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Explanatory Text of Geological Map of Rundvågskollane and Rundvågshetta, Antarctica

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Explanatory Text of Geological Map of Rundvågskollane and Rundvågshetta, Antarctica

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1. Introduction

Rundvågskollane and Rundvågshetta are located at 69°50′–69°56′S latitude and 38°57′–39°16′E longitude in 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 this 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, followed by K. SASAKI (JARE-22), Y. MOTOYOSHI and H. MATSUEDA (JARE-23) in January–February 1982, and completed by Y. MOTOYOSHI and S. MATSUBARA (JARE-24) in January 1983. The geodetic survey was conducted by the Geographical Survey Institute in 1974 and the topographical maps, "Rundvågshetta" and "Rundvågshetta: the southern part" on a scale of 1:25000, were published in 1984.

2. Geomorphology

The land surface of the Rundvågskollane and Rundvågshetta district generally slopes gently seaward, probably due to successive erosion by past ice sheets, and locally the bedrock surface is drowned to form small embayments.

Glacial striae are developed on the bedrock surface (Plates 3 and 4) and are a result of considerable glacial erosion in the past (MORIWAKI and YOSHIDA, 1983; SASAKI, 1984). As shown in Fig. 1, the main directions of the striae in the Rundvågskollane area are similar to those at other ice-free outcrops in the Lützow-Holm Bay region (MORIWAKI, 1976). However, two major directions of the striae suggest that changes in ice flow occurred during shrinkage of the ice sheet. In addition, glacial grooves and curved striae (Plates 3B and 4A) are evidence that movement of the gravel or ice flow has not always been uniform during the glacial epoch (MORIWAKI, 1976).

Aggregates of moraines form ques at the eastern margin of Rundvågshetta. They may be stranded moraines accompanied by a shear plane at the margin of the continental ice flow. The direction of the stress indicated by these moraines almost coin-

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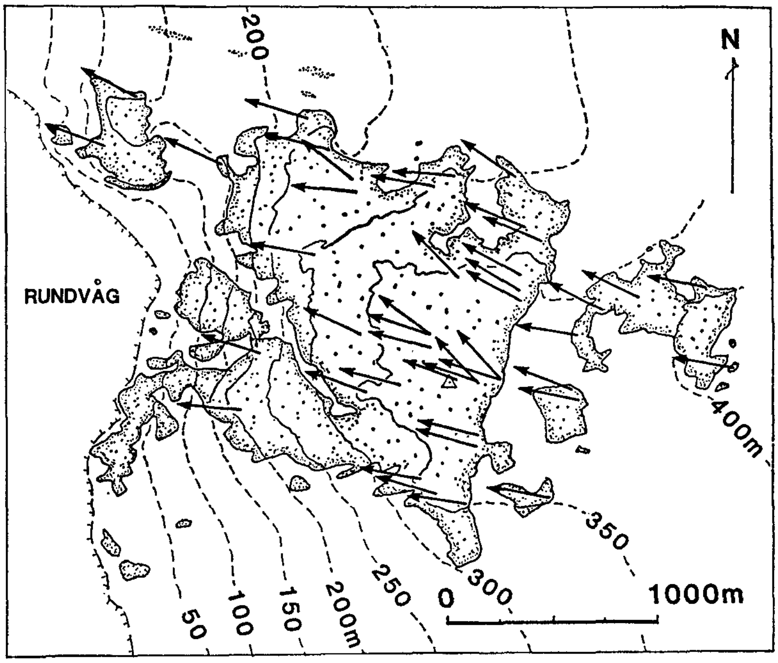

Fig. 1. Ice movement indicated by glacial striae in the Rundvågskollane area.

cides with those determined from glacial striae on the bedrock surface (MORIWAKI, 1976). The variation of the moraine material suggests their exotic origin. The characteristic types of these materials are described briefly in the text.

3. Geology and Petrography

3.1. Geology

The Rundvågskollane and Rundvågshetta district is underlain chiefly by Precambrian high-grade metamorphic rocks including pyroxene gneiss (charnockitic rock), biotite-hornblende gneiss, garnet-biotite gneiss and garnet gneiss with subordinate amounts of garnet-sillimanite gneiss, pyroxene amphibolite, ultramafic rock and garnet aplite. These rocks are intruded locally by pegmatite. Migmatites occur occasionally in the garnet-biotite gneiss and garnet gneiss. They often disturb the macroscopically and/or mesoscopically well-layered structure of the gneiss. Calc-silicate rock has not been found.

Chemical compositions of 14 specimens from Rundvågskollane and 7 specimens from Rundvågshetta are listed in Tables 1 and 2, respectively, with a list identifying the rock types of all included as Table 3. The variety of the mineral assemblages in the rocks are controlled largely by the bulk chemical compositions.

Radiometric determinations of absolute ages for these basement rocks have not been performed.

The basement rocks of the district are classified into the following types on the

Table 1. Chemical compositions of rocks from Rundvågskollane.

No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SiO_2	41.21	46.26	48.66	75.30	66.06	47.32	47.75	71.08	65.72	68.34	63.60	62.42	43.21	70.02
TiO_2	0.51	1.21	1.28	—	0.51	3.08	0.52	—	0.71	0.48	0.60	1.08	0.20	0.49
Al_2O_3	4.88	18.74	16.69	12.32	15.10	7.33	5.35	14.50	16.62	15.65	17.35	14.62	16.52	13.41
Fe_2O_3	6.08	6.27	3.72	0.67	3.76	11.51	5.69	0.86	2.38	2.70	3.66	4.56	5.15	3.60
FeO	9.79	8.85	9.32	0.22	3.12	20.32	7.87	0.44	2.47	2.07	3.34	5.48	6.19	2.32
MnO	0.18	0.20	0.15	0.05	0.20	0.52	0.17	0.06	0.12	0.08	0.06	0.19	0.13	0.12
MgO	31.33	5.74	4.84	0.44	2.17	7.04	23.88	0.46	1.87	1.17	2.95	2.51	17.14	0.34
CaO	2.95	9.74	9.72	1.17	2.82	1.52	5.87	1.31	2.67	2.12	1.76	4.26	8.67	1.81
Na_2O	0.56	2.56	3.71	2.79	3.60	0.49	1.09	3.71	4.41	2.97	2.79	2.56	1.26	2.47
K_2O	0.64	0.48	1.30	6.83	2.59	0.20	0.69	6.96	2.51	4.07	2.59	1.17	0.42	4.77
H_2O (+)	1.78	0.03	2.51	0.48	0.40	0.03	0.86	0.41	0.41	0.26	0.31	0.64	0.98	0.61
H_2O (−)	0.01	0.16	0.31	0.21	0.16	0.15	0.19	0.11	0.13	0.05	0.17	0.34	0.10	0.17
P_2O_5	0.06	0.09	0.06	0.03	0.08	0.04	0.09	0.23	0.06	0.18	0.05	0.09	0.02	0.06
Total	99.98	100.33	100.27	100.51	100.57	99.55	99.99	100.13	100.08	100.14	99.23	100.42	99.99	100.19
C. I. P. W. norms														
Q	—	—	—	30.87	25.17	19.93	—	20.49	21.38	29.29	28.41	26.31	—	32.86
C	—	—	—	—	1.44	3.82	—	—	1.94	2.94	6.88	1.07	—	1.04
or	3.78	2.84	7.68	40.36	15.31	0.18	4.08	41.13	14.83	24.05	15.31	9.87	2.48	28.19
ab	4.74	21.66	27.80	23.61	30.46	4.15	9.22	31.39	37.32	25.13	23.61	21.66	10.66	20.91
an	8.91	38.25	25.05	0.92	13.47	7.28	7.67	2.35	12.85	9.34	8.40	20.55	38.18	8.59
ne	—	—	1.95	—	—	—	—	—	—	—	—	—	—	—
di wo	2.23	3.97	9.51	1.27	—	—	8.79	1.10	—	—	—	—	1.96	—
di en	1.72	2.28	5.34	1.10	—	—	6.80	0.84	—	—	—	—	1.51	—
di fs	0.27	1.51	3.78	—	—	—	1.05	0.15	—	—	—	—	0.25	—
hy en	11.14	7.81	—	—	5.41	17.54	26.12	0.31	4.66	2.91	7.35	6.25	5.59	0.85
hy fs	1.78	5.16	—	—	2.15	23.69	4.04	0.06	1.62	0.93	2.23	4.87	0.92	0.70
ol fo	45.67	2.95	4.70	—	—	—	18.61	—	—	—	—	—	24.94	—
ol fa	8.03	2.15	3.67	—	—	—	3.18	—	—	—	—	—	4.52	—
mt	8.81	9.09	5.39	0.87	5.45	16.69	8.25	1.25	3.45	3.91	5.31	6.61	7.47	5.22
hm	—	—	—	0.07	—	—	—	—	—	—	—	—	—	—
il	0.97	2.30	2.43	—	0.97	5.85	0.99	—	1.35	0.91	1.14	2.05	0.38	0.93
ap	0.14	0.21	0.14	0.07	0.19	0.09	0.14	0.53	0.14	0.42	0.12	0.21	0.05	0.14
Analyst*	S.K.	T.H.	T.H.	T.H.	T.H.	T.H.	S.K.	T.H.	T.H.	T.H.	T.H.	T.H.	S.K.	T.H.

*Analyst: S.K., S. KANISAWA; T.H., T. HIRANO.

Table 2. Chemical compositions of rocks from Rundvågshetta.

