GEOLOGICAL REPORT

HUDSON BAY MTN., SMITHERS, B. C.

Owner - Climax Molybdenum (B.C.)Ltd

802524

Dr. M. Klugman November, 1962

GEOLOGICAL REPORT

HUDSON BAY MTN., SMITHERS, B. C.

by

DR. M. A. KLUGMAN NOVEMBER, 1962

MINERAL CLAIMS	Goat, Beaver, Lynx, Fox & Coyote Groups (see attached schedule)
OWNERS	Climax Molybdenum (B.C.) Ltd., 718 Granville Street, Vancouver 2, B.C.
LOCATION	54° 50' North Latitude 127° 15' West Longitude
MAPPING PERIOD	June 15 - September 10, 1962

FOREWORD

Geological mapping of the Hudson Bay Mountain claim groups was conducted for Climax Molybdenum (B.C.) Ltd., by Dr. M. Klugman (Asst. Professor of Geology, Colorado School of Mines). The work was performed under the supervision of R. E.Anderson, Prof. Eng. B.C. No. 2922, who is permanently employed as a geologist by American Metal Climax, Inc.

GEOLOGICAL MAPPING EXPENDITURES

Personnel

Project Geologist	Dr. M. Klugman	June 10-Sept. 15
Geologist	C. L. Smith	June 11-Sept. 15
Geologist	R. McMillan	May 1 -Oct. 2
Assistant	D. Varley	May 14-Sept. 9
Assistant	D. Goodbrand	May 14-Sept. 6

Expenditures

Dr. M. Klugman	$3,240.00
C. L. Smith @ $525.00/mo.	1,738.00
R. McMillan @ $450.00/mo.	2,383.00
D. Varley @ $300.00/mo.	1,178.00
D. Goodbrand@ $300.00/mo.	1,164.00
Total......	$9,703.00

Certified Correct

R. E. Anderson
Prof. Eng. (B.C.) #2922

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February 1963.
Phil Turner

TABLE OF CONTENTS PAGE No.

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TABLE OF CONTENTS PAGE No.

SECTION I

REGIONAL GEOLOGY

GENERAL GEOLOGY

In mapping previously undifferentiated volcanics, particularly where a great thickness of volcanics exists, it is necessary to try and break down the rock-types into mappable units in order to fully understand the geology and structure.

Apart from the intrusive rocks and the overlying sediments, eleven recognizable units were seen on Hudson Bay Mountain. In some the units were uniform and of one specific rock-type (Unit F - limestone), but in most each unit composed an assemblage of rock-types. In order to distinguish distinct units in a volcanic sequence it is necessary to find a characteristic feature in each unit. In most cases on Hudson Bay Mountain a repeating or predominant member of a unit was the most reliable criterion. Other features such as being quartz-rich or quartz-poor rocks were helpful characteristics in some places. In one particular case the colour is distinctive. It must be noted that the characterizing member in some cases is not necessarily the most abundant member, but rather the most distinctive.

LITHOLOGY

The units described are based entirely upon megascopic examination and field characteristics.

Unit A is primarily a greenish-grey, massively bedded fine- to coarse-grained tuff, in places fossiliferous. Sedimentary interbeds of argillaceous and well defined limestone horizons occur throughout the exposed parts of the unit. The most prominent feature of the unit is the abundance of fossils with beds of Mesozoic belemnite guards up to five feet thick. Also present are pelecypods, brachiopods and plant leaves.

Because of the fineness of the ash the rocks have a dense massive appearance giving them the appearance of flows. Bedding is only observable where sedimentary interbeds occur.

Unit B is a greyish-purple to reddish-purple, massive, crystal tuff. The distinguishing characteristic of the unit is the presence of potash feldspar phenocrysts varying from sub-microscopic to one-quarter inch long. The unit contains scattered elliptical to circular "fossil" remains up to four inches in diameter. They are composed entirely of calcite and some faint internal structures can still be recognized. Some graded fragmental and ash beds are the only recognizable bedding. Parts of this unit are definitely of subaqueous deposition.

The contact of Unit B with Unit C is gradational over about 200 feet, and is defined by the gradation from purple tuffs (b) to bright red tuffs of Unit C.

Unit C is the most striking unit in the area. It is a bright red, massive, fine- to coarse-grained tuff composed of white and pink feldspar crystals in a fine hematitic ground mass. The crystals are from one-sixteenth to three-eighths of an inch long. Because of the uniformity of the colour the hematitic groundmass is apparently primary, and not the result of later alteration. Scattered beds of lithic ash occur throughout the section.

