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Geology of
Carbonatite - Alkalic Rock Complexes in Ontario:
Prairie Lake Carbonatite Complex
District of Thunder Bay

by R.P. Sage

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Foreword

The Prairie Lake Carbonatite Complex was examined as part of a project, begun in 1974, to study alkalic rock – carbonatite complexes in Ontario. The study describes the rock types and mineralogy of the complex and outlines the history of mineral exploration within the complex.

V.G. Milne

Director
Ontario Geological Survey

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CONVERSION FACTORS FOR MEASUREMENTS IN ONTARIO GEOLOGICAL SURVEY PUBLICATIONS

Conversion from SI to Imperial			Conversion from Imperial to SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
		LENGTH			
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
		AREA			
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
		VOLUME			
1 cm^3	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.308 0	cubic yards	1 cubic yard	0.764 555	m^3
		CAPACITY			
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
		MASS			
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 908 8**	t
		CONCENTRATION			
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

Note: Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in cooperation with the Coal Association of Canada.

Geology of
Carbonatite – Alkalic Rock Complexes in Ontario:
Prairie Lake Carbonatite Complex
District of Thunder Bay

R.P. Sage[1]

1. Geologist, Precambrian Geology Section, Ontario Geological Survey, Toronto. Manuscript approved for publication by John Wood, Chief Geologist, Ontario Geological Survey, April 11, 1983.

This report is published with the permission of V.G. Milne, Director, Ontario Geological Survey.

Abstract

The Prairie Lake Carbonatite Complex is located at 49°02'N Latitude and 86°43'W Longitude, about 45 km northwest of Marathon, Ontario. The complex consists of an ijolite core enclosed in an outer rim of mixed carbonatite, silicocarbonatite and calcitic ijolite. The complex has been dated by Rb–Sr isotopic techniques at 1023 ± 74 Ma (Bell and Blenkinsop 1980). The emplacement of the intrusion is related to fractures subsidiary to the northern extension of the Big Bay – Ashburton Bay Fault defined by Hinze et al. (1966) and which controlled the location of the alkalic rock – carbonatite intrusive complexes north–northeast of Lake Superior. The Prairie Lake Carbonatite Complex is part of the alkalic rock – carbonatite petrologic province which extends north–northeast of Lake Superior. The complex hosts uranium and niobium mineralization and has been subjected to several investigations by exploration companies.

Résumé

Le complexe de carbonatite de Prairie Lake se trouve à 49°02' de latitude nord et 86°43' de longitude ouest, à environ 45 km au nord–ouest de Marathon (Ontario). Il se compose d'un noyau d'ijolite enchâssé dans un rebord extérieur composé d'un mélange de carbonatite, de silicocarbonatite et d'ijolite calcaire. On a pu dater le complexe grâce à des techniques isotopiques au Rb–Sr à 1023 ± 74 Ma (Bell et Blenkinsop 1980). L'emplacement de l'intrusion est relié à des fractures secondaires à l'extension vers le nord des complexes intrusifs de carbonatite situés au nord–nord–est du lac Supérieur – faille d'Ashburton Bay définie par Hinze et autres (1966) et qui détermine l'emplacement des roches alcalines. Le complexe de carbonatite de Prairie Lake fait partie des roches alcalines – province pétrologique de carbonatite qui s'étend vers le nord–nord–est du lac Supérieur. Le complexe contient de l'uranium et du niobium minéralisés et a fait l'objet de plusieurs prospections de la part de compagnies minières.

Geology of Carbonatite - Alkalic Rock Complexes in Ontario: Prairie Lake Carbonatite Complex, District of Thunder Bay, by R.P. Sage. Ontario Geological Survey, Study 46, 91p. Published 1987. ISBN 0-7729-0581-9

Introduction

The Prairie Lake Carbonatite Complex was the first complex to be mapped in the Ontario Geological Survey's province–wide study of the economic potential of alkalic rock – carbonatite complexes. The complex causes a strong circular aeromagnetic anomaly and consists of carbonatite and carbonate–rich rocks along its periphery and rocks of the ijolite–melteigite–urtite series within its core. The intrusion is known to contain uranium and niobium mineralization.

Acknowledgments

The author was aided in initial mapping of the complex, in 1974, by D. Meloche, D. Bathe, C. Daley and D. Johnson. In 1975, mapping of the complex was completed with the assistance of D. Bathe, senior geological assistant, and P. Chamois, W. Wright, and K. Shewbridge. Mr. Bathe mapped the periphery of the complex from the northwest corner of the complex north of "Anomaly" Lake (local name) to Parsons' Zone. The author examined the interior and the remainder of the periphery.

Logistical support for the project was supplied by Geraldton District Office of the Ontario Ministry of Natural Resources. Wilf Belisle, Field Services Superintendent, and Don McNabe, pilot for the ministry, deserve special thanks for their efforts on behalf of the field party.

The Newmont Mining Corporation of Canada Limited supplied private maps, reports, and assays to the ministry, which were of considerable benefit to the project. J.A. Coope, Exploration Manager for Newmont Mining Corporation of Canada Limited, gave freely of his time to discuss various aspects of the complex with the author.

Dr. D.H. Watkinson, Carleton University, made available to the author much unpublished data.

Mr. Doug Hume, President, Nuinsco Resources Limited, has given freely of all data resulting from work on the complex subsequent to mapping by the author. Some of this new data has been incorporated into the revised geological map (see Figure 3, back pocket) of the complex. Dr. Ulrich Kretschmar, consulting geologist for Nuinsco Resources, provided informed discussion on recent work completed on the complex.

Location and Access

The Prairie Lake complex (Figure 1) can be reached by float–equipped aircraft from Geraldton or Pays Plat to Prairie Lake. Pays Plat lies 64 km southwest of the complex and Geraldton 77 km north of the complex. In 1978, after completion of mapping, the Dead Horse Creek forest access road was completed north to the complex and road access is now available to the northwest corner of the carbonatite complex. Skid roads now branch off from the access road into the interior of the complex.

During the winter of 1975–1976, the International Minerals and Chemical Corporation constructed approximately 8.0 km of tractor road into the complex from a logging access road west of the intrusion. This road was used to haul in reverse circulation drilling equipment. This tractor road has now been abandoned.

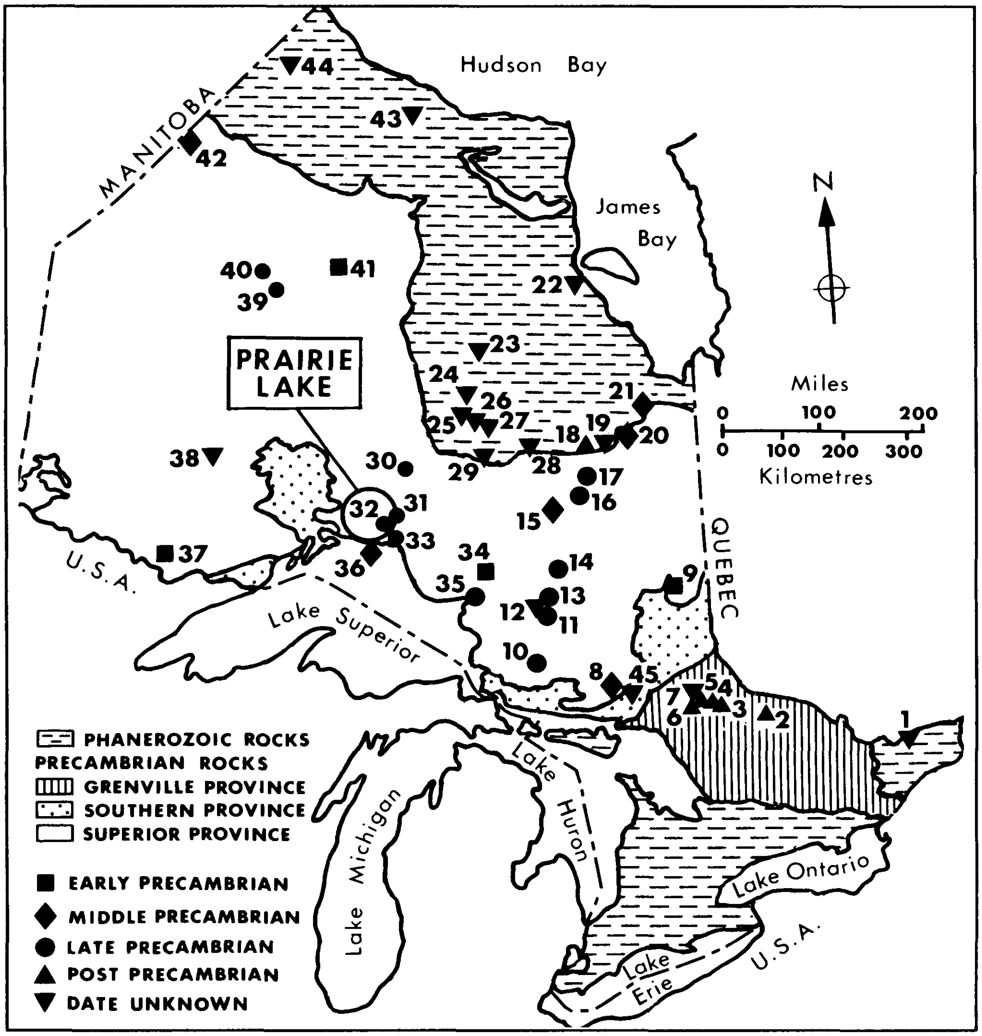


Figure 1. *Key map showing location of carbonatite – alkalic rock complexes in Ontario.*

1. *Eastview*
2. *Brent*
3. *Callander B.*
4. *Manitou Is.*
5. *Burritt Is.*
6. *Iron Is.*
7. *Lavergne*
8. *Spanish R.*
9. *Otto Stock*
10. *Seabrook L.*
11. *Lackner L.*
12. *Borden L.*
13. *Nemegosenda L.*
14. *Shenango Tp.*
15. *Cargill Tp.*
16. *Teetzel Tp.*
17. *Clay-Howells*
18. *Hecla-Kilmer*
19. *Valentine Tp.*
20. *Goldray*
21. *Argor*
22. *Lawashi R.*
23. *Poplar R.*
24. *Albany Forks*
25. *L. Drowning R.*
26. *Kingfisher R. West*
27. *Kingfisher R. East*
28. *Martison L.*
29. *Nagagami R.*
30. *Chipman L. (dikes)*
31. *Killala L.*
32. **Prairie L.**
33. *Port Coldwell*
34. *Herman L.*
35. *Firesand R.*
36. *Slate Is.*
37. *Poohbah L.*
38. *Sturgeon Narrows & Squaw L.*
39. *Schryburt L.*
40. *Big Beaver House*
41. *Wapikopa L.*
42. *"Carb" L.*
43. *Gooseberry Br.*
44. *Niskibi L.*
45. *Nemag L. & Lusk L.*

The intrusion is located on the west side of Prairie Lake at 49°02'N Latitude and 86°43'W Longitude. The complex is circular with a surface area of approximately 8.8 km^2.

Dead–falls, thick underbrush, and local magnetic anomalies make accurate traversing of the complex difficult.

Field Methods

The base map at a scale of 1:2400 (1 inch to 200 feet) was supplied by the Newmont Mining Corporation of Canada Limited. The base lines formerly cut by the company were recut and chained by members of the field party. The baselines are needed for mapping control because highly erratic magnetic anomalies affect the compass and inhibit control by pace and compass methods. The crosslines for Newmont's grid were generally overgrown and not usable. Lines were run between baselines at 120 m spacing. Subsequent to mapping by the author, Nuinsco Resources cut another grid over the complex. This grid is not shown on the accompanying map (Figure 3).

All outcrops were noted, all slumped outcrop recorded, and wherever regolithic soil could be identified, it was described. The map is thus an interpretation of three types of exposures: outcrop, slumped outcrop, and soils derived from weathered outcrop. The reliability of the different types of exposures as indicators of the underlying bedrock decreases in the order listed.

Regolith soils were obtained and examined by shoving hollow stainless steel tubes into the ground, by examination of rodent holes and by material turned up by roots of fallen trees.

The present survey involved a total of 20 man–days work.

Previous Geological Work

The complex had not been previously examined by a government geological survey party. The first work on the complex was in 1968 by J. Gareau, while employed as a prospector by the Newmont Mining Corporation of Canada Limited. Gareau located radioactive showings and the company subsequently completed geophysical and geological surveys. In addition, the company dug 1375 feet (419 m) of trenches, and completed 1742 feet (531 m) of diamond drilling with a Winkie drill.

Satterly (1968) published the first geological interpretation of the complex. He suggested that the aeromagnetic anomaly at Prairie Lake might be caused by a carbonatite body.

Watkinson (1976) is currently completing a study of the complex, and has published an abstract on U–Nb mineralization within the complex (Watkinson 1971).

In 1977 Nuinsco Resources Limited completed 5154 feet (1570 m) of diamond drilling. In 1978 the company completed additional ground geophysical surveys and in 1983 an additional 5618 feet (1712 m) of diamond drilling was completed.

Melnik (1984) completed a B.Sc. thesis on the complex.

Physiography

The complex is topographically expressed by a circular hill (on the west side of Prairie Lake) surrounded by low lying marshy ground. Two small shallow lakes and local areas of marshy ground overlie the complex. Outcrops of the intrusion are small and widely scattered. Extensive areas of the complex are covered by glacial drift or regolith soils derived from weathering of the rocks of the complex. Those areas covered by drift tend to be more open and have less brush cover than those areas underlain by regolith soils.

At the campsite near the north end of Prairie Lake, a flat sandy plain standing approximately 6 m above the present level of Prairie Lake probably represents a former lake level.

Nomenclature

The nomenclature in the present report conforms with the nomenclature used in describing other alkalic rock – carbonatite complexes in northern Ontario. For the alkalic rocks, the author prefers to use mineralogic, colour, or textural modifiers, which are familiar to all readers, rather than unfamiliar rock names. Alkalic rock nomenclature is cumbersome, due in large part to the profusion of unfamiliar rock names. Consequently, as an aid to the reader, the use of less familiar rock names will be limited. The rock terms retained by the author and the way they are used are given below.

Ijolite. A nepheline–pyroxene rock with a nepheline content between 30 and 70 percent. Rocks containing more than 70 percent nepheline are classified as urtite and those with less than 30 percent as melteigite. Some specimens may contain significant amounts of biotite in place of pyroxene. Potassium feldspar content is 10 percent or less and those rocks with 10 percent or less nepheline are classified as pyroxenite.

Malignite. A melanocratic nepheline syenite. In general, nepheline, pyroxene and potassium feldspar occur in roughly equal proportions. The potassium feldspar content must exceed 10 percent or the rock is classified as belonging to the ijolite suite. Both the nepheline and pyroxene content must exceed 10 percent or the rock would be classified with the syenites. This rock group is transitional between the ijolites and overlaps the syenitic rock groups.

Sovite. A carbonatite rock composed of 50 percent or more calcite. Various mineralogic modifiers are used to classify the sovite, for example, apatite–magnetite sovite, olivine–amphibole sovite, etc.

Silicocarbonatite. A carbonatite rock containing 50 percent or more oxide and silicate minerals. Where the silicate or oxide mineralogy exceeds 90 percent various other rock names are applied; i.e. ijolite, biotite, pyroxenite, etc.

There is no standard subdivision of the ijolite suite into ijolite, urtite, and melteigite. Bailey (1974) classified urtites as having more than 70 percent nepheline, however he uses the term ijolite to apply only to those rocks containing between 50 and 70 percent nepheline. The author finds this range to be too restricted for field use and prefers the 30 to 70 percent range given by Williams *et al.* (1954, p.70).

Malignite from the Poohbah Lake Complex in northwestern Ontario was originally defined by Lawson (1896) as an alkali–rich rock containing pyroxene and potassium feldspar, with or without nepheline, garnet and amphibole. The author has examined the malignite of this complex in the field and in a large number of thin sections. The malignites are melanocratic and contain pyroxene, nepheline, orthoclase, garnet, and amphibole. The nepheline content of the type location is relatively low compared with the definition given above. For field work and to better emphasize the gradational nature of malignite into ijolites and syenites without the use of cumbersome terminology, a broader usage of the term has been applied by the author. Williams *et al.* (1954, p.65–66)described a number of malignites of varying mineralogy.

The Poohbah Lake type location for malignite was re–investigated by Mitchell and Platt (1978) and malignite was redefined by them as a nepheline syenite containing oikocrystic potassium feldspar. The author considers the definition of Mitchell and Platt too restrictive. In this report, the term malignite is used, as defined by Sorensen (1974, p.27), for a melanocratic nepheline syenite.

The definitions of sovite and silicocarbonatite are modified from Heinrich (1966, p.12). The author has found Heinrich's subdivision of the carbonatitic rocks generally suitable for field usage when modified to a two–fold subdivision at about 50 percent oxide and silicate mineral contents. The two–fold subdivision is more convenient than the four–fold subdivision of Heinrich (1966) because carbonatites show extreme variations in mineral content over distances of less than a few centimetres. It is difficult to rigorously classify such heterogeneous rocks.

Only one outcrop of syenite was encountered within the Prairie Lake complex and this rock is likely the product of relatively complete fenitization. The term "syenite" is used in this report to apply to a rock with no recognizable quartz, composed predominantly of alkali feldspar. The term syenite was applied to the one outcrop of syenitic rock found in the complex.

General Geology

The Prairie Lake Carbonatite Complex (Figures 2, 3) lies within the Wawa Subprovince of the Superior Province (Ayres et al. 1971) and has been dated at 1033 ± 59 Ma by the Rb–Sr isochron method (Bell and Blenkinsop 1980).

The Prairie Lake complex forms a circular topographic high west of Prairie Lake. The complex consists of a complexly interfingered sequence of arcuate to curvilinear bands of carbonatite and of pyroxene–nepheline rocks of the melteigite–urtite series collectively referred to as ijolite. The ijolitic rocks are, by far, the dominant rock in the core of Prairie Lake complex. The carbonatite rocks are more abundant towards the periphery of the intrusion.

The carbonatite rocks are predominantly composed of calcite but minor amounts of dolomite are locally present. The age relationships between the calcitic and dolomitic phases are uncertain. The calcite carbonatite rocks are medium grained and contain minor quantities of fine–grained accessory magnetite, pyrite–pyrrhotite, amphibole and biotite–phlogopite. Locally the calcite is coarse grained and visually appears to be nearly pure, probably having formed during a later pegmatitic phase of development.

In some areas of the complex, a rusty weathering, ferruginous carbonatite locally appears to be younger than the non–ferruginous carbonatite. The ferruginous carbonatite is generally medium to coarse–grained and, in the field, is characterized by the presence of a limonitic coating on the weathered surface. This ferruginous carbonatite may be ankeritic to ferruginous dolomite in composition.

Trace amounts of dolomite are not uncommon within the sovites and ijolitic rocks. At "Jim's Showing" dolomite is the dominant carbonate phase in the mineralized zone and contains xenolithic fragments of other rocks found within the complex.

The ijolitic rocks make up most of the Prairie Lake complex and visually can be roughly divided into three phases. Contact relationships between the various phases were not observed in the field.

Along the margins of the complex, one phase consists of fine–grained ijolite to silicocarbonatite composed predominantly of biotite–phlogopite, calcite, magnetite and minor nepheline (map–unit 2c). This phase is intimately associated with the carbonatite rocks. The carbonatite and ijolitic phases display both gradational and crosscutting relationships. Where crosscutting relations exist, the carbonatite phase is always the younger.

In the north–central area of the intrusion, a second phase of ijolitic rock consists of a number of small exposures of medium– to coarse–grained ijolite containing abundant interstitial wollastonite (map–unit 2a). Wollastonite is also abundant in nepheline–rich, coarse–grained pegmatitic segregations found within finer–grained phases. The pegmatitic segregations may contain up to 50 percent wollastonite and are composed almost exclusively of nepheline plus wollastonite. Black garnet, biotite, and calcite are common accessory minerals in this ijolitic group.

In the south to southeast corner of the complex and enclosing the wollastonite ijolite are exposures of generally medium– to coarse–grained ijolite with minor or no wollastonite. These rocks compose a third ijolitic phase (map–unit

2b). Pegmatitic phases are common and there are local coarse-grained pegmatites of nearly pure nepheline (urtite). Black garnet, biotite, and calcite are common accessory minerals.

The relationship between the wollastonite-poor and wollastonite-rich ijolitic rocks is unknown due to lack of critical outcrop exposure, but they may be gradational into each other.

Table 1 lists the lithologic units of the Prairie Lake Carbonatite Complex.

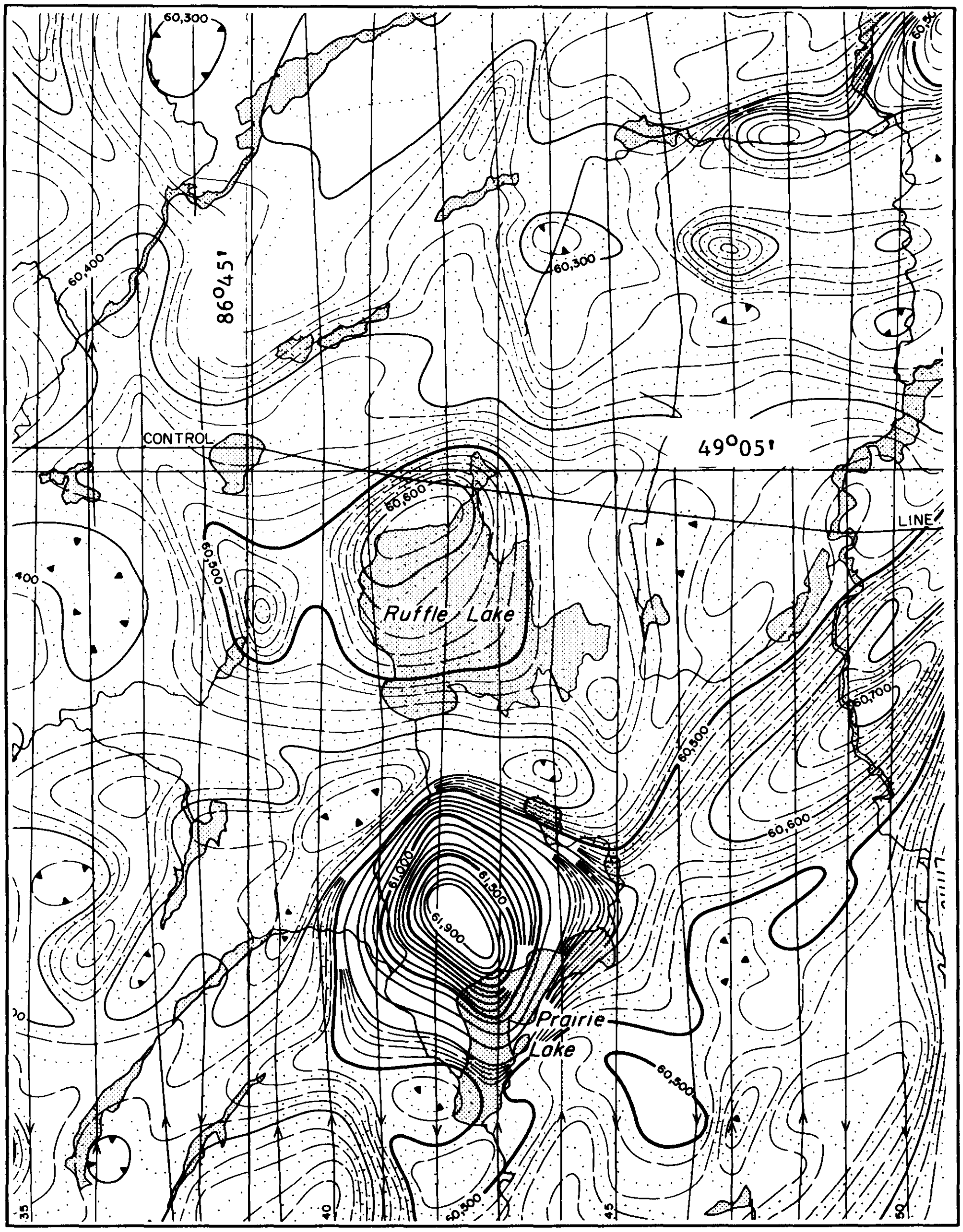


Figure 2. *Aeromagnetic map of the Prairie Lake Carbonatite Complex (from Aeromagnetic Map 2148G, ODM-GSC 1963).*

TABLE 1. TABLE OF LITHOLOGIC UNITS FOR THE PRAIRIE LAKE CARBONATITE COMPLEX.

CENOZOIC

Recent and Pleistocene

Swamp and stream deposits; glacial drift, boulders, gravel, sand and till.

Unconformity

LATE PRECAMBRIAN (PROTEROZOIC)

Prairie Lake Complex

Dike Rocks

Biotite-porphyritic silicocarbonatite dikes, pyroxene- and feldspar-porphyritic diabase dikes, breccia dikes, ijolite dikes, gabbro dikes, diatreme breccia.

Intrusive and Gradational Contacts

Carbonatite Rocks

Ferruginous carbonatite, sovite, rauhaugite (dolomitic carbonatite), sovite breccia.

Intrusive Contact

Syenitic Rocks

Aegirine "syenite" (highly fenitized wall rock).

Intrusive Contact

Ijolitic Rocks

Wollastonite ijolite (melteigite to urtite), silicocarbonatite to calcitic ijolite, mafic breccia, biotite rock, nepheline-porphyritic ijolite.

Intrusive Contact

Fenites and Altered Wall Rocks

Fenitized granitic country rocks, carbonatized country rock, breccia, biotite-quartz-feldspar gneiss with local carbonate alteration.

Gradational Contact

EARLY PRECAMBRIAN (ARCHEAN)

Gneiss

Biotite-quartz-feldspar paragneiss.

EARLY PRECAMBRIAN (ARCHEAN)

GNEISS

Exposures of rocks enclosing the Prairie Lake Carbonatite Complex are scarce. One gneissic outcrop is present outside the map-area on the east side of Prairie Lake and one outcrop of weakly fenetized gneissic rock was observed close to the contact at the southeast corner of the complex. Along the northern margin of the complex, several exposures of highly carbonatized rock are thought by the author to be altered equivalents of the enclosing wall rocks.

The unfenitized gneissic exposure on the east to southeast side of Prairie Lake is interpreted to be paragneiss with bulk composition approaching arkose. It has a well developed foliation largely defined by variations in biotite content from 0 to 30 percent. The foliation is represented by gneissic banding up to 5 cm in width with local biotite concentrations imparting a schistosity to the more biotite-rich bands. The rock weathers pink to red, has a saccharoidal appearance, and is fine to medium grained and equigranular. Banding strikes N45E and dips 47° south. This well banded paragneiss is cut by irregularly-shaped quartz microcline granitic pegmatites.

In thin section the paragneiss is fine grained, equigranular, massive, granoblastic, with straight to curved grain boundaries. The sample is estimated to contain 5 percent biotite, 35 percent microcline, 35 percent plagioclase (andesine), 30 percent quartz, and trace amounts of sericite and epidote. No evidence of fenitization was present.

LATE PRECAMBRIAN (PROTEROZOIC)

FENITES AND ALTERED WALL ROCKS

A small exposure of weakly fenitized, arkosic paragneiss or granodiorite gneiss (map-unit 1d) occurs at the southeast corner of the intrusion. A thin section of this rock contains an estimated 5 to 8 percent biotite, 35 to 40 percent quartz, 15 to 20 percent microcline, and 40 percent plagioclase of oligoclase-andesine composition. Trace amounts of sericite are present and small crystals of aegirine occur along some cracks. The rock is fine grained, massive, equigranular, weakly granoblastic, with straight to curved grain boundaries. The lack of intense development of pyroxene, amphibole and mica minerals characteristic of fenitic halos that commonly enclose carbonatite intrusions indicates that the Prairie Lake intrusion may not have an extensively developed fenitic halo. A relatively narrow fenitic halo is also considered to be characteristic of a relatively deep level of exposure (Vartiainen and Woolley 1976, p.80).