No.	15	16	17	18	19	20	21
SiO_2	65. 37	83. 40	79. 19	74. 81	51. 12	57. 80	49. 93
TiO_2	0. 45	0. 65	0. 39	0. 42	0. 92	0. 09	0. 58
Al_2O_3	15. 22	6. 33	10. 66	13. 13	8. 45	11. 10	7. 40
Fe_2O_3	1. 23	0. 48	0. 44	0. 50	3. 44	1. 76	2. 63
FeO	3. 10	3. 66	2. 09	2. 02	9. 65	4. 72	10. 42
MnO	0. 07	0. 07	0. 04	0. 03	0. 21	0. 12	0. 24
MgO	3. 23	2. 17	1. 34	1. 06	11. 25	7. 47	20. 01
CaO	3. 11	0. 09	0. 37	2. 23	10. 99	6. 05	6. 72
Na_2O	4. 50	0. 99	1. 96	2. 31	2. 35	2. 12	0. 92
K_2O	2. 65	0. 87	2. 77	2. 65	1. 06	5. 41	0. 28
H_2O (+)	0. 80	0. 52	0. 51	0. 38	0. 47	0. 74	0. 55
H_2O (−)	0. 10	0. 05	0. 05	0. 07	0. 09	0. 14	0. 04
P_2O_5	0. 22	0. 12	0. 03	0. 04	0. 16	1. 21	0. 11
Total	100. 05	99. 40	99. 84	99. 65	100. 16	99. 33	99. 83
			C. I. P. W. norms				
Q	16. 45	68. 58	53. 16	43. 77	—	4. 95	—
C	—	3. 72	3. 84	2. 50	—	—	—
or	15. 66	5. 14	16. 37	15. 66	6. 26	31. 97	1. 65
ab	38. 08	8. 38	16. 59	19. 55	19. 89	17. 94	7. 78
an	13. 50	0. 12	1. 64	10. 80	9. 38	4. 79	15. 23
di wo	0. 20	—	—	—	18. 41	7. 23	7. 26
di en	0. 13	—	—	—	11. 59	4. 97	5. 01
di fs	0. 06	—	—	—	5. 69	1. 68	1. 65
hy en	7. 92	5. 41	3. 34	2. 64	8. 61	13. 64	33. 72
hy fs	4. 00	5. 38	2. 90	2. 66	4. 23	4. 62	11. 13
ol fo	—	—	—	—	5. 48	—	7. 80
ol fa	—	—	—	—	2. 96	—	2. 83
mt	1. 78	0. 70	0. 64	0. 72	4. 99	2. 55	3. 81
il	0. 85	1. 24	—	0. 80	1. 75	1. 31	1. 10
ap	0. 51	0. 12	0. 74	0. 09	0. 37	2. 80	0. 25

Chemical analysis by Japan Chemical Analysis Center.

basis of their modes of occurrence and petrographical features.

1. Garnet aplite (Ag)
2. Garnet gneiss (Gg)
3. Garnet-biotite gneiss (Ggb)
4. Garnet-sillimanite gneiss (Ggs)
5. Pyroxene amphibolite (Ap)
6. Ultramafic rock (U)
7. Biotite-hornblende gneiss (Gbh)
8. Pyroxene gneiss (Gp)
9. Pegmatite (P)

In addition to these basement rocks, moraine materials are described as

10. Moraines (M).

Table 3. Rocks analyzed for bulk chemistry.

1.	RK-131-04	Ultramafic rock (olivine, orthopyroxene, amphibole)
2.	RK-131-05	Pyroxene gneiss
3.	RK-131-08	Hornblende gneiss
4.	RK-131-21	Garnet gneiss
5.	RK-131-22	Garnet-biotite gneiss
6.	RK-131-27	Basic inclusion (garnet, orthopyroxene, ilmenite, quartz)
7.	RK-131-28	Ultramafic rock (olivine, orthopyroxene, amphibole)
8.	RK-201-35A	Garnet aplite
9.	RK-201-35B	Garnet-biotite gneiss
10.	RK-201-47	Garnet-bg. hornblende gneiss
11.	RK-202-53	Garnet-biotite gneiss
12.	RK-203-58	Garnet-biotite gneiss
13.	RK-203-59	Ultramafic rock (orthopyroxene, spinel, plagioclase)
14.	RK-203-62	Garnet-bg. pyroxene gneiss
15.	RH-111-02	Pyroxene gneiss
16.	RH-111-04	Garnet-biotite gneiss
17.	RH-111-07A	Garnet-sillimanite gneiss
18.	RH-112-20B	Garnet-sillimanite gneiss
19.	RH-113-23C	Pyroxene amphibolite
20.	RH-113-24A	Pyroxene gneiss
21.	RH-113-27B	Pyroxene amphibolite

3.2. Petrography

3.2.1. Garnet aplite (Ag)

This rock occurs in the isolated bedrock surface situated at the north of Rundvågskollane, probably intruding into the surrounding garnet-biotite gneiss. Rounded garnet is characteristic and is associated with plagioclase, K-feldspar and quartz (Plate 8A). Mafic silicates other than garnet and oxide minerals are rarely present. Microperthite in K-feldspar and antiperthite in plagioclase are observed.

3.2.2. Garnet gneiss (Gg)

This gneiss occurs at the northeastern part of Rundvågskollane as a large-scale folded mass whose axis plunging southwestward steeply. A migmatitic facies is occasionally seen both in the mass itself and along the contact with the surrounding rocks (Plate 6A and 6B).

The main constituent minerals are garnet, biotite, plagioclase, K-feldspar and quartz, but biotite is sometimes missing. Biotite shows pleochroism of X'=pale brown and $Y'=Z'$=reddish brown, and includes zircon with metamict halo. Ilmenite and rutile occur as accessory minerals. Microperthitic K-feldspar and antiperthitic plagioclase are common. Green spinel, rarely observed in garnet (Plate 8C), is never present in the matrix.

3.2.3. Garnet-biotite gneiss (Ggb)

This gneiss occurs both in Rundvågskollane and Rundvågshetta interlayered concordantly with the surrounding biotite-hornblende gneiss or pyroxene gneiss. Gneissose structure is well-developed by alignment of garnet and biotite (Plate 8B). A migmatitic facies is occasionally observed. Although mineral assemblages of the gneiss are similar to those of the garnet gneiss, biotite is much more abundant while K-feldspar is sometimes missing. Pleochroism of biotite is X' = pale brown and $Y' = Z'$ = reddish brown. Zircon with metamict halo is commonly observed in biotite. Orthopyroxene is locally associated with garnet and biotite (Plate 12A).

3.2.4. Garnet-sillimanite gneiss (Ggs)

This gneiss usually occurs as thin layers (the thickness is up to 1 m) within the garnet-biotite gneiss and pyroxene gneiss (Plate 5B). The rock is leucocratic and coarse-grained with porphyroblastic garnet and idiomorphic sillimanite. Biotite is less abundant and sometimes occurs only as inclusions in garnet. The rock contains plagioclase, K-feldspar and quartz as main constituents with subordinate amounts of ilmenite and rutile. The sillimanite + K-feldspar association seems to be stable.

Garnet is generally rounded and coarse-grained up to 5 mm in diameter. Porphyroblastic garnets frequently include other minerals such as quartz, plagioclase, sillimanite, kyanite, spinel, sapphirine, ilmenite, rutile and biotite. Garnet is usually zoned with Ca-rich cores and Ca-poor margins; but there is no significant difference in the Fe/Mg ratios of the cores and margins. On the other hand, coexiting plagioclase is reversely zoned.

Kyanite is exclusively found as an inclusion in garnet (MOTOYOSHI *et al.*, 1985; Plate 9B). Because sillimanite is a stable phase in the matrix (Plate 9A), the kyanite inclusion is reasonably interpreted as a relict phase during prograde recrystallization.

Sapphirine also occurs as inclusions in pyrope-rich garnet ($X_{Mg}=0.56$ in maximum) being interlocked with sillimanite and plagioclase (Plate 9C). This sapphirine is the first such reported in the pelitic rocks from the Lützow-Holm Bay region (MOTOYOSHI *et al.*, 1985).

Other characteristic mineral associations are garnet + sillimanite + spinel (Plate 10A) and spinel + quartz (Plate 10B and 10C). The former has been reported from many localities in the Prince Olav Coast and the Lützow-Holm Bay region (HIROI *et al.*, 1983; MOTOYOSHI *et al.*, 1985), and is considered to be the dehydration breakdown product after staurolite. The latter would be a relatively high temperature assemblage as predicted by MIYASHIRO (1965) and HENSEN and GREEN (1971).

3.2.5. Pyroxene amphibolite (Ap)

This rock has been collectively referred to as a member of metabasite in the region around Lützow-Holm Bay since JARE-1 (TATSUMI and KIKUCHI, 1959). It occurs generally as a concordant layer or locally as a lenticular body in basement gneisses. The principal constituent minerals are hornblende, pyroxenes, plagioclase and opaque minerals. K-feldspar, biotite and quartz are recognized as minor phases.

Hornblende predominates in this rock, and is pleochroic with X' = pale brown and Z' = greenish brown. Clino- and orthopyroxene occur generally in association with hornblende (Plate 11C). They show characteristic pleochroism. Plagioclase displays distinct albite twinning and is free from a zoned structure. The An content varies from specimen to specimen. Opaque phases are relatively scarce in this rock, though ilmenite with hematite lamellae, magnetite and unidentified sulfide globules are sporadically present.

3.2.6. Ultramafic rock (U)

This rock generally occurs as isolated blocks in the basement gneisses (Plate 7A). The size of the block is up to 1–2 m in diameter.

The characteristic type is an orthopyroxene-amphibole rock containing olivine, spinel, biotite and opaque mineral (Plate 13B and 13C). In the olivine-bearing rocks, plagioclase is never present, and *vice versa*. Spinel sometimes occurs as symplectitic intergrowth with orthopyroxene. Olivine (Fo 78 $\pm$; Specimen No. RK-131-28) seems to be a relict phase.

