GEOCHEMISTRY AND PETROLOGY OF GRANITOID ROCKS OF THE GANDER ZONE, BAY D'ESPOIR AREA, NEWFOUNDLAND

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by

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ABSTRACT

Two pulses of granitoid plutonism have been recorded in the Bay D'Espoir area: (1) The Northern Granitoids were intruded discordantly into medium to low grade sedimentary and volcanic rocks of the Bay D'Espoir Group, at ca. 430 Ma. (2) The Southern Granitoids were intruded concordantly into gneisses and migmatites of the Little Passage Gneisses at ca. 350 Ma. Although the granitoids occupy a cross section through the Gander Zone, they do not show any systematic petrographic, geochemical, or isotopic variation from north to south.

The "Straddling Granite", formerly considered to lie astride the Gander-Avalon Zone boundary, consists of at least two separate plutons on either side of the boundary. Although no economic mineral deposits have yet been discovered, leucogranites with ore-bearing potential occur in sufficient quantity to warrant further investigation. Structural, stratigraphic, geochemical and isotopic evidence suggest that the granitoids were intruded into a back-arc basin during the Acadian Orogeny.

ACKNOWLEDGEMENTS

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CHAPTER 1

GENERAL INTRODUCTION

1.1 Location and Access

The study area comprises a cross section of the Gander Zone (Williams, 1979) from Bay D'Espoir to Mount Cormack (see Map 1). It can be reached by the Bay D'Espoir highway (Routes 360, 361) which is paved most of the way. A few secondary roads and a power transmission line provide access to the interior. Coastal exposures can be reached by boat along Hermitage Bay, Little Passage, and Bay D'Espoir. Round Pond and Long Pond are excellent inland waterways. Because of the extremely rugged topography, some points are best reached by air.

1.2 Previous Work

Alexander Murray (1881) did the first reconnaissance study in the area, recognizing the sedimentary rocks along Bay D'Espoir, the gneisses in Little Passage, and the coarse granitoid rocks at Gaultois. He suggested that the Bay D'Espoir sediments lay uncomformably upon the gneisses.

The first detailed study was done by Jewell (1939). He named the sedimentary rocks the Bay D'Espoir series and argued for a gradational relation between the sediments and the gneisses. He named and described the North Bay granite which he correlated with those cropping out in the Garrison Hills. Jewell noted the abundant gneissic and sedimentary xenoliths in the granites and proposed intrusion by stoping and assimilation. He suggested a Devonian Age for the granites. Widmer (1950) suggested a Precambrian age for the Bay D'Espoir series, and like Jewell, thought the sediments grade into the gneisses. He suggested that the Hermitage Bay Fault was a steep reverse fault.

Anderson (1965) and Anderson and Williams (1970) mapped the area on a scale of 1:250,000. They outlined most of the granitoid intrusions in the area and noted the large number of flanking mafic-ultramafic bodies. They suggested that at least some of the mafic-ultramafic bodies were post-Ordovician intrusions.

Williams (1971) noted close similarities among gneissic rocks in the Wesleyville area, the Garrison Hills and Grey River Area on the south coast of Newfoundland. This belt of rocks forms the Hermitage Flexure. The peculiar sinusoidal nature of the belt was attributed to folding and sinistral movement along the Cabot Fault (Williams et al, 1970). This interpretation was later disputed by Brown and Colman-Sadd (1976), who proposed that the curvature was an original feature related to the closing of Iapetus to which these rocks were thought to be marginal.

Colman-Sadd (1974, 1975, 1976, 1977, 1978, 1979, 1980) has done extensive mapping in the Bay D'Espoir area on a scale of 1:50,000. Unlike Murray and Jewell, he proposed a thrust fault for the contact between the Bay D'Espoir sediments (Bay D'Espoir Group) and the gneisses (Little Passage Gneisses). He divided the Bay D'Espoir group into several formations, separated the granitoid plutons around Garrison Hills into a number of distinct plutons, and provided general descriptions for all the granitoid plutons considered in the present study. He was also actively involved in the planning and execution of the present project.

1.3. General Geotectonic Setting

Williams (1964) divided the Newfoundland Appalachians into three zones: 1. Western Platform, 2. Central Paleozoic Mobile Belt, 3. Avalon Platform. This division emphasized the supposed symmetry of the orogen, with rocks representing from either side, a transition from stable platform through continental margin to the Proto-Atlantic ocean (Iapetus). He noted that granitoid intrusions in Newfoundland were mostly concentrated in the Central Mobile Belt (Fig.1.1) and suggested a Devonian age for most of them (Williams, 1969). As Fig 1.1 illustrates, the study area is located at the southeastern edge of the Central Mobile Belt, marginal to Iapetus.

With further development in Plate-Tectonic Theory, Williams and others (1974) refined the earlier tripartite division of the Newfoundland Appalachians to yield eight tectonostratigraphic zones (Fig.1.2). Thus the Central Mobile Belt is divided into five zones, of which the Gander and Botwood Zones are partly covered by the present study area. The Gander Zone comprises "Hermitage Flexure" gneisses and adjacent sediments. The Botwood Zone consists mainly of Ordovician pelitic sediments, overlain in places by Silurian rocks of non-marine origin. Together they appear to represent the eastern continental margin of Iapetus, in a model which reaffirms the symmetry of the orogen.

Strong and others (1974), and Stevens and others (1974), disputing the supposed symmetry of the Appalachian orogen, proposed closure of Iapetus by means of an eastward dipping subduction zone (Fig.1.4).

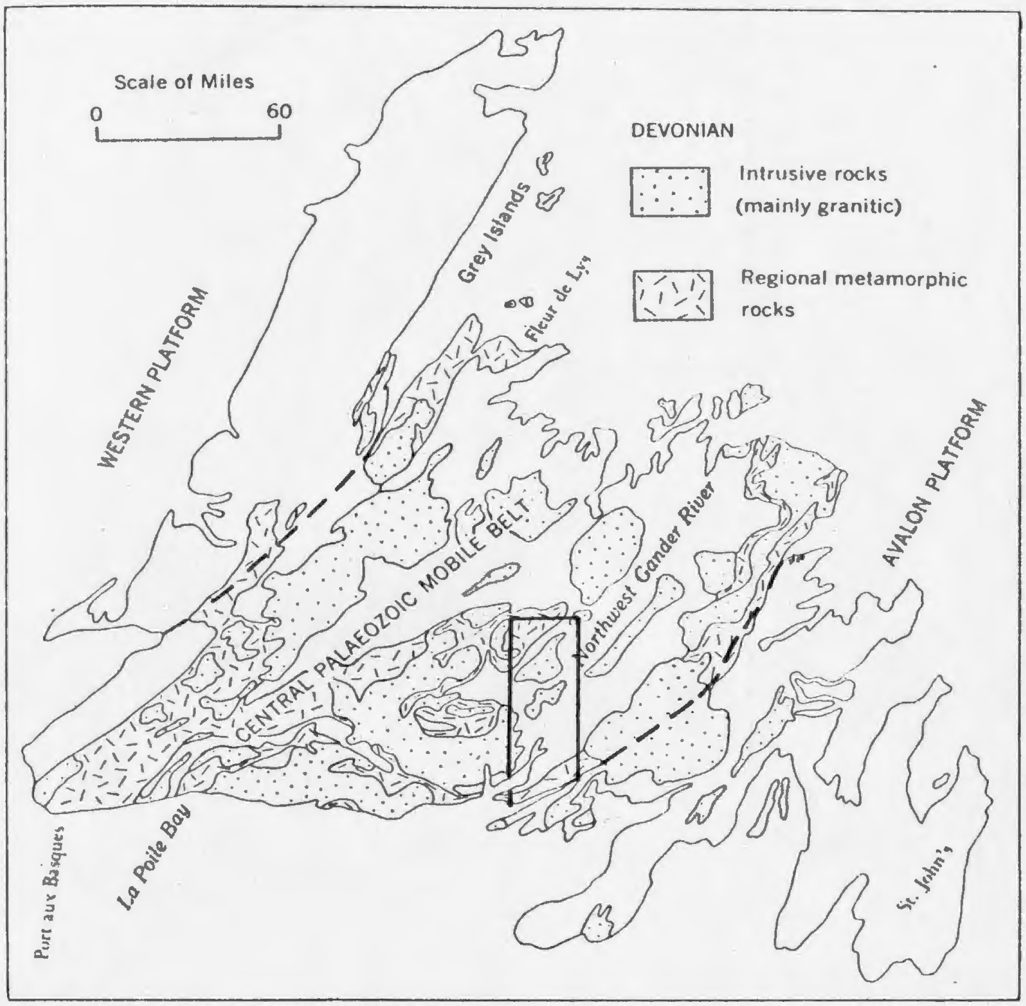


Fig. 1.1 Tripartite subdivision of the Newfoundland Appalachians,(Williams,1964). Note concentration of granitoid plutons in the Central Mobile Belt. The study area outlined is a section across the southeastern margin of the Central Mobile Belt.

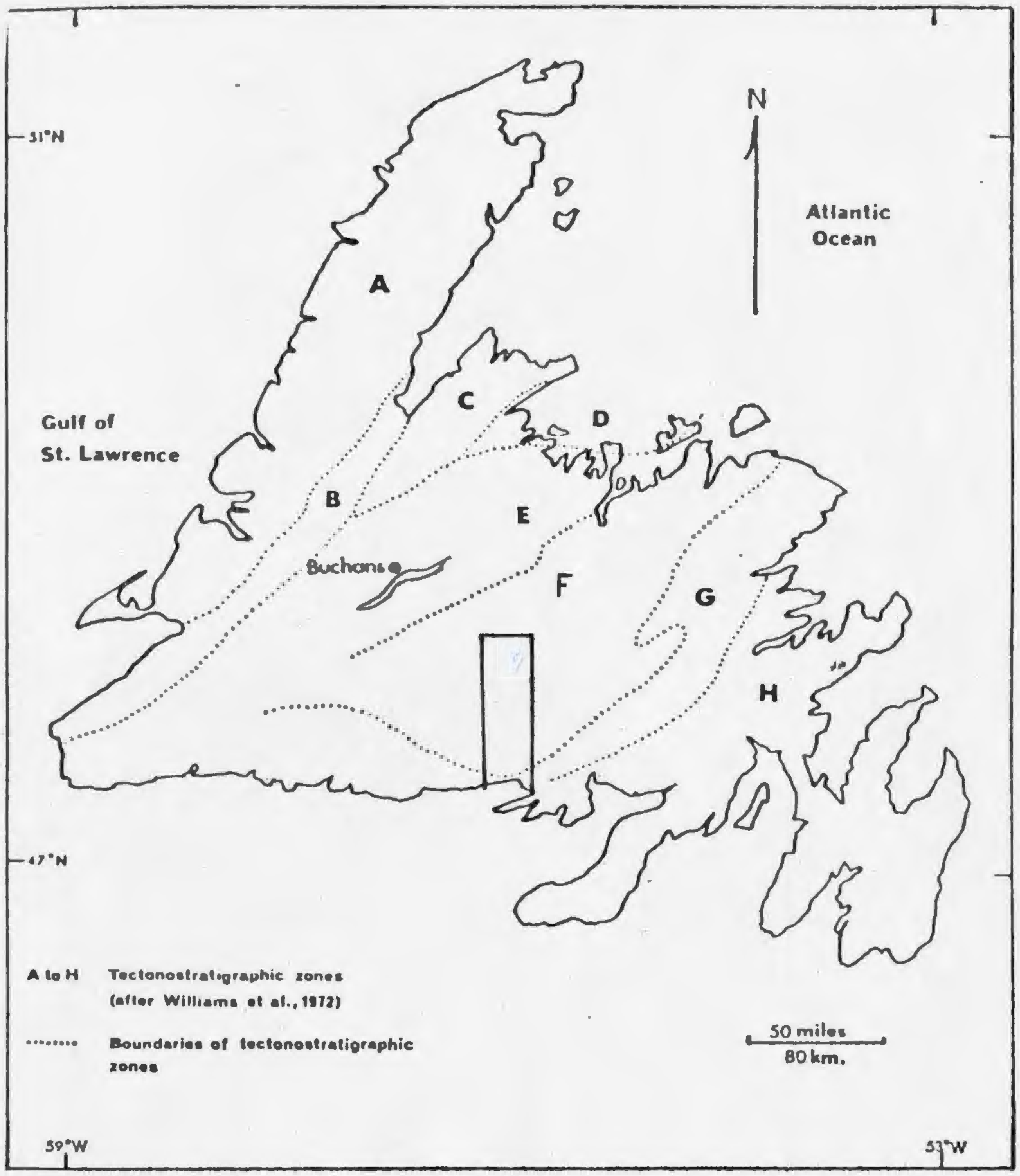


Fig. 1.2. Tectonostratigraphic sub-divisions of the Newfoundland Appalachians. (after Williams et al. 1972)
The study area extends northward through zones G and F. (Gander and Botwood).

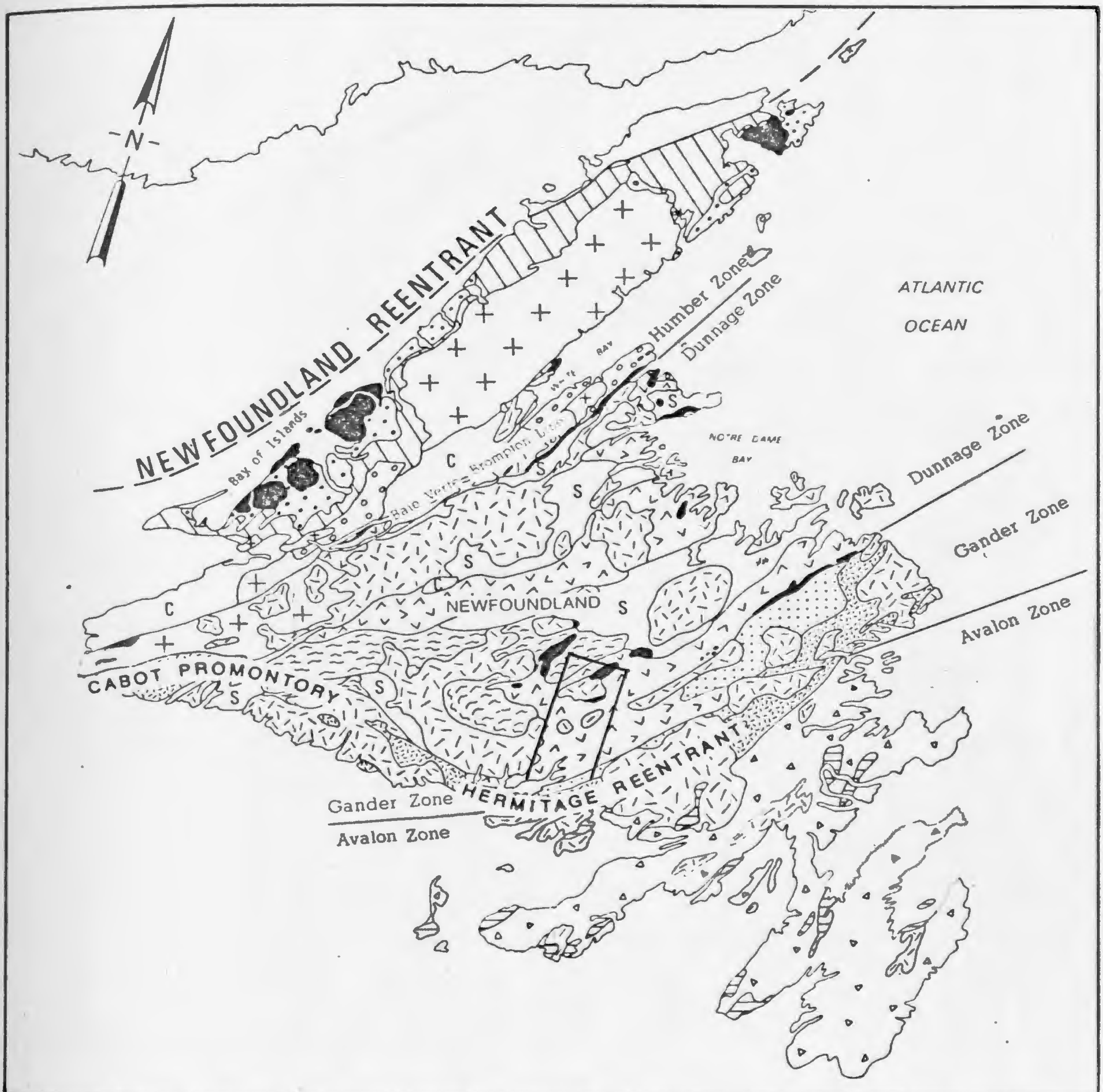


Fig. 1.3. Most recent tectonostratigraphic subdivision of the Newfoundland Appalachians. (Williams, 1979). The study area lies entirely within the Gander Zone.

According to the model of Stevens and others, the Gander Zone sediments were deposited in a marginal (back- arc) basin and intruded by ultramafic diapirs. Although precise timing of ultramafic intrusion was not given, Strong and others (1974) suggested that the subduction zone may have been active long after its supposed initiation in the Ordovician Taconic Orogeny, since some of these diapirs were thought to intrude Silurian sediments and many of them are spatially associated with granitoid plutons (of probable Devonian age), it seemed likely that the life of the subduction zone extended into the Acadian.

Kennedy (1975, 1976), inspired by the concept of symmetry, proposed a rather sophisticated model for development of the orogen which included the following: (1) A Hadrynian orogenic episode (Ganderian Orogeny) during which some of the granites were produced by partial melting of the gneisses, and a small ocean basin was closed; (2) Taconic orogeny during which two oppositely dipping subduction zones produced island arc volcanism in the Central Mobile Belt; (3) Collision of the two subduction zones and the formation of transform faults were considered to be the final events in the destruction of Iapetus during the Devonian Acadian Orogeny.

Pickerill and others (1978), and Currie and others (1979), working in the Carmanville area (northern Gander zone), disagreed sharply with earlier models. They found no evidence for any pre-Ordovician Ganderian Orogeny, and doubted the existence of an easterly dipping subduction zone. Their model envisages plate collision by transform faults during the Taconic, with later deformation and Acadian plutonism related to the same event - closure of Iapetus. With some modification,

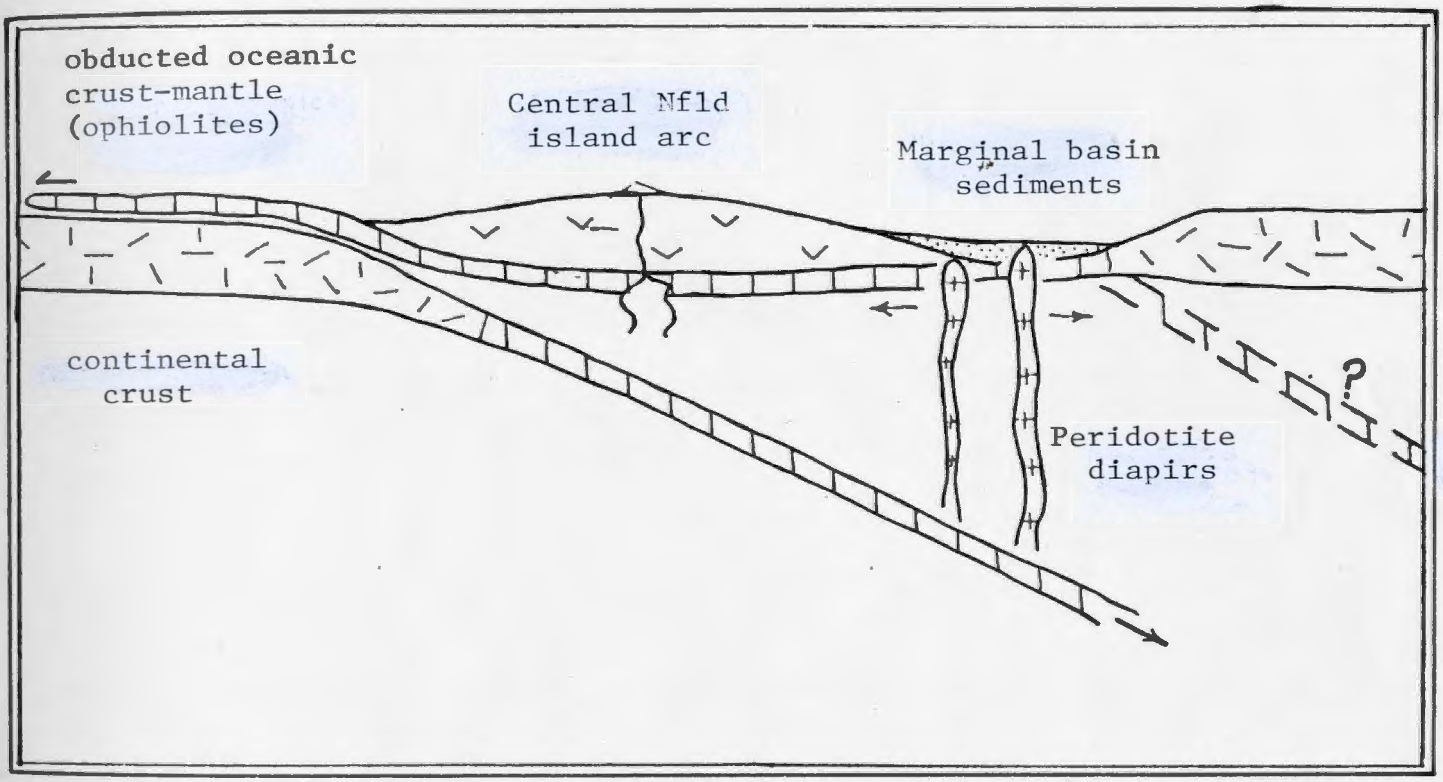


Fig. 1.4. Schematic cross-section of the Newfoundland Appalachians, showing emplacement of ultramafic bodies into a marginal (back-arc) basin. (Stevens et al; 1974).

this model upholds the symmetry of the Appalachian orogen as proposed by Williams.

In a recent contribution to the controversy, Colman-Sadd (1980) supported the idea of an easterly-dipping subduction zone, and an asymmetric orogen. Subduction was supposed to have commenced in the Taconic, with its effects lasting through the Acadian Orogeny,producing deformation and granitoid plutonism. The theme of asymmetry was supported by other recent studies in the Gander Zone (Haworth and others 1978), Hanmer, (1981).

1.4 Objectives of the Present Study

The immediate objectives of this study are:

(1) To investigate petrographic and geochemical variation among the plutons across the Gander Zone (or the Gander-Botwood Zone boundary).

(2) To establish which (if any) of the various models proposed for development of the Gander Zone is most compatible with plutonism in the area

(3) To identify areas of potential economic mineralization.

CHAPTER 2

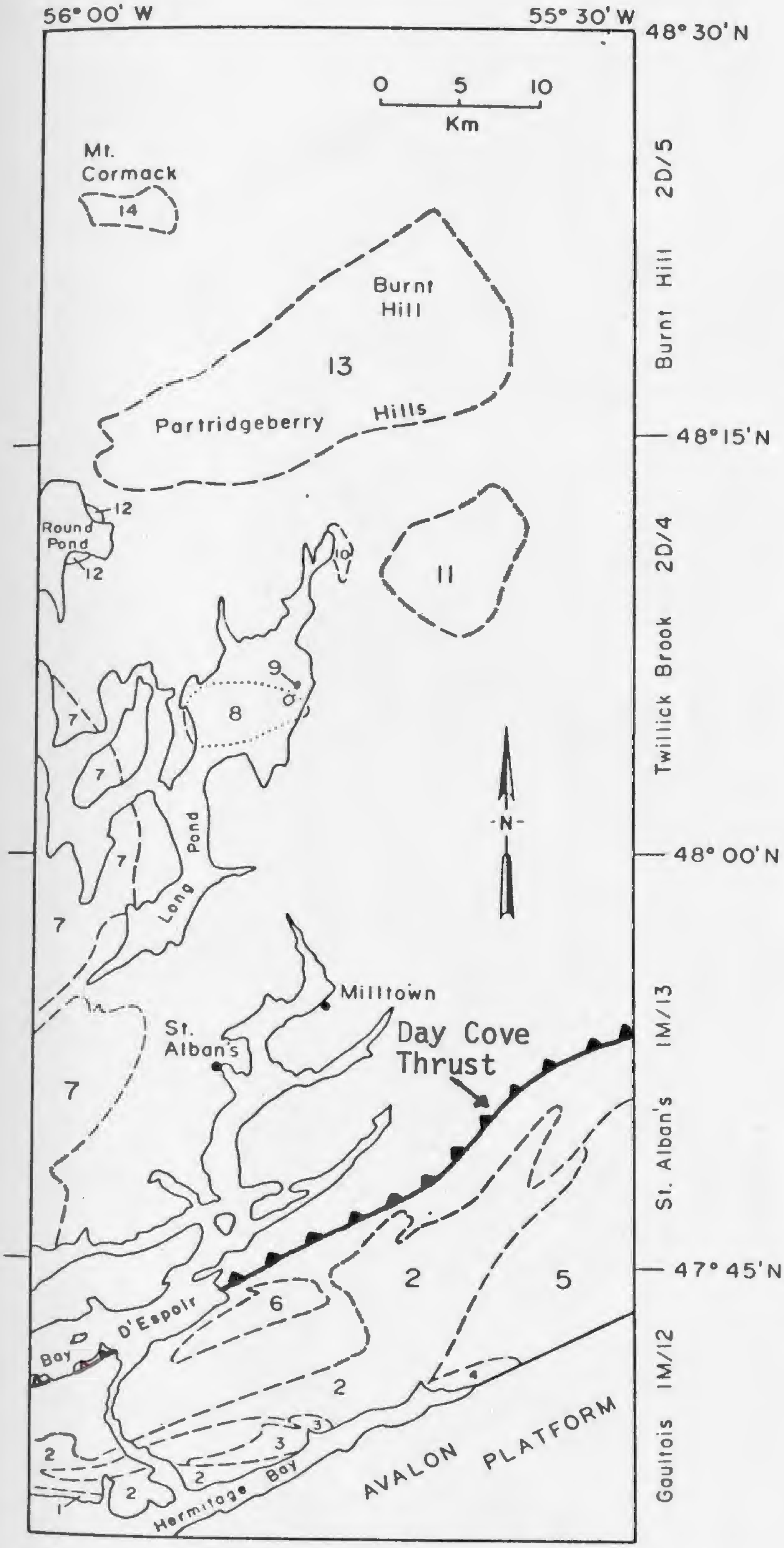
FIELD RELATIONS OF INDIVIDUAL PLUTONS

2.1 Introduction

The plutons have been previously mapped by S.P. Colman-Sadd (1976, 1977, 1978, 1979, 1980a), on a scale of 1:50 000. Some of the descriptions given below are partly based on his work.

The main features of the plutons are summarized in Table 1 and the following comments are generally applicable to the study area. The plutons are all equigranular, except for the Gaultois megacrystic granite, small parts of the North Bay granite, and the Rocky Bottom Tonalite (biotite phenocrysts). K-feldspar phenocrysts occur locally in the Piccaire, Northwest Cove, Northwest Brook and Dolland Bight plutons. They range in composition from granodiorite to adamellite, with minor amounts of tonalite diorite, granite (ss), and gabbro. A number of mafic to ultramafic bodies occur at the margins of the plutons, increasing in number and size northward where erosion has removed much of the cover rocks.

As shown in Map 1, the granitoids occur in two contrasting terranes: (1) Those intruding the Little Passage gneisses, and lying south of the Day Cove Thrust (Map 1) and here referred to as the Southern Granitoids. The Little Passage gneisses, as stated above, are part of the high grade metamorphic terrane producing the Hermitage Flexure . Amphibolitic, psammitic and tonalitic gneisses (Fig.2.2) occur as prominent northeasterly-trending sheets. Although the gneisses bear evidence of a complex deformation history, they are overprinted by a dominant steep northeasterly-striking foliation. Metamorphic grade reaches upper amphibolite facies,



LEGEND

1 Piccaire Granite.

2 Gaultois Granite.

3 Northwest Cove Granite. granite.

4 Straddling Granite.

5 Northwest Brook Granite.

6 Dolland Bight Granite.

7 North Bay Granite.

8 Missing Island Granodiorite.

9 Long Pond diorite.

10 Rocky Bottom Tonalite.

11 Matthews Pond Granodiorite.

12 Round Pond Gabbronorite–granodiorite.

13 Partridgeberry Hills Granite and granodiorite.

14 Through Hill granite.

Fig. 2.1.Sketch map of study area showing location of plutons.Plutons 1-6 are the Southern Granitoids;Plutons 7-14 are the Northern Granitoids.Note that plutons 7,8,9 and 12 have been combined as pluton no.15--see text.

Table 2.1.

FIELD RELATIONS AND MEGASCOPIC FEATURES OF GRANITOID PLUTONS OF THE BAY D'ESPOIR AREA

No.	Pluton Name	(Km^2) Size	Rock Type(s) MAIN, Minor	Contact Relations	Xenoliths	Fabric	Petrography	Other Features
1	Piccaire	2*	BIOTITE ADAMELLITE granodiorite	Intrudes Gaultois	mafic gneiss	Mild lineation defined by quartz	Patch perthite equigranular	Very little alteration barren (no economic minerals observed)
2	Gaultois	160*	MEGACRYSTIC BIOTITE ADAMELLITE hornblende diorite	Intrudes LPG Intruded by PIC, DB etc.	biotite-amphibole feldspar clots gneiss	Intense foliation. Biotite quartz, augen microcline megacrysts	Microcline megacrysts sphene, hornblende common.	Barren; cut by numerous barren pegmatites, aplites.
3	N.W. Cove	16	MUSCOVITE (BIOTITE) ADAMELLITE granite	Intrudes Gaultois Intrudes LPG	gneiss GG	Intense foliation. Alignment of mica flattened quartz, feldspar.	Equigranular; garnet, tourmaline locally. mu/bi variable.	v. similar to N.W. BK.
4	Straddling (Indian Point)	5*	BIOTITE (MUSCOVITE) ADAMELLITE granodiorite	Intrudes N.W. Brook	none	Intense mylonitic foliation adjacent to H.B. Fault.	Equigranular secondary muscovite extensive alteration.	v. similar to Piccaire barren
5	N.W. Brook	90*	MUSCOVITE (BIOTITE) ADAMELLITE granodiorite granite	Intrudes GG Intrudes LPG	gneiss GG	Intense foliation. Alignment of mica flattened quartz, feldspar.	Equigranular; garnet, tourmaline, beryl locally mu/bi variable.	F, Be mineralization
6	Dolland Bight	18	GARNET-MUSCOVITE ADAMELLITE granodiorite, granite	Intrudes GG Intrudes LPG - as concordant sheets.	gneiss	- do -	Equigranular, garnet, ubiquitous, locally pegmatitic, biotite locally.	No economic mineralization observed.
7	N. Bay	115*	BIOTITE (MUSCOVITE) ADAMELLITE diorite, granodiorite granite	Intrudes BDG	biotite feldspar clots Pelitic sediments	Mild foliation. Locally mylonitic. Locally massive.	Equigranular, patch perthite; local garnet; locally mu/bi variable	Mo mineralization Part of complex batholith.
8	M. Island	25	BIOTITE GRANODIORITE	Intrudes BDG	biotite-feldspar clots	none	Equigranular; uniform	Probable marginal phase of North Bay.

Table 2.1 (continued).

9	Long Pond	1	PYROXENE AMPHIBOLE biotite - diorite	Unknown	none	none	Equigranular opx and cpx replaced by hornblende and tremolite-actinolite.	Cut by barren pegmatite
10	Rocky Bottom	2	BIOTITE TONALITE granodiorite	Intrudes BDG	biotite feldspar clots	none	Poikilitic biotite phenocrysts	Barren
11	Matthews Pond	55	BIOTITE GRANODIORITE	Intrudes BDG	biotite feldspar clots	none	Equigranular oscillatory zoning in plagioclase.	Uniform, barren.
12	Round Pond	15	OLIVINE NORITE HORNBLENDE DIORITE	Intrudes BDG	none	Mild foliation local	Equigranular olivine rimmed by opx in norite	
13	Partridgeberry Hills	250	BIOTITE ADAMELLITE GRANODIORITE	Intrudes BDG	biotite feldspar clots pelitic sediments	Massive; foliation locally, defined by biotite, flattened quartz.	Locally perthitic highly altered	Pb, Zn, Cu, Ag, Au Mineralization bordered by mafic and ultramafic bodies.
14	Through Hill	13	GARNET-MUSCOVITE ADAMELLITE	Intrudes "Botwood equivalent" semipelites	semi-pelites	none	Garnet ubiquitous locally pegmatitic	Cut by diabase dike No economic mineralization observed.

* These plutons extend beyond the study area. Estimates refer to study area only.

Abbreviations: PIC = Piccaire; GG = Gaultois, DB = Dolland Bight; LPG = Little Passage Gneiss; BDG = Bay D'Espoir Group

Gneisses include psammitic, tonalitic and amphibolitic varieties similar to the Little Passage gneisses.

Fig. 2.2 Pegmatite injected into Little Passage gneiss;Little Passage.

with growth of hornblende,sillimanite,and pods of granitic partial melts locally. (2) Granitoids intruding the low to medium grade rocks north of the Day Cove Thrust are here referred to as the Northern Granitoids. The country rocks are dominantly semipelitic and volcanogenic sediments, with minor volcanics metamorphosed to greenschist and lower amphibolite facies and higher metamorphic grades in the aureoles of the granitoids. Although zones of intense deformation occur locally,bedding and other primary structures are preserved in most places. Ordovician fossils, (Brachiopods,Bryozoa and Pelmatozoa) have been found in some units (Colman-Sadd,1976).

2.2 The Southern Granitoids

2.2.0 General Statement

The Southern Granitoids comprise six plutons: (1) Piccaire,(2)Gaultois, (3) Northwest Cove, (4) Straddling, (5) Northwest Brook, (6) Dolland Bight. They are mainly of adamellite composition,intruding the Little Passage Gneisses. The plutons are all very well exposed,forming spectacular cliffs along Hermitage Bay and the Little Passage.

The plutons are all elongate bodies with an average length to width ratio of 5:1. The long axis of each pluton is parallel to the prominent northeasterly-striking foliation in the gneisses. A moderate to intense steep foliation follows the same trend in four of them (98% of aerial exposure). This northeasterly-trending structural pattern is clearly visible from the air,especially over the Garrison Hills. Even the two relatively undeformed plutons (Piccaire,Straddling) are elongated parallel to the main foliation. Tonalitic,amphibolitic and psammitic gneisses in long narrow sheets (over 7 km) occur as xenoliths within the granitoids (Colman-Sadd,1976). In places the Northwest Brook Granite can be seen to have intruded the Gaultois granite parallel to the foliation in both of them (Fig.2.3). Although some late pegmatite dikes are seen to cut across the foliation,many of them are subparallel to the foliation and are presumed to have been injected parallel to it.

Pitcher (1979) in a general review of granite plutonism,suggested that granite intrusion is triggered by crustal flaws. The spatial correlation of granitoid intrusions and crustal weakness has been discussed by Strong (1980) citing examples in Brittany and Newfoundland. The above descriptions strongly suggest that intrusion of the Southern Granitoids was not only permitted by zones of crustal weakness,but was also controlled by those zones. It seems likely that the present geometry was produced largely by deformation during intrusion of the Southern Granitoids; i.e. they are syntectonic. As Map 1 shows,the Southern Granitoids are flanked by two major faults; the Day Cove Thrust and the Hermitage Bay Fault. They are both northeasterly-trending structures and are thought to have been active during the Acadian Orogeny (Colman-Sadd,1980; Blackwood and O'Driscoll,1976). The Gaultois granite has yielded a Rb/Sr age of 350 $\pm$ 18 million years,coinciding with the Acadian Orogeny. Therefore it seems likely that movement along these two faults exercised structural control on the emplacement of the Southern Granitoids. Structural features are further discussed in Chapter 5.

2.2.1 Piccaire Granite

The Piccaire Granite is a small intrusion (2 km^2) extending westward from Piccaire beyond the map area. Exposure is almost continuous.

Fig.2.3 Northwest Brook leucogranite(left) cuts megacrystic Gaultois granite.Note chilled margin and parallel foliation in the two plutons;highway 360, Bay D'Espoir.

Fig.2.4 Abundant tourmaline in Northwest Brook leucogranite,indicating significant boron activity;highway 360, Bay D'Espoir.

Fig. 2.5. Pegmatite with tourmaline cutting marginal phase of Gaultois granite, Highway 360 Bay D'Espoir.

Fig. 2.6 Gaultois megacrystic granite cut by aplite. Gneissic xenolith is partly digested, and overgrown by K-feldspar megacryst. Piccaire, Hermitage Bay.

Fig.2.7. Massive Piccaire granite (left),post-tectonically intrudes Gaultois megacrystic granite,Piccaire Harbour.

The granite is medium to coarse grained, buff to pink and generally massive. A poorly developed linear fabric, defined by elongate quartz, occurs locally. The Piccaire granite intrudes the Gaultois granite and associated pegmatites (Fig 2.7), and is itself intruded by later pegmatites and aplite dikes. Gneissic xenoliths occur sparsely within the granite.

2.2.2 Gaultois Granite

The Gaultois Megacrystic granite crops out over an area of about 160 km^2, extending northeastward from Long Island through the Garrison Hills towards the eastern edge of the St. Alban's (1M13) map area. Exposure is almost continuous, with vegetation restricted to low shrubbery. Outcrops commonly form spectacular cliffs, best exposed along Hermitage Bay and Little Passage. The rock consists of a coarse grey to pink porphyritic granite (sl) with conspicuous pink phenocrysts of potash feldspar up to 5 cm long. Locally, especially towards the northeastern margin, K-feldspar phenocrysts are rare, and the rock grades into a diorite.

The Gaultois granite intrudes the Little Passage gneisses and contains abundant xenoliths of the gneisses in various stages of digestion and dismemberment (Fig 2.6). A moderate to intense foliation, defined mainly by elongate quartz and biotite, follows the northeasterly-trending long axis of the pluton, parallel to the main foliation in the gneisses. Local mylonite zones are developed near the margins. The Gaultois granite is intruded by Piccaire, Dolland Bight, Northwest Cove, Northwest Brook and presumably by the Straddling granite, making it the oldest of the

Southern Garnitoids. The Gaultois granite is cut by numerous pink pegmatite and aplite dikes (Fig 2.6), and by a few mafic dikes. A small ultramafic body, about 100 m^2 of uncertain origin, occurs at the contact with the Northwest Brook granite, just off the Harbour Breton Road (Route 360).

2.2.3 Northwest Cove Granite

The Northwest Cove Granite is a small (16 km^2) elongate pluton well-exposed inland from Northwest Cove in Hermitage Bay. It is a buff to pink, medium grained granite, intrusive into the Gaultois granite and Little Passage gneisses, and containing xenoliths of both. The granite bears an intense foliation defined by muscovite, biotite and elongate quartz. Towards the Hermitage Bay Fault, a cataclastic fabric is superimposed on the main foliation, accompanied by a distinct pink alteration.

2.2.4 Straddling Granite

The Straddling Granite is a small (5 km^2) well-exposed pluton at the head of Hermitage Bay. This pluton was considered to extend into the Avalon Zone, and thus 'straddle' the Avalon-Gander Zone boundary (Blackwood & O'Driscoll, 1976; O'Driscoll & Strong, 1979). Relations between the Straddling and its country rocks across the Avalon-Gander Zone boundary are discussed in Chapter 5. The rock is a buff to pink, medium grained granite. A strong mylonitic fabric is developed adjacent to the Hermitage Bay and Russel Head Faults, but the rock appears massive further northeast. In the fault zone the granite has been brecciated, and degraded to a crumbling red rubble. The straddling granite is faulted against the Gaultois granite at Russel Head, but intrudes the Northwest

Brook Granite to the northeast.

2.2.5. Northwest Brook Granite

This pluton forms a large (90 km^2) wedge between the Hermitage Bay and Russel Head Faults,extending eastwards outside of the map area. Outcrop distribution is excellent. It is a grey to buff medium-grained granite, with a strong foliation defined by muscovite,biotite and quartz. The Northwest Brook Granite intrudes the Little Passage gneisses and the Gaultois Granite,engulfing xenoliths of both (Fig.2.3.). In the Hermitage Bay Fault Zone the granite is brecciated and altered to a crumbling red rubble. The Northwest Brook Granite very closely resembles the Northwest Cove Granite.

2.2.6 Dolland Bight Granite

This lenticular pluton occupies an area of about 18 km^2 just east of Dolland Bight,adjacent to the Day Cove Thrust. Exposure is good in the area. The granite crops out as sheet-like dikes several meters wide,into the Little Passage Gneisses.. Intermingled sheets of granite and gneiss make the boundaries of the pluton difficult to define. Sparse sheets of this granite are injected into the gneisses on the Garrison Hills,where dikes of the Dolland Bight intrude the Gaultois Granite. The rock is a white to buff,medium grained,leucogranite with ubiquitous pink garnet. Locally the granite assumes a graphic texture and bears black tourmaline. Although this pluton is adjacent to the Day Cove Thrust,it appears not to have developed any mylonitic fabric as observed in the granites along Hermitage Bay.

2.2.7 Summary

Field relations of the Southern Granitoids suggest the following order of intrusion:

Latest................	Pegmatites
	Piccaire,Straddling
	Dolland Bight,Pegmatites,Aplites
	Northwest Brook,Northwest Cove
Earliest	Gaultois

The Gaultois Granite has been radiometrically dated at 350 ± 18 Ma, suggesting that intrusion of the Southern Granitoids began during the late stages of the Acadian orogeny. This is discussed further in Chapter 5.

2.3 The Northern Granitoids

2.3.0 General Statement

The Northern Granitoids comprise eight granitoid bodies: (1) North Bay (2) Missing Island (3) Long Pond (4) Rocky Bottom (5) Matthews Pond (7) Partridgeberry Hills (8) Through Hill. They are dominantly oval plutons intruding the Bay D'Espoir Group and similar rocks. Unlike the Southern Granitoids,they are sharply discordant and without a pervasive penetrative fabric. Few major faults appear to be spatially associated with the plutons. Regional metamorphic grade is in the greenschist to the lower amphibolite facies;hence many of the granitoids display well-developed contact aureoles (Map 1). The Missing Island Granodiorite and the Long Pond Diorite,together with the northern part of the North Bay Granite, have yielded a Rb/Sr isochron age of 430 ± 4 million years. This suggests a comagmatic relation between these three plutons. The Northern Granitoids are highly variable in composition but are dominated by granodiorite.

Fig. 2.8 Megacrysts in flow alignment.Equigranular North Bay granite grades into porphyritic variety,Long Pond.

Fig. 2.9. North Bay pegmatite folded with D2 of Bay D'Espoir group; Lampidoes Passage.

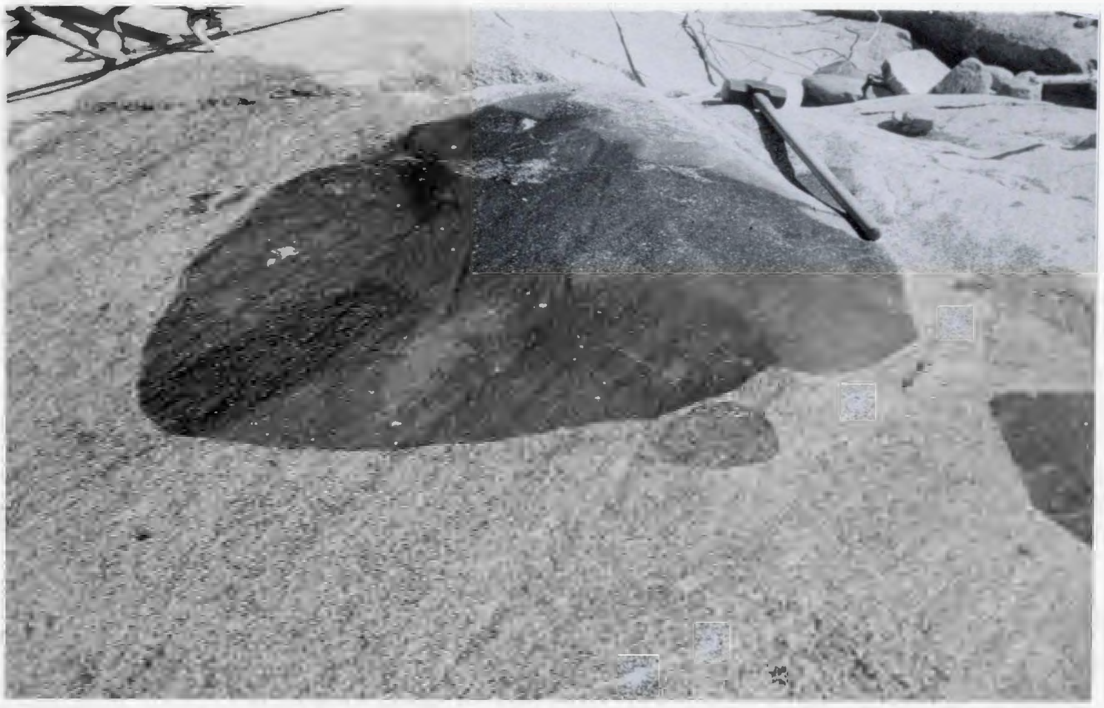


Fig.2.10. Xenoliths of country rocks engulfed at the margin of North Bay Pluton;Long Pond.

Fig. 2.11.Xenoliths of country rocks in various stages of digestion at the margin of North Bay pluton;Long Pond.

2.3.1 North Bay Granite

Although the North Bay Granite occupies an area of about 115 km^2 in the study area, it is only the eastern margin of the large Facheau Bay Batholith (over 4000 km^2). Previous work on the Facheau Bay Batholith (Williams, 1970, 1971; Jewell 1939), and the present study indicate that it consists of several phases, i.e. it is a composite batholith.

Exposure is fair, especially in the southern part of the pluton, where several imposing cliffs dominate the skyline along North Bay and Lampidoes Passage. It is a grey equigranular rock, adamellite to granodiorite, with minor amounts of hornblende diorite. Locally K-felspar phenocrysts up to 4 cm occur in flow alignment (Fig.2.8). The rock has no penetrative fabric, except for local mylonite zones. The Salmon River Dam Fault divides the North Bay Granite into two segments, which appear similar in the field, but which produce separate Rb/Sr isochrons. (Fig. 4.2)

The North Bay granite intrudes the Bay D'Espoir Group (Salmon River Dam and Riches Island Formations) with sillimanite and staurolite in the aureole. Part of the contact is faulted (Colman-Sadd, 1976). Xenoliths of the country rock have been engulfed and digested, especially near the contact (Fig.2.11). The North Bay granite is cut by pegmatite and aplite dikes (Jewell 1939). Although none of these dikes have been seen by the present author, pegmatite dikes, presumably associated with the North Bay granite, have been seen to intrude metasediments near the contact with the granite. One such pegmatite (Fig.2.9) in Lampidoes Passage, bearing molybdenite, has been folded by what is interpreted as the second deformation of the Bay D'Espoir group (Colman-Sadd, personal communication).

2.3.2 Missing Island Granodiorite

Despite occupying a map area of about 25 km^2, the Missing Island granodiorite is only poorly exposed, most of it presumably submerged beneath the waters of Long Pond. The rock is a massive, grey, medium grained granodiorite intruding the Bay D'Espoir Group (Salmon River Dam Formation). No penetrative fabric has been noted and few xenoliths have been found. The Missing Island granodiorite is very similar to the North Bay granite, with which it produces a single Rb/Sr isochron (Fig. 4.2). The Missing Island granodiorite is presumed to be a marginal phase of Facheau Bay Batholith.

2.3.3 Long Pond Diorite

The Long Pond Diorite is a small body cropping out on an island less than 500m^2 in area.It is a massive grey medium grained rock, intruded by a pink pegmatite dike about 1 m wide. The Long Pond Diorite does not come into contact with any other rocks, but bears close resemblance to the hornblende diorites occurring near Salmon River Dam at the edge of the North Bay Granite. The Long Pond Diorite is considered to be a marginal phase of the North Bay Granite, with which it produces a single Rb/Sr isochron (Fig. 4.2).

2.3.4 Rocky Bottom Tonalite

This is a small (2 km^2) rather poorly exposed pluton, outcropping at Rocky Bottom in the northern tip of Long Pond. It is a massive grey, medium to coarse grained rock with prominent phenocrysts of biotite up to 1 cm. It bears a striking resemblance to the Rocky Bay pluton in northeast Newfoundland (Strong and others, 1974). The Rocky Bottom Tonalite intrudes the Bay D'Espoir Group (North Steady Pond Formation) forming an aureole with prominent andalusite porphyroblasts. The rock is only slightly altered, and except for local flow alignment of biotite phenocrysts, bears no penetrative fabric. Few xenoliths have been observed.

2.3.5 Matthews Pond Granodiorite

This is a large (55 km^2) but poorly exposed pluton outcropping just east of Matthews Pond. It consists of a massive, grey, medium grained rock which is slightly altered locally. The Matthews Pond granodiorite intrudes the Bay D'Espoir Group (North Steady Pond Formation) forming an aureole bearing cordierite and andalusite (Colman-Sadd, 1980). Few xenoliths have been found in this granite, and it bears no penetrative fabric.

2.3.6 Round Pond Norite-Diorite

Most of this pluton (15 km^2) is presumed to lie beneath the waters of Round Pond. The rock is grey to black, medium grained and altered locally. It intrudes the Bay D'Espoir Group (North Steady Pond Formation) but no aureole has been identified, probably because of poor outcrop distribution. A mild foliation defined mainly by biotite occurs locally. The norite is believed to be akin to the numerous mafic and ultramafic bodies which occur at the margins of granitoid plutons in the area. The diorite is presumed to be a marginal phase of the North Bay granite.

2.3.7 Partridgeberry Hills Granite

This is the largest pluton in the study area (250 km^2), but is rather poorly exposed. It consists of essentially two phases: (1) coarse to medium grained perthitic biotite adamellite, (2) medium to coarse grained biotite granodiorite-tonalite. Composition varies between the extremes of these two phases and since no internal contacts have been observed they are presumed to be gradational. The rock is pervasively altered and has a moderate foliation locally, especially towards the margins. The Partridgeberry Hills granite intrudes the Bay D'Espoir Group (North Steady Pond Formation), as well as the Botwood Group Equivalent. Numerous xenoliths of country rock, especially near the southwestern contact, have been assimilated by the granite. Mafic and ultramafic rocks occur at the eastern and northeastern margin of the granite. They are thought to be fault-emplaced and intruded by the granite. The occurrence of vugs locally in the Partridgeberry Hills granite suggests a high level of intrusion.

2.3.8 Through Hill Granite

The Through Hill granite is a small pluton (13 km^2) cropping out at the western edge of the Burnt Hill area, immediately south of Mount Cormack. It is a white to buff, medium to coarse, garnetiferous leucogranite. Locally the rock assumes a striking graphic texture, well displayed on Through Hill. Veins of blue potash feldspar can be seen traversing the granite in a few places, indicating a late stage K-feldspathization. The granite appears entirely undeformed. It contains abundant xenoliths of the surrounding semipelitic country rock in various stages of assimilation. The Through Hill granite is cut by at least one diabase dike about 1 m wide trending east-west. Miarolitic cavities occur locally, indicating a high level of intrusion. Except for the absence of a fabric, and intrusion style, the Through Hill granite is identical to the Dolland Bight Granite.

2.3.9 Summary

As can be seen on Map 1, the Northern Granitoids do not have any exposed mutual contact. The order of intrusion is therefore rather less certain than for the Southern Granitoids. Based on radiometric dates (Chapter 4) and the extent of deformation, the following tentative order of intrusion is suggested:

Youngest	Through Hill
	Rocky Bottom Matthews Pond
	North Bay (including Round Pond, Long Pond, Missing Island)
Earliest	Partridgeberry Hills

More radiometric dates are required to test this outline.

CHAPTER 3

PETROGRAPHY

3.1 Introduction

The descriptions given in this chapter are based on petrographic studies of about 400 thin sections. Petrographic nomenclature follows the scheme outlined in Fig.3.1, modified after Streckeisen (1976). Averages of mineral composition are based on modal analyses after the method described by Chayes (1956). For details of modal analyses, see Appendix 1.

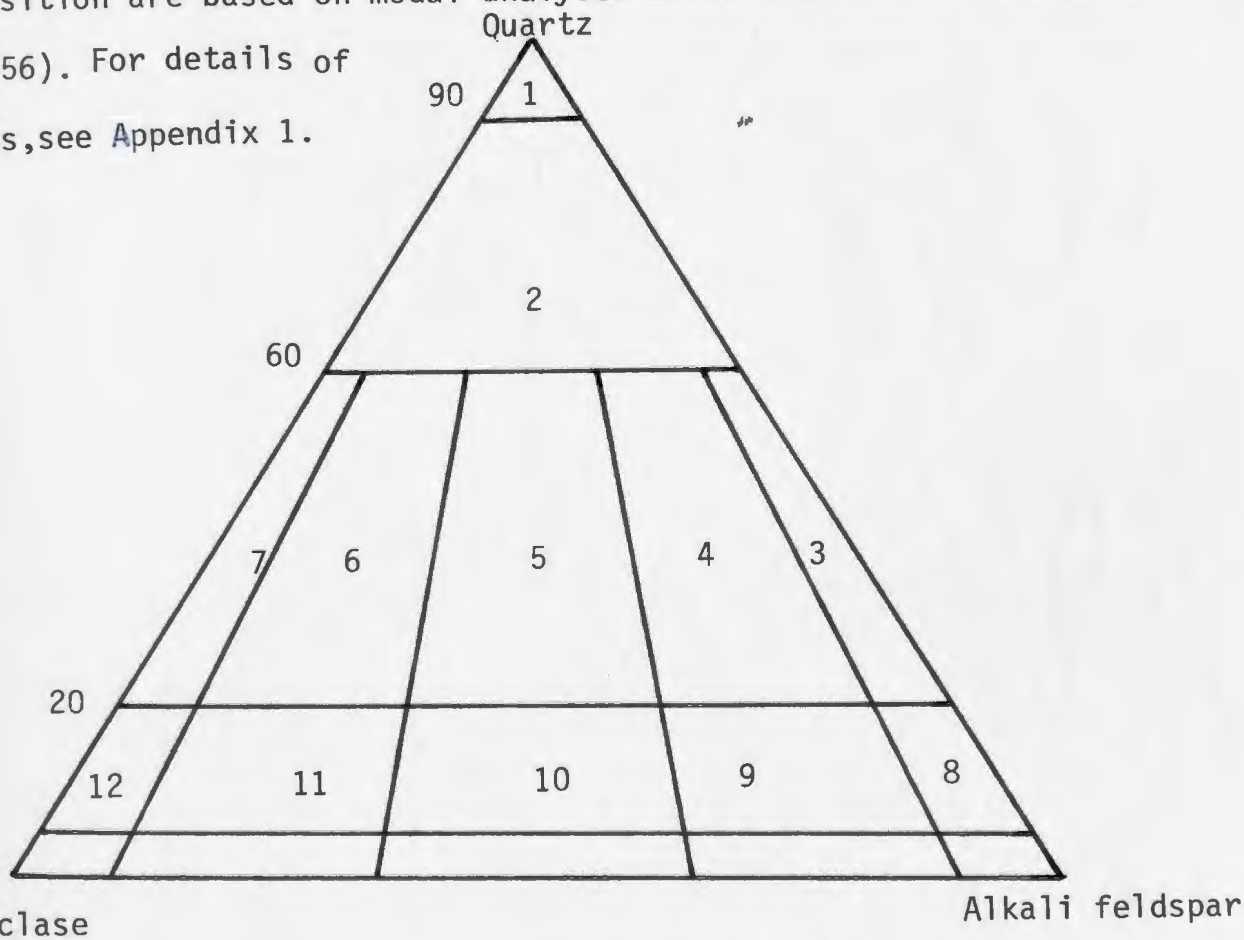


Fig.3.1. Classification scheme for granitoid rocks used in this chapter, modified after Streckeisen,(1976). 1=quartzolite;2=quartz-rich granitoids;3=Alkali-feldspar granite, (M <10=alaskite);4=granite (ss);5=adamellite;6=granodiorite; 7=tonalite,(M < 10=trondhjemite);8=alkali feldspar quartz syenite; 9=quartz syenite;10=quartz monzonite;11=quartz monzodiorite/quartz monzogabbro;12=quartz diorite/quartz gabbro/quartz anorthosite.M=mafics etc.,(micas,amphiboles,pyroxenes,olivine,opaques,accessories, epidote,etc).

3.2 Piccaire

The Piccaire pluton consists mainly of medium-coarse grained biotite adamellite. Although the exposed area is only about 2 km^2, alkali feldspar varies sufficiently to produce small domains of granodiorite, and even tonalite. The average modal composition is (%): Quartz 26.5, K-feldspar 24.2, plagioclase 39.4, biotite 8.6, muscovite 1.1, opaques 0.2 Accessory minerals are epidote, apatite, magnetite and rare sphene.

Alkali feldspar forms patch perthite locally and encloses both plagioclase and quartz. Plagioclase is extensively saussuritized, and displays oscillatory zoning. Biotite is strongly altered to chlorite, muscovite, and epidote. Quartz shows undulose extinction and extensive subgrain formation, producing a lineation locally. Myrmekite is developed locally.

3.3 Gaultois

The main petrographic facies of the Gaultois pluton is a K-feldspar megacrystic biotite adamellite-granodiorite. Towards the margin of the pluton, especially in the northeast, biotite, hornblende and plagioclase have crystallized with only small amounts of quartz and K-feldspar. Naney (1978) has shown that undercooling of silicate liquids of granitic composition causes crystallization of ferromagnesian minerals $\pm$ plagioclase, to the exclusion of quartz and alkali feldspar. This is attributed to slow nucleation of quartz and alkali feldspar. Mafic border phases observed in the Gaultois pluton could be due to this mechanism, without requiring gravitational settling or differential flow. Pegmatite intrusions (Fig 2.5) probably represent the felsic residue.

Away from the margin alkali feldspar and quartz increase in abundance so that the rock varies from diorite through granodiorite to adamellite. The pluton is cut by garnetiferous pegmatites and aplites. Average modal composition (estimated) is (%): Quartz 25,microline 28,plagioclase 35,and biotite 10. Accessory minerals are epidote (1%), apatite,zircon,magnetite, pyrite,and coarse euhedral sphene(1%)- see Fig.3.2.

Euhedral microcline megacrysts up to 5 cm long commonly form patch perthite and enclose quartz,biotite,and euhedral plagioclase (Fig.3.3). Although the inclusions do not appear to be oriented,their euhedral nature, in contrast to later anhedral quartz,biotite, plagioclase and K-feldspar, suggests that the microcline megacrysts are early phenocrysts,i.e. of magmatic origin. Plagioclase shows simple normal zoning,and is commonly saussuritized. Biotite is commonly altered to chlorite,and rarely,muscovite. In the vicinity of Hermitage Bay Fault,the granite is coated by brown hematitic staining.

The Gaultois Granite bears a strong foliation,which increases in intensity towards the margins. The foliation is defined by biotite,and elongate polycrystalline aggregates of quartz,forming augen of the megacrysts. Locally the fabric is mylonitic with fractured feldspars in a matrix of dismembered biotite and quartz ribbons. This is especially evident towards the Hermitage Bay and Russel Head Faults.

The wide range of rock types and occurrence of hornblende,sphene and magnetite make the Gaultois pluton conform to the 'I'- type of Chappel and White (1974),and the 'M' series of Ishihara (1977),although the presence of metasedimentary xenoliths creates some ambiguity. This is further discussed in Chapter 6.

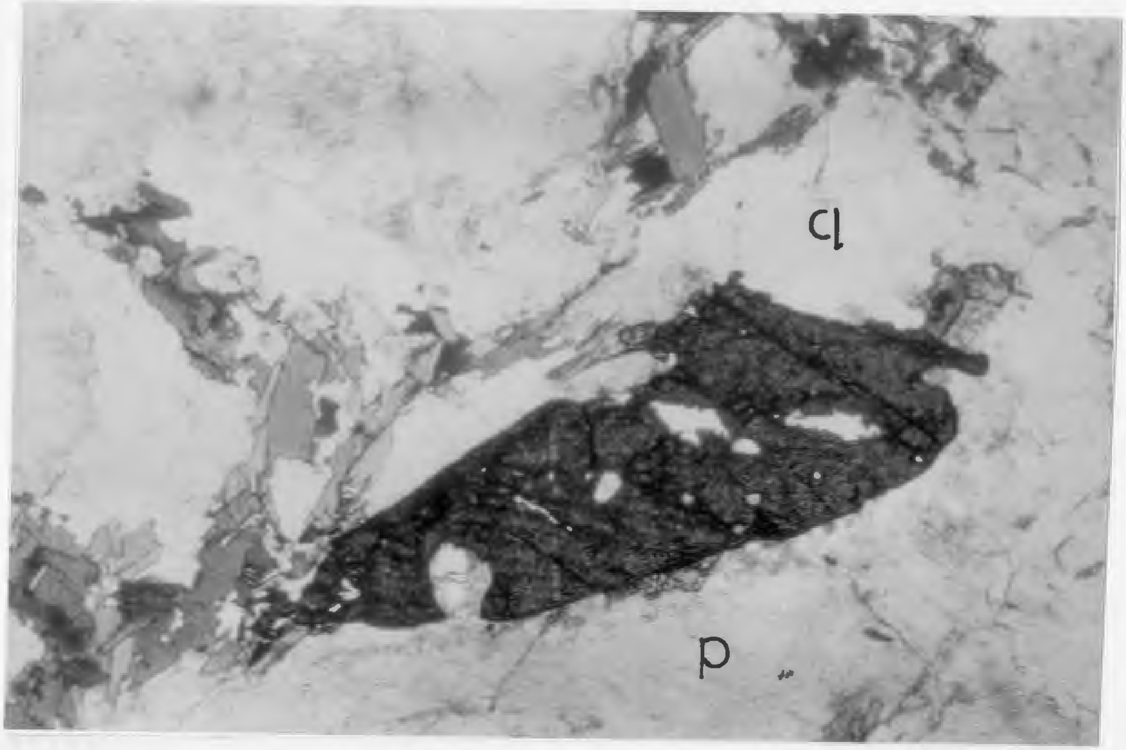


Fig.3.2. Euhedral sphene with quartz (q),plagioclase (p),and biotite in Gaultois granite (x 10).

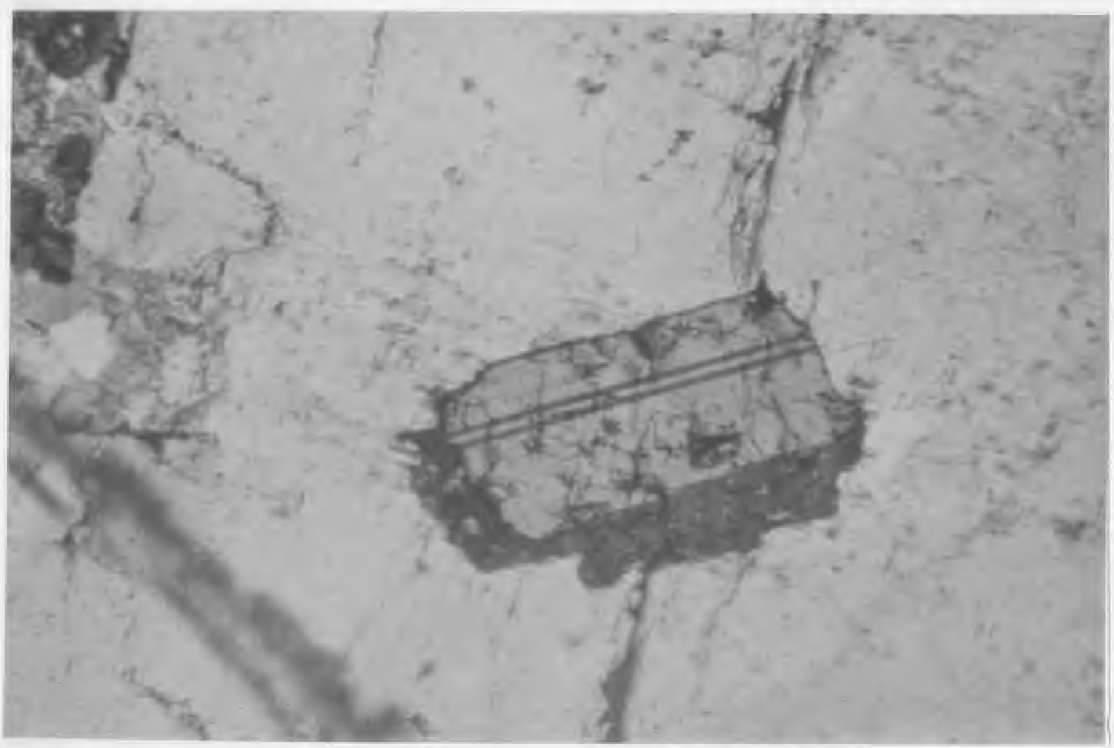


Fig.3.3. Euhedral plagioclase enclosed by microcline megacryst,Gaultois granite (x 20,x nicols).

3.4 Northwest Cove

The Northwest Cove pluton consists of a fairly homogeneous adamellite. Muscovite is the main mica, with biotite less than 2% if not absent. Garnet and black tourmaline occur locally.

The average modal composition is (%): Quartz 27.9, K-feldspar 25.8, plagioclase 34.6, biotite 3.6, muscovite 7.8. Accessory minerals are apatite, zircon, epidote and rare opaque oxides.

Alkali feldspar forms patch perthite locally and commonly encloses quartz and euhedral plagioclase. Plagioclase is commonly saussuritized, and mostly normally zoned. Biotite is partly chloritized.

A very strong pervasive foliation is defined by muscovite, biotite, and elongate quartz. The fabric is mylonitic locally with fractured alkali feldspar and plagioclase in a matrix of quartz ribbons and strongly sheared mica.

