CHAPTER 2 GEOLOGICAL SURVEY

2-1 Methods

The survey methods are shown in Table II-2-1.

2-2 Geology

2-2-1 Geology in adit

Geological plan of the 1,850m tunnel and two sections are shown in Fig.II-2-1 and Fig.II-2-2 and Fig.II-2-3, respectively. The geological observations in the tunnel may be summarized as follows:

(i) The geology is composed of the Altyn-Jylga intrusive body of Late Carboniferous to Early Permian age, mainly granodiorite and dikes of lamprophyre and the limestone of the Kumbel Formation of Devonian age.

(ii) The boundary zone between the Altyn-Jylga intrusive body and the limestone strikes nearly N-S and dips 65° ～ 70° east, along which skarn zone occurs.

(iii)In the tunnel, the Altyn-Jylga intrusive body is composed of granodiorite, granodiorite porphyry, diorite, monzonite and gabbro. The limestone is white-colored, crystalline and massive. According to the existing data by the surface survey, the limestone has a nearly N-S strike and a steep dip to the east or the west, forming a marked folding structure.

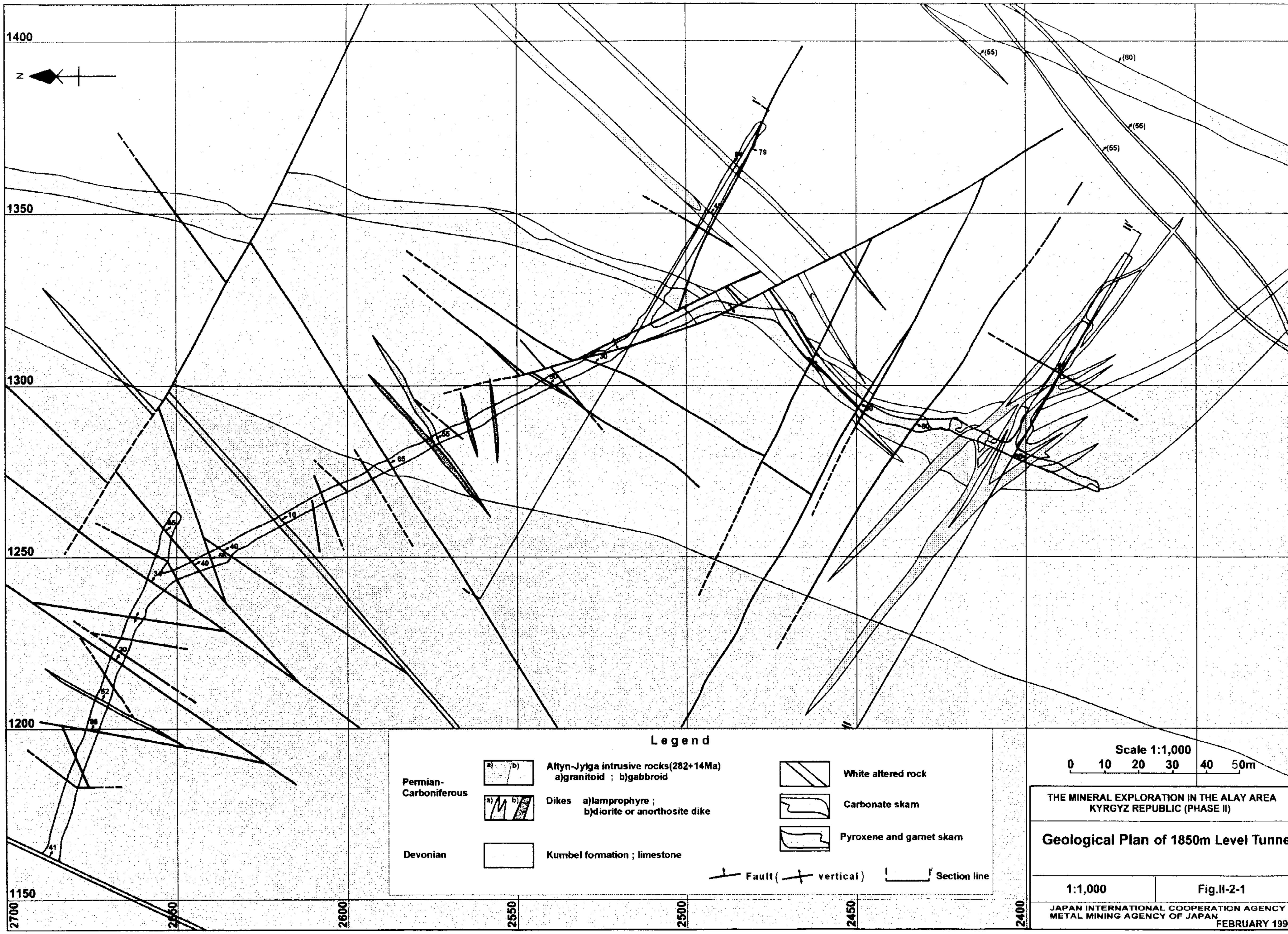
Descriptions of the Altyn-Jylga intrusive body and the dikes are given in the following paragraphs, while those of the skarns in a separate paragraph.

(1) Altyn-Jylga intrusive body

The intrusive body occurs between the mouth of the tunnel and the 9.8m point of the side track II. From the mouth to the 72m point of the tunnel II, acidic lithofacies, mainly granodiorite, are observed whilst, from the 72m point of the tunnel II to the 9.8m point of the side track II, basic lithofacies, mainly gabbro, are prevailing. The boundary between them, transitional within narrow widths, strikes NNE-SSW and dips approximately 75° east. The rock facies dominated by gabbro are somewhat skarnized from around the 85m point of the tunnel II (thin section T-2-85F; the observations of thin sections are shown in Appendices 2

Table II - 2 - 1 Method of the Geological Survey in the 1850m Level Tunnel

Method		Location/Sample (quantity)	Procedure	Results & remarks
Tunnel sketch (side walls and roof)		Whole area of the 1,850m level tunnel(555m)	Scale 1/200, detailed sketch of important outcrops and faces, photography	Plate 1～3
Sampling	Assay	Mineralization zones (529)	Dimension of channel samples : principally 1m(l)×10cm(w)×5cm(d) at 1m in height from the floor Taken from both side walls of cross-cut or each face of drift, and from side walls and faces in the part where the direction of ore zone was unidentified	Appendix 6 (including 540 results assayed independently by the South Kyrghyz Geol. Exp.)
	Thin sections	Fresh rocks and altered rocks without mineralization(27)		Appendices 2 and 3
	Polished thin section and EPMA	Ore and mineralized rocks(19) EPMA was done to identify ore minerals and determine Au-Ag ratio of electrum(6)		Appendices 4 and 5 Appendix 10(EPMA)
	X-ray diffraction analysis	Clay and altered or cryptocrystalline minerals of the thin section and polished thin section samples(8)		Appendix 7
	Homogenization temperature of fluid inclusions	Quartz and calcite accompanied with ore minerals(15)	Chosen from assay samples of each ore types and each skarn subzone keeping the sample even distribution in the tunnel	Appendices 8 and 9
	Mineral separation test	Skarn ores represent different types of mineral assemblage (4)	3kg for each sample taken within a circle of 1m in diameter and tested for whole taken volume	Appendices 11 ～ 18



THE MINERAL EXPLORATION IN THE ALAY AREA
KYRGYZ REPUBLIC (PHASE II)

Geological Plan of 1850m Level Tunnel

1:1,000	Fig.II-2-1

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METAL MINING AGENCY OF JAPAN
FEBRUARY 1999

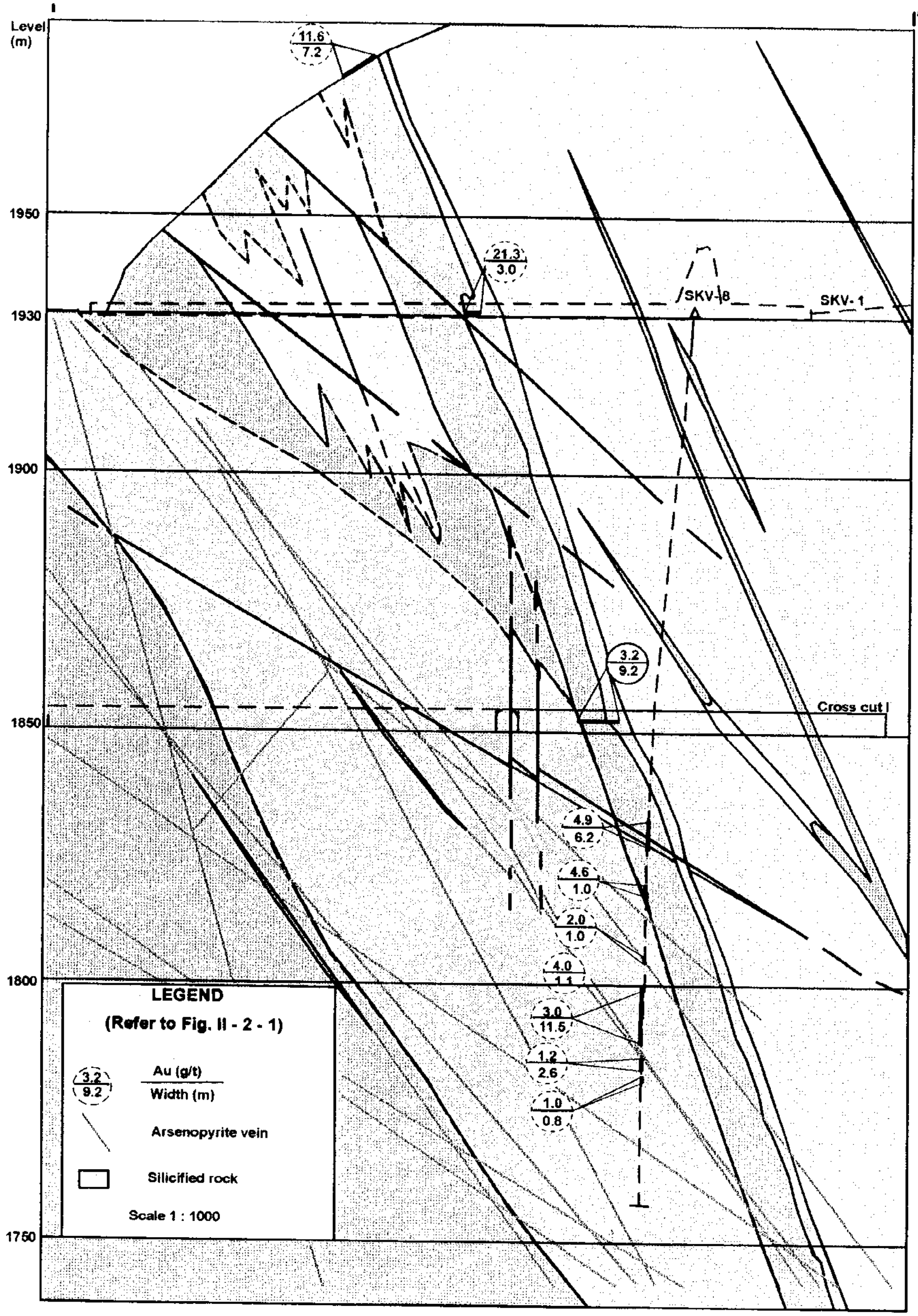


Fig. II - 2 - 2 Geological Section I - I'

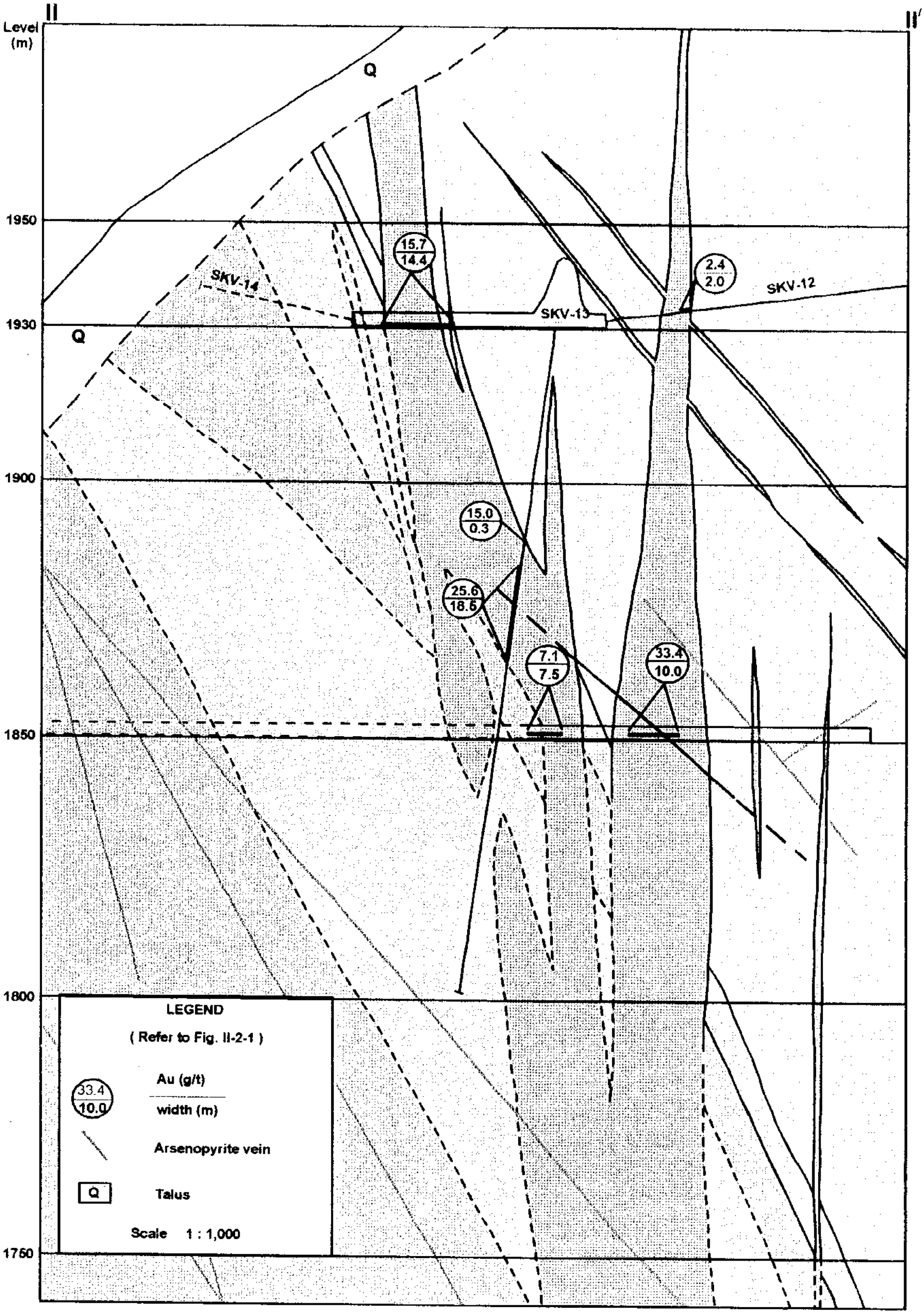


Fig. II-2-3 Geological Section II-II′

and 3), while, from around the 108.5m point of the tunnel II, the skarnization becomes clear(T2-126R) and it changes into pyroxene skarn at the 9.8m point of the side track II. In skarns of the tunnel III, intrusive rocks preserving the original rock texture are observable in places. These are gabbro (thin sections T-3-33R, T3-87.5L, T3-89L, T3-104.1L, T3-104.2L, T3-105.4L, C2-7.6L) and quartz monzodiorite(T3-127FR).

The main component minerals of gabbro are euhedral to subhedral plagioclase, anhedral hornblende, biotite and olivine. Depending on its position within a rock body, the quantitative ratio of plagioclase substantially varies from 10% to 70% or so. In skarnized gabbro, abundant clinopyroxene is observed.

Several faults, striking NE-SW and dipping about 40° south, occur in the intrusive rocks. These faults are accompanied by white alteration zones (thin section T1-57R), several centimeters to 1m wide, with dissemination of arsenopyrite. On the fault planes and the accompanying parallel shear joint planes, numerous quartz-calcite veins, 1mm to 4cm wide, accompanied by arsenopyrite, are observable.

(2) Dikes

Lamprophyre, diorite porphyry, anorthosite and quartz monzodiorite occur as dikes.

(i) The lamprophyre dikes are not more than 3m wide, dominantly less than 1m wide. These dikes are divided into two groups: one striking NE-SW and gently dipping south; and another striking NE-SW and dipping steeply to vertically.

Macroscopically, the dikes are dark grey-colored porphyritic, fine-grained and compact. Under the microscope, the phenocrysts are hornblende of 2mm in length, plagioclase of 1mm, biotite of 0.5mm and potash feldspar of 0.5mm. The groundmass are composed of hornblende, biotite, plagioclase, etc. (T2-150R).

Around the skarn zones along the boundary between the Altyn-Jylga intrusive body and the limestone, lamprophyre dike is skarnized along the contact planes, joint planes and shear planes. The skarn minerals are garnet, clinopyroxene and sericite, and gold mineralization is observable (T3-57.8F, C1-54.5R).

(ii) The dikes of diorite porphyry, anorthosite and quartz monzodiorite are intruding into gabbro. The widths are no more than 1m, dominantly 20cm or less. Some of these dikes have irregular rugged boundaries with the host rocks, while the others have branch veins, irregular networks that fill cracks of gabbro, or lenticular shapes. In skarn zones near the southernmost part of the tunnel III, quartz monzodiorite dikes are seen as the cores free from skarnization.

Macroscopically, diorite porphyry is grey white. Under the microscope, phenocrysts are composed of plagioclase of 0.5mm in diameter and biotite, hornblende, clinopyroxene and quartz of 0.2mm in diameter. The groundmass minerals are 0.05mm in diameter or less (T2-101.5L).

Anorthosite is white-colored, fine-grained and compact, whilst, under the microscope, it is made principally of anhedral, equigranular plagioclase of 0.5mm in diameter.

2-2-2 Geological structure

(1) The boundary between the Altyn-Jylga intrusive body and the limestone at the 1850m level extends in the N-S direction (Fig.II-2-1), which is almost concordant with the N-S-trending structure confirmed on the surface and in the 1930m level tunnel.

(2) Limestone is white-colored, massive, so its structure is obscure in the tunnels. According to the existing data on the surface geology, it strikes nearly N-S and steeply dips east or west, forming a marked folding structure.

(3) The position of the skarn zone in the 1850m level tunnel is situated on the same plane as confirmed in the 1930m level tunnel and in drillholes(Fig.II-2-2, Fig.II-2-3). The skarn zone is 8m to 25m wide, dips 65° ~ 70° east and shows a plate-like shape.

(4) Two fracture systems occur, one striking NE-SW, another striking NW-SE (Table II-2-2).

Table II-2-2 Classification of Fracture System

Strike	Dip	Nature(width)	Mineralization
NE-SW	35° ~ 70° S	fault(<1m) dike(<2m, <1m dominant) shear joint	mainly accompanied with Au-bearing arsenopyrite vein
NW-SE	70° N~ 80° S	fault(<1m) dike(<3m, <1m dominant) shear joint	mainly accompanied with Au-bearing chalcopyrite-bornite

2-2-3 Skarns

Occurrence of the skarns in the survey tunnels is schematically shown in Fig. I-4-2.

