GEOLOGY OF THE SOUTHWESTERN MARGIN OF THE CENTRAL MINERAL BELT

by
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INTRODUCTION

Mapping at a 1:50,000 scale of the rocks bordering the southwestern part of the Central Mineral Belt was begun in 1978 and covered the southeast part of N.T.S. sheet 13L/2 and parts of sheets 13L/1 and 13L/8. During 1979, mapping was extended eastwards to cover all of N.T.S. sheets 13L/1 and 13K/4, an area bounded by longitudes 61°30'W to 62°30'W and latitudes 54°00'N to 54°15'N.

Rocks of the Seal Lake Group have been mapped at reconnaissance scale (Fahrig, 1959; Brummer and Mann, 1961; Roscoe and Emslie, 1973) and at a more detailed scale by Frobisher Ltd., Brinex and Cominco. Marten (1975) has worked locally around Letitia Lake. The gneiss terrain south of Red Wine Lake is included in the regional maps of Geiger (1961) and Stevenson (1969).

Rocks south of the Red Wine River have been mapped in more detail by Emslie *et al.* (1978). The most recent comprehensive study of the Red Wine alkaline complex has been done by Curtis and Currie (in press).

GENERAL GEOLOGY

The central part of the map area is underlain by a basement terrain consisting of Aphebian or Archean Wapustan gneiss intruded by late Aphebian or early Helikian granitic and dioritic rocks of the North Pole Brook complex. In the southern part of the area, this basement terrain is in fault contact with the Disappointment and Hope gneisses which represent for the most part probable older basement reworked during the Grenville Orogeny.

Rocks of Paleohelikian age in the area include the Letitia Lake and Arc Lake Groups, Red Wine alkaline complex and several bodies of gabbro and diabase. The Letitia Lake Group consists principally of felsic volcanic rocks and porphyries which both overlie and intrude basement granite. The Letitia Lake Group is intruded by rocks of the Arc Lake group which consist of alkali syenite, alkali granite and associated porphyries. Metamorphosed agpaitic plutonic rocks of the Red Wine complex are minor in the area and occur in association with Arc Lake group syenites. The gabbro and diabase bodies intrude Disappointment gneiss, (where they have been metamorphosed to amphibolite) and granite of the North Pole Brook complex.

Conglomerate, quartzite, siltstone and argillite interbedded with mafic flows and gabbro sills comprise the lower part of the Neohelikian Seal Lake Group. These rocks rest unconformably upon Letitia Lake Group rocks and basement granite in the northern part of the area.

The entire map area lies within the Grenville Front tectonic zone. It is cut by mainly east-west trending faults of Grenvillian age and exhibits Grenvillian metamorphic effects and fabric overprints.

Hope gneiss (Unit 1)

Rocks of the Hope gneiss are confined to the Red Wine mountains

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LEGEND

NEOHELIKIAN

Seal Lake Group

9a Bessie Lake Formation: Amygdaloidal to massive green basalt flows interbedded with feldspathic to clean, gritty coarse white quartzite (base of unit characterized by porphyry cobble conglomerate and hematite-magnetite shale and wacke derived from unit 6).

9b Wuchusk Lake Formation: Gabbro sills, diabase dikes and sills, siltstone, shale, argillite and interbedded chert.

PALEOHELIKIAN

8 Red Wine alkaline complex: 8a, Green pyroxenic-aenigmatitic gneiss; 8b, blue-black omphacitic-nephelinic gneiss; 8c, leucocratic medium grained arfvedsonite-feldspar gneiss with minor nepheline, pyroxene and eudialyte; 8d, malignite and nepheline syenite.

7 Arc Lake group: 7a, Dark to pink green mafic alkali syenite; 7b, gray, intermediate alkali, quartz syenite; 7c, felsic alkali quartz syenite and alkali quartz-feldspar porphyry; 7d, alkali granite.

