NATIONAL INSTITUTE OF POLAR RESEARCH

ANTARCTIC GEOLOGICAL MAP SERIES
SHEET 17 NIBAN ROCK

Explanatory Text of Geological Map
of
Niban Rock, Antarctica

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1. Introduction

The Niban Rock is located at 68°16′S in latitude and 42°30′E in longitude 130 km northeast of Syowa Station on the Prince Olav Coast.

Two principal outcrops called the Niban-higasi and Niban-nisi Rocks pointed to the Antarctic sea at the edge of the continental ice sheet are surrounded by small rock outcrops. The ice-free rocks are scattered within the area of 3.5 km north-south and 2.5 km east-west. The highest point is 113.6 m above sea level at the Niban-nisi Rock. It is apparent that the area was previously covered with ice sheet, because many glaciation features such as grooves and smooth rock surfaces remains clearly. A few ponds filled with meltwater appear in the lower part of the area in the summer season, and patterned grounds are widely distributed around the Niban-nisi Rock.

The geological survey was carried out by the senior author in the 21st Japanese Antarctic Research Expedition (JARE-21) during the period from January 30 to February 1, 1980, in collaboration with the geodetic survey party led by K. MIYAZAKI.

2. Geology and Petrography

2.1. *General*

It is characteristic of the Niban Rock area that migmatization and granitization occurred usually in association with granitoid emplacement as observed throughout the outcrops, and this means that the older gneisses were mixed up with the later granitic material thus producing various types of migmatite with some deformational patterns.

The basement rocks of the area are classified into the following types on the basis of their petrographical features:

1. Sillimanite-garnet-biotite gneiss (Gsb)
   - 1.1. Sillimanite-garnet-biotite gneiss
   - 1.2. Kyanite-sillimanite-garnet-biotite-K-feldspar gneiss
2. Biotite gneiss (Gb)
   - 2.1. Biotite gneiss
   - 2.2. Migmatitic biotite gneiss
3. Metabasite (Mb)
   - 3.1. Clinopyroxene amphibolite
   - 3.2. Biotite amphibolite

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Table 1. Chemical compositions of rocks from the Niban Rock.

No.	1	2	3	4	5	6	7
SiO_2	64.29	49.25	68.18	69.96	75.12	67.01	49.76
TiO_2	1.39	0.29	0.39	0.28	0.26	0.45	1.32
Al_2O_3	18.31	6.02	16.41	16.31	12.75	16.23	14.81
Fe_2O_3	1.91	0.87	0.75	0.42	0.59	1.11	3.45
FeO	5.42	2.78	1.93	1.67	1.10	2.57	6.98
MnO	0.05	0.29	0.03	0.03	0.02	0.05	0.23
MgO	2.41	15.87	1.00	0.70	0.76	1.50	7.19
CaO	0.75	19.48	2.87	3.30	2.02	3.67	11.16
Na_2O	1.54	0.58	4.70	4.51	3.29	3.94	2.93
K_2O	2.49	1.66	2.03	1.72	2.47	1.70	0.90
$H_2O(+)$	1.31	2.46	1.20	0.91	1.34	1.27	1.36
$H_2O(-)$	0.09	0.04	0.04	0.09	0.05	0.11	0.04
P_2O_5	0.06	0.12	0.18	0.10	0.05	0.18	0.13
Total	100.02	99.71	99.71	100.00	99.82	99.79	100.26

No. 1. 801301 : Kyanite-bearing sillimanite-garnet-biotite gneiss
2. 801302 : Phlogopite-clinopyroxene-scapolite rock (calc-silicate gneiss)
3. 801303 : Biotite gneiss
4. 801306 : Biotite gneiss
5. 801317 : Muscovite biotite granite
6. 801318′: Biotite gneiss
7. 801319 : Biotite amphibolite (metabasite)
Analyst: S. KANISAWA

4. Biotite-hornblende gneiss (Gbh)
5. Calc-silicate gneiss (Gcs)
  5.1. Garnet-clinopyroxene rock
  5.2. Phlogopite-clinopyroxene-scapolite rock
6. Granite and aplite (Gr)
  6.1. Biotite granite
  6.2. Muscovite-biotite aplite
7. Unconsolidated deposits (At)

Chemical compositions of some representative rocks are listed in Table 1.

