GEOLOGY OF SEVERAL ISLANDS OF THE WEST OF LANGHOVDE, EAST ANTARCTICA

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Abstract: Several islands of the west of Langhovde composed of seven main islands and their neighboring islets are situated at 69°08′–69°17′S latitude and 39°24′–39°36′E longitude.

The basement rocks exposed in this region are classified as follows: (1) metabasite, (2) pyroxene gneiss, (3) garnet-biotite gneiss, (4) garnet gneiss, (5) leucocratic biotite gneiss, (6) pegmatite. The gneissic rocks have been subjected to granulite facies metamorphism and are correlated with the Ongul Group of the Lützow-Holm Bay System.

Their folding axes in this region trend northwest like those in the Langhovde region.

1. Introduction

Several islands of the west of Langhovde are situated in the northeastern part of Lützow-Holm Bay, East Antarctica, and bounded by latitude 69°08′–69°17′S and longitude 39°24′–39°36′E (Fig. 1). They consist of Nabböya (island), Ungane (islands), Systerflesene (islands), Ytrehovdeholmen (island) and its neighboring islets, Indrehovdeholmen (island), Sigaren (islands) and Rumpa (island).

Geological maps on a scale of 1 : 5000 of the Ongul Islands, about 8 km north of this region, were already published on the four larger islands, East Ongul Island, West Ongul Island, Teöya and Ongulkalven, by YANAI *et al.* (1974a, b, 1975a, b), and a geological map on a scale of 1 : 25000 of Langhovde, east of this district, by ISHIKAWA *et al.* (1976). The geologic structure of the Lützow-Holm Bay region including the Ongul Islands and Langhovde, has been reported by ISHIKAWA (1976), YOSHIDA (1978) and MATSUMOTO *et al.* (1979, 1982), but the geology of several islands of the west of Langhovde, which are situated near the Ongul Islands and Langhovde, has not yet been described. Since detailed topographical maps of these islands are not available, field data are plotted on the conventional maps compiled from the aerial photographs taken by JARE-6 in 1962 on a scale of approximately 1 : 26000. In Nabböya no aerial photographs have been taken yet. Therefore, only a brief sketch map was

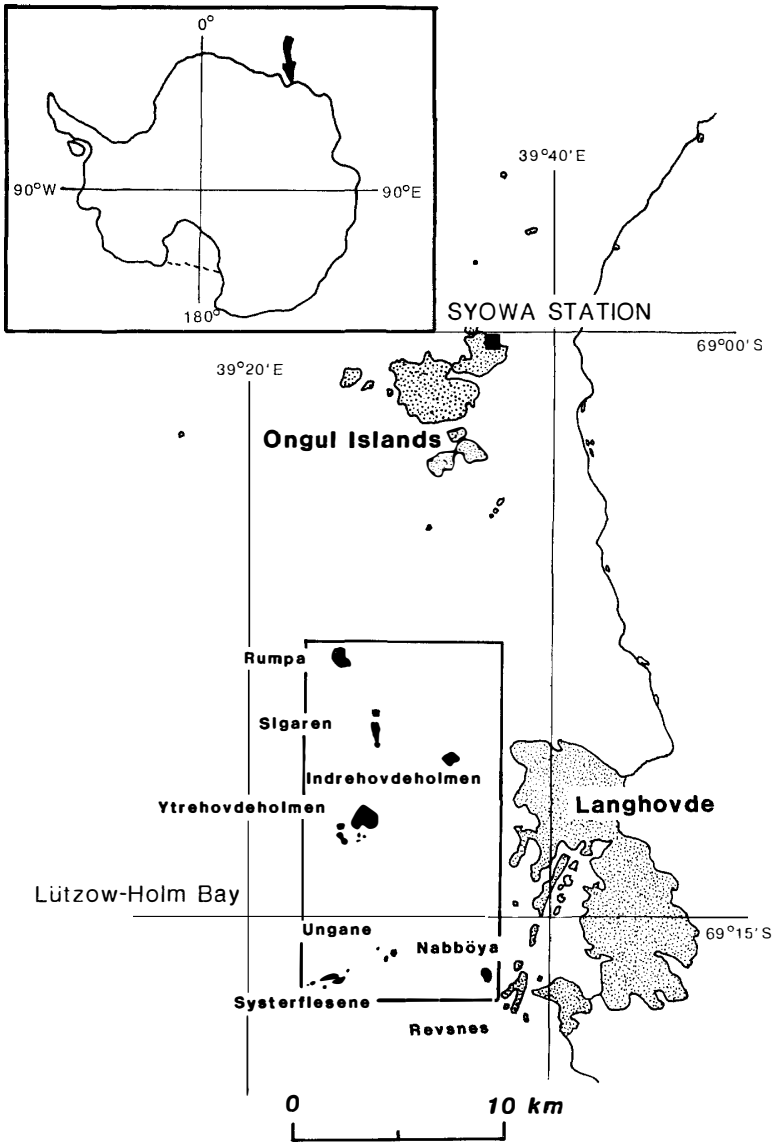

Fig. 1. Location map of several islands of the west of Langhovde.

used there.