(1) The skarns were formed along the boundary between the intrusive body and limestone as well as in lamprophyre. The former occurs as a belt and forms a skarn zone, some 10m wide. Many skarnized lamprophyre dikes occur in the vicinity of the junction of the crosscut tunnel II.

(2) The skarn zone along the boundary between the intrusive body and limestone, can be divided into three subzones. These subzones are, from the footwall side (the intrusive body side),

(i) a fine-grained pyroxene (-silicified) subzone (endoskarn, 5m wide or less, pyroxene skarn, garnet-pyroxene skarn, magnetite-pyroxene skarn; thin section T2-181.8R),

(ii) a garnet skarn subzone (endoskarn-exsoskarn boundary, 9m wide or less, garnet skarn, pyroxene-garnet skarn; polished thin sections T3-78.9Fa, T3-83.9F, T3-87.5Fa; the observations of polished thin sections are shown in Appendices 4 and 5) and

(iii) a carbonate skarn subzone (exsoskarn, 1m wide or less; polished thin section T3-83.9Fa).

(3) Garnet skarn in the skarn zones occurs as cloud-like, network-like or vein-like forms in the pyroxene skarn.

(4) Lamprophyre that intersects the skarn zone assumes green color due to alteration. Garnet skarns were formed along the both sides of dikes, internal lattice-like joint planes and shear joints (polished thin sections C2-19.5L, C2-19.5La, C2-19.8R, C2-20FR).

(5) The skarns are composed mainly of clinopyroxene, garnet and calcite, and, in places, of quartz, plagioclase, potash feldspar, hornblende, and biotite. Under the microscope, the skarns has granoblastic texture. In some cases, original plagioclase, orthopyroxene, hornblende and biotite are replaced by clinopyroxene (thin sections T2-85F, T3-37R) while, in others, skarns mainly of pyroxene are penetrated by garnet or garnet-hornblende veinlets (thin sections T3-104.1L, C2-7.6L). Garnet is identified as andradite by the EPMA (Appendix 18).

2-2-4 Mineralized parts

The major mineralized parts in the tunnel, averaging 1 g/t Au or higher in intrusive bodies and 3 g/t Au or higher in skarns, are listed in Table II-2-3.

(1) Gold mineralization is observed in skarns and the Altyn-Jylga intrusive body.

Table II-2-3 Mineralization Zones in 1850m Level Tunnel

Location	Distance (m)	Length (m)	Ore type	Host rock	Assay Au (g/t)	Ag (g/t)	Cu (ppm)	As (ppm)	No.
Tunnel I	70.0 ~ 76.5	6.5	Au-As	Granodiorite	1.1	0.3	43	1044	1
Side track I	16.0 ~ 18.0	2.0	Au-As	Granodiorite	1.2	0.2	75	1553	2
Tunnel II	13.0 ~ 14.0	1.0	Au-As	Granodiorite	1.0	0.2	120	150	3
	27.5 ~ 28.5	1.0	Au-As	Granodiorite	1.0	0.1	20	400	4
	31.5 ~ 32.5	1.0	Au-As	Granodiorite	1.4	<0.1	20	200	5
	56.0 ~ 57.0	1.0	Au-As	Granodiorite	2.0	0.2	39	363	6
	65.6 ~ 66.6	1.0	Au-As	Granodiorite	1.2	0.1	80	175	7
	72.6 ~ 73.9	1.3	Au-As	Granodiorite	1.2	0.1	61	257	8
	81.0 ~ 82.0	1.0	Au-(As)	Gabbro	1.2	<0.1	15	0	9
	88.0 ~ 91.3	3.3	Au-(As)	Gabbro	1.4	0.0	30	18	10
	92.2 ~ 94.2	2.0	Au-As	Gabbro	1.6	0.0	20	1050	11
	99.0 ~ 100.0	1.0	Au-As	Gabbro	2.1	0.1	66	2100	12
	108.8 ~ 110.8	2.0	Au-(As)	Gabbro	1.9	0.1	39	28	13
	117.8 ~ 118.8	1.0	Au-As	Gabbro	1.9	0.2	40	200	14
	123.8 ~ 124.8	1.0	Au-As	Gabbro	1.1	0.1	18	600	15
	125.5 ~ 127.5	2.0	Au-(As)	Gabbro	1.3	0.1	40	0	16
	133.5 ~ 134.5	1.0	Au-(As)	Gabbro	1.3	0.1	12	0	17
	137.8 ~ 139.8	2.0	Au-(As)	Gabbro	2.6	0.1	17	60	18
	142.8 ~ 143.8	1.0	Au-As	Gabbro	1.2	<0.1	30	300	19
	148.5 ~ 149.5	1.0	Au-(As)	Gabbro	1.8	0.2	90	0	20
	153.5 ~ 154.5	1.0	Au-(As)	Gabbro	1.2	0.2	12	0	21
Side track II	7.5 ~ 12.4	4.9	Au-Cu	Ga < Cpx skarn	5.2	0.5	132	224	22
right wall	14.7 ~ 16.7	2.0	Au-Cu	Ga < Cpx skarn	6.3	0.6	275	350	23
left wall	16.4 ~ 18.6	2.2	Au-Fe	Carb skarn	4.4	0.4	95	2100	24
Tunnel II-III	182.0 ~ 5.0	10.5	Au-Fe&Au-Cu	Cpx, Ga & Carb skarn	4.8	1.2	156	1830	25
Tunnel III	13.8 ~ 16.7	2.9	Au-Fe&Au-Cu	Cpx, Ga & Carb skarn	4.2	0.1	91	376	26
	20.6 ~ 20.8	0.2	Au-Fe	Asp-Cp vein	20.3	70.0	37100	6340	27
	51.0 ~ 52.8	1.8	Au-Fe&Au-Cu	Cpx, Ga skarn	3.1	0.2	150	1153	28
	55.7 ~ 70.7	15.0	Au-Cu	Cpx <Ga skarn	6.0	0.6	431	155	29
	78.9 ~ 81.4	2.5	Au-Cu	Cpx <Ga skarn, Carb skarn	14.7	12.3	4410	333	30
	83.9 ~ 88.4	4.5	Au-Cu	Ga skarn (dike)	20.6	44.2	12166	31	31
	109.0 ~ 110.0	1.0	Au-Cu	Ga skarn	13.1	0.3	151	0	32
	115.0 ~ 115.0	1.0	Au-Cu	Ga skarn	10.9	3.0	90	0	33
	121.0 ~ 121.0	1.0	Au-Cu	Ga skarn	4.1	0.5	50	0	34
Tunnel III—Cross cut II	103.0 ~ 11.5	13.5	Au-Cu	Ga skarn (dike)	7.9	6.1	2472	191	35
Cross cut II	20.0 ~ 27.0	7.0	Au-Cu	Ga skarn (dike)	23.9	10.2	5621	43	36

Asp: Arsenopyrite, Carb: Carbonate, Cpx: Clinopyroxene, Ga: Garnet
Location of the mineralization zones are shown on Fig. I-4-1

The mineralization is intensive along the fractures.

(2) Gold mineralization in skarns is observed in the skarn zones along the boundary between the intrusive body and limestone as well as in garnet skarns in lamprophyre dikes.

In the fine-grained pyroxene skarn subzone, gold mineralization is sporadic, and the maximum average grade of mineralized part is 6.3g/t Au.

The garnet skarn subzone as a whole represents gold mineralization accompanied with chalcopyrite and bornite, and the maximum average grade of mineralized part is 30.2 g/t Au.

The carbonate skarn zone is accompanied with fine-grained pyrite and arsenopyrite, and maximum average grade of mineralized part is 19.0 g/t Au.

Garnet skarn in lamprophyre dikes is accompanied with chalcopyrite and bornite, and constitute a high-grade mineralized part, often showing the average grade of 10 g/t Au or more with the maximum grade of 366.4 g/t Au.

(3) The gold grade of 5.2 g/t for 4.9m has been confirmed in the skarn zone in the Side track II, which corresponds to the northernmost part of the No.3 ore body in the 1850m level tunnel, while, at the crosscut II in the southernmost part, the grade of 33.4 g/t Au for 10m has been confirmed in skarnized dike.

(4) Arsenopyrite-quartz-calcite veinlets, 1mm to 4cm in width, and white-alteration zones with arsenopyrite dissemination, 1m wide or less, are frequently observed along fractures in the intrusive body. These veinlets and alteration zones contain gold, and maximum average grade of mineralization part is 2.6 g/t Au.

2-2-5 Mode of occurrence of ores

The ores of the No. 3 ore body can be classified into three types according to mineral assemblage: Au-Cu ore, Au-Fe ore and Au-As ore. Characteristic of the respective types of ore is shown in Table II-2-4. Of these ores, the Au-Cu ore is the largest in quantity whereas the Au-Fe ore is far smaller than the former, intermittently occurring in the carbonate skarn subzone. Au-Fe ore shows banded texture composed of fine-grained pyrite-arsenopyrite band and carbonate band, contains a substantial amount of arsenic. Au-As ore occurs along fractures in the intrusive bodies and is low in gold grade.

2-2-6 Homogenization temperature of fluid inclusions

The results of homogenization temperature measurement of fluid inclusions are shown in Table II-2-5, the measurement data in Appendix 8 and the histograms of the temperatures classified according to the ore types in Appendices

Table II -2-4 Classification and Characteristics of Ores

Ore type	Mode of occurrence	Au grade(g/t)	Ore minerals	Au mineral	Texture of ore
Au-Cu ore	1) Irregular, vein-like or lens-like shape along fractures in garnet skarn and pyroxene skarn 2)Dissemination of chalcopyrite and bornite in massive brown garnet. 3)Spot or knot of chalcopyrite and bornite with calcite & amphibole filling druse in garnet skarn	1-336.4	Chalcopyrite Bornite	Electrum(Au66-72%), granular, vein-like, irregular 1-600 μ m	Electrum is granular or irregular shape, associated with chalcopyrite and bornite Electrum tends to be associated with bornite than chalcopyrite in high Au grade part Vein-like electrum filling the cracks of garnet Small grains of electrum mainly in and between gangue minerals
Au-As ore	Vein and dissemination along the fractures(NE-Swdirection, dipping eastward in moderate angle) in Altyn-Jylga intrusive body	1-2.7	Arsenopyrite	Unknown	Arsenopyrite is euhedral, often crushed and filled with calcite and quartz
Au-Fe ore	1)Banded structure of fine-grained calcite-siderite and fine-grained pyrite-arsenopyrite in hanging wall limestone along the skarn zone 2)Veins or lenses of arsenopyrite, chalcopyrite and bornite along the boundary between the skarn zone and limestone	1-30.2	Siderite Pyrite Arsenopyrite Chalcopyrite	Native gold(contain Ag), granular 1-10 μ m	Native gold occurs as small grains in the arsenopyrite

Table II-2-5 Result of Homogenization Temperature Mesurement of Fluid Inclusions

Ore type		Sample No.	Average temperature			Assay results			
			Mineral	Peak1 (℃)	Peak2 (℃)	Au (g/t)	Ag (g/t)	Cu (ppm)	As (ppm)
Au-Cu ore	Ga skarn	C2-19.5L	Calcite	109	170	64.6	20.0	4000	-
		C2-19.5La	Calcite	97	125	81.6	20.0	>10000	-
		C2-19.8R	Calcite	140	240	366.4	40.0	>10000	-
		C2-20FR	Calcite	146	258	102.4	7.0	>10000	-
		Range of ave. temp		97-258					
	Px skarn	T3-63.7L (1)	Quartz	138	-	6.5	-	120	-
		T3-63.7L (2)	Calcite	121	-				
		C1-12L (1)	Quartz	195	267	11.3	0.9	120	200
		C1-12L (2)	Calcite	103	146				
		C1-12L (2)	Quartz	131	170				
		Range of ave. temp		103-267					
Au-Fe ore	Carb skarn	T3-3L (1)	Calcite	108	-	19.0	1.2	400	3000
		T3-3L (2)	Calcite	116	-				
		C1-16C (1)	Calcite	108	-	0.5	0.7	120	1200
		C1-16C (2)	Calcite	117	-				
		Range of ave. temp		108-117					
Au-As ore	Qz-Cal-(Asp) vein	T1-106L	Quartz	135	-	0.3	0.2	120	200
		T2-32.5F	Calcite	116	-	0.5	<0.1	30	900
		T2-131.8L	Calcite	112	-	0.1	-	15	-
		Range of ave. temp		112-135					

Asp : Arsenopyrite
Carb: Carbonate
Ga : Garnet
Px : Pyroxene
Qz : Quartz

9 (1) ~ (4), respectively. The average temperatures are calculated for each sample, while, for a sample whose temperature distribution has more than one peak, an average for each peak is calcurated.

(1) Quartz and calcite associated with Au-Cu ore in garnet/pyroxene skarns often have two or three peaks of homogenization temperature distribution. The average homogenization temperatures for the peaks obtained from garnet skarn and pyroxene skarn ranges from 97℃ to 258℃ and 103℃ to 267℃, respectively. The maximum measured temperatures for pyroxene skarn and garnet skarn are 374℃ (C1-12L(2)) and 276℃ (C2-19.5La), respectively. The range of average temperatures for pyroxene skarn is similar to that for garnet skarn whereas the maximum measured temperature for pyroxene skarn is significantly higher than that for garnet skarn.

(2) Calcite associated with Au-Fe ore in carbonate skarn has only one peak, averaging 108℃-117℃.

(3) Quartz and calcite associated with Au-As ore also has a peak, averaging 112℃-135℃.

2-2-7 Mineral separation test

In order to clarify characteristics of ore and to estimate difficulty of dressing, the four representative types of the ores in skarns were selected for the mineral separation test. The flow of analysis is exhibited in Appendix 11, while the test results are summarized in the form of cumulative distribution of gold as shown in Table II-2-6.

(1) Samples

①T3-3L :Au-Fe ore(carbonate skarn)
②T3-63.7L :Au-Cu ore(magnetite-pyroxene skarn)
③T3-87.5F :Au-Cu ore(garnet skarn)
④C1-12L :Au-Cu ore(garnet-pyroxene skarn)

(2) Outline of the test procedure

Milling → Sieving (6 sizes) → Assay of each sieved sample → Heavy liquid separation of the sieved samples with the highest and the lowest grade sieved samples → Modal analysis

(3) Test results

(i) Native gold and electrum are 1 μm to 600 μm in grain size, chiefly

Table Ⅱ-2-6 Cumulative Distribution of Au in Sieved Milling Ore

	T3-3L	T3-63.7L	T3-87.5F	C2-12L
Grain size (mesh)	Au-Fe ore (Carb skarn)	Au-Cu ore (Mg-Cpx skarn)	Au-Cu ore (Mg-Cpx skarn)	Au-Cu ore (Ga skarn)
+60	8.4%	39.5%	38.0%	8.7%
-60～+100	11.2%	57.6%	53.9%	13.8%
-100～+150	20.4%	69.5%	65.4%	47.3%
-150～+200	39.9%	81.7%	79.5%	66.6%
-200～+325	66.7%	89.4%	92.2%	82.5%
-325	100.0%	100.0%	100.0%	100.0%
Au grade of original samples	1.6g/t	<1g/t	41.3g/t	1.3g/t

Carb: carbonate, Cpx: clinopyroxene, Ga: garnet, Mg: magnetite associated with bornite and chalcopyrite. A part of these grains are observable in arsenopyrite, siderite and garnet, as well.

(ii) Coarse-grained gold minerals of some 50 μ m often occur around chalcopyrite and bornite and along crucks of these minerals. Fine-grained gold minerals partially occur as dots in gangue minerals.

(iii) The coarse grains (+65 mesh) of gold minerals in milling ore samples form middlings with bornite, clinopyroxene and garnet whilst the fine grains remains as simple substance. When the milling grain size is large, the gold grade tends to be high.

2-3 Consideration

2-3-1 Continuity of the ore body

(1) The continuity of the No.3 ore body between the 1,930m and 1,850m levels was ascertained. The ore body is inferred to continue vertically downward.

(2) The bonanza at the intersection of the skarn zone and lamprophyre dike of NW-SE direction in the southern part of the 1,930m level tunnel was ascertained to continue to the 1,850m level tunnel. The bonanza is inferred to continue vertically further downward.

(3) The skarn zone as a host rock of the gold deposit extends southward from the northern part through the central part including the No.3 ore body to the southern part of the Altyn-Jylga district on the surface. The mineralization of the ore body in the 1,850m level tunnel shows no signs of degeneration at the both ends in the north and south. The ore body is therefore inferred to continue further north and south.

(4) To the south of the No.3 ore body, the No.5 ore body (vein-like ore body with average 16.6g/t Au, mineralized dike with 4.7g/t Au) and the Southern deposit (mineralized skarn with 3.2-13.8g/t Au, mineralized dike with 3.0-50.0g/t Au) had been ascertained at the surface by the past surveys. These ore bodies were probably formed in the similar condition as the bonanzas of the No.3 ore body. The No.5 ore body and the Southern deposit are assumed to constitute a continuous mineralization zone extending in ENE-WSW direction (Fig.I-4-3, Fig.I-4-4).

(5) To the east of the No.3 ore body, a vein-like ore body (average 13.9g/t Au) had been ascertained at the surface by the past survey. The ore body extends parallel to the bonanza of the No.3 ore body, therefore those two ore bodies consist a continuous mineralization zone extending in NW-SE direction (Fig.I-4-4).

2-3-2 Mineralization

(1) Process

(i) Skarnization and mineralization

The skarn zone mainly of clinopyroxene was formed along the boundary between the Altyn-Jylga intrusive body and the limestone. Gold mineralization with grade under 1g/t is recognized widely in the skarn zone, therefore low-grade gold mineralization is inferred to have been accompanied with the skarnization.

(ii) Reskarnization

Intrusion of lamprophyre dikes along fractures striking NE-SW and NW-SE, and reskarnization forming garnet skarn in the lamprophyre and the former skarn zone at the lower temperature than that of the first skarnization occurred succeedingly.

(iii) Remineralization and concentration of gold

Most of Au-Cu ore bodies were formed at the late stage of the reskarnization by the mineralization along the same fracture systems.

(iv) Mineralization of arsenopyrite and gold

Au-As mineralization took place along the NE-SW trending fractures in the intrusive body and in the limestone along the skarn. Au-As ore mainly of arsenopyrite was formed along the fractures. Au-Fe ore composed of pyrite, arsenopyrite and chalcopyrite was formed in the limestone.

(2) Controlling factor

The mineralization was controlled by the skarn zone extending in N-S direction and by fractures trending NE-SW and NW-SE, which intersect the skarn zone. Bonanzas are inferred to have been formed at the intersections.

2-3-3 Potential of gold reserves

Potential of ore reserves for the No.3 and the No.5 ore bodies and the Southern deposit is estimated. The No.5 ore body and the Southern deposit had been ascertained at the surface by the past surveys. These ore bodies was probably formed in the similar condition as the bonanzas of the No.3 ore body. Perspective section of ore reserves is shown in Fig.I-4-5.

