URANIUM INVESTIGATIONS IN SOUTHEASTERN ALASKA

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by GILBERT R. EAKINS

ABSTRACT

Radioactive mineral deposits at 14 localities in Southeastern Alaska are discussed to assist in the exploration for uranium. These areas, visited during the 1970 field season, were selected because of known or reported radioactivity and (or) favorable geology. Vein deposits and nonmarine Tertiary sandstones were examined. Radiometric surveys were made on foot, and small areas were mapped to show the spatial relationship between radioactivity and certain ore deposits.

Previously unreported low radioactive anomalies were found at several localities, but none of the deposits was indicated to be of commercial grade. Slightly radioactive sandstones were found at Port Camden and on the west side of Zarembo Island. Radioactive pegmatites at Endicott Arm and elsewhere in Southeastern Alaska do not appear to have commercial possibilities, but may serve as guides to mineralization.

Geochemical stream-sediment samples were collected at most of the localities examined. A total of 205 samples were taken. Results of atomic absorption analyses are given for copper, lead and zinc. Strong geochemical anomalies were found at William Henry Bay and Kook Lake.

The best guides for uranium exploration in Southeastern Alaska are soda-rich granite and the ores and gangue minerals frequently associated with uranium. These include minerals containing copper, silver, cobalt and molybdenum, and hematite and fluorite. There is some indication that unusual amounts of uranium minerals are present in zones peripheral to major copper districts.

INTRODUCTION

PURPOSE AND LOCATION

A strong demand for uranium to meet a critical energy shortage in the industrial nations is anticipated for the next 25 years (Schubert, 1971, p. 102). This forecast is supported by many experts in the nuclear energy field. Thus, in spite of the current oversupply of uranium and the possible development of breeder reactors, large new reserves will be required. In 1968 the Alaska Geological Survey began a study of uranium mineralization to encourage prospecting for radioactive deposits in Alaska, which still is relatively unexplored for uranium. In 1970 an investigation was conducted in Southeastern Alaska, because this region contains an important uranium-thorium mine and several radioactive prospects. Figure 1 shows the locations of 14 areas visited.

These were selected on the basis of known radioactivity, favorable geology, or reports of radioactivity received from prospectors. However, this report is by no means a complete evaluation of the uranium potential in Southeastern Alaska. Rugged terrain, dense vegetation, and heavy rainfall inhibited field work, so that only the more accessible areas were examined.

REGIONAL SETTING AND MINERAL PRODUCTION

Southeastern Alaska is the panhandle extending from 54° 30′ to 60° N. latitude. It includes a narrow strip along the mainland and more than 1,000 islands in the Alexander Archipelago. The entire region is part of the western Cordillera. The outstanding geologic features include late Mesozoic intrusive masses forming the northwest-trending Coast Range batholith and smaller subsidiary intrusives. The batholith is complex, and consists of a variety of igneous rocks of slightly different ages. The geology of the region has been complicated by tectonic activity since early Paleozoic time. Metamorphism of pre-Tertiary rocks is widespread. Major high-angle faults, with lateral displacements of many miles have determined the locations of numerous canals and inlets.

Ore deposits in Southeastern Alaska occur near intrusive rocks. The most important ones are concentrated in four general areas (fig. 2). These include (1) the Juneau gold belt extending for approximately 125 miles along or near the coast from Berners Bay to Windham Bay, (2) the Chichagof gold district on the northwestern part of Chichagof Island, (3) the Hyder silver-lead-gold-tungsten district at the easternmost tip of Southeastern Alaska, and (4) east-central and southeastern Prince of Wales Island and the adjoining Ketchikan area, which contain mostly copper, with some gold, uranium, silver, and lead.

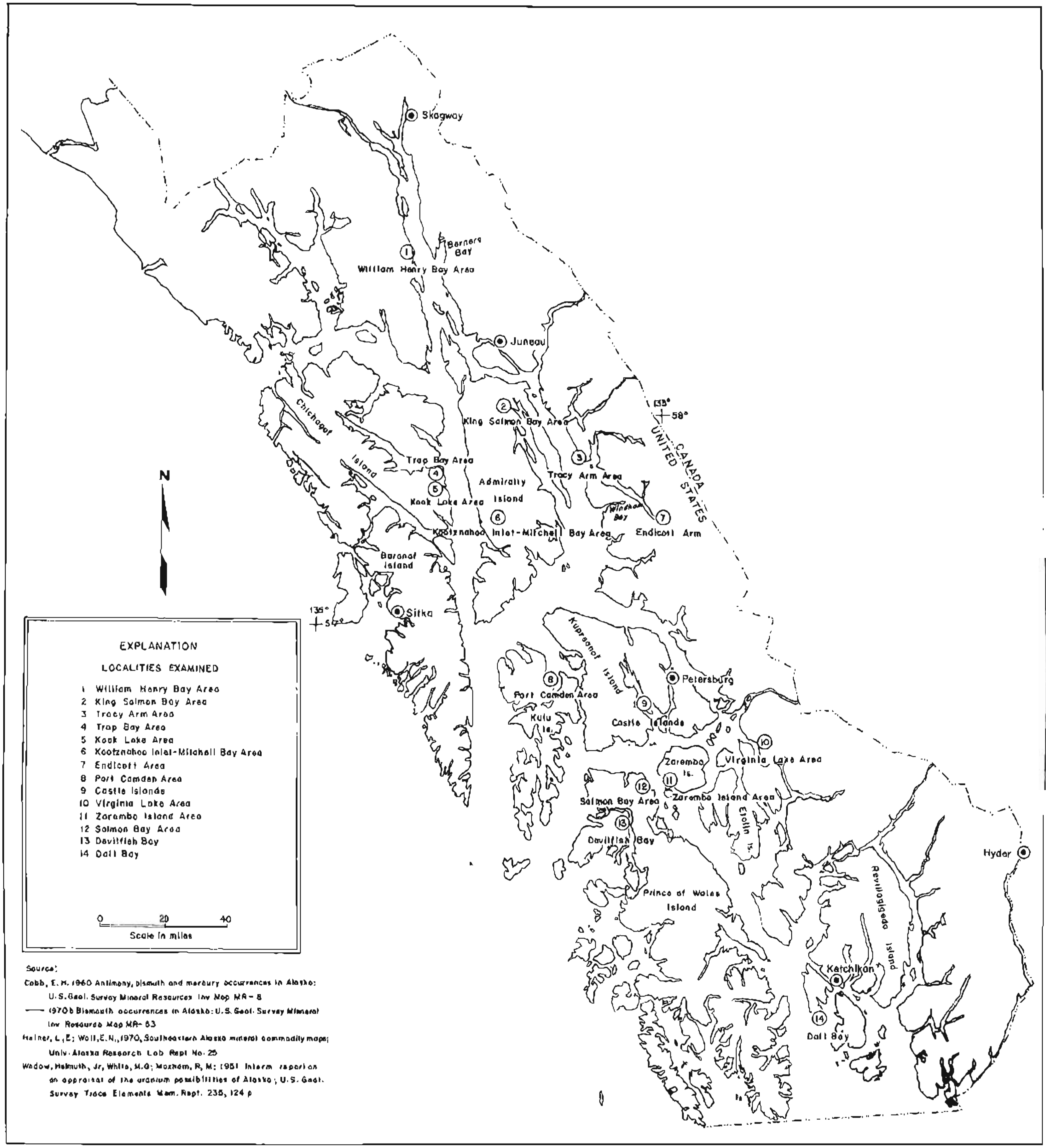


Figure I. Localities Examined For Radioactivity in Southeastern Alaska

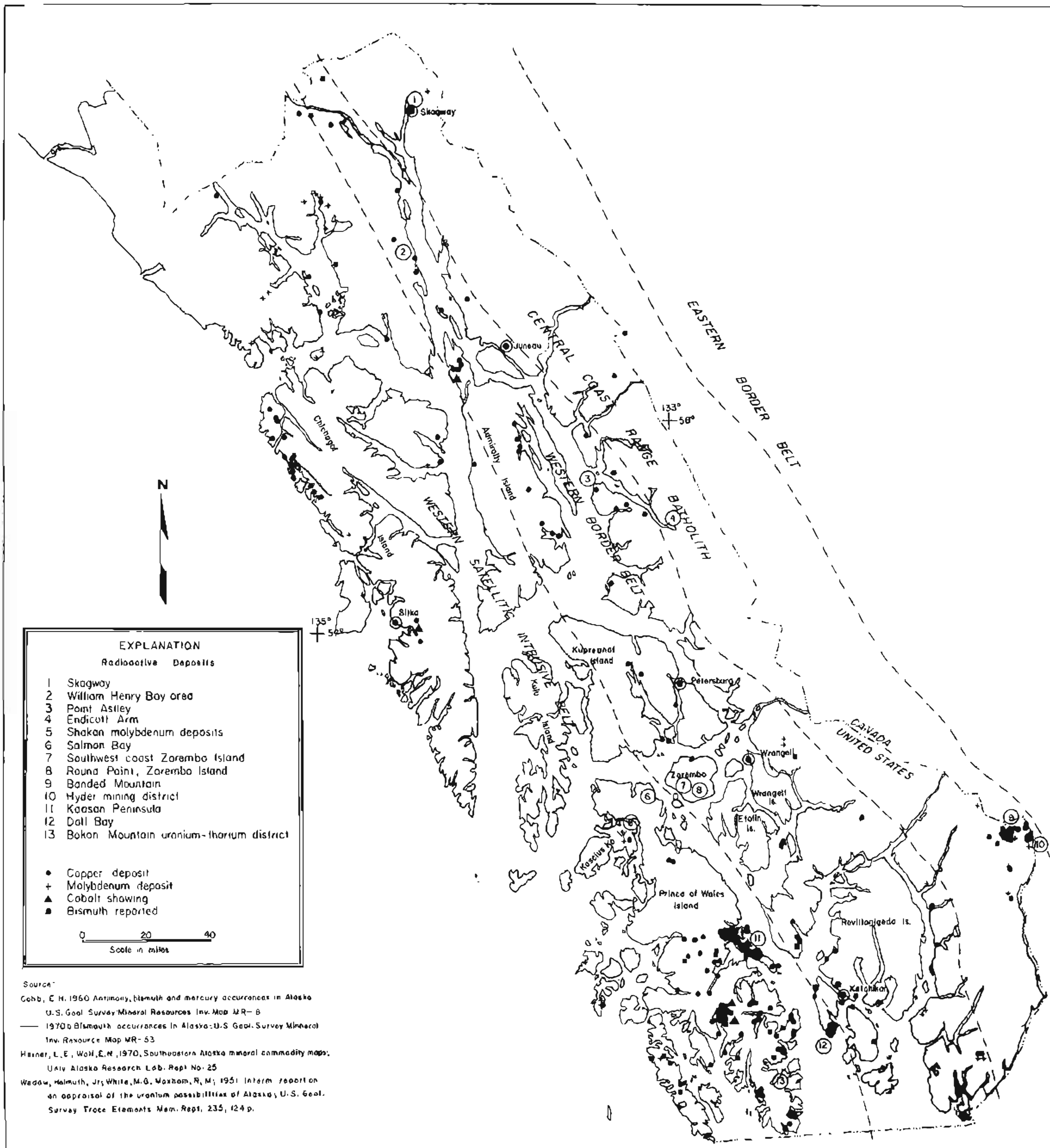


Figure 2. Distrubution of Certain Metallic Deposits and Locations of Known Radioactive Deposits, Southeastern Alaska

Between 1906 and 1956 Southeastern Alaska yielded 6.2 million ounces of gold, 3.3 million ounces of silver, 37 million pounds of copper, 48.3 million pounds of lead, 111 thousand pounds of zinc, and 14 thousand ounces of the platinum group of metals, mainly palladium (Kaufman, 1958, p. 7). Other ores mined or located contain antimony, barite, garnet, iron, molybdenum, titanium, tungsten, and recently, uranium and thorium.

PREVIOUS INVESTIGATIONS

During the intensive search for uranium in the late 1940's and early 1950's, the U.S. Geological Survey on behalf of the Atomic Energy Commission investigated numerous mines and placer deposits in Alaska for radioactivity. Reports pertaining to reconnaissance in Southeastern Alaska were made by Bates and Wedow (1953), Houston (1952), Houston, Bates, Velikanje and Wedow (1958), Matzko and Freeman (1963), Wedow, White, and Moxham (1951), West and Benson (1955), and White, West, Tolbert, Nelson, and Houston (1952). MacKevett (1963) made a thorough study of the uranium-thorium district at Bokan Mountain on Prince of Wales Island. Cobb (1970a) has compiled an index of uranium, thorium, and rare-earth elements known in Alaska. Reports on radioactive deposits in Southeastern Alaska by the Alaska Territorial Department of Mines include those by Fowler (1949) and Williams (1952a,b,1955a,b,c,d, and 1956). Reports by the Alaska Geological Surveys include those of Eakins (1969, 1970). Exploration by major companies and numerous private parties has included radiometric surveys, but the results are not available to the public.

ACKNOWLEDGEMENTS

Claude Williams assisted the author during the 1970 field season and had charge of geochemical sampling. Prospector Bill Huff of Ward Cove, Alaska, was very generous with his time and knowledge of the geology of Southeastern Alaska and directed the author to several areas of interest. Various members of the U.S. Geological Survey encouraged the project with helpful discussions on the geology of uranium.

TYPICAL URANIUM DEPOSITS OR OCCURRENCES

Areas having significant radioactivity in Southeastern Alaska are shown on figure 2 and listed in table 1. Various modes of occurrence have been found. For example, radioactivity is associated with sulfide ore veins in the Hyder mining district, carbonate veins at Salmon Bay, pegmatite pods at Endicott Arm and Dall Bay, aplite and pegmatite dikes in the Bokan Mountain district, and granitic stocks at Bokan Mountain and William Henry Bay.

The study of many radioactive veins throughout the world has shown that uranium is often associated with ores of cobalt, lead, silver, copper, and bismuth. The most characteristic gangue minerals are hematite and fluorite. Because of its mobility, uranium is most frequently concentrated near the outer borders of mineral districts and near the margins of intrusive bodies. These associations may also serve as general guides in the search for uranium in Alaska.

VEINLIKE DEPOSITS

Vein deposits are of particular interest in Southeastern Alaska because high-grade uranium ore has been produced from a hydrothermal deposit at Bokan Mountain near the southern end of Prince of Wales Island (fig. 2, loc. 13). This deposit constitutes the main stimulus for uranium exploration in Southeastern Alaska. The geology of the area has been mapped and described in detail by MacKevett (1963). The following description of the Bokan Mountain district is taken largely from that report.

The Bokan Mountain district covers about 70 square miles in the Kendrick Bay area. Uranium is associated with light-colored granitic rocks high in quartz and soda-rich minerals. The following four types of radioactive deposits have been found:

- A primary segregation of uranium-thorium minerals in a late stage of peralkaline granite magma emplacement and subsequent hydrothermal deposition. This type occurs at the Ross-Adams mine.
- Syngenetic deposits in pegmatite and aplite dikes.
- Epigenetic hydrothermal deposits, chiefly open-space filling, but with some replacement.
- A hydrothermal deposit formed in clastic sedimentary rock by filling of interstices at the Cheri No. 1 prospect.

TABLE 1.-*Areas in Southeastern Alaska with Significant Radioactivity*

Location on Figure 2	Area	Geology and Radioactivity	References
1	Skagway	Country rock is quartz diorite, altered rhyolite, and andesite dikes. Specks of fluorite and iron stain present in rhyolite. One hand-picked sample from a clayey material had 1.2% U but very scarce.	Freeman, 1963, p. 30,33
2	William Henry Bay, west side of Lynn Canal	Widely scattered grains of euxenite and traces of thorianite present in an altered and brecciated granite stock which crops out over an area of one square mile. Material containing up to 1.2% eU* reported from the Lucky Six claims.	Matzko and Freeman, 1963, p. 44; present report
3	Point Astley, east side of Stephens Passage	Pyrite, sphalerite, bornite, pyrrhotite, galena, covellite, and traces of native silver in veins cutting schist. A grab sample from a copper-silver deposit assayed 0.006% eU.	Houston, Bates, Velikanje and Wedow, 1958, p. 25; Wedow and others, 1953, p. 6
4	BBH claim, Endicott Arm	Pegmatite pods in granodiorite, some pyrite and alteration. Samples collected in 1955 produced 0.04% eU. Samples collected in 1970 produced 0.004% U. A prospector reported fluorescent uranium minerals on top of ridge south of the head of Endicott Arm.	Huff, written communication, 1970; Williams, 1955a; present report
5	Shakan—molybdenum deposit, Kosciusko Island	Molybdenite, pyrite, pyrrhotite, chalcopyrite, sphalerite, and iron oxide in a breccia zone near the contact of Late Jurassic or Early Cretaceous diorite with Silurian graywacke. Maximum eU found was 0.004%.	Houston, Bates, Velikanje and Wedow, 1958, p. 24; Wedow and others, 1953, p. 9, 10
6	Salmon Bay, Prince of Wales Island	Radioactive carbonate veins cut Paleozoic graywacke and volcanics. Up to 0.13% eU, due mostly to thorium.	Bates and Wedow, 1953, p. 1, 8; Glover, 1951; Houston, 1952; Houston, Bates Velikanje and Wedow, 1958, p. 6—23; Wedow and others, 1953, p. 8, 9, 10; White and others, 1952, p. 13, 14, 16; present report
7	Zarembo Island, southwest coast	Fluorite veinlets with pyrite cutting volcanic rocks. Maximum eU in felsic volcanics was 0.005%.	White and others, 1952, p. 16; present report
8	Round Point, Zarembo Island	Mesozoic granite intruded into graywacke. Thin epidote veinlets. Radioactivity in granite of 0.004% eU probably due to accessory minerals.	Houston, Bates, Velikanje and Wedow, 1958, p. 24; Wedow and others, 1953, p. 10

TABLE 1.-*Areas in Southeastern Alaska with Significant Radioactivity* -Continued

Location on Figure 2	Area	Geology and Radioactivity	References
9	Banded Mountain, Hyder District	A radioactive sample from a copper-molybdenum prospect assayed 0.03% U.	Samples received from J. W. Huff, 1970
10	Hyder District	Silver, gold, lead, zinc, molybdenum, and tin in veins in granodiorite, greenstone, and metasediments. Small amount of U associated with hematite and the ores. A sample from the Mountain View mine assayed 0.045% eU, and lesser showings were found at other locations. An unverified assay of 0.7% eU was reported for a sample from the Mountain View property.	Fowler, 1949; Houston, Bates, Velikanje and Wedow, 1958, p. 25—29; Wedow and others, 1951, p. 54, 55; West and Benson, 1955, p. 27—45; Williams, 1952a
11	Kasaan Peninsula, east coast of Prince of Wales Island	Area has been a small copper producer. Deposits contain chalcopyrite and magnetite in a contact zone between granodiorite stocks and metasediments and limestone. Hematite, bornite and secondary copper minerals also present. One sample, the source of which is uncertain, but believed to be from Kasaan Peninsula assayed 0.1% due to allanite and a copper uranite.	Wedow, 1951, p. 63; White and others, 1952, p. 16
12	Dall Bay, south end of Gravina Island	Pods of radioactive feldspar in schist have up to 0.07% U.	Williams, 1956; present report
13	Bokan Mountain District, Prince of Wales Island	The Ross-Adams mine has yielded uranium and thorium ore from a deposit in a peralkaline granite stock. Small samples have assayed up to 3% U308. Past production has averaged almost 1.0% U and 1.0% thorium. Ore minerals are uranothorite and uranoan thorianite.	Eakins, 1970; Freeman, 1963, p. 44—49; MacKevett, 1963; Williams, 1955c

The principal ore deposit in the Bokan Mountain area is at the Ross-Adams mine, which was discovered in 1955 near the head of Kendrick Bay by Don Ross and Kelly Adams using an airborne geiger counter. While the ore is not in a vein, it is a hydrothermal deposit. The ore is a uranium-thorium concentration in a peralkaline granite stock, which is roughly circular and about two miles in diameter. It forms prominant outcrops at Bokan Mountain.

The peralkaline granite is an unusual variety of igneous rock characteristically high in quartz and the sodium-bearing pyroxene (acmite) and amphibole (riebeckite), which may be present in amounts up to 12%. It is generally light gray with an average of about 10% dark minerals. Accessory minerals are chiefly zircon, uranothorite, pyrite, xenotime, fluorite, cordierite, and magnetite. Unusual amounts of the minor elements, uranium, thorium, yttrium, lanthanum, niobium, cerium, and other rare earths are present. Aplite and pegmatite dikes genetically related to the Bokan Mountain granite are interesting because some contain uranium, thorium, zirconium, and niobium. Lead-alpha and potassium-argon measurements show the granite to be Late Triassic or Early Jurassic in age (Lamphere, MacKevett, and Stern, 1964). The peralkaline granite stock has been intruded into an older pluton of diorite and monzonite of Ordovician age.

The Ross-Adams ore body is an irregular pipelike body that plunges generally southward. The percentage of uranium minerals decreases gradually outward from a high-grade core, and ore limits are indefinite. Ore mined from an open pit originally contained a high-grade core which averaged over 0.5% U_3O_8. A large portion contained 1% U_3O_8, and pods contained up to 3% U_3O_8. Twelve samples analyzed by the U.S.G.S. yielded from 0.18 to 3.2% uranium. High-grade ore can be distinguished by its dark color due to the presence of associated hematite in the granite. The core was surrounded by a zone of lower-grade ore 2 to 20 feet thick that averaged less than 0.5% U_3O_8. Information is not available on the tenor of the ore mined later by underground methods or on new ore discovered by recent drilling.

Almost all the ore minerals are primary. They occur both as grains scattered throughout the peralkaline granite and in numerous thin (0.1 to 0.8 mm) veinlets. Anhedral to euhedral grains up to 2 mm wide are typical. The dominant ore minerals are uranothorite (uranium-bearing thorite) and uranoan thorianite (uranium-bearing thorianite). Coffinite, $U(SiO_4)(OH)_4$ is found in minor amounts. Other vein minerals accompanying the ore minerals are abundant hematite and calcite, and lesser amounts of fluorite, pyrite, limonite, galena, quartz, clay minerals, and chlorite.

There is no sharp boundary between the ore and the host granite. The ore zone contains slightly more iron, lead, aluminum, zirconium, titanium, magnesium, calcium, manganese, and arsenic, but less quartz and potassium than the surrounding rock. Most of the ore is out of radioactive equilibrium, but the thorium combines with the uranium in such a way to give the effect of apparent equilibrium.

A total of 60,000 tons of ore averaging almost 1% of both U_3O_8 and thorium has been produced by various operators of the Ross-Adams mine by underground and open pit methods. The mine was closed between 1964 and early 1971, when Newmont reopened it. Drilling by Newmont has proven the presence of ore beyond previously known limits and has shown that the structure of the deposit is much more complicated than had been suspected.

Uranium-thorium minerals have been found in small amounts at some other prospects in the area. These minerals include uraninite, uranophane, allanite, possibly davidite or brannerite, and ellsworthite. Only minor amounts of the secondary uranium minerals gummite, sklodowskite, beta uranophane, bassetite, and novacekite have been reported from the Ross-Adams property. The scarcity of secondary uranium minerals is undoubtedly due to their solubility and the heavy rainfall in the area.

Some claims and prospects in the district are near altered dacite dikes in albitized zones along the margin of the peralkaline granite. Others are on small pegmatite dikes within the granite. Most of these claims are only slightly explored. One prospect was located for fluorite. About eight miles southeast of Bokan Mountain, weak anomalies occur in pegmatites near Gardner Bay. Low radioactivity has been found in altered andesite dikes cutting syenite near Stone Rock Bay about three miles south of Gardner Bay. None of the more common metals associated with the Bokan Mountain uranium-thorium ores appear to be present in commercial amounts, but old copper and gold prospects have also been worked in the past, mostly around Gardner Bay, McLean Arm, and Mallard Bay, 25 to 30 miles southeast of Bokan Mountain. It is possible but not proven that the uranium-thorium ore is related to the copper district on the island (fig. 2).

DEPOSITS IN SEDIMENTARY ROCKS

Ninety-five percent of the uranium reserves in the United States are in nonmarine sandstone and conglomerate formations of Triassic and Jurassic ages in the Colorado Plateau region and in Tertiary basins in Wyoming. Host rocks for bedded uranium deposits in the western United States characteristically are nonmarine, arkosic, often carbonaceous sandstones and conglomerates derived from ancient granites. In some districts they are overlain by acidic volcanic ash or tuff. The ancient granites and volcanic ashes are considered to be the sources of the uranium. This is thought to have been removed by weathering and solution, transported by meteoric water into the sandstones and concentrated in certain beds or at solution "fronts" under proper reducing conditions.

Some of the conditions necessary for this type of deposit are present in Alaska, where nonmarine, arkosic, and carbonaceous Tertiary sandstones and conglomerates have been deposited in basins near granitic mountains. Volcanic ash and tuffs also are present in some areas. On the other hand, factors possibly unfavorable to the formation or detection of uranium deposits in Tertiary sandstones of Alaska are: (1) high annual precipitation, especially in Southeastern Alaska where the rainfall is generally over 100 inches a year, (2) relatively steep dips in contrast to comparatively flat-lying beds of the western states, (3) apparent lack of pyrite and trace elements commonly associated with ore-bearing formations of the western United States, and (4) climatic changes since Tertiary time leading to the presence of permafrost in some Alaskan basins. In any case, very little has been done to investigate the uranium potential of Tertiary sandstones in Alaska, and apparently there has been no drilling to test these formations at depth other than in the Cook Inlet petroleum province.

Throughout Southeastern Alaska, Tertiary beds overlie Mesozoic and (or) Paleozoic rocks with a pronounced unconformity. Dips vary from 8° in some places at Port Camden to 60° south of Kootznahoo Inlet. The sandstones and conglomerates are poorly sorted, compact, unmetamorphosed, and cross-bedded. They consist of an assortment of rock detritus which includes quartz, shale, phyllite, and volcanics. Interbedded coal lenses and plant fossils are common.