This paper presents an outline of the geology and geologic structure of the basement rocks in several islands of the west of Langhovde.

2. Geology

Geologic maps of these islands are given in Figs. 2 to 8. Nomenclature of the metamorphic rocks in the region is generally based on KANÔ (1982).

2.1. Nabböya (Fig. 2)

Nabböya is situated about 800 m northwest of Revsnes (island), whose geology was already shown in the geological map of Langhovde on a scale of 1: 25000 (ISHIKAWA *et al.*, 1976). The top of the island is the highest of several islands of the west

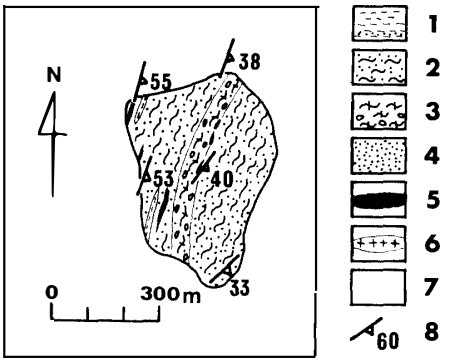

Fig. 2. Geologic map of Nabböya. 1. Pyroxene gneiss; dotted parts indicate garnet-bearing. 2. Garnet-biotite gneiss. 3. Leucocratic biotite gneiss; ellipsoidal parts indicate potash feldspar porphyroblast-bearing. 4. Garnet gneiss. 5. Metabasite. 6. Pegmatite. 7. Moraine. 8. Strike and dip of foliation. Legend is the same in Figs. 3–8.

of Langhoved, *i.e.*, 98 m above sea level. The island has steeper slopes in the northern and the western parts.

The island is composed mainly of garnet-biotite gneiss. Leucocratic biotite gneiss with potassium feldspar porphyroblasts occurs in the central part of this island. Thin layers and lenticular bodies of pyroxene gneiss and metabasite are associated with garnet-biotite gneiss.

Foliation of the rocks is generally well developed, with strikes N3°–55°E, and dips 30°–50°SE. Minor foldings are sometimes observed, and their axes strike N60°W and dip 30°SE.

2.2. *Ungane* (*Fig. 3*)

Ungane is situated about 4 km west of Nabböya. They consist of two bigger islands about 300 m in diameter each and one smaller islet. The islands are rather flat, and the highest peak attains to 29 m above sea level.

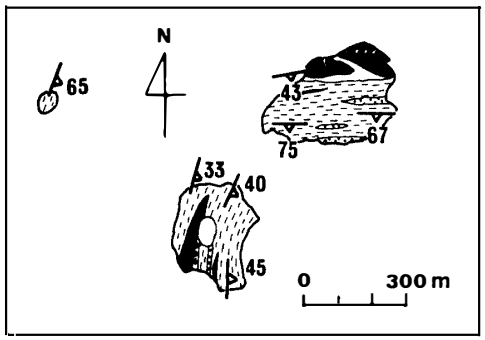

Fig. 3. Geologic map of Ungane.

They are composed mainly of pyroxene gneiss, intercalated with thin layers of garnet gneiss and basic pyroxene gneiss. Two dikes of pegmatite about 1 to 2 m in width intrude into pyroxene gneiss and metabasite.

The foliation of these gneisses strikes east and dips south in the northern island, and south and east in the southern island. This fact suggests presence of a syncline plunging to southeast between the northern and the southern islands.

2.3. *Systerflesene* (*Fig. 4*)

Systerflesene, situated about 3 km west of Ungane, consists of two bigger islands,

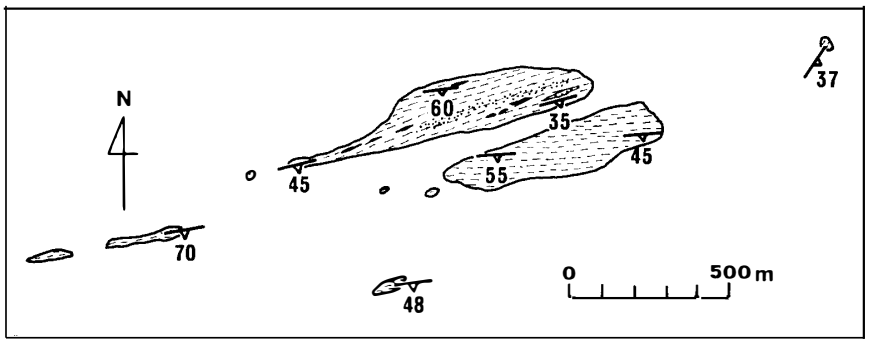

Fig. 4. Geologic map of Systerflesene.

both of which are very slender in shape and 700 m and 1 km in length, respectively, and are associated with several islets.