(1) Rules of the estimation of ore reserves

Cut-off grade : 1g/t Au

Area : area over 1g/t Au or determined by geological structure. Width of horse rock is less than 1m

Depth : for the No.3 ore body, lower limit is 1,710m(exploration level for the succeeding year)

: for the No.5 ore body and the Southern deposit, lower limit is 1,850m

Calculation : the section method, specific gravity = 3.0(on the basis of the measured value by the Kyrghyz side)

Area and grade at each level :

Ore body	Level (m)	Area (m²)	Au grade (g/t)	Height (m)
NO. 3 ore body	Surface (1,980m)	3,100	5.5	50
	1,930m	3,100	5.5	80
	1,850m	2,000	7.0	140
	1,710m	2,000	7.0	
No. 5 ore body	Surface (2,170m)	536	13.6	320
Southern deposit	Surface (2,100m)	1,370	7.4	250

(2) Potential of gold reserves

	Au average grade	Au reserves	Category
The No.3 ore body			
Above 1,930m level	5.5g/t	2.6t	C_2
1,930 – 1,850m levels	6.1g/t	3.7t	C_2
1,850 – 1,710m levels	7.0g/t	8.4t	P_1
subtotal		14.7t	
The No.5 ore body			
2,170 – 1,850m levels	13.6g/t	7.0t	P_2
The Southern deposit			
2,170 – 1,850m levels	7.4g/t	7.6t	P_2
subtotal		14.6t	

The No.3 ore body + the No.5 ore body + the Southern deposit = 29.3t

2-3-4 Mineral separatibility

(1) Microscopic observation of milling ore samples indicates that coarse-grained gold often occurs around chalcopyrite, bornite and chalcocite, and also along cracks of these minerals. Presumably, the liberation will be relatively easy.

(2) The Au cumulative distribution indicates that gold is apt to remain in the coarse-grained portion. From this, it can be anticipated that up to 60% of gold content is recovered by specific gravity separation and some 30% by flotation or cyanidation, the total recovery coming to 80% to 90%.

PART III

CONCLUSION AND RECOMMENDATION

CHAPTER 1 CONCLUSIONS

(1) The continuity of the No.3 ore body between 1,930m level and 1,850m level and of the high-grade zone found by the past drilling surveys has been ascertained. Area and average grade of the ore body at the 1,850m level was estimated to be 2,000m^2 and 7.0g/t Au (cut-off grade 1g/t), respectively. The ore body is inferred to continue horizontally and vertically downward.

(2) The gold mineralization of the No.3 ore body can be divided into the following three stages:

Stage A. Mineralization accompanied with the pyroxene-dominant skarnization along the boundary of the Altyn-Jylga intrusive body and the limestone in the late stage of the skarnization

Stage B. Mineralization accompanied with the garnet-dominant reskarnization of the lamprophyre and the skarn of the first stage in the late stage of the reskarnization

Stage C. Mineralization which occurred along the fractures near the skarn after formation of the skarn

High-grade ore and bonanzas were formed in the second stage around intersections of the skarn zone and the dikes.

(3) It is inferred that the No.5 ore body and the Southern deposit consist a continuous mineralization zone. The mineralization of these ore bodies was probably formed in the similar mode of occurrence as the bonanzas of the No.3 ore body. The potential gold reserves of the No.3, the No.5 and the Southern ore bodies are estimated altogether at 29.3 tons.

CHAPTER 2 RECOMMENDATIONS

It is required to explore the deeper part below the 1,850m level thereby clarifying a potential of the ore body.

In order to bring the Altyn-Jylga District to the development stage, it would be necessary to clarify further the mechanism of the mineralization on the basis of Phase II results, and also to establish guidelines for exploring the ore zone consisting of the No. 5 ore body, the Southern deposit, as well as the other promising ore bodies and deposits, thereby increasing ore reserves substantially.

(1) Exploration targets

(i) **Extensions of the skarn zone in the horizontal and vertical directions**

(ii) **Intersections of the skarn zones with dikes**

(2) Localities and methods of survey

A. Downward and horizontal drilling survey of the No.3 ore body

B. Driving a survey adit toward the ore zone consisting of the No.5 and the Southern ore bodies and detailed surface geological survey of the ore zone

C. Detailed surface geological survey of the vein-like ore bodies at the extreme north and to the east of the No. 3 ore body, as well as the Western and Far Western deposits.

D. Ore dressing test (quantification of ore characteristics and studies on ore dressing process)

Appendices

Result of Laboratory Works

Appendix 1 List of Laboratory Test Samples

	Sample no.	Rock name	Laboratory test						Remarks
1	T1-57R	Altered granodiorite porphyry	T		X				
2	T1-106L	Qz-Cal-Asp vein		P		F			Quartz(F)
3	T2-32.5F	Cal-Qz-Asp vein				F			Calcite(F)
4	T2-85F	Anorthosite(dike)/Skarnized gabbro(wall rock)	T						
5	T2-101.5L	Diorite porphyry(dike)/Monzodiorite(wall rock)	T						Calcite(F)
6	T2-104L	Skarnized gabbro	T						
7	T2-123F	Mo ore in monzonite		P					
8	T2-126R	Skarnized gabbro	T						
9	T2-131.8L	Cal-Py vein				F			Calcite(F)
10	T2-150R	Lamprophyre	T						
11	T2-181.8R	Cpx skarn(siliceous skarn)	T						
12	T3-3L	Py ore in Px-Qz-Carb skarn				F		M	Calcite(F)
13	T3-33R	Skarnized gabbro	T						
14	T3-35.6L	Brecciated limestone	T		X				
15	T3-37R	Cpx skarn(lamprophyre?)	T		X				
16	T3-56.8F	Bn-Cp ore in Ga skarn		P					
17	T3-57.8F	Skarnized lamprophyre	T						
18	T3-63.7L	Cp-Py ore in Mt-Cpx skarn				F		M	Quartz & Calcite(F)
19	T3-64.7F	Cp ore in Ga-Cpx-Mt skarn		P					
20	T3-78.9F	Py ore in Cpx skarn(brecciated)		P					
21	T3-78.9Fa	Cp ore in Cpx-Ga skarn		P			E		Tetrahedrite(EPMA)
22	T3-83.9F	Cp ore in Cpx-Ga skarn ore(fine-grained)		P					
23	T3-83.9Fa	Mineralized Cpx crystal		P					
24	T3-83.9Fb	Py ore in Py-Cal-Sid banded skarn		P					
25	T3-87.5F	Bn-Cp ore in Cpx-Ga skarn						M	
26	T3-87.5Fa	Mineralized Endoskarn(light green)		P					
27	T3-87.5Fb	Bn-Cp ore in Cpx-Amp-Ga skarn		P					
28	T3-87.5L	Cpx skarn(gabbro?)	T						
29	T3-88.4F	Cp-Bn ore in Cpx skarn		P					
30	T3-89L	Cpx skarn(gabbro?)	T						
31	T3-104.1L	Ga-Hb-Cpx skarn (gabbro?)	T						
32	T3-104.2L	Ga-Hb-Cpx skarn (gabbro?)	T		X				
33	T3-105.4L	Gabbro	T						
34	T3-107.3R	Cpx-Ga skarn	T		X				
35	T3-127F	Qz monzodiorite	T						
36	T3-127FR	Cpx skarn	T						
37	C1-11.5L	Asp ore in Ga-Cpx skarn		P					
38	C1-12L	Py-Cp ore in Ga-Cpx skarn				F		M	Quartz & Calcite(F)
39	C1-16C	Py-Cal skarn				F			Calcite(F)
40	C1-19L	Cp-Mt-Asp ore in Qz-Cal-Amp skarn		P					
41	C1-54.5R	Skarnized lamprophyre	T		X				
42	C1-55.9L	Lamprophyre	T						
43	C1-58.2C	Marble	T						
44	C2-7.6L	Cpx skarn (gabbro?)	T						
45	C2-13.2C	Wollastonite skarn			X				
46	C2-13.5C	Cpx-wo skarn	T						
47	C2-19FL	Cpx skarn	T						
48	C2-19FR	Cpx skarn	T						
49	C2-19.5L	Au-Cp ore in Ga skarn		P		F	E		Electrum(EPMA), Calcite(F)
50	C2-19.5La	Au-Cp ore in Ga-Cal-Cpx		P		F			Calcite(F)
51	C2-19.8R	Au-Cp ore in Cal-Ga-Cpx skarn		P	X	F	E		Electrum&Bi-Te mineral(EPMA), Calcite(F)
52	C2-20FR	Au-Cp ore in Ga-Cpx-Cal skarn		P		F	E		Electrum(EPMA), Calcite(F)
53	C2-49.8L	Cpx skarn	T						
54	C2-55C	Py-Asp aggregates ore		P					

E : EPMA, F : Homogenization temperature of fluid inclusions, M : Mineral separation test, T : Thin section,
P : Polished thin section, X : X-ray diffraction analysis. Refer to Appendix 2 for abbreviations of minerals.

Appendix 2 Microscopic Observations of the Thin Sections

No.	Sample number	Rock name	Primary minerals: Qz	Pl	Kf	Bt	Hb	Cpx	Opx	Ol	Mt	Sph	Zr	Ap	Secondary minerals: Qz	Pl	Kf	Bt	Hb	Ac	Se	Ch	Sp	Cal	Ep	Prh	Sph	Ap	Cpx	Ga	Wol	Py	Remarks
1	T1-57R	Granodiorite porphyry	○	◎	△	(△)	(△)						·	·							△			△								·	Hydrothermally altered
2	T2-85F(a)	Anorthosite(dike)		◎							·									△	△	·		·	·	△	·						Sharp contact with(b)
	T2-85F(b)	Skarnized gabbro(wall rock)		△		△	△		△											△	·					△			○				Cpx:replacing Pl, Opx, Hb, Bt
3	T2-101.5L(a)	Diorite porphyry(dike)	△	○		△	△	△				·		·							·	·											Qz:xenocrysts. Groundmass:cryptocrystalline
	T2-101.5L(b)	Monzodiorite(wall rock)	·	○	△	△	△	△	(△)		·			·						·	·			·									Corona structure (Opx→Cpx→Hb→Bt)
4	T2-104L	Skarnized gabbro		○		△					·							△		△	△					·	·	·	○				Cpx:replacing Pl, Bt
5	T2-126R	Skarnized gabbro		○		△	△			△								△		△			·			△			○				Cpx:replacing Pl, Hb
6	T2-150R	Lamprophyre		◎	△	△	△	△	△		·	·		·							·												With abundant Pl phenocrysts.
7	T2-181.8R	Cpx skarn(siliceous skarn)													○	△	△				·	·			·				○				Fine-grained, granoblastic.
8	T3-33R	Skarnized gabbro		◎		·	△	△				△								△	△			△	·	△			○				Pl:mostly altered to Se, Prh
9	T3-35.6L	Brecciated limestone													△							△		◎									Including cherty lens or fragment. With Cal vein.
10	T3-37R	Cpx skarn(lamprophyre?)		○			·														△					△	△		○				Hb:replaced by Cpx. With Prh-, Ep-, Cal veins.
11	T3-57.8F	Skarnized lamprophyre		○		○	○	·					·	·							·			△			·		○				Hb, Bt:replaced by Cpx
12	T3-87.5L	Cpx skarn(gabbro?)		○		△															△	·					△	△	◎				Pl:replaced By Cpx, Se. With sulfide(?)
13	T3-89L	Cpx skarn(gabbro?)		○												○					·	·		·		·	△	△	○			·?	Pl:mostly granoblastic With sulfide(?)
14	T3-104.1L	Ga-Hb-Cpx skarn (gabbro?)		△		△													△					·	△		△		○	△			Ga・Hb : forming network-like veins.
15	T3-104.2L	Cpx skarn (gabbro)		○		△								·				·		·	·	·		·		△		·	○				
16	T3-105.4L	Gabbro		○		○	△	○			·	·	·	·							·												Corona structure (Cpx→Hb→Bt)
17	T3-107.3R	Cpx-Ga skarn																			·					△	·		△	◎			
18	T3-127F	Qz monzodiorite	△	◎	○	△	·	○			·	·	·	·							·					·			·				Weakly skarnized
19	T3-127FR	Cpx skarn		○																	·					△	·	△	◎				With Prh-, Cal-, Act- veins.
20	C1-54.5R	Skarnized lamprophyre	·	◎	△		△														·			△	△	△	·		○				Hb:partly replaced by Cpx.
21	C1-55.9L	Lamprophyre	·	○	·	△	○						·	·							△			·									
22	C1-58.2C	Marble																○	○					○	△				△	△		·	Compositional banding.
23	C2-7.6L	Cpx skarn (gabbro?)		○					·												·					·	△		◎	·			Pl:partly replaced by Cpx, Prh, Se. With Ga vein.
24	C2-13.5C	Cpx-wo skarn																											○		◎		Cpx:pale green, strong dispersion(hedenbergite)
25	C2-19FL	Cpx skarn				△	·																	·			△		◎	·			With Cal-Ga vein, Cpx:hedenbergite
26	C2-19FR	Cpx skarn		△			·									○		△	·								·		◎			·	With Cal-Prh vein.
27	C2-49.8L	Cpx skarn														○	△	△		·						△		·	○				Granoblastic

Ac:Actinolite-tremolite
Ap:Apatite
Bt:Biotite
Cal:Calcite
Ch:Chlorite
Cpx:Clinopyroxene
Ep:Epidote
Ga:Garnet
Hb:Hornblende
Kf:K-feldsper
Mt:Magnetite-ilmenite
Ol:Olivine
Opx:Orthopyroxene
Pl:Plagioclase
Prh:Prehnite
Py:Pyrite
Qz:Quartz
Se:Sericite
Sp:Serpentine
Sph:Sphene
Wol:Wollastonite
Zr:Zircon

Sample number : T1(Tunnel-Ⅰ), T2(Tunnel-Ⅱ), T3(Tunnel-Ⅲ), C1(Crosscut-Ⅰ), C2(Crosscut-Ⅱ),
R(Right wall), L(Left wall), F(Face), FR(Right hand on a Face), FL(Left hand on a Face), C(Roof)
*numerical figures in a sample number show the distance from the starting point in each tunnel segments.

Appendix 3

Photomicrographs of the Thin Sections

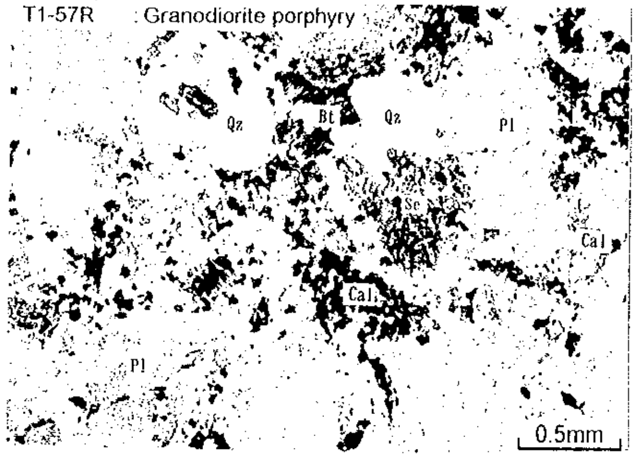
Abbreviations

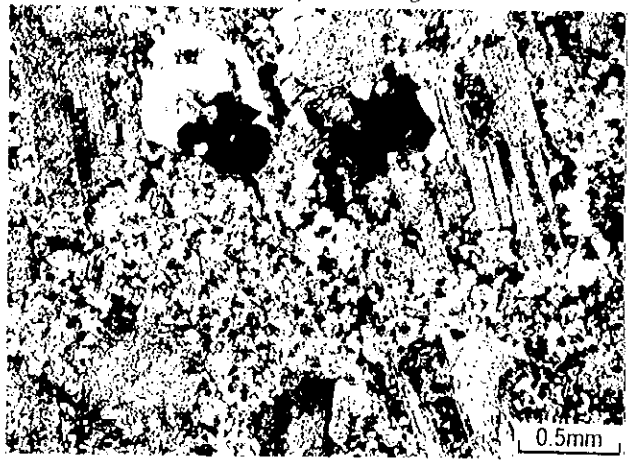
Ac	:Actinolite-tremolite
Ap	:Apatite
Bt	: Biotite
Cal	:Calcite
Ch	:Chlorite
Cpx	:Clinopyroxene
Ga	:Garnet
Hb	:Hornblende
Kf	:K-feldspar
Ol	:Olivine
Pl	:Plagioclase
Prh	:Prehnite
Qz	:Quartz
Se	:Sericite
Sp	:Serpentine
Sph	:Sphene
Wol	:Wollastonite

Appendix 3 Photomicrographs of the Thin Sections

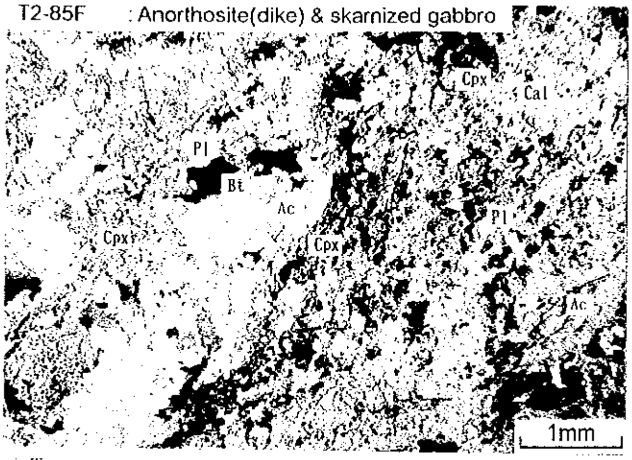
Plane polarized light | Crossed polarized light