3.5 Straddling (Indian Point)

The Straddling Granite (Gander Zone) consists predominantly of medium grained adamellite. Although it grades locally into a granodiorite-tonalite, this phase does not exceed 15% of the total outcrop area.

The average modal composition is (%): Quartz 26.8, K-feldspar 22.1, plagioclase 41.7, biotite 6.7, muscovite (secondary) 2.0, opaques 0.5. Accessory minerals are zircon, epidote, apatite, opaque oxides, and rare sphene.

Alkali feldspar is not visibly perthitic, but hypidiomorphic microcline commonly encloses biotite, quartz and euhedral plagioclase. Plagioclase is extensively corroded and saussuritized. Biotite is bleached and altered to muscovite, chlorite, and opaque oxides. A strong mylonitic fabric can be seen in most samples, where potash feldspar and plagioclase are crushed, and set in a matrix of quartz ribbons and sheared biotite. Secondary muscovite appears to overgrow the fabric, and many fractures have been invaded by veins of carbonate and epidote. Locally the rock appears to have no fabric, and seems to have recrystallized. The mylonitic fabric is attributed to the Hermitage Bay and Russel Head Faults. The relation of this pluton to the 'Straddling Granite' southeast of the Hermitage Bay Fault (Avalon Zone) is discussed in Chapter 5.

3.6 Northwest Brook

The Northwest Brook pluton is a rather homogeneous adamellite. Muscovite is the dominant mica, and biotite, which rarely exceeds 3% is absent locally. Garnet and black tourmaline occur sparsely.

The average modal composition is (%): Quartz 29.6, K-feldspar 27.2, plagioclase 33.4, biotite 2.8, muscovite 7.0. Accessory minerals are apatite, zircon, epidote and rare opaque oxides.

Alkali feldspar, which is mostly interstitial, locally forms patch perthite. It also encloses biotite, quartz, and euhedral plagioclase. Plagioclase is commonly saussuritized and displays mainly normal zoning. Biotite is partly chloritized.

A very strong planar fabric pervades the Northwest Brook granite. It is defined by muscovite, biotite, and elongate polycrystalline aggregates of quartz. This fabric becomes mylonitic locally, especially near the Russel Head and Hermitage Bay faults. Alkali feldspar and plagioclase are fractured and set in a matrix of quartz ribbons and severely sheared mica.

The Northwest Brook granite is petrographically indistinguishable from the Northwest Cove granite.

3.7 Dolland Bight

The Dolland Bight pluton consists mainly of adamellite, but about 25% of the outcrop area is covered by granodiorite.

The average modal composition is (%): Quartz 31.7, K-feldspar 24.5, plagioclase 33.8, biotite 1.0, muscovite 9.1. Garnet is a ubiquitous phase and biotite occurs sporadically, mainly as replacement for muscovite, tourmaline occurs locally. Zircon is the only accessory mineral seen. Perthite is rare and K-feldspar commonly encloses quartz and euhedral plagioclase. Plagioclase is slightly saussuritized, and poorly zoned.

A strong foliation pervades the granite, and becomes mylonitic locally. In places, the rock has been extensively recrystallized.

3.8 North Bay

The typical rock type is a medium grained biotite adamellite. There is subtle variation to granodiorite in many areas, with hornblende diorite locally at the margin. Small zones of alkali granite also occur. Locally, especially towards the north the equigranular granite is seen to grade into a megacrystic variety. The average modal composition is (%): Quartz 29.0, K-feldspar 22.1, plagioclase 38.5, biotite 7.6, muscovite 2.0. Accessory minerals are zircon, apatite, rare sphene and opaque oxides.

Alkali feldspar crystals form a rather striking patch perthite. Plagioclase and biotite are only slightly altered. Muscovite appears to be a primary mineral in a few specimens, and garnet has been observed in one sample. Although the pluton has no pervasive fabric, quartz shows undulose extinction,and a strong mylonitic texture is developed locally.

The Long Pond diorite, Missing Island granodiorite and Round Pond norite-tonalite are considered marginal phases of the North Bay pluton. They are considered as ferromagnesian-rich border facies formed after the manner described for the Gaultois pluton.

3.9 Missing Island

The Missing Island Pluton consists of massive medium grained hornblende-biotite granodiorite. Potash feldspar, although consistently less than plagioclase, increases in abundance locally to make the rock an adamellite. The average modal composition is (%): Quartz 25.4, K-feldspar 20.1, plagioclase 42.8, biotite 8.5, hornblende 2.5, clinozoisite 0.4. Accessory minerals are sphene, epidote, apatite zircon and opaque oxides.

Plagioclase displays oscillatory zoning and is commonly saussuritized. Biotite is slightly chloritized. Hornblende has been partly altered to tremolite-actinolite. Quartz shows undulatory extinction, with formation of subgrains.

3.10 Long Pond Diorite

The Long Pond diorite has the following average composition (%): plagioclase (oligoclase-andesine) 60, biotite 13, hornblende 7, tremolite-actinolite 6, quartz 5, orthopyroxene 4, clinopyroxene 5, opaques 1. Apatite and zircon are prominent accessories. Plagioclase shows oscillatory zoning; biotite is pleochroic from dark brown to pale yellow; hornblende is pleochroic from pale green to dark green. The rock shows little sign of alteration and bears no evidence of deformation.

3.11 Rocky Bottom

The Rocky Bottom Pluton consists of a homogeneous medium to coarse grained hornblende-biotite tonalite.

The average modal composition is (%): Quartz 26.7, K-feldspar 2.2, plagioclase 53.9, biotite 10.7, muscovite 1.6, amphibole 3.5, clinozoisite 1.5. Accessory minerals are epidote, zircon, apatite and opaque oxides.

Plagioclase displays oscillatory zoning, is extensively saussuritized, and biotite which occurs as phenocrysts, is severely chloritized and partly altered to muscovite. Hornblende is partly altered to tremolite-actinolite. No foliation is visible, but quartz shows undulatory extinction and biotite is strongly wrinkled.

3.12 Matthews Pond

The Matthews Pond pluton is relatively homogeneous, medium grained equigranular biotite granodiorite. Of the 17 samples studied, all are of granodiorite composition, with an average modal analysis of (%): Quartz 26.5, K-feldspar 10.2, plagioclase 49.9, biotite 10.5, muscovite (secondary) 2.8. Accessory minerals are zircon, apatite, sphene and rutile.

Plagioclase displays spectacular oscillatory zoning and is saussuritized. Biotite is commonly altered to chlorite, epidote, muscovite sphene and opaque oxides. Although no penetrative fabric is visible, quartz shows undulose extinction and extensive development of subgrain boundaries.

3.13 Round Pond

Three phases are recognized in the Round Pond pluton: (1) medium grained massive olivine norite. This is an olivine-plagioclase cumulate, with large oikocrysts of orthopyroxene. The average modal composition is (%): olivine 6.2, orthopyroxene 14.3, plagioclase 64.9, biotite 3.7, amphibole 9.3, opaques 1.6. Magnetite is the accessory mineral. Olivine , one of the early crystallizing phases,is commonly replaced and rimmed by orthopyroxene. (Fig. 3.4). Orthopyroxene is partly replaced by hornblende and biotite. No fabric is present in the rock and alteration is only slight. (2) Medium grained massive hornblende gabbro. Average modal composition is (%): Plagioclase 36.7, orthopyroxene 2.7, hornblende 41.4, tremolite 17.3, opaques 1.9. Hornblende is commonly replaced by tremolite-actinolite, and chlorite. Plagioclase is partly saussuritized. No penetrative fabric has been observed. (3) Medium grained massive hornblende-biotite granodiorite. Average modal composition is (%): Quartz 22.4, K-feldspar 17.9, plagioclase 43.7, biotite 8.0, hornblende 4.7, epidote 3.1, opaques 0.2. Accessory minerals are epidote, sphene and opaque oxides. Plagioclase is partly saussuritized, biotite is strongly chloritized and hornblende is partly replaced by tremolite-actinolite. No fabric has been observed, but quartz shows undulatory extinction, with subgrain development.

Although no contacts have been found between the three phases in the Round Pond pluton, composite pegmatite veins suggest a genetic relationship (Colman-Sadd, 1979).

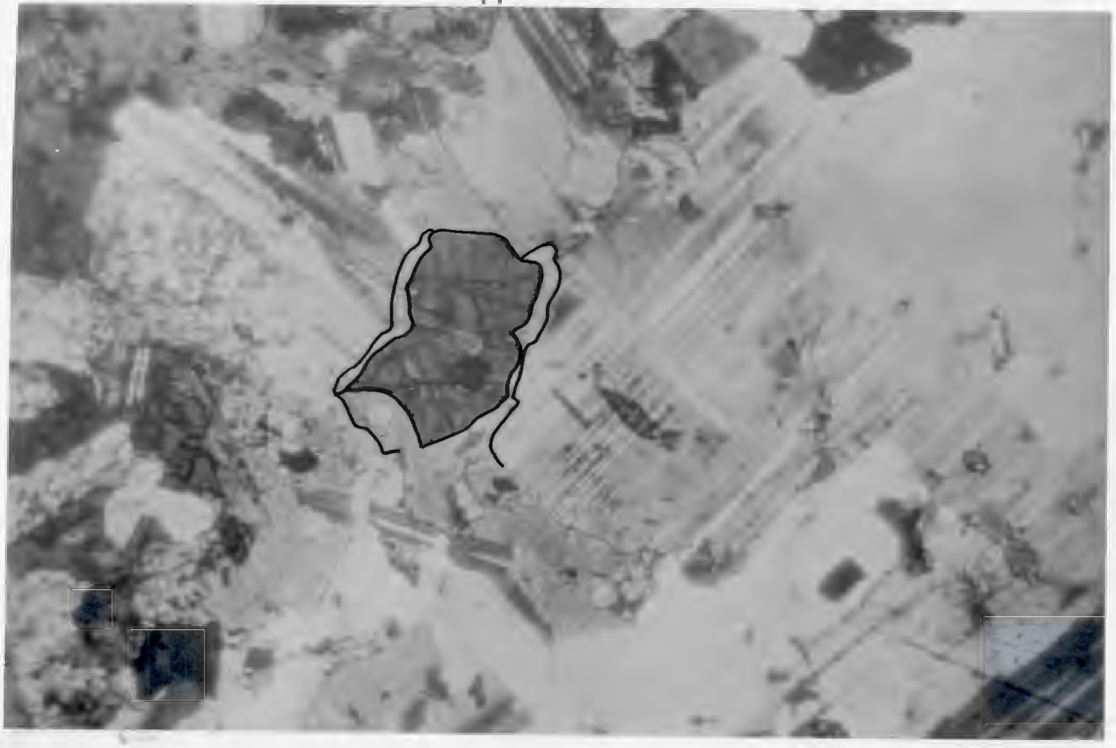


Fig.3.4. Olivine norite,Round Pond Pluton,showing olivine (in centre) rimmed by orthopyroxene.Plagioclase shows excellent lamellar twinning (x10 x nicols).

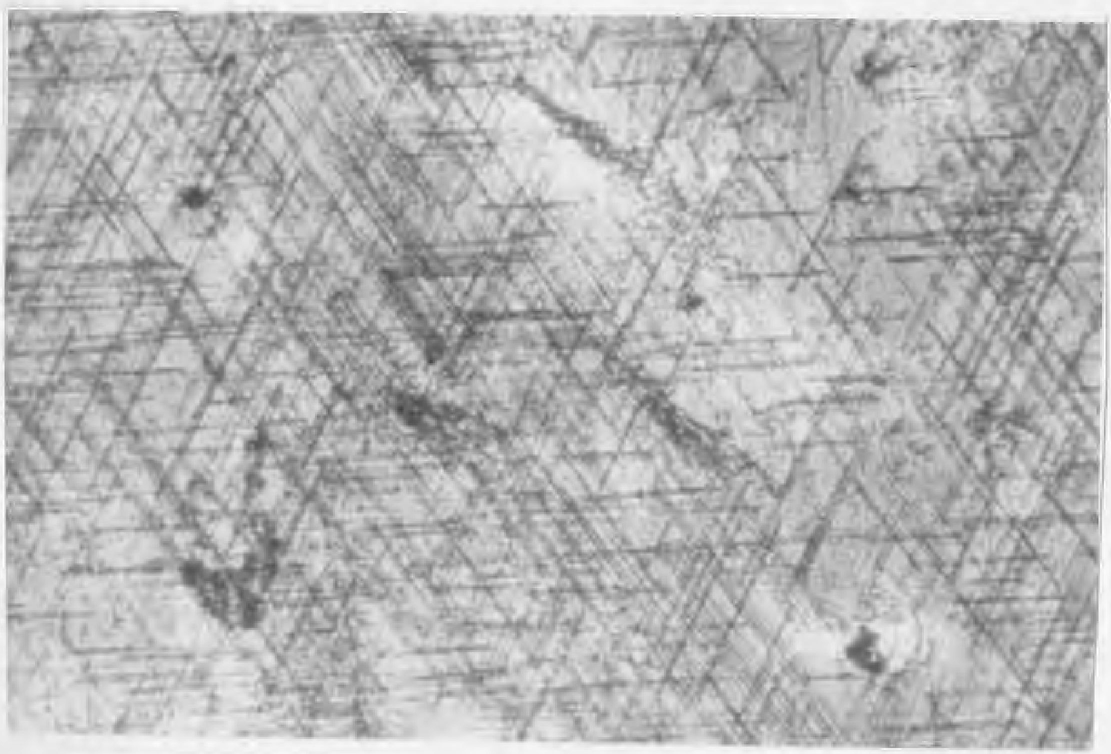


Fig.3.5.Sagenitic texture, Partridgeberry Hills granite.Rutile needles form rhombohedral array in altered biotite. (x20, x nicols).

Partridgeberry Hills

Two phases can be recognized in the Partridgeberry Hills pluton: coarse to medium grained perthitic biotite adamellite; (2) medium to coarse grained biotite granodiorite-tonalite. The average modal composition is (%): Quartz 29.2, K-feldspar 18.4, plagioclase 39.6, biotite 9.3, muscovite 2.9, opaques 0.5.

Accessory minerals are zircon, sphene, rutile, and apatite. Andalusite, garnet and tourmaline occur locally in the adamellite.

Regardless of composition the rock is severely altered. Plagioclase is saussuritized almost beyond recognition. Biotite is very severely altered to chlorite, muscovite, and opaque oxides. Oriented needles of rutile (sagenite) can be seen in many sections of chloritized biotite (Fig. 3.5). In places the rock has been invaded by veins of carbonate and epidote. This alteration is probably due to percolating fluids during the later stages of consolidation.

3.15 Through Hill

This is a medium to coarse grained adamellite-granodiorite, with minor amounts of tonalite. Muscovite and pink garnet up to 2mm are ubiquitous. Biotite and black tourmaline occur locally. The average modal composition is (%): Quartz 27.4, K-feldspar 22.2, plagioclase 39.1, biotite 1.3, muscovite 10.0. Zircon is the accessory mineral. Locally, the granite assumes a graphic texture, indicating a near eutectic crystallization. No penetrative fabric has been observed, but quartz shows undulatory extinction and some micas are slightly kinked. There are no signs of any significant alteration.

3.16 Summary

From the preceding descriptions it is clear that the Bay D'Espoir granitoids fall almost exclusively in the adamellite-granodiorite clan. Tonalite and diorite constitute about 10%, while granite (ss) is less than 1%. This pattern is remarkably similar to that of the Sierra Nevada calcalkaline batholith (Bateman et al, 1963) as shown in Fig.3.6. Of the total aerial exposure granodiorite: ademellite ratio is higher among the Northern Granitoids than the Southern Granitoids. However, there is no systematic decrease in the ratio from northwest to southeast, some of the lowest ratios being recorded in the most northerly pluton, the Through Hill. The North Bay pluton with its mafic border facies and the Gaultois pluton with its late pegmatitic phases are used to illustrate mineral paragenesis in the Northern and Southern granitoids respectively.

The North Bay pluton may be characterized by the following assemblages, where quartz occurs in all except the first, in which olivine is present:

olivine + orthopyroxene + magnetite

orthopyroxene + magnetite + clinopyroxene + amphibole

magnetite + amphibole + biotite

(magnetite) + biotite (most common)

biotite + muscovite

muscovite + garnet

The Gaultois pluton may be characterized by the following assemblages, in which quartz and plagioclase are present throughout:

amphibole + magnetite + biotite + sphene

magnetite + biotite + sphene (most common)

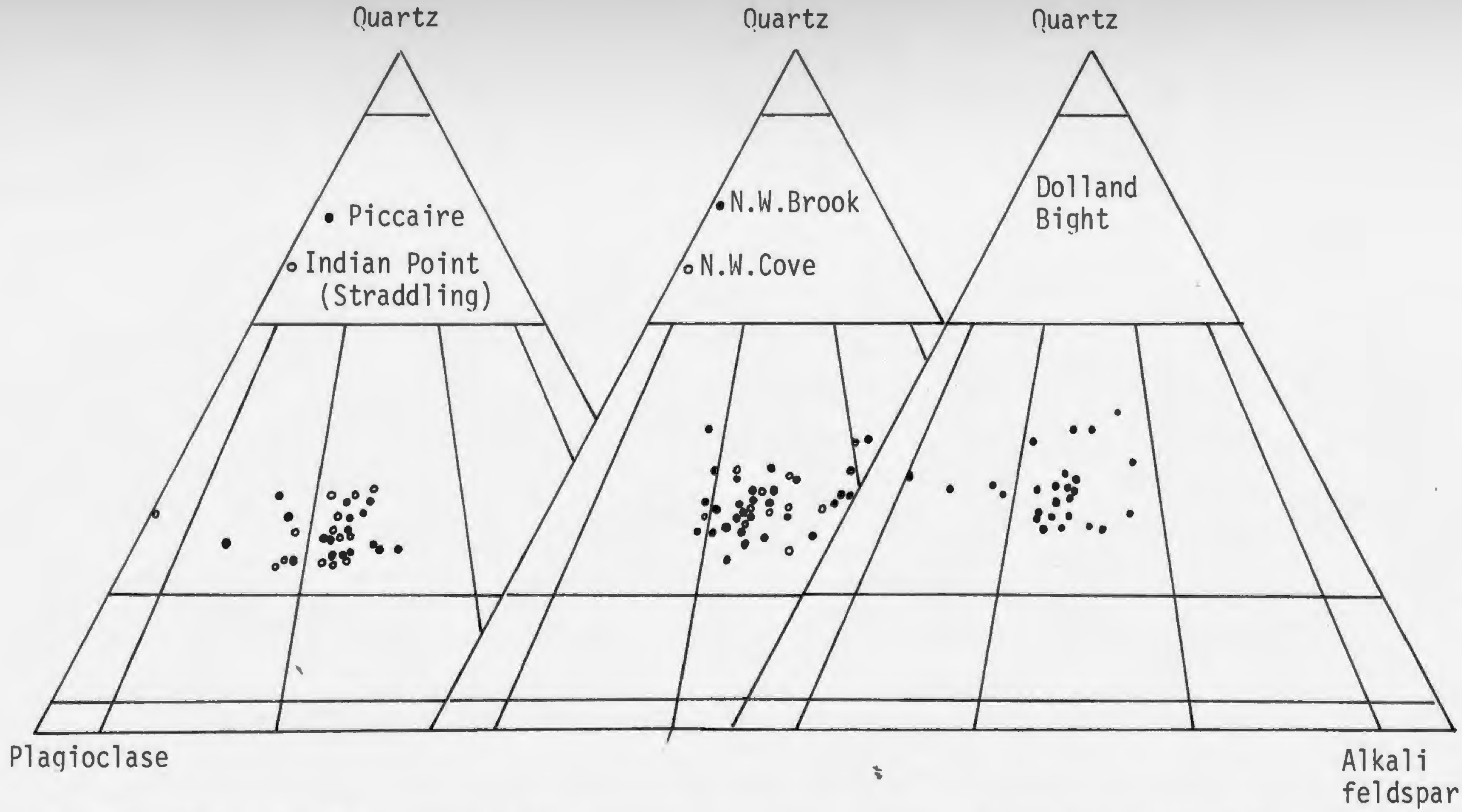


Fig.3.6a. Plots of modal compositions,Southern Granitoids.Nomenclature as in Fig. 3.1.

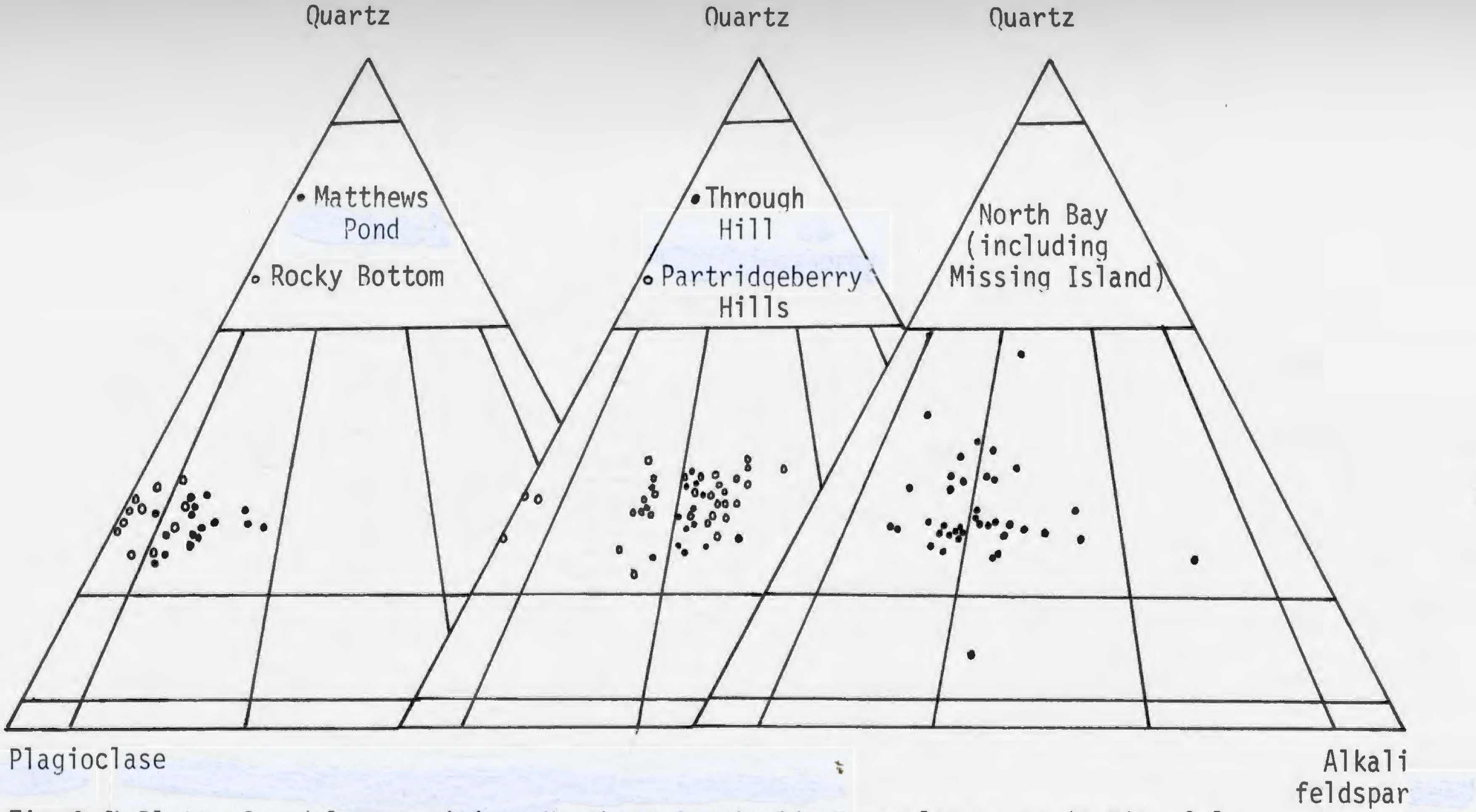


Fig. 3.6b.Plots of modal compositions,Northern Granitoids.Nomenclature as in Fig. 3.1.

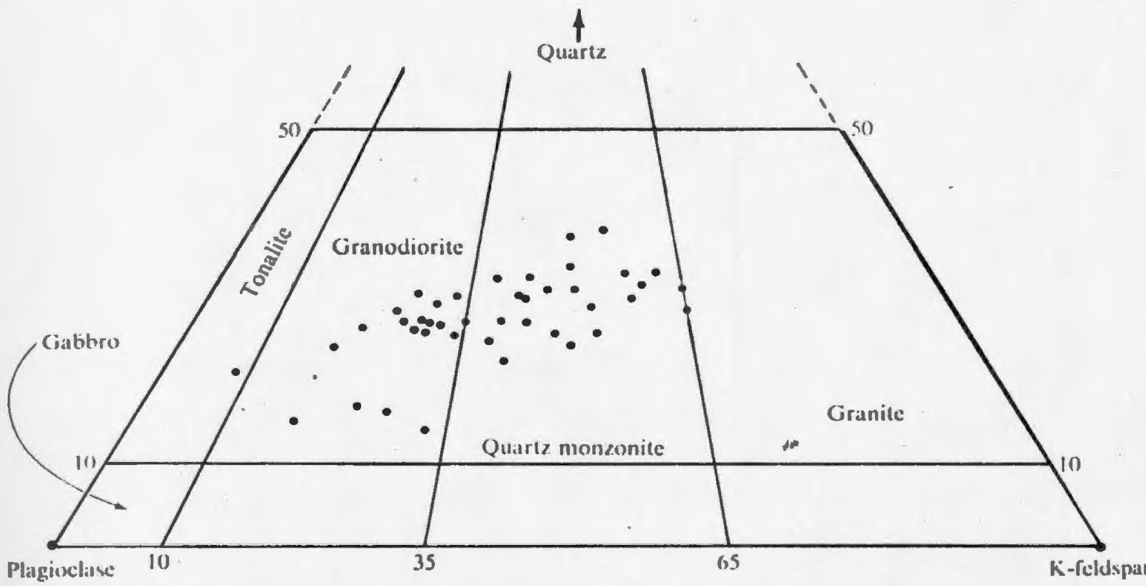


Fig.3.6c. Plot of 40 average modal compositions of granitic rocks, Sierra Nevada batholith, representing 597 analyses. (After Bateman et al., 1963) Compositional range is very similar to that of the Bay D'Espoir granitoids.

biotite + muscovite

muscovite + garnet

The assemblages above partly shared by each of the plutons are very similar to those described for calc-alkaline suites elsewhere (Kuno, 1960; Best & Mercy 1967; Strong, 1979). However it should be noted that in both North Bay and Gaultois plutons, garnet is associated with muscovite, with no biotite or hornblende. Garnet occurs ubiquitously only in the muscovite granites Through Hill and Dolland Bight. Where garnet occurs in the other plutons, there is a clear inverse relation between it and other ferromagnesian minerals. These observations support the contention by Cawthorn and Brown (1976) that once garnet begins to precipitate other ferromagnesian minerals (biotite and hornblende) are in reaction relationship with the melt.

Strong (1980) proposed the following classification for Appalachian-Caledonian granitoids, with implications for their ore-bearing potential .

Suite (1) Composite mafic-silicic amphibole bearing calcalkaline plutons.

Suite (2) Biotite granite-granodiorite often containing megacrysts of microcline.

Suite (3) Muscovite-biotite (2 mica) leucogranites.

Suite (4) Alkaline-peralkaline granites.

The distinction between suites (1) and (2) is not always clear. Suite (2) granitoids are often amphibole bearing and have the petrographic signature of calcalkaline suites, as illustrated for the Gaultois and North Bay plutons. With this in mind, the Bay D'Espoir granitoids can be placed into Suites (2) and (3) as follows:

Northern Granitoids	
Suite 2	Suite 3
North Bay	Through Hill
Rocky Bottom	
Matthews Pond	
Partridgeberry Hills	
Southern Granitoids	
Suite 2	Suite 3
Piccaire	Northwest Cove
Gaultois	Northwest Brook
Indian Point	Dolland Bight

In terms of outcrop area, the Southern Granitoids are evenly divided between suites 2 and 3 whereas the Northern Granitoids are over 90% of suite 2. Strong (1980) has noted that suite 3 granitoids in Western Europe are associated with U, Sn, W, and Be, whereas suite 2 granitoids are generally barren. The applicaton of this observation to the study area will be examined in Chapter 7.

CHAPTER 4

RUBIDIUM - STRONTIUM ISOTOPIC AGE DETERMINATIONS

4.1 Introduction

The Rubidium Strontium isotopic method (York and Farquhar, 1972) was used to obtain radiometric dates for four plutons in the area, to place constraints on the nature of the source materials, and to provide constraints on the timing of structural development as discussed in Chapter 5. The plutons dated are: (1) North Bay granite (2) Through Hill granite (3) Partridgeberry Hills granite and (4) Gaultois megacrystic granite. Field and laboratory methods, and whole rock chemistry are given in Appendix 2. Implications of the isochrons for the Southern and Northern granitoids are examined below.

4.2 The Northern Granitoids

Among the Northern Granitoids, three plutons were dated: North Bay, Through Hill and Partridgeberry Hills granites. The data are as follows:

Pluton	Age (Ma)	Strontium Initial Ratio	No. of Points	MSWD
North Bay-A	427 ± 12	0.7053 ± 0.0003	4	4.2
North Bay-B	430 ± 4	0.7066 ± 0.0001	8	6.1
Through Hill	429 ± 2	0.7207 ± 0.0005	6	2.7
Partridgeberry Hills	431 ± 5	0.7154 ± 0.0004	6	12

These ages overlap, within the limits of experimental error suggesting that at least some of the Northern Granitoids (ca.80% of outcrop area) were emplaced over a short period in Silurian time. Whether this wide range of strontium isotope initial ratios represents those of the source material or reflects varying degrees of crustal contamination during magmatic ascent cannot be stated with certainty. However, it seems likely that the crust underlying the study area had input from both continental and oceanic sources during the Silurian. That such a variety of source material was available is attested to by the variety of lithologies comprising country rocks to the Northern granitoids: pelites, siliceous sandstones, acid volcanics, pillow basalts, diabase, gabbro and ultramafics. Individual isochrons are discussed below.

4.4.1 North Bay Granite

The North Bay granite forms the eastern margin of the Facheau Bay batholith. The Salmon River Dam fault divides the pluton into north and south lobes. The north lobe is dominantly granodiorite, while the south lobe mostly biotite adamellite. An isochron was generated for each lobe(Figs.4.1,4.2),but the isochrons are nearly parallel and have very similar intercepts. For the north and south lobes respecively, the ages are 430 $\pm$ 4 Ma (NB-B) and 427 $\pm$ 12 Ma (NB-A) with corresponding strontium isotope initial ratios of 0.7066 and 0.7053. Details of the data are given with the isochron below .(Figs.4.1,4.2; Tables 4.1,4.2).

Although the two lobes of the North Bay granite appear to produce separate isochrons, the ages overlap within experimental error. They appear to be consanguineous on geochemical grounds (Chapter 6). The slight difference in strontium initial ratio is therefore attributed to minor contamination, to which the margin of the pluton must have been

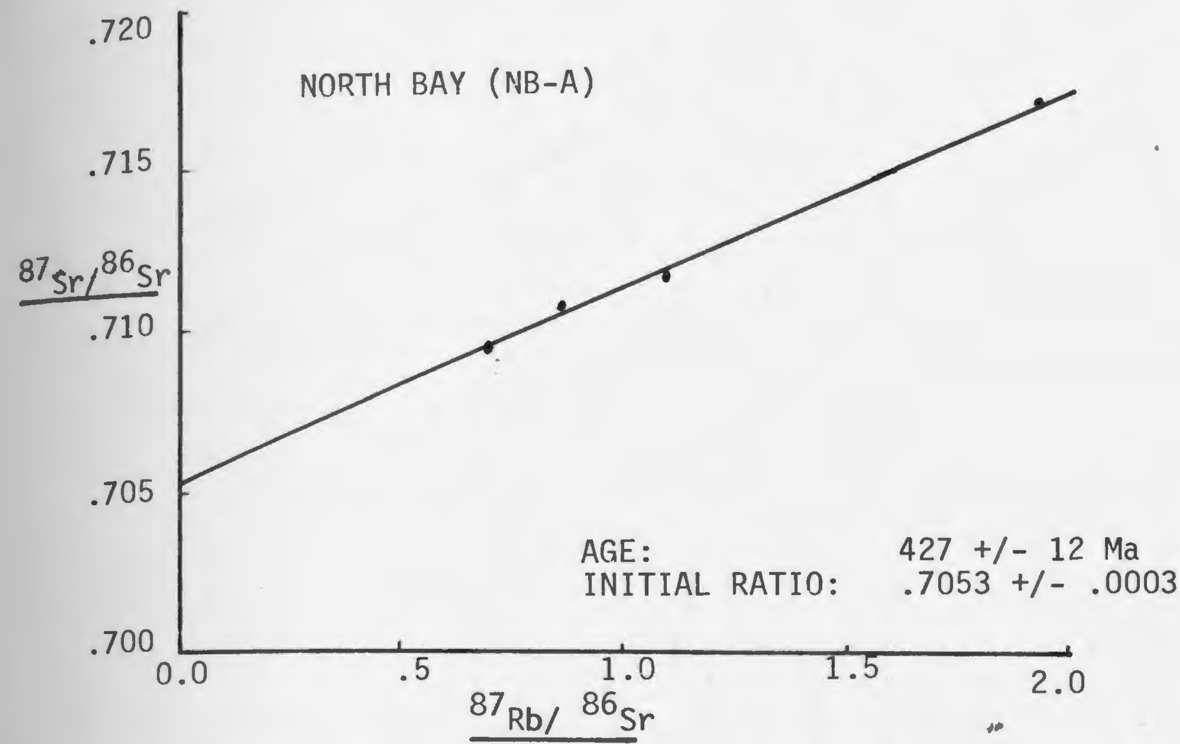


Fig.4.1. Rubidium-Strontium isochron NB-A,North Bay Granite,south of the Salmon River Dam Fault.

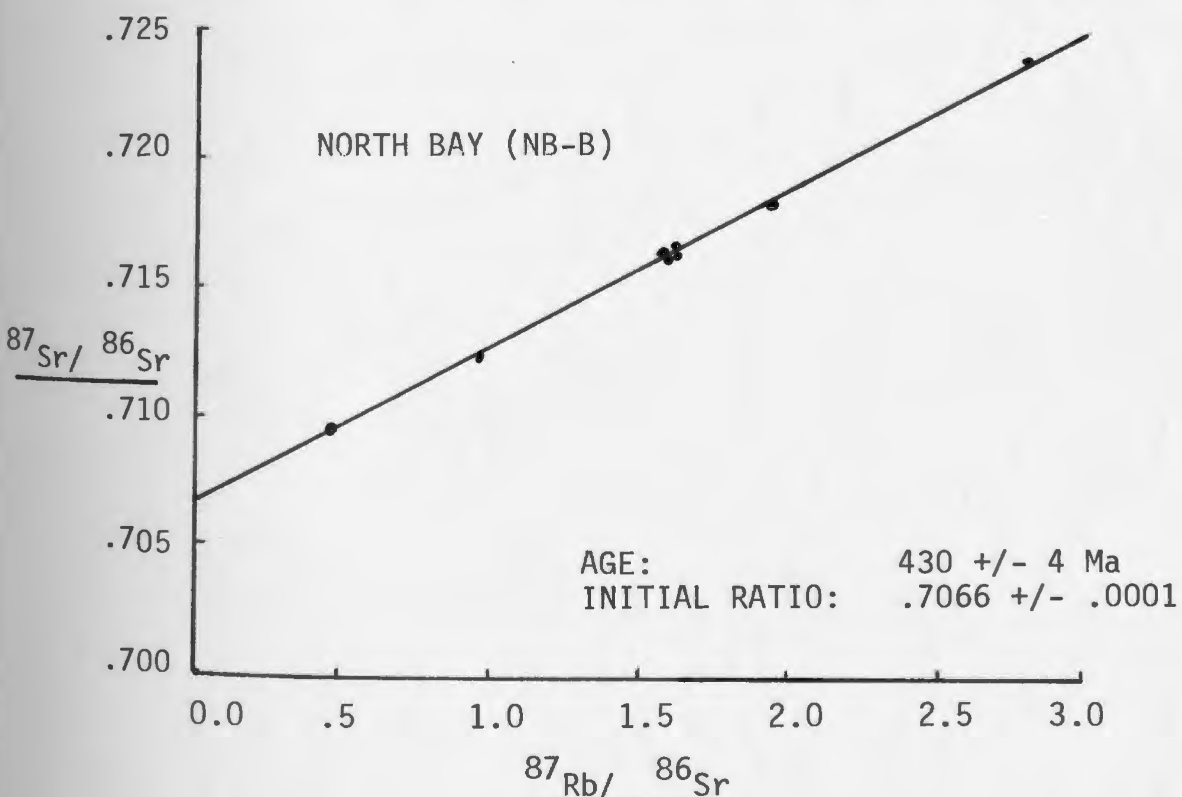


Fig.4.2. Rubidium-Strontium isochron NB-B,North Bay Granite,north of the Salmon River Dam Fault.

TABLE 4.1.

Rb-Sr Data for North Bay (NB-A) Pluton

Sample No.	Rb	Sr	Rb/Sr (weight)	Rb^{87}/Sr^{86} (mol)	Sr^{87}/Sr^{86} (mol)
NB 1	132.1	198.2	.666	1.930	.7170
170072	175.1	463.7	.377	1.093	.7116
170080	136.4	456.9	.298	.864	.7107
170198	128.5	536.0	.239	.694	.7091

TABLE 4.2.

Rb-Sr Data for North Bay (NB-B) Pluton

Sample No.	Rb	Sr	Rb/Sr (weight)	Rb^{87}/Sr^{86} (mol)	Sr^{87}/Sr^{86} (mol)
NB 5	57.14	355.6	.160	.465	.7095
NB 6	146.1	218.1	.669	1.94	.7184
NB 8	133.1	240.4	.553	1.603	.7163
NB 9	129.6	230.8	.561	1.626	.7166
NB 10	168.1	174.8	.962	2.78	.7239
NB 11	108.5	198.3	.547	1.585	.7164
170374	74.5	223.2	.334	.966	.7124
170385	132.8	237	.560	1.624	.7164

exposed, as evident from the abundance of xenoliths occurring there (Chapter 2). The narrow range of Rb^{87}/Sr^{86} (0 to 3) tends to accentuate any error due to natural contamination and analytical shortcomings. Samples NB-5 and NB-6 were taken from the Long Pond diorite and Missing Island granodiorite respectively . These two samples have Sr isotope values consistent with their being part of the North Bay pluton,as suggested in Chapter 3.

[illegible].2 Through Hill Granite

The Through Hill granite is a small pluton in the northern extremity of the study area, consisting mostly of garnet-muscovite adamellite. A six point isochron was produced, indicating an age of 429 $\pm$ 2 Ma, and strontium initial ratio of 0.7207. This date is almost identical to those obtained for the North Bay granite, whereas the strontium initial ratios are of sharply contrasting values. The strontium initial ratio is unusually high for Gander Zone granitoids (see Strong, 1980). Since the Through Hill granite shows little sign of alteration, the strontium initial ratio is considered to be original, indicating that the source material was largely recycled continental crust (c.f. Faure and Powell, 1972). This is consistent with the highly peraluminous nature of the granite (Chapter 6), indicated in the field by the ubiquitous occurrence of garnet and muscovite, and highly siliceous sedimentary xenoliths. The Silurian Botwood group cropping out adjacent to the Through Hill granite, and consisting largely of continental siliceous sandstones and subaerial volcanics (Williams, 1970; Dean, 1977) may have been derived from a source similar to that of the Through Hill granite. The closest likely source for recycled continental sediments should have been the Avalon Zone (c.f. Colman-Sadd, 1980b) about seventy kilometers to the east, where Precambrian sediments and subaerial volcanics occur (Hussey, 1979). The juxtapositioning of such highly radiogenic sediments with mafic and ultramafic rocks in such a small area (as described above) underscores the local heterogeneity of the crust in Silurian time, and may be a reflection of the considerable east-west crustal shortening thought to have occurred in the Appalachian orogen during the Taconic and Acadian orogenies (Williams, 1980). Detailed data and the isochron are shown below. (Fig.4.3;Table 4.3).

4.2.3 Partridgeberry Hills Granite

The Partridgeberry Hills granite is a large pluton ranging from biotite granodiorite to adamellite with metasedimentary xenoliths. The granite is extensively altered, as described in Chapter 3. The isochron indicates an age of 431 $\pm$ 5 Ma and a strontium initial ratio of 0.7154. Details of the data are shown in Table 4.4.

As can be seen from Fig.4.4, the isochron has been constructed with a very wide range in Rb^{87}/Sr^{86} (0 to 50) with no points lying between the extremes. The isochron is therefore to be regarded as only preliminary. However, the close agreement with the ages obtained for the North Bay and Through Hill granites suggests that 431 Ma is probably close to the true age of the Partridgeberry Hills granite. The high Strontium initial ratio of 0.7154 indicates an origin from continental crust, consistent with the local occurrence of apparently primary andalusite and garnet (Chapter 3), and the presence of metasedimentary xenoliths.

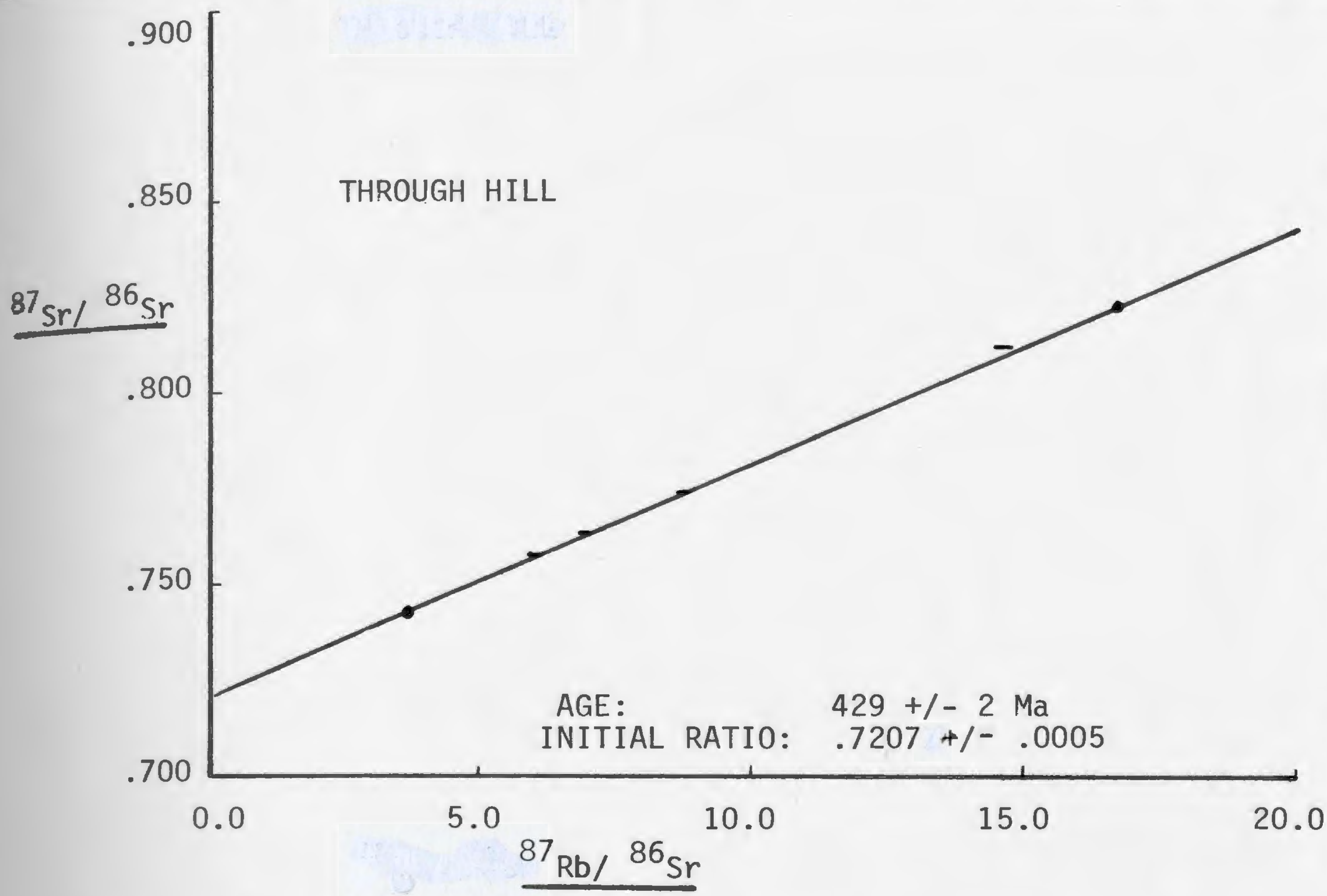


Fig.4.3. Rubidium Strontium isochron,Through Hill Granite.

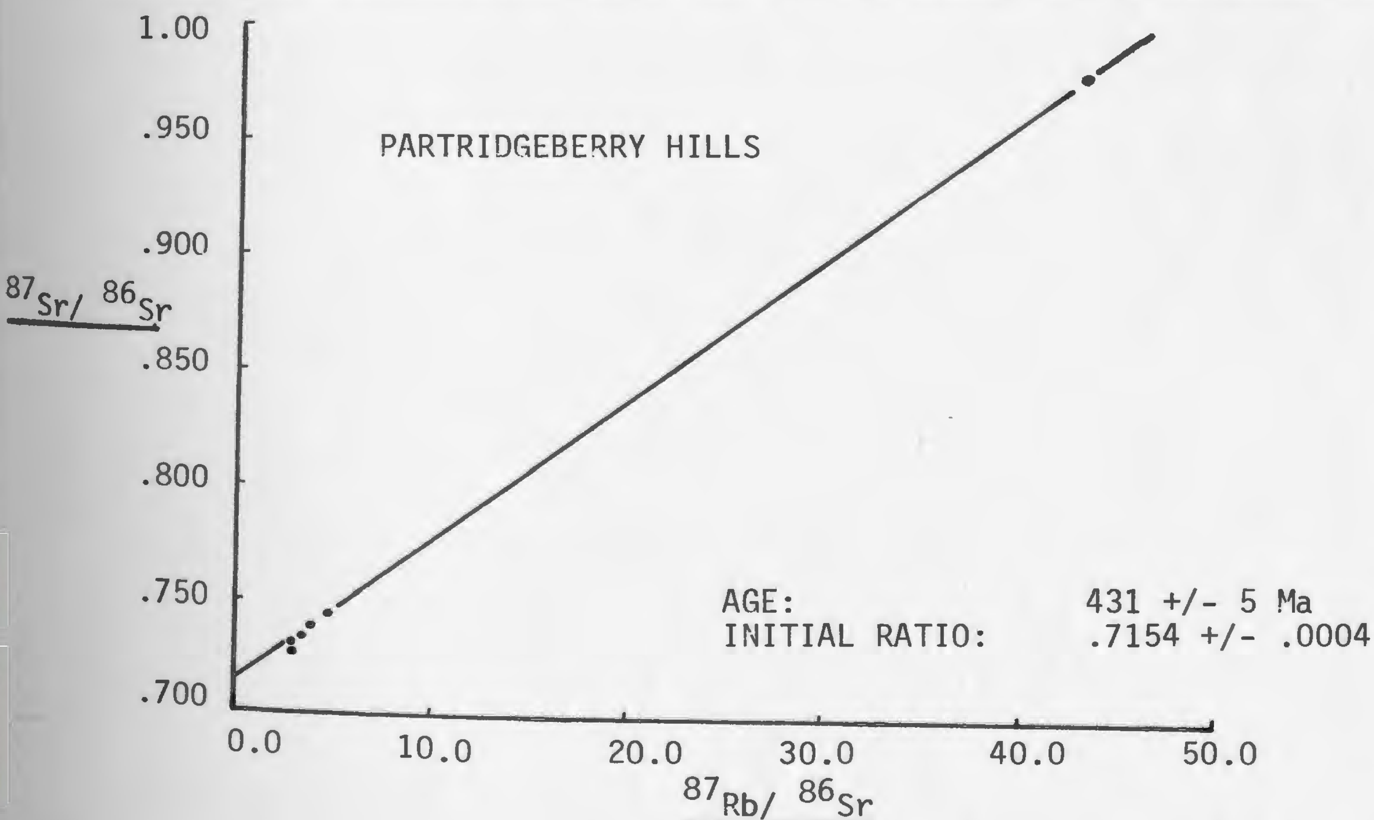


Fig.4.4. Rubidium-Strontium isochron,Partridgeberry Hills Granite.

TABLE 4.3

Rb-Sr Data for Through Hill Pluton

Sample No.	Rb	Sr	Rb/Sr (weight)	Rb^{87}/Sr^{86} (mol)	Sr^{87}/Sr^{86} (mol)
170501	163.7	69.1	2.37	6.899	0.7634
170504	127.2	100.7	1.26	3.670	0.7427
170506	158.4	31.9	4.98	14.55	0.8119
170511	159.3	53.4	2.98	8.699	0.7739
170516	164.3	28.9	5.69	16.66	0.8225
170518	69.4	33.8	2.05	5.972	0.7576

TABLE 4.4

Rb-Sr Data for Partridgeberry Hills Pluton

Sample No.	Rb	Sr	Rb/Sr (weight)	Rb^{87}/Sr^{86} (mol)	Sr^{87}/Sr^{86} (mol)
P 13	266.1	18.4	14.50	43.09	0.9798
P 20	173.8	135.9	1.28	3.713	0.7385
P 35	159.3	137.6	1.16	3.360	0.7348
P 39	148.5	112.6	1.32	3.827	0.7391
P 49	176.0	107.6	1.64	4.750	0.7445
P 50	113.6	112.0	1.02	2.945	0.7300

[redacted] The Southern Granitoids

Among the Southern granitoids, only the Gaultois megacrystic granite was dated. From field relations (Chapter 2) the Gaultois granite is inferred to be the oldest of the Southern granitoids. Determination of its age therefore provides a lower age limit for all of the Southern granitoids. The Gaultois granite varies from hornblende-biotite diorite in the northeast through granodiorite to biotite adamellite in the south-west. A ten point isochron was constructed, using this range of rock types. The isochron, (Fig 4.5) gives a date of 350 $\pm$ 18 Ma, with Sr^{87}/Sr^{86} initial ratio of 0.7105 $\pm$ 0.0004, and M.S.W.D. of 16.6. Details of the data are given in Table 4.5.

The age of 350 $\pm$ 18 Ma has relatively a large error (ca 5%) with an M.S.W.D. of 16.6. Although care was exercised in selecting samples showing a minimum of alteration, it was not entirely possible to avoid samples which were partly chloritized and hematitized especially near the Hermitage Bay fault. A small degree of metasomatic alteration appears to be responsible for the slight scatter of points. Furthermore, the narrow range of $Rb^{87}-Sr^{86}$ (1-2) tends to amplify the error.

Within the limits of experimental error the age of the Gaultois granite overlaps that of the Ackley City batholith immediately to the east (345 $\pm$ 5Ma Bell et. al., 1977) (352 $\pm$ 10, 355 $\pm$ 10, 356 $\pm$ 10 Ma, O' Driscoll and Gibbons, 1980). Both of these plutons are megacrystic, and together occupy an area of over 5000 km^2. The two similar ages suggest considerable deep level granitoid generation in the area in late Devonian - early Carboniferous time. The higher strontium initial ratio (0.7105) for the Gaultois granite suggests that this pluton was generated from source material rich in radiogenic strontium, probably largely of continental origin, whereas the source material for the Ackley City batholith (initial ratio 0.7048) had a greater mantle input (c.f. Faure and Powell, 1972). This substantial difference in strontium initial ratio for similar granitoids of apparently similar age within such a relatively small area reflects considerable heterogenity of the lower crust from which the plutons are thought to have been generated by partial melting in late Devonian - early Carboniferous time. The Ackley City batholith is relatively undeformed, and from field relations was intruded later than the Southern Granitoids (Dickson et. al. 1980). The ages of the Gaultois granite and Ackley City batholith provide lower and upper limits respectively for intrusion of all of the Southern Granitoids. It is therefore likely that the entire suite was intruded over a short interval in late Paleozoic time during the Acadian orogeny.

4.4 Summary

The Bay D'Espoir granitoids fall into two groups: (1) the Northern granitoids which appear to have crystallized and intruded, probably all together (ca. 430 Ma) in Silurian time; (2) the Southern granitoids which apparently crystallized and were intruded in early Carboniferous (ca. 350 Ma). The considerable variation in strontium initial ratios within two relatively small areas indicates significant heterogenity of the lower crust during the Acadian orogeny. It appears that granitoid magmatism in the Bay D'Espoir area occurred in two pulses coinciding with the earliest and latest stages of the Acadian orogeny.

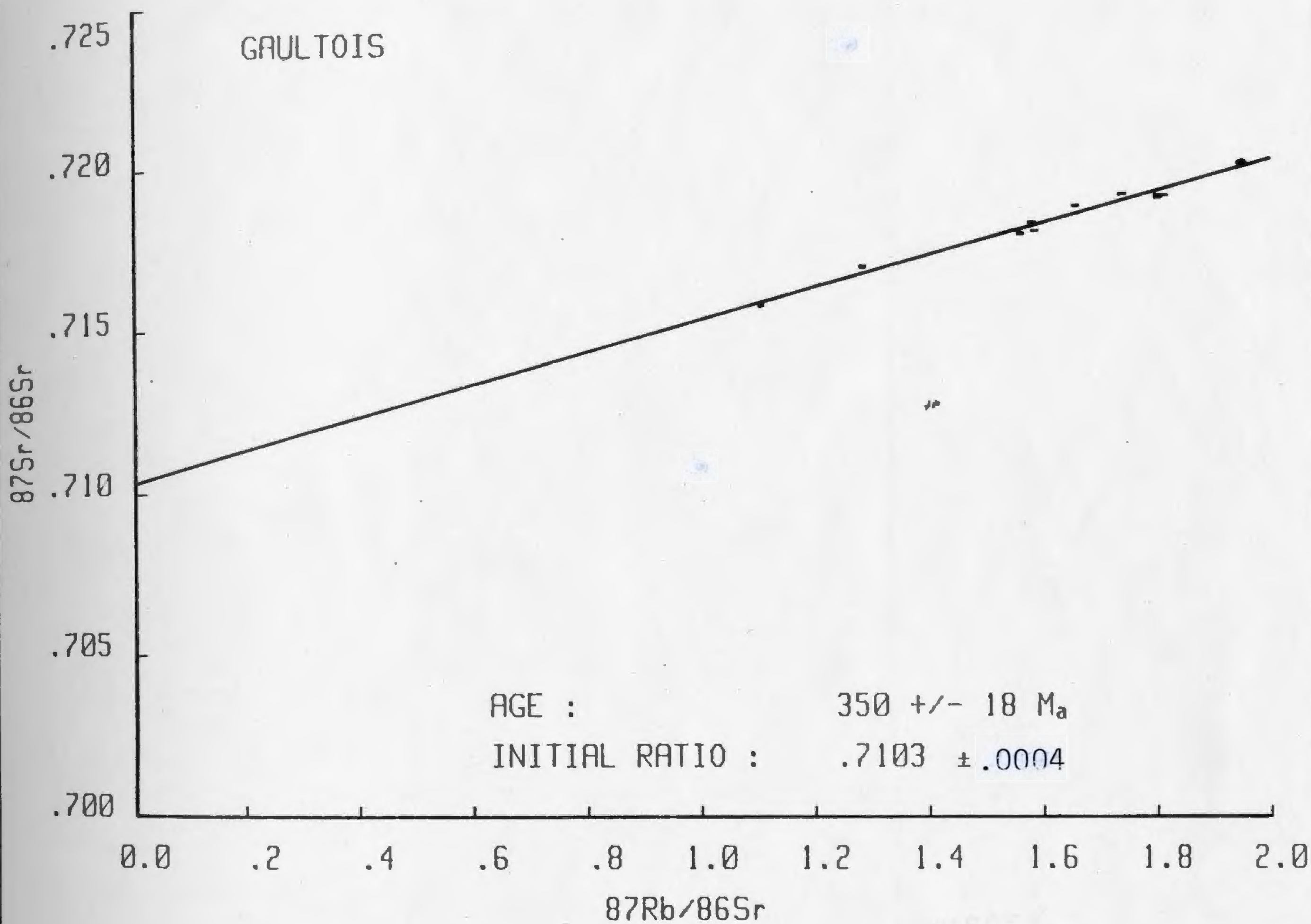


Fig.4.5. Rubidium-Strontium isochron,Gaultois Megacrystic Granite.

TABLE 4.5.

Rb-Sr Data for Gaultois Pluton

Sample No.	Rb	Sr	Rb/Sr (weight)	Rb^{87}/Sr^{86} (mol)	Sr^{87}/Sr^{86} (mol)
G 1	169.0	380.7	.4441	1.286	.7169
G 2	236.9	378.0	.6267	1.815	.7191
G 4	184.1	341.3	.5394.	1.562	.7179
G 5	191.9	351.2	.546	1.583	.718
G 6	229.4	368.4	.6227	1.804	.7190
G 7	178.8	312.0	.5729	1.659	.7188
G 8	199.3	363.8	.5479	1.587	.718
G 9	192.4	320.3	.6009	1.740	.719
G 10	234.2	345.9	.6771	1.961	.720
G 11	152.8	399.3	.3827	1.108	.7157

CHAPTER 5

STRUCTURAL GEOLOGY

5.1 Introduction

The structural evolution of the Bay D'Espoir area has been summarized by Colman-Sadd (1980). The Little Passage gneisses were deformed prior to the first deformation in the Bay D'Espoir group. The gneisses were later overprinted by a steep northeasterly-trending foliation which is axial planar to tight isoclinal folds. The gneisses are intruded by the southern granitoids which are also overprinted by the same steep northeasterly-trending fabric. Several steep faults cut the gneisses and granitoids (Colman-Sadd et al, in press), most prominent among which are the Day Cove Thrust, the Russel Head and Hermitage Bay faults. The Hermitage Bay Fault is part of a major structure separating the low-grade Avalon Zone terrane from highly metamorphosed Gander Zone rocks (Blackwood and O'Driscoll, 1976). The Russel Head fault is probably a secondary structure (cf. Chinnery, 1966; Lajtai, 1969) related to movement along the Hermitage Bay fault.

Two episodes of deformation have been identified in the Bay D'Espoir Group (Colman-Sadd, 1980), into which the Northern granitoids have been intruded. In contrast to the Little Passage gneisses, primary structures and fossils are preserved in the Bay D'Espoir Group (Coleman-Sadd, 1980). Several faults traverse the Bay D'Espoir Group (map 1), producing zones of intense mylonitization.

5.2 Structural Features of the Southern Granitoids

As stated in Chapter 2, except for the Indian Point and Piccaire, all of the southern granitoids bear a strong northeasterly-trending foliation. The foliation is defined mainly by aligned micas and flattened quartz aggregates. The following observations may be noted: (1) The foliation in the plutons is steep and parallel (or near parallel) to the latest overprinting foliation in the host gneisses. (2) The plutons are elongated parallel to the foliation ,(see map 1) (3) Late-stage pegmatites either cut across the foliation or are injected subparallel to the foliation, and deformed with the granite. No convoluted pegmatites have been observed. (4) Within the limits of error the ages of the Gaultois and Ackley City granitoids overlap (Chapter 4). The Ackley City pluton truncates the foliation in the Northwest Brook granite (Dickson and others, 1980) which in turn intrudes the Gaultois. The Hermitage Bay Fault abruptly truncates the Southern granitoids and offsets the southwestern tip of the Ackley City batholith for a few kilometers towards the northeast. Further north, the Ackley City batholith cuts off the Hermitage Bay Fault.

The above evidence suggests that intrusion and foliation of the southern granitoids occurred over a short time span. It appears that intrusion of the plutons and the pegmatites occurred in the same stress field that produced the foliation. The Southern Granitoids are therefore probably syntectonic.

5.3 Structural Features of the Northern Granitoids

The Northern Granitoids intrude the Bay D'Espoir Group, after the first of two major deformation episodes (Colman-Sadd, 1980). The first deformation (D_1) formed northeast-trending, shallowly-plunging isoclinal folds through the group. Some of these structures indicate that the sediments were largely unlithified at the time of deformation.

The Northern granitoids cut across structures attributed to D_1 are generally oval shaped and, except locally, lack a penetrative fabric. The Northern granitoids are therefore post-tectonic with respect to D_1.

The second deformation of the Bay D'Espoir Group (D_2) resulted in northeasterly-trending recumbent folds. Deformation is strongest in the Isle Galet Formation, adjacent to the Day Cove Thrust, where isoclinal folds have transposed the earlier fabric, and obliterated primary structures in some units. Towards the north, folds become more open (Fig. 2.9) and the axial planar fabric is reduced to a crenulation cleavage. The granitoids, which are well-removed from the Day Cove Thrust, show little sign of deformation from D_2, although local mylonite zones associated with faulting, have been observed in the North Bay and Partridgeberry Hills granites. It appears that D_2 was related to movement along the Day Cove Thrust. Consequently deformation is strongest in the frontline Isle Galet Formation. Northward, the bulk of the stress has been absorbed by faulting. The Big Rattling Brook Thrust and the Salmon River Dam Fault are examples (see Map 1). The second deformation with its extensive faulting is correlated with the latest overprinting foliation in the Little Passage gneisses and therefore with intrusion of the syntectonic Southern Granitoids.

5.4 The Hermitage Bay Fault

5.4.1 Introduction

The Hermitage Bay Fault has been interpreted as a high angle reverse fault by Widmer (1950). Its tectonic significance as the boundary between the Avalon and Gander Zones has been discussed by Blackwood and

O'Driscoll (1977). In the study area the fault forms a prominent steep gorge extending southwesterly into Hermitage Bay. Granitoid rocks from the Indian Point, Northwest Brook, and Gaultois plutons, and Hardy's Cove complex have been severely fractured, shattered, pulverized and altered within the fault zone (Fig.5.1). Fault breccia and fault gouge (cf. Higgins, 1971) can be observed in roadcuts within the fault zone. Clasts from adjacent plutons can be recognized within the breccia. Zones of mylonitization were observed in granitoids adjacent to the fault.

[redacted].2 Deformation in the Indian Point Granite

The Indian Point granite is a small pluton (ca 5 km^2) at the head of Hermitage Bay. Immediately adjacent to the Hermitage Bay and Russel Head faults, the granite bears evidence of both brittle and plastic deformation. Locally, the rock lacks primary cohesion, and has been reduced to a red fault breccia and fault gouge. This type of structure is probably due to rapid movement along the fault at relatively low temperatures and low confining pressures - seismic faulting (Scholz and Fitch, 1969). In other areas along the fault zone the granite has been mylonitized. Quartz grains have been transformed into elongate polycrystalline ribbons probably by dynamic recrystallization and intra-crystalline slip (Nicolas and Poirier, 1976; Vauchez, 1980). Biotite has been bent, stretched, recrystallized and altered. Microcline and plagioclase porphyroclasts have been partly fractured and recrystallized around the edges. Neomineralization produced epidote, carbonate, sphene, chlorite, muscovite and opaque oxides. Mylonitization, in contrast to brecciation,was probably produced by a slower strain rate

Fig. 5.1. Fault gouge and fault breccia,Hermitage Bay Fault;recent road cut along highway 360 exposes the rubble.

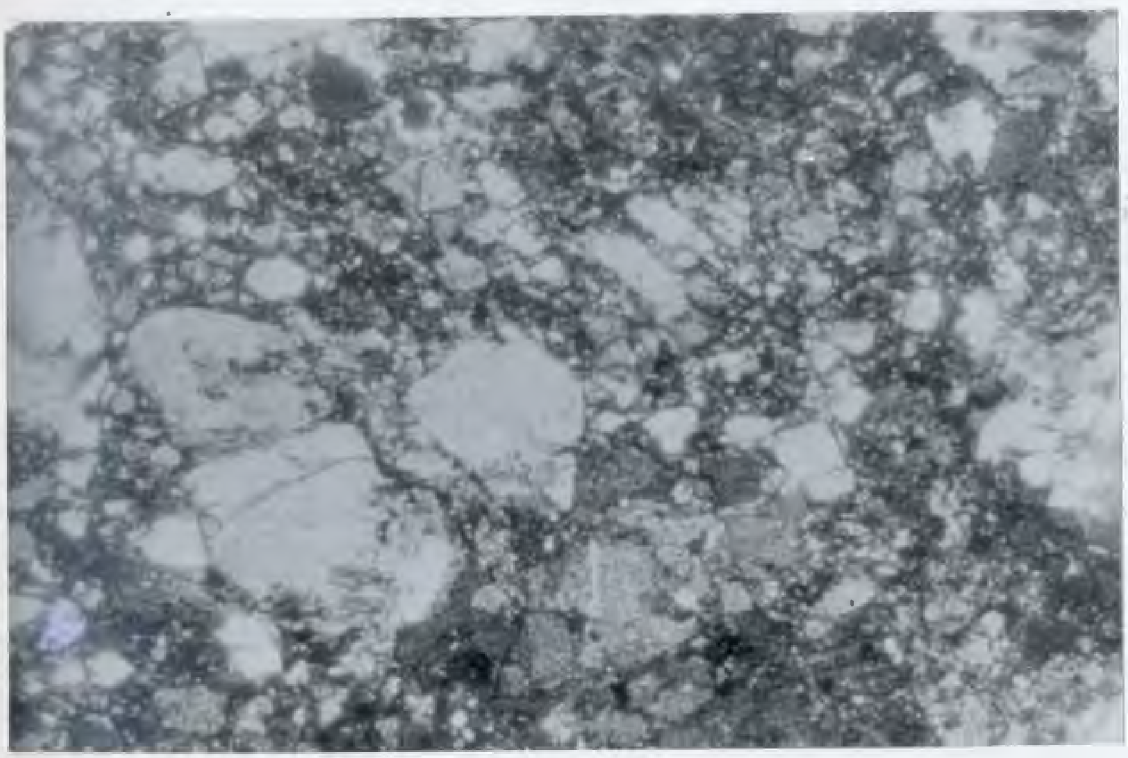


Fig. 5.2. Brecciated granite;Hermitage Bay Fault (x 5.)

under significant confining pressure (cf. Ball 1980).