Unit D is a dark purple, well bedded, lithic, coarse-lapilli tuff sequence. The recurrence of the well-bedded purple material is its most distinctive feature. The rest of the unit is composed of diverse tuffs. The lithic fragments are commonly rounded, volcanics with graded bedding occurring in individual beds in many places. Some interbeds of massive bright red tuffs are also present in a few parts. The lithic nature of the unit gives it an agglomeritic appearance. The matrix is most commonly purplish, dense and fine-grained.

Unit E a distinctive marker bed, is a greyish-green, well layered fine- to coarse-grained sequence of tuffs, usually less than 200 feet thick. The layering is the result of an alteration of fine and coarse material, commonly showing graded bedding and cross-bedding. The thickness of the unit is diverse and the unit is in places absent. Its overlying contact may represent a minor disconformity.

Unit F is composed of a diverse variety of limestones. In the northwest section of the area, bioclastic and aphanitic types are most common. These limestones are grey-blue, well bedded and contain mainly pelecypod fragments. The unit is less than 100 feet thick here.

In the southwest part the limestone is more diverse in composition and is thicker. Its composition ranges from an aphanitic, dolomitic variety to the more abundant finely bedded aphanitic limestone. The upper part of this unit is composed of a volcanic breccia of green and black volcanics in a groundmass of calcite. The calcite makes up 40 to 50 per cent of the breccia. This member also occurs as a much thinner horizon at the base of the unit in the northwest part.

Unit G is one of the most variable types observed. Its diagnostic characteristic is the recurrence of dark purple to black, amygdaloidal basic flows which are rarely porphyritic. Amygdules are commonly calcite filled. Most of the interbedded material is either a dense purple tuff, a brownish-grey porphyritic diopside bearing flow, or diverse tuffs.

Unit H is composed of a variety of dense flows and lithic crystal tuffs. The unit occurs in the northern, southwestern, and southern parts of the area. The distinguishing member is a finely layered felsitic flow rock with layers about one-eighth of an inch thick. The next most abundant member is a commonly purple or black "trachyte" flow containing feldspar phenocrysts. Minor interbeds of dark coloured flows are also present.

Tuffs do not occur in abundance in the northern part, but do constitute a major portion of the unit in the southwest and south. These tuffs are notably quartz deficient. They are mainly lithic crystal tuffs with many coarse lapilli. Fragments as large as six feet across were observed but are usually more in the range of one half to two inches.

Unit I underlies the greater portion of the southern part. It consists of a nondescript pyroclastic composed of volcanic material of all conceivable sizes and compositions. Its most characteristic features are its diverse composition and a notable quartz deficiency.

Quartz Eye Rhyolite Tuff Unit is described in detail in Section II, under Lithology.

INTRUSIVE ROCKS

Granodiorite is buff, grey to pinkish, fine- to medium-grained and most commonly hypidiomorphic granular. The composition is diverse, ranging from quartz monzonite to quartz diorite with an average of granodiorite. It is exposed in the northwest part of the area and in the cirque area.

Quartz Monzonite (Granodiorite) in many cases greatly resembles the granodiorite observed on the surface and in the diamond drill core, and is probably genetically related to the massive granodiorite. This rock occurs entirely as dykes and sills. The main difference is that the tabular bodies are usually porphyritic with large (commonly up to one half inch) phenocrysts of potash feldspar. Nowhere does it approach the dioritic phase observed in the granodiorite, but within the range quartz monzonite-granodiorite its composition is in places diverse. The rock is most commonly light grey weathering to a light pink. It is fine- to medium-grained, slightly ophitic in places but usually hypidiomorphic granular.

Basalts (Diabase) occur throughout the whole area and were variously called greenstone, basalt, diabase and lamprophyre. They occur as rather irregular, but basically tabular shaped bodies as dykes and sills. Their composition is from basalt to a slightly acidic basalt and the grain-size is from very-fine to medium. They are dark green to green-black. Some individual dykes, and others in parts, have a well defined sub-ophitic texture, hence the name diabase. Many of the larger dykes carry a few fragments of slightly more acidic rock. "Pink feldspar" blotches are commonly associated with their contacts with the older volcanics.

"Lamprophyre" dykes have many of the characteristics of the fine-grained basalt and may merely represent a finer grained variety of that rock.

REGIONAL STRUCTURE

The geologic structure of the map area can be considered as three distinct structural blocks separated by two faults. The western block lies to the west of a steeply dipping north-south trending fault and is made up of the overturned units A, B and C. The second major block underlies an extensive thrust-fault, which is exposed in the central, south, southeast and north central parts. This second block is exposed around the perimeter of the thrust and underlies the rest of the mapped area except west of the steeply dipping north-south fault. The lighology of the second block is diverse comprising units D, E. F. G. H. and I. The third block lies above the thrust fault and is made up almost entirely of Quartz Eye Rhyolite Tuff unit. Sediments overlie the Quartz Eye Rhyolite Tuff in the north and east.

