NATIONAL INSTITUTE OF POLAR RESEARCH

# ANTARCTIC GEOLOGICAL MAP SERIES
# SHEET 29 BELGICA MOUNTAINS

## Explanatory Text of Geological Map
## of
## The Belgica Mountains, Antarctica

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# Explanatory Text of Geological Map of The Belgica Mountains, Antarctica

Hideyasu KOJIMA,* Keizo YANAI** and Tamio NISHIDA***

## 1. The Belgica Mountains

The Belgica Mountains, located at 72°18′S–72°43′S latitude and 30°57′E–31°20′E longitude, lie between the Yamato Mountains and the Sør Rondane Mountains, East Queen Maud Land, Antarctica. This situation is approximately 500 km southwest of Syowa Station on East Ongul Island and about 200 km southwest of the Yamato Mountains.

It was the first time that the Belgian party visited the mountains in 1958 for surveying. The Belgian party revisited the mountains in 1967 and collected rock samples from four sites. A brief description of those rock specimens was given by Drs. T. V. AUTENBOER and W. ROY (AUTENBOER and ROY, 1972).

In December 1979, the traverse party of the 20th Japanese Antarctic Research Expedition visited the mountains and carried out geological survey, surveying and meteorites search during a period of two weeks.

The mountains consist of three massifs and several nunataks. These massifs called northwest, southeast and southwest massifs in this paper occupy the main part of the mountains. Most of the massifs and nunataks have gentle ridges and steep wings. In the northwest massif, the north wing of Mt. Verhaegen is 400 meters of walls, and Mt. N.-D. de Lorette has some needle-like peaks.

In this area, most of the peaks are 2300 to 2600 meters high. The highest peak is Mt. Victor with over 2600 meters elevation. Ice surface of the eastern area is about 300 meters higher than that of the western. There are two large glaciers, Glacier Giaever between the southwest and the southeast massifs and Glacier Norsk Polarinstitutt between the northwest and the southeast massifs. Some outlet glaciers flow over the southeast and the southwest massifs from southeast to northwest. One of them is the Glacier Giaever. The Glacier Norsk Polarinstitutt flows between the northwest massif and the southeast massif from northeast to southwest. On the other hand, bare ice is distributed mainly on the west side of the massifs. The moraine fields covering the ice, are recognized in several areas adjacent to the massifs and the moraine also covers some part of basement rocks.

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## 2. General Geology

The Belgica Mountains are situated far from the Yamato Mountains and the Sør Rondane Mountains at a distance of 150–200 km. The mountains consist of crystalline basement rocks such as granitic gneiss, hornblende-biotite banded gneiss, marble with skarn, amphibolite, and dyke rocks. The geological features in this area seem to be more similar to the Sør Rondane Mountains than to the Yamato Mountains which are characterized by widely distributed charnockitic sequences (SHIRAISHI and KIZAKI, 1979).

The crystalline basement rocks in this area are called Belgica group in this paper. The Belgica group is divided into the Belgica upper formation and the Belgica lower formation. The lower formation is distributed in the southwestern area of the northwest massif and throughout the southwest massif. This formation is characterized by predominance of granitic gneiss with amphibolite and marble and skarn beds.

The upper formation is exposed in the southeast massif and in main part of the northwest massif. This formation is characterized by alternation of hornblende-biotite melanocratic gneiss, biotite gneiss and quartz-feldspathic gneiss with well-developed banded structure and amphibolite. Hornblende-biotite melanocratic gneiss occupies the main part of the both massifs. Furthermore, some layers of crystalline limestone and thin beds of garnet-biotite gneiss, clinopyroxene gneiss and augen gneiss are also distributed.

Gentle and superposed folds are developed throughout the region.

## 3. Petrography

The crystalline basement rocks exposed in this region are classified into the following types on the basis of their mode of occurrences and petrographical features.

1. Granitic gneiss (Ggr)
2. Marble and skarn (UMb & LMb)
3. Amphibolite (UAm & LAm)
4. Hornblende-biotite banded gneiss and alternating rocks (Ghb)
   - 4.1. Hornblende-biotite gneiss
   - 4.2. Clinopyroxene-hornblende-biotite gneiss
   - 4.3. Quartz-feldspathic gneiss
5. Augen gneiss (Gpo)
6. Clinopyroxene gneiss (Gp)
   - 6.1. Clinopyroxene gneiss
   - 6.2. Clinopyroxene biotite gneiss
7. Garnet-biotite gneiss (Ggb)
   - 7.1. Garnet-biotite gneiss
   - 7.2. Garnet gneiss

