	
36-42 S	6	0.4	0.2	T	0.25	
42-50 S	8	0.3	0.2	N	T	
50-55 S	5	0.3	0.2	N	T	
55-59 S	4	0.3	0.2	N	N	
59-64 S	5	0.2	0.2	N	N	
64-68 S	4	0.3	0.2	N	N	
68-71 S	3	0.3	0.2	N	N	
S = Sludge. T = Trace. N = None detected.						

Figure 5. - Vertical section through drill hole 1, with log and analyses of samples.



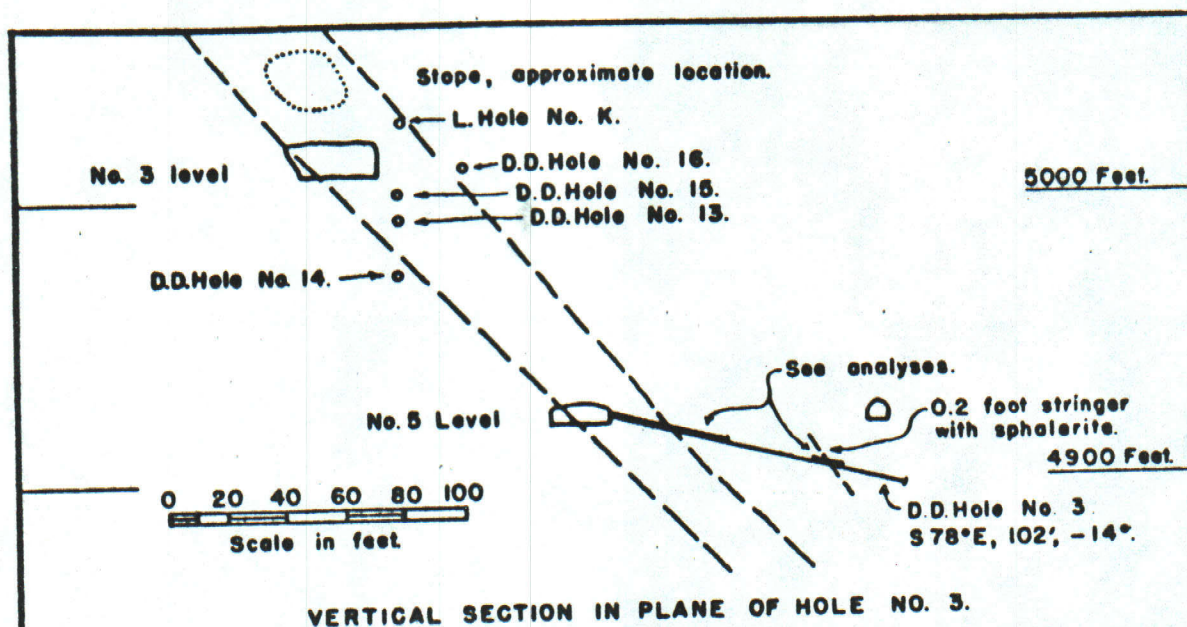


ANALYSES OF SAMPLES FROM HOLE NO. 2.					
FEET	LENGTH	PERCENT		Oz./ ton.	
		LEAD	ZINC	GOLD	SILVER
0- 8 S	8	x	0.2	0.035	0.06
10- 15 S	5	x	x	0.005	T
15-16.5 S	1.5	x	0.1	T	0.5
16.5-22 S	5.5	x	0.2	N	N
22-27 S	5	x	x	T	0.1
27-35 S	8	x	0.2	N	0.2
35-45 S	10	x	x	N	0.2
45-47 S	2	x	x	N	0.5

S = Sludge.  
 x = Less than 0.1 percent.  
 T = Trace.  
 N = None detected.

Figure 6. - Vertical section through drill hole 2, with log and analyses of samples.





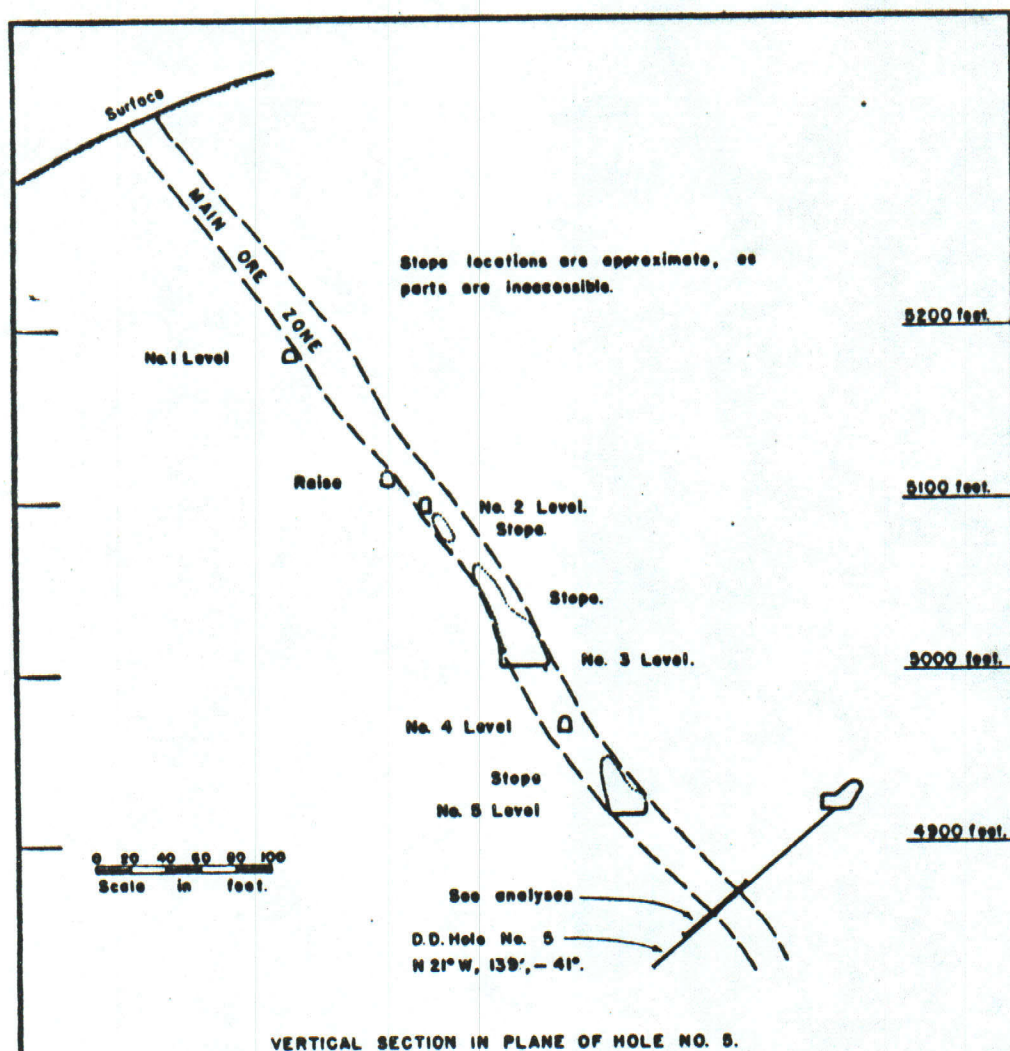
VERTICAL SECTION IN PLANE OF HOLE NO. 3.