They are mostly composed of pyroxene gneiss, which is partly garnet-bearing. Several lenticular bodies of garnet gneiss and metabasite occur within pyroxene gneiss.

The foliation strikes east, parallel to the direction of extension of the island, and dips south.

2.4. Ytrehovdeholmen and neighboring islets (Fig. 5)

Ytrehovdeholmen is situated 7 km north of Systerflesene and 8 km west of the Hukuro Cove in Langhovde. It is the biggest island of several islands of the west of Langhovde and attains to 3.5 km in circumference. There are several islets to the southwest and south of it.

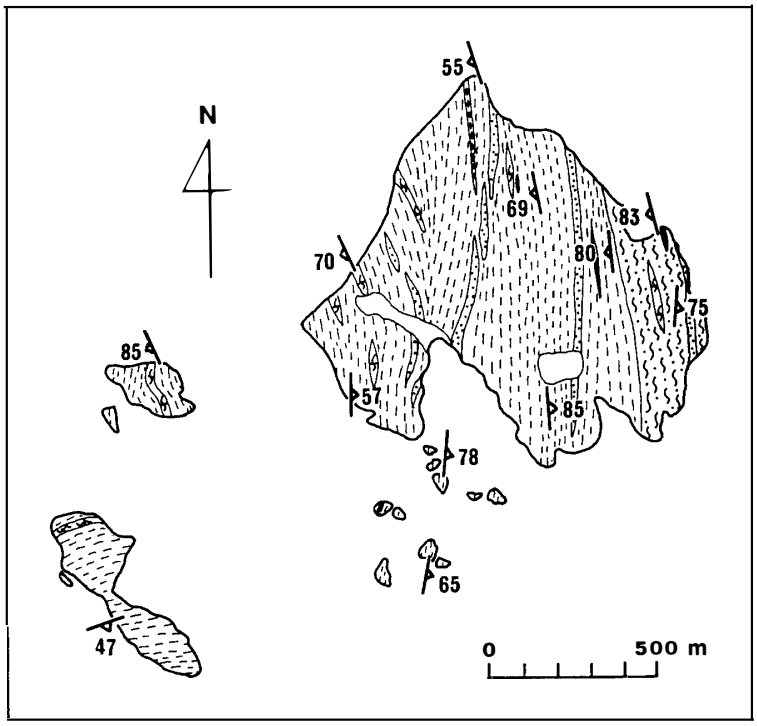

Fig. 5. Geologic map of Ytrehovdeholmen and neighboring islets.

Ytrehovdeholmen and its neighboring islets are composed of pyroxene gneiss with some layers of garnet gneiss. Garnet-biotite gneiss occurs at the eastern margin of the island. Many pegmatites, 5 cm to 1 m in width, intrude into pyroxene gneiss, garnet gneiss and garnet-biotite gneiss.

In Ytrehovdeholmen the foliation trends north and dips steeply 55°W–57°E, whereas the foliation in the southwestern islet trends west. Accordingly, it may be inferred that there is a synform and its folding axis trends northwest between Ytrehovdeholmen and the southwestern islet.

2.5. *Indrehovdeholmen* (*Fig. 6*)

Indrehovdeholmen is situated 3 km west of the northwestern coast of Langhovde.

It is composed mainly of leucocratic biotite gneiss and interbedded with garnet gneiss. Thin layers of pyroxene amphibolite alternating with garnet-biotite gneiss are found in the central part of the island. There are some pegmatite veins 10 to 30 cm in width.

Strike of the foliation varies from N40°W in the west to E-W in the east.

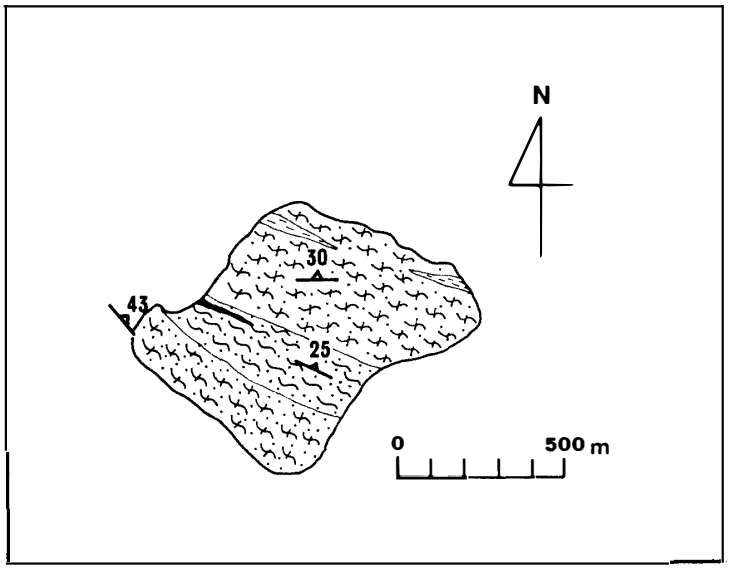

Fig. 6. Geologic map of Indrehovdeholmen.

