85-393-13684 5186

# TODD CREEK PROPERTY
# PETROGRAPHIC REPORT

Skeena M.D.
104A 5W

**GEOLOGICAL BRANCH**
**ASSESSMENT REPORT**

13,684

for

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by
J. R. Woodcock
May, 1985

JRW

# TABLE OF CONTENTS



## TABLES



## FIGURES



## APPENDICES



JRW

# TODD CREEK PROPERTY

## INTRODUCTION

A large conspicuous gossan occurs along the steep western side of Todd Creek, north of Stewart. In 1980, J. R. Woodcock was able to charter a helicopter one evening to briefly examine some of the gossan zones lying north of Stewart, including the one on the Todd Creek. In this quick stop below the gossan zone, a float of mineralized rock was collected and this included white volcanics with quartz sericite alteration, barite-bearing float, etc. The quartz sericite rock was somewhat anomalous in base metals.

In June of 1981, the claims which covered this part of this gossan zone expired and Dennis Gorc and Henry Awmack went to Stewart to stake the Todd 1 and 2 claims in preparation for some detailed prospecting and mapping to be carried on when the snow conditions improved.

Dennis Gorc and Henry Awmack returned to the area with J. R. Woodcock in July to start a program of mapping and prospecting. The base map for this mapping was an enlargement of a 40 chain air photo, B.C. 5504-041. This mapping and prospecting led to the discovery of widespread barite mineralization, in places associated with jasper and galena. In late July and early August, a stadia base map was made over the zone containing the most abundant barite-jasper-galena mineralization and this zone was mapped and sampled.

... 2

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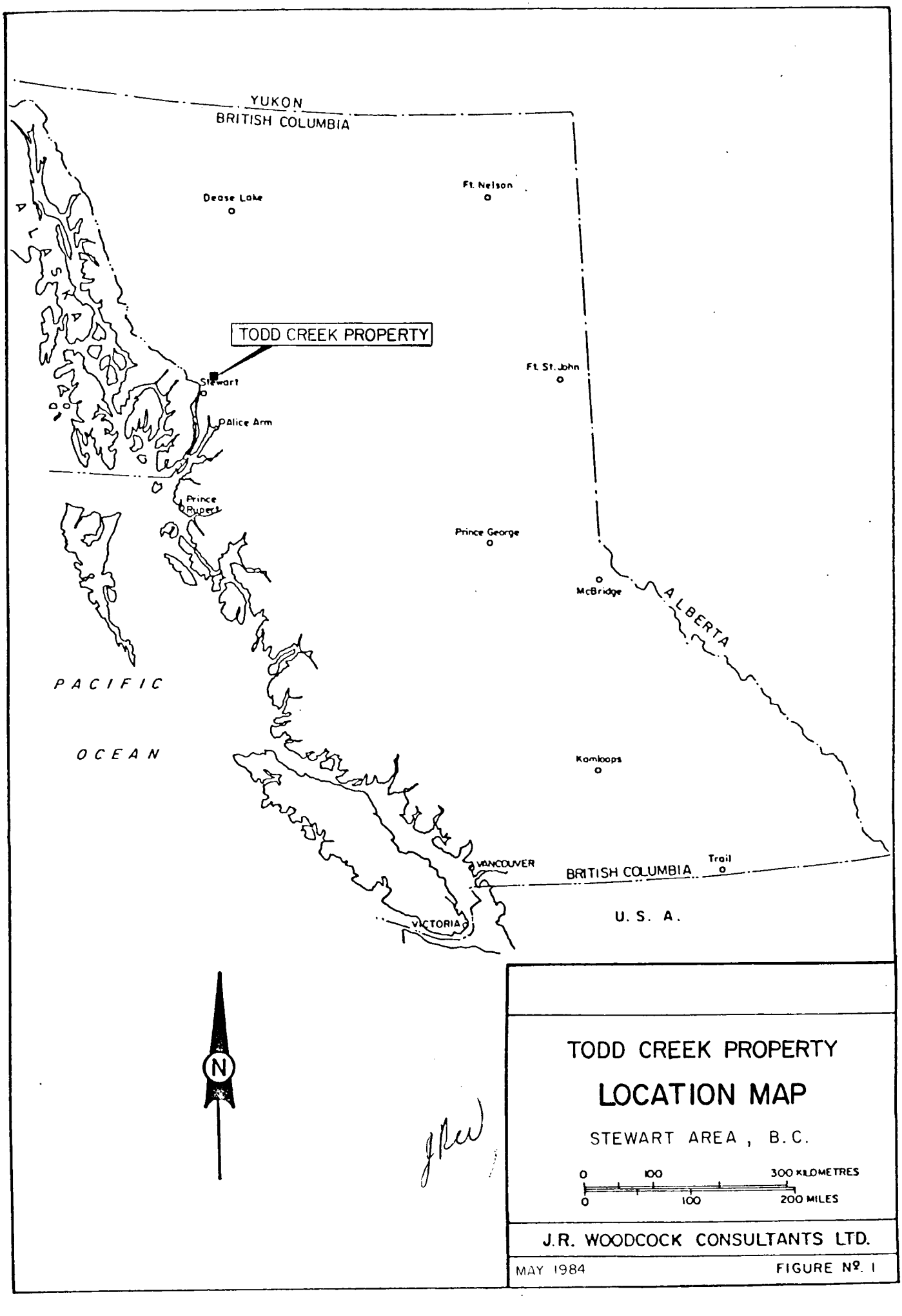

YUKON
BRITISH COLUMBIA
Dease Lake
Ft. Nelson
ALASKA
TODD CREEK PROPERTY
Stewart
Alice Arm
Ft. St. John
Prince Rupert
Prince George
McBride
ALBERTA
PACIFIC
OCEAN
Kamloops
VANCOUVER
BRITISH COLUMBIA
Trail
U. S. A.
VICTORIA
N
TODD CREEK PROPERTY
LOCATION MAP
STEWART AREA , B.C.
0 100 300 KILOMETRES
0 100 200 MILES
J.R. WOODCOCK CONSULTANTS LTD.
MAY 1984
FIGURE Nº. 1

The work was done for Riocanex Incorporated and this company applied the results of the field work for assessment work in 1982.

The rock chip samples were analyzed for antimony and arsenic in 1984 and this work was applied for assessment.

In 1985, 29 specimens from the various rock types and alteration zones were selected for thin section studies. In addition about 10 specimens were sawn to allow better macroscopic examination.

This report duplicates the data on geology from the report of June 1984, as a base for discussion of the petrographic studies. Also included is one geological map on which is plotted the studied specimens.

