GEOLOGY OF KASUMI ROCK, EAST ANTARCTICA

Tamio NISHIDA,

Institute of Earth Science, Faculty of Education, Saga University, 1, Honjo-machi, Saga 840

Keizo YANAI

National Institute of Polar Research, 9–10, Kaga 1-chome, Itabashi-ku, Tokyo 173

and

Hideyasu KOJIMA

Institute of Mining Geology, Mining College, Akita University, 1-1, Tegatagakuen-cho, Akita 010

Abstract: Kasumi Rock is a small triangle of ice-free area on the middle course of the Prince Olav Coast, East Antarctica. The crystalline basement rocks of the area are classified into the following types; (1) biotite gneiss, (2) marble and skarn, (3) amphibolites, (4) garnet-biotite gneiss and (5) granitic gneiss and pink granite.

Biotite gneiss is most widely distributed and granitic rocks of a subordinate amount are associated with it and other gneisses. A thin marble and skarn bed intercalated in the biotite gneiss in the lower portion of the sequence is traced well as a key bed. Towards the upper part of the sequence increase amphibolites.

The sequence of the area is summed up less than 1000 m in thickness.

Stracturally the core of an antiform of a larger order named Kasumi Rock Antiform lies along the north coast of the area and the rest corresponds to the southern limb of this antiform. There the metamorphic rocks apparently homoclinally dip to the south with fairly steep angles.

1. Introduction

Kasumi Rock which had been tentatively called "Mondai-iwa Rock" till October 1962 is situated at 68°21.5′S in latitude and 42°13.3′E in longitude on the Prince Olav Coast, East Antarctica and about 150 km northeast of Syowa Station of East Ongul Island. It is a small triangle of ice-free area about 2 km^2, bounded by the Antarctic Sea on the north, by the Kasumi Glacier on the east and by the Itime Glacier on the west (Figs. 1, 4, 5).

The area was first visited by members of the summer party of the 5th Japanese Antarctic Research Expedition (JARE-5) in 1960 and then biological and geodetic surveys were attempted in a short space of time.

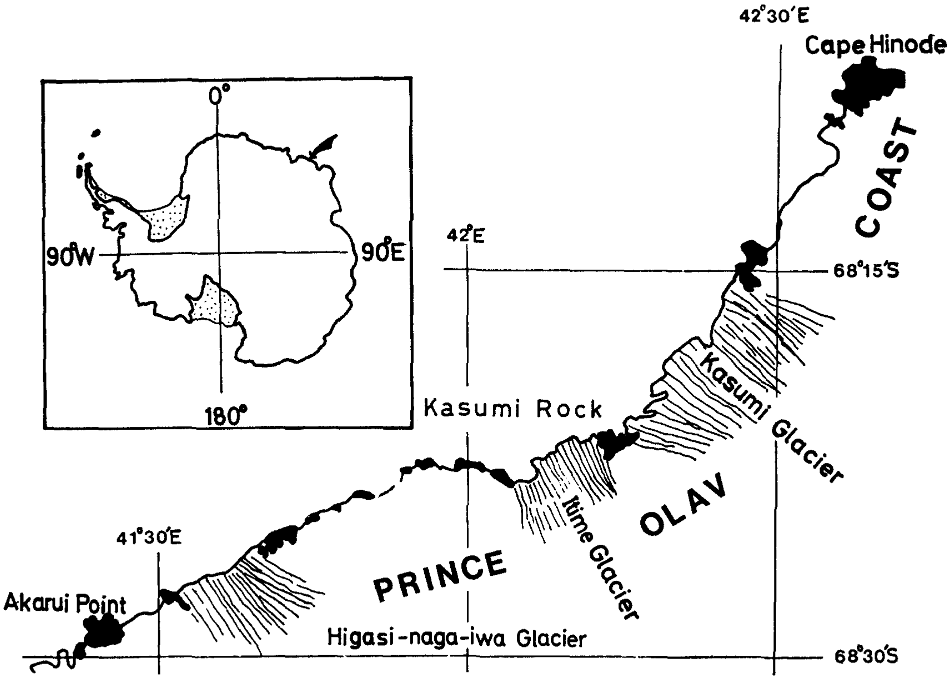

Fig. 1. Index map of the location of Kasumi Rock.