Scholz and Fitch, (1969) working on the San Andreas Fault showed that movement along the fault consists of alternating episodes of rapid (seismic) faulting and creep. When strain accumulation outpaced strain-softening processes like dynamic recrystallization, during the quiescent (creep) periods, the stage was set for a catastrophic seismic event. Similar processes can be envisaged for the Hermitage Bay Fault, to explain the superimposition of brittle deformation on a mylonitic fabric.

5.4.3 Tectonic Significance of the Hermitage Bay Fault

Together with the Dover Fault in northeastern Newfoundland, the Hermitage Bay Fault forms the boundary between the Avalon and Gander Zones (Blackwood and Kennedy, 1975; Blackwood and O'Driscoll, 1976). Gander and Avalon Zone rocks adjacent to the fault contrast sharply in age, grade of metamorphism, lithology, and style of deformation (Blackwood and O'Driscoll, 1976; O'Driscoll and Strong, 1979; Colman-Sadd, 1980). The Hermitage-Dover fault system was considered to have been initiated in Hadrynian time, based on correlation with structures in Hadrynian rocks (Love Cove Group) east of the fault. This contention gained further acceptance when a Rb/Sr date of 490 $\pm$ 10 Ma for the 'Straddling' Granite set an upper age limit on initiation of the fault (Blackwood and O'Driscoll, 1976; O'Driscoll and Strong, 1979). Since the 'Straddling' (Indian Point) Granite intrudes the Gaultois granite, an age of at least lower Ordovician would be inferred for the southern granitoids.

Recent work along the Hermitage-Dover fault system suggests movement occurred during the Acadian orogeny, with no evidence for activity prior to that. Bell and others, (1979) have shown that the Dover Fault cuts the Newport pluton dated at 332 $\pm$ 42 Ma. Hussey (1979) presented several radiometric dates indicating that deformation in the Love Cove Group which correlated with movement along the Dover Fault was in Devonian time. From the present study (Chapter 4) it seems that the Indian Point pluton is different from rocks southeast of the fault assigned to the 'straddling' Granite. The age of 490 $\pm$ 10 Ma (Blenkinsop <u>et al</u>, 1976) was obtained for samples collected southeast of the fault, on the Avalon side (O'Driscoll, pers. com., 1980). Most of the Southern granitoids are truncated by the Hermitage Bay Fault; among them is the Gaultois Granite dated at 350 $\pm$ 18 Ma (this study) which is intruded by the Indian Point Granite. This not only suggests Acadian movement for the Hermitage Bay Fault, but also strengthens the suggestion in Chapter 4 that the 'Straddling' Granite, as defined by O'Driscoll (1977), is a composite of several igneous entities.

The following conclusions may be drawn from the preceding discussion: (1) The apparent conflict between field and radiometric evidence for age relations among the Southern granitoids is resolved. The previous age of 490 $\pm$ 10 Ma for the Indian Point ("Straddling") conflicted with the Rb/Sr age of 350 $\pm$ 18 Ma for the Gaultois granite which seems to have been intruded by the Indian Point Granite. (2) Since all of the Southern granitoids adjacent to the Hermitage Bay fault are truncated by it, significant movement must have occurred during and/or after emplacment of the plutons. From field relations the sequence of intrusion for the granitoids in the vicinity of the Hermitage Bay Fault is as follows:

Ackley City . . . . 345 $\pm$ 5 Ma (Bell et al, 1977)

Indian Point

N.W. Brook, N.W. Cove

Gaultois . . . . 350 $\pm$ 18 Ma (this study)

Although more work is clearly needed in radiometric dating, it seems likely that intrusion of the entire suite occurred over a short period of time in early Carboniferous. Major movement along the fault probably occurred during emplacement of the syntectonic Southern Granitoids and for a short time thereafter, the fault being abruptly truncated by the Ackley City batholith. (3) The Ackley City Batholith is the only granitoid pluton to straddle the Gander-Avalon Zone boundary, and appears to have done so in the Lower Carboniferous (Bell et al, 1977; O'Driscoll and Gibbons, 1980). Hence, with the recent findings of Hussey (1979) there is no unambiguous evidence for movement along the Hermitage-Dover fault system in Hadrynian time (Blackwood and O'Driscoll, 1976). Indeed, there is little evidence for juxtapositioning of the Avalon and Gander Zones prior to the Carboniferous. (4) To account for the juxtapositioning of the two terranes of such contrasting metamorphic grade, movement of the fault must have had a significant vertical component, as suggested by Widmer (1950). The extent of lateral movement is open to speculation (Kennedy, 1976), although the presence of what appears to be a secondary fault (Russel Head) suggests some strike slip movement (cf. Chinnery, 1966).

5.5 Summary

Rocks of the Bay D'Espoir area seem to have undergone significant compression about a northeasterly trending axis. Most of the strain was recorded in the gneissic terrane and units of the Bay D'Espoir group immediately adjacent to it. Whereas deformation in the north appears to have been at low temperatures, compression in the south (gneissic terrane) was accompanied by high heat flow and intrusion of syntectonic granitoids.

CHAPTER 6

GEOCHEMISTRY AND PETROGENESIS

6.1 Introduction

This chapter aims to outline significant chemical trends among the plutons and evaluate the bearing of these trends on their petrogenesis. Four hundred analyses were done from eleven plutons, six of which are from the Southern Granitoids, with the other five being from the Northern Granitoids. For reasons outlined in Chapter 3, analyses from the Long Pond Diorite, Missing Island Granodiorite and Round Pond norite-granodiorite are included with those of the North Bay Granite.

Samples were analysed for major elements as well as Ba, Be, Cr, Ni, Cu, F, Ga, Li, Mo, Nb, Pb, Rb, Sr, U, V, Zn and Zr. In addition, the Partridgeberry Hills and Through Hill plutons were analysed for Ce, La, Th and Y. Detailed analyses and laboratory methods are outlined in Appendix 1.

The problem of the "Straddling Granite", discussed in Chapter 5 is further investigated. The application of genetic classification schemes such as the I-S system (Chappel and White, 1974) to the granitoids is evaluated. The significance of the granitoids to tectonic development of the Gander Zone is discussed, with wider implications for the entire Appalachian Orogen.

The plutons are listed in Table 6.1. with brief descriptions and the symbols used to denote them in the diagrams that follow.

TABLE 6.1.

GRANITOID PLUTONS OF THE BAY D'ESPOIR AREA

Southern Granitoids

Symbol	Pluton Name	Main Rock Type	Minor Phase
1	Piccaire	biotite adamellite	granodiorite
2	Gaultois	megacrystic biotite adamellite	biotite diorite granodiorite
3	North West Cove	muscovite (biotite) adamellite	none
4	Indian Point ("Straddling")	biotite adamellite	granodiorite
5	North West Brook	muscovite (biotite) adamellite	none
6	Dolland Bight	garnet-muscovite adamellite	granodiorite

Northern Granitoids

Symbol	Pluton Name	Main Rock Type	Minor Phase
10	Rocky Bottom	hornblende-biotite tonalite	none
11	Matthews Pond	biotite granodiorite	none
13	Partridgeberry Hills	biotite adamellite/ graniodiorite	
14	Through Hill	garnet-muscovite adamellite	none
15	North Bay (including Long Pond Round Pond, Missing Island)	biotite adamellite/ granodiorite	diorite/norite

General Remarks on Major Element Trends

There are no unusual concentrations of major elements among the Bay D'Espoir granitoids. They are of intermediate to high silica content, with nearly all values of SiO_2 between 55% and 80%; most of the 400 analyses cluster in the range 65% to 75%. The low silica points on the North Bay (15) variation diagrams represent mafic (probably cumulate) marginal facies. Therefore the apparent silica gap in the variation diagrams does not reflect a true bimodal character (e.g. Fig. 6.1).

The plutons are consistently peraluminous, with molecular $Al_2O_3/(CaO + NA_2O + K_2O) > 1$ (Fig.6.6) and modal muscovite and garnet in some of them. Total alkalis ($Na_2O + K_2O$) vary sympathetically with SiO_2, (Fig.6.1), although the correlation is somewhat imperfect due to variation in biotite, muscovite and alkali feldspar as SiO_2 increases. As expected CaO, TiO_2 (Figs.6.2,6.3), FeO, Fe_2O_3, MgO, MnO and P_2O_5 vary inversely with SiO_2, corresponding with the following petrographic observations (Chapter 3): In the series diorite-granodiorite-biotite adamellite-muscovite adamellite, there is a tendency towards less calcic plagioclase (Ca), and fewer ferromagnesian minerals (FeO, Fe_2O_3, MgO, MnO). P_2O_5 and TiO_2 are concentrated in apatite and sphene, two early phases common in diorites but rare in muscovite adamellite.

Trends in the AFM diagrams for the Gaultois and North Bay plutons (Figs. 6.14,6.7) are very similar to those obtained for the Cascades orogenic suite which was presumably generated in a compressional environment (Martin and Piwinski, 1972, 1974). This geochemical feature is consistent with the structural interpretation (Chapter 5) that the study area suffered significant compression, mainly during the Acadian orogeny. The

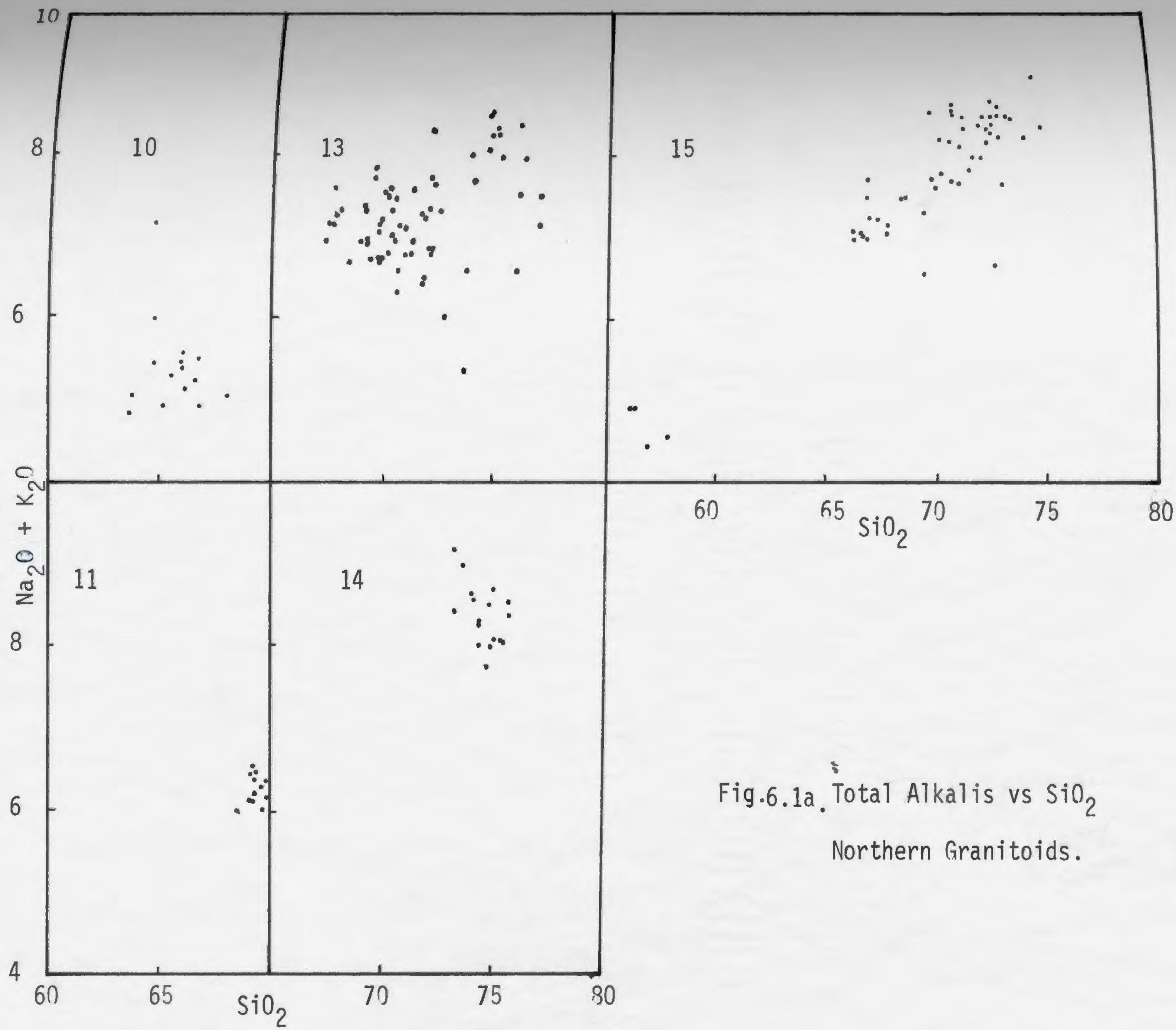


Fig.6.1a. Total Alkalis vs SiO_2

Northern Granitoids.

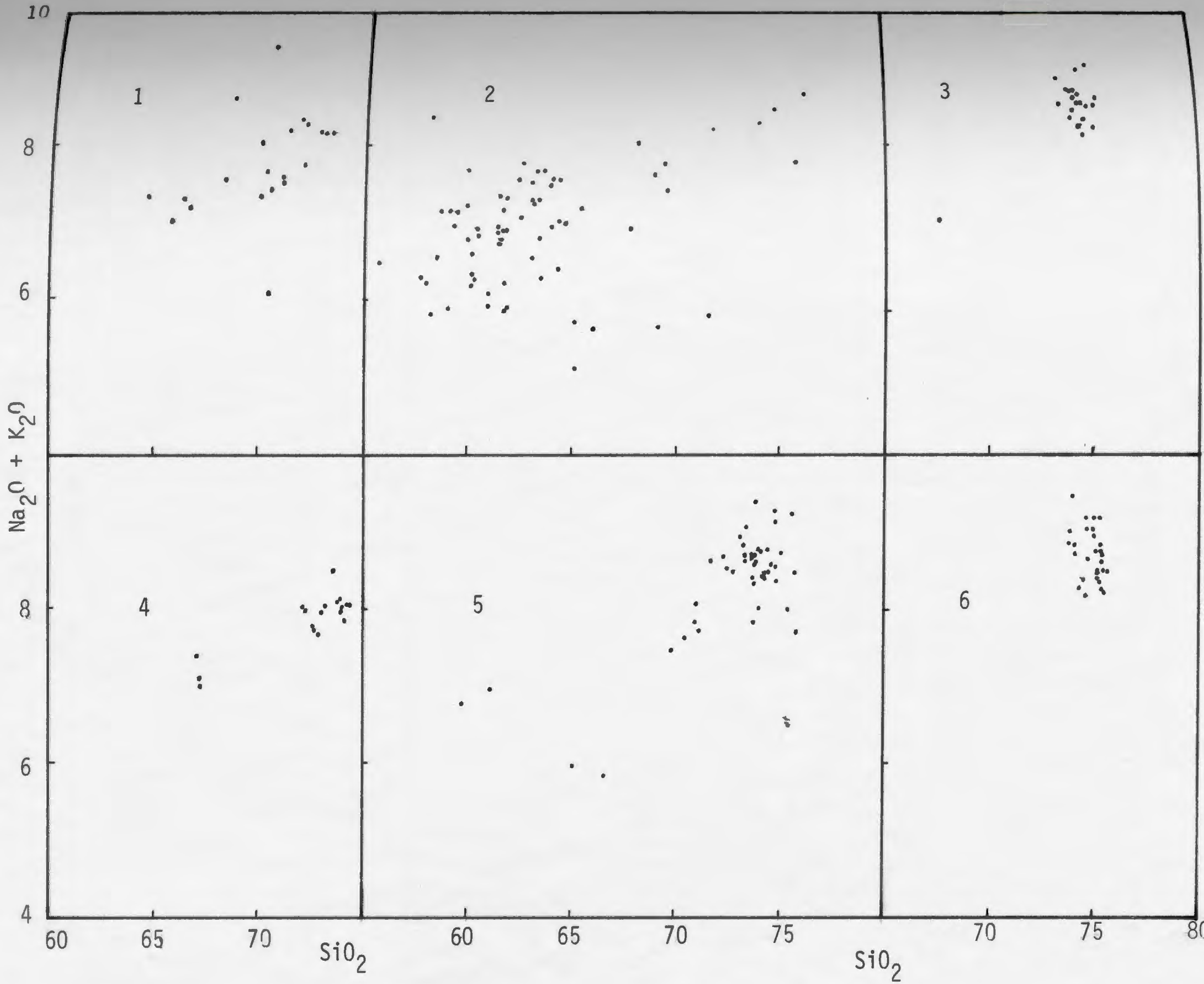


Fig. 6.1b. Total Alkalis vs SiO_2, Southern Granitoids.

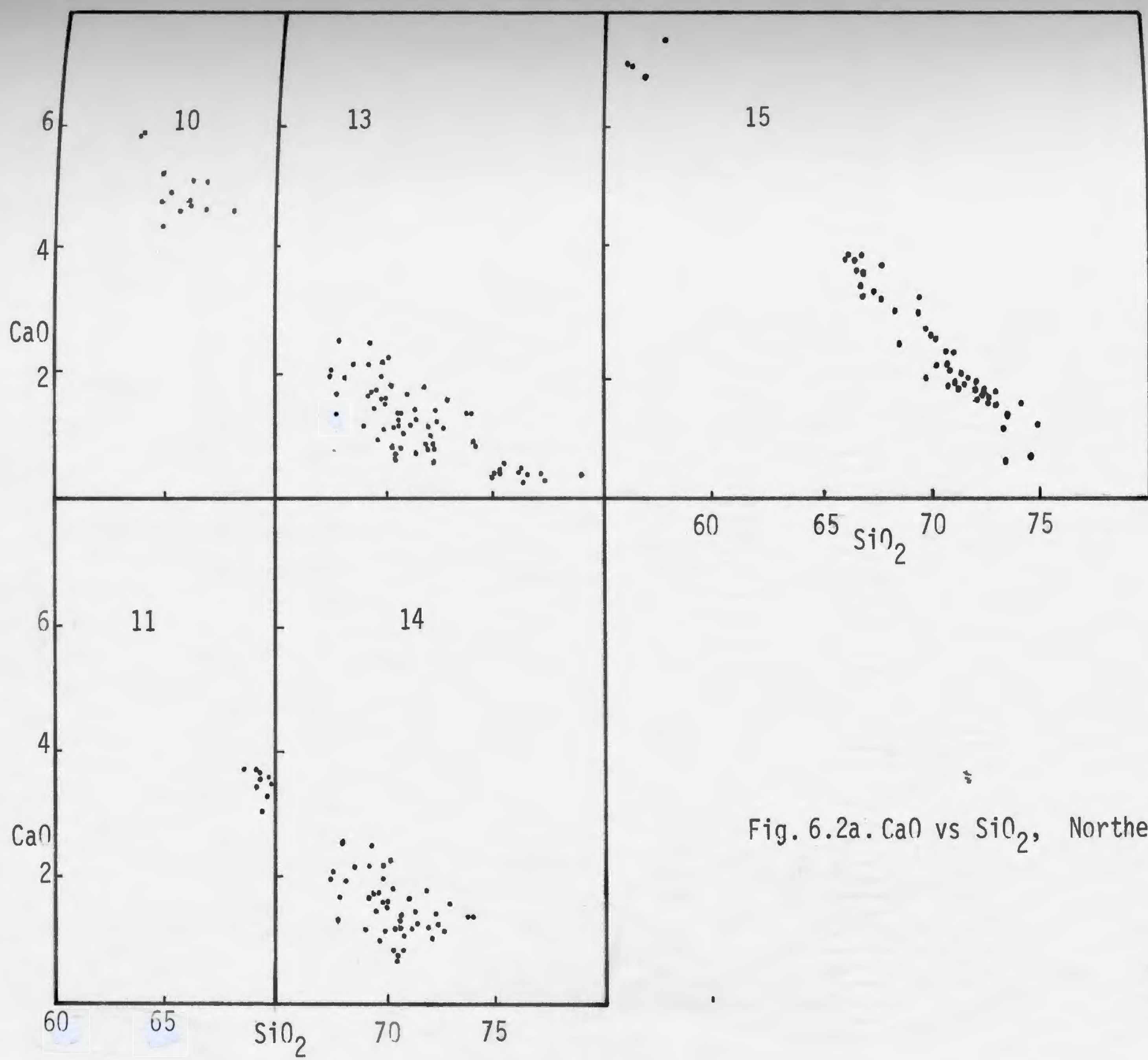


Fig. 6.2a. CaO vs SiO_2, Northern Granitoids.

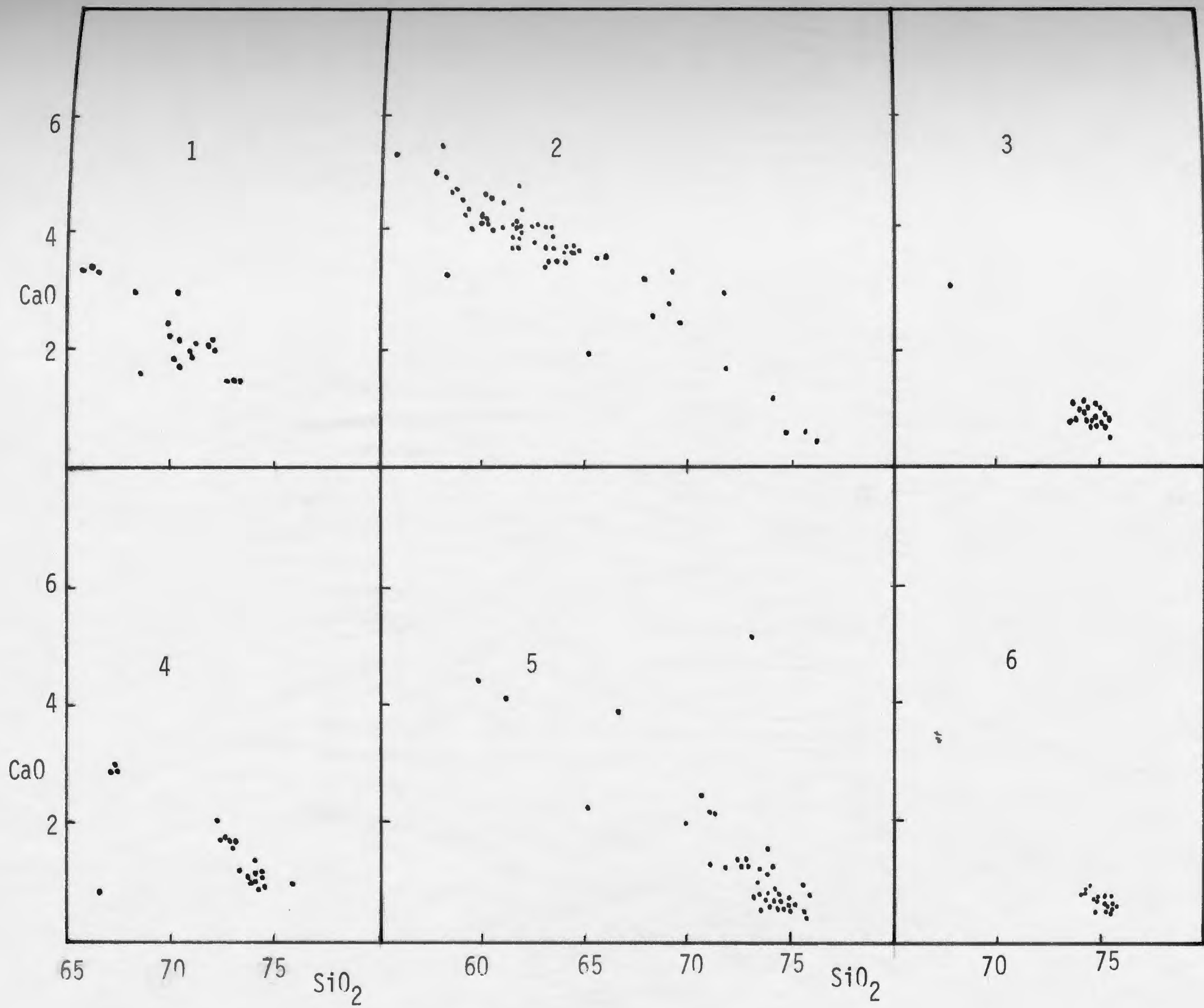


Fig.6.2b. CaO vs SiO_2 , Southern Granitoids.

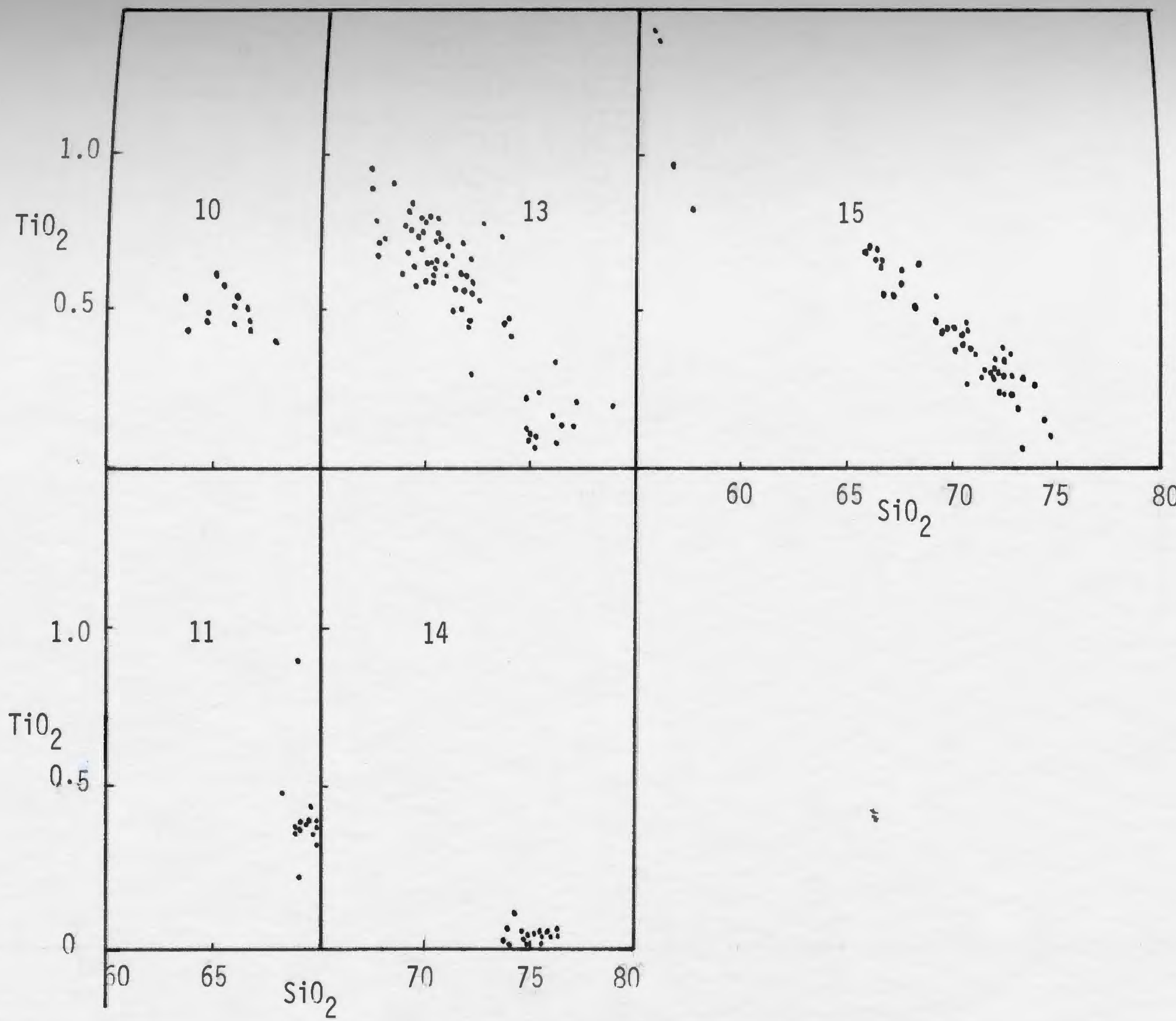


Fig. 6.3a. TiO_2 vs SiO_2, Northern Granitoids.

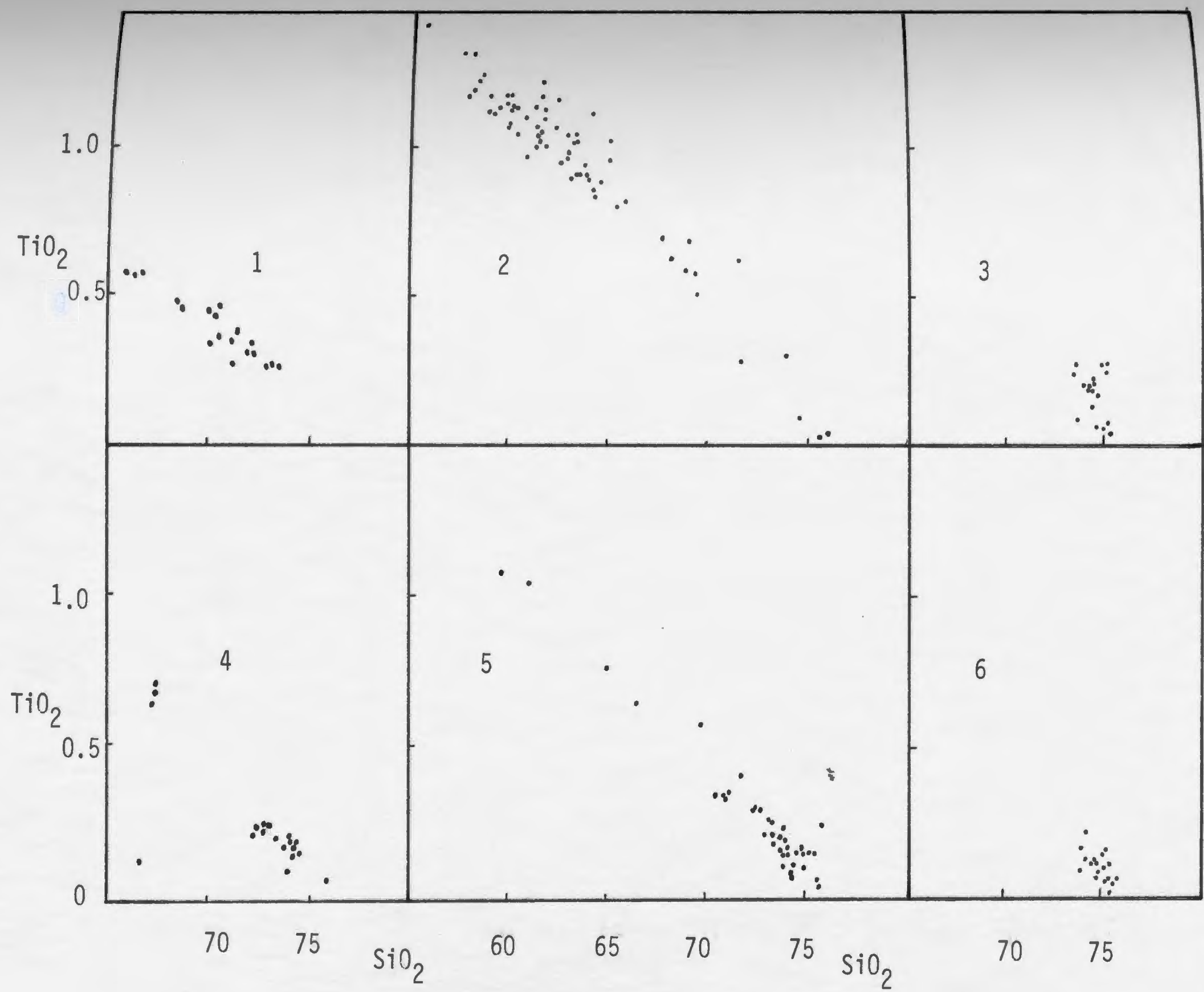


Fig.6.3b.TiO_2vs SiO_2,Southern Granitoids.

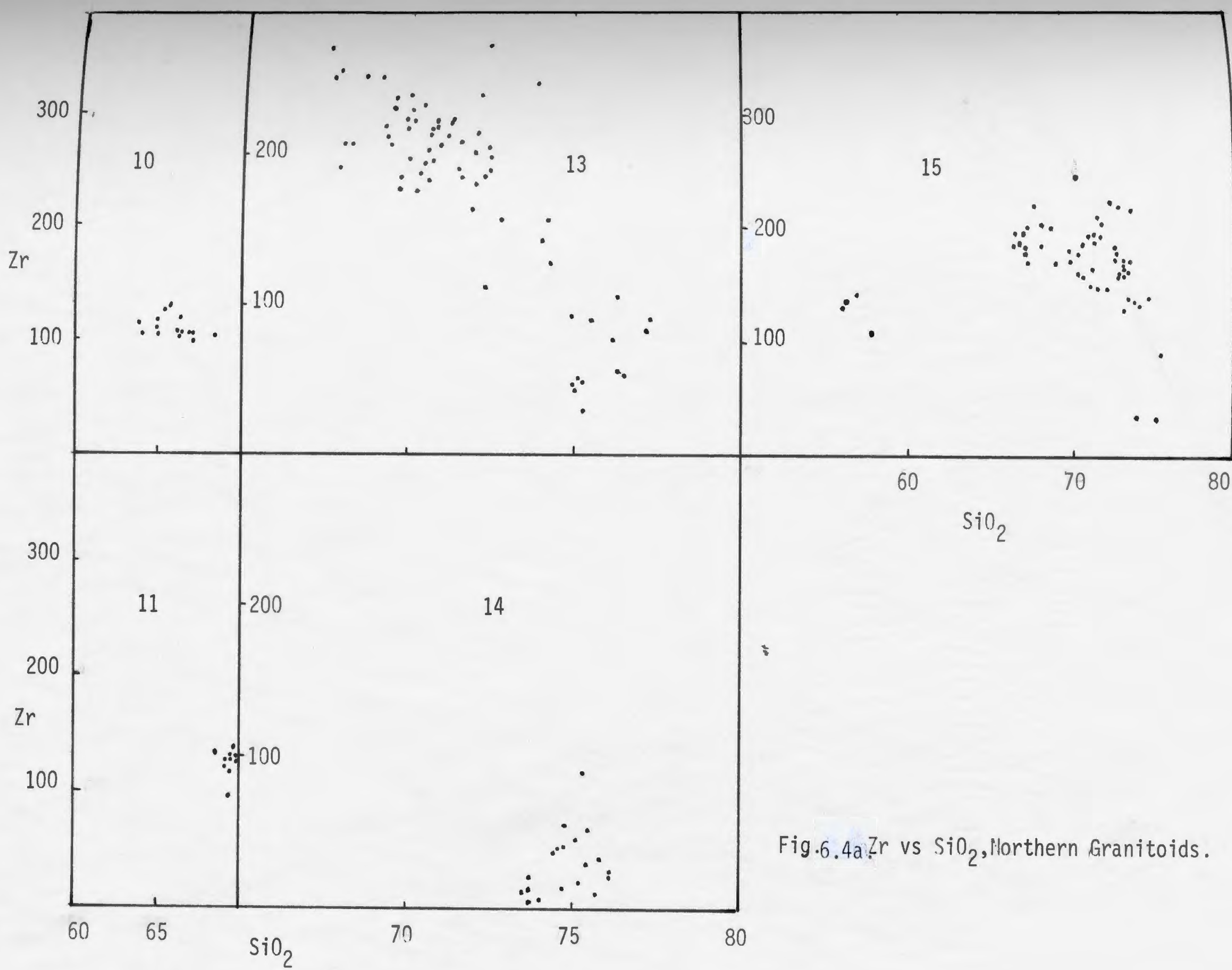


Fig.6.4a. Zr vs SiO_2, Northern Granitoids.

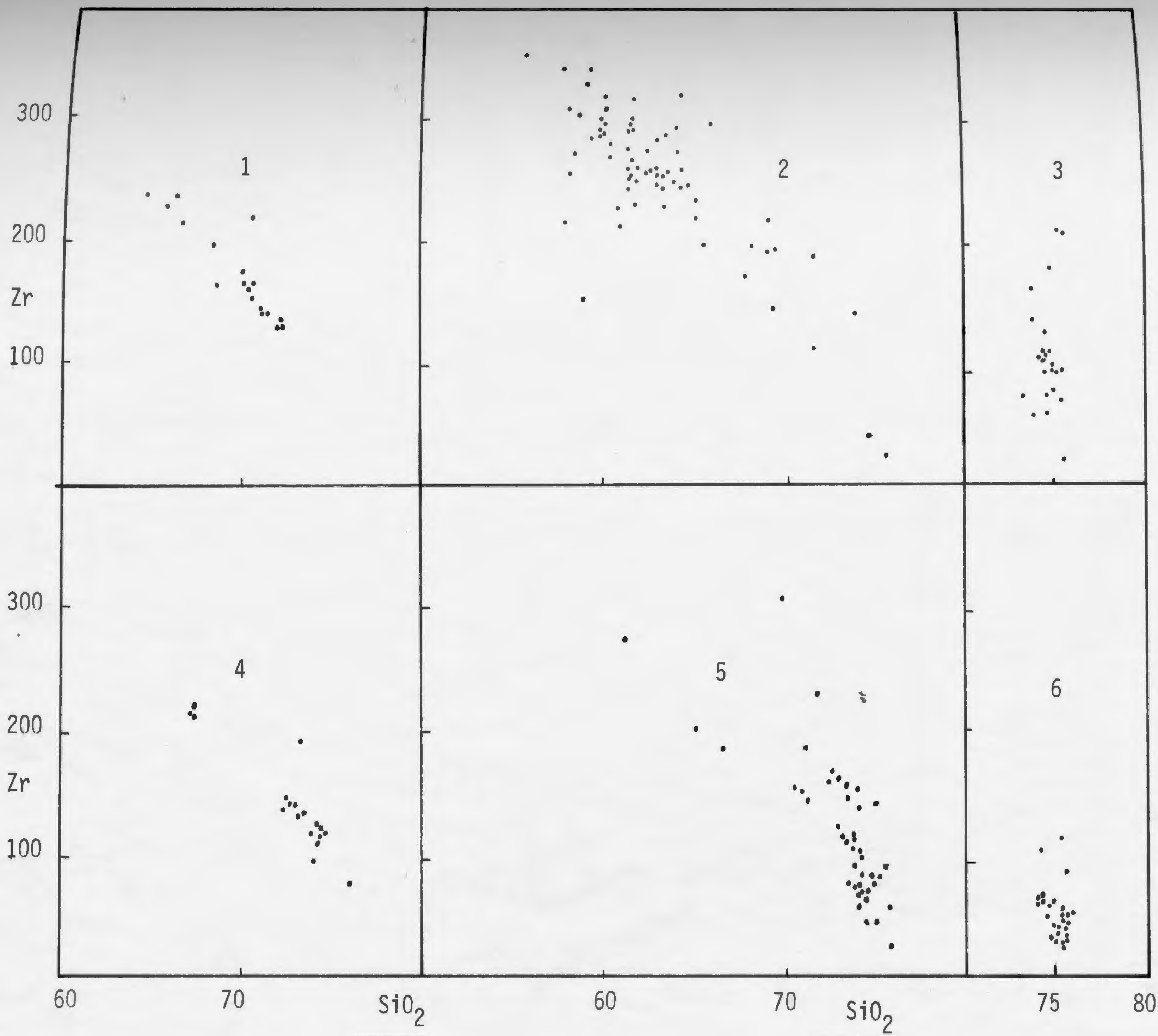


Fig.64b Zr vs SiO_2, Southern Granitoids.

Gander Zone, in which the study area is located, has been interpreted by many workers as a region of intense crustal shortening (Blackwood and Kennedy, 1972; Stevens et al., 1974; Jayasinghe, 1979; Colman-Sadd, 1980b; Williams, 1980).

6.3 General Remarks on Trace Elements

As for the major elements the Bay D'Espoir Granitoids show no unusual concentrations of trace elements. Trace elements of economic importance such as Be, Cu, Mo and U are restricted to 'background' levels. This is further discussed in Chapter 7. The following general observations may be noted.

Zirconium varies inversely with silica, often producing linear trends (Fig.6.4). This is consistent with the petrographic observation that zircon is an early formed phase, commonly enclosed in hornblende and especially biotite. Near linear trends may therefore reflect fractionation of biotite. Rb:Sr ratios tend to be higher in the more differentiated leucogranites than in the biotite granodiorites (Fig. 6.11). This could be due to fractionation of K-feldspar and plagioclase, as discussed below. K:Rb ratios are restricted to normal crustal abundances (cf. Taylor, 1965). K:Rb ratios are generally lower in the Southern Granitoids than in the Northern Granitoids (Figs. 6.12,6.18), and are discussed in greater detail below.

6.4 The I-S System of Classification

Chappel and White (1974) proposed a genetic system for classifying granitoid rocks, depending on whether the source material was igneous (I-type) or sedimentary (S-type). A number of criteria were listed for identifying the two classes (Chappel and White, 1974; White and Chappel, 1977; Chappel, 1978; Hine et al., 1978), as follows:

"I"-Type	"S"-Type
1. Variation diagrams produce linear trends	1. Variation diagrams tend to be irregular
2. Wide silica range	2. Restricted to high silica compositions
3. Na relatively high; $Na_2O >$ 3.2% in felsic varieties falling to 2.2% in more mafic types	3. Na relatively low; $Na_2O <$ 3.2% in rocks with 5% K_2O, falling to less than 2.2% in rocks with $<$ 2% K_2O.
4. C.I.P.W. normative diopside or $<$ 1% normative corundum	4. C.I.P.W. normative corundum $>$ 1%
5. Mol. $Al_2O_3/(CaO + Na_2O + K_2O)$ $<$ 1.1	5. Mol. $Al_2O_3/(CaO + Na_2O + K_2O)$ $>$ 1.1
6. Contain biotite + hornblende $\pm$ sphene $\pm$ magnetite	6. Contain biotite $\pm$ muscovite $\pm$ cordierite $\pm$ garnet $\pm$ ilmenite
7. Low initial $^{86}Sr/Sr^{87}$ ratios (0.704 - 0.706)	7. Higher $^{87}Sr/Sr^{86}$ ratios $>$ 0.708

The I-S system is examined in Table 6.2, to test its applicability to the Bay D'Espoir granitoids. "I" and "S" characteristics are identified by numbers in the above list.

TABLE 6-2

I-S CLASSIFICATION OF THE GRANITOIDS

Pluton	I-Character	S-Character	Classification
Piccaire	3	2, 4, 5, 6	Ambiguous (S)
Gaultois	1, 2, 3, 6	4, 5, 7	Ambiguous (I)
Northwest Cove	3	1, 2, 4, 5, 6	Ambiguous (S)
Indian Point	1, 3, 4	2, 4, 5, 6	Ambiguous
Northwest Brook	3	1, 2, 4, 5, 6	Ambiguous (S)
Dolland Bight	3	1, 2, 4, 5, 6	Ambiguous (S)
North Bay	1, 2, 3, 4, 6, 7	4, 5, 6	Ambiguous (I)
Rocky Bottom	3, 4, 6	5	Ambiguous (I)
Matthews Pond	3, 6	4, 5	Ambiguous
Partridgeberry Hills	3	1, 2, 3, 4, 5	Ambiguous (S)
Through Hill	3	1, 2, 4, 5, 6, 7	Ambiguous (S)

Although some plutons like Northwest Brook, Partridgeberry Hills and Through Hill show many features in one or other of the two classes, the above list clearly illustrates that the I-S system cannot be unambiguously applied to the Bay D'Espoir granitoids.

Na_2O/K_2O ratios (Fig6.5.) place all of the plutons in the "I" category, even though they may have several 'S' characters. Similarly, all of the plutons are strongly peraluminous (Fig6.6.). It appears that although individual plutons show tendencies towards the "I" or "S" category the system does not unambiguously classify them. The assumption made by Chappel and White (1974) is that 'S'-type granitoids are produced

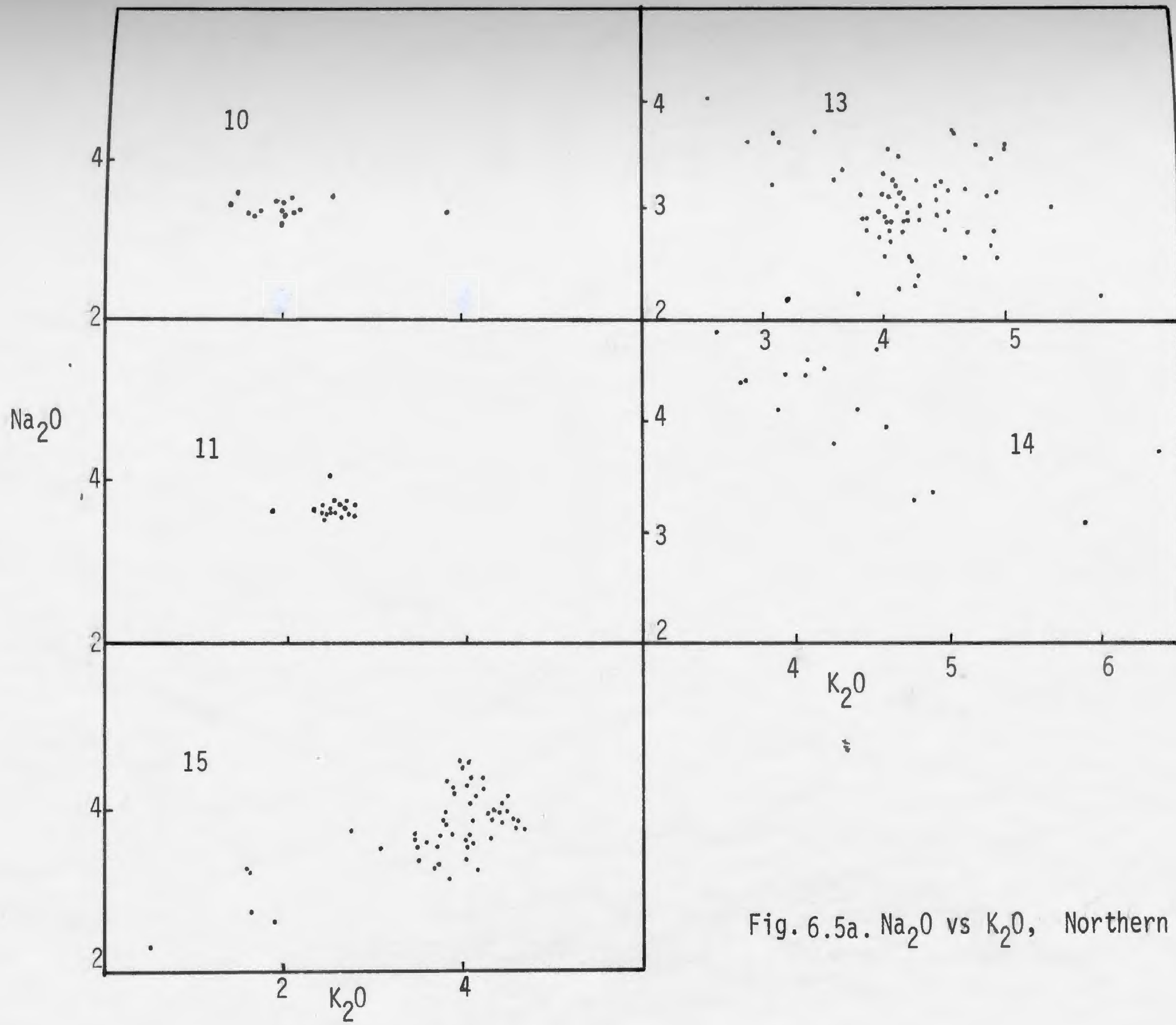


Fig. 6.5a. Na_2O vs K_2O, Northern Granitoids.

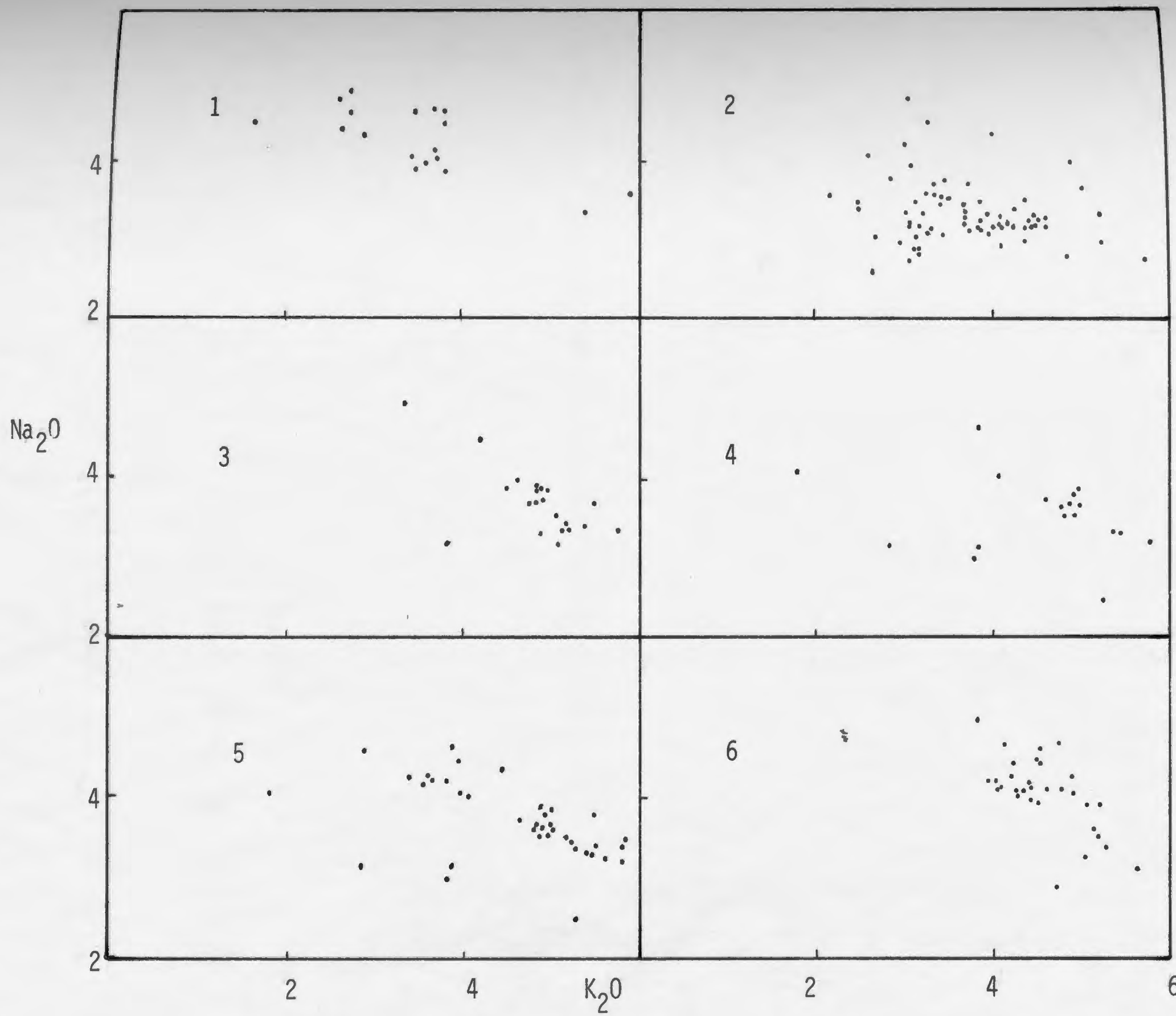


Fig. 6.5b. Na_2O vs K_2O, Southern Granitoids.

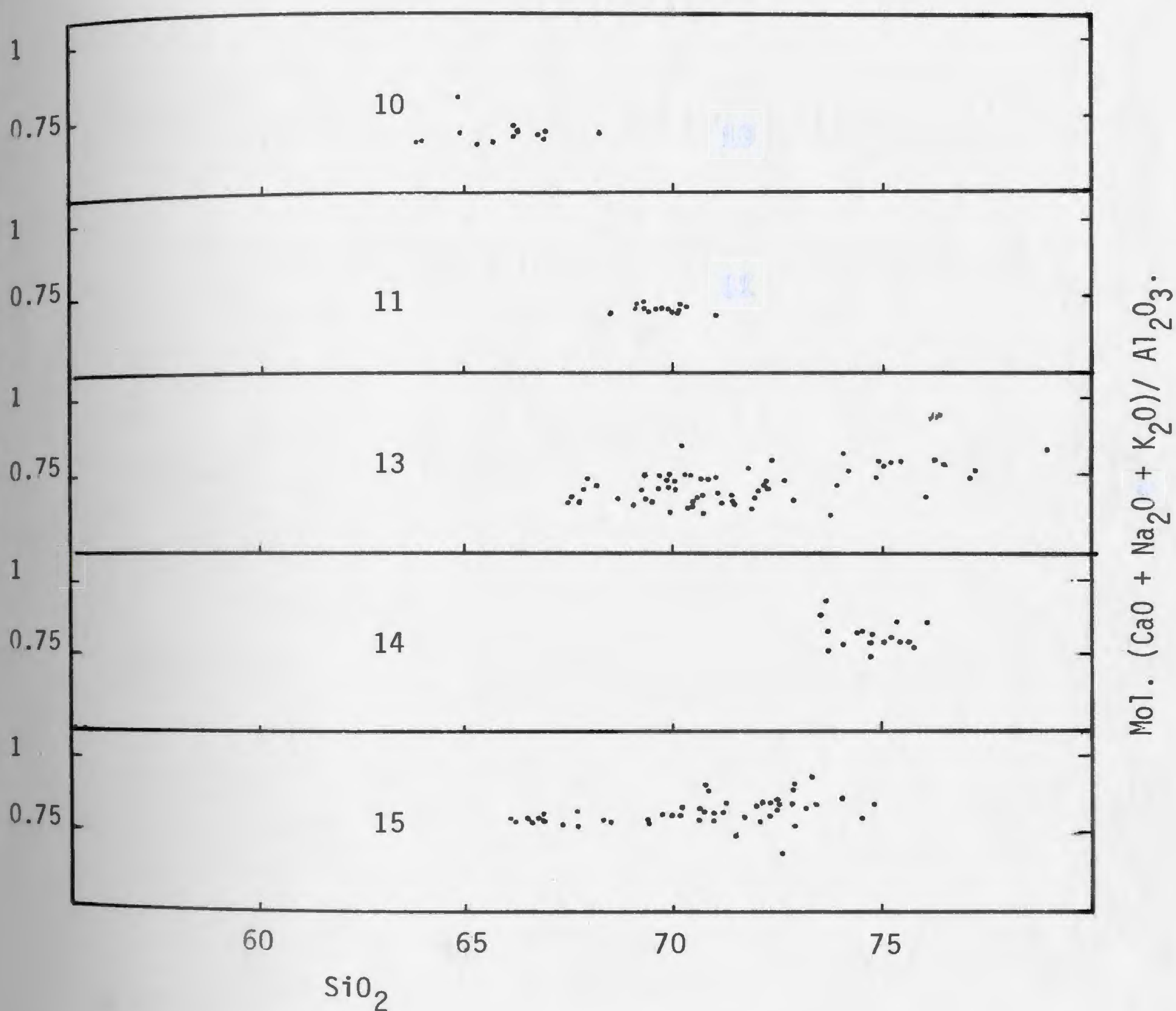


Fig.6.6a. Mol. CNK/ Al_2O_3 vs SiO_2. Northern Granitoids.

Note that all plutons are strongly peraluminous, and therefore 'S' - type.

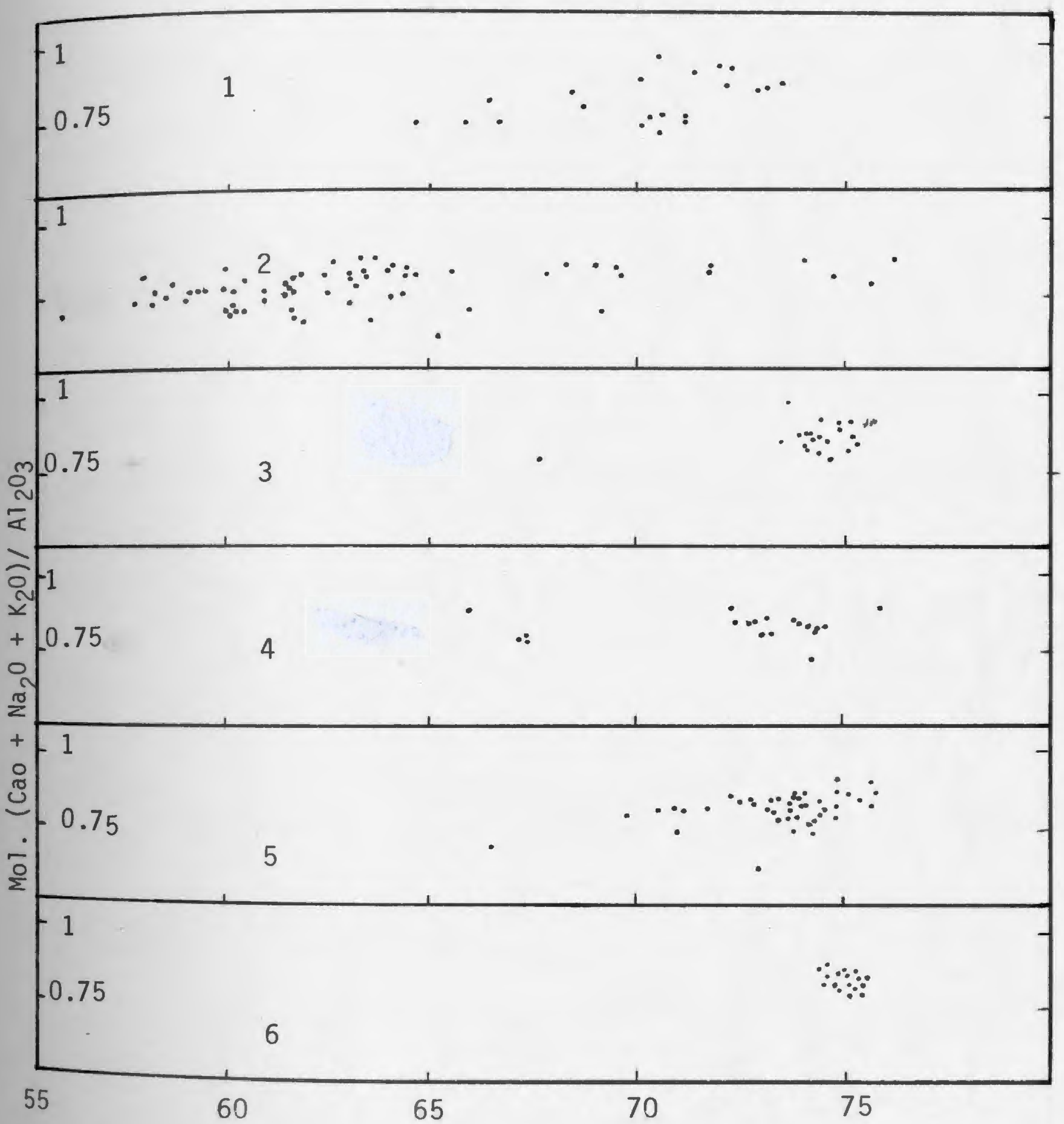


Fig.6.6b. Mol. CNK /Al_2O_3 vs SiO_2, Southern Granitoids.

Note that all plutons are strongly peraluminous and therefore 'S' - type.

from material that was leached of Na and Ca in the crust, with resultant relative enrichment in Al. This is responsible for the contrast with 'I'-type granitoids whose source materials are not considered to have been exposed to such chemical weathering. Because chemical weathering is time dependent, there would be gradations of 'S' character (cf. Chappel, 1978). It appears that the Bay D'Espoir granitoids were derived from a mixture of lithologies that underwent various degrees of chemical weathering, with both mafic (mantle) and felsic (continental) inputs, as suggested by the strontium initial ratios in Chapter 4.

Geochemistry of the Northern Granitoids

6.5.1 Introduction

In this section, geochemical trends in the five plutons assigned to the Northern Granitoids are examined. Comparisons are drawn with similar granitoids elsewhere. Plots of major elements on AFM, CNK and alkali ratio diagrams are considered, along with selected trace element plots. Petrogenetic implications are also considered. Since the precise composition of the initial melt is often difficult to establish, the terms "differentiation" and "fractionation" are used in this section in reference to both crystal-liquid and melt-restite relationships.

6.5.2 $(Na_2O + K_2O)$-$(FeO + 0.89\ Fe_2O_3)$ - MgO (AFM) Diagrams

The AFM diagrams(Fig. 6.7) all show a consistent trend towards alkali enrichment, typical of calc-alkaline suites (Martin and Piwinski, 1972). The apparent bimodal plot for the North Bay pluton (15) is due

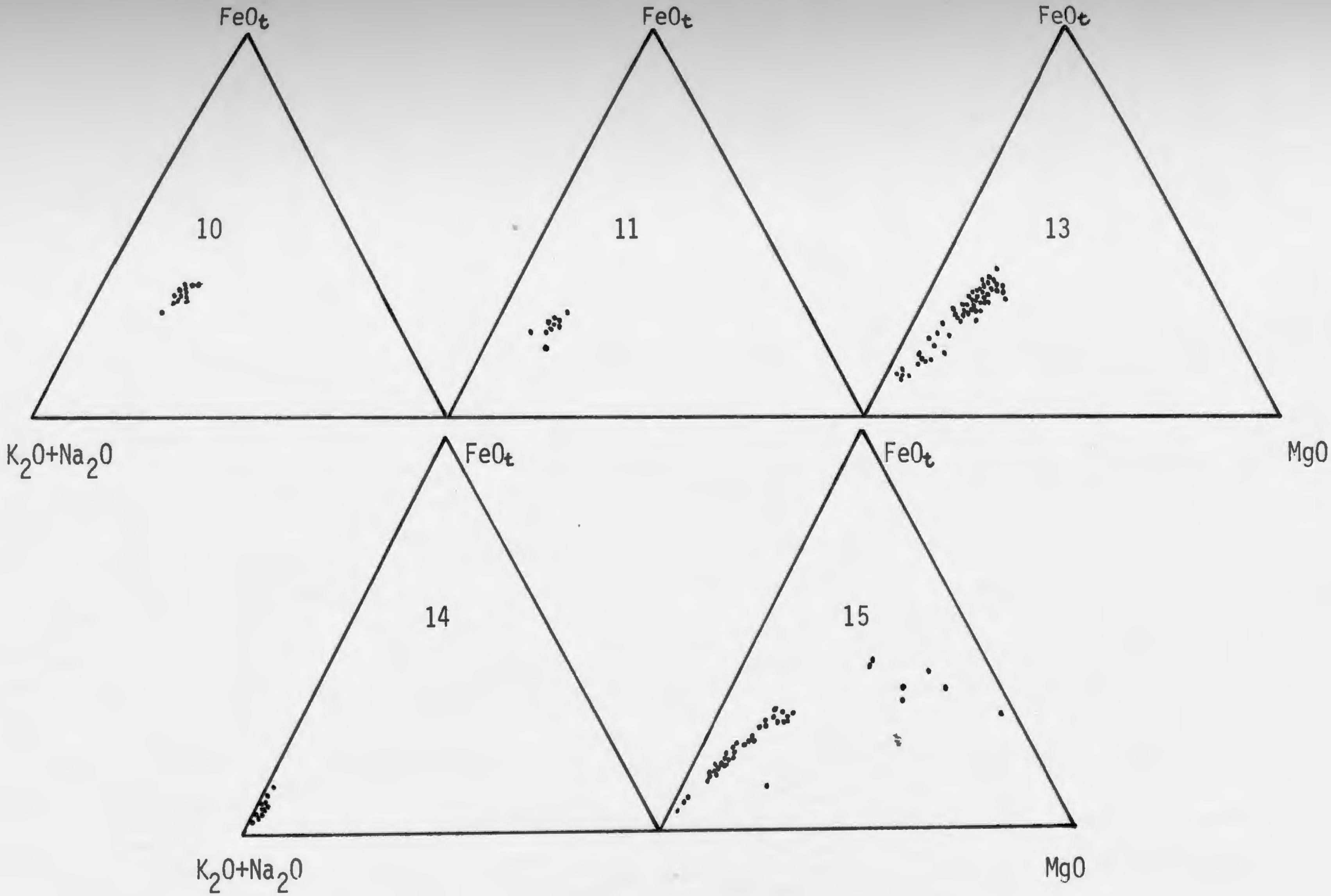


Fig 6.7. AFM diagrams, Northern Granitoids.

to extreme concentration of pyroxene,hornblende and biotite in apparently cumulate marginal facies. The pattern in the North Bay pluton (15) corresponds well with the observed petrographic trend: biotite-hornblende diorite;hornblende-biotite granodiorite;biotite adamellite;muscovite-biotite adamellite. Early removal of magnesian hornblende,followed later by fractionation of mainly biotite,could account for the observed trend. There is no apparent trend of variation of Fe:Mg ratio with degree of alkalinity within individual plutons. Although this could be accomplished in several ways,the simplest explanation is fractionation of ferromagnesian phases of fixed intermediate Fe:Mg ratio. The linear trends for different plutons project back to different points on the F-M sideline,suggesting that the material removed was different for each pluton,supporting the contention in Chapter 4 that they were derived from separate source materials. Fractionation of biotite is consistent with decreasing Zr, especially obvious in the North Bay and Partridgeberry Hills plutons (Fig.6.4).