2.6. *Sigaren* (*Fig. 7*)

Sigaren is situated 4 km west of Indrehovdeholmen and 4 km north of Ytrehovdeholmen. They are composed of three islands arranged for 1.7 km from north to south, associated with several islets. The west side of the islands is generally steeper than the east side.

The rocks exposed in the islands are pyroxene gneiss with thin layers of basic pyroxene gneiss, garnet gneiss and garnet-pyroxene rock. Many small bodies of pegmatite are present, running in two directions, E-W and N30°W.

The foliation strikes parallel to the direction of extension of the island, *i.e.*, N-S, and dips 30° to 80°E (predominantly 65° to 80°E).

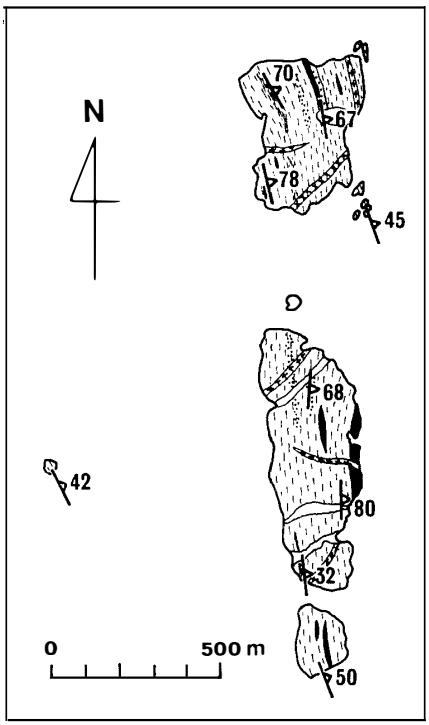

Fig. 7. Geologic map of Sigaren.

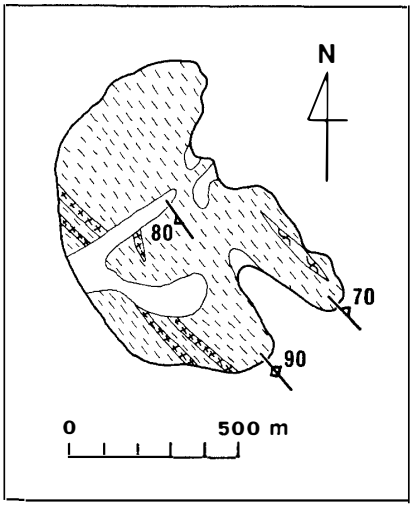

Fig. 8. Geologic map of Rumpa.

2.7. Rumpa (Fig. 8)

Rumpa in the northern end of several islands of the west of Langhovde is situated about 17 km south-southwest of Syowa Station and 3 km northwest of Sigaren. It is known as a rookery of Adélie penguins.

It is mostly composed of pyroxene gneiss, partially intruded by pegmatite, and associated with thin beds of leucocratic biotite gneiss.

The foliation strikes N35° to 45°W and dips steeply 80°W to 70°E.

3. Petrography

The basement rocks exposed in this region are classified on the basis of their modes of occurrence and petrographic features as follows: (1) metabasite, (2) pyroxene gneiss, (3) garnet-biotite gneiss, (4) garnet gneiss, (5) leucocratic biotite gneiss, (6) pegmatite. Mineral assemblages of the metamorphic rocks in this region are listed in Table 1. They are generally subjected to granulite facies metamorphism, and some parts of the rocks have been locally affected by the pegmatite intrusion at the later stage. The metamorphic rocks may be correlated with the Ongul Group defined by YOSHIDA (1978) of the Lützow-Holm Bay System of TATSUMI *et al.* (1964).

3.1. Metabasite

Metabasite is referred to all the metamorphic rocks of basic composition. They are petrographically classified into three types of amphibolite, basic pyroxene gneiss and garnet-pyroxene rock.

Table 1. Mineral assemblages of the metamorphic rocks.