Geological survey was carried out by the present authors, members of JARE-20, from February 2 to 5, 1979. At that time geodetic survey was practiced again and one astronomical and three controlled points were set up in the area. However, since any detailed topographical map has not been published, field data are plotted on the conventional map compiled from the aerial photographs taken by JARE-3 in 1959 on a scale of 1:24000 and those by JARE-6 in 1962 on a scale of 1:26000.

The present report deals with the outline of geology and geologic structure of the area. Age determination and detailed petrological and chemical studies still remain to be done in the future.

Before going further, the present authors wish to express their sincere gratitude to Professor Y. YOSHIDA of the National Institute of Polar Research, who was the leader of JARE-20, and to the members of this party for their kind help in operation, and also to Mr. M. TANABE, the then Captain of icebreaker FUJI and to the crew for their logistic supports.

They are greatly indebted to Professor Y. MATSUMOTO of the Department of Mineralogical Sciences and Geology, Faculty of Science, Yamaguchi University, for his valuable suggestions, and also Dr. H. MATSUEDA of the Institute of Mining Geology, Mining College, Akita University, for his kind permission to use the unpublished data of skarn deposits of the area.

2. Geology

Except for thin morainic cover along the eastern and western margins of Kasumi Rock, the area consists of metamorphic and plutonic rocks which are classified on the basis of their modes of occurrence and petrologic features as follows:

2.1. Biotite gneiss
2.2. Marble and skarn
2.3. Amphibolites
2.4. Garnet-biotite gneiss
2.5. Granitic gneiss and pink granite.

The distribution of these rocks and the succession are shown in Fig. 2. The lower portion of the sequence of metamorphic rocks is distributed in the northern part of the area and the upper portion in the southern part.

Biotite gneiss is most widely distributed throughout the area and is associated with subordinate amounts of granitic rocks and other metamorphic rocks. The sequence of less than 1000 m in thickness is observable in the area. The lower 300 m of the sequence is characterized by thick biotite gneiss in which thin marble and skarn bed is intercalated and a relatively large amount of pink granite intrudes as sheets or dykes. The upper 700 m also consist of thick biotite gneiss and is associated with a subordinate amount of amphibolites. At least three thick amphibolite layers lie in the upper part of this upper sequence.

This metamorphic sequence of the area may be correlated with the Oku-iwa Group of YOSHIDA (1978). Although in the type-locality of the group, Oku-iwa Rock, no calcareous bed occurs (YOSHIDA, 1978; NAKAI *et al.*, 1979a, b, c, 1981), it has been reported only from Cape Ryûgû which is situated far northeast of the present area by NAKAI *et al.* (1979a, b, c).

2.1. Biotite gneiss

The rock is most widely distributed throughout the area and is composed mainly of biotite, quartz, plagioclase, hornblende and potassium feldspar (Fig. 6). Accessories are sphene, zircon, apatite and opaque minerals. Biotite is pleochroic with dark brown to yellowish brown. Foliation in this rock is represented by parallel arrangement of biotite grains and intensified by alternation of melanocratic layer and leucocratic one. Plagioclase is commonly larger in amount than potassium feldspar.

Massive melanocratic part of the rock due to concentration of biotites is often interbedded as layers of lenticular shape of maximum 10 m in thickness to make narrow valley or shallow groove because of its rather weak resistance to erosion (Fig. 7).

With increasing hornblende the rock grades into biotite-hornblende gneiss.

