NATIONAL INSTITUTE OF POLAR RESEARCH

ANTARCTIC GEOLOGICAL MAP SERIES
SHEET 27 NORTHERN YAMATO MOUNTAINS
(1) MT. FUKUSHIMA

Explanatory Text of Geological Map of Northern Yamato Mountains, Antarctica (1) Mt. Fukushima

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Explanatory Text of Geological Map of Northern Yamato Mountains, Antarctica (1) Mt. Fukushima

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1. The Yamato Mountains

The Yamato Mountains situated at about 300 km southwest of Syowa Station on Ongul Islands are believed to have been first from the air in 1937 by the Norwegian Antarctic Expedition led by H. CHRISTENSEN. In 1960, a Belgian party confirmed the existence of the mountains from the air. Subsequently, an over-snow traverse party of the fourth Japanese Antarctic Research Expedition (JARE) stepped into the mountain area for the first time and made geological and geomorphological surveys.

Later, in 1961, 1970, 1973, 1974 and 1975 the traverse parties of JARE successively visited the mountains to investigate glaciology, geology, geomorphology, gravity and so forth.

The geological investigation of the Yamato Mountains was carried out first by KIZAKI who made a geologic map of the area (1/100,000 in scale) and described the outline of geology and petrography of the mountains (KIZAKI, 1964). The regional geomorphology was also outlined first by Y. YOSHIDA and FUJIWARA (1963). M. YOSHIDA and ANDO surveyed the JARE IV Nunataks in the south-eastern area of the mountains, and further checked the geology of the whole Yamato Mountains (YOSHIDA and ANDO, 1971). SHIRAISHI investigated the northern Yamato Mountains and made a geologic map (1/25,000 in scale) (SHIRAISHI, 1977). Unsurveyed areas were traced by YANAI and MATSUMOTO in 1974 and 1975, respectively.

A summarized report including the Lützow-Holm Bay region was published by TATSUMI *et al.* (1964), and a colored map (1/500,000 in scale) with a brief text was published as a sheet of the Antarctic map folio series (TATSUMI and KIZAKI, 1969).

2. Mt. Fukushima

The Mt. Fukushima region, located at 71°20′S–71°27′S latitude and 35°25′E–

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35°45′E longitude, occupies a part of the northern Yamato Mountains and consists of the biggest massif including the highest peak (2494 m) of the Yamato Mountains and several nunataks around it (Plate 1a).*

The massif is U-shaped in plan open to the northwest parallel to the general direction of the ice sheet flow. The moraine field spreads out with a concentric fan-like pattern from the bay of the massif on the downstream ice sheet. The surface moraine shows wavy reliefs a few meters high, and developed perpendicular to the direction of the flow (Plate 1b).

The greater part of the ice-free bedrock is covered with morainic deposit and weathered rock fragments, while the margin of the massif and nunataks is skirted by well-exposed cliffs. Three different levels of the flat planes, some of which are gently inclined, are recognized in the massif. Erratics and glaciated surfaces are found on the lower two planes.

3. Geology of Mt. Fukushima

3.1. General geology

The Yamato Mountains belong to one of the geological systems constructing the platform of the East Antarctic Continent which is composed of various sedimentary, metamorphic and plutonic rocks of Precambrian to Cambrian systems. It is noted that the distribution of granite gneiss and migmatite gneiss in the region is much more significant than those in the Lützow-Holm Bay region.

The rocks of the northern Yamato Mountains are divided into three groups, namely, syenite gneiss, granite gneiss and migmatite gneiss. The syenite gneiss group seems to have been formed by the granulite facies metamorphism, judging from the field occurrence and petrographical characteristics. Still, it is probable that a part of the group was emplaced as a plutonic mass. On the other hand, the granite gneiss and migmatite gneiss groups were produced by the subsequent metamorphism under the amphibolite facies conditions in association with granitization. However, the petrological as well as structural relationships between the granite gneiss group and the migmatite gneiss group are not clear yet.

The isotope dating on a rock of the Yamato Mountains is obtained from the Mt. Fukushima region (Table 1), and the result may signify the age of the granitization.

Table 1. Radiometric age of biotite from the Mt. Fukushima region.

Locality	Rock	Method	Age	Reference
71°24′S, 35°37′E	Leucocratic quartz syenite gneiss*	Rb-Sr	457 m.y.	PICCIOTTO and COPPEZ, 1964

* Designated as granitic gneiss in the reference.

