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GEOLOGY OF THE BAYONET, ASHTON, POTTS AND CHARLES LAKES DISTRICTS, ALBERTA

by

John D. Godfrey

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GEOLOGY OF THE BAYONET, ASHTON, POTTS AND CHARLES LAKES DISTRICTS, ALBERTA

Abstract

The geology of 308.5 square miles of Precambrian Shield in northeastern Alberta is presented on six colored maps of scale 2 inches to 1 mile.

Some 22 rock-types have been distinguished on the maps. Their characteristics are systematically described, and modal analyses are given.

The older granite gneiss complex of biotite and hornblende granite gneisses with minor amphibolite and metasedimentary rocks forms the predominant terrain. Biotite granite F is petrologically distinct and unique in its close association with certain metasedimentary rock bands.

All of these rock-types have been locally subjected to intensive cataclasis to give rise to four major mylonite zones, which generally extend tens of miles in length and up to one mile in width.

Post-cataclastic intrustions of massive to foliated granites are concentrated in a band to the west. The last phase of igneous activity is recorded by uncommon small basic dykes.

Later confined fault movements have developed secondary mylonites and breccias which are aligned within the major mylonite zones, and a late series of transverse faults offsets some rock contacts.

A northerly regional structural trend prevails, expressed as a general alignment of gneissosity and schistosity, of metasedimentary, amphibolite and granite bands and masses, and of major mylonite zones.

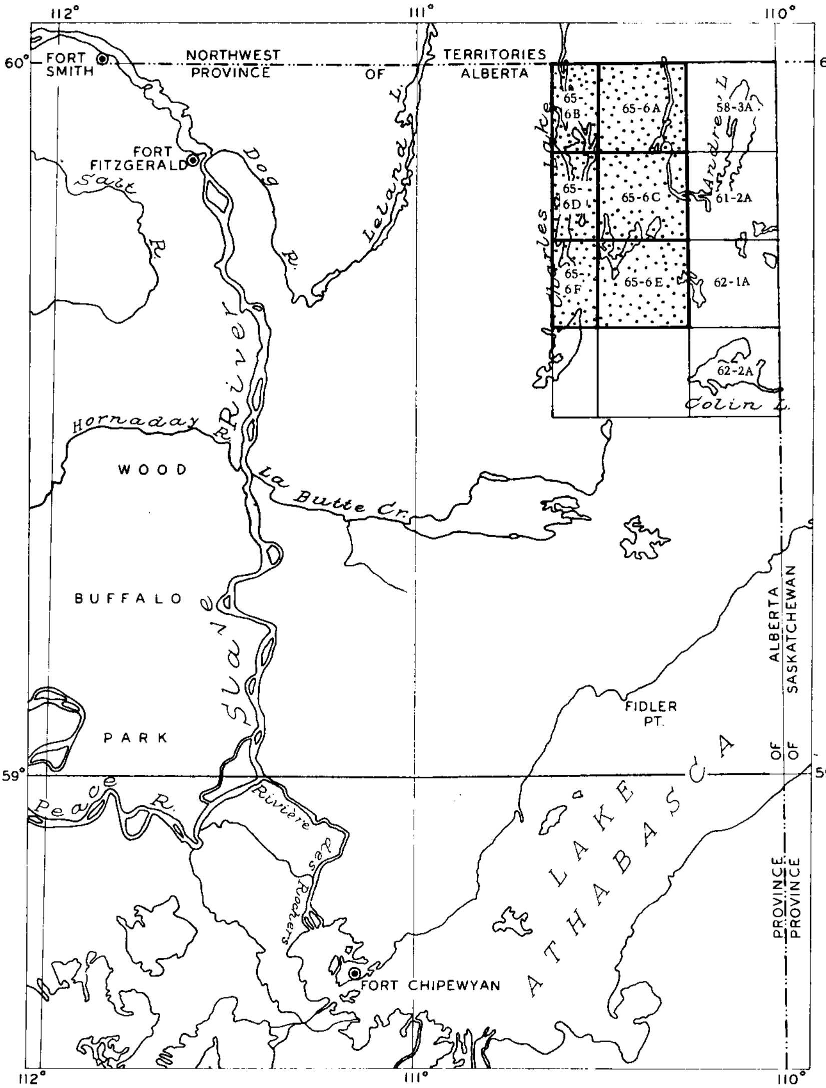

FIGURE 1

LOCATION OF MAP-AREA

SCALE IN MILES

4 0 4 8 12 16 20 24

INTRODUCTION

This report deals with the geology of a portion of the 3,600 square miles of Precambrian Shield in northeastern Alberta, north of Lake Athabasca. It describes the general geology and mineralization of 308.5 square miles of Shield which adjoin the west side of four recently published map-areas (Godfrey 1961, 1963; Godfrey and Peikert, 1963, 1964).

Location and Access

The six districts constituting the map-area are located in the northeast part of Alberta and adjoin the Northwest Territories boundary (Fig. 1). The map-area lies between longitudes 110 degrees 15 minutes and 110 degrees 37 minutes 30 seconds west, and between latitudes 59 degrees 37 minutes 30 seconds and 60 degrees north.

Uranium City, Saskatchewan, is 61 miles east of the map-area, and Fort Smith, Northwest Territories, lies 43 miles west of the map-area. Both centres have regularly scheduled commercial airline flights from and to Edmonton, Alberta. Pontoon-equipped planes may be chartered from either Uranium City or Fort Smith into the map-area, where many scattered lakes are suitable for landing these aircraft.

The southern tip of Charles Lake in district 65-6F is 32 miles north of Lake Athabasca, the nearest commercially utilized water route. Tugs and barges of the Northern Transportation Co. Ltd., operate along this route from Fort McMurray, Alberta, to supply settlements towards the east end of Lake Athabasca, principally Uranium City, Fond-du-Lac and Stony Rapids, Saskatchewan.

Physiography

Pleistocene glacial scouring has left numerous rock-basin lakes, low-rounded hills, and a locally rugged surface having a maximum relief of about 250 feet. The elevation ranges from 950 to 1,300 feet above sea level on a typical peneplained surface of the Precambrian Shield. Striae and giant grooves (flutings) are the most obvious ice-erosional features seen on outcrop and large-scale aerial photographs. The direction of ice advance was from north 59 to 69 degrees east. Bedrock is exposed over about two thirds of the map-area, and only a small proportion of the covered area is muskeg. Glacial sandy plains, such as in the north-central part of the Bayonet Lake district and at Pans and Whaleback Lakes, have an open parkland-type cover. As a rule, the lakes are either disconnected or poorly connected, and cross-country canoe travel involves many portages. The principal drainage of Bayonet, Potts and Charles Lakes is first north and then eventually west to the Slave River.

The distribution, sizes and shapes of lakes are controlled by both structural and lithological features, modified by ice erosion. Many narrow elongate bays are related to the erosion of fault zones, and straight shorelines on portions of lakes, especially where transecting foliation, suggest fault-line features. Fracture zones and structurally weak rocks have been plucked out by ice erosion, particularly on the west and southwest lake-shores, giving rise to irregular shorelines. Exceptionally clean, fresh bedrock surfaces are found on low, wide aprons bordering some rock-basin lakes. Such water-washed surfaces are particularly suitable for the detailed examination of bedrock geology.

Previous Work

J. B. Tyrrell (1896) made the initial traverse along the north shore of Lake Athabasca in 1892 and 1893, and subsequently F. J. Alcock (1915, 1917) worked in this general area. In 1929 and 1930 A. E. Cameron and H. S. Hicks (Cameron, 1930; Cameron and Hicks, 1931; Hicks, 1930, 1932) conducted a reconnaissance survey of the Shield area north of Lake Athabasca, within Alberta.

After gold was discovered at Goldfields, Saskatchewan, Alcock (1936) returned to map the Precambrian Shield on a scale of 1 inch to 4 miles in the extreme northwest corner of Saskatchewan adjoining Alberta to the east. Mapping of the Fort Smith, N.W.T., area, which adjoins Alberta to the north, was completed in 1938 by J. T. Wilson (1941) on a scale of 1 inch to 4 miles.

In 1954, uranium-prospecting activities spread to the Precambrian Shield of Alberta, and G. A. Collins and A. G. Swan (1954) spent several weeks examining mineralization at a number of points in the northeastern corner of the province. Low-grade uranium mineralization was found in the course of this prospecting and exploration activity (e.g., Ferguson, 1953).

In 1959, the Geological Survey of Canada carried out a reconnaissance survey of the Precambrian Shield in Alberta north of Lake Athabasca and published a map on the scale of 1 inch to 4 miles with marginal notes (Riley, 1960).

In 1960, 1961 and 1962, the Saskatchewan Department of Mineral Resources (Koster, 1961, 1962, 1963) carried out a mapping program on a scale of 1 inch to 1 mile in the northwestern corner of Saskatchewan adjacent to the Alberta boundary.

The pattern of aeromagnetic anomalies and contours outlined on an aeromagnetic survey carried out by the Geological Survey of Canada (1958a, 1958b, 1958c, 1958d) can be correlated regionally with both the structures and principal rock-types in the map-area.

Present Study

Field work for this report was carried out during 1958, 1959, 1960, 1961, and 1963. The accompanying maps are based on parallel pace and compass traverses generally spaced at one-quarter to one-third mile intervals. Anomalous compass readings were obtained in the vicinity of some hornblende granite gneisses and amphibolites. Magnetite was observed at several of these granite gneiss localities, and its presence has since been confirmed in the course of laboratory investigations, thus accounting for at least some of the magnetic anomalies.

Vertical aerial photographs are of considerable help in prospecting, exploration and geological mapping, and are available for this area from two sets, both on a scale of 1:40,000. Photographs can be obtained from the National Air Photographic Library, Topographic Survey, Ottawa, Ontario, and from the Technical Division, Department of Lands and Forests, Government of Alberta, Edmonton, Alberta. An interpretation of geological structures from air photographs of the Shield in Alberta north of Lake Athabasca has been made by Godfrey (1958a).

Acknowledgments

The help of each member of the field parties is acknowledged and appreciated. In 1958 the field party consisted of J. M. McLelland, E. W. Peikert, assistant geologists, and D. Clements, R. Jull, J. Steiner, J. G. Tansey and G. Wysocki, field assistants; in 1959 — E. W. Peikert, assistant geologist, and G. G. Harrington, P. Hofsteenge and M. Isaac, field assistants; in 1960 — R. Y. Watanabe, assistant geologist, and G. G. Harrington, A. Puzey and M. Treasure, field assistants; in 1961 — R. Y. Watanabe, assistant geologist, and L. G. Fahner, L. Hanson and B. Rippin, field assistants; in 1963 — R. Y. Watanabe, assistant geologist, and R. Toogood, F. Spears and G. Wind, field assistants.

The assistance of the staff and pilots of McMurray Air Service Ltd., Uranium City, Saskatchewan, is gratefully acknowledged.

GENERAL GEOLOGY

A Precambrian [1] complex of igneous and metamorphic rocks underlies the study area.

Perhaps the most striking feature of the area is the prevailing northerly trend and the vertical or steep attitude of all major geologic features, such as the foliation and gneissosity, the metasedimentary and amphibolitic bands, the mylonite zones, and the elongated outlines of both the younger intrusive granites and the porphyroblastic biotite granite F.

Six rock groups are distinguished in all six map-areas (Tables 1 to 6): metasedimentary and associated rocks, porphyroblastic biotite granites, granite gneiss, amphibolite, massive to foliated granites and pegmatites, and mylonites. Biotite and hornblende granite gneisses with scattered bands and lenses of metasedimentary rocks and amphibolite predominate. Two distinctive granite types are present in the area: (1) a porphyroblastic, foliated to massive granite (biotite granite F), intimately associated with discontinuous bands of metasedimentary rocks trending northerly through Treasure Loch (65-6A) and along the east side of Charles Lake (65-6B, D, F); and (2) a group of young intrusive granites (raisin, leucocratic, Arch Lake, foliated hornblende and biotite 'q' granites) scattered throughout the map-area in addition to constituting a remarkably continuous composite band on the western margin of map districts 65-6B, D and F.

Four major mylonite zones cut the map-area in northerly trending bands. These are situated on the east side of Bayonet and One-Week Lakes passing through Mylonite and Pans Lakes (65-6A); through Treasure Loch and Logan Lake (65-6A); from Selwyn Lake south on the east side of Charles Lake to Alexander Lake (65-6A); and on the west and central parts of Charles Lake (65-6B). A minor band passing through Collins Lake (65-6A) is included with the Bayonet Lake band to the east.

Northeast and northwest transverse faults truncate and offset contacts of all the rock groups, including the mylonite bands. An extension of the Bonny Fault of the Andrew Lake North and Andrew Lake South map-areas passes to the north of Bayonet Lake into the Northwest Territories.

[1] K-Ar, Rb-Sr and U-Pb diffusion age determinations on a variety of minerals from the Shield in northeastern Alberta have yielded dates ranging from 1.7 to 2.3 billion years (Godfrey and Baadsgaard, 1962; Baadsgaard _et al._, 1964).