8. Basic meta-dyke (Bm)
9. Syenite (Sy)
10. Granodiorite-diorite (Grm)
11. Pink granite (Grm)

### *3.1. Granitic gneiss (Ggr)*

Granitic gneiss is the largest exposure in the southwest massif and it is distributed in the southern part of the northwest massif. This rock occupies the lowermost part of crystalline basement rocks in this region. Sometimes it shows a migmatized structure. It is leucocratic, pinkish gray to gray in color, fine- to medium-grained and strongly foliated characterized by abundance of pink, occasionally white K-feldspar. The constituent minerals are biotite, K-feldspar, plagioclase and quartz, with minor amounts of primary muscovite and zircon. In hand specimen, this rock appears fresh, but most of plagioclase are characteristically altered into carbonate and sericite under the microscope. Biotite shows reddish-brown, brown to yellow pleochroism. Some biotites are altered into chlorite and muscovite. K-feldspar, fine- to coarse-grained, shows a microcline texture. Quartz has a characteristic smoky color.

### *3.2. Marble and skarn (UMb & LMb)*

Marble and skarn occur as interlayered several beds in the lower formation and four to six beds in the upper formation. These beds range in thickness from several meters to approximately fifty meters. There is no obvious difference among them except one bed in the lower formation which consists mainly of marble gneiss. Generally marble and pale green to green, massive clinopyroxe rock are predominant in these beds. The marble and skarn are classified into the following five types of rocks that are layered or randomly mixed with one another.

(1) Marble
(2) Spinel-humite-dolomite-calcite rock
(3) Green clinopyroxene rock
(4) Phlogopite rock
(5) Dark brown garnet rock

Occasionally small-sized irregular xenolithic blocks of scapolite occur in association with these rocks. Scapolite is very coarse-grained, white to pale blue in color and euhedral.

#### 3.2.1. Marble

Marble constitutes a main part of the marble and skarn layers with green clinopyroxene rock. The marble is leucocratic, white to very pale yellow in color, coarse- to very coarse-grained and equigranular in texture. It consists mainly of calcite with minor amounts of forsterite, clinopyroxene and apatite. Amount of forsterite and clinopyroxene is variable. Where these minerals are abundant, the marble grades into impure marble. Commonly forsterite is altered to surpentine.

3.2.2. Spinel-humite-dolomite-calcite rock

The rock occurs in association with thin beds or lenses of phlogopite rock. It is leucocratic, with scattered colored minerals, medium- to coarse-grained, and equigranular in texture. Humite is pale orange to orange in color with euhedral to subhedral granular texture, and shows orange to pale yellow pleochroism. Spinel is bluish gray and euhedral. There are varieties of color in spinel of this region. Small amounts of phlogopite and forsterite is also found.

3.2.3. Green clinopyroxene rock

This pyroxene rock is one of the most abundant rocks in limy layers. The rock is pale green to green in color, medium- to coarse-grained, and equigranular in texture, being composed mostly of clinopyroxene. Small amounts of phlogopite, amphibole, scapolite and calcite are contained.

3.2.4. Phlogopite rock

Phlogopite rock occurs as thin layers or lenses in limy rocks. The layers are several centimeters to several tens of centimeters thick. Phlogopite is characteristic golden yellow in color, coarse- to very coarse-grained, with an inequigranular texture.

3.2.5. Dark brown garnet rock

This rock is associated with other limy rocks, but sometimes it occurs as nodules in hornblende-biotite gneiss. In the latter case, dark green clinopyroxene rock (several centimeters thick) covers the garnet rock like a crust. Garnet, dark brown in color and anhedral, shows a poikilitic texture with clinopyroxene and epidote.

*3.3. Amphibolite (UAm & LAm)*

Amphibolite is distributed throughout this region. In the lower formation, this rock occasionally shows an agmatite structure. In the upper formation, amphibolite occurs in close association with hornblende-biotite gneiss. The rock is several centimeters to several tens of meters thick and alternating with hornblende-biotite gneiss. It seems that a large amount of amphibolite is distributed in the northwest margine near Mt. Bastin.

Generally this rock is greenish black in color and medium- to coarse-grained. Under the microscope, it shows a granoblastic to lepidoblastic texture. It contains pale green clinopyroxene which occurs as spots and occasionally as thin layers. Constituent minerals are clinopyroxene, hornblende, biotite, plagioclase and quartz, with minor amounts of sphene, apatite and zircon. Amount of clinopyroxene and biotite is variable. Clinopyroxene is fine- to medium-grained, anhedral and pleochroic colorless to pale green. Hornblende is green and brown in color and subhedral to anhedral.