Along the northern periphery of the complex are several outcrops of altered wall rock (map-unit 1b). These exposures are fine grained, weather rusty brown, and are grey to greenish grey on fresh surface. The samples react variably to the application of hydrochloric acid, undoubtedly due to variations in calcium carbonate content or type of carbonate present. Fine-grained, disseminated pyrrhotite occurs locally in amounts up to 1 percent. Some very fine-grained feldspar may also be present. The rusty limonitic weathered crust is up to 0.5 cm thick. On fresh surface several samples contain very fine-grained chlorite. The rock appears to consist mostly of very fine-grained ferruginous dolomite and subordinate calcite. The presence of chlorite and the fact that these outcrops weather rounded (not characteristic of other exposures on the complex) indicates that these rocks may be highly altered mafic metavolcanics. Thin sections were not prepared from this unit.

Just south of "Parsons Zone" is a slumped outcrop of fenitized granitic country rock (map-unit 1a). This rock weathers mottled black to grey and has fractures or joints filled with dark green amphiboles and/or pyroxenes. It consists predominantly of light-coloured feldspathic material separated by dark green fracture fillings which give it the appearance of a breccia. The feldspars are mottled pale pink and green. The amphibole and pyroxene are concentrated between angular areas of light-coloured feldspathic material.

Watkinson (1976) reported the presence of both dark green pyroxene and dark blue-black amphibole along healed fractures in this rock. The amphibole and pyroxene replace quartz (Watkinson 1976).

In one thin section of a sample collected by the author from the location near "Parsons Zone", the mafic mineral is aegirine-augite which comprises an estimated 40 percent of the sample. The rock contains 5 percent carbonate and the remainder is plagioclase of oligoclase composition. No quartz was observed. The pyroxene consists of granular aggregates in an irregular, crisscrossing pattern suggesting that they fill fractures. The plagioclase grains have strongly developed lobate grain boundaries, locally lack albite twinning, and are often turbid and saussuritized. The carbonate occurs as capillary veinlets in the rock and as patchy replacement of the plagioclase. The rock likely was formed by extreme fenitization of granitic wall rock enclosing the complex. Alteration by metasomatism has been too extensive to speculate on the original composition of this outcrop.

IJOLITIC ROCKS

Two major groups of ijolitic rocks are present: (1) a fine–grained biotite–phlogopite–magnetite–rich peripheral phase, transitional between ijolite and silicocarbonatite, which is intimately associated with the carbonate rocks, and (2) a medium– to coarse–grained phase within the core of the complex. This second group can be subdivided further into wollastonite–poor (< 10%) and wollastonite–rich (> 10%) varieties. The ijolitic rocks appear older than, and are cut by, the carbonatite rocks.

Within the core, it is difficult to subdivide the ijolite series into melteigite, ijolite, and urtite because the members grade imperceptibly into each other. Within any given outcrop, rocks varying from melteigite to urtite in composition may be present. Therefore in those areas of restricted exposure, any one sample may not be representative of the unexposed surrounding rocks. As a general rule, the melteigites are fine to medium grained, and the urtites are coarse grained and pegmatitic. Several samples collected from the core of the complex display banding on the order of 4–6 cm. The bands vary from melteigite to urtite in composition. Both cumulate and segregation phases are likely present. The melteigites are thought to likely be cumulate phases relatively rich in pyroxene and garnet. The urtites are coarse–grained irregular pods, bands, and clots that display diffuse contacts with the ijolite host, which suggests the urtite formed as late–stage pegmatitic segregations within the ijolitic magma. Sampling of ijolitic rocks for petrographic and chemical analysis was restricted to medium–grained, equigranular, massive phases (see Table A–1 in Appendix A).

Silicocarbonatite to Calcitic Ijolite

Along the periphery of the complex a very fine– to fine–grained silicocarbonatite to ijolite rock (map–unit 2c) occurs in intimate relation with carbonate–rich phases of the intrusion. This ijolitic rock is rich in carbonate, and in thin section often has the composition of either silicocarbonatite or carbonatitic ijolite. In thin section, some samples are clearly recognized as ijolite, however others are of more questionable classification and could be cumulate phases of the carbonate–rich phases or lamprophyric dike rocks. The olivine–bearing samples are most likely dike rocks, since olivine is not a common mineral phase in those ijolite and carbonate–rich samples that are clearly part of the carbonatite complex.

On weathered surface the rock is brown, dark brown and brownish–black. Weathering of the rock produces a dark brown, biotite–phlogopite–magnetite–rich soil. At least some of the weathered mica is vermiculite since it will exfoliate when touched with a flame. This unit occurs in lit–par–lit fashion with carbonatite rocks. Several specimens were collected in which small ramifying veinlets of carbonate impart a brecciated appearance to the rock. Several specimens collected from Newmont Mining Corporation of Canada Limited's trenches and from the northeast corner of the complex contain subparallel capillary stringers of carbonate on the weathered surface. These stringers are 0.5 mm wide or thinner, 2–4 cm long and are parallel to each other, imparting a striped or zebra-like pattern to the rock. The significance of this feature is unclear. It may represent a separation of carbonate liquid from the ijolitic rock due to emplacement under stress and/or it may represent liquid immiscibility.

In thin section, rocks of this group contain widely varying amounts of aegirine–augite, olivine, phlogopite, biotite, apatite, nepheline, carbonate, magnetite and perovskite. Pyrochlore was noted in one thin section. Thin sections prepared from samples collected relatively close together display extreme variation in modal percentages and no representative modal composition can be determined. Texturally, rocks of this group are fine grained, massive, allotriomorphic to hypidiomorphic. The aegirine–augite tends to occur in bead–like grains or aggregates with no clear crystal outline. Microprobe analysis by Watkinson (1976) indicates that the clinopyroxenes are rich in iron, magnesium, and calcium components (Table 2). Sodium is the next most abundant element. The bead–like olivine grains are generally fresh and unaltered. Phlogopite and biotite were separated in thin section on the basis of their birefringence. Both occur in euhedral to anhedral booklets. The biotite may locally contain poikilitic inclusions of one or more of apatite, phlogopite, and magnetite. Apatite is by far the most common mineral to occur as inclusions. The apatite generally occurs as clear, colourless, euhedral to subhedral rounded grains. Probe analysis of biotite by Watkinson (1976) indicates that titanium, magnesium and iron are the major cation components (Table 2).

Melnik (1984) reported the presence of up to 60 percent anhedral, pale green, weakly zoned diopside in this unit. She described the pyroxene as containing abundant inclusions of biotite, opaques, calcite, and some pyrochlore.

Nepheline occurs in stubby, euhedral to subrounded crystals and interstitial anhedral grains and varies from fresh to completely altered. The alteration products are too fine–grained for optical determination. In two sections, apatite occurs poikilitically in the nepheline.

Disseminations and aggregates of anhedral to euhedral grains of magnetite are present. The magnetite is a common alteration mineral of biotite and common as inclusions in major mineral phases.

Carbonate occurs as an interstitial mosaic of anhedral grains. Perovskite is an uncommon minor accessory and generally occurs in euhedral crystals. The one observed occurrence of pyrochlore consists of reddish brown euhedral grains.

Melnik (1984) reported microprobe determinations of mineral chemistry of pyroxene and biotite from a silicocarbonatite. The analyses are reproduced in Table 3.

Wollastonite Ijolite and Wollastonite–Bearing Ijolite

Within the core of the intrusion, massive ijolitic rocks are present which vary from fine to coarse grained (map–units 2a, 2b). These rocks vary in colour from black to green–black to pink–black to pink. The pink colours reflect those rocks high in nepheline content while the darker coloured varieties are more pyroxene–rich. This rock group weathers to a light brown to brown crumbly grus. The presence of vermiculite was confirmed in several samples of the weathered rock by applying a flame to mica grains and observing exfoliation of the sample. The rocks were subdivided in the field on the basis of wollastonite content (more than

TABLE 2. ELECTRON MICROPROBE ANALYSES OF MINERALS IN IJOLITE PHASE OF PRAIRIE LAKE CARBONATITE (Watkinson 1976).

	Clinopyroxene. All Fe calculated as FeO.				
Sample	222	196	232	006	053
SiO_2	54.70	52.35	53.28	50.95	51.98
Al_2O_3	0.13	0.04	0.39	1.53	0.44
TiO_2	0.08	0.14	0.16	0.47	0.51
FeO	3.36	3.91	6.69	10.22	10.30
MnO	0.33	0.47	0.58	0.86	0.96
MgO	16.64	16.53	14.78	12.15	11.53
CaO	24.36	24.97	23.61	24.17	23.46
Na_2O	0.60	0.15	0.58	0.36	1.72
K_2O	0.02	0.02	0.02	0.03	0.01
Total	100.23	98.58	100.09	100.74	100.91

	Clinopyroxene. All Fe calculated as FeO.				
Sample	092	169	032	012	399
SiO_2	50.04	51.71	52.24	49.88	51.65
Al_2O_3	2.32	1.35	2.08	0.98	0.67
TiO_2	0.94	0.33	0.12	0.48	0.15
FeO	11.45	11.29	14.61	15.17	21.22
MnO	0.61	0.99	0.64	0.94	-
MgO	11.23	10.31	9.39	8.51	6.25
CaO	23.49	22.50	18.34	21.84	17.84
Na_2O	0.57	0.78	4.37	1.57	2.82
K_2O	0.04	0.00	0.01	0.00	-
Total	100.68	99.26	101.80	99.38	100.50

	Biotite. Sample PL012				
Sample	2A	3A	6A	9A	7A
SiO_2	36.64	37.47	33.81	33.87	36.21
Al_2O_3	11.12	11.35	11.01	11.39	10.59
TiO_2	4.21	4.24	4.36	4.49	4.30
FeO	28.14	27.75	27.65	27.74	26.07
MnO	0.90	0.90	0.87	0.86	0.84
MgO	8.44	8.40	8.96	8.32	7.84
CaO	0.05	0.00	0.07	0.13	0.31
ZnO_2	0.13	0.16	0.15	0.13	0.14
Na_2O	0.25	0.18	0.24	0.15	0.02
Total	89.98	90.65	87.22	87.08	86.32

	Garnet. Sample PL012. All Fe calculated as Fe_2O_3.				
Sample	8A	8B	8C	8D	8E
SiO_2	27.82	29.05	28.99	26.53	29.19
Al_2O_3	2.68	2.03	1.77	2.16	0.50
TiO_2	15.48	13.20	13.83	16.13	12.15
Fe_2O_3	18.69	17.96	17.54	17.50	19.55
MnO	0.68	0.60	0.64	0.59	0.69
MgO	1.05	0.97	0.76	1.06	0.62
CaO	29.58	32.07	31.31	31.48	31.78
ZnO_2	2.73	2.65	2.58	2.78	2.08
Na_2O	8.34	0.40	0.44	0.24	0.74
Total	99.05	98.93	97.92	98.47	97.30

Continued.

TABLE 2. CONTINUED.

	Garnet. Sample PL012. All Fe calculated as Fe_2O_3.				
Sample	10A	10B	10C	1A	2A
SiO_2	28.61	25.99	27.76	29.31	27.18
Al_2O_3	1.14	2.21	2.08	0.41	1.81
TiO_2	13.85	15.82	15.47	11.11	14.96
Fe_2O_3	18.41	17.55	16.80	20.07	17.33
MnO	0.68	0.65	0.67	1.05	0.67
MgO	0.96	1.13	0.98	0.46	0.83
CaO	30.75	30.26	30.32	31.69	31.64
ZnO_2	2.66	2.77	2.68	0.19	2.86
Na_2O	0.45	0.44	0.42	1.81	0.61
Total	97.50	96.82	97.27	96.10	97.85

	Garnet. Sample PL169. All Fe calculated as FeO.					
Sample	A	1B	1C	3A	3B	4A
SiO_2	28.83	29.22	29.92	30.11	30.62	32.06
Al_2O_3	1.57	1.05	1.01	0.93	1.23	0.96
TiO_2	8.61	10.75	9.54	8.99	8.05	7.94
FeO	20.88	21.21	21.12	21.72	20.79	21.78
MnO	0.77	0.81	0.82	0.79	0.76	0.78
MgO	0.86	0.66	0.64	0.55	0.70	0.56
CaO	31.13	31.06	30.73	31.57	31.91	31.78
ZnO_2	1.91	1.91	2.33	2.34	1.52	1.99
Na_2O	0.19	0.32	0.35	0.31	0.24	0.36
Total	94.75	96.99	96.45	95.33	95.84	98.16

	Garnet. Sample PL169. All Fe calculated as FeO.					
Sample	4B	6A	6B	8A	8B	8C
SiO_2	31.82	31.18	27.64	31.04	30.23	30.21
Al_2O_3	1.26	1.88	2.15	1.28	1.00	1.49
TiO_2	8.03	7.72	15.31	7.67	9.48	8.38
FeO	20.94	19.93	17.25	20.22	20.95	20.13
MnO	0.83	0.73	0.56	0.72	0.76	0.74
MgO	0.66	0.95	1.08	0.82	0.61	0.74
CaO	31.51	31.56	30.85	31.33	31.05	36.31
ZnO_2	1.78	2.65	2.73	2.11	1.85	1.85
Na_2O	0.19	0.09	0.37	0.28	0.38	0.30
Total	97.01	96.69	97.93	94.99	96.30	95.25

	Garnet. Sample PL012. All Fe calculated as Fe_2O_3.			
Sample	2A	3A	8B	6A
	1	2	3	4
SiO_2	31.86	31.27	30.34	30.33
Al_2O_3	1.63	1.07	0.69	0.68
TiO_2	6.42	9.25	11.10	10.71
Fe_2O_3	21.03	22.09	22.58	22.48
MnO	0.67	6.79	0.72	0.77
MgO	0.76	0.47	0.57	0.58
CaO	30.60	30.62	31.24	30.94
ZrO_2	4.66	1.51	1.63	1.98
Na_2O	0.13	0.16	0.18	0.26
Total	97.77	97.25	99.04	98.72

Continued.

TABLE 2. CONTINUED.

Sample	Garnet. Sample PL012. All Fe calculated as Fe_2O_3.			
	10B	10C	10D	8A
	5	6	7	8
SiO_2	31.74	32.06	31.89	32.21
Al_2O_3	1.58	1.61	1.52	1.56
TiO_2	6.10	5.98	6.74	6.73
Fe_2O_3	22.73	22.35	21.96	21.09
MnO	0.72	0.74	0.66	0.80
MgO	0.62	0.64	0.60	0.52
CaO	32.01	32.00	31.39	31.63
ZrO_2	1.65	1.97	4.63	1.86
Na_2O	0.22	0.00	0.24	0.36
Total	97.37	97.34	99.64	96.67

Note: Several analyses have been repeated.

TABLE 3. MICROPROBE MINERAL CHEMISTRY OF SILICOCARBONATITE IN WEIGHT PERCENT, SAMPLE T-559K. (From Melnik, 1984).

	1	2	3
SiO_2	53.00	38.93	36.65
TiO_2	0.25	1.99	2.83
Al_2O_3	0.00	10.05	12.37
Cr_2O_3	0.09	0.12	0.00
FeO	8.52	17.13	18.13
MnO	0.73	0.61	0.81
MgO	12.41	16.39	14.08
CaO	22.95	0.21	0.25
Na_2O	1.26	0.32	0.20
K_2O	0.08	9.59	9.04
Total	99.27	95.35	94.37

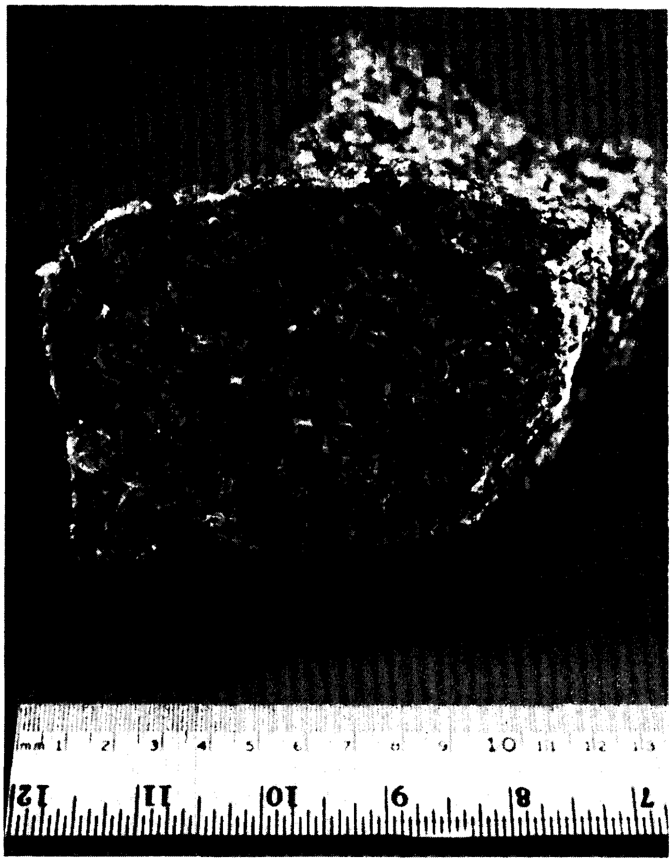
1. Pyroxene
2. Biotite
3. Rim of zoned biotite

or less than 10 percent). On the basis of both field and petrographic examination, these two rock types appear gradational into each other. The wollastonite–rich rocks are concentrated principally in the north–central area of the complex, west of "Centre" Lake.

In hand sample, rocks of this group consist of pink to red nepheline, black to dark green pyroxene, black garnet, and white calcite (Photo 1). Fluorite and sphene in trace amounts occur in pegmatitic phases of map–unit 2b in the southeast corner of the intrusion. Their identity was confirmed by X–ray diffraction studies (Geoscience Laboratories, Ontario Geological Survey, Toronto). An amorphous light–green mineral, in one coarse–grained pegmatitic sample, showed a crude conchoidal fracture and gave a calcite pattern upon X–ray diffraction study.

The wollastonite is white to colourless and forms interstitial, white, prismatic grains. A wollastonite–nepheline pegmatite located in the north–central part of the complex contains wollastonite crystals exceeding 15 cm in length in pink to red nepheline. This pegmatite is estimated to contain 30 percent wollastonite and

Photo 1. *Medium- to coarse-grained ijolite. Subhedral to euhedral nepheline crystals enclosed within a matrix of melanite garnet and aegirine-augite. Map-unit 2b. Location P-5. Sample number 43.*



70 percent nepheline with minor amounts of black garnet and white calcite. Within a coarse-grained segregation associated with the wollastonite pegmatite are weathered-out, blue-grey euhedral crystals up to 5 mm in size. These have been identified as albite by X-ray diffraction (Geoscience Laboratories, Ontario Geological Survey, Toronto). Coarse-grained, pegmatitic ijolite exposed in trenches on the "North Highgrade Showing" (see Figure 3, back pocket) contains wollastonite crystals up to 3 cm in length in association with black garnet, white calcite, aegirine-augite, and olivine.

In thin section, map-units 2a and 2b are medium grained, equigranular, massive, allotriomorphic to hypidiomorphic. The aegirine-augite occurs as green to dark green composite grains that form a mesh surrounding and enclosing the nepheline grains (see Photo 1).

The individual pyroxene grains are subangular to subrounded in outline. Some grains of pyroxene poikilitically enclose euhedral apatite and irregular nepheline grains. The pyroxene grains locally display pale green colour zoning. The clinopyroxene is interlocking with garnet and may display alteration to biotite. Melnik (1984) classified the pyroxene as salite.

Nepheline generally forms an interlocking mosaic of nepheline and nepheline plus pyroxene grains. The nepheline grains commonly have no clear crystal outlines, and rarely show a crystal face. The nepheline may be fresh and unaltered or extensively altered to an optically unresolvable birefringent mass. The

TABLE 4. ELECTRON MICROPROBE AVERAGE ANALYSES OF PSEUDOLEUCITE AND CONSITUENT NEPHELINE AND FELDSPAR, PRAIRIE LAKE CARBONATITE COMPLEX (FROM WATKINSON 1973).

	1	2	3	4	5	6
SiO_2	56.24	41.86	41.51	41.01	60.70	65.52
Al_2O_3	23.14	34.17	34.33	35.27	21.26	18.70
Na_2O	5.03	15.99	16.45	14.76	0.32	0.64
K_2O	14.39	8.09	7.95	8.40	15.08	17.76
TOTAL	99.34	100.11	100.24	99.40	97.36	106.62

1. Pseudoleucite from Praire Lake urtite PL012
2. Nepheline from urtite PL212.
3. Nepheline from urtite PL171.
4. Nepheline from urtite PL399.
5. Feldspar in sample PL399.
6. Feldspar in sample PL171.

nepheline contains rare inclusions of apatite; there is a suggestion of concentric zoning in one crystal. Nepheline may also occur as interstitial intergrowths with potassium feldspar.

The black garnet in thin section is dark brown and some grains are so deeply coloured as to transmit light rather poorly with uncrossed nicols. The garnet occurs in a manner very similar to that of aegirine–augite. It occurs as an irregular aggregate of grains enclosing nepheline. Euhedral crystal outlines are usually absent except where the garnet projects into calcite. The garnet poikilitically encloses nepheline and one grain partially encloses aegirine–augite. The position of garnet in the sequence of crystallization appears to be similar to aegirine–augite with which it is intergrown. Microprobe analysis of garnets by Watkinson (1976) indicated that titanium, iron, and calcium are the most abundant cations and that in several garnets, the zirconium content approaches 5 percent (Table 2.)

Calcite is a common minor component which forms an interstitial, interlocking mosaic.

Biotite may be present as anhedral red–brown grains. The biotite commonly replaces pyroxene and Melnik (1984) reported that it replaces garnet.

Within the wollastonite–bearing varieties, the wollastonite occurs as clusters of prismatic crystals with irregular terminations. The wollastonite is interstitial to and encloses the dominant aegirine–augite – nepheline – garnet assemblage and in one place, appears to also contain some poikilitic inclusions of carbonate. The wollastonite is late in the sequence of crystallization. Melnik (1984) reported that pectolite may be associated with the wollastonite. Dark, fine–grained reaction rims were reported by Melnik between wollastonite and both nepheline and pyroxene.

Several thin sections contain a very fine–grained, symplectic intergrowth which has been interpreted by Watkinson (1973) as pseudoleucite (Table 4).

Thin section examination indicates that widely varying amounts of biotite, pyrochlore, albite, orthoclase, sphene, and irregular grains of magnetite are also present as minor accessories. Watkinson (1976) reported that the magnetite is titaniferous and that cancrinite is a common alteration product of nepheline.

TABLE 5. MICROPROBE MINERAL CHEMISTRY OF MICRO-IJOLITE IN WEIGHT PERCENT, SAMPLE T-559U (From Melnik1984).

	1	2	3	4
SiO_2	30.50	52.44	53.42	41.59
TiO_2	11.83	0.13	0.06	0.00
Al_2O_3	0.70	0.35	29.17	35.51
Cr_2O_3	0.16	0.26	0.00	0.00
FeO	20.56	11.19	0.37	0.77
MnO	0.87	1.07	0.00	0.00
MgO	0.76	10.77	0.00	0.00
CaO	31.26	23.92	0.27	0.26
Na_2O	0.37	0.46	5.57	15.52
K_2O	0.16	0.16	1.33	7.63
Total	97.17	100.75	90.19	101.28

1. Garnet
2. Pyroxene
3. Analcite inclusion in pyroxene
4. Nepheline inclusion in biotite

TABLE 6. MICROPROBE MINERAL CHEMISTRY OF WOLLASTONITE MALIGNITE IN WEIGHT PERCENT, SAMPLE T-559W (From Melnik 1984).

	1	2	3	4	5
SiO_2	30.49	50.61	42.14	36.59	39.37
TiO_2	11.83	0.69	0.10	3.71	0.00
Al_2O_3	0.95	1.06	34.06	11.92	33.74
Cr_2O_3	0.21	0.10	0.00	0.00	0.11
FeO	21.05	16.42	1.11	26.33	0.83
MnO	0.37	0.90	0.00	1.40	0.00
MgO	0.60	7.71	0.00	8.78	0.00
CaO	31.88	21.85	0.72	0.20	4.25
Na_2O	0.20	1.56	15.47	0.00	16.63
K_2O	0.00	0.00	6.51	9.80	3.80
Total	97.57	100.70	100.12	98.74	98.73

	6	7	8	9
SiO_2	33.95	55.33	66.02	29.44
TiO_2	1.17	0.00	0.00	13.72
Al_2O_3	0.07	0.09	19.44	1.06
Cr_2O_3	0.11	0.28	0.00	0.21
FeO	0.52	0.17	0.00	19.87
MnO	0.37	0.53	0.00	0.63
MgO	0.00	0.00	0.00	0.62
CaO	29.53	34.40	0.22	31.16
Na_2O	7.38	9.35	0.30	0.30
K_2O	0.25	0.13	16.65	0.10
Total	73.34	100.28	102.64	97.14

1. Garnet (melanite)
2. Pyroxene (diopside)
3. Nepheline
4. Biotite
5. Nepheline
6. Wohlerite(?)
7. Wollastonite or pectolite
8. Orthoclase in fingerprint texture
9. Garnet

Melnik (1984) reported microprobe determinations of mineral chemistry for fine–grained ijolite and wollastonite malignite. These are reproduced in Tables 5 and 6. The author has not observed the presence of sufficient potassium feldspar (> 10%) in the ijolitic suite to apply the term malignite.

Orbicular Ijolite

A most unusual and spectacular rock is located on L44E of the Newmont grid and approximately 94 m north of an unnamed creek in the southeast corner of the complex. D.H. Watkinson (Carleton University, Ottawa, personal communication, 1975) reported the presence of this unusual rock to the author and, to the author's knowledge, this is the first known occurrence in the world of this texture in rocks of this composition. The showing occurs in a shallow gulch and consists of some slumped fragments. Digging to bedrock disclosed an orbicular rock in which the orbicules appear to be concentrated in bands. Units of "normal", medium–grained ijolite alternate with zones of densely packed orbicules. One orbicule band measures 15 cm in width and is bounded on both sides by medium–grained, fresh looking ijolite. The orbicules are of uniform size, approximately 3 cm in diameter and slightly oval rather than strictly spherical in shape. In sawn sections (Photo 2) the largest orbicules contain cores of spotted, fine– to medium–grained ijolitic material, approximately 1 cm in diameter, which appears texturally similar to the enclosing ijolite groundmass. Those orbicules containing cores are the largest, and are relatively uniform in size. Orbicules that don't display cores on sawn sections are smaller and the author interprets this to indicate that the saw cut through the finely laminated rim of the orbicule rather than passing through the core of orbicule. The equigranular core may thus be present in all the orbicules.

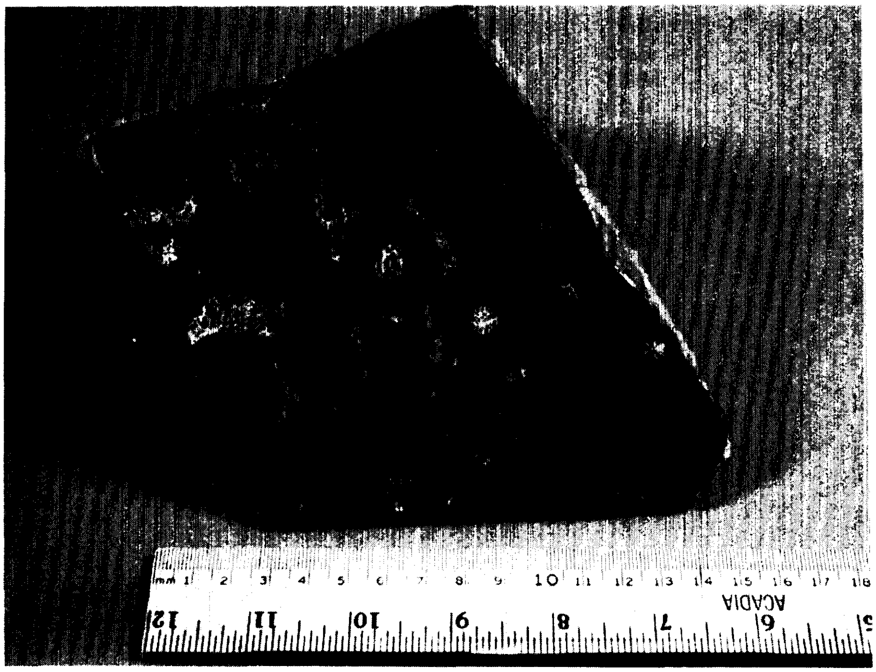


Photo 2. *Orbicular ijolite. Individual laminae consist dominantly of one of melanite garnet, nepheline, or aegirine–augite. Location P–1.*

On the sawn surfaces of some samples, the margins of one or two orbicules appear to indent the medium–grained ijolite along the margin of the band of orbicular rock.