Tertiary sediments remain today in the following areas:

- The Kootznahoo Inlet-Mitchell Bay area near Angoon on the west side of Admiralty Island, where approximately 36 square miles are underlain by sandstones and conglomerates with small amounts of shales and coal;
- Little Pybus Bay on the southeast side of Admiralty Island, which contains about 5 square miles of sandstone;
- Port Camden area on Kuiu Island, which contains the most complete section of Tertiary beds; and the nearby Hamilton Bay area of Kupreanof Island;
- Cleveland Peninsula near Ketchikan, where sediments are exposed for a short distance along shore;
- Coal Bay on the south side of Kasaan Bay, Prince of Wales Island; and
- Zarembo Island, along the southwestern coast.

Sedimentary rocks possibly correlative with the sandstones of the Kootznahoo Inlet area are exposed on Pleasant Island in Icy Strait north of Chichagof Island.

In the present study, only three areas of Tertiary sandstones were examined. For the report they are described later under the titles: Kootznahoo Inlet-Mitchell Bay area, Admiralty Island; Port Camden Area, Kuiu Island; and Zarembo Island Area.

The Tertiary rocks in these six areas consist of volcanics and continental sandstones and conglomerates. The volcanics, including flows, sills, agglomerates, and breccias, are more widespread than the sandstones. In some places the volcanic rocks are interbedded with or overlie the sandstones. The sandstones and conglomerates in Southeastern Alaska occupy troughs created during Paleocene through Miocene time. Though now separated, these strata may once have been parts of a more or less continuous deposit over an extensive area. The sandstone formation of the Kootznahoo Inlet-Mitchell Bay area is probably 5,000 feet thick. A map by Brew, Loney, and Muffler (1966, p. 165) shows an interpretation of Tertiary paleogeography in which a belt 200 miles long and about 30 miles wide is inferred to have extended from the northern part of Admiralty Island to the middle of the western side of Prince of Wales Island. The map shows a core of volcanic rocks surrounded by sandstones and conglomerates.

URANIUM IN PEGMATITE DIKES

Quartz and alkali feldspars frequently separate from cooling magmas to form pegmatite dikes, which may contain concentrations of rare metals, including thorium and uranium. This type of deposit may produce some fine specimens and small amounts of high-grade radioactive material, but there are few pegmatites in the world mined for uranium and so far none in Alaska (Sainsbury, 1957). In the Bokan Mountain uranium-thorium district, radioactivity has been found at scattered prospects in pegmatite dikes as well as in aplite and dacite dikes. Radioactive pegmatites have also been discovered at the BBH claim on Endicott Arm and in pods of feldspar at Dall Bay. These localities were visited during 1970 and are described below under appropriate titles. Regardless of composition, such dikes are probably most valuable as indicators or guides to possibly more extensive deposits rather than being of commercial value in themselves.

MISCELLANEOUS DEPOSITS

Three localities (not listed in table 1) where radioactivity was very low, but where the mineralogy was favorable or rare-earths were detected, may have possibilities for uranium. These are:

> Admiralty Island, 5 miles west-southwest of the head of Seymour Canal (King Salmon Bay area). Yttrium, zirconium, niobium, thorium(?) and the rare-earth elements lanthanum, cerium, praseodymium, and neodymium were detected by X-ray spectroscopic analysis of heavy minerals from pegmatite veins (Lathram, Pomeroy, Berg,

and Loney, 1965, p. R43, R45).

- Sandy Cove prospect at Glacier Bay. Quartz monzonite bedrock contains allanite plus copper, gold, silver, molybdenum, and bismuth in a mineralized zone (MacKevett, Brew, Hawley, Huff, and Smith 1967, p. 114-115).
- Goddard Hot Springs area, west side of Baranof Island. Stream gravel concentrates yielded from 0.012 to 0.016% equivalent uranium, probably due to thorium in allanite. Radiometric surveys located no radioactive mineral concentrations, but the background over granite areas was considerably above that of metasedimentary rocks (West and Benson, 1955, p. 47-49).

SUGGESTIONS FOR PROSPECTING

In general, igneous rocks that are late-stage differentiates of granite or syenite, including leucogranite, late rhyolite, aplite, alkalic syenite, and phonolite, have been found to contain the greatest amount of uranium (Faul, 1954, p. 86). Also, uranium is more often found at the border zones of batholiths and peripherial to mineralized districts.

Intrusive rocks are scattered throughout Southeastern Alaska (fig. 3), but geologic mapping of some portions is incomplete or does not distinguish the more acidic granites from the intermediate igneous types. Thus, the most favorable rock types cannot generally be pinpointed from published maps alone, and considerable field work is normally required.

Veins containing copper, lead, silver, cobalt, and nickel should be checked for radioactivity. In British Columbia, molybdenite is found to be the sulfide most commonly associated with uraninite (Stevenson, 1951, p. 362). Hematite (both the specular and the red varieties, including hematitic jasper) and fluorite are probably the most universal gangue minerals associated with uranium deposits.

The fact that commercial radioactive ore has been found in a soda-rich granite in Southeastern Alaska suggests that similar granites offer the most potential in the region. Exploration can be guided by geologic data that indicate the location of acid rocks intruded at shallow depths subsequent to major orogenic activity, especially those high in soda-rich feldspars, amphiboles, and accessory minerals, and granites having zones or borders displaying albitization. Soda-rich granites have also been noted to be favorable for uranium in other areas outside Alaska (Clark and Washington, 1924, p. 107; Faul, 1954, p. 84, and table 2.2.2; Lang, 1949, p. 8). The alkalic syenite near Tenakee Inlet on the east side of Chichagof Island may offer possibilities.

Areas to consider for uranium exploration in Southeastern Alaska should include the intrusive rocks bordering mineralized districts especially the Ketchikan-Prince of Wales Island copper district, the Chichagof copper mining area, and the Hyder district. However, widespread distribution of radiometric showings and sulfide mineralization in Southeastern Alaska indicate that no part of the region can be completely eliminated from prospecting for uranium deposits.

While the characteristics of Tertiary sandstone and conglomerate in Southeastern Alaska do not appear to be favorable for commercial uranium deposits, anomalous radioactivity was detected at a few places. There is no information to indicate that the beds have been tested at depth.

Aerial radiometric surveys from low-flying aircraft are the most rapid means of prospecting large areas, but because of the ruggedness of Southeastern Alaska, the method has its limitations. Geochemical techniques are applicable in some areas. Stream-sediment, soil, and mulch samples can be analyzed for uranium to a sensitivity of 1 ppm. Geobotanical prospecting and the analysis of ashed plant material may be useful in outlining a uranium deposit beneath soil. Field work by the author (Eakins, 1970) at the Ross-Adams mine has shown that the deposit has a strong expression in stream sediments and several types of organic material, especially lodgepole pine.

INVESTIGATIONS BY THE DIVISION IN 1970

WILLIAM HENRY BAY AREA

LOCATION AND ACCESS

The Lucky Six Claim Group, hereafter referred to as Lucky Six claims, is located on the west side of Lynn Canal, approximately 42 miles northwest of Juneau (figs. 1, 4). These claims lie between 1,500 and 2,000 feet above sea level on a ridge 1-1/2 miles south of Endicott River and 2 miles north of the mouth of William Henry Bay. It is a steep, difficult climb on foot from the coast. But above 1,500 feet, the claims are mostly above timber line and the bedrock is exposed in many places. The locality was visited in early June, and about two-thirds of the area occupied by the claims was still snow-covered, prohibiting full examination of the ground.

Figure 3 Acid and intermediate intrusive rocks, Southeastern Alaska

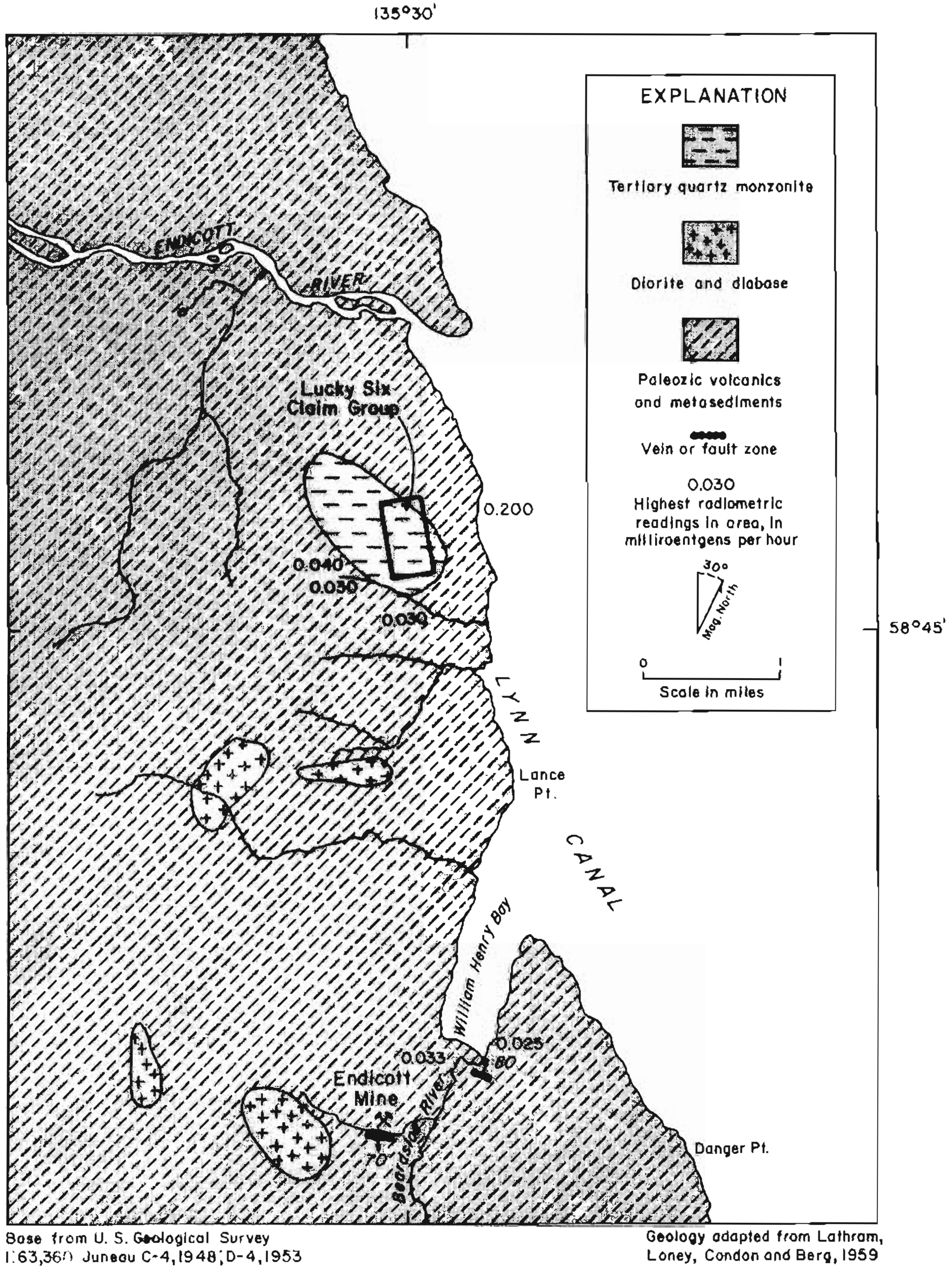


Figure 4. Locations of veins, intrusive rocks, radiometric readings, and Lucky Six claim group, William Henry Bay area (fig. 1, area 1)

HISTORY

A radioactive anomaly was detected from the air by prospectors during the 1950's. Shallow prospect pits, trenches, and one diamond-drill hole revealed mineralized material. One sample was reported to contain 0.20% eU (equivalent uranium), but a commercial deposit was not indicated.

GEOLOGY

The area considered here lies between William Henry Bay on the south and the Endicott River on the north. The geology of the area has been discussed by Berg (1960, p. B39); Herbert and Race (1964, p. 10; 1965, p. 25-26); MacKevett (1957, p. 175); Matzko and Freeman (1963, p. 44); Mertie (1921, p. 109-112); and Twenhofel, Reed, and Gates (1949, p. 28-30).

The Lucky Six claims are situated on the southeastern edge of a small Tertiary quartz monzonite intrusive that is exposed over an area of approximately three-fourths of a square mile. The intrusive is surrounded by Paleozoic volcanics and metasediments (fig. 4). The general strike of the strata and the dominant structures is north to northwest. However, the geology is complex, the rocks are metamorphosed, and subordinate east-west faults cut the major structures.

About 1/2 mile south of the mouth of the Endicott River, a predominantly carbonate sequence containing argillite and basalt dikes is in contact with an altered sequence of volcanics to the south. The contact is well-exposed on the coast and appears to be a northwest-trending fault. Small diorite and diabase intrusives lie west and north of William Henry Bay.

MINERAL DEPOSITS

Two prospect pits on the Lucky Six claims (fig. 5) expose zones containing soft, vuggy, black- and red-stained fractured material. No well-defined veins were visible, but a prominent fracture in pit No. 2 strikes N 5° E and dips 80° W. Fractures in pit No. 1 also seem to trend northeast. The intrusive underlying the claims is a light-gray porphyry with feldspar crystals up to 1-1/2 inches long. There is an abundance of altered mica throughout the rock, which is especially noticeable on fractures and in vugs. Some brecciated, fine-grained, siliceous rock was found on the surface 150 feet southwest of pit No. 1, which may represent an extension of a crushed zone from that pit. Traces of thorianite in small red patches were reported by Matzko and Freeman (1963), and scattered grains of euxenite were reported by MacKevett (1957). Rare earths were found by Lathram, Loney, Condon and Berg (1959) in a sample containing pyrite, chalcopyrite, galena and sphalerite.

Copper ore has been mined from the Alaska Endicott Mining and Milling Company mine located in the valley 3/4 mile southwest of the head of William Henry Bay at an elevation of 160 feet (fig. 5). Development was done between 1916 and 1920. The ore zone cuts greenstone country rock and consists of an irregular quartz-calcite brecciated zone averaging 10 feet wide. The strike is east and the dip averages 80° S. The ore mineral was chalcopyrite. Pyrite and traces of gold and silver were also present. Underground work consisted of 1800 feet of tunneling and some stopes. Other copper claims have been staked on the south side of William Henry Bay and near Lance Point on the north side of the bay.

A 200-square-mile area with widely distributed gossans north of the Endicott River was reported by Berg (1960). The gossans contain showings of cobalt, copper, zinc, and lead. Berg indicated that they have not been adequately explored.

RADIOMETRIC SURVEY

Foot traverses with a scintillometer showed the intrusive on which the Lucky Six claims are located to have an overall anomalous amount of radioactivity. The radiometric response increased from 0.01 mr/hr (milliroentgens per hour) or less on the volcanic rocks along the coast to 0.04 mr/hr on the intrusive. The average in the area of the claims was about 0.03 mr/hr, but readings to a maximum of 0.20 mr/hr were obtained in the bottom of prospect pit No. 2. Wherever the scintillometer was placed in a hole or pit, a pronounced increase in radioactivity was recorded because of the mass effect of the bedrock.

A radiometric survey was made of the Lucky Six No. 1 claim and part of the Lucky Six No. 4 claim using a Detectron Model DG-7 geiger counter. This instrument is not as sensitive as the scintillometer, but the readings ranged from 0.015 to 0.200 mr/hr (fig. 5). Three samples taken by the author from prospect pits Nos. 1 and 2 were assayed for uranium and yielded 27, 11, and 8 ppm U. These values may be compared with the average of 4 ppm for acid igneous rocks.

A fault zone near the head of William Henry Bay gave an increase in response up to 0.033 mr/hr from the nearby background of 0.012 mr/hr. This locality is discussed under Geochemistry. Ore from the mill ruins near the old Endicott Mine did not show any radioactivity.

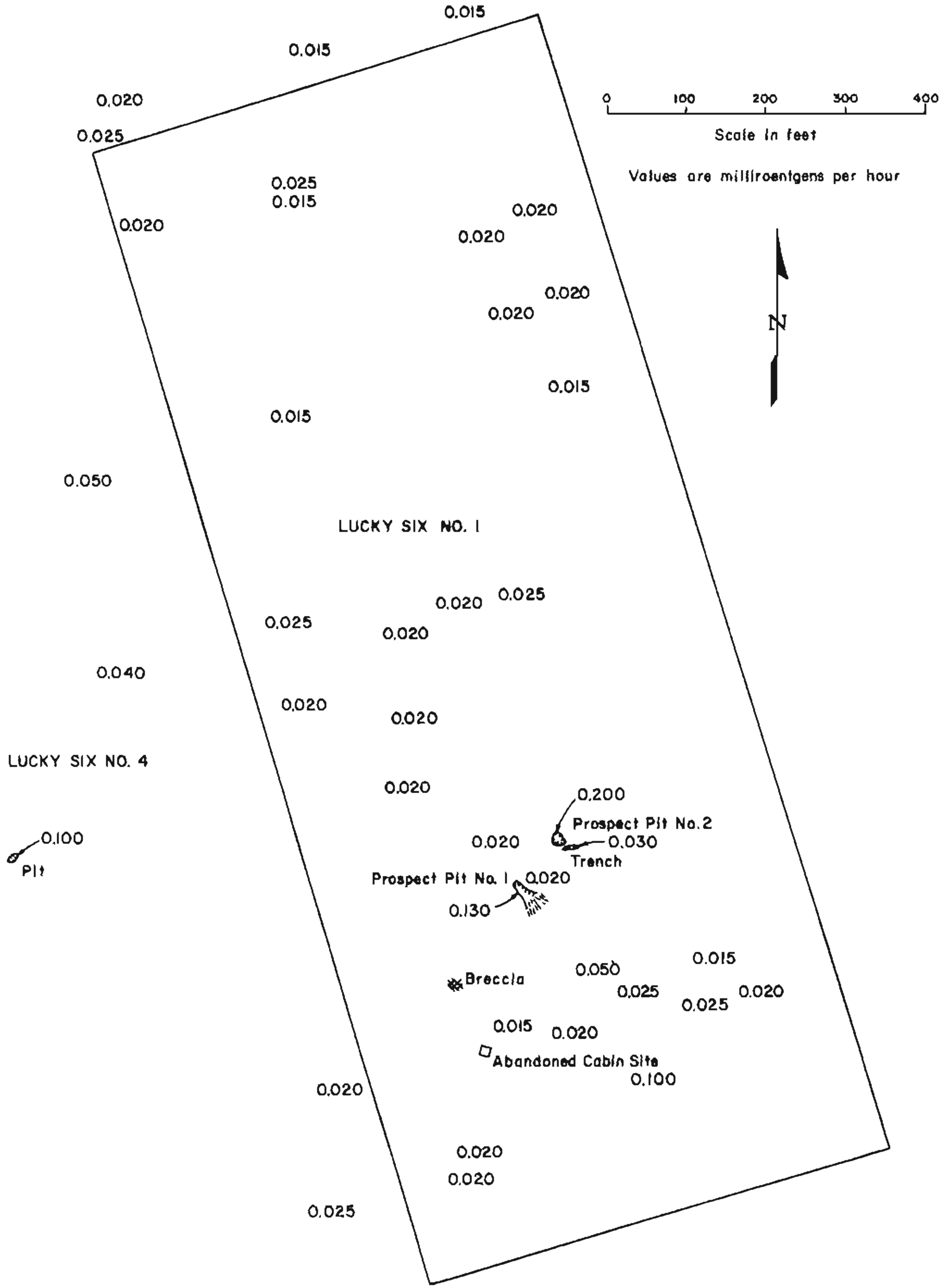


Figure 5 Radiometric survey on Lucky Six No. 1 claim

GEOCHEMISTRY

Six stream-sediment samples and one soil samplè were collected on the south side of the Lucky Six claims. Eleven stream-sediment samples were also collected from the William Henry Bay area (fig. 6). Atomic absorption analyses are given in table 2. Histograms appear in figure 7. Anomalous values from samples taken near the Lucky Six claims were as follows: copper, 140, 160, 175, 180, and 190. The copper anomalies may be derived from disseminated minerals in the intrusive. The stream, however, was not followed above 1,450 feet, and it is possible that veins exist higher in the drainage.

TABLE 2.-*Atomic Absorption Analyses, William Henry Bay Area* (anomalous values underlined)

Location on Figure 6	Field Sample Number	Copper ppm	Lead ppm	Zinc ppm
	(Lucky Six Claim Group)			
1	P3	210	30	150
2	P12	140	20	75
3	P13	175	40	80
4	P2	190	35	130
5	P11	40	65	85
6	P1	160	35	120
7	P4	180	40	120
	(William Henry Bay Area)			
8	P10	45	20	135
9	P9	45	30	170
10	P8	45	20	255
11	P7	35	20	130
12	E1	55	15	100
13	E2	55	70	2000
14	E3	35	95	670
15	E4	60	90	2700
16	E5	55	45	1350
17	P5	55	60	1850
18	P6	45	140	1500

High zinc values were obtained from sediment samples taken from a stream near the head of William Henry Bay draining the ridge on the south side. This anomaly has been reported previously (Herbert and Race, 1964, p. 10, 11, 1965, p. 25-27). Five samples (fig. 6, locs. 13-17) collected from this stream in 1970 produced zinc values of 670 to 2,700 ppm, copper 35 to 60 ppm, and lead 40 to 65 ppm. Sampling was done only to an elevation of 225 feet. A fractured iron-stained zone near the mouth of the stream probably represents east-west fault. A single sample collected near the mouth of the next stream southwest (fig. 6, loc. 18) yielded a zinc value of 1,500 ppm, copper 45 ppm, and lead 140 ppm. Two samples (fig. 6, locs. 9 and 10) collected from the northwest side of the bay, were slightly anomalous for zinc.

CONCLUSIONS

The small quartz monzonite intrusive just discussed has not been found to be commercial at or near the surface, but the amount of drilling done was probably insufficient to properly evaluate the area. The zinc anomaly obtained in streams draining the ridge south of William Henry Bay is very pronounced, and a copper anomaly is present in the stream south of the Lucky Six claims. It is not known if they have been prospected or sampled more extensively, but on the basis of the anomalies, the upper parts of the drainages in both areas should be examined and sampled.

KING SALMON BAY AREA, ADMIRALTY ISLAND

LOCATION AND ACCESS

The area investigated lies on a subsidiary peak between 1,500 and 3,000 feet elevation 3 miles west of the head of King Salmon Bay, on the northeastern part of Admiralty Island. It lies in the Juneau A-2 quadrangle, approximately 18 miles south of Juneau. A helicopter was chartered in Juneau for transportation to and from the locality.

GEOLOGY

A geologic map and bedrock descriptions by the U. S. Geological Survey (Lathram, Pomeroy, Berg, and Loney, 1965, p. R43) suggested to the author that a small felsic intrusive near King Salmon Bay should be examined for possible radioactivity.