6 Letitia Lake Group: 6a, Massive intermediate to felsic feldspar porphyry and quartz-feldspar porphyry; 6b, felsic volcanics including porphyritic rhyolite, banded rhyolite, crystal tuff and ignimbritic tuff; 6c, regolith of oxidized felsic volcanics, oxidized and hematized quartz-feldspar porphyry, magnetitic grit, muscovite-sericite schist.

5 Gabbro, diabase.

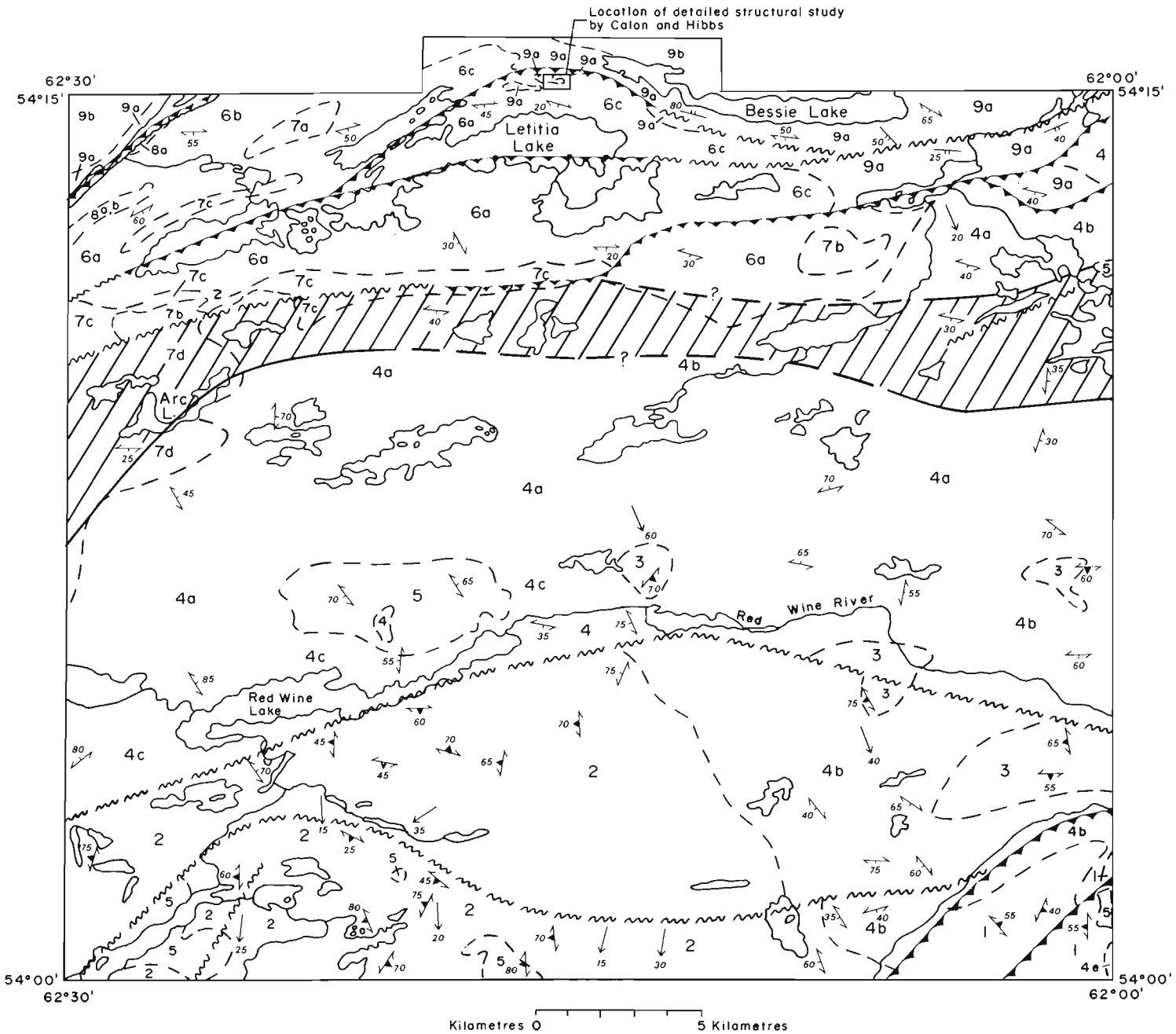
4 North Pole Brook complex: 4a, Equigranular hornblende-biotite granite; 4b, porphyritic hornblende-biotite granite; 4c, equigranular biotite granite; 4d, porphyritic biotite granite; 4e, monzodiorite, quartz monzonite.

