Appendix 3

Mining History of the Uudam-Tal Area

オーダムタル地域の鉱業史概略年表

1938： ロシアがユグゼル周辺で地質調査を開始する。

1939： ロシア人カバリアムが水資源の調査中にユグゼル鉱床の一部でタングステン鉱脈を発見する。

1942～1943： ユグゼル鉱床周辺で縮尺1/10,000地質調査が開始され，45条のタングステン鉱脈が発見される。（ソ）。

1943： ユグゼル鉱床の採掘が開始される（ソ）。

1954： ハル・アイラグ地区で縮尺1/200,000 の地質調査が開始される（ソ）。

1954： 1/200,000 地質調査中にサイハンオール，ツァガンオール等のＭｏ，Ｗ，Ｂｅの鉱徴が発見される（ソ）。

1956： ボルウンドゥル鉱床が発見される（ソ）。ユグゼル鉱山閉山。

1957～1958： ボルウンドゥル鉱床の評価作業が実施される（ソ）。

1964： ツァガーンスヴラグ鉱床が地元住民によって発見される。

1964： エルデネット鉱床周辺の銅鉱床探査が開始される（ソ）＊。

1965： ツァガーンスヴラグ鉱床周辺の広域調査が開始される（ソ）。

1966： ハンガリー・モンゴル共同調査によりヌフット・ダワー地区にサラー，サルヒート等の鉱床が発見される。

1967： ハンガリー・モンゴル共同調査隊によりアリンノール銅・モリブデン鉱床が発見される。

1969： バヤンハイラスト鉱床が発見される（モ－ソ）。

1971： マイハント，ツァガーンタキルチ蛍石鉱床が発見される（ソ）。

1971～72： ツァガーン・スヴラグ鉱床周辺一帯の地質調査により，20か所の銅鉱徴が発見される（ソ）。

1972： マルダイ・ウラン鉱床及びルギン・ゴル鉱床が発見される（ソ）。

1973： 東独・モンゴル共同調査隊がトゥムルテイン・オボ地区で空中磁気探査を実施する。

1973： 1/200,000 地質調査中にツァガーンチョルトホダク砂金地が発見される（ソ）。

1974： 東独・モンゴル共同調査隊によりトゥムルテイン・オボ鉱床が発見される。

1974： ホンゴル蛍石鉱床の開発開始（モ）。

1974～1977： ムシギア・ホダク鉱床が発見される（モ－ソ）。

1975： 1/200,000 地質調査中にツァヴ及びバヤンウール鉱床が発見される（ソ）。

1975： 南ゴビ銅鉱床帯調査のためツァガーン・スヴラグ地質調査隊が設立される（ソ）。

1975～1977：　ツェントル及びアロンサル鉱床が発見される。

1976：　1/200,000 地質調査中にバヤンホショー鉱床が発見される（ソ）。

1978：　チョル・ツァガーンデル蛍石鉱床発見される（ソ）。

1978：　エルデネット銅山の出鉱が開始される（モ－ソ）＊。

1979：　チョル・ツァガーンデル蛍石鉱床の探鉱が開始される（チェコ）。

1979～1981：　ボル・ウンドゥル蛍石鉱床の詳細調査が実施される（ソ）。

1979～1982：　ツァガーン・スヴラグ鉱床の詳細調査が実施される（ソ）。

1979～1982：　1/200,000 地質調査中にオロンオボート，オンホ等ウルズィート地区の多数の金鉱徴地が発見される（ソ）。

1980：　マルダイウラン鉱床出鉱開始（ソ）

1980：　チョル・ツァガーンデル鉱床の出鉱が開始される（モ－チェコ）。

1981：　ツァヴ鉱床の詳細地質調査が開始される（ソ）。

1982：　ツァヴ鉱床に対してボーリング調査が開始される（ソ）。

1982：　ボル・ウンドゥル蛍石鉱床の埋蔵鉱量 11,886,270tが計上される（ソ）。

1983：　ドルノト探鉱所によりツァヴ鉱床の調査が開始される（モ－ソ）

1984～1986：　バヤンウールに対してボーリングやトレンチが実施される（モ）。

1985：　ツァヴ鉱床に対し，1/10,000地質調査と地化学探査が実施される（モ－ソ）。

1986～1989：　ツァヴ鉱床に対し，詳細調査が実施される（モ－ソ）。

1988：　1/50,000調査中にサルヒート鉱床が発見される。

1988：　ツァヴ鉱床に対し，No.14 竪坑が開削される（モ）。

1988～1991：　バヤンウールに対して地化学探査及び物理探査が実施される（モ－ソ）。

1989：　トゥムルテイン・オボ鉱床に対する最終的Ｆ／Ｓがモンゴル独自に実施される。

1989～1990：　ジオロジー社がウルズィート地区で1/50,000地質調査中にオロンオボート金鉱徴地で一部に高品位の金を確認する。

1990：　ツァヴ鉱床に対し，No.15 竪坑が開削される（モ）。

1990：　トゥムルテイン・オボ鉱床の開発許可がモンゴル鉱山公社に与えられる。

1991：　ジオロジー社がウルズィート地区でオロンオボート金鉱徴地に対してボーリング５孔，トレンチ１１か所を実施する（モ）。

