RESULTS OF 1985 BUREAU OF MINES INVESTIGATIONS IN THE JOHNS HOPKINS INLET - MARGERIE GLACIER AREA, GLACIER BAY, ALASKA

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Donald P. Hodel, Secretary

OF MINES
. Horton, Director

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CONTENTS

TABLE

ILLUSTRATIONS

APPENDIX FIGURES

UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

ft	feet
in	inch
yd^3	cubic yard
mi	mile
oz	troy ounce
%	percent
ppm	parts per million
st	short ton

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By Joseph M. Kurtak[1]

ABSTRACT

The Bureau of Mines (Bureau) conducted mineral investigations of specific sites in the Johns Hopkins Inlet - Margerie Glacier area of Glacier Bay, Alaska during 1985. The area contains occurrences of copper, zinc, molybdenum, and gold. Several small mines produced a total of approximately 7,100 oz gold in the period 1938 to 1950.

Approximately 17 square miles were mapped and over 99 rock and placer samples were collected in an effort to determine possible extensions of known mineralization.

Several rock samples contained anomalous copper and gold values and anomalous gold was detected in several placer samples.

A very low frequency (VLF) survey conducted over concealed extensions of known massive sulfide mineralization identified several anomalies.

INTRODUCTION

During 1985, the Bureau undertook an investigation of the Johns Hopkins Inlet - Margerie Glacier area in Glacier Bay, Alaska (figs. 1 and 2). This study was initiated to further investigate copper-zinc sulfide occurrences previously discovered by the Bureau in the area (Brew and others, 1978). Previously undiscovered sulfide-rich veins containing precious metal values were sampled and several drainages containing anomalous gold values were examined for their placer gold potential. Geophysical methods in the form of very low frequency (VLF) surveys were carried out to explore areas containing possible hidden extensions of massive sulfide zones.

ACKNOWLEDGMENTS

The author wishes to acknowledge Jan Still, Lance Miller, and Brian Peck, U.S. Bureau of Mines, Juneau, Alaska, for sharing their knowledge of the area and Bill Roberts, U.S. Bureau of Mines, Anchorage, who helped to prepare a statistical analysis of the analytical results.

PREVIOUS WORK

Reed (1938) published the first description of sulfide mineralization on the north side of Johns Hopkins Inlet. Rossman (1959 and 1963) examined gold-bearing veins that were discovered in 1924 in Reid Inlet.

The most detailed investigation in the Glacier Bay area was a joint effort by the Bureau and the U.S. Geological Survey (USGS) to evaluate

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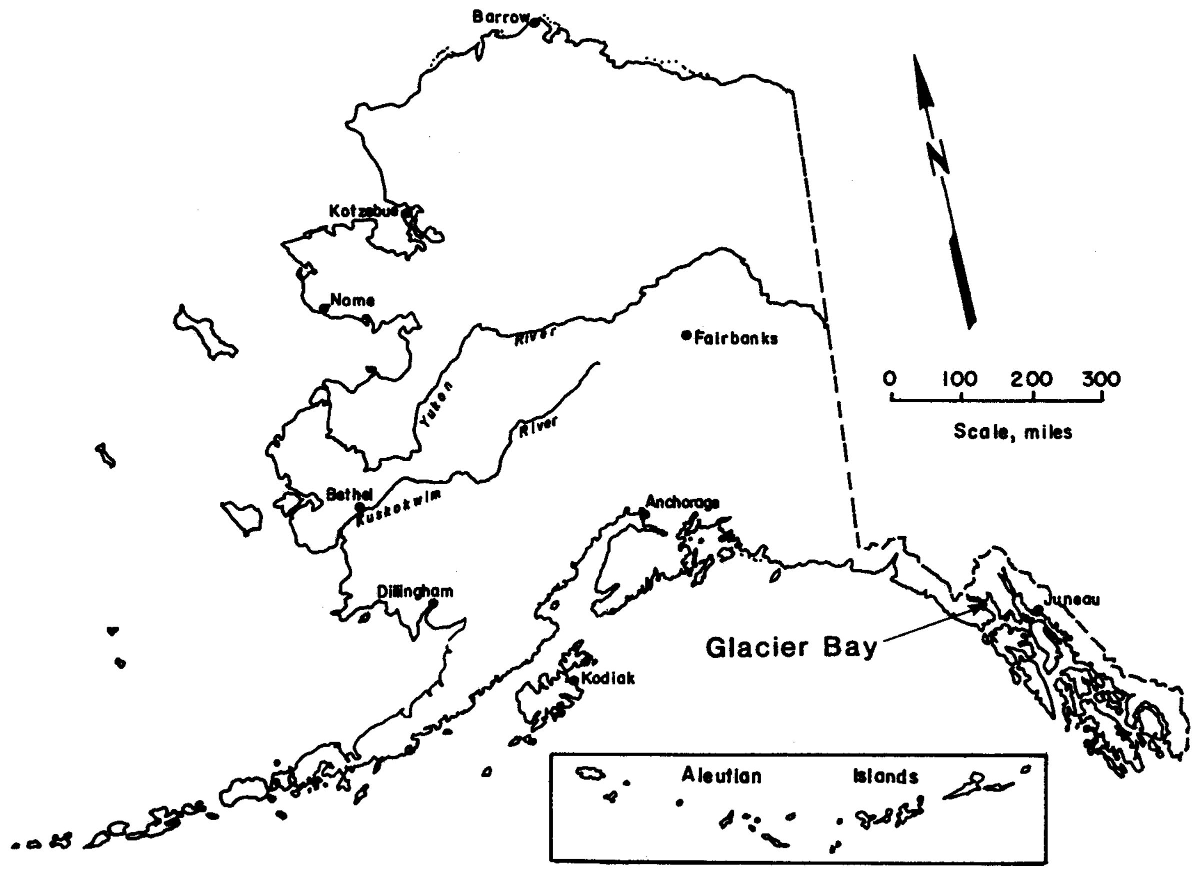

Figure 1. -- Location of Glacier Bay, Alaska

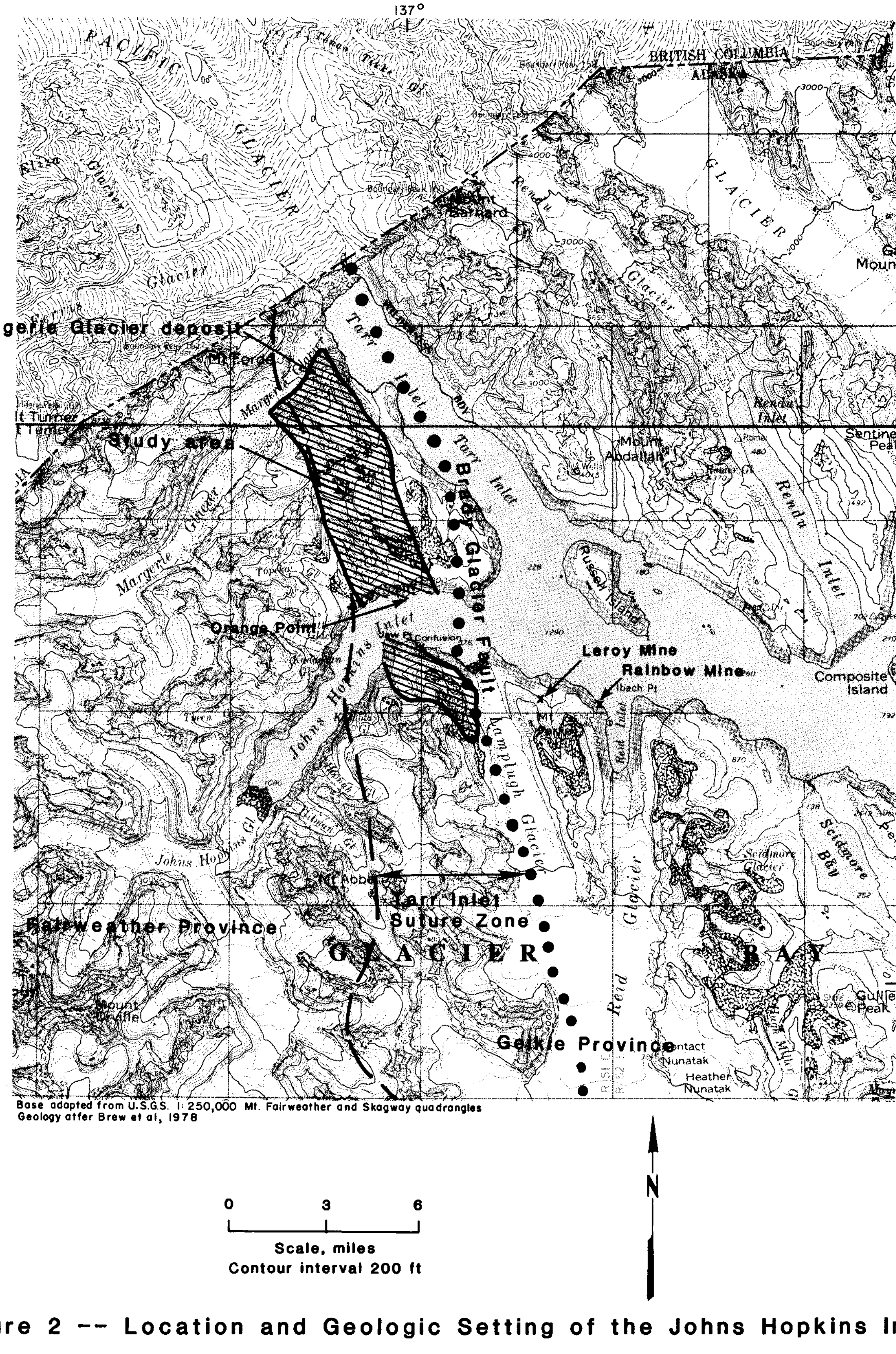

Figure 2 -- Location and Geologic Setting of the Johns Hopkins Inlet-Margerie Glacier Study Area, Glacier Bay, Alaska

the mineral resources of Glacier Bay National Wilderness Study Area (Brew and others, 1978). During this study copper-zinc mineralization was discovered by the Bureau at Orange Point in Johns Hopkins Inlet (fig. 2). Also, molybdenum and tungsten mineralization occurring near the Margerie Glacier were examined. Field work conducted by a Bureau employee at this time (Parke, 1978) resulted in an unpublished masters thesis.

LAND STATUS

The area of investigation is federal land located within Glacier Bay National Park and Preserve which is administered by the National Park Service and is presently closed to mineral entry.

MINING AND PROSPECTING HISTORY

Mining claims were located on the east shore of Rendu Inlet, Glacier Bay area as early as 1892. Early residents of the area discovered gold on some of the gravel-covered icebergs coming from Lamplugh and Johns Hopkins Glaciers sometime before 1924.

A gold-bearing area was discovered between Reid Inlet and Lamplugh Glacier in 1924 (Rossman, 1963, p. K4). Production records from individual mines is either lacking or incomplete. Sluicing of surface material developed above weathered veins produced less than 100 oz of gold. From 1938 to 1950, 2,500 st of high-grade ore with a recovery of about $100 per st, was mined from several properties in the area (Rossman, 1959, p. 39). These include the Rainbow claim and the LeRoy Mine (fig. 2). Based on this information a total production of at least 7,100 oz gold can be estimated.

Glacier Bay was closed to prospecting from 1925 to 1936, after which time it was again opened to mineral entry. In 1944 claims were located at the Tarr Inlet Knob copper prospect 2 mi southeast of the Margerie Glacier prospect. Discovery of the Margerie Glacier porphyry copper deposit on the south flank of the Margerie Glacier followed in 1960 (Brew and others, 1978).

In 1976, the Bureau discovered zinc-copper mineralization at Orange Point on the north side of Johns Hopkins Inlet. The park and preserve has been closed to prospecting since 1976 (Brew and others, 1978).

GEOLOGY

Rocks in the Johns Hopkins Inlet - Margerie Glacier area lie on the western boundary of the Geikie Province and consist of mid-Paleozoic andesitic and volcaniclastic rocks (greenstones) intermixed with a northwest-trending, steeply west dipping, metamorphosed sequence of argillite, phyllite, slate, and marble. These rocks were probably deposited as a thick section of marine shale, graywacke, arkose, volcanic flow or tuffs, and limestone in a shallower environment than the older rocks of Fairweather Province to the west. Stratigraphic tops are to the east. It is these rocks of the Geikie Province that contain zinc-copper mineralization. These rocks have been intruded and assimilated by Cretaceous and Tertiary diorites and monzonites that form both sharp and gradational contacts with the volcanic-sediment package (Brew and others, 1978, pp. C131-C132). The intrusives form fingers and bands parallel to regional structural trends. Contact effects include introduction of abundant chlorite, and epidote, along with local hornfelsing. Basaltic dikes cut the volcanics and aplite dikes cut all rock types.