3.2.7. Biotite-hornblende gneiss (Gbh)

This gneiss occurs in Rundvågskollane with intercalation of the garnet-biotite gneiss and pyroxene gneiss. Basic inclusions are locally included in the gneiss. The representative type is composed of garnet, orthopyroxene, ilmenite and quartz as shown in Plate 13A.

The main constituent minerals are hornblende, biotite, plagioclase, K-feldspar and quartz (Plate 11A). Apatite, zircon and opaque minerals (mostly of magnetite) 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 commonly occurs as flakes and occasionally contains zircon with metamict halo. It shows pleochroism of X' = pale brown and $Y' = Z'$ = deep brown.

3.2.8. Pyroxene gneiss (Gp)

This gneiss is widely distributed in the present district and sometimes has been referred to as a charnockitic rock in the Lützow-Holm Bay region (TATSUMI and KIKUCHI, 1959; YOSHIDA and ANDO, 1971; YOSHIDA, 1978). The gneissosity is generally less developed with occasional alignment of mafic minerals. The rock is partly intruded by discordant basic dikes (a member of pyroxene amphibolite; Plate 5A) and pegmatites. Dark yellowish color is one of the characteristics of the rock. Ptygmatic veining is occasionally observed (Plate 4A). The principal constituent minerals are clinopyroxene, orthopyroxene, hornblende, biotite, plagioclase, K-feldspar, quartz and opaque minerals. Scapolite rarely appears in an appropriate bulk composition being associated with clinopyroxene and plagioclase (Plate 12B and 12C).

Clino- and orthopyroxene 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' = brownish green. As is shown in Plate 11C, its textural relation to pyroxenes suggests that hornblende coexisted stably with pyroxenes at the peak of regional metamorphism. Biotite is frequently associated with pyroxenes. It shows pleochroism of X' = light brown and $Y' = Z'$ = deep brown.

Plagioclases are usually unzoned but reversely zoned texture is observed for those of a certain specimen. An contents are generally low around 20 to 25% by EPMA determinations. Some plagioclases display an antiperthitic texture. K-feldspar commonly occurs, though its modal proportion to plagioclase varies from specimen to specimen. Microperthitic texture in K-feldspar is frequently observed.

Opaque minerals comprise mostly ilmenite and magnetite.

3.2.9. Pegmatite (P)

Concordant and discordant pegmatite veins are intruded into basement gneisses at many localities in the district. Thickness of the pegmatites ranges up to about 1 m (Plate 7B), and pegmatites locally cut basic dike (Plate 7C). The main constituent minerals are megacrystic quartz, K-feldspar, plagioclase occasionally with biotite, amphibole and magnetite. Garnet-rich portions are sometimes observed. The mineral assemblage in pegmatites seems to be controlled largely by the original composition of the host rock.

3.2.10. Moraines (M)

Among the moraines, two characteristic specimens are described here.

1) Sillimanite-biotite gneiss (Plate 14A)

This rock was collected at Rundvågskollane by K. SASAKI in 1982. Strong lineation by sillimanite crystals is characteristic. Other constituent minerals are green biotite, plagioclase, quartz and opaque phase. Blue-green amphibole is additionally included in association with biotite and sillimanite.

2) Cordierite-sillimanite-biotite gneiss (Plate 14B)

This rock was collected at Rundvågshetta by S. MATSUBARA in 1983. The constituent minerals are cordierite, sillimanite, green biotite, muscovite, K-feldspar, plagioclase, quartz and opaque phase. Sapphirine is also present in association with sillimanite and biotite. K-feldspar is a microcline and a perthite. Since cordierite is an unstable mineral under the metamorphic conditions in the Lützow-Holm Bay region (MOTOYOSHI *et al.*, 1985), the original source of this rock is probably beyond the presently surveyed area.

4. Geologic Structure

Rundvågskollane: General foliation of the gneisses trends NE-SW dipping 50–70° northwestward. This structure is locally disturbed by development of a migmatitic facies, in particular in garnet-biotite gneiss zone at the northern part of the bedrock. Garnet gneiss forms large-scale overturned synform and antiform whose axes dipping northwestward. The plunges are estimated to be trending southwestward steeply.

Rundvågshetta: General foliation of the gneisses trends WNW-ESE dipping 50–70° southward. Different structure is observed in the northern part where overturned synform is formed. The axial trace is trending northwestward but the plunge is not exactly known. This block is in fault contact with the adjacent part of the bedrock.

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Appendix: Mineral Chemistry

Representative mafic silicates, *i.e.* garnet, biotite, sapphirine, clinopyroxene and orthopyroxene in the rocks from Rundvågskollane and Rundvågshetta were chemically analyzed by an 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 rocks for microprobe analyses are summarized in Table A1, and analytical results are listed in Tables A2 and A3.

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

Reference

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Table A1. Mineral assemblages of rocks used for microprobe analysis.

Specimen No.	Rock type	Gar	Bt	Pl	Kf	Qz	Sill	Ky	Sa	Sp	Ru	Il	others
RH-111-04	Ggb	+	+	+		+					+	+	Zr, Op
RH-111-07A	Ggs	+	−	+	+	+	+			+	+	+	Zr
RH-111-09	Ggs	+	−	+	+	+	+	(−)	(−)	−	+	+	
RH-112-20B	Ggs	+	+	+		+	−			−		+	Zr

		Cpx	Opx	Hb	Bt	Pl	Kf	Qz	Il	Mt	others
RK-131-03	Ap	+	+	+	+	+					Op, Ap, Zr
RH-111-02	Gp	+	+		+	+	+	+			Op, Ap
RH-112-13B	Gp	+	+	+	+	+	+	+	+	+	Ap, Car
RH-113-23C	Ap	+	+	+	+	+				+	Ap
RH-113-24A	Gp	+	+		+	+	+	+		+	Ap, Zr

Abbreviations: Ap, apatite; Bt, biotite; Car, carbonate; Cpx clinopyroxene; Gar, garnet; Hb, hornblende; Il, ilmenite; Kf, K-feldspar; Ky, kyanite; Mt, magnetite; Op, unidentified opaque phase; Opx, orthopyroxene; Qz, quartz; Ru, rutile; Sa, sapphirine; Sill, sillimanite; Sp, spinel; Zr, zircon. +: common or abundant, −: rare, ( ): as inclusion.

Table A2. Microprobe analyses of garnet, biotite and sapphirine from Rundvågshetta.

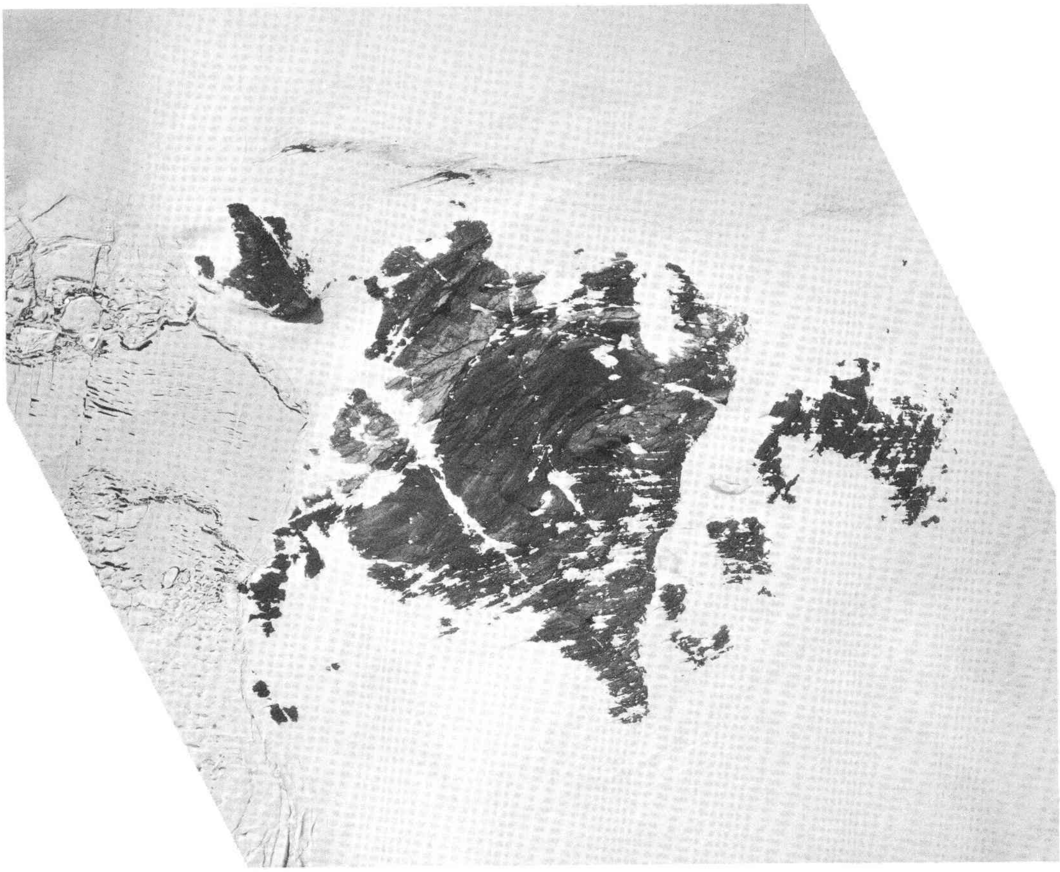
Sp. No.	RH-111-04		RH-111-07A		RH-111-09		RH-112-20B	
Mineral	Gar	Bt	Gar	Bt	Gar	Sa	Gar	Bt
Anal. No.	11	26	37	8	85	1	29	5
SiO_2	38.01	37.04	38.92	36.34	40.43	12.50	38.14	34.89
TiO_2	—	5.41	—	5.37	—	0.05	—	5.86
Al_2O_3	21.69	15.89	22.35	17.71	22.64	61.97	21.12	15.97
Cr_2O_3	—	0.09	—	0.16	—	0.28	—	0.20
FeO*	29.31	12.68	25.51	13.28	20.02	5.98	27.87	16.18
MnO	0.61	0.12	0.36	0.03	0.26	0.07	0.56	—
MgO	7.59	14.77	10.79	13.50	14.79	17.56	8.65	11.52
CaO	2.17	0.07	1.67	0.06	1.83	0.03	3.14	—
Na_2O	—	0.12	—	0.13	—	—	—	0.05
K_2O	—	8.93	—	9.05	—	—	—	9.04
Total	99.38	95.12	99.60	95.63	99.97	98.44	99.49	93.71
O	12	22	12	22	12	20	12	22
Si	2.980	5.468	2.975	5.349	2.997	1.505	2.976	5.346
Ti	—	0.601	—	0.594	—	0.005	—	0.675
Al	2.004	2.765	2.013	3.072	1.978	8.793	1.942	2.883
Cr	—	0.011	—	0.019	—	0.027	—	0.024
Fe	1.921	1.565	1.631	1.635	1.241	0.602	1.819	2.073
Mn	0.041	0.015	0.023	0.004	0.016	0.007	0.037	—
Mg	0.887	3.251	1.230	2.962	1.634	3.152	1.006	2.631
Ca	0.182	0.011	0.137	0.010	0.145	0.004	0.263	—
Na	—	0.034	—	0.037	—	—	—	0.015
K	—	1.682	—	1.699	—	—	—	1.767
Mg/(Fe+Mg)	0.316	0.675	0.430	0.644	0.568	0.840	0.356	0.559

