ORIGINAL

841687

HARRISON PROJECT

REGIONAL MAPPING AND EVALUATION

for

Chevron Standard Limited
Minerals Staff,
Vancouver, B.C.

by

G. L. Garratt, P. Geol.

October 30, 1979

TABLE OF CONTENTS

ILLUSTRATIONS

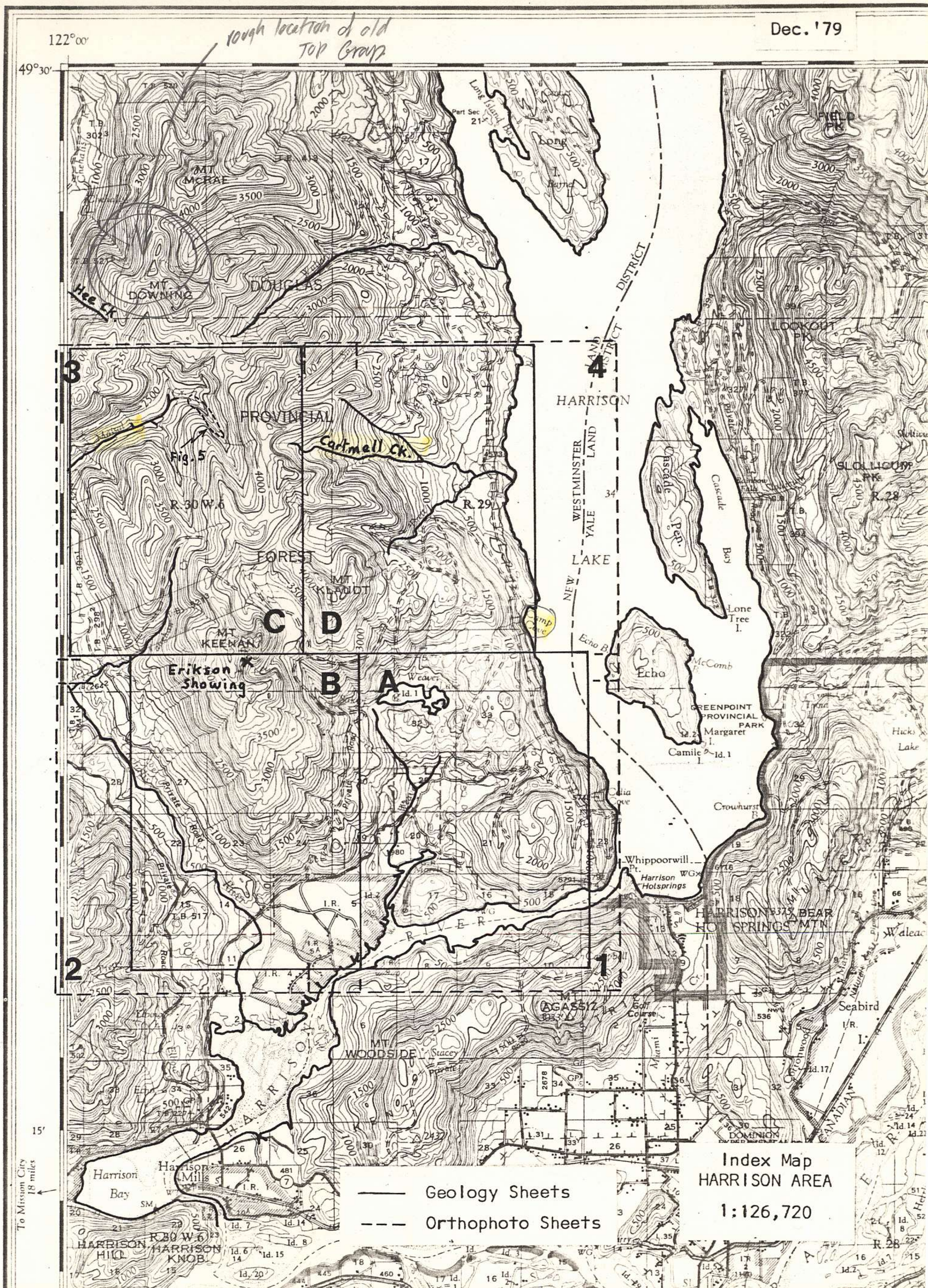
I. INTRODUCTION

The author was contracted by Chevron Minerals of Vancouver to undertake regional geologic mapping in an area west of Harrison Lake and designated by Chevron as Sheet C. This work utilized a 1:10,000 scale base map and represents a continuation of an ongoing regional mapping program on the Chehalis (Harrison Group) Pendant, being carried out by Chevron. In addition, the author was requested to evaluate three geochemical anomalies and one mineral showing, all of which occur within the Pendant, but outside the boundary of Sheet C. The above work was carried out by the author during the period October 1 to October 23, 1979, under the general supervision of D. Arscott of Chevron Minerals.

II. HARRISON REGIONAL GEOLOGY - Sheet C

1. Mapping Parameters and Approach

The author was requested to complete the mapping of Sheet C by traversing unmapped roads and accessible creek areas. A legend, giving stratigraphic names and descriptive terminology, was supplied to the author, and some alternatives to this system have been applied. The major variation applied by the author to previous mapping involves the definition or recognition and classification of the varieties of feldspar porphyry which outcrop in this area. At present, the classification includes RDfp, RDqfp, Dfp, Dqfp and Gz, indicating rhyodacite, dacite and monzonite varieties of porphyritic rocks. Four important observations by the author led to a new classification scheme, the intent of which is to simplify regional mapping. These observations were:


Dec. '79
122°00'
49°30'
rough location of old Top Group
MT McRAE
MT DOWNING
Hee Ck
DOUGLAS
Long I.
DISTRICT
FIELD PK
LOOKOUT PK
PROVINCIAL
Fig. 5
Cartmell Ck.
R. 30 W. 6
R. 29
FOREST
MT KLAUDT
MT KEENAN
HARRISON
WESTMINSTER
LAND
NEW
YALE
LAKE
Cascade Pen.
Cascade Bay
SLOLLICUM PK
R. 28
Lone Tree I.
Echo
Echo B.
GREENPOINT PROVINCIAL PARK
Margaret I.
Camile I.
Crowhurst
Hicks Lake
Erikson Showing
3
4
C
D
B
A
2
1
Whippoorwill Pt.
Harrison Hotsprings
HARRISON HOT SPRINGS
BEAR MTN
Seabird I.
AGASSIZ
MT WOODSIDE
HARRISON
RIVER
Harrison Bay
Harrison Mills
HARRISON HILL
HARRISON KNOB
R. 30 W. 6
To Mission City 18 miles
15'
DOMINION
CANADIAN
Geology Sheets
Orthophoto Sheets
Index Map
HARRISON AREA
1:126,720

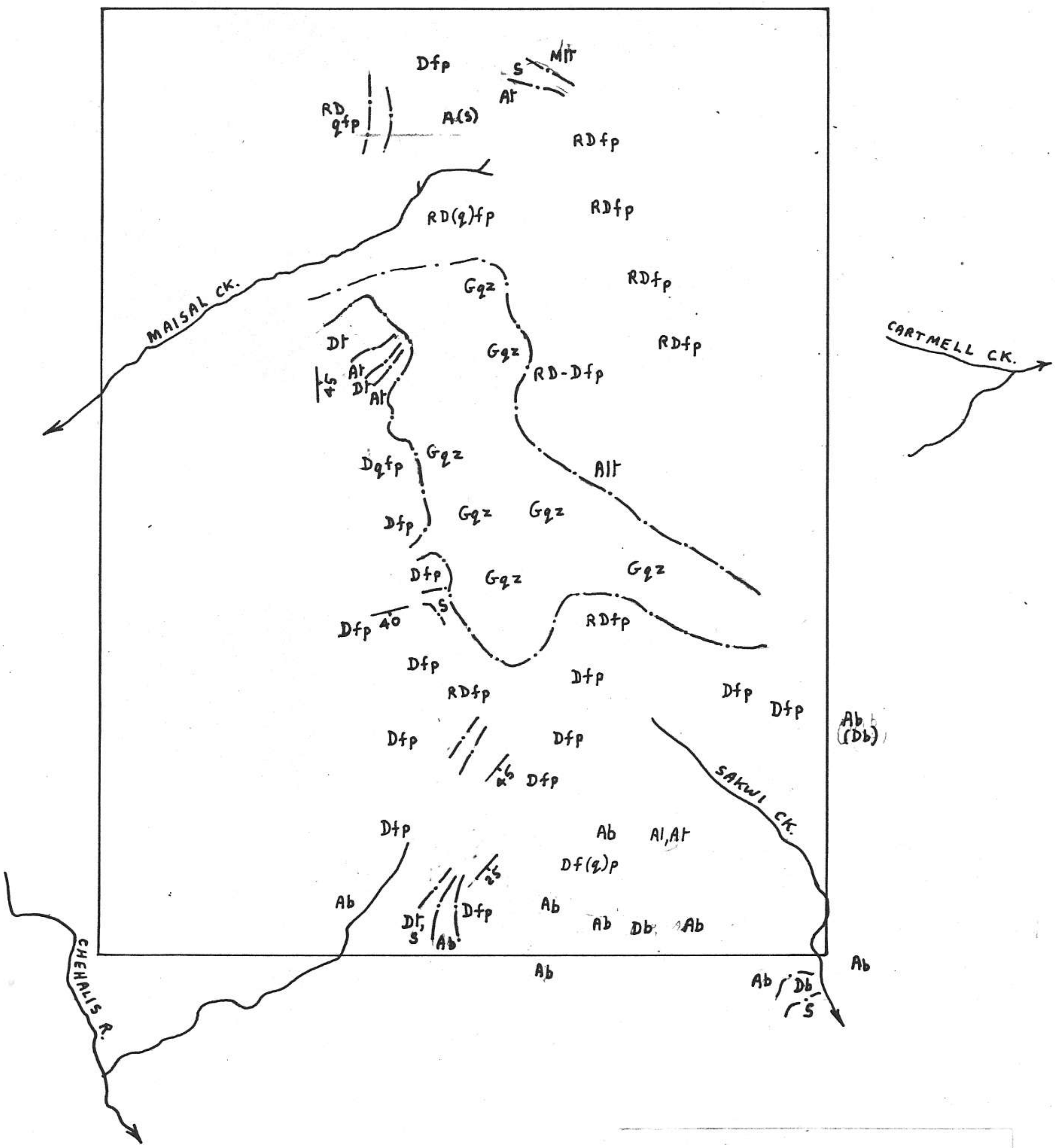


Fig. 2
REGIONAL GEOLOGY - Sheet C
(Simplified)