Table 1. Principal Rock Groups, Constituent Rock-Types, and their Field Associations for the BAYONET LAKE DISTRICT

Porphyroblastic Biotite Granite Group (0.1)*	Mylonite Group (7.7)	Granite Gneiss (55.0)	Metasedimentary and Associated Rocks (6.5)	Massive Granite and Pegmatite Group (2.2)
	** Recrystallized mylonite K; Recrystallized mylonite L —	Biotite granite gneiss		
	Recrystallized mylonite M —	Hornblende granite gneiss		
	Recrystallized mylonite N —	—	Biotite schist	
	Recrystallized mylonite O —	—	Quartzite	
Biotite granite F —	Recrystallized mylonite P			
			←	Muscovite granite and pegmatite
		←	←	Granite pegmatite
		←	←	Biotite 'q' granite
		←	←	Leucocratic granite
		Amphibolite ***		

* Per cent outcrop of district
** Abbreviated form: mylonite K, etc.
*** Outcrop area included with each rock group as determined by field association (i.e. in columns)

Table 2. Principal Rock Groups, Constituent Rock-Types, and their Field Associations for the CHARLES LAKE NORTH DISTRICT

Porphyroblastic Biotite Granite Group (1.1)*	Mylonite Group (11.0)	Granite Gneiss (34.5)	Metasedimentary and Associated Rocks (2.4)	Massive to Foliated Granite and Pegmatite Group (14.1)
	Recrystallized mylonite K Recrystallized mylonite L	Biotite granite gneiss		
Biotite granite F	Recrystallized mylonite P			
	** Recrystallized porphyroclastic hornblende cataclasite	Hornblende granite gneiss		Foliated hornblende granite
			Quartzite	Raisin granite
			Biotite schist	Arch Lake granite
			←	Muscovite granite and pegmatite
		←	←	Granite pegmatite
		←	←	Leucocratic granite
		Amphibolite ***	→	→

* Per cent outcrop of district
** Abbreviated form: hornblende cataclasite
*** Outcrop area included with each rock group as determined by field association (i.e. in columns)

Table 3. Principal Rock Groups, Constituent Rock-Types, and their Field Associations for the ASHTON LAKE DISTRICT

Porphyroblastic Biotite Granite Group (0.1)*	Mylonite Group (3.4)	Granite Gneiss (60.0)	Metasedimentary and Associated Rocks (6.9)	Massive Granite and Pegmatite Group (0.4)
	** Recrystallized mylonite K Recrystallized mylonite L } — —	Biotite granite gneiss		
Biotite granite F — —	Recrystallized mylonite P			
		Hornblende granite gneiss	Quartzite	
			Biotite schist	
			← — — — —	Muscovite granite and pegmatite
		← — — — —	— — — — —	Granite pegmatite
		← — — — —	— — — — —	Biotite 'q' granite
		Amphibolite *** —	— — — — —	— — — — →

* Per cent outcrop of district
** Abbreviated form: mylonite K, etc.
*** Outcrop area included with each rock group as determined by field association (i.e. in columns)

Table 4. Principal Rock Groups, Constituent Rock-Types, and their Field Associations for the CHARLES LAKE CENTRAL DISTRICT

Porphyroblastic Biotite Granite Group (6.9)*	Mylonite Group (8.1)	Granite Gneiss (21.8)	Metasedimentary and Associated Rocks (3.9)	Massive to Foliated Granite and Pegmatite Group (19.7)
	** Recrystallized mylonite K Recrystallized mylonite L	Biotite granite gneiss		
Biotite granite F	Recrystallized mylonite P			
	Recrystallized *** porphyroblastic hornblende cataclasite	Hornblende granite gneiss		Grey hornblende granite
			Quartzite	Arch Lake granite
			Biotite schist	
			←	Muscovite granite and pegmatite
		←		Granite pegmatite
		←		Leucocratic granite
		Amphibolite ****		→

* Per cent outcrop of district
** Abbreviated form: mylonite K, etc.
*** Abbreviated form: hornblende cataclasite
**** Outcrop area included with each rock group as determined by field association (i.e. in columns)

Table 5. Principal Rock Groups, Constituent Rock-Types, and their Field Associations for the POTTS LAKE DISTRICT

Porphyroblastic Biotite Granite Group (0.2)*	Mylonite Group (1.1)	Granite Gneiss (54.6)	Metasedimentary and Associated Rocks (9.2)	Massive Granite and Pegmatite Group (1.4)
	** Recrystallized mylonite K	Biotite granite gneiss		
	Recrystallized mylonite M	Hornblende granite gneiss		
	Recrystallized mylonite N		Biotite schist	
				Microsyenite
	Recrystallized mylonite O		Quartzite	
Biotite granite F				
				Muscovite granite and pegmatite
				Granite pegmatite
				Biotite granite
				Biotite 'q' granite
				Leucocratic granite
		Amphibolite ***		

* Per cent outcrop of district
** Abbreviated form: mylonite K, etc.
*** Outcrop areas included with each rock group as determined by field association (i.e. in columns)

Table 6. Principal Rock Groups, Constituent Rock-Types, and their Field Associations for the CHARLES LAKE SOUTH DISTRICT

Porphyroblastic Biotite Granite Group (1.4)*	Mylonite Group (8.5)	Granite Gneiss (15.9)	Metasedimentary and Associated Rocks (0.2)	Massive to Foliated Granite and Pegmatite Group (13.4)
	** Recrystallized mylonite K — —	— Biotite granite gneiss		
	Recrystallized mylonite M — —	— Hornblende granite gneiss		
	Recrystallized mylonite N — —	— — — — —	— Biotite schist	
Biotite granite F — —	— Recrystallized mylonite P			
	Recrystallized *** porphyroclastic hornblende cataclasite — —	— — — — —	— — — — —	— Grey hornblende granite
			Quartzite	Arch Lake granite
			← — — —	— Muscovite granite and pegmatite
		← — — —	— — — —	— Granite pegmatite
		← — — —	— — — —	— Leucocratic granite
		Amphibolite **** —	— — — —	— — — →

* Per cent outcrop of district
** Abbreviated form: mylonite K, etc.
*** Abbreviated form: hornblende cataclasite
**** Outcrop areas included with each rock group as determined by field association (i.e. in columns)

Geologic History

The oldest rocks are contained in the granite gneiss complex. Here, repeated sedimentation, metamorphism and intrusion have yielded a welded, heterogeneous mixture of para- and ortho-gneisses composed of biotite and hornblende granite gneisses with minor bands of metasedimentary rocks and amphibolites. This rock assemblage has undergone plastic deformation and recrystallization under deep-seated conditions.

The metasedimentary rocks represent either relatively well-preserved remnants of the paragneissic parental material, or a younger series of sediments which was infolded and downfaulted during the late history of the gneisses, or both.

The history of the amphibolites is more complex than that of the metasedimentary rocks in that they are probably of both intrusive and extrusive igneous origin. Amphibolites may have persisted from the paragneissic parent material stage (volcanic material) and may also have intruded the derived paragneissic rocks. Since the effects of several orogenic cycles are believed to be present in the granite gneiss terrain, igneous material could have been added during one or more of these cycles.

Biotite granite F, a probable metasomatic granite, seems to have developed from certain sedimentary rocks with which it is associated and largely enclosed in the northern region. The transformation must have taken place during the late formative stages of the granite gneiss complex. Biotite granite F is enveloped in metasedimentary rocks at Treasure Loch, and it occurs in places in a similar setting along strike from the Selwyn Lake (65-6A) district in the north to beyond the map-area boundary in the south (65-6F).

Bulk flow by plastic deformation has imposed a prevailing northerly strike and a vertical or steep dip to banded, foliated and elongated rock bodies. Consequently, the principal plane of relief of stress was oriented both vertically and northerly, the region having been subjected to upward plastic movement in the granite gneiss complex from laterally directed maximum stress on an east-west axis.

Subsequent cataclastic deformation in a deep-seated zone resulted in the formation of four major mylonite bands described above. Rocks involved in these mylonite bands as parental material include biotite and hornblende granite gneisses, biotite granite F, metasedimentary rocks of schistose and siliceous character, and basic rocks probably partly of amphibolitic character. The mylonite bands are over tens of miles in length, are up to one mile in true thickness, and are extensively recrystallized, cohesive and weather-resistant rocks where unfractured. The mylonites were plastically deformed to varying degrees after cataclasis, and this deformation is likely largely related to the period of recrystallization. Restricted reactivated fault movements are apparent in the formation of narrow secondary mylonites and breccias within the mylonite bands.

Several young granites have intruded most other rock-types in the map-area, the major intrusive bodies being concentrated in the west. These granites, which are relatively unaffected by large-scale intense cataclasis and therefore are believed to be post-deformational in age, include leucocratic granite, biotite 'q' granite, biotite granite, foliated hornblende granite, raisin granite and Arch Lake granite. Masses of these younger granites are typically elongated in outline and conform to the northerly regional trend. The elongate form is especially evident in the large foliated hornblende granite body at the north end of Charles Lake (65-6B) and in the multiple intrusive plutonic mass to the west of Charles Lake (65-6B, D). The marked effects of repeatedly activated, northerly oriented tectonic forces are evident from the parallel arrangement of the granite gneiss fabric, the metasedimentary and amphibolitic bands, the major mylonite bands, and the elongate outlines of the younger granites.

Later fault movements in this region at a high crustal level are evident from breccia development in the mylonite zones and from cross-faults where some rock bands are terminated or their contacts displaced. Young basic dykes east of Charles Lake (65-6A), for example, represent the last phase of igneous activity and may be synchronous with late cross-faulting. Vein quartz on the east shore of Charles Lake (65-6B) and east of Bayonet Lake (65-6A) probably also is associated with the period of cross-faulting.

Extended erosion from the Precambrian to the present time is evident in the peneplained surface of the Shield.

Glacially smoothed outcrop surfaces, rock-basin lakes, sandy outwash plains, striations, grooves and erratics all attest to a recent ice age.

Rock-Type Classification

Repeated sedimentation, metamorphism, intrusion and deformation have obscured many original structures and contact zones and have produced typically mixed-rock assemblages on both the outcrop and regional scales. Thus, most map-units only indicate the predominant rock-type, and the finer details of lithologic variation are omitted.

In order to standardize and clarify the rock-type descriptions and classification, certain hand specimens were designated as standard reference samples to represent as nearly as possible the typical lithology of each map-unit as seen in the field. The standard samples are listed in tables 7 to 12 with their modal analyses, and their field locations are shown on the accompanying geological maps.

MAP - UNITS

Metasedimentary and Associated Rocks

Metasedimentary rocks form 5.6 per cent of the exposed bedrock in the map-area, making up 7.4 per cent of the three easterly districts (65-6A, C, E) but only 2.2 per cent of the three westerly districts (65-6B, D, F). They occur as lenses and bands, ranging in size from a few inches in width and several feet in length to more than 1 mile in width and over 14 miles in length.

The metasedimentary rocks are a distinct and common component scattered throughout the granite gneiss terrain. They also occur as small lenses in the younger granites: biotite 'q' granite, foliated hornblende granite, leucocratic granite, raisin granite and Arch Lake granite.

Each major band of metasedimentary rocks is a mixture of rock-types which may include pure to impure quartzite, biotite schist and phyllite, and minor amounts of sericite schist, phyllonite, hornblende schist and amphibolite. Varied amounts of late-formed crystalline constituents also may be present, such as feldspar megacrysts, pegmatite, granite, microgranite and milky quartz.

Layering produced by the alternation of the metasedimentary rock-types on a large scale, or by slight changes of mineral content or color on a small scale, is interpreted as relict sedimentary stratification. Alternating individual layers of quartzite and biotite schist or phyllite are generally laterally persistent though not of great thickness (commonly from 1/2 to 4 inches). Amphibolite seems to be concentrated, or at least is more evident, in bands of metasedimentary rocks in the Potts and Boudin Lakes areas.

Granitic material is common in most of the metasedimentary bands, locally making up to 20 per cent of the total rock in outcrop. Feldspar occurs as individual porphyroblasts and augen up to 1/2 inch in size and as feldspathic stringers and pegmatites, usually elongated in the direction of the enclosing rock layering and foliation. Quartzo-feldspathic bodies range in size from a few inches up to 100 feet or more in length, and, though contacts may be irregular in outline, they are generally sharp. Minor granitic and pegmatitic lenses and stringers, and quartz lenses and veins also exhibit irregular, sharp contacts against metasedimentary rocks.

Muscovite granite and pegmatite, and minor biotite granite and pegmatite are the most common granitic materials. Garnets are present in most metasedimentary rock bands and selectively occupy certain layers up to 4 inches thick.

Except for the layering referred to above, primary sedimentary structures have not been noted in the metasedimentary rocks. Small-scale deformational structures include folds and crenulations from 1 to 2 inches to several feet in amplitude, and fracture cleavage in the more quartzose layers. Structures in biotite schist are similar to those in quartzite except that folds and crenulations tend to be of smaller dimensions. Some areas exhibit migmatitic structures as a result of the deformation of interlayered granitic and metasedimentary materials, similar to those in granite gneiss.

The contacts of metasedimentary rocks with granite gneiss are generally gradational and concordant with the gneissic structures, whereas contacts with the younger granites may be either discordant or concordant with the granite foliation.

Many of the minor bands and lenses of metasedimentary rocks are aligned on strike or in an *en echelon* manner as though they once formed a continuous major band, as, for example, in the Eagle Lake area from Andrew Lake Arm to Pans Lake (65-6C), and east of Charles Lake (65-6C, D). It would appear that shear folding combined with bulk flow (rheomorphic folding) during plastic deformation has been largely responsible for these discontinuities in the major metasedimentary bands.

Quartzite

The metasedimentary rocks are divided into two map-units, quartzite and biotite schist. Both units represent a mixture of rock-types, the predominant lithologic character being indicated by each unit. Lithologic gradations both between and within these two map-units may either parallel or cross the strike of the foliation and schistosity.

The pure to impure quartzites are white, grey, pink, green or blue where fresh, with color banding showing in the thicker beds. Weathered surfaces tend to be lighter in color and may have an orange-brown iron stain. Rocks containing garnet produce a pitted surface on weathering, and smooth to uneven fracture surfaces mostly parallel the rock foliation.

The common, typically impure quartzite contains from 60 to 80 per cent combined quartz and feldspar, from 15 to 35 per cent combined biotite, muscovite and chlorite, and may have minor amounts of garnet, amphibole, epidote, sillimanite and cordierite. The quartzites are fine to medium grained, sugary textured, and have a foliation produced by micaceous and schistose layers. The most common type is a garnetiferous impure quartzite which is locally phyllitic or schistose.

Other rock-types present in the quartzite map-unit include minor amounts of biotite and hornblende schists, amphibolite and some granitic material. Small amounts of sericite schist and phyllonite characterize sheared areas.

Biotite Schist

Biotite schist is dark grey-brown on fresh surfaces with lighter bands and patches of feldspar and quartz. Many weathered outcrop surfaces are coated by an orange-brown iron-oxide stain. As little as 25 per cent micaceous material imparts a distinctive schistose appearance to these rocks. Small concentrations of garnet, graphite and pyrite are locally present. Mineralogic banding on a small scale is particularly exemplified by the layering of quartzo-feldspathic constituents.

The chief rock-type included in the biotite schist map-unit is impure quartzite, with smaller amounts of sericite schist, chlorite schist, phyllonite and amphibolite.

Porphyroblastic Biotite Granites and Associated Rocks

Biotite Granite F

Porphyroblastic biotite granite F underlies about 0.1 per cent of the map-area. This map-unit is included in the porphyroblastic biotite granite group (Godfrey, 1961) because of its texture and composition, and because it has a close field relationship to the metasedimentary rocks.

Biotite granite F and its closely related cataclastic derivative — recrystallized mylonite P — are typically enclosed together in a sheath of garnetiferous quartzitic metasedimentary rocks. Biotite granite F and mylonite P occur in two discontinuous northerly trending belts; one passes through the east side of Treasure Loch (65-6A), and the second through the Selwyn-Charles-Alexander Lakes area (65-6A, B, C, D, E, F). These erosion-resistant rocks tend to form ridges, headlands, and islands, which are especially prominent in the Charles Lake and Treasure Loch (65-6A) areas.

On both fresh and weathered surfaces, biotite granite F appears mottled, with large pink to white and grey feldspar crystals enclosed in a grey granular matrix. Both texture and composition are typically uniform in this map-unit. Large subhedral to euhedral potash feldspars from 1 to 5 inches long, but averaging about 2 inches, may be either subparallel or randomly oriented in a coarse-grained massive matrix of quartz, feldspar and biotite.