Sulfide-rich quartz veins containing anomalous gold and tungsten occur at or near contacts between the intrusives and the volcanic-sediment sequence. The intrusives themselves host porphyry-type copper mineralization.

All these rock types lie within the 5 to 12-kilometer wide Tarr Inlet Suture Zone which includes the Brady Glacier fault and makes up the western boundary of the Geikie Province. It is suggested that the suture zone resulted from the collision, during Permian to mid-Cretaceous time, between a block of probable Precambrian or lower Paleozoic rocks to the west and a large block of middle Paleozoic rock to the east. Its relationship to regional tectonic models is not clear (Brew and Morrel, 1978, p. B90).

BUREAU OF MINES INVESTIGATION

This study was initiated to follow-up sampling done in the Johns Hopkins - Margerie Glacier area by the Bureau in 1976 (Brew and others, 1978). The Bureau spent 28 man days in the study area and collected a total of 95 rock and four placer samples. The geology of the Orange Point area was mapped (fig. 3), iron-stained zones were investigated (fig. 4), and reconnaissance mapping was done of the regional geology (fig. 5).

Sample locations are shown in figure 6, and table 1 shows analytical results.

Also, 2,000 ft of VLF survey lines were run. The results of this work will be discussed under the various deposit types investigated.

Zinc-Copper Sulfide Deposits

The Orange Point area on the north side of Johns Hopkins Inlet contains a zinc-copper sulfide deposit discovered by the Bureau in 1976 (fig. 3). Inferred resources total 0.8 million tons averaging 1.2% copper and 1.9% zinc (Brew and others, 1978, p. D12). It is conformably hosted by metamorphosed Permian andesite and volcaniclastic rock which has been assimilated by diorite and occurs within the Tarr Inlet Suture Zone. The deposit forms a spectacular iron-stained area visible for miles across the inlet. The sulfide bodies occur as elongate, massive, parallel lenses up to 80 ft wide and narrow intermittent tabular bodies extending for up to 560 ft along strike. Both disseminated and massive sulfides occur within andesites. Sulfides consist of pyrite, pyrrhotite, sphalerite, and chalcopyrite. Samples contain up to 19% zinc and 5.2% copper. Precious metal values run up to 0.1 oz/st gold and 2.0 oz/st silver.

The deposit is proposed as being volcanogenic in orgin, but later metamorphism and intrusion has deformed the original sulfide lenses, and remobilized at least some of the sulfides (Brew and others, 1978, p. C129-C147).

The north and south strike extensions of the rock types hosting the massive sulfides were investigated due to recommendations made by Brew and others (1978, p. C149). The diorites, metavolcanics, and metasediments were mapped and sampled along a 10-mi trend northwest and southeast from Orange Point. A considerable portion of the area was either ice-covered or in country too steep to safely access. The Bureau investigated many iron-stained zones which occur in this belt of rocks and found most to be the result of finely disseminated sulfides in the rock (fig. 4). Also, argillite inclusions or xenoliths within andesite are often iron-stained due to disseminated sulfides. These stain zones were found to occur in andesites, diorites, and metasediments, but mostly concentrated in the andesite near contacts with diorite. Sulfides consist of pyrite, pyrrhotite, and chalcopyrite. An anomalous sample collected from float contained 0.99% copper (Sample No. 44).

Averages of analytical results show that the highest average background geochemical copper and zinc values (148 ppm and 81 ppm, respectively), occur in metavolcanics, while the highest average background geochemical lead values (14 ppm) come from the plutonic rocks (Appendix B).

The sulfides occur in massive and disseminated form in small lense-like or poddy masses. No sulfide masses of significant size were discovered.

Sulfide Veins

Sulfide-rich quartz veins discovered and sampled along the margins of the Margerie monzodiorite by Brew and others (1978, pp. C150-C162) were further delineated and sampled during this study. The veins with the highest sulfide content occur approximately 0.7 mi south of the Margerie Glacier porphyry copper deposit. A series of subparallel veins trend approximately north 35°W, dip from 75°-90°W, and can be traced intermittently for up to 350 ft along strike. Widths vary from a few inches to four ft. The wider veins contain 3 to 6-in wide zones of pyrrhotite, arsenopyrite, and chalcopyrite. Disseminated pyrite and arsenopyrite also occur in the quartz. Greenish scorodite was observed on weathered surfaces. Locally, arsenopyrite veinlets less than 0.5 in wide occur within the quartz monzonite adjacent to the quartz veins.

The widest vein with the highest sulfide content occurred at the contact between monzonite and metasediments. No veins were observed within the metasediments themselves. Select high grade samples contained up to 0.12 oz/st gold, 0.92% copper (Sample No. 16), and 225 ppm tungsten (Sample No. 25).

A chip sample collected over a 2.5-ft wide vein with a high sulfide content contained 0.018 oz/st gold and 0.14% copper (Sample No. 19). Snow covered some of the vein extensions at the time of the Bureau visit so they could not be sampled. A northeast trending 1.5-ft wide sheared vein located 1,000 ft to the northwest contains massive arsenopyrite lenses in a zone averaging 6.5 ft wide. A select sample contained 0.12 oz/st gold and 1.1% copper (Sample No. 9).

Background gold values are highest in the metavolcanics, averaging 0.021 ppm (Appendix B). The highest gold values occur in samples with the lowest copper values.

Placer Gold

Brew and others (1978, p. C128) reported anomalous gold values in Beaver Creek, a 1.3-mi long glacial fed stream draining the eastern

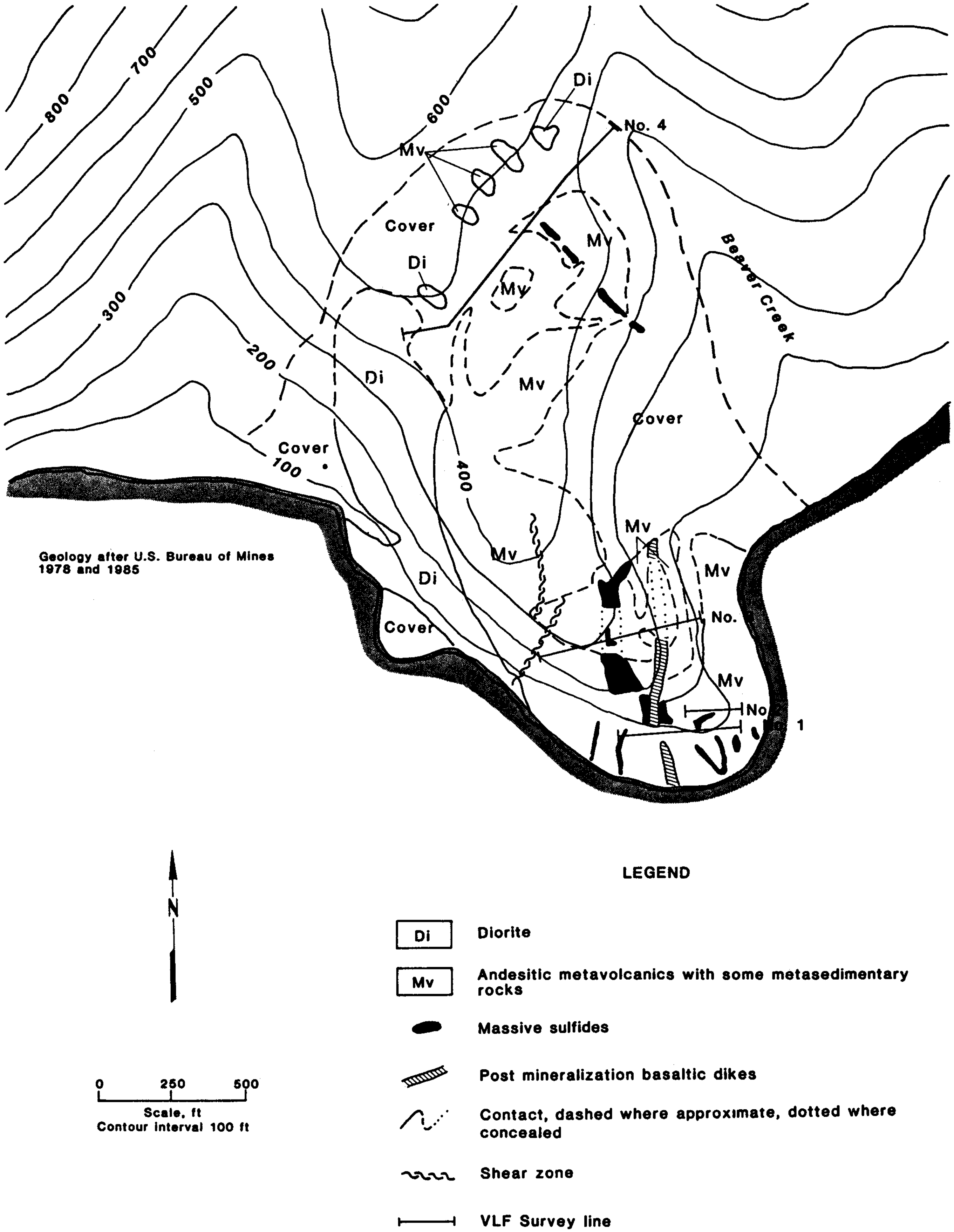

Figure 3. -- Geologic Map and VLF survey line locations, Orange Point area, Glacier Bay, Alaska

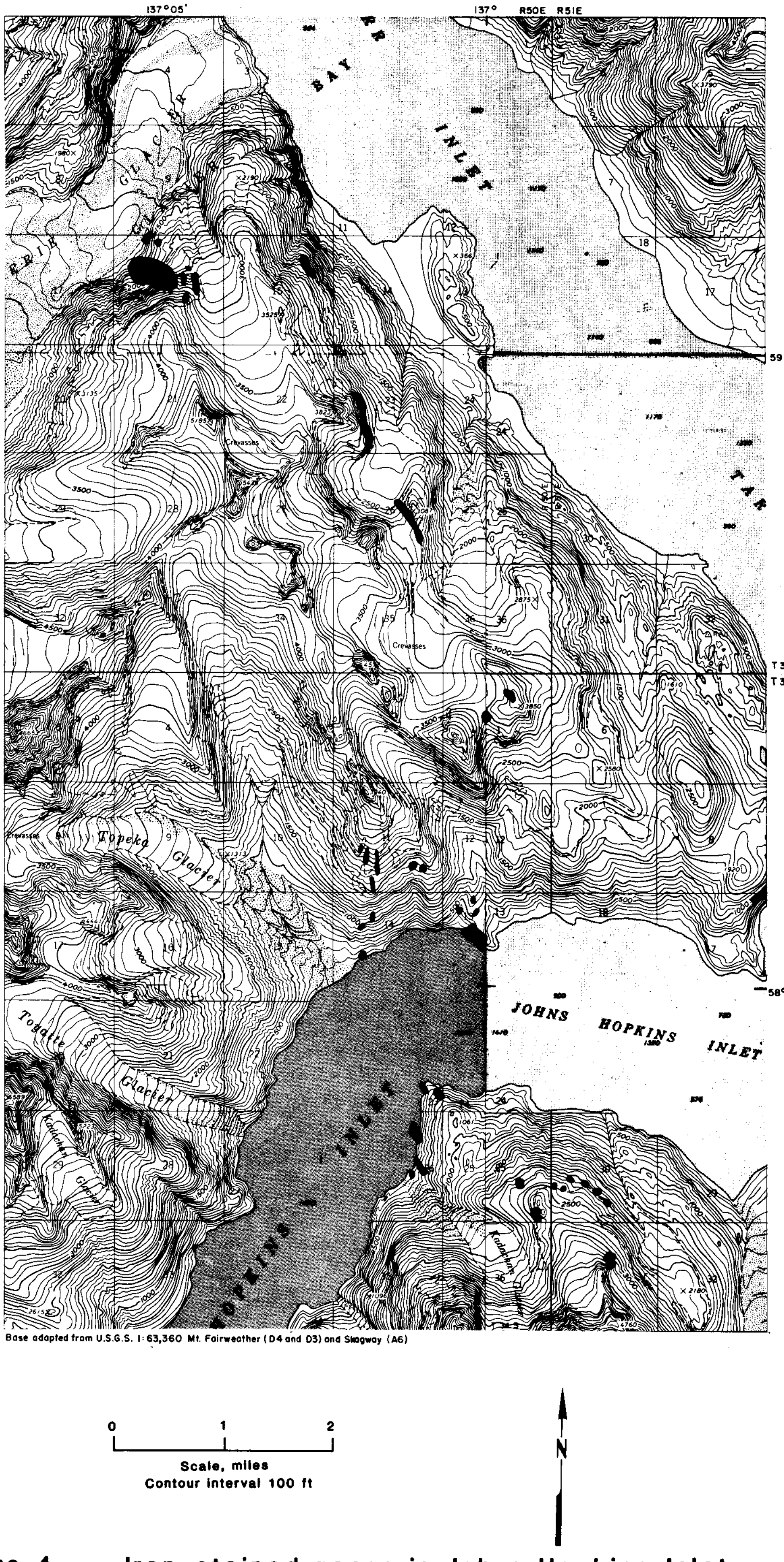

Figure 4. -- Iron-stained zones in Johns Hopkins Inlet-Margerie Glacier area, Glacier Bay, Alaska

side of the Orange Point deposit (fig. 3). A series of 1/10 yd^3 placer samples were collected along this drainage to evaluate gold distribution. The sample locations were near the shoreline in an alluvial fan deposit adjacent to the present stream course. The samples were not collected down to bedrock. Sample No. 59 contained up to 0.006 oz/yd^3 gold which is highly anomalous. The gold occurs as flakes ranging from 0.02-0.04 in. in diameter. Two placer samples collected 0.4 mi upstream above the massive sulfides contained no anomalous gold. This indicates that the source of gold may be the massive sulfide bodies in the Orange Point deposit adjacent to Beaver Creek. Samples of the sulfides contain up to 3.5 ppm gold. Since the anomalous area is essentially at tidewater and a moderate amount of stream gravel is readily available, a low cost mining operation could be feasible in the area. More samples should be taken to determine the extent of the placer gold within the fan and the volume of gravel available.