* The following names of the nunataks are provisionally used in the geologic map: Kasuri Iwa, Sankaku Iwa, Hae Iwa, Suisyo Iwa and Konsei Point.

3.2. Petrography of the Mt. Fukushima region*

The rocks exposed in the region are classified into the following species on the basis of their mode of occurrences and their petrographic features.

1. Metabasites
2. Quartz syenite gneiss
3. Pink granite gneiss
4. Migmatite gneiss
5. Aplitic granite
6. Acid dyke

Table 2. Chemical composition of rocks from the Mt. Fukushima region.

No.	1	2	3	4	5	6	7	8	9	10
SiO_2	56.60	63.33	63.80	64.25	70.53	77.24	64.58	71.25	73.13	70.80
TiO_2	0.80	0.74	0.59	1.00	0.34	0.14	0.71	tr	0.24	0.64
Al_2O_3	14.19	14.46	15.87	15.05	14.94	11.96	15.48	15.84	13.78	13.04
Fe_2O_3	1.51	1.43	2.08	2.25	0.65	0.92	1.60	0.16	0.55	1.10
FeO	3.73	2.63	1.41	2.14	1.42	0.49	2.79	0.16	1.08	3.51
MnO	0.08	0.03	0.03	0.04	0.02	tr	0.03	tr	tr	0.04
MgO	5.40	2.59	0.96	1.14	0.73	0.11	0.75	tr	0.55	0.64
CaO	5.65	3.10	2.25	1.94	1.48	1.12	2.49	2.31	1.75	1.52
Na_2O	3.65	3.56	4.16	4.28	3.62	3.75	3.22	3.77	3.58	3.49
K_2O	6.54	6.94	7.29	6.74	5.74	3.34	7.00	6.13	4.99	4.20
P_2O_5	0.85	0.56	0.21	0.35	0.13	0.03	0.26	0.32	0.09	0.14
$H_2O(+)$	0.44	0.24	0.19	0.38	0.30	0.42	0.36	tr	0.14	0.31
$H_2O(-)$	0.32	0.18	0.27	0.10	0.18	0.22	0.16	0.15	0.18	0.27
CO_2						0.26		0.15	0.06	0.18
Total	99.76	99.79	99.11	99.66	100.08	100.09	99.43	100.24	100.12	99.88

No. 1. Mesocratic quartz syenite gneiss (Two pyroxene syenite gneiss) 73120802, SHIRAISHI, 1977.
2. Leucocratic quartz syenite gneiss (Clinopyroxene quartz syenite gneiss), 73120303, SHIRAISHI, 1977.
3. Leucocratic quartz syenite gneiss (Clinopyroxene quartz syenite gneiss), 73120904A, SHIRAISHI, 1977.
4. Leucocratic quartz syenite gneiss (Clinopyroxene quartz syenite gneiss), 73120905, SHIRAISHI, 1977.
5. Pink granite gneiss (Granite gneiss), 73120715, SHIRAISHI, 1977.
6. Pink granite gneiss (Granitic gneiss), YD224, KIZAKI, 1964.
7. Biotite granite, 73120705, SHIRAISHI, 1977.
8. Biotite granite, YD335, KIZAKI, 1964.
9. Biotite granite (Migmatitic gneiss), YD320, KIZAKI, 1964.
10. Acid dyke (Microcline granite dyke), YD333, KIZAKI, 1964.
( ): Rock names used in the references.

* The structural terminology by MEHNERT (1968) pertaining to granitic rocks and textural classifications by MOORE (1970) with modifications by COLLERSON (1974) were used in this study.

7. Unconsolidated deposits

Quartz syenite gneisses constitute a part of the syenite gneiss group, and the granite gneiss group consists of pink granite gneiss. Migmatite gneiss group consists of migmatite gneiss and aplitic granite.

The chemical compositions are shown in Table 2.

3.2.1. Metabasites

1) Concordant metabasite layers, 0.2–2 m in width, are band, lens or flame-like in shape, occurring mainly in the quartz syenite gneiss and the granite gneiss (Plate 2b). The interlayer is a fine to medium-grained foliated rock in a hand-specimen.

2) Concordant agmatitic metabasite occurs in the migmatite gneiss around the Konsei Point (Plate 2c). The rock agmatized by biotite granite of neosome represents pyroxene amphibolite about 10 m in width generally.

