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UNITED STATES
DEPARTMENT OF THE INTERIOR
J. A. KRUG, SECRETARY

BUREAU OF MINES
JAMES BOYD, DIRECTOR

REPORT OF INVESTIGATIONS

MIRROR HARBOR NICKEL DEPOSITS
CHICHAGOF ISLAND, ALASKA

BY

W. M. TRAVER, JR.

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By W. M. Traver, Jr.[2/]

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ILLUSTRATIONS

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Report of Investigations 4168."

2/ Mining engineer, Bureau of Mines, Denver, Colo.

ILLUSTRATIONS (Continued)

INTRODUCTION

As a direct result of the second World War, consumption of nickel in the United States has increased to such an extent that it has been considered timely to investigate undeveloped deposits of the nickel minerals.

Funds were made available to the Bureau of Mines in 1941 to investigate the extent, occurrence, and quality of nickel ores in the Mirror Harbor area. The Federal Geological Survey3/ mapped and studied the area during the summer of 1941 and Robert S. Sanford, an engineer of the Bureau of Mines, made a preliminary examination in June 1942. A contract for drilling the deposits under the direction of the author was let in July 1942.

ACKNOWLEDGMENTS

This paper is one of many reporting on various aspects of the Bureau of Mines program initiated in August 1939 by passage of the Strategic Minerals Act, the scope of which was greatly expanded by subsequent legislation.

Some of these papers are published as war mineral reports, others as bulletins, technical papers, reports of investigations, and information circulars of the Bureau of Mines, or in technical journals.

In its program of investigation of mineral deposits, the Bureau of Mines has as its primary objective the more effective utilization of our mineral resources to the end that they make the greatest possible contribution to national security and economy. It is the policy of the Bureau to publish the facts developed by each project as soon as practicable after its conclusion. The Mining Branch, Lowell B. Moon, chief, conducts preliminary examinations, performs the actual investigative work, and prepares the final report. The Metallurgical Branch, Oliver C. Ralston, chief, analyses samples and performs the beneficiation tests.

The Mirror Harbor project was a part of a program for the investigation of mineral deposits in Alaska, under the general supervision of R. S. Sanford, acting division chief.

Acknowledgment is made to William T. Pecora and George C. Kennedy for geologic maps and cooperation in making drill hole interpretations.

3/ Pecora, William T., Nickel-copper Deposits on the West Coast of Chichagof Island, Alaska: U. S. Geol. Survey Bull. 936-I, pp. 221-243, 1942.

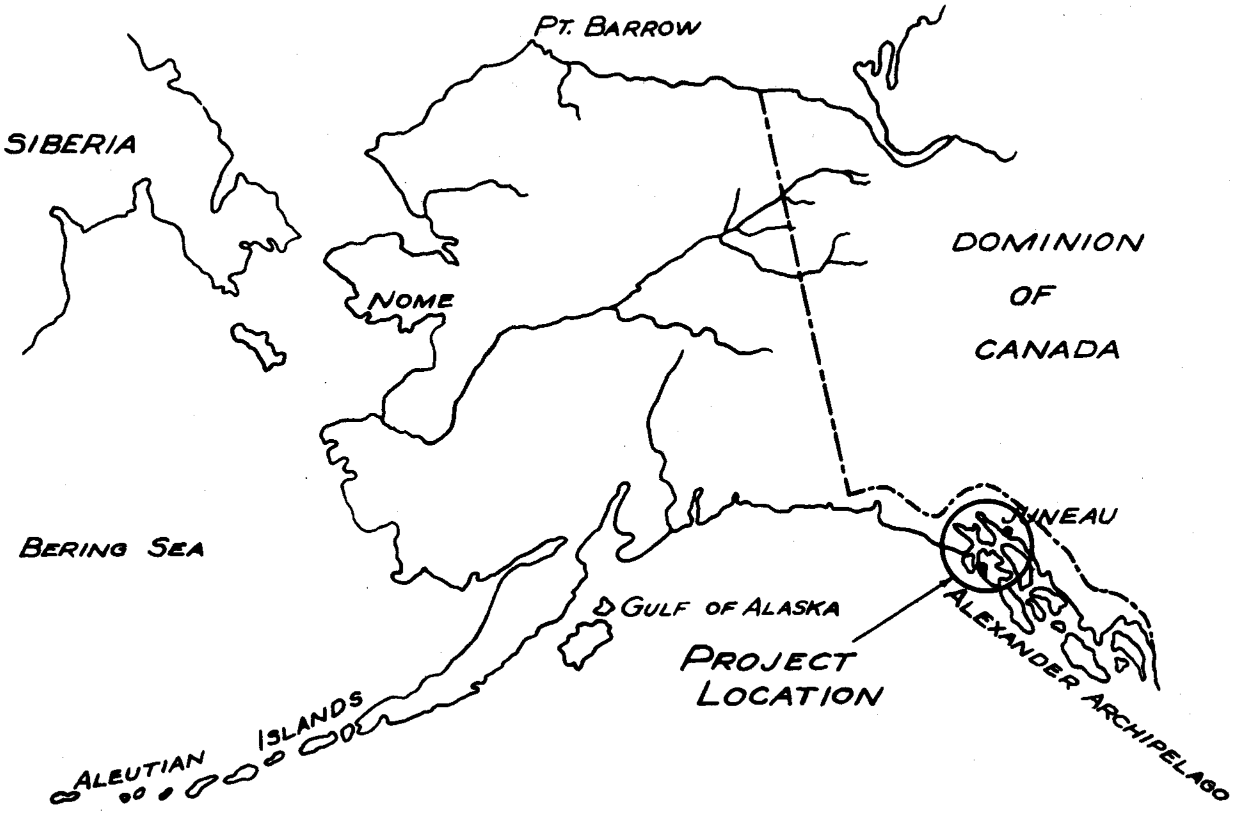


Figure 1. - Territory of Alaska index map, Mirror Harbor, Alaska.

