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PLUTONIC ROCKS OF THE EASTERN CENTRAL MINERAL BELT, LABRADOR: GENERAL GEOLOGY AND DESCRIPTION OF REGIONAL GRANITOID UNITS

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ABSTRACT

This preliminary report outlines results from a three-year project initiated in late 1984 to assess the potential of granitoid rocks in the eastern Central Mineral Belt for granophile mineralization, and gather information on the major early to middle Proterozoic batholiths of which they form a part.

Granitoid rocks in the area fall into two major groups. An earlier group (Makkovikian granitoids) consists of foliated to gneissic rocks emplaced c.1.85 Ga, contemporaneous with a major period of deformation and metamorphism. These contrast with a younger group of posttectonic intrusions that form the c.1.65 Ga Trans-Labrador batholith, which is generally undeformed or only weakly foliated over much of the study area. Although it includes layered gabbros, monzonites and syenites, the Trans-Labrador batholith is dominated mostly by granites and alkali-feldspar granites. The northern margin of the batholith in this area includes a number of small, leucocratic granite bodies whose outcrop patterns suggest that their upper surfaces are cut by the present erosion surface. Some of these bodies host Mo-Cu mineralization, and others appear to be spatially associated with hydrothermal veins containing Mo and base metal sulfides.

INTRODUCTION

Project Description

This project was initiated in late 1984 following previous recognition of the potential of some granites in the area for granophile mineralization (Ryan, 1977; Gower *et al.*, 1982; Wardle, 1984). The primary objective of this project is to assess the overall potential of granitoid rocks throughout the eastern Central Mineral Belt for granophile mineralization and to define areas underlain by highly evolved or specialized granites which may merit more detailed investigation or exploration in future years. A parallel objective is to develop an understanding of the anatomy, evolution and petrogenesis of the extensive 1.65 Ga granitoid terrane known as the Trans-Labrador batholith, which is one of the most important geological elements of central Labrador (Figure 1).

In view of the large areas underlain by granitoid rocks in the eastern Central Mineral Belt, it was decided that the initial phase of this project should involve an examination of regional lithogeochemical patterns, and the first field season was thus largely devoted to the completion of an extensive helicopter-supported rock sampling and mapping program. This work is aimed at delineation of broad petrographic subdivisions within the batholith and identification of areas of potential enrichment in lithophile elements of economic importance. It will also provide a systematic sample collection for subsequent geochemical and petrogenetic studies. This year's field work involved the collection of about 650 samples with an average site spacing of approximately 2 km, over a total area of approximately 5000 km^2, of which 60 to 70 percent is underlain by granitoid rocks. Additional detailed field work and sampling were carried out within several of the smaller granitoid plutons associated with known mineralization or considered to have potential for granophile deposits. Most of these areas will be revisited next year and examined in more detail.

Current research is directed at the examination of hand samples, stained slabs and available thin sections in order to outline a general framework of regional granitoid units, which will form a basis for assessment of geochemical data. Much of this framework is derived from previous subdivisions suggested by Gower *et al.* (1982) and Ryan (1985), with the addition of several new units defined by the initial results of this project.

Sampling and Mapping Methods

In view of the large size of the study area, a structured approach to mapping and sampling is required in order to cover all areas in more-or-less equal detail. The methods used in Labrador were derived mostly from those developed during the Ackley project (Dickson, 1983), which were in turn derived from a system devised by R.G.Garret in 1979. For a full discussion of the statistical basis for this and other sampling methods, the reader is referred to Garret (1983). The system utilizes a 2 by 2 km grid based on UTM co-ordinates, and sample locations are preselected on a random basis within each grid cell.

Random preselection of sample locations in this fashion has obvious advantages in any geochemical study involving statistical data analysis methods, but cannot readily be applied in the field, where outcrops are not randomly distributed. Nevertheless, the system worked very effectively in coastal areas and in areas of generally high elevations.

This project is a contribution to the Canada-Newfoundland Mineral Development Agreement, 1984-1989