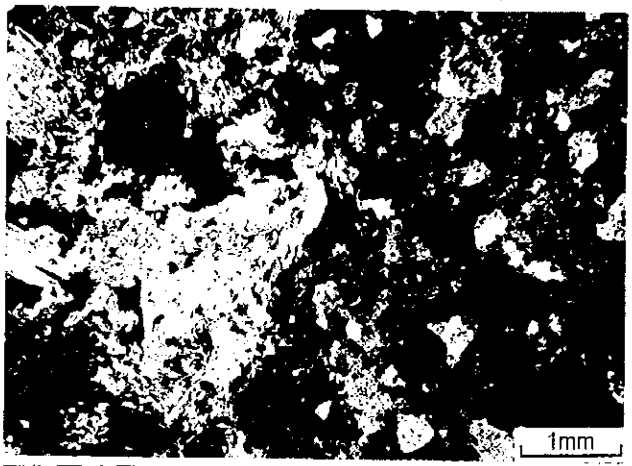
1 T1-57R : Granodiorite porphyry



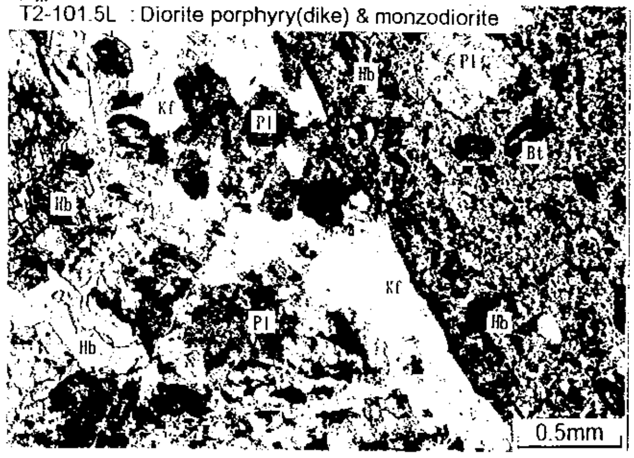


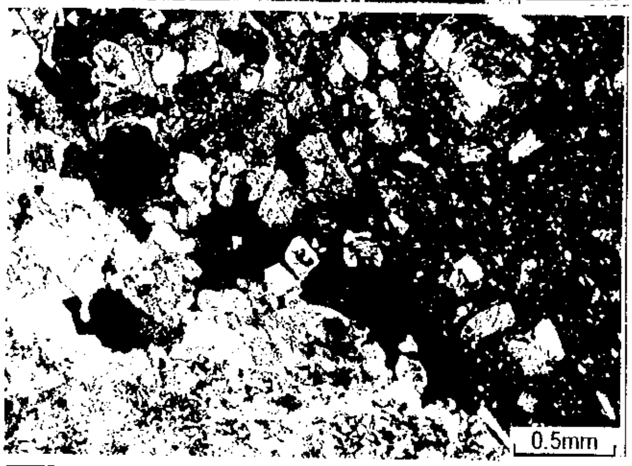
2 T2-85F : Anorthosite(dike) & skarnized gabbro



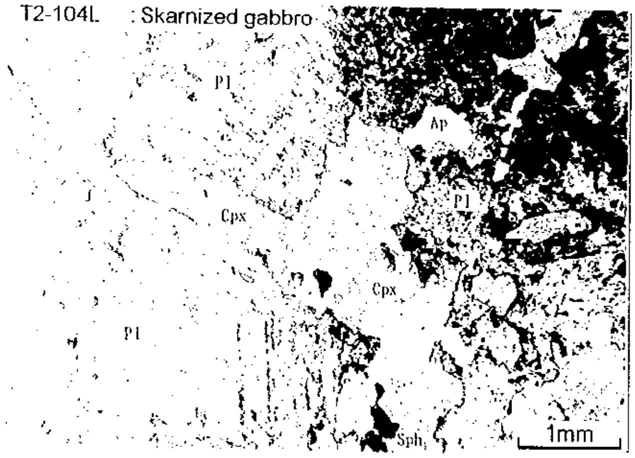


3 T2-101.5L : Diorite porphyry(dike) & monzodiorite





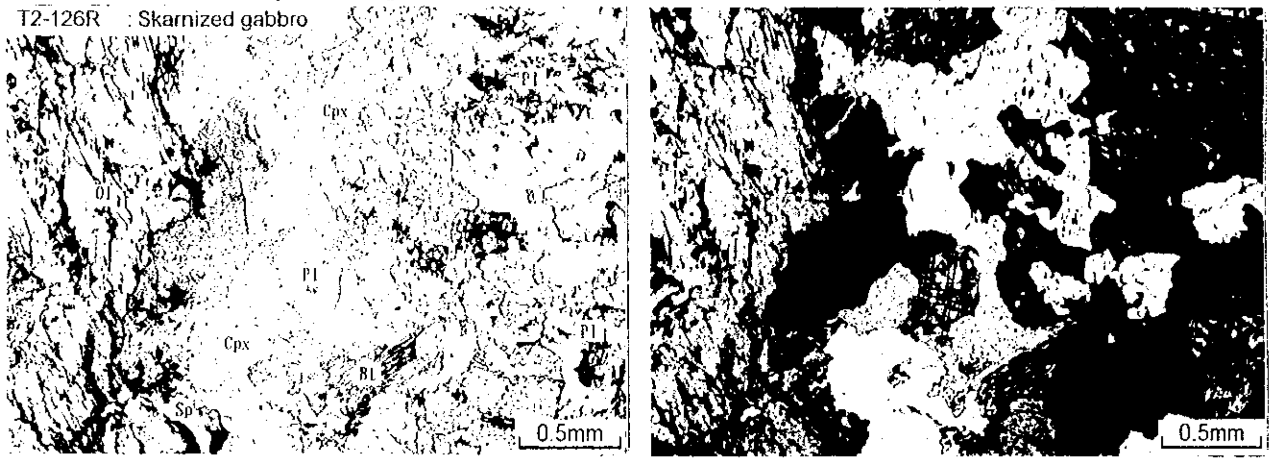
4 T2-104L : Skarnized gabbro



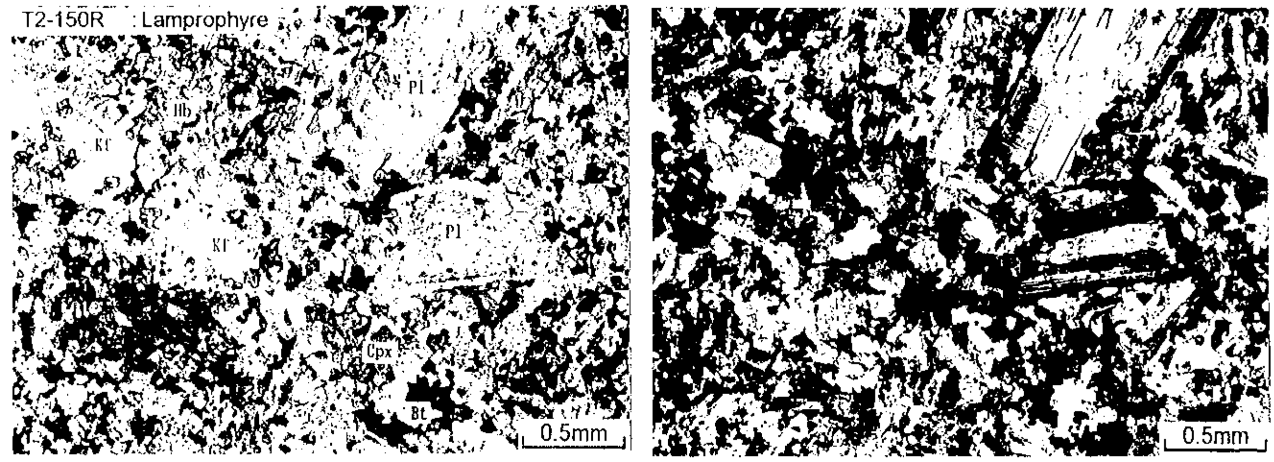
Appendix 3 Photomicrographs of the Thin Sections

Plane polarized light | Crossed polarized light

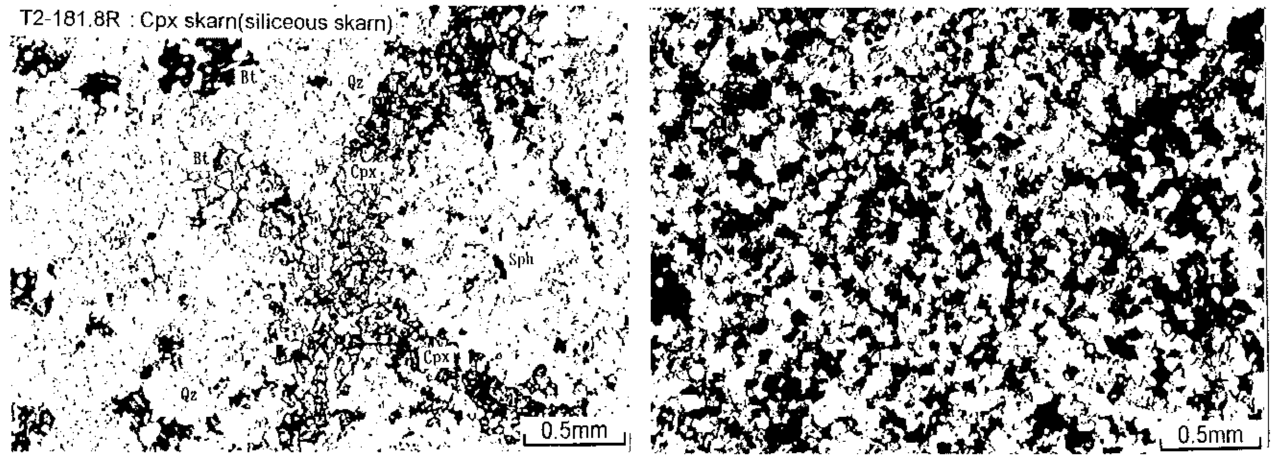
5 T2-126R : Skarnized gabbro



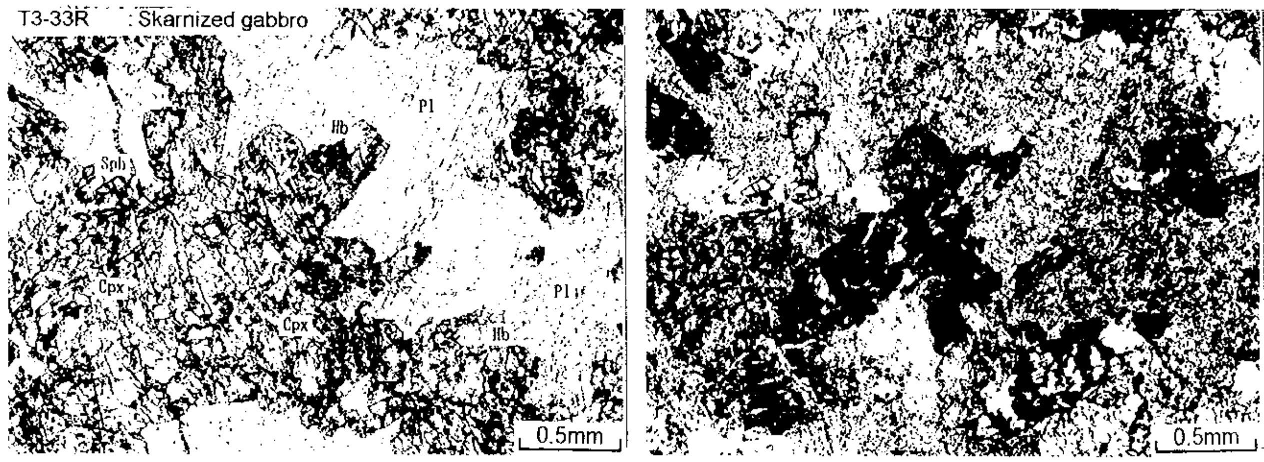
6 T2-150R : Lamprophyre



7 T2-181.8R : Cpx skarn(siliceous skarn)



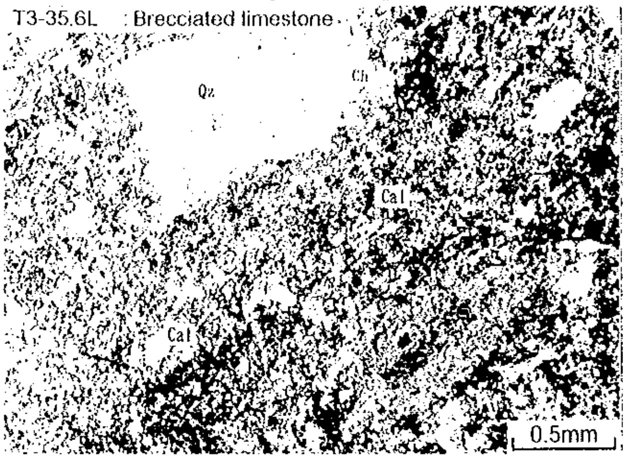
8 T3-33R : Skarnized gabbro

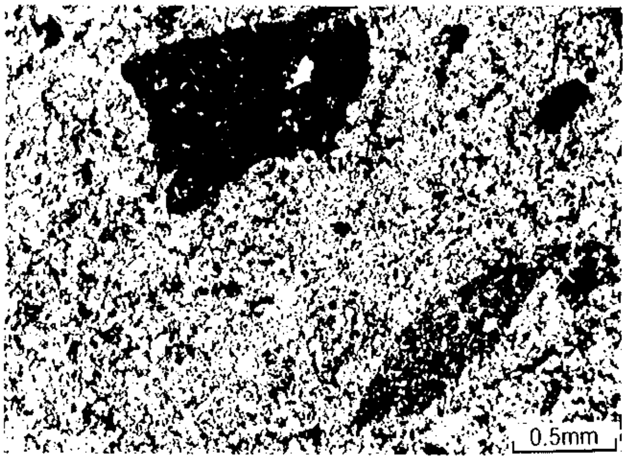


Appendix 3 Photomicrographs of the Thin Sections

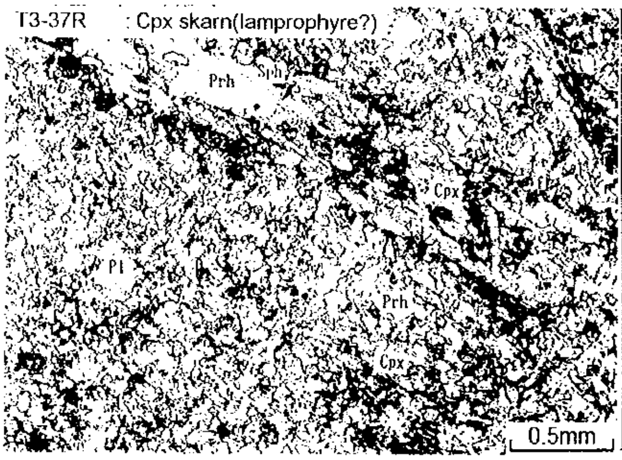
Plane polarized light | Crossed polarized light

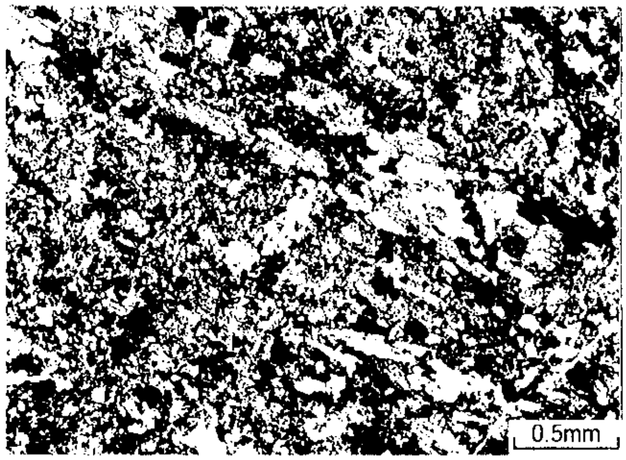
9 T3-35.6L : Brecciated limestone



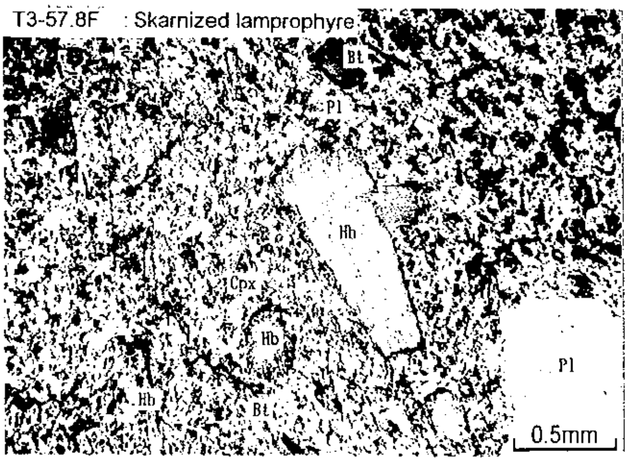


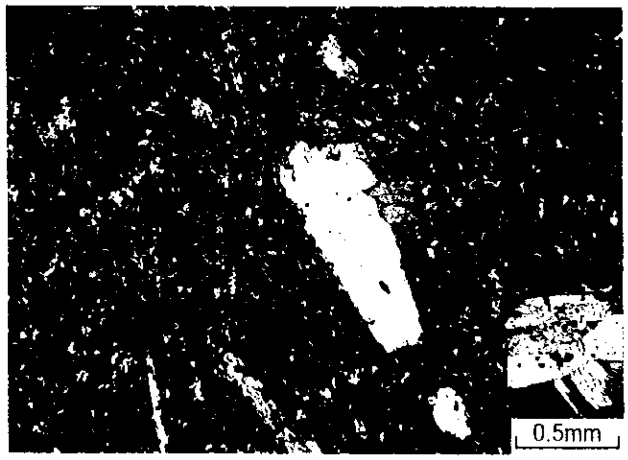
10 T3-37R : Cpx skarn(lamprophyre?)