*3.4. Hornblende-biotite banded gneiss and alternating rocks (Ghb)*

In this region, hornblende-biotite gneiss is predominant and occupies a main part of the upper formation. The gneiss is alternating with amphibolite, biotite

gneiss, quartz-feldspathic gneiss and clinopyroxene gneiss. Banded structure of the gneiss is well developed in the region. The rock is divided into clinopyroxene-bearing type and clinopyroxene-free type. Furthermore, the relative amounts of hornblende and biotite are variable, so the rock type grades from hornblende-biotite gneiss to biotite-hornblende gneiss. In this paper, however, hornblende-biotite gneiss and biotite-hornblende gneiss are described as hornblende-biotite gneiss.

3.4.1. Hornblende-biotite gneiss

This rock is melanocratic, dark gray to brownish black in color, fine- to medium-grained, and shows a granoblastic to lepidoblastic texture. It is composed mainly of hornblende, biotite, plagioclase, K-feldspar and quartz, with minor amounts of apatite, zircon, sphene and opaque minerals. Hornblende is subhedral to anhedral and pleochroic brownish green to yellow. Biotite shows dark brown to brownish yellow or reddish brown to yellow pleochroism. K-feldspar shows a microcline texture and quartz shows wavy extinction.

3.4.2. Clinopyroxene-hornblende-biotite gneiss

A small amount of clinopyroxene-hornblende-biotite gneiss is interlayered with hornblende-biotite gneiss. This rock is melanocratic, dark gray to brownish black in color, fine- to medium-grained, and shows a granoblastic to lepidoblastic texture. It consists mainly of clinopyroxene, hornblende, biotite, plagioclase and quartz, with minor amounts of apatite, zircon, sphene and opaque minerals.

3.4.3. Quartz-feldspathic gneiss

This gneiss is distributed throughout the upper formation, and alternating with hornblende-biotite gneiss. It is several centimeters to several meters thick, leucocratic, white to light gray in color, and medium- to coarse-grained. The rock is strongly foliated due to parallel orientation of quartz and feldspar. Constituent minerals are K-feldspar, plagioclase and quartz with minor amounts of biotite and muscovite. K-feldspar shows a microcline texture and plagioclase is altered to carbonate and sericite.

### *3.5. Augen gneiss (Gpo)*

A small amount of augen gneiss is associated with other alternating gneisses in the upper formation. The rock is approximately ten centimeters to several meters thick, mesocratic and coarse- to very coarse-grained. It consists mainly of biotite, K-feldspar, plagioclase and quartz.

### *3.6. Clinopyroxene gneiss (Gp)*

3.6.1. Clinopyroxene gneiss

This rock occurs in a peak near Mt. de Maere. It is several meters to approximately ten meters thick. The rock is dark greenish gray in color, medium-grained and shows a granoblastic to lepidoblastic texture. Medium-grained, pale brown sphene is abundant. Constituent minerals are mainly clinopyroxene, plagioclase, quartz and sphene, with minor amounts of hornblende and opaque minerals. Horn-

blende shows green to bluish green pleochroism, seems to be secondary mineral derived from clinopyroxene. Clinopyroxene is subhedral to anhedral and shows colorless to pale green pleochroism. Sphene is one to two millimeters across, euhedral and pleocroic reddish brown to pale brown.

3.6.2. Clinopyroxene-biotite gneiss

A small amount of clinopyroxene-biotite gneiss occurs in the northern wing of Mt. Bastin. It is concordant with hornblende-biotite gneiss. This rock is melanocratic, black to brownish black in color, and fine- to medium-grained. In hand specimen, K-feldspar shows schillarization. Constituent minerals are mainly clinopyroxene, biotite, K-feldspar and quartz, with accessory sphene and apatite. K-feldspar shows a distinct perthite texture. Clinopyroxene is approximately one millimeter across, anhedral and shows colorless to pale yellow pleochroism. Biotite is pleochroic reddish brown to pale brownish yellow.

*3.7. Garnet-biotite gneiss (Ggb)*

3.7.1. Garnet-biotite gneiss

Only one layer of garnet-biotite gneiss, several meters thick, is found in the northwestern margine of the northwest massif. This rock is weathered brown in color, medium-grained and shows compositional banding with ferromagnesian and quartz-feldspathic bands. Main constituents are garnet, plagioclase, K-feldspar and quartz, with accessory zircon, apatite and opaque minerals. Garnet is several millimeters across, anhedral and shows a poikiloblastic texture. Biotite shows brown to pale yellow pleochroism.

