REPORT - PHOTOGEOLOGIC ANALYSIS
" O " GROUP OF MINERAL CLAIMS
BABINE LAKE AREA, OMINECA M.D.
54° 40' - 126° 15' N.W.
December 1963 93L/16W

by Peter J. Haman, Ph.D., P.Geol.
for RIP VAN MINING LTD.(NPL)

93L 9/16

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PHOTOGEOLOGIC ANALYSIS

BABINE LAKE AREA, B.C.

prepared for

DEL NORTE MINING GROUP

by

STEREOGRAMMETRY LTD.

Peter J. Haman, Ph.D., P.Geol.

CALGARY, ALBERTA

December 1967

TABLE OF CONTENTS

INTRODUCTION

A photogeological analysis was carried out west of Babine Lake, British Columbia, covering approximately 70 square miles. The purpose of this study was the mapping of the surface geology for outlining favourable areas for mineral exploration. Anomalous geological conditions are outlined on the accompanying photogeological map, and their nature as well as possible relations to mineralizations are described in detail. The photogeological results are compared with a geophysical map supplied by DEL NORTE. Published geological information is incorporated in this report.

AERIAL PHOTOGRAPHS

Two sets of aerial photographs were obtained from the Government of British Columbia. The first set of photographs is on a scale 1 inch to 2 miles and was used for the mosaic construction. The mosaic serves as a base map. The second set of photographs has a scale of 4 inches to 1 mile, and was used for a stereoscopic inspection of the area. The photographs are generally of good quality.

MAP COMPILATION

A contact negative of the mosaic outlay supplies the base map of the area, on a scale of approximately 2 inches to 1 mile. The geological and topographic data observed by stereoscopic investigation were drawn on one print of the base map. The data were then drafted onto a clear acetate overlay, and were printed together with the negative of the base map to produce the original photogeologic map which was coloured with an air brush.

A half-tone negative was obtained from the photogeological map and a half-tone positive was then produced. This half-tone positive is suitable for reproducing paper prints by the dry printing (direct Ammonia) Diazo process.

ACCESSIBILITY

The general area can be reached from highway 16, or by Canadian National Railway, connecting Prince George with Prince Rupert. A good gravel road leads 27 miles to the north from Topley, the closest settlement at the highway, to Topley Landing which has several resorts, a government wharf and a camp site. One side road, the Sawmill road, branches off to the north to Fulton Lake. A new road was constructed recently from Topley Landing, for approximately 6 miles to the north, to the Granisle townsite. Several lumber roads branch off from these access roads. A ferry crosses Babine Lake from the Granisle townsite, connecting to the minesite of the Granisle Copper Mine.

The access roads from Topley to Topley Landing, and to Fulton Lake, are visible on the aerial photographs and their position on the mosaic is plotted accurately. The position of the lumber roads is present only on the 4 inch to 1 mile photography, taken on May 28, 1958. Their approximate position was transferred to the mosaic. The positions of the Granisle road, from Topley Landing to the Granisle townsite, and of the Fishery road, from Topley Landing to Fulton Lake, were transferred to the mosaic from a map produced by S.J. Hunter and Associates, and their positions on the mosaic are inaccurate.

The area is part of the Nechako Plateau, and is characterized by fairly gentle slopes rising from lake-level at 2,332 feet to elevations between 2,500 and 3,000 feet. Cold winters and warm summers with moderate amounts of precipitation are typical of the northern interior region.

Extensive forest cover is present over much of the area, with dense underbrush and windfall in logged and burned areas. The forest type consists of Spruce, Balsam fir, Lodgepole pine and varying amounts of Aspen which occurs mainly near the shores of Babine and Fulton Lakes. Inspection of the aerial

photographs indicated a tendency of Aspen growing on, or near, outcropping bedrock. Access through the well timbered areas may pose lesser difficulties than through the logged and burned areas. An extensive burned area north of Fulton Lake is apparent on the mosaic by its lighter tone, and originates from a forest fire in 1930. Another burned area occurs in the northwest corner of the map area originating from a forest fire of the same year.

GENERAL GEOLOGY

Bedrock is generally very poorly exposed and crops out only in cliffs and canyons and on the flanks of some hills. Elsewhere the bedrock is concealed by glacial and stream deposits, these being thickest along valley bottoms and on terraces flanking the principal valleys.