GEOPHYSICS

To test for concealed massive sulfide bodies in the Orange Point area 2,000 ft of VLF geophysical lines were run. Two test lines were run at the Orange Point deposit over an exposed massive sulfide zone up to 10 ft wide. Lines were laid out normal to sulfide zone trends to get maximum contrast. Figure 3 shows line locations and Appendix B shows the VLF profiles. Transmitter stations at Cutler, Maine and Seattle, Washington were used. Strong anomalies were obtained over the exposed sulfides using the Seattle station.

Two lines were run over the possible northern concealed extension of known sulfide zones and anomalies were obtained at several locations, though not as strong as those exposed at the Orange Point deposit. These anomalies should be further investigated using detailed VLF surveys or other geophysical methods. Trenching or drilling to verify these results would eventually be required.

CONCLUSIONS

Examinations of the Johns Hopkins area by the Bureau identified anomalous concentrations of copper-zinc sulfides and placer and lode gold.

Numerous iron-stained zones occur in the area and select samples of greenstone float contain up to 0.99% copper. The area contains numerous snow fields and the source of the sulfide-bearing float could not be determined, due to poor exposure.

Select samples collected from sulfide-rich quartz veins and shear zones up to 6.5 ft wide near the Margerie Glacier contained up to 0.12 oz/st gold. Closer spaced sampling is needed to further delineate the extent of the vein mineralization.

Placer samples collected from stream gravels near tidewater in the vicinity of Orange Point contained up to 0.006 oz/yd^3 gold. More detailed placer sampling is required to determine the extent of the gold-bearing gravels.

Geophysical testing for covered extensions of known massive sulfide zones near Orange Point produced several weak anomalies.

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ABBREVIATIONS USED IN TABLE 1

Sample Types:

Grab	:	A collection of mineral or rock fragments, some broken from larger pieces, taken at random from an outcrop or float, or from a dump, heap, or scattered pile.
Random chip	:	A regular series of mineral or rock fragments taken randomly over an outcrop.
Continous chip (cont. chip)	:	A regular series of mineral or rock fragments taken in a continous line across an outcrop.
Spaced chip	:	A regular series of mineral or rock fragments taken at uniformly spaced intervals across an outcrop.
Representative chip (Rep. chip)	:	Taken to be entirely representative of an entire rock or mineralized exposure.
Select	:	A highly mineralized sample taken to indicate maximum values present.
Placer	:	Approximately 0.1 $yd/^3$ stream gravel run through a 10-in wide x 34-in long sluice box.
Stream sediment	:	Silt size material collected from active portion of stream drainage.

Table 1. - Analytical Results - Glacier Bay, Alaska

Sample number	Material type	Sample type	Sample width (ft.)	Elements (ppm unless otherwise indicated)										Descriptions
				Au	Ag	Cu	Pb	Zn	As	Mo	Ni	Sb	W	
1.....	Granite.....	Random chip.	NAp	0.045	< 0.2	43.0	9.0	13.0	NAp	NAp	NAp	NAp	NAp	Quartz-rich granitoid.
2.....	...do.......	...do....	NAp	.015	.2	30	14	53	NAp	NAp	NAp	NAp	NAp	Do.
3.....	...do.......	Grab.....	NAp	.560	.2	119	25	75	NAP	NAp	NAp	NAp	NAp	Quartz-rich granitoid dike.
4.....	Gabbro......	Random chip.	NAp	.020	.3	102	7	41	NAp	NAp	NAp	NAp	NAp	Sheared/altered gabbro; minor pyrrhotite.
5.....	...do.......	...do....	NAp	.785	2.3	.18[1]	41	137	NAp	NAp	NAp	NAp	NAp	Silicified fractures in diorite. Pyrrhotite, arsenopyrite.
6.....	Slate.......	Grab.....	NAp	< .005	< .2	95	21	107	NAp	4	NAp	NAp	2	Black slate; minor pyrite.
7.....	...do.......	...do....	NAp	.005	< .2	84	17	102	NAp	2	NAp	NAp	2	Sheared/silicified black slate.
8.....	Diorite.....	Select...	NAp	.020	< .2	229	10	56	NAp	2	NAp	NAp	13	Diorite/greenstone; minor pyrrhotite, arsenopyrite.
9.....	...do.......	...do....	NAp	.121[2]	29	1.1[1]	27	278	NAp	3	NAp	NAp	6	Shear zone in diorite; massive arsenopyrite, trace chalcopyrite.
10....	...do.......	...do....	NAp	.050	10	.43[1]	11	78	NAp	10	NAp	NAp	19	Greenstone with malachite stain.

See footnotes at end of table.

Table 1. - Analytical Results - Glacier Bay, Alaska--Continued

Sample number	Material type	Sample type	Sample width (ft.)	Elements (ppm unless otherwise indicated) Au	Ag	Cu	Pb	Zn	As	Mo	Ni	Sb	W	Descriptions
11....	Diorite/ greenstone.	...do....	NAp	0.095	0.3	525.0	4.0	43.0	NAp	NAp	NAp	NAp	NAp	Diorite/greenstone; arsenopyrite, chalcopyrite.
12....	Greenstone..	Select...	NAp	.050	.3	670	13	63	NAp	3	NAp	NAp	8	Greenstone/diorite.
13....	Diorite.....	Select...	NAp	.005	.2	133	23	341	NAp	2	NAp	NAp	4	Shear zone in diorite.
14....	...do.......	Grab.....	NAp	.010	< .2	233	4	55	NAp	NAp	NAp	NAp	NAp	Limonite stained silicified diorite. Pyrrhotite.
15....	Granite.....	Select...	NAp	.005	< .2	49	11	18	NAp	1	NAp	NAp	4	Felsic granite disseminated arsenopyrite.
16....	Diorite.....	...do....	NAp	.12 2/	.8	96	20	28	NAp	3	NAp	NAp	4	Diorite with altered arsenopyrite/pyrrhotite.
17....	...do.......	...do....	NAp	.02 2/	5.8	.12 1/	18	79	NAp	1	NAp	NAp	3	Siliceous diorite with arsenopyrite, chalcopyrite.
18....	...do.......	...do....	NAp	.029 2/	26	.92 1/	14	430	NAp	2	NAp	NAp	5	Siliceous diorite with arsenopyrite, pyrrhotite chalcopyrite.
19....	...do.......	Cont. chip.	2.5	.018 2/	4.4	.14 1/	14	115	NAp	2	NAp	NAp	3	Do.
20....	Greenstone..	Spaced chip.	.75	.170	5.4	.18 1/	22	106	NAP	3	NAp	NAp	36	Siliceous greenstone.
21....	Diorite.....	...do....	2.0	.455	5.8	.28 1/	26	255	NAp	2	NAp	NAp	82	Breccia zone; massive pyrite, chalcopyrite.

See footnotes at end of table.

Table 1. - Analytical Results - Glacier Bay, Alaska--Continued

Sample number	Material type	Sample type	Sample width (ft.)	Elements (ppm unless otherwise indicated)										Descriptions
				Au	Ag	Cu	Pb	Zn	As	Mo	Ni	Sb	W	
22....	Diorite/ greenstone.	Rep. chip.	NAp	0.045	< 0.2	287.0 1/	6.0	67.0	NAp	NAp	NAp	NAp	NAp	Diorite/greenstone; pyr- rhotite arsenopyrite, chalcopyrite.
23....	Greenstone..	Select...	NAp	.005	< .2	288	5	42	NAP	NAp	NAp	NAp	NAp	Limonite stained green- stone.
24....	...do.......	Spaced chip.	1.4	.105	1.2	.10	15	107	NAp	7	NAp	NAp	150	Sheared greenstone; up to 5% sulfide.
25....	Greenstone..	Select...	NAp	.050	.8	.18 1/	7	99	NAp	2	NAp	NAp	225	Mixed greenstone/diorite; chalcopyrite, pyrrhotite.
26....	Quartz......	Grab.....	NAp	.020	.8	.70 1/	6	37	NAp	NAp	NAp	NAp	NAp	Vein quartz, float chalcopyrite, malachite.
27....	Greenstone..	Spaced... chip	2.5	.100	.4	550	10	19	NAp	5	NAp	NAp	2	Greenstone/argillite; pyrite, chalcopyrite.
28....	...do.......	Select...	NAp	.005	.2	119	14	103	NAp	13	NAp	NAp	2	Argillite; minor pyrite.
29....	Argillite...	...do....	NAp	< .005	< .2	54	8	87	NAp	6	NAp	NAp	2	Limonite stained argillite with limestone lenses.
30....	...do.......	...do....	NAp	.015	.4	154	14	99	NAp	5	NAp	NAp	3	Argillite; trace pyrite.
31....	...do.......	...do....	NAp	.005	< .2	56	8	88	NAp	5	NAp	NAp	3	Do.
32....	Greenstone..	...do....	NAp	.005	< .2	200	4	75	NAp	14	NAp	NAp	4	Greenstone; minor pyrrhotite.

See footnotes at end of table.

Table 1. - Analytical Results - Glacier Bay, Alaska--Continued

Sample number	Material type	Sample type	Sample width (ft.)	Elements (ppm unless otherwise indicated) Au	Ag	Cu	Pb	Zn	As	Mo	Ni	Sb	W	Descriptions
33....	Argillite...	...do....	NAp	0.015	< 0.2	99.0	11.0	61.0	NAP	8.0	NAp	NAp	3.0	Argillite/greenstone; minor pyrrhotite.
34....	...do.......	...do....	NAp	.005	< .2	89	10	59	410	NAp	NAp	NAp	3	Argillite float; up to 5% pyrite.
35....	Greenstone..	...do....	NAp	< .005	< .2	51	13	49	NAp	NAp	NAp	NAp	NAp	Epidotized greenstone; trace pyrite.
36....	Slate.......	Grab.....	NAp	.015	< .3	87	12	81	NAp	NAp	NAp	NAp	NAp	Hornfelsic slate; minor pyrite.
37....	Greenstone/ argillite.	Select...	NAp	.010	.2	110	9	97	530	NAp	NAp	NAp	2	Greenstone/argillite with pyrite.
38....	Argillite...	Select...	NAp	< .002	< .2	74	7	87	400	NAp	NAp	NAp	2	Argillite with minor pyrite.
39....	Diorite.....	Random chip.	NAp	.02	< .2	17	6	37	740	NAp	NAp	NAp	2	Quartz diorite; trace pyrite.
40....	Magnetite...	Grab.....	NAp	.010	< .2	745	15	58	NAp	10	NAp	NAp	3	Magnetite float.
41....	Gossan......	...do....	NAp	.005	< .2	60	7	59	NAp	3	NAp	NAp	2	Pyritic gossan.
42....	Slate.......	...do....	NAp	.010	< .2	30	8	33	NAp	3	NAp	NAp	3	Black slate.
43....	Skarn?......	...do....	NAp	.115	< .5	120	2	99	NAp	NAp	NAp	NAp	NAp	Skarn? float; minor pyrite, chalcopyrite.
44....	Greenstone..	Grab.....	NAp	.195	8.5	.99 1/	13	645	NAp	NAp	NAp	NAp	NAp	Greenstone; minor pyrite/ chalcopyrite.

See footnotes at end of table.