ANALYSES OF SAMPLES FROM D.D. HOLE NO. 3.									
FEET		LENGTH	% RECOVERY		PERCENT			Oz. per ton	
			CORE OR SLUDGE		LEAD	ZINC	COPPER	GOLD	SILVER
0-2	S	2		34	2.2	2.4	0.05	T	1.10
0-2	C	2	30		3.3	3.8	0.10	T	2.40
2-6	S	4		31	0.2	2.4	-	N	2.20
2-3.5	C	1.5	53		x	2.7	-	T	1.40
3.5-4	C	0.5	80		6.2	2.5	0.32	T	5.50
4-6	C	2	50		3.8	2.0	0.11	T	2.95
6-10	S	4		34	5.0	3.9	0.05	T	1.55
6-10	C	4	80		x	2.0	-	T	1.50
10-15	S	5		47	2.5	4.0	0.05	N	1.60
10-11	C	1	40		x	0.2	-	T	0.75
11-15	C	4	25		0.3	3.6	-	T	2.40
15-20	S	5		53	0.2	2.3	-	N	0.75
15-20	C	5	16		0.5	4.3	-	T	1.70
20-26	S	6		76	x	0.5	-	N	0.25
20-26	C	6	28		x	x	-	T	T
26-31	S	5		59	x	0.2	-	N	0.05
31-36	S	5		86	x	x	-	N	N
36-40	S	4		35	x	x	-	N	0.45
70-80	S	10		54	x	x	-	N	0.10
74-74.2	C	0.2	64		x	3.4	-	T	T

S = Sludge.  
C = Core.  
x = Less than 0.1 percent.  
T = Trace.  
N = None.  
- = No analysis.

Figure 7. - Vertical section through drill hole 3, with log and analyses of samples.



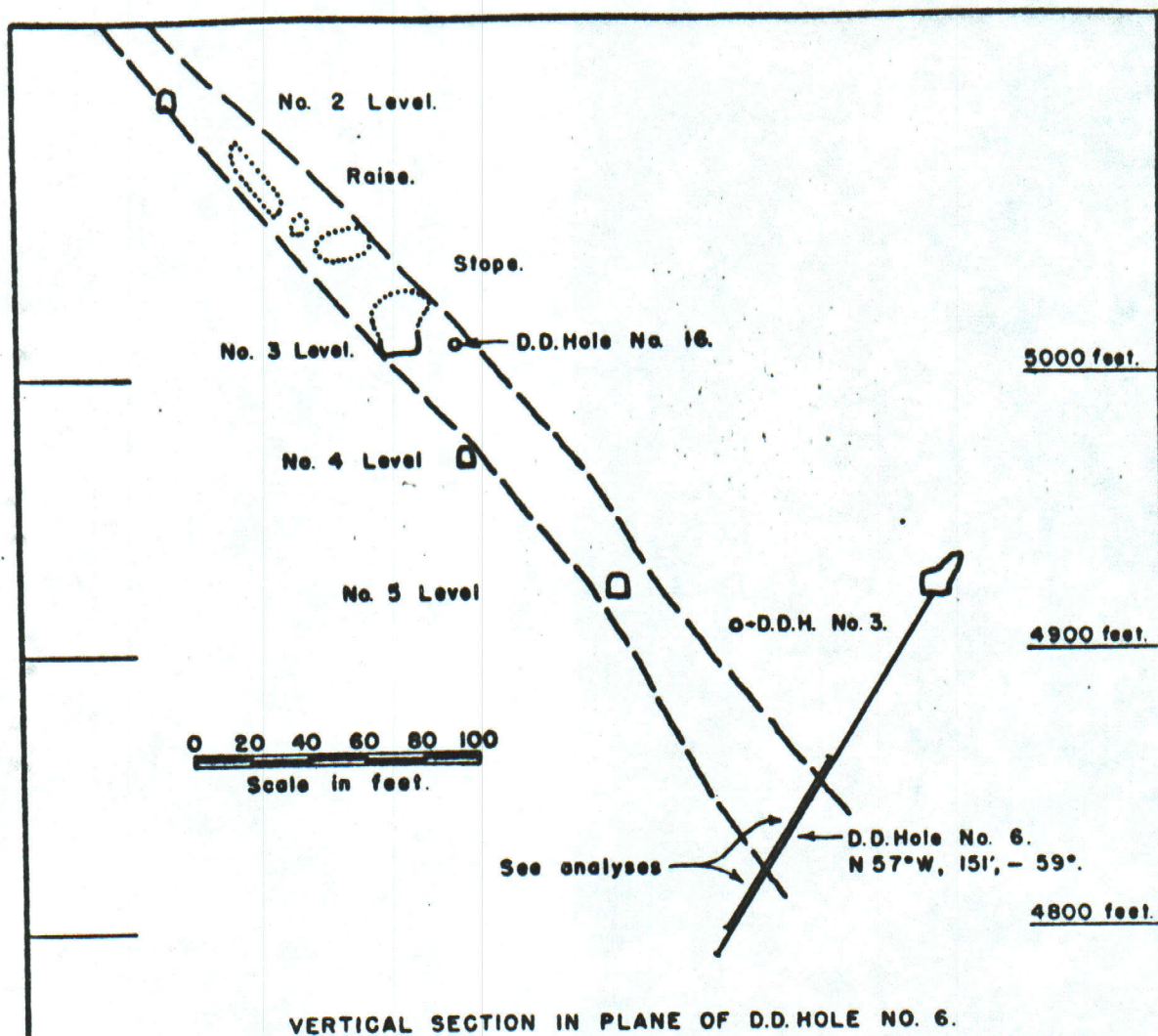


ANALYSES OF SAMPLES FROM D.D. HOLE NO. 5.						
FEET	LENGTH	% RECOVERY		PERCENT		Oz. per ton
		CORE OR SLUDGE		LEAD	ZINC	
66 - 73.5 S	7.5	47	x	1.0	T	T
73.5 - 77 S	3.5	31	x	1.0	T	T
77 - 88 S	11.0	45	x	1.1	T	T
83 - 88 C	5.0	44	x	0.5	N	N
88 - 92 S	4.0	82	x	1.8	T	T
92 - 101 S	9.0	39	x	0.2	T	T
92 - 101 C	9.0	32	x	x	N	N
101 - 113 S	12.0	58	x	0.2	T	T

S = Sludge.  
 C = Core.  
 x = Less than 0.1 percent.  
 T = Trace.  
 N = None detected.

Figure 8. - Vertical section through drill hole 5, with log and analyses of samples.





