

Special Publication

Bureau of Mines
Mineral Investigations in the
Juneau Mining District, Alaska,
1984–1988

Volume 2.—Detailed Mine, Prospect, and
Mineral Occurrence Descriptions

Section B

Glacier Bay Subarea



UNITED STATES DEPARTMENT OF THE INTERIOR



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By Jan C. Still

UNITED STATES DEPARTMENT OF THE INTERIOR
Manuel Lujan, Jr., Secretary

BUREAU OF MINES
T S Ary, Director

GLACIER BAY SUBAREA

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GLACIER BAY SUBAREA

by Jan C. Still ¹

INTRODUCTION

The Glacier Bay subarea is that part of the Juneau Mining District (JMD) within Glacier Bay National Park and Preserve (GBNP). It is the western portion of the JMD and consists of the land between the Fairweather Range crest and the Takhinsha and Chilkat Ranges crests (excluding that land east of Excursion Inlet.) Figure B-1 shows the area. It is bounded on the north by the Alaska-British Columbia International boundary, to the south by Cross Sound and Icy Strait, and contains

Glacier Bay. During 1975 - 1977 the Bureau conducted a detailed study of the occurrences, prospects, and deposits in GBNP (B-4).² This work was in cooperation with the U.S. Geological Survey (USGS) under the provisions of the Wilderness Act (Public Law 88-577). As a follow up to this earlier Bureau work, limited studies were conducted, during 1985 and 1986, as part of the JMD study. This report covers the most important aspects of the earlier studies and the 1985 and 1986 studies.

ACCESS

The Glacier Bay area may be reached through Gustavus airport, a paved strip which is serviced by scheduled jet airliners in the summer and air taxi services year-round. The airport is connected to Bartlett Cove (GBNP headquarters) by an all-weather road. No other roads exist in the area except a skid road to the LeRoy Mine and mill in the Reid Inlet area. Much of the Glacier Bay area is accessible through the salt water inlets and fjords which are part of Glacier Bay. Cruise ships, charter

boats, and fishing boats visit these inlets and fjords during the summer months. Elevations within the area range from sea level to over 15,000 feet in the rugged Fairweather Mountain Range. More remote areas are accessible by small boat, foot, or helicopter. Glacier ice is a year-round hazard to navigation in Glacier Bay, and during the winter months some of the more northerly inlets are frozen.

LAND STATUS

The GBNP is Federal land under the administration of the National Park Service. It was open to mineral entry prior to 1924 under the General Mining Law of 1872 and closed to mineral entry from 1924 to 1936. In 1936 it was opened to mining under the Act of June 22, 1936 (49 Stat. 1817) which allowed "exploration, development,

and extraction of minerals on the claim." In the Mining in Parks Act of September 28, 1976, the Park was closed to new mineral entry and existing unpatented claims were subject to validation examinations by National Park Service personnel. As of 1989 the two LeRoy Mine claims are the only valid unpatented claims. Twenty-three patented mining claims exist within the Park; twenty of these locate the Brady Glacier deposit. Almost all of GBNP was recently classified as wilderness and activities on existing valid mining claims are severely restricted. All mineral activity within GBNP must be conducted under special use permits granted by the National Park Service.

¹ Mining Engineer, Alaska Field Operations Center, Juneau, Alaska.

² Italic numbers in parentheses refer to list of references preceding the appendixes.

ACKNOWLEDGEMENTS

Thanks go to the National Park Service for their speed and cooperation in processing permits that allowed this work to be accomplished. Bureau employees Arthur L. Kimball (retired), Jan C. Still, and Jeanne L. Rataj conducted the field work (1975-1977) and wrote the report (B-4) on which much of this study is based.

Bureau employee Joseph M. Kurtak conducted field work during 1985 and wrote a report (B-5) covering investigations in the Johns Hopkins Inlet-Margerie Glacier area of Glacier Bay.

PREVIOUS STUDIES

The GBNP was the scene of mineral investigations as early as 1892. The first mining claims were located and patented in 1894. A number of early investigators from the USGS, Bureau, Territorial Department of Mines, and private companies visited the GBNP. The most prominent of these were Reed in 1938 (B-9), Twenhofel in 1942 (B-14), Sanford in 1942 and 1943 (B-13), Roehm in 1942 (B-10), and Rossman in 1949 (B-11, B-12). In 1966, the USGS conducted field studies of the geology and prospects of GBNP (B-7). A number of private exploration companies have examined prospects in GBNP, including Alvenco, Inc., Bear Creek Mining Co., American Explo-

ration and Mining Co., Anadarko Production Co., Newmont Exploration, Ltd., Fremont Mining Co., Superior Oil Co., Moneta-Porcupine Mines, Ltd., and Cyprus Mines Corp.

The most comprehensive and detailed study of the mines, prospects, and occurrences in GBNP occurred during 1975-1977 by the Bureau. The investigators were Arthur Kimball, J. Still, and J. Rataj and the study was in cooperation with the USGS. The study was presented in USGS Open File Report 78-494, Chapter C (B-4). Chapter B of the report covers USGS geologic studies in GBNP and is authored by Brew and others (B-1).

PRESENT STUDY

Previous detailed Bureau studies and prohibition of mining in GBNP resulted in only limited follow up investigations as part of the Juneau Mining District study. These consisted of several days in the Fairweather Range collecting metallurgical test samples from the Brady Glacier deposit, and ten days in the Johns Hopkins Inlet-Margerie Glacier area to follow up and exam-

ine massive sulfide and vein mineralization discovered during the 1975-1977 Bureau investigations. Appendix B-1 contains detailed information on these follow up studies, appendix B-2 covers metallurgical testing, appendix B-3 contains analytical results, and appendix B-4 contains drill hole and surface sample analytical results for the Nunatak Molybdenum deposit.

MINES, PROSPECTS, AND OCCURRENCES

A total of 132 mines, prospects, and occurrences have been identified in the Glacier Bay area. These are listed on pages C-21 to C-26 of USGS Open File Report 78-494 (B-1) and described on pages C-96 to C-395. The twenty-four most important are listed and shown on figure B-1. These consist of a variety of deposit types including copper porphyry, molybdenum porphyry,

skarn, vein, volcanogenic massive sulfide, and magmatic. The most prominent of these are the Nunatak Molybdenum, Massive Chalcopyrite, Margerie Glacier, Orange Point, and Brady Glacier deposits, and the inactive LeRoy and Rainbow Mines. These latter seven contain gold, silver, nickel, copper, zinc, molybdenum, tungsten, and platinum group metals and are described

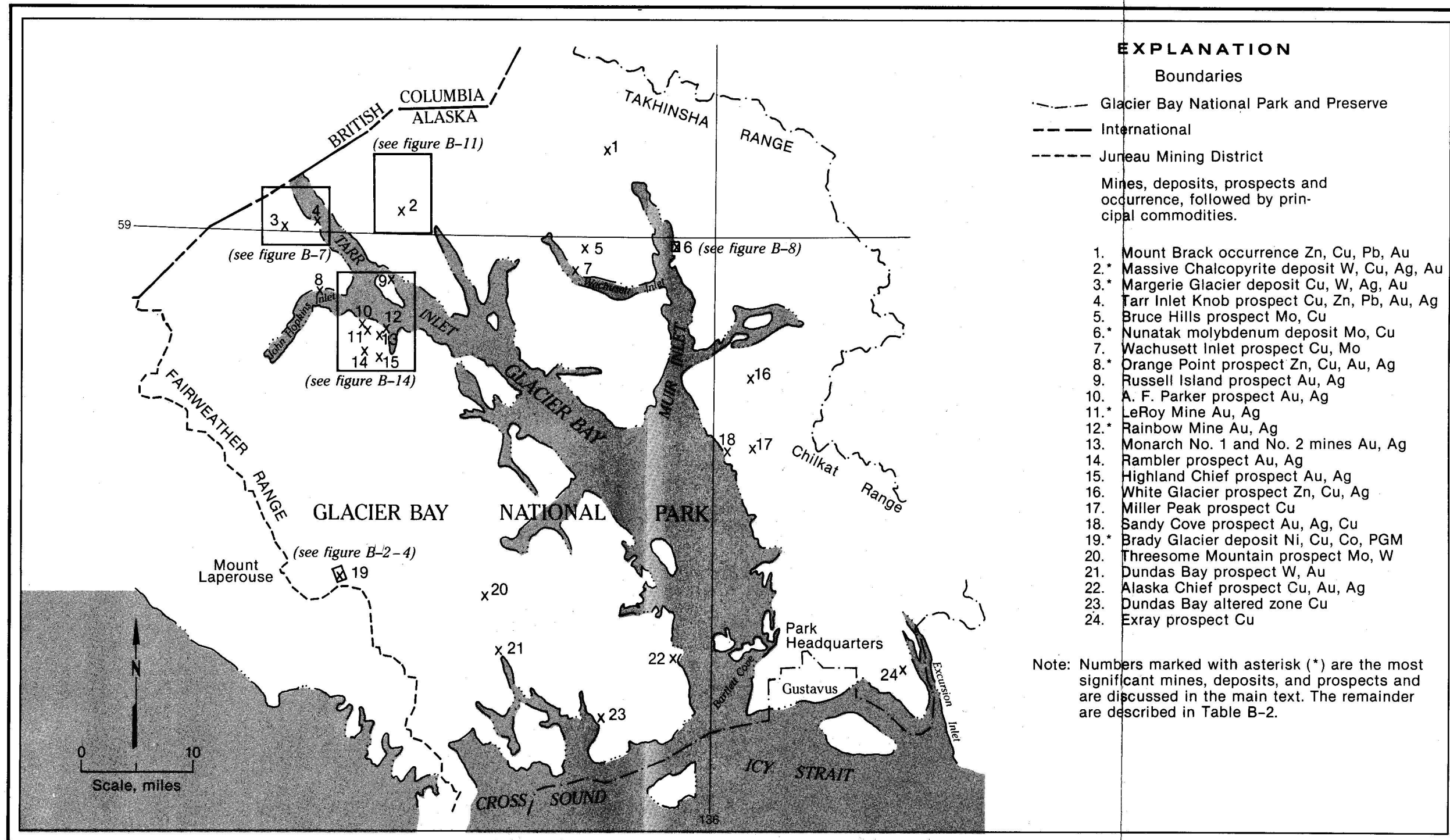


Figure B-1. — Glacier Bay subarea showing most important mines, deposits, prospects, and occurrences, their commodities and figure outlines.

herein. The remaining 17 deposits shown on figure B-1 are described in table 2. There are numerous additional less important occurrences in GBNP and all these are described in B-4. Information contained herein was adopted from Bureau reports (B-4, B-5). Further information covering Bureau investigations during the JMD study is contained in Appendix B-1 and metallurgical test sample data are contained in appendix B-2.

BRADY GLACIER DEPOSIT

Introduction—History

The world class Brady Glacier copper-nickel deposit is located 40 miles westerly from Bartlett Cove and outcrops in three nunataks of the Brady Glacier (fig. B-1, No. 19). It was discovered in 1958 by Fremont Mining Company. By late 1959, Fremont had drilled 32 diamond drill holes (B-7). Newmont Exploration, Limited, became manager of the property through a lease agreement with Fremont in 1960, and during that same year and the next, drilled 14 diamond drill holes. In 1965, twenty mining claims were patented and the remaining unpatented claims were allowed to lapse. Union Pacific Mining Corporation and City Services Minerals Corporation joint ventured the property with Newmont retaining managership. In 1962, 1971, and 1972, 36 holes were drilled for a total on the deposit of 82. During 1982 and 1986 the Bureau collected metallurgical test samples from the deposit to determine platinum group metals recovery. Figure B-2 shows Bureau personnel collecting a bulk sample. Figure B-3 is an idealized block diagram of the deposit; figure B-4 shows patented claims, selected diamond drill holes, drilled ore and probable ore, and the nunataks; and figure B-5 is an idealized cross section through the deposit.

Land Status

The 20 Brady Glacier deposit claims were patented under the Act of June 22, 1936, (49 Stat. 1817) "To permit mining within Glacier Bay National Monument." A December 28, 1936 decision (56 I.D. 437) by the Interior Department concerning the June 22, 1936 Act that states "the occupation and use of the surface of an unpatented or patented mining claim is restricted by the general law to such as is reasonably incident to exploration, development, and extraction of minerals on the claim." The National Park Service, in a March 1973 revised draft environmental statement covering a GBNP wilderness proposal, contends that the 1936 Act provides

only limited entry or the right to mine and remove the minerals but not the right to process or mill them. This is also the opinion of the Department of Interior's Associate Solicitor for Minerals. On May 16, 1974, he wrote that the 1936 Act authorized mining in the monument but did not extend the mining laws to the monument. Further, the Associate Solicitor, in reference to a 1969 Solicitor's opinion that refers to millsite locations "as an integral part of the mining law," concluded thereby that the millsite law is not applicable to the monument. Moreover, he concluded that "the surface of mining claims, patented or unpatented, in the Glacier Bay National Monument cannot be used as a plant site for processing purposes, as a matter of right."

A plant site located near the Brady Glacier deposit is critical to its development. The contentions of the National Park Service and the rulings of the Associate Solicitor place a cloud over future development of this deposit.

Deposit Description

The following deposit description is based on briefings from company geologists in 1976, information published in the Glacier Bay Wilderness Study (B-4), Bureau Minerals Availability System (MAS) deposit files, metallurgical test sample studies, and examinations and observations of the deposit by Bureau crews during 1976, 1982, and 1986.

The Brady Glacier deposit is located near the eastern basal contact of the Crillon-La Perouse layered mafic/ultramafic stock. Three nunataks expose the deposit that is mostly covered by the moving ice of the Brady Glacier. The nunataks are principally composed of indistinctly layered peridotite and gabbro that is intruded by dikes and irregular bodies of gabbro, diorite, aplite, and peridotite. Post-crystallization faulting is evident.

Peridotite made up of the constituent minerals forsterite and enstatite is the predominant host rock for the Brady Glacier nickel-copper sulfide deposits. Dunite is also present. Alteration to tremolite, serpentine, and epidote is common. The peridotite contains lenses of coarse gabbro and gabbro pegmatite which are also common host rocks for the nickel-copper sulfide deposit. Dikes of fine-grained gabbro, diorite, and aplite, up to 5 feet thick, are common and are generally oriented crosswise to the layering of the peridotite and gabbro.

The ore minerals chalcopyrite, pentlandite, and violarite along with pyrrhotite and pyrite are hosted in all rock types (except the aplite) but predominate in the altered peridotite and gabbro pegmatite. They occur as disseminated grains, veinlets, and lenticular masses as much as 15 feet in diameter and 35 feet long. The massive

sulfide lenses make up about 15% of the deposit's mineralization.

Examination of metallurgical test samples collected from the deposit by the Bureau's Albany Research Center revealed the following metallic minerals (in addition to those listed above): greigite, cobaltite, iridarsenite, ruarsite, osarsite, irarsite, nickel-bismuth-palladium telluride, palladium-bismuth telluride, and a palladium telluride.

Studies by the USGS (B-2) on core samples indicate that the massive sulfide ore may average 1.3 ppm platinum group metals and the remainder 0.02 ppm platinum group metals.

Gangue minerals for the deposit include forsterite, enstatite, augite, tremolite, serpentine, plagioclase, pyroxene, and quartz.

Metallurgical Test Samples

In 1982 and 1986, metallurgical test samples were collected by the Bureau from the High and Small nunataks of the deposit, which were processed by the Bureau

Albany Research Center. These consisted of disseminated sulfides (sample number 1S162) and massive sulfides (1S161). Sample 1S162 contained 1.24% copper, 0.13% nickel, 0.01% cobalt, 0.007 ounce/ton palladium, 0.004 ounce/ton gold, 0.112 ounce/ton silver, and less than 0.004 ounce/ton platinum. Sample 1S161 contained 1.41% copper, 2.84% nickel, 0.29% cobalt, 0.013% rhenium, 0.007 ounce/ton palladium, less than 0.004 ounce/ton platinum, less than 0.008 ounce/ton gold, and less than 0.04 ounce/ton silver.

Bulk sulfide flotation tests of sample 1S161 indicated a recovery of 89% of the copper, 88% of the cobalt, and 40% of the nickel at concentrate grades of 12.9% copper, 0.04% cobalt, and 0.69% nickel. The precious metals were in the concentrate. Details of the various metallurgical concentration tests are contained in appendix B-2.

Identified Resources

The average dimensions of the Brady Glacier ore body, as determined by drilling, are 1,700 feet in diameter and at least 750 feet in length. Figures B-3—B-5



Figure B-2.—Bureau employee collecting a metallurgical test sample from a massive sulfide lens in the Small Nunatak of the Brady Glacier deposit (J. Still, photographer.)

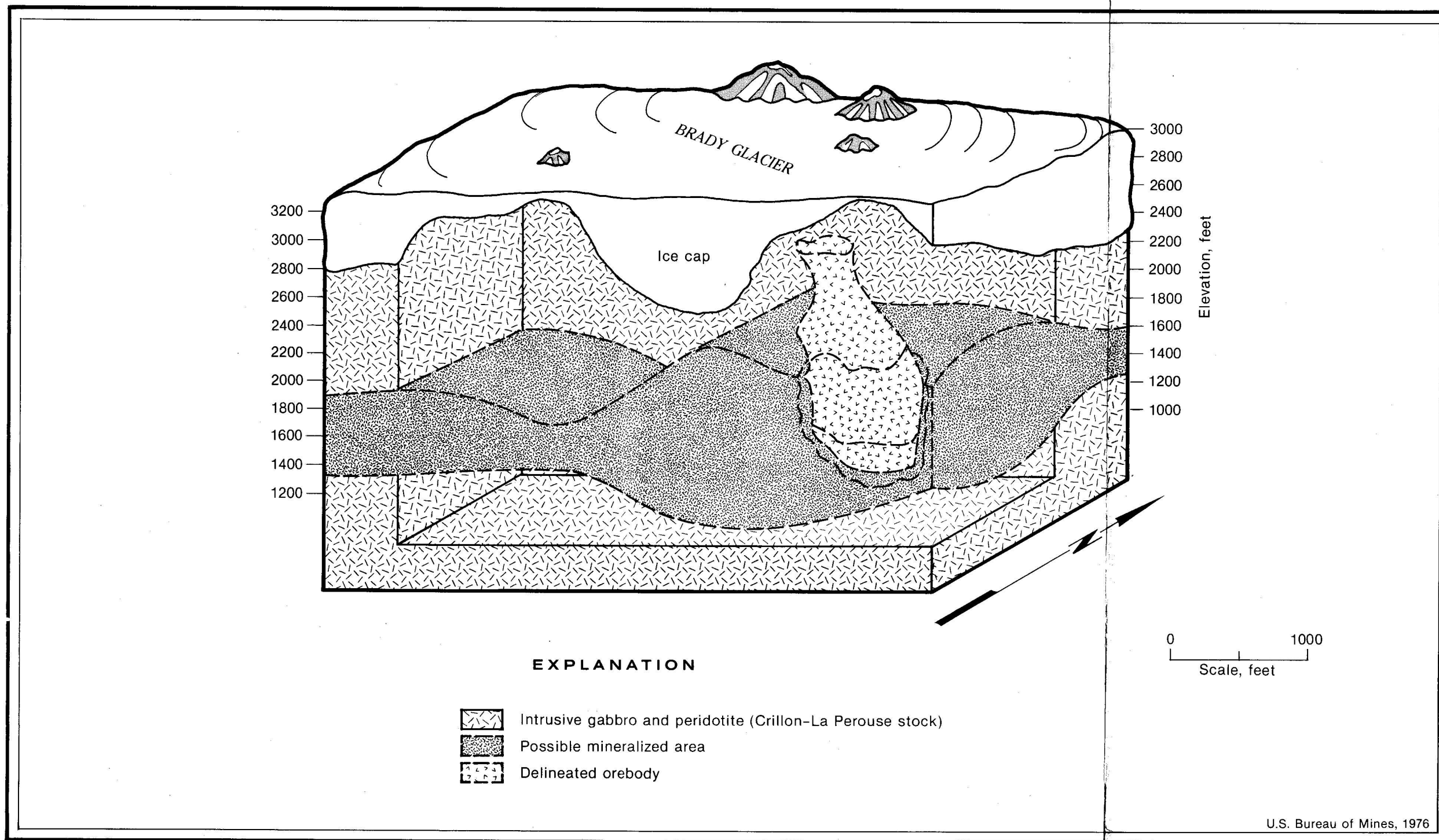


Figure B-3. — Idealized block diagram of Brady Glacier deposit.

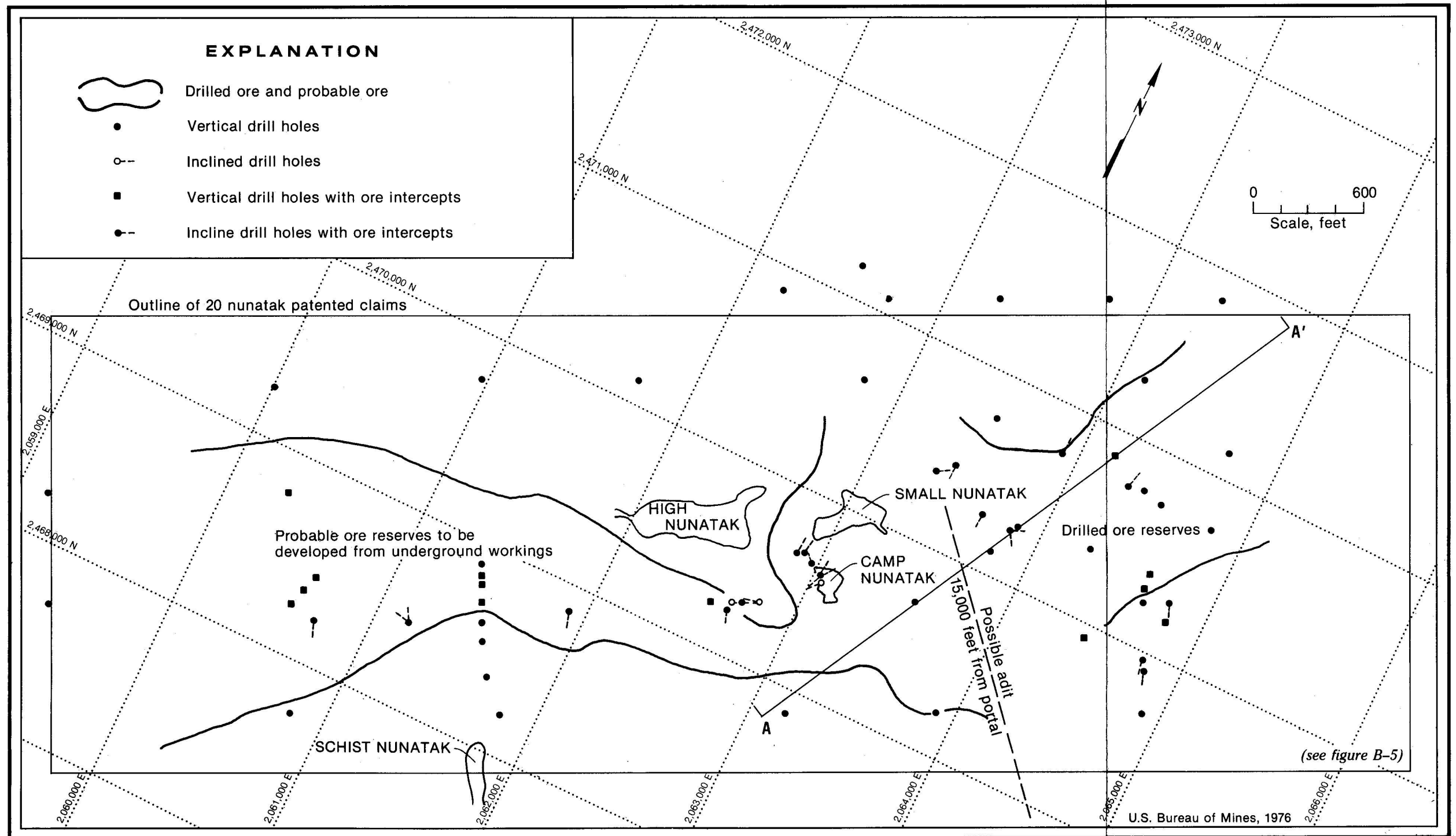


Figure B-4. — Brady Glacier deposit, showing claims, selected drill holes, ore and the nunataks.

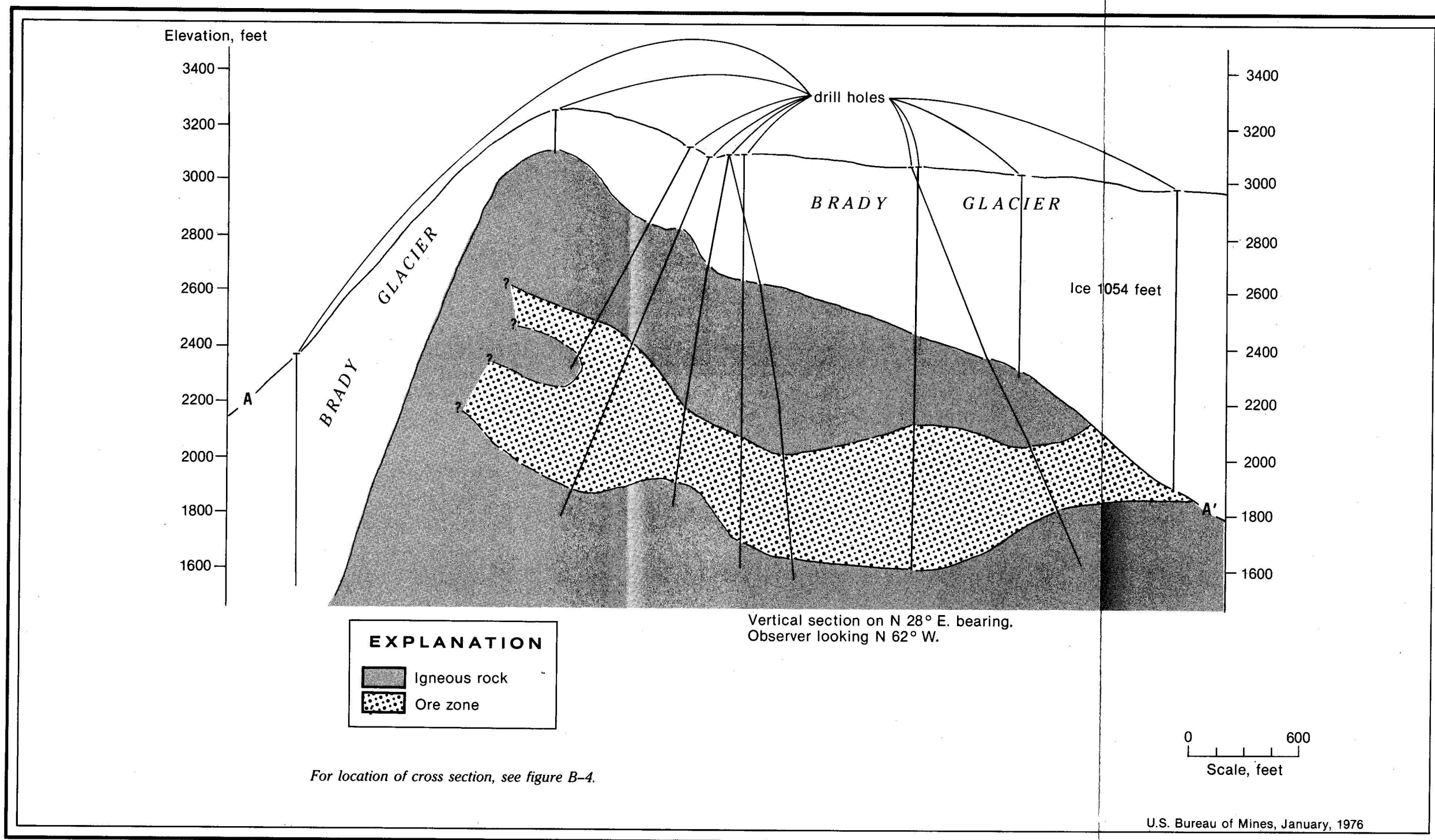


Figure B-5. — Idealized section A-A' of the Brady Glacier deposit showing drill holes.

show the ore body, locations of selected diamond drill holes, and sections through the ore body. Within the area of the 20 patented claims, the deposit contains 90 million indicated tons at 0.53% nickel and 0.33% copper (B-4).