West of the head of Seymour Canal an area of about 50 square miles of Paleozoic and Mesozoic migmatite, gneiss and schist contains, near its center, a felsic intrusive about a mile in diameter. The intrusive consists of allanite-biotite granite, biotite-quartz monzonite, and quartz-albite-microcline pegmatite. Rare-earth elements and possibly a trace of thorium in pegmatite dikes were located less than 2 miles north of

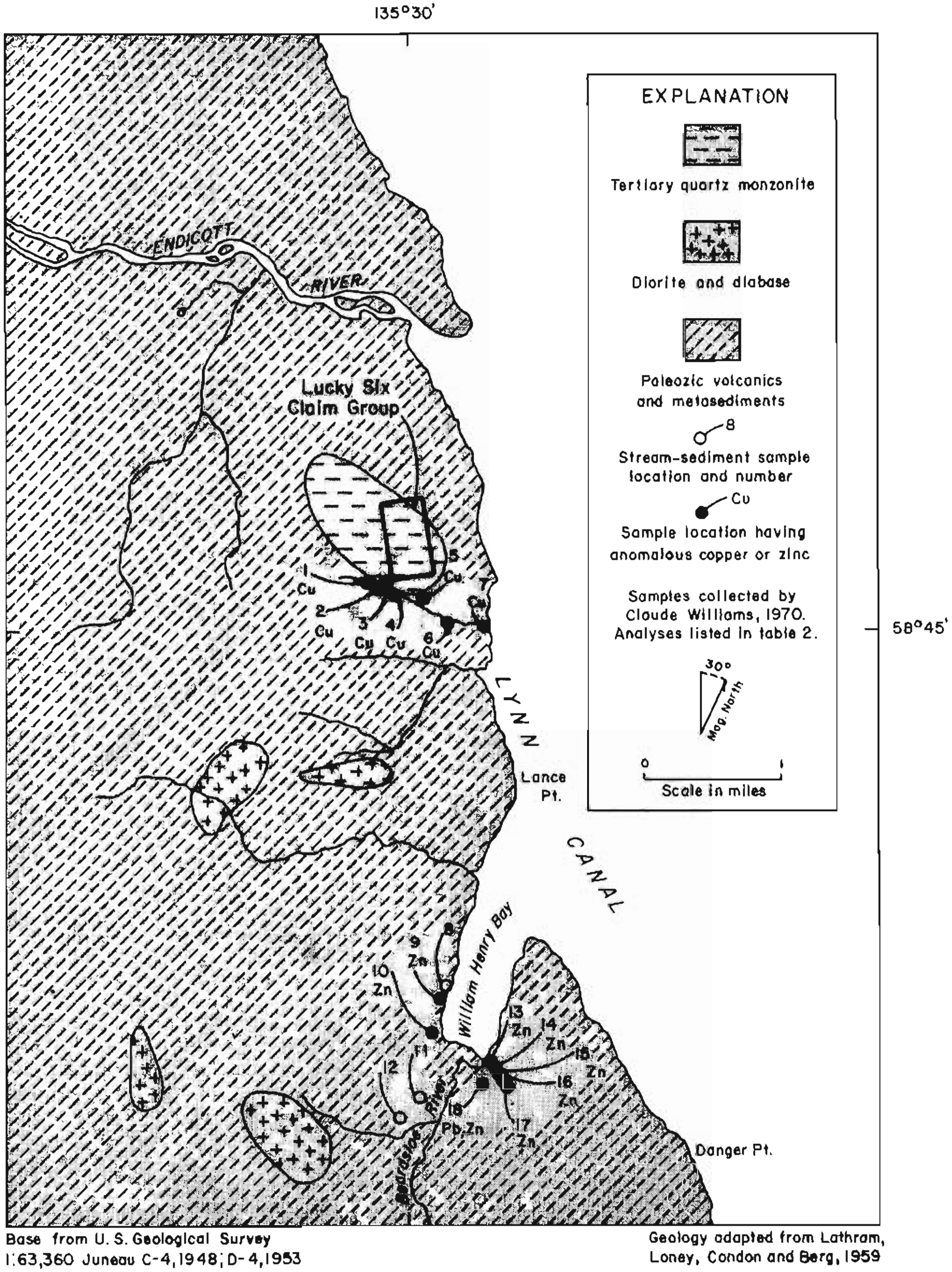


Figure 6 Locations of geochemical samples and intrusive rocks, William Henry Bay area (fig. 1, area 1)

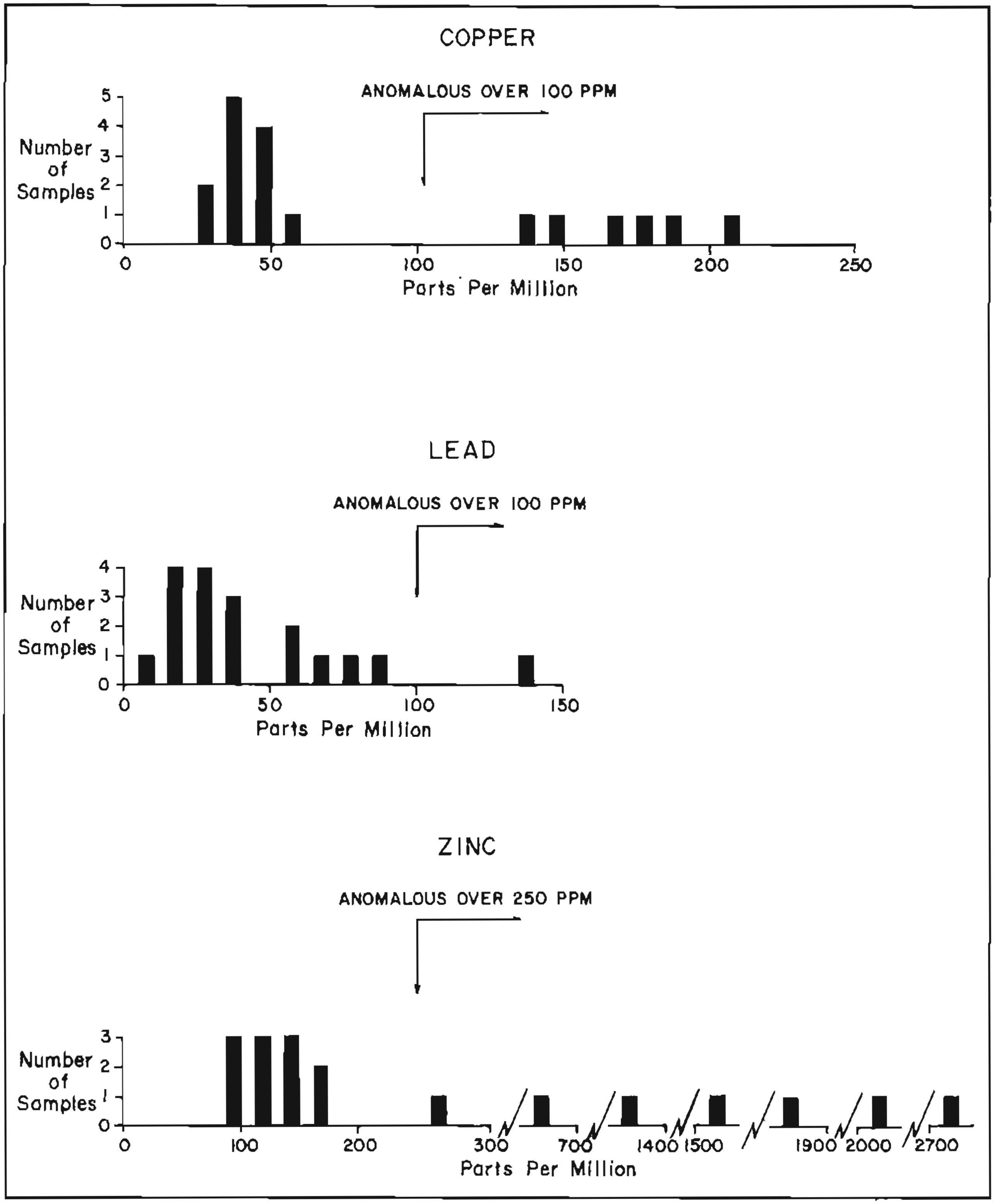


Figure 7 Frequency distribution histogram based on atomic absorption analyses for copper, lead, and zinc, William Henry Bay area

the granite (Lathram, Pomeroy, Berg, and Loney, 1965, p. R43). That report plus knowledge of the composition of the granite intrusive suggested the possibility of uranium in the granitic rock. Some of the granitic outcrops weather nearly white. No sulfide minerals were found except a small amount of pyrite in migmatite near the margins of the intrusive. Iron staining was heavy near the head of a draw on the north side of the peak at 2,200 feet, and small veinlets and pods of white, massive quartz are present in the migmatite contacts at two or three locations. The largest quartz pod seen was 2.5 feet. A pegmatite dike 1 x 10 feet containing quartz, feldspar, and biotite was found to be barren of sulfides and radioactivity. The pegmatite dikes reported by the U.S. Geological Survey to the north were not examined.

MINERAL DEPOSITS

No mineral deposits or prospects are known to be in the area visited by the author. The iron-stained zone and small quartz pods near the margins of the intrusive do not appear to contain ore minerals.

Copper and nickel deposits in a mafic intrusive are located near Funter Bay 25 miles to the northwest. A copper prospect is near the coast of Seymour Canal west of Swan Island, 8 miles southeast of the felsic intrusive.

RADIOMETRIC SURVEY

Foot traverses with a scintillometer across the intrusive yielded responses from 0.005 to 0.02 mr/hr. The higher readings were obtained over localized zones of pegmatitic granite. General radioactivity was no higher than would normally be expected over acidic rocks.

GEOCHEMISTRY

Four stream-sediment samples were collected from short streams draining the steep walls of a cirque 1/2 mile west of the peak that had been examined for radioactivity (fig. 8). Atomic absorption analyses are given in table 3. The highest values obtained were 65 ppm copper, 25 ppm lead, and 70 ppm zinc. None was anomalous.

CONCLUSIONS

No significant radioactivity was detected at the felsic intrusive near King Salmon Bay, and prospecting for uranium there is not encouraged.

TABLE 3.-*Atomic Absorption Analyses, King Salmon Bay Area*

Location on Figure 8	Copper ppm	Lead ppm	Zinc ppm
1	65	20	55
2	60	25	55
3	55	25	70
4	55	15	70

TRACY ARM AREA, CHICHAGOF ISLAND

William Huff (written communication, 1970) reported that while using an airborne scintillometer he encountered a radiometric anomaly on the east side of the entrance to Tracy Arm. The location was estimated by him to be approximately 57°50'N, 133°33'W at an elevation of about 1,500 feet. This is in the Sumdum D-5 quadrangle approximately 50 miles southeast of Juneau (fig. 1).

The area is occupied by strongly foliated, northwest-trending schists and phyllites, and is near the western margin of the Coast Range batholith. The extensive Sumdum copper-zinc prospect is located 4 miles southeast at an elevation of 4,000 feet on both sides of and beneath the Sumdum Glacier (MacKevett and Blake, 1964). Several prospects containing copper, lead, zinc, and gold are on Tracy and Endicott Arms (Gault and Fellows, 1953; Herreid, 1962; Race, 1962).

The author visited the area for 1 day but never reached the location where the radioactive anomaly was believed to be. A foot traverse was made from the east shore of Tracy Arm, near its mouth, to an elevation of 1,000 feet. Scintillometer readings on the schist were between 0.005 and 0.01 mr/hr. It is possible that the radioactive anomaly reportedly detected from the air was due to outcrops of granodiorite containing considerably higher radioactivity than the surrounding schist. Dioritic boulders contain much visible disseminated pyrite and magnetite. No geochemical samples were taken.

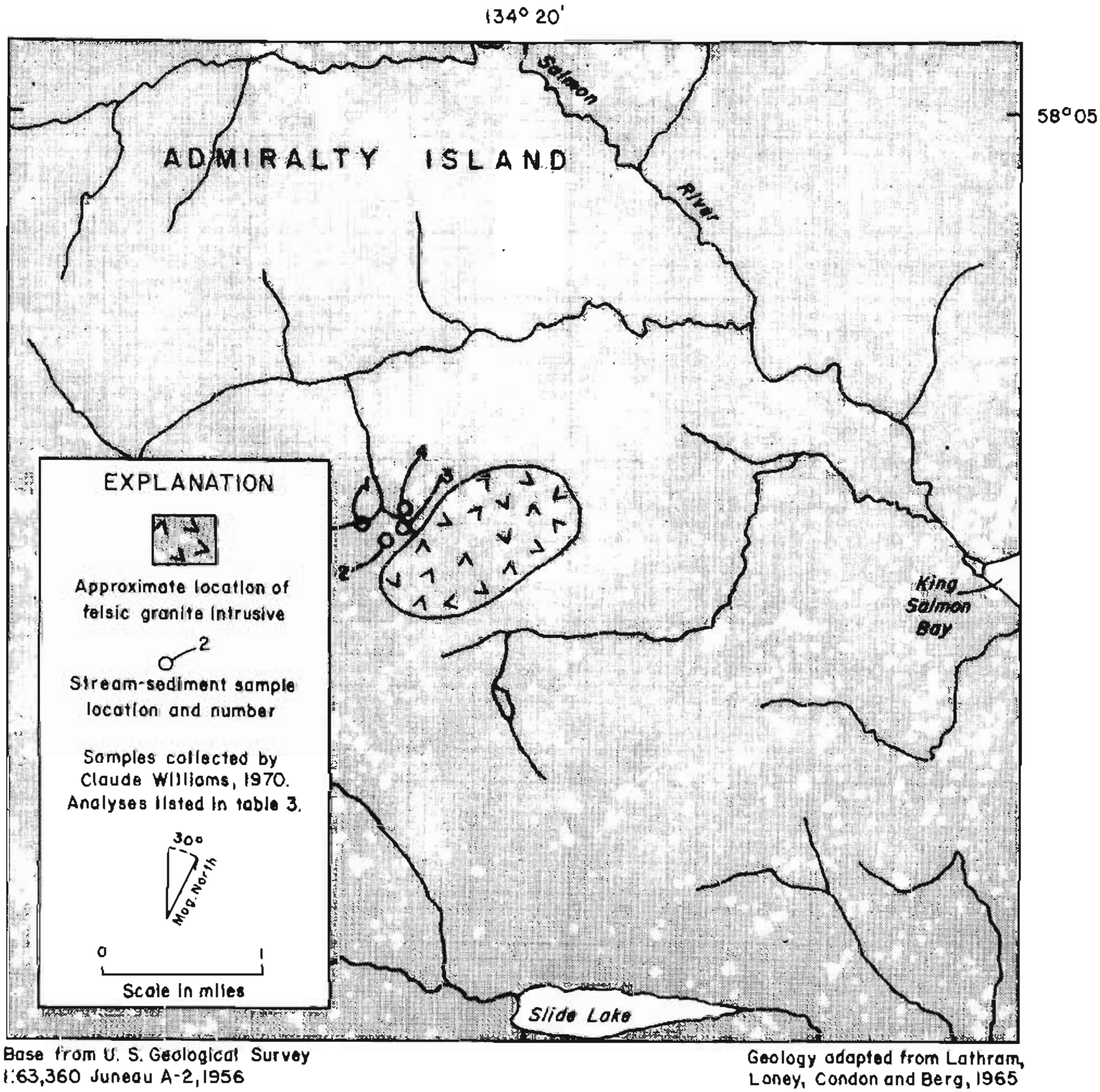


Figure 8 Locations of granite intrusive and stream-sediment samples, King Salmon Bay area, Admiralty Island (fig. 1, area 2)

TRAP BAY AREA, CHICHAGOF ISLAND

LOCATION AND ACCESS

Trap Bay is an indentation on the south coast of Tenakee Inlet, Chichagof Island, about three miles from Chatham Strait. The area visited is near the junction of the Sitka C-3, C-4, B-3, and B-4 quadrangles, 23 miles northwest of the village of Angoon. The area can be reached by boat or float plane. The Trap Bay locality was visited to examine a radioactive anomaly detected from the air while flying the Kook Lake area with a scintillometer.

GEOLOGY

The geology of the Trap Bay region has been mapped by Loney, Berg, Pomeroy and Brew (1963). Bedrock along the coast on the east side of the bay is Silurian(?) and Devonian(?) graywacke and argillite. These rocks are overlain by a thick unit of pebble to cobble conglomerate on the ridge east of Trap Bay. A stock of granodiorite crops out on the west side of Trap Bay. The east side of the stock along the valley at the head of Trap Bay and on the west side of the bay is bordered by a narrow zone of hornfels. Devonian limestone forms conspicuous bluffs on the north side of Tenakee Inlet opposite Trap Bay and forms a northwest-trending belt west of Trap Bay.

MINERAL DEPOSITS

A nickel-copper prospect known as the Big Ledge claim is located on the north side of Tenakee Inlet, 4-1/2 miles north of the head of Trap Bay (fig. 9). This deposit was described by Buddington (1925, p. 107-108). A basic dike 20 feet thick intruding conglomerate contains disseminated pyrrhotite, chalcopyrite, pentlandite, and a little sphalerite and pyrite.

Another prospect, the Three J claim, also on the north side of Tenakee Inlet, is about 3-1/2 miles northwest of Trap Bay (fig. 9). The claim covers a copper-molybdenum prospect consisting of veinlets and dikes which contain chalcopyrite and traces of molybdenum, nickel, zinc, and chromium (Berg and Cobb, 1967, p. 145, 146). Neither of the above claims was visited.

On the west side of Trap Bay near its head a shear zone in granodiorite contains considerable iron oxide and trace amounts of copper, cobalt, and zinc. Minor anomalous radiometric responses were noted.

RADIOMETRIC SURVEY

Foot traverses with a scintillometer along the shores of Trap Bay, Tenakee Inlet, and up a short stream draining into Trap Bay showed that coarse conglomerate on the ridge south of Tenakee Inlet produces an abnormally high radioactive back ground of 0.015 to 0.0025 mr/hr. Argillite and limestone bedrock in the area produced less than 0.010 mr/hr. The strongest radioactivity, 0.040 mr/hr, was found in crushed material containing iron oxides in the sheared zone cuting granodiorite at the head of Trap Bay. No radioactive minerals could be isolated and the radioactivity was limited to areas a few inches across on fracture surfaces.

GEOCHEMISTRY

Only two geochemical samples were collected at Trap Bay. These were from separate streams draining into the east side of the bay (fig. 9). Atomic absorption analyses are given in table 4. The highest values were: copper 80 ppm, lead 35 ppm, and zinc 160 ppm.

TABLE 4.-*Atomic Absorption Analyses, Trap Bay Area*

Location on Figure 9	Field Sample Number	Copper ppm	Lead ppm	Zinc ppm
1	E31	35	30	160
2	E145	80	35	40

The zinc value for sample location No. 1 is about 50% higher than amounts usually considered a high normal, but the importance of a single analysis is uncertain. The stream from which it was taken crosses conglomerate over most of its course, but cuts argillite below an elevation of 100 feet.

CONCLUSION

The anomaly detected at Trap Bay from the air apparently is due to the relatively high radioactivity of coarse conglomerate on the hill east of the bay. The

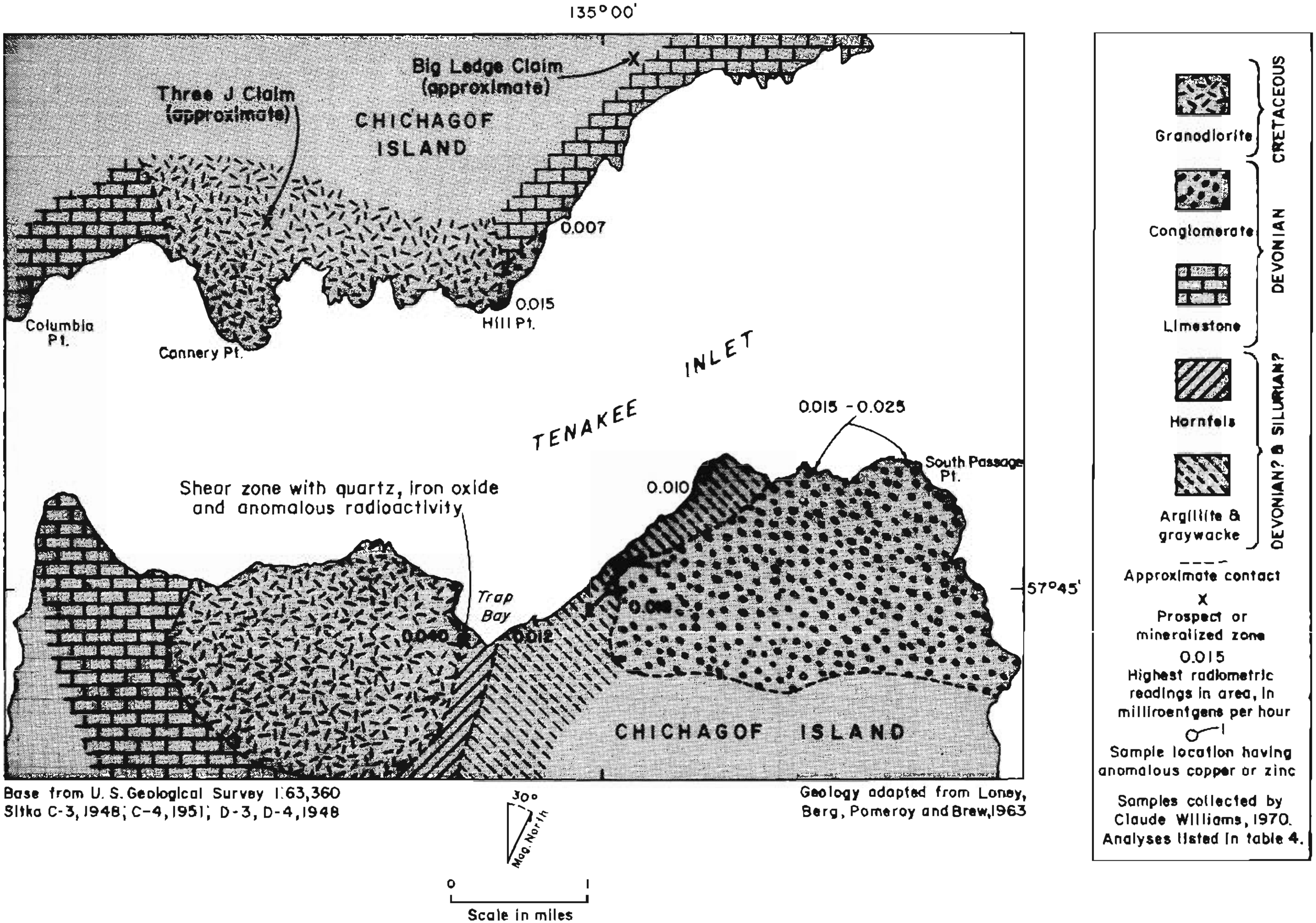


Figure 9 Geology, radiometric survey and stream-sediment sample locations, Trap Bay area, Chichagof Island

source of the radioactivity is probably the felsic igneous debris so abundant in the conglomerate. The radioactivity at the shear zone near the head of the bay is believed to be due to a trace of uranium or thorium, but it was not in sufficient quantity to encourage prospecting for these elements.

KOOK LAKE AREA, CHICHAGOF ISLAND

LOCATION AND ACCESS

Kook Lake is located on the eastern side of Chichagof Island one mile inland from the head of Basket Bay. It is in the Sitka C-3 and C-4 quadrangles, about 45 miles southwest of Juneau. Float plane is the most practical means of reaching the lake. A U.S. Forest Service cabin is maintained near a good beach at the west end of the lake. The village of Tenakee on Tenakee Inlet lies approximately 11 miles to the northwest. The terrain consists of steep mountains which rise abruptly to altitudes of 2,500 feet within 1-1/2 miles of the lake.

HISTORY

Most of the mining activity on Chichagof Island has been along the western edge of the island, especially in the old Chichagof mining district. Prospects on the eastern side are few, but some have been located 6 to 8 miles north of Kook Lake along Tenakee Inlet. A hot spring at Tenakee has been a health resort since the late 1800's. The Kook Lake area was chosen for examination because a sodalite syenite and a nepheline syenite mapped by Loney, Berg, Pomeroy, and Brew (1963) were considered to be favorable rock types for radioactive minerals.

GEOLOGY

The geology of the Kook Lake area is shown on a reconnaissance geologic map of Chichagof Island (fig. 10) compiled by Loney, Berg, Pomeroy and Brew (1963). A report on the ages of the plutonic rocks was prepared by Lanphere, Loney, and Brew (1965). The eastern third of Kook Lake lies in the northwest-trending belt of Devonian conglomerate, argillite and limestone. The limestone forms conspicuous white bluffs at the northeast end of the lake. Coarse conglomerate is present between limestone outcrops on the southeast side. Sodalite syenite and nepheline syenite of early Paleozoic age border the western part of the lake. Several kinds of Paleozoic granite occupy the area west of the Devonian sediments between Peril Strait south of Kook Lake and Tenakee Inlet to the north.

MINERAL DEPOSITS

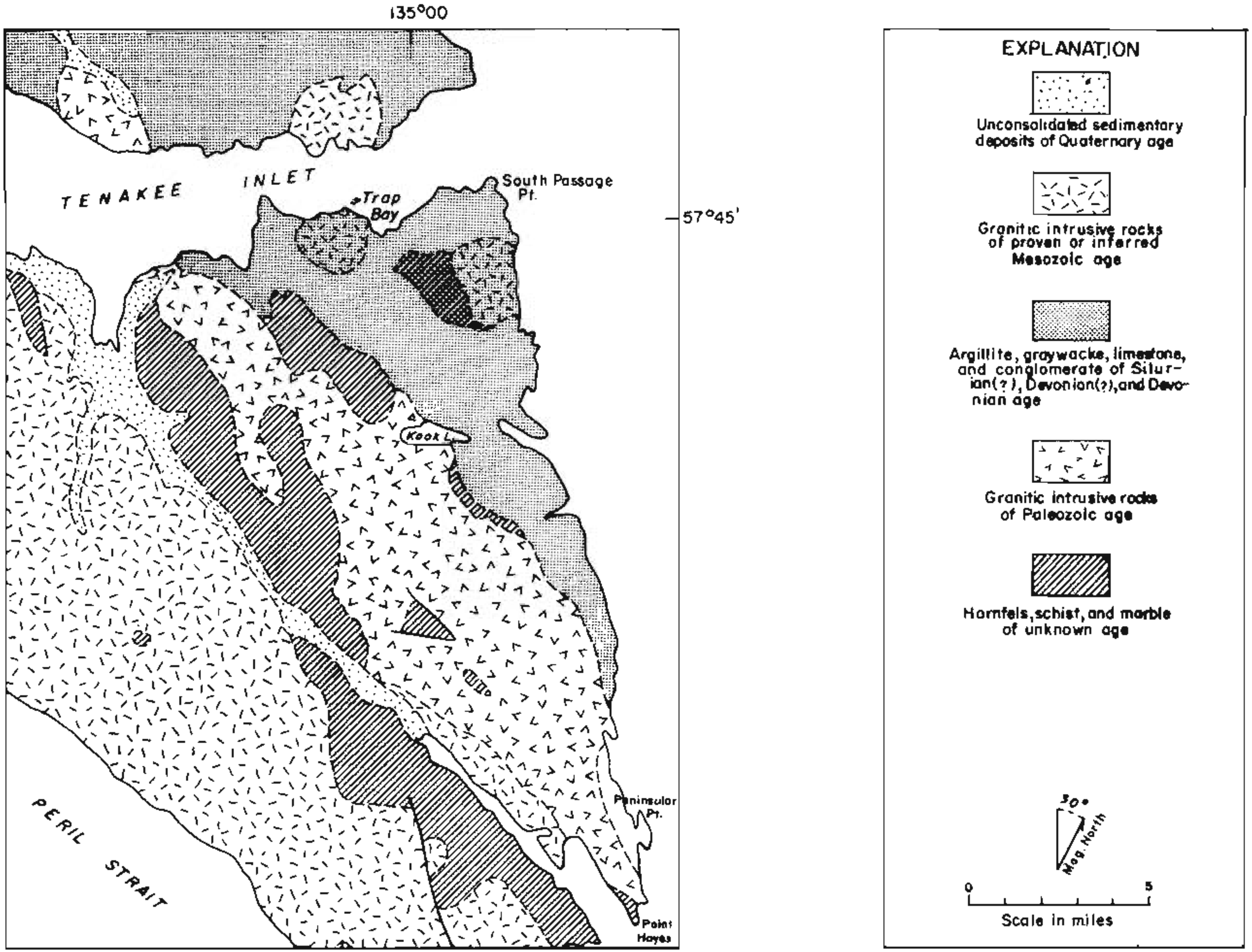
Mineral deposits or prospects are not known in the immediate vicinity of Kook Lake. Prospects are present near the entrance to Tenakee Inlet where minor quantities of copper, lead, zinc, nickel, molybdenum, and chromium have been reported from mafic and felsic dikes. Along a stream entering the southeast end of Kook Lake the author found considerable pyrite in small felsic intrusives in limestone. Pyrite was also found in pods up to 2 inches thick with much iron oxide at 600 feet elevation along a large stream draining a cirque south of the ridge south of Kook Lake. One 10-inch piece of float assayed 0.012 oz/T gold, 0.014 oz/T silver, and 0.004% copper. A sample of iron-stained material with an abundance of pyrite from a zone between geochemical sample locations 3 and 4 (fig. 11) yielded 10 ppm uranium, approximately twice the average uranium content of acid agneous rocks. The sample also yielded a trace of gold.

