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SHEET 26 STRANDNIBBA

Explanatory Text of Geological Map of Strandnibba, Antarctica

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1. Introduction

The Strandnibba district includes three major ice-free outcrops, *i.e.* Vesleknausen, Strandnibba and Ytstekleppane, and are located at 69°57′–70°00′S in latitude and at 38°44′–38°54′E in longitude, on the southern part of the Sôya Coast around Lützow-Holm Bay, East Antarctica. A geological and geomorphological survey by the Japanese Antarctic Research Expedition (JARE) in the Strandnibba district was begun by M. YOSHIDA and H. ANDO (JARE-10) in August 1969 and continued by K. YANAI and K. MORIWAKI (JARE-15) in January 1974, Y. MATSUMOTO (JARE-16) in August 1975 and completed by Y. MOTOYOSHI and S. MATSUBARA (JARE-24) in January 1983. Vesleknausen, regretfully, has not been surveyed. The geodetic survey was conducted by the Geographical Survey Institute in 1974 and the topographical map, "Strandnibba" on a scale of 1 : 25000, was published in 1985.

2. Geomorphology

The Strandnibba district is located at the southern part of the Sôya Coast around Lützow-Holm Bay. Its western edge is bounded by the Shirase Glacier. Rapid movement of the Shirase Glacier has cut the outcrop, leaving a vertical cliff which is typically observed at the western face of Ytstekleppane (Plate 2C). Besides the steep cliff at the glacier, the present district generally forms gentle slopes to the sea (Plate 2), probably due to the successive erosion by past ice sheets. Glacial striae are visible on the bedrock surface trending NW-SE, which is similar to those seen at other ice-free outcrops in the Lützow-Holm Bay region (MORIWAKI, 1976). These striae suggest the considerable glacial erosion of the outcrops in the past (MORIWAKI and YOSHIDA, 1983).

Strandnibba is the main outcrop in the district. It extends in a nearly E-W direction which is similar to the geological structure of the basement rocks. The landform gently dips to the sea, though shallow glacial troughs cut the central and eastern parts and the bedrocks are drowned to form small embayments. The development of a raised beach was recognized indistinctly at 4 m above sea level, and ice pushed ridge (NICHOLS, 1968) of 3 m height was formed from detrital gravel, sand and silt (MORIWAKI,

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1976). In addition, three terrace surfaces probably formed by a meltwater stream were also described by MORIWAKI (1976) at Strandnibba.

Several fractures which run NNE-SSW are recognized at Strandnibba. They clearly cut the general trend of the basement structure. Weakly deformed microscopic textures are observed in the rocks along these fractures.

Aggregates of moraines form queues at the southern margin of Strandnibba and eastern side of Vesleknausen. They are known as stranded moraine and are accompanied by a shear plane in the margin of the continental ice at Strandnibba. The shear plane declines towards the upper stream of the continental ice flow, which is striking N45–60°E and dipping 32–40°S, and the direction of the stress is estimated to be around NW-SE. The present direction almost coincides with those of the glacial striae on the bedrock surface (MORIWAKI, 1976). The varieties of rocks in the moraines suggest their exotic origin. Their characteristic types are briefly described in the text.

3. Geology and Petrography

3.1. Geology

The Strandnibba district is underlain chiefly by pyroxene gneiss (charnockitic rock), and subordinate amounts of biotite-pyroxene gneiss (basic charnockitic rock) and amphibolite (a kind of so called metabasite) are present. Hornblende-biotite gneiss and pegmatite occur locally. Biotite gneiss, garnet gneiss and granitic gneiss, which are common in other areas of the Lützow-Holm Bay region, are generally scarce and migmatites are rarely developed. Calc-silicate rocks are not present. Neither macroscopically well-layered structure nor mesoscopically gneissose structure are well developed.

Chemical compositions of six specimens from Strandnibba are listed in Table 1. Reflecting their Al-poor petrochemical features suggested by the absence of normative corundum, alumino-silicates are rarely present in these rocks and it is not possible to assess the conditions of metamorphism petrographically. In addition, the scarcity of garnet in the gneisses is characteristic.

The basement rocks of the Strandnibba district are classified into the following types on the basis of their modes of occurrence and petrographic features.

1. Pyroxene gneiss (Gp)
2. Biotite-pyroxene gneiss (Gbp)
3. Hornblende-biotite gneiss (Ghb)
4. Amphibolite (Am)
5. Pegmatite (P)

In addition to these basement rocks, characteristic types among the moraines are also described as

6. Moraines (M).

3.2. Petrography

3.2.1. Pyroxene gneiss (Gp)

This is the most widely distributed rock type in the district and has been sometimes referred to as a charnockitic rock in the Lützow-Holm Bay region (TATSUMI and

Table 1. Chemical compositions of rocks from Strandnibba.

No.	1	2	3	4	5	6
SiO_2	50.58	47.18	65.26	46.86	50.87	67.67
TiO_2	1.22	1.19	0.38	2.19	0.62	0.23
Al_2O_3	10.16	11.29	14.59	8.82	12.17	15.09
Fe_2O_3	3.34	3.52	1.85	3.89	2.38	1.60
FeO	10.11	8.80	2.49	10.15	7.64	1.24
MnO	0.19	0.17	0.07	0.20	0.18	0.04
MgO	12.02	14.13	2.94	13.88	10.85	1.80
CaO	6.27	7.69	2.87	7.96	8.96	2.53
Na_2O	2.30	2.06	3.52	1.35	2.54	4.06
K_2O	2.49	2.13	5.26	3.05	2.39	4.61
P_2O_5	0.29	0.13	0.27	0.30	0.31	0.18
H_2O (+)	0.73	1.25	0.41	1.29	0.82	0.45
H_2O (−)	0.13	0.07	0.08	0.08	0.07	0.13
Total	99.83	99.61	99.99	100.02	99.80	99.63
			C. I. P. W. norms			
Q	—	—	14.59	—	—	18.96
C	—	—	—	—	—	—
or	14.72	12.59	31.09	18.02	14.12	29.24
ab	19.46	17.43	29.79	11.42	21.49	34.36
an	10.04	15.27	8.47	9.00	14.75	9.33
di wo	8.00	9.20	1.67	11.91	11.56	0.85
di en	5.09	6.36	1.14	8.12	7.57	0.66
di fs	2.40	2.10	0.40	2.86	3.18	0.10
hy en	12.15	0.37	6.18	2.86	2.37	3.82
hy fs	5.74	0.12	2.15	1.01	1.00	0.55
ol fo	8.90	19.95	—	16.53	11.98	—
ol fa	4.63	7.25	—	6.42	5.56	—
mt	4.84	5.10	2.68	5.46	3.45	2.32
il	2.32	2.26	0.72	4.16	1.18	0.44
ap	0.67	0.30	0.63	0.70	0.72	0.42