* Total Fe as FeO. Analyst: Y. MOTOYOSHI

Table A3. Microprobe analyses of pyroxenes from Rundvågskollane and Rundvågshetta.

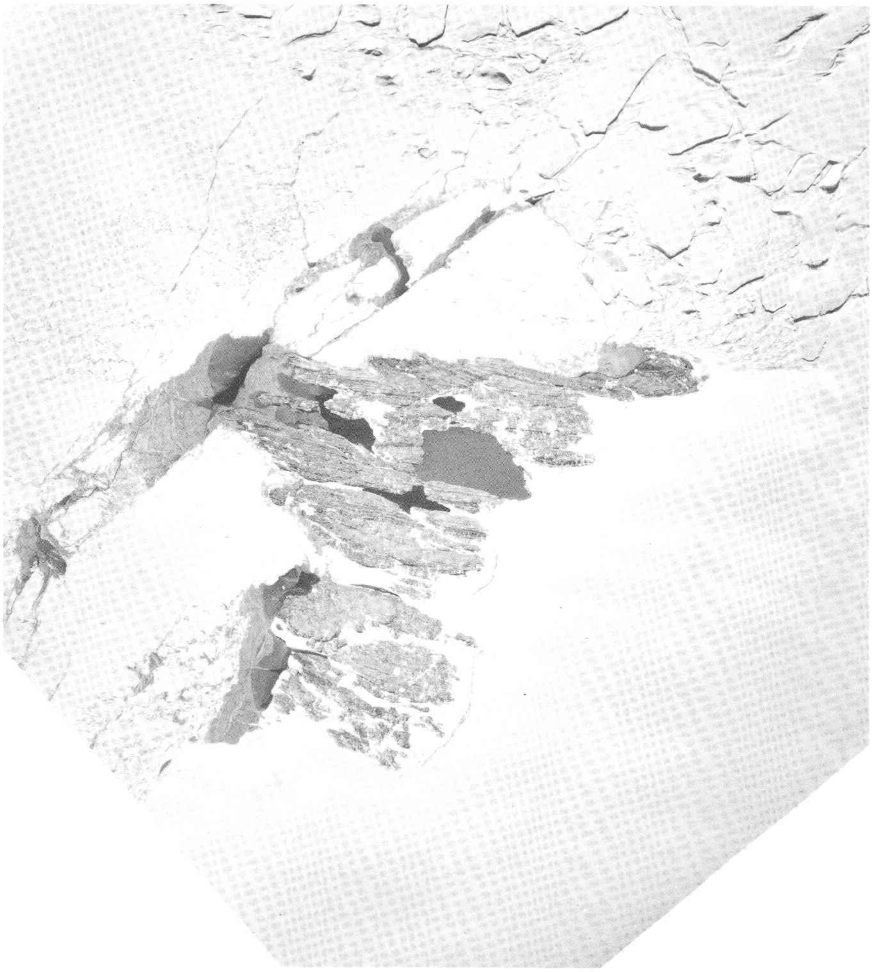
Sp. No.	RK-131-03		RH-111-02		RH-112-13B		RH-113-23C		RH-113-24A	
Anal. No.	26	27	15	3	36	42	25	21	39	21
SiO_2	50. 80	51. 16	53. 04	52. 36	50. 84	50. 92	51. 29	51. 51	50. 93	51. 11
TiO_2	0. 28	0. 13	0. 13	0. 04	0. 14	0. 06	0. 18	0. 12	0. 23	0. 05
Al_2O_3	2. 37	0. 92	1. 17	0. 66	1. 33	0. 69	1. 91	0. 58	2. 23	0. 97
Cr_2O_3	0. 05	0. 03	0. 08	0. 02	0. 07	0. 04	0. 13	0. 03	0. 07	0. 10
FeO*	10. 77	27. 43	8. 52	23. 71	11. 30	27. 97	11. 02	25. 69	10. 74	26. 44
MnO	0. 36	0. 67	0. 10	0. 60	0. 41	0. 64	0. 26	0. 54	0. 46	0. 55
MgO	12. 49	18. 88	13. 78	21. 34	12. 58	18. 19	12. 93	20. 09	12. 70	19. 20
CaO	22. 46	0. 72	21. 71	0. 65	21. 65	0. 61	20. 84	0. 52	21. 12	0. 54
Na_2O	0. 41	0. 03	0. 71	0. 00	0. 63	0. 03	0. 75	0. 00	0. 76	0. 02
Total	99. 99	99. 97	99. 24	99. 38	98. 95	99. 15	99. 31	99. 08	99. 24	98. 98
On the basis of 6 oxygrens										
Si	1. 921	1. 960	1. 987	1. 978	1. 947	1. 972	1. 946	1. 972	1. 935	1. 966
Al (IV)	0. 079	0. 040	0. 013	0. 022	0. 053	0. 028	0. 054	0. 026	0. 065	0. 034
Al (VI)	0. 027	0. 001	0. 039	0. 008	0. 007	0. 003	0. 031	0. 000	0. 035	0. 010
Ti	0. 008	0. 004	0. 004	0. 001	0. 004	0. 002	0. 005	0. 003	0. 007	0. 001
Cr	0. 001	0. 001	0. 002	0. 001	0. 002	0. 001	0. 004	0. 001	0. 002	0. 003
Fe	0. 341	0. 879	0. 267	0. 749	0. 362	0. 906	0. 350	0. 823	0. 341	0. 851
Mn	0. 012	0. 022	0. 003	0. 019	0. 013	0. 021	0. 008	0. 018	0. 015	0. 018
Mg	0. 704	1. 078	0. 770	1. 202	0. 718	1. 050	0. 731	1. 147	0. 719	1. 101
Ca	0. 910	0. 030	0. 871	0. 027	0. 888	0. 026	0. 847	0. 022	0. 859	0. 023
Na	0. 030	0. 002	0. 052	0. 000	0. 047	0. 002	0. 055	0. 000	0. 056	0. 001
Mg/(Fe+Mg)	0. 674	0. 551	0. 742	0. 616	0. 665	0. 537	0. 677	0. 582	0. 678	0. 564

* Total Fe as FeO. Analyst: Y. MOTOYOSHI



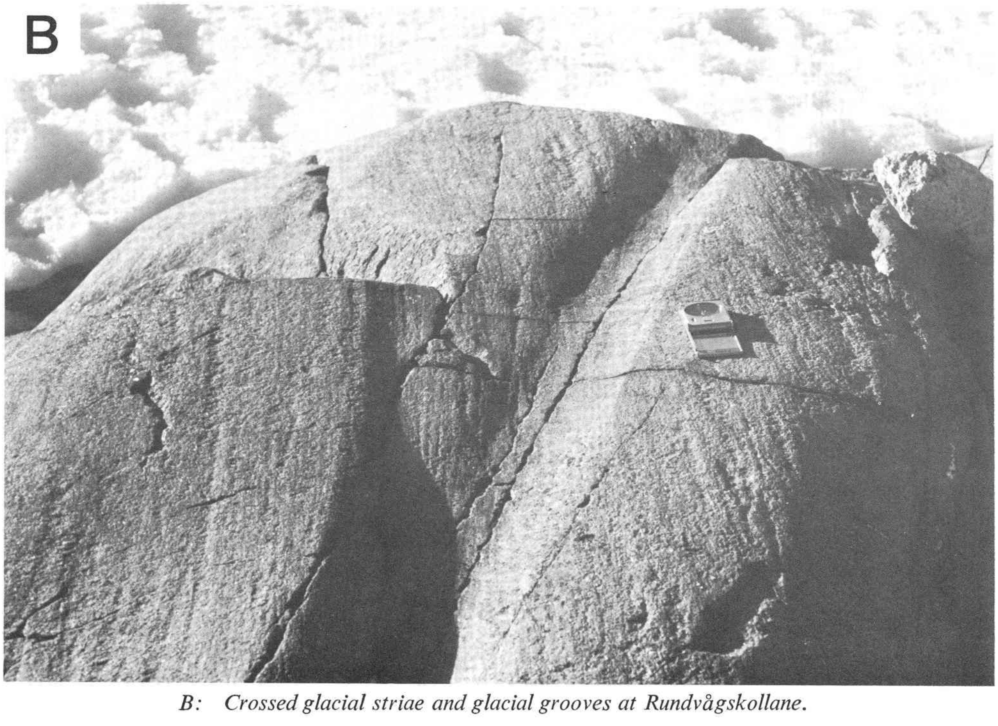
Aerial photograph of Rundvågskollane. JARE Antarctic air photograph (10AV-III, 578 and 579).