Individual laminae forming the orbicular structure are 0.1 mm to 0.5 mm in thickness and 50 or more laminae may comprise an individual orbicular structure. In the samples collected by the author, orbicules make up about 50 percent of the rock and matrix makes up the other 50 percent. Where orbicules are present, they are densely packed. From visual examination the orbicules are of ijolite composition and the matrix is a nepheline–rich ijolite.

Watkinson (1976) reported that the orbicules are composed of concentrically arranged minerals: melanite garnet, nepheline, biotite, and apatite. A white, lath–like, altered mineral gives a chlorite X–ray diffraction pattern and upon microprobe analysis, a composition close to melilite (Watkinson 1976). The author found turbid altered pyroxene and minor magnetite in the orbicules in addition to the minerals found by Watkinson. Watkinson reported that the groundmass consists of garnet, pyroxene, biotite, calcite, magnetite, cancrinite after nepheline, and aggregates of a white mineral. The cores of the orbicules contain the same assemblage as the enclosing groundmass.

A detailed discussion of the origin of orbicular rocks is beyond the scope of the present study, however a brief statement on some ideas of their origin is warranted. Williams et al. (1954, p.132) attributed orbicule formation to rhythmic crystallization around xenolithic fragments, whereas Moore and Lockwood (1973) have ascribed orbicular structures in the Sierra Nevada Batholith, California, to comb layering around disrupted (xenoliths), previously formed, comb layers. Van Diver (1970) proposed that orbicules in "bullseye granite" at Craftsbury, Vermont, formed around nuclei of aggregated–flocculated biotite flakes. The Craftsbury orbicules consist of numerous spherical layers of biotite and thus differ from the alternating light and dark layers in the orbicules described by Moore and Lockwood (1973) and the orbicules observed by the author at Prairie Lake.

Levenson (1966) reviewed the orbicule problem and noted that the structures occur in magmatic, metamorphic, and migmatic terrains and are not restricted to any single composition. Levenson (1966) summarized the various proposals that have been made to explain orbicular structures, as follows:

1. Orbicules are the result of liquid immiscibility.
2. Orbicules are the result of fluctuations of a melt about a eutectic or eutectoid due to variations in pressure and temperature.
3. Orbicules are the result of reactions between magmas and xenoliths.
4. Orbicules are the result of xenoliths moving through parts of magma of different compositions;
5. Orbicules are the result of crystallization of concentric envelopes of contrasting composition in a highly viscous magma that retards viscous diffusion.
6. Orbicules are formed by excessive crystallization of one component around a nucleus, followed by excessive crystallization of a second component. Alternating excessive crystallization results in alternating supersaturation of the alternate mineralogy. Crystallization continues until the magma is depleted.
7. Orbicules are formed by rhythmic supersaturation and crystallization about centres in a magma in a manner analogous to Leisegang ring formation in a gel.

Since the Prairie Lake ijolites are unmetamorphosed igneous rocks, the mechanisms for developing such structures in metamorphic rock can be rejected.

The Prairie Lake orbicules display (1) massive, medium–grained cores similar in texture and composition to the enclosing ijolites; (2) numerous thin concentric shells as finely developed as any found in the most finely banded agate; (3) extensive alteration of their mineralogy which contrasts with the relatively fresh orbicule–free ijolite bounding the orbicule; (4) similar mineralogy in both the orbicular and non–orbicular ijolitic rocks. The orbicular structures occur as relatively narrow bands in medium– to coarse–grained ijolite. As a working hypothesis, the author would suggest that the Prairie Lake orbicular structures occur in areas of localized accumulation of late–stage, volatile–rich, magmatic fluids and are a result of diffusion processes around nuclei of consolidated ijolite.

Recently, Elliston (1984) has proposed that orbicules form in granitic rocks from a hydrosilicate magma under alternating static and dynamic conditions. While volatiles have likely played a role in forming the Prairie Lake orbicules, evidence for an alternating dynamic and static environment cannot be established from the existing data.

Melnik (1984) reported micoprobe determinations of mineral chemistry for the orbicules and observed no significant compositional differences between the orbicule mineralogy and the host ijolite. The analyses are reproduced in Table 7.

Mafic Breccia

Along the shore of "Anomaly" Lake (local name), is an exposure of mafic breccia (map–unit 2d). The rock weathers dark green and is greenish black on fresh surface; weathered surfaces have a distinctive brecciated appearance. Fragments within the breccia were visually identified as ijolite, pyroxenite, and syenite (fenite?). Carbonate is abundant in the matrix and some disseminated, fine–grained iron sulphide is present. Limonite coatings indicate that the carbonate is ferruginous.

Biotite Rock

Scattered outcrops of rock consisting largely of biotite occur in the southeast corner of the complex (map–unit 2e). Minor amounts of white, coarse–grained calcite are sometimes present. The rock weathers black to greenish black and is

TABLE 7. MICROPROBE MINERAL CHEMISTRY OF ORBICULAR IJOLITE IN WEIGHT PERCENT, SAMPLE T-559T (From Melnik 1984).

	1	2	3	4
SiO_2	28.98	0.12	36.40	41.98
TiO_2	12.51	6.27	2.05	0.08
Al_2O_3	2.47	2.12	15.83	34.77
Cr_2O_3	0.08	0.10	0.00	0.07
FeO	17.54	80.94	12.85	0.97
MnO	0.49	2.09	0.37	0.11
MgO	1.32	0.12	16.82	0.00
CaO	32.10	0.29	0.17	1.31
Na_2O	0.12	0.23	0.00	15.03
K_2O	0.14	0.05	9.52	7.12
Total	95.74	92.33	94.01	101.44

1. Garnet
2. Magnetite
3. Biotite
4. Nepheline

black on fresh surface. It is most commonly medium grained, equigranular, massive. Locally, the rock is coarse grained.

This lithologic unit is located near the margins of the complex and in the contact area between ijolitic rocks (map–units 2a,b,c) and sovite (map–unit 4b). Thin sections were not prepared from this unit.

Watkinson (1976) reported that these rocks may be the result of reaction between carbonatite and silicate rocks (ijolite) and that some have the appearance of biotitized breccias. The author did not observe a brecciated pattern on outcrops.

Porphyritic Ijolite

On the east side of the complex, several distinctive outcrops of ijolitic rock contain euhedral crystals of nepheline (map–unit 2f). The outcrops of this rock type are too few to define a mappable unit.

On weathered outcrop, buff to brown, euhedral nepheline crystals up to 1 cm in diameter, weather in relief, imparting a rough, knobby surface to the rock. On fresh surface the rock is grey to grey–black. Euhedral nepheline crystals form an estimated 30–40 percent of the rock.

In thin section the nepheline phenocrysts are unaltered. The groundmass is fine to medium grained and consists of aegirine–augite, magnetite, nepheline, calcite, and biotite. The texture is fine to medium grained, inequigranular, porphyritic, hypidiomorphic. The groundmass is not distinctly different from other ijolitic rocks of map–unit 2c found within the complex.

Ijolite Breccia

Along the shore of "Centre" Lake (local name), within the centre of the complex, are several outcrops of ijolite intrusion breccia (map–unit 2g) (Photo 3). The clasts within the breccia are elongate elliptical fragments of fine–grained,

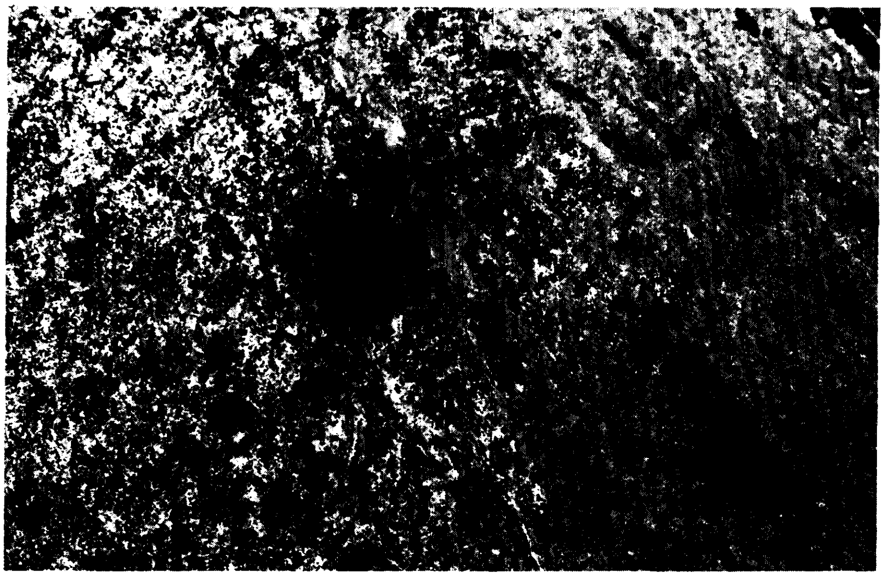


Photo 3. *Fine–grained ijolite intruding medium–grained ijolite, forming an intrusion breccia. Location P–2.*

biotite-rich ijolite, fine-grained ijolite, and medium-grained ijolite set in a matrix of grey ijolite. A reaction rim up to 5 mm wide was noted on some clasts, but generally, little evidence exists for reaction between the two ages of ijolite. The clasts are commonly on the order of 3 cm long but in places exceed 15 cm. Some outcrops weather rough and/or pitted due to selective weathering of the clasts relative to the matrix.

In thin section, except for grain size, the fine-grained, younger or intruding grey ijolite appears no different in mineralogy or texture than the medium-grained ijolite found within the major part of the intrusion. This observation suggests that there were at least two pulses of ijolite magma of similar composition.

In thin section the matrix ijolite is composed of aegirine-augite, nepheline, apatite and magnetite. Wollastonite is present in one section along with pseudoleucite (Watkinson 1973). Watkinson (1973) described the pseudoleucite as nepheline – potassium feldspar intergrowths that resulted from the breakdown of sodic leucite under subsolidus conditions. Several grains of sphene are also present in one section. The texture is fine grained, massive, equigranular, allotriomorphic.

SYENITIC ROCKS (FENITE?)

Syenitic rocks are scarce within this complex. One outcrop of syenitic rock was found on "Centre" Lake (local name) near the center of the intrusion. Its spatial relation to other lithologies is uncertain. On fresh surface the rock is bright red, contains radiating tufts of blue-green aegirine, and interstitial white calcite.

In thin section the rock contains 30 percent aegirine, 5 to 10 percent biotite, and 65 to 70 percent plagioclase (An30). The rock is fine to medium grained, inequigranular-seriate, allotriomorphic. This occurrence may represent an ultra-fenitized xenolithic block of former wall rock or cover rock that has subsided within the intruding ijolite carbonatite magma.

CARBONATITE ROCKS

The carbonatite rocks form one of the dominant lithologies within the complex and are intimately associated with ijolitic rocks (map-unit 2). The carbonatite rocks weather easily to form a soil consisting of carbonate rhombs and various silicate and oxide minerals.

Sovite

Sovite (calcite carbonatite, map-unit 4b) is the dominant carbonatite phase within the intrusion, and with increasing accessory mineral content, is gradational into silicocarbonatite and ijolite. This unit is commonly banded, and individual bands vary from 1 or 2 mm to many centimetres in width. Banding is generally on the order of 2 to 3 cm and is defined by variations in the relative proportions of silicate and oxide minerals and host carbonate. On weathered surface, sovite is grey, white, grey-white and on fresh surface grey to grey-white. Fractures in this unit commonly are coated with a white botryoidal caliche-like secondary carbonate.

In thin section, sovite consists dominantly of an interlocking mosaic of calcite grains. Apatite, amphibole, biotite-phlogopite, pyrrhotite, magnetite, perovskite, and olivine were all noted in amounts exceeding an estimated 1 percent in one or more thin sections and/or hand samples. The texture is fine to medium grained, inequigranular, seriate to hiatal, allotriomorphic to hypidiomorphic. The inequigranular texture results from the carbonate grains being, on the average, much larger than the associated oxide and silicate phases. Locally, very coarse–grained pegmatite phases of this unit are present. Such pegmatites are essentially pure carbonate with individual cleavage surfaces approaching 2 cm in diameter.

Carbonate in the sovite forms an interlocking mosaic of anhedral grains.

Mica occurs as anhedral to subhedral, reddish brown grains which may display a turbid alteration along margins of the grains. The biotite grains may display embayed margins with carbonate.

Opaque minerals form anhedral to subhedral grains. The grains occur as isolated grains or aggregates of several grains. Some of the fine–grained magnetite in association with biotite may be an alteration product of the biotite.

Apatite is very common in the sovite and occurs as anhedral to subhedral, rounded to rounded–elongate, bead–like grains.

Amphibole occurs as acicular, subhedral to euhedral grains. Crystals of amphibole locally occur in radial clusters.

Olivine is present as rounded bead–like grains of high relief. The olivine is relatively fresh.

Table 8 presents microprobe mineral compositions of sovite as reported by Melnik (1984).

One outcrop of sovite displaying a definite porphyritic texture was noted on the west side of the intrusion. At this location an outcrop of sovite contains calcite phenocrysts up to 8 mm long in a seriate distribution. These larger carbonate grains constitute 15–20 percent of the rock. In thin section, this rock consists of an estimated 85 percent calcite and minor amounts of apatite, nepheline, and magnetite. Watkinson (1976) reported orbicular structures in carbonate–rich phases within the diamond drill core obtained in the drilling program of Newmont Mining Corporation of Canada Limited in 1970. The author did not observe this feature in the field.

Ferruginous (Ankeritic?) Carbonatite

Along the west side of the complex are a number of weathered exposures of limonitic–stained carbonate (map–unit 4a). The accessory mineral content is low and the rock's most characteristic feature is the iron–stained weathering. The rock is medium grained and pinkish to very pale red on fresh surface. Good exposures of this unit are lacking and thus age relations between this unit and the sovite were not positively determined. From the spatial distribution of outcrops, this ferruginous carbonate unit is believed to intrude the sovite and thus be younger. Material suitable for thin sectioning is generally lacking. One thin–sectioned sample contains minor amounts of apatite, amphibole, phlogopite, biotite, pyroxene, chlorite, and magnetite. On the basis of textural criteria, the pyroxene crystals in the one thin section appeared broken and may be xenocrystic. Microprobe analysis by Watkinson (1976) indicated a significant magnesium content, and thus this ferruginous carbonate is likely ankerite.

Three carbonate samples mapped as sovite, and one as ferruginous (ankeritic?) carbonatite were selected at random for X–ray diffraction examination. X–ray diffraction scans of the carbonate returned dolomite peaks along with those of calcite (Geoscience Laboratories, Ontario Geological Survey). These carbonate compositions could not be distinguished in thin section. By scanning known mixtures of calcite and dolomite and examination of the corresponding

TABLE 8. MICROPROBE MINERAL CHEMISTRY OF BIOTITE SOVITE AND SOVITE IN WEIGHT PERCENT, SAMPLES T-562F AND T-562J (From Melnik 1984).

	1	2	3	4	5
SiO_2	38.04	0.00	0.00	47.65	0.21
TiO_2	2.12	0.07	0.06	0.32	6.98
Al_2O_3	12.43	0.00	0.16	0.84	0.07
Cr_2O_3	0.08	0.00	0.00	0.09	0.38
FeO	16.27	1.68	0.36	2.77	85.05
MnO	0.80	0.72	0.59	0.25	0.84
MgO	15.64	18.31	1.07	18.69	0.14
CaO	0.25	28.66	53.60	13.84	0.19
Na_2O	0.00	0.00	0.10	5.35	0.00
K_2O	8.95	0.11	0.15	1.72	0.00
Total	94.58	49.54	56.09	91.51	93.86

	6	7	8	9
SiO_2	41.18	0.00	35.00	53.11
TiO_2	0.20	0.00	0.00	0.31
Al_2O_3	7.41	0.00	0.23	0.50
Cr_2O_3	0.00	0.00	0.08	0.00
FeO	9.30	1.56	4.49	3.88
MnO	0.00	0.79	0.58	0.29
MgO	25.27	18.75	19.21	21.54
CaO	0.23	28.68	15.51	7.46
Na_2O	0.00	0.00	3.12	6.38
K_2O	10.34	0.19	1.47	1.71
Total	93.93	49.97	79.71	95.19

1. Biotite, sample T-562F
2. Dolomite within amphibole needle, sample T-562J
3. Calcite next to dolomite, sample T-562J
4. Acicular amphibole, sample T-562J
5. Magnetite grain, sample T-562J
6. Edge of large biotite grain, sample T-562J
7. Dolomite sheath around amphibole grain, sample T-562J
8. Pyroxene, sample T-562J
9. Acicular amphibole, sample T-562J

peaks on the unknown carbonatite samples, it was concluded that the amount of dolomite present in these three samples is very low. Four samples of sovite were leached with hydrochloric acid and the residue was hand-picked and examined by optical and X-ray diffraction techniques (Geoscience Laboratories, Ontario Geological Survey). This work disclosed the presence of magnetite, pyrrhotite, phlogopite, muscovite, amphibole and pyrochlore.

Rauhaugite (Beforsite?)

Rauhaugite (dolomitic carbonatite, map-unit 4c) is not a common carbonate phase within the complex. Dolomite commonly occurs as accessory anhedral grains in other carbonate units and within the ijolitic rocks. The dolomitic carbonatite is, however, of significant importance to the complex for it is the host for the uranium-niobium mineralization found at "Jim's Showing". Two samples of carbonatite were collected from trenches dug by Newmont Mining Corporation of Canada Limited and examined in thin section. These samples had a limonitic weathered rim up to 1 cm thick and are dark grey on fresh surface. The rocks are very fine grained and gave a strong reaction to hydrochloric acid resulting in their erroneous classification in the field as calcite. In thin section the rock is visually estimated to contain 35 to 70 percent dolomite. Limonite, chert, calcite, albite, sericite, biotite, nepheline, and augite comprise the remaining phases. The strong reaction to hydrochloric acid is due to the minor calcite content. X– ray diffraction (Geoscience Laboratories, Ontario Geological Survey) confirmed the identification of a fine–grained mosaic of interstitial chert and the identification of the carbonate phase as dolomite. The sericite + biotite + pyroxene mineralogy appears to be representative of an altered diabase clast. Since diabase dikes cut sovite, the presence of such a clast in the dolomite suggests that the dolomite is the younger of the two. The individual mineral grains are anhedral to subhedral and are possibly xenocrysts derived to a large extent from the enclosing wall rocks. The rock is a xenolithic and possibly xenocrystic, fine–grained, equigranular, massive, hypidiomorphic rauhaugite.

Mapping by members of this field party indicated that this mineralized dolomite lies between wollastonite–bearing ijolite (map–unit 2a) to the south and medium–grained, locally pegmatitic sovite (map–unit 4b) to the north. While definitive outcrop is lacking to establish age relations between the various lithologic units, a working hypothesis based on spatial considerations may be considered. This mineralized zone may represent a late dike–like intrusion emplaced along the ijolite–sovite contact. If this mineralized zone is in fact a dike, the rock would be classified as beforsite. The terms rauhaugite and beforsite refer to rocks of identical composition; beforsite applies to rocks that occur in a dike–like manner.

Sovite Breccia

Along the shore of "Anomaly" Lake (local name), are a number of outcrops of sovite breccia (map–unit 4d), consisting of elongated clots of ijolitic rock (map–unit 2c) in a matrix of sovite (map–unit 4b). The elongate shape and often strung–out nature of the ijolitic fragments suggests a boudinage structure. Whether these boudinaged (?) mafic bands are former dikes cutting the sovite or former lit–par–lit bands in an interlayered ijolite–sovite unit is uncertain, but, on the basis of abundance and relatively narrow width, the author considers the latter possibility the most likely. Mapping of trenches dug by Newmont Mining Corporation of Canada Limited and one exposure along the shore of "Centre" Lake discloses that a lit–par–lit banded nature is a characteristic feature of the sovite and associated ijolite units (4b and 2c) and that no chilled contact exists between the melanocratic ijolite and leucocratic carbonatite bands. Post–emplacement deformation could have segmented the more competent bands (map–unit 2c) and imparted a brecciated appearance to the outcrop.

In summation, based on somewhat inconclusive field and petrographic data, the carbonate–rich rocks display decreasing age with increasing magnesium and iron content. This sequence is in agreement with the sequence of emplacement suggested by Heinrich (1966, p.152). It is also consistent with the interpretation of experimental data (Wyllie 1965, p.118; Byrnes and Wyllie 1981).

DIKE ROCKS

A number of dike rocks cut the Prairie Lake Carbonatite Complex. These dikes have widely varying compositions and textures and often the classification of an occurrence as a dike is rather subjective since the most common exposures are resistant clots in a weathered carbonatite soil.

Diabase Dikes

One of the most interesting types of dikes are the diabase dikes of which there are two mappable types (map–units 5b and 5c). On the north side of "Anomaly"

Lake, a porphyritic diabase contains tiny, ovoid, white, 1–2 mm feldspar phenocrysts (map–unit 5c). The phenocrysts rarely approach 4 mm in diameter. The occurrence consists of angular slumped blocks at two closely spaced locations. Chilled margins on both sides of one clast indicate a dike width of 35 cm. The rock weathers tan to brown with white spots and on fresh surface is grey-black. The tiny feldspar phenocrysts compose less than an estimated 5 percent of the rock.

In thin section the phenocrysts are glomeroporphyritic clusters composed of plagioclase grains of the same size as the groundmass. The rock is estimated to contain 45 percent plagioclase of andesine composition, 10 percent magnetite, and 45 percent pyroxene. The plagioclase is fresh and sometimes weakly zoned (An35 at the rim to An47 at the core). The pyroxene is turbid and slightly platey in appearance. The texture is very fine grained, equigranular, glomeroporphyritic, massive, hypidiomorphic, diabasic.

At several locations within the complex, a second type of diabase (map–unit 5b) is present and was originally mapped as a pyroxene–bearing lamprophyre. In outcrop the rock is grey–green, dark green to black, and consists of euhedral pyroxene crystals set in an aphanitic groundmass. These dikes are 1 m or less in width and contain up to 35 percent pyroxene phenocrysts. The pyroxene crystals are up to 7 mm in maximum dimension and seriate in distribution. Some dikes have a pitted weathered surface suggesting selective weathering of some of the phenocrysts. One dike exposed in the northwest corner of the complex has a well–developed columnar jointing, and a dike in the most easterly trench of Newmont Mining Corporation of Canada Limited was observed to cut sovite (map-unit 4b). These dikes may weather in relief with respect to the enclosing carbonatite.

In thin section the dikes are estimated to contain 30 to 50 percent augite, 50 to 60 percent plagioclase of andesine to labradorite composition, 0 to 10 percent olivine, and 0 to 5 percent magnetite. Some carbonate replaces plagioclase and some plagioclase grains display a tendency to form clusters. The pyroxene is euhedral, zoned, somewhat turbid, and sometimes glomeroporphyritic. These dikes were classified as olivine diabase by Watkinson (1976) and have been studied by microprobe. Microprobe analysis indicates that the olivine is 79 percent fosterite. The plagioclase is labradorite, and the pyroxene is titanaugite (Table 9). The rock is a fine– to medium–grained, inequigranular–porphyritic, massive, hypidiomorphic diabase.

Breccia Dikes

At several locations narrow breccia dikes (map–unit 5d) sharply crosscut carbonate and ijolite units of the complex. These dikes are best exposed along the south shore of "Anomaly" Lake and the east shore of "Centre" Lake.

These breccia dikes do not, as a rule, exceed 20 cm in width. In outcrop, the dikes contain phlogopite crystals up to 1 cm in diameter, magnetite grains, and rounded clasts of ijolite, biotite, and carbonatite. In thin section, diabase clasts were also recognized. The fact that these dikes contain clasts representative of all rock types found within the pluton indicates that they represent one of the latest intrusive activities.

In thin section the matrix of the breccia dikes consists predominantly of carbonate with minor aegirine–augite, apatite, augite, plagioclase (labradorite), limonite, phlogopite, perovskite, garnet, and nepheline. The rocks are late–stage xenocrystic and xenolithic carbonatite dikes.

TABLE 9. CHEMICAL ANALYSES OF OLIVINE DIABASE AND CONSTITUENT MINERALS (FROM WATKINSON 1976).

	Rock	Olivine	Pyroxene	Plagioclase
SiO_2	41.50	38.05	47.37	53.63
Al_2O_3	12.32	0.69	7.02	28.29
TiO_2	2.07	0.03	1.63	
Fe_2O_3	5.08			
FeO	9.66	18.08	13.57	
MgO	8.68	40.88	11.08	
CaO	9.97	0.46	18.47	13.19
Na_2O	2.25	0.02	1.23	4.25
K_2O	2.07			0.43
P_2O_5	0.68			
MnO	0.19			
LOI	1.67			
TOTAL	96.14	98.21	100.37	99.79

LOI - Thermogravimetric analysis by G.Y. Chao
Rock - Atomic absorption and flame photometric analysis by C. Murray (specimen 398).
Olivine - Electron microprobe average analysis of nine grains. SiO_2 generated assuming stoichiometry. All Fe calculated as FeO.
Plagioclase - Electron microprobe average analysis of seventeen grains. SiO_2 generated assuming stoichiometry.
Pyroxene - Electron microprobe analysis of eight grains.

A portion of the carbonate–rich matrix was extracted from two breccias dikes and scanned by X–ray diffraction techniques (Geoscience Laboratories, Ontario Geological Survey). One dike has carbonate matrix composed dominantly of dolomite with minor calcite. The second sample contains calcite with a trace of dolomite.

Ijolite Dikes

On "Anomaly" Lake and on "Centre" Lake outcrops of very fine–grained dark ijolitic rock are considered to be dikes (map–unit 5e). The best exposure of this dike forms the backbone of the peninsula jutting into "Centre" Lake. At this location, weathered surfaces of the rock are black to green black and fresh surfaces are black. In thin section the rock contains aegirine–augite and nepheline in roughly equal proportions with minor to trace amounts of magnetite, perovskite, dolomite and/or calcite. Resistant blocks from the trenches at the "West Zone" (see Figure 3) and representative of dike rocks similar in age, contain apatite and olivine (?) in addition to those minerals found at "Centre" Lake. The pyroxene in these samples lacks the deep green colour of the aegirine–augite at "Centre" Lake and optically is closest to a diopsidic augite. The pyroxene in one sample is turbid and partially altered to carbonate.

Gabbro Dikes

Another mafic dike rock is map–unit 5g. This dike forms a mappable unit along the east side of the complex where its presence is defined by a series of fairly large outcrops. This dike rock weathers grey–black and on fresh surface is grey–green. It contains rare plagioclase phenocrysts that may reach a centimetre in maximum dimension and pyroxene phenocrysts up to 5 mm long. On the outcrop the plagioclase appears fresh to weakly saussuritized and the pyroxene is glassy and light green in colour.

In thin section the plagioclase varies from fresh to extensively saussuritized. The plagioclase is andesine in composition and the pyroxene is diopsidic augite. The pyroxene is fresh and sometimes displays a weak zoning. Biotite and magnetite are common accessory minerals and chlorite, calcite, and actinolite occur as alteration products of the primary mineral assemblage. The rock is classified as a gabbro.

This dike is fine to medium grained, equigranular to inequigranular–seriate, massive, hypidiomorphic. There is a suggestion of a weakly–developed diabasic texture.

Diatreme Breccia

Along the southeast corner of the complex is a breccia zone that is likely a diatreme structure. The breccia (map–unit 5h) is composed of very fine–grained clasts presumed to be derived from the wall rocks and ijolite, and which are veined and cemented with sovite. Some limonitic coating suggests that the carbonate is ferruginous. The clasts are angular to subangular and up to 30 cm in maximum dimension. Any rigorous interpretation as to its genesis or significance is impossible because the exposure is slumped and only 3 by 1 m in surface area.

In thin section a sample from one of the presumed wall rock clasts contains an estimated 95 percent plagioclase of sodic andesine composition, 5 percent carbonate, and 2 to 3 percent colourless pyroxene that was tenuously identified as hedenbergite. The pyroxene and carbonate are clearly interstitial and occur together. The texture is fine grained, inequigranular, massive, granoblastic, with highly developed lobate grain margins. The original rock represented by this clast is unknown.