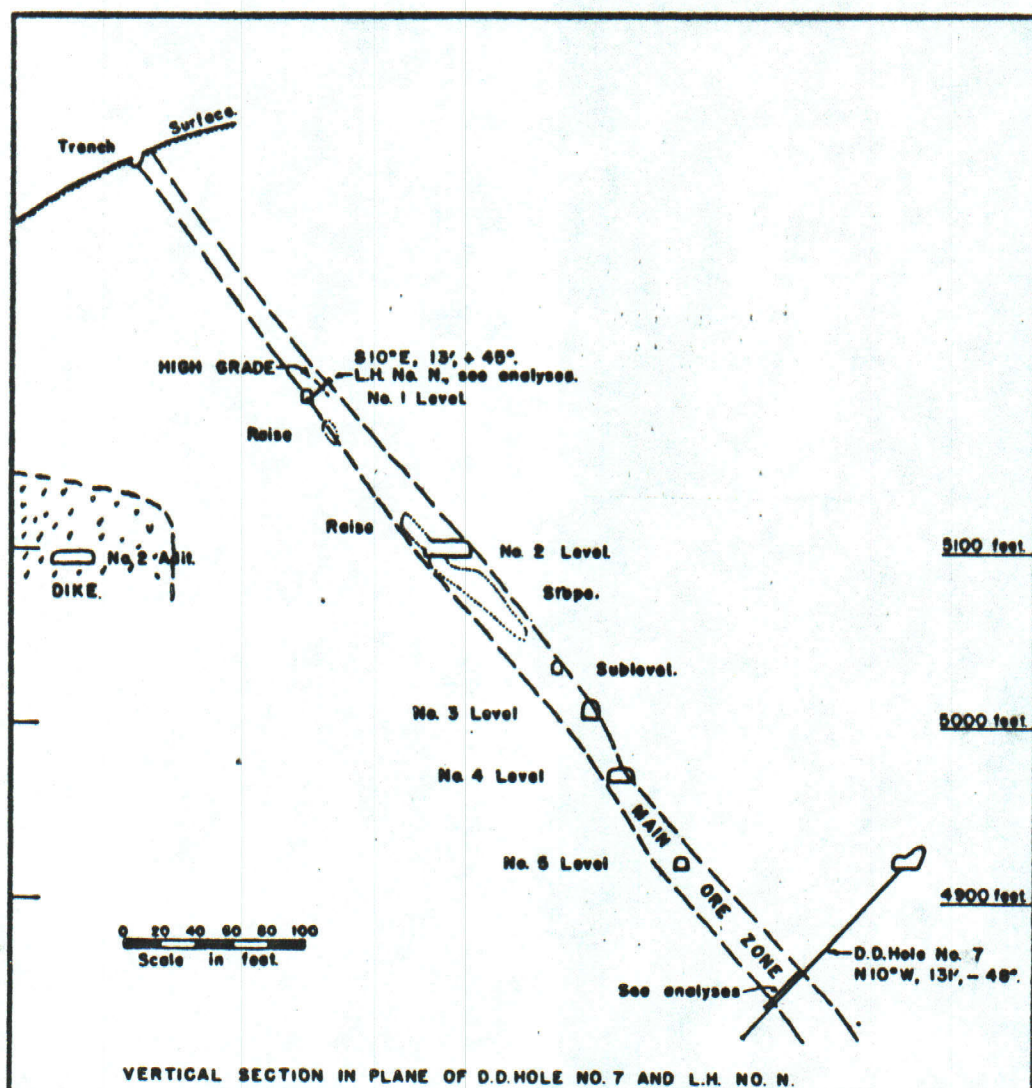
VERTICAL SECTION IN PLANE OF D.D. HOLE NO. 6.

ANALYSES OF SAMPLES FROM D.D. HOLE NO. 6						
FEET	LENGTH	% RECOVERY	PERCENT		Oz. per ton	
		CORE OR SLUDGE	LEAD	ZINC	GOLD	SILVER
69 - 73 S	4	13	x	x	T	T
73 - 78 S	5	62	x	0.2	T	T
78 - 87 S	9	44	x	1.7	T	T
87 - 101 S	14	39	x	0.6	T	T
101 - 106 S	5	48	x	0.7	T	T
106 - 111 S	5	41	x	1.1	T	T
111 - 116 S	5	117	x	1.0	T	T
116 - 123 S	7	88	x	0.2	T	T
123 - 130 S	7	39	x	x	T	T
130 - 136 S	6	59	x	0.2	T	T
136 - 141 S	5	78	x	0.5	T	T

S = Sludge, x = Less than 0.1 percent, T = Trace.

Figure 9. - Vertical section through drill hole 6, with log and analyses of samples.





VERTICAL SECTION IN PLANE OF D.D. HOLE NO. 7 AND L.H. NO. N.

ANALYSES OF SAMPLES FROM D.D. HOLE NO. 7.								
FEET	LENGTH	% RECOVERY		PERCENT				Oz. per ton
		CORE OR SLUDGE	LEAD	ZINC	COPPER	ARSENIC	GOLD	
81 - 86 S	5	49	x	1.5	-	-	T	0.30
81 - 86 C	5	40	x	0.7	0.10	3.41	T	0.40
86 - 89 S	3	45	x	4.0	-	-	0.01	0.50
86 - 89 C	3	50	x	5.2	0.10	10.16	0.01	0.55
89 - 94 S	5	31	x	3.1	-	-	N	0.35
89 - 94 C	5	42	x	4.2	0.29	0.40	N	0.65
94 - 99 S	5	30	x	3.4	-	-	0.01	0.55
94 - 99 C	5	28	x	2.5	0.14	3.92	0.04	0.68
99 - 104 S	5	26	x	0.9	-	-	N	0.20
99 - 102 C	3	74	x	1.0	0.16	9.52	N	0.15
102 - 104 C	2	74	x	0.11	0.95	N	N	N
104 - 109 S	5	32	x	x	-	-	N	N
ANALYSES OF SAMPLES FROM L.HOLE NO. N.								
0 - 5	5		x	1.7	-	-	T	0.60
5 - 10	5		6.6	3.0	-	-	0.005	0.60
10 - 13	3		x	1.0	-	-	T	0.30

S = Sludge, C = Core, x = less than 0.1 percent, - = no analysis, T = trace, N = none detected.

Figure 10. - Vertical section through drill hole 7, with log and analyses of samples.