RADIOMETRIC SURVEY

Foot traverses with a scintillometer were made along streams south of Kook Lake (fig. 11). The radiometric background was between 0.005 and 0.010 mr/hr. A response up to 0.050 mr/hr was encountered at an elevation of 500 feet on the south side of Kook Lake where fractures cut basic dikes. Outcrops of syenite (?) in this area gave readings up to 0.020 mr/hr.

Another low-grade anomaly of 0.030 mr/hr was found at an elevation of 450 feet at geochemical sample location 36 near the southeast end of the lake. In contrast, limestone and conglomerate beds in that area produced only 0.005 mr/hr.

A one-hour flight in a light plane with a scintillometer probe tied outside the cabin was made over the east side of Chichagof Island from Tenakee Inlet south to Kitkoh Bay in an attempt to locate any radiometric anomalies present in the various intrusives in the area. The terrain flown was very rugged and flying conditions were poor. There was little control as far as maintaining constant speeds or distance above ground, and radiometric readings



Geology after Loney, Berg, Pomeroy and Brew, 1963.

Figure 10 Generalized geologic map, Kook Lake area, Southeastern Alaska (fig. 1, area 5) therefore were rather haphazard. The pilot attempted to contour-fly a number of the mountain peaks at distances between 300 to 600 feet. During most of the flight the responses were under 100 counts per minute. The highest readings, 180 counts per minute were obtained over a 3,000-foot mountain on the south side of an unnamed lake two miles south of Basket Lake, and over the ridge just east of Trap Bay near the entrance to Tenakee Inlet. Only the anomaly at Trap Bay was checked on the ground.

GEOCHEMISTRY

Stream-sediment samples were collected at 44 localities in the Kook Lake area (fig. 11). Atomic absorption analyses are given in table 5. Histograms appear in figure 12. Slightly anomalous values were: copper, 80 and 90 ppm; lead, 55, 75, 85, and 225 ppm; and zinc, 210, 210, 220, 230, 250, 275, and 290 ppm.

Seven zinc values considered anomalous were from sample locations 16, 25, 26, 27, 28, 30, and 38. Five of these were from the stream south of the west end of the lake between elevations of 500 and 1,000 feet. The bedrock is granite. One sample is from near the head of a stream on the south side of the lake, and one is from a small stream on the north side. The highest lead value, 225 ppm, was from the area at the southeast end of the lake.

TABLE 5.-*Atomic Absorption Analyses, Kook Lake Area* (anomalous values underlined)

Location on Figure 11	Field Sample Number	Copper ppm	Lead ppm	Zinc ppm
1	P44	30	15	80
2	P45	40	20	100
3	P46	20	25	110
4	P47	30	35	115
5	P48	20	25	95
6	P49	30	25	110
7	P50	35	30	170
8	P51	30	25	110
9	P52	25	20	115
10	P53	20	20	110
11	P54	20	20	100
12	P64	25	20	75
13	P65	20	20	75
14	P63	15	20	80
15	P66	15	15	65

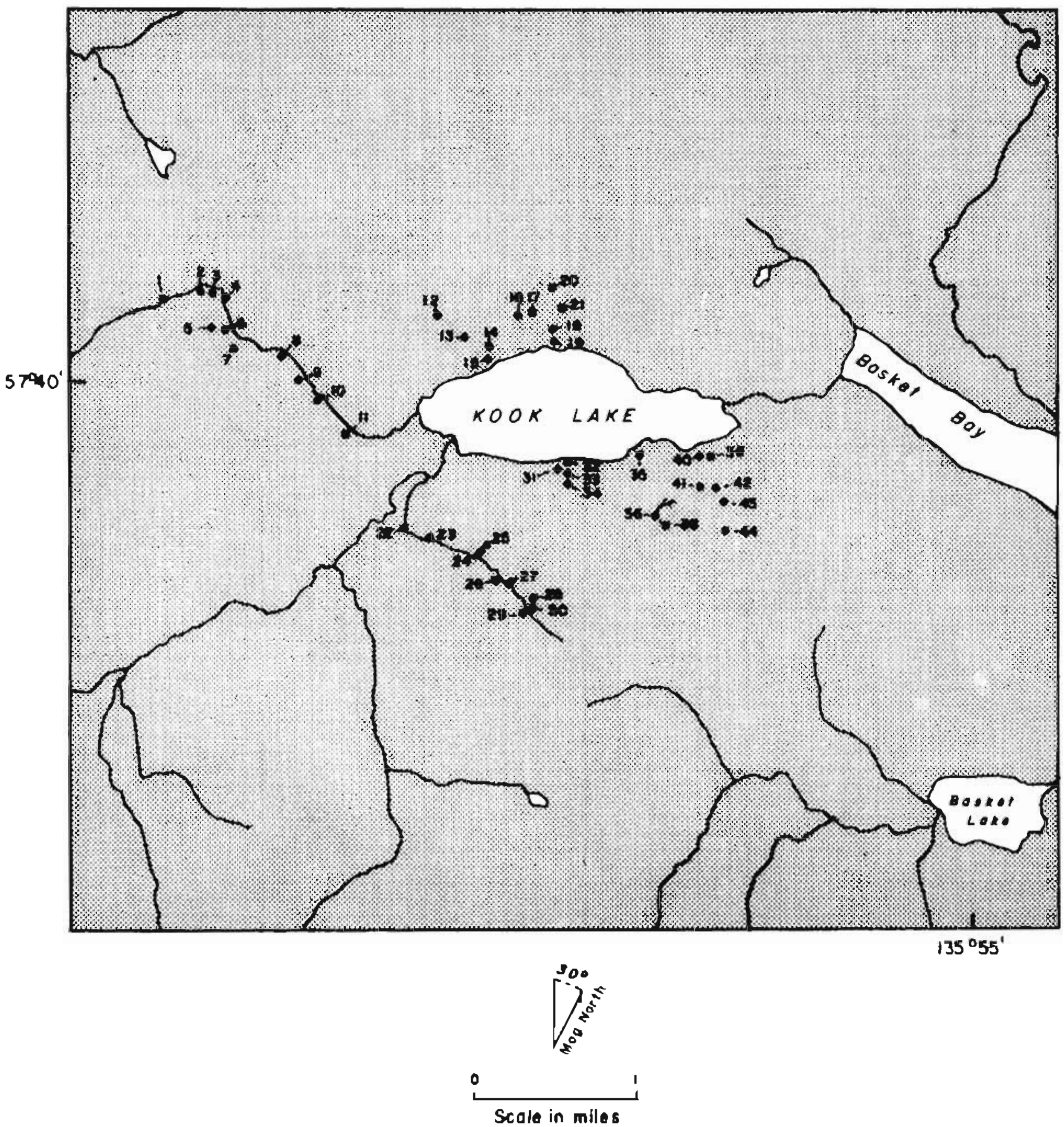
TABLE 5.- *Atomic Absorption Analyses Kook Lake Area* -Continued

Location on Figure 11	Field Sample Number	Copper ppm	Lead ppm	Zinc ppm
16	P62	25	25	275
17	P61	20	15	90
18	P60	60	15	70
19	P59	65	20	90
20	P57	60	20	75
21	P58	60	20	75
22	P43	10	10	50
23	P42	40	35	190
24	P41	40	35	180
25	P40	40	30	290
26	P39	45	35	210
27	P38	40	45	210
28	P37	35	55	250
29	P36	10	85	190
30	P35	20	75	220
31	E16	15	15	85
32	E14	20	20	100
33	E15	20	35	95
34	E16	15	15	85
35	E9	35	20	95
36	E10	40	20	40
37	E12	25	15	30
38	E11	55	25	230
39	E5B	95	35	110
40	P56	45	15	95
41	P55	45	15	100
42	E8	55	40	150
43	E6	55	225	140
44	E7	80	45	160

CONCLUSIONS

The radiometric responses encountered near Kook Lake did not indicate uranium deposits. However, above average radioactivity was generally found in the country rocks. This investigation was very limited, but the intrusives occupying a much larger portion of the east side of Chichagof Island appear to offer possibilities. The flight over these was inadequate, and more controlled aerial surveys with the proper equipment might produce more positive results.

A sample of light-colored granitic rock from 1/2 mile south of the west end of Kook Lake was analyzed for uranium and showed 10 ppm eU, which is twice



EXPLANATION

• 1-44 Stream sediment sample location and number
Analyses are listed in table 5

Figure 11 Stream-sediment sample locations, Kook Lake area, Chichagof Island (area shown on figure 10)

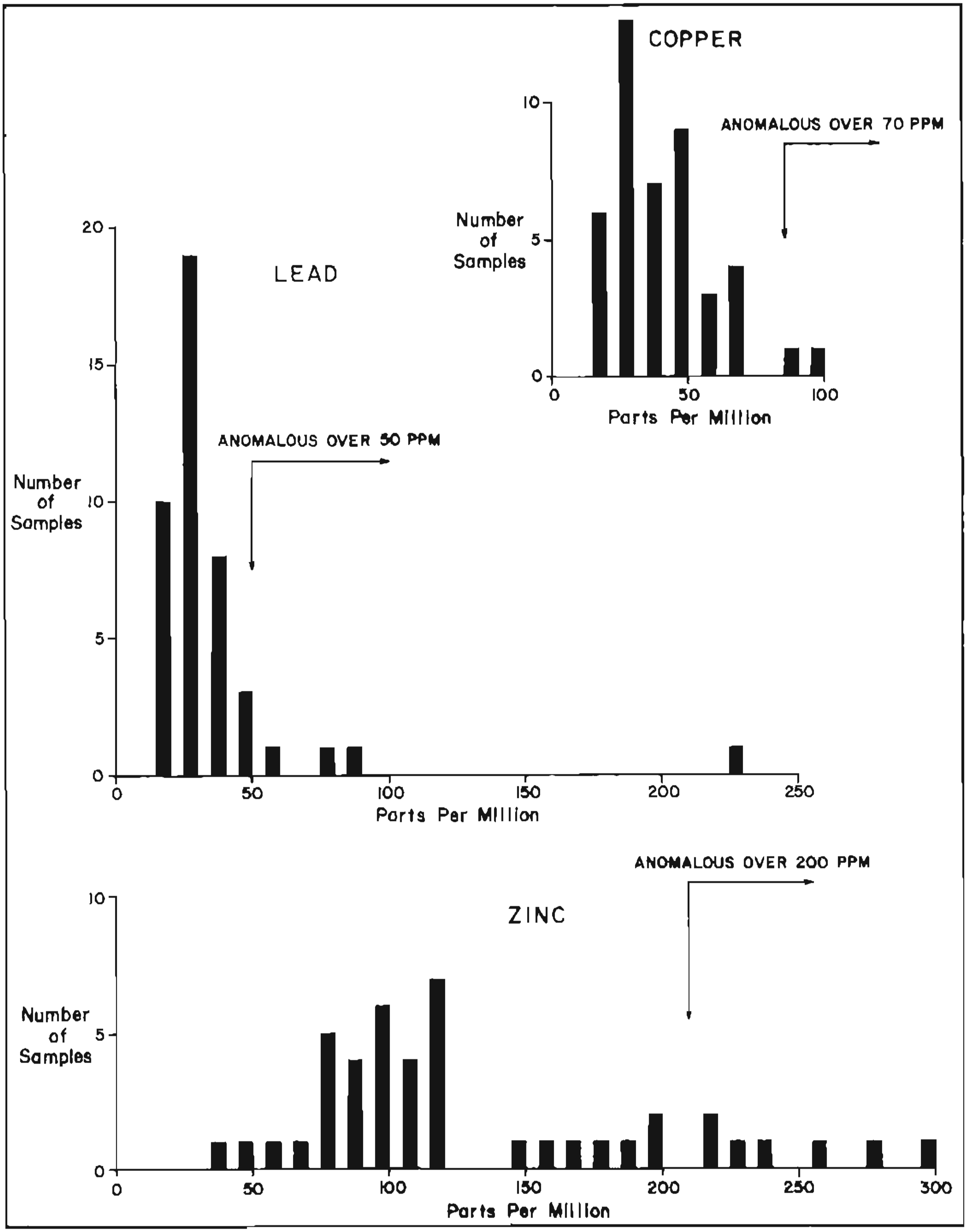


Figure 12 Frequency distribution histogram based on atomic absorption analyses for copper, lead, and zinc, Kook Lake area

the average for acid igneous rocks. Anomalous values for lead and zinc from stream-sediment samples suggest that the area could contain concentrations of base metals.

KOOTZNAHOO INLET-MITCHELL BAY AREA ADMIRALTY ISLAND

LOCATION AND ACCESS

Kootznahoo Inlet and Mitchell Bay are in an area of low relief on the west side of Admiralty Island near its midpoint in the Sitka B-2 and C-2 quadrangles. Angoon, the only permanently inhabited village on the island, is near the entrance to Kootznahoo Inlet about 43 miles northwest of Sitka. Angoon is served by scheduled flights from Juneau and Sitka. Landings by chartered float planes may be made anywhere in Mitchell Bay. Numerous narrow waterways make it possible to examine well-exposed Tertiary sandstones along the shores by small boat. However, very strong tidal currents in Kootznahoo Inlet and Davis Creek make it advisable for small craft to travel these narrows during slack tide.

HISTORY

No metallic mineral deposits have been discovered in the area. Exploration has been restricted to the search for coal, which has been found in the lower part of the Tertiary sequence. The first coal sample reported from Mitchell Bay was submitted to the Navy Department in 1896. The coal prospects have been described by Wright (1906, p. 153, 154), and Dall (1896, p. 776-783). These apparently were all abandoned by the time of Wright's investigation, having been found unsuitable for use by the Navy. Ruins of the most extensive operation are still evident on the south side of Kanalku Bay (fig. 13). Brief examinations of the sediments in the area, possibly for uranium, are rumored to have been made in recent years by petroleum company geologists.

GEOLOGY

The following summary of the geology of the Kootznahoo-Mitchell Bay area is taken from Buddington and Chapin (1929, p. 261-263), Lathram, Pomeroy, Berg, and Loney (1965), and Smith 1939). Approximately 36 square miles are occupied by nonmarine sediments belonging to the Kootznahoo Formation, which is present in the low areas around Kootznahoo Inlet, Mitchell Bay, Kanalku Bay, and Davis Creek, and on the low hills north of Kootznahoo Inlet. Fossil flora indicate the age of the formation to be Paleocene through Miocene. Its total thickness is believed to be about 5,000 feet. Its lithology is described as predominantly pebble to cobble conglomerate, fine-grained to arkosic sandstone, lithic sandstone, calcareous siltstone, calcareous shale, lignite and subbituminous coal. Carbonized plant material is common.

The Tertiary sediments overlie, with angular unconformity, Devonian schist and phyllite and undifferentiated Mesozoic metamorphic rocks. Conspicuous lineation of channels and topographic features are evident on topographic maps and aerial photos. Some of the channels are apparently occupied by large faults. Tilting of the beds is thought to be due mostly to faulting and central-basin subsidence rather than to folding. Dips average about 30°, but vary from a few degrees to 45°.

The coarseness, poor sorting, and grain angularity of much of the Kootznahoo Formation indicate deposition near its source (fig. 14). Some beds of conglomerate around Mitchell Bay contain boulders up to 12 inches in diameter. These rocks represent consolidated alluvial fans formed in an intermontane basin. Fine-grained material with silt and coal near the middle and southern part of the basin indicate ancient swamps. An apparent northward increase in coarseness of the sediments and crossbedding, observed during the Division's uranium investigation, suggest that their source was north of the basin.

Intrusive quartz diorite and granodiorite form a batholith occupying approximately 150 square miles beginning about 5 miles north of Mitchell Bay (north of the map area). Smaller intrusives are present at the northwest end and south side of Mitchell Bay.

MINERAL DEPOSITS

The only material of economic significance so far discovered in the area is coal. The deposits were rather well prospected in early days and are of no economic interest at the present.

RADIOMETRIC SURVEY

No significant radioactivity was encountered in the Kootznahoo Inlet-Mitchell Bay area. The highest scintillometer reading encountered was 0.02 mr/hr or

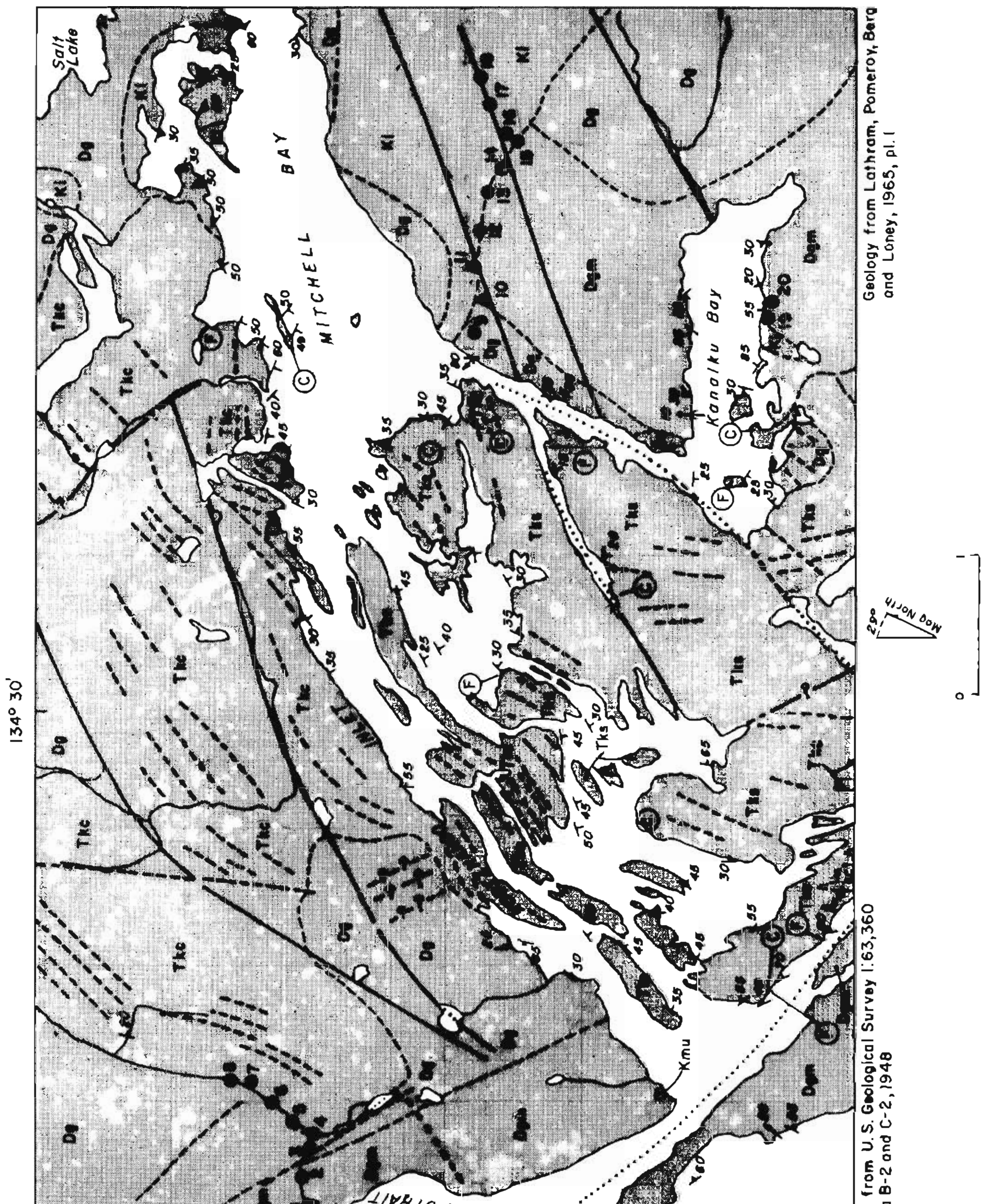
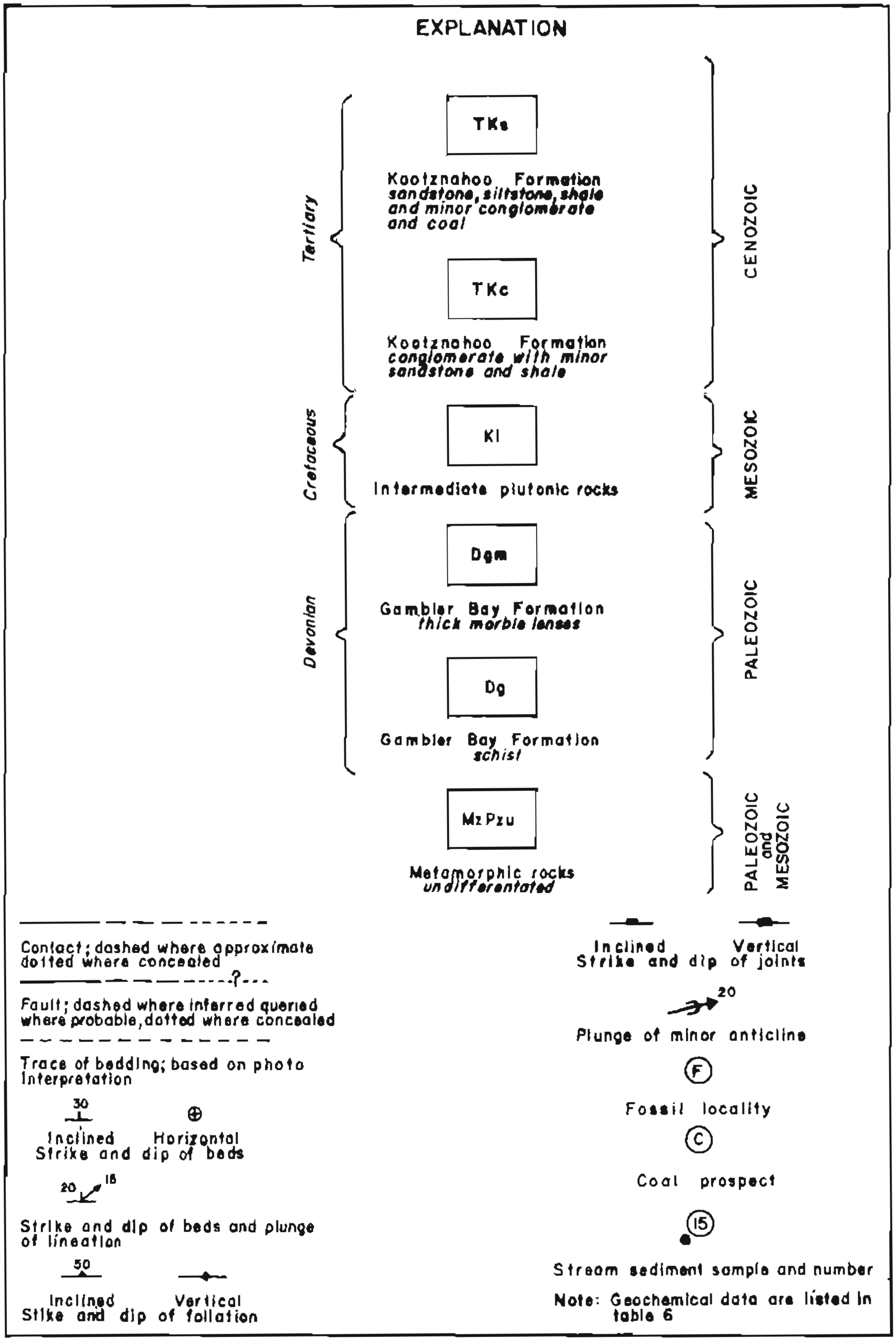


Figure 13 Geologic and geochemical sample location map, Kootznahoo Inlet-Mitchell Bay area


EXPLANATION
TKs
Kootznahoo Formation
sandstone, siltstone, shale and minor conglomerate and coal
TKc
Kootznahoo Formation
conglomerate with minor sandstone and shale
Tertiary
CENOZOIC
Kl
Intermediate plutonic rocks
Cretaceous
MESOZOIC
Dgm
Gambler Bay Formation
thick marble lenses
Dg
Gambler Bay Formation
schist
Devonian
PALEOZOIC
MzPzu
Metamorphic rocks
undifferentated
PALEOZOIC and MESOZOIC
Contact; dashed where approximate dotted where concealed
?
Fault; dashed where inferred queried where probable, dotted where concealed
Trace of bedding; based on photo interpretation
30
Inclined
Horizontal
Strike and dip of beds
20
15
Strike and dip of beds and plunge of lineation
50
Inclined
Vertical
Stike and dip of foliation
Inclined
Vertical
Strike and dip of joints
20
Plunge of minor anticline
F
Fossil locality
C
Coal prospect
15
Stream sediment sample and number
Note: Geochemical data are listed in table 6

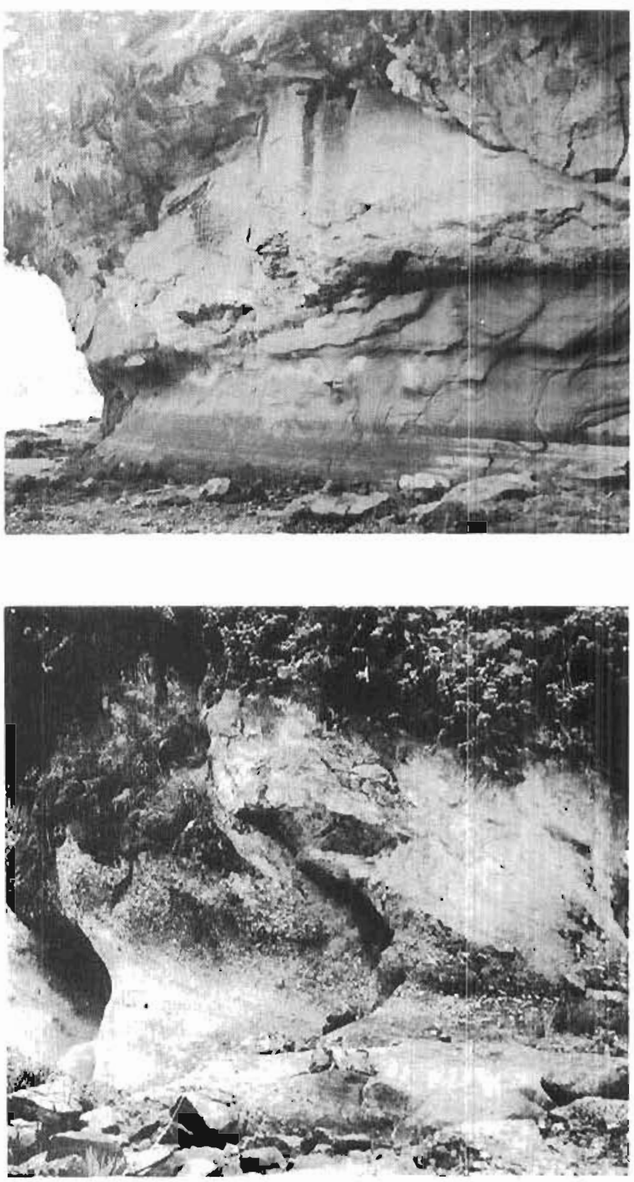


FIGURE 14. Tertiary sandstone with lenses of conglomerate, Kootznahoo Formation, Kootznahoo Inlet

about three times the background, which was found in an oxidized zone cutting schist approximately 100 yards from shore up a stream entering Mitchell Bay just north of the mouth of Davis Creek, on the east side.