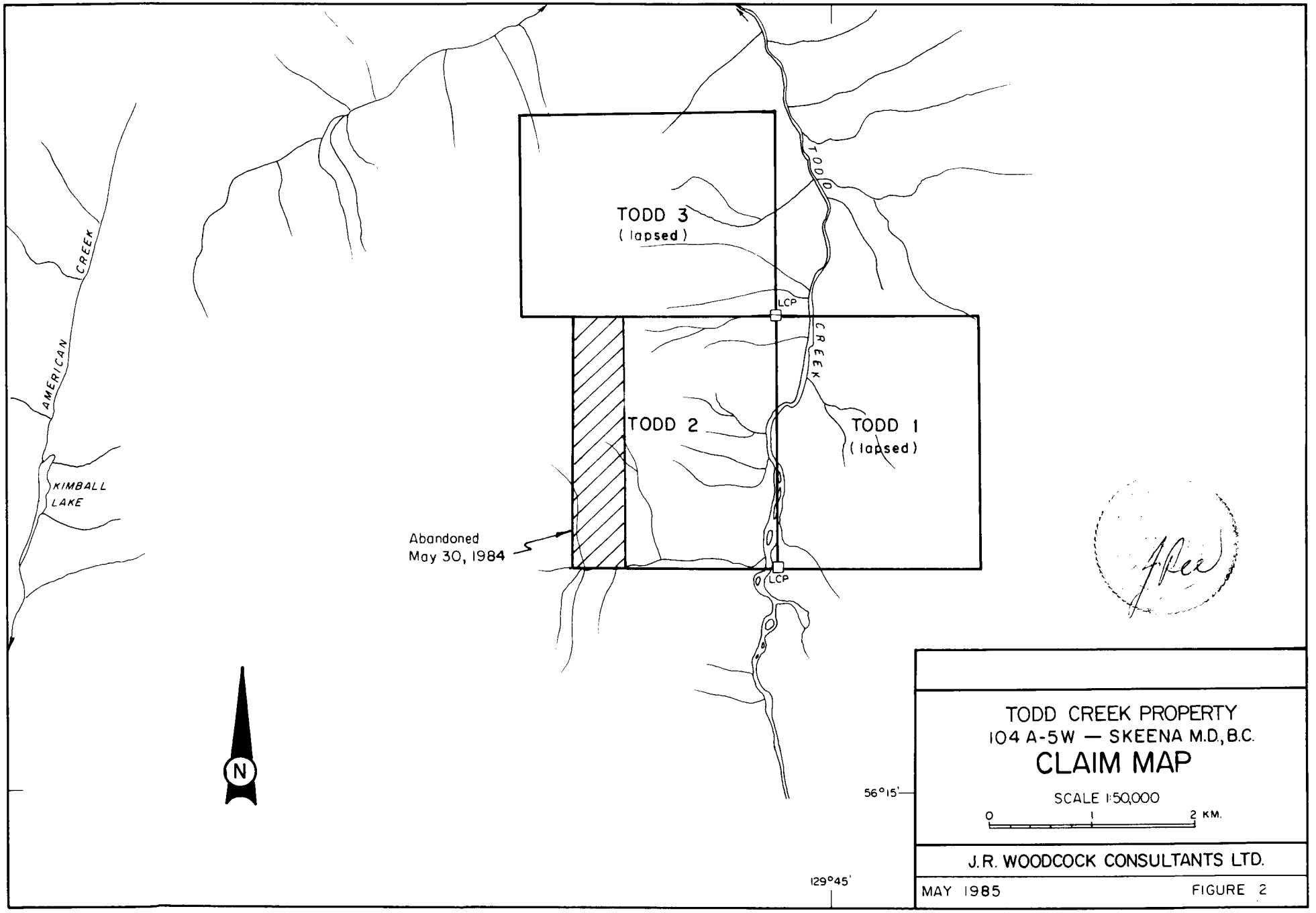
## LOCATION AND ACCESS

The Todd Creek gossan lies along the west side of Todd Creek at latitude 56° 17', longitude 129° 47' on map sheet 104A-5W.

It is an area of extremely rugged and steep terrain with the mineralized zone extending between elevations 2700 feet and 6700 feet. The treeline is at 4000 feet and most of the gossan is above treeline. Access is only by helicopter from Stewart, 40 kilometers to the south-southwest. Access for any mine would need to be down Todd Creek to the valley of the Bowser River and then easterly to the Stewart-Cassiar Highway.

... 3

JRW


TODD 3
(lapsed)
TODD 2
TODD 1
(lapsed)
LCP
LCP
TODD CREEK
CREEK
AMERICAN CREEK
KIMBALL LAKE
Abandoned
May 30, 1984
N
56°15'
129°45'
TODD CREEK PROPERTY
104 A-5W — SKEENA M.D., B.C.
CLAIM MAP
SCALE 1:50,000
0
2 KM.
J.R. WOODCOCK CONSULTANTS LTD.
MAY 1985
FIGURE 2

## CLAIM DATA

The Todd 1 and 2 claims were staked by Dennis Gorc and Henry Awmack in the spring of 1981 to protect the gossan on the west side of the valley. This gossan is largely covered by the Todd 2 claim; the Todd 1 claim covers the east side of the valley. The Todd 3 claim was added to the north of the Todd 2 while mapping.

The claims were staked by Dennis Gorc in his own name and on April 13, 1982 transferred to Riocanex Incorporated. On May 17, 1984 the Todd 1 to 3 claims were transferred from Riocanex Incorporated to John R. Woodcock.

The original claim data was as follows:

| Claim Name | Units | Record Number | Date Staked | Date Recorded |
|---|---|---|---|---|
| Todd 1 | 20 | 3093 | June 5, 1981 | June 12, 1981 |
| Todd 2 | 20 | 3094 | June 5, 1981 | June 12, 1981 |
| Todd 3 | 20 | 3153 | June 17, 1981 | Aug. 6, 1981 |

The western five units (4, 13, 20, 24, 31) of the Todd 2 claim were abandoned on May 30, 1984 leaving this claim with 15 units.

## REGIONAL GEOLOGY

Although the Todd Creek area is on the edge of a region which has received considerable exploration intermittently over the last 80 years, the geological mapping has not covered this area. The map and studies made by George Hansen of the Portland Canal area, cover the area to the west and the area to the south as far as Alice Arm.

... 4

JRW

The more detailed recent study of the Stewart area by E. W. Grove concentrates only on the area west of Todd Creek. The only geological map covering this area is the large reconnaissance survey of the Stikine River area (map 9-1957).

The upper part of Todd Creek is underlain by volcanics of the Hazelton Group (lower to middle Jurassic age). These consist of red and green volcanic conglomerates, crystal and lithic tuffs, and minor breccia and minor siltstone. Bowser Lake sedimentary rocks are largely black, in places very carboniferous, shales, greywackes, and gritstones. These extend from the edge of the Bowser Basin southwesterly, remnants occurring in the high mountains where they unconformably overlie the strata of the Hazelton Group.

Gently dipping strata of the Bowser Lake Sediments crop out along the lower reaches of Todd Creek. These strata and the underlying Hazelton Group of strata appear to be gently folded, with the fold axis striking north-northwest.

To the west of the Todd Creek, intrusive dikes and small plugs are quite common and in places dikes appear as swarms. However, on the Todd Creek property only a few basic dikes occur.

The Stewart area of British Columbia has been the focus of considerable mineral exploration, especially for precious metals, since the turn of the century. Currently several precious metal prospects in the area are being explored. The important developments in the area in recent years included the mining at the Granduc Mine, the start-up of the Scottie Gold Mine in 1981, the ongoing exploration of the Silbak-Premier and Big Missouri prospects by Westmin Mineral Resources and the exploration of the Sulpherets Creek property by Esso Minerals.

... 5

JRW

## PROPERTY GEOLOGY

This property and the adjacent ground was prospected and mapped in 1981, mainly by Mr. Dennis Gorc. His preliminary classification of rock types and alteration is represented in the report of 1984 which was submitted for assessment work on June 7, 1984. This preliminary map and classification forms the basis for the present petrographic study and so the pertinent data of the 1984 report are presented without changes. This is followed by the observations and conclusions from the petrographic study and in this case the references are made in places to the Dennis Gorc data.

### Rock Types

#### Intermediate Volcanics

These rocks are predominantly massive light-grey, fine-grained tuffs with little or no bedding. In places the rocks are characterized by small (0.5 cm) white clasts and/or small vugs. The rocks, which con-

... 6

JRW

tain only trace pyrite, weather grey.

The rocks crop out predominantly along the eastern edge of the property on the slope adjacent to Todd Creek.

Red Agglomerate

This is a distinctive rock with a predominantly reddish to purplish matrix, characterized by abundant subrounded clasts up to 30 cm across. Most of the clasts are of fine-grained volcanic rocks. In places the agglomerate has a greyish matrix but such zones are minor. A few thin horizons of crystal tuffs were also noted. The unit contains only trace pyrite and is not iron-stained. The unit is characteristically hard, resistant and massive, although good bedding occurs in a few places. The massive and resistant nature of these rocks account for much of the ruggedness of the area.

Red Tuff

This unit, with a similar reddish to purplish matrix, may in part be equivalent to the red agglomerate. However, the clasts of this unit are less than 0.5 cm. The unit is also massive with only trace pyrite. It occurs predominantly in the northern part of the property where it is widespread. This unit is uniform except for a few thin lenses or horizons of greyish fine-grained intermediate volcanics. In a triangular area between Shear and Cirque Creek, the rock is strongly sheared (orientation 154° dip 59° E).

Light-grey Siliceous Tuff

This unit is found only at the junction of the Todd Creek and Fall Creek. It is characteristically light-grey, fine-grained, massive, hard and siliceous and contains no pyrite.

... 7

JRW

Brown-weathering Tuff

Adjacent to the above siliceous unit is a soft, brown-weathering, fine-grained carbonate-rich tuff.

Volcanic Breccia

This unit is found only along Fall Creek. It is characteristically grey-weathering, massive and resistant. The unit has a fine-grained grey matrix with abundant angular clasts of volcanic rock. Generally the unit contains no pyrite; however, a few random small pods of very altered, iron-stained rock occur. These are associated with barite and/or quartz-pyrite veins.

Carbonate-rich Pyritic Tuff

Also found along Fall Creek is a unit which contains abundant carbonate and up to 15% finely disseminated pyrite. Despite the high pyrite content the unit is grey-weathering. This unit is the host for copper-gold mineralization which will be described in a subsequent section. The unit is fine-grained, very light-grey and relatively soft. Note that little of the unit is exposed because a thin zone of glacial debris covers most of the valley.

Rock similar to this unit also occurs a short distance to the north near sample site 516.

Limestone

A platy, thinly-bedded grey limestone occurs on the northern edge of the property.

... 8

JRW

### Basic Dikes

Thin (20-30 cm) basic dikes are the only intrusive rocks on the property. The dikes are fine-grained, dark-grey with small hornblende phenocrysts. They contain no pyrite and have no alteration selvages.

## Alteration

The Todd Creek target is characterized by intensely altered rock which is hard siliceous and pyritic and which weathers to create a brilliant yellow to orange gossan. The hard, resistant nature of the altered rock forms steep iron-stained cliffs to the west of Todd Creek.

The alteration includes introduction of abundant silica and pyrite and bleaching associated with the introduction of the silica and minor sericite.

The altered rocks are classified and mapped according to three grades of intensity:

### Intense

Intensely altered rock is very fine-grained, highly siliceous and generally white but grey in places of very high pyrite content. The alteration is so intense that the original rock and bedding is indecipherable. It is feasible that felsic rock units may be included within the larger altered zones. The widespread surface leaching of the pyrite makes it difficult to estimate pyrite content. However, the abundant jarosite stain both on the surface and within small vugs within the rock as well as small pockets containing up to 15% pyrite suggest that originally the pyrite content was high.

