GEOCHRONOMETRY AND CHEMISTRY

OF THE

CRETACEOUS

CARMACKS GROUP, YUKON

By

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A thesis submitted in
partial fulfillment of the
requirements for the
Degree of Bachelor of Science

in

The Faculty of Science
Department of Geological Sciences
The University of British Columbia
April, 1980

ABSTRACT

Volcanic rocks of the Carmacks Group cover scattered areas of the southwestern Yukon. Four stratigraphic sections in the Group were measured at various locations surrounding the town of Carmacks. The sections consisted of lava flows, epiclastic breccias, sintered tuff, and immature volcanic sandstone.

Three samples collected from different sections were dated by K-Ar isotope methods. Two whole-rock analyses yielded dates of 73.1 ± 2.5 Ma and 67.9 ± 2.3 Ma. One biotite separate yielded a K-Ar date of 68.0 ± 2.2 Ma. Dates indicate that the Carmacks Group is coeval with the adjacent Mount Nansen Group.

Lava flows and clasts in epiclastic breccias range in chemical composition from calc-alkaline andesite to alkali basalt, trachybasalt, and tristanite. Chemistry indicates that the Mount Nansen and Carmacks suites form a calc-alkaline to alkaline gradient from volcanic front towards the craton.

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ACKNOWLEDGMENTS

D.J. Tempelman-Kluit of the Geological Survey of Canada provided inspiration and assistance during the summer, fall and winter of 1979-80. Pam Reid gave excellent assistance in the field.

R.L. Armstrong supervised thesis work at UBC. Graduate students Graham Nixon and Randy Parrish provided technical and academic assistance. Thanks are due to J. Harakal and K.L. Scott for K-Ar and Rb-Sr dating. Finally, discussion with fellow student Helen Grond was of great benefit.

I INTRODUCTION

Description of Problem

The Carmacks Group is recognized throughout the southwestern Yukon, in an area bounded approximately by Whitehorse, the Tintina Fault, Dawson City, and the Shakwak Fault. (Figure 1) These volcanics were first called the Carmacks Basalts by D.D. Cairnes (1910). In 1936 H.S. Bostock renamed the volcanics the Carmacks Group. These rocks are the scattered remnants of a thick volcanic assemblage that probably once covered much of the southwestern Yukon.

No published chemical analysis or isotopic date exist for the Carmacks Group. Previous investigators have thought its age to be Eocene to Miocene (Tempelman-Kluit, 1974, 1976). This thesis will present petrologic and major element chemical data for the Carmacks Group, plus three K-Ar dates and a Rb-Sr isochron that show the Carmacks Group to be Upper Cretaceous.

Present Study

This investigation into the Carmacks Group was undertaken at the suggestion of D.J. Tempelman-Kluit of the Geological Survey of Canada. Field work was completed during the summer of 1979. The study of the Carmacks Group was concentrated in three areas; on Miller's Ridge five kilometers west of the town of Carmacks, in the Glenlyon map sheet nineteen kilometers east of Carmacks, and in the Aishihik Lake map sheet fourteen kilometers south of Carmacks (Figure 2). In each area sections were measured and samples were taken for petrographic studies, chemical analysis, K-Ar dating and pollen dating. Pollen from the immature sandstones of the Carmacks Group is being studied by

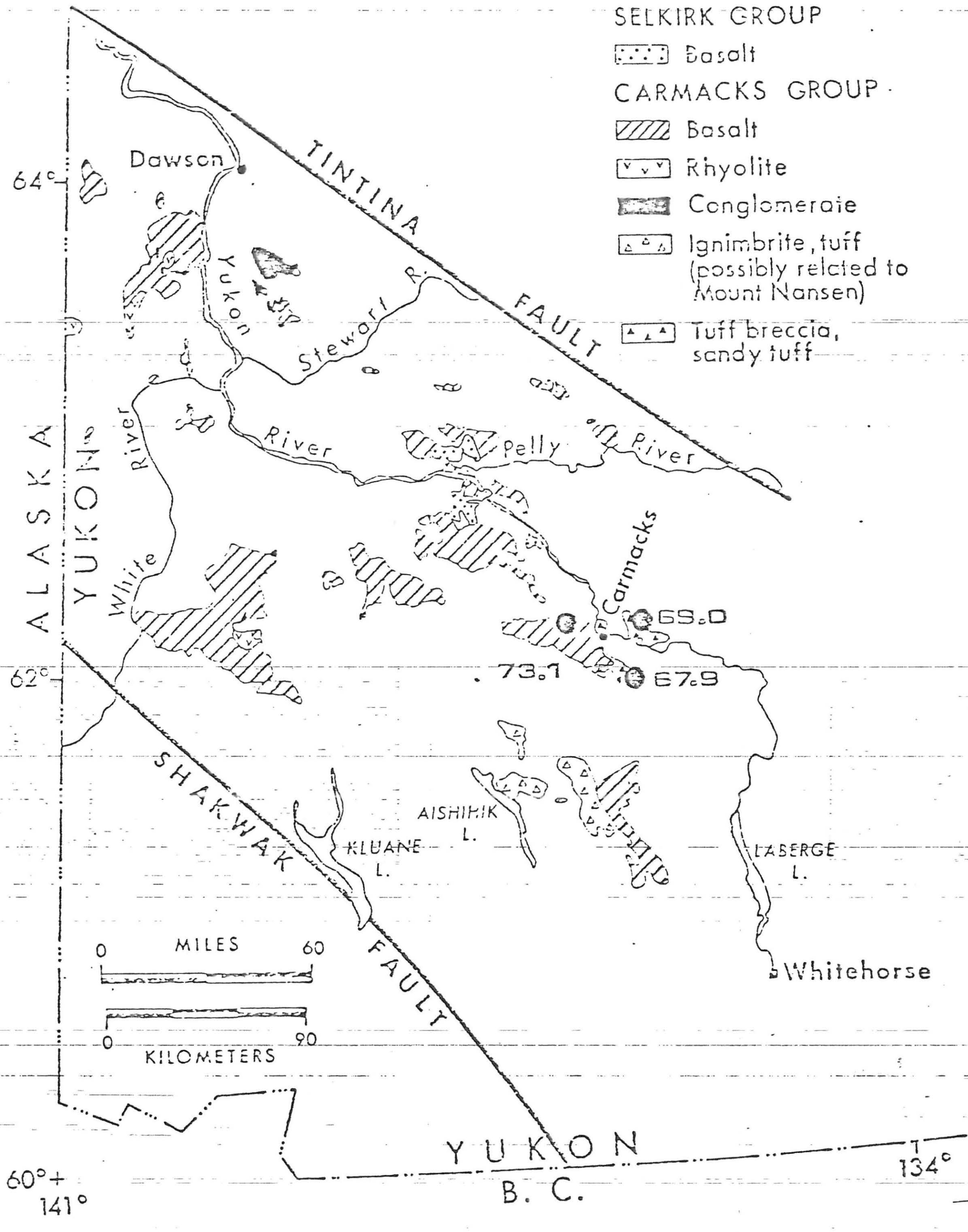


Figure 1 - Distribution of the Carmacks Group and Locations of the Three K-Ar Dated Samples.

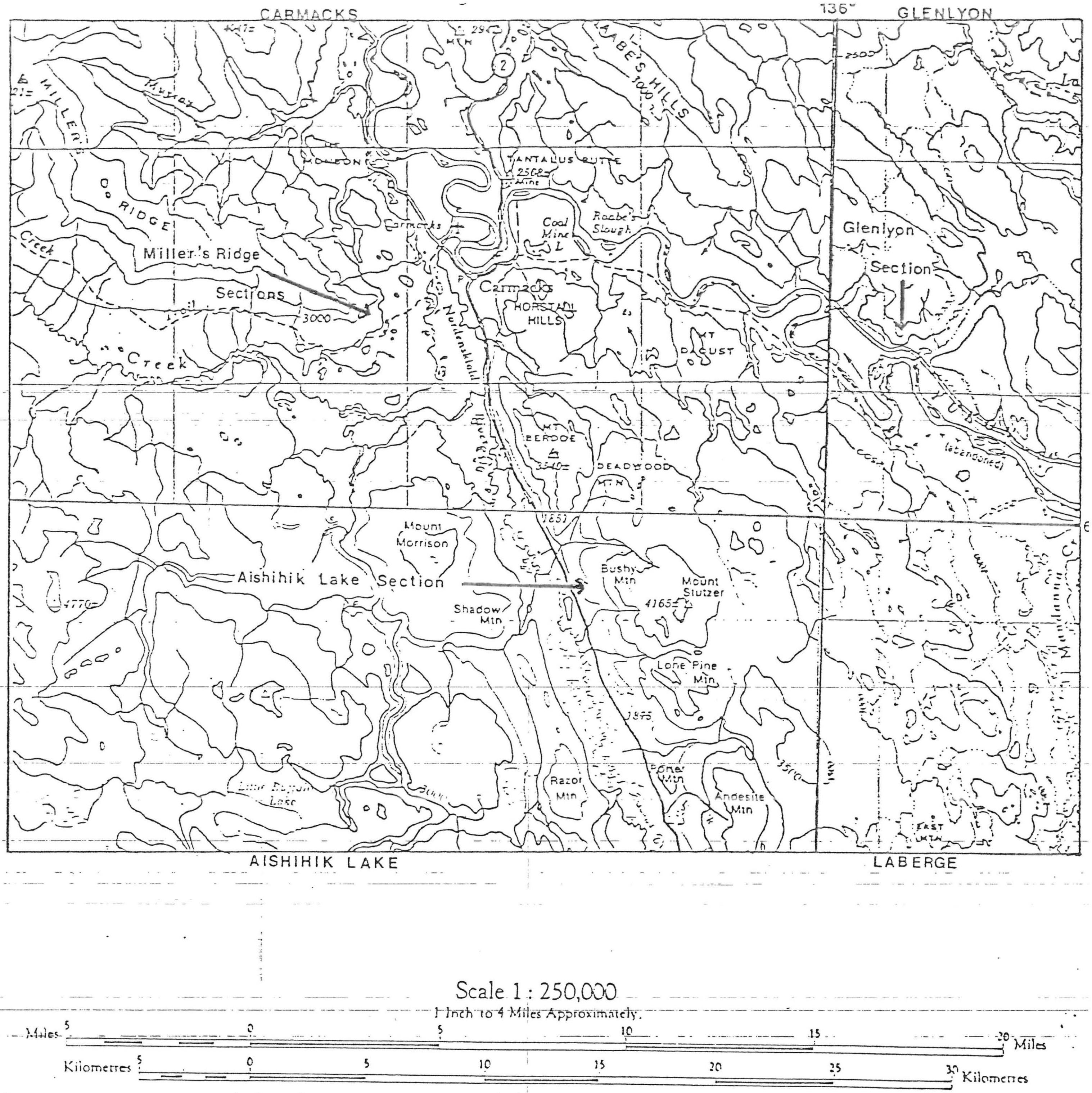


Figure 2 - Topographic map showing locations of the measured sections.

the Geological Survey of Canada.

During the fall and winter of 1979-80 selected rocks from the three areas were studied. One sample from each section was used for K-Ar dating to determine the absolute age of the rocks.

II GEOLOGY

General Geology of Area

The area in which the Carmacks Group is exposed is largely covered by the Carmacks, Glenlyon, Aishihik Lake and Laberge map sheets. These areas were first investigated by D.D. Cairnes at the beginning of the twentieth century. In 1936 H.S. Bostock published a Geological Survey of Canada Memoir on the Carmacks District. Bostock described all the formations in the area, from the metamorphic Yukon Group to the Late Tertiary Selkirk Volcanics. The table of formations which Bostock produced is still used, the only important changes being in the absolute ages of some formations. Bostock considered that the Mount Nansen Group Andesites were Late Jurassic and/or Early Cretaceous and that the Carmacks Group was Eocene or older. K-Ar dates reported here demonstrate that the Carmacks Group is Late Cretaceous, and the same age as the Mount Nansen Group (Grond, 1980).

The following depositional history and tectonic model is summarized from Bostock (1930) and from Tempelman-Kluit (1976,1979 and personal communication).

The Yukon Group is an agglomeration of several distinct groups of metamorphic rocks, with different ages of deposition and different grades and ages of metamorphism. Because of lack of continuity of units and lack of fossils, the depositional ages cannot be established, but they are probably Paleozoic and Early Mesozoic.

The Lewes River and Laberge Groups are Upper Triassic and Lower Jurassic volcanic rocks, limestone reefs, and coarse clastic rocks derived from them. They were deposited in a forearc basin northeast of the Lewes River arc.

The Tantalus Formation was deposited unconformably above the Laberge Group in the Late Jurassic or Early Cretaceous. The formation is terrestrial in origin with a probable source to the east in the Omineca Crystalline Belt.

In the Early to Middle Cretaceous the entire assemblage was metamorphosed, by folding, faulting, and intrusions. Metamorphism was followed by erosion.

In the Late Cretaceous, subduction of Pacific Ocean floor beneath the accreted Intermontane Belt led to plutonism and extrusion of the coeval Mount Nansen and Carmacks Groups.In the Aishihik Lake map area Carmacks volcanics overlie the Mount Nansen Group (Tempelman-Kluit, 1974), but broadly the two groups are coeval. The more acid Mount Nansen Group is found to the southwest of the more basic Carmacks Group. Overlap between the two groups is seen in parts of the Dawson Range (Tempelman-Kluit, 1980).

The Carmacks Group was extruded from a few widely placed centres onto a topographic surface with considerable relief. The relief on the depositional surface was up to 1500 meters. Uplift of the Yukon Plateau accompanied the extrusion (Tempelman-Kluit, 1980).

In the Pleistocene, the Selkirk Lavas were extruded onto the surface of the Yukon Plateau. During the Pleistocene parts of the areas underlain by the Carmacks Group were glaciated.

General Geology of the Carmacks Group

The Carmacks Group has been studied and described in detail by Cairnes (1910), Bostock (1936), and Tempelman-Kluit (1975,76), amoung others. The following is a brief description of the characteristics of the Carmacks Group taken from the above references.

The Carmacks Group forms a thick section of lavas, epiclastic breccias, tuff, and immature volcanic sandstones, unconformably above the Cretaceous Tantalus Formation and older rocks. They are themselves unconformably overlain by the Selkirk Lavas. The dip of the flows ranges from horizontal to 20° and the entire section is cut by northeast trending faults.

The base is marked by a thin conglomerate. Above this conglomerate are thick, massive lavas, that grade upward into interbedded vesicular lavas and epiclastic breccias.

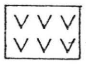
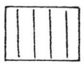
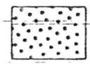
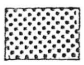
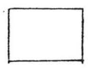
The lavas are generally andesite, but range in composition from rhyolite, trachyte, and dacite to basalt. Individual flows can be anywhere from 0.5m to 50m thick. The lava flows are extremely fresh in appearance. Flows weather brown, reddish brown, red, green or grey. Fresh surfaces are grey, blue-green, brown or black. Massive flows are coarsely jointed and in some places show irregular but distinct columnar jointing. Vesicular flows do not show regular jointing. The lava includes phenocrysts of pyroxene, biotite, plagioclase, and/or olivine in a groundmass of pyroxene, biotite, plagioclase, magnetite and devitrified glass. The plagioclase is generally andesine. Vesicular flows have the same general composition. Vesicles may be filled with carbonate, zeolites, or silica. Some flows are vesicular to the point of being pumiceous or scoriaceous.

Epiclastic breccias of the Carmacks Group are generally well indurated and form large, massive outcrops. These weather brown to red brown and are difficult to distinguish from lavas at a distance. Clasts in the epiclastic flow breccias range in size to

2m and are all volcanic. They are derived from flows of the Carmacks Group. Clasts range in composition from siliceous rhyolite to mafic basalt and from massive to vesicular. The matrix of the epiclastic breccias is fine to coarse grained tuff and volcanic sand. Sporadically between flows are deposits of immature volcanic sandstone.

TABLE 1

SYMBOLS AND ABBREVIATIONS USED IN TEXT, TABLES, AND FIGURES

	lava flow	■	sample 12-2d
	epiclastic breccia	●	sample 15-1e
	sintered tuff	○	sample 14
	volcanic sandstone	△	sample 14-1h
	cover		

Ma- million years	Ol'- olivine + 3/4 orthopyroxene
mag- magnification	Ne'- nepheline + 3/5 albite
crs- coarse	Ab- albite
cong- conglomerate	Q'- quartz + 2/5 albite + 1/4 orthopyroxene
SST- sandstone	Opx- orthopyroxene
fg- fine grained	An- anorthite
m- meter	Ab'- albite + 5/3 nepheline
cm- centimeter	Or- orthoclase
mm- millimeter	A- Na_2O + K_2O (weight %)
km- kilometer	F- Fe_2O_3 "
mg- medium grained	M- MgO "
SLST- siltstone	

Normative plagioclase composition = 100 An/(An + Ab')

Normative colour index = olivine + orthopyroxene + clinopyroxene + magnetite + illmenite

III GEOLOGY OF SPECIFIC SECTIONS

Terminology

Nomenclature used in section descriptions was established in the field, by literature investigations, and by thin section studies. In the field basaltic and andesitic flows were distinguished by colour and phenocryst composition. Basalts were black in colour and contained phenocrysts of pyroxene and olivine, while andesites were medium to dark grey and contained phenocrysts of plagioclase and pyroxene. Samples which underwent chemical analysis were given more specific names, after Irvine and Baragar (1971). These samples were found to be more alkaline in nature than could be discerned in the field. Epiclastic breccia was chosen as an appropriate term for the volcanic breccias in the measured sections. The coarse tuff matrix,sorting, compositional variation, and roundness of clasts indicate a moving flow containing brecciated lava, that is mixing and becoming less angular with continued movement, rather than a breccia of explosive origin. The term sintered tuff was given to a specific rock type after thin section analysis. Volcanic sandstone was used in the field to describe lenses of immature, poorly sorted, fine grained clastics, containing angular grains of probable volcanic origin.

Miller's Ridge Area

Miller's Ridge, located 5km west of the town of Carmacks, trends east-west. Its eastern end was carved by Pleistocene ice and forms a cliff approximately 1.5km long. This cliff exposes a 200m section of the Carmack Group (Plate 1). The cliff face shows that the ridge

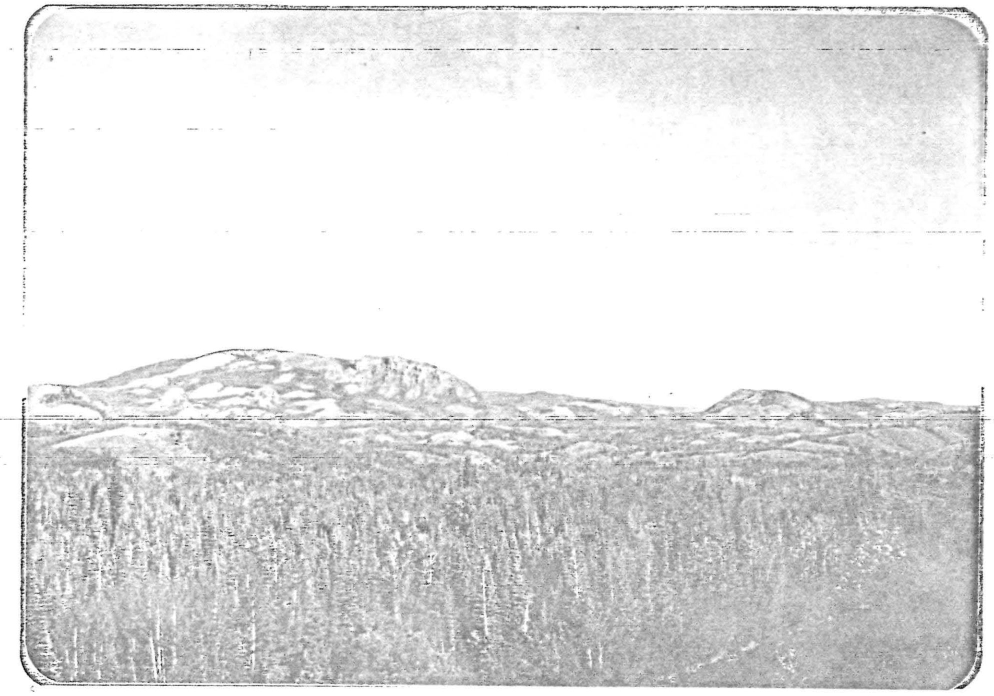


Plate 1 - Section exposed at southern end of Miller's Ridge, giving locations of Miller's Ridge East and West sections.

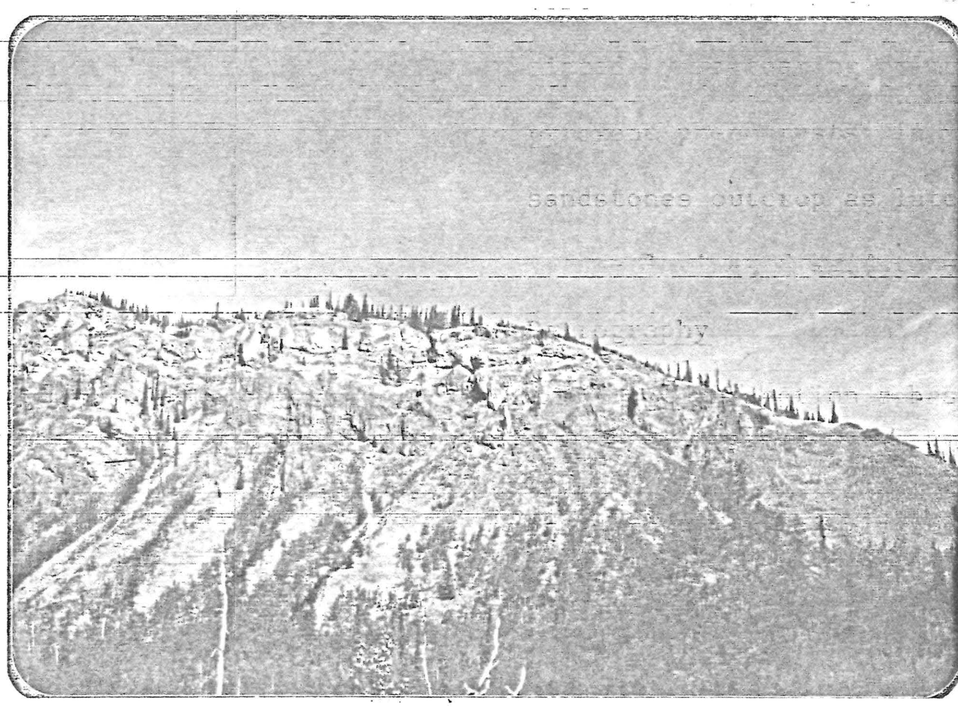


Plate 2 - Close up of location of Miller's Ridge East section.

is faulted. Because of this faulting two different sections are exposed in the cliff. The northeastern and southwestern sections were measured separately.

Miller's Ridge East

Description

The Miller's Ridge East section is summarized in Figure 3 and Appendix I. It consists of 186m of interbedded epiclastic flow breccias, lavas, sintered tuff and immature volcanic sands (Plate 2). Epiclastic breccias predominate. Clasts in the breccias are angular to rounded, and have a size range of 1cm to 1m (Plate 3). Clasts are massive to vesicular andesites and basalts. The epiclastic breccias form massive cliff-like outcrops. Contacts between the breccias, lavas, and volcanic sands are sharp, and contacts between the epiclastic breccias and the sintered tuff are gradational. The lava found in the section is vesicular, brecciated, and mixed with volcanic sand. The sintered tuff forms thick beds that are differentiated by weathering colours (Plate 4). All tuff beds have black pyroxene phenocrysts in variably devitrified glass matrix. Volcanic sandstones outcrop as laterally discontinuous lenses of fine to coarse laminated sandstone. Grains are poorly sorted and angular.

Petrography

In thin section a basalt clast from an epiclastic breccia (sample 11-1) contained phenocrysts of olivine and clinopyroxene in a groundmass of plagioclase (An_{35}). Clinopyroxene shows twinning and zoning. A thin section of the sintered tuff (sample 11-1i) consists of clinopyroxene and plagioclase phenocrysts in a very vesicular, devitrified glass matrix.