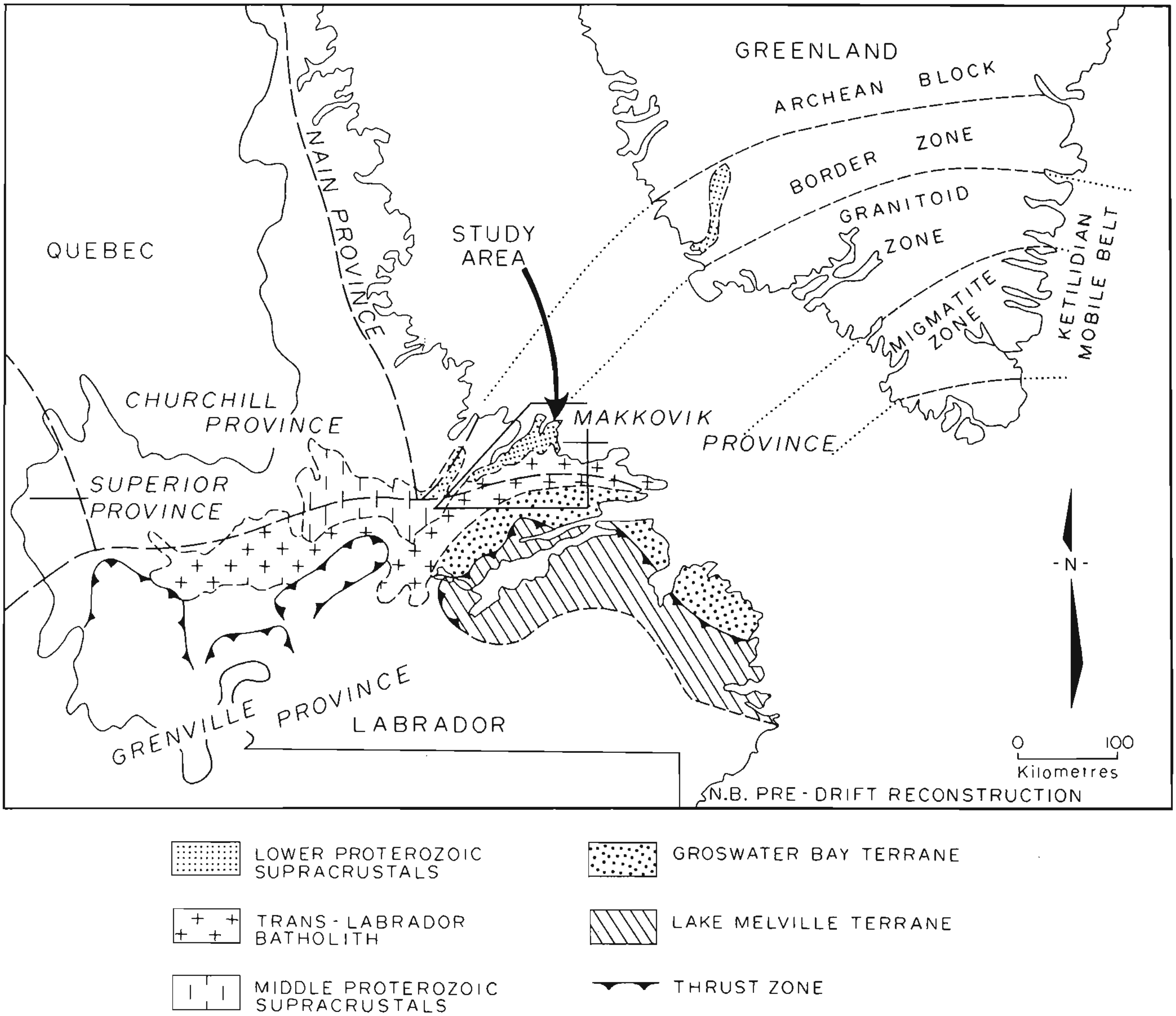

Figure 1: *Principal geotectonic elements of east-central Labrador, showing the extent of the Trans-Labrador batholith and adjacent terranes. The Groswater Bay terrane consists of quartzofeldspathic orthogneisses and paragneisses, and the Lake Melville terrane contains similar rock types with a higher proportion of paragneisses. Elements of the pre-Trans-Labrador batholith geology of the Makkovik Province appear to be correlative with the Ketilidian Mobile Belt of Greenland (after Gower and Ryan, in press).*

In poorly exposed areas, some difficulties were encountered and sample sites were dictated mostly by availability of outcrops and natural features for topographic control and landing spots. However, the original grid system was adhered to as much as possible to control sample spacing.

Location, Access and Topography

The field area forms a rough quadrilateral having a maximum length of about 130 km and a maximum width of about 75 km (Figure 1), including a deeply indented coastal strip, numerous offshore islands and adjacent inland areas . Access is provided by CN Marine coastal boat services and by scheduled air services from Goose Bay via LABAIR. The settlements of Makkovik and Postville provide good bases for field work in the eastern half of the area, and the BRINCO exploration camp at Melody Lake is ideally situated for work in the west. Helicopter and fixed wing support are available from Goose Bay, approximately 250 km to the southwest.

The topography of the area ranges from rugged barren mountainous terrain, containing 60 to 80 percent exposure along the coastal strip and south of Makkovik, to a sporadically exposed boulder-strewn plateau in inland areas to the south and west.

Previous Work

Thorough and detailed descriptions of previous work and mineral exploration throughout the area are given by Gower *et al.* (1982) and Ryan (1985), and only a very brief review is presented here.

The earliest work consisted largely of descriptions of coastal outcrops (Leiber, 1860; Packard, 1891; Daly, 1902), with some later mapping along the coast by officers of the Newfoundland Geological Survey and the Geological Survey of Canada (Kranck, 1939, 1953; Christie *et al.*, 1953; Douglas, 1953). 1:250,000 scale geological mapping was completed by the Geological Survey of Canada (Stevenson, 1970; Taylor, 1975).

In 1954 pitchblende was discovered near Makkovik, leading eventually to a 25-year period of uranium and lesser base-metal exploration by British Newfoundland Exploration Company Ltd (BRINCO) and several joint venture partners. Most of the exploration and research work from 1955 to 1978 was related to the search for economic mineralization in uranium-bearing supracrustal sequences. However, several more general studies were carried out via university theses, including regional geological and structural work by Clark (1970, 1973) and Marten (1977) in the Makkovik and Kaipokok Bay areas, and petrochemical studies of uranium-bearing volcanic rocks by White (1976) and Evans (1980).

The Newfoundland Department of Mines and Energy started work in the area in 1976 and regional 1:100,000 scale mapping was completed in 1980 (Bailey, 1978; Bailey *et al.*, 1979; Ryan and Harris, 1978; Doherty, 1980). Compilation and synthesis of this information was presented by Gower *et al.* (1982) for the eastern half, and by Bailey (1979) and Ryan (1985) for the west. Attention during these mapping programs was directed mostly toward supracrustal sequences and associated mineralization, but the areal importance of post-tectonic granitoid rocks was recognized, as was their polyphase and compositionally variable nature. However, many inland areas are very poorly known, and in some (particularly the large area south of the Adlavik Brook fault zone and around Big River) the granitoid rocks have not been subdivided.

Regional Geological Framework

The study area forms the eastern termination of the Central Mineral Belt of Labrador (Greene, 1974; Figure 1). The Central Mineral Belt is a zone of Aphebian and Helikian supracrustal sequences and associated intrusive rocks which contain a large number and variety of base-metal, uranium and rare-metal mineral occurrences. The belt lies along the junction between four structural provinces: the Nain (c.2.5 Ga), Makkovik (c.1.85 Ga) and Churchill (c.1.8 Ga) provinces to the north, and the Grenville Province (c.1.1 Ga) to the south (Figure 1). Most of the present study area lies within the Makkovik Province, but the southern edge and southwestern extremity are within the Grenville Province, where later tectonism obliterates primary features and relationships.