Minor quartzo-feldspathic segregations occur as irregularly shaped and distributed aplite and pegmatite bodies in biotite granite F.

Internal structures in biotite granite F are largely lacking: the matrix may be either massive or poorly foliated, and the feldspar porphyroblasts may be either subparallel or randomly arranged in the matrix.

Biotite granite F and recrystallized mylonite P are texturally gradational, and therefore an arbitrary limit has been established in order to differentiate the two rock-types. The massive to poorly foliated matrix of biotite granite F grades to the foliated, finer-grained, crushed matrix of recrystallized mylonite P.

Towards the south in the south-central Charles Lake Central district (65-6D) and Charles Lake South district (65-6E), several small bands and lenses of combined biotite granite F and mylonite P, are without the envelope of metasedimentary rocks so characteristic of the north region, being in direct contact with granite gneiss. Furthermore, towards the south there is also evidence of plastic flowage within biotite granite F and mylonite P, internal folds are indicated in the main body of biotite granite F plus mylonite P, and a highly folded contact of mylonite P appears in the south-central area of the Charles Lake Central district (65-6D). It is suggested that greater mobility in the deep-seated zone of this area has involved bulk plastic flow and intrusion into a higher crustal level, resulting in folding of the composite biotite granite F-mylonite P band and its displacement from the metasedimentary rock environment in which biotite granite F developed.

Granite Gneiss

Biotite and hornblende granite gneisses are the principal rock-types in the region, together underlying 45 per cent of the map-area. They are particularly abundant in the eastern districts of the map-area (65-6A, C, E).

This heterogeneous terrain is characterized by:

(1) massive to foliated to banded rocks;

(2) a wide variety of rock-types on a detailed scale, consisting of orthogneisses and paragneisses in which biotite and hornblende gneisses are dominant, with minor amphibolite and metasedimentary bands and lenses; indistinct foliated biotite and leucocratic granites with pegmatites, probably of several ages but largely pre-mylonitization, have intruded this complex and now are blended to form an integral part of the gneissic terrain;

(3) gradations in degree of mylonitization to the ultramylonite stage, with subsequent recrystallization to varying degrees;

(4) a variety of small-scale structures related to extensive plastic deformation, such as swirls, ptygmatic structures and drag folds.

A further complication in the gneissic terrain arises from the presence of a group of mappable younger granites which are largely post-mylonitization in age: Arch Lake granite, raisin granite, leucocratic granite, biotite 'q' granite and foliated hornblende granite. These granites are elongated in the direction of the regional gneissosity, which locally flows around them. Blocks and lenses of granite gneiss with sharp to gradational borders are included in the younger granitic rocks.

In addition to the major bodies of younger granitic rocks shown on the maps, small bodies of the same rocks are distributed throughout the biotite and hornblende granite gneisses, though they tend to be more evident in the vicinity of the larger masses. Quartzo-feldspathic pegmatite is present in almost every outcrop of granite gneiss, and in some it forms an important constituent. Though the pegmatite bodies are irregular in size, shape and texture, they typically conform to the structure of the enclosing gneiss. Many pegmatites in this gneissic terrain appear to be genetically related to the gneiss rather than to be of external origin.

As a result of gradational variations in both texture and mineralogy, and the heterogeneous nature of the constituent rock-types on a fine scale, map-units in this terrain are composite lithologies and the geographic limits of subdivisions within the gneissic terrain cannot always be clearly delineated in the field. Nonetheless, much can be done on this scale of mapping to outline concentrations of either biotite or hornblende granite gneiss, amphibolite and metasedimentary rocks. Major folds can be outlined, areas of saddle folding distinguished, and zones of excessive contortion (7) or tight folding (8) indicated.

The granite gneiss is characterized by alternating 1/4- to 4-inch wide mafic- and felsic-rich bands which produce distinct color banding. These bands may be well defined and laterally continuous, but where the gneisses become leucocratic banding becomes faint and more discontinuous, giving way to a general foliation expressed by wisps of biotite and lenticular quartz grains. The felsic layers usually dominate over the mafic layers.

Readily visible hornblende in hand specimens (greater than about 5 per cent) is used to distinguish the hornblende and biotite granite gneiss map-units, although biotite also may be a prominent constituent in the hornblende granite gneiss. Leucocratic varieties of gneiss are common, but their systematic distinction as additional subdivisions of the gneissic terrain is not reliable on the scale of mapping used.

The presence of scattered metamorphic minerals (cordierite, sillimanite, diopside, and especially garnet) in the granite gneisses and associated metasedimentary rocks indicates medium- to high-grade metamorphism of both rock-types. This fact, plus the intimate association and gradation between the two rock-types, suggests a largely metasedimentary-metavolcanic origin for the gneissic terrain.

Biotite Granite Gneiss

Biotite granite gneiss is present in all parts of the map-area and forms the dominant gneissic rock in the eastern districts (65-6A, C, E).

On fresh and weathered surfaces biotite granite gneiss is generally pink to red, and dark brown biotite-rich streaks and lenses give the rock a characteristic color banding.

Typical biotite granite gneiss contains from 25 to 30 per cent quartz, 25 to 34 per cent K-feldspar, 32 to 44 per cent plagioclase, and up to 9 per cent combined mafic minerals, with biotite predominating. Chlorite, epidote (commonly present as fracture fillings from 1/16 to 1/8 inch thick) amphibole, garnet, calcite, hematite, magnetite and allanite are locally present in small amounts. Local feldspar-rich leucocratic varieties generally contain only 2 or 3 per cent biotite, whereas the more common type has abundant, sharply defined, biotite-rich bands. Much of the granite gneiss is medium grained, but pegmatitic and porphyroblastic textures with 1/4- to 1/3-inch feldspar crystals are locally present.

Numerous small bands and lenses of other rock-types — principally hornblende granite gneiss, amphibolite and metasedimentary rocks — in the biotite granite gneiss are too small to be shown on the maps. Only larger bodies or concentrations of small bodies are depicted. Gradations in mineralogy and intimate mixing are common between these four rock-types. Hornblende granite gneiss and amphibolite are widely distributed and can be found in almost every outcrop of biotite granite gneiss. These rocks typically have gradational contacts with biotite granite gneiss. Indistinct areas of granitic rocks or feldspar-rich rocks in the gneiss lack a well-defined layered structure, but their penetrative foliation readily distinguishes them from most of the younger massive to poorly foliated granitic rocks, as, for example, biotite 'q' granite.

Hornblende Granite Gneiss

Hornblende granite gneiss is usually present as small patches in the predominant biotite granite gneiss terrain. However, four unusual concentrations have been noted: north and west of Logan Lake (65-6A), north and east of Charles Lake (65-6A, B), around Potts Lake (65-6E), and east of Whaleback Lake (65-6E). Two types of hornblende granite gneiss are recognized, based on the distribution of hornblende.

The first type resembles biotite granite gneiss, but with hornblende present with biotite. Small disseminated hornblende crystals are generally oriented in the foliation or gneissosity of the gneiss to form indistinct layers. Quartz and pink and white feldspars make up the remainder of the rock.

The second type of hornblende granite gneiss consists of alternating dark green and white to pink layers from 1/2 to 2 inches thick. In spite of the distinct banding the rock tends to split with an irregular fracture as does the biotite granite gneiss. The dark layers consist of hornblende and biotite with minor feldspar and quartz. The light-colored layers consist of quartz and feldspar with a medium-grained granoblastic texture. The alternation of layers is fairly regular, and with an increase in the proportion of mafic layers (and generally grain size) the gneiss grades into banded amphibolite.

As in the case of biotite granite gneiss, hornblende granite gneiss contains amphibolite, metasedimentary rocks and younger massive granites, and shows features of plastic deformation characteristic of the gneissic terrain in general. Pegmatites in the hornblende and biotite granite gneisses as a rule contain the corresponding mafic mineral: hornblende or biotite, respectively.

Some areas of hornblende granite gneiss, as, for example, the major mass east of Charles Lake (65-6B), are well foliated rather than banded and on the hand-specimen scale may be confused with foliated hornblende granite. However, other features of the foliated hornblende granite gneiss in outcrop — plastically folded internal structures, mixtures and wide range of lithologies — are akin to those of the granite gneiss terrain.

Amphibolite

The amphibolites [1] include a variety of hornblende-rich rocks which are associated with various map-units. The younger basic dykes are

[1] In a general reference "amphibolite" is used to include the two petrological terms "amphibolite" and "hornblendite". Shaw's (1957) definition 6A is preferred for amphibolite, i.e. "a metamorphic rock of medium to coarse grain, containing essential amphibole and plagioclase", whereas hornblendite is simply "a rock containing more than 90 per cent hornblende". Both of these rock-types are found in the terrains referred to, but amphibolite is the more common.

amphibolitic in part and are treated in this section. Amphibolites are characteristic of the granite gneiss and metasedimentary rocks but are also present in the younger granites and mylonites.

Amphibolites are dark green on fresh surfaces, weathering to greenish-grey, with some banded varieties consisting of alternating green and white to pink layers. Feldspars are prominent on weathered surfaces so that the rocks resemble hornblende granite gneiss.

Hornblende and feldspar are the principal minerals, with minor biotite, chlorite, epidote and quartz. As the proportion of hornblende decreases, the rock-type grades from hornblendite to amphibolite, to hornblende granite gneiss or amphibolitic metasedimentary rocks. The grain size ranges from fine to coarse with 1/4-inch and larger hornblende crystals common in hornblendites. The texture ranges from massive to foliated, some banded types consisting of alternating 1/2- to 1-inch thick bands of hornblende and feldspar.

Most amphibolite bodies are from 5 to 25 feet across, and only a few exceed 200 feet in width. Many are too small to be shown on the maps. The bodies are elongate and are aligned in accordance with the structure of the host rock.

All types of amphibolite, except the dykes described below, are associated with envelopes, veins and patches of granite pegmatite. Where amphibolites have been disrupted in the course of extreme boudinage development, or sheared and broken up, the blocks of amphibolite are commonly set in a pegmatitic matrix which may comprise up to 30 per cent of some outcrops. Contacts of amphibolite with pegmatite appear sharp because of the color contrast but are typically gradational where observed in detail.

Most metasedimentary bands contain noticeable amounts of amphibolite as layers and lenses commonly 10 to 30 feet wide. Two apparent exceptions are the metasedimentary band trending into the south end of Sedgwick Lake (65-6A), and the major band of metasedimentary rocks enclosing biotite granite F and recrystallized mylonite P which trends through Treasure Loch (65-6A).

Granite gneiss contains both banded and slightly foliated amphibolites, each accompanied by granite pegmatite. Banded amphibolite is similar to that in the metasedimentary rocks except for a lower quartz content, grading into hornblende granite gneiss in some places. Slightly foliated amphibolite with blocky green crystals of hornblende and feldspar has a coarse-grained texture and is usually accompanied by abundant pegmatite.

Internal structures of the amphibolites generally conform to those in the surrounding rocks, and in many amphibolites boudinage structure is developed because of their relatively competent nature. Banded varieties in the granite gneiss and metasedimentary rocks show a high degree of contortion, but hornblendites show only a simple foliation.

Contacts of amphibolites with biotite granite gneiss and with mylonites tend to be sharp, but those with hornblende granite gneiss and metasedimentary rocks are commonly gradational, especially where the amphibolite is of the layered type.

Some groups of small, elongate amphibolite bodies appear as on-strike "swarms" in parts of the granite gneiss. This type of distribution likely has resulted from the breakup of volcanic materials in the course of deformation, rather than from individual bodies of igneous intrusive origin. Such a situation leads to the possibility of using these amphibolites as marker horizons for structural and stratigraphic studies.

Many of the amphibolites in the granite gneiss terrain are noticeably rusty, a characteristic feature of the metasedimentary rocks with which they are associated in many places. The interlayering or interlensing of rusty amphibolites in the gneissic terrain suggests a metasedimentary-metavolcanic origin for the rusty amphibolites. Again, alignments of rusty amphibolite lenses offer the possibility of providing marker horizons for structural and stratigraphic studies.

Four small basic bodies believed to be dykes, but possibly sills, were mapped: two are located 1 mile east of Selwyn Lake, and the others are 1 mile west of Treasure Loch and 2 miles east of the southwest corner of the Charles Lake North map-district. Three of the dykes are aligned almost on strike within the granite gneiss foliation. These aphanitic dykes are dark greyish-green on fresh surfaces and brownish on weathered surfaces. They are up to 20 feet in width and are altered in part to chlorite. Margins may be fine grained or chilled, and xenoliths may be enclosed. They are apparently the youngest igneous rocks in the map-area, although they have been observed only in the granite gneiss terrain.

Massive to Foliated Biotite, Hornblende, and Leucocratic Granites and Pegmatites

Young granites of various types have invaded the older granite gneiss, recrystallized mylonite, and metasedimentary rock groups. These younger granites underlie 6.5 per cent of the map-area and have a distinct concentration in the west, making up 17.7 per cent of the bedrock in the three western districts (65-6B, D, F).

Some of the younger granites cut the foliation of the enclosing rock, but most bodies are characteristically aligned parallel to the foliation of the enclosing rock on both regional and local scales. Two of the granitic rock-types — biotite 'q' and leucocratic granites — are massive to locally foliated, particularly at shear contacts, whereas others — raisin, Arch Lake, and foliated hornblende granites — have a good penetrative foliation. The entire group of granites ranges texturally from medium grained to pegmatitic and from even grained to megacrystic.

Their contacts generally consist of a zone from a few to hundreds of feet in width of dykes and irregularly shaped bodies of younger granites enclosing remnants of country rock oriented in the regional trend. Any local foliation in the young massive granite is generally best developed parallel and near to the contacts.

The diversity of textures, mineralogy, field associations and contact relationships displayed by this group of granites suggests that they are not of common origin or age.

Biotite Granite

Massive biotite granite as described in the map-areas to the east (Godfrey and Peikert, 1963, 1964) is found as small intrusive bodies in the eastern border of the Potts Lake district (65-6E), particularly near St. Agnes Lake.

Biotite granite is pink to red on fresh and weathered surfaces. It contains white to pink to red feldspars, biotite and minor sericite in a medium-grained, typically massive matrix. Equigranular biotite granite is mixed with and locally grades to both leucocratic granite and biotite 'q' granite.

Other characters are similar to those already described (ibid.) and lead to the conclusion that this rock is a member of the intrusive younger biotite granites.