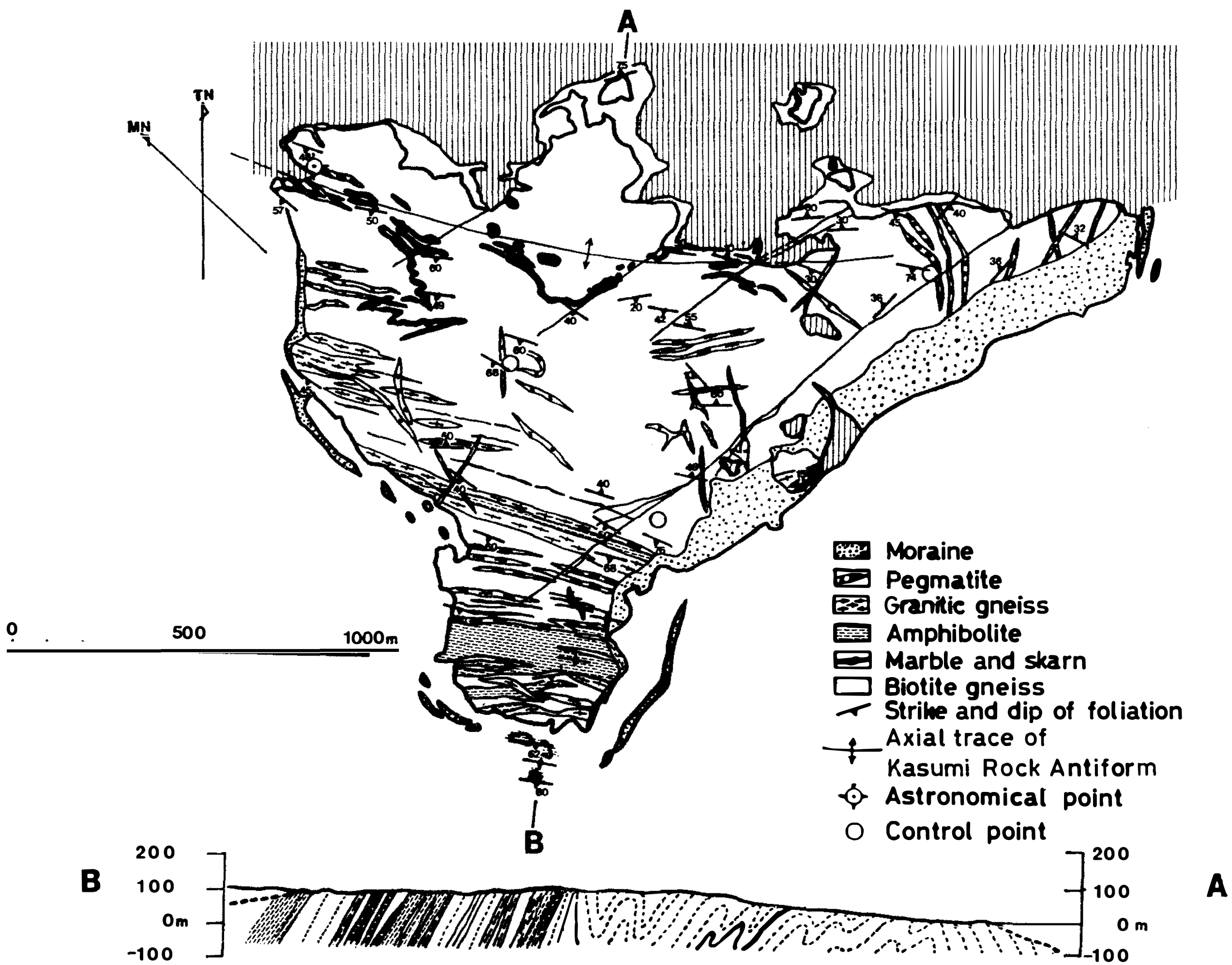

Fig. 2. Geological map of Kasumi Rock. The distribution of pink granite is largely omitted in this map.

Except for larger quantity of hornblende, this rock has the same mineral assemblage as the biotite gneiss (Fig. 8). Hornblende has a pleochroism of greenish brown to yellowish green.

2.2. Marble and skarn

A marble and skarn bed is intercalated within biotite gneiss in the northwestern part as shown in Figs. 2 and 3. This bed is ranging from 10 m to 1 m in thickness. In the eastern part of the distribution it diverges into the lower thin bed of less than 1 m and the upper rather thick one of 5 to 6 m. Marble occupies one-third to one-fourth of the bed where it exceeds about 2 m, and is leucocratic, white to pinkish white in color, coarse- to very coarse-grained and equigranular in texture, being monomineralically composed of equant calcite. Impure marble which is surrounded by marble or alternates with skarn contains dolomite grains sporadically and is yellowish white in color. The rock grades into skarn and allied rock with increasing scattered minerals. So far as fourteen samples of skarn deposits collected from five localities shown in Fig. 3 are microscopically examined, they may be tentatively divided into the following varieties:

(1) Banded phlogopite marble
(2) Clinopyroxene-skarn
(3) Banded amphibole-plagioclase-calcite-skarn
(4) Garnet-plagioclase rock.

