SAMPLING THE MOTH BAY ZINC-COPPER DEPOSIT, REVILLAGIGEDO ISLAND, SOUTHEASTERN ALASKA

by Robert S. Warfield and R. R. Wells

* open-file report

UNITED STATES DEPARTMENT OF THE INTERIOR

Stewart L. Udall, Secretary

BUREAU OF MINES

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SAMPLING THE MOTH BAY ZINC-COPPER DEPOSIT, REVILLAGIGEDO ISLAND, SOUTHEASTERN ALASKA

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Robert S. Warfield[1/] and R. R. Wells[2/]

ABSTRACT

The Bureau of Mines sampled surface and underground exposures and core drilled for possible extensions of the Moth Bay zinc-copper deposit during the summer field season of 1950. The deposit is less than a mile inland from the head of Moth Bay on Revillagigedo Island.

Diamond-drill holes penetrating the mineralized section below the main drift encountered mineralization through a greater width but at considerably lower grade than was found on the drift level and in the surface outcrops.

Large samples taken from representative underground exposures of the ore were concentrated by standard selective flotation methods to produce marketable copper and zinc concentrates with reasonably good recoveries.

INTRODUCTION

The investigation was initiated as a part of the Department of the Interior program for the evaluation of base metal resources. Zinc and copper mineralization were explored by surface cuts and underground workings to depths of slightly more than 100 feet during periods of activity in 1911-13 and 1929-31. After the claims were patented in 1932 there was no additional exploration until the date of this investigation in 1950.

The object of the investigation was to obtain information about mineral deposition at a depth below existing underground workings. It was considered probable that evidence of mineralization of the grade and width found on the surface and in underground workings would encourage exploitation of these resources by private operators.

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Work on manuscript completed September 1966.

ACKNOWLEDGMENT

August Bushman, of Seattle, Washington, president of the Freeburn Development Co. granted the government access to the property for the purpose of this investigation.

Special acknowledgment is given to B. D. Stewart,[3/] Harry Townsend,[4/] and members of the U.S. Geological Survey for free use of reports supplied or published prior to this investigation and to W. S. Twenhofel, Survey geologist, for logging the core extracted during this investigation.

LOCATION AND ACCESSIBILITY

Moth Bay is on the north side of the entrance to Thorne Arm approximately 15 miles southwest of Ketchikan on Revillagigedo Island (fig. 1). The zinc-copper deposit is approximately three-fourths of a mile inland from the head of Moth Bay (fig. 2) at altitudes of from 250 to 500 feet. The property is accessible from tidewater over a fair trail. Building of a road from Moth Bay to the property would not be difficult.

No docking facilities are available in Moth Bay; therefore, Bureau of Mines equipment and supplies had to be landed on the beach by small, flat bottomed skiff. The diamond drill was moved to the property under its own power. Two pumps were also moved to the property at the same time. A system of pulling the drill ahead one cable length then reaching back to pull the pumps to the drill was employed. All other equipment and supplies, rod, pipe, tools, gasoline, oil, etc., were back-packed to the property.

Charter airplane service between Ketchikan and Moth Bay is available at reasonable rates. The Bureau of Mines had excellent success with a radiotelephone operated on schedule with the Air Force Communications System (ACS) in Ketchikan.

3/ Stewart, B. D. Retired Commissioner of Mines, Territorial Department of Mines. Excerpt from Report on Cooperation Between the Territory of Alaska and the United States in Making Mining Investigations and in the Inspections of the Mines for the Biennium Ending March 31, 1931.

4/ Townsend, Harry. Consulting geological and mining engineer (deceased). Report on the Maiden Bay Prospect, Revillagigedo Island, Alaska. 4 pp., map. Private report.

