LIST OF DRAWINGS

AIRBORNE MAGNETOMETER SURVEYS, 1956–57

INTRODUCTION*

Between August, 1956, and October, 1957, airborne magnetometer surveys were made for the British Columbia Department of Mines by Photographic Surveys Limited (affiliate of Aeromagnetic Surveys Limited of Toronto). The resulting twelve aeromagnetic maps, covering most of Texada Island, parts of Quadra Island, and several areas on Vancouver Island, were released to the public between February 8th, 1957, and January 9th, 1958.

The identifying designations of the twelve map-sheets and particulars concerning scale, line spacing, terrain clearance, etc., are tabulated on page 13. The relative positions of the map-sheets are shown in Figure 1.

The airborne magnetometer surveys were undertaken to gain information on the practical usefulness of such work in searching for deposits of magnetic iron ore, and also to assist in the search in so far as the maps contribute information of value. The maps may also throw light on geological features that may have no relation to bodies of magnetic iron ore.

Before the airborne magnetometer surveys were made for the Department of Mines, the writer had an opportunity to examine an aeromagnetic map made in 1951 and 1952 for the Utah Co. of the Americas and a geophysicist's appraisal of the results. The area covered lies immediately south of Department of Mines map A.M. 57-2, and includes the Iron Hill and Iron River magnetite deposits. Grateful acknowledgment is made to Mr. L. C. Clark, geologist for the Utah company, for his kindness in giving access to the information and granting permission for the reproduction of the map in the present publication. Figure 2 of this report is taken from the Utah company map.

Rugged topography and high relief limit the application of the techniques usually employed in making airborne magnetometer surveys. It was possible to select two areas with relief suitable for survey with a fixed-wing aircraft and the usual line spacing and terrain clearance. One of these areas, the northern two thirds of Texada Island (A.M. 57-3), contains the group of magnetite bodies worked by Texada Mines Ltd. The other area (Maps A.M. 57-1 and A.M. 57-2) includes part of Quadra Island and part of Vancouver Island generally north of Campbell River.

Areas in which bodies of magnetic iron ore are known, in the main, have considerable topographic relief. In the Quatsino Sound-Nimpkish Lake-Zeballos area, on Vancouver Island, topographic relief of more than 2,500 feet a mile is not uncommon, and the country is so cut up by deep valleys that areas of uniform slope are small and rare. In such terrain it is impracticable with a fixed-wing aircraft to maintain ground clearance of 500 feet within acceptable limits, but it was considered that survey by helicopter would permit such clearance to be maintained.

Experimental helicopter-magnetometer surveys were undertaken in March, 1957. Part of this work was over ground on which a survey had been made with fixed-wing aircraft. The helicopter work also extended into more rugged country immediately adjoining that where work was done with fixed-wing aircraft. The experimental work also included two small areas surveyed by helicopter with 600-foot line spacing and 300-foot terrain clearance.

Following the experimental work, a campaign of helicopter-magnetometer surveys was undertaken, covering a total of 333 square miles in four areas. The four areas are in the Quatsino Sound-Zeballos section of Vancouver Island and were selected on geological grounds. Each contains at least one known concentration of magnetite. The field work for these areas was completed in September, 1957. Aeromagnetic Surveys Limited, after review of the mapping, put a note on the four maps reading "due to the high topographic relief the location and shape of some anomalies may show local inaccuracies." The boundaries of the four aeromagnetic maps lie within the geological maps

* By H. Sargent.

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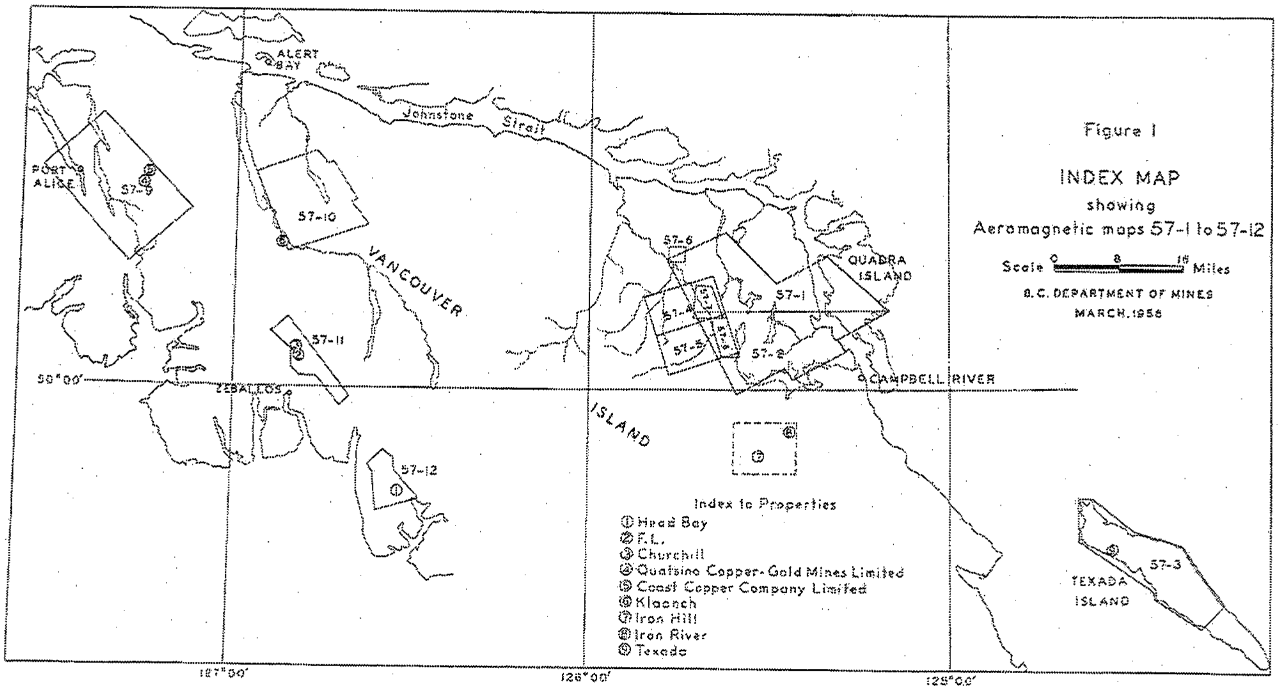


Figure 1

INDEX MAP showing Aeromagnetic maps 57-1 to 57-12 at the scale of 1 mile to 1 inch that accompany *Geological Survey of Canada,* Memoir 272, "Geology and Mineral Deposits of the Zeballos-Nimpkish Area, Vancouver Island, British Columbia," by J. W. Hoadley.

The surveying was done with an Anson Mark V aircraft and a Gulf Mark III magnetometer, in a "bird" at the end of a 125-foot towline, or with a Bell 47G helicopter and a Gulf Mark III magnetometer, in a "bird" at the end of a 75-foot towline.

Known bodies of magnetite on Vancouver and Texada Islands have a wide range in size; few individual orebodies have any dimension exceeding 400 feet, but some mineralized zones are believed to contain semi-continuous or closely spaced bodies for a length of 1,200 to 1,500 feet. Clusters of orebodies may occur; for example, on Texada Island where at least seven considerable bodies are known in an area less than 2 miles from east to west and 1¼ miles from north to south. Within an orebody or a mineralized zone, abrupt changes may occur from massive magnetite to skarn containing very little magnetite.

With the usual terrain clearance and line spacing, magnetite bodies such as those outlined are believed to give magnetic anomalies with relief of a few hundred gammas. Similar and greater magnetic relief, recorded on the aeromagnetic maps, appears to be related to topographic relief, to exposures of bedrock such as lava containing minor amounts of disseminated magnetite, or to margins of some bodies of granitic rock.