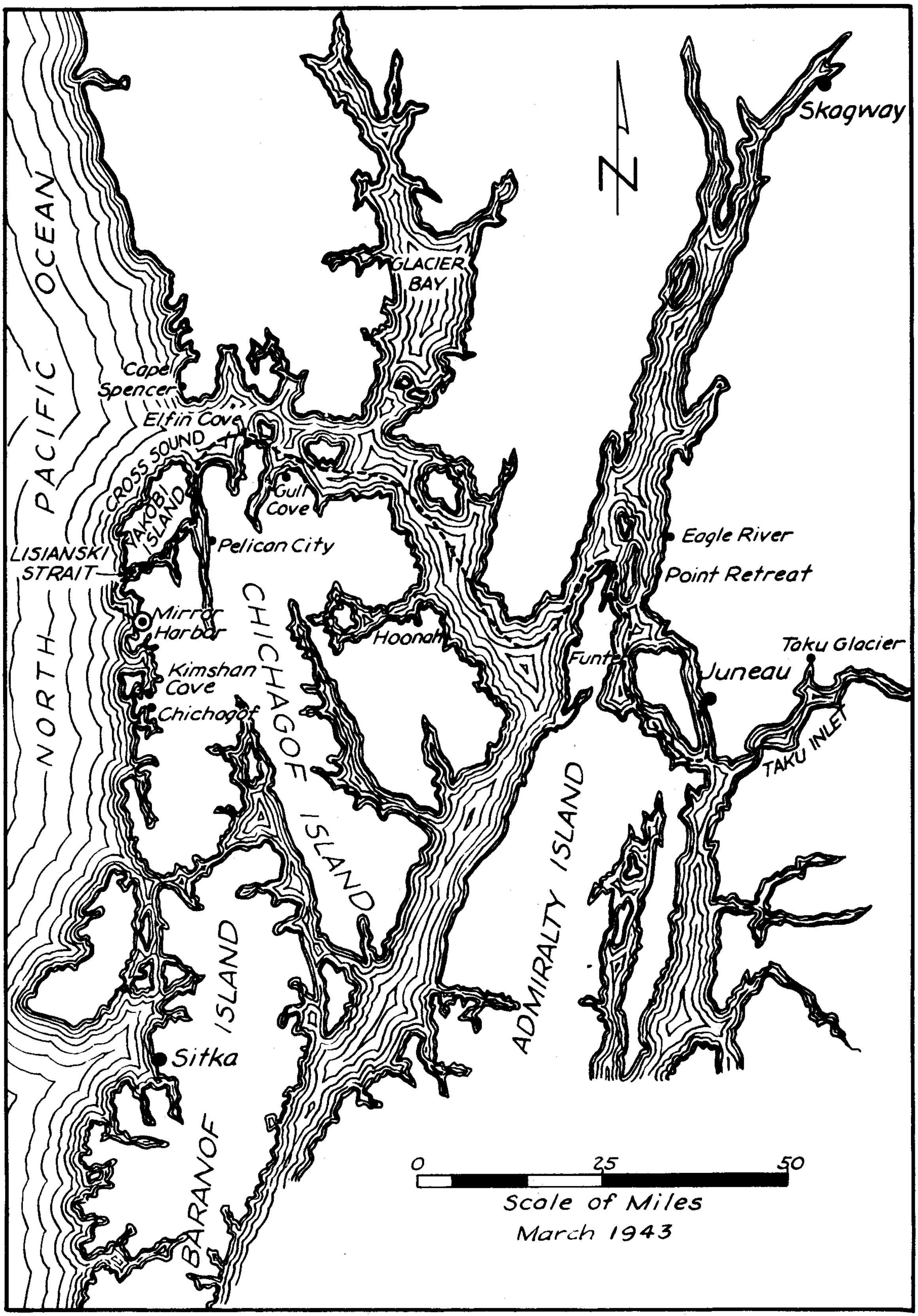


Figure 2. - Location map, Mirror Harbor nickel deposits.

LOCATION AND ACCESSIBILITY

Chichagof Island is one of the most northern of the islands of the Alexander Archipelago of southeastern Alaska (fig. 1) and is in the Sitka mining district. The prospects reported herewith are confined to an area east of Davison Bay and to one deposit of concentrated sulfide on the north end of Fleming Island at the entrance to Mirror Harbor. This area is about midway between the south entrance to Lisianski Strait and the town of Chichagof at north latitude 57° 47' and west longitude 136° 19'. By water, the deposits are about 150 miles west of Juneau and 70 miles north of Sitka. The area is 12 miles north of Kimshan Cove, which is headquarters of the Hirst-Chichagof Mining Co. and the closest post office and point for receipt and dispatch of freight and express shipments.

Navigation along the west coast of Chichagof Island is hazardous, owing to the numerous rocks and reefs, but a detailed chart[4] is available for the guidance of boatmen. Mirror Harbor is inaccessible to large ocean-going vessels but can readily be reached by smaller boats. Mirror Harbor and West Arm afford safe, protected anchorage from storms, which are frequent on the Pacific Ocean in this locality. A comparatively safe course for small boats (fig. 2) from Juneau is subject to the hazards of open ocean travel for only about 7 miles between the south entrance to Lisianski Strait and Mirror Harbor.

A weekly schedule between Juneau and Sitka is maintained by a motorship that calls at both Chichagof and Kimshan Cove for mail, express, and freight when the mines at those towns are in operation. Freight rates to Kimshan Cove from Juneau are $7 a ton or $0.17½ a cubic foot, whichever is greater.

Airplane service is no longer available to intermediate points on scheduled flights of the Alaska Coastal Airways between Juneau and Sitka. When there is enough traffic to warrant it, stops are made at both Chichagof and Kimshan Cove; the fare is $20.88, including tax, from Juneau to Kimshan Cove.

An excellent foot trail built and maintained by the U. S. Forest Service extends from Portlock Harbor to White Sulphur Springs, on Bertha Bay, and crosses Falls Creek on a bridge east of Davison Bay. A branch leads to Mirror Harbor and West Arm.

At present, with the curtailment of gold mining at both Chichagof and Kimshan Cove, the only means of transportation directly to and from Mirror Harbor is by chartered small boats.

TOPOGRAPHY

Most of the west coast of Chichagof Island is extremely rugged, with mountains rising abruptly from the coast to 2,500 feet; occasional peaks rise to over 3,000 feet.

A low coastal plain almost completely surrounds Davison Bay. This plain averages 2 miles in width but reaches a width of 4 miles at one point. The

4/ U. S. Coast and Geodetic Survey No. 8258.

general altitude of this coastal plain is less than 150 feet. The plain is an area of low, rounded hills rising above swamps and small ponds. Muskeg is as much as 5 feet in depth here and is underlain by a thin layer of hard pan. The land slopes gently to the inner edge of the coastal plain, from which point it rises precipitously to the higher elevations.

CLIMATE

The climate is cool and moist. Precipitation is heavy and chiefly in the form of rain. Average annual precipitation at Sitka is 88 inches, but as much as 23 inches has been recorded in one month.

The U. S. Weather station established at Kimshan Cove in August 1940 reported average annual precipitation of 120 inches, maximum temperature 57° F., and minimum 30° F. between that date and July 1942.

Winter snows are not reported to reach great depth except at the higher altitudes. Year-round mining is possible.

TIMBER

Spruce, hemlock, and cedar grow abundantly in the vicinity of the deposits, but very little of it is suitable for mine purposes. Most of the timber used by operating mines in the district is obtained from Baranof Island.

WATER

A small pond near the center of Fleming Island could furnish enough water for domestic use and for the operation of a small plant. A 1,000-foot pipe line would be needed. For a permanent and unlimited fresh-water supply, it would be necessary to install a pipeline from the falls in Falls Creek, a distance of 10,000 feet. This would deliver water at a 400-foot head and provide adequate fire protection and might be utilized to furnish limited power for operation of small mining units.

POWER

No electric power is available. Early operators in the district applied to the United States Department of Agriculture for two hydro-electric power and transmission line permits. One was for the utilization of Falls Creek with a drainage basin of 12 square miles, which, with a flume 700 feet long at the head of the falls, would give a head between penstock and water wheel of 266 feet and deliver 2,500 horsepower through a transmission line of 9,600 feet. The other would utilize Porcupine River, which has a drainage basin of 16 square miles and, with a flume 2,700 feet long, would give a head between penstock and water wheel of slightly less than 200 feet, delivering 3,000 horsepower through 16,500 feet of transmission line.

