

A REPORT SUBMITTED IN PARTIAL
FULFILLMENT OF THE REQUIREMENTS IN

GEOLOGY 409, Ore Microscopy.

600300

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Title: AN ALTERATION ZONE IN A GRANITIC
STOCK SOUTH OF TCHENTLO LAKE,
CENTRAL BRITISH COLUMBIA.

INTRODUCTION:

This report is the result of an investigation of a mineralized alteration zone which was intersected during diamond-drill sampling of a granitic stock. The stock is located south of Tchentlo Lake, central B.C. (see map, fig. 1.).

The area is being explored for copper-sulphide ore-bodies by N.B.C. Syndicate and samples were obtained from the site by the writer, when in the employ of this syndicate, in August, 1970.

AIM:

The object of this investigation was to acquaint the writer with the X-ray diffractometer identification of minerals; specifically, the clay minerals formed as a result of hydrothermal alteration. It was further intended that a rigorous assignment of an hydrothermal alteration "facies" could then be made.

Scale: one inch = one hundred twenty five miles.

130°W.

125°W.

B. C.

55°N

FT. ST. JAMES

TRINITY LAKE

PRINCE GEORGE

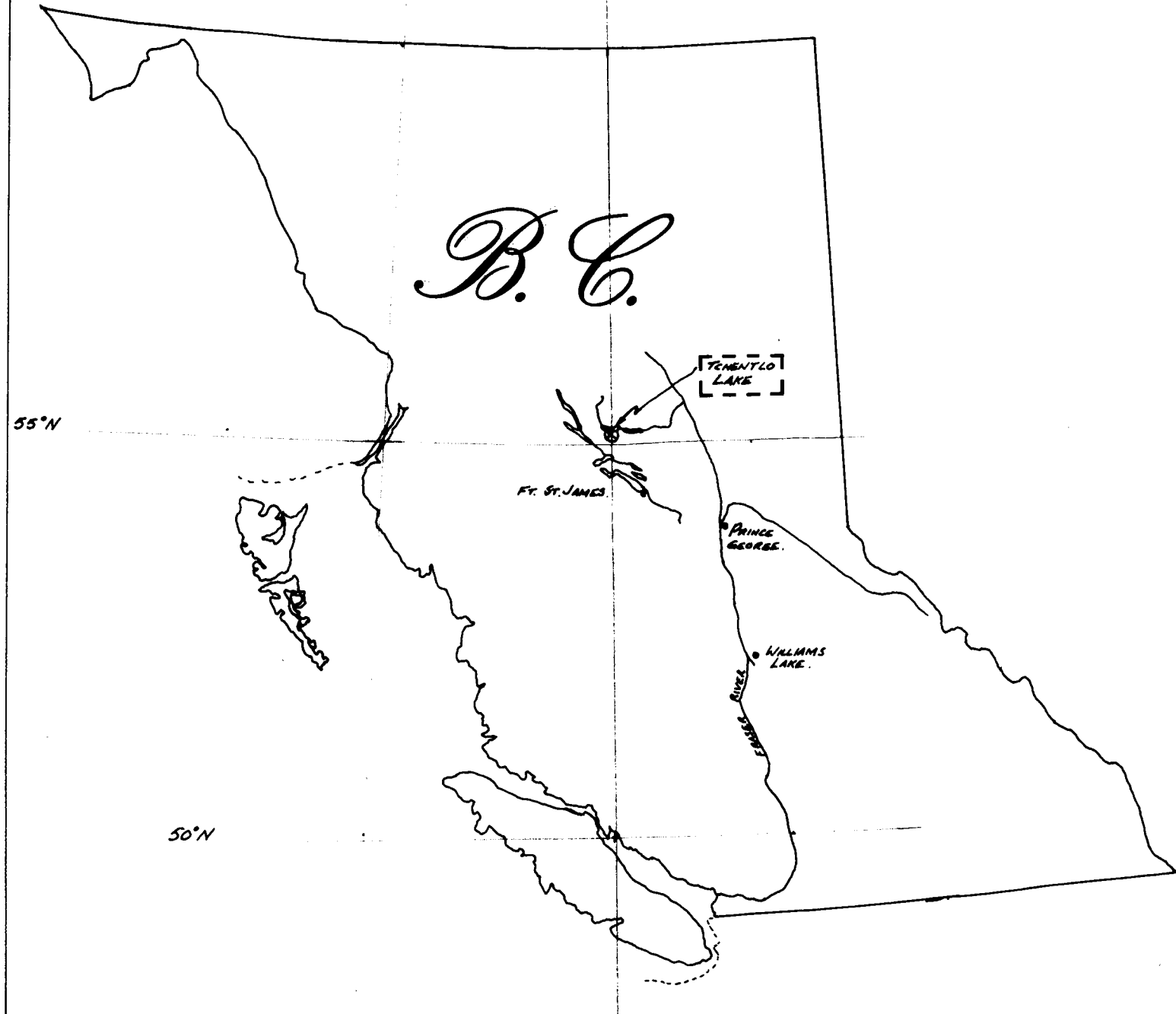
WILLIAMS LAKE

RIVER

RIVER

50°N

fig. 1.



GEOLOGY:

General:

The stock is about 10 miles long and 2 miles wide. The outcrop exposure is poor (less than 1%) but a number of granitic phases are indicated which range in composition from dioritic to granitic (true granite).

The stock intrudes rocks of the Takla Group which are locally exposed as andesites and basalts with lesser amounts of more acidic volcanics and some sedimentary rocks.

Hole J-2:

This diamond drill hole is located as indicated in fig. 2. The hole was collared in outcrop of massive diorite and extended to 204 feet, inclined at 45° to the vertical. An alteration zone bearing chalcopyrite was intersected at 87 feet from surface. The zone extended for 12 feet and the contacts with fresh rock at the margins are very sharp (less than 1 inch).