1)	Metabasite
	Amphibolite
	Hb+Bi+Opx+Cpx+Gar+Pl±Qz
	Hb+Bi+Opx+Gar+Pl+Qz
	Hb+Bi+Opx+Cpx+Pl+Qz
	Hb+Bi+Opx+Pl+Qz
	Hb+Bi+Cpx±Opx+Pl
	Basic pyroxene gneiss
	Opx+Cpx+Bi±Hb+Pl+Kf+Qz
	Garnet-pyroxene rock
	Gar+Cpx+Opx+Hb+Pl+Kf+Qz
2)	Pyroxene gneiss
	Opx+Cpx+Gar±Hb+Pl+Kf+Qz
	Opx+Cpx+Bi+Pl+Kf+Qz
	Opx+Bi±Gar+Pl+Kf+Qz
	Opx+Bi+Hb+Pl+Kf+Qz
3)	Garnet-biotite gneiss
	Gar+Bi+Pl+Kf+Qz
4)	Garnet gneiss
	Gar+Bi+Pl+Kf+Qz
	Gar+Hb+Pl+Kf+Qz
5)	Leucocratic biotite gneiss
	Bi±Hb±Gar+Pl+Kf+Qz

Abbreviations: Hb=Hornblende, Bi=Biotite, Opx=Orthopyroxene, Cpx=Clinopyroxene, Gar=Garnet, Pl=Plagioclase, Qz=Quartz, Kf=Potassium feldspar.

3.1.1. Amphibolite

Amphibolite is distributed as irregular-shaped lenticular bodies, 10 cm to 7 m in width, within garnet-biotite gneiss and pyroxene gneiss throughout this region (Fig. 9). It is fine- to medium-graind and black to dark green in color. The foliation is generally observed by preferred arrangement of biotite and hornblende. The rock is composed mainly of hornblende, biotite, plagioclase with subordinate amounts of garnet, clinopyroxene, orthopyroxene, opaque mineral and quartz.

3.1.2. Basic pyroxene gneiss

The rock is distributed in the pyroxene gneiss area, especially in Ungane and Sigaren. It is fine- to medium-grained melanocratic rock with similar mineral assemblages to the pyroxene gneiss described in the following section, but is distinguished by abundant occurrence of mafic minerals. The rock is more foliated than the pyroxene gneiss, due to parallel arrangement of mafic minerals.

3.1.3. Garnet-pyroxene rock

A concordant layer of garnet-pyroxene rock, 6 to 10 m in thickness, is found within the pyroxene gneiss in the northern island of Sigaren (Fig. 10). The garnet-pyroxene rock, characterized by many scattered grains of garnet, 2 to 5 mm in diameter, is melanocratic and has a high density. The rock is composed mainly of pinkish orange garnet and pale green clinopyroxene associated with orthopyroxene, opaque mineral, plagioclase and potassium feldspar.

Fig. 9. Lenticular bodies of amphibolite within garnet-biotite gneiss. Locality: Nabböya.

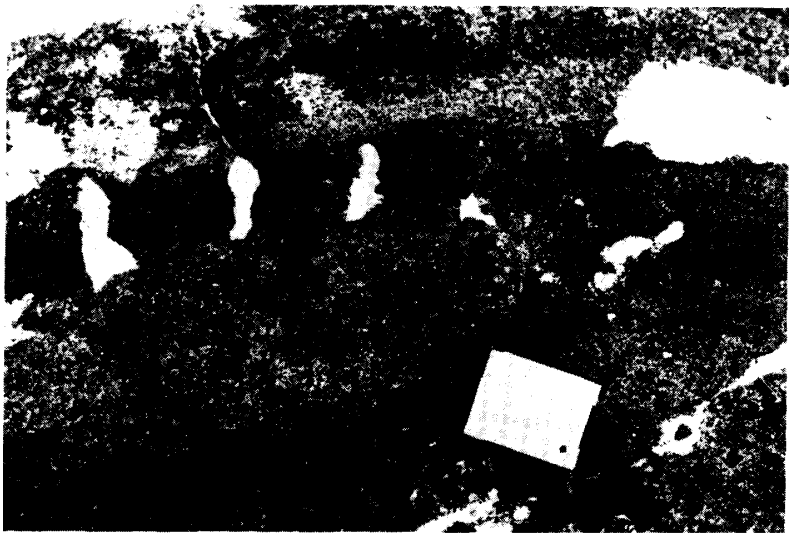

Fig. 10. Garnet-pyroxene rock. Many grains of garnet are observed. Locality: Sigaren.

Fig. 11. The mode of occurrence of pyroxene gneiss. Locality: Sigaren.