About 3 miles north of the mouth of Kootznahoo Inlet a large stream enters Chatham Strait. A foot traverse up this stream was made to examine the Tertiary rocks present on a 1,500-foot hill one mile from shore. A maximum of 0.015 mr/hr was found in schist at elevations of 100 and 250 feet. The background was 0.006 mr/hr. Very few sandstone outcrops were observed.

GEOCHEMISTRY

Twenty stream-sediment samples were collected in the area. Eight were taken in a large stream entering Chatham Strait about 3 miles north of Angoon and in the mouth of Kootznahoo Inlet. Ten samples were taken just south of Mitchell Bay and 2 from Kanalku Bay. Sample locations are shown on figure 13. Atomic absorption analyses are given in table 6. Histograms are shown in figure 15. The highest values were 45 ppm copper, 15 ppm lead, and 120 ppm zinc. None of these samples was found to be anomalous.

TABLE 6.-*Atomic Absorption Analyses, Kootznahoo Inlet-Mitchell Bay Area*

Location on Figure 13	Field Sample Number	Copper ppm	Lead ppm	Zinc ppm
1	P27	30	15	100
2	P28	30	15	100
3	P29	15	10	45
4	P30	25	15	95
5	P31	25	15	115
6	P32	25	10	90
7	P33	20	15	55
8	P34	30	10	65
9	P23	35	15	70
10	P22	40	15	80
11	P21	30	15	75
12	P20	45	15	85
13	P19	20	10	50
14	P18	15	10	45
15	P17	20	10	55
16	P16	10	15	55
17	P15	10	15	55
18	P14	10	15	45
19	P24	35	15	85
20	P25	30	15	120

Fourteen stream sediment samples were collected around Mitchell Bay and Kanalku Bay by Race and Rose (1967, fig. 1) None of these was anomalous for

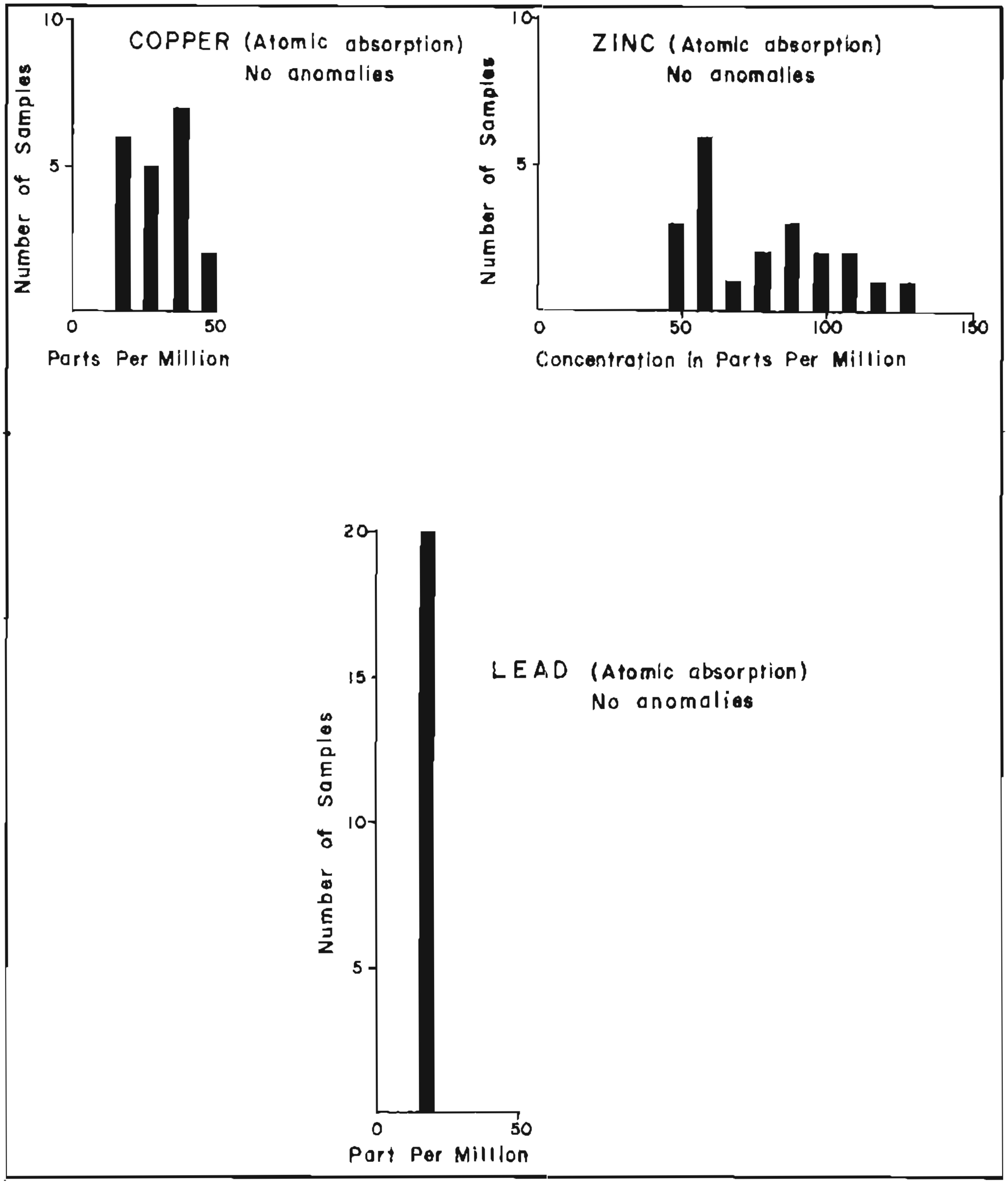


Figure 15 Frequency distribution histogram based on atomic absorption analyses for copper, lead, and zinc, Kootznahoo Inlet-Mitchell Bay area

copper, lead or zinc. A moderate anomally in zinc was encountered in two samples from two streams draining Yellow Bear Mountain about 4 miles east of Mitchell Bay.

CONCLUSIONS

Radiometric readings and mineralogy of the nonmarine Tertiary outcrops in the Kootznahoo Inlet-Mitchell Bay area did not suggest the possibility of radioactive deposits. Certain features generally considered to be characteristic of uranium-bearing sandstones such as the presence of pyrite, vanadium, copper, arsenic, good porosity, and alteration or bleaching, were not observed.

BBH URANIUM CLAIM ENDICOTT ARM AREA

LOCATION AND ACCESS

The BBH No. 1 uranium claim is near the east shore of a short branch of Endicott Arm 2 miles below the present terminus of North Dawes Glacier. It is about 75 miles southeast of Juneau in the Sumdum C-3 and C-4 quadrangles (fig. 16). The prospect is on a stream draining a steep slope on the east side of the inlet.

The area can be reached by boat or float plane. Landings along the shoreline are difficult, because the walls of Endicott Arm are steep and there are no beaches. Icebergs from the main Dawes Glacier are usually numerous in the main arm and may choke the waterway. However, the shorter arm below North Dawes Glacier is usually free of ice during the summer months.

HISTORY

The BBH No. 1 claim was staked in 1955. Two samples submitted to the Territorial Assay Office showed 0.03% and 0.04% eU, and 0.015% and 0.032% U by fluorimeter. These results led to an examination of the claim by the Territorial Department of Mines (Williams, 1955a). Samples collected by Williams had lower values: 0.01%, 0.002%, 0.002%, and 0.011% eU. Apparently no further exploration or development work was done on the property, but William Huff (written commun., 1969) reported that fluorescent uranium minerals are present on a ridge south of Endicott Arm.

GEOLOGY

The BBH claim is near the western margin of the Coast Range batholith. Bedrock at the claim is Cretaceous granodiorite or quartz diorite. The batholith is bounded on the west by a belt of metamorphic rocks and outlying intrusives of upper Paleozoic to Mesozoic age, which contain numerous old claims and prospects. Mapping across this belt north of Juneau (Forbes, 1959) shows a progressive increase in metamorphic grade eastward toward the batholith. Gradational layering of schist and gneiss are present. Forbes showed that the gneiss is a schist which has been transformed by the late injection of Na, SiO_2, and minor K. Herreid (1962, p. 6) found no disruption of minor structures along contacts between gneiss and quartz diorite, indicating a passive introduction of the igneous rock.

At the BBH claim, small pegmatite pods and lenses within a medium-gray, medium-grained quartz diorite are radioactive. The quartz diorite there is slightly foliated. Reconnaissance geology of the area is shown in figure 17.

MINERAL DEPOSITS

Several mines and prospects are located 10 to 25 miles west of the BBH claim. No mines are active, but several prospects are. The better known properties include a zinc-copper lode on Tracy Arm, which was estimated to average 3.2% zinc, 1.5% copper, plus a little gold and silver (Berg and Cobb, 1967). Near Sumdum Glacier a copper-zinc lode was discovered in 1958 and explored during 1959. The mineralized zone may extend 2 miles (MacKevett and Blake, 1964). The Sumdum Chief mine on Endicott Arm is said to have produced about $50,000 in gold prior to closing in 1904. Underground exploration has been done on silver-and gold-bearing lodes near Point Astley. Near the head of Windham Bay, about 12 miles west of the head of Endicott Arm, a number of placer and lode gold deposits were worked between 1900 and 1937. The lodes are quartz stringers in schist, which contain pyrite, pyrrhotite, galena, sphalerite, arsenopyrite, chalcopyrite, and free gold (Berg and Cobb, 1967, p. -191).

Radioactive pegmatitic zones are exposed at the BBH claim along a steep stream from the shore to an elevation of about 150 feet. They lie within an area approximately 100 to 250 feet (fig. 18). Four small pods or lenses of pegmatite up to 12 feet long roughly parallel cleaveage planes in granodiorite (fig. 19). The radioactive mineral was tentatively identified as uraninite (Williams, 1955a). Country rock at the

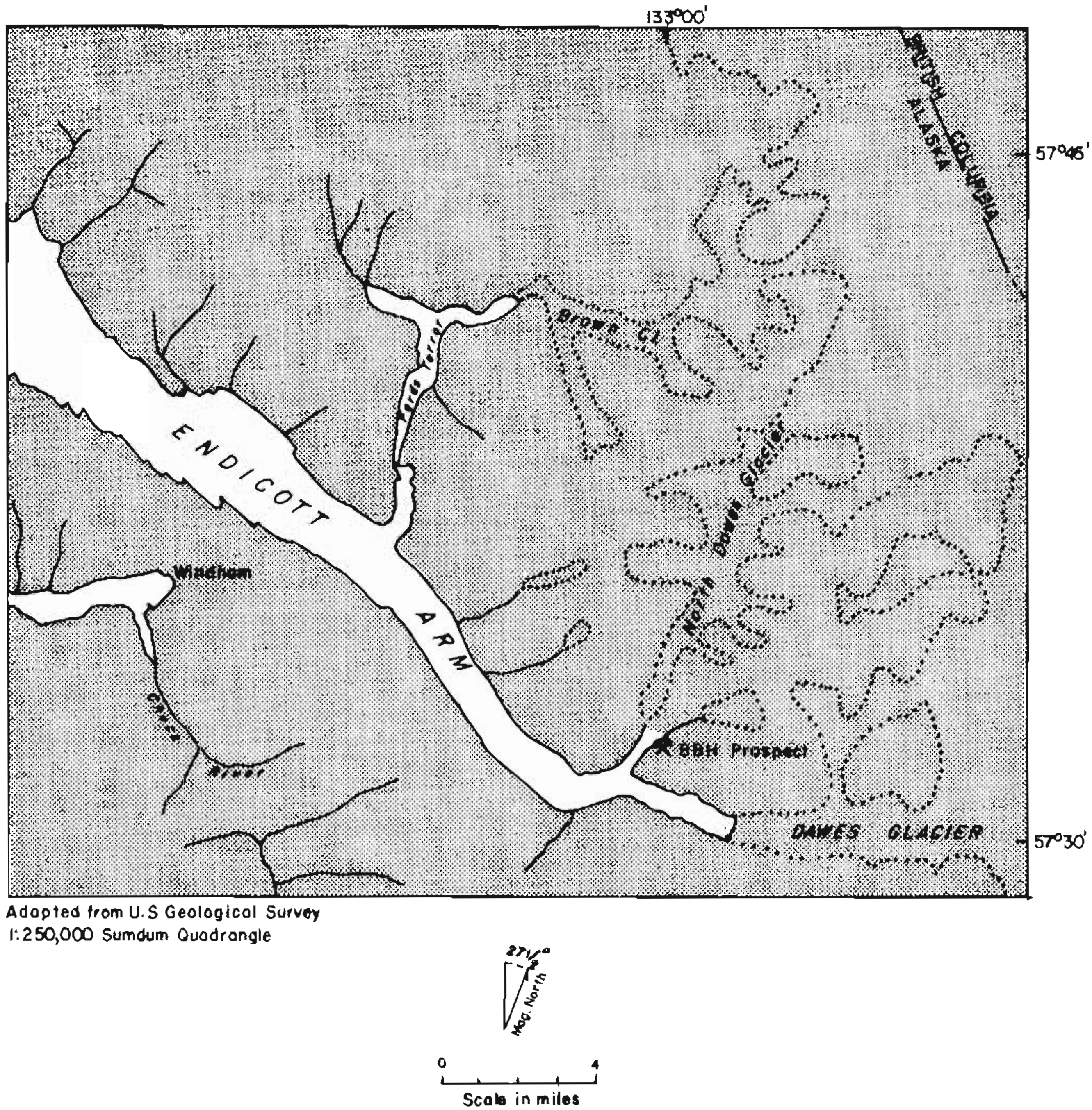


Figure 16 Location of the BBH prospect, Endicott Arm area (fig. 1, area 7)

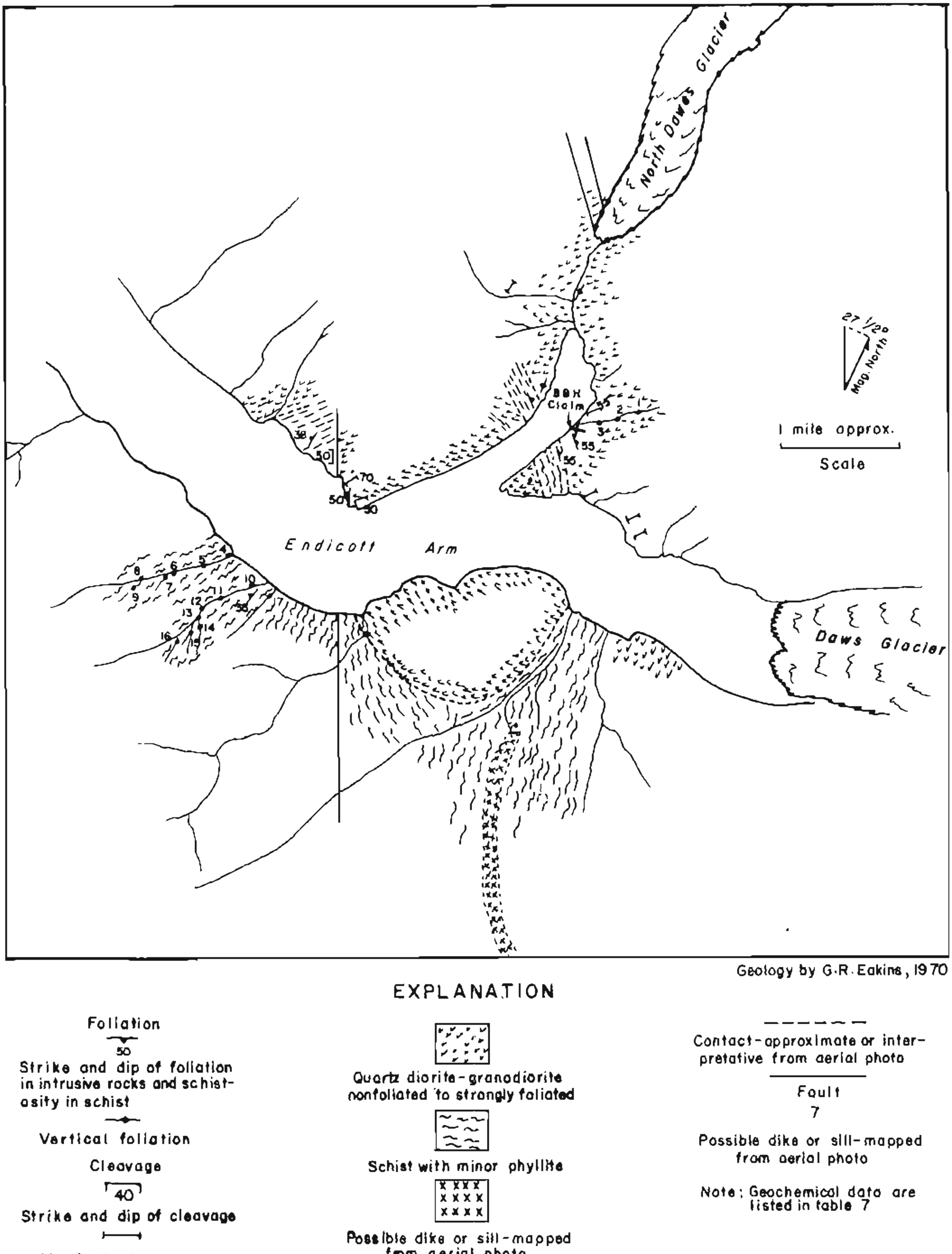


Figure 17 Reconnaissance geologic and stream-sediment sample locations, part of Endicott Arm area, Sumdum quadrangle

FIGURE 18. BBH claim on the lower part of a stream course at Endicott Arm

property normally is a fresh gray granodiorite, but it is partly altered to a brown, softer material. Alteration zones trend N60-70° E, parallel to cleaveage. Minerals in the pegmatite identifiable in hand specimens are K-feldspar, quartz, pyrite, and biotite which was found in plates up to 10 inches across. Two samples of pegmatite from the BBH claim assayed in 1970 yielded 35 and 45 ppm uranium.

Foot traverses along the shores and stream bordering the north branch of Endicott Arm and along the river to the terminus of North Dawes glacier revealed that small pegmatites similar to those of the BBH claim are fairly common in the area. None of these was more than 30 feet long or 2 feet wide. The largest observed is shown in figure 20. Most of the pegmatites in the area produced an appreciable radiometric response, but significant alteration and rather large amounts of pyrite were seen only at the BBH property.

A copper-bearing vein at Point Astley near the south side of the entrance to Endicott Arm was studied by Houston, Bates, Velikanje and Wedow (1958, p. 25). Slight radioactivity was reported at one point underground. A 2-foot sample assayed 0.006% equivalent uranium, but no radioactive minerals were identified.

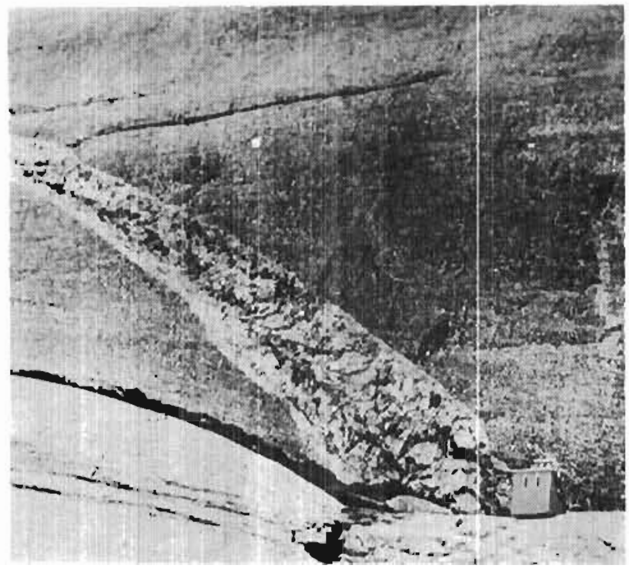


FIGURE 20. Pegmatite lens in diorite near terminus of North Dawes Glacier, Endicott Arm area

RADIOMETRIC SURVEYS

Examination of the BBH claim with a scintillometer produced a maximum response of 0.1 mr/hr, which was about ten times the average background of 0.01 mr/hr over the granodiorite. Most of the pegmatites on the claim and at other places in the general area yielded around 0.05 mr/hr, but one pegmatite along the river draining North Dawes Glacier also gave a 0.1 mr/hr reading at one point. Radioactivity of schist was lower than that of granodiorite, usually less than 0.005 mr/hr.

GEOCHEMISTRY

Seventeen stream-sediment samples were collected at Endicott Arm. Three came from the stream crossing the BBH claim and 14 from three streams on the south side. Sample locations are shown on figure 17. Atomic absorption analyses are given in table 7. The highest values were 70 ppm copper, 15 ppm lead, and 120 ppm zinc.

These came from sample location 10, near a zone of highly iron-stained schist. Additional geochemical data from the Sumdum C-4 quadrangle were reported by Clark, Brew, Grybeck, and Wehr (1970).

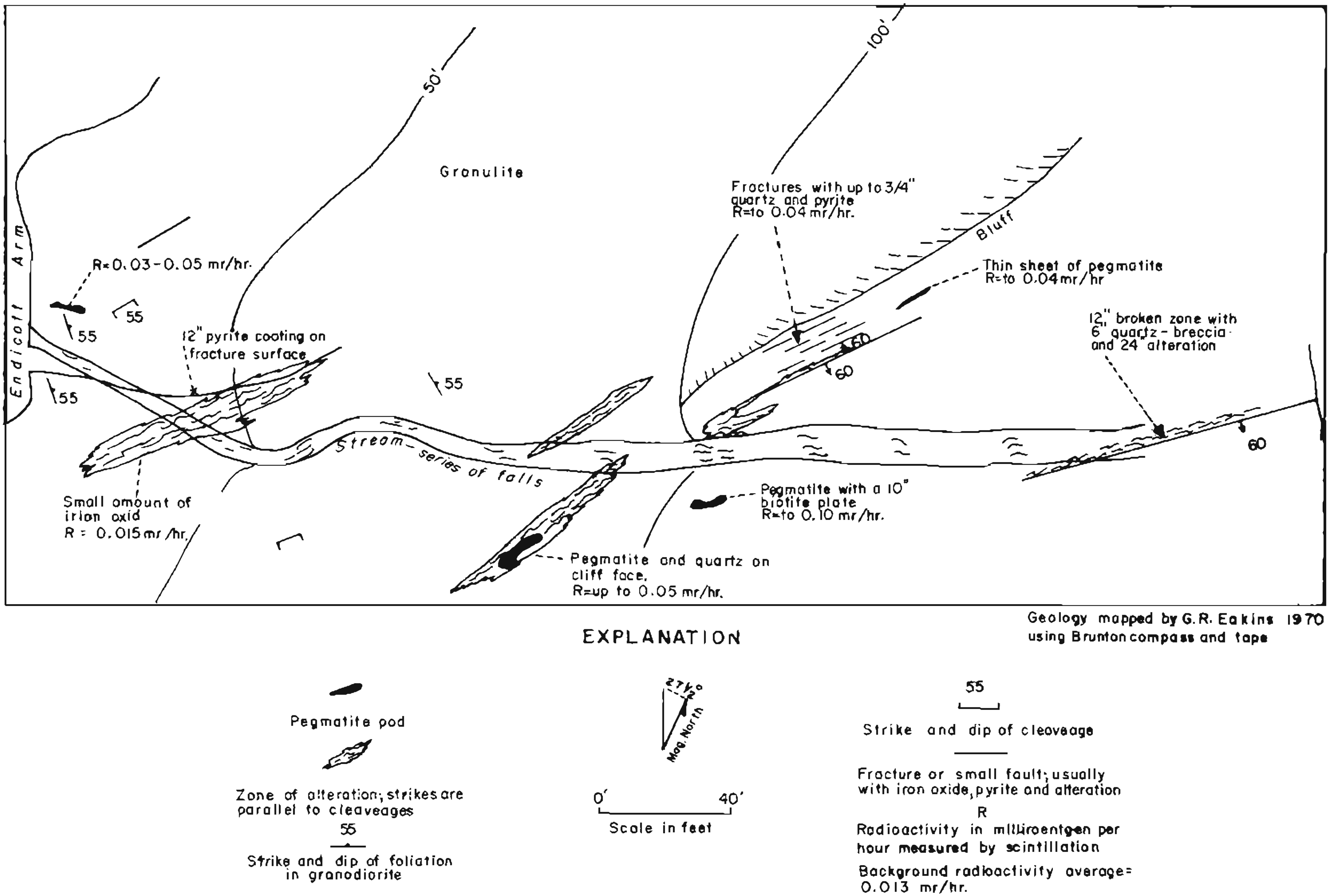


Figure 19 Geologic sketch map of the BBH claim, Endicott Arm area, Sumdum quadrangle

TABLE 7 -*Atomic Absorption Analyses, Endicott Arm Area* (anomalous value underlined)

Location on Figure 17	Field Sample Number	Copper ppm	Lead ppm	Zinc ppm
1	P67	25	10	55
2	P68	30	15	70
3	P69	20	10	45
4	P78	50	10	55
5	P79	45	10	45
6	P80	45	10	40
7	P81	40	5	25
8	P83	55	10	55
9	P82	50	5	35
10	P70	70	15	<u>120</u>
11	P71	50	5	40
12	P72	80	10	55
13	P73	40	5	30
14	P74	45	10	70
15	P75	45	10	35
16	P76	55	5	45
17	P77	35	10	40

CONCLUSIONS

Pegmatites in the area do not appear to warrant further exploration for uranium. However, the fact that they do display a certain amount of radioactivity, combined with the possible presence of uranium 4 miles southwest of the BBH claim, may indicate that this region, between the Coast Range batholith and the Pacific Ocean, deserves more study. Sulfide deposits, especially those containing copper and silver, west of this claim, also may be favorable indicators, as uranium sometimes is associated with such deposits or is peripheral to districts that contain them.