MILLER'S RIDGE EAST SECTION

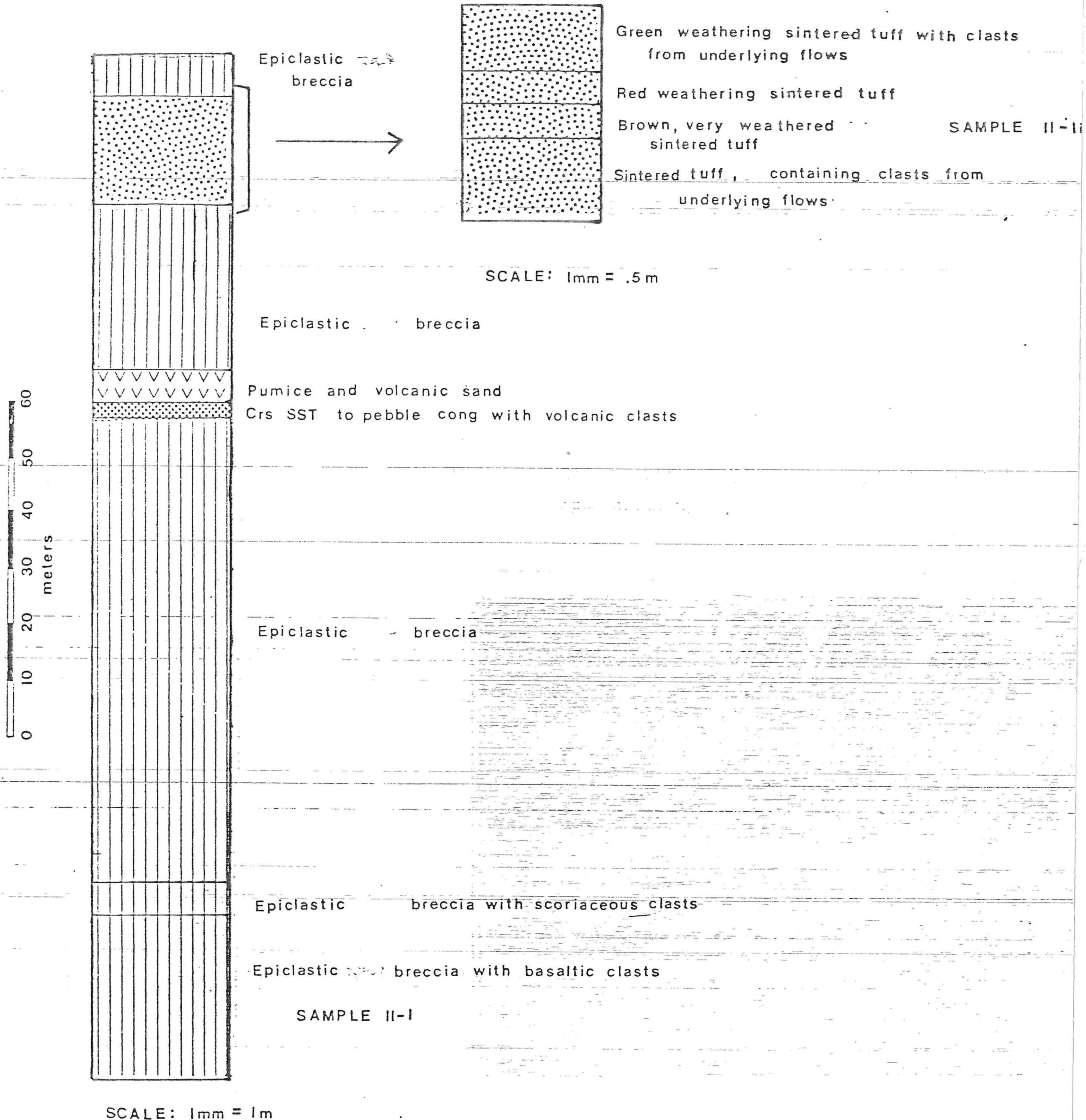


Figure 3 - Miller's Ridge East section

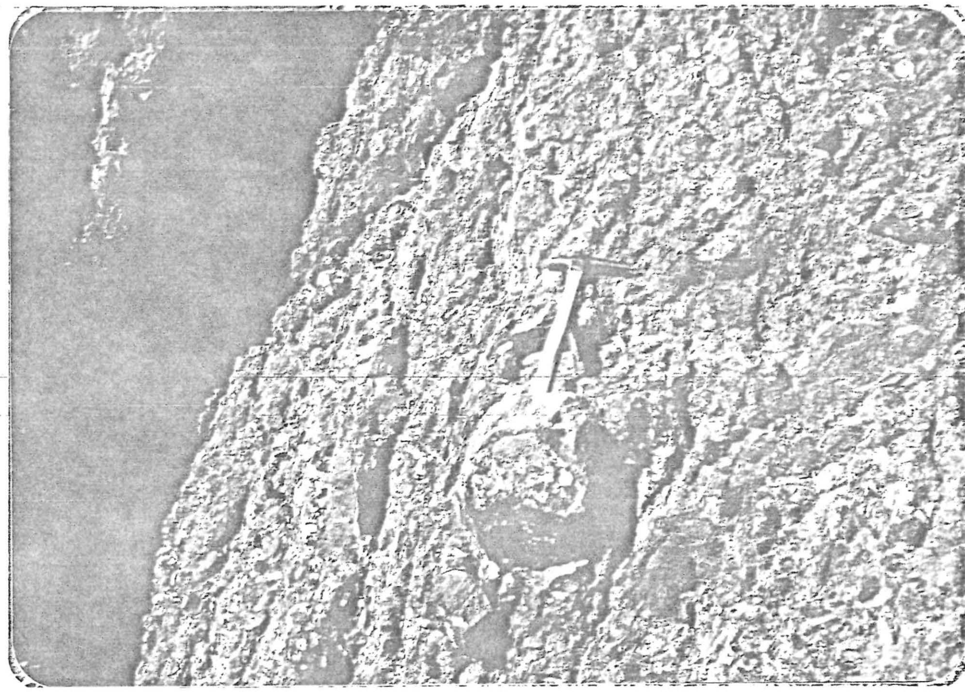


Plate 3 - Epiclastic breccia in Miller's Ridge East section, 48m above base.

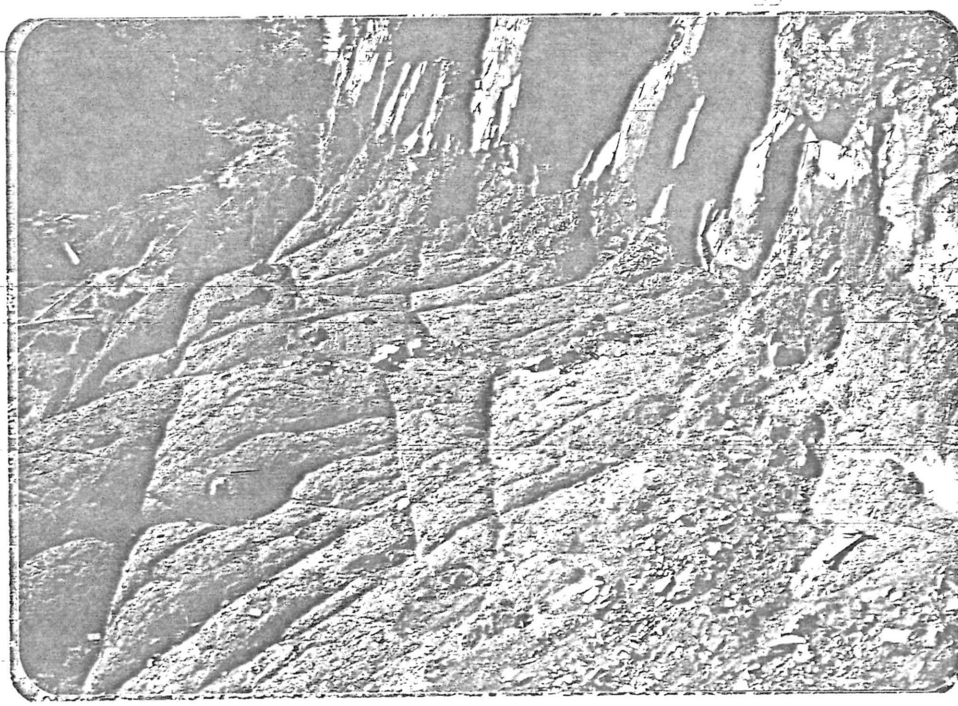


Plate 4 - Contact between two sintered tuff beds in Miller's Ridge East section, 167m above base.

Miller's Ridge West

Description

The Miller's Ridge West section is summarized in Figure 4 and Appendix I. It consists of 79.5m of interbedded epiclastic breccias, lavas, and immature volcanic sandstones. The epiclastic breccias are very similar to those found in the Miller's Ridge East section (Plate 5). They often intertongue with thin lava flows. The lava flows are andesite or basalt and are vesicular to massive. The top of the section is capped by a thick massive basalt (Plate 6), which displays crude columnar jointing. A sample of this lava flow was used for chemical analysis and isotope dating (sample 12-2d).

Petrography

A thin section of an andesitic lava (sample 12-2e) contains phenocrysts of plagioclase (An_{35}) and clinopyroxene. The clinopyroxene is partially altered to actinolite and chlorite and the plagioclase to epidote and zoisite (Plate 7). The presence of these alteration minerals indicates that the rock has undergone lower greenschist facies metamorphism. The basalt used for chemical analysis and isotope dating (sample 12-2d) was also analysed in thin section. The basalt has phenocrysts of twinned clinopyroxene and olivine partially altered to iddingsite (Plate 8), in a groundmass of plagioclase, pyroxene crystals, magnetite, and other opaques.

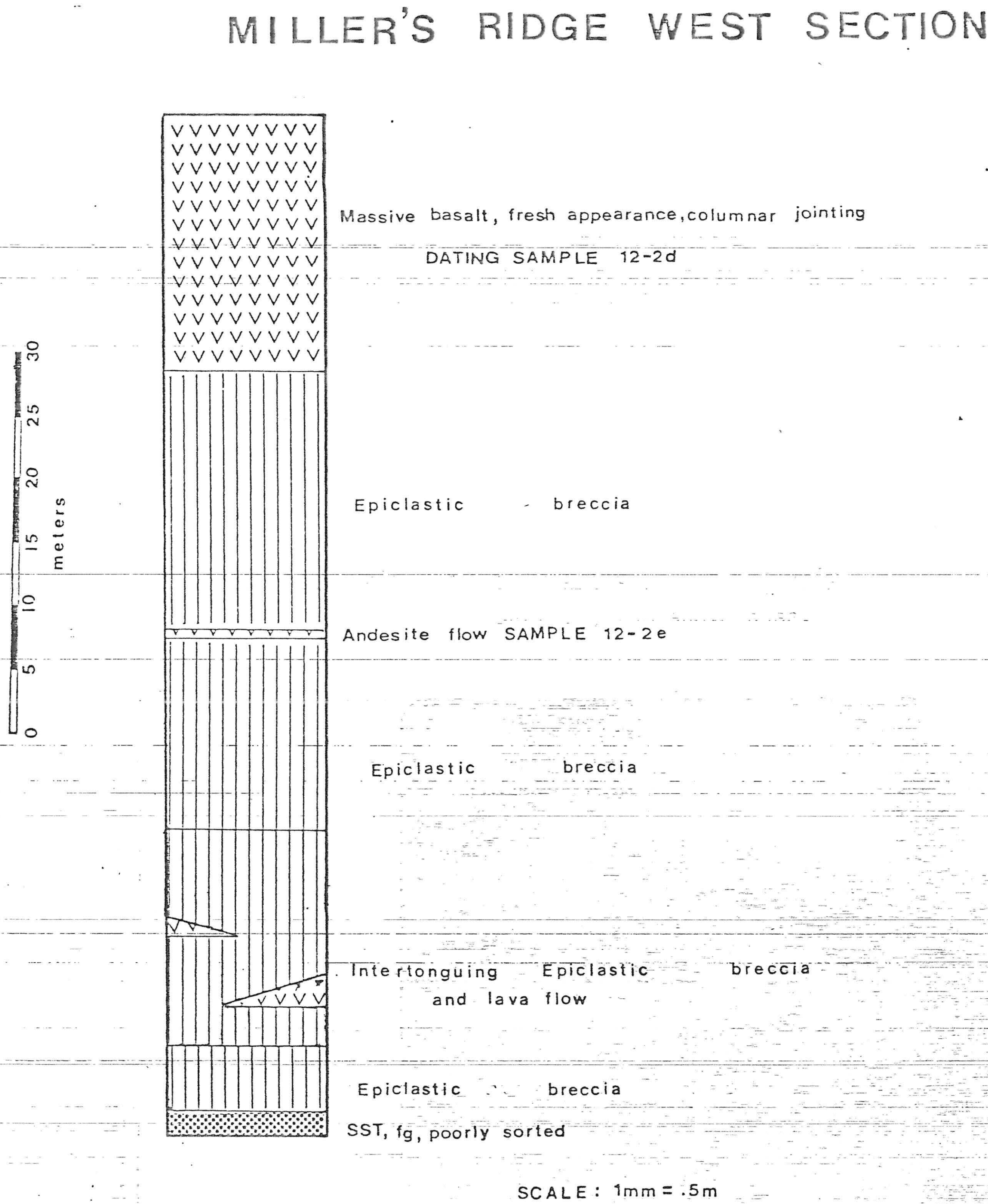


Figure 4 - Miller's Ridge West section

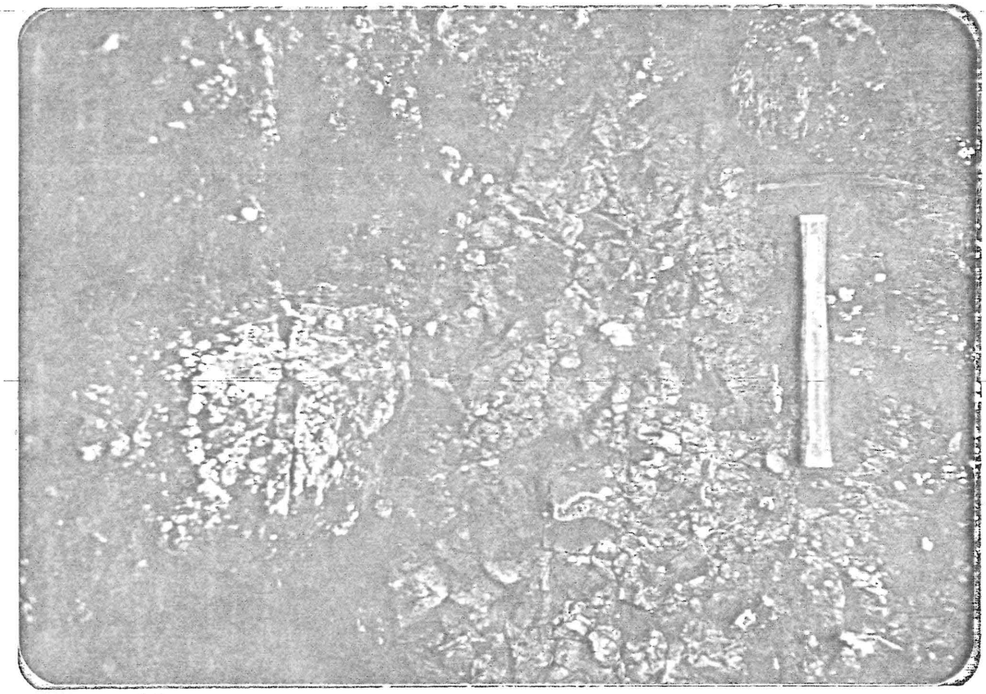


Plate 5 - Epiclastic breccia from Miller's Ridge West section, 25m above base.

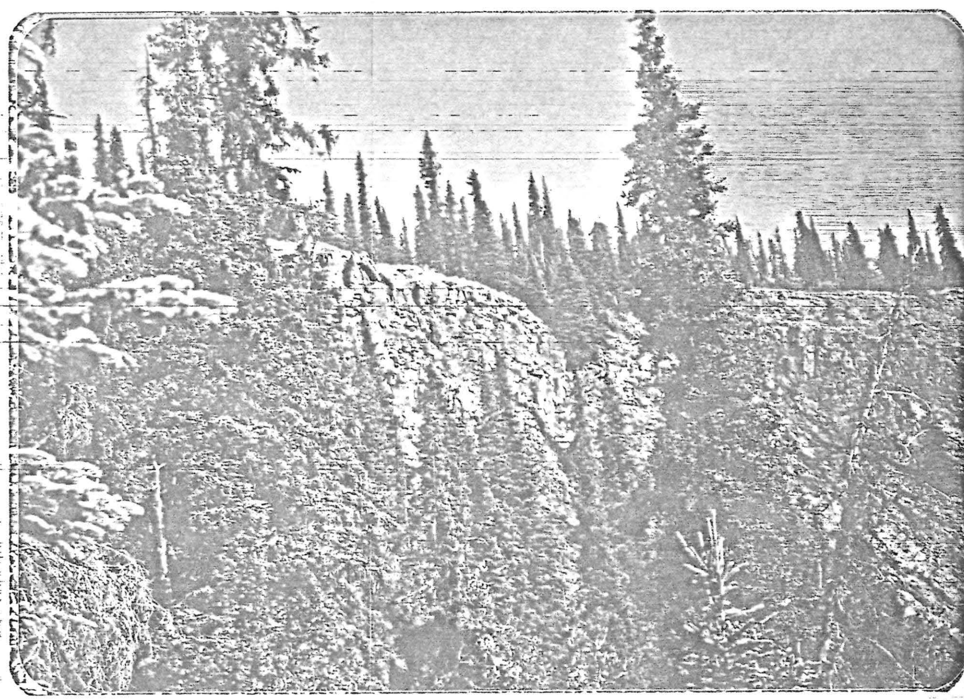


Plate 6- Massive, jointed basalt at top of Miller's Ridge East section. Dating sample 12-2d taken from this basalt.

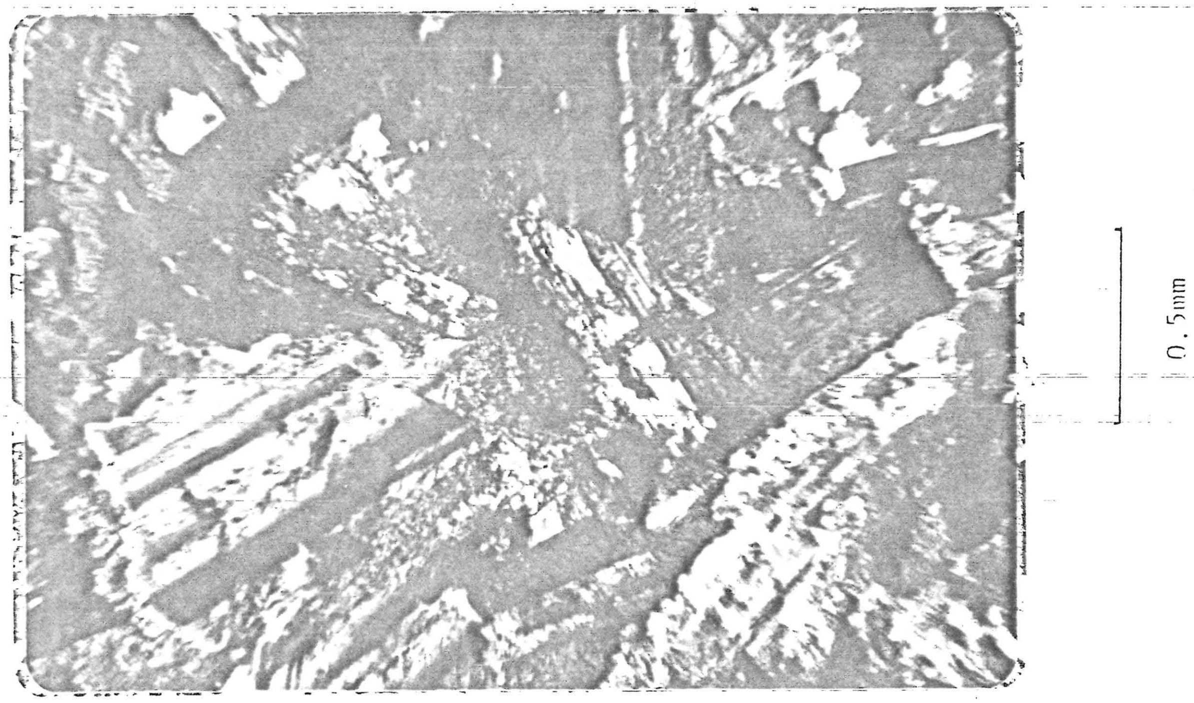


Plate 7 - Thin section of sample 12-2e. Plagioclase altering to epidote.

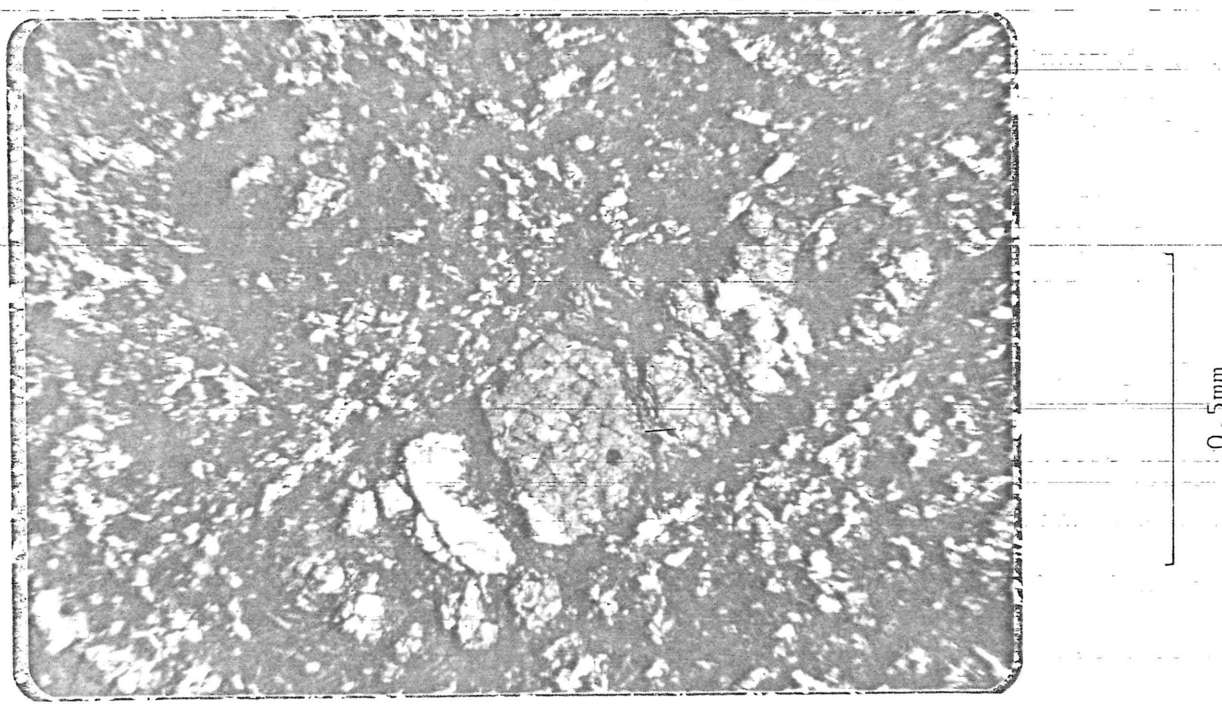


Plate 8 - Thin section of sample 12-2d. Olivine altering to iddingsite.

Aishihik Lake Section

Description

The Aishihik Lake section lies 100m east of the Whitehorse-Dawson highway, 14km south of the town of Carmacks. The bluff which makes up the section does not have good outcrop as at Miller's Ridge (Plate 9). In fact, over half the section is covered. However, the exposed parts of the section are similar in form and mineralogy to the sections at Miller's Ridge.

The Aishihik Lake section is summarized in Figure 5 and Appendix I. It consists of 89m of epiclastic breccias, lava, and covered intervals. Contacts between the different epiclastic breccias and the lava flow are not visible. Clasts in the breccias are up to 2m across (Plate 10), and are rounded to angular basalts and andesites. A sample of one of these large clasts was used for chemical analysis and isotope dating (sample 15-1e). One outcrop shows a series of successive epiclastic breccias which are distinguished by different clast sizes (Plate 11). Between these successive breccias are small lenses of immature, coarse sandstone. The lava flow in the section has covered intervals below and above it. It consists of a highly altered andesite.