Table 1. - Analytical Results - Glacier Bay, Alaska--Continued

Sample number	Material type	Sample type	Sample width (ft.)	Elements (ppm unless otherwise indicated) Au	Ag	Cu	Pb	Zn	As	Mo	Ni	Sb	W	Descriptions
45....	Granite.....	Grab.....	NAp	<0.005	< 0.2	37.0	10.0	72.0	NAp	NAp	NAp	NAp	NAp	Limonite stained felsic dike.
46....	...do.......	...do....	NAp	< .005	< .2	85	7	51	NAp	NAp	NAp	NAp	NAp	Limonite stained felsic intrusive.
47....	Greenstone..	...do....	NAp	<0.005	.2	91	15	53	NAp	NAp	NAp	NAp	NAp	Greenstone; minor pyrite.
48....	...do.......	...do....	NAp	< .005	.9	40	10	43	NAp	NAp	NAp	NAp	NAp	Metagreenstone; minor pyrite.
49....	Diorite.....	...do....	NAp	< .005	< .2	88	15	69	NAp	NAp	NAp	NAp	NAp	Silicified greenstone; pyrite.
50....	Greenstone..	...do....	NAp	.040	< .2	41	13	52	NAp	NAp	NAp	NAp	NAp	Silicified greenstone/ argillite.
51....	Schist......	...do....	NAp	< .005	< .2	183	5	47	NAp	NAp	NAp	NAp	NAp	Limonite stained chlorite schist.
52....	Diorite.....	Grab.....	NAp	< .005	.2	145	11	46	NAp	2	NAp	NAp	2	Chloritized monzodiorite; minor pyrite.
53....	...do.......	...do....	NAp	.045	9.8	1/ .56	31	295	NAp	NAp	NAp	NAp	NAp	Diorite/metavolcanic; contact pyrite, chalco-pyrite.
54....	Schist......	...do....	NAp	.010	1.9	425	30	180	NAp	NAp	NAp	NAp	NAp	Quartz schist pyrite.
55....	Gravel......	Placer...	NAp	.010	< .2	81	12	86	NAp	NAp	NAp	NAp	NAp	Beaver Creek.
56....	Silt........	Stream sediment	NAp	.035	< .2	49	7	70		35			2	Do.

See footnotes at end of table.

Table 1. - Analytical Results - Glacier Bay, Alaska--Continued

Sample number	Material type	Sample type	Sample width (ft.)	Elements (ppm unless otherwise indicated) Au	Ag	Cu	Pb	Zn	As	Mo	Ni	Sb	W	Descriptions
57....	Diorite.....	...do....	NAp	<0.005	< 0.2	5.0	9.0	12.0	NAp	1.0	NAp	NAp	3.0	Silicified monzodiorite; minor pyrite.
58....	...do.......	...do....	NAp	< .005	< .2	29	4	41	NAp	4	NAp	NAp	2	Monzodiorite pyrite.
59....	Gravel......	Placer...	NAp	1.165	0.2	96	9	79	NAp	NAp	NAp	NAp	NAp	Beaver Creek; adjacent to Orange Point .006 oz/yd^3.
60....	Silt........	Stream silt.	NAp	.005	< .2	38	13	75	NAp	NAp	NAp	NAp	NAp	Do.
61....	Gravel......	Placer...	NAp	.730	60	14	83	< .2	NAp	NAp	NAp	NAp	NAp	No weighable Au fraction.
62....	...do.......	...do....	NAp	< .005	52	3	72	< .2	NAp	NAp	NAp	NAp	NAp	Do.
63....	Sulfides....	Grab.....	NAp	.105	5.7	1/ .43	144.0	1/ .99	NAp	77	NAp	NAp	2	Orange Point; massive sulfides, sphalerite, chalcopyrite.
64....	Slate.......	...do....	NAp	< .005	< .2	16	7	75	NAp	3	NAp	NAp	2	Black slate.
65....	Granite.....	Grab.....	NAp	.005	.2	10	11	29	NAP	2	NAp	NAp	4	Aplite dike; 10% pyrite.
66....	Diorite.....	...do....	NAp	.005	< .2	57	3	67	NAp	4	NAp	NAp	2	Limonite stained diorite; 15% pyrite, pyrrhotite.
67....	Greenstone..	...do....	NAp	.005	< .2	42	2	117	NAp	4	NAp	NAp	2	Metagreenstone; 10% pyrite.
68....	...do.......	...do....	NAp	.005	.2	131	8	61	NAp	4	NAp	NAp	3	Do.

See footnotes at end of table.

Table 1. - Analytical Results - Glacier Bay, Alaska--Continued

Sample number	Material type	Sample type	Sample width (ft.)	Elements (ppm unless otherwise indicated) Au	Ag	Cu	Pb	Zn	As	Mo	Ni	Sb	W	Descriptions
69....	...do.......	Select...	NAp	0.005	< 0.2	25.0	6.0	28.0	NAp	14.0	NAp	NAp	4.0	Siliceous greenstone; trace pyrite.
70....	Sulfides....	Cont. chip.	1.0	< .005	.3	11	13	35	NAp	NAp	NAp	NAp	NAp	Do.
71....	Diorite.....	...do....	5	.005	< .2	20	17	59	NAp	NAp	NAp	NAp	NAp	Sheared chloritic diorite; disseminated pyrite.
72....	...do.......	...do....	5	.005	.2	29	17	57	NAp	NAp	NAp	NAp	NAp	Do.
73....	...do.......	Rep. chip.	NAp	.010	< .2	36	11	58	NAp	NAp	NAp	NAp	NAp	Chloritic diorite float; disseminated sulfides.
74....	Argillite...	...do....	NAp	.005	< .2	140	19	68	NAp	32	NAp	NAp	3	Argillite xenolith; trace pyrite.
75....	...do.......	...do....	NAp	.005	.5	110	22	376	NAp	60	NAp	NAp	3	Siliceous argillite; trace pyrrhotite.
76....	Aplite......	Spaced chip.	6	.005	< .2	14	17	81	NAp	NAp	NAp	NAp	NAp	Chloritic aplite dike rock; minor sulfide.
77....	Slate.......	Rep. chip.	NAp	< .005	< .2	52	15	99	NAp	NAp	NAp	NAp	NAp	Black slate.
78....	Greenstone..	Select...	NAp	< .005	< .2	80	13	64	NAp	3	NAp	NAp	2	Siliceous greenstone; trace pyrrhotite.
79....	Diorite.....	...do....	NAp	< .005	< .2	150	16	76	NAp	NAp	NAp	NAp	NAp	Diorite; minor pyrite.
80....	...do.......	...do....	NAp	< .005	< .2	98	11	56	NAp	NAp	NAp	NAp	NAp	Do.

See footnotes at end of table.

Table 1. - Analytical Results - Glacier Bay, Alaska--Continued

Sample number	Material type	Sample type	Sample width (ft.)	Elements (ppm unless otherwise indicated)										Descriptions
				Au	Ag	Cu	Pb	Zn	Ba	Mo	Ni	Sb	W	
81....	Greenstone/ argillite.	...do....	NAp	<0.005	< 0.2	60.0	11.0	55.0	NAp	NAp	NAp	NAp	NAp	Siliceous argillite; minor pyrrhotite.
82....	...do.......	...do....	NAp	< .005	< .2	81	9	117	NAP	NAp	NAp	NAp	NAp	Limonite stained siliceous greenstone/argillite.
83....	Greenstone..	...do....	NAp	.020	.06	84	16	105	NAp	NAp	NAp	NAp	NAp	Limonite stained green-stone.
84....	Greenstone/ slate.	...do....	NAp	< .005	< .2	65	18	126	NAp	NAp	NAp	NAp	NAp	Limonite stained green-stone/argillite.
85....	Argillite...	...do....	NAp	< .005	< .2	97	13	104	NAp	NAp	NAp	NAp	NAp	Argillite lense in dio-rite; minor pyrrhotite.
86....	Greenstone..	...do....	NAp	< .005	< .2	125	3	146	NAp	NAp	NAp	NAp	NAp	Siliceous greenstone.
87....	Granite.....	...do....	NAp	< .005	< .2	11	2	51	NAp	NAp	NAp	NAp	NAp	Siliceous granite.
88....	Hornfels....	Rep. chip.	NAp	< .005	2	62	33	109	NAP	NAp	NAp	NAp	NAp	Limonite stained hornfels; pyrite.
89....	Slate.......	...do....	NAp	< .005	< .2	28	18	79	NAp	NAp	NAp	NAp	NAp	Black slate; trace pyrite.
90....	...do.......	...do....	NAp	< .005	< .2	47	15	85	NAp	NAp	NAp	NAp	NAp	Black slate.
91....	Slate/ argillite.	...do....	NAp	< .005	.2	35	21	103	NAp	3	NAp	NAp	2	Slate/argillite; minor pyrite.
92....	Greenstone..	Select...	NAp	.005	< .2	104	14	77	NAp	3	NAp	NAp	3	Siliceous greenstone; trace pyrite/pyrrhotite.

See footnotes at end of table.

Table 1. - Analytical Results - Glacier Bay, Alaska

Sample number	Material type	Sample type	Sample width (ft.)	Elements (ppm unless otherwise indicated) Au	Ag	Cu	Pb	Zn	Ba	Mo	Ni	Sb	W	Descriptions
93....	...do.......	...do....	NAp	<0.005	0.2	50.0	17.0	21.0	NAp	17.0	NAp	NAp	3.0	Siliceous greenstone float; stringer pyrrhotite.
94....	Marble......	...do....	NAp	.070	.4	321	28	470	NAp	44	NAp	NAp	3	Massive sulfides in marble.
95....	Diorite/ greenstone.	...do....	NAp	.010	< .2	23	22	80	NAp	7	NAp	NAp	2	Diorite/greenstone.
96....	Greenstone..	...do....	NAp	.010	< .2	80	15	207	NAP	7	NAp	NAp	2	Siliceous greenstone.
97....	Greenstone/ argillite.	...do....	NAp	.005	< .2	61	14	99	NAp	2	NAp	NAp	3	Greenstone/argillite.
98....	Greenstone/ marble.	...do....	NAp	.060	< .2	81	10	16	NAp	5	NAp	NAp	3	Massive sulfides; pyrite/ pyrrhotite.
99. .	Greenstone..	...do....	NAp	.065	< .2	41	13	15	NAp	6	NAp	NAp	3	Massive sulfides in greenstone.

1/percent
2/ounces per ton

APPENDIX A. - VLF SURVEY RESULTS

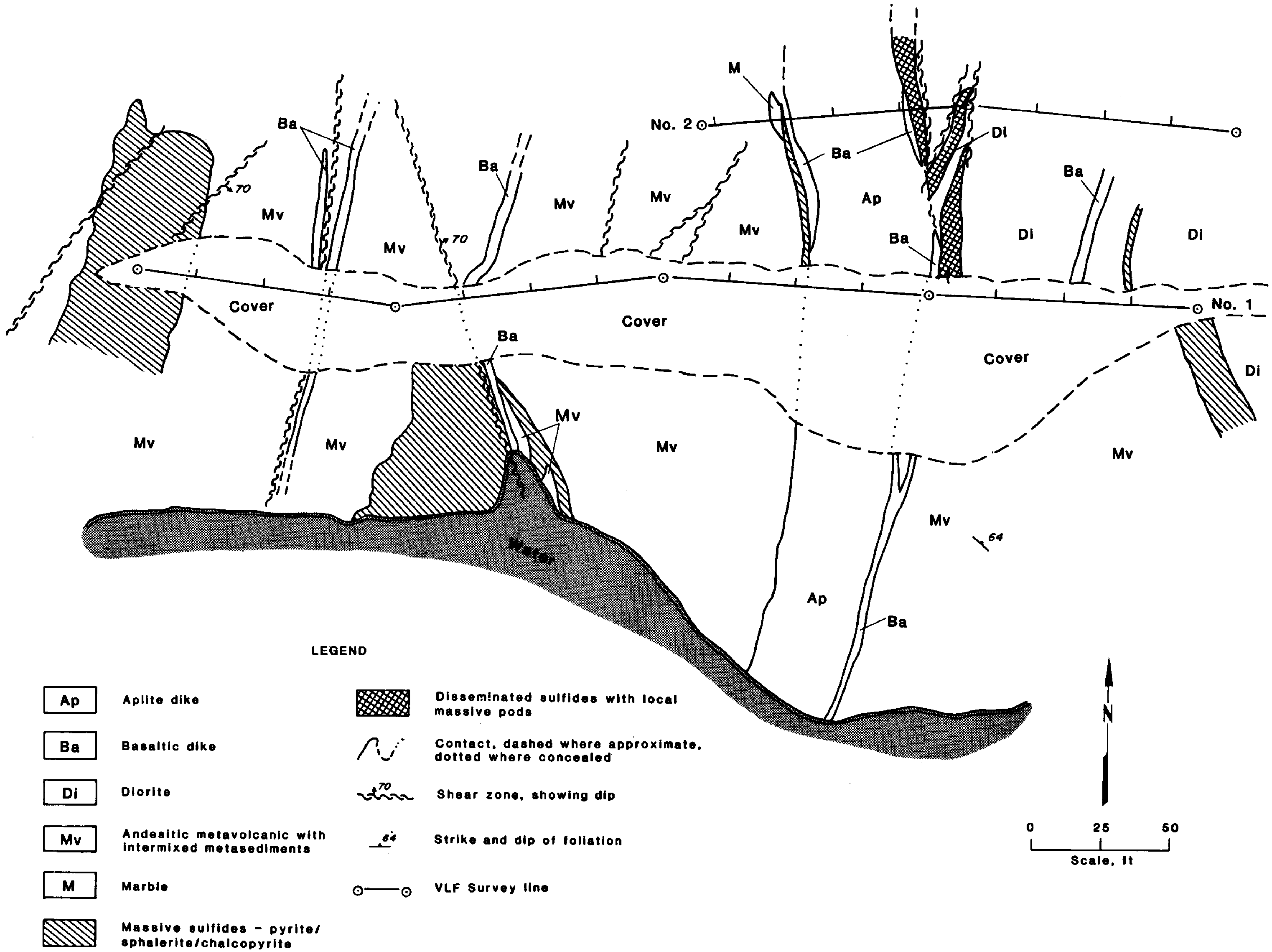


Figure A1. -- Geologic and VLF line location map, Orange Point, Glacier Bay, Alaska. See figure 3 for VLF profiles.