The limits of the ore body have not been determined and there is a high probability that the ore body extends beyond the limits of the drill holes, particularly to the west. An additional 90 million tons at 0.53% nickel and



Figure B-6.—Bureau employee examines the Hill No. 2 portion of the Orange Point deposit discovered by the Bureau in 1976 (J. Still, photographer).

0.33% copper is inferred beyond the limits of the present drill holes (B-1).

Cobalt, gold, silver, and platinum group metals would be recovered if the deposit is mined, but data is insufficient to calculate specific reserves (appendix B-2 provides details of the metallurgical testing).

An order-of-magnitude economic study by the Bureau's MAS program indicates the deposit approaches being economically feasible to mine (based on copper at \$1.00 a pound, nickel at \$4.69 a pound, and on a 15% rate of return in 1970 dollars.)

ORANGE POINT DEPOSIT

Introduction—History

The Orange Point deposit is located 50 miles northwest from Bartlett Cove on the north side of Johns Hopkins Inlet in a sequence of metamorphosed Permian volcanic and sedimentary rocks. It forms a spectacular iron-stained zone that is visible for miles across the Inlet. Figure B-1 shows the deposit location (No. 8). The area was examined by USGS crews during the 1930's (B-9) and in 1966 (B-6). No claims are located in the area. Zinc-copper bearing sulfide mineralization was first discovered by a Bureau crew late in the summer of 1976. Follow up Bureau work in 1977 indicated the zinc-copper mineralization extended from sea level to an elevation of 500 feet over a horizontal distance of 2,100 feet.

During 1982, a Bureau crew collected metallurgical test samples from the deposit (fig. B-6). As a part of the Juneau Mining District study, in 1985, a Bureau crew conducted geophysics studies of the deposit and collected 99 rock and placer samples from the trend of the rocks that host the deposit (B-5). The details of the metallurgical test samples are in appendix B-2, while the results of the 1985 mapping and sampling are in appendix B-1. The geophysical studies are contained in this deposit description.

Deposit Description

The Orange Point deposit is conformably hosted in a marine sequence of metamorphosed Permian andesite and volcanoclastic rocks, which are part of a large northwest-trending steeply-dipping sedimentary and volcanic sequence whose top is to the east. This sequence is intruded, and in some places assimilated, by Cretaceous and Tertiary diorite and monzonite that form both sharp and gradational contacts. The deposit is considered volcanogenic in origin (B-4).

The Orange Point deposit consists of massive sulfide lenses exposed in three hills located near tidewater. Figures B-7 and B-8 show the deposit, its geology, sample locations, and identifies the hills as numbers 1, 2, and 3. Number 1 is the lowest in elevation and closest to tidewater.

The sulfide lenses are predominately composed of pyrite, pyrrhotite, sphalerite, and chalcopyrite and form elongate lenticular massive sulfide zones up to 80 feet wide, or narrow intermittent elongate tabular zones up to 560 feet long. The sulfide zones form fairly sharp unaltered contacts with the volcanics, but within the zones there is a gradation from andesite with disseminated sulfides to massive sulfides. The sulfides are recrystallized from the thermal effects of regional metamorphism and at some locations from the thermal effects of adjacent intrusives that have assimilated some of the original host rock. Banding parallel to the wall rock is evident and may be part of the original texture. The sulfide zones also contain, in varying amounts, andesine, oligoclase, chlorite, sericite, muscovite, calcite, quartz, epidote, and rarely small amounts of hornblende-actinolite and biotite.

Metallurgical Test Samples

In 1982 the Bureau collected a metallurgical test sample from the Hill number 2 mineralized zone, that was processed by the Bureau Albany Research Center. It was predominately massive pyrite, pyrrhotite, sphalerite, and chalcopyrite which assayed 1.7% copper, 8.4% zinc, 0.025 ounce/ton gold, 0.73 ounce/ton silver, 0.018% cobalt, 35.1% iron, and 34.6% sulfur. Fine-grained sulfide intergrowth in the sample renders complete liberation impractical, but grinding to 200- to 400-mesh may provide reasonable liberation and recovery. Sulfide flotation tests indicated that only 3% of the copper and 4% of the zinc was lost to tailings. Minor amounts of platinum were found in the scavenger concentrates. Appendix B-2 contains additional data on the results of the metallurgical testing.

Geophysics

During 1985, a Bureau crew ran 2,000 feet of VLF geophysical lines to test for concealed massive sulfide bodies in the Orange Point deposit vicinity. A line ran over the possible northern extension of the Hill number 3 sulfide mineralized zone indicated geophysical anomalies at several locations. Appendix B-1 contains more detailed information (B-5).

Identified Resources

Figure B-7 shows the Hill numbers 1, 2, and 3 mineralized zones and sample locations. Appendix B-3, table 1 contains the analytical results. The Hill number 3 zone extends intermittently for 560 feet along strike, is up to 16 feet wide, and samples from it contain up to 1.9% zinc and 3.6% copper. It disappears under cover to the north and south. The Hill number 1 mineralized zones are small, discontinuous, and contain up to 0.40% copper and 0.39% zinc. Neither the Hill number 1 or 3 zones are sufficient in extent or grade to approach development considerations.

The main Hill number 2 zinc-copper mineralized zone starts at an abrupt truncation at an elevation of 200 feet on the south side of Hill number 2, extends over the top of that hill to an elevation of 290 feet and down the north side of the hill to an elevation of 195 feet, where it disappears under cover. This zone does not reappear in outcrops 800 feet further north. On top of Hill number 2, most of the zone is under cover. The steeply-dipping sequence of marine sediments and volcanics in the region has a trend approximately parallel to the mineralized zone. The massive sulfide body has a wedge-shaped exposure, 50 feet across its upper portion (elevation 290 feet) and 80 feet across the lower portion (elevation 200 feet), indicating increasing zone width with depth. Its strike length is 400 feet; the body contains 800,000 inferred tons (B-4).

The Hill number 2 zone was sampled at its south and north ends and at sparse outcrops in between. Sampling indicates that lens-shaped portions of the zone, from 15 to 25 feet wide, average 8 times more copper and zinc than the remainder of the zone. Samples 5 feet long from these higher grade lenses contain up to 5.2% copper, 19% zinc, 0.1 ounce/ton gold, and 2 ounce/ton silver. These higher grade lenses contain an inferred 270,000 tons that average 2.7% copper, 5.2% zinc, 0.03 ounce/ton gold, and 1 ounce/ton silver. The remainder of the Hill number 2 zone contains 530,000 inferred tons that average 0.4% copper, 0.3% zinc, 0.006 ounce/ton gold, and 0.35 ounce/ton silver (B-4).

It would be necessary to develop an additional 10 million tons at an average grade of 1.5 times higher than the average grade of the higher grade lenses of Hill number 2 for the Orange Point deposit to be considered for economic development.

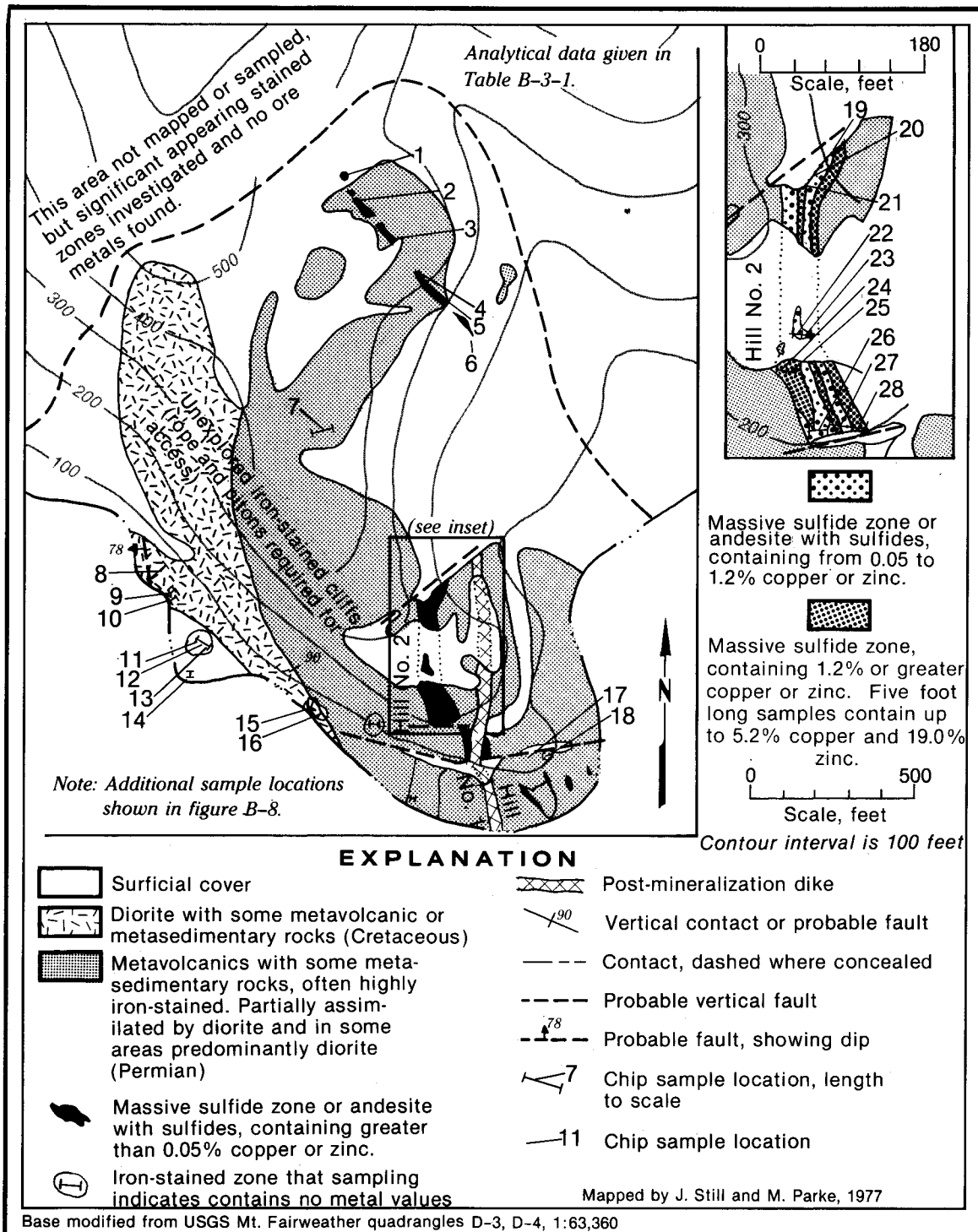


Figure B-7.—Orange Point deposit showing geology and sample locations.

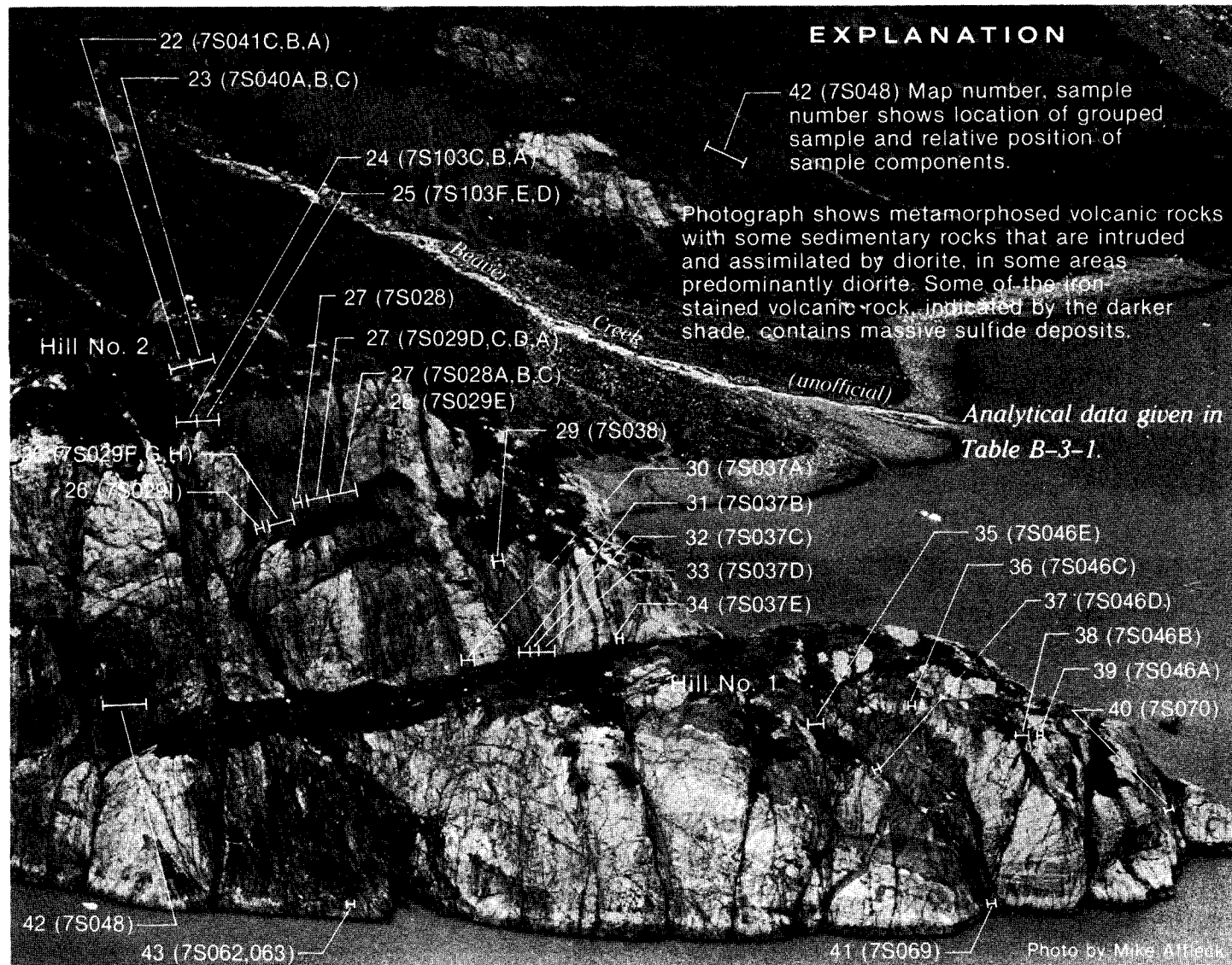


Figure B-8.—Oblique aerial photograph of the Orange Point deposit, showing the southwest side of Hill No. 1 and No. 2 mineralized zones and sample locations.

MARGERIE GLACIER DEPOSIT

Introduction—History

The Margerie Glacier deposit is located 58 miles northwest of Bartlett Cove on the south side of the Margerie Glacier (fig. B-1, No. 3). It is a porphyry copper deposit whose host rock is intruded into the same sequence of marine volcanic and sedimentary rocks that are found at the Orange Point deposit, seven miles to the south-southeast. This deposit is located in rugged terrane at elevations from 1,100 to 3,200 feet and is not reasonably accessible by foot from tidewater, because of terribly crevassed glaciers and steep mountain cliffs. Access is gained by several natural helipads on the deposit.

The deposit was discovered by Leo Mark Anthony (a mining engineer working for Moneta Porcupine Co.) in 1960 through following up glacial float containing chalcopryrite. Six claims were staked on the prospect in that year. Later, brief investigations were made of the deposit by the USGS under MacKevett in 1966, George Moerlein in 1968, and the Bureau in 1975 and 1976. The bulk of the work presented on this report was completed by a Master's thesis student employed by the Bureau. In 1977, she camped on the prospect for 4 days while mapping and taking samples (B-4).

Present Study

During this study, 2 days were spent investigating extensions of the Margerie Glacier deposit vein mineralization to the southwest and south into metavolcanics and metasedimentary rocks. This work was previously reported (B-5) and is summarized herein. Details are contained in appendix B-1.

Deposit Description

The Margerie Glacier deposit consists of a massive Tertiary porphyritic quartz monzodiorite stock intruded into marine volcanic and sedimentary rocks. Figure B-9 shows the prospect geology and sample locations. Appendix B-3 contains the analytical results. This stock contains a porphyritic quartz monzonite core. A prominent joint set trending 50° and dipping steeply northwest, cuts across the stock and extends into the adjacent country rock. Porphyritic monzodiorite dikes ranging in width from 1 to 50 feet, and quartz-sulfide veins up to 1.7 feet wide commonly occupy the joint set. The dikes extend into the country rock at most locations, but the veins do not. The quartz monzodiorite host rock, its core, and the dikes contain disseminated sulfide mineralization which consists of chalcopryrite, pyrite, pyrrho-

tite, and powellite-scheelite. The joint system was probably the conduit for this sulfide mineralization that replaces mafics in the host rocks. Limited investigation indicates that significant disseminated mineralization does not extend into the marine section and, where the dikes extend into the marine section, they contain much less sulfides (B-4).

Quartz-sulfide fracture- or joint-filling veins are found throughout the stock area. Those are up to 1.7 feet wide and contain chalcopryrite, arsenopyrite, sphalerite, pyrite, pyrrhotite, powellite-scheelite, and molybdenite.

Investigation of quartz-sulfide veins along the margins of the Margerie monzodiorite to the south and southwest of the Margerie Glacier porphyry deposit, by this study indicated lower grade mineralization than that at the deposit. Select samples contained up to 4.1 ppm gold, 29 ppm silver, 1.1% copper, and 225 ppm tungsten. Background gold values in the metavolcanics average 0.021 ppm (B-5). See appendix B-1 for sample locations and analytical results.

Identified Resources

The area of disseminated sulfides containing copper, tungsten, silver, and gold mineralization is 900 feet wide, extends for 2,000 feet, and is inferred to be 1,000 feet deep. Figure B-9 shows the mineralized area. It includes portions of the monzodiorite stock and almost all of its core. The ground between the Margerie Glacier and the mineralized area consists of steep cliffs and permanent snow fields, and was not examined. The deposit is open to the north in the area of the cliffs and under the glacier. Samples collected from the mineralized area contain up to 4,900 ppm copper, 1.50 ppm gold, 15 ppm silver, and 634 ppm tungsten. This mineralized area contains 160 million inferred tons that average 0.2% copper, 0.008 ounce/ton gold, 0.13 ounce/ton silver, and 0.01% tungsten (B-4).

Most of the quartz-sulfide veins examined are not persistent enough to be economically significant. Samples from these veins contained up to 50 ppm gold, 150 ppm silver, 6.5% copper, 1,300 ppm zinc, and 6,100 ppm tungsten. The most persistent vein examined was traced through intermittent outcrops for 700 feet (fig. B-7, Nos. 21-27). Samples from this vein contained up to 11.0% copper, 18 ppm gold, 150 ppm silver, 1,100 ppm zinc, 397 ppm tungsten, and 700 ppm molybdenum. The 700-foot length of this vein across a 4-foot mining width contains 75,000 inferred tons that average 0.5% copper, 0.05 ounce/ton gold, and 0.4 ounce/ton silver (B-4). The average grades of the disseminated and the vein mineralization are not sufficient to constitute an economic deposit at 1989 metal prices.

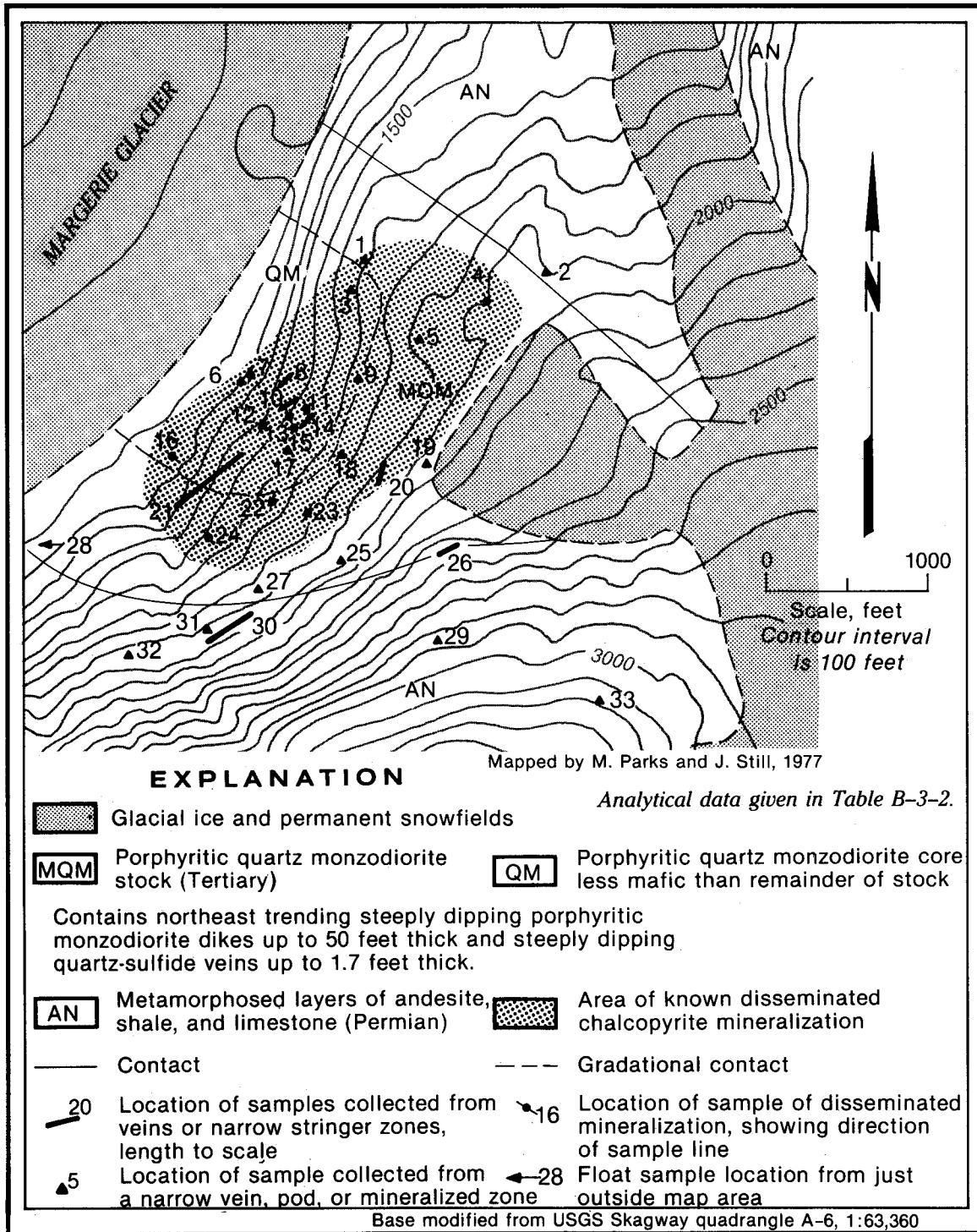


Figure B-9.—Margerie Glacier deposit showing geology and sample locations.

NUNATAK MOLYBDENUM DEPOSIT

Introduction—History

The Nunatak molybdenum deposit is located 38 miles north of Bartlett Cove on the east side of Muir Inlet around a 1,100-foot-high isolated knob known as "The Nunatak" (fig. B-1, No. 6). It consists of stockworks of quartz-molybdenite veins in skarn forming a large low-grade molybdenum deposit.

The deposit was discovered and staked in 1941, just in front of the ice of the rapidly retreating Muir Glacier. During World War II a party from the Bureau and USGS mapped and sampled the deposit and drilled two diamond drill holes (B-5). During 1966, the USGS further mapped and sampled the deposit and American Exploration and Mining Company drilled three diamond drill holes (B-6). Superior Oil Company completed the most detailed and comprehensive study of the deposit during 1966: seven holes were drilled (totalling 5,430 feet), the area was mapped on a scale of 1 inch = 50 feet, rock samples were collected, and some geophysical work was completed (B-8).

During 1977, the deposit was briefly visited by Bureau personnel. Indicated resources were calculated for the deposit by Bureau personnel in 1977 based on the Superior Oil Company's study (B-4). The mining claims holding this deposit lapsed after GBNP was closed to mining in 1976.

Deposit Description

The following description of the Nunatak molybdenum deposit is based on Moerlein's work for Superior Oil Company in 1968 (B-8). Figure B-10 shows the deposit geology and diamond drill hole locations. Figures B-11 and B-12 show details of the more highly mineralized portions of the deposit.

The deposit area consists of Paleozoic limestone and limy argillites that strike in a northerly direction and dip steeply to the east and west. These are intruded by quartz monzonite porphyry that is exposed as dikes and plugs on the Nunatak. Outward from the quartz monzonite is a series of alteration halos consisting of a silicified halo, a skarn halo, and furthest from the quartz monzonite a cherty halo. The skarn alteration is the primary control for molybdenite mineralization with faulting and breccia zones exerting secondary control (B-8).

The molybdenum mineralization consists mostly of closely-spaced quartz veins and veinlets containing selvages of molybdenite, rosettes of molybdenite crystals, and disseminations of molybdenite. These veins also contain pyrite, pyrrhotite, chalcopyrite, tetrahedrite, bor-

nite, and euaugite, usually strike 290°, dip vertically, and are mostly an inch or less in width (B-8).