The texture of the amphibolite is typically equigranular polygonal. It is composed of plagioclase, hornblende, clinopyroxene and biotite with or without orthopyroxene. Plagioclase shows albite, pericline and their composite twins. Biotite and hornblende are aligned in a preferred orientation. Some poikiloblastic clinopyroxene grains are often converted to hornblende. Orthopyroxene is found as small rounded grains, though less in amount.

3) Discordant migmatitic metabasite is found at the northwestern part of the Mt. Fukushima massif. The rock shows a flame-like shape at the boundary because it is agmatized by the later acid dyke intrusion.

3.2.2. Quartz syenite gneiss

Quartz syenite gneiss is one of the constituents of the syenite gniess group which corresponds to the charnockitic group designated by KIZAKI (1964). It is distributed along the southeastern margin of the massif and in the nunataks around it. The gneiss is an intermediate type between the proper syenite gneisses, which are not exposed in the present region, and the granite gneiss. The quartz syenite gneiss can be divided into two types by the color index: leucocratic quartz syenite gneiss and mesocratic quartz syenite gneiss (Plate 2a). The two types are alternating, 2–50 m in width, and are similar in mineral assemblages. The leucocratic quartz syenite gneiss is generally pale pink in color owing to weathering, whereas the fresh surface is pale brown to light grey because of the color of potash feldspar porphyroblasts. The rocks are coarse and rather massive in appearance.

The following assemblage is common: potash feldspar+plagioclase+quartz +hornblende+biotite+clinopyroxene (relic)+sphene+apatite+opaque minerals+ zircon.

Potash feldspar is a main constituent, and perthite is well developed, showing ribbon, flame, braid and patch type in shape. It may be intermediate closer to maximum microcline, because the grid is sharp near the perthite lamellae. Relic clinopyroxene is conspicuous by its bluish green pleochroism.

Occasionally it is almost completely altered to hornblende or biotite. Hornblende and biotite are generally poikiloblastic. Xenoblastic quartz grains show undulatory extinction. Sphene is abundant in accessory mineral.

3.2.3. *Pink granite gneiss*

Pink granite gneiss occupies the central part of the Mt. Fukushima massif. It shows various migmatite structures such as nebulitic, schlieren and banded structures though their petrographical characters are almost identical (Plate 2b). It is a fine- to medium-grained quartzo-feldspathic rock containing abundunt pink microcline. Basic schlierens and layers consisting of the aggregate of biotite and hornblende characterize the gneiss. In the southeastern part of the massif, the pink granite gneiss grades into the quartz syenite gneiss which is composed of alternating leucocratic and mesocratic quartz syenite gneisses.

Nebulite gneiss and schlieren gneiss are inequigranular interlobate to amoeboid, though the former includes melanosome which is equigranular. The texture of banded gneiss is granoblastic though it shows a slightly preferred orientation principally due to the presence of elongated quartz grains. Mineral assemblage of the granite gneiss is essentially microcline, quartz, plagioclase and biotite with or without hornblende. Biotite is the main mafic mineral. Biotite laths show a preferred orientation with hornblende laths particularly in the banded gneiss. Hornblende and biotite are often altered to chlorite. Accessories are apatite, opaque minerals, zircon and sphene.

3.2.4. *Migmatite gneiss*

Migmatite gneiss is distributed in the western area of the massif and the Kasuri Iwa. The type locality is the Konsei Point at the southwestern end of the Mt. Fukushima massif. It is conspicuous that microcline grains in the rock are white in color in contrast with those of the pink granite gneiss in the outcrops. The rock shows very heterogeneous appearance, and consists of paleosome of two pyroxene biotite plagioclase gneiss and neosome of biotite granite. Metabasites occur sometimes as paleosomes. Thus, the rock shows agmatite, schollen and banded structures.

Two pyroxene biotite plagioclase gneiss is a fine-grained melanocratic rock with intense foliation. The mineral assemblage is plagioclase, quartz, potash feldspar, biotite, hornblende, clinopyroxene with or without orthopyroxene. The latter three minerals generally disappear at the Kasuri Iwa where aplitic granite is emplaced. Plagioclase which has albite and pericline twins is the most common mineral. Biotite laths have a strong preferred orientation, resulting in the marked schistosity of the rock. Pleochroism of clinopyroxene is very weak, colorless to pale green.