No. 1. SN–119–01 Biotite-pyroxene gneiss
2. SN–119–02B Amphibolite
3. SN–119–08 Pyroxene gneiss
4. SN–119–09 Amphibolite
5. SN–120–11 Biotite-pyroxene gneiss
6. SN–120–16 Pyroxene gneiss

Analysis by Japan Chemical Analysis Center.

KIKUCHI, 1959; YOSHIDA and ANDO, 1971; YOSHIDA, 1978). The gneissosity is generally weak and indistinct alignments of mafic minerals are observed (Plate 3A). Dark yellowish color is one of the characteristics of this rock. Ptygmatic veining is occasionally observed (Plate 4A).

Clinopyroxene, orthopyroxene, plagioclase, K-feldspar and quartz are the main constituent minerals with apatite, zircon and opaque minerals as accessories. Small amounts of hornblende and biotite occur in some cases.

Pyroxenes are characterized by their distinct pleochroism; pale green for clinopyroxene and pale green to pale pink for orthopyroxene. Hornblende shows pleochroism of X' = pale yellow and Z' = deep green. As is shown in Plate 5A, its textural relation to pyroxenes suggests that all these phases have coexisted stably at the peak of metamorphism. Biotite is rare, and is frequently associated with pyroxenes and/or hornblende. It shows pleochroism of X' = pale yellow and $Y'=Z'$ = deep brown. From the textural evidence, biotite might be a retrograde product during cooling and hydration. Plagioclase shows distinct albite twining and it is slightly deformed locally (Plate 5B). No microscopically zoned structure is detected but the An content ranges from 20 to 25% by EPMA determinations. Some plagioclases show the antiperthitic texture and the myrmekite texture is occasionally observed. K-feldspar commonly occurs, though the modal proportion relative to plagioclase and quartz varies from specimen to specimen. It is generally microperthitic with spotted and/or bladed exsolved albite (Plate 5B). Quartz is always present, and includes tiny unidentified phases. Opaque phases are mainly ilmenite with hematite lamellae and occasional magnetite.

Pyroxene gneiss close to the fractures at Strandnibba shows a slighly deformed structure. Mafic minerals have been selectively altered to secondary chlorite and feldspars have been partly replaced by sericite. Sporadic distribution of sulfide globules and calcite are commonly observed in such a rock.

3.2.2. Biotite-pyroxene gneiss (Gbp)

This rock is petrographically a mafic pyroxene gneiss and is less abundant than pyroxene gneiss, though their relations are usually gradational. This rock is bluish gray in the field and generally lacks distinct gneissosity and is locally intruded by pegmatite (Plate 4B).

The main constituent minerals are clinopyroxene, orthopyroxene, biotite, plagioclase and opaque minerals. Hornblende and K-feldspar occur occasionally. Quartz is recognized locally associated with biotite.

Clinopyroxene and orthopyroxene are predominant and show distinct pleochroism. The textural relationships suggests their equilibrium coexistence (Plate 5C). Biotite is closely associated with pyroxenes. Some of them are idiomorphic with pleochroism of X' = pale brown and $Y'=Z'$ = dark brown. Zircon with a metamict halo is occasionally observed in biotite flakes. Hornblende is a minor constituent associated with or included in pyroxenes. It shows pleochroism of X' = pale green and Z' = deep green. Plagioclase with distinct albite twining is not optically zoned. Antiperthitic and myrmekitic textures are rarely observed. The An content of plagioclases range from 30 to 35% by EPMA measurement and the values are rather higher than those of pyroxene gneiss. K-feldspar is a minor phase. It shows microperthitic texture with spotted exsolved albite. Opaque phases comprise magnetite with or without ilmenite as independent grains (Plate 7A). Magnetite is microscopically homogeneous, whereas exsolved hematite is commonly observed in ilmenite.

3.2.3. Hornblende-biotite gneiss (Ghb)

This rock locally occurs at the small island to the north of Strandnibba with intercalation of an amphibolite layer. The geological structure of the island is very similar to that of Strandnibba.

The main constituents are hornblende, biotite and plagioclase whereas pyroxenes, K-feldspar and quartz are absent (Plates 6A, 6B). Apatite, zircon and opaque minerals are present as accessories.

Hornblende is pleochroic with X' = light yellow and Z' = green and distinct cleavage is frequently observed. Some grains include apatite, biotite and an opaque phase. Biotite frequently occurs as idiomorphic flakes and occasionally includes zircon with metamict halos. It shows pleochroism of X' = pale brown and Y' = Z' = reddish brown. Plagioclase is characterized by the distinct albite twining and is optically unzoned.

3.2.4. Amphibolite (Am)

This rock has been collectively referred to as a member of metabasite in the region around Lützow-Holm Bay since the JARE-1 (Tatsumi and Kikuchi, 1959). On the basis of the mineral assemblage, this kind of rock in the Strandnibba district is named as amphibolite. It occurs generally as a concordant layer or locally as a lenticular body in the basement pyroxene gneiss (Plate 3B). The main constituent minerals are hornblende, biotite, pyroxenes, plagioclase and opaque minerals (Plate 6C). K-feldspar and quartz are recognized as minor phases. The pyroxene-predominant rock type resembles petrographically the biotite-pyroxene gneiss in mineral assemblage.