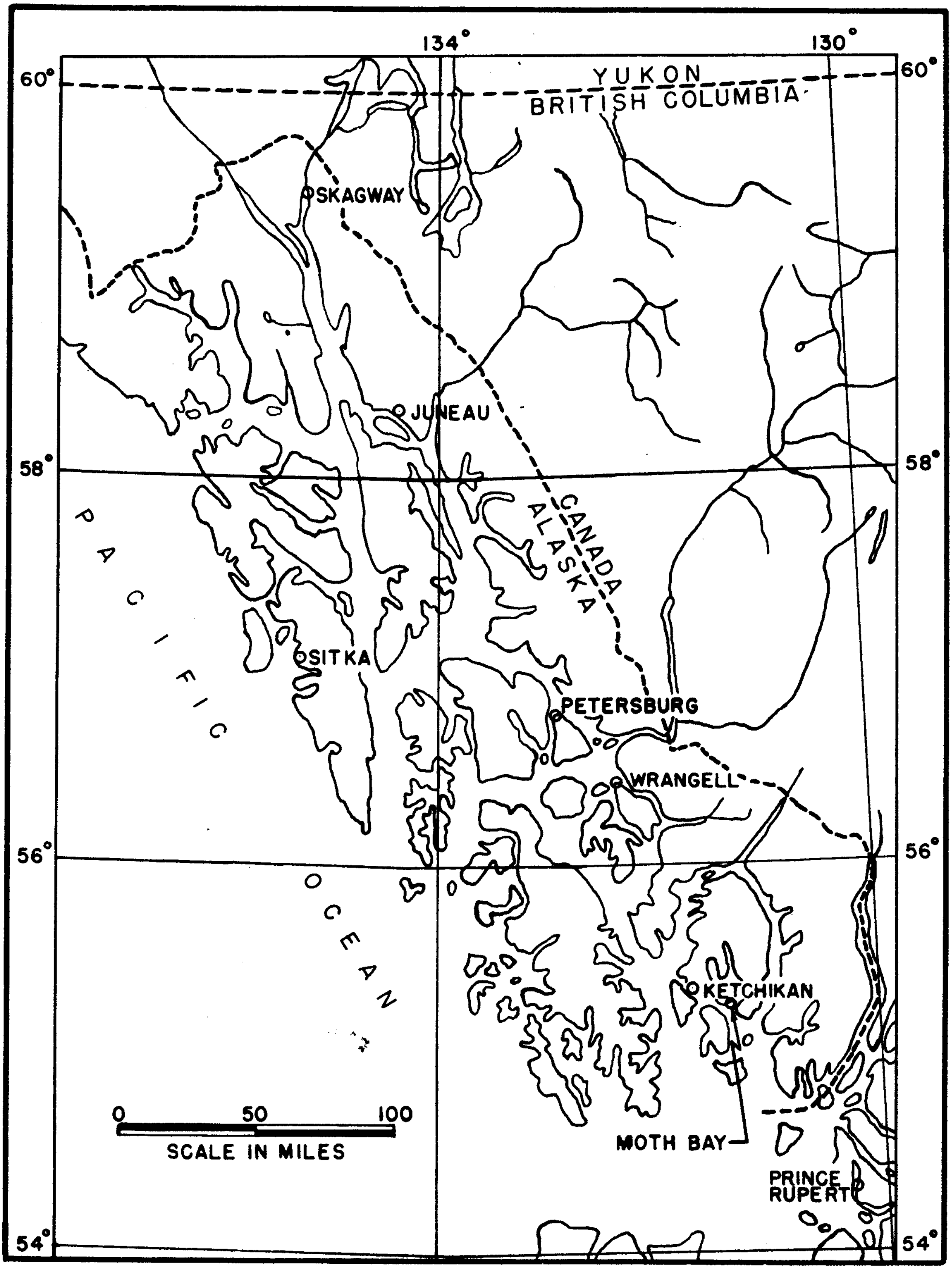

FIGURE 1. -INDEX MAP OF SOUTHEASTERN ALASKA

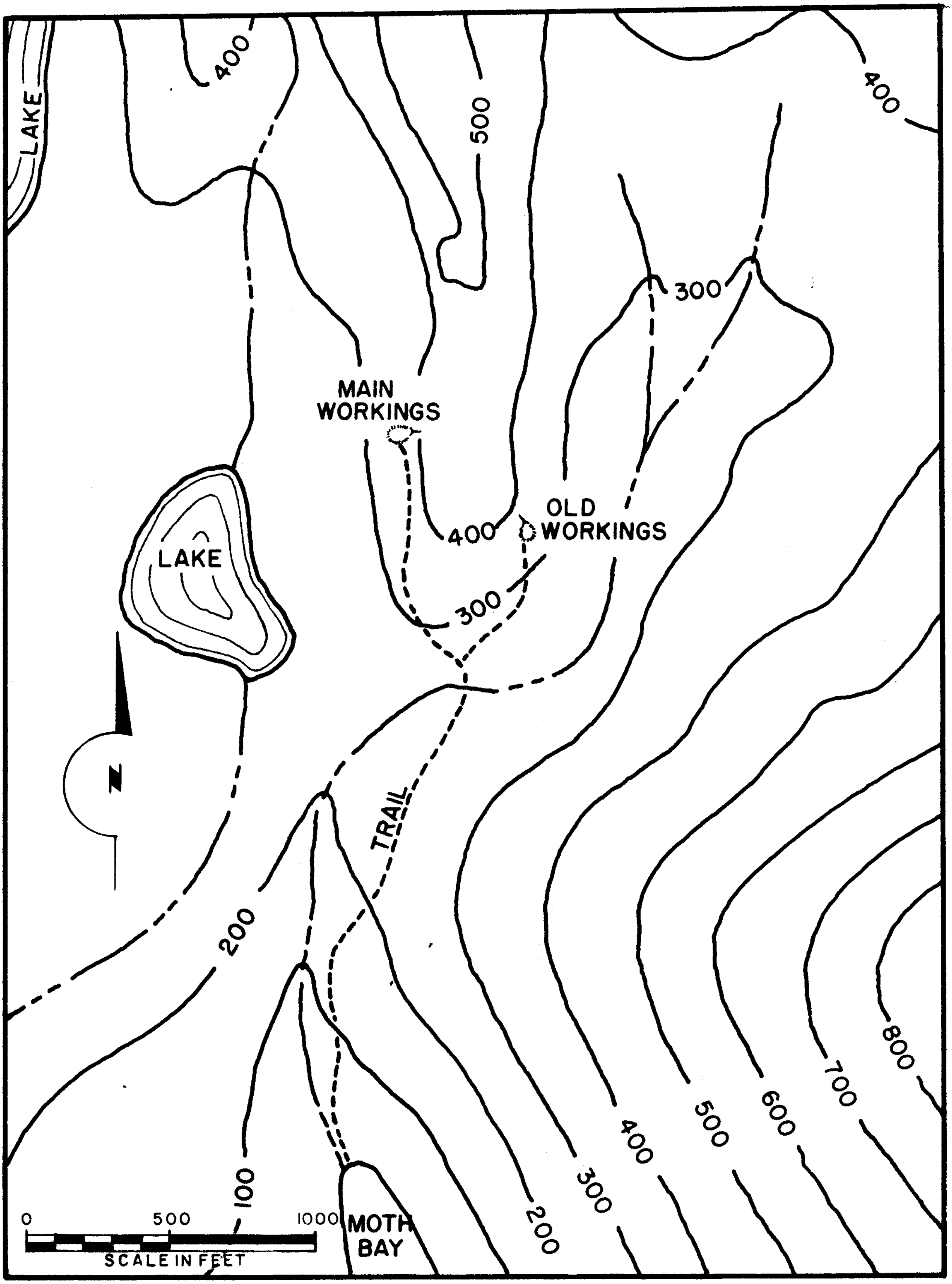

FIGURE 2.-LOCATION MAP OF MOTH BAY ZINC COPPER DEPOSIT

PHYSICAL FEATURES AND CLIMATE

The deposit is on a low ridge which rises slightly above a muskeg- and lake-covered lowland extending 7 miles from north of the mouth of Thorne Bay to Carrol Inlet. Multipeaked land masses rise to altitudes of about 2,000 feet on either side of this glacially eroded lowland. Most of the area is covered by glacial till which in turn supports dense vegetation. Where drainage is good, cedar, spruce, and hemlock timber, suitable for mining purposes, is abundant. Moss, berry brush, and devils club obscure all except a few rock exposures and impede foot travel. Fresh water for mining purposes is available.

Ketchikan has an average annual precipitation of 150.89 inches which includes an average annual snowfall of 34.7 inches; a mean annual temperature of 45.0° F with a 96° F maximum and a -8° F minimum.

HISTORY, OWNERSHIP, AND DEVELOPMENT

The Gold Standard Mining Co. did the first recorded[5/] exploration and development of the Moth Bay deposit from 1911-13. The work consisted of surface exploration, a 75-foot adit-drift, and a steeply inclined 100-foot winze, driven off the drift; the winze is now more than half full of water. The adit and winze are referred to as the old workings.

The Freeburn Development Co. secured control of the property in 1929 from Griswold, McGuire, and Dodge of Ketchikan and began an exploration and development program. Surface cuts exposed zinc-copper mineralization which was explored by 800 feet of underground workings. Underground work consisted of a crosscut adit which intersected the ore bed at 180 feet, a drift in the footwall driven in either direction from the crosscut, and 9 short crosscuts driven off the footwall drift; the footwall drift has a maximum depth beneath the surface of about 125 feet. Timber supports were not used and no significant rock falls had occurred during the 25 years since completion of the work.

The Freeburn Development Co. property consisted of five patented lode claims, the Lone Jack, the Black Jack, Youzinka, Bonanza King, and Sulphide; all covered by U.S. Mineral Survey 1590.

In 1959, as a result of civil action, the State of Alaska was awarded title to the Moth Bay patented claims; this status prevails currently (1966).

There are no usable buildings or equipment on the property.

5/ Work cited in footnote 3.

GEOLOGY

The geology of the Moth Bay zinc-copper deposit is briefly summarized from a report by the U.S. Geological Survey,[6/] a private report,[7/] and supplemented by information resulting from the Bureau of Mines drilling program.

The metallic mineralization of the Moth Bay deposit occurs in a metamorphic remnant of mica quartz schist having dimensions of more than 1/2 mile in length by over 1/4 mile in width. The schist rocks are centrally and longitudinally divided by a transition from biotite quartz schist to muscovite quartz schist; the biotite overlies the muscovite. Quartz diorite and granite, surround and intrude the remnant; intrusions into the remnant are generally in the form of dikes. The schist rocks are of probable Ordovician to Jurassic age and the granitic rocks of Late Jurassic or Early Cretaceous age.