1991：　７月にエルデネ社がトゥムルテイン・オボ鉱床の開発に着手，剥土を開始する。

1991：　７月にソ連よりオラーン鉱床の探鉱関係資料が一式モンゴル政府に譲渡される。

1991：　７月現在，ツァガーンチョルトホダ砂金地を 270名の人員で探鉱中。生産開始目標1992年。

注：＊　地域外

Appendix 4

Statistical Data

Name of the Mines	Mineral	P r o d u c t s	Unit	1986	1987	1988	1989	1990	N o t e
1. Erdenet	Cu, Mo	Crude ore	M. t	17.0	16.6	17.3	17.9	17.9	Porphyry type
		Cu-conc. (35% Cu)	T. t	344.4	345.4	347.7	352.9	354.1	All exported
		Mo-conc. (47% Mo)	t	3,232	3,240	3,268	3,361	4,208	to USSR & JPN
1. Modot	Sn, W	Sn-conc. (50% Sn)	t	175.4	178.1	181.7	273.0	317.4	Placer type
		W- conc. (20%WO_3)	t	81.4	50.4	103.9	0	0	Exptd to CSR
1. Ulaan-uul(USSR)	W	W- conc. (60%WO_3)	t	15.0	20.0	30.3	50.0	45.0	Quartz vein
2. Tsagaandawaa(HPR)									All exported
1. Bor-undur	CaF_2	Crude ore	T. t	730.2	754.2	890.9	974.0	895.3	Vein type
2. Har-airag									All exported,
3. Berh		CaF_2 conc.	T. t	41.0	72.7	115.1	115.4	118.9	1.～3. to USSR,
4. Chuluut-tsagaandel		(95～96% CaF_2)							4. to CSR

Abbreviations; USSR; Union of Soviet Socialist Republics , JPN; Japan, HPR; Hungarian People's Republic
CSR; Czechoslovac Sosialist Republic, conc.; concentrate, exptd; exported , Tt; thousand tons , t; ton

Stat. 1. Productions of Non-ferrous metal minerals and Fluorite of the Mongolian People's Republic (1986～1990).

Name of the Mines	Mineral	P r o d u c t s	Unit	1986	1987	1988	1989	1990	N o t e
1. Erdenet	Cu, Mo	Crude ore	M. t	17.0	16.6	17.3	17.9	17.9	Porphyry type
		Cu-conc. (35% Cu)	T. t	344.4	345.4	347.7	352.9	354.1	All exported
		Mo-conc. (47% Mo)	t	3,232	3,240	3,268	3,361	4,208	to USSR & JPN
1. Modot	Sn, W	Sn-conc. (50% Sn)	t	175.4	178.1	181.7	273.0	317.4	Placer type
		W- conc. (20%WO_3)	t	81.4	50.4	103.9	0	0	Exptd to CSR
1. Ulaan-uul(USSR)	W	W- conc. (60%WO_3)	t	15.0	20.0	30.3	50.0	45.0	Quartz vein
2. Tsagaandawaa(HPR)									All exptd
1. Bor-undur	CaF_2	Crude ore	T. t	730.2	754.2	890.9	974.0	895.3	Vein type
2. Har-airag									All exported,
3. Berh		CaF_2 conc.	T. t	41.0	72.7	115.1	115.4	118.9	1.～3. to USSR,
4. Chuluut-tsagaandel		(95～96% CaF_2)							4. to CSR