APHEBIAN-ARCHEAN

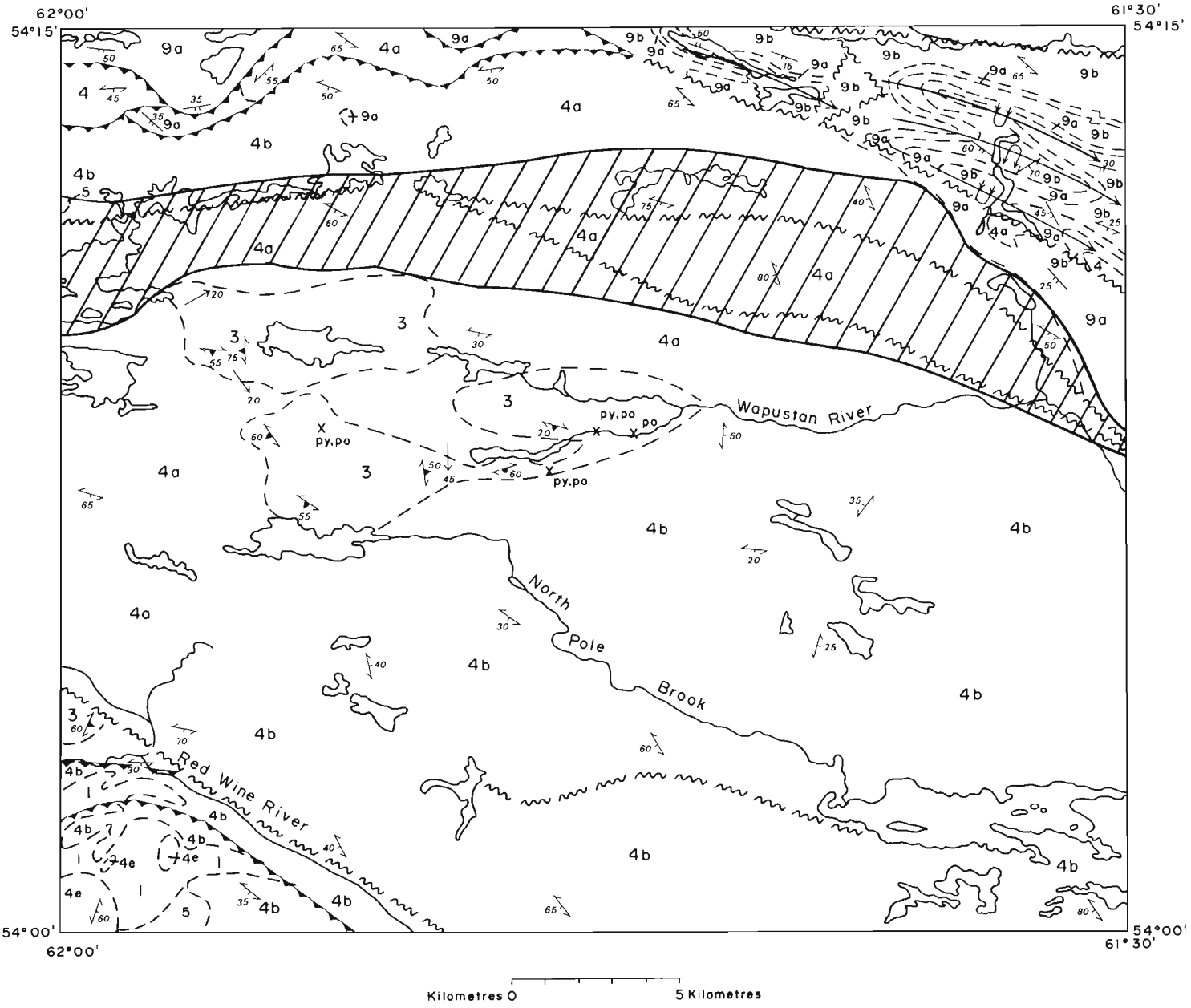
3 Wapustan Gneiss: Siliceous, quartz-feldspar-muscovite-biotite, minor sillimanite paragneiss cut by mafic dikes, now metamorphosed and boudinaged into massive to banded amphibolite pods. Gneiss is highly contorted and commonly contains disseminated pyrite and pyrrhotite mineralization. Gneiss also contains large bodies of massive to banded greenstone composed of hornblende, quartz and chlorite.