Hornblende predominates in this rock, being pleochroic with X' = pale brown and Z' = greenish brown. The axial color is slightly inhomogeneous in a single grain. Biotite occurs always as idiomorphic flakes with pleochroism of X' = light brown and Y' = Z' = dark brown. Pyroxenes generally occur among these hydrous minerals and show characteristic pleochroism. Plagioclase shows distinct albite twining and is free from a zoned structure. Its An content is around 35%. Opaque phases are relatively scarce in this rock, though ilmenite with hematite lamellae, magnetite and unidentified sulfide globules are sporadically present.

3.2.5. Pegmatite (P)

The development of pegmatite in the present district is relatively poor, but concordant to discordant pegmatite veins are intruded into the basement gneisses at several localities (Plate 4B). The thickness of the pegmatite is generally small, up to about 30–40 cm. The constituent minerals are megacrystic quartz, K-feldspar, plagioclase, biotite and occasionally magnetite.

3.2.6. Moraines (M)

Among the exotic moraines, two characteristic types are described here.

1) Garnet-sillimanite-biotite gneiss: This rock was collected at Strandnibba. It shows strong gneissosity by the alignment of biotite and tabular sillimanite. Pinkish garnet is also present and other constituent minerals are quartz, plagioclase and opaque phases. Although this rock is probably exotic, rocks with the same mineral assemblage have been reported from several localities in the Lützow-Holm Bay region as a part of the basement (Motoyoshi *et al.*, 1985).

2) Sapphirine-orthopyroxene-sillimanite-cordierite gneiss: This rock was collected by K. Yanai in 1974 at Strandnibba and was briefly described by Kojima *et al.* (1983). As is shown in Plate 8B, symplectitic sapphirine, cordierite, distinctly pleochroic orthopyroxene, sillimanite, biotite (X' = light yellow, Y' = Z' = brown) and plagioclase are the constituent minerals. Although various kinds of sapphirine-bearing rocks have been reported from the Archean Napier Complex in Enderby Land, about

600 km ENE of the present district, the original locality of the present rock is geologically and glaciologically unclear and certainly outside the presently surveyed area.

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Appendix: Mineral Chemistry

Representative mafic silicates, clinopyroxene, orthopyroxene, hornblende and biotite in the rocks from Strandnibba were chemically analyzed by electron microprobe analyzer using JEOL JCXA-733 at the National Institute of Polar Research. Specimen current was always kept at 0.012–0.015 microampere and accelerating voltage at 15 kV. Synthesized pure oxides and natural minerals were used for standards with intensity data being adjusted using BENCE and ALBEE's (1968) correction method.

Mineral assemblages of the rocks for microprobe analyses are summarized in Table A1, and the analytical results are listed in Tables A2 to A5.

Mr. H. KOJIMA of the National Institute of Polar Research is acknowledged for his technical assistance in microprobe analysis.

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Table A1. Mineral assemblages of the rocks for microprobe analyses.

Sample No.	Rock type	Cpx	Opx	Hb	Bt	Pl	Kf	Qz	Il	Mt
SN-119-01	Gbp	+	+		+	+	−		+	+
-02A	Gp	+	+			+	+	+	+	
-02B	Am	+	+	+	+	+	−	+		
-06	Gp	+	+	−	+	+		+	+	+
-08	Gp	+	+	+	−	+	+	+	+	+
-09	Am	+	+	+	+	+			+	+
-120-11	Gbp	+	+	−	+	+				+
-13	Am	+	+	+	+	+			+	
-19B	Am	+	−	+	+	+				+

Abbreviations: Cpx–clinopyroxene, Opx–orthopyroxene, Hb–hornblende, Bt–biotite, Pl–plagioclase, Kf–K-feldspar, Qz–quartz, Il–ilmenite, Mt–magnetite.

Table A2. Microprobe analyses of clinopyroxene from Strandnibba.

Sp. No.	119-01	119-02A	119-02B	119-06	119-08	119-09	120-11	120-13	120-19B
Anal. No.	22	43	59	3	34	63	1	36	53
SiO_2	51.72	52.22	52.03	52.04	51.67	51.82	51.96	51.41	51.22
TiO_2	0.25	0.18	0.10	0.19	0.21	0.28	0.08	0.47	0.23
Al_2O_3	2.02	1.85	2.39	1.60	1.83	2.11	2.02	2.71	2.45
Cr_2O_3	0.13	0.02	0.12	0.07	0.10	0.26	0.20	0.18	0.14
FeO*	9.41	9.50	8.06	9.31	9.83	7.89	9.09	7.62	8.48
MnO	0.22	0.14	0.17	0.21	0.27	0.22	0.28	0.21	0.19
MgO	13.07	13.03	13.66	13.77	13.32	13.81	13.61	14.15	13.38
CaO	22.14	22.25	22.00	22.02	21.78	22.70	21.60	22.33	22.25
Na_2O	0.76	0.63	0.69	0.89	0.82	0.82	0.61	0.79	0.80
K_2O	0.00	0.00	0.02	0.02	0.01	0.00	0.00	0.01	0.00
Total	99.72	99.82	99.24	100.12	99.84	99.91	99.45	99.88	99.14
On the basis of 6 oxygens									
Si	1.945	1.959	1.950	1.949	1.944	1.936	1.952	1.917	1.932
Al(IV)	0.055	0.041	0.050	0.051	0.056	0.064	0.048	0.083	0.068
Al(VI)	0.035	0.041	0.056	0.019	0.025	0.029	0.041	0.037	0.041
Ti	0.007	0.005	0.003	0.005	0.006	0.008	0.002	0.013	0.007
Cr	0.004	0.001	0.004	0.002	0.003	0.008	0.006	0.005	0.004
Fe	0.296	0.298	0.253	0.292	0.309	0.247	0.286	0.238	0.267
Mn	0.007	0.004	0.005	0.007	0.009	0.007	0.009	0.007	0.006
Mg	0.733	0.729	0.763	0.769	0.747	0.769	0.762	0.787	0.752
Ca	0.892	0.894	0.883	0.883	0.878	0.909	0.869	0.892	0.899
Na	0.055	0.046	0.050	0.065	0.060	0.059	0.044	0.057	0.058
K	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000
Mg/Fe+Mg	0.712	0.710	0.751	0.725	0.707	0.757	0.727	0.768	0.738

* Total Fe as FeO.

Analyst: Y. MOTOYOSHI

Table A3. Microprobe analyses of orthopyroxene from Strandnibba.