Abbreviations; USSR; Union of Soviet Socialist Republics , JPN; Japan, HPR; Hungarian People's Republic
CSR; Czechoslovac Socialist Republic, conc.; concentrate, exptd; exported , Tt; thousand tons , t; ton

Appendix4-1 Productions of Non-ferrous Metallic Minerals and Fluorite of MPR (1986～1990)

(unit in thousand tons)

No.	Name of mine	Spec.	1986	1987	1988	1989	1990	Note	
1	Baganuur (Багануур)	Ant-c	–	–	–	–	–	Age Cr$_1$	Open pit mining
		Cok-c	–	–	–	–	–	Rsv 487.9 Mt	
		Bts-c	–	–	–	–	–	F/R	
		Brn-c	2,881.8	3,339.4	4,053.0	3,785.8	3,700.6	3,000 kcal/kg	
2	Shariin gol (Шарингол)	Ant-c	–	–	–	–	–	Age $J_2 \sim J_3$	Open pit mining
		Cok-c	–	–	–	–	–	Rsv 34.8 Mt	
		Bts-c	–	–	–	–	–	F/R	
		Brn-c	2,025.8	1,984.4	2,053.0	1,900.2	1,474.8	4,000 Kcal/kg	
3	Aduunchuluun (Адуунчулуун)	Ant-c	–	–	–	–	–	Age Cr$_1$	Open pit mining
		Cok-c	–	–	–	–	–	Rsv 23.7 Mt	
		Bts-c	–	–	–	–	–	F/R	
		Brn-c	388.4	469.3	612.9	536.1	512.2	2,800 Kcal/kg	
4	Naraih (Нарайх)	Ant-c	–	–	–	–	–	Age Cr$_1$	Underground mining
		Cok-c	–	–	–	–	–	Rsv 15 Mt	
		Bts-c	–	–	–	–	–	F/R	
		Brn-c	629.8	712.7	538.0	434.5	234.9	3,500 Kcal/kg	
5	Bayanteeg (Баянтээг)	Ant-c	–	–	–	–	–	Age $J_2 \sim J_3$	Open pit mining
		Cok-c	–	–	–	–	–	Rsv 26.9 Mt	
		Bts-c	220.6	221.6	230.1	240.3	226.1	F/R	
		Brn-c	–	–	–	–	–	4,600 Kcal/kg	

Ant-c; Anthracite, Cok-c; Coking coal, Bts-c; Bituminous coal, Brn-c; Brown coal, Rsve; Reserve, F/R; Fuel ratio

Appendix4-3 Coal Production in MPR (1986 ~1990) (1)

(unit in thousand tons)

No.	Name of mine	Spec.	1986	1987	1988	1989	1990	Note	
6	Hartarvagatai (Хартарвагатай)	Ant-c	–	–	–	–	–	Age $C_2 \sim C_3$	Open pit mining
		Cok-c	–	–	–	–	–	Rsv 17.7 Mt	
		Bts-c	110.5	172.5	192.0	219.7	213.0	F/R	
		Brn-c	–	–	–	–	–	3,800 kcal/kg	
7	Nuursthotogol (Нууртхоттог)	Ant-c	–	–	–	–	–	Age $C_2 \sim C_3$	Open pit mining
		Cok-c	–	–	–	–	–	Rsv 9.6 Mt	
		Bts-c	138.6	146.3	180.5	192.0	198.4	F/R	
		Brn-c	–	–	–	–	–	4,000 Kcal/kg	
8	Tavantolgoi (Тавантолгой)	Ant-c	–	–	–	–	–	Age P_3	Open pit mining
		Cok-c	–	–	–	–	–	Rsv 5,000 Mt	
		Bts-c	129.2	133.0	136.3	137.3	115.0	F/R	
		Brn-c	–	–	–	–	–	5,500 Kcal/kg	
9	Mogoingol (Могойнгол)	Ant-c	–	–	–	–	–	Age $J_2 \sim J_3$	Open pit mining &
		Cok-c	–	–	–	–	–	Rsv 14.2 Mt	Underground
		Bts-c	107.5	122.6	124.8	127.9	103.5	F/R	
		Brn-c	–	–	–	–	–	5,000 Kcal/kg	
10	Chandganatal (Чандганатай)	Ant-c	–	–	–	–	–	Age Cr_1	Open pit mining
		Cok-c	–	–	–	–	–	Rsv 121.3 Mt	
		Bts-c	–	–	–	–	–	F/R	
		Brn-c	85.7	100.8	113.0	120.5	95.7	3,000 Kcal/kg	