A dome with its apex just south of the southernmost part of the cirque proper, is probably the most important structural feature. The dome is probably the result of the intrusion of a granodiorite cupola in this part. A cupola is indicated because the overall doming appears to be fairly wide-spread with the main pluton better exposed to the west of the present map-area. Further, the exposure of two small granodiorite bodies, one in the cirque area and the other in the northwest part, tends to confirm this overall structure. The doming is probably the main feature which controlled and caused most of the deformation in the area. The sporadic introduction of this cupola is responsible for the radial faulting and the annular tensional faults, around the perimeter of the mountain, and also the "block fault" structures in the southwest part. Most important is its probable role in the development of the major fault zone (striking roughly east-west in the cirque area) and the flat lying silica-carbonate shears and their continued movement. Evidence in support of the apex of the dome is the flat attitude of the volcanics in this southern part as contrasted with the increasing dips (up to 70°) away from it.

The western block has as its most striking features two large overturned folds which are separated by a steeply dipping east-west trending zone of intense shearing. The northern most fold is spectacularly exposed on a cliff in the western part of the map area. The hinge line plunges at approximately 20 degrees north with the overlying limb overturned up to 70 degrees from the vertical. The attitudes in this part appear to indicate a broad steep west plunging syncline upon which the overturn is superimposed. Whether this can be considered as simply a syncline or part of the domal uplift cannot be entirely established at present. The attitude of the beds in the southern half of the western block indicate a similar structure with the plunge toward the north.

Because the overturned limb is exposed at a lower elevation than in the northern structure, movement along the steeply dipping shear dividing the area must have been such that the southern block was dropped. There is also evidence that a rotational movement accompanied the folding and faulting.

The steep bounding fault appears to be along a "hinge line" of a deformational structure which might have been an anticline, monocline or a major warp related to the doming. The writer believes that, whatever the exact nature of this structure, it is related to the doming. The movement of the second block relative to the western block is up as it has older beds exposed at a higher elevation in many places.

The second block is composed of units, D, E, F, G, and H in the northwestern and northern parts of the map area. The beds are most commonly steeply dipping in a northerly direction. These volcanics are intruded in the northwest by a granodiorite stock and numerous lamprophyre dykes. Numerous quartz monzonite-granodiorite dykes cut these units and have a regional trend from southeast to northeast. They also cut the overlying Quartz Eye Rhyolite Tuff Unit in the central part.

In the southwestern part the units of the second block are irregularly folded with a syncline-like structure which plunges at a low angle toward the south. Unit I is exposed in the southern and southwestern parts.

<u>The third block</u> lies above a flat lying thrust fault which transgresses the area from the southeast, through the central part where its trace turns northward and leaves the area in the north centre. The thrust fault is well defined throughout most of its length and appears to be the product of movement along an unconformity which separates the Quartz Eye Rhyolite Tuff Unit from the underlying units. The most notable feature of the relationship between the underlying units and the overlying unit is that nowhere does the thrust transect one unit in spite of the great thickness of some of the units. Also, the attitude of the layering in the Quartz Eye Rhyolite Tuff unit is gently dipping whereas the underlying units are commonly intermediate or steeply dipping. For this reason the writer believes that the prime control of the thrust fault is an unconformity. In one place there is a subsidiary thrust which exposes units of the second block in the underlying wedge. The whole of the third block is made up of members of the Quartz Eye Rhyolite Tuff unit. Nowhere is the Quartz Eye Rhyolite unit exposed below the thrust.

<u>RADIAL FAULTS</u>

Numerous cliff walls expose radial faults which converge approximately on a point in the southern part of the cirque. The displacement in many is small, and they may have been the product of rotation and tension with the axis of rotation located fairly close to the cirque. Many of the faults should more correctly be considered as imbricate zones with differential movement of "blocks" within the zones accounting for the total movement. This differential movement is seldom more than 50 feet although the composite may total hundreds of feet.

This type of movement along the radial faults tends to confirm a domal uplift. The development of tensional "small" movement faults in competent rocks can adequately compensate for the space increase produced by the intrusion of a body below the volcanics.

MAJOR FAULT ZONE

This zone is described in more detail in Section II. It has been traced out into the peripheral areas of the mountain.

SECTION II

CIRQUE AREA

LITHOLOGY

The only volcanic unit exposed in the cirque area is the Quartz Eye Rhyolite Tuff unit. The unit is typified by the presence of quartz eyes in nearly all members including the most basic. Certain horizons within the members do not always contain quartz eyes, however, 80 per cent of all members have this diagnostic feature. The most distinctive members of the unit are the two rhyolite members, which occur periodically throughout as comparatively narrow (usually up to 100 feet thick) layers. The most distinctive members of the unit are the two rhyolite members, which occur periodically throughout as comparatively narrow (usually up to 100 feet thick) layers. The most extensive occurrence within the section is at the top of the section as observed in the field, where the two rhyolitic members reach a thickness of over 1,000 feet. Whether this represents the top of the unit is unknown.