Most of the rocks belong to the Hazelton Group of Jurassic or probably Jurassic age. Tightly folded grey to white-banded limestones and black argillites with some andesite sills form the canyon below the falls at the outlet of Fulton Lake, and are also exposed on the north shore of that lake. These sediments contain fossils of probable Triassic or late Paleozoic age. It appears to be questionable whether these rocks belong to the younger Hazelton group. The Hazelton Group was subdivided into three units in the Babine Mountains, namely:

The lower volcanic division consisting of Andesite, agglomerate, water-lain tuff, minor basalt and rhyolite,

the middle sedimentary division consisting of argillites and quartzites, limestone and tuff, and

the upper volcanic division with andesite, breccia, and rhyolite.

The middle sedimentary division is thought to thin out within the map area (Geol. Map sheet 671 A, Houston). Accordingly the geological dating of sedimentary rocks appears to be difficult at the present time, and the strata may either belong to an older series (Fulton Lake), or to the Jurassic Hazelton Group.

Outcrops of pinkish-buff rhyolite (indicated as Syenite porphyry with molybdenite and breccia on the map supplied by DEL NORTE) occurs on the west shore of Babine Lake, between Topley Landing and the Granisle townsite. The alignment of these rocks suggests that they may be part of a large dyke, or sill, in which case they are younger than the Hazelton Group.

A major granitic batholith (Topley Granite) is present south and east of Babine Lake, with a smaller stock occurring on the east end of Fulton Lake. The Topley intrusions consist mainly of quartz monzonite and commonly contain euhedral phenocrysts of pink potash feldspar as much as 1-1/2 inches long. These porphyritic quartz monzonites are cut by numerous north-northeasterly striking dykes of rhyolite and quartz latite porphyry which are up to 25 feet wide. No contacts of the granite with the rocks typical of the Hazelton Group are exposed, so that it is not known whether the granite is of pre-Hazelton or post-Hazelton age, or whether the overlying rocks may not be part of the Hazelton Group.

Fairly flat lying sedimentary rocks, consisting of greywacke, siltstone, and pebble conglomerate, overlie Hazelton fragmental volcanic rocks unconformably along the west shore of Babine Lake in the vicinity of Bear Island. In general these rocks are similar to flat-lying interbedded conglomerates, sandstones, mudstones and shales which occur in Tachek Creek, south of Topley Landing, and are classified as part of the Sustut Group of Upper Cretaceous age (B.C. Dept. Mines and Petr. Res., 1965).

The younger intrusive rocks of the area are of several varieties and ages. Biotite-feldsparporphyries and hornblende-biotite feldspar porphyries, with which the copper deposits are associated, occur as dykes, sills, and stock-like bodies cutting the sedimentary and volcanic sequence. These intrusive rocks which may be a stage of the Omineca Intrusions, form local topographic highs,

including the ridges on McDonald Island and the southern part of Newman Peninsula. Dykes of biotite-feldspar porphyry, such as those on McDonald Island and northern Newman Peninsula, trend northeastward.

Other intrusive rocks include quartz latite and dacite porphyries which cut the Hazelton sedimentary and volcanic sequence as stocks, dykes, and sills. The age relationships of these rocks with respect to the biotite-feldspar porphyry intrusions are not completely known.

Northeasterly trending fault zones which preceded the northwesterly ones probably were the zones of weakness into which the biotite-feldspar porphyry dykes on McDonald Island and Newman Peninsula were intruded. A dominant east-northeast joint set and a complementary north-northwest set are present in all rocks of the area, with the exception of the younger flat-lying sedimentary rocks (Sustut Group of Upper Cretaceous age).

Lode deposits containing silver, gold, copper, lead and zinc occur in Hazelton rocks, in the upper (Hazelton?) volcanic group, and in small intrusive bodies. No significant mineralization has been found associated with the Topley granitic batholith at Babine and Fulton Lakes. The definite association of many mineral deposits with the small intrusives suggests that all, or most of them, were formed in post-Lower Cretaceous, and probably Tertiary time. The vicinity of the intrusions constitutes favourable prospecting ground. All but one of the mines and prospects in the Babine Mountains are close to the boundary between the middle and upper divisions of the Hazelton Group.

PHOTOGEOLOGIC ANALYSIS

The aerial photographs on a scale 4 inches to 1 mile were studied with a stereoscope for mapping the geological surface conditions. Four geological map units are distinguished and lineaments were observed. The geological map units are:

Intrusives;

The Hazelton Group consisting of sedimentary rocks and volcanics;

Areas characterized by apparently thin glacial overburden, and where the bedrock is interpreted to be close to the surface;

Areas covered by thick glacial overburden and/or apparently deeply weathered rock.