CAMP FACILITIES

There are no buildings at the property except a small bunkhouse, which will accommodate 3 men, and a blacksmith shop, both near the Fleming Island

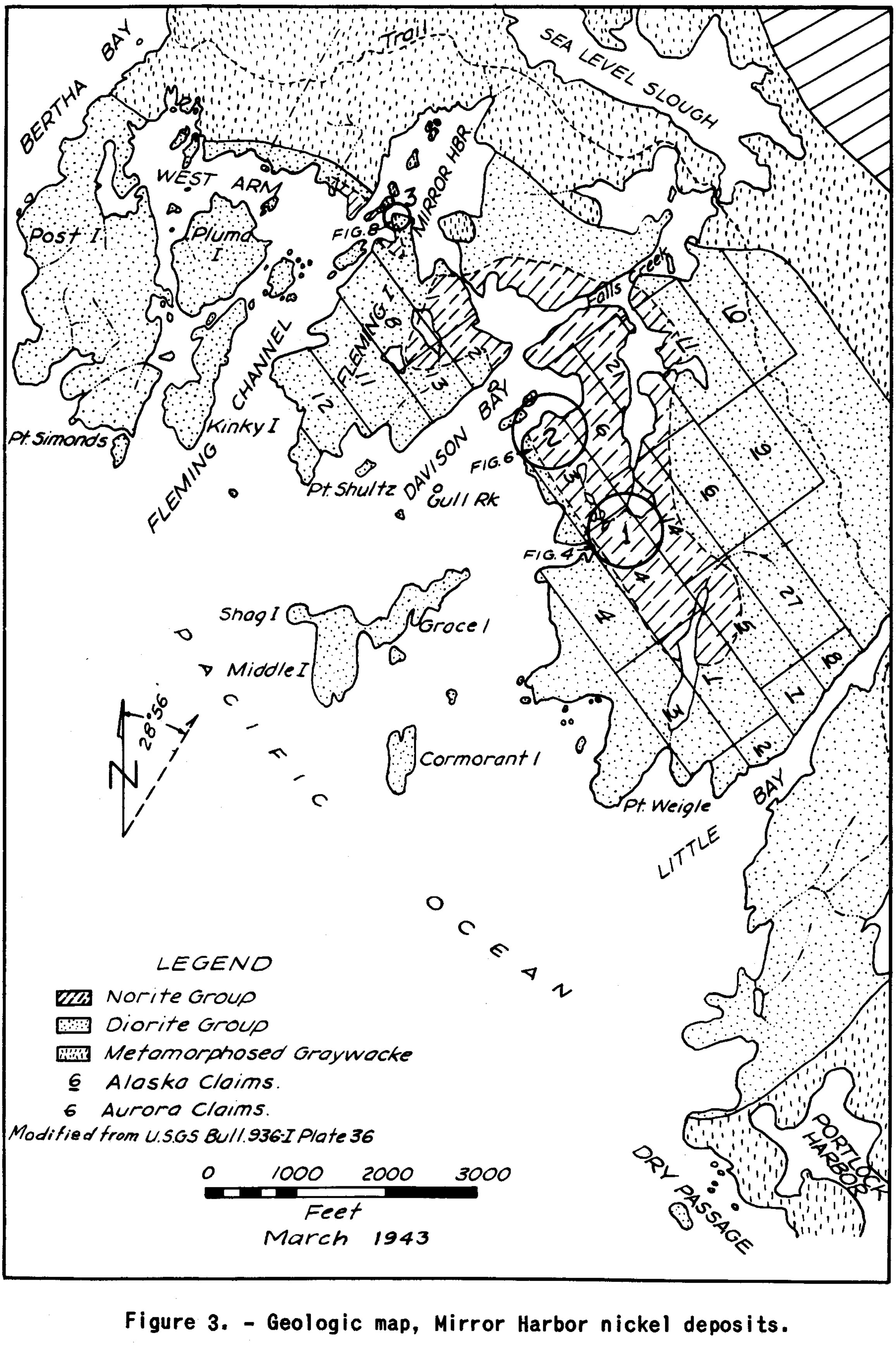


Figure 3. - Geologic map, Mirror Harbor nickel deposits.

shaft. A 12- by 16-foot office building was constructed by the Bureau of Mines before exploration was begun. A 16- by 40-foot house float was rented at Pelican City and was towed to the deposits to provide quarters and boarding accommodations for the workmen. The house float was removed when exploration was terminated.

HISTORY AND PRODUCTION

Authentic historical information concerning the deposits is meager. Discovery was presumably made in 1911, and original locations were made at that time and relocations in 1915 under the name of the Juneau Sea Level Copper Mines. In 1917 the name was changed to the Alaska Nickel Mines.

No ore shipments have been made as a result of development work on Fleming Island, except for small amounts used for testing purposes. Very little of the mined ore is left on the dumps, and a considerable quantity is reported to have been taken by passing boatmen for use as ballast.

OWNERSHIP

The ore deposits are controlled by Carl Vevelstad, of Petersburg, and associates. Only the claims that cover the particular mineral areas discussed in this report are shown on figure 3. Information as to their location was furnished by Carl Vevelstad, one of the owners.

GEOLOGY[5]

In the area between the south entrance to Lisianski Strait and Dry Passage, the older stratified rocks, mostly composed of graywacke and greenstone, have been intruded by three large stocks of igneous rocks. The earlier rocks have a northwest and southeast strike, are considered to be older than lower Cretaceous or upper Triassic Age, and locally have been highly metamorphosed.

The igneous rocks are flow rocks and intrusives representing granite, diorites, alaskite, aplite, morite, gabbro, and andesite.

Significant sulfide concentrations, either as disseminated or massive ore, are found only in three areas of the stock in the vicinity of Davison Bay. Areas 1, 2, and 3 are shown on figure 3. It is exposed only along the shore lines of the coastal plain, the remainder northeastward being concealed by vegetation or muskeg, and a possibly much larger area west and south extends under the ocean.

Mineralization is present in all the rocks of the stock, but the better showings are confined to the norite. The ore concentration, both disseminated and massive, are considered to be the results of magmatic segrations and are mainly pyrrhotite, pentlandite, and chalcopyrite.

5/ See footnote 3.

INVESTIGATIONS BY BUREAU OF MINES

The ores at the three locations in the stock were explored by the Bureau by diamond drilling. These included (1) a disseminated sulfide deposit 1,000 feet southeast of Davison Bay, (2) exposures of a concentrated sulfide deposit at the head of Davison Bay, and (3) a concentrated sulfide deposit on the northern end of Fleming Island.

Disseminated Sulfide Deposit

During the summer of 1941 the property owners excavated a total of 45 pits under the direction of the Federal Geological Survey to expose the underlying formations and permit sampling and examination. Subsequently, some of these pits were further extended, as shown on figure 4. Complete delimiting of the area would have required more drilling than could have been accomplished in the short working season. Therefore, in order to test the depth of mineralization, core-drill hole 1 was located at a point selected as representative of the deposit.

Deposits Near the Head of Davison Bay

Small sulfide outcrops occur at points marked A, B, C, and D on figure 5. The outcrop at A is by far the largest of these, and that at B was completely obliterated in attempting to trench around it. C is a slight concentration surrounded by some disseminated sulfide, and that at D is covered by water at high tide. The rock from this latter exposure shows only small amounts of nickel or copper minerals but contains some graphite, which was also observed in slightly more than 1 foot of core from each of two drill holes.

Short holes (2 and 3) were drilled under the outcrops at A and B to determine whether they extend to any appreciable depth below the surface. Figure 6 shows a vertical section through these holes.

Horizontal and vertical extent of the larger exposure is virtually limited to the surface. It has been eroded around the base, and portions of barren underlying rock are exposed. There is nothing suggestive of a workable body or any apparent connection with any other deposit. Mineralization, although similar to that at the shaft on Fleming Island, is of no commercial importance.

Deposit on Fleming Island

The outcrop is partly covered by Fleming Channel at high tide, and a small part is under the mine dump. Trenching delineated the outcrop as roughly elliptical in shape, with a long axis of 40 feet and a short axis of 27 feet. Limits are well-defined, and there is nothing to indicate greater longitudinal dimensions.