PORT CAMDEN AREA, KUIU ISLAND

LOCATION AND ACCESS

The Port Camden area lies in the Petersburg D-6 quadrangle 36 miles west of Petersburg. The area visited is on the west side of Port Camden on Kuiu Island, and can be reached by boat or float plane. For this investigation a plane was chartered in Petersburg. Field work was confined to Tertiary sandstones and conglomerates along the west shore of Port Camden extending 5 miles south from the mouth of Kadak Bay.

HISTORY

No prospects are known to the author in the immediate area, but barite and witherite deposits and a zinc prospect to the northwest around Saginaw Bay and on the Keku Islets have been known for many years. Logging has been extensive near the village of Kake and on the north side of Hamilton Bay about 10 miles north of Port Camden.

GEOLOGY

The Port Camden area is underlain by gently dipping Tertiary volcanics and clastic sediments. These rocks presumably overlie strongly folded Paleozoic sedimentary and metamorphic rocks that are exposed to the west on Kuiu Island and to the east in the vicinity of Duncan Canal on Kupreanof Island. The sediments at Port Camden have been discussed by Wright and Wright (1908, p. 59-60), Buddington and Chapin (1929, p. 261-263, 353), and Muffler (1967, p. C47-C50). Buddington and Chapin give an approximate total thickness of 2,850 feet for the Tertiary sequence at Port Camden. The upper 1,500 feet are volcanic rocks and the lower 1,350 feet consist of nonmarine sandstone and conglomerate with intercalated sills.

Nonmarine sandstones and conglomerates are exposed along the northern edge of the Tertiary deposits, from Kadak Bay south for about 5 miles. Similar material is present 5 to 8 miles to the northeast on the south side of Hamilton Bay east of Keku Strait. That area is one of very low relief and many swamps, and was not examined.

Reconnaissance mapping in conjunction with a radiometric survey in the area is shown on figure 21. The "felsite" shown there may correspond to rhyolite flows and breccia mapped by Buddington and Chapin (1929, p. 263-264), and altered dellenite mapped by Muffler (1967, p. C48-C-49). The volcanics may be equivalent to gabbro and microgabbro mapped by Muffler (1967, p. C49).

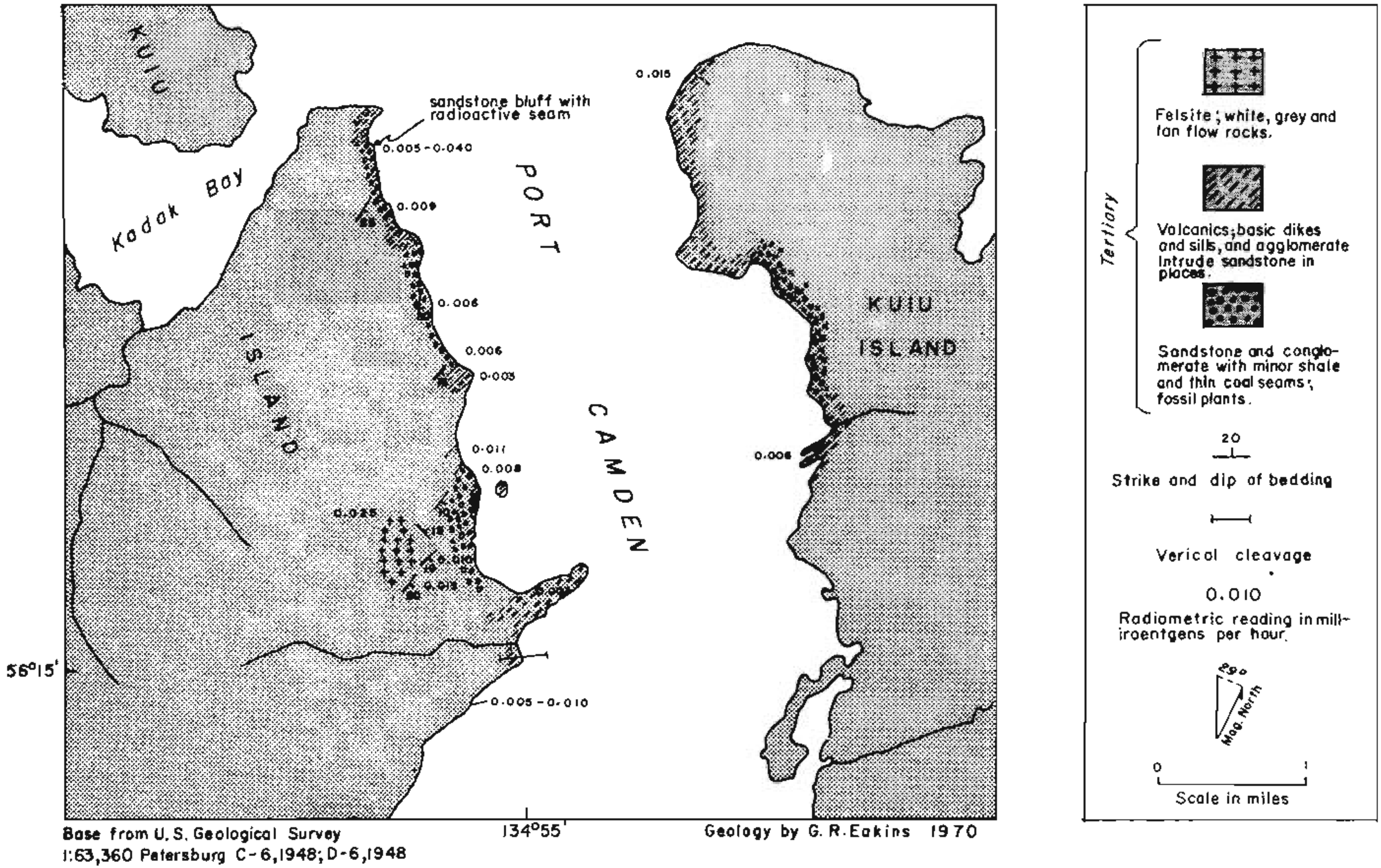


Figure 21 Reconnaissance geologic map and radiometric data, Port Camden area (fig. 1, area 8)

MINERAL DEPOSITS

Tertiary rocks are not known to be hosts for metallic ores in Southeastern Alaska. The nearest prospects are the barite and witherite deposits around Saginaw Bay and on the Keku Islets 10 to 15 miles north of Port Camden, and one zinc prospect on one of the Keku Islets (Buddington, 1925, p. 136-138). Coal seams in the sedimentary sequence at Port Camden are much too thin to be of economic interest.

RADIOMETRIC SURVEY

Radiometric testing with a scintillometer was done on foot, principally along the east side of Kuiu Island from Kadak Bay to a point about five miles south. Typical meter responses in milliroentgens per hour are shown on figure 21. The readings range from a low of .003 mr/hr to a maximum of .04 mr/hr, a ratio of 13 to 1. The relatively high response of .025 mr/hr obtained at a conspicuous felsite bluff 1/2 mile from the coast is attributed to a high potassium content rather than uranium.

The strongest anomaly, .02 to .04 mr/hr, was found along a 4-inch bed of fine-grained sandstone within a 25-foot bluff of massive sandstone 1/3 mile south of a prominent point south of the mouth of Kadak Bay (fig. 21). Two chemical assays of this sandstone revealed 11 and 12 ppm uranium, or about 5 times the average uranium content of sedimentary rocks. The radioactive seam is about 5 feet above beach level at its northern end, but dips gently south for about 100 feet. It is soft and red on weathered surfaces, but is hard and gray on fresh breaks. It has a very high magnetite content, estimated visually as 30%. Fragments of rock up to 1/2 inch in diameter will cling to a pocket magnet. Other visible minerals include pyrite, quartz, plagioclase, and mica flakes in a groundmass of very fine-grained altered material. The adjacent sandstone is light brown, softer, and appears to lack visible magnetite or pyrite. The sandstone immediately above and below the radioactive seam gave .008 mr/hr and .005 mr/hr, respectively.

Other slightly anomalous readings from sandstone in the area ranged from .010 to .023 mr/hr. These were found along streams west of Port Camden near the southern end of the area mapped. Chemical assays of these zones yielded less than 2 ppm uranium.

GEOCHEMISTRY

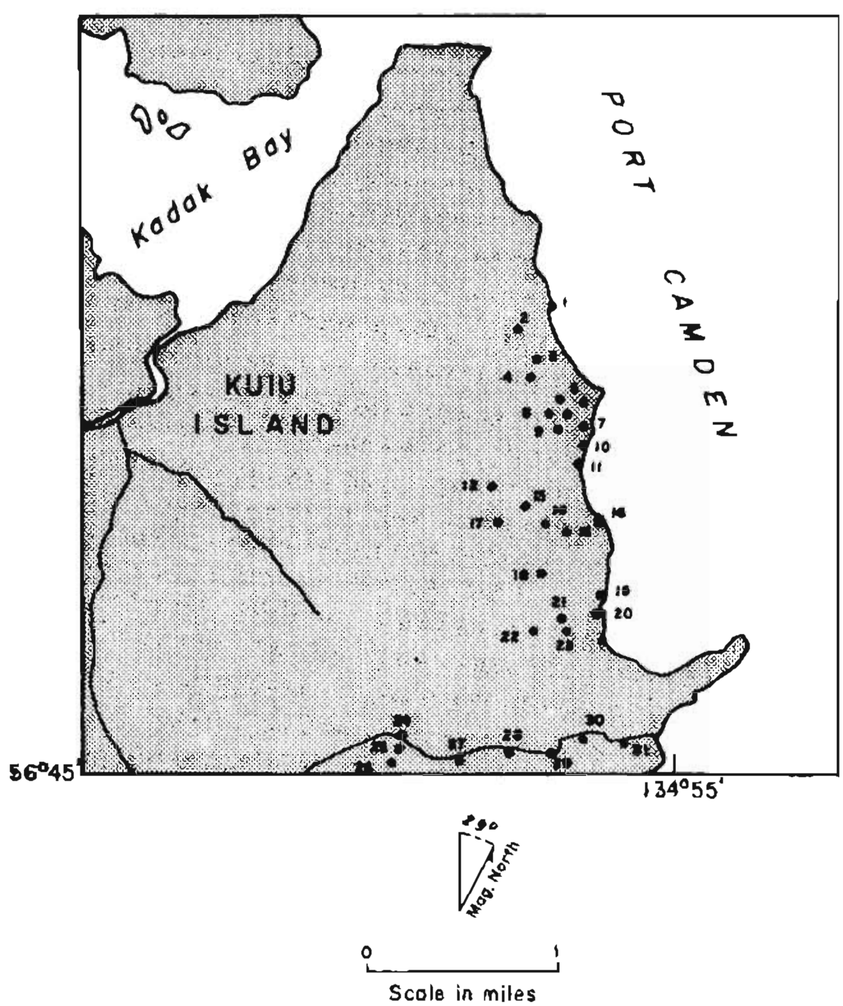
Thirty-one sediment samples were collected from streams flowing east toward Port Camden (fig. 22). Atomic absorption analyses are given in table 8. Histograms appear in figure 23. The highest values were 45 ppm copper, 65 ppm lead, and 160 ppm zinc. Sample location number 1 was slightly anomalous for copper, and number 24 for lead and zinc.

TABLE 8.-*Atomic Absorption Analyses, Port Camden Area* (anomalous values underlined)

Location on Figure 22	Field Sample Number	Copper ppm	Lead ppm	Zinc ppm
1	OP112	45	15	65
2	OP 94	15	15	140
3	OP 95	15	10	120
4	OP 98	15	10	95
5	OP 96	10	15	120
6	OP 97	10	20	95
7	OP101	15	15	90
8	OP 99	15	15	95
9	OP100	15	15	100
10	OP102	10	20	70
11	OP103	15	20	80
12	OP 88	20	20	80
13	OP90	15	20	90
14	OP91	10	20	120
15	OP92	15	15	80
16	OP93	15	15	90
17	OP89	15	20	115
18	OP113	15	20	120
19	OP114	15	20	150
20	OP 87	10	15	110
21	OP 85	10	20	110
22	OP 84	10	15	85
23	OP 86	10	15	120
24	OP105	15	65	160
25	OP104	10	25	100
26	OP106	15	30	130
27	OP107	10	26	150
28	OP108	10	30	130
29	OP109	15	25	120
30	OP110	10	15	110
31	OP111	15	25	120

CONCLUSIONS

Radioactivity in the thin bed of magnetic sandstone



EXPLANATION

• 1–31 Stream sediment sample location and number
Analyses are listed in table 8

Figure 22 Locations of stream-sediment samples and prospects, part of the Port Camden area

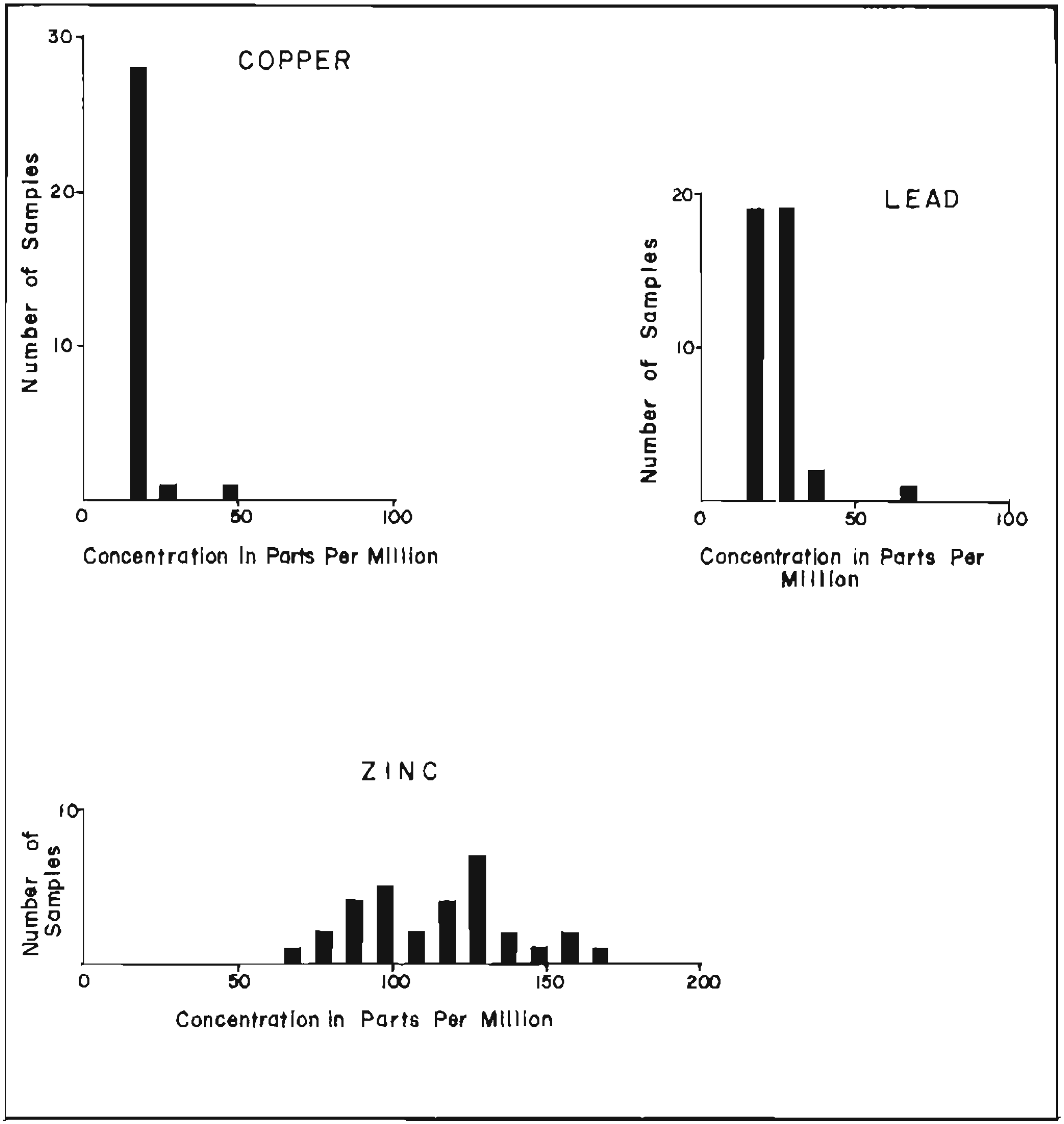


Figure 23 Frequency distribution histogram based on atomic absorption analyses for copper, lead, and zinc, Port Camden area

is the strongest so far found by the author in sedimentary rock in Southeastern Alaska. While the level of radioactivity of this zone does not necessarily indicate commercial possibilities, it shows that a certain degree of concentration can take place in sandstone in this region. The bed probably represents a local placer-like accumulation of heavy minerals. The source of those minerals in uncertain, but they may have been derived from a granitic rock containing anomalous amounts of radioactive minerals. A more complete examination of the Tertiary sediments in the Port Camden-Hamilton Bay area, therefore, is recommended. It might reveal more anomalous radioactive material and aid in the determination of its source. Stream-sediment samples, on the other hand, did not indicate metal anomalies warranting further geochemical investigations.

CASTLE ISLANDS, DUNCAN CANAL

A barite deposit on the east side of Castle Island in Duncan Canal 14 miles southwest of Petersburg (fig. 1, area 9) is currently being mined by Alaska Barite Company for use as mud weighting material by the petroleum industry in Alaska. The Castle Island operation was visited during the course of the uranium project, but no radioactivity was detected at the barite deposit or on any of the nearby islands. Bedrock includes Devonian schist, greenstone, limestone (which is the host for the barite), and Tertiary volcanics. No geochemical sampling was done.

VIRGINIA LAKE AREA, WRANGELL DISTRICT

LOCATION AND ACCESS

Virginia Lake is on the mainland about 8 miles east of Wrangell townsite. The lake is approximately 2 miles long and 3/4 mile from tidewater at an elevation of 100 feet. The most convenient means of access is by float plane. The U. S. Forest Service maintains a cabin near a sandy beach at the northeast end. A foot trail follows Mill Creek from the coast to the lower end of the lake.

HISTORY

Uranium investigation was limited to bedrock exposures within a short distance of the Virginia Lake shoreline. There are no known mineral deposits within that area. However, a mineralized belt lies between 2 and 4 miles east of Virginia Lake, where considerable exploration and some underground work has been done on sulfide deposits. The visit to Virginia Lake was prompted by reported radioactivity on the north side of the Lake (William Huff, written commun., 1969).

GEOLOGY

The general geology of the region and mineral deposits east of Virginia Lake have been described by Buddington (1923, p. 58-63), Wright and Wright (1908, p. 188-190), and Gault, Rossman, Flint and Ray (1953, p. 15-55). Bedrock surrounding the lake is schist, marble, and quartz diorite (fig. 24). Bedding and cleaveage in the schist strike about N 35° W parallel to regional structure. A massive limestone bed crops out on the south side of the lake near its east end. Quartz diorite is in contact with the schist at the eastern part of the lake. The quartz diorite is light gray, medium grained, crystalline to porphyritic, and contains up to 25% altered biotite.

MINERAL DEPOSITS

There are no known mineral deposits along the perimeter of Virginia Lake, but gold-silver-lead and zinc prospects have long been known at Berg Basin, Glacier Basin, Groundhog Basin, and the Lake group of claims (fig. 24). These lie within a northwest-trending metamorphic sequence between areas of quartz diorite.

RADIOMETRIC SURVEY

Radiometric checks were made on bedrock along the shore of Virginia Lake and streams draining into the lake. Typical scintillometer responses are indicated on the geologic map (fig. 24). Average responses of 0.007 to 0.012 mr/hr were obtained for both quartz diorite and schist bedrock. The limestone bed yielded only 0.002 mr/hr.

An anomalous zone was found in the schist along one stream north of the lake. This was examined from the shore up to an elevation of 350 feet. Readings ranged from 0.020 to 0.035 mr/hr, or about four times average background. This zone apparently extends south to include an island near the south shore (fig. 24) where the average radioactivity was about 0.025 mr/hr. The approximate position of the anomaly is indicated on the map. It is about on strike with the

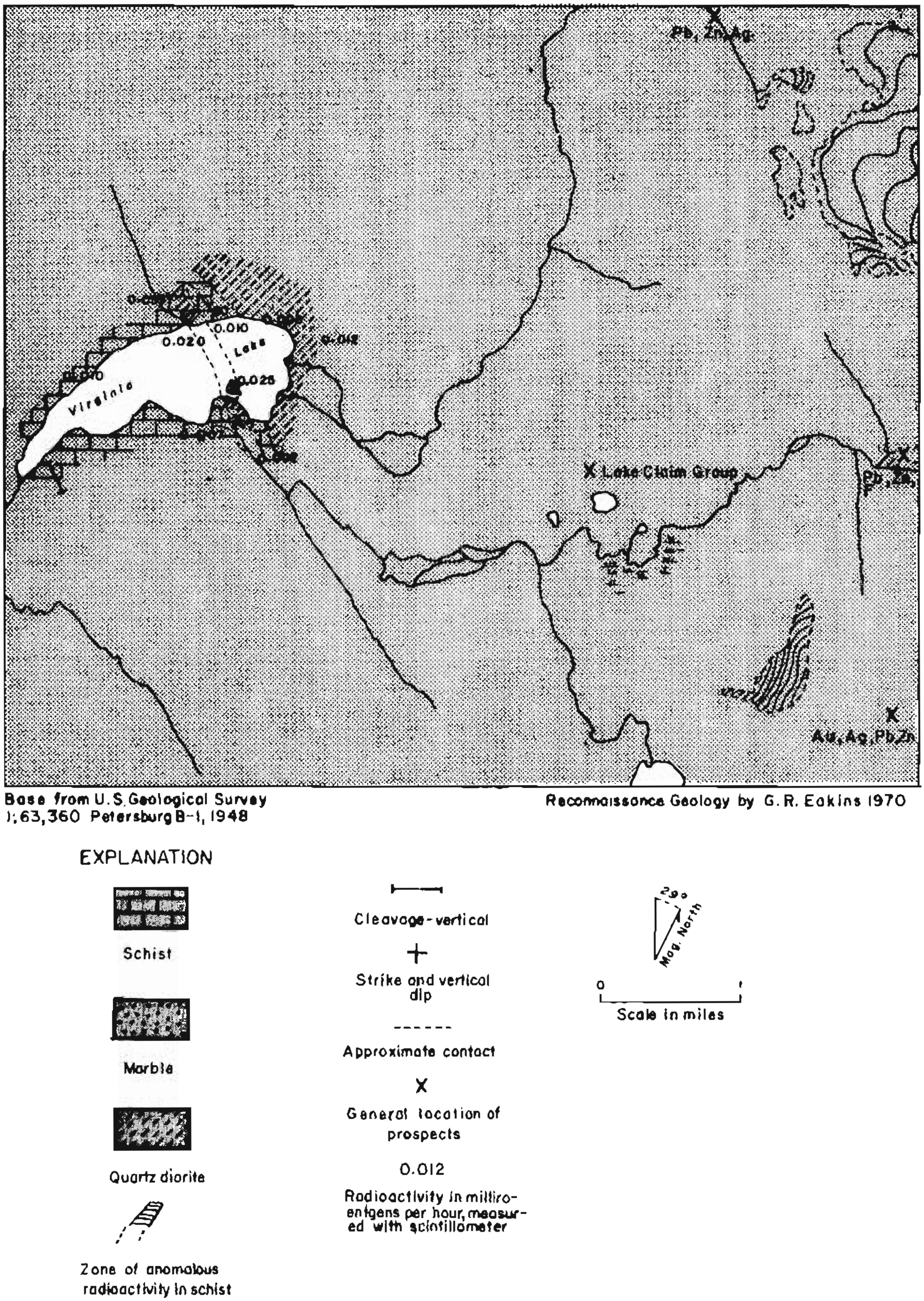


Figure 24 Reconnaissance geologic map and radiometric data, Virginia Lake area (fig. 1, area 10)

limestone but they are probably separated by a fault.