The geological conditions and anomalies are described from north to south. An intrusive body is interpreted to occur in the northwest corner of the map area and was identified by photogeology only. No previously published maps available to the writer showed an intrusive in this area. The topography is comparatively high, with elevations up to 4,000 feet. The material appears to be massive, and no bedding schistosity is apparent on the photographs. For this reason these rocks are interpreted as possibly being an intrusive. The age of the intrusive is unknown. The oldest intrusives are the Topley granitic rocks which occur, however, to the southeast of the map area only. It is more likely that the intrusives are of a younger age, and possibly related to the Omineca intrusions. Field investigations will have to determine whether the postulated intrusive belongs to the feldspar porphyry series similar to the stock-like body with which the Newman copper deposit is associated. It is also possible that the intrusive belongs to the group including quartz latite and dacite porphyries.

The aerial photographs suggest that the intrusive may be flanked to the east by sediments of the Hazelton (?) Group (Station 1). This interpretation will have to be checked in the field. A contact of the Hazelton Group with an intrusive would render this area very favourable for mineralizations. Displacement mineralization occupying the intergranular pore space of breccias, tuffs, sandstones etc. may occur if the material of the Hazelton Group consists of the sedimentary series. In case of limestone one may expect skarn mineralization. The intrusive contact may have been sealed if the rocks adjacent to the intrusive

are tight volcanics or argillites and mineralization more likely occurs in fractures intersecting the contact.

A radioactive, magnetometer and electromagnetic anomaly occurs immediately south of the postulated intrusive.

Anomaly 2 is a very strong fracture density anomaly, south of the postulated intrusive. Most of the fractures trend west-northwest and east-northeast, and intersect at an acute angle. The fractures are interpreted as transcurrent faults, and may have been formed under tension. The anomaly probably marks a prominent rupture separating the postulated intrusive to the north from sediments of the Hazelton Group to the south. The anomaly is rated as most promising for mineral exploration. The overburden is thought to be generally thin and bedrock may be exposed in cliffs and on the slopes of hills, whereas the overburden may be locally thick in the valley floor. To the south is a mature stand of balsam fir and spruce, whereas to the north is relatively open country with bushes and shrubs due to a forest fire in 1930.

Anomaly 3 is a very vaguely defined semi-circular stream pattern on the north side of a prominent fracture. The area lies within an electromagnetic and radioactive anomaly.

Anomaly 4 shows a distinct circular drainage pattern located centrally within an area where bedrock is interpreted to be at, or close to, the surface. The cause of circular drainage patterns in mountainous areas is still imperfectly understood. A minor intrusive stock is suggested because of the central location within a relatively high topographic area with abundant outcrop of the Hazelton Group. Uplift may also be indicated by the concentration of east-northeast trending fractures which are interpreted to be tensional in origin. Next to Anomaly 2 this area is considered very favourable for mineral exploration.

Anomaly 5 is a circular vegetal anomaly consisting of a dense stand of Lodgepole Pine in the age group 66 to 125 years, surrounded by mature stands of spruce more than 125 years old. The nature of the anomaly with reference to geological anomalous conditions is unknown.

Anomaly 6 is a vaguely defined semi-circular topographic and vegetal anomaly, north of Fulton Lake. The area lies within a radioactive, magnetometer, and electromagnetic anomaly, but its nature remains obscure at the present time.

Anomaly 7 outlines the extent of the Topley quartz monzonite intrusive at the outlet of Fulton Lake. The intrusive is surrounded by rocks of the Hazelton or older groups. Very prominent fractures trending north appear to separate the intrusive to the west from sediments to the east, exposed along Fulton river. The presence of a major intrusive in contact with surrounding sediments, and the presence of major lineaments near the contact, may render this area favourable for mineral exploration. No noticeable mineralizations have so far been observed near the intrusives of the Topley granitic rocks. This may be due to the fact that the intrusive is older than the Jurassic Hazelton Group, which unconformably overlies the intrusive. Some fossils suggested, on the other hand, that the sediments along Fulton River may be older than the Hazelton Group, and are possibly of late Paleozoic or early Mesozoic age. It is still unknown whether the Topley intrusives are still older, or whether they may have intruded rocks older than the Hazelton Group. A detailed geological field investigation will have to determine the age relationships of all sediments and of the intrusive for evaluating the potential of mineral occurrences. Such studies are, however, hindered by the generally very poor outcrop conditions.

