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ANTARCTIC GEOLOGICAL MAP SERIES
SHEET 21 CAPE OMEGA

Explanatory Text of Geological Map of Cape Omega, Antarctica

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1. The Cape Omega Area

Cape Omega with an area of 6.8 km^2 (ice-free area: 3.3 km^2) is located at 68°34′S–68°36′S and 41°00′E–41°08′E on the Prince Olav Coast, East Antarctica. It is about 80 km northeast of Syowa Station, East Ongul Island. Along the coast of Cape Omega, basement rocks are distributed widely, and behind the rocks the fringe zone of moraine is developed.

Field scientists used for survey aerial photographs which had been taken on the scale of approximately 1: 25500 by the 3rd Japanese Antarctic Research Expedition (JARE–3).

The first geological investigation of Cape Omega was conducted by Masaru YOSHIDA in 1969, a member of JARE–10; he reported that the metamorphites in the area belong to the Oku-iwa group which is the youngest in the Lützow-Holm Bay system (M. YOSHIDA, 1978).

The second survey, which is more extensive, was made by a four-man party including the present authors in January 1977 (JARE–18). At the same time, the geodesic survey was carried out by Sigeru OTAKI and others to produce the present topographic map on the scale of 1: 25000.

The easternmost part of the area and Daruma Rock were not surveyed geologically because of the shortage of time.

2. Geomorphology

Cape Omega is composed of three main bare rocks. This is bounded by the Antarctic Sea on the north and west, and is covered with continental ice on the southeastern margin. The highest point of bare rocks is about 95 m above the sea level.

NW–SE and NE–SW relief features are characteristic of the area. Trends of them reflect the strike of foliation and the joint system of gneissic basement rocks. The hilly topography is ascribed to resistive granitic basement rocks. The surface

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of bare rocks was apparently subjected to glaciation as is shown by roche moutonnée, glacial striae and glacial deposits laid down in shallow depressions. Glacial striae remain more poorly in the northern part of the area than in the southern part. It suggests that the northern area was subjected to weathering for a longer period than the southern area, because the retreat of ice sheet from bare rocks was not uniform and it took place earlier in the northern area than in the southern area. Directions of glacial striae are commonly NW–SE, though they often vary in a range of 25° (Plate 1a). It suggests that the direction of ice movement slightly changed with advance and retreat of ice sheet in the past. Many stone circles with a diameter of 60–300 cm are developed in the glacial deposits in the shallow depressions.

A conspicuous moraine bank lies in a higher place about 5–95 m from bare rocks; the highest point of this moraine is 160 m above the sea level. This moraine bank, about 5.2 km in length and 380 m in maximum width, seems to be the largest one along the Sôya Coast and the Prince Olav Coast. The thickness of the moraine is often 1 meter above ice surface according to measurements at banks of meltwater streams cutting the moraine bank (Plate 1b). Large scale patterned grounds consisting of sorted stone circles, sorted steps and contraction cracks are developed well in the moraine bank (Plate 1c).

The age of formation of this moraine bank is not clear at the present time, but it is likely in the late Quaternary.

Ice-free area of Cape Omega faces the sea with steep slope. There is no deposit on this steep slope, which is in contrast to many other ice-free areas where marine deposits bearing fossil shells and indicating the existence of raised beaches have been found.

3. Geology and Petrography of Basement

The surveyed area is composed of various kinds of metamorphic and plutonic rocks. Metamorphic rocks consist of the derivatives of such sedimentogenetic equivalents as basic, pelitic, psammitic and calcareous rocks. So-called metabasites are also the representatives among the metamorphic rocks. Plutonic rocks are divided into three kinds, *i.e.*, gneissose granite, pink granite and pegmatite.

Macroscopic feature of this area is characterized by the existence of major-scale folds with the axes of E–W direction. Distinct gneissosity parallel to the lithologic layering of the metamorphites has the general trend of NW–SE direction.

Generally speaking, the stratigraphically lower horizon crops out in the more eastern part of the area. It is composed of metamorphic rocks originated from basic rocks, while the middle horizon consists of basic, calcareous and psammitic metamorphites associated with pink granite. In the upper horizon, main constituents are metamorphic equivalents of pelitic and psammitic rocks, associated with gneissose granite.

The petrographical characters of the constituent rocks will be described below. Some representatives of the chemical compositions of metamorphic minerals are given in Table 1.