Maps A.M. 57-1 to A.M. 57-8 were available by the spring of 1957. In order to obtain a better idea of the probable usefulness of such maps, some of the areas for which the airborne magnetometer maps indicated magnetic anomalies were investigated on the ground early in the 1957 field season. The selected areas lie within sheets A.M. 57-1, A.M. 57-2, and A.M. 57-3. The field investigations were made by N. D. McKechnie, J. W. McCammon, and A. Sutherland Brown, and included studying the geology and checking the local magnetic features by making dip-needle or ground magnetometer surveys. Notes covering these field investigations follow.

AEROMAGNETIC MAPS

Map No.	Title	Mean Line Spacing	Mean Terrain Clearance	Scale	Date Flown	Type of Aircraft
		Ft.	Ft.			
A.M. 57-1	Salmon River	1,320	500	1″=2,640′	Aug. 1956	A[1]
A.M. 57-2	Menzies Bay	1,320	500	1″=2,640′	Aug. 1956	A
A.M. 57-3	Texada Island	1,320	500	1″=2,640′	July 1956	A
A.M. 57-4	Salmon River (North)	1,320	500	1″=1,320′	Mar. 1957	B[2]
A.M. 57-5	Salmon River (South)	1,320	500	1″=1,320′	Mar. 1957	B
A.M. 57-6	Big Tree Creek	1,320	500	1″=1,320′	Mar. 1957	B
A.M. 57-7	Spirit Lake	600	300	1″=1,320′	Mar. 1957	B
A.M. 57-8	Bodil Lake	600	300	1″=1,320′	Mar. 1957	B
A.M. 57-9	Alice Lake	1,320	500	1″=2,640′	Sept. 1957	B
A.M. 57-10	Nimpkish area	1,320	500	1″=2,640′	Sept. 1957	B
A.M. 57-11	Lime Creek	1,320	500	1″=2,640′	Sept. 1957	B
A.M. 57-12	Head Bay	1,320	500	1″=2,640′	Sept. 1957	B

[1] Anson Mark V fixed wing, with Gulf Mark III magnetometer and 125-foot towline.
[2] Bell 47G helicopter, with Gulf Mark III magnetometer and 75-foot towline.

LARGE ANOMALY ON NORTH SHORE OF CAMPBELL LAKE

A strongly anomalous high on the north side of Campbell Lake near the west end (*see* Fig. 3) was examined in 1956 by W. R. Bacon. The anomaly is represented as an eliptical area 5,000 feet long and 3,500 feet wide with magnetic relief of 2,000 gammas. Where the anomaly is shown, a spur or point with a hill near its southern end runs southward into the lake, the hill rising some 400 feet above lake level. The centre of the anomaly is nearly 2,000 feet northwestward from the top of the hill. Dr. Bacon collected and examined numerous specimens of intermediate to basic volcanic rock from outcrops in the eliptical area. Of these specimens a few were magnetic enough to affect a compass needle noticeably when held near the compass case. Examination on the ground did not disclose a probable cause of the anomaly other than the varyingly magnetic volcanic rock.

ANOMALIES NORTH OF THE CENTRAL PART OF CAMPBELL LAKE AND NEAR SPIRIT LAKE*

Between May 20th and June 7th, 1957, traverses were made east of the Salmon River and north of Lower Campbell Lake in the Sayward Provincial Forest. The object of the investigation was to determine whether or not certain high magnetic anomalies, indicated in three parts of Aeromagnetic Maps A.M. 57-1 and A.M. 57-2, might be due to concentrations of magnetite.

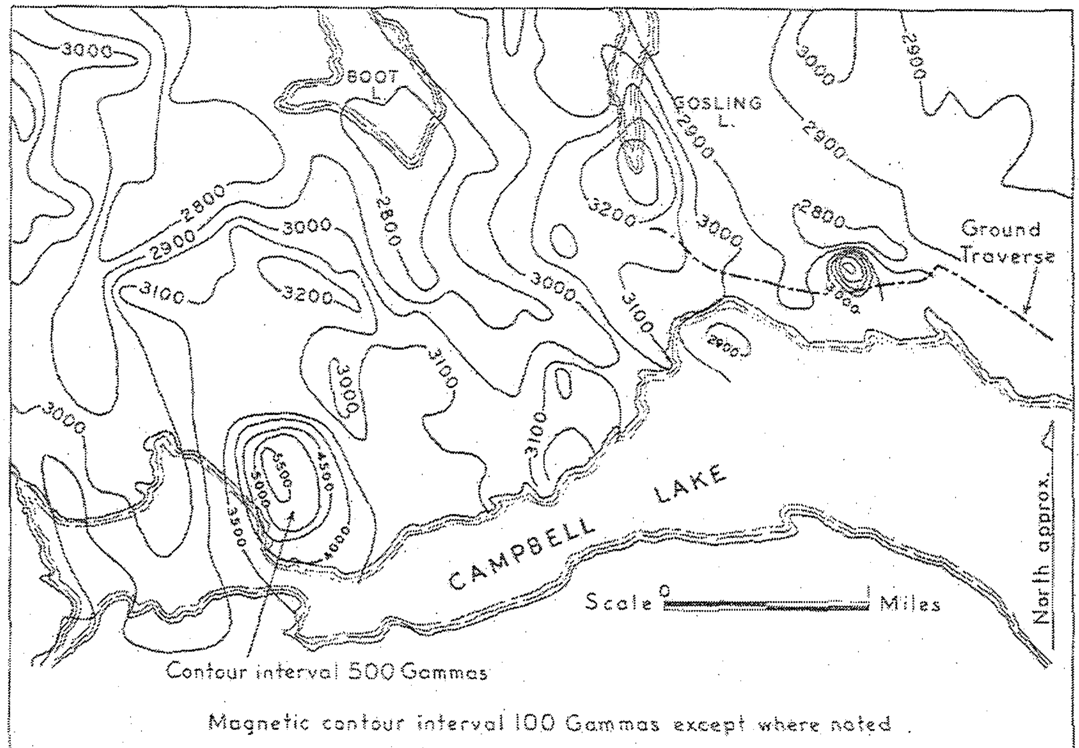


Figure 3.—Aeromagnetic map of selected area on north side of Campbell Lake (shows ground traverse).

In each area, control points were established by plane-table survey. Magnetometer readings were taken at regular intervals along surveyed lines. Cross traverses, measured by Brunton compass and chain and tied in to the surveyed lines, were made with the magnetometer where it was thought advisable. The magnetometer was a Sharpe Model DI-M. Three readings were taken on the down-swing of the needle, averaged, and converted to gammas according to a chart supplied with the instrument. This instrument has a weighted needle and so measures the variation in vertical magnetic intensity, as does a dip needle. The converted readings are comparative and do not indicate the actual magnitude of the vertical component of the earth's field.

Anomalies in three areas were tested: Area A is within Map A.M. 57-2 on the north shore of Campbell Lake, about 1 mile east of the creek flowing out of Gosling Lake; Area B is within Map A.M. 57-7 (*see* Fig. 1) on the east side of the Salmon River, 5 miles south of the Campbell River-Kelsey Bay highway at Bigtree Creek; and Area C is

* By N. D. McKechnie.

on the mountain immediately north of the highway and west of Bigtree Creek, within Map A.M. 57-6.

In each area three factors appeared in common with the anomalous highs on the aeromagnetic maps. These were the presence of slightly magnetic basalt, the presence of intrusive contacts, and relatively large areas of outcrop. It was observed, too, that the higher knobs of exposed rock correspond in position to some small local aeromagnetic highs.