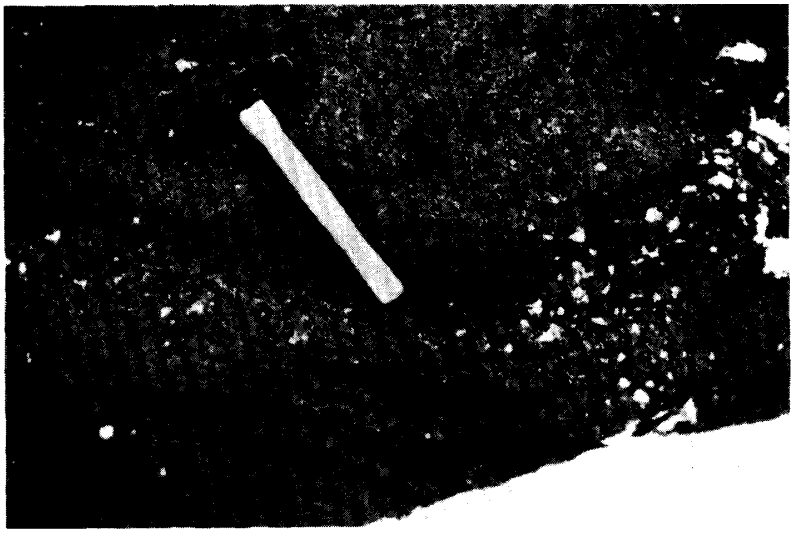

Fig. 12. Elongated dark inclusions of amphibolite within pyroxene gneiss. Locality: Ungane.

Fig. 13. Photomicrograph of pyroxene gneiss. Ribbon perthite and clinopyroxene are observed. Locality: Sigaren.

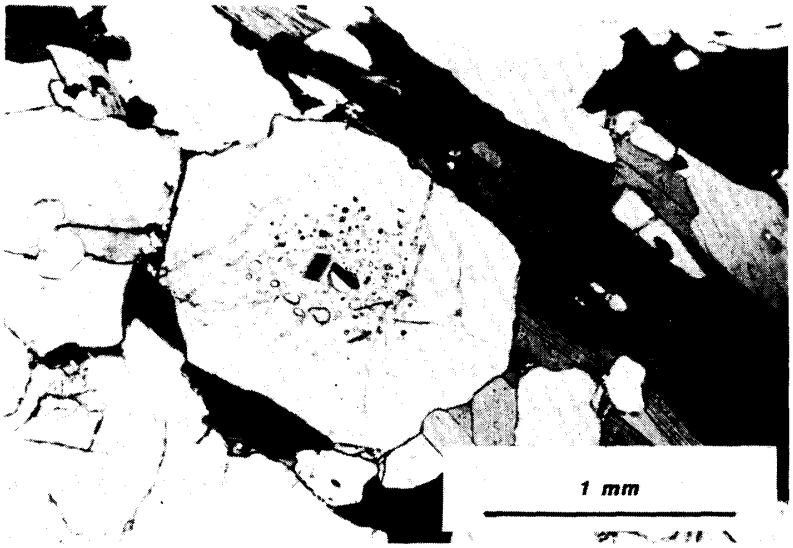

Fig. 14. Photomicrograph of garnet-biotite gneiss. Garnet includes small grains of biotite and quartz. Biotite shows preferred arrangement. Locality: Nabböya.

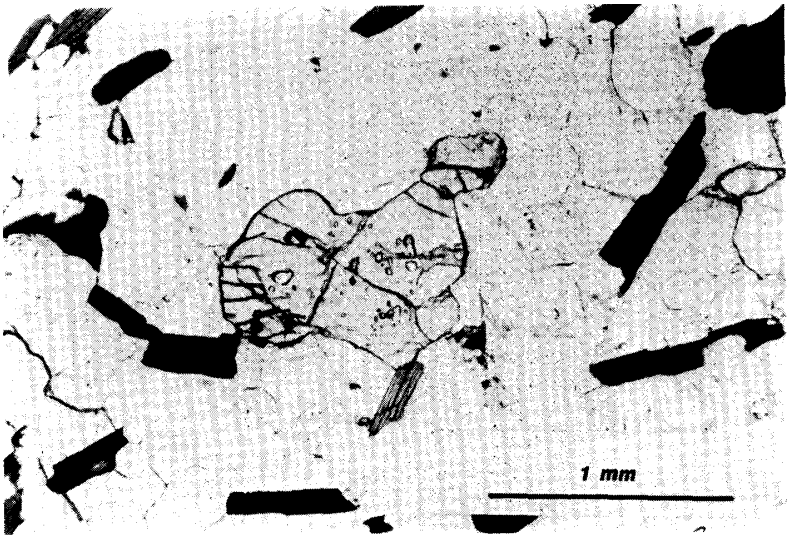

Fig. 15. Photomicrograph of garnet gneiss. Locality: Ytrehovdeholmen.