Biotite–Porphyritic Dikes

East of "Centre" Lake, three outcrops stand 3 m in relief above the surrounding terrain. This feature combined with a somewhat discordant strike relative to the interpreted strike of the surrounding lithologies indicates that the outcrops may represent a dike.

The eastern and more prominent of these three outcrops has a porphyritic appearance with biotite phenocrysts composing up to 30 percent of the rock (map–unit 5f). The weathered surface is black to greenish black and has a rough irregular surface. On fresh surfaces the rock is black with white carbonate streaking. The biotite phenocrysts are up to 3 mm in diameter and seriate in distribution. The carbonate streaks do not exceed 1 cm in length or 1 mm in width. The outcrop is massive and homogeneous in appearance.

In thin section the rock is estimated to consist of 30 percent totally altered nepheline, 30 percent biotite poikilitically enclosing altered nepheline, and 35 percent diopsidic augite with a very pale greenish tint. Approximately 5 percent interstitial carbonate is present. The fine–grained, birefringent, alteration minerals after nepheline could not be optically identified. The rock is fine to medium grained, inequigranular–seriate, allotriomorphic, and may be the recrystallized wall rock marginal to a dike that is not exposed.

At the western end of this body, an outcrop of biotite porphyry has a more decidedly dike–like appearance. The rock is massive with phenocrysts of biotite up to 3 mm in diameter set in a fine–grained to aphanitic groundmass. The phenocrysts are seriate in distribution but hiatal to the groundmass. The weathered surface is black, green–black and irregular to rough. The fresh surface is grey–black to grey–green. The phenocrysts constitute no more than 10 percent of this rock.

In thin section the rock contains an estimated 12 percent biotite, 60 percent diopsidic augite, 20 percent carbonate, 5 to 10 percent magnetite and a trace of zircon. The zircons are poikilitically enclosed within biotite and display dark haloes or rings due to radioactive bombardment from radioactive elements contained within the zircons. The rock is fine to medium grained, porphyritic–seriate, allotriomorphic to hypidiomorphic.

One outcrop of a similar rock (map–unit 5a) was noted in the northern portion of the complex but it was not examined in thin section.

The thin section examination of samples from the three outcrops indicate all exposures of this proposed dike are silicocarbonatite in composition. The mineral mode is highly variable between samples.

STRUCTURAL GEOLOGY AND GEOCHRONOLOGY

The Prairie Lake Carbonatite Complex lies within the Quetico Subprovince of the Superior Province of the Canadian Shield (Ayres et al. 1971). The complex displays a prominent circular magnetic anomaly on aeromagnetic map 2148G (ODM–GSC 1963) of approximately 1400 gammas absolute total field above background of approximately 60,500 gammas (see Figure 2).

Within the intrusion, banding within the carbonate phases crudely outlines the oval shape of the intrusion. The lack of exposed wall rock bordering the intrusion prevents any assessment of the relationship of the carbonatite intrusion to the rocks that enclose it. The general lack of outcrop within and bordering the intrusion prevents any vigorous interpretation regarding possible controls of emplacement or internal structure. Examination of trenches excavated by Newmont Mining Corporation of Canada Limited indicates rapid lithologic variations over distances of a few feet; thus the contacts indicated on the accompanying map (see Figure 3) are a generalization.

On topographic maps and ERTS photographs (from the Canada Centre for Remote Sensing, Ottawa), the Prairie Lake carbonatite is seen to be located at the intersection of two lineaments. One, defined by the Steel River, trends north, and the other, defined by a series of lakes between Prairie Lake and Killala Lake trends northeast. The northeast–trending lineament connecting Prairie Lake and Killala Lake also lies along an aeromagnetic trend which has an intensity approaching 200 gammas absolute total field above background of approximately 60,500 gammas (aeromagnetic map 2148G). This topographic and aeromagnetic lineament infers a possible close relationship between the Prairie Lake carbonatite and the Killala Lake alkalic rock intrusive complex. The Killala Lake alkalic intrusion has been previously described by Coates (1970) and was remapped by the author (Sage 1983a). Mapping in the area between the Prairie Lake carbonatite and the Killala Lake Alkalic Rock Complex by Coates (1970) indicated that the aeromagnetic trend connecting the two complexes in part reflects the intervening lithologies. The Killala Lake complex lies along a north–trending crustal fracture which is the site of several alkalic rock – carbonatite intrusions: Port Coldwell, Chipman Lake (carbonatite dikes and fenites), and Killala Lake. The importance of this fracture (Figure 4) to the localization of alkaline magmatism was recognized by Sage (1978, 1983b) after mapping of the Slate Islands. This crustal fracture is the northern extension of the Big Bay – Ashburton Bay Fault which crosses the Lake Superior basin and has been defined from aeromagnetic studies by Hinze et al. (1966).

The Prairie Lake complex, therefore, occurs on fractures parallel and subsidiary to the Big Bay – Ashburton Bay Fault which has served as a major site of alkalic rock – carbonatite intrusive activity northeast of the Lake Superior basin.

The emplacement of carbonatites and alkalic rocks into stable continental environments is well documented (Heinrich 1966, p.320; Bailey 1974, p.148–160; Kumarapelli and Saull 1966). The Prairie Lake carbonatite lies at the intersection of fractures subsidiary to the northern extension of the Big Bay – Ashburton Bay Fault of Hinze et al. (1966). On the basis of geologic data and air photo interpretation, the diatreme structures of the Slate Islands, the Port Coldwell Alkalic Rock Complex, the Killala Lake Alkalic Rock Complex, the Dead Horse Creek and McKellar Creek diatremes and the Chipman Lake fenites are located along the northern extension of the Big Bay – Ashburton Bay fault zone (Sage 1978, 1982, 1983a,b,c). The Prairie Lake carbonatite is located in a fractured or faulted continental shield environment characteristic for this type of complex. The Big Bay – Ashburton Bay fault lies along a ridge–like structure that crosses the Lake Superior Basin (Hough 1958) in a northeast direction; along this structure, on the basis of seismic data, the crust is postulated to be nearly 60 km thick (Smith et al. 1966).

The dominant alkalic magmatic event along this structure is Late Precambrian in age: Port Coldwell, 1070 $\pm$ 15 Ma; Killala Lake, 1050 $\pm$ 35 Ma; and Prairie Lake, 1023 $\pm$ 74 Ma (Bell and Blenkinsop 1980). The isotopic ages determined by Bell and Blenkinsop (1980) are based on rubidium–strontium techniques. J.C. Baubron (Bureau de Récherches, Géologiques ét Minière, Orléans, France, written communication, 1980) reported that K–Ar isotopic ages determined on amphibole from the Chipman Lake fenites give ages of 1029 $\pm$ 31 Ma. The isotopic ages on the major occurrences of alkalic rock and carbonatite complexes in the northeast corner of the Lake Superior region indicate that a major event of alkalic magma formation took place between 1000 and 1100 Ma ago.

The structures and existing isotopic age dates define an alkalic petrogenic province which lies north to northeast of the Lake Superior Basin. Chemical variations within the Prairie Lake carbonatite will define only a small portion of magmatic activity within this province. A more complete model of petrogenesis must therefore await synoptic synthesis of all the complexes within this petrologic province. The author suggests that this petrologic province be named the *Port Coldwell Alkalic Rock Province*.

PETROLOGY

Samples for chemical analysis were selected on the basis of freshness and homogeneity. Coarse–grained pegmatitic phases were avoided. Only surface samples were available for analysis. Outcrops of the complex are scarce and sampling was largely restricted to slumped outcrop or resistant clots within the regolith. All samples collected for analysis were trimmed in the field and then by diamond saw in the Geoscience Laboratories of the Ontario Geological Survey before analysis. The samples were closely inspected for any evidence of weathering or alteration

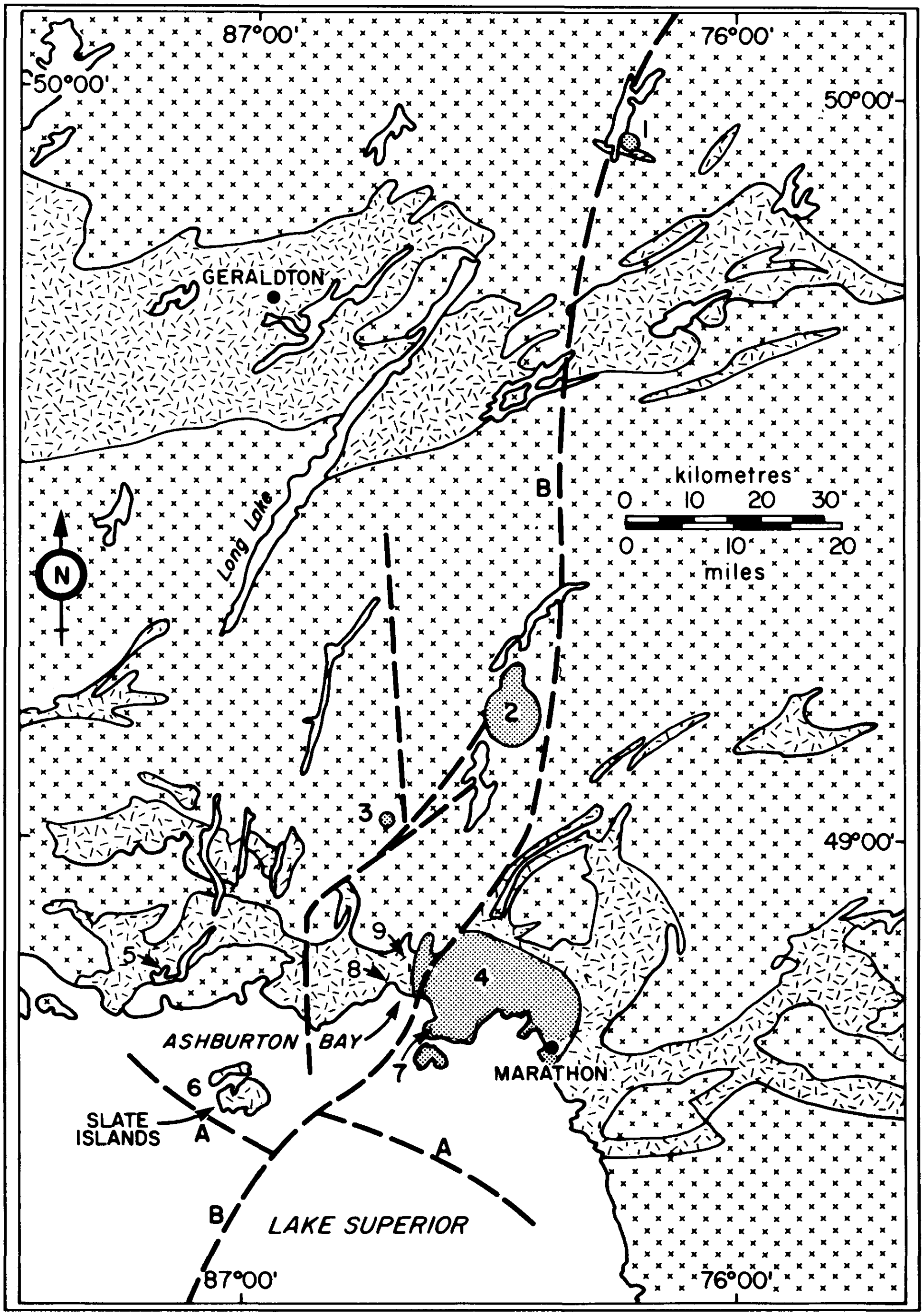


Figure 4. *Sketch map showing relationship of faulting and alkalic rock magmatism north of Lake Superior.*

Key:

1. Chipman L. dikes & fenites
2. Killala L. complex
3. Prairie L complex
4. Port Coldwell complex
5. Gold Range diatreme
6. Slate Islands diatreme
7. Neys diatreme
8. McKellar Cr diatreme
9. Dead Horse Cr diatreme
A. Michipicoten Island fault
B. Big Bay – Ashburton Bay fault

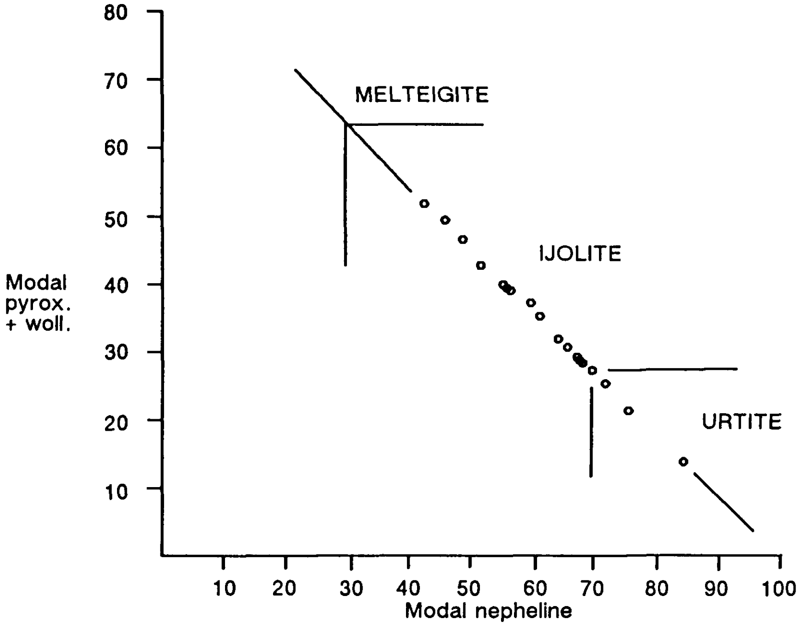


Figure 5. *Plot of modal pyroxene + wollastonite vs. nepheline for ijolitic rocks (map-units 2a, 2b). Pyroxene + wollastonite + nepheline have been recalculated to 100%. Composition fields from Williams et al. (1954).*

before grinding for analysis to ensure that only fresh rock was analyzed. Larger samples of the medium-grained rocks, relative to samples of the finer-grained rocks, were submitted for analysis. Field and petrographic descriptions of samples are given in Table A-1, Appendix A; major and trace element analyses are given in Tables A-2 and A-3 respectively; LeBas norms for alkalic rocks are given in Table A-4; and statistical parameters for the lithologic units are given in Table A-5.

A plot of modal pyroxene + wollastonite vs. nepheline (Figure 5) indicates that most samples of map-units 2a,b fall within the ijolite classification (between 30 and 70 percent nepheline). If wollastonite is excluded, the samples would shift towards the urtite end. Inclusion of garnet within the pyroxene would shift the samples back toward the melteigite end.

In the field, wollastonite is white and the garnet dark brown to black. On the basis of colour index alone, the analyzed samples would fall almost exclusively into the ijolite group.

Thin sections prepared from the Prairie Lake samples were examined briefly by the author and, on the basis of textural relations, the main mineral phases have a distinct order of crystallization. Apatite is exclusively euhedral and sphene is commonly euhedral, suggesting early crystallization of these mineral species. Nepheline commonly occurs in subrounded stubby crystals and may poikilitically enclose apatite. Surrounding the subrounded nepheline crystals are irregular, anhedral, composite grains of sodic pyroxene and dark brown garnet. The sodic pyroxene and garnet poikilitically enclose euhedral apatite and anhedral nepheline. The sodic pyroxene and garnet appear to have crystallized contemporaneously. Anhedral ragged crystals of wollastonite are next, followed by an interstitial, anhedral mosaic of carbonate. The order of crystallization is, from

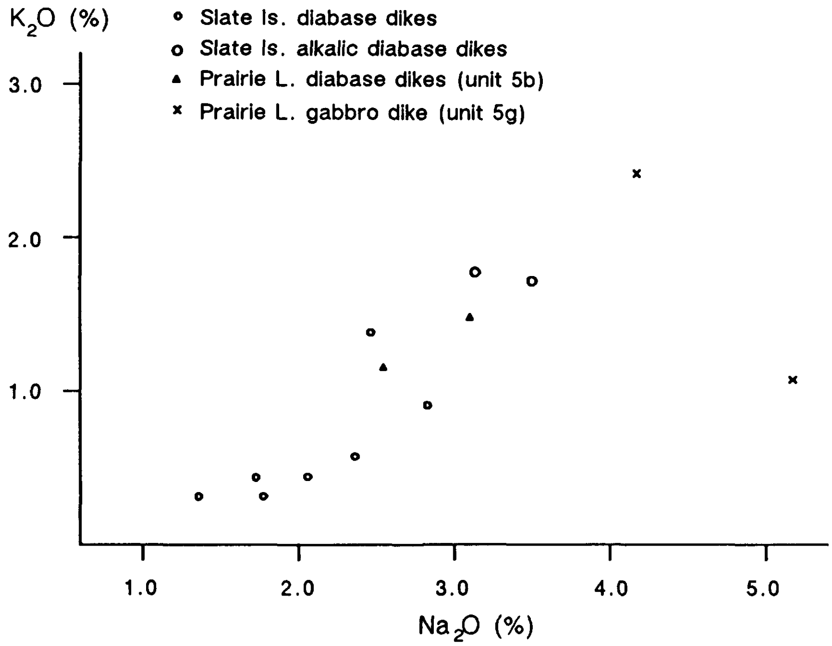


Figure 6. *Plot of K_2O vs. Na_2O for diabase and gabbro dikes from the Prairie Lake Carbonatite Complex. Alkalic and subalkalic diabase dikes of roughly equivalent age from the Slate Islands (Sage 1983b) are shown for comparison.*

early to late, apatite + sphene, nepheline, sodic pyroxene + garnet, wollastonite, and carbonate.

Comparison of the Prairie Lake complex with its extensive development of wollastonite ijolite with similar carbonatite complexes in Ontario or North America appears impossible since wollastonite ijolite is not extensively developed in any other complexes. Wollastonite–bearing phases of minor extent have been reported from Lackner Lake (Parsons 1961) and Oka (Gold 1969). A carbonatite–ijolite complex that appears to be closely analogous to the one at Prairie Lake is the one at Homa Bay in western Kenya (Pulfrey 1950). Pulfrey (1950) described, in detail, a series of wollastonite–bearing ijolites with similar composition and very similar mineralogy to ijolitic rocks of the Prairie Lake complex. Pulfrey (1950) reported cancrinite and pectolite in the Homa Bay rocks, but these are absent or not abundant in the Prairie Lake rocks. The author did not clearly identify cancrinite but some of the material occurring as an alteration of the nepheline may be cancrinite. Watkinson (1976) reported cancrinite after nepheline in samples examined by him. Neither the author or Watkinson (1976) have identified pectolite.

In Figure 6, plots of Na_2O vs. K_2O for diabase dikes of the Prairie Lake complex are compared with diabase dikes on the Slate Islands (Sage 1983b). The Prairie Lake dikes plot between subalkalic diabase dikes and strongly alkalic diabase dikes that occur on the Slate Islands. The Prairie Lake dikes are thus considered to be mildly alkalic. A gabbro dike (map–unit 5g) from the Prairie Lake complex is strongly alkalic.

Variation diagrams have been plotted to compare the various ijolite units. These diagrams, CaO vs. CO_2 (Figure 7), CaO vs. SiO_2 (Figure 8), and CO_2 vs. SiO_2 (Figure 9), indicate that the wollastonite ijolites are lower in CO_2 than the

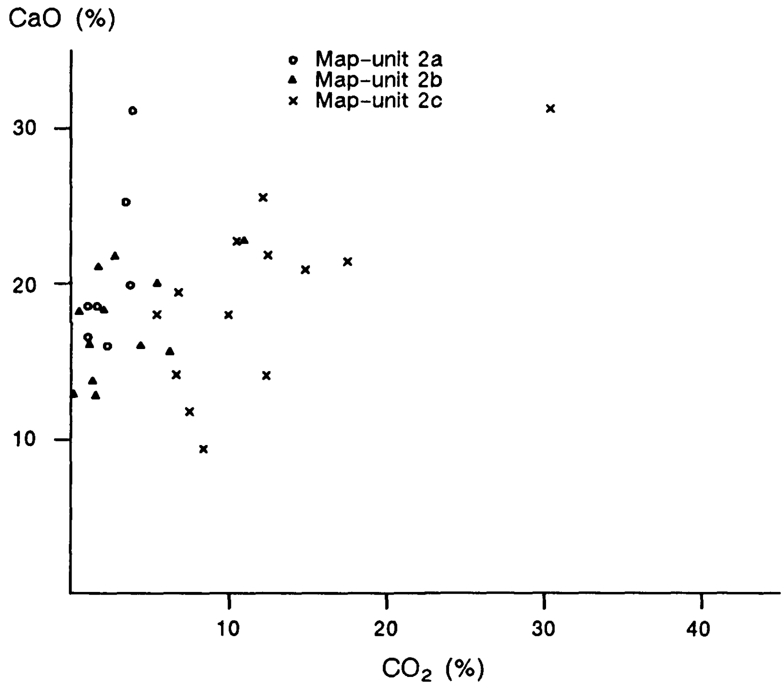


Figure 7. *Plot of CaO vs. CO_2 for ijolitic rocks from the Prairie Lake Carbonatite Complex. Note the generally lower CO_2 content of the wollastonite ijolites with respect to the non–wollastonite–bearing ijolites.*

non–wollastonite–bearing ijolites, higher in SiO_2 and similar in CaO. Chemical data for unit 2c was added to the diagrams and the scatter for this unit is in keeping with its much greater mineralogic and modal heterogeneity. Unit 2c is a transitional phase between the ijolites and sovites and may, in part, be the product of reaction between carbonatite magma and previously crystallized ijolite magma.

Fluid inclusion studies on apatites removed from coeval carbonatite and ijolite magmas have been completed by Rankin and LeBas (1974a, 1974b), LeBas et al. (1977), Hamilton et al. (1979), and LeBas and Handley (1979). These studies have indicated that (1) the carbonatite magma has a liquid immiscibility relationship with an alkalic silicate magma; (2) the carbonatite magma is an aqueous alkali–rich fluid; (3) the alkalic silicate magma is possibly equivalent to ijolite and crystallizes at temperatures between 1000 and 1100°C and the carbonatite magma crystallizes between temperatures of 400 and 600°C. The alkali–carbonate inclusions are considered by Rankin and Le Bas (1974b) to be equivalent to the alkali carbonatite lavas of Oldoinyo L'Engai (Dawson 1966). A model to explain the contrasting compositions (calcite–dolomite) of the carbonate rocks of the Prairie Lake complex and all other carbonatite complexes has been proposed by Gittins et al. (1975). According to their model, aqueous alkali–rich carbonatite magma loses the alkalies in an aqueous fluid, leaving behind calcite–dolomite as a residuum. The lost fluid gives rise to alkali metasomatism and forms the fenitic zone of alkali metasomatism that characteristically encloses carbonatite complexes. Mica, pyroxene, amphibole, and carbonate characteristically form in this fenite envelope.

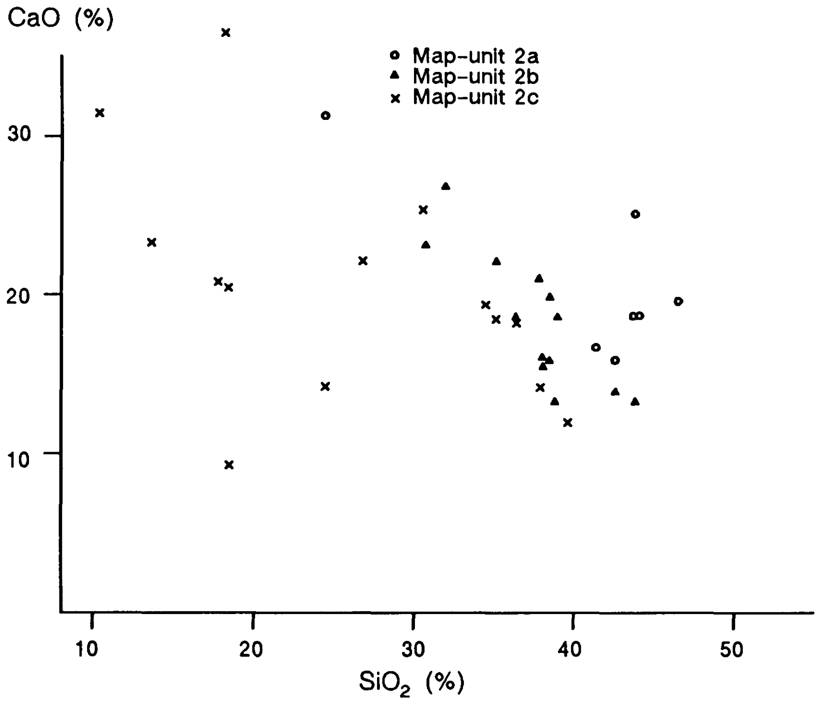


Figure 8. *Plot of CaO vs. SiO_2 for ijolitic rocks from the Prairie Lake Carbonatite Complex. Note that the wollastonite ijolites generally contain more SiO_2 than the non-wollastonite-bearing ijolites. CaO contents are similar.*

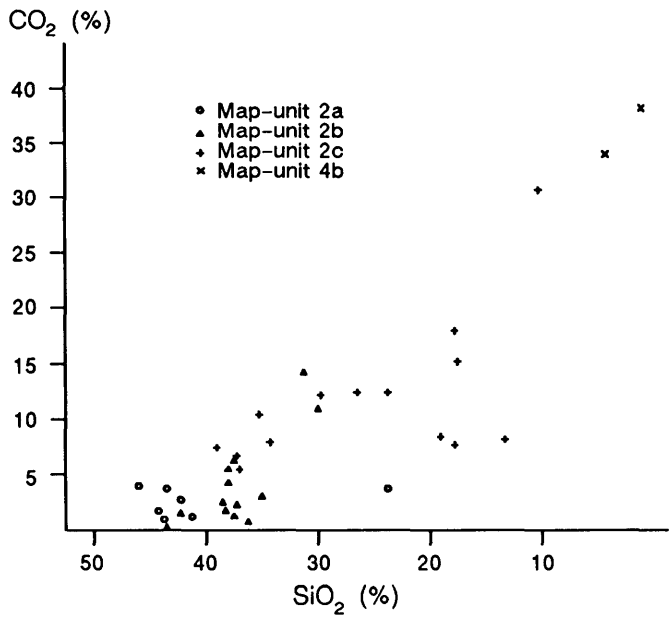


Figure 9. *Plot of CO_2 vs. SiO_2 for ijolitic rocks from the Prairie Lake Carbonatite Complex. Note the generally lower CO_2 and higher SiO_2 contents of the wollastonite ijolites with respect to the non-wollastonite-bearing ijolites.*

The studies cited above indicate that a carbonatite magma is still fluid after the silicate portion (ijolite) has crystallized (LeBas 1981). This carbonatite magma is at least initially a super–heated magma which can intrude and fenitize the earlier crystallized silicate phase. At Prairie Lake, the development of biotite in the area between the carbonatite and ijolite, and the development of biotite–phlogopite along the margins of carbonatite veins cutting the ijolite, can be explained as a result of reaction of the carbonatitic magma with the previously crystallized ijolite (Gittins et al. 1975).

The association of ijolite and carbonatite, such as is found at Prairie Lake, is well documented (Heinrich 1966) and therefore a close petrogenetic link is indicated between the ijolite and carbonatite phases. Since the carbonate phase is a residuum after loss of alkali elements and volatiles, and has been subjected to crystal fractionation and cumulus processes, chemical analyses of the carbonate–rich rocks do not reflect magma composition. The alkali silicate phase represents the crystallized product of an alkali silicate magma resulting from an immiscible split of a carbonated alkalic magma. This silicate magma has been subjected to crystal fractionation, cumulus processes and alkali–element and volatile metasomatism.

This complex has been, and is being, examined for uranium, niobium, wollastonite and apatite mineralization. Work has disclosed interesting uranium and niobium values but testing for apatite and wollastonite has been less fruitful.

Newmont Mining Corporation of Canada Limited

In 1968, J. Gareau, employed as a prospector for Newmont Mining Corporation of Canada Limited, discovered radioactive occurrences within the Prairie Lake carbonatite–alkalic complex. During the following years of 1968, 1969 and 1970, the company conducted radiometric, magnetic, and geochemical surveys over a grid established on the complex. The company completed 1742 feet (531 m) of diamond drilling using a Winkie drill, 1375 feet (419 m) of trenching, and a large number of assays. Most of the assays were for niobium and uranium (J.A. Coope, Newmont Mining Corporation of Canada, personal communication, 1975). Some spot analyses for tantalum, thorium, and rare earths were also made, and a few specimens were checked by 31– element spectrographic analyses (Coope, personal communication, 1975).