The largest geological element in the area is the Trans-Labrador batholith, a complex polyphase granitoid batholith that shows a range of ages (2.0 to 1.5 Ga) clustering mostly around 1.65 Ga. Mapping and geochronological studies in central Labrador (Wardle *et al.*, 1982; Thomas *et al.*, 1984; Nunn *et al.*, 1985) have shown that this feature can be traced to western Labrador, and Gower and Owen (1984) have suggested that it may also correlate with a similar 800 km long granitoid belt in southern Scandinavia. The Trans-Labrador batholith is bounded to the south by a number of thrust-bounded blocks containing high-grade gneisses, which may record the effects of broadly contemporaneous metamorphism. This middle Proterozoic orogenic event is now termed the Labradorian orogeny (Nunn *et al.*, 1985) and appears to represent an orogenic cycle separating the Hudsonian and Makkovikian (see below) events from the younger Grenvillian cycle.

GENERAL GEOLOGY

Introduction

The study area can be subdivided into four broad geological domains. These are as follows:

1. Archean basement rocks and reworked Archean basement exposed mostly to the north of Kaipokok Bay (Hopedale gneisses and Makkovik gneisses). These comprise banded quartzofeldspathic gneisses of probable igneous derivation with associated amphibolites and high-grade metasedimentary rocks. All of these rocks were remobilized to some extent during lower Proterozoic orogenic events, now termed the Makkovikian orogeny (Gower and Ryan, *in press*). In general, the degree of reworking increases from northwest to southeast toward Kaipokok Bay (Ryan and Kay,1982).

2. Lower Proterozoic supracrustal rocks (Aillik Group), consisting of two contrasting assemblages that do not necessarily represent a single stratigraphic sequence (Marten, 1977). The lower Aillik Group is exposed in a zone of intense folding and thrusting along Kaipokok Bay, and consists of mafic metavolcanic rocks and assorted arenaceous to pelitic metasedimentary rocks. The upper Aillik Group is more widespread, and consists of a thick pile of felsic volcanic and volcaniclastic rocks including related subvolcanic intrusives. In general, it appears less deformed than the lower Aillik Group, but this may to some extent be a function of differences in lithology.

3. Foliated to gneissic granitoid intrusive rocks containing north-northeast-trending fabrics; the granitoids intrude both the Archean basement and the Aillik Group. Marten (1977) established that this granitoid suite was emplaced syntectonically with respect to the main deformational events within the lower Aillik Group. These events correspond with the Makkovikian orogeny of Gower and Ryan (*in press*) and the term 'Makkovikian granitoids' is thus applied to intrusive rocks formed during this period. Limited radiometric age data suggest emplacement around 1.85 Ga.(Gandhi *et al.*, 1969; Brooks, 1982; 1983).

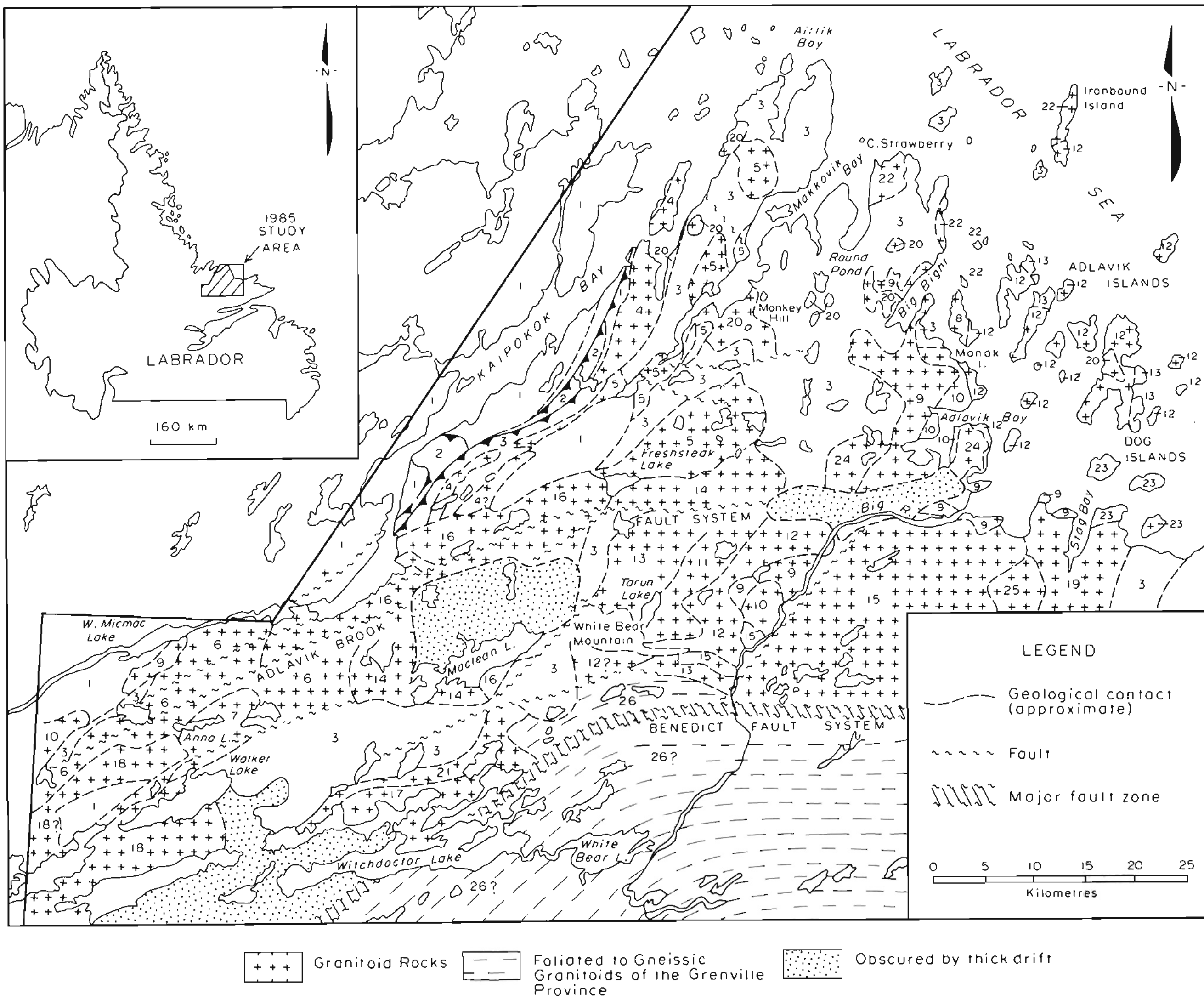

Figure 2: *Generalized geological map showing the distribution of granitoid units within the Makkovikian and Trans-Labrador batholiths. Partly after Gower et al. (1982) and Ryan (1985), with revisions in some areas.*

4. Massive, dominantly posttectonic, polyphase granitoid intrusive rocks (Trans-Labrador batholith) emplaced c.1.65 Ga. These rocks are generally undeformed to only weakly foliated, except in the extreme south where they acquire strong east-trending fabrics of Grenvillian age. The Trans-Labrador batholith is dominated by quartz monzonite to granite, but includes a wide variety of rock types ranging from hornblende peridotites to alkali-feldspar granites. The batholith in this area is divided into three major intrusive suites by Gower *et al.*(1982) and Ryan (1985), but these do not necessarily represent single plutons or magma sequences.