The stratigraphy of this unit as determined from the north wall of the cirque area, the grid area and the back of the mountain (west and southwest sides) is as follows: - (It must be remembered that volcanic sequences by the very nature of their occurrence very commonly are erratic and discontinuous).

Thickness in excess of 3,000 feet.

PENCIL LINE RHYOLITE

This member is one of the two youngest members of the unit. In the grid area it is the youngest while immediately adjacent, on the north wall, it is the second youngest. In order to find the reason for this reversal the contacts were closely examined to determine whether they were fault contacts. On the north wall this possibility remains but in the grid area it can definitely be established that there is no break along the contact and that in fact they are gradational into one another.

The Pencil Line Rhyolite is a white to pink very finely bedded tuffaceous rhyolite. The beds are commonly highly contorted and may change their strike through 90° over distances of less than 20 feet. A few fragments are occasionally present. Lenses and layers of the massive Quartz Eye Rhyolite are present in places. In spite of the contortions the overall attitude in any one area is constant.

This member is far less wide-spread and appears to be confined to the north side of the lower cirque area. It has not been recognized in any of the 1961 and 1962 diamond drill cores.

QUARTZ EYE RHYOLITE TUFF

This member is the most wide-spread of the rhyolite. Its thickest section is near the top of the unit, although it occurs as narrower layers throughout the section and forms the marker bed at the observed foot of the unit. It is a light grey to white, fine- to medium-grained rhyolite fragmental although in places it intrudes the older members and also occurs as a lava to a minor extent. Its most diagnostic features is the presence of quartz eyes which in places make up 30 per cent of the rock and are up to one-eighth of an inch in some places. The Quartz eyes are not always obvious but in all cases leaching with HF has shown their presence. The fragments present are most commonly acid-intermediate to acid in composition but more basic fragments commonly occur. Layering is sometimes present but the rock is most commonly massive. Lenses and restricted layers of other members can occur.

This rock-type appears to be particularly susceptible to alteration as it is commonly silicified and/or argillized to diverse extent. However, this may also be due in part to the fact that it is most commonly in contact with the later granodiorite stock which underlies the southern and eastern sections of the map area. Furthermore much of the observed member has too high a quartz content to be a primary igneous rock. Two types of "porcellaneous" rhyolite occur in this member.

The one, not observed on the surface is a dense, white to greyish rock which occurs in layers of diverse thickness within the member and is not observed in any other rock-type. It is believed that it is the result of alteration of susceptible horizons. The other variety, observed on the surface of the western and southwestern parts of the mountain, is dense bluish-grey and may be the appearance of the rock prior to alteration. This variety is also observed in the core. It can be traced over several hundred feet on the surface as distinct layers, and in all probability has already become partially silicified as the quartz content is too high for a primary igneous rock.

Contacts between the "porcellaneous" horizons and the adjacent quartz eye rhyolite are commonly gradational.

WELL LAYERED ANDESITE FRAGMENTAL

This member occurs throughout the unit but is most prominent in this upper part. The layering is well defined, consisting of light grey and grey layers from one inch up to 18 inches thick. From megascopic examination both parts have the same or similar composition, the main difference being the amount of mafic minerals present. Fragments are not as notable as in the lower members.

The rock is fine- to medium-grained and andesitic in composition. This member makes up a relatively small part of the section.

BRECCIA

The breccia forms a relatively small part of the unit, but is fairly widespread. The thickest occurrence is immediately below the Well Layered Andesite Fragmental. It is composed of large (half inch or larger) angular, abundant fragments, mainly intermediate to basic in composition, in a fine- to medium-grained andesitic groundmass. Quartz eyes are sometimes present. Immediately underlying the breccia another horizon of well layered andesite is commonly present. Further work may indicate that these two members should be considered as one.

GENERAL STATEMENT

All of the following members are fundamentally andesitic in composition although they may range from dacitic to basaltic. Each however can be recognized as distinct layers with slightly gradational contacts in many places. Together they represent over 75 per cent of the unit and are not restricted to any position within the unit. However, in the lower cirque and grid areas their sequence is relatively consistent, and that sequence is given below.

All of the following members are layered to diverse extent, but none approach the clarity of layering of the Well Layered Andesite Fragmental.