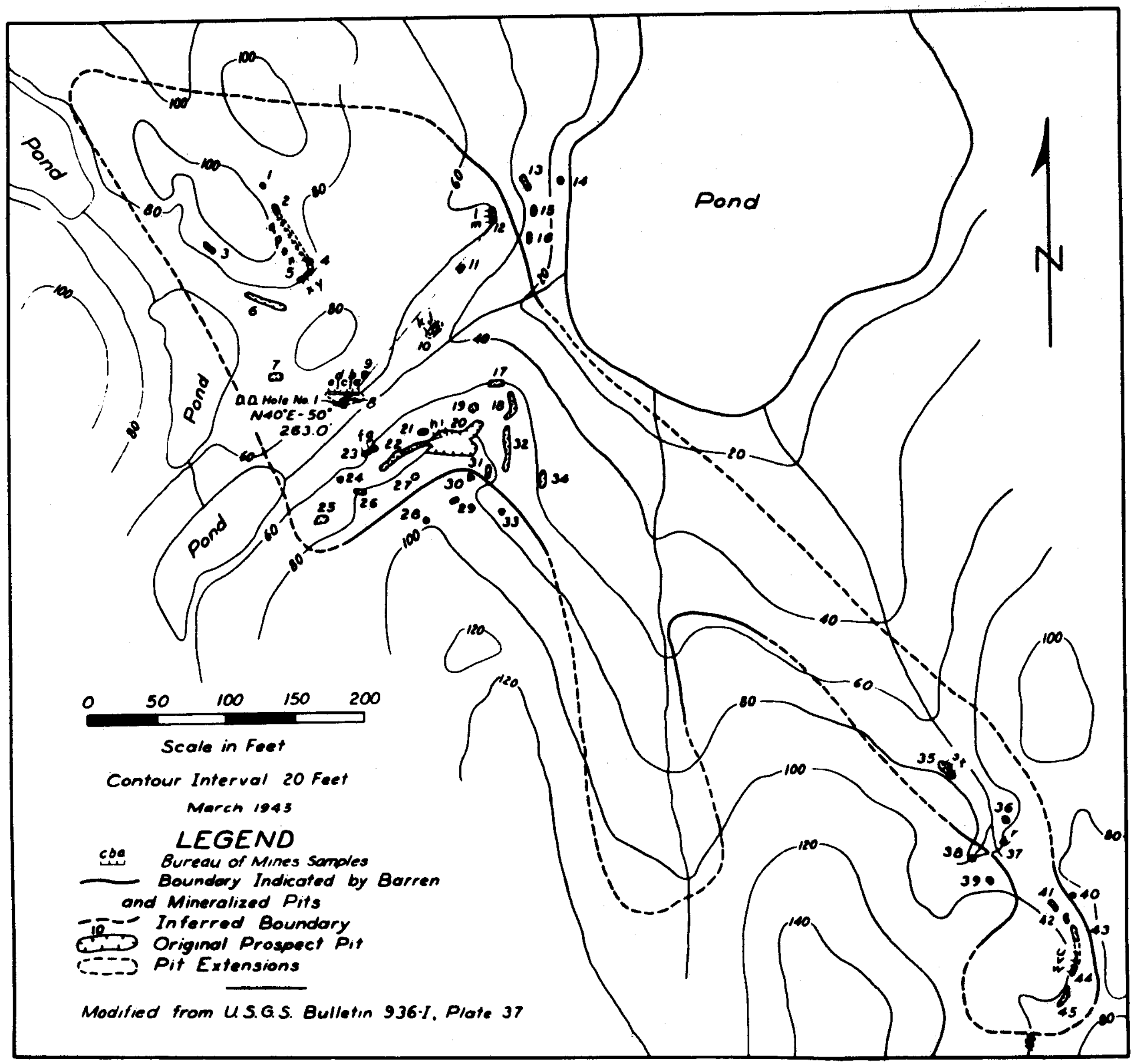


Figure 4. - Map of disseminated-sulfide deposit, Mirror Harbor nickel deposits.

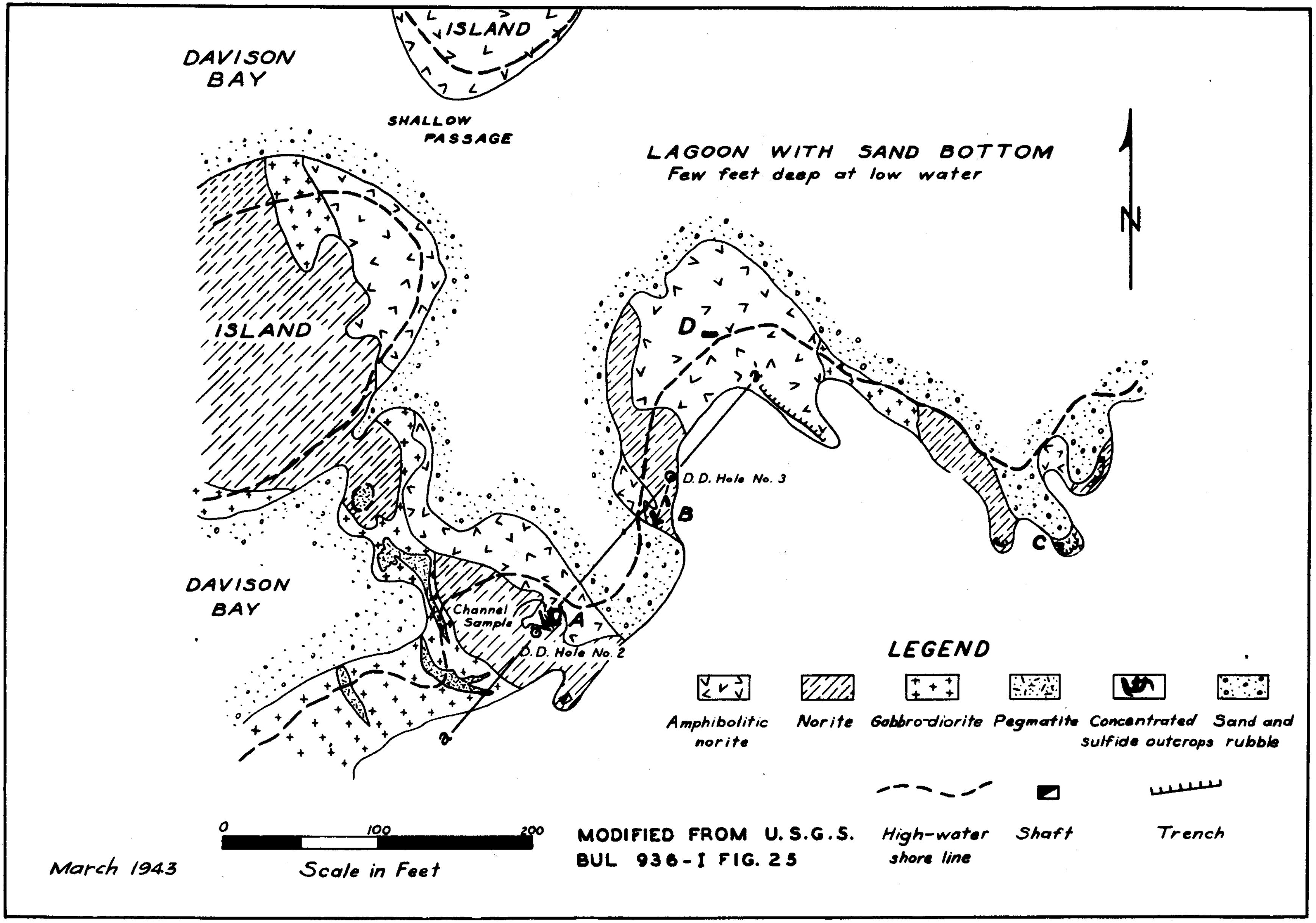
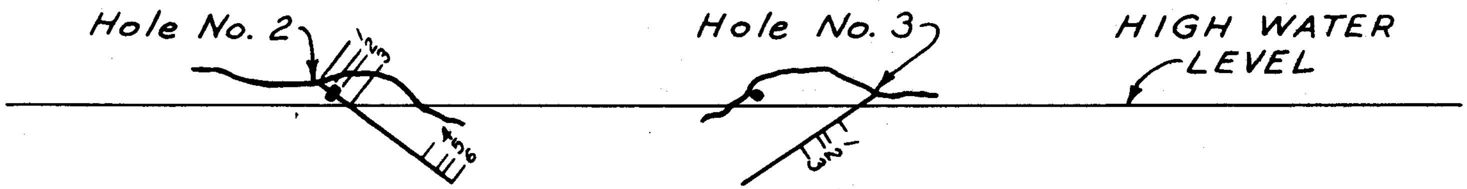