The prominent structural feature of the area is a north-northeast-trending, strongly deformed, fold-thrust belt along Kaipokok Bay, whose trend is also shared by penetrative fabrics in Makkovikian granitoids. This belt is cross-cut by a system of east-trending faults and shear zones that mark the Grenville Front Zone. The most prominent of these are the Adlavik Brook fault system and the Benedict fault system, which divide the area into three blocks that exhibit differing amounts of Grenvillian deformation. North of the Adlavik Brook fault system, intrusive rocks of the Trans-Labrador batholith are generally undeformed, whereas the area between the two fault systems shows a heterogeneous development of strongly foliated and cataclastic zones with trends that are generally parallel to the major faults. South of the Benedict fault system, strong east-trending fabrics are almost ubiquitous within the study area. Mapping by Gower (1981, 1984) south and east of the present study area suggests that strain is more heterogeneous away from the immediate vicinity of the Grenville Front Zone. Orthogneisses within the Grenville Province may be deformed equivalents of the Trans-Labrador batholith. The area south of the Benedict fault system probably represents a somewhat deeper level within the batholith.

LEGEND

EARLY TO MIDDLE PROTEROZOIC

Grenville Province gneisses

26 Strongly deformed granitoid rocks (probably equivalent to the Trans-Labrador batholith).

Trans-Labrador batholith c. 1650 Ma

Smaller granitoid bodies

25 Medium grained, equigranular, alkali-feldspar granite.

24 Assorted granite, alkali-feldspar granite and quartz syenite.

23 *Dog Islands granite:* fluorite-bearing biotite granite similar to Strawberry granite (included in Benedict Mountains intrusive suite by Gower, 1981).

22 *Strawberry granite:* variably textured, porphyritic, biotite granite containing accessory fluorite.

21 Fine grained quartz monzonite to granite.

20 *Monkey Hill granite:* gray to pink, fine grained adamellite.

Benedict Mountains / Nipishish Lake intrusive suites

19 K-feldspar porphyritic granodiorite.

18 *Otter Lake-Walker Lake granite:* gray to pink, K-feldspar porphyritic, biotite-hornblende quartz monzonite to granite.

17 Pink equigranular alkali-feldspar leucogranite.

16 Pink to white biotite-hornblende granite and leucogranite.

15 Pink K-feldspar porphyritic granite to alkali-feldspar granite displaying 'pseudo-rapakivi' texture.

14 Gray to brown porphyritic granodiorite to adamellite.

Adlavik intrusive suite

13 Brown to gray K-feldspar porphyritic syenite.

12 Pink to white quartz monzonite.

11 Plagioclase porphyritic monzonite.

10 Diorite and monzodiorite.

9 Gabbro and leucogabbro.

EARLY PROTEROZOIC

Makkovikian granitoid rocks c. 1850 Ma

8 Gray leucocratic granodiorite.

7 Foliated granodiorite, diorite and quartz monzonite.

6 Pink, foliated, K-feldspar porphyritic granite and equigranular leucogranite.

5 Foliated biotite-hornblende quartz monzonite to granite, local fluorite-bearing leucogranite.

4 *Long Island quartz monzonite:* variably foliated melanocratic quartz monzonite.

Supracrustal rocks

3 **Upper Aillik Group:** felsic volcanic and volcaniclastic rocks, subvolcanic intrusive rocks, minor metasedimentary rocks and mafic volcanic rocks.

2 **Lower Aillik Group:** mafic metavolcanic rocks and assorted metasedimentary rocks.

ARCHEAN

1 Quartzofeldspathic orthogneisses, amphibolites, metasedimentary rocks and metamorphosed granitoid rocks (includes gneisses reactivated during early Proterozoic events).

The Adlavik Brook fault system appears to have a transcurrent component to its motion and a dextral displacement of about 20 km, based on the relative positions of supracrustal and granitoid units on either side of it (Gower *et al.*, 1982).

Figure 2 shows the generalized granitoid geology of the study area and is mostly intended to convey the general distribution of units; contacts are taken wherever possible from the more detailed ground-based mapping summarized by Gower *et al.* (1982). Some portions of Figure 3 differ from previous maps of the area, most particularly in areas south of the Adlavik Brook fault zone and around Big River, because very little information was previously available.

A total of 22 granitoid units have been distinguished within the study area, of which four are assigned to the earlier Makkovikian suite and 17 to the Trans-Labrador batholith (the status of one unit is unclear). Some of these units are equivalent to previously defined units or are extensions of such units, but several are new. The Archean gneisses and Aphebian supracrustal rocks (Units 1 to 3 on Figure 2) that form the country rocks to these granitoid units have not been examined in any detail and will not be discussed here. For full descriptions, see Gower *et al.* (1982) and Ryan (1985). Granitoid nomenclature follows the IUGS system proposed by Streckeisen (1976), but the term 'adamellite' has been retained for quartz-rich granitoids containing similar amounts of K-feldspar and plagioclase.