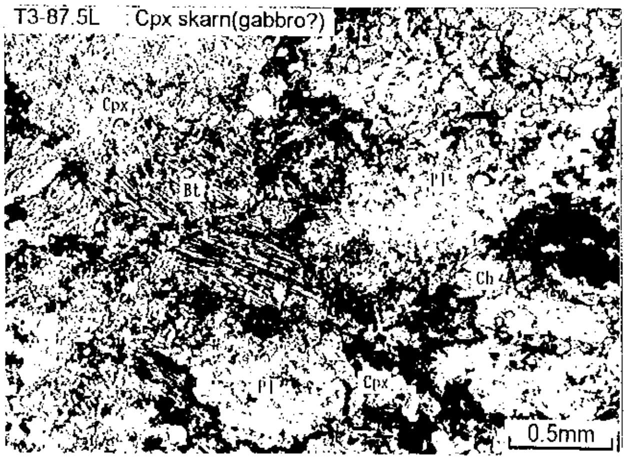


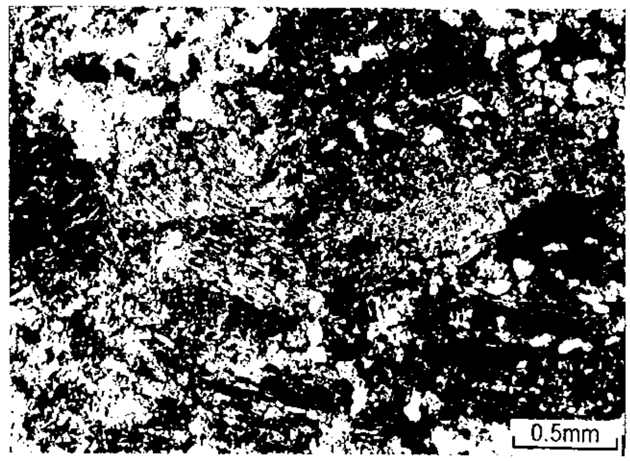
11 T3-57.8F : Skarnized lamprophyre





12 T3-87.5L : Cpx skarn(gabbro?)

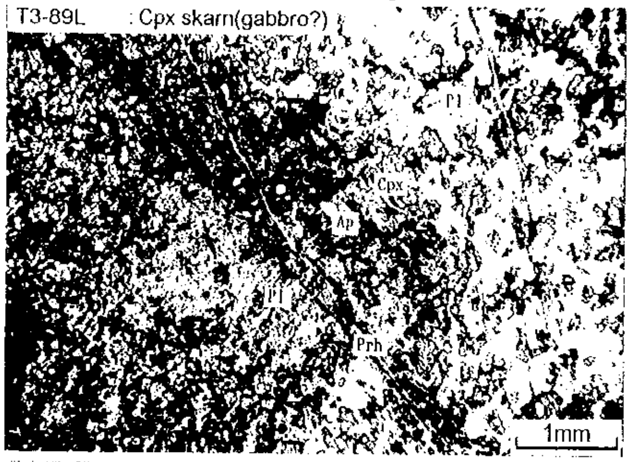


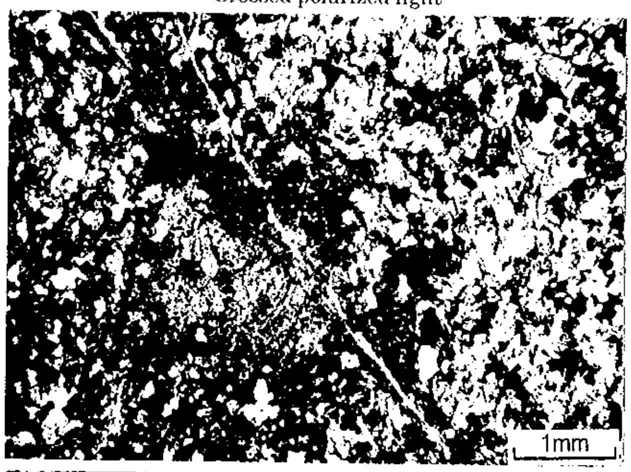


Appendix 3 Photomicrographs of the Thin Sections

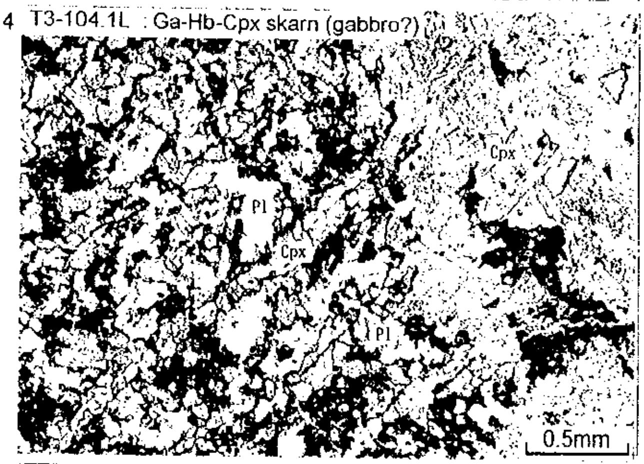
Plane polarized light | Crossed polarized light

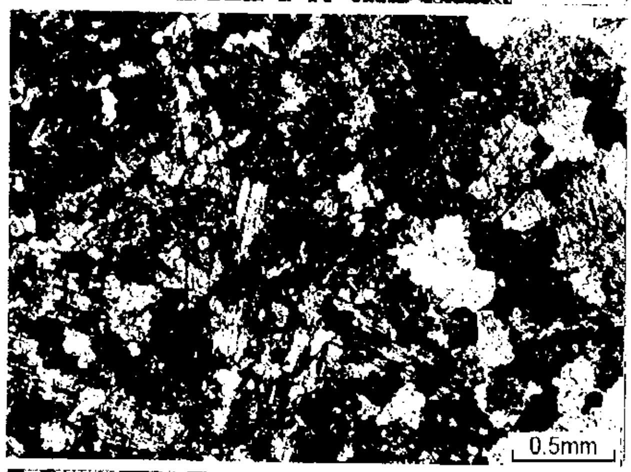
13 T3-89L : Cpx skarn(gabbro?)



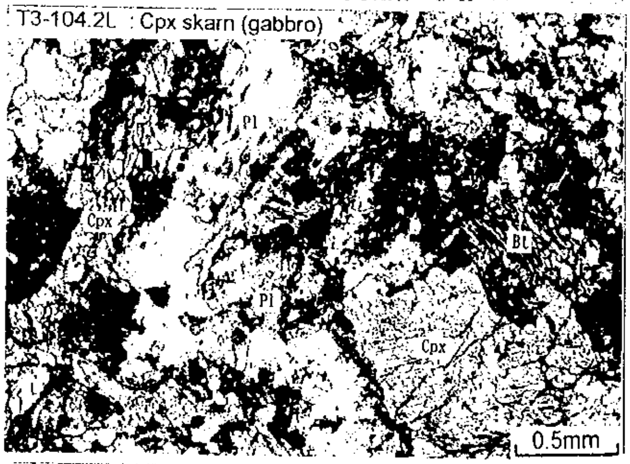


14 T3-104.1L : Ga-Hb-Cpx skarn (gabbro?)

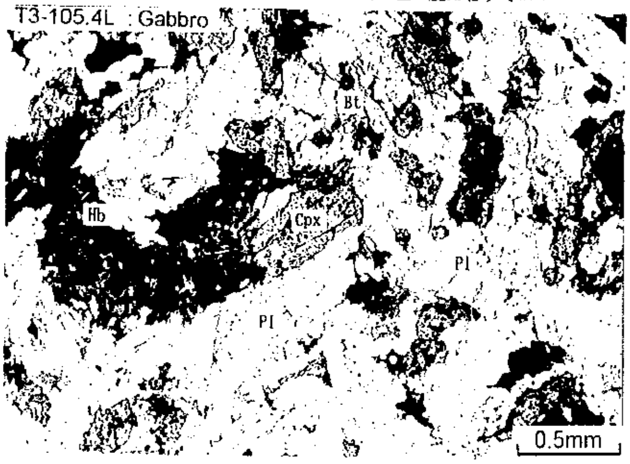




15 T3-104.2L : Cpx skarn (gabbro)



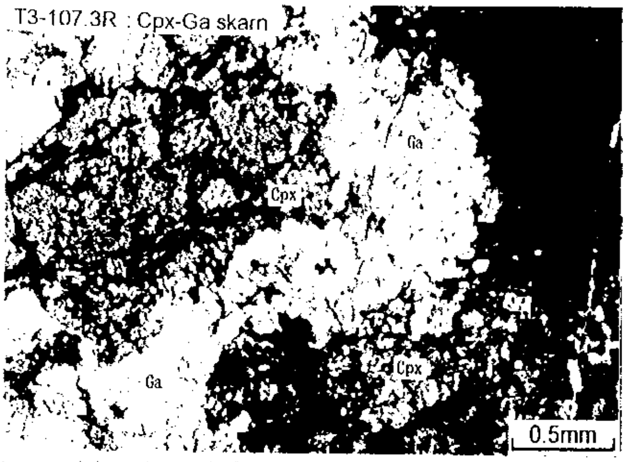
16 T3-105.4L : Gabbro

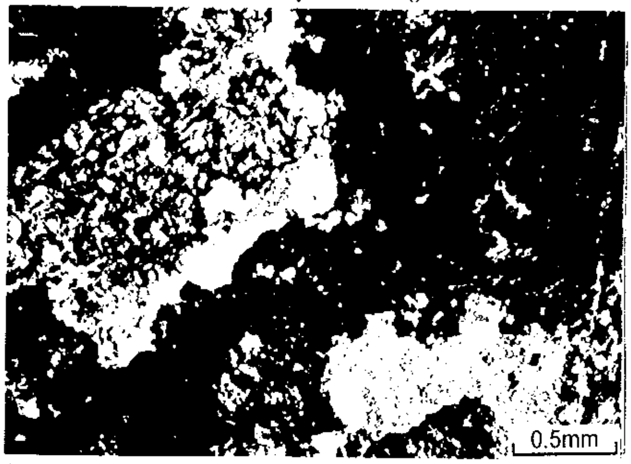


Appendix 3 Photomicrographs of the Thin Sections

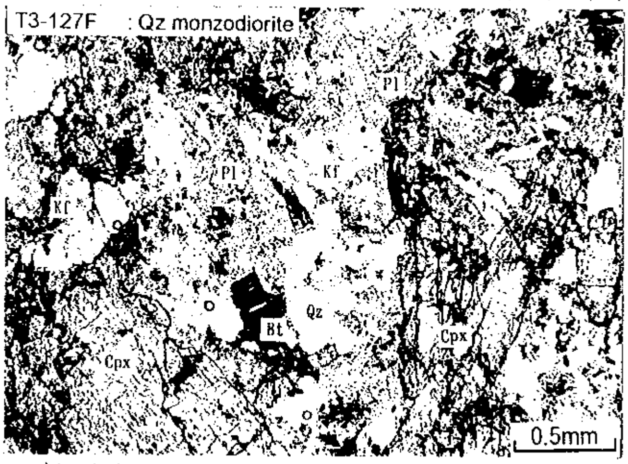
Plane polarized light | Crossed polarized light

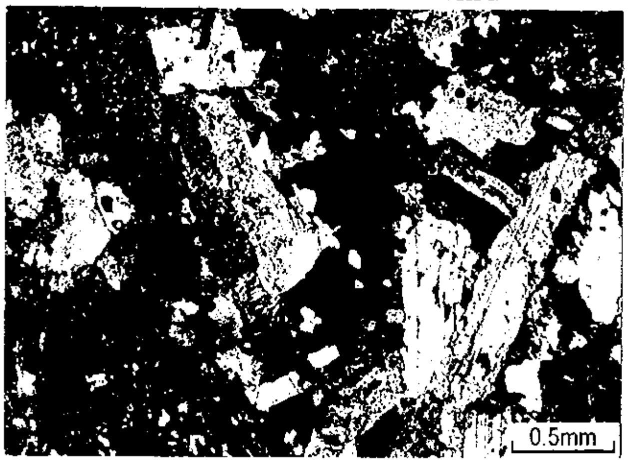
17 T3-107.3R : Cpx-Ga skarn



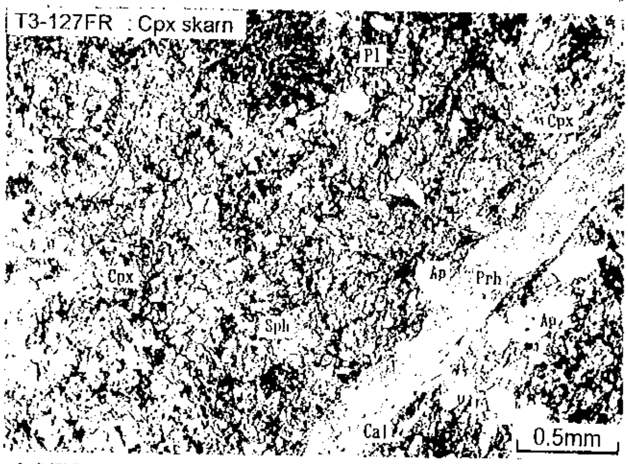


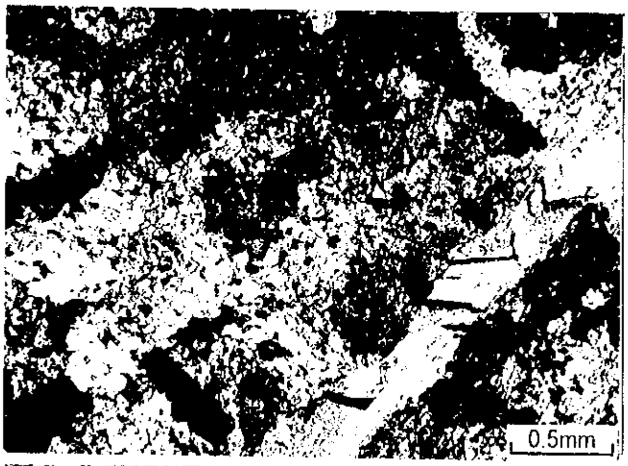
18 T3-127F : Qz monzodiorite



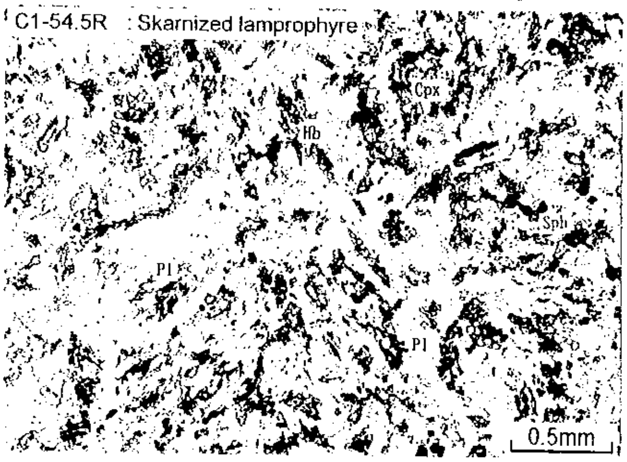


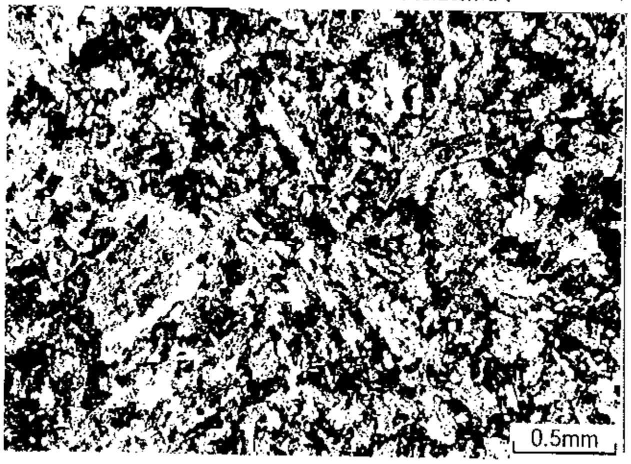
19 T3-127FR : Cpx skarn





20 C1-54.5R : Skarnized lamprophyre

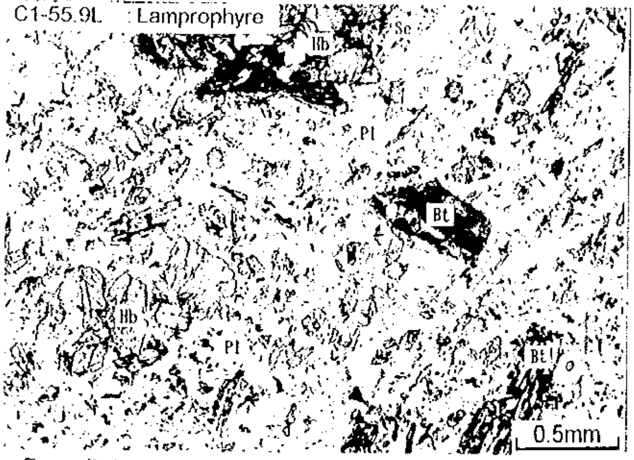


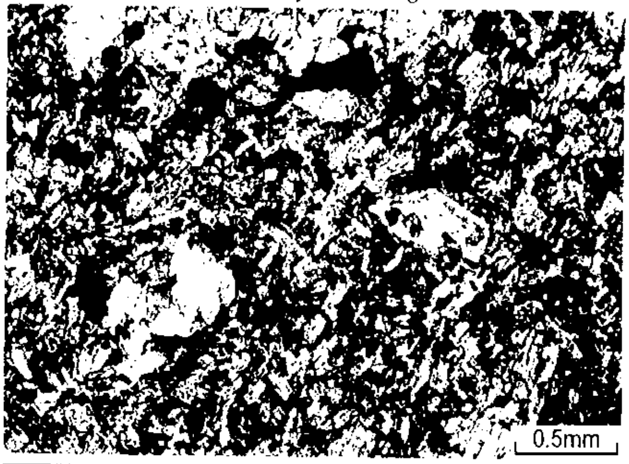


Appendix 3 Photomicrographs of the Thin Sections

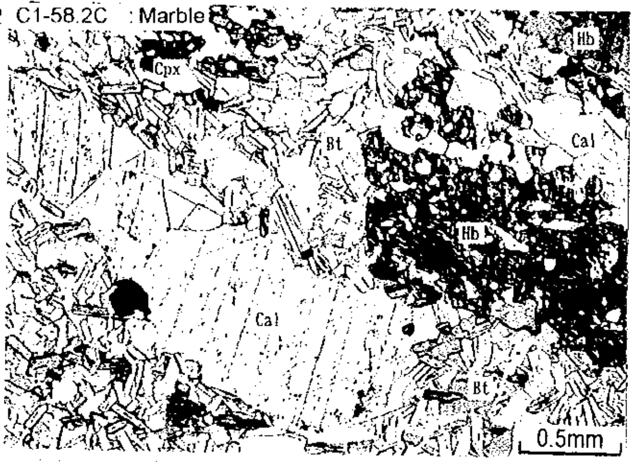
Plane polarized light | Crossed polarized light

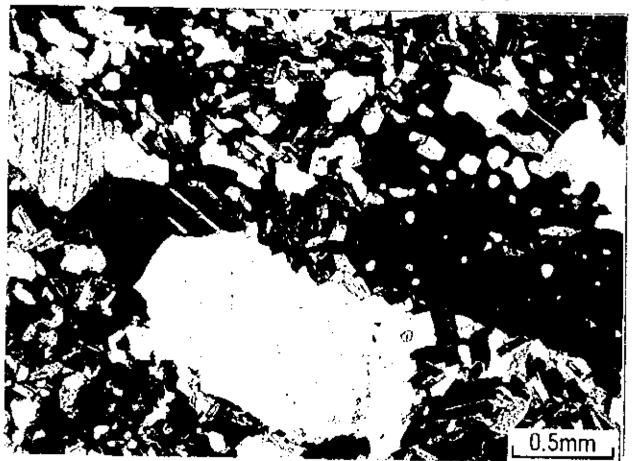
21 C1-55.9L : Lamprophyre



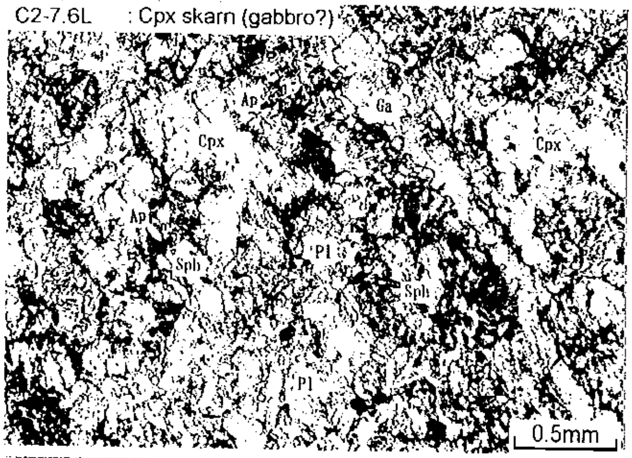


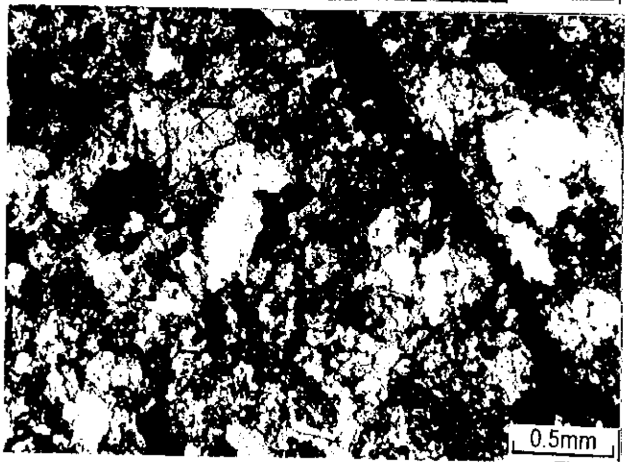
22 C1-58.2C : Marble



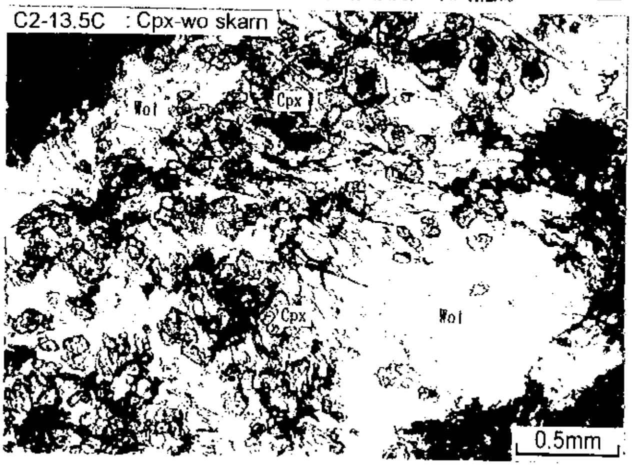


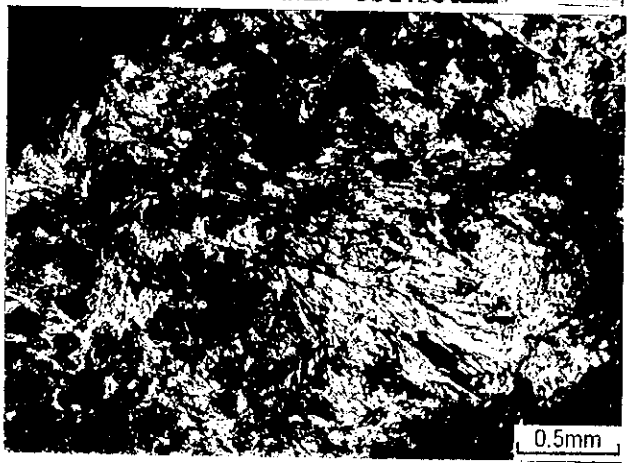
23 C2-7.6L : Cpx skarn (gabbro?)