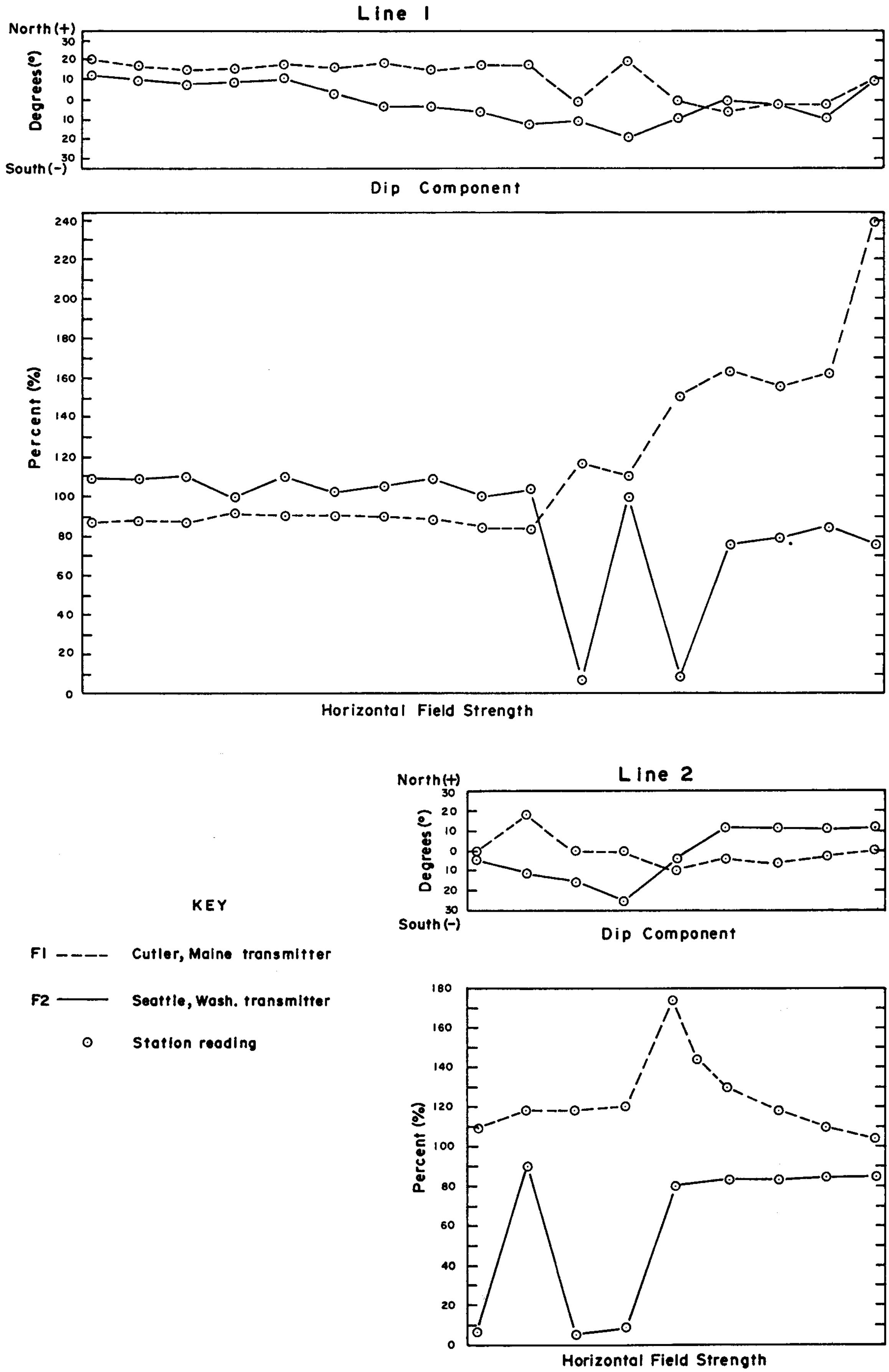
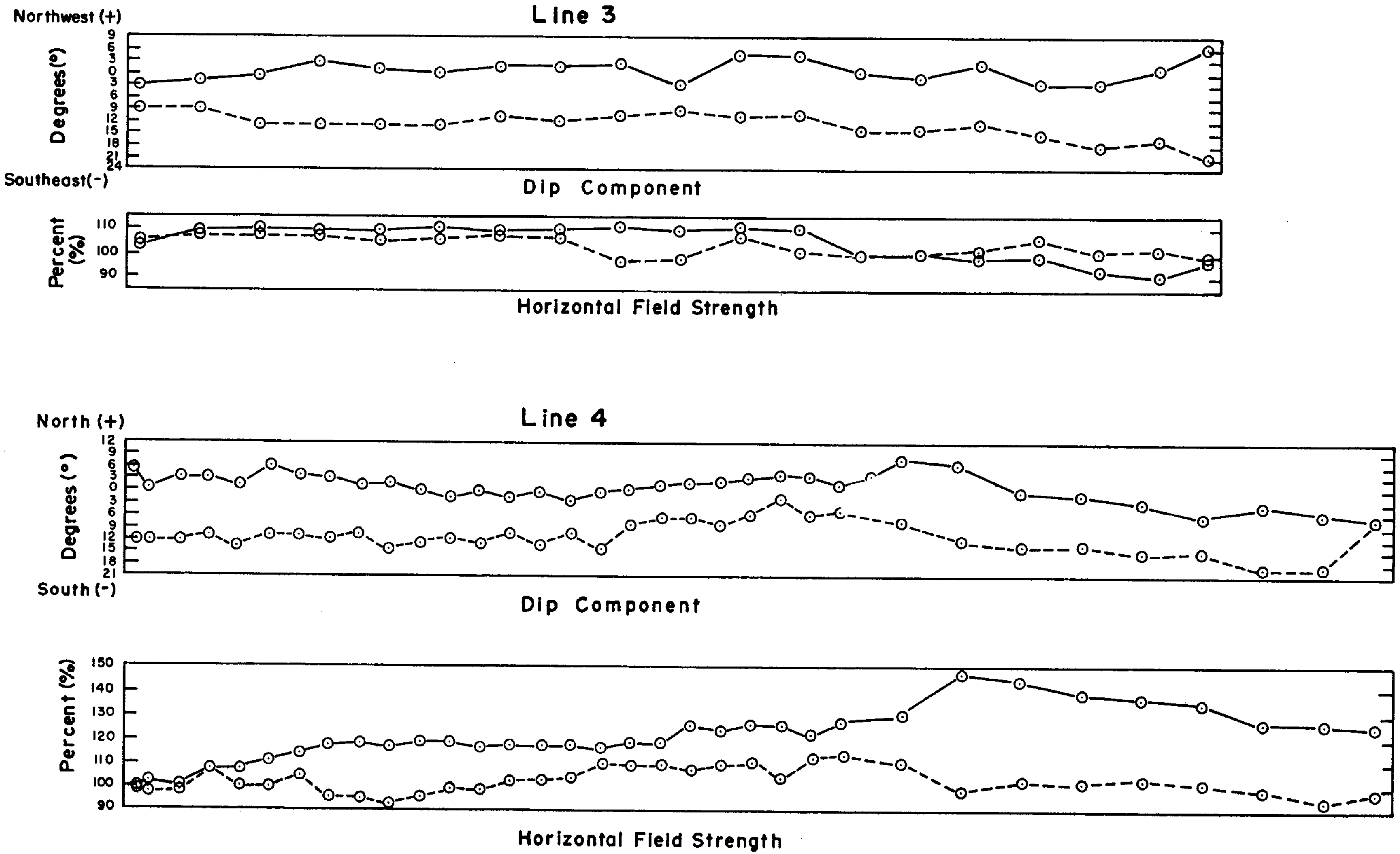


Figure A2. -- VLF lines over exposed massive sulfides, Orange Point area, Glacier Bay, Alaska