The intrusive porphyry, the silicified rock, and the cherty rock are unfavorable host rocks for the molybdenite mineralization.

The molybdenum mineralization surrounds the porphyry dikes and plugs of the Nunatak. It extends to the beach on the north side and to a small lake on the south, a distance of 4,600 feet over a vertical distance of 1,100 feet. The mineralization is open to the west under Muir Inlet and to the northeast under glacial moraine. Indications are that the mineralized zone may expand at depth and that a high grade discontinuous halo might exist around the silicified rock and quartz monzonite porphyry (B-8).

Identified Resources

Based on surface samples, mapping, and drilling of the deposit, three areas of identified resources have been identified: stockwork with conspicuous molybdenite, stockwork with inconspicuous molybdenite, and higher-grade mineralized halo exposed in three diamond drill holes and along the Nunatak fault on the surface. Figure B-11 shows the area of conspicuous molybdenite and sample locations, while figure B-12 shows the area of the Nunatak fault and sample locations. Analyses of samples and diamond drill hole cores are in appendix B-4. Table B-1 presents identified resources for the deposit.

This deposit contains 145 million indicated tons accessible to surface mining at a grade of from 0.04%–0.06% molybdenum and 0.02% copper, and an additional inferred 9.1 million tons below sea level near the coastline at 0.06% molybdenum and 0.02% copper. Within the 145 million tons accessible to surface mining is a higher grade halo that, if mined by itself, would require underground mining.

MASSIVE CHALCOPYRITE DEPOSIT

Introduction—History

The Massive Chalcopyrite deposit is located 55 miles northwest of Bartlett Cove on the west side of an unnamed mountain located near the Rendu Glacier (fig. B-1, No. 2). It is a skarn deposit located 200 feet below the top of a 3,000-foot-high mountain cliff in a mixed contact zone formed from a Devonian sedimentary section and Cretaceous diorite.

Prior to the Bureau's examination of the deposit in 1976 and 1977, investigators in 1960 and 1966 reported finding chalcopyrite-bearing float near the terminus of

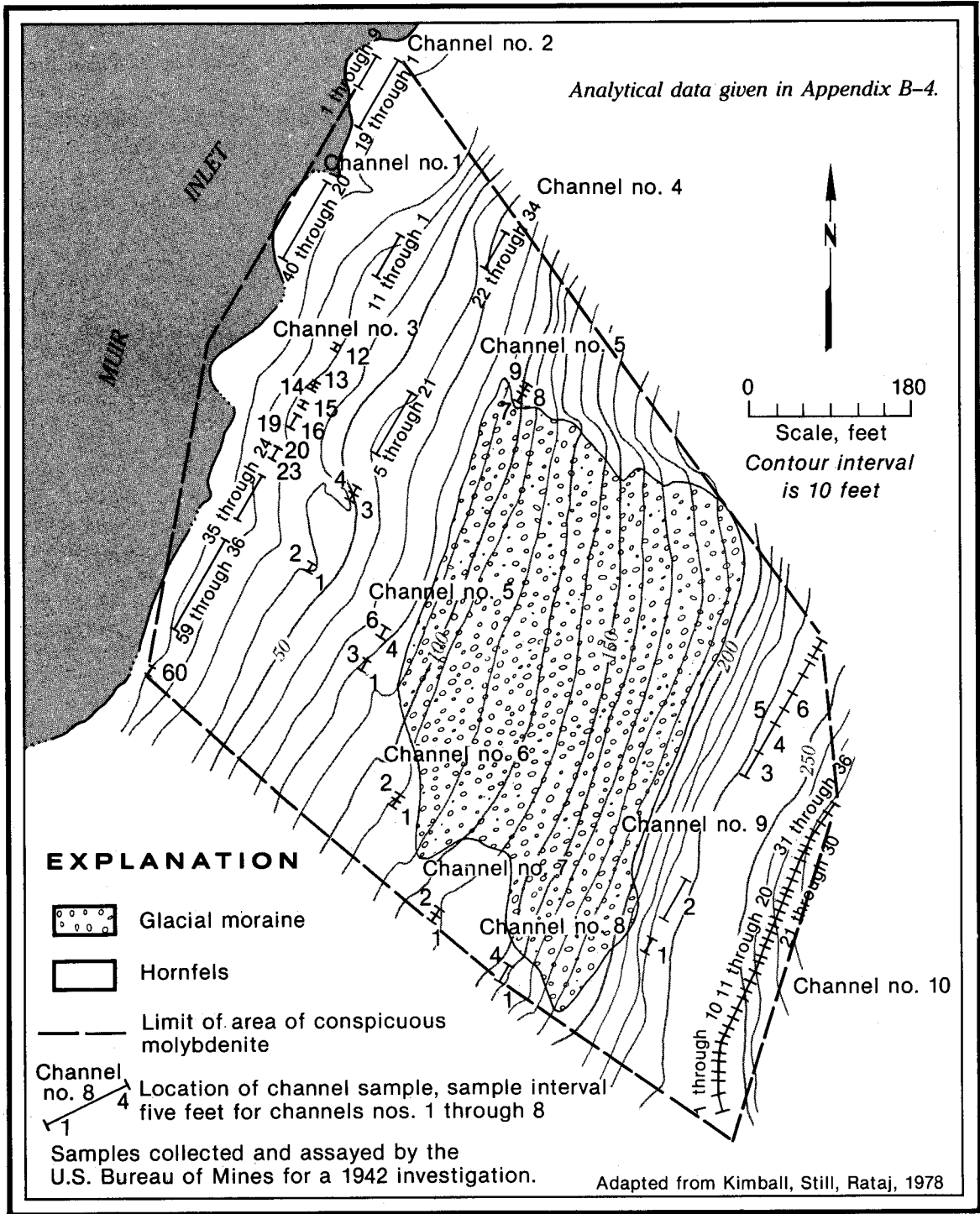


Figure B-11.—Nunatak molybdenum deposit, area of conspicuous molybdenite, showing sample locations (see figure B-10 for location).

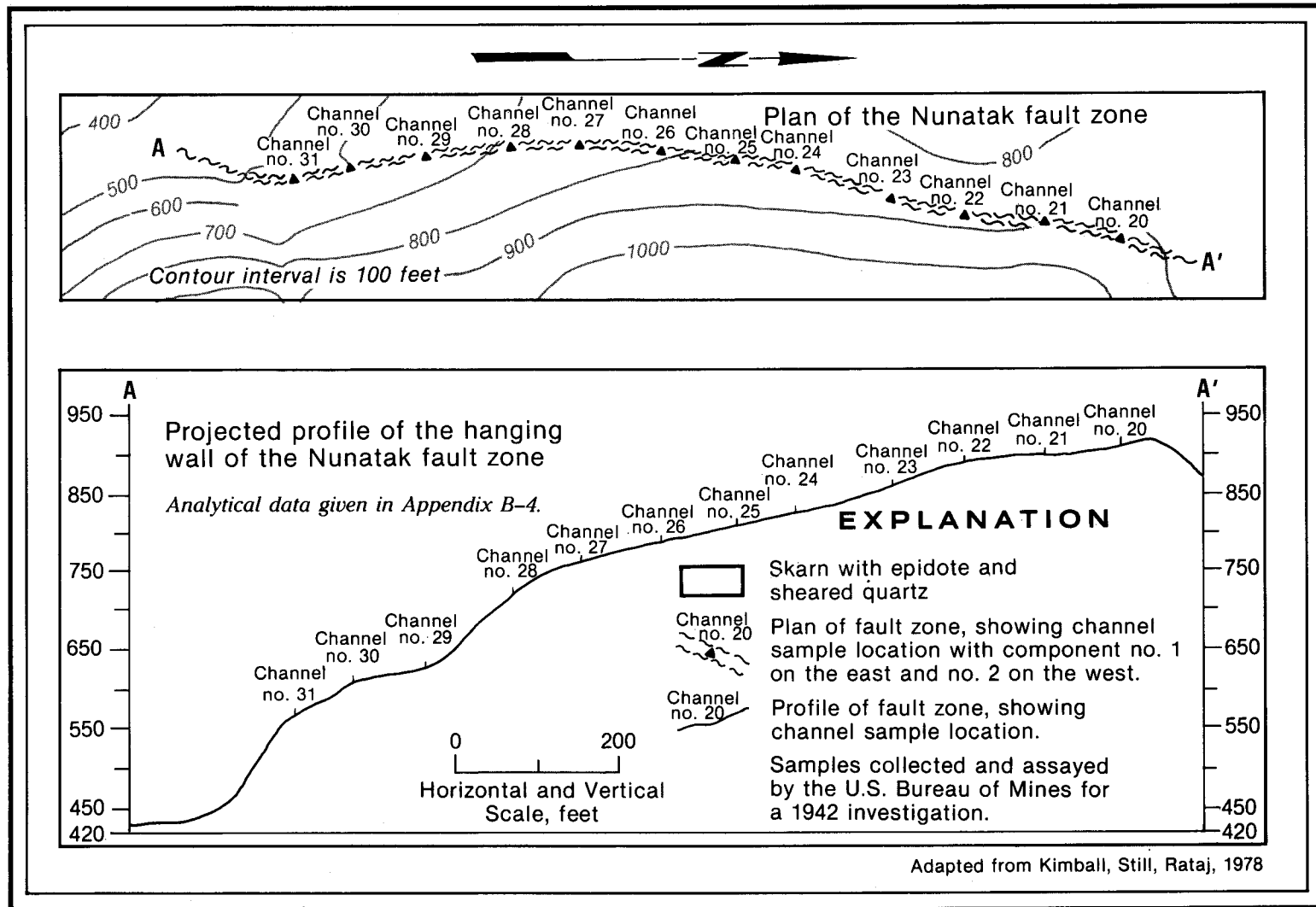


Figure B-12.—Nunatak molybdenum deposit, Nunatak fault zone showing sample locations (see figure B-10 for location of A-A' cross section).

**Table B-1.—Identified resources of the Nunatak molybdenum deposit
Adopted from Kimball, Still, and Rataj (B-4)**

Area	Dimensions	Tonnage	Estimated* avg. grade %
1 Stockwork with conspicuous molybdenite	875 feet long by 600 feet wide, 0 to 360 feet above sea level. Additional area from sea level to 200 feet below sea level.	8.2 million indicated tons above sea level, an additional 9.1 million inferred tons below sea level.	0.06% Mo 0.02% Cu
2 Stockwork with inconspicuous molybdenite	Mineralized zone up to 1,100 feet wide and 300 feet long. Open pit designed around above area with 60° walls, up to 1,700 feet wide and with a floor 200 feet below sea level.	137 million indicated tons of mineralized rock, 52 million tons of waste from open pit. Of the above, 20 million tons of mineralized rock and 4 million tons of waste are located below sea level.	0.04% Mo 0.02% Cu
3 Higher grade mineralized halo exposed in the AMEX No. 2, Muir Nos. 1 and 2 drill holes and along the Nunatak fault on the surface	Exposed by drill holes up to 500 feet apart. Estimated width from 50 to 160 feet. May be discontinuous halo around the stock.	Tonnage included in No. 2 area.	0.11–0.143% Mo

*An estimate of the average grade of the indicated area based on the extent and type of sampling, and on the various previous estimates.

an unnamed glacier on the floor of the valley below the 3,000-foot-high mountain cliff (B-4).

Bureau investigations in the area revealed a 3-mile-wide by 5-mile-long contact zone exposed in a rugged mountain ridge between the Rendu Glacier to the east and an unnamed glacier to the west. Access to most locations on this ridge requires mountaineers with ropes, ice axes, and pitons. Helicopter landing sites are limited (fig. B-13). A number of mineralized showings were discovered as a result of the 1976–1977 Bureau investigations in the area. The most important of these is the Massive Chalcopyrite deposit which was reached by rappelling down the top 200 feet of a 3,000-foot-high cliff (fig. B-14).

Deposit Setting

The setting of the Massive Chalcopyrite deposit is shown in figure B-15. The mountain ridge on which it is located consists of a mixed contact zone, a Devonian sedimentary section, and Cretaceous diorite. The sedimentary section is composed of argillite, limestone, and some volcanics. At places, this section is metamorphosed to hornfels, marble, or calcsilicate hornfels. The mixed contact zone consists of diorite mixed with partly assimilated sedimentary rock including large blocks of limestone. The eastern side of this mountain ridge is mostly covered with glaciers and snow fields while the western side of the ridge consists of a steep broken mountain face up to 3,000 feet high, occasionally laced with ice and snow-filled gullies.

Exposed on this mountain face for 2 miles and at elevations from 4,000 to 5,000 feet in the mixed contact zone are iron-stained layers and masses. Similar layers

but more difficult to access are found on the east side of the mountain. Helicopter observation indicates these layers are up to 50 feet thick, strike with the mountain face, dip gently into it, and are up to 1,000 feet long while the masses are up to 100 feet in maximum dimension. In the southern portion of this western mountain face, highly fractured white diorite forms a sharp contact with the mixed contact zone. The Massive Chalcopyrite deposit is located on this contact. Figure B-16 is a photograph showing this contact (B-4).

Locations of samples collected from this mountain ridge are shown in figure B-15 and the analytical results are contained in appendix B-3, table 3. Excluding the Massive Chalcopyrite deposit and vicinity analytical results, the samples contained up to 2,000 ppm copper, 238 ppm tungsten, 5 ppm silver, and 0.3 ppm gold (fig. B-15, map Nos. 1–7, 13–15).

Deposit Description

The Massive Chalcopyrite deposit consists of a 12-foot-wide massive sulfide zone located between a 5-foot-wide zone of epidote-bearing diorite that grades into white diorite to the south and a 10-foot-wide section of calcsilicate rock that grades into marble to the north. The calcsilicate rock is predominately garnet, epidote, and diopside with small sulfide and scheelite veins. The massive sulfide zone consisted of chalcopyrite, augite, goethite, pyrrhotite, scheelite, and sphalerite. The vertical to overhanging nature of the rock in the vicinity of the deposit limited investigations. Figures B-16 and B-17 show the deposit and sample locations (B-4). Appendix B-3, table 3 contains the analytical results.



Figure B-13.—The Massive Chalcopyrite deposit was discovered by Bureau personnel in 1976. Shown is a helicopter on the rugged glaciated crest of the deposit vicinity. Lack of helicopter landing sites and rugged terrane made mineral investigations in this area difficult (J. Still, photographer).



Figure B-14.—Magnetometer survey at a location just above the Massive Chalcopryite deposit. In the far background is the Reid Glacier, Reid Inlet, and the Reid Inlet gold area (J. Still, photographer).

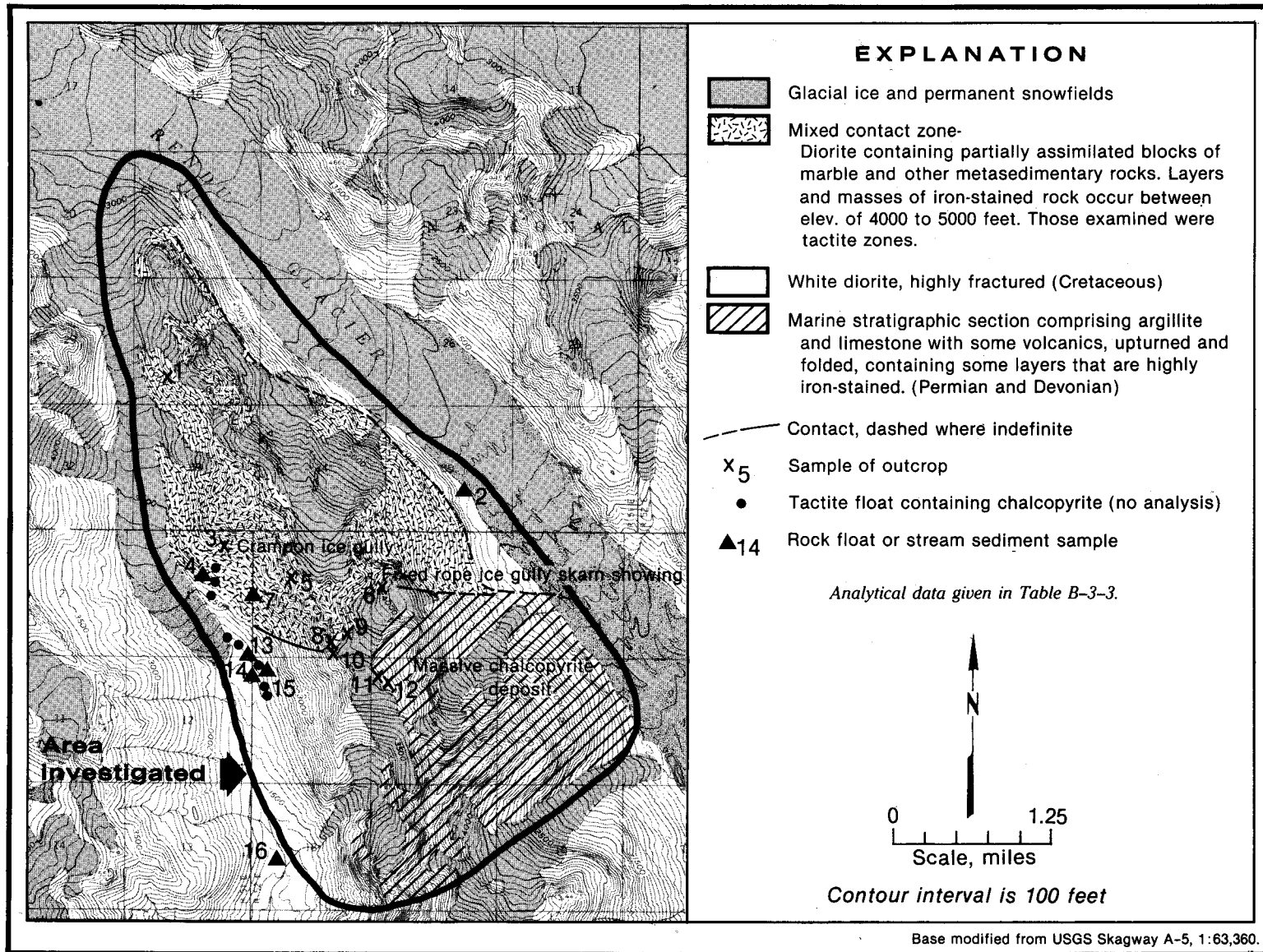


Figure B-15.—Massive Chalcopyrite deposit area showing geology, mineralization, and sample locations.



Figure B-16.—Oblique aerial photograph of the west side of the Massive Chalcopyrite deposit area, showing copper-stained zones and sample locations.

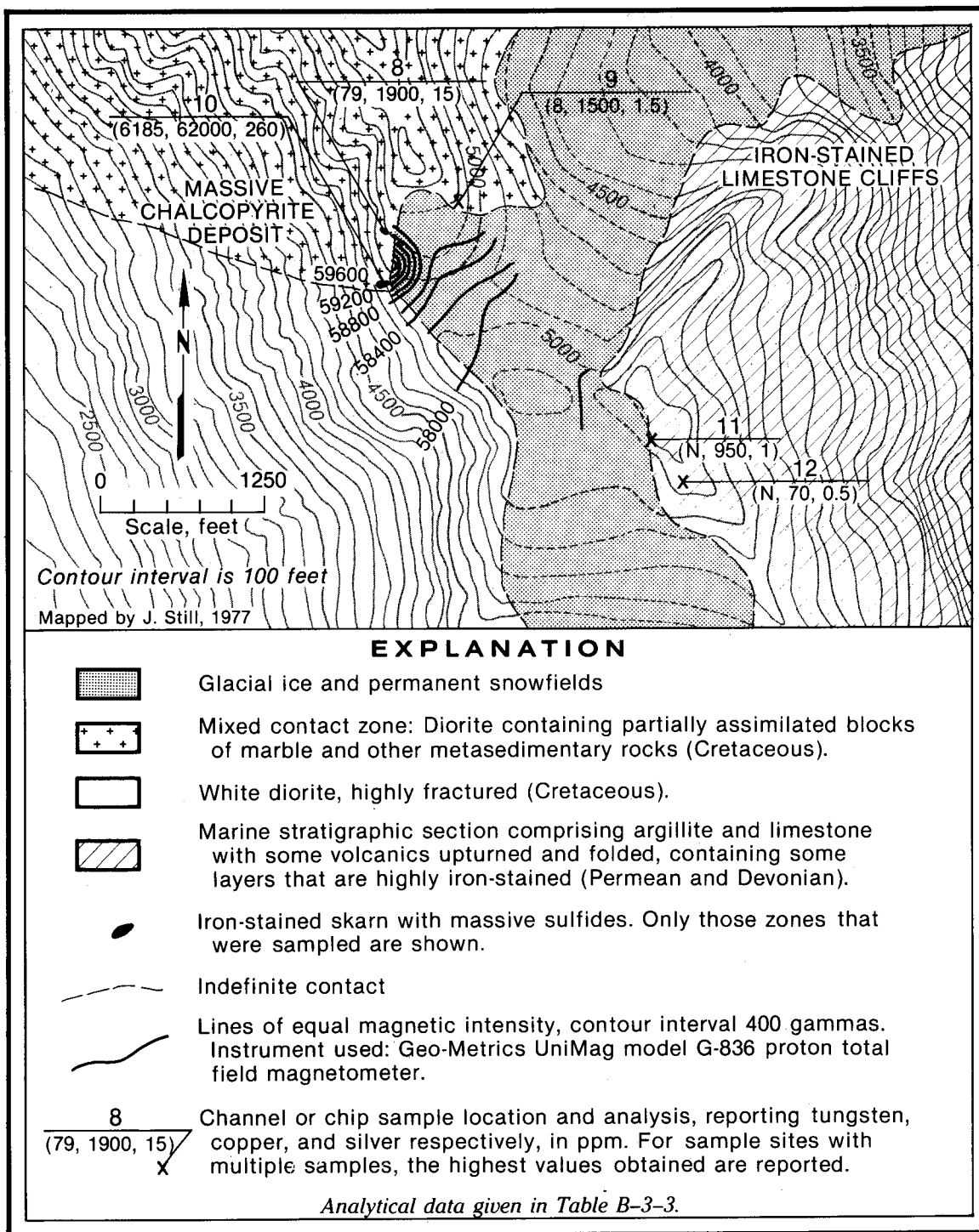


Figure B-17.—Massive Chalcopyrite deposit and vicinity, showing sample locations and magnetometer survey results.

Samples collected of calcisilicate mineralized zones in the vicinity of the Massive Chalcopyrite deposit contained up to 1,900 ppm copper, 15 ppm silver, 0.50 ppm gold, and 79 ppm tungsten (map Nos. 8, 9, 11, and 12). Figures B-16 and B-17 show the sample locations.

Geophysics

A total field magnetometer survey was taken on the glacier above the Massive Chalcopyrite deposit. Figure B-17 shows the results of the survey. A sharp total field magnetic anomaly with a magnitude of at least 1,000 gammas is centered above the Massive Chalcopyrite deposit and may indicate possible extensive mineralization under the glacier (B-4).

Identified Resources

The massive sulfide zone is 12 feet wide and extends for an estimated 80 feet down the face of a vertical to overhanging cliff. Samples from this zone contain up to 6.2% copper, 500 ppm silver, 5.5 ppm gold, 2,600 ppm zinc, and 6,185 ppm tungsten (fig. B-17, map No. 10). Sample 6S049 contained 15 ppm gallium and 20 ppm germanium. The zone is estimated to contain an inferred 4,300 tons that average 5,200 ppm tungsten, 5.0% copper, 7.0 ounces/ton silver, and 0.15 ounce/ton gold. The magnetic anomaly, located to the east of the massive sulfides exposed in the cliff, may indicate much more extensive resources, however, diamond drilling would be required to determine this (B-4).

LEROY MINE

Introduction—History

The LeRoy Mine is located 45 miles northwest of Bartlett Cove on the west side of Reid Inlet at an elevation of 950 feet (fig. B-1, No. 11). It consists of a series of shear-controlled, steeply-dipping, gold-bearing quartz veins hosted in metasedimentary rocks and sheared granodiorite.

The mine was discovered in 1938 by A.L. Parker and L.F. Parker and mining started that year. A small mill was established capable of crushing, grinding, table concentration, amalgamation, and flotation. Between 1938 and 1950, between 3,700 and 4,800 ounces of gold were mined from the LeRoy Mine. Reportedly, the ore averaged between 2.85 and 3.3 ounces/ton gold (B-4).

A number of geologists and engineers from the Territorial Department of Mines, USGS, and Bureau mapped and sampled the properties between 1954 and 1978 (B-3,

B-4, B-7, B-11) A detailed account is contained in USGS Open File Report 78-494 (B-4).

Mining claims holding the LeRoy Mine have remained in the Parker family until the present (1989.) After GBNP was closed to mining in 1976, Park Service geologists conducted a validity examination of the mine and declared the claims holding it invalid. The Parker family challenged this decision, and after extensive litigation, two of the claims were declared valid.

Mine Setting

The LeRoy Mine is located in the Reid Inlet gold area where 17 gold mines and prospects have been identified (B-4). Figure B-18 shows the area, its geology, and the locations and names of the mines and prospects. These mines and prospects consist of discontinuous steeply-dipping gold-bearing quartz veins hosted in metasedimentary rocks, altered diorite, and granodioritic rocks. Almost all the production from the Reid Inlet gold area was between 1938 and 1954 from the LeRoy and Rainbow Mines. It is estimated at 7,150 ounces of gold (B-4).

Mine Description

The LeRoy Mine is located on somewhat discontinuous quartz veins following a shear zone in altered granodiorite and slate, hornfels, and schist. These veins carry sparse pyrite, arsenopyrite, galena, and sphalerite. Figure B-19 shows the mine, sample locations, and geology. Analytical results are in appendix B-3, table 4.

The west workings consist of a drift driven on discontinuous veins. The east mine workings consist of a 250-foot-long haulage drift and a shorter drift 35 feet above. The veins have been stoped out between the drifts and for some undetermined distance above the shorter drift. At one point a stope is open to the surface at a distance of 70 feet above the lower level floor. Workings off the 250-foot-long drift and at a location 240 feet to the west of it, explore narrow veins parallel to the mine veins.

Almost all of the ore has been stoped out between the 250-foot-long drift and the surface. The mine stops at a basalt dike. No mining has occurred below the 250-foot-long drift and no exploration has occurred beyond the basalt dike.

The mine workings have been sampled at numerous locations. The best results are from a 50-foot-long strike length of vein exposed in the floor of the 250-foot-long drift (map Nos. 33-40.) The 50-foot length averaged 1.25 ounces/ton gold at an average width of 2.0 feet (B-4).