Ore occurs in the transition zone where metallic sulfides have intermittently replaced schist beds along a total strike length of about 1,100 feet. The metallic minerals include, in order of decreasing abundance, iron sulfides, dark iron-rich sphalerite, copper sulfides (principally chalcopyrite with minor amounts of bornite and covellite), magnetite, galena, silver, and gold.

The average strike of the ore-bearing beds is N 55° W with dips ranging from 80° NW through vertical to 40° S; the northwest dipping beds are apparently overturned. Underground, in the main workings drift, dips increase from 45° SW in the northwest end to 70° in the southeast end. Vertical sections constructed in the planes of the four drillholes that intercept the same strata as that encountered in the main drift workings indicate similar trending dips as in the main drift except that there is considerable flattening at depth to the northwest.

The main drift follows a gouge seam or fault fracture that parallels the ore bed near the footwall. This fault fracture has been mapped as one of several that branch from a main fault near the southern end of the drift. Displacements of dikes by the branch faults do not exceed a few feet. Displacement of the main fault, which strikes N 15° W and dips approximately 70° E, is unknown and continuity of ore which it cuts off is also unknown. In addition, even though the south end of the drift is only about 25 feet beneath the surface and surface exposures are relatively abundant, neither a surface expression of the principal fault nor a displaced segment of the ore body was found. Robinson[8/] believes displacement may have been mostly vertical rather than horizontal.

6/ Robinson, G. D. and W. S. Twenhofel. Some Lead-Zinc and Zinc-Copper Deposits of the Ketchikan and Wales Districts, Alaska. U.S. Geol. Survey Bull. 998-C, 1953, pp. 59-71.

7/ Work cited in footnote 4.

8/ Work cited in footnote 6.

WORK DONE BY THE BUREAU OF MINES

Work by the Bureau of Mines consisted of seven diamond drillholes totaling 2,148.5 feet, channel sampling both underground and on the surface (figs. 3-4), and metallurgical testing. The channel samples provided material for the metallurgical testing.

Drillholes were oriented to test for continuity of zinc-copper mineralization to moderate depths beneath surface and underground workings. The results of assays made on core samples indicate greater widths of sulfide mineralization at drillhole depth than on the surface or in the underground workings but lower grade of ore (figs. 5-6). Complete results of assays made on core and channel samples are in tables 1 and 2.

Core logs giving complete descriptions of the strata penetrated by each drillhole are in table 3.

All holes were drilled from the hanging wall or southwest side of known ore deposition. Two holes were inclined at -35°, 4 at -40°, and one at -45°; lengths of holes varied from 147.3 to 428 feet.

Drillholes were all started and drilled BX (2-3/8-inch-diameter hole by 1-5/8-inch-diameter core) to solid bedrock; AX casing was then installed and the holes were continued AX (1-15/16-inch-diameter hole by 1-1/8-inch-diameter core) to bottom. Excellent drilling conditions with good core and water recovery were encountered in all drillholes. Since core recovery was generally very good, sludge samples were not saved.

Drill cores were returned to Juneau in entirety where they were carefully logged, sampled, and the samples assayed. Several years later, the cores remaining after sampling were skeletonized and the representative skeleton cores currently (1966) remain on file in the Bureau of Mines Juneau core library.

Channel samples, aggregating 190.8 lineal feet, were taken in both the underground workings and in the surface open cuts (figs. 3-4); analyses are in table 2. Most of the open cuts were still in good condition so that very little retrenching was necessary.

TABLE 1. - Diamond-drill core sample analyses

Hole No.	Sample No.	Interval		Core recovery, percent	Percent		Ounce per ton	
		From	To		Zinc	Copper	Gold	Silver
1	1	253.0	260.0	84	0.1	0.09	-	-
	2	260.0	265.0	86	.4	None	-	-
	3	265.0	269.0	87	1.3	None	-	-