Figure 5. - Davison Bay area No. 2, Mirror Harbor nickel deposits.



Section a-a', Fig. 6

Hole No. 2
CORE SAMPLES

SAMPLE NO.	PERCENT		FOOTAGE	
	Ni	Cu	From	To
1	0.11	0.10	2.0	4.4
2	1.86	.40	4.4	5.6
3	* .01	.03	5.6	10.6
—	* .01	.02	10.6	31.0
4	* .01	.03	31.0	36.0
**5	* .01	.10	36.0	37.3
6	* .01	.04	37.3	41.0

* Less than
** Sample shows Graphite

Hole No. 3
CORE SAMPLES

SAMPLE NO.	PERCENT		FOOTAGE	
	Ni	Cu	From	To
—	—	—	20	11.0
1	*0.01	0.03	11.0	15.1
**2	.03	.02	15.1	16.4
3	* .01	.03	16.4	21.4
—	—	—	21.4	40.0

DAVISON BAY
CHANNEL SAMPLES

SAMPLE NO.	LENGTH	PERCENT	
		Ni	Cu
13	5.0	0.14	0.18
14	5.0	.05	.03
15	5.0	.53	.38
16	1.5	.86	.30
Selected Ore		1.36	.77

MARCH 1943

Figure 6. - Vertical section through holes 2 and 3.

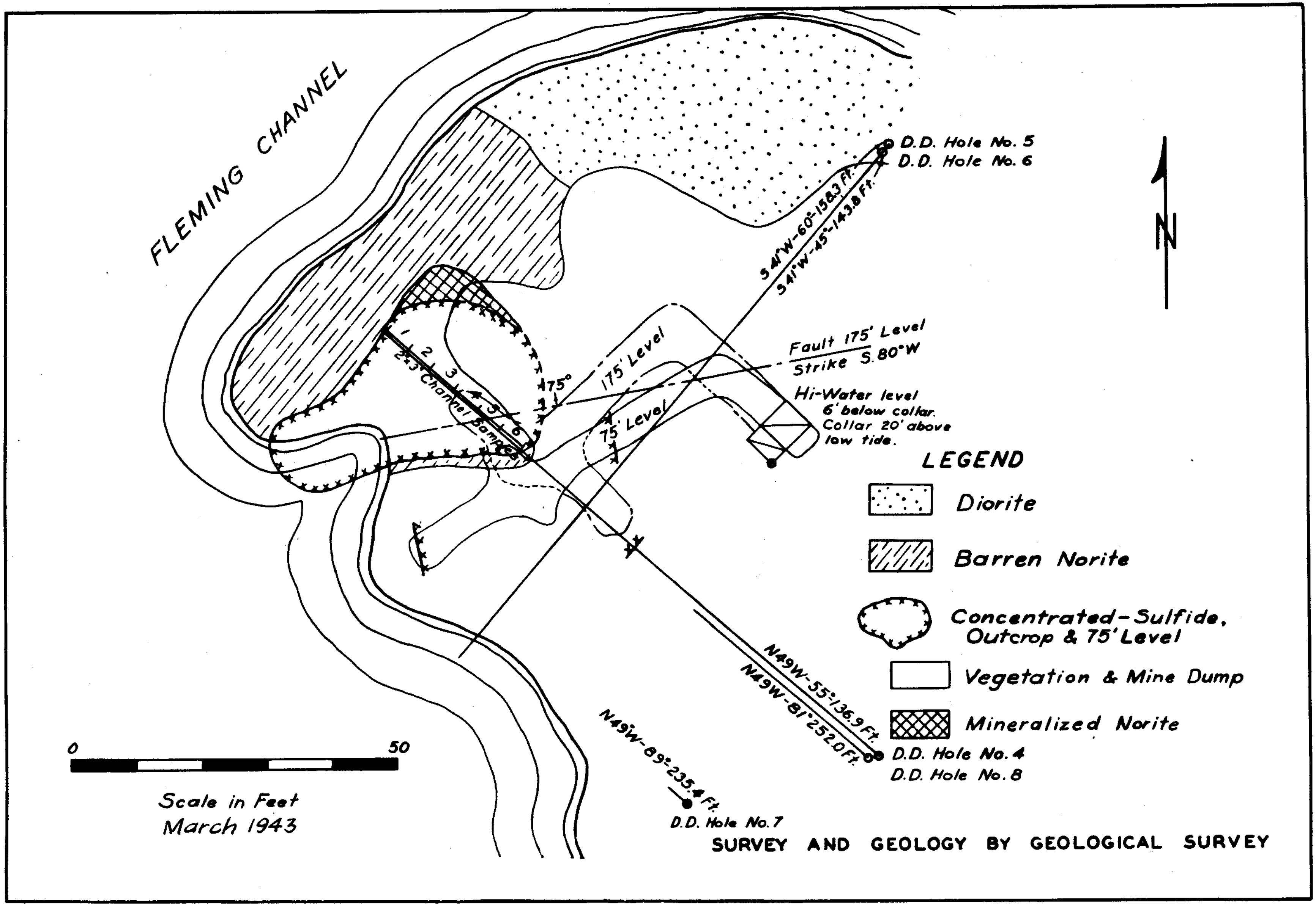


Figure 7. - Fleming Island outcrop and mine workings.