ANDESITE FRAGMENTAL

This member is composed of intermediate to basic fragments, making up about 25 to 35 per cent of the rock, in a groundmass of fine-grained andesite which commonly contains quartz eyes. The Andesite Fragmental makes up over 50 per cent of the unit, and the presence of quartz eyes is its main distinguishing feature. The underlying unit, Nondescript Tuff, is notably quartz deficient. Layering in this unit is weak but never-the-less still discernable in many places. In the grid area the layering has been accentuated by alteration which, particularly in the southwestern section, has been controlled by the lines of weakness represented by the interbeds of the fragmental.

ANDESITE BASALT FRAGMENTAL

The Andesitic Basalt Fragmental is a dark grey, fine-grained, andesitic basalt with few fragments. Because of the lack of fragments it might be considered principally as a flow. Apart from the relatively thick (between 75 and 150 feet thick) occurrence in the southern part of the grid area, the rock usually occurs as narrow, (up to 30 feet) elongate layers in the Andesite Fragmental. In this form it can easily be mistaken for a sill. These layers and lenses occur throughout all of the andesitic members of the unit. Lapilli structure is commonly observed, however their attitudes do not necessarily correspond to the attitude of the member.

BASALTIC ANDESITE FRAGMENTAL

This member is a slightly less basic rock than the previous member and contains far more fragments. The fragments are intermediate to basic in composition and the groundmass is grey and medium-grained. Layering is discernable with some layers having far larger fragments than those adjacent. Lapilli structure is also present in places. This member is commonly found interbedded with the Andesitic Fragmental, and is widespread.

LAYERED ANDESITE FRAGMENTAL

This member represents a layered phase of andesite fragmental with layering distinct and traceable over several hundred feet, but not the sharp distinct layering of the Well Layered Andesite Fragmental. The layering in the southern portion of the grid area has definitely been accentuated by subsequent alteration. The composition of the rock is the same as that of the Andesite Fragmental and it is from grey to dark grey.

LIGHT GREY ANDESITE FRAGMENTAL

The light grey Andesite Fragmental represents a more siliceous variety, probably dacitic in composition. Its proximity to a major fault may account for the higher quartz content and the slight argillization. The occurrence of this member throughout the cirque area is spotty, and it may represent an altered variety of Andesite Fragmental. The presence of quartz eyes in this member is notable giving support to it being an alteration product rather than a primary rock type.

GENERAL GEOLOGY

Two major structures are present in the cirque area. The first and probably the major structure of the mountain is reflected in the attitudes of the volcanics exposed in the cirque area. These attitudes indicate doming with the apex of the uplifted area just south of the cirque proper. This structure is modified by a major fault zone, post doming, which runs in and along the south wall of the lower cirque across the cirque and passes through the west and southwest of the bergschrund. The strike of the zone is approximately 240°.

The attitudes of the volcanics are consistent along the entire north wall and grid area with a strike of between 80° and 110° with dips from 45° to 85° towards the northeast. The average dip along most of the area described is 65°. On the northern section of the bergschrund the strike swings toward the west until they are approximately east-west. The dips here reach 60° north but decrease going south along the bergschrund to 25° until they reach the major fault zone.

South of the fault zone the strike changes radically along the bergschrund with the dominant direction N.N.W. The dip is low and toward the west. Along the south wall of the cirque proper the strike swings back toward the east-west

(300°) with decreasing dips toward the southwest. In the southernmost section of the cirque the volcanic layering is horizontal indicating the apex of the uplift. East of this area the strikes swing back toward the north with an average attitude of 330° dipping east. Along the south wall of the lower cirque area the strikes are erratic as much of this area lies within the fault zone.

A third prominent feature of the cirque area are north-north westerly striking Silica-Carbonate shears which dip gently west. The attitude of these is diverse along any one shear with dips up to 60° and as low as 10°. The overall dip however is 35° or less.

ROCK TYPES

The volcanics in the cirque area have already been described under Lithology. The volcanic rocks are cut by three major intrusives.

Granodiorite intrudes the volcanics as a discordant body on the south wall where the lower cirque area joins the cirque proper. This intrusive lies almost entirely within the major fault zone. The body is both pre- and post-movement as evidenced by faults both transgressing it and abutting against it.

The composition is diverse, ranging from monzonite to quartz diorite with an average of granodiorite. The granodiorite probably represents a small cupola or finger of the underlying larger body.

Quartz Monzonite-Granodiorite dykes and sills transgress the volcanics along both north and south walls. The most notable concentration of this intrusive is in the centre of the north wall. Here the dykes strike roughly north-south and are in places complex, bifurcating and commonly rejoining. In places they transgress the volcanic layering and in others they swing along it to form sills. Two north-north-east trending dykes are also exposed on this wall. In most cases these dykes are post faulting although some minor faults do cut them but with no noticeable displacement.