Makkovikian Granitoid Rocks (Units 4-7)

Foliated to gneissic granitoids of the Makkovikian batholith underlie much of the northwestern edge of the study area. They are characterized by the presence of strong penetrative fabrics that are locally cataclastic and have north to northeast trends. The granitoids are only rarely massive, even in their innermost portions. In the extreme southwest, where Grenvillian effects are significant, distinction between Makkovikian granitoids and deformed members of the Trans-Labrador batholith suite becomes locally difficult. However, there is still a distinct *regional* contrast in deformation state; for example, the granites of Unit 6 invariably display a strong fabric, whereas the adjacent Otter Lake-Walker Lake granite and Unit 16 of the Trans-Labrador batholith show only localized fabric development and are most commonly massive. A number of radiometric age dates obtained from Makkovikian granitoid rocks (Gandhi *et al.*, 1969; Brooks, 1979, 1982) suggest emplacement in the interval 1.95-1.80 Ga. Most Rb/Sr data and K/Ar data cluster around 1.85 Ga.

Long Island quartz monzonite (Unit 4). This unit is identical to that described by Gower *et al.* (1982) under this name, and previously was referred to as the Long Island gneiss by Gandhi *et al.* (1969). The main body of this unit is exposed on Long Island and extends southward onto the mainland for 10 to 15 km. Two smaller narrow belts of foliated granitoid along strike from the main body appear to be lithologically similar (on the basis of a few samples) and are here grouped with the Long Island pluton following Gower *et al.* (1982).

The Long Island suite is generally uniform in composition and is dominated by fine to medium grained, melanocratic, foliated quartz monzonites, which locally contain deformed enclaves of amphibolite and diorite. Only rarely is it gneissose, although local areas around the margins of the body have a banded appearance, which probably resulted from intense deformation of an enclave-rich phase. The most conspicuous textural feature is variably preserved zoned plagioclase phenocrysts. The unit typically contains 10 to 20 percent mafics by volume, with subequal amounts of biotite and hornblende (both appear to be primary) and some secondary biotite after hornblende.

Unit 5. This is a new unit which combines the Kennedy's Cove gneiss of Clark (1970) with other very similar foliated granitoid units described by Gower *et al.* (1982), and also includes an extensive body of foliated granite mapped during this project.

The unit includes three elliptical areas east of Makkovik and a large inland area south of Monkey Hill. It is a very distinctive, variably foliated, biotite or biotite-hornblende granite to leucogranite, commonly displaying a K-feldspar porphyritic texture, and, where more strongly deformed, an augen texture. Biotite is the dominant mafic phase in most samples, although a few samples from the Narrows area of Makkovik Bay contain only hornblende and are of quartz-monzonitic composition. Foliations are defined by streaky biotite aggregates and K-feldspar augen. A particularly distinctive variant of this granite is a buff-colored, equigranular, fluorite-bearing leucogranite, which has been recognized in all of the plutons described above. It is not clear if this is a separate phase of the granite or simply a textural variant of the dominant porphyritic granites, which also locally contain accessory fluorite. In general, the unit is rich in accessory phases such as apatite, allanite, sphene and zircon, and locally contains up to 1 percent sphene.

Unit 6. This unit underlies a large area in the southwest part of the study area. It was previously described by Bailey (1979) as pink leucogranite (Melody Hill granite). Unit 6, as defined here, includes two units described by Ryan (1985); a foliated granodiorite and a less abundant leucogranite. Samples collected this year demonstrate that there are at least two textural variants within this broad area, but also suggest a general similarity in composition and the possibility of a gradational relationship between them. The area is thus depicted as a single unit, although it may be possible to subdivide it on the basis of geochemical data. The unit as a whole displays a ubiquitous northeast- to north-northeast-trending foliation and is locally very strongly deformed, contrasting markedly with the younger Trans-Labrador batholith units that surround it. For this reason, it is assigned to the Makkovikian granitoids, and presumed to be about 1.85 Ga in age.

The most common rock types are gray to grayish-pink, coarse grained, K-feldspar porphyritic granite and a pink to red, coarse grained, equigranular biotite leucogranite, both of which have moderate to strong penetrative foliations. The generally similar composition and deformation state suggest that they are best grouped together at this stage in the project.

Other Foliated Granitoids (Units 7 and 8)

Unit 7. This unit comprises foliated granodiorite, diorite and quartz monzonite that were mapped by Bailey (1979) and

Ryan (1985) around Anna Lake. Samples collected this year suggest that these rocks represent a different unit than the adjacent Unit 6, but also demonstrate considerable variation in their characteristics. Rather than add three more units based on very small numbers of samples, these areas have been grouped together pending further information.

Unit 8. Foliated granite of Unit 8 occurs on Manak Island, just north of Adlavik Bay. It consists of medium to coarse grained, gray, leucocratic biotite granodiorite and granite, which display a moderate north-trending foliation but lack the intensity of deformation normally associated with the Makkovikian granitoids. The status of this unit is uncertain at present.

In addition to the regional units discussed above, two smaller foliated granitoid bodies occur near Kaipokok Bay that cannot satisfactorily be represented in Figure 2. These include the Brumwater granite (Marten, 1977), which is a leucocratic biotite granite that intrudes remobilized Archean gneisses, and the Pitre Lake granite, which is a narrow body of biotite-muscovite granite that intrudes lower Aillik Group metasedimentsary rocks. These granitoids have not yet been examined in detail in this study.

Trans-Labrador Batholith

Gower (1981) and Gower *et al.* (1982) divided the granitoid rocks now referred to as the Trans-Labrador batholith into the Adlavik Intrusive Suite, composed of gabbro and monzodiorite, and the Benedict Mountains Intrusive Suite, which is dominated by granitic rocks. Ryan (1985) defined a third division in central Labrador termed the Nipishish Lake Intrusive suite to encompass granitoid rocks that are somewhat younger than the other subdivisions. The following descriptions adhere to this general framework, although some units previously assigned to the Benedict Mountains Suite have been tentatively included with the Adlavik Suite. Radiometric age data for the eastern Trans-Labrador batholith suggests emplacement c.1.65 Ga, although the Nipishish Lake Suite may be as young as c.1.50 Ga. (Kontak, 1979; Brooks, 1982, 1983)

Adlavik Intrusive Suite (Units 9-13)

This suite was first named by Stevenson (1970), and has been described by Gandhi *et al.* (1969) and Clark (1973). Gower (1981) defined the Adlavik Intrusive Suite to include gabbros and diorites around Adlavik Bay, but in this report it is expanded to include monzonites, quartz monzonites and syenites that are all thought to be related. This revision is based mostly on the close spatial association between these rock types, originally pointed out by Gower (1981), and strengthened by the recognition during this project of the same package of rocks south of the Adlavik Brook fault zone. The main body of the suite is undated, but it is probably one of the older portions of the Trans-Labrador batholith as it is intruded by the Monkey Hill granite (Unit 20), which is dated at c.1.62 Ga.