If several thousand tons of ore at a grade of between 2 and 3 ounces/ton gold could be blocked out in this

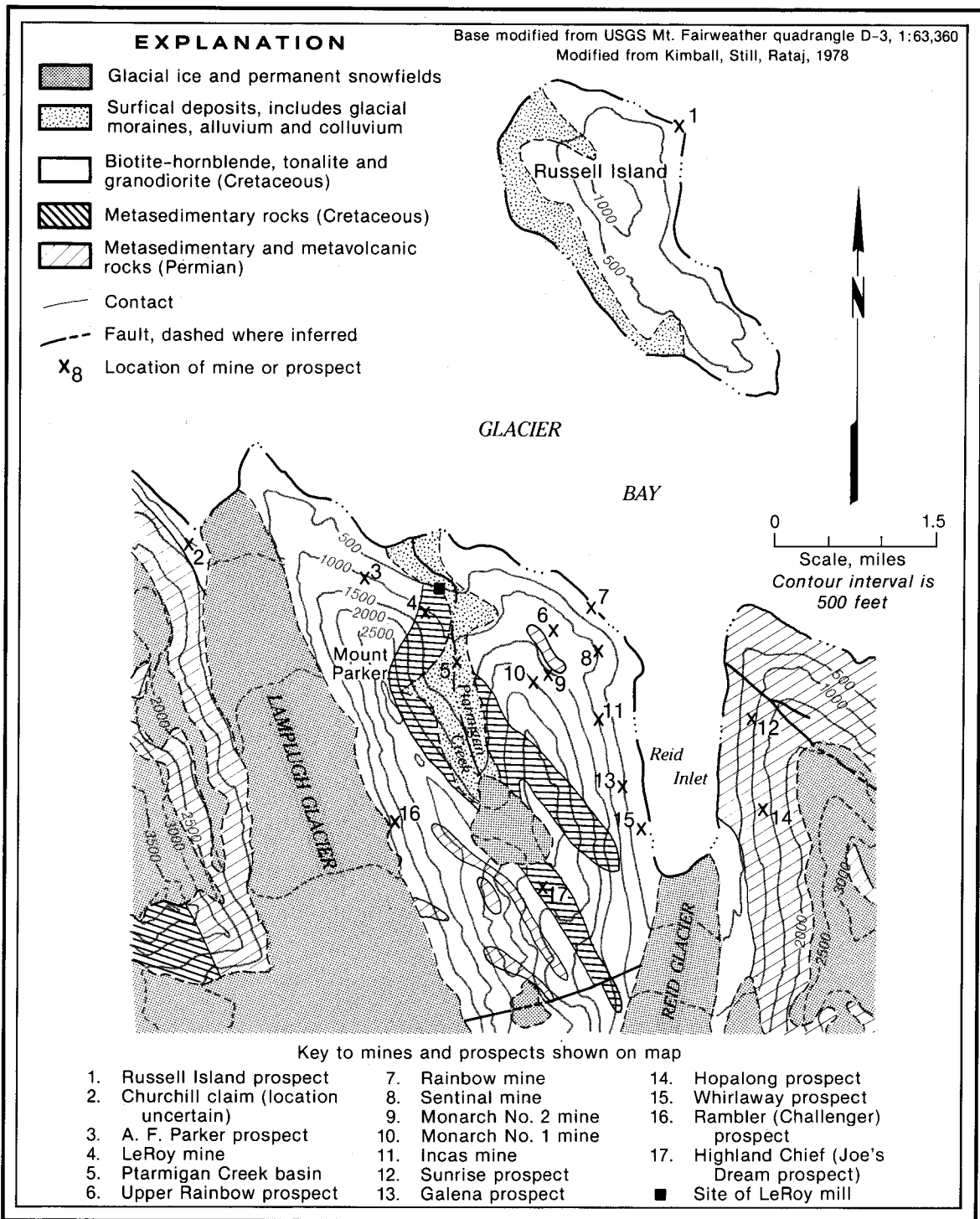
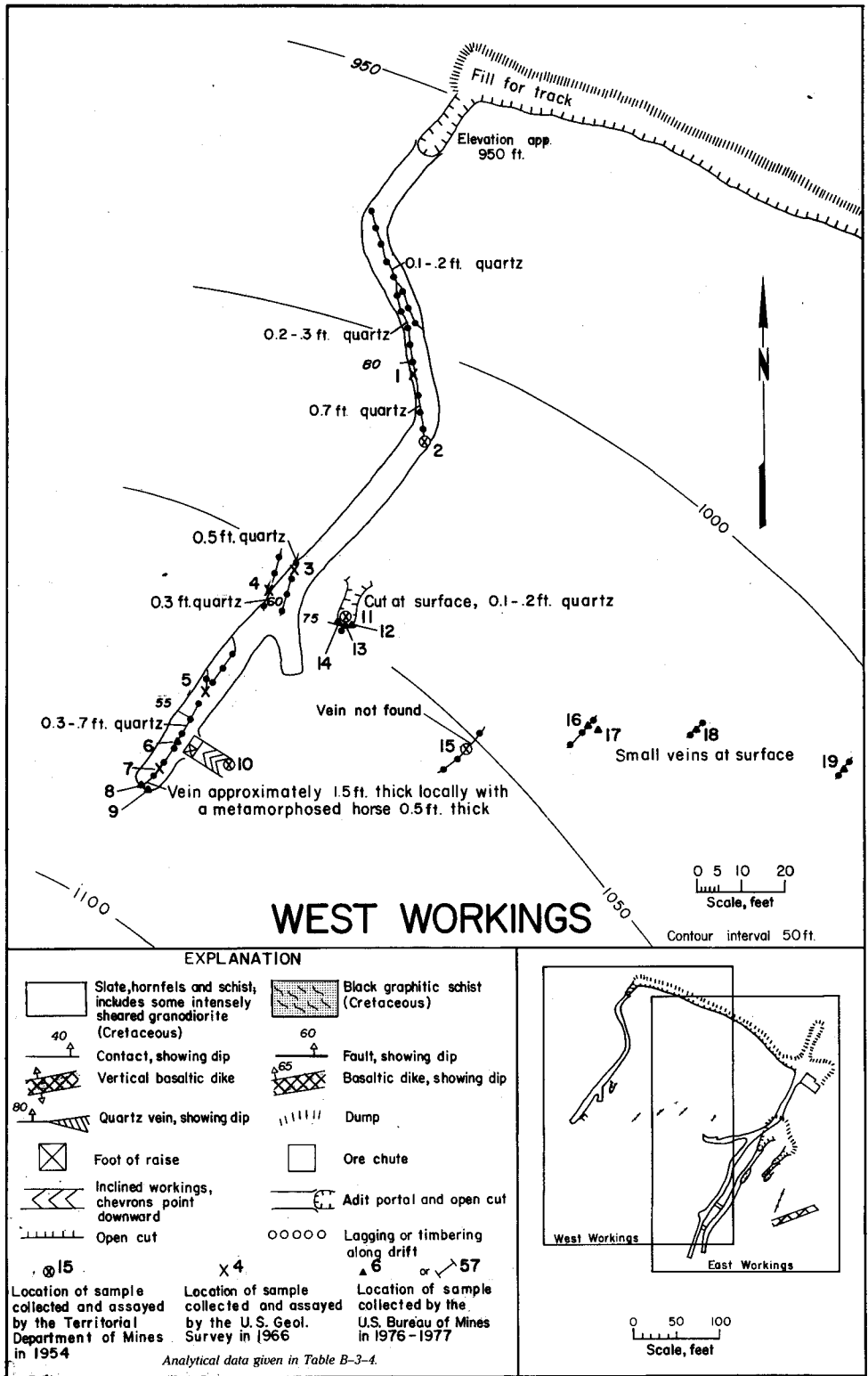
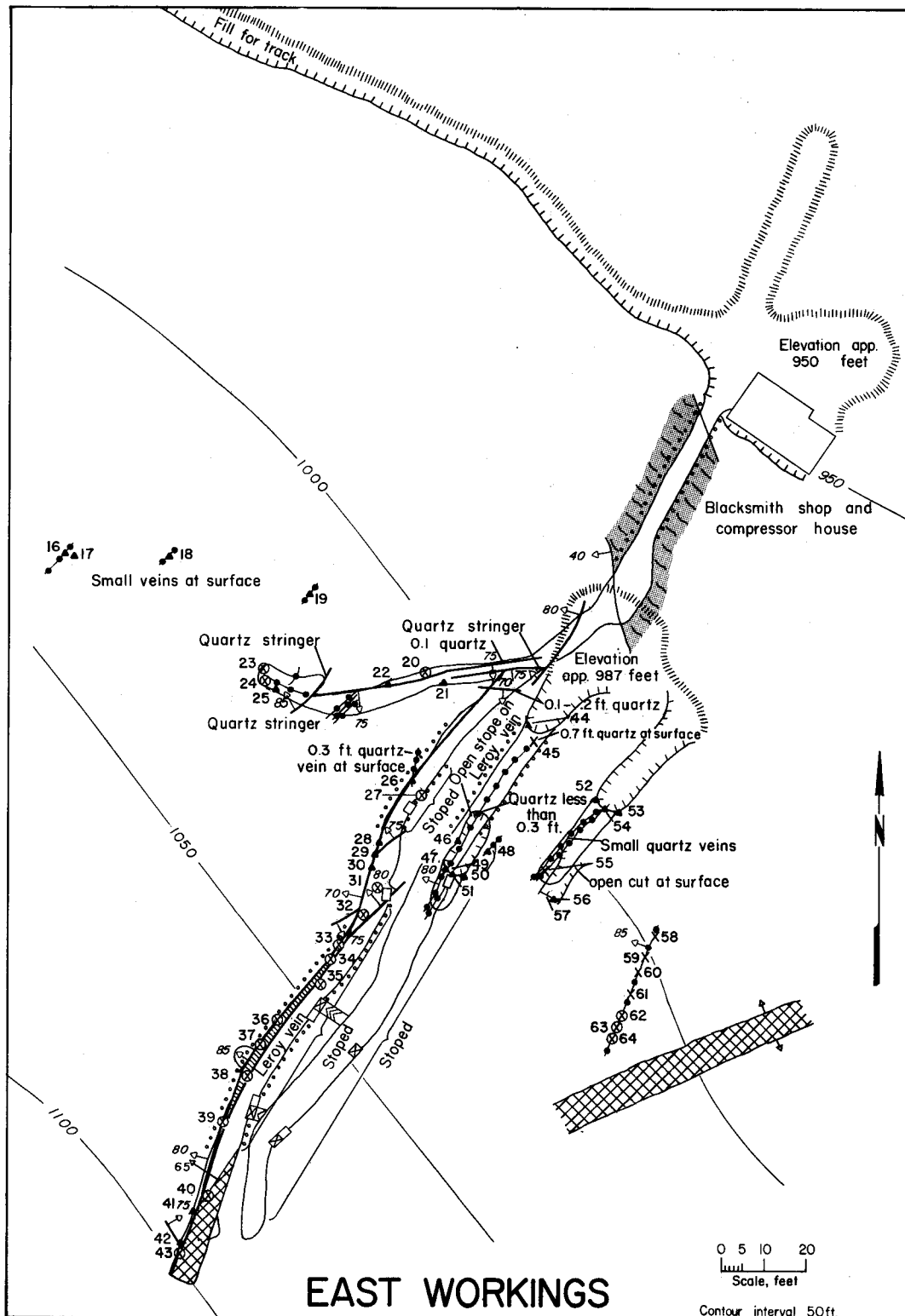


Figure B-18.—Reid Inlet gold area, showing the setting for the LeRoy and Rainbow mines, and other area gold mines and prospects.



Adopted from Kimball, Still, Rataj, 1978

Figure B-19.—LeRoy Mine showing workings, geology, and sample locations.



mine, it might be economically feasible for a very small operation to mine it.

RAINBOW MINE

Introduction—History

The Rainbow Mine is located at tidewater 1.3 miles east from the LeRoy Mine in the Reid Inlet gold area (fig. B-1, No. 12). It was staked in 1936 but the claims lapsed in 1977. Production, mostly between 1945 and 1954, is reported at several hundred tons of ore averaging 2.85 ounces/ton gold, or about 2,000 ounces of gold (B-11). Workings consist of a 200-foot-long drift and stopes an undetermined distance above the drift. Reportedly, the ore was barged to Ptarmigan Creek and hauled to the LeRoy mill where it was processed (B-4). Figure B-20 shows the mine workings, geology, and sample locations.

The mine has been mapped and sampled by Territorial Department of Mines, USGS, and Bureau geologists and engineers between 1954 and 1977. The last investigation was completed by Bureau personnel in 1975 and 1976 (B-4). The presentation herein is based on that study.

Mine Description

The Rainbow Mine workings follow a 1-foot-thick altered zone in granodiorite containing a steeply-dipping crushed quartz vein. The altered zone can be traced up

the mountainside to an elevation of 1,000 feet. Sparse pyrite, galena, sphalerite, and arsenopyrite are found in the quartz veins. Samples from the mine workings contain up to 10.2 ounces/ton gold and average approximately 1.3 ounces/ton gold across a 3-foot mining width for a distance of 180 feet. Some of these samples were from pillars left in the mine stope and are mostly representative of the material mined rather than the material remaining.

Detailed examination of the surface exposures of the altered zone on which the Rainbow Mine is located may reveal ore-grade mineralization.

OTHER MINES, DEPOSITS, PROSPECTS, AND OCCURRENCES

The 24 most important mines, deposits, prospects, and occurrences of the 132 identified within the Glacier Bay area are shown on figure B-1. The seven most important of these, (fig. B-1, Nos. 2, 3, 6, 8, 11, 12, and 19), were previously discussed in the text. The remaining 17 are briefly described in table 2. More detailed descriptions of these, and the remaining 108 occurrences not described herein, are found in USGS Open File Report 78-494 (B-4). These were all mapped and sampled by Bureau geologists and engineers during the 1975-1977 Bureau study of GBNP.

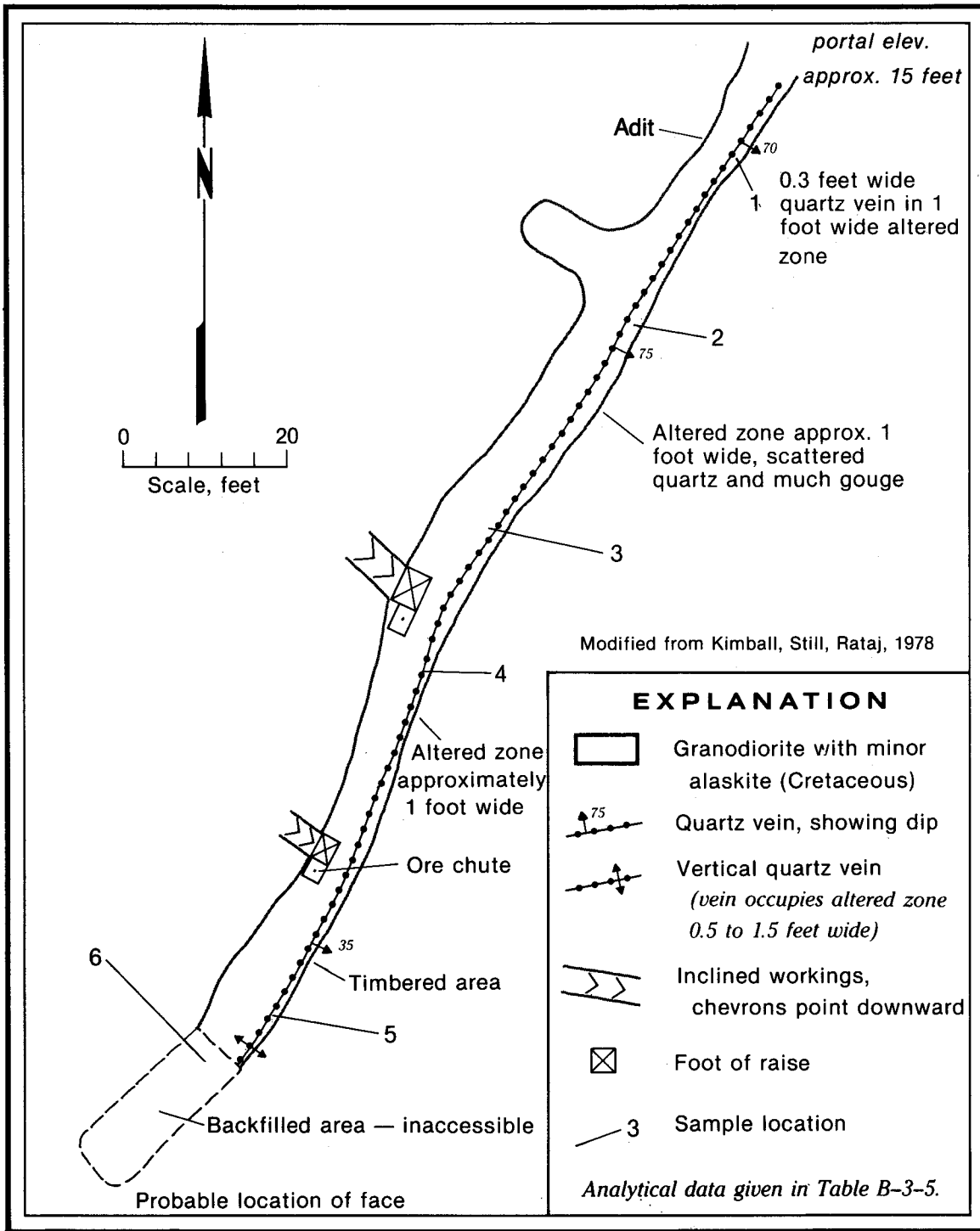


Figure B-20.—Rainbow Mine showing workings, geology, and sample locations.

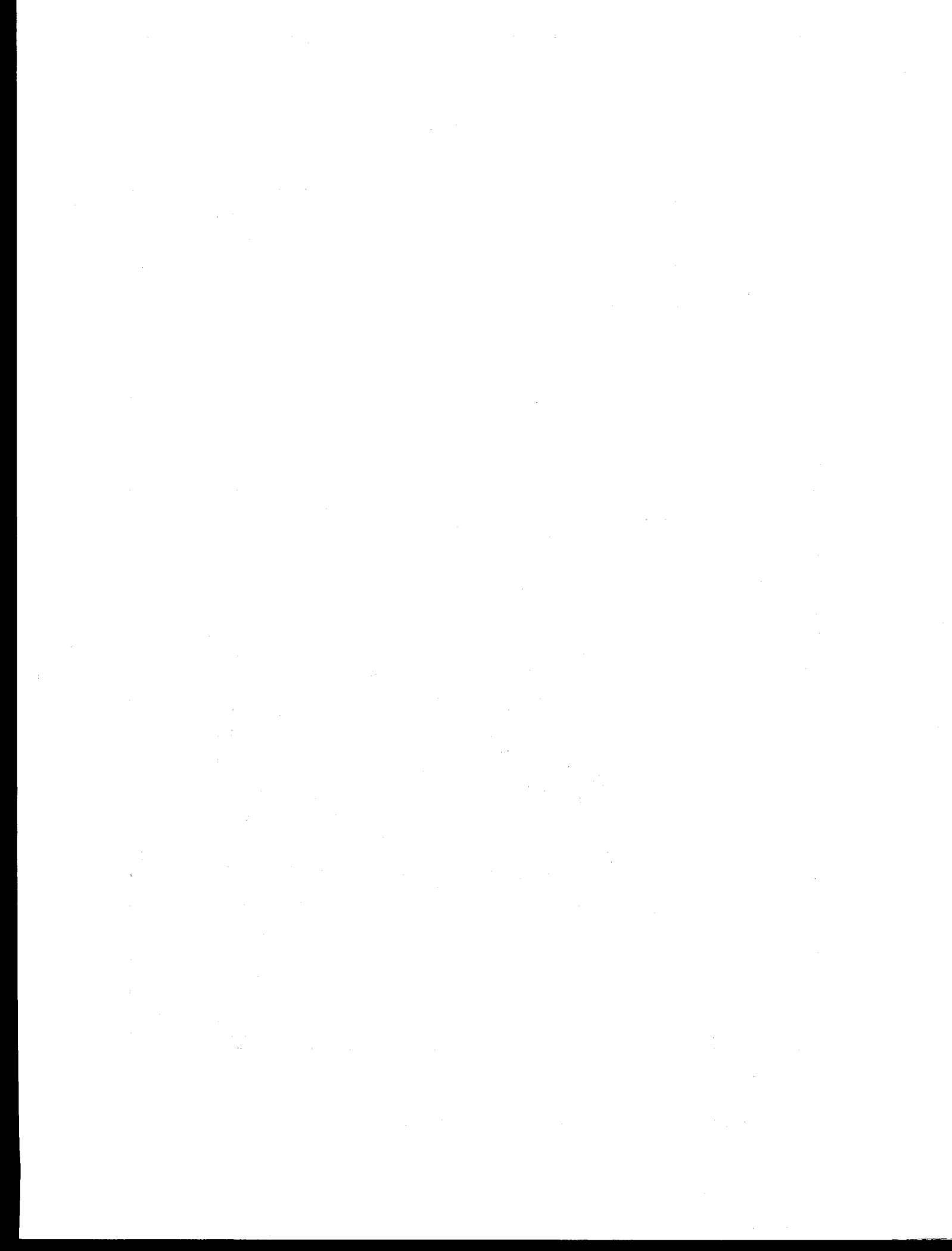


Table B-2.—Description of mines, deposits, prospects, and occurrences in the Glacier Bay area shown on figure B-1 and not previously discussed in this report

Fig. B-1 Map No.	Name	Main Commodities	Description
1	Mount Brack occurrence	Zn, Cu, Pb, Au	Quartz-calcite veins up to 1.8 feet thick hosted in metasediments, metavolcanics, and dikes contain cp, sl, gn, py, aspy, and ankerite. Samples from these veins contain up to 1.3% Cu, .9% Pb, 4.2% Zn, 0.7% Sb, 70 ppm Ag, and traces of Au.
4	Tarr Inlet Knob prospect	Cu, Zn, Pb, Ag, Au	Altered fault zones containing py, cp, sl, aspy, and qz hosted in quartz monzodiorite intruded by porphyritic granite and containing large xenoliths of shale and volcanics. Mineralization found over an area extending for 2 miles and from elevations of 0 to 1,400 feet. Samples from the altered fault zones ranging in width from 3 to 16 feet contain up to 3,300 ppm Cu, 5,000 ppm Zn, 3,100 ppm Pb, 50 ppm Ag, 0.15 ppm Au, 600 ppm W, 200 ppm Sn, and more than 10,000 ppm As.
5	Bruce Hills prospect	Cu, Mo	Shear zones, disseminations, and thin qz veins hosted in granodiorite and qz diorite contain py, po, cp, md, and ml. Small roof pendants of hornfels, and andesite dikes are present. Cu and Mo mineralization is scattered through an area 1 mile by 1 mile. One area, 400 feet in diameter, is reported to average 0.2% Cu and 0.17% Mo. A 325-foot-long Bureau sample line averaged 0.17% Cu and 0.026% Mo.
7	Wachusett Inlet prospect	Cu, Mo	Qz sulfide vein hosted in shear zone in granitic rock. The 50-foot-long by 0.7-foot thick vein contains py, cp, and md. Samples from it contain up to 7.4% Cu, 0.15% Mo, and 30 ppm Ag. Over a 4-foot mining width the vein averages 0.44% Cu, 0.005% Mo, and 0.034 ounce/ton Ag.
9	Russell Island prospect	Au, Ag	Narrow iron-stained fracture zone containing qz veins is hosted in granodiorite and at least 280 feet long. The zone consists of hydrothermally altered granodiorite (chlorite, sericite, introduced qz) containing narrow qz veins that contain ankerite, py, po, sericite, calc., and scheelite. Metallic Au found in py. Samples from the qz veins contain up to 5.81 ounces/ton Au, 2.64 ounces/ton Ag, 890 ppm Pb, and 550 ppm Zn. Average values across a 4-foot mining width range from 0.35 ounce/ton Au to 0.02 ounce/ton Au.
10	A.F. Parker prospect	Au, Ag	A 16-foot-long drift follows a narrow gougy shear zone hosted in granodiorite containing qz up to 0.1 foot thick. Samples from the qz contain up to 5.13 ounces/ton Au. Reportedly a few tons of ore were mined from the prospect during the 1940's.
13	Monarch No. 1 and No. 2 mines	Au, Ag	Surface trenches and a 225-foot drift and a 140-foot crosscut develop narrow qz fissure veins hosted in granodiorite. Reportedly small amounts of ore were trammed to the beach and milled. Samples from the veins contain up to 0.03 ounce/ton Au.
14	Rambler prospect	Au, Ag	Qz vein system hosted in granodiorite, metamorphic rocks, and mafic dikes contains py, sl, and gn. Samples from the veins contained up to 6.45 ounces/ton Au over a 0.9-foot width. Across a 4-foot mining width the veins average between 0.40 and 0.57 ounce/ton Au. Because of cover the extent of the veins could not be determined.
15	Highland Chief prospect	Au, Ag	Several altered zones containing parallel qz veinlets bearing aspy, py, gn, and free Au are hosted in marble, schist, and granodiorite. Samples collected from the area during the 1977 Bureau study contained up to 3.49 ounces/ton Au. The prospect is developed with numerous pits, trenches, and cuts. Most of these are snow covered except in late August and early September. The mineralization is scattered over a distance of 1,800 feet.
16	White Glacier prospect	Zn, Cu, Ag	Lenses and disseminations of py in volcanic rocks that contain slightly elevated amounts of Au, Pb, and Mo form iron-stained zones hundreds of feet thick. An 8-foot thick zone of pyrite chert hosted in limestone near a volcanic contact contained cp, sl, native Au and Ag, ankerite, ba, celestite, strontianite, and witherite. Samples from the zone contain up to 4.5% Zn, 1,900 ppm Cu, 7 ppm Ag, 5,000 ppm Ba, and 500 ppm Sb. These are stratabound volcanogenic occurrences.
17	Miller Peak prospect	Cu	Widely-spaced narrow qz-calc veins containing py, cp, ml, and ankerite hosted conformably in limestone contain up to 1.5% Cu. These veins can be traced for hundreds of feet.
18	Sandy Cove prospect	Au, Ag, Cu	A 110-foot-long adit is driven on a steeply-dipping discontinuous altered zone up to 4.5 feet wide that is hosted in qz monzonite and limestone. The altered zone contains quartz stringers and veins up to 2.0 feet wide. The veins and altered qz monzonite contain up to 0.333 ounce/ton Au, 3.0% Cu, and 1.75 ounces/ton Ag and average 0.019 ounce/ton Au, 0.18% Cu, and 0.16 ounce/ton Ag for a 110-foot length. Samples of qz veins in the vicinity contained up to 0.588 ounce/ton Au, 0.583 ounce/ton Ag, and 10% Cu.