... 9

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Two variations of intense alteration are mapped within the area of detailed mapping (Figure 5). One variation has a red hematite colour and lower pyrite content. Within the area of this red silicification is a small area of light-grey completely silicified rock.

Medium Alteration

Such alteration is also quite intense but differs from the above in that the resulting rock is coarser-grained and contains less pyrite (1%). The amount of pyrite is again difficult to estimate because of surface leaching. However, the preponderance of orange limonite versus jarosite suggests a lower pyrite content. Silica alteration is somewhat less than in the intensely altered zones.

Low to Minimal Alteration

These rocks are fine-grained intermediate volcanics slightly altered with sporadic, small patches (5 square cm to 5 square m) of highly altered rock. Pyrite content is low although noticeably more than in the unaltered intermediate volcanics. Often such rock reacts to acid, sometimes quite vigorously. Except for the small altered patches, the rock is grey-weathering. This rock is not siliceous.

Distribution of Alteration

The gossans and zones of alteration occur within an area bounded by Glacier Creek to the north, Drill Creek to the west and Todd Creek to the east. The southern boundary is not well defined because of forest cover, but it probably does not extend far beyond the area of exposure.

Within this large area (1500 m by 1200 m) are four separate zones of intense to medium alteration that stand out distinctly from the unaltered or minimally altered rock.

... 10

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Main Zone

Occurring between Drill and Camp Creeks and bounded by sample sites G-81342, 392, 402, 183, 359, and 355, this zone of alteration and iron-staining is the largest on the property (1000 m x 500 m) and encompasses much of the barite mineralization.

The zone is bounded very sharply on the west and northwest by a discontinuity which may be a fault with an easterly dip. This discontinuity, be it fault or otherwise, is significant in that it so sharply delimits the zone of alteration and gossan. Essentially no pyrite or alteration extends to the west of this contact.

The eastern boundary of this main altered zone is partly obscured by talus.

Camp Creek, Fault Creek, Glacier Creek

The remaining altered zones are much smaller and seem to be related to or affected by faults. The alteration zones along Glacier and Fault Creeks especially are noticeably linear. In places, small faults separate unaltered from altered rock.

Structure

Bedding is almost non-existent. The few unquestionable bedding attitudes and any possible bedding attitudes indicate northwest to north strike and an easterly dip of 45°. Such attitudes are compatible with Grove's measurements to the west along American Creek.

... 11

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Faults are numerous with two and perhaps three sets of faults:

a) Main Set - strike NW; dip approximately 60° W

b) Second Set - strike E; vertical dip

c) Third Set - strike E; dip approximately 25° N.

These faults have had a significant effect on the distribution of alteration and on the barite mineralization.

## Mineralization

### Pyrite

Pyrite is the most widespread and abundant mineralization. Although much of the pyrite has been leached from the surface rocks, pockets of up to 15% pyrite and abundant jarosite suggest a high content in the original rock. The pyrite is predominantly finely disseminated with lesser amounts along fractures or within barite veins.

### Barite

Barite is found throughout the property although much of the mineralization occurs within the zones of alteration. Only the larger more significant barite showings are indicated on Figure 3.

The barite mineralization occurs in pods or lenses, veins, and small concentrations.

The pods are irregular in shape but generally elongated. These pods range in size from one meter width to 30 meters by 7 meters. The pods consist of massive white barite with minor galena and pyrite in places.

... 12

JRW

The barite is quite pure, generally without jasper, quartz or calcite.

The veins vary in thickness from 10 cm to 2 m and most veins have a length of 10 m to 20 m. A few of the larger veins have a length of 30 m to 60 m. One should stress the discontinuous nature of most veins.

The two largest veins may have a length of 300-500 m but this is based partly on projection under semi overburden. One of these includes the "Jasper-Barite Zone" which was the locus of the detailed mapping (Figure 5). The other structure extends scutheasterly from G-81-468 to 460 and perhaps to 218. In this second vein, calcite is the dominant mineral with secondary amounts of jasper and barite and only a trace of galena.

The small concentrations of barite are up to a maximum of 4 cm across and are found both within altered rock and within unaltered rock near the altered zones. In many of these concentrations the barite may have replaced some of the surrounding rock. In such cases barite is intermixed with the volcanic.

Jasper-Barite Zone

This zone consisting of jasper, barite, jasper breccia and minor galena and pyrite, extends from G-81-519 to 407 (Figure 5).

It is characterized by somewhat convoluted banding in which layers of brick-red jasper or jasper breccia alternate with layers of coarse bladed barite. The amount of barite versus jasper varies considerably along the zone. In its western part, near G-81-519 and G-81-526, the zone is predominantly barite with most horizons of jasper only 3-4 cm

... 13

JRW

wide and one horizon of 1 meter width. However, at G-81-385, the zone is predominantly jasper with only small amounts of barite. At G-81-407, the zone is again predominantly barite.

The jasper breccia is a distinctive rock type within the zone. The breccia is found only in localized pockets and is best observed near G-81-526 and G-81-407. Characterized by clasts of brick-red jasper to 20 cm across, the breccia varies from that with a barite cementing matrix to that with a jasper matrix.

This zone is not the only vein structure containing such breccia. Jasper breccia is also found along many veins within the property.

The zone appears to be thinning and pinching out at the western end but may swing around to the south and abut against an east-west fault (south of G-81-396). The eastern end may abut against another east-west fault.

The main large silicified gossan zone and this barite-jasper zone are part of a marked zonation in geology. From the southeast to northwest this zonation includes:

1. White to medium-grey highly silicified and pyritic volcanics.
2. Hematite-rich and highly silicified rock which is less pyritic and has a width of about 50 meters.
3. Jasper-barite zone which is approximately 10 meters wide.
4. Non-pyritic, unaltered coarse-red agglomerate.

The sharp change in alteration on the northwest side of this jasper-barite zone and the geological zonation imply that the jasper-barite zone lies along a discontinuity which could be fault or a depositional feature.

... 14

JRW

To the northeast the jasper-barite zone gives way to some of the bleached pyritic rock.

## PETROGRAPHIC STUDY

The results of this study are summarized on Table I; this table has been added to a copy of the original geology map (Figure 3). The individual rock descriptions are presented in Appendix I. Arrangement in Table I and in Appendix I is according to three groups: (1) Trachytes (2) Jasper-rich Breccia and (3) Outlying Volcanic Rocks.

### Observations

1. The zone of interest is essentially a pile of trachytic volcanic rocks and this trachytic pile is coextensive with the pyritized zone and the zone of interesting mineralization and alteration.

2. The trachyte consists of 10% to 30% phenocrysts of K-feldspar in an aphanitic matrix which is also composed of K-feldspar. The trachyte probably originally contained some hornblende which has been completely altered to sericite, dark opaques, and variable quartz. There is no indication that any quartz occurred either as phenocrysts or as interstitial material in the original rock.

In most places this matrix K-feldspar occurs as minute laths with some flow alignment. In a few sections the matrix is more of a mosaic of equi-dimensional K-feldspar crystals. In some specimens

... 15

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TABLE 1

PETROGRAPHIC SUMMARY

| SPECIMEN | NAME | ALTERATIONS |
|---|---|---|
| **Trachyte Pile** | | |
| 35 | Tr | Ca |
| G81-158 | Tr tu | Ser +, K |
| 159 | Tr bx | Ser |
| 172 | Tr | Si |
| 178 | Tr | Si |
| 179 | Tr | Si +, Ser |
| 321 | Tr | Si + |
| 333 | Tr | Si - |
| 343 | Tr tu | Si |
| 344 | Tr tu | Ser -, Si - |
| 357 | Tr fr | Si +, Ser |
| 404 | Tr tu | Ser veinlets |
| 512 | Tr | Ca, Ser, Si - |
| 513 | Tr tu | Si +, Ser |
| **Hematitic Breccia Zone** | | |
| Bx-1 | Ba | |
| G81- 77 | Tr; Tr bx | Ser +; Si +, H |
| 382 | Tr | Ser +, H + |
| 383 | Op | Si + + |
| 388 | Tr bx | Si +, H |
| 543 | Tr | Si + |
| 556 | Tr bx | Ser +, H, Si - |
| 557 | Tr | H +, Ser, K, Si - |
| 560 | Tr bx | Si +, H |
| **Outlying Volcanics** | | |
| G81-185 | Di d | Ca, Ch, |
| 266 | Tr tu | Ca +, H + |
| 398 | An | Pr +, H - |
| 401 | An | Ca |
| 491 | Ry | H + |
| 518 | An; tu | Pr; H |

LEGEND

**Rock Types**

| | |
|---|---|
| Tr | porphyritic trachyte |
| fr | fragmental |
| tu | tuff |
| An | andesite |
| Ry | rhyolite |
| Di | diabase |
| d | dike |
| bx | breccia |

**Alteration**

| | |
|---|---|
| Ser | sericite |
| Si | silica |
| Ca | carbonate |
| H | hematite |
| Ch | chlorite |
| Pr | propylitic |
| K | kaolinite |
| Ba | barite-quartz |
| Op | opaline |
| + | high alteration |
| - | low alteration |

the trachyte appears to be unfractured flow rock, but many specimens display fragmentation. Some could be volcanic fragmentals, a number are obvious tuffs of fine trachyte fragments.