Gabbro (Unit 9). The gabbroic unit of the Adlavik Intrusive Suite is present in two main areas between Big Bight and Adlavik Bay, and also underlies much of the Big River valley. The latter area is separated from the northern body by the Adlavik Brook fault zone, and thus may represent a different intrusion that was originally located farther to the east. The dominant rock type in both areas is a dark-gray to green, coarse grained gabbro to leucogabbro containing clinopyroxene, hornblende and biotite.The mafic minerals show a distinctive 'interstitial' texture to interlocking plagioclase laths, suggesting that the rocks originated as plagioclase cumulates with intercumulus mafic minerals. Most samples also contain minor interstitial K-feldspar. Some of the more mafic phases in marginal areas of the main body contain large pyroxene phenocrysts variably altered to amphibole, and may represent mafic mineral cumulates. Layering (including features typical of many layered intrusions) has been reported by Clark (1973, 1979), but is generally not obvious in inland outcrops.

Diorite-Monzodiorite (Unit 10). This facies of the suite is present around Adlavik Bay and in lesser amounts in the Big River valley. There does not appear to be a sharp contact between this unit and the gabbroic facies at Adlavik Bay, and the strong textural similarity between the two suggests that the relationship may be gradational. The diorite contains more K-feldspar than the gabbro and also small amounts of quartz. Locally, it displays a 'pegmatitic' or appinitic texture and contains large hornblende crystals up to 5 cm in length.

Plagiophyric Monzonite (Unit 11). This unit is present mostly in the area south of the Adlavik Brook fault zone, where it is positioned between Unit 12 monzonite and Unit 13 syenite. Two isolated samples from the Adlavik Islands are very similar, but do not allow a discrete unit to be defined in that area. It is a very distinctive rock containing 20 to 40 percent plagioclase phenocrysts, up to 2 cm across, that are set in a medium grained groundmass of K-feldspar, hornblende and minor quartz.

Monzonite-Quartz Monzonite (Unit 12). This unit corresponds to the Adlavik Islands monzonite of Gower (1981), which forms most of the inner Adlavik Islands. A belt of identical rocks extends from the Adlavik Brook fault zone toward White Bear Mountain in the centre of the area. The dominant rock type is a distinctive, fresh-looking, white to pale-pink, coarse grained monzonite containing euhedral hornblende and biotite. It is generally K-feldspar porphyritic and locally contains phenocrysts of both feldspars. It ranges in composition from monzonite to quartz monzonite and is locally potassic enough to qualify as a quartz syenite. Contacts between this unit and the gabbro-diorite (Units 9 and 10) around Adlavik Bay form an intrusive breccia zone that consists largely of gabbro blocks entrained in porphyritic quartz monzonite.

Syenite-Quartz Syenite (Unit 13). This unit combines syenites exposed on the outer Adlavik Islands with a unit previously designated as the Tarun syenite (Gandhi *et al.*, 1969) in the central part of the area. Although geographically discrete, rocks from these two areas are very similar and are in both cases associated with the other units of the suite. Unit 13 is dominated by gray-green to chocolate-brown, coarse grained syenites and quartz syenites containing perthitic

K-feldspar phenocrysts and interstitial altered clinopyroxene. Some areas are quartz rich and qualify as alkali-feldspar granites. A syenite dike typical of Unit 13 intrudes the agmatitic contact zone of Unit 12 quartz-monzonite, suggesting that this is the youngest unit within the Adlavik suite.

Benedict Mountains and Nipishish Lake Intrusive Suites (Units 14-26)

All other posttectonic intrusive rocks in the area are assigned to one or the other of these suites. As contact relationships are still largely unknown, the units that are the most important in terms of areal extent are discussed first. Five major regional units are recognized.

Unit 14. This is a new unit representing a subdivision of Unit 27 of Gower *et al.* (1982). It has been identified in two separate locations on either side of the Adlavik Brook fault zone; these are interpreted to represent portions of an originally continuous pluton. The dominant rock type is a gray to brown, medium grained, slightly porphyritic, hornblende-biotite granodiorite, quartz monzonite or adamellite. Small plagioclase phenocrysts are generally present and some variants contain phenocrysts of both feldspars. There is some similarity between these rocks and the plagiophyric monzonites of the Adlavik Intrusive Suite, but Unit 14 is generally more siliceous and finer grained.

Unit 15. This is a new unit representing a subdivision of the Benedict granite of Gower *et al.* (1982), and it occupies a large area southeast of Big River. The western margin of the unit is marked by a prominent escarpment along the south side of the Big River valley, which is interpreted as a fault zone. The most common rock type is a massive, pink, coarse grained, K-feldspar porphyritic granite to alkali-feldspar granite, which has a distinctive 'pseudo-rapakivi' texture, i.e., K-feldspar phenocrysts contain rounded plagioclase centres instead of being mantled by plagioclase. A non-porphyritic variant also occurs, but, to date, it has not been possible to delineate subunits within the map area. Both biotite and amphibole are present as mafic minerals and Gower (1981) reports the presence of riebeckite, suggesting that these rocks may have alkaline or peralkaline affinities. Petrographic studies will establish if this is a general feature of the unit.

Unit 15 lies close to the Benedict Fault zone and locally displays strong east-trending fabrics resulting from Grenvillian deformation. Augen gneisses south of the fault zone (Unit 26) may be highly deformed equivalents, as they have a similar K-feldspar-rich appearance.