Table B-2.—Description of mines, deposits, prospects, and occurrences in the Glacier Bay area shown on figure B-1 and not previously discussed in this report—Continued

Fig. B-1 Map No.	Name	Main Commodities	Description
20	Threesome Mountain deposit	Mo, W	Stockwork of qz-molybdenite-scheelite fracture coatings near the top of a granodiorite stock that intrudes volcanics, limestones, granitics. The fracture coatings average 0.08 foot thick and their maximum density is eight per 100 feet. Samples from them contain up to 2,000 ppm Mg, 7 ppm Ag, 330 ppm Cu, and 4,917 ppm W. In 1969 Alvenco drilled three diamond drill holes to evaluate the deposit. Claims covering this deposit were allowed to lapse.
21	Dundas Bay prospect	W, Au	Follow up of stream sediment samples containing up to 150 ppm W led to a 300- by 300-foot limestone inclusion in foliated hornblende diorite. Some of the limestone is altered to skarn which contains wollastonite, vesuvianite, grossularite, epidote, diopside, tremolite, chlorite, biotite, and powellite. Samples collected from the skarn contained up to 79 ppm W, 8.5 ppm Au, 200 ppm Bi, and 150 ppm Sn. Molybdenite was observed in some specimens.
22	Alaska Chief prospect	Cu, Au, Ag	Skarn zone at a diorite-limestone contact contains irregular lenses and bands of massive sulfides composed of py, cp, po, and sl that are hosted in tactite, hornfels, and marble. The prospect is covered by the Alaska Chief No. 2 claim patented in 1924. The prospect has been stripped of surface cover and trenched. It is estimated to contain 28,000 inferred tons that average 1% Cu, 2 ounces/ton Ag, and 0.1 ounce/ton Au. The patented Alaska Chief No. 2 claim was purchased by the Nature Conservancy and donated to GBNP.
23	Dundas Bay altered zone	Cu	A 100- to 1,000-foot-wide zone of qz semischist in metabasalt contains bands, lenses, and disseminations of py and cp, and qz veins with py and cp. Samples across portions of the zone contain up to 1,000 ppm Cu, 230 ppm pb, 20 ppm Mo, and 2 ppm Ag. Chip samples across a separate shear up to 35 feet wide contain up to 0.510% Cu. The semischist extends for at least 1 mile and is open at both ends.
24	Exray prospect	Cu	Calcite veins hosted in calcareous argillite and brecciated limestone contain cp and are exposed in five prospect pits. Samples from the pits contain 80 to 4,300 ppm Cu across widths of 1 to 6 feet.

NOTE.—See beginning of appendix B-3 for mineralogical abbreviations.

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APPENDIX B-1.—RESULTS OF 1985 INVESTIGATIONS IN THE JOHNS HOPKINS INLET-MARGERIE GLACIER AREA

Adopted from Kurtak (B-5)

INTRODUCTION

During 1985, the Bureau undertook an investigation of the Johns Hopkins Inlet-Margerie Glacier area in Glacier Bay, Alaska (fig. B-1-1). This study was initiated to further investigate copper-zinc sulfide occurrences previously discovered by the Bureau in the area (B-4). Previously undiscovered sulfide-rich veins containing precious metal values were sampled and several drainages containing high stream sediment 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. The most important aspects of this 1985 work have been integrated into the main body of the report while the details of the work are contained in this appendix.

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 and 1977 (B-4). The Bureau spent 28 staff 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. B-1-2), iron-stained zones were investigated (fig. B-1-3), and the geology of the areas in the vicinity of deposits was mapped (fig. B-1-4, in pocket). Sample locations are shown in figure B-1-5 (in pocket), and table B-1-1 shows analytical results. Also, 2,000 feet of VLF survey lines were run over the Orange Point deposit (figs. A-6 through A-8).

Orange Point Vicinity

Diorites, metavolcanics, and metasediments were mapped and sampled along a 10-mile 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. B-1-3). Also, argillite inclusions or xenoliths within andesite are often iron-stained due to disseminated sulfides. These stain zones were found to occur in andesite, diorite, and metasedimentary rocks,

but mostly concentrated in the andesite near contacts with diorite. Sulfides consist of pyrite, pyrrhotite, and chalcopyrite. No significant sulfide bodies were discovered; however, a sample collected from float contained 0.99% copper (sample No. 44.)

Sulfide Veins in the Margerie Glacier Deposit Vicinity

Sulfide-rich quartz veins discovered and sampled along the margins of the Margerie monzodiorite by Kimball, Still, and Rataj (B-4) were further delineated and sampled during the JMD study. The veins with the highest sulfide content occur approximately 0.7 mile south of the Margerie Glacier porphyry copper deposit. A series of subparallel veins trend approximately 325°, dip from 75° to 90° west, and can be traced intermittently for up to 350 feet along strike. Widths vary from a few inches to 4 feet. The wider veins contain 3- to 6-inch-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 inch 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 ounce/ton gold, 0.92% copper (sample No. 16), and 225 ppm tungsten (sample No. 25).

A chip sample collected over a 2.5-foot-wide vein with a high sulfide content contained 0.018 ounce/ton 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-foot-wide sheared vein located 1,000 feet to the northwest contains massive arsenopyrite lenses in a zone averaging 6.5 feet wide. A select sample contained 0.12 ounce/ton gold and 1.1% copper (sample No. 9).

Placer Gold

Kimball, Still, and Rataj (B-4) reported anomalous gold values in Beaver Creek, a 1.3-mile-long glacial-fed stream draining the eastern side of the Orange Point deposit (fig. B-1-2). A series of 1/10 yd³ placer samples

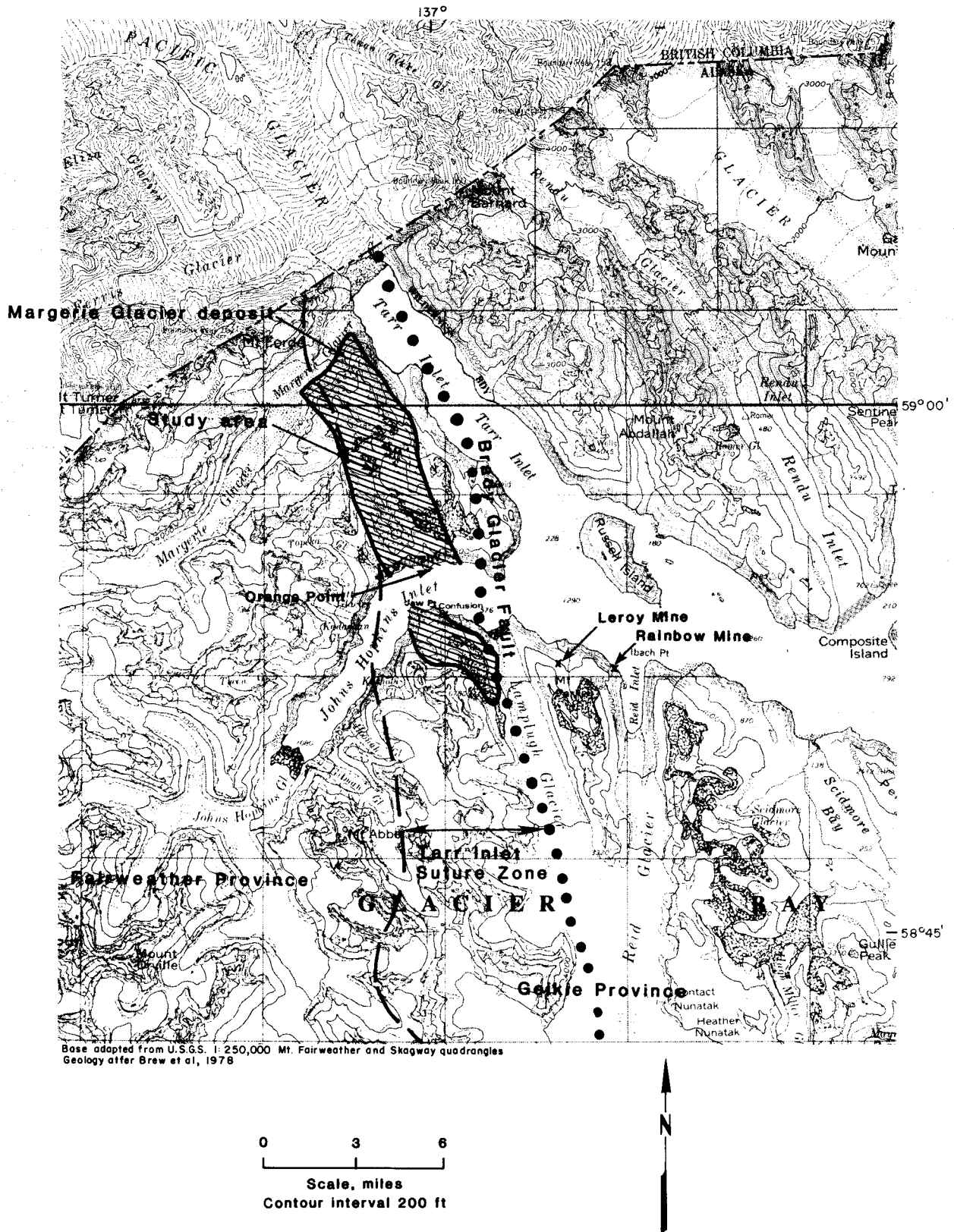


Figure B-1-1.—Location and Geologic setting of the Johns Hopkins Inlet-Margerie Glacier Study Area, Glacier Bay, Alaska.

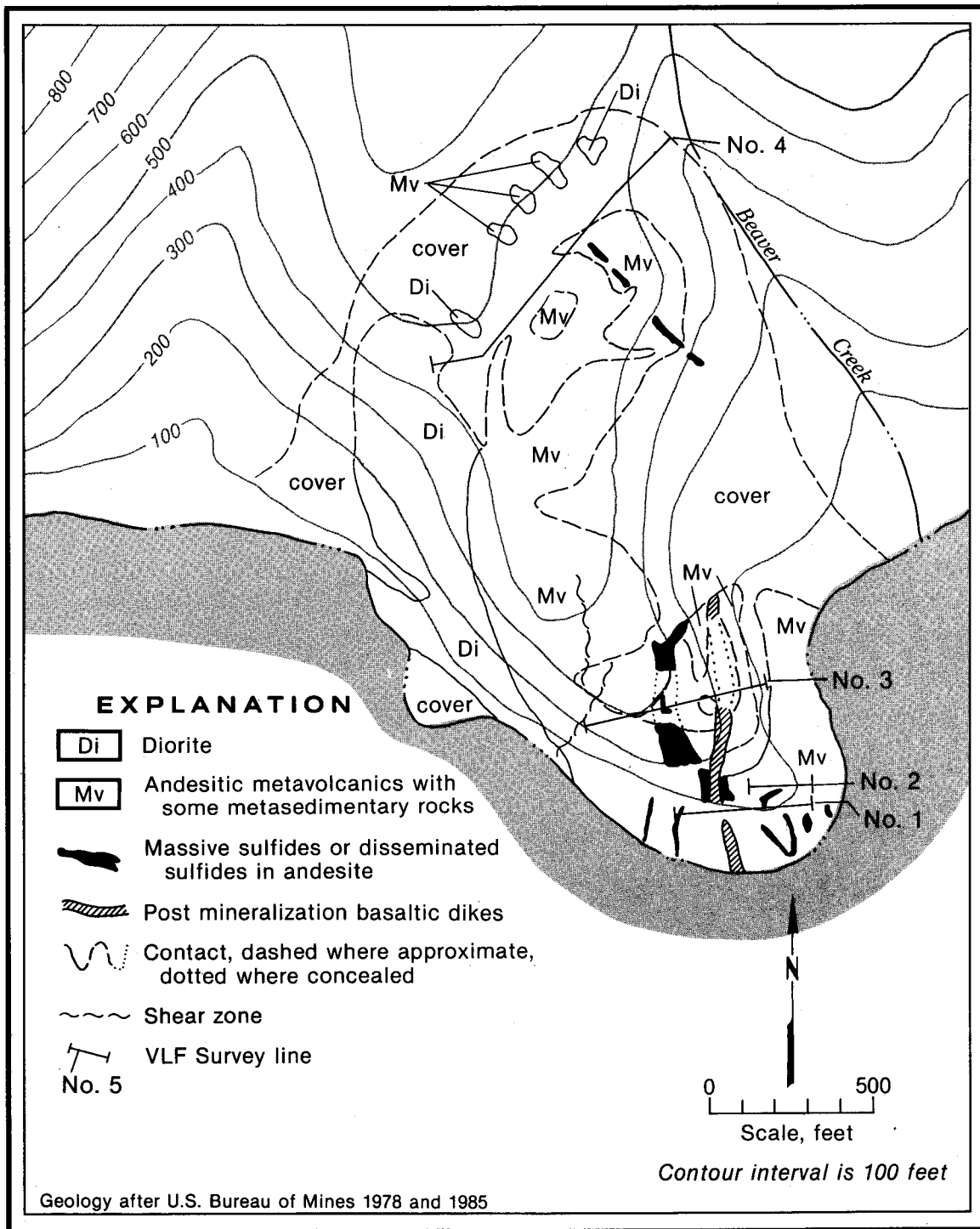
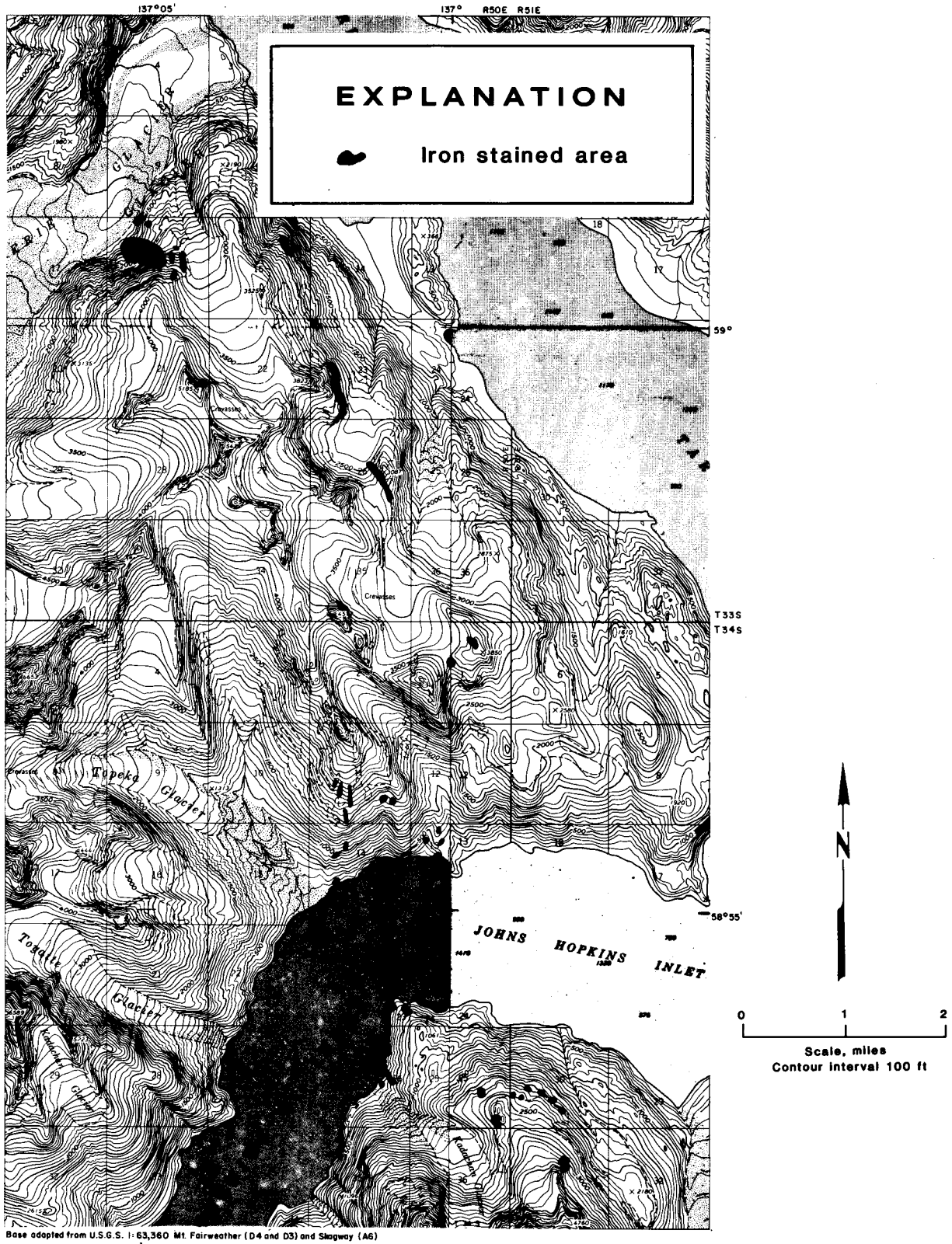


Figure B-1-2.—Geologic Map and VLF survey line locations, Orange Point area, Glacier Bay, Alaska.



B-1-3.—Iron-stained zones in Johns Hopkins Inlet-Margerie Glacier area, Glacier Bay, Alaska.

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 ounce/yd³ gold. The gold occurs as flakes ranging from 0.02–0.04 inch in diameter. Two placer samples collected 0.4 mile upstream above the massive sulfides contained no significant 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 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.

Orange Point Deposit Geophysics

To test for concealed massive sulfide bodies in the Orange Point area 2,000 feet 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 feet wide. Lines were laid out normal to sulfide zone trends to get maximum contrast. Figure B-1-2 shows line locations and figures B-1-6 through B-1-8 show the VLF profiles. Transmitter stations at Cutler, Maine and Seattle, Washington were used. Strong geophysical 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 VLF 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.

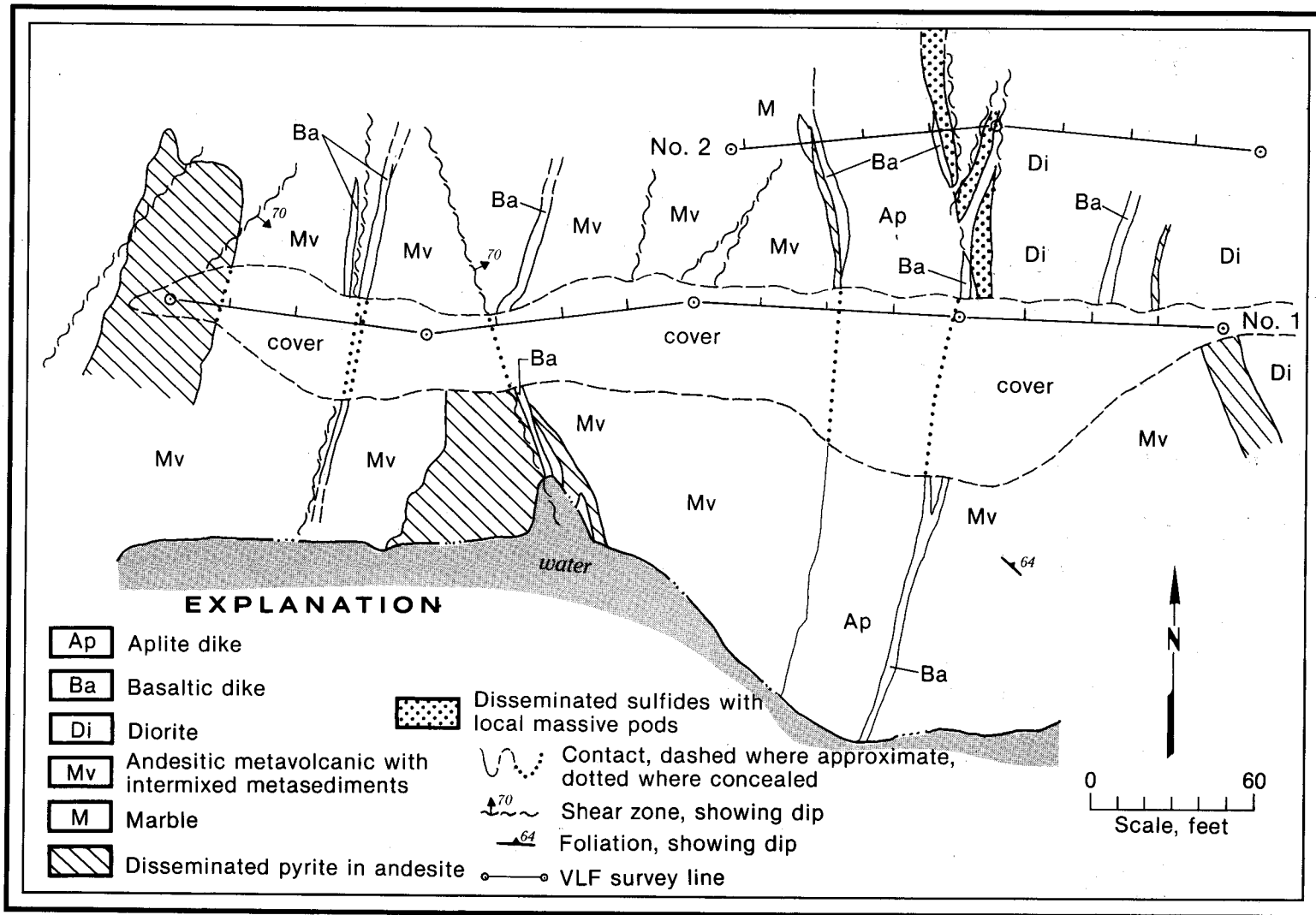


Figure B-1-6.—Geologic and VLF line location map, Orange Point area, Glacier Bay, Alaska (see figure B-1-7 for VLF profiles).

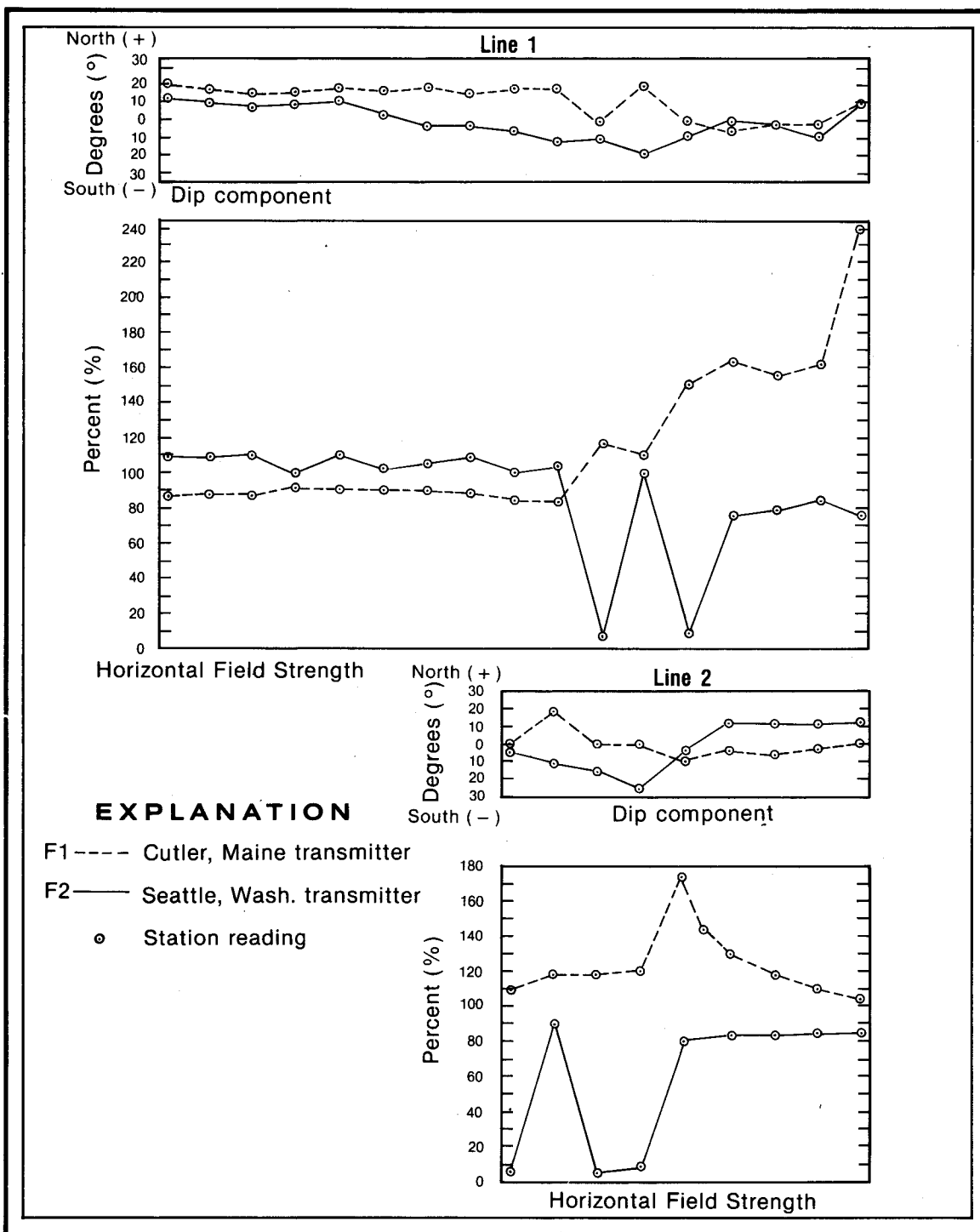


Figure B-1-7.—VLF lines over exposed massive sulfides, Orange Point, Glacier Bay, Alaska.