Sp. No.	119-01	119-02A	119-02B	119-06	119-08	119-09	120-11	120-13	120-19B
Anal. No.	19	42	51	8	31	64	2	35	52
SiO_2	52.10	51.79	52.66	52.84	52.35	52.31	52.01	52.84	52.36
TiO_2	0.08	0.07	0.04	0.07	0.09	0.04	0.00	0.14	0.08
Al_2O_3	0.85	0.89	1.03	0.70	0.83	1.15	0.92	1.18	1.08
Cr_2O_3	0.03	0.08	0.02	0.01	0.06	0.06	0.07	0.07	0.00
FeO*	23.27	23.68	21.53	23.01	23.94	21.64	23.24	18.98	21.76
MnO	0.46	0.55	0.60	0.46	0.72	0.71	0.64	0.42	0.58
MgO	21.89	21.35	23.39	21.90	21.05	23.44	21.82	25.39	23.04
CaO	0.77	0.59	0.59	0.59	0.65	0.53	0.55	0.49	0.62
Na_2O	0.01	0.01	0.03	0.02	0.01	0.03	0.06	0.04	0.02
K_2O	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Total	99.46	99.01	99.90	99.61	99.70	99.91	99.31	99.55	99.54
On the basis of 6 oxygens									
Si	1.964	1.966	1.959	1.982	1.974	1.949	1.964	1.949	1.958
Al(IV)	0.036	0.034	0.041	0.018	0.026	0.051	0.036	0.051	0.042
Al(VI)	0.002	0.005	0.004	0.013	0.011	—	0.005	—	0.005
Ti	0.002	0.002	0.001	0.002	0.003	0.001	0.000	0.004	0.002
Cr	0.001	0.002	0.001	0.000	0.002	0.002	0.002	0.002	0.000
Fe	0.734	0.752	0.670	0.722	0.755	0.674	0.734	0.585	0.680
Mn	0.015	0.018	0.019	0.015	0.023	0.022	0.020	0.013	0.018
Mg	1.230	1.208	1.297	1.225	1.184	1.302	1.228	1.396	1.284
Ca	0.031	0.024	0.024	0.024	0.026	0.021	0.022	0.019	0.025
Na	0.001	0.001	0.002	0.001	0.001	0.002	0.004	0.003	0.001
K	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mg/Fe+Mg	0.626	0.616	0.659	0.629	0.611	0.659	0.626	0.705	0.654

* Total Fe as FeO.

Analyst: Y. MOTOYOSHI

Table A4. Microprobe analyses of hornblende from Strandnibba.

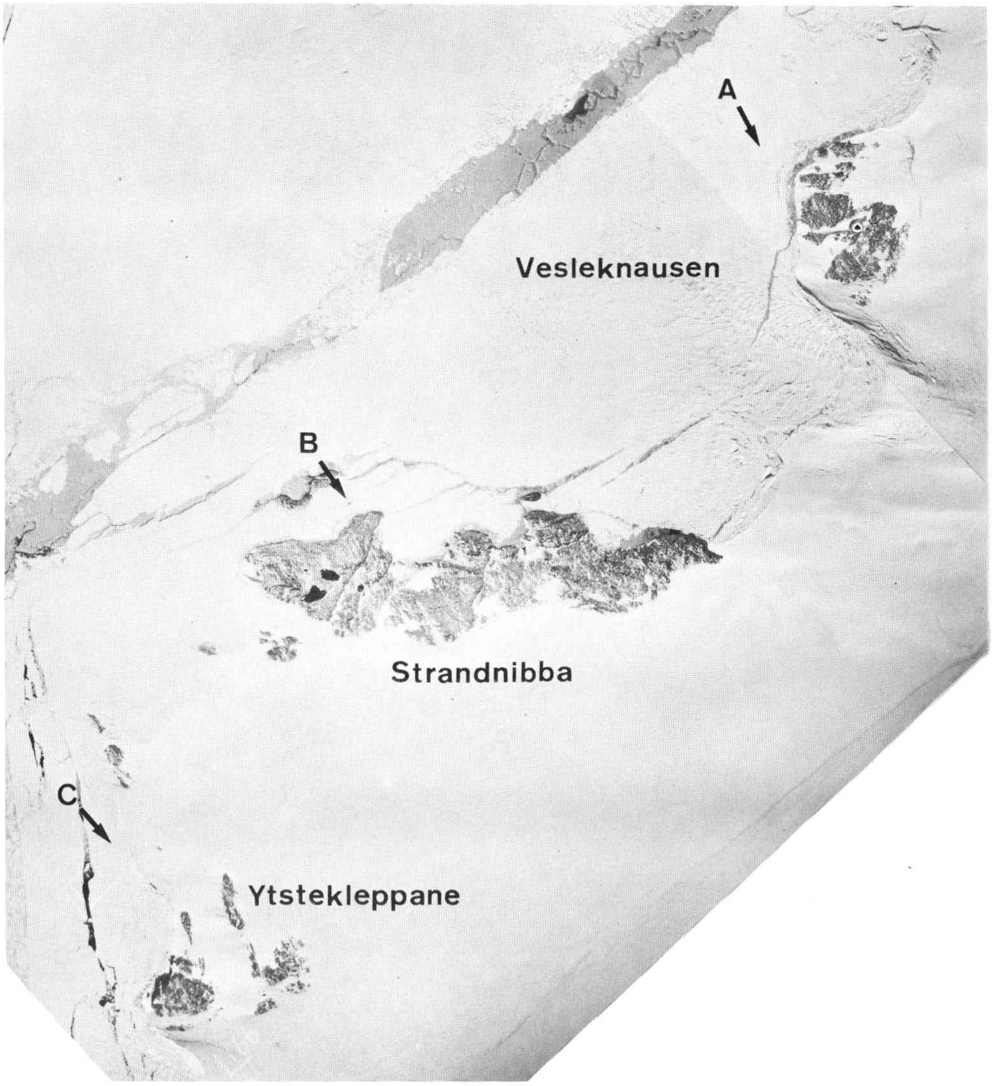
Sp. No.	119-02B	119-06	119-08	119-09	120-13	120-19B
Anal. No.	70	10	30	60	33	56
SiO_2	43.63	43.70	43.28	42.38	41.83	42.65
TiO_2	1.39	1.80	2.01	2.46	3.34	2.12
Al_2O_3	10.28	9.46	9.62	10.71	11.05	10.30
Cr_2O_3	0.23	0.08	0.17	0.39	0.32	0.32
FeO*	12.25	13.34	14.55	13.40	11.85	13.25
MnO	0.13	0.00	0.12	0.18	0.08	0.15
MgO	14.41	13.49	12.79	12.50	13.15	12.80
CaO	11.69	11.51	11.49	11.83	11.53	11.48
Na_2O	1.98	1.56	1.80	1.79	2.17	1.84
K_2O	1.25	1.36	1.21	1.45	1.22	1.31
Total	97.24	96.30	97.04	97.09	96.54	96.22
On the basis of 23 oxygens						
Si	6.479	6.573	6.508	6.363	6.271	6.441
Al(IV)	1.521	1.427	1.492	1.637	1.729	1.559
Al(VI)	0.279	0.250	0.213	0.258	0.224	0.275
Ti	0.155	0.204	0.227	0.278	0.377	0.241
Cr	0.027	0.010	0.020	0.046	0.038	0.038
Fe	1.521	1.678	1.830	1.683	1.486	1.674
Mn	0.016	0.000	0.015	0.023	0.010	0.019
Mg	3.190	3.025	2.867	2.798	2.939	2.882
Ca	1.860	1.855	1.851	1.903	1.852	1.858
Na	0.570	0.455	0.525	0.521	0.631	0.539
K	0.237	0.261	0.232	0.278	0.233	0.252
Mg/Fe+Mg	0.677	0.643	0.610	0.624	0.664	0.633