3.1. *Hornblende gneiss* (*Gh*)

The rock occurs principally in the northeastern part. It is medium-grained, and shows distinct gneissosity. The constituent minerals are greenish hornblende, biotite, plagioclase, microcline and quartz. Clinopyroxene is sometimes found. Judged from the mineral association, the rock seems to have been derived from basic rocks.

3.2. *Clinopyroxene gneiss* (*Gcp*)

This occurs mainly in the central part, and does not appear so frequently as the other metamorphites. The rock is medium-grained, and is weathered more highly than are the surrounding rocks (Plate 2a). The constituent minerals are clinopyroxene, brown to greenish hornblende, plagioclase, calcite and sphene. Ca-rich garnet is occasionally found. Based on the mineral association, the original rock of the gneiss can be calcareous one.

3.3. *Biotite gneiss* (*Gb*)

This is found mainly in the central part. The rock is medium-grained without distinct gneissosity. It is characteristic that the rock is often associated with pink granite. Biotite, microcline, plagioclase and quartz are the main compositional minerals. The texture and mineral assemblage of the rock suggest its original rock to be psammitic.

3.4. *Garnet-biotite gneiss* (*Ggb*)

This is generally developed in the western part, closely associated with gneissose granite. The rock is dark in color, being characterized by the sporadic occurrence of porphyroblastic garnet (Plate 2b). The main constituent minerals are garnet, biotite, muscovite, plagioclase, microcline and quartz, associated with no aluminosilicate minerals. Judged from the mineralogy, it is most likely that the original rock is a pelitic equivalent.

3.5. *Metabasite* (*Bm*)

This occurs often throughout the area concerned, and is found as a bed or a lens in the surrounding gneisses and granites (Plate 2c). The rocks included under the name of metabasites show such a wide variation in the mineral association as eclogitic rock (garnet-clinopyroxene-plagioclase-scapolite-quartz), clinopyroxe amphibolite (clinopyroxene-hornblende-biotite-microcline-plagioclase-quartz) and biotite amphibolite (biotite-hornblende-plagioclase-quartz). They may have been derived from calcareous, basic and ultrabasic rocks.

3.6. *Gneissose granite* (*Grg*)

This occurs mainly in the western part. The gneissose structure characterized

Table 1. Some representative EPMA analyses of metamorphic minerals from the Cape Omega area.

	1	2	3	4	5	6	7	8	9	10
SiO_2	62.5	64.1	46.0	37.4	35.5	44.3	45.1	46.6	38.1	48.1
TiO_2	0.02	0.04	0.41	0.07	3.68	0.03	0.03	0.52	0.52	0.92
Al_2O_3	23.1	18.3	33.7	21.2	17.9	26.7	33.9	5.02	14.0	5.84
FeO*	0.21	0.20	2.07	33.5	20.2	0.22	0.18	14.8	14.5	14.0
MnO	0.06	0.06	0.04	1.57	0.12	tr.	0.03	0.67	1.58	0.39
MgO	0.01	0.01	0.76	4.78	9.19	0.05	0.02	8.48	0.53	14.9
CaO	4.99	0.13	0.03	1.86	0.05	20.2	18.5	23.4	30.1	11.9
Na_2O	8.51	1.19	0.30	0.01	0.08	2.52	1.21	0.67	0.02	1.61
K_2O	0.36	15.1	11.0	0.04	9.91	0.12	0.03	0.05	0.04	0.69
Total	99.8	99.1	94.3	100.4	96.6	94.1	99.0	100.2	99.4	98.4
Numbers of ions										
O	32.000	32.000	22.000	24.000	22.000		32.000	6.000	24.000	23.000
Si+Al						12.000				
Si	11.118	11.934	6.229	5.950	5.370	7.011	8.414	1.813	6.165	7.052
Al	4.840	4.028	5.381	3.975	3.200	4.989	7.471	0.230	2.672	1.010
Ti	0.002	0.006	0.042	0.008	0.419	0.003	0.005	0.015	0.063	0.102
Mg	0.002	0.003	0.154	1.134	2.074	0.013	0.006	0.492	0.128	3.248
Fe''	0.031	0.031	0.234	4.454	2.554	0.030	0.028	0.483	1.964	1.713
Mn	0.009	0.010	0.005	0.212	0.015	—	0.004	0.022	0.216	0.049
Ca	0.951	0.026	0.005	0.317	0.008	3.420	3.696	0.974	5.221	1.874
Na	2.933	0.431	0.077	0.002	0.024	0.773	0.437	0.051	0.006	0.458
K	0.081	3.584	1.900	0.008	1.915	0.023	0.008	0.003	0.009	0.129