6.5.3 CaO-Na_2O-K_2O (CNK) Diagrams

Some of the CNK diagrams show a similar trend towards alkali enrichment e.g. North Bay (15). This is consistent with the early crystallization of hornblende,sphene,epidote and clinozoisite (Chapter 3), and the trend towards more sodic plagioclase with advancing differentiation. Scatter in the Na_2O: K_2O ratio may reflect alkali exchange,especially evident in the altered Partridgeberry Hills granite (13). The extremely differentiated nature of the garnet-muscovite Through Hill granite (14) is reflected in the near absence of CaO. The Matthews Pond granodiorite (11) which is petrographically uniform (Chapter 3), shows

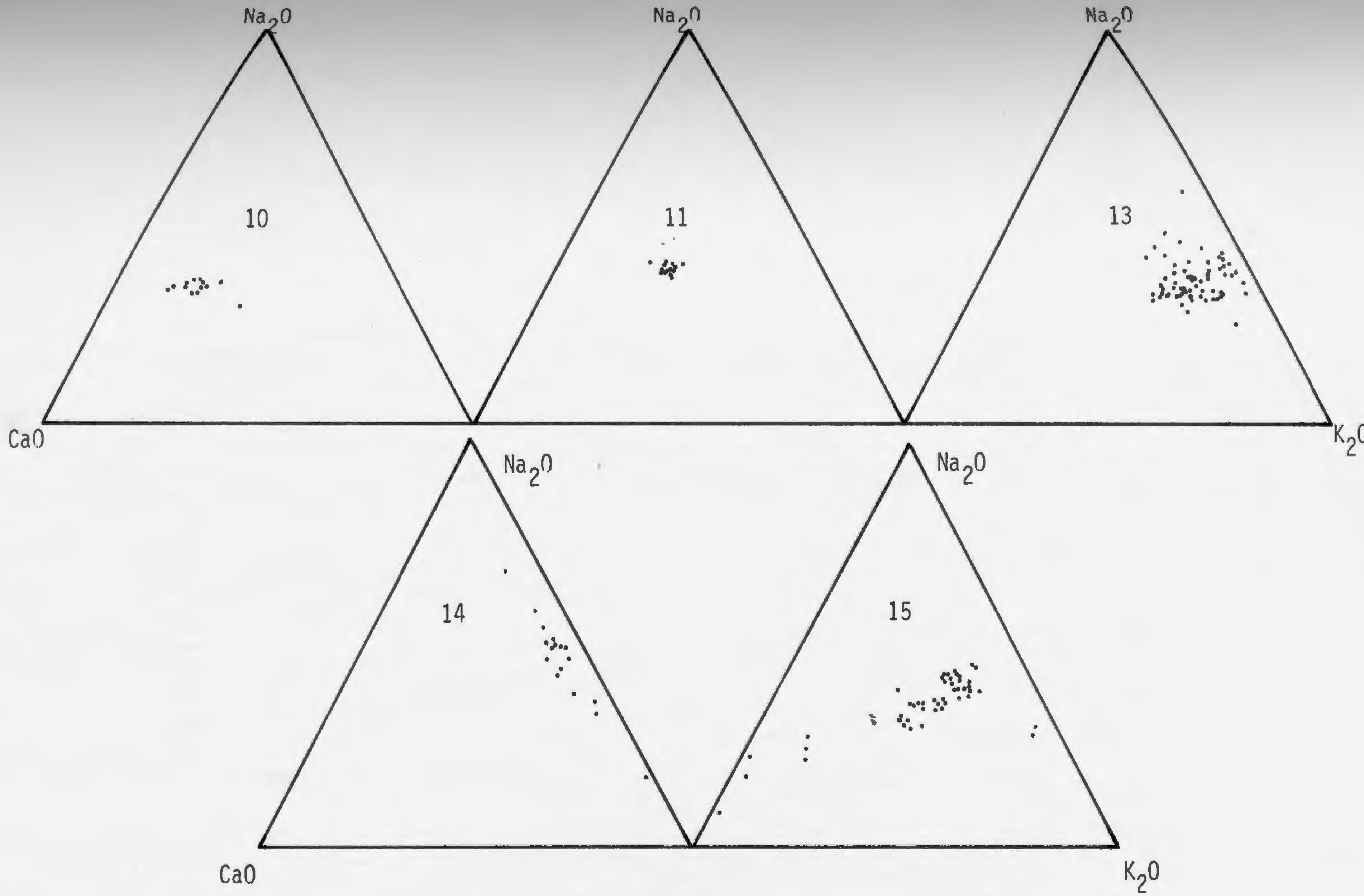


Fig 6.8. CNK diagrams, Northern Granitoids.

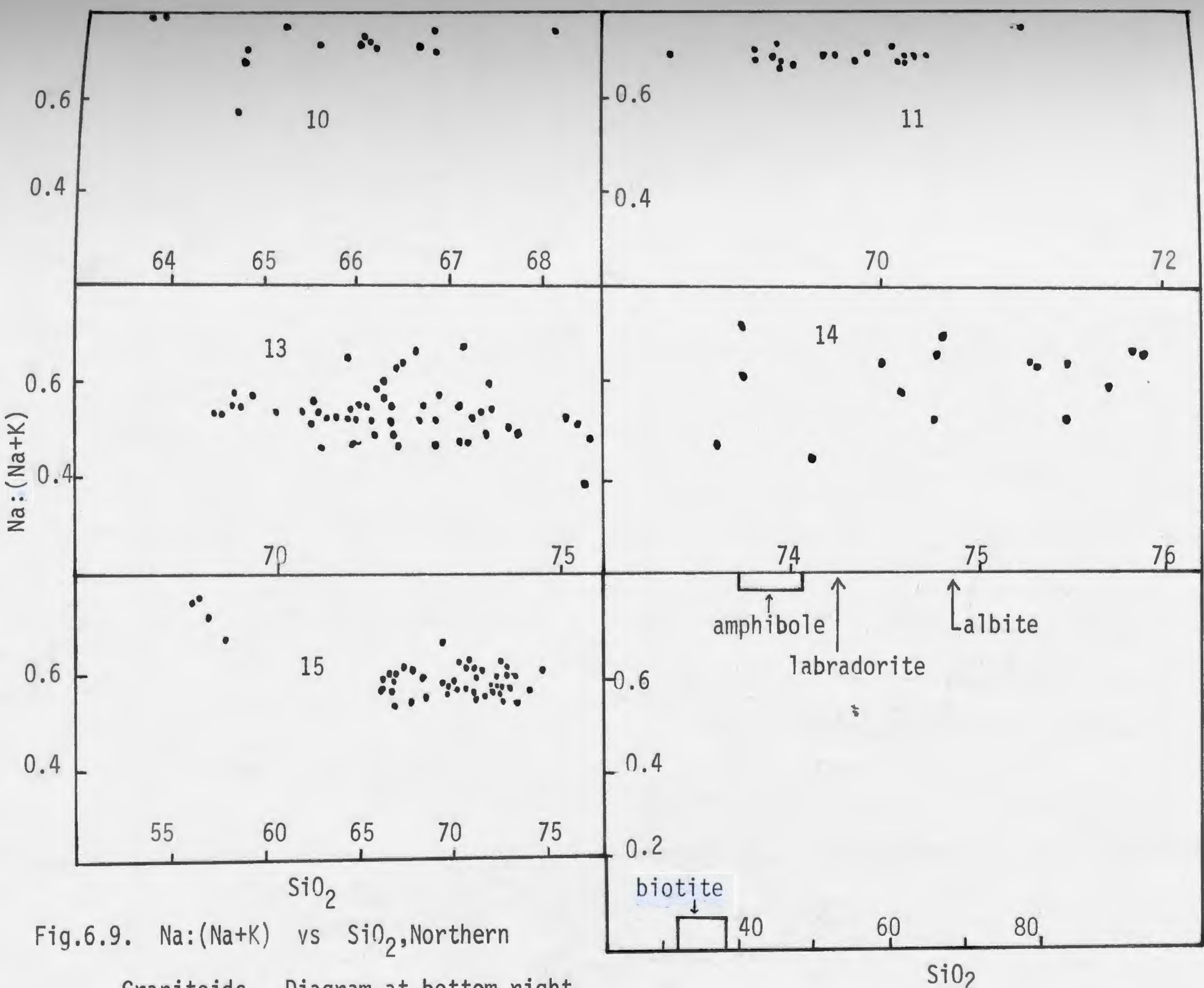


Fig.6.9. Na:(Na+K) vs SiO_2,Northern Granitoids. Diagram at bottom right shows position of amphibole,biotite and plagioclase,three possible fractionating phases.

a cluster of points, indicating very little differentiation. Like the AFM diagrams, the CNK plots underscore the individuality of the plutons.

6.5.4 Na:(Na + K) vs SiO_2

Plots of Na:(Na + K) vs SiO_2 (Fig.6.8) indicate mostly flat linear trends, with somewhat different values of Na:(Na + K) for each pluton. The Rocky Bottom Tonalite (10) and the less silicic marginal members of the North Bay granite plot on a trend away from amphibole, consistent with hornblende fractionation suggested above. Similar trends have been noted in similar granitoids in northeast Newfoundland" eg. Fredericton and Rocky Bay plutons (Strong and Dickson, 1978). The flat Na:(Na + K) profiles suggest that if biotite was fractionated, its removal was accompanied by a sodic phase like hornblende or sodic plagioclase. This will be further examined below, using trace element distributions. As in the preceeding diagrams the plutons do not seem to be related by any process of fractionation.

6.5.5 Trace Element Geochemistry of the Northern Granitoids

6.5.5.1 Introduction

Within a suite of granitoid rocks major elements may vary only over a narrow range, often concealing trends in magmatic differentiation. The trace elements, in contrast, may vary quite substantially, often exponentially. A knowledge of possible phases involved in differentiation along with their trace element behaviour can be used to monitor magmatic evolution. From petrographic observation the possible fractionating phases in the Bay D'Espoir granitoids are: hornblende, plagioclase, biotite, K-feldspar, and garnet. The mineral/melt distribution coefficients for Rb, Sr, and Ba along with K (Table 6.3.) can be used to infer patterns of fractionation. Because the trace element concentrations in the Bay D'Espoir granitoids tend to spread over a wide range (e.g. Fig 6.11) only a qualitative treatment is attempted.

TABLE 6.3.

MINERAL/MELT DISTRIBUTION COEFFICIENTS

APPLICABLE TO GRANITOID SYSTEMS (AFTER HANSON, 1978)

Element	Hornblende	Plagioclase	Biotite	K-feldspar	Garnet
K	0.081	0.10	(5.63)*	(1.49)*	0.020
Rb	0.014	0.041	3.26	0.659	0.0085
Sr	0.22	4.4	0.120	3.87	0.015
Ba	0.044	0.31	6.36	6.12	0.017

*not strictly a distribution coefficient since K is an essential structural component of biotite and K-feldspar.

From the above table, it is clear that hornblende and garnet, with relatively small distribution coefficients, will not significantly affect the concentration of K, Rb, Sr and Ba, unless they are fractionated in very large proportions. Ratios of K:Rb, Rb:Sr, Sr:Ba etc. are therefore considered to be affected mainly by removal of the three phases plagioclase, biotite, and K-feldspar. Expected trends during magmatic differentiation of a uniform initial composition are shown below. Complications due to variable initial compositions are not considered.

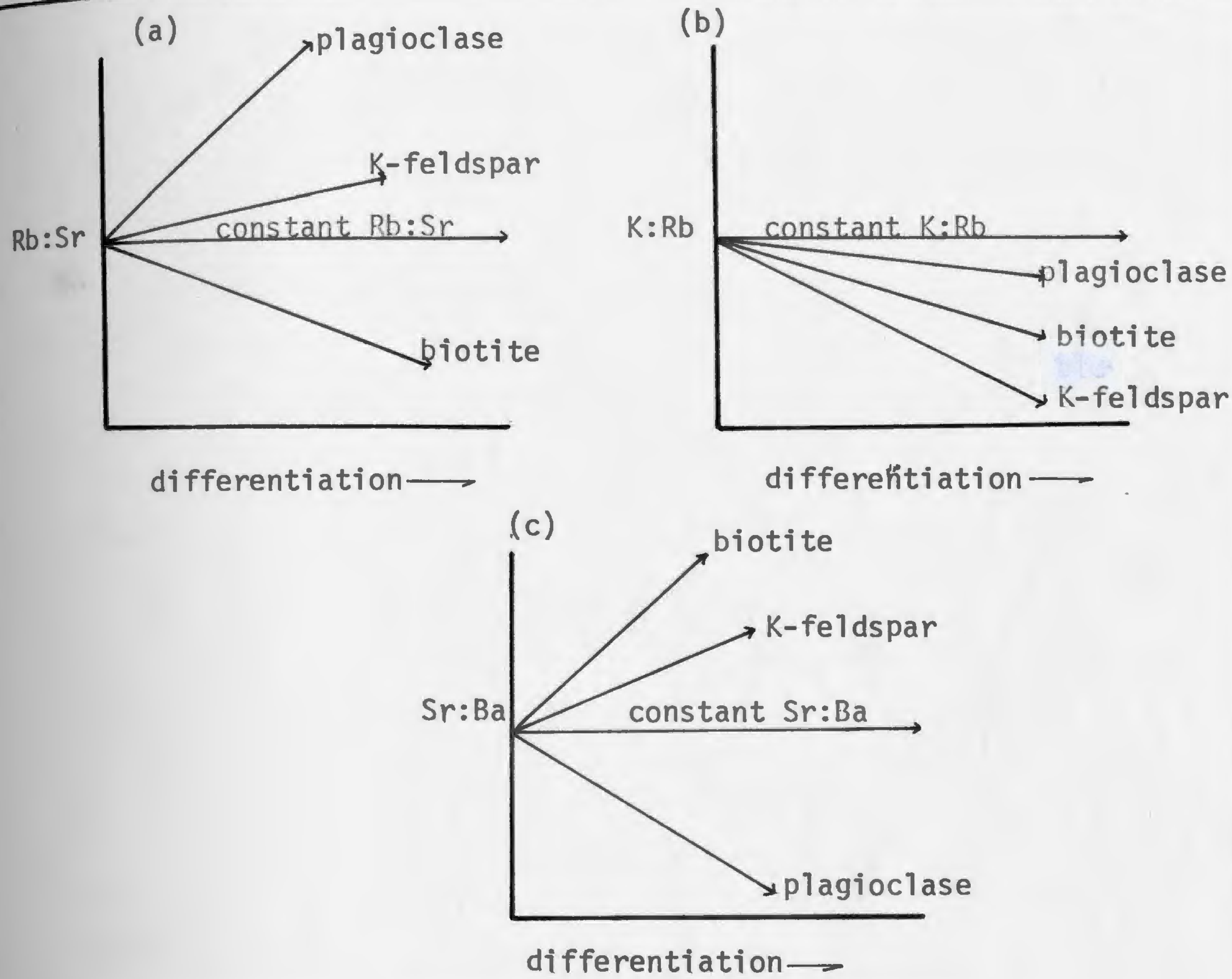


Fig.6.10. Schemetic Diagrams showing predicted paths of differentiation from a uniform initial composition.

The diagrams above indicate the following: (1) Fractionation of plagioclase, biotite or K feldspar cannot cause an increase in K:Rb; fractionation of K-feldspar, biotite and to a much lesser extent plagioclase can lead to a decrease in K:Rb. (2) Fractionation of plagioclase and to a lesser extent K-feldspar leads to an increase in Rb:Sr, whereas removal of biotite leads to a decrease. (3) Fractionation of biotite and K-feldspar causes an increase in Sr:Ba, while removal of plagioclase leads to a decrease.

These predicted trends are compared below with those observed in the Northern granitoids.

6.5.2 Rb - Sr

Plots of Rb vs Sr are shown in Fig.6.11; it is evident that the Rocky Bottom Tonalite (10) and Matthews Pond granodiorite (11) have Rb:Sr ratios matching average values published for such rocks (Faure and Powell, 1972). In contrast, the North Bay, and more so the Partridgeberry Hills (13) and Through Hill (14) plutons have Rb:Sr values substantially exceeding the average of 0.53 for granite (Faure and Powell, 1972), being up to 20 times higher in some samples for the Partridgeberry Hills pluton. Since there are no crustal rocks with such high Rb:Sr ratios, the high values are considered to have been produced by fractionation and/or alteration. As Fig.6.11 illustrates the high Rb:Sr values are not produced by increasing Rb, but progressive reduction in Sr. This is consistent with fractionation of K-feldspar and especially plagioclase, as suggested by the Na:(Na + K) ratios.

Condie (1973) used the Rb-Sr plot to estimate thickness of the

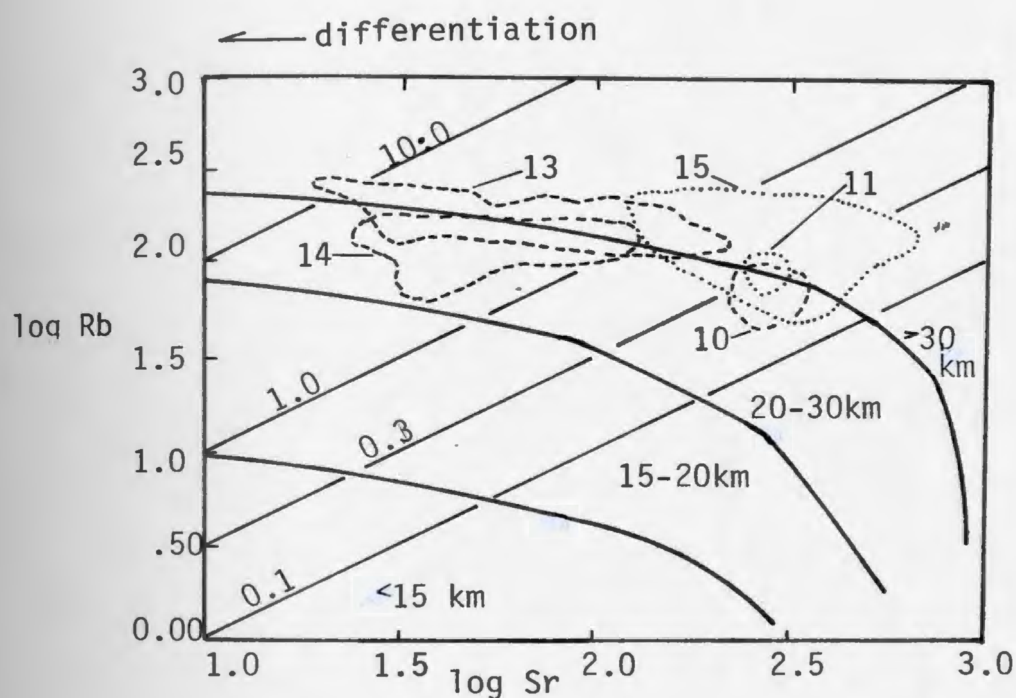


Fig. 6.11. Rb-Sr plots, Northern Granitoids.
Depth estimates after Condie (1973). The field for each pluton is outlined and numbered as above.

crust from which various rocks were derived. On this basis the Northern Granitoids are inferred to have been derived from a crust about 30 km thick (Fig.6.11) corresponding to a pressure of about 8 kbars. With a geothermal gradient of about 25^{0} km^{-1}, the temperature at the base of such a crust would be about 750^{0}, high enough to generate granitic magma (e.g. Winkler, 1974; Fyfe, 1978). Similar plots (Fig.6.17) suggest that the Southern Granitoids were generated at a depth greater than 30 km consistent with their structural setting (Chapter 5).

6.5.5.3 K:Rb vs Rb:Sr

As Fig.6.12 and Table 6.4 illustrate, K:Rb ratios fall in the range 160-350, corresponding to normal crustal abundances (Taylor, 1965), and comparable with values obtained for similar granitoid rocks in northeast Newfoundland (Dickson, 1974). If Rb:Sr can be taken as an index of differentiation, it can be seen that K:Rb decreases with differentiation in the Partridgeberry Hills (13), Through Hill (14) and North Bay (15) plutons. Such trends could be produced by fractionation of biotite, K-feldspar and plagioclase, as suggested by the major element plots and the Rb:Sr plots above. The Matthews Pond and Rocky Bottom plutons which show restricted values in Rb:Sr also show a narrower range of K:Rb than the more leucocratic plutons, suggesting limited fractionation in the former. K:Rb reaches its highest values in the most leucocratic Through Hill pluton, while values for the least leucocratic Rocky Bottom Tonalite are among the lowest. This is consistent with previous suggestions that the Northern granitoids are not related by fractionation.

TABLE 6.4

K:RB RATIOS FOR THE NORTHERN GRANITOIDS

Pluton	K:Rb
Through Hill (14	190-360
Partridgeberry Hills (13)	170-280
North Bay (15)	160-280
Matthews Pond (11)	220-250
Rocky Bottom (10)	180-240

6.5.5.4 Sr:Ba vs SiO_2

As stated above, fractionation of biotite and K-feldspar should lead to an increase in Sr:Ba, whereas plagioclase fractionation should produce the opposite effect. The relatively narrow range for the Rocky Bottom and Matthews Pond plutons is consistent with little or no fractionation as stated above. Applying the distribution coefficients listed above, it may be concluded that the effect of plagioclase fractionation was dominant early, whereas biotite and K-feldspar dominated late in the evolution of the Partridgeberry Hills granite (13). The opposite effect may be inferred for the North Bay granite (15). No clear trend can be seen in the Through Hill granite (14). The relatively wide range of Sr:Ba over a narrow silica range suggests that the Through Hill pluton may have been affected by deuteric metasomatic alteration, as suggested by the CNK diagram (Fig.6.8), and the presence of potash feldspar veins (Chapter 3). However, it appears that the alteration did not disturb the Rb:Sr system, as indicated by the low scatter on the Rb:Sr isochron for the Through Hill pluton (Fig. 4.3). The

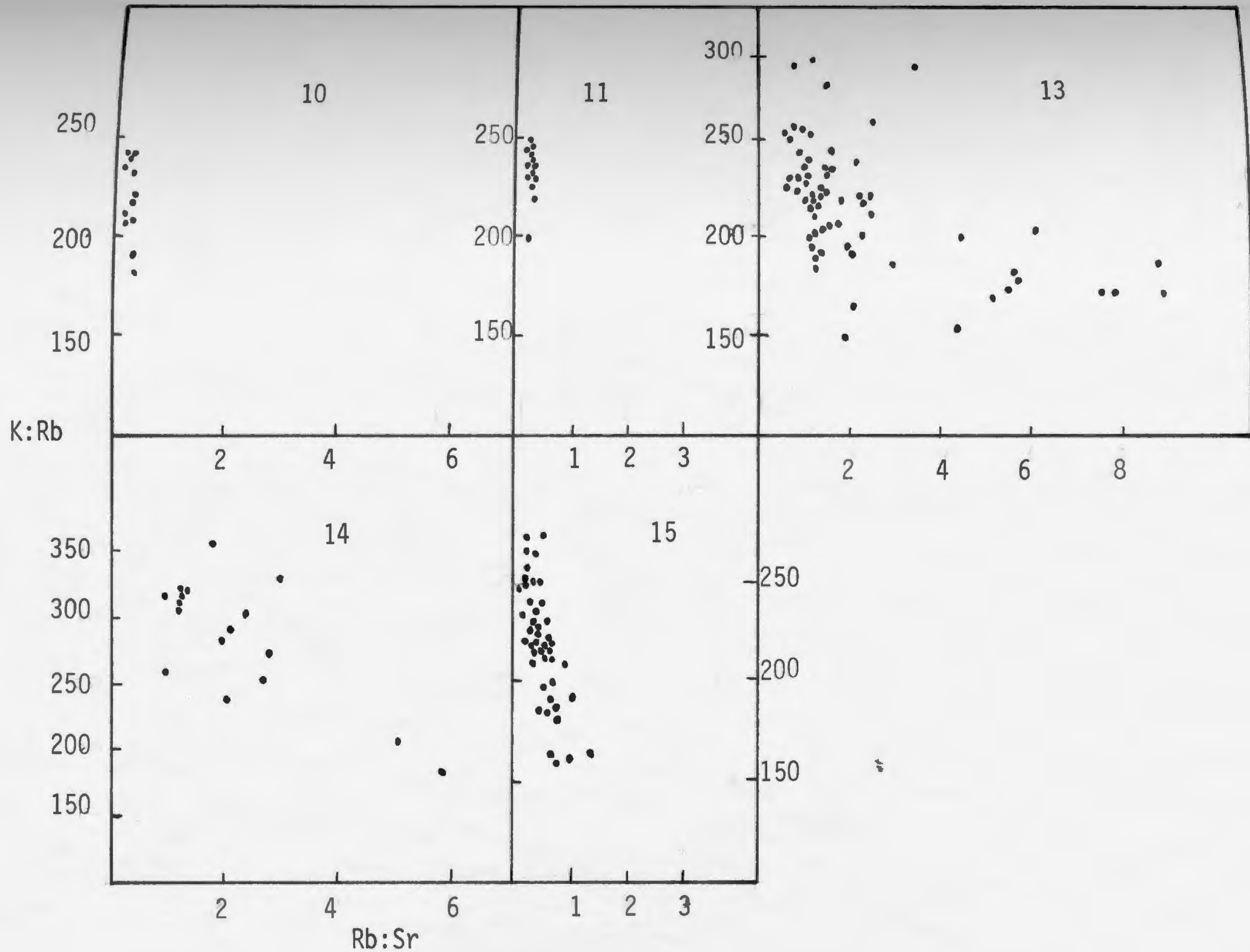


Fig. 6.12. K:Rb vs Rb:Sr, Northern Granitoids.

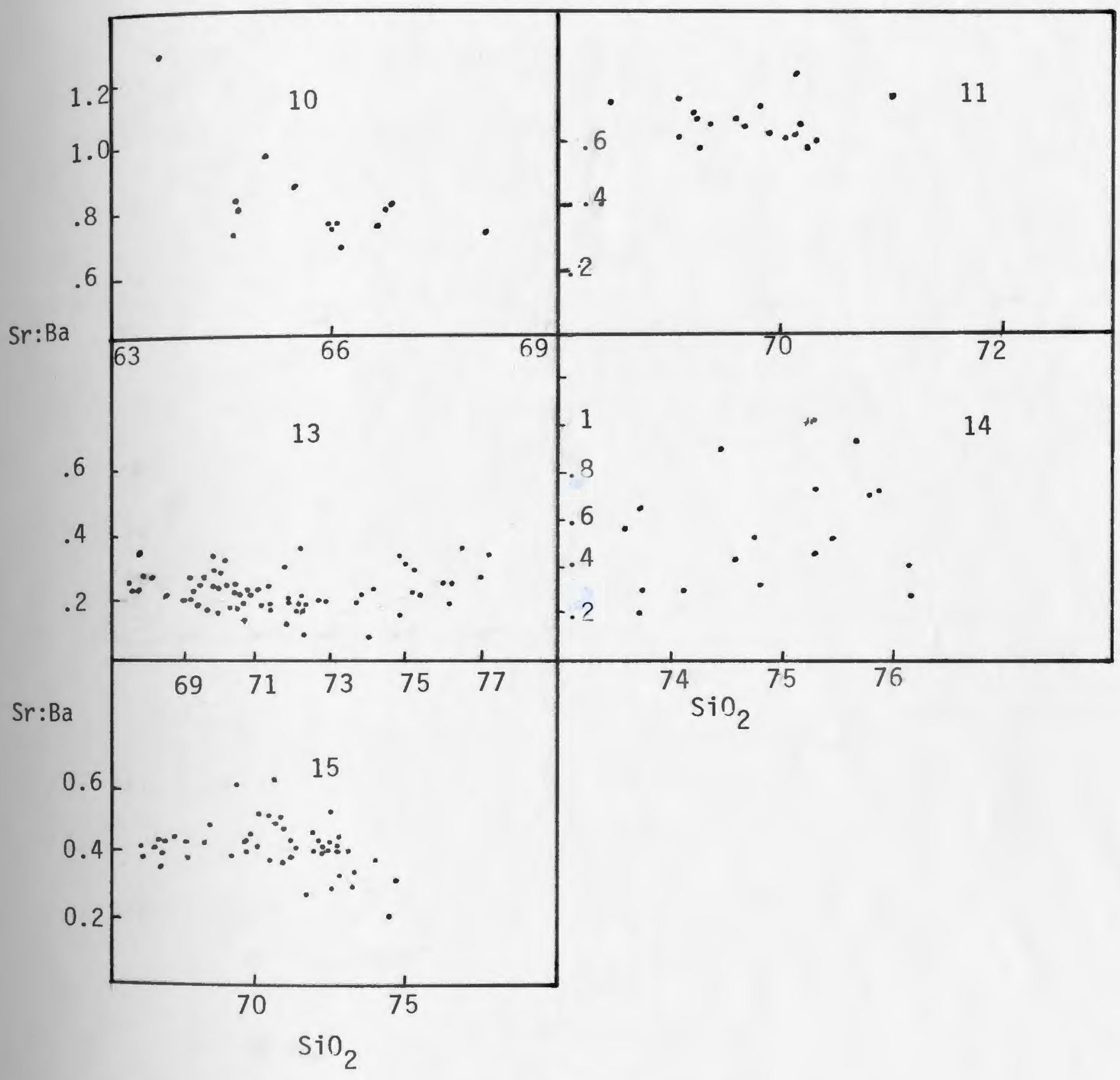


Fig6.13. Sr:Ba vs SiO_2, Northern Granitoids.

different profiles for the individual plutons once again underscore the contention that the Northern granitoids are not related by fractionation.

5.6 Summary

Major and trace element profiles indicate that the Northern Granitoids evolved along separate paths, as suggested by available strontium isotope initial ratios. Fractionation appears to have been restricted in the Rocky Bottom and Matthews Pond plutons, being more extensive in the other three plutons. The likely fractionating phases were biotite, plagioclase, K-feldspar, and minor hornblende, in differing proportions.

Geochemistry of the Southern Granitoids

6.6.1 Introduction

In this section, the six plutons assigned to the Southern Granitoids are examined, using the same parameters employed for the Northern Granitoids in section 6.5. The terms "fractionation" and "differentiation" are similarly used to cover both crystal-liquid and melt-restite relations.

6.6.2 $Na_2O + K_2O$ - (FeO +0.89 Fe_2O_3) - MgO (AFM) Diagrams

As for the Northern Granitoids the AFM patterns (Fig6.14) for the Southern Granitoids follow a calc-alkaline trend (cf. Martin and Piwinski, 1972). Plots for the plutons (1-6) form a series of overlapping trends towards the alkali apex. The least differentiated hornblende-bearing megacrystic Gaultois granite (2) forms the base, whereas the most differentiated garnet muscovite Dolland Bight granite (6) forms the Apex of the trend. Since the Southern Granitoids appear to be of similar ages (Chapter 5), and the leucogranites intrude the Gaultois megacrystic

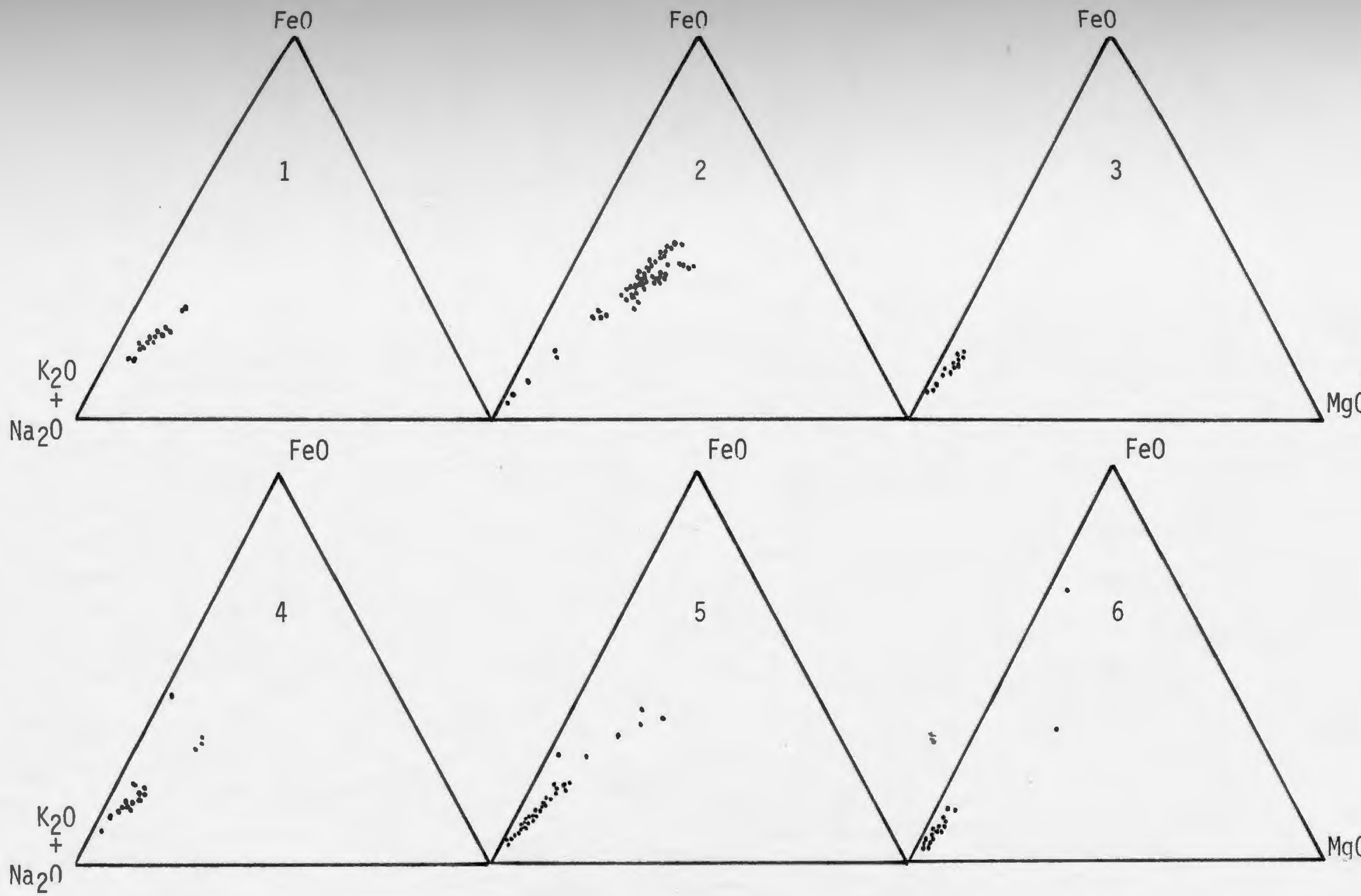


Fig.6.14 AFM diagrams, Southern Granitoids.

granite, the AFM pattern may be interpreted to imply that the leucogranites (3, 5, 6) and possibly the equigranular biotite granites (1, 4) could have been derived from the megacrystic granite (2) by fractional crystallization, although Carmichael et al. (1974) caution against drawing genetic conclusions from variation diagrams. A similar relationship was inferred for other Gander Zone granitoids in northeast Newfoundland (Jayasinghe, 1979). The straight trends away from the FM sideline may be explained by fractionation of ferromagnesian phases of fixed intermediate Fe:Mg ratio. The most likely ferromagnesian phases fractionated are biotite and hornblende as suggested in Chapter 3. Biotite and zircon fractionation is indicated by an inverse relation between Zr and SiO_2 (Fig.6.4). The AFM plots appear to reflect an evolutionary series corresponding with the observed petrographic lineage (Chaper 3) hornblende-biotite diorite (2); biotite granodiorite-adamellite (1, 2, 4); (biotite) muscovite adamellite (3, 5, 6). Although the Southern Granitoids appear superficially to be related by fractional crystallization, this relationship is not unequivocal, and is further examined below.

6.6.3 CaO-Na_2O-K_2O (CNK) Diagrams

The patterns in these diagrams scatter quite considerably,(Fig.6.15.) indicating probable sub-solidus alkali exchange, especially in samples from the deformed plutons (2, 3, 4, 5, 6) which have been at least slightly altered (Chapter 3). However it is clear that the least differentiated Gaultois granite is significantly more calcic than all the others, while the more differentiated granites (3, 4, 5, 6) overlap along the NK sideline, supporting the suggestion above that they could have been derived from the Gaultois granite (2).

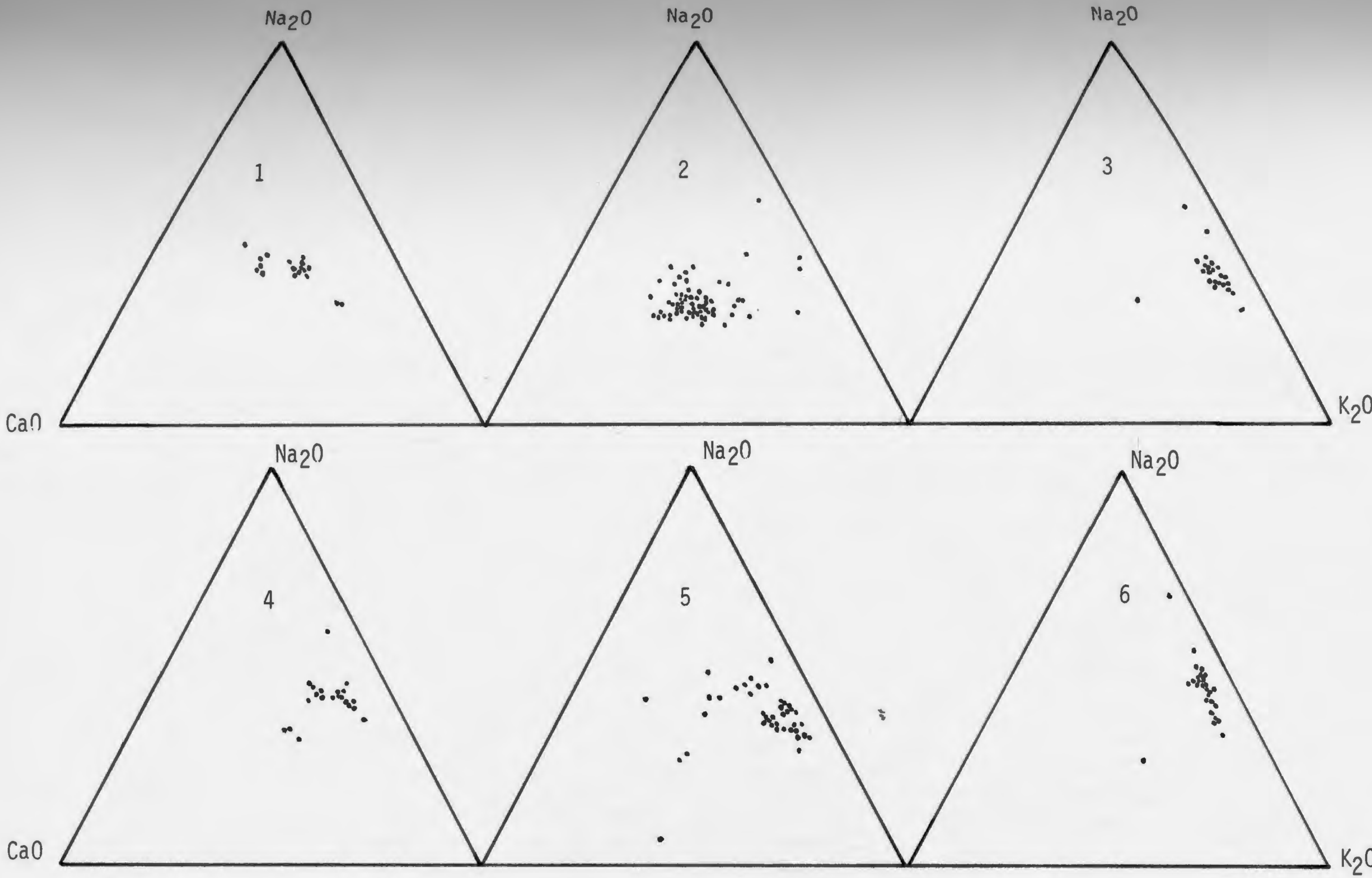


Fig.6.15 CNK diagrams,Southern Granitoids.

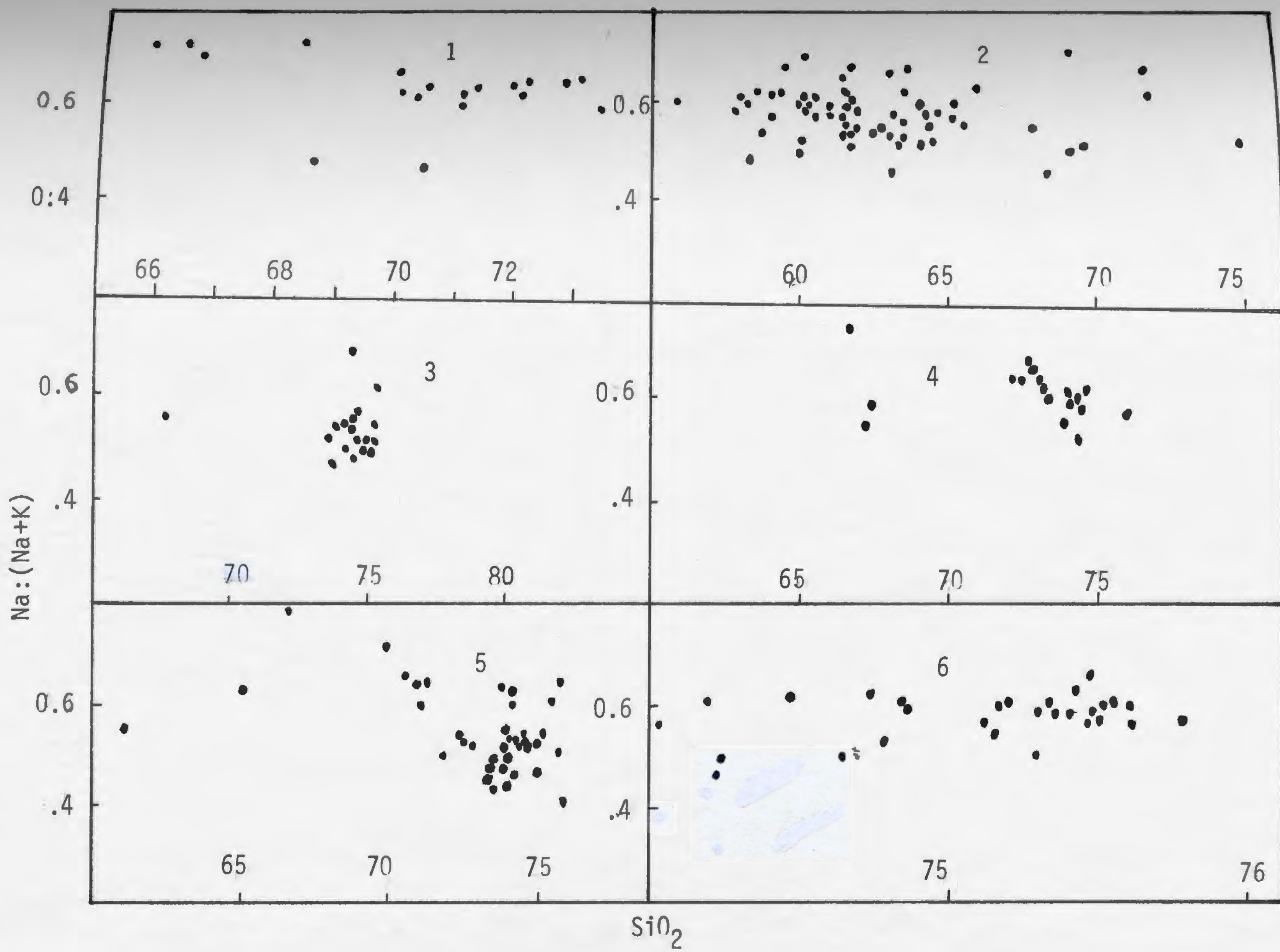


Fig.6.16. Na:(Na+K) vs SiO_2,Southern Granitoids.

[redacted] Na: (Na + K) Diagrams (Fig.6.16.)

Unlike those for the Northern Granitoids, the trends in the Na: (Na + K) diagrams for the Southern Granitoids are less regular. They do not project away from either hornblende or biotite. From Fig. 6.9 it is clear that fractionation of hornblende or plagioclase would produce a downward trend, whereas fractionation of biotite leads to an upward trend. Although the undulating patterns may be attributed to alteration, fractionation of hornblende, plagioclase and biotite in various proportions could produce the same results. From field and petrographic evidence (Chapters 2, 3) the Gaultois pluton (2) appears to have fractionated biotite, hornblende and plagioclase in varying proportions. Therefore, the patterns on the Na: (Na + K) diagrams are consistent with derivation of the Southern Granitoids by fractional crystallization.

[redacted] Trace Element Geochemistry of the Southern Granitoids

6.6.5.1 Introduction

Trace element behaviour in the Southern Granitoids is examined in the same way as for the Northern Granitoids with reference to Fig.6.10. As stated in section 6.5.5.1 the distribution coefficients for hornblende and garnet with respect to K, Rb, Sr, and Ba are too small to significantly affect the fractionation profile. Therefore, the study focuses on plagioclase, biotite and K-feldspar, the other major crystallizing phases in the Southern Granitoids.

6.6.5.2 Rb-Sr

Two groupings are evident from Fig.6.17. The biotite ($\pm$ hornblende) granitoids (1, 2, 4) have normal crustal Rb:Sr ratios (Faure and Powell, 1972). In contrast the muscovite bearing leucogranite (3, 5, 6) have

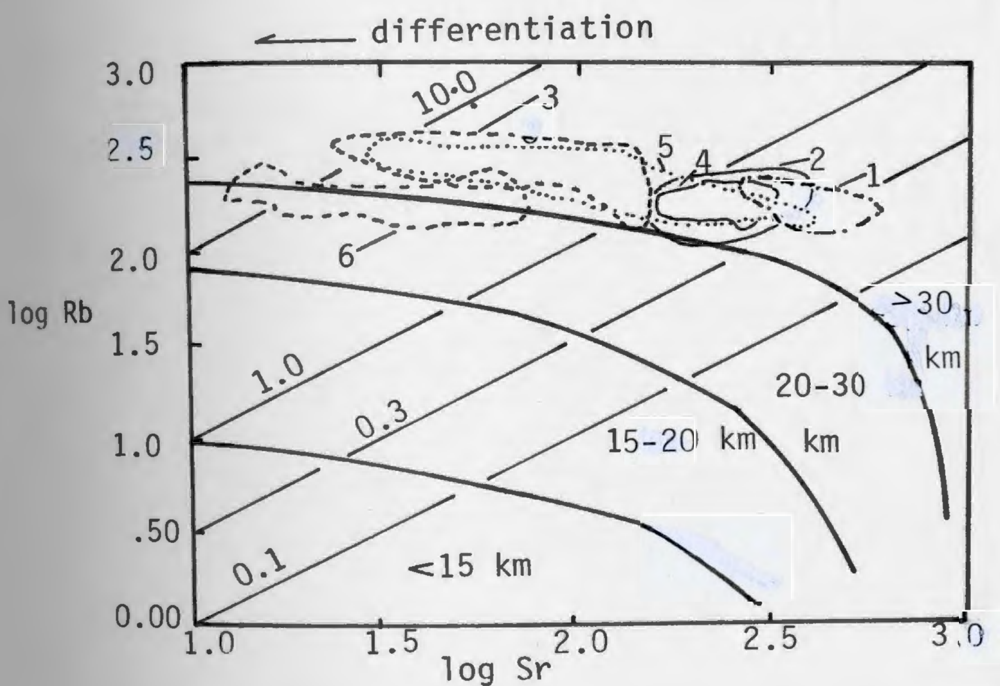


Fig. 6.17. Rb-Sr plots, Southern Granitoids.

Depth estimates after Condie (1973).

The field for each pluton is outlined and numbered as above.

substantially higher values exceeding 10 in the Dolland Bight (6) and Northwest Cove plutons. Moreover, the Northwest Cove (3) and Northwest Brook (5) lie on a smooth trend away from the megacrystic Gaultois granite (2). Such a systematic pattern due to decreasing strontium at nearly constant Rubidium, is attributed mainly to plagioclase fractionation (Fig.6.10. Removal of K-feldspar which is a phenocryst phase at least locally in most of the Southern Granitoids (Chapter 2) may have also played a role. The Dolland Bight granite (6) lies slightly off the trend, indicating that it may have evolved along a separate lineage, probably as a separate melt. This theory can be tested by means of rare earth and additional strontium isotope studies.

Using the method of Condie (1973), the Dolland Bight granite like the Northern Granitoids is estimated to have been generated at a depth of 30 km (8 kbars). The estimate for the other five Southern Granitoids is 40 km (10 kbars).

6.6.5.3 K;Rb vs Rb:Sr

As can be seen from Fig.6.18 and Table 6.5 K:Rb ratios for the Southern Granitoids fall in the range 110-260, somewhat lower than those for Northern Granitoids, but still within normal crustal abundances (Taylor, 1965). Scatter among the leucogranites (3, 5, 6) makes interpretation difficult. However, the distinction between trends in the biotite granites (1, 2, 4) and the leucogranites (3, 5, 6) is clear. Whereas K:Rb tends to decrease with increasing Rb:Sr in the leucogranites, K:Rb decreases at nearly constant Rb:Sr in the biotite granites. Although alteration may have played a role, from the distribution coefficients in Table 6.3, the contrasting trends can be explained as follows. Removal of biotite and plagioclase (and hornblende) from the biotite granites (as observed in the field) in such proportions as to maintain a near constant Rb:Sr ratio. Fractionation of biotite, plagioclase and K-feldspar in various proportions could account for the scattered pattern in the leucogranites. The plots of K:Rb vs Rb:Sr, although suggesting fractionation of phases indicated above, do not clearly relate the Southern Granitoids by fractionation.

TABLE 6.5

K:Rb RATIOS SOUTHERN GRANITOIDS

Pluton	K:Rb
Piccaire	130-250
Gaultois Granite	120-240
Northwest Cove	110-220
Indian Point	150-240
Northwest Brook	110-220
Dolland Bight	160-260

6.6.5.4 Sr:Ba vs SiO_2

From Fig 6.19, it can be deduced that fractionation of plagioclase should lead to a decrease in Sr:Ba, whereas removal of biotite and K-feldspar should produce an increase. A combination of plagioclase and biotite $\pm$ K-feldspar would produce flat or irregular trends as seen in Fig.6.10. Although these trends could have been produced by alteration, this is considered unlikely because of the smooth linear patterns in the Rb:Sr plots (Fig.6.17). It is not possible to deduce relationships among the granitoids from these plots.

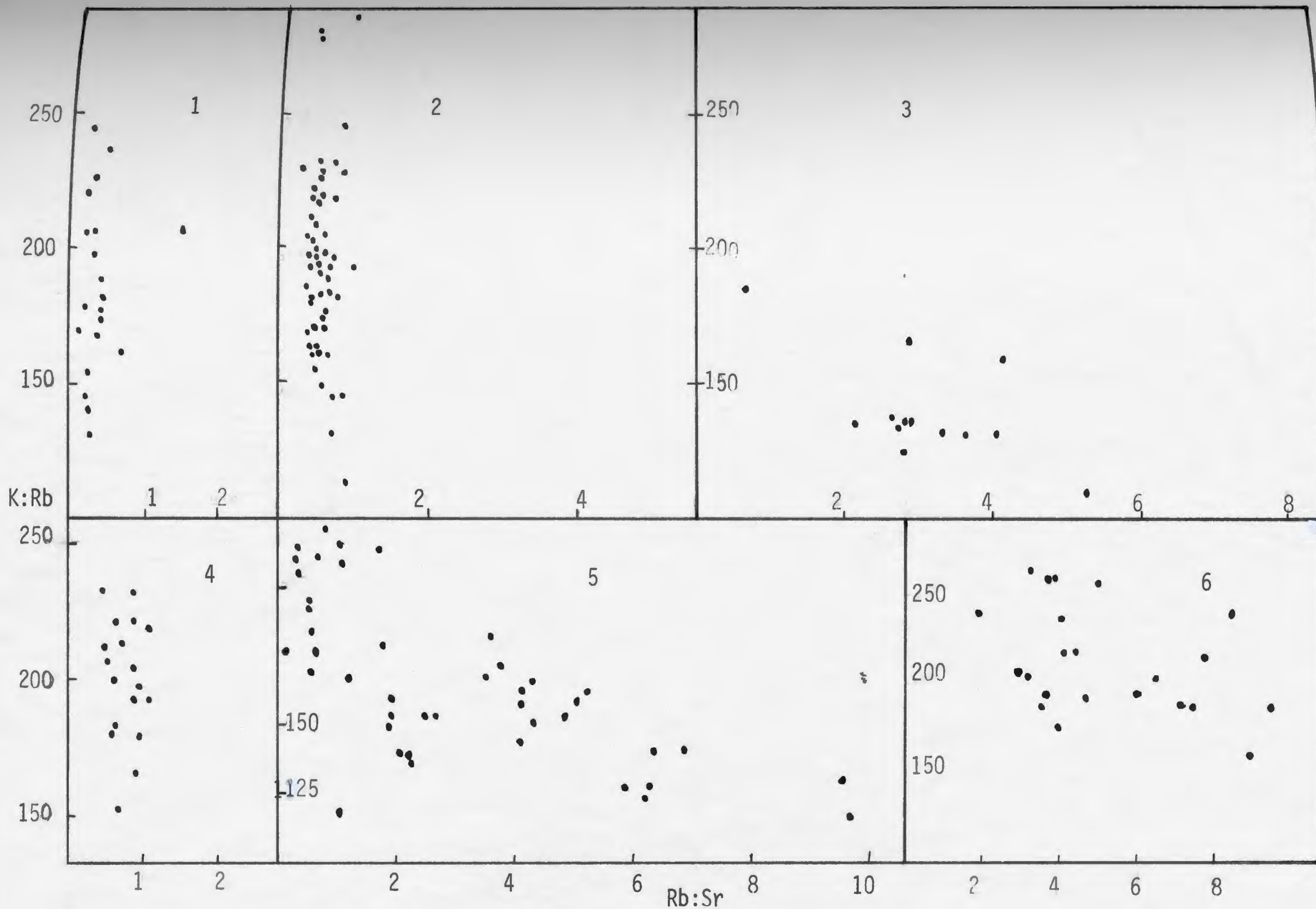


Fig.6.18. K:Rb vs Rb:Sr, Southern Granitoids.

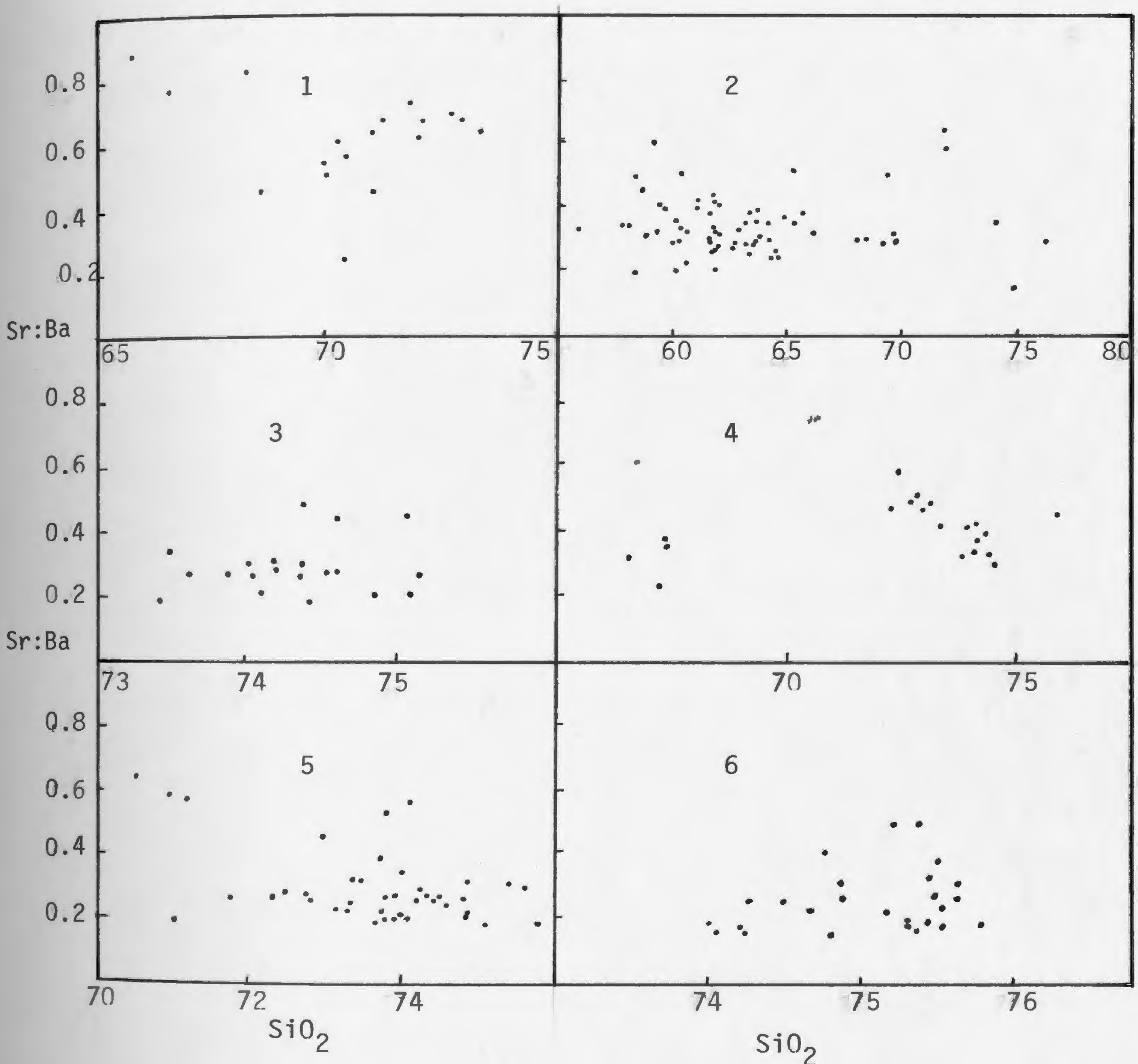


Fig.6.19. Sr:Ba vs SiO_2,Southern Granitoids.

[redacted]6 Summary

The Southern Granitoids appear to have been generated over a short period of time in early Carboniferous. Field, petrographic and major element chemistry suggest that the leucogranites were derived from the megacrystic Gaultois granite. Trace element profiles suggest that biotite, plagioclase, K-feldspar (and hornblende) were fractionated in various proportions. Further studies (e.g. rare earth, strontium isotope) are required to firmly establish whether the Southern Granitoids are related by fractionation.

[redacted] The 'Straddling' Granite

The 'Straddling' granite has been described in detail by previous workers (O'Driscoll, 1977; Blackwood and O'Driscoll, 1976; O'Driscoll and Strong, 1979). As shown in Fig6.20 the 'Straddling' granite as defined lies astride the Gander-Avalon Zone boundary, and is cut by the Hermitage Bay fault. O'Driscoll and Strong (1979) described the straddling granite as follows: "medium-grained, pink to grey alaskite; hornblende-biotite granite and granodiorite; fine grained pink to purple felsite". They also state "Possibly some of the rocks mapped as Straddling Granite are actually Harbour Breton Granite." (op. cit. p. 27)

The portion of the 'Straddling' granite northwest of the fault falls in the present study area. It was therefore decided to compare the granite on either side of the fault. Northwest of the fault, the granite is a medium grained biotite adamellite, with minor granodiorite, in contrast to the varieties described by O"Driscoll and Strong (1979). Samples were taken from both sides of the fault and compared with those obtained by O'Driscoll and Strong (1979). The data are presented diagrammatically

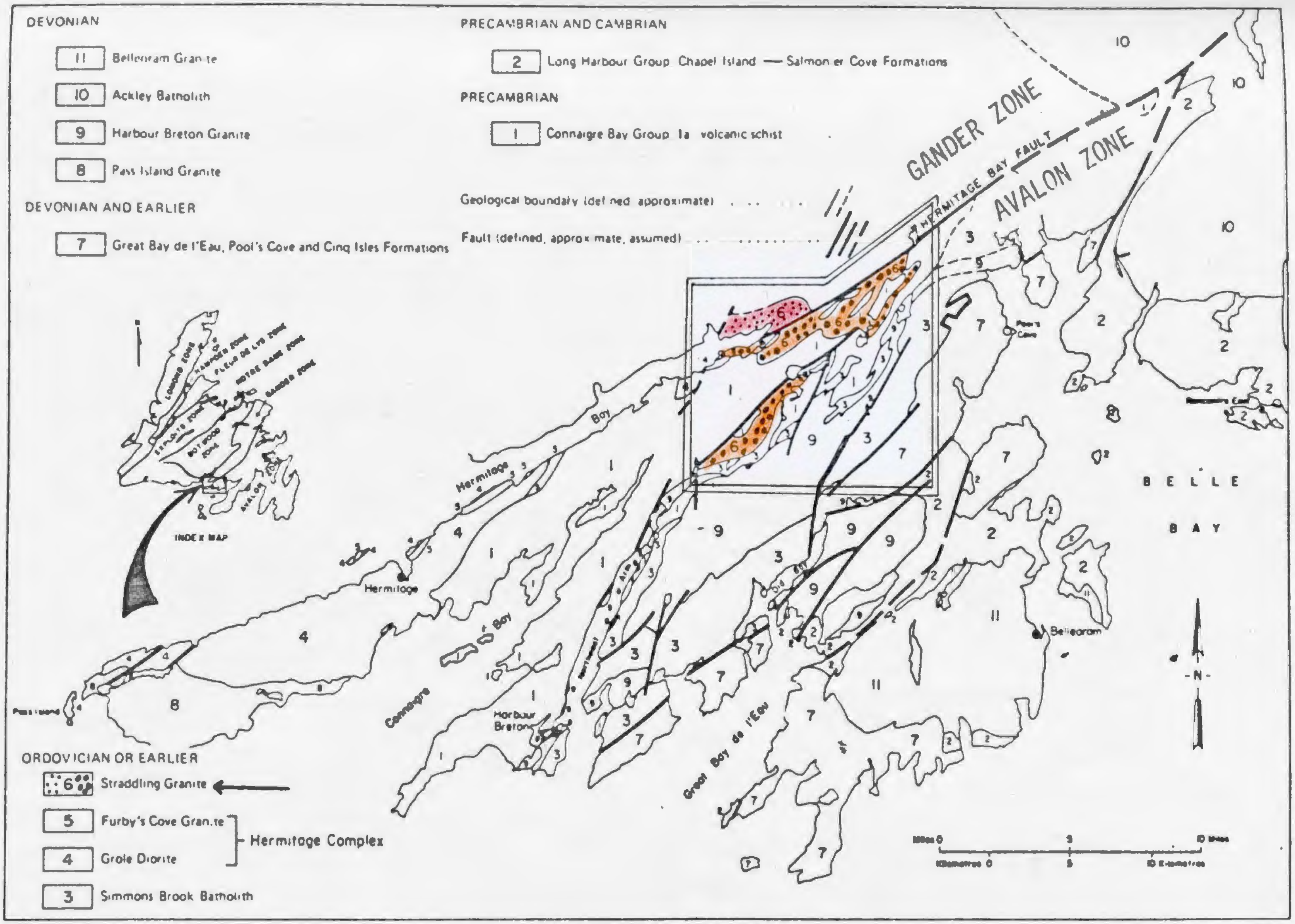


Fig.6.20. Generalized geologic map of the Hermitage - Belle Bay area (O'Driscoll and Strong,1979).The "Straddling Granite"(6,stippled)lies within the pentagonal box. Indian Point. Hardy's Cove Complex.

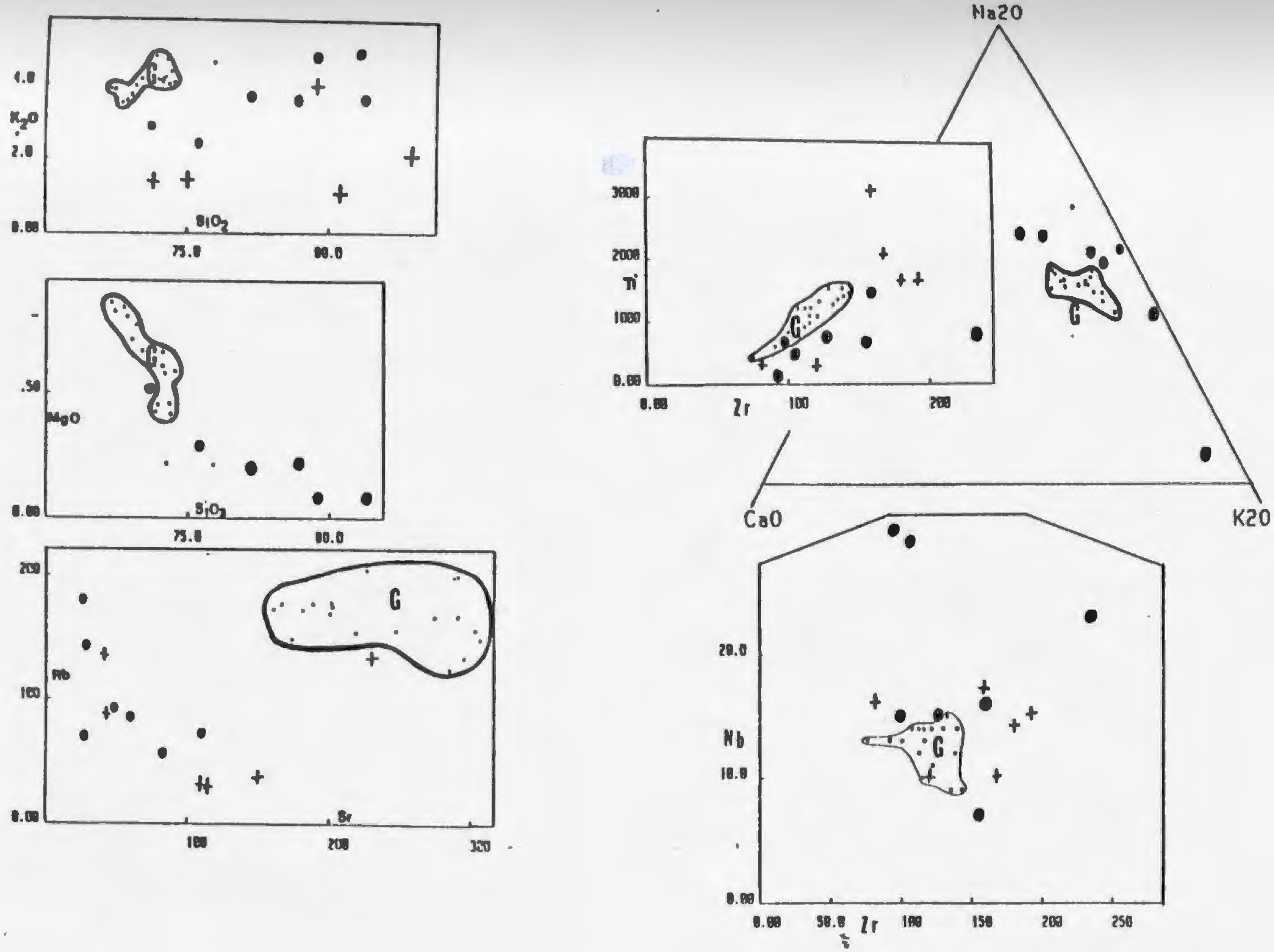


Fig 6.21. Variation diagrams showing geochemical differences between Indian Point pluton,within the Gander Zone (G) and "Hardy's Cove Complex",within the Avalon Zone(crosses and large dots). Part of the Avalon Zone data (crosses) after O'Driscoll,(1977).