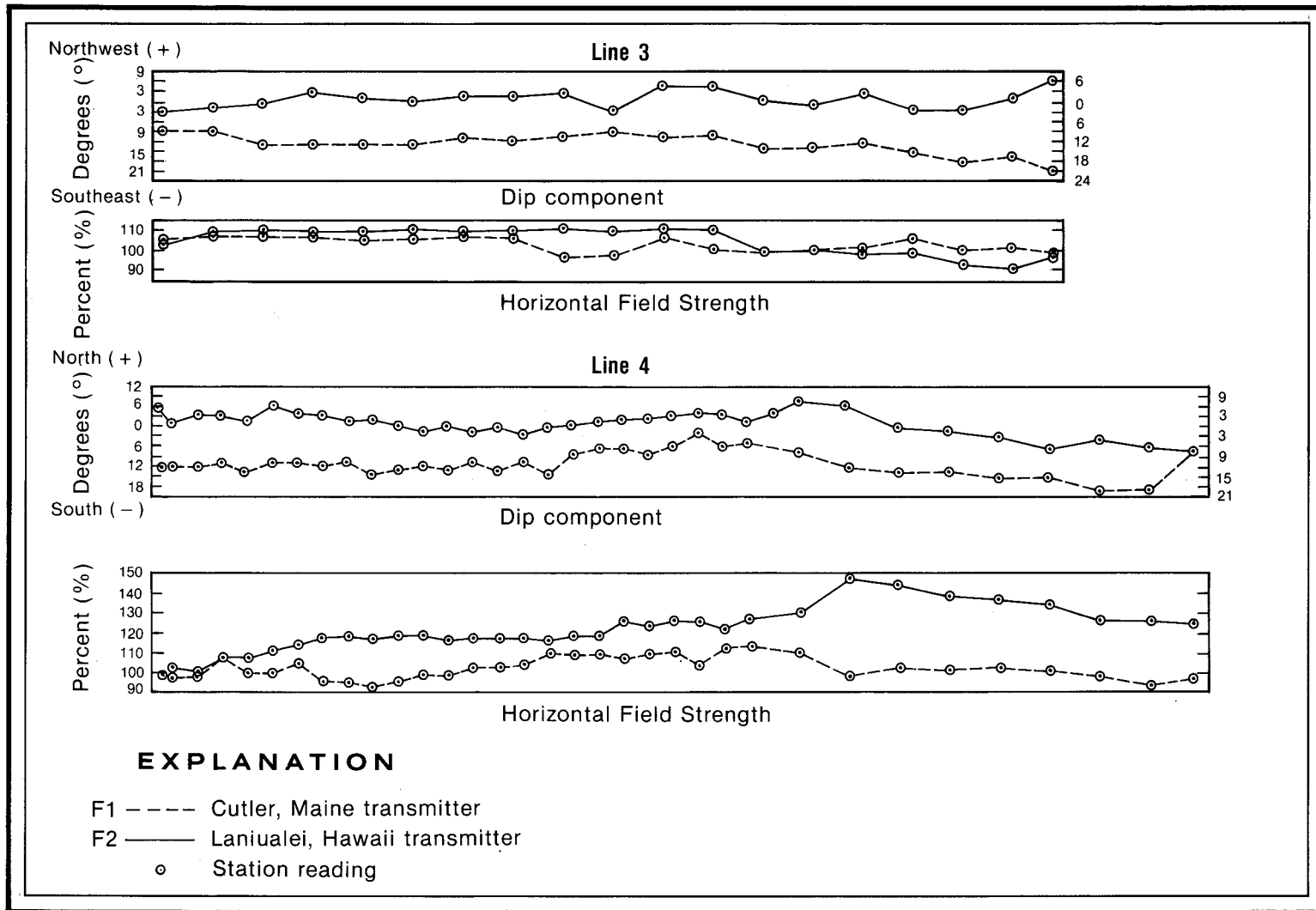


Figure B-1-8.—VLF survey lines north of Orange Point, Glacier Bay, Alaska.

Table B-1-1.—Analytical Results, Johns Hopkins Inlet-Margerie Glacier Area

Sample No.	Material type	Sample type	Sample width (ft.)	Elements (ppm unless otherwise indicated)										Description
				Au	Ag	Cu	Pb	Zn	As	Mo	Ni	Sb	W	
1	Granite	Random chip ¹	NAp	0.045	L 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 ²	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%	41	137	NAp	NAp	NAp	NAp	NAp	Silicified fractures in diorite. Pyrrhotite, arsenopyrite.
6	Slate	Grab	NAp	L .005	L .2	95	21	107	NAp	4	NAP	NAP	2	Black slate; minor pyrite.
7	do	do	NAp	.005	L .2	84	17	102	NAP	2	NAP	NAP	2	Sheared/silicified black slate.
8	Diorite	Select ³	NAp	.020	L .2	229	10	56	NAP	2	NAP	NAP	13	Diorite/greenstone; minor pyrrhotite, arsenopyrite.
9	do	do	NAp	.121	29	1.1%	27	278	NAp	3	NAP	NAP	6	Shear zone in diorite; massive arsenopyrite, trace chalcopyrite.
10	do	do	NAp	.050	10	.43%	11	78	NAp	10	NAP	NAP	19	Greenstone with malachite stain.
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	L .2	233	4	55	NAP	NAP	NAP	NAP	NAP	Limonite stained silicified diorite. Pyrrhotite.
15	Granite	Select	NAp	.005	L .2	49	11	18	NAP	1	NAP	NAP	4	Felsic granite disseminated arsenopyrite.
16	Diorite	do	NAp	.12	.8	96	20	28	NAP	3	NAP	NAP	4	Diorite with altered arsenopyrite/pyrrhotite.
17	do	do	NAp	.02	5.8	.12%	18	79	NAP	1	NAP	NAP	3	Siliceous diorite with arsenopyrite, chalcopyrite.
18	do	do	NAp	.029	26	.92%	14	430	NAP	2	NAP	NAP	5	Siliceous diorite with arsenopyrite, pyrrhotite chalcopyrite.
19	do	Cont. chip. ⁴	2.5	.018	4.4	.14%	14	115	NAP	2	NAP	NAP	3	Do.
20	Greenstone	Spaced chip ⁵	.75	.170	5.4	.18%	22	106	NAP	3	NAP	NAP	36	Siliceous greenstone.
21	Diorite	do	2.0	.455	5.8	.28%	26	255	NAP	2	NAP	NAP	82	Breccia zone; massive pyrite, chalcopyrite.
22	Diorite/greenstone	Rep. chip ⁶	NAp	0.045	L 0.2	287.0%	6.0	67.0	NAP	NAP	NAP	NAP	NAP	Diorite/greenstone; pyrrhotite arsenopyrite, chalcopyrite.
23	Greenstone	Select	NAp	.005	L .2	288	5	42	NAP	NAP	NAP	NAP	NAP	Limonite stained greenstone.
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%	7	99	NAP	2	NAP	NAP	225	Mixed greenstone/diorite; chalcopyrite, pyrrhotite.
26	Quartz	Grab	NAp	.020	.8	.70%	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.

See footnotes at end of table.

Table B-1-1.—Analytical Results, Johns Hopkins Inlet-Margerie Glacier Area—Continued

Sample No.	Material type	Sample type	Sample width (ft.)	Elements (ppm unless otherwise indicated)											Description
				Au	Ag	Cu	Pb	Zn	As	Mo	Ni	Sb	W		
29.....	Argillite .....	.....do	NAP	L .005	L .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	L .2	56	8	88	NAP	5	NAP	NAP	3	Do.
32.....	Greenstone .....	.....do	NAP	.005	L .2	200	4	75	NAP	14	NAP	NAP	4	Greenstone; minor pyrrhotite.
33.....	Argillite .....	.....do	NAP	0.015	L 0.2	99.0	11.0	61.0	NAP	8.0	NAP	NAP	3.0	Argillite/greenstone; minor pyrrhotite.
34.....	.....do .....	.....do	NAP	.005	L .2	89	10	59	410	NAP	NAP	NAP	3	Argillite float; up to 5% pyrite.
35.....	Greenstone .....	.....do	NAP	L .005	L .2	51	13	49	NAP	NAP	NAP	NAP	NAP	Epidotized greenstone; trace pyrite.
36.....	Slate	Grab	NAP	.015	L .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	L .002	L .2	74	7	87	400	NAP	NAP	NAP	2	Argillite with minor pyrite.	
39.....	Diorite	Random chip	NAP	.02	L .2	17	6	37	740	NAP	NAP	NAP	2	Quartz diorite; trace pyrite.	
40.....	Magnetite.....	Grab	NAP	.010	L .2	745	15	58	NAP	10	NAP	NAP	3	Magnetite float.	
41.....	Gossan .....	.....do	NAP	.005	L .2	60	7	59	NAP	3	NAP	NAP	2	Pyritic gossan.
42.....	Slate.....	.....do	NAP	.010	L .2	30	8	33	NAP	3	NAP	NAP	3	Black slate.
43.....	Skarn? .....	.....do	NAP	.115	L .5	120	2	99	NAP	NAP	NAP	NAP	NAP	Skarn? float; minor pyrite, chalcopyrite.
44.....	Greenstone	Grab	NAP	.195	8.5	.99%	13	645	NAP	NAP	NAP	NAP	NAP	Greenstone; minor pyrite/chalcopyrite.	
45.....	Granite.....	Grab	NAP	L0.005	L 0.2	37.0	10.0	72.0	NAP	NAP	NAP	NAP	NAP	Limonite stained felsic dike.	
46.....	.....do .....	.....do	NAP	L .005	L .2	85	7	51	NAP	NAP	NAP	NAP	NAP	Limonite stained felsic intrusive.
47.....	Greenstone .....	.....do	NAP	L0.005	.2	91	15	53	NAP	NAP	NAP	NAP	NAP	Greenstone; minor pyrite.
48.....	.....do .....	.....do	NAP	L .005	.9	40	10	43	NAP	NAP	NAP	NAP	NAP	Metagreenstone; minor pyrite.
49.....	Diorite.....	.....do	NAP	L .005	L .2	88	15	69	NAP	NAP	NAP	NAP	NAP	Silicified greenstone; pyrite.
50.....	Greenstone .....	.....do	NAP	.040	L .2	41	13	52	NAP	NAP	NAP	NAP	NAP	Silicified greenstone/argillite.
51.....	Schist .....	.....do	NAP	L .005	L .2	183	5	47	NAP	NAP	NAP	NAP	NAP	Limonite stained chlorite schist.
52.....	Diorite.....	Grab	NAP	L .005	.2	145	11	46	NAP	2	NAP	NAP	2	Chloritized monzodiorite; minor pyrite.	
53.....	.....do .....	.....do	NAP	.045	9.8	.56%	31	295	NAP	NAP	NAP	NAP	NAP	Diorite/metavolcanic; contact pyrite, chalcopyrite.
54.....	Schist .....	.....do	NAP	.010	1.9	425	30	180	NAP	NAP	NAP	NAP	NAP	Quartz schist pyrite.
55.....	Gravel.....	Placer ⁷	NAP	.010	L .2	81	12	86	NAP	NAP	NAP	NAP	NAP	Beaver Creek.	
56.....	Silt	Stream sediment ^a	NAP	.035	L .2	49	7	70		35			2	Do.	
57.....	Diorite.....	.....do	NAP	L0.005	L 0.2	5.0	9.0	12.0	NAP	1.0	NAP	NAP	3.0	Silicified monzodiorite; minor pyrite.
58.....	.....do .....	.....do	NAP	L .005	L .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	L .2	38	13	75	NAP	NAP	NAP	NAP	NAP	Do.	
61.....	Gravel.....	Placer	NAP	.730	60	14	83	L .2	NAP	NAP	NAP	NAP	NAP	No weighable Au fraction.	
62.....	.....do .....	.....do	NAP	L .005	52	3	72	L .2	NAP	NAP	NAP	NAP	NAP	Do.
63.....	Sulfides.....	Grab	NAP	.105	5.7	.43%	144.0	.99%	NAP	77	NAP	NAP	2	Orange Point; massive sulfides, sphalerite, chalcopyrite.	
64.....	Slate .....	.....do	NAP	L .005	L .2	16	7	75	NAP	3	NAP	NAP	2	Black slate.

See footnotes at end of table.

Table B-1-1.—Analytical Results, Johns Hopkins Inlet-Margerie Glacier Area—Continued

Sample No.	Material type	Sample type	Sample width (ft.)	Elements (ppm unless otherwise indicated)										Description
				Au	Ag	Cu	Pb	Zn	As	Mo	Ni	Sb	W	
65.....	Granite.....	Grab.....	NAp	.005	.2	10	11	29	NAP	2	NAp	NAp	4	Aplite dike; 10% pyrite.
66.....	Diorite.....	.....do.....	NAp	.005	L .2	57	3	67	NAP	4	NAp	NAp	2	Limonite stained diorite; 15% pyrite, pyrrhotite.
67.....	Greenstone.....	.....do.....	NAp	.005	L .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.
69.....	.....do.....	Select.....	NAp	0.005	L 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	L .005	.3	11	13	35	NAP	NAP	NAp	NAp	NAP	Do.
71.....	Diorite.....	.....do.....	5	.005	L .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	L .2	36	11	58	NAP	NAP	NAp	NAp	NAP	Chloritic diorite float; disseminated sulfides.
74.....	Argillite.....	.....do.....	NAP	.005	L .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	L .2	14	17	81	NAP	NAP	NAp	NAp	NAP	Chloritic aplite dike rock; minor sulfide.
77.....	Slate.....	Rep. chip.....	NAP	L .005	L .2	52	15	99	NAP	NAP	NAp	NAp	NAP	Black slate.
78.....	Greenstone.....	Select.....	NAP	L .005	L .2	80	13	64	NAP	3	NAp	NAp	2	Siliceous greenstone; trace pyrrhotite.
79.....	Diorite.....	.....do.....	NAP	L .005	L .2	150	16	76	NAP	NAP	NAp	NAp	NAP	Diorite; minor pyrite.
80.....	.....do.....	.....do.....	NAP	L .005	L .2	98	11	56	NAP	NAP	NAp	NAp	NAP	Do.
81.....	Greenstone/ argillite.....	.....do.....	NAP	L0.005	L 0.2	60.0	11.0	55.0	NAP	NAP	NAp	NAp	NAP	Siliceous argillite; minor pyrrhotite.
82.....	.....do.....	.....do.....	NAP	L .005	L .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 greenstone.
84.....	Greenstone/ slate.....	.....do.....	NAP	L .005	L .2	65	18	126	NAP	NAP	NAp	NAp	NAP	Limonite stained greenstone/argillite.
85.....	Argillite.....	.....do.....	NAP	L .005	L .2	97	13	104	NAP	NAP	NAp	NAp	NAP	Argillite lens in diorite; minor pyrrhotite.
86.....	Greenstone.....	.....do.....	NAP	L .005	L .2	125	3	146	NAP	NAP	NAp	NAp	NAP	Siliceous greenstone.
87.....	Granite.....	.....do.....	NAP	L .005	L .2	11	2	51	NAP	NAP	NAp	NAp	NAP	Siliceous granite.
88.....	Hornfels.....	Rep. chip.....	NAP	L .005	.2	62	33	109	NAP	NAP	NAp	NAp	NAP	Limonite stained hornfels; pyrite.
89.....	Slate.....	.....do.....	NAP	L .005	L .2	28	18	79	NAP	NAP	NAp	NAp	NAP	Black slate; trace pyrite.
90.....	do.....	.....do.....	NAP	L .005	L .2	47	15	85	NAP	NAP	NAp	NAp	NAP	Black slate.
91.....	Slate/ argillite.....	.....do.....	NAP	L .005	.2	35	21	103	NAP	3	NAp	NAp	2	Slate/argillite; minor pyrite.
92.....	Greenstone.....	Select.....	NAP	.005	L .2	104	14	77	NAP	3	NAp	NAp	3	Siliceous greenstone; trace pyrite/pyrrhotite.
93.....	.....do.....	.....do.....	NAP	L0.005	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	L .2	23	22	80	NAP	7	NAp	NAp	2	Diorite/greenstone.
96.....	Greenstone.....	.....do.....	NAP	.010	L .2	80	15	207	NAP	7	NAp	NAp	2	Siliceous greenstone.

See footnotes at end of table.

Table B-1-1.—Analytical Results, Johns Hopkins Inlet-Margerie Glacier Area—Continued

Sample No.	Material type	Sample type	Sample width (ft.)	Elements (ppm unless otherwise indicated)										Description
				Au	Ag	Cu	Pb	Zn	As	Mo	Ni	Sb	W	
97.....	Greenstone/ argillite .....	.....do	NAp	.005	L .2	61	14	99	NAp	2	NAp	NAp	3	Greenstone/argillite.
98.....	Greenstone/ marble .....	.....do	NAp	.060	L .2	81	10	16	NAp	5	NAp	NAp	3	Massive sulfides; pyrite/pyrrhotite.
99.....	Greenstone .....	.....do	NAp	.065	L .2	41	13	15	NAp	6	NAp	NAp	3	Massive sulfides in greenstone.

NAp Not applicable. L Less than.

¹ Random chip: A regular series of mineral or rock fragments taken randomly over an outcrop.

² 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.

³ Select: A highly mineralized sample taken to indicate maximum values present.

⁴ Continuous chip: A regular series of mineral or rock fragments taken in a continuous line across an outcrop.

⁵ Spaced chip: A regular series of mineral or rock fragments taken at uniformly spaced intervals across an outcrop.

⁶ Representative chip: Taken to be entirely representative of an entire rock or mineralized exposure.

⁷ Placer: Approximately 0.1 yd³ stream gravel run through a 10-inch-wide by 34-inch-long sluice box.

⁸ Stream sediment: Silt size material collected from active portion of stream drainage.

APPENDIX B-2

METALLURGICAL TEST RESULTS

BRADY GLACIER DEPOSIT AND ORANGE POINT DEPOSIT

RESULTS OF METALLURGICAL TESTS ON SAMPLES FROM THE BRADY GLACIER DEPOSIT

Two test samples were collected from the Brady Glacier deposit. One, 1S162 (ME 1418-PX 1610), from the High Nunatak consisted of gabbroic rock with disseminated sulfides. The other, 1S161 (ME 419-PS 1611), from the Small Nunatak consisted of massive sulfides in peridotite and gabbro. These were tested at the Bureau's Albany Research Center.

MINERALOGICAL CHARACTERIZATION

Sample 1S162 (ME 1418-PS 1610)

The sample is a gabbroic rock consisting essentially of ferromagnesian silicate minerals (pyroxene) with less feldspar and small amounts of sulfide minerals abundantly scattered throughout. The sulfides occur mostly as small to very small individual grains although a few large agglomerations are observed. Limonite-hematite coats fracture surfaces and fills voids and holes where other minerals have altered and weathered away. A very small amount of malachite occurs in places with the limonite.

Polished surface study by optical, SEM, and SEM-EDAX methods show that the scattered sulfides are small to extremely small angular single grains and clots that occur as fillings of interstices between silicate minerals and in microfractures across silicate grains. A few sulfide grains are found included within the silicates, mostly in the ferromagnesian silicates. Sulfide minerals present are pyrrhotite, chalcopyrite, and probably violarite, $(\text{Ni, Fe})_3\text{S}_4$. A separate polished surface mount was not made of the sulfide mineral concentrate. Analysis of typical silicate phases gave the following results in percent:

	Na_2O	CaO	FeO	MgO	Al_2O_3	SiO_2
Femag.....	10.2	14.7	17.1	9.1	9.3	50.0
Feldspar.....	1.4	15.3	10.5	10.2	31.2	52

At least two ferromagnesian silicate (femag) minerals are present and the above analysis represents the major phase present.

Liberation of some of the sulfide minerals is accomplished at 100 mesh or less with better liberation at 200 mesh. Complete liberation would not be accomplished without prohibitively expensive fine grinding.

Sample 1S161 (ME 1419-PS 1611)

The sample is a massive sulfide material which consists essentially of highly fractured, considerably altered and highly iron-stained pyrrhotite containing randomly scattered clots, grains, and small veins of chalcopyrite. Limonite-goethite is abundant on fracture surfaces and penetrating the pyrrhotite. The chalcopyrite does not appear to be altered. Iron sulfate minerals occur as thin coatings on some surfaces.

Polished surface study by optical, SEM, SEM-EDAX, and microprobe methods show that the "pyrrhotite" is highly fractured and veined and is, in reality, a lath-like layered mixture of iron sulfides varying from troilite (FeS) through pyrrhotite (Fe_{1-x}S), greigite ($\text{Fe} + 2\text{Fe}_2 + 3\text{S}_4$ -linnaeite group), and pyrite (FeS_2) plus mixed iron oxides, varying from goethite to hematite. In any particular area only two sulfide layers exist side by side. Thickness of the mixed iron oxide laths parallel to the sulfide laths, generally, is less than that of the sulfide laths, however, a comparatively thick lath (10 to 40 micrometers) is frequently encountered. Mixed iron oxide veins also run across the lath structure and these are the thickest ranging up to 100 micrometers. Chalcopyrite and violarite, $(\text{Ni, Fe})_3\text{S}_4$ -linnaeite group, with up to 4% Co, are present as scattered grains in the other sulfide minerals. Typical analyses of some of the sulfides are as follows, in percent:

	<i>Fe</i>	<i>Ni</i>	<i>Co</i>	<i>Cu</i>	<i>S</i>
Pyrrhotite.....	62	0.6	0.3	9.1	36
Greigite.....	57	0.9	0.1	10.1	41
Pyrite.....	50	2.3	0.2	ND	47
Violarite.....	32	24	4	0.2	39
Chalcopyrite.....	31	10.1	10.1	36.0	33

A number of minor mineralogical phases were found in the specimens. Small (10 to 20 micrometer) euhedral crystals of Fe- and Ni-bearing cobaltite, $(\text{Co, Fe, Ni})\text{AsS}$, occur as inclusions in the "pyrrhotite." In each case a central portion of the crystal contains a crystal of

iridarsenite, (Ir, Ru) As₂, which may have served as a "seed crystal" for the growth of the cobaltite. Also present, as inclusions in the cobaltite were grains of ruarsite and osarsite, (Ru, OS) AsS-arsenopyrite group, and irarsite, (Ir, Ru, Rh, Pt) AsS-cobaltite group. The irarsite contains minor quantities of Co, Fe, and Ni. Analysis gave the following results: 44.3% Ir, 30.5% As, 15.2% S, 4.51% Co, 3.77% Fe, and 1.81% Ni. Typical analysis of the cobaltite gave 26.7% Co, 5.61% Fe, 48.5% As, and 19.2% S, with up to 6% Ni.

The chalcopyrite contains inclusions of a rhenium-iron sulfide, a nickel-bismuth-palladium telluride, a palladium-bismuth telluride, and palladium telluride. The rhenium-bearing mineral has a composition of about 56% Re, 12% Fe, and 32% S with a probable formula of (Re, Fe)S₂. No such mineral has been described to our knowledge and the other 20 by 10 micrometers were found in one polished surface and a thorough search of additional surfaces revealed no other grains. The nickel-bismuth-palladium-telluride has a composition of about 20% Ni, 24% Bi, 3.32% Pd, 1% Fe, and 52% Te. The mineral may be an analog of the mineral hexastibiopanickelite, (Ni, Pd)₂SbTe, although no description of such a mineral was found. This mineral was found both as inclusions in chalcopyrite and in a probable spinel, most likely a chromite variety, with a composition of about 56% Cr, 35% Fe, 3.4% Mn, 3% V, and 2.7% Zn. The palladium-bismuth telluride has a composition of about 22% Pd, 53% Bi, and 24% Te with 1% Ni and 0.75% Fe. It has the same associations as the Ni-bearing telluride and probably is kotulskite, Pd (Te, Bi). The palladium telluride may be telluropalladinite,

Pd₂Te₄. No analyses were obtained on this mineral. SEM micrographs of minerals and mineral associations observed accompany the original of this report and are available for reference.

It is difficult to address liberation of this sample because of the mineralogical complexity and the wide range of sizes of grains. In addition, the highly fractured, altered, and iron-stained nature of the sample complicates crushing and beneficiation steps. Some of the chalcopyrite would be liberated at 65 to 100 mesh but much finer sizes would be needed to provide even a reasonable total liberation, and recovery would be poor. Liberation of the other component minerals would require extremely fine grinding and complicated beneficiation steps of the resulting "slime" sized particles. Recovery in almost any case would probably be very poor.

Beneficiation Characterization

After petrographic samples were selected, the remainder of the material was crushed to minus 1/4 inch and split for head analysis and beneficiation tests. 1S162 (ME 1418) contained, in weight percent, 1.24 Cu, 0.13 Ni, 0.01 Co, 11.4 Fe, 1.7 S, and 0.003 As; and in ounce/ton less than 0.004 Pt, 0.007 Pd, 0.004 Au, and 0.112 Ag (table B-2-1). 1S161 (ME 1419) contained, in weight percent, 1.41 Cu, 2.84 Ni, 0.29 Co, 50.8 Fe, 36.6 S, 0.004 As, and 0.013 Re; and in ounces/ton, less than 0.004 Pt, 0.007 Pd, less than 0.008 Au, and less than 0.04 Ag. Precious metals analyses were done at the Reno Research Center, and the other analyses were done at the Albany Research Center.

Table B-2-1.—Metallurgical Test Results from Brady Glacier Deposit, High Nunatak

Sample No.:	ME 1418-2	AFOC No.:	1S162	Location:	Brady Glacier, High Nunatak
Grind:	Initial: -0.25 in	Final:	+100 mesh 1%	Time:	25 minutes
	Addition: None		-400 mesh 53%	Percent solids:	50

Metallurgical Results

Product	Wt. pct.	Analysis, pct.					Analysis, oz/ton				Distribution, pct.				
		Cu	Fe	Ni	Co	S	Pt	Pd	Au	Ag	Cu	Fe	Ni	Co	S
Rougher concentrate	8.6	12.9	20.8	0.69	0.04	16.1	0.009	0.044	0.038	0.76	89.4	16.0	40.4	88.2	86.2
Scavenger concentrate	2.2	1.13	12.8	.32	.02	2.0	.025	.026	.012	.23	2.0	2.5	4.8	11.8	2.7
Flotation tailings	89.2	.12	10.2	.09	L.01	.2	L.0006	L.0006	.001	L.02	8.6	81.5	54.8	—	11.1
Composite or Total	100.0	1.24	11.2	.15	L.01	1.6					100.0	100.0	100.0	100.0	100.0
Head		1.24	11.4	.13	.01	1.7	L.004	.007	.004	.112					

Test Procedure

Reagents	Condition	Rougher Flotation	Condition	Scavenger Flotation
Potassium Amyl Xanthate	0.1 lb/ton		0.05 lb/ton	
Frother	0.05 lb/ton			
pH (natural = 5.3)	5.45		5.45	
Time (minutes)	1.5	2.5	1.5	1.5

ME 1418 was the disseminated sulfide sample, and a bulk sulfide flotation procedure was used to concentrate the sample. The procedure and results are described in the attached table. The rougher concentrate contained 89% of the Cu, 88% of the Co, and 40% of the Ni at grades of 12.9% Cu, 0.04% Co, and 0.69% Ni. The scavenger flotation step improved recovery slightly. The minor amounts of precious metals in the sample were concentrated in the flotation products. Table B-2-1 contains the analytical data.

ME 1419 was the massive-sulfide sample. Only one flotation test was done on this sample and the results were very poor. Essentially no concentration was achieved. Due to priorities on other samples, no further tests were done.

Additional PGM Analysis

Head samples from 1S161 and 1S162 were sent to the Reno Research Center for analysis of Ir, Os, Rh, and Ru. The results are in table B-2-2.