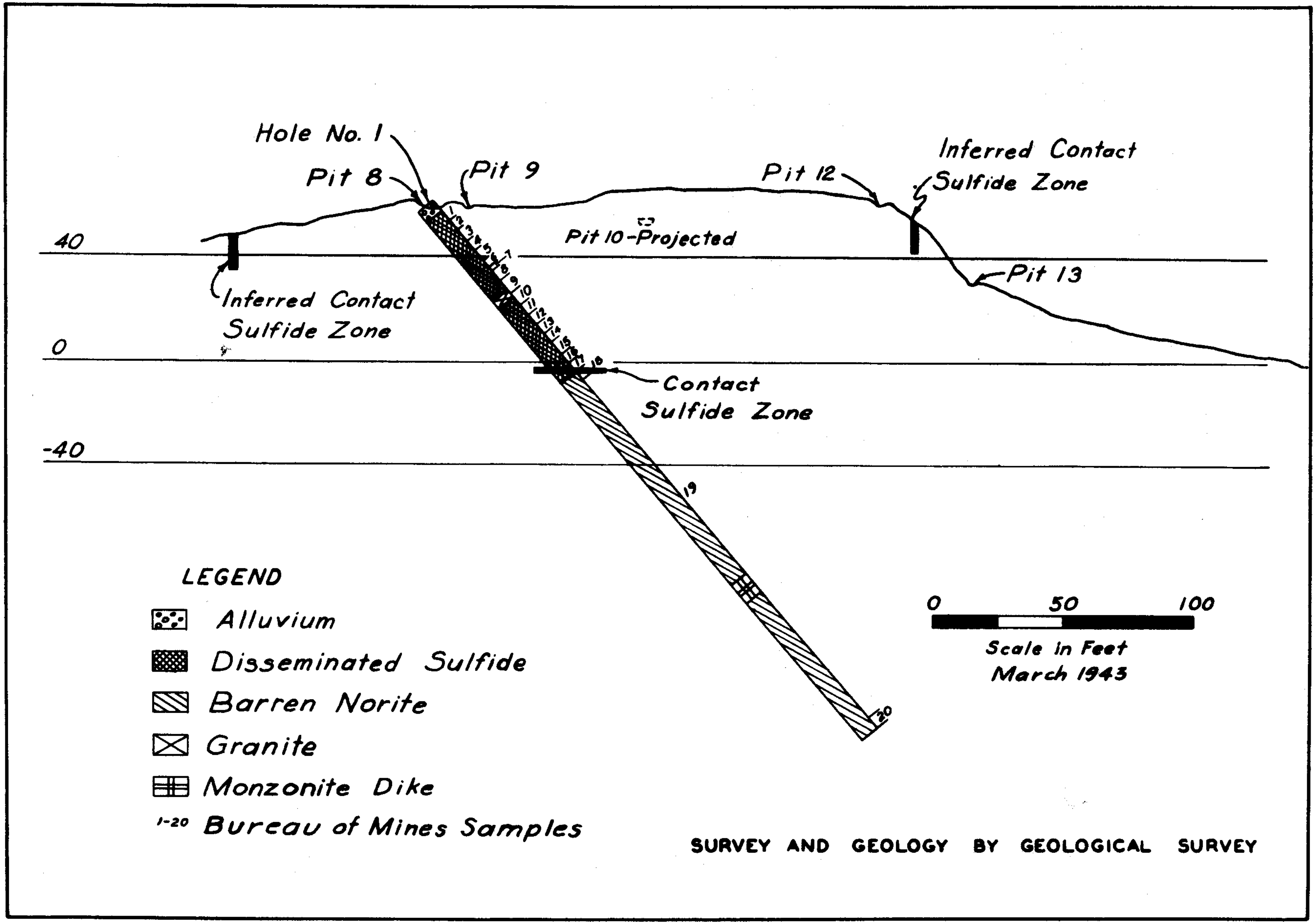


Figure 8. - Vertical section through hole 1.

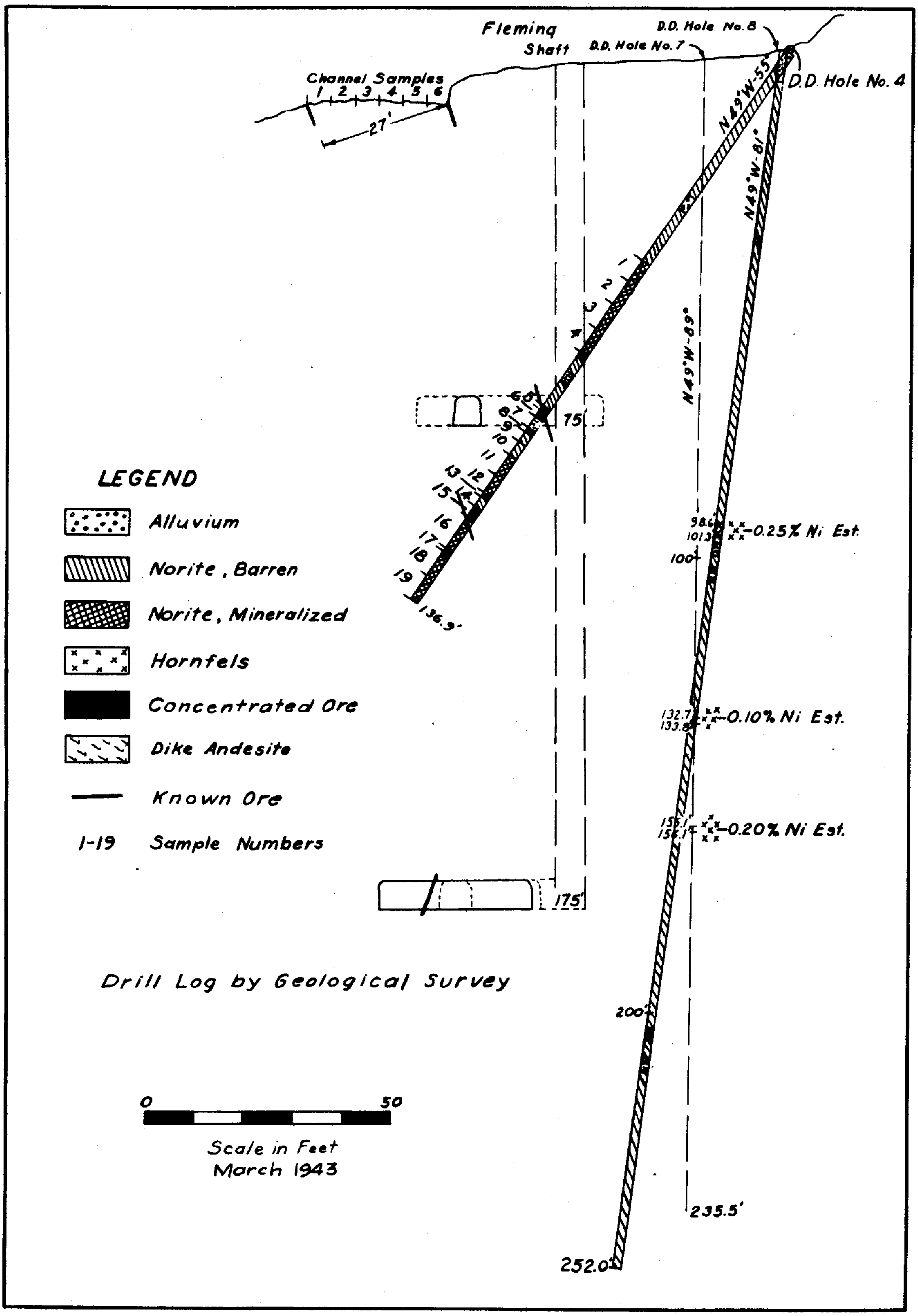


Figure 9. - Section through hole 4, Fleming Island.