The geochemical sampling was confined to soils, principally regolith, and the samples were tested for copper and nickel and some for uranium (Coope, personal communication, 1975). The samples were collected at 200–foot (60 m) intervals on two traverses striking a little west of north from the center of the west shore of Prairie Lake. Mineralogic studies conducted by the company indicated the presence of pyrochlore, ilmenite, apatite, and brookite, in addition to dolomite, pyrite, magnetite, biotite and phlogopite which were recognizable in hand samples collected by members of this field party during mapping of the complex.

The work of the company has indicated that "Jim's Showing", located near the centre of the complex, contains the most promising mineralization, roughly estimated by the company at 109,024 tons grading 0.12 percent U_3O_8. The zone has a probable length of 320 feet (98 m) and an average width of 23 feet (7.0 m), and is open in both directions.

This showing was examined by members of the field party and the presence of anomalous radioactivity was confirmed. Fresh rock cannot be obtained from the trenches dug by the company and the diamond drill core is no longer usable. Figure 10, taken from reports of Newmont Mining Corporation of Canada Limited, shows the geology of the showing. The readings of radioactivity (counts per second) were confirmed by the author, however, the uranium and niobium assays could not be confirmed because of lack of fresh rock for samples. The mineralization occurs as uraniferous pyrochlore in grains ranging in size from 5 to 120 micrometres. Electron microprobe analyses of the pyrochlore were completed by D. Watkinson (1971) of Carleton University, Ottawa, while working as a consultant for the company. The analyses indicated that the pyrochlore is zoned, with the uranium concentrated towards the periphery of the pyrochlore grain. The uranium content was observed to vary inversely with niobium and may compose up to 30 percent of the pyrochlore grain along its periphery.

Watkinson (1976) has completed more detailed petrographic and microprobe studies on Prairie Lake pyrochlore since the earlier work completed for Newmont Mining Corporation of Canada Limited. In 1977, Watkinson (unpublished data) completed a microprobe study of uranium–bearing pyrochlore from carbonatite

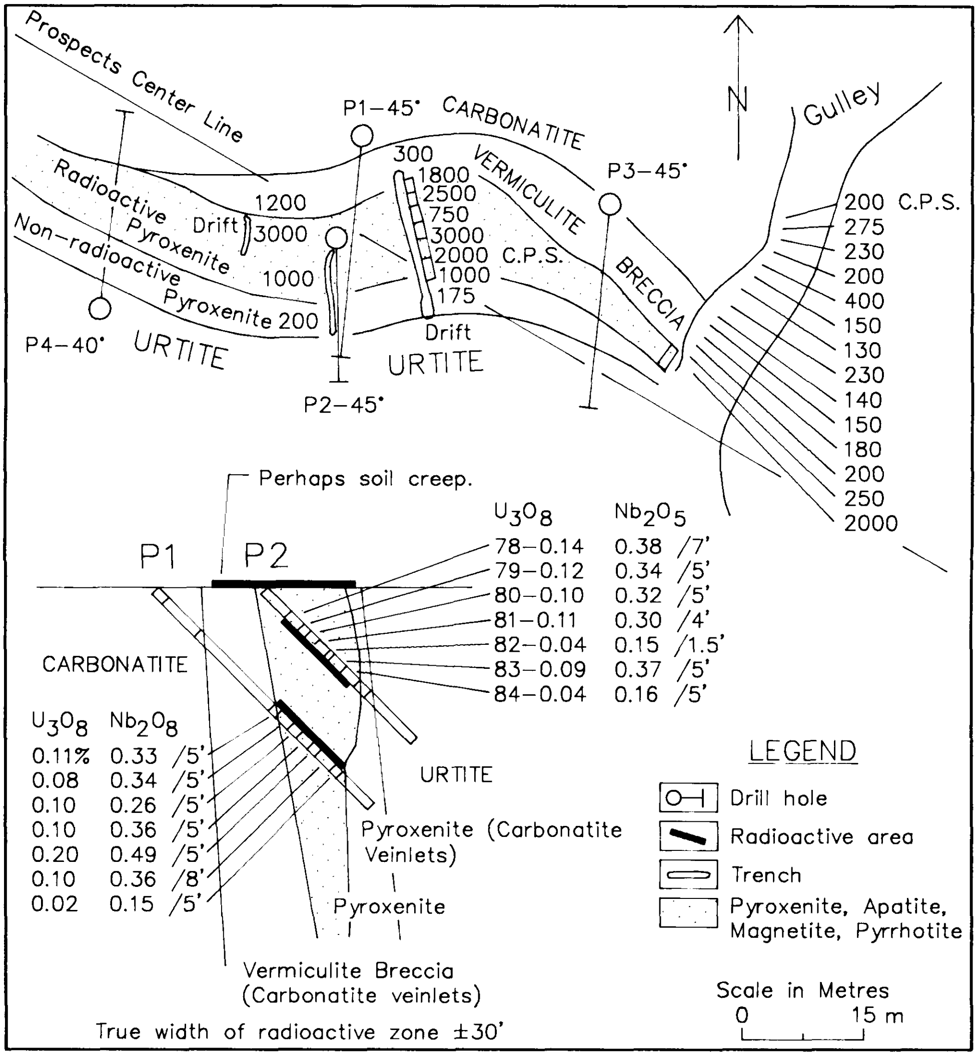


Figure 10. *Geological plan and cross-sections of "Jim's Showing", showing drill holes and assays. Geology by J. Meillon, Newmont Mining Corporation of Canada Limited, 1969.*

boulders located south of "Jim's Showing". These analyses are given in Table 10. Mariano (1979a) reported microprobe determinations of mineral chemistry on uranium-rich and uranium-poor pyrochlore. These analyses are reproduced in Table 11.

Watkinson (1976) reported that reddish-brown pyrochlore in ijolitic rocks occurs (1) as inclusions in pyroxene, (2) in calcite-apatite segregations, and (3) in altered nepheline. In the sovite, the pyrochlore is yellow-brown to dark reddish brown, larger in grain size than in the ijolite, and occurs in bands with other oxide or silicate minerals or in clusters with magnetite-apatite (Watkinson 1976). Radial cracks locally occur in pyroxene, olivine, or apatite grains adjacent to a pyrochlore grain, and may be related to expansion of the grain as it became metamict (Watkinson 1976).

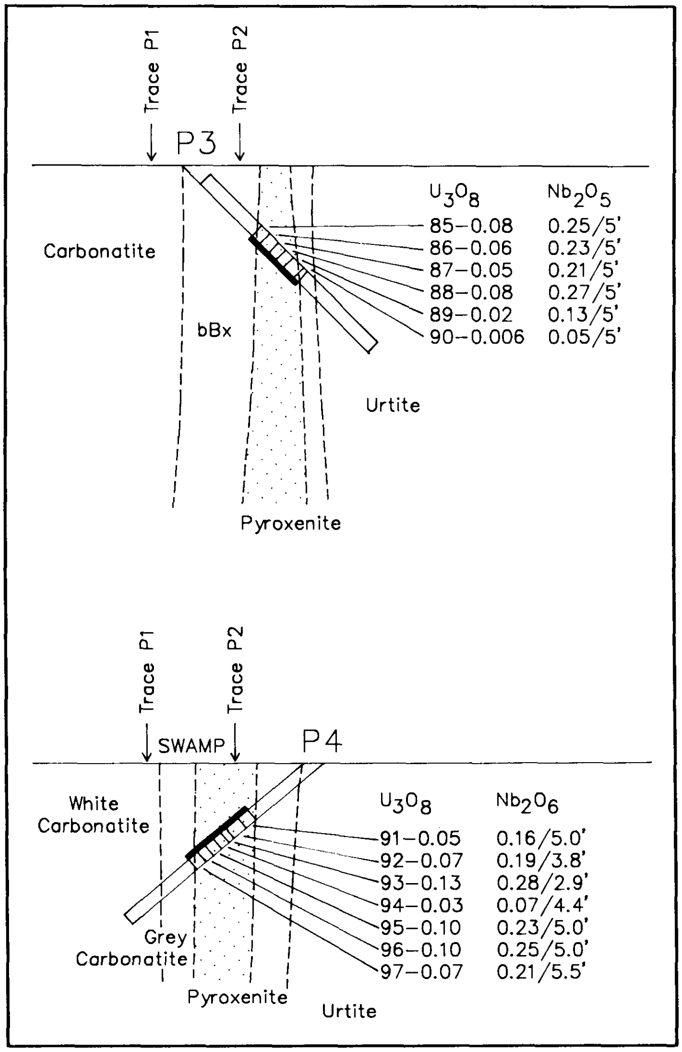


Figure 10. *Continued. Cross-sections of "Jim's Showing".*

Two samples of radioactive carbonatite were selected for thin section examination. The samples were taken from the centre of more resistant material in the trenches dug by Newmont Mining Corporation of Canada Limited. The specimens are coated with a weathered rim of pulverulent limonite which locally exceeds 1 cm in thickness. The unweathered material is fine grained and dark grey in colour. Pyroxene and disseminated pyrrhotite were noted in some specimens.

The samples consist largely of dolomite with minor amounts of calcite. The dolomite occurs both in euhedral and anhedral grains. In thin section the rock is seen to contain minor amounts of limonite, calcite, albite, sericite, nepheline, biotite and augite. One sample contains polycrystalline grains which were identified as quartz by X-ray diffraction (Geoscience Laboratories, Ontario Geological Survey). The sample containing sericite appears to contain a highly altered diabase xenolith.

TABLE 10. MICROPROBE DATA ON URANIFEROUS PYROCHLORE FROM CARBONATITE BOULDERS SOUTH OF "JIMS SHOWING" (Watkinson 1977, Unpublished Data).

Sample	1	2	3	4	5
U_3O_8	20.09	19.87	23.70	19.39	20.61
SiO_2	1.11	1.74	1.91	4.28	7.54
CaO	16.57	16.49	12.37	4.32	14.44
F	1.64	1.71	1.04	0.00	1.42
Nb_2O_5	32.19	35.43	35.81	39.32	32.50
Na_2O	0.57	0.80	0.39	0.01	0.00
BaO	0.29	0.44	0.71	3.53	0.75
TiO_2	7.78	8.43	11.27	14.19	10.95
FeO	1.79	2.16	1.20	1.49	1.22
Total	82.03	87.08	88.40	86.54	89.43
Sample	**6**	**7**	**8**	**9**	**10**
U_3O_8	19.66	24.93	22.76	22.89	24.97
SiO_2	1.77	0.45	0.63	2.95	7.86
CaO	14.64	16.59	17.29	13.49	5.26
F	1.11	1.20	1.65	0.47	0.00
Nb_2O_5	35.83	32.77	35.39	31.14	32.43
Na_2O	0.05	0.40	0.98	0.18	0.00
BaO	0.62	0.46	0.68	1.71	1.46
TiO_2	10.49	13.57	14.05	13.44	15.26
FeO	2.54	2.29	0.81	5.35	1.79
Total	86.71	92.66	44.23	41.60	89.02

TABLE 11. AVERAGE COMPOSITION OF MICROPROBE ANALYSIS OF PYROCHLORE GRAINS, PRAIRIE LAKE CARBONATITE (From Mariano 1979a).

Sample	1	2
Na_2O	1.23	3.31
MgO	0.01	0.01
Al_2O_3	0.25	0.49
SiO_2	3.66	0.88
SrO	0.07	0.76
ZrO_2	0.75	2.19
Nb_2O_5	32.98	55.84
ThO_2	1.09	0.76
U_3O_8	18.01	1.10
K_2O	0.27	0.07
CaO	7.18	17.15
BaO	4.17	0.74
Ce_2O_3	1.11	0.68
TiO_2	12.57	6.34
MnO	1.02	0.23
FeO	2.39	0.79
Ta_2O_5	2.13	0.42
PbO	0.95	0.13
Total	89.82	91.86

1. Average of 9 determinations on sample from D.D.H. 16, 293 feet. Mineral is betafite.
2. Average of 4 determinations on sample from outcrop, Grid 1 line 19E, 9 + 50 N.

The rock is ferruginous rauhaugite (dolomitic carbonatite) containing xenolithic and, most likely, xenocrystic fragments. This rock unit, which contains the uranium–niobium mineralization, may be a late dike rock. The inferred presence of a diabase fragment indicated that it would be post–diabase, as diabase dikes cut the complex in several areas. Mapping by members of the field party suggests that this unit was emplaced between wollastonite–bearing ijolite to the south and a predominantly sovite lithology to the north.

Pyrochlore was not observed in the two thin sections examined by the author. Pyrochlore grains in appreciable concentration were noted only in one sample collected from the "West Zone". The grains comprise an estimated 5 percent of the section, are dark brown in colour, euhedral in shape and average approximately 0.04 mm in diameter. One grain of 0.38 mm diameter was noted. An assay of this sample returned 1.36 percent niobium, 0.29 percent cerium, 0.08 percent lanthanum, 0.07 percent neodymium, and a trace of ytterbium (Geoscience Laboratories, Ontario Geological Survey).

In 1968 through 1969, Newmont Mining Corporation of Canada Limited completed some preliminary mineral dressing investigations in conjunction with its mineralogical studies.

Diamond drilling and assays by the company on other showings returned negligible uranium values and a few interesting niobium values. Those intersections returning values in excess of 0.25 percent Nb_2O_5 are listed in Table 12.

International Minerals and Chemical Corporation (Canada) Limited

In 1975, the International Minerals and Chemical Corporation (Canada) Limited restaked the former holdings of Newmont Mining Corporation of Canada Limited for apatite, with the exception of two claims covering "Jim's Showing" which were optioned to New Insco Mines Limited by their present owner, Jim Gareau. The company moved drill equipment into the Prairie Lake area over winter roads and completed three holes totalling 345 feet (103.5 m) using reverse circulation techniques. This program was unsuccessful in locating any significant concentrations of apatite and, later in 1976, the claims were optioned to New Insco Mines Limited for testing of their uranium potential.

The company submitted five drill samples for assay of their phosphorous content. The assay results are given in Table 13.

Nuinsco Resources Limited (New Insco Mines Limited)

In 1975, New Insco Mines Limited optioned two claims, in the centre of the Prairie Lake complex, which covered the uranium showing previously located by Newmont Mining Corporation of Canada Limited. New Insco Mines Limited completed its control of the Prairie Lake carbonatite by optioning the 39 claims of the International Minerals and Chemicals Corporation (Canada) Limited in 1975. During 1976, New Insco Mines Limited completed radiometric surveys, 131 shallow overburden power auger drill holes, mapping, prospecting, and limited trenching and pitting.

In 1975, diamond drilling totalling 5154 feet (1546.2 m) in 15 holes was completed, identifying uranium mineralization in two zones. "Jim's Showing" was indicated to be 300 feet (90.0 m) long by 20 feet (6.0 m) wide. The second zone, which was named the "Lake Zone", has a minimum length of 150 feet, but no grade or width was indicated. Non–radioactive pyrochlore (niobium) mineralization was indicated to be present. Hole P–17 gave an assay at 0.28 percent Nb_2O_5

TABLE 12. NIOBIUM ASSAYS (> 0.25%) OF SAMPLES FROM DIAMOND DRILLING BY THE NEWMONT MINING CORPORATION OF CANADA LIMITED.

Hole	Assay (%)	Length* (feet) (not true width)
P5	0.43	1.60
	0.37	1.20
P6	0.32	1.90
P7	0.25	1.0
P12	0.31	5.0
P14A	0.44	6.0

*Depths of intersections not recorded.
Assays reported by the company.

TABLE 13. ASSAY OF SAMPLES FROM REVERSE CIRCULATION DRILLING BY INTERNATIONAL MINERALS AND CHEMICAL CORPORATION (CANADA) LIMITED.

Sample No.	Hole No.	Footage	% P_2O_5	Insolubles
064234	P-1	35-40	2.4	10.2
064235	P-2	65-70	2.0	3.95
064236	P-2	115-120	2.3	15.3
065237	P-3	115-120	3.8	5.88
064238	P-3	85-90	0.3	55.7

Assays reported by the company.

and 7.69 percent P_2O_5 over a length of 30 feet (9.0 m). Selected assays over 10 foot (3.0 m) lengths for holes P-17 and P-29 gave P_2O_5 values of 4.46 to 8.93 percent, and Nb_2O_5 values at 0.08 to 0.31 percent.

The reserves for the main showing were enlarged as a result of this work and have been estimated to be 200,000 tons to a depth or 275 feet, in a zone 300 feet long by 22 feet wide, with a grade of 1.8 pounds U_3O_8 per ton and 5.0 pounds Nb_2O_5 per ton (Canadian Mines Handbook, 1978-1979, p.81).

Also in 1977, a magnetometer survey and additional prospecting were completed. In 1978 the company completed additional magnetometer surveys, geological mapping, assays, and prospecting for U, Nb and P. This work uncovered additional areas of anomalous Nb, P and U. The company located an area of anomalous niobium in the northern part of the complex and referred to it as the "1810 Showing". The company changed its name to Nuinsco Resources Limited in 1979.

In 1983, the company undertook additional work to evaluate the economic potential of the carbonatite complex. This work also completed a preliminary assessment of the wollastonite potential of the complex. The company completed an additional 5618 feet (1730 m) of drilling and extensive assay work on the resulting core. Table 14 is a composite summary of significant drill intersections resulting from the 1977 and 1983 diamond drill programs. Table 15 is a summary of the more significant wollastonite and apatite intersections as tabulated by Kretschmar (1984). Mariano (1979a) in unpublished reports to the company determined that the uranium content in pyrochlore ranged from 1.10 to 32.98 weight percent. The mineralogy is therefore one of pyrochlore, uranopyrochlore,

TABLE 14. SIGNIFICANT NIOBIUM AND PHOSPHOROUS ASSAYS FROM THE 1977 AND 1983 DRILL PROGRAMS OF NUINSCO RESOURCES LTD.

Hole	Footage	Core Length (ft)	U_3O_8(%)	Nb_2O_5(%)	P_2O_5(%)
1977*					
P16	17-25	8	0.4		
	291-336	45	1.98		
P17	142-172	30		0.28	7.7
	576-611	35	0.9		
P18	321-331	10	0.35		
P19	228-240	12	0.62		
P20	no significant values				
P21	149-155	6	0.4		
P22	71.5-72.5	1	0.8		
	77-78	1	1.20		
P23	108-114	6	0.8		
P24	no significant values				
P25	154-164	11	0.95		
P26	221-248	27	0.64		
P27	278-293	15	0.3		
P28	66-68	2	0.5		
	93-99	6	0.6		
P29	159-164	5	1.0		
	179-180	1	0.8		
	126-156	30			5.02
P30	237-267	30	0.78		
1983*					
P21A	149-154	5		0.576	2.27
P31	13-18	5		0.565	5.27
	28-33	5		1.01	4.04
	42.3-47	4.7		0.122	6.36
	100-105	5		0.018	6.08
	244-274	30		0.503	4.36
	286.5-335.5	38		0.605	5.26
	446-460.5	14.5		0.563	5.48
	469.5-508	38.5		0.684	4.46
	522.5-531.5	9		0.515	3.81
	541.5-546.5	5		0.587	4.44
P32	no significant values				
P33	30.5-35.5	5		0.025	6.93
	69-74	5		0.026	6.51
	188.5-193.5	5		0.050	6.30
	251-256	5		0.061	7.69
	316.5-321.5	5		0.037	8.33
P34	373-378	5		0.116	7.49
	395-400	5		0.152	6.72
	409.5-414.5	5		0.196	6.50
	549-559	10		0.623	2.80
P35	125-130	5		0.069	7.39
P36	no significant values				
P37	no significant values				
P38	no significant values				
P39	133-138	5		0.060	6.43
	143-148	5		0.030	8.82
	161-166	5		0.040	9.85
	189.5-194.5	5		0.070	6.89
	213.4-218.4	5		0.050	10.10
P40	446-500	54		0.582	4.23
P41	533-565	32		0.527	4.33

Hole ends in 0.47% Nb_2O_5, 4.4% P_2O_5

*1977 results compiled by the author from unpublished reports prepared for Nuinsco Resources Ltd. 1983 results were compiled by Kretschmar, 1984.

TABLE 15. ESTIMATED WOLLASTONITE AND APATITE IN THIN SECTIONS OF DRILL CORE FROM 1983 DRILL PROGRAM OF NUINSCO RESOURCES LTD. (From Kretschmar 1984).

Sample No.	Estimated % Wollastonite	Rock Type
P34-551.3	40	sovite
P35-117.8	40 (also 40% apatite)	wollastonite-apatite
P35-408.5	40	apatite-melanite ijolite
P35-429	60	apatite-melanite ijolite
P35-437-7	50	altered melanite ijolite
P35-480.5	60	altered melanite ijolite
P36-17.8	75	wollastonite alteration rock
P36-86	60	wollastonite alteration
P36-97.8	60	wollastonite alteration
P36-130.5	45	wollastonite alteration
P36-197	30	wollastonite altered melanite ijolite

In holes P21A, P31 and P32 significant apatite, magnetite and nepheline were noted.

Sample No.	Mineral	Rock Type
P21A-208.0	40% nepheline	dolomitic phosphorite
P21-326.8	53% apatite	apatite phosphorite
P31-347.2	50% apatite, 20% magnetite	magnetite phosphorite
P31-478.5	27% apatite, 35% magnetite	siderite-magnetite phosphorite
P31-553	25% apatite, 15% magnetite	sovite
P32-147.5	35% nepheline	malignite

and betafite. Tantalum may also be present in pyrochlore in quantities up to 2 percent (Mariano 1979b). Mariano (1979a,b) reported that Nb in rutile varied between 4 and 6 percent and he identified niobium-bearing perovskite, wohlerite [$(Na,Ca)_3(Zr,Ti,Nb)Si_2O_7(O,OH,F)_3$] and possible calzirtite [$Ca(Zr,Ca)_2Zr_4(Ti,Nb,Fe)_2O_{16}$].

Work by Nuinsco Resources Limited indicated the presence of significant concentrations of niobium and uranium with the possibility of apatite (phosphorous) and wollastonite as by-products. Large areas of the carbonatite complex remain untested and the potential for an economic mineral deposit is good.

RECOMMENDATIONS TO THE PROSPECTOR

The complex potentially contains both uranium and niobium deposits. The uranium and niobium are intimately related within the complex since they both occur within the mineral pyrochlore in widely varying ratios.

Where the pyrochlore is uraniferous and outcrops occur at surface, a radiometric survey would be adequate to locate any promising mineralization. However, large areas of the complex are drift-covered and the presence of any radioactive zones is masked. In addition, non-uraniferous pyrochlore (niobium) will have no radiometric response and thus cannot be detected by a radiometric survey.

Pyrochlore is a non-magnetic, non-conductive, and non-radioactive (without uranium), and therefore, prospecting for this mineral using magnetic instrumentation is pointless. A magnetic survey is useful for lithologic correlations within the complex if limited outcrop, slumped rock, or regolith is available to correlate magnetic patterns with lithology. Widely varying magnetite concentrations within a given lithologic unit, however, will make any long–range lithologic correlations tenuous if such correlations cannot be confirmed by direct observation. If the presence of pyrochlore can be established in a given lithologic unit, a magnetic survey may provide useful information to interpret the areal extent of the unit of interest. As pointed out by Watkinson (1976), work by the Newmont Mining Corporation of Canada Limited has failed to disclose any relationship between radioactivity and magnetic anomalies.

Because of the very fine grain size of the mineralization, and lack of suitable geophysical instrumentation to search for it, the technique most likely to evaluate the potential of the complex would be closely spaced auger holes into the upper surface of the weathered carbonatite or the overlying regolith. Samples obtained should be carefully panned and examined for the presence or absence of pyrochlore. Diamond drilling would follow up any indicated anomalous areas. Such a prospecting technique would be time–consuming but appears to be the only technique available that can adequately test the complex. In addition, mapping by members of this party indicated that "Jim's Showing", the most promising uranium showing within the body, occurs within or close to the contact between ijolitic rocks containing abundant wollastonite, and sovite rocks. Thus, the most promising area of the intrusion for uranium mineralization may be along the contact between these two rock types located in the northwest corner of the intrusion.

The areas of radioactivity located along the northern margin of the complex and not tested by Newmont Mining Corporation of Canada Limited, warrant closer inspection. The presence of ferruginous carbonate and radioactivity in some of these exposures are considered to be favourable indicators for uranium mineralization. More detailed work in this area might disclose whether some of these outcrops mapped as altered wall rocks by the author are, in reality, part of the intrusive complex.

Testing for uranium at "Jim's Showing" should, perhaps, emphasize expanding indicated tonnages in the vertical plane rather than laterally. Carbonatites characteristically form arcuate lithologic bands which, in plan view, are rather limited in extent relative to their vertical dimension.

While the main economic interest in the complex is apparently the uranium or niobium potential, any testing of the complex should also check for economic accumulations of apatite, wollastonite, and vermiculite.

Due to the lack of outcrop, the Prairie Lake Carbonatite Complex will require systematic cross–sectional drilling to determine the presence or absence of economic concentrations of minerals.

Appendix A

Petrographic Descriptions, Chemical Analyses, Normative Compositions, and Statistical Compositions of Lithologic Units of the Prairie Lake Carbonatite Complex

TABLE A-1. PETROGRAPHIC AND FIELD DESCRIPTIONS OF WHOLE-ROCK SAMPLES FROM THE PRAIRIE LAKE COMPLEX

Map No. 1
Sample No. JM59-1

Ijolite.

Field Description. Medium to coarse grained, magnetite–bearing. Sample was taken from bottom of Newmont Mining Corporation of Canada Limited's trench No. 59. Map–unit 2b.

Petrographic Description. Fine to medium grained, equigranular, allotriomorphic to hypidiomorphic. The rock consists of subhedral, moderately to lightly altered nepheline and fresh to altered anhedral sodic pyroxene, with minor accessory magnetite, abundant apatite and minor biotite.

Map No. 2
Sample No. JM59-12

Dunite.

Field Description. Fine– to medium–grained, resistant clot in a predominantly ijolite to urtite rock that is deeply weathered. Sample was taken from bottom of Newmont trench No. 59. Map–unit 2c.

Petrographic Description. Fine grained, massive, equigranular, allotriomorphic to hypidiomorphic. Subhedral to euhedral crystals of highly altered olivine are set in a matrix of anhedral fresh olivine showing incipient serpentine development. Phlogopite crystals are scattered along the margins of anhedral magnetite grains. Carbonate and apatite are accessory minerals.

Map No. 3
Sample No. JM59-21

Silicocarbonatite.

Field Description. Fine grained, very homogeneous. Weathered surfaces are dark brown. Sample was taken from bottom of Newmont trench No. 59. Map–unit 2c.

Petrographic Description. Fine grained, equigranular, massive, allotriomorphic to hypidiomorphic. Subhedral sodic pyroxene and altered nepheline with altered magnetite (limonite) are set in a mosaic of interlocking anhedral grains of carbonate. Minor apatite.

Map No. 4
Sample No. JM59-35

Silicocarbonatite.

Field Description. Fine grained, mica–rich. Weathered surfaces are dark brown. The rock is slightly inhomogeneous with carbonate displaying tendency to form streaky segregations. Sample was taken from Newmont trench No. 59. Map-unit 2c.

Petrographic Description. Fine grained, equigranular, massive, allotriomorphic. Small bead-like grains of olivine, subhedral magnetite and booklets of phlogopite are set in a mosaic of interlocking anhedral carbonate grains.

Map No. 5
Sample No. 169-6

Silicocarbonatite.

Field Description. Fine grained, equigranular, carbonate-rich, magnetic. Weathered surfaces are dark brown. Sample was taken from Newmont trench No. 169. Map-unit 2c.

Petrographic Description. Fine grained, equigranular, massive, allotriomorphic. Bead-like grains of fresh-looking olivine contain subhedral disseminated magnetite. Minor quantities of phlogopite are present. Olivine, magnetite and phlogopite are set in an interlocking mosaic of carbonate. Minor altered nepheline and fresh nepheline are present.

Map No. 6
Sample No. 169-10

Silicocarbonatite.