No visible mineralized material or fault is associated with the anomaly. It is assumed that this zone contains the radioactivity reported by Huff, which is mentioned above. A chemical assay of a sample of the radioactive schist showed only 3 ppm uranium. This is not adequate to account for the radiometric anomaly, which may be due to either high potassium or traces of thorium.

GEOCHEMISTRY

Seventeen stream-sediment samples were collected at Virginia Lake (fig. 25). Atomic absorption analyses are given in table 9. Histograms appear in figure 26. The highest values were 90 ppm copper, 30 ppm lead, and 130 ppm zinc. Samples from locations 4 and 16 were slightly anomalous for zinc, but these values do not indicate that additional work is warranted.

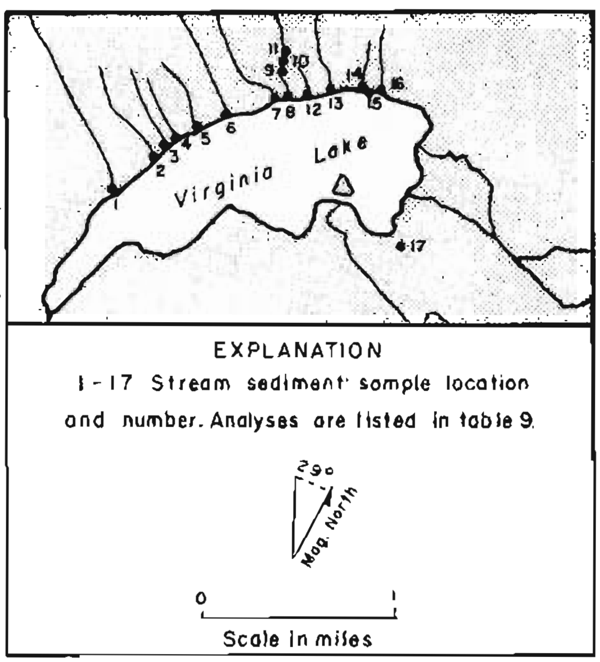


FIGURE 25. Virginia Lake area, stream-sediment sample locations

CONCLUSIONS

A weak radioactive zone in schist parallel to regional structure extends from an island near the south shore of Virginia Lake northwest to a point at least 350 feet above sea level in a stream valley north of the lake. The source of the radioactivity was not identified. The low level of radioactivity and the fact that it is not concentrated suggest that the possibilities for finding much uranium in the area examined are poor. Prospecting for radioactive materials near mineralized areas east of Virginia Lake might be more worthwhile.

TABLE 9.-*Atomic Absorption Analyses, Virginia Lake Area* (anomalous values underlined)

Location on Figure 25	Field Sample Number	Copper ppm	Lead ppm	Zinc ppm
1	P143	35	15	65
2	P142	25	10	65
3	P141	25	10	60
4	P140	45	30	130
5	P139	55	30	95
6	P138	60	30	110
7	P137	90	25	80
8	P136	70	25	75
9	E 27	65	30	70
10	E 28	65	30	65
11	E 29	60	30	60
12	P135	30	20	65
13	P134	15	25	75
14	P133	30	25	100
15	P132	5	15	85
16	P131	5	25	130
17	E 30	10	25	55

ZAREMBO ISLAND AREA

LOCATION AND ACCESS

Zarembo Island is 25 miles southwest of Wrangell along Clarence Strait in the Petersburg quadrangle. It can be reached by boat or float plane.

HISTORY

The southwest coast of Zarembo Island from Macnamara Point southwest to a point opposite the south end of Bushy Island has been reported to contain minor uranium showings. There has been no mining in the area examined, but fluorite veins have been known along the shores for many years (Buddington, 1923, p. 75).

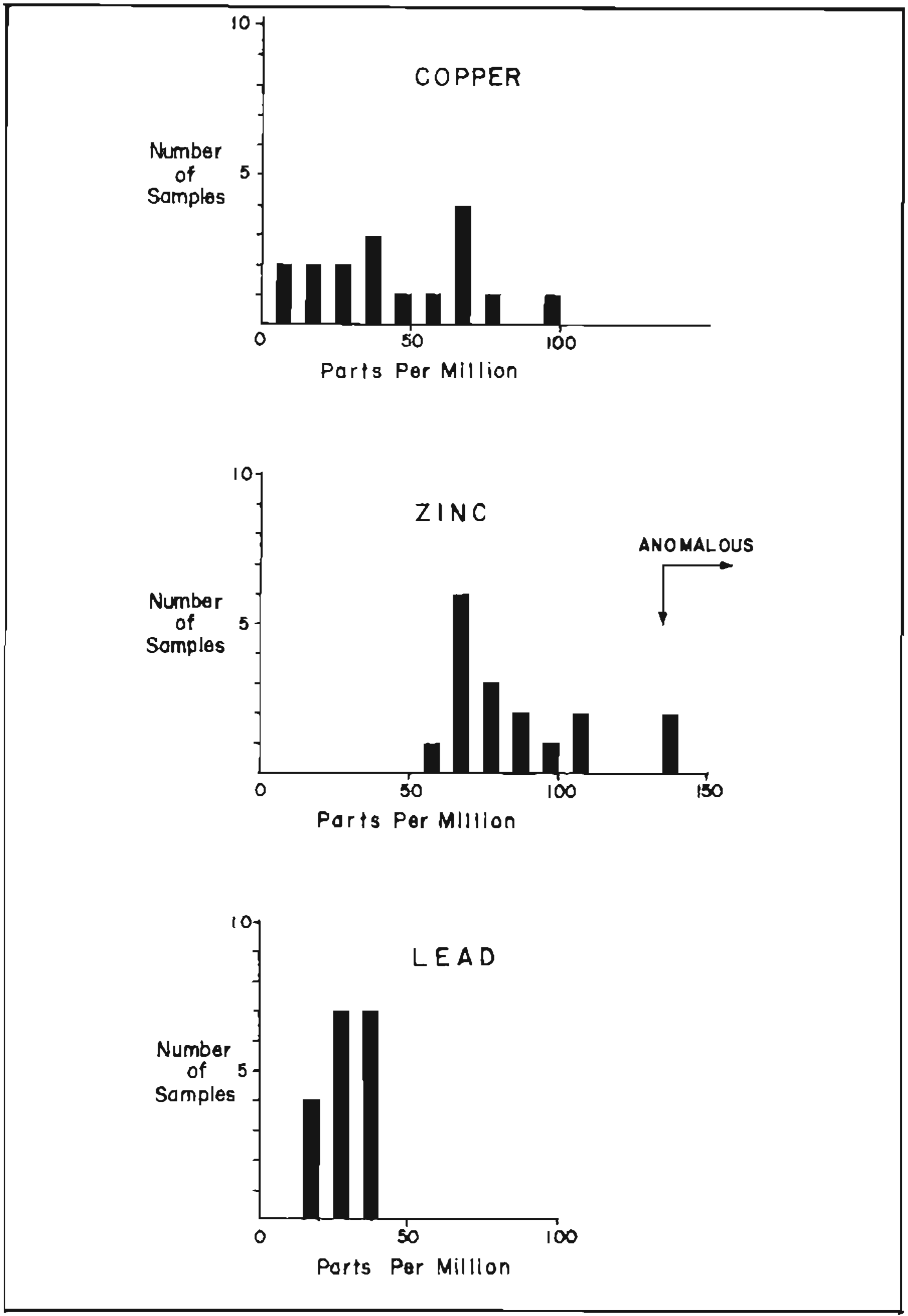


Figure 26 Frequency distribution histograms based on atomic absorption analyses for copper, lead, and zinc, Virginia Lake area

GEOLOGY

The Tertiary rocks of Zarembo Island have been described by Buddington (1923, p. 75), Buddington and Chapin (1929, p. 261, 266, 272, 273), and Roehm (1942, p. 14; 1945, p. 11-12). The southwest coast of Zarembo Island is covered with Tertiary rocks, which include predominantly greenish lavas, agglomerates, tuffs, and more recent dikes. However, Tertiary sandstones, shales, and conglomerates are present for a distance of 4 miles, from a point 1/2 mile south of Macnamara Point to a point on the coast approximately east of the north end of Bushy Island (fig. 27). The sandstone contains quartz, feldspar, and altered mica. At some locations it is conglomeratic and displays good cross-bedding. Interbedded shaley material is common and often contains fossil leaves. The sediments strike northwest and dip 20° to 40°E. Both felsic and basaltic dikes cut the sediments. Shear zones and fractures generally trend east-west.

Houston, Bates, Velikanjc and Wedow (1958, p. 24) sampled granite at Round Point at the southern tip of Zarembo Island. The granite assayed 0.004% eU, which is about average for granitic rocks.

White, West, Tolbert, Nelson and Houston (1952, p. 16) sampled shear zones in basaltic, andesitic, and rhyolitic volcanic rocks in two areas on the west side of Zarembo Island in 1951. They reported assays generally less than 0.001% eU, but locally the felsic rocks contained up to 0.005%.

MINERAL DEPOSITS

Fluorite veins cutting lava on the west coast of Zarembo Island have been described by Buddington (1923, p. 75) and Roehm (1942, p. 14; 1945, p. 11-12). These include irregular fracture fillings of quartz and fluorite at Point Nesbit, at a point 3 miles northeast of Macnamara Point, and at a locality east of Bushy Island. The author examined the fluorite locality east of Bushy Island (fig. 27). Quartz and fluorite veins vary from 1 inch to 1 foot in width and trend roughly east-west. The quartz was deposited before fluorite. The veins were not always completely filled, so that fluorite frequently was euhedral.

RADIOMETRIC SURVEY

Scintillometer readings ranged from 0.005 to 0.025 mr/hr. The average background over sediments was about 0.008 mr/hr. The highest readings were obtained over sandstone on the beach and on a small island close to shore about one mile south of Macnamara Point. This was a definite anomaly, but a chemical assay of this material showed only 2 ppm U. Thorium or potassium probably caused the anomalous readings. Volcanic tuffs and felsic dikes gave readings up to 0.02 mr/hr, which are fairly common to felsic rocks. The tuffaceous material may be the source of a slight concentration of radioactive minerals in the sandstones.

GEOCHEMISTRY

Five stream-sediment samples were collected on Zarembo Island. Four were from a stream that enters Clearence Strait 2 1/3 miles southeast of Macnamara Point. The fifth was collected near the mouth of a large stream opposite the south end of Bushy Island (fig. 27). Atomic absorption analyses are given in table 10. The highest values were 15 ppm copper, 25 ppm lead, and 100 ppm zinc. None is considered anomalous.

TABLE 10.-*Atomic Absorption Analyses, Zarembo Island*

Location on Figure 27	Field Sample Number	Copper ppm	Lead ppm	Zinc ppm
1	P118	10	15	85
2	P117	15	15	75
3	P115	15	15	65
4	P116	15	15	70
5	P119	10	25	100

CONCLUSIONS

The slight radiometric anomaly of 0.025 mr/hr found in sandstone along the coast is difficult to evaluate, because the zone examined has been subjected to wave action and weathering. Thus any uranium minerals originally present might have been largely leached out. A chemical assay did not reveal an unusual amount of uranium, and the radiometric anomaly may be due to thorium. Overlying tuffaceous beds are a possible source of uranium. However, the rocks examined lack good porosity, pyrite, or other indications of mineralization.

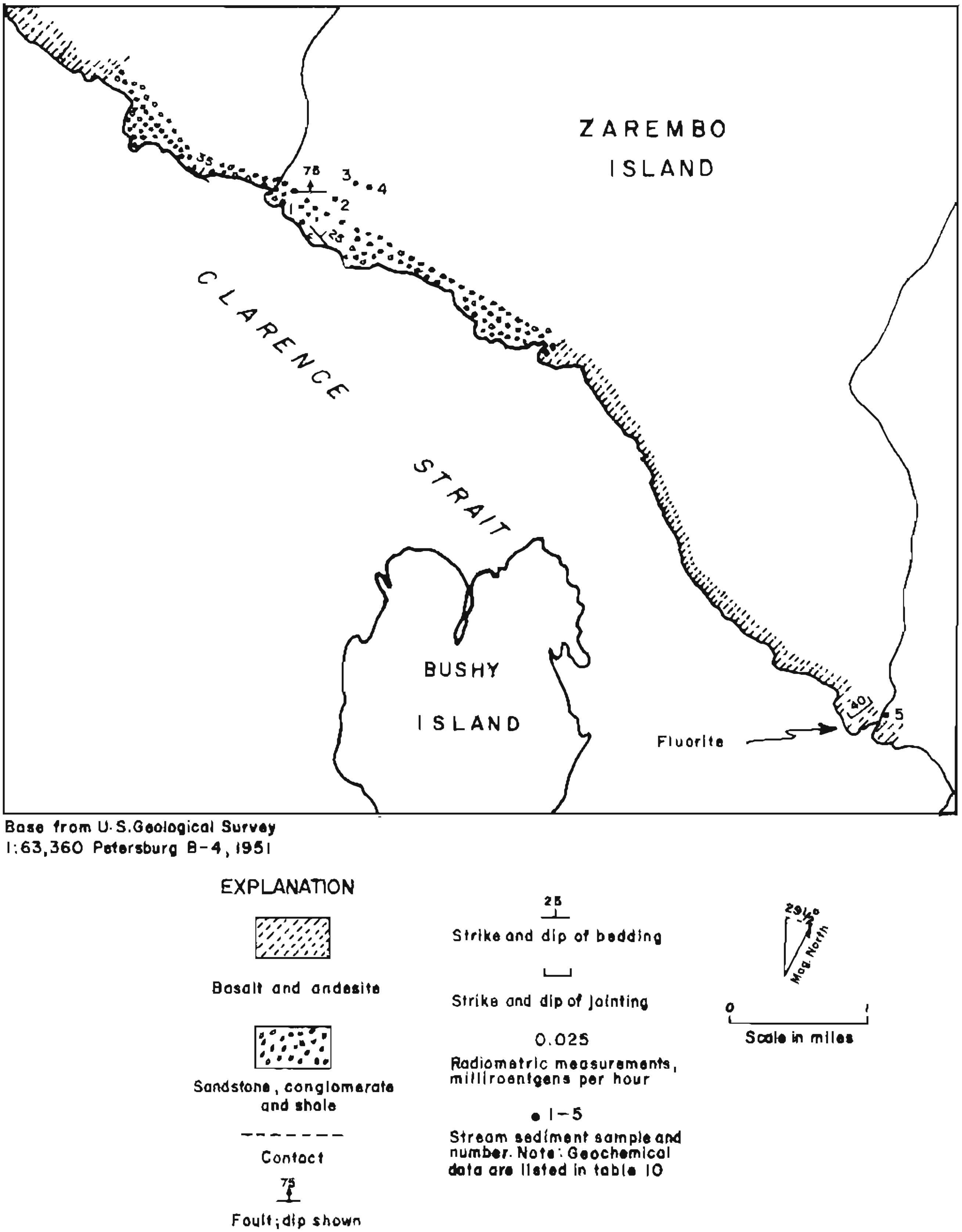


Figure 27 Geologic sketch map and stream-sediment sample locations, southwest coast of Zarembo Island (fig. 1, area 11)

SALMON BAY AREA, PRINCE OF WALES ISLAND

LOCATION AND ACCESS

The Salmon Bay area is on the northwest coast of Prince of Wales Island, about 35 miles southwest of Wrangell, in the Petersburg B-4 quadrangle. The area can be reached by boat or float plane. Salmon Bay is frequently used as an overnight harbor for fishing boats. One family runs a logging operation and has a float camp there.

HISTORY

On May 30, 1950, John Wandve of Ketchikan submitted to the Alaska Teritorial Department of Mines samples of red, jaspery rock from the northwest coast of Prince of Wales Island. These samples showed significant radioactivity and averaged 0.01% eU (Glover, 1951, p. 1). In July, 1951, Glover and members of the U. S. Geological Survey Alaska Trace Elements Unit examined the area and found additional radioactive material both north and south of the original discovery near Salmon Bay (Houston, 1952, p. 5). Claims were staked by various prospectors, but no subsurface exploration was done. Interest in the area led to a more detailed study by Houston, Bates, Velikanje and Wedow (1958, p. 6-23) during the summer of 1952.

GEOLOGY

Geology of the Salmon Bay area was mapped by Buddington and Chapin (1929, pl. 1). Figure 28, adapted from that report, shows the general geology along a part of the coast visited in 1970. Houston (1952), Houston, Bates, Velikanje, and Wedow (1958, p. 3-23), Glover (1951), and Wedow and others (1953, p. 6, 9, 13) discussed the general geology in reports on radioactive veins in the area. The following summary of geology is mostly taken from those sources.

The predominant bedrock unit in the area discussed is a thick graywacke formation of Silurian age, which is the host for radioactive veins. The graywacke sequence includes beds of indurated sandstone, shale, and conglomerate composed of pebbles and cobbles of greenstone, limestone, and granitic rock. A bed of conglomerate 300 to 400 feet thick is present at the base of the sequence. Part of the graywacke displays beds a few inches to several feet thick, but other parts are massive and difficult to distinguish from volcanic rock. The strike and dip average about N15°W and 45°W, respectively. The graywacke is composed mostly of feldspar, chert, quartz, and iron oxides, but parts of it are very limy. The iron oxides impart a dark reddish color. Many fine-grained, steeply dipping basalt and lamprophyre dikes cut the graywacke. They vary in thickness from a few inches to 60 feet. Their age is believed to range from Cretaceous to Tertiary.

Thick, light colored, massive limestone of Silurian age underlies the graywacke 8 miles southeast of the entrance to Salmon Bay. Similar rock is exposed just west of Point Colpoys on the north coast of the Prince of Wales Island.

The only granitoid rock seen in the Salmon Bay area during the 1970 investigation was a dark quartz diorite or granodiorite which forms the Rookery Islands in Clarence Strait (fig. 28). However, about 10 miles west of Salmon Bay on the western side of Prince of Wales Island there is a north-trending dioritic batholith approximately 15 miles long and 4 miles wide. This intrusive is thought to be an outlier of the Late Jurassic to Cretaceous Coast Range batholith. The dioritic rock of the Rookery Islands, the dikes, and the radioactive veins in this area may be of similar age. Figure 29 is a geologic sketch map showing the veins near the entrance to Salmon Bay.

A linear feature plotted from aerial photos probably is an expression of a high angle fault or large joint. This feature strikes N20°E for at least 4 miles near the northwest corner of Fishery Island (fig. 28).

MINERAL DEPOSITS

The only mineral deposits known in the immediate vicinity of Salmon Bay are radioactive carbonate-hematite veins and nonradioactive rare-earth carbonate veins found along 8 miles of coast between Point Colpeys and Pitcher Island (fig. 28). Veins having the strongest radioactivity are those on the east side of Fishery Island and on Pitcher Island. Most of the veins can be examined only at low tide. The radioactive veins are from 2 inches to 2 1/2 feet wide, generally straight and steeply dipping. Their strikes are mostly north to N30°W. They can be traced for 200 to 300 feet, but often they extend beneath water or soil and vegetation. Thus their true lengths cannot be measured easily. The vein material and the host rock are both stained about the same dark color. However, the veins can be traced as straight, shallow, notches, because the carbonate material erodes more easily than the argillite (fig. 30). There is no difference in appearance between the highly radioactive parts of

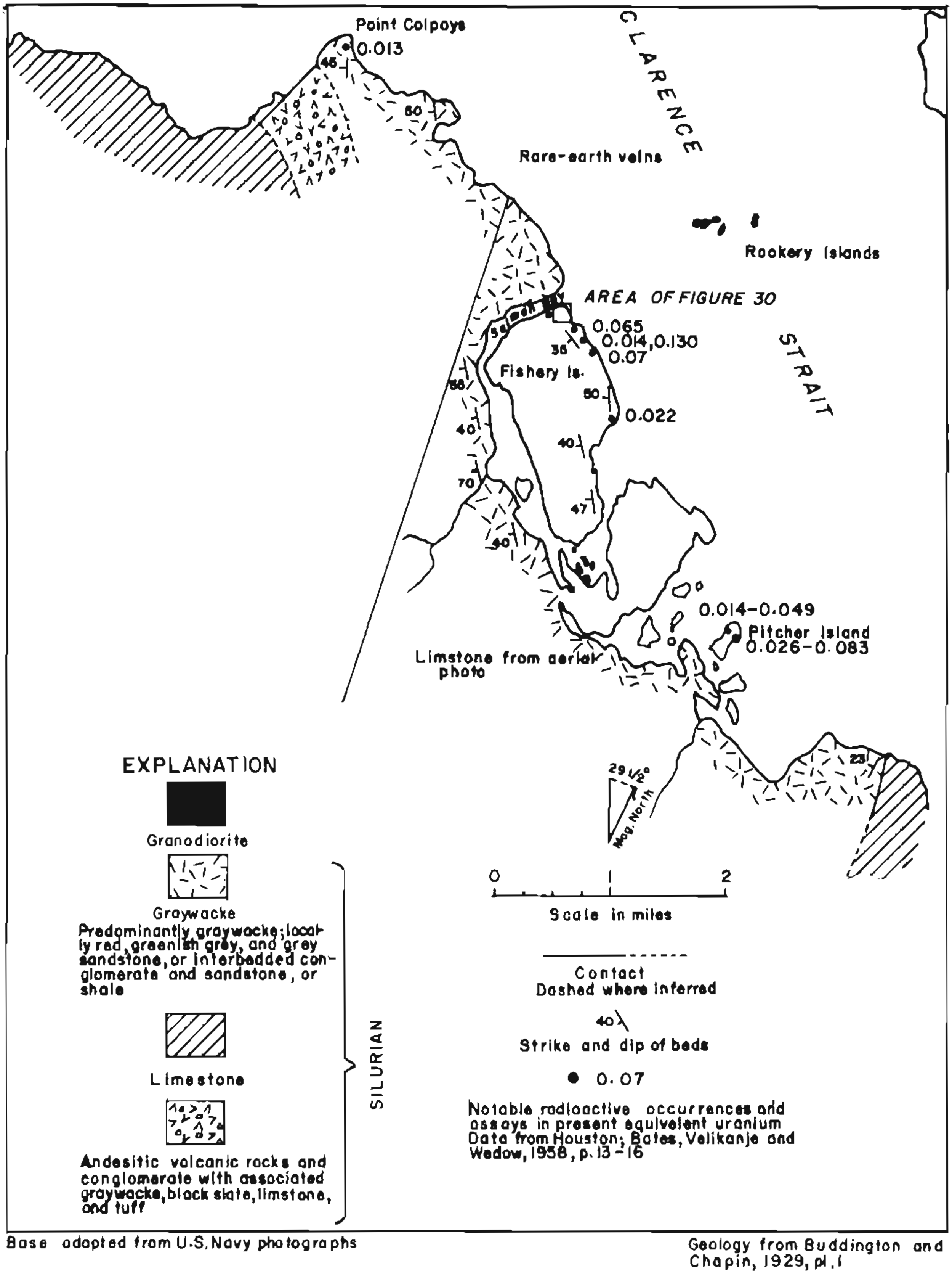


Figure 28 Geologic sketch map and radiometric data, Salmon Bay area, Prince of Wales Island (fig. 1, area 12)

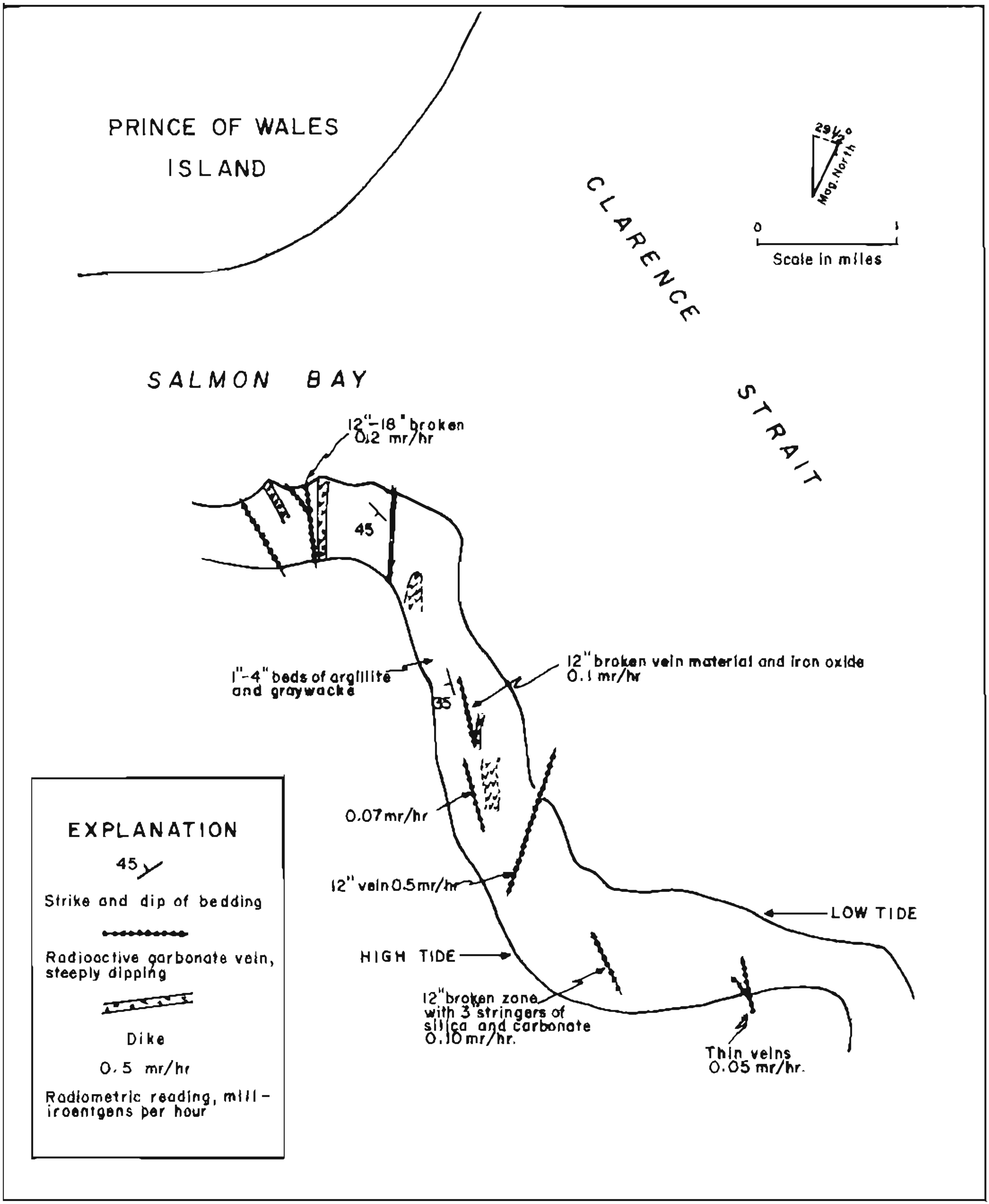


Figure 29 Geologic sketch map, shore near Salmon Bay, Prince of Wales Island

FIGURE 30. Radioactive carbonate vein cutting argillite, Salmon Bay area

the veins and those parts with little or no radioactivity. Walls of the veins show some alteration and low radioactivity.