Biotite granite carrying purple-grey quartz grains is generally massive. The rock consists of microcline, quartz, plagioclase, biotite and a small amount of hornblende.

3.2.5. *Aplitic granite*

Aplitic granite occurs in the Kasuri Iwa north of the Mt. Fukushima massif. The rock intrudes as a sheet parallel to the foliation of the host rock which is the migmatite gneiss, and no contact effects are recognizable. The features in hand specimen are variable but the majority represents a medium-grained quartzo-feldspathic rock. Garnet grains are found in the central part of the body. Biotite tends to be richer at the margin. Quartz grains are purple-grey in color. Therefore, a genetic relationship is expected between the aplitic granite and the biotite granite of the migmatite gneiss. Mineral assemblage of the rock is potash feldspar, quartz and plagioclase with biotite and/or garnet. Accessories are rare, but opaque minerals, zircon and/or muscovite are found. Garnet is not abundant but is a characteristic mineral of this rock type. The grains are 0.8-5 mm in size and show a slightly idiomorphic shape though they are usually cracked.

3.2.6. Acid dyke

Acid dyke, 0.3-3 m in width, occurs throughout the present region, and is considered to cut all the rocks mentioned above. It is pink microcline granite in composition. The grain size varies from aplite to pegmatite. The dyke is composed of potash feldspar, quartz, plagioclase and biotite with or without hornblende.

3.2.7. Unconsolidated deposits

Unconsolidated deposits are moraines, talus and weathered rock fragments. The moraine usually continues to the talus which is accumulated at the foot of the cliffs. It is evident that the moraine deposits were derived not far from the region but from the rocks distributed in the present region. They are silt to boulder in size. Rounded erratics are occasionally contained. Weathered rock fragments distribute on the gentle slopes of the ice-free bedrock. It is often found that they are weathered *in situ*, and so their arrangements reflect the original distribution of the basement rocks.

4. Geologic Structure

The megascopic structure of the present region is rather simple. The foliation generally trends in the NE-SW direction and dips 20°- 40° SE in the granite gneiss and migmatite gneiss areas. Along the southeastern margin of the Mt. Fukushima massif, there is a zone having a steep dip of 60°-80° which suggests the presence of a shear zone. At the Kasuri Iwa, there seems to be a small anticlinorium. Thus, the northwestern side of the shear zone may form a limb of a large-scale antiform on the whole. The other side of the shear zone seems to be more complicated.

There are three kinds of lineations; mineral lineation which is defined by aggregate of mafic minerals, microfolding axis lineation and crenulation lineation. Meso-microscopic folding is seen in the granite gneiss and migmatite gneiss areas. Occasionally, the mineral lineation is cut by the folding axis lineation. Detailed structural analysis is not completed yet.

Small-scale thrust faults striking almost parallel to the foliation of the rocks are found in the migmatite gneiss area near the Konsei Point.