Fig.6.22. Massive Alaskite,part of "Hardy's Cove Complex".
Highway 360, Bay D'Espoir.

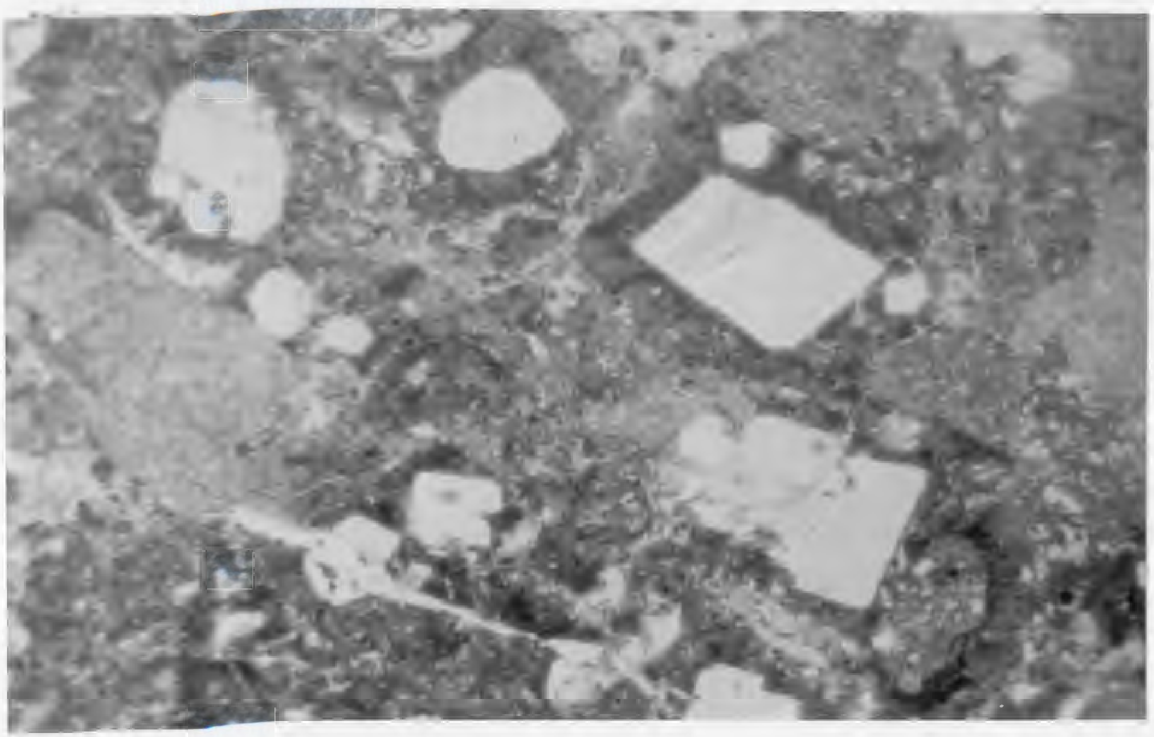


Fig.6.23.Euhedral quartz in porphyry,"Hardy's Cove Complex" (x10, x nicols).This porphyry and the alaskite above are facies that do not occur in the'Indian Point' granite.

in Fig 6.21.

As the foregoing diagrams illustrate those samples taken Northwest of the fault (Gander Zone) form a coherent grouping, and appear to be a petrographic as well as a geochemical unit, in spite of some alteration. Samples taken southeast of the fault (Avalon Zone) tend to be more scattered, in keeping with their petrographic heterogeneity (O'Driscoll and Strong, 1979). Their SiO_2 values tend to be higher, whereas Al_2O_3, CaO, MgO, TiO_2, Rb and Sr tend to be significantly lower than those from northwest of the Hermitage Bay fault.

It appears that the Straddling granite as defined by O'Driscoll (1977) is not a single pluton, but a complex of granitoid facies. It is therefore proposed to discontinue use of the name 'Straddling Granite'. For the portion northwest of the fault, the name 'Indian Point Granite' is proposed, since this appears to be a single plutonic unit. For the remainder southeast of the fault, the name 'Hardy's Cove Complex' is proposed while the relations between the various facies await further investigation. (See Figs.6.20 to 6.23).

6.8 Petrogenesis

6.8.1 Introduction

Any petrogenetic scheme proposed for the granitoids of Bay D'Espoir must take into account among other factors, the following: (1) Possible source materials (2) Temperature, pressure, and the role of fluids (3) Possible heat sources. These factors are discussed below with respect to the tectonic setting of the granitoids.

2 Possible Source Materials

Most granitoid plutons throughout the world occur in continental areas (Carmichael et al; 1974), leading to the conclusion among many geologists that granitic plutons are the products of crustal melting (Brown and Fyfe, 1970; White and Chappel, 1977; Pitcher, 1979). The case for a mantle origin has also been argued (Kistler et al; 1971; Brown and Hennessy, 1978). In the light of Plate Tectonic Theory, it has been proposed that granitoid rocks can be produced by melting of subducted lithosphere, the mantle, or lower crust (Wyllie, 1977). Using geochemical evidence, Strong and Dickson (1978) observed that the granitoid rocks of northeastern Newfoundland faithfully reflect the nature of the crust underlying the tectonic zone in which they occur. The Botwood Zone, which should include most of the Northern Granitoids was inferred to represent a more oceanward tectonic domain than the Gander Zone (old definition, Williams et al.,1974). Thus the granitoids were shown to display a systematic K_2O increase from northwest to southeast, reflecting a progressively greater continental input into the source material, as suggested for the Sierra Nevada and other Cordilleran plutonic regions (e.g. Bateman and Dodge, 1970). Such a systematic trend is not observed among the Bay D'Espoir granitoids. Some of the highest values of K_2O are recorded in the northernmost of the plutons (Through Hill). The strontium isotope initial ratios (Chaper 5) fail to show a systematic increase from northwest to southeast, the highest ratio being recorded in the Through Hill granite. Thus although the Newfoundland Appalachians may show a K_2O polarity on a gross scale (Strong and Dickson, 1978), this may not be so in detail. As stated in Chaper 5, it seems that the rocks which were melted to produce the Bay D'Espoir granitoids had input from both continental and oceanic (mantle) sources. The variety of lithologies in the presently exposed crust (Colman-Sadd 1980) attest to this suggestion. Crust of this nature where mafic and ultramafic bodies are juxtaposed with sediments of both island arc and continental origin is consistent with the model which interprets the area to represent a back-arc basin that was subjected to compression during the Taconic-Acadian orogenic regime (Stevens et al; 1974; Colman-Sadd, 1980) (Fig.1.4). Similar settings of various commingled lithologies in several marginal basins have been recorded in the modern Pacific Ocean (Packham and Falvey, 1971).

[redacted] Temperature, Pressure and the Role of Fluids.

The association of granitic rocks with high grade metamorphic terranes is a common feature of continental areas (Mehnert, 1968; Winkler, 1974). However, without significant heating during ascent (e.g. exothermic reactions, adiabatic rise), water-saturated melts would freeze as they begin to rise and thus have little chance of reaching the surface (Burnham, 1967; Brown and Fyfe, 1970). Most plutons presently exposed are therefore considered to have been produced from fluid-undersaturated melts, the fluid being mainly water from the breakdown of muscovite, biotite, and hornblende. Other fluids of lesser importance are CO_2, H_2S, HCl, HF and H_2 (Burnham, 1967; Burnham, 1979). Undersaturated melts would have been formed at higher temperatures than those for saturated melts, reaching up to 900^{o}C (Brown and Fyfe, 1970). Such melts could ascend to high levels in the crust before becoming fluid-saturated (by removal of anhydrous phases), and crystallize.

The depth at which the Northern Granitoids were generated has been estimated to be about 30 km (8 kbars), whereas the depth for the Southern Granitoids is estimated to be about 40 km (10 kb) - see Fig.6.11 These relative values are consistent with the field setting of the Bay D'Espoir granitoids (Chapter 2). The Northern Granitoids are discordant high level intrusions, whereas the Southern Granitoids are concordant plutons intrusive into, and locally gradational with gneisses and migmatites.

Fig6.24 (Burnham, 1979; Strong, 1980) summarizes P-T conditions of melting and crystallization pertinent to granitoid rocks. The following features may be noted: (1) Solidi for granite, tonalite, and amphibolite converge at high pressures, permitting formation of melts from a wide spectrum of source rocks over a narrow temperature range. Granitoids of contrasting geochemical characters can be generated under similar conditions of temperature and pressure. (2) Muscovite crystallization requires higher water activity than biotite or hornblende; this is consistent with muscovite granites being first formed (minimum) melts, or late stage differentiates from biotite/hornblende granitic melts. (3) Muscovite is not a stable liquidus phase below 4 kbars pressure. However, any significant celadonite [$K(Mg, Fe)(Al, Fe^{3+}) Si_4O_{10}(OH)_2$] component in muscovite tends to expand the stability range to lower pressures and higher temperatures (Anderson et al., 1980). (4) It appears that frictional heating can cause significant increase in the local geothermal gradient, sufficient to produce partial melting, although Strong (1980) cautions that the process tends to be self-arresting as a result of lubrication from initial melts. (5) The aluminosilicate triple point (Richardson et al.,

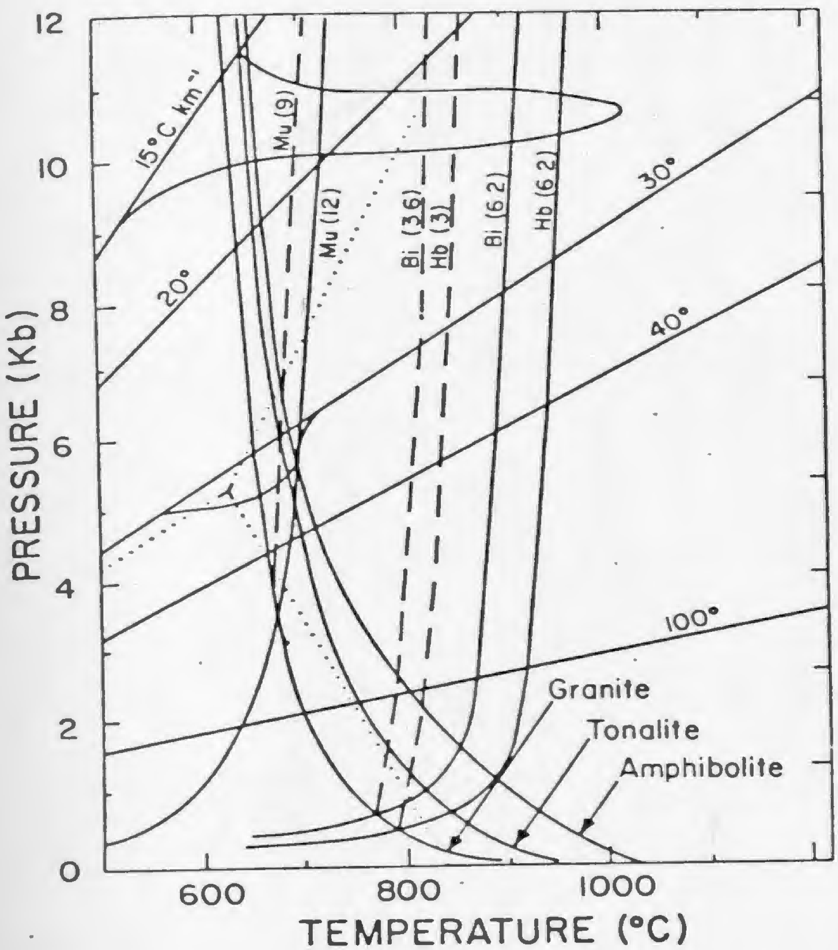


Fig.6.24a Pressure-temperature projection of some melting and reaction relations relevant to the genesis of granitoid rocks. The solid lines labelled "granite", "tonalite", and "amphibolite" are the solidi of these compositions as shown by Wyllie (1977). The straight lines labelled 100, etc., are geotherms showing these rates of temperature change per kilometre depth. The solid and dashed lines labelled Mu, Bi and Hb are liquidus and solidus curves respectively for each of the minerals muscovite, biotite and hornblende, as shown by Burnham (1979). The aluminosilicate triple point and reaction curves (dotted lines) are from Richardson *et al.* (1969) The perturbation of the 30°C km⁻¹ geotherm is the 100°C temperature increase allowed by frictional heating as calculated by Reitan (1968), but note that any melting would result in lubrication and consequently limit the extent of such temperature increase. The numbers in brackets on solidi and liquidi are the approximate minimum amounts of water (wt%) present in any melt in equilibrium with these phases, over the interval where they are straight, as calculated by Burnham (1979). The water contents change significantly with pressure over the intervals where these lines are curved (cf. Wyllie, 1977).

Diagram and caption after Strong (1980).

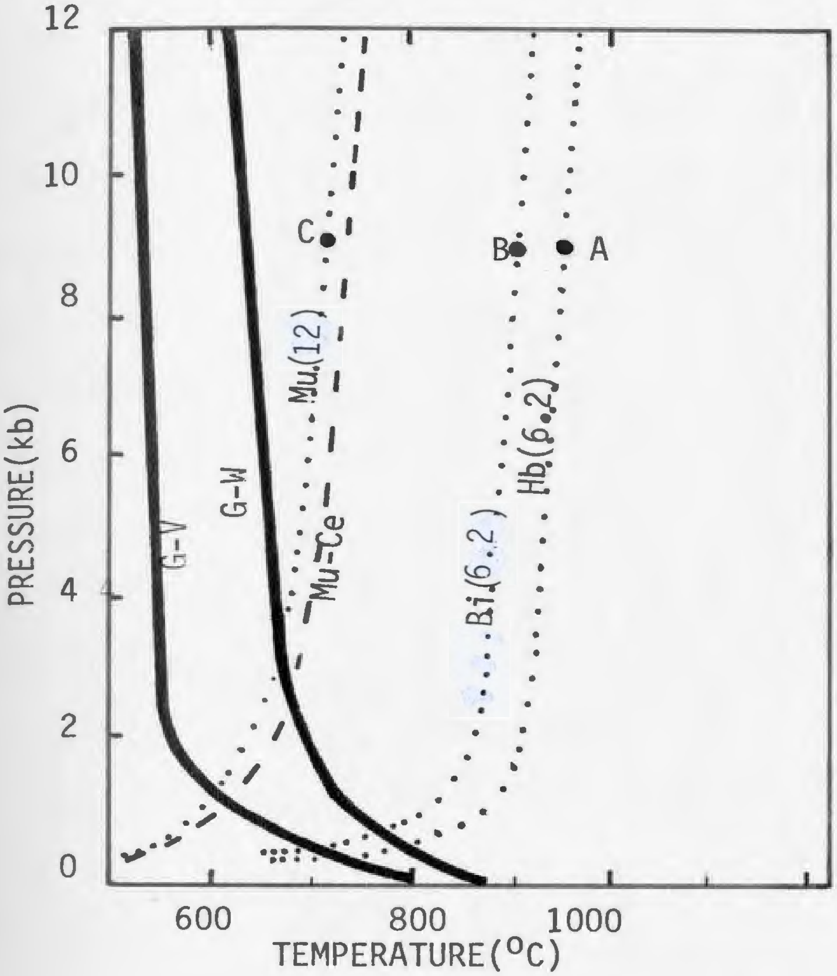


Fig.6.24b Pressure-temperature projection showing estimated P-T conditions under which the Bay D'Espoir granitoids crystallized. A--hornblende-bearing granitoids. B--biotite-bearing granitoids. C--muscovite-bearing granitoids. Heavy line G-W is the water-saturated granite solidus. The heavy line G-V is a possible granite solidus where the melt is saturated with volatiles such as B,F,Cl,etc.,in addition to water.The dashed line Mu-Ce is the stability curve for celadonitic muscovite. Note that celadonitic muscovite is stable at low pressures,especially on the "volatile-saturated" curve G-V. Dotted curves as in Fig.6.24a.

1969) lies close to the granite solidus, indicating that crustal rocks heated to temperatures just above sillimanite grade can begin melting to produce granite, although a rather high geothermal gradient would be required. These points are examined below with respect to the Bay D'Espoir granitoids.

Assuming that the pressure estimates of 8-10 kbars made earlier are correct, minimum temperatures of melting for the Bay D'Espoir granitoids can be deduced from Fig. 6.24b. The amphibole bearing granitoids, Gaultois (2), Rocky Bottom (10) and North Bay (15) reached a temperature of at least 950^oC. The biotite bearing granitoids, Piccaire (1), Northwest Cove (3), Indian Point (4). Northwest Brook (5), Matthews Pond (11), and Partridgeberry Hills (13) would have reached a temperature of at least 900^oC. The minimum for the muscovite granites Dolland Bight (6) and Through Hill (14) is about 700^oC. Illustrative examples from individual plutons are discussed below.

Five of the eleven plutons studied have crystallized apparently primary muscovite. Electron microprobe analyses (Appendix 3) of white mica from the Through Hill pluton revealed that the mica is 90% muscovite $KAl_3Si_3O_{10}(OH)_2$, with 5.0 to 6.5% celadonite. This suggests that there is some uncertainty in using muscovite as a geobarometer. Garnet occurs at least locally in six of the plutons. Green (1976, 1977) suggested that garnet would not be a liquidus phase below 7 kbars unless it had a substantial Mn content, and that Mg:Fe is lower in garnet than in the coexisting melt if crystallization occurred below 950^oC. Electron microprobe analyses of garnets from the Through Hill pluton (Appendix 3) shows the garnets to be of about 18% spessartine content, indicating that they cannot be used to place constraints on pressure of crystallization. It has also been argued that garnets in granites are a natural product of differentiation and do not require high pressures for crystallization (Cawthorn and Brown, 1976). The garnets have MgO:FeO about 0.06, which compares with 0.2 for the whole rock analyses from the Through Hill pluton. Using the results of Green (1977), it may be inferred that the Through Hill pluton crystallized at temperatures less than 950°C, consistent with the estimate made above.

Metamorphic aureoles around the Northern Granitoids reach up to sillimanite grade, although regional metamorphism is often as low as greenschist grade (e.g. Colman-Sadd, 1981). This suggests that the Northern Granitoids reached the surface before much of their heat was dissipated. The Partridgeberry Hills pluton, estimated above to have started crystallization at about 900°C, 8 kbars, bears petrographic evidence suggesting continued crystallization at lower pressures. Primary andalusite appears to have crystallized with K-feldspar. The assemblage K-feldspar + andalusite + melt is stable at pressures less than 4 kbars, and temperatures of 675-800°C (Miyashiro, 1973; McKenzie, 1974). If these estimates are correct, it can be concluded that the pluton reached a high level in the crust before losing much of its heat, probably by rapid ascent.

6.8.4 Possible Heat Sources

As stated above, the setting, chemistry and isotopic signatures of the Bay D'Espoir granitoids fit the model of intrusion into a Paleozoic back arc basin. In this context, a number of possible heat sources may be envisaged, which are partly interrelated: (1) Abnormally high geothermal gradients within the back arc basin due to mantle convection as theorized by Andrews and Sleep (1974). (2) Injection of mantle-derived mafic magma into the crust at sufficiently high temperatures to cause fusion (Wyllie, 1977). (3) Frictional heat (Reitan, 1968a, 1968b; McKenzie and Brune, 1972) (4) Crustal thickening (Strong, 1977; Pitcher, 1979).

If the model of easterly subduction and east-west compression is accepted for the Taconic-Acadian development of the Appalachian orogen, it is possible to envisage interaction between a lithospheric slab and the underlying mantle. The temperature contrast and relative motion could generate convection cells leading to abnormally high temperatures within the lower crust (c.f Andrews and Sleep, 1974). Mafic magma was also injected into the lower crust (Strong, 1977; Colman-Sadd, 1980a). Examples of such magma injection are widespread in the study area. Mafic volcanics occur within the Bay D'Espoir group (Colman-Sadd, 1980b). Mafic and ultramafic bodies several square kilometers in area appear faulted against rocks intruded by the Partridgeberry Hills and Through Hill plutons (Colman-Sadd, 1980a). The Round Pond pluton consists partly of olivine norite. Mafic dikes cut the Little Passage gneisses, the Gaultois granite (Colman-Sadd, 1978) and the Through Hill granite (see Chapter 2). This evidence suggests that mafic and ultramafic magmas from the mantle were being injected into the crust before, during, and after emplacement of the granitoids. These mafic-ultramafic magmas are therefore regarded as the principal source of heat which caused partial melting of the crust in Silurian-Carboniferous time. Similar mechanisms have been suggested by others for granitoid genesis in the Appalachian orogen and elsewhere (Presnall and Bateman, 1973; Jayasinghe, 1979; Fyffe et al; 1980, Wones, 1980). It has been pointed out by Wones (1980) that whereas basaltic magmas erupt to the surface during periods of crustal expansion, they are likely to be trapped beneath the crust during compression, where they provide heat for crustal fusion. This may partly explain why basaltic rocks are not exposed in greater abundance in the Bay D'Espoir area.

In the context of the model of crustal compression outlined above, it is likely that heat of friction, caused by shearing, did contribute to the total heat budget. Although, as illustrated in Fig.6.24a, the local geotherm might be sufficiently raised by frictional heating to intersect the granite solidus, producing melt, lubrication by the first formed melt would tend to arrest the process (Strong, 1980). Hence frictional heating would have been a secondary contributor to the heat flux. The Southern Granitoids, whose generation is considered to have been accompanied by major movement along the Hermitage Bay and associated faults, are thought to have derived much of their heat by friction. Repeated shearing within fault zones is considered capable of generating significant quantities of granitoid rock, as described for the leucogranites of Southern Brittany (Strong and Hanmer, 1981).

Pitcher (1979), in a major review of granitoid plutonism, observed that irrespective of their tectonic setting,generation of granitoids is commonly associated with crustal thickening. Whether a thickened crust can produce melts without heat input from the mantle has been contested (e.g. Brown and Hennessy, 1978), but this phenomenon is regarded as a contributor to granitoid plutonism in the Bay D'Espoir area and other parts of the Appalachian orogen (Strong, 1977; Colman-Sadd, 1980).

[illegible].9 Summary

The Bay D'Espoir granitoids are a calc-alkaline suite intruded in two pulses of magmatism. Major element and trace element chemistry and strontium isotope ratios suggest that the Silurian Northern Granitoids were generated from separate magma batches, and are not related by any process of fractionation. Although the early Carboniferous Southern Granitoids appear to be related by fractionation along a common magmatic lineage, further studies (e.g. strontium isotope and rare earth) are needed to support this contention. The principal fractionating phases were biotite, plagioclase, K-feldspar and hornblende in various proportions. The Bay D'Espoir granitoids appear to have been generated by partial melting in the lower crust within a back-arc basin. The most likely heat sources were mafic-ultramafic magmas which were repeatedly injected into the crust from the mantle. Crustal thickening and frictional heating may have played a subordinate role. The 'Straddling' granite on the Gander zone side of the Hermitage Bay fault is geochemically very different from its counterpart on the Avalon Zone side. Radiometric dates and field relations suggest the "Straddling granite" consists of at least two plutons.

CHAPTER 7

ECONOMIC GEOLOGY

7.1 Introduction

In this chapter, the economic potential of the Bay D'Espoir granitoids is summarized. For a fuller treatment, including the economic geology of the entire South-Central Newfoundland area, the reader is referred to Colman-Sadd and Swinden (in press). This study included analyses for economically valuable elements Be, Li, Mo, Cu, Pb, Zn and U. No areas of anomalous rare metal concentration have been identified either from this study or from stream sediment sampling (Butler and Davenport, 1978). Scintillometer readings taken randomly over the Partridgeberry Hills, Through Hill and Northwest Brook plutons produced total radioactivity counts of less than 250 cps. In spite of these apparently negative results, it should be emphasized that present studies are only preliminary. Some of the plutons may be singled out for future consideration as discussed below. Tables and diagrams are taken from Colman-Sadd and Swinden (in press).

Several attempts have been recently made to classify granitoid rocks with respect to their economic potential (Tauson and Kozlov, 1972); Tischendorf, 1977; Strong, 1980). The following plutons correspond with Strong's (1980) Suite 3 leucogranites, which are usually associated with economic mineralization e.g. uranium, tin, tungsten and beryllium: Northwest Cove (3), Northwest Brook (5), Dolland Bight (6), Through Hill (14), and some parts of the North Bay granite. These are high silica (> 75%) muscovite-bearing plutons, and are therefore the most likely candidates for rare element concentration. The Partridgeberry Hills pluton is a large (250 km^2) high level intrusive, which has suffered extensive hydrothermal alteration, (chlorite-sericite) a favourable indication of potential for uranium and porphyry type mineralization (c.f. Henley and McNabb, 1978; Strong, 1980). It should be noted that the chlorite-sericite alteration assemblage so common in the Partridgeberry Hills pluton usually occurs in a zone removed from the main ore-bearing areas in a porphyry copper deposit (Henley and McNabb, 1978). Therefore closer examination of the Partridgeberry Hills pluton to better identify various zones of alteration (e.g. phyllic, argillic, potassic) might help in isolating possible economic mineralization.

[redacted] Tauson-Kozlov Criteria

Tauson and Kozlov (1972) identified five main types of granitoid rocks. They noted that "palingenic" granites, formed by complete remelting of metamorphic rocks, may differentiate to form "plumasitic" granites, often associated with tin mineralization. Table 7.1 compares the Bay D'Espoir granitoids with Tauson-Kozlov parameters. The Bay D'Espoir granitoids do not fit closely with either "palingenic" or plumasitic" granitoids, but the following affinities may be noted. The Piccaire, Gaultois, Indian Point, North Bay (biotite) and Partridgeberry Hills (low silica) plutons partly resemble "palingenic" granites, whereas the Northwest Cove, Northwest Brook and Dolland Bight have "plumasitic" affinities. F, Rb, and Zr are anomalously low in these plutons. The tungsten-bearing Grey River leucogranite which outcrops just west of Bay D'Espoir and the

TABLE 7-1

COMPARISON OF THE AVERAGE COMPOSITION OF SOUTH-CENTRAL NEWFOUNDLAND GRANITOIDS WITH PALINGENIC AND PLUMASITIC GRANITES, AFTER TAUSON AND KOZLOV, (1972)

Name	% K	% Na	F	Li	Rb	Be	Sr	Ba	Zn	Pb	Zr	Nb	K/Na	K/Rb	Ba/Rb	Li/K	F/Li	Li/Zn
Palingenic Granites Tauson & Koslov (1972)	3.3	2.9	600	36	140	3.5	300	750	45	25	200	20	1.1	240	5.3	1.1	16	.8
Plumasitic leucogranite, Tauson & Koslov, (1972)	4.0	2.8	3000	97	400	6.8	100	200	57	30	260	22.6	1.4	100	.05	2.4	31	1.7
Indian Point (Straddling)	3.33	2.78	514	50	167	6	251	644	49	23	136	12.8	1.17	202	3.45	1.49	10.66	.99
Through Hill	3.77	3.02	137	15	128	3.3	63	141	1.09	43	30	9.3	1.25	295	1.10	.40	9.13	13.76
Northwest Brook	3.77	2.66	596	100	237	7	146	451	52	28	119	13.5	1.57	169	224	2.81	6.45	2.02
Northwest Cove	4.00	2.71	691	121	281	8	101	354	52	28	116	15	1.51	165	1.71	3.38	7.08	2.2
Partridgeberry Hills (low silica phase)	3.37	2.92	555	31	154	3	118	589	42	24	209	18	1.59	221	3.95	1.04	19.18	.87
Partridgeberry Hills (high silica phase)	3.64	2.55	409	22	208	3	41	163	17	22	79	14	1.51	188	1.37	1.45	19.70	2.66
North Bay (1 mica)(biotite)	3.25	2.82	523	54	142	4	336	742	50	21	174	9.27	1.15	224	5.08	1.71	10.78	1.04
North Bay (2 mica)	3.39	3.26	327	38	159	5	224	517	33	27	109	9.3	1.04	207	3.52	1.33	8.74	1.15
Dolland Bight	3.77	3.03	286	48	190	6	34	176	36	41	48	14.5	1.27	205	1.01	1.31	6.72	1.34
Matthews Pond	2.08	2.65	322	45	90	3.2	286	438	51	16	121	8.6	.78	231	4.86	2.16	7.16	.88
Missing Island	3.07	2.43	521	50	149	3.7	223	560	55	27	143	11	1.26	206	3.76	1.63	10.42	.91
Middle Ridge	3.9	3.1	640	-	375	-	200	250	51	-	128	-	1.26	104	.67	-	-	-
Gaultois	3.09	2.39	1021	96	162	3.8	256	778	71	21	224	14	1.30	193	4.80	3.07	10.6	1.34
Piccaire	2.93	3.16	622	63	158	5.3	434	657	54	22	160	9.6	.92	183	4.16	2.17	9.87	1.16
Grey River leucogranite	4.08	2.79	-	.3	170	N.D.	161	350	21	56	69	12	1.46	241	2.06	.07	-	.01

Trace elements in ppm.

Through Hill granite show no obvious affinity to either "palingenic" or "plumasitic" granites.

7.3 Tischendorf Criteria

Tischendorf (1977) listed a number of criteria by which "metallogenetically specialized" granites and their "precursor" may be identified. He noted that "metallogenetically specialized" granitoids are characterized by higher SiO_2 and K_2O, and lower TiO_2, Fe_2O_3, MgO and CaO relative to normal granites. They are also enriched in F, Rb, Li, Sn, Be, W, Mo, B, Nb, Ta, Cs, U, Th and rare earth elements; Ni, Cr, Co, V, Sr, and Ba are depleted. Selected oxides and trace elements are listed in Table 7.2, comparing the Bay D'Espoir granitoids with Tischendorf's "specialized" and "precursor" granites.

Using Tischendorf's criteria, the Northwest Cove, Northwest Brook, Dolland Bight, Through Hill and more differentiated parts of the Partridgeberry Hills and North Bay plutons are favourable candidates for mineralization, especially from their major element profiles. Outstanding among them is the Northwest Cove granite. By the same criteria, the Piccaire, Gaultois and Matthews Pond plutons are distinctly unfavourable. This classification conforms approximately with Suite 3 (mineralized) and Suite 2 (barren) of Strong (1980).

[redacted]ler-Raatz Indices

Kohler-Raatz indices (Sattran and Klominsky, 1970; Hesp and Rigby, 1974) are a measure of how differentiated a granitoid composition is in terms of quartz, alkali-feldspar and ferromagnesian minerals. The plots in Fig. 7.1

Table 7-2 Comparison of south-central Newfoundland granitoids with "specialized" and "precursor" Granites of Tischendorff (1977) (Oxides in %; traces in ppm)

Name	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	TiO_2	MnO	F	Rb	Li	Be	Mo
"Specialized" Granite	71.99–74.77	12.90–15.04	0.33–1.27	0.63–1.57	0–1.03	0.34–1.16	2.59–3.81	4.01–5.37	0.06 0.26	0.01–0.09	2200–5200	380–780	200–600	7–19	1.5–5.5
"Precursors"	71.52–73.88	13.55–14.61	0.31–0.65	0.88–1.82	0.09–0.81	0.7–1.38	2.72–3.72	4.39–5.29	0.13–0.35	0–0.31	610–1010	200–300	80–180	5.5–9.5	1.7
Straddling	71.8	14.55	0.73	1.27	0.83	1.55	3.76	4.01	0.28	0.05	514	167	50	5.9	3.1
Through Hill	74.9	14.75	0.01	0.51	0.12	0.60	4.09	4.55	0.04	0.1	137	128	15	3.3	2.2
Northwest Brook	72.6	14.75	0.39	1.3	0.63	1.36	3.59	4.54	0.26	0.05	575	232	98	69	3.1
Northwest Cove	73.1	14.21	0.34	1.2	0.52	0.99	3.67	4.82	0.21	0.05	691	281	121	7.8	3.8
Partridgeberry Hills (low silica phase)	69.5	14.59	0.54	3.10	1.43	1.4	2.92	4.06	0.65	0.06	555	154	34	3.2	2.7
Partridgeberry Hills (high silica phase)	75.0	13.71	0.23	1.21	0.5	0.47	3.45	4.38	0.19	0.03	409	208	22	2.6	2.6
North Bay (bio)	69.07	15.29	0.31	2.19	1.08	2.22	3.81	3.91	0.41		523	142	54	4.1	3.3
North Bay 2 mica)	72.98	14.99	0.11	1.05	0.41	1.25	4.41	4.09	0.18		327	159	38	5.4	2.93
Dolland Bight	74.4	14.33	0.14	0.77	0.33	0.78	4.09	4.54	0.11	0.05	286	190	48	5.7	2.1
Matthews Pond	68.5	16.19	0.41	1.95	1.31	3.42	3.58	2.5	0.39	0.06	322	90	45	3.2	3.8
Missing Island	66.1	15.75	0.52	3.12	2.16	3.69	3.29	3.7	0.64	0.08	521	149	50	4.7	3.0
Middle Ridge	72.04	14.43	–	–	0.65	0.64	4.24	4.08	0.16	0.07	612	350	–	–	–
Gaultois	63.0	16.37	1.10	4.05	2.71	3.54	3.24	3.77	0.90	0.11	1021	162	96	4.8	4.4
Piccaire	69.5	16.51	0.51	1.72	0.99	2.44	4.25	3.50	0.43	0.04	622	158	66	5.3	4.4
Grey River leucogranites	74.71	14.13	0.66	–	0.19	1.01	3.77	4.91	0.05	0.02	64*	170	0.3	–	–

* F detected only in 4 of 21 samples

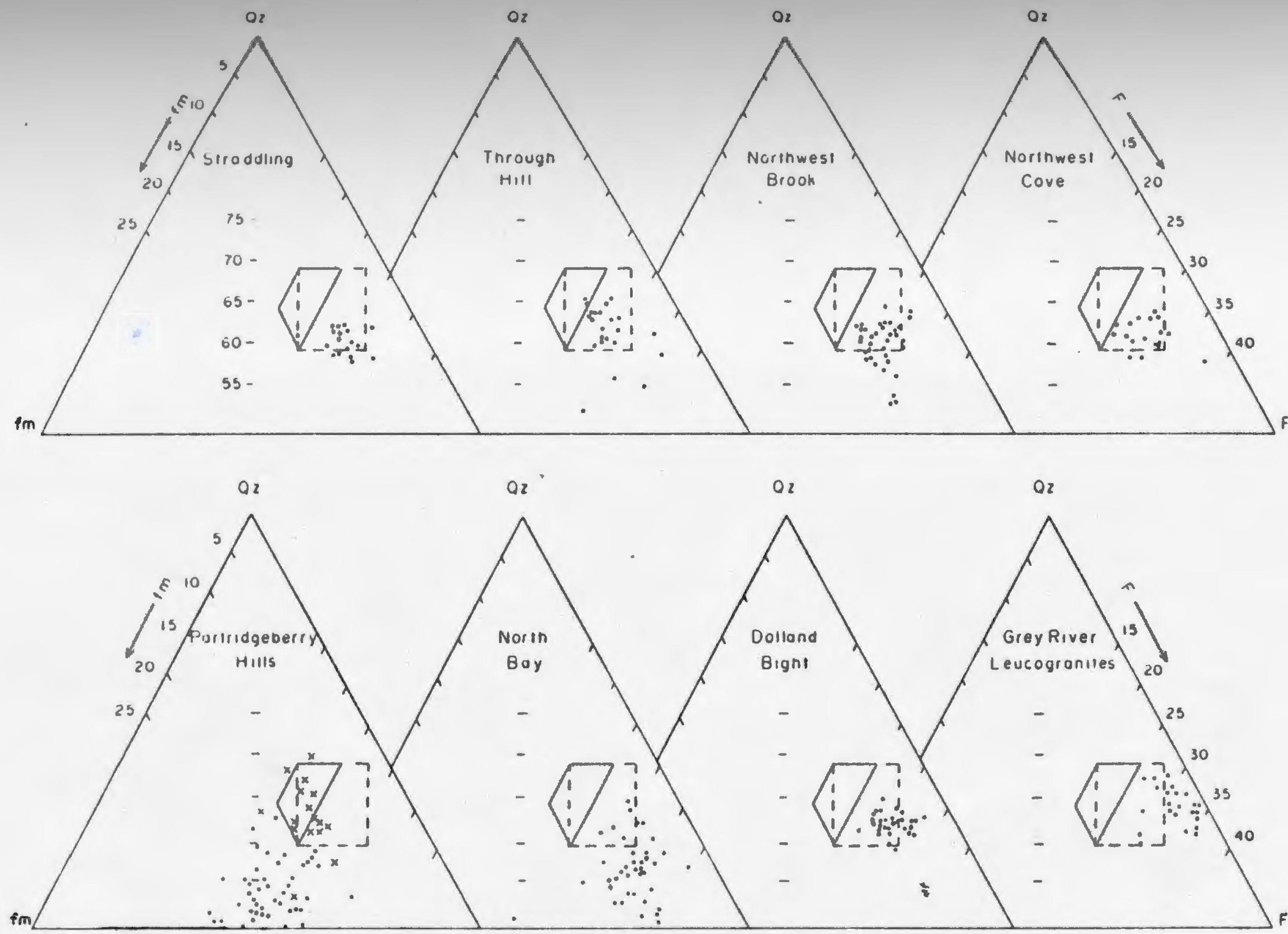


Fig ·7·1. Kohler-Raatz indices for selected South-Central Newfoundland granitoids. Dashed square indicates the field of favourable tin granites of the Bohemian Massif after Sattran and Klominsky (1970). Solid trapezoid outlines the favourable field for tin granites of Eastern Australia after Hesp and Rigby (1977). Qz=silicon in quartz; F=sodium and potassium in feldspar. fm=femic cations in ferromagnesian minerals.

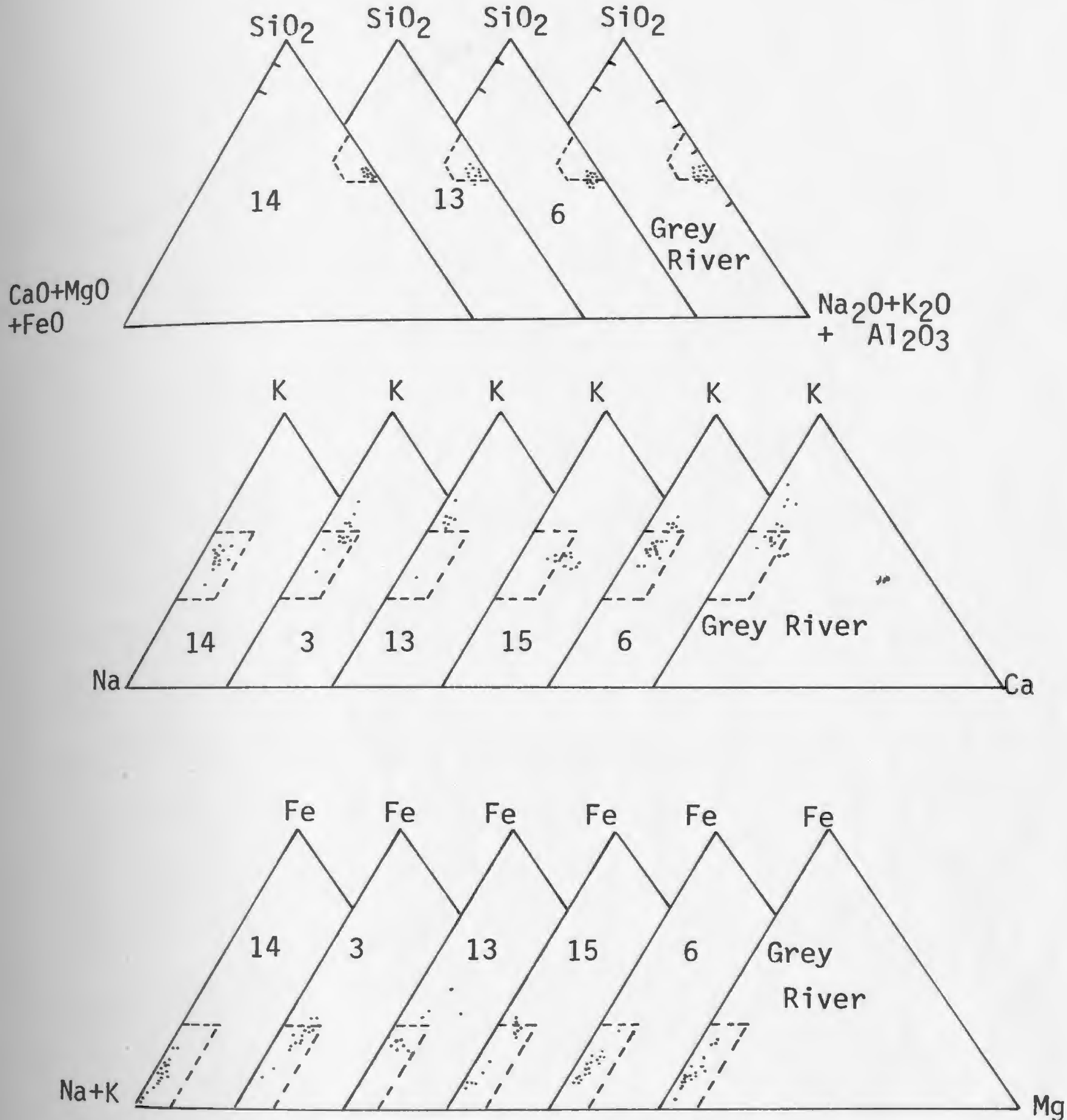


Fig.7.2. Comparison of major element geochemistry of selected South-Central Newfoundland granitoids with those of Eastern Australia. Dashed lines indicate favourable fields for tin-bearing granites outlined by Juniper and Kleeman(1979).Numbers used to denote plutons as in Chapter 6.

show fields for granitoids with tin bearing potential, as described by Sattran and Klominsky (1970) and Hesp and Rigby, (1974). The leucogranites and the more differentiated members of the Partridgeberry Hills and North Bay plutons plot mostly in the favourable domain, consistent with suggestions from Tauson-Kozlov and Tischendorf criteria. The Indian Point biotite granite and Grey River leucogranite are inconsistent in that they plot mostly in and out of the fields respectively. Most samples from the North Bay and Partridgeberry Hills (biotite) granites plot outside of the field, consistent with the findings above.

7.5 Known Mineral Occurrences

(a) North Bay Pluton

Most of the known mineralization in the area is associated with the more differentiated parts of the North Bay granite. Molybdenite occurs in pegmatites at the margin of the pluton in Lampidoes Passage. The two mica phase of the granite lying south of Salmon River Dam is associated with zoned Cu-Mo-Pb-Zn-Ba-Sb (Colman-Sadd and Swinden, in press). Mo-W-F mineralization has been recently reported from the northwestern margin of the North Bay (Facheau Bay) batholith (Dickson and McLellan, 1981).

(b) Other Occurrences

Little mineralization has been so far reported for the other plutons in the study area. Small occurrences of beryl are associated with the Northwest Brook and Northwest Cove plutons, and one occurrence of fluorite has been reported from the Northwest Brook granite (Elias 1980). Small zones of intense tourmalinization have been noted in the Northwest Brook, Dolland Bight and Through Hill plutons. A felsite dike with pyrite, galena, sphalerite and gold intrudes the Partridgeberry Hills pluton near its southwestern margin(Colman-Sadd,1980a).

[illegible].6 Summary

No substantial quantities of economic minerals have yet been found in the study area. The leucogranites and more differentiated facies of the Partridgeberry Hills and North Bay plutons are favourable targets for future exploration.

CHAPTER 8

SUMMARY

The Bay D'Espoir area in South-Central Newfoundland occupies a cross section through the Gander Zone. The area is underlain by two contrasting terranes: (1) Medium-low grade sedimentary and volcanic rocks of the Bay D'Espoir Group. (2) High grade gneisses and migmatites of the Little Passage Gneisses. These rocks are correlatives of metasediments, metavolcanics, gneisses, and migmatites in northeastern Newfoundland.

Two pulses of granitoid plutonism have been recorded in the area: (1) The Northern Granitoids were intruded post-tectonically into the Bay D'Espoir Group at ca.430 Ma. (2) The Southern Granitoids were intruded syntectonically into the Little Passage Gneisses at ca.350 Ma. The granitoids do not show any systematic variation in petrography, geochemistry, or strontium isotope initial ratio from north to south across the Gander Zone, or Gander-Botwood Zones. The granitoids are of calc-alkaline affinity and are considered to be products of crustal melting, with heat input from mafic-ultramafic magma. The "Straddling Granite", formerly considered to lie astride the Gander-Avalon Zone boundary, consists of at least two separate plutons on either side of the boundary. The pluton on the Gander Zone side has been informally named "Indian Point Granite", while the counterparts on the Avalon Zone side have been informally named "Hardy's Cove Complex".

Although up to the present, only small uneconomical mineral showings have been discovered, leucogranites with ore-bearing potential occur in sufficient quantity to warrant further investigation.

Structural, stratigraphic, geochemical and isotopic evidence suggests that the granitoids were intruded into a back-arc basin during the Acadian Orogeny.

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APPENDIX 1

ANALYTICAL PROCEDURES

1.1 Field Methods

The granites were mapped on a scale of 1:50 000 (Colman-Sadd 1976, 1977, 1978, 1979, 1980). More detailed field work was carried out by the author during the field seasons of 1978 and 1979.

Fourteen granitoid bodies were sampled during the 1978 and 1979 field seasons. Where outcrop distribution was sparse samples were obtained at convenient locations. In areas of adequate exposure, sample locations were determined by a grid method (Garrett and Goss, manuscript; Elias 1979; Elias, 1980). Outcrop duplicates were collected at some locations.

Samples of 5-10 kg were obtained by means of an eight-pound sledge hammer. Instead of a single large block, several small fresh chips were collected from a given location, and secured in polythene bags.

1.2 Laboratory Methods

1.2.1 Thin Sections

A representative piece was selected from each sample bag for thin sectioning. Sections were stained with sodium cobaltinitrite for potash feldspar, as described by Hutchinson (1974). Those sections with sufficiently fine grain size were point counted after the method of Chayes (1949). A minimum of 750 points were counted from each 4.5x2.5 cm thin section.

1.2.2 Crushing

A representative sample of fresh rock was first broken into 3-4 cm chips with a sledge hammer. After further crushing in a steel jaw crusher, the sample was pulverized to -100 mesh in a tungsten carbide vibrating mill. Analytical splits were made from outcrop duplicates.

[redacted] Chemical Analyses

Major elements were analysed by standard Atomic Absorption. Most trace elements were analysed by X-ray Fluorescence on baked pellets made by the following procedure:

> 10.0g rock powder was thoroughly mixed with 1.3-1.4g Phenolic Resin binder. The mixture was pressed into a pellet and baked at 200°C for about 8 minutes.
>
> Some uranium samples were analysed by neutron activation at the GSC,Ottawa. Fluorine analyses were done by the Ion Electrode method.*

Analytical splits from outcrop duplicates and Geochemical Reference Standards (G-2, GSP-1, STM-1, RGM-1 and SDC-1) were used to monitor precision and accuracy respectively. Further details can be obtained from the author, or Department of Mines and Energy,Government of Newfoundland and Labrador.

Details of Chemical and modal analyses are given below. Note that only the Partridgeberry Hills and Through Hill plutons,and the Hardy's Cove Complex have been analysed for Ce,Th,La,U and Y by X-Ray fluorescence.

* For a full description of this method see Ficklin,W.H., (1970). A rapid method for determination of fluoride in rocks and soils using an ion-selective electrode. U.S.G.S. Prof. Paper 700C,p.c186-c188.

PICCAIRE GRANITE

SAMPLE	170004	170005	170006	170007	170008
PERCENT					
SIO2	66.60	64.90	65.50	70.80	66.40
AL203	18.60	19.10	17.00	16.70	18.40
FE203	0.79	0.72	0.60	0.08	0.35
FEO	2.40	2.60	2.70	1.97	2.04
MGO	1.47	1.51	1.52	1.00	1.24
CAO	3.47	3.35	3.43	1.87	3.37
NA20	4.45	4.79	4.54	4.00	4.30
K20	2.68	2.60	2.69	3.74	2.88
TIO2	0.58	0.67	0.56	0.43	0.57
MNO	0.04	0.07	0.06	0.04	0.02
P205	0.11	0.09	0.10	0.05	0.07
LOI	0.82	0.95	0.94	0.92	0.77
TOTAL	102.01	101.35	99.64	101.60	100.41
PPM					
*U	2.3	2.9	2.2	2.3	1.6
**U2	0.0	0.0	0.0	0.0	0.0
LI	79.0	104.0	101.0	90.0	68.0
BE	4.0	6.0	5.0	5.0	5.0
ZR	228.0	235.0	234.0	158.0	213.0
SR	601.0	552.0	570.0	449.0	582.0
RB	152.0	164.0	161.0	185.0	135.0
ZN	71.0	80.0	83.0	55.0	66.0
CU	56.0	56.0	54.0	28.0	63.0
BA	683.0	563.0	560.0	751.0	757.0
TH	0.0	0.0	0.0	0.0	0.0
MO	6.0	6.0	8.0	8.0	8.0
NB	8.0	10.0	11.0	8.0	6.0
GA	24.0	25.0	28.0	21.0	24.0
PB	15.0	17.0	25.0	12.0	20.0
NI	6.0	9.0	14.0	6.0	7.0
LA	0.0	0.0	0.0	0.0	0.0
CR	20.0	11.0	9.0	10.0	8.0
V	72.0	80.0	79.0	45.0	64.0
Y	0.0	0.0	0.0	0.0	0.0
F	938.0	1057.0	1113.0	861.0	696.0
CE	0.0	0.0	0.0	0.0	0.0

* Determined by neutron activation

** Determined by X-Ray Fluorescence.

PICCAIRE GRANITE

SAMPLE	170009	170011	170012	170013	170014
PERCENT					
SIO2	67.80	70.70	69.70	71.50	70.90
AL2O3	16.30	17.40	16.30	16.80	17.40
FE2O3	0.70	0.49	0.37	0.38	0.46
FEO	1.93	1.39	1.60	1.30	1.50
MGO	1.28	0.80	0.83	0.72	0.82
CAO	1.62	2.99	2.15	1.91	2.28
NA2O	3.25	4.48	3.96	3.96	3.90
K2O	5.34	1.63	3.40	3.62	3.55
TIO2	0.45	0.36	0.46	0.27	0.35
MNO	0.04	0.04	0.04	0.03	0.02
P2O5	0.08	0.01	0.03	0.01	0.01
LOI	1.06	0.95	0.90	0.73	0.75
TOTAL	99.85	101.24	99.74	101.23	101.94
PPM					
U	4.8	2.8	1.9	3.3	2.7
U2	0.0	0.0	0.0	0.0	0.0
LI	72.0	50.0	54.0	63.0	55.0
BE	4.0	6.0	6.0	4.0	3.0
ZR	162.0	151.0	162.0	140.0	163.0
SR	353.0	530.0	486.0	352.0	429.0
RB	189.0	80.0	139.0	159.0	147.0
ZN	70.0	50.0	56.0	52.0	57.0
CU	23.0	24.0	25.0	36.0	50.0
BA	787.0	258.0	887.0	567.0	866.0
TH	0.0	0.0	0.0	0.0	0.0
MO	6.0	4.0	4.0	6.0	6.0
NB	13.0	9.0	9.0	8.0	5.0
GA	22.0	23.0	22.0	21.0	26.0
PB	21.0	11.0	21.0	22.0	32.0
NI	11.0	1.0	5.0	4.0	6.0
LA	0.0	0.0	0.0	0.0	0.0
CR	18.0	1.0	6.0	4.0	8.0
V	54.0	37.0	38.0	33.0	44.0
Y	0.0	0.0	0.0	0.0	0.0
F	785.0	581.0	594.0	632.0	492.0
CE	0.0	0.0	0.0	0.0	0.0

PICCAIRE GRANITE

SAMPLE	170015	170167	170168	170169	170171
PERCENT					
SIO2	71.70	69.10	72.70	71.80	67.50
AL2O3	16.60	15.40	15.00	14.90	16.50
FE2O3	0.46	0.59	0.58	0.44	0.55
FEO	1.30	1.71	0.99	1.14	2.04
MGO	0.72	1.00	0.65	0.70	1.16
CAO	1.99	2.43	2.01	2.06	2.99
NA2O	3.85	4.56	4.65	4.59	4.81
K2O	3.83	3.41	3.73	3.78	2.68
TIO2	0.35	0.44	0.30	0.31	0.47
MNO	0.02	0.05	0.05	0.05	0.04
P2O5	0.02	0.13	0.07	0.09	0.13
LOI	0.63	0.99	0.91	1.03	1.25
TOTAL	101.47	99.81	101.64	100.89	100.12

PPM					
U	3.9	3.4	8.6	6.3	3.5
U2	0.0	0.0	0.0	0.0	0.0
LI	50.0	63.0	49.0	51.0	74.0
BE	5.0	4.0	8.0	9.0	7.0
ZR	142.0	172.0	129.0	129.0	195.0
SR	360.0	493.0	407.0	418.0	552.0
RB	174.0	130.0	156.0	153.0	147.0
ZN	56.0	61.0	48.0	50.0	65.0
CU	43.0	76.0	32.0	38.0	59.0
BA	818.0	921.0	621.0	588.0	672.0
TH	0.0	0.0	0.0	0.0	0.0
MO	4.0	4.0	2.0	1.0	4.0
NB	9.0	7.0	11.0	10.0	9.0
GA	22.0	23.0	22.0	24.0	26.0
PB	25.0	23.0	18.0	21.0	15.0
NI	3.0	4.0	9.0	7.0	10.0
LA	0.0	0.0	0.0	0.0	0.0
CR	12.0	10.0	10.0	3.0	9.0
V	39.0	48.0	34.0	28.0	61.0
Y	0.0	0.0	0.0	0.0	0.0
F	530.0	708.0	454.0	403.0	696.0
CE	0.0	0.0	0.0	0.0	0.0

PICCAIRE GRANITE

SAMPLE	170172	170175	170176	170395	170396
PERCENT					
SIO2	71.30	70.50	71.80	73.30	71.90
AL203	14.90	14.70	15.20	14.70	15.35
FE203	0.47	0.48	0.67	0.29	0.13
FEO	1.26	1.82	1.31	0.95	0.95
MGO	0.71	0.82	0.79	0.49	0.40
CAO	2.14	1.72	2.15	1.48	1.47
NA2O	4.45	3.54	4.46	4.09	4.56
K2O	3.65	5.94	3.84	4.10	3.56
TIO2	0.33	0.46	0.38	0.26	0.26
MNO	0.05	0.05	0.04	0.04	0.04
P2O5	0.03	0.11	0.07	0.06	0.04
LOI	0.95	0.77	0.88	1.21	1.27
TOTAL	100.24	100.91	101.59	100.97	99.93
PPM					
U	3.2	3.7	2.9	11.5	3.1
U2	0.0	0.0	0.0	0.0	0.0
LI	49.0	65.0	58.0	47.0	37.0
BE	4.0	3.0	4.0	5.0	7.0
ZR	134.0	216.0	139.0	93.0	85.0
SR	403.0	155.0	399.0	290.0	369.0
RB	125.0	239.0	140.0	212.0	170.0
ZN	48.0	50.0	42.0	28.0	25.0
CU	70.0	20.0	30.0	15.0	12.0
BA	662.0	658.0	603.0	466.0	546.0
TH	0.0	0.0	0.0	13.0	7.0
MO	2.0	1.0	4.0	2.0	3.0
NB	8.0	13.0	9.0	15.0	12.0
GA	20.0	19.0	24.0	17.0	19.0
PB	26.0	38.0	25.0	30.0	26.0
NI	4.0	8.0	3.0	9.0	8.0
LA	0.0	0.0	0.0	22.0	14.0
CR	4.0	6.0	12.0	1.0	1.0
V	35.0	44.0	39.0	21.0	20.0
Y	0.0	0.0	0.0	16.0	12.0
F	379.0	746.0	555.0	296.0	272.0
CE	0.0	0.0	0.0	48.0	47.0

PICCAIRE GRANITE

SAMPLE	170397
PERCENT	
SIO2	72.20
AL203	15.20
FE203	0.22
FEO	0.88
MGO	0.40
CAO	1.46
NA2O	4.56
K2O	3.54
TIO2	0.26
MNO	0.04
P205	0.01
LOI	1.15
TOTAL	99.92
PPM	
U	3.3
U2	0.0
LI	36.0
BE	7.0
ZR	83.0
SR	372.0
RB	171.0
ZN	25.0
CU	12.0
BA	564.0
TH	9.0
MO	3.0
NB	12.0
GA	18.0
PB	27.0
NI	8.0
LA	14.0
CR	1.0
V	19.0
Y	13.0
F	270.0
CE	44.0

GAULTOIS GRANITE

SAMPLE	170002	170003	170016	170019	170020
PERCENT					
SIO2	51.60	62.80	61.60	62.10	58.60
AL2O3	19.80	17.80	18.10	17.80	16.50
FE2O3	2.41	0.39	1.60	1.06	1.19
FEO	7.82	3.67	3.87	5.20	5.92
MGO	5.10	2.84	2.90	2.37	5.16
CAO	5.93	3.38	3.73	4.00	4.50
NA2O	2.47	2.67	2.80	2.82	2.73
K2O	3.09	4.83	4.08	3.11	3.13
TIO2	1.64	0.97	1.03	1.13	1.11
MNO	0.18	0.11	0.09	0.13	0.17
P2O5	0.28	0.13	0.12	0.14	0.29
LOI	1.26	1.36	1.78	1.48	1.80
TOTAL	101.58	100.95	101.70	101.84	101.10
PPM					
U	1.6	2.2	2.5	1.5	3.1
U2	0.0	0.0	0.0	0.0	0.0
LI	193.0	96.0	70.0	188.0	256.0
BE	3.0	4.0	3.0	3.0	8.0
ZR	184.0	243.0	264.0	257.0	152.0
SR	390.0	383.0	323.0	321.0	256.0
RB	150.0	221.0	163.0	141.0	229.0
ZN	119.0	67.0	73.0	83.0	104.0
CU	67.0	39.0	38.0	42.0	38.0
BA	1232.0	1382.0	1024.0	801.0	431.0
TH	0.0	0.0	0.0	0.0	0.0
MO	8.0	8.0	10.0	4.0	2.0
NB	11.0	14.0	13.0	13.0	16.0
GA	23.0	21.0	22.0	26.0	24.0
PB	22.0	24.0	20.0	15.0	9.0
NI	33.0	29.0	31.0	23.0	57.0
LA	0.0	0.0	0.0	0.0	0.0
CR	88.0	50.0	49.0	39.0	126.0
V	266.0	120.0	142.0	151.0	180.0
Y	0.0	0.0	0.0	0.0	0.0
F	2004.0	1312.0	1005.0	971.0	1738.0
CE	0.0	0.0	0.0	0.0	0.0

GAULTOIS GRANITE

SAMPLE	170021	170022	170023	170026	170031
PERCENT					
SIO2	61.10	55.50	45.50	69.00	61.60
AL2O3	17.90	19.90	17.20	16.10	18.30
FE2O3	1.00	1.74	3.16	0.71	1.26
FEO	4.87	5.47	9.17	2.73	4.24
MGO	2.64	3.41	8.47	1.52	2.89
CAO	3.84	5.29	8.95	3.32	4.18
NA2O	3.12	3.23	1.39	3.49	3.10
K2O	3.03	3.22	2.31	2.16	3.88
TIO2	1.21	1.43	1.96	0.67	1.05
MNO	0.12	0.15	0.81	0.06	0.11
P2O5	0.14	0.19	0.47	0.02	0.13
LOI	1.22	1.32	1.58	0.55	0.81
TOTAL	100.19	100.85	100.97	100.33	101.55
PPM					
U	1.9	1.9	1.6	2.2	3.2
U2	0.0	0.0	0.0	0.0	0.0
LI	225.0	250.0	91.0	129.0	216.0
BE	4.0	3.0	2.0	4.0	4.0
ZR	318.0	355.0	125.0	214.0	271.0
SR	283.0	374.0	414.0	263.0	292.0
RB	157.0	164.0	136.0	106.0	163.0
ZN	83.0	100.0	126.0	54.0	76.0
CU	42.0	47.0	56.0	46.0	35.0
BA	1063.0	1143.0	1015.0	533.0	1137.0
TH	0.0	0.0	0.0	0.0	0.0
MO	2.0	8.0	4.0	6.0	1.0
NB	13.0	15.0	8.0	11.0	12.0
GA	29.0	29.0	25.0	24.0	27.0
PB	19.0	14.0	1.0	14.0	13.0
NI	23.0	24.0	52.0	13.0	30.0
LA	0.0	0.0	0.0	0.0	0.0
CR	40.0	37.0	138.0	27.0	48.0
V	147.0	164.0	378.0	86.0	123.0
Y	0.0	0.0	0.0	0.0	0.0
F	1738.0	1908.0	1937.0	1057.0	1028.0
CE	0.0	0.0	0.0	0.0	0.0

GAULTOIS GRANITE

SAMPLE	170035	170036	170037	170038	170039
PERCENT					
SIO2	62.60	60.80	60.00	65.10	62.90
AL2O3	17.80	18.90	19.00	16.60	17.30
FE2O3	0.66	1.47	1.36	1.81	1.30
FEO	4.44	4.42	4.55	5.07	4.15
MGO	2.21	2.59	2.64	3.19	2.60
CAO	3.43	4.32	4.28	1.91	3.85
NA2O	3.23	3.48	3.36	2.50	3.09
K2O	2.97	3.37	3.42	2.61	4.03
TIO2	1.00	1.04	1.06	1.01	1.17
MNO	0.10	0.11	0.10	0.12	0.09
P2O5	0.11	0.22	0.22	0.01	0.17
LOI	0.92	0.87	1.10	1.82	0.96
TOTAL	99.47	101.59	101.09	101.75	101.61
PPM					
U	3.0	1.5	1.7	1.6	3.2
U2	0.0	0.0	0.0	0.0	0.0
LI	88.0	42.0	40.0	64.0	48.0
BE	2.0	4.0	4.0	2.0	5.0
ZR	234.0	267.0	286.0	232.0	255.0
SR	240.0	297.0	297.0	206.0	256.0
RB	156.0	139.0	140.0	112.0	162.0
ZN	89.0	80.0	85.0	94.0	76.0
CU	27.0	37.0	33.0	46.0	36.0
BA	623.0	1330.0	1477.0	406.0	918.0
TH	0.0	0.0	0.0	0.0	0.0
MO	8.0	4.0	6.0	1.0	2.0
NB	17.0	14.0	15.0	15.0	14.0
GA	25.0	28.0	29.0	24.0	27.0
PB	18.0	21.0	16.0	16.0	20.0
NI	16.0	20.0	17.0	44.0	28.0
LA	0.0	0.0	0.0	0.0	0.0
CR	27.0	30.0	34.0	81.0	45.0
V	123.0	141.0	142.0	176.0	124.0
Y	0.0	0.0	0.0	0.0	0.0
F	971.0	1170.0	1511.0	811.0	1005.0
CE	0.0	0.0	0.0	0.0	0.0