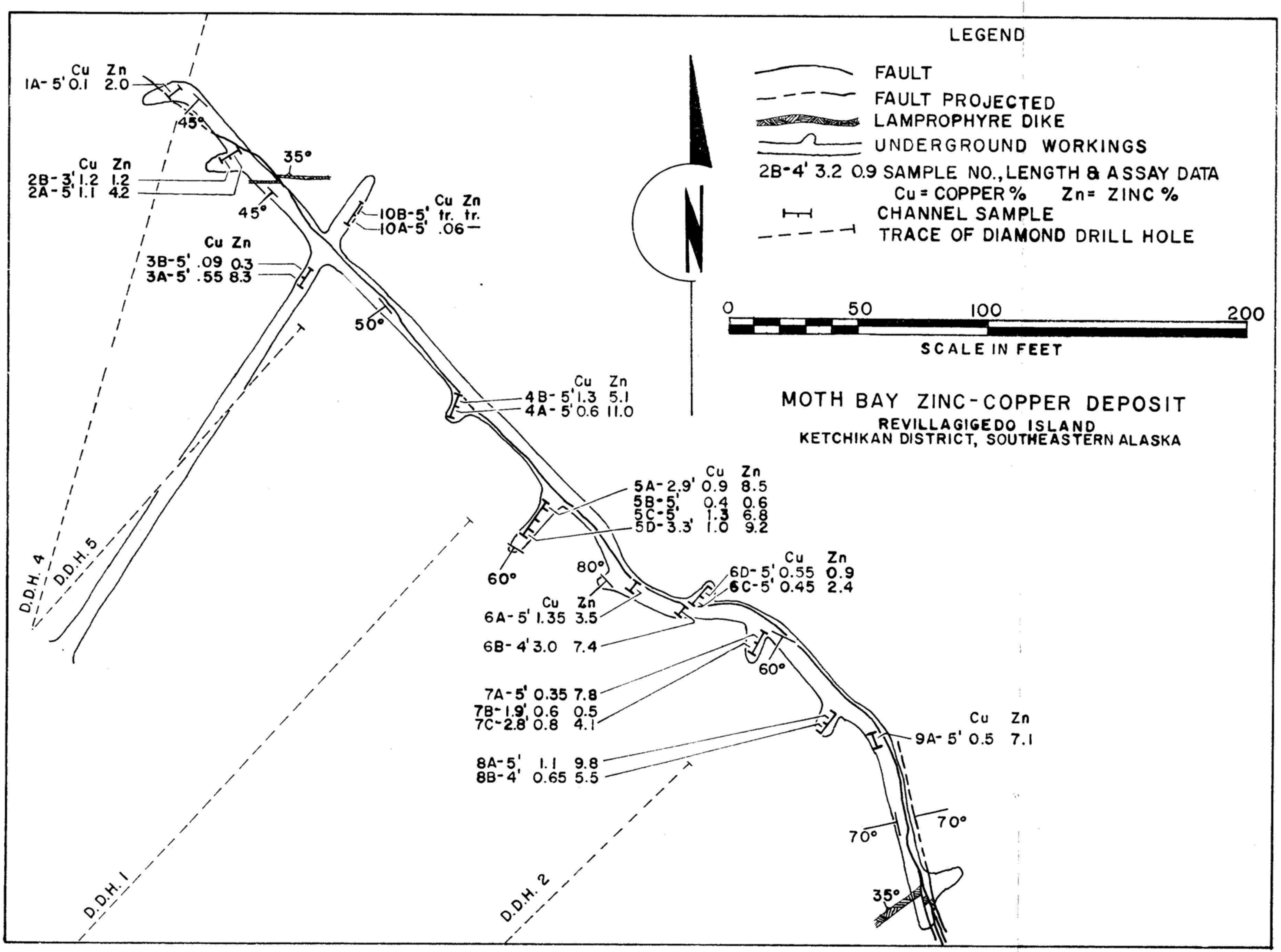

FIGURE 4. -MAP SHOWING MAIN UNDERGROUND WORKINGS AND CHANNEL SAMPLES

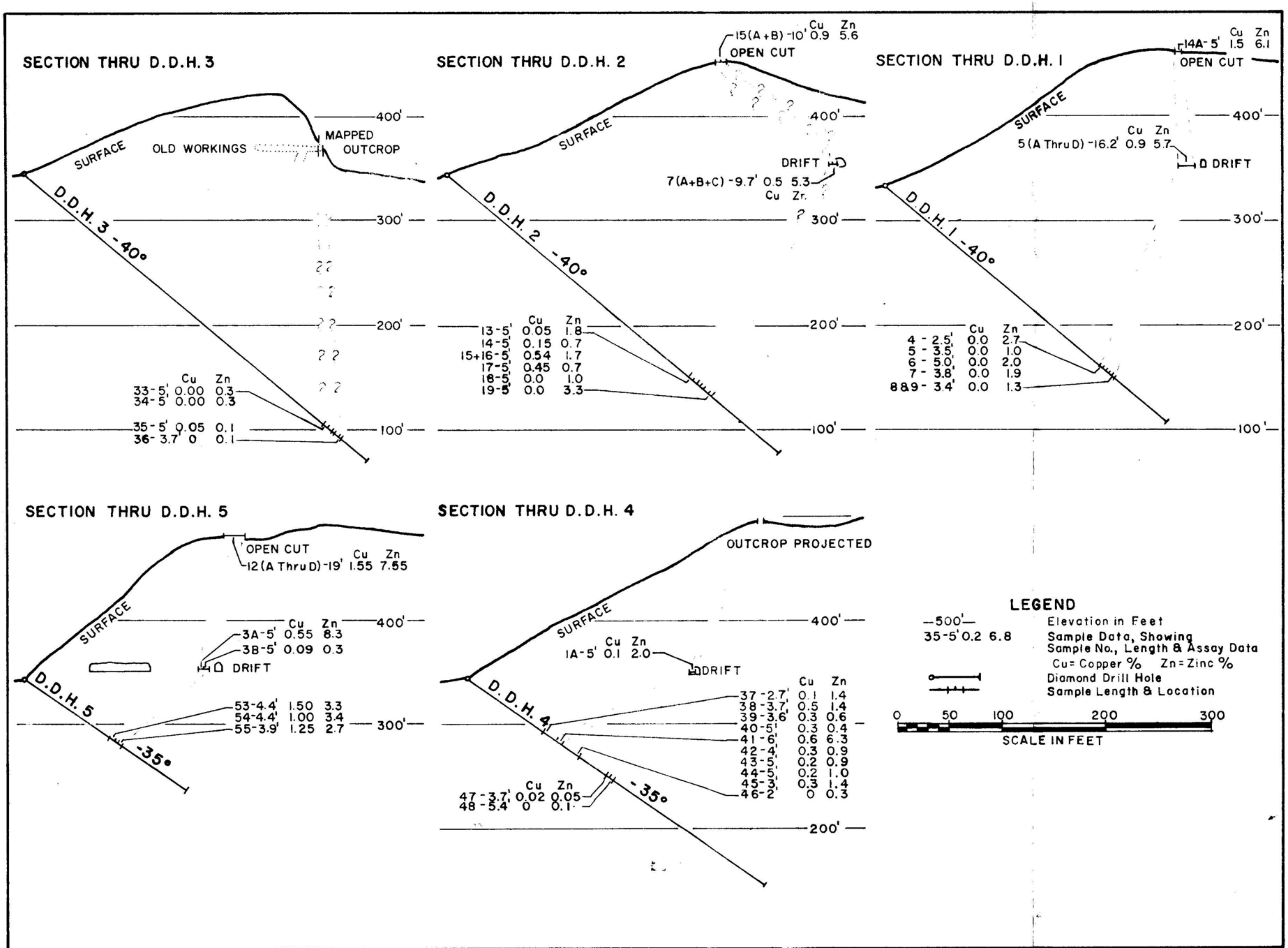

FIGURE 5.-SECTIONS- MOTH BAY ZINC-COPPER DEPOSIT

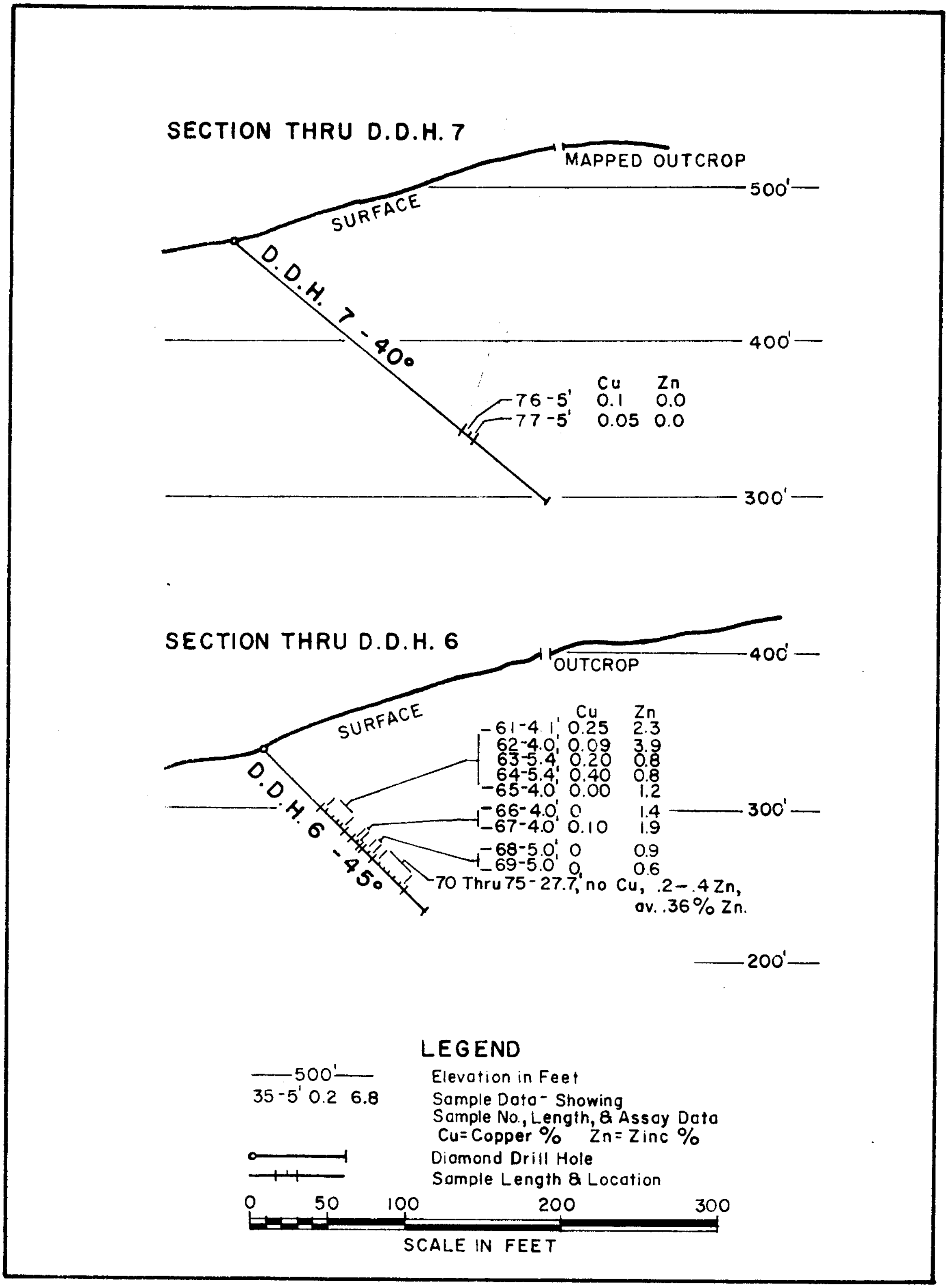

FIGURE 6.- SECTIONS- MOTH BAY ZINC-COPPER DEPOSIT, NW END

TABLE 1. - Diamond-drill core sample analyses--continued

Hole No.	Sample No.	Interval From	Interval To	Core recovery, percent	Percent Zinc	Percent Copper	Ounce per ton Gold	Ounce per ton Silver
1	4	269.0	271.5	92	2.7	None)		
	5	271.5	275.0	91	1.0	None)		
	6	275.0	280.0	96	2.0	None)	Trace	Trace
	7	280.0	283.8	100	1.9	None)		
	8	283.8	285.6	100	1.1	0.02)		
	9	285.6	287.2	100	1.8	None)		
	10	287.2	290.0	100	.6	None	-	-
	11	290.0	295.0	96	.8	None	-	-
	12	295.0	300.0	96	1.0	None	-	-
2	13	299.0	304.0	92	1.8	.05)		
	14	304.0	309.0	92	.7	.15)		
	15	309.0	311.2	100	1.3	.02)		
	16	311.2	314.0	100	2.0	.95)	Trace	0.42
	17	314.0	319.0	96	.7	.45)		
	18	319.0	324.0	54	1.0	None)		
	19	324.0	329.0	54	3.3	None)		
	20	329.0	334.0	86	.5	.20	-	-
	21	334.0	339.0	86	.4	None	-	-
	22	339.0	344.0	94	None	None	-	-
	23	344.0	349.0	94	.02	.05	-	-
	24	349.0	354.0	100	.1	None	-	-
	25	354.0	359.0	100	.1	None	-	-
	26	359.0	364.0	100	.1	None	-	-
	27	364.0	369.0	100	.4	.05	-	-
	28	369.0	373.7	100	.2	None	-	-
	29	381.0	387.0	100	.3	None	-	-
	30	387.0	392.0	86	.1	None	-	-
	31	392.0	397.0	86	.1	None	-	-
	32	397.0	400.6	100	.5	None	-	-
3	33	374.0	379.0	86	.3	None)		
	34	379.0	384.0	86	.3	None)	Trace	Trace
	35	388.4	393.4	100	.1	.05)		
	36	393.4	397.1	100	.1	None)		