3. Alteration of this trachyte is mainly silicification. This can occur as a few small pockets, generally adjacent to feldspar phenocrysts. In its more intense form it occurs as lenses and veinlets throughout the section. The quartz within the lenses can be coarse-grained in comparison with the matrix, but it can grade sharply to a fine-grained material that becomes a granular matrix for the rock. In most specimens the relatively coarse-grained quartz of the veinlets or the lenses has some associated barite.

In most sections the K-feldspar phenocrysts are intensely sericitized and in some places they are almost completely altered to sericite. Ordinarily K-feldspar does not alter to sericite as readily as does plagioclase. Thus this sericitization does indicate very strong hydrothermal alteration.

A few outlying specimens exhibit carbonate alteration of the phenocrysts.

4. Many of the outlying volcanics have been mapped as andesites and in the Summary Chart (Table I) most of these have been called andesite. The main feldspar in these is plagioclase and, where measured, it is andesine. Staining shows K-feldspar in the matrix of some (Specimen G401); but in others (Specimen G398, G518) the staining has not disclosed any K-feldspar. These rocks, however, are not particularly dark; some of them have an overall green colour due to the chlorite alteration and others have a reddish colour due to the dispersed hematite.

... 16

JRW

Alteration in these outlying "andesites" is propylitic with carbonate predominating. In some of the sections chlorite and sericite are present and in one place some epidote was noted.

These dark coloured outlying rocks, which have been mapped as andesites, are interbedded in places with maroon coloured rocks which may be of different composition. In particular Specimen G266 is a maroon trachytic tuff with intense carbonitization and abundant dispersed hematite. This lies about 800 meters north of the main trachyte pile.

5. Only one of the outlying volcanics (Specimen G491) has been mapped as rhyolite and this is based on the composition and unusual texture. It does not seem to be a silicified rock. This rock, also stained a maroon colour by dispersed hematite, lies along the northeast side of the trachyte pile.

6. Only one specimen of dike rock was examined. This specimen (G185) occurs in the eastern part of the trachyte pile. It has an ophitic texture and was probably originally composed of interlocking laths of plagioclase and of a mafic mineral. Its ophitic texture indicates that it is probably a diabase; however it could be a lamprophyre. This rock has intense carbonate alteration along with some chlorite and albite.

7. A maroon coloured breccia zone lies along the northwest part of the trachyte pile and is sharply separated from the outlying andesitic volcanics by faults lying to the north and west. This breccia zone consists generally of altered fragments of porphyritic trachyte within a hematite-rich silica-rich matrix. The hematite within this zone appears to be associated with the secondary quartz in contrast to the maroon outlying volcanics where the hematite is dispersed throughout the rock. It is named the "jasper-breccia zone."

... 17

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8. One specimen (G383), from the north edge of the jasper-breccia zone, consists of banded opaline silica. The opaline bands vary in colour from brick red to light red to buff to white. The crustiform banding is formed by variations in crystal size, crystal shape, and abundance of hematite impurities. This specimen lacks any barite.

9. Throughout the large overall alteration zone are a number of white veins with fairly high specific gravity; these have been mapped as barite veins. One specimen (Bx-1) was examined in thin section. The rock consists of quartz plus barite with quartz predominant. This particular specimen contained a fragment of brick red jasper or opal which is devoid of barite.

10. The work done thus far indicates that the degree of alteration within the zone is somewhat erratic. The studies are insufficient to draw zones or trends in type or degree of alteration.

Paragenesis in Alteration Zone and Conclusions

The outlying volcanic rocks with their propylitic alteration and dispersed hematite are completely separated from the mineralized trachytic pile and will therefore not be considered in this suggested sequence of events.

For the trachytic pile a number of relationships are summarized as follows:

1. The sericitization, in places accompanied by kaolinite, occurs in all of the trachyte including fragments of the breccia. Whether or not this preceded the brecciation or was superimposed on the breccia as well as the trachyte flows and tuffs is unknown. The fact that one of the outlying specimens (35) examined contained carbonatized

... 18

JRW

K-feldspar instead of the usual highly sericitized K-feldspar implies that possibly there is a zoning with sericitization in the central parts changing to propylitization in the outer parts of the trachyte pile.

2. Silicification could be of several types, although they may all be of one phase. The fine-grained silicification found in the matrix of altered trachyte as a granular replacement is associated with the coarser-grained quartz lenses. However some of these coarser-grained quartz lenses and veinlets have associated barite which appears to be missing from the finer-grained replacement silica. It appears that at least part of this silica introduction post dates the sericitization.

3. One of the specimens (G404) shows a fragmental in which many of the fragments are trachyte and some of these trachyte fragments have silicified K-feldspar phenocrysts. Also there are fragments of fine-grained secondary quartz and some fragments of quartz crystals. This seems to indicate some fragmentation subsequent to some silicification.

4. Several sections show networks or veinlets of sericite crossing the rock including the phenocrysts and the quartz veinlets. This could indicate a second stage of sericitization. In places this sericite has associated pyrite.

5. The jasper-breccia zone owes its colour to the introduction of silica with specular hematite and some barite. This fills the interstices of this breccia zone and is probably a separate phase of silicification from that found throughout the large silicified trachyte pile.

On its northern side this jasper-breccia zone has some banded opaline type of mineralization. Possibly this is some vein filling and it may be part of the hematite-silica phase of alteration of the breccia zone itself. However it lacks barite.

... 19

JRW

6. On the south side of the jasper-breccia zone, is a very sharp contact between highly sericitized trachyte on the south and jasper carrying sericitized fragments on the north (Specimen 77). This very sharp contact between the breccia and the unbrecciated trachyte could occur along the edges of a diatreme.

7. Relatively large white veins and lenses of quartz-barite occur throughout the area including the silicified zone, the jasper-breccia zone and the outlying volcanics. The one specimen examined (Bx-1) contains a small fragment of jasper-like opal which lacks any barite. This would indicate that these larger veins of quartz barite are relatively late in the history of the mineralized zone. Note that some of these quartz-barite veins do carry galena, some of which has associated silver.

J. R. Woodcock, P. Eng.

JRW

# APPENDIX I

# PETROGRAPHY

# APPENDIX I

## PETROGRAPHY

### TRACHYTE PILE

#### Specimen 35

##### Macroscopic

The rock has a watery siliceous aphanitic matrix forming about 60% and containing numerous small white phenocrysts or crystal fragments. A few dark inclusions may be lithic fragments. The numerous vugs throughout the rock may be weathered-out altered crystals.

Staining shows that the matrix and some of the phenocrysts are K-feldspar. A few dark altered phenocrysts and some thin siliceous appearing network remain unstained.

##### Microscopic

The rock is composed of about 70% fine-grained aphanitic matrix with grain size > .02 mm. It is composed largely of small K-feldspar crystals, in this case without the usual parallel alignment.

The phenocrysts are mainly K-feldspars which occur singularly or as clusters. They are highly altered or completely altered to carbonate with sericite and epidote as minor alteration products. In addition there are patches that are largely hematite containing some fine-

...2

JRW

grained highly birefringent epidote (?). Some of these alteration pseudomorphs have good euhedral outlines; they could be altered hornblende phenocrysts.

Cavities are very abundant throughout the rock and in some places have remnants of feldspar at the edges; some also contain carbonate. These are probably plucked or leached carbonatized K-feldspar phenocrysts.

The rock does not contain any introduced quartz or any quartz in the matrix.

Rock Name

This is a porphyritic trachyte with intense carbonatization of K-feldspar phenocrysts.

Specimen G81-158

Macroscopic

This is a dense grey rock, the grey colour probably from abundant disseminated pyrite. Weathering, related to fractures, has changed the colour to white or cream. Many of the fractures in the centre of the light leached zones are coated with jarosite. The rock does have a clay smell.

Staining shows abundant K-feldspar in the larger lithic fragments.

Microscopic

The rock is highly altered to sericite and kaolinite; variations in degree of alteration and in amounts of pyrite reveal outlines of crystals and of fragments. The sericite coarsens adjacent to jarosite (originally pyrite) veinlets.

...3

JRW

Some of the euhedral alteration patches do have some K-feldspar indicating that they were previously K-feldspar phenocrysts.

The matrix is mainly feldspar with abundant pyrite grains. In places this forms optically continuous patches of K-feldspar which could have formed by recrystallization.

The rock contains only a few small grains of quartz and these could be crystal fragments or inclusions.

Rock Name

The rock is a trachyte tuff. Alteration is intense sericite and kaolinite without any silicification.

Specimen G81-159

Macroscopic

This is a watery siliceous looking rock with some vague white patches and with some greenish spots which might indicate sericite alteration.

The staining shows angular K-feldspar-rich fragments in a matrix of quartz. Some of the fragments with only slight yellow staining might possibly be sericitized.

Microscopic

The fragments are trachyte with a matrix of blurred intergrowing dirty K-feldspar crystals and with much clay and opaque specks.