Banded phlogopite marble comprises two types on the basis of mineral assemblage, one is a carbonate (calcite and dolomite)-phlogopite-diopside-(olivin) rock and the other a carbonate-phlogopite-plagioclase rock. The rock of the first type shows an equigranular or mozaic texture. When it contains olivine most of the

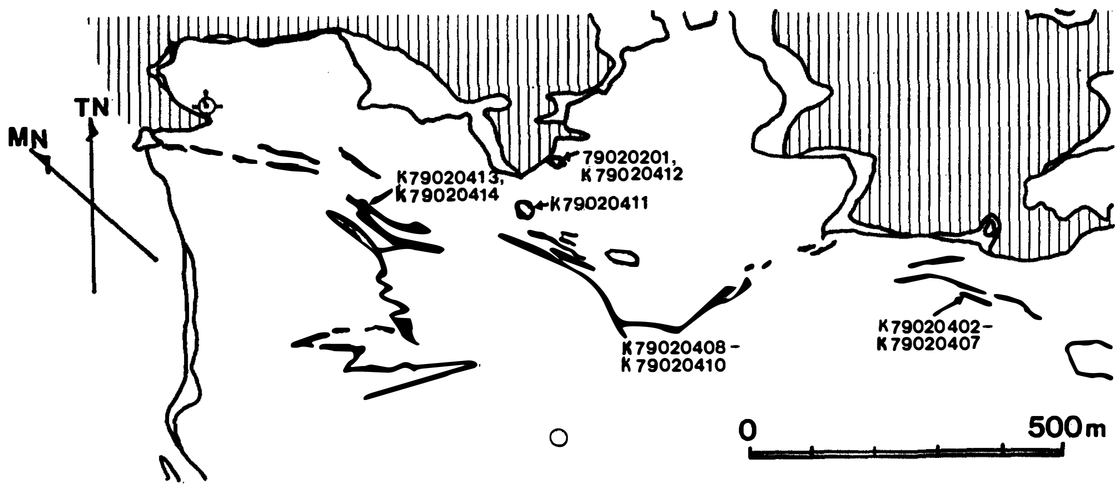

Fig. 3. Map showing the distribution of marble and skarn bed and sampling localities of skarn deposits.

grains are largely serpentinized along fractures and around the periphery. In the rock of the second type phlogopite and plagioclase characteristically occur as spots in carbonate matrix which may have been derived from unhomogeneity of the host rock.

Clinopyroxene-skarn also has various mineral assemblages such as (a) diopside-pale green amphibole-calcite-sphene-phlogopite-plagioclase, (b) clinopyroxene(diopside?)-calcite-quartz-sphene and (c) massive wollastonite-mica-calcite-quartz-clinopyroxene (salite?)-plagioclase-clinozoisite.

Banded amphibole-plagioclase-calcite-skarn is composed mainly of quartz, plagioclase, pale green amphibole, green amphibole and such accessories as sphene, clinopyroxene and apatite. The rock may be divided into quartz-plagioclase zone and amphibole-plagioclase zone.

Garnet-plagioclase rock is composed of garnet, plagioclase, wollastonite, calcite and smaller amounts of sphene, opaque mineral, chlorite, muscovite and clinozoisite. The rock shows a brecciated texture, and quartz and plagioclase fill the interstices of brecciated colored minerals. The rock is found only in the northernmost locality.

Where a granitic rock meets a calcareous bed, the former is essentially composed of potassium feldspar, quartz, plagioclase, biotite, hornblende and clinopyroxene, and has a granitic texture on the whole but the interstices between those mineral grains are filled by calcite and mica (muscovite?).

2.3. *Amphibolites*

The rocks belonging to the so-called metabasites are collectively represented in the geological map under the name of amphibolites. These rocks are distributed mostly in the southern part. They are fine-grained melanocratic rocks with slightly massive appearance. However, weak foliation due to parallel orientation of mafic minerals and thin folio of salic minerals is often developed. Amphibolite (*s. s.*) is usually composed mainly of hornblende, clinopyroxene, biotite, plagioclase and quartz, without garnet and potassium feldspar (Fig. 9). Amphibolite often grades into hornblende gneiss and rarely into eclogite-like rock of almost Ca-rich garnet.