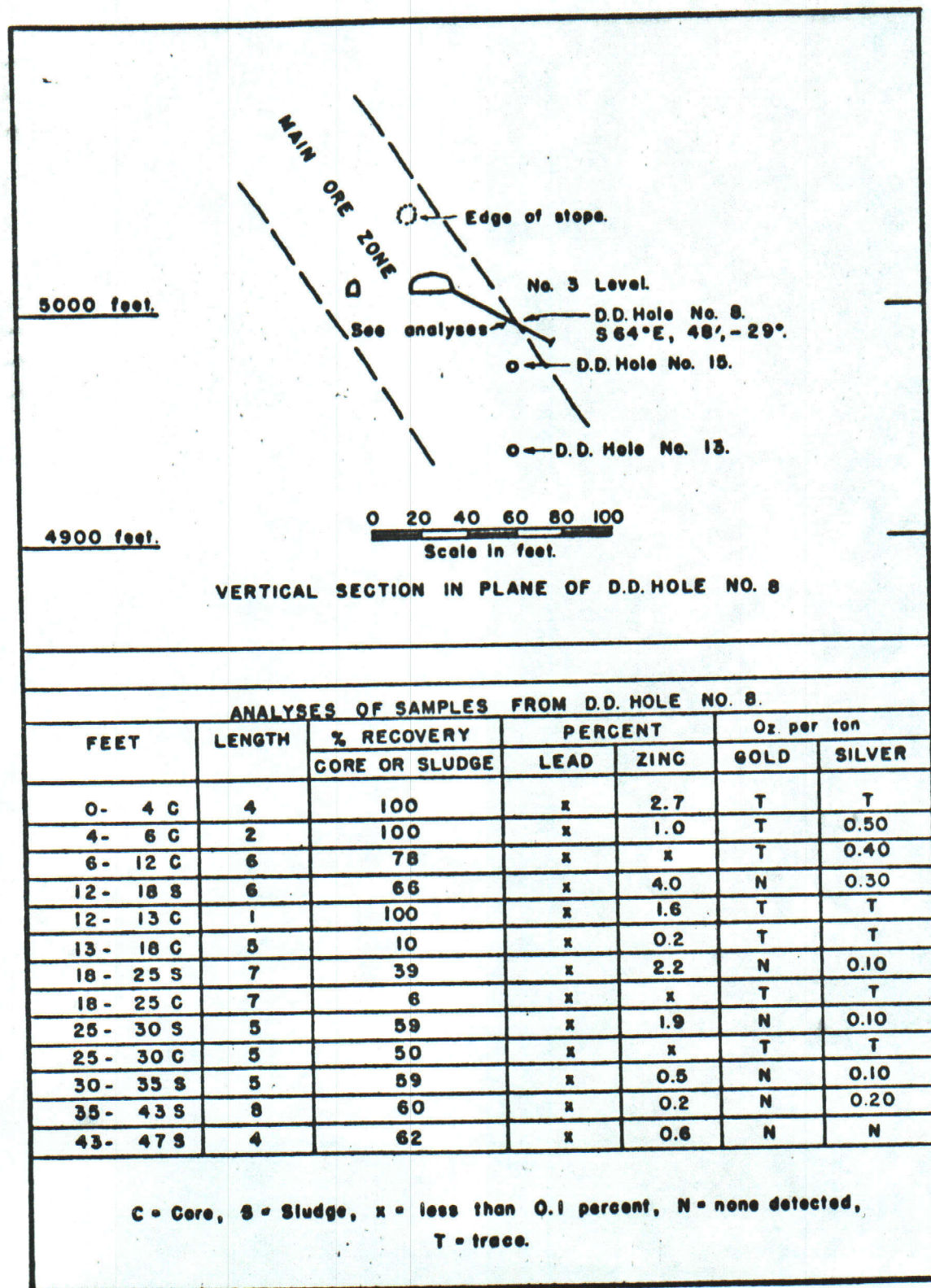


Figure 11. - Vertical section through drill hole 8, with log and analyses of samples.



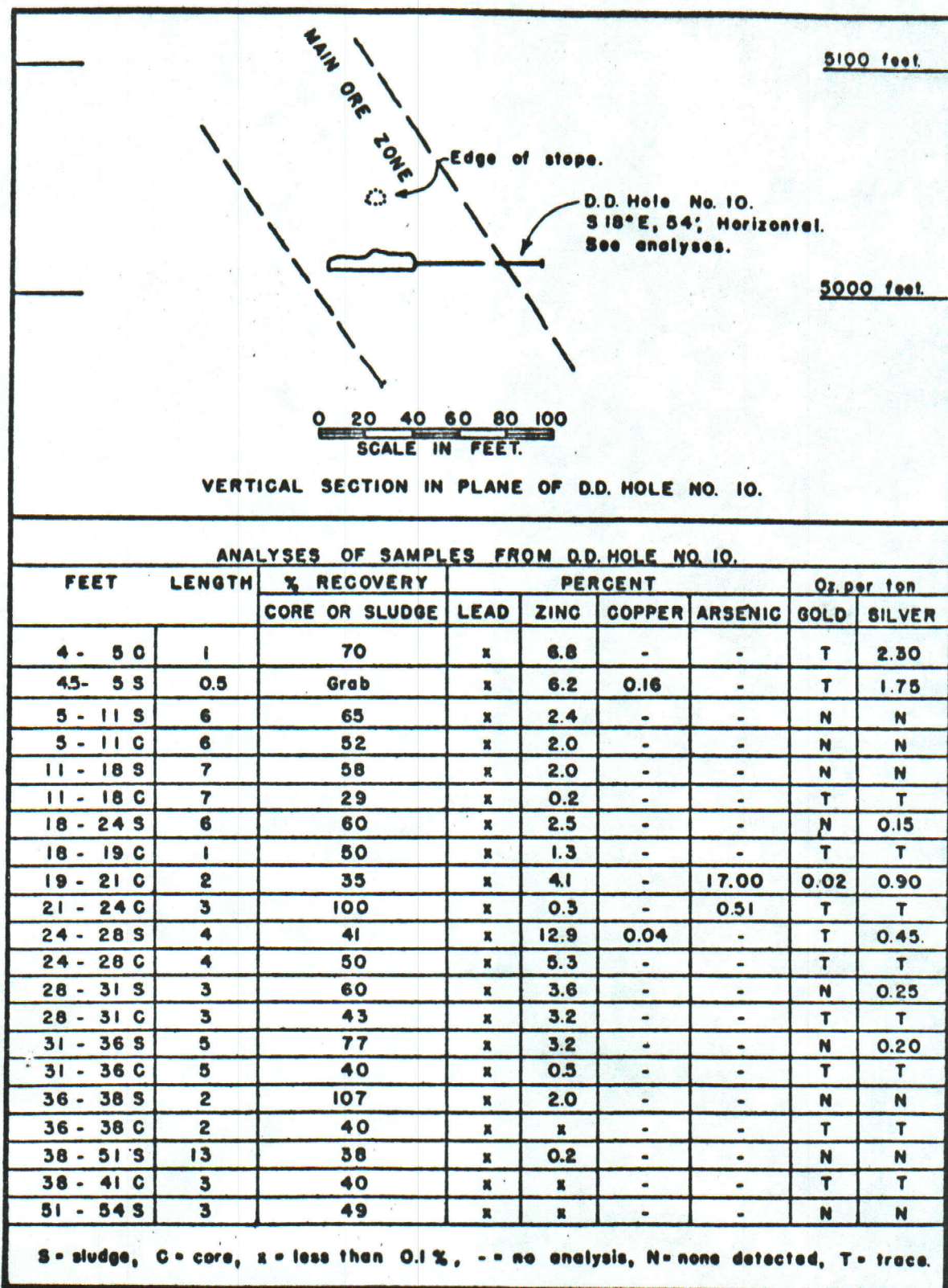
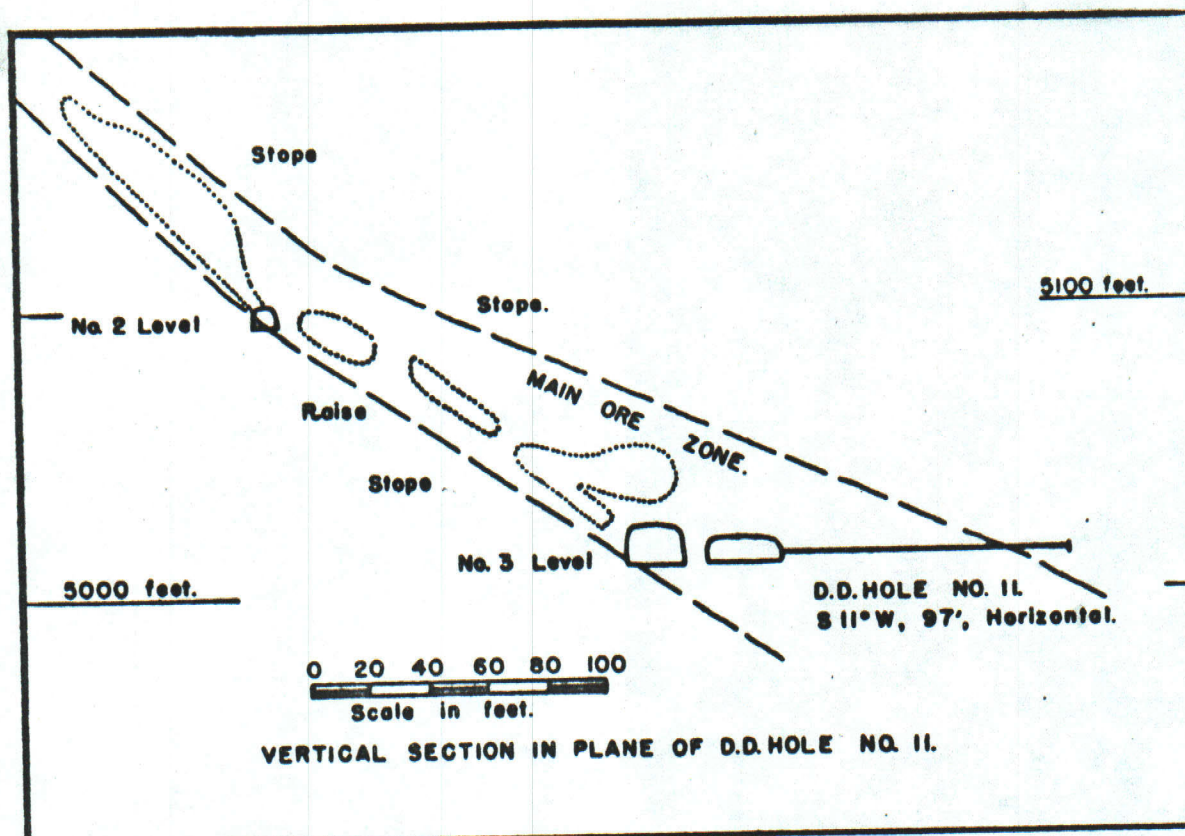