GAULTUIS GRANITE

SAMPLE	170040	170046	170048	170049	170051
PERCENT					
SIO2	73.70	59.50	61.20	59.70	60.40
AL2O3	14.50	17.20	16.60	16.70	16.50
FE2O3	0.06	1.72	1.74	1.79	1.67
FEO	0.87	4.70	4.14	3.89	3.50
MGO	0.31	3.96	3.65	3.31	2.96
CAO	0.59	4.42	4.14	3.80	4.26
NA2O	3.49	2.92	2.98	3.09	3.14
K2O	4.95	3.79	3.94	3.58	4.01
TIO2	0.08	1.07	0.99	1.10	0.97
MNO	0.05	0.12	0.10	0.10	0.10
P2O5	0.04	0.13	0.09	0.11	0.10
LOI	0.96	1.08	0.95	2.37	1.06
TOTAL	99.60	100.61	100.52	99.54	98.67
PPM					
U	4.9	2.1	2.3	2.6	2.0
U2	0.0	0.0	0.0	0.0	0.0
LI	110.0	251.0	24.0	30.0	39.0
BE	4.0	4.0	5.0	3.0	3.0
ZR	42.0	258.0	241.0	274.0	247.0
SR	22.0	289.0	259.0	302.0	315.0
RB	248.0	171.0	174.0	146.0	153.0
ZN	44.0	77.0	79.0	77.0	72.0
CU	17.0	45.0	44.0	38.0	37.0
BA	149.0	963.0	895.0	1008.0	1038.0
TH	0.0	0.0	0.0	0.0	0.0
MO	4.0	6.0	6.0	2.0	8.0
NB	20.0	15.0	14.0	14.0	10.0
GA	24.0	21.0	25.0	27.0	29.0
PB	43.0	9.0	23.0	20.0	20.0
NI	5.0	43.0	47.0	33.0	29.0
LA	0.0	0.0	0.0	0.0	0.0
CR	1.0	69.0	71.0	59.0	44.0
V	5.0	159.0	134.0	144.0	127.0
Y	0.0	0.0	0.0	0.0	0.0
F	543.0	1312.0	1028.0	887.0	971.0
CE	0.0	0.0	0.0	0.0	0.0

GAULTOIS GRANITE

SAMPLE	170052	170053	170063	170064	170065
PERCENT					
SIO2	59.40	57.60	61.20	62.10	59.30
AL2O3	16.70	17.80	15.80	16.70	18.00
FE2O3	1.73	1.69	1.27	0.43	1.00
FEO	4.28	4.99	4.77	4.30	5.82
MGO	3.42	3.70	3.85	2.35	3.05
CAO	4.49	4.62	4.06	3.36	4.20
NA2O	3.19	3.36	3.01	3.34	3.07
K2O	3.62	3.09	3.83	3.42	3.03
TIO2	1.11	1.21	1.08	0.87	1.06
MNO	0.10	0.12	0.12	0.12	0.13
P2O5	0.24	0.26	0.26	0.42	0.41
LOI	0.93	1.01	0.94	1.29	1.04
TOTAL	99.21	99.45	100.19	98.70	100.11
PPM					
U	4.5	1.8	2.1	2.9	2.4
U2	0.0	0.0	0.0	0.0	0.0
LI	106.0	56.0	28.0	39.0	94.0
BE	4.0	4.0	3.0	2.0	3.0
ZR	279.0	270.0	227.0	291.0	287.0
SR	295.0	364.0	238.0	229.0	251.0
RB	175.0	140.0	166.0	147.0	129.0
ZN	83.0	92.0	76.0	202.0	92.0
CU	43.0	43.0	38.0	27.0	40.0
BA	931.0	809.0	866.0	792.0	871.0
TH	0.0	0.0	0.0	0.0	0.0
MO	8.0	6.0	2.0	4.0	2.0
NB	10.0	9.0	13.0	15.0	14.0
GA	25.0	27.0	25.0	29.0	30.0
PB	17.0	6.0	14.0	29.0	21.0
NI	35.0	37.0	42.0	20.0	26.0
LA	0.0	0.0	0.0	0.0	0.0
CR	51.0	65.0	75.0	27.0	43.0
V	148.0	171.0	143.0	110.0	147.0
Y	0.0	0.0	0.0	0.0	0.0
F	1227.0	1085.0	1085.0	1312.0	1085.0
CE	0.0	0.0	0.0	0.0	0.0

GAULTOIS GRANITE

SAMPLE	170066	170067	170068	170069	170071
PERCENT					
SIO2	59.40	58.80	58.40	57.10	58.00
AL2O3	17.60	17.00	18.00	17.00	17.50
FE2O3	1.18	1.24	1.46	0.86	1.94
FEO	5.73	5.86	5.36	7.11	4.60
MGO	3.17	3.25	3.00	4.04	3.71
CAO	4.08	4.09	4.23	4.84	4.66
NA2O	3.05	2.98	3.65	2.83	3.06
K2O	3.14	3.22	3.42	2.88	4.01
TIO2	1.12	1.15	1.16	1.30	1.23
MNO	0.12	0.12	0.12	0.17	0.12
P2O5	0.35	0.46	0.41	0.30	0.29
LOI	0.73	1.00	1.06	1.01	1.05
TOTAL	99.67	99.17	100.27	99.44	100.17
PPM					
U	1.5	1.4	2.1	1.7	1.4
U2	0.0	0.0	0.0	0.0	0.0
LI	51.0	52.0	75.0	81.0	37.0
BE	3.0	3.0	4.0	2.0	2.0
ZR	307.0	319.0	329.0	307.0	303.0
SR	269.0	268.0	256.0	281.0	319.0
RB	125.0	131.0	163.0	134.0	154.0
ZN	90.0	95.0	96.0	101.0	87.0
CU	46.0	50.0	41.0	44.0	43.0
BA	818.0	816.0	805.0	580.0	1048.0
TH	0.0	0.0	0.0	0.0	0.0
MO	6.0	1.0	6.0	6.0	2.0
NB	14.0	15.0	19.0	14.0	15.0
GA	26.0	30.0	26.0	25.0	30.0
PB	21.0	26.0	10.0	16.0	11.0
NI	29.0	37.0	25.0	40.0	45.0
LA	0.0	0.0	0.0	0.0	0.0
CR	60.0	57.0	38.0	67.0	75.0
V	160.0	162.0	160.0	189.0	164.0
Y	0.0	0.0	0.0	0.0	0.0
F	971.0	971.0	1426.0	1142.0	1369.0
CE	0.0	0.0	0.0	0.0	0.0

GAULTOIS GRANITE

SAMPLE	170074	170075	170077	170078	170083
PERCENT					
SIO2	63.30	60.60	65.30	60.50	69.10
AL2O3	15.80	17.40	15.70	16.40	14.90
FE2O3	0.57	1.26	1.97	1.48	0.66
FEO	5.03	4.39	5.22	5.41	2.54
MGO	2.65	2.64	3.29	4.31	1.42
CAO	3.59	4.10	1.95	4.04	2.45
NA2O	2.92	3.42	2.66	2.94	3.16
K2O	3.38	3.38	3.07	3.10	4.58
TIO2	1.09	0.99	0.95	0.95	0.56
MNO	0.11	0.15	0.12	0.14	0.06
P2O5	0.23	0.21	0.05	0.29	0.09
LOI	0.89	1.65	1.35	1.59	0.77
TOTAL	99.56	100.19	101.63	101.15	100.29
PPM					
U	2.9	1.7	1.3	2.3	1.5
U2	0.0	0.0	0.0	0.0	0.0
LI	22.0	49.0	42.0	93.0	123.0
BE	4.0	3.0	2.0	4.0	3.0
ZR	242.0	298.0	217.0	225.0	192.0
SR	221.0	285.0	195.0	339.0	194.0
RB	144.0	143.0	112.0	161.0	198.0
ZN	81.0	76.0	93.0	87.0	54.0
CU	37.0	44.0	32.0	45.0	25.0
BA	871.0	1112.0	570.0	862.0	625.0
TH	0.0	0.0	0.0	0.0	0.0
MO	6.0	8.0	6.0	14.0	8.0
NB	15.0	10.0	14.0	16.0	11.0
GA	26.0	27.0	25.0	24.0	19.0
PB	23.0	10.0	9.0	13.0	26.0
NI	31.0	18.0	48.0	53.0	12.0
LA	0.0	0.0	0.0	0.0	0.0
CR	42.0	37.0	75.0	86.0	18.0
V	138.0	124.0	140.0	162.0	64.0
Y	0.0	0.0	0.0	0.0	0.0
F	1142.0	1113.0	619.0	971.0	1170.0
CE	0.0	0.0	0.0	0.0	0.0

GAULTOIS GRANITE

SAMPLE	170084	170085	170086	170087	170088
PERCENT					
SIO2	64.00	64.20	68.80	60.80	73.70
AL2O3	15.90	16.00	15.20	16.10	13.50
FE2O3	1.76	1.65	1.07	1.59	0.35
FEO	3.45	3.37	2.57	4.63	1.53
MGO	2.43	2.36	1.73	3.82	0.70
CAO	3.73	3.64	2.61	4.15	1.17
NA2O	3.09	3.14	2.87	2.96	2.62
K2O	4.48	4.41	5.26	3.69	5.69
TIO2	0.88	0.82	0.62	1.02	0.29
MNO	0.12	0.10	0.08	0.12	0.04
P2O5	0.19	0.20	0.14	0.26	0.01
LOI	1.37	1.48	1.14	1.53	0.94
TOTAL	101.40	101.37	102.09	100.67	100.54
PPM					
U	1.9	1.9	2.2	1.4	1.5
U2	0.0	0.0	0.0	0.0	0.0
LI	91.0	88.0	93.0	54.0	70.0
BE	3.0	2.0	4.0	4.0	2.0
ZR	271.0	256.0	195.0	250.0	142.0
SR	259.0	264.0	239.0	294.0	168.0
RB	132.0	129.0	186.0	159.0	163.0
ZN	67.0	67.0	54.0	74.0	32.0
CU	35.0	37.0	33.0	50.0	17.0
BA	1035.0	1109.0	824.0	982.0	485.0
TH	0.0	0.0	0.0	0.0	0.0
MO	4.0	4.0	4.0	16.0	6.0
NB	12.0	12.0	12.0	11.0	8.0
GA	21.0	25.0	21.0	23.0	15.0
PB	11.0	7.0	22.0	12.0	24.0
NI	23.0	22.0	20.0	52.0	5.0
LA	0.0	0.0	0.0	0.0	0.0
CR	32.0	28.0	22.0	82.0	8.0
V	107.0	108.0	74.0	145.0	34.0
Y	0.0	0.0	0.0	0.0	0.0
F	887.0	361.0	823.0	1028.0	341.0
CE	0.0	0.0	0.0	0.0	0.0

GAULTOIS GRANITE

SAMPLE	170093	170094	170095	170098	170099
PERCENT					
SIO2	62.30	70.90	68.00	60.60	62.20
AL2O3	15.90	15.20	14.50	16.60	15.90
FE2O3	0.98	0.46	0.63	0.34	1.67
FEO	4.12	1.34	2.67	4.12	3.75
MGO	2.67	0.72	1.69	2.94	2.73
CAO	3.43	1.67	2.40	3.99	3.62
NA2O	4.32	4.21	2.97	3.21	3.00
K2O	3.22	3.96	4.28	4.14	4.16
TIO2	0.88	0.27	0.48	1.03	0.88
MNO	0.11	0.07	0.11	0.13	0.12
P2O5	0.19	0.07	0.03	0.22	0.16
LOI	1.15	0.84	1.10	1.04	1.47
TOTAL	99.27	99.71	98.86	98.36	99.66
PPM					
U	1.4	5.1	1.9	3.5	2.8
U2	0.0	0.0	0.0	0.0	0.0
LI	79.0	107.0	78.0	53.0	84.0
BE	3.0	7.0	2.0	4.0	5.0
ZR	254.0	112.0	145.0	272.0	252.0
SR	247.0	304.0	178.0	268.0	330.0
RB	156.0	188.0	159.0	152.0	168.0
ZN	68.0	51.0	54.0	73.0	70.0
CU	42.0	35.0	19.0	39.0	36.0
BA	810.0	531.0	614.0	1017.0	950.0
TH	0.0	0.0	0.0	0.0	0.0
MO	1.0	4.0	2.0	2.0	10.0
NB	13.0	12.0	12.0	12.0	16.0
GA	24.0	23.0	18.0	25.0	20.0
PB	8.0	24.0	28.0	12.0	15.0
NI	32.0	7.0	16.0	31.0	23.0
LA	0.0	0.0	0.0	0.0	0.0
CR	47.0	5.0	25.0	53.0	51.0
V	122.0	29.0	70.0	131.0	130.0
Y	0.0	0.0	0.0	0.0	0.0
F	971.0	505.0	683.0	1113.0	925.0
CE	0.0	0.0	0.0	0.0	0.0

GAULTOIS GRANITE

SAMPLE	170104	170105	170106	170109	170111
PERCENT					
SIO2	57.10	59.00	59.70	56.90	58.40
AL2O3	18.20	17.70	17.20	17.90	17.80
FE2O3	1.25	1.74	0.68	2.44	0.85
FEO	5.18	4.67	5.28	5.19	5.88
MGO	3.57	2.68	2.72	3.45	3.00
CAO	3.20	4.55	3.60	4.96	3.97
NA2O	3.14	3.91	3.74	2.98	4.05
K2O	5.12	2.56	3.02	3.21	2.97
TIO2	1.17	1.10	1.10	1.31	1.11
MNO	0.14	0.14	0.12	0.21	0.16
P2O5	0.55	0.36	0.33	0.39	0.48
LOI	1.26	1.17	1.06	1.29	1.29
TOTAL	99.88	99.58	98.55	100.23	99.96
PPM					
U	1.8	1.3	4.4	2.6	2.9
U2	0.0	0.0	0.0	0.0	0.0
LI	102.0	331.0	246.0	204.0	159.0
BE	5.0	5.0	4.0	4.0	3.0
ZR	253.0	294.0	257.0	343.0	283.0
SR	300.0	281.0	244.0	317.0	309.0
RB	221.0	139.0	178.0	140.0	147.0
ZN	103.0	96.0	97.0	97.0	97.0
CU	43.0	38.0	29.0	45.0	46.0
BA	1573.0	563.0	654.0	944.0	800.0
TH	0.0	0.0	0.0	0.0	0.0
MO	4.0	2.0	1.0	6.0	6.0
NB	14.0	14.0	19.0	10.0	12.0
GA	30.0	26.0	26.0	25.0	29.0
PB	25.0	13.0	19.0	6.0	18.0
NI	39.0	13.0	24.0	26.0	26.0
LA	0.0	0.0	0.0	0.0	0.0
CR	64.0	38.0	40.0	54.0	46.0
V	157.0	141.0	161.0	174.0	158.0
Y	0.0	0.0	0.0	0.0	0.0
F	1005.0	811.0	971.0	1199.0	925.0
CE	0.0	0.0	0.0	0.0	0.0

GAULTOIS GRANITE

SAMPLE	170125	170128	170129	170131	170132
PERCENT					
SIO2	58.60	59.90	57.80	62.20	62.10
AL2O3	16.90	16.60	17.50	16.40	15.80
FE2O3	1.39	1.55	1.89	1.47	1.52
FEO	4.84	4.70	4.97	4.02	3.76
MGO	3.59	2.80	3.09	2.82	2.68
CAO	4.07	4.00	4.25	3.42	3.74
NA2O	2.81	3.41	3.53	3.33	3.14
K2O	4.26	3.17	3.26	3.80	3.86
TIO2	1.15	1.03	1.08	0.87	0.84
MNO	0.12	0.15	0.12	0.13	0.12
P2O5	0.44	0.29	0.42	0.35	0.23
LOI	2.40	1.46	1.34	1.56	1.62
TOTAL	100.57	99.06	99.25	100.37	99.41
PPM					
U	2.5	3.1	2.9	1.7	3.7
U2	0.0	0.0	0.0	0.0	0.0
LI	97.0	127.0	108.0	52.0	80.0
BE	3.0	4.0	5.0	4.0	5.0
ZR	299.0	289.0	341.0	258.0	230.0
SR	423.0	215.0	316.0	314.0	300.0
RB	177.0	137.0	185.0	175.0	167.0
ZN	79.0	83.0	98.0	78.0	75.0
CU	47.0	51.0	46.0	40.0	39.0
BA	1437.0	497.0	780.0	826.0	897.0
TH	0.0	0.0	0.0	0.0	0.0
MO	2.0	1.0	4.0	2.0	2.0
NB	12.0	15.0	13.0	10.0	10.0
GA	26.0	25.0	26.0	24.0	24.0
PB	13.0	13.0	21.0	16.0	19.0
NI	35.0	22.0	27.0	33.0	29.0
LA	0.0	0.0	0.0	0.0	0.0
CR	75.0	41.0	44.0	63.0	49.0
V	168.0	145.0	173.0	132.0	122.0
Y	0.0	0.0	0.0	0.0	0.0
F	950.0	1255.0	1426.0	1085.0	1113.0
CE	0.0	0.0	0.0	0.0	0.0

GAULTOIS GRANITE

SAMPLE	170139	170141	170142	170143	170148
PERCENT					
SIO2	60.40	64.30	69.40	67.40	63.10
AL2O3	16.20	15.70	15.00	14.90	15.80
FE2O3	1.58	1.48	0.49	0.94	1.34
FEO	4.30	3.87	2.95	3.13	3.61
MGO	3.27	2.42	1.55	2.19	2.78
CAO	3.99	3.64	2.80	3.17	3.60
NA2O	3.03	3.30	3.06	3.06	3.04
K2O	4.03	3.62	4.63	3.82	4.37
TIO2	1.02	0.86	0.58	0.68	0.98
MNO	0.12	0.09	0.08	0.10	0.08
P2O5	0.33	0.27	0.14	0.14	0.27
LOI	2.92	0.73	0.61	0.71	1.30
TOTAL	101.19	100.28	101.29	100.24	100.27
PPM					
U	4.2	4.7	1.6	1.8	3.7
U2	0.0	0.0	0.0	0.0	0.0
LI	58.0	129.0	134.0	113.0	82.0
BE	5.0	7.0	3.0	5.0	3.0
ZR	290.0	243.0	190.0	170.0	247.0
SR	266.0	206.0	178.0	189.0	338.0
RB	186.0	167.0	155.0	146.0	192.0
ZN	75.0	77.0	55.0	56.0	69.0
CU	39.0	32.0	28.0	24.0	37.0
BA	1285.0	569.0	632.0	647.0	985.0
TH	0.0	0.0	0.0	0.0	0.0
MO	1.0	2.0	2.0	2.0	1.0
NB	16.0	14.0	15.0	15.0	14.0
GA	21.0	26.0	19.0	19.0	23.0
PB	22.0	17.0	34.0	19.0	14.0
NI	32.0	21.0	12.0	13.0	31.0
LA	0.0	0.0	0.0	0.0	0.0
CR	54.0	28.0	19.0	34.0	55.0
V	150.0	119.0	75.0	86.0	119.0
Y	0.0	0.0	0.0	0.0	0.0
F	1369.0	1160.0	848.0	938.0	1284.0
CE	0.0	0.0	0.0	0.0	0.0

GAULTOIS GRANITE

SAMPLE	170149	170151	170173	170174	170180
PERCENT					
SIO2	58.70	75.90	62.20	64.30	62.90
AL2O3	16.50	14.00	15.20	15.60	15.80
FE2O3	1.48	0.14	1.03	0.15	1.51
FEO	4.69	0.25	4.52	4.37	3.61
MGO	3.59	0.13	3.52	2.47	2.73
CAO	4.12	0.45	3.84	3.50	4.04
NA2O	3.13	3.85	3.05	3.21	3.14
K2O	4.40	4.90	3.61	3.92	4.50
TIO2	1.12	0.03	1.02	0.78	1.00
MNO	0.11	0.01	0.12	0.11	0.11
P2O5	0.36	0.34	0.30	0.13	0.28
LOI	2.00	1.95	1.05	1.08	0.99
TOTAL	100.20	101.95	99.46	100.12	100.61
PPM					
U	1.7	3.2	0.9	1.9	4.2
U2	0.0	0.0	0.0	0.0	0.0
LI	78.0	87.0	206.0	113.0	93.0
BE	3.0	4.0	6.0	3.0	4.0
ZR	289.0	264.0	226.0	196.0	243.0
SR	372.0	299.0	243.0	242.0	277.0
RB	168.0	207.0	209.0	171.0	164.0
ZN	79.0	76.0	78.0	65.0	66.0
CU	44.0	39.0	44.0	26.0	39.0
BA	1056.0	1029.0	843.0	641.0	993.0
TH	0.0	0.0	0.0	0.0	0.0
MO	6.0	1.0	4.0	6.0	4.0
NB	11.0	18.0	13.0	15.0	15.0
GA	21.0	23.0	23.0	23.0	26.0
PB	18.0	13.0	12.0	20.0	29.0
NI	33.0	33.0	46.0	24.0	34.0
LA	0.0	0.0	0.0	0.0	0.0
CR	71.0	57.0	91.0	47.0	50.0
V	152.0	134.0	146.0	107.0	125.0
Y	0.0	0.0	0.0	0.0	0.0
F	1113.0	1454.0	1852.0	938.0	1085.0
CE	0.0	0.0	0.0	0.0	0.0

GAULTOIS GRANITE

SAMPLE	170183	170185	170202	170215	170216
PERCENT					
SIO2	70.70	62.80	65.50	59.60	57.20
AL2O3	13.10	16.50	15.90	15.60	16.50
FE2O3	1.11	1.49	0.34	1.53	1.80
FEO	2.69	3.65	4.60	5.20	5.34
MGO	1.73	2.80	2.95	4.44	4.90
CAO	2.93	4.12	3.53	4.40	5.41
NA2O	3.29	3.43	2.95	2.73	3.11
K2O	2.44	4.38	2.64	3.07	3.03
TIO2	0.60	0.94	0.80	1.07	1.16
MNO	0.06	0.11	0.11	0.14	0.13
P2O5	0.14	0.26	0.19	0.41	0.45
LOI	0.41	0.65	1.08	1.62	1.23
TOTAL	99.20	101.13	100.59	99.81	100.36
PPM					
U	3.4	3.1	2.7	1.6	2.0
U2	0.0	0.0	0.0	0.0	0.0
LI	40.0	45.0	99.0	98.0	56.0
BE	3.0	5.0	3.0	4.0	2.0
ZR	187.0	256.0	296.0	210.0	214.0
SR	195.0	300.0	235.0	331.0	311.0
RB	120.0	168.0	168.0	145.0	129.0
ZN	55.0	67.0	83.0	84.0	89.0
CU	24.0	36.0	26.0	52.0	47.0
BA	309.0	933.0	740.0	789.0	926.0
TH	0.0	0.0	0.0	0.0	0.0
MO	2.0	4.0	4.0	4.0	1.0
NB	7.0	11.0	17.0	13.0	14.0
GA	21.0	25.0	23.0	27.0	26.0
PB	10.0	26.0	16.0	8.0	9.0
NI	18.0	28.0	27.0	58.0	53.0
LA	0.0	0.0	0.0	0.0	0.0
CR	40.0	49.0	54.0	97.0	103.0
V	94.0	131.0	135.0	177.0	174.0
Y	0.0	0.0	0.0	0.0	0.0
F	772.0	1199.0	889.0	899.0	938.0
CE	0.0	0.0	0.0	0.0	0.0

GAULTOIS GRANITE

SAMPLE	170237	170246	170255	170256	170276
PERCENT					
SIO2	61.30	61.80	61.20	62.60	76.00
AL2O3	15.60	17.30	16.60	16.10	13.80
FE2O3	1.66	1.29	1.83	1.15	0.19
FEO	4.05	4.49	4.72	4.87	0.47
MGO	2.84	2.76	2.95	2.87	0.16
CAO	3.63	4.17	4.76	4.04	0.50
NA2O	3.04	3.64	3.57	3.66	4.60
K2O	4.07	3.74	3.45	2.85	4.36
TIO2	0.93	1.02	1.16	1.03	0.01
MNO	0.10	0.12	0.13	0.10	0.02
P2O5	0.35	0.36	0.29	0.34	0.20
LOI	3.23	1.21	0.91	1.27	1.08
TOTAL	100.80	101.90	101.57	100.88	101.39
PPM					
U	3.8	1.3	2.0	1.2	4.4
U2	0.0	0.0	0.0	0.0	0.0
LI	114.0	173.0	38.0	167.0	7.0
BE	4.0	4.0	3.0	3.0	4.0
ZR	281.0	295.0	253.0	253.0	46.0
SR	260.0	280.0	266.0	292.0	22.0
RB	158.0	175.0	89.0	146.0	178.0
ZN	80.0	79.0	81.0	77.0	18.0
CU	38.0	40.0	48.0	49.0	21.0
BA	1042.0	843.0	648.0	824.0	54.0
TH	0.0	0.0	0.0	0.0	0.0
MO	2.0	4.0	6.0	6.0	2.0
NB	15.0	15.0	14.0	14.0	14.0
GA	24.0	25.0	25.0	24.0	21.0
PB	14.0	22.0	18.0	9.0	32.0
NI	35.0	20.0	26.0	25.0	7.0
LA	0.0	0.0	0.0	0.0	0.0
CR	54.0	35.0	38.0	50.0	4.0
V	133.0	138.0	169.0	152.0	2.0
Y	0.0	0.0	0.0	0.0	0.0
F	1710.0	1028.0	670.0	874.0	215.0
CE	0.0	0.0	0.0	0.0	0.0

NW COVE GRANITE

SAMPLE	170089	170091	170096	170097	170107
PERCENT					
SIO2	65.90	73.10	73.90	74.60	73.00
AL2O3	17.20	14.40	14.50	14.10	14.50
FE2O3	0.77	0.20	0.05	0.21	0.35
FEO	2.92	1.04	0.54	0.55	0.79
MGO	1.71	0.41	0.09	0.25	0.29
CAO	3.63	1.05	0.42	0.70	0.62
NA2O	4.10	3.66	4.43	3.69	3.67
K2O	2.34	4.65	4.10	5.46	4.79
TIO2	0.59	0.18	0.04	0.06	0.13
MNO	0.08	0.06	0.08	0.04	0.04
P2O5	0.14	0.09	0.16	0.09	0.29
LOI	1.32	1.12	0.89	0.86	1.17
TOTAL	100.70	99.96	99.20	100.61	99.64
PPM					
U	1.9	2.9	4.1	4.5	5.0
U2	0.0	0.0	0.0	0.0	0.0
LI	167.0	150.0	184.0	53.0	107.0
BE	4.0	8.0	6.0	10.0	10.0
ZR	197.0	107.0	21.0	93.0	60.0
SR	297.0	111.0	4.0	96.0	42.0
RB	160.0	314.0	484.0	275.0	334.0
ZN	60.0	55.0	50.0	28.0	54.0
CU	36.0	26.0	20.0	22.0	20.0
BA	598.0	364.0	1.0	458.0	158.0
TH	0.0	0.0	0.0	0.0	0.0
MO	1.0	2.0	6.0	6.0	1.0
NB	13.0	17.0	19.0	11.0	14.0
GA	23.0	26.0	25.0	22.0	24.0
PB	14.0	19.0	6.0	33.0	24.0
NI	20.0	15.0	14.0	9.0	7.0
LA	0.0	0.0	0.0	0.0	0.0
CR	18.0	2.0	7.0	10.0	4.0
V	95.0	16.0	1.0	7.0	7.0
Y	0.0	0.0	0.0	0.0	0.0
F	912.0	811.0	1085.0	311.0	823.0
CE	0.0	0.0	0.0	0.0	0.0

NW COVE GRANITE

SAMPLE	170126	170127	170140	170144	170145
PERCENT					
SIO2	74.30	72.60	73.60	74.70	72.90
AL2O3	13.80	14.00	14.00	13.80	14.00
FE2O3	0.18	0.11	0.41	0.31	0.47
FEO	0.91	1.10	1.03	1.15	1.24
MGO	0.29	0.37	0.48	0.43	0.45
CAO	0.78	0.74	0.69	0.61	0.60
NA2O	3.69	3.92	3.40	3.19	4.86
K2O	4.30	4.47	5.33	5.04	3.26
TIO2	0.08	0.06	0.20	0.24	0.22
MNO	0.05	0.03	0.05	0.05	0.03
P2O5	0.11	0.08	0.17	0.23	0.18
LOI	1.29	1.13	0.92	0.90	1.06
TOTAL	100.28	98.61	100.28	100.65	99.27
PPM					
U	10.0	3.5	4.5	6.4	4.9
U2	0.0	0.0	0.0	0.0	0.0
LI	83.0	67.0	77.0	270.0	293.0
BE	17.0	7.0	9.0	15.0	12.0
ZR	94.0	94.0	92.0	70.0	76.0
SR	70.0	80.0	68.0	27.0	27.0
RB	370.0	292.0	282.0	357.0	355.0
ZN	61.0	48.0	58.0	64.0	73.0
CU	22.0	21.0	21.0	17.0	20.0
BA	255.0	285.0	235.0	59.0	55.0
TH	0.0	0.0	0.0	0.0	0.0
MO	12.0	4.0	1.0	6.0	1.0
NB	17.0	14.0	13.0	15.0	17.0
GA	25.0	22.0	22.0	26.0	23.0
PB	27.0	26.0	36.0	33.0	21.0
NI	8.0	11.0	6.0	10.0	12.0
LA	0.0	0.0	0.0	0.0	0.0
CR	4.0	8.0	2.0	8.0	10.0
V	17.0	17.0	17.0	19.0	19.0
Y	0.0	0.0	0.0	0.0	0.0
F	1227.0	734.0	683.0	971.0	1057.0
CE	0.0	0.0	0.0	0.0	0.0

NW COVE GRANITE

SAMPLE	170146	170147	170177	170178	170179
PERCENT					
SIO2	74.30	72.80	74.20	73.10	73.60
AL2O3	14.30	14.30	14.20	14.10	14.30
FE2O3	0.33	0.49	0.32	0.13	0.41
FEO	1.22	1.08	0.96	1.18	0.93
MGO	0.45	0.52	0.40	0.41	0.45
CAO	0.63	1.01	0.74	0.86	0.92
NA2O	3.32	3.53	3.91	3.84	3.85
K2O	4.84	5.09	4.81	4.83	4.92
TIO2	0.17	0.27	0.18	0.20	0.20
MNO	0.04	0.05	0.05	0.06	0.04
P2O5	0.12	0.26	0.07	0.09	0.09
LOI	1.09	0.95	1.08	1.06	1.05
TOTAL	100.81	100.35	100.92	99.86	100.76
PPM					
U	4.8	2.8	2.2	2.3	2.2
U2	0.0	0.0	0.0	0.0	0.0
LI	299.0	91.0	108.0	156.0	157.0
BE	13.0	10.0	9.0	8.0	8.0
ZR	77.0	134.0	109.0	102.0	103.0
SR	26.0	144.0	110.0	105.0	104.0
RB	353.0	311.0	293.0	300.0	303.0
ZN	75.0	52.0	57.0	47.0	50.0
CU	19.0	25.0	24.0	22.0	23.0
BA	58.0	416.0	361.0	388.0	379.0
TH	0.0	0.0	0.0	0.0	0.0
MO	4.0	8.0	2.0	2.0	4.0
NB	16.0	17.0	15.0	14.0	16.0
GA	27.0	25.0	25.0	23.0	26.0
PB	25.0	32.0	26.0	24.0	30.0
NI	11.0	8.0	9.0	9.0	11.0
LA	0.0	0.0	0.0	0.0	0.0
CR	6.0	10.0	11.0	2.0	7.0
V	21.0	22.0	17.0	14.0	12.0
Y	0.0	0.0	0.0	0.0	0.0
F	1028.0	670.0	581.0	568.0	594.0
CE	0.0	0.0	0.0	0.0	0.0

NW COVE GRANITE

SAMPLE	170182	170184	170247	170248	170249
PERCENT					
SIO2	74.20	73.30	74.90	75.40	74.80
AL2O3	14.20	14.00	13.60	13.20	13.00
FE2O3	0.33	0.24	0.31	0.31	0.28
FEO	0.95	0.96	1.20	1.42	1.38
MGO	0.45	0.31	0.51	0.57	0.51
CAO	0.93	1.00	0.73	0.92	0.81
NA2O	3.88	3.85	3.39	3.41	3.41
K2O	4.82	4.59	5.78	5.22	5.13
TIO2	0.19	0.16	0.21	0.27	0.27
MNO	0.06	0.05	0.02	0.02	0.03
P2O5	0.11	0.11	0.05	0.06	0.06
LOI	0.66	0.98	1.02	1.00	1.02
TOTAL	100.78	99.55	101.72	101.80	100.70
PPM					
U	2.2	3.1	4.8	4.6	4.9
U2	0.0	0.0	0.0	0.0	0.0
LI	89.0	78.0	47.0	46.0	44.0
BE	7.0	10.0	3.0	1.0	2.0
ZR	106.0	97.0	177.0	207.0	206.0
SR	110.0	85.0	134.0	147.0	150.0
RB	300.0	282.0	154.0	138.0	133.0
ZN	49.0	45.0	32.0	36.0	35.0
CU	20.0	20.0	23.0	20.0	24.0
BA	348.0	300.0	707.0	686.0	701.0
TH	0.0	0.0	0.0	0.0	0.0
MO	1.0	12.0	6.0	1.0	1.0
NB	15.0	17.0	11.0	9.0	10.0
GA	21.0	21.0	17.0	17.0	16.0
PB	27.0	26.0	44.0	35.0	37.0
NI	6.0	5.0	10.0	12.0	10.0
LA	0.0	0.0	0.0	0.0	0.0
CR	6.0	2.0	7.0	11.0	4.0
V	19.0	10.0	25.0	17.0	18.0
Y	0.0	0.0	0.0	0.0	0.0
F	772.0	836.0	141.0	184.0	169.0
CE	0.0	0.0	0.0	0.0	0.0

NW COVE GRANITE

SAMPLE	170251	170259	170260	170261
PERCENT				
SIO2	73.80	66.80	72.00	73.70
AL2O3	14.10	15.30	13.80	14.40
FE2O3	0.20	0.92	0.58	0.27
FEO	0.78	3.14	1.34	1.07
MGO	0.30	1.92	0.57	0.45
CAO	0.75	3.02	0.69	0.86
NA2O	3.67	3.18	2.76	3.37
K2O	6.52	3.76	6.05	5.09
TIO2	0.09	0.65	0.23	0.19
MNO	0.03	0.10	0.04	0.05
P2O5	0.22	0.24	0.22	0.14
LOI	0.81	1.49	1.30	1.26
TOTAL	101.27	100.52	99.58	100.85
PPM				
U	2.7	3.8	3.3	3.3
U2	0.0	0.0	0.0	0.0
LI	15.0	138.0	48.0	140.0
BE	6.0	5.0	2.0	5.0
ZR	57.0	209.0	160.0	124.0
SR	62.0	247.0	88.0	80.0
RB	217.0	171.0	238.0	325.0
ZN	35.0	65.0	49.0	53.0
CU	20.0	32.0	22.0	21.0
BA	228.0	737.0	451.0	371.0
TH	0.0	0.0	0.0	0.0
MO	2.0	4.0	2.0	2.0
NB	11.0	12.0	14.0	17.0
GA	16.0	20.0	21.0	27.0
PB	51.0	28.0	34.0	24.0
NI	7.0	18.0	10.0	16.0
LA	0.0	0.0	0.0	0.0
CR	3.0	28.0	8.0	1.0
V	7.0	99.0	32.0	18.0
Y	0.0	0.0	0.0	0.0
F	304.0	861.0	364.0	899.0
CE	0.0	0.0	0.0	0.0

Indian Point granite

SAMPLE	170133	170134	170135	170136	170137
PERCENT					
SIO2	71.80	71.10	71.40	70.90	73.80
AL2O3	14.70	14.20	14.50	14.20	14.10
FE2O3	0.57	0.70	0.64	0.81	0.54
FEO	1.39	1.32	1.23	1.19	0.96
MGO	0.81	0.78	0.82	0.84	0.58
CAO	1.67	1.64	1.69	2.00	0.87
NA2O	4.11	4.09	4.21	4.08	3.99
K2O	3.79	3.44	3.41	3.79	3.97
TIO2	0.24	0.25	0.23	0.22	0.16
MNO	0.05	0.03	0.05	0.05	0.02
P2O5	0.08	0.10	0.09	0.07	0.08
LOI	1.65	1.98	1.63	1.27	1.62
TOTAL	100.86	99.63	99.90	99.42	100.69
PPM					
U	4.1	4.9	3.0	4.1	4.9
U2	0.0	0.0	0.0	0.0	0.0
LI	31.0	43.0	31.0	32.0	49.0
BE	5.0	6.0	5.0	3.0	4.0
ZR	143.0	138.0	139.0	135.0	115.0
SR	391.0	284.0	294.0	306.0	173.0
RB	121.0	125.0	135.0	150.0	149.0
ZN	55.0	56.0	54.0	51.0	44.0
CU	39.0	33.0	34.0	32.0	28.0
BA	662.0	550.0	596.0	645.0	579.0
TH	0.0	0.0	0.0	0.0	0.0
MO	4.0	6.0	2.0	4.0	6.0
NB	9.0	12.0	14.0	9.0	10.0
GA	21.0	23.0	23.0	23.0	20.0
PB	22.0	18.0	21.0	24.0	12.0
NI	5.0	6.0	6.0	6.0	1.0
LA	0.0	0.0	0.0	0.0	0.0
CR	11.0	7.0	9.0	10.0	5.0
V	41.0	38.0	43.0	40.0	28.0
Y	0.0	0.0	0.0	0.0	0.0
F	415.0	441.0	555.0	543.0	429.0
CE	0.0	0.0	0.0	0.0	0.0

Indian Point granite

SAMPLE	170138	170219	170220	170221	170222
PERCENT					
SIO2	73.40	72.90	66.10	66.90	66.80
AL2O3	14.30	14.10	15.50	15.50	15.40
FE2O3	0.58	0.37	1.60	1.19	1.12
FEO	0.91	0.86	2.73	3.05	3.02
MGO	0.60	0.59	2.01	2.02	2.04
CAO	0.99	1.56	3.07	2.86	2.94
NA2O	3.95	3.90	3.08	3.32	3.38
K2O	4.09	4.18	3.82	3.64	3.67
TIO2	0.20	0.16	0.67	0.72	0.69
MNO	0.03	0.05	0.10	0.11	0.11
P2O5	0.06	0.03	0.16	0.22	0.21
LOI	1.53	0.78	1.50	1.09	1.12
TOTAL	100.64	99.48	100.34	100.62	100.50
PPM					
U	2.7	3.8	3.4	4.0	3.9
U2	0.0	0.0	0.0	0.0	0.0
LI	42.0	32.0	52.0	83.0	85.0
BE	5.0	6.0	3.0	7.0	6.0
ZR	112.0	92.0	209.0	216.0	209.0
SR	166.0	242.0	257.0	288.0	290.0
RB	177.0	172.0	147.0	199.0	200.0
ZN	50.0	38.0	64.0	67.0	65.0
CU	29.0	22.0	35.0	31.0	32.0
BA	495.0	524.0	1635.0	795.0	750.0
TH	0.0	0.0	0.0	0.0	0.0
MO	1.0	1.0	8.0	6.0	4.0
NB	14.0	10.0	14.0	14.0	15.0
GA	24.0	22.0	21.0	23.0	20.0
PB	28.0	30.0	28.0	17.0	31.0
NI	8.0	3.0	18.0	20.0	17.0
LA	0.0	0.0	0.0	0.0	0.0
CR	8.0	9.0	32.0	30.0	32.0
V	35.0	22.0	105.0	103.0	99.0
Y	0.0	0.0	0.0	0.0	0.0
F	708.0	348.0	811.0	1227.0	1284.0
CE	0.0	0.0	0.0	0.0	0.0

Indian Point granite

SAMPLE	170223	170224	170225	170226	170227
PERCENT					
SIO2	66.00	74.20	73.80	74.70	73.80
AL2O3	15.60	14.30	14.30	13.40	14.30
FE2O3	1.15	0.32	0.59	0.44	0.86
FEO	2.72	1.09	0.90	0.35	0.77
MGO	1.94	0.66	0.57	0.21	0.45
CAO	2.80	1.32	1.12	0.93	1.11
NA2O	3.15	3.91	3.83	3.74	3.81
K2O	4.12	4.05	4.14	4.53	3.96
TIO2	0.65	0.22	0.20	0.07	0.18
MNO	0.10	0.04	0.03	0.02	0.03
P2O5	0.21	0.05	0.05	0.02	0.06
LOI	1.19	1.01	1.20	1.57	1.37
TOTAL	99.63	101.17	100.73	99.98	100.70
PPM					
U	2.8	4.3	3.4	4.6	4.6
U2	0.0	0.0	0.0	0.0	0.0
LI	68.0	65.0	45.0	24.0	45.0
BE	4.0	4.0	6.0	5.0	8.0
ZR	213.0	122.0	107.0	75.0	121.0
SR	246.0	274.0	201.0	160.0	218.0
RB	156.0	167.0	178.0	173.0	154.0
ZN	62.0	42.0	46.0	27.0	51.0
CU	35.0	24.0	27.0	23.0	28.0
BA	1033.0	652.0	540.0	351.0	557.0
TH	0.0	0.0	0.0	0.0	0.0
MO	2.0	2.0	4.0	2.0	4.0
NB	17.0	11.0	14.0	13.0	14.0
GA	22.0	22.0	24.0	22.0	23.0
PB	25.0	26.0	21.0	21.0	17.0
NI	17.0	2.0	7.0	2.0	2.0
LA	0.0	0.0	0.0	0.0	0.0
CR	25.0	3.0	10.0	8.0	10.0
V	99.0	22.0	25.0	17.0	31.0
Y	0.0	0.0	0.0	0.0	0.0
F	811.0	379.0	364.0	189.0	311.0
CE	0.0	0.0	0.0	0.0	0.0

Indian Point granite

SAMPLE	170228	170229	170231	170232	170233
PERCENT					
SIO2	73.40	73.80	72.90	72.60	72.10
AL2O3	14.40	14.20	14.60	14.70	14.70
FE2O3	0.81	0.76	0.62	0.53	0.63
FEO	0.70	0.73	0.84	1.10	1.23
MGO	0.42	0.41	0.50	0.66	0.70
CAO	1.04	1.06	0.87	1.16	1.51
NA2O	3.68	3.69	3.72	3.84	3.94
K2O	4.76	4.29	4.22	4.09	3.63
TIO2	0.18	0.20	0.15	0.21	0.25
MNO	0.03	0.04	0.02	0.05	0.05
P2O5	0.05	0.06	0.08	0.07	0.11
LOI	1.37	1.34	1.46	1.21	1.18
TOTAL	100.84	100.58	99.98	100.22	100.03
PPM					
U	4.7	5.0	3.4	2.9	2.9
U2	0.0	0.0	0.0	0.0	0.0
LI	46.0	46.0	41.0	54.0	68.0
BE	7.0	7.0	10.0	7.0	8.0
ZR	115.0	116.0	100.0	132.0	129.0
SR	200.0	202.0	188.0	226.0	290.0
RB	170.0	175.0	177.0	205.0	168.0
ZN	46.0	46.0	40.0	49.0	47.0
CU	29.0	26.0	27.0	24.0	28.0
BA	618.0	607.0	569.0	537.0	614.0
TH	0.0	0.0	0.0	0.0	0.0
MO	1.0	2.0	1.0	4.0	1.0
NB	14.0	13.0	13.0	15.0	14.0
GA	22.0	23.0	22.0	25.0	27.0
PB	26.0	23.0	27.0	20.0	16.0
NI	1.0	7.0	1.0	8.0	8.0
LA	0.0	0.0	0.0	0.0	0.0
CR	8.0	2.0	4.0	10.0	9.0
V	28.0	24.0	27.0	31.0	33.0
Y	0.0	0.0	0.0	0.0	0.0
F	245.0	267.0	319.0	530.0	356.0
CE	0.0	0.0	0.0	0.0	0.0

Indian Point granite

SAMPLE	170234	170235	170240
PERCENT			
SIO2	72.50	74.10	73.00
AL2O3	14.30	14.20	15.20
FE2O3	0.61	0.39	0.95
FEO	1.12	0.82	0.24
MGO	0.76	0.45	0.21
CAO	1.63	1.00	0.83
NA2O	3.97	3.98	3.10
K2O	3.90	4.12	4.60
TIO2	0.25	0.10	0.15
MNO	0.06	0.04	0.02
P2O5	0.08	0.06	0.18
LOI	0.98	1.65	2.61
TOTAL	100.16	100.91	101.09
PPM			
U	2.2	3.6	2.3
U2	0.0	0.0	0.0
LI	89.0	41.0	27.0
BE	8.0	5.0	7.0
ZR	190.0	91.0	112.0
SR	302.0	181.0	338.0
RB	157.0	172.0	211.0
ZN	43.0	40.0	44.0
CU	28.0	26.0	27.0
BA	616.0	435.0	446.0
TH	0.0	0.0	0.0
MO	1.0	1.0	4.0
NB	11.0	13.0	12.0
GA	21.0	22.0	23.0
PB	25.0	34.0	35.0
NI	3.0	6.0	2.0
LA	0.0	0.0	0.0
CR	7.0	8.0	9.0
V	35.0	23.0	21.0
Y	0.0	0.0	0.0
F	517.0	326.0	441.0
CE	0.0	0.0	0.0

NW BROOK GRANITE

SAMPLE	170001	170017	170018	170024	170025
PERCENT					
SI02	74.20	72.90	65.50	73.00	73.60
AL203	14.90	14.50	18.20	14.70	15.30
FE203	0.11	0.43	0.86	0.26	0.12
FEO	1.31	0.71	4.57	1.23	0.89
MGO	0.53	0.33	2.38	0.53	0.37
CAO	0.86	0.70	2.31	0.84	0.60
NA20	3.25	3.71	3.13	3.11	3.04
K20	5.49	4.91	2.86	5.77	6.00
TI02	0.25	0.14	0.77	0.26	0.18
MNO	0.06	0.04	0.10	0.04	0.02
P205	0.09	0.09	0.01	0.11	0.03
LOI	0.88	0.88	1.04	0.80	0.50
TOTAL	101.93	99.34	101.73	100.65	100.65
PPM					
U	3.7	3.9	2.0	3.7	3.4
U2	0.0	0.0	0.0	0.0	0.0
LI	148.0	35.0	183.0	212.0	94.0
BE	9.0	8.0	8.0	6.0	5.0
ZR	106.0	72.0	199.0	111.0	73.0
SR	76.0	55.0	233.0	73.0	75.0
RB	313.0	268.0	139.0	317.0	271.0
ZN	61.0	53.0	76.0	56.0	43.0
CU	20.0	19.0	40.0	18.0	17.0
BA	313.0	272.0	654.0	321.0	240.0
TH	0.0	0.0	0.0	0.0	0.0
MO	10.0	8.0	1.0	4.0	4.0
NB	13.0	18.0	15.0	13.0	10.0
GA	26.0	20.0	25.0	23.0	21.0
PB	35.0	33.0	22.0	36.0	41.0
NI	14.0	5.0	24.0	8.0	5.0
LA	0.0	0.0	0.0	0.0	0.0
CR	10.0	9.0	59.0	10.0	7.0
V	18.0	13.0	119.0	16.0	8.0
Y	0.0	0.0	0.0	0.0	0.0
F	899.0	304.0	836.0	950.0	568.0
CE	0.0	0.0	0.0	0.0	0.0

NW BROOK GRANITE

SAMPLE	170027	170028	170029	170032	170041
PERCENT					
SIO2	71.80	75.00	75.30	75.10	73.30
AL2O3	16.50	11.80	15.90	15.30	14.30
FE2O3	0.30	0.84	0.08	0.24	0.60
FEO	1.80	2.20	0.59	0.50	0.39
MGO	0.69	0.34	0.21	0.24	0.32
CAO	1.39	0.86	0.62	0.89	0.76
NA2O	4.00	2.38	3.61	3.52	3.71
K2O	4.11	5.19	4.86	5.00	4.89
TIO2	0.33	0.24	0.09	0.07	0.11
MNO	0.05	0.03	0.03	0.08	0.04
P2O5	0.08	0.01	0.16	0.02	0.07
LOI	0.53	0.53	0.73	0.56	1.01
TOTAL	101.58	99.42	102.18	101.52	99.50
PPM					
U	3.7	1.8	3.7	4.2	2.4
U2	0.0	0.0	0.0	0.0	0.0
LI	125.0	168.0	214.0	79.0	83.0
BE	7.0	1.0	19.0	8.0	9.0
ZR	184.0	339.0	43.0	60.0	67.0
SR	114.0	177.0	35.0	61.0	46.0
RB	219.0	110.0	339.0	252.0	293.0
ZN	63.0	39.0	41.0	27.0	40.0
CU	22.0	34.0	19.0	18.0	21.0
BA	584.0	998.0	124.0	229.0	182.0
TH	0.0	0.0	0.0	0.0	0.0
MO	6.0	4.0	2.0	8.0	1.0
NB	14.0	5.0	15.0	13.0	14.0
GA	14.0	18.0	25.0	22.0	21.0
PB	35.0	30.0	26.0	28.0	25.0
NI	6.0	1.0	7.0	1.0	3.0
LA	0.0	0.0	0.0	0.0	0.0
CR	7.0	1.0	8.0	6.0	7.0
V	32.0	3.0	6.0	9.0	8.0
Y	0.0	0.0	0.0	0.0	0.0
F	811.0	105.0	594.0	568.0	568.0
CE	0.0	0.0	0.0	0.0	0.0

NW BROOK GRANITE

SAMPLE	170042	170043	170044	170045	170047
PERCENT					
SIO2	74.20	74.90	74.50	75.20	75.10
AL2O3	15.60	15.20	14.60	14.90	14.50
FE2O3	0.15	0.11	0.19	0.24	0.25
FEO	0.86	0.94	0.90	0.31	0.87
MGO	0.29	0.31	0.31	0.11	0.35
CAO	0.69	0.63	0.63	0.61	0.60
NA2O	3.68	3.61	3.58	4.72	3.47
K2O	4.65	4.86	4.87	3.06	4.88
TIO2	0.15	0.17	0.15	0.02	0.17
MNO	0.04	0.05	0.04	0.04	0.03
P2O5	0.13	0.10	0.17	0.19	0.06
LOI	1.03	1.10	1.08	0.97	1.05
TOTAL	101.47	101.98	101.02	100.37	101.33
PPM					
U	4.0	3.3	2.9	2.3	4.1
U2	0.0	0.0	0.0	0.0	0.0
LI	107.0	77.0	74.0	32.0	119.0
BE	10.0	8.0	9.0	9.0	6.0
ZR	71.0	66.0	67.0	25.0	72.0
SR	50.0	53.0	50.0	21.0	32.0
RB	311.0	313.0	315.0	180.0	345.0
ZN	60.0	51.0	52.0	25.0	43.0
CU	21.0	21.0	18.0	17.0	18.0
BA	190.0	211.0	191.0	19.0	154.0
TH	0.0	0.0	0.0	0.0	0.0
MO	4.0	2.0	2.0	6.0	2.0
NB	17.0	15.0	18.0	18.0	18.0
GA	27.0	25.0	25.0	21.0	24.0
PB	26.0	23.0	31.0	22.0	22.0
NI	8.0	4.0	7.0	4.0	6.0
LA	0.0	0.0	0.0	0.0	0.0
CR	11.0	8.0	1.0	8.0	5.0
V	8.0	7.0	13.0	2.0	11.0
Y	0.0	0.0	0.0	0.0	0.0
F	836.0	708.0	632.0	657.0	708.0
CE	0.0	0.0	0.0	0.0	0.0

NW BROOK GRANITE

SAMPLE	170058	170059	170060	170061	170062
PERCENT					
SIO2	72.60	73.40	73.70	75.40	72.40
AL2O3	14.90	14.90	14.20	14.50	14.30
FE2O3	0.22	0.17	0.21	0.18	0.19
FEO	0.74	1.07	0.98	0.23	1.18
MGO	0.29	0.43	0.33	0.14	0.44
CAO	0.64	0.75	0.63	0.48	0.84
NA2O	3.66	3.23	3.53	4.55	3.17
K2O	4.85	5.36	4.91	3.85	5.34
TIO2	0.11	0.16	0.15	0.04	0.20
MNO	0.04	0.03	0.07	0.03	0.05
P2O5	0.13	0.01	0.01	0.08	0.15
LOI	1.04	1.03	1.14	0.94	0.95
TOTAL	99.22	100.54	99.86	100.42	99.21
PPM					
U	2.9	3.6	4.4	2.6	2.9
U2	0.0	0.0	0.0	0.0	0.0
LI	72.0	85.0	149.0	128.0	93.0
BE	8.0	7.0	8.0	8.0	7.0
ZR	56.0	102.0	78.0	22.0	109.0
SR	42.0	55.0	36.0	9.0	69.0
RB	289.0	280.0	374.0	349.0	285.0
ZN	50.0	57.0	64.0	31.0	57.0
CU	19.0	22.0	17.0	18.0	19.0
BA	212.0	288.0	154.0	7.0	320.0
TH	0.0	0.0	0.0	0.0	0.0
MO	4.0	2.0	4.0	4.0	4.0
NB	13.0	14.0	22.0	18.0	15.0
GA	23.0	22.0	26.0	27.0	26.0
PB	26.0	35.0	25.0	9.0	41.0
NI	7.0	5.0	13.0	8.0	9.0
LA	0.0	0.0	0.0	0.0	0.0
CR	5.0	1.0	4.0	7.0	2.0
V	10.0	18.0	12.0	1.0	17.0
Y	0.0	0.0	0.0	0.0	0.0
F	568.0	454.0	848.0	645.0	619.0
CE	0.0	0.0	0.0	0.0	0.0

NW BROOK GRANITE

SAMPLE	170076	170112	170113	170114	170115
PERCENT					
SIO2	73.30	74.10	73.10	75.50	72.10
AL2O3	14.20	14.10	14.10	13.90	14.30
FE2O3	0.39	0.13	0.20	0.23	0.35
FEO	0.91	0.52	1.23	0.86	0.88
MGO	0.48	0.17	0.54	0.38	0.40
CAO	0.76	0.63	1.36	1.04	1.19
NA2O	3.11	3.38	4.11	3.98	4.32
K2O	5.53	5.76	3.76	3.98	3.86
TIO2	0.16	0.10	0.19	0.15	0.16
MNO	0.03	0.01	0.03	0.02	0.08
P2O5	0.15	0.11	0.05	0.01	0.05
LOI	1.34	0.70	0.94	0.81	0.89
TOTAL	100.36	99.71	99.61	100.86	98.58
PPM					
U	4.1	1.9	2.6	2.6	8.9
U2	0.0	0.0	0.0	0.0	0.0
LI	36.0	46.0	50.0	57.0	87.0
BE	16.0	3.0	5.0	5.0	6.0
ZR	94.0	41.0	98.0	86.0	88.0
SR	78.0	50.0	213.0	181.0	160.0
RB	275.0	178.0	149.0	148.0	196.0
ZN	61.0	21.0	52.0	42.0	52.0
CU	22.0	19.0	26.0	22.0	25.0
BA	403.0	163.0	630.0	597.0	309.0
TH	0.0	0.0	0.0	0.0	0.0
MO	2.0	2.0	4.0	1.0	1.0
NB	12.0	7.0	13.0	10.0	13.0
GA	22.0	18.0	22.0	20.0	22.0
PB	40.0	43.0	21.0	22.0	22.0
NI	12.0	1.0	2.0	1.0	3.0
LA	0.0	0.0	0.0	0.0	0.0
CR	7.0	4.0	4.0	8.0	10.0
V	22.0	3.0	22.0	16.0	16.0
Y	0.0	0.0	0.0	0.0	0.0
F	429.0	209.0	505.0	119.0	721.0
CE	0.0	0.0	0.0	0.0	0.0

NW BROOK GRANITE

SAMPLE	170116	170181	170201	170212	170213
PERCENT					
SIO2	70.40	74.60	73.70	70.30	71.20
AL203	14.70	13.40	14.00	15.70	15.50
FE2O3	0.34	0.10	0.29	0.53	0.33
FEO	1.70	1.11	1.26	1.69	1.70
MGO	0.76	0.37	0.53	0.95	0.94
CAO	1.29	0.80	1.23	2.52	2.24
NA2O	3.55	3.29	3.53	4.18	4.13
K2O	5.08	5.77	4.99	3.40	3.56
TIO2	0.40	0.15	0.21	0.34	0.35
MNO	0.05	0.01	0.04	0.04	0.03
P205	0.14	0.02	0.13	0.21	0.21
LOI	0.89	0.33	0.64	1.74	0.81
TOTAL	99.30	99.95	100.55	101.60	101.00
PPM					
U	4.7	3.7	4.7	4.0	6.1
U2	0.0	0.0	0.0	0.0	0.0
LI	53.0	51.0	65.0	82.0	129.0
BE	5.0	3.0	5.0	5.0	5.0
ZR	227.0	138.0	150.0	151.0	141.0
SR	186.0	130.0	111.0	413.0	389.0
RB	198.0	168.0	193.0	134.0	143.0
ZN	69.0	31.0	39.0	64.0	62.0
CU	21.0	17.0	20.0	59.0	35.0
BA	713.0	660.0	551.0	648.0	698.0
TH	0.0	0.0	0.0	0.0	0.0
MO	4.0	6.0	2.0	2.0	2.0
NB	11.0	10.0	10.0	9.0	11.0
GA	22.0	17.0	17.0	24.0	24.0
PB	30.0	50.0	49.0	18.0	28.0
NI	7.0	8.0	5.0	3.0	3.0
LA	0.0	0.0	0.0	0.0	0.0
CR	6.0	11.0	6.0	11.0	6.0
V	36.0	22.0	16.0	42.0	42.0
Y	0.0	0.0	0.0	0.0	0.0
F	480.0	150.0	260.0	657.0	606.0
CE	0.0	0.0	0.0	0.0	0.0

NW BROOK GRANITE

SAMPLE	170214	170217	170218	170236	170238
PERCENT					
SIO2	70.50	73.50	72.90	72.80	73.30
AL2O3	15.40	14.00	14.50	14.40	14.40
FE2O3	0.43	0.37	0.56	0.19	0.43
FEO	1.69	1.03	1.24	1.23	1.09
MGO	0.93	0.47	0.66	0.57	0.51
CAO	2.24	1.21	2.03	1.06	1.30
NA2O	4.15	3.36	3.86	3.30	3.30
K2O	3.59	5.18	3.25	5.43	5.25
TIO2	0.34	0.23	0.23	0.25	0.21
MNO	0.03	0.04	0.06	0.04	0.04
P2O5	0.21	0.09	0.02	0.16	0.14
LOI	0.82	0.68	0.83	1.50	1.52
TOTAL	100.33	100.16	100.14	100.93	101.49
PPM					
U	5.7	5.9	2.6	5.2	4.2
U2	0.0	0.0	0.0	0.0	0.0
LI	128.0	85.0	85.0	110.0	68.0
BE	5.0	7.0	9.0	6.0	7.0
ZR	147.0	134.0	124.0	154.0	142.0
SR	389.0	112.0	261.0	110.0	141.0
RB	139.0	281.0	174.0	295.0	272.0
ZN	61.0	48.0	51.0	60.0	56.0
CU	37.0	22.0	33.0	22.0	22.0
BA	671.0	419.0	610.0	498.0	444.0
TH	0.0	0.0	0.0	0.0	0.0
MO	2.0	1.0	1.0	2.0	1.0
NB	12.0	13.0	12.0	16.0	15.0
GA	21.0	23.0	23.0	25.0	23.0
PB	25.0	30.0	21.0	30.0	34.0
NI	21.0	7.0	7.0	12.0	12.0
LA	0.0	0.0	0.0	0.0	0.0
CR	5.0	12.0	13.0	10.0	10.0
V	42.0	23.0	32.0	25.0	25.0
Y	0.0	0.0	0.0	0.0	0.0
F	619.0	480.0	230.0	785.0	938.0
CE	0.0	0.0	0.0	0.0	0.0

NW BROOK GRANITE

SAMPLE	170239	170241	170242	170243	170244
PERCENT					
SIO2	68.00	72.70	72.70	71.50	72.50
AL2O3	14.60	14.30	14.70	14.60	14.50
FE2O3	0.52	0.25	0.36	0.40	0.37
FEO	0.60	1.16	1.45	1.41	1.38
MGO	0.32	0.56	0.67	0.60	0.62
CAO	4.85	1.63	1.37	1.42	1.46
NA2O	0.59	4.10	3.56	3.70	3.49
K2O	3.44	3.58	4.93	4.86	4.93
TIO2	0.20	0.20	0.30	0.29	0.29
MNO	0.03	0.06	0.05	0.04	0.04
P2O5	0.13	0.13	0.16	0.18	0.16
LOI	7.96	1.07	1.05	0.97	1.00
TOTAL	101.24	99.74	101.30	99.97	100.74
PPM					
U	6.0	2.7	5.1	5.0	4.4
U2	0.0	0.0	0.0	0.0	0.0
LI	72.0	124.0	69.0	154.0	120.0
BE	5.0	6.0	6.0	8.0	9.0
ZR	119.0	111.0	164.0	155.0	157.0
SR	291.0	260.0	145.0	138.0	133.0
RB	158.0	170.0	274.0	290.0	295.0
ZN	33.0	53.0	57.0	57.0	53.0
CU	28.0	25.0	25.0	22.0	25.0
BA	643.0	672.0	523.0	520.0	490.0
TH	0.0	0.0	0.0	0.0	0.0
MO	4.0	1.0	1.0	1.0	1.0
NB	11.0	13.0	14.0	15.0	14.0
GA	20.0	21.0	24.0	26.0	23.0
PB	30.0	22.0	33.0	26.0	26.0
NI	3.0	6.0	13.0	10.0	11.0
LA	0.0	0.0	0.0	0.0	0.0
CR	8.0	6.0	9.0	16.0	6.0
V	28.0	16.0	27.0	25.0	24.0
Y	0.0	0.0	0.0	0.0	0.0
F	390.0	1005.0	721.0	823.0	823.0
CE	0.0	0.0	0.0	0.0	0.0

NW BROOK GRANITE

SAMPLE	170245	170252	170253	170254	170257
PERCENT					
SIO2	72.80	74.10	75.60	70.10	74.00
AL2O3	14.70	14.60	14.00	15.60	14.50
FE2O3	0.38	0.27	0.20	0.56	0.26
FEO	1.34	0.67	0.89	2.71	0.77
MGO	0.58	0.29	0.29	1.18	0.39
CAO	1.34	0.68	0.70	2.09	0.97
NA2O	3.52	3.22	3.83	4.56	4.29
K2O	4.94	6.15	4.91	2.90	4.41
TIO2	0.29	0.14	0.15	0.58	0.14
MNO	0.04	0.03	0.02	0.08	0.04
P2O5	0.17	0.20	0.11	0.22	0.08
LOI	0.94	1.07	0.80	0.91	1.18
TOTAL	101.04	101.43	101.50	101.49	101.03
PPM					
U	4.5	3.9	3.5	5.2	2.3
U2	0.0	0.0	0.0	0.0	0.0
LI	119.0	73.0	67.0	219.0	126.0
BE	8.0	6.0	4.0	5.0	4.0
ZR	157.0	64.0	79.0	304.0	78.0
SR	133.0	71.0	125.0	192.0	158.0
RB	299.0	306.0	225.0	202.0	174.0
ZN	54.0	34.0	51.0	90.0	43.0
CU	26.0	20.0	20.0	37.0	25.0
BA	519.0	364.0	774.0	590.0	284.0
TH	0.0	0.0	0.0	0.0	0.0
MO	1.0	2.0	4.0	4.0	4.0
NB	16.0	13.0	9.0	18.0	12.0
GA	23.0	21.0	23.0	27.0	22.0
PB	30.0	34.0	32.0	19.0	26.0
NI	13.0	8.0	5.0	11.0	5.0
LA	0.0	0.0	0.0	0.0	0.0
CR	14.0	8.0	12.0	14.0	8.0
V	27.0	5.0	9.0	60.0	15.0
Y	0.0	0.0	0.0	0.0	0.0
F	772.0	379.0	304.0	874.0	364.0
CE	0.0	0.0	0.0	0.0	0.0

NW BROOK GRANITE

SAMPLE	170258	170262	170284	170286	170415
PERCENT					
SIO2	74.60	75.40	75.00	77.40	74.30
AL2O3	14.20	13.70	14.30	13.00	14.60
FE2O3	0.24	0.01	0.09	0.17	0.63
FEO	0.89	0.54	0.46	0.80	0.41
MGO	0.35	0.14	0.14	0.32	0.24
CAO	0.69	0.59	0.50	1.23	0.81
NA2O	3.53	3.71	4.23	4.12	3.47
K2O	4.94	5.46	4.32	2.85	4.60
TIO2	0.16	0.06	0.09	0.10	0.13
MNO	0.03	0.05	0.05	0.05	0.05
P2O5	0.21	0.05	0.18	0.07	0.19
LOI	1.21	0.64	0.90	0.92	0.89
TOTAL	101.05	100.35	100.26	101.03	100.32
PPM					
U	5.4	1.7	2.9	1.8	0.0
U2	0.0	0.0	0.0	0.0	0.0
LI	116.0	58.0	59.0	54.0	0.0
BE	14.0	5.0	6.0	7.0	0.0
ZR	73.0	53.0	26.0	100.0	49.0
SR	33.0	70.0	15.0	325.0	34.0
RB	315.0	264.0	293.0	129.0	213.0
ZN	48.0	29.0	32.0	45.0	38.0
CU	22.0	25.0	15.0	25.0	11.0
BA	128.0	243.0	27.0	861.0	135.0
TH	0.0	0.0	0.0	0.0	7.0
MO	1.0	4.0	6.0	4.0	0.0
NB	19.0	12.0	19.0	10.0	24.0
GA	22.0	16.0	21.0	20.0	16.0
PB	21.0	28.0	13.0	15.0	45.0
NI	8.0	7.0	4.0	3.0	11.0
LA	0.0	0.0	0.0	0.0	5.0
CR	16.0	3.0	2.0	5.0	5.0
V	12.0	2.0	1.0	6.0	3.0
Y	0.0	0.0	0.0	0.0	24.0
F	645.0	129.0	594.0	215.0	0.0
CE	0.0	0.0	0.0	0.0	18.0