24 C2-13.5C : Cpx-wo skarn

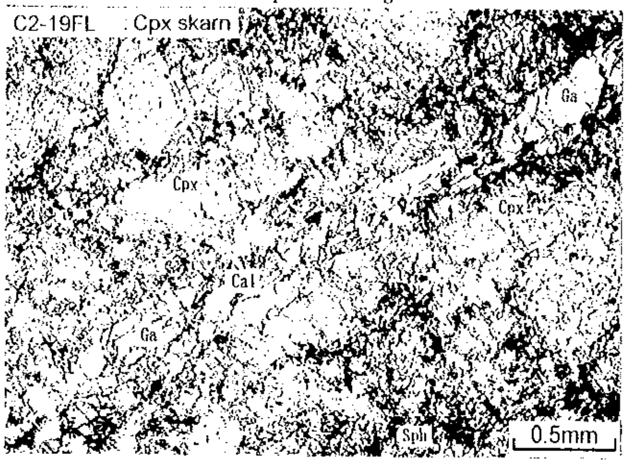


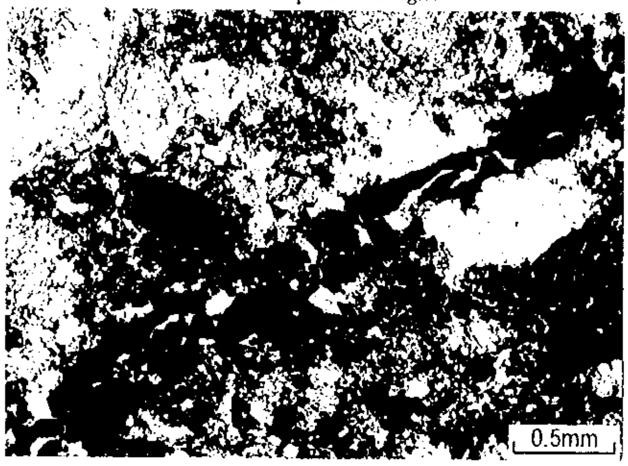


Appendix 3 Photomicrographs of the Thin Sections

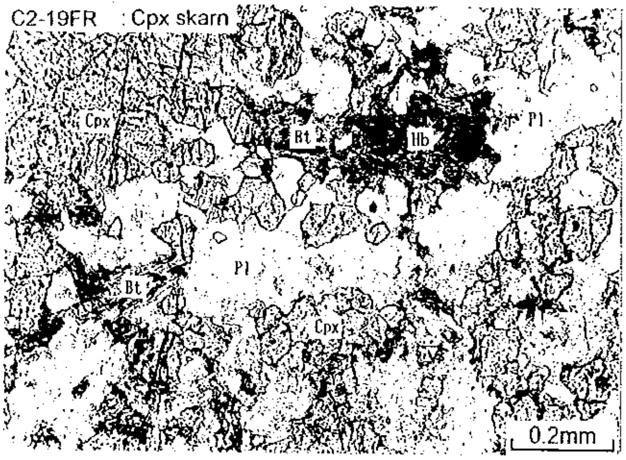
Plane polarized light / Crossed polarized light

25 C2-19FL : Cpx skarn

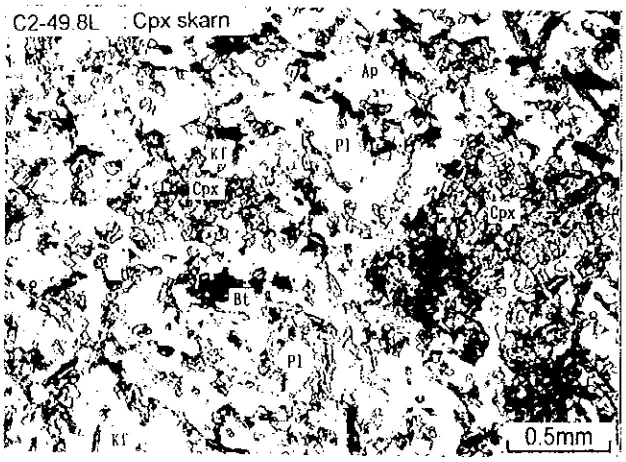


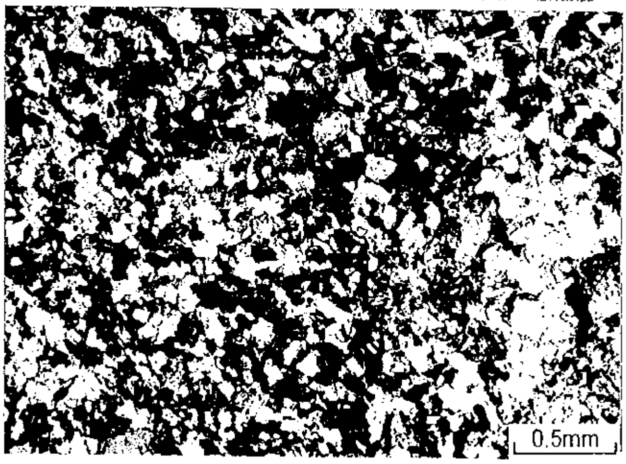


26 C2-19FR : Cpx skarn



27 C2-49.8L : Cpx skarn





Appendix 4 Microscopic Observations of the Polished Thin Sections of the Ore

No.	Sample number	Rock name	Ore minerals																					Gangue minerals															Au grade
			El	Hs	Td	Tb	Cl	Bt	Cp	Bn	Cc	Sp	Py	Ms	Asp	Po	Ilv	Mt	Hem	Mo	Std	Ilm	X	Ga	Cpx	Pl	Kf	Qz	Carb	Sid	Se	Ch	Rt	Ep	Cal	Sph	At	Hb	(g/t) (m)
1	T1-106L	Qz-Cal-Asp vein											·		◎					·						◎		◎	◎		△	△	·						0.3 (1.0)
2	T2-123F	Mo ore in Monzonite																		△		·			◎	◎	◎	△			○			△	△	△			0.3 (1.0)
3	T3-56.8F	Bn-Cp ore in Ga skarn	·		△	·			◎	△		△	·					△	△	·				◎	○			○	○										35.0 (1.0)
4	T3-64.7F	Cp ore in Ga-Cpx-Mt skarn							△			·		△		·		◎						○	◎			△	○									△	2.8 (1.0)
5	T3-78.9F	Py ore in Cpx skarn(brecciated)							·				△	·				○	·						◎			○	◎			△						△	1.1 (1.0)
6	T3-78.9Fa	Cp ore in Cpx-Ga skarn							○			·	·											◎				△			△	△			○	△	○		21.0 (0.8)
7	T3-83.9F	Cp ore in Cpx-Ga skarn ore(fine-grained)	·					·	△	·														◎	○			△	○									△	0.04 (0.5)
8	T3-83.9Fa	Mineralized Cpx							△				◎			△		△										○	◎	◎									0.7 (0.5)
9	T3-83.9Fb	Py ore in Py-Cal-Sid banded skarn							·				◎	△		△		△							△			△	○	△								○	0.7 (0.5)
10	T3-87.5Fa	Mineralized Endoskarn(light green)							△	△			△					·		·					◎	○	△	△	△										0.7 (0.9)
11	T3-87.5Fb	Bn-Cp ore in Cpx-Amp-Ga skarn	·	·		·	·		○	△					·		△							◎	◎			△	○									◎	0.7 (0.9)
12	T3-88.4F	Cp-Bn ore in Cpx skarn	·						△	○	△		△												◎			△	△									△	12.6 (1.0)
13	C1-11.5L	Asp ore in Ga-Cpx skarn													·									○	◎			△				△			△	·		○	11.3 (1.0)
14	C1-19L	Cp-Mt-Asp ore in Qz-Cal-Cpx-Amp skarn							·						△			○										○							○		·	○	<0.01 (1.0)
15	C2-19.5L	Au-Cp ore in Ga skarn	△						○													·		◎			△	△			○	△		○	○				64.6 (1.5)
16	C2-19.5La	Au-Cp ore in Ga-Cal-Cpx	△						◎				△											◎	○							△		△	○	△	○		81.6 (1.5)
17	C2-19.8R	Au-Cp ore in Cal-Ga-Cpx skarn	△						◎												·		△	◎	○			△			○	△			○		○		366.4 (0.8)
18	C2-20FR	Au-Cp ore in Ga-Cpx-Cal skarn	△						○														·	◎				○				△			◎				102.4 (0.5)
19	C2-55C	Py-Asp aggregates ore							△				◎		◎										◎			○			○	○			◎		△	△	

Asp:Arsenopyrite
At:Actinolite-tremolite
Bn:Bornite
Bt:Biotite
Cal:Calcite
Carb:Carbonate
Cc:Chalcocite
Ch:Chlorite
Cl:Clausthalite
Cp:Chalcopyrite
Cpx:Clinopyroxene
El:Electrum
Ep:Epidote
Ga:Garnet
Hb:Hornblende
Hem:Hematite
Hs:Hessite
Ilm:Ilmenite
Ilv:Ilvaite
Kf:K-feldsper
Mo:Molybdenite
Ms:Marcasite
Mt:Magnetite
Pl:Plagioclase
Po:Pyrrhotite
Py:Pyrite
Qz:Quartz
Rt:Rutile
Se:Sericite
Sid:Siderite
Sp:Sphalerite
Sph:Sphene
Std:Stannoidite
Tb:Telluro bismuthinite
Td:Tetrahedrite
X:unidentified minerals

Sample number : T1(Tunnel-Ⅰ), T2(Tunnel-Ⅱ), T3(Tunnel-Ⅲ), C1(Crosscut-Ⅰ), C2(Crosscut-Ⅱ),
R(Right wall), L(Left wall), F(Face), FR(Right hand on a Face), FL(Left hand on a Face), C(Roof)
*numerical figures in a sample number show the distance from the starting point in each tunnel segments.

Au grade : The grades show the assay results of channel samples which include the specimens for the polished thin sections.

Appendix 5

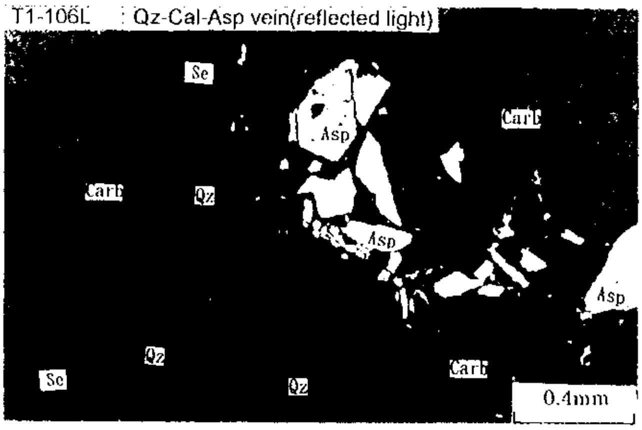
Photomicrographs of the Polished Thin Sections

Abbreviations

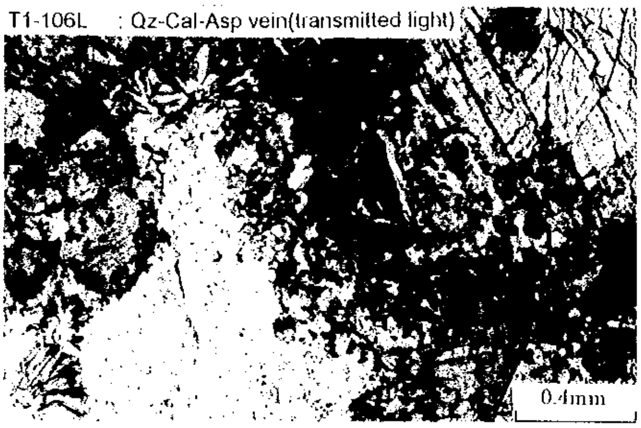
Ank	:Ankerite
Asp	:Arsenopyrite
Bn	:Bornite
Cal	:Calcite
Carb	:Carbonate
Ch	:Chlorite
Cp	:Chalcopyrite
Cpx	:Clinopyroxene
El	:Electrum
Ga	:Garnet
Hb	:Hornblende
Mo	:Molybdenite
Mt	:Magnetite
Po	:Pyrrhotite
Py	:Pyrite
Qz	:Quartz
Se	:Sericite
Sph	:Sphene
Tb	:Telluro Bismuthinite
Td	:Tetrahedrite
X	:unidentified minerals

Appendix 5 Photomicrographs of the Polished Thin Sections

1

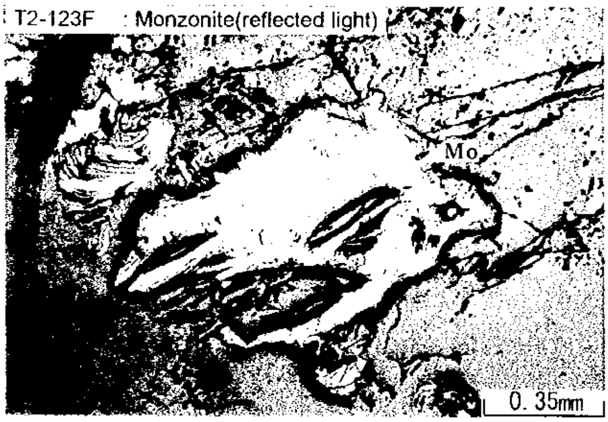


T1-106L : Qz-Cal-Asp vein(reflected light)

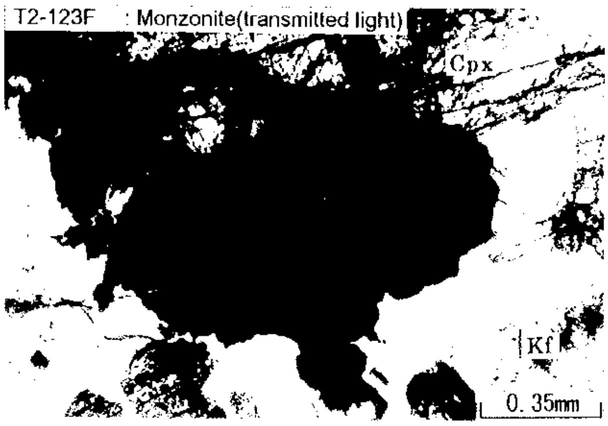


T1-106L : Qz-Cal-Asp vein(transmitted light)

2

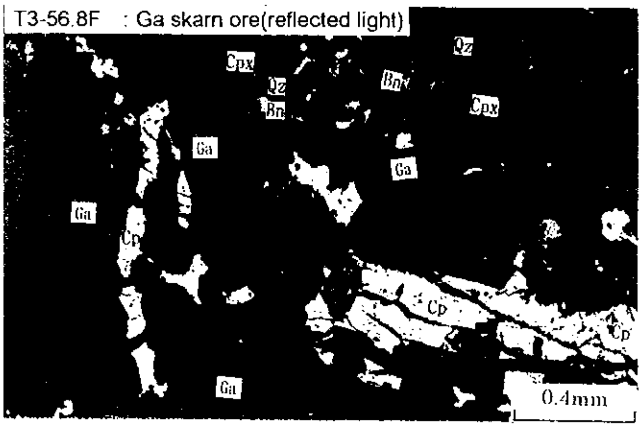


T2-123F : Monzonite(reflected light)

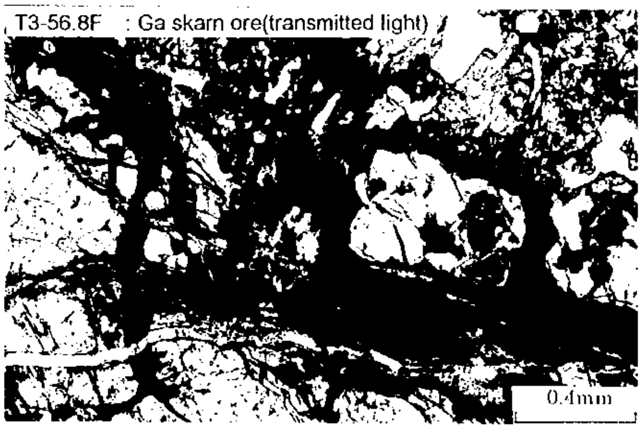


T2-123F : Monzonite(transmitted light)