Biotite 'q' Granite

This rock is the principal local representative of the massive biotite granites in adjacent areas (e.g. Godfrey, 1963). It is present only in the three eastern map districts (65-6A, C, E) as a number of scattered, generally small masses, which to the south are confined to a relatively narrow zone. Biotite 'q' granite is a megacrystic phase of the young biotite granites and contains about equal amounts of quartz, potash feldspar and plagioclase, with 5 to 8 per cent biotite and minor sericite. Allanite is a minor but common constituent. Abundant white to pink to red subhedral feldspar megacrysts, mostly 1/4 inch but up to 1/2 inch in size, are enclosed in a medium-grained, massive to foliated matrix. In many respects biotite 'q' granite is similar to biotite 'p' granite (Godfrey and Peikert, 1963, 1964); however, in the latter the 1/4-inch feldspar megacrysts are more uniformly distributed and tend to be more abundant, forming up to 25 per cent of the rock.

The rock may be massive but is more typically slightly foliated with a slight tendency towards local banding. Effects of shear are common, and the megacrysts may form augen.

Biotite 'q' granite is cut by very few amphibolites or aplites, but each major body contains minor bands of metasedimentary rocks generally from 5 to 15 feet wide.

Biotite 'q' granite is resistant to weathering and as a rule forms topographic highs. Granite gneiss is structurally complex and typically porphyroblastic at the margins of biotite 'q' granite, where the two rock-types have an interlensed gradational contact zone.

Microsyenite

A small area mapped as microsyenite is enclosed by biotite granite gneiss south of Whaleback Lake (65-6E).

In general appearance and character, microsyenite is similar to raisin granite, including a finer-scale raisin texture. It consists of abundant pink to red rounded feldspar megacrysts typically 1/10 inch in size, with a few up to 1/4 inch, in a fine-grained, generally poorly foliated chlorite-epidote matrix. Limited information on this rock-type suggests it belongs with raisin, leucocratic and biotite 'q' granites in the group of intrusive, younger, massive to foliated biotite granites.

Raisin Granite

This map-unit is confined to the northwest margin of the Charles Lake North district (65-6B) and in conjunction with leucocratic and Arch Lake granites forms a continuous north-trending band of younger granites throughout the entire length of the map-area.

The rock is mottled pink to red in a dark background on both weathered and fresh surfaces, but the typical raisin texture is best seen on a weathered surface. The rock name is derived from a characteristic and distinctive "raisin-textured" appearance of white to pink to red, rounded to subrounded, equidimensional feldspars, mostly 1/10 to 1/4 inch in size, making up 50 to 70 per cent of the rock, enclosed in a sheared, foliated, green, chloritic matrix. The matrix also includes lenticular quartz, biotite, sericite and minor epidote. The raisin-textured appearance corresponds to a flaser structure. Local variations of this rock-type may possess a poor foliation, with biotite present to the exclusion of chlorite, hornblende and feldspar megacrysts. The foliation tends toward gneissic banding where shearing is particularly evident.

Rare mafic xenoliths up to 6 feet long and a small lens of ferruginous impure quartzite were noted in the raisin granite, aligned in the foliation of the granite. Rarely, amphibolite or hornblendite in the contact area appear to have developed an incipient raisin texture, and small discontinuous patches and layers of a raisin texture also were noted in the adjacent granite gneiss.

Raisin granite has an interfingering contact with granite gneiss, especially well shown in the extreme northwest part of the map-area, and is interpreted as probably intrusive.

The common occurrence of sericite with biotite and chlorite in the matrix, the rounded feldspars, and the generally sheared raisin texture of this foliated rock suggest that dynamic metamorphic effects are widespread throughout much of the mass.

Arch Lake Granite

This map-unit is confined to the region west of Charles Lake, and is one of three granites forming a continuous band of younger granites along the west margin of three map districts (65-6B, D, F).

Arch Lake granite has an over-all reddish appearance on both weathered and fresh surfaces. It consists of white to pink, subhedral, elongate, subparallel feldspar megacrysts from 1/2 to 1 inch in size, uncommonly up to 2 inches, aligned in a medium-grained, streaky to foliated matrix of typically blue quartz, biotite, feldspar, and minor muscovite. Quartz and feldspar make up from 90 to 95 per cent of the rock, and biotite (partly chloritic) about 4 per cent. The predominant features of the Arch Lake granite are the good foliation and the parallel-aligned feldspar megacrysts, which comprise from 30 to 50 per cent of the rock.

Deformation has produced textural variations including a gneissic phase and a mylonitic or highly crushed phase. In some deformed phases the quartz grains have been stretched to form elongated grains up to 6 inches in length. Similarly, the feldspar megacrysts show augen development, fracturing and granulation to numerous smaller grains. A coarse-grained granoblastic phase with only scattered felaspar megacrysts and a biotite-rich phase represent minor textural variations.

Lenses of well-layered granite gneiss up to 20 feet wide occur within this map-unit; these lenses are commonly interlayered with thin layers of Arch Lake granite. Blocky, massive amphibolite lenses up to 6 feet wide also occur as xenoliths within the granite.

The westerly contact of Arch Lake granite lies beyond the map-area, and the contact to the east is a mixed zone with leucocratic granite, amphibolite and hornblende granite gneiss, conformable with the adjacent granite gneiss.

Leucocratic Granite

This granite is present as dispersed small bodies within every major rock group. Most of the leucocratic granite lies in a north-trending zone centred on Charles Lake, with the major masses to the west of the lake (65-6B).

Light grey to pink to red on fresh and weathered surfaces, this medium- to coarse-grained, massive granite consists of equigranular feldspar and quartz with about 3 per cent mafic minerals. Although the granite is typically massive, local foliation is indicated by lenticular quartz. Minor microgranite and pegmatite phases also are present.

Patches and bands of granite gneiss, amphibolite and metasedimentary rocks are found in the otherwise uniform leucocratic granite. Contacts of the leucocratic granite are generally sharp against granite gneiss, though interlensed contact zones may be encountered. These contacts are interpreted as being intrusive.

Granitic Material

Quartzo-feldspathic material present either as discrete masses not large enough to be mapped or as clusters of crystals in metasedimentary rocks are grouped in this category. Pegmatites, dispersed metamorphic feldspar crystals, or quartzo-feldspathic aggregates of an intermediate character are typical of many metasedimentary rock bands. The larger crystalline bodies are distinguished on the map, but much of the granitic material is dispersed and mixed in the metasedimentary rock. Such concentrations are indicated on the map by specific symbols for the granitic and pegmatitic phases.

Feldspars in such masses tend to be white or pink, and biotite is the typical mafic mineral, although well-developed masses are leucocratic and may contain muscovite. An equigranular texture is more common than a porphyroblastic one. Muscovite granites and pegmatites, biotite granites and feldspar pegmatites are the most common rock-types, and coarse-grained textures are typical of these rocks.

Granitic masses are irregular in outline and may or may not follow the foliation of the enclosing rock. There is little evidence of the enclosing rock having been disturbed as, for example, by dilation, and field observations point to a primarily metamorphic origin.

Foliated Hornblende Granite

This distinctive map-unit occurs in two masses: a major body in the main peninsula to the northeast of Charles Lake (65-6B), and a small band west of Charles Lake on the Northwest Territories boundary (65-6B).

Foliated hornblende granite is typically pink on weathered surfaces and pink to grey on fresh surfaces. A weathering characteristic of this rock-type is the uniformly well-developed exfoliation layer, up to 4 to 5 inches thick, on glacially smoothed outcrops. This rock is composed of pink feldspar and quartz with streaky patches of hornblende aggregates and minor biotite providing a poor to well-developed foliation in an equigranular, medium- to coarse-grained texture. Though typically foliated, the mafic mineral aggregates also may be rod-like in shape, imparting a lineation to the granite. Minor moderately developed banding of gneissosity is related to local shear deformation. Other variations include local pegmatitic or fine-grained massive phases. The outstanding feature of this rather homogeneous rock is the streaky foliation produced by aligned plates of mafic mineral aggregates averaging from 1 to 1-1/2 inches in length.

Several large, blocky, basic masses up to 30 feet in width of dioritic or amphibolitic composition are present, possibly as inclusions. Lenses of amphibolite and granite gneiss are typically elongate and aligned in the foliation of the granite.

The foliation of this granite is tightly folded, and structural complexities are especially evident along the in-folded and drag-folded contacts with granite gneiss.

This map-unit is considered to be intrusive in the granite gneiss terrain, with post-intrusion plastic deformation.

Grey Hornblende Granite

This rock-type is of limited distribution, being only locally present as small bodies in close association with hornblende cataclasite in the Charles Lake Central and South districts (65-6D, F).

On both fresh and weathered surfaces grey hornblende granite is buff to grey with small dark specks of mafic material. Hornblende porphyroclasts from 1/16 to 1/8 inch in size make up from 1 to 4 per cent of the rock and are enclosed in a typically fine- to medium-grained, quartzo-feldspathic matrix. As a rule the matrix is massive, but a slight foliation may be locally present. Uncommon feldspar porphyroclasts range from 1/4 to 1/2 inch in size.

Grey hornblende granite is gradational to hornblende cataclasite on a scale visible in outcrop. Though the main bodies of grey hornblende granite are outlined on the maps, other bodies within the hornblende cataclasite are too small to be represented.

Internal foliation structures are either absent or poorly developed and simple in form; external contacts are gradational into hornblende cataclasite and are probably interlensed with hornblende granite gneiss.

Grey hornblende granite is apparently derived from the complete reconstitution and recrystallization of hornblende cataclasite. Contacts with other rocks depend upon the type of parental material from which the cataclasite was originally developed, and upon any subsequent remobilization and intrusion which the grey hornblende granite has undergone.

Mylonite Group

Zones of intensive granulation in the map-area have given rise to four distinctive major parallel bands of rock of mylonitic character, recently studied in detail by Watanabe (1965). The four mylonitic bands all trend northerly and from east to west are designated the Bayonet-Pans Lakes band, the Treasure Loch band, the Selwyn-Alexander Lakes band, and the Charles Lake band.

Rocks of the mylonite group underlie 6.1 per cent of the area mapped. Three of the bands extend continuously beyond the map-area boundary to the north, whereas only one extends beyond the boundary to the south. The Treasure Loch band is entirely within the map-area. The maximum width developed in any band is 1-1/2 miles, whereas the average width is from 1/3 to 1/2 mile.

The color and megascopic texture of the mylonites together with gradational contacts to less deformed rocks have allowed a field classification of these cataclastic rocks which is both descriptive and also meaningful in terms of parental relationships. In a few cases distinctions among mylonites are not always clear; the parental materials themselves, at least in the gneissic terrain, are already mixtures of rock-types on a detailed scale which are further blended by mylonitization; the ultra fine-grained nature of some mylonites obscures the natural color and makes the rock appear dark. Among the types of mylonites present, the hornblende cataclasite is readily distinguished from other crushed rocks. Mylonite P is also distinctive and genetically is related to biotite granite F. Mylonites K, L, M, N and O are derived from the granite gneisses and metasedimentary rocks; consequently, an overlap or gradation of geologic characters among these mylonites in outcrop or hand specimen is inevitable.

Many rocks of the mylonite bands are ultramylonitic in character, even glassy in extreme cases. Feldspar augen are common, and a streaked or banded matrix is typical. All the cataclastic rocks show recrystallization in thin sections, but to varied degrees.

The hornblende cataclasite unit has been distinguished because of its lack of banding and the presence of characteristic hornblende porphyroclasts.

Mylonite K is a light-colored rock which either lacks feldspar porphyroclasts or has low amounts (up to 2 per cent). It has formed from felsic or biotite granite gneiss.

Mylonite L is a light-colored rock with about 5 per cent feldspar porphyroclasts. It has formed from felsic or biotite granite gneiss.

Mylonite M is a dark-colored rock with about 5 per cent feldspar porphyroclasts. It probably has formed from mafic hornblende granite gneiss and amphibolitic granite gneiss.

Mylonite N is green to black, has a schistose or slaty appearance, and has minor quartz and feldspar porphyroclasts. It probably has formed from schistose metasedimentary rocks containing amphibolite.

Mylonite O is green to black, has a siliceous nature, and has minor feldspar porphyroclasts. It probably has formed from quartzose metasedimentary rocks with intercalated minor amphibolite.

Mylonites K, L, M, N and O generally range from blasto-mylonites and protomylonites to ultramylonites and cryptomylonites. The character of freshly broken surfaces largely depends on the relative effects of mylonitization, recrystallization, and chemical changes such as silicification. These mylonitic rocks commonly possess a splintery fracture, exhibiting a flinty character and conchoidal fracture, especially in the finer-grained massive phases.

On the maps open and solid rectangles are used to represent feldspar and hornblende porphyroclasts, respectively, and are aligned to show the structural trend.

Recrystallized Porphyroclastic Hornblende Cataclasite

Hornblende cataclasite is confined to the Charles Lake mylonite band, occurring in minor amounts in the three western districts (65-6B, D, F), where it makes up 0.8 per cent of the bedrock. This rock-type is always closely associated with either grey hornblende granite or hornblende granite gneiss.

Hornblende cataclasite weathers into distinctive, large, flaggy, rectangular slabs 3 to 6 inches thick. Fresh and weathered surfaces are typically greyish-green and may possess a delicate pinkish hue in places. The obvious minerals include epidotized hornblende porphyroclasts up to 1/10 inch in size making up to 7 per cent of the rock, and feldspar porphyroclasts from 1/2 to 3/4 inch in size making up 5 per cent of the rock. The matrix is fine grained, foliated to indistinctly banded, and comprised of quartz, feldspar and chloritized biotite.

Hornblende cataclasite is present as narrow bands oriented in the regional structural trend, proximal to the probable hornblendic parent rocks. It is homogeneous in that xenolithic lenses or masses were not noted. Uncommon, locally developed, medium-grained, typically massive phases, generally too small to be represented on the map, are classified as grey hornblende granite. They are coarser grained than the cataclasite and appear to result from advanced recrystallization.

Internal metamorphic structures are simple both in outcrop and regionally and are evident in outcrop as either foliation or lineation.

Contacts with mylonite L, grey hornblende granite and hornblende granite gneiss are fairly well defined in the field, although they may be gradational over a few feet.

This rock-type has been derived by extensive cataclasis and subsequent recrystallization of a hornblendic parent rock, probably hornblende granite gneiss (Watanabe, 1965).

Recrystallized Mylonite K

Mylonite K is pale pink to red on both fresh and weathered surfaces. White to pink feldspar porphyroclasts from 1/4 to 3/4 inch in size make up about 2 per cent of the rock. The abundance of feldspar porphyroclasts distinguishes it from mylonite L. The porphyroclasts may have trails of smaller feldspar crystals and fragments that are enclosed in a foliated, aphanitic, finely banded matrix.

Small amounts of other rock-types of the mylonite group (L, M, N and O) are mixed in this map-unit on a scale too fine to be distinguished separately on the present scale of mapping. As these bodies become smaller in size, distinctions among rock-types in the field and map-units become more difficult.