On the southern wall the dykes and sills strike east-west, southeast and southwest. Here the intrusives are both pre- and post-faulting. The continuing movement of the major east-west fault zone has displaced some while others have been displaced by low angle faults which strike north-south and dip west and east. These faults are quite possibly related to the major thrust fault exposed around the perimeter of the mountain and described under Regional Geology.

The composition of these intrusives is quartz-monzonite-granodiorite and in many cases greatly resembles the granodiorite observed on the surface and in the diamond drill core. The main difference is that the tabular bodies are usually porphyritic with large (commonly up to one half inch) phenocrysts of potash feldspar. These dykes are probably genetically related to the main granodiorite. No correlation across the cirque is possible due to the displacement by the major fault zone.

Basalt (Diabase) dykes and sills cut and are cut by the previously described rocks. Only the quartz monzonite cuts them in places. These intrusives have no dominant attitude and commonly occur as rather irregular, though basically tabular shaped,bodies. In the grid area particularly they tned to follow either the volcanic layering or the trend of the major fault zone. Their composition is from basalt to a slightly acidic basalt and the grain size is from very-fine to medium. Some individual dykes and others in parts have a well defined sub-ophitic texture hence diabase. Many of the larger dykes carry a few fragments of slightly more acidic rock. "Pink feldspar" blotches are commonly associated with their contacts with the older volcanics.

"Lamprophyre" dykes are commonly seen in the core and are exposed at a few places on the surface. These dykes have many of the characteristics of the basalt and may merely represent a finer grained variety of that rock.

STRUCTURAL GEOLOGY

As mentioned previously, two major structures dominate the cirque area, the doming, which is one of the primary structures of the mountain, and the major fault zone which trends roughly 240°. A third important structure is the north-northwest striking low angle Silica-Carbonate shears.

Other faults, mainly earlier, are related to the regional doming. The most prominent of these are radial faults which appear to have been the control for much of the quartz-monzonite porphyry intrusions. A few annular faults also appear to be related to this period.

Major Fault Zone is not a single fault but is represented by numerous strong steeply dipping faults. Their dip is either north, south, or vertical with subsidiary faults at all attitudes to form lenses or blocks which have been differentially displaced. The zone is from one to two thousand feet wide, with an average of one thousand. On the western wall the zone splits into two, the southernmost a complex zone one thousand feet wide and the northern a major fault zone 250 feet wide. On the surface the zone runs, from east to west, along the south flank of the lower Glacier Gulch; through the south falls and beneath the talus on the south side; cuts through and along the nose of the lower cirque south wall and southern grid area; and bifurcates beneath the glacier into the two breaks on the west wall. The fault zone does not represent one period of movement but rather a continuing movement which initiated at the time of the granodiorite intrusion and continued after consolidation. Most of the movement was prior to the deposition of the major sediments on the eastern flank of the area. However, some doming and some faulting occurred subsequently as they are tilted toward the east, southeast and northeast and are cut to a minor extent by fault of the fault zone.

Evidence in support of this major fault zone are:-

(1) The marked change in attitude of the volcanics from the grid area to the south wall.

(2) The change in trend of the quartz-monzonite porphyry across the cirque area.

(3) The concentration of roughly east-west trending steeply dipping and subsidiary faults in this area.

(4) The high degree of "breakage" in the rocks along the south wall.

(5) The marked iron oxide staining on the south wall and in the two areas on the west wall.

North-Northwest Shears have been called silica-carbonate shears although not all carry silica and/or carbonate, but generally they do.

Close examination of the individual shears in the grid area shows that even within one shear they form wedges and an analyses of the shear attitudes strongly indicates this same phenomenon on the gross scale. The silica-carbonate shears are in many cases correlatable with the north wall of the lower cirque area, but no correlation can be made with the south wall.

These shears are recognizable along most of the south wall as far west as the most southern part of the cirque although their occurrence at this western portion is sparse. The main concentration of these shears is in the grid area and along the south wall of the lower cirque area.

Subsidiary faults trending roughly north-south and east-west are related to these two major structures.

The major thrust exposed in the perimeter does not crop out in the cirque area. It cuts under and underlies this area. Whether it has an affect on the underlying stock is not known.

<u>Joints</u> - the main joint sets in the grid area trend 110°, dip 10°-50° S.W., 30° dip 80°S-80°N and 65° dips between 45°N and 45°S.

The most significant "joints" are the quartz filled breaks which occur in all parts of the grid area and along the lower cirque south wall. The maximum concentration of these "quartz veins" is in the southern, southwestern, and central parts of the grid area and along the central and western parts of the lower cirque south wall. In many places they reach a density of 14 per square inch. Also notable is the persistence of some of these "quartz veins". Where these occur they have been shown schematically on the grid area map. (Persistent veins = longer than 20 feet)

The most striking feature of these joints is their "movement". No one direction seems to particularly offset others, they appear to be mutually affected. Displacements are as much as one foot but on the average only a fraction of an inch to one or two inches. The width of the veins does not appear to have any relation to the displacement as in many cases hairline veins will have the maximum offset along them. Veins are as much as two inches wide but in the mean are between one-eighth and half an inch.