KEY

F1 ---- Cutler, Maine transmitter

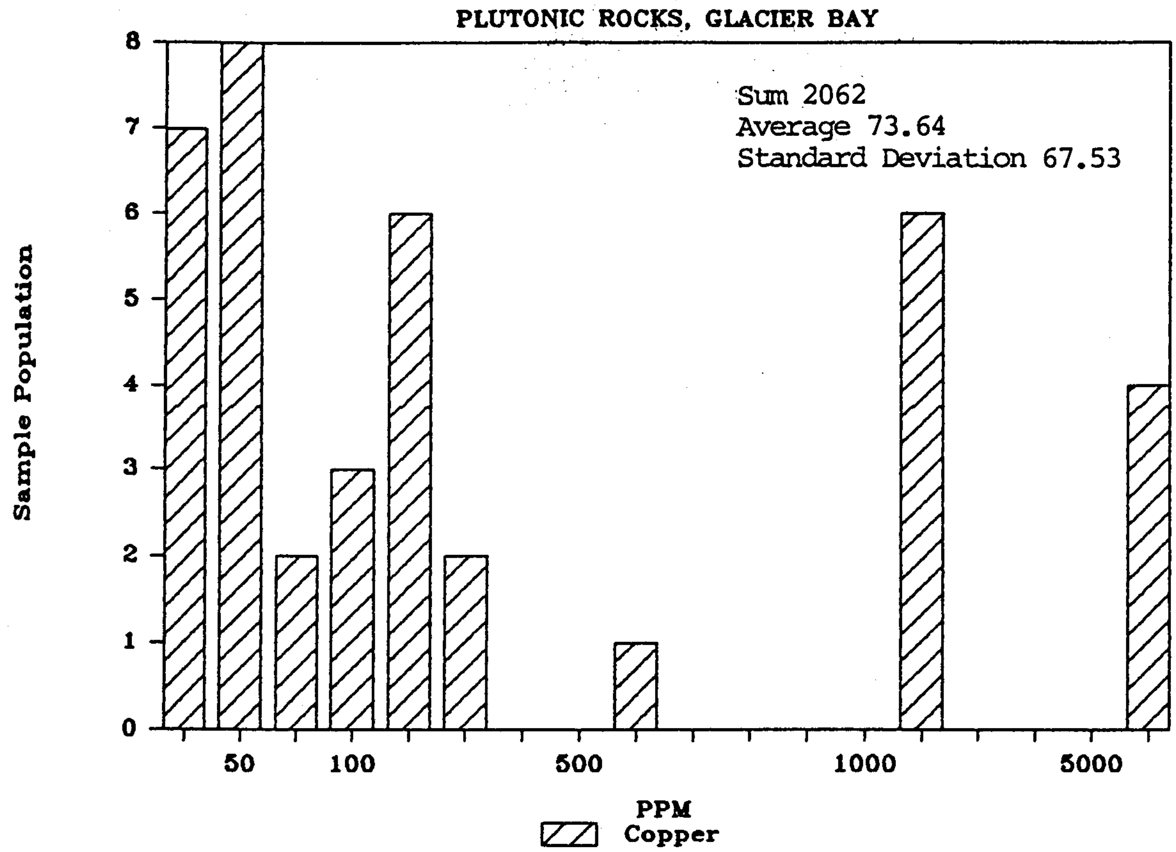
F2 —— Lanlualei, Hawaii transmitter

⊙ Station reading

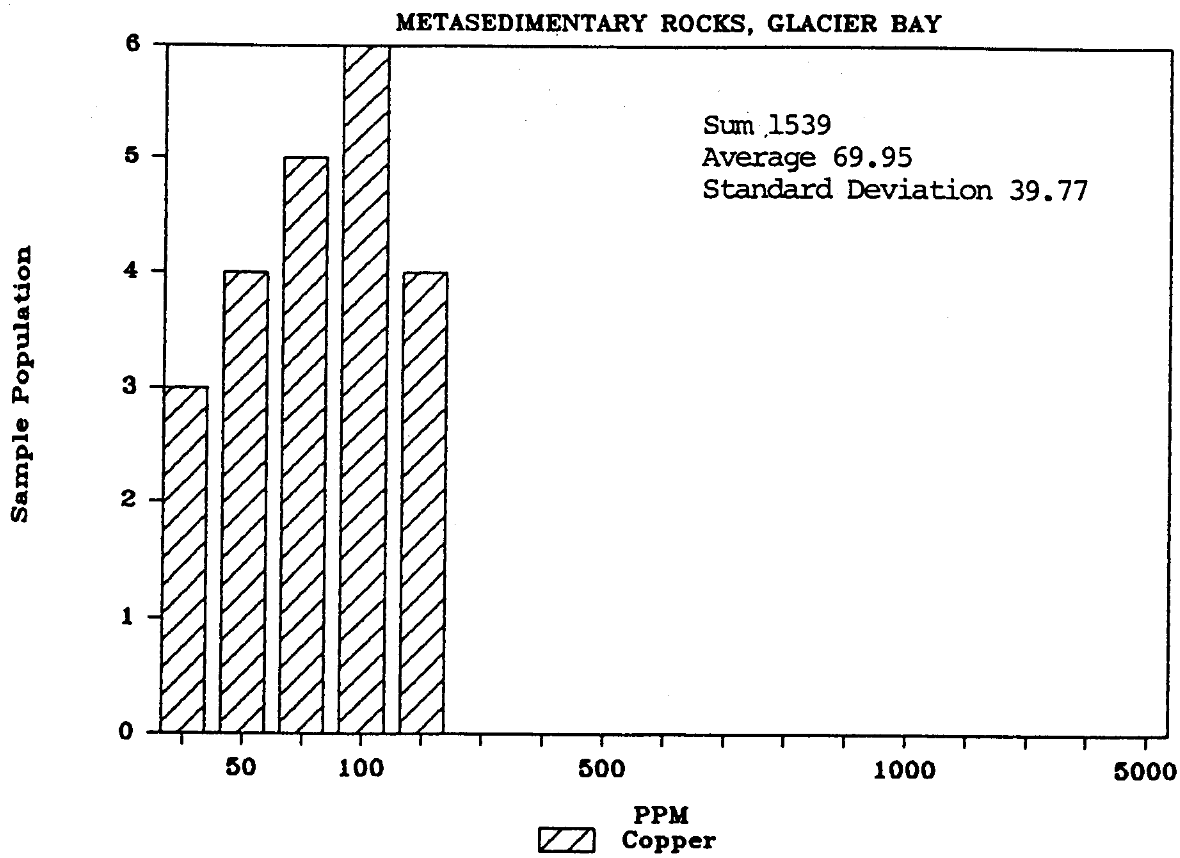
Figure A3. -- VLF survey lines north of Orange Point, Glacier Bay, Alaska