Metamorphic foliation structures are generally simple in outcrop, but on the regional scale folds can be clearly demonstrated in mylonite K, especially in the Bayonet-Pans Lakes band.

Mylonite K is always enclosed by and associated with a rock assemblage typical of the granite gneiss terrain. The contact with these rocks — gneisses, metasedimentary rocks and amphibolite — is commonly gradational.

It is quite obvious that biotite granite gneiss was the predominant parental material from which mylonite K was developed.

Recrystallized Mylonite L

This mylonitic unit is abundant in the three major mylonite bands: Charles Lake, Selwyn-Alexander Lakes and Bayonet-Pans Lakes. Adjoining unsheared rock is commonly biotite granite gneiss and rarely hornblende granite gneiss.

Mylonite L is similar to and gradational with mylonite K, mylonite L being distinguished by its more abundant feldspar porphyroclasts (about 5 per cent). Outlines of the principal mylonite L areas show a band or lens oriented parallel to the northerly tectonic trend. It is not clear from field data alone whether the development of abundant porphyroclasts is controlled primarily by metamorphic conditions (cataclasis plus recrystallization) or compositional (geochemical) factors.

Biotite granite gneiss is the predominant parental material of mylonite L.

Recrystallized Mylonite M

This dark-colored mylonite is virtually confined to the Bayonet Lake district (65-6A), only minor amounts being present in two other districts (65-6E, F). In the Bayonet Lake district, mylonite M occurs in the Bayonet-Pans Lakes mylonite band, in a small band north of Collins Lake, and in a small lens one mile west of Logan Lake.

Mylonitic basic or predominantly mafic rocks are included in the mylonite M category. Difficulties arise in this particular mylonitic division since extreme granulation may create the illusion of a dark-colored rock. The relative specific gravity of hand specimens is of some help in resolving this problem in the field. Fresh and weathered surfaces are characteristically dark colored and greenish. White to pink feldspar porphyroclasts from 1/4 to 3/4 inch in size make up about 5 per cent of the rock. The matrix is typically foliated, finely banded and aphanitic.

Mylonite M is typically present as several relatively small lenses associated with and enclosed by rocks of the granite gneiss terrain and their mylonitic equivalents, K, L, N and O. These lenses range up to one mile in length with a maximum width of one quarter of a mile, and together total one per cent of the Bayonet Lake district where they are most abundant.

Internal structures and contacts are typical of those described for mylonite K. The predominant parental materials for mylonite M are probably hornblende granite gneiss and amphibolitic gneiss.

Recrystallized Mylonite N

This mylonite is confined to a few small lenses in the Bayonet Lake (65-6A) and Potts Lake (65-6E) districts where it makes up 0.3 and 0.5 per cent of the bedrock, respectively. Mylonite N is present in the Bayonet-Pans Lakes mylonite band and its discontinuous extension to the south.

Fresh and weathered surfaces are dark green to black. Minor porphyroclasts of feldspar and of rarer quartz are enclosed in a biotite-sericite-chlorite, schistose to slaty matrix which is finely banded and largely aphanitic. Siliceous mylonite O is interlayered and mixed with mylonite N.

Internal structures are evident as simple straight-line patterns in this well-foliated rock. Contacts are gradational to unsheared metasedimentary rock or granite gneiss.

The phyllonitic character of this mylonite, due to its relatively high mica content, strongly suggests a schistose metasedimentary parentage.

Recrystallized Mylonite O

Similar to mylonite N, this mylonite is present as small lenses in the Bayonet Lake (65-6A) and Potts Lake (65-6E) districts where it makes up 0.2 and 0.7 per cent of the bedrock, respectively.

Fresh and weathered surfaces are dark green to grey in color, and freshly broken surfaces are vitreous. Minor feldspar porphyroclasts are enclosed in a siliceous, banded, massive to foliated, aphanitic matrix, with biotite, chlorite and sericite. Phyllonitic mylonite N is intimately intermixed with this mylonite.

Simple internal foliation structures and gradational crushed and sheared contacts follow the pattern established for other mylonites of granite gneiss and metasedimentary rock association.

It is apparent that quartzose metasedimentary rocks with minor schistose material and basic rocks were the parental rocks of mylonite O.

Recrystallized Mylonite P

This mylonite is present in the three western mylonite bands: Charles Lake, Selwyn-Alexander Lakes and Treasure Loch. The combined areas underlain by mylonite P amount to 2.9 per cent of the map-area.

Fresh and weathered surfaces are medium to dark grey. White to grey feldspar augen and euhedral porphyroblasts from 1/2 to 3 inches in size make up from 5 to 15 per cent of the rock. The matrix is typically aphanitic and foliated, though locally gneissose and medium grained. Minor aplites and pegmatites are present in small bodies which follow the main structural trend, though in a somewhat irregular manner.

Foliation patterns are generally simple in outcrop, but on a regional scale they grade from simple forms in the north to distinctly folded and more complex forms in the south. The contact with impure quartzose metasedimentary rock is typically interlensed and is gradational both texturally and mineralogically over a short distance. Mylonite P surrounds and is completely gradational to uncrushed cores of biotite granite F, which is the parent rock-type. Granite gneiss in contact with mylonite P becomes less contorted, more mylonitic, and the size of feldspar porphyroclasts gradually increases from 1/2 to 3 inches as mylonite P is approached. Bands of granite gneiss from 1 to 10 feet thick can be recognized in the contact zone, and felsic and mafic layers remain distinctive in the mylonitic granite gneiss.

In the two northern districts (65-6A, B) mylonite P is consistently sheathed in an envelope of garnetiferous quartzose metasedimentary rock, except where contact relationships have been complicated by faulting. In the central districts (65-6C, D), mylonite P is only partially sheathed by metasedimentary rocks, and some mylonite P comes in direct contact with either granite gneiss or mylonitic granite gneiss equivalents. In the southern districts (65-6 E, F), mylonite P generally lacks any metasedimentary rock envelope. Those masses of mylonite P lacking a metasedimentary rock envelope also seem to have developed folded internal foliation patterns (unlike masses to the north having a metasedimentary rock envelope), and their contacts with granite gneiss are also deformed and folded (again unlike the simple, straight contacts of the masses to the north). These relationships suggest that the zones to the south may have been more deeply buried and during remobilization were moved from their natural environment in the metasedimentary rocks and intruded into the adjacent granite gneiss. Folding of both the mylonite P foliation and the mylonite P-granite gneiss contact is an expression of deformation, probably of both concurrent and post-intrusion age, in a deep-seated zone. The presence of mylonitic granite gneiss adjacent to mylonite P east of Cornwall Lake indicates that granulation was effective after intrusion of mylonite P. Ultramylonitic phases in the Charles Lake band are confined to the north, and plastically deformed phases confined to the south, further indications that depth of burial of the mylonite band increases southwards.

MODAL ANALYSES

Nineteen crystalline map-units distinguished in the field are represented by a group of 94 standard samples. These standard samples have been modally analysed and the results presented in table 7 to 12, each table corresponding to a map district.

Largely according to the classification of Moorhouse (1959), the standard rock samples are classified as follows:

Field Term	Petrographic Classification
Biotite granite gneiss	Biotite granite to quartz monzonite gneiss
Hornblende granite gneiss	Hornblende quartz monzonite to granodiorite gneiss
Amphibolite	Amphibolite
Biotite granite	Biotite granite
Biotite granite F	Porphyroblastic granodiorite
Biotite 'q' granite	Quartz monzonite
Microsyenite	Micromonzonite
Raisin granite	Flaser granodiorite
Arch Lake granite	Quartz monzonite
Leucocratic granite	Leucocratic granite
Foliated hornblende granite	Hornblende granite
Grey hornblende granite	Hornblende microgranodiorite

The adopted terms for the seven cataclastic map-units do not require reclassification. Detailed descriptions, chemical and X-ray fluorescence analyses and discussions of the petrogenesis of these rock-types are presented by Watanabe (1965).

Table 7. Modal Analyses of Standard Rock-Type Samples
BAYONET LAKE DISTRICT

Sample No.	74	80	83	81	9	69	82	76	65	71	72	77	78	79	66	67	68	70	73	75
Quartz	24.4	24.8	27.3	29.6	21.1	19.2	3.9	31.1	10	21.7	15	20.9	20	25			20	25	27.0	28.8
Potash Feldspar	6.7	22.0	28.5	12.0	35.5	15.9	0.0	34.7	39	1.8	20	24.4	30	10			8	30	7.3	7.5
Plagioclase	44.2	44.2	34.7	45.0	31.1	47.6	34.1	24.1	40	68.8	45	38.5	40	35			35	35	47.1	50.5
Biotite	19.9	5.2	6.6	7.8	3.4	8.3	0.1	5.8	0	0.0	0	5.8	0	20			10	0	3.1	10.8
Chlorite	0.4	2.7	1.0	0.7	0.1	0.8	0.0	0.7	5	3.3	0	1.5	3	1			0.5	5	12.8	0.2
Hornblende	0.0	0.0	0.0	2.8	6.6	3.5	60.8	0.0	0	0.0	0	0.0	0	0			0	0	0.0	0.0
Epidote	0.2	0.6	0.7	1.2	0.0	0.3	0.0	0.2	5	3.1	4	4.5	0	0.2			0.5	0.5	0.1	0.1
Muscovite	3.7	0.1	0.0	0.1	0.0	0.0	0.0	1.0	0.5	0.3	15	1.9	6	7.7			25	0	2.1	1.5
Garnet	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0	0	0.0	0	0			0	0	0.0	0.0
Calcite	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0	0.0	0	0.1	0	0.1			0.2	0	0.0	0.1
Accessories	0.2	0.4	1.2	0.7	2.2	4.3	1.0	2.4	0.5	1.0	1	2.4	1	1			0.8	4.5	0.5	0.5
Number of Points	2500	2500	2500	2000	2000	2500	2000	2500	*	2500	*	2500	*	*	**	**	*	*	2500	2500

74 Biotite granite F
80 Biotite granite gneiss
83 Biotite granite gneiss
81 Biotite granite gneiss
9 Hornblende granite gneiss
69 Hornblende granite gneiss
82 Amphibolite
76 Biotite 'q' granite
65 Recrystallized mylonite K
71 Recrystallized mylonite K
72 Recrystallized mylonite K
77 Recrystallized mylonite K
78 Recrystallized mylonite L
79 Recrystallized mylonite M
66 Recrystallized mylonite N
67 Recrystallized mylonite O
68 Recrystallized mylonite O
70 Recrystallized mylonite O
73 Recrystallized mylonite P
75 Recrystallized mylonite P

* Too fine to count, estimate only
** Too fine to estimate

Table 8. Modal Analyses of Standard Rock-Type Samples

CHARLES LAKE NORTH DISTRICT

Sample No.	90	93	86	89	92	97	84	91	100	96	87	88	94	95	98	85	99
Quartz	29.8	8.6	1.0	0.0	0.4	0.0	25.7	24.4	21.9	26.2	22.5	41.9	17.3	31.9	29.0	15	23.8
Potash Feldspar	24.4	13.7	0.2	0.0	0.1	0.0	9.2	2.7	45.4	41.8	44.5	37.3	11.6	25.8	23.2	15	7.0
Plagioclase	36.3	48.4	39.1	20.6	54.4	1.3	49.8	64.0	26.6	27.7	14.7	7.6	59.0	35.2	37.7	50	52.0
Biotite	5.4	15.5	12.4	1.7	5.5	0.0	0.0	2.9	1.9	0.0	3.6	5.3	4.4	2.7	0.0	1.5	0.2
Chlorite	0.4	0.0	0.1	18.6	0.1	0.0	9.3	1.4	1.7	3.4	0.0	0.0	1.5	1.0	6.1	0.5	9.7
Hornblende	0.0	3.2	33.3	55.2	38.4	87.5	0.0	0.0	0.0	0.0	14.1	7.4	0.4	0.0	0.0	0.0	0.0
Epidote	2.7	4.1	0.1	0.0	0.0	0.0	3.2	0.0	0.1	0.2	0.0	0.0	4.7	1.7	1.7	trace	0.4
Muscovite	0.2	0.0	8.7+	0.0	0.0	10.9	2.2	3.6	2.0	0.2	0.0	0.0	0.0	1.0	0.6	17	6.0
Garnet	0.0	0.0	0.5++	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calcite	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.6	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.5	0.1
Accessories	0.7	6.5	4.6	3.8	1.1	0.3	0.5	0.4	0.3	0.4	0.6	0.5	1.0	0.6	1.5	0.5	0.8
Number of Points	2500	2000	2000	2000	2000	2000	2500	2500	2500	2000	2000	2500	2500	2500	2500	*	2500

90 Biotite granite gneiss
93 Hornblende granite gneiss
86 Amphibolite (feldspathic)
89 Amphibolite
92 Amphibolite (feldspathic)

97 Amphibolite
84 Raisin granite
91 Raisin granite
100 Arch Lake granite

96 Leucocratic granite
87 Foliated hornblende granite
88 Foliated hornblende granite
94 Recrystallized porphyroclastic hornblende cataclasite

95 Recrystallized mylonite K
98 Recrystallized mylonite K
85 Recrystallized mylonite L
99 Recrystallized mylonite P

* Too fine to count, estimate only
\+ Diopside
++ Hypersthene

Table 9. Modal Analyses of Standard Rock-Type Samples

ASHTON LAKE DISTRICT

Sample No.	102	103	105	107	110	112	117	108	113	106	114	116	115	101	104	111	109
Quartz	18.0	28.1	29.4	30.3	26.7	29.1	19.8	35.5	17.0	0.2	4.5	2.8	26.7	19.2	29.4	24.0	21.7
Potash Feldspar	25.2	32.6	34.1	13.3	24.5	26.7	10.3	3.0	6.9	0.0	0.0	0.0	0.0	trace	4.9	15.4	25.2
Plagioclase	40.2	31.6	32.7	39.5	35.1	35.1	48.3	42.9	42.5	24.8	42.0	40.9	58.0	74.9	60.0	41.3	33.0
Biotite	13.7	4.1	0.7	13.6	10.9	7.8	13.9	1.9	9.7	1.6	21.5	1.5	11.5	0.0	0.0	0.9	10.5
Chlorite	0.0	0.4	1.7	0.1	0.4	0.3	2.4	7.8	7.8	0.0	0.0	0.0	0.0	5.3	4.6	12.5	3.3
Hornblende	0.0	0.0	0.0	1.8	0.7	0.0	0.0	4.7	6.3	68.1	26.3	46.2	0.0	0.0	0.0	0.0	0.0
Epidote	0.1	0.3	0.1	0.3	1.3	0.3	2.2	2.3	7.7	1.5	4.2	0.0	0.0	0.0	0.6	2.6	3.5
Muscovite	0.0	1.2	0.8	0.0	0.0	0.1	0.0	0.0	0.4	3.2	0.0	0.0	3.2	0.0	0.0	1.2	0.4
Garnet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4++	0.0	6.5+	0.0	0.0	0.0	0.0	0.0
Calcite	0.1	0.2	0.3	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.5
Accessories	2.7	1.5	0.2	1.1	0.4	0.6	3.1	1.3	1.7	0.2	1.4	2.1	0.6	0.6	0.5	1.8	1.9
Number of Points	2000	2500	2500	2000	2500	2000	2500	2000	2500	2000	2000	2000	2500	2500	2500	2500	2500