North Shore of Campbell Lake.—The Area A anomaly is shown on Map A.M. 57-2 as a roughly circular area 1,000 by 1,200 feet with an increase in magnetic intensity from 3,000 gammas at the margin to 3,400 gammas at the centre. It is at the edge of an area of extensive basaltic outcrops. Ground magnetometer readings were taken at intervals of 200 feet from about 5,000 feet west of the anomaly to about 3,500 feet east and south of it, along and near a road made on the right-of-way of a former logging railroad. Magnetic and ground surface profiles along the traverse are shown in Figure 4 and the traverse is indicated in Figure 3. For the first 7,000 feet the readings were irregular and varied within a range of 500 gammas. The readings across the anomaly varied similarly to the others. The remaining readings were consistent at near the previous maximum; they were on larger and more consistent basaltic outcrops. The highest reading obtained was at a contact between a granitic dyke and the basalt.

The variations in the readings in the first 7,000 feet may be due to varying thicknesses of overburden. Some higher readings may have been due to buried iron scrap from the old railroad.

The rocks where the highest readings were obtained showed no appreciable amount of magnetite, although, when held close to the case, some specimens were magnetic enough to affect a compass needle noticeably.

Spirit Lake.—The Area B anomaly (*see* Figs. 5 and 6) consists of a series of magnetic highs lying along a curving axis in a direction of approximately north 25 degrees west. It is 2 miles long and a half-mile wide. Exposures of basaltic rock, some slightly magnetic, are frequent along the anomalous zone. The range of vertical magnetic intensity is, according to Map A.M. 57-7, from 3,400 to 4,500 gammas. Ground magnetometer readings were taken at 500-foot intervals along stadia lines ranging from 1,000 to 1,800 feet apart, with additional crosslines where the greater airborne magnetometer anomalies had been found. Where readings showed noticeable increase, the intervals were shortened to 250 feet. The positions of the magnetometer stations are shown in Figure 6, on which the magnetometer readings, converted to gammas, have been contoured. The greatest local increases were approximately 400 and 700 gammas. Both were near and on the basalt side of exposed contacts with granitic intrusives. The axis of aeromagnetic highs was found to pass very near to these exposures, and it is probable that the anomaly follows this granitic contact.

Area C.—The Area C anomaly, shown on Maps A.M. 57-1 and A.M. 57-6, consists of two highs, 4,350 and 4,775 gammas, representing local increases in vertical intensity of 850 and 1,275 gammas respectively. The numerous outcrops in the anomalous areas were mapped. They consisted of basalt intruded by dykes of diorite. Because of the similarity of the geology and the correspondence of the range of vertical magnetic intensities with those of Area B, and the frequency of outcrop, it was apparent that no purpose would be served by taking additional magnetometer readings here.

ANOMALIES ON QUADRA ISLAND*

Maps A.M. 57-1 and A.M. 57-2 show on Quadra Island one positive anomaly of 1,000 to 1,500 gammas centred north and east of Open and Village Bays, and a general magnetic high with many isolated peaks of 200 or 300 gammas in the western part of the

* By A. Sutherland Brown.

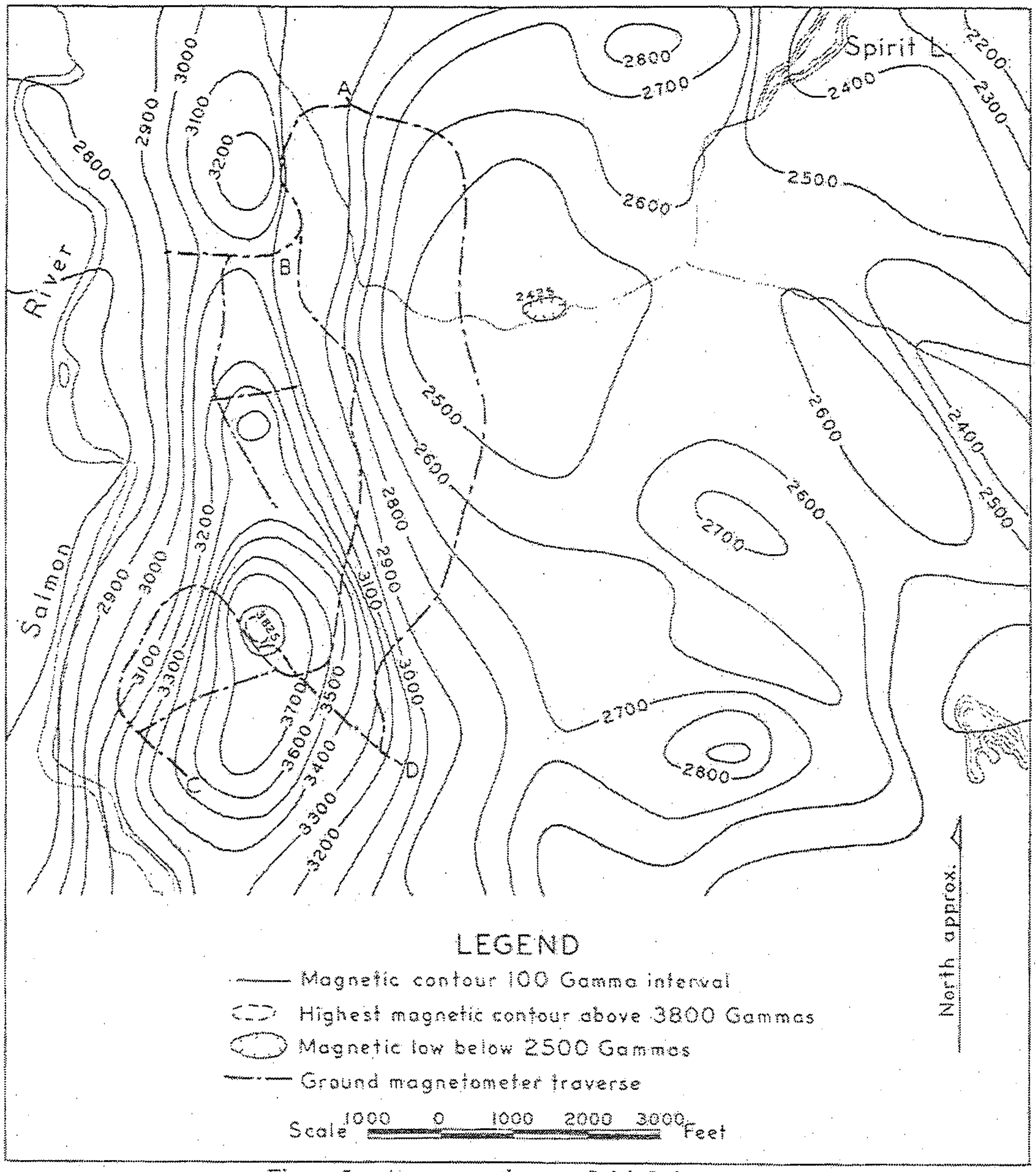


Figure 5.—Aeromagnetic map, Spirit Lake area.

island. Approximately two weeks in May, 1957, was spent investigating the cause of the anomalies and general magnetic high areas by geological mapping and dip-needle surveys.

Rock Exposure

Quadra Island east and south of a line between Heriot Bay and Quathiaski Cove is completely covered by glacial drift. West of a line from Open Bay to Granite Bay, rock is well exposed. East of this line, exposure is only fair; isolated glaciated rock knobs are common, but between them, in swamp and forest, exposure is meagre.

Stratigraphy

The geology of a major part of Quadra Island is shown on the accompanying map, Figure 9. The oldest rocks exposed comprise about 3,000 feet of basalts and basaltic andesites of the Texada group. These are predominantly massive flows but many pillow lavas, breccias, and tuffs are intercalated. Conformably overlying and interbedded at the top of the flows are argillaceous, fetid limestones and marbles of the Marble Bay limestone. These limestones contain in places abundant ammonites that are severely deformed and almost completely replaced by massive calcite. They have been recognized as Upper Triassic (*see B.C. Dept. of Mines*, Bull. 23, p. 36, or Bull. 40, p. 36). The Texada and Marble Bay formations are cut by the Coast intrusions which in this area can be divided into two main types—a predominantly quartzose granodiorite that is commonly foliated and a hornblende diorite. The latter occurs as small bodies along the contact, as dykes near the contact, and as one moderate-sized body that extends over half a mile from the contact. It is this latter body that apparently causes the major anomaly of the Open Bay-Village Bay area.