2 Disappointment Gneiss: Granodioritic hornblende-biotite-muscovite-sillimanite-feldspar-quartz gneiss cut by mafic dikes, now boudinaged and metamorphosed into massive to banded amphibolite pods.

1 Hope Gneiss: Hypersthene-biotite-garnet-sillimanite-feldspar-quartz gneiss.



LETITIA LAKE 13L/1



DOROTHY LAKE 13K/4

massif in the south central part of the map area. Defined by Emslie *et al.* (1978), Hope gneiss outcrops extensively in his Ptarmigan Complex but underlies only a small part of the map area of this study. The gneiss weathers buff-white to gray, is primarily leucocratic with rare mafic zones and layers, commonly foliated and locally, on a small scale, layered (Emslie *et al.* 1978). It contains quartz, feldspar, hypersthene, biotite, garnet and sillimanite (Emslie *et al.* 1978) indicating that it has undergone at least one granulite grade metamorphic event which is presumed to be of Grenville age.

No absolute age dates are yet available on the Hope gneiss but Emslie *et al.* (1978) consider that it is probably not older than Aphebian. Mapping during this study suggests the gneiss may be at least in part as old as Archean. This conclusion is supported by a preliminary Rb-Sr date of 2200 Ma obtained on biotite from the Wilson Lake granulite (J. Gittens, personal communication, 1979) which may be correlative with Hope gneiss in the extreme southern part of the Ptarmigan Complex.

Disappointment gneiss (Unit 2)

Disappointment gneiss outcrops south of Red Wine Lake in the southwest corner of the map area. It is commonly pink on weathered and fresh surfaces, less commonly gray or buff-white and consists of fine grained (0.5 mm to 2.0 mm) quartz, feldspar bands up to 2.0 cm wide separated by biotite, muscovite and sillimanite bands of comparable width. In addition, rare garnet is also present. Although coarse grained and of granitic composition in places, it is generally a monotonously uniform banded granodioritic gneiss, cut by deformed aplite and pegmatite dikes.

Within the gneiss, bodies (up to 2.0 km diameter), pods and strings of aligned pods (up to 2.0 m long) of massive to banded amphibolite are ubiquitous. Pods represent metamorphosed, boudinaged diabase dikes and consist of hornblende, biotite, plagioclase, magnetite and minor pyrite. The maximum metamorphic grade of these rocks is amphibolite and is probably due to a Grenvillian event.

The age of a large body of gabbro-diabase, which intrudes basement granite north of Red Wine Lake, must be greater than or equal to 1278±92 Ma, the Rb-Sr date on the Seal lake Group (Wanless and Loveridge, 1977). Several large intrusive bodies of amphibolite within the gneiss can be correlated with the gabbro-diabase and therefore probably have an age greater than or equal to 1278 Ma. The gneiss exhibits at least two periods of deformation, the amphibolites only one, whereas the gabbro-diabase is only mildly deformed and unmetamorphosed. This suggests that the fabric in the amphibolite and probably F_2 in the gneiss is Grenville in age. F_1 is older, and possibly of Hudsonian age. Thus, based on this reasoning, the Disappointment gneiss is probably Aphebian in age.