2.2. *Geology and petrography*

2.2.1. Sillimanite-garnet-biotite gneiss (Gsb)

Sillimanite-garnet-biotite gneiss is easily distinguished in the field owing to its fissility and dark brown color. Sillimanite crystals are sometimes as long as 10 cm.

1) Sillimanite-garnet-biotite gneiss: This rock is distributed at the Niban-nisi Rock. It is a fine- to medium-grained melanocratic rock with leucocratic (quartzose) layers. It shows a lepidoblastic texture and contains abundant garnet porphyroblasts up to 2 mm in diameter. The rock is sometimes folded finely (Plate 3a). Constituent minerals are sillimanite, garnet, biotite, plagioclase, quartz, apatite, zircon, and opaque minerals. Sillimanite commonly occurs as fibers, needles, and long prismatic crystals in the matrix, being closely associated with biotite. It also occurs in the leucocratic layer and as inclusions in garnet porphyroblasts. Garnet is ubiquitously present in

the rock as anhedral porphyroblasts containing inclusions of sillimanite, biotite, and quartz. Biotite shows reddish brown to brown pleochroism and occurs as plates in the matrix. It also occurs along cracks in garnet porphyroblasts and as inclusions in garnet. Plagioclase sometimes forms rounded porphyroblasts up to 2 mm in diameter, but it usually constitutes the matrix with sillimanite, biotite and quartz.

2) Kyanite-sillimanite-garnet-biotite-K-feldspar gneiss: This rock occurs as discontinuous thin layers within biotite gneiss and migmatitic biotite gneiss at the Niban-higasi Rock. It is fine- to medium-grained and similar in both appearance and mineral assemblage to the above-mentioned sillimanite-garnet-biotite gneiss. But the rock is characterized by the occurrence of kyanite and K-feldspar, and looks more leucocratic than the sillimanite-garnet-biotite gneiss. Kyanite is usually included in garnet as anhedral grains in marked contrast with sillimanite which is ubiquitous in the matrix, suggesting that kyanite is a metastable relic formed at the earlier stage of prograde recrystallization of the rock and that the regional metamorphism is of kyanite-sillimanite type. K-feldspar is usually orthoclase of a perthitic texture. It is in contact with sillimanite, suggesting the metamorphic grade of the rock is as high as sillimanite-K-feldspar zone.

2.2.2. Biotite gneiss (Gb)

1) Biotite gneiss: This rock is most widespread in the Niban Rock area. It is a fine to coarse-grained rock of granoblastic to lepidoblastic textures. It is gray in hand specimen, and sometimes contains plagioclase porphyroblasts up to 1 cm in diameter. The rock is composed of biotite, plagioclase, K-feldspar, white mica, chlorite, quartz, apatite, zircon, sphene, alanite, calcite, and opaque minerals. Biotite is brownish green to brown in color and is sometimes replaced by chlorite. Plagioclase occasionally displays an antiperthitic texture. K-feldspar commonly occurs as interstitial grains and shows microcline grid twinning. The modal amount of K-feldspar varies markedly from specimen to specimen. Muscovite is also a poikilitic interstitial mineral without a preferred orientation and is probably of retrograde origin.

2) Migmatitic biotite gneiss: The above-mentioned biotite gneiss changes to diktyonitic migmatite due to the introduction of aplitic granite in which the units of the biotite gneiss are rotated resulting from the conjugated granitic vein. Therefore, the foliation around there does not show a preferred orientation. On the other hand, static migmatization is also observed. K-feldspar porphyroblasts within the biotite gneiss develop apparently to present massive granitic part in which a preferred orientation of biotite reserved is parallel to that of the biotite gneiss. The migmatitic biotite gneiss is usually pink in hand specimen. It is similar in appearance and petrographic features to the gray biotite gneiss except for the color due to pink K-feldspar.