GEOPHYSICAL ANOMALIES

A comparison of the map showing the geophysical anomalies with the photogeological map demonstrates that most of the geophysical anomalies fall into areas interpreted to be covered by relatively thick glacial overburden, or have deeply weathered rock. There is no indication that the geophysical anomalies are related to outcropping bedrock, or to areas where bedrock appears to be close to the surface. We therefore conclude that a combination of geophysical and photogeological investigations must presently be considered to fail as a combined exploration tool in this particular area.

LINEAMENT AND FRACTURE ANALYSIS

The stereoscopic study on the photographs of the scale 4 inches to 1 mile showed numerous fine, more or less rectilinear streaks expressed by minor soil tonal, vegetal and geomorphic changes. These lineaments are interpreted as the surface expressions of fractures and faults (Haman, 1961, 1967). The validity of this concept must continuously be proved by comparing the lineament pattern with joint patterns in bedrock. Field investigations showed that one congeneric system of joint sets striking east-northeast and north-northwest is characteristic for this general area (B.C. Dept. Mines and Petrol. Res., 1965, p.93). This joint pattern is also dominant as a lineament pattern on the aerial photographs, particularly in the northern part of the map area.

Very little is known about the age relationship of various fracture patterns. We may tentatively group this prominent fracture pattern as being pre-Upper Cretaceous because it is reported to be absent in the Upper Cretaceous (?)

Sustut Group. Mineralizations within this fracture system must originate from intrusions older than the Sustut Group.

The forces which generated fracture patterns and fold structures were active from the Jurassic to the Tertiary within the Cordillera. The direction and nature of the forces has changed during this long interval resulting in a complex structural pattern. The grouping of congeneric fracture patterns, and their relative age relationships, are very important for mineral exploration. On a regional scale the compressive forces acted in east-west, or northeast-southwest direction. By fitting the prominent NNW and ENE fracture system into this regional stress orientation we may conclude that the NNW fractures are normal to the maximum principal stress and should be characterized by predominance of thrust faulting, or reverse faulting. The ENE fractures are normal to the least principal stress and should be characterized by predominance of tension jointing and normal faulting. Dykes may have followed these fractures if fracturing occurred during an intrusive cycle. This hypothesis is supported by the predominance of northeast striking dykes.

The geological map of McDonald Island shows, on the other hand, that the dykes associated with mineralizations strike N 20° to 30° E. There is presently no indication that the fractures occupied by dykes are related to the regional fracture and joint set trending NNW and ENE.

It was stated above (page 5) that the northeast trending fault zones and being intruded by dykes were thought to be post-Lower Cretaceous in age, and were probably formed during Tertiary time. The mineralized fractures are then younger than the fracture system toward NNW and ENE, which is apparently pre-Upper Cretaceous in age. It is presently not known whether the east-northeast

trending fractures were formed during an intrusive cycle and would be as prospective as the northeast to north-northeast trending fractures.

Anomaly 2 represents a lineament anomaly of fractures trending west-northwest and east-northeast. The bisectrix of the acute angle of intersection trends east-west. The fracture pattern is interpreted to represent an intense shear zone of transcurrent faults formed by east-west compression. Similar fracture patterns were previously observed on the flanks of horsts and grabens, and appear to have a tensional component. The fracture anomaly is thought to mark the border between an intrusive body to the north, and rocks of the Hazelton Group to the south. The involvement of east-northeast trending fractures suggests that the system is of pre-Upper Cretaceous age. The consequences for mineralizations remain unknown until the age relationship between intrusive and fracture pattern is solved. A few north-northeast trending fractures close to Anomaly 2 may deserve particular attention.

East-northeast trending fractures are concentrated near Anomaly 4, indicating a postulated uplift associated with tension fractures. The uplift may have been caused by an intrusive stock outlined by the remarkably circular topographic Anomaly 4.

The interpretations rendered in this report must be considered tentative and the results of photogeology must be dovetailed by detailed structural and stratigraphic analysis in the field.