102 Biotite granite gneiss
103 Biotite granite gneiss
105 Biotite granite gneiss
107 Biotite granite gneiss
110 Biotite granite gneiss
112 Biotite granite gneiss
117 Biotite granite gneiss
108 Hornblende granite gneiss
113 Hornblende granite gneiss
106 Amphibolite
114 Amphibolite (feldspathic)
116 Amphibolite
115 Biotite 'q' granite
101 Recrystallized mylonite K
104 Recrystallized mylonite K
111 Recrystallized mylonite K
109 Recrystallized mylonite L

\+ Diopside
++ Hypersthene

Table 10. Modal Analyses of Standard Rock-Type Samples

CHARLES LAKE CENTRAL DISTRICT

Sample No.	127	129	128	122	119	118	124	125	126	134	121	131	123	120	130	132	133
Quartz	30.3	34.5	24.4	27.5	16.4	0.4	0.0	0.1	3.9	0.6	19.4	44.6	35.0	15.5	26.0	17.3	27.8
Potash Feldspar	13.0	10.7	11.2	30.1	13.2	0.2	0.0	1.6	0.4	0.2	42.2	16.8	30.9	21.6	5.0	11.1	13.3
Plagioclase	37.6	40.6	47.0	29.8	53.5	23.1	32.3	17.7	36.9	44.4	32.7	28.9	32.1	47.8	41.9	37.8	40.2
Biotite	5.7	11.0	13.9	5.2	7.7	0.0	0.0	0.0	11.7	7.5	3.3	3.6	0.1	0.0	20.0	30.3	13.0
Chlorite	7.2	3.0	0.2	1.3	3.8	0.3	0.0	9.9	6.8	12.0	0.9	0.7	1.1	6.2	3.0	0.9	0.3
Hornblende	0.0	0.0	0.0	0.6	1.9	69.3	65.1	59.1	38.4	33.1	0.0	0.0	0.0	0.4	0.0	0.0	0.0
Epidote	0.0	0.0	0.9	3.1	1.9	1.1	0.5	5.7	0.1	1.0	0.3	1.4	0.2	7.2	3.0	0.8	0.5
Muscovite	1.8	0.0	0.6	0.1	0.0	4.1	0.2	1.2	0.0	0.0	0.9	3.5	0.2	0.1	1.0	1.0	4.0
Garnet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calcite	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.1	0.4
Accessories	4.3	0.2	1.8	2.1	1.6	1.5	1.9	4.7	1.8	1.2	0.3	0.3	0.4	1.0	0.1	0.7	0.5
Number of Points	2500	2500	2000	2000	2000	2000	2000	2000	2000	2000	2500	2500	2000	2500	*	2500	2500

127 Biotite granite F
129 Biotite granite F
128 Biotite granite gneiss
122 Biotite granite gneiss
119 Hornblende granite gneiss
118 Amphibolite
124 Amphibolite
125 Amphibolite
126 Amphibolite (feldspathic)
134 Amphibolite (feldspathic)
121 Arch Lake granite
131 Arch Lake granite
123 Leucocratic granite
120 Hornblende cataclasite
130 Recrystallized mylonite P
132 Recrystallized mylonite P
133 Recrystallized mylonite P

* Too fine to count, estimate only

Table 11. Modal Analyses of Standard Rock-Type Samples
POTTS LAKE DISTRICT

Sample No.	136	139	140	50	135	138	141	142	137	143
Quartz	26.9	27.7	29.9	19.1	2.6	20.3	28.0	0.5	21.7	15.5
Potash Feldspar	35.0	7.1	30.3	36.5	25.7	19.2	30.5	27.3	4.2	7.0
Plagioclase	28.3	52.0	34.1	33.3	32.2	43.1	29.8	33.3	40.0	46.0
Biotite	7.4	10.4	2.6	5.7	11.6	9.9	4.4	0.0	31.2	20.0
Chlorite	0.6	1.2	1.6	0.0	0.3	0.1	0.1	12.9	0.6	0.2
Hornblende	trace	0.0	0.0	3.8	21.1	3.2	0.0	0.0	0.0	0.0
Epidote	0.1	0.6	0.3	0.2	0.8	2.2	0.0	19.3	0.0	0.2
Muscovite	0.0	0.0	0.1	0.0	0.0	0.0	5.6	0.0	0.0	9.9
Garnet	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calcite	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.8	0.0
Accessories	1.6	1.0	1.1	1.4	5.7	1.8	1.6	6.7	0.5	1.2
Number of Points	2500	2500	2000	2000	2000	2000	2500	2500	2500	2500

136 Biotite granite gneiss
139 Biotite granite gneiss
140 Biotite granite gneiss
50 Hornblende granite gneiss
135 Hornblende granite gneiss
138 Hornblende granite gneiss
141 Biotite 'q' granite
142 Microsyenite
137 Recrystallized mylonite N
143 Recrystallized mylonite N

Table 12. Modal Analyses of Standard Rock-Type Samples
CHARLES LAKE SOUTH DISTRICT

Sample No.	146	151	152	147	148	155	150	156	154	144	149	145	153
Quartz	29.4	24.6	21.2	0.1	22.8	33.5	13.9	24.4	25.0	25.7	15.0		22.9
Potash Feldspar	4.5	34.1	0.1	0.0	37.3	26.4	23.1	18.0	30.8	10.4	14.0		8.6
Plagioclase	46.8	33.3	55.7	27.6	30.7	26.5	54.9	54.0	40.5	58.4	64.8		46.5
Biotite	16.8	2.7	8.5	0.1	5.0	6.9	1.4	1.6	0.0	1.4	0.0		6.5
Chlorite	0.2	2.7	2.1	0.1	1.0	0.6	0.0	trace	1.1	1.5	2.0		6.9
Hornblende	0.0	0.5	7.8	70.6	0.0	0.0	3.9	0.0	0.0	0.0	0.0		0.0
Epidote	0.0	1.1	0.7	1.0	0.6	0.0	1.5	0.8	1.4	1.6	0.0		0.4
Muscovite	0.0	0.0	0.0	0.0	1.7	5.9	0.0	0.5	1.0	0.2	1.0		7.2
Garnet	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Calcite	0.0	0.1	0.0	0.2	0.1	0.0	0.0	0.0	0.0	trace	0.0		trace
Accessories	0.1	0.9	3.9	0.3	0.8	0.2	1.3	0.7	0.2	0.8	0.2		1.0
Number of Points	2500	2000	2000	2000	2500	2500	2500	2500	2500	2500	*	**	2500

146 Biotite granite F
151 Biotite granite gneiss
152 Hornblende granite gneiss
147 Amphibolite
148 Arch Lake granite
155 Arch Lake granite
150 Grey hornblende granite
156 Grey hornblende granite
154 Leucocratic granite
144 Recrystallized porphyroclastic hornblende cataclasite
149 Recrystallized mylonite K
145 Recrystallized mylonite P
153 Recrystallized mylonite P

* Too fine to count, estimate only
** Too fine to estimate

STRUCTURAL GEOLOGY

The complex structural history of the map-area can be ascribed to three distinct phases:

(1) deep-seated, plastic deformation leading to the development of the igneous-metamorphic granite-gneiss complex;

(2) deep-seated cataclastic deformation resulting in the formation of major mylonitic crushed zones up to 1-1/2 miles in thickness;

(3) cataclastic deformation in high-crustal levels, evident as restricted brecciation aligned within the older crushed zones and as transverse faults.

The granite gneiss terrain, or older part of the basement, has undoubtedly been built up in the course of repeated cycles of sedimentation, metamorphism and intrusion. During this stage a welded, complex combination of mixed rock-types was developed in a plutonic environment, which has undergone plastic deformation. The folded outlines of distinctive rock bands, such as the metasedimentary rocks, indicate several periods and orientations of applied stress. The main relief of the stresses, however, has resulted in a regionally dominant northerly structural trend, and in a nearly vertical orientation of the foliation in the bands of rocks. Only in local areas, where saddle-fold structures have not been stretched excessively and elongated to conform to the regional northerly trend and steep dips, can foliation dips of less than 70 degrees be found.

Intense cataclasis within the deep-seated plutonic environment marks the second deformation phase and is evidenced by several mylonitic crushed zones, tens of miles in length, and up to one mile in width. All pre-existing rocks provided parental material for the crushed zones, and it is apparent that mechanical mixing was limited despite the intensity of the deformation. In most cases the mylonitic derivatives have retained sufficient distinctive characteristics to be directly related to the parental material.

It is suggested that greater mobilization and intrusion by bulk flow (corresponding to conditions of deeper burial) has taken place in the Selwyn-Alexander Lakes mylonite band towards the south. Farther south beyond the map-area, where presumably even greater depths of burial prevailed, the effects of plastic deformation in this band should be even more pronounced, the mylonitic character less distinct, and the band discontinuous. To the north beyond the map-area, where progressively shallower depths of burial prevailed, the mylonitic zone should become more confined, the single plane of shear should become a two-fold series of shears (initially at low intersecting angles), and breccia should become more abundant relative to mylonite.

The third and final phase of deformation is expressed as small breccia zones aligned within the major crushed zones. These movements are related to a high-crustal level environment and indicate reactivation of the old fault scars. Multiple plutonic intrusions took place in the west prior to the development of transverse faults, which are probably related to the third period of deformation. These faults have caused horizontal separation of some contacts of the plutonic igneous bodies, for example, raisin granite.

MINERAL OCCURRENCES

Two widely separated areas have milky quartz veins. East of Bayonet Lake towards the south end, closely spaced quartz veins up to 4 inches wide are interlaced to form a stockwork. The wall rock is relatively unshattered, and the quartz veins appear clean and unmineralized. A substantial milky quartz vein over 10 feet wide extends along a cliff face about 30 by 180 feet on the east shore in the central Charles Lake district (65-6B). Though iron-stained along fractures, this quartz vein appears to be unmineralized.

Five molybdenite occurrences, primarily within metasedimentary rocks, have been noted in an area around Andrew Lake Arm (65-6C). One of these occurrences is associated with uranium mineralization and was previously reported (Godfrey, 1958b). These molybdenite occurrences are apparently on the southern extension of a major metasedimentary band known to contain well-developed gossans and minor sulphides with nickel, gold and silver values. Other molybdenite occurrences were noted on the east shore of Potts Lake (65-6E), north of Camsell Lake (65-6E), west of Potts Lake (65-6E) and at the south end of Charles Lake (65-6F), where they are associated with chalcopyrite. Here, molybdenite and chalcopyrite occur in fractures in a gossan zone about 5 feet by 6 inches, with parallel quartz veins. This structure trends almost perpendicular to the regional foliation. G. C. Riley[1], of the Geological Survey of Canada, has indicated that molybdenite also was found in metasedimentary rocks at the north end of St. Anges Lake during his reconnaissance survey. It is assumed that this mineralization is located within the metasedimentary rocks mapped on the south shore of the hook at the north end of St. Agnes Lake (65-6C).

Concentrations of massive arsenopyrite were present in a 3-foot wide zone within a siliceous, chloritic metasedimentary band on the west side of Potts Lake, towards the south end (65-6E). Minor blue and green staining is evident. Assays show that gold, silver and nickel are absent.

[1] Personal communication

Numerous small but well-developed gossans have been noted, especially in the metasedimentary rocks towards the south-east side of the map-area, at Potts and Boudin Lakes.

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RESEARCH COUNCIL OF ALBERTA
GEOLOGICAL DIVISION

LEGEND

PRECAMBRIAN*

- Quartzite, *pure and impure, white, grey, green, pink and blue; including biotite sericite schist, minor milky quartz pods, feldspar augen, granite and pegmatite lenses, ferruginous and garnetiferous zones.*
- Biotite schist, *with abundant quartz, some sericite; including phyllite, phyllonite, quartzite, minor milky quartz pods, feldspar augen, granite and pegmatite lenses, ferruginous and garnetiferous zones.*
- Biotite granite F, *with white to grey subhedral to euhedral feldspar megacrysts, one to four inches in size, averaging two inches, in a coarse-grained, massive matrix of quartz, feldspar and biotite; including minor aplite and pegmatite.*
- Biotite granite gneiss, *with some hornblende, chlorite, megacrystic feldspar phases; including minor massive to foliated granite - some megacrystic, granodiorite, alaskite, lenses of biotite, quartzite, amphibolite; garnetiferous zones.*
- Hornblende granite gneiss, *with some biotite, chlorite, megacrystic feldspar phases; including minor massive to foliated granite - some megacrystic, granodiorite and amphibolite.*
- Amphibolite, *including biotite amphibolite, hornblendite; mainly massive, little banded. Feldspar - rich type F.*
- Biotite 'q' granite, *with white to pink to red abundant feldspar megacrysts one-quarter inch in size, minor sericite; in medium-grained, massive to foliated matrix of biotite, feldspar and quartz.*
- Arch Lake granite, *with white to pink subhedral elongate feldspar megacrysts from one-half to one inch in size subparallel aligned, in a medium-grained, streaky to foliated matrix of blue quartz, biotite and feldspar.*
- Leucocratic granite, *with pink to red anhedral feldspars, equigranular; massive, locally foliated; including minor microgranite and pegmatite.*
- Granitic material, *biotite- and muscovite-granite and pegmatite, some leucocratic phases, intermixed with host rock; typically massive, generally equigranular.*
- Grey hornblende granite, *buff to grey, with dark specks of hornblende and local feldspar porphyroclasts from one-quarter to one-half inch in size in a quartz-feldspar matrix; texture fine to medium grained, massive to slightly foliated. Locally mixed with and gradational to recrystallized porphyroclastic hornblende cataclasite.*
- Recrystallized porphyroclastic hornblende cataclasite, *light greyish-green, with hornblende porphyroclasts up to one-tenth inch in size, and local feldspar porphyroclasts from one-half to three-quarters inch in size, in a crushed, foliated, fine-grained matrix, some indistinct banding. Locally mixed with and transitional to minor grey hornblende granite.*
- Recrystallized mylonite K, *light colored, with minor white to pink feldspar porphyroclasts, one-quarter to three-quarters inch in size, constituting up to 2 per cent of rock, in a foliated, finely banded, aphanitic matrix; including recrystallized mylonites L, M, N, and O.*
- Recrystallized mylonite L, *light colored, with white to pink feldspar porphyroclasts, one-quarter to three-quarters inch in size, constituting about 5 per cent of rock, in a foliated, finely banded, aphanitic matrix; including recrystallized mylonites K, M, N, and O.*
- Recrystallized mylonite P, *dark colored, with white to grey anhedral porphyroclasts and euhedral feldspar porphyroblasts, one-half to two inches in size, foliated, locally gneissose, in an aphanitic locally medium-grained, matrix; including minor aplite and pegmatite.*