In the upper part of the sequence three relatively thick layers of amphibolites are developed concordantly within biotite-gneiss and granitic gneiss. Amphibolite (*s. s.*) of the lowest amphibolite layer interbedded in the granitic gneiss alternates with hornblende gneiss of a lesser amount. Amphibolites in the middle portion are most widely distributed and alternate with biotite gneiss in various thicknesses. The uppermost amphibolites of alternation include irregular-shaped bodies of scapolite-clinopyroxene rock. The amphibolites themselves are composed of brown amphibole, pale green amphibole, plagioclase, phlogopite, calcite and apatite. The scapolite-clinopyroxene rock is composed of much scapolite and clinopyroxene and a smaller amount of hornblende and a very small amount of quartz (Fig. 10) and shows a heteroblastic texture due to sporadic subspherical clinopyroxene grains of approximately 5 mm in diameter. The grain is surrounded by finer green hornblende grains.

2.4. Garnet-biotite gneiss

Garnet-biotite gneiss occurs as thin layers within biotite gneiss in two outcrops in the central part. It is too small to be represented in the geological map. The rock is composed of biotite, garnet, plagioclase, potassium feldspar, quartz and muscovite. Relatively large porphyroblasts of garnet of 3 to 5 mm in diameter characterize this rock.

2.5. Granitic gneiss and pink granite

Throughout the area are widely distributed granitic rocks. They comprise the following three types.

2.5.1. Granitic gneiss

Gray granitic gneiss which possesses fairly strong gneissose structure and gneissic granite are distributed in biotite gneiss nearly concordantly with it in the central and the southern parts of the area. Both of the rocks are coarse-grained and composed of potassium feldspar, quartz, biotite and plagioclase (Fig. 12).

2.5.2. Garnet-bearing granitic gneiss

The rock forms sheet-like masses of several meters thick in biotite gneiss The rock is composed of potassium feldspar, quartz, plagioclase and garnet, often with a minor amount of biotite.

2.5.3. Pink granite

The rock occurs as dykes, sheets and irregular-shaped pools or veinlets of various scales throughout the area. Nevertheless the wide distribution of the rock, it is too complicated to be represented in an exact form in the geological map. The rock is usually pinkish-colored owing to abundant pinkish potassium feldspar. Quartz, plagioclase, biotite, hornblende and small amounts of apatite, zircon, sphene and opaque mineral are other constituents (Fig. 13). Pegmatitic and aplitic varieties of this rock also identified throughout the area, a part of which is represented in the geological map.

3. Geologic Structure

Many folds of various scales are identified in the area. Judging from the attitudes of metamorphic rocks, especially the distribution of the marble and skarn key bed and the amphibolite layers in biotite gneiss, the area is probably under the control of an antiform of larger order. It is named herein Kasumi Rock Antiform. The core of the antiform lies along the north coast and the axis of it runs east-west but its plunge is known only obscurely.

The zigzag pattern of the marble and skarn bed extending southerly may represent steeply plunging recumbent folds of a smaller scale on the southern limb of the Kasumi Rock Antiform. The distribution of an intensely folded calcareous bed in the area suggests that there is something that resembles the structure of the Skallen region of Lützow-Holm Bay on which many valuable studies have been made by YOSHIDA (1970, 1977, 1978), ISHIKAWA (1976) and YOSHIDA *et al.* (1976, 1977). However, the differences between the two areas are clear. The structure of the Skallen region is essentially recumbent folds of a larger scale while that of the Kasumi Rock area may be an open fold of a comparative scale.

Systematic study of fractures in the area has not been finished. Some structural lineaments with a northeast-southwest trend can be traced for over several hundreds meters. The fractures are almost vertical and run straight and there are no apparent movement and intrusion of igneous rock along the fractures. Thus these fractures may represent one of the joint sets of the area. They are oblique to the general structure of the area but almost parallel to the general direction of the Prince Olav Coast.