Structure

The geological structure is simple in broad outline but complex in detail. The over-all pattern is that of a northeast-dipping monoclinal arch of stratified rocks cut on the northeast by granitic rocks intruded forcefully along a contact subparallel with the regional strike. The Texada flows dip northeastward with angles that increase from about 10 to 15 degrees on the southwest to 45 to 70 degrees adjacent to the limestone. The overlying limestone and its included flows, dykes, and sills are severely compressed into isoclinal folds overturned toward the southwest. The limestone is commonly schistose and the included volcanic rocks are squeezed (boudinage). Folds of a type that may be produced by rock flowage occur near the granitic rocks. Marble, and garnet, tremolite, pyroxene skarns are common toward the contact in some places. Some of these skarns contain sufficient magnetite to affect the compass needle, but none observed contained readily visible magnetite. Pyrite and pyrrhotite are also widely distributed in minor amounts, and showings of chalcopyrite and pyrrhotite are known from Stramberg Lake to the northwest.

The quartzose granodiorite commonly shows a foliation which is subparallel to the strike of sedimentary and volcanic rocks and which dips steeply southwestward near the contact and more nearly vertical or northeastward away from the contact. The granodiorite has minor marginal aplitic or pegmatitic phases, and some of its dykes in the older rocks are porphyritic. The hornblende diorite is not noticeably foliated. The contact of the largest hornblende diorite body is gradational, but some of the smaller bodies are cut, or even fragmented, by the granodiorite. Inclusions, large and small, are found in both types of granitic rock. Some inclusions in the hornblende diorite that seem to be volcanic rock or skarn are very rusty weathering and iron-rich, but they do not contain much readily identifiable magnetite.

Geophysics

1. A survey was made of the Village Bay-Open Bay area using a Sharpe D-2 dip needle. Readings were taken facing west, with the instrument held in the plane of the meridian. Swing was generated by rotating the instrument from the horizontal position. A difference of 1 degree of dip was found to be equivalent to about 100 gammas. Position was plotted on vertical aerial photographs.

The dip-needle survey confirms the aeromagnetometer survey; a magnetic high is found centred on the same general locality but with a slightly different shape and orientation. A difference of about 15 degrees is found between the magnetic high and the surrounding areas. Figure 8 shows the contoured dip-needle traverses. This can be compared with the geology (Fig. 9) and the aeromagnetic map (Fig. 7). It will be noticed there is a striking correlation between the distribution of the main hornblende diorite body and the dip-needle anomaly. Hand specimens of hornblende diorite tested from the main body without exception contained enough magnetite to move a compass needle and in some cases did so very readily, as did many specimens of fine-grained inclusions, but in no case did any specimen seem to contain more than 5 to 10 per cent magnetite.

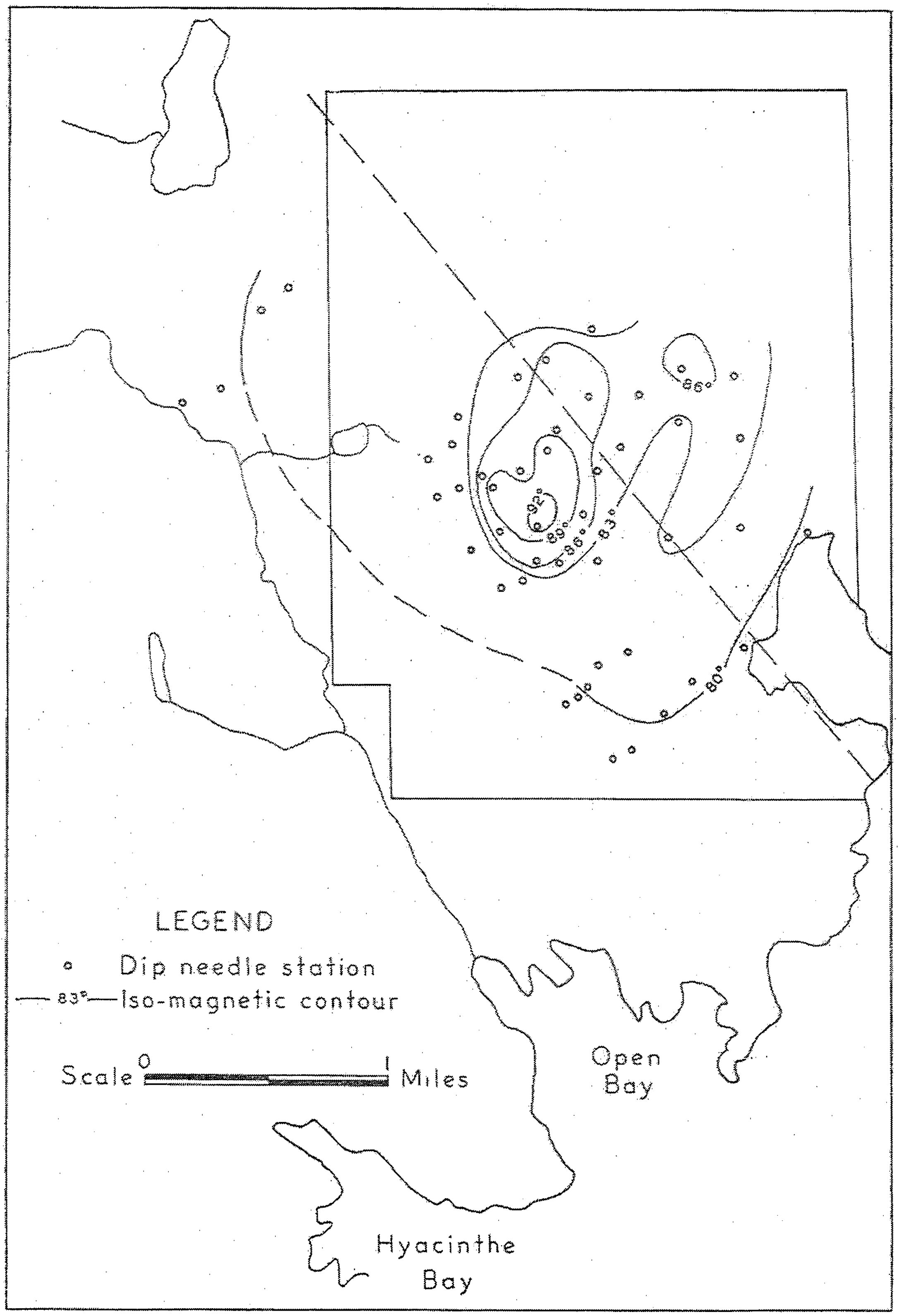


Figure 8.—Dip-needle survey, Quadra Island.

2. The general magnetic high area of the western part of Quadra Island is related to the topography, as can be seen by comparing Figure 9 with Figure 7. In particular the deep valley north of Mount Seymour corresponds exactly with a similar valley in the magnetic relief.

3. There is a definite regional gradient of magnetic intensity increasing toward the granitic rocks, where the plateau level is about 3,600 to 4,000 gammas, compared with about 3,300 to 3,600 gammas for the volcanic rocks.

Conclusions

1. There is a small regional gradient in magnetic intensity with values increasing toward the granitic rocks.

2. There is a direct correlation between topography and a general magnetic high area in the western part of Quadra Island.

3. There is a magnetic anomaly of some intensity in the Open Bay-Village Bay area; the anomaly shown on the aeromagnetic map is confirmed by a dip-needle survey.

4. The cause of this anomaly appears to be a magnetite-rich hornblende diorite, a local phase of the Coast intrusions.

5. It is possible but not likely that magnetite orebodies could exist within the general area of the anomaly and be masked by the general magnetic high.