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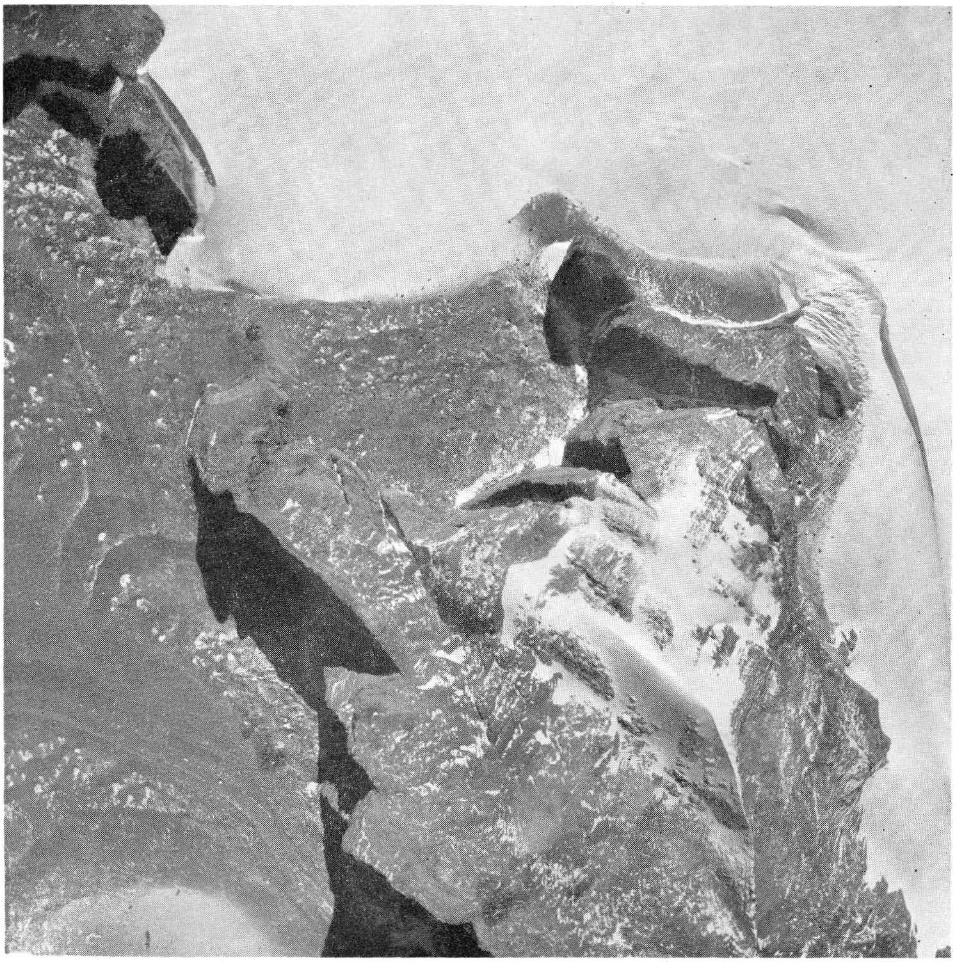
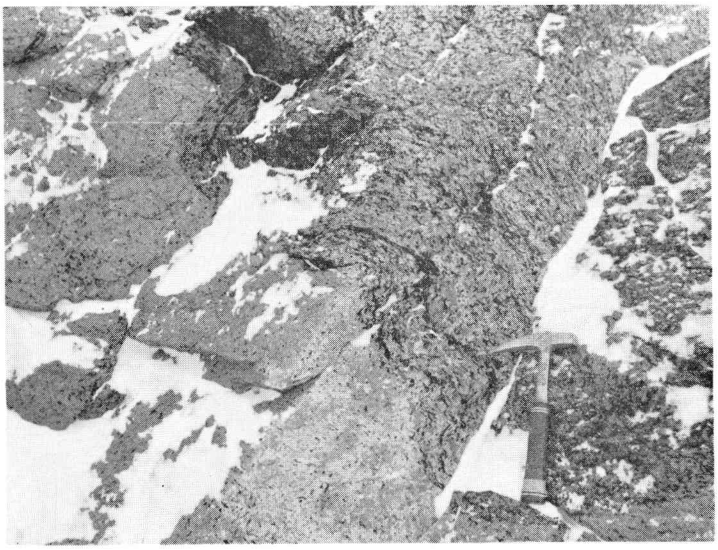


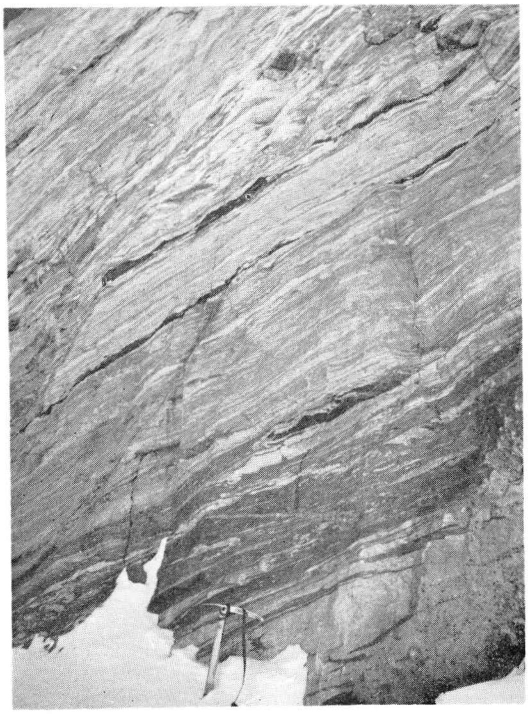
a. Aerial photograph showing the northern part of the massif and Kasuri Iwa (top, left). JARE Antarctic air photo, 11AV–III, No. 112.

b. Fan-like moraine field, viewed from the summit of Mt. Fukushima.