RESULTS OF METALLURGICAL TESTS ON SAMPLES FROM THE ORANGE POINT DEPOSIT

A test sample, 2S392 (ME 1462-PS1650), was collected from the Hill Number 2 portion of the Orange Point deposit and metallurgical tests were conducted at the Bureau's Albany Research Center.

MINERAL CHARACTERIZATION

Hand specimens show that this sample is a massive sulfide sample consisting of a coarse-to-fine-grained,

complex intergrowth of pyrite and sphalerite with less chalcopyrite and variable amounts of pyrrhotite. Limonite-goethite is abundant on fracture surfaces.

Polished surface and SEM examinations reveal that the sulfide minerals are highly fractured and highly variable in grain size and consist essentially of pyrite and ferrous sphalerite with less pyrrhotite, some chalcopyrite, small amounts of galena, and trace amounts of molybdenite. Also associated are trace amounts of three unidentified minerals, a Zn-Pb sulfide with iron, a Zn-Pb-Fe mineral with a little sulfur (possibly an altered phase of the first mineral), and a Zn-Pb-Fe-Cl-S mineral. The latter mineral occurs as very small to scattered grains. None of the unidentified minerals correspond to any listed mineral compositions. Small amounts of calcite and quartz are also present. Limonite-goethite with some hematite fills fractures. The original grain size of the sulfide minerals on any one observation surface varies considerably from very small to relatively large, as does the percentage of specific sulfide minerals present. For example, one surface contained about 15% sphalerite-chalcopyrite and 85% pyrite-pyrrhotite and a second surface contained 50% sphalerite, 35% pyrrhotite, and 15% pyrite. Chalcopyrite is closely associated with the sphalerite and some relatively large chalcopyrite grains are shot through with fine sphalerite. Some of the chalcopyrite and sphalerite is apparently late deposited as a very fine, to extremely fine, anastomosing system of veins and fractures within the earlier formed pyrite-pyrrhotite. Cobalt or precious metal-bearing minerals are not observed. SEM micrographs showing mineral occurrences and associations will be retained with the original of this report.

Because of the extremely fine intergrowth and anastomosing vein system, grinding to complete liberation is not practical. However, grinding to 200 to 400 mesh may

Table B-2-2.—Metallurgical Test Results from Brady Glacier Deposit, Low Nunatak

Sample	Analysis oz/ton							
	Pt	Pd	Au	Ag	Ir	Os	Rn	Ru
1S161 ME 1419								
Head I	L0.004	0.007	L0.0008	L0.04	NA	NA	NA	NA
Head II .....	.002	.007	L.0008	L.1	0.023	0.0044	L0.0040	L0.040
Head III	L.001	.006	L.0008	L.1	.0025	.0014	L.0010	L.010
1S162 ME 1418-2								
Head	L.004	.007	.004	.112	NA	NA	NA	NA
Rougher Concentrate I.....	.009	.044	.038	.76	NA	NA	NA	NA
Rougher Concentrate II.....	.010	.043	.026	1.0	ND	ND	ND	ND
Scavenger Concentrate I .....	.025	.026	.012	.23	NA	NA	NA	NA
Scavenger Concentrate II.....	.028	.031	.014	.5	L.0020	ND	L.0040	ND

ND Not detected. NA Not available.

L The element was detected but at a level less than the lowest standard.

NA Not analyzed.

provide reasonable liberation and recovery. The highly fractured nature of the sulfide minerals should aid in liberation of the minerals.

BENEFICIATION CHARACTERIZATION

After petrographic specimens were selected, the remainder of the samples was crushed to minus 1/4 inch and split for head analysis and beneficiation tests. Results of head sample analyses are as follows: 8.4% Zn, 1.61% Cu, 35.1% Fe, 0.01% Ni, 0.018% Co, 34.6% S, L0.002 ounce/ton Pt, L0.002 ounce/ton Pd, 0.026 ounce/ton Au, and 0.73 ounce/ton Ag. Base metals and sulfur analyses were done at the Albany Research Center, and precious metals analyses were done at the Reno Research Center.

Preliminary beneficiation tests were done on 1-kg samples to establish appropriate grinding and reagent additions for selective sulfide flotation. As a final test, a 10-kg sample was beneficiated; the procedure and results are described in table B-2-3. The sample was ground with CaO to minimize activation of pyrite. The rougher flotation step recovered 95% of the Cu at a grade of 6.7% Cu; the rougher concentrate also contained 1.16 ounces/ton Ag and 0.07 ounce/ton Au. The rougher tailings were conditioned with CuSO₄ to activate sphalerite, and two scavenger flotation steps recovered 73% of the Zn at a grade of 33.8% Zn. This product also contained 0.43 ounce/ton Ag, and minor amounts of Pt and Au. The first scavenger concentrate contained 26% of the Zn at a grade of 46.5% Zn. Only 3% of the Cu and 4% of the Zn was lost to the final flotation tailings that represented 58% of the weight of the sample. Conditions to improve selectivity in the Cu and Zn flotation steps were not investigated.

Table B-2-3.—Metallurgical Test Results from Orange Point

Sample No.: ME 1462-3		AFOC No.: 2S392				Location: Orange Point							
Grind: Initial: -0.25 in		Final: +100 mesh 0%				Time: 25 minutes							
Addition: 2.9 lb/ton CaO		-400 mesh 56%				Percent solids: 50							
Metallurgical Results													
Product	Wt. pct.	Analysis, pct.				Analysis, oz/ton				Distribution, pct.			
		Cu	Fe	Zn	S	Pt	Pd	Au	Ag	Cu	Fe	Zn	S
Rougher concentrate	26.3	6.66	37.0	6.60	39.2	L.001	L.001	.073	1.163	94.8	28.2	23.4	31.4
1st Scavenger concentrate	4.2	.30	14.5	46.5	34.7	.002	L.001	.008	.452	.7	1.8	26.3	4.4
2nd Scavenger concentrate	11.8	.22	30.6	29.3	37.2	.001	L.001	.007	.418	1.4	10.5	46.5	13.3
Flotation tailings	57.7	.10	35.6	.49	29.0	L.001	L.001	L.006	.280	3.1	59.5	3.8	50.9
Composite or Total	100.0	1.8	34.5	7.4	32.9					100.0	100.0	100.0	100.0
Head		1.7	35.4	8.4	34.6	L.002	L.002	.025	.73				
Test Procedure													
Reagents	Condition	Rougher Flotation		Condition	1st Scavenger Flotation		Condition	2nd Scavenger Flotation					
Potassium Amyl Xanthate	0.1 lb/ton						0.05 lb/ton						
Frother	0.05 lb/ton												
CaO	0.05 lb/ton												
CuSO ₄				0.5 lb/ton									
pH (natural = 8.9)													
after grinding	11.1			11.9			11.5		11.2				
Time (minutes)	1.5		5.25	10		7.5	1.5		6				

APPENDIX B-3

ANALYTICAL RESULTS

Analytical Results Table Abbreviations

Sample Type Abbreviations

C	—	continuous chip	PC	—	pan concentrate
CC	—	chip channel	RC	—	random chip
CH	—	channel	S	—	select
Rep or CR	—	representative chip	SC	—	spaced chip
F	—	float	SS	—	stream sediment
G	—	grab	MTS	—	metallurgical test sample

Lithologic and Mineralogic Abbreviations

aspy	—	arsenopyrite	gn	—	galena	po	—	pyrrhotite
az	—	azurite	hem	—	hematite	py	—	pyrite
bn	—	bornite	jm	—	jamesonite	qz	—	quartz
calc	—	calcite	mag	—	magnetite	sl	—	sphalerite
cp	—	chalcopyrite	meta	—	metamorphosed	st	—	stained
ep	—	epidote	ml	—	malachite	sulf	—	sulfide
fe	—	iron	mv	—	metavolcanic			
fest	—	iron-stained	mz	—	monzonite			

Additional Abbreviations

dissem	=	disseminated	N	=	nil	—	=	not analyzed
el	=	elevation	NA	=	not applicable	w/	=	with

Note: 1975-1977 sample analysis by Bureau Research Center in Reno, Nevada, or by the USGS in Denver, Colorado. Au analyses were by Fire Assay-Atomic Absorption (FA-AA), or Fire Assay (FA). Cu, Pb, Zn, and Ag were by spectrographic or atomic absorption analysis.

Units of measure abbreviation used: ppm = parts per million, L0.0003 = not detected above the lower limit of detection, that is, 0.0003 ounce/ton, G10.00 = greater than 10.00%, — = not analyzed.

Table B-3-1.—Orange Point deposit (figs. B-7 and B-8)

Map No.	Sample No.	Sample Size Feet	Sample Type	Fire Assay Au ppm	Atomic Absorption (ppm unless marked %)					X-ray Ba %	Spectrographic (ppm)						Lithology and Remarks	
					Ag ppm	Zn ppm	Cu ppm	Pb ppm	Co ppm		W ppm	Mo ppm	Sn ppm	As ppm	Ni ppm	Bi ppm		Sb ppm
1	77S035A	4.0	SC	0.20	10.0	470	3400	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
1	77S035B	4.5	SC	N	7.0	300	1900	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
2	77S034A	6.0	SC	.10	7.0	1900	2500	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
2	77S034B	6.0	SC	.30	30.0	4000	1500	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
3	77S036A	5.0	SC	.10	20.0	6500	1.3%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
3	77S036B	5.0	SC	.20	20.0	2400	1.9%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
4	77S094	4.5	SC	.30	10.0	3.6%	4700	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
5	77S092	6.0	SC	.30	10.0	1.7%	4200	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
6	77S091A	.8	C	1.50	15.0	2.0%	1.1%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
6	77S091B	7.2	SC	N	3.0	660	2200	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
11	77S052A	3.1		.10	1.0	15	820	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
7	77M068	85.0	SC	N	N	10	35	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
8	77M081	78.0	SC	N	N	15	130	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
9	77M082	20.0	SC	N	N	10	130	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
10	77M083	30.0	SC	N	N	45	160	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
11	77S065A	20.0	SC	N	N	35	5	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
12	77S064	.8	C	N	N	10	10	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
13	77S065B	Sample missing		—	—	—	—	—	—	—	—	—	—	—	—	—	—	
14	77S066	8.0	SC	N	N	80	300	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
15	77S067	6.0	SC	N	N	170	50	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
16	77S068	4.5	SC	N	N	140	90	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
17	77S039	8.0	SC	.40	7.0	630	1600	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
18	77S047	30.0	RC	N	N	65	300	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
19	77S031A	5.0	SC	.40	50.0	4.7%	3.3%	—	—	—	—	—	—	—	—	—	—	massive sulf-py,po,cp,sl w/mv
19	77S031B	5.0	SC	1.00	50.0	19.0%	2.5%	—	—	—	—	—	—	—	—	—	—	massive sulf-py,po,cp,sl w/mv
19	77S031C	5.0	SC	1.50	50.0	11.0%	4.0%	—	—	—	—	—	—	—	—	—	—	massive sulf-py,po,cp,sl w/mv
19	77S031D	5.0	SC	1.50	50.0	13.0%	2.8%	—	—	—	—	—	—	—	—	—	—	massive sulf-py,po,cp,sl w/mv
20	77S031E	4.7	SC	N	1.5	2600	1800	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
20	77S031F	7.3	SC	N	7.0	420	3000	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
20	77S032A	5.0	SC	.15	7.0	3700	1000	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
20	77S032B	5.0	SC	.10	7.0	820	1200	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
20	77S032C	5.0	SC	.10	7.0	300	770	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
20	77S032D	5.0	SC	.10	5.0	200	330	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
20	77S032E	5.0	SC	.10	10.0	390	2500	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
21	77S030A	10.0	SC	0.15	10.0	5000	3400	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
21	77S030B	11.0	SC	.10	10.0	1800	3600	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
21	77S030C	5.0	SC	.10	7.0	800	800	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
21	77S030D	5.0	SC	N	N	160	450	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
21	77S030E	5.0	SC	.15	1.5	3100	420	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
21	77S030F	5.0	SC	.25	50.0	5700	1.9%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
21	77S030G	5.0	SC	.10	7.0	1700	2300	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
21	77S030H	5.0	SC	N	7.0	880	1400	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
22	77S041A	5.0	SC	.75	10.0	1400	4400	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
22	77S041B	5.0	SC	.30	7.0	510	2400	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl

Table B-3-1.—Orange Point deposit (figs. B-7 and B-8)—Continued

Map No.	Sample No.	Sample Size Feet	Sample Type	Fire Assay Au ppm	Atomic Absorption (ppm unless marked %)					X-ray Ba %	Spectrographic (ppm)							Lithology and Remarks
					Ag ppm	Zn ppm	Cu ppm	Pb ppm	Co ppm		W ppm	Mo ppm	Sn ppm	As ppm	Ni ppm	Bi ppm	Sb ppm	
22	77S041C	7.5	SC	.30	15.0	2100	6500	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
23	77S040A	5.0	SC	.10	10.0	7400	3800	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
23	77S040B	5.0	SC	.15	7.0	1100	2300	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
23	77S040C	6.0	SC	.15	7.0	3500	2000	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
24	77S103A	5.0	SC	3.50	30.0	2.3%	2.8%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
24	77S103B	5.0	SC	1.50	20.0	3.7%	2.5%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
24	77S103C	5.0	SC	2.00	50.0	2.7%	4.8%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
25	77S103D	5.0	SC	2.00	50.0	3.5%	3.9%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
25	77S103E	5.0	SC	.80	30.0	2.2%	2.7%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
25	77S103F	5.0	SC	1.50	70.0	4700	5.2%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
26	77S029F	5.0	SC	.10	7.0	340	1800	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
26	77S029G	4.4	SC	.05	5.0	320	730	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
26	77S029H	4.1	SC	.25	70.0	7200	5000	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
26	77S029I	1.8	SC	.40	70.0	8.8%	1.0%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
27	77S029A	6.2	SC	.30	10.0	5000	5700	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
27	77S029B	5.0	SC	.15	20.0	1.8%	1.0%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
27	77S029C	5.0	SC	.10	7.0	3000	2900	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
27	77S029D	5.0	SC	N	7.0	1600	3700	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
27	77S028D	5.0	SC	.30	30.0	4000	1.4%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
28	77S029E	6.0	SC	.20	30.0	2800	1.0%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
28	77S028A	5.0	SC	.20	15.0	2000	1.2%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
28	77S028B	9.5	SC	.30	30.0	3.5%	1.8%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
28	77S028C	4.5	SC	.20	10.0	670	7300	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
29	77S038	6.0	SC	0.70	30.0	7.7%	1.1%	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
30	77S037A	6.5	SC	.20	7.0	1800	2800	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,pc,cp,sl
31	77S037B	8.0	SC	.10	7.0	450	1600	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
32	77S037C	8.0	SC	.25	7.0	1300	1800	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
33	77S037D	13.0	SC	.25	7.0	450	720	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
34	77S037E	1.5	SC	N	N	45	200	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
35	77S046E	12.0	SC	.25	15.0	3900	3200	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
36	77S046C	2.0	RG	.15	3.0	340	1500	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
37	77S046D	1.0	SC	.20	20.0	3500	4000	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
38	77S046B	9.0	SC	N	2.0	75	630	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
39	77S046A	.3	CH	N	7.0	45	6000	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
40	77S070	—	G	N	.7	80	450	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
41	77S069	3.0	G	N	3.0	130	360	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
42	77S048	30.0	SC	N	N	120	50	—	—	—	—	—	—	—	—	—	—	meta-andesite w/py,po,cp,sl
43	77S062	.2	C	N	N	10	15	—	—	—	—	300	—	—	—	—	—	meta-andesite w/py,po,cp,sl
43	77S063	14.0	SC	N	N	15	15	—	—	—	—	70	—	—	—	—	—	meta-andesite w/py,po,cp,sl

Table B-3-2.—Margerie Glacier deposit (fig. B-9)—Continued

Map No.	Sample No.	Sample Size Feet	Sample Type	Fire Assay Au ppm	Atomic Absorption (ppm unless marked %)					X-Ray Ba %	Spectrographic (ppm)						Lithology and Remarks	
					Ag ppm	Zn ppm	Cu ppm	Pb ppm	Co ppm		W ppm	Mo ppm	Sn ppm	As ppm	Ni ppm	Bi ppm		Sb ppm
26	75S150	.14	CH	.20	20.0	300	1.8%	—	—	—	N	N	—	N	—	100	—	qz vein w/sulf
26	75S151	.04	CH	.25	20.0	480	1.4%	—	—	—	476	N	—	N	—	150	—	qz vein w/sulf
26	75S152	3.0	SC	N	.5	55	680	—	—	—	N	N	—	N	—	N	—	metadiorite
26	75S153	.05	CH	.40	7.0	270	7400	—	—	—	1427	N	—	500	—	300	—	qz vein w/sulf
26	75S154	5.0	SC	.10	.7	50	1500	—	—	—	1427	N	—	N	—	50	—	meta-andesite
26	75S155	.15	CH	N	.7	60	2100	—	—	—	157	N	—	N	—	15	—	qz vein w/sulf
26	75S156	3.15	SC	N	.5	40	1000	—	—	—	N	N	—	N	—	N	—	meta-andesite
26	75S157	.08	CH	.10	.7	40	1800	—	—	—	159	N	—	N	—	20	—	qz vein w/sulf
26	75S158	.17	CH	N	N	25	320	—	—	—	N	N	—	N	—	N	—	qz vein w/sulf
26	75S159	4.0	CH	N	.5	40	530	—	—	—	159	N	—	N	—	N	—	foot and hanging wall of 75S158
26	75S160	.2	CH	.30	3.0	25	320	—	—	—	N	N	—	G1.0%	—	100	—	aspy vein in shale and chert
26	75S161	2.0	CR	N	2.0	50	890	—	—	—	N	N	—	1000	—	N	—	foot and hanging wall of 75S160
27	76S105	2.4	C	.30	15.0	130	4200	—	—	—	150	10	—	2000	—	20	—	silicified breccia zone w/sulf
28	76S108	—	F	1.50	1.0	20	1800	—	—	—	N	N	—	N	—	N	—	meta-andesite gneiss w/cp,po
29	76S080	50.0	SC	N	N	20	280	—	—	—	N	N	—	700	—	N	—	silicified zone w/aspy,cp
30	76S102	1.2	CH	.50	15.0	75	950	—	—	—	397	N	—	N	—	100	—	fault gouge zone w/sulf
30	76S103	1.0	CH	2.50	10.0	75	1000	—	—	—	180	N	—	G1.0%	—	100	—	fault gouge zone w/sulf
31	76S104	.5	CH	.50	3.0	65	4000	—	—	—	555	N	—	N	—	300	—	qz vein w/sulf
32	77S023	2.0	CR	N	1.5	1300	1700	—	—	—	N	10	—	N	—	N	—	massive sulf pod w/po,cp
33	76S079	9.0	SC	N	N	180	140	—	—	—	N	N	—	1000	—	N	—	fe-st slate w/aspy
disseminated mineralization																		
4	77S167A	23.0	SC	0.50	3.0	55	1600	—	—	—	N	N	—	500	—	10	—	qz mz stock
4	77S167B	20.0	SC	.10	1.0	55	1100	—	—	—	N	N	—	N	—	30	—	qz mz stock
4	77S167C	20.0	SC	.10	3.0	60	1800	—	—	—	634	N	—	N	—	100	—	mz dike
4	77S168A	16.0	SC	.05	3.0	60	1800	—	—	—	159	N	—	N	—	15	—	qz mz stock
4	77S168B	4.0	SC	N	1.0	50	670	—	—	—	N	N	—	N	—	N	—	mz dike
4	77S168C	20.0	SC	.15	7.0	70	2800	—	—	—	397	N	—	N	—	30	—	qz mz stock
7	76S087	12.0	SC	.40	10.0	35	4900	—	—	—	200	10	—	N	—	100	—	fe-st qz mz
11	77S052A	3.1	SC	.10	1.0	15	820	—	—	—	N	N	—	N	—	N	—	qz mz core
11	77S052B	3.9	SC	N	N	35	490	—	—	—	N	N	—	N	—	N	—	mz dike
11	77S052C	30.0	SC	N	N	15	150	—	—	—	N	N	—	N	—	N	—	mz core
11	77S052D	4.4	C	1.50	7.0	60	4800	—	—	—	159	N	—	N	—	200	—	mz core,qz stringer zone
12	76S154	32.0	SC	.20	5.0	65	2500	—	—	—	238	N	—	N	—	100	—	mz dike
13	76S169	33.0	SC	.20	7.0	70	4400	—	—	—	N	N	—	N	—	200	—	qz mz core
15	77S170	16.0	SC	.25	3.0	65	4000	—	—	—	N	N	—	N	—	20	—	qz mz core
16	76S145	53.0	SC	.10	2.0	25	670	—	—	—	N	N	—	N	—	20	—	qz mz core
22	77S153	50.0	SC	.40	10.0	70	2700	—	—	—	317	N	—	3000	—	100	—	qz mz stock
23	77S143	53.0	SC	.20	7.0	65	2000	—	—	—	50	N	—	N	—	50	—	mz dike
24	76S148	100.0	SC	N	5.0	60	810	—	—	—	N	N	—	N	—	N	—	qz mz stock
24	76S149	100.0	SC	1.50	15.0	65	3300	—	—	—	N	N	—	300	—	700	—	qz mz stock

Table B-3-3. - Massive Chalcopyrite deposit (figs. B-15, B-16, and B-17)

Map No.	Sample No.	Sample Size Feet	Sample Type	Fire Assay Au ppm	Atomic Absorption (ppm unless marked %)					X-Ray Ba %	Spectrographic (ppm)							Lithology and Remarks
					Ag ppm	Zn ppm	Cu ppm	Pb ppm	Co ppm		W ppm	Mo ppm	Sn ppm	As ppm	Ni ppm	Bi ppm	Sb ppm	
1	77S086	—	G	N	N	45	75	—	15	—	—	—	—	—	—	—	—	fe-st mixed contact rock
2	76S058	—	F	N	N	60	85	—	10	—	N	—	—	—	—	—	—	biotite gneiss w/py vein
3	76S054	7.0	SC	0.30	1.5	25	250	—	20	—	159	—	—	—	—	—	—	fe-st hornblende diorite w/mag,po
3	76S055	8.0	SC	N	N	35	180	—	50	—	N	—	—	—	—	—	—	fe-st hornblende diorite w/mag,po
4	76K099	—	SS	.05	N	130	20	—	15	—	N	—	—	—	—	—	—	tactite zone w/po,cp
5	77S061	10.0	SC	.10	3.0	60	1900	—	30	—	N	—	—	—	—	—	—	tactite zone w/po,cp
6	77S075	—	G	N	N	25	30	—	10	—	—	—	—	—	—	—	—	fe-st mixed contact rock
7	76S053	—	F	.05	1.0	15	840	—	15	—	238	—	—	—	—	—	—	tactite w/sulf
8	76S051	.6	CR	.05	15.0	65	1900	—	150	—	79	—	—	—	—	—	—	amphibolite vein in marble w/mag,po,cp
9	77S072	.6	C	.50	1.5	35	1500	—	100	—	N	—	—	—	—	—	—	tactite zone w/po,py,cp
10	77S048	8.0	SC	5.50	500.0	1200	3.8%	—	100	—	4203	—	—	—	—	—	—	tactite zone w/gossan,cp,po,sl
10	77S049	12.0	SC	4.50	500.0	2600	6.2%	—	100	—	6185	—	—	—	—	—	—	tactite zone w/gossan,cp,po,sl
10	77S050	12.0	SC	3.50	500.0	220	5.8%	—	100	—	4996	—	—	—	—	—	—	tactite zone w/gossan,cp,po,sl
11	77S073	4.0	G	N	1.0	35	950	—	30	—	N	—	—	—	—	—	—	fe-st zone of marble-argillite
12	77S074	50.0	G	N	.5	95	70	—	20	—	N	—	—	—	—	—	—	fe-st zone of marble-argillite
13	76S046	—	F	.10	1.0	25	1400	—	150	—	N	—	—	—	—	—	—	tactite w/sulf
13	76S047	—	F	.30	5.0	70	1800	—	30	—	N	—	—	—	—	—	—	tactite w/sulf
14	76R020	—	SS	N	N	30	35	—	20	—	N	—	—	—	—	—	—	
15	66Bd723	—	F	N	N	N	2000	—	15	—	—	—	—	—	—	—	—	
16	76S057	—	G	N	N	80	110	—	20	—	N	—	—	—	—	—	—	tactite

Table B-3-4.—LeRoy Mine (fig. B-19)