1:50,000

Fig. 3
TOPOGRAPHY - Sheet C
1:50,000

(1) that discrepancies occur in previous mapping in the designation of dacite versus rhyodacite varieties and that, without staining or thin section study, this breakdown is difficult to diagnose in the field;

(2) that quartz-eye or quartz porphyry varieties of dacite or rhyodacite are distinguisable and mappable as separate, probably intrusive bodies;

(3) that the Gz or monzonite intrusive invariably contains an abundance of quartz-eye or phenocrysts and

(4) that texturally and compositionally, a gradation can be observed between the monzonite and dacite varieties and that quartz porphyry varieties are often difficult to distinguish from monzonite. These observations have led to the following conclusions:

   (a) that dacite be used in place of rhyodacite (i.e. eliminate RDfp);

   (b) that Gqz or QMP (quartz monzonite porphyry) be used to describe the monzonite, which is invariably quartz rich;

   (c) that Dqfp be used to name quartz-feldspar porphyries which display a distinctive texture relative to the Gqz in that phenocryst to groundmass ratios are much higher in the Gqz. In addition to the above statements, a realization made late in the mapping program that much of the Dfp is actually intrusive rather than extrusive, leads to the the conclusion that in future mapping, closer attention should be paid to contact attitudes and, in particular, grain size of this units occurrence. From observations made outside of Sheet C, the author feels that color variation (e.g. green versus grey) may also be useful segregating varieties or types of Dfp. With respect to the above statements concerning the classification of Dfp as intrusive or extrusive, it was found that on occasion only contact relationships to adjacent rock types were useful and that in some cases the mode of occurrence could not be substantiated in any way.

2. Discussion

The area covered by Map Sheet C appears to be underlain by an intrusive core to the surrounding volcanic pile. A well defined body of Quartz Monzonite Porphyry occupies, and appears to parallel, a north-northwest (340^o) trending tributary of Maisal Creek, in the centre of the map area. To the southeast, the QMP (Gqz) trends approximately 300^o in contrast to the northwest where the intrusive appears to follow the 250^o trend of Maisal Creek. A separate, or apparently separate, QMP body outcrops on the north side of Maisal Creek and trends approximately 340^o, parallel to the main intrusive body. This coarse grained quartz rich intrusive is similar in appearance, and often indistinguishable from the Dqfp unit. Small, often linear, bodies of Dqfp occur through the map area but generally show their greatest abundance adjacent to the main intrusive body. Quartz monzonite dykes show a similar occurrence to Dqfp and the distinction between the two may be superfluous.

In the west to northwest corner of the map area, the occurrence of massive, generally medium grained, dacite feldspar porphyry is interpreted by the author to form part of the intrusive complex involving Gqz and Dqfp. The Dfp is similar in texture and apparent composition to Dqfp with the exception of quartz eyes. Vertical or near vertical contacts are commonly observed and Dfp dykes are common throughout the map area. These intrusive rocks are notably of a massive character in outcrops, are generally well jointed, and often display a weak lineation. In association with the emplacement of these bodies, and crosscutting all units of the map area, are fine grained, siliceous, often sheeted, dacite dykes. As with other intrusives, these dykes display steep contacts and trend parallel to regional structures.

Andesite dykes, varying from very linear-walled to irregular but generally linear bodies, cut through all the units of the region and imply, to the author, the probability of later, intermediate volcanism subsequent to the emplacement of Gqz, Dqfp and Dfp as well as the pyroclastic units. This occurrence, combined with the occurrence of blocks (up to ~10 m) of sediments and pyroclastic units within the dacitic to monzonitic intrusives and the similarity in composition and texture between extrusive and intrusive rocks, indicates the coeval relationship between the Gqz, Dqfp, Dfp and their extrusive counterparts.

The definition of extrusive Dfp versus intrusive Dfp is not always possible but it is certain that a segregation exists and it appears that a great part of the map area is underlain by intrusive rocks. Areas where extrusives and pyroclastics predominate occur primarily along the northern boundary of the map sheet and less, extensively, to the south of the main monzonite intrusive. In these areas an intimate relationship between porphyritic rocks and sedimentary or pyroclastic rocks can be observed. Often the porphyritic rocks are finer grained than their definitely intrusive counterparts but this cannot be generally assumed as a defining characteristic in all cases.

Pyroclastic rocks were nowhere observed by the author to attain sizable areal extent in occurrence nor coarse grain size. They generally vary from fine grained sediment-tuffs to lapilli tuffs. One notable occurrence of black, very fine grained sediment at location 117 contains bedded and disseminated pyrite and has been selected for geochemical analysis. The occurrence, at the north boundary of the map sheet, is an area where pyroclastic rocks are in relative abundance, possibly indicating a proximity to the original intrusive-extrusive interface. Poorly exposed contacts in this area make it difficult to determine the extent of the sedimentary unit or its relationship with the Dfp, which may be intrusive at this locality.

The contacts along intrusive bodies are generally sharp and show little metasomatic alteration, where observed. Many small (less than 50 meter) zones of bleaching, silicification and pyritization occur sporadically and profusely throughout the area. These zones are commonly heavily fractured and likely relate to fault associated, late phase fluids rising after the emplacement of the intrusives as they are not restricted to any particular host.

Alteration generally consists of chloritization of mafic minerals, usually hornblende, and the breakdown of feldspar to clay minerals. Sericite is locally associated with quartz infusion in bleached zones but is nowhere prolific. Unaltered rocks are veritably nonexistant and this probably is a reflection of the late stage quartz-pyrite veining and regional metamorphism.

It is apparent that the area covered by Map Sheet C represents an uplifted zone relative to the surrounding terrain to the west and south. This is indicated by the great abundance of intrusive material in this area, relative to peripheral regions visited by the author, in particular the Camp Cove - Cartmell Creek areas.

As intrusives dominate the area, a tentative age relationship is given below:

Oldest:	Quartz Monzonite Porphyry
	Dqfp
	QMP dykes
	Dfp and Dfp dykes
	Quartz-pyrite veins (Erickson Workings)
	Dacite dykes
Youngest:	Andesite dykes

These relationships are probably not totally definitive as the QMP, Dqfp and Dfp may be in part coincident.

III. CAMP COVE AREA GEOCHEMICAL ANOMALY

On day was spent traversing road exposures in the area surrounding a geochemical (stream sediment) anomaly delineated by the McDonald Consultant's survey approximately 1.5 km south of Camp Cove. An overlay on airphoto BC 7476-240 shows the area covered and the sample locations.

A probable vertical section can be described along the road paralleling the geochemical anomaly, and including samples CC-1 to CC-18 inclusive. Bedding attitudes at stations 2 and 8 are in severe contrast which likely reflect faulting and dislocation along the weak topographic depression of the intervening drainage. The section is roughly divisible into three segments, the lowest of which is represented by samples 13 through 16. Dacite tuff and lapilli tuff occupy the base (15, 16) which is overlain by a dacite-andesite lapilli tuff breccia in which lapilli-tuff fragments reach diameters of several centimeters. This explosive event is apparently overlain by amygdaloidal andesitic (calcic) flow which is in turn overlain by very fine grained black, shattered sediments, marking a distinctive break with the overlying section. This next section, represented by samples 8 through 12, is a series of dacite and dacite tuffs which are generally fine grained. A grey, veny fine grained dacite-rhyolite porphyry (flow?) occurs at site 11. This section is topped by black well bedded sediments (8) similar to those topping the lower section (13), again marking a break in the volcanic cycle. The topmost section, represented by samples 2 through 7 and 18, is generally a series of dacitic pyroclasitc rocks consisting of poorly sorted cherty fragmental (7), moderately sorted medium grained multilithic tuff (6), lapilli tuff (5), multilithic chert breccia (4), and crystal lapilli tuff (3) in apparent upward succession. Site 2 is a series of black to brown, very fine grained to sandy sediments and lapilli tuffs which might possibly be correlative with site 8. The succession of this section is questionable but site 18 is topographically higher and this coarse, multilithic, siliceous breccia apparently overlies the other units of this section.

Sample 1 represents a shattered, vein healed chert breccia with local accumulations of pyrite and vein pyrite. This grey-black cherty rock probably represents a siliceous hydrothermal infusion and the mottley black coloration may be due to carbonaceous impurities. Sample 17 is a medium grained diorite intrusive which carries minor amounts of disseminated pyrite.