Wapustan gneiss (Unit 3)

Isolated "rafts" (ranging in size from 2.0 km by 2.0 km to 12.0 km by 4.0 km) of metamorphosed, deformed siliceous rocks, completely surrounded and intruded by little deformed granite of the North Pole Brook complex comprise the Wapustan gneiss. Along with the granite, this gneiss constitutes basement to the Seal Lake Group. Commonly finely banded, mesocratic to leucocratic, the gneiss weathers gray to buff white and consists of quartz, plagioclase, K-feldspar, muscovite, minor biotite and locally, sillimanite, garnet, hornblende, pyrite and pyrrhotite. The predominance of quartz and muscovite as mineral constituents suggests that this unit is mainly paragneiss.

Bodies of massive to banded greenstone (presumably of volcanic origin) up to 1.5 km long, consisting of hornblende, quartz, feldspar and chlorite are present within the gneiss, as well as boudinaged dikes and pods (up to 4.0 m long) of massive to banded amphibolite derived from diabase. Deformed pegmatite and aplite dikes are also common.

The presence of hornblende, biotite, sillimanite and garnet indicates the gneiss has been metamorphosed to amphibolite grade. The granite which intrudes the gneiss is itself intruded by Letitia Lake porphyry, which has a tentative relative age of 1400-1500 Ma. (Brummer and Mann, 1961). Therefore, Wapustan gneiss is older than Helikian. The metamorphism is Hudsonian or earlier in age since the granite exhibits at most a moderate Grenvillian metamorphic-tectonic fabric and in many places is undeformed. In addition to these relationships the polydeformed nature of the gneiss suggests that it is of Aphebian or possibly Archean age.

North Pole Brook complex (Unit 4)

Rocks of this complex form an arcuate band 15 to 25 km wide from east to west across the central part of the map area. The complex consists of plutonic rocks which have been divided on the basis of mineralogy and texture into five subunits. The composition and relative content of hornblende and biotite is highly variable so that in the field, contacts between the various subunits appear to be gradational. Equigranular hornblende, biotite granite (4a) is typically buff-white on weathered surface and gray on fresh surface with a grain size of 2.0 to 5.0 mm. It consists of quartz, orthoclase, plagioclase and biotite with lesser amounts of hornblende and magnetite. Locally, hornblende is the dominant mafic mineral and the composition approaches that of diorite.

Porphyritic hornblende, biotite granite (4b) is identical in mineralogy to the equigranular granite but contains gray, pink or purple phenocrysts (from 1.0 to 5.0 cm long) of orthoclase in a groundmass of average grain size equal to 0.5 cm. Both equigranular and porphyritic granite in places approach granodiorite in composition and commonly contain angular to subangular dioritic inclusions as large as 0.2 m.

Equigranular biotite granite and minor biotite diorite (4c) consist of quartz, orthoclase, plagioclase, biotite, magnetite and rare muscovite. A peculiar texture of randomly oriented feathery biotite crystals somewhat like "quench" texture, is present within this subunit west of Red Wine Lake. Also in this area biotite granite contains large numbers of angular and subangular xenoliths (up to 1.0 m in size) of mafic gneiss, greenstone, diorite and porphyritic mafic rock. Porphyritic biotite granite (4d) is similar to subunit 4b except that biotite is the dominant ferromagnesian mineral. Medium grained monzodiorite and quartz monzonite (4e) were mapped by Emslie *et al.* (1978) and are confined to the Red Wine mountains in the south central part of the area.

Although there is a lack of suitable metamorphic index minerals, the granites within the complex have been metamorphosed during the Grenvillian Orogeny probably to at least greenschist facies. The structural-stratigraphic position of the complex suggests that it is late Aphebian or early Helikian in age.