DOLLAND BIGHT GRNT

SAMPLE	170152	170153	170154	170155	170156
PERCENT					
SIO2	62.90	75.00	74.80	75.50	75.10
AL2O3	16.00	14.10	14.80	13.80	13.80
FE2O3	1.56	0.01	0.14	0.07	0.15
FEO	4.05	0.73	0.83	0.83	0.80
MGO	3.15	0.20	0.33	0.25	0.33
CAO	3.39	0.66	0.73	0.66	0.68
NA2O	2.96	3.99	3.36	4.18	4.18
K2O	4.70	5.03	5.04	4.57	4.76
TIO2	1.07	0.05	0.13	0.11	0.14
MNO	0.11	0.03	0.04	0.02	0.03
P2O5	0.08	0.10	0.15	0.05	0.05
LOI	0.80	0.68	1.12	0.72	0.58
TOTAL	100.77	100.58	101.47	100.76	100.60
PPM					
U	1.2	2.2	3.0	4.5	3.5
U2	0.0	0.0	0.0	0.0	0.0
LI	12.0	30.0	29.0	19.0	22.0
BE	5.0	9.0	5.0	4.0	4.0
ZR	27.0	38.0	57.0	83.0	89.0
SR	19.0	32.0	46.0	43.0	46.0
RB	162.0	162.0	191.0	143.0	155.0
ZN	18.0	29.0	53.0	34.0	36.0
CU	19.0	18.0	19.0	19.0	16.0
BA	118.0	151.0	208.0	261.0	330.0
TH	0.0	0.0	0.0	0.0	0.0
MO	4.0	2.0	2.0	1.0	4.0
NB	15.0	11.0	15.0	11.0	13.0
GA	22.0	17.0	20.0	21.0	20.0
PB	30.0	51.0	57.0	31.0	41.0
NI	4.0	3.0	6.0	4.0	7.0
LA	0.0	0.0	0.0	0.0	0.0
CR	7.0	2.0	9.0	6.0	12.0
V	2.0	1.0	9.0	6.0	11.0
Y	0.0	0.0	0.0	0.0	0.0
F	199.0	169.0	289.0	126.0	135.0
CE	0.0	0.0	0.0	0.0	0.0

DOLLAND BIGHT GRNT

SAMPLE	170157	170158	170159	170160	170161
PERCENT					
SIO2	75.70	74.20	73.60	74.40	75.00
AL2O3	13.70	13.90	14.60	14.70	14.30
FE2O3	0.06	0.22	0.14	0.14	0.07
FEO	1.00	1.22	0.62	0.52	0.57
MGO	0.29	0.50	0.30	0.21	0.26
CAO	0.79	0.84	0.95	0.69	0.68
NA2O	3.59	3.21	4.22	4.23	4.00
K2O	5.21	5.62	3.96	4.36	5.21
TIO2	0.16	0.22	0.11	0.07	0.11
MNO	0.03	0.04	0.03	0.06	0.08
P2O5	0.03	0.05	0.11	0.06	0.05
LOI	0.83	0.95	1.01	0.92	0.78
TOTAL	101.39	100.97	99.65	100.36	101.11
PPM					
U	5.0	5.0	5.5	3.0	2.8
U2	0.0	0.0	0.0	0.0	0.0
LI	42.0	34.0	71.0	64.0	49.0
BE	5.0	3.0	6.0	5.0	4.0
ZR	111.0	102.0	47.0	39.0	59.0
SR	68.0	76.0	69.0	37.0	43.0
RB	207.0	158.0	138.0	166.0	165.0
ZN	37.0	49.0	38.0	34.0	37.0
CU	19.0	20.0	19.0	19.0	18.0
BA	377.0	494.0	276.0	141.0	299.0
TH	0.0	0.0	0.0	0.0	0.0
MO	1.0	2.0	1.0	2.0	1.0
NB	16.0	11.0	13.0	15.0	11.0
GA	20.0	21.0	20.0	21.0	18.0
PB	32.0	49.0	44.0	47.0	61.0
NI	9.0	8.0	7.0	7.0	5.0
LA	0.0	0.0	0.0	0.0	0.0
CR	6.0	3.0	3.0	6.0	6.0
V	10.0	7.0	3.0	4.0	5.0
Y	0.0	0.0	0.0	0.0	0.0
F	147.0	215.0	275.0	250.0	189.0
CE	0.0	0.0	0.0	0.0	0.0

DOLLAND BIGHT GRNT

SAMPLE	170162	170163	170164	170165	170166
PERCENT					
SIO2	75.80	74.70	75.10	72.20	73.40
AL2O3	14.30	14.10	14.10	14.20	14.30
FE2O3	0.01	0.04	0.16	0.14	0.05
FEO	0.35	0.47	0.85	0.86	0.40
MGO	0.10	0.20	0.40	0.35	0.19
CAO	0.55	0.79	0.86	0.80	0.75
NA2O	4.35	4.48	4.02	4.01	4.47
K2O	4.88	4.47	4.77	4.77	4.39
TIO2	0.02	0.10	0.13	0.16	0.08
MNO	0.07	0.02	0.04	0.04	0.03
P2O5	0.07	0.07	0.24	0.21	0.11
LOI	0.77	0.79	0.86	0.85	0.86
TOTAL	101.27	100.23	101.53	98.59	99.03
PPM					
U	1.8	2.0	4.1	4.1	2.8
U2	0.0	0.0	0.0	0.0	0.0
LI	33.0	37.0	94.0	94.0	55.0
BE	7.0	3.0	3.0	3.0	4.0
ZR	37.0	34.0	64.0	63.0	27.0
SR	24.0	38.0	58.0	56.0	36.0
RB	187.0	157.0	208.0	209.0	142.0
ZN	18.0	27.0	54.0	57.0	27.0
CU	17.0	18.0	19.0	18.0	15.0
BA	91.0	175.0	348.0	353.0	118.0
TH	0.0	0.0	0.0	0.0	0.0
MO	4.0	4.0	1.0	1.0	1.0
NB	12.0	11.0	16.0	18.0	15.0
GA	17.0	17.0	19.0	21.0	18.0
PB	33.0	48.0	50.0	49.0	64.0
NI	1.0	8.0	6.0	8.0	3.0
LA	0.0	0.0	0.0	0.0	0.0
CR	4.0	12.0	9.0	15.0	4.0
V	1.0	7.0	8.0	11.0	1.0
Y	0.0	0.0	0.0	0.0	0.0
F	169.0	135.0	379.0	390.0	298.0
CE	0.0	0.0	0.0	0.0	0.0

DOLLAND BIGHT GRNT

SAMPLE	170186	170187	170188	170189	170191
PERCENT					
SIO2	76.00	76.30	75.50	74.20	76.30
AL2O3	14.60	14.70	14.40	14.60	14.50
FE2O3	0.01	0.18	0.22	0.01	0.03
FEO	0.48	0.48	0.32	1.40	0.50
MGO	0.09	0.18	0.10	0.29	0.17
CAO	0.51	0.66	0.57	0.82	0.64
NA2O	5.08	4.23	4.50	3.71	4.80
K2O	3.82	4.07	4.21	5.16	4.15
TIO2	0.02	0.05	0.01	0.09	0.01
MNO	0.09	0.06	0.09	0.02	0.05
P2O5	0.11	0.08	0.17	0.10	0.28
LOI	0.26	0.60	0.40	0.38	0.40
TOTAL	101.07	101.59	100.49	100.78	101.83
PPM					
U	2.7	5.8	2.3	4.5	4.2
U2	0.0	0.0	0.0	0.0	0.0
LI	34.0	74.0	44.0	68.0	33.0
BE	9.0	5.0	8.0	5.0	11.0
ZR	28.0	48.0	27.0	58.0	26.0
SR	7.0	23.0	9.0	60.0	9.0
RB	217.0	207.0	218.0	242.0	257.0
ZN	24.0	52.0	30.0	45.0	25.0
CU	16.0	18.0	16.0	18.0	19.0
BA	1.0	89.0	2.0	326.0	28.0
TH	0.0	0.0	0.0	0.0	0.0
MO	1.0	1.0	4.0	2.0	2.0
NB	13.0	14.0	14.0	15.0	20.0
GA	23.0	23.0	21.0	23.0	24.0
PB	21.0	45.0	21.0	49.0	22.0
NI	5.0	1.0	3.0	8.0	5.0
LA	0.0	0.0	0.0	0.0	0.0
CR	6.0	6.0	1.0	9.0	4.0
V	1.0	2.0	1.0	8.0	1.0
Y	0.0	0.0	0.0	0.0	0.0
F	298.0	543.0	356.0	390.0	403.0
CE	0.0	0.0	0.0	0.0	0.0

DOLLAND BIGHT GRNT

SAMPLE	170192	170193	170194	170203	170204
PERCENT					
SIO2	75.70	73.70	74.70	73.20	74.50
AL2O3	14.50	14.10	14.10	13.00	14.30
FE2O3	0.01	0.09	0.01	0.16	0.24
FEO	0.52	0.45	0.80	0.71	0.54
MGO	0.12	0.16	0.14	0.24	0.25
CAO	0.53	0.60	0.60	0.50	0.58
NA2O	4.72	3.92	4.16	4.18	4.27
K2O	4.53	4.37	4.37	3.83	4.14
TIO2	0.01	0.04	0.05	0.06	0.05
MNO	0.04	0.03	0.03	0.06	0.01
P2O5	0.21	0.21	0.19	0.15	0.11
LOI	0.34	1.06	1.08	1.00	0.88
TOTAL	101.23	98.73	100.23	97.09	99.87
PPM					
U	1.9	2.3	2.0	5.1	6.9
U2	0.0	0.0	0.0	0.0	0.0
LI	48.0	61.0	64.0	112.0	31.0
BE	7.0	5.0	5.0	8.0	4.0
ZR	27.0	32.0	32.0	29.0	53.0
SR	15.0	13.0	16.0	16.0	26.0
RB	213.0	197.0	203.0	274.0	170.0
ZN	34.0	28.0	30.0	55.0	34.0
CU	20.0	16.0	19.0	17.0	15.0
BA	31.0	43.0	43.0	40.0	169.0
TH	0.0	0.0	0.0	0.0	0.0
MO	1.0	2.0	2.0	4.0	2.0
NB	16.0	18.0	16.0	18.0	15.0
GA	23.0	22.0	21.0	25.0	22.0
PB	32.0	34.0	41.0	26.0	43.0
NI	6.0	2.0	1.0	8.0	4.0
LA	0.0	0.0	0.0	0.0	0.0
CR	3.0	1.0	6.0	1.0	9.0
V	2.0	1.0	1.0	4.0	2.0
Y	0.0	0.0	0.0	0.0	0.0
F	260.0	492.0	517.0	356.0	240.0
CE	0.0	0.0	0.0	0.0	0.0

DOLLAND BIGHT GRNT

SAMPLE	170205	170206	170207	170208	170209
PERCENT					
SIO2	74.80	73.80	75.40	74.60	74.30
AL2O3	14.40	14.60	14.10	14.50	14.40
FE2O3	0.11	0.15	0.01	0.05	0.12
FEO	0.48	0.84	0.60	0.60	0.54
MGO	0.20	0.29	0.25	0.21	0.21
CAO	0.79	0.89	0.62	0.64	0.65
NA2O	4.16	3.44	4.04	4.11	4.03
K2O	4.02	5.23	4.40	4.21	4.20
TIO2	0.04	0.13	0.06	0.06	0.02
MNO	0.04	0.04	0.01	0.08	0.06
P2O5	0.17	0.19	0.14	0.14	0.13
LOI	0.84	0.89	0.84	0.79	0.78
TOTAL	100.05	100.49	100.47	99.99	99.44
PPM					
U	2.4	3.0	2.9	3.7	3.5
U2	0.0	0.0	0.0	0.0	0.0
LI	52.0	50.0	38.0	36.0	36.0
BE	6.0	4.0	9.0	7.0	7.0
ZR	41.0	59.0	50.0	48.0	45.0
SR	37.0	66.0	31.0	25.0	26.0
RB	175.0	213.0	188.0	188.0	187.0
ZN	32.0	46.0	34.0	39.0	38.0
CU	15.0	21.0	19.0	20.0	17.0
BA	163.0	263.0	175.0	147.0	143.0
TH	0.0	0.0	0.0	0.0	0.0
MO	1.0	4.0	1.0	2.0	2.0
NB	12.0	12.0	14.0	16.0	17.0
GA	18.0	20.0	22.0	24.0	24.0
PB	47.0	60.0	34.0	38.0	40.0
NI	4.0	7.0	6.0	7.0	4.0
LA	0.0	0.0	0.0	0.0	0.0
CR	6.0	5.0	7.0	12.0	1.0
V	5.0	9.0	3.0	1.0	6.0
Y	0.0	0.0	0.0	0.0	0.0
F	282.0	304.0	220.0	289.0	240.0
CE	0.0	0.0	0.0	0.0	0.0

DOLLAND BIGHT GRNT

SAMPLE	170211
PERCENT	
SIO2	74.80
AL2O3	14.60
FE2O3	0.03
FEO	0.56
MGO	0.17
CAO	0.64
NA2O	4.12
K2O	4.29
TIO2	0.01
MNO	0.03
P2O5	0.20
LOI	0.80
TOTAL	100.25
PPM	
U	3.7
U2	0.0
LI	27.0
BE	7.0
ZR	22.0
SR	20.0
RB	191.0
ZN	30.0
CU	16.0
BA	41.0
TH	0.0
MO	4.0
NB	18.0
GA	25.0
PB	42.0
NI	7.0
LA	0.0
CR	3.0
V	1.0
Y	0.0
F	326.0
CE	0.0

MISSING ISLAND GRDR

SAMPLE	170359	170363	170366	170368	170379
PERCENT					
SIO2	67.20	66.00	66.20	65.70	66.00
AL2O3	15.20	16.00	15.90	15.60	15.80
FE2O3	0.33	0.62	0.60	0.67	0.35
FEO	3.14	3.27	3.14	2.93	3.17
MGO	2.08	2.32	2.24	2.15	2.12
CAO	3.67	3.83	3.62	3.33	3.84
NA2O	3.13	3.32	3.28	3.23	3.38
K2O	3.82	3.71	3.64	4.11	3.46
TIO2	0.60	0.67	0.67	0.61	0.63
MNO	0.08	0.08	0.08	0.07	0.07
P2O5	0.15	0.13	0.18	0.17	0.07
LOI	0.88	1.06	1.06	1.11	0.84
TOTAL	100.28	101.01	100.61	99.68	99.73
PPM					
U	2.3	3.2	3.0	4.0	2.3
U2	0.0	0.0	0.0	0.0	0.0
LI	49.0	50.0	50.0	48.0	48.0
BE	3.0	3.0	4.0	3.0	4.0
ZR	182.0	191.0	191.0	175.0	179.0
SR	224.0	236.0	213.0	255.0	208.0
RB	150.0	144.0	140.0	158.0	145.0
ZN	51.0	57.0	60.0	53.0	53.0
CU	31.0	24.0	33.0	28.0	30.0
BA	584.0	565.0	511.0	583.0	591.0
TH	0.0	0.0	0.0	0.0	0.0
MO	1.0	6.0	4.0	4.0	2.0
NB	11.0	12.0	11.0	10.0	9.0
GA	21.0	22.0	21.0	20.0	20.0
PB	33.0	22.0	24.0	34.0	23.0
NI	13.0	17.0	20.0	19.0	18.0
LA	0.0	0.0	0.0	0.0	0.0
CR	38.0	43.0	31.0	26.0	38.0
V	70.0	72.0	69.0	59.0	75.0
Y	0.0	0.0	0.0	0.0	0.0
F	6.0	670.0	581.0	555.0	645.0
CE	0.0	0.0	0.0	0.0	0.0

MISSING ISLAND GRDR

SAMPLE	170380
PERCENT	
SIO2	65.30
AL2O3	16.00
FE2O3	0.56
FEO	3.05
MGO	2.20
CAO	3.84
NA2O	3.37
K2O	3.46
TIO2	0.67
MNO	0.08
P2O5	0.10
LOI	0.99
TOTAL	99.62
PPM	
U	2.4
U2	0.0
LI	58.0
BE	5.0
ZR	182.0
SR	204.0
RB	155.0
ZN	56.0
CU	26.0
BA	525.0
TH	0.0
MO	1.0
NB	12.0
GA	22.0
PB	28.0
NI	15.0
LA	0.0
CR	34.0
V	60.0
Y	0.0
F	670.0
CE	0.0

LONG POND DIORITE

SAMPLE	170381	170382	170383
PERCENT			
SIO2	56.20	55.90	56.50
AL2O3	15.70	17.20	17.60
FE2O3	0.84	1.52	1.36
FEO	5.98	6.08	5.98
MGO	7.79	5.45	5.40
CAO	6.78	7.06	7.07
NA2O	2.73	3.23	3.28
K2O	1.61	1.61	1.60
TIO2	0.94	1.41	1.38
MNO	0.12	0.15	0.14
P2O5	0.20	0.37	0.38
LOI	1.44	0.93	1.10
TOTAL	100.33	100.91	101.79
PPM			
U	3.0	2.1	2.0
U2	0.0	0.0	0.0
LI	26.0	30.0	28.0
BE	3.0	3.0	3.0
ZR	138.0	127.0	133.0
SR	306.0	354.0	365.0
RB	61.0	57.0	53.0
ZN	76.0	87.0	83.0
CU	46.0	46.0	50.0
BA	271.0	337.0	351.0
TH	0.0	0.0	0.0
MO	4.0	6.0	4.0
NB	11.0	11.0	12.0
GA	25.0	25.0	23.0
PB	14.0	20.0	9.0
NI	146.0	52.0	50.0
LA	0.0	0.0	0.0
CR	259.0	113.0	108.0
V	160.0	182.0	178.0
Y	0.0	0.0	0.0
F	326.0	505.0	480.0
CE	0.0	0.0	0.0

ROCKY BOTTOM TONALITE

SAMPLE	170353	170354	170355	170356	170357
PERCENT					
SIO2	65.80	65.60	67.80	65.90	64.40
AL2O3	17.00	16.90	16.50	17.00	17.40
FE2O3	0.33	0.42	0.35	0.28	0.33
FEO	2.97	3.22	2.84	3.26	3.67
MGO	2.07	2.36	2.01	2.37	2.65
CAO	5.02	4.71	4.62	5.13	4.88
NA2O	3.23	3.49	3.33	3.18	3.28
K2O	1.61	2.04	1.70	1.94	1.58
TIO2	0.45	0.50	0.39	0.53	0.60
MNO	0.08	0.06	0.06	0.08	0.08
P2O5	0.11	0.14	0.10	0.12	0.09
LOI	1.65	0.93	1.98	1.12	2.03
TOTAL	100.32	100.37	101.68	100.91	100.99
PPM					
U	2.2	2.1	2.5	1.4	2.2
U2	0.0	0.0	0.0	0.0	0.0
LI	34.0	38.0	42.0	36.0	39.0
BE	3.0	4.0	3.0	3.0	3.0
ZR	104.0	117.0	102.0	106.0	125.0
SR	253.0	259.0	247.0	260.0	325.0
RB	56.0	94.0	59.0	85.0	64.0
ZN	56.0	66.0	57.0	65.0	61.0
CU	28.0	20.0	22.0	28.0	31.0
BA	318.0	345.0	340.0	384.0	338.0
TH	0.0	0.0	0.0	0.0	0.0
MO	4.0	1.0	6.0	4.0	8.0
NB	9.0	11.0	7.0	8.0	6.0
GA	22.0	26.0	23.0	24.0	24.0
PB	9.0	19.0	16.0	20.0	11.0
NI	10.0	9.0	10.0	13.0	12.0
LA	0.0	0.0	0.0	0.0	0.0
CR	21.0	25.0	28.0	26.0	23.0
V	76.0	76.0	70.0	80.0	92.0
Y	0.0	0.0	0.0	0.0	0.0
F	230.0	341.0	304.0	341.0	298.0
CE	0.0	0.0	0.0	0.0	0.0

ROCKY BOTTOM TONALITE

SAMPLE	170358	170360	170361	170362	170364
PERCENT					
SIO2	65.70	66.50	64.80	64.50	64.70
AL2O3	16.70	17.10	17.20	17.30	17.00
FE2O3	0.41	0.37	0.41	0.61	0.39
FEO	3.19	2.89	3.06	3.28	3.12
MGO	2.27	2.11	2.22	2.36	2.33
CAO	4.60	4.63	4.63	4.55	4.79
NA2O	3.23	3.34	3.41	3.28	3.35
K2O	1.95	2.14	1.87	1.93	3.81
TIO2	0.49	0.43	0.49	0.56	0.46
MNO	0.07	0.06	0.07	0.06	0.08
P2O5	0.12	0.08	0.09	0.15	0.12
LOI	1.38	1.00	1.50	1.75	1.45
TOTAL	100.11	100.65	99.75	100.33	101.60
PPM					
U	1.5	1.5	2.7	1.5	1.5
U2	0.0	0.0	0.0	0.0	0.0
LI	39.0	36.0	38.0	54.0	32.0
BE	2.0	3.0	3.0	3.0	2.0
ZR	105.0	98.0	104.0	129.0	109.0
SR	266.0	243.0	254.0	345.0	255.0
RB	86.0	81.0	73.0	79.0	74.0
ZN	60.0	55.0	58.0	64.0	61.0
CU	29.0	25.0	26.0	25.0	27.0
BA	357.0	302.0	341.0	395.0	354.0
TH	0.0	0.0	0.0	0.0	0.0
MO	2.0	2.0	8.0	4.0	4.0
NB	8.0	7.0	8.0	9.0	8.0
GA	23.0	24.0	24.0	24.0	24.0
PB	20.0	17.0	13.0	9.0	5.0
NI	10.0	8.0	11.0	10.0	12.0
LA	0.0	0.0	0.0	0.0	0.0
CR	24.0	13.0	24.0	17.0	33.0
V	76.0	64.0	71.0	75.0	83.0
Y	0.0	0.0	0.0	0.0	0.0
F	326.0	275.0	250.0	492.0	319.0
CE	0.0	0.0	0.0	0.0	0.0

ROCKY BOTTOM TONALITE

SAMPLE	170365	170367	170369	170371	170373
PERCENT					
SIO2	62.00	63.10	64.00	64.90	63.60
AL2O3	18.10	18.80	17.60	17.30	17.30
FE2O3	0.36	0.43	0.70	0.54	0.51
FEO	3.42	2.88	3.08	2.78	3.27
MGO	2.45	2.32	2.40	2.19	2.79
CAO	5.72	5.84	5.19	4.73	4.32
NA2O	3.35	3.54	3.30	3.42	3.45
K2O	1.35	1.45	2.08	1.95	2.44
TIO2	0.52	0.42	0.46	0.44	0.47
MNO	0.09	0.08	0.07	0.08	0.08
P2O5	0.09	0.07	0.10	0.12	0.12
LOI	1.96	1.67	1.38	1.67	1.40
TOTAL	99.41	100.60	100.36	100.12	99.75
PPM					
U	2.0	1.1	2.0	2.3	4.0
U2	0.0	0.0	0.0	0.0	0.0
LI	33.0	35.0	44.0	43.0	58.0
BE	4.0	2.0	2.0	3.0	2.0
ZR	114.0	104.0	116.0	106.0	103.0
SR	301.0	321.0	262.0	253.0	304.0
RB	49.0	58.0	84.0	68.0	89.0
ZN	59.0	56.0	59.0	53.0	61.0
CU	36.0	31.0	27.0	25.0	32.0
BA	236.0	226.0	319.0	345.0	382.0
TH	0.0	0.0	0.0	0.0	0.0
MO	6.0	1.0	1.0	1.0	2.0
NB	7.0	6.0	7.0	7.0	9.0
GA	25.0	22.0	24.0	21.0	23.0
PB	5.0	14.0	10.0	19.0	12.0
NI	14.0	11.0	10.0	8.0	12.0
LA	0.0	0.0	0.0	0.0	0.0
CR	16.0	18.0	15.0	24.0	29.0
V	92.0	67.0	73.0	69.0	77.0
Y	0.0	0.0	0.0	0.0	0.0
F	204.0	267.0	267.0	319.0	333.0
CE	0.0	0.0	0.0	0.0	0.0

MATTHEWS POND GRDR

SAMPLE	170331	170332	170333	170334	170335
PERCENT					
SIO2	68.70	68.90	69.10	68.10	68.90
AL2O3	16.30	15.80	16.40	16.30	15.60
FE2O3	0.54	0.42	0.32	0.57	0.37
FEO	1.90	1.88	2.12	1.91	1.72
MGO	1.33	1.23	1.36	1.37	1.28
CAO	3.60	3.48	3.29	3.49	3.50
NA2O	3.54	3.47	3.70	3.48	3.50
K2O	2.77	2.59	2.54	2.61	1.82
TIO2	0.38	0.37	0.38	0.37	0.27
MNO	0.07	0.05	0.06	0.06	0.05
P2O5	0.16	0.16	0.18	0.17	0.14
LOI	1.00	1.25	1.35	1.53	1.06
TOTAL	100.29	99.60	100.80	99.96	98.21
PPM					
U	1.6	2.4	1.5	2.2	1.5
U2	0.0	0.0	0.0	0.0	0.0
LI	47.0	41.0	50.0	46.0	49.0
BE	4.0	4.0	4.0	3.0	3.0
ZR	115.0	127.0	138.0	126.0	103.0
SR	266.0	290.0	294.0	288.0	286.0
RB	101.0	92.0	91.0	98.0	78.0
ZN	52.0	49.0	49.0	55.0	50.0
CU	21.0	21.0	24.0	24.0	23.0
BA	470.0	476.0	448.0	442.0	393.0
TH	0.0	0.0	0.0	0.0	0.0
MO	4.0	4.0	2.0	4.0	1.0
NB	10.0	9.0	8.0	8.0	8.0
GA	23.0	23.0	23.0	25.0	22.0
PB	18.0	18.0	13.0	18.0	14.0
NI	6.0	3.0	3.0	5.0	4.0
LA	0.0	0.0	0.0	0.0	0.0
CR	18.0	16.0	17.0	11.0	17.0
V	52.0	42.0	50.0	52.0	38.0
Y	0.0	0.0	0.0	0.0	0.0
F	348.0	319.0	333.0	333.0	304.0
CE	0.0	0.0	0.0	0.0	0.0

MATTHEWS POND GRDR

SAMPLE	170336	170337	170338	170339	170340
PERCENT					
SIO2	69.20	68.80	68.50	66.80	67.10
AL2O3	16.20	16.30	17.10	16.20	15.70
FE2O3	0.22	0.50	0.01	0.41	0.48
FEO	1.86	1.72	2.03	1.96	1.94
MGO	1.21	1.22	0.86	1.34	1.34
CAO	3.29	3.38	3.65	3.62	3.47
NA2O	3.63	3.59	3.99	3.55	3.42
K2O	2.61	2.46	2.48	2.36	2.37
TIO2	0.32	0.35	0.22	0.35	0.38
MNO	0.06	0.06	0.05	0.06	0.06
P2O5	0.17	0.14	0.11	0.18	0.15
LOI	1.31	1.04	0.99	1.38	1.30
TOTAL	100.08	99.56	99.99	98.21	97.71
PPM					
U	2.5	1.7	1.3	1.2	1.5
U2	0.0	0.0	0.0	0.0	0.0
LI	57.0	43.0	43.0	43.0	43.0
BE	4.0	3.0	5.0	2.0	3.0
ZR	112.0	121.0	95.0	126.0	129.0
SR	294.0	276.0	303.0	278.0	272.0
RB	97.0	90.0	85.0	81.0	83.0
ZN	54.0	47.0	42.0	51.0	50.0
CU	25.0	24.0	22.0	23.0	23.0
BA	369.0	454.0	457.0	386.0	428.0
TH	0.0	0.0	0.0	0.0	0.0
MO	2.0	6.0	6.0	4.0	4.0
NB	9.0	10.0	6.0	8.0	11.0
GA	25.0	22.0	22.0	22.0	23.0
PB	15.0	18.0	19.0	14.0	19.0
NI	5.0	2.0	1.0	2.0	2.0
LA	0.0	0.0	0.0	0.0	0.0
CR	19.0	28.0	11.0	29.0	10.0
V	43.0	44.0	30.0	52.0	45.0
Y	0.0	0.0	0.0	0.0	0.0
F	333.0	348.0	240.0	403.0	403.0
CE	0.0	0.0	0.0	0.0	0.0

MATTHEWS POND GRDR

SAMPLE	170341	170342	170343	170344	170345
PERCENT					
SIO2	69.40	69.40	67.40	67.90	68.20
AL2O3	15.70	15.90	16.30	16.30	15.70
FE2O3	0.50	0.33	0.38	0.46	0.13
FEO	1.94	2.02	1.99	2.03	2.25
MGO	1.37	1.27	1.35	1.39	1.37
CAO	3.41	3.34	3.37	3.00	2.90
NA2O	3.47	3.54	3.64	3.58	3.50
K2O	2.42	2.53	2.65	2.74	2.65
TIO2	0.39	0.38	0.37	0.39	0.39
MNO	0.05	0.05	0.05	0.06	0.06
P2O5	0.14	0.16	0.15	0.15	0.17
LOI	1.30	1.11	1.15	2.29	2.28
TOTAL	100.09	100.03	98.80	100.29	99.60
PPM					
U	1.5	1.7	1.6	1.7	1.6
U2	0.0	0.0	0.0	0.0	0.0
LI	41.0	43.0	50.0	43.0	44.0
BE	2.0	3.0	4.0	3.0	3.0
ZR	125.0	123.0	121.0	130.0	130.0
SR	272.0	269.0	279.0	319.0	302.0
RB	81.0	90.0	94.0	97.0	93.0
ZN	50.0	49.0	55.0	53.0	52.0
CU	27.0	24.0	24.0	22.0	22.0
BA	460.0	470.0	462.0	502.0	467.0
TH	0.0	0.0	0.0	0.0	0.0
MO	6.0	4.0	8.0	2.0	4.0
NB	8.0	8.0	8.0	11.0	7.0
GA	22.0	25.0	25.0	23.0	26.0
PB	13.0	24.0	16.0	16.0	11.0
NI	3.0	5.0	7.0	1.0	3.0
LA	0.0	0.0	0.0	0.0	0.0
CR	12.0	25.0	22.0	24.0	16.0
V	46.0	49.0	49.0	48.0	50.0
Y	0.0	0.0	0.0	0.0	0.0
F	333.0	319.0	319.0	333.0	298.0
CE	0.0	0.0	0.0	0.0	0.0

MATTHEWS POND GRDR

SAMPLE	170346	170347	170348	170349
PERCENT				
SIO2	68.90	70.20	69.00	67.50
AL2O3	16.50	16.60	16.20	16.60
FE2O3	0.52	0.64	0.45	0.56
FEO	1.93	1.59	2.02	2.18
MGO	1.36	1.26	1.36	1.55
CAO	3.46	3.48	3.56	3.69
NA2O	3.60	3.66	3.57	3.51
K2O	2.66	2.34	2.51	2.39
TIO2	0.44	0.32	0.90	0.48
MNO	0.07	0.05	0.06	0.07
P2O5	0.15	0.13	0.16	0.18
LOI	1.91	1.66	1.48	1.63
TOTAL	101.50	101.93	101.27	100.34
PPM				
U	1.8	1.8	1.2	1.2
U2	0.0	0.0	0.0	0.0
LI	49.0	45.0	41.0	41.0
BE	4.0	3.0	2.0	2.0
ZR	123.0	103.0	127.0	134.0
SR	274.0	300.0	276.0	305.0
RB	102.0	84.0	90.0	85.0
ZN	49.0	51.0	54.0	57.0
CU	23.0	23.0	24.0	27.0
BA	390.0	400.0	410.0	431.0
TH	0.0	0.0	0.0	0.0
MO	4.0	1.0	2.0	4.0
NB	10.0	8.0	8.0	9.0
GA	24.0	23.0	23.0	22.0
PB	18.0	16.0	17.0	14.0
NI	4.0	5.0	6.0	1.0
LA	0.0	0.0	0.0	0.0
CR	13.0	26.0	20.0	33.0
V	50.0	44.0	53.0	60.0
Y	0.0	0.0	0.0	0.0
F	341.0	129.0	326.0	356.0
CE	0.0	0.0	0.0	0.0

RUND POND GABBRO

SAMPLE	170329	170391	170392	170447	170448
PERCENT					
SIO2	48.60	50.60	49.90	65.10	64.80
AL2O3	18.10	7.20	17.10	15.15	15.50
FE2O3	1.72	1.73	0.89	1.43	1.44
FEO	6.63	8.15	6.82	3.35	3.24
MGO	11.86	22.95	8.84	1.66	1.59
CAO	9.10	7.99	10.30	3.74	3.75
NA2O	2.67	0.74	2.28	3.26	3.40
K2O	0.29	0.19	0.50	3.73	3.74
TIO2	0.95	0.51	1.54	0.84	0.81
MNO	0.13	0.17	0.16	0.10	0.10
P2O5	0.16	0.14	0.11	0.15	0.07
LOI	0.72	0.61	2.21	1.28	1.10
TOTAL	100.93	100.98	100.65	99.79	99.54
PPM					
U	0.2	0.2	0.4	2.7	2.7
U2	0.0	0.0	0.0	0.0	0.0
LI	9.0	6.0	12.0	39.0	40.0
BE	1.0	1.0	1.0	3.0	3.0
ZR	108.0	46.0	66.0	241.0	233.0
SR	329.0	127.0	336.0	240.0	239.0
RB	10.0	10.0	17.0	125.0	126.0
ZN	63.0	96.0	64.0	51.0	51.0
CU	81.0	39.0	43.0	12.0	7.0
BA	37.0	74.0	98.0	576.0	519.0
TH	0.0	0.0	0.0	10.0	9.0
MO	10.0	1.0	2.0	4.0	4.0
NB	4.0	6.0	5.0	13.0	11.0
GA	19.0	16.0	21.0	20.0	18.0
PB	1.0	1.0	1.0	27.0	25.0
NI	245.0	245.0	41.0	29.0	30.0
LA	0.0	0.0	0.0	31.0	36.0
CR	203.0	692.0	134.0	1.0	2.0
V	124.0	131.0	242.0	83.0	78.0
Y	0.0	0.0	0.0	43.0	39.0
F	123.0	135.0	105.0	596.0	520.0
CE	0.0	0.0	0.0	107.0	75.0

RDND POND GABBRO

SAMPLE	170449
PERCENT	
SIO2	64.40
AL2O3	15.65
FE2O3	1.49
FEO	3.22
MGO	1.63
CAO	3.80
NA2O	3.41
K2O	3.72
TIO2	0.83
MNO	0.10
P2O5	0.15
LOI	1.10
TOTAL	99.50
PPM	
U	2.5
U2	0.0
LI	41.0
BE	3.0
ZR	231.0
SR	235.0
RB	126.0
ZN	50.0
CU	3.0
BA	524.0
TH	11.0
MO	3.0
NB	12.0
GA	19.0
PB	28.0
NI	28.0
LA	32.0
CR	2.0
V	80.0
Y	40.0
F	604.0
CE	73.0

PARTRIDGEBERY H GRNT

SAMPLE	170443	170444	170445	170446	170451
PERCENT					
SIO2	70.50	69.10	67.90	69.50	70.10
AL2O3	15.05	14.70	15.15	14.25	15.35
FE2O3	0.40	0.40	0.56	0.38	0.63
FEO	1.82	2.75	3.00	3.08	2.29
MGO	0.56	1.19	1.51	1.36	0.88
CAO	0.59	0.71	0.94	1.42	1.25
NA2O	3.38	2.60	3.12	2.64	3.07
K2O	4.76	4.73	4.54	3.96	4.74
TIO2	0.29	0.48	0.56	0.65	0.55
MNO	0.05	0.05	0.07	0.06	0.04
P2O5	0.21	0.08	0.12	0.06	0.20
LOI	1.56	2.01	2.05	2.56	1.44
TOTAL	99.17	98.80	99.52	99.92	100.54
PPM					
U	2.6	2.5	2.3	2.6	3.0
U2	0.0	0.0	0.0	0.0	0.0
LI	17.0	21.0	24.0	23.0	29.0
BE	4.0	3.0	4.0	3.0	3.0
ZR	112.0	189.0	184.0	208.0	185.0
SR	46.0	77.0	78.0	134.0	112.0
RB	239.0	192.0	176.0	132.0	212.0
ZN	33.0	29.0	39.0	36.0	38.0
CU	7.0	17.0	10.0	2.0	6.0
BA	130.0	485.0	506.0	794.0	474.0
TH	11.0	18.0	14.0	17.0	17.0
MO	2.0	3.0	3.0	2.0	2.0
NB	19.0	19.0	17.0	18.0	18.0
GA	23.0	19.0	16.0	18.0	20.0
PB	26.0	23.0	28.0	15.0	27.0
NI	28.0	31.0	35.0	36.0	35.0
LA	7.0	52.0	36.0	44.0	30.0
CR	1.0	8.0	2.0	9.0	14.0
V	22.0	56.0	58.0	74.0	46.0
Y	25.0	34.0	51.0	39.0	37.0
F	440.0	592.0	580.0	660.0	760.0
CE	146.0	115.0	95.0	151.0	75.0

PARTRIDGEBERY H GRNT

SAMPLE	170452	170453	170454	170455	170456
PERCENT					
SIO2	70.00	69.30	71.90	71.40	73.20
AL2O3	14.60	14.05	14.00	13.90	13.00
FE2O3	0.76	0.07	0.63	0.55	0.68
FEO	3.28	3.76	2.20	2.95	3.42
MGO	1.52	1.71	1.16	1.17	1.38
CAO	1.16	1.04	1.13	1.42	1.37
NA2O	2.96	3.62	2.79	2.53	2.14
K2O	3.93	3.37	4.45	4.16	3.18
TIO2	0.71	0.71	0.52	0.46	0.72
MNO	0.06	0.06	0.05	0.04	0.05
P2O5	0.17	0.17	0.10	0.21	0.11
LOI	1.77	1.89	1.51	1.67	1.90
TOTAL	100.92	99.75	100.44	100.46	101.15
PPM					
U	2.6	2.5	3.5	3.4	1.8
U2	0.0	0.0	0.0	0.0	0.0
LI	44.0	37.0	39.0	36.0	22.0
BE	3.0	3.0	3.0	3.0	3.0
ZR	214.0	206.0	158.0	206.0	250.0
SR	127.0	105.0	82.0	112.0	114.0
RB	154.0	133.0	187.0	158.0	121.0
ZN	62.0	39.0	31.0	37.0	52.0
CU	13.0	34.0	11.0	13.0	15.0
BA	622.0	522.0	442.0	553.0	643.0
TH	16.0	16.0	15.0	16.0	19.0
MO	2.0	3.0	3.0	2.0	2.0
NB	20.0	18.0	16.0	21.0	20.0
GA	20.0	17.0	17.0	18.0	19.0
PB	25.0	19.0	28.0	31.0	23.0
NI	32.0	31.0	33.0	32.0	34.0
LA	48.0	38.0	35.0	35.0	42.0
CR	14.0	12.0	4.0	1.0	19.0
V	58.0	69.0	44.0	44.0	81.0
Y	44.0	48.0	43.0	40.0	37.0
F	540.0	596.0	440.0	588.0	560.0
CE	88.0	92.0	86.0	117.0	112.0

PARTRIDGEBERY H GRNT

SAMPLE	170457	170458	170459	170460	170461
PERCENT					
SIO2	69.80	67.90	72.50	71.10	70.00
AL2O3	14.05	14.70	13.10	14.13	14.05
FE2O3	0.44	0.71	0.20	0.25	0.48
FEO	2.91	3.85	2.61	2.67	3.72
MGO	1.53	1.50	1.18	1.67	2.03
CAO	1.15	1.43	1.34	0.86	1.38
NA2O	3.50	2.69	2.52	3.00	3.19
K2O	2.80	3.87	3.93	4.23	3.06
TIO2	0.59	0.82	0.45	0.43	0.78
MNO	0.06	0.07	0.05	0.05	0.06
P2O5	0.20	0.17	0.19	0.11	0.23
LOI	2.25	2.17	1.61	2.00	1.38
TOTAL	99.28	99.88	99.68	100.51	100.36
PPM					
U	2.7	3.2	2.6	2.8	3.2
U2	0.0	0.0	0.0	0.0	0.0
LI	32.0	43.0	27.0	39.0	29.0
BE	3.0	3.0	3.0	3.0	3.0
ZR	181.0	238.0	142.0	185.0	220.0
SR	70.0	145.0	102.0	88.0	113.0
RB	146.0	150.0	150.0	146.0	129.0
ZN	42.0	64.0	28.0	37.0	46.0
CU	6.0	10.0	10.0	4.0	18.0
BA	367.0	619.0	497.0	510.0	520.0
TH	15.0	14.0	10.0	15.0	15.0
MO	2.0	2.0	2.0	2.0	2.0
NB	17.0	21.0	12.0	16.0	20.0
GA	18.0	18.0	13.0	18.0	19.0
PB	23.0	21.0	29.0	31.0	29.0
NI	32.0	36.0	29.0	29.0	34.0
LA	33.0	39.0	19.0	36.0	38.0
CR	3.0	16.0	6.0	1.0	20.0
V	60.0	73.0	45.0	38.0	78.0
Y	44.0	54.0	51.0	45.0	48.0
F	480.0	588.0	360.0	508.0	644.0
CE	90.0	90.0	108.0	143.0	125.0

PARTRIDGEBERY H GRNT

SAMPLE	170462	170463	170464	170465	170466
PERCENT					
SIO2	71.70	67.20	71.90	70.60	69.50
AL2O3	14.35	15.80	13.30	14.55	14.85
FE2O3	0.41	0.34	0.52	0.63	0.67
FEO	2.59	3.60	3.21	2.03	2.86
MGO	1.12	1.25	1.27	0.70	1.37
CAO	1.41	2.53	1.56	0.79	2.18
NA2O	3.23	3.11	2.21	3.19	3.02
K2O	3.56	4.08	3.73	4.57	4.08
TIO2	0.58	0.71	0.76	0.64	0.69
MNO	0.04	0.08	0.05	0.04	0.08
P2O5	0.13	0.20	0.17	0.18	0.11
LOI	1.99	1.19	2.00	1.97	1.57
TOTAL	101.11	100.09	100.68	99.89	100.98
PPM					
U	2.3	4.2	1.9	3.1	3.7
U2	0.0	0.0	0.0	0.0	0.0
LI	15.0	47.0	24.0	17.0	46.0
BE	2.0	3.0	2.0	3.0	3.0
ZR	189.0	206.0	236.0	277.0	196.0
SR	117.0	131.0	156.0	56.0	151.0
RB	130.0	179.0	122.0	143.0	175.0
ZN	30.0	46.0	46.0	16.0	41.0
CU	8.0	11.0	14.0	5.0	13.0
BA	576.0	502.0	873.0	697.0	541.0
TH	15.0	15.0	20.0	17.0	17.0
MO	3.0	4.0	3.0	3.0	3.0
NB	15.0	18.0	20.0	21.0	16.0
GA	14.0	22.0	16.0	20.0	20.0
PB	16.0	29.0	27.0	14.0	32.0
NI	20.0	41.0	34.0	30.0	39.0
LA	27.0	26.0	41.0	43.0	38.0
CR	9.0	8.0	18.0	1.0	25.0
V	62.0	59.0	71.0	49.0	59.0
Y	30.0	53.0	42.0	50.0	52.0
F	486.0	552.0	664.0	476.0	546.0
CE	126.0	141.0	109.0	117.0	102.0

PARTRIDGEBERY H GRNT

SAMPLE	170467	170468	170469	170471	170472
PERCENT					
SIO2	77.20	69.30	76.10	67.20	69.60
AL2O3	13.05	14.75	12.40	14.90	14.40
FE2O3	0.22	0.48	0.12	0.67	0.60
FEO	1.12	3.07	1.41	3.33	2.99
MGO	0.62	1.56	0.43	1.36	1.34
CAO	0.40	1.37	0.28	1.68	1.16
NA2O	3.15	2.74	2.53	2.37	2.84
K2O	4.00	4.08	4.86	4.38	4.11
TIO2	0.13	0.62	0.20	0.73	0.59
MNO	0.01	0.06	0.02	0.04	0.05
P2O5	0.21	0.13	0.19	0.20	0.20
LOI	1.41	1.93	1.19	2.73	1.54
TOTAL	101.52	100.09	99.73	99.59	99.42
PPM					
U	4.2	2.6	2.8	1.9	3.0
U2	0.0	0.0	0.0	0.0	0.0
LI	10.0	40.0	18.0	30.0	83.0
BE	2.0	3.0	2.0	3.0	3.0
ZR	84.0	195.0	91.0	231.0	222.0
SR	37.0	94.0	33.0	140.0	133.0
RB	166.0	167.0	202.0	173.0	159.0
ZN	12.0	43.0	16.0	49.0	50.0
CU	4.0	17.0	1.0	9.0	15.0
BA	142.0	537.0	99.0	808.0	602.0
TH	12.0	15.0	11.0	20.0	17.0
MO	2.0	2.0	2.0	2.0	4.0
NB	16.0	18.0	14.0	21.0	22.0
GA	18.0	20.0	15.0	18.0	21.0
PB	12.0	20.0	22.0	21.0	25.0
NI	22.0	32.0	24.0	38.0	29.0
LA	5.0	32.0	16.0	46.0	37.0
CR	1.0	3.0	1.0	16.0	1.0
V	8.0	54.0	11.0	74.0	47.0
Y	35.0	53.0	35.0	34.0	38.0
F	396.0	560.0	420.0	840.0	552.0
CE	49.0	79.0	78.0	101.0	150.0

PARTRIDGEBERY H GRNT

SAMPLE	170473	170474	170475	170476	170477
PERCENT					
SIO2	67.10	69.60	68.20	71.40	69.60
AL2O3	15.00	14.15	14.60	13.85	15.15
FE2O3	0.49	0.59	0.42	0.57	0.47
FEO	4.05	3.56	3.69	3.35	2.96
MGO	1.77	2.23	1.92	1.26	1.76
CAO	1.14	0.81	1.10	1.02	0.72
NA2O	2.86	2.29	2.55	2.78	3.22
K2O	3.89	4.19	4.18	4.01	4.02
TIO2	0.60	0.73	0.77	0.60	0.60
MNO	0.07	0.06	0.07	0.06	0.06
P2O5	0.23	0.19	0.23	0.15	0.20
LOI	2.27	1.69	1.94	1.94	2.01
TOTAL	99.47	100.09	99.67	100.99	100.77
PPM					
U	3.2	2.7	3.1	2.9	2.6
U2	0.0	0.0	0.0	0.0	0.0
LI	28.0	25.0	28.0	25.0	50.0
BE	4.0	3.0	3.0	4.0	4.0
ZR	254.0	223.0	240.0	241.0	203.0
SR	105.0	70.0	88.0	95.0	89.0
RB	149.0	163.0	163.0	145.0	174.0
ZN	56.0	54.0	46.0	59.0	37.0
CU	11.0	1.0	7.0	8.0	24.0
BA	553.0	578.0	603.0	615.0	541.0
TH	17.0	16.0	16.0	15.0	15.0
MO	3.0	4.0	3.0	1.0	3.0
NB	22.0	20.0	21.0	19.0	18.0
GA	22.0	15.0	20.0	18.0	20.0
PB	24.0	25.0	20.0	26.0	23.0
NI	37.0	32.0	34.0	31.0	34.0
LA	44.0	37.0	40.0	36.0	25.0
CR	5.0	8.0	25.0	1.0	1.0
V	58.0	70.0	76.0	49.0	58.0
Y	61.0	43.0	51.0	57.0	47.0
F	560.0	600.0	680.0	440.0	540.0
CE	102.0	105.0	95.0	97.0	130.0

PARTRIDGEBERY H GRNT

SAMPLE	170478	170479	170480	170481	170482
PERCENT					
SIO2	68.40	71.90	67.50	70.90	70.00
AL2O3	14.35	13.70	15.75	14.23	13.53
FE2O3	0.61	0.51	0.66	0.46	0.59
FEO	2.98	2.50	3.45	2.98	3.45
MGO	1.46	1.16	1.50	1.22	1.77
CAO	1.13	1.23	1.93	0.79	0.87
NA2O	3.45	3.20	3.29	2.53	2.24
K2O	3.94	4.40	3.97	4.59	4.01
TIO2	0.63	0.54	0.72	0.55	0.69
MNO	0.07	0.06	0.08	0.05	0.06
P2O5	0.15	0.17	0.20	0.21	0.17
LOI	2.04	1.69	1.97	2.08	2.55
TOTAL	99.21	101.06	101.02	100.59	99.93
PPM					
U	2.4	2.9	2.7	2.8	2.6
U2	0.0	0.0	0.0	0.0	0.0
LI	38.0	25.0	25.0	26.0	38.0
BE	3.0	3.0	4.0	3.0	3.0
ZR	195.0	199.0	207.0	214.0	202.0
SR	125.0	96.0	132.0	107.0	62.0
RB	155.0	157.0	145.0	165.0	155.0
ZN	41.0	46.0	42.0	50.0	51.0
CU	4.0	6.0	17.0	13.0	20.0
BA	532.0	566.0	508.0	608.0	542.0
TH	13.0	17.0	15.0	14.0	14.0
MO	2.0	2.0	2.0	2.0	3.0
NB	16.0	18.0	18.0	20.0	18.0
GA	17.0	16.0	21.0	19.0	19.0
PB	21.0	21.0	23.0	24.0	23.0
NI	34.0	35.0	38.0	31.0	36.0
LA	29.0	32.0	28.0	31.0	33.0
CR	1.0	1.0	1.0	1.0	8.0
V	63.0	43.0	66.0	49.0	69.0
Y	57.0	55.0	54.0	42.0	45.0
F	568.0	552.0	600.0	480.0	640.0
CE	135.0	167.0	131.0	148.0	128.0

PARTRIDGEBERY H GRNT

SAMPLE	170483	170484	170485	170486	170487
PERCENT					
SIO2	69.00	67.80	68.00	66.70	67.30
AL2O3	15.30	15.55	14.50	15.55	15.20
FE2O3	0.81	0.49	0.66	0.48	0.44
FEO	3.08	2.90	3.30	3.70	3.23
MGO	1.20	1.61	1.42	1.52	1.27
CAO	2.16	2.19	1.57	2.11	1.62
NA2O	3.21	3.16	2.81	2.73	2.87
K2O	4.08	4.14	4.05	3.76	4.31
TIO2	0.58	0.57	0.72	0.88	0.74
MNO	0.07	0.06	0.06	0.06	0.05
P2O5	0.20	0.16	0.23	0.17	0.20
LOI	1.72	1.60	1.67	1.66	2.10
TOTAL	101.51	100.23	98.99	99.32	99.33
PPM					
U	4.5	4.3	3.4	2.0	2.1
U2	0.0	0.0	0.0	0.0	0.0
LI	45.0	46.0	39.0	31.0	28.0
BE	4.0	5.0	3.0	3.0	3.0
ZR	212.0	176.0	218.0	254.0	219.0
SR	139.0	155.0	135.0	195.0	151.0
RB	180.0	194.0	165.0	140.0	162.0
ZN	47.0	42.0	48.0	47.0	45.0
CU	7.0	14.0	9.0	12.0	12.0
BA	549.0	499.0	589.0	954.0	796.0
TH	14.0	15.0	15.0	17.0	20.0
MO	4.0	2.0	4.0	6.0	3.0
NB	19.0	15.0	23.0	19.0	20.0
GA	19.0	20.0	16.0	17.0	19.0
PB	27.0	29.0	25.0	25.0	21.0
NI	36.0	36.0	31.0	36.0	34.0
LA	34.0	21.0	29.0	43.0	37.0
CR	1.0	3.0	7.0	22.0	7.0
V	57.0	48.0	62.0	93.0	77.0
Y	52.0	38.0	47.0	37.0	39.0
F	560.0	440.0	520.0	552.0	568.0
CE	118.0	88.0	99.0	123.0	155.0

PARTRIDGEBERY H GRNT

SAMPLE	170488	170489	170491	170492	170493
PERCENT					
SIO2	74.00	69.80	74.30	69.60	69.00
AL2O3	13.95	14.25	13.75	14.50	14.30
FE2O3	0.01	0.58	0.28	0.81	0.63
FEO	1.01	3.09	1.19	3.37	3.78
MGO	0.29	1.35	0.92	1.74	1.88
CAO	0.45	1.65	0.42	1.61	0.82
NA2O	3.55	3.62	3.92	2.89	2.50
K2O	4.68	3.03	2.49	3.80	4.17
TIO2	0.06	0.63	0.16	0.78	0.78
MNO	0.03	0.07	0.03	0.07	0.06
P2O5	0.29	0.17	0.20	0.21	0.20
LOI	1.37	2.10	1.83	1.91	2.39
TOTAL	99.69	100.34	99.49	101.29	100.51
PPM					
U	2.2	4.3	3.5	3.0	2.3
U2	0.0	0.0	0.0	0.0	0.0
LI	38.0	29.0	21.0	37.0	31.0
BE	2.0	4.0	3.0	3.0	2.0
ZR	31.0	214.0	76.0	224.0	234.0
SR	12.0	128.0	31.0	128.0	96.0
RB	344.0	115.0	137.0	158.0	120.0
ZN	16.0	47.0	10.0	40.0	52.0
CU	1.0	10.0	1.0	8.0	22.0
BA	57.0	593.0	129.0	472.0	574.0
TH	6.0	15.0	10.0	16.0	15.0
MO	3.0	4.0	3.0	3.0	3.0
NB	17.0	19.0	15.0	19.0	20.0
GA	18.0	18.0	18.0	18.0	19.0
PB	15.0	24.0	15.0	23.0	23.0
NI	28.0	33.0	19.0	36.0	31.0
LA	1.0	35.0	9.0	24.0	37.0
CR	1.0	1.0	1.0	1.0	1.0
V	1.0	59.0	14.0	72.0	76.0
Y	13.0	52.0	30.0	48.0	51.0
F	632.0	440.0	460.0	580.0	480.0
CE	181.0	136.0	183.0	161.0	153.0

PARTRIDGEBERY H GRNT

SAMPLE	170494	171495	170496	170497	170498
PERCENT					
SIO2	69.00	76.60	71.90	69.00	73.30
AL2O3	14.95	12.75	14.40	15.20	12.75
FE2O3	0.34	0.18	0.51	0.58	0.19
FEO	3.54	1.66	2.51	2.82	2.21
MGO	1.31	0.72	0.98	1.21	1.09
CAO	2.50	0.51	1.80	1.74	0.91
NA2O	2.88	3.12	3.11	3.16	2.22
K2O	4.00	4.44	4.18	4.49	5.72
TIO2	0.81	0.33	0.58	0.63	0.46
MNO	0.05	0.03	0.06	0.07	0.04
P2O5	0.15	0.14	0.17	0.17	0.12
LOI	1.33	1.17	1.30	1.46	1.87
TOTAL	100.86	101.65	101.50	100.53	100.88
PPM					
U	2.1	3.3	2.9	3.1	2.3
U2	0.0	0.0	0.0	0.0	0.0
LI	25.0	13.0	20.0	48.0	33.0
BE	2.0	2.0	3.0	3.0	3.0
ZR	205.0	116.0	163.0	177.0	157.0
SR	144.0	15.0	140.0	122.0	47.0
RB	137.0	111.0	147.0	184.0	165.0
ZN	48.0	15.0	28.0	36.0	20.0
CU	14.0	6.0	1.0	10.0	1.0
BA	668.0	412.0	477.0	472.0	603.0
TH	16.0	11.0	16.0	17.0	16.0
MO	3.0	3.0	2.0	2.0	2.0
NB	19.0	9.0	15.0	16.0	14.0
GA	20.0	12.0	16.0	17.0	13.0
PB	25.0	28.0	27.0	32.0	26.0
NI	28.0	23.0	27.0	35.0	34.0
LA	32.0	26.0	31.0	21.0	22.0
CR	12.0	1.0	2.0	1.0	1.0
V	73.0	30.0	45.0	56.0	34.0
Y	27.0	35.0	40.0	55.0	55.0
F	504.0	256.0	420.0	10.0	168.0
CE	93.0	90.0	90.0	152.0	168.0

PARTRIDGEBERY H GRNT

SAMPLE	170499	170500	170525	170526	170527
PERCENT					
SIO2	69.50	69.40	66.40	76.60	75.00
AL2O3	15.10	14.70	16.15	13.40	14.35
FE2O3	0.59	0.63	0.89	0.20	0.37
FEO	3.18	2.86	2.98	0.97	0.74
MGO	1.86	1.15	1.48	0.26	0.45
CAO	0.63	1.80	1.65	0.38	0.40
NA2O	3.31	2.94	3.41	3.13	3.70
K2O	3.61	4.47	4.04	4.85	4.58
TIO2	0.58	0.64	0.66	0.13	0.11
MNO	0.06	0.07	0.08	0.03	0.03
P2O5	0.20	0.12	0.16	0.20	0.24
LOI	2.30	1.31	1.86	1.26	1.35
TOTAL	100.92	100.09	99.76	101.41	101.32
PPM					
U	2.7	3.0	3.4	2.9	5.5
U2	0.0	0.0	0.0	0.0	0.0
LI	42.0	37.0	31.0	18.0	24.0
BE	3.0	4.0	4.0	3.0	3.0
ZR	184.0	187.0	190.0	54.0	52.0
SR	76.0	127.0	180.0	39.0	29.0
RB	159.0	184.0	149.0	221.0	221.0
ZN	35.0	40.0	36.0	14.0	21.0
CU	10.0	8.0	7.0	1.0	1.0
BA	357.0	543.0	538.0	112.0	94.0
TH	17.0	15.0	16.0	9.0	7.0
MO	2.0	3.0	4.0	2.0	2.0
NB	18.0	16.0	18.0	12.0	15.0
GA	17.0	15.0	15.0	15.0	16.0
PB	24.0	25.0	27.0	32.0	18.0
NI	34.0	35.0	27.0	24.0	22.0
LA	23.0	29.0	25.0	3.0	2.0
CR	1.0	1.0	1.0	1.0	1.0
V	67.0	59.0	61.0	6.0	5.0
Y	51.0	49.0	50.0	20.0	22.0
F	116.0	88.0	520.0	336.0	432.0
CE	155.0	151.0	158.0	158.0	139.0

PARTRIDGEBERY H GRNT

SAMPLE	170528	170529	170531	170532	170533
PERCENT					
SIO2	74.80	69.90	74.60	74.50	66.30
AL2O3	14.10	14.25	14.25	14.30	16.05
FE2O3	0.45	0.71	0.54	0.24	0.87
FEO	0.65	3.17	0.89	1.00	3.31
MGO	0.45	1.33	0.55	0.26	1.40
CAO	0.40	1.27	0.33	0.39	2.04
NA2O	3.70	2.76	3.16	3.54	2.92
K2O	4.53	4.63	4.90	4.96	4.11
TIO2	0.10	0.65	0.22	0.12	0.87
MNO	0.03	0.07	0.02	0.03	0.06
P2O5	0.22	0.20	0.20	0.22	0.18
LOI	1.33	2.53	1.49	1.17	1.99
TOTAL	100.76	101.47	101.15	100.73	100.10
PPM					
U	5.2	2.5	4.1	4.1	1.9
U2	0.0	0.0	0.0	0.0	0.0
LI	24.0	33.0	14.0	19.0	23.0
BE	3.0	4.0	3.0	2.0	3.0
ZR	49.0	218.0	93.0	48.0	252.0
SR	28.0	75.0	40.0	27.0	202.0
RB	220.0	163.0	229.0	241.0	139.0
ZN	14.0	45.0	7.0	17.0	40.0
CU	4.0	7.0	4.0	1.0	7.0
BA	98.0	596.0	282.0	82.0	925.0
TH	7.0	16.0	10.0	9.0	19.0
MO	2.0	2.0	4.0	2.0	3.0
NB	13.0	19.0	15.0	15.0	19.0
GA	18.0	18.0	19.0	16.0	19.0
PB	18.0	23.0	21.0	27.0	23.0
NI	20.0	34.0	21.0	22.0	30.0
LA	3.0	31.0	17.0	2.0	42.0
CR	1.0	1.0	1.0	1.0	25.0
V	5.0	66.0	22.0	1.0	91.0
Y	21.0	41.0	20.0	20.0	39.0
F	480.0	620.0	346.0	368.0	640.0
CE	121.0	164.0	147.0	70.0	131.0

PARTRIDGEBERY H GRNT

SAMPLE	170534	170535	170536	170537	170538
PERCENT					
SIO2	74.90	76.40	79.30	67.40	73.80
AL2O3	14.30	13.45	12.35	15.80	13.65
FE2O3	0.15	0.21	0.01	0.65	0.20
FEO	0.94	0.81	1.18	3.52	2.09
MGO	0.22	0.32	0.61	2.62	0.69
CAO	0.43	0.26	0.38	1.30	0.82
NA2O	3.59	3.04	6.07	3.09	2.79
K2O	4.99	5.38	0.19	4.02	4.87
TIO2	0.09	0.08	0.19	0.78	0.41
MNO	0.03	0.02	0.02	0.07	0.05
P2O5	0.24	0.20	0.11	0.18	0.15
LOI	1.19	1.09	0.89	1.66	1.33
TOTAL	101.07	101.26	101.30	101.09	100.85
PPM					
U	2.6	3.7	1.5	3.5	3.2
U2	0.0	0.0	0.0	0.0	0.0
LI	19.0	13.0	24.0	28.0	39.0
BE	3.0	2.0	1.0	4.0	3.0
ZR	45.0	56.0	103.0	258.0	127.0
SR	21.0	27.0	46.0	117.0	75.0
RB	264.0	238.0	5.0	133.0	219.0
ZN	19.0	18.0	1.0	45.0	37.0
CU	1.0	3.0	1.0	8.0	9.0
BA	69.0	112.0	46.0	537.0	336.0
TH	8.0	8.0	8.0	14.0	14.0
MO	4.0	4.0	4.0	4.0	3.0
NB	14.0	10.0	6.0	27.0	17.0
GA	15.0	16.0	10.0	20.0	17.0
PB	27.0	32.0	3.0	21.0	29.0
NI	23.0	22.0	14.0	35.0	34.0
LA	8.0	1.0	13.0	59.0	20.0
CR	1.0	1.0	1.0	12.0	1.0
V	1.0	6.0	12.0	98.0	35.0
Y	20.0	21.0	70.0	50.0	35.0
F	328.0	344.0	136.0	1080.0	720.0
CE	85.0	154.0	139.0	137.0	101.0

PARTRIDGEBERY H GRNT

SAMPLE	170539	170540	170541	170542	170543
PERCENT					
SIO2	65.80	74.40	69.30	69.10	70.50
AL2O3	15.85	13.25	14.45	14.70	14.80
FE2O3	0.56	0.10	0.81	0.56	0.49
FEO	3.89	1.39	3.32	3.30	3.13
MGO	1.55	0.60	1.52	1.73	1.33
CAO	1.93	0.55	1.52	1.96	1.18
NA2O	2.82	3.09	2.89	3.56	2.89
K2O	3.96	4.79	4.25	3.10	3.82
TIO2	0.93	0.23	0.74	0.73	0.69
MNO	0.07	0.04	0.08	0.06	0.05
P2O5	0.13	0.17	0.15	0.15	0.14
LOI	2.21	1.28	1.82	1.36	2.44
TOTAL	99.70	99.89	100.85	100.31	101.46
PPM					
U	1.9	2.4	3.2	1.8	1.7
U2	0.0	0.0	0.0	0.0	0.0
LI	24.0	34.0	30.0	138.0	20.0
BE	3.0	3.0	3.0	3.0	3.0
ZR	274.0	91.0	230.0	224.0	225.0
SR	218.0	42.0	125.0	183.0	132.0
RB	133.0	223.0	149.0	116.0	110.0
ZN	54.0	21.0	54.0	24.0	51.0
CU	22.0	5.0	20.0	2.0	14.0
BA	933.0	206.0	602.0	566.0	780.0
TH	19.0	11.0	14.0	15.0	17.0
MO	2.0	2.0	2.0	1.0	2.0
NB	19.0	15.0	18.0	20.0	18.0
GA	23.0	16.0	18.0	19.0	19.0
PB	27.0	24.0	20.0	23.0	23.0
NI	40.0	28.0	33.0	33.0	28.0
LA	45.0	14.0	36.0	32.0	40.0
CR	22.0	1.0	12.0	16.0	17.0
V	93.0	16.0	65.0	65.0	74.0
Y	37.0	27.0	47.0	47.0	36.0
F	940.0	640.0	680.0	760.0	640.0
CF	147.0	112.0	79.0	71.0	100.0

PARTRIDGEBERY H GRNT

SAMPLE	170568	170569	170571
PERCENT			
SIO2	72.60	71.00	70.60
AL2O3	14.65	14.30	14.10
FE2O3	0.26	0.35	0.38
FEO	1.66	2.17	2.13
MGO	0.50	0.78	0.78
CAO	0.93	1.24	1.24
NA2O	3.21	3.14	3.19
K2O	5.22	4.39	4.46
TIO2	0.33	0.43	0.44
MNO	0.04	0.04	0.04
P2O5	0.04	0.06	0.05
LOI	1.17	1.86	1.77
TOTAL	100.61	99.76	99.18
PPM			
U	3.2	2.4	2.5
U2	0.0	0.0	0.0
LI	24.0	18.0	19.0
BE	3.0	3.0	3.0
ZR	118.0	163.0	162.0
SR	79.0	85.0	85.0
RB	239.0	159.0	159.0
ZN	22.0	31.0	32.0
CU	2.0	4.0	3.0
BA	306.0	499.0	503.0
TH	14.0	14.0	15.0
MO	1.0	2.0	3.0
NB	16.0	15.0	16.0
GA	20.0	19.0	16.0
PB	30.0	23.0	26.0
NI	33.0	32.0	29.0
LA	28.0	29.0	32.0
CR	7.0	8.0	21.0
V	25.0	41.0	43.0
Y	26.0	35.0	36.0
F	216.0	640.0	880.0
CE	58.0	75.0	77.0