SUMMARY AND CONCLUSIONS

A photogeological analysis was carried out west of Babine Lake, British Columbia, covering approximately 70 square miles. Four geological map units are distinguished and lineaments were observed and are presented on a map obtained from a photo mosaic on a scale 2 inches to 1 mile. The map units are: Intrusives; The Hazelton Group; Areas characterized by apparently thin glacial overburden, and where bedrock is interpreted to be close to the surface; Areas covered by thick glacial overburden and/or deeply weathered rock.

7 stations or anomalies are shown on the map and are described in more detail. Photogeology suggests the presence of an intrusive body in the northwest corner of the map area. Station 1 marks the location of a contact postulated between the intrusive and rocks of the Hazelton (?) Group. Mineralizations may occur along the contact or in fractures intersecting the contact.

Anomaly 2 is the most prominent anomaly expressed by a concentration of intersecting fractures, separating the postulated intrusive to the north from rocks of the Hazelton Group to the south.

Anomaly 3 is a vaguely defined geomorphic anomaly coinciding with an electromagnetic and radioactive anomaly.

Anomaly 4 shows a distinct circular drainage pattern associated with tension fractures and may indicate a minor intrusive. The area is considered favourable for mineral exploration.

Anomaly 5 is a circular vegetal anomaly but the nature of the anomaly with reference to geological conditions is unknown.

Anomaly 6 is a vaguely defined semi-circular topographic and vegetal anomaly and is located within a geophysical anomaly.

Anomaly 7 outlines the extent of the Topley quartz monzonite intrusive which is surrounded by sediments of the Hazelton or older rocks. Contact mineralization

may occur in rocks older than the Hazelton Group.

A comparison of geophysical and photogeological data indicates that the geophysical anomalies fall mainly into areas of thick glacial overburden, or deeply weathered rock. There is no indication that the geophysical anomalies are related to outcropping bedrock. A combination of geophysical and photogeological investigations appears to fail as a combined exploration tool in this particular area.

The lineament analysis on aerial photographs resulted in the recognition of several dominant fracture trends which were also observed as joints and fractures in the field. A prominent system of fractures trending north-northwest and east-northeast was apparently formed in pre-Upper Cretaceous time and does not seem to be related with mineral bearing fractures trending N 20° to 30° E on McDonald Island, which appear to be younger, and are probably Tertiary in age. The relationship of the north-northwest and east-northeast fracture systems to intrusive cycles is not known at the present time. The northeast trending fractures are more likely mineralized due to their interpreted tensional nature, whereas the north-northwest fractures may have been formed under compression and may represent thrust faults.

The interpretations rendered in this report must be considered tentative and require extensive additional field investigations.

Respectfully submitted,

Peter J. Haman

Peter J. Haman, Ph.D., P.Geol.

REFERENCES CITED

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HAMAN, Peter J. Lineament Analysis on aerial Photographs, 1961, West Canadian Research Publications, Calgary

Geomechanics applied to Fracture Analysis, 1964 West Canadian Research Publications, Calgary.

CERTIFICATE

I, Peter Jurgen Haman, do hereby certify that:

1. I am a practising Consulting Geologist with offices and residence at:
   225 - 25th Avenue NE., Calgary, Alberta, Canada.

2. I have received the following university degree:
   Ph.D. Philipps University, Marburg, Lahn - West Germany (1956).

3. I have practised my profession for 14 years.

4. I am a member, in good standing, of the Association of Professional Engineers of the Province of Alberta.

5. I am a member, in good standing, of the Alberta Society of Peteroleum Geologists.

6. I am a member of the British Columbia and Yukon Chamber of Mines.

7. I am the author of 6 published reports and articles on geologic matters.

8. This certificate is part of the attached report on the Photogeologic Analysis, Babine Lake area, B.C., prepared for Del Norte Mining Group, Dates: December 1967.

Calgary, Alberta
January 18, 1968

Peter J. Haman
Ph.D., P.Geol.

Statement of Expenses

The following expenses were incurred in preparation of the accompanying Photogeologic Analysis Report on 70 square miles of the west side of Babine Lake for Rip Van Mining Ltd.(NPL) (Del Norte Mining Group).