Explanation - The most probable cause for the breakup of the volcanics to produce this highly fractured structure is a continued movement of the major fault zone and the silica-carbonate shears and the "wedges" formed by them. The elasticity of the volcanics is not great and in order to compensate for this coupled movement the competent volcanics have fractured. Further movement and subsequent breakage has accounted for this apparently complex structure. The forces exerted on the "wedges" by the two systems are horizontal, diagonal and vertical causing rotational, tensional and compressional stresses simultaneously.

ALTERATION

No major alteration, such as that found at Climax or the porphyry coppers exists in the area. The alteration present is not generally widespread and bears a direct relation to the major structural breaks in the cirque area.

Epidotization is widespread occurring as light alteration in the peripheral areas. In these areas it is sometimes accompanied by minor chloritization. In the cirque area, particularly in the lower cirque area it becomes intense in places and is commonly accompanied by "pink blotches" of "feldspathization".

Chloritization is in places accompanied by amphibole (actinolite and hornblende) and commonly magnetite. The most intense chloritization occurs in areas of MoS_2 mineralization, but cannot be specifically tied to grade as it is often intense when MoS_2 is low particularly in the granodiorite. Chloritization is to a lesser extent widespread throughout the whole Hudson Bay Mountain area.

Note: Tremolite is found in many of the shears, sometimes with associated actinolite.

Feldspathization is not widespread. In the core logs feldspathization has been used incorrectly and should in many cases be regarded as argillization. This alteration represents the removal of a constituent (usually Si) rather than the addition of some. Three types of feldspathization are recognized.

(i) The formation of "pink feldspar" blotches, restricted, but usually associated with epidotization and/or with the contacts of basalt and "lamprophyre" dykes. The determination whether these are in fact "pink feldspar" must await closer thin-section examination.

(ii) Associated with silica-carbonate shears. The intensity of alkalization along these shears and their subsidiary breaks is directly related to the complexity, mineralization and alteration of the shear. These zones can extend for as much as 10 feet on either side of a shear. The width of the zones tends to be greater on the upper block of the shear. The alteration is distinctly light pink to pink and commonly produces a granular appearance.

(iii) Feldspathization associated with the granodiorite intrusive. This variety is not observed on the surface but is seen in the core. The proximity of the intrusion can in many cases be detected in the volcanics adjacent to the intrusive. A distinct increase in pinkish alkali feldspar can be seen in the Quartz Eye Rhyolite tuff member of the Quartz Eye Rhyolite tuff unit. This type of feldspathization does not appear to be related to metallic mineralization but rather to the intrusion of the stock. Some feldspathization of this nature is however related to metallic mineralization in that the granodiorite is itself feldspathized and in some places made up almost entirely of alkali feldspar.

Both of these types of feldspathizations are commonly associated with silicification.

Silicification appears as three types. (1) As the moderate silicification of susceptible horizons in rocks of the Quartz Eye Rhyolite Tuff unit in the upper peripheral areas of the whole area. This silicification is most notable on the upper west, southwest and southern flanks of Hudson Bay Mountain. There appears to be a distinct spatial relationship between the apex of the uplift and this silicification, and hence its relation to the underlying stock. This type of silicification produces a dense bluish grey rock in the more susceptible horizons and a distinct increase in quartz and a concomitant lightening of the rock is less susceptible. The latter is commonly accompanied by slight argillization. (2) This type is, like the third type of feldspathization, intense in the proximity of the intrusion and is also undoubtedly associated with metallic mineralization. The presence of "too much" quartz in the rocks of the Quartz Eye Rhyolite Tuff member adjacent to the granodiorite in the stock, indicates its source.

The granodiote is also in places highly silicified, shown by a distinct increase in the silica content, a lightening of the rock, and a more dense rock in places indicates a later silicification.

The same is true for the Quartz-Eye Rhyolite Tuff member as described in the preceding paragraph. The intense silicification of the susceptible horizon of this member has produced a dense white "porcellaneous" rock which shows a minimum amount of fracturing. The fractures found in adjacent layers not porcellanized appear to have been healed by the introduced silica. This in itself is excellent evidence of subsequent silicification. (3) Silicification of the andesite fragmentals is noticeable in the southwestern part of the grid area and along the adjacent lower cirque south wall. This has produced a lightening of the rock and a noticeable increase in the quartz content. The light Grey Andesite Fragmental member may in fact be a silicified variety of the Andesite Fragmental member. Quartz Veins may in part be considered as silicification. In places there is a definite lightening of the rock adjacent to them and quartz can be recognized as part of the cause in some. Most veins are however cleanly bounded by the country rock on the surface although in the core there is a definite impregnation in many cases. This effect however only extends for fractions of an inch.