2.2.3. Metabasite (Mb)

Metabasite occurs throughout the Niban Rock area as thin layers and blocks within biotite gneiss and migmatitic biotite gneiss. Therefore, the total amount of metabasite in the area is rather small.

1) Clinopyroxene amphibolite: This is a medium- to coarse-grained rock with weak foliation due to the preferred orientation of hornblende crystals. Constituent minerals are clinopyroxene, hornblende, biotite, plagioclase, sphene, apatite, zircon, and opaque minerals. Quartz is sometimes present in a small amount. Clinopyroxene

usually occurs as anhedral poikillitic crystals with inclusions of hornblende and plagioclase, and is closely associated with larger hornblende crystals. It is pale green under the microscope. Hornblende is most abundant in the rock as poikilitic porphyroblasts and/or smaller matrix grains. It shows pleochroism with X′=yellow and Z′=bluish green and green. Brown biotite occurs only in a small amount. Plagioclase sometimes shows a distinct zonal structure.

2) Biotite amphibolite, and biotite-hornblende gneiss (Gbh): It seems in the field that clinopyroxene amphibolite grades into biotite amphibolite and further into biotite-hornblende gneiss as a result of introduction of granitic material from the intruding granite and aplite. Numerous blocks of amphibolite are scattered within the granite and aplite, and are cut by network of granitic veins. On the other hand, biotite-hornblende gneiss is captured in the granite and aplite producing the banded structure with leucocratic bands. The biotite amphibolite is similar in both appearance and mineral composition except for the absence of clinopyroxene and the larger modal amount of biotite. K-feldspar is an additional constituent mineral of the biotite-hornblende gneiss.

2.2.4. Calc-silicate gneiss (Gcs)

The calc-silicate gneiss occurs only in a small amount as lenses included in biotite gneiss and metabasite.

1) Garnet-clinopyroxene rock: This is a massive fine-grained rock with gradual compositional layering. The garnet-rich part is reddish brown and the hornblende-rich part deep green in hand specimen. Constituent minerals are garnet, clinopyroxene, hornblende, plagioclase, quartz, sphene, apatite, zircon, and opaque minerals. The most garnet-rich part is free of hornblende, while garnet is present only in a small amount in the hornblende-rich part. However, garnet, clinopyroxene, and hornblende are usually in direct contact with each other. Garnet is pale red and occurs as anhedral grains up to 0.3 mm in diameter. Clinopyroxene is pale green. Hornblende is pleochroic with brownish green to pale greenish brown. Calcite has not been found in the rock, but it is probable that the garnet-clinophyroxene rock is derived from a calcareous sediment.