To the southwest of the above units, dacite and dacite-andesite tuffs and flows outcrop and appear to indicate a finer grained, less siliceous trend. Sample 22, however, appears to be a folded and silica-replaced sediment, distinctly anomalous to the rest of the observed units. It is possible that this is part of a much younger series of sedimentary units, unrelated to the above volcanics.

Although no direct source of metals could be found to account for the geochemical anomaly, it is concluded that the exposed section of rocks represents a highly active series of cyclic volcanics with coarse pyroclastic facies and intermittent sedimentation, that defines a high potential environment for hosting volcanogenic mineralization. In this respect it is recommended that more detailed mapping and prospecting of the surrounding area be carried out. In particular, attention should be paid to the extent of the cherty breccia and the occurrence of coarse siliceous fragmentals. Although the rhyo-dacite porphyry has a massive appearance in outcrop it is highly possible in the realm of this environment that breccias may occur away from this exposure.

IV. CARTMELL CREEK GEOCHEMICAL ANOMALY

Traverses were carried out in the vicinity of, and along a part of Cartmell Creek, to determine the source of geochemical anomalies found by a McDonald Consultant's survey. The sample locations are displayed on an overlay on airphoto BC 7469-151.

In the area of the geochemical anomaly on the south fork of upper Cartmell Creek, a granitic body is exposed which appears to be a narrow, generally linear stock trending 320 to 340 degrees. The intrusive is very gossanous and the erosion of pyrite from the rock has left outcrops in a crumbly, sandy state. A distinct fracture-lineation in the intrusive was measured at 320/66 SW and 345/45 NE and appears to be the source of the linear features on the airphoto in this area. These features have a 0.5 cm spacing in outcrop and are observable in a continuous fashion throughout the creek exposure. The intrusive has affected the surrounding volcanics by silicification, bleaching, destroying feldspar phenocrysts, sericitization and pyritization. The contact zone at 164 shows a 3 to 5 meter chilled zone where grain size is severely diminished or phenocrysts are absent. To the north of this contact zone is an outcrop of Dqfp which may be related to the granitic stock. Volcanics in this area are generally altered forms of Dfp, although sediments outcrop at 160 and these are locally very pyritic (2-4%) and carry minor amounts of disseminated chalcopyrite. Pyrite occurs as disseminations as well as fracture coatings. On the eastern boundary of the stock, south of Cartmell Creek, Afp (with diss. magnetite), Dfp, a sheeted dacite dyke and dacite tuffs(?) are exposed. These rocks are locally bleached and pyritized and several andesite dykes cut these units.

Three dykes were exposed cutting the intrusive in the creek. These were (1) Andesite dyke @ 204°, (2) Dacite dyke @ 240° and (3) a hornblende porphyry (mafic-andesite?) dyke @ 316°/90°. The latter is a very fine grained dark green to brown rock with needle-like euhedral crystals of hornblende scattered throughout.

An interesting feature was observed at 171 which appears to represent the intrusive contact. This is a quartz-feldspar vein stockwork trending 12°, carrying intrusive fragments up to 10 cm in length. Adjacent to this, up the creek, is what appears to be a fine grained, altered Dfp.

A short traverse on the north side of Cartmell Creek, where mineralized float and soil geochemical anomalies are reported, revealed a large area of little to no outcrop. A great variety of gossanous float was observed and this included Dfp, diorite, siliceousmultilithic coarse fragmentals and well bedded sediments. The outcrops observed at 172 through 175 include a grey, siliceous Dfp, a series of laminated to thin bedded black to grey-brown sediments (flat lying) and a dacitic multilithic tuff breccia. Although overburden covers the contact between the sediments and surrounding rocks, it is very obvious that sharp, steep contacts exist and probably are fault contacts or fault-intrusive contacts.

The area around Cartmell Creek is interesting economically because of the existance of intrusive rocks (possible vents),which are pyritic, as well as the preponderance of pyroclastic and sedimentary float. The Dfp in this area is a grey colored variety with well developed feldspar phenocrysts and appears to be more siliceous than its counterparts in the Maisal Creek area. It is similar, in fact, to the Dfp exposed at the Camp Cove anomaly. Although no directive conclusions can be made, it is recommended that this area be more thoroughly traversed and mapped, with perhaps a greater than normal attention being paid to float boulders in the large overburden covered area. An interesting feature noted in the intrusive exposures was the existence of andesitic and dacitic dykes cutting the intrusive. This occurrence lends support to the author's belief that these coarse grained intrusives were emplaced before the end of volcanism and are at least in part coeval with the Harrison volcanics.

Soils in this area are extremely iron rich and impart a distinctive rusty color to transported boulders suspended in the till-soil horizon.

Boulders of well bedded sediments were observed as float at a distance of less than 300 meters from outcrop of the same unit. This occurrence might indicate transport distances for the pyroclastic float boulders (not observed in outcrop).

V. HEE CREEK GEOCHEMICAL ANOMALY

One day was spent traversing up Hee Creek from a logging road at approximately 1650 feet a.s.l. A sketch on an overlay of airphoto BC 7469-54 shows sample and outcrop locations.

The entire creek is underlain by dacite quartz-feldspar porphyry intrusive. In the Maisal Creek area this unit was seen to occur as peripheral intrusive bodies to the quartz monzonite porphyry (Gqz) and in Hee Creek probably represents a northwesterly extension of the intrusives mapped in the northwest corner of Map Sheet C (Chevron Regional Geology). The linear nature of the creek serves to enhance this interpretation. The Dqfp is a medium to coarse grained rock with a variably colored pale grey to green very fine grained groundmass. Quartz eyes vary in abundance from one to in excess of ten percent probably indicating internal variation rather than multiple intrusion.

Three dacite dykes were observed and are characterized by a grey-black to pale green color and very fine grained weakly pyritic texture. Sample 153 displays poorly developed and barely visible (generally tiny) feldspar phenocrysts. The dyke at 149 carries blocks of Dqfp up to 50 cm across and is a siliceous indurate rock (conchoidal fracture-break) with chilled margins. The dyke at 148 has a more irregular contact and carries thin epidote veinlets which parallel the dyke walls.

In the slide area on the north bank upstream from 148, is exposed a 3 meter zone of 5 to 10 cm quartz-pyrite-epidote veins. The veins are irregular in orientation but generally trend $90^{o}/80^{o}$S. This area marks a decrease upstream in the amount of siliceous, pyritic, pyroclastic (fine grained tuff to coarse fragmental) float boulders. The boulders are often angular but are generally subangular and indicate a not too distant source, probably to the north.

To the south of Hee Creek, outcrops of well bedded dacite tuff (sediments) which display shallow dips to the northeast are exposed on logging roads. On the lower road (156, 157) a sharp, steep ($60^{o}/60^{o}$SE) contact with Dqfp indicates that the intrusive activity drastically limits the extent of extrusive or bedded rocks in this area.

Near the head of Hee Creek (154) an intense shear zone is exposed over an area of approximately 5 m by 10 m and the surrounding rocks are extremely shattered for a distance of up to 10 meters away from this zone. The shear is pyritic and is typified by slickensided, lenticular chlorite-feldspar smears up to 5 cm long. The zone can be seen to grade into Dqfp on the banks of the creek where alteration decreases.

Hee Creek represents an exposure of an intrusive core which does not appear to account for the geochemical anomalies, with the possible exception of the pyritic shear zone at the head of the creek. The rocks are generally massive and sulphide poor. The occurrence of siliceous, pyritic pyroclastic float in the lower reaches of the creek, combined with the occurrence of geochemical anomalies and copper-zinc mineralization to the north (Top Creek) indicate a potential on the intervening hillside for finding additional mineralization. This area is very steep and rugged (often precipitous) and would be difficult to prospect. Some effort should be made, however, to evaluate this area with respect to the possible occurrence of flanking extrusive rocks to the underlying intrusives exposed in Hee Creek.

VI. ERICKSON WORKINGS

One day was spent, traversing from a logging slash to the northwest, visiting the Erickson showing. Unfortunately 10 to 15 cm of snow cover inhibited mapping of the surrounding terrain but the creek area, in which the showings are well exposed, offered sufficient outcrop exposure to determine the mode of occurrence of the sulphides. A rough sketch of the zone is attached and the approximate location of the area is marked on the overlay for airphoto BC 7105-140.

The occurrence consists of a quartz-pyrite (chalcopyrite) vein which occupies a linear zone marked by minor shearing. In the lower exposures (below the trench area) the vein pinches and swells from 0.5 cm to 15 cm occasionally splays into two or more veins. The linear trend enclosing the veining is approximately 320 degrees with a steep westerly dip. The main trench exposes a thickened section of the vein which appears to be about 2 meters wide, pinching dramatically downstream and disappearing into overburden to the northwest. An attitude measured on the hangingwall of the vein was $310^{0}/58^{0}$SW.

The pyrite occurs as a crystalline mass of sub to euhedral pyrite, either as a core within a quartz vein or without quartz. In the very massive pyrite sections (70 - 80% pyrite), occasional sericitized fragments up to 0.5 cm diameter occur. Chalcopyrite occurs as rare to occasional anhedral blebs enclosed by pyrite. In the trench area the vein generally is comprised of approximately a 1:1 ratio of quartz and pyrite, the quartz being a grey-white massive groundmass interstitial to the pyrite. A pale bluish tinge pervades the vein in this zone and is believed to represent an Fe (Mg) enriched sericite.