Field Description. Fine grained, mica-rich, magnetic. The rock is inhomogeneous, containing capillary, discontinuous, parallel streaks of carbonate. Weathered surfaces are brown. Sample was taken from Newmont trench No. 169. Map-unit 2c.

Petrographic Description. Fine grained, massive, inequigranular-seriate, allotriomorphic. Isolated grains and clusters of anhedral to subhedral grains of phlogopite are associated with irregular to rounded grains of magnetite and dark brown, altered, bead-like olivine. Carbonate forms a mosaic of interlocking anhedral grains. Fresh bead-like olivine occurs locally. Minor accessory apatite.

Map No. 7
Sample No. 169-N

Silicocarbonatite.

Field Description. Fine grained, mica-rich, homogeneous, equigranular. Fresh surfaces are pinkish due to nepheline content. Sample was taken from Newmont trench No. 169. Map-unit 2c.

Petrographic Description. Fine grained, equigranular, massive, allotriomorphic. The rock consists of abundant carbonate, dark brown irregular grains of biotite, and anhedral grains of altered nepheline. Accessories include disseminated magnetite and minor apatite. Clear rims on turbid nepheline grains are possibly orthoclase or albite.

Map No. 8
Sample No. 169-0

Silicocarbonatite.

Field Description. Fine grained, magnetic, carbonate-rich, homogeneous, equigranular. Weathered surfaces are dark brown. Sample was taken from Newmont trench No. 169. Map-unit 2c.

Petrographic Description. Fine grained, massive, equigranular, hypidiomorphic. Very fine–grained aggregates of phlogopite occur within an interlocking mosaic of anhedral carbonate. Nepheline is altered and anhedral. Accessory apatite and magnetite.

Map No. 9
Sample No. 204B

Silicocarbonatite.

Field Description. Fine to medium grained, mica– and carbonate–rich. Nepheline tends to be slightly clotty. Sample is pink on fresh surface. Sample was taken from Newmont trench No. 204. Map–unit 2c.

Petrographic Description. Fine to medium grained, massive, allotriomorphic. The rock consists predominantly of interlocking, dark brown, irregular clusters of biotite and highly altered nepheline. Sodic pyroxene is a very minor phase. Interstitial carbonate is abundant. Accessories include apatite and magnetite. Orthoclase (?) is irregular and somewhat skeletal.

Map No. 10
Sample No. 204D

Actinolite sovite.

Field Description. Fine to medium grained, homogeneous. The sample contains minor magnetite and biotite. Sample was taken from Newmont trench No. 204. Map–unit 4b.

Petrographic Description. Fine to medium grained, equigranular, allotriomorphic. An interlocking mosaic of carbonate grains contains tremolite needles, apatite and minor biotite. Accessory magnetite and trace amounts of perovskite(?) are present.

Map No. 11
Sample No. 204K

Silicocarbonatite.

Field Description. Fine grained, magnetic, carbonate–rich, homogeneous. Sample was taken from Newmont trench No. 204. Map–unit 2c.

Petrographic Description. Fine to medium grained, equigranular, allotriomorphic. Mildly serpentinized, rounded olivine contains irregular, ragged magnetite grains. Carbonate is interstitial. Phlogopite occurs as composite aggregates and isolated grains between olivine grains. Trace amounts of apatite.

Map No. 12
Sample No. 159–J

Garnet – wollastonite ijolite.

Field Description. Coarse grained, equigranular, wollastonite–bearing, pegmatitic, homogeneous. Sample was taken from Newmont trench No. 159. Sample for analysis was taken from finer–grained portion. Map–unit 2a.

Petrographic Description. Medium to coarse grained, massive, equigranular to inequigranular–seriate, allotriomorphic. The rock consists mainly of anhedral sodic pyroxene and altered nepheline with interstitial carbonate. Dark brown garnet is euhedral to subhedral. Accessory minerals include irregular–shaped magnetite, abundant apatite, and traces of pyrochlore. Wollastonite forms irregular acicular grains with ragged outlines.

Map No. 13
Sample No. DP–1

Glomeroporphyritic diabase.

Field Description. Fine grained, porphyritic. The rock contains small glomeroporphyritic clots of plagioclase crystals. Sample was taken from slumped outcrop. Map–unit 5c.

Petrographic Description. Fine grained, massive, inequigranular–seriate, glomeroporphyritic, hypidiomorphic. Clusters of fresh plagioclase (An45–54) occur in a matrix of fresh plagioclase and altered interstitial pyroxene. The section is dusted with very fine grained magnetite.

Map No. 14
Sample No. DP–26F

Silicocarbonatite.

Field Description. Fine grained, mica–rich, carbonate–rich, homogeneous, equigranular. The rock is pink on fresh surface. Sample was taken from slumped outcrop. Map–unit 2c.

Petrographic Description. Fine grained, massive, equigranular, allotriomorphic. The rock consists mainly of an interlocking mosaic of sodic pyroxene and altered nepheline with abundant interstitial carbonate. Accessory minerals are apatite and magnetite. Dark brown biotite forms a minor phase associated with the pyroxene and altered nepheline.

Map No. 15
Sample No. DP–61C

Porphyritic sovite.

Field Description. Medium grained, inequigranular–seriate porphyritic. Carbonate is grey to pale pink. Larger grains of carbonate, up to 1 cm in diameter, are set in a matrix of finer–grained carbonate. Map–unit 4a.

Petrographic Description. Fine to medium grained, inequigranular–seriate, porphyritic, massive, allotriomorphic. Anhedral carbonate grains containing poikilitic apatite form an interlocking mosaic. Carbonate phenocrysts are up to 1 cm in diameter. Biotite, pyrochlore and limonite occur in trace amounts.

Map No. 16
Sample No. JM59–46

Silicocarbonatite.

Field Description. The rock is fine grained and weathers dark brown. Some nepheline is evident in hand specimen. Carbonate grains are locally up to 2 mm in size. Sample was taken from Newmont trench No. 59. Map–unit 2c.

Petrographic Description. Fine grained, equigranular, massive, allotriomorphic to hypidiomorphic. The rock consists of intermixed anhedral sodic pyroxene and altered nepheline, and abundant interstitial carbonate. Dark brown biotite is associated with pyroxene and nepheline. Accessory magnetite.

Map No. 17
Sample No. J-10

Wollastonite ijolite.

Field Description. Fine grained, equigranular, homogeneous. The sample was taken from a slumped outcrop. Map-unit 2a.

Petrographic Description. Fine to medium grained, equigranular, massive, allotriomorphic. Mosaics of anhedral nepheline are subdivided by irregular composite grains of sodic pyroxene. Dark brown garnet is commonly associated with the pyroxene. Wollastonite forms acicular, ragged, prismatic grains. Carbonate occurs interstitially; apatite is accessory.

Map No. 18
Sample No. RP-7A

Porphyritic olivine diabase.

Field Description. Fine grained, porphyritic. Pyroxene phenocrysts are up to 7 mm across. Sample was taken from outcrop. Map-unit 5b.

Petrographic Description. Fine to medium grained, inequigranular-porphyritic-seriate, hypidiomorphic. Euhedral, zoned, calcic pyroxene phenocrysts, up to 3 mm in size, are set in a fine-grained matrix of pyroxene and fresh plagioclase (An56-66). The matrix is dusted with fine grained magnetite. Scattered rounded grains of fresh olivine occur in the matrix and as poikilitic inclusions in pyroxene.

Map No. 19
Sample No. RP-10

Ijolite.

Field Description. Fine grained, equigranular, homogeneous. The rock forms a ridge behind the shore of "Centre" Lake, and is probably a dike rock. Map-unit 5e.

Petrographic Description. Very fine to almost medium grained, inequigranular-seriate, massive, allotriomorphic. Fine grained, irregular aggregates of sodic pyroxene separate fine grained mosaics of anhedral nepheline. Interstitial carbonate. Accessory magnetite and sphene.

Map No. 20
Sample No. RP-28

Wollastonite ijolite.

Field Description. Fine to medium grained, homogeneous, equigranular. Sample was collected from roots of fallen tree which pulled up pieces of bedrock. Map-unit 2a.

Petrographic Description. Fine grained, equigranular, massive, allotriomorphic. Mosaics of anhedral nepheline are separated by irregular composite grains of sodic pyroxene. Pyroxene and nepheline contain poikilitic apatite. Wollastonite forms optically continuous, interstitial grains engulfing nepheline, pyroxene and apatite. The rock also contains accessory magnetite, trace of sphene, and minor carbonate.

Map No. 21
Sample No. RP-50

Wollastonite ijolite.

Field Description. Fine to medium grained, equigranular, homogeneous. Sample was collected from outcrop. Map-unit 2a.

Petrographic Description. Fine grained, equigranular, massive, allotriomorphic. The rock consists mainly of anhedral nepheline and sodic pyroxene with minor irregular grains of dark brown garnet. Garnet and pyroxene grains are amoeboid and enclose nepheline and apatite. Acicular wollastonite forms irregular, interstitial grains.

Map No. 22
Sample No. RP-52

Melanite-bearing, wollastonite ijolite.

Field Description. Medium grained, massive, homogeneous, equigranular. Sample was collected from outcrop. Map-unit 2a.

Petrographic Description. Fine to medium grained, equigranular, allotriomorphic. The rock consists predominantly of anhedral to subhedral nepheline and sodic pyroxene. Minor dark brown garnet is associated with the pyroxene. Wollastonite forms acicular, ragged, interstitial grains. Accessory magnetite.

Map No. 23
Sample No. RP-56

Melteigite.

Field Description. Medium grained, equigranular, massive, carbonate-rich ijolite. Sample from outcrop. Map-unit 2a.

Petrographic Description. Fine to medium grained, equigranular to inequigranular-seriate, allotriomorphic. Relatively large anhedral grains of sodic pyroxene occur with altered, anhedral to subrounded, interstitial grains of nepheline. Minor dark brown biotite is marginal to some pyroxene grains. Carbonate is interstitial. Minor amounts of slightly turbid to clear potassium feldspar (?) form amoeboid, optically continuous grains enclosing altered nepheline and possibly some of the pyroxene. Minor sphene is present.

Map No. 24
Sample No. RP-70

Wollastonite - garnet urtite.

Field Description. Fine grained, equigranular, homogeneous. The sample was taken from a resistant lump in residual soil. Map-unit 2a.

Petrographic Description. Fine grained, massive, equigranular, allotriomorphic. Nepheline crystals form an interlocking mosaic. Nepheline is partly engulfed by irregular composite grains of sodic pyroxene. Dark brown garnet forms irregular grains which are commonly associated with the pyroxene. Wollastonite forms ragged grains with a clearly fibrous habit interstitial to the other components. Minor apatite and calcite are present.

Map No. 25
Sample No. RP-81

Olivine–rich silicocarbonatite.

Field Description. Fine grained, magnetic, homogeneous, carbonate–rich. Sample was taken from slumped outcrop. Map–unit 2c.

Petrographic Description. Fine grained, equigranular, massive, allotriomorphic. Oblate fresh grains of olivine are associated with anhedral grains of magnetite and euhedral apatite in an interlocking matrix of carbonate. Minor nepheline (locally altered) is present.

Map No. 26
Sample No. RP-94

Garnet–bearing urtite.

Field Description. Fine to medium grained, equigranular, homogeneous. Sample was taken from a resistant clot in soil. Map–unit 2b.

Petrographic Description. Fine grained, equigranular, allotriomorphic. Anhedral to subhedral nepheline, locally cloudy and altered, forms a mosaic. Sodic pyroxene forms irregular, isolated grains and irregular aggregates. Subhedral to anhedral garnet is disseminated throughout. Apatite is a common minor accessory. Apatite is poikilitic in nepheline.

Map No. 27
Sample No. RP-114

Garnet–bearing ijolite.

Field Description. Fine grained, equigranular, homogeneous. Sample was taken from a resistant clot in soil. Map–unit 2b.

Petrographic Description. Fine grained, equigranular, massive, allotriomorphic. An interlocking mosaic of nepheline grains is divided by stringy aggregates and isolated grains of sodic pyroxene. Minor apatite and magnetite are present. Garnet forms dark brown, subhedral grains which are scattered evenly through the section.

Map No. 28
Sample No. RP-115

Garnet–bearing ijolite.

Field Description. Medium grained, equigranular, massive. The sample is very homogeneous, and was taken from an outcrop exposed by a fallen tree. Map–unit 2b.

Petrographic Description. Fine to medium grained, massive, hypidiomorphic to allotriomorphic. Nepheline forms an interlocking mosaic of angular to subrounded grains separated by irregular composite grains of sodic pyroxene. Dark brown, irregular grains of garnet form a significant but minor component. Biotite, carbonate and apatite are minor phases.

Map No. 29
Sample No. RP-128

Magnetite – olivine sovite.

Field Description. Fine to medium grained, equigranular, homogeneous. Sample was taken from outcrop. Map–unit 4b.

Petrographic Description. Fine to medium grained, equigranular, massive, hypidiomorphic to allotriomorphic. Carbonate forms an interlocking mosaic. Rounded, bead–like grains of fresh olivine are associated with euhedral to subhedral magnetite. Phlogopite and apatite are abundant minor constituents; traces of pyrochlore are present.

Map No. 30

Carbonate–rich biotite ijolite.

Field Description. Fine grained, equigranular, weakly magnetic. Sample was taken from outcrop. Map–unit 2c.

Petrographic Description. Fine grained, equigranular, massive, allotriomorphic. Subrounded, blocky, nepheline crystals form an interlocking mosaic which is divided by isolated grains and stringy aggregates of sodic pyroxene. Euhedral sphene is common; apatite and magnetite are present. Biotite forms larger irregular grains which partially enclose the pyroxene. Interstitial carbonate is abundant.

Map No. 31
Sample No. RP-134

Ijolite.

Field Description. Fine grained, equigranular, massive, carbonate–rich. The sample was taken from a slumped outcrop beneath a fallen tree. Map–unit 2b.

Petrographic Description. Fine grained, equigranular, massive, hypidiomorphic. Rounded to subrounded grains of nepheline form a mosaic, separated by irregular composite grains of sodic pyroxene. Minor biotite occurs between and borders some pyroxene grains. Other phases include euhedral sphene, minor magnetite, and relatively abundant apatite. Carbonate is interstitial.

Map No. 32
Sample No. RP-166

Amphibole sovite.

Field Description. Fine to medium grained. Sample was taken from outcrop. Map–unit 4b.

Petrographic Description. Fine to medium grained, equigranular, massive, hypidiomorphic. An interlocking mosaic of carbonate grains contains random clusters of acicular amphibole crystals. Apatite is abundant, magnetite a minor phase. Some yellowish brown limonite staining is present.

Map No. 33
Sample No. RP-168

Silicocarbonatite.

Field Description. Fine grained, equigranular, magnetic. The outcrop contains discontinuous capillary streaks of carbonate in parallel orientation. Sample was taken from outcrop. Map–unit 2c.

Petrographic Description. Very fine grained, equigranular, massive, hypidiomorphic. Very fine-grained phlogopite and magnetite are intimately intermixed with coarser grained carbonate, which forms nearly 50 percent of the rock. Trace amounts of actinolite and olivine may be present.

Map No. 34
Sample No. RP-217

Wollastonite-bearing, carbonate – melanite ijolite.

Field Description. Fine grained, equigranular, homogeneous. Sample was taken from outcrop. Map-unit 2a.

Petrographic Description. Fine grained, equigranular, massive, allotriomorphic. Anhedral to subrounded nepheline grains form an interlocking mosaic. Irregular grains of sodic pyroxene are weakly zoned; grain margins are slightly more pleochroic than grain cores. Dark brown, subhedral to almost euhedral garnet is interstitial to pyroxene and nepheline. Ragged fibrous, interstitial wollastonite forms a minor component. Carbonate is interstitial. Minor apatite is present.

Map No. 35
Sample No. RP-218

Carbonate-bearing ijolite.

Field Description. Fine to medium grained, equigranular. The rock is rich in mica and carbonate. Sample was taken from outcrop. Map-unit 2b or 2c.

Petrographic Description. Fine grained, equigranular, massive, allotriomorphic. The rock consists mainly of anhedral to subhedral clusters of nepheline and irregular stringy aggregates of bead-like sodic pyroxene. Minor biotite occurs between and marginal to pyroxene grains. Minor magnetite and apatite are common. Carbonate is interstitial and a dominant phase.

Map No. 36
Sample No. RP-226

Alkalic gabbro.

Field Description. Fine grained, inequigranular, porphyritic. Plagioclase phenocrysts are up to 2 cm in size. Sample was taken from outcrop. Map-unit 5g.

Petrographic Description. Fine to medium grained, inequigranular-porphyritic-seriate, hypidiomorphic. Plagioclase is highly saussuritized; some grains form distinct phenocrysts. Pyroxene is generally fresh, and displays weak zoning in larger grains. Small pyroxene grains tend to be anhedral and interstitial, larger grains euhedral. Minor magnetite is present. Pyroxene is locally altered to chlorite and actinolite.

Map No. 37
Sample No. RP-236

Carbonate-rich, nepheline-porphyritic ijolite.

Field Description. Nepheline porphyry. Euhedral nepheline crystals are up to 1 cm across and are set in a biotite – calcite matrix. Sample was taken from outcrop. Map-unit 2f.

Petrographic Description. Fine to medium grained, inequigranular-porphyritic-seriate, hypidiomorphic. Sharply euhedral, fresh nepheline crystals are set in a carbonate-rich (interstitial), allotriomorphic groundmass. Nepheline in the matrix is anhedral to subhedral. Composite grains of sodic pyroxene form irregular stringy clots. Biotite forms irregular, ragged grains with poikilitic inclusions of nepheline and pyroxene. Minor apatite, sphene and magnetite are present.

Map No. 38
Sample No. RP-246

Melanite ijolite.

Field Description. Medium to coarse grained, massive, homogeneous, equigranular. Sample was taken from slumped outcrop. Map-unit 2b.

Petrographic Description. Fine grained, equigranular, massive, allotriomorphic. Anhedral to subhedral, interlocking nepheline grains form a mosaic. Domains of nepheline are separated by irregular composite grains of sodic pyroxene. Irregular amoeboid grains of dark brown garnet contain poikilitic inclusions of pyroxene and nepheline. Some pyroxene has been altered to biotite. Some biotite is poikilitic in pyroxene. Apatite is present, and a trace of interstitial carbonate was noted.

Map No. 39
Sample No. RP-267

Carbonate-rich urtite.

Field Description. Fine to medium grained, homogeneous, carbonate-rich. Sample was taken from outcrop. Map-unit 2b.

Petrographic Description. Fine to medium grained, inequigranular to equigranular, massive, allotriomorphic. Calcic to slightly sodic pyroxene partially encloses some subhedral nepheline crystals. Nepheline generally forms irregular, cloudy, highly altered grains. Minor biotite, magnetite and garnet are present. Carbonate is interstitial and a major component of the rock.

Map No. 40
Sample No. RP-279

Ijolite.

Field Description. Fine to medium grained, equigranular, massive, homogeneous. Sample was taken from slumped outcrop. Map-unit 2b.

Petrographic Description. Fine grained, equigranular, allotriomorphic. Irregular, partially altered nepheline grains form a mosaic which is subdivided by aggregates of subhedral sodic pyroxene grains. Minor biotite, apatite, magnetite, sphene are present. Carbonate is interstitial.

Map No. 41
Sample No. RP-280

Alkalic olivine diabase.

Field Description. Fine grained, inequigranular, porphyritic, dike rock. Phenocrysts of pyroxene are up to 5 mm across, and have a seriate distribution. The dike weathers in relief. Isolated glomeroporphyritic clots of plagioclase are 1-2 mm in diameter. Map-unit 5b.

Petrographic Description. Fine grained, inequigranular, porphyritic-seriate, hypidiomorphic. Euhedral, strongly zoned, pyroxene phenocrysts are set in a matrix of fine-grained plagioclase (An45–54) and granular interstitial pyroxene. Fresh olivine constitutes up to 10 percent of the rock. The rock is generally very fresh-looking. Minor magnetite and calcite are present.

Map No. 42
Sample No. RP-51

Wollastonite – garnet ijolite.

Field Description. Fine to medium grained, equigranular, massive. Sample was taken from outcrop. Map-unit 2a.

Petrographic Description. Medium grained, equigranular, massive, hypidiomorphic. Subhedral to euhedral nepheline crystals form a mosaic. Sodic pyroxene forms an irregular aggregate of bead-like grains interstitial to nepheline. Garnet forms large, amoeboid, composite aggregates partially enclosing nepheline and pyroxene. The wollastonite is interstitial to the other minerals, and forms irregular grains with ragged outlines. Carbonate is also interstitial.

Map No. 43
Sample No. RP-247

Melanite ijolite.

Field Description. Coarse grained, massive, homogeneous, equigranular. In places, the rock is porphyritic with nepheline crystals up to 1 cm across. Sample was taken from slumped outcrop. Map-unit 2b.

Petrographic Description. Medium grained, equigranular, massive, hypidiomorphic. Anhedral to euhedral grains of nepheline form an interlocking mosaic. Sodic pyroxene forms irregular grains which contain irregular inclusions of nepheline. Amoeboid grains of garnet contain irregular grains of sodic pyroxene and nepheline. Biotite occurs as large grains between pyroxene and nepheline crystals and as small inclusions within the sodic pyroxene. Carbonate is interstitial. Sphene is a minor accessory.

Map No. 44
Sample No. RP-326

Melanite ijolite.

Field Description. Coarse grained, equigranular, massive, homogeneous, calcite-bearing. Sample was taken from slumped outcrop. Map-unit 2b.

Petrographic Description. Medium grained, equigranular, hypidiomorphic. Euhedral to subhedral nepheline forms an interlocking mosaic. Dark brown, amoeboid garnet poikilitically encloses some euhedral nepheline. Sodic pyroxene occurs as composite anhedral grains with irregular inclusions of nepheline. Biotite occurs as isolated grains between pyroxene and nepheline. Carbonate is interstitial.

Map No. 45
Sample No. RP-161A

Biotite ijolite.

Field Description. Fine to medium grained, inequigranular, homogeneous dike rock. Mica phenocrysts up to 3 mm across occur in a carbonate-mica groundmass. Outcrop forms a prominent ridge in swamp. Map-unit 5f.

Petrographic Description. Fine to medium grained, inequigranular, seriate, allotriomorphic. Highly altered, subhedral nepheline is enclosed in irregular to bead–like calcic pyroxene and ragged biotite. Minor subhedral to euhedral sphene is present. Carbonate is interstitial.

Map No. 46
Sample No. RP-229

Alkalic gabbro.

Field Description. Fine grained, inequigranular, porphyritic. Green plagioclase phenocrysts are up to 3 to 4 mm across. Sample was taken from outcrop. Map–unit 5g.

Petrographic Description. Fine to medium grained, inequigranular–porphyritic–seriate, hypidiomorphic. Plagioclase is An30–37 in composition and saussuritized. Pyroxene has been extensively altered to chlorite and actinolite. Minor magnetite and calcite (alteration products) are present. A well developed porphyritic texture is not evident in thin section.

Map No. 47
Sample No. RP-161B

Calcite–bearing ijolite.

Field Description. Fine grained mica porphyry. Grey aphanitic groundmass encloses mica phenocrysts up to 8 mm in diameter. Outcrop forms ridge in swamp and is possibly a dike. Sample was taken from outcrop. Map–unit 5a.

Petrographic Description. Fine grained, massive, inequigranular–porphyritic–seriate, allotriomorphic. Calcic pyroxene occurs as bead–like grains which in part poikilitically enclose subhedral nepheline. Calcite is interstitial. Sphene, apatite and magnetite occur in minor amounts. Biotite phenocrysts, up to 5 mm across, have ragged edges. Small dark brown circles enclose tiny unidentified grains within biotite phenocrysts; these may be radioactive decay bombardment haloes enclosing radioactive zircons.

Map No. 48

Orbicular ijolite

Field Description. This very distinctive rock consists of finely laminated orbicules up to 3 cm in diameter. Individual laminae are about 0.5 mm thick. The cores of some orbicules consist of fine– to medium–grained ijolite. The orbicular rock occurs in bands up to 15 cm wide in medium–grained, equigranular, homogeneous ijolite. Orbicular bands have sharp contacts with medium grained ijolite. Sample was taken from pit beneath slumped rock. Orbicular ijolite.

Petrographic Description. The matrix consists of fine–grained, subhedral nepheline enclosed in anhedral biotite, sodic pyroxene and garnet. An unidentified, cloudy, highly altered mineral constitutes approximately 5 percent of the sample. Minor magnetite is present. The orbicules consist of very fine–grained, anhedral nepheline, garnet and the cloudy highly altered mineral. The orbicules also contain minor pyroxene, fine– to medium–grained poikilitic biotite, and magnetite. The cores of the orbicules are similar to the enclosing matrix. On the basis of microprobe data Watkinson (1976) postulated that the cloudy, highly altered mineral may be former melilite, now altered to chlorite.

TABLE A-2. MAJOR ELEMENT ANALYSES OF WHOLE-ROCK SAMPLES FROM THE PRAIRIE LAKE CARBONATITE COMPLEX

	Unit 2A					
Map No.	17	21	22	23	24	42
SiO_2	42.3	43.3	43.7	46.3	41.2	43.4
Al_2O_3	17.40	17.80	16.50	5.28	18.40	6.55
Fe_2O_3	3.71	3.70	3.40	3.21	3.88	5.31
FeO	2.38	1.05	1.40	7.28	1.82	6.02
MgO	1.52	0.39	0.51	7.14	1.12	3.54
CaO	15.8	18.3	18.3	19.6	16.5	25.0
Na_2O	7.92	9.23	7.71	2.87	8.89	3.09
K_2O	4.30	4.11	4.37	2.29	4.12	1.29
TiO_2	0.83	0.60	0.53	1.15	0.92	0.70
P_2O_5	0.65	0.09	0.65	0.04	1.20	0.07
S	0.00	0.00	0.01	0.00	0.03	0.01
MnO	0.33	0.27	0.28	0.63	0.29	0.59
CO_2	2.14	1.10	1.78	3.70	1.18	3.30
H_2O +	0.85	0.35	1.42	0.28	0.30	0.50
H_2O −	0.36	0.40	0.49	0.41	0.36	0.30

	Unit 2A			Unit 2B		
Map No.	12	20	34	26	27	28
SiO_2	24.2	37.5	38.2	37.8	43.4	42.3
Al_2O_3	3.40	14.0	16.3	18.3	18.2	16.5
Fe_2O_3	12.10	4.29	3.33	4.58	8.40	4.20
FeO	8.15	3.15	1.82	2.17	3.99	4.48
MgO	3.00	1.84	1.04	1.74	4.07	3.73
CaO	31.0	21.0	19.8	16.0	13.0	13.8
Na_2O	1.05	7.23	8.34	8.13	7.22	7.82
K_2O	0.41	3.12	3.85	3.85	3.63	3.63
TiO_2	0.20	1.58	0.92	1.71	1.17	1.43
P_2O_5	8.40	3.86	0.61	1.90	0.78	0.34
S	1.94	0.03	0.03	0.00	0.10	0.04
MnO	0.59	0.29	0.28	0.23	0.34	0.34
CO_2	3.90	1.92	5.50	1.37	0.28	1.52
H_2O +	0.73	0.06	0.13	0.45	1.04	0.09
H_2O −	0.18	0.36	0.33	0.24	0.36	0.34

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Map No.	Sample No.	Map No.	Sample No.
17	J-10	12	159-J
21	RP-50	20	RP-28
22	RP-52	34	RP-217
23	RP-56	26	RP-94
24	RP-70	27	RP-114
42	RP-51	28	RP-115

TABLE A-2. CONTINUED.