The samples studied are from the fresh-rock margin and from within the alteration zone. They are designated as; J-2/80'6" (fresh rock), J-2/98' (unmineralized, altered rock), and J-2/89' (mineralized, altered rock).

PETROGRAPHY:

J-2/80'6": (handspecimen)

The rock is called "grey diorite". It contains less than 10% quartz by handlens estimate and is dominated by the clear to white plagioclase which constitutes about 60% of the rock. The plagioclase is zoned and euhedral to sub-hedral. Pink K-feldspar is sometimes evident but occurs in small quantities. Biotite and hornblende make up 30% of the rock with the biotite:hornblende ratio being about 1:3. Sphene and magnetite each make up about 1% of the rock at most.

(thin section)

Mode:		Description:
plag.(An ₃₀)	60%	The plagioclase is generally
horn.	20%	euhedral and exhibits concentric
biot.	10%	zoning (normal). The range of
qrtz.	5%	plag. composition appears to be
magt.	1%	from An ₂₈ to An ₃₃ . The grain size
sphn.	1%	for all phases except magnetite &
K-sp.	< 5%	sphene ranges from about 1mm to
		4mm with an average about 3mm.
		Magnetite and shene exhibit a small
		range about an average of 1mm.

J-2/89':(handspecimen)

This rock is called "greenish-grey diorite" The plagioclase is greenish to milky white and the rock has lost the panidiomorphic texture of the previously described unaltered sample. Hematite has replaced magnetite and calcite is intimately associated with chlorite. The chlorite (light, "washed-out" green) is after biotite and hornblende, particularly the latter.

The chalcopyrite and pyrite blebs are irregular in shape and are intimately associated with the mafic sites. The ratio of chalcopyrite to pyrite for this representative sample is 1:3 and the sulphides constitute about 5% of the rock.