Figure 12. - Vertical section through drill hole 10, with log and analyses of samples.





VERTICAL SECTION IN PLANE OF D.D. HOLE NO. 11.

ANALYSES OF SAMPLES FROM D.D. HOLE NO. 11.							
FEET	LENGTH	% RECOVERY	PERCENT			Oz. per ton.	
		CORE OR SLUDGE	LEAD	ZINC	COPPER	GOLD	SILVER
5 - 14 S	9	45	x	x	-	N	0.30
14 - 20 S	6	42	x	x	-	N	0.10
20 - 30 S	10	54	x	0.2	-	N	N
30 - 37 S	7	61	x	2.5	-	N	N
30 - 34 C	4	40	x	0.9	-	T	T
34 - 37 C	3	43	x	0.7	-	T	T
37 - 44 S	7	55	x	2.8	-	N	0.40
37 - 44 C	7	11	x	2.4	-	T	T
44 - 50 S	6	59	2.6	4.0	0.06	N	2.10
44 - 50 C	6	20	3.1	1.9	-	T	2.70
50 - 55 S	5	25	4.0	5.3	0.04	N	2.75
50 - 55 C	5	40	x	0.8	-	T	1.10
55 - 60 S	5	54	4.0	4.6	0.06	N	4.00
55 - 60 C	5	14	x	2.3	-	T	1.15
60 - 65 S	5	60	x	3.6	-	T	0.30
60 - 65 C	5	40	x	1.3	-	0.02	T
65 - 74 S	9	52	x	2.2	-	N	0.70
65 - 69 C	4	40	x	0.4	-	0.01	0.45
69 - 74 C	5	60	x	x	-	T	T

S = sludge, C = core, - = no analysis, x = less than 0.1%, N = none detected, T = trace.

Figure 13. - Vertical section through drill hole 11, with log and analyses of samples.



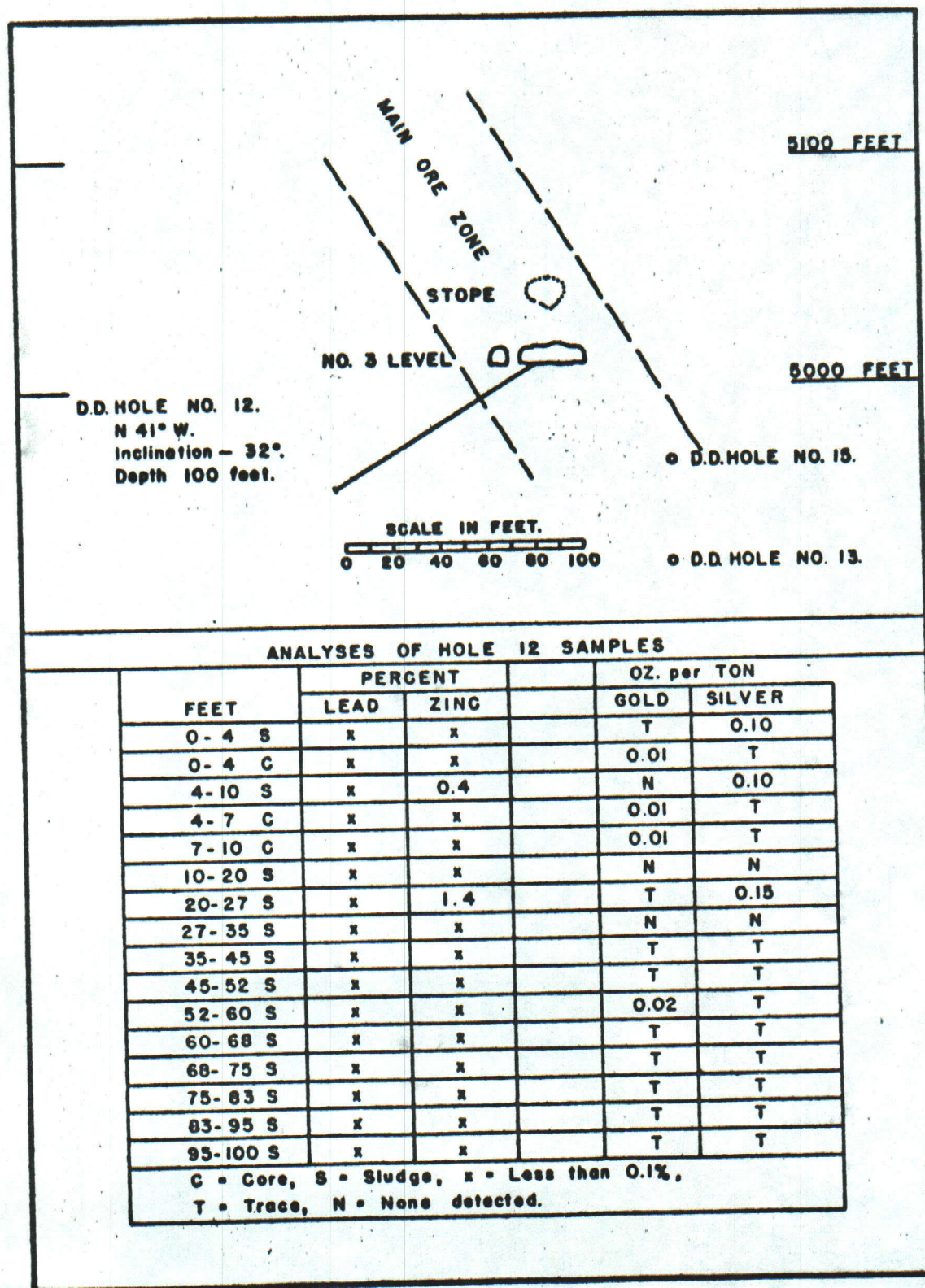


Figure 14. - Vertical section through drill hole 12,  
with log and analyses of samples.