4	37	90.0	92.7	92	.4	.10	-	-
	38	92.7	96.4	100	1.4	.50	-	-
	39	96.4	100.0	89	.6	.30	-	-
	40	100.0	105.0	98	.4	.30	-	-
	1/41	105.0	111.0	98	6.3	.65	Trace	.68
	42	111.0	115.0	100	.9	.30	-	-
	43	115.0	120.0	100	.9	.20	-	-
	44	120.0	125.0	98	1.0	.20	-	-
	45	125.0	128.0	100	1.4	.30)		
	46	128.0	130.0	95	.3	None)	.01	1.11
	47	162.5	166.2	100	.05	.02)		

TABLE 1. - Diamond-drill core sample analyses--continued

Hole No.	Sample No.	Interval From	Interval To	Core recovery, percent	Percent Zinc	Percent Copper	Ounce per ton Gold	Ounce per ton Silver
4	48	166.2	171.6	100	0.1	None	-	-
5	49	79.4	85.4	100	.2	None)	0.01	0.87
	50	89.5	92.2	100	1.8	0.5)		
	51	92.9	96.4	94	.6	.3	-	-
	52	96.4	100.0	92	.9	.1	-	-
	2/ 53	100.0	104.4	98	3.3	1.50)	Trace	Trace
	54	104.4	108.8	98	3.4	1.00)		
	55	108.8	112.7	97	2.7	1.25	-	-
	56	112.7	116.6	97	.8	.25	-	-
	57	116.6	120.3	92	.4	None	-	-
	58	140.5	146.0	96	.4	None	-	-
	59	146.0	150.0	93	.5	None	-	-
	60	150.0	155.0	100	.5	None	-	-
6	61	51.4	55.5	90	2.3	.25	-	-
	62	55.5	59.5	93	3.9	.09	-	-
	63	59.5	64.9	91	.8	.20	-	-
	64	64.9	70.3	91	.8	.40	-	-
	65	70.3	74.3	100	1.2	None	-	-
	66	80.0	84.0	100	1.4	None	-	-
	67	84.0	88.0	100	1.9	.10	-	-
	68	90.0	95.0	100	.9	None	-	-
	69	95.0	100.0	100	.6	None	-	-
	70	100.0	103.8	76	.4	None	-	-
	71	103.8	107.1	88	.2	None	-	-
	72	107.1	112.1	100	.3	None	-	-
	73	112.1	117.1	100	.4	None	-	-
	74	117.1	122.4	74	.4	None	-	-
	75	122.4	127.7	75	.4	None	-	-
7	76	195.0	200.0	94	None	.08	-	-
	77	200.0	205.0	94	None	.05	-	-

1/ Lead analysis, 0.1 percent.
2/ Lead analysis, 0.15 percent.