(reflective microscopy)

Pyrite and chalcopyrite grains range in size from exsolution blebs of chalcopyrite in pyrite of less than 0.01mm, to pyrite masses of greater than 3mm. The grain shapes are very irregular but show constant association with the mafic mineral alteration products, and are in fact replacing them in many instances. The sphene in *i.e. no longer in* this section has been altered to leucoxene.

Some twinning in chalcopyrite is observed but is not common.

J-2/98': (handspecimen)

This rock is called "green altered diorite" in which the plagioclase has been sericitized and is now green in colour with, in some cases, a white rim. This specimen shows no magnetic response to a suspended magnet. Biotite is present but is different in character from that in the fresh rock. While the fresh rock contains black-green biotite, the biotite in this specimen is greenish-brown.

(thin section)

The most striking feature of this section is the heavily sericitized plagioclase with some epidote. Calcite veinlets are seen in some sections. The biotite appears to be more "stringy" in appearance and is optically less uniform in some sections than in others (secondary biotite).

CLAY MINERAL IDENTIFICATION BY USE OF THE
X-RAY DIFFRACTOMETER.

PROCEDURE:

1. Crushing:

Approximately 5g. of rock sample was crushed with a mortar and pestle. In order to prevent overgrinding the crushings were frequently sieved through a -110 mesh screen. The unsieved segment was returned to the mortar and re-crushed.

2. Suspension:

The crushed sample was placed in a 100ml. beaker and stirred in a 5cm column of distilled water. After 30 seconds the supernatant liquid was carefully extracted by pipette and placed in a clean centrifuge tube. This suspension contained the silt and clay size fractions.

3. Centrifuge:

The silt plus clay suspension was centrifuged at 1250 rpm for 3 minutes. This left the clay size fraction (less than 2 microns) in suspension. The supernatant liquid was then poured into a second clean centrifuge tube and centrifuged for a further 3 minutes at 2065 rpm.

4. Slide Mount:

Two slide mounts were made from the fraction brought out of suspension as a result of the second centrifuging described above. A slurry was made and oriented samples (001 basal sections) were obtained by placing drops of suspension on the slide and allowing them to dry. This process was repeated until the slide was opaque.

5. Glycolation:

One of the two slides (above) was placed in a closed container of ethylene glycol for 12 hours and kept in this container until immediately prior to mounting in the x-ray goniometer shaft.

6. Heat Treatment:

After running the untreated slide in the diffractometer the slide was removed and placed in a muffle furnace for 6 hours at 500°C.

7. Acid Treatment:

The remaining suspension (left after the preparation of the slides in 4. (above)) was made up to a 6N solution of HCl and was boiled for 1 hour. A slide was made from the cooled suspension, following the procedure in 4.(above).

All the prepared slides were run in the diffractometer at $2^\circ 2\theta$ per minute.

RESULTS:

In all untreated samples the presence of quartz, plagioclase feldspar, and illite group (biotite, sericite) was noted. In the untreated slide for J-2/80'6" the distinctive peaks for amphibole were noted whereas these were absent in all other slides. In the untreated samples from altered rock the presence of albite was indicated and peaks for calcite were quite strong.

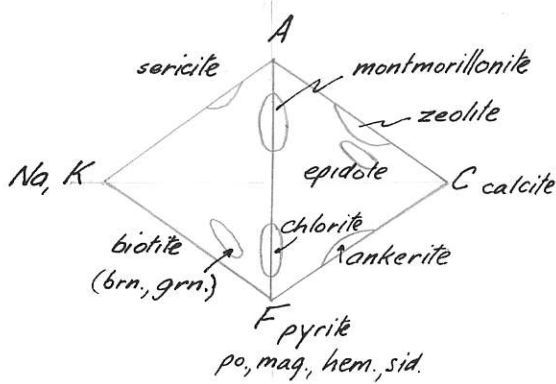
In diffractograms from glycolated samples the presence of montmorillonite is indicated in J-2/89' and J-2/98' but not from the fresh rock sample J-2/80'6".