Ant-c; Anthracite, Cok-c; Coking coal, Bts-c; Bituminous coal, Brn-c; Brown coal, Rsv; Reserve, F/R; Fuel ratio

Appendix4-3 Coal Production in MPR (1986 ～1990) (2)

(unit in thousand tons)

No.	Name of mine	Spec.	1986	1987	1988	1989	1990	Note	
11	Talbulag (Талбулаг)	Ant-c	–	–	–	–	–	Age Cr_1	Open pit mining
		Cok-c	–	–	–	–	–	Rsv 47.6 Mt	
		Bts-c	–	–	–	–	–	F/R	
		Brn-c	95.7	105.9	111.2	110.1	95.5	3,000 kcal/kg	
12	Zeegt (Зээгт)	Ant-c	–	–	–	–	–	Age Cr_1	Open pit mining
		Cok-c	–	–	–	–	–	Rsv 4.0 Mt	
		Bts-c	–	–	–	–	–	F/R	
		Brn-c	72.6	78.7	86.7	91.2	72.2	4,000 Kcal/kg	
13	Hoshoot (Хошоот)	Ant-c	–	–	–	–	–	Age $J_2 \sim J_3$	Open pit mining
		Cok-c	–	–	–	–	–	Rsv 14.4 Mt	
		Bts-c	85.6	76.0	60.7	65.4	61.5	F/R	
		Brn-c	–	–	–	–	–	4,700 Kcal/kg	
14	Tevshiingovi (Тэвшиинговь)	Ant-c	–	–	–	–	–	Age Cr_1	Open pit mining
		Cok-c	–	–	–	–	–	Rsv 769.0 Mt	
		Bts-c	–	–	–	–	–	F/R	
		Brn-c	62.0	70.1	72.3	57.5	37.8	3,000 Kcal/kg	
15	Saihanovoo (Сайхановоо)	Ant-c	–	–	–	–	–	Age $J_2 \sim J_3$	Underground
		Cok-c	–	–	–	–	–	Rsv 20.0 Mt	
		Bts-c	27.0	28.1	29.0	26.0	9.2	F/R	
		Brn-c	–	–	–	–	–	5,000 Kcal/kg	

Ant-c; Anthracite, Cok-c; Coking coal, Bts-c; Bituminous coal, Brn-c; Brown coal, Rsv; Reserve, F/R; Fuel ratio

Appendix4-3 Coal Production in MPR (1986 ～1990) (3)

No.	Name of mine	Spec.	1986	1987	1988	1989	1990	Note	
16	Jinst (Жинст)	Ant-c	—	—	—	—	—	Age Cr_1	Open pit mining
		Cok-c	—	—	—	—	—	Rsv 2.4 Mt	
		Bts-c	—	—	—	—	5.7	F/R	
		Brn-c	—	—	—	—	—	4,000 kcal/kg	
17	Zeegt (Зээгт)	Ant-c	—	—	—	—	—	Age Cr_1	Open pit mining
		Cok-c	—	—	—	—	—	Rsv 1,000.0 Mt	Under strippinng
		Bts-c	—	—	—	—	—	F/R	beginning of pro-
		Brn-c	72.6	78.7	86.7	91.2	72.2	3,000 Kcal/kg	duction 1992.
Total		Ant-c	—	—	—	—	—	Rsv —	Coal production MPR
		Cok-c	—	—	—	—	—	Rsv —	1960: 600 Tt
		Bts-c	819.0	900.1	953.4	1,008.6	926.7	Rsv 5,102.8 Mt	1970: 2,000
		Brn-c	6,241.8	6,861.3	7,640.1	7,035.9	6,229.4	Rsv 2,505.7 Mt	1980: 4,400
			7,060.8	7,761.4	8,593.5	8,044.5	7,156.1	7,608.5 Mt	1985: 6,500