Petrography

A thin section was taken of the epiclastic breccia clast used for chemical analysis and isotope dating (sample 15-1e). The clast is andesite with clinopyroxene and plagioclase phenocrysts, in a groundmass of plagioclase, chlorite, devitrified glass and opaques. The chlorite may be the result of olivine alteration. The plagioclase phenocrysts are zoned (Plate 12), but an accurate

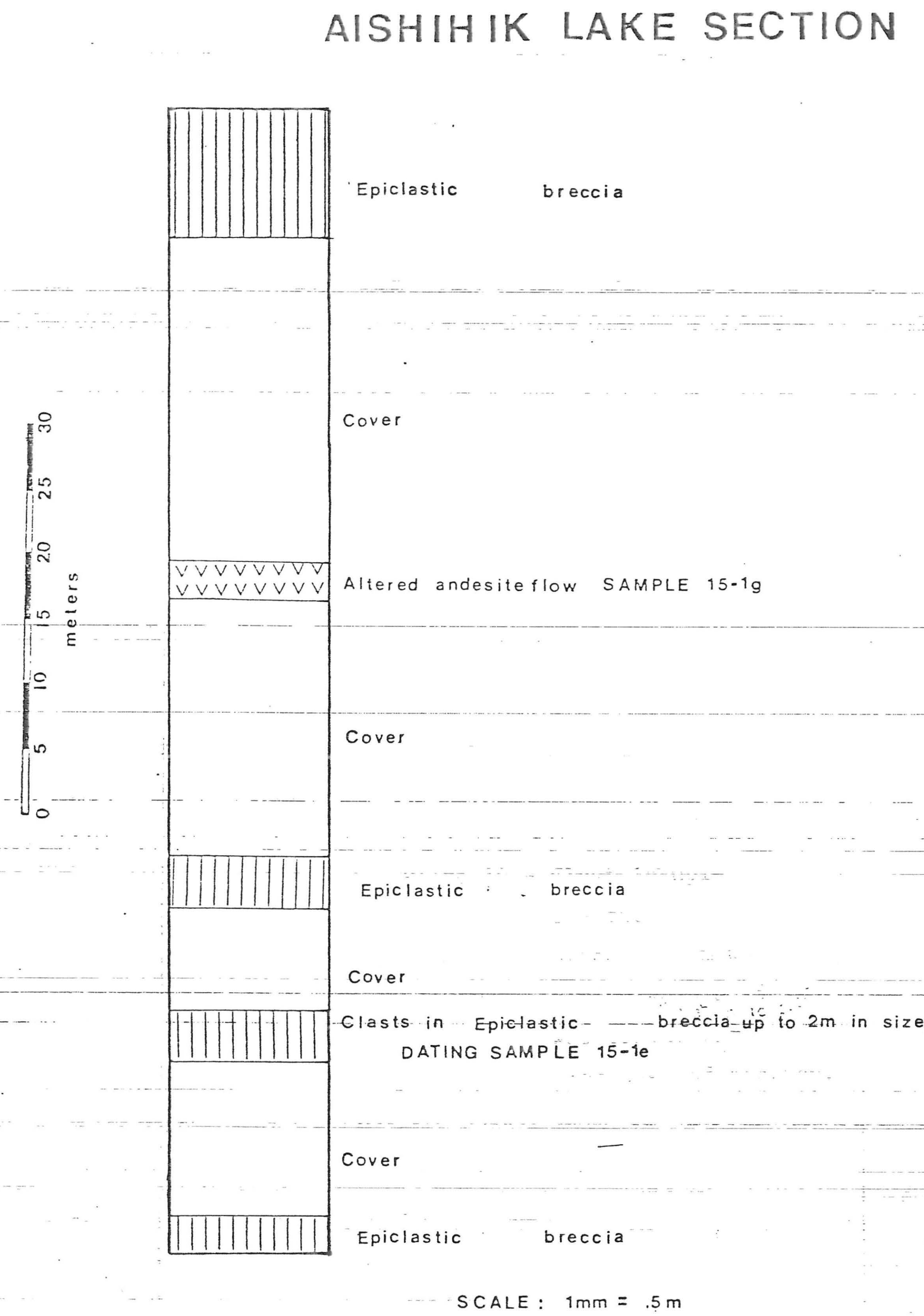


Figure 5 - Aishihik Lake section

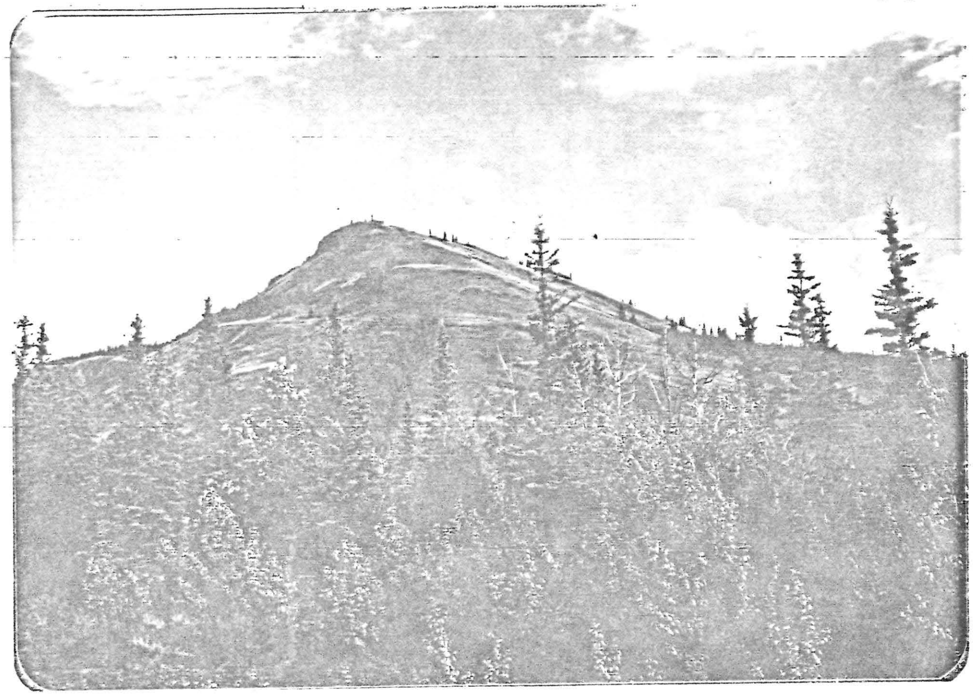


Plate 9 - Slope on which the Aishihik Lake section was measured.

Plate 10 - Clast in epi-
clastic
breccia from which
dating sample 15-1e
was taken. 15m
from base of section.

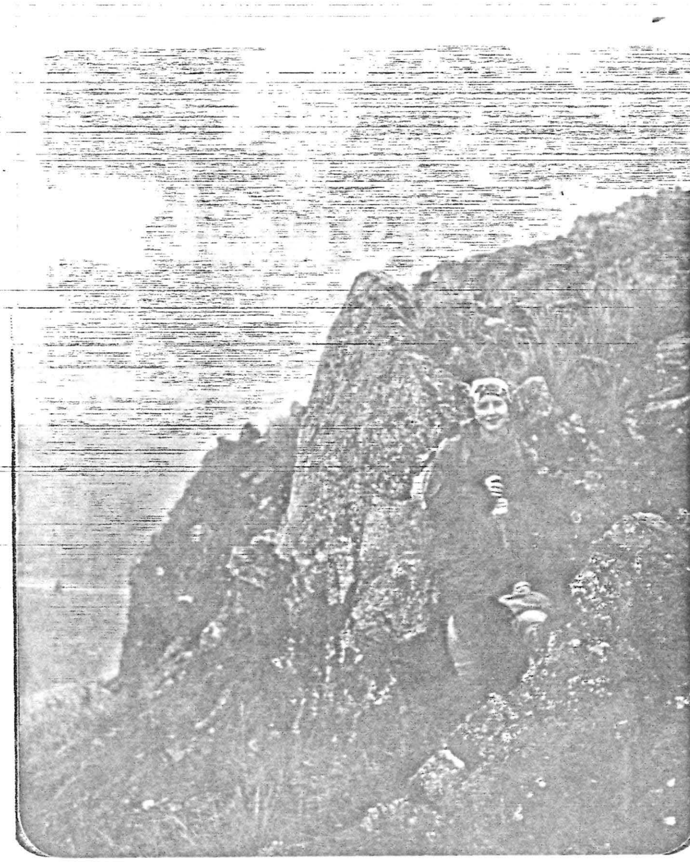
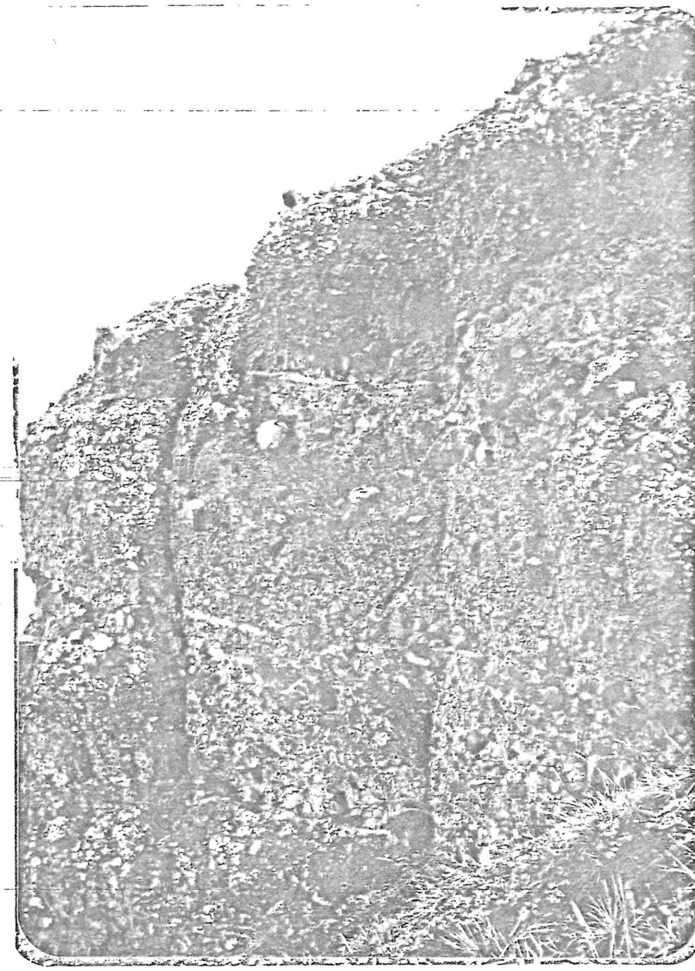


Plate 11 - Epiclastic breccia in Aishihik Lake section. Size grading of clasts indicates successive flow breccias. 79m from base of section.



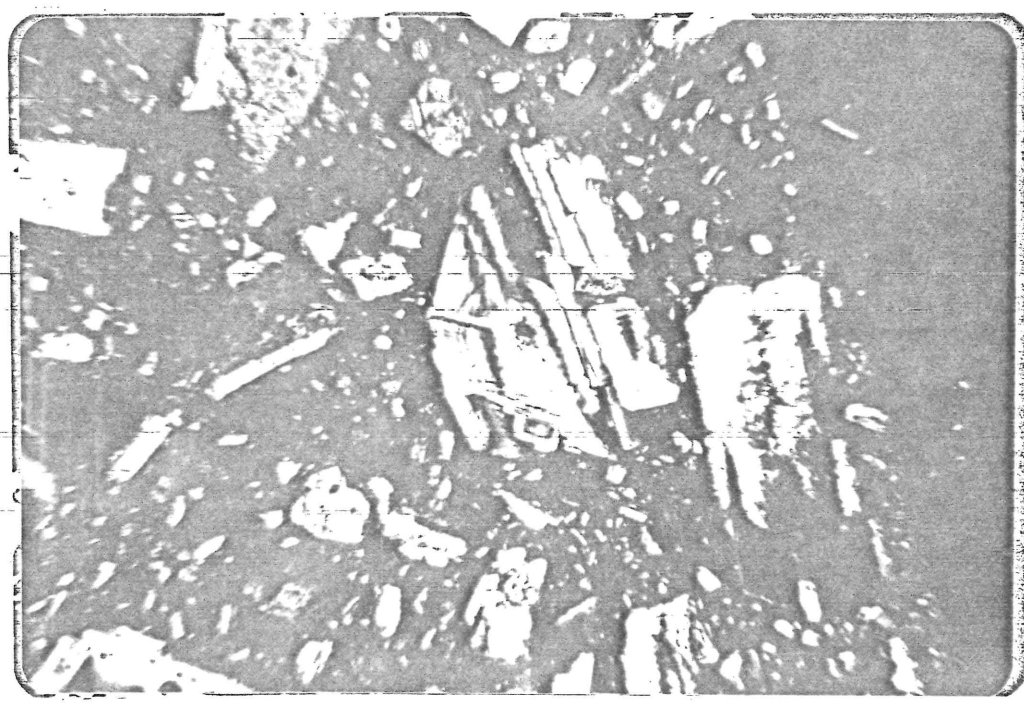


Plate 12 - Thin section of dating sample 15-1e showing plagioclase zoning.

plagioclase determination was not possible. A thin section taken of the altered andesite (sample 15-1g) consists of phenocrysts of altered plagioclase and clinopyroxene in a fine grained groundmass of plagioclase and opaques with groundmass voids filled by celadonite and silca (Plate 13).

Glenlyon Section

Discription

The Glenlyon section starts on the north bank of the Yukon River, 19km east of Carmacks. The section crosses the Carmacks-Faro highway and continues north to the top of the bluff. This section is also partially covered. None of the epiclastic breccias so common in the Miller's Ridge and Aishihik Lake sections were observed.

The Glenlyon section is summarized in Figure 6 and Appendix I. It consists of 122m of lava flows, immature volcanic sandstone, and covered intervals. The sandstone is fine grained and interbedded with siltstone (Plate 14). It is found on the shore of the Yukon River at the base of the section. The lava flows are massive, and contacts between the flows are sharp where exposed. The flows appear to be andesitic but chemical analysis on samples from two of the flows indicate that they are a trachybasalt and a tristanite. The trachybasalt flow is exposed on the road cut of the Carmacks-Faro highway and shows crude columnar jointing (Plate 15).

Petrography

A thin section of the sandstone (sample 14-1b) shows it to have a few rounded quartz grains as well as angular plagioclase and volcanic rock fragments. The quartz may be from some distal source but the rest of the rock is definitely proximal to its source. A thin section

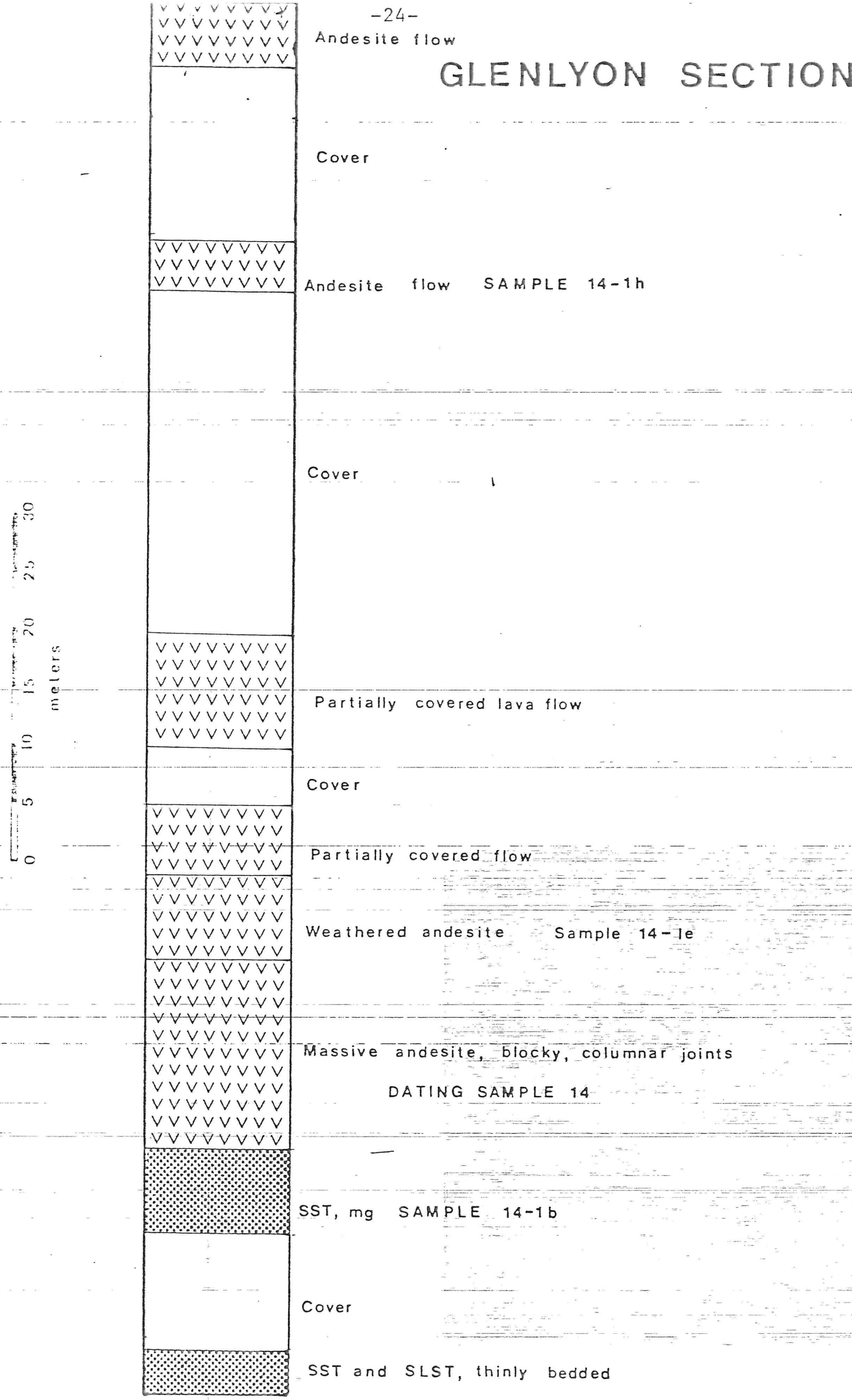


Figure 6 - Glenlyon Section SCALE: 1mm = .5m

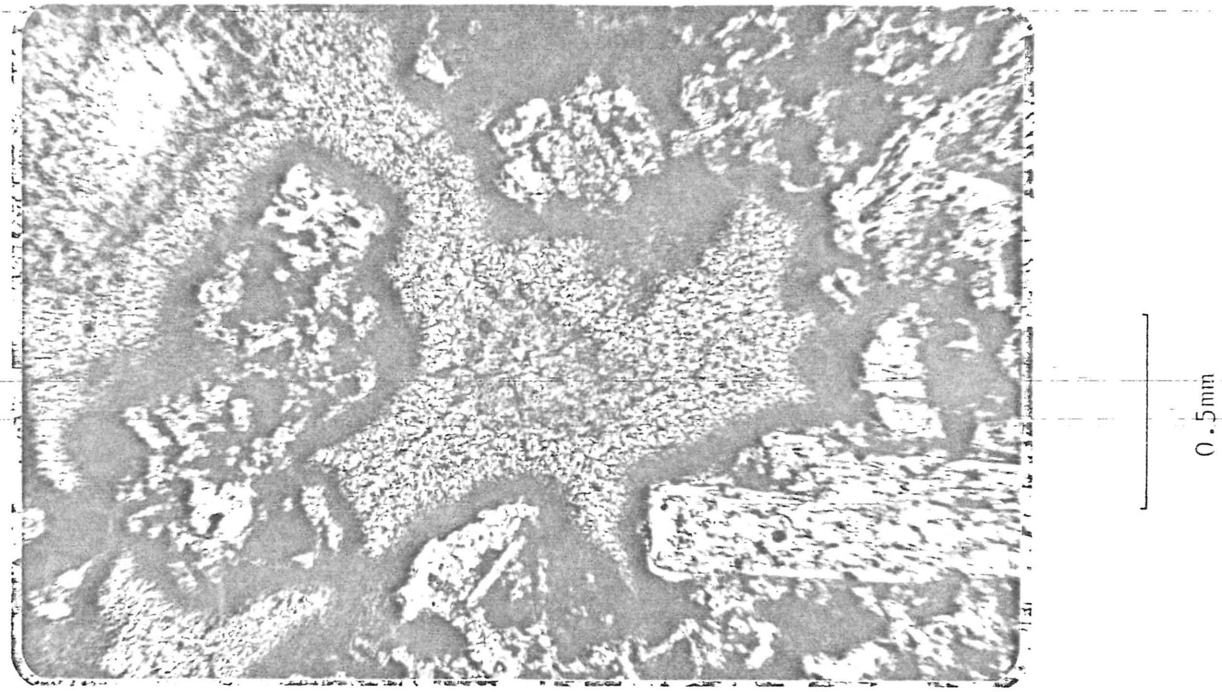


Plate 13 - Thin section of sample 15-1g. Celadonite and SiO_2 in vesicles. (uncrossed nicols)

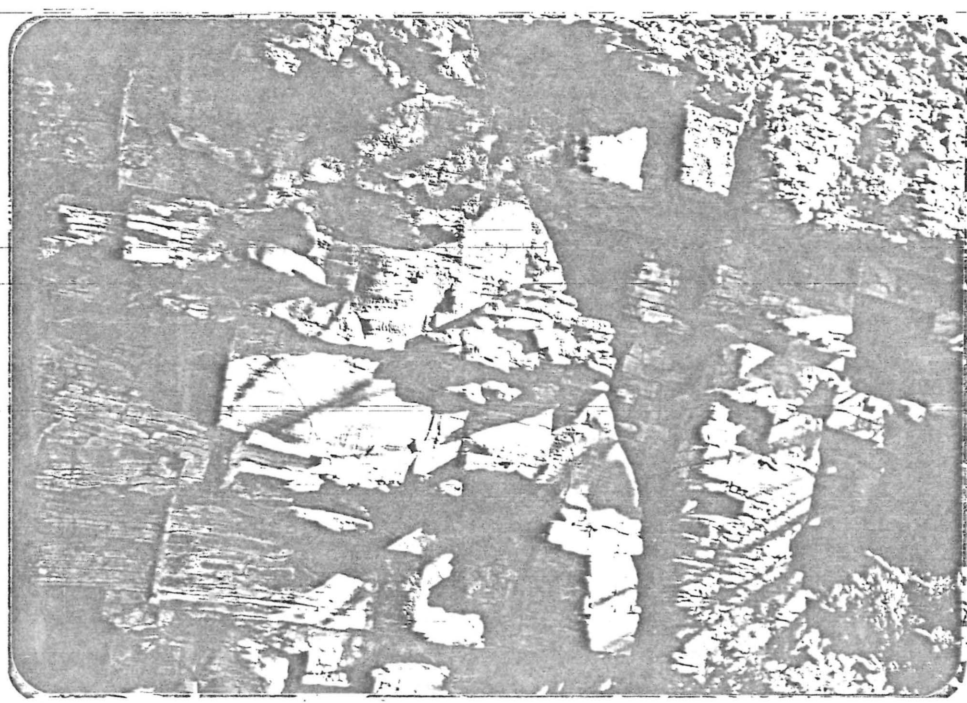


Plate 14 - Siltstone from Glenlyon section, 2m from base of section.

of the trachybasalt (sample 14) contains phenocrysts of plagioclase (An_{35}), clinopyroxene, and olivine (almost completely altered to iddingsite). The groundmass is of plagioclase,poikilitic biotite,apatite and opaques. A thin section of an andesitic flow (sample 14-1e) contains phenocrysts of plagioclase (An_{32}), clino-pyroxene,and olivine (mostly altered to iddingsite) in a groundmass of plagioclase,orthoclase, poikilitic biotite, and opaques. A thin section of the tristanite flow (sample14-1h) contains phenocrysts of twinned clinopyroxene, plagioclase (An_{28}) rimmed by orthoclase (Plate 16) and olivine (almost completely altered to iddingsite and chlorite). The groundmass consists of plagioclase, pyroxene crystals, orthoclase, poikilitic biotite,and opaques.

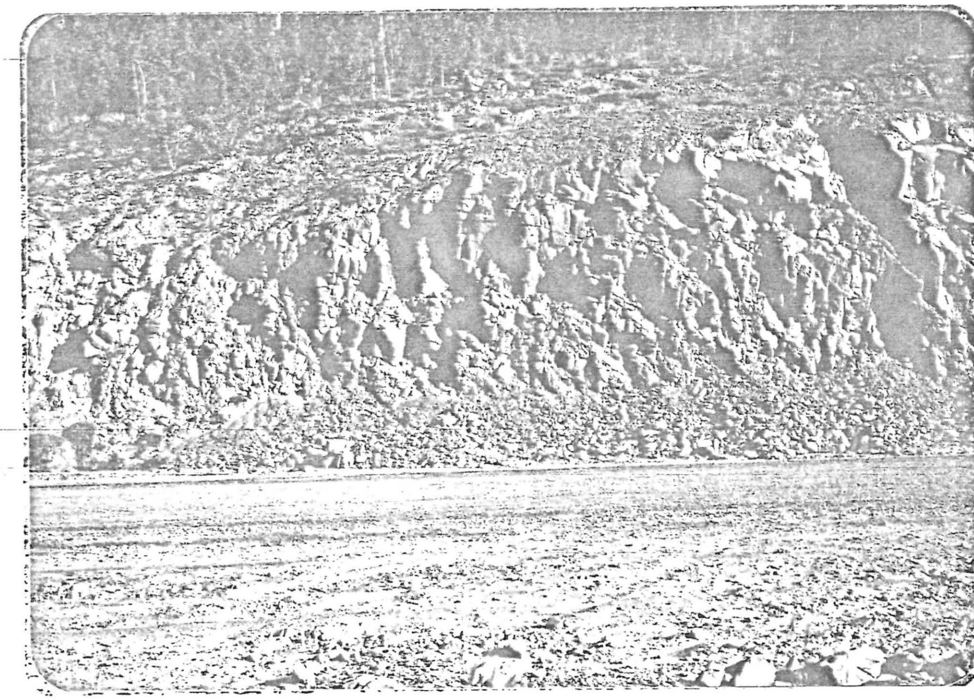


Plate 15 - Road cut exposing trachybasalt flow in Glenlyon section. Dating sample 14 taken from this flow, 27m from base of section.

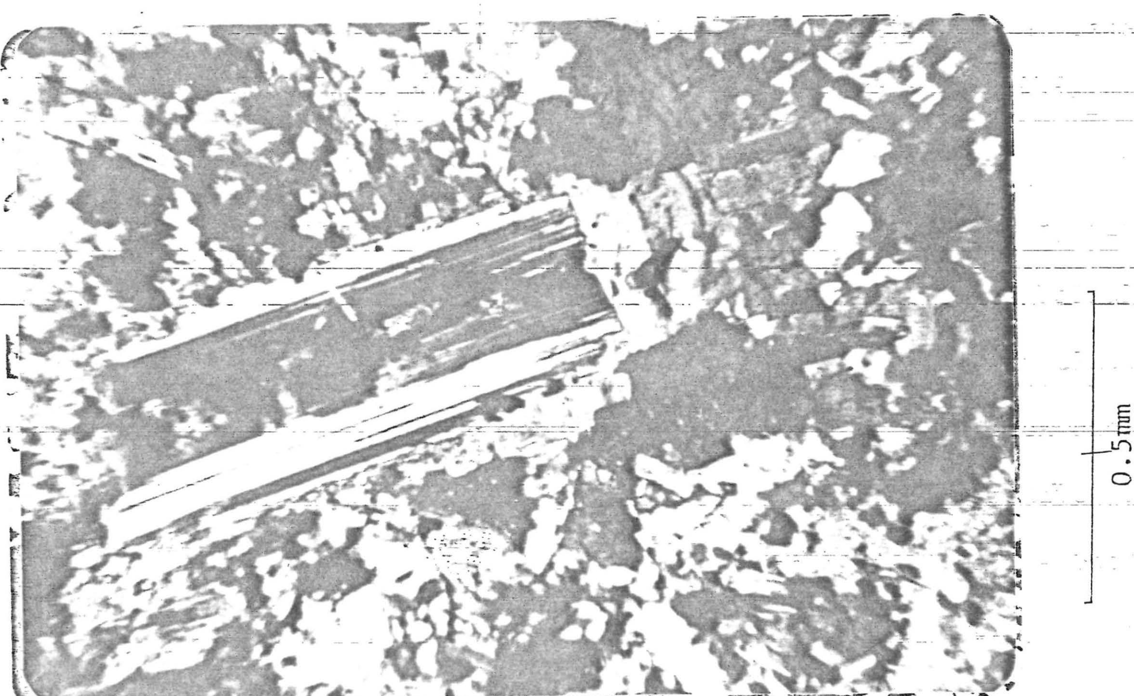


Plate 16 - Thin section of sample 14-1h. Orthoclase rimming plagioclase.