These fragments of trachyte contain feldspar phenocrysts that are highly or completely sericitized and that generally are brownish with a possible clay alteration. A few euhedral patches of muscovite plus opaques probably represent altered amphibole phenocrysts.

...4

JRW

The fragments are surrounded by fine-grained quartz-sericite mixture which is also dirty, possibly with clay, and which contains abundant euhedral pyrite crystals.

Rock Name

Sericitized trachytic breccia.

Specimen G81-172

Macroscopic

This is a dense siliceous appearing rock containing numerous small white feldspar phenocrysts of a variety of sizes and also some small patches of pyrite.

The stained section shows that the rock is mainly K-feldspar including the phenocrysts and the matrix and that a few watery patches which occur within this may be quartz.

Microscopic

This is a porphyritic volcanic rock containing about 10% large (up to 2.5 mm long) phenocrysts of K-feldspar in an aphanitic matrix. Very few of the phenocrysts have good crystal outlines as most of them appear to have been resorbed. Alteration of the phenocrysts includes some sericite and some brown dusting. In places quartz occurring within these phenocrysts could also be secondary.

The matrix, which is largely K-feldspar, has probably been largely recrystallized to form a relatively coarse-grained mosaic. Coarser grains occur in pockets or quasi veinlets.

Quartz occurs as very thin veinlets cutting the rock, as pockets, and also intermixed with the feldspar matrix in places. This is probably all secondary quartz.

...5

JRW

A few rounded mosaics of quartz could be inclusions. Apatite crystals occur in these. The quartz-K-feldspar mixture of the matrix probably has been formed by silicification of the trachyte. All traces of the usual felted laths are gone.

Pyrite crystals occur in the matrix and also in some of the phenocrysts. They are especially abundant in the secondary coarser grained pockets or veinlets. Also sericite is scattered throughout, although it is only minor in the phenocrysts. It is also concentrated in patches of the recrystallized matrix, especially with the concentrations of pyrite grains.

Rock Name

This rock is a highly silicified trachyte. Whether it was originally a fragmental cannot be discerned.

Specimen G81-178

Macroscopic

This is a grey porphyry composed of a dense matrix containing distinct white feldspar phenocrysts.

The stained section shows that the matrix of K-feldspar and the phenocrysts of K-feldspar form most of the rock. Irregular patches and network of unstained rock are probably fine-grained quartz.

Microscopic

The matrix of the rock is fine-grained K-feldspar. This contains K-feldspar phenocrysts, many of which have some sericite alteration. One long phenocryst, now composed of interlocking irregular patches of K-feldspar plus abundant pyrite, may be a replaced hornblende phenocryst.

...6

JRW

The section exhibits lenses of quartz which have relatively coarse grain size compared to that of other sections. Such lenses have sharp contacts with the matrix, with no transition through fine quartz to mixed quartz-K-feldspar. Also some quartz extends along irregular discontinuous veinlets. This may indicate control by incipient fractures and open spaces more than replacement.

Rock Name

Porphyritic trachyte with some quartz mineralization.

Specimen G81-179

Macroscopic

This looks like a siliceous rock in which vague white dots could be altered phenocrysts. It also looks as though the rock has been brecciated subsequent to formation and that the vuggy spaces between the fragments are lined with limonite.

The stained slab shows that it is mainly K-feldspar with many small unstained rounded or oblong white spots.

Microscopic

The matrix of this rock is a feathery intermixture of quartz and K-feldspar with a larger portion of quartz around the pockets of coarse quartz. Thus the matrix could be formed by silicification with recrystallization. The white unstained spots of the slab are the quartz concentrations.

K-feldspar phenocrysts form about 20% of the section. Most are euhedral and untwinned. These have moderate sericitization. Euhedral outlines of muscovite plus pyrite plus opaques are probably altered amphibole phenocrysts.

...7

JRW

Rock Name

Porphyritic trachyte with high silicification and moderate sericitization of phenocrysts.

Specimen G81-321

Macroscopic

This is a dense siliceous-appearing rock with abundant pockets of pyrite. The watery halo around many of the pockets may be quartz. It also contains vugs or irregular voids with white rims or halos.

It is impossible to distinguish any sharp phenocrysts although some of the vague white spots may be altered phenocrysts.

Staining indicates that most of the rock is K-feldspar.

Microscopic

The aphanitic K-feldspar matrix lacks conspicuous alignment of laths.

The K-feldspar phenocrysts have been largely recrystallized and/or replaced by quartz. There is some sericite alteration on the K-feldspar phenocrysts.

There are abundant replacement pockets and veinlets of quartz and one end of the section is nearly all fine-grained quartz. Also pyrite concentrations are accompanied by an increase in the content and coarseness of the quartz.

Jarosite veinlets cut the section.

Rock Name

Highly silicified trachyte.

...8

JRW

Specimen G81-333

Macroscopic

This is a dense light grey to white rock; the grey is due to pockets of pyrite.

Staining shows interlocking irregular patches of yellow and white with most of the rock having about 30% K-feldspar but with two zones in which there appears to be an increase in K-feldspar, possibly along some indefinite controlling fractures.

Microscopic

The rock is 50% monomineralic matrix consisting of K-feldspar. Possibly the staining on the slab was incomplete.

Phenocrysts form 30% of the section, mainly K-feldspar. This appears to be resorbed in most cases around the edges by the matrix; the phenocrysts have very few sharp straight sides. A few pseudomorphs of sericite plus opaques are probably replacements of amphibole.

There is minor sericite alteration of the K-feldspar phenocrysts.

Silica occurs in pockets and networks and forms about 20% of the section. It also forms the center of some of the K-feldspar phenocrysts. This is a secondary or replacement mineral.

Rock Name

Slightly silicified porphyritic trachyte.

... 9

JRW

Specimen G81-343

Macroscopic

This is a light grey, altered rock with most of the phenocrysts so altered that their outlines have become indefinite. However staining reveals that the rock is at least three quarters K-feldspar either in phenocrysts or lithic fragments and that this is set in a matrix of watery material, probably quartz.

Some disseminated pyrite is present.

Microscopic

This is a fine-grained fragmental with many trachyte fragments, identified by the numerous small parallel K-feldspar laths of the matrix. In some, however, the matrix is more granular. The occurrence of fragments is indicated by the drastic changes in orientation of feldspars in adjacent fragments. This matrix in most cases is quite dirty with minute grains of an unidentified mineral.

The remnant phenocrysts are K-feldspar with very little alteration to sericite or to clay minerals. Skeletal outlines of black opaques with albite and sericite are probably altered amphiboles.

Quartz replaces much of the rock. Some is in the form of veinlets but most concentrates around and between the feldspar phenocrysts where it replaces much of the phenocryst. Barite occurs with the quartz in parts of the network.

A late irregular fracture containing sericite snakes through the section, following phenocryst boundaries in places.

Rock Name

Silicified trachyte tuff.

...10

JRW

Specimen G81-344

Macroscopic

This is a light greenish grey rock which appears to be highly sericitized and does have a clay smell.

Staining shows that it is composed of porphyritic fragments rich in K-feldspar, probably porphyritic trachyte. The unstained spots or fragments could be quartz concentrations.

Microscopic

Within the angular fragments, the phenocrysts are K-feldspar and most of the larger ones are rounded or have broken edges. They are relatively unaltered. The matrix of these fragments, however, is sericitized K-feldspar.

Rounded fragments of trachyte are also present and many of these smaller fragments are also not sericitized.

Quartz fills the interstices between some of the fragments.

Abundant pyrite occurs throughout. Some patches of white opaque are also present.

Rock Name

This is a trachyte tuff of crystal and lithic fragments. Alteration is light sericitization with minor quartz introduction.

... 11

JRW

Specimen G81-357

Macroscopic

This is a grey volcanic which owes its colour to disseminated pyrite. Near fractures weathering and leaching have converted it to a white altered rock. Some of these fractures have coatings of jarosite. The rock contains some small sharp rectangular buff phenocrysts; but most are blurred due to alteration.

Staining shows that this is actually a breccia in which the lithic fragments have high K-feldspar and are probably trachyte. These trachyte fragments contain some phenocrysts that are partly stained and other phenocrysts that are watery and siliceous and completely unstained. The interstices between the fragments are filled with a siliceous-appearing product which is unstained and is probably quartz.

Microscopic

The porphyry fragments have less than 10% feldspar phenocrysts which are K-feldspar. The central parts are completely altered to sericite with the outer parts of such phenocrysts completely unaltered. This is unusual unless the central part was originally plagioclase with the outer part late magmatic K-feldspar. In some places sericitization follows cleavages in the phenocrysts or other weaknesses throughout the phenocrysts. In such places granular low birefringent mineral is also present; probably kaolinite. The K-feldspar of the phenocrysts is perthitic with replacement patches of twinned albite occurring in places.

The matrix of the lithic fragments is matted fine-grained K-feldspar; however the distinct laths seen in some of the trachytes are absent. The matrix is quite dirty with some granular white opaques and some fine-grained pyrite.

...12

JRW

Secondary quartz occurs as a network throughout, enlarging in places to fill pockets especially near phenocrysts. However the intense replacement of phenocrysts such as exhibited by Specimen G343 is absent.