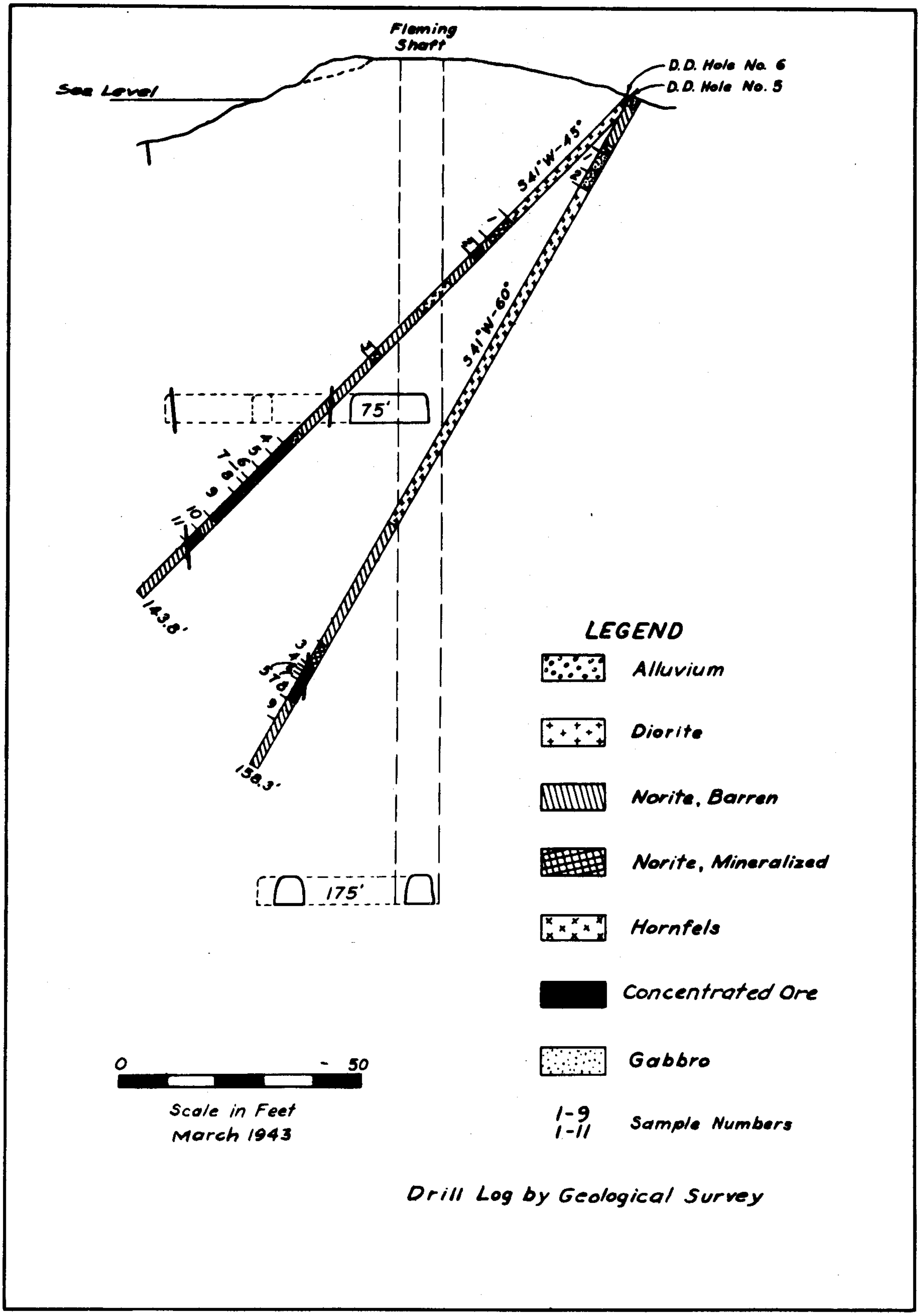


Figure 10. - Section through holes 5 and 6, Fleming Island.

Considerable information relative to underground development and geology is contained in reports of examinations made by engineers and geologists during 1917 and 1918.[6]

A 6- by 8-foot shaft had been sunk east of the outcrop prior to 1917, and levels at 75 and 175 feet were driven from it. These workings are flooded, and water stands within 6 feet of the collar.

The reports concur, in the main, that the drift from the shaft on the 75-foot level exposes 32 feet of concentrated ore on the long axis of the ore body, and crosscuts from this drift expose 10 feet of ore on the short axis. These crosscuts were terminated in ore. Development work on the 175-foot level is reported as showing a highly fractured area of disseminated ore with some concentration along fault slips.

A normal fault encountered on the lower level is not considered to have displaced the ore appreciably, and on the lower side of the fault it would be found in a direction southeast from the workings. This is the area explored by the Bureau of Mines.

The advantages of unwatering the shaft and core drilling underground were largely offset by the difficulty of employing experienced workmen and obtaining critical materials and equipment. It was anticipated that comparable results would be realized by strategically located surface drill holes, requiring some additional drill footage but saving the expense of pumping and shaft timbering.

The plan of Fleming Island outcrop and mine workings is shown in figure 7. Locations of drill holes also are shown, numbered in the order in which they were drilled. Figure 8 is a vertical section through drill hole 1. Figure 9 is a section of drill hole 4 with the surface channel cut, and figure 10 is a section of drill holes 5 and 6. Sections were not made of drill holes 7 and 8, as no ore was encountered, but they are projected on the section shown in figure 9.

The ore, as disclosed by core-drill holes and surface outcrops, appears to consist of irregular pods of high-grade ore, none of which are of any great dimensions, surrounded by areas of norite. In places the norite contains slight disseminations of mineral and in others it is virtually barren. These changes from ore to waste are abrupt and irregular and suggest that in mining some effort at sorting would be necessary.

CORE DRILLING

One of the drills from the Bohemia Basin nickel project at Yakobi Island was moved to Mirror Harbor, and drilling continued by the same private contractor under the direct supervision of a Bureau of Mines engineer. The drill

6/ Reports of examination made for the owners of the Alaska Nickel Mines by E. E. Fleming, G. T. Jackson, Ralph L. Healey, J. C. Rogers, and Horace V. Winchell in 1917 and 1918, made available to the Bureau of Mines from the files of the Alaska Juneau Gold Mining Co., Juneau, Alaska, by J. A. Williams, general superintendent.

rig was a standard portable rotary drill powered by a Model T Ford motor, recovering cores of standard "BX", "AX", and "EX" sizes through a double core barrel.

The contractor's equipment was unloaded at Mirror Harbor beach on August 16, 1942, and drilling was completed and equipment was loaded on a scow for transportation to Juneau on September 24, 1942.

Table 1 gives pertinent data concerning drill holes.

TABLE 1. - Diamond drill hole data, Mirror Harbor nickel deposits

Hole	Collar elevation, feet	Bearing	Inclination	Length, feet	Feet in ore	Percent core recovered
			Disseminated sulfide deposit			
1	60	N. 40° E.	-50°	263.0	78.5	95.9
			Davison Bay deposit			
2	6	N. 45° E.	-36°	41.0	1.2	90.3
3	4	S. 24° W.	-33°	40.0	0	91.1
			Fleming Island concentrated-sulfide deposit			
4	22.5	N. 49° W.	-55°	136.9	28.0	91.5
5	12.0	S. 41° W.	-60°	158.3	8.0	93.9
6	12.0	S. 41° W.	-45°	143.8	28.3	94.1
7	14.0	N. 49° W.	-89°	235.4	0	96.5
8	22.5	N. 49° W.	-81°	252.0	0	94.1

DIAMOND-DRILL SAMPLING

Cores were filed in wooden core boxes with metal dividers until logged by George C. Kennedy, junior geologist of the Federal Geological Survey, after which they were split longitudinally, one half going for analysis and the duplicates retained on file at the project office.

Standard metal "sludge tanks" were used, and cuttings were recovered in all holes while drilling in ore. Core recovery was high, and the cuttings were discarded when the core was removed from the holes. No cuttings of samples were sent for analysis. Core analyses are shown in tables 2, 3, 4, and 5. Table 6 shows the lengths and analyses of 6 surface channel samples. Table 7 summarizes the channel and core sampling.