Unit 16. This is a new unit representing a subdivision of Unit 27 of Gower *et al.* (1982). It forms an elongate mass along the north side of the Adlavik Brook fault zone, extending from Freshsteak Lake to the head of Kaipokok Bay, and it is massive and undeformed, contrasting strongly with the deformed granitoids of Unit 6, which abut Unit 16 in the southwest. The dominant rock type is a pink to white, biotite or biotite-hornblende leucogranite showing a variably porphyritic texture and euhedral mafic minerals. There is some grain size and textural variation within it, but in general the unit is very homogeneous. The general characteristics of this unit are reminiscent of the Strawberry and Dog Islands granites farther to the east, but some of the most porphyritic variants resemble some samples of the Otter Lake-Walker Lake granite (see below). Dextral movements inferred for the Adlavik Brook fault zone suggest that the continuation of this unit (if displaced) lies within the area underlain by Unit 6 and units of the Nipishish Lake Intrusive suite, but it has not been identified in this area. A small area south of Maclean Lake for which only two samples are available is tentatively grouped with this unit.

Unit 17. This unit corresponds generally with the 'Walker Lake granite' mapped by BRINCO geologists and described by Bailey (1979) and Gower *et al.* (1982). The term 'Walker Lake' is already in use as a rock name elsewhere and Gower, *et al.* (1982) recommended that its use be discontinued. Granites of Unit 17 are exposed mostly on the north side of Witchdoctor Lake, and are dominated by white to pink, coarse grained, equigranular alkali-feldspar granite containing minor biotite. It is close to the fault zones marking the northern margin of the Grenville Front Zone, and is locally foliated. The southern limit of the unit is unknown due to heavy drift cover.

Otter Lake - Walker Lake Granite (Unit 18). The Otter Lake-Walker Lake granite is one of two major subdivisions of the Nipishish Lake intrusive suite defined by Ryan (1985). The Nipishish Lake suite was originally separated from the Benedict Mountains Intrusive suite of Gower *et al.* (1982) because parts of it intrude the Paleohelikian supracrustal rocks of the Bruce River Group, suggesting that it may be younger than most of the other granitoids, which are nonconformably overlain by the Bruce River Group. However, these relationships do not rule out the possibility that portions of the Benedict Mountains suite are time-equivalents of the Nipishish Lake suite, and an unpublished U-Pb age on the Bruce River Group (T. Krogh, personal communication to R.J. Wardle, 1985) suggests that it may in fact be about 1.65 Ga old and coeval with much of the Trans-Labrador batholith.

Within the study area, Unit 18 is dominated by massive, medium to coarse grained, gray to pink, K-feldspar porphyritic granodiorite to granite and quartz monzonite containing biotite and/or hornblende. The texture is locally either seriate or equigranular. Blue quartz is particularly characteristic, as is a greenish hue caused by saussuritization of plagioclase. In addition to those areas indicated by Ryan (1985), an area northwest of Walker Lake is underlain by similar, but somewhat more texturally variable granitoids. This has been tentatively included with the Otter Lake-Walker Lake granite, but may represent a separate subunit.

Unit 19. A few samples were collected this summer from a megacrystic granodiorite unit defined by Gower (1981) around Stag Bay. This unit does not appear to fit readily with any of those described above and it is thus shown as a discrete unit in the extreme southeast part of the study area. Gower (1981) mapped similar rocks farther to the east in the Benedict Mountains, suggesting that this may be an important component of the Trans-Labrador batholith elsewhere.

Smaller Granitoid Plutons and Plugs (Units 20-25)

In addition to the regional granitoid units discussed in the preceding section, numerous smaller bodies of granite and leucogranite are present throughout the area, particularly in the north, where a higher level within the batholith appears to be exposed. These have been grouped into seven units, most of which correspond with units defined by Gower (1981) and Gower *et al.* (1982).

Monkey Hill granite and related rocks (Unit 20). This unit is largely equivalent to Unit 28 of Gower *et al.* (1982), but includes some additional areas recognized during this project. The unit is composite, as it includes most of the fine grained granites in the area. The type locality is a small pluton exposed south of Makkovik Bay, which consists mostly of a quartz-rich, fine to medium grained, pink to pinkish-gray adamellite or granite. Most samples contain equal amounts of the two feldspars, which gives the rock a distinctive 'speckled' appearance when stained. The normal mafic mineral is biotite, which is extensively to completely altered to chlorite. The main body displays little textural or grain size variation and is very homogeneous.

Of more interest from an economic point of view are a number of satellite intrusions within 10 to 15 km of the main body, some of which either host mineralization or are spatially related to it. The granite at Duck Island in Kaipokok Bay appears to be a small plug or cupola of altered leucogranite containing disseminated pyrite and molybdenite, with lesser chalcopyrite and bornite. Rather similar pyritized granite plugs in the Round Pond area are spatially associated with hydrothermal veins carrying molybdenite, pyrite and chalcopyrite. Details of this mineralization are discussed by Wilton *et al. (in preparation).*

Several other small bodies of fine grained granite with broadly similar characteristics are grouped with the Monkey Hill granite suite, but these are not presently known to host any mineralization.

Unit 21. This unit corresponds to a unit previously defined by Bailey (1979) south of Maclean Lake, which he considered to be comagmatic with Aillik Group rhyolites. It is a fine grained, equigranular, leucocratic quartz monzonite to granite, which is locally difficult to distinguish from recrystallized members of the Aillik Group. However, L. McKenzie (personal communication, 1985) has identified clear intrusive contacts, suggesting that it is a younger post-tectonic body. Unit 21 contains a molybdenite showing near Burnt Lake, which locally contains high-grade mineralization and is hosted by granite similar to that observed at Duck Island.

Strawberry granite (Unit 22). This unit generally corresponds with Unit 29 of Gower *et al.* (1982), but does not include the granite of Manak Island, which is now tentatively interpreted to be part of the earlier Makkovikian suite. The main Strawberry granite pluton is a small, rounded body that intrudes Aillik Group volcanic rocks northeast of Makkovik. The dominant rock type is a coarse grained, pink to orange-red K-feldspar porphyritic biotite granite containing conspicuous accessory fluorite. As with the Monkey Hill granite, the biotite is strongly altered to chlorite. Much of the pluton is homogeneous, but a very distinctive biotite layering, displaying trough-like patterns highly reminiscent of cumulate layering, is present in several localities, and a large cumulate-layered block of gray granite was observed in one outcrop.