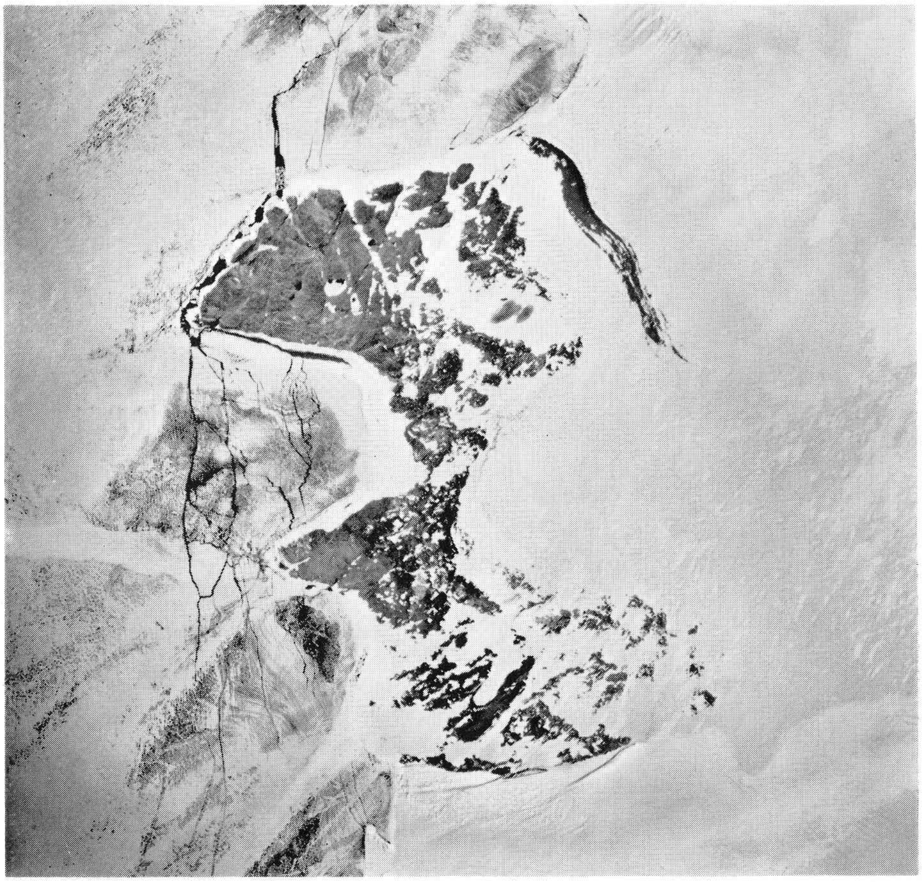
2) Phlogopite-clinopyroxene-scapolite rock: This rock is a medium- to coarse-grained rock with weak foliation due to the preferred orientation of phlogopite. It is green in hand specimen. The constituent minerals are clinopyroxene, tremolite, phlogopite, scapolite, plagioclase, K-feldspar, calcite, sphene, and zircon. Clinopyroxene is colorless under the microscope, and occurs as poikilitic porphyroblasts containing tremolite, phlogopite, and other minerals. Colorless tremolite occurs as prismatic crystals. Pale brown phlogopite sometimes shows pleochroic haloes around zircon inclusions. Scapolite and plagioclase constitute the matrix, while calcite and K-feldspar occurs only in small amounts as interstitial grains. K-feldspar shows a distinct microcline texture.

2.2.5. Granite and aplite (Gr)

The granite and aplite occur throughout the Niban Rock area as discordant dykes and sheets in the well-layered gneisses. The granite dykes are sometimes emplaced along the shear zone with right-lateral movement and show a preferred orientation of the componental biotite flakes parallel to the shear. The granite dykes generally represent a gneissose structure which is gradually transformed into the biotite gneiss side by side in some cases while the granite encloses the biotite gneiss blocks like xenolith. It is clear that the granite emplacement was associated with migmatization and deformation in any case.

3. Geologic Structure

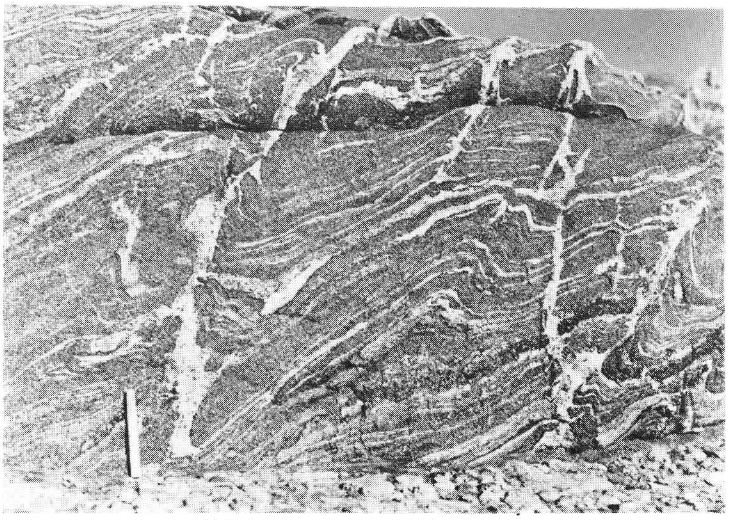
Geologic structure of the Niban Rock area is complicated. Trend of the foliation of the gneisses is generally E-W and the dip is to the north. A steep basin and S-structure are revealed at the Niban-higasi Rock, whereas a shallow basin and a gentle dome are found at the Niban-nisi Rock. A structural break might exist between the Niban-higasi and Niban-nisi Rocks though the evidence is not revealed because of snow cover.



a. Aerial photograph of the Niban Rock. JARE Antarctic air photographs 22AV-81-Prince Olav, C3-7.

b. Patterned ground.