TABLE 2. - Analyses of trench and underground channel samples

Sample No.	Length, feet	Location	Percent Zinc	Percent Copper	Percent Lead	Ounce per ton Gold	Ounce per ton Silver
1A	5.0	Underground.......	2.0	0.08	Trace	0.01	0.71
2A	5.0	........do........	4.2	1.05	0.10	-	-
2B	3.0	........do........	1.2	1.20	Trace	-	-
3A	4.4	........do........	8.3	.55	.10	-	-
3B	5.0	........do........	.3	.09	.05	-	-

TABLE 2. - Analyses of trench and underground channel samples--continued

Description			Percent			Ounce per ton	
Sample No.	Length, feet	Location	Zinc	Copper	Lead	Gold	Silver
4A	5.0	Underground.......	11.0	0.60	Trace	-	-
4B	5.0	........do........	5.1	1.30	-	-	-
5A	2.9	........do........	8.5	.90	0.10	-	-
5B	5.0	........do........	.6	.40	-	-	-
5C	5.0	........do........	6.8	1.30	Trace	-	-
5D	3.3	........do........	9.2	.95	-	-	-
6A	5.0	........do........	3.8	1.35	Trace	-	-
6B	4.0	........do........	7.4	3.00	.05	-	-
6C	5.0	........do........	2.4	.45	Trace	-	-
6D	5.0	........do........	.9	.55	.20	-	-
7A	5.0	........do........	7.8	.35	.25	-	-
7B	1.9	........do........	.5	.60	.05	-	-
7C	2.8	........do........	4.1	.80	.25	-	-
8A	5.0	........do........	9.8	1.10	.15	-	-
8B	4.0	........do........	5.5	.65	.10	-	-
9A	5.0	........do........	7.1	.50	.05	-	-
10A	5.0	........do........	-	.06	.10	-	-
10B	5.0	........do........	Trace	.05	Trace	-	-
11A	5.0	Surface...........	6.0	3.50	.10	-	-
12A	5.0	........do........	11.3	.15	Trace	-	-
12B	5.0	........do........	8.6	1.00	.05	-	-
12C	5.0	........do........	6.0	3.70	.10	-	-
12D	4.0	........do........	3.5	1.10	.10	-	-
13A	5.0	........do........	4.3	.85	.10	-	-
13B	5.0	........do........	3.7	2.35	.10	-	-
14A	5.0	........do........	6.1	1.50	.10	-	-
15A	5.0	........do........	8.7	.75	.10	-	-
15B	5.0	........do........	2.5	1.15	.20	-	-
16A	5.0	........do........	2.9	.80	.10	-	-
17A	5.0	........do........	5.3	.80	.10	-	-
17B	2.5	........do........	4.7	.20	.15	-	-
18A	5.0	........do........	.7	.35	Trace	-	-
18B	5.0	........do........	.1	.30	.10	-	-
18C	3.0	........do........	3.0	.75	.75	-	-
19A	5.0	Underground.......	28.5	2.95	.05	-	-
19B	5.0	........do........	7.4	5.75	.10	-	-
20A	5.0	Surface...........	16.4	3.00	.10	-	-
		Composite of samples Nos. 2A, 3A, 4A, 4B, 5A, 5B, 5C, 5D, 6A, 6B, 7A, 7B, 7C, 8A, 8B, 11A, 19A, 19B, 12A, 12B, 12C, 12D, 13A, 13B, 14A.	7.35	1.62	.07	0.005	0.515

TABLE 3. - Log of diamond-drill hole cores

Interval, feet From	To	Description	Bedding or schistosity angles
		Diamond-drill hole No. 1	
		Location: See figure 3 Altitude of collar: 335 feet Length: 355 feet Inclination: -40° Date begun: June 2, 1950 Date completed: June 9, 1950 Core sizes: BX to 11.0 feet AX to 355.0 feet	
0.0	125.0	Biotite quartz schist......................	70°
125.0	161.5	Biotite hornblende quartz diorite..........	60°
161.5	192.0	Biotite quartz schist......................	-
192.0	199.0	Biotite quartz schist, with three 1-foot bands of lamprophyre dike.	-
199.0	201.0	Biotite quartz schist......................	80°
201.0	213.0	Muscovite quartz schist....................	-
213.0	221.0	Biotite quartz schist......................	-
221.0	231.0	Biotite quartz.............................	
231.0	236.0	Muscovite quartz schist, with a very few scattered grains of pyrite at 232.0 to 233.0 feet.	-
236.0	239.0	Biotite quartz diorite, a few grains of chalcopyrite and pyrite at 239.0 feet.	-
239.0	246.0	Muscovite quartz schist....................	-
246.0	250.0	Biotite quartz diorite.....................	60°
250.0	260.0	Muscovite quartz schist, with disseminated pyrite and a trace of chalcopyrite and sphalerite.	-
260.0	290.0	Muscovite quartz schist, with scattered seams of disseminated pyrite, chalcopyrite and sphalerite.	-
290.0	292.0	Muscovite quartz schist, with no sulfides..	-
292.0	301.0	Biotite quartz schist......................	62°
301.0	309.0	White sugary quartz, with scattered large (1/4-inch) hornblende crystals.	-
309.0	329.0	Muscovite quartz schist, with a few 3- to 4-inch bands of quartz diorite.	-
329.0	347.0	Biotite quartz schist......................	-
347.0	353.0	Biotite quartz diorite.....................	58°
353.0	355.0	Biotite quartz schist......................	-

TABLE 3. - Log of diamond-drill hole cores--continued

Interval, feet From	To	Description	Bedding or schistosity angles
		Diamond-drill hole No. 2	
		Location: See figure 3; Altitude of collar: 345 feet; Length: 416 feet; Inclination: -40°; Bearing: N 44° E; Date begun: June 12, 1950; Date completed: June 19, 1950; Core sizes: BX to 20.0 feet, AX to 416.0 feet	
0.0	45.0	Biotite quartz schist.....................	65°
45.0	47.0	Biotite quartz diorite....................	-
47.0	93.0	Biotite quartz schist.....................	50°
93.0	101.0	Biotite quartz diorite....................	50°
101.0	142.5	Biotite quartz schist.....................	-
142.5	157.5	Hornblende quartz diorite.................	65°
157.5	252.0	Biotite quartz schist.....................	65° - 70°
252.0	258.0	Biotite quartz diorite....................	-
258.0	260.0	Biotite quartz schist.....................	-
260.0	263.0	Lamprophyre dike..........................	-
263.0	268.0	Biotite quartz schist.....................	-
268.0	274.0	Muscovite quartz schist...................	-
274.0	280.0	Biotite quartz diorite....................	-
280.0	289.0	Muscovite quartz schist...................	-
289.0	295.0	Biotite quartz schist.....................	-
295.0	299.0	Muscovite quartz schist...................	-
299.0	329.0	Muscovite quartz schist, with disseminated pyrite and chalcopyrite and sphalerite.	50°
329.0	366.0	Muscovite quartz schist, with disseminated pyrite, no chalcopyrite or sphalerite.	65°
366.0	369.0	Biotite quartz diorite....................	-
369.0	373.0	Muscovite quartz schist, with pyrite, no chalcopyrite or sphalerite.	-
373.0	381.0	Biotite quartz diorite....................	-
381.0	395.0	Muscovite quartz schist, with pyrite.......	-
395.0	400.0	Biotite quartz schist.....................	60°
400.0	406.0	Biotite quartz diorite....................	-
406.0	410.0	Biotite quartz schist.....................	-
410.0	416.0	Muscovite quartz schist...................	-

TABLE 3. - Log of diamond-drill hole cores--continued

Interval, feet From	To	Description	Bedding or schistosity angles
		Diamond-drill hole No. 3	

Location: See figure 3
Altitude of collar: 345 feet
Length: 428 feet
Inclination: -40°
Bearing: N 80° E

Date begun: June 21, 1950
Date completed: June 27, 1950
Core sizes: BX to 12.0 feet
AX to 428.0 feet