IV CHEMISTRY OF THE CARMACKS GROUP

General Statement

Chemical analysis of the Carmacks Group volcanic rocks was undertaken on four samples, the three dating samples plus one sample from the Glenlyon section. These samples were each crushed and ground, then made into pellets for Na_2O determinations, and into fused discs for major element determination. Determinations were obtained using x-ray fluoresence, following a method outlined by G. Nixon. A computer program obtained from G. Nixon was used for norm calculations. Chemical classification was made using the method outlined by Irvine and Baragar (1971). Chemical data is summarized in Appendix III. Normative compositions are shown in Table 2.

Sample 12-2d

This sample, taken from the Miller's Ridge West section, was also used for whole rock K-Ar dating. On the total alkalies (Na_2O + K_2O) versus SiO_2 diagram it is classified as alkaline. On the Ol'-Ne'-Q' ternary diagram it is classified as subalkaline but it is very near the subalkaline - alkaline boundary. Therefore this rock can be generally classed as alkaline. On the An-Ab'-Or ternary diagram this rock plots in the potassic field of alkaline basalts. Using the normative plagioclase - normative colour index plot for potassic alkaline basalts, the sample falls into the alkali basalt field. Thus sample 12-2d can be classified as an alkali basalt.

Sample 15-1e

This sample was taken from the Aishihik Lake section and was also used for whole rock K-Ar dating. The rock is classified as subalkaline on both the total alkalies versus SiO_2 and the Ol'-Ne'-Q' ternary diagram. In both cases it is close to the subalkaline - alkaline boundary. On both the normative plagioclase versus Al_2O_3 and the AFM ternary diagram the sample plots as calc-alkaline. On the An-Ab'-Or ternary diagram for subalkaline rocks the sample plots as an average rock. On the normative plagioclase - normative colour index plot for subalkaline rocks, the rock plots as an andesite. Therefore, sample 15-1e can be classified as a calc-alkaline, average andesite.

Sample 14

This sample, taken from the Glenlyon section, also provided a biotite separate for K-Ar dating. On the total alkalies versus SiO_2 the rock is classified as alkaline. On the Ol'-Ne'-Q' ternary diagram the rock is classified as subalkaline, but again it is very near the subalkaline - alkaline boundary. Therefore, this rock can be generally classified as alkaline. On the An-Ab'-Or ternary diagram for alkaline rocks the rock is classified in the potassic series. Using the normative plagioclase - normative colour index plot for the potassic series of alkaline rocks the sample falls into the trachybasalt field. Thus, sample 14 can be classified as a trachybasalt.

Sample 14-1h

This sample was also taken from the Glenlyon section, but not used for dating. The rock can be classified as alkaline on both the total alkalies versus SiO_2 and on the Ol'-Ne'-Q' ternary diagram. On the An-Ab'-Or ternary diagram the rock is classified as one of the potassic series. Using the normative plagioclase - normative colour index plot for the potassic series the rock falls into the tristanite field. Thus, sample 14-1h can be classified as a tristanite. This is the most differentiated rock of the suite analysed.

Samples 14 and 14-1h are very high in potassium, therefore they can be alternatively classified into the shoshonite series rather than the potassic alkali basalt series. The shoshonite series was first outlined by Joplin (1965) as being composed of high alkali basalts with Na_2O/K_2O ratios from 1 to .5 or less. These rocks contain relatively abundant potassium feldspar in addition to plagioclase as groundmass phases.

TABLE 2

TABLE OF NORMATIVE COMPOSITIONS

	12-2d	15-1e	14	14-1h
Orthoclase	18.80	8.75	31.16	29.68
Albite	26.19	38.72	33.35	39.63
Anorthite	15.50	23.88	12.05	7.52
Nepheline	0.00	0.00	0.00	1.85
Diopside	15.20	9.99	6.23	9.61
Hypersthene	1.01	13.14	10.93	0.0
Forsterite	13.86	0.00	0.90	5.07
Fayalite	4.59	0.00	0.41	1.73
Quartz	0.00	1.26	0.00	0.00
Magnetite	2.53	2.41	2.50	2.47
Ilmenite	1.31	1.14	1.26	1.23
Apatite	1.00	0.70	1.24	1.21

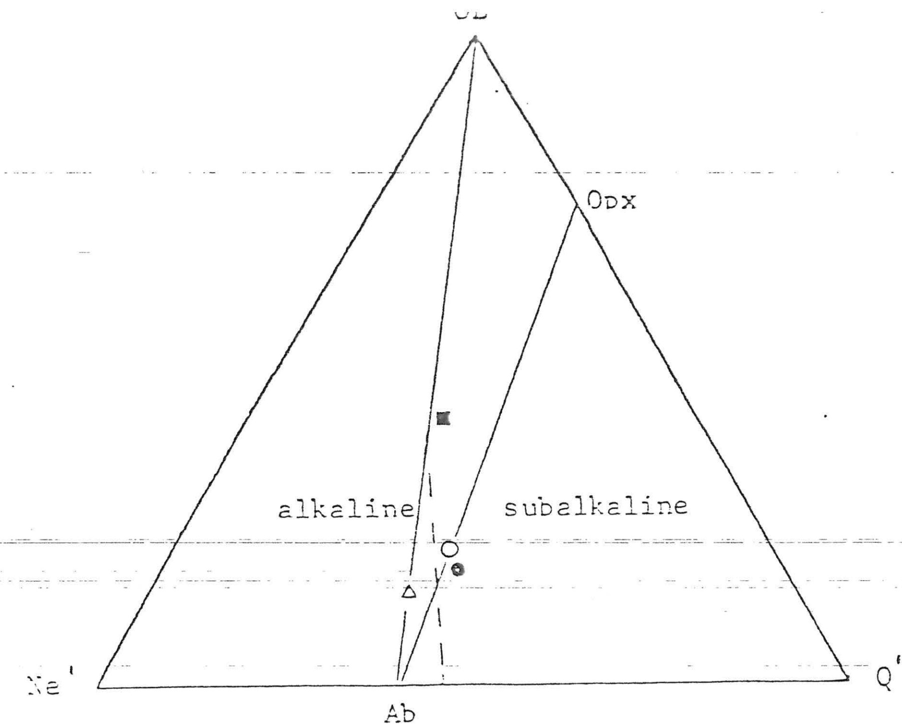


Figure 7 - Ol'-Ne'-Q' projection showing rock analyses on alkaline and subalkaline fields.

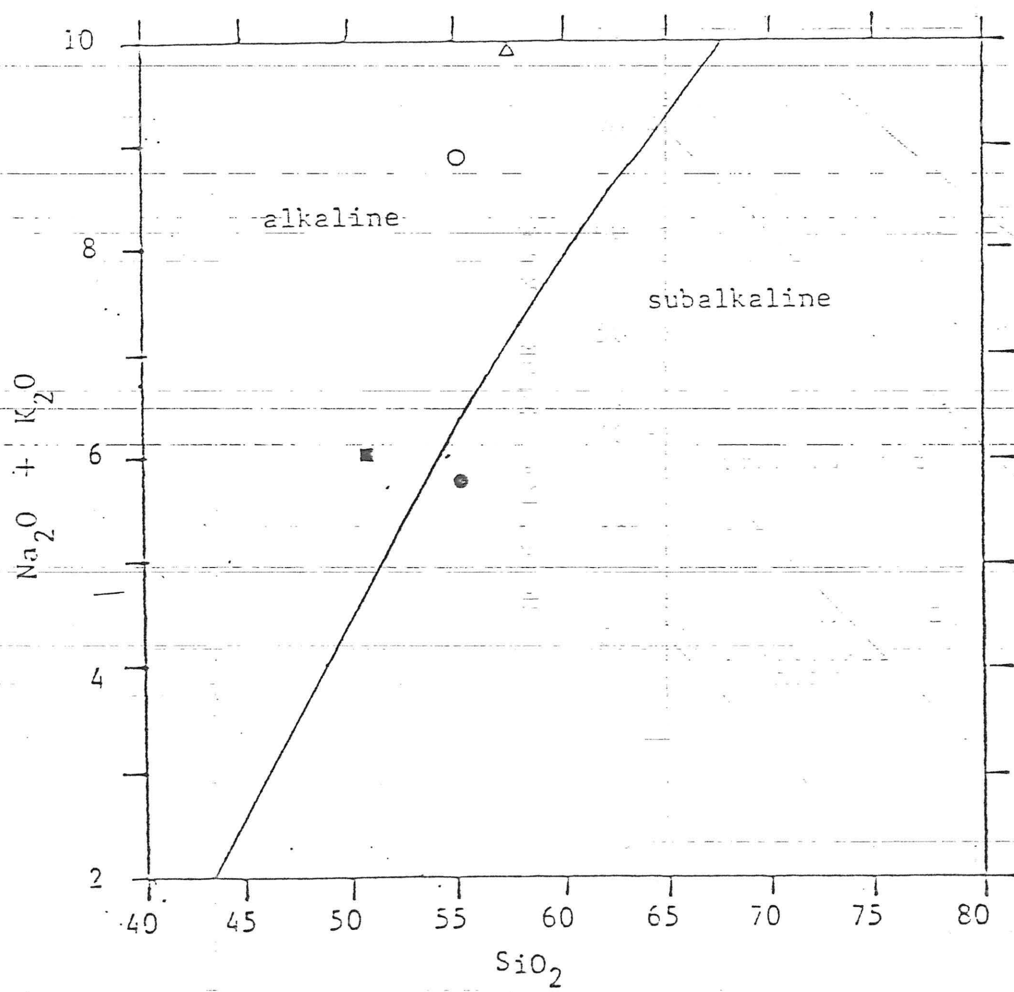


Figure 8 - Total alkalies vesus SiO_2 plot showing rock analyses on alkaline and subalkaline fields.

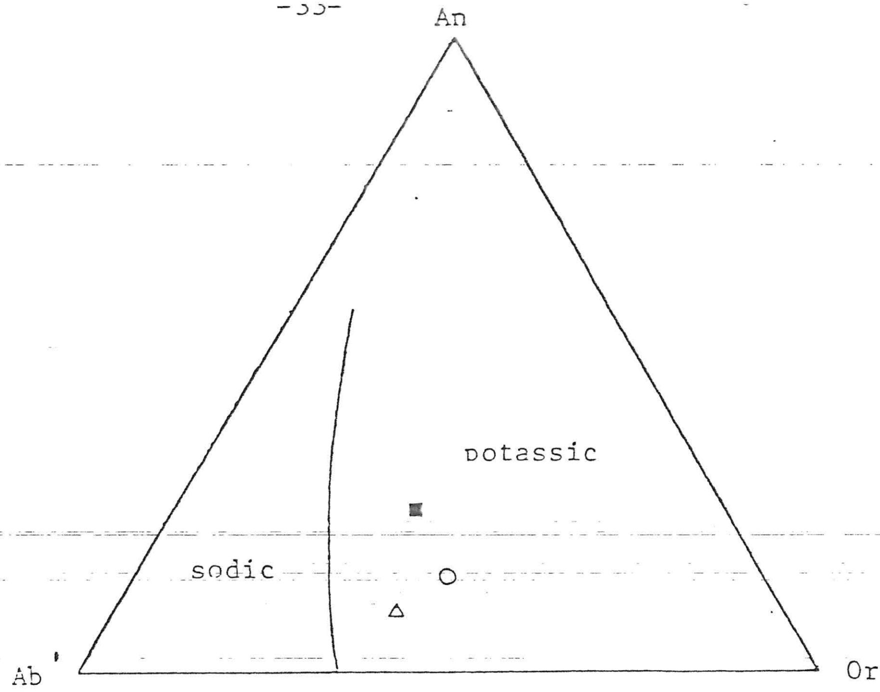


Figure 9 - An-Ab'-Or projection of sodic and potassic alkali rocks.

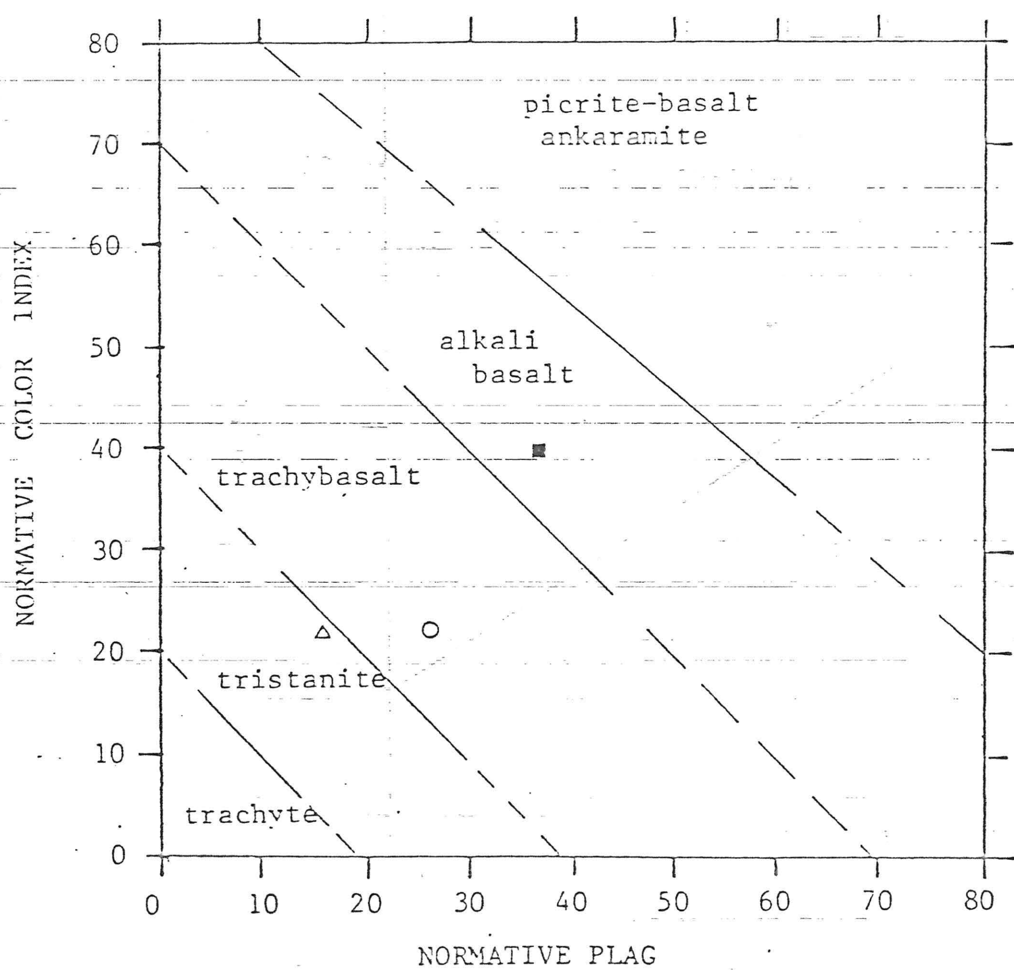


Figure 10 - Normative plagioclase - normative colour index plot for potassic alkaline rocks.

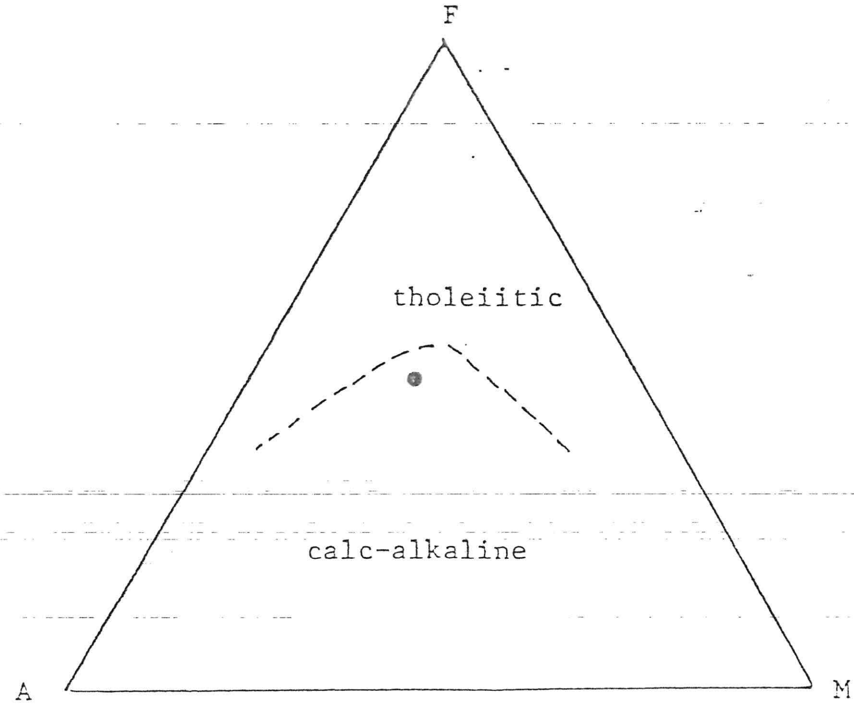


Figure 11 - AFM plot of subalkaline rocks.

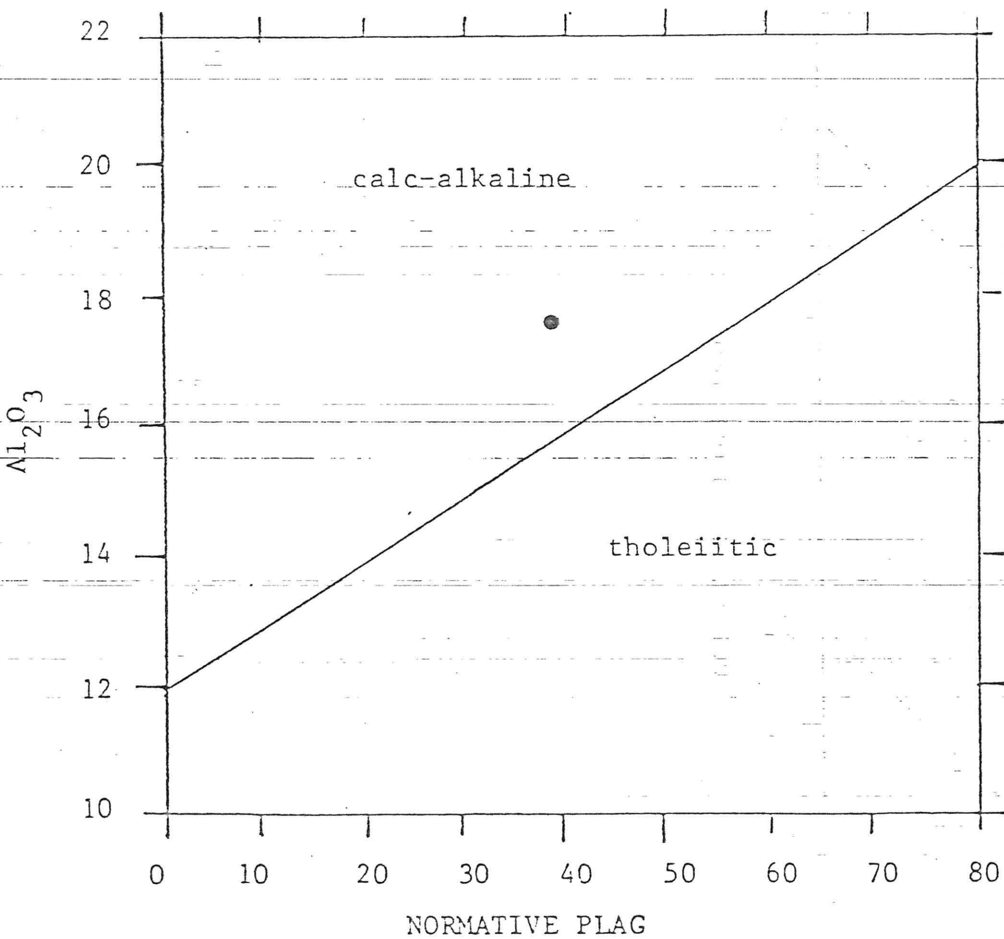


Figure 12 - Normative plagioclase versus weight percent Al_2O_3 for subalkaline rocks.

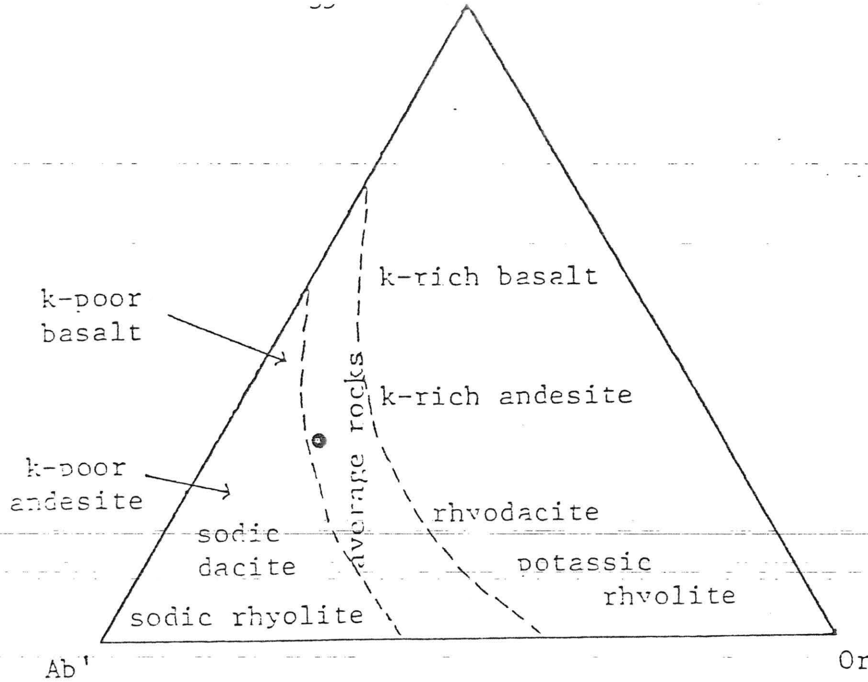


Figure 13 - Subdivison of the subalkaline rocks using the An-Ab'-Or projection.

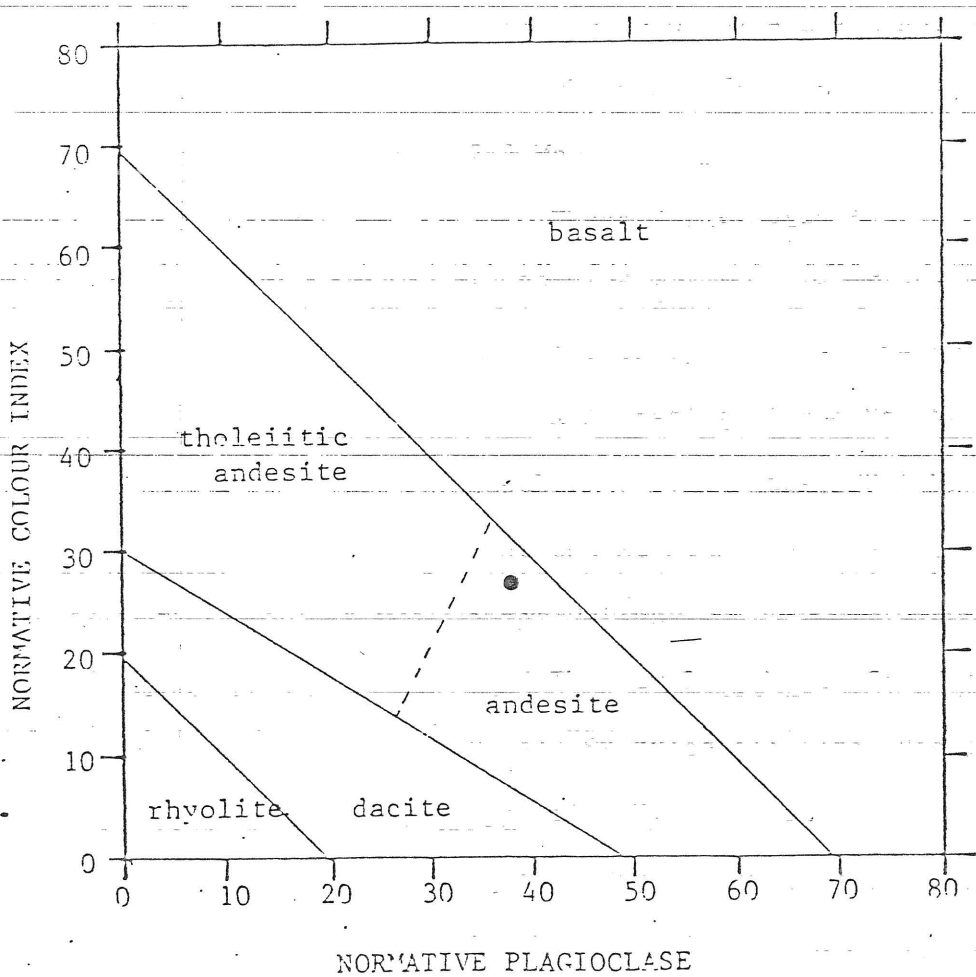


Figure 14 - Subdivision of the subalkaline rocks using normative colour index versus normative plagioclase plot.