Black opaques, generally in small grains are pyrite. In places skeletal outlines of pyrite probably indicate original hornblende phenocrysts replaced by albite and pyrite and in some places sericite.

Rock Name

This is a trachyte fragmental with moderate silicification and moderate sericitization of phenocrysts.

Specimen G81-404

Macroscopic

This is a blurred siliceous appearing rock. Some vague greenish patches may be sericitized areas.

The stained slab shows that the rock itself is about 70% K-feldspar which contains watery spots and patches, probably quartz. In addition, a white quartz-rich lens projects into the section.

Microscopic

This is a fragmental in which the fragments are separated by a network of sericite plus kaolinite(?).

The fragments have a variety of compositions, textures, and grain size with adjacent ones contrasting sharply. The fragments can be composed of trachyte, some of which contains silicified phenocrysts. Other fragments consist of fine-grained secondary quartz, quartz crystal fragments and feldspar crystal fragments.

... 13

JRW

Some irregular discontinuous zones of quartz-barite have relatively coarse crystals and have associated relatively coarse-grained sericite. These are probably later than the breccia.

Paragenesis

1. It appears that some silicified fragments have been incorporated into the breccia.
2. Formation of the breccia.
3. Sericitization.
4. Introduction of quartz-barite.

Rock Name

This is a trachyte tuff with crystal and lithic fragments and with late sericitization.

Specimen G81-512

Macroscopic

In hand specimen this rock is very similar to Specimen 35 but does contain less vacant leached cavities.

The stained section shows abundant K-feldspar forming the matrix and containing white patches, some of which effervesce vigorously, indicating presence of calcite. They are probably altered phenocrysts.

Microscopic

This is a porphyritic trachyte with uniform aphanitic matrix and about 45% phenocryst.

The matrix is composed of K-feldspar laths and it is slightly coarser grained than most of the trachytes on the property. These laths show good alignment or flow texture.

...14

JRW

The white patches are untwinned feldspar phenocrysts with abundant sericite and carbonate alteration or with complete alteration to carbonate.

One of the sections has some replacement quartz in irregular pockets or as pseudomorphs after feldspar phenocrysts.

Rock Name

Porphyritic trachyte with carbonate-sericite alteration and with local or restricted silicification.

Specimen G81-513

Macroscopic

This is an altered grey rock containing blurred white spots which could be altered phenocrysts. The grey colour is from the abundant disseminated pyrite.

Staining shows that the matrix is an irregular mix of K-feldspar, white unstained rock, and siliceous unstained rock. This contains dark partially stained phenocrysts and also some unstained siliceous-appearing phenocrysts.

Microscopic

The rock is about 10% K-feldspar phenocrysts up to 2 mm long. The central parts of many of the feldspar phenocrysts are altered to sericite. This should indicate a differing composition and possibly the central parts of these phenocrysts were plagioclase which was resorbed and altered to K-feldspar in a magmatic stage.

Most of the matrix is a felted mass of very small K-feldspar laths and these exhibit flow alignment in places. Variations in flow direction indicate the fragment boundaries.

...15

JRW

Quartz is the most prevalent alteration product. It occurs as numerous veinlets and as lenses throughout. These lenses would be the siliceous parts noted under the macroscopic description. In places this quartz alteration extends into the adjacent rock forming a fine-grained granular matrix; this is probably the white unstained part of the matrix noted above. Also in places, complete alteration of a prior phenocryst leaves a euhedral quartz mosaic.

Concentrations of small pyrite grains mark some specific fragments.

Rock Name

The rock is a trachyte tuff or breccia with intense silicification and with some sericitization of K-feldspar phenocrysts.

HEMATITIC BRECCIA ZONE

Specimen Bx-1 (breccia)

Macroscopic

This is a light-coloured, slightly greyish mineral with high specific gravity and with some red iron oxide staining in parts. It contains an angular fragment of reddish fine-grained rock, possibly jasper.

It does not effervesce and so contains no calcite.

Microscopic

The rock is mainly fine-grained quartz containing barite patches. The content of barite ranges from minimal on one side of the section to about 40% on the other side of the section. In places the barite may be in the form of fragments which have been partly replaced by the quartz.

...16

JRW

The quartz is extremely variable in grain size. In places it forms unusual daisy-like structures with centers that are very small grains, surrounded by radiating blade-like quartz crystals. Hematite dusting occurs in the larger patches.

The "jasper fragment" is a mosaic of quartz with scattered spots of hematite dust and with many of the daisy-like clusters. It contains no barite except at its sharp boundaries with the host rock where there are some barite crystals or patches that project into it.

Rock Name

White quartz-barite containing fragments of reddish jasper.

Specimen G81-77

Macroscopic

This specimen has two rock types in sharp contact. Part is an altered volcanic rock with a distinct clay smell but no effervescence. It has an overall light greenish grey colour with greenish altered phenocrysts similar to the fragments of Specimen G388. This is in sharp contact with a maroon jarosite-rich rock. Both rock types are cut by thin parallel quartz veinlets.

Staining shows that the light coloured rock is largely a matrix of K-feldspar which contains some phenocrysts of K-feldspar and also some phenocrysts which are watery and unstained and are possibly altered. The staining also shows that the maroon rock is a fragmental and has a few fragments rich in K-feldspar but essentially most of the jasper is unstained.

...17

JRW

Microscopic

Reflected light shows the differences in the abundance of opaques in both rock types. In the grey rock white opaque patches are abundant except at the contact with the maroon rock where the opaques are mainly pyrite. In the maroon rock opaques are all red hematite.

The matrix of the grey rock is a mosaic of K-feldspar, coarser than that of the usual trachyte and without the lath shapes. It is very dirty, probably contains some fine clay alteration and also contains some specks of white opaques.

In the grey rock K-feldspar phenocrysts form about 15%. Many of these are highly sericitized and show up in sharp contrast to the unsericitized matrix. A few are only slightly sericitized.

The maroon rock is highly silicified and consists of mainly quartz veins with a great variety in grain size. Pockets and veinlets of the coarser quartz have abundant associated barite. One fragment of fine-grained material with abundant parallel laths is a trachyte fragment as noted in the macroscopic description.

Sericite does occur within the silicified jasper; however it is generally along quartz veinlets or along irregular fractures and weaknesses in the rock. This could possibly be due to the fact that there are no minerals left for easy sericitization.

Both rock types are cut by quartz veinlets and many of these have abundant barite. Sericite occurs in many of these and also in irregular veinlets or zones of veinlets which snake through the section in several directions. Jarosite is also present in some of the more persistent veinlets and fractures.

...18

JRW

Rock Name

The light coloured rock is a porphyritic trachyte with high sericite alteration of phenocrysts. The maroon rock is a highly silicified breccia containing sericitized fragments of the trachyte.

Specimen G81-382

Macroscopic

This is a maroon rock with elongated light greenish grey patches which could be fragments or unusual bleached zones within the rock.

The staining shows that most of the rock including the bleached areas is K-feldspar and that both rock types contain small altered phenocrysts; those within the light coloured areas are generally altered to a greenish colour, possibly sericitization whereas those in the maroon part of the rock generally have a hematitic alteration.

Little cream coloured specks, which occur throughout the rock, appear to be most abundant in the phenocrysts. These may be opaque.

The rock does not effervesce.

Microscopic

This is a porphyritic volcanic without breccia or silicification. White opaques occur as dense patches, possibly a replacement of crystals. These are very abundant in the bleached areas; however in the maroon areas such patches are less common and many that are present contain metallic hematite. There is no great difference, except in abundance of hematite dust, between the maroon rock and the bleached rock.

...19

JRW

The feldspar phenocrysts of both types of rock are intensely altered to sericite and the feldspar matrix is also sericitized to a lesser degree.

Thin quartz veinlets cut the section; the thickest one contains barite.

Rock Name

This is a sericitized porphyritic trachyte much of which is intensely altered with hematite.

Section G81-383

Macroscopic

This is a red silica-rich rock with good banding, some of which has crustiform structure. Colour of bands range from jasper-like red to light red to buff to watery white. The rock is an opalized or chalcedony open spaced filling and/or replacement.

Microscopic

The rock is all quartz with variations in crystal size or shape or type of interlocking mosaic and with variations in colour or concentration of red iron oxide, all creating a complex crustiform structure. In places it is emphasized by parallel lines of fine dust of unknown composition. In one band the iron oxide occurs in numerous small curved lath-like shapes and resembles a cluster of short scattered straws.

The rock does not contain barite and so differs considerably from the quartz-barite specimens.

Rock Name

Reddish banded opaline silica.

...20

JRW

Specimen G81-388

Macroscopic

This is a maroon rock, either jasper or lava, containing numerous white rock fragments. Silicification of the maroon material shows as a watery white network.

Staining shows that the lithic fragments are composed mainly of K-feldspar.

Microscopic

The largest rock fragment is a porphyritic aphanitic volcanic with a K-feldspar matrix and K-feldspar phenocrysts. The phenocrysts are highly sericitized with only minor K-feldspar remaining. The matrix is very dirty; however it contrasts with the phenocrysts in that sericite is not present.