No. 1. Plagioclase in garnet-biotite gneiss, 77010501.
2. Microcline in garnet-biotite gneiss, 77010501.
3. Muscovite in garnet-biotite gneiss, 77010501.
4. Garnet in garnet-biotite gneiss, 77010501.
5. Biotite in garnet-biotite gneiss, 77010501.
6. Scapolite in eclogitic rock, 77010907A.
7. Plagioclase in eclogitic rock, 77010907A.
8. Clinopyroxene in eclogitic rock, 77010804.
9. Garnet in eclogitic rock, 77010804.
10. Hornblende in clinopyroxene amphibolite, 77010615
* Total Fe as FeO.

Analyst: M. SUZUKI

by the parallel arrangement of biotite is distinct, which generally coincides with the gneissosity of the surrounding gneisses. The rock is coarse-grained, the main constituents being biotite, plagioclase, microcline and quartz.

3.7. Pink granite (Grp)

This is developed throughout the area and is often accompanied by biotite gneiss. It is fine- to medium-grained, being rather massive in appearance. The main constituent minerals are biotite, plagioclase, microcline and quartz. Pinky color of microcline is characteristic.

3.8. Pegmatite (Pg)

This is sometimes found throughout the area concerned, penetrating the surrounding rocks obliquely to their general trend. The rock is characterized by the association of biotite, pinky-colored microcline, plagioclase and quartz. It sometimes shows ptygmatic folds.

4. Metamorphic Condition

Judged from the mineral associations and mineralogical characters of metamorphites, the metamorphic grade in the area concerned is, in general, as high as the amphibolite facies.

On the other hand, some specimens suggesting the granulite facies metamorphism have been found among the ubiquitous amphibolite facies metamorphites. Among the higher-grade rocks, the representatives are metabasites with the stable association of scapolite (meionite 77 to 81 mole %) and plagioclase (anorthite 87 to 95 mole %) with some garnet-biotite gneiss. In the latter gneiss, the metamorphic temperature calculated from the garnet-biotite geothermometer is as high as 828°C, assuming the total pressure to be 5 kb.

Judged from the mode of occurrence and microscopic features the granulite facies rocks seem to be the products of older phase metamorphism. They may have escaped the later alteration under the amphibolite facies metamorphic condition (SUZUKI, 1979).

References

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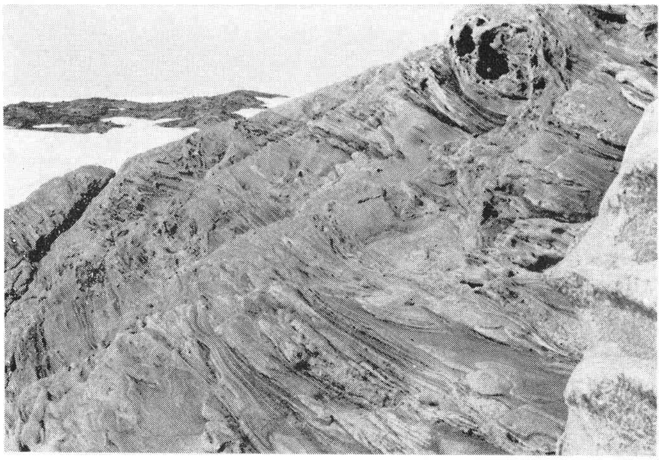
YOSHIDA, M. (1978): Tectonics and petrology of charnockites around Lützow-Holmbukta, East Antarctica. J. Geosci., Osaka City Univ., **21**, 65–152.

a. Two directions of glacial striae; the pencil shows N28W and the ball pen shows N54W.

b. Moraine and core ice which were cut by a meltwater stream.

c. Patterned ground in the moraine bank.

Plate 2



a. Alternation of clinopyroxene gneiss, biotite gneiss and garnet-biotite gneiss.

b. Porphyroblastic garnet in garnet-biotite gneiss.

c. Mode of occurrence of metabasite.

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