Heat treated and acid treated slides produce diffractograms that indicate the absence of kaolinite.

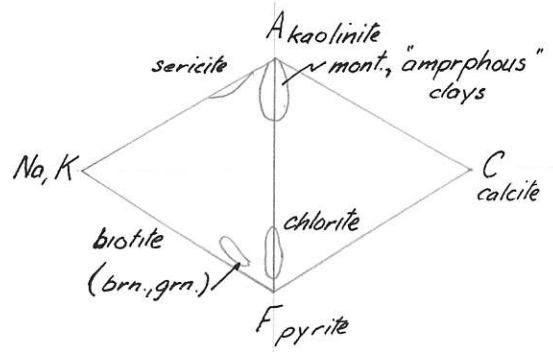
No zeolite minerals were determined to be present in any of the samples.

DISCUSSION OF RESULTS:

Since chlorite was observed to be stable in the altered specimens the rocks were assumed to be in either the propylitic or intermediate - argillic "facies", or both. It was considered sufficient, therefore, to identify the critical minerals, montmorillonite and kaolinite. This becomes apparent when considering the following diagrams of Meyer and Hemley (1967)...



Propylitic assemblages

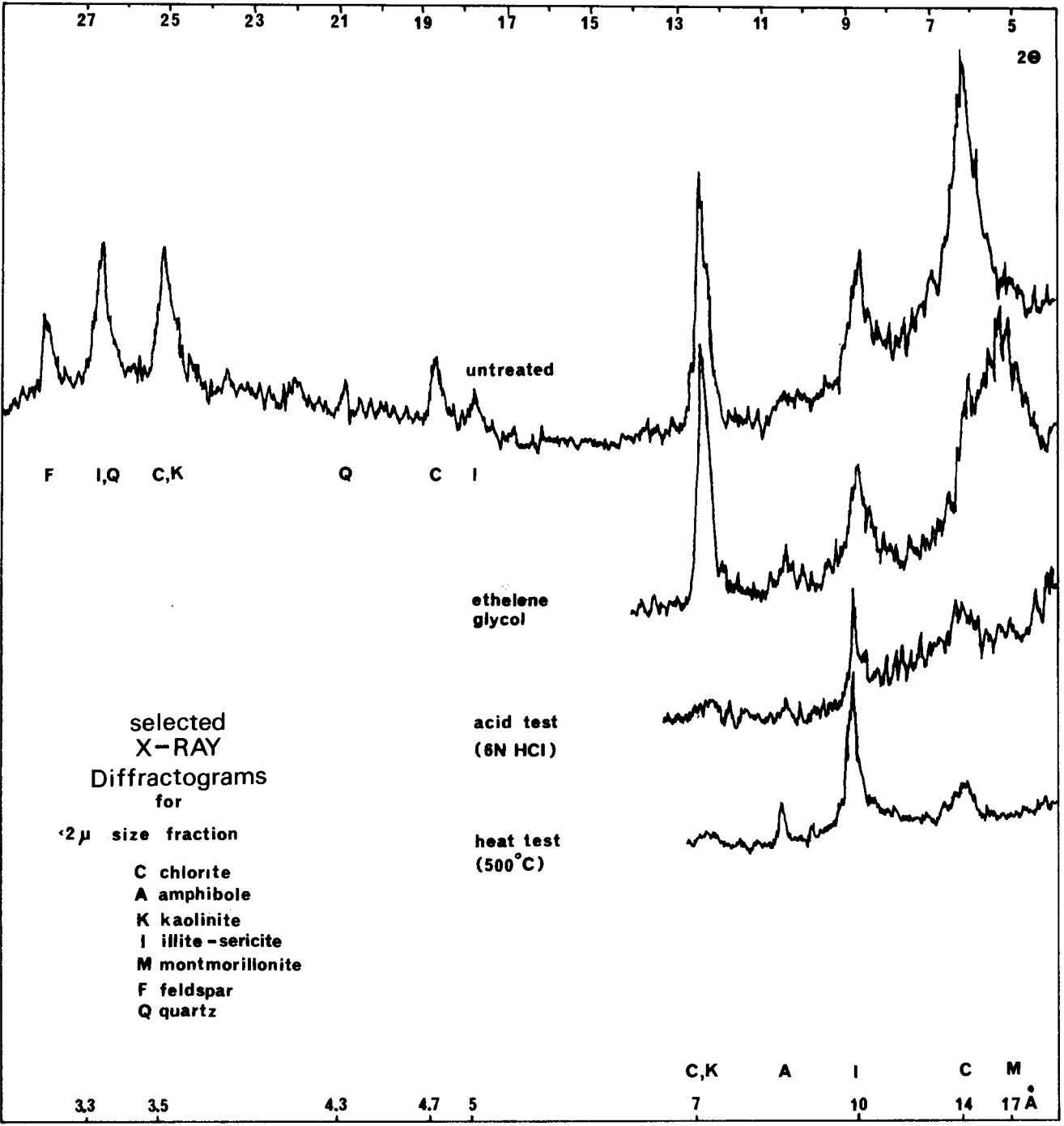


Intermediate Argillic assemblages

As Meyer and Hemley point out, the use of these ACF_AKF is merely pictorial; chemical equilibrium among the phases represented is not necessarily implied.

It is noted that workers at UBC interested in hydrothermal alteration assemblages, and their expression in x-ray diffractograms, generally follow procedures outlined by clay mineral specialists whose prime allegiance is to soil science and sedimentology. The steps included by such specialists that require homoionization were omitted in this study since the clay minerals only came into contact with de-ionized water. Flocculation procedures were also omitted since this step did not produce samples that gave sensibly different diffractograms from those samples from which clays were centrifuged from suspension. When dealing with large numbers of samples flocculation is probably more convenient than centrifuging.

~~Kaolinite is identified by the fact that the acid-treated sample shows a remnant peak in the ? A chlorite-kaolinite site on the figure which follows.~~