The country rock is a dacite feldspar porphyry. Away from the vein, this unit is weakly altered, characterized by soft, white feldspars in a fine to very fine grained pale green groundmass carrying minor amounts of disseminated cubic pyrite. As the vein is approached to Dfp becomes increasingly altered to the point where phenocrysts are destroyed totally and the rock becomes a crumbly quartz-sericite, pyrite mass. In the transition, partially destroyed feldspar phenocrysts take on pale blue or blue green color which probably represents sericitic alteration (and/or

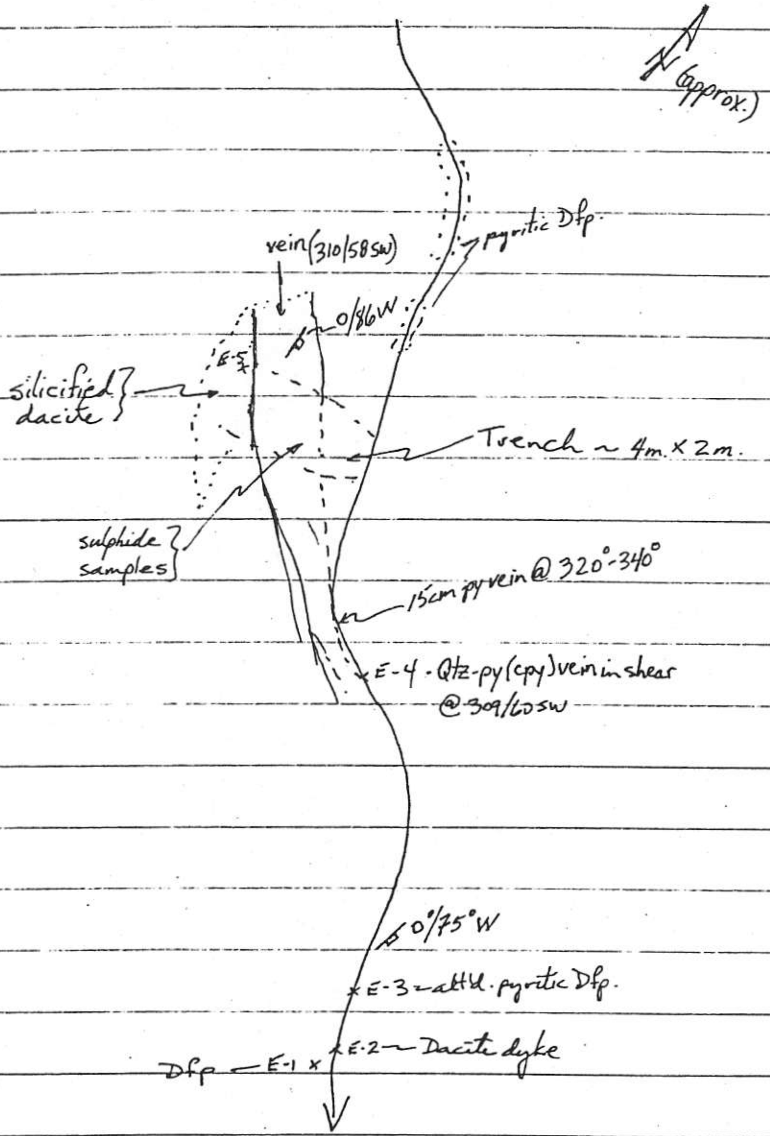


Figure 4

Erickson Workings
Detail Sketch

0 m 10
approx.

montmorillonite). The hangingwall of the vein exposed in the trench is a siliceous, grey, weakly banded rock which represents a high degree of silicification of the host Dfp. The hangingwall rock carries very little pyrite.

A barren, very fine grained, grey-black dacitic dyke, approximately 0.5 meters wide, is exposed downstream from the trench area and appears to parallel the vein trend.

The vein appears to occupy a strong northwesterly linear trend which is apparent on the airphoto and which dominates the Mount Keenan area. A 225 degree plunge on columnar joints in a Dfp dyke on the north face of Mount Keenan might indicate parallel intrusive activity to the vein system. These entities are, therefore, believed to represent late stage volcanic related intrusive features which appear to have culminated (throughout the region) in dacitic dyking.

VII. LINEAMENT STUDY

A lineament analysis was undertaken, utilizing standard British Columbia airphotographs, and this data was plotted on an overlay on 1:10,000 airphoto blow-ups. An additional overlay was emplaced and the lineament sets were generalized into major trends, defining the major regional structures. The area studied covers airphoto blow-ups 1, 2, 3 and 4 and geology base maps A, B, C and D.

Excellent continuity of regional structures (faults) can be observed throughout the region and this continuity is reinforced by: (1) observable continuous lineaments, (2) sets of parallel or sub-parallel lineaments and (3) faults and linear features which were observed in the field.

Four major trends can be observed of which two appear to dominate the structural setting. The latter consist of northwest (A) and northeast to east-southeast (B) trends which transect the entire region. West-northwest (D) and north-south (C) orientations appear to be much more localized in their occurrence on a regional basis and where they occur locally as minor lineaments are likely related (as conjugate sets) to other major fault trends.

Only Map Sheet C was underlain to the lineament map to attempt a geology lineament correlation and only generalizations can be made to this incomplete match. It is evident, however, that the quartz monzonite porphyry and related peripheral intrusions do generally align with lineament trends. The main body of Gqz (Q.M.P.) with a northwest trend, is bound by, and parallels the two major Weaver Lake northwest trending fault systems (A2-A3). On the northwest boundary of this body, at the northern end of A-2, a west-northwest trend (B-3) dominates and may be reinforced by the occurrence of Dqfp peripheral intrusions in this direction. On the eastern flank of the Gqz body, Dfqp and Gqz dykes and linear intrusive bodies appear to parallel the A-3 trend, the major Weaver Lake fault.

The Weaver Lake area presents an anomalous structural setting where A, B and C trends cross, forming a major junction point. Northerly trends are strong through and to the north of Weaver Lake and are rare elsewhere. It might be speculated that the lake's location is not purely coincidental but reflects a fault controlled depression. It is also interesting to note that the large gossan zones (domes?) on the I AM claims occur just north of Weaver Lake.

Northeast trending structures B6 and B7 cut through the main Seneca property and bound the pit zone. The significance of this occurrence is beyond the author's knowldge of the geology in this area but should warrant the consideration of the property geologist.

To speculate on a grandiose scale, the author would like to mention the significance of northeast trending structures elsewhere in the Cordillera. In the Stikine, Skeena and Bella Coola areas, all of which are underlain by Jura-Cretaceous volcanic-sedimentary packages, these northeast trending structures represent ancient, deep (probably crustal) structures which were the controlling influence on major uplift (Skeena-Stikine Arches) intrusive emplacement and volcanic activity in these regions. Northwest trending structures in those regions are more directly related to basin boundaries (Hazelton-Nechako and Bowser Basins) as well as the Coast Range uplift and intrusive emplacement. Whether similar mechanics can be applied to the Harrison area is at best speculative, but the similarities of common age and type of the underlying geology and the distribution of regional structures makes an interesting comparison.

A plot of intrusive bodies (which the author believes are intimately associated with the volcanism), in the region covered by the lineament study, should be undertaken to determine which structures controlled their emplacment.

Although it has been shown that considerable lateral and vertical movement has occurred along fault zones (D. Arscott, W. Howell, personal communication), it is reasonable to assume that the major fault trends reflect structures which are original to the depositional site. In this respect it should be possible to define the structural controls on the volcanism and this might successfully be achieved by relating intrusive (core and vent systems) emplacement to the structural setting.

VIII. SUMMARY AND RECOMMENDATIONS

The following general conclusions have been made and relate primarily to the mapping carried out in Sheet C. Speculative conclusions relating to areas peripheral to Sheet C are ideas which are felt to be worthy of further study.

1. The area of Map Sheet C is dominated by a multiphase intrusive complex of quartz monzonite composition.
2. The intrusive rocks are generally oriented parallel to regional structures and commonly show linear boundaries.

3. The intrusive complex is, at least in part, coeval with the surrounding volcanics.

4. The area covered by Sheet C shows little potential for hosting a volcanogenic massive sulphide deposit.

5. The area of Sheet C has been uplifted relative to regions to the west and south.

6. The areas surrounding the Cartmell Creek and Camp Cove geochemical anomalies show a good potential for hosting volcanogenic deposits.

7. Intrusive bodies generally follow northwest trends (Maisal Creek and Cartmell Creek).

8. Areas, peripheral to intrusive bodies, which display a high component of coarse pyroclastic material and/or sedimentary successions, should be considered as vent zones with a high priority for prospecting.

Recommendations resulting from such a general study are in themselves only a directive to ascertain the validity of the conclusions. In this respect, all future work should take into account any data which would substantiate or denounce the coeval nature of the intrusive complex as interpreted herein. This would entail a search for intrusive rocks which lend themselves to age dating as well as a reconsideration of the relationship of feldspar porphyries in the area of the Seneca deposit.

More specifically, the author recommends that prospecting and regional mapping be directed at the belt covering the Cartmell Creek through Camp Cove areas.

To supplement the lineament study and, indeed, justify its existence, a plot of mineral occurrences and a geologic base map should be prepared and overlayed with the lineament map. In this respect, particular attention should be paid to intrusive occurrences and major regional structure. This should prove invaluable to defining regional metallogenic targets.