The maroon part of the rock is quartz with spots of hematite dusting and with numerous partially replaced fragments of rock.

The coarser quartz forms a network of irregular veinlets and scattered barite patches occur, mainly with the coarsest quartz.

The concentrations of sericite occur in an irregular zone that crosses the section and also crosses the quartz veinlets.

Rock Name

This is a breccia of porphyritic trachyte cemented by hematite-rich silica (jasper). Alteration is mainly sericitization of phenocrysts and later cross-cutting sericite veinlets.

...21

JRW

Specimen G81-543

Macroscopic

This rock resembles Specimen 35 and Specimen G172. The phenocrysts, however, have more blurred edges and so may be more altered. The more altered parts have thin indefinite veinlets, probably quartz. The matrix has a buff colour. Pyrite is scattered throughout.

Staining shows that the rock is mainly K-feldspar with some unstained phenocrysts and unstained quartz veinlets.

Microscopic

Phenocrysts of K-feldspar form about 5% of the rock. The largest phenocryst contains internal euhedral patches of quartz; needles of an unknown mineral radiate into the quartz from the contacts of the K-feldspar. In places the quartz mosaics almost completely replace the feldspar phenocrysts. These probably are the unstained phenocrysts noted in the stained slab.

In places the aphanitic matrix of the rock is composed completely of parallel feldspar laths however the orientation of the laths varies considerably. In places it is parallel to the contacts of phenocrysts and in other places it occurs as quasi euhedral forms within a more granular matrix. This could be an unaltered remnant within a more crystallized matrix.

Quartz occurs as veinlets and replacement pockets. Such veinlets do have some K-feldspar within them. In the vicinity of the quartz replacements and veinlets the matrix becomes granular. Thus the granular nature of the matrix is probably an alteration or recrystallization phenomena.

...22

JRW

Rock Name

This is a porphyritic trachyte, possibly a fragmental. Alteration is moderate to high silicification.

Specimen G81-556

Macroscopic

This is a breccia with angular reddish fragments occurring in a very dark brown to black siliceous-appearing matrix. The fragments are also dappled in places, consisting mainly of red rock but containing irregular brown-black wormy patches.

Staining shows that the larger rock fragments are up to 2 cm long and range in size down to about 1 mm. They consist mainly of K-feldspar, including the matrix and any possible phenocrysts. Within this are the siliceous irregular patches and also a few of the highly altered phenocrysts which were not stained.

The matrix does have some less definite staining throughout in addition to the sharp yellow stained fragments. It also has a dark grey brown constituent.

Microscopic

The larger fragments are about 20% phenocrysts consisting of highly sericitized K-feldspar. The matrix for these phenocrysts is a felted mass of K-feldspar laths which do contain some brown dusting. These rock fragments also contain very irregular pockets composed of quartz and sericite with abundant hematite forming the boundaries. The matrix for these larger fragments is merely finer fragments of the same material but with more abundant hematite.

...23

JRW

A granular alteration product with very low birefringence is especially abundant in some of the altered phenocrysts and also throughout the matrix. It may be kaolinite.

The pockets or interstices are filled with secondary quartz along with sericite and possibly kaolinite. Abundant hematite occurs in parts of the matrix.

Rock Name

This is a trachyte breccia. Alteration includes sericite-kaolinite, some silicification and abundant hematite.

Specimen G81-557

Macroscopic

This is a maroon coloured rock which has vague small altered phenocrysts.

The staining affected much of the matrix and the phenocrysts. Some irregular unstained dark patches give a dappled appearance in places.

Microscopic

The matrix is fine-grained K-feldspar, some of which is in feathery laths. This is mixed with abundant hematite.

The phenocrysts are K-feldspar replaced partly with sericite and with abundant kaolinite(?).

The watery irregular patches are concentrations of secondary quartz plus hematite plus sericite.

Small quartz veinlets cut the section and in some of the thicker ones barite patches occur, especially at the intersections of veinlets.

...24

JRW

Rock Name

This is a porphyritic trachyte strongly altered with hematite and partially altered with quartz. In addition sericite-kaolinite alter the phenocrysts.

Specimen G81-560

Macroscopic

This is a breccia of altered rock fragments immersed in a matrix of yellow brown to dark brown to brick red silica. A milky network of silica occurs at some of the contacts of the rock fragments. The fragments may be silicified; many have greenish sericitized (?) phenocrysts.

Microscopic

Most of the fragments have a fine-grained feldspar matrix either as distinct parallel laths or as a somewhat coarser mosaic in which case the feldspar is very dirty and probably has some clay alteration.

The phenocrysts are untwinned feldspar, probably K-feldspar. Many are partially replaced by secondary quartz mosaic.

One fragment has small euhedral isometric crystals of high relief. These look like garnets.

Secondary quartz occurs between the fragments and works out into the volcanic fragments, first forming fine-grained mixtures with K-feldspar and then completely replacing and coarsening. The final clear relatively coarse mosaic can contain large patches of barite.

Rock Name

Silicified trachyte breccia.

...25

JRW

## OUTLYING VOLCANICS

### Specimen G81-185

#### Macroscopic

This looks like a dark green volcanic rock, possibly with chlorite alteration. Small white irregular spots are calcite-rich.

Staining indicates minor K-feldspar in the matrix.

#### Microscopic

The rock is composed largely of two minerals as intergrown lath-like forms. It has an ophitic texture.

One of the minerals does have some diamond-shaped cross sections and was probably originally amphibole. It is now a pseudomorph composed of carbonate, white opaques which are probably incipient epidote, dark opaques, chlorite and actinolite. Minute crystals of sphene are associated with some chlorite patches.

The second mineral is plagioclase which is partly or completely altered to fine-grained carbonate. In addition some large oblong patches of relatively coarse-grained calcite may also be large replaced plagioclase phenocrysts. Interstitial to the above mineral types are pockets of chlorite, of untwinned albite, of carbonate, plus a few small flakes of sericite.

Carbonate veinlets cut the section; in places some hematite occurs in the veinlets.

#### Rock Name

The rock is a basic dike with ophitic texture, possibly a diabase or lamprophyre. Alteration is to carbonate with some chlorite and albite.

...26

JRW

Specimen G81-266

Macroscopic

This is a maroon volcanic containing small white spots or altered phenocrysts.

Staining shows that numerous small K-feldspar-rich porphyritic fragments occur in a fine-grained maroon matrix. These fragments are 3 mm or less across. Also there are some watery patches which could be a second type of fragment or an alteration product.

Microscopic

A great variety of fragments occur within this rock; however most of them are rich in K-feldspar. The largest fragments are porphyritic trachyte with clear K-feldspar phenocrysts and without the usual laths within the matrix. There is some sericite alteration of these phenocrysts especially along fractures; however the main alteration is carbonate.

Carbonate completely replaces many of the fragments and as such does appear itself to be a fragment. However it also occurs as large replacement patches.

The abundant thick iron oxide coating, which is probably hematite, occurs between the fragments making the matrix opaque.

There is no quartz as phenocrysts or veinlets or alteration.

Rock Name

This is a trachyte tuff with abundant iron oxide and with intense carbonatization.

...27

JRW

Specimen G81-398

Macroscopic

This specimen shows a contact between a green basic volcanic and a somewhat maroon volcanic. The maroon volcanic is similar in macroscopic appearance to Specimen G518. It also contains the three same types of altered phenocrysts.

The green basalt has some vague green spots, probably altered phenocrysts, plus numerous white altered plagioclase crystals. However the maroon altered phenocrysts are lacking.

Staining yields some vague yellow colours throughout the green rock; there is probably some K-feldspar in the matrix.

Microscopic

The two rock types differ basically in that the maroon volcanic has opaques of hematite plus some pyrite whereas the green volcanic has abundant pyrite plus white opaque patches. Also the green rock has a dirtier matrix containing very fine-grained chlorite and white opaque patches of incipient epidote.

In the green rock most of the plagioclase phenocrysts are highly altered to sericite. The cloudy white opaque with its underlying incipient epidote occurs in such plagioclase phenocrysts as well as in the matrix. The largest plagioclase phenocrysts (the white forms of the hand specimen) have patches of carbonate alteration and are cut by fractured controlled sericite or patches of sericite.

Some euhedral patches consisting of epidote, carbonate and iron oxide and also muscovite in places are probably altered mafic phenocrysts.

...28

JRW

In places the greenish basalt contains patches of bright green chlorite flakes which contrast with the extremely fine-grained yellow green chlorite that occurs throughout the rock.

In the maroon rock, patches of fine-grained yellow-green chlorite are very common. A few small pockets of clear secondary quartz plus albite occur. Most of the crystals are fragments and many of these are quartz. Some of the larger plagioclase crystals or fragments are very clear whereas others are quite brown with the clay(?) dusting. White opaque patches with some dark opaques are probably altered mafic crystals. The concentrations of chlorite in patches could be altered lithic fragments.

The matrix does include many very small crystal fragments and this contrasts to the uniform plagioclase matrix of the green rock. Thus the rock is probably a crystal tuff.

Rock Name

Porphyritic green basalt in contact with maroon crystal tuff. Alteration is intense propylitic.

