009878

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March 31, 1970.

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Dear Sir:

I hereby respectfully submit this thesis, entitled The Geology of the South Dansey Property, in partial fulfillment of the requirements for a Bachelor of Science Degree in Honours Geology.

Yours sincerely,

P. M. McAndless

P. M. McAndless

THE GEOLOGY OF THE SOUTH DANSEY PROPERTY

A thesis submitted during the final year in the Faculty of Science, Department of Geology, at the University of British Columbia.

P. M. McAndless

March 31, 1970.

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ABSTRACT

The South Dansey property underlies an approximate three square mile area on the west side of the Guichon batholith. The property is underlain by a variety of intrusive rocks ranging in composition from diorite to quartz monzonite. These rocks are believed to be Upper Triassic in age.

The rock units were subjected to three periods of faulting and fracture alteration. Sulphide mineralization is associated with the second period of fractures in diorite and quartz diorite rock units.

The rock units on the South Dansey property form a part of the Guichon batholith. They are thought to be derived from the differentiation of a pulsating magma and the assimilation of Nicola volcanic rocks.

INTRODUCTION

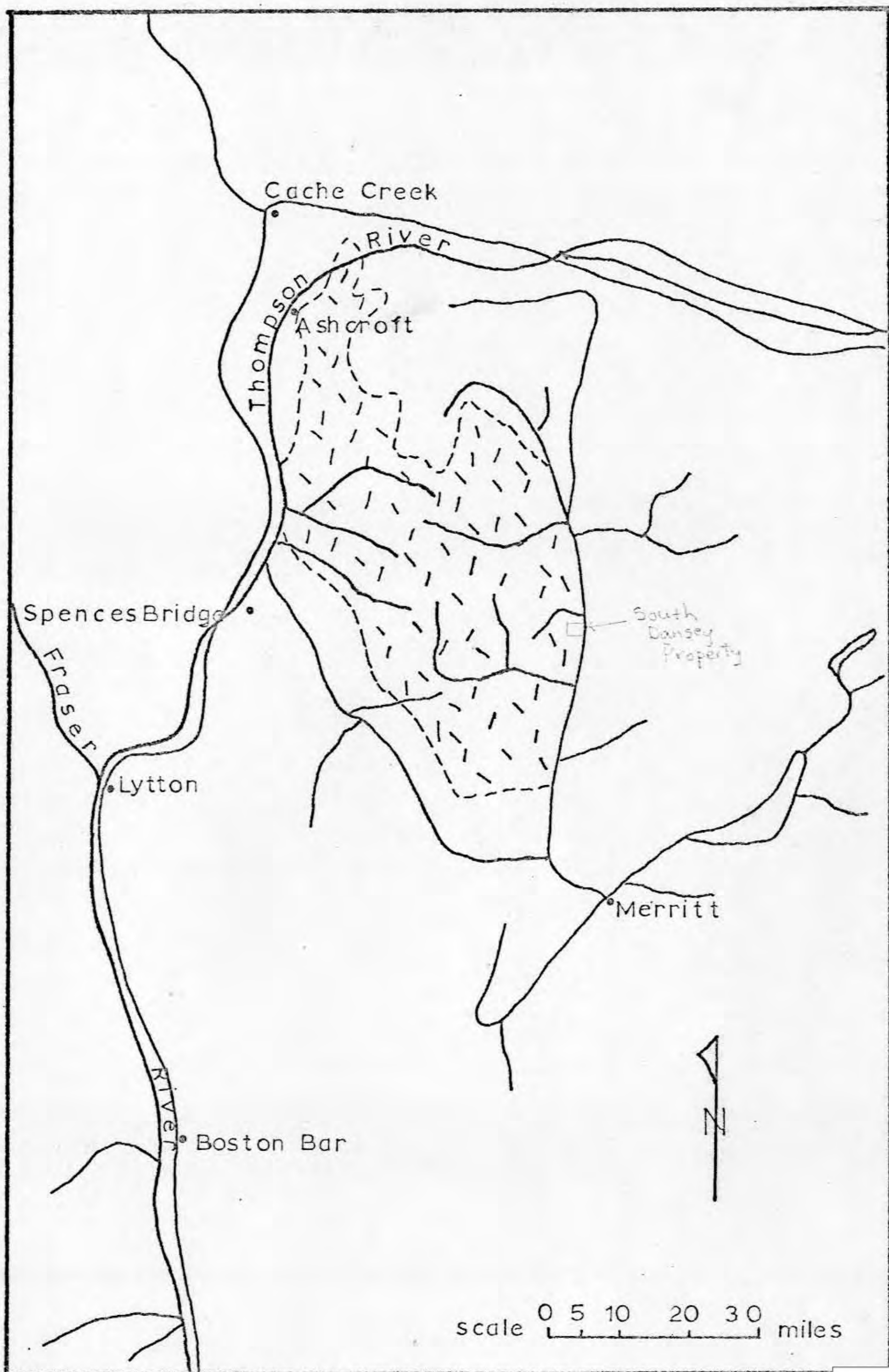
Location and Access

The South Dansey property lies near the northeast side of the Guichon Creek batholith (Fig. 3) and approximately 34 miles north of Merritt, B.C. The property, part of the Thermochem - North Pacific Option, consists of 40 claims (approximately 3 square miles) bounded by Guichon Creek and adjacent mineral properties.

The Highland Valley area is readily accessible and the property can be approached from various major towns. An unpaved secondary road follows Guichon Creek Valley north from Merritt to Savona (Fig. 3). A secondary road from Ashcroft, paved for 20 miles to service the Bethlehem Copper mine, follows Highland Valley and joins the Merritt - Savona road at the junction of Witches Brook and Guichon Creek. A four-wheel drive vehicle road links the property with the Merritt - Savona road, approximately 3 miles north of the Witches Brook junction.

Nature of the Area

The Highland Valley is generally hot and dry in summer but lower temperatures and increased rainfall prevail in bordering mountains.



Index Map of the Guichon Batholith and Highland Valley (Northcote, 1969)

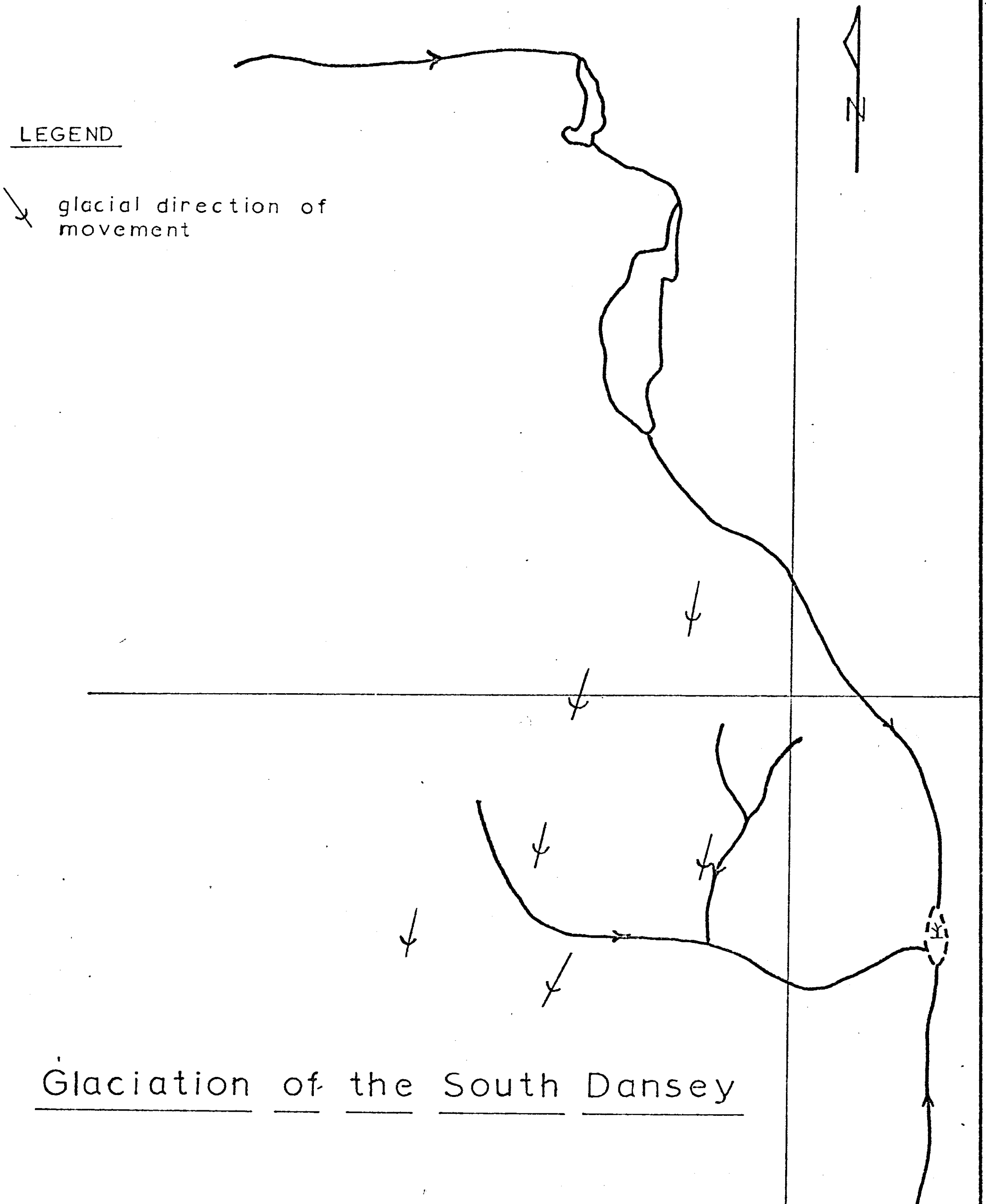
(Fig. 1)

The vegetation on the South Dansey property consists of grasslands and sparse pine forests along Guichon Creek (3000' above sea level) whereas the ridge areas, ranging from 3,500 to 4,000 feet elevation, support dense forest growth consisting of a mixture of pine, fir and spruce with minor aspen and willow. The topography is characterized by a series of north and east trending gullies. Traversing is relatively easy on the South Dansey property and only in a few windfall areas is it difficult.

Bedrock exposures are not plentiful. Outcrop totals less than 15 per cent of the area and below 3,500 feet elevation there is practically no outcrop. The best exposures are found along the minor ridge crests and in abandoned stream gullies. Most of the creeks on the South Dansey property are seasonal.

Glacial Features

Pleistocene glaciation was the major geomorphological process responsible for the present topography of the area (Northcote, 1969). Small glacial features such as striations (Fig. 2) indicate direction of movement of the ice. Eskers, crevasse fillings and erratics are present in the grassland and slightly wooded areas. Original drainage in the area was disorganized by glaciation. Mathews (1944) quotes that "during ablation of glaciers, ice stagnated in valleys and formed a series of ice-dammed lakes. Possibly other lakes



Glaciation of the South Dansey

scale 0 1000 feet

(Fig. 2)

were formed by alluvium blocking the main river channels. Gradually the ice disappeared, lake water was released, water flow diminished, meltwater channels became dry and upland streams were reduced to relative trickles".

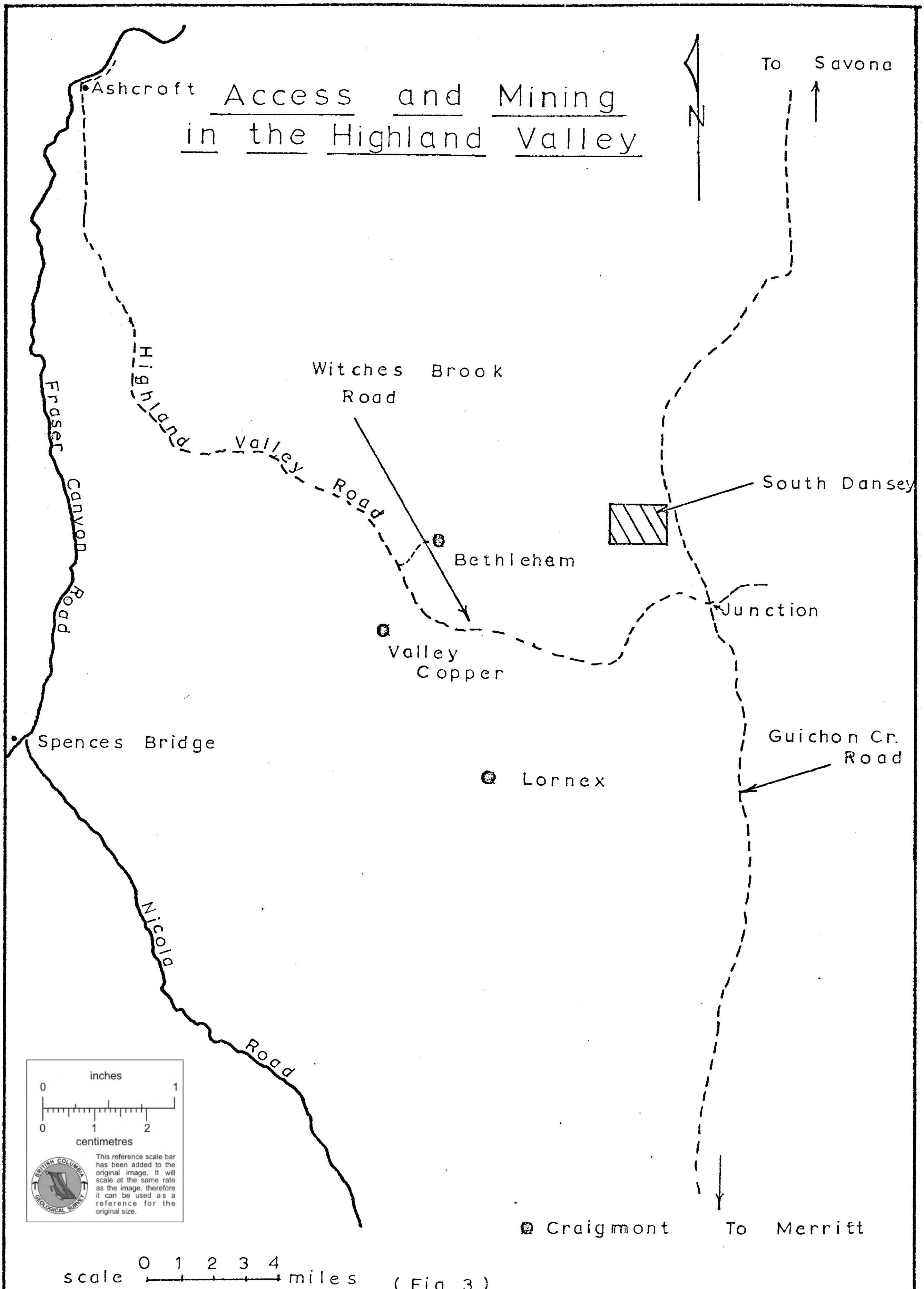
The present glacial features have been modified only slightly by later subaerial processes.

Population and Industry

Ashcroft and Merritt are the major population centers near the Highland Valley and also the focal points for industry. The major forms of industry include mining, agriculture, logging, and cattle ranching. Farms, in the Guichon and Highland Valleys, are engaged in agriculture and cattle ranching. Mineral exploration and mining are the major attractions headed by the mining developments of Bethlehem Copper, Valley Copper, Lornex and Craigmont Mines (Fig. 3). At present the Highland Valley is one of the most active mineral exploration areas in B.C.

Previous Work

The writer mapped the South Dansey property during the 1969 summer field season. Previous work on the property was done by Allen Engineering in 1966. The work included; soil sampling, magnetometer and induced polarization surveys,


Access and Mining in the Highland Valley
To Savona
N
Ashcroft
Fraser Canyon Road
Highland Valley Road
Witches Brook Road
South Dansey
Bethlehem
Junction
Valley Copper
Spences Bridge
Guichon Cr. Road
Lornex
Nicola Road
Craigmont
To Merritt
inches
0
1
0
1
2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
scale 0 1 2 3 4 miles

(Fig. 3)

reconnaissance geology, trenching and six diamond drill holes.

Acknowledgments

I am greatly indebted to Noranda Exploration Company Limited for its cooperation and assistance during the 1969 field season and to Dr. A. E. Soregaroli for his interest, advice and encouragement. Valuable discussions were held in the field with T. Richards and Dr. W. J. McMillan. Dr. W. J. McMillan also gave valuable advice on field work, petrological and petrographic problems. Dr. K. C. McTaggart gave helpful advice on petrographic problems and preparation and editing of this thesis. K. Carter photographed thin sections and rock specimens for this thesis.

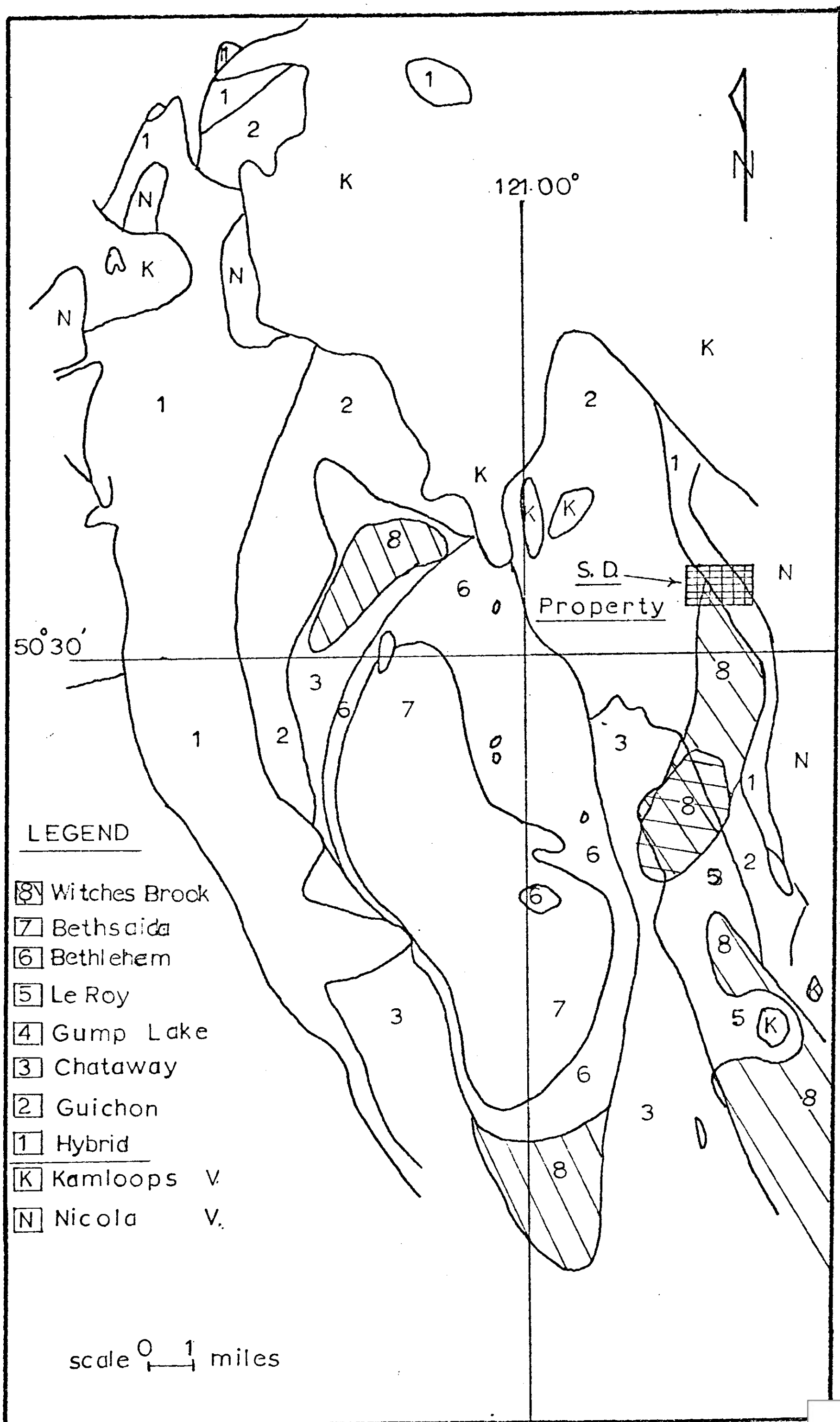
REGIONAL GEOLOGY

Introduction

The Guichon Creek batholith underlies an area of 400 square miles and is bounded by the Thompson, Nicola, and Guichon Valleys. The batholith is an elongate semi-concordant dome and is composed of several zoned, concentric phases. Sedimentary and volcanic rocks of the Cache Creek Group (Permian) and Nicola Group (Upper Triassic) are intruded by the batholith. Middle and Upper Jurassic sediments, Lower Cretaceous and Tertiary volcanic rocks unconformably overlie the intrusive rocks (Fig. 4) (Northcote, 1969).