V GEOCHRONOLOGY

K-Ar Dating

Three samples of Carmacks Group volcanic rocks were dated using K-Ar methods, which are summarized in Appendix IV. The samples were chosen from three different areas in order to confirm that all three sections were from the Carmacks Group and to establish a range in ages for the extrusion of the Carmacks Group. The samples taken were all of relatively fresh and unaltered rock.

Sample 12-2d, an alkali basalt collected from the Miller's Ridge West section, gave a date of 73.1 ± 2.5 Ma. Sample 15-le, a calc-alkaline andesite collected from the Aishihik Lake section, gave a date of 67.9 ± 2.3 Ma. Biotite, separated from sample 14, a trachybasalt from the Glenlyon section, was found to be 68.0 ± 2.2 Ma.

These dates establish an approximate range of ages, from 68 to 73 Ma for extrusion of the Carmacks Group. In other words, the Carmacks Group is Upper Cretaceous - Campanian in age.

K-Ar dating of the Mt. Nansen Group by H. Grond (1980) has resulted in two dates, 72.4 Ma and 69.1 Ma. These dates establish that the Mt Nansen and Carmacks Groups are coeval.

Rb-Sr Dating

The samples chosen for K-Ar dating were also analysed for Rb and Sr trace elements. Results obtained are summarized in Appendix IV. The initial ratio calculated by the York Least Squares Regression (York, 1969) was 0.70489 ± .00015. The isochron obtained gave an age of 76.8 ± 19.6 Ma (Figure 15).

The Carmacks Group Rb-Sr data was compared with two samples from the Mount Nansen Group (Grond, 1980) and one sample from the Hutshi Formation of Graham Inlet, British Columbia. The intial ratio, again calculated by the York Least Squares Regression, was 0.70484 ± .00007. The isochron obtained gave an age of 72.4 ± 2.1 Ma.

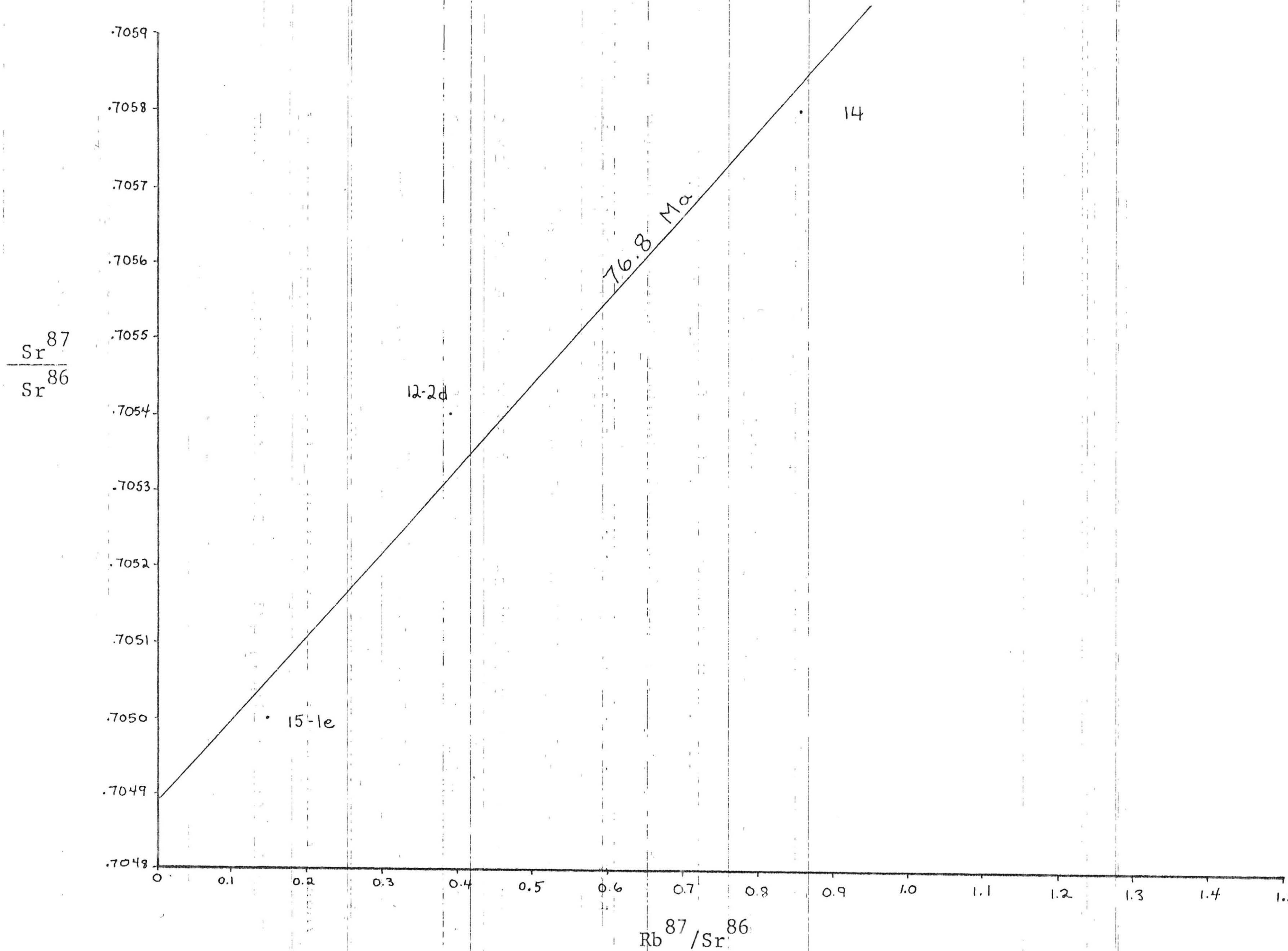


Figure 15 - Rb-Sr isochron for the Carmacks Group

VI DISCUSSION OF CHEMISTRY

Investigations into the chemistry of the Carmacks Group makes it possible to illustrate chemical trends which these rocks follow. First, looking just at the Carmacks Group, the lavas differentiate in that the oldest lavas are alkali basalts, a younger lava is a trachybasalt, and a still younger lava is a tristanite (samples 12-2d, 14, and 14-1h respectively). The alkali basalt and trachybasalt have no normative nepheline or quartz, while the tristanite has normative nepheline. This chemical trend follows the fractionation trend in alkali rocks, first elaborated by Kennedy in 1933. The trend is that silica undersaturation increases in successively younger flows from the same parental basalts. An explanation of how the Kennedy trend originates is given by Yoder and Tilley (1962).

On a more regional scale, the Carmacks Group appear to be part of a chemical gradient first outlined by Kuno (1966). Kuno observed that the chemical composition of volcanics in an island arc and/or continent changes from tholeiitic to calc-alkaline to alkalic, from active volcanic arc towards the stable craton. The Carmacks Group form a linear belt of volcanics trending approximately northwest - southeast (see Figure 1). Directly to the southwest, the Mount Nansen Group forms a parallel linear belt of volcanics, but these volcanics are calc-alkaline in composition (Grond, 1980). Thus, the two suites of volcanics show the gradient outlined by Kuno - calc-alkaline near trench to alkaline cratonward.

There are two theories to explain this gradient. Kuno (1966) postulates that magmas formed at higher pressures will be more alkalic, and also that the further inward on a continent, the deeper is the level of melting of the magma. Thus it makes sense that the further inward on a continent, the more alkalic the volcanism. This trend may be caused by different magma reservoirs at different depths or by one common reservoir supplying all the magma, which differentiates at deeper depths as you move inward on the continental side. Miyashiro (1975)postulates: The continentward increase in K_2O across the arc is not due to the successive occurence of tholeiitic, calc-alkaline, and alkaline rocks but is mainly due to the continentward increase of K_2O in tholeiitic as well as in calc-alkaline series rocks across the arc.

The one calc-alkaline rock found in the Carmacks Group was a sample of an epiclastic breccia in the southwestward edge of the Carmacks Group. This epiclastic breccia could have its origin further west, which would account for its calc-alkaline composition. The calc-alkaline composition could also be just normal variation within the Carmacks Group.

VII CONCLUSIONS

The studied sections of the Carmacks Group were found to be composed of lava flows, epiclastic breccias, sintered tuffs, and volcanic sandstones. Chemical analysis revealed that the lava flows were alkaline and high in potassium. K-Ar dating established an Upper Cretaceous age for the Carmacks Group, which was previously thought to be Eocene to Miocene. Rb-Sr isotope dating also gave an Upper Cretaceous age.

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APPENDIX I

SUMMARY OF MEASURED SECTIONS

MILLER'S RIDGE EAST SECTION

Height in Section (m)	Thickness (m)	Description
0	30	Epiclastic breccia. Clasts range in size from 1cm to 30cm. Clasts are of basaltic compostion. Matrix is coarse tuff.
30	6	Epiclastic breccia. Clasts are light coloured and highly vesicular.
36	84	Epiclastic breccia. Clast composition is andesite to basalt, mainly massive rather than vesicular. Clasts are 1cm to 2m in size.
120	3	Laminated volcanic sandstone grades up into pebble conglomerate and then to coarse, unlaminated volcanic sanstone.
123	6	Extremely vesicular lava brecciated and mixed with volcanic sandstone.
129	30	Epiclastic breccia. Clast composition is andesite to basalt.
159	7.5	Very weathered, brown sintered tuff with pyroxene phenocrysts. Clasts from underlying epiclastic breccias at base.
166.5	3	Brown weathering sintered tuff with pyroxene phenocrysts.
169.5	3	Red weathering sintered tuff with pyroxene phenocrysts. Some volcanic clasts 10cm-30cm in size.
172.5	6	Green weathering sintered tuff with pyroxene phenocrysts. Contains numerous volcanic clasts 1cm to 30 cm in size
178.5	7.5	Epiclastic breccia. Clasts are andesitic to basaltic in composition.
186		

MILLER'S RIDGE WEST SECTION

Height in Section (m)	Thickness (m)	Description
0	2	Volcanic sandstone, fine to medium grained, finely laminated. Poorly sorted.
2	5	Epiclastic breccia intertonguing with vesicular, brecciated, lava flows.
24	15	Epiclastic breccia with basaltic and andesitic clasts.
39	.5	Blocky andesitic lava flow. Massive at bottom, becoming extremely vesicular at top. Phenocrysts of feldspar and pyroxene.
39.5	20	Epiclastic breccia with andesitic and basaltic clasts. Base of breccia contains vesicular clasts from under-lying lava flow.
59.5	20	Massive, blocky basaltic lava flow, with pyroxene phenocrysts. Crude columnar jointing. Dating sample 12-2d obtained from this unit.
79.5		

AISHIHIK LAKE SECTION

Height in Section (m)	Thickness (m)	Description
0	3	Epiclastic breccia. Clasts are andesitic and basaltic in composition. Size range from 1cm to 50cm.
3	12	Covered interval
15	4	Epiclastic breccia. Clast size range from 1cm to 2m. Dating sample 15-1e obtained from this unit.
19	8	Covered interval
27	4	Epiclastic breccia. Clasts are andesitic and basaltic in composition. Size range 1cm to 50cm.
31	20	Covered interval
51	3	Altered andesitic lava flow. Green weathering, brecciated in places.
54	25	Covered interval
79	10	Successive epiclastic breccias in large outcrop. Clasts show size grading from coarse to fine, then coarse again. Clast sizes range from 1cm to 1m.
89		

GLENLYON SECTION

Height in Section (m)	Thickness (m)	Description
0	4	Thinly bedded fine grained sandstone and siltstone, poorly sorted.
4	10	Covered interval
14	7.5	Interbedded coarse and fine grained volcanic sandstone. Poorly sorted.
21.5	16.5	Massive, blocky andesite lava flow in sharp contact with underlying sandstone. Flow has phenocrysts of pyroxene, feldspar, and biotite. Crude columnar jointing.
38	7.5	Medium grey andesite lava flow , blocky weathering, pyroxene phenocrysts.
45.5	6	Partially covered andesitic flow.
51.5	5	Covered interval
56.5	10	Partially covered andesitic flow. Very weathered, does not crop out well.
66.5	30	Covered interval
96.5	4.5	Partially covered andesite lava flow.
101	15	Covered interval
116	6	Partially covered andesitic lava flow.
122		

APPENDIX II

PETROGRAPHIC DISCRIPTIONS

Sample locations are given on Figures 3, 4, 5, and 6.

Abbreviations:

PLAG - plagioclase
CPX - clinopyroxene
OL - olivine
BIO - biotite
AP - apatite
OP - opaques
IDD - iddingsite
ORTH - orthoclase
CHL - chlorite
QTZ - quartz
ACT - actinolite
EP - epidote
ZO - zoisite
CARB - carbonate
CEL - celadonite
PAL - palagonite
GL - glass

SECTION # 11-1 BASALT

DESCRIPTION: Phenocrysts of olivine and clinopyroxene in plagioclase groundmass. Clinopyroxene shows abundant twinning and zoning. Olivine is altering to iddingsite. Pyroxene also occurs in groundmass. Groundmass is trachytic to pilotaxitic.

Grain size abreviations: E=equigranular I=inequigranular Phenos/mtx

Textures: E=euhedral S=subhedral A=anhedral Sk=skeletal R=rounded

MINERAL	MODE %	GRN. SIZE mm	TEXTURE	COMMENTS
1 PLAG	55	E 0.2	E	An_{35}
2 CPX	10	E 1.0	S	zoned
3 OL	10	E 1.0	S	
4 OP	20	E 0.1		
5 IDD	5			
6				
7				
8				
9				

HISTORY:

	Primary	Secondary
PLAG		
OL		
CPX		
OP		
IDD		

DIAGRAM:

SECTION # 11-1i SINTERED TUFF

DESCRIPTION: Rock is mostly glass with clinopyroxene and plagioclase phenocrysts, and some basaltic fragments. Glass has in a great part altered to palagonite. Clinopyroxene phenocrysts inclose pockets of glass. Rock is very vesicular and not well indurated. Carbonate and quartz are found in some vesicles.

Grain size abreviations: E=equigranular I=inequigranular Phenos/mtx

Textures: E=euhedral S=subhedral A=anhedral Sk=skeletal R=rounded

MINERAL	MODE %	GRN. SIZE mm	TEXTURE	COMMENTS
1 PLAG	5	E 0.1	E	
2 CPX	15	I 1.5/0.5	S-A	
3 OP	2			
4 PAL	53			
5 GL	20			
6 CARB	2			
7 QTZ	3			
8				
9				

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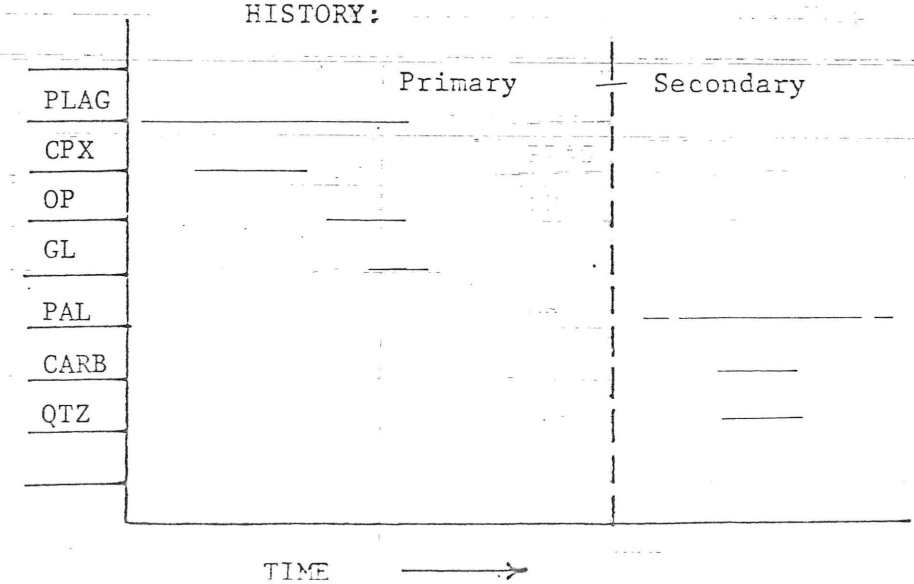

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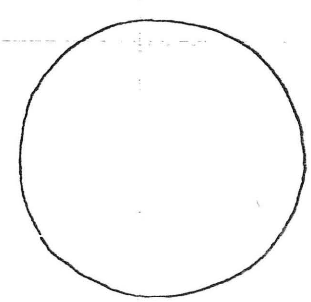

SECTION # 12-2d ALKALI BASALT

DESCRIPTION: Porphyritic, larger clinopyroxene crystals in a fine grained intergranular plagioclase-clinopyroxene-opaque groundmass. Rock also contains smaller olivine phenocrysts with well developed iddingsite and chlorite alteration. Clinopyroxene is twinned.

Grain size abreviations: E=equigranular I=inequigranular Phenos/mtx

Textures: E=euhedral S=subhedral A=anhedral Sk=skeletal R=rounded

MINERAL	MODE %	GRN. SIZE mm	TEXTURE	COMMENTS
1 PLAG	50	E 0.05	E	
2 CPX	10	I 3.0/0.5	E	
3 OL	10	E 0.6	S	
4 OP	20	E 0.1	S	
5 IDD	8			
6 CHL	2			
7				
8				
9				

HISTORY:

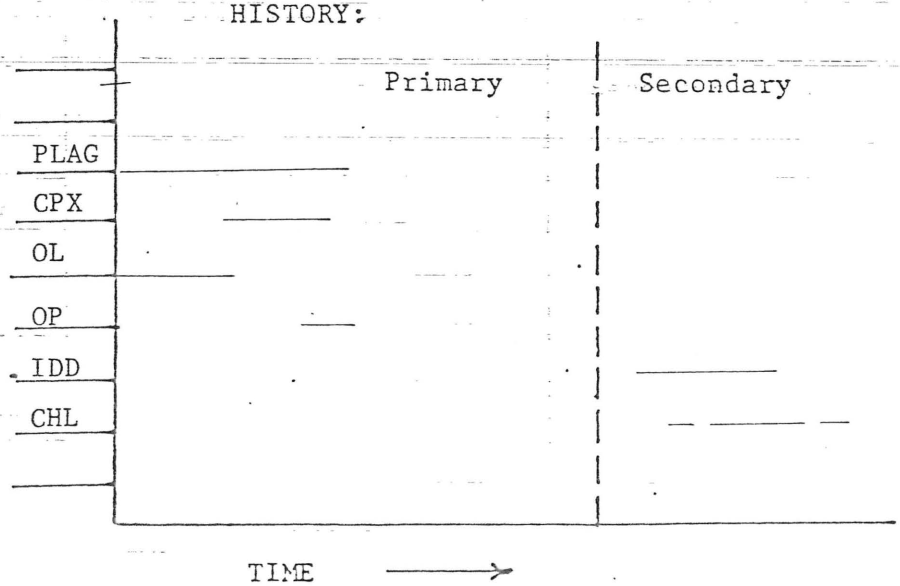

DIAGRAM:

SEE PLATE 8

SECTION # 12-2e ANDESITE

DESCRIPTION: Coarse grained andesite with phenocrysts of plagioclase and clinopyroxene. Clinopyroxene is highly altered to actinolite and some chlorite. Plagioclase is partially altered to epidote, zoisite and carbonate. Groundmass is holocrystalline plagioclase, orthoclase, quartz, apatite and opaques.

Grain size abreviations: E=equigranular I=inequigranular Phenos/mtx

Textures: E=euhedral S=subhedral A=anhedral Sk=skeletal R=rounded

MINERAL	MODE %	GRN. SIZE mm	TEXTURE	COMMENTS
1 PLAG	40	I 1.5/0.5	E	An_{35}
2 CPX	10	E 1.5	S-A	
3 BIO	8	E 0.3	E-A	brown & green
4 ORTH	10	E 0.3	E-A	
5 OP	10	E 0.3	S-A	
6 AP	1	E 0.2	E	
7 QTZ	4	E 0.3	E-S	
8 ACT	3	E 0.2	S	
9 CHL	2			
10 EP-ZO-CARB	12			

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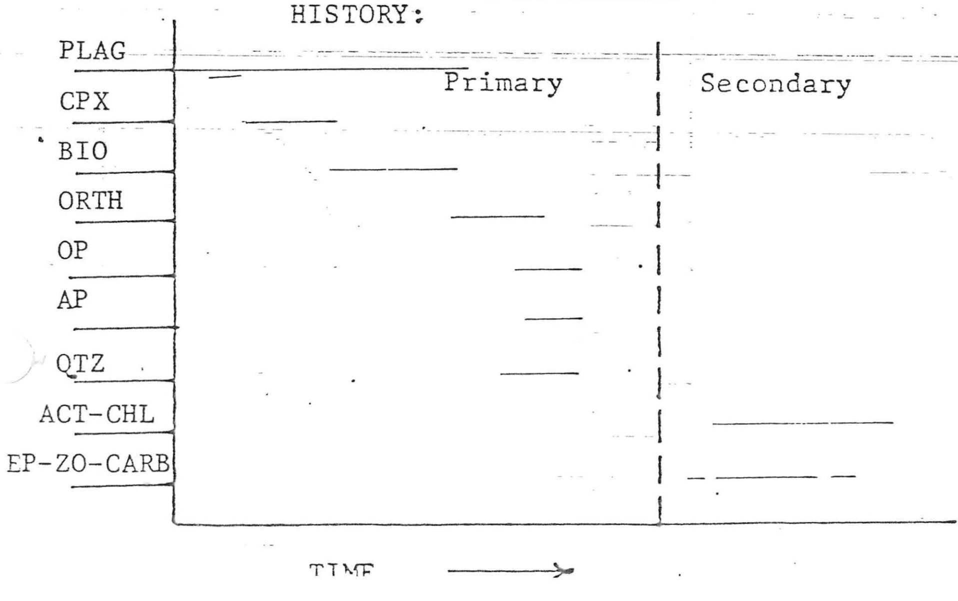

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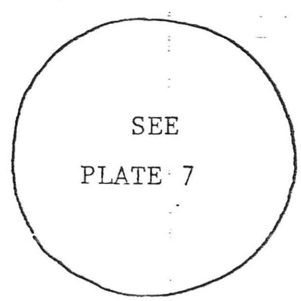


SECTION # 15-1e ANDESITE

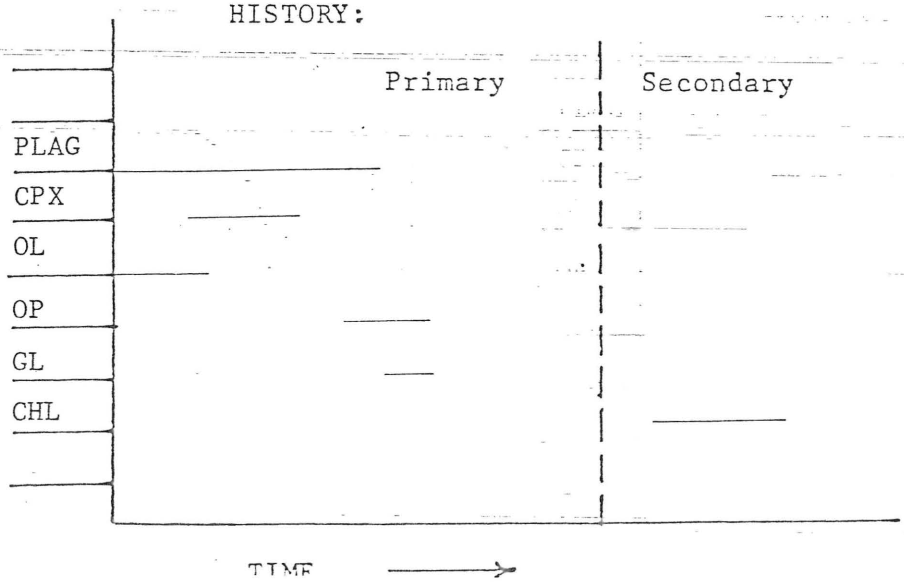
DESCRIPTION: Clinopyroxene, plagioclase and olivine phenocrysts which are partially chloritized. Clinopyroxene is glomeroporphyroblastic with opaques, plagioclase, and minor olivine. Groundmass is fine grained, dark brown and composed of plagioclase, opaques and cloudy glass. Plagioclase phenocrysts are zoned. Some olivine has completely altered to chlorite.