THROUGH HILL GRANITE

SAMPLE	170501	170502	170503	170504	170505
PERCENT					
SIO2	72.80	76.20	76.10	73.30	75.70
AL2O3	14.80	13.90	14.75	14.15	14.05
FE2O3	0.01	0.01	0.01	0.01	0.01
FEO	0.63	0.36	0.68	1.05	1.03
MGO	0.20	0.11	0.13	0.14	0.11
CAO	0.53	0.47	0.90	0.78	0.74
NA2O	3.00	4.09	4.12	3.28	3.28
K2O	5.80	4.41	3.93	4.80	4.79
TIO2	0.11	0.04	0.04	0.02	0.03
MNO	0.03	0.06	0.19	0.36	0.36
P2O5	0.26	0.22	0.17	0.17	0.19
LOI	1.23	0.88	0.75	0.64	0.65
TOTAL	99.40	100.75	101.77	98.70	100.94
PPM					
U	1.3	2.2	4.4	4.2	4.0
U2	0.0	0.0	0.0	0.0	0.0
LI	58.0	6.0	14.0	14.0	14.0
BE	3.0	3.0	2.0	2.0	2.0
ZR	7.0	22.0	90.0	55.0	52.0
SR	68.0	54.0	127.0	100.0	99.0
RB	161.0	144.0	124.0	126.0	124.0
ZN	3.0	1.0	1.0	1.0	1.0
CU	1.0	1.0	1.0	1.0	4.0
BA	221.0	135.0	172.0	190.0	190.0
TH	2.0	2.0	6.0	4.0	3.0
MO	2.0	2.0	3.0	3.0	1.0
NB	17.0	5.0	9.0	6.0	5.0
GA	17.0	10.0	14.0	11.0	14.0
PB	44.0	50.0	47.0	52.0	52.0
NI	14.0	9.0	8.0	9.0	13.0
LA	1.0	1.0	2.0	1.0	1.0
CR	1.0	1.0	1.0	1.0	1.0
V	2.0	2.0	1.0	1.0	1.0
Y	11.0	5.0	11.0	12.0	12.0
F	68.0	152.0	104.0	83.0	92.0
CE	131.0	152.0	127.0	91.0	87.0

THROUGH HILL GRANITE

SAMPLE	170506	170507	170508	170509	170511
PERCENT					
SIO2	74.20	75.30	75.80	75.50	74.40
AL2O3	13.60	15.00	14.85	14.83	15.25
FE2O3	0.01	0.01	0.01	0.01	0.01
FEO	0.39	0.29	0.37	0.37	0.26
MGO	0.12	0.12	0.13	0.13	0.06
CAO	0.58	0.52	0.53	0.53	0.47
NA2O	4.28	4.40	4.33	4.34	3.73
K2O	3.84	4.08	3.67	3.66	6.46
TIO2	0.05	0.05	0.04	0.04	0.02
MNO	0.02	0.01	0.01	0.01	0.04
P2O5	0.26	0.19	0.16	0.15	0.18
LOI	0.75	1.07	1.19	1.20	0.75
TOTAL	98.10	101.04	101.09	100.77	101.63
PPM					
U	3.7	1.3	2.0	1.9	0.9
U2	0.0	0.0	0.0	0.0	0.0
LI	15.0	5.0	8.0	8.0	3.0
BE	3.0	3.0	3.0	2.0	2.0
ZR	24.0	18.0	33.0	33.0	13.0
SR	31.0	80.0	82.0	81.0	54.0
RB	157.0	105.0	99.0	98.0	160.0
ZN	1.0	1.0	1.0	1.0	1.0
CU	1.0	1.0	1.0	1.0	1.0
BA	118.0	177.0	113.0	114.0	94.0
TH	4.0	4.0	4.0	3.0	3.0
MO	1.0	2.0	3.0	3.0	3.0
NB	10.0	8.0	10.0	9.0	5.0
GA	12.0	12.0	12.0	13.0	10.0
PB	33.0	39.0	35.0	33.0	55.0
NI	11.0	6.0	8.0	4.0	10.0
LA	1.0	1.0	1.0	4.0	1.0
CR	1.0	1.0	1.0	1.0	1.0
V	1.0	1.0	1.0	1.0	1.0
Y	9.0	10.0	13.0	14.0	4.0
F	188.0	204.0	148.0	186.0	60.0
CE	61.0	75.0	67.0	76.0	88.0

THROUGH HILL GRANITE

SAMPLE	170512	170513	170514	170515	170516
PERCENT					
SIO2	74.40	74.80	73.90	74.40	75.90
AL2O3	14.80	14.43	14.35	15.05	14.80
FE2O3	0.07	0.01	0.01	0.01	0.01
FEO	0.76	0.13	0.14	0.59	0.43
MGO	0.10	0.03	0.03	0.19	0.12
CAO	0.64	0.16	0.16	0.70	0.70
NA2O	4.76	1.91	1.90	4.52	4.40
K2O	3.47	9.29	9.33	4.08	3.70
TIO2	0.01	0.01	0.02	0.05	0.04
MNO	0.26	0.01	0.01	0.04	0.03
P2O5	0.19	0.17	0.19	0.17	0.27
LOI	0.67	0.69	0.65	0.90	0.96
TOTAL	100.13	101.64	100.69	100.70	101.36
PPM					
U	8.9	0.9	0.6	2.2	4.4
U2	0.0	0.0	0.0	0.0	0.0
LI	5.0	1.0	1.0	10.0	50.0
BE	3.0	1.0	1.0	2.0	7.0
ZR	42.0	5.0	5.0	36.0	14.0
SR	46.0	108.0	108.0	55.0	28.0
RB	81.0	171.0	171.0	116.0	163.0
ZN	1.0	1.0	1.0	1.0	1.0
CU	1.0	1.0	2.0	1.0	1.0
BA	145.0	490.0	519.0	60.0	11.0
TH	2.0	2.0	5.0	5.0	5.0
MO	1.0	2.0	2.0	2.0	2.0
NB	3.0	1.0	1.0	10.0	19.0
GA	10.0	9.0	8.0	13.0	16.0
PB	38.0	81.0	85.0	40.0	30.0
NI	3.0	10.0	13.0	11.0	12.0
LA	4.0	1.0	4.0	1.0	1.0
CR	1.0	1.0	1.0	1.0	1.0
V	1.0	1.0	1.0	1.0	1.0
Y	12.0	1.0	2.0	15.0	5.0
F	58.0	54.0	48.0	132.0	316.0
CE	83.0	147.0	67.0	15.0	96.0

THROUGH HILL GRANITE

SAMPLE	170517	170518	170519	170520	170521
PERCENT					
SIO2	73.20	74.90	74.80	74.50	76.50
AL2O3	16.20	15.30	15.30	14.70	14.50
FE2O3	0.02	0.01	0.01	0.01	0.01
FEO	0.43	0.51	0.50	0.68	0.55
MGO	0.16	0.19	0.19	0.12	0.06
CAO	0.63	0.77	0.77	0.90	0.50
NA2O	5.15	5.71	5.69	3.93	4.52
K2O	3.19	1.99	2.00	4.59	4.25
TIO2	0.06	0.05	0.04	0.03	0.01
MNO	0.02	0.03	0.03	0.22	0.14
P2O5	0.20	0.23	0.20	0.14	0.17
LOI	1.03	0.91	0.84	0.67	0.59
TOTAL	100.29	100.60	100.37	100.49	101.80
PPM					
U	2.8	4.1	3.9	1.4	3.4
U2	0.0	0.0	0.0	0.0	0.0
LI	27.0	20.0	19.0	9.0	10.0
BE	4.0	4.0	4.0	3.0	2.0
ZR	14.0	48.0	47.0	39.0	30.0
SR	35.0	34.0	34.0	129.0	7.0
RB	97.0	69.0	70.0	120.0	105.0
ZN	1.0	1.0	1.0	1.0	1.0
CU	1.0	1.0	1.0	1.0	1.0
BA	53.0	18.0	26.0	297.0	1.0
TH	5.0	3.0	4.0	2.0	4.0
MO	2.0	1.0	3.0	3.0	1.0
NB	13.0	13.0	14.0	6.0	7.0
GA	17.0	13.0	15.0	11.0	12.0
PB	29.0	27.0	27.0	53.0	27.0
NI	8.0	3.0	4.0	6.0	5.0
LA	1.0	1.0	2.0	1.0	7.0
CR	1.0	1.0	1.0	1.0	1.0
V	1.0	1.0	1.0	1.0	1.0
Y	12.0	14.0	14.0	7.0	8.0
F	180.0	136.0	150.0	88.0	67.0
CE	109.0	174.0	151.0	146.0	52.0

THROUGH HILL GRANITE

SAMPLE	170522	170523	170524
PERCENT			
SIO2	75.80	74.40	75.80
AL2O3	14.45	15.60	14.50
FE2O3	0.01	0.01	0.01
FEO	0.45	0.67	0.54
MGO	0.16	0.09	0.10
CAO	0.73	0.41	0.58
NA2O	3.79	4.66	4.21
K2O	4.26	4.58	4.41
TIO2	0.05	0.01	0.01
MNO	0.03	0.17	0.13
P2O5	0.31	0.29	0.19
LOI	1.20	0.96	0.87
TOTAL	101.24	101.85	101.35
PPM			
U	1.5	6.8	4.0
U2	0.0	0.0	0.0
LI	31.0	15.0	13.0
BE	10.0	5.0	5.0
ZR	10.0	20.0	26.0
SR	63.0	6.0	25.0
RB	124.0	213.0	142.0
ZN	1.0	1.0	1.0
CU	1.0	1.0	1.0
BA	67.0	20.0	21.0
TH	1.0	4.0	7.0
MO	3.0	3.0	2.0
NB	12.0	21.0	9.0
GA	12.0	17.0	12.0
PB	33.0	29.0	38.0
NI	7.0	17.0	7.0
LA	1.0	1.0	1.0
CR	1.0	1.0	1.0
V	1.0	1.0	3.0
Y	11.0	2.0	7.0
F	368.0	128.0	136.0
CE	92.0	112.0	137.0

NORTH BAY GRANITE

SAMPLE	170034	170054	170055	170056	170057
PERCENT					
SIO2	72.20	70.70	69.20	69.00	71.10
AL2O3	16.60	14.70	15.10	15.90	15.20
FE2O3	0.34	0.27	0.14	0.01	0.06
FEO	1.31	1.30	1.66	1.48	1.51
MGO	0.53	0.64	0.75	0.69	0.58
CAO	1.84	1.63	1.69	1.75	1.63
NA2O	4.04	3.73	3.77	4.48	4.01
K2O	3.86	3.68	4.48	3.98	4.03
TIO2	0.27	0.26	0.33	0.24	0.22
MNO	0.04	0.04	0.03	0.03	0.03
P2O5	0.02	0.03	0.06	0.01	0.01
LOI	0.49	0.78	0.90	0.66	0.68
TOTAL	101.54	97.76	98.11	98.23	99.06
PPM					
U	1.7	2.8	2.0	1.4	3.3
U2	0.0	0.0	0.0	0.0	0.0
LI	53.0	28.0	32.0	58.0	40.0
BE	2.0	2.0	4.0	4.0	3.0
ZR	144.0	168.0	199.0	161.0	156.0
SR	401.0	293.0	422.0	651.0	390.0
RB	144.0	125.0	161.0	133.0	147.0
ZN	39.0	46.0	47.0	52.0	44.0
CU	23.0	24.0	44.0	24.0	22.0
BA	966.0	884.0	1097.0	1040.0	984.0
TH	0.0	0.0	0.0	0.0	0.0
MO	1.0	4.0	6.0	2.0	6.0
NB	7.0	9.0	7.0	6.0	8.0
GA	19.0	20.0	23.0	23.0	23.0
PB	16.0	30.0	21.0	16.0	19.0
NI	1.0	5.0	4.0	3.0	4.0
LA	0.0	0.0	0.0	0.0	0.0
CR	4.0	7.0	4.0	6.0	1.0
V	22.0	26.0	39.0	27.0	23.0
Y	0.0	0.0	0.0	0.0	0.0
F	298.0	260.0	454.0	429.0	289.0
CE	0.0	0.0	0.0	0.0	0.0

NORTH BAY GRANITE

SAMPLE	170072	170073	170079	170080	170081
PERCENT					
SIO2	69.50	72.00	73.00	70.00	74.20
AL2O3	16.10	15.60	14.60	15.20	14.70
FE2O3	0.18	0.04	0.01	0.01	0.01
FEO	2.12	1.59	0.56	2.30	0.67
MGO	0.93	0.62	0.18	0.84	0.22
CAO	1.91	1.86	0.57	1.84	0.64
NA2O	4.09	3.86	3.33	4.13	2.69
K2O	4.44	4.11	7.29	3.85	6.33
TIO2	0.42	0.27	0.04	0.35	0.13
MNO	0.04	0.03	0.02	0.05	0.05
P2O5	0.05	0.04	0.02	0.04	0.04
LOI	0.56	0.54	0.58	0.68	0.86
TOTAL	100.34	100.56	100.20	99.29	100.54
PPM					
U	1.7	2.2	1.8	1.3	2.1
U2	0.0	0.0	0.0	0.0	0.0
LI	52.0	39.0	8.0	41.0	14.0
BE	6.0	5.0	1.0	5.0	2.0
ZR	241.0	170.0	34.0	207.0	33.0
SR	461.0	368.0	129.0	455.0	116.0
RB	171.0	153.0	211.0	134.0	163.0
ZN	54.0	44.0	19.0	53.0	19.0
CU	41.0	23.0	20.0	25.0	17.0
BA	1156.0	795.0	440.0	966.0	568.0
TH	0.0	0.0	0.0	0.0	0.0
MO	2.0	6.0	8.0	1.0	1.0
NB	7.0	9.0	7.0	8.0	6.0
GA	23.0	21.0	20.0	23.0	17.0
PB	10.0	24.0	57.0	27.0	45.0
NI	6.0	4.0	1.0	6.0	7.0
LA	0.0	0.0	0.0	0.0	0.0
CR	8.0	9.0	4.0	12.0	6.0
V	48.0	29.0	5.0	41.0	9.0
Y	0.0	0.0	0.0	0.0	0.0
F	785.0	364.0	89.0	505.0	117.0
CE	0.0	0.0	0.0	0.0	0.0

NORTH BAY GRANITE

SAMPLE	170082	170092	170100	170101	170102
PERCENT					
SIO2	70.80	72.20	74.00	71.80	71.70
AL2O3	15.20	14.80	14.70	14.70	14.80
FE2O3	0.01	0.34	0.13	0.01	0.02
FEO	2.04	1.16	1.30	1.66	1.78
MGO	0.67	0.47	0.50	0.60	0.69
CAO	1.89	1.09	1.35	1.59	1.56
NA2O	3.61	4.21	3.82	3.87	3.98
K2O	4.26	4.18	4.72	4.55	4.48
TIO2	0.29	0.17	0.26	0.27	0.29
MNO	0.04	0.03	0.04	0.03	0.04
P2O5	0.05	0.01	0.05	0.04	0.04
LOI	0.60	1.38	0.76	0.68	0.77
TOTAL	99.46	100.04	101.63	99.80	100.15
PPM					
U	3.0	1.9	5.1	2.0	2.7
U2	0.0	0.0	0.0	0.0	0.0
LI	32.0	49.0	59.0	45.0	40.0
BE	4.0	4.0	8.0	3.0	3.0
ZR	221.0	132.0	130.0	165.0	216.0
SR	345.0	337.0	171.0	378.0	388.0
RB	157.0	132.0	234.0	161.0	158.0
ZN	30.0	46.0	43.0	39.0	40.0
CU	25.0	31.0	28.0	28.0	37.0
BA	1253.0	821.0	497.0	923.0	890.0
TH	0.0	0.0	0.0	0.0	0.0
MO	2.0	1.0	4.0	8.0	2.0
NB	5.0	9.0	10.0	7.0	8.0
GA	20.0	22.0	23.0	22.0	23.0
PB	20.0	17.0	25.0	29.0	19.0
NI	4.0	5.0	10.0	5.0	6.0
LA	0.0	0.0	0.0	0.0	0.0
CP	2.0	2.0	8.0	17.0	10.0
V	35.0	29.0	24.0	27.0	41.0
Y	0.0	0.0	0.0	0.0	0.0
F	298.0	275.0	568.0	619.0	492.0
CF	0.0	0.0	0.0	0.0	0.0

NORTH BAY GRANITE

SAMPLE	170103	170108	170117	170118	170119
PERCENT					
SIO2	72.80	74.10	72.70	70.70	72.90
AL2O3	14.50	14.50	14.00	15.10	15.00
FE2O3	0.03	0.04	0.07	0.01	0.01
FEO	1.81	0.73	1.18	2.03	1.69
MGO	0.69	0.22	0.46	0.76	0.65
CAO	1.48	1.15	1.49	1.97	1.63
NA2O	3.94	4.28	3.82	4.16	3.88
K2O	4.30	4.01	4.27	4.12	4.46
TIO2	0.34	0.08	0.24	0.34	0.32
MNO	0.04	0.03	0.04	0.05	0.03
P2O5	0.06	0.12	0.06	0.08	0.09
LOI	0.78	0.84	0.71	0.47	0.54
TOTAL	100.77	100.10	99.04	99.79	101.20
PPM					
U	2.9	2.0	3.3	2.4	2.8
U2	0.0	0.0	0.0	0.0	0.0
LI	40.0	72.0	39.0	61.0	60.0
BE	3.0	11.0	4.0	7.0	7.0
ZR	213.0	88.0	137.0	189.0	169.0
SR	377.0	204.0	248.0	377.0	396.0
RB	159.0	206.0	155.0	185.0	164.0
ZN	40.0	37.0	47.0	58.0	43.0
CU	38.0	27.0	42.0	29.0	26.0
BA	843.0	637.0	656.0	857.0	993.0
TH	0.0	0.0	0.0	0.0	0.0
MO	6.0	4.0	4.0	1.0	4.0
NB	11.0	10.0	8.0	9.0	8.0
GA	21.0	19.0	19.0	25.0	18.0
PB	27.0	34.0	26.0	19.0	25.0
NI	7.0	4.0	3.0	8.0	1.0
LA	0.0	0.0	0.0	0.0	0.0
CR	11.0	6.0	1.0	14.0	11.0
V	39.0	9.0	20.0	40.0	27.0
Y	0.0	0.0	0.0	0.0	0.0
F	517.0	250.0	267.0	811.0	454.0
CE	0.0	0.0	0.0	0.0	0.0

NORTH BAY GRANITE

SAMPLE	170120	170121	170122	170123	170124
PERCENT					
SIO2	70.80	71.00	71.60	71.40	71.60
AL2O3	14.70	14.90	14.80	14.80	14.70
FE2O3	0.01	0.01	0.01	0.08	0.22
FEO	1.76	1.81	1.69	1.34	1.36
MGO	0.64	0.64	0.61	0.50	0.52
CAO	1.58	1.69	1.73	1.50	1.69
NA2O	3.93	3.92	3.96	4.11	3.74
K2O	4.41	4.36	4.29	4.46	4.55
TIO2	0.32	0.28	0.28	0.21	0.27
MNO	0.04	0.04	0.05	0.04	0.03
P2O5	0.07	0.06	0.11	0.05	0.04
LOI	0.50	0.60	0.62	0.64	0.83
TOTAL	98.76	99.31	99.75	99.13	99.55
PPM					
U	2.4	2.2	1.7	2.7	2.3
U2	0.0	0.0	0.0	0.0	0.0
LI	62.0	65.0	38.0	29.0	36.0
BE	6.0	6.0	5.0	5.0	4.0
ZR	176.0	180.0	158.0	126.0	161.0
SR	402.0	397.0	349.0	332.0	299.0
RB	168.0	160.0	159.0	189.0	200.0
ZN	47.0	47.0	47.0	48.0	43.0
CU	46.0	46.0	29.0	26.0	30.0
BA	997.0	967.0	842.0	767.0	1031.0
TH	0.0	0.0	0.0	0.0	0.0
MO	2.0	4.0	1.0	2.0	2.0
NB	9.0	10.0	10.0	11.0	9.0
GA	23.0	25.0	23.0	21.0	21.0
PB	25.0	20.0	27.0	30.0	29.0
NI	5.0	6.0	8.0	4.0	7.0
LA	0.0	0.0	0.0	0.0	0.0
CR	8.0	8.0	13.0	7.0	3.0
V	31.0	37.0	33.0	27.0	27.0
Y	0.0	0.0	0.0	0.0	0.0
F	708.0	683.0	403.0	304.0	304.0
CE	0.0	0.0	0.0	0.0	0.0

NORTH BAY GRANITE

SAMPLE	170195	170196	170197	170198	170199
PERCENT					
SIO2	72.50	72.90	70.00	71.30	69.60
AL2O3	14.60	14.50	15.00	15.10	15.50
FE2O3	0.37	0.10	0.27	0.17	0.01
FEO	1.18	1.42	1.81	1.99	2.49
MGO	0.48	0.54	0.88	0.96	0.90
CAO	1.70	1.71	2.01	2.14	2.10
NA2O	4.40	4.40	4.48	4.64	4.33
K2O	4.08	4.24	3.96	4.02	3.79
TIO2	0.21	0.21	0.41	0.44	0.42
MNO	0.04	0.03	0.03	0.03	0.03
P2O5	0.08	0.06	0.10	0.12	0.12
LOI	0.83	0.74	0.87	0.71	0.64
TOTAL	100.47	100.85	99.82	101.62	99.93
PPM					
U	1.9	1.4	1.4	1.4	1.5
U2	0.0	0.0	0.0	0.0	0.0
LI	54.0	29.0	102.0	75.0	76.0
BE	4.0	2.0	3.0	4.0	4.0
ZR	159.0	135.0	186.0	191.0	185.0
SR	417.0	386.0	529.0	534.0	531.0
RB	148.0	139.0	121.0	128.0	125.0
ZN	49.0	41.0	49.0	52.0	48.0
CU	27.0	20.0	33.0	37.0	33.0
BA	999.0	951.0	1046.0	1088.0	1020.0
TH	0.0	0.0	0.0	0.0	0.0
MO	2.0	2.0	1.0	1.0	2.0
NB	6.0	7.0	7.0	11.0	7.0
GA	26.0	21.0	22.0	25.0	21.0
PB	26.0	26.0	16.0	21.0	17.0
NI	6.0	1.0	2.0	5.0	2.0
LA	0.0	0.0	0.0	0.0	0.0
CR	2.0	22.0	7.0	10.0	8.0
V	20.0	20.0	40.0	47.0	41.0
Y	0.0	0.0	0.0	0.0	0.0
F	209.0	326.0	797.0	836.0	874.0
CE	0.0	0.0	0.0	0.0	0.0

NORTH BAY GRANITE

SAMPLE	170200	170288	170289	170291	170351
PERCENT					
SIO2	70.10	73.10	76.60	75.50	67.80
AL2O3	15.50	17.30	14.30	14.50	15.20
FE2O3	0.11	0.01	0.01	0.10	0.45
FEO	2.03	0.33	0.33	0.35	3.06
MGO	0.89	0.12	0.08	0.15	1.93
CAO	2.12	0.48	0.48	0.89	2.43
NA2O	4.23	8.38	6.73	4.40	3.39
K2O	3.88	1.01	0.73	3.93	4.00
TIO2	0.40	0.01	0.01	0.08	0.62
MNO	0.04	0.04	0.04	0.02	0.09
P2O5	0.11	0.07	0.10	0.08	0.14
LOI	0.57	0.70	0.68	0.62	1.05
TOTAL	99.98	101.55	100.09	100.62	100.16
PPM					
U	2.3	13.2	10.0	3.3	4.9
U2	0.0	0.0	0.0	0.0	0.0
LI	74.0	15.0	10.0	35.0	40.0
BE	5.0	8.0	7.0	8.0	4.0
ZR	190.0	26.0	31.0	16.0	166.0
SR	536.0	52.0	57.0	37.0	231.0
RB	121.0	63.0	50.0	223.0	184.0
ZN	49.0	17.0	13.0	14.0	53.0
CU	34.0	25.0	18.0	19.0	30.0
BA	1046.0	44.0	28.0	8.0	472.0
TH	0.0	0.0	0.0	0.0	0.0
MO	2.0	37.0	1.0	4.0	4.0
NB	8.0	8.0	10.0	17.0	11.0
GA	23.0	23.0	24.0	26.0	20.0
PB	20.0	24.0	16.0	22.0	25.0
NI	4.0	1.0	1.0	6.0	21.0
LA	0.0	0.0	0.0	0.0	0.0
CR	12.0	1.0	6.0	2.0	34.0
V	44.0	3.0	4.0	3.0	73.0
Y	0.0	0.0	0.0	0.0	0.0
F	759.0	194.0	194.0	429.0	480.0
CE	0.0	0.0	0.0	0.0	0.0

NORTH BAY GRANITE

SAMPLE	170352	170372	170374	170375	170376
PERCENT					
SIO2	70.30	65.20	57.00	65.40	68.40
AL2O3	14.90	15.80	14.90	15.50	15.10
FE2O3	0.16	0.54	1.36	0.60	0.62
FEO	2.04	3.08	4.74	3.14	2.07
MGO	1.10	2.12	7.76	1.89	1.21
CAO	1.56	3.74	7.43	3.51	2.54
NA2O	3.44	3.45	2.60	3.53	3.62
K2O	3.98	3.43	1.86	3.52	3.80
TIO2	0.35	0.63	0.80	0.62	0.41
MNO	0.06	0.06	0.12	0.06	0.05
P2O5	0.15	0.17	0.13	0.22	0.17
LOI	1.23	0.92	1.20	0.93	1.11
TOTAL	99.27	99.14	99.90	98.92	99.10
PPM					
U	2.5	3.0	2.2	2.5	3.3
U2	0.0	0.0	0.0	0.0	0.0
LI	50.0	51.0	27.0	38.0	60.0
BE	3.0	4.0	3.0	4.0	4.0
ZR	157.0	184.0	107.0	166.0	175.0
SR	231.0	216.0	223.0	206.0	221.0
RB	156.0	145.0	74.0	141.0	146.0
ZN	47.0	55.0	58.0	55.0	53.0
CU	32.0	29.0	61.0	30.0	27.0
BA	438.0	505.0	240.0	476.0	476.0
TH	0.0	0.0	0.0	0.0	0.0
MO	6.0	4.0	2.0	6.0	4.0
NB	9.0	11.0	5.0	13.0	13.0
GA	20.0	24.0	20.0	22.0	23.0
PB	17.0	27.0	10.0	21.0	18.0
NI	9.0	18.0	102.0	19.0	11.0
LA	0.0	0.0	0.0	0.0	0.0
CR	29.0	41.0	254.0	22.0	15.0
V	35.0	72.0	162.0	75.0	41.0
Y	0.0	0.0	0.0	0.0	0.0
F	260.0	619.0	319.0	683.0	530.0
CE	0.0	0.0	0.0	0.0	0.0

NORTH BAY GRANITE

SAMPLE	170377	170378	170384	170385	170386
PERCENT					
SIO2	66.70	65.20	68.20	66.00	66.10
AL2O3	15.50	16.20	15.30	15.70	16.00
FE2O3	0.74	0.78	0.69	0.71	0.77
FEO	2.53	2.66	2.28	2.82	2.81
MGO	1.45	1.48	1.30	1.58	1.59
CAO	2.91	3.14	2.92	3.10	3.24
NA2O	3.61	3.79	3.49	3.55	3.66
K2O	3.66	3.70	3.65	3.38	3.40
TIO2	0.48	0.52	0.44	0.55	0.52
MNO	0.08	0.07	0.07	0.08	0.08
P2O5	0.20	0.20	0.18	0.16	0.16
LOI	0.80	0.84	1.05	1.09	1.09
TOTAL	98.66	98.58	99.57	98.72	99.42
PPM					
U	2.3	3.1	3.0	4.0	4.2
U2	0.0	0.0	0.0	0.0	0.0
LI	54.0	62.0	34.0	43.0	42.0
BE	4.0	5.0	4.0	4.0	4.0
ZR	197.0	197.0	177.0	200.0	215.0
SR	240.0	242.0	222.0	235.0	240.0
RB	134.0	130.0	138.0	179.0	132.0
ZN	58.0	60.0	54.0	64.0	62.0
CU	31.0	22.0	28.0	33.0	33.0
BA	553.0	613.0	575.0	544.0	535.0
TH	0.0	0.0	0.0	0.0	0.0
MO	2.0	4.0	2.0	4.0	1.0
NB	13.0	12.0	9.0	10.0	12.0
GA	19.0	23.0	22.0	24.0	21.0
PB	24.0	19.0	20.0	15.0	22.0
NI	5.0	10.0	10.0	15.0	8.0
LA	0.0	0.0	0.0	0.0	0.0
CR	14.0	20.0	14.0	15.0	13.0
V	58.0	55.0	59.0	67.0	63.0
Y	0.0	0.0	0.0	0.0	0.0
F	606.0	606.0	505.0	594.0	670.0
CE	0.0	0.0	0.0	0.0	0.0

NORTH BAY GRANITE

SAMPLE	170387	170388	170389	170393	170394
PERCENT					
SIO2	69.00	69.50	68.90	67.70	69.30
AL203	15.40	15.00	15.10	14.90	15.40
FE203	0.14	0.19	0.20	0.59	0.60
FEO	2.21	2.09	2.15	2.84	2.07
MGO	1.06	1.02	1.03	1.46	1.22
CAO	2.50	2.27	2.29	3.13	2.68
NA20	3.63	3.49	3.54	3.67	3.56
K20	4.00	3.98	3.94	2.69	4.09
TIO2	0.35	0.34	0.36	0.51	0.41
MNO	0.06	0.07	0.06	0.07	0.06
P205	0.12	0.17	0.16	0.24	0.22
LOI	0.74	0.90	0.86	0.78	1.28
TOTAL	99.21	99.02	98.59	98.58	100.89
PPM					
U	2.5	2.4	2.5	3.3	2.1
U2	0.0	0.0	0.0	0.0	0.0
LI	94.0	99.0	97.0	69.0	44.0
BE	5.0	4.0	6.0	4.0	3.0
ZR	155.0	145.0	147.0	170.0	158.0
SR	174.0	164.0	166.0	201.0	237.0
RB	161.0	175.0	174.0	123.0	124.0
ZN	48.0	50.0	48.0	67.0	56.0
CU	35.0	25.0	22.0	27.0	35.0
BA	416.0	440.0	441.0	325.0	544.0
TH	0.0	0.0	0.0	0.0	0.0
MO	4.0	4.0	4.0	4.0	6.0
NB	12.0	13.0	15.0	12.0	10.0
GA	20.0	22.0	22.0	22.0	24.0
PB	19.0	27.0	21.0	23.0	26.0
NI	10.0	7.0	8.0	9.0	13.0
LA	0.0	0.0	0.0	0.0	0.0
CR	17.0	20.0	13.0	18.0	18.0
V	32.0	39.0	34.0	54.0	44.0
Y	0.0	0.0	0.0	0.0	0.0
F	606.0	619.0	581.0	670.0	403.0
CE	0.0	0.0	0.0	0.0	0.0

Hardy's Cove Complex

SAMPLE	170545	170553	170555	170557	170558
PERCENT					
SIO2	81.20	79.60	74.00	73.00	77.80
AL2O3	10.85	12.00	13.25	14.10	11.65
FE2O3	0.03	0.43	0.32	0.70	0.38
FEO	0.27	0.25	1.06	1.34	0.89
MGO	0.08	0.08	0.28	0.51	0.21
CAO	0.13	0.11	1.89	1.48	0.49
NA2O	3.69	2.75	4.83	4.78	3.55
K2O	3.56	4.72	2.34	2.81	3.49
TIO2	0.02	0.08	0.12	0.24	0.13
MNO	0.01	0.01	0.05	0.07	0.02
P2O5	0.05	0.01	0.02	0.02	0.01
LOI	0.92	1.28	2.55	2.03	1.62
TOTAL	100.81	101.32	100.71	101.08	100.24
PPM					
U	0.0	0.0	0.0	0.0	0.0
U2	0.0	0.0	0.0	0.0	0.0
LI	19.0	7.0	0.0	0.0	0.0
BE	3.0	2.0	0.0	0.0	0.0
ZR	93.0	105.0	127.0	158.0	234.0
SR	28.0	26.0	93.0	110.0	48.0
RB	143.0	190.0	57.0	73.0	93.0
ZN	19.0	1.0	17.0	19.0	9.0
CU	3.0	1.0	10.0	1.0	13.0
BA	339.0	293.0	475.0	558.0	453.0
TH	19.0	28.0	11.0	11.0	13.0
MO	2.0	2.0	0.0	0.0	0.0
NB	30.0	29.0	15.0	16.0	23.0
GA	16.0	13.0	17.0	10.0	15.0
PB	18.0	9.0	5.0	7.0	9.0
NI	44.0	24.0	16.0	11.0	30.0
LA	3.0	35.0	20.0	24.0	31.0
CR	1.0	1.0	1.0	1.0	1.0
V	2.0	1.0	11.0	13.0	1.0
Y	113.0	43.0	41.0	38.0	83.0
F	0.0	0.0	0.0	0.0	0.0
CE	103.0	126.0	135.0	151.0	128.0

Hardy's Cove Complex

SAMPLE	170559
PERCENT	
SIO2	77.80
AL2O3	12.65
FE2O3	0.27
FEO	0.88
MGO	0.20
CAO	0.71
NA2O	4.28
K2O	3.67
TIO2	0.11
MNO	0.04
P2O5	0.14
LOI	1.03
TOTAL	101.78
PPM	
U	0.0
U2	0.0
LI	0.0
BE	0.0
ZR	98.0
SR	59.0
RB	86.0
ZN	8.0
CU	1.0
BA	799.0
TH	15.0
MO	0.0
NB	15.0
GA	14.0
PB	10.0
NI	19.0
LA	35.0
CR	1.0
V	1.0
Y	47.0
F	0.0
CE	152.0

MODAL ANALYSES

PICCAIRE

Number	Quartz	K-feldspar	Plagioclase	Biotite	Muscovite	Opaques
170004	27.7	17.0	43.3	11.7	-	0.3
170005	23.2	26.7	39.7	10.4	-	-
170007	24.3	26.8	43.6	5.1	-	0.2
170008	22.5	20.7	46.6	10.0	-	0.2
170009	24.7	29.4	35.5	10.2	-	0.2
170011	31.3	14.7	44.3	9.6	-	0.1
170012	23.9	27.2	39.2	9.1	0.2	0.2
170013	24.6	31.2	35.7	8.2	-	0.3
170014	25.1	34.2	34.0	6.4	-	0.3
170015	30.4	23.6	36.4	8.4	1.2	-
170167	25.7	24.2	41.6	8.1	-	0.2
170168	28.4	25.2	37.6	7.3	1.5	-
170171	24.9	11.2	54.1	9.3	-	-
170172	27.4	26.1	38.7	7.3	0.2	-
170175	28.2	25.9	34.3	11.3	0.1	0.3
170176	26.4	24.1	42.6	6.7	-	0.2
170395	29.7	25.8	32.6	9.2	2.3	0.4
170396	28.2	23.7	38.3	7.2	2.4	0.2

MODAL ANALYSES

NORTHWEST COVE

Number	Quartz	K-feldspar	Plagioclase	Biotite	Muscovite	Opaques
170091	27.3	26.2	31.5	4.6	10.4	-
170096	27.3	19.8	41.5	-	11.4	-
170126	28.4	27.7	33.8	-	10.1	-
170127	30.6	24.9	32.8	2.4	9.3	-
170144	28.3	26.1	32.1	4.2	9.3	-
170177	27.3	23.9	37.3	2.1	9.4	-
170178	23.7	45.8	15.4	3.4	11.7	-
170182	26.9	25.3	37.3	3.7	7.8	-
170184	34.7	21.4	36.1	1.2	6.6	-
170247	29.8	25.2	36.0	4.7	4.3	-
170248	28.4	24.7	35.0	8.2	3.7	-
170251	30.4	31.2	32.8	3.2	2.4	-
170259	25.1	-	59.4	13.1	-	2.4
170260	22.4	31.4	32.3	3.2	10.7	-
170097	28.4	33.6	26.5	1.2	10.3	-

MODAL ANALYSES

INDIAN POINT

Number	Quartz	K-feldspar	Plagioclase	Biotite	Muscovite	Opaques
170133	22.6	25.7	43.0	3.9	2.0	1.1
170134	32.3	24.5	35.7	6.5	-	1.0
170135	22.4	18.9	50.1	6.1	2.5	-
170136	32.4	25.7	32.3	8.4	1.2	-
170138	28.2	24.7	37.1	8.1	1.9	-
170219	23.4	19.7	48.8	4.7	2.2	-
170220	23.2	26.7	40.1	9.8	-	0.2
170221	27.9	-	58.4	11.4	-	2.3
170223	25.6	18.3	43.6	10.7	-	1.8
170225	27.2	23.7	40.5	6.8	1.5	0.3
170226	30.4	24.9	41.0	-	3.7	-
170228	31.5	20.7	38.0	8.3	1.3	0.2
170231	27.3	24.7	37.2	7.3	3.5	-
170232	22.8	24.2	43.7	7.1	2.2	-
170235	26.2	25.8	38.3	7.3	2.4	-
170240	25.9	24.7	39.6	-	8.2	1.6

MODAL ANALYSES

NORTHWEST BROOK

Number	Quartz	K-feldspar	Plagioclase	Biotite	Muscovite	Opaques
170001	31.4	27.7	27.1	2.1	11.7	-
170017	32.5	21.2	34.9	0.7	10.7	-
170024	23.7	26.2	37.6	2.1	10.4	-
170025	27.8	30.3	31.8	2.5	7.6	-
170027	23.2	26.9	44.1	4.8	1.0	-
170028	37.3	33.7	18.5	9.9	-	-
170032	31.0	28.0	34.1	0.8	6.1	-
170041	30.7	23.5	33.6	2.0	10.2	-
170042	30.2	25.4	30.1	1.5	12.8	-
170043	37.0	13.8	33.7	0.3	15.2	-
170045	29.3	18.4	40.6	-	11.7	-
170058	33.5	24.3	29.8	0.5	11.8	-
170059	38.2	35.3	16.4	1.8	8.3	-
170060	26.2	20.2	44.3	0.2	9.0	-
170061	33.3	18.3	36.9	-	11.1	-
170062	33.3	34.5	20.5	5.1	6.6	-
170076	31.0	37.6	22.6	-	8.8	-
170112	25.1	21.3	40.7	3.2	9.7	-
170114	30.4	25.2	35.4	2.3	6.7	-
170115	24.6	28.3	35.0	1.2	10.9	-

MODAL ANALYSES

NORTHWEST BROOK

Number	Quartz	K-feldspar	Plagioclase	Biotite	Muscovite	Opaques
170116	26.3	25.9	38.5	5.3	1.8	0.9
170181	29.8	35.5	25.1	4.4	3.1	-
170201	27.9	26.4	31.8	10.2	3.7	-
170212	25.1	22.5	38.1	9.8	3.1	-
170213	27.4	23.7	37.2	7.4	2.5	-
170029	25.7	35.6	30.3	-	8.4	-
170218	28.4	20.3	39.6	4.7	4.1	-
170241	28.4	24.6	37.1	8.4	1.5	-
170243	29.7	23.4	37.2	8.4	1.3	-
170244	28.4	26.2	37.0	3.1	5.3	-
170253	30.1	26.4	38.2	4.3	1.0	-
170254	26.2	22.7	39.7	11.4	-	-
170257	31.4	24.7	34.1	2.1	6.2	-
170262	32.8	38.1	25.1	0.5	3.4	-

MODAL ANALYSES

DOLLAND BIGHT

Number	Quartz	K-feldspar	Plagioclase	Biotite	Muscovite	Opaques
170152	31.4	26.8	31.3	-	10.5	-
170153	29.1	28.6	35.1	-	7.1	-
170154	29.3	25.1	34.2	-	11.4	-
170155	36.4	26.6	33.7	0.8	2.5	-
170156	30.4	25.2	39.7	2.6	2.3	-
170157	34.4	27.4	31.8	2.3	4.1	-
170158	27.5	32.0	32.4	5.3	2.8	-
170159	40.3	26.2	19.8	1.6	12.1	-
170160	32.1	23.9	33.3	-	10.7	-
170161	31.5	25.9	32.4	1.8	8.4	-
170162	28.7	26.1	36.9	-	8.3	-
170163	32.4	26.1	32.1	1.3	8.1	-
170164	30.4	25.2	34.3	2.1	8.0	-
170166	28.4	24.3	38.6	-	8.7	-
170186	33.5	5.2	51.0	1.2	9.1	-
170187	35.2	17.0	30.6	0.5	16.7	-
170188	38.0	34.7	24.1	-	3.2	-
170189	37.6	21.3	26.0	1.6	13.4	-
170191	31.4	18.4	40.5	-	9.7	-
170192	30.5	10.8	44.6	-	14.0	-
170193	33.3	23.2	37.9	-	5.6	-

MODAL ANALYSES

DOLLAND BIGHT

Number	Quartz	K-feldspar	Plagioclase	Biotite	Muscovite	Opaques
170203	30.4	26.7	32.1	-	10.8	-
170204	38.1	24.2	24.2	0.4	13.1	-
170205	33.6	17.1	42.8	1.5	4.9	-
170206	26.3	27.4	35.2	3.7	7.4	-
170207	24.4	30.7	28.4	-	16.4	-
170208	28.1	34.6	25.5	-	11.8	-

MODAL ANALYSES

MISSING ISLAND

Number	Quartz	K-feldspar	Plagioclase	Biotite	Muscovite	Opaques
170359	23.7	17.8	46.8	7.6	-	-
170363	24.9	20.1	41.1	8.3	1.3	-
170366	26.3	15.7	44.7	9.2	-	0.4
170368	25.5	28.4	34.3	8.7	-	-
170372	25.6	20.4	43.2	9.2	-	-
170380	26.7	18.4	44.7	8.3	-	-

MODAL ANALYSES

ROCKY BOTTOM

Number	Quartz	K-feldspar	Plagioclase	Biotite	Muscovite	Opaques
170353	23.6	3.4	62.0	6.1	2.4	-
170354	28.3	2.1	54.3	13.4	1.2	-
170355	30.4	2.2	51.0	12.3	1.4	-
170356	24.9	-	56.9	11.2	-	-
170357	25.7	-	53.2	12.3	0.8	0.4
170358	26.2	-	53.7	11.4	3.2	-
170360	25.2	6.7	51.1	13.3	0.5	-
170361	25.1	-	54.3	12.2	4.0	-
170362	20.7	5.9	53.4	12.0	2.1	-
170364	25.7	1.2	50.7	14.4	2.4	-
170365	29.8	-	56.5	7.1	0.8	-
170367	28.1	-	56.3	7.3	1.4	-
170369	27.5	-	60.4	8.2	0.7	-
170371	29.3	7.2	50.3	8.6	1.7	-
170373	29.4	4.1	44.8	11.4	1.1	-

MODAL ANALYSES

MATTHEWS POND

Number	Quartz	K-feldspar	Plagioclase	Biotite	Muscovite	Opaques
170331	21.7	7.5	58.7	8.9	2.3	-
170332	27.4	8.7	49.7	10.4	3.2	-
170333	28.8	8.9	49.5	9.4	2.7	-
170334	25.4	7.1	55.1	8.3	4.1	-
170335	24.7	10.2	50.8	10.5	3.0	-
170336	29.3	7.2	48.3	11.7	3.5	-
170337	20.4	7.2	50.9	18.5	3.0	-
170338	29.9	9.2	46.7	12.6	1.6	-
170339	27.3	11.1	52.5	3.3	1.9	-
170340	29.7	15.8	45.9	6.7	1.9	-
170342	23.7	10.4	52.0	11.1	2.8	-
170343	26.7	12.1	47.8	9.3	3,4	-
170344	28.1	8.3	48.4	12.5	2.7	-
170346	26.9	16.4	44.3	10.3	2.1	-
170347	24.3	10.7	49.8	12.5	2.7	-
170348	26.2	18.3	42.3	10.1	2.9	0.2
170349	26.4	4.1	51.8	13.2	4.5	-

MODAL ANALYSES

PARTRIDGEBERRY HILLS

Number	Quartz	K-feldspar	Plagioclase	Biotite	Muscovite	Opaques
170446	30.1	-	56.7	10.7	2.5	-
170452	32.4	18.7	36.9	11.4	-	0.6
170453	27.4	15.2	41.6	13.1	2.7	-
170454	23.1	15.2	49.0	10.4	2.3	-
170455	29.3	24.6	34.0	7.2	3.4	1.5
170456	33.7	12.4	38.2	11.4	3.2	1.1
170457	28.1	14.2	45.2	8.3	2.5	0.7
170458	32.9	22.1	32.5	10.4	1.2	0.9
170460	31.4	14.3	39.4	9.2	5.7	-
170461	29.7	-	57.1	13.2	-	-
170462	29.5	22.3	33.3	9.4	4.7	0.8
170465	34.1	26.2	31.6	-	8.1	-
170468	-	-	30.1	5.2	5.4	-
170472	34.7	25.3	27.4	12.6	-	-
170474	37.1	-	45.9	10.4	6.2	0.4
170475	30.3	15.7	40.8	11.4	1.2	0.6
170476	32.6	27.4	29.7	8.7	1.4	-
170477	28.2	15.6	44.1	9.4	2.3	0.4
170478	28.3	25.7	30.5	12.4	1.5	1.6
170479	20.4	19.3	50.2	10.1	-	-
170482	30.2	2.1	57.0	2.3	2.4	-

MODAL ANALYSES

PARTRIDGEBERRY HILLS

Number	Quartz	K-feldspar	Plagioclase	Biotite	Muscovite	Opaques
170483	24.9	26.5	36.3	8.7	2.4	1.2
170484	28.4	24.9	32.4	12.1	2.2	-
170489	31.8	23.4	33.1	9.7	0.4	1.6
170492	23.5	-	60.5	10.2	4.6	1.2
170493	26.2	23.7	35.6	12.3	0.4	1.6
170497	29.2	14.7	41.9	11.3	2.9	-
170498	26.3	23.5	34.1	12.4	2.4	1.3
170499	29.8	20.1	35.3	12.4	1.6	0.8
170500	31.5	25.2	33.2	8.3	1.8	-
170527	24.2	26.2	38.8	4.3	6.5	-
170529	32.7	20.4	35.1	9.7	0.8	1.3
170531	31.6	25.2	30.0	3.1	10.1	-
170532	34.4	30.6	23.9	3.8	7.3	-
170536	26.5	-	67.3	5.4	-	0.8
170541	33.1	24.8	27.1	12.7	-	0.9
170542	28.4	17.3	44.2	10.1	-	-
170525	28.4	22.9	40.2	8.3	-	0.2
170526	27.4	26.3	34.0	3.4	8.9	-

MODAL ANALYSES

THROUGH HILL

Number	Quartz	K-feldspar	Plagioclase	Biotite	Muscovite	Opaques
170501	31.7	20.4	35.0	1.3	11.6	-
170502	25.3	30.4	34.6	-	9.7	-
170503	32.6	15.8	42.5	-	8.4	-
170504	28.4	24.3	40.9	-	6.4	-
170506	24.7	25.3	44.6	-	5.4	-
170507	23.9	24.7	42.5	-	8.9	-
170508	31.5	19.7	36.5	-	12.3	-
170512	22.6	20.3	46.6	-	10.5	-
170515	26.3	22.5	39.8	-	11.4	-
170516	33.4	19.4	34.8	-	12.4	-
170520	24.3	22.7	42.5	-	10.5	-
170521	29.3	22.4	37.9	-	10.4	-
170522	27.4	20.1	39.4	-	13.1	-
170523	24.2	26.3	38.8	-	10.7	-
170524	31.1	22.3	36.2	-	10.4	-

MODAL ANALYSES

NORTH BAY

Number	Quartz	K-feldspar	Plagioclase	Biotite	Muscovite	Opaques
170123	29.8	21.4	40.1	8.4	0.2	0.1
170124	27.2	32.4	33.9	5.5	1.0	0.2
170195	26.3	26.7	38.5	4.2	4.3	-
170196	25.1	28.3	42.4	4.2	-	-
170197	36.8	15.5	38.6	9.1	-	-
170198	38.7	16.7	35.0	9.6	-	-
170200	35.6	23.6	32.4	8.3	-	-
170351	26.2	19.4	42.5	10.6	1.3	-
170352	25.3	20.6	43.3	7.3	2.7	-
170374	16.9	-	48.8	11.6	-	-
170375	26.7	11.2	50.7	8.4	-	-
170377	26.2	12.3	49.8	8.2	1.2	-
170388	27.4	23.4	38.7	8.6	1.9	-
170393	25.4	19.2	43.9	9.3	2.2	-
170394	27.5	22.1	39.8	7.2	2.1	-

MODAL ANALYSES

NORTH BAY

Number	Quartz	K-feldspar	Plagioclase	Biotite	Muscovite	Opaques
170034	39.4	20.1	35.4	3.1	2.0	-
170054	49.5	16.0	23.3	5.6	5.6	-
170055	29.4	22.0	41.8	6.8	-	-
170056	34.8	18.2	41.3	5.7	-	-
170057	43.0	8.6	40.5	6.9	1.0	-
170072	10.0	30.2	49.5	10.2	-	-
170073	25.7	36.7	28.8	8.7	0.1	-
170079	24.3	55.4	16.5	-	3.8	-
170080	31.6	10.7	45.3	11.4	-	-
170081	39.8	43.5	-	4.1	12.6	-
170082	23.2	26.3	40.7	9.8	-	-
170092	28.3	24.9	38.8	4.2	3.8	-
170100	33.4	21.5	35.4	9.7	-	-
170101	31.8	16.5	41.4	10.2	-	-
170102	33.6	15.4	40.3	10.8	-	-
170108	34.3	20.2	36.5	2.1	6.9	-
170117	29.1	33.4	27.0	4.2	6.3	-
170118	27.2	20.2	43.0	7.4	2.2	-
170119	23.9	19.4	46.2	8.1	2.4	-
170120	26.2	24.6	34.3	9.7	5.2	-
170122	26.4	18.4	46.5	7.3	1.4	-

APPENDIX 2

RUBIDIUM-STRONTIUM ISOTOPIC METHOD

2.1 Field Methods

Samples of about 10 to 25 kg were collected from points within each prospective pluton so as to attain maximum spatial and varietal coverage. Instead of large massive samples, several fresh chips of about 50-100 g were collected over an area of a few square meters at each location. Samples were stored in plastic bags or plastic buckets. Whole rock chemical analyses are given below.

2.2 Laboratory Methods

Samples (1 to 2 kg) were first crushed in a steel jaw crusher, then ground in a tungsten carbide vibrating pulverizer. The powder was thoroughly mixed to homogenize the sample. A thin section was made from a representative piece for petrographic examination.

From each sample 10g was selected for determination of Rb and Sr by X-ray fluorescence; 0.1 g was selected for determination of major and trace elements.

A third portion (0.5-1 g) for determination of Sr^{87}/Sr^{86} ratios was weighed into a teflon beaker and dissolved in 10 cm^3 hydrofluoric acid after any carbonate present was driven off by a few drops of 2M HCL. To the solution was added 1 cm^3 perchloric acid. The sample was then digested on a hot plate at 150^oC until a solid residue of fluorides and perchlorates remained. The residue was redissolved in

2M HCl (10 cm^3) and perchloric acid (2 cm^3). This was allowed to evaporate at 150^oC, leaving a solid residue of soluble chlorides and perchlorates.

The residue was again dissolved in 1M HCl (10 cm^3) and passed through an ion exchange resin. Elution was done with 2M HCl. The strontium (20 cm^3) fraction was collected after the first 110 cm^3 had been discarded.

The solution was evaporated to dryness, first on a hot plate at 150^oC, then under an infra red lamp. Finally the sample was dissolved in a few drops of 2M HCl and carefully applied to an electrode. The sample was ignited under high voltage and analysed by a Micromass Mass Spectrometer for Sr^{87} and Sr^{86}. Rb^{87} was calculated from measured Rb:Sr (XRF) using a computer program. With the aid of a computer, the radiometric date was calculated, using the decay constant of 1.42×10^{-11} yr^{-1}.

TABLE 2.1.

CHEMICAL ANALYSES-NORTH BAY (NB-A)

SAMPLE PERCENT	(NB-1) 170117	170072	170080	170198
SiO_2	72.7	69.5	70.0	71.3
TiO_2	.24	.42	.35	.44
Al_2O_3	14.0	16.1	15.2	15.1
Fe_2O_3	.07	.18	N.D.	.17
FeO	1.18	2.12	2.30	1.99
MnO	.04	.04	.05	.03
MgO	.46	.93	.84	.96
CaO	1.49	1.91	1.84	2.14
Na_2O	3.82	4.09	4.13	4.64
K_2O	4.27	4.44	3.85	4.20
P_2O_5	.06	.05	.04	.12
L.O.I.	.71	.56	.68	.71
TOTAL	99.04	100.34	99.28	101.62
ppm				
Zr	137	241	207	191
Ar	248	464	457	536
Rb	155	175	136	128
Zn	47	54	53	52
Cu	42	41	25	37
Ba	656	1156	966	1088
Nb	08	07	08	11
Ga	19	23	23	25
Pb	26	10	27	21
Ni	03	06	06	05
Cr	01	08	12	10
V	20	48	41	47

TABLE 2.2.

CHEMICAL ANALYSES-NORTH BAY (NB-B)

SAMPLE PERCENT	(381) NB 5	(372) NB 6	(377) NB 8	(378) NB 9	(387) NB 10	(393) NB 11	170374	170385
SiO_2	56.2	65.2	66.7	65.2	69.0	67.7	57.0	66.0
TiO_2	.94	.63	.48	.52	.35	.51	.80	.55
Al_2O_3	15.7	15.8	15.5	16.2	15.4	14.9	14.9	15.7
Fe_2O_3	.84	.54	.74	.78	.14	.59	1.36	.71
FeO	5.98	3.08	2.53	2.66	2.21	2.84	4.74	2.82
MnO	.12	.06	.08	.07	.06	.07	.12	.08
MgO	7.79	2.12	1.45	1.48	1.06	1.46	7.76	1.58
CaO	6.78	3.74	2.91	3.14	2.50	3.13	7.43	3.10
Na_2O	2.73	3.45	3.61	3.79	3.63	3.67	2.60	3.55
K_2O	1.61	3.43	3.66	3.70	4.00	2.69	1.86	3.38
P_2O_5	.80	.17	.20	.20	.12	.24	.13	.16
L.O.I.	1.44	.92	.80	.84	.74	.78	1.20	1.09
TOTAL	100.23	99.14	98.66	98.58	99.21	98.58	99.90	98.72
ppm								
Zr	138	184	197	197	155	170	107	200
Sr	356	218	240	231	175	198	223	235
Rb	57	146	133	130	168	109	74	179
Zn	76	55	58	60	48	67	58	64
Cu	46	29	31	22	35	27	61	33
Ba	271	505	553	613	416	325	240	544
Nb	11	11	13	12	12	12	05	10
Ga	25	24	19	23	20	22	20	24
Pb	14	27	24	19	19	23	10	15
Ni	146	18	.05	10	10	09	102	15
Cr	259	41	14	20	17	18	254	15
V	160	72	58	55	32	54	162	67

TABLE 2.3.

CHEMICAL ANALYSES-THROUGH HILL GRANITE

SAMPLE PERCENT	170501	170504	170506	170511	170516	170518
SiO_2	72.8	73.3	74.2	74.4	75.9	74.9
TiO_2	.11	.02	.05	.02	.04	.05
Al_2O_3	14.80	14.15	13.60	15.85	14.80	15.30
Fe_2O_3	-*	-*	-*	-*	-*	-*
FeO	.70	1.04	.48	.48	.54	.57
MnO	.03	.36	.02	.04	.03	.03
MgO	.20	.14	.12	.06	.12	.19
CaO	.53	.78	.58	.47	.70	.77
Na_2O	3.00	3.28	4.28	3.73	4.40	5.71
K_2O	5.80	4.80	3.84	6.46	3.70	1.99
P_2O_5	.26	.17	.26	.18	.27	.23
L.O.I.	1.23	.64	.75	.75	.96	.91
TOTAL	99.46	98.80	98.13	101.65	101.40	100.65
ppm						
Zr	07	55	24	13	14	48
Sr	69	100	32	53	28	34
Rb	166	127	158	159	164	69
Zn	03	00	00	00	01	00
Cu	00	00	00	00	00	00
Ba	221	190	118	94	11	18
Nb	17	06	10	05	19	13
Ga	17	11	12	10	16	13
Pb	44	52	33	55	30	27
Ni	14	09	11	10	12	03
Cr	00	00	00	00	00	00
V	02	00	00	00	00	00

TABLE 2.4.

CHEMICAL ANALYSES-PARTRIDGEBERRY HILLS PLUTON

SAMPLE PERCENT	(P49) 170444	(P20) 170471	(P35) 170485	(P13) 170526	(P39) 170539	(P50) 170543
SiO_2	69.1	67.2	68.0	76.6	65.8	70.5
TiO_2	.48	.73	.72	.13	.93	.69
Al_2O_3	14.70	14.90	14.50	13.40	15.85	14.80
Fe_2O_3	.40	.67	.66	.20	.56	.49
FeO	2.75	3.33	3.30	.97	3.89	3.13
MnO	.05	.04	.06	.03	.07	.05
MgO	1.19	1.36	1.42	.26	1.55	1.33
CaO	.71	1.68	1.57	.38	1.93	1.18
Na_2O	2.60	2.37	2.81	3.13	2.82	2.89
K_2O	4.73	4.38	4.05	4.85	3.96	3.82
P_2O_5	.08	.20	.23	.20	.13	.14
L.O.I.	2.01	2.73	1.67	1.26	2.21	2.44
TOTAL	98.80	99.59	98.99	101.47	99.70	101.46
ppm						
Zr	189	231	218	54	274	225
Sr	77	136	138	18	113	112
Rb	192	174	159	266	148	114
Zn	29	49	48	14	54	51
Cu	17	09	09	00	22	14
Ba	485	808	589	112	933	780
Nb	19	21	23	12	19	18
Ga	19	18	16	15	23	19
Pb	23	21	25	32	27	23
Ni	31	38	31	24	40	28
Cr	08	16	07	00	22	17
V	56	74	62	06	93	74

TABLE 2.5.

CHEMICAL ANALYSES-GAULTOIS GRANITE

SAMPLE PERCENT	(149) G 1	(561) G 2	(562) G 4	(563) G 5	(170003) G 6	(564) G 7	(148) G 8	(565) G 9	(566) G 10	(170023) G 11
SiO_2	73.1	59.2	62.7	61.7	62.8	65.2	63.1	64.0	63.1	45.5
TiO_2	.18	.95	.94	1.00	.97	.78	.92	.80	.84	1.96
Al_2O_3	14.4	18.15	16.45	16.35	17.8	15.55	15.8	16.70	16.45	17.2
Fe_2O_3	.20	1.38	1.52	1.38	.39	1.01	1.34	1.08	1.29	3.16
FeO	1.04	3.96	3.59	3.91	3.67	3.36	3.61	3.25	3.58	9.17
MnO	.06	.10	.10	.11	.11	.08	.08	.09	.11	.21
MgO	.41	2.70	2.47	2.65	2.84	2.05	2.78	2.11	2.48	8.47
CaO	1.05	4.23	3.91	3.94	3.38	3.24	3.60	3.88	3.35	8.95
Na_2O	3.66	3.50	3.08	3.00	2.67	3.14	3.04	3.25	3.10	1.39
K_2O	4.65	4.20	4.15	4.14	4.83	3.63	4.37	3.93	4.68	2.31
P_2O_5	.09	.18	.18	.20	.13	.13	.27	.17	.19	.47
L.O.I.	1.12	1.37	1.34	1.40	1.36	1.57	1.30	1.01	1.40	1.58
TOTAL	99.96	99.92	100.43	99.78	100.95	99.74	100.21	100.27	100.57	100.37
ppm										
Zr	289	246	243	253	243	231	247	220	238	125
Sr	381	378	341	351	368	312	364	320	346	399
Rb	169	237	184	192	229	179	199	192	234	153
Zn	79	58	52	54	67	44	69	40	53	126
Cu	44	14	11	11	39	18	37	06	12*	56
Ba	1056	925	1011	854	1382	843	985	1024	1086	1015
Nb	11	11	16	17	14	14	14	11	12	08
Ga	21	21	16	17	21	17	23	15	16	25
Pb	18	20	20	21	24	19	14	20	19	01
Ni	33	51	44	51	29	38	31	39	51	52
Cr	71	37	36	41	50	31	55	35	41	138
V	152	120	116	121	120	101	119	95	110	378

APPENDIX 3

MICROPROBE DATA,GARNET,MUSCOVITE

A Jeol JXA 50A electron microprobe was used to analyse garnet and muscovite on polished thin sections. Samples of Kakanui garnet and hornblende were used as standards to monitor precision.Results from the Through Hill pluton are tabulated below.

Garnet - sample 170504;average of 4.

	Mg	Al	Si	Ca	Ti	Mn	Fe	Total
Oxide %	1.97	21.7	37.6	.33	.00	7.65	30.9	100.1
Cations	.236	2.06	3.02	.028	.00	.520	2.08	7.94

Pyrope $Mg_3Al_2(SiO_4)_3$ - 73.4%

Almandine $Fe_3Al_2(SiO_4)_3$ - 8.4%

Spessartine $Mn_3Al_2(SiO_4)_3$ - 18.2%

Garnet - sample 170512;average of 4.

	Mg	Al	Si	Ca	Ti	Mn	Fe	Total
Oxide %	1.80	21.9	38.2	.39	.02	7.19	30.8	100.3
Cations	.213	2.064	3.051	.033	.00	.485	2.059	7.906

Spessartine (Mn) component = 17.4%.

<u>Garnet</u> - sample 170518, average of 3.

	Mg	Al	Si	Ca	Ti	Mn	Fe	Total
Oxides %	1.72	21.7	37.9	.31	.01	7.06	31.19	99.93
Cations	.205	2.057	3.048	.026	.00	.479	2.097	7.912

Spessartine (Mn) component = 17.1%

<u>Garnet</u> - sample 170520; average of 4.

	Mg	Al	Si	Ca	Ti	Mn	Fe	Total
Oxide %	1.72	21.7	37.7	.52	.00	7.73	29.9	99.2
Cations	.206	2.063	3.048	.042	.00	.529	2.021	7.909

Spessartine (Mn) component = 18.9%.

Average Spessartine component 17.9%.

The garnets are mainly Almandine.

Muscovite- sample 170515, single analysis.

SiO_2	52.14
Al_2O_3	36.98
*FeO	1.39
MgO	0.52
TiO_2	0.17
Na_2O	0.35
K_2O	8.44
Total	99.99

*All Fe measured as FeO.

Cations per 6 (octahedral and tetrahedral) sites

			Explanations
Si_{iv}	3.20	4	Tetrehedral (Si + Al)=4 as in ideal muscovite formula
Al_{iv}	0.80		
Al	1.87		
Fe	0.07		Assigned to celadonite. Assumed to be shared equally between bivalent and higher valency states.
Mg	0.05		
Ti	0.01		
Total	6.000		
Na	0.041		-------- Assigned to paragonite
K	0.659		

Muscovite composition based on the above calculations:-

$K\ Al_2(AlSi_3)\ O_{10}(OH)_2$ - Muscovite - 89.6 mol%

$K(Mg,Fe)\ (Al,Fe^{3+})\ Si_4O_{10}\ (OH)_2$- Celadonite - 6.3 mol%

$NaAl_2\ (AlSi_3)\ O_{10}\ (OH)_2$ - Paragonite - 4.1 mol %

Muscovite - sample 170520, average of 2 analyses.

SiO_2	49.52
Al_2O_3	38.75
*FeO	1.28
MgO	0.58
TiO_2	0.04
Na_2O	0.45
K_2O	9.38
Total	100.00

*All Fe measured as FeO.

Cations per 6 (octahedral and tetrahedral) sites

Si_{iv}	3.06
Al_{iv}	0.94
Al	1.89
Fe	0.06
Mg	0.05
Ti	0.00
Total	6.00
Na	0.054
K	0.736

			mol %
Composition:-	Muscovite	-	89.1
	Celadonite	-	5.5
	Paragonite	-	5.4.

Muscovite - sample 170512, average of 6

SiO_2	49.73
Al_2O_3	39.01
*Fe O	0.98
MgO	0.49
TiO_2	0.29
Na_2O	0.52
K_2O	8.89
Total	99.91

All Fe measured as Feo.

Cations per 6 (octahedral and tetrahedral) sites

Si_{iv}	3.07
Al_{iv}	0.93
Al	1.90
Fe	.05
Mg	.04
Ti	.01
Total	6.00
Na	.061
K	.698

			mol%
Composition:-	Muscovite	-	88.9
	Celadonite	-	5.0
	Paragonite	-	6.1

Muscovite _ sample 170504, average of 2.

SiO_2	49.53
Al_2O_3	38.24
*FeO	1.34
MgO	.64
TiO_2	.26
Na_2O	.48
K_2O	9.50
Total	99.99

All Fe measured as FeO.

Cations per 6 (octahedral and tetrahedral) sites

Si_{iv}	3.07
Al_{iv}	0.93
Al	1.87
Fe	.07
Mg	.05
Ti	.01
Total	6.00
Na	0.055
K	.75

		mol%
Composition:-	Muscovite -	88.0
	Celadonite	6.5
	Paragonite	5.5

Muscovite - sample 170518, average of 3.

SiO_2	49.42
Al_2O_3	38.80
*FeO	1.10
MgO	.57
TiO_2	.25
Na_2O	.58
K_2O	9.27
Total	99.99

All Fe measured as FeO.

Cations per 6 (octahedral and tetrahedral) sites

Si_{iv}	3.06
Al_{iv}	0.94
Al	1.89
Fe	.05
Mg	.05
Ti	.01
Total	6.00
Na	.068
K	.728

		mol %
Composition :-	Muscovite -	87.7
	Celadonite -	5.5
	Paragonite -	6.8