Plate 2



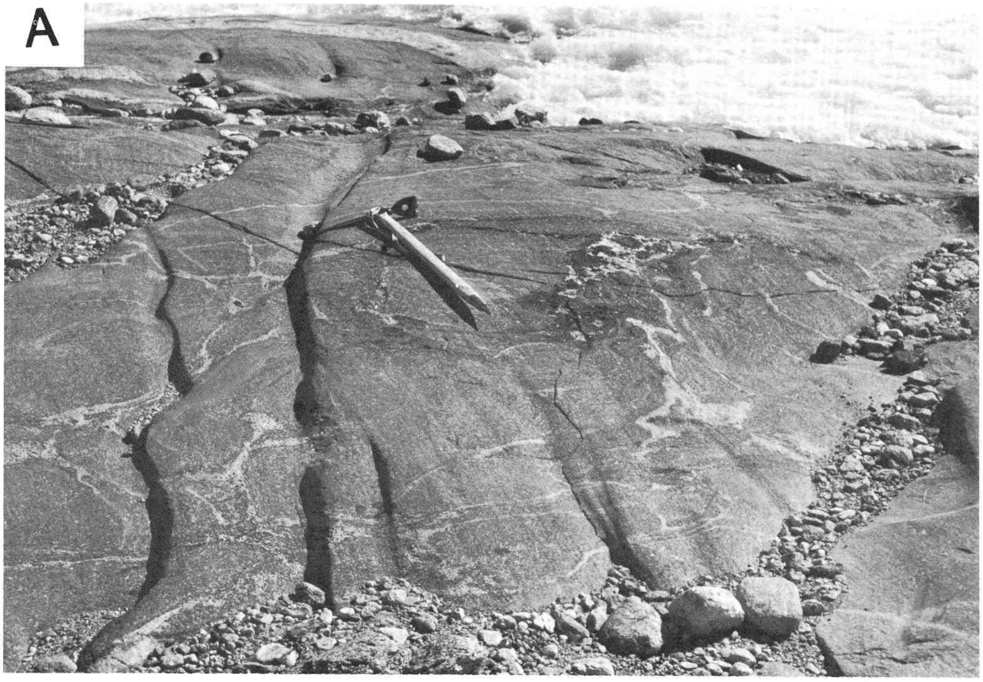
Aerial photograph of Rundvågshetta. JARE Antarctic air photograph (16AV1, C11-7).

A: Crossed glacial striae. The pencil shows early one (N73W) cut by later one (N45W) in the foreground at Rundvågskollane.

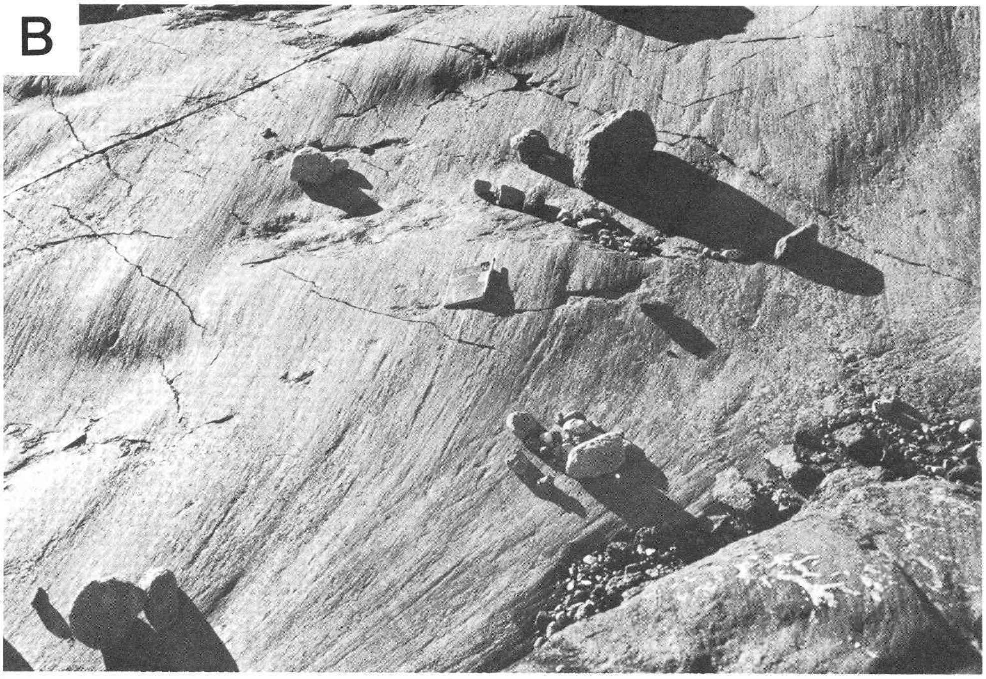


B: Crossed glacial striae and glacial grooves at Rundvågskollane.

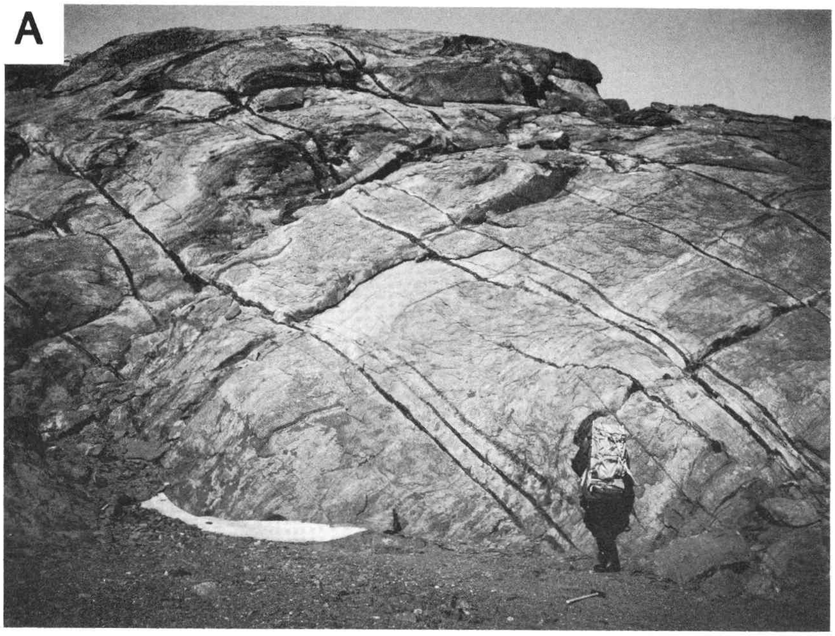
Plate 4



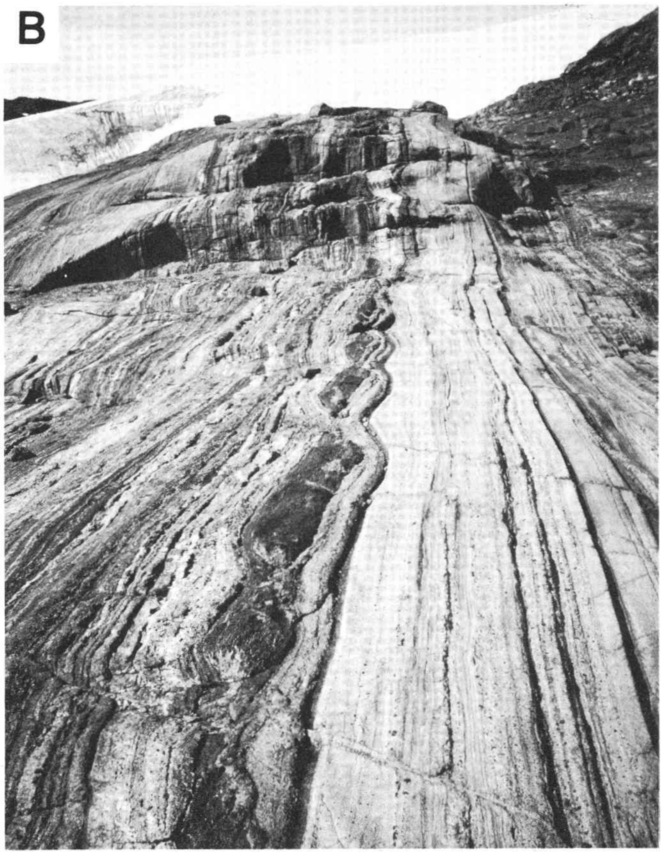
A: Curved glacial grooves on pyroxene gneiss with ptygmatic veining at Rundvågskollane.



B: Curved glacial striae at Rundvågskollane.



A: Pyroxene gneiss intruded by basic dikes at Rundvågshetta.