Specimen G81-401

Macroscopic

This is a dark grey volcanic with an aphanitic matrix. It contains numerous small (< 1 mm) phenocrysts, many of which are plagioclase. Some of the phenocrysts have corroded centers. The rock displays slight effervescence in acid.

Staining shows some K-feldspar in the matrix, but not in phenocrysts.

...29

JRW

Microscopic

The matrix is too fine-grained to decipher most minerals; but some of the thin laths of plagioclase are present. Also, abundant opaques are present and include distinct grains of magnetite which are scattered throughout.

Phenocrysts form about 45% of the section. Augite crystals, up to 1 mm long, are generally unaltered; however the larger ones can be up to 90% altered to carbonate with chlorite in places. In places clusters of the augite crystals occur and such clusters exhibit more alteration than the single scattered crystals.

Plagioclase phenocrysts include relatively fresh andesine (generally < 0.3 mm long) ranging to highly altered ones which are much larger (> 1 mm long). Alteration includes sericite and carbonate.

The rock is unusual in that some phenocrysts, especially augite, can be highly altered to carbonate and exist adjacent to fresh crystals.

Veinlets of carbonate cut the rock.

Rock Name

Porphyritic andesite with carbonate alteration.

Specimen G81-491

Macroscopic

This is a maroon volcanic rock containing some watery altered phenocrysts and a few white patches which may be silica.

...30

JRW

Staining shows that much of the rock is K-feldspar except for the irregular siliceous patches and some deep maroon spots. This staining emphasizes the K-feldspar phenocrysts but it also shows that the matrix does appear to have some K-feldspar.

Microscopic

K-feldspar phenocrysts form about 20% of the rock. Many of these are euhedral with sharp boundaries with the unique matrix material. Others are partially resorbed on one side. Alteration includes only slight sericitization.

A few of these phenocrysts, especially an exceptionally large one, have been altered to clear small crystals of polysynthetically twinned albite and minor associated quartz.

In addition to the K-feldspar phenocrysts there are also some quartz phenocrysts which are generally resorbed on at least one side. A euhedral muscovite crystal with some iron oxide alteration is probably an original phenocryst and one euhedral patch composed of barite and muscovite may also be a similar original phenocryst.

The matrix is very unusual in that it is at least 50% quartz containing alkalic feldspar. In many places these small grains of alkalic feldspar form rectangular euhedral crystals and many of these have polysynthetic twinning. Thus at least part of this alkalic feldspar is albite. The quartz itself forms a mosaic of large interlocking crystals or patches which are poikilitic with the feldspar crystals. The fact that there is little replacement of this matrix on the phenocrysts indicates that it is probably magmatic rather than hydrothermal alteration.

...31

JRW

The hematite occurs irregularly through the rock but is mainly concentrated in areas of the unusual matrix and in fractures that cut the feldspar phenocrysts.

One large irregular patch of high relief mineral appears to be barite.

Rock Name

This is an acidic igneous rock, either a porphyritic rhyolite or an intrusive aplite. The hematite alteration confuses its identification in hand specimen.

Specimen G81-518

Macroscopic

This is a volcanic rock with a maroon coloured matrix. It contains three distinct types of phenocrysts including scattered relatively large white phenocrysts, small euhedral crystals with green alteration, and glassy maroon crystals many of which have pointed ends.

The staining indicates that K-feldspar is absent.

Microscopic

The fine-grained aphanitic matrix is extremely dirty with brown clay (?) dusting and with hematite dusting. With increased concentration this shows as metallic hematite.

The relatively large white phenocrysts are plagioclase with abundant patches of carbonate alteration. The composition is andesine. These crystals and the altered carbonate are cut by fractures which are filled with sericite.

...32

JRW

Some of the smaller twinned plagioclase phenocrysts are intensely altered to chlorite with minor epidote and with variable amounts of carbonate. These crystals also contain later fracture-controlled sericite.

The maroon phenocrysts are probably completely altered mafic crystals, possibly hornblende. Alteration is mainly hematite, both as a red dusting and as specular hematite. Carbonate is common and muscovite occurs in places.

The rock contains no quartz or K-feldspar.

Rock Name

Porphyritic maroon andesite with propylitic alteration and hematite dusting.

JRW

# APPENDIX II

## COST STATEMENT

# APPENDIX II

## COST STATEMENT

### Fees and Wages

J. R. Woodcock - petrography and report

March 10 - 2/3 day
April 8, 9 - 1 day
April 26 - 1 day
April 29, 30 - 1 day
May 13 to 17 - 2 $\frac{1}{2}$ days
May 21 - 23 - 2 $\frac{1}{2}$ days
May 24 - 2/3 day

| | | |
|---|---|---|
| Total: 9 1/3 days @ $385 | $3,593.33 | |
| D. Gorc - sort specimens, compile maps, etc. | | |
| April; May 23 - 1 day @ $185 | 185.00 | |
| F. Chong - drafting | 30.00 | |
| M. Brooks - typing | | |
| May 17 to May 24 - 11 hrs. @ $15 | 165.00 | $3,973.33 |

### Disbursements

| | | |
|---|---|---|
| Thin section preparation | $ 235.00 | |
| Reproductions, etc. | 50.00 | 285.00 |
| Total | | $4,258.33 |

JRW

GLACIER

not mapped

L

rt

V

BEAR CK

60°

not mapped

?

rt

sheared

CIRQUE CK

sheared

rt

rt

O266

rt

SHELA CK

sheared

not mapped

V

V

rt

rt

GLACIER

GLACIER CK

rt

V

rt

rA

V

rt

V

FAULT CK

rA

rV

V

KNOB CK

rt

Area of 1:1000 scale map

? not mapped

GLACIER

401a

404

383

388

543

Breccia

560

377

382

556

557

169

398

158

rt

bd

513

172

512

V

491

not mapped

A35

V

V

V

rt

CAMP CK

TODD CREEK

321

bd

343

378

179

333

518

344

V

345

bd

357

? grey rock

not mapped ?

DRILL CK

V

Drill site

Ct

Vb

FALL CREEK

bt

St

TABLE I

| SPECIMEN | NAME | ALTERATIONS |
|---|---|---|
| **Trachyte Plie** | | |
| 35 | Tr | Ca |
| G81-158 | Tr tu | Ser +, K |
| 159 | Tr bx | Ser |
| 172 | Tr | Si |
| 178 | Tr | Si |
| 179 | Tr | Si +, Ser |
| 321 | Tr | Si + |
| 333 | Tr | Si - |
| 343 | Tr tu | Si |
| 344 | Tr tu | Ser -, Si - |
| 357 | Tr fr | Si +, Ser |
| 404 | Tr tu | Ser veinlets |
| 512 | Tr | Ca, Ser, Si - |
| 513 | Tr tu | Si +, Ser |
| **Hematitic Breccia Zone** | | |
| Bx-1 | Ba | |
| G81- 77 | Tr; Tr bx | Ser +; Si +, H |
| 382 | Tr | Ser +, H + |
| 383 | Op | Si + + |
| 388 | Tr bx | Si +, H |
| 543 | Tr | Si + |
| 556 | Tr bx | Ser +, H, Si - |
| 557 | Tr | H +, Ser, K, Si - |
| 560 | Tr bx | Si +, H |
| **Outlying Volcanics** | | |
| G81-185 | Di d | Ca, Ch, |
| 266 | Tr tu | Ca +, H + |
| 398 | An | Pr +, H - |
| 401 | An | Ca |
| 491 | Ry | H + |
| 518 | An; tu | Pr; H |

LEGEND

Rock Types

| | |
|---|---|
| Tr | porphyritic trachyte |
| fr | fragmental |
| tu | tuff |
| An | andesite |
| Ry | rhyolite |
| Di | diabase |
| d | dike |
| bx | breccia |

Alteration

| | |
|---|---|
| Ser | sericite |
| Si | silica |
| Ca | carbonate |
| H | hematite |
| Ch | chlorite |
| Pr | propylytic |
| K | kaolinite |
| Ba | barite-quartz |
| Op | opaline |
| + | high alteration |
| - | low alteration |

## LEGEND

VOLCANICS

- V — Intermediate volcanics
- rA — Red tuff agglomerate (large clasts)
- rt — Red tuff
- St — Light grey siliceous tuff
- bt — Brown weathering, carbonate-rich tuff
- Vb — Volcanic breccia
- Ct — Carbonaceous pyritic tuff

SEDIMENTS

- L — Limestone

INTRUSIVES

- bd — Basic dykes

ALTERATION

- Intensily altered; white silification, high pyrite content
- Intensily altered; red silification; includes minor grey silification
- Medium alteration; generally less pyrite than above, siliceous
- Low to minimal alteration; equivalent to intermediate volcanics

- Barite mineralization; pod, vein
- Abundant barite float
- Gravel
- 518 — Specimen number - thin section (1985)

SYMBOLS

- Stream
- Edge of glacier
- Trench
- Outcrop
- Geological contact
- Fault

GEOLOGICAL BRANCH
ASSESSMENT REPORT

13,684

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA

# TODD CREEK PROJECT
# GEOLOGY

SCALE 1:5000

0 100 200 300 m.

J. R. WOODCOCK CONSULTANTS LTD.

MAY 1985 FIGURE Nº. 3