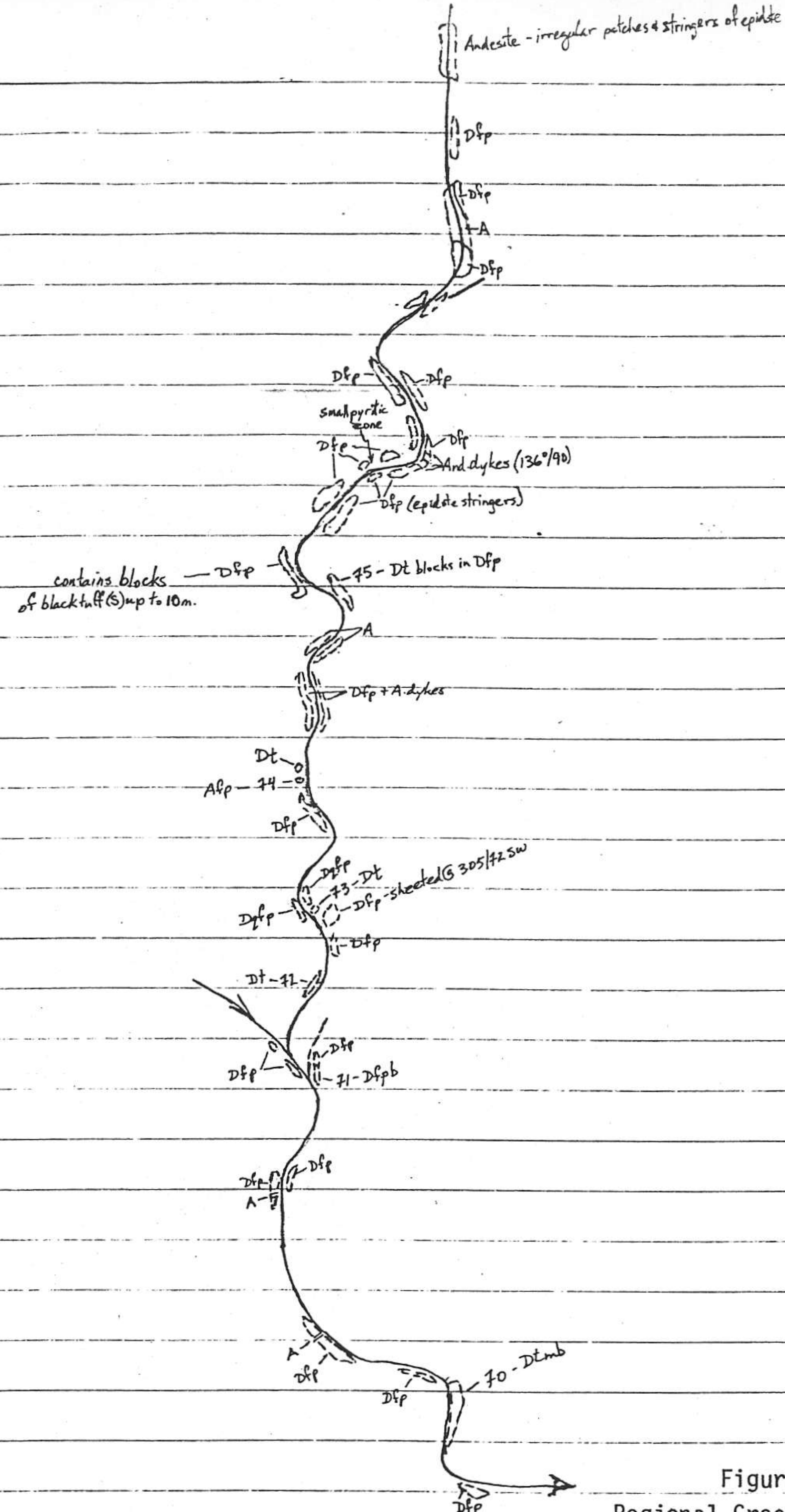


Figure 5
Regional Creek Traverse

No scale

HAND SPECIMEN DESCRIPTIONS

1. Dacite crystal lapilli tuff: Very fine grained, pale green to medium green rock with occasional chloritic fragments or chloritized fragments. Feldspar phenocrysts are rare and poorly developed. The rocks are locally silicified and 1/8 to 1/4 inch glassy quartz veins can be observed. Epidote locally replaces fragments or phenocrysts. Silicified, bleached zones generally carry disseminated euhedral pyrite and these zones do not exceed 6 meters in length.

2. Quartz monzonite porphyry: 1/4 inch sub to euhedral quartz and feldspar phenocrysts set in a pale green very fine grained matrix. Chlorite and chloritized hornblende occur in minor amounts and locally chlorite accumulations give the appearance of being fragments. Four of these intrusive dykes occur in a 100 meter interval and are probably related to the QMP (Gqz) pluton to the east.

3. Dacite crystal lapilli tuff: Same as 1. Feldspar crystals are visible and these appear to be broken. Faint outlines of pale, subangular fragments are visible.

4. Dacite: Massive, very fine grained pale green rock. Darker green blotches are likely due to chlorite accumulation.

5. Dacite lapilli tuff: Black, chloritic, rounded and occasionally resorbed lapilli in a fine grained green matrix. The lapilli almost invariably have grey siliceous(?) rims. Pyrite occurs as disseminations and thin veinlets and probably accounts for 1% of the volume.

6. Dacite quartz porphyry: 1/4 inch subhedral quartz phenocrysts are set in a very fine grained pale to medium green matrix. Feldspar phenocrysts are occasionally visible.

7. Dacite quartz feldspar (lapilli?) porphyry: Subhedral phenocrysts of quartz and feldspar in a very fine grained pale green matrix. Chloritized hornblende laths are occasionally visible. Some quartz-feldspar accumulations give the appearance of being fragments, and this may be the case.

8. Dacite crystal lapilli-tuff: Fragments of feldspar porphyry, broken feldspar phenocrysts and poorly developed quartz phenocrysts are set in a very fine grained pale green matrix. It is likely that this is equivalent to 7.

9. Dacite quartz feldspar porphyry and dacite feldspar porphyry: These two samples are from the same outcrop, perhaps five meters apart, and may slow the variation in flow composition over this short distance. A distinct contact was not visible. Subhedral phenocrysts of quartz and/or feldspar in a very fine grained pale green matrix. Chlorite specks may indicate remnant mafics (hornblende). Some of the feldspars have been replaced by epidote.

10. Dacite quartz-feldspar porphyry: Well developed single and clusters of white altered feldspar laths and less distinctive subhedral quartz phenocrysts in a very fine grained, pale green groundmass. Chloritized hornblende laths are easily visible.

11. Dacite feldspar porphyry flow breccia: Sub-rounded, often embayed, fragments of varying sizes up to one inch in diameter. The flow varies in grain size and mafic content dramatically over a few meters and it appears that quartz eyes may develop within a Dfp (i.e. Dfqp within Dfp).

12. Dfp breccia and dacite tuff: The breccia is from a fault zone contact between Dfp and a 6 meter block of the fine grained tuff. Faint traces of fragment alignment (indicating bedding) are visible and the tuff contains 1 - 2% finely disseminated fragments. Lapilli are occasionally present.

13. Dfp breccia dyke: This narrow unit crosscuts Dfp at an orientation of 90°. The fragments and pink colored quartz-feldspar veining are aligned parallel to the dyke walls. The pink coloration is believed to be due to Fe contamination or staining of the feldspar.

14. Dacite feldspar porphyry: White (clay alt'd) feldspar phenocryst take on subhedral forms in a very fine grained very pale green groundmass. This flow varies in color from pale to medium green due to a variation in chlorite content.

15. Dacite feldspar porphyry and amygdaloidal andesite: The latter appears to overlie the dacite but may be a dyke, due to the outcrop exposure. The amygdales are filled with subhedral epidote and are weakly aligned in the probable flow direction.

16. Dfqp: No sample taken.

17. Dacite crystal tuff: On a weathered surface the rock has a feldspar porphyry texture. On a fresh or cut surface, sub-rounded green fragments (possibly alt'd feldspar) are visible. The groundmass is very fine grained, pale green.

18. Dqp(?): This fine grained grey rock is difficult to name due to the lack of distinguishing phenocrysts. Chloritized hornblende laths are occasionally visible as are some quartz eyes.

19. Equivalent of 18:

20. Dfp(?): Feldspar phenocrysts are barely visible in this fine grained, green rock. Dark green crystalline or anhedral phenocrysts may be hornblende.

21. to 27. Dacite crystal tuff: Same as 17 - 20. These rocks appear as Dfp containing sub-grounded lapilli. 27(b) shows how well developed the feldspar porphyry texture can get although in other samples, feldspar crystals appear to be broken indicating a tuff. Thin section study might help in determining the origin of 17 - 27 in light of their fine grained nature.

28. to 32. Altered dacite quartz - feldspar porphyry: This rock is light brown to white to purple in color depending on hematite content and the degree of silicification. Thin, glassy, black or white quartz veinlets are common in the white variety. Disseminated pyrite occurs in minor amounts. A strong fault fracture set is oriented $15^{o}/68^{o}$SE. Sample 32 shows minor brecciation along quartz veinlets.

33. Dacite feldspar porphyry: Fine to medium grained, pale green, with white feldspar laths (single and clustered) which are partially to completely replaced by epidote. The groundmass is very fine grained and chloritic.

34. Dacite feldspar porphyry: This rock somewhat resembles 17 - 27, although the feldspar phenocrysts are euhedral and hornblende laths (chloritized) common. Perhaps 17 - 27 are flows with poorly developed, altered feldspar phenocrysts which appear as fragments.

35. Dacite quartz-feldspar porphyry: Phenocrysts of white feldspar, chloritic hornblende and rare quartz are set in a fine to very fine grained grey groundmass.