Despite the homogeneity of central parts of the body, the Strawberry granite displays considerable variation in both texture and grain size around its margins, where three or four phases can be recognized. These include fine grained granites containing disseminated fluorite, which may represent a chilled roof or border facies. Near its outer contacts, the granite contains numerous xenoliths of fine grained granite, some of which are cut by biotite-rich breccia zones, which may be indicative of volatile exsolution and hydrothermal activity. The southern contact zone of the body is particularly variable and also contains pegmatite sheets, again suggestive of a fairly high volatile content. Pegmatites containing a hard, green mineral, thought to be beryl, were also observed in one coastal exposure.

The northern half of Ironbound Island is also tentatively grouped with Unit 22. Granites in this area are texturally variable, but are mineralogically similar to the Strawberry granite and locally contain disseminated fluorite.

Dog Islands granite (Unit 23). This unit is identical to that described by Gower (1981) and is a coarse grained biotite granite containing accessory fluorite, similar in many respects to the Strawberry granite, but generally equigranular rather than porphyritic. However, locally the granite appears to be slightly quartz porphyritic. The most obvious contrast with the Strawberry granite is an overall textural homogeneity, and a conspicuous lack of fine grained phases and pegmatites. Biotite layering with a cumulate-like appearance is present in two localities. Quartz-feldspar and feldspar porphyry dikes that occur on the nearby Adlavik Islands may be related to this body.

Unit 24. This unit includes two small granite bodies in the Adlavik Bay-Big River area that do not readily fit into any of the groups discussed above. The unit includes rocks previously assigned to the Monkey Hill granite, and also to the Tarun syenite unit of Gower *et al.* (1982). They are typically medium to coarse grained, buff to gray, porphyritic alkali-feldspar granites, which locally grade into quartz syenites. Coarsely perthitic K-feldspar phenocrysts are a characteristic feature, but there are also equigranular variants and fine grained granites in this area. This map unit is not well defined, but the rocks included within it seem to have more affinity for one another than for any of the other units in the Trans-Labrador batholith.

Unit 25. This unit corresponds to a small area of coarse grained, equigranular, pink alkali-feldspar granite, which forms a prominent hill in the extreme southeast part of the area. It is clearly different from the adjacent Unit 15 granites, and may perhaps be part of a more extensive unit outside the study area, as Gower (personal communication, 1985) has collected similar rocks well to the south of here.

Grenville Province Gneisses (Unit 26)

Areas to the south of the Benedict fault system are underlain by strongly foliated to gneissic granitoid rocks which are presumed to be largely equivalent to granites of the Trans-Labrador batholith north of the fault zone. Unit 26 is dominated by pink to buff, augen-textured microcline-rich granitoids containing a variably developed cataclastic fabric. These rocks could perhaps be derived from the adjacent and compositionally similar Unit 15.

MINERAL POTENTIAL

In the absence of geochemical data from the 1985 field program, it is a little premature to attempt a detailed discussion of the granophile mineral potential of the area. However, some general comments are possible.

Sampling carried out in 1985 demonstrates that, even though the Makkovikian and Trans-Labrador batholith granitoids are compositionally varied, granites and alkali-feldspar granites are the dominant components of both groups. These siliceous, evolved rocks merit further examination should geochemical data suggest anomalous enrichment in granophile trace elements of economic interest. Of the new regional units defined in this report, Units 15, 16 and 17 appear to hold the most promise.

The Adlavik intrusive suite, which appears to be more areally extensive than previously thought, is dominated by quartz-poor granitoids that appear to be related components of a layered mafic-intermediate intrusion. Although the gabbroic to monzonitic facies of the suite is probably of limited potential for granophile mineralization, the syenites and quartz syenites may merit more detailed examination. If these are indeed the final differentiates of the Adlavik magma, it is possible that they may be enriched in a variety of economic elements. Analytical data for similar syenites on the Ragged Islands, just east of the study area, suggest higher than normal levels of REE and other lithophile elements (Gower, personal communication, 1985). An area of particular interest is the poorly known inland portion of this unit around Tarun Lake, which is close to Aillik Group country rocks (and thus perhaps exposed at high levels).

Makkovikian granitoids include extensive leucocratic granites in the form of Units 5 and 6. In the latter unit, high-grade uranium mineralization was discovered in altered and brecciated granitoid boulders several years ago by BRINCO geologists, but the source was not located. Some of the Unit 5 granites display signs of fluorine enrichment and should not be dismissed in any evaluation of the area.

The units with the greatest economic potential are a number of smaller granitoid bodies in the northern part of the area, which have some of the characteristics of epizonal granites traditionally regarded as favourable environments for granophile mineralization. Of these, the Monkey Hill granite and the granites of Unit 21 are the most obvious examples, as they host or are associated with Mo-Cu mineralization in several areas. The Strawberry granite has fine grained marginal phases and other features suggesting a high level of emplacement and the presence of volatiles during crystallization. It is also in close proximity to molybdenite showings around its southern margin.

The most favourable zones within small specialized granitoid bodies are typically within their roof zones, and mineralization is commonly concentrated in or around small plugs or cupolas on the upper surface of the pluton. Map patterns in the northern part of the Trans-Labrador batholith strongly suggest that the present erosion surface cuts the upper levels of several small granitoid bodies, and also that large areas underlain by the upper Aillik Group (Unit 3) may be underlain by granite at relatively shallow depths. This entire area is thus worthy of further investigation.

The Dog Islands granite is a fluorite-bearing leucogranite, similar in many respects to the Strawberry granite. However, the overall homogeneity and lack of pegmatites and aplites suggest that it may represent a deeper level, and there is no evidence of a preserved roof zone or border facies. Units 24 and 25 are as yet poorly known, but both are in close proximity to Aillik Group supracrustal rocks, suggesting that the erosion surface truncates the structural top of the plutons.

Future field work will be aimed at establishing contact relations between the regional subdivisions outlined in this report, and also examination of areas which appear to have economic potential on the basis of geochemical data. The regional geochemical survey coverage will be extended, and more detailed mapping is planned for some of the smaller plutons, and particularly the Monkey Hill and Strawberry granites.

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