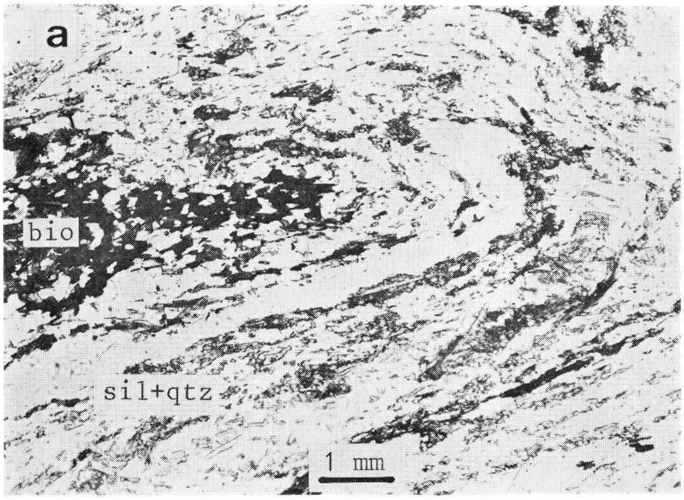
Plate 2



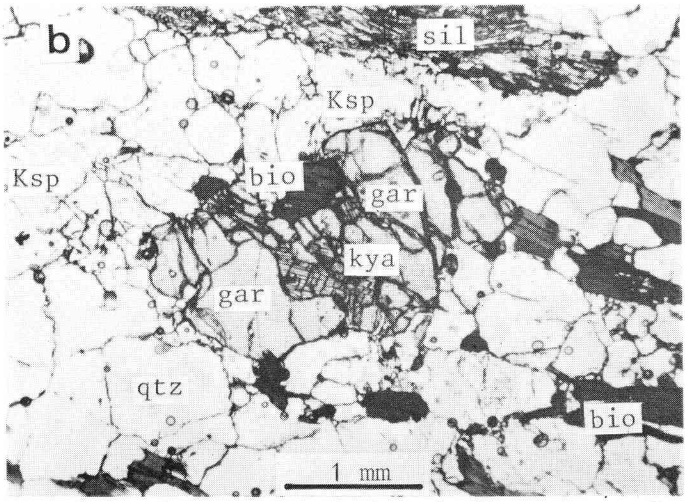
a. Diktyonitic structure in biotite gneiss

b. Agmatitic structure in biotite gneiss.

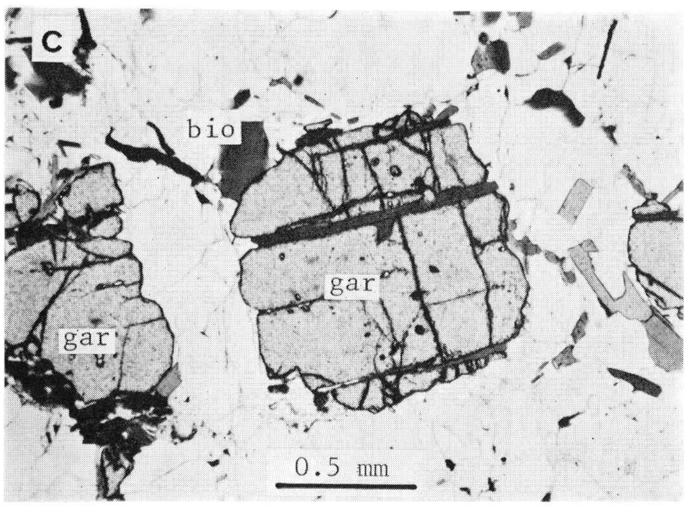
c. Migmatization by pink granite emplacement.



a. *Minor folding of sillimanite-garnet-biotite gneiss (sp. 801314). sil; sillimanite, bio; biotite, qtz; quartz.*