	Unit 2B					
Map No.	**31**	**35**	**38**	**39**	**40**	**43**
SiO_2	38.2	30.4	38.8	31.7	37.8	38.7
Al_2O_3	14.8	12.1	12.9	10.1	14.3	19.1
Fe_2O_3	3.18	3.73	5.36	2.18	3.96	5.57
FeO	3.78	4.83	3.92	2.52	4.34	2.59
MgO	3.23	3.01	3.59	4.00	2.95	2.01
CaO	15.9	22.9	18.3	26.6	15.5	13.0
Na_2O	8.10	5.35	6.67	4.01	7.68	9.18
K_2O	3.58	3.22	2.77	2.76	3.82	4.16
TiO_2	2.03	0.58	2.17	1.91	1.18	2.35
P_2O_5	1.00	2.64	1.62	0.09	0.18	0.39
S	0.07	0.17	0.00	0.00	0.83	0.06
MnO	0.30	0.37	0.32	0.33	0.39	0.24
CO_2	4.30	10.80	2.05	14.3	6.40	1.78
H_2O +	0.04	1.19	0.19	0.07	0.05	0.13
H_2O -	0.32	0.26	0.45	0.41	0.39	0.34

	Unit 2B		Unit 2C,F			
Map No.	**44**	**1**	**25**	**33**	**7**	**11**
SiO_2	35.0	36.1	17.9	17.7	39.4	19.2
Al_2O_3	11.4	12.7	3.40	2.70	15.10	1.01
Fe_2O_3	7.23	8.09	7.33	8.87	1.59	22.20
FeO	3.57	5.68	4.83	7.14	5.61	14.10
MgO	2.13	3.45	8.60	14.40	3.17	18.70
CaO	21.8	18.2	38.6	20.6	11.8	9.12
Na_2O	5.85	4.64	0.03	0.40	1.00	0.13
K_2O	2.22	2.34	0.00	2.75	8.75	1.03
TiO_2	3.75	1.20	1.73	3.47	1.16	1.39
P_2O_5	1.90	3.40	5.92	2.90	0.80	0.00
S	0.02	0.32	0.07	0.26	0.10	0.02
MnO	0.32	0.39	0.61	0.28	0.28	0.66
CO_2	2.75	0.75	7.80	14.70	7.50	8.20
H_2O +	0.10	1.02	1.18	0.74	1.50	2.47
H_2O -	0.33	0.26	0.28	0.00	0.33	0.28

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Map No.	Sample No.	Map No.	Sample No.
31	RP-134	44	RP-326
35	RP-218	1	JM59-1
38	RP-246	25	RP-81
39	RP-267	33	RP-168
40	RP-279	7	169-N
43	RP-247	11	204K

TABLE A-2. CONTINUED.

	Unit 2C,F					
Map No.	**14**	**16**	**30**	**2**	**3**	**4**
SiO_2	35.5	36.2	34.4	13.5	30.2	26.7
Al_2O_3	11.8	12.9	12.6	1.7	11.8	3.7
Fe_2O_3	4.00	3.21	3.23	15.40	3.49	5.77
FeO	6.30	6.02	4.27	8.88	4.07	5.97
MgO	3.05	3.80	3.49	10.40	3.00	11.80
CaO	18.0	18.0	19.2	22.7	25.2	21.8
Na_2O	1.52	1.98	6.38	0.16	2.08	0.30
K_2O	4.44	3.40	3.47	0.31	2.15	4.02
TiO_2	1.53	2.53	2.15	0.00	0.10	4.01
P_2O_5	1.10	1.55	1.68	12.00	1.19	1.80
S	0.33	0.41	0.04	0.02	0.12	0.01
MnO	0.38	0.33	0.24	1.03	0.32	0.54
CO_2	9.9	5.4	7.8	10.4	12.1	12.5
H_2O +	1.68	1.95	0.01	1.23	2.24	0.52
H_2O -	0.42	0.48	0.47	0.28	0.23	0.34

	Unit 2C,F					Unit 4A,B
Map No.	**5**	**6**	**8**	**9**	**37**	**15**
SiO_2	18.1	24.2	10.4	37.5	31.0	3.27
Al_2O_3	1.5	4.06	2.4	15.3	12.2	0.30
Fe_2O_3	11.00	9.39	2.93	2.62	2.76	1.46
FeO	7.72	6.85	6.19	5.96	4.48	3.01
MgO	16.70	16.80	8.80	3.09	2.93	3.80
CaO	21.3	14.0	31.1	14.0	22.2	45.6
Na_2O	0.08	0.16	0.54	4.31	5.86	0.00
K_2O	1.36	3.99	1.71	5.57	3.34	0.01
TiO_2	2.75	3.12	0.30	2.12	1.15	0.31
P_2O_5	1.30	1.70	3.08	1.10	1.71	2.24
S	0.14	0.42	0.54	0.20	0.09	0.35
MnO	0.29	0.27	0.54	0.27	0.39	0.38
CO_2	17.5	12.3	30.2	6.7	12.2	40.0
H_2O +	1.53	1.89	0.51	1.24	0.09	0.28
H_2O -	0.37	0.69	0.20	0.28	0.42	0.40

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Map No.	Sample No.	Map No.	Sample No.
14	DP-26F	5	169-6
16	JM59-46	6	169-10
30	RP-131	8	169-0
2	JM59-12	9	204B
3	JM59-21	37	RP-236
4	JM59-35	15	DP-61C

TABLE A-2. CONTINUED.

	Unit 4A,B			Unit 5F		Unit 5B,C,E,G
Map No.	29	32	10	47	45	18
SiO_2	4.90	5.42	1.80	30.8	38.4	43.0
Al_2O_3	0.50	0.10	0.70	5.88	11.50	11.5
Fe_2O_3	3.66	6.14	2.93	6.59	2.38	3.5
FeO	3.01	3.29	2.77	7.21	8.75	9.31
MgO	2.40	2.80	2.10	6.99	5.32	12.40
CaO	47.6	42.0	47.1	23.4	13.7	12.20
Na_2O	0.03	0.65	0.13	1.80	2.02	2.53
K_2O	0.12	0.07	0.17	1.83	5.45	1.17
TiO_2	0.15	0.41	0.00	3.59	3.80	1.65
P_2O_5	1.75	3.78	4.12	0.72	0.14	1.00
S	0.10	0.19	0.21	0.11	0.13	0.02
MnO	0.69	0.81	0.30	0.59	0.43	0.22
CO_2	33.5	31.5	38.0	8.20	4.75	0.94
H_2O +	0.11	0.18	0.01	0.45	1.25	1.07
H_2O -	0.45	0.52	0.05	0.33	0.35	0.35

	Unit 5B,C,E,G					Orbicular Ijolite
Map No.	41	13	19	36	46	48
SiO_2	42.8	45.5	40.4	49.3	49.0	37.2
Al_2O_3	12.8	16.1	11.8	15.2	14.9	14.0
Fe_2O_3	11.2	3.9	5.61	2.70	1.90	10.1
FeO	2.87	9.59	6.65	9.31	9.10	4.34
MgO	9.67	4.01	2.90	4.50	4.78	3.81
CaO	11.50	9.28	15.00	8.59	8.41	17.6
Na_2O	3.09	4.82	5.36	4.16	5.17	4.38
K_2O	1.45	1.99	4.21	2.41	1.08	2.72
TiO_2	1.81	1.74	2.70	1.58	1.46	3.47
P_2O_5	1.20	1.40	0.54	1.20	1.10	0.44
S	0.02	0.07	0.22	0.07	0.05	0.03
MnO	0.23	0.27	0.50	0.22	0.21	0.32
CO_2	0.43	0.15	3.72	0.21	1.16	0.69
H_2O +	0.59	1.24	0.27	0.47	2.12	1.02
H_2O -	0.74	0.42	0.37	0.27	0.41	0.28

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Map No.	Sample No.	Map No.	Sample No.
29	RP-128	41	RP-280
32	RP-166	13	DP-1
10	204D	19	RP-10
47	RP-161B	36	RP-226
45	RP-161A	46	RP-229
18	RP-7A	48	Orbicular Ijolite

TABLE A-3. TRACE ELEMENT ANALYSES OF WHOLE-ROCK SAMPLES FROM THE PRAIRIE LAKE CARBONATITE COMPLEX

	Unit 2A					
Map No.	17	21	22	23	24	42
Ag	<1	<1	<1	<1	<1	<1
Au						
As						
Ba	120	70	60	380	100	460
Be	10	7	7	15	10	8
Bi						
Co	10	5	5	15	10	15
Cr	<5	5	<5	15	<5	5
Cu	5	5	<5	5	5	5
Ga	20	15	20	15	25	25
Hg						
Li	<3	<3	<3	3	<3	5
Mn						
Mo	<1	<1	<1	<1	<1	<1
Nb	150	100	60	300	100	80
Pb	<10	<10	<10	<10	<10	<10
Rb	90	50	130	30	60	20
Sb						
Sc	5	<5	<5	<5	5	<5
Sn	<1	<1	<1	<1	<1	<1
Sr	900	400	700	1500	900	2500
Ti						
V	150	70	90	250	150	150
Y	70	35	40	30	60	35
Zn	115	75	90	310	115	290
Zr	600	450	400	600	600	150
La	<10	<10	<10	<10	60	<10
Nd	<300	<300	<300	<300	<300	<300
Ce	<500	<500	<500	<500	<500	<500

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Map No.	Sample No.	Map No.	Sample No.
17	J-10	23	RP-56
21	RP-50	24	RP-70
22	RP-52	42	RP-51

TABLE A-3. CONTINUED.

	Unit 2A			Unit 2B		
Map.No.	12	20	34	26	27	28
Ag	<1	<1	<1	<1	<1	<1
Au						
As						
Ba	120	60	140	80	140	80
Be	40	10	5	15	10	10
Bi						
Co	30	10	<5	10	10	15
Cr	<5	5	5	<5	<5	<5
Cu	60	5	5	5	10	5
Ga	45	20	15	25	20	20
Hg						
Li	5	<3	<3	<3	<3	3
Mn						
Mo	<1	<1	<1	<1	<1	<1
Nb	3000	150	150	100	150	100
Pb	60	<10	25	<10	<10	<10
Rb		40	50	50	30	40
Sb						
Sc	<5	7	<5	7	6	8
Sn	1	6	1	3	3	2
Sr	2000	1500	1500	2000	600	700
Ti						
V	150	200	100	200	250	200
Y	150	200	60	200	100	150
Zn	2100	300	60	500	105	180
Zr	350	1000	500	700	600	700
La	700	200	<10	100	35	20
Nd	400	<300	<300	<300	<300	<300
Ce	3000	<500	<500	<500	<500	<500

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Map No.	Sample No.	Map No.	Sample No.
12	159-J	26	RP-94
20	RP-28	27	RP-114
34	RP-217	28	RP-115

TABLE A-3. CONTINUED.

	Unit 2B					
Map No.	31	35	38	39	40	43
Ag	<1	<1	<1	<1	<1	<1
Au						
As						
Ba	240	200	120	190	600	90
Be	8	2	7	6	10	5
Bi						
Co	10	10	10	5	10	10
Cr	<5	<5	5	<45	<5	5
Cu	15	10	5	5	10	15
Ga	15	10	25	10	20	15
Hg						
Li	5	3	5	5	5	<3
Mn						
Mo	<1	<1	<1	<1	<1	<1
Nb	400	<10	150	700	250	100
Pb	<10	<10	<10	<10	<10	<10
Rb	40	40	30	20	50	30
Sb						
Sc	<5	<5	10	5	5	8
Sn	3	1	5	1	5	4
Sr	2000	2500	1000	3000	2000	700
Ti						
V	100	60	250	200	2000	150
Y	30	<10	250	90	20	200
Zn	125	105	180	160	170	105
Zr	1000	60	1000	700	700	1000
La	80	100	80	<10	<10	<10
Nd	<300	<300	<300	<300	<300	<300
Ce	<500	<500	500	<500	<500	<500

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Map No.	Sample No.	Map No.	Sample No.
31	RP-134	39	RP-267
35	RP-218	40	RP-279
38	RP-246	43	RP-247

TABLE A-3. CONTINUED.

	Unit 2B		Unit 2C,F			
Map No.	44	1	25	33	7	11
Ag	<1	1	<1	<1	<1	<1
Au						
As						
Ba	100	260	80	2550	372	110
Be	5	15	9	25	5	<1
Bi						
Co	10	20	25	60	10	30
Cr	20	<5	30	290	<5	110
Cu	5	20	25	105	5	<5
Ga	25	20	10	5	20	9
Hg						
Li	5	<3	<3	20	10	5
Mn						
Mo	<1	<1	<1	<1	<1	<1
Nb	200	20	400	250	400	150
Pb	15	190	25	30	<10	20
Rb	20		<10	70		
Sb						
Sc	15	<5	<5	20	<5	15
Sn	8	1	<1	3	<1	8
Sr	1000	1000	2000	3500	1000	400
Ti						
V	250	100	100	100	70	200
Y	350	20	200	20	15	<10
Zn	210	1080	250	510	240	490
Zr	1000	20	700	250	400	500
La	80	100	600	800	<10	<10
Nd	<300	<300	700	350	<300	<300
Ce	<500	<1000	1500	3000	<1000	<1000

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Map No.	Sample No.	Map No.	Sample No.
44	RP-326	33	RP-168
1	JM59-1	7	169-N
25	RP-81	11	204K

TABLE A-3. CONTINUED.

	Unit 2C,F					
Map No.	**14**	**16**	**30**	**2**	**3**	**4**
Ag	<1	<1	<1	<1	<1	<1
Au						
As						
Ba	4100	780	220	240	370	840
Be	8	10	7	<1	4	6
Bi						
Co	15	25	20	15	5	40
Cr	5	<5	<5	<5	<5	200
Cu	30	35	10	<5	10	200
Ga	20	20	15	5	15	7
Hg						
Li	15	5	3	40	30	5
Mn						
Mo	<1	<1	<1	<1	<1	<1
Nb	400	500	400	70	150	400
Pb	<10	<10	<10	90	80	10
Rb	60	40	50			
Sb						
Sc	5	<5	<5	<5	<5	15
Sn	5	4	<1	4	1	1
Sr	3000	3500	2000	2000	1000	2000
Ti						
V	250	150	150	90	90	150
Y	50	50	40	200	60	40
Zn	200	170	145	450	110	400
Zr	1000	600	500	400	450	100
La	<10	100	100	900	60	250
Nd	<300	<300	<300	900	<300	<300
Ce	<500	<500	<500	5000	<1000	1500

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Map No.	Sample No.	Map No.	Sample No.
14	DP-26F	2	JM59-12
16	JM59-46	3	JM59-21
30	RP-131	4	JM59-35

TABLE A-3. CONTINUED.

	Unit 2C,F					Unit 4A,B
Map No.	5	6	8	9	37	15
Ag	<1	<1	<1	<1	<1	<1
Au						
As						
Ba	280	2220	550	700	350	200
Be	<1	6	12	4	6	<1
Bi						
Co	30	35	15	10	10	15
Cr	380	425	138	<5	<5	30
Cu	10	105	45	10	5	10
Ga	3	7	5	15	15	10
Hg						
Li	<3	25	130	5	5	<3
Mn						
Mo	<1	<1	<1	<1	<1	<1
Nb	300	600	600	150	250	350
Pb	20	30	20	10	20	20
Rb					40	<10
Sb						
Sc	10	15	15	<5	<5	<5
Sn	8	5	<1	1	3	<1
Sr	1000	800	2000	1000	2000	3500
Ti						
V	70	100	90	90	70	50
Y	20	25	60	30	90	150
Zn	1190	720	260	200	200	160
Zr	250	200	100	400	600	150
La	<10	<10	200	<10	150	1000
Nd	<300	<300	<300	<300	<300	1000
Ce	<1000	<1000	<1000	<1000	<500	1000

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Map No.	Sample No.
5	169-6
6	169-10
8	169-0
9	204B
37	RP-236
15	DP-61C

TABLE A-3. CONTINUED.

	Unit 4A,B			Unit 5F		Unit 5B,C,E,G
Map No.	29	32	10	47	45	18
Ag	<1	<1	<1	<1	<1	<1
Au						
As						
Ba	680	1060	360	450	840	580
Be	<1	5	<1	10	8	5
Bi						
Co	10	10	5	40	20	70
Cr	5	<5	360	70	30	680
Cu	10	10	5	55	10	120
Ga	20	<1	<1	8	20	9
Hg						
Li	<3	5	<3	<3	5	5
Mn						
Mo	<1	<1	<1	<1	<1	<1
Nb	250	60	700	450	1000	70
Ni						400
Pb	15	<10	20	<10	<10	<10
Rb	<10	<10		20	100	20
Sb						
Sc	<5	10	<5	10	5	20
Sn	<1	<1	<1	<1	2	<1
Sr	3500	3500	4000	2000	1500	800
Ti						
V	150	150	300	80	250	200
Y	150	70	60	60	20	25
Zn	130	320	85	390	340	115
Zr	150	150	100	600	600	200
La	500	250	150	200	80	50
Nd	700	300	<300	<300	<300	<300
Ce	600	1000	1000	500	<500	<500

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Map No.	Sample No.
29	RP-128
32	RP-166
10	204D

Map No.	Sample No.
47	RP-161B
45	RP-161A
18	RP-7A

TABLE A-3. CONTINUED.

	Unit 5B,C,E,G					Orbicular Ijolite
Map No.	41	13	19	36	46	48
Ag	<1	<1	<1	<1	<1	<1
Au						
As						
Ba	820	780	50	1490	480	200
Be	4	6	10	4	3	10
Bi						
Co	65	55	15	45	40	25
Cr	540	5	10	35	40	<5
Cu	160	180	15	55	60	<5
Ga	10	10	20	10	10	20
Hg						
Li	5	10	<3	10	5	<3
Mn						
Mo	<1	<1	<1	<1	<1	<1
Nb	100	90	450	80	100	500
Ni	275	15	<5	25	30	
Pb	<10	<10	<10	<10	30	<10
Rb	20	30	130	30	10	40
Sb						
Sc	20	9	8	20	20	<5
Sn	<1	<1	9	<1	<1	<1
Sr	1500	1500	1000	900	900	2500
Ti						
V	200	100	300	150	100	150
Y	30	35	200	35	25	50
Zn	125	170	230	130	180	540
Zr	250	200	1000	200	200	500
La	100	100	<10	80	80	200
Nd	<300	<300	<300	<300	<300	<300
Ce	500	<500	<500	<500	<500	1000

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Map No.	Sample No.	Map No.	Sample No.
41	RP-280	36	RP-226
13	DP-1	46	RP-229
19	RP-10	48	Orbicular Ijolite

TABLE A-4. NORMATIVE MINERALS (ALKALIC ROCKS) FOR WHOLE-ROCK SAMPLES FROM THE PRAIRIE LAKE CARBONATITE COMPLEX

	Unit 2A					
Map No.	**17**	**21**	**22**	**23**	**24**	**42**
Quartz	0.0	0.0	0.0	0.0	0.0	0.0
Corundum	0.0	0.0	0.0	0.0	0.0	0.0
Orthoclase	3.77	0.0	5.51	8.43	0.0	0.56
Albite	4.40	0.0	3.14	0.03	2.87	5.85
Leucite	0.0	0.0	0.0	0.0	0.0	0.0
Kalsilite	0.0	0.0	0.0	0.0	0.0	0.0
Nepheline	45.40	50.96	42.61	10.67	51.08	14.82
Carnegieite	0.0	0.02	0.0	0.0	0.01	0.0
Na_2SiO_3	0.0	0.0	0.0	0.0	0.0	0.0
Acmite	0.99	8.01	3.85	8.41	2.09	0.0
Thenardite	0.09	0.09	0.09	0.09	0.31	0.09
Gehlenite	0.0	0.0	0.0	0.0	0.0	0.36
Akermanite	0.0	1.11	0.0	0.0	0.0	0.0
Fe-Aker.	0.0	2.36	0.0	0.0	0.0	0.0
Wollastonite	16.73	29.07	26.11	29.01	18.17	29.93
Enstatite	3.77	0.15	1.27	15.42	2.79	8.78
Ferrosilite	4.99	0.38	3.09	12.66	3.88	12.16
Forsterite	0.0	0.29	0.0	1.61	0.0	0.0
Fayalite	0.0	0.79	0.0	1.46	0.0	0.0
Andradite	10.71	2.96	6.58	0.0	10.04	16.89
Hematite	0.0	0.0	0.0	0.30	0.0	0.0
Magnetite	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	2.04	0.0	1.30	2.82	2.26	1.72
Perovskite	0.0	1.02	0.0	0.0	0.0	0.0
Rutile	0.0	0.0	0.0	0.0	0.0	0.0
Apatite	1.54	0.21	1.54	0.09	4.02	0.17
Calcite	4.86	2.50	4.04	8.41	2.68	7.50
Magnesite	0.0	0.0	0.0	0.0	0.0	0.0
Fluorite	0.0	0.0	0.0	0.0	0.0	0.0
Zircon	0.0	0.0	0.0	0.0	0.0	0.0
Baddeleyite	0.0	0.0	0.0	0.0	0.0	0.0
H_2O	1.21	0.75	1.91	0.69	0.66	0.80

Notes: For sample descriptions, see Table A-1. Alkalic norms were calculated using the method of LeBas (1973).

Map No.	Sample No.	Map No.	Sample No.
17	J-10	23	RP-56
21	RP-50	24	RP-70
22	RP-52	42	RP-51

TABLE A-4 CONTINUED.

	Unit 2A			Unit 2B		
Map No.	**12**	**20**	**34**	**26**	**27**	**28**
Quartz	0.0	0.0	0.0	0.0	0.0	0.0
Corundum	0.0	0.0	0.0	0.0	0.0	0.0
Orthoclase	0.0	0.0	0.0	0.0	4.66	0.0
Albite	0.0	0.0	0.0	0.0	9.54	2.33
Leucite	0.0	0.0	0.0	0.0	0.0	0.0
Kalsilite	1.38	0.0	0.38	0.0	0.0	0.0
Nepheline	0.0	38.69	46.33	47.74	35.23	45.01
Carnegieite	0.0	1.37	0.0	4.54	0.0	0.85
Na_2SiO_3	0.0	0.0	0.0	0.0	0.0	0.0
Acmite	0.0	4.75	6.18	1.12	0.0	0.0
Thenardite	2.41	0.31	0.31	0.09	1.11	0.44
Gehlenite	7.94	0.0	0.0	0.0	8.57	0.07
Akermanite	2.59	0.0	0.0	0.45	0.0	0.0
Fe-Aker.	4.72	0.0	0.0	0.39	0.0	0.0
Wollastonite	16.95	19.80	20.86	12.01	15.07	18.52
Enstatite	5.54	3.32	2.58	3.99	8.13	9.25
Ferrosilite	11.97	6.33	3.86	4.08	6.42	8.86
Forsterite	0.67	0.0	0.0	0.11	1.37	0.0
Fayalite	1.59	0.0	0.0	0.13	1.20	0.0
Andradite	1.74	8.42	3.80	13.34	0.0	4.32
Hematite	11.58	0.0	0.0	0.0	3.41	2.85
Magnetite	0.0	0.0	0.0	0.0	0.0	0.0
Sphene	0.0	1.32	1.00	0.0	2.87	3.51
Perovskite	0.0	1.77	0.87	2.91	0.0	0.0
Rutile	0.34	0.0	0.0	0.0	0.0	0.0
Apatite	0.0	9.14	1.44	4.50	1.85	0.80
Calcite	19.88	4.36	12.50	3.11	0.64	3.45
Magnesite	8.86	0.0	0.0	0.0	0.0	0.0
Fluorite	0.0	0.0	0.0	0.0	0.0	0.0
Zircon	0.0	0.0	0.0	0.0	0.0	0.0
Baddeleyite	0.0	0.0	0.0	0.0	0.0	0.0
H_2O	0.91	0.42	0.46	0.69	1.40	0.43

Notes: For sample descriptions, see Table A-1. Alkalic norms were calculated using the method of LeBas (1973).

Map No.	Sample No.	Map No.	Sample No.
12	159-J	26	RP-94
20	RP-28	27	RP-114
34	RP-217	28	RP-115

TABLE A-4 CONTINUED.

Map No.	Unit 2B 31	35	38	39	40	43
Quartz	0.0	0.0	0.0	0.0	0.0	0.0
Corundum	0.0	0.0	0.0	0.0	0.0	0.0
Orthoclase	0.0	7.31	0.0	5.87	18.05	0.0
Albite	0.0	5.29	0.0	4.12	18.37	0.0
Leucite	0.0	0.0	0.0	0.0	0.0	0.0
Kalsilite	0.72	0.0	0.0	0.0	0.0	0.0
Nepheline	41.72	24.58	34.35	21.88	9.45	51.58
Carnegieite	0.0	0.0	2.53	0.0	0.0	3.03
Na_2SiO_3	0.0	0.0	0.0	0.0	0.0	0.0
Acmite	8.42	0.0	4.56	0.0	0.0	0.12
Thenardite	0.75	1.86	0.09	0.09	9.17	0.66
Gehlenite	0.0	3.09	0.0	1.56	11.06	0.0
Akermanite	0.15	0.0	1.04	0.0	0.0	0.0
Fe-Aker.	0.12	0.0	0.77	0.0	0.0	0.0
Wollastonite	15.67	8.25	15.71	12.99	3.63	10.36
Enstatite	7.90	3.64	8.14	8.00	2.00	4.99
Ferrosilite	7.40	4.58	7.13	4.23	1.48	5.20
Forsterite	0.04	2.68	0.27	1.35	3.72	0.0
Fayalite	0.04	3.72	0.26	0.79	3.05	0.0
Andradite	0.0	0.0	11.25	0.0	0.0	10.75
Hematite	0.27	3.53	0.25	2.18	0.0	2.15
Magnetite	0.0	0.30	0.0	0.0	5.75	0.0
Sphene	0.0	1.42	0.0	4.69	2.89	5.14
Perovskite	3.46	0.0	3.69	0.0	0.0	0.43
Rutile	0.0	0.0	0.0	0.0	0.0	0.0
Apatite	2.37	6.25	3.83	0.21	0.43	0.92
Calcite	9.77	24.54	4.66	32.49	14.54	4.04
Magnesite	0.0	0.0	0.0	0.0	0.0	0.0
Fluorite	0.0	0.0	0.0	0.0	0.0	0.0
Zircon	0.0	0.0	0.0	0.0	0.0	0.0
Baddeleyite	0.0	0.0	0.0	0.0	0.0	0.0
H_2O	0.36	1.45	0.64	0.48	0.44	0.47

Notes: For sample descriptions, see Table A-1. Alkalic norms were calculated using the method of LeBas (1973).

Map No.	Sample No.	Map No.	Sample No.
31	RP-134	39	RP-267
35	RP-218	40	RP-279
38	RP-246	43	RP-247

TABLE A-4 CONTINUED.

	Unit 2B		Unit 2C,F			
Map No.	44	1	25	33	7	11
Quartz	0.0	0.0	0.0	0.0	0.0	0.26
Corundum	0.0	0.0	0.0	0.0	3.70	0.0
Orthoclase	0.0	8.00	0.0	0.98	50.38	5.51
Albite	0.0	9.73	0.0	0.0	0.80	0.0
Leucite	0.0	0.0	0.0	10.78	0.0	0.0
Kalsilite	0.0	0.0	0.0	0.0	0.0	0.0
Nepheline	27.53	12.20	0.0	0.0	2.65	0.0
Carnegieite	4.98	0.0	0.0	0.0	0.0	0.0
Na_2SiO_3	0.0	0.0	0.0	0.0	0.0	0.0
Acmite	2.12	0.0	0.0	0.0	0.0	0.25
Thenardite	0.22	3.54	0.07	0.92	1.11	0.22
Gehlenite	0.0	13.65	9.14	0.0	2.91	0.0
Akermanite	0.0	0.0	42.76	0.0	0.0	0.0
Fe-Aker.	0.0	0.0	16.92	0.0	0.0	0.0
Wollastonite	12.90	13.11	-15.71	0.0	0.0	0.0
Enstatite	5.23	5.69	-9.99	0.0	0.0	0.0
Ferrosilite	7.15	7.41	-4.69	0.0	0.0	0.0
Forsterite	0.0	2.01	10.97	22.57	5.50	30.81
Fayalite	0.0	2.90	5.68	4.87	7.09	6.84
Andradite	20.67	0.0	0.79	0.0	0.0	0.0
Hematite	0.0	8.11	7.09	0.0	0.0	0.0
Magnetite	0.0	0.0	0.0	12.89	2.31	32.13
Sphene	0.04	2.94	0.0	0.0	0.0	0.0
Perovskite	6.36	0.0	1.57	0.0	0.0	0.0
Rutile	0.0	0.0	0.0	3.47	1.16	1.39
Apatite	4.64	8.05	14.01	6.86	1.89	0.0
Calcite	6.25	1.70	17.72	29.92	17.04	16.26
Magnesite	0.0	0.0	0.0	2.92	0.0	1.99
Fluorite	0.0	0.0	0.0	0.0	0.0	0.0
Zircon	0.0	0.0	0.0	0.0	0.0	0.0
Baddeleyite	0.0	0.0	0.0	0.0	0.0	0.0
H_2O	0.43	1.28	3.46	0.74	1.83	2.75

Notes: For sample descriptions, see Table A-1. Alkalic norms were calculated using the method of LeBas (1973).