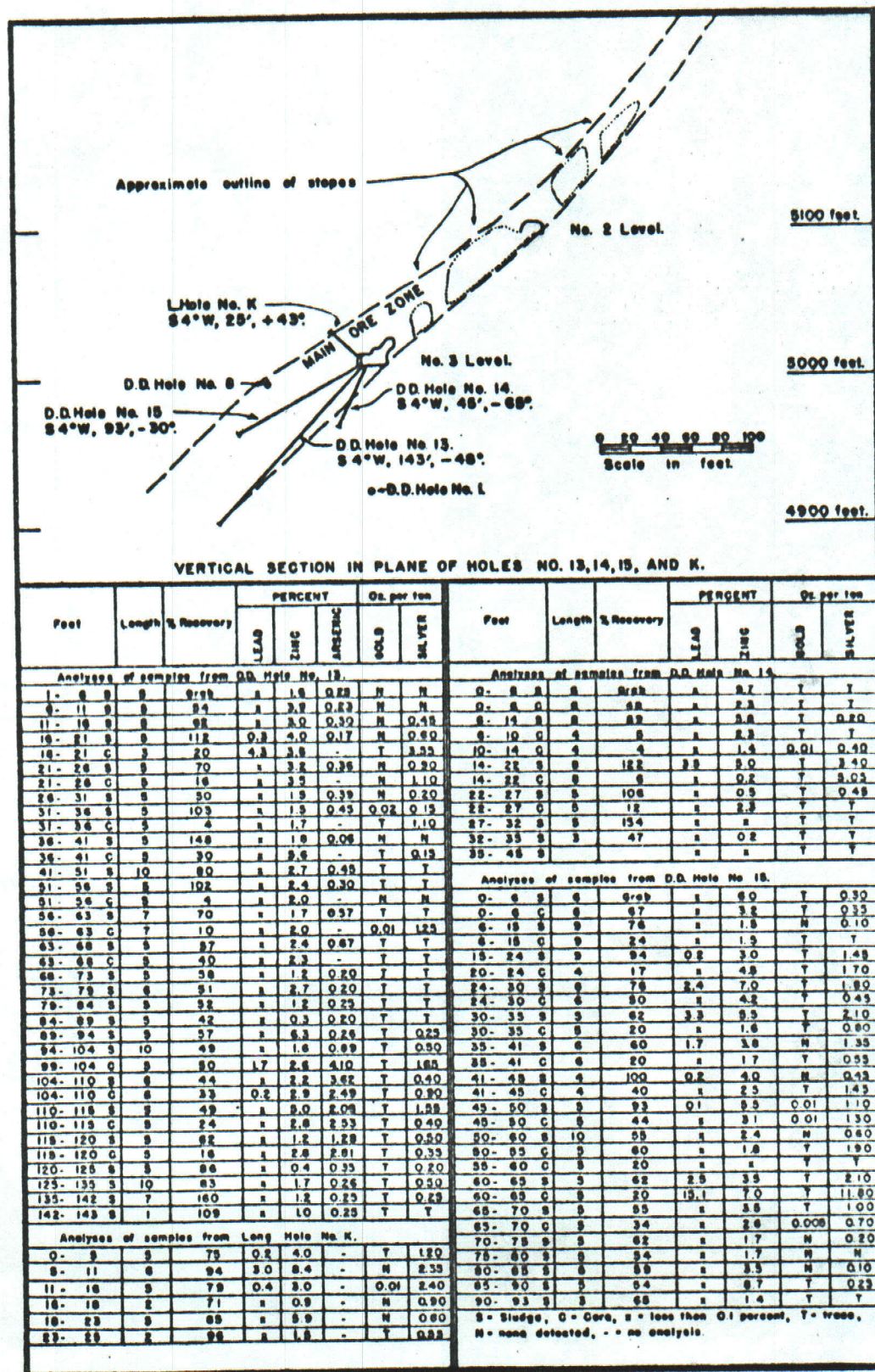
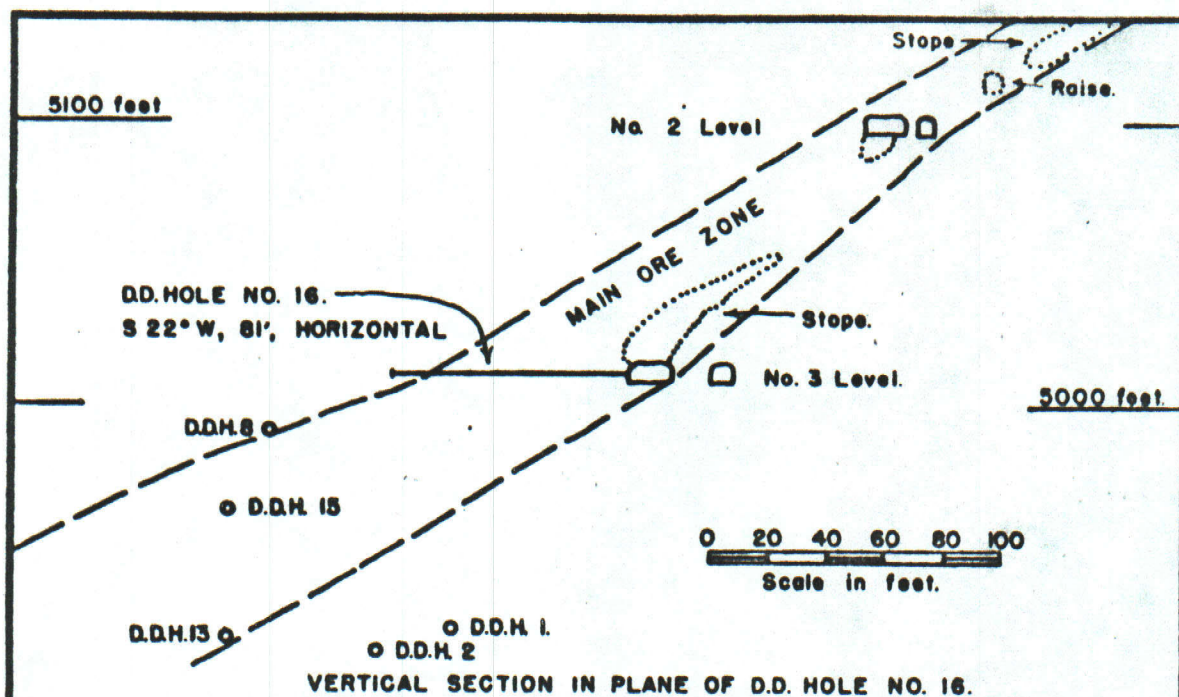


Figure 15. - Vertical section through drill holes 13, 14, 15, and K, with log and analyses of samples.