36. Dacite: Pale green, massive in outcrop. Very fine grained almost textureless rock.

37. Refer to diagrammatic section:

(a) Dacite crystal lapilli tuff: Dark green chloritic fragments are subangular to irregular resorbed grains. Quartz and feldspar subhedral phenocrysts form void or circular clusters and some are epidotized. Pyrite occurs in minor amounts as fine granular accumulations.

(b) Rhyolite crystal lapilli tuff: subrounded to subhedral phenocrysts of quartz and feldspar in a pale green to white siliceous very fine grained groundmass. The fragments and crystals are aligned parallel to bedding.

(c) Rhyolite crystal lapilli tuff breccia: Brecciated top of the underlying 37(b). The fragments of (b) are attenuated and aligned parallel to bedding at $124^{0}/36^{0}$NE.

(d) Rhyolite crystal lapilli tuff: Not as well defined but similar in appearance to (b) (some similarity to 17 - 27).

(e) Same as (a).

(f) Dacite quartz feldspar porphyry: White euhedral feldspar phenocrysts form clusters (crystal aggregates) and clear to grey quartz eyes are common (>10%).

38. Dacite crystal lapilli tuff: Fine to medium grained; rounded to subhedral feldspar phenocrysts and green to black angular (chloritic?) fragments set in a very fine grained pale green groundmass.

39. Quartz monzonite porphyry(?): Light pale green groundmass with 1/8 inch quartz eyes (up to 1/4 inch). Bluff and cliff forming outcrops. No sample.

40. Dacite feldspar porphyry (x.t.?): Massive porphyry flow with 1 to 3 meter zones of coarse (to 6 inches) angular breccia fragments of flow material. The feldspar phenocrysts appear as rounded masses with occasional crystal forms appearing out of them, or as distinct euhedral phenocrysts.

41. Andesite porphyry dyke: Euhedral zoned feldspars in a fine grained chlorite-feldspar groundmass.

42. Multilithic vein breccia: 70% of the fragments are Dfp of the enclosing host. The breccia zone is about 5 - 6 cm wide and is exposed over 1 meter. One 8 cm zone consists of massive crystalline pyrite which forms the matrix.

43. Dacite feldspar porphyry: Yellow-white altered feldspar phenocrysts in a very fine grained groundmass. Less than 1% disseminated pyrite throughout the groundmass and feldspars.

44. Tuff: Grey to black, fine to very fine grained pyritic tuff; thin irregular beds (~1% finely disseminated pyrite). Float sample.

45. Pyroclastic breccia: Bleached siliceous fragments of lapilli tuff in a very chloritic matrix. Epidote stringers are blebs common. Float sample.

46. Fine grained crystal feldspar tuff: 1 - 2 mm anhedral to subhedral equigranular appearing tuff with a chloritic matrix.

47. Bedded and epidotized variety of 46:

48. No sample. RDqfp:

49. Altered Dfp(?): Very fine grained rock, white to grey in colour, with faint outlines of feldspar phenocrysts. Silicified and bleached. Minor amounts of disseminated pyrite.

50. Andesite (dacite) crystal tuff(?): fine grained, dark green; shattered outcrop.

51. Pale green to brown tuffs: The outcrop is so shattered that sampling was not undertaken.

52. Black dacite tuff:

(a) White spotted. Very fine grained black matrix with 1 mm white specks throughout.

(b) Dacite multilithic lapilli tuff. Black to grey subangular fragments in less than 30% matrix.

53. No sample - Dfqp: Contains blocks of 52 (a) up to 3 meters in length. Feldspar phenocrysts in much greater abundance than quartz.

54. Dacite lapilli-tuff: Fragments of feldspar porphyry in a green chloritic matrix.

55. Dfqp: No sample.

56. Sheeted dacite: Locally observe breccia and feldspar porphyry but generally the rock is weakly banded with chloritic patches accentuating the flow texture. The banding is wavy and irregular but generally trends $120^o/90^o$.

57. Dacite crystal lapilli tuff: Broken, white feldspar phenocrysts, black lapilli and possibly pyrite fragments in a very fine grained, grey-green matrix.

58. Dacite lapilli tuff: Black to green angular and greenish to grey subrounded fragments with little matrix (<20%). Rare fragments are hematized.

59. Dacite lapilli-tuff: Black to dark green attenuated to subangular fragments which often contain feldspar phenocrysts, in a fine grained green matrix.

60. Dacite crystal lapilli tuff: The dominant fragment type is Dfp although rare feldspar phenocrysts and chloritic fragments are also present. Pyrite occasionally borders fragments.

61. Banded dacite: No sample.

62. Dfp: No sample. 1 - 2% pyrite on fracture surfaces.

63. Dacite crystal lapilli tuff: As 60.

64. Dacite feldspar (hornblende) porphyry: subhedral phenocrysts and clusters of hornblende and feldspar in a very fine grained pale green groundmass.

65. Dfqp: No sample.

66. Altered dacite: Bleached. No sample.

67. Dacite lapilli tuff: Fragments of Dfp, subangular, in a very fine grained matrix.

68. Dfp & Dfp breccia: No sample.

69. Gqz (quartz monzonite porphyry): Has the appearance of Dqfp (coarse). No sample.

70. Dacite tuff breccia (multilithic): Angular to sub-angular resorbed fragments of pale green dacite tuff in a matrix of lapilli size fragments. The tuff fragments commonly have dark green (chlorite?) reaction rims. Two other fragment types all distinguishable and these are: very pyritic, siliceous, possibly massive pyrite; and dark green very fine grained, probably chloritic, fragments. Rare 0.7 m blocks of Dfp were also observed.

71. Dacite feldspar porphyry breccia: Attenuated >15 to 25 mm fragments of Dfp are variably bleached but generally are relatively unaltered. There is less than 20% matrix and the unit is in apparent contact with Dfp.

72. Dacite tuff: Same as 52(a). Black, very fine grained rock with 1 - 2 mm white specks dissemianted throughout. This tuff also appears without the white mineral.

73. Dacite tuff: Same as 72.

74. Andesite feldspar porphyry: Dark green fine to medium grained rock with 1 - 2 mm subhedral and anhedral phenocrysts of white feldspar.

75. Dacite tuffs: 5 to 10 meter blocks of black very fine grained tuff occur in Dfp. These tuffs are similar to 72 except that 2 - 10 cm lenses of carbonate occur within the unit. Faint outlines of angular 2 - 5 mm fragments can be seen. Thin quartz-feldspar (pyrite) veinlets randomly cut the unit.

76. Andesite: Dark green chlorite andesite with 1 to 5 mm epidotized euhedral and subhedral feldspar phenocrysts.

77. to 79. Quartz monzonite porphyry:

80. Dacite crystal tuff: This outcrop is a 5 meter block within QMP (Gqz). The tuff is silicified, pale green and locally banded although bedding is not readily apparent. The unit appears to be composed of closely packed subhedral feldspar phenocrysts although the fine grained texture makes this a difficult assessment.

81. Dfqp(h) Pale green very fine grained matrix with white feldspar phenocrysts and quartz eyes to 5 mm. Approximately 5% hornblende (h) laths which are partially or completely chloritized. No sample.

82. Dacite tuff: Almost textureless fine grained pale green unit with laminated to 0.4 meter thick beds. Bedding attitude is $56^{O}/44^{O}$SE.

83. QMP (Gqz):

84. Dacite tuff: Very fine grained to medium grained tuff block within the QMP. The coarser tuff is multilithic and contains subhedral feldspar grains (crystal tuff).

85. Dacite tuff: Similar to 84.

86. Dacite tuff (crystal): Same as 84 - 85. Thin quartz veinlets cut the tuff and most of the feldspar fragments have been epidotized.

87. to 89. QMP:

90. Altered dacite feldspar porphyry: Grey, very fine grained groundmass with euhedral feldspar phenocrysts which are altered and have a bluish tinge and hornblende laths which are chloritized. The close proximity of QMP probably explains the alteration.

91. to 92. QMP(Gqz):

93. Dacite feldspar porphyry:

94. QMP (Gqz):

95. Dacite feldspar porphyry: Pale green with white euhedral feldspar phenocrysts.

96. Andesite dacite tuff: Black attenuated lapilli and siliceous spheroids in a fine to very fine grained grey to green matrix.

97. to 99: QMP (Gqz):

INTRUSIVE SAMPLES

Samples numbered 77, 79, 81, 83, 87, 88, 89 91, 92, 94, 97, 98 and 99 represent the quartz monzonite porphyry or Gqz intrusive body. The intrusive occurs in both stock and dyke form and is a relatively homogeneous coarse grained rock. Locally, however, the intrusive is very similar to what might be classified as Dacite quartz feldspar porphyry as samples 81, 83, 97 and 98 exemplify. In these samples, chloritization lends a greenish tinge to the groundmass and this, combined with a greater percentage of groundmass than normal, creates the similarity to mapped varieties of dacite.

100. Dfp: Altered and silicified; randomly oriented hairline fractures are often hematitic. Faint outlines of subhedral feldspar phenoorysts and occasional chloritized hornblende laths to 3 mm are set in a very fine grained, pale green groundmass.

101. Dacite crystal tuff: Pale green to white; laminated to thin bedded; ocassional white very siliceous bands indicate silicification along bedding (irregular boundaries) and a yellow coloration of subhedral feldspar phenocrysts are observable.

102. Banded dacite: Epidotized patches and lenses to 0.75 meter long in a strongly banded, predominantly grey, very fine grained dacite. This unit is very indurate and banding is oriented at $110^0/90^0$.