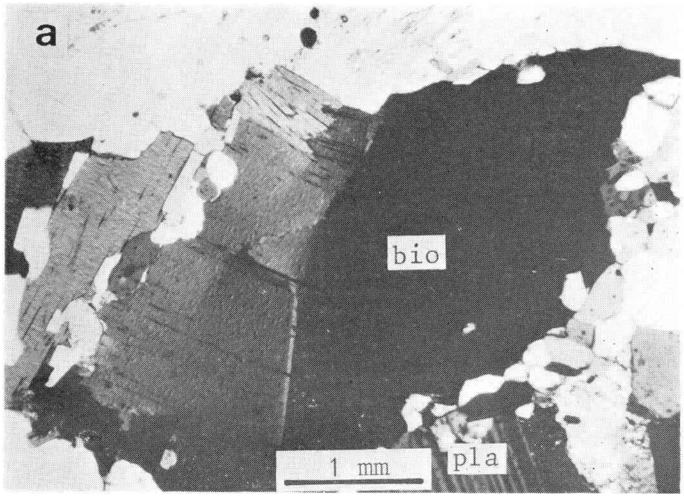


b. *Kyanite (kya) inclusions in garnet (gar) porphyroblast in kyanite-sillimanite-garnet-biotite-K-feldspar gneiss (sp. 801301). Ksp; K-feldspar.*

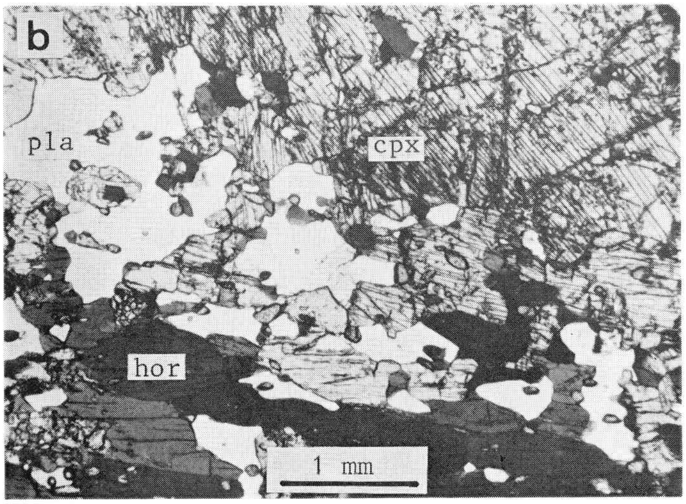


c. *Garnet porphyroblasts in sillimanite-garnet-biotite gneiss (sp. 801311). Biotite occurs in the matrix and along cracks of garnet porphyroblasts.*

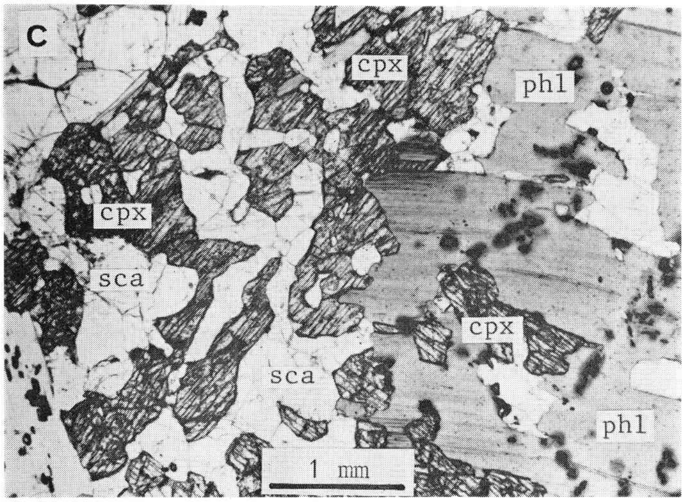
Plate 4



a. Deformed biotite in coarse-grained biotite gneiss (sp. 801318).



b. Clinopyroxene (cpx), hornblende (hor), and plagioclase (pla) in clinopyroxene amphibolite (sp. 801316).



c. Clinopyroxene, phlogopite (phl), and scapolite (sca) in phlogopite-clinopyroxene-scapolite rock (sp. 801302).

Antarctic Geological Map Series

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