The expenses were made up as follows:

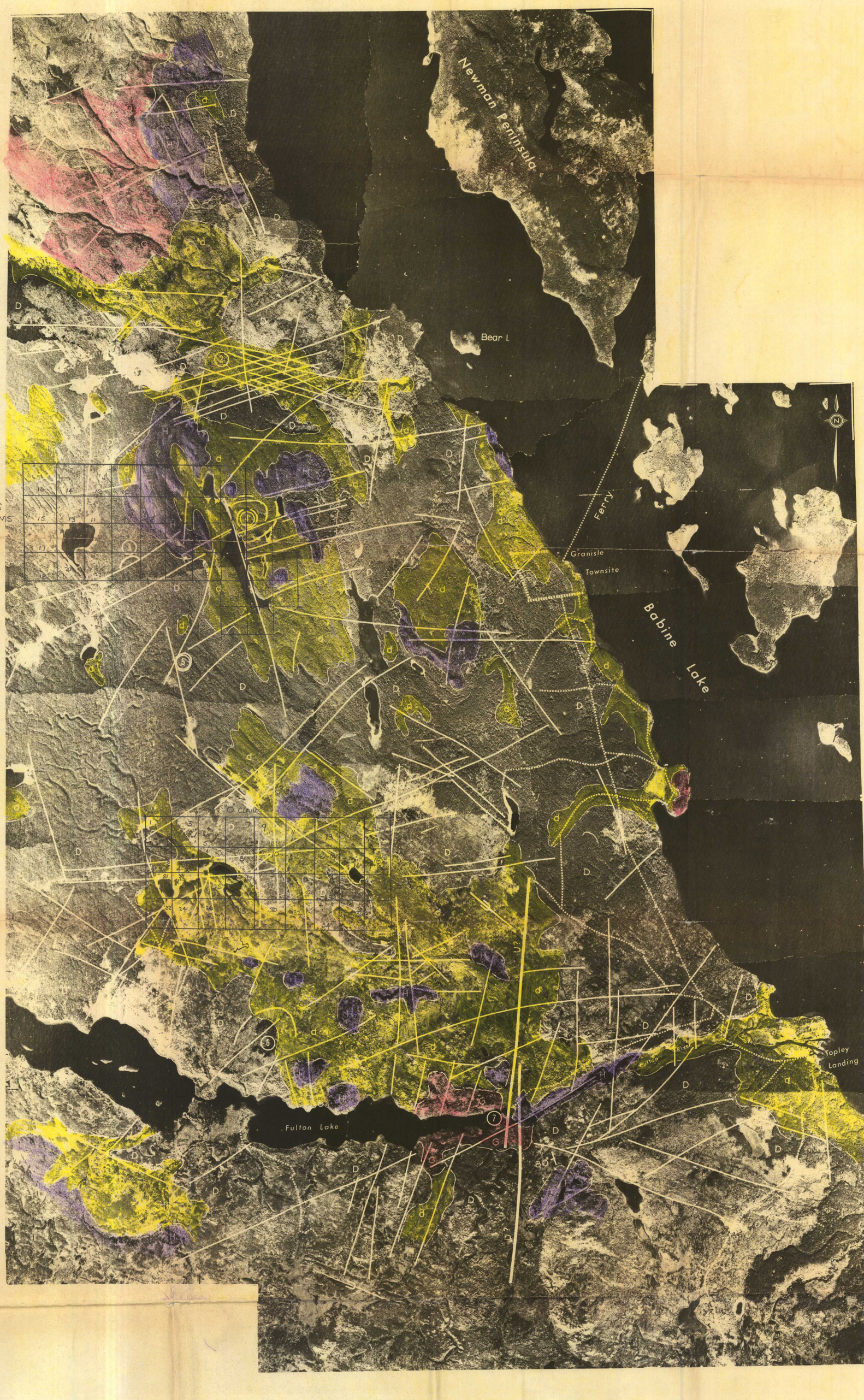
Senior Consultants Time 22 days at $100 per day	$2200.00
Supplies	373.00
Total	$2573.00

Amount applicable to the Claim area of " O " Group -

7/70 x $2573 = $257.00

Certified correct S. J. Hunter

S. J. Hunter, P. Eng.



Legend

- Roads, trails
- Glacial lineation
- Fracture
- U — Fault, "U" indicates upthrown block
- G — Intrusive
- H — Hazelton Group
- d — Thin glacial overburden. Bedrock close to surface ?
- D — Thick glacial overburden or deeply weathered rock
- (8) — Anomaly or location as described in report

DEL NORTE MINING GROUP

Babine Lake Area, B.C.

Scale approx. : 2 inches to 1 Mile

prepared by

Stereogrammetry Ltd.

Peter J. Haman, Ph.D., P. Geol,

December 1967

Per S. J. Haman

1160