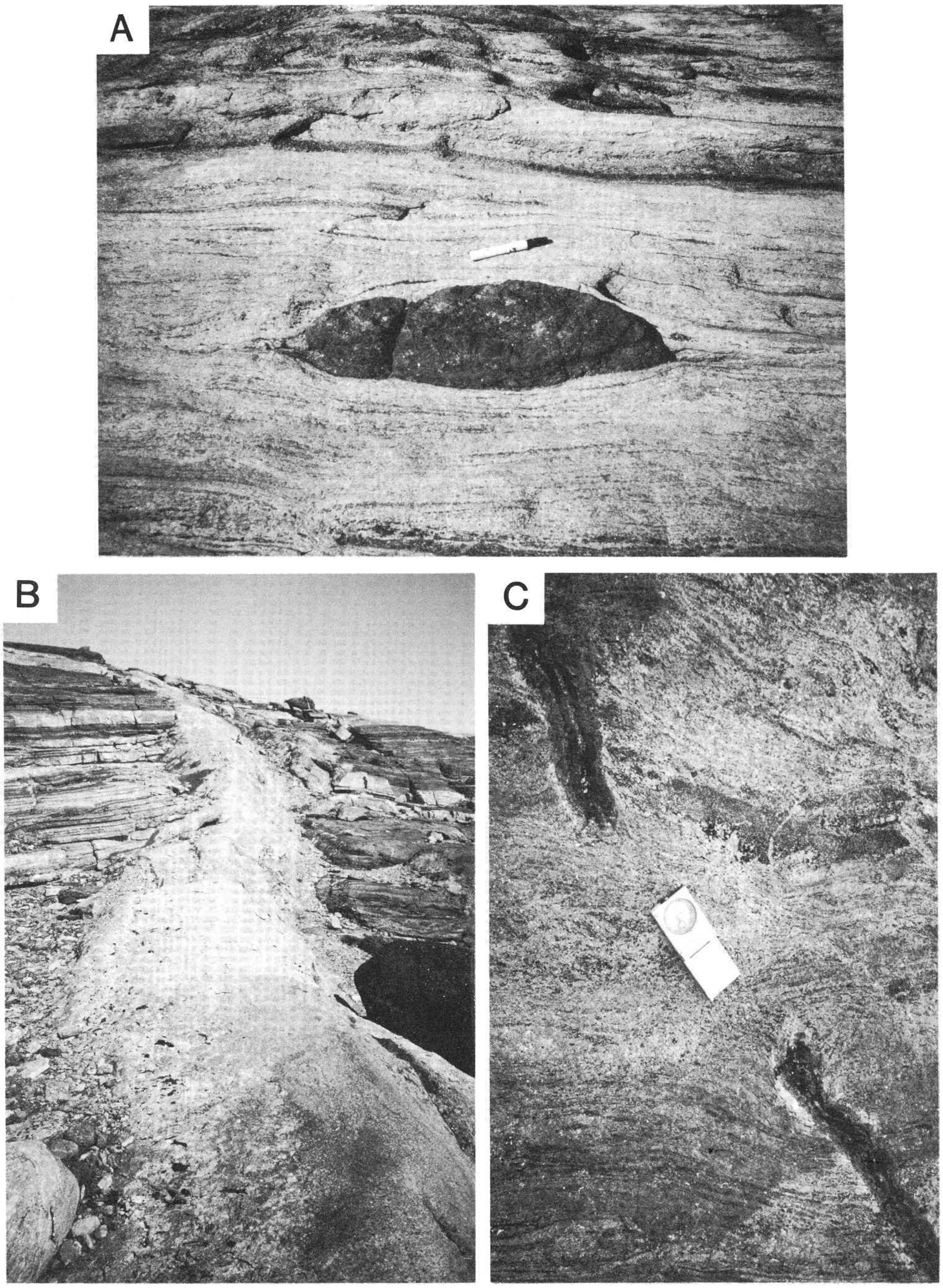


B: Garnet-sillimanite gneiss layer in pyroxene gneiss at Rundvågshetta.

Plate 6

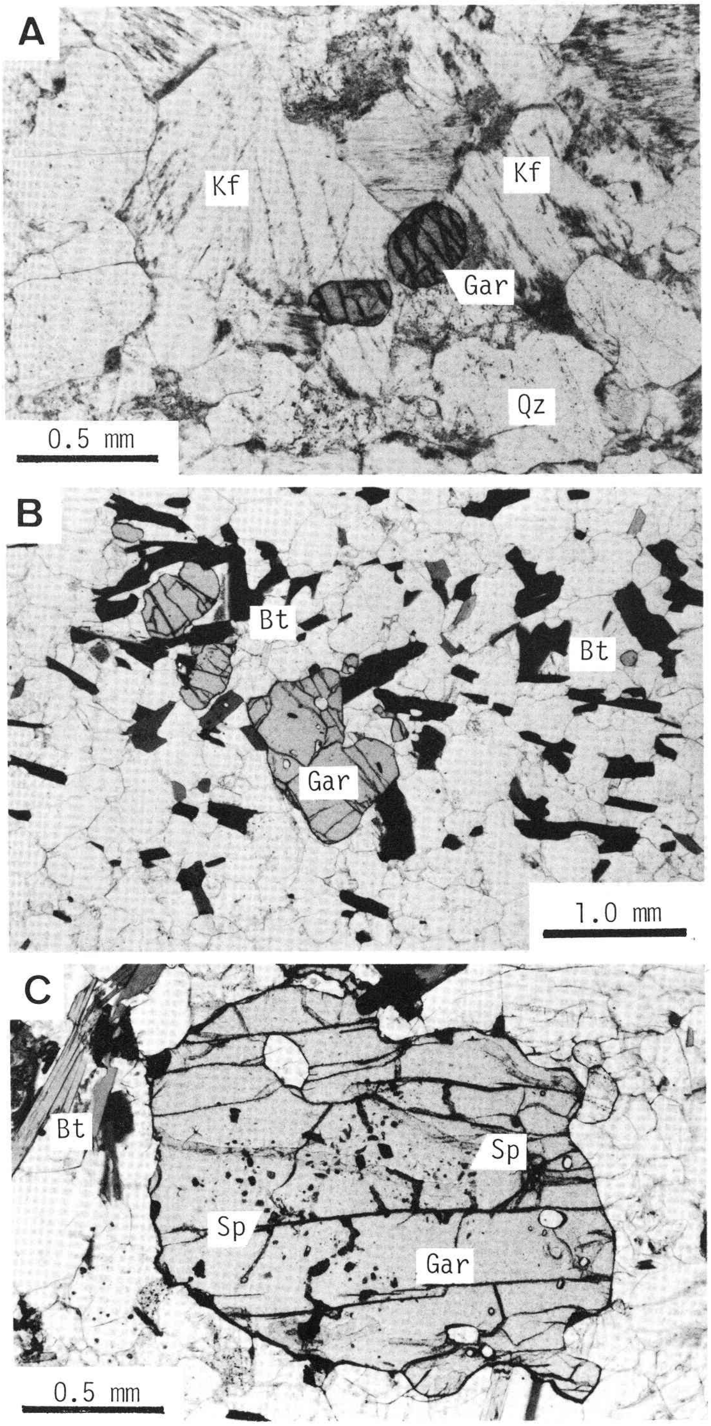
A: Migmatitic facies in garnet-biotite gneiss at Rundvågskollane.

B: Migmatitic facies along the contact between garnet gneiss and biotite-hornblende gneiss at Rundvågskollane.



A: Isolated block of ultramafic rock in basement pyroxene gneiss at Rundvågshetta.
B: Pegmatite intruded into well-layered sequence of garnet-biotite gneiss at Rundvågshetta.
C: Basic dike cut by pegmatite at Rundvågshetta.

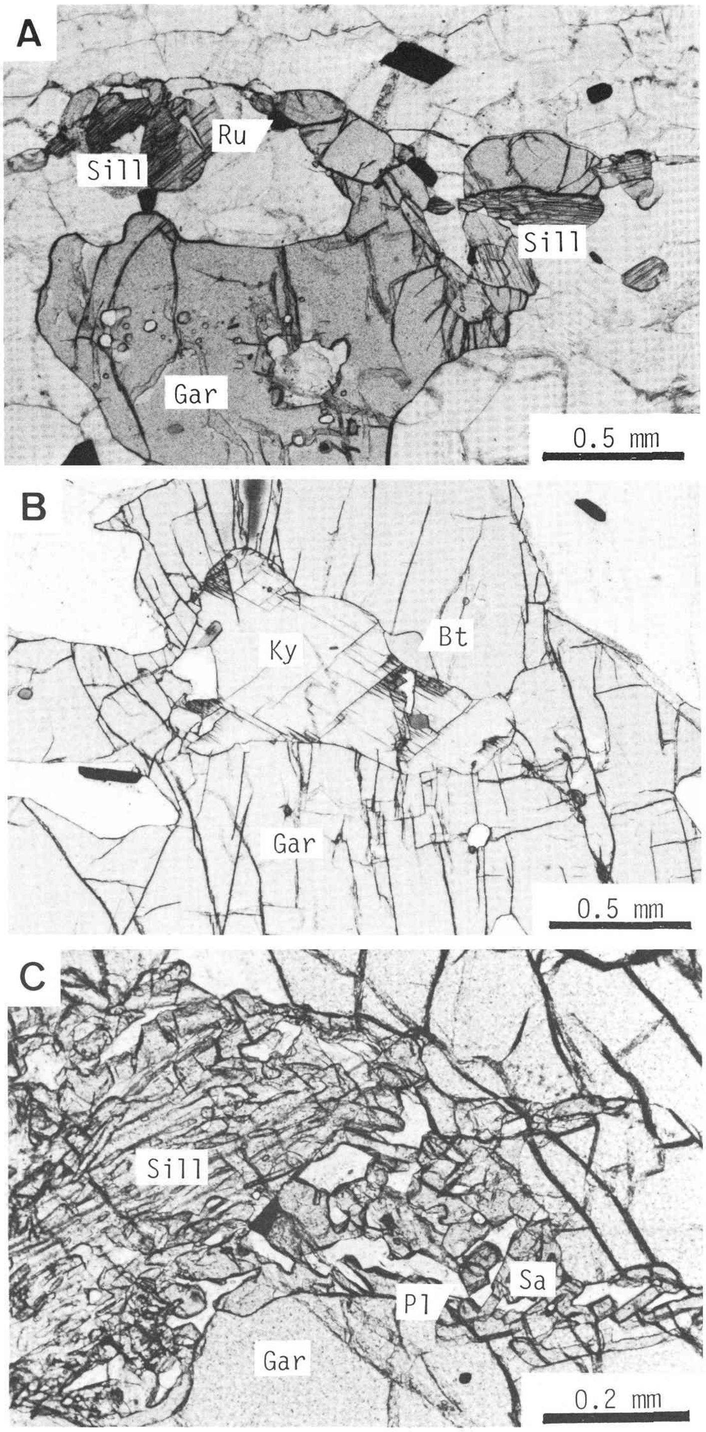
Plate 8



A: Photomicrograph of garnet aplite (Specimen No. RK-131-35A). It is characteristically free from biotite.