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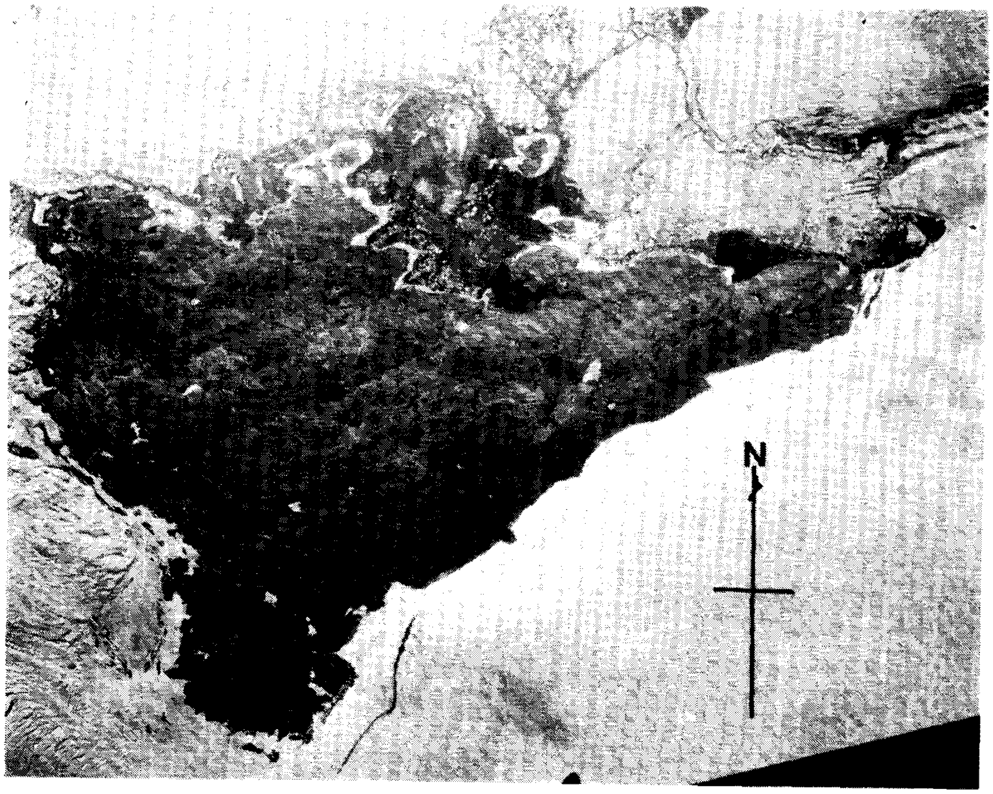

Fig. 4. Aerial photograph of Kasumi Rock. JARE Antarctic air photo, 3AV-1, 77. Four pinholes show the position of astronomical and controlled points.

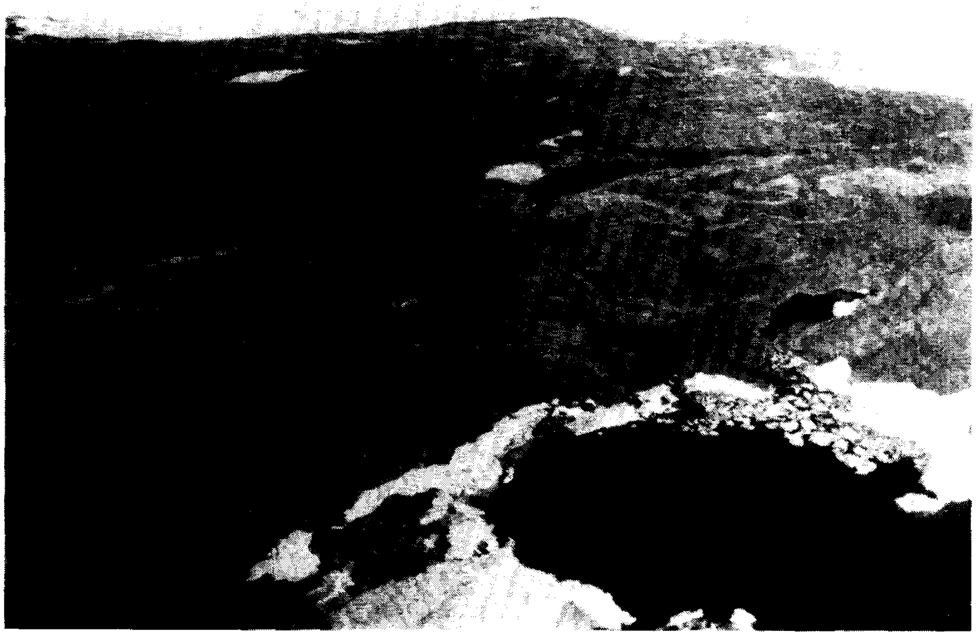

Fig. 5. Oblique aerial photograph of the northwestern part of Kasumi Rock.

Fig. 6. Biotite gneiss. Specimen No. N79020311. Plane polarized light, long dimension of photograph is about 1.5 mm.