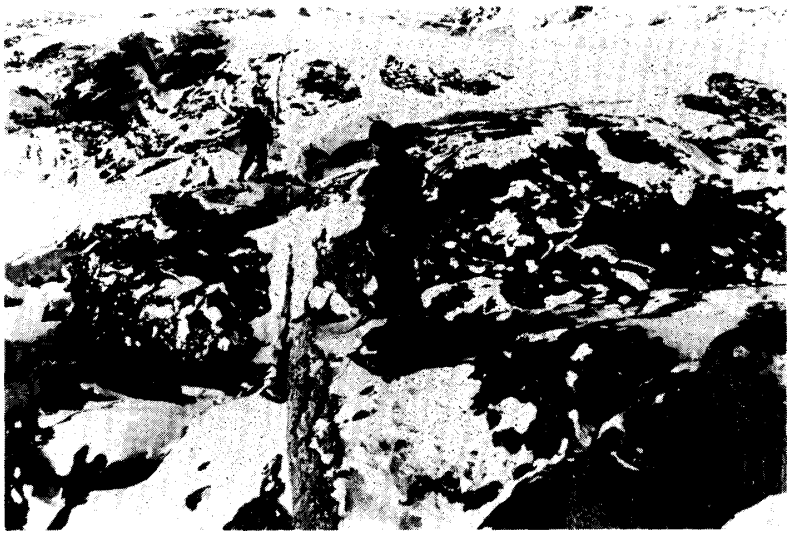

Fig. 16. Pegmatite dikes intruding into pyroxene gneiss. Locality: Ytrehovdeholmen.

3.2. Pyroxene gneiss

Pyroxene gneiss is most widely distributed in this region. The rock is characterized by the presence of orthopyroxene and by brown color owing to colored quartz and feldspar. It is identical with most of charnockitic rocks described by YOSHIDA (1978) and MATSUMOTO *et al.* (1979). It is usually massive and/or weakly foliated, although elongated dark inclusions are partially observed (Figs. 11, 12). The rock is intermediate to acidic. The texture is granoblastic inequigranular interlobate. The mineral assemblages are somewhat variable as presented in Table 1. Potassium feldspar, plagioclase and quartz are main constituents, associated with various assemblages of the mafic minerals such as clinopyroxene, biotite, hornblende and garnet. Accessory minerals are apatite, zircon and opaque mineral. Potassium feldspar is mostly perthitic, showing ribbon or stringlet type, whereas antiperthite is also found in patch type. Myrmekite texture is often observed. Orthopyroxene with embayed anhedral form shows pleochroism from pale pink to pale green. Clinopyroxene is pale green with or without weak pleochroism. Garnet is found

only in the restricted layer of this rock and is not in contact with other mafic minerals (Fig. 13).

3.3. Garnet-biotite gneiss

The rock is mainly distributed in Nabböya and on the east side of Ytrehovdeholmen. It is fine- to medium-grained, and is intermediate to acidic in composition. The gneissose texture is usually conspicuous owing to preferred arrangement of biotite grains. The banded structure consisting of alternation of melanocratic and leucocratic layers is also common. The rock is composed of garnet, biotite, plagioclase, potassium feldspar and quartz, with such accessory minerals as apatite, zircon and opaque mineral. Potassium feldspar, locally porphyroblastic, is perthitic of stringlet type. Some of the plagioclase grains are antiperthitic with patch shape. Myrmekite texture is often found. Garnet is usually anhedral, and sometimes has small inclusions of biotite and quartz in the central part (Fig. 14).

3.4. Garnet gneiss

The rock is found as thin layers or lenticular bodies throughout this region. It is generally medium-grained and massive, and is characteristically white in color, with spotted reddish brown garnet crystals. The texture is similar to the pyroxene gneiss, but foliation is not distinct. The constituent minerals are potassium feldspar, plagioclase, quartz and garnet, with minor amounts of biotite, apatite, zircon and opaque mineral. Perthite of stringlet type and myrmekite texture are common. Some of the plagioclase grains show antiperthite of patch type (Fig. 15).

3.5. Leucocratic biotite gneiss

This rock occurs mostly in the easten part of this region, *i.e.*, Indrehovdeholmen and Nabböya. The rock is interbedded with garnet gneiss. It is leucocratic and medium to coarse-grained. The foliation is not conspicuous. The constituents are quartz, potassium feldspar and plagioclase, with minor amounts of biotite and rarely hornblende or garnet. Accessory minerals are apatite and opaque mineral.

3.6. Pegmatite

This occurs as clear-cut veins and dikes from 5 cm to 2 m in width throughout this region, and is easily recognized from a great distance, standing out in high relief from the country rocks (Fig. 16). The constituents are microcline perthite, quartz, biotite and magnetite.

4. Geologic Structure

A compiled map of the geology and geologic structure in the northeastern region of Lützow-Holm Bay, including the investigated area is given in Fig. 17.