DIP-NEEDLE INVESTIGATION OF AEROMAGNETIC ANOMALIES ON NORTHERN TEXADA ISLAND*

Introduction

In June, 1957, fifteen working-days were spent in a ground investigation of aeromagnetic anomalies that had been mapped on northern Texada Island in 1956.

The anomalies examined were as follows (*see* Fig. 10):—

- The high on the road at the east end of Priest Lake.
- The high over the Cameron orebody on the Texada Mines property.
- The two highs on Comet Mountain—southeast of Raven Bay and west of Pocahontas Bay.
- The high on the north peak of Mount Pocahontas beside the Forestry Lookout.
- The northwest-trending line of lows along a supposed fault east of Mount Pocahontas.

Traverses were made across the anomalies. Dip-needle and altitude readings were taken at regular intervals along the traverses and geology was noted.

Dip-needle readings were taken with a hand-held instrument made by T. Harrison & Co., Montreal. This instrument is calibrated in degrees so the needle reads zero when horizontal and 90 degrees when vertical. If the south end of the needle is depressed, the readings are considered to be negative. Readings were taken facing west with the instrument held so the needle could swing in the earth's magnetic line of force at that point. Three readings were taken at each station. In most cases all three readings were the same, but occasionally 1-degree differences were noted. Except for readings taken at the Texada Mines property over exposed magnetite lenses, the readings ranged from 16 to 37 degrees, with most being in the 23- to 27-degree range. It was noted that as much as 3 degrees difference in dip was recorded between a reading taken on a bare rock exposure and another taken on overburden less than 20 feet away.

Summary of Results

1. No new magnetite bodies were found.

2. In general the aeromagnetic highs correspond closely to topographic highs and (or) bedrock exposures, and aeromagnetic lows correspond to topographic lows.

*By J. W. McCammon.

3. There is over-all correspondence between the aeromagnetic map and ground results, although the latter show variations not indicated by the former.

Survey Details

The Aeromagnetic High Anomaly on the Road at the East End of Priest Lake (see *Figs. 10, 11*).—A pace-aneroid traverse was made along the road around the southeast end of Priest Lake. The road goes through the centre of an aeromagnetic high anomaly. Dip-needle readings ranged from 23 degrees over limestone at the north end of the traverse up to 27 degrees over volcanics and quartz diorite in the centre of the traverse and back down to 22 degrees over limestone at the south end of the traverse. Small lenses of magnetite occur in the bush northeast of the lake, but none is exposed along the road. The small difference in dip can probably be entirely accounted for by the difference in magnetic susceptibility of the igneous rocks and the limestone.

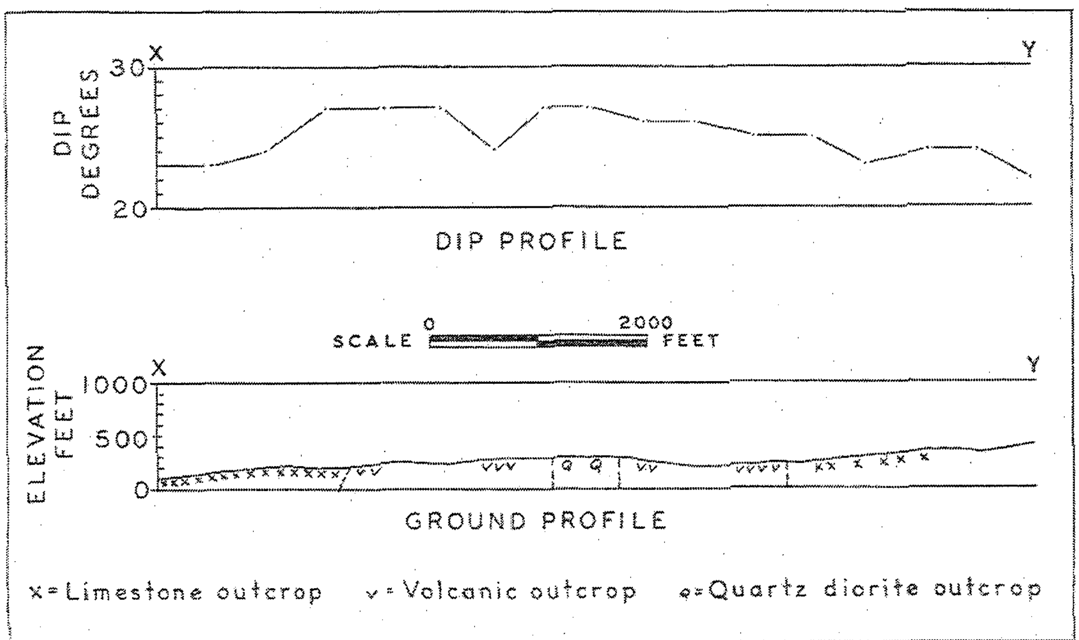


Figure 11.—Dip-needle survey, Priest Lake, Texada Island.

The Aeromagnetic High Anomaly over the Cameron Orebody at the Texada Mine (see *Figs. 10, 12*).—A small magnetite body, the Cameron, lies near the centre of an aeromagnetic high anomaly shown on the Texada Mines property. The orebody is reported to contain about 30,000 tons of magnetite and is exposed on the surface over an area about 60 feet wide and 160 feet long. The surrounding rock is limestone. Dip-needle readings over the centre of the orebody were 80 to 82 degrees. The dip fell off rapidly at increasing distances away from the centre, registering 29 degrees at 400 feet to the east, 25 degrees at 400 feet to the north, and 27 degrees at 400 feet to the west. A deep open pit lies to the south. The dip at the south edge of the magnetite was minus 40 degrees and at the north edge was plus 120 degrees, indicating that the orebody is polarized.

It was not found practical to do much around the three main pits on the property because of the amount of tramp iron and broken ore scattered about.

Comet Mountain High Anomaly Southeast of Raven Bay (see *Figs. 10, 13A*).—Three stadia-planetable traverses—BH, EJ, and GL—and two pace-compass traverses—CM and FK—were run in this area. The plane-table traverses were along abandoned logging roads.