**Note: Rock units are not arranged chronologically.*

Geological boundary (defined, approximate)
Schistosity, gneissosity, foliation (defined, dip known, dip vertical; assumed) 85
Extreme contortion (structural trend)
Tight folds (structural trend)
Fault (defined, approximate, assumed)
Shear
Breccia
Mylonite
Joint (dip known, vertical, unknown) 65
Sample location 114
Glacial striae (direction of ice movement known)
Mineral occurrence (molybdenite) X mol
Radioactivity ●
Garnet G
Chlorite, abundant C
Epidote, abundant E
Hornblende H
Graphite R
Magnetite M

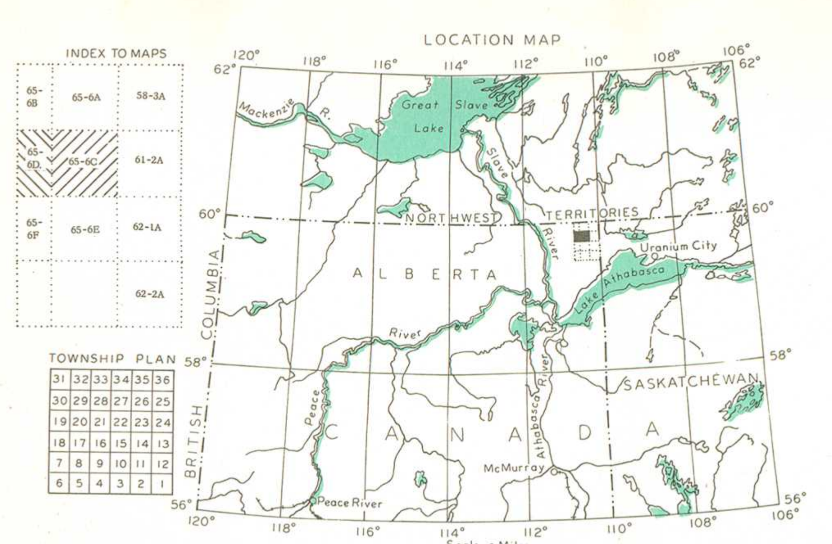
Geology by John D. Godfrey, 1958, 1960, 1961; Ashton Lake District.
Geology by John D. Godfrey and Roy Y. Watanabe, 1961; Charles Lake Central District.

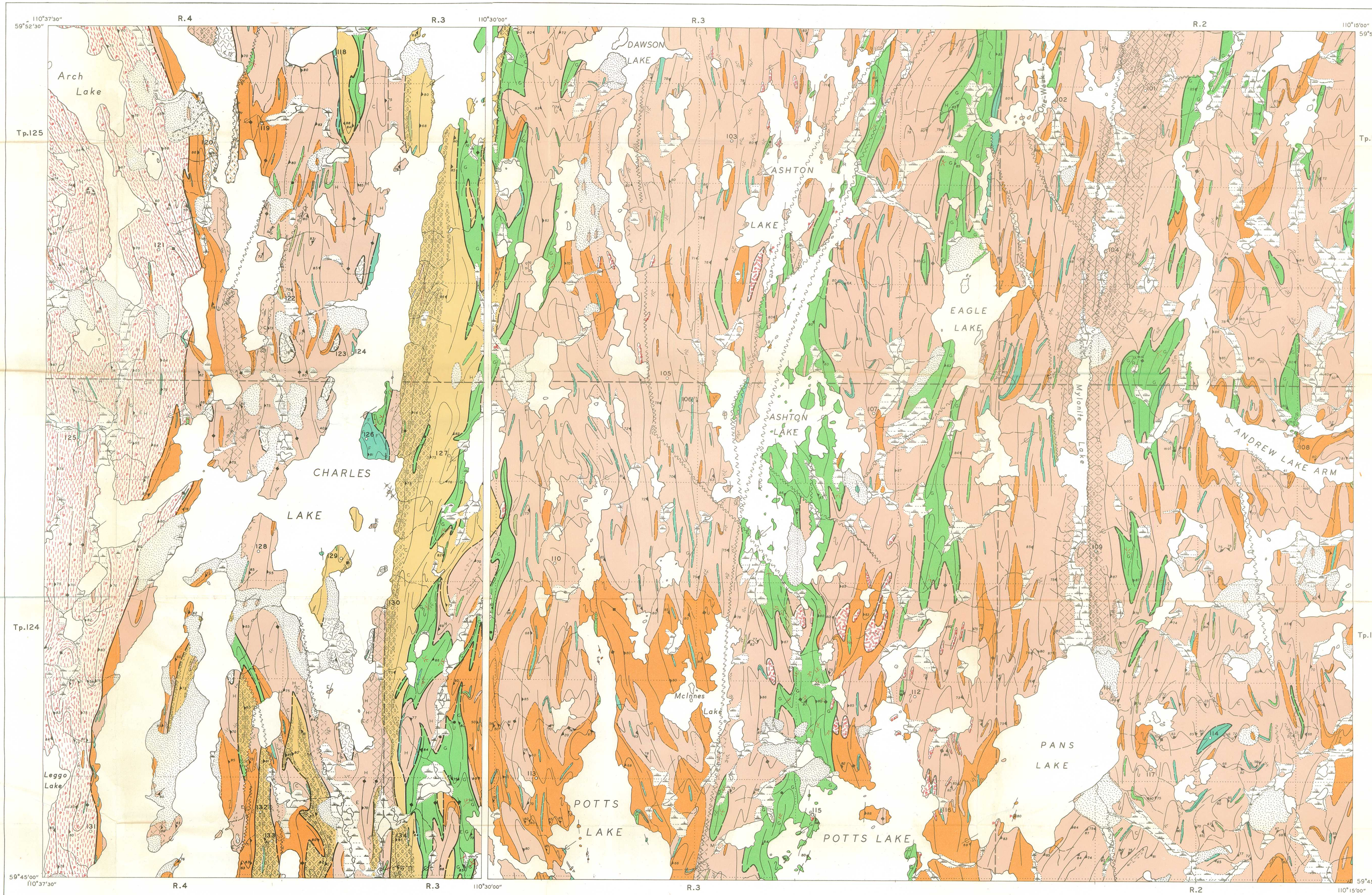
Drainage (permanent, intermittent)
Muskeg
Sand-covered area
Sand- and boulder-covered area
Township boundary
Section line

Base maps compiled from planimetric sheets 74 M/16 SW. and 74 M/15 SE., published by Government of Alberta, Department of Lands and Forests, Edmonton.

Air photographs covering this area are obtainable from the Technical Division, Department of Lands and Forests, Government of Alberta, Edmonton, and the National Air Photographic Library, Topographical Survey, Ottawa.

Approximate magnetic declination 25° 40′ East in 1965, decreasing 6′ annually.





Maps to Accompany Preliminary Report 65-6

Published 1966

MAP 65-6D
CHARLES LAKE, CENTRAL
WEST OF FOURTH MERIDIAN

Scale: Two Inches to One Mile 1/31,680

MAP 65-6C
ASHTON LAKE DISTRICT
WEST OF FOURTH MERIDIAN

Scale: Two Inches to One Mile 1/31,680

RESEARCH COUNCIL OF ALBERTA

LEGEND

PRECAMBRIAN*

- Quartzite, *pure and impure, white, grey, green, pink and blue; including biotite sericite schist, minor milky quartz pods, feldspar augen, granite and pegmatite lenses, ferruginous and garnetiferous zones.*
- Biotite schist, *with abundant quartz, some sericite; including phyllite, phyllonite, quartzite, minor milky quartz pods, feldspar augen, granite and pegmatite lenses, ferruginous and garnetiferous zones.*
- Biotite granite F, *with white to grey subhedral to euhedral feldspar megacrysts, one to four inches in size, averaging two inches, in a coarse-grained, massive matrix of quartz, feldspar and biotite; including minor aplite and pegmatite.*
- Biotite granite gneiss, *with some hornblende, chlorite, megacrystic feldspar phases; including minor massive to foliated granite - some megacrystic, granodiorite, alaskite, lenses of biotite, quartzite, amphibolite; garnetiferous zones.*
- Hornblende granite gneiss, *with some biotite, chlorite, megacrystic feldspar phases; including minor massive to foliated granite - some megacrystic, granodiorite and amphibolite.*
- Amphibolite, *including biotite amphibolite, hornblendite; mainly massive, little banded.*
- Biotite granite, *with white to pink to red feldspars, minor sericite; including leucocratic phases; massive. Phases with abundant feldspar megacrysts (p), one-quarter to one-third inch in size.*
- Biotite 'q' granite, *with white to pink to red abundant feldspar megacrysts one-quarter inch in size, minor sericite; in medium-grained, massive to foliated matrix of biotite, feldspar and quartz.*
- Microsyenite, *with abundant red to pink feldspars, red feldspar megacrysts typically one-tenth inch, few up to one-quarter inch in size; in a fine-grained, mafic matrix, locally well foliated.*
- Arch Lake granite, *with white to pink subhedral elongate feldspar megacrysts from one-half to one inch in size subparallel aligned, in a medium-grained, streaky to foliated matrix of blue quartz, biotite and feldspar.*
- Leucocratic granite, *with pink to red anhedral feldspars, equigranular; massive, locally foliated; including minor microgranite and pegmatite.*
- Granitic material, *biotite- and muscovite-granite and pegmatite, some leucocratic phases, intermixed with host rock; typically massive, generally equigranular.*
- Grey hornblende granite, *buff to grey, with dark specks of hornblende and local feldspar porphyroclasts from one-quarter to one-half inch in size in a quartz-feldspar matrix; texture fine to medium grained, massive to slightly foliated. Locally mixed with and gradational to recrystallized porphyroclastic hornblende cataclasite.*
- Recrystallized porphyroclastic hornblende cataclasite, *light greyish-green, with hornblende porphyroclasts up to one-tenth inch in size, and local feldspar porphyroclasts from one-half to three-quarters inch in size, in a crushed, foliated, fine-grained matrix, some indistinct banding. Locally mixed with and transitional to minor grey hornblende granite.*
- Recrystallized mylonite K, *light colored, with minor white to pink feldspar porphyroclasts, one-quarter to three-quarters inch in size, constituting up to 2 per cent of rock, in a foliated, finely banded, aphanitic matrix; including recrystallized mylonites L, M, N, and O.*
- Recrystallized mylonite L, *light colored, with white to pink feldspar porphyroclasts, one-quarter to three-quarters inch in size, constituting about 5 per cent of rock, in a foliated, finely banded, aphanitic matrix; including recrystallized mylonites K, M, N, and O.*
- Recrystallized mylonite M, *dark colored, with white to pink feldspar porphyroclasts, one-quarter to three-quarters inch in size, constituting about 5 per cent of rock, in a foliated, finely banded, aphanitic matrix; including recrystallized mylonites K, L, N, and O.*
- Recrystallized mylonite N, *green to black, schistose to slaty, with biotite, sericite, and some chlorite; feldspar and minor quartz porphyroclasts in a foliated, finely banded, aphanitic matrix; including minor recrystallized mylonite O.*
- Recrystallized mylonite O, *green to black, siliceous, with biotite, chlorite, sericite, and minor feldspar porphyroclasts in a banded, aphanitic matrix; massive to foliated; including minor recrystallized mylonite N.*
- Recrystallized mylonite P, *dark colored, with white to grey anhedral porphyroclasts and euhedral feldspar porphyroblasts, one-half to two inches in size, foliated, locally gneissose, in an aphanitic locally medium-grained, matrix; including minor aplite and pegmatite.*

*Note: Rock units are not arranged chronologically.

Geological boundary (defined, approximate)
Schistosity, gneissosity, foliation (defined, dip known, dip vertical; assumed)
Lineation
Extreme contortion (structural trend)
Tight folds (structural trend)
Fault (defined, approximate, assumed)
Shear
Breccia
Mylonite
Gossan
Quartz vein
Joint
Sample location 143
Glacial striae (direction of ice movement known)
Mineral occurrence (copper) X Cu
Mineral occurrence (arsenopyrite) X asp
Molybdenite X mol
Radioactivity
Garnet G
Chlorite, abundant C
Epidote, abundant E
Hornblende H
Graphite R

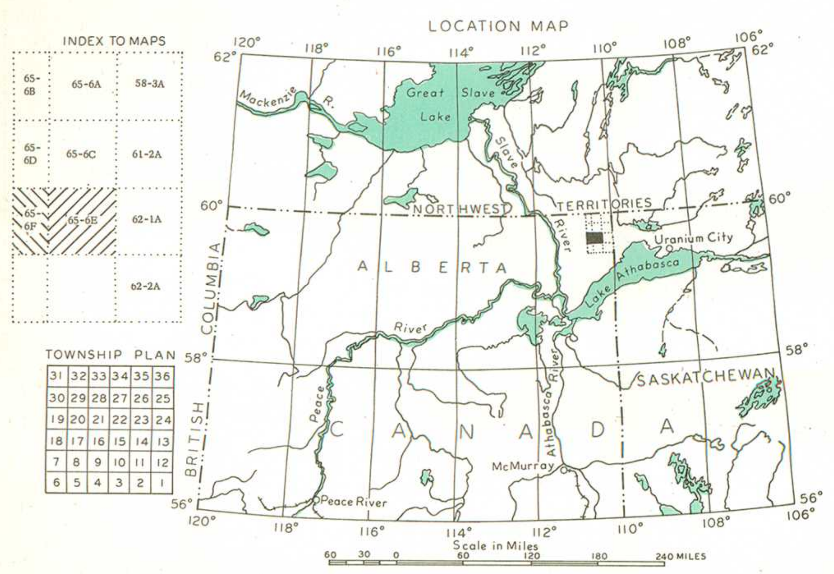
Geology by John D. Godfrey, 1961, 1963, Potts Lake District.
Geology by John D. Godfrey and Roy Y. Watanabe, 1961, 1963, Charles Lake South District.