From	To	Description	Bedding or schistosity angles
0.0	93.0	Biotite quartz schist......................	20° - 40°
98.0	108.5	Biotite quartz diorite.....................	25° - 30°
108.5	118.0	Lamprophyre dike...........................	-
118.0	167.0	Biotite quartz schist......................	40°
167.0	173.5	Biotite quartz diorite.....................	-
173.5	178.0	Biotite quartz schist......................	-
178.0	179.0	Biotite quartz diorite.....................	-
179.0	188.0	Biotite quartz schist......................	-
188.0	193.0	Biotite quartz diorite.....................	-
193.0	214.0	Biotite quartz schist......................	37°
214.0	218.0	Lamprophyre dike...........................	-
218.0	223.0	Biotite quartz schist......................	-
223.0	225.5	Lamprophyre dike...........................	-
225.5	325.0	Biotite quartz schist......................	42° - 47°
325.0	330.0	Biotite quartz diorite.....................	-
330.0	361.0	Biotite quartz schist......................	-
361.0	365.0	Biotite quartz diorite, with disseminated pyrite.	-
365.0	369.0	Biotite quartz schist......................	-
369.0	374.0	Muscovite quartz schist....................	-
374.0	389.0	Lamprophyre dike...........................	-
389.0	391.0	Biotite quartz schist, with disseminated pyrite.	-
391.0	394.0	Muscovite quartz schist, with disseminated pyrite.	-
394.0	403.0	Muscovite quartz schist....................	35°
403.0	409.0	Biotite quartz diorite.....................	-
409.0	428.0	Interbedded muscovite quartz schist and biotite quartz schist.	-

TABLE 3. - Log of diamond-drill hole cores--continued

Interval, feet From	To	Description	Bedding or schistosity angles
		Diamond-drill hole No. 4	

Location: See figure 3
Altitude of collar: 345 feet
Length: 347.7 feet
Inclination: -35°
Bearing: N 15° E

Date begun: June 29, 1950
Date completed: July 9, 1950
Core sizes: BX to 7.5 feet
AX to 347.7 feet

From	To	Description	Bedding or schistosity angles
0.0	18.0	Biotite quartz schist......................	45°
18.0	20.0	Hornblende biotite quartz diorite..........	-
20.0	63.0	Biotite quartz schist......................	60°
63.0	78.0	Muscovite quartz schist....................	-
78.0	81.0	Biotite quartz schist......................	-
81.0	91.0	Muscovite quartz schist....................	-
91.0	106.0	Muscovite quartz schist, with pyrite, chalcopyrite and sphalerite.	50°
106.0	111.0	Muscovite quartz schist, with pyrite, sphalerite and chalcopyrite.	-
111.0	127.0	Muscovite quartz schist, with pyrite, chalcopyrite and sphalerite.	-
127.0	173.0	Muscovite quartz schist, with trace of pyrite at 155.0 and 169.0 feet.	60°?
173.0	179.0	Biotite quartz schist......................	-
179.0	216.0	Muscovite quartz schist....................	75°
216.0	221.0	Biotite quartz diorite.....................	-
221.0	223.0	Muscovite quartz schist....................	-
223.0	227.0	Biotite quartz diorite.....................	-
227.0	231.0	Biotite quartz schist......................	-
231.0	233.0	Biotite quartz diorite.....................	-
233.0	242.0	Biotite quartz schist......................	-
242.0	245.0	Biotite quartz diorite.....................	-
245.0	250.0	Biotite quartz schist......................	-
250.0	252.0	Biotite quartz diorite.....................	-
252.0	328.0	Biotite quartz schist......................	-
328.0	338.0	Biotite quartz diorite.....................	-
338.0	347.7	Biotite quartz schist, with a few 2-inch stringers of diorite.	-

TABLE 3. - Log of diamond-drill hole cores--continued

Diamond-drill hole No. 5

Location: See figure 3
Altitude of collar: 345 feet
Length: 190 feet
Inclination: -35°
Bearing: N 40° E

Date begun: July 10, 1950
Date completed: July 12, 1950
Core sizes: BX to 7.0 feet
AX to 190.0 feet

Interval, feet From	To	Description	Bedding or schistosity angles
0.0	18.0	Biotite quartz schist......................	40°
18.0	24.0	Lamprophyre dike...........................	-
24.0	56.0	Biotite quartz schist......................	65°
56.0	78.0	Muscovite quartz schist, with a trace of pyrite and chalcopyrite at 57.0 feet.	-
78.0	85.0	Biotite quartz schist, with a trace of pyrite at 80.0 feet.	-
85.0	90.0	Biotite quartz diorite.....................	-
90.0	101.0	Muscovite quartz schist, with pyrite, chalcopyrite and sphalerite.	70° - 90°
101.0	103.0	Muscovite quartz schist, with pyrite, sphalerite and chalcopyrite.	-
103.0	105.0	Muscovite quartz schist....................	-
105.0	117.0	Muscovite quartz schist, with pyrite, sphalerite and chalcopyrite.	-
117.0	129.0	Muscovite quartz schist, with pyrite.......	-
129.0	131.0	Biotite quartz diorite.....................	-
131.0	158.0	Muscovite quartz schist, with disseminated pyrite.	70° - 80°
158.0	167.0	Biotite quartz schist......................	60°
167.0	190.0	Muscovite quartz schist....................	60°

Diamond-drill hole No. 6

Location: See figure 3
Altitude of collar: 337 feet
Length: 147.3 feet
Inclination: -45°
Bearing: N 15° E

Date begun: July 14, 1950
Date completed: July 16, 1950
Core sizes: BX to 7.5 feet
AX to 147.3 feet

Interval, feet From	To	Description	Bedding or schistosity angles
0.0	52.0	Biotite quartz schist......................	50°
52.0	56.0	Biotite quartz schist, with pyrite, chalcopyrite and sphalerite.	60° - 70°
56.0	70.0	Muscovite quartz schist, with pyrite, chalcopyrite and sphalerite.	-
70.0	86.0	Biotite quartz schist......................	60°
86.0	89.0	Biotite quartz diorite.....................	-
89.0	129.0	Muscovite quartz schist, with pyrite.......	-
129.0	147.3	Muscovite quartz schist....................	-

TABLE 3. - Log of diamond-drill hole cores--continued

Interval, feet From	To	Description	Bedding or schistosity angles
		Diamond-drill hole No. 7	
0.0	11.0	Biotite quartz schist......................	-
11.0	19.0	Hornblende biotite diorite.................	-
19.0	24.0	Biotite quartz schist......................	-
24.0	26.0	Hornblende biotite quartz diorite..........	-
26.0	134.0	Biotite quartz schist......................	65°
134.0	136.0	Biotite quartz diorite.....................	-
136.0	147.0	Biotite quartz schist......................	-
147.0	150.0	Biotite quartz diorite.....................	70°
150.0	175.0	Biotite quartz schist......................	-
175.0	180.0	Biotite quartz diorite.....................	-
180.0	195.0	Muscovite quartz schist, with a trace of pyrite.	-
195.0	201.0	Muscovite quartz schist, with pyrite and chalcopyrite.	65°
201.0	209.0	Muscovite quartz schist....................	-
209.0	251.0	Biotite quartz schist......................	55°
251.0	264.5	Biotite quartz diorite.....................	-

Location: See figure 3
Altitude of collar: 265 feet
Length: 264.5 feet
Inclination: -40°
Bearing: N 46° E

Date begun: July 19, 1950
Date completed: July 24, 1950
Core sizes: BX to 11.0 feet
AX to 264.5 feet

METALLURGICAL TESTING

The sample of ore tested was a composite prepared from channel samples taken from the various underground workings and open cuts during the course of examination. Since the samples were added in weighted proportion to the footage represented by each sample, the composite should be representative of the exposed ore in the mine. Samples used for the composites were as follows: 2A, 3A, 4A, 4B, 5A, 5B, 5C, 5D, 6A, 6B, 7A, 7B, 7C, 8A, 8B, 11A, 19A, 19B, 12A, 12B, 12C, 12D, 13A, 13B, 14A (figs. 3-4).