APPENDIX B. - DISTRIBUTION OF METAL VALUES

DISTRIBUTION OF COPPER VALUES

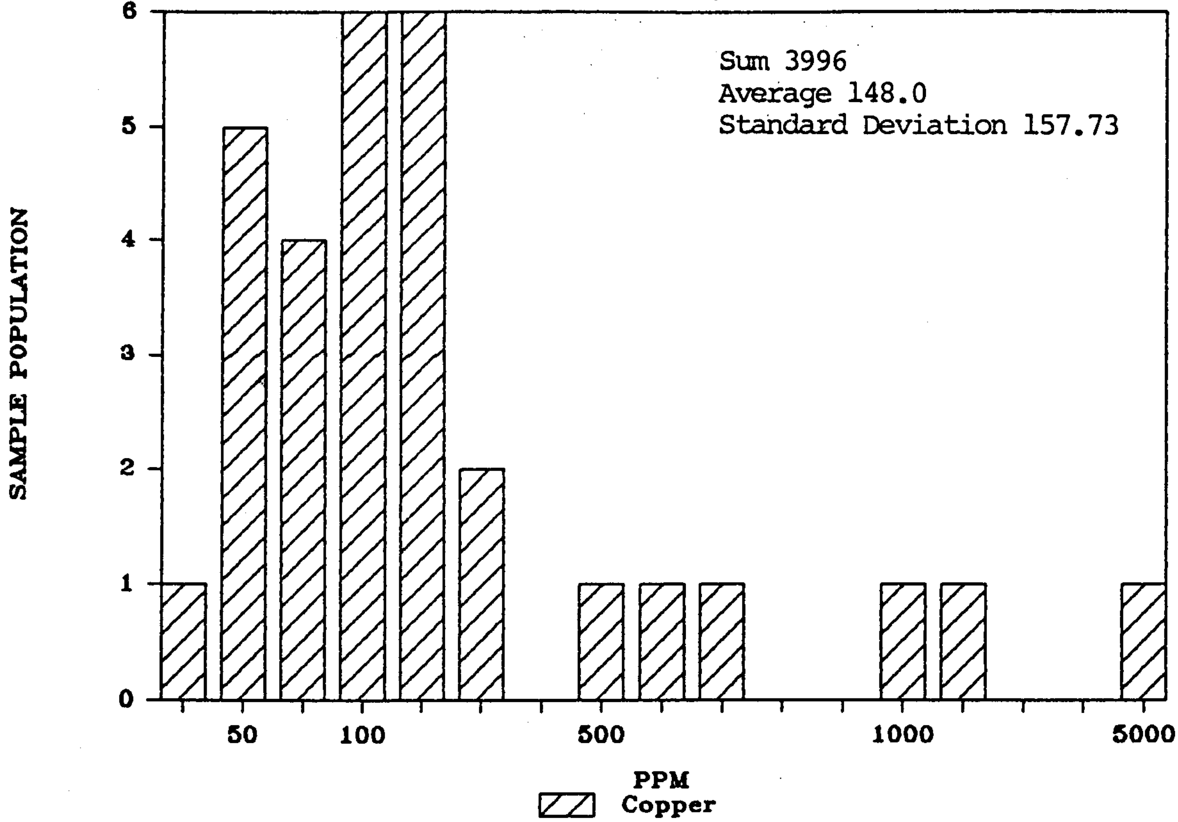


DISTRIBUTION OF COPPER VALUES



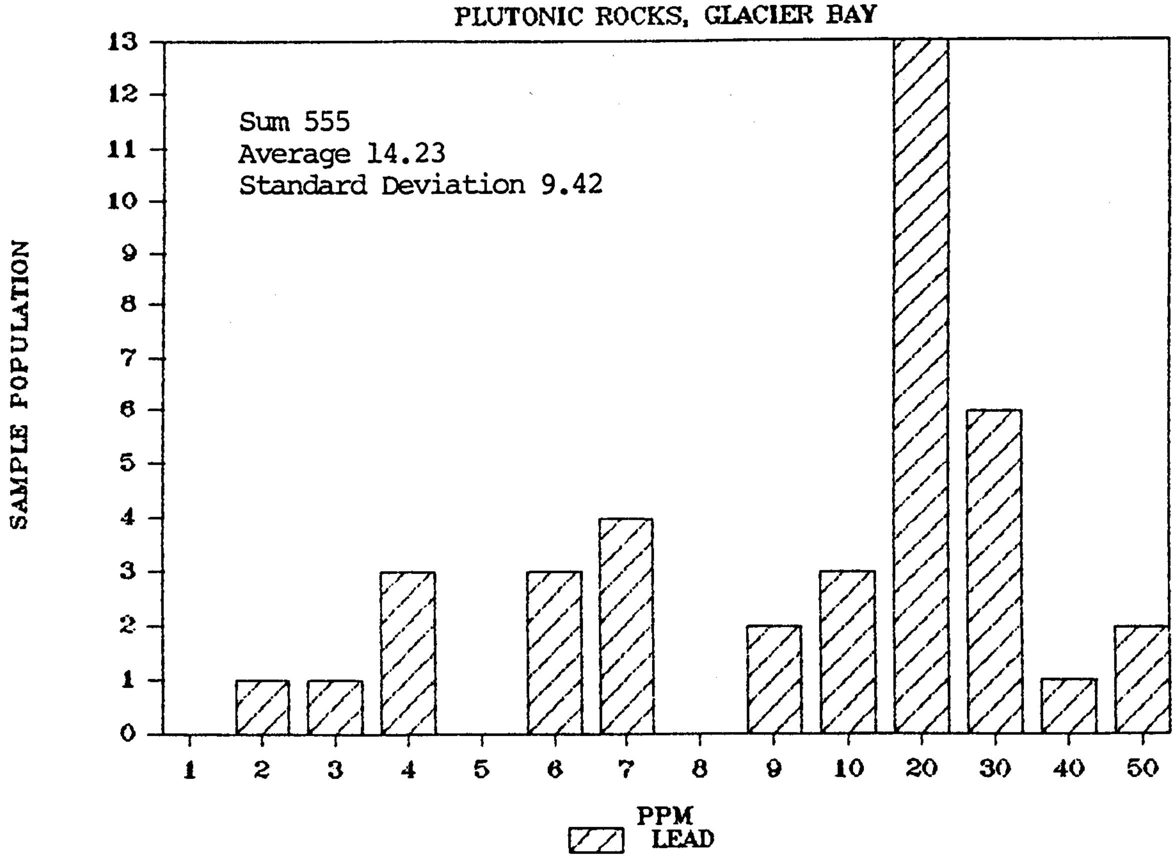
DISTRIBUTION OF COPPER VALUES

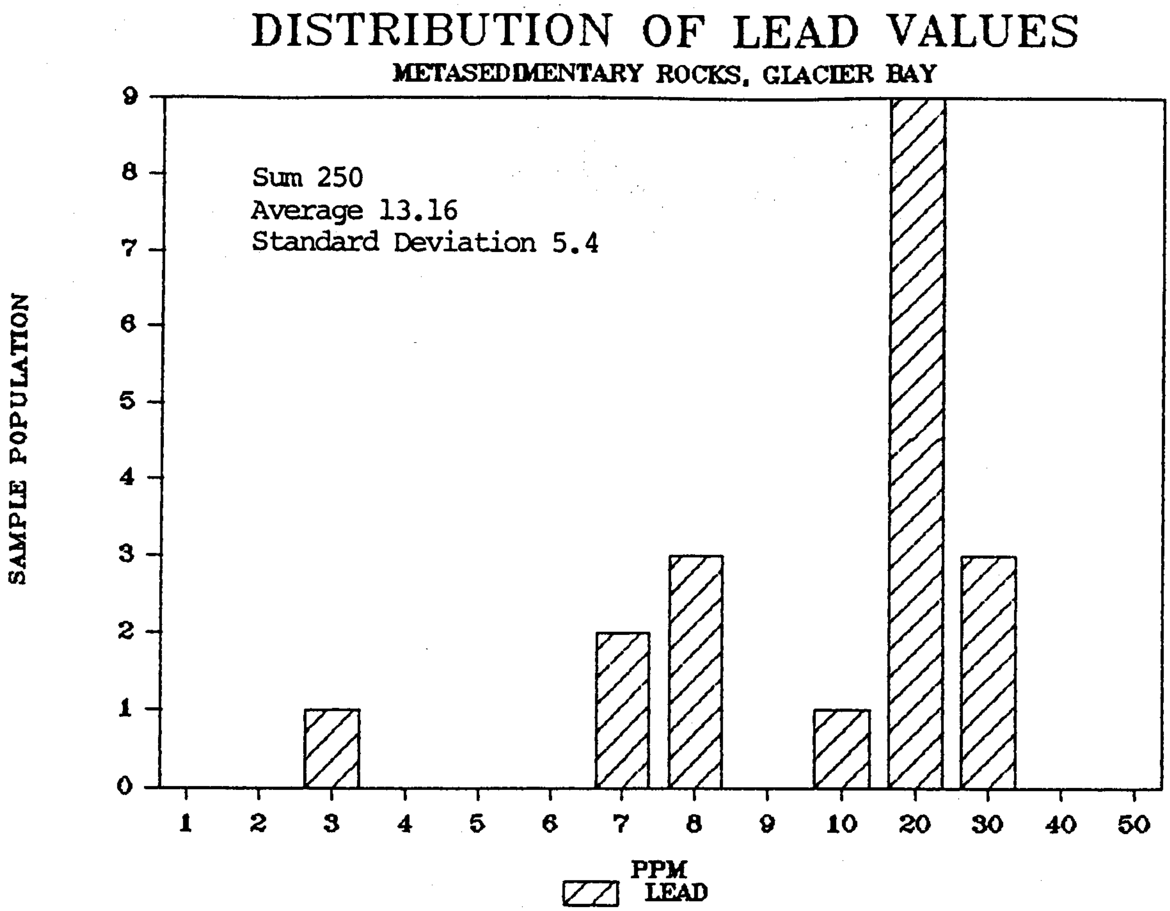
METAVOLCANIC ROCKS, GLACIER BAY



DISTRIBUTION OF LEAD VALUES

PLUTONIC ROCKS, GLACIER BAY




DISTRIBUTION OF LEAD VALUES
METASEDIMENTARY ROCKS, GLACIER BAY
Sum 250
Average 13.16
Standard Deviation 5.4
SAMPLE POPULATION
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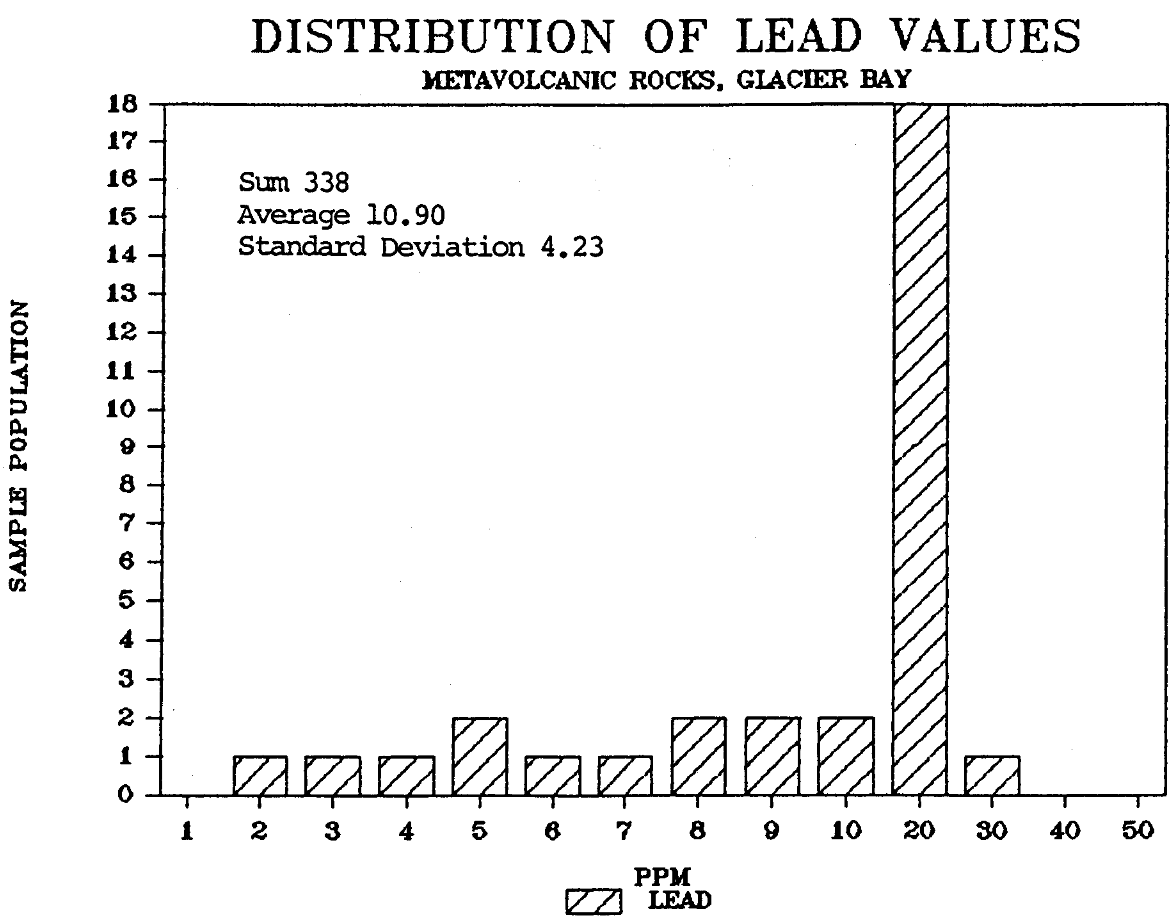
1
2
3
4
5
6
7
8
9
1 2 3 4 5 6 7 8 9 10 20 30 40 50
PPM
LEAD


DISTRIBUTION OF LEAD VALUES
METAVOLCANIC ROCKS, GLACIER BAY
Sum 338
Average 10.90
Standard Deviation 4.23
SAMPLE POPULATION
0
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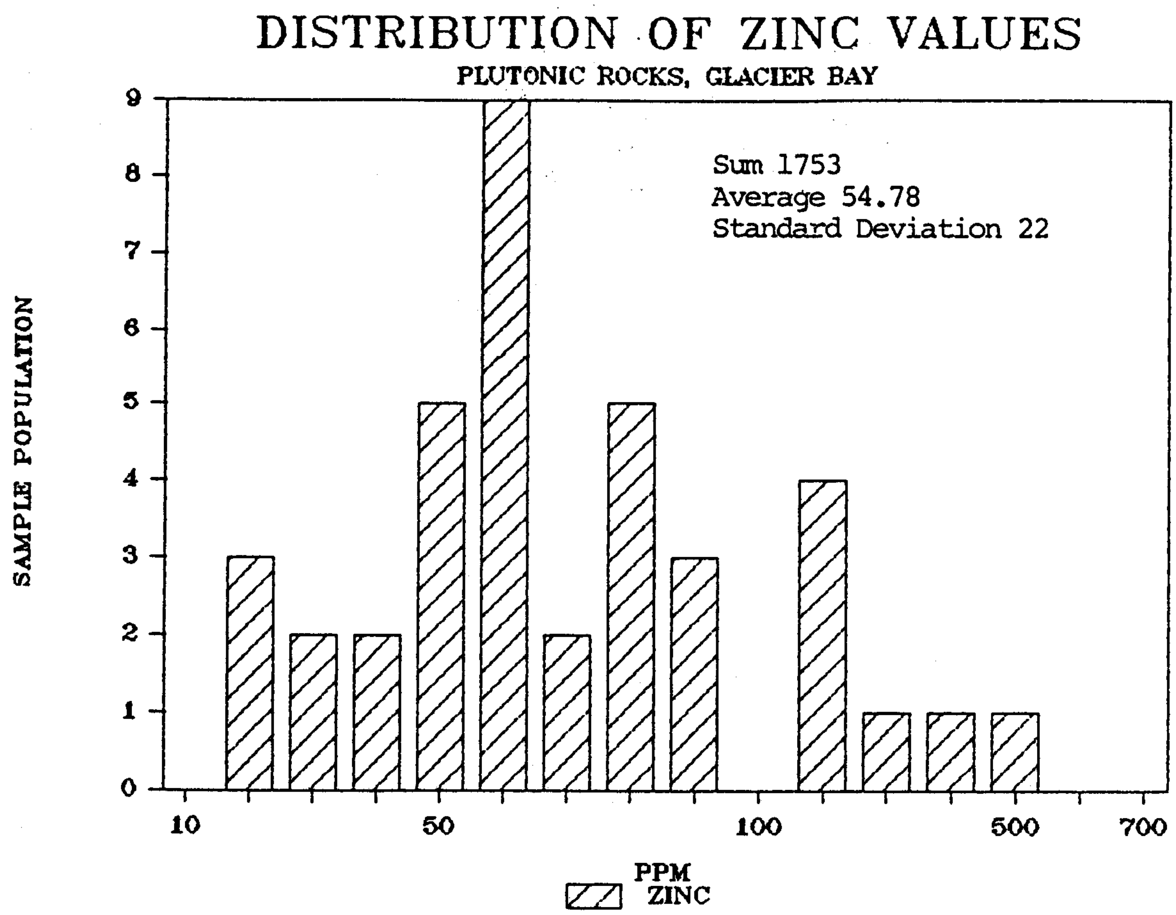
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
1 2 3 4 5 6 7 8 9 10 20 30 40 50
PPM
LEAD


DISTRIBUTION OF ZINC VALUES
PLUTONIC ROCKS, GLACIER BAY
Sum 1753
Average 54.78
Standard Deviation 22
SAMPLE POPULATION
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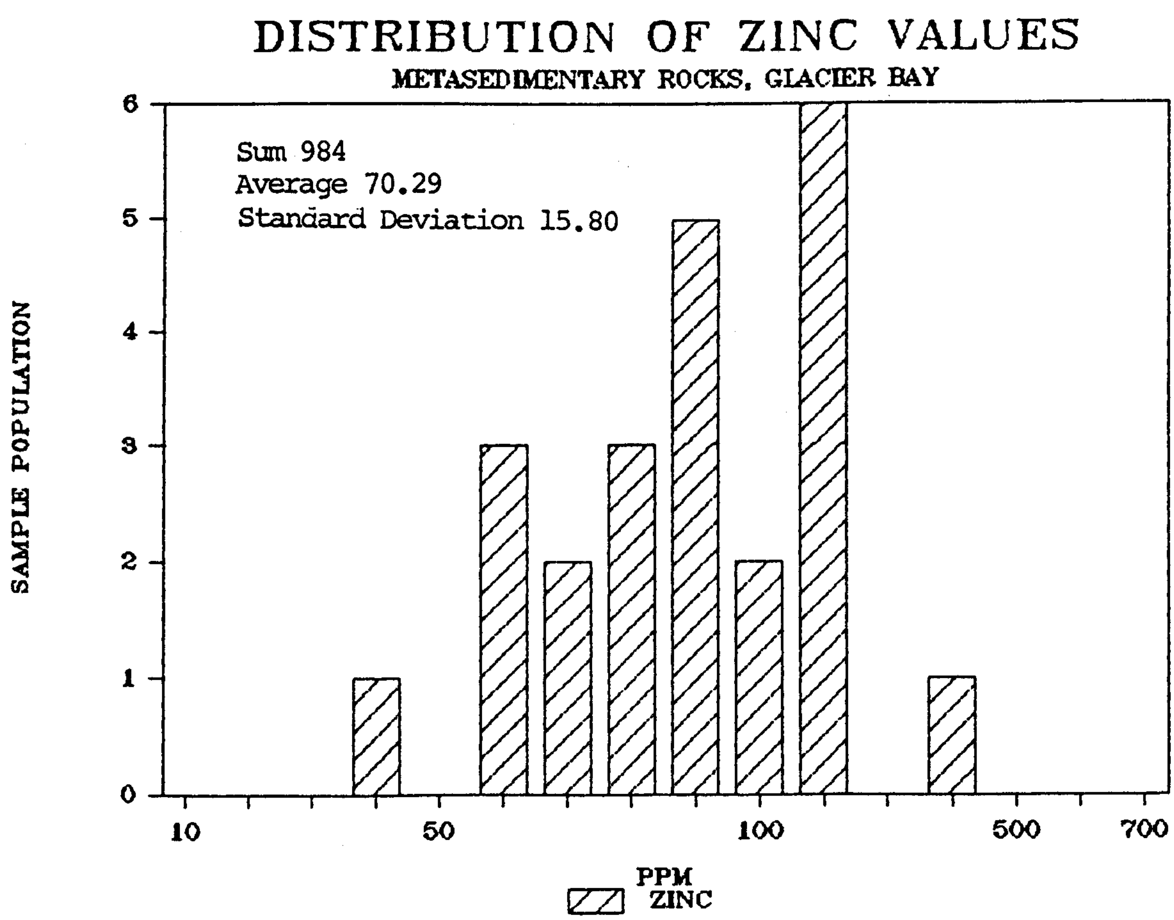
2
3
4
5
6
7
8
9
10
50
100
500
700
PPM
ZINC