Grain size abreviations: E=equigranular I=inequigranular Phenos/mtx

Textures: E=euhedral S=subhedral A=anhedral Sk=skeletal R=rounded

MINERAL	MODE %	GRN. SIZE mm	TEXTURE	COMMENTS
1 PLAG	50	I 1.0/0.3	E-A	An_{33}
2 CPX	15	E 1.5	S-A	
3 OL	2	E 0.5	A	
4 OP	15	E 0.05	A	
5 GL	10			
6 CHL	8			
7				
8				
9				

HISTORY:



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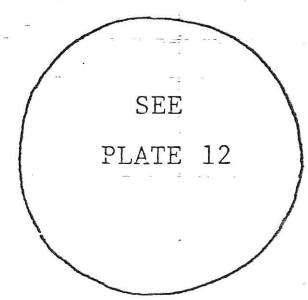


SECTION # 15-1g ALTERED ANDESITE

DESCRIPTION: Contains phenocrysts of plagioclase, clinopyroxene, and olivine that are highly altered. The plagioclase shows spectacular zoning. Olivine is altered to iddingsite. Celadonite and silica fill interstitial spaces. A small amount of pyrite is visible in hand specimen.

Grain size abreviations: E=equigranular I=inequigranular Phenos/mtx
Textures: E=euhedral S=subhedral A=anhedral Sk=skeletal R=rounded

MINERAL	MODE %	GRN. SIZE mm	TEXTURE	COMMENTS
1 PLAG	40	I 0.8/0.05	E	An_{42}
2 CPX	10	E 0.8	A-S	
3 OL	3	E 0.7	A	
4 OP	25	E 0.1	S	
5 IDD	2			
6 CEL	15			
7 QTZ	5			opal, chalcedony
8				
9				

HISTORY:

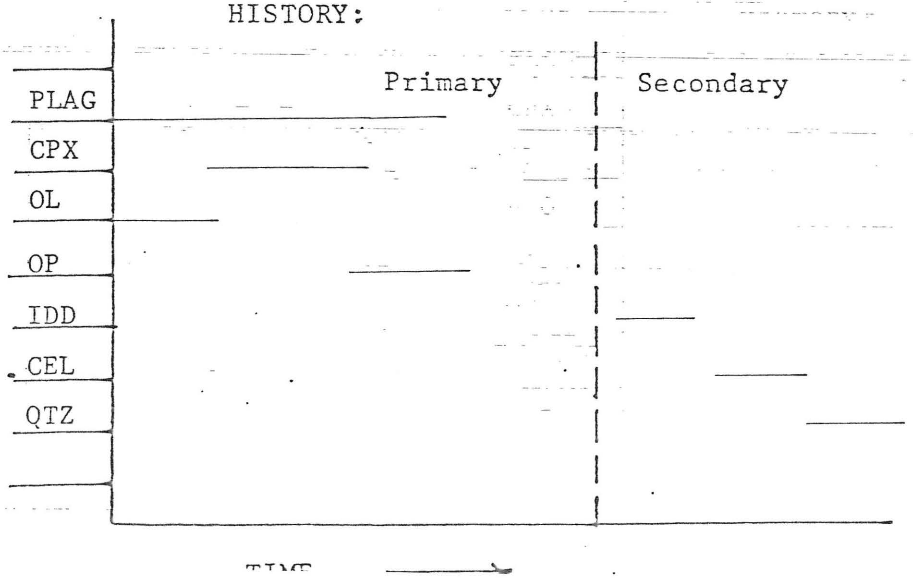


DIAGRAM:

SEE PLATE 13

SECTION # 14 TRACHYBASALT

DESCRIPTION: Phenocrysts of cloudy altered plagioclase, clinopyroxene and olivine in a holocrystalline groudmass of apatite, plagioclase, biotite and, opaques. Olivine is partially altered to iddingsite. Biotite and clinopyroxene are partially altered to chlorite, actinolite, and carbonate.

Grain size abreviations: E=equigranular I=inequigranular Phenos/mtx
Textures: E=euhedral S=subhedral A=anhedral Sk=skeletal R=rounded

MINERAL	MODE %	GRN. SIZE mm	TEXTURE	COMMENTS
1 PLAG	50	I 1.0/0.2	E	An_{30}
2 CPX	12	E 1.5	S	
3 OL	5	E 0.5	S	
4 BIO	10	E 0.3	A	poikilitic, brown & green
5 AP	3	E 0.2	E	
6 OP	10	E 0.2	E	
7 CHL	3			
8 IDD	3			
9 ACT	2			
10 CARB	2			

HISTORY:

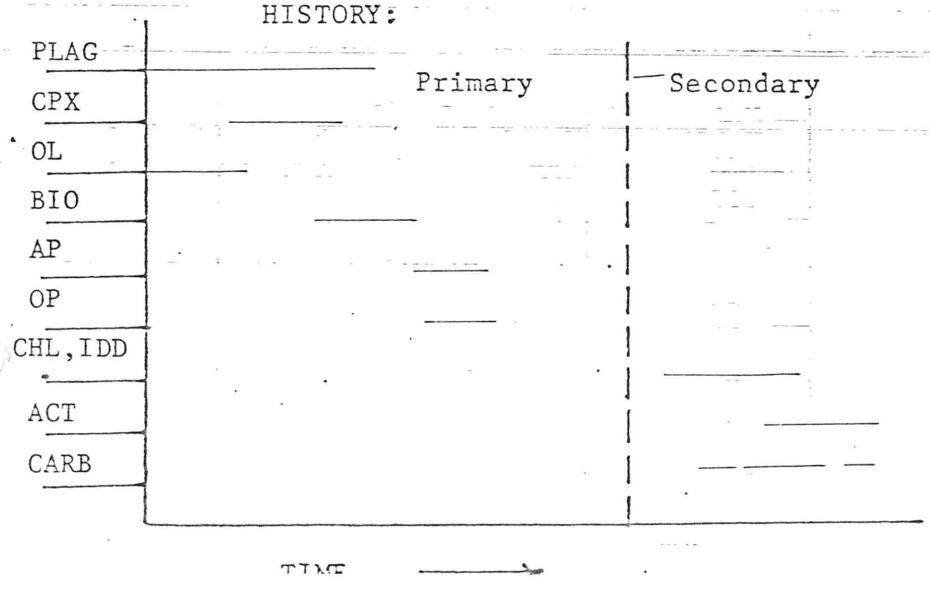
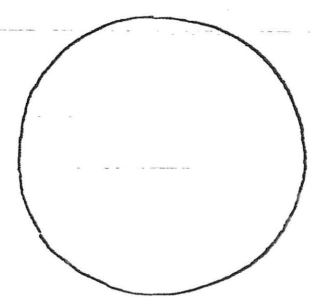


DIAGRAM:



SECTION # 14-1e ANDESITE (?)

DESCRIPTION: Glomeroporphyritic plagioclase, clinopyroxene, and olivine with a groundmass of plagioclase, orthoclase, and opaques. Olivine is almost completely altered to iddingsite. Clinopyroxene occasionally encloses plagioclase.

Grain size abreviations: E=equigranular I=inequigranular Phenos/mtx
Textures: E=euhedral S=subhedral A=anhedral Sk=skeletal R=rounded

MINERAL	MODE %	GRN. SIZE mm	TEXTURE	COMMENTS
1 PLAG	35	I 2.7/0.1	E-A	An 32 zoned
2 CPX	15	E 0.9	S-A	
3 OL	5	E 0.8	A	
4 BIO	8	E 0.4	S-A	poikilitic brown&green
5 ORTH	5	E 0.2	S-A	
6 OP	10	E 0.3	A-Sk	
7 AP	2	E 0.1	E	
8 IDD	3			
9 ACT	2			

HISTORY:

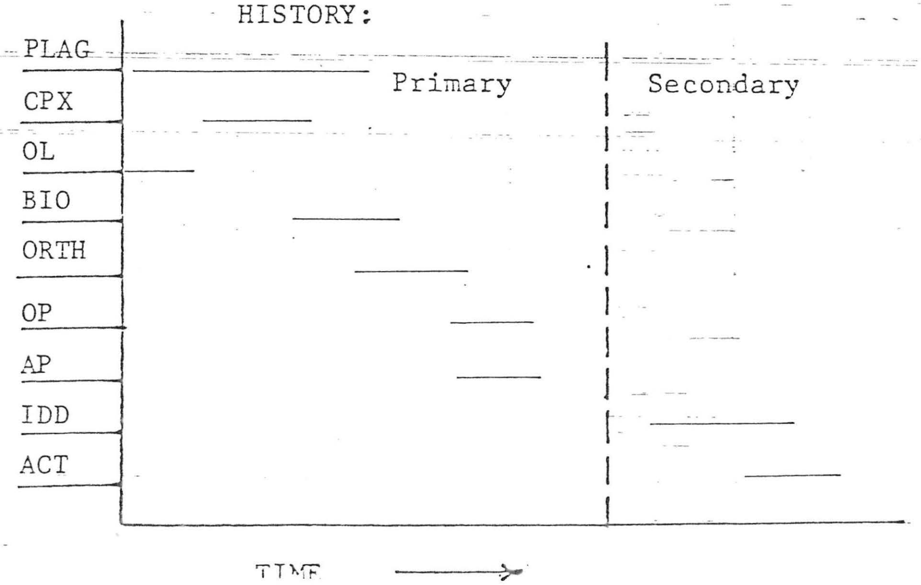
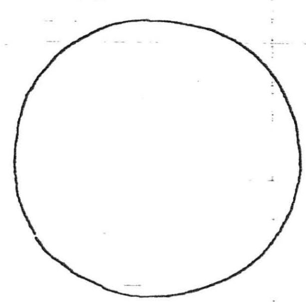


DIAGRAM:



SECTION # 14-1h TRISTANITE

DESCRIPTION: Phenocrysts of clinopyroxene, olivine, and plagioclase in a holocrystalline groundmass of plagioclase, biotite, orthoclase, and opaques. Orthoclase encloses some plagioclase phenocrysts. Biotite and clinopyroxene have partially altered to chlorite and actinolite. Olivine is rimmed by clinopyroxene. Olivine is almost completely altered to iddingsite.

Grain size abreviations: E=equigranular I=inequigranular Phenos/mtx

Textures: E=euhedral S=subhedral A=anhedral Sk=skeletal R=rounded

MINERAL	MODE %	GRN. SIZE mm	TEXTURE	COMMENTS
1 PLAG	45	I 0.8/0.2	E	An_{28}
2 OL	3	E 0.5	S	
3 CPX	10	E 1.0	S	
4 BIO	5	I 0.2/1.1	S-A	poikilitic
5 ORTH	20	E 0.2	E-S	
6 OP	8	E 0.1	A	
7 AP	2	E o.1	E	
8 CHL	3			
9 IDD	2			
10 ACT	2			

HISTORY:

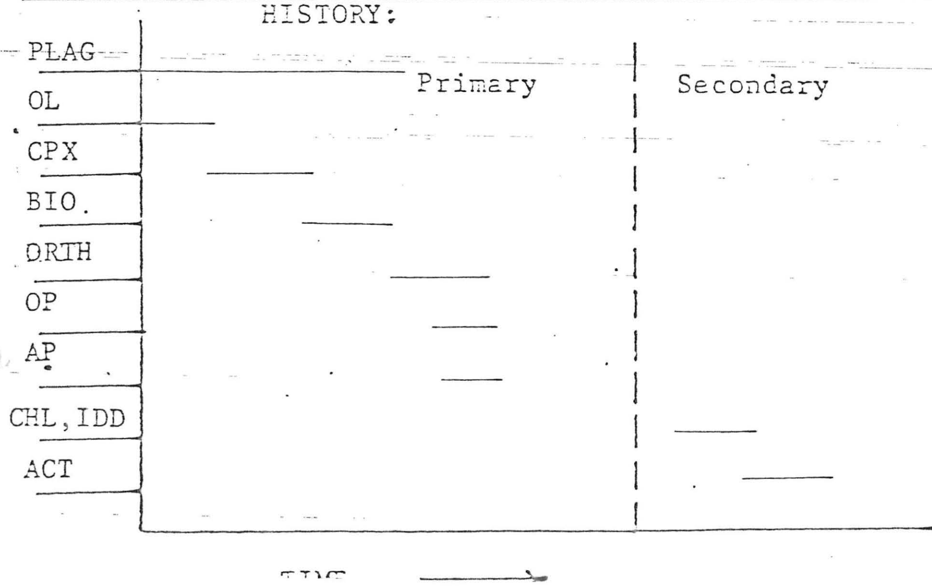


DIAGRAM:

SEE PLATE 16

APPENDIX III

CHEMICAL ANALYSES

GROUP TITLE-AND-REFERENCE SHEET

CONTRIBUTOR'S NAME
SHEILA CHURCHILL

CONTRIBUTION NUMBER

GROUP TITLE (TOPICAL RESUME OF GROUP CONTENTS, 72 CHARACTERS ONLY)

CARMACKS GROUP

GROUP LOCATION (THE MOST NORTHEASTERLY SAMPLE SITE RECORDED ON ANY SPECIMEN SHEET ATTACHED TO THIS GROUP)

LATITUDE 62.07° LONGITUDE 135.95°

DATA SOURCES

REF. NO. *	REFERENCE(S)**
1	CHURCHILL, S.J. 1980 Geochronometry and Chemistry of the Cretaceous Carmacks Group, Yukon. Unpublished Bachelor's Thesis, UBC.

* A NUMBER IN THE RANGE 1 - 10, BY WHICH THE REFERENCE IS TO BE CITED O ALL SPECIMEN SHEETS ATTACHED TO THIS GROUP. (CONTINUE ON BACK OF SHEET IF NECESSARY.)

** PLEASE USE CURRENT (1977) GEOL. SOC. AMER. FORMAT, E.G. COGOLU, E., ET KRUMMENACHER, D., 1967, PROBLEMES GEOCHRONOMETRIQUES DANS LA PARTIE NW DE L'ANATOLE CENTRALE (TURQUIE): SCHWEIZER. MINERAL. U. PETROG. MITT., V. 47, P. 825-831.

NTS 115-I / 1

CONTRIBUTOR'S NAME
SHEILA CHURCHILL
CONTRIBUTION NO.

A. HEADING INFORMATION

ROCK NAME
Alkali Basalt

LOCATION
LATITUDE 62.07°
LONGITUDE 136.40°

GEOLOGIC UNIT
CARMACKS GROUP

REFERENCE NO.
1

B. ESSENTIAL OXIDES

SIO2	TIO2	AL2O3	FE2O3	FEO	MNO	MGO	CAO	NA2O	K2O	P2O5	CO2	H2O+	H2O-	TOTAL
51.31	0.94	13.94	10.42		0.16	9.05	7.60	2.92	3.19	.48		1.76		100.00

C. TRACE ELEMENTS OR COMPONENTS

..1A
..1B
..1C
..1D

NAME											
AMOUNT											
REFERENCE											

..2A
..(2B)
..2C
..2D
..2E
..2F
..(2G)
..2H
..2I

NAME											
AMOUNT											
REFERENCE											

NAME											
AMOUNT											
REFERENCE											

D. AGE

..3A STRATIGRAPHIC Upper Cretaceous REFERENCE NO.
..3B ISOTOPIC OR PHYSICAL
..3C
..3D
..(3E)
..3F
..3G
..3H
..3I

YEARS	73.1						
METHOD	K-Ar						
MATERIAL	Whole Rock						
REF. NO.							

E. PETROGRAPHIC DESCRIPTORS

..4A
..4B
..4C
..4D
..4E
..4F
..4G
..4H
..4I

ERUPTIVE TYPE, MODE OF OCCURRENCE

AA NO INFORMATION
AB AA
AC AGGLOMERATE
AD ASH
AE ASH FLOW
AF BATHOLITH
AG BLOCK LAVA
AH BOMB
AI BOSS
AJ BRECCIA
AK CONE SHEET
AL DIATREME
AM DIKE (DYKE)
AN DOME
AO EXTRUSIVE
AP FLOW
AQ FLOW BRECCIA
AR HYALOCLASTITE
AS HYPABYSSAL
AT IGNIMBRITE
AU INTRUSIVE
AV INTRUSIVE (INTRUSION) BRECCIA
AW LACCOLITH
AX LAPILLI
(AY) LAVA
AZ LAVA LAKE
BA LAYERED INTRUSION
BB LOPOLITH
BC NECK
BD NUEE ARDENTE
BE NODULE
BF PAHOEHOE
BG PHACOLITH
BH PILLOW LAVA
BI PIPE
BJ PLUG
BK PLUTON
BL PLUTONIC
BM PUMICE
BN PYROCLASTIC
BO RING DIKE
BP ROPY LAVA
BQ SCORIA
BR SEGREGATION
BS SILL
BT SPATTER
BU STOCK
BV SUBAERIAL
BW SUBAQUEOUS
BX SUBMARINE
BY TEPHRA
BZ TUFF
CA TUFF BRECCIA
CB VEIN
CC VOLCANIC
CD VOLCANICLASTIC
CE WELDED TUFF
CF XENOLITH

DP OTHER (ADD IN BLOCK G)

TEXTURE, STRUCTURE, GRAIN SIZE

DQ NO INFORMATION

DR AMYGDULAR
DS APHANITIC
DT APHYRIC
DU APLITIC
DV BANDED
DW COARSE
DX CRYPTOCRYSTLN.
DY CUMULATE
DZ DEVITRIFIED
EA DISCRYSTALLINE
EB DOLERITIC
EC EUCRYSTALLINE
ED EQUIGRANULAR
EF FELSITIC
EG FINE
EH GLASSY
EI FOLIATED
EJ GLOMEROPORPH.
EK GNEISSIC
EL GRANITIC
EM GRANOPHYRIC
EN GRANULITIC
EO GRAPHIC
EP HOLOCRYSTALLINE
EQ HOLOHYALINE
ER HYALINE
ES HYALOPILITIC
ET HYPOCRYSTALLINE
EU INTERSERTAL
EV LAMPROPHYRIC
EW LINEATED
EX MASSIVE
EY MEDIUM
EZ MICROCRYSTALLINE
FA MICROGRAPHIC
FB MICROLITIC
FC MICROPEGMATITIC
FD MICROPOIKILITIC
FE MICROPORPHYRITIC
FF MICROSPHERULITIC
FG MYRMEKITIC
FH OPHITIC
FI ORBICULAR
FJ PEGMATITIC
FK PERLITIC
FL PHANERITIC
FM PILOTAXITIC
FN PLATY
FO POIKILITIC
(FP) PORPHYRITIC
FQ PUMICEOUS
FR RECRYSTALLIZED
FS SCHISTOSE
FT SCORIACEOUS
FU SERIATE
FV SPHERULITIC
FW SPINIFEX
FX SUBOPHITIC
FY TRACHYTIC
FZ VARIOLITIC
GA VESICULAR
GB VITREOUS
GC VITROPHYRIC
GD XENOCRYSTIC

HY OTHER (ADD IN BLOCK G)

GE eutaxitic
GF hypidiomorphic
GG panidiomorphic

STATE OF PRESERVATION

IA NO INFORMATION
IB FRESH
(IC) ALTERED
(ID) SLIGHTLY
IE MODERATELY
IF EXTENSIVELY

IJ OTHER (ADD IN BLOCK G)

TYPE OF ALTERATION

IK NO INFORMATION

IL ARGILLITIC
IM CHLORITIC
IN DEUTERIC
IO FENITIC
IP HYDRATED
IQ HYDROTHERMAL
IR LEACHED
IS METAMORPHIC
IT METASOMATIC
IU OXIDATION
IV PALAGONITIC
IW PROPYLITIC
IX PYRITIC
IY SAUSSURITIC
IZ SERICITIC
JA SERPENTINIZED
JB SILICIFICATION
JC SOLFATARIC
JD WEATHERED

JJ OTHER (ADD IN BLOCK G)

JE carbonatic
JF prehnitic
JG zeolitic

F. MINERAL ASSEMBLAGE

NA NO INFORMATION

FELDSPARS, FOIDS

NB FELDSPAR

NC ALKALI FELDSPAR
ND ANORTHOCLASE
NE K-FELDSPAR
NF MICROCLINE
NG MICROPERTHITE
NH ORTHOCLASE
NI PERTHITE
NJ SANIDINE
OK albite
NK ANTIPERTHITE

NL PLAGIOCLASE
NM NA-PLAGIOCLASE
NN INTERMED. PLAG.
NO CA-PLAGIOCLASE
NP ALBITE
NQ ALBITE-OLIGOCLASE
(NR) OLIGOCLASE
NS OLIGOCL.-ANDESN.
NT ANDESINE
NU ANDSN.-LBRDRT.
NV LABRADORITE
NW LBRDRT.-BYTWNT.
NX BYTOWNITE
NY BYTWNT.-ANORTHITE
NZ ANORTHITE

N9 OTHER (ADD IN BLOCK G)

OA FELDSPATHOID
OB ANALCIME
OC CANCRINITE
OD HAUYNE
OE KALSILITE
OF LEUCITE
OG NEPHELINE
OH NOSEAN
OI PSEUDOLEUCITE
OJ SODALITE

O9 OTHER (ADD IN BLOCK G)

PHYLLOSILICATES, DOUBLE CHAIN SILICATES, AND AMPHIBOLOIDS

PA MICA
PB BIOTITE
PC LEPIDOLITE
PD MUSCOVITE
PE PHLOGOPITE
PF SERICITE
PI paragonite
PG CHLORITE
PH SERPENTINE

P9 OTHER (ADD IN BLOCK G)

QA AMPHIBOLE
QB BASALTIC HNBLND.
QC CUMMINGTONITE
QD HORNBLENDE
QP pargasite
QE ALKALI AMPHIBOLE
QF ARFVEDSONITE
QG BARKEVIKITE
QH HASTINGSITE
QI KAERSUTITE
QJ KATOPHORITE
QK RIEBECKITE
QL SODIC

QM AENIGMATITE
QN COSSYRITE
QO RHONITE

Q9 OTHER (ADD IN BLOCK G)

PYROXENES, PYROXENOIDS, OLIVINES

RA PYROXENE

RB ORTHOPYROXENE
RC BRONZITE
RD ENSTATITE
RE HYPERSTHENE

RF CLINOPYROXENE
(RG) AUGITE
RH DIOPSIDE
RI DIOPSIDE-AUGITE
RJ CHROME-DIOPSIDE
RK FERROAUGITE
RL HEDENBERGITE
RM HIGH-AL AUGITE
RN PIGEONITE
RO SUBCALCIC AUGITE
RP TITANAUGITE

RQ ALKALI PYROXENE
RR ACMITE
RS ACMITE-DIOPSIDE
RT AEGIRINE
RU AEGIRINE-AUGITE
RV AEGIRINE-DIOPSIDE
RW OMPHACITE
RX SODIC

RY PECTOLITE
RZ WOLLASTONITE
R1 SPODUMENE

R9 OTHER (ADD IN BLOCK G)

(SA) OLIVINE
SB FAYALITIC
SC FORSTERITIC
SD MONTICELLITE

S9 OTHER (ADD IN BLOCK G)

OTHER SILICATES

TA ALLANITE
ALUMINO-SILICATES
TB ANDALUSITE
TC KYANITE
TD SILLIMANITE
TE BERYL
TF CLAY MINERAL(S)
TG CORDIERITE
TH EPIDOTE
TI GARNET
TJ ALMANDINE
TK ANDRADITE
TL GROSSULAR
TM MELANITE
TN PYROPE
TO SPESSARTINE
TP MELILITE
TQ TITANITE, SPHENE
TR TOPAZ
TS TOURMALINE
TT VESUVIANITE
TU ZEOLITE(S)
TV CHABAZITE
TW HEULANDITE
TX LAUMONTITE
TY NATROLITE
TZ PHILLIPSITE
T1 ZIRCON
T2 ZOISITE

T9 OTHER (ADD IN BLOCK G)

OXIDES

UA ANATASE
UB BROOKITE
UC CASSITERITE
UD CORUNDUM
UE HEMATITE
UF ILMENITE
UG LIMONITE
UH PEROVSKITE
UI PSEUDOBROOKITE
UJ RUTILE

SILICA GROUP
UK CRISTOBALITE
UL CRYPTOCRYST.
UM QUARTZ
UN TRIDYMITE

UO SPINEL
UP CHROMITE
UQ HERCYNITE
UR MAGHEMITE
US MAGNETITE
UT PLEONASTE
UU TITANOMAGNETITE
UV ULVOSPINEL ux picotite
(UW) OPAQUES, ORES

U9 OTHER (ADD IN BLOCK G)

NON-OXIDES, NON-SILICATES

VA APATITE
VB CARBONATE(S)
VC CALCITE
VD DOLOMITE
VE SIDERITE
VF FLUORITE
VG MONAZITE
UW OPAQUES, ORES
VH NATIVE ELEMENT(S)
VI SULFATE(S)
VJ SULFIDE(S)
VK CHALCOPYRITE
VL PYRITE
VM PYRRHOTITE

V9 OTHER (ADD IN BLOCK G)

MINERALOIDS

WA CHLOROPHAEITE
WB GLASS
(WC) IDDINGSITE
WD LEUCOXENE
WE PALAGONITE
WF SIDEROMELANE

W9 OTHER (ADD IN BLOCK G)

G. ADDITIONAL NOTES

SAMPLE NUMBER 12-2d

NTS 115-H / 16-E

CONTRIBUTOR'S NAME
SHEILA CHURCHILL
CONTRIBUTION NO.