* Total Fe as FeO. Analyst: Y. MOTOYOSHI

Table A5. Microprobe analyses of biotite from Strandnibba.

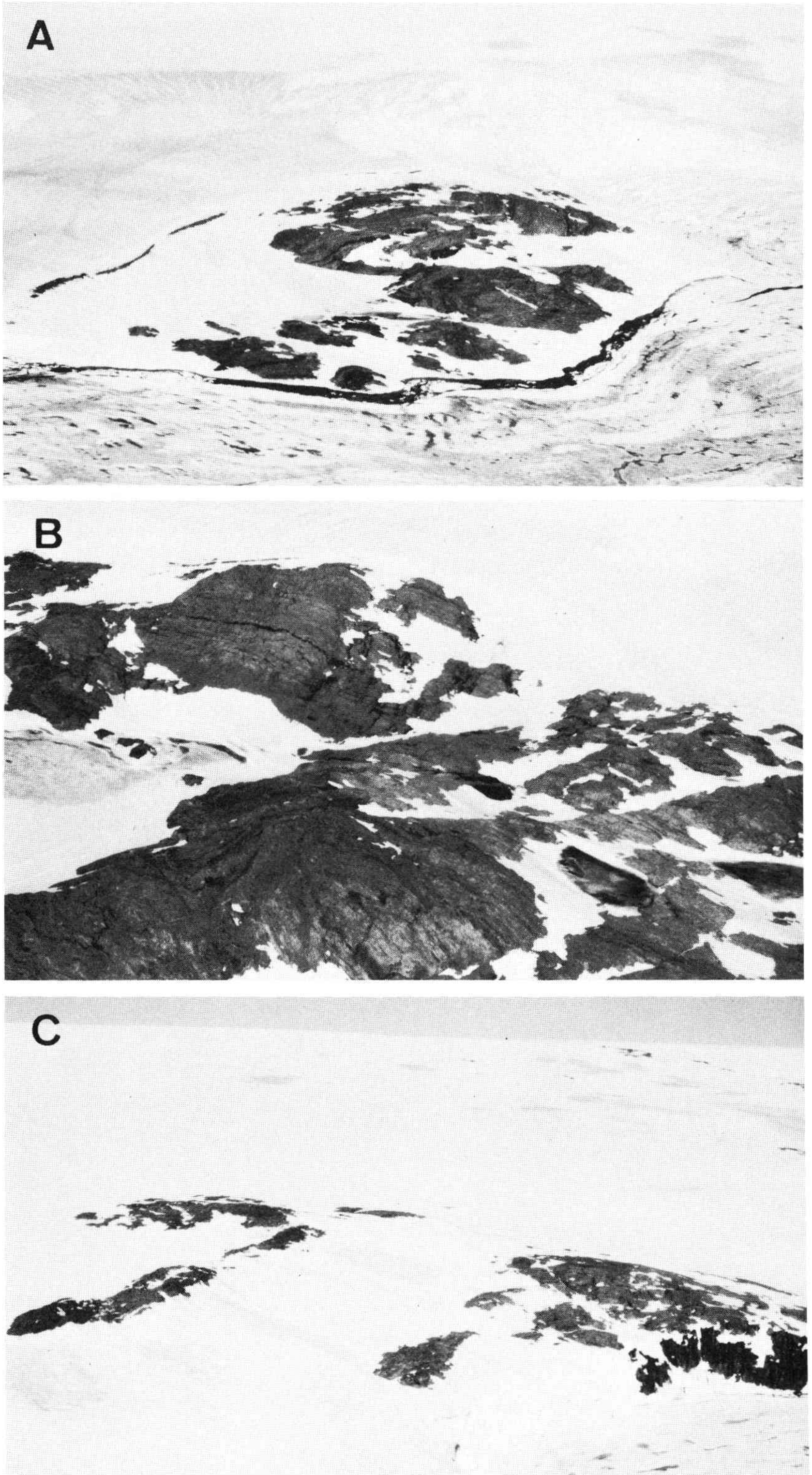
Sp. No.	119-01	119-02B	119-09	120-11	120-13	120-19B
Anal. No.	13	61	81	29	40	72
SiO_2	37.33	38.00	36.93	37.58	36.79	37.38
TiO_2	6.00	3.39	5.63	2.76	6.87	5.36
Al_2O_3	13.80	14.01	14.09	13.90	14.30	13.37
Cr_2O_3	0.06	0.14	0.34	0.22	0.36	0.22
FeO*	12.73	12.00	13.84	12.97	11.76	13.79
MnO	0.04	0.07	0.06	0.00	0.10	0.03
MgO	14.97	17.99	15.15	17.09	15.40	15.64
CaO	0.00	0.00	0.06	0.01	0.01	0.00
Na_2O	0.07	0.12	0.16	0.10	0.26	0.22
K_2O	9.46	9.40	9.05	9.55	8.98	9.12
Total	94.46	95.12	95.31	94.18	94.83	95.13
On the basis of 22 oxygens						
Si	5.577	5.609	5.495	5.637	5.451	5.571
Al(IV)	2.423	2.391	2.472	2.363	2.497	2.348
Al(VI)	0.007	0.046	—	0.094	—	—
Ti	0.674	0.376	0.630	0.311	0.765	0.601
Cr	0.007	0.016	0.040	0.026	0.042	0.026
Fe	1.591	1.481	1.722	1.627	1.457	1.719
Mn	0.005	0.009	0.008	0.000	0.013	0.004
Mg	3.334	3.958	3.361	3.822	3.401	3.475
Ca	0.000	0.000	0.010	0.002	0.002	0.000
Na	0.020	0.034	0.046	0.029	0.075	0.064
K	1.803	1.770	1.718	1.827	1.697	1.734
Mg/Fe+Mg	0.677	0.728	0.661	0.701	0.700	0.669