ANALYSES OF SAMPLES FROM D.D. HOLE NO. 16.

FEET	LENGTH	% RECOVERY	PERCENT			Oz. per ton	
			LEAD	ZINC	ARSENIC	GOLD	SILVER
05 - 3 C	2.5	57	x	1.8	-	N	0.60
3 - 4 C	1	57	23.3	6.0	-	T	19.30
4 - 7 C	3	57	1.8	1.4	-	N	2.55
7 - 11 S	4	65	5.5	3.5	-	T	4.45
7 - 11 C	4	90	5.1	3.8	-	T	5.10
11 - 16 S	5	57	1.8	1.9	-	T	1.30
11 - 16 C	5	54	1.8	3.4	-	N	1.60
16 - 21 S	5	60	0.5	2.2	-	T	0.80
16 - 21 C	5	28	5.2	6.2	-	N	4.60
21 - 26 S	5	75	5.0	5.9	-	T	3.85
21 - 26 C	5	80	4.2	5.8	-	N	3.80
26 - 31 S	5	52	5.2	5.8	-	T	5.15
26 - 31 C	5	36	4.2	5.4	-	T	3.50
31 - 36 S	5	57	1.2	1.9	-	N	0.95
31 - 36 C	5	36	1.6	1.9	-	N	2.15
36 - 41 S	5	58	1.0	1.2	-	T	0.85
36 - 41 C	5	20	0.2	1.6	-	T	1.30
41 - 46 S	5	64	0.4	x	-	T	0.40
46 - 51 S	5	70	1.5	2.8	-	T	1.05
41 - 51 C	10	14	x	1.1	-	T	0.50
51 - 56 S	5	69	5.3	4.1	-	N	3.85
51 - 56 C	5	80	8.3	6.0	-	T	7.20
56 - 61 S	5	79	2.2	3.4	-	N	1.40
56 - 61 C	5	44	x	2.6	0.59	T	1.30
61 - 66 S	5	65	x	15.2	-	T	0.85
61 - 66 C	5	12	x	4.6	8.15	0.005	0.40
66 - 71 S	10	51	x	1.5	-	N	N
66 - 68 C	2	20	x	2.3	10.12	0.01	0.20
66 - 71 C	3	60	x	0.8	-	T	T
71 - 81 S	5	46	x	0.4	-	N	N

S = sludge, C = core, x = less than 0.1%, T = trace, N = none detected, - = no analysis.

Figure 16. - Vertical section through drill hole 16, with log and analyses of samples.



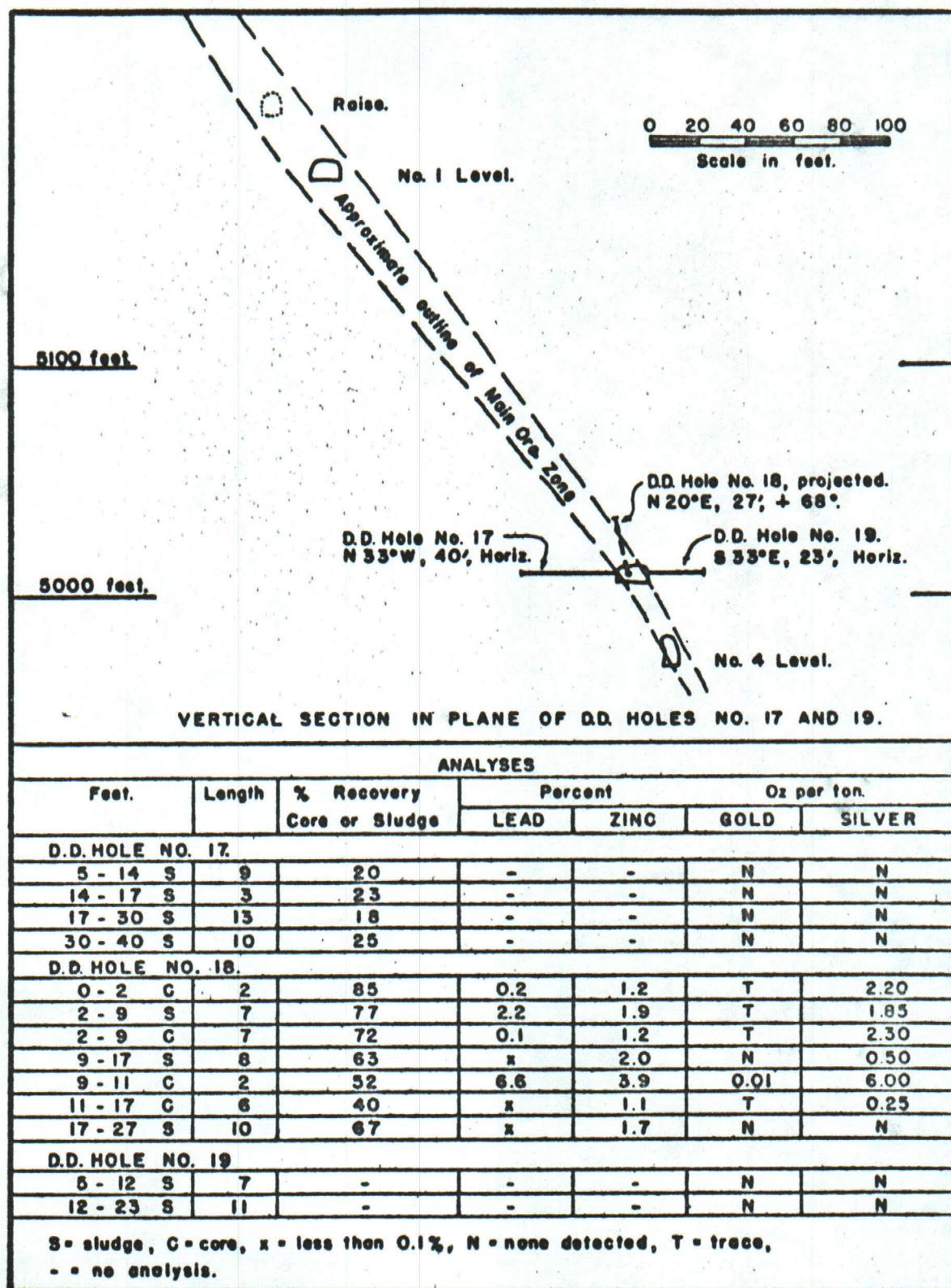


Figure 17. - Vertical section through drill holes 17, 18, and 19, with log and analyses of samples.