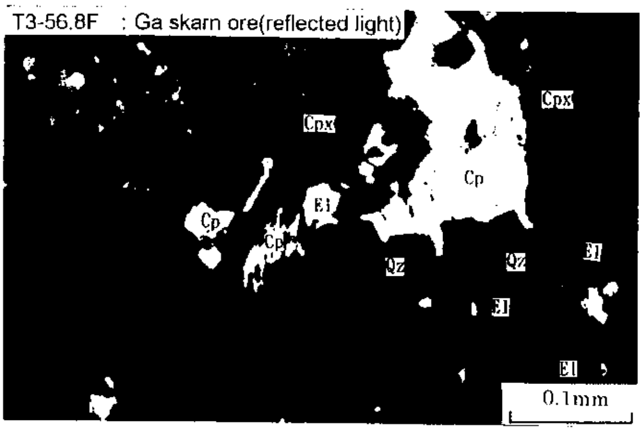
3



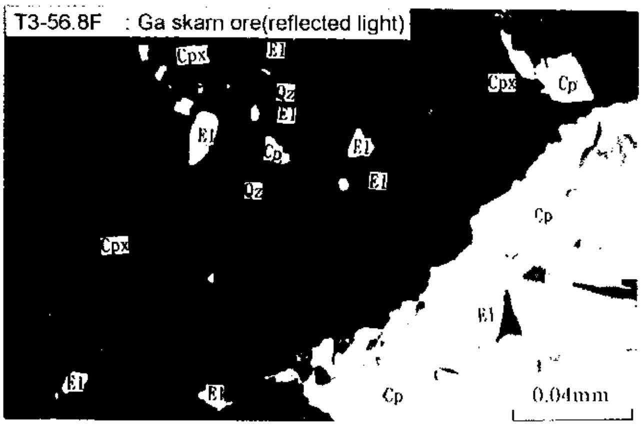
T3-56.8F : Ga skarn ore(reflected light)



T3-56.8F : Ga skarn ore(transmitted light)

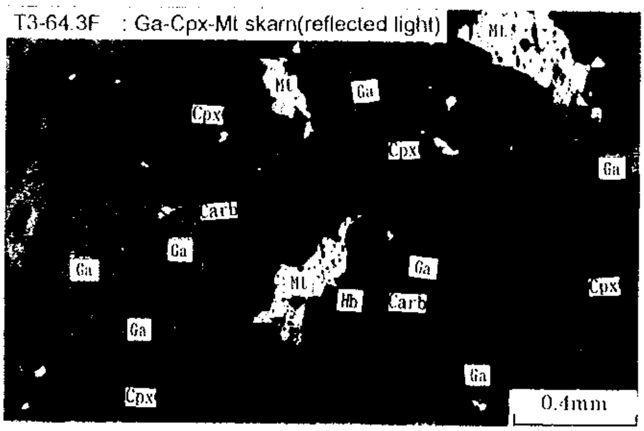


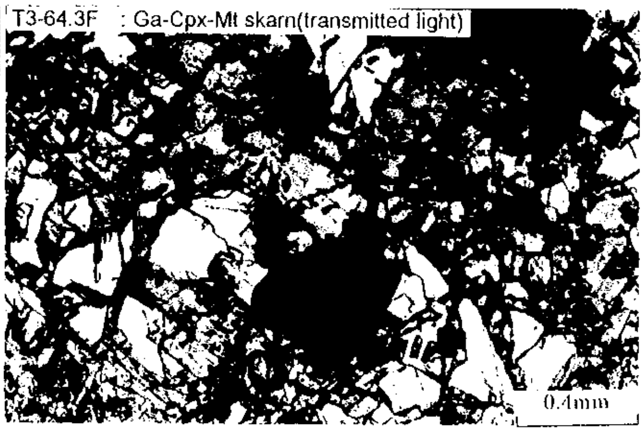
T3-56.8F : Ga skarn ore(reflected light)



T3-56.8F : Ga skarn ore(reflected light)

Appendix 5 Photomicrographs of the Polished Thin Sections

4




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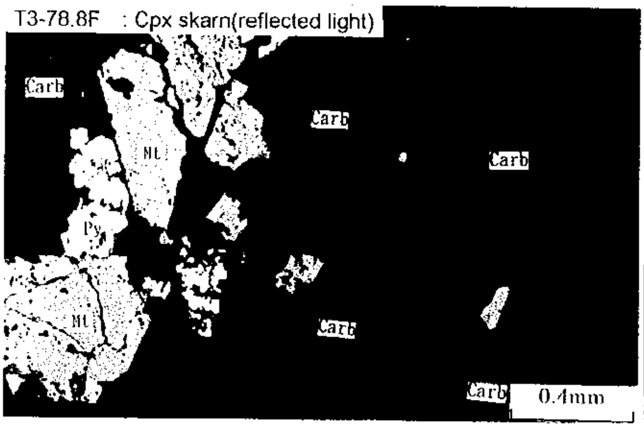

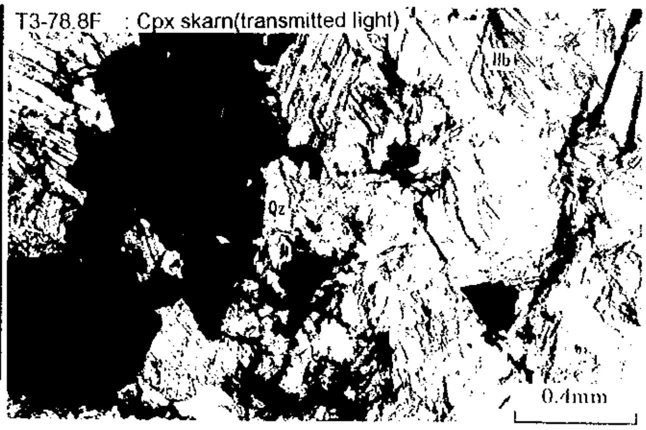

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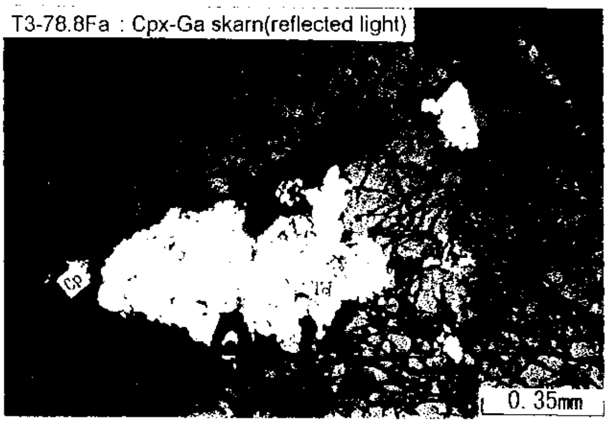

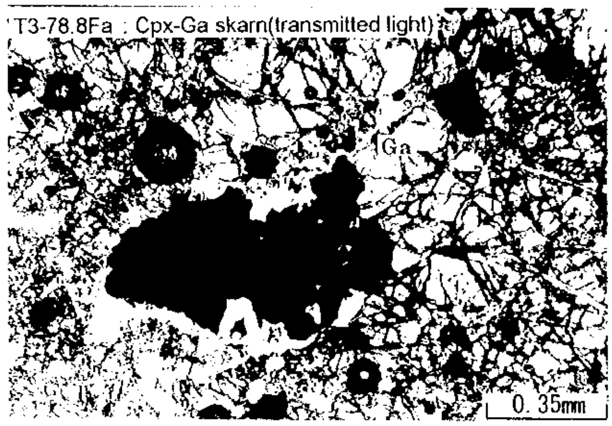

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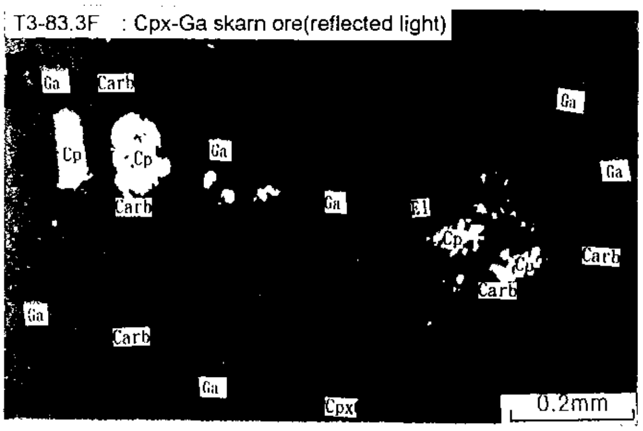
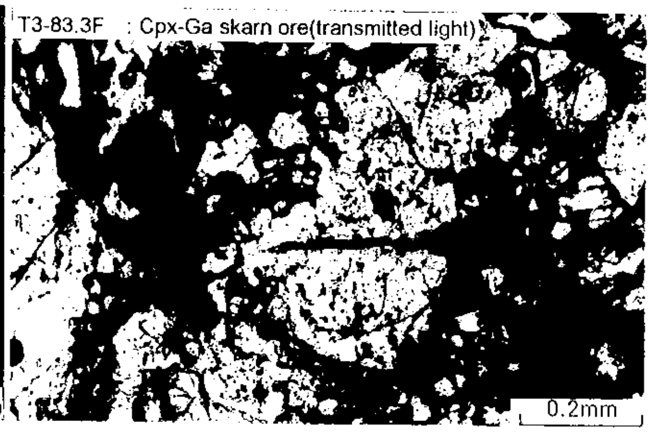
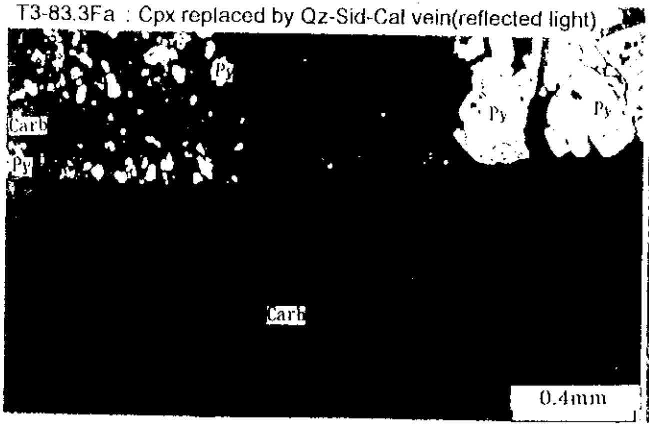




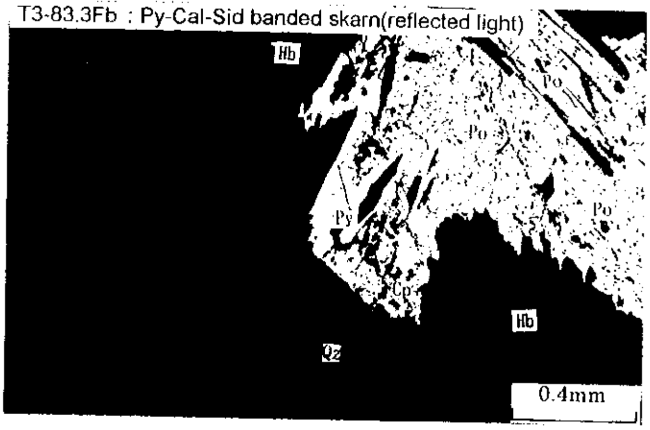
Appendix 5 Photomicrographs of the Polished Thin Sections

8 T3-83.3Fa : Cpx replaced by Qz-Sid-Cal vein(reflected light)

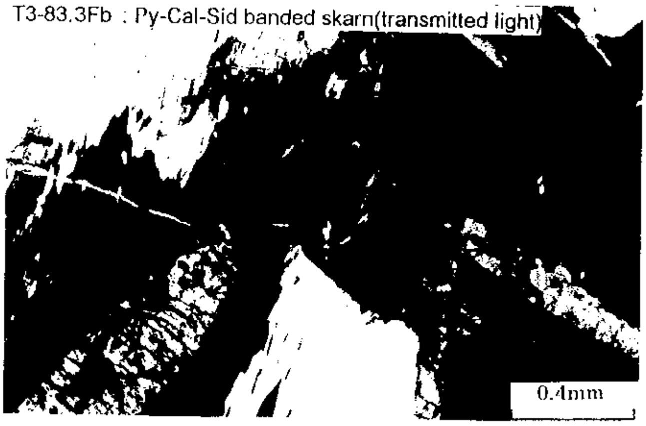


T3-83.3Fa : Cpx replaced by Qz-Sid-Cal vein(transmitted light)

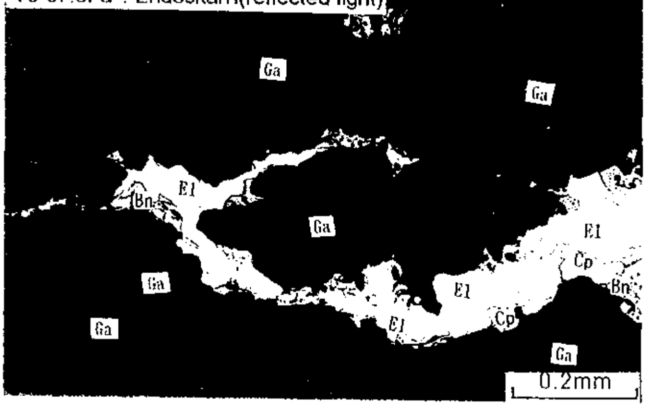
9 T3-83.3Fb : Py-Cal-Sid banded skarn(reflected light)



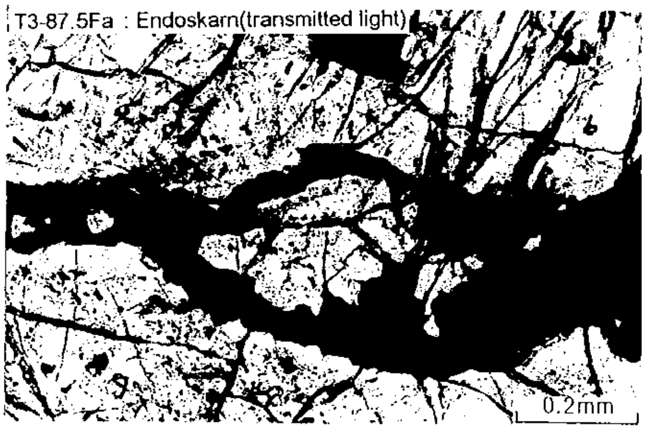
T3-83.3Fb : Py-Cal-Sid banded skarn(transmitted light)



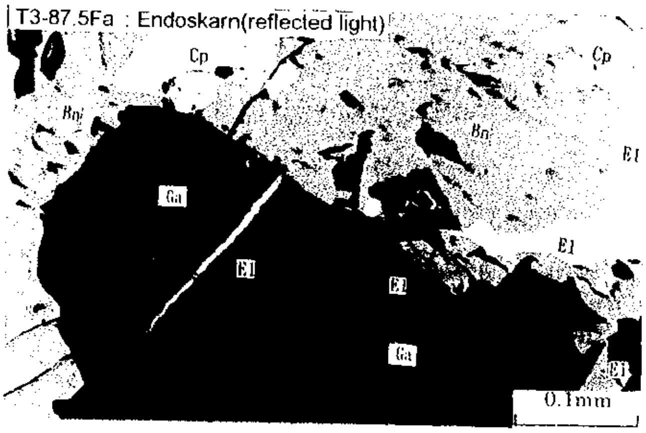
10 T3-87.5Fa : Endoskarn(reflected light)



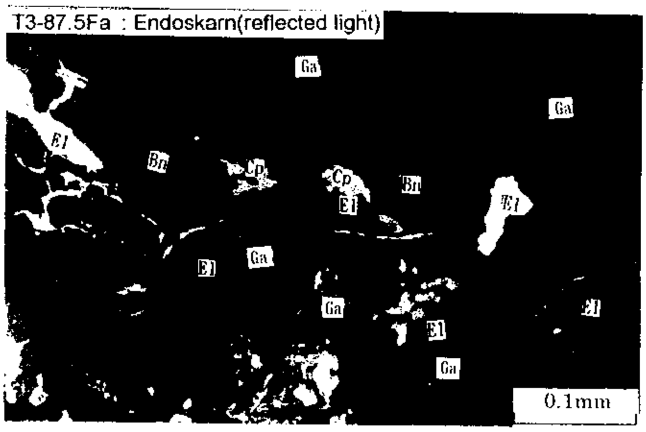
T3-87.5Fa : Endoskarn(transmitted light)



T3-87.5Fa : Endoskarn(reflected light)

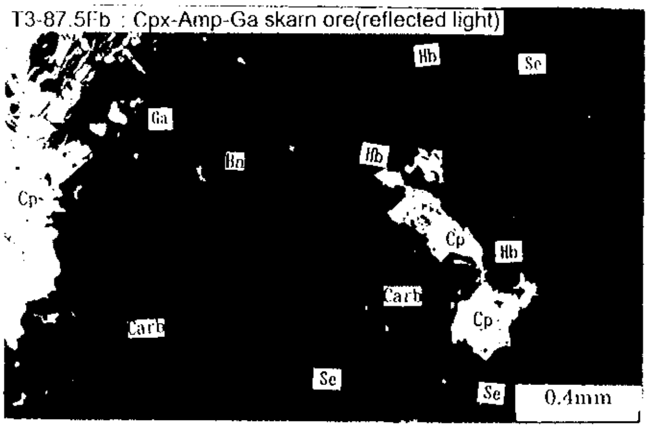


T3-87.5Fa : Endoskarn(reflected light)

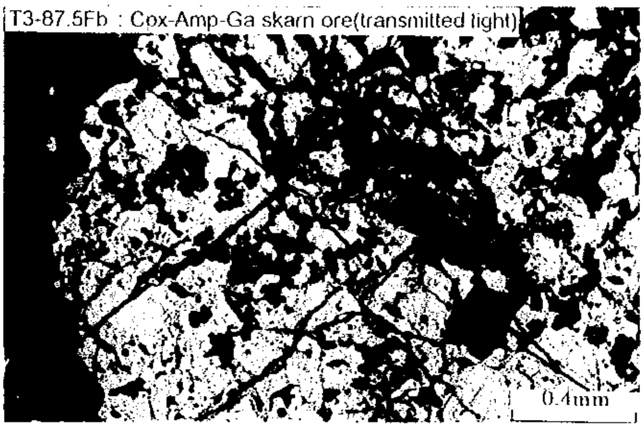


Appendix 5 Photomicrographs of the Polished Thin Sections

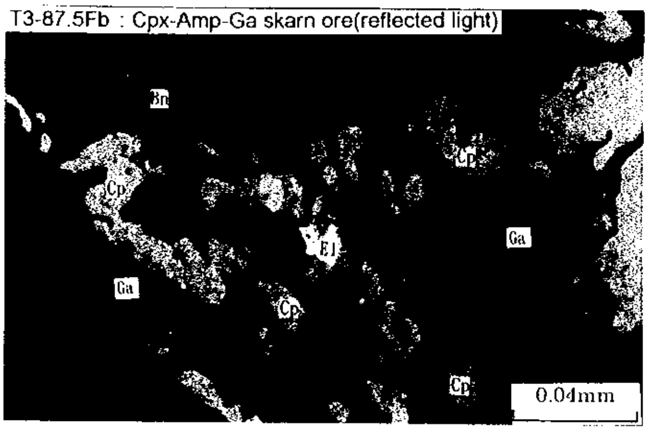
11



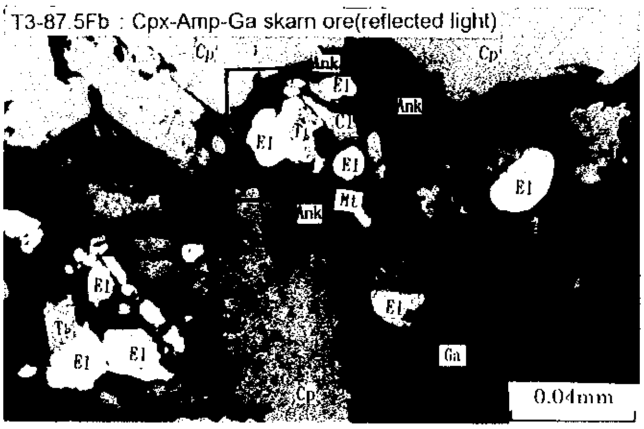
T3-87.5Fb : Cpx-Amp-Ga skarn ore(reflected light)