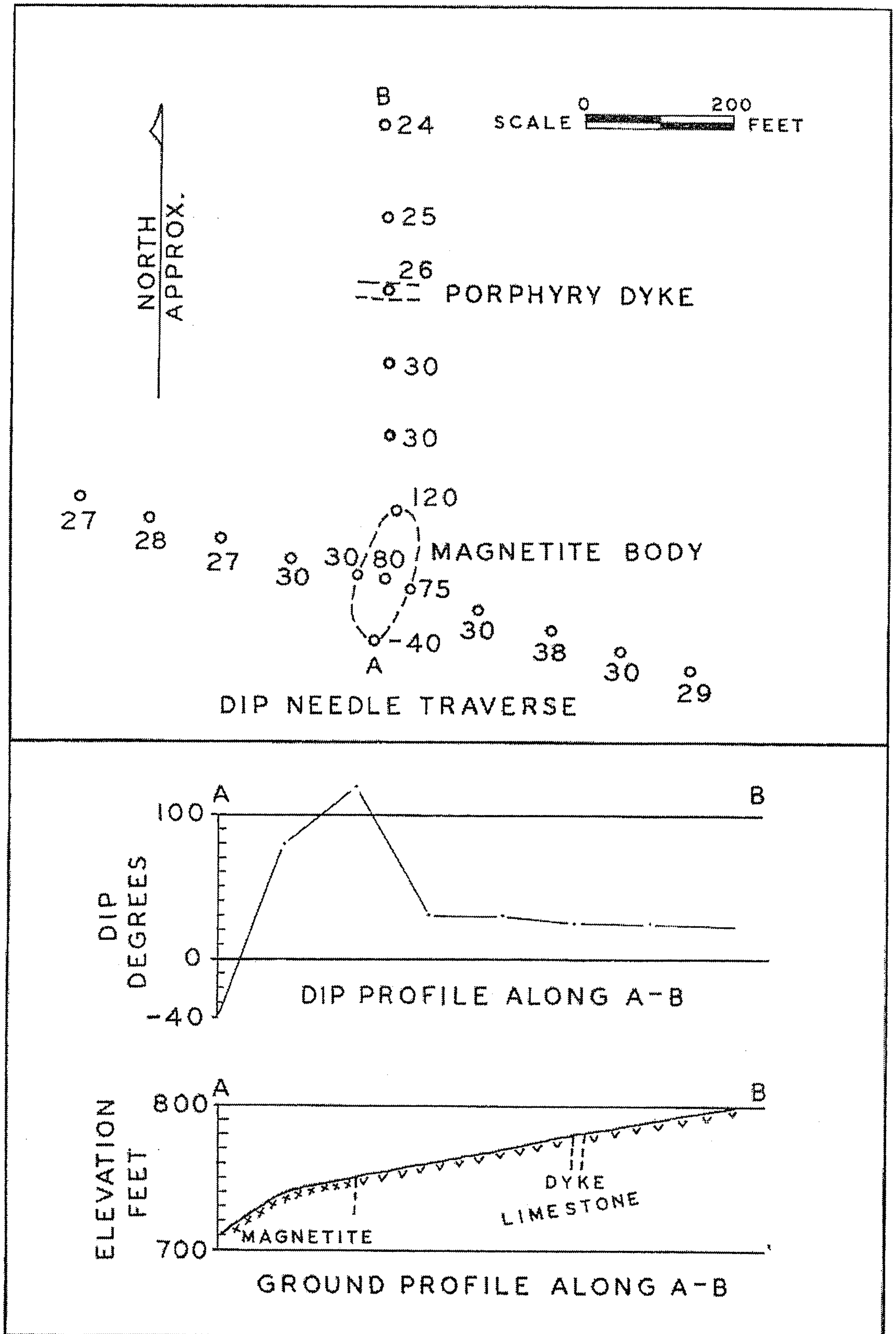


Figure 12.—Dip-needle survey at Cameron orebody, Texada Island.

Traverse CM went from the road northeastward across the anomaly on Comet Mountain peak and down to the seashore. Dip-needle readings ranged from a low of 23 degrees by the road to a maximum of 37 degrees at the mountain peak and back down to 25 degrees at the shoreline. There is a marked parallelism between the magnetic and ground profiles along this traverse. The maximum dip is on the highest point on the mountain, which is a bare rock exposure. Similarly, on traverse FK, across the anomaly perpendicular to CM, the greatest dip is on the bare rock peak. Comet Mountain is composed of basic volcanic rocks that are generally fine grained although somewhat variable in texture but uniform in mineral composition. The rock* on the peak is coarser grained than much of the rest of the rock but does not appear to contain any greater amount of magnetite. Careful search near the highest dip readings failed to disclose any magnetite bodies.

This anomalous high is apparently chiefly due to topography combined with abundance of rock exposure and perhaps partly influenced by rock type.

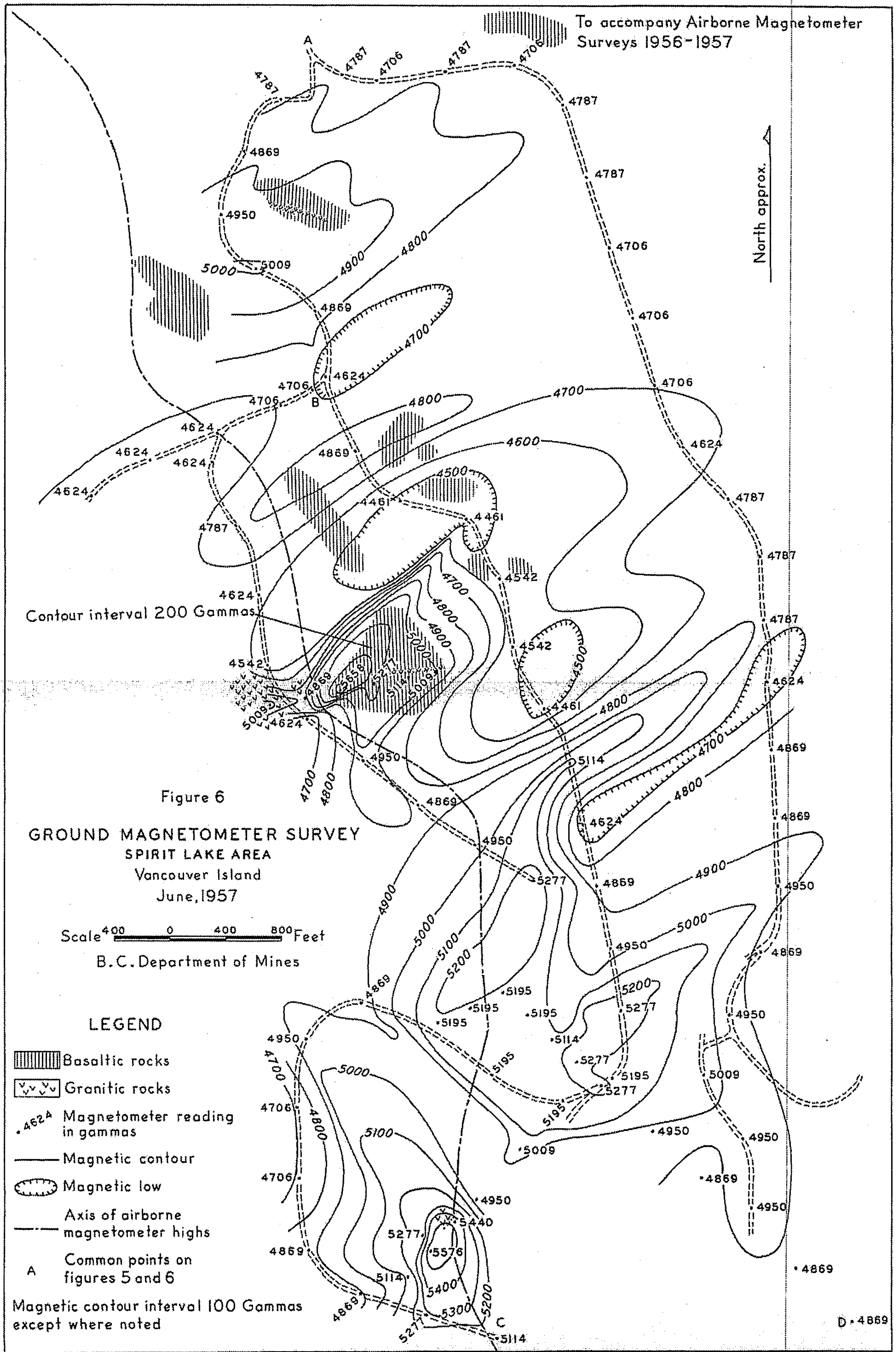
Comet Mountain High Anomaly West of Pocahontas Bay (see *Figs. 10, 13B*).—One plane-table traverse, PR, was run along a logging road northwestward across the anomaly near its centre. Dip readings ranged from 24 degrees at the start of the traverse to a maximum of 33 degrees near the centre of the anomaly and back to 25 degrees on the shore at the end of the traverse. Rock is scarce along the traverse route, and all exposures seen were of dark volcanics showing little or no variation. Except for the drop down to the shoreline near the end of the traverse, the ground is relatively flat. No readily apparent cause for the high readings was discovered.