103. Quartz monzonite porphyry:

104. Quartz monzonite porphyry:

105. (a) Quartz monzonite porphyry:
(b) Fine grained, dacite-andesite dyke but by hairline quartz-feldspar veinlets:
(c) Siliceous Dfp (dyke?):
(d) Dfp:

106. Dacite feldspar porphyry and andesite dacite porphyry: the latter being dark grey-green in color and weathering black; possibly a dyke.

107. Dacite quartz feldspar porphyry: Overlying a shattered altered Dfp and may likely be a quartz monzonite porphyry (Gqz).

108. Dacite crystal lapilli tuff: Partially embayed green (chloritic) fragments; occasional chloritized hornblende crystals and anhedral feldspar grains in a fine grained matrix.

109. Dacite lapille tuff: Rounded siliceous,pale green to grey lapilli; extensive iron oxide coloration from pervasive hairline veinlets; also angular undistinguishable rock fragments.

110. Dacite tuff: Very fine grained black; occasional pale green, lapilli (irregular shapes to 4 mm); 1 - 2 mm quartz veinlets.

111. Dacite feldspar porphyry: Epidote occurs on hairline fractures, and pyrite accumulations and disseminations are less than 1%; chloritic groundmass accounts for medium green color.

112. Dacite crystal tuff: Grey, fine grained, subhedral feldspar phenocrysts; also at this occurrence is a black, very fine grained tuff(?) with tiny white specks (feldspars?).

113. Dacite quartz feldspar porphyry: Glassy quartz eyes are set in a siliceous (cherty) pale green groundmass.

114. Dacite feldspar porphyry multilithic breccia: Unsorted fragments of Dfp and black, very fine grained tuff(?) up to 5 cm in length set in a matrix of Dfp in which euhedral feldspar phenocrysts occur.

115. Tuff breccia(?): Angular fragments to 0.4 meter diamter of black, very fine grained tuff (sediment?); poorly sorted; apparently cross-cutting Dfp.

116. Dacite feldspar porphyry: A 3 meter altered zone - bleached white to pale brown; 1 - 2% py in randomly oriented and pervasive veinlets, oxidizing to give brown coloration to rock; chlorite on fractures.

117. (a) Dacite feldspar porphyry: Encloses (b) in apparent fault contact (intrusive?).

(b) Mudstone - tuff(?): Black, very fine grained with 1 - 2% pyrite pervasively disseminated within and on fractures as well as thin (0.5 cm x 5 cm) lenses apparently paralleling bedding. This very gossanous outcrop may only be a block within Dfp although the contact relationships are obscured by overburden.

118. Dacite quartz feldspar porphyry: Pale to medium green groundmass with glassy quartz eyes varying in abundance from 0 to 5%; less than 5% chloritized hornblende laths; white to pale yellow 2 to 5 mm feldspar phenocrysts; grain size varies noticeably over a few centimeters as does quartz-eye abundance.

119. Quartz monzonite porphyry:

120. Dacite feldspar porphyry: Medium to dark green, very fine grained with soft altered or totally destroyed feldspar phenocrysts; hornblende laths are completely chloritized.

121. Dacite feldspar porphyry breccia: Quartz vein healed breccia of pale green Dfp with patches (5 mm) of epidote throughout.

122. Dacite crystal (lapilli) tuff: Cherty, very fine grained pale green-bedding not visible.

123. (a) Sheeted dacite feldspar porphyry: (at $335^{\circ}/80^{\circ}$SW), very fine grained siliceous (cherty) banded contact zone; ubiquitous white specks (feldspar phenocrysts?).

(b) Fine grained dark green to black tuff?, andesite?

124. Dacite feldspar porphyry: Siliceous with well formed hornblende phenocrysts; epidote alteration partial; chlorite-epidote fault contact with 123(a) at $325^o/90^o$.

125. Quartz monzonite porphyry: Strong lineation at $316^o/82^o$SW, medium grained, no mafics; grades to pale green, very fine grained siliceous rock which may represent a chilled margin.

(a) Dacite feldspar porphyry: With hornblende laths, 10 meters from 125 in almost continuous outcrop - apparent phase change of QMP.

126. Dacite feldspar porphyry: Coarse grained, dark green chloritic groundmass.

127. (a) Dacite feldspar porphyry dyke: 1.5 meter dyke with irregular chloritic contact trending $312^o/90^o$; cuts

(b) Dacite feldspar porphyry: Siliceous, mafic free with pale yellow altered feldspar phenocrysts and cut by several thin pyrite veinlets.

128. (a) Apparently flat-lying 3 meter long block of andesite-dacite lapilli-tuff within

(b) Dacite feldspar porphyry.

129. (a) 1 meter wide sheeted dacite dyke at $320^o/90^o$; very fine grained, siliceous, banded, occurs crosscutting

(b) Quartz monzonite porphyry: Coarse grained.

130. Banded Dacite(?): Banding or sheeting (?) quite variable with one attitude at $70^o/90^o$; green to grey to black, siliceous rock within Dfp.

131. Sheeted dacite dyke: As 129(a); 1 meter wide at $320^o/78^o$NE; grey, rare quartz eyes, minor disseminated pyrite; appears to cut Dfp.

132. Dacite quartz-feldspar porphyry: Cuts banded unit 131 at $320^o/74^o$NE.

133. Andesite: Fine grained, dark green.

134. Banded intrusive showing grain size and crystal development variation possible in sheeted or banded intrusive zones.

135. Quartz monzonite porphyry and dacite feldspar porphyry:

136. Andesite: Very chloritic with epidote patches and minor amounts of disseminated and veinlet pyrite.

137. Tuff?: Black, very fine grained rock with ubiquitous white specks; very shattered outcrop.

138. Dacite feldspar porphyry breccia (Dlt?): Angular fragments to 2 cm long of pale green, very fine grained dacite. Reaction rims around many fragments.

139. Dacite feldspar porphyry: Medium grained.

140. Black, very fine grained tuff - dyke?

141. Dacite feldspar porphyry vein breccia: Multilithic fragments set in a Dfp matrix.

142. Dacite feldspar porphyry: Weakly bleached and cut by sheeted dacite.

143. Float-talus samples of altered Dfp:

144. Dacite feldspar porphyry dyke: Columnar joints plunge at $225^{0}/23^{0}$; minor disseminated euhedral pyrite; pale green-grey; mafic free; weakly porphyritic.

145. Dacite feldspar porphyry breccia: Rounded to sub-angular fragments (to 5 cm long) of Dfp in a Dfp matrix; 1% disseminated pyrite; locally bleached and 1 to 2 meters long, irregular dark green chloritic zones.

146. Dacite feldspar porphyry breccia: As 145; some siliceous altered zones with flow textures(?) - alignment of hornblende laths sub-parallel quartz veinlets.

147. Andesite: Fine grained, dark green with less than 1% disseminated pyrite.

148. Dyke: Very fine grained, black with epidote veinlets cutting the dyke sub-parallel to the irregular dyke walls; at $324^{o}/90^{o}$.

149. Dacite dyke: Very fine grained; grey-black; siliceous; pyritic; carries up to 50 cm blocks of Dqfp; intensely fractured; indurate; the adjacent Dqfp has been quenched (diminished grain size) near the dyke contact.

150. Dacite quartz-feldspar porphyry:

151. Dacite quartz-feldspar porphyry:

152. Dacite quartz-feldspar porphyry: Increase in quartz eye abundance.

153. Dacite dyke: Very fine grained, weakly porphyritic, pyritic.

154. Dfqp: Adjacent intense shear zone. No sample.

155. Dacite tuff: Very fine grained, black to light grey; thin bedded.

156. Dacite tuff: Same as 155.

157. Dacite feldspar porphyry:

158. Dacite quartz-feldspar porphyry: White, intensely fractured and gossanous bleached; 2 - 3 mm quartz eyes and rare remnants of feldspar phenocrysts.

159. Dqfp: Silicified; faint thin quartz veinlets; minor disseminated pyrite; fine grained, grey.

160. (a) Altered feldspar porphyry - grey with white, soft feldspar phenocrysts and 1 - 2% disseminated pyrite.

(b) White, rusty, siliceous, pyritic, rock-equivalent of (a)?

(c) Dacite tuff(?), black, fine grained, very pyritic rock (2-4% pyrite).

(d) Fine grained black tuff(?), pyritic; minor (trace) disseminated chalcopyrite.

161. Altered dacite: Blue green patches may indicate sericitic alteration of remnant feldspars; 1 - 2% disseminated pyrite; minor pyrite on fractures.

162. Altered dacite feldspar porphyry: Feldspar phenocrysts are only occasionally visible; less than 1% pyrite.

163. Quartz monzonite(?) porphyry: very oxidized and altered, crumbly, coarse grained intrusive; gossanous.

164. Chilled intrusive: 3 to 5 meter chilled margin of 163.

165. Tuff(?): Near intrusive contact.

166. Dacite crystall tuff(?): Near intrusive contact.

167. Andesite feldspar porphyry: Anhedral to euhedral close packed feldspar phenocrysts in a green chloritic, fine grained groundmass carrying finely disseminated magnetite; 1-2% disseminated pyrite.

168. (a) Dfp: Grey-green; minor disseminated pyrite.

(b) Felsitized Dfp: Grey-white.

(c) Dfp: A few chloritized hornblende laths and yellowish feldspar phenocrysts.

169. Sheeted Dacite: At 0/60°W; indurate, grey, very fine grained to weakly porphyritic.

170. Hornblende porphyry dyke (ultramafic?): At $316^{o}/90^{o}$; very fine grained dark green to brown groundmass with needle-lie enhedral hornblende crystals.