B: Photomicrograph of garnet-biotite gneiss (Specimen No. RK-201-35B).

C: Photomicrograph of garnet-biotite gneiss (Specimen No. RK-203-60). Green spinel grains are included in garnet.

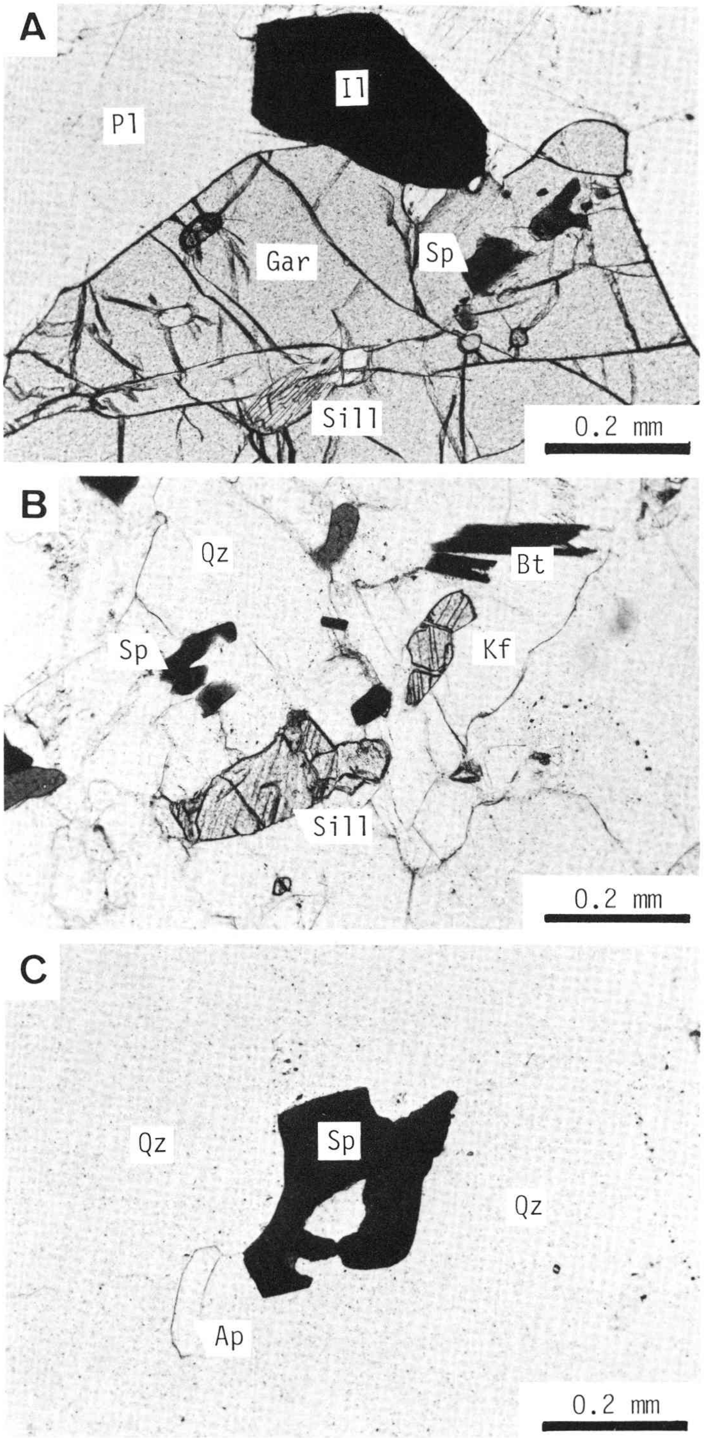


A: *Photomicrograph of garnet-sillimanite gneiss (Specimen No. RH-111-09). Rutile is also present.*

B: *Photomicrograph of kyanite inclusion in garnet of the same rock as A. Kyanite is never present in the matrix.*

C: *Photomicrograph of sapphirine + sillimanite + plagioclase association in garnet of the same rock as A and B.*

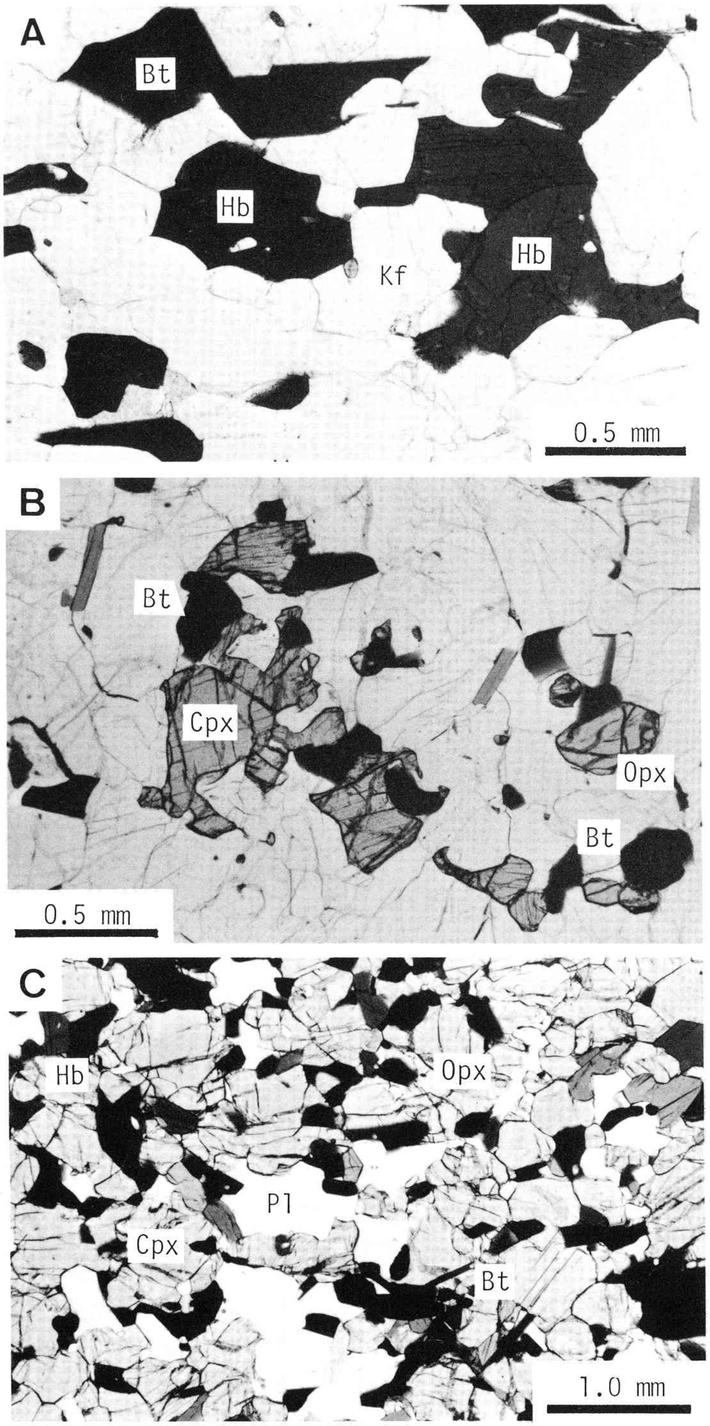
Plate 10



A: *Photomicrograph of garnet + sillimanite + spinel association coexisting with ilmenite and plagioclase (Specimen No. RH-112-20B).*