DISTRIBUTION OF ZINC VALUES
METASEDIMENTARY ROCKS, GLACIER BAY
Sum 984
Average 70.29
Standard Deviation 15.80
SAMPLE POPULATION
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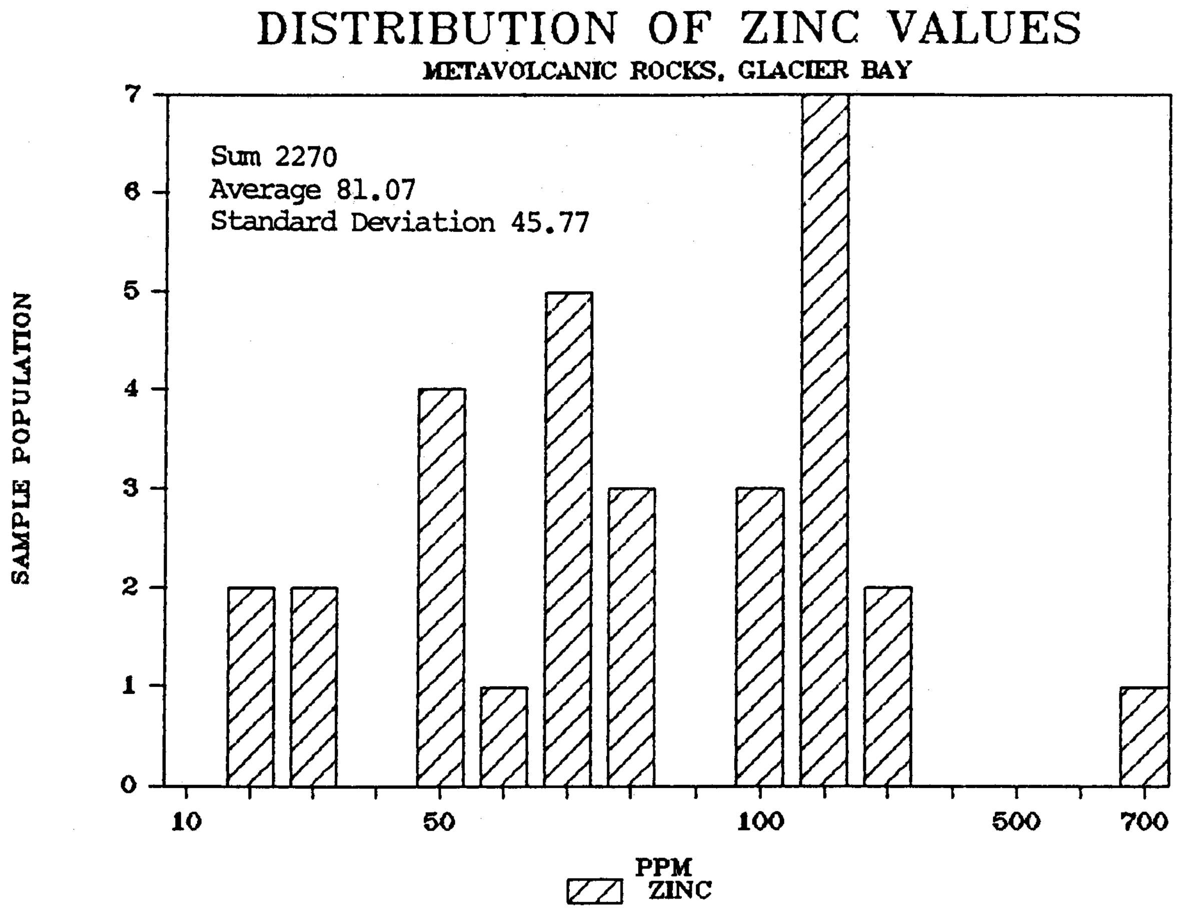
2
3
4
5
6
10
50
100
500
700
PPM
ZINC


DISTRIBUTION OF ZINC VALUES
METAVOLCANIC ROCKS, GLACIER BAY
Sum 2270
Average 81.07
Standard Deviation 45.77
SAMPLE POPULATION
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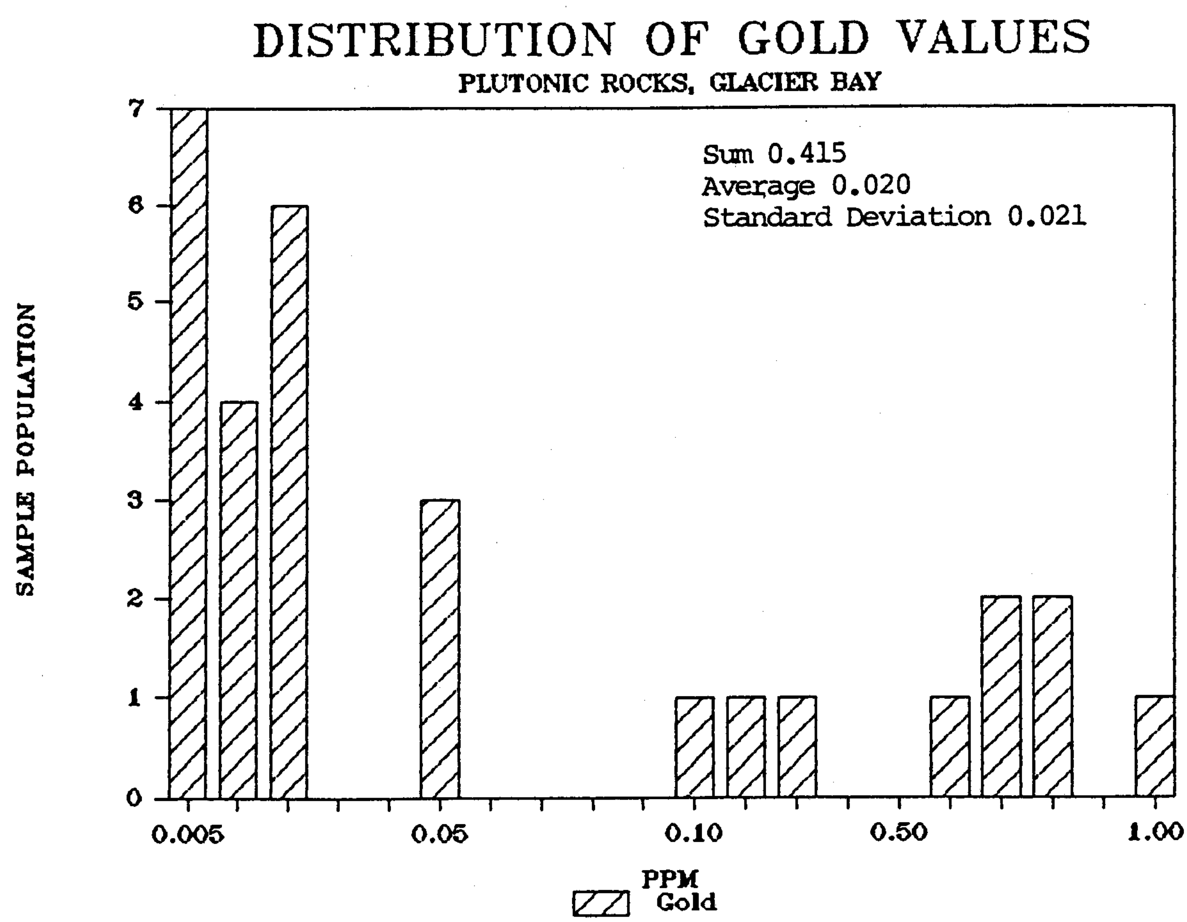
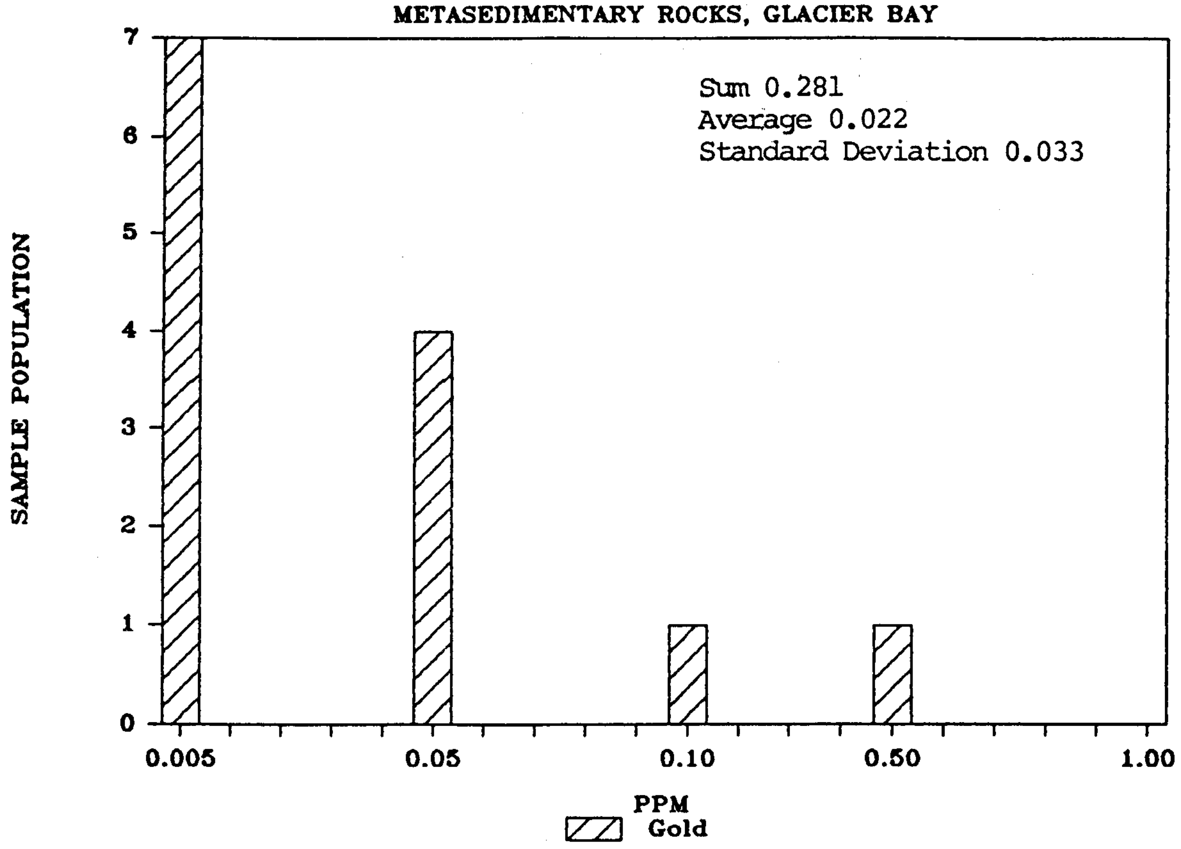
1
2
3
4
5
6
7
10
50
100
500
700
PPM
ZINC


DISTRIBUTION OF GOLD VALUES
PLUTONIC ROCKS, GLACIER BAY
Sum 0.415
Average 0.020
Standard Deviation 0.021
SAMPLE POPULATION
0
1
2
3
4
5
6
7
0.005
0.05
0.10
0.50
1.00
PPM
Gold

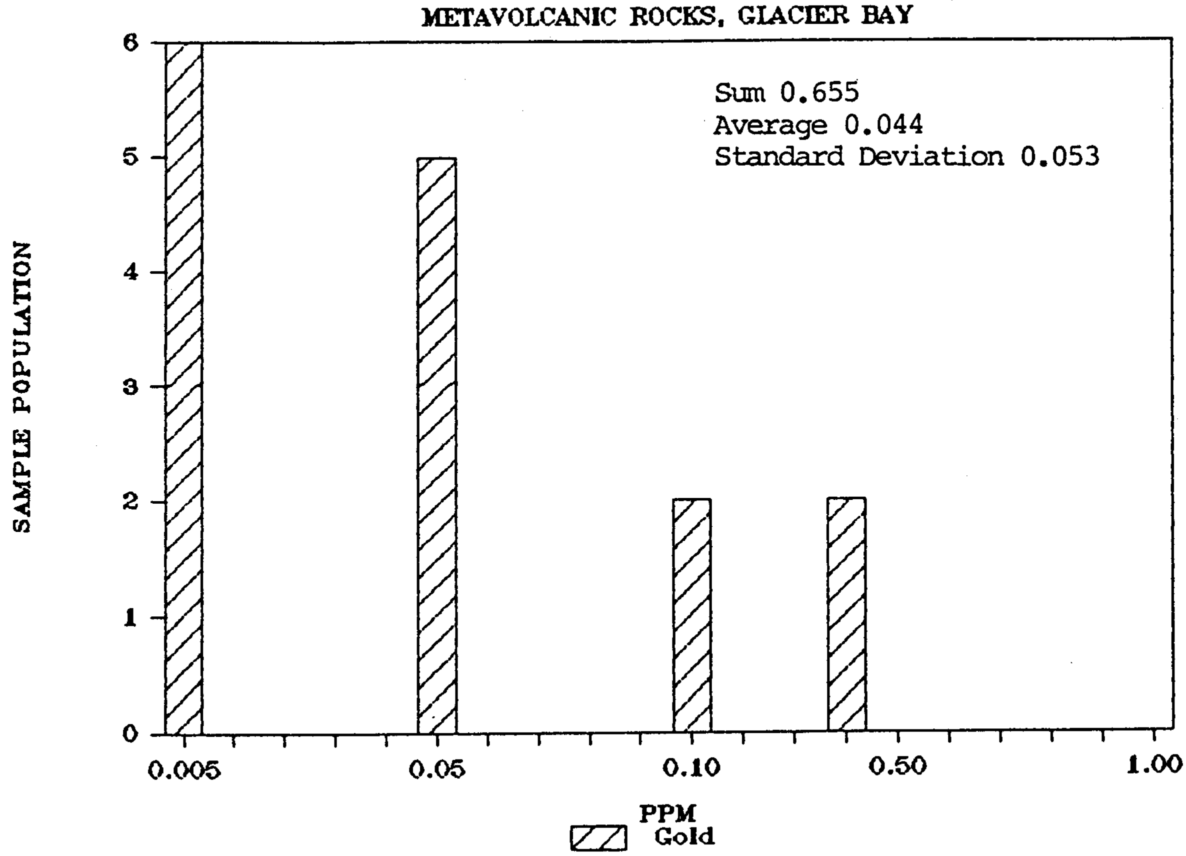
DISTRIBUTION OF GOLD VALUES

METASEDIMENTARY ROCKS, GLACIER BAY



DISTRIBUTION OF GOLD VALUES

METAVOLCANIC ROCKS, GLACIER BAY



IM-FPP 3553-87