Ant-c; Anthracite, Cok-c; Coking coal, Bts-c; Bituminous coal, Brn-c; Brown coal, Rsv; Reserve, F/R; Fuel ratio
Annual production; in thousand tons, Reserve; in million tons.

Appendix4-3 Coal Production in MPR (1986 ～1990) (4)

No.	Name of mine	1986	1987	1988	1989	1990	N o t e
1	Baganuur	(200)	(500)	(940)	676.0	417.6	Exported to USSR
2	Aduunchuluun	(100)	(100)	(100)	100.0	94.8	Exported to USSR
T o t a l		300	600	1,040	776.0	515.4	

Unit; thousand tons, Numbers with ( ); estimation.

Appendix4-4 Exportation of Coal (1986～1990)

Appendix 5

Correlation Table of Terminology

Appendix-5. Correlation Table of Terminology (1)

MONGOLIAN	RUSSIAN	ENGLISH	JAPANESE
БҮГД НАЙРАМДАХ МОНГОЛ АРД УЛС (БНМАУ)	МОНГОЛЬСКОЙ НАРОДНОЙ РЕСПУБЛИКИ (МНР)	MONGOLIAN PEOPLE´S REPUBLIC (MPR)	モンゴル人民共和国（モンゴル，（モ））
ЯПОН	ЯПОНИЯ	JAPAN （JPN）	日本
ЗСБНХОУ	СОЮЗ СОВЕТСКХ СОЦИАЛИТИЧЕСКИХ РЕСПУБЛК (СССР)	UNION OF SOVIET SOCIALIST REPUBLICS (USSR)	ソビエト社会主義共和国連邦（ソ連，（ソ））
ЧЕХОСЛОВАК	ЧЕХОСЛОВАКИЯ	CZECHOSLOVAK SOCIALIST REPUBLIC	チェコソロバキア（チェコ）
АРДЧЛСАН ГЕРМАН	ГЕРМАНСКАЯ ДЕМОКРАТИЧЕСКАЯ РЕСПУБЛИКА (ГДР)	GERMAN DEMOCRATIC REPUBLIC	ドイツ民主共和国（東独）
ПОЛЬШ	ПОЛЬША	POLISH PEOPLE´S REPUBLIC	ポーランド人民共和国
УНГЕР	БЕНГРИЯ	UNGARIAN PEOPLE´S REPUBLIC	ハンガリー人民共和国
ХЯТАД	КИТАЙ	PEOPLE´S REPUBLIC OF CHINA	中華人民共和国
Уудам Тал Бус	Уудам Тал	Udam-Tal Area	オーダムタル地域
	ЯПОНСКИЙ МЕЖДУНАРДНЫЙ ОРГАН КООПЕРАЦИЙ	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	国際協力事業団（JICA）
	ЯПОНСКОЕ АГЕНСТВО ГОРНОГО ДЕЛА ПО МЕТАЛЛАМ	METAL MININGT AGENCY OF JAPAN (MMAJ)	金属鉱業事業団(MMAJ)
БНМАУ-ЫН УЛСЫН ГЕОЛОГИЙН ТОВ		STATE GEOLOGICAL CENTER OF THEMONGOLIAN PEOPLE´S REPUBLIC	モンゴル人民共和国　国家地質センター
УЛААНБААТАР	УЛАН-БАТОР	ULAANBAATAR	ウランバートル
ДОРНОД	ДОРНОД	DORNOD	ドルノト
ХЭНТИЙ	ХЭНТИЙ	HENTII	ヘンテイ
СҮХБААТАР	СУХБАТОР	SUHBAATAR	スフバートル
ДОРНОГОВЬ	ДОРНОГОВЬ	DORNOGOVI	ドルノゴビ（東ゴビ県）
ДУНДГОВЬ	ДУНДГОВЬ	DUNDGOVI	ドゥンドゴビ（中央ゴビ県）
ӨМНӨГОВЬ	УМНУГОВЬ	UMNUGOVI	ウムヌゴビ（南ゴビ県）
Чойбалсан	Чойбалсан	Choibalsan	チョイバルサン
Барун-урт	Барун-урт	Barn-Urt	バルンウルト
Даланзадгад	Даланзадгад	Dalanzadgad	ダランザドガド
Хөх нуур	Хух	L. khuh	フッフ湖
Гурван Сайхан нуруу	Гурван Сайхан	Gurvan Saihan Mountains	ゴルバンサイハン山地
Монголын Дорнод Тал	Монголын Дорнод Равнина	Mongol Dornot Plane	（モンゴル）ドルノト平原