Gabbro-diabase (Unit 5)

Gabbro, diabase and minor pyroxenite are present within an elliptical east-west trending body north of Red Wine Lake and as smaller bodies and dikes throughout the map area. They consist of plagioclase, pyroxene,

hornblende, biotite, magnetite and minor pyrite. The texture varies from gabbroic to diabasic and accumulations of pyroxene form local pyroxenite zones.

Bodies north of Red Wine Lake intrude granite of the North Pole Brook complex suggesting they are early Helikian in age, possibly associated with the Elsonian Harp Lake anorthosite. It has also been suggested (Bailey, personal communication, 1979) that these gabbro bodies may be correlative with the Michael Gabbro south of the Makkovik area to the east.

Letitia Lake Group (Unit 6)

Rocks of this unit occur in a narrow arcuate band 5.0 km wide in the northwest part of the map area. Massive, intermediate to felsic intrusive quartz-feldspar porphyry (6a) lies at the base. This subunit contains buff to white K-feldspar phenocrysts and oval quartz eyes in a green to white, fine grained siliceous groundmass. Also included within this subunit (although it may be an older separate unit) is a minor porphyritic andesite flow. It consists of buff to green, euhedral to subhedral and broken K-feldspar phenocrysts up to 3.0 cm long and oval blue quartz eyes up to 4.0 mm in a green biotite, aegirine groundmass. Quartz filled amygdules and reaction rims around feldspar phenocrysts are common as is zoning in the feldspar phenocrysts. Felsic porphyry is in intrusuve contact with granite of the North Pole Brook complex.

Porphyritic rhyolite, flow-banded rhyolite and tuffaceous equivalents, including ignimbrite, constitute subunit 6b and lie on the flanks and over felsic porphyry of subunit 6a. These rocks contain euhedral and broken feldspar phenocrysts averaging 4.0 mm but up to 1.5 cm in a salmon pink, siliceous aphanitic groundmass and represent extrusive equivalents of the rocks of subunit 6a.

Subunit 6c includes parts of 6a and 6b that have undergone subaerial weathering during late Paleohelikian or early Neohelikian time. At that time, oxidation of porphyry and locally rhyolite along fracture planes resulted in the development of hematite and magnetite in discrete patches of various sizes.

Quartz-orthoclase-muscovite-chlorite-biotite-epidote assemblages indicate a metamorphic grade for these rocks of upper greenschist facies. The age of the metamorphism is Grenville. The Letitia Lake Group has been tentatively correlated with Croteau (now Bruce River Group) volcanics to the east (Brummer and Mann, 1961) which have been dated by Wanless and Loveridge (1972) at 1474±42 Ma by Rb-Sr method. More recent data (Thomas, in press) indicate that Letitia Lake Group rocks have an average composition of comendite and are virtually identical in chemistry to alkali granite of the Arc Lake group. Based on this information it is now thought that the Letitia Lake Group is geochemically correlative with and consists mainly of extrusive equivalents of the Arc Lake group. These facts still may not invalidate the time-stratigraphic correlation with the Bruce River Group.

Arc Lake group (Unit 7)

Rocks of this unit occur in the northwestern part of the map area south of Letitia Lake. Mafic alkali syenite (7a) occurs as oval bodies less than 4.0 km long usually elongate parallel to the foliation. Mafic syenite is dark green to pink-green, exhibits equigranular igneous or relict igneous texture and consists of aegirine, arfvedsonite-riebeckite, aenigmatite, plagioclase, orthoclase, microcline, minor astrophyllite and rarely minor quartz.

Intermediate alkali quartz syenite (7b) is distinguished from felsic

syenites and alkali granite by its fresh igneous texture, characteristic tan gray weathering and greater proportion of mafic minerals. The rock is equigranular with an average grain size of 0.75 cm and consists of aegirine, arfvedsonite-riebeckite, aenigmatite, astrophyllite, orthoclase and quartz.