Map No.	Sample No.	Sample Size Feet	Sample Type	Fire Assay Au ppm	Atomic Absorption (ppm unless marked %)					X-Ray Ba %	Spectrographic (ppm)							Lithology and Remarks
					Ag ppm	Zn ppm	Cu ppm	Pb ppm	Co ppm		W ppm	Mo ppm	Sn ppm	As ppm	Ni ppm	Bi ppm	Sb ppm	
1	66AMk-332	0.7	CH	10.012	N	N	—	20	—	—	—	—	—	7.0%	—	—	—	qz vein
2	54-13	.3	S	3.771	N	—	—	—	—	—	—	—	—	—	—	—	—	qz vein
3	66AMk-330	.7	CH	.411	N	N	—	N	—	—	—	—	—	1000	—	—	—	qz vein
4	66AMk-329	.3	S	.994	N	N	—	50	—	—	—	—	—	1.5%	—	—	—	qz vein
5	66AMk-328	.3	S	.514	N	N	—	N	—	—	—	—	—	7000	—	—	—	qz vein
6	76K063	.5	CH	1.200	2.7	30	—	15	—	—	—	—	—	N	—	—	—	qz vein
7	66AMk-326	1.5	SC	.302	N	N	—	N	—	—	—	—	—	2.0%	—	—	—	qz vein w/minor horses
8	76K062	.5	CH	N	N	10	—	5	—	—	—	—	—	3000	—	—	—	qz vein
9	76K061	.2	CH	N	4.8	85	—	15	—	—	—	—	—	1500	—	—	—	qz vein
10	54-12	1.0	—	7.543	Tr	—	—	—	—	—	—	—	—	—	—	—	—	
11	54-08	.5	—	72.686	27.4	—	—	—	—	—	—	—	—	—	—	—	—	
12	76K128	.3	CH	18.514	11.3	600	—	600	—	—	—	—	—	G1.0%	—	—	—	qz vein
13	76K130	.6	CH	3.771	1.4	100	—	35	—	—	—	—	—	700	—	—	—	metamorphic host rock
14	76K129	.1	CH	32.400	16.5	45	—	65	—	—	—	—	—	G1.0%	—	—	—	qz vein
15	54-09	.5	—	354.517	253.7	—	—	—	—	—	—	—	—	—	—	—	—	
16	76K132	.4	CH	3.429	2.4	25	—	30	—	—	—	—	—	G1.0%	—	—	—	qz vein
17	76K131	.1	CH	N	3.4	35	—	40	—	—	—	—	—	1500	—	—	—	qz vein
18	76K133	.5	CH	1.029	2.7	10	—	20	—	—	—	—	—	G1.0%	—	—	—	qz-calc vein
19	76K134	.2	CH	12.000	8.2	30	—	75	—	—	—	—	—	3000	—	—	—	qz vein
20	54-10	.5	—	46.972	N	—	—	—	—	—	—	—	—	—	—	—	—	
21	77K110	.35	CH	2.743	Tr	20	—	15	—	—	—	—	—	500	—	—	—	qz-calc vein, brecciated
22	77K111	.45	CH	.343	Tr	15	—	15	—	—	—	—	—	1000	—	—	—	qz-calc vein
23	2	.7	—	12.343	N	—	—	—	—	—	—	—	—	—	—	—	—	
24	1	—	S	4.800	N	—	—	—	—	—	—	—	—	—	—	—	—	
25	77K109	.3	CH	N	N	10	—	10	—	—	—	—	—	N	—	—	—	qz vein
26	77K024	.3	CH	6.857	3.4	600	—	1500	—	—	—	—	—	G1.0%	—	—	—	qz vein
27	5	—	S	14.400	20.6	—	—	—	—	—	—	—	—	—	—	—	—	
28	77K108	.35	CH	.686	Tr	15	—	20	—	—	—	—	—	N	—	—	—	calc-qz vein
29	77K113	.1	CH	.343	Tr	45	—	15	—	—	—	—	—	N	—	—	—	shear zone w/minor qz
30	77K112	1.0	C	.686	Tr	65	—	15	—	—	—	—	—	N	—	—	—	qz vein
31	6	—	S	8.914	Tr	—	—	—	—	—	—	—	—	—	—	—	—	
32	9	1.5	—	24.000	61.7	—	—	—	—	—	—	—	—	—	—	—	—	
33	54-33	1.0	—	53.486	Tr	—	—	—	—	—	—	—	—	—	—	—	—	
34	54-34	1.8	—	14.400	Tr	—	—	—	—	—	—	—	—	—	—	—	—	
35	7	.7	—	99.429	22.6	—	—	—	—	—	—	—	—	—	—	—	—	
36	54-29	4.0	—	90.172	Tr	—	—	—	—	—	—	—	—	—	—	—	—	
37	54-35	2.0	—	25.029	Tr	—	—	—	—	—	—	—	—	—	—	—	—	
38	54-28	2.3	—	13.029	Tr	—	—	—	—	—	—	—	—	—	—	—	—	
39	54-30	.3	—	8.572	Tr	—	—	—	—	—	—	—	—	—	—	—	—	
40	54-31	.5	—	3.429	N	—	—	—	—	—	—	—	—	—	—	—	—	
41	77K107	.3	CH	1.029	Tr	10	—	260	—	—	—	—	—	1500	—	—	—	qz vein
42	77S106	.25	CH	34.972	Tr	240	—	540	—	—	—	—	—	3000	—	—	—	qz vein
43	54-32	.1	—	15.772	Tr	—	—	—	—	—	—	—	—	—	—	—	—	
44	76K066	.1	CH	3.086	4.8	360	—	300	—	—	—	—	—	3000	—	—	—	fault gouge

Table B-3-4.—LeRoy Mine (fig. B-19)—Continued

Map No.	Sample No.	Sample Size Feet	Sample Type	Fire Assay Au ppm	Atomic Absorption (ppm unless marked %)					X-Ray Ba %	Spectrographic (ppm)							Lithology and Remarks
					Ag ppm	Zn ppm	Cu ppm	Pb ppm	Co ppm		W ppm	Mo ppm	Sn ppm	As ppm	Ni ppm	Bi ppm	Sb ppm	
44	76K067	—	G	40.800	18.5	600	—	1800	—	—	—	—	—	G1.0%	—	—	—	vein qz
45	66AMk-333	.4	CH	.206	N	N	—	N	—	—	—	—	—	3.0%	—	—	—	qz vein
46	77K023	.25	CH	190.184	37.7	120	—	1200	—	—	—	—	—	G1.0%	—	—	—	qz vein
47	77K031	.3	CH	124.390	66.9	3400	—	1.4%	—	—	—	—	—	G1.0%	—	—	—	qz vein
48	77K025	.4	CH	.171	4.1	10	—	20	—	—	—	—	—	200	—	—	—	qz vein
49	77K065	.25	CH	857.493	274.9	4800	—	8800	—	—	—	—	—	G1.0%	—	—	—	qz vein
50	77K029	.3	CH	591.125	91.5	7200	—	1.3%	—	—	—	—	—	G1.0%	—	—	—	qz vein
51	77K030	.15	CH	.343	.7	240	—	120	—	—	—	—	—	700	—	—	—	silicified zone
52	77K028	.2	CH	2.743	1.7	15	—	60	—	—	—	—	—	3000	—	—	—	qz vein
53	77K026	.35	CH	.686	Tr	15	—	15	—	—	—	—	—	N	—	—	—	
54	77K027	.1	CH	1.200	Tr	15	—	15	—	—	—	—	—	N	—	—	—	
55	66AMk-334	1.3	CH	.302	N	N	—	N	—	—	—	—	—	N	—	—	—	0.3 ft qz veins
56	75K070	.4	CH	93.944	39.4	4300	—	6300	—	—	—	—	—	3000	—	—	—	qz vein
56	76K064	.8	CH	25.715	14.1	5500	—	6500	—	—	—	—	—	1500	—	—	—	qz vein
57	75K069	5.3	CH	5.143	3.1	1900	—	1500	—	—	—	—	—	N	—	—	—	qz vein w/metamorphic rock
58	66AMk-383	1.3	CH	11.006	1.0	500	—	1500	—	—	—	—	—	2000	—	—	—	qz vein w/wall rock
59	66AMk-384	.7	CH	16.972	1.5	500	—	500	—	—	—	—	—	1500	—	—	—	qz vein
60	66AMk-385	1.0	CH	12.000	10.0	2000	—	7000	—	—	—	—	—	7000	—	—	—	qz vein w/wall rock
61	66AMk-386	—	S	36.995	15.0	1.5%	—	7000	—	—	—	—	—	N	—	—	—	0.08 ft qz vein
62	10	—	G	8.914	Tr	—	—	—	—	—	—	—	—	—	—	—	—	
63	3	—	—	17.143	N	—	—	—	—	—	—	—	—	—	—	—	—	
64	54-11	1.3	—	17.143	Tr	—	—	—	—	—	—	—	—	—	—	—	—	

Table B-3-5.—Rainbow Mine (fig. B-20)

Map No.	Sample No.	Sample Size Feet	Sample Type	Fire Assay Au ppm	Atomic Absorption (ppm unless marked %)					X-Ray Ba %	Spectrographic (ppm)							Lithology and Remarks
					Ag ppm	Zn ppm	Cu ppm	Pb ppm	Co ppm		W ppm	Mo ppm	Sn ppm	As ppm	Ni ppm	Bi ppm	Sb ppm	
1	66AMk-392	1.0	CH	0.514	N	N	—	N	—	—	—	—	—	N	—	—	—	qz vein
2	66AMk-391	1.0	CH	.302	N	N	—	N	—	—	—	—	—	N	—	—	—	qz vein
3	66AMk-390	1.0	CH	349.991	70.0	2000	—	500	—	—	—	—	—	1000	—	—	—	qz vein
3	75K068	.6	CH	271.031	661.4	25	—	10	—	—	—	—	—	N	—	—	—	fracture zone w/fault gouge and qz
4	66AMk-389	—	G	56.058	10.0	N	—	300	—	—	—	—	—	1500	—	—	—	qz vein
5	66AMk-388	1.0	CH	52.046	10.0	N	—	500	—	—	—	—	—	5000	—	—	—	qz vein
6	66AMk-387	—	G	3.977	N	N	—	70	—	—	—	—	—	1500	—	—	—	ore pile near face

APPENDIX B-4

NUNATAK MOLYBDENUM DEPOSIT

DIAMOND DRILL HOLE AND SURFACE ANALYTICAL RESULTS

Table B-4-1.—Assay data, Nunatak Molybdenum deposit, diamond drill hole samples
(samples from intervals not listed were not assayed)

Muir No. 1							
Sample depth, ft.		Sample interval, ft.	Mo,%	Sample depth, ft.		Sample interval, ft.	Mo,%
From	To			From	To		
20	32	12	0.044	830	840	10	0.151
41	50	9	.022	840	850	10	.109
50	60	10	.007	850	860	10	.062
60	70	10	.007	860	870	10	.111
70	80	10	.004	870	880	10	.233
80	90	10	.009	880	890	10	.127
90	100	10	.007	890	900	10	.102
100	110	10	.022	900	910	10	.093
110	120	10	.011	910	920	10	.089
170	180	10	.038	920	930	10	.109
180	190	10	.013	930	940	10	.044
190	200	10	.011	940	950	10	.122
200	210	10	.016	950	960	10	.074
210	220	10	.025	960	970	10	.036
220	230	10	.013	970	980	10	.070
230	240	10	.002	980	990	10	.031
240	250	10	.002	990	1000	10	.097
250	270	20	N	1000	1010	10	.028
270	280	10	.002	1010	1020	10	.043
520	530	10	.004	1020	1030	10	.016
530	540	10	.011	1030	1040	10	.013
540	580	40	N	1040	1050	10	.021
580	590	10	.007	1050	1060	10	.024
590	610	20	N	1060	1070	10	.038
610	620	10	.009	1070	1080	10	.024
750	760	10	.013	1080	1090	10	.016
760	770	10	.020	1090	1100	10	.014
770	780	10	.016	1100	1110	10	.081
780	790	10	.029	1110	1120	10	.023
790	800	10	.095	1120	1130	10	.040
800	810	10	.031	1130	1140	10	.069
810	820	10	.035	1140	1150	10	.016
820	830	10	.077	1150	1160	10	.016
Muir No. 2							
225	235	10	0.033	530	540	10	0.193
235	245	10	.062	540	550	10	.069
245	255	10	.095	550	560	10	.188
255	265	10	.060	560	570	10	.169
265	275	10	.056	570	580	10	.120
305	315	10	.077	580	590	10	.182
315	325	10	.044	590	600	10	.089
325	335	10	.040	600	610	10	.113
335	345	10	.017	610	620	10	.111
460	470	10	.067	620	630	10	.161
470	480	10	.035	630	640	10	.073
480	490	10	.084	640	650	10	.020
490	500	10	.089	655	665	10	.035
500	510	10	.120	665	675	10	.049
510	520	10	.082	675	685	10	.020
520	530	10	.118	685	695	10	.017
Composite sample		Sample interval, ft.	Mo,%				
460-470 to 480-490		20	0.061				
620-630 to 640-649		19	.085				

Table B-4-1.—Assay data, Nunatak Molybdenum deposit, diamond drill hole samples—Continued
(samples from intervals not listed were not assayed)

Muir No. 3							
Sample depth, ft.		Sample interval, ft.	Mo, %	Sample depth, ft.		Sample interval, ft.	Mo, %
From	To			From	To		
95	105	10	0.020	135	145	10	0.062
105	115	10	.026	145	155	10	.033
115	125	10	.035	162	172	10	.052
125	135	10	.064	172	182	10	.020
Muir No. 4							
135	145	10	0.007	195	205	10	0.033
145	155	10	.106	205	215	10	.031
155	165	10	.025	215	225	10	.053
165	175	10	.013	225	235	10	.009
175	185	10	.047	235	245	10	.017
185	195	10	.031				
Composite sample		Sample interval, ft.	Au, oz/ton	Ag, oz/ton	Cu, %	MoS ₂ , %	WO ₃ , %
135-147 to 175-185		22	N	N	0.018	0.063	N
185-195 to 235-245		20	N	0.1	.006	.051	N
Muir No. 5							
Mineralization noted in hole not sufficient to justify assaying samples.							
Muir No. 6							
Seventy feet of rock were cored. The hole was stopped because the alteration suggested that it was well outside the mineralized zone.							
Muir No. 7							
Between 333 feet, the base of the gravel, and 598 feet, the bottom of the hole, no significant sulfides were noted.							
AMEX No. 1							
Sample depth, ft.		Sample interval, ft.	Mo, %		Cu, %		
From	To		Sludge	Core	Sludge	Core	
10	20	10	N	N	0.340	0.226	
20	30	10	N	N	.126	.252	
30	40	10	—	—	.056	—	
40	50	10	—	—	.126	—	
50	60	10	—	—	.277	.270	
60	70	10	—	—	.270	.207	
70	80	10	—	—	.220	.176	
80	90	10	—	—	.245	.422	
90	100	10	—	—	.144	.170	
100	110	10	—	—	.107	.340	
110	120	10	—	—	.384	.107	
120	130	10	—	—	.088	.081	
130	140	10	—	—	.170	.170	
140	150	10	—	—	.100	.081	
150	160	10	—	—	.094	—	
160	170	10	—	—	.050	—	
170	180	10	—	—	.044	—	
180	190	10	—	—	.144	—	
190	200	10	—	—	.050	—	
200	210	10	—	—	.107	—	
210	220	10	—	—	.075	—	
220	230	10	—	—	.044	—	
230	240	10	—	—	.018	—	
240	250	10	—	0.006	.050	.025	
250	260	10	—	—	.018	—	

Table B-4-1.—Assay data, Nunatak Molybdenum deposit, diamond drill hole samples—Continued
(samples from intervals not listed were not assayed)

AMEX No. 1—Continued							
Sample depth, ft.		Sample interval, ft.	Mo, %		Cu, %		Core
From	To		Sludge	Core	Sludge	Core	
260	270	10	—	—	.056	—	—
270	280	10	—	.002	.069	—	—
290	300	10	—	.001	—	—	—
300	310	10	—	N	—	—	—
310	320	10	—	.002	—	—	—
320	330	10	—	.001	—	—	.069
330	340	10	—	N	—	—	—
340	350	10	—	N	—	—	—
350	360	10	—	N	—	—	—
360	370	10	—	N	—	—	—
370	380	10	—	.013	—	—	—
480	490	10	—	.001	—	—	.018
503.4	512	8.	6-	.002	—	—	.088

Sample depth, ft.		Sample interval, ft.	Mo, %		Cu, %		Core sample	
From	To		Sludge ¹	Core	Sludge ¹	Core	Au, oz/ton	Ag, oz/ton
530	540	10	—	—	—	.113	NN	—
540	550	10	—	—	—	.037	NN	—
550	560	10	—	N	—	.037	N	0.1
560	570	10	—	—	—	.113	trN	—
570	580	10	—	—	—	.056	NN	—
580	590	10	—	—	—	.081	N.1	—

AMEX No. 2							
Sample depth, ft.		Sample interval, ft.	Mo, %		Cu, %		Core
From	To		Sludge	Core	Sludge	Core	
20	30	10	0.048	0.017	—	—	—
30	40	10	.050	.014	—	—	—
40	50	10	.075	.086	—	—	—
50	60	10	.020	.009	—	—	—
60	70	10	.023	.008	—	—	0.050
70	80	10	.005	.002	—	—	—
80	90	10	.012	.011	—	—	—
90	100	10	.009	.012	—	—	—
100	110	10	.011	.004	—	—	—
110	120	10	.012	.004	—	—	—
120	130	10	.014	.011	—	—	—
130	140	10	.011	.013	—	—	—
140	150	10	.013	.014	—	—	—
150	160	10	.008	—	0.025	—	—
160	170	10	.016	—	—	—	—
170	180	10	.011	—	—	—	—
180	190	10	.008	—	—	—	—
190	200	10	.009	.005	—	—	—
200	210	10	.007	—	—	—	—
210	220	10	.008	—	—	—	—
220	230	10	.019	—	—	—	—
230	240	10	.013	—	—	—	—
240	250	10	.023	—	—	—	—
250	260	10	.019	—	—	—	—
260	270	10	.013	—	—	—	—
270	280	10	.014	—	—	—	—
280	290	10	.011	.009	—	—	—
290	300	10	.008	.007	.037	—	.069

¹ Sludge sample too small for accuracy beyond 280 feet.

Table B-4-1.—Assay data, Nunatak Molybdenum deposit, diamond drill hole samples—Continued
(samples from intervals not listed were not assayed)

AMEX No. 2—Continued							
Sample depth, ft.		Sample interval, ft.	Mo, %		Cu, %		
From	To		Sludge	Core	Sludge	Core	
300	310	10	.019	.024	—	—	
310	320	10	.011	.005	—	—	.516
320	330	10	.005	.001	—	—	
330	340	10	—	.001	—	—	
340	350	10	.006	—	—	—	
350	360	10	.016	.014	—	—	
360	370	10	.009	.013	—	—	
370	380	10	.013	.011	—	—	
380	390	10	.004	—	—	—	
390	400	10	.002	—	—	—	
400	410	10	.008	—	.004	—	
410	420	10	.011	.004	.044	—	.025
420	430	10	—	.005	—	—	
430	440	10	.014	.004	—	—	
440	450	10	.023	—	—	—	
450	460	10	.007	—	—	—	
460	470	10	.017	.011	.026	—	.037
470	480	10	.009	.007	—	—	
480	490	10	.013	—	—	—	
490	500	10	.014	²	.044	—	
500	510	10	.019	.013	—	—	.012
510	520	10	.011	.009	—	—	
520	530	10	.013	.007	—	—	
530	540	10	.019	.019	—	—	
540	550	10	.021	.007	—	—	.019
550	560	10	.026	.013	—	—	
560	570	10	.023	.029	—	—	
570	580	10	.048	.077	.056	—	.056
580	590	10	.035	.036	—	—	
590	600	10	.053	.029	—	—	
600	610	10	.026	.021	—	—	
610	620	10	.040	.045	—	—	
620	630	10	.060	.037	—	—	
630	640	10	.057	.013	—	—	
640	650	10	.186	.112	—	—	
650	660	10	.168	.053	—	—	
660	670	10	.588	.255	—	—	
670	680	10	.231	.053	—	—	
680	690	10	—	.033	—	—	
690	700	10	—	.102	—	—	
700	710	10	.104	.080	—	—	
710	720	10	.162	.051	—	—	.012
720	730	10	.122	.029	—	—	
730	740	10	—	.029	—	—	
740	750	10	—	.062	—	—	
750	760	10	—	.025	—	—	
760	770	10	—	.016	—	—	
770	780	10	—	.002	—	—	
840	850	10	.020	.007	.025	—	
850	860	10	.007	—	—	—	
860	870	10	.038	N	—	—	
870	880	10	.029	.011	—	—	
880	892.5	12.5	.035	.013	—	—	

² Illegible entry in company drilling hole log.

Table B-4-1.—Assay data, Nunatak Molybdenum deposit, diamond drill hole samples—Continued
(samples from intervals not listed were not assayed)

AMEX No. 3					
Sample depth, ft.		Sample interval, ft.	Mo, %		
From	To		Sludge	Core	
2	10	8	0.013	—	
10	20	10	.007	.009	
20	30	10	.009	.016	
30	40	10	.013	.004	
40	50	10	.013	.007	
50	60	10	.007	.011	
60	70	10	.011	.004	
70	80	10	.009	.002	
80	90	10	.009	.007	
90	100	10	.007	.009	
100	110	10	.009	.007	
110	120	10	.011	.004	
120	130	10	.017	.026	
130	140	10	.016	.009	
140	150	10	.007	.004	
150	160	10	.007	—	
153	160	7	—	.004	
160	170	10	.007	.004 ³	
170	180	10	.007	.004	
180	190	10	.007	.011	
190	200	10	.004	.002	
200	210	10	.011	.009	
210	220	10	.009	.004	
220	230	10	.009	— ⁴	
230	240	10	.002	—	
240	250	10	.004	—	
250	260	10	.004	—	
260	270	10	.031	.047	
270	280	10	.029	.020	
280	290	10	.036	.098	
290	300	10	.033	.029	
300	310	10	.042	.031	
310	320	10	.038	.009	
320	330	10	.016	.016	
330	340	10	.004	.004	
340	350	10	.007	.002	
350	360	10	—	.004	
360	370	10	—	.007	
370	380	10	—	.004	
380	390	10	—	.007	
390	400	10	—	.004	
400	410	10	—	.002	
410	420	10	—	.017	
420	430	10	—	.009	
430	440	10	—	.004	
440	450	10	—	.009	
450	460	10	—	.020	
460	470	10	—	.004	
470	480	10	—	.017	
480	490	10	—	.002	
490	500	10	—	.004	

U.S. Bureau of Mines Drill Holes

Hole	Depth, feet	Mo, %		
		Core	Sludge	Adjusted average
1	46.7	0.043	0.041	0.042
2	238.1	.063	.073	.072

³ Core sample also contained 0.037% Cu.

⁴ Core recovery too poor from 220- to 260-foot depth for an accurate sample.

Table B-4-2.—Assay data, Nunatak Molybdenum deposit fault zone samples
(From Sanford and others, 1949, figure 6)

Channel number	Sample	Length		Mo, %	Description
		Ft.	(m.)		
20	1	4.5	(1.4)	0.06	Epidotized zone in skarn; east section of channel No. 20.
20	2	3.6	(1.1)	.05	Sheared quartz zone in skarn; west section of channel No. 20.
21	1	6.0	(1.8)	.12	Epidotized zone in skarn; east section of channel No. 21.
21	2	4.4	(1.3)	.04	Sheared quartz zone in skarn; west section of channel No. 21.
22	1	7.0	(2.1)	.10	Epidotized zone in skarn; east section of channel No. 22.
22	2	4.8	(1.5)	.09	Sheared quartz zone in skarn; west section of channel No. 22.
23	1	6.0	(1.8)	.06	Epidotized zone in skarn.
24	1	5.8	(1.8)	.05	Sheared quartz and epidote in skarn; west section of channel No. 24.
24	2	5.7	(1.7)	.04	Sheared quartz and epidote in skarn; east section of channel No. 24.
25	1	15.8	(4.8)	.04	Epidotized zone in skarn.
26	1	11.0	(3.4)	.16	Do.
27	1	9.7	(3.0)	.34	Do.
28	1	6.0	(1.8)	.24	Shattered quartz and epidote in skarn.
29	1	10.4	(3.2)	.10	Do.
30	1	11.2	(3.4)	.05	Do.
31	1	10.4	(3.2)	.04	
		Weighted Average value		.10	

Table B-4-3.—Assay data, Nunatak Molybdenum deposit, area of conspicuous molybdenite
(from Sanford and others, 1949, figure 5)

U.S. Bureau of Mines Channel Samples											
		Channel No. 1						Channel No. 2			
Sample ¹	Mo,%	Sample	Mo,%	Sample	Mo,%	Sample	Mo,%	Sample	Mo,%	Sample	Mo,%
1	0.09	11	0.10	21	0.07	31	0.07	1	0.03		
2	.07	12	.14	22	.06	32	.05	2	.05		
3	.09	13	.08	23	.06	33	.09	3	.03		
4	.09	14	.12	24	.05	34	.06	4	.07		
5	.04	15	.04	25	.05	35	.07	5	.02		
6	.04	16	.05	26	.04	36	.08	6	.04		
7	.08	17	.07	27	.05	37	.10	7	.05		
8	.08	18	.05	28	.06	38	.04	8	.03		
9	.09	19	.05	29	.09	39	.05	9	.06		
10	.08	20	.09	30	.05	40	.06				

Channel No. 3											
Sample	Mo,%	Sample	Mo,%	Sample	Mo,%	Sample	Mo,%	Sample	Mo,%	Sample	Mo,%
1	0.05	11	0.03	21	0.02	31	0.03	41	0.02	51	0.06
2	.07	12	.08	22	.03	32	.04	42	.07	52	.05
3	.03	13	.06	23	.03	33	.13	43	.03	53	.05
4	.04	14	.06	24	.03	34	.03	44	.06	54	.06
5	.08	15	.10	25	.03	35	.06	45	.08	55	.04
6	.06	16	.05	26	.02	36	.07	46	.04	56	.06
7	.08	17	.04	27	.05	37	.04	47	.04	57	.08
8	.09	18	.02	28	.03	38	.08	48	.02	58	.05
9	.10	19	.03	29	.03	39	.04	49	.06	59	.06
10	.10	20	.04	30	.02	40	.04	50	.04	60	.07

See footnotes at end of table.

Table B-4-3.—Assay data, Nunatak Molybdenum deposit, area of conspicuous molybdenite—Continued
(from Sanford and others, 1949, figure 5)

U.S. Bureau of Mines Channel Samples									
Channel No. 4						Channel No. 5			
Sample	Mo,%	Sample	Mo,%	Sample	Mo,%	Sample	Mo,%	Sample	Mo,%
1	0.08	11	0.06	21	0.06	31	0.06	1	0.05
2	.08	12	.07	22	.10			2	.03
3	.07	13	.14	23	.05			3	.08
4	.03	14	.15	24	.08			4	.05
5	.06	15	.05	25	.05			5	.04
6	.07	16	.13	26	.06			6	.05
7	.09	17	.08	27	.04			7	.52
8	.09	18	.09	28	.05			8	.06
9	.12	19	.07	29	.02			9	.11
10	.09	20	.07	30	.06				
Channel No. 6		Channel No. 7		Channel No. 8		Channel No. 9			
Sample	Mo,%	Sample	Mo,%	Sample	Mo,%	Sample	Mo,%	Sample	Mo,%
1	0.05	1	0.02	1	0.05	1	0.05	6	0.11
2	.04	2	.04	2	.04	2	.05	7	.08
				3	.04	3	.06	8	.11
				4	.07	4	.09	9	.08
						5	.08	10	.07
Channel No. 10								Average for each channel sample	
Sample ¹	Mo,%	Sample	Mo,%	Sample	Mo,%	Sample	Mo,%	Channel Mo,%	
1	0.06	11	0.04	21	0.05	31	0.09	1	0.07
2	.10	12	.06	22	.10	32	.21	2	.05
3	.05	13	.04	23	.08	33	.09	3	.05
4	.05	14	.05	24	.07	34	.11	4	.07
5	.07	15	.04	25	.11	35	.10	5	.11
6	.09	16	.04	26	.10	36	.07	6 ²	.05
7	.06	17	.07	27	.09			7 ²	.03
8	.04	18	.05	28	.08			8 ³	.04
9	.03	19	.07	29	.13			9	.07
10	.04	20	.07	30	.20			10	.07
								Weighted average over all channel samples	.06

¹ Component sample sections are 5 ft. in length (1.5 meters) for all samples.

² Includes 2 samples that are not representative.

³ Includes 4 samples that are not representative.