Appendix-5. Correlation Table of Terminology (2)

MONGOLIAN	RUSSIAN	ENGLISH	JAPANESE
Хэнтэй	Хэнтэй	Hentei Mts.	ヘンテイ（山地）
Хангай	Хангай	Hangai Mts.	ハンガイ（山地）
Говь Алтай нуруу	Говь Алтай	Govi Altai Mts.	ゴビアルタイ山地
Их Шанхай нуруу	Их Шанхай	Ih Shanhai Mts.	イヒシャンハイ山地
Улз	Улз	Ulz river	ウルズ川
Галын гол	Галын	Galin river	ガリン川
Хэрлэн	Хэрлэн	Kherlen river	ケルレン川
Халхын гол	Халхын	Halhin river	ハルヒン川
Аймаг	Аймаг	Aimag	県（アイマグ）
Сум	Сум	Sum	村（ソム）
Улаанбаатар	Улан-Батор	Ulaanbaatar	ウランバートル
Дорнод	Дорнод	Dornod	ドルノト（県）
Дорнод Тал	Дорнод Поле	Dornod Plane	ドルノト平原
Чойбалсан	Чойбалсан	Choibalsan	チョイバルサン（村）
Гурбанзагал	Гурбанзагал	Gurvanzagal	グルバンガザル（村）
Дашбалбар	Дашбалбар	Dashbalbar	ダシュバルバル（村）
Баяндун	Баяндун	Bayandun	バヤンヅーン（村）
Сэргэлэн	Сэргэлэн	Sergelen	セルゲレン（村）
Дөч	Дуч	Duch river	ドチ（川）
Галын Гол		Galin river	ガリン川
Хөх Нуур	Хух Нуур	Khuhu	フッフ湖
Чойбалсан	Чойбалсан	Choibalsan	チョイバルサン
Чингэсхан	Чингэсхан	Chingis Khaan	チンギス・ハーン
Цав	Цав	Tsav	ツァヴ
Улаан	Улаан	Ulaan	オラーン
Мухар	Мухар	Muhar	ムホル
Баян-Уур	Баян-Уул	Bayan-Uul	バヤン・ウール
Салхийт	Салхийт	Salhiit	サルヒート
Дэлгэр Мөнх	Дэлгэр Мунх	Delger-Munh	デルゲルムンフ
Цагаан Чулуут Худуг	Цагаан Чулуут Худук	Tsagaan-Chuluut Huduk	ツァガーン・チョルトホダク
Мардай	Мардай	Mardai	マルダイ
Хөх толгой	Хух	Khuhu hill	フッフ 丘

Appendix-5. Correlation Table of Terminology (3)