A noticeable increase in the number of quartz veins can be seen in the southwest part of the grid area and on the adjacent wall.

Argillization and leaching (the removal rather than addition of material) is most evident both in the southwestern part of the grid area and the adjacent wall, and more particularly in the core. On the surface this alteration is controlled by fractures, hairline in places, and by the "bedding planes" of the volcanics. The layers are made more evident by the contrast produced by this alteration. The effect of these fractures sometimes extends up to one foot. The feldspars became cloudy and stand out in greater contrast.

In the core the breakdown of the feldspars is more obvious in places becoming so intense that the rock becomes earthy in appearance.

Note: Most intense alteration occurs associated with breaks. Apart from the regional epidotization and chloritization, and silicification, alteration is localized, occurring most commonly with the major fault zone and with silica-carbonate shears.

Dr. M.A. Klugman

Per: ______________________ Prof. Eng. B.C. #2922

(CLIMAX MOLYBDENUM (B.C.) LTD.

SCHEDULE OF MINERAL CLAIMS
HELD UNDER OPTION BY CLIMAX MOLYBDENUM (B.C.) LTD.

February 18, 1963.

Group	Claim No.	Record No.	Tag No.	Record Date
Goat	J-47	15945	447379	Sept. 17/62
"	J-45	15943	447377	"
"	J-43	15941	447376	"
"	J-41	15939	447374	"
"	J-39	15937	447372	"
"	J-37	15935	447370	"
"	J-35	15933	447368	"
"	J-36	15934	447369	"
"	J-38	15936	447371	"
"	J-40	15938	447373	"
"	J-42	15940	447375	"
"	J-44	15942	447381	"
"	J-46	15944	447380	"
"	J-48	15946	447378	"
"	J-33	15931	447350	"
"	J-31	15929	447348	"
"	J-29	15927	447346	"
"	J-27	15925	447344	"
"	J-25	15923	447342	"
"	J-23	15921	447340	"
Beaver	J-21	15919	447332	Sept. 17/62
"	J-22	15920	447333	"
"	J-24	15922	447341	"
"	J-26	15924	447343	"
"	J-28	15926	447345	"
"	J-30	15928	447347	"
"	J-32	15930	447349	"
"	J-34	15932	447351	"
"	T-48	15946	447378	"
"	T-47	15945	447379	"
"	T-46	15944	447380	"
"	T-45	15943	447377	"
"	H-12 Fr.	15865	447249	Sept. 5/62
"	H-11 Fr.	15864	447250	"
"	T-44	15963	447395	Sept.19/62
"	T-43	15962	447396	"
"	T-42	15961	447393	"

Group	Claim No.	Record No.	Tag No.	Record Date
Beaver	T-41	15960	447394	Sept.19/62
"	T-40	15959	447391	"
"	T-39	15958	447392	"
Lynx	T-22	15976	447313	Sept.20/62
"	T-23	15977	447316	"
"	T-24	15978	447325	"
"	T-25	15979	447324	"
"	T-27	15981	447315	"
"	T-28	15982	447338	"
"	T-29	15983	447337	"
"	T-30	15984	447328	"
"	T-31	15985	447327	"
"	T-32	15951	447384	Sept.19/62
"	T-33	15952	447386	"
"	T-34	15953	447315	"
"	T-35	15954	447388	"
"	T-36	15955	447387	"
"	T-37	15956	447390	"
"	T-38	15957	447389	"
"	T-26	15980	447326	Sept.20/62
Fox	M-69	14608	439169	Feb. 26/62
"	M-1	14540	439101	"
"	M-2	14541	439102	"
"	M-3	14542	439103	"
"	M-4	14543	439104	"
"	M-5	14544	439105	"
"	M-6	14545	439106	"
"	M-7	14546	439107	"
"	M-8	14547	439108	"
"	M-9	14548	439109	"
"	M-22	14561	439122	"
"	M-23	14562	439123	"
"	H-8 Fr.	15861	447242	"
"	H-9 Fr.	15862	447243	"
--	M-70	14609	439176	Feb. 26/62

Group	Claim No.	Record No.	Tag No.	Record Date
Coyote	M-10	14549	439110	Feb. 26/62
"	M-11	14550	439111	"
"	M-12	14551	439112	"
"	M-13	14552	439113	"
"	M-14	14553	439114	"
"	M-15	14554	439115	"
"	M-16	14555	439116	"
"	M-17	14556	439117	"
"	M-18	14557	439118	"
"	M-19	14558	439119	"
"	M-20	14559	439120	"
"	M-21	14560	439121	"