Kaolinite is identified by the fact that the acid treated sample shows a remnant peak at the 7 \AA site indicated in the "selected diffractograms" figure. Note that the substantial peak which appeared at this site in the untreated samples (attributed mainly to the presence of chlorite) has disappeared. The chlorite structure has been destroyed by the boiling acid.

The presence of montmorillonite is indicated by the fact that the diffractograms for glycolated samples indicate a new, broad peak about the 17 \AA site. This indicates that the 14 \AA layer has been expanded, and hence explains the lower intensity of the 14 \AA peak in glycolated samples which contain montmorillonite.

In heated samples the presence of kaolinite cannot be confirmed since heating destroys the crystal structure. The basal spacing in the smectite group, which includes montmorillonite, collapses to approximately 9.5 \AA but this peak was not positively attributed to montmorillonite since it was masked by illite group peaks. The chlorite peak at 14 \AA did show some increase, but because of its broad nature no confirmation of an expected shift to 13.8 \AA was made.

In untreated samples of altered rock the presence of albite was substantiated by the appearance of a medium intensity peak at $13.8^\circ 2\theta$.

CONCLUSIONS:

The mineral assemblage; chlorite, epidote, calcite biotite, sericite, hematite and montmorillonite, together with the absence of detectable amounts of kaolinite, suggests a confident assignment of the alteration zone to the propylitic "facies" of Meyer and Hemley can be made.

It is not clear whether the formation of the pyrite and chalcopyrite assemblage took place at the same time as the above assemblage was forming or at some later stage. The rock in the zone is not well fractured and it is suggested that the zone represents a late stage (deuteric?) alteration pipe.

ACKNOWLEDGEMENTS:

The writer is grateful for the assistance given him by UBC graduate students, particularly G. Cargill, J. Luternauer and A. Panteleyev.

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