A. HEADING INFORMATION

ROCK NAME ANDESITE

LOCATION: LATITUDE 61.97°, LONGITUDE 136.20°

GEOLOGIC UNIT
CARMACKS GROUP

REFERENCE NO.
1

B. ESSENTIAL OXIDES

SIO2	TIO2	AL2O3	FE2O3	FEO	MNO	MGO	CAO	NA2O	K2O	P2O5	CO2	H2O+	H2O-	TOTAL
54.64	0.82	17.37	9.25		0.16	3.96	7.73	4.29	1.47	0.33		0.72		100.00

C. TRACE ELEMENTS OR COMPONENTS

..1A
..1B
..1C
..1D

NAME												
AMOUNT												
REFERENCE												

..2A
..(2B)
..2C
..2D
..2E
..2F
..(2G)
..2H
..2I

NAME												
AMOUNT												
REFERENCE												

NAME												
AMOUNT												
REFERENCE												

D. AGE

..3A STRATIGRAPHIC UPPER CRETACEOUS REFERENCE NO.
..3B ISOTOPIC OR PHYSICAL
..3C
..3D
..(3E)
..3F
..3G
..3H
..3I

YEARS	67.9					
METHOD	K-Ar					
MATERIAL	Whole Rock					
REF. NO.						

E. PETROGRAPHIC DESCRIPTORS

..4A
..4B
..4C
..4D
..4E
..4F
..4G
..4H
..4I

ERUPTIVE TYPE, MODE OF OCCURRENCE

AA NO INFORMATION

AB AA
AC AGGLOMERATE
AD ASH
AE ASH FLOW
AF BATHOLITH
AG BLOCK LAVA
AH BOMB
AI BOSS
AJ BRECCIA
AK CONE SHEET
AL DIATREME
AM DIKE (DYKE)
AN DOME
AO EXTRUSIVE
AP FLOW
(AQ) FLOW BRECCIA
AR HYALOCLASTITE
AS HYPABYSSAL
AT IGNIMBRITE
AU INTRUSIVE
AV INTRUSIVE (INTRUSION) BRECCIA
AW LACCOLITH
AX LAPILLI
AY LAVA
AZ LAVA LAKE
BA LAYERED INTRUSION
BB LOPOLITH
BC NECK
BD NUEE ARDENTE
BE NODULE
BF PAHOEHOE
BG PHACOLITH
BH PILLOW LAVA
BI PIPE
BJ PLUG
BK PLUTON
BL PLUTONIC
BM PUMICE
BN PYROCLASTIC
BO RING DIKE
BP ROPY LAVA
BQ SCORIA
BR SEGREGATION
BS SILL
BT SPATTER
BU STOCK
BV SUBAERIAL
BW SUBAQUEOUS
BX SUBMARINE
BY TEPHRA
BZ TUFF
CA TUFF BRECCIA
CB VEIN
CC VOLCANIC
CD VOLCANICLASTIC
CE WELDED TUFF
CF XENOLITH

DP OTHER (ADD IN BLOCK G)

TEXTURE, STRUCTURE, GRAIN SIZE

DQ NO INFORMATION

DR AMYGDULAR
DS APHANITIC
DT APHYRIC
DU APLITIC
DV BANDED
DW COARSE
DX CRYPTOCRYSTLN.
DY CUMULATE
DZ DEVITRIFIED
EA DISCRYSTALLINE
EB DOLERITIC
EC EUCRYSTALLINE
ED EQUIGRANULAR
EF FELSITIC
EG FINE
(EH) GLASSY
EI FOLIATED
(EJ) GLOMEROPORPH.
EK GNEISSIC
EL GRANITIC
EM GRANOPHYRIC
EN GRANULITIC
EO GRAPHIC
EP HOLOCRYSTALLINE
EQ HOLOHYALINE
ER HYALINE
ES HYALOPILITIC
ET HYPOCRYSTALLINE
EU INTERSERTAL
EV LAMPROPHYRIC
EW LINEATED
EX MASSIVE
EY MEDIUM
EZ MICROCRYSTALLINE
FA MICROGRAPHIC
FB MICROLITIC
FC MICROPEGMATITIC
FD MICROPOIKILITIC
FE MICROPORPHYRITIC
FF MICROSPHERULITIC
FG MYRMEKITIC
FH OPHITIC
FI ORBICULAR
FJ PEGMATITIC
FK PERLITIC
FL PHANERITIC
FM PILOTAXITIC
FN PLATY
FO POIKILITIC
(FP) PORPHYRITIC
FQ PUMICEOUS
FR RECRYSTALLIZED
FS SCHISTOSE
FT SCORIACEOUS
FU SERIATE
FV SPHERULITIC
FW SPINIFEX
FX SUBOPHITIC
FY TRACHYTIC
FZ VARIOLITIC
GA VESICULAR
GB VITREOUS
GC VITROPHYRIC
GD XENOCRYSTIC

HY OTHER (ADD IN BLOCK G)

GE eutaxitic
GF hypidiomorphic
GG panidiomorphic

STATE OF PRESERVATION

IA NO INFORMATION
IB FRESH
(IC) ALTERED
(ID) SLIGHTLY
IE MODERATELY
IF EXTENSIVELY

IJ OTHER (ADD IN BLOCK G)

TYPE OF ALTERATION

IK NO INFORMATION

IL ARGILLITIC
(IM) CHLORITIC
IN DEUTERIC
IO FENITIC
IP HYDRATED
IQ HYDROTHERMAL
IR LEACHED
IS METAMORPHIC
IT METASOMATIC
IU OXIDATION
IV PALAGONITIC
IW PROPYLITIC
IX PYRITIC
IY SAUSSURITIC
IZ SERICITIC
JA SERPENTINIZED
JB SILICIFICATION
JC SOLFATARIC
JD WEATHERED

JJ OTHER (ADD IN BLOCK G)

JE carbonatic
JF prehnitic
JG zeolitic

F. MINERAL ASSEMBLAGE

NA NO INFORMATION

FELDSPARS, FOIDS

NB FELDSPAR

NC ALKALI FELDSPAR
ND ANORTHOCLASE
NE K-FELDSPAR
NF MICROCLINE
NG MICROPERTHITE
NH ORTHOCLASE
NI PERTHITE
NJ SANIDINE
OK albite
NK ANTIPERTHITE

NL PLAGIOCLASE
NM NA-PLAGIOCLASE
NN INTERMED. PLAG.
NO CA-PLAGIOCLASE
NP ALBITE
NQ ALBITE-OLIGOCLASE
(NR) OLIGOCLASE
NS OLIGOCL.-ANDESN.
NT ANDESINE
NU ANDSN-LBRDRT.
NV LABRADORITE
NW LBRDRT.-BYTWNT.
NX BYTOWNITE
NY BYTWNT.-ANORTHITE
NZ ANORTHITE

N9 OTHER (ADD IN BLOCK G)

OA FELDSPATHOID
OB ANALCIME
OC CANCRINITE
OD HAUYNE
OE KALSILITE
OF LEUCITE
OG NEPHELINE
OH NOSEAN
OI PSEUDOLEUCITE
OJ SODALITE

O9 OTHER (ADD IN BLOCK G)

PHYLLOSILICATES, DOUBLE CHAIN SILICATES, AND AMPHIBOLOIDS

PA MICA
PB BIOTITE
PC LEPIDOLITE
PD MUSCOVITE
PE PHLOGOPITE
PF SERICITE
PI paragonite
(PG) CHLORITE
PH SERPENTINE

P9 OTHER (ADD IN BLOCK G)

QA AMPHIBOLE
QB BASALTIC HNBLND.
QC CUMMINGTONITE
QD HORNBLENDE
QP pargasite
QE ALKALI AMPHIBOLE
QF ARFVEDSONITE
QG BARKEVIKITE
QH HASTINGSITE
QI KAERSUTITE
QJ KATOPHORITE
QK RIEBECKITE
QL SODIC

QM AENIGMATITE
QN COSSYRITE
QO RHONITE

Q9 OTHER (ADD IN BLOCK G)

PYROXENES, PYROXENOIDS, OLIVINES

RA PYROXENE

RB ORTHOPYROXENE
RC BRONZITE
RD ENSTATITE
RE HYPERSTHENE

RF CLINOPYROXENE
(RG) AUGITE
RH DIOPSIDE
RI DIOPSIDE-AUGITE
RJ CHROME-DIOPSIDE
RK FERROAUGITE
RL HEDENBERGITE
RM HIGH-AL AUGITE
RN PIGEONITE
RO SUBCALCIC AUGITE
RP TITANAUGITE

RQ ALKALI PYROXENE
RR ACMITE
RS ACMITE-DIOPSIDE
RT AEGIRINE
RU AEGIRINE-AUGITE
RV AEGIRINE-DIOPSIDE
RW OMPHACITE
RX SODIC

RY PECTOLITE
RZ WOLLASTONITE
R1 SPODUMENE

R9 OTHER (ADD IN BLOCK G)

SA OLIVINE
SB FAYALITIC
SC FORSTERITIC
SD MONTICELLITE

S9 OTHER (ADD IN BLOCK G)

OTHER SILICATES

TA ALLANITE
ALUMINO-SILICATES
TB ANDALUSITE
TC KYANITE
TD SILLIMANITE
TE BERYL
TF CLAY MINERAL(S)
TG CORDIERITE
TH EPIDOTE
TI GARNET
TJ ALMANDINE
TK ANDRADITE
TL GROSSULAR
TM MELANITE
TN PYROPE
TO SPESSARTINE
TP MELILITE
TQ TITANITE, SPHENE
TR TOPAZ
TS TOURMALINE
TT VESUVIANITE
TU ZEOLITE(S)
TV CHABAZITE
TW HEULANDITE
TX LAUMONTITE
TY NATROLITE
TZ PHILLIPSITE
T1 ZIRCON
T2 ZOISITE

T9 OTHER (ADD IN BLOCK G)

OXIDES

UA ANATASE
UB BROOKITE
UC CASSITERITE
UD CORUNDUM
UE HEMATITE
UF ILMENITE
UG LIMONITE
UH PEROVSKITE
UI PSEUDOBROOKITE
UJ RUTILE

SILICA GROUP
UK CRISTOBALITE
UL CRYPTOCRYST.
UM QUARTZ
UN TRIDYMITE

UO SPINEL
UP CHROMITE
UQ HERCYNITE
UR MAGHEMITE
US MAGNETITE
UT PLEONASTE
UU TITANOMAGNETITE ux picotite
UV ULVOSPINEL
(UW) OPAQUES, ORES

U9 OTHER (ADD IN BLOCK G)

NON-OXIDES, NON-SILICATES

VA APATITE
VB CARBONATE(S)
VC CALCITE
VD DOLOMITE
VE SIDERITE
VF FLUORITE
VG MONAZITE
UW OPAQUES, ORES
VH NATIVE ELEMENT(S)
VI SULFATE(S)
VJ SULFIDE(S)
VK CHALCOPYRITE
VL PYRITE
VM PYRRHOTITE

V9 OTHER (ADD IN BLOCK G)

MINERALOIDS

WA CHLOROPHAEITE
WB GLASS
WC IDDINGSITE
WD LEUCOXENE
(WE) PALAGONITE
WF SIDEROMELANE

W9 OTHER (ADD IN BLOCK G)

G. ADDITIONAL NOTES

SAMPLE NUMBER 15-1e

CONTRIBUTOR'S NAME
SHEILA CHURCHILL
CONTRIBUTION NO.

A. HEADING INFORMATION

ROCK NAME TRACHYBASALT

LOCATION LATITUDE 62.07°
LONGITUDE 135.95°

GEOLOGIC UNIT CARMACKS GROUP

REFERENCE NO. 1

B. ESSENTIAL OXIDES

SIO2	TIO2	AL2O3	FE2O3	FEO	MNO	MGO	CAO	NA2O	K2O	P2O5	CO2	H2O+	H2O-	TOTAL
56.61	0.90	16.20	7.89		.13	3.93	4.77	3.71	5.27	0.60		1.82		100.00

C. TRACE ELEMENTS OR COMPONENTS

..1A
..1B
..1C
..1D

NAME												
AMOUNT												
REFERENCE												

..2A
..(2B)
..2C
..2D
..2E
..2F
..(2G)
..2H
..2I

NAME												
AMOUNT												
REFERENCE												

NAME												
AMOUNT												
REFERENCE												

D. AGE UPPER CRETACEOUS

..3A STRATIGRAPHIC REFERENCE NO.

..3B ISOTOPIC OR PHYSICAL

..3C
..3D
..(3E)
..3F
..3G

YEARS	68.0 Ma					
METHOD	K-Ar					
MATERIAL	Biotite					
REF. NO.						

..3H
..3I

E. PETROGRAPHIC DESCRIPTORS

..4A
..4B
..4C
..4D
..4E
..4F
..4G
..4H
..4I

ERUPTIVE TYPE, MODE OF OCCURRENCE

AA NO INFORMATION

AB AA
AC AGGLOMERATE
AD ASH
AE ASH FLOW
AF BATHOLITH
AG BLOCK LAVA
AH BOMB
AI BOSS
AJ BRECCIA
AK CONE SHEET
AL DIATREME
AM DIKE (DYKE)
AN DOME
AO EXTRUSIVE
AP FLOW
AQ FLOW BRECCIA
AR HYALOCLASTITE
AS HYPABYSSAL
AT IGNIMBRITE
AU INTRUSIVE
AV INTRUSIVE (INTRUSION) BRECCIA
AW LACCOLITH
AX LAPILLI
(AY) LAVA
AZ LAVA LAKE
BA LAYERED INTRUSION
BB LOPOLITH
BC NECK
BD NUEE ARDENTE
BE NODULE
BF PAHOEHOE
BG PHACOLITH
BH PILLOW LAVA
BI PIPE
BJ PLUG
BK PLUTON
BL PLUTONIC
BM PUMICE
BN PYROCLASTIC
BO RING DIKE
BP ROPY LAVA
BQ SCORIA
BR SEGREGATION
BS SILL
BT SPATTER
BU STOCK
BV SUBAERIAL
BW SUBAQUEOUS
BX SUBMARINE
BY TEPHRA
BZ TUFF
CA TUFF BRECCIA
CB VEIN
CC VOLCANIC
CD VOLCANICLASTIC
CE WELDED TUFF
CF XENOLITH

DP OTHER (ADD IN BLOCK G)

TEXTURE, STRUCTURE, GRAIN SIZE

DQ NO INFORMATION

DR AMYGDULAR
DS APHANITIC
DT APHYRIC
DU APLITIC
DV BANDED
DW COARSE
DX CRYPTOCRYSTLN
DY CUMULATE
DZ DEVITRIFIED
EA DISCRYSTALLINE
EB DOLERITIC
EC EUCRYSTALLINE
ED EQUIGRANULAR
EF FELSITIC
EG FINE
EH GLASSY
EI FOLIATED
EJ GLOMEROPORPH.
EK GNEISSIC
EL GRANITIC
EM GRANOPHYRIC
EN GRANULITIC
EO GRAPHIC
(EP) HOLOCRYSTALLINE
EQ HOLOHYALINE
ER HYALINE
ES HYALOPILITIC
ET HYPOCRYSTALLINE
EU INTERSERTAL
EV LAMPROPHYRIC
EW LINEATED
EX MASSIVE
EY MEDIUM
EZ MICROCRYSTALLINE
FA MICROGRAPHIC
FB MICROLITIC
FC MICROPEGMATITIC
FD MICROPOIKILITIC
FE MICROPORPHYRITIC
FF MICROSPHERULITIC
FG MYRMEKITIC
FH OPHITIC
FI ORBICULAR
FJ PEGMATITIC
FK PERLITIC
FL PHANERITIC
FM PILOTAXITIC
FN PLATY
FO POIKILITIC
(FP) PORPHYRITIC
FQ PUMICEOUS
FR RECRYSTALLIZED
FS SCHISTOSE
FT SCORIACEOUS
FU SERIATE
FV SPHERULITIC
FW SPINIFEX
FX SUBOPHITIC
FY TRACHYTIC
FZ VARIOLITIC
GA VESICULAR
GB VITREOUS
GC VITROPHYRIC
GD XENOCRYSTIC

HY OTHER (ADD IN BLOCK G)

GE entaxitic
GF hypidiomorphic
GG panidiomorphic

STATE OF PRESERVATION

IA NO INFORMATION
IB FRESH
(IC) ALTERED
(ID) SLIGHTLY
IE MODERATELY
IF EXTENSIVELY

IJ OTHER (ADD IN BLOCK G)

TYPE OF ALTERATION

IK NO INFORMATION

IL ARGILLITIC
IM CHLORITIC
IN DEUTERIC
IO FENITIC
IP HYDRATED
IQ HYDROTHERMAL
IR LEACHED
IS METAMORPHIC
IT METASOMATIC
IU OXIDATION
IV PALAGONITIC
IW PROPYLITIC
IX PYRITIC
IY SAUSSURITIC
IZ SERICITIC
JA SERPENTINIZED
JB SILICIFICATION
JC SOLFATARIC
JD WEATHERED

JJ OTHER (ADD IN BLOCK G)

JE carbonatic
JF prehnitic
JG zeolitic

F. MINERAL ASSEMBLAGE

NA NO INFORMATION

FELDSPARS, FOIDS

NB FELDSPAR

NC ALKALI FELDSPAR
ND ANORTHOCLASE
NE K-FELDSPAR
NF MICROCLINE
NG MICROPERTHITE
NH ORTHOCLASE
NI PERTHITE
NJ SANIDINE
OK albite
NK ANTIPERTHITE

NL PLAGIOCLASE
NM NA-PLAGIOCLASE
NN INTERMED. PLAG.
NO CA-PLAGIOCLASE
NP ALBITE
NQ ALBITE-OLIGOCLASE
(NR) OLIGOCLASE
NS OLIGOCL.-ANDESN.
NT ANDESINE
NU ANDSN-LBRDRT.
NV LABRADORITE
NW LBRDRT.-BYTWNT.
NX BYTOWNITE
NY BYTWNT.-ANORTHITE
NZ ANORTHITE

N9 OTHER (ADD IN BLOCK G)

OA FELDSPATHOID
OB ANALCIME
OC CANCRINITE
OD HAUYNE
OE KALSILITE
OF LEUCITE
OG NEPHELINE
OH NOSEAN
OI PSEUDOLEUCITE
OJ SODALITE

O9 OTHER (ADD IN BLOCK G)

PHYLLOSILICATES, DOUBLE CHAIN SILICATES, AND AMPHIBOLOIDS

PA MICA
(PB) BIOTITE
PC LEPIDOLITE
PD MUSCOVITE
PE PHLOGOPITE
PF SERICITE
PI paragonite
(PG) CHLORITE
PH SERPENTINE

P9 OTHER (ADD IN BLOCK G)

QA AMPHIBOLE
QB BASALTIC HNBLND.
QC CUMMINGTONITE
QD HORNBLENDE
QP pargasite
QE ALKALI AMPHIBOLE
QF ARFVEDSONITE
QG BARKEVIKITE
QH HASTINGSITE
QI KAERSUTITE
QJ KATOPHORITE
QK RIEBECKITE
QL SODIC

QM AENIGMATITE
QN COSSYRITE
QO RHONITE

Q9 OTHER (ADD IN BLOCK G)

PYROXENES, PYROXENOIDS, OLIVINES

RA PYROXENE

RB ORTHOPYROXENE
RC BRONZITE
RD ENSTATITE
RE HYPERSTHENE
RF CLINOPYROXENE
(RG) AUGITE
RH DIOPSIDE
RI DIOPSIDE-AUGITE
RJ CHROME-DIOPSIDE
RK FERROAUGITE
RL HEDENBERGITE
RM HIGH-AL AUGITE
RN PIGEONITE
RO SUBCALCIC AUGITE
RP TITANAUGITE

RQ ALKALI PYROXENE
RR ACMITE
RS ACMITE-DIOPSIDE
RT AEGIRINE
RU AEGIRINE-AUGITE
RV AEGIRINE-DIOPSIDE
RW OMPHACITE
RX SODIC

RY PECTOLITE
RZ WOLLASTONITE
R1 SPODUMENE

R9 OTHER (ADD IN BLOCK G)

(SA) OLIVINE
SB FAYALITIC
SC FORSTERITIC
SD MONTICELLITE

S9 OTHER (ADD IN BLOCK G)

OTHER SILICATES

TA ALLANITE
ALUMINO-SILICATES
TB ANDALUSITE
TC KYANITE
TD SILLIMANITE
TE BERYL
TF CLAY MINERAL(S)
TG CORDIERITE
TH EPIDOTE
TI GARNET
TJ ALMANDINE
TK ANDRADITE
TL GROSSULAR
TM MELANITE
TN PYROPE
TO SPESSARTINE
TP MELILITE
TQ TITANITE, SPHENE
TR TOPAZ
TS TOURMALINE
TT VESUVIANITE
TU ZEOLITE(S)
TV CHABAZITE
TW HEULANDITE
TX LAUMONTITE
TY NATROLITE
TZ PHILLIPSITE
T1 ZIRCON
T2 ZOISITE

T9 OTHER (ADD IN BLOCK G)

OXIDES

UA ANATASE
UB BROOKITE
UC CASSITERITE
UD CORUNDUM
UE HEMATITE
UF ILMENITE
UG LIMONITE
UH PEROVSKITE
UI PSEUDOBROOKITE
UJ RUTILE

SILICA GROUP
UK CRISTOBALITE
UL CRYPTOCRYST.
UM QUARTZ
UN TRIDYMITE

UO SPINEL
UP CHROMITE
UQ HERCYNITE
UR MAGHEMITE
US MAGNETITE
UT PLEONASTE
UU TITANOMAGNETITE
UV ULVOSPINEL ux picotite
(UW) OPAQUES, ORES

U9 OTHER (ADD IN BLOCK G)

NON-OXIDES, NON-SILICATES

(VA) APATITE
VB CARBONATE(S)
VC CALCITE
VD DOLOMITE
VE SIDERITE
VF FLUORITE
VG MONAZITE
UW OPAQUES, ORES
VH NATIVE ELEMENT(S)
VI SULFATE(S)
VJ SULFIDE(S)
VK CHALCOPYRITE
VL PYRITE
VM PYRRHOTITE

V9 OTHER (ADD IN BLOCK G)

MINERALOIDS

WA CHLOROPHAEITE
WB GLASS
(WC) IDDINGSITE
WD LEUCOXENE
WE PALAGONITE
WF SIDEROMELANE

W9 OTHER (ADD IN BLOCK G)

G. ADDITIONAL NOTES

SAMPLE NUMBER _ 14

NTS 105-L/ T

CONTRIBUTOR'S NAME
SHEILA CHURCHILL
CONTRIBUTION NO.

A. HEADING INFORMATION

ROCK NAME TRISTONITE

LOCATION LATITUDE 62.07°
LONGITUDE 135.95°

GEOLOGIC UNIT
CARMACKS GROUP

REFERENCE NO.
1

B. ESSENTIAL OXIDES

SIO2	TIO2	AL2O3	FE2O3	FEO	MNO	MGO	CAO	NA2O	K2O	P2O5	CO2	H2O+	H2O-	TOTAL
56.93	0.90	16.16	6.94		0.11	3.78	4.74	4.80	5.06	0.59		0.17		100.00

C. TRACE ELEMENTS OR COMPONENTS

..1A
..1B
..1C
..1D

NAME											
AMOUNT											
REFERENCE											

..2A
..(2B)
..2C
..2D

NAME											
AMOUNT											
REFERENCE											

..2E
..2F
..(2G)
..2H
..2I

NAME											
AMOUNT											
REFERENCE											

D. AGE

..3A STRATIGRAPHIC UPPER CRETACEOUS REFERENCE NO.
..3B ISOTOPIC OR PHYSICAL
..3C
..3D
..(3E)
..3F
..3G

YEARS						
METHOD						
MATERIAL						
REF. NO.						