Felsic alkali quartz syenite and alkali quartz-feldspar porphyry (7c) grade into, and are difficult to distinguish from, alkali granite. Rocks of this subunit are white to light gray on weathered surface, porphyritic or pegmatitic and consist of aegirine, arfvedsonite-riebeckite, rosenbuschite, albite, perthite, orthoclase, quartz and minor fluorite. Alkali granite (7d) is porphyroclastic, buff white to light gray on weathered surface and consists of aegirine, arvedsonite-riebeckite, aenigmatite, astrophyllite, rosenbuschite, albite, perthite, microcline, quartz and minor fluorite. The rock is thoroughly recrystallized and lies within an extensive cataclastic zone.

Secondary acicular red-brown biotite within rocks of the Arc Lake group is Grenville in age and indicates a probable metamorphic grade of upper greenschist or lower amphibolite. The age of the group is approximately equal to 1400-1500 Ma, the tentative age range of the Letitia Lake Group which is both intruded by and forms extrusive equivalents of the Arc Lake group rocks.

Red Wine alkaline complex (Unit 8)

Rocks of this unit are confined to two small zones of outcrop in the extreme northwest part of the map area. The terminology and description of these rocks is that of Curtis and Currie (in press) and represents a field subdivision of the units. "Green gneiss" (8a) occurs as stretched pods and bands peripheral to the agpaitic plutons. It consists of jadeitic pyroxene, arfvedsonite, nepheline, feldspar, eudialyte, biotite, apatite, pectolite and aenigmatite. "Blue-black gneiss" (8b) also occurs as stretched pods associated with "green gneiss" and consists of omphacitic pyroxene, arfvedsonite, albite, microcline, nepheline, pectolite, aenigmatite, eudialyte and fluorite. Nepheline syenite and malignite (nepheline syenite with colour index between 50 and 90) (8d) occur as large, irregular pods of coarse grained to pegmatitic rock with igneous or relict igneous textures. These rocks contain arfvedsonite, albite, microcline, nepheline, eudialyte, aenigmatite and aegirine. Based on pyroxene geothermometry, Curtis and Currie (in press) estimate the grade of metamorphism for rocks of the alkaline complex to be middle to upper amphibolite. Their Rb-Sr age of 1345±75 Ma indicates the rocks are of Helikian age and the metamorphism of Grenvillian age.

Seal Lake Group (Unit 9)

Rocks of the lower Seal Lake Group form the approximate northern boundary of the map area. The Bessie Lake Formation (9a) consists of 1280m (Brummer and Mann, 1961) of amygdaloidal to massive green basalt flows interbedded with coarse to medium grained clean to arkosic white quartzite. The base of the formation lies unconformably upon rocks of the Letitia Lake Group and the North Pole Brook complex and is characterized by locally occurring thin wedges of polymictic cobble conglomerate. The clasts consist of rounded, stretched cobbles (up to 0.25 m in length) of quartz porphyry, quartz feldspar porphyry, felsic volcanics and hornblende, biotite granite derived from the underlying rocks. The matrix consists of quartz and feldspar grains (averaging 0.5 mm in diameter), sericite, broken zircon crystals and detrital magnetite. Hematite-magnetite wacke and shale (in part metamorphosed to phyllitic schist) derived from underlying rock, marginally interfinger with, and form discontinuous lenses within, the conglomerate.

The Wuchusk Lake Formation (9b) conformably overlies the Bessie Lake Formation and consists of approximately 6096 m (Brummer and Mann, 1961) of gabbro sills, diabase sills and dikes, siltstone, shale, argillite and interbedded chert. The sills comprise the bulk of this subunit and form prominent ridges, whereas sedimentary rocks weather more readily and are found as minor outcrops in the valleys between ridges.