Map No.	Sample No.
44	RP-326
1	JM59-1
25	RP-81

Map No.	Sample No.
33	RP-168
7	169-N
11	204K

TABLE A-4 CONTINUED.

	Unit 2C,F					
Map No.	**14**	**16**	**30**	**2**	**3**	**4**
Quartz	12.06	13.37	0.0	6.34	4.91	0.0
Corundum	3.42	0.95	0.0	1.26	0.0	0.0
Orthoclase	26.21	20.07	3.80	1.83	12.69	10.56
Albite	0.0	0.07	0.0	0.54	12.68	0.0
Leucite	0.0	0.0	0.48	0.0	0.0	7.54
Kalsilite	0.0	0.0	0.0	0.0	0.0	0.0
Nepheline	0.0	0.0	33.77	0.0	0.0	0.0
Carnegieite	0.0	0.0	0.0	0.0	0.0	0.0
Na_2SiO_3	0.0	0.0	0.0	0.0	0.0	0.0
Acmite	0.0	0.0	6.04	0.0	0.0	1.95
Thenardite	3.48	4.52	0.44	0.22	1.33	0.09
Gehlenite	9.62	22.13	0.0	0.0	18.83	0.0
Akermanite	0.0	0.0	0.0	0.0	0.0	0.0
Fe-Aker.	0.0	0.0	0.0	0.0	0.0	0.0
Wollastonite	0.0	0.0	10.01	0.0	0.91	1.42
Enstatite	0.0	0.0	5.00	0.0	0.51	1.02
Ferrosilite	0.0	0.0	4.79	0.0	0.36	0.27
Forsterite	5.30	6.60	2.56	10.13	4.85	19.78
Fayalite	6.94	6.97	2.71	4.25	3.73	5.79
Andradite	0.0	0.0	0.0	0.0	0.0	0.0
Hematite	0.0	0.0	1.14	0.0	0.0	0.0
Magnetite	5.81	4.66	0.0	22.37	5.01	7.40
Sphene	0.0	0.0	7.73	0.0	0.25	9.84
Perovskite	0.0	0.0	0.0	0.0	0.0	0.0
Rutile	1.53	2.53	0.0	0.10	0.0	0.0
Apatite	2.60	3.61	3.98	28.40	2.82	4.26
Calcite	22.49	12.27	17.72	12.30	27.49	28.40
Magnesite	0.0	0.0	0.0	9.52	0.0	0.0
Fluorite	0.0	0.0	0.0	0.0	0.0	0.0
Zircon	0.0	0.0	0.0	0.0	0.0	0.0
Baddeleyite	0.0	0.0	0.0	0.0	0.0	0.0
H_2O	2.10	2.43	0.48	1.51	2.47	0.86

Notes: For sample descriptions, see Table A-1. Alkalic norms were calculated using the method of LeBas (1973).

Map No.	Sample No.	Map No.	Sample No.
14	DP-26F	2	JM59-12
16	JM59-46	3	JM59-21
30	RP-131	4	JM59-35

TABLE A-4 CONTINUED.

	Unit 2C,F					Unit 4A,B
Map No.	**5**	**6**	**8**	**9**	**37**	**15**
Quartz	0.62	0.0	1.16	0.0	0.0	0.0
Corundum	0.08	0.0	0.55	0.12	0.0	0.29
Orthoclase	8.03	13.84	10.09	27.19	6.23	0.0
Albite	0.0	0.0	0.0	12.19	4.88	0.0
Leucite	0.0	6.51	0.0	0.0	0.0	0.0
Kalsilite	0.0	0.0	0.0	0.0	0.0	0.03
Nepheline	0.0	0.0	0.0	11.95	28.95	0.0
Carnegieite	0.0	0.0	0.0	0.0	0.0	0.0
Na_2SiO_3	0.0	0.0	0.0	0.0	0.0	0.0
Acmite	0.0	0.0	0.0	0.0	1.86	0.0
Thenardite	0.18	0.37	1.24	2.21	0.97	0.0
Gehlenite	0.0	0.0	0.0	9.81	0.0	0.0
Akermanite	0.0	0.0	0.0	0.0	0.0	0.0
Fe-Aker.	0.0	0.0	0.0	0.0	0.0	2.89
Wollastonite	0.0	0.0	0.0	0.0	7.41	-2.21
Enstatite	0.0	0.0	0.0	0.0	3.40	0.0
Ferrosilite	0.0	0.0	0.0	0.0	3.94	-2.51
Forsterite	25.63	24.29	1.00	5.37	2.71	0.0
Fayalite	4.35	4.12	7.69	7.18	3.47	4.86
Andradite	0.0	0.0	0.0	0.0	0.0	0.0
Hematite	0.0	0.0	0.0	0.0	1.51	0.0
Magnetite	15.98	13.64	4.26	3.81	0.89	2.12
Sphene	0.0	0.0	0.0	0.0	2.82	0.0
Perovskite	0.0	0.0	0.0	0.0	0.0	0.0
Rutile	2.75	3.12	0.30	2.12	0.0	0.31
Apatite	3.08	4.02	7.29	2.60	4.07	5.30
Calcite	34.93	20.97	48.22	15.22	27.72	76.05
Magnesite	4.06	5.86	17.13	0.0	0.0	7.92
Fluorite	0.0	0.0	0.0	0.0	0.0	0.0
Zircon	0.0	0.0	0.0	0.0	0.0	0.0
Baddeleyite	0.0	0.0	0.0	0.0	0.0	0.0
H_2O	1.90	2.58	0.76	1.52	0.51	0.76

Notes: For sample descriptions, see Table A-1. Alkalic norms were calculated using the method of LeBas (1973).

Map No.	Sample No.	Map No.	Sample No.
5	169-6	9	204B
6	169-10	37	RP-236
8	169-0	15	DP-61C

TABLE A-4 CONTINUED.

	Unit 4A,B			Unit 5F		Unit 5B,C,E,G
Map No.	29	32	10	47	45	18
Quartz	0.0	4.17	0.41	0.0	0.0	4.19
Corundum	0.0	0.02	0.52	0.0	0.0	0.0
Orthoclase	0.0	0.41	1.00	0.83	29.48	6.11
Albite	0.0	0.0	0.0	0.0	4.24	20.57
Leucite	0.0	0.0	0.0	4.82	0.0	0.0
Kalsilite	0.40	0.0	0.0	0.0	0.0	0.0
Nepheline	0.0	0.0	0.0	8.03	5.65	0.0
Carnegieite	0.0	0.0	0.0	0.0	0.0	0.0
Na_2SiO_3	0.0	0.0	0.0	0.0	0.0	0.0
Acmite	0.0	0.0	0.0	0.0	0.0	0.0
Thenardite	0.07	1.49	0.30	1.20	1.42	0.22
Gehlenite	0.99	0.0	0.0	4.83	8.80	16.74
Akermanite	3.26	0.0	0.0	0.0	0.0	0.0
Fe-Aker.	2.28	0.0	0.0	0.0	0.0	0.0
Wollastonite	-0.17	0.0	0.0	15.53	2.42	3.46
Enstatite	-0.09	0.0	0.0	8.23	1.12	2.19
Ferrosilite	-0.08	0.0	0.0	6.81	1.27	1.04
Forsterite	3.40	0.97	0.0	6.38	8.45	20.00
Fayalite	3.11	1.91	2.49	5.82	10.54	10.44
Andradite	0.0	0.0	0.0	0.0	0.0	0.0
Hematite	1.39	0.0	0.0	6.60	0.0	0.0
Magnetite	3.31	8.92	4.26	0.0	8.46	5.08
Sphene	0.0	0.0	0.0	8.81	9.32	4.05
Perovskite	0.26	0.0	0.0	0.0	0.0	0.0
Rutile	0.0	0.41	0.10	0.0	0.0	0.0
Apatite	4.14	8.95	9.75	1.70	0.33	2.37
Calcite	76.12	66.02	15.11	18.63	10.79	2.14
Magnesite	0.0	4.67	4.38	0.0	0.0	0.0
Fluorite	0.0	0.0	0.0	0.0	0.0	0.0
Zircon	0.0	0.0	0.0	0.0	0.0	0.0
Baddeleyite	0.0	0.0	0.0	0.0	0.0	0.0
H_2O	0.56	0.70	0.06	0.78	1.60	1.42

Notes: For sample descriptions, see Table A-1. Alkalic norms were calculated using the method of LeBas (1973).

Map No.	Sample No.	Map No.	Sample No.
29	RP-128	47	RP-161B
32	RP-166	45	RP-161A
10	204D	18	RP-7A

TABLE A-4 CONTINUED.

	Unit 5B,C,E,G				Orbicular Ijolite
Map No.	**41**	**19**	**36**	**46**	**48**
Quartz	5.05	0.0	7.37	6.10	0.0
Corundum	0.0	0.0	0.23	0.62	0.0
Orthoclase	8.56	13.29	14.22	6.37	8.21
Albite	25.31	3.65	32.39	41.75	3.57
Leucite	0.0	0.0	0.0	0.0	0.0
Kalsilite	0.0	0.0	0.0	0.0	0.0
Nepheline	0.0	24.28	0.0	0.0	16.48
Carnegieite	0.0	0.0	0.0	0.0	0.0
Na_2SiO_3	0.0	0.0	0.0	0.0	0.0
Acmite	0.0	0.0	0.0	0.0	0.0
Thenardite	0.22	2.44	0.75	0.53	3.06
Gehlenite	16.95	0.47	16.28	13.40	16.24
Akermanite	0.0	0.0	0.0	0.0	0.0
Fe-Aker.	0.0	0.0	0.0	0.0	0.0
Wollastonite	2.41	15.43	0.0	0.0	13.35
Enstatite	1.91	5.58	0.0	0.0	6.82
Ferrosilite	0.22	10.20	0.0	0.0	6.19
Forsterite	15.45	1.13	7.81	8.30	1.84
Fayalite	1.95	2.28	11.81	12.01	1.84
Andradite	0.0	0.0	0.0	0.0	0.0
Hematite	7.63	5.62	0.0	0.0	10.12
Magnetite	5.20	0.0	3.92	2.76	0.0
Sphene	4.44	6.62	0.0	0.0	8.51
Perovskite	0.0	0.0	0.0	0.0	0.0
Rutile	0.0	0.0	1.58	1.46	0.0
Apatite	2.84	1.28	2.84	2.60	1.04
Calcite	0.98	8.45	0.61	2.64	1.57
Magnesite	0.0	0.0	0.0	0.0	0.0
Fluorite	0.0	0.0	0.0	0.0	0.0
Zircon	0.0	0.0	0.0	0.0	0.0
Baddeleyite	0.0	0.0	0.0	0.0	0.0
H_2O	1.33	0.64	0.74	2.53	1.30

Notes: For sample descriptions, see Table A-1. Alkalic norms were calculated using the method of LeBas (1973).

Map No.	Sample No.
41	RP-280
19	RP-10
36	RP-226
46	RP-229
48	Orbicular Ijolite

TABLE A-5. AVERAGE CHEMICAL COMPOSITIONS OF LITHOLOGIC UNITS FOR THE PRAIRIE LAKE CARBONATITE COMPLEX. (CALCULATED 1987)

	Unit 2a (N = 9)		Unit 2b (N = 11)	
	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION
SiO_2	40.01	6.54	37.29	3.92
Al_2O_3	12.85	6.01	14.58	3.06
Fe_2O_3	4.77	2.82	4.68	1.77
FeO	3.67	2.73	3.81	1.06
MgO	2.18	2.14	3.08	0.81
CaO	20.59	4.74	17.73	4.40
Na_2O	6.26	3.05	6.85	1.69
K_2O	3.10	1.45	3.27	0.65
TiO_2	0.83	0.39	1.77	0.84
P_2O_5	1.23	1.46	1.29	1.09
MnO	0.39	0.16	0.32	0.05
CO_2	2.72	1.47	4.21	4.53
S	0.23	0.64	0.15	0.25
H_2O+	0.51	0.43	0.40	0.46
H_2O-	0.35	0.09	0.36	0.14
LOI	0.00	0.00	0.00	0.00
TOTAL	100.26	0.55	99.69	1.22
Ag	0.00	0.00	0.09	0.30
Ba	167.78	147.12	190.91	150.10
Co	11.11	8.58	10.91	3.75
Cr	3.33	5.00	6.36	14.16
Cu	10.56	18.62	9.55	5.22
Li	1.44	2.24	2.82	2.36
Ni	2.22	6.67	2.27	5.18
Pb	9.44	20.68	18.64	57.01
Zn	383.89	651.69	265.45	292.13
Be	12.44	10.71	8.45	4.08
Mo	0.00	0.00	0.00	0.00
Sc	1.89	2.89	5.82	4.64
Sr	1322.22	664.79	1500.00	827.04
V	145.56	55.70	191.82	81.46
Y	75.56	59.34	128.18	112.50
Ga	23.89	14.09	18.64	5.52
Nb	454.44	957.13	197.27	199.95
Rb	58.75	35.63	35.00	10.80
Zr	516.67	233.18	3134.27	4418.19
Sn	0.11	0.33	3.00	2.49
Ce	333.33	1000.00	90.91	301.51
La	106.67	232.16	54.09	43.18
Nd	44.44	133.33	0.00	0.00

TABLE A-5. CONTINUED.

	Unit 2C & 2F (N = 15)		Unit 4a & 4b (N = 4)	
	MEAN	STANDARD DEVIATION	MEAN	STANDARD DEVIATION
SiO_2	26.65	9.99	7.05	7.26
Al_2O_3	7.52	5.63	0.95	1.19
Fe_2O_3	7.09	5.64	4.85	3.32
FeO	6.52	2.50	4.05	2.07
MgO	8.63	5.84	5.77	5.79
CaO	20.25	7.45	38.82	12.34
Na_2O	1.72	2.26	0.29	0.29
K_2O	3.25	2.48	0.75	1.33
TiO_2	1.91	1.19	1.07	1.60
P_2O_5	2.38	2.51	3.26	0.85
MnO	0.42	0.22	0.44	0.25
CO_2	11.00	6.56	31.05	11.49
S	0.18	0.17	0.25	0.07
H_2O+	1.26	0.74	0.30	0.31
H_2O-	0.36	0.12	0.32	0.20
LOI	0.00	0.00	0.00	0.00
TOTAL	99.12	1.01	99.28	2.02
Ag	0.00	0.00	0.00	0.00
Ba	1125.33	1350.78	1042.50	1072.14
Co	23.00	14.49	22.50	25.33
Cr	105.53	149.80	170.00	181.66
Cu	39.67	55.85	32.50	48.39
Li	19.87	32.69	6.25	9.46
Ni	70.00	107.80	57.50	102.10
Pb	21.33	28.00	17.50	12.58
Zn	367.67	284.31	268.75	188.34
Be	6.87	6.17	7.50	11.90
Mo	0.00	0.00	0.00	0.00
Sc	7.00	7.51	7.50	9.57
Sr	1746.67	983.34	3625.00	250.00
V	130.00	60.47	150.00	108.01
Y	82.67	83.47	120.00	66.83
Ga	32.00	53.31	5.00	4.08
Nb	328.00	169.80	340.00	268.45
Rb	41.67	24.83	23.33	40.41
Zr	1656.53	3391.33	162.50	62.92
Sn	9.60	25.16	0.75	1.50
Ce	1200.00	1306.58	1500.00	1000.00
La	206.67	304.95	2799.75	4808.00
Nd	130.00	288.96	2662.25	4893.61

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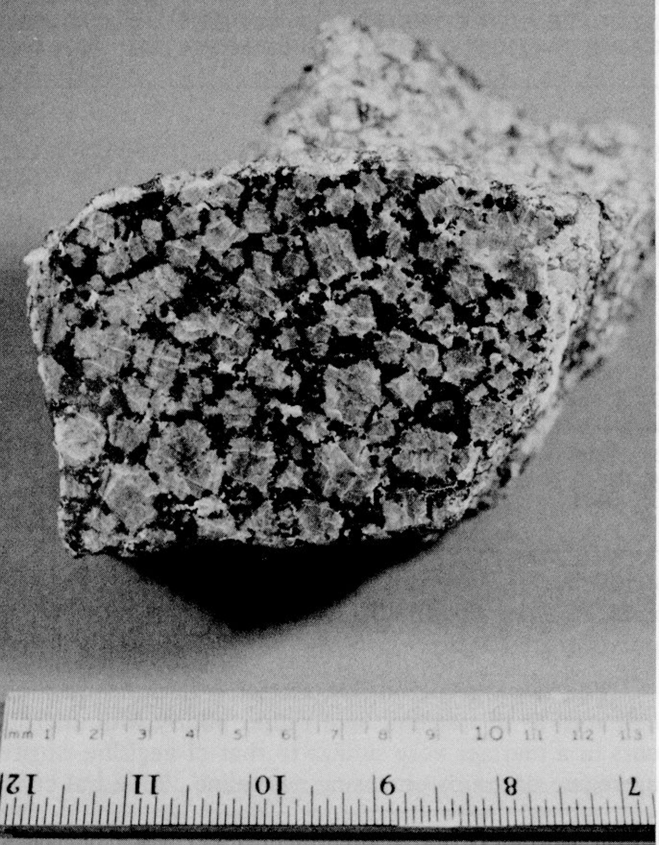

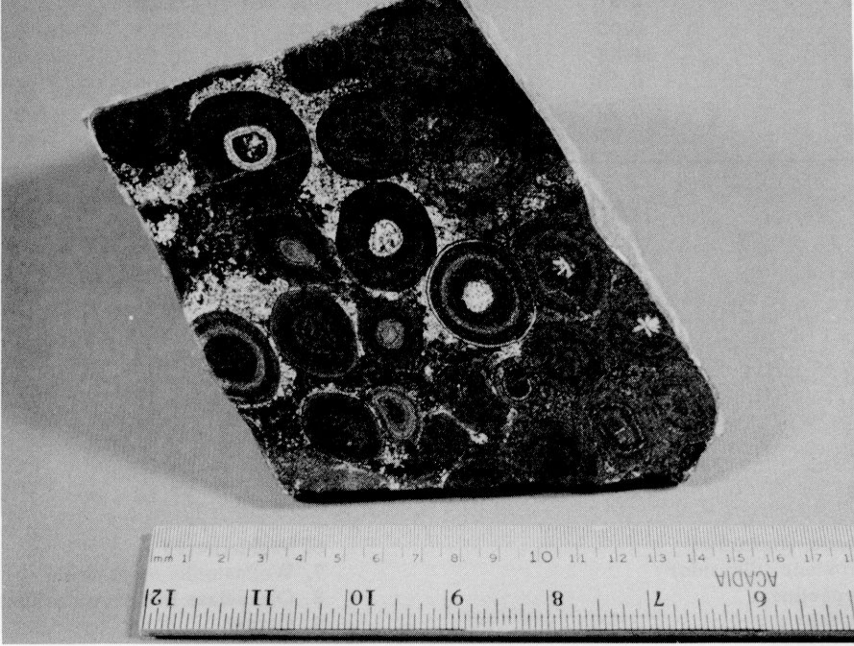
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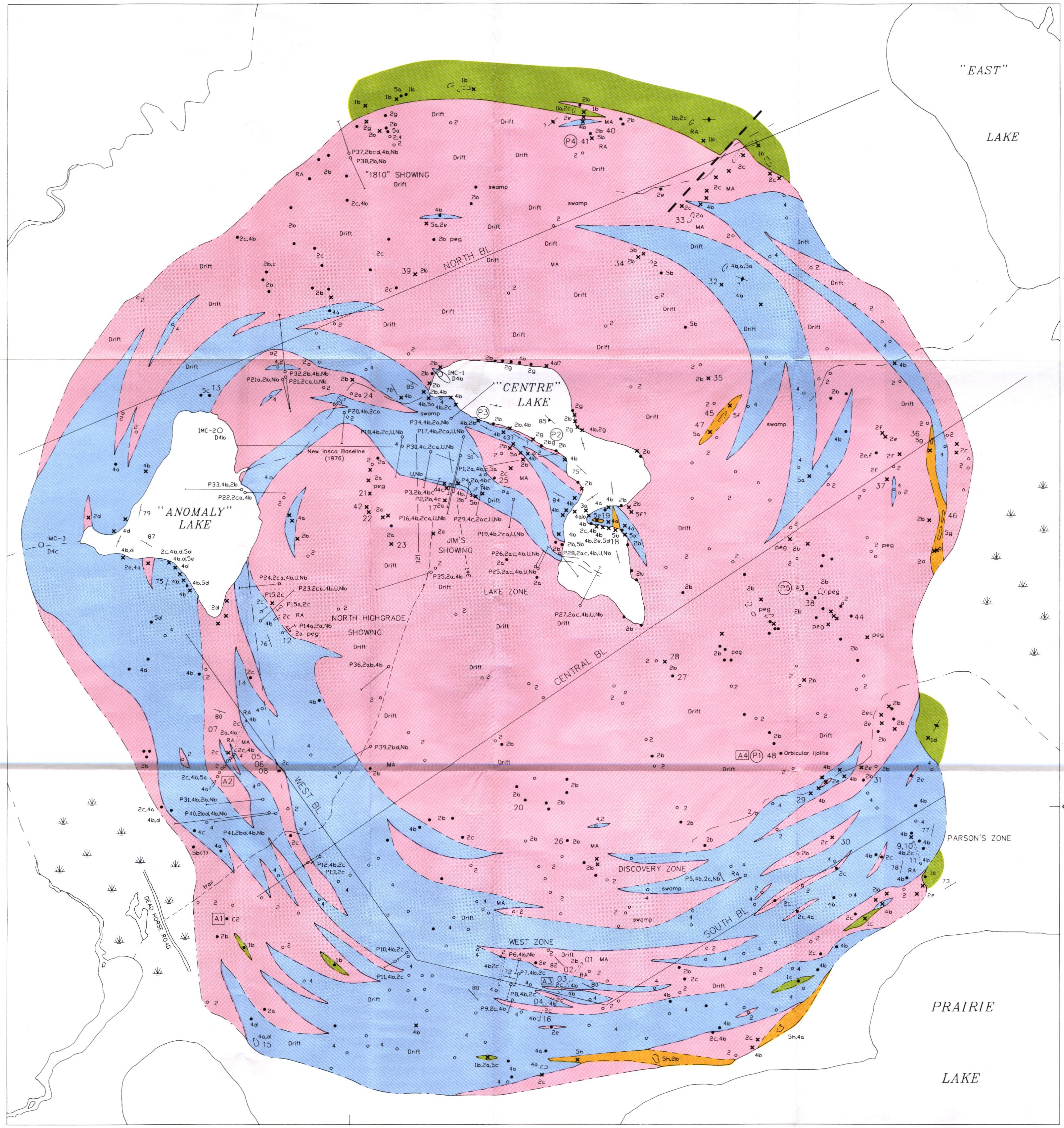

Chart A — Prairie Lake Carbonatite Complex

Figure 3. Geology of the Prairie Lake Carbonatite Complex. Geology by R.P. Sage. Additional information from assessment work files and company files.

LEGEND

CENOZOIC[1]
QUATERNARY
RECENT
Stream, lake, and swamp deposits
PLEISTOCENE
Glacial deposits

UNCONFORMITY

LATE PRECAMBRIAN (PROTEROZOIC)[2]
PRAIRIE LAKE CARBONATITE COMPLEX
DIKE ROCKS[3]

5
- 5a Biotite-porphyritic silicocarbonatite dikes; aphanitic groundmass.
- 5b Pyroxene-porphyritic diabase dikes.
- 5c Feldspar-porphyritic diabase dikes; 1-2 mm feldspar phenocrysts; aphanitic groundmass.
- 5d Breccia dike; mica-rich; clasts of biotite, carbonate and diabase.
- 5e Fine-grained ijolite dikes.
- 5f Biotite-porphyritic silicocarbonatite dikes; fine-grained groundmass.
- 5g Plagioclase-porphyritic gabbro; plagioclase phenocrysts up to 5 mm in diameter; fine-grained gabbroic groundmass.
- 5h Diatreme breccia; clasts of carbonatized fine-grained country rock, locally some granitoid clasts; ijolitic matrix.

INTRUSIVE & GRADATIONAL CONTACT

CARBONATITE ROCKS

4
- 4 Unsubdivided
- 4a Ferruginous (ankeritic) carbonatite; pinkish to light orange-brown; limonitic weathered surface; generally <5% accessory oxide, silicate and sulphide minerals.
- 4b Sovite (calcite carbonatite); up to 10-15% accessory oxide, silicate and sulphide minerals; locally extensively interlayered with silicocarbonatite rock of unit 2c.
- 4c Rauhaugite; locally Nb- and U-bearing; dolomitic carbonatite composition; locally complexly intermixed with the sovite.
- 4d Sovite breccia; ijolite clasts and/or boudinaged dike rocks in a calcite matrix.

INTRUSIVE CONTACT

SYENITIC ROCKS[4]

3
- 3a Aegirine "syenite" (highly fenitized wall rock)

INTRUSIVE CONTACT

IJOLITIC ROCKS[5]

2
- 2 Unsubdivided.
- 2a Wollastonite ijolite (>10% wollastonite); melteigite to urtite in composition; fine to medium grained, locally pegmatitic.
- 2b Wollastonite-bearing ijolite (<10% wollastonite); melteigite to urtite in composition; fine to medium grained, locally pegmatitic.
- 2c Silicocarbonatite to calcitic ijolite; fine to very fine grained; 30% or more calcite; magnetite is generally abundant enough to affect a compass.
- 2d Mafic breccia; mafic clasts and matrix; highly carbonatized, mica phenocrysts common.
- 2e Biotite rock; composed predominantly of biotite and 10-15% calcite.
- 2f Nepheline-porphyritic ijolite; euhedral nepheline crystals up to 1 cm in diameter.
- 2g Ijolite with abundant ijolitic inclusions.

INTRUSIVE CONTACT

FENITES AND ALTERED WALL ROCKS

1
- 1a Fenitized country rock; presumably originally granitic in composition, now characterized by deficiency in quartz and presence of blue-green fibrous amphibole or pyroxene.
- 1b Highly carbonatized fine-grained country rock (possible metavolcanics); locally contains fine-grained feldspar.
- 1c Breccia; containing clasts of carbonatized fine-grained country rock, locally some granitoid clasts in ijolite matrix.
- 1d Biotite-quartz-feldspar gneiss (arkosic paragneiss or granodiorite orthogneiss); local carbonate alteration along joint surfaces.

GRADATIONAL CONTACT

EARLY PRECAMBRIAN (ARCHEAN)[2]
GNEISS[6]
Biotite-quartz-feldspar paragneiss; fine to medium grained, equigranular.

NOTES
1. Unconsolidated deposits.
2. Bedrock geology.
3. Age relationships between dike rocks uncertain; dike trends and widths often impossible to establish.
4. Age relationships between syenite and other rock types are certain.
5. Age relationships between various ijolititc rocks are uncertain.
6. Occurs outside the map-area.

ABBREVIATIONS

U .... Uranium
Nb .... Niobium

SYMBOLS

×	Small bedrock outcrop.
	Area of bedrock outcrop.
•	Slumped outcrop.
46	Location of sample for whole rock analysis (see report appendix).
○	Soil sample (weathered bedrock).
P1	Photograph location (see report).
A1	Location of samples for isotopic dating (see report).
P15,2c	Lithologic data from diamond drilling.
	Fault
85	Gneissosity; (vertical).
73	Banding; (inclined, vertical)
peg	Pegmatitic phase.
	Geological boundary (position interpreted; deduced from geophysics).
	Diamond drill hole; Newmont Mining Corporation Canada Ltd.; Nuinsco Resources Ltd.
○ IMC-1	Reverse circulation drill hole; International Minerals and Chemical Corporation (Canada) Ltd.
MA	Magnetic attraction.
RA	Radioactivity; from unpublished data of Newmont Mining Corporation of Canada Ltd.
U,Nb	Mineral occurrence.
	Stream.
	Swamp.

Scale 1:5000

Metres 500 0 250 500 Metres

Miles 0 0.25 Miles