Fig. 7. Melanocratic part of biotite gneiss. Specimen No. K79020311. Plane polarized light, long dimension of photograph is about 1.5 mm.

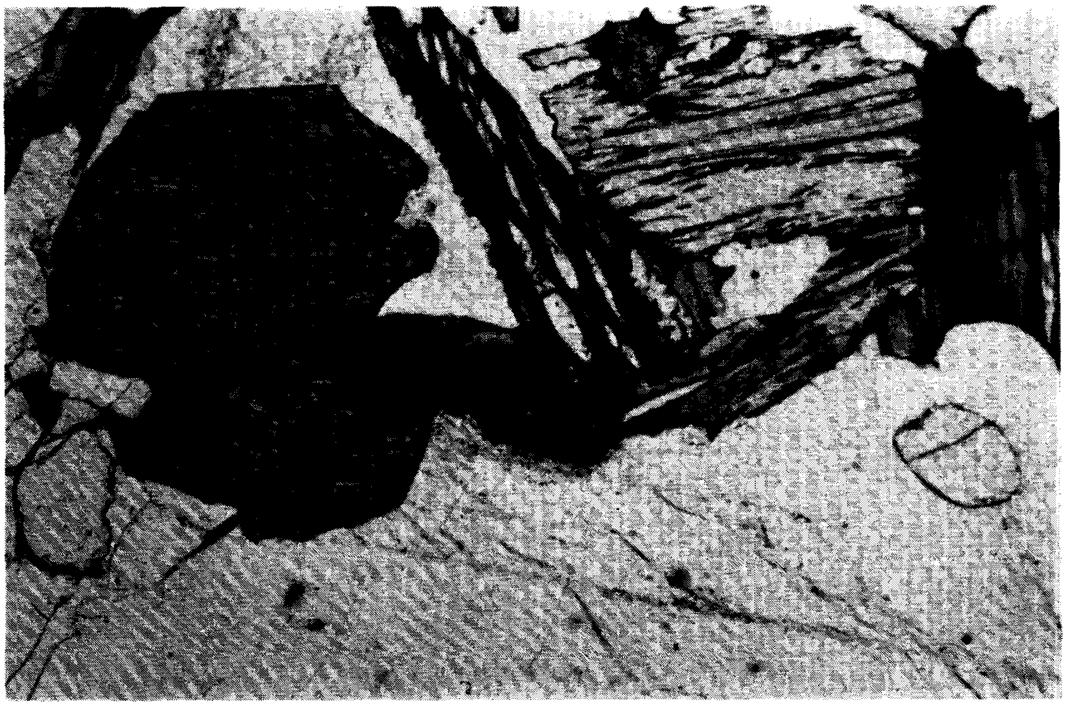

Fig. 8. Biotite-hornblende gneiss. Specimen No. K79020303. Plane polarized light, long dimension of photograph is about 1.5 mm.