* Total Fe as FeO. Analyst Y. MOTOYOSHI

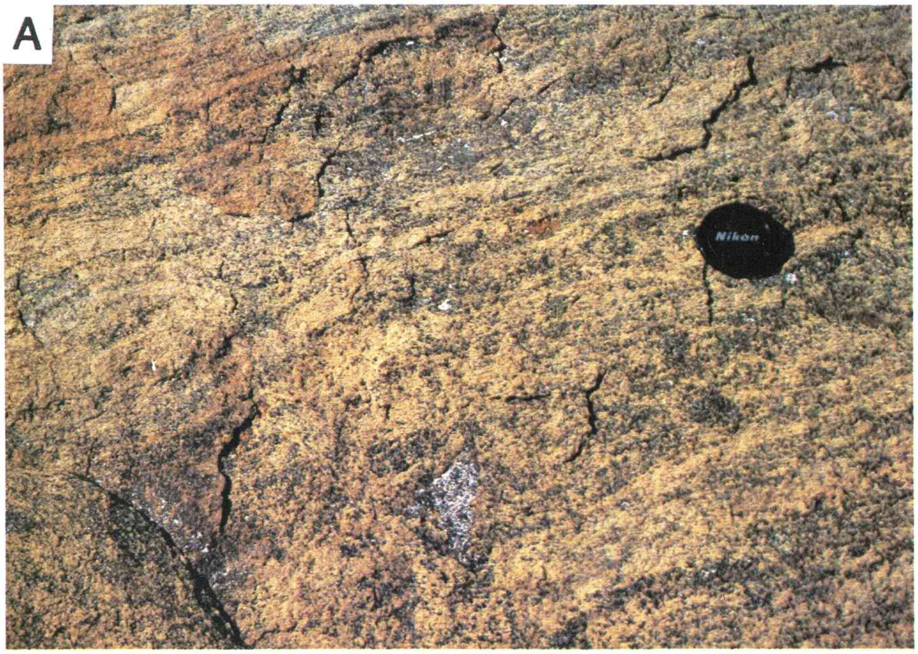


Aerial photograph of the Strandnibba district. JARE Antarctic air photograph (16AV-1, Nos. C11-3 and C11-4). Arrows indicate the viewing direction for each outcrop shown in Plate 2.

Plate 2



Oblique air photographs. A. Vesleknausen. B. Strandnibba. C. Ytstekleppane.



A. Pyroxene gneiss (Gp) at Strandnibba. Indistinct preferred orientation of mafic minerals (mostly of pyroxenes) are observed.

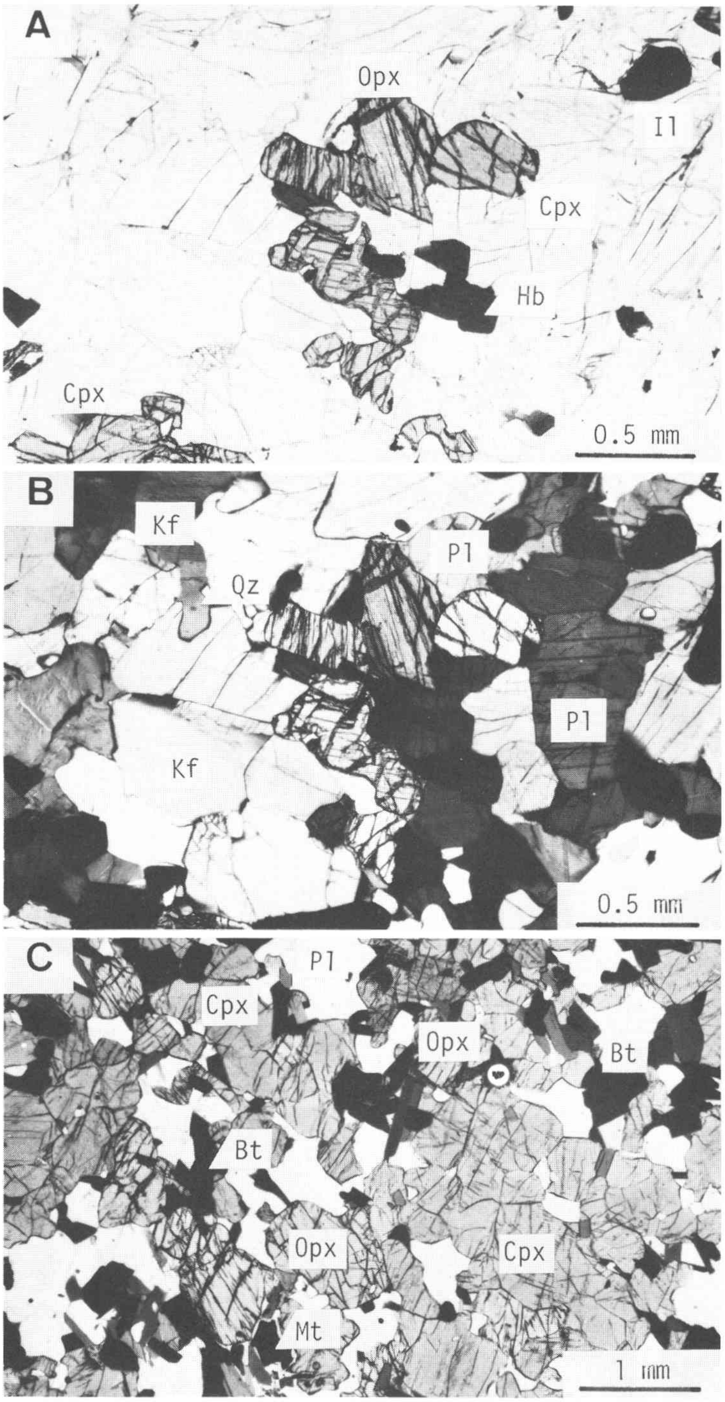
B. Amphibolite (Am) layer in the basement pyroxene gneiss at Strandnibba.