Plate 2



a. Contact of leucocratic quartz syenite gneiss and mesocratic quartz syenite gneiss.



b. Pink granite gneiss showing banded structure, intercalated with concordant metabasite layers.

c. Migmatite gneiss traversed by acid dyke (Konsei Point).

Antarctic Geological Map Series

Sheet 1	East Ongul Island	March 1974
Sheet 2	West Ongul Island	March 1974
Sheet 3	Teöya	March 1975
Sheet 4	Ongulkalven Island	March 1975
Sheet 5	Langhovde	March 1976
Sheet 6 & 7	Skarvsnes	March 1977
Sheet 9	Skallen	March 1976
Sheet 10	Padda Island	March 1977
Sheet 11	Cape Hinode	March 1978
Sheet 27(1)	Mt. Fukushima, Northern Yamato Mountains	March 1978

GEOLOGICAL MAP OF NORTHERN YAMATO MOUNTAINS
(1) MT. FUKUSHIMA
やまと山脈地質図
(1) 福 島 岳

地形図は国土地理院原図による

ANTARCTIC GEOLOGICAL MAP SERIES, SHEET 27 (1) (1978)

Unconsolidated deposits (moraine, talus, and weathered sand and gravels)
未凝固堆積物（モレーン，テーラス，風化砂礫）

Acid dyke
酸性岩脈

Aplitic granite (garnet bearing)
アプライト質花崗岩（ザクロ石を含む）

Migmatite gneiss with basic paleosomes
ミグマタイト質片麻岩，塩基性パレオゾームをもつ

Pink granite gneiss
桃色花崗岩質片麻岩

Leucocratic quartz syenite gneiss
優白色石英閃長岩質片麻岩

Mesocratic quartz syenite gneiss
中色石英閃長岩質片麻岩

Discordant migmatitic metabasite
非調和性ミグマタイト質変塩基性岩

Concordant agmatitic metabasite
調和性アグマタイト質変塩基性岩

Concordant metabasite layer
調和性変塩基性岩層

Banding, foliation, or schistosity planes
縞状構造，葉状構造，又は片状構造の面方向

Lineation, due to elongation or continuation of minerals
鉱物線構造

Ibid., due to crenulations
ちりめんじわ線構造

Axis of minorfolds
小褶曲の褶曲軸方向

Axial trace, antiform or synform
褶曲軸

Shear zone
剪断帯

457Rb Rediometric age determination showing age in m.y., method (R=Rb−Sr, U=U−Pb), mineral (b=biotite, e=euxenite)
放射能年代を出した地点と年代（百万年），方法　R：ルビジューム・ストロンチュウム法，U：ウラン鉛法，使用した鉱物(b：黒雲母，e：ユークセン石)

73120303 Point of sample analyzed chemically
化学分析値の地点

Astro control point
天測点

▲67.5 Triangulation point
三 角 点

·74 Spot height
標 高 点

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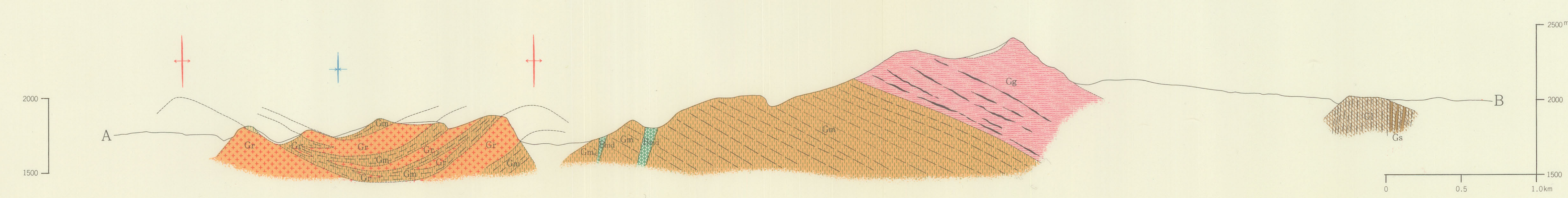
編集者：白石和行

Place-names in the right upper index map and in the geologic map are provisional except *Yamato Mountains* and *Mt. Fukushima*.

Geological survey by Koshiro KIZAKI in 1960
Hisao ANDO in 1970
Masaru YOSHIDA in 1970
Kazuyuki SHIRAISHI in 1973
Yukio MATSUMOTO in 1975
Compiled by Kazuyuki SHIRAISHI



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