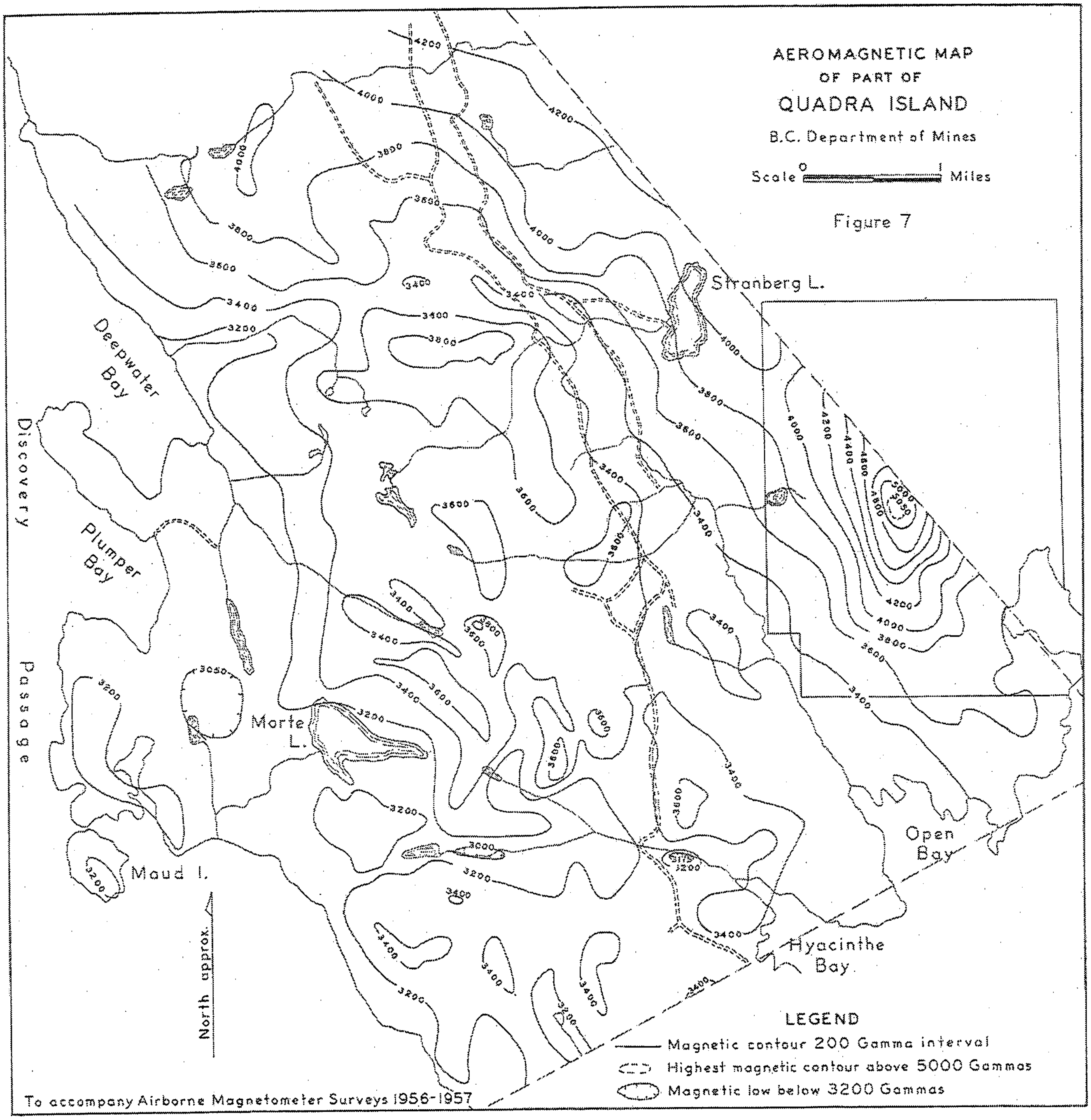
Pace-compass traverse TS was run perpendicular to PR across the centre of the aeromagnetic high. On this traverse the dip readings ranged from 23 to 36 degrees. The high reading was over a narrow body of diorite enclosed in volcanic rocks. Nothing else unusual was found.

The High Anomaly on the North Peak of Mount Pocahontas beside the Forestry Lookout (see *Figs. 10, 13B*).—A pace-compass traverse, NO, was run eastward up over the anomaly and mountain peak, down the east side of the peak, and then north to the seashore. Dip readings ranged from 20 degrees at the start of the traverse to 30 degrees on the mountain peak and back to 20 degrees at the shore. Rock exposures are numerous on the peak but scattered elsewhere. Volcanic rocks underlie the west slope, peak, and top half of the east slope of the mountain. Halfway down the east slope the volcanic rocks are in contact with quartz diorite which underlies the area east of the contact. On this traverse the range in dips is not great and the magnetic profile corresponds very closely to the ground profile so the anomaly is probably caused by topography. No significant change in dip was noted at the volcanic-quartz diorite contact.

Northwest-trending Line of Aeromagnetic Lows East of Mount Pocahontas (see *Line UV in Fig 10*).—One day was spent in the area of the line of lows shown on the aeromagnetic map. This line has been interpreted as representing a fault zone. Little geological information was obtained. The lows lie along a rather broad drift-filled valley wherein few outcrops are visible. Dip-needle readings averaged 19 degrees. At one point in the valley bottom about 4 miles from the north shore of the island an outcrop of volcanic rock was found. The rock was highly sheared. The shearing was vertical with a strike of north 25 degrees west, closely approximating the strike of the line of low anomalies. There are several elongate swamps in the valley. These features suggest the possibility of a major fault or fault zone, but much more work would be necessary to prove it.

* This rock has the mineral composition of a basalt or gabbro. It is probably a flow but could be a sill.


To accompany Airborne Magnetometer Surveys 1956-1957
North approx.
Contour interval 200 Gammas
Figure 6
GROUND MAGNETOMETER SURVEY
SPIRIT LAKE AREA
Vancouver Island
June, 1957
Scale 400 0 400 800 Feet
B.C. Department of Mines
LEGEND
Basaltic rocks
Granitic rocks
Magnetometer reading in gammas
Magnetic contour
Magnetic low
Axis of airborne magnetometer highs
Common points on figures 5 and 6
Magnetic contour interval 100 Gammas except where noted


AEROMAGNETIC MAP
OF PART OF
QUADRA ISLAND
B.C. Department of Mines
Scale 0 1 Miles
Figure 7
Stranberg L.
Deepwater Bay
Discovery Passage
Plumper Bay
Morte L.
Maud I.
Open Bay
Hyacinthe Bay
North approx.
LEGEND
Magnetic contour 200 Gamma interval
Highest magnetic contour above 5000 Gammas
Magnetic low below 3200 Gammas
To accompany Airborne Magnetometer Surveys 1956-1957