..3H
..3I E. PETROGRAPHIC DESCRIPTORS

..4A
..4B
..(4C)
..4D
..4E
..4F
..4G
..4H
..4I

ERUPTIVE TYPE, MODE OF OCCURRENCE

AA NO INFORMATION
AB AA
AC AGGLOMERATE
AD ASH
AE ASH FLOW
AF BATHOLITH
AG BLOCK LAVA
AH BOMB
AI BOSS
AJ BRECCIA
AK CONE SHEET
AL DIATREME
AM DIKE (DYKE)
AN DOME
AO EXTRUSIVE
AP FLOW
AQ FLOW BRECCIA
AR HYALOCLASTITE
AS HYPABYSSAL
AT IGNIMBRITE
AU INTRUSIVE
AV INTRUSIVE (INTRUSION) BRECCIA
AW LACCOLITH
AX LAPILLI
(AY) LAVA
AZ LAVA LAKE
BA LAYERED INTRUSION
BB LOPOLITH
BC NECK
BD NUEE ARDENTE
BE NODULE
BF PAHOEHOE
BG PHACOLITH
BH PILLOW LAVA
BI PIPE
BJ PLUG
BK PLUTON
BL PLUTONIC
BM PUMICE
BN PYROCLASTIC
BO RING DIKE
BP ROPY LAVA
BQ SCORIA
BR SEGREGATION
BS SILL
BT SPATTER
BU STOCK
BV SUBAERIAL
BW SUBAQUEOUS
BX SUBMARINE
BY TEPHRA
BZ TUFF
CA TUFF BRECCIA
CB VEIN
CC VOLCANIC
CD VOLCANICLASTIC
CE WELDED TUFF
CF XENOLITH

DP OTHER (ADD IN BLOCK G)

TEXTURE, STRUCTURE, GRAIN SIZE

DQ NO INFORMATION

DR AMYGDULAR
DS APHANITIC
DT APHYRIC
DU APLITIC
DV BANDED
DW COARSE
DX CRYPTOCRYSTLN.
DY CUMULATE
DZ DEVITRIFIED
EA DISCRYSTALLINE
EB DOLERITIC
EC EUCRYSTALLINE
ED EQUIGRANULAR
EF FELSITIC
EG FINE
EH GLASSY
EI FOLIATED
EJ GLOMEROPORPH.
EK GNEISSIC
EL GRANITIC
EM GRANOPHYRIC
EN GRANULITIC
EO GRAPHIC
(EP) HOLOCRYSTALLINE
EQ HOLOHYALINE
ER HYALINE
ES HYALOPILITIC
ET HYPOCRYSTALLINE
EU INTERSERTAL
EV LAMPROPHYRIC
EW LINEATED
EX MASSIVE
EY MEDIUM
EZ MICROCRYSTALLINE
FA MICROGRAPHIC
FB MICROLITIC
FC MICROPEGMATITIC
FD MICROPOIKILITIC
FE MICROPORPHYRITIC
FF MICROSPHERULITIC
FG MYRMEKITIC
FH OPHITIC
FI ORBICULAR
FJ PEGMATITIC
FK PERLITIC
FL PHANERITIC
FM PILOTAXITIC
FN PLATY
FO POIKILITIC
(FP) PORPHYRITIC
FQ PUMICEOUS
FR RECRYSTALLIZED
FS SCHISTOSE
FT SCORIACEOUS
FU SERIATE
FV SPHERULITIC
FW SPINIFEX
FX SUBOPHITIC
FY TRACHYTIC
FZ VARIOLITIC
GA VESICULAR
GB VITREOUS
GC VITROPHYRIC
GD XENOCRYSTIC

GE eutaxitic
GF hypidiomorphic
GG panidiomorphic

HY OTHER (ADD IN BLOCK G)

STATE OF PRESERVATION

IA NO INFORMATION
(IB) FRESH
(IC) ALTERED
(ID) SLIGHTLY
IE MODERATELY
IF EXTENSIVELY

IJ OTHER (ADD IN BLOCK G)

TYPE OF ALTERATION

IK NO INFORMATION

IL ARGILLITIC
IM CHLORITIC
IN DEUTERIC
IO FENITIC
IP HYDRATED
IQ HYDROTHERMAL
IR LEACHED
IS METAMORPHIC
IT METASOMATIC
IU OXIDATION
IV PALAGONITIC
IW PROPYLITIC
IX PYRITIC
IY SAUSSURITIC
IZ SERICITIC
JA SERPENTINIZED
JB SILICIFICATION
JC SOLFATARIC
JD WEATHERED

JJ OTHER (ADD IN BLOCK G)

JE carbonatic
JF prehnitic
JG zeolitic

F. MINERAL ASSEMBLAGE

NA NO INFORMATION

FELDSPARS, FOIDS

NB FELDSPAR

NC ALKALI FELDSPAR
ND ANORTHOCLASE
NE K-FELDSPAR
NF MICROCLINE
NG MICROPERTHITE
(NH) ORTHOCLASE
NI PERTHITE
NJ SANIDINE
OK albite
NK ANTIPERTHITE

NL PLAGIOCLASE
NM NA-PLAGIOCLASE
NN INTERMED. PLAG.
NO CA-PLAGIOCLASE
NP ALBITE
(NQ) ALBITE-OLIGOCLASE
NR OLIGOCLASE
NS OLIGOCL.-ANDESN.
NT ANDESINE
NU ANDSN.-LBRDRT.
NV LABRADORITE
NW LBRDRT.-BYTWNT.
NX BYTOWNITE
NY BYTWNT.-ANORTHITE
NZ ANORTHITE

N9 OTHER (ADD IN BLOCK G)

OA FELDSPATHOID
OB ANALCIME
OC CANCRINITE
OD HAUYNE
OE KALSILITE
OF LEUCITE
OG NEPHELINE
OH NOSEAN
OI PSEUDOLEUCITE
OJ SODALITE

O9 OTHER (ADD IN BLOCK G)

PHYLLOSILICATES, DOUBLE CHAIN SILICATES, AND AMPHIBOLOIDS

PA MICA
(PB) BIOTITE
PC LEPIDOLITE
PD MUSCOVITE
PE PHLOGOPITE
PF SERICITE
PI paragonite
(PG) CHLORITE
PH SERPENTINE

P9 OTHER (ADD IN BLOCK G)

QA AMPHIBOLE
QB BASALTIC HNBLND.
QC CUMMINGTONITE
QD HORNBLENDE
QP pargasite
QE ALKALI AMPHIBOLE
QF ARFVEDSONITE
QG BARKEVIKITE
QH HASTINGSITE
QI KAERSUTITE

GJ KATOPHORITE
GK RIEBECKITE
GL SODIC

GM AENIGMATITE
GN COSSYRITE
GO RHONITE

G9 OTHER (ADD IN BLOCK G)

PYROXENES, PYROXENOIDS, OLIVINES

RA PYROXENE

RB ORTHOPYROXENE
RC BRONZITE
RD ENSTATITE
RE HYPERSTHENE
RF CLINOPYROXENE
(RG) AUGITE
RH DIOPSIDE
RI DIOPSIDE-AUGITE
RJ CHROME-DIOPSIDE
RK FERROAUGITE
RL HEDENBERGITE
RM HIGH-AL AUGITE
RN PIGEONITE
RO SUBCALCIC AUGITE
RP TITANAUGITE

RQ ALKALI PYROXENE
RR ACMITE
RS ACMITE-DIOPSIDE
RT AEGIRINE
RU AEGIRINE-AUGITE
RV AEGIRINE-DIOPSIDE
RW OMPHACITE
RX SODIC

RY PECTOLITE
RZ WOLLASTONITE
R1 SPODUMENE

R9 OTHER (ADD IN BLOCK G)

(SA) OLIVINE
SB FAYALITIC
SC FORSTERITIC
SD MONTICELLITE

S9 OTHER (ADD IN BLOCK G)

OTHER SILICATES

TA ALLANITE
ALUMINO-SILICATES
TB ANDALUSITE
TC KYANITE
TD SILLIMANITE
TE BERYL
TF CLAY MINERAL(S)
TG CORDIERITE
TH EPIDOTE
TI GARNET
TJ ALMANDINE
TK ANDRADITE
TL GROSSULAR
TM MELANITE
TN PYROPE
TO SPESSARTINE
TP MELILITE
TQ TITANITE, SPHENE
TR TOPAZ

TS TOURMALINE
TT VESUVIANITE
TU ZEOLITE(S)
TV CHABAZITE
TW HEULANDITE
TX LAUMONTITE
TY NATROLITE
TZ PHILLIPSITE
T1 ZIRCON
T2 ZOISITE

T9 OTHER (ADD IN BLOCK G)

OXIDES

UA ANATASE
UB BROOKITE
UC CASSITERITE
UD CORUNDUM
UE HEMATITE
UF ILMENITE
UG LIMONITE
UH PEROVSKITE
UI PSEUDOBROOKITE
UJ RUTILE

SILICA GROUP
UK CRISTOBALITE
UL CRYPTOCRYST.
UM QUARTZ
UN TRIDYMITE

UO SPINEL
UP CHROMITE
UQ HERCYNITE
UR MAGHEMITE
US MAGNETITE
UT PLEONASTE
UU TITANOMAGNETITE
UV ULVOSPINEL
UX picotite
(UW) OPAQUES, ORES

U9 OTHER (ADD IN BLOCK G)

NON-OXIDES, NON-SILICATES

(VA) APATITE
VB CARBONATE(S)
VC CALCITE
VD DOLOMITE
VE SIDERITE
VF FLUORITE
VG MONAZITE
UW OPAQUES, ORES
VH NATIVE ELEMENT(S)
VI SULFATE(S)
VJ SULFIDE(S)
VK CHALCOPYRITE
VL PYRITE
VM PYRRHOTITE

V9 OTHER (ADD IN BLOCK G)

MINERALOIDS

WA CHLOROPHAEITE
WB GLASS
(WC) IDDINGSITE
WD LEUCOXENE
WE PALAGONITE
WF SIDEROMELANE

W9 OTHER (ADD IN BLOCK G)

G. ADDITIONAL NOTES

— SAMPLE NUMBER 14-1h

APPENDIX IV

DATING INFORMATION

Analytical Techniques:

K is determined in duplicate by atomic absorption using a Techtron AA4 spectrophotometer and Ar by isotope dilution using an AEI MS - 10 mass spectrometer and high purity ^{38}Ar spike. Errors reported are for one standard deviation. The constants used are:

$K\lambda_e = 0.581 \times 10^{-10} y^{-1}$, $K\lambda_\beta = 4.962 \times 10^{-10} y^{-1}$,

$^{40}K/K = 0.01167$ atom percent.

Rb and Sr concentration were determined by replicate analysis of pressed powder pellets using X-ray fluorescence. U.S. Geological Survey rock standards were used for calibration; mass absorption coefficients were obtained from Mo $K\alpha$ Compton scattering measurements. Rb/Sr ratios have a precision of 2% (1σ) and concentrations a precision of 5% (1σ). Sr isotopic composition was measured on unspiked samples prepared using standard ion exchange techniques. The mass spectrometer (60° sector, 30 cm radius, solid source) is of U.S. National Bureau of Standards design, modified by H. Faul. Data aquisition is digitized and automated using a NOVA computer. Experimental data have been normalized to a $^{86}Sr/^{88}Sr$ ratio of 0.1194 and adjusted so that the NBS standard $SrCO_3$ (SRM987) gives a $^{87}Sr/^{86}Sr$ ratio of .71022 ± 2 and the Eimer and Amend Sr a ratio of 0.70800 ± 2. The precision of a single $^{87}Sr/^{86}Sr$ ratio is 0.00013 (1σ). Rb-Sr dates are based on a Rb decay constant of $1.42 \times 10^{-11} y^{-1}$. The regressions are calculated according to the technique of York (1967; 1969).

K-Ar

Sample Number(s) and Reference(s)

Lab No: 12-2d

Ref: R. Armstrong, S. Churchill &

decay constants:
- ☐ 4.72/.584/1.19
- ☐ 4.72/.584/1.18
- ☒ 4.96/.581/1.167
- ☐ not reported

material	Date	1σ error
(Whole Rx)	73.1	± 2.5 Ma
( )		± Ma
( )		± Ma
( )		± Ma

Record No:

Suite No:

Sample Name:

Latitude: Longitude: (X° Y' Z" or X° Y.Y')

(62° 04' 12" N, 136° 24' 30" W (± 2");

UTM Zone ____ ____ E ____ N; Province ____

Sec. ____, T. ____, R. ____; ____ Co., State ____.

(NTS 115-I/1) Carmacks Map Area, Scale 1:50,000

Location: Carmacks map area, 5 km west of Carmacks

Source Type: outcrop

Rock: Alkali Basalt

Geologic Unit: Carmacks Group

Geologic Age: Upper Cretaceous

Material Analyzed: Whole rock, quality fine - very fine.

Analytical Data: (list duplicate analyses or indicate n = 2, n = 3, etc.)

K = 2.49 2.49 %; (Ar^{40*} = 7.219 $x10^{-6}$ cc/gm)
K_2O= %; 3.222 $x10^{-10}$ mol/gm); (89.9 %ΣAr^{40})

K = %; (Ar^{40*} = $x10^{-6}$ cc/gm)
K_2O= % $x10^{-10}$ mol/gm); (%ΣAr^{40})

K = %; (Ar^{40*} = $x10^{-6}$ cc/gm)
K_2O= % $x10^{-10}$ mol/gm); (%ΣAr^{40})

K = %; (Ar^{40*} = $x10^{-6}$ cc/gm)
K_2O= % $x10^{-10}$ mol/gm); (%ΣAr^{40})

Comment on Analyses:

Interpretation:

Collected by: S.J. Churchill

Dated by: J.E. Harakal

Listed by: ____ (name, institution) Date: 01.02.80

K-Ar

Sample Number(s) and Reference(s)

Lab No: 15-Je60

Ref: R. Armstrong
S. Churchill

Record No:
Suite No:
Sample Name:

decay constants:
- ☐ 4.72/.584/1.19
- ☐ 4.72/.584/1.18
- ■ 4.96/.581/1.167
- ☐ not reported

material	Date	1σ error
(Whole Rx)	67.9	± 2.3 Ma
( )		± Ma
( )		± Ma
( )		± Ma

Latitude: Longitude: (X° Y' Z" or X° Y.Y')
(61° 58' 05" N , 136° 13' 30" W (± 2");

UTM Zone ___ ___ E ___ N; Province Yukon

Sec.___, T.___, R.___; ___ Co., State___.

(NTS 115-H/16E) Ashihik Lake Map Area, Scale 1:50,000

Location: Aishihik Lake map area, 14 km south of Carmacks
Source Type: Outcrop
Rock: Andesite
Geologic Unit: Carmacks Group
Geologic Age: Upper Cretaceous
Material Analyzed: Whole rock, quality Fine - Very Fine.

Analytical Data: (list duplicate analyses or indicate n = 2, n = 3, etc.)

K = 1.26 1.26 %; (Ar^{40*} = 3.386 $\times 10^{-6}$ cc/gm); (63.4 %ΣAr^{40})
K_2O= %; 1.511 $\times 10^{-10}$ mol/gm)

K = %; (Ar^{40*} = $\times 10^{-6}$ cc/gm); (%ΣAr^{40})
K_2O= % $\times 10^{-10}$ mol/gm)

K = %; (Ar^{40*} = $\times 10^{-6}$ cc/gm); (%ΣAr^{40})
K_2O= % $\times 10^{-10}$ mol/gm)

K = %; (Ar^{40*} = $\times 10^{-6}$ cc/gm); (%ΣAr^{40})
K_2O= % $\times 10^{-10}$ mol/gm)

Comment on Analyses:

Interpretation:

Collected by: S.J. Churchill

Dated by: J.E. Harakal

Listed by: ___ Date: 01.11.80
(name, institution)

K-Ar

Sample Number(s) and Reference(s)

Lab No: #14

Ref: R. Armstrong
S. Churchill

decay constants:
- ☐ 4.72/.584/1.19
- ☐ 4.72/.584/1.18
- ■ 4.96/.581/1.167
- ☐ not reported

material	Date	1σ error
(Biotite)	68.0	± 2.2 Ma
( )		± Ma
( )		± Ma
( )		± Ma

Record No:

Suite No:

Sample Name:

Latitude: Longitude: (X° Y' Z" or X° Y.Y')

(62° 04' 07" N, 135° 56' 48" W (± 2");

UTM Zone ___ ______ E ______ N; Province Yukon

Sec.___, T.___, R.___; ______ Co., State ______.

(NTS 105-L/4) Glenlyon Map Area, Scale 1:50,000

Location: Glenlyon map area, 19 km east of Carmacks

Source Type: outcrop

Rock: Trachybasalt

Geologic Unit: Carmacks Group

Geologic Age: Upper Cretaceous

Material Analyzed: Biotite, quality fine-very fine.

Analytical Data: (list duplicate analyses or indicate n = 2, n = 3, etc.)

K = 6.87 6.78 (±1.3%) %; (Ar^{40*} = 18.384 $\times 10^{-6}$ cc/gm)
K_2O= %; 8.203 $\times 10^{-10}$ mol/gm); (84.4 %ΣAr^{40})

K = %; (Ar^{40*} = $\times 10^{-6}$ cc/gm)
K_2O= %; $\times 10^{-10}$ mol/gm); (%ΣAr^{40})

K = %; (Ar^{40*} = $\times 10^{-6}$ cc/gm)
K_2O= %; $\times 10^{-10}$ mol/gm); (%ΣAr^{40})

K = %; (Ar^{40*} = $\times 10^{-6}$ cc/gm)
K_2O= %; $\times 10^{-10}$ mol/gm); (%ΣAr^{40})

Comment on Analyses:

Interpretation:

Collected by: S.J. Churchill

Dated by: J. E. Harakal

Listed by: ______ (name, institution) Date: 01.14.80

Rb-Sr DATA

	12-2d	15-1e	14
Latitude	62° 04' 12"N	61° 58' 05"N	62° 04' 07"N
Longitude	136° 24' 30"W	136° 13" 30"W	135° 56' 48"W
ppm Sr	597	805	726
ppm Rb	79.7	41.8	216
Rb/Sr	0.135	0.052	0.297
$^{87}Rb/^{86}Sr$	0.389	0.150	0.859
$^{87}Sr/^{86}Sr$	0.7054	0.7050	0.7058
Initial $^{87}Sr/^{86}Sr$	0.7050	0.7048	0.7049

LD 3

K-Ar

Sample Number(s) and Reference(s)

Lab No: *Plagioclase*

Ref: *H. Grond.*
R. Armstrong

Record No:

Suite No:

Sample Name:

decay constants:
- □ 4.72/.584/1.19
- □ 4.72/.584/1.18
- ☒ 4.96/.581/1.167
- □ not reported

material	Date	1σ error
(*Plag.*)	*69.1*	± *2.6* Ma
( )		± Ma
( )		± Ma
( )		± Ma

Latitude: Longitude: (X° Y' Z" or X° Y.Y')
(° ' " N , ° ' " W (±);

UTM Zone ___ ___ E ___ N; Province ___

Sec.___, T.___, R.___; ___ Co., State___.

(NTS___) ___ Map Area, Scale___

Location:

Source Type:

Rock:

Geologic Unit:

Geologic Age:

Material Analyzed: *Plagioclase, quality fine-very fine.*

Analytical Data: (list duplicate analyses or indicate n = 2, n = 3, etc.)

K = *0.735 0.721 (±1.97)* %; (Ar^{40*} = *1.993* $\times10^{-6}$ cc/gm); (*66.2* %ΣAr^{40})
K_2O= % *0.889* $\times10^{-10}$ mol/gm)

K = %; (Ar^{40*} = $\times10^{-6}$ cc/gm); (%ΣAr^{40})
K_2O= % $\times10^{-10}$ mol/gm)

K = %; (Ar^{40*} = $\times10^{-6}$ cc/gm); (%ΣAr^{40})
K_2O= % $\times10^{-10}$ mol/gm)

K = %; (Ar^{40*} = $\times10^{-6}$ cc/gm); (%ΣAr^{40})
K_2O= % $\times10^{-10}$ mol/gm)

Comment on Analyses:

Interpretation:

Collected by:

Dated by: *J. E. Harakal*

Listed by: ___ (name, institution)   Date: *01-02-80*

ZC-00

K-Ar

Sample Number(s) and Reference(s)
Lab No: "Whole Rock."

Ref: H. Grond.
R. Armstrong

Record No:
Suite No:
Sample Name:

decay constants:
- ☐ 4.72/.584/1.19
- ☐ 4.72/.584/1.18
- ☐ 4.96/.581/1.167
- ☐ not reported

material	Date	1σ error
(Whole Rk)	72.4	± 2.5 Ma
( )		± Ma
( )		± Ma
( )		± Ma

Latitude: Longitude: (X° Y' Z" or X° Y.Y')
(° ' " N, ° ' " W (±));

UTM Zone ___ ___ E ___ N; Province ___

Sec.___, T.___, R.___; ___ Co., State___.

(NTS___) ___ Map Area, Scale___

Location:
Source Type:
Rock:
Geologic Unit:
Geologic Age:
Material Analyzed: Whole rock, quality very fine.

Analytical Data: (list duplicate analyses or indicate n = 2, n = 3, etc.)

K = 1.318 1.306 (±0.9%) %; (Ar^{40*} = 3.769 $\times 10^{-6}$ cc/gm); (81.3 %ΣAr^{40})
K_2O= %; 1.682 $\times 10^{-10}$ mol/gm)

K = %; (Ar^{40*} = $\times 10^{-6}$ cc/gm); (%ΣAr^{40})
K_2O= %; $\times 10^{-10}$ mol/gm)

K = %; (Ar^{40*} = $\times 10^{-6}$ cc/gm); (%ΣAr^{40})
K_2O= %; $\times 10^{-10}$ mol/gm)

K = %; (Ar^{40*} = $\times 10^{-6}$ cc/gm); (%ΣAr^{40})
K_2O= %; $\times 10^{-10}$ mol/gm)

Comment on Analyses:

Interpretation:

Collected by:
Dated by: J. E. Harakal
Listed by: Date: 01-02-80
(name, institution)

K-Ar

Sample Number(s) and Reference(s)

Lab No: #14

Ref: R. Armstrong
S. Churchill

	material	Date	1σ error
decay constants:	(Biotite)	68.0	± 2.2 Ma
☐ 4.72/.584/1.19	( )		± Ma
☐ 4.72/.584/1.18	( )		± Ma
■ 4.96/.581/1.167	( )		± Ma

☐ not reported

Record No:

Suite No:

Sample Name:

Latitude: Longitude: (X° Y' Z" or X° Y.Y')

(° ' " N , ° ' " W (±) ;

UTM Zone ___ ___ E ___ N; Province ___

Sec. ___, T. ___, R. ___; ___ Co., State ___.

(NTS ___) ___ Map Area, Scale ___

Location:

Source Type:

Rock:

Geologic Unit:

Geologic Age:

Material Analyzed: Biotite, quality fine-very fine.

Analytical Data: (list duplicate analyses or indicate n = 2, n = 3, etc.)

K = 6.87 6.78 (±1.3%) %; (Ar^{40*} = 18.384 $x10^{-6}$ cc/gm)
K_2O = % 8.203 $x10^{-10}$ mol/gm) ; (84.4 %ΣAr^{40})

K = %; (Ar^{40*} = $x10^{-6}$ cc/gm) ; (%ΣAr^{40})
K_2O = % $x10^{-10}$ mol/gm)

K = %; (Ar^{40*} = $x10^{-6}$ cc/gm) ; (%ΣAr^{40})
K_2O = % $x10^{-10}$ mol/gm)

K = %; (Ar^{40*} = $x10^{-6}$ cc/gm) ; (%ΣAr^{40})
K_2O = % $x10^{-10}$ mol/gm)

Comment on Analyses:

Interpretation:

Collected by:

Dated by: J. E. Harakal

Listed by: (name, institution) Date: 01.14.80

K-Ar

Sample Number(s) and Reference(s)
Lab No: 15-Je60

Ref: R. Armstrong
S. Churchill

decay constants:
- ☐ 4.72/.584/1.19
- ☐ 4.72/.584/1.18
- ☐ 4.96/.581/1.167
- ☐ not reported

material	Date	1σ error
(Whole Rx)	67.9	± 2.3 Ma
( )		± Ma
( )		± Ma
( )		± Ma

Record No:
Suite No:
Sample Name:

Latitude: Longitude: (X° Y' Z" or X° Y.Y')
(° ' " N , ° ' " W (±);

UTM Zone ___ ___E ___N; Province ___

Sec.___, T.___, R.___; ___ Co., State___.

(NTS___) ___ Map Area, Scale___

Location:
Source Type:
Rock:
Geologic Unit:
Geologic Age:
Material Analyzed: Whole rock, quality fine - very fine.

Analytical Data: (list duplicate analyses or indicate n = 2, n = 3, etc.)

K = 1.26 1.26 %; (Ar^{40*} = 3.386 $x10^{-6}$ cc/gm); (63.4 %ΣAr^{40})
K_2O= %; 1.511 $x10^{-10}$ mol/gm)

K = %; (Ar^{40*} = $x10^{-6}$ cc/gm); (%ΣAr^{40})
K_2O= % $x10^{-10}$ mol/gm)

K = %; (Ar^{40*} = $x10^{-6}$ cc/gm); (%ΣAr^{40})
K_2O= % $x10^{-10}$ mol/gm)

K = %; (Ar^{40*}= $x10^{-6}$ cc/gm); (%ΣAr^{40})
K_2O= % $x10^{-10}$ mol/gm)

Comment on Analyses:

Interpretation:

Collected by:
Dated by: J.E. Harakal
Listed by: ___ (name, institution) Date: 01.11.80

K-Ar

Sample Number(s) and Reference(s)		material	Date	1σ error
Lab No: 12-2d	decay constants:	(Whole Rx)	73.1	± 2.5 Ma
	☐ 4.72/.584/1.19	( )		± Ma
Ref: R. Armstrong S. Churchill	☐ 4.72/.584/1.18	( )		± Ma
	☒ 4.96/.581/1.167	( )		± Ma
Record No:				
Suite No:	☐ not reported			
Sample Name:				

Latitude: Longitude: (X° Y' Z" or X° Y.Y')

(° ' " N , ° ' " W (±);

UTM Zone ___ ___ E ___ N; Province ___

Sec. ___, T. ___, R. ___; ___ Co., State ___.

(NTS ___) ___ Map Area, Scale ___

Location:

Source Type:

Rock:

Geologic Unit:

Geologic Age:

Material Analyzed: Whole rock, quality fine - very fine.

Analytical Data: (list duplicate analyses or indicate n = 2, n = 3, etc.)

K = 2.49 2.49 %; (Ar^{40*} = 7.219 $x10^{-6}$ cc/gm)
K_2O= %; 3.222 $x10^{-10}$ mol/gm); (89.9 $\%\Sigma Ar^{40}$)

K = %; (Ar^{40*} = $x10^{-6}$ cc/gm); ($\%\Sigma Ar^{40}$)
K_2O= % $x10^{-10}$ mol/gm)

K = %; (Ar^{40*} = $x10^{-6}$ cc/gm); ($\%\Sigma Ar^{40}$)
K_2O= % $x10^{-10}$ mol/gm)

K = %; (Ar^{40*}= $x10^{-6}$ cc/gm); ($\%\Sigma Ar^{40}$)
K_2O= % $x10^{-10}$ mol/gm)

Comment on Analyses:

Interpretation:

Collected by:

Dated by: J.E. Harakal

Listed by: (name, institution) Date: 01.02.80