A head sample prepared from the composite had the following partial chemical analysis:

Assay, percent					Ounce per ton	
Copper	Lead	Zinc	Iron	Insoluble	Gold	Silver
1.62	0.07	7.35	15.6	54.2	0.005	0.515

A semiquantitative spectrographic analysis made at the Bureau of Mines Albany, Oreg. laboratories on the same head sample revealed the presence and quantities of elements listed in the following table. Any other elements, if present, were in amounts lower than the minimum detectable by the routine technique employed.

Spectrographic Analyses

Aluminum	Barium	Cadmium	Calcium	Copper	Iron	Lead	Magnesium	Manganese
A	C	E	C	C	B	C	C	E

Molybdenum	Nickel	Platinum	Silicon	Silver	Tellurium	Titanium	Vanadium
F	E	ND	A	F	ND	E	E

Zinc	Zirconium
B	E

A--over 10 percent; B--5 to 10 percent; C--1 to 5 percent; D--0.1 to 1 percent; E--0.01 to 0.1 percent; F--0.001 to 0.01 percent; G--less than 0.001 percent; ND--not detected.

Petrographic examination of a representative portion of the composite sample showed the sulfides present in the ore include pyrite, sphalerite, chalcopyrite with minor amounts of galena and bornite. The gangue classified as a mica schist is predominantly quartz together with barite, muscovite, biotite, chlorite, limonite, magnetite, and feldspar. The microscopic study indicated that grinding to minus 65-mesh would provide satisfactory liberation.

A sample of ore crushed to minus 6-mesh was screened, using standard Tyler screens, to produce plus 10-, plus 20-, plus 35-, plus 48-, plus 65-, plus 100-, plus 200-, and minus 200-mesh sand products. The finest fraction was deslimed by decantation. Each sized fraction was assayed. No significant concentration of zinc or copper was noted in any size range.

To determine the feasibility of removing a waste product at a comparatively coarse size, one test was made employing heavy liquid separation methods. A sample of ore was crushed to approximately minus 1/2-inch and the minus 10-mesh fraction was removed by screening. The oversize material was treated by sink-float at media specific gravities of 2.69, 2.77, and 2.88. This treatment rejected only 9.7 percent of the total ore in a product assaying 0.80 percent Cu and 2.1 percent Zn, and containing 5.2 percent of the copper and 2.8 percent of the zinc.

A sample of ore was crushed to minus 20-mesh and treated, unsized on a laboratory shaking table. Attempts to make separate high zinc and high copper concentrates were unsuccessful. Combined table concentrate and middling contained approximately 80 percent of the zinc and copper at grades of 11.5 percent Zn and 2.37 percent Cu. The combined tailing and slime, representing 49.3 percent of the total weight, contained 20 percent of the zinc and copper and assayed 3.05 percent Zn and 0.60 percent Cu.

The poor results obtained by gravity methods of concentration are attributed to the lack of liberation of minerals at the sizes treated.

Several preliminary flotation tests were run. Best results were obtained by treatment, by standard selective flotation methods of ore ground to 95 percent minus 65-mesh.

The ore was pulped with laboratory tap water, the pH was adjusted with lime, and a copper concentrate was floated using sodium ethyl xanthate (Z-4)[9/] as promoter. The copper tailing was conditioned with copper sulfate and a zinc rougher concentrate was floated using potassium secondary amyl xanthate (Z-5)[10/] as collector. The latter product was cleaned once. Zinc was depressed in the copper circuit with zinc sulfate. Sodium cyanide was employed to inhibit pyrite flotation. No silica depressant or slime dispersant was required.

Results and consumption of reagents are shown in tables 4 and 5.

By selective flotation, 78.7 percent of the copper, 40.0 percent of the gold, and 60.1 percent of the silver were recovered in a copper rougher concentrate that assayed 20.8 percent Cu, 2.95 percent Zn, 0.03 ounce Au, and 3.95 ounces Ag per ton. The zinc cleaner concentrate contained 85.0 percent of the total zinc and assayed 52.0 percent Zn and 1.8 percent Cu.

The Moth Bay sample submitted for testing contained 7.35 percent Zn and 1.62 percent Cu. The ore was found to be amenable to concentration by standard selective flotation methods to produce marketable copper and zinc concentrates with reasonably good recoveries.

Intimacy of association of ore minerals and gangue precluded concentration by gravity methods.

9/ This product is named for identification only; mention of it does not imply endorsement by the Bureau of Mines.

10/ This product is named for identification only; mention of it does not imply endorsement by the Bureau of Mines.

TABLE 4. - Flotation, Moth Bay ore, metallurgical data

Product	Weight, percent	Assay data					
		Percent				Ounce per ton	
		Copper	Zinc	Iron	Insoluble	Gold	Silver
Copper concentrate..	6.34	20.8	2.95	29.2	14.7	0.03	3.95
Zinc cleaner concentrate.	11.88	1.80	52.0	10.6	2.9	.005	.44
Zinc cleaner tailings.	1.54	1.40	15.0	22.0	28.4	.02	1.16
Rougher tailings....	80.24	.15	.75	12.95	66.3	1/ Trace	.12
Calculated head.....	100.00	1.65	7.2	13.8	54.9	.005	.42

1/ Calculated as 0.0025 ounce gold per ton.

Product	Weight, percent	Distribution, percent					
		Copper	Zinc	Iron	Insoluble	Gold	Silver
Copper concentrate..	6.34	78.7	2.6	13.4	1.7	40.0	60.1
Zinc cleaner concentrate.	11.88	12.8	85.8	9.1	.6	12.0	12.5
Zinc cleaner tailings.	1.54	1.3	3.2	2.5	.8	8.0	4.3
Rougher tailings....	80.24	7.2	8.4	75.0	96.9	40.0	23.1
Calculated head.....	100.00	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 5. - Flotation, Moth Bay ore, operation data

Circuit	pH	Reagents, pounds per ton						
		CaO	NaCN	$ZnSO_4$	Xanthate Z-4	$CuSO_4$	Xanthate Z-5	Pine oil
Grind........	9.8	8.0	0.20	1.5	-	-	-	-
Copper.......	9.8	-	-	-	0.1	-	-	0.08
Condition....	-	2.0	.05	-	-	1.5	0.10	-
Zinc rougher.	10.9	-	-	-	-	-	-	-
Zinc cleaner.	11.4	2.0	.05	-	-	-	.05	-
Total........	-	12.0	.30	1.5	.1	1.5	.15	.08