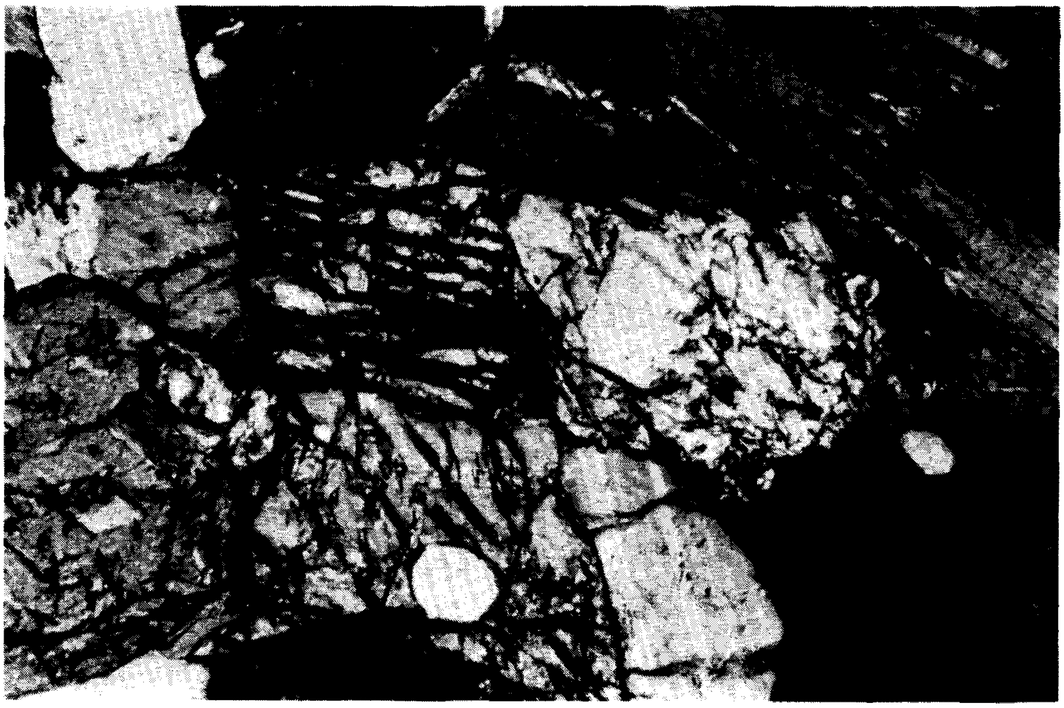

Fig. 9. Biotite amphibolite. Specimen No. K79020307. Crossed polarized light, long dimension of photograph is about 1.5 mm.

Fig. 10. Scapolite-clinopyroxene rock. Specimen No. Y79020305. Plane polarized light, long dimension of photograph is about 1.5 mm.

Fig. 11. Scapolite-clinopyroxene rock. Specimen No. Y79020305. Clinopyroxene altered to hornblende around its periphery. Crossed polarized light, long dimension of photograph is about 1.5 mm.

Fig. 12. Granitic gneiss. Specimen No. Y79020301. Crossed polarized light, long dimension of photograph is about 1.5 mm.

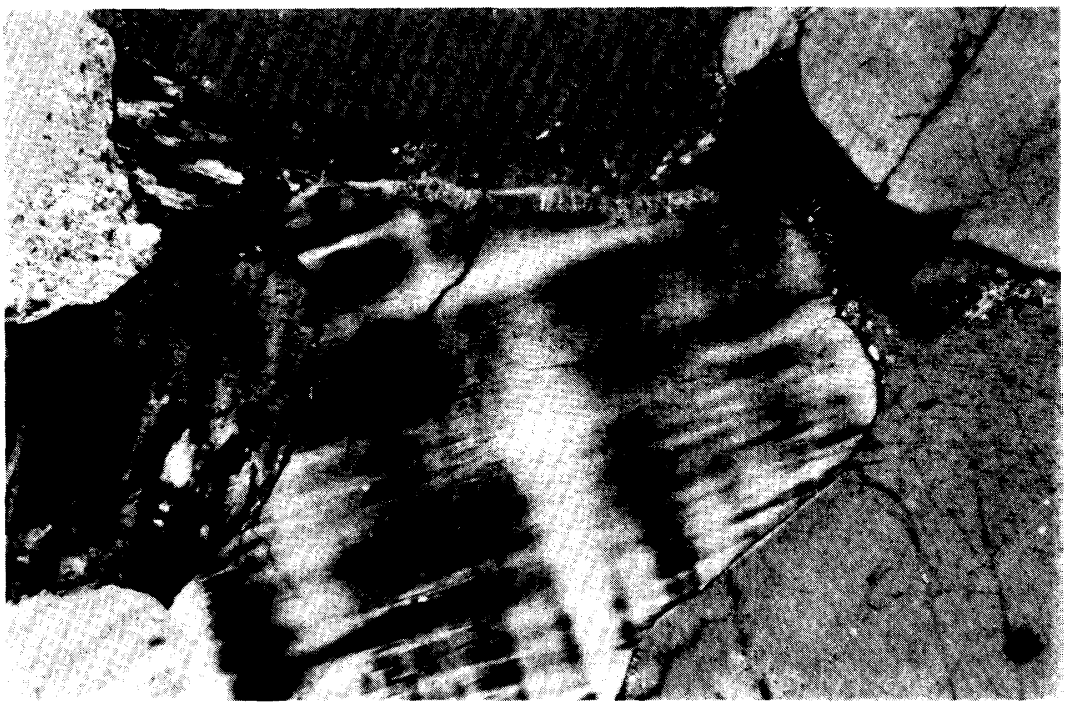

Fig. 13. Pink granite. Specimen No. N79020313. Crossed polarized light, long dimension of photograph is about 1.5 mm.