3.7.2. Garnet gneiss

This rock is found in association with garnet-biotite gneiss. It is only fifteen centimeters thick, leucocratic, pale brown in color and granoblastic equigranular in texture. The rock is similar to the garnet gneiss distributed near Syowa Station on East Ongul Island. It consists of garnet, plagioclase and quartz with minor biotite.

*3.8. Basic meta-dyke (Bm)*

This dyke consists of biotite clinopyroxenite and amphibolite, and is distributed mainly in the vicinity of Mt. Lahaye, Mt. Van Mieghem and Mts. Perov, center of the mountains. It is some tens of centimeters to several tens of meters thick, and discordant with wall rocks.

*3.9. Syenite (Sy)*

Small mass of syenite intrudes into hornblende-biotite gneiss and amphibolite. This rock is a few meters to approximately ten meters width, melanocratic, fine- to medium-grained and shows strong foliation. It consists of clinopyroxene-bearing assemblage and clinopyroxene-free assemblage. Constituent minerals of syenite are clinopyroxene, hornblende, biotite, plagioclase, K-feldspar and quartz, with minor sphene, zircon and apatite. Clinopyroxene is pale yellowish green and partly

altered to hornblende. Biotite shows dark brown to pale yellow pleochroism and pleochroic halo. K-feldspar shows a microcline texture.

*3.10. Granodiorite-Diorite (Grm)*

This rock is distributed in the vicinity of Mt. Solvay, Mt. Van Mieghem and Nakanagaone (tentative). It occurs as clean-cut dykes ranging in width from several meters to approximately ten meters. The rock is melanocratic to mesocratic and fine- to medium-grained.

*3.11. Pink granite (Ggr)*

Pink granite is subdivided into two types. One occurs as network dyke ranging in width from scores of centimeters to several meters in the upper formation. The other is straight and clear-cut dyke. The former is leucocratic, medium-grained and occasionally grades into pegmatite. The latter is leucocratic, pink to reddish gray in color and medium-grained. The dyke is composed of biotite, K-feldspar, plagioclase and quartz.

## 4. Geologic Structure

Two types of folds were found in this region. One type is a series of northwest to southeast trending four folds, which are gentle to open folds developed between Mt. Lahaye and Mt. Van Mieghem, southern part of Mts. Perov, near Mt. de Limburc Stirum and between Kitanagaone (tentative) and Mt. Gara (tentative). The other type trending northeast to southwest is a gentle anticline and is superposed on the former. It is developed from the center of Glacier Norsk Polarinstitutt to the southwest massif.

### References

AUTENBOER, T. B. and LOY, W. (1972): Recent geological investigations in the Sør-Rondane Mountains, Belgicafjella and Sverdrupfjella, Dronning Maud Land. Antarctic Geology and Geophysics, ed. by J. A. RAIMOND. Oslo, Universitetsforlaget, 563–571.

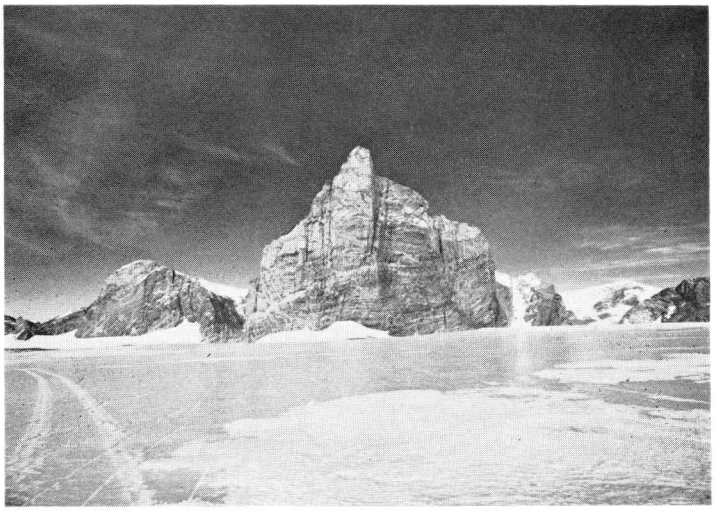
SHIRAISHI, K. and KIZAKI, K. (1979): Yamato Sanmyaku no chishitsu (Geology of the Yamato Mountains). Gekkan Chikyu (The Earth Monthly), **1** (12), 928–937.