The typical mineral assemblage in rocks of the Seal Lake Group is albite, epidote, muscovite, quartz and chlorite. This, together with the extensive preservation of primary structures and textures, suggests a metamorphic grade of lower to middle greenschist. Rocks of the Seal Lake Group are Neohelikian in age; the metamorphism is Grenvillian as indicated by a 1278±92 Ma Rb-Sr date obtained by Wanless and Loveridge (1972) on the group.

STRUCTURE

The area can be divided into three blocks in thrust contact with one another. Internally, each block is structurally consistent, the southern and central blocks appearing to have acted as rigid masses during the latest phase of deformation. The southern block is defined by the Red Wine mountains massif consisting mainly of Hope gneiss with minor amounts of diorite, monzodiorite, gabbro and porphyritic granite. Within the block, gneiss is polydeformed and exhibits small scale folding (Emslie *et al.* 1978). Gneissic banding and foliation trends are irregular in orientation. Near the thrust faults which mark the northern boundary of the block, rocks become intensely sheared and the foliation becomes oriented parallel to these faults.

The central block contains Disappointment gneiss, Wapustan gneiss, North Pole Brook complex and parts of the Arc and Letitia Lake Groups which straddle the boundary with the northern block. Lineations and minor fold axes in gneisses in the southern part of the block exhibit predominantly shallow south plunging trends. This is particularly true of Disappointment gneiss where quartz-feldspar bands have been deformed into tight first period isoclinal folds, refolded by a second period of deformation into open to tight folds. First and second period fold axes commonly plunge to the south at angles less than 45°, colinear with the fabric in many of the amphibolite pods. Due to the tightness of this folding, the gneiss in places takes on a distinctive "rodded" appearance with quartz, feldspar segregations forming long narrow south plunging tubes and rods. These structures are associated with thrust faults between the south and central blocks. Gneissosity is more variable but also shows a southerly trend. Within the interior of the block, rocks are undeformed or weakly to moderately foliated commonly in a north-south direction. An exception here is Wapustan gneiss which is intensely deformed and exhibits complex small scale fold interference patterns. In places chevron folding or crenulations are present but most commonly the gneiss is contorted with gneissic banding having no regular trend. In the northern part of this block, rocks are intensely sheared and strongly foliated parallel to the thrust faults between the central and northern blocks.

The northern block consists mainly of rocks of the Seal and Letitia Lake Groups. These have been folded into tight, isoclinal F_1 folds, later refolded into open, to closed isoclinal regional F_2 folds. The F_2 folds are overturned to the north, have axial planes that dip to the south and axes and foliations parallel to the faults between the central and northern blocks. In the northeastern part of the map area, F_2 fold axes have a shallow east or southeast plunge. The unconformity between the Seal Lake Group and

underlying rocks of the basement terrain, has to a large degree, been obliterated by thrusting along the boundary between the central and northern blocks.

MINERALIZATION

Rare earth element, zirconium, thorium and uranium mineralization is associated with rocks of the Red Wine alkaline complex (Thomas, 1978a). Anomalous amounts of uranium are associated with rocks along the unconformity between Letitia Lake and Seal Lake Groups relative to the amount of uranium associated with other units in the area. Values of up to 15.5 ppm U were obtained from volcanics, regolith, magnetite grit and conglomerate in the paleoweathered upper part of the Letitia Lake Group, whereas values no higher than 6.3 ppm occur in unweathered rocks of the lower part of the Group. A more complete description of mineralization in the Letitia Lake Group and Red Wine alkaline complex has been given by Thomas (1978b).

Disseminated pyrite and pyrrhotite are present in association with amphibolite pods in Wapustan gneiss. These minerals occur along fractures within the pods and in muscovite rich zones along the contact between the pods and enclosing siliceous gneiss. A minor occurrence of zirconium bearing eudialyte was tentatively identified in intermediate alkali syenite southeast of Letitia Lake. The granite and gneiss terrain which underlies most of the map area is apparently barren of economic mineralization.

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