MONGOLIAN	RUSSIAN	ENGLISH	JAPANESE
Хавирга	Хавирга	Havirga	ハビルガ
Хөгнө Уул	Хугиу Гора	Mt. Khugnu	クグヌ山
Ханан Уур	Ханан Гора	Mt. Hanan	ハナン山
Зрхт Овоот Тохгой	Зрхт Овоот Гора	Mt. Dzurhut Ovoot	ヅルフト・オボート山
Төмөртыйн Овоо	Тумуртыйн Овоо	Tumurtiin-Ovoo	トゥムルティン・オボ
Сухбаатр	Сухбаатр	Suhbaatar	スフバートル
Баруун-Урт	Баруун-Урт	Baruun-Urt	バルン・ウルト
Дарьгангын Тэгш Өндөрлөг	Дарьганг	Dariganga Highland	ダリガンガ高地
Салхит	Салхит	Salhit	サルヒート
Арын-Нуур	Арын-Нуур	Arin-Nuur	アリンヌール
Салаа	Салаа	Salaa	サラー
Дунд Уртын Худук	Дунд Урт	Dund Urt	ドンド・オルト
Баян Голын Худук	Баян Гол	Bayan Gol	バヤンゴル
Бор Уур	Бор Гора	Mt. Bor	ボル山
Нухөт-Даваа	Нухут-Даваа	Nuhut-Dawaa	ヌフット・ダワー
Хуйсийн гол Жаран гол	Хуйсийн, Жаран	Khuishiin, Jyaran	クイシーン川, ジャラン川
Сайн Усны Уул, Ширээ гол	Сайн Ус, Ширээ	Sain Os hill, Shiree river	サイン・オス丘, シレー川
Югөзнр(Эрдэнэцагаан)	Югөзнр(Эрдэнэцагаан)	Yuguzer(Erdenetsagan)	ユグゼル(エルデネツァガーン)
Төв	Центр	Tsentr	ツェントル
Нухотийн-Цагаантолгой	Нухутийн-Цагаантолгой	Nuhuttiin-Tsagaantolgoi	ヌフッティン・ツァガーン・トルゴイ
Ар-Баян	Ар-Баян	Ar-Bayan	アルバヤン
Алтан	Алтан	Artan	アルタン
Батгуй группа	Батгуй группа	Batgui group	バトグイ グループ
Баян-Хайраст	Баян-Хайраст	Bayan-Hairast	バヤンハイラスト
Баян-Ул	Баян-Ул	Bayan-Ul	バヤン・オール
Цаган-Чулут	Цаган-Чулут	Tsagan-Chulut	ツァガーン・チョルト
Мөнгөт	Мунгут	Mungut	ムングト
Нухөтийн	Нухутийн	Nuhuttiin	ヌフッティーン
Урт группа	Урт группа	Urt group	オルト グループ
Сайхан Ула	Сайхан-Ула	Saihan-Ula	サイハン・ウラ
Тарвагатай	Тарвагатай	Tarvagatai	タルヴァガタイ
Увур-Баян	Увур-Баян	Uvur-Bayan	ウヴルバヤン
Дзурх-Овоо	Дзурх-Ово	Dzurh-Ovoo	ズルフオボー

Appendix-5. Correlation Table of Terminology (4)