*a. Aerial photograph of the central part of the Belgica Mountains. JARE Antarctic air photo, 16AV–7, C4–3.*

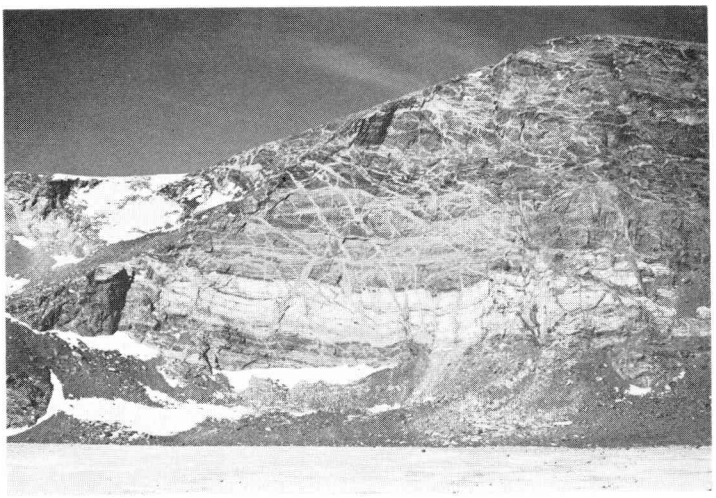
*b. View of the western part of the northwest massif.*

**Plate 2**

*a. Granitic gneiss in the northern cliff of the southwest massif.*



*b. Western cliff of Mt. Verhaegen.*



*c. Marble and skarn, and banded gneiss in the central part of the northwest massif.*

## Antarctic Geological Map Series

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| Sheet 29 | Belgica Mountains | March 1981 |

# GEOLOGICAL MAP OF THE BELGICA MOUNTAINS (REVISED EDITION)

# ベルジカ山脈地質図（改訂版）

地形は国立極地研究所刊行25,000分の1地形図による

ANTARCTIC GEOLOGICAL MAP SERIES, SHEET 29 (1981)

LOCATION DIAGRAM

Bare ice 裸氷

Moraine モレーン

Pink granite 桃色花崗岩 Grm

Granodiorite–diorite 花崗閃緑岩–閃緑岩 Grm

Syenite 閃長岩 Sy

Basic meta-dyke 変塩基性岩脈 Dm

Belgica upper formation ベルジカ上部層

Garnet-biotite gneiss ざくろ石 黒雲母 片麻岩 Gab

Clinopyroxene gneiss 単斜輝石片麻岩

Amphibolite 角閃岩

Augen gneiss 眼球状片麻岩 Gpo

Marble and skarn 大理石、スカルン UMb

Hornblende-biotite banded gneiss 角閃石黒雲母縞状片麻岩 Ghb

Belgica lower formation ベルジカ下部層

Amphibolite 角閃岩

Marble and skarn 大理石、スカルン LMb

Granitic gneiss 花崗岩質片麻岩 Ggr

Anticlinal axis 背斜軸

Synclinal axis 向斜軸

Strike and dip of foliation and lineation 片麻状構造の走向、傾斜及び線構造

0–30°

31–60°

61–90°

Astro control point 天測点

Triangulation point 三角点 ▲67.5

Spot height 標高点 ·74

Pond 池

不時着氷原 Fuzityaku Ice Field

鏡氷河 Kagami Ice Field

Mt. Hutshagen

Mt. Vanderheyden

Mt. de Maere

Mt. Loudis

Mt. Van Roggen

Kitami Ridge

Namako Glacier

Nanka-no-taki Valley

Minami Ridge

Mt. de Limburg Stirum

Mount Dido

Mt. Imbert

Mt. de Launoit

Mt. Ghiist

Mt. Brouwer

Mt. Hoge

Mt. van der Essen

Mt. Eyre

Teriga Ice Fall

Mt. Victor

Mt. Von Mieghem

Mt. Lahaye

Mt. Rossel

Mt. Paulus

Ura Ridge

GLACIER GLAEVER

Mt. de Kerckhove de Denterghem

Mt. Bellard

GLACIER NORSK POLARINSTITUTT

Ura Ridge

LOCATION DIAGRAM

Rauer Larsen Peninsula

Syowa Station

Prince Harald Coast

Lützow-Holm Bay

Soya Coast

Yamato Mountains

Minami-Yamato Nunataks

Mizuho Plateau

Belgica Mountains

1:25,000

500 0 500 1000 1500 2000 Meters

NATIONAL INSTITUTE OF POLAR RESEARCH, TOKYO, JAPAN

Geological survey by Keizo YANAI, Tamio NISHIDA and Hideyasu KOJIMA in 1979

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BELGICA MOUNTAINS

ベルジカ山脈

1：25,000

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