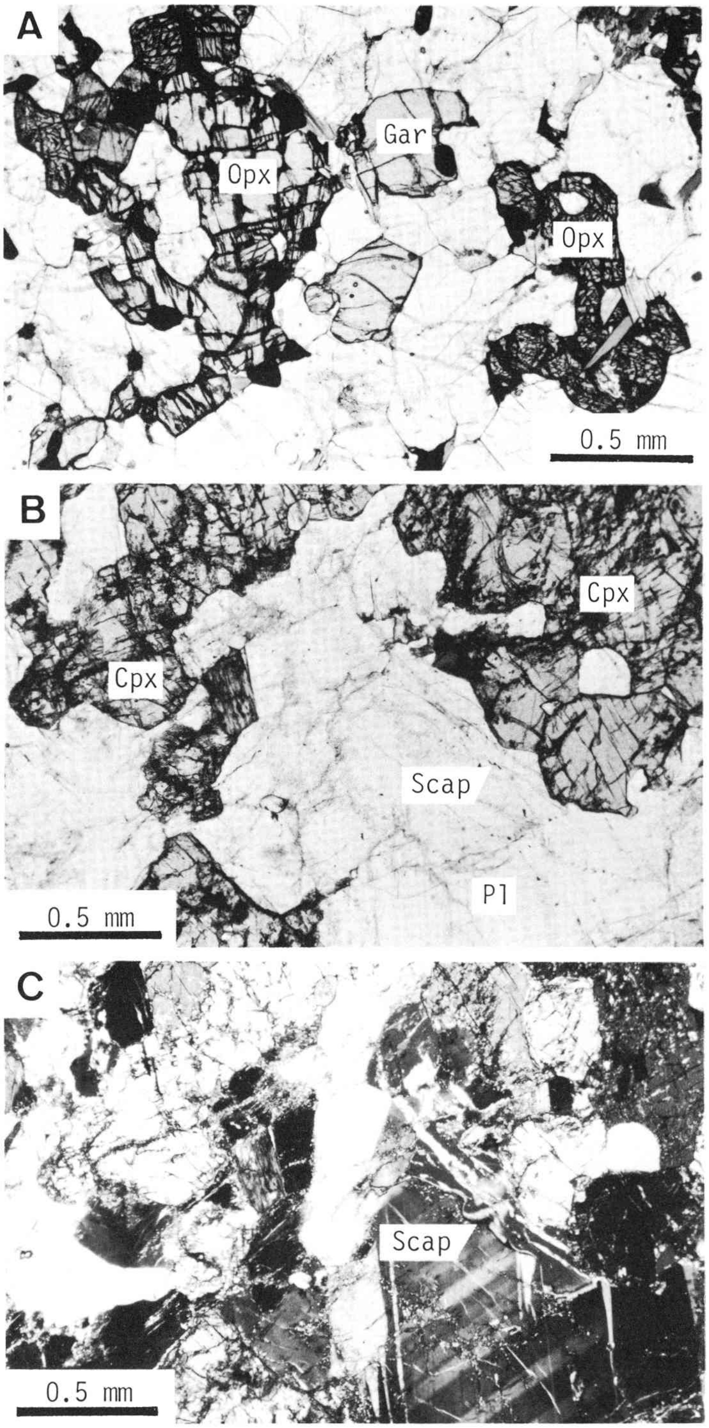
B: *Photomicrograph of sillimanite and spinel in the matrix coexisting with K-feldspar, quartz and biotite (Specimen No. RH-113-26).*

C: *Photomicrograph of spinal + quartz association (Specimen No. RH-113-26). Spinel is in direct contact with quartz.*

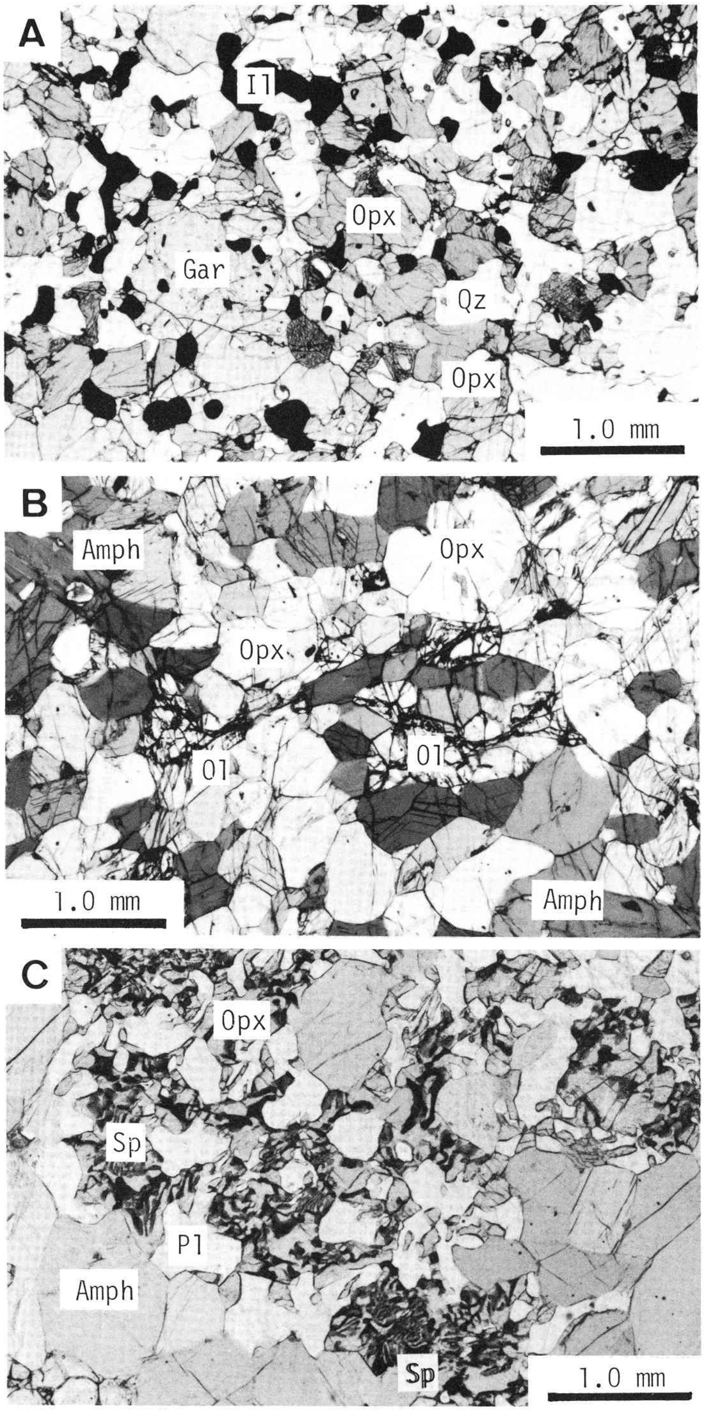


A: Photomicrograph of biotite-hornblende gneiss (Specimen No. RK-202-51).
B: Photomicrograph of pyroxene gneiss (Specimen No. RH-111-02).
C: Photomicrograph of pyroxene amphibolite (Specimen No. RH-113-23C).

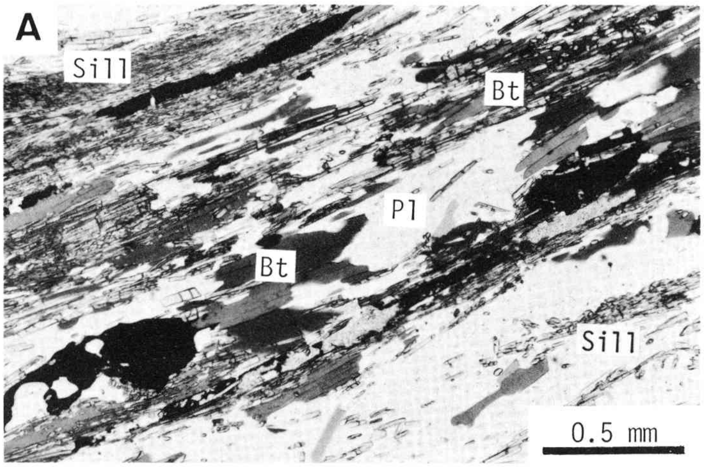
Plate 12

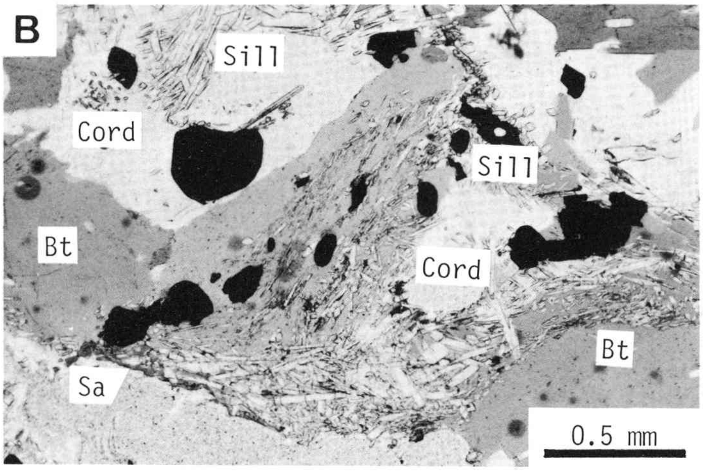


A: Photomicrograph of orthopyroxene-bearing garnet-biotite gneiss (Specimen No. RK-203-60).
B: Photomicrograph of scapolite-bearing pyroxene gneiss (Specimen No. RH-112-13A).
C: As B. Nicols crossed.



A: Photomicrograph of garnet-orthopyroxene-ilmenite-quartz rock (Specimen No. RK-131-27), which occurs as a basic inclusion in biotite-hornblende gneiss.
B: Photomicrograph of ultramafic rock (Specimen No. RK-131-28).
C: Photomicrograph of ultramafic rock (Specimen No. RK-203-59). Note symplectitic intergrowth of spinel and orthopyroxene.





Photomicrographs of moraine materials.
A: Sillimanite-biotite gneiss (Specimen No. RK-203-63).
B: Cordierite-sillimanite-biotite gneiss (Specimen No. RS-02).
Sapphirine is additionally present in association with sillimanite and biotite.

Mineral abbreviations used in Plates

Amph:	*amphibole*	*Il:*	*ilmenite*	*Ru:*	*rutile*
Ap:	*apatite*	*Kf:*	*K-feldspar*	*Sa:*	*sapphirine*
Bt:	*biotite*	*Ky:*	*kyanite*	*Scap:*	*scapolite*
Cord:	*cordierite*	*Opx:*	*orthopyroxene*	*Sill:*	*sillimanite*
Cpx:	*clinopyroxene*	*Ol:*	*olivine*	*Sp:*	*spinel*
Gar:	*garnet*	*Pl:*	*plagioclase*		
Hb:	*hornblende*	*Qz:*	*quartz*		

Antarctic Geological Map Series

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Sheet 11	Cape Hinode	March 1978
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Sheet 18	Kasumi Rock	March 1984
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