Regional Geology of the Guichon Batholith

The Guichon batholith consists of eight major phases characterized by a variation in texture and composition (Table I). The contacts between phases are sharp in the case of dyke bodies but typically gradational between larger masses. In some cases the intrusive contacts are brecciated. At the periphery of the batholith is the oldest intrusive rock, the Hybrid phase. It is predominantly a quartz diorite but shows variation from hornblendite to diorite. Towards the inner phases, the age of the rocks decrease and the rock compositions become more "acidic" as illustrated in Table I.



The South Dansey Property Relative to the Guichon Batholith. (Northcote, 1969) - see Table I.

(Fig. 4)

For example, the Guichon rocks which form a concentric ring within the Hybrid phase, intrudes the Hybrid phase and the composition of the Guichon rocks is primarily granodiorite. The Bethsaida phase at the core of the batholith, is the youngest phase and is predominantly of quartz monzonite composition. Irregular shaped dyke masses referred to as Witches Brook in Fig. 4 intrude relatively old rocks (Table I) and range in composition from granodiorite to quartz monzonite.

Table I - Phases of Intrusive Rocks*

Relatively Old	Intermediate Age	Relatively Young
Hybrid phase quartz diorite, granodiorite (1)	Gump Lake phase granodiorite, quartz monz. (4)	Bethsaida phase quartz monz., granodiorite (7)
Guichon variety quartz diorite, granodiorite (2) Chataway variety granodiorite, quartz monz. (3)	Bethlehem phase granodiorite, quartz monz. (6) Witches Brook phase granodiorite, quartz monz. (8)	Leucocratic dykes
LeRoy phase granodiorite, quartz monz. (5)		

*Rock classification after A. Johannsen, 1931.

Location of the South Dansey Property in the Batholith

The South Dansey property is located at the ~~western~~ eastern edge of the Guichon batholith and directly above the 50°30' latitude (Fig. 4). It overlies the contact between Hybrid and Guichon phases and also includes irregular dykes of the Witches Brook phase. The above phases as described by Northcote were correlated with the rocks on the South Dansey property examined by the writer.

GEOLOGY OF THE SOUTH DANSEY PROPERTY

Introduction

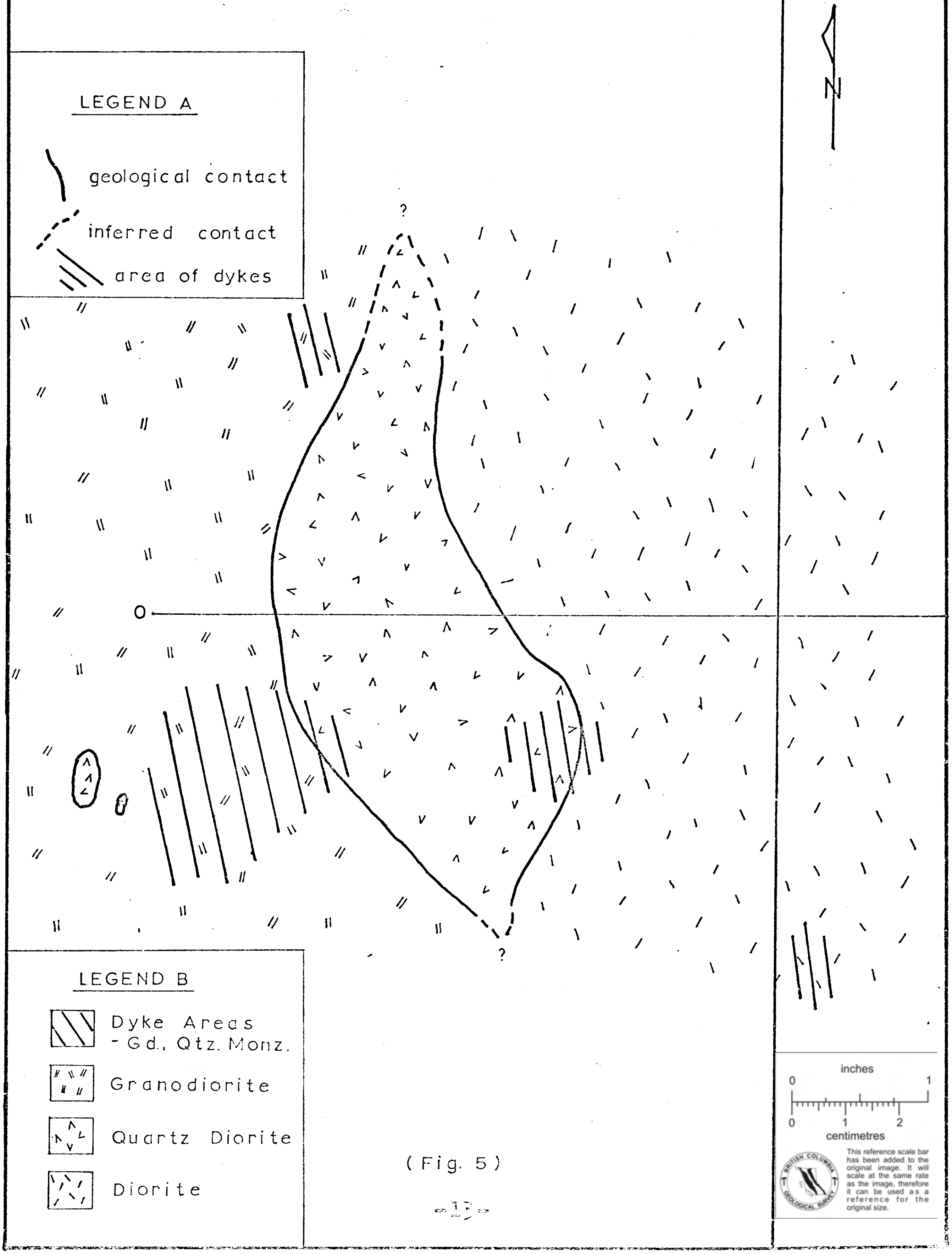
The South Dansey property is underlain by a variety of intrusive rocks of Upper Triassic to Lower Jurassic age, which form a part of the Guichon Creek batholith.

The intrusive rocks may be divided into distinctive units by their field relationships, texture, mineral content and mineral composition. Age relationships between rock units are demonstrated by dykes, contact brecciation, xenoliths and chilled contacts. More commonly gradational contacts exist between rock units. Four rock units are exposed on the property. The major units show a compositional gradient from basic to intermediate compositions and a decrease in age from east to west (Fig. 5).

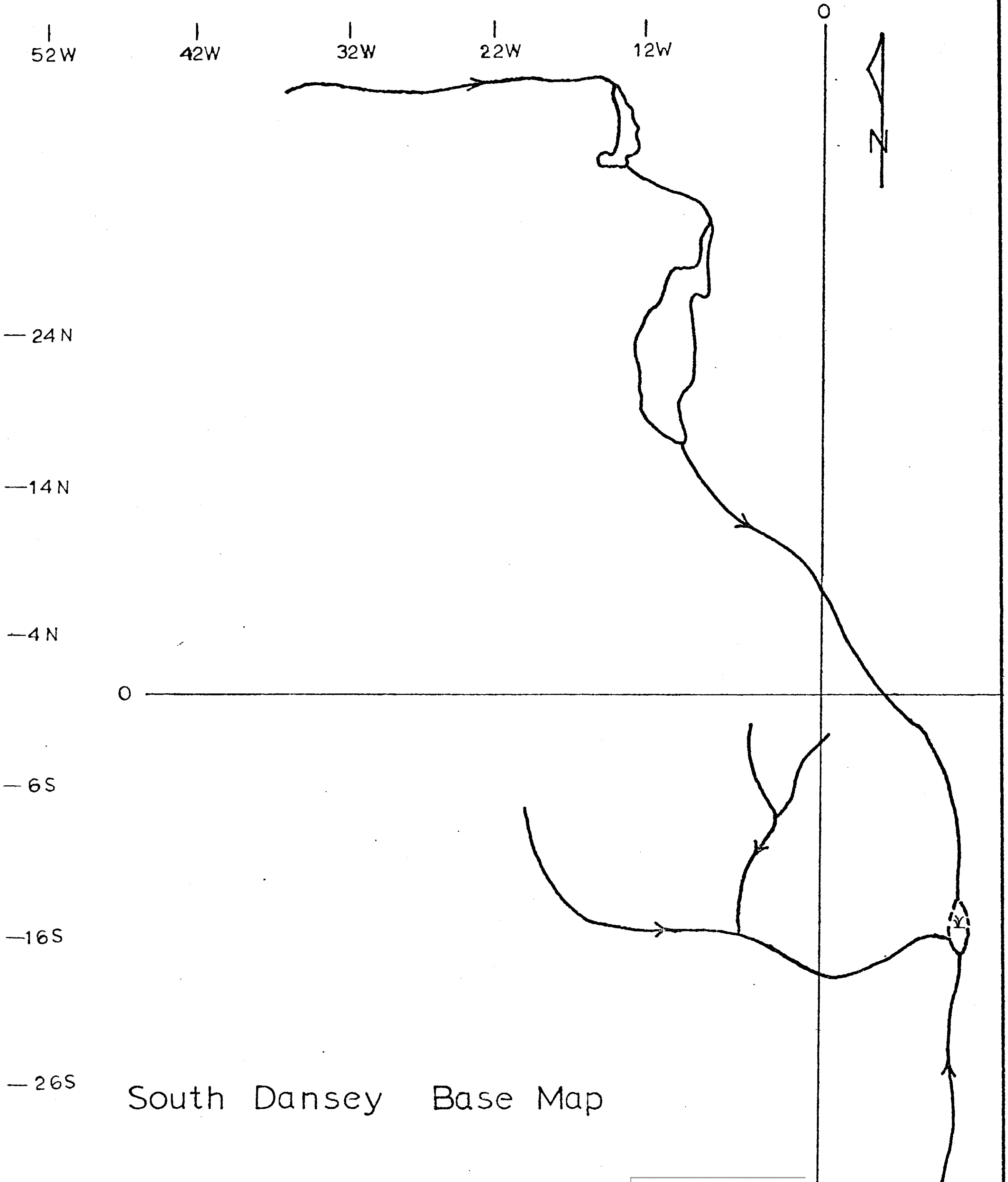
Diorite underlies the eastern section of the property and is intrusive into adjacent Nicola volcanic rocks (east of the South Dansey property). Hornblendite and quartz diorite are not abundant. Diorite has a strong foliated structure (Fig. 11) and is cut by dykes of the other three units.

Quartz diorite forms an eye-shaped body that separates diorite on the east from granodiorite on the west. It is predominantly quartz diorite, contaminated by other units and

Geology of the South Dansey



(Fig. 5)



South Dansey Base Map

Scale 0 1000 feet

(Fig. 6)

has produced variation from diorite to granodiorite. Dykes of quartz diorite cut diorite and contain xenoliths of diorite.

Granodiorite lies adjacent to and to the west of the quartz diorite and covers approximately half of the mapped area. The granodiorite also contains small bodies of quartz diorite and is cut by later dyke phases. A gradational contact exists between the granodiorite and the diorite and causes difficulty in determining age relationships between them.

The three major rock units described above are intruded by dykes and irregular masses of granodiorite and quartz monzonite.

Later phases include apilites and intrusive breccias which commonly occur in the diorite unit.

Description of Rock Units

Diorite

Diorites are somewhat equigranular, holocrystalline and foliated and consist of plagioclase, biotite, hornblende, augite with minor amounts of quartz and orthoclase. Accessory minerals include sphene, apatite, zircon and magnetite. Some specimens contain sulphides, including pyrite, chalcopyrite, molybdenite and minor bornite.

Modes of several diorites were listed in Table II. The mode values of quartz, plagioclase, and orthoclase were normalized and listed in Table IV. These values were plotted on a Ternary diagram as illustrated in Fig. 7. The plots fall within the diorite field of the Ternary diagram.

Quartz forms small isolated inclusions in other minerals. Orthoclase is a minor constituent and is anhedral and interstitial. Plagioclase is euhedral to anhedral and somewhat equigranular. Measured compositions (using $X \wedge 010, \perp a$)of plagioclase yielded a range of An_{36} to An_{43}. Normal zoning is prominant in some thin sections. Sericite and albite occur as minor alteration products towards the plagioclase rim.

The mafic minerals include hornblende, biotite and augite in variable amounts. Augite usually occurs as mottled anhedral grains in hornblende. Hornblende is the major mafic mineral and is subhedral to anhedral, and poikilitically encloses plagioclase and quartz grains. Biotite usually has a ragged outline and commonly alters to chlorite and sericite along the cleavage planes.

Apatite, and rarely zircon, occur as euhedral to subhedral grains usually within larger rock forming minerals. Sphene occurs as irregular aggregates related to the mafic minerals. Magnetite occurs peripherally to the augite as anhedral aggregates and generally associated with mafic minerals. The former association suggests the magnetite formed from the deuteric alteration of pyroxene to hornblende yielding excess iron.

Quartz Diorite

The quartz diorite body is texturally and compositionally more uniform than the diorite. Gradational contacts between the diorite and quartz diorite are common with xenoliths of diorite occurring in the quartz diorite.

Quartz diorite is hypidiomorphic granular, fine to medium grained with an increase in grain size towards the granodiorite. The quartz diorite consists of plagioclase, quartz, biotite, hornblende and minor amounts of orthoclase and augite. Accessory minerals include apatite, zircon, magnetite and sphene. Sulphides are present but less abundant than in the diorite.

Modes of the quartz diorite are shown in Table II. The modes for quartz, plagioclase and orthoclase were normalized and listed in Table IV. These values were plotted on a Ternary diagram (Fig. 7). Modes that occur close to the diorite field are possibly the result of contamination from the diorite.

Plagioclase is subhedral to anhedral and generally coarser grained than the plagioclase in diorite. Most of the plagioclase shows moderate to intense sericitic alteration with poorly developed zoning. Where it was possible compositional determinations yielded ranges of An_{31} to An_{38}. Orthoclase is a minor interstitial constituent. Quartz is anhedral, interstitial and some of it exhibits undalatory extinction.

Mafic minerals show a foliation near the diorite/quartz diorite boundary. The major mafic constituents include hornblende, biotite and minor augite. Biotite is more abundant towards the granodiorite and commonly appears as clusters of grains. Biotite has a ragged outline and is commonly bent. Hornblende appears as irregular grains with remnant anhedral augite cores. Hornblende and biotite commonly show poikilitic texture, enclosing anhedral quartz, plagioclase and opaque grains. Biotite is commonly altered to chlorite and epidote.

Anhedral grains of magnetite occur in clusters around the outer edge of remnant augite grains and also with mafic minerals in general. Sphene occurs as a minor constituent associated with opaque and mafic minerals. Zircon and apatite are euhedral to subhedral and occur within larger rock forming minerals.

Granodiorite

The granodiorite is texturally similar to the quartz diorite body but compositionally different. Typically it is a light cream-grey color mottled with pink and flecked with dark mafic minerals. This third major rock type is predominantly granodiorite, with potassium feldspar becoming more abundant away from the quartz diorite/granodiorite contact. Typical rock specimens are medium to coarse grained, hypidiomorphic granular and commonly contain phenocrysts of hornblende.

The modes of seven granodiorite specimens are listed in Table III. The values of plagioclase, quartz, and orthoclase were normalized and listed in Table IV. These values were plotted on a Ternary diagram (Fig. 8).

Plagioclase is euhedral to subhedral, with moderate to intense sericite alteration similar to plagioclase in quartz diorite. Composition ranges from An_{28} to An_{35} in the unaltered plagioclase grains. Reverse zoning is present but in general, zoning is poorly developed. Albitic alteration of plagioclase is common towards the outer rim. Orthoclase occurs as coarse interstitial grains and as embayments in the plagioclase. Quartz is anhedral and interstitial but not in contact with orthoclase. Undalatory extinction is common in quartz grains.

Mafic minerals are evenly distributed throughout the rock specimens. Biotite is more common in the granodiorite than the other rock units. Biotite typically has ragged edges and poikilitically includes zircon and opaque minerals Biotite commonly is altered to chlorite, sericite and rarely to epidote. Hornblende, about equal in amount to biotite, is subhedral to anhedral with a core of mottled augite and opaque grains.

Magnetite commonly occurs as clusters around the outer edges of the pyroxene cores, and with hornblende and biotite.

Accessory minerals such as zircon and apatite occur as inclusions in major rock forming minerals.

Dyke Phase

The fourth major rock phase on the South Dansey property occurs as irregular masses of dykes. The dykes range in thickness from ½" to 3' and strike approximately north. They are not a continuous feature in the field. For example, some dykes were traced for only 10'.

The dyke phase is notably finer grained and richer in quartz and potassium feldspar than the granodiorite. Rock-forming minerals include plagioclase, quartz, orthoclase, biotite, hornblende and minor augite. Accessory minerals include apatite, and opaque minerals. Typically, the dykes are light grey to cream-grey colored granodiorite to quartz monzonite and usually mottled by pink. The dykes are texturally finer grained than the granodiorite.

Modes of 6 dykes are listed in Table III. Normalized values of plagioclase, quartz and orthoclase are listed in Table IV. These values are plotted on a Ternary diagram in Fig. 8.

Quartz is subhedral to anhedral, rounded and interstitially related to orthoclase (unlike the granodiorite quartz). Plagioclase is subhedral to anhedral, medium grained with no preferred orientation. The composition of the plagioclase ranges from An_{35} to An_{36} and shows poorly developed oscillitory zoning. Most grains demonstrate moderate to intense sericitic alteration and albitized rims. Orthoclase is anhedral, fine to medium grained, interstitial and in contact with quartz. Orthoclase is commonly poikilitic enclosing major and minor rock constituents.

Mafic minerals consist of an equal amount of hornblende and biotite with minor pyroxene. Biotite occurs in clusters amongst larger unevenly distributed hornblende crystals. Both hornblende and biotite are poikilitic and exhibit chlorite and minor epidote alteration. Minor pyroxene occurs as mottled grains enclosed in hornblende.

Apatite and magnetite occur in minor quantities enclosed in major rock forming minerals and sulphides such as pyrite and chalcopyrite occur interstitially.

Table II - Modal Analysis in Weight Percent

Diorite

	3E-12S	4W-16S	7W-6N	10W-21S	15W-4S	15W-9S	21W-6N
Plagioclase	57.0	63.0	65.0	67.0	69.0	70.0	66.0
Orthoclase	tr.	tr.	tr.	0.5	tr.	tr.	0.1
Quartz	6.0	0.5	2.0	3.0	1.0	0.5	5.0
Mafics	35.0	32.0	29.0	25.0	25.0	24.0	25.0
Opaques	1.0	3.0	0.5	1.5	2.0	1.0	0.5
	99.05	98.51	96.55	96.0	97.05	95.55	96.6

Quartz Diorite

	10W-8N	16W-3S	20W-2N	23W-10S	28W-8N	32W-10S	34W-9N
Plagioclase	55.0	56.0	54.0	60.0	52.0	52.0	53.0
Orthoclase	3.0	0.5	4.0	0.1	2.0	5.0	5.0
Quartz	12.0	10.0	14.0	15.0	10.0	15.0	11.0
Mafics	27.0	30.0	26.0	25.0	34.0	25.0	29.0
Opaques	0.5	1.0	0.5	1.0	0.5	1.5	0.5
	97.5	97.5	98.5	91.1	98.5	98.5	98.5

Table III - Modal Analysis in Weight Percent

Granodiorite

	20W-21S	35W-16N	49W-30S	56W-8S	58W-10N	64W-18S	71W-18S
Plag.	48.0	45.0	38.0	40.0	53.0	34.0	31.0
Ortho.	11.0	15.0	15.0	10.0	14.0	17.0	20.0
Quartz	16.0	10.0	16.0	17.0	10.0	16.0	19.0
Mafics	20.0	28.0	29.0	30.0	20.0	30.0	27.0
Opaques	1.0	0.5	1.0	1.0	0.5	1.0	1.0
	96.0	98.5	99.0	98.0	97.5	98.0	98.0

Dyke Phase

	2E-34S	24W-10S	28W-27S	31W-11S	36W-25S	41W-11S	44W-13S
Plag.	30.0	34.0	28.0	32.0	32.0	50.0	32.0
Ortho.	21.0	24.0	36.0	27.0	25.0	23.0	33.0
Quartz	18.0	20.0	20.0	13.0	12.0	20.0	14.0
Mafics	25.0	20.0	12.0	25.0	27.0	5.0	17.0
Opaques	1.0	0.5	1.0	1.0	1.0	1.0	1.0
	97.0	98.5	97.0	98.0	97.0	99.0	97.0

Table IV - Modal Analysis (%) - Normalized Quartz, Plagioclase and Orthoclase

Diorite

	3E-12S	4W-16S	7W-6N	10W-21S	15W-4S	15W-9S	21W-6N
Plagioclase	90.0	99.0	97.0	94.0	98.0	99.0	92.0
Orthoclase	tr.	tr.	tr.	0.7	tr.	tr.	tr.
Quartz	9.5	0.7	2.5	4.5	1.5	0.7	7.0
	99.5	99.7	99.5	99.6	99.5	99.7	99.0

Quartz Diorite

	10W-8N	16W-3S	20W-2N	23W-10S	28W-8N	32W-10S	34W-9N
Plagioclase	78.5	84.0	75.0	80.0	81.0	72.0	76.5
Orthoclase	4.0	0.8	5.5	1.0	3.0	8.0	7.0
Quartz	17.0	15.0	19.0	19.0	15.5	19.0	16.0
	99.5	99.8	99.5	100.0	99.0	99.0	99.5

Granodiorite

	20W-21S	35W-16N	49W-30S	56W-8S	58W-10N	64W-18S	71W-18S
Plag.	64.0	62.5	57.0	62.0	70.0	55.0	46.0
Ortho.	14.5	21.0	21.5	16.0	18.5	25.0	28.5
Quartz	21.0	16.0	19.0	22.0	11.0	19.0	24.0
	99.5	99.5	99.5	99.0	99.5	99.0	99.5

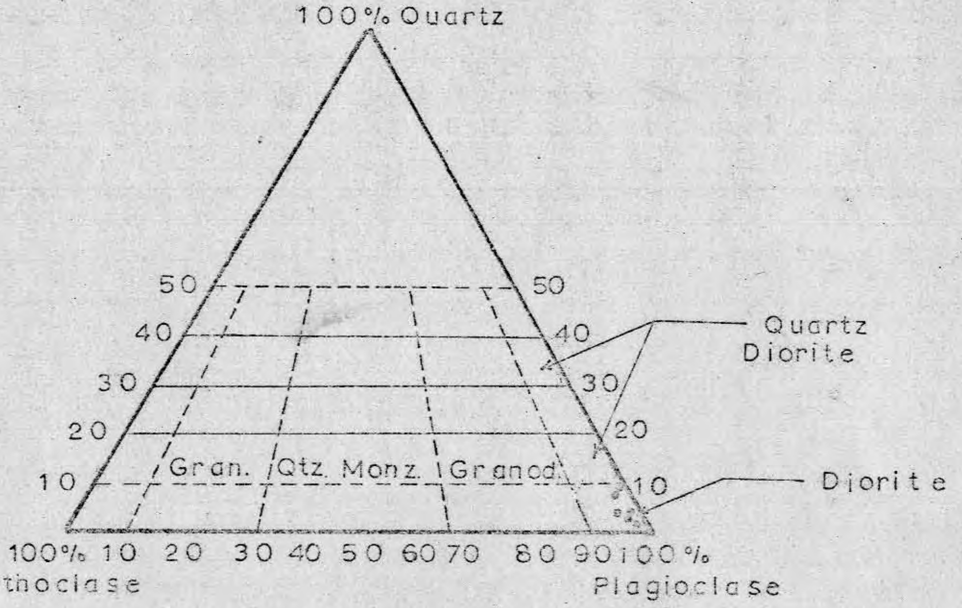
Dyke Phase

	2E-34S	24W-10S	28W-27S	31W-11S	36W-25S	41W-11S	44W-13S
Plag.	43.5	43.5	33.0	44.5	46.5	54.0	40.0
Ortho.	30.0	31.0	43.0	37.5	36.0	24.5	41.5
Quartz	26.0	25.0	23.0	18.0	17.0	21.0	17.5
	99.5	99.5	99.5	99.0	99.5	99.5	99.0

*Plots on the Ternary diagram (Fig. 7 & 8) are based on quartz and orthoclase values.

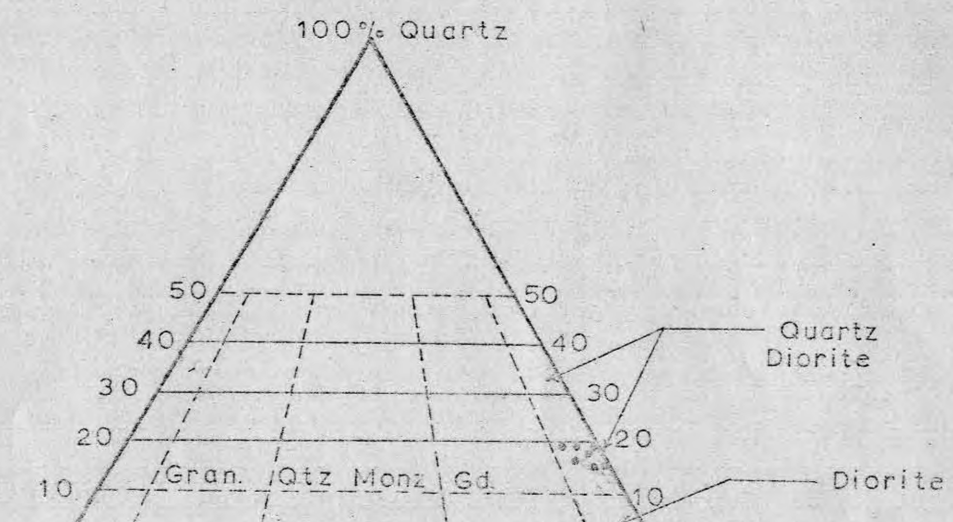
Modal Analyses

a) Diorite



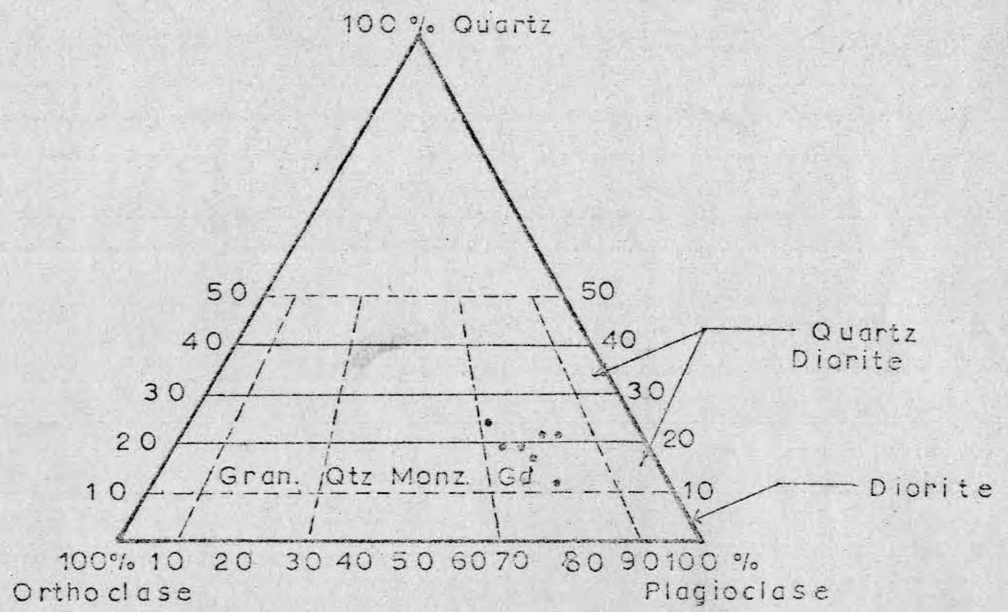
• stained slab

b) Quartz Diorite



(Fig. 7)

c) Granodiorite



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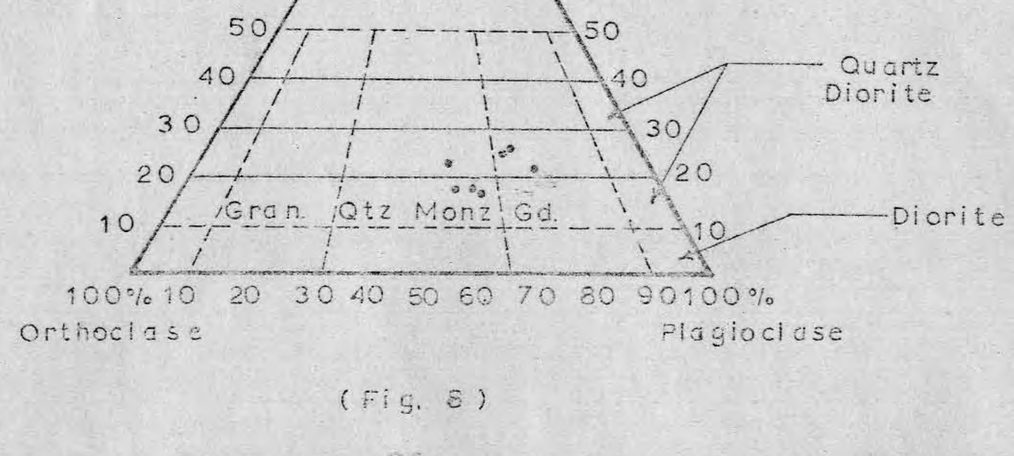
d) Dyke Phase



(Fig. 8)

Intrusive Breccia

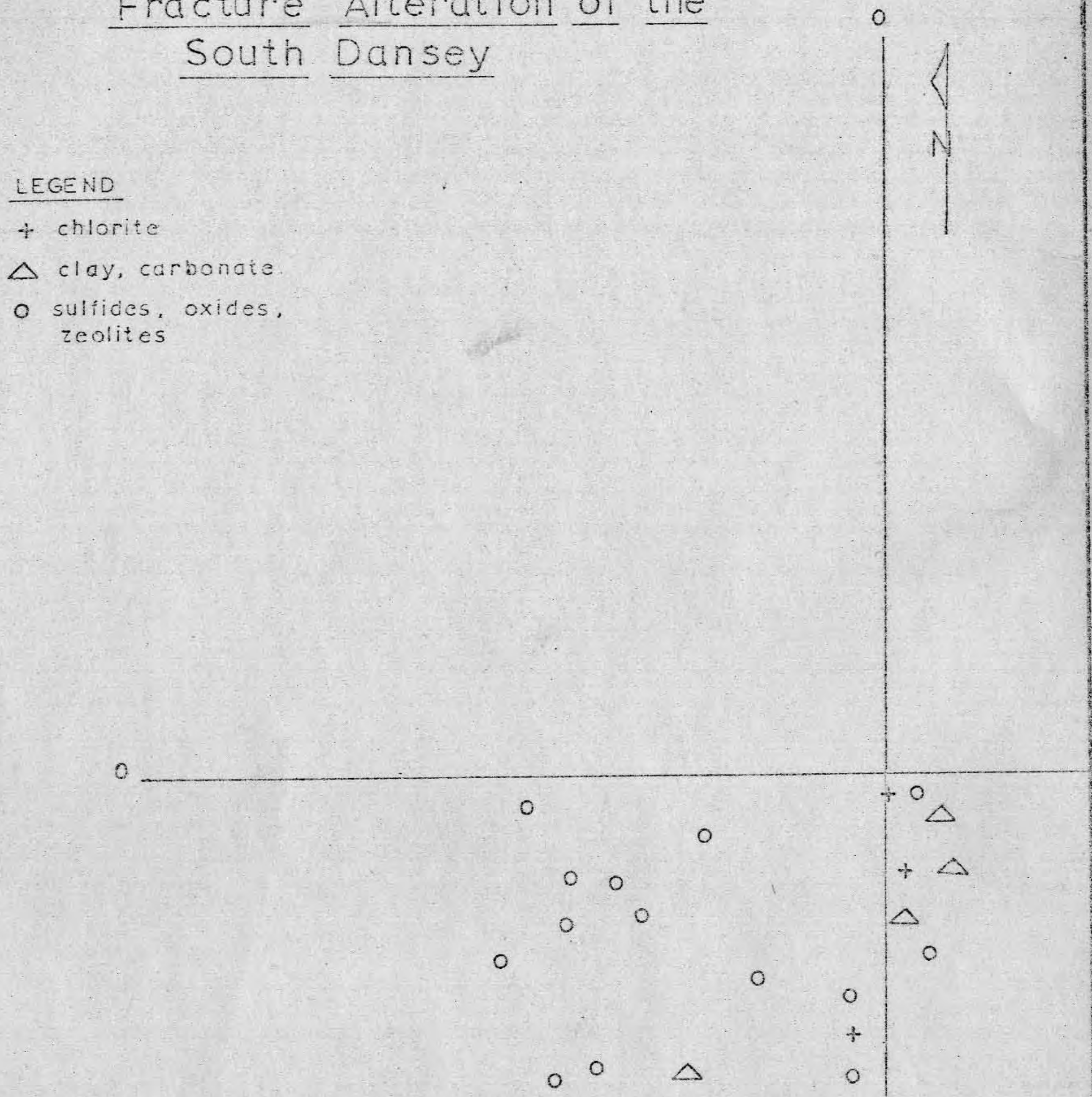
An intrusive breccia is situated in the southeast corner of the map area. It occurs at the contact of diorite and a granodiorite dyke ranging in width from a few inches to a few feet. The breccia is composed of angular fragments of the diorite and matrix of the dyke phase with abundant chlorite, epidote and sulphide mineralization.

Alteration

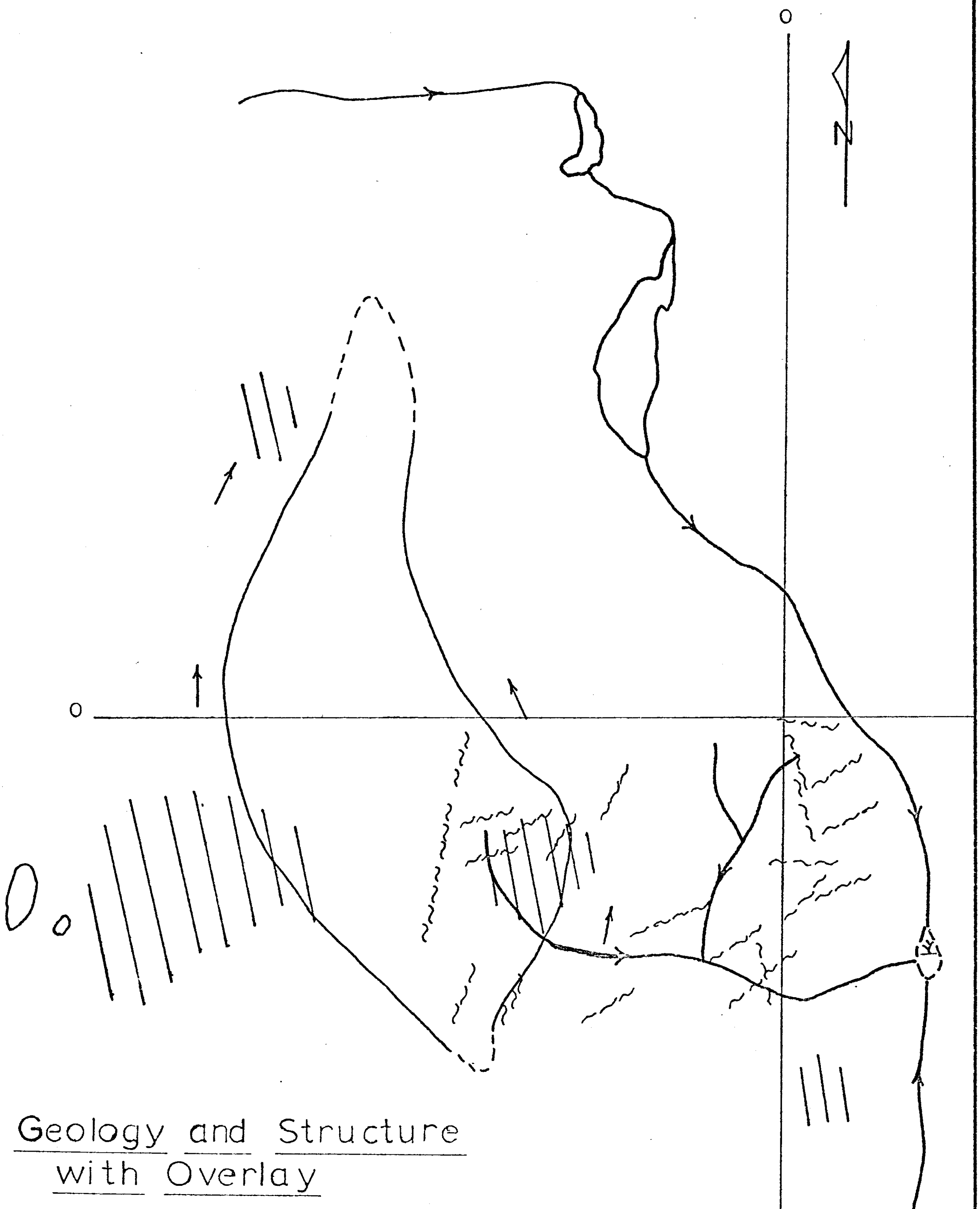
Deuteric alteration is widespread and common in all rock units in the map area. Sericitic alteration of plagioclase is common in quartz diorite and granodiorite but negligable in the diorite. Albitic alteration of plagioclase rims is also a common feature in the quartz diorite and granodiorite. Deuteric alteration of augite to hornblende and magnetite is common in quartz diorite and granodiorite but less abundant in the diorite. Biotite shows selective replacement by sericite, and hornblende is commonly replaced by actinolite. Both hornblende and biotite are chloritized and epidotized. In some rocks orthoclase occurs as a late stage alteration product of plagioclase and biotite.

Hydrothermal minerals associated with the three major periods of fracturing include chlorite, zeolites, carbonates, clay minerals, oxides, sulphates and sulphides (Fig. 9). These

Fracture Alteration of the South Dansey



(Fig. 9)



Geology and Structure with Overlay

Scale 0 1000 feet

(Fig.10)

minerals are mainly in the fractures of diorite and granodiorite.

Other minor hydrothermal minerals that occur in joints and fractures include orthoclase, epidote, hornblende, sericite and tourmaline. The amount of hydrothermal alteration and mineralization is directly proportional to the abundance and frequency of fracturing.

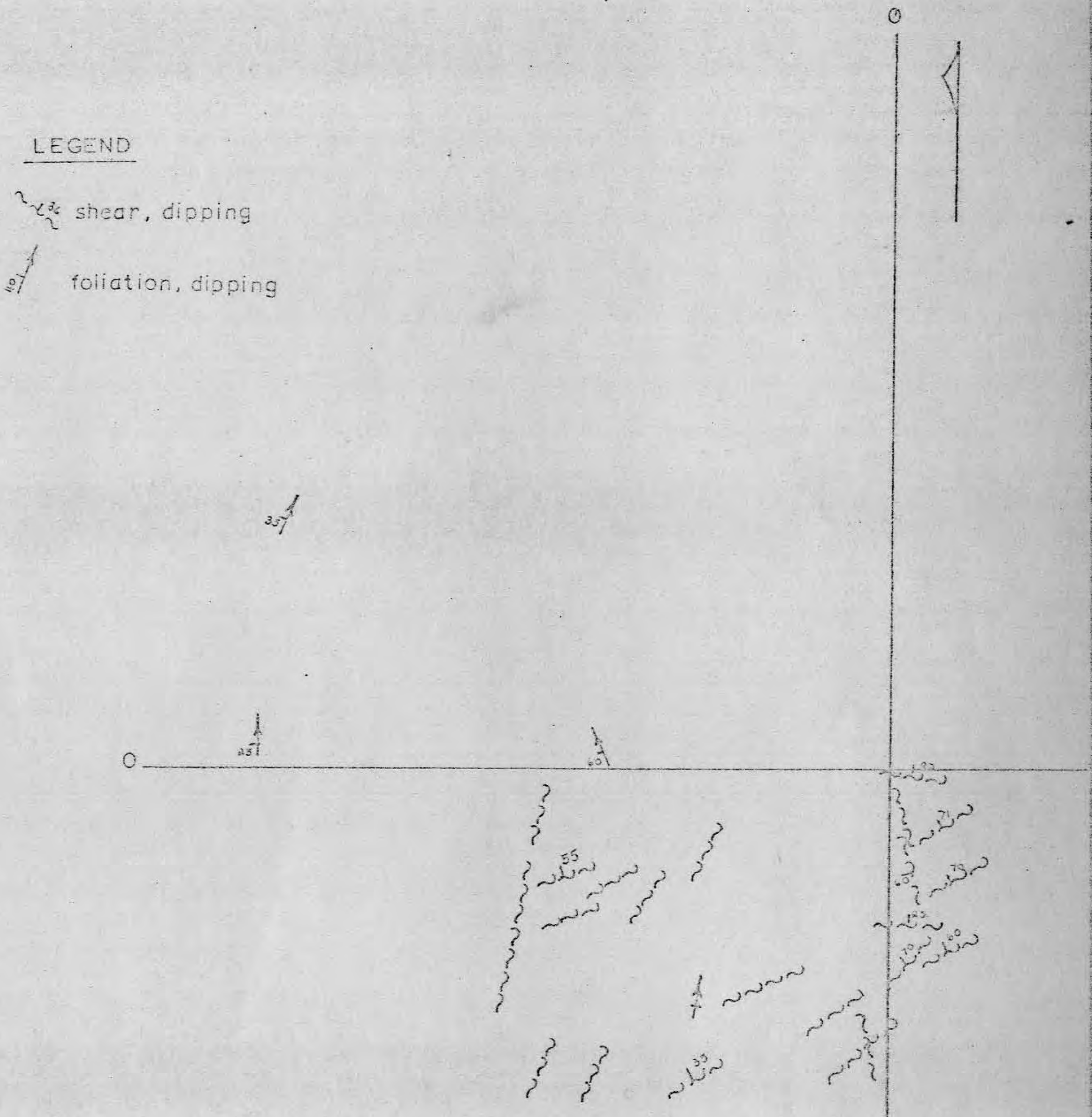
Structure

Structural features of the South Dansey property include xenoliths, contacts between rock units, shear zones, fractures, joints and foliation.

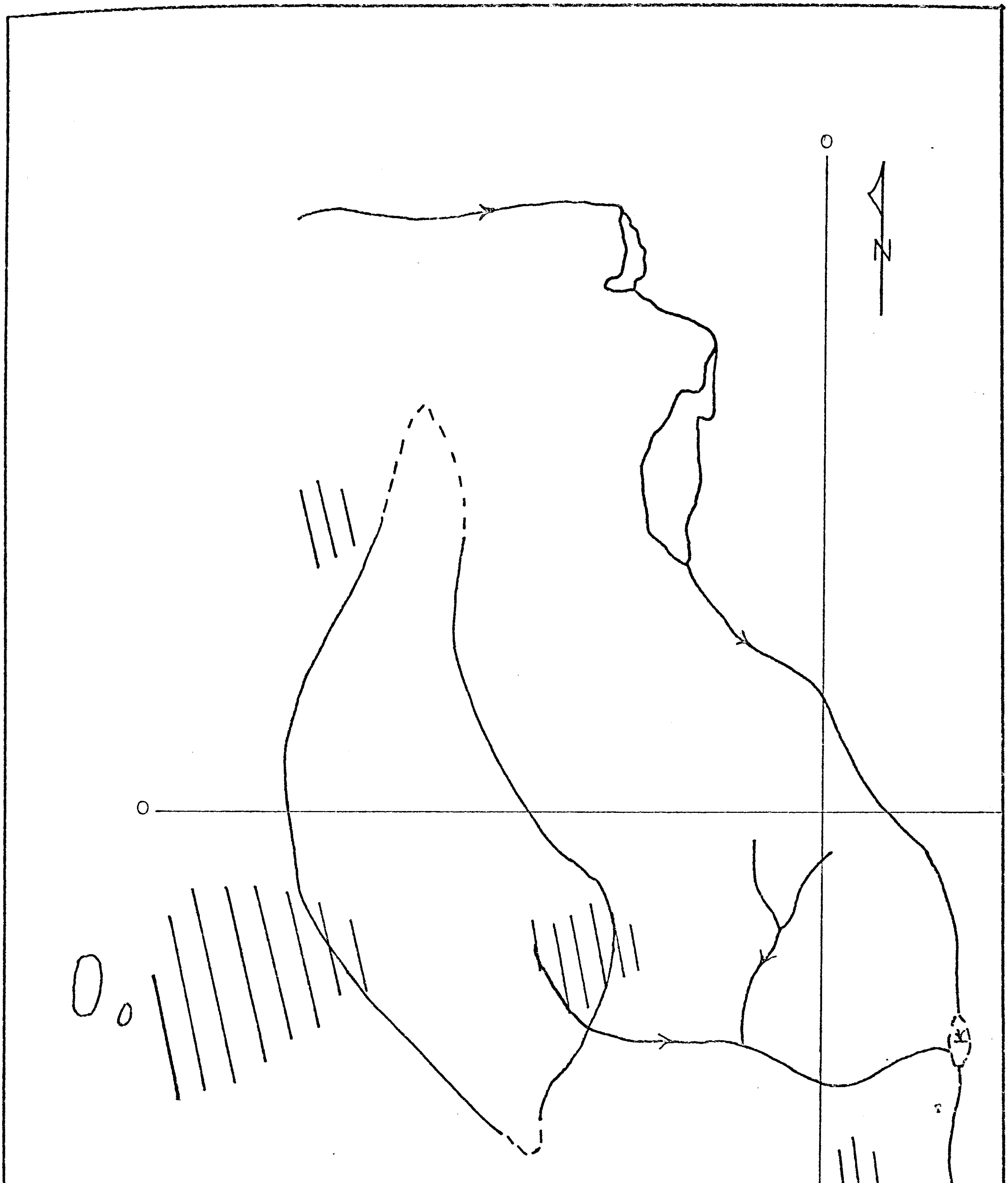
Xenoliths occur predominantly in diorite and quartz diorite and show variation in size, degree of assimilation and grain size. Granodiorite is relatively devoid of xenoliths. The nature of the contacts between the xenolith and host rock range from distinct to gradational and indistinct. The size and shape of the xenoliths are variable. Sizes range from a few centimeters to many feet. Some xenoliths have rounded outlines with distinct contacts while others have an angular outline and show a sharp contact with the surrounding rock. These mafic rich xenoliths are believed to be remnants of a roof of older volcanic rocks.*

*Fine-grained mafic-rich clots in the Hybrid phase may represent xenoliths (of Nicola volcanics) that have been assimilated but incompletely mixed with magma (Northcote, 1969).

Structure of South Dansey



(Fig. 11)



Geology with Overlay

scale 0 ⊢———⊣ 1000 feet

(Fig. 12)

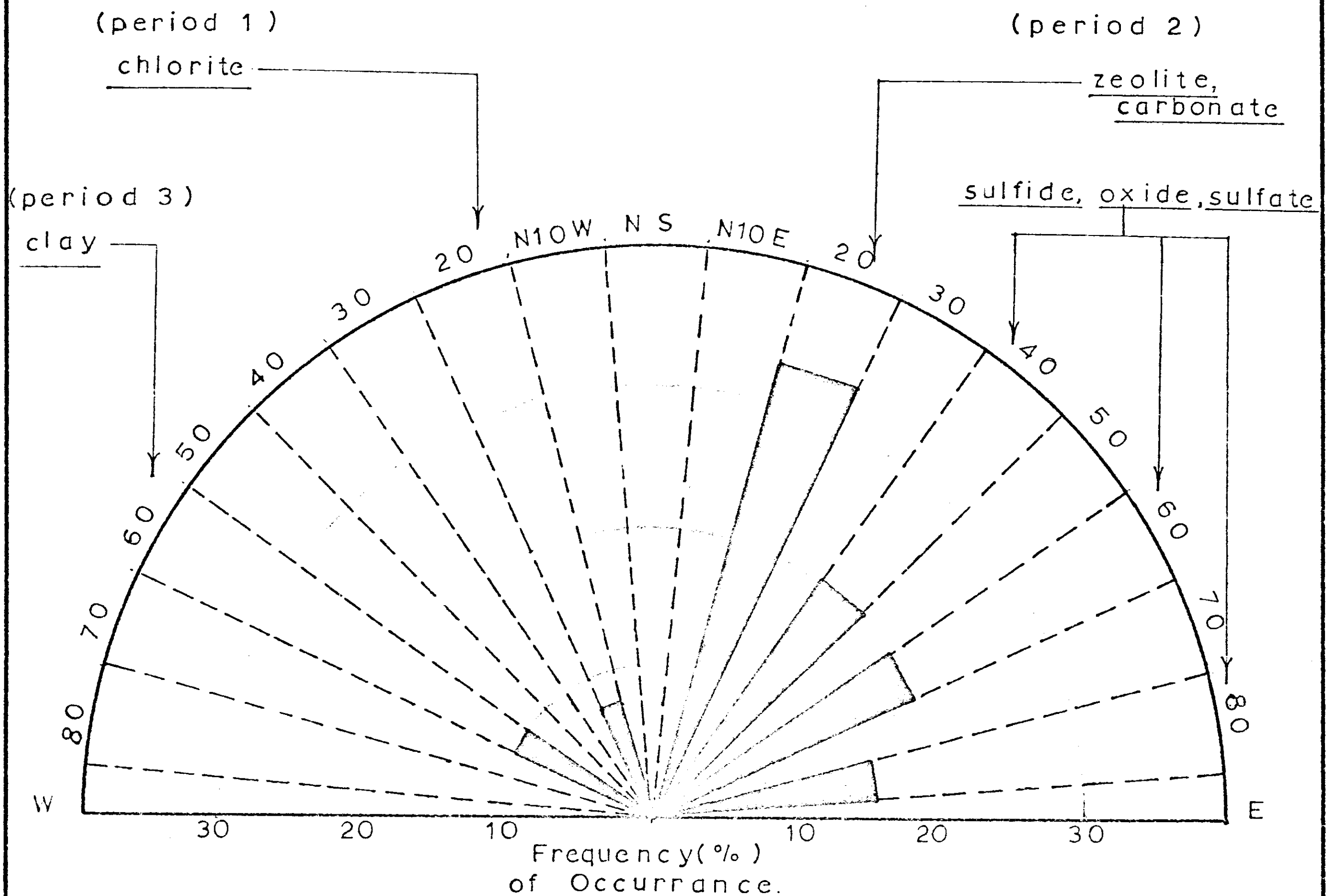
Contacts between major rock units are generally gradational with no distinct border except the dyke phase which has a sharp contact between the dyke wall and host rock.

Foliation is evident in the diorite unit and in parts of the quartz diorite.

Fracturing and shearing are abundant in the diorite and quartz diorite markedly less in the granodiorite. Fig. 13 indicates the frequency and direction of the major fractures. Prominant faults adjacent to a major north trending gully strike northeast. This type of fracture pattern is analogous with the Bethlehem property, as illustrated by Northcote who quotes (1969, p. 66),"They are described as complicated, branching or braided structures of sheared, comminuted, altered rock and gouge ranging in width from a few feet to more than 100 feet."

There are three major periods of faulting in the South Dansey property. These periods are represented on an Attitude - Frequency diagram (Fig. 13). The interpretation of timing of the faults was based on cross cutting and truncating relationships between the fractures. The earliest faults strike north 20° west and are coated with chlorite. The most prominant fractures which represent a second period of faulting strike 20° east, north 40° east and north 60° east.

- Diagram illustrates the strike, frequency of occurrence, and associated alteration minerals of the major fracture periods.



Shear Attitudes and Frequency (%) of Occurrence

(Fig.13)

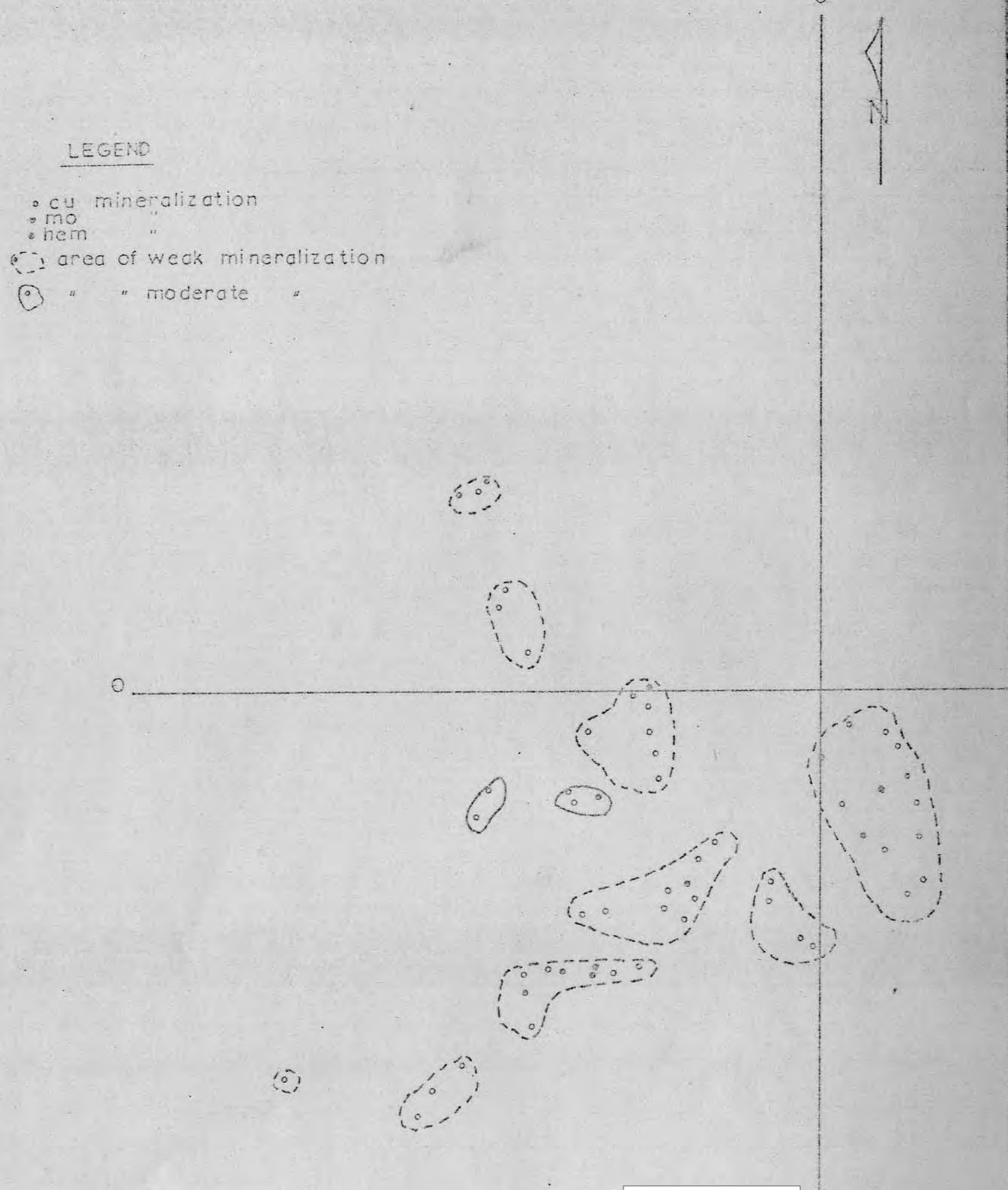
They are mineralized with carbonates, sulphides, oxides and sulphates. The final period of faulting strikes north 60° west and is associated with clay minerals.

Mineralization

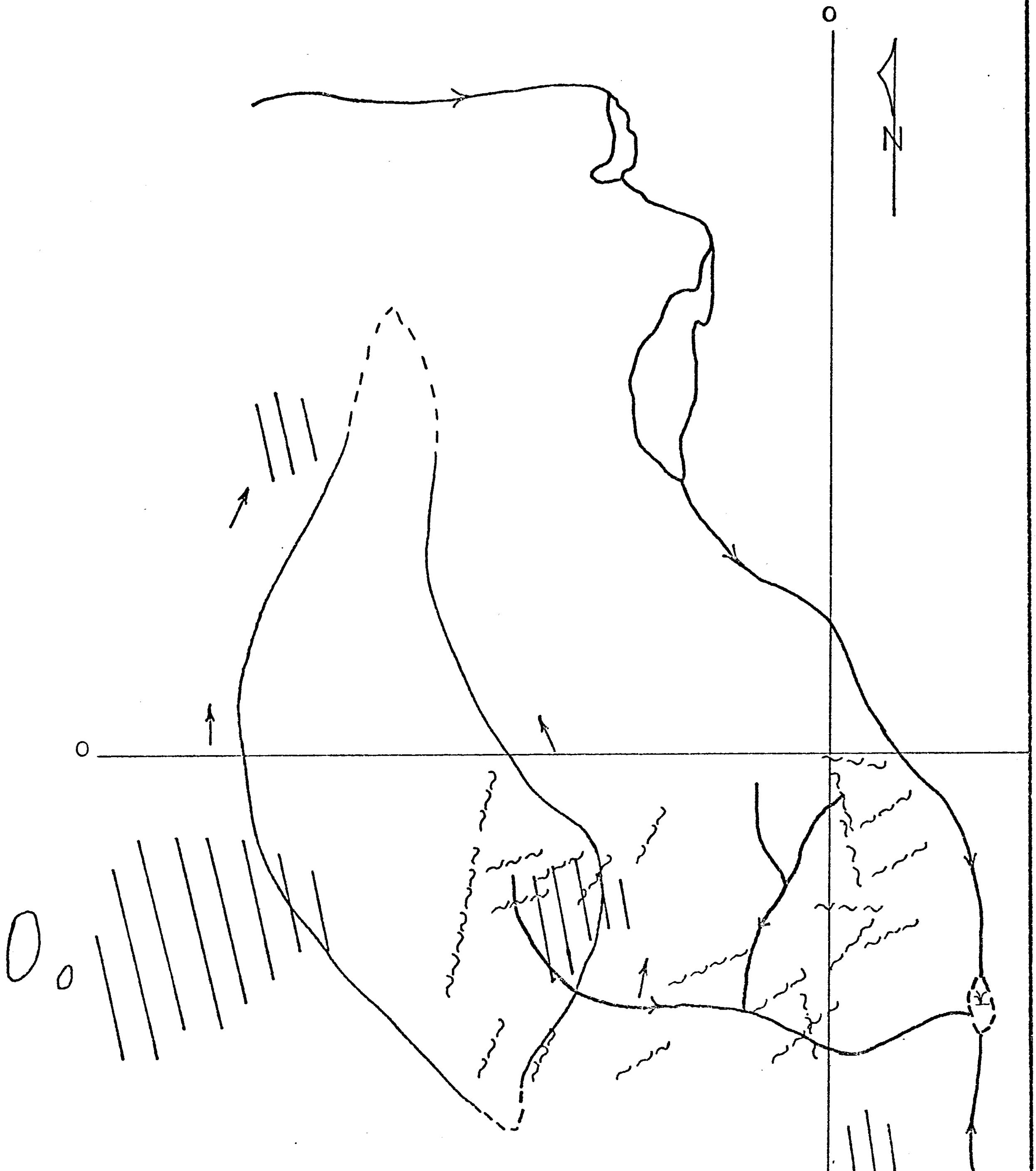
Mineralization on the South Dansey property is associated with diorite and quartz diorite. Most of it occurs along fractures, and the bulk of mineralization is associated with the second group of fractures which range from north 40° east, north 60° east to north 80° east. The main minerals include chalcopyrite and pyrite, with minor amounts of molybdenite, specularite, chalcocite and bornite. Malachite and azurite occur as secondary minerals. Areas of moderate copper-molybdenite mineralization ($>0.1\%$ Cu) occur near the contact between diorite and quartz diorite with weak zones of copper-molybdenite mineralization scattered throughout the diorite. Areas of weak and moderate mineralization plus individual mineral showings are shown in Fig. 14.

The intensity of fracturing is proportional to the amount of mineralization. For example, areas of intense faulting and fracturing contain the greatest abundance of mineralization as seen by comparing Fig. 14 with Fig. 15.

Mineralization of the South Dansey



(Fig. 14)



Geology and Structure
with Overlay

scale 0 1000 feet

(Fig. 15)

DISCUSSION

Petrogenesis

The petrogenesis of the rock units underlying the South Dansey property is directly related to the emplacement of the Guichon batholith. The process of emplacement of the batholith was suggested by Northcote (p. 55) who stated that "phases of the Guichon Creek batholith appear to have been emplaced in a roughly concentric series of pulses* of partially crystallized magma. Emplacement was affected by a combination of wallrock stoping, assimilation of stratified country rock, and forceful intrusion".

Differentiation of the South Dansey rock units is illustrated on an Q-Ab-An-Or system diagram (Fig. 16). The differentiation line d - dp was established from the average modes of the four rock units listed on Table V . The manner of differentiation of the South Dansey rock units is debatable. Two possibilities include: a) crystallization of a magma in a closed system,

and b) crystallization of a magma and assimilation of Nicola volcanic rocks.

* Textural and compositional differences between phases and the intrusive nature of internal contacts suggest that the magma was emplaced by a series of pulses (Northcote, 1969).

Table V - Modal Analysis (%) - Average Norms of Albite, Anorthite, Quartz and Orthoclase.

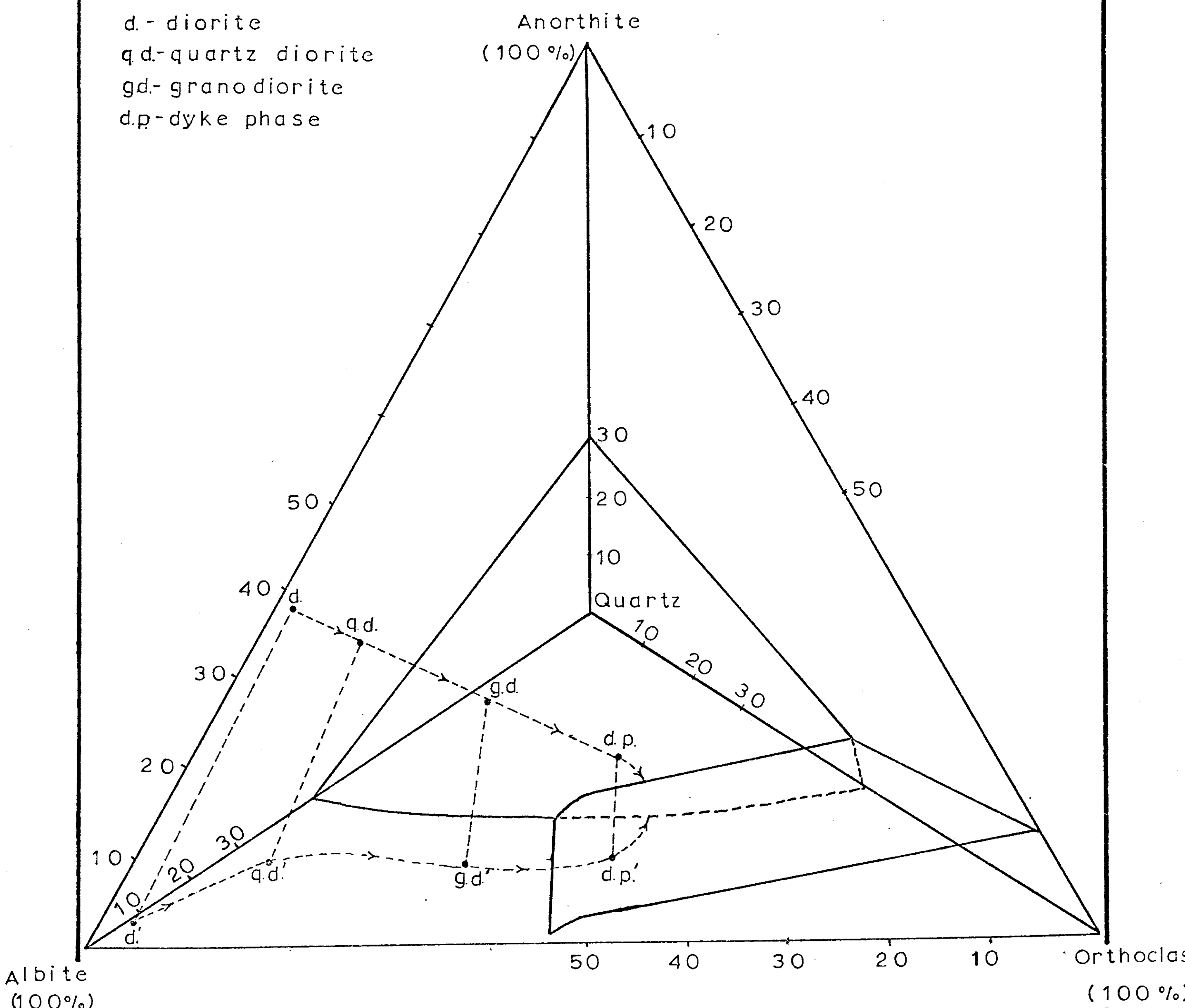
	Albite	Anorthite	Quartz	Orthoclase
Diorite	59.3	36.3	4.3	0.1
Quartz Diorite	50.5	27.1	18.5	3.9
Granodiorite	41.3	19.4	18.6	20.7
Dyke Phase	30.5	13.0	21.8	34.7

Differentiation of the Major South Dansey Rock Units.†

- using the Q-Ab-An-Or system.

LEGEND

d. - diorite
q.d.-quartz diorite
g.d.- granodiorite
d.p.-dyke phase



† average modes represented by dot on diagram.

(Fig. 16)

The second possibility is more favorable on the basis of field evidence including, textural inhomogeneity of the diorite compared to a relatively homogeneous granodiorite, and xenoliths of diorite in the quartz diorite. The major rock units, represented in Table VI, might have been derived from the following crystallization history:

1. Initial crystallization of plagioclase and pyroxene in the magma chamber.

2. Continued crystallization of plagioclase and deuteric alteration of pyroxene to hornblende and magnetite.

3. Wallrock stoping and assimilation at the margins of the magma chamber.* The assimilated Nicola volcanics by the magma produced a diorite.

4. Crystallization of quartz followed by orthoclase. Interstitial relationship of quartz and orthoclase with plagioclase. Initial crystallization of granodiorite.

5. Granodiorite continues to crystallize in a [illegible] quartz-orthoclase rich liquid.

6. Liquid phase is drawn off along shear zones and crystallizes as a series of quartz monzonite dykes.

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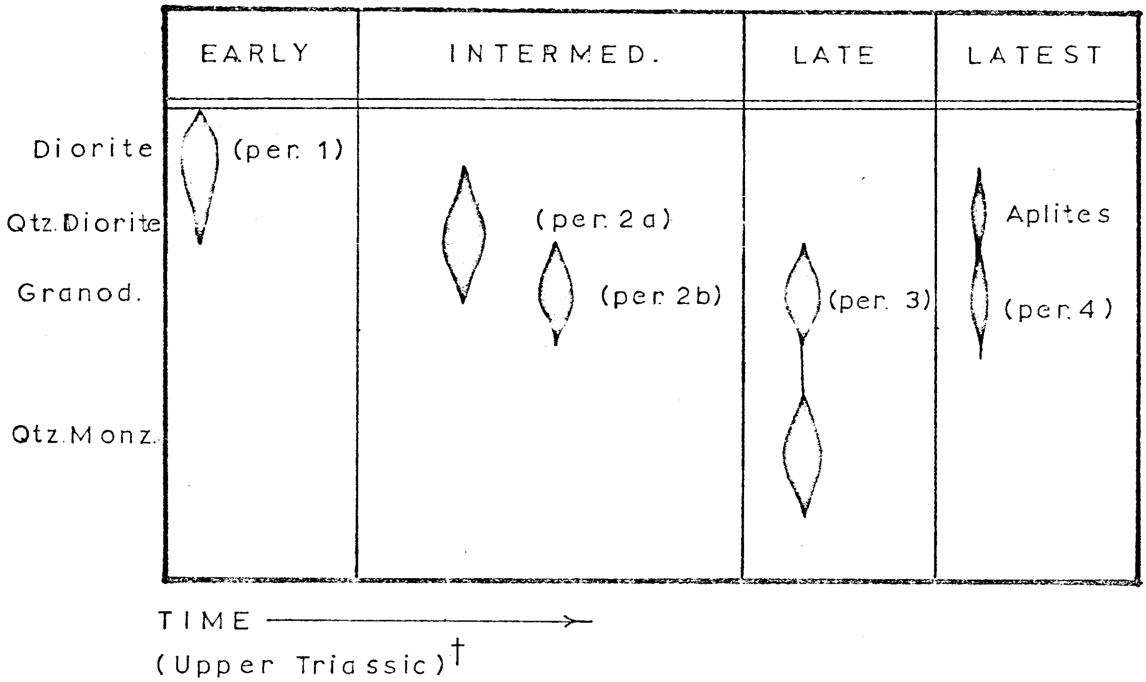
* Outward diffusion of volatile constituents from the magma to marginal zones and inward diffusion of volatile constituents from the country rock to the magma, possibly lowered the temperature of crystallization, and aided in the assimilation of basic material (Northcote, p. 58).

VI—Table of the Major Rock Units



- Illustration of relative ages of rock units and their rock compositions.

†-Isotope values from the Guichon batholith - 198 m.yrs. (Northcote, 1969.)

If the magma composition is assumed to be granodiorite, then diorite and quartz diorite are products of assimilation. The effect of assimilation of the Nicola volcanic rocks tends to decrease towards the "uncontaminated" granodiorite. The quartz diorite contains xenoliths of diorite which indicates partial assimilation of the country rocks by a granodiorite magma.

The modes of an average Nicola volcanic* granodiorite (Guichon phase) and a quartz diorite (contaminated Guichon**) (Table VII) were plotted on an assimilation diagram (Fig. 17). Straight lines between some of the corresponding components for each rock type were achieved.*** This would seem to indicate a valid assimilation of Nicola volcanics by a granodiorite magma producing a quartz diorite (contaminated Guichon phase).

Mode of Mineralization

The crystallization - assimilation model can be correlated with the sulphide and oxide occurrences on the South Dansey property. For example, the Nicola volcanics contain a relatively high proportion of oxides (up to 8%, Schau). Metallic minerals possibly remobilized along shear zones and concentrated in the contaminated intrusive rocks during assimilation. Evidence of this is the fact that the majority

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* Nicola volcanic, sample 25, cycle A, p.98, Table 15 - M. P. Schau.

** Chemical analysis of an average contaminated Guichon and Guichon rocks - C. Westerman.

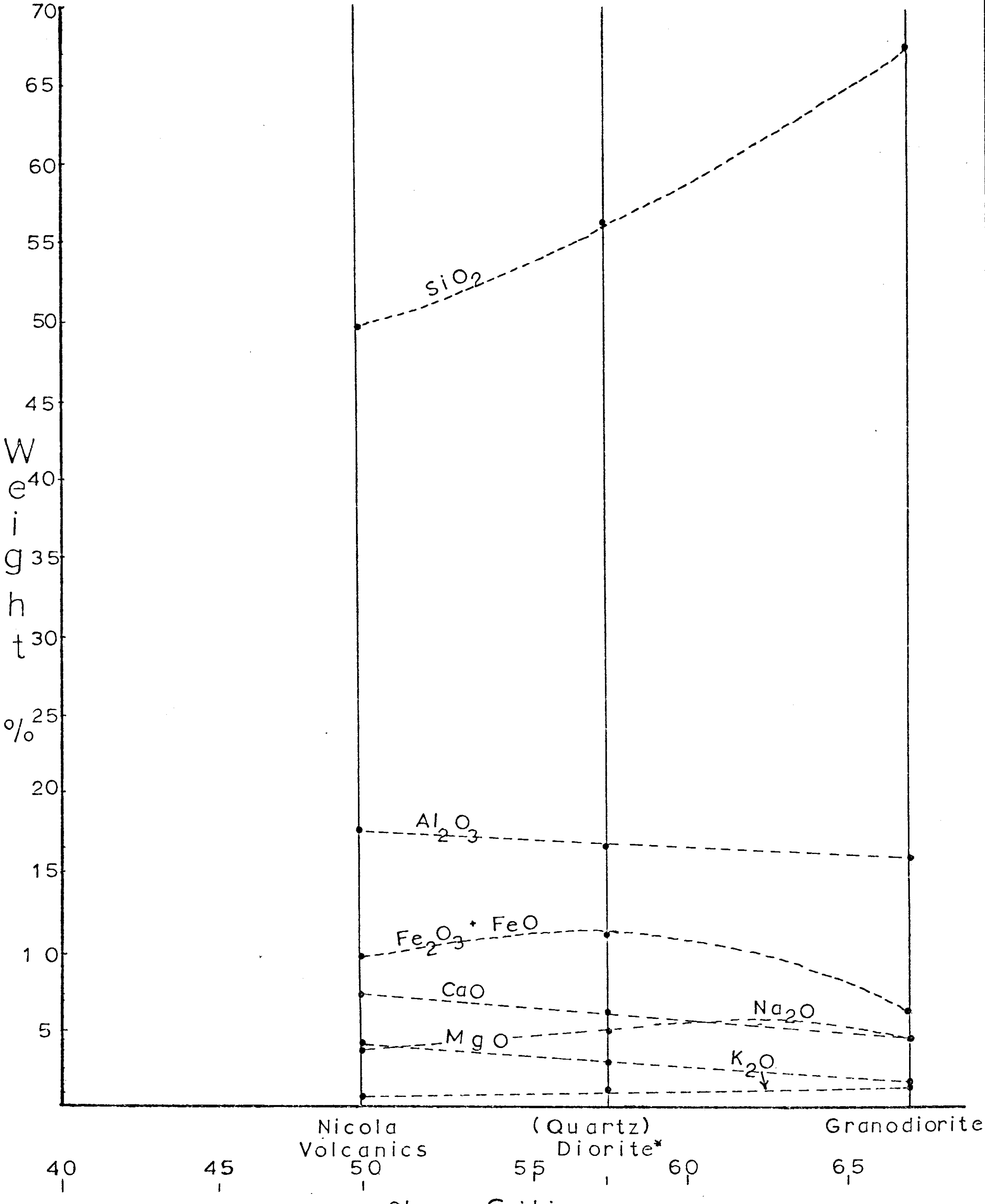
*** Rock compositions are variable and lines between rock components will not always be straight lines.

Table VII - Chemical Analysis (%) of Average Nicola*, Quartz Diorite (Contaminated Guichon) and Granodiorite** (Guichon) Rocks.

	Nicola	Quartz Diorite	Granodiorite
SiO	49.5	56.2	67.0
Al O	17.2	16.4	14.9
Fe O	8.1	6.05	2.79
FeO	2.4	5.68	2.77
MgO	3.7	2.41	1.27
CaO	7.3	6.05	4.34
Na O	3.8	4.59	4.29
K O	0.8	1.12	1.57

* M. P. Schau, Geology of Upper Triassic Group in South Central B. C.; Nicola volcanic sample 25, cycle A, p.98, Table 15.

** C. Westerman, Minerology of the Guichon Batholith; chemical analysis of an average contaminated Guichon and Guichon rocks.



Assimilation Diagram

-(See Table VI)

(Fig. 17)

of metallic minerals occur in the diorite and quartz diorite.

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APPENDIX I

Modal Analysis

Four parallel east-west lines consisting of 90 rock specimens were used for a modal analysis of the rock units of the South Dansey property (Fig. 18). The mineralogy and rock composition were determined* for each specimen and listed on Tables II and III. The values for each section were plotted on graphs (Fig. 21) and from the values of quartz and orthoclase the geological contacts were established (Fig. 20).

In section A the percentage of mafic minerals tends to increase towards the diorite. The mafic minerals of rock specimens in sections B, C and D generally decrease in percentage towards the quartz diorite/diorite contact but increase into the diorite unit. In all four sections, the percentage of quartz and orthoclase tends to decrease slightly from the granodiorite into the quartz diorite. From the quartz diorite/diorite contact towards the diorite unit there is a significant decrease of quartz and orthoclase.

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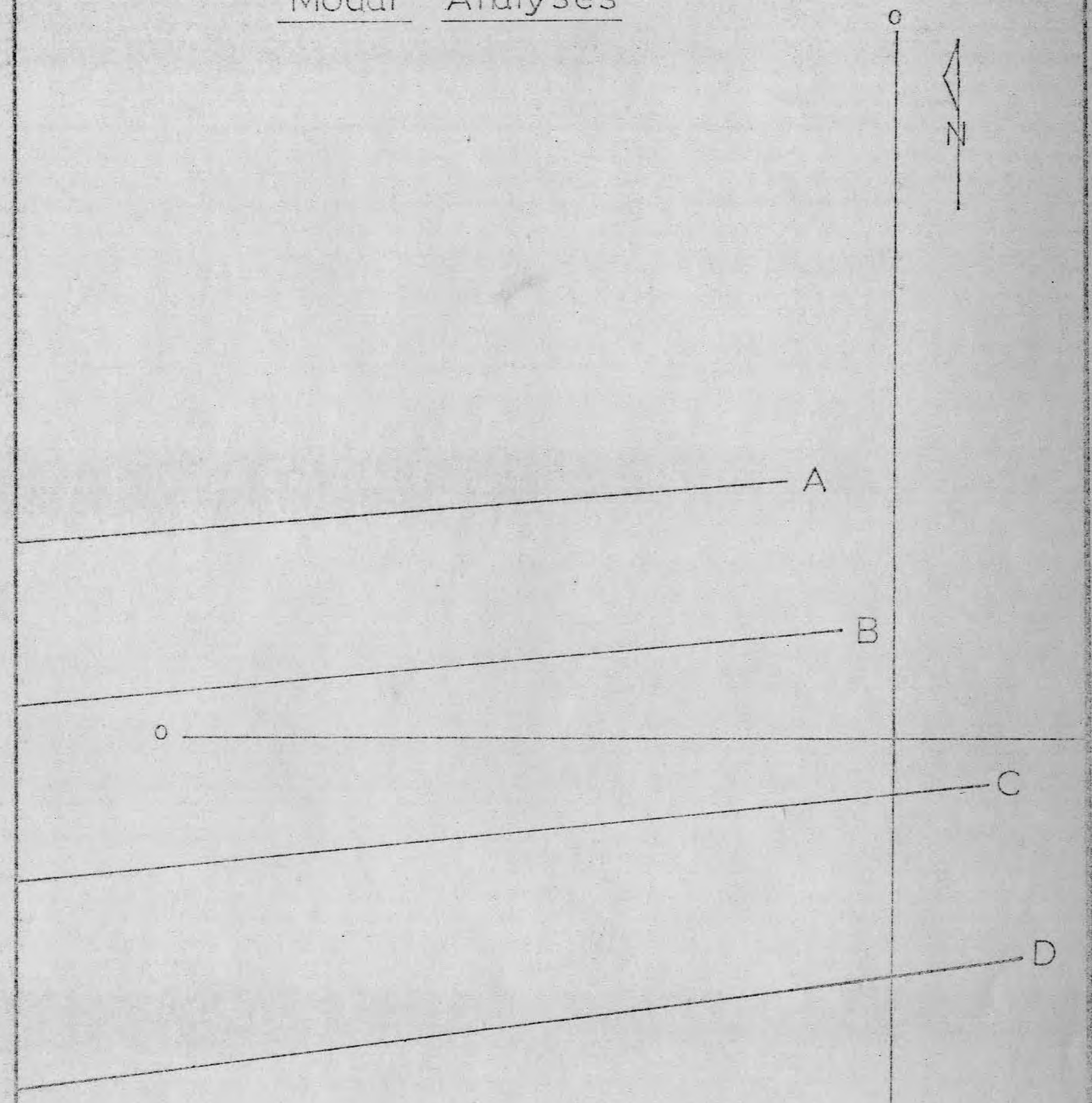
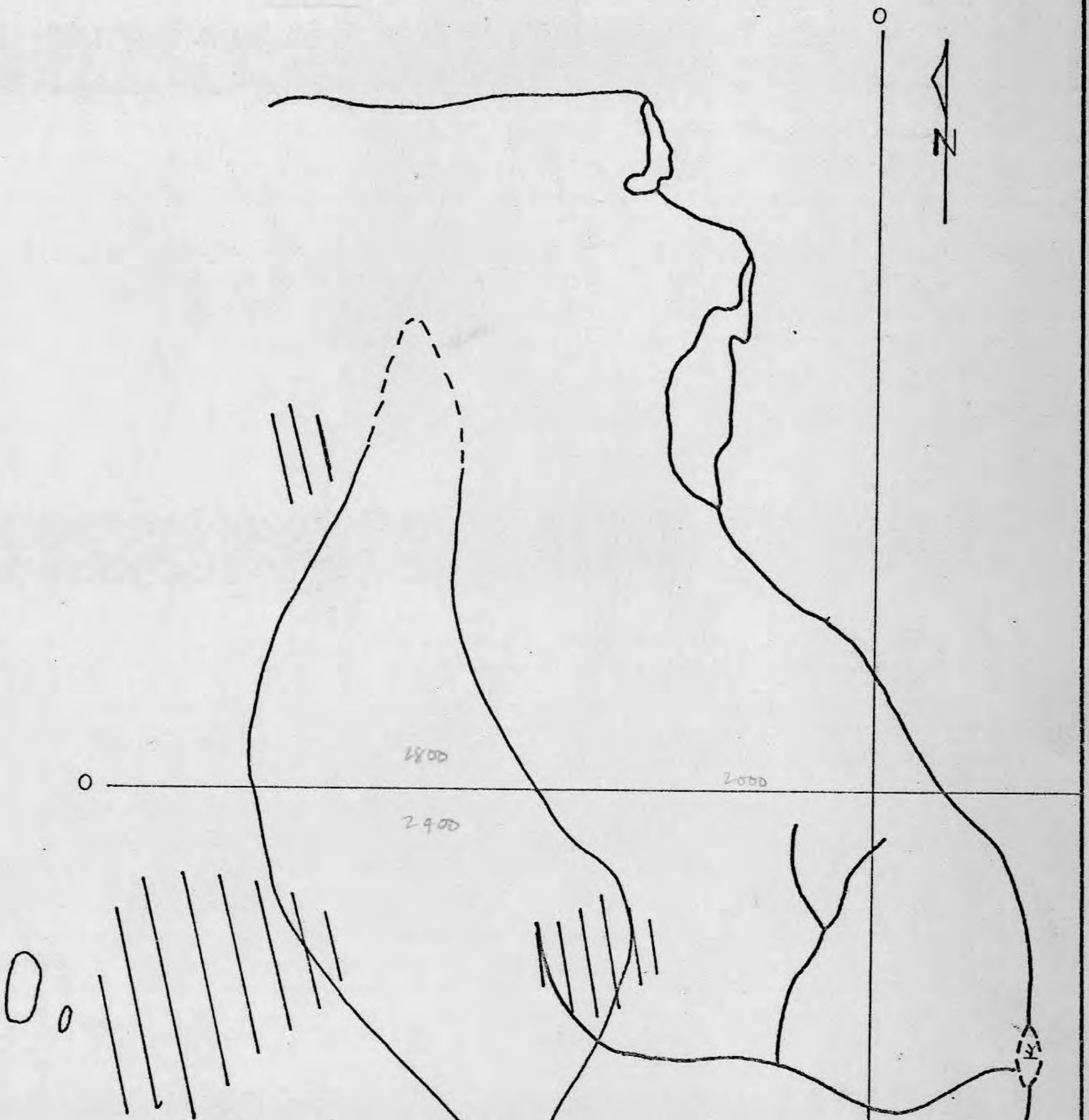
* Thin sections were made of the 90 specimens selected for detailed analysis. The rock slabs were then stained with HF and point counted.

Modal Analyses



Sections composed of numerous stained slabs and thin sections.

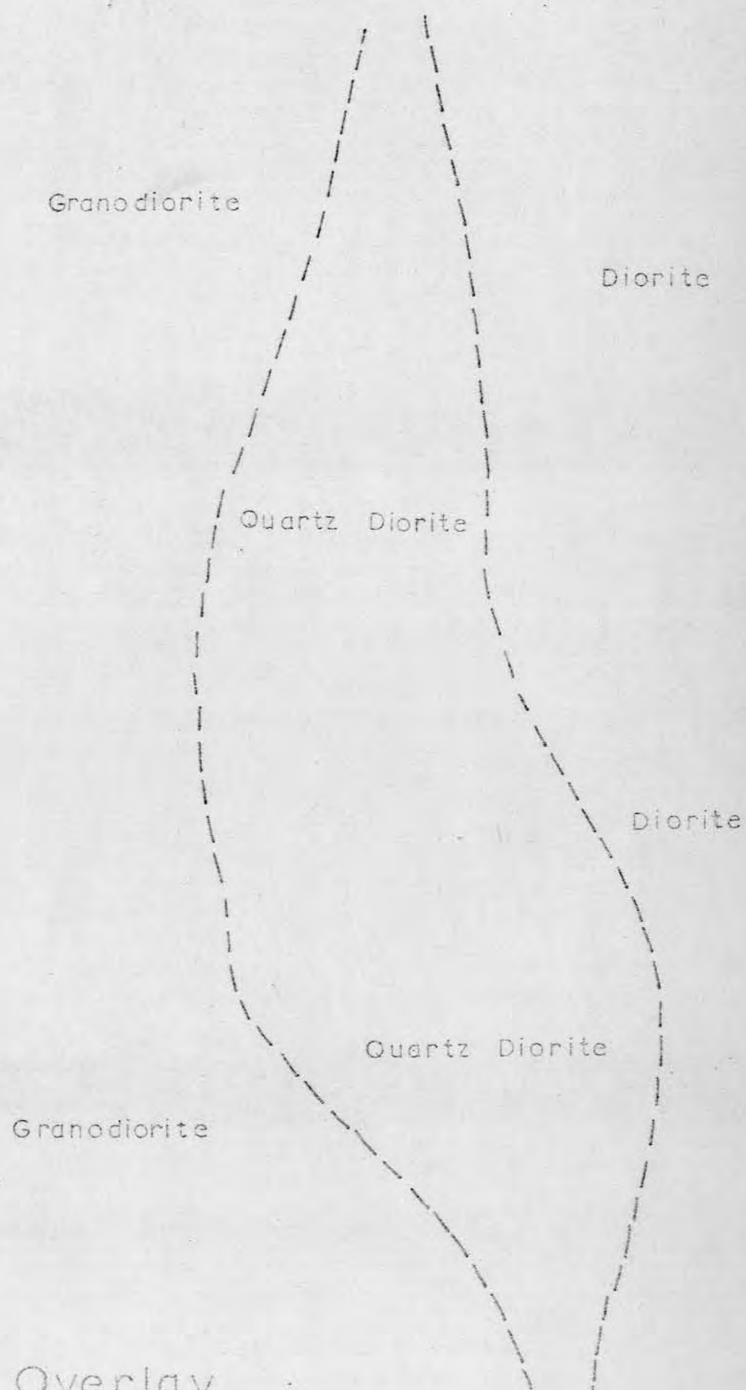
(Fig. 18)



Geology with Overlay

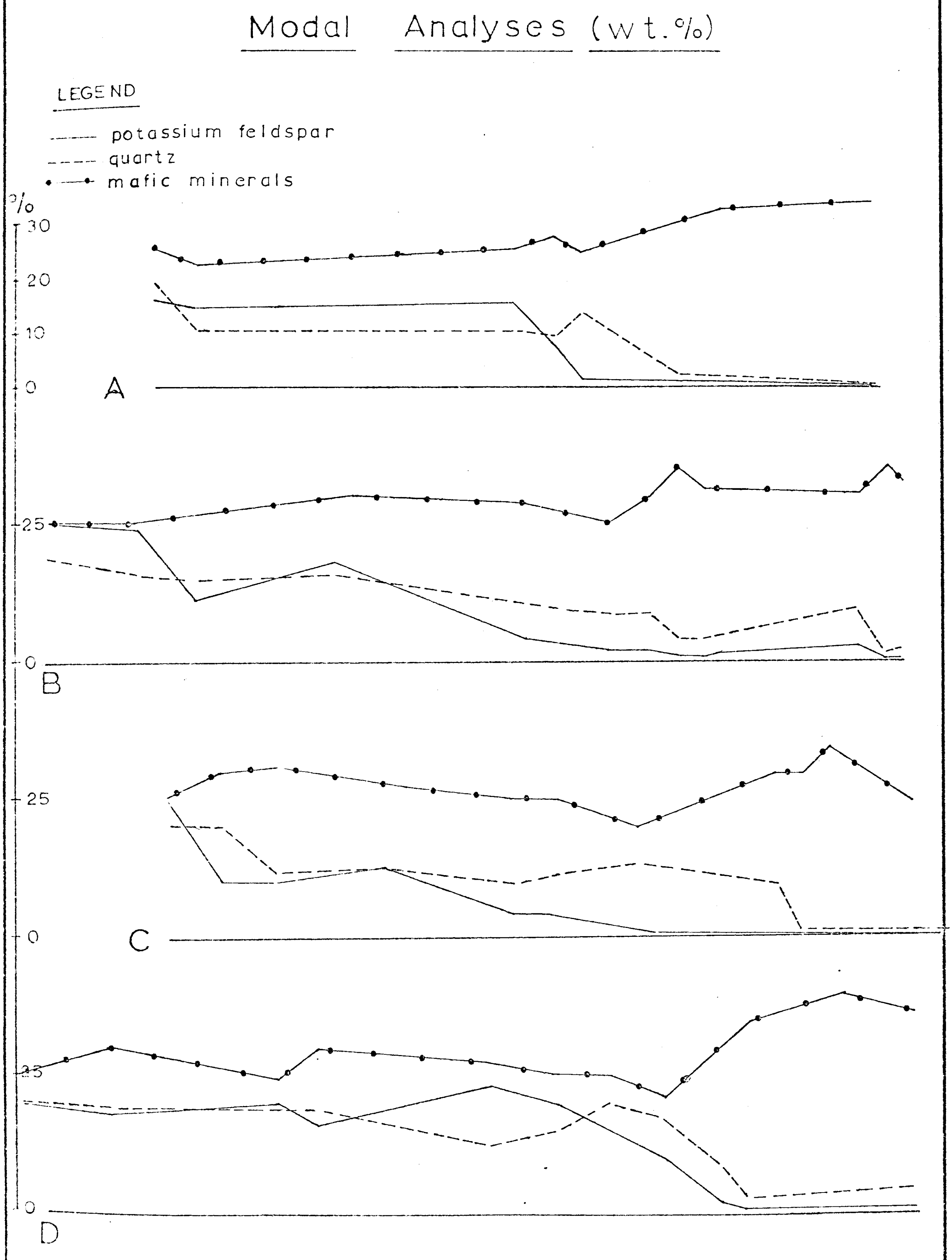
(Fig.19)

SCALE 0 ——— 1000 FEET



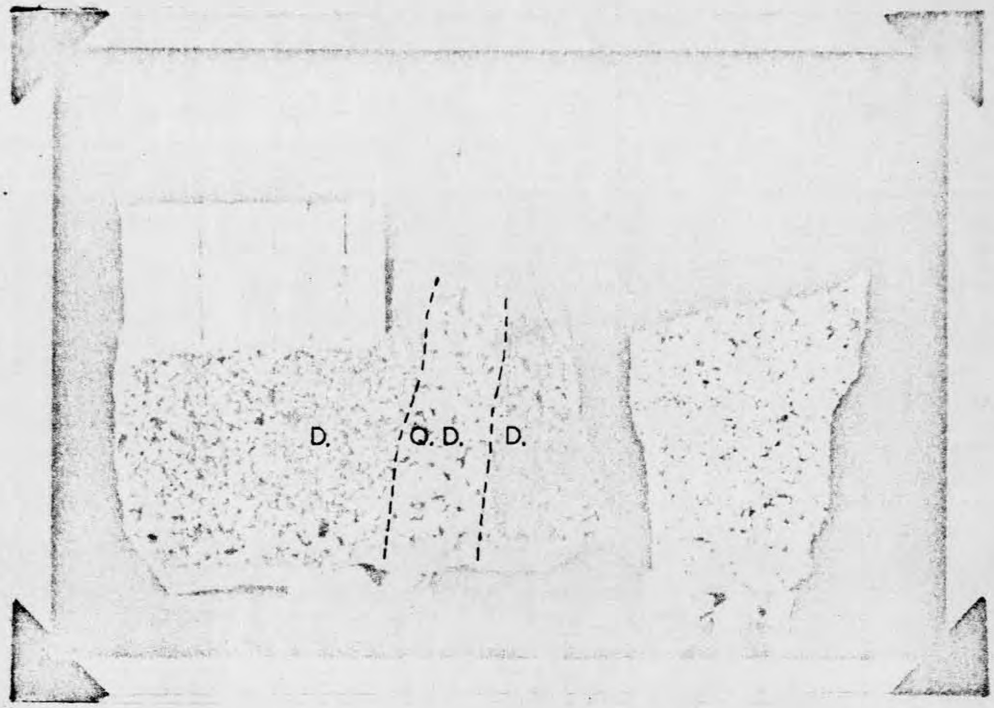
Geology Overlay

(Fig. 20)

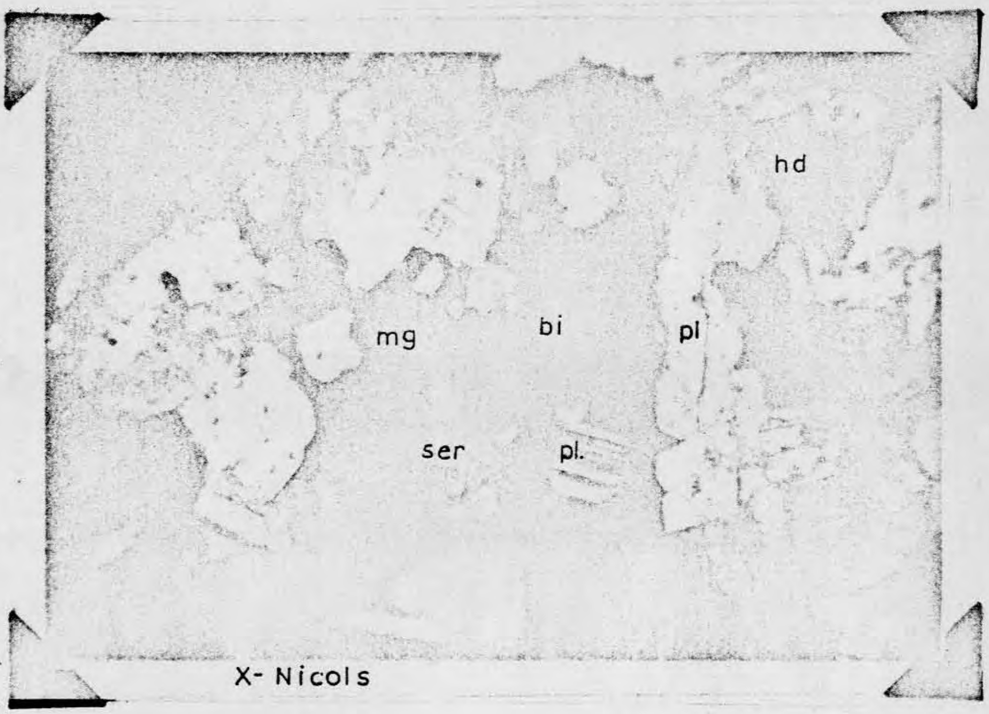


Modal Analyses (wt.%)
LEGEND
potassium feldspar
quartz
mafic minerals
%
30
20
10
0
A
25
0
B
25
0
C
25
0
D

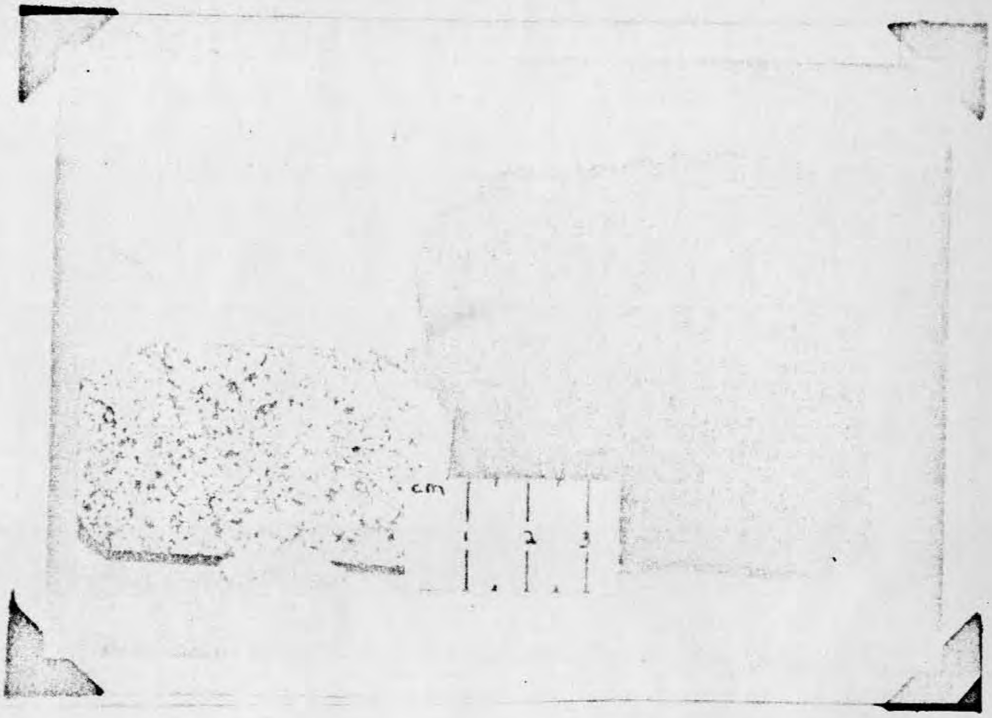
(Fig. 21)



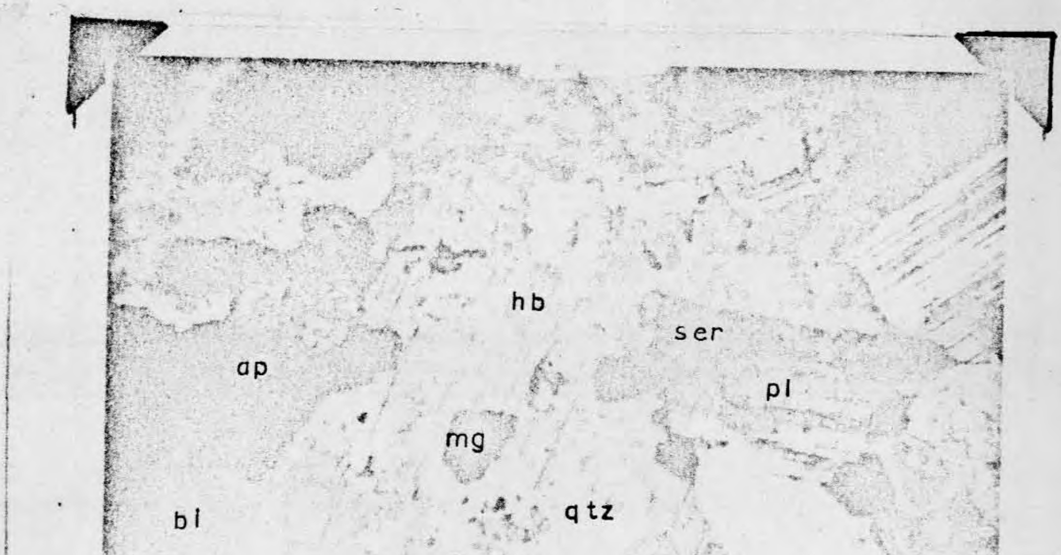
**Print I - Left: Diorite cut by quartz diorite.
Right: Stained rock slab of diorite.**



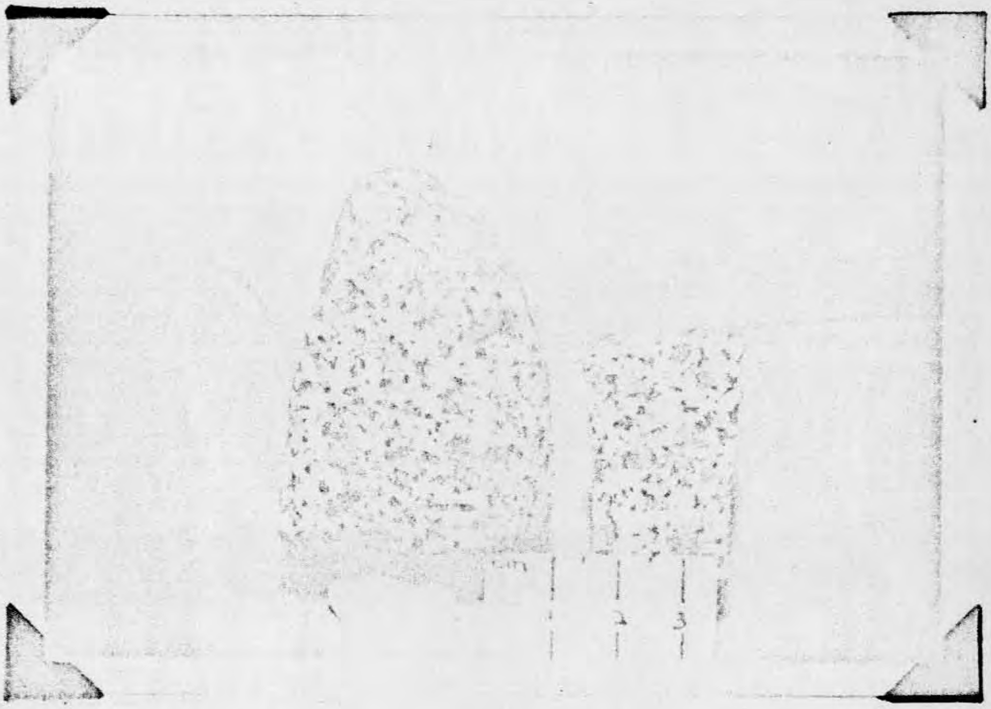
Print II - Thin section of diorite. (Objective x4)



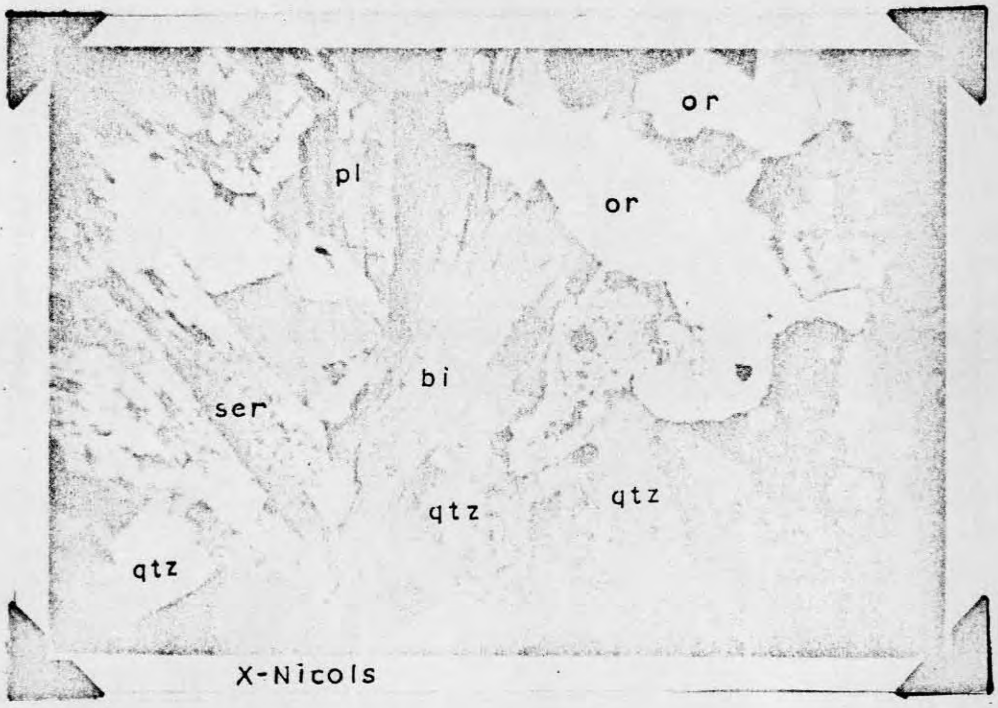
Print III - Left: Stained rock slab of quartz diorite.
Right: Rock slab of quartz diorite.



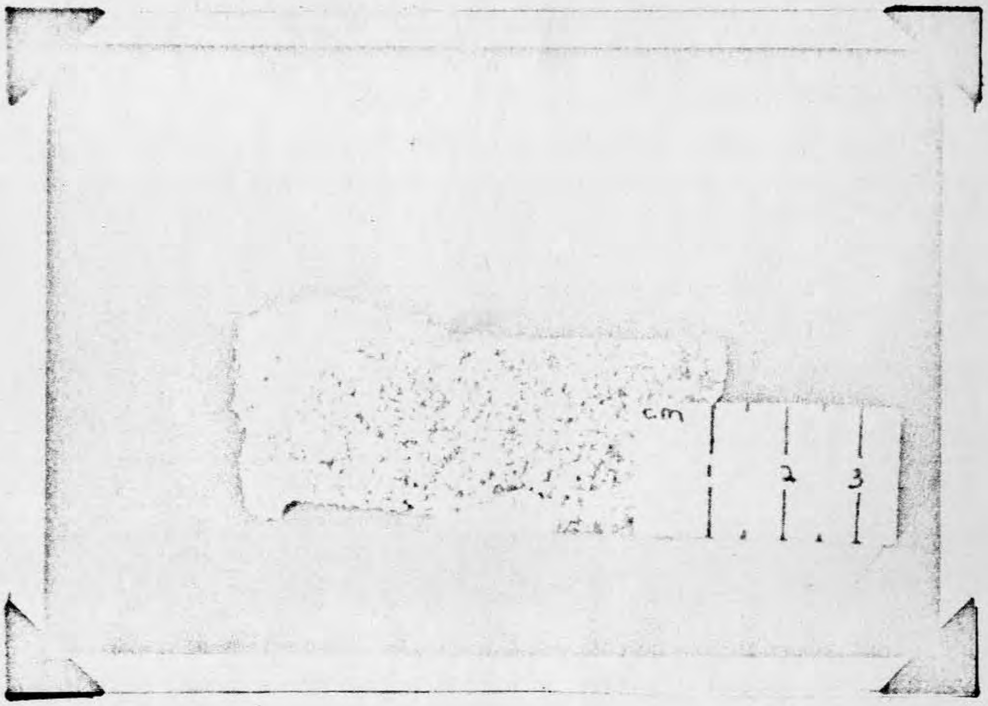
Print IV - Thin section of quartz diorite.
(Objective x4)



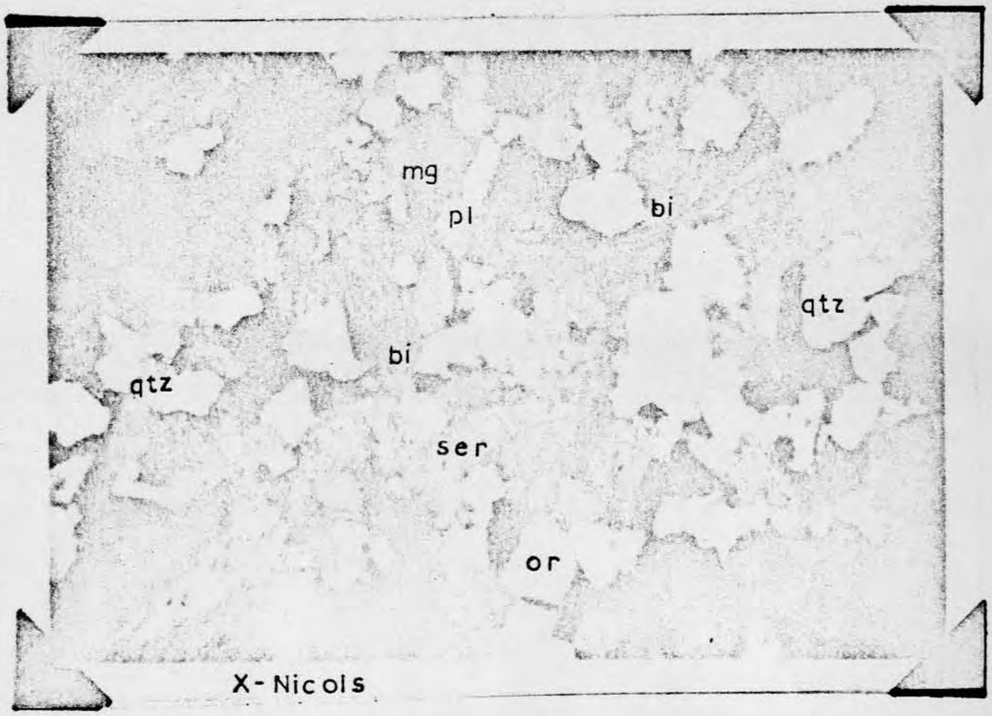
**Print V - Left: Rock slab of granodiorite.
Right: Rock slab of stained granodiorite.**



Print VI - Thin section of granodiorite. (Objective x4)

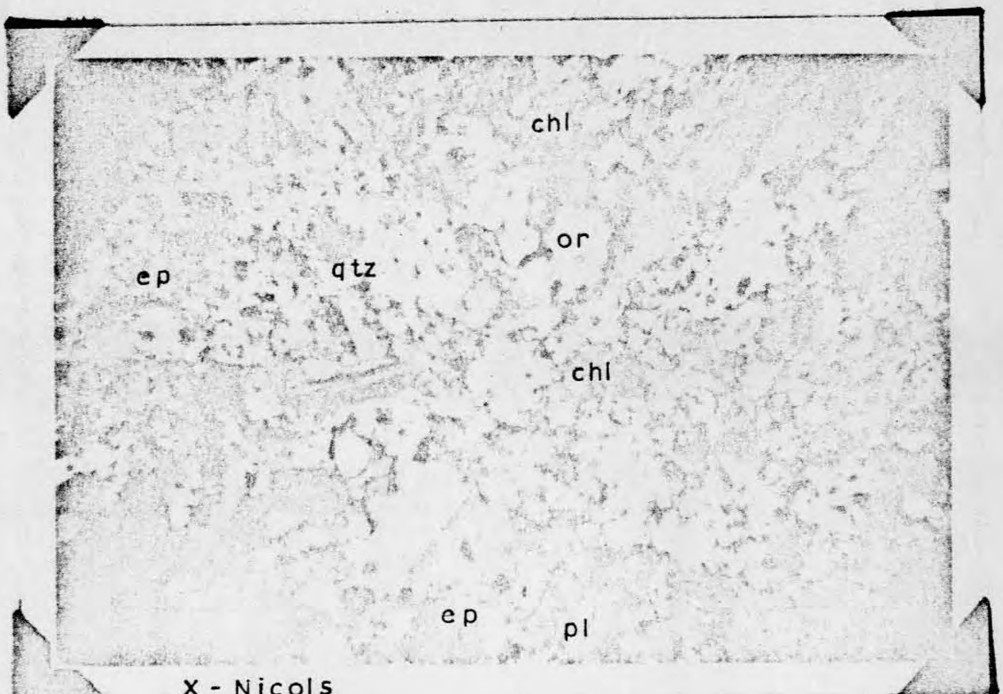


Print VII - Stained rock slab of dyke phase.

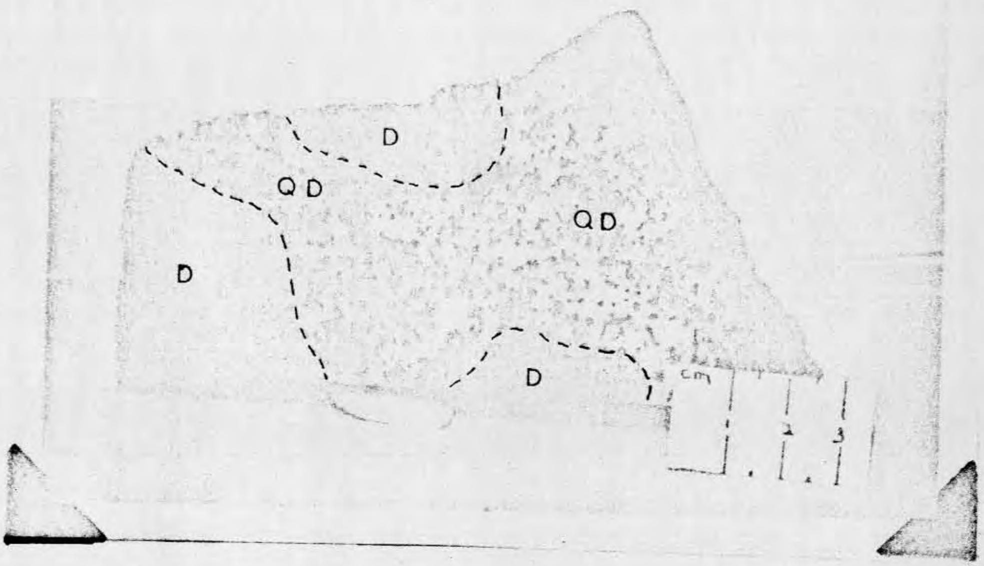


Print VIII - Thin section of dyke phase.
(Objective x4)

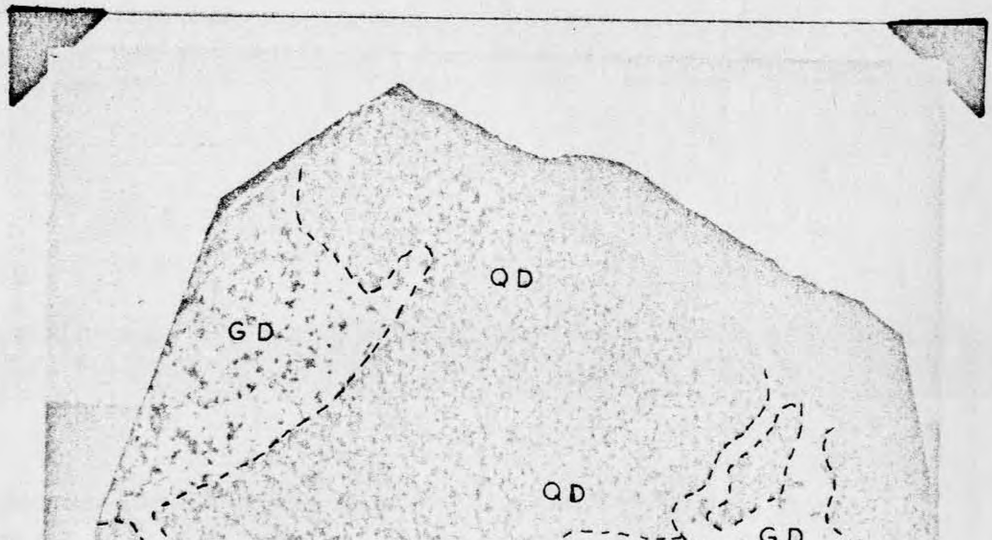
Print IX - Rock slab of intrusive breccia.



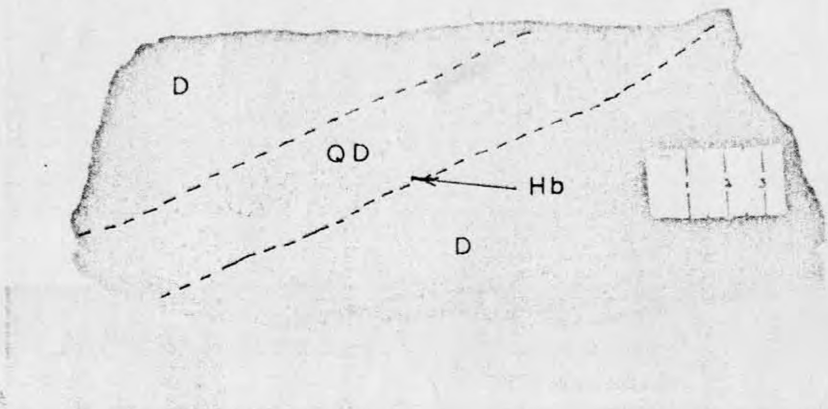
Print X - Thin section of intrusive breccia.
(Objective x10)



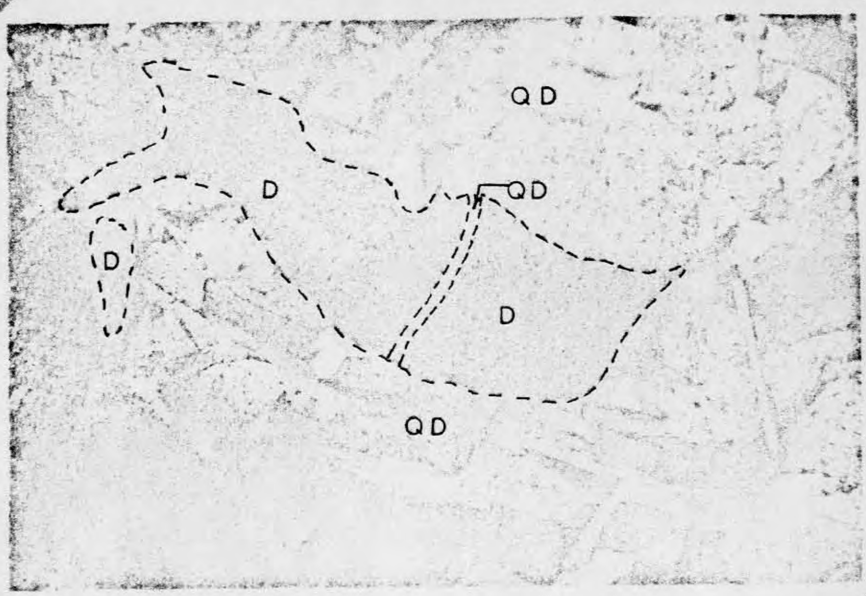
Print XI - Quartz diorite with inclusions of diorite.



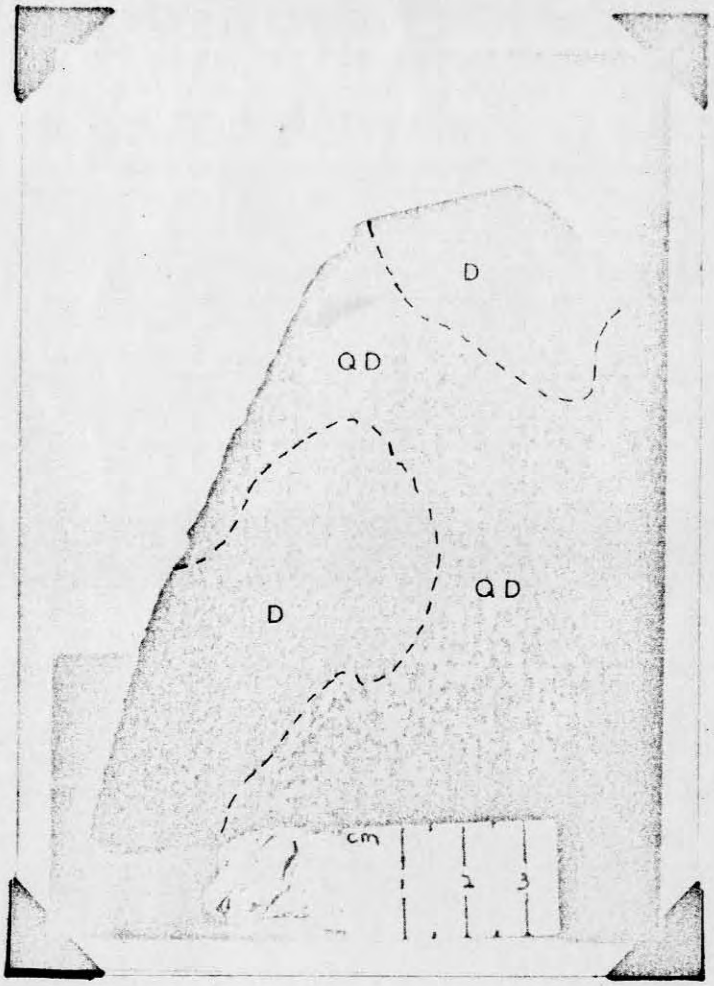
Print XII - Granodiorite intruding quartz diorite. Xenolith of diorite in quartz diorite.



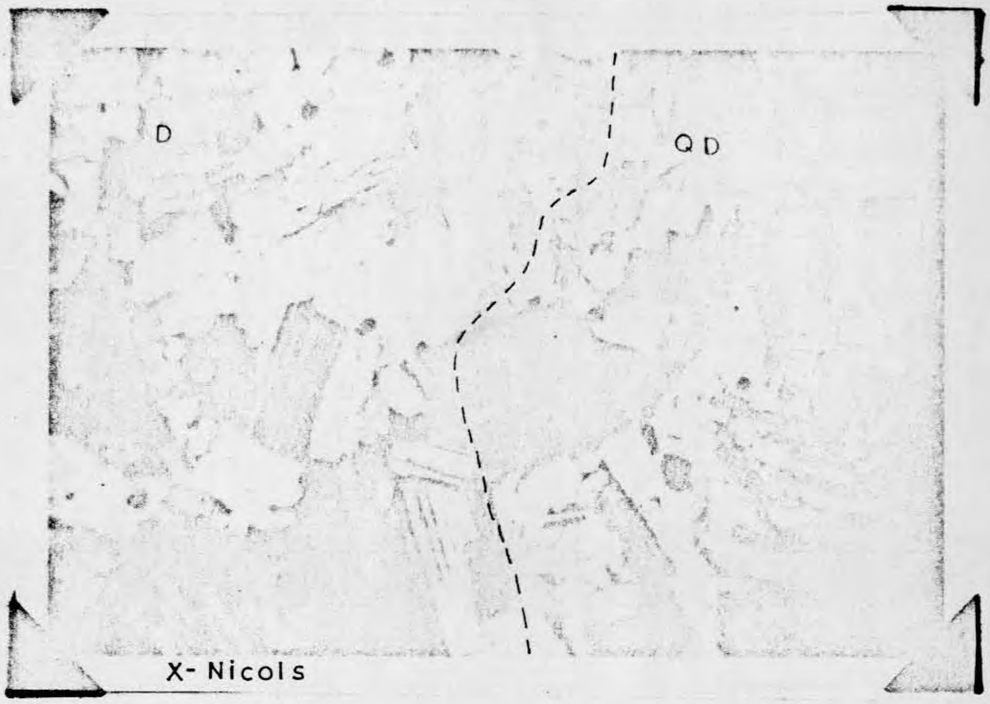
Print XIII - Quartz diorite intruding diorite.



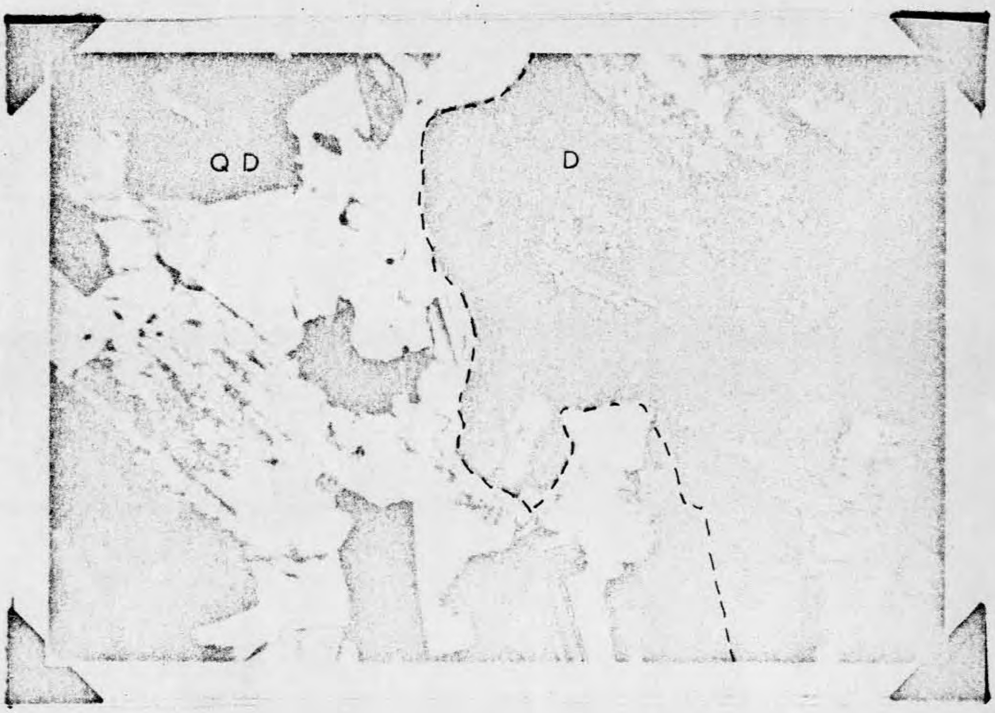
Print XIV - Quartz diorite with large diorite xenolith.



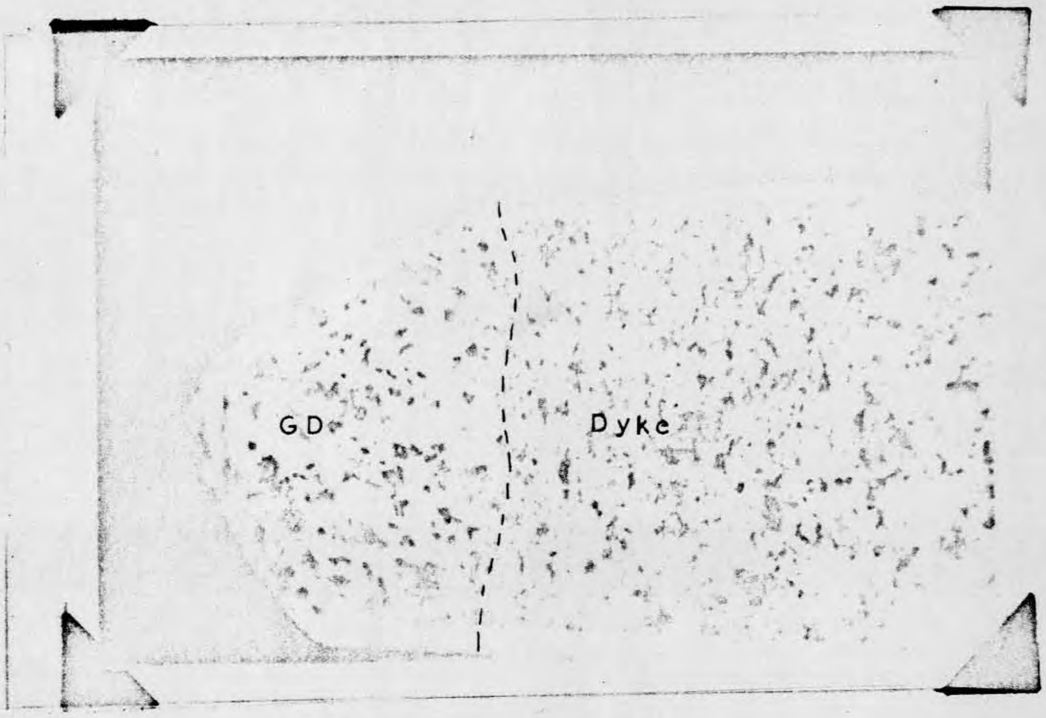
Print XV - Quartz diorite with diorite xenoliths.



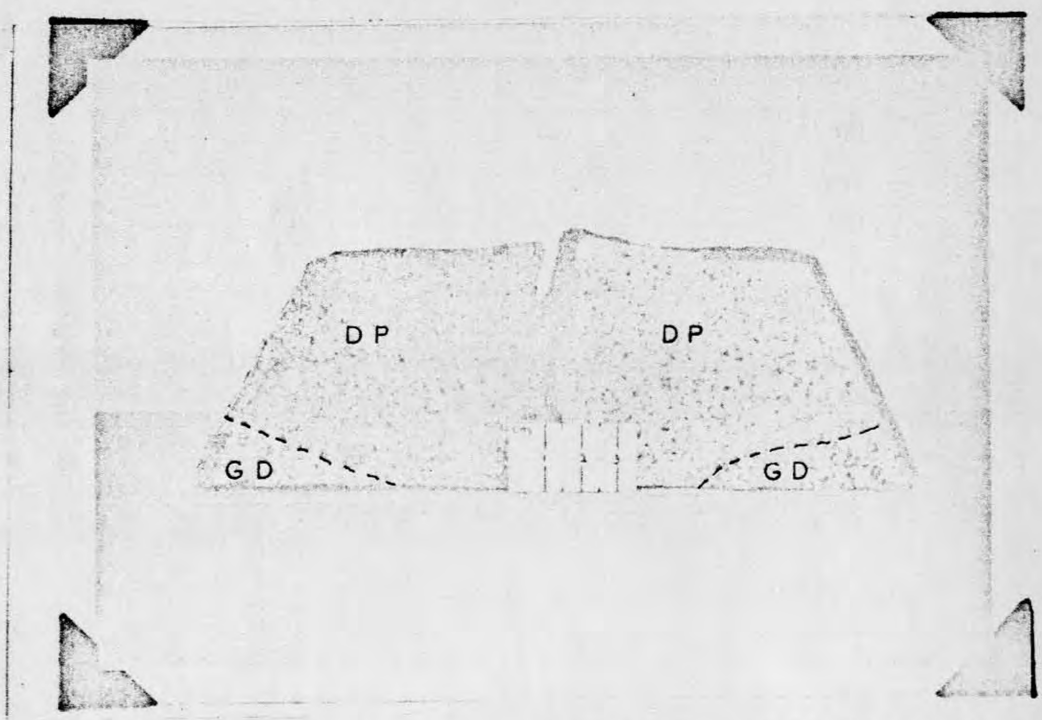
Print XVI - Thin section of diorite and quartz diorite. (Objective x4)



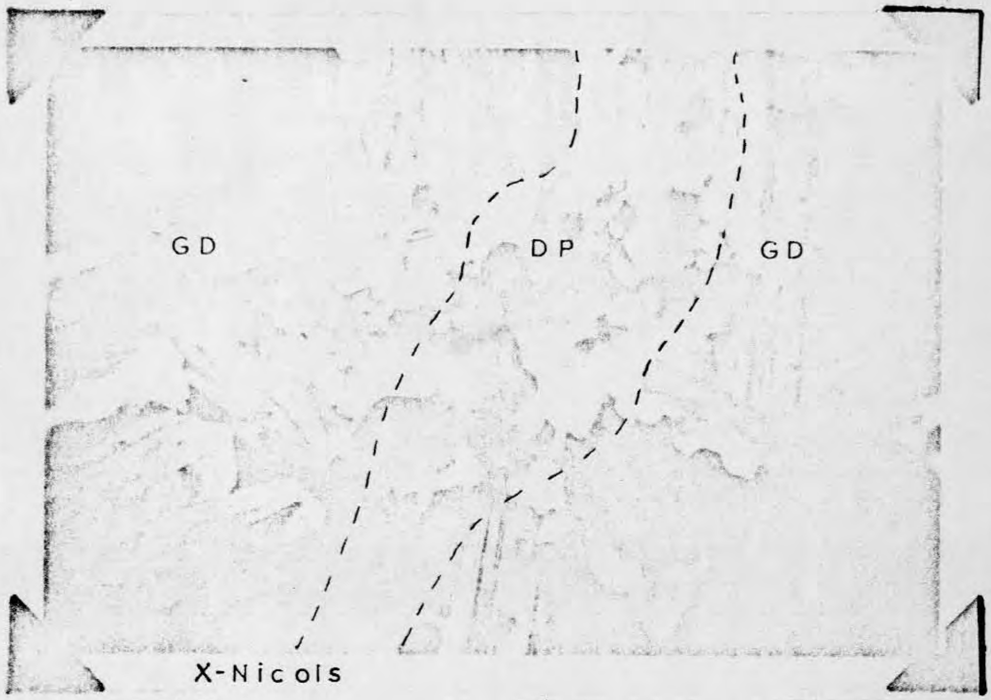
Print XVII - Thin section of diorite and quartz diorite. (Objective x4)



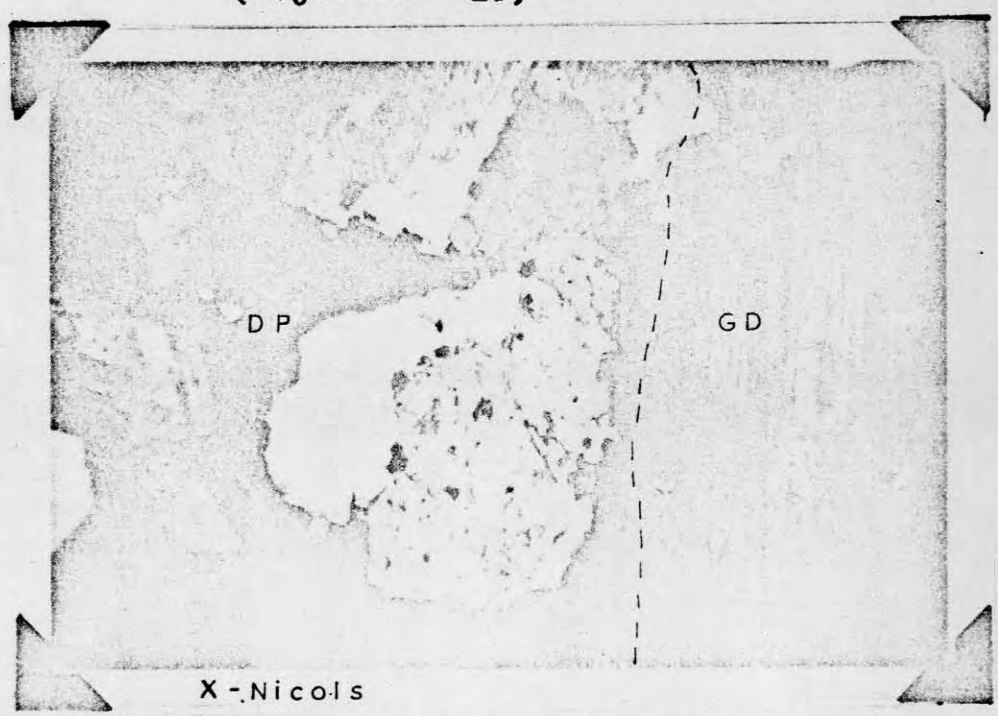
Print XVIII - Contact between granodiorite and dyke phase. (x2)



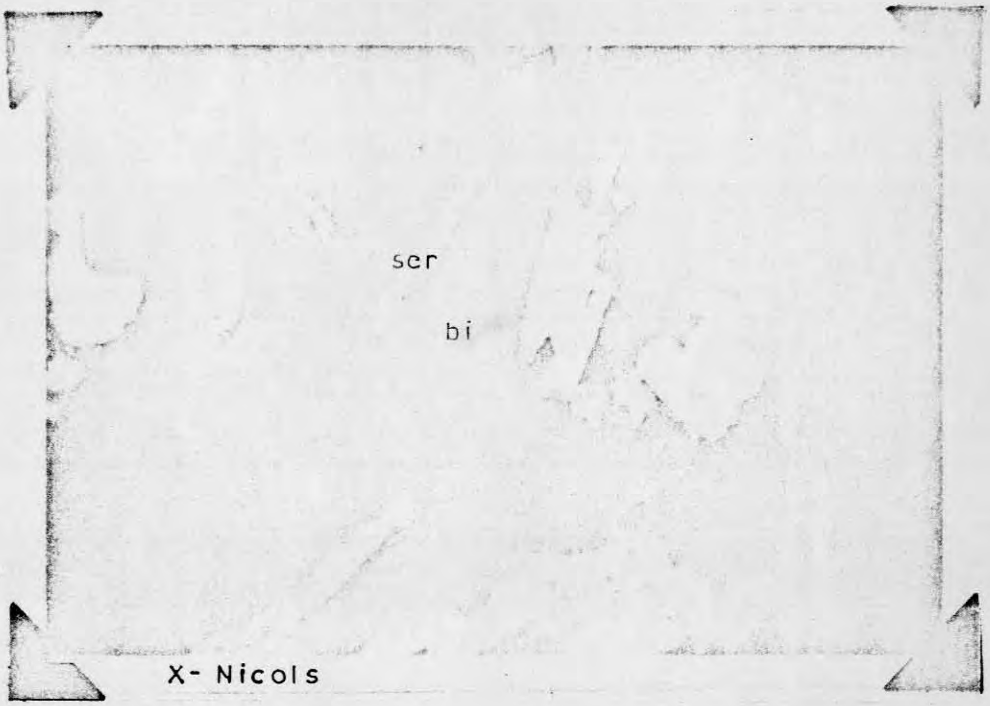
Print XIX - Left: Contact between granodiorite and dyke phase.
Right: Stained slab of the same rock.



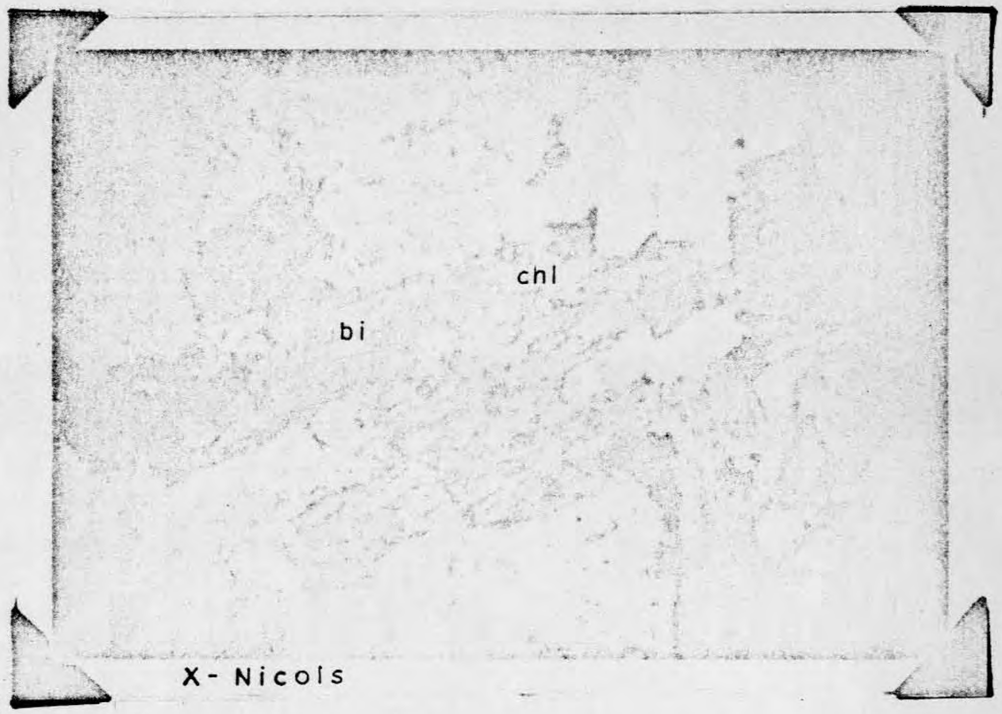
Print XX - Thin section of contact between granodiorite and dyke phase. (Objective x10)



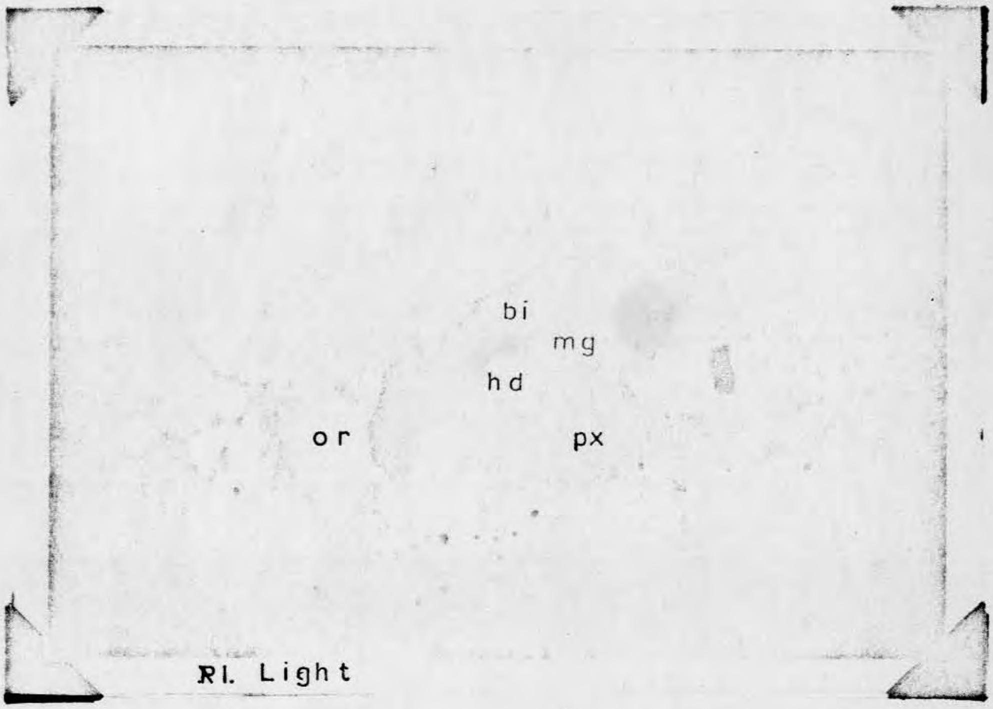
Print XXI - Thin section of contact between granodiorite and dyke phase. (Objective x4)



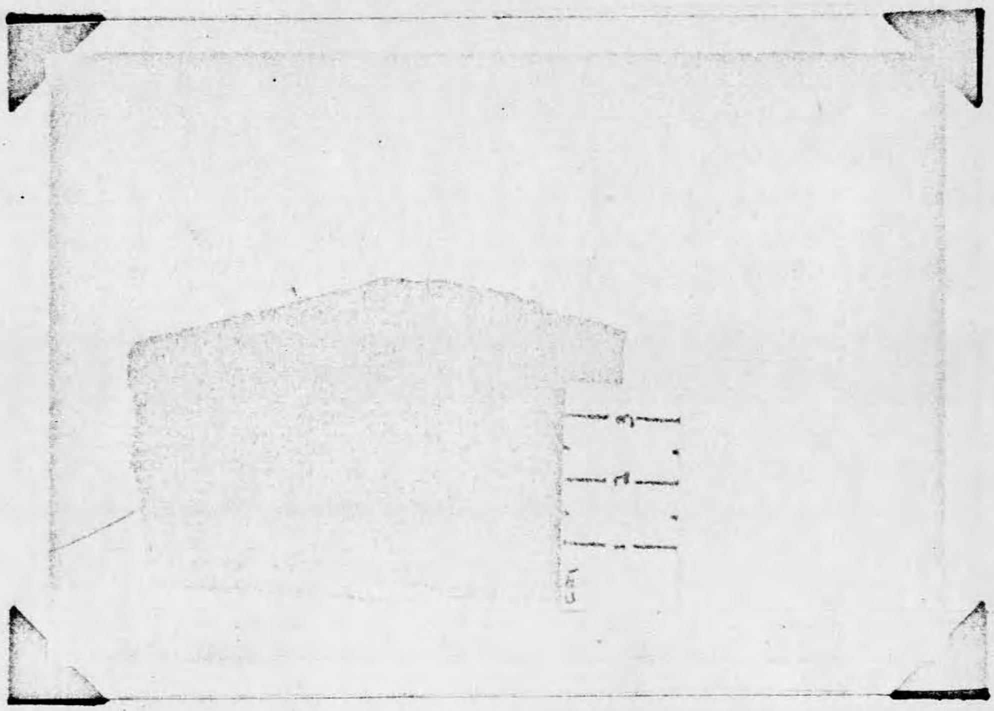
Print XXII - Sericite alteration of biotite in granodiorite. (Objective x4)



Print XXIII - Chlorite alteration of biotite in granodiorite. (Objective x4)



Print XXIV - Pyroxene, hornblende, biotite, potassium feldspar deuteric alteration in granodiorite. (Objective x4)



Print XXV - Saussuritization of intrusive breccia.