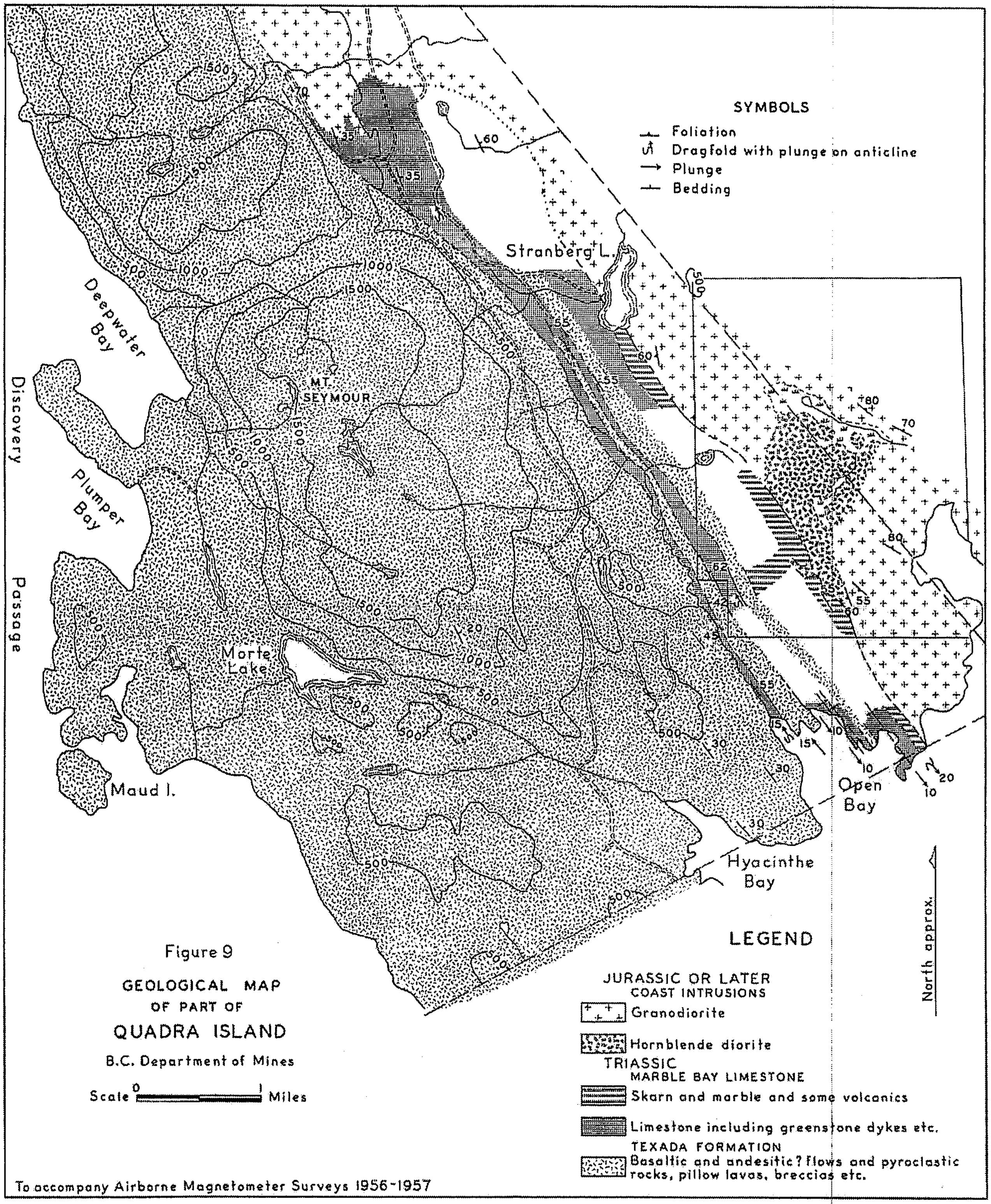


Figure 9

GEOLOGICAL MAP OF PART OF QUADRA ISLAND

B.C. Department of Mines

To accompany Airborne Magnetometer Surveys 1956-1957

Location/Identification

MINFILE Number: 092K 015

National Mineral Inventory Number: 092K3 Au1

Name(s): LUCKY JIM (L.723)
GREAT GRANITE

Status: Past Producer

Mining Division: Nanaimo

Mining Method Underground

Regions: British Columbia, Vancouver Island

NTS Map: 092K03W

UTM Zone: 10 (NAD 83)

Latitude: 50 12 19 N

Northing: 5563943

Longitude: 125 16 48 W

Easting: 337304

Elevation: 90 metres

Location Accuracy: Within 500M

Comments: The Lucky Jim occurs on Crown Grant Lot 723. The Lucky Jim group, consisting of the Lucky Jim, Rising Sun (092K 102), Saxon and Standard claims (Minister of Mines Annual Report 1908), lies 4 kilometres southeast of Granite Bay on Quadra Island.

Mineral Occurrence

Commodities: Gold, Silver, Copper

Minerals

Significant: Pyrrhotite, Chalcopyrite, Pyrite, Marcasite, Gold, Sylvanite, Telluride

Associated: Quartz

Alteration: Epidote, Garnet, Magnetite

Alteration Type: Skarn

Mineralization Age: Unknown

Deposit

Character: Massive

Classification: Skarn

Type: K01: Cu skarn

Host Rock

Dominant Host Rock: Volcanic

Stratigraphic Age	Group	Formation	Igneous/Metamorphic/Other
Upper Triassic	Vancouver	Karmutsen	------
Upper Triassic	Vancouver	Quatsino	------
Mesozoic-Cenozoic	------	------	Coast Plutonic Complex

Isotopic Age	Dating Method	Material Method
------	------	------
------	------	------
------	------	------

Lithology: Andesite, Limestone, Basalt, Quartz Diorite

Comments: Skarn mineralization occurs mainly at the volcanic-limestone contact. Coast Plutonic Complex rocks intrude to the immediate east.

Geological Setting

Tectonic Belt: Insular

Physiographic Area: Georgia Depression

Terrane: Wrangell

Inventory

Ore Zone: LUCKY JIM | **Year:** 1986

Category: Indicated | **Report On:** Y

Quantity: 12,700 tonnes | **NI 43-101:** N

Commodity	Grade
Silver	17.1400 grams per tonne
Gold	10.9700 grams per tonne
Copper	2.0000 per cent

Comments: Drill indicated reserves as of 1986.

Reference: George Cross Newsletter April 28, 1986.

Summary Production

		Metric		Imperial	
	Mined:	478	tonnes	526	tons
	Milled:	0	tonnes	0	tons
Recovery	Gold	7,371	grams	237	ounces
	Silver	7,123	grams	229	ounces
	Copper	11,274	kilograms	24,855	pounds

what years?

Capsule Geology

The western half of Quadra Island lies within the Insular belt and is underlain primarily by andesitic volcanics of the Upper Triassic Karmutsen Formation, Vancouver Group. These are interbedded with and overlain to the east by a northwest trending belt of Upper Triassic Quatsino Formation limestone, also of the Vancouver Group.

The eastern half of Quadra Island lies within the Coast Crystalline belt and is mainly underlain by Jurassic to Tertiary intrusive rocks of the Coast Plutonic Complex. These granitic rocks are in fault and/or intrusive contact with the Insular rocks along a northwest trending zone from Open Bay to Granite Bay.

The Lucky Jim deposit is situated 4 kilometres southeast of Granite Bay. Irregular lenticular bodies of limestone occur at intervals along a narrow northeast trending zone intercalated with rocks of andesitic composition.

The skarn-type main zone upon which a shaft has been sunk, strikes between 111 and 128 degrees and dips about 80 degrees to the southwest. The ore material follows a prominent line of faulting within the andesite but occurs along the limestone-andesite contact in the shaft area.

The ore material consists almost entirely of pyrrhotite with some chalcopyrite, pyrite and marcasite. At other points along its strike this deposit includes more quartz, epidote, garnet and other silicates, and to the southeast of the shaft a mass of magnetite is exposed. A 0.5 metre sample was taken near the top of the shaft and assayed 8.23 grams per tonne gold and 4.13 per cent copper (Geological Survey of Canada Summary Report 1913). Free gold and sylvanite were also reported (Minister of Mines Annual Report 1908).

The shaft was reported to be down 46 metres with ore still present near the bottom. Drifts are present at the 15 and 30 metre levels with drifts on the latter totalling some 67 metres.

Two parallel zones of mineralization occur 90 metres to the north and 90 metres to the south of the Lucky Jim shaft. All ore deposits in the area occur in the vicinity of limestone.

Over 396 metres of drilling were completed in 1984 by Butler Mountain Minerals Corporation. The resulting indicated reserves were 12,700 tonnes grading 10.97 grams per tonne gold, 17.14 grams per tonne silver and 2 per cent copper (George Cross Newsletter, April 28, 1986).

The Lucky Jim was discovered in 1903 and held by G.D. Mumford. It was later taken over by Great Granite Development Syndicate Ltd.

Bibliography

EMPR AR 1907-160; 1908-148; 1909-274; *1910-158,159,166; 1911-194; 1913-286; *1916-345,519; 1919-218; 1925-282; 1926-313;