TABLE 2. - D. D. Hole 1

Footage		Sample	Sample length, ft.	Core analysis, percent	
From-	To-			Ni	Cu
0	4.5	-*	-	-	-
4.5	9.5	1	5.0	0.21	0.05
9.5	14.5	2	5.0	.15	.01
14.5	19.5	3	5.0	.11	.03
19.5	24.5	4	5.0	.07	.03
24.5	29.5	5	5.0	.07	.03
29.5	32.5	6	3.0	.20	.01
32.5	34.0	7	1.5	.33	.08
34.0	39.0	8	5.0	.12	.02
39.0	44.1	9	5.1	.10	.02
44.1	47.0	-***	2.9	-	-
47.0	51.5	10	4.5	0.04	0.02
51.5	56.2	11	4.7	.08	.02
56.2	60.9	12	4.7	.45	.12
60.9	66.0	13	5.1	.07	.02
66.0	71.0	14	5.0	.10	.02
71.0	76.0	15	5.0	.07	.02
76.0	80.0	16	4.0	.02	.02
80.0	83.0	17	3.0	.08	.02
			78.5	.120	.029
83.0	88.0	18	5.0	0.03	0.02
88.0	258.0	19	170.0	-	-
258.0	263.0	20	5.0	-	-
D. D. hole 1		-	78.5	0.120	0.029
Pit 8		-	25.0	.312	.108
Pit 10		-	10.0	.360	.060
Pit 12		-	10.0	.040	.040
			123.5	.172	.049

*Overburden.
***Sample not analyzed.

TABLE 3. - D. D. Hole 4

Footage		Sample	Sample length, ft.	Core analysis, percent	
From-	To-			Ni	Cu
0	4.0	-*	-	-	-
4.0	52.5	-***	48.5	-	-
52.5	57.5	1	5.0	0.05	0.06
57.5	63.0	2	5.5	.10	.04
63.0	69.0	3	6.0	.07	.04
69.0	75.0	4	6.0	.11	.09
75.0	88.3	-***	13.3	-	-
88.3	89.3	5	1.0	0.22	0.03
89.3	91.0	6	1.7	2.88	1.54
91.0	94.0	7	3.0	.06	.20
94.0	95.1	8	1.1	1.99	.81
95.1	97.4	9	2.3	.10	.04
97.4	100.8	10	3.4	.04	.03
100.8	105.8	11	5.0	.48	.48
105.8	110.3	12	4.5	.44	.30
110.3	111.0	13	.7	4.20	.83
111.0	113.7	14	2.7	.07	.05
113.7	116.3	15	2.6	4.39	2.77
			28.0	.956	.571
116.3	124.7	16	8.4	0.13	0.08
124.7	125.0	17	.3	1.05	2.12
125.0	131.0	18	6.0	.20	.16
131.0	136.9	19	5.9	.18	.14

*Overburden.
***Sample not analyzed.

TABLE 4. - D. D. Hole 5

Footage		Sample	Sample length, ft.	Core analysis, percent	
From-	To-			Ni	Cu
0	2.0	-*	-	-	-
2.0	13.0	-***	11.0	-	-
13.0	18.0	1	5.0	0.07	0.04
18.0	21.5	2	3.5	.05	.03
21.5	129.5	-***	108.0	-	-
129.5	134.5	3	5.0	0.17	0.09
134.5	135.5	4	1.0	1.70	.44
135.5	136.7	5	1.2	4.23	.60
136.7	137.5	6	.8	.07	.03
137.5	138.3	7	.8	4.30	.17
138.3	143.0	8	4.7	3.02	.60
			8.5	2.878	.487
143.0	148.0	9	5.0	0.01**	0.02
148.0	158.3	-***	10.3	-	-

*Overburden.
**Less than.
***Sample not analyzed.

TABLE 5. - D. D. Hole 6

Footage From-	To-	Sample	Sample length, ft.	Core analysis, percent Ni	Cu
0	2.0	-*	-	-	-
2.0	35.0	-***	33.0	-	-
35.0	41.0	1	6.0	0.21	0.09
41.0	43.5	-***	2.5	-	-
43.5	45.8	2	2.3	0.97	0.19
45.8	73.7	-***	27.9	-	-
73.7	75.8	3	2.1	0.15	0.15
75.8	100.7	-***	24.9	-	-
100.7	104.0	4	3.3	2.20	0.87
104.0	108.0	5	4.0	1.91	1.79
108.0	111.0	6	3.0	.73	.19
111.0	112.3	7	1.3	3.51	2.89
112.3	115.0	8	2.7	.21	.04
115.0	122.0	9	7.0	3.70	2.54
122.0	125.7	10	3.7	.06	.02
125.7	129.0	11	3.3	2.62	3.58
			28.3	2.014	1.560
129.0	143.8	-	14.8	-	-

*Overburden.
***Sample not analyzed.

TABLE 6. - Surface channel
(See fig. 9)

Sample	Sample length, ft.	Core analysis, percent Ni	Cu
1	5.0	1.65	0.81
2	5.0	1.08	.47
3	5.0	1.20	2.24
4	5.0	.88	.89
5	5.0	1.08	.81
6	4.0	3.21	.84
	29.0	1.458	1.016

TABLE 7. - Totals

	Sample length, ft.	Core analysis, percent Ni	Cu
Hole 4	28.0	0.956	0.571
Hole 5	8.5	2.878	.487
Hole 6	28.3	2.014	1.560
	64.8	1.670	0.992
Channel	29.0	1.458	1.016
Total average	93.8	1.605	0.999
Channel and hole 4, average.	57.0	1.212	.798
Holes 5 and 6, average	36.8	2.213	1.312

PIT SAMPLING

Channel samples were taken in a number of the pits, mainly where they had been extended since originally sampled by the Federal Geological Survey. In other pits, samples were taken of the most highly mineralized zones, and resulting assays are not to be considered as representative of the grade of the deposits. Twenty-five pit samples were shipped for analysis and are recorded in table 8. Figure 4 shows the location of these samples.

TABLE 8. - Pit samples disseminated sulfide deposit

Sample	Pit	Sample length, ft.	Analysis Ni	Analysis Cu	Remarks
a	8	5.0	0.20	0.08	
b	8	5.0	.24	.09	
c	8	5.0	.33	.15	
d	8	5.0	.46	.21	
e	8	5.0	.33	.01	
		25.0	1.56	0.54	Total
		25.0	.312	.108	Average table 2
j	10	5.0	.17	.06	
k	10	5.0	.55	.06	
		10.0	0.72	0.12	Total
		10.0	.360	.060	Average table 2
l	12	5.0	.01	.03	
m	12	5.0	.07	.05	
		10.0	0.08	0.08	Total
		10.0	.040	.040	Average table 2
f	23	5.0	.32	.12	
g	23	5.0	.38	.10	
h	20	5.0	.67	.28	
i	20	5.0	.21	.17	
n	5	5.0	.62	.33	
o	5	5.0	.69	.40	
p	5	5.0	.12	.20	
q	5	5.0	.05	.05	
x	5	5.0	.29	.14	
y	5	5.0	.20	.09	
r	37	5.0	.33	.25	
s	35	5.0	.43	.18	
t	35	5.0	.56	.18	
u	44	5.0	.41	.09	
v	44	1.0	1.28	.88	
w	44	5.0	tr.	tr.	

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