MONGOLIAN	RUSSIAN	ENGLISH	JAPANESE
Хар－Айраг	Хар－Айраг	Har－Airag	ハル・アイラグ
Хэнтий	Хэнтий	Hentii	ヘンティ県
Дорноговь	Дорноговь	Dornogovi	ドルノゴビ県（東ゴビ県）
Дундговь	Дундговь	Dundugobi	ドンドゴビ県（中央ゴビ県）
Өндөрхаан	Ундурхаан	Undurkhaan	ウンドゥルハーン
Сайншанд	Сайншанд	Sainshand	サインシャンド
Даланжаргалан	Даланжаргалан	Dalanjargalan	ダランジャルガラン（村）
Айраг	Айраг	Airag	アイラグ（村）
Дархан	Дархан	Darhan	ダルハン（村）
Баянцагаан	Баянцагаан	Bayantsagaan	バヤンツァガーン（村）
Хэрлэн гол	Хэрлэн	Kherlen river	ケルレン川
Мандалговь	Мандалговь	Mandalgovi	マンダルゴビ
Сумбэр уул	Сумбэр гора	Mt. Sumber	スンベル山
Их Бор Өндөр уул	Их Бор Ундур гора	Mt. Ih Bor Undur	イヒ・ボル・ウンドゥル山
Өлгий уул	Улгий гора	Mt. Ulgii	ウルギー山
Их Хонгор толгой	Их Хонгор гора	Mt. Ih Hongol	イヒホンゴル山
Хороот Ухаа	Хороот Ухаа	Khoroot Uhaa	ホロート・ウハー
Халзангийн аршаан	Халзангийн аршаан	Khalzangiin alshan	ハッツンギン・アルシャン
Бор－Өндөр	Бор－Ундур	Bor－Undur	ボル・ウンドゥル
Адаг	Адаг	Adag	アダグ
Хонгор	Хонгор	Hongor	ホンゴル
Майханта	Майханта	Maihanta	マイハント
Цагантахильци	Цагантахильци	Tsagantakhilch	ツァガーンタキルチ
Хажуу－Улаан	Хажу－Улан	Hajyuu－Ulaan	ハチョーオラン
Барун-Цаган-Дэль	Барун-Цаган-Дэль	Barun-Tsagan-Del	バルンツァガーンデル
Буджигер	Буджигер	Budjiger	ブジゲル
Өлгэн	Улгэн	Ulgen	ウルゲン
Цул-Цагаан-Дэль	Цул－Цаган－Дэль	Chol-Tsagaan-Del	チョルツァガーンデル
Хаирта	Хаирта	Hailta	ハイルタ
Хамар－Ус	Хамар－Ус	Hamar－Us	ハマルオス
Цагаан-Элгэгэни	Цаган-Элегени	Tsagaan-Elegeni	ツァガーンエリゲニ
Дзуун-Цагаан-Дэль	Дзун-Цаган-Дэль	Dzuun-Tsagaan-Del	ゾーンツァガーンデル
Чойр	Чойр	Choir	チョイル

Appendix-5. Correlation Table of Terminology (5)

MONGOLIAN	RUSSIAN	ENGLISH	JAPANESE
Лугийнгол	Лугийнгол	Lugiingol	ルギーンゴル
Дорноговь	Дорноговь	Dornogovi	ドルノゴビ（東ゴビ）県
Сайншанд	Сайншанд	Sainshand	サインシャンド
Хатанбулаг	Хатанбулаг	Hatanbulag	ハタンブラグ（村）
Ганц Модны Хяр	Ганц Модны Хяр	Gants Modn Khayar	ガンツ・モドゥン・ハヤル
Цагаансуврага	Цагансубурга	Tsagaansuvraga	ツァガーン・スヴラグ
Дорноговь	Дорноговь	Dornogovi	ドルノゴビ（東ゴビ県）
Өмнөговь	Умнуговь	Umnugovi	ウムヌゴビ（南ゴビ県）
Дундговь	Дундговь	Dundgovi	ドゥンドゴビ（中央ゴビ県）
Даланзадгад	Даланзадгад	Dalanzadgad	ダランザドガド
Сайншанд	Сайншанд	Sainshand	サインシャンド
Мандах	Мандах	Mandaha	マンダハ
Манлай	Манлай	Manlai	マンライ
Цогтцэций	Цогтцэций	Tsogttsechii	ツォグトツェツィ
Ханбогд	Ханбогд	Hanbogd	ハンボグト
Баян-Овоо	Баян-Овоо	Bayan-Ovoo	バヤン・オボ
Өлзийт	Улзийт	Ulziit	ウルズィート
Наринхудук	Наринхудук	Narinhuduk	ナリンホダク
Хармагтай	Хармагтай	Harmagtai	ハルマクタイ
Ихэ-шанхай	Ихэ-шанхай	Ih-Shanhai	イヒシャンハイ
Дучин-Хурал	Дучин-Хурал	Duchin-Hural	ドゥッチンホラル
Сэрвэн-Сухайт	Сэрвэн-Сухайт	Serven-Suhait	セルベンスハイト
Цаагаан-Цав	Цаган-Цав	Tsagaan-Tsav	ツァガーン・ツァヴ
Хунгут	Хунгут	Hungut	フングート
Эрдэнэтын уурхай	Эрдэнэтской рудничный	Erdenet mine	エルデネット鉱山
Овоотуу-Хира	Овоту-Хира	Ovootu-Hira	オボートