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TITLE OF THESIS/TITRE DE LA THÈSE SEDIMENTATION ON THE MARGIN
OF AN ARCHEAN FELSIC VOLCANIC COMPLEX
(SLAVE STRUCTURAL PROVINCE)

UNIVERSITY/UNIVERSITÉ CARLETON U.

DEGREE FOR WHICH THESIS WAS PRESENTED/
GRADE POUR LEQUEL CETTE THÈSE FUT PRÉSENTÉE M.Sc.

YEAR THIS DEGREE CONFERRED/ANNÉE D'OBTENTION DE CE DEGRÉ 1977

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SEDIMENTATION ON THE MARGIN
OF AN ARCHEAN FELSIC VOLCANIC COMPLEX
(SLAVE STRUCTURAL PROVINCE)

by

John Ostler, B.A.

A thesis submitted to the Faculty of
Graduate Studies and Research in
partial fulfilment of the requirements
for the degree of Master of Science

Department of Geology

Carleton University

Ottawa, Ontario

April 8, 1977

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The undersigned recommend to the Faculty
of Graduate Studies and Research acceptance
of the thesis

"Sedimentation on the margin
of an Archean felsic volcanic complex
(Slave Structural Province)"

submitted by John Ostler, B.A.
in partial fulfilment of the requirements for
the degree of Master of Science.

Thesis Supervisor

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April 28, 1977

ABSTRACT

The Back River Volcanic Complex, exposed in a 20 by 40 km area within the Slave Province of the Canadian Shield, is one of the largest felsic volcanic complexes in that province. This Archean volcanic complex was formed during the deposition of the upper part of the Yellowknife Supergroup. Subaerial tuffs form the central part of the complex; flows and subaqueous pyroclastics are exposed near its margins. At 'Islands Lake', on the southeastern margin of the complex, the volcanic assemblage comprises basaltic to andesitic flows and tuffs overlain by dacitic to rhyolitic pyroclastic units.

Chemical and clastic sedimentary rocks overlie the volcanic complex. A basal chemical unit, composed of silicate and oxide iron formations, carbonates and carbonaceous slates is overlain by a clastic unit composed of greywacke-argillite couplets, argillite and carbonate beds. The chemical unit is about 50 m thick; the clastic unit is more than 2500 m thick.

Two phases of deformation affected the area. During the first phase, tight folds formed in the sedimentary rocks and in a narrow, peripheral zone in the volcanic complex. The interior of the volcanic complex was not tightly folded but a pervasive cleavage, with a south-southeast strike and a steep westward dip, formed there. Fold geometry indicates that ductile sedimentary

strata were compressed against a comparatively rigid volcanic mass during the first phase of deformation.

During the second phase of deformation, large box folds developed in the sedimentary rocks. This phase of deformation may have been caused by constriction of sedimentary strata between the volcanic complex and two rising plutons.

The sedimentary rocks appear to represent a transgressive sequence deposited on the flank of a volcanic island within a subsiding basin. The chemical sediments were deposited during or after volcanism when the flanks of the volcanic island were above the surrounding basin floor. Clastic sediments, transported by turbidity currents from a volcanic source terrain to the southeast, subsequently buried the chemical sediments (and perhaps the volcanic complex as well).

The clastic sediments are coarse grained to the southeast of the volcanic complex and fine grained to the northwest. The volcanic complex may have been a barrier to sedimentation, diverting northwestward-flowing currents to a more northerly direction of transport.

There is a distinct northwestward decrease in grain size in the turbidites indicating that there may have been a single basin in the northeastern part of the Slave Province during the late stages of deposition of the Yellowknife Supergroup sediments.

ACKNOWLEDGEMENTS

The author would like to thank his supervisors, Dr. J.A. Donaldson of Carleton University and Dr. M.B. Lambert of the Geological Survey of Canada, for their support and guidance. Dr. Donaldson's discussion of the research, Dr. Lambert's guidance in the field and the criticism of the manuscript by both are greatly appreciated. Enthusiastic field assistance was provided by Jean LaFleur. Dr. R.A. Frith of the Geological Survey of Canada contributed to valuable discussions on the stratigraphy of the northeastern part of the Slave Province and enabled the author to revisit the thesis map-area. The author would also like to thank Lori Ostler who endured typing the manuscript. Support for the thesis was provided through Dr. Donaldson's National Research Council of Canada operating grant A5536 and through Dr. Lambert's Geological Survey of Canada project 740019.

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Graphic Methods

Structural maps on the scales of 1:5000 and 1:25000 were drawn of the area around 'Islands Lake' and the southeastern margin of the volcanic complex (Maps 3, 4).

Eight cross-sections of the sedimentary rocks near the volcanic-sedimentary contact display the stratigraphy in the chemical and lower clastic units (Figures 3,4,5,6); five cross-sections of the rocks east of 'Islands Lake' display the stratigraphy of the clastic unit (Figures 7,8,9). From these cross-sections, columnar geological sections were compiled and correlated (Figure 10) to illustrate the stratigraphy and facies changes in the sedimentary rocks around 'Islands Lake'.

Petrographic Techniques

Eighty thin sections were examined under a petrographic microscope. Forty of them were stained for carbonate and feldspar.

Carbonates were stained by alizarin red S and potassium ferricyanide in solutions of hydrochloric acid following the method of Dickson (1966). From this process, CaCO_3 is stained red and iron-bearing dolomites are stained Prussian blue. Other carbonates are stained various shades of purple, mauve and brown. Carbonates

Areal view of 'Islands Lake from the centre of the Back
River Volcanic Complex.

View of 'Islands Lake' from the southwest shore.

INTRODUCTION

GENERAL GEOLOGY

One of the largest Archean felsic volcanic complexes in the eastern Slave Province of the Canadian Shield occupies a 20 km by 40 km area along and west of the Back River near Regan Lake (Figure 1). Felsic to intermediate pyroclastics and intermediate to mafic pyroclastics and flows are the principal rocks in the complex. The complex is surrounded by igneous intrusions and metasedimentary* rocks of the Yellowknife Supergroup (Henderson, 1975A).

Along the southeastern margin of the volcanic complex are chemical sedimentary rocks, including silicate and oxide iron formations, carbonates and carbonaceous slates. Clastic rocks including greywacke-argillite couplets, argillites and carbonates overlie the chemical sedimentary rocks.

Rocks in the area are metamorphosed to greenschist facies (Henderson, 1975A). Metamorphic minerals include biotite, epidote, muscovite and chlorite. Metamorphism is related to two periods of deformation.

* The term meta- is subsequently omitted because the deposition, not the metamorphism of the rocks is stressed.

FIGURE 1: COMPILATION FROM GEOLOGICAL SURVEY OF CANADA MAPS
1031A, 45-1963, 1216A, 1267A

PREVIOUS WORK

Cominco, Great Plains, DuPont, International Mining Services and other mining companies have been active in the area. Most of the volcanic complex and some of the sedimentary rocks have been staked at various times since the early 1960's. Cominco conducted an extensive drilling program on the eastern margin of the volcanic complex.

Parts of the volcanic complex are on four Geological Survey of Canada maps: 1031A (Lord and Barnes, 1950), 45-1963 (Fraser, 1964), 1216A (Wright, 1967) and 1267A (Tremblay, 1971). Henderson (1975A) studied the eastern margin of the volcanic complex and Baragar (1975) described some of the volcanic rocks at 'Wolverine Lake' (unofficial name).

Most of the belt was mapped as undifferentiated felsic volcanics. A belt of mafic volcanics were recognized at the northeastern margin of the complex (Figure 1).

PRESENT WORK

The volcanic complex was mapped as part of a Geological Survey of Canada project led by M.B. Lambert (Lambert, 1976). Field work for this thesis was done by the author as a member of Dr. Lambert's party in 1975. The field-area was revisited briefly in 1976.

The thesis map-area contains a segment of the Back River Volcanic Complex including a significant volcanic-sedimentary contact on its southeastern margin, and adjacent sedimentary rocks.

An area flanking the west side of the Back River was chosen for detailed study because of its superior outcrops.

OBJECTIVES AND METHODS

OBJECTIVES

The objectives of this study were: to determine the nature of the sedimentary rocks and their relation to the volcanic rocks on the southeastern margin of the volcanic complex, to describe the changes in sedimentation through time and in space, to describe the environments of deposition and to infer the provenance of the sediments.

Yellowknife Supergroup sediments are well preserved near the Back River. Metamorphic grade is of the greenschist facies, and deformation has not been sufficiently severe to obliterate sedimentary textures and lithological relationships. Unlike the volcanic rocks at Yellowknife Bay, those near the Back River are mostly felsic to intermediate. This second and somewhat different example of Yellowknife Supergroup sediments in association with abundant felsic volcanic rocks was studied as a contribution to the knowledge of Archean Slave Province stratigraphy and sedimentation.

METHODS

Field Work

Mapping was done by the author, assisted by Jean La Fleur, from a camp on the Back River, from July 26 until August 16, 1975.

The area along the volcanic-sedimentary contact west of the Back River was mapped at a scale of 1:5000 (Map 1). This scale was chosen to facilitate representation of thin sedimentary units near the contact and of structural trends on the many small islands in the river.

The rest of the area was mapped at a scale of 1:25000 to outline the stratigraphy and structure in both the volcanic and sedimentary rocks near the southeastern margin of the volcanic complex (Map 2).

Both maps may be considered outcrop maps in that areas of 85% outcrop or felsenmeer of one lithology are shown.

The area has been significantly affected by the Pleistocene glaciation. A thin veneer of drift covers most low-lying areas, and cryoturbation has dislocated blocks of bedrock and moved them through the drift to form felsenmeer. Some blocks several metres across have been rotated only a few degrees from original positions, allowing reliable lithological determinations but unreliable structural measurements.

7

Thick drift occurs on the southwest sides of some of the larger hills in drumlinoid ridges and in broad valleys. Drift-covered areas are blank on the geological maps.

Ice moving from the northeast deposited a thick layer of drift on the northeastern part of the complex near Begon Lake. Drift thickness gradually decreases toward the southwestern margin of the volcanic complex where rock exposure increases to over 80% of the surface area. The study area is in the transition between areas of sparse rock exposure to the north and abundant rock exposure to the south in the Heywood Range.

Most outcrops are covered with a thin layer of grey, green, orange, black and blue encrusting lichens, making detailed field study of textures and primary structures difficult. Greywacke-argillite units can be recognized by the deflection of cleavage, differences in colour and fissility, and the tendency for greywackes to be comparatively resistant to weathering.

Clean outcrops occur on the northeast-facing shores of 'Islands Lake' on the Back River, where ice polishing occurs during spring breakup.

Detailed sections were measured across the southwest shore of the lake (Figure 2). Thicknesses of greywacke-argillite couplets were measured according to Bouma's cycle (1962). Paleocurrent directions and structural attitudes were also measured.

FIGURE 2
MEASURED
SECTIONS

LEGEND

- FELSIC PORPHYRY
- GREYWACKE
coarse, thickly bedded
- GREYWACKE
fine, thinly bedded
- GREYWACKE and
ARGILLITE
- CROSS-BEDDED
SANDSTONE
- ARGILLITE
- CARBONATE
siliceous dolostone

Graphic Methods

Structural maps on the scales of 1:5000 and 1:25000 were drawn of the area around 'Islands Lake' and the southeastern margin of the volcanic complex (Maps 3, 4).

Eight cross-sections of the sedimentary rocks near the volcanic-sedimentary contact display the stratigraphy in the chemical and lower clastic units (Figures 3,4,5,6); five cross-sections of the rocks east of 'Islands Lake' display the stratigraphy of the clastic unit (Figures 7,8,9). From these cross-sections, columnar geological sections were compiled and correlated (Figure 10) to illustrate the stratigraphy and facies changes in the sedimentary rocks around 'Islands Lake'.

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FIGURE 3

LEGEND TO CROSS-SECTIONS

FIGURES 4-9

FELSIC PORPHYRY

CLASTIC UNIT

GREYWACKE-ARGILLITE
thickly bedded / thinly bedded

ARGILLITE

CARBONATE
siliceous dolostone

CHEMICAL UNIT

CARBONATE
siliceous dolostone

CARBONACEOUS SLATE

OXIDE IRON FORMATION
chert, magnetite SILICATE IRON FORMATION
abundant riebeckite BACK RIVER
VOLCANIC COMPLEX
flows and pyroclastics

Geological contact (defined, approximate) ————

not in
stratigraphic
order

FIGURE 5
CROSS-SECTIONS
3, 4, 5

FIGURE 6
CROSS-SECTIONS
6, 7, 8

See figure 3 for legend and figure 10 for compilation.

FIGURE 8
CROSS-SECTIONS
9, 10, 11

SCALE

See figure 3 for legend, figure 7
for locations and figure 10 for
compilation.

* dip unknown

9

FIGURE 9
CROSS-SECTIONS
12,13

from the study area were stained deep blue, indicating a ferroan dolomitic composition.

Feldspars were stained by sodium cobaltinitrate, barium chloride and rhodizonic acid dipotassium salt following the method of Bailey and Stephens (1960) with a minor modification. Instead of etching slides with hydrofluoric acid fumes, the slides were dipped directly into 60% HF for 10 to 15 seconds, a much faster and safer method. Glass slides were protected from the acid by cellulose tape. By this method, potassium feldspars are stained lemon-yellow and plagioclase is stained red. The intensity of the red stain is proportional to the calcium content in plagioclase. Staining revealed that no potassium feldspar is present and that the plagioclase is sodic. The success of both stains was verified by their reaction with micas.

Observations through the microscope were augmented by point counts of mineralogy in the volcanics, and determinations of mineralogy, grain size and clast lithologies in the sediments (Appendices 1, 2, 3). Point counts were conducted using an automatic counter and microscope stage following the method of Chayes (1949). Four hundred to 500 points were counted for each thin section. Counts were tested for accuracy by comparing the results of three traverses of 150 counts each, across some slides. Results of these traverses differed by less than 5% of the total number of counts from the slide.

Two polished sections were examined to identify sulphide minerals in a ~~massive~~ zone and in the carbonaceous slates near the volcanic-sedimentary contact.

Paleocurrent Measurements

Paleocurrent directions were inferred from crossbeds at the bases of Bouma 'C' units in greywacke beds, where crossbed orientations most likely reflect turbidity current directions and not local bottom current directions. One hundred and twenty-six measurements were taken at 11 stations around 'Islands Lake'.

Ductile deformation of sedimentary structures has greatly decreased the usefulness of crossbed plane measurements. Current direction vectors were measured instead. A current direction vector is the normal to the crossbed, measured in the down-current direction relative to the bedding plane of the 'C' unit.

Near the volcanic-sedimentary contact, where there is only one significant phase of deformation, fold axial traces are parallel to the contact. It is assumed that 0.5 km from the contact first-phase fold axial traces were also parallel to the volcanic-sedimentary contact before being reoriented by the second phase of deformation.

Thus to restore beds and current direction vectors to original positions, they were rotated through small circles around steep second-phase hinge lines to positions parallel to the volcanic-sedimentary contact, and made horizontal by rotation through small circles around shallow first-phase fold hinges.

Current direction vectors were plotted as points on equal-angle stereonet.

Eight of the 11 stations have northwestward unimodal paleocurrent distributions (Map 5). Three stations indicate southward- and eastward-flowing paleocurrents.

Two stations on the same limb of a second-phase fold have southward- and northwestward-flowing paleocurrents indicating that the paleocurrent distribution (Map 5) is due to paleocurrent directions and not to reorientation during deformation.

STRATIGRAPHY

Volcanic rocks underlie chemical and clastic sedimentary rocks on the southeastern margin of the Back River Volcanic Complex (Figure 11).

The lower part of the volcanic section consists of mafic to intermediate flows and the upper part consists of intermediate to felsic pyroclastics.

Chemical sedimentary rocks consisting of iron formation, carbonate and carbonaceous slate overlie the volcanics and underlie clastic sedimentary rocks. The clastic rocks comprise greywacke-argillite couplets, argillite and carbonate.

VOLCANIC ROCK UNITS

In the field, volcanic rocks were divided into four compositional types: basalt, andesite, dacite and rhyolite.

The basalts are dark green on fresh surfaces, due to an abundance of chlorite or amphibole. They weather light green or dark brown and form smooth rounded outcrops. Primary textures are rarely visible in hand specimen, but pillowed and brecciated structures are commonly seen in outcrop.

The andesites are predominantly green, weathering brown, but abundant plagioclase may give them a somewhat

FIGURE 11
TABLE OF UNITS

Don	Unit and thickness (m)	Sub-unit	Description
?	diabase dykes		
	Intrusive contact		
Archean	felsic porphyry		
	Intrusive contact		
	clastic unit 2 500+	greywacke-argillite	graded greywacke-argillite couplets
		argillite	argillite; minor siltstone
		carbonate	siliceous dolostone
	chemical unit 50±	carbonate	siliceous dolostone
		carbonaceous slate	gossan-forming black slate
		oxide iron formation	chert, magnetite
		silicate iron formation	abundant riebeckite
	rhyolite-carbonate 10±		dolomite-bearing rhyolite tuff
	south dacite 10±		tuff
	south rhyolite 10+		tuffaceous in part
	north dacite 20+		tuff and lapilli tuff
	upper andesite 20±		tuff and lapilli tuff
	upper basalt 10±		amygdaloidal and brecciated in part
	lower andesite 60±		porphyritic
	lower basalt 10+		pillowed in part

grey appearance. The porphyritic andesites have bluish grey phenocrysts of plagioclase up to 3 mm in length.

Some of the andesites contain some lithic fragments up to 4 cm long.

Contacts between andesites and dacites appear to be gradational. The dacites are light grey rocks that weather white. They may be aphanitic or have pyroclastic textures. The grey colour is due to a high ratio of plagioclase to mafic minerals. Quartz phenocrysts are also present in some of these rocks.

The rhyolites are white to light brown and weather light grey or white. They have a distinctive, sugary texture. Phenocrysts of quartz and plagioclase are present as minor constituents.

Lower Basalt

The lower basalt is exposed southwest of 'Islands Lake' (Map 2). Its thickness is not known. It underlies the lower andesite. A sharp contact between them is defined by a compositional change.

The lower basalt is a dark green rock that weathers light green. It commonly displays amygdaloidal or brecciated textures. Near 'Islands Lake' it contains pillows about 0.5 m across which have amygdaloidal rims. Textures and depositional structures are significantly deformed.

Chlorite, plagioclase and biotite are the main minerals in the lower basalt (Appendix 1). Outlines of biotite, epidote and chlorite concentrations vaguely resemble pyroxene outlines and may represent relict pyroxene. Chlorite, plagioclase laths and quartz form a groundmass that is segregated into chlorite- or plagioclase-rich areas.

The presence of pillows indicates that the lower basalt was deposited as a subaqueous flow.

Lower Andesite

The lower andesite, exposed west of 'Islands Lake' (Map 2), is about 60 m thick. It lies above the lower basalt and below the upper basalt. Both contacts seem to be conformable.

The lower andesite is greenish-grey and weathers light brown. The lack of platy mineral development makes cleavages difficult to recognize.

Near the volcanic-sedimentary contact, the lower andesite is massive. One kilometre west of the contact, broken plagioclase phenocrysts have a fragmental appearance. One and one half kilometres west of the contact, the lower andesite is porphyritic, with plagioclase phenocrysts up to 3 mm long composing half the volume of the rock.

The lower andesite is brecciated within three metres of its upper contact, southwest of 'Islands Lake'. The brecciated andesite is porphyritic and rarely amygdaloidal.

Plagioclase, biotite, muscovite, chlorite and quartz are the main minerals in the lower andesite (Appendix 1).

Twinned phenocrysts of albite (An_8) are abundant (Plate Ia). Alteration of plagioclase to sericite is common and is most pronounced where the plagioclase crystals have been broken.

Some biotite and epidote concentrations have pyroxene-like outlines (Plate Ib).

The groundmass consists of plagioclase laths, and biotite and quartz anhedral. The groundmass is segregated into plagioclase- and biotite-rich areas which may reflect original mineral distribution.

The lower and-site seems to be a uniform, porphyritic flow. The fragmental appearance of broken crystals in this rock near the volcanic-sedimentary contact is due to deformation.

Upper Basalt

Outcrops of the upper basalt have an elliptical distribution on the map (Maps 1,2). They circle a dome-shaped ridge northwest of 'Islands Lake' and cap two hills of porphyritic andesite south of the ridge.

On the northwest slope of the ridge this unit is 20 m thick, and on the southeast slope it is less than 5 m thick. It is wedge shaped, with the thick side to the southwest.

The upper basalt conformably overlies the lower andesite and underlies the upper andesite.

The upper basalt is dark green, weathering light green to greenish brown. Outcrops of this rock are significantly more rounded and massive than those of adjacent andesites.

Two outcrops at the lake northwest of the dome-shaped ridge have vague, pillow-like structures. Near 'Islands Lake' the whole unit is brecciated. Clasts range from 3 to 10 cm long. Southeast of the domal ridge this

unit is brecciated near its base and top and has amygdules in its upper part.

Most of the upper basalt is composed of chlorite, epidote and biotite. Relic andesine phenocrysts (An_{45}) are partially altered to quartz, albite, chlorite and muscovite. Metamorphic albite laths (An_5) are common in the groundmass. Amygdules filled with quartz and chlorite are present near the upper contact of this unit southeast of the domal ridge (Plate IIa).

The upper basalt is interpreted as a thin flow. It has an even crystal-size distribution throughout and no chilled margins. It is brecciated near its lower contact, and is brecciated and contains amygdules near its upper contact, indicating the presence of a flow top and bottom.

Upper Andesite

The upper andesite caps the domal ridge northwest of 'Islands Lake' (Map 2). This unit is about 10 m thick at the northeastern end of the ridge, where it underlies the north dacite, and at the southwestern end of the ridge it is at least 30 m thick. It conformably underlies the north dacite. The contact is gradational, defined by a change from andesitic to dacitic clasts.

The upper andesite is predominantly green. Non-welded andesite clasts ranging from 0.5 to 10 cm long compose most of the rock. They are green to greyish green and commonly porphyritic. Because of clast recrystallization it is difficult to determine clast to matrix ratios. Dark green lensoidal biotite concentrations, about 3 mm long, are common in the matrix and are most abundant near the bottom of the unit where clast size is relatively small. Biotite concentrations form less than 10% of the matrix.

Brown weathered surfaces have a distinctive, rubbly texture due to variations in weathering of clasts and matrix.

The upper andesite can be divided into three sub-units on the basis of clast size. A fine-grained sub-unit extends for 5 to 10 m above the contact with the upper basalt. There is a gradual clast-size increase to a maximum length of 10 cm in a coarse sub-unit, 5 m thick. Clast size then declines to a few millimetres near the contact with the north dacite. It is not known how many cooling units are present.

Andesite clasts have a groundmass of plagioclase and quartz mosaics, chlorite laths, and biotite and muscovite plates. Plagioclase phenocrysts (An_{10}) ranging from 0.5 to 2 mm long, are variably sericitized.

The matrix is similar to the groundmass of the

andesite clasts but it contains comparatively more biotite and chlorite (Plate 11b). The lensoidal concentrations of biotite seen in outcrop are clots of partly chloritized, post-tectonic biotite.

The upper andesite contains volcanic clasts with various textures that are sorted into graded and inversely graded sub-units and lacks bedding and flow structures. It is interpreted as a pyroclastic deposit.

North Dacite

The north dacite is exposed north of 'Islands Lake' and near the northwest shore of the lake (Map 2). Its thickness is not known.

Near the northwest shore of 'Islands Lake', the north dacite is a fine-grained grey rock that weathers white. North of the lake, this unit has abundant dacite clasts ranging from 0.5 to 15 cm long (Plate 11Fa) and rare dark, brown-weathering andesite clasts. Clasts are commonly light grey, weathering white; they display various textures from aphanitic to porphyritic. They define fine- and coarse-grained, graded and inversely graded strata up to 3 m thick. The matrix is grey-green, weathering green, with a slightly pitted appearance due to carbonate solution.

Dacite clasts are composed of quartz and

plagioclase mosaics, biotite flakes and chlorite laths.

A few porphyritic andesite clasts are also present.

Albite phenocrysts (An_4) in the clasts are coarsely twinned and partially altered to chlorite and muscovite.

The matrix is very similar to the groundmass of the dacite clasts in both appearance and mineralogy. It is composed quartz and plagioclase mosaics, ferroan dolomite anhedral, biotite plates and chlorite laths. Quartz and plagioclase mosaics are less abundant in the matrix than in the groundmass of the clasts.

The north dacite contains volcanic clasts of various compositions and textures commonly sorted into crudely graded and inversely graded strata. It also lacks flow structures. It is interpreted as a pyroclastic deposit.

South Rhyolite

The south rhyolite is exposed on the west half of the peninsula that forms the north shore of 'Slingshot Lake' (Map 2). It is of unknown thickness and conformably underlies the south dacite. The contact between them is sharp and is defined by changes in composition and weathering.

The south rhyolite is light grey to brown, weathering grey to white, and has a sugary texture.

Quartz and plagioclase phenocrysts, 0.5 to 3 mm across,

form less than 1% of the rock. Most of the south rhyolite is massive; the upper part has a lensoidal texture. The lenses are 0.5 to 1 cm long and may be clasts.

The groundmass of the south rhyolite is composed almost entirely of a mosaic of quartz and plagioclase, in a ratio of 7:3.

Phenocrysts of quartz and oligoclase (An_{18}) are scattered randomly throughout the groundmass. Quartz phenocrysts are commonly subhedral, with one domain and undulatory extinction (Plate IIIb). Oligoclase phenocrysts are slightly sericitized, twinned cleavage fragments (Plate IIIb).

The mode of deposition of the south rhyolite is not known.

South Dacite

The south dacite, exposed on the north shore of 'Slingshot Lake' (Map 2), is about 10 m thick. It conformably underlies the rhyolite-carbonate. The contact is sharp and is defined by changes in composition, weathering and clast size.

In the south dacite, lenticular, white-weathering dacite clasts locally exceed lengths of 1 cm but are commonly smaller (Plate IVa). They are abundant but difficult to see in outcrop. Relic shards and pumice fragments less than 0.3 cm long are also present (Plate IVa).

Subhedral quartz and plagioclase phenocrysts are sparsely scattered throughout the clasts and matrix. The phenocrysts rarely attain 2 mm in diameter. Where they are fine grained, it is difficult to distinguish phenocrysts from the groundmass. Biotite flecks and minute tourmaline crystals are common in fine-grained parts of the south dacite.

The groundmass of the south dacite is composed mostly of quartz and plagioclase mosaics (Appendix 1). Plates of muscovite are scattered unevenly throughout the mosaics. Dark green blebs visible in outcrop are concentrations of biotite and epidote (Plate IVa). Blades of blue schorl are also present, forming bands parallel to "bedding" (Plate IVb).

The abundance of volcanic clasts and the lack of bedding or flow structures indicates that the south dacite may be a pyroclastic deposit.

Rhyolite-carbonate

The rhyolite-carbonate, exposed on the peninsula north of 'Slingshot Lake' is about 10 m thick.

The rhyolite-carbonate has a granular texture, defined by subround lenticular grains that range from 1 to 3 mm across. Large grains are more abundant at the

base of the unit than at the top producing ill-defined grading.

Subhedral quartz phenocrysts, about .3 mm across, are present in small quantities.

The rocks range in texture from a grey, pitted rhyolite to a chocolate-brown dolomitic rock containing resistant siliceous blebs and spines. Dolomite content ranges from about 5% to 35%. Dolomite-rich zones, 100 m across, grade along strike into siliceous zones of similar size.

The groundmass of the rhyolite-carbonate is composed mostly of quartz-plagioclase mosaics interspersed randomly with recrystallized ferroan dolomite clots. The ferroan dolomite content ranges from a trace in the siliceous zones to over 50% in the carbonate-rich zones. (Appendix 1). Blue tourmaline is concentrated around the dolomite blebs. Muscovite plates are scattered throughout the quartz-plagioclase mosaics and biotite is concentrated in coarsely recrystallized blebs.

Subhedral, embayed, unidomainal quartz phenocrysts, up to 2 mm across, are present (Plate IVc).

The non-welded granular texture and grading in the rhyolite-carbonate indicates that it may have been deposited as a tuff. The dolomite and tourmaline seem to be post depositional.

Alteration of the South Dacite and Rhyolites

The south dacite and rhyolites are the only rocks in the map-area that contain significant amounts of tourmaline.

Both tourmaline and ferroan dolomite seem to be alteration minerals.

Tourmaline content rises gradually from a trace, in the upper part of the south rhyolite, to 4.2% in the south dacite and then declines to 0.5% in the rhyolite-carbonate. Tourmaline concentration does not change abruptly at contacts.

Tourmaline is associated with dolomite blebs in the rhyolite-carbonate and may have a similar origin.

The carbonate-rich zones in the rhyolite-carbonate are stratibound but not stratiform. Facies changes within 100 m along strike seem less likely than differential replacement of a rhyolitic tuff to account for lateral alternation of rhyolitic and carbonate-rich zones.

Tourmaline and dolomite crystals are bent and broken parallel with the first cleavage direction: thus replacement is pre-tectonic.

There is no tourmaline in the sediments above the rhyolite-carbonate. The chert-magnetite iron formation directly above may have acted as an impermeable cap above the alteration zone. For a trap to operate, alteration would have to post-date consolidation of the sediments.

SEDIMENTARY ROCK UNITS

Chemical Unit

Chemical sedimentary rocks overlie the volcanics in a narrow belt along the volcanic-sedimentary contact west of 'Islands Lake' (Maps 1, 2). They comprise silicate and oxide iron formation, carbonate, and carbonaceous slate (Figure 11).

Silicate Iron Formation

The silicate iron formation forms low bluffs southwest of 'Islands Lake'. It is about 5 m thick south of the lake and thins to 0.5 m thick west of the lake.

The silicate iron formation conformably overlies the volcanics and underlies the oxide iron formation (Figure 10).

The silicate iron formation is deep green on both fresh and weathered surfaces. Garnet porphyroblasts about 5 mm across and angular quartz grains about 2 mm across are readily discernible in the dark green matrix.

Most of the rock consists of subangular dacite and andesite clasts, ranging from 2 to 6 mm long. The dacite clasts are mosaics of quartz and feldspar with muscovite plates scattered sparsely throughout (Plate Va).

In the porphyritic andesite clasts, albite phenocrysts (Mr 10) up to 1 mm long are set in quartz-plagioclase mosaics (Plate Vb).

Subround unidominal quartz and twinned plagioclase grains are common. They range from 1 to 3 mm across (Plate Vc).

Layering, from 3 to 5 cm thick, is defined by the alternation of clast-rich and clast-poor areas.

The matrix comprises riebeckite and minor amounts of helicitic garnet. Riebeckite occurs as sheaves of blue-green crystals and moss-green aggregates in both the matrix and the volcanic clasts, causing the silicate iron formation to be a homogeneous, dark green colour in outcrop. Non-rotated, helicitic garnet porphyroblasts, about 5 mm across, predate the second phase of deformation. They were fractured during that phase.

Oxide Iron Formation

The oxide iron formation is less than 5 m. thick and is exposed along the length of the volcanic-sedimentary contact in the map-area (Map 2, Figure 10). It conformably overlies the silicate iron formation and underlies carbonates and carbonaceous slates.

It is an Algoman-type iron formation composed of alternating bands of magnetite and chert, 2 to 3 mm thick.

Concave-shaped depressions in laminae, about 20 mm in diameter, are preserved (Plate VIa). They may be due to the release of gas bubbles from soft sediment near its surface.

Weathered surfaces of altered oxide iron formation have a brown corroded texture, due to hematite weathering and staining.

Quartz and magnetite are the major minerals in the oxide iron formation. Fine-grained magnetite grains 0.05 mm across and quartz mosaics predominate in the dark layers. The light layers are composed of stilpnomelane needles, 0.25 mm long, and quartz mosaics.

The dark laminae have crenulations with 0.25 mm amplitudes, and quartz-rich lenses about 1 mm long that may be due to algal growth (Plate VIa).

In altered outcrops, all primary structures are lost. Magnetite forms 0.25 mm clots, stilpnomelane and quartz form fan-shaped intergrowths and ferroan dolomite is commonly found in blebs associated with garnet porphyroblasts, 1 to 2 mm in diameter.

Carbonate

Carbonate rock^{**}, exposed south and west of 'Islands Lake' near the volcanic-sedimentary contact (Map 1, 2), ranges from 2 to 10 m thick.

The carbonate rock is greyish-blue on fresh surfaces. It consists of massive, recrystallized dolomite and brownish green biotite flakes about 2 mm long, aligned in the first cleavage. It is very soft and has a distinctive, grey-blue, corroded weathered surface.

Albite (An₆), red-brown biotite and ferroan dolomite are the major minerals (Appendix 3). Elliptical areas, about 5 mm long, of twinned albite laths and dolomite blebs, are separated by partly chloritized biotite concentrations. Subangular, unidomainal quartz grains and coarsely twinned albite grains, about 2 mm across, are minor constituents.

The presence of quartz and albite clasts indicates that there was minor clastic input during the deposition of the carbonates. However, recrystallization has destroyed original textures, obscuring the nature of the carbonate deposition.

^{**} These rocks are referred to as carbonate in keeping with the present usage of the term by geologists mapping Archean greenstone belts in the Slave Structural Province. The carbonate content of these rocks is commonly less than 20% of the total volume (Appendix 3).

Carbonaceous Slate

The carbonaceous slate is exposed near the volcanic-sedimentary contact. It is about 10 m thick west of 'Islands Lake' and only 5 m thick on the north shore of 'Slingshot Lake'. It overlies and is interbedded with carbonates and conformably underlies the clastic unit.

The carbonaceous slate has a black, earthy appearance on fresh surfaces. It weathers black if the sulphide content is low, and rusty orange if disseminated sulphides are present.

Most of the carbonaceous slate comprises an aggregate of muscovite and chlorite crystals with finely disseminated particles of carbon and pyrite. The average crystal size is about 0.03 mm. Coarser crystals of muscovite, carbon and pyrite fill veins. A yellow iron stain permeates samples taken near weathered surfaces.

There are no original textures in the carbonaceous slate. The presence of carbon and pyrite indicates that this unit was deposited under anaerobic conditions. Anaerobic bacteria and water chemistry may be factors affecting deposition.

Clastic Unit

Clastic sedimentary rocks, exceeding 2500 m in thickness near 'Islands Lake', conformably overlie the chemical sedimentary rocks. The clastic rocks comprise greywacke-argillites, argillites and carbonates. Almost all of the clastic rocks are greywacke-argillites.

Greywacke-argillite

The greywacke-argillites are divided into two types: thickly bedded greywackes, that have beds thicker than 20 cm characterized by medium to coarse sand at the bases of graded beds, and thinly bedded greywackes that have beds thinner than 20 cm with fine sand or silt at the bases of graded beds (Maps 1,2). The two divisions have the same bedding characteristics and sedimentary structures.

Graded Bedding

Beds of greywacke-argillite display graded beds defined by grey-weathering sand that grades up from a sharp basal contact to black-weathering argillite.

The Bouma sequence has been previously used to describe the structures in greywacke-argillite sequences.

content can exceed 35% of the clasts. Volcanic rock fragments commonly compose 15 to 25% of clasts and sedimentary rock fragments compose less than 5% of the total.

Accurate estimates of rock fragment contents are difficult to obtain because of clast recrystallization which makes them difficult to distinguish from the matrix. Rock fragments can be distinguished by differences in colour and texture among clasts, and between rock fragments and the matrix. Rhodizonate stains are useful for rock fragment identification. Minor variations in plagioclase content and composition are reflected in different hues of red in stained thin sections.

Rock fragments assumed to be altered basalt are rounded masses of chlorite and biotite, with minor amounts of quartz and dolomite (Plate XIIc).

Andesitic rock fragments (Plate XIIIa) are porphyritic. Twinned plagioclase phenocrysts ranging from 0.1 to 2 mm long, with compositions ranging from albite to andesine, constitute half the volume of andesitic rock fragments. The groundmass is a mosaic of plagioclase and minor amounts of quartz. Muscovite and chlorite are common throughout the groundmass, and pyrite and hematite masses 0.1 mm across are present in small quantities, the alteration of which produces a yellow stain in andesitic rock fragments.

Dacitic rock fragments are not porphyritic

occur in beds up to 2 m thick (Plate VIIb).

At the bases of some thick cross-bedded units, the graded beds are eroded. These beds seem to be due to the reworking of turbidite units by bottom currents.

Ripples are common within and at the tops of 'C' units. There are two types of ripples: simple asymmetric ripples and climbing ripples.

Simple asymmetric ripples are exposed at the tops of 'C' units (Plate VIIIa). Where not significantly deformed, they have wavelengths of up to 8 cm and amplitudes of up to 2 cm.

Climbing ripples are exposed at the tops of 'C' units (Plate VIII) and in thick cross-bedded beds. Climbing ripple sets migrate up to 50 cm laterally and 20 cm vertically.

Other Sedimentary Structures

Sedimentary structures formed as a result of erosion and deposition by turbidity currents, soft-sediment deformation and diagenesis are present.

The lack of bedding-plane exposure prevents the reliable measurement of current directions from scour marks and hinders the identification of other sole marks.

On rare bedding-plane exposures, scours are

oriented parallel to the first cleavage, making them unreliable paleocurrent indicators.

Scour marks are most obvious below thick graded beds where they have been enlarged by post-depositional loading (Plate VIIa). They are rarely filled with medium to coarse sand of the bed above, but more commonly they contain finely laminated or graded coarse-grained silt or fine sand (Plate VIIa).

Soft-sediment deformation structures are common. They include: load casts, flame structures, disrupted beds and convolute beds.

Load casts range from slight undulations at the bases of sand beds to bulbous lobes of sand that have descended into pelitic beds below (Plate IXa). Most are less than 20 cm long, but under coarse sand beds over 2 m thick they attain lengths of up to 50 cm (Plate IXb). Load casts are most abundant where the thicknesses and grain sizes of adjacent beds are very different.

As load forms descended into pelitic beds, they became disconnected from the parent sand bed and descended as streamlined bodies (Plate Xa). Streamlining was accomplished by internal reorganization of grains rather than by abrasion of the surface of the descending mass. Planar bedding within the load form is plastically deformed to orientations parallel to the outline of the body (Plate IXb).

If a thin pelitic band lies between two sand

beds, a thin one above and a thick one below, bedding can be disrupted by the rise of the pelite through the sand to another pelite bed above. The result is a jagged contact between the sand bed below and the pelite above. Distorted remnants of the thin sand bed may remain in the pelite (Plate Xb).

A thin pelitic bed between two thick sandy beds may be disrupted at regular intervals. The result is a group of imbricated angular pelitic clasts within a thick sandy layer. Such imbrication may be inconsistent with local paleocurrent directions and if rotated, many of the clasts would fit together to form a thin layer.

Convolute bedding is rare compared with loading and disrupted bedding. It tends to occur in fine-grained beds where homogeneity facilitates turbulence during slumping (Plate XIa).

Concretions and diagenetic alteration spots are rare. Irregular dolomitic concretions are exposed in cross-bedded sands near contacts with carbonate beds.

Petrography

On the basis of quartz, feldspar and rock fragment content, the greywacke-argillites are classified as lithic to feldspathic greywackes (Pettijohn, 1975; pp.209-230).

Medium-grained sands (1 to 2 mm) are composed of quartz grains and lesser quantities of plagioclase grains and rock fragments. As grain size decreases, the rock fragment declines, and as silt size is attained, plagioclase grain content increases and the quartz grain content decreases (Appendix 2).

Quartz is the most abundant constituent in the greywackes. In sand beds, it makes up about half of the total, in both mineralogical and clast lithology point counts (Appendix 2). It is less abundant in fine silts and argillites.

Most of the quartz clasts are subangular to subround, having roundness values of 0.3 to 0.6 and sphericities of 0.4 to 0.6 (Pettijohn, 1975; pp. 52-61). Subhedral outlines and embayments indicate that some are abraded phenocrysts.

Most of the sand-size quartz clasts have undulose extinction and may display deformation lamellae that have a preferred orientation throughout each sample.

The greywackes commonly have a bimodal distribution of unidomainal and polydomainal quartz grains (having six or more domains) (Appendix 2). The polydomainal quartz grains tend to have one large domain in the centre surrounded by several small domains, some with planar extinction (Plate XIIa,b).

Deformation lamellae with a preferred orientation and polydomainal quartz grains with a large strained central domain surrounded by small unstrained domains are attributed to in situ deformation (Blatt, 1967; Tullis, Christie and Griggs, 1973). This limits the usefulness of quartz grains as provenance indicators. Quartz grains with significantly elongate domains, attributed to schistose or gneissic source areas (Blatt, 1967) are absent.

The most common identifiable inclusions in quartz clasts are apatite, zircon and rutile. Inclusions of metamorphic index minerals and potassium feldspar are absent.

Plagioclase is the second most abundant mineral. It composes an average of 20% of the clasts and an average of 24.7% of the total in mineralogical point counts. There are two types of plagioclase. One is anorthite-rich and the other is anorthite-poor.

The anorthite-poor plagioclase makes up clasts and mosaics with quartz in the matrix. Plagioclase clasts are smaller than quartz clasts in the same thin section. The mean grain sizes differ by about 0.5 ϕ . Plagioclase clasts have roundness values of 0.6 to 0.8 and sphericities of 0.5 to 0.7.

Twins are rare and very poorly developed in anorthite-poor plagioclase. Determinations of the extinction angles of albite twins of optically positive

plagioclase indicates an average composition of An₇ (Appendix 4), with little variability. The composition of untwinned, optically positive plagioclase clasts and mosaics in the matrix is assumed to be similar.

Albite clasts tend to display a corroded appearance. Clast margins are invaded by matrix minerals and most of the clasts are partly sericitized. Muscovite, sericite and chlorite crystals tend to form a cross-hatched pattern in altered albite clasts. The centres of the clasts tend to be more altered than the margins.

The anorthite-rich plagioclase clasts are easily distinguished from the albite clasts. They are significantly smaller and more rounded than the albite clasts in the same thin section. They have roundness values of 0.7 to 0.9 and sphericities of 0.5 to 0.7. The anorthite-rich clasts are optically negative and have fine albite twins. Optical determinations indicate an anorthite content of An₄₂ (andesine).

Andesine clasts are less altered than albite clasts in the same thin section. The alteration is not concentrated in clast centres. Minute crystals of muscovite, sericite and chlorite are scattered evenly throughout.

Volcanic and sedimentary rock fragments compose 10% to 15% of the clasts in the fine-grained greywackes. In medium- to coarse-grained greywackes, rock fragment

content can exceed 35% of the clasts. Volcanic rock fragments commonly compose 15 to 25% of clasts and sedimentary rock fragments compose less than 5% of the total.

Accurate estimates of rock fragment contents are difficult to obtain because of clast recrystallization which makes them difficult to distinguish from the matrix. Rock fragments can be distinguished by differences in colour and texture among clasts, and between rock fragments and the matrix. Rhodizonate stains are useful for rock fragment identification. Minor variations in plagioclase content and composition are reflected in different hues of red in stained thin sections.

Rock fragments assumed to be altered basalt are rounded masses of chlorite and biotite, with minor amounts of quartz and dolomite (Plate XIIc).

Andesitic rock fragments (Plate XIIIa) are porphyritic. Twinned plagioclase phenocrysts ranging from 0.1 to 2 mm long, with compositions ranging from albite to andesine, constitute half the volume of andesitic rock fragments. The groundmass is a mosaic of plagioclase and minor amounts of quartz. Muscovite and chlorite are common throughout the groundmass, and pyrite and hematite masses 0.1 mm across are present in small quantities, the alteration of which produces a yellow stain in andesitic rock fragments.

Dacitic rock fragments are not porphyritic

(Plate XIIIb). They comprise mosaics of quartz and plagioclase in which quartz is predominant. Throughout the mosaics are scattered muscovite and chlorite, but these minerals are less common in the dacitic rock fragments than in the andesitic rock fragments.

Rhyolitic rock fragments are made up of a mosaic of mostly quartz. Plagioclase, chlorite and muscovite are sparingly dispersed throughout (Plate XIIIc). Tourmaline (blue schörl) may also be present.

Basaltic rock fragments are rare, making up about 1% of medium to coarse sand (Appendix 2). Medium-grained greywackes usually contain mostly andesitic and dacitic rock fragments. As grain size declines, so does the ratio of mafic to felsic rock fragments. At grain-size distributions averaging 0.12 mm and smaller only dacitic and rhyolitic rock fragments are present.

Sedimentary rock fragments include chert, iron formation and siltstone.

Chert fragments are made up of quartz mosaics. They are similar to rhyolitic rock fragments in general appearance, but unlike rhyolitic rock fragments, they are composed entirely of quartz.

Iron formation rock fragments are composed of quartz mosaics that contain significant amounts of magnetite, pyrite or hematite. The iron minerals occur as anhedral masses (Plate XIVA).

Siltstone rock fragments occur only in medium- and coarse-grained greywackes. They consist of angular grains of quartz and plagioclase in a muscovite and chlorite matrix. The banded appearance of these clasts is the result of variability of mineral concentration.

Myrmekite is present in very small quantities in coarse-grained greywackes. Rounded silt-size grains have lobate intergrowths of quartz and plagioclase.

Heavy minerals in the greywackes include zircon, tourmaline, rutile, apatite and magnetite.

Zircon is the most common heavy mineral, composing an average of 0.1% of all mineralogical point counts (Appendix 2). Rounded subhedra of clear to light brown malachon, about 0.1 mm long are present in some of the medium-grained greywackes.

Tourmaline is rarer than zircon. It is most common in rhyolitic rock fragments. Elongate grains of blue schorl are rare in the matrix.

Subangular rutile grains are also present in very small quantities in the matrix.

Euhedral apatite inclusions occur in quartz grains and in the matrix, commonly in clusters.

Most of the opaque grains in the matrix are pyrite, but some subhedral and anhedral grains of magnetite, about 0.05 mm across, are also present.

Matrix is defined here as being composed of

mineral grains less than 0.00 mm long, which are not contained within aggregates with recognizable boundaries. This size was chosen because the metamorphic minerals attain lengths of 0.05 mm, rendering point counts of smaller sizes unreliable in terms of matrix content.

As in the greywackes at Yellowknife Bay. (Henderson, 1975B), there are two kinds of matrix material, quartz-plagioclase mosaics and mica-chlorite concentrations.

The mosaics are made up of optically positive plagioclase and quartz crystals, about 0.01 mm across, with a granoblastic texture that is similar to the texture of the dacitic rock fragments. Various amounts of muscovite, biotite and chlorite are present in the mosaics.

The mica- and chlorite-rich areas contain biotite, muscovite, chlorite, and minor epidote and pyrite. Muscovite occurs as white plates ranging from 0.02 to 0.05 mm long. Biotite occurs as red-brown plates ranging from 0.02 to 0.1 mm long. Biotite to chlorite alteration is marked by a gradual loss of bright interference colours and a change from red-brown to green colours.

Green chlorite with olive interference colours may occur as laths or masses. Some chlorite is optically positive, indicating it to be prochlorite.

Epidote is comparatively rare. Yellow-brown masses of zoisite are present in micaceous parts of the matrix. Epidote crystal form is less well developed in the greywackes than in the volcanics.

Pyrite occurs in small quantities throughout the matrix as subhedral and anhedral grains, commonly altering to hematite.

Argillite

Argillite beds (up to 10 m thick) are exposed within the greywacke-argillites (Figure 10). They are useful stratigraphic marker horizons due to their distinctive black-weathering outcrops. Beds are composed of argillite layers, up to 20 cm thick, defined by minor compositional and grain-size differences. They resemble Bouma 'E' units. Cleavages are commonly more apparent than bedding on lichen-covered outcrops. (Plate XIVb).

Argillite comprises fine-grained plagioclase, biotite, muscovite and chlorite with preferred orientation along cleavages.

Some of the argillite beds contain graded basal silty units about 0.5 cm thick, that appear to be distal turbidite beds. Other non-graded layers may be due entirely to pelagic sedimentation.

Carbonates

Carbonate-rich beds occur within the greywacke-argillites, at various levels in the section within 1 km of the volcanic-sedimentary contact (Map 1, Figure 15). These beds are up to 15 m thick (Plate XV).

In outcrop, these beds resemble the carbonates in the chemical unit. They are homogeneous, soft grey-blue rocks with pitted weathered surfaces (Plate XVIIa). Near the base of some carbonate beds are rare subround, fine-grained quartz clasts (Plate XVIIb).

These rocks can be defined as siliceous dolostones. Veins of quartz and optically positive plagioclase crystals (about 0.05 mm across) are randomly dispersed throughout the matrix. Twinned albite laths (0.7) are aligned in the first cleavage direction. Plagioclase and quartz account for 28.8% of the total (Appendix 3).

Yellow-brown biotite knots up to 1 mm across, partly altered to chlorite, are also oriented in the first cleavage direction. Biotite and chlorite constitute 51.5% of the total volume.

Peridotite dolomite occurs as massive blebs, making up 17.3% of the total volume.

No original structures are preserved in the carbonates. The presence of quartz grains (Plate XVIIb) indicates that these beds were deposited in a sedimentary

environment with minor clastic input. The source of the carbonate is not known.

INTRUSIVE ROCK UNITS

Felsic Porphyry

Porphyritic granodiorites intrude the clastic unit, usually within 0.25 km of the volcanic-sedimentary contact (Maps 1,2).

These felsic porphyries display white, twinned and zoned phenocrysts of plagioclase in a massive light grey matrix on fresh surfaces. Weathered surfaces are white, with resistant phenocrysts standing out from the surface. They have discordant contacts with the sedimentary rocks and contain sedimentary xenoliths (Plate XVII).

Regional greenschist metamorphism has masked any contact metamorphic aureoles that may have formed around the felsic porphyry bodies.

Zoned and twinned albite to oligoclase (An_{10}) phenocrysts attain 5 mm in length and compose over 60% of the total volume of this unit (Plate XVIIIa). Rare euhedral quartz phenocrysts range from 2 to 6 mm across and have planar to mildly undulose extinction.

The groundmass is composed of granoblastic mosaics of quartz and optically positive plagioclase,

with muscovite and chlorite crystals dispersed throughout. Orange-brown biotite and pyrite are concentrated in vague plagioclase poikiloclasts and small amounts of yellow-brown zoisite are intergrown with the biotite.

Diabase Dykes

Diabase dykes are rare in the map-area. Their east-northeast trend suggests that they may be related to a 2200 to 2400 million year old dyke swarm in the southern Slave Province, reported by McGlynn and Henderson (1972).

Diabase dykes in the map-area are comparatively resistant to erosion, forming low ridges. They are green, weathering to brown and have coarse-grained sub-ophitic textures near their centres, grading outward to fine-grained chilled margins.

The diabase is composed mostly of andesine, cumingtonite and blue-green hornblende. Some of the hornblende is in pseudomorphs after pyroxene. Minor amounts of skeletal magnetite are altered to hematite.

The diabase dykes have no cleavages and are not involved in folding. They are therefore post-tectonic.

STRUCTURE

The map-area has been affected by two phases of folding during which two corresponding sets of cleavage were formed.

FIELD EVIDENCE OF DEFORMATION

Volcanic Rocks

Two cleavages are preserved in the volcanics.

The first cleavage strikes south-southeast and generally dips steeply west (Figure 12). It is pervasive and is defined by platy mineral growth (Plate XVIIIb).

The second cleavage strikes east-northeast and generally dips steeply south (Figure 13). It is usually a fracture cleavage. Platy mineral alignment in the second cleavage direction is weak.

The gross stratigraphy of the volcanic complex appears to be comparatively flat-lying in the interior and tightly folded only near the margin (Figure 14).

Mapping in the interior of the volcanic complex is not sufficiently detailed to reveal whether undulations of contacts are due to open folding during the first phase of deformation or to paleotopography. Both factors have probably contributed.

Poles to first cleavage are not distributed in an arc around the poles to second cleavage, indicating that

FIGURE 12
POLES OF CLEAVAGE PLANES
FIRST PHASE OF DEFORMATION

Equal angle projection,
lower hemisphere.

FIGURE 13

POLES OF CLEAVAGE PLANES

SECOND PHASE OF DEFORMATION

VOLCANICS **SEDIMENTS**Equal angle projection,
lower hemisphere.

FIGURE 14
DEFORMATION NEAR THE
VOLCANIC-SEDIMENTARY CONTACT

the volcanic complex was not tightly folded during the second phase of deformation.

Detailed mapping reveals that the volcanics have been tightly folded at the volcanic-sedimentary contact during the first phase of deformation (Maps 3, 4). Within 200 m of the contact, the volcanics are fine-grained and contain mostly broken phenocrysts. Cleavages near the contact are deflected from their regional orientations to directions more closely parallel to the contact. This appears to represent a narrow deformed zone, peripheral to the main volcanic mass (Figure 14).

Sedimentary Rocks

The abundance of primary structures suitable for tectonic determinations and the well-developed cleavage in the argillites makes structural analysis in the sedimentary rocks more reliable than in the volcanics.

There are two cleavages in the sediments (Plate XIX). The first cleavage is the most penetrative. It is deflected in the more competent strata, forming a step-like pattern of cleavage arcs in sequences of graded beds. Some clasts are commonly reoriented in line with this cleavage in the hinges of first-phase minor folds.

The distribution of poles to first cleavages (Figure 12) has concentrations similar to those of the first cleavage in the volcanics, but in general, the distribution from the sediments has a higher dispersion.

Concentrations of poles to first cleavage have persisted because second-phase box folds did not reorient bed attitudes in many areas.

Second cleavage in the sediments is most prominent in the argillaceous beds and layers, where it is expressed as planar fractures. The poles to the second cleavage are scattered about a concentration similar to the second cleavage concentration in the volcanics (Figure 13). This cleavage is absent near the volcanic-sedimentary contact, but is visible 200 m away from the contact.

In the sedimentary rocks, the first-phase folds are close to tight. They are tightest at the volcanic-sedimentary contact, becoming gradually more open away from the contact (Figure 14). Near the contact, where there is only one significant phase of folding, the axial traces of folds are parallel to the contact.

First-phase minor folds record continuous deformation in that bedding and tension fissures are absent.

Breaks in the stratigraphy on the northwestern limb of a major anticline 2 km southeast of 'Islands Lake' (Figures 8, 9), may be associated with a thrust fault with northwestward displacement (Map 4). Beds in outcrop and in frost-heaved blocks on one side of a syncline do not correspond with those on the other side.

The exact location of the fault is not known because it is always in felsenmeer.

The fault is assumed to be a reverse fault which would be consistent with compression of sedimentary strata against the volcanic complex during the first phase of deformation.

Second-phase folds are large box folds with steep hinges (Maps 3, 4). They may have developed along major slide planes. A slide plane is a surface along which displacement occurs. They include fault planes and shear zones.

A slide contact 2.5 km southeast of 'Islands Lake' is at the contact of fine- and coarse-grained greywackes in the southern part of the map-area. The fine-grained greywacke may have been faulted out in the eastern part of the map-area during the second phase of deformation, or it may coarsen laterally.

The variability of the second cleavage in the sediments may be due to the variability of local stress orientations in the hinges of the box folds. A third phase of deformation may have produced some of the cleavage on the peninsula between 'Islands Lake' and 'Slingshot Lake'; some second cleavages there are not axial planar to second-phase folds.

Second-phase minor folds were formed by less continuous deformation than those of the first phase. In areas of extension, some competent strata are boudinaged or have tension cracks that are filled with less competent argillaceous material.

PETROGRAPHIC EVIDENCE OF DEFORMATION

First Phase of Deformation

The preferred orientation of muscovite, chlorite and biotite defines the first cleavage (Plate XVIIIb; Figure 15). This is enhanced in some volcanics by the parallel growth of twinned albite laths.

Quartz phenocrysts and sand grains commonly have deformation lamellae and show various degrees of polygonization (Plates XIb; XIIa, b). Polygonized quartz grains are due to deformation and are not inherited from source rocks. Polygonization proceeds from the margin of a grain to the centre, and grains at all stages of polygonization occur together. Most polygonized grains have granoblastic textures.

Twinned plagioclase grains and phenocrysts were bent during the first phase of deformation.

Ferroan dolomite was recrystallized during the first deformational phase. Deformation of carbonate twins can be attributed only to the second phase.

Second Phase of Deformation

Mineral growth continued after the second phase of deformation (Figure 15). This contrasts with the first phase in which deformation coincided with mineral growth.

FIGURE 15
DEFORMATION₈
AND
METAMORPHIC MINERAL GROWTH

Second cleavage in the volcanics is commonly expressed as a slight crenulation of the first cleavage, where large plates are recrystallized into smaller, unstrained plates.

In the andesites and basalts in the west of the map-area there are local occurrences of blue-green hornblende (Figure 16). Hornblende laths about 0.1 mm. long replace late biotite. The distribution of hornblende occurrences in the volcanics (Figure 16) indicates that metamorphic grade rises toward the western part of the map-area.

In the rest of the map-area, ragged plates of biotite and grainy masses of epidote are formed in the graywacke matrix. Biotite is partly replaced by chlorite, indicating that there was a retrogressive stage of metamorphism after biotite crystallization.

INTERPRETATION OF STRUCTURE

During the first phase of deformation the pattern of folding near the southeastern margin of the volcanic complex produced a pattern suggesting deflection of cleavage around a rigid body by compression, as described by Sory (1969; pp. 251-256). The volcanic complex is a comparatively competent body around which the sedimentary rocks have been deformed.

FIGURE 16

BLUE-GREEN HORNBLENDE OCCURRENCES

Both the volcanics and the sedimentary rocks may have undergone vertical dilation and lateral shortening early in the first phase of deformation.

Ramsay (1967; pp. 403-404) suggested that there is a limit to the amount of shortening that can be taken up by the dilation of stratified rocks during progressive deformation. The ductility differences between rock layers assists the development of inhomogeneous strain (buckling). When maximum dilation was achieved, folding began.

There was a distinct ductility difference between the volcanics and the sedimentary rocks. The volcanics resisted folding and were tightly folded only near the volcanic-sedimentary contact, where they thin and possibly interfinger with sedimentary strata. As folding progressed in the sedimentary rocks, the tightest folds developed at the volcanic-sedimentary contact.

Near the contact, the axial traces of folds in the sediments are parallel to the contact. The folds wrap around the volcanic complex like cleavage wrapping around a porphyroblast. Thus, on the southeastern margin of the volcanic complex, folds trend northeast (Maps 1 to 4).

On the southeastern margin of the volcanic complex, the second phase of deformation may be related to the emplacement of plutons northeast and south of 'Islands Lake' (Figure 1). The second-phase box folds may be due to compression of sedimentary strata between the plutons and the volcanic complex.

RELATIONSHIP OF DEPOSITION

RELATIONSHIP OF THE JACK RIVER VOLCANICS TO THE YELLOWKRIFF SUPRAGROUP SEDIMENTS

The Jack River Volcanic Complex is situated in the upper part of the section in the Yellowstone Supragroup sediments (Trith et al., 1977). On the northwestern margin of the complex, the sedimentary rocks underlie the volcanics and on the southeastern margin, sedimentary strata overlie the volcanics.

VOLCANIC ENVIRONMENTS OF DEPOSITION

Both subaqueous and subaerial volcanic rocks are exposed in the complex (Lambert, 1976). The subaqueous volcanics are most common near the bottom and at the margins of the volcanic pile and subaerial volcanics are restricted to the upper portion of the pile, near the centre of the complex.

On the southeastern margin of the complex there is a twofold division in the volcanic stratigraphy. Subaqueous, mafic to intermediate flows underlie intermediate to felsic pyroclastics.

The lower basalt, the lower andesite and the upper basalt are interpreted as flows (Figure 11).

The lower basalt is a pillowed flow with highly vesicular pillow margins, indicating that it may have been deposited in relatively shallow water.

Porphyritic andesites are common in the western part of the volcanic complex. In outcrop, they are similar to the lower andesite. These porphyritic andesites may have attained significant topographic relief.

The lower andesite is a porphyritic flow or series of flows, deposited as a broad wedge. The thick end of the wedge is toward the centre of the complex to the southwest and the margin of the flow is exposed on the southwest shore of 'Islands Lake'.

Overlying the lower andesite is the upper basalt. It is interpreted as a thin, probably pillowed flow with a vesicular, brecciated top and a brecciated base.

Unlike the units beneath, the upper andesite and north dacite are pyroclastic units that thicken to the west and the northwest, respectively. The north dacite at 'Islands Lake' is the southern extremity of a dacitic unit that is exposed for 5 km along the volcanic-sedimentary contact on the eastern margin of the volcanic complex.

The south dacite and rhyolite-carbonate are pyroclastics that may be part of the north dacite or they may have been extruded from a local vent.

SEDIMENTARY ENVIRONMENTS OF DEPOSITION

Chemical Unit

Silicate Iron Formation

The silicate iron formation lies directly above the volcanics. It may have been deposited either during or after the late stages of volcanic activity.

Angular andesite and dacite fragments and quartz grains are concentrated in ill-defined beds that are separated by riebeckite-rich horizons. This texture indicates that volcanic detritus was mixed with locally precipitated, iron-rich mud.

The iron-rich mud was a background sediment that precipitated over the sea-bed at a relatively constant rate. Mud deposition may have been due to: the flocculation of clay-size volcanic ash, the precipitation of material from supersaturated sea-water, or the reduction of iron by organisms.

Volcanic clasts deposited in the mud may have fallen in as pyroclasts or they may have been transported by bottom currents from the eroding volcanic complex by bottom currents.

Oxide Iron Formation

The oxide iron formation is composed of thin magnetite- and chert-rich laminae. The magnetite may have been derived by the reduction of iron-rich compounds by organisms. Organic activity may have been responsible for the crumplings and elliptical structures in the magnetite-rich laminae. The laminae resulted from the fluctuation of iron and silica precipitation.

Because there is no clastic detritus in the oxide iron formation, it may have been deposited after the silicate iron formation, during a period of non-erosion of the volcanic complex; or it may have been deposited synchronously with the silicate iron formation, but farther from the shoreline.

The second possibility seems more probable. It is unlikely that the volcanic complex would suddenly stop producing detritus during the deposition of the oxide iron formation.

Walther's law (Krambein and Sloss, 1963; pp. 318-319) implies that if the two iron formations were deposited contemporaneously and the oxide iron formation was farther from shore than the silicate iron formation, the stratigraphy at Islands Lake should be a transgressive sequence.

Carbonate and Carbonaceous Slate

Overlying the iron formations are the carbonates and carbonaceous slates.

Sedimentary structures and textures have not survived in the carbonates. Only the geometry of carbonate beds gives clues to their origin.

The carbonates were deposited in lenses of various thicknesses within the carbonaceous slates and in the lower part of the clastic unit. A carbonate lens on the northwest shore of 'Islands Lake' is 250 m long and 50 m thick (Maps 1,2). Most lenses are less than 10 m thick.

The carbonates may have been deposited as a result of precipitation from sea-water, or of organic activity.

Tourmaline enrichment in the south dacite and rhyolites indicates that there was local geothermal activity after volcanism. Carbonate precipitation may have been caused by the discharge of carbonate-rich fluids into the sea-water at the margin of the volcanic complex, or by sea-water temperature changes.

Stromatolites are exposed in Yellowknife.

Supergroup sediments at Snodgrass Lake (Henderson, 1975).

They are in the lower part of a clastic unit about 0.5 km from a volcanic-sedimentary contact that is similar to the one at 'Islands Lake'. The carbonate lenses at 'Islands Lake' may have been stromatolite reefs.

In the chemical unit, carbonaceous slates are interbedded with carbonates. The carbonaceous slates contain significant amounts of free carbon and pyrite, possibly due to the reduction of carbon-bearing compounds by organisms.

The carbonates and carbonaceous slates may have been deposited at about the same time as the oxide iron formation, but farther from shore.

The sequence of deposition of the iron formations, carbonates and carbonaceous sediments indicates that there was a zonation of water chemistry from the shore out into the basin (Figure 17). Near shore, the water may have been saturated with respect to iron, and silica that precipitated to form the iron formations. Farther out, the water may have been rich in carbonate and oxygen, possibly enabling algae to build reefs. In the deeper parts of the basin, carbon, iron and sulphur were precipitated as carbon and pyrite.

The application of Walther's law to the aforementioned arrangement of depositional environments reveals the chemical unit to be a transgressive sequence (Figures 10, 17). This implies that when volcanic activity ceased, the complex submerged as the basin floor beneath subsided.

During deposition of the chemical unit, there was very little clastic input from the volcanic pile. Eventually, the flanks of the complex were covered by

FIGURE 17
POSSIBLE ARRANGEMENT OF DEPOSITIONAL ENVIRONMENTS
DURING THE DEPOSITION OF THE CHEMICAL UNIT

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clastic deposits from both the basin margin and the volcanic complex itself.

The contact between the clastic and chemical units indicates an abrupt change in the mode of deposition. However, chemical conditions in the water near the volcanic margin may have changed more gradually. Frequent turbidite deposits would mask any slow chemical precipitation.

Carbonate lenses in the lower part of the clastic unit indicate that unusual water chemistry may have persisted near the margin of the volcanic complex.

Clastic Unit

Graywacke-argillite accounts for almost all of the volume of the clastic unit. The beds are interpreted as turbidites. Individual beds show variations of the Bouma sequence, and the sedimentary structures are typical of flysch deposits (cf. Dzulynski and Walton, 1965).

The clastic unit is composed of large wedges of thickly or thinly bedded greywacke. These wedges extend as far as 1.5 km along strike and are up to 500 m thick (Figure 10, Map 2).

The wedges are interpreted as the expression in the section of individual turbidite fans. The coarse-grained, thickly bedded greywackes represent more proximal parts of the fans than do the fine-grained,

thinly bedded greywackes. Some coarse-grained, thickly bedded greywackes grade laterally into fine-grained, thinly bedded greywackes and siltstones, recording a transition from proximal to distal sedimentation.

From the pattern of overlapping depositional wedges in the clastic unit, the basin appears to have been filled by the deposition of overlapping turbidite fans debouching from many sources along the basin margin.

The coarse-grained, thickly bedded greywackes are very heterogeneous with regard to grain size and bed thickness.

Sections were measured across the south shore of 'Islands Lake' in a coarse-grained, thickly bedded turbidite wedge. Thick and thin beds were deposited in "bundles" (cf Shleiger, 1964) rather than randomly (Figure 2).

Walker (1967) related the thickness and completeness of a Bouma Sequence to its proximity to the source area. According to Walker's interpretation, thick beds that contain all of the textural units are proximal, and thin beds with only 'A' and 'E' units are distal deposits.

The arrangement of the thickly and thinly bedded turbidites in the section indicates that there was an alternating deposition of proximal and distal beds within the fan. If the turbidite fans emanated from discrete sources along the basin margin, the alternating proximal and distal deposition at a point within the fan could be

due to an irregular fluctuation of sediment supply to the head of the fan.

Argillite beds up to 10 m thick occur in the clastic unit. They are composed of thin argillite and fine silt bands in a ratio of 95% argillite to 5% silt.

The argillite beds are continuous along strike through the whole map-area (Map 2), recording the deposition of distal and pelagic sediments throughout the map-area at various times.

If the sediment source was a volcanic terrain, the sediment supply to the basin would be related to the amount and distribution of volcanic activity. During periods of frequent eruptions, sediment supply to the basin would increase and greywackes would be deposited in the basin. During periods of little volcanic activity, argillite beds would be deposited.

The deposition of large, overlapping turbidite fans is also congruent with irregular volcanic activity, perhaps along the length of an island arc.

The depositional environment at 'Islands Lake' may have been similar to some of the environments of clastic deposition in the recent marginal seas within the Pacific and Indian Oceans.

The water depth at which the clastic unit was deposited, is not known.

Five carbonate beds are exposed in the section across the south shore of 'Islands Lake' (Figure 2, Map

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1). They are up to 10 m thick and can be traced for less than 0.5 km along strike.

The carbonate beds in the clastic unit are mineralogically and texturally identical to the carbonates in the chemical unit. They may also have been stromatolite reefs.

If the sea-water turbidity was similar in the Archean to what is at present, stromatolite reefs could only develop in the upper photic zone, within 100 m of the surface.

The environment of carbonate deposition may be related to the nature of the sediments directly above and below the carbonate beds.

All of the carbonate beds in the section overlie thickly bedded, coarse-grained greywacke beds containing thin pelagic 'E' units. The firm bottom provided by the greywacke beds may have been easier for bioherms to develop on than a muddy bottom. The lack of pelagic sedimentation in the beds below the carbonates may indicate that the water was relatively clear during carbonate deposition, facilitating algal growth.

Carbonate beds are almost absent east of 'Islands Lake' although the sedimentary structures in the greywackes indicate that there was no change in sea-bed morphology.

The lack of carbonates may be attributed to an increase in water depth, which would decrease light penetration to the sea bed, or a cessation of volcanic

activity causing a change in water chemistry. Both may have happened together.

A transgression during the deposition of the chemical unit may have continued during the deposition of the elastic unit (Figure 13).

FIGURE 18
DEVELOPMENT OF A TRANSGRESSIVE SEQUENCE
OVERLYING THE
BACK RIVER VOLCANIC COMPLEX

PROVENANCE OF CLASTIC SEDIMENTS
AND BASIN MORPHOLOGY

PALEOCURRENTS

Paleocurrent directions were measured at 11 stations around 'Islands Lake' (Map 5).

Northwestward paleocurrents are indicated at eight stations, and southward to eastward paleocurrents are indicated at the other three (all relatively close to the volcanic-sedimentary contact).

The paleocurrent data indicate that most of the clastic sediments were transported into the area from sources southeast of 'Islands Lake' and not from the Back River Volcanic Complex. However, the volcanic complex contributed a minor amount of sediment early in the deposition of the clastic unit, forming the beds with southward and eastward paleocurrents.

Sediments from the southeast contain volcanic and sedimentary rock fragments, myrmekite and quartz grains with abundant euhedral inclusions indicating a mixed provenance. Sediments from the volcanic complex have only a volcanic provenance.

Clastic input from the volcanic complex may have ceased when the complex was buried beneath turbidites from the southeast.

In the lower part of the clastic unit, turbidites with southeastward and northwestward paleocurrent directions are interbedded. In the upper part, the turbidites have

only northwesterward paleocurrents. The contribution of sediments from the volcanic complex ceases rather abruptly 1.5 km above the volcanic-sedimentary contact.

PROVINANCE OF THE CLASTIC SEDIMENTS

The coarse-grained greywackes contain abundant volcanic rock fragments, ranging from rhyolite to basalt (Appendix 2). The compositions and textures of these rock fragments are identical to those of the volcanic rocks west of 'Islands Lake'. However, paleocurrent directions indicate that the Back River Volcanic Complex was not a major clastic source. It is concluded that there was a volcanic source terrain of similar composition (mostly intermediate) southeast of 'Islands Lake'.

Sedimentary rock fragments are also present in the coarse-grained greywackes. They include fragments of: chert, iron formation and siltstone. Sedimentary rock fragments are comparatively rare, accounting for less than 5% of the rock fragments (Appendix 2). The lithologies of the sedimentary rock fragments are similar to those of the sedimentary rocks exposed near the volcanic-sedimentary contact at 'Islands Lake'.

Sedimentary environments at the basin margin may have resembled those on the flank of the Back River Volcanic Complex; a narrow zone of chemical and immature clastic sediments on the flanks of the volcanic source

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PLATE I

a. Plagioclase phenocrysts in the lower andesite.

(crossed nicols; length of bar equals 1 mm)

b. Concentrically zoned biotite and quartz concentration
with pyroxene-like outline.

(plane polarized light; length of bar equals 1 mm)

PLATE II

- a. Amygdale of chlorite and quartz in the upper basalt.

(plane polarized light; length of bar equals 1 mm)

- b. Pyroclast in the upper andesite.

(crossed nicols; length of bar equals 1 mm)

PLATE III

a. Pyroclastic texture of the north dacite northwest of 'Islands Lake'.

b. Quartz and oligoclase phenocrysts in the south rhyolite.

(crossed nicols; length of bar equals 1 mm)

PLATE IV

- a. Pyroclasts in the south dacite. Light clasts are mosaics of quartz and plagioclase and dark clasts are composed of biotite and epidote.

(plane polarized light; length of bar equals 1 mm)

- b. Tourmaline crystals aligned with bedding in the south dacite.

(plane polarized light; length of bar equals 1 mm)

- c. Quartz phenocryst with possible embayments, in a groundmass of dolomite; rhyolite-carbonate.

(crossed nicols; length of bar equals 1 mm)

PLATE V

- a. Dacite rock fragment (X) in the silicate iron formation.

(plane polarized light; length of bar equals 1 mm)

- b. Porphyritic andesite rock fragment in the silicate iron formation. The groundmass of the rock fragment is composed of riebeckite and quartz. The matrix is mostly riebeckite.

(plane polarized light; length of bar equals 1 mm)

- c. Quartz and plagioclase clasts in a riebeckite-rich matrix; silicate iron formation.

(crossed nicols; length of bar equals 1 mm)

PLATE VI

- a. Cross-section of a cone-shaped structure in the oxide iron formation.

(plane polarized light; length of bar equals 1 mm)

- b. Silt lamination between a pelitic 'E' unit (below) and a graded 'A' unit (above) in a greywacke-argillite bed.

(plane polarized light; length of bar equals 1 mm)

PLATE VII

a. Scours filled with finely laminated sand.

b. Cross beds in a Bouma 'C' unit.

PLATE VIII

- a. An asymmetric ripple overlying a climbing ripple set at the top of a Bouma 'C' unit.

- b. Oversteepened climbing ripple sets.
-

PLATE IX

a. Load casts developed from scour infillings below a graded sand bed. The laminae in the scour infillings have been plastically deformed during load form development.

b. Load structures at the base of a thick graded bed.

PLATE X

a. Streamlined sand bodies that have descended into a pelitic bed.

b. The injection of a thin pelitic bed (P) up through a thin sandy bed (S) into a thick pelitic bed above.

PLATE XI

a. Convolute bedding.

a. Deformation lamellae in a quartz phenocryst; south rhyolite.

(crossed nicols; length of bar equals 1 mm)

PLATE XII

Polydomainal quartz grain. The large central domain has undulose extinction and deformation lamellae. The small peripheral domains have planar extinction.

(crossed nicols; length of bar equals 1 mm)

b. Polydomainal grain with one large central domain surrounded by several small domains.

(crossed nicols; length of bar equals 1 mm)

c. Basaltic rock fragment.

(plane polarized light; length of bar equals 1 mm)

PLATE XIII

a. Andesitic rock fragment.

(plane polarized light; length of bar equals 1 mm)

b. Dacitic rock fragment.

(plane polarized light; length of bar equals 1 mm)

c. Rhyolitic rock fragment containing numerous tourmaline crystals.

(plane polarized light; length of bar equals 1 mm)

PLATE XIV

a. Iron formation rock fragment.

(plane polarized light; length of bar equals 1 mm)

b. Bedding and cleavage in argillite.
(The hammer handle is parallel to bedding.)

-PLATE XV

A carbonate bed in the clastic unit. (Greywacke in the lower foreground)

PLATE XVI

- a. Typical weathered surface of a carbonate bed.
(The knife is parallel to bedding.)
-

- b. Quartz clast in a dolomitic matrix near the base of a carbonate bed.
-

(plane polarized light; length of bar equals 1 cm)

PLATE XVII

1. An intrusive contact of a felsic porphyritic body and greywacke beds. (The hammer is parallel to greywacke bedding.)

b. Sedimentary xenoliths in felsic porphyry.

PLATE XVIII

-
- a. Zoned plagioclase phenocryst in the felsic porphyry.
(crossed nicols; length of bar equals 1 mm)

-
- b. First cleavage (vertical) defined by chlorite and biotite in the lower andesite.

(plane. polarized light; length of bar equals 1 mm)

PLATE XIX

Bedding and cleavages in greywacke-argillite beds:

bedding is horizontal,

first cleavage is arcuate from upper right to lower left,

second cleavage is straight from upper left to lower right,
displayed only in the argillite.

(chart for scale)

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terrain, contributing sediment to turbidite deposits in the interior of the basin.

The evidence confirming the existence of plutonic rocks in the source terrain is less direct than for sedimentary and volcanic rocks.

Some quartz grains contain minute, euhedral inclusions of zircon, apatite and rutile, which are rare in quartz phenocrysts in the volcanic rocks. Euhedral inclusions are characteristic of plutonic and high-grade metamorphic quartz (Pettijohn, 1975; p. 201).

Trace amounts of silt-size myrmekite are also present. Myrmekite is due to the eutectic crystallization of quartz and feldspar in acid plutonic rocks (Carmichael, Turner and Verhooogen, 1974; pp. 25-26).

Inclusions in quartz grains and the presence of myrmekite both indicate that there were some plutonic rocks in the source terrain. Unfortunately, no plutonic rock fragments were observed in the greywackes at 'Islands Lake'.

Peeling (1974) observed a few plutonic rock fragments in the greywackes north of Yellowknife Bay and attributed them to the unroofing of the granitic plutons exposed west of Yellowknife Bay. Similar plutons may have been unroofed in the source terrain southeast of 'Islands Lake'.

The greywackes at 'Islands Lake' are texturally immature, having angular quartz grains and abundant soft rock fragments. They are clearly first-cycle sediments,

Lacking quartz grains containing rounded domain boundaries and quartz overgrowths.

The greywacke clasts may have been transported only a short distance across the source terrain to the basin margin, moved rapidly across a narrow shelf and then swept into the basin by turbidity currents.

The Back River Volcanic Complex is exposed in a 20 km by 40 km area, and subaerial volcanics are restricted to the central part of this area. The greywackes with northwestward paleocurrent directions are just as immature as those from the volcanic complex. Thus the sediment transport distance across the volcanic source terrain southeast of 'Islands Lake' may have been equivalent to the width of the subaerial Back River Volcanic Complex, only 10 to 15 km.

Schistose and gneissic rock fragments, and quartz grains with elongate domains are absent in the greywackes, so it seems unlikely that the source terrain southeast of 'Islands Lake' underwent high-grade regional metamorphism before the deposition of the Yellowknife Supergroup sediments.

It is deduced that the sediment source terrain southeast of 'Islands Lake' was a volcanic terrain containing some granitic plutons that may have been similar to Japan or the Philippines with regard to size and rock types.

INFLUENCE OF THE BACK RIVER VOLCANIC COMPLEX
ON ARCHEAN SEDIMENTATION IN THE NORTHEAST SLAVE PROVINCE

The sedimentary rocks of the Yellowknife Supergroup in the northeast Slave Province are a record of the filling of an Archean basin by turbidity currents. The sedimentary section is best preserved near Beechy Lake (Figure 19). There, the section seems to be composed of three parts: a lower part, composed mostly of medium-grained greywackes; a middle part, composed mostly of fine-grained greywackes and argillites, and an upper part, composed of medium-grained greywackes.

The Back River Volcanic Complex was formed during the deposition of the upper part of the Beechy Lake section.

Although the clastic unit at 'Islands Lake' correlates with the upper part of the Beechy Lake section, the greywackes at 'Islands Lake' are much coarser than those at Beechy Lake. North of Beechy Lake, sediments correlative with the upper part of the Beechy Lake section become still finer grained. East of Index Lake they are mostly siltstones and argillites. The difference in grain size from 'Islands Lake' to Index Lake may be due to a transition from a proximal to a distal facies in one large basin (Figure 19).

This facies change is further substantiated by the palaeocurrents at 'Islands Lake', which are northwest, swinging north toward Beechy Lake.

FIGURE 19

INFLUENCE OF THE BACK RIVER VOLCANIC COMPLEX ON ARCHEAN SEDIMENTATION IN THE NORTHEAST SLAVE PROVINCE

shape of subaerial complex from

Lambert, M.B., 1976: The Back River Volcanic Complex; Geological Survey of Canada
Paper 76-1 Pt. A, pp 363-382.

The Back River Volcanic Complex may have acted as a barrier to turbidity currents flowing into the basin from the margin to the southeast. Northwestward palaeocurrents may have been deflected around the north end of the volcanic complex instead of taking a straight, northwesterly route to Rose Lake (Figure 19). Also, the sediments deposited on the northwestern margin of the volcanic complex were very fine-grained, perhaps indicating deposition behind a barrier.

The distance from the Back River Volcanic Complex to the sediment source terrain to the southeast is not known. Most of the area from Islands Lake to the Slave-Churchill province boundary is occupied by late felsic plutons (Geological Survey of Canada Map 45-1963; Fraser, 1964). Detailed study of the supracrustal rocks among the plutons may reveal the position and extent of the source terrain.

During deposition of the upper portion of the Yellowknife Supergroup sediments, there may have been a single basin in the area that is now the northeastern part of the Slave Province that received turbidite sediments from a volcanic source terrain close to the Back River Volcanic Complex. The sediment source terrain may have been at a basin margin, near the Slave-Churchill Province boundary, east of Mylner Lake (Figure 19).

APPENDICES

APPENDIX 1

Volcanics: mineralogical point-counts

Sample No.	lower basalt		lower andesite		
	Ø359-3	Ø347-1	Ø360-1	Ø364-3	Ø365-1
Quartz and Plagioclase	30.1	44.6	59.7	52.0	52.1
Chlorite	49.0	0.4	20.7	0.6	1.9
Biotite **	17.1	42.4	0.0	29.4	33.1
Muscovite	0.0	0.0	15.3	0.0	0.0
Hornblende	0.0	0.0	0.0	0.0	0.0
Epidote	2.1	9.3	2.5	2.7	8.0
Dolomite	0.0	0.0	0.4	5.2	1.3
Hematite and Pyrite	1.8	3.3	0.8	8.2	1.5
Apatite	0.0	0.0	0.4	0.0	1.7
Zircon	0.0	0.0	0.0	0.3	0.0
Rutile	0.0	0.2	0.2	1.6	0.4
Tourmaline	0.0	0.0	0.0	0.0	0.0
Total	100.0%	100.0%	100.0%	100.0%	100.0%

* Plagioclase much more common than quartz in basalts.
Plagioclase more common than quartz in andesites.

** Basalts are named on the basis of field criteria.
High biotite indicates that they may not be true basalts.

APPENDIX 1

Volcanics: Mineralogical point-counts.

	lower andesite				upper basalt
Sample No.	J366-1	J91-7	J92-3	J96-1	J311-1
Quartz and Plagioclase	49.9	50.0	55.2	59.0	35.9
Chlorite	5.7	12.4	21.7	1.8	11.4
Biotite	23.6	15.2	4.1	15.6	33.8
Muscovite	0.0	0.0	0.0	16.4	0.0
Hornblende	0.0	0.0	0.4	0.0	0.0
Epidote	17.9	17.4	8.0	4.6	12.7
Dolomite	0.6	3.1	2.1	0.0	0.9
Hematite and Pyrite	2.0	1.7	8.5	2.2	1.3
Apatite	0.3	0.0	0.0	0.2	0.0
Zircon	0.0	0.0	0.0	0.0	0.0
Rutile	0.0	0.2	0.0	0.2	0.0
Tourmaline	0.0	0.0	0.0	0.0	0.0
Total	100.0%	100.0%	100.0%	100.0%	100.0%

APPENDIX 1

Volcanics: mineralogical point-counts

upper basalt

Sample No.	Ø351-1	Ø353-2	Ø361-1	Ø364-1	Ø378-2
Quartz and Plagioclase	25.5	31.4	25.0	18.9	46.7
Chlorite	38.2	39.0	0.0	0.0	4.1
Biotite	0.0	8.9	16.7	9.0	40.6
Muscovite	0.0	0.0	0.0	0.0	0.0
Hornblende	0.0	0.0	36.7	63.1	0.0
Epidote	14.6	4.0	20.8	8.1	4.8
Dolomite	20.4	10.1	0.0	0.0	1.8
Hematite and Pyrite	1.6	6.6	0.8	0.9	1.6
Apatite	0.7	0.0	0.0	0.0	0.2
Zircon	0.0	0.0	0.0	0.0	0.0
Rutile	0.0	0.0	0.0	0.0	0.2
Tourmaline	0.0	0.0	0.0	0.0	0.0
Total	100.0%	100.0%	100.0%	100.0%	100.0%

APPENDIX 1

Volcanics: mineralogical point-counts

	upper andesite				north dacite
Sample No.	Ø310-1	Ø312-2	Ø349-2	Ø352-2	Ø255-1
Quartz and Plagioclase ***	34.7	34.5	38.8	43.1	52.2
Chlorite	18.9	8.6	11.1	10.4	15.3
Biotite	30.1	27.7	22.0	23.9	23.3
Muscovite	12.3	0.0	24.5	16.2	0.6
Hornblende	0.0	0.0	0.0	0.0	0.0
Epidote	1.1	0.6	1.3	0.2	2.0
Dolomite	0.2	27.0	0.0	14.8	4.6
Hematite and Pyrite	2.7	1.6	2.3	1.4	2.0
Apatite	0.0	0.0	0.0	0.0	0.0
Zircon	0.0	0.0	0.0	0.0	0.0
Rutile	0.0	0.0	0.0	0.0	0.0
Toumaline	0.0	0.0	0.0	0.0	0.0
Total	100.0%	100.0%	100.0%	100.0%	100.0%

*** Quartz more common than plagioclase in dacites.

APPENDIX 1

Volcanics: mineralogical point-counts

	north dacite		south dacite		rhyolite- carbonate
Sample No.	Ø309-1	Ø309-2	Ø392-2	J98-2	Ø392-1
Quartz and Plagioclase	37.4	33.8	42.5	54.1	29.5
Chlorite	14.9	10.4	0.0	0.6	0.0
Biotite	34.6	27.9	35.0	9.4	4.2
Muscovite	4.5	2.9	17.2	31.7	7.2
Hornblende	0.0	0.0	0.0	0.0	0.0
Epidote	2.3	6.1	0.2	2.5	0.0
Dolomite	3.6	15.5	0.0	0.6	56.1
Hematite and Pyrite	2.3	3.2	0.4	0.0	2.5
Apatite	0.4	0.0	0.0	0.0	0.0
Zircon	0.0	0.2	0.0	0.0	0.0
Rutile	0.0	0.0	0.0	0.0	0.0
Tourmaline	0.0	0.0	4.2	0.6	0.5
Total	100.0%	100.0%	100.0%	100.0%	100.0%

**** Quartz much more common than plagioclase in
rhyolites.

APPENDIX 2a

Greywackes: mineralogical point-counts ²

Sample No.	Ø257-5 run a.	b.	c.	Ø257-5 average	Ø266-2
Quartz	39.3	38.1	40.7	39.4	45.0
Plagioclase	34.0	38.5	30.8	33.8	33.2
Chlorite	4.2	2.9	8.5	5.2	1.3
Biotite	15.7	16.1	15.2	15.6	17.4
Muscovite	4.7	3.9	3.8	4.1	0.4
Hornblende	0.0	0.0	0.0	0.0	0.0
Epidote	0.0	0.0	0.5	0.2	0.4
Hematite	2.1	0.5	0.5	1.0	0.0
Pyrite	0.0	0.0	0.0	0.0	1.7
Rutile	0.0	0.0	0.0	0.0	0.0
Apatite	0.0	0.0	0.0	0.0	0.2
Zircon	0.0	0.0	0.0	0.0	0.2
Tourmaline	0.0	0.0	0.0	0.0	0.2
Dolomite	0.0	0.0	0.0	0.0	0.0
Total	100.0%	100.0%	100.0%		100.0%

* The mineralogical point-count reflects the bulk composition of the rock.

APPENDIX 2a

Greywackes: mineralogical point-counts

Sample No.	ø268-3	ø290-3 run a.	b.	c.	ø290-3 average
Quartz	40.9	42.7	50.8	51.8	48.4
Plagioclase	28.4	15.2	15.9	25.5	18.9
Chlorite	2.5	19.3	9.5	12.0	13.6
Biotite	23.0	22.8	18.2	7.1	16.0
Muscovite	2.7	0.0	1.6	0.0	0.5
Hornblende	0.0	0.0	0.0	0.0	0.0
Epidote	1.0	0.0	2.4	1.4	1.3
Hematite	0.0	0.0	0.0	0.0	0.0
Pyrite	1.3	0.0	1.6	2.1	1.2
Rutile	0.0	0.0	0.0	0.0	0.0
Apatite	0.0	0.0	0.0	0.0	0.0
Zircon	0.0	0.0	0.0	0.0	0.0
Tourmaline	0.0	0.0	0.0	0.0	0.0
Dolomite	0.0	0.0	0.0	0.0	0.0
Total	100.0%	100.0%	100.0%	100.0%	

APPENDIX 2a

Greywackes: mineralogical point-counts

Sample No.	ø315-1	ø321-1 run a.	b.	c.	ø321-1 average
Quartz	44.1	54.1	47.8	54.6	52.1
Plagioclase	33.8	28.9	13.4	19.0	20.4
Chlorite	5.4	8.0	4.6	3.1	5.2
Biotite	14.7	7.5	22.0	18.4	16.0
Muscovite	0.0	0.5	6.6	1.2	2.8
Hornblende	0.0	0.0	0.0	0.0	0.0
Epidote	0.0	0.0	1.5	0.6	0.7
Hematite	0.0	0.0	0.0	0.0	0.0
Pyrite	1.6	0.5	4.1	3.1	2.6
Rutile	0.0	0.0	0.0	0.0	0.0
Apatite	0.2	0.0	0.0	0.0	0.0
Zircon	0.2	0.0	0.0	0.0	0.0
Tourmaline	0.0	0.5	0.0	0.0	0.2
Dolomite	0.0	0.0	0.0	0.0	0.0
Total	100.0%	100.0%	100.0%	100.0%	

APPENDIX 2a

Greywackes: mineralogical point-counts

Sample No.	Ø298-4	Ø336-2 run a.	b.	c.	Ø336-2 average
Quartz	62.5	51.4	56.7	51.2	53.1
Plagioclase	18.2	20.4	15.2	29.4	21.6
Chlorite	4.9	5.4	7.0	4.5	5.6
Biotite	9.3	2.4	1.8	1.1	1.8
Muscovite	2.7	14.4	14.0	11.2	13.2
Hornblende	0.0	0.0	0.0	0.0	0.0
Epidote	1.1	4.2	4.1	1.7	3.3
Hematite	0.0	1.2	1.2	1.1	1.2
Pyrite	1.1	0.0	0.0	0.0	0.0
Rutile	0.0	0.0	0.0	0.0	0.0
Apatite	0.0	0.0	0.0	0.0	0.0
Zircon	0.2	0.0	0.0	0.0	0.0
Tourmaline	0.0	0.0	0.0	0.0	0.0
Dolomite	0.0	0.6	0.0	0.0	0.2
Total	100.0%	100.0%	100.0%	100.0%	

APPENDIX 2a

Greywackes: mineralogical point-counts

Sample No.	Ø338-1	Ø399-1 run a.	b.	c.	Ø399-1 average
Quartz	67.0	30.1	36.4	39.9	35.5
Plagioclase	14.8	30.8	25.4	18.7	24.9
Chlorite	10.3	3.6	4.6	6.1	4.8
Biotite	3.0	30.1	28.3	29.8	29.4
Muscovite	0.0	3.0	1.2	3.0	2.4
Hornblende	0.0	0.0	0.0	0.0	0.0
Epidote	3.0	0.6	0.6	1.0	0.7
Hematite	0.0	1.8	3.5	1.5	2.3
Pyrite	1.9	0.0	0.0	0.0	0.0
Rutile	0.0	0.0	0.0	0.0	0.0
Apatite	0.0	0.0	0.0	0.0	0.0
Zircon	0.0	0.0	0.0	0.0	0.0
Tourmaline	0.0	0.0	0.0	0.0	0.0
Dolomite	0.0	0.0	0.0	0.0	0.0
Total:	100.0%	100.0%	100.0%	100.0%	

APPENDIX 2a

Greywackes: mineralogical point-counts

Sample No. 0337-1

Quartz 54.1

Plagioclase 24.5

Chlorite 3.6

Biotite 10.6

Muscovite 4.2

Hornblende 0.0

Epidote 0.9

Hematite 0.5

Pyrite 1.0

Rutile 0.2

Apatite 0.0

Zircon 0.4

Tourmaline 0.0

Dolomite 0.0

Total 100.0%

APPENDIX 2b

Greywackes: apparent grain-size distribution in thin section

% Grain size greater than	mm	Sample Numbers				
		Ø257-5	Ø266-2	Ø268-3	Ø290-3	Ø298-4
Ø -2	4	0.0	0.0	0.0	0.0	0.0
-1	2	0.0	0.0	0.0	0.0	1.2
0	1	0.0	0.0	0.0	2.2	5.2
1	0.5	2.5	3.7	0.8	15.4	19.3
2	0.25	22.0	28.0	6.6	27.3	30.2
3	0.125	24.5	32.6	27.3	26.3	22.1
4	0.065	27.0	23.7	38.9	12.9	12.4
< 0.065		23.9	12.0	32.3	16.0	9.6

% Grain size greater than	mm	Sample Numbers				Ø321-1 average
		Ø315-1	Ø321-1 run a.	b.	c.	
Ø -2	4	0.0	0.0	0.0	0.0	0.0
-1	2	0.0	0.0	0.0	0.0	0.0
0	1	0.0	2.2	0.0	1.3	1.9
1	0.5	2.9	12.4	17.1	12.8	14.1
2	0.25	11.0	35.8	34.1	42.3	37.4
3	0.125	27.8	21.9	21.7	21.2	21.6
4	0.065	33.6	15.3	18.6	11.5	15.2
< 0.065		24.6	12.4	8.5	10.9	10.6

APPENDIX 2b

Greywackes: apparent grain-size distribution in thin section

% Grain size greater than	mm	Sample Numbers			Ø336-2 average	Ø337-1
		Ø336-2 run a.	b.	c.		
Ø -2	4	0.0	0.0	0.0	0.0	0.0
-1	2	0.0	0.0	0.0	0.0	25.6
0	1	0.0	0.0	0.0	0.0	33.2
1	0.5	1.0	0.0	0.0	0.3	21.9
2	0.25	6.9	7.7	4.8	6.5	7.5
3	0.125	21.8	17.5	18.7	19.3	8.0
4	0.065	43.1	39.3	44.6	42.3	3.9
<0.065		27.2	35.5	31.9	31.6	0.0

% Grain size greater than	mm	Sample Numbers	
		Ø338-1	Ø399-1
Ø -2	4	0.8	0.0
-1	2	9.8	0.0
0	1	24.1	0.0
1	0.5	38.4	0.0
2	0.25	19.2	6.7
3	0.125	5.6	15.2
4	0.065	2.1	42.9
<0.065		0.0	35.2

APPENDIX 2c

Greywackes: clast lithologies

Sample No.	Ø266-2	Ø290-3 run a.	b.	c.	Ø290-3 average
Quartz 1 domain	8.9	39.2	40.5	25.6	35.2
Quartz 2-6 domains	4.1	6.9	2.1	4.7	4.6
Quartz >6 domains	29.0	3.1	5.6	8.8	5.8
Plagioclase	17.5	18.5	20.3	18.1	19.0
Basaltic Rock Frag.	8.1	3.1	3.5	6.8	4.5
Andesitic Rock Frag.	1.4	0.8	0.7	1.6	1.0
Dacitic Rock Frag.	1.7	2.3	1.4	2.0	1.9
Rhyolitic Rock Frag.	1.0	2.3	1.4	5.4	3.0
Chert Rock Frag.	0.0	0.0	0.0	0.0	0.0
Iron Form. Rock Frag.	0.0	1.5	0.0	2.0	1.2
Siltstone Rock Frag.	0.0	0.0	0.0	0.0	0.0
Detrital Muscovite	0.0	0.0	0.0	0.0	0.0
Detrital Pyrite	0.0	0.0	0.0	0.0	0.0
Matrix	27.4	22.3	24.5	25.0	23.9
Total	100.0%	100.0%	100.0%	100.0%	

* Clast lithology point-counts are a record of the proportions of clast types not of mineralogy.

APPENDIX 2c

Greywackes: clast lithologies

Sample No.	Ø298-4	Ø321-1 run a.	b.	c.	Ø321-1 average
Quartz 1 domain	25.7	10.9	13.0	11.8	11.9
Quartz 2-6 domains	5.2	15.3	13.7	14.6	14.5
Quartz >6 domains	19.7	39.4	34.9	35.5	36.6
Plagioclase	16.9	10.2	13.7	14.5	12.8
Basaltic Rock Frag.	2.6	0.0	1.4	1.1	0.8
Andesitic Rock Frag.	2.4	2.2	1.4	0.5	1.4
Dacitic Rock Frag.	1.3	5.1	4.1	5.4	4.9
Rhyolitic Rock Frag.	1.3	2.9	4.1	4.3	3.8
Chert Rock Frag.	1.0	0.2	0.0	0.0	0.1
Iron Form. Rock Frag.	0.2	0.7	0.0	0.5	0.4
Siltstone Rock Frag.	1.6	0.7	0.0	0.0	0.2
Detrital Muscovite	0.2	0.0	0.0	0.0	0.0
Detrital Pyrite	0.0	0.0	0.0	0.0	0.0
Matrix	22.4	12.4	13.7	11.8	12.6
Total	100.0%	100.0%	100.0%	100.0%	

APPENDIX 2c

Greywackes: clast. lithologies

Sample No.	Ø257-5	Ø338-1	Ø337-1
Quartz 1 domain	25.7	6.7	15.7
Quartz 2-6 domains	6.6	5.8	11.0
Quartz >6 domains	5.8	49.3	18.5
Plagioclase	32.3	5.3	6.3
Basaltic Rock Frag.	0.0	2.4	7.0
Andesitic Rock Frag.	8.0	0.9	17.5
Dacitic Rock Frag.	3.5	3.5	5.4
Rhyolitic Rock Frag.	3.1	5.4	7.3
Chert Rock Frag.	0.0	0.0	2.0
Iron Form. Rock Frag.	0.0	0.0	1.1
Siltstone Rock Frag.	0.0	0.9	3.3
Detrital Muscovite	0.0	0.0	0.0
Detrital Pyrite	0.0	0.0	0.0
Matrix	15.0	15.8	4.9
Total	100.0%	100.0%	100.0%

APPENDIX 3a

Carbonates: mineralogical point-counts
chemical unit

Sample No.	Ø346-1	Ø358-1
Quartz and Plagioclase	37.1	34.6
Chlorite	5.2	14.2
Biotite	31.4	14.0
Muscovite	0.0	0.0
Hornblende	0.0	0.0
Epidote	0.7	0.2
Dolomite	23.4	35.7
Hematite and Pyrite	2.2	0.9
Apatite	0.0	0.4
Tourmaline	0.0	0.0
Total	100.0%	100.9%

APPENDIX 3b

Carbonates: mineralogical point-counts
clastic unit

Sample No.	Ø273-1	Ø273-2	Ø273-3	Ø326-1
Quartz and Plagioclase	24.1	32.8	31.3	40.5
Chlorite	24.6	17.7	38.6	40.0
Biotite	27.7	26.7	5.5	8.4
Muscovite	0.8	0.0	0.0	0.0
Hornblende	0.0	0.0	0.0	0.0
Epidote	0.4	0.5	1.4	1.0
Dolomite	22.2	21.7	21.7	7.1
Hematite and Pyrite	0.8	0.5	1.4	3.0
Apatite	0.0	0.0	0.0	0.0
Tourmaline	0.0	0.0	0.0	0.0
Total	100.0%	100.0%	100.0%	100.0%

APPENDIX 4

Greywackes: anorthite content of plagioclase clasts

Sample No.	optically + minimum An. content %	optically - maximum An. content %
Ø257-5	-	40
Ø260-2	-	45
Ø266-2	7	45
Ø268-3	-	40
Ø290-3	8	35
Ø298-4	-	42
Ø315-1	-	42
Ø321-1	-	45
Ø337-1	7	40
Ø338-1	8	46
Ø384-2	7	45
Ø399-1	-	45

Anorthite content was determined from intertwin angles of albite twins (Michel-Levy method).

APPENDIX 5

Felsic Porphyries: mineralogical point-counts

Sample No.	Ø289-1 run a.	b.	c.	Ø289-1 average	Ø383-1
Quartz and Plagioclase*	70.2	71.4	70.6	70.7	77.9
Chlorite	2.7	2.6	2.2	2.5	14.2
Biotite	8.1	7.8	5.0	7.0	1.4
Muscovite	17.6	17.5	19.4	18.2	0.0
Epidote	0.0	0.0	0.7	0.2	3.9
Dolomite	0.0	0.6	0.7	0.5	1.6
Hematite and Pyrite	1.4	0.0	0.0	0.5	0.4
Apatite	0.0	0.0	1.4	0.5	0.6
Total	100.0%	100.0%	100.0%		100.0%

* Quartz and plagioclase are equally abundant.

PLATLS

GEOLOGY OF THE 'ISLANDS LAKE' AREA

MAP 1

John Ostler 1977

A

LEGEND

DIABASE

FELSIC PORPHYRY

CLASTIC UNIT

GREYWACKE-ARGILLITE
thickly bedded / thinly bedded

ARGILLITE

CARBONATE
siliceous dolostone

CHEMICAL UNIT

CARBONATE
siliceous dolostone

CARBONACEOUS SLATE

OXIDE IRON FORMATION
chert, magnetite

SILICATE IRON FORMATION
abundant riebeckite

BACK RIVER VOLCANIC COMPLEX

NORTH DACITE
tuff and lapilli tuff

UPPER ANDESITE
tuff and lapilli tuff

UPPER BASALT
amygdaloidal and brecciated in part

70F

CHEMICAL UNIT

CARBONATE
siliceous dolostone

CARBONACEOUS SLATE

OXIDE IRON FORMATION
chert, magnetite

SILICATE IRON FORMATION
abundant riebeckite

BACK RIVER VOLCANIC COMPLEX

NORTH DACITE
tuff and lapilli tuff

UPPER ANDESITE
tuff and lapilli tuff

UPPER BASALT
amygdaloidal and brecciated in part

LOWER ANDESITE
porphyritic

LOWER BASALT
pillowed in part

Geological boundary (defined, approximate)

Bedding (tops: known, unknown, overturned)
pillow tops

Cleavage (first, second)

Fault (defined, assumed)

Limit of outcrop

note see Map 3 for structure
see Map 2 for units 6-8

SCALE

949

15.0.1

OXIDE IRON FORMATION
 chert, magnetite

SILICATE IRON FORMATION
 abundant riebeckite

BACK RIVER VOLCANIC COMPLEX

RHYOLITE-CARBONATE
 carbonate bearing, rhyolite tuff

SOUTH DACITE
 tuff

SOUTH RHYOLITE
 tuffaceous in part

NORTH DACITE
 tuff and lapilli tuff

UPPER ANDESITE
 tuff and lapilli tuff

UPPER BASALT
 amygdaloidal and brecciated in part

LOWER ANDESITE
 porphyritic

LOWER BASALT
 pillowed in part

Geological boundary (defined, approximate) ————

Bedding (tops: known, unknown)

Cleavage (first, second)

Fault (defined, assumed)

Limit of outcrop

note: see Map 4 for structure

SCALE

608

STRUCTURE OF THE 'ISLANDS LAKE' AREA

MAP 3

John Ostler 1977

107° 45' W

A

1 OF 1

LEGEND

FIRST PHASE OF DEFORMATION

defined

approximate

Syncline

Anticline

SECOND PHASE OF DEFORMATION

defined

approximate

'ISLANDS LAKE'

LEGEND

FIRST PHASE OF DEFORMATION

SECOND PHASE OF DEFORMATION

Bedding (tops: known, unknown, overturned)
pillow tops

Cleavage (first, second)

Fault (defined, assumed)

note: see map 1 for geology

SCALE

STRUCTURE

SOUTHEAST OF THE BACK RIVER VOLCANIC COMPLEX

MAP 4

John Ostler 1977

64° 52' N

107° 50'

107° 45'

107° 40'

107° 35'

2 OF 1

BACK RIVER

FIRST

Syncline

Anticline

Thrust

SECOND

107° 35'

64° 52'

INDEX MAP

LEGEND

FIRST PHASE OF DEFORMATION

	defined	approximate
Syncline		
Anticline		
Thrust (teeth down dip)		

SECOND PHASE OF DEFORMATION

defined approximate

40F1

FIRST

Syncline

Anticline

Thrust

SECO

Syncline

Anticline

Slide C

Bedding

Cleavage

Fault

note: s

c

C

F

C

5.0

SUR

3 3

OF/DE

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

LEGEND

FIRST PHASE OF DEFORMATION

	defined	approximate
Syncline		
Anticline		
Thrust (teeth down dip)		

SECOND PHASE OF DEFORMATION

	defined	approximate
Syncline		
Anticline		
Slide Contact (net displacement unknown)		

Bedding (tops known, unknown)

Cleavage (first, second)

Fault (defined, assumed)

note see Map 3 for structural measurements at Islands Lake and Map 2 for geology

SCALE

PALEOCURRENTS AND SAMPLE LOCATIONS AT 'ISLANDS LAKE'

MAP 5

John Ostler 1977

Ø 255-1

Ø 256-1

Ø 256-2

Ø 256-4

Ø 256-3

Ø 317-1

Ø 315-1

Ø 315-2

Ø 313-3-4

Ø 313-1

Ø 313-2

Ø 306-2

Ø 306-1

Ø 306-3

Ø 298-1-3

Ø 298-4

2 OF 1

ø 298-4

ø 332-3

ø 333-1

ø 332-1-2

ø 333

ø 321

ø 321-1-3

ø 334-1

ø 334-2

60F

LEGEND

Sample location

• J78-2

• Ø401-1

Paleocurrent distribution

SCALE

9491

TOPOGRAPHY
AND
SAMPLE LOCATIONS
SOUTHEAST OF THE
BACK RIVER VOLCANIC COMPLEX
MAP 6

John Ostler 1977

107° 35'

64° 52'

130F

64° 50'

INDEX MAP

Coronation Gulf
Coppermine

[4. F]

15.0

• p250-1

64°50'

1200

INDEX MAP

Coronation Gulf

Coppermine

Yellowknife

Great Slave Lake

64°48'

1200

LEGEND

Sample location

• J98-2 • p370-1

Topographic contour (feet)

1200

note see map 5 for sample locations at Islands Lake

SCALE

16.F6

LEGEND

FELSIC PORPHYRY

CLASTIC UNIT

not in
stratigraphic
order

GREYWACKE-ARGILLITE
thickly bedded / thinly bedded

ARGILLITE

CARBONATE
siliceous dolostone

CHEMICAL UNIT

CARBONATE
siliceous dolostone

CARBONACEOUS SLATE

OXIDE IRON FORMATION
chert, magnetite

SILICATE IRON FORMATION
abundant riebeckite

BACK RIVER
VOLCANIC COMPLEX
flows and pyroclastics

Geological contact (dashed, approximate) ————

SCALE

CORRELA

2 OF 1

FIGURE 10

RELATION OF SEDIMENTARY S IN THE 'ISLANDS LAKE' AREA

John Ostler 1977

3 of 1

STRATA

CROSS-S

CROSS-SECTION LOCATIONS

Geological contact (defined..approximate) -----

SCALE

(VERTICAL + HORIZONTAL)

0

0.3 mile

0

0.5 km

60F4

70F

8 of

oil

SLINGSHOT LAKE

9.51

SCALE

100 F

2

11.0F1

10

12 OF 1

note

signature

11

COMPOSITE
SECTION

13 OF 1

COMPOSITE SECTION

12

14 of 1

13

150F1

10

16 of 1

1709

note
FIGURE 2

1

COMPOSITE
SECTION

COMPOSITE SECTION

180F

12

5

6

7

19 of 1

13

7

8

20-P20

END

0

4

7

FIN