T3-87.5Fb : Cpx-Amp-Ga skarn ore(transmitted light)

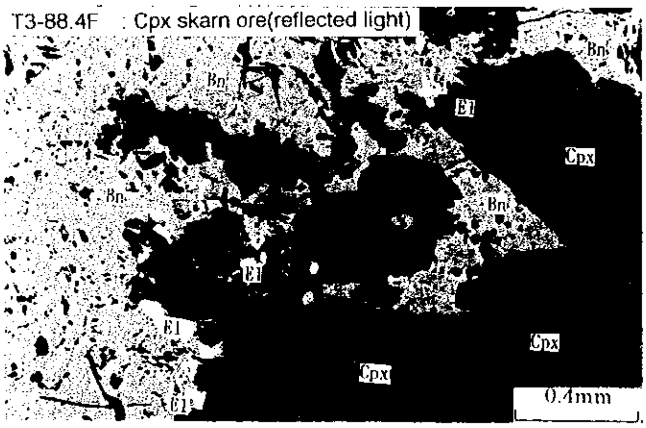


T3-87.5Fb : Cpx-Amp-Ga skarn ore(reflected light)

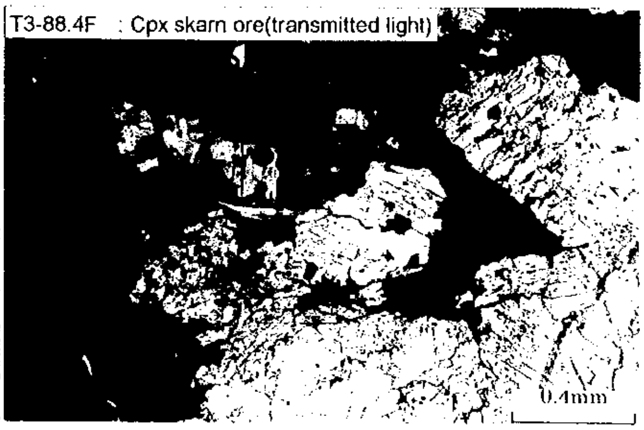


T3-87.5Fb : Cpx-Amp-Ga skarn ore(reflected light)

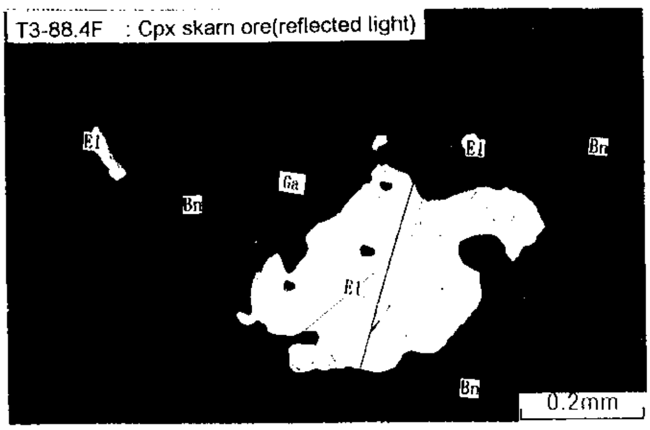
12



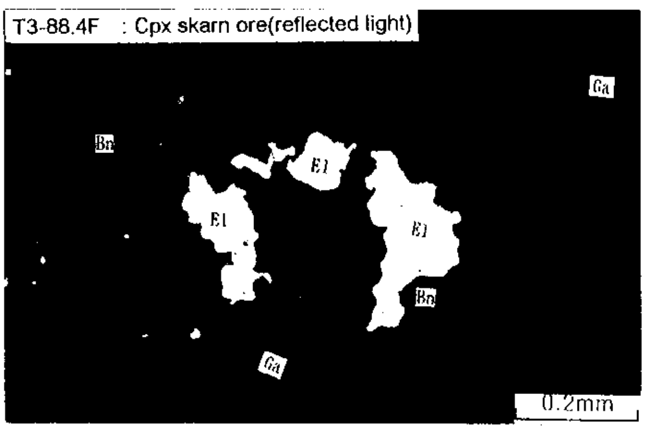
T3-88.4F : Cpx skarn ore(reflected light)



T3-88.4F : Cpx skarn ore(transmitted light)

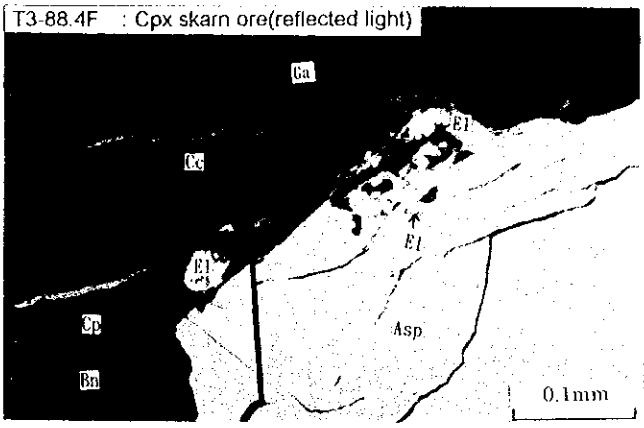


T3-88.4F : Cpx skarn ore(reflected light)

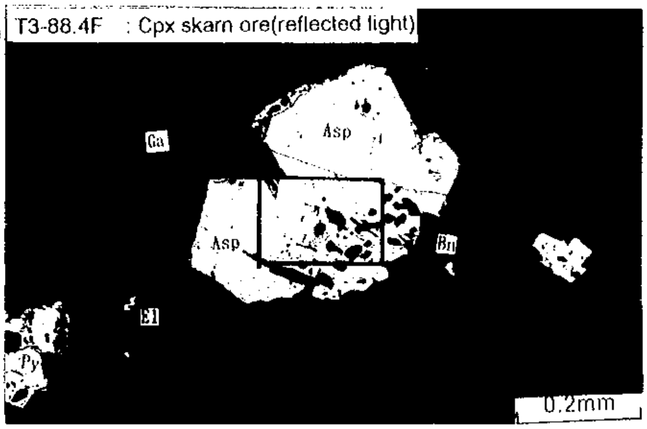


T3-88.4F : Cpx skarn ore(reflected light)

Appendix 5 Photomicrographs of the Polished Thin Sections

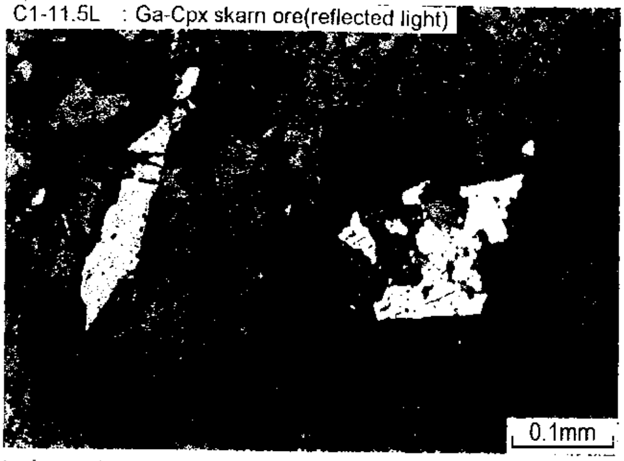


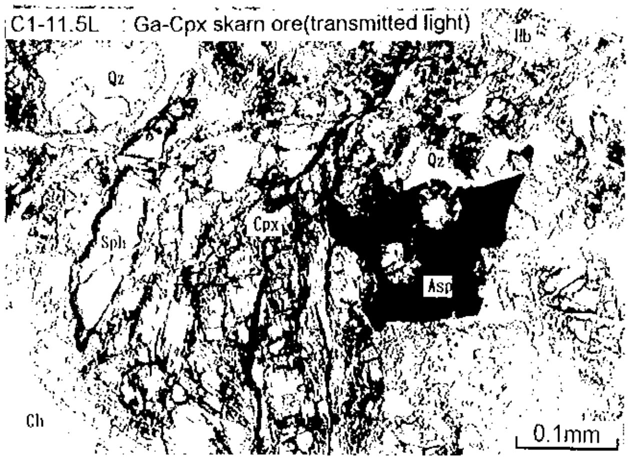
T3-88.4F : Cpx skarn ore(reflected light)



T3-88.4F : Cpx skarn ore(reflected light)

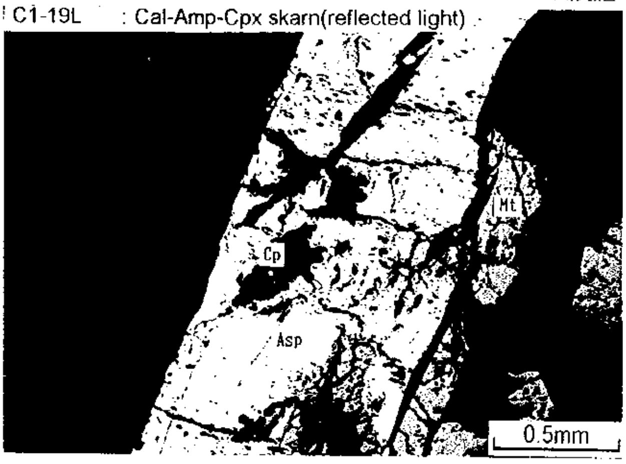
13 C1-11.5L : Ga-Cpx skarn ore(reflected light)

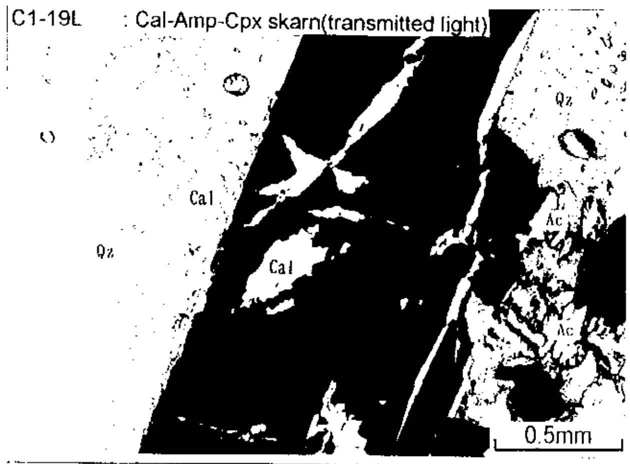




C1-11.5L : Ga-Cpx skarn ore(transmitted light)

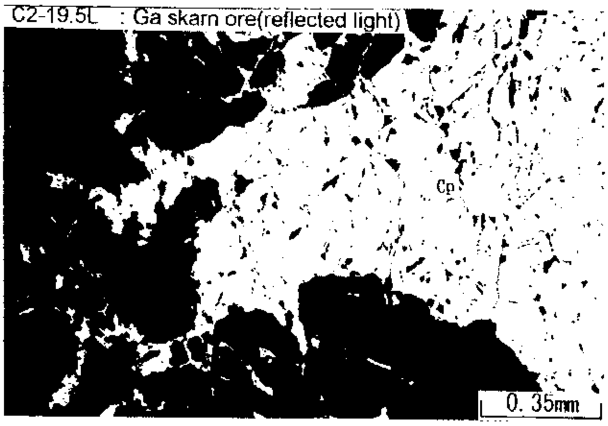
14 C1-19L : Cal-Amp-Cpx skarn(reflected light)

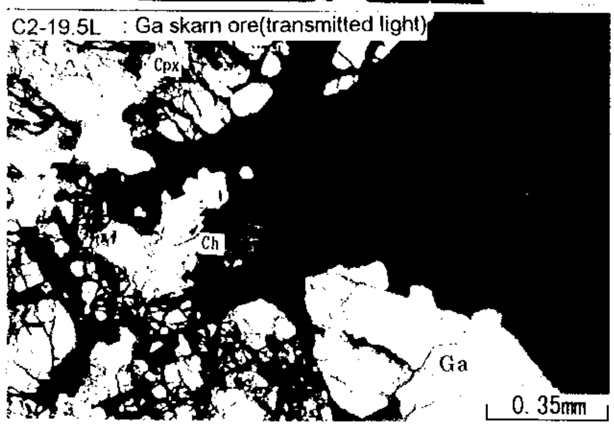




C1-19L : Cal-Amp-Cpx skarn(transmitted light)

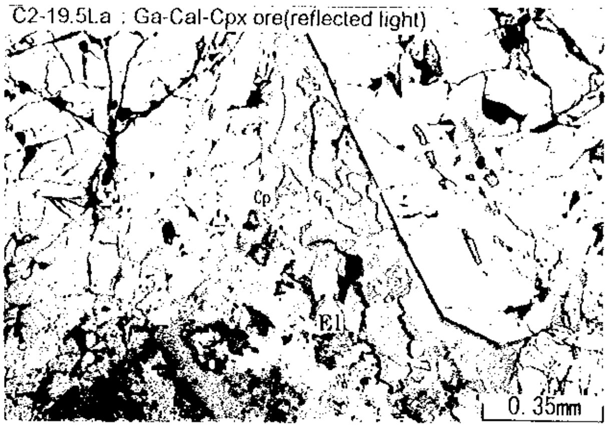
15 C2-19.5L : Ga skarn ore(reflected light)



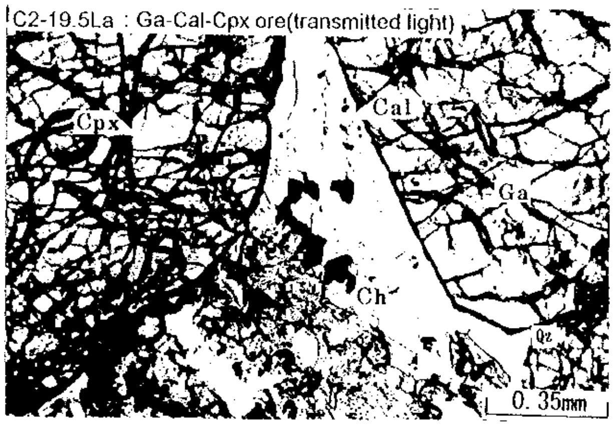


C2-19.5L : Ga skarn ore(transmitted light)

16 C2-19.5La : Ga-Cal-Cpx ore(reflected light)



C2-19.5La : Ga-Cal-Cpx ore(transmitted light)



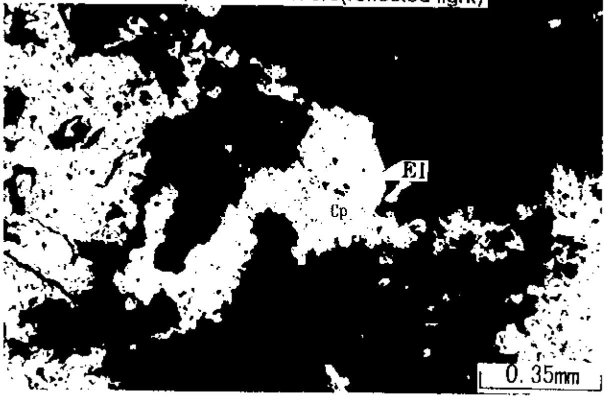
17 C2-19.8R : Cal-Ga-Cpx skarn ore(reflected light)

C2-19.8R : Cal-Ga-Cpx skarn ore(transmitted light)

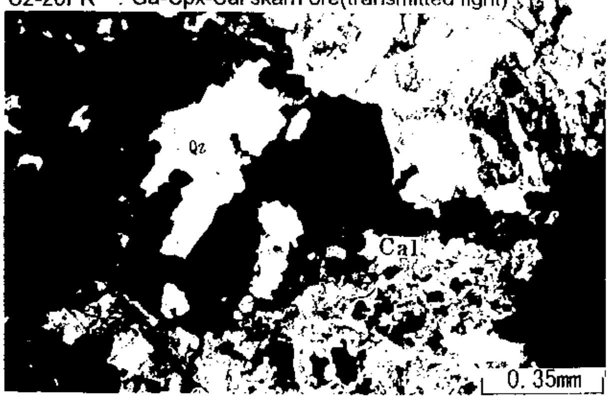
C2-19.8R : Cal-Ga-Cpx skarn ore(reflected light)

C2-19.8R : Cal-Ga-Cpx skarn ore(transmitted light)

18 C2-20FR : Ga-Cpx-Cal skarn ore(reflected light)



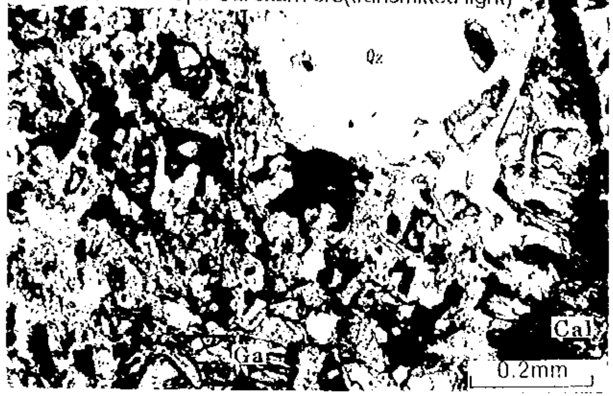
C2-20FR : Ga-Cpx-Cal skarn ore(transmitted light)



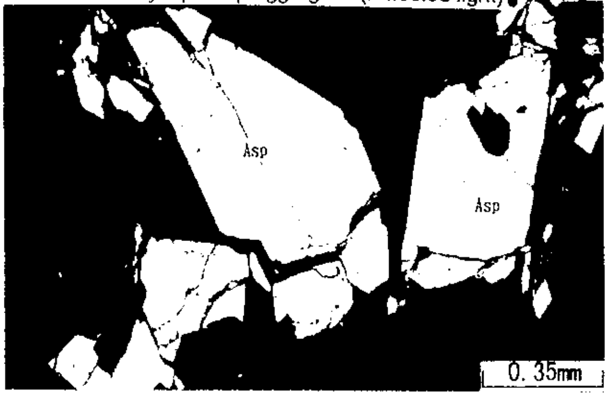
Appendix 5 Photomicrographs of the Polished Thin Sections

C2-20FR : Ga-Cpx-Cal skarn ore(reflected light)

C2-20FR : Ga-Cpx-Cal skarn ore(transmitted light)



19 C2-55C : Py-Cpx-Asp aggregates(reflected light)



C2-55C : Py-Cpx-Asp aggregates(transmitted light)