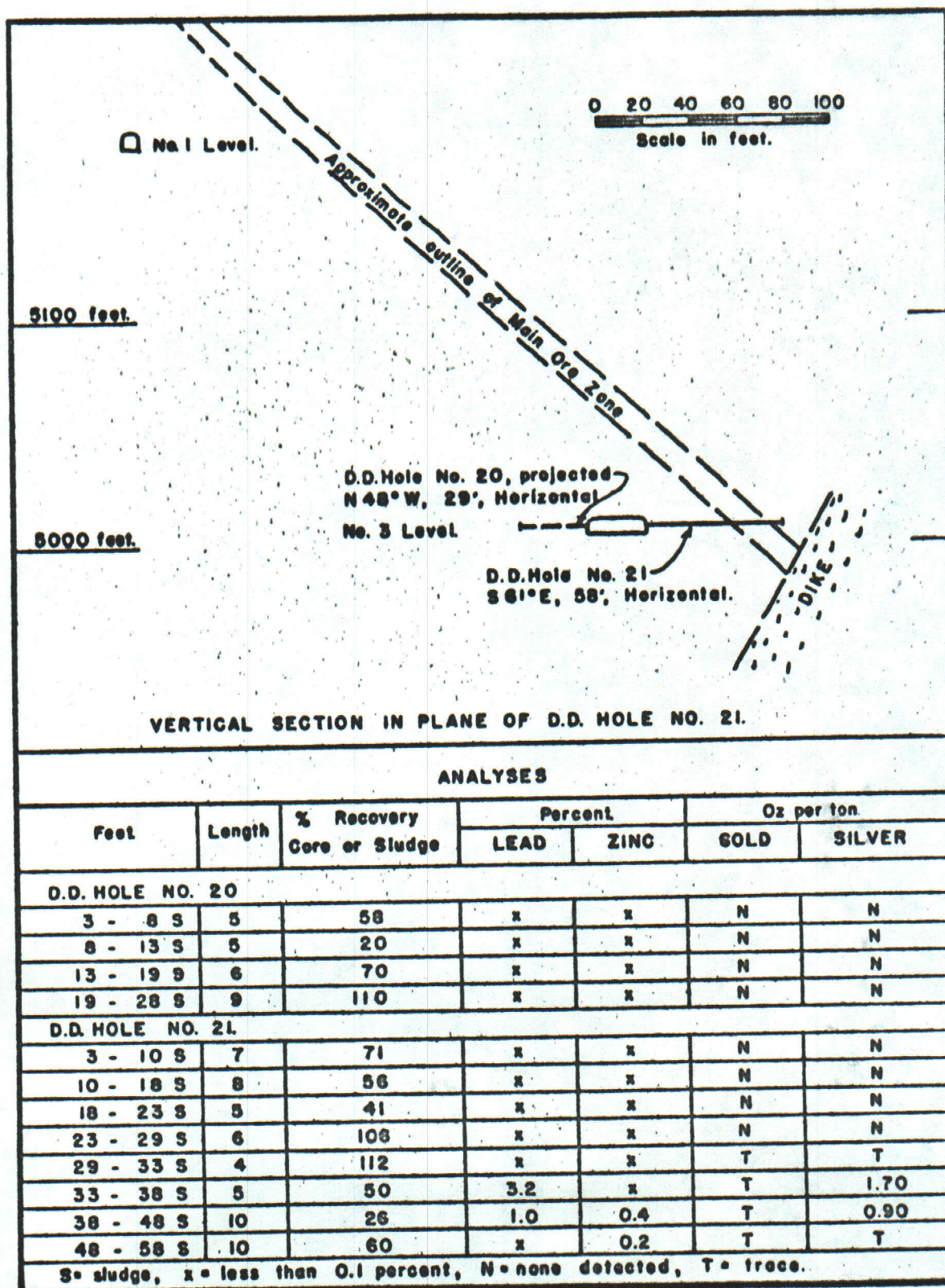


Figure 18. - Vertical section through drill holes 20 and 21, with log and analyses of samples.



Holes A, B, C, D, E, F, and G were used to sample the ore zone at the No. 5 level. Holes H, I, and J were used to locate and sample the ore zone at the No. 4 level. Holes L, M, N, P, R, S, and T were designed to locate and sample the ore zone on the No. 1 level.

#### DRILLING METHODS

All holes were drilled from underground stations. Core drilling was done by the contractor and the long hammer-drill holes were drilled by the Bureau of Mines.

Standard diamond-drilling equipment and technique were used on the core-drill holes. Factors that made diamond drilling difficult were:

1. Numerous small fractures and brecciated zones, which resulted in caving conditions along the holes and frequent blocking of the bit.
2. Some larger fault-type fractures with several inches of gouge. (At times several feet of hole had to be reamed because of slippage along a fault. Cementing to stop the caving was difficult, as the cement did not penetrate the gouge.)
3. Artesian water under heads great enough to force water out of the holes drilled from the No. 5 level. (This factor made it necessary to pump cement into the holes and hold the pressure until the cement set. As frequent cementing was required to stop caving, the extra time required on each cement job was an appreciable amount of the total time lost.)

The disadvantages mentioned above were compensated for by the small amount of cementing required to stop water loss in the holes. Only twice was there a total loss of water return. As a result, the sampler was able to pan the sludge at all times and accurately determine the points where mineralization began and ended.

All diamond-drill holes were collared at EX (2-3/8-inch) size and reduced to AX (1-7/8-inch) size as soon as the shattered rock adjacent to the mine workings was penetrated. Further reduction to EX (1-1/2-inch) size was made only when drilling conditions made it necessary. Reaming to a larger size to permit the advance of casing was necessary in some holes. An attempt was made to use thin-wall casing bits to ream the casing down, but this did not prove practical, because the excessive amount of caved material created so much drag that the casing could not be turned.

As the average core recovery in the ore zone was poor, it was necessary to save the sludge for analyses. Sludge was piped to a four compartment settling box, and between drill runs the contents of this box were transferred to a 50-gallon barrel for settling. In some of the high-sulfide zones penetrated, the sludge contained a high percentage of slimes that did not settle. Tests made on the overflow show that a 24-hour period of settling was required to permit decanting clear water from the slimes. The addition of settling agents, such as slacked carbide, to the sludge reduced this period to 1 hour.



At this mine there is a main ore zone trending northeast and dipping to the south. Within this zone are ore shoots and small ore-bearing fissures with a general trend transverse to the main structure. This made it desirable to locate each drill hole so as to cut across both the main ore zone and the transverse fractures. In some instances, two or more holes were required, in others, it was not practicable to cut both structures by drilling.

Long holes, which were used to sample areas where holes not over 30 feet long were required, were drilled with a medium-weight sinker-type drill mounted on a screw feed shell and operated from a vertical column. Sectional steel was used in lengths of 2, 2-1/2, 4, and 6 feet threaded for detachable bits and coupled with sleeves. The detachable bits ranged in size from 2-1/2 to 1-3/4 inches. This method of sampling proved to be very satisfactory. Analyses from barren zones between stringers of ore indicate that there was virtually no sloughing from the walls of the holes. Two holes, H and P, were stopped short of the desired depth because of caving ground. However, holes drilled with a slight offset were completed in the same areas. The steel was stuck several times and had to be hammered out, but no bits or sections of steel were lost in the holes.

A sampler panned the sludge from diamond drill holes and the cuttings from long holes, logged the data, gave instructions as to sample lengths, and was responsible for delivery of samples to the surface.