171. Stockwork intrusive breccia: Quartz-feldspar vein network trending 12^{o}, carrying coarse granitic fragments up to 10 cm in length; contact zone.

172. Dacite feldspar porphyry: Grey, siliceous, pyritic; white altered 2 - 4 mm feldspar phenocrysts.

173. Sediments: Well bedded laminated to thin bedded, fine to very fine grained, black to grey, brown weathering; rare broken feldspar crystals.

174. Dacite multilithic tuff breccia: Fragments generally lapilli size, subrounded and subangular green, black and white with occasionally larger fragments to 2 cm.

175. Dacite quartz-feldspar porphyry: Siliceous grey very fine grained groundmass with 2 - 4 mm quartz eyes and 2 - 6 mm white, sub to euhedral feldspar phenocrysts; less than 0.5% finely disseminated pyrite.

VP

Vancouver Petrographics Ltd.

JAMES VINNELL, Manager
JOHN G. PAYNE, Ph. D. Geologist

P.O. BOX 39
8887 NASH STREET
FORT LANGLEY, B.C.
VOX 1JO

PHONE (604) 888-1323

Invoice 1875

Report for: Dave Arscott,
Chevron Standard Ltd.,
901 - 355 Burrard St.,
VANCOUVER, B.C., V6C 2G8

Project M454

The samples are from Jurassic Harrison Lake volcanic and sedimentary rocks. They are grouped as follows:

A) Dacite
   1. Flow or dome rocks with igneous groundmass
      15-206, 15-233, 15-263, 15-313, 15-337, M-23, M-38, M-40
      (M-38 and M-40 may be of a different unit than the other rocks)
   2. Tuff
      15-208, 79-T-538

B) Andesite, commonly siliceous
   1. Flow
      M-14, M-32, 15-143, 79-T-537?
   2. Tuff-Breccia, possibly flow breccia
      M-25

C) Volcanoclastic Sediments
   1. Andesite
      102
   2. Fragmental Mudstone
      M-36
   3. Layered Mudstone, with pyrite-rich and carbonaceous? layers
      117B

D) Late Dikes
   170: hornblende porphyry

In all samples except the late dike and layered mudstone, rocks show a greenschist facies alteration assemblage. All these samples contain quartz and Ti-oxide, and all but sample 102 contain sericite. The intensity of sericite alteration varies from sample to sample as recorded in the detailed descriptions. Following are the other alteration mineral assemblages:

1) K-feldspar (as alteration of plagioclase or in veins):
   with chlorite-pyrite : 15-206
   with chlorite-pyrite-actinolite-biotite : M-40
   with chlorite: M-14
   with chlorite, pyrite, sphalerite, epidote, calcite : 15-143

2) chlorite-pyrite
   15-208,
3) chlorite
   79-T-538, M-36, M-23(chlorite-calcite), 79-T-537 (with pyrrhotite)
4) chlorite-calcite-pyrite
   15-233, 15-313, 15-337, M-25, M-23 (no pyrite)
5) epidote-bearing assemblages
   M-38 (epidote-chlorite-pyrite)
   102 (epidote-chlorite)

Sample 102 Andesitic sediment

The sample oonsists of thinly layered andesitic debris; layering is more prominent in hand sample than in thin section. The pale green layers in the hand sample are the only ones to stand out in thin section.

fragments

plagioclase	15-20%
epidote	4- 5
quartz	1½-2
Ti-oxide	1½-2
sphene	½- 1

patches

quartz-epidote-sphene	3- 4%
chlorite	2- 3

groundmass

plagioclase	50-55	(may include some quartz and other minerals)
chlorite	10-15	

Fragments are mainly angular and irregular, with size ranging from 0.03 to 0.25 mm, averaging 0.05-0.1 mm. Plagioclase fragments commonly are of prismatic grains; they show slight dusty alteration of unknown composition. Epidote forms scattered grains and clusters in the groundmass, and locally occurs as an alteration of plagioclase. Most epidote appears to be fragmental rather than an alteration of the groundmass. Quartz forms rounded to angular fragments averaging 0.05 mm across. Ti-oxide forms disseminated patches averaging 0.02-0.05 mm in size. Sphene forms a few grains averaging 0.05 mm across, and one elongate grain with epidote 0.5 mm in length.

Patches up to 1.5 mm across, averaging 0.5 mm in size consist of aggregates of fine to medium grained quartz and fine grained epidote and lesser sphene. These probably are secondary in origin.

Patches averaging 0.03-0.05 mm across consist of very fine grained aggregates of chlorite; most have rounded outlines. They probably represent a secondary replacement, based on their uniform texture, with formation similar to that for epidote nodules in many rocks.

The groundmass is an extremely fine grained (0.002-0.01 mm) interlocking aggregate dominated by plagioclase, with lesser chlorite, and possibly other minerals (quartz, other minerals with low relief and low birefringence).

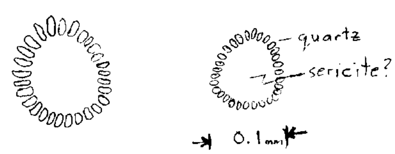
The pale green layers are similar to the darker green layers except that the extremely fine grained groundmass is sparse. The layers contain fragments as in the darker layers set in a "groundmass" of very fine grained (0.02-0.05 mm) plagioclase and minor quartz.

The rock is cut by a braided vein zone up to 0.5 mm wide containing Ti-oxide with grain size averaging 0.01-0.02 mm. Beds are offset along this vein zone, as is obvious in hand sample. This vein zone is cut by a late set of quartz stringers from 0.01-0.03 mm wide.

Sample 117B   Layered Mudstone, with Pyritic and Carbonaceous Layers

The sample is mainly extremely fine grained, and mineral identification is difficult. The sample contains two main types of layers, a black carbonaceous type, and a light grey non-carbonaceous type. In the former is a thin discontinuous layer of siltstone, and in the latter is a pyrite-rich layer containing scattered nodules of pyrite with interstitial sericite.

The carbonaceous layers contain 15-20% fragments up to 0.03 mm in average size composed of plagioclase laths and minor angular quartz grains. Sericite forms a few patches up to 0.05 mm long of very fine grained aggregates, which appear to be fragments. The layers contain a few round~~ed~~ fossil fragments up to 0.1 mm across. These are as sketched below, with the outer blebs being quartz, and the rest being very fine grained sericite?. Pyrite forms a few grains up to 0.03 mm across, and a few laths of Ti-oxide? are up to 0.1 mm long. These are included in an extremely fine grained groundmass of sericite, dusty patches of semi-opaque and opaque (Ti-oxide? and carbonaceous material? respectively, and possibly some clay minerals (not identified, but suspected on the basis of very fine grain size).



The siltstone layer in the carbonaceous layer contains fragments of quartz and plagioclase, scattered pyrite and a few fossil fragments as in the carbonaceous layer, all in a groundmass of sericite and minor Ti-oxide, opaque, and pyrite.

The light-grey layers consist mainly of sericite (80%) as an extremely fine grained aggregate with local coarser flakes and patches, the latter especially abundant near pyrite clusters. Fragments include lathy plagioclase (10-12%) up to 0.05 mm long, minor quartz, pyrite (5-7%) as scattered grains from 0.01-0.02 mm, and dusty patches of Ti-oxide? (5-7%) up to 0.05 mm across.

A central layer contains more abundant pyrite, within which are nodules? containing 75-80% pyrite as subhedral to euhedral grains from 0.02-0.05 mm in average size, with interstitial extremely fine to fine grained sericite.

The rock is cut by discontinuous veinlets of pyrite-sericite-Ti-oxide which cut across bedding. Ti-oxide forms extremely fine grained aggregates on borders of pyrite grains.

The pyrite-rich layer and nodules probably represent sedimentary pyrite.

Sample 170 Hornblende Porphyry Andesite (Dike)

The sample is very different from the other andesite samples, and is much fresher. It is a late dike rock.

phenocrysts		
hornblende	10-12%	
plagioclase	1½-2	
limonite-clay?	3- 4	
groundmass		
plagioclase	40-45	(laths)
amphibole	25-30	(or possibly biotite)
opaque	5- 7	(in part magnetite)
vein		
limonite		

Hornblende forms phenocrysts averaging 0.3-0.7 mm in size, with a few coarse ones up to 1.5 mm long. Many are euhedral to subhedral in outline. Pleochroism is from light to medium yellowish green. Some are in clusters, and a few are intergrown with plagioclase grains, with average grain size 0.3-0.5 mm. Plagioclase forms a few phenocrysts up to 0.2 mm across as well as the intergrowths with hornblende.

Patches averaging 0.3-0.7 mm in size commonly contain rims of very fine grained limonite, with cores removed from the section. White patches in the hand sample appear to be extremely fine grained kaolinite, and it is probable that these are equivalent to the holes in the section. The nature of the original mineral in the patches is unknown.

The groundmass contains laths of plagioclase averaging 0.05-0.2 mm in size, with a few up to 0.5 mm long. Flow foliation is weak to moderate, and laths swirl around the phenocrysts. Plagioclase is fresh or very slightly altered to sericite. Hornblende forms a few elongate grains averaging 0.1-0.2 mm in size. As well, very fine grained interstitial groundmass material is probably hornblende or biotite; it is too fine grained to determine, having an average grain size of 0.01-0.02 mm. Opaque forms disseminated irregular to equant grains averaging 0.005-0.02 mm in size.

The rock is cut by an irregular veinlet of limonite, which has a thin halo of limonitic rock adjacent to it.

Color variation in the hand sample probably represents banding parallel to the walls of the dike. A thin zone at one end of the sample may be a chilled border zone.