Plate 4

A. Ptygmatic veins in pyroxene gneiss (Gp).

B. Pegmatite (P) intruded into biotite-pyroxene gneiss (Gbp) discordantly at Strandnibba.

Plate 5

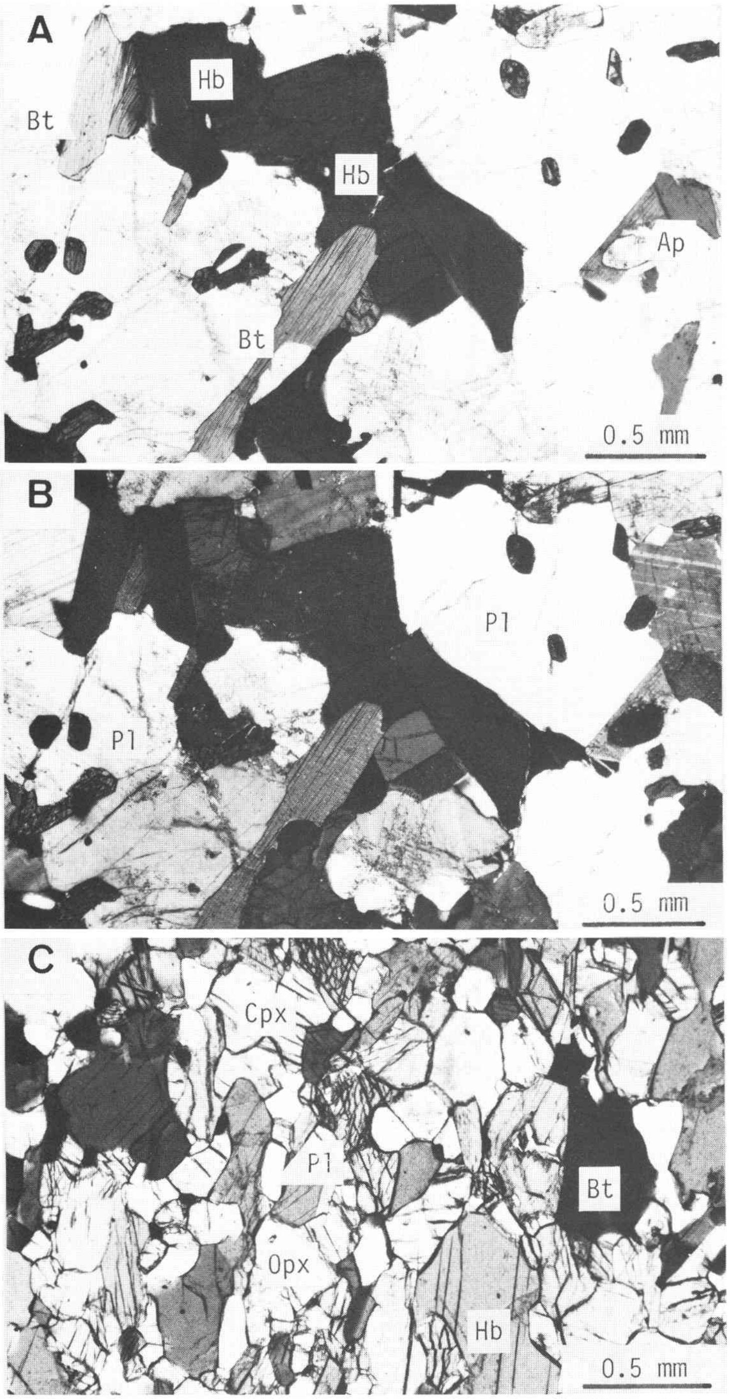


A. *Photomicrograph of pyroxene gneiss (Specimen No. SN–119–08). Clinopyroxene (Cpx), orthopyroxene (Opx), hornblende (Hb) show mutual relationship. Opaque phase is ilmenite (Il).*

B. *As A. Nicols crossed. Note distinct albite twining in plagioclase (Pl) and microperthitic texture in K-feldspar (Kf).*

C. *Photomicrograph of biotite-pyroxene gneiss (Specimen No. SN–119–01). Clinopyroxene (Cpx), orthopyroxene (Opx), biotite (Bt) and plagioclase (Pl) are the main constituents with minor magnetite (Mt).*