Composition of the veins was reported by Houston, Bates, Velikanje and Wedow (1958, table 1) as 80 to 99% dolomite-ankerite. Alkalic feldspar is the next most abundant mineral, comprising up to 10% of the vein material. Red to specular hematite was found in small amounts in most veins. Pyrite is always present. A number of accessory minerals were found in trace amounts. The presence of fluorite, hematite and chalcedony are considered to be aids to prospecting, because these minerals are frequently associated with uranium.

Thorite, monazite, zircon and apatite are the only radioactive minerals identified and are present only in small amounts. Radioactive minerals could not be determined in some samples, but it was concluded that most radioactivity is due to thorium in thorite and monazite. Uranium appears to be present only in trace amounts. The highest grade sample was a grab sample taken near the entrance to Salmon Bay, which averaged 0.13% equivalent uranium and 0.64% equivalent thorium (Houston, Bates, Velikanje and Wedow, 1958, p. 12, 13). One channel sample taken along 100 feet of the Paystreak vein on Pitcher Island averaged 0.034% equivalent uranium and 0.16% thorium (Houston, Bates, Velikanje and Wedow, 1958, p. 18). Assays were run on three of the most radioactive zones sampled by the present author in 1970. These produced only 10, 7, and 3 ppm uranium, confirming that the radioactivity is due principally to thorium. However, due to the high solubility of uranium, it may originally have been present in greater quantities that have since been leached out of the near-surface portion of the veins.

Besides the radioactive veins, larger ones containing rare-earths, fluorcarbonate and hematite have been found one mile north of the entrance to Salmon Bay and on Pitcher Island. These are as much as 10 feet wide and 400 feet long. Assays reported by Houston, Bates, Velikanje and Wedow (1958, p. 19) show a maximum rare-earth oxide content of 5.0%. Fourteen other assays ranged from 0.07% to 1.95% rare-earth oxides. The minerals parisite and bastnaesite were identified.

RADIOMETRIC SURVEY

The radiometric values at Salmon Bay were the strongest found in 1970. The background count measured with a scintillometer (Precision Radiation Instrument 117-B) was 0.015 mr/hr. Radioactivity of the richest spots on the veins reached 5.0 mr/hr, and up to 11,500 counts per minute with a four-channel spectrometer. Radioactivity varied along the veins but was found to be highest in narrow parts and particularly at the junction of veins. Radioactivity of the dioritic rock on the Rookery Islands was 0.015 mr/hr, which is considered to be about normal for this type of igneous rock. Because of the availability of sampling and assay data published by the U. S. Geological Survey no radiometric survey map is included in this report.

GEOCHEMISTRY

No geochemical samples were collected at Salmon Bay.

CONCLUSIONS

Control for emplacement of the radioactive veins is principally structural. Veins appear to be fillings in a particular set of fractures. The occurrence of radioactive veins only in graywacke is probably due to the presence of open fractures during a time of hydrothermal activty in the area. Houston, Bates, Velikanje and Wedow (1958, p. 22) suggested that the carbonate-hematite veins are actually carbonatites.

The nearest plutonic rock, not mentioned in earlier reports, is the granodiorite of the Rookery Islands. It is not known what relation this rock may have to the veins along the shore of Prince of Wales Island.

Information is limited due to a lack of geologic mapping on the northern part of the island and the dense vegetation and soil cover there. Careful work might reveal a wider distribution of veins and disclose their relation to plutonic activity. The known veins are too low in uranium, thorium, and rare-earths to be of commercial value at present, and their mineralogy does not indicate that values would increase greatly with depth. Some increase in uranium may be expected though, because of near-surface leaching. The veins are of interest principally because they could be related to undiscovered mineralization in the interior of Prince of Wales Island and because high-grade uranium ore has been found near Kendrick Bay at the southern end of the island.

DEVILFISH BAY AREA, KOSCIUSKO ISLAND

LOCATION AND ACCESS

Devilfish Bay is on the east side of Kosciusko Island west of El Capitan Passage (fig. 31). It is in the Petersburg quadrangle about 50 miles south of Petersburg, and can be reached by boat or float plane. The area of primary interest is near the southwestern end of Devilfish Bay, where there are several mining claims and prospects pits.

HISTORY

Claims were staked for copper and molybdenum near the head of Devilfish Bay in 1962 by Ketchikan prospectors. Assessment work and additional exploration were done subsequently. Herreid and Kaufman (1964, p. 9) made a brief visit to the area and described three prospects located near the head of Devilfish Bay (fig. 31). A major company staked claims in the area in 1969. Prospector William Huff noted anomalous radioactivity in the area and suggested that an investigation for uranium was justified.

GEOLOGY

Devilfish Bay lies on the east side of the Dry Pass dioritic batholith. Silurian graywacke and limestone are present as inclusions within the granodiorite near the southwest end of the bay (fig. 31). Reaction between the sediments and the intrusive rocks has formed masses of brown and greenish garnet and marble. Some well developed garnet crystals up to 1 inch in diameter are present in the marble. Small deposits containing metallic minerals have been found in the contact metamorphic zone. Irregular pegmatite dikes within the diorite are exposed along the shore at the southwest end of the bay. These strike southwest and are up to 20 feet long.

MINERAL DEPOSITS

Only small pits and trenches have been dug to explore the sites. The two prospects (prospects A and B, fig. 31) closest to the bay contain pyrite, chalcopyrite and a little molybdenum. The third (prospect C, fig. 31) contains massive granular magnetite with minor chalcopyrite. Only the prospect nearest the shoreline was located during the Division's investigation in 1970. Figure 32 is a sketch of the pit showing exposed bedrock and radiometric readings. Considerable pyrite with minor chalcopyrite were found on a dump at the prospect. Molybdenum is reported to have been found here, but none was seen by the author. However, a 3-foot boulder containing molybdenite flakes up to 1/2 inch in diameter was found a few hundred yards southeast of this prospect at an elevation of 350 feet.

Molybdenum deposits are known at Shakan, about 5 miles northwest of Devilfish Bay (Twenhofel, Robinson, and Gault, 1946, p. 19-30; Herreid and Kaufman, 1964, p. 1-9) where considerable development work was done during and shortly after World War I.

RADIOMETRIC SURVEY

Anomalous radioactivity was found at several points within the area examined. The average background over exposed granodiorite was approximately 0.008 mr/hr. The pegmatite dikes along the shore registered up to 0.025 mr/hr. Exposed granodiorite at an elevation of 130 feet on the south side of the bay produced 0.03 mr/hr. The copper-molybdenum prospect (prospect A) contains one spot that registered 0.045 mr/hr, the highest reading in the area. Most of the material in the prospect pit yielded 0.025 mr/hr or less. A chemical assay of a sample from the prospect produced a value of 8 ppm uranium, about twice that of the average acid igneous rock. The

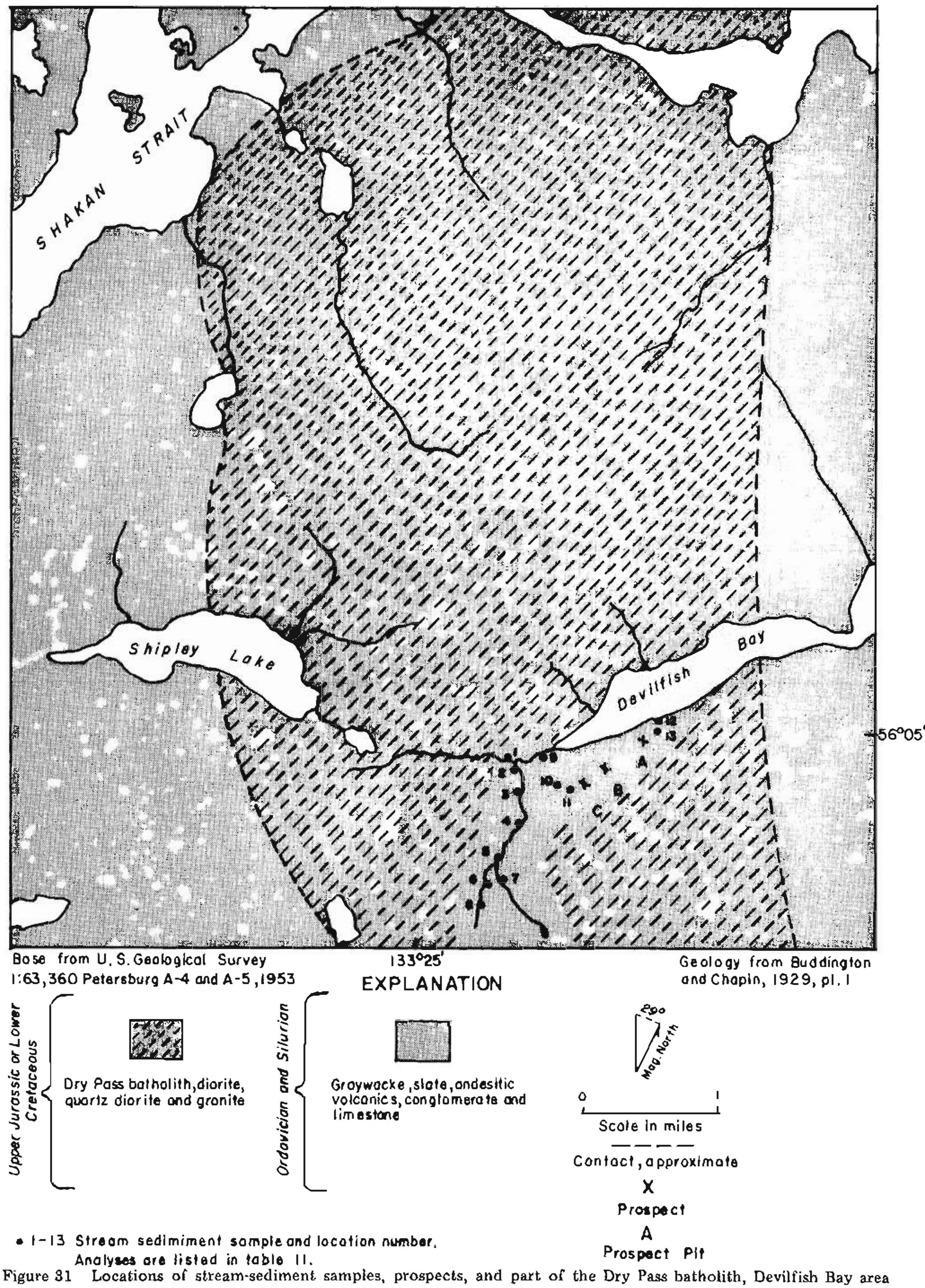


Figure 31 Locations of stream-sediment samples, prospects, and part of the Dry Pass batholith, Devilfish Bay area (fig. 1, area 13)

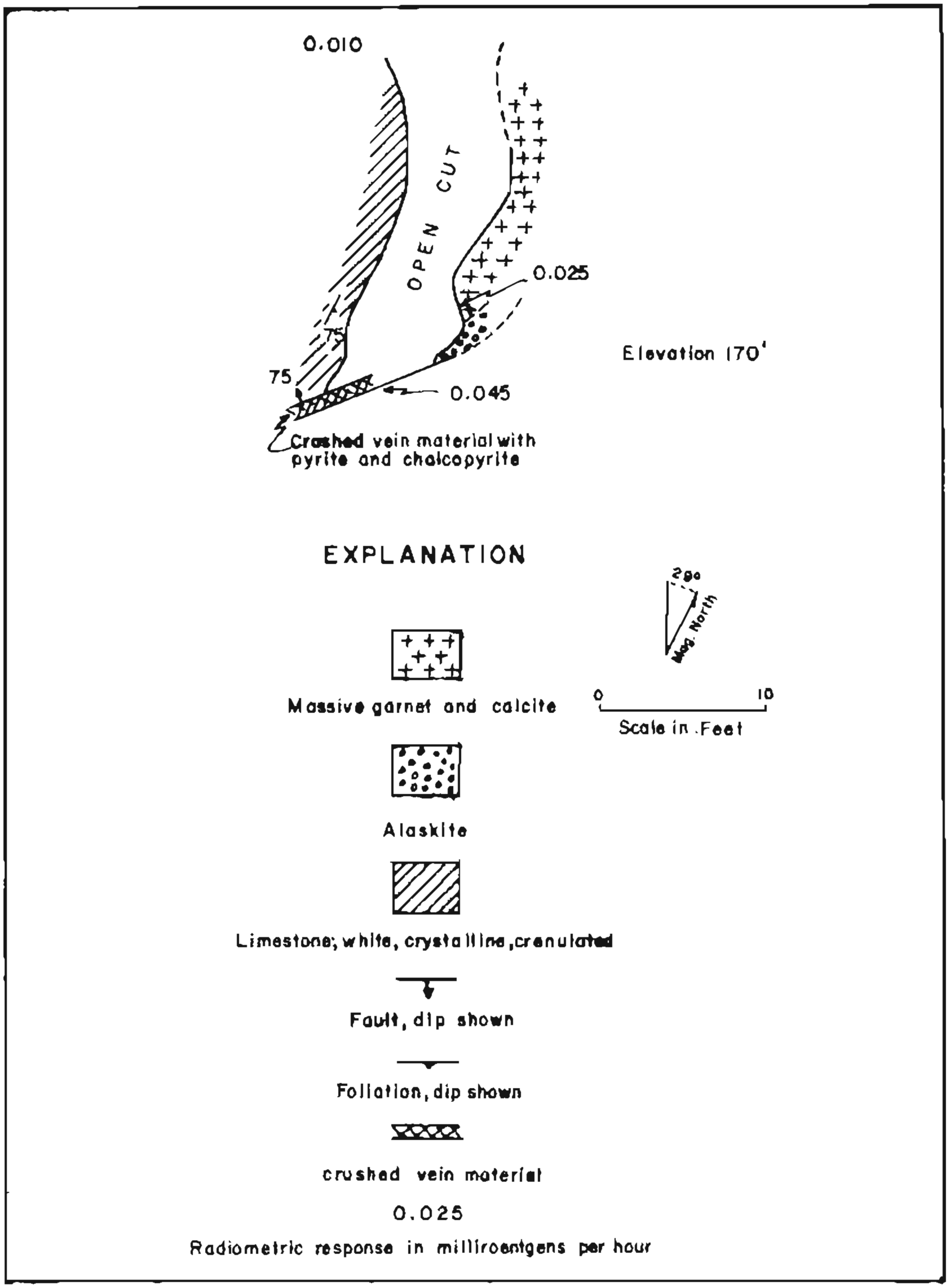


Figure 32 Geologic sketch map, prospect pit, Devilfish Bay

radioactive mineral was not identified.

GEOCHEMISTRY

Thirteen stream-sediment samples were collected at Devilfish Bay (fig. 31). Atomic absorption analyses are given in table 11. The highest values were 95 ppm copper, 25 ppm lead, and 90 ppm zinc. Sample location 11 may be anomalous for copper, but too few samples were collected to draw any definite conclusions.

TABLE 11.-*Atomic Absorption Analyses, Devilfish Bay Area*

Location on Figure 31	Field Sample Number	Copper ppm	Lead ppm	Zinc ppm
1	P127	50	15	30
2	P126	15	10	25
3	P125	30	25	90
4	P124	10	10	20
5	P123	10	10	15
6	P121	3	10	10
7	P122	30	10	35
8	P120	10	20	15
9	P128	35	10	35
10	P129	50	15	65
11	P130	95	15	60
12	E 25	30	20	50
13	E 26	60	20	55

CONCLUSIONS

Rather pronounced radioactive anomalies were found at Devilfish Bay, especially the 0.045 mr/hr reading obtained in the prospect pit containing pyrite, chalcopyrite and molybdenum. The mineralogy and general geology, however, do not suggest the presence of sufficient uranium to justify exploration for this element. The anomalous radioactivity does illustrate how it may be associated with various mineral deposits and used as an aid in general prospecting.

DALL BAY, GRAVINA ISLAND

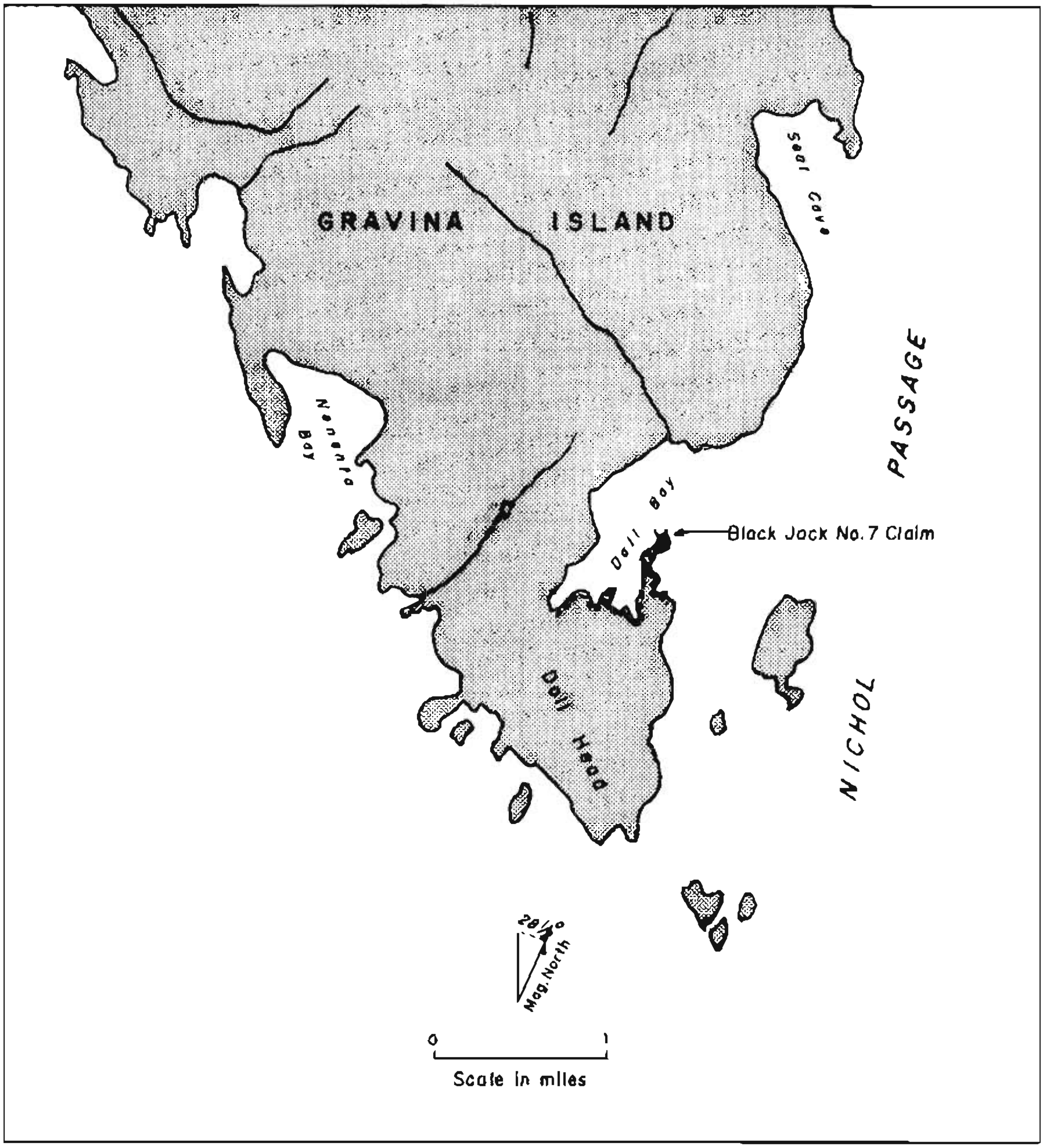
LOCATION AND ACCESS

A uranium prospect is located on the east side of Dall Head near the southern end of Gravina Island in the Ketchikan A-6 quadrangle, 13 miles south of Ketchikan. Radioactive zones are exposed on the shore on the west side and near the north end of a small peninsula extending into Dall Bay (fig. 33). The area can be reached by boat or float plane.

HISTORY

The southern part of Gravina Island was an area of considerable prospecting and some mine development prior to 1915. During the winter of 1955, Ketchikan prospectors discovered radioactivity south of the entrance to Dall Bay. Several lode claims, called the Black Jack group after the Black Jack Mining Company, were staked. Radioactive samples received by the Alaska Territorial Department of Mines led to an examination of the property (Williams, 1956). Assays on file at the Alaska Division of Geological Survey office record values up to 0.07% uranium, but one report mentions that one sample carried several percent equivalent uranium.

During 1951, prior to the discovery of radioactivity on the Black Jack claims, White, West, Tolbert, Nelson, and Houston (1952, p. 15) made a reconnaissance survey for uranium along the southeast side of Gravina Island. They reported a maximum of 0.005% equivalent uranium in felsic volcanic rocks, but evidently did not find the radioactive material.



EXPLANATION

Foot traverse

Figure 33 Dall Bay area, Gravina Island (fig. 1, area 14)

GEOLOGY

Buddington and Chapin (1929, pl. 1) mapped the bedrock surrounding Dall Bay as Upper Jurassic or Lower Cretaceous quartz diorite to granodiorite. Inland from Dall Bay is a large area of banded gneiss. Farther west and north are limestone, conglomerate, schist, quartzite and greenstone. The present author noted medium-grained dioritic rock and basic and felsic dikes on the east side of Dall Bay. A sheared and brecciated zone 75 feet wide striking N 20° E is present on the west side of the small peninsula south of the entrance to the Bay. This zone contains angular fragments of dark fine-grained rock in a dolomite cement with some iron staining and a small amount of pyrite. The country rock is somewhat altered and slightly gneissic. Foliation trends S 40° E. Small felsic dikes and pods of feldspar exposed along the east side of the peninsula strike N 35° W. These are slightly radioactive.

MINERAL DEPOSITS

Several copper deposits were discovered around 1900 between Dall Bay and Seal Cove, 2 miles to the north (Wright and Wright, 1908, p. 138-139; Brooks, 1902, p. 38). The prospects are in sheared and brecciated zones cutting schist and metavolcanic rocks. Pyrite and chalcopyrite are the principle metals, but minor amounts of bornite, sphalerite, gold, and silver were reported. Small tonnages of ore were shipped from the Bay View and War Eagle properties west of Seal Cove.

Williams (1956) has described the radioactive material at the Black Jack No. 7 claim at Dall Bay. The discovery reportedly was made on a very thin seam or vein of radioactive material which contained several percent uranium, but very little was found. Two small excavations were made by blasting in an effort to follow the seam, but it apparently could not be traced either laterally or in depth. Two small mineralized areas were found in one pit but were only a fraction of an inch wide. The largest was on a joint or fault plane of slight displacement, and was apparently part of the "seam" from which the earlier samples were taken. The geiger counter gave readings of 2 mr/hr at both places. Immediately adjacent to the pits the general readings were above normal, but moving away from the pits in any direction brought the readings back to normal.

The country rock in the vicinity of the No. 7 discovery is a serpentinized basalt or gabbro. The serpentinized zone strikes north and dips 57° W. A 2 1/2 foot layer or sill of pink feldspar (later identified as albite) lies on the hanging wall side of the fault plane from which the radioactive material was taken. The owners reported that the same association exists at their other showings. The actual uranium mineral resembles pitchblende.

RADIOMETRIC SURVEY

A radiometric examination of the coast from one mile south of the entrance to Dall Bay to an old sawmill site at the southern extremity of Dall Bay was made in 1970 using a four channel spectrometer. Pegmatite dikes and pods of albite on the east side of the small peninsula extending into Dall Bay produced up to 200 counts per minute against an average background of 75 counts. Feldspar pods at the Black Jack No. 7 claim on the west side of the peninsula produced up to 2,000 counts per minute. A chemical assay of the radioactive material collected in 1970 showed 80 ppm (0.008%) uranium. However, small hand samples of material from the area produce only a very slight amount of radioactivity. The feldspar pods are at two places about 100 feet apart. These are irregular and measure up to 2 1/2 feet wide and 10 feet long. They are adjacent to small serpentinized zones. The feldspar is reddish and coarsely crystalline. No metallic minerals were seen and the most radioactive portions of the pods appear to be associated with thin black coatings along fractures in the feldspar. No minerals other than feldspar could be recognized. The prospect pit mentioned by Williams was not found.

GEOCHEMISTRY

No geochemical sampling was done at Dall Bay.

CONCLUSIONS

The radioactive material exposed at the Black Jack No. 7 claim does not suggest commercial possibilities at that immediate location. However, the radioactivity may have significance by being associated with undiscovered deposits in the general area. This possibility is mentioned because radioactive dikes are known to be present as much as 8 miles distant around the high-grade uranium deposit at Bokan Mountain on Prince of Wales Island, about 22 miles southwest of Dall Bay.

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