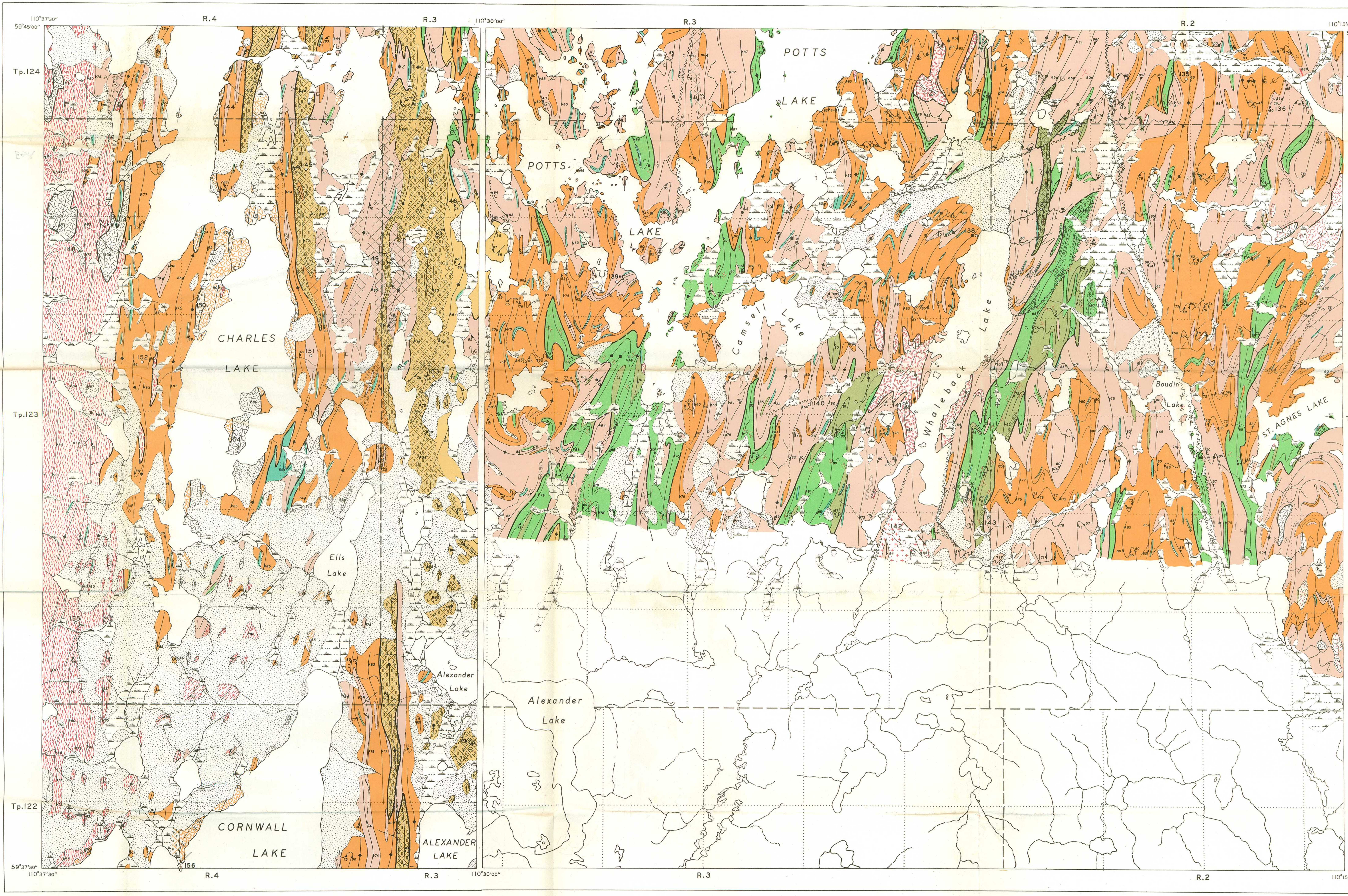
Drainage (permanent, intermittent)
Muskeg
Sand-covered area
Sand- and boulder-covered area
Township boundary
Section line

Base maps compiled from planimetric sheets 74 M/9 NW. and 74 M/10 NE., published by Government of Alberta, Department of Lands and Forests, Edmonton.

Air photographs covering this area are obtainable from the Technical Division, Department of Lands and Forests, Government of Alberta, Edmonton, and the National Air Photographic Library, Topographical Survey, Ottawa.

Approximate magnetic declination 25° 40′ East in 1965, decreasing 6′ annually.





Maps to Accompany Preliminary Report 65-6

Published 1966

MAP 65-6F
CHARLES LAKE, SOUTH DISTRICT
WEST OF FOURTH MERIDIAN

Scale: Two Inches to One Mile $\frac{1}{31,680}$

MAP 65-6E
POTTS LAKE DISTRICT
WEST OF FOURTH MERIDIAN

Scale: Two Inches to One Mile $\frac{1}{31,680}$

RESEARCH COUNCIL OF ALBERTA

LEGEND

PRECAMBRIAN*

Quartzite, *pure and impure, white, grey, green, pink and blue; including biotite sericite schist, minor milky quartz pods, feldspar augen, granite and pegmatite lenses, ferruginous and garnetiferous zones.*

Biotite schist, *with abundant quartz, some sericite; including phyllite, phyllonite, quartzite, minor milky quartz pods, feldspar augen, granite and pegmatite lenses, ferruginous and garnetiferous zones.*

Biotite granite F, *with white to grey subhedral to euhedral feldspar megacrysts, one to four inches in size, averaging two inches, in a coarse-grained, massive matrix of quartz, feldspar and biotite; including minor aplite and pegmatite.*

Biotite granite gneiss, *with some hornblende, chlorite, megacrystic feldspar phases; including minor massive to foliated granite - some megacrystic, granodiorite, alaskite, lenses of biotite, quartzite, amphibolite; garnetiferous zones.*

Hornblende granite gneiss, *with some biotite, chlorite, megacrystic feldspar phases; including minor massive to foliated granite - some megacrystic, granodiorite and amphibolite.*

Amphibolite, *including biotite amphibolite, hornblendite; mainly massive, little banded.*

Biotite 'q' granite, *with white to pink to red abundant feldspar megacrysts one-quarter inch in size, minor sericite; in medium-grained, massive to foliated matrix of biotite, feldspar and quartz.*

Raisin granite, *mottled, with abundant white to red, rounded, feldspars one-tenth to one-quarter inch in size, in a sheared green chloritic foliated matrix with lenticular quartz and mica; rare white to pink feldspar augen up to one-half inch in size.*

Arch Lake granite, *with white to pink subhedral elongate feldspar megacrysts from one-half to one inch in size subparallel aligned, in a medium-grained, streaky to foliated matrix of blue quartz, biotite and feldspar.*

Leucocratic granite, *with pink to red anhedral feldspars, equigranular; massive, locally foliated; including minor microgranite and pegmatite.*

Granitic material, *biotite- and muscovite-granite and pegmatite, some leucocratic phases, intermixed with host rock; typically massive, generally equigranular.*

Foliated hornblende granite, *pink to grey, with pink feldspar, quartz, and streaky patches of hornblende aggregates; texture equigranular, medium- to coarse-grained, typically foliated.*

Recrystallized porphyroclastic hornblende cataclasite, *light greyish-green, with hornblende porphyroclasts up to one-tenth inch in size, and local feldspar porphyroclasts from one-half to three-quarters inch in size in a crushed, foliated, fine-grained matrix, some indistinct banding. Locally mixed with and transitional to minor grey hornblende granite,* (see legend map 65-6F).

Recrystallized mylonite K, *light colored, with minor white to pink feldspar porphyroclasts, one-quarter to three-quarters inch in size, constituting up to 2 per cent of rock, in a foliated, finely banded, aphanitic matrix; including recrystallized mylonites L, M, N, and O.*

Recrystallized mylonite L, *light colored, with white to pink feldspar porphyroclasts, one-quarter to three-quarters inch in size, constituting about 5 per cent of rock, in a foliated, finely banded, aphanitic matrix; including recrystallized mylonites K, M, N, and O.*

Recrystallized mylonite M, *dark colored, with white to pink feldspar porphyroclasts, one-quarter to three-quarters inch in size, constituting about 5 per cent of rock, in a foliated, finely banded, aphanitic matrix; including recrystallized mylonites K, L, N, and O.*

Recrystallized mylonite N, *green to black, schistose to slaty, with biotite, sericite, and some chlorite; feldspar and minor quartz porphyroclasts in a foliated, finely banded, aphanitic matrix; including minor recrystallized mylonite O.*

Recrystallized mylonite O, *green to black, siliceous, with biotite, chlorite, sericite, and minor feldspar porphyroclasts in a banded, aphanitic matrix; massive to foliated; including minor recrystallized mylonite N.*

Recrystallized mylonite P, *dark colored, with white to grey anhedral porphyroclasts and euhedral feldspar porphyroblasts, one-half to two inches in size, foliated, locally gneissose, in an aphanitic locally medium-grained, matrix; including minor aplite and pegmatite.*

Basic dyke, *massive, locally sheared with chlorite.*

**Note: Rock units are not arranged chronologically.*

Geological boundary (defined, approximate, assumed)
Schistosity, gneissosity, foliation (defined, dip known, dip vertical; assumed)
Lineation (plunge known)
Extreme contortion (structural trend)
Tight folds (structural trend)
Fault (defined, approximate, assumed)
Shear
Breccia
Mylonite
Quartz vein
Joint (dip known, unkown)
Sample location — 96 ○
Glacial striae (direction of ice movement known)
Radioactivity — ●
Garnet — G
Chlorite, abundant — C
Epidote, abundant — E
Hornblende — H
Graphite — R
Magnetite — M

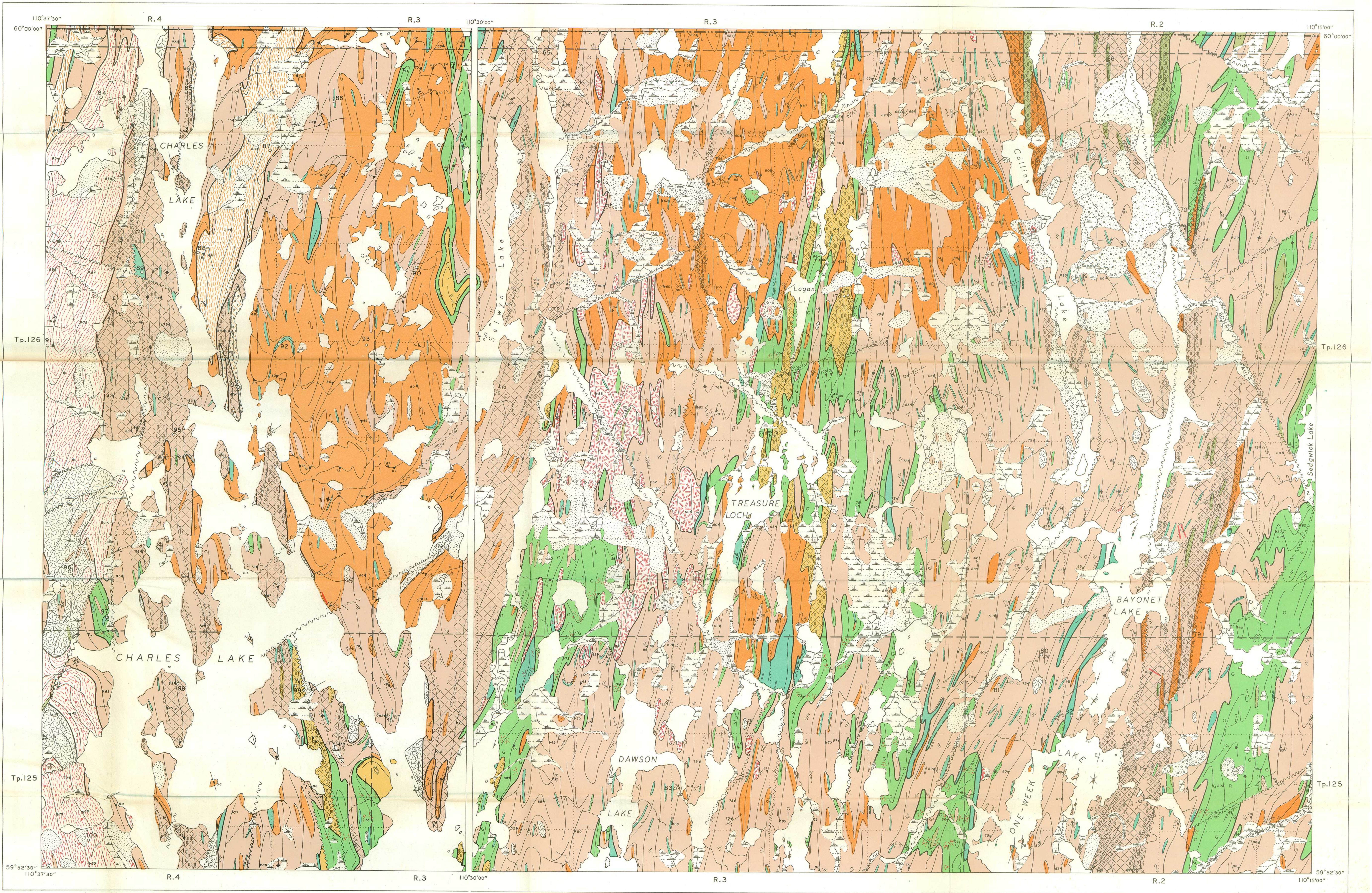
Geology by John D. Godfrey, 1959, 1960; Bayonet Lake District.
Geology by John D. Godfrey, and Roy Y. Watanabe, 1960, 1961; Charles Lake North District.

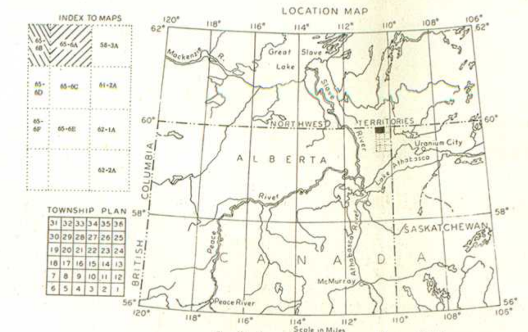
Drainage (permanent, intermittent)
Muskeg
Sand-covered area
Sand- and boulder-covered area
Provincial boundary
Township boundary
Section line
Cabin

Base maps compiled from planimetric sheets 74 $\frac{M}{16}$ NW. and 74 $\frac{M}{15}$ NE. published by Government of Alberta, Department of Lands and Forests, Edmonton.

Air photographs covering this area are obtainable from the Technical Division, Department of Lands and Forests, Government of Alberta, Edmonton, and the National Air Photographic Library, Topographical Survey, Ottawa.

Approximate magnetic declination 25° 40′ East in 1965, decreasing 6′ annually.





MAP 65-6B

CHARLES LAKE, NORTH DISTRICT

WEST OF FOURTH MERIDIAN

Scale: Two Inches to One Mile = $\frac{1}{31,680}$

MAP 65-6A

BAYONET LAKE DISTRICT

WEST OF FOURTH MERIDIAN

Scale: Two Inches to One Mile = $\frac{1}{31,680}$

Maps to Accompany Preliminary Report 65-6

Published 1966