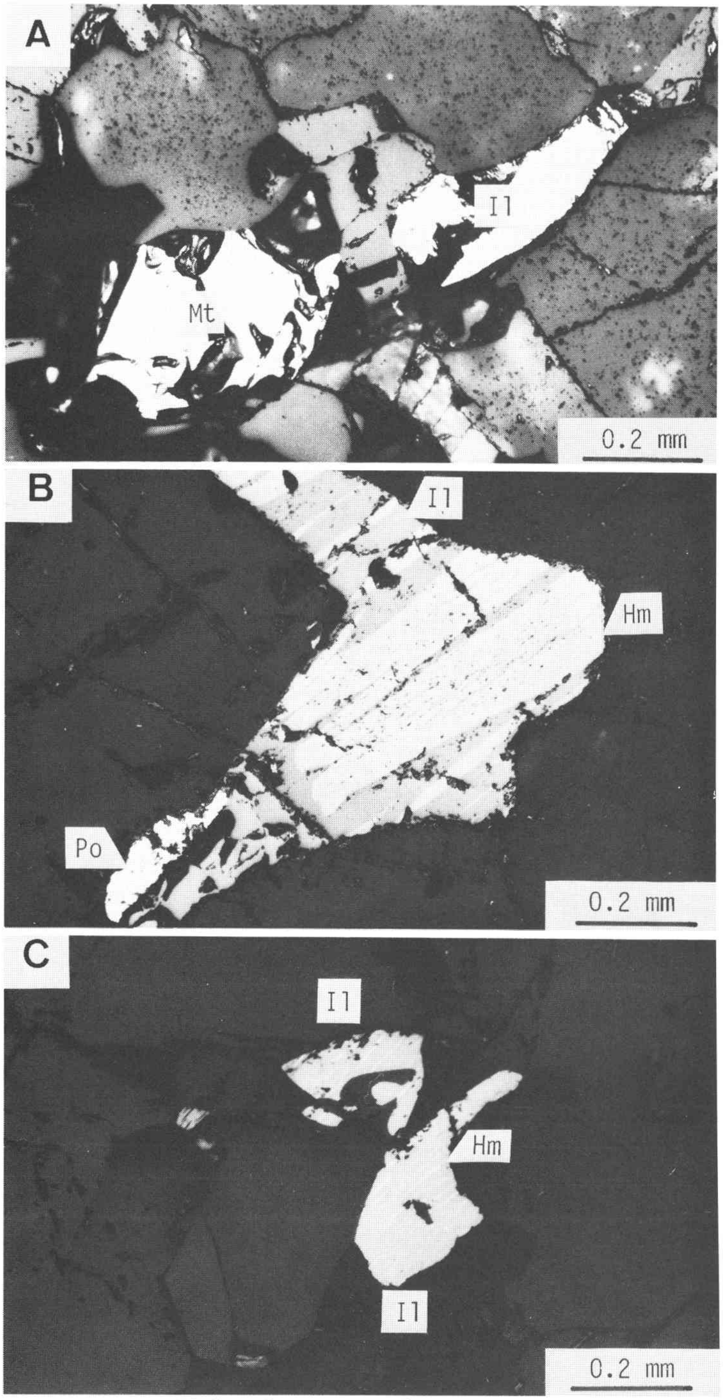
Plate 6



A. *Photomicrograph of hornblende-biotite gneiss (Specimen No. 75081806). Main constituents are hornblende (Hb), biotite (Bt) and plagioclase (Pl) with accessory apatite (Ap).*

B. *As A. Nicols crossed.*

C. *Photomicrograph of amphibolite (Specimen No. SN–120–13). Clinopyroxene (Cpx), orthopyroxene (Opx), hornblende (Hb) and biotite (Bt) are the main mafic minerals with minor plagioclase (Pl).*



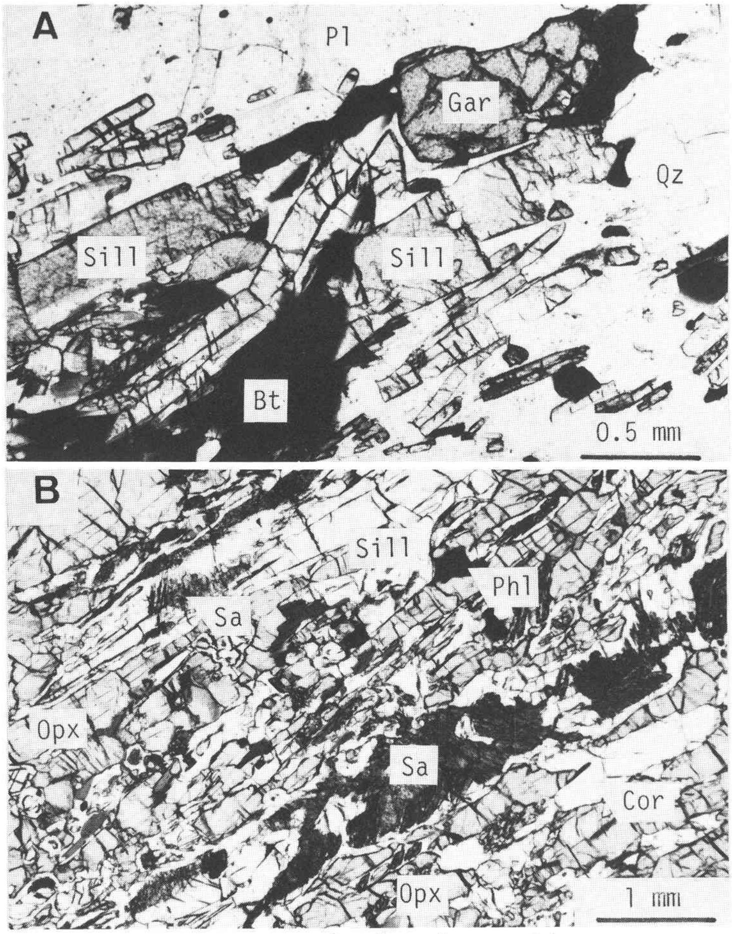
Modes of occurrence of opaque minerals.

A. *Ilmenite (Il) and magnetite (Mt) in pyroxene gneiss (Specimen No. SN–119–06), reflected light.*

B. *Ilmenite (Il) with exsolved hematite (Hm) and associated pyrrhotite (Po) in biotite-pyroxene gneiss (Specimen No. SN–119–01), reflected light.*

C. *Ilmenite (Il) with exsolved hematite (Hm) in amphibolite (Specimen No. SN–120–13), reflected light.*

Plate 8



Photomicrographs of moraine material.

A. *Garnet (Gar)-sillimanite (Sill)-biotite (Bt) gneiss (Specimen No. SN–120–10).*

B. *Sapphirine (Sa)-orthopyroxene (Opx)-sillimanite (Sill)-cordierite (Cor) gneiss (Specimen No. 74012923).*

Antarctic Geological Map Series

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