The foliation of the basement rocks strikes generally N-S and dips steeply east in the northern part of the islands, whereas it strikes E-W in the southern part. Therefore, it may be inferred that the basement rocks have been folded and all the three folding axes trend northwest in this region. These folds are considered to be cor-

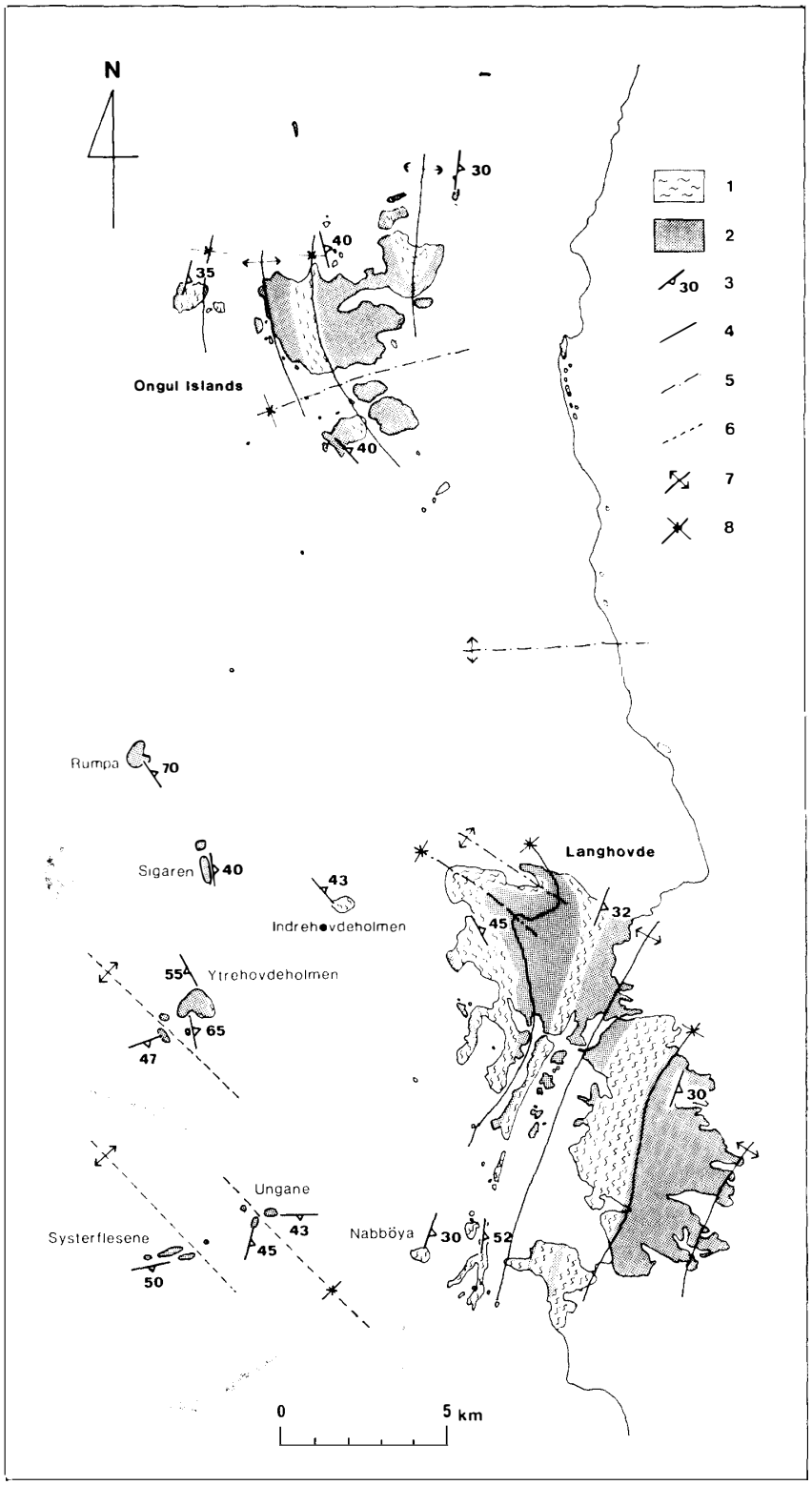

Fig. 17. Geologic map around several islands of the west of Langhovde. 1. Garnet-biotite gneiss and leucocratic gneiss. 2. Pyroxene gneiss and hornblende gneiss. 3. Strike and dip of foliation. 4. Axial trace of the first stage folds by YOSHIDA *(1978). 5. Axial trace of the second stage folds by* YOSHIDA *(1978). 6. Axial trace of the folds inferred in this paper. 7. Antiform. 8. Synform.*

related with the second stage (D2) folds in Langhovde described by YOSHIDA (1978).

5. Conclusions

On the basis of the geological study on the basement rocks of several islands of the west of Langhovde, the authors have come to the following conclusions.

1) The islands are mainly composed of the metamorphic rocks subjected to granulite facies metamorphism, and similar to the rocks in the Ongul Islands and the Langhovde region around several islands of the west of Langhovde. Therefore, the rocks in this region may be correlated with the Ongul Group defined by YOSHIDA (1978).

2) The three folding axes trend in similar directions to those of D2 folds in Langhovde described by YOSHIDA (1978). Geology and geologic structure of this region are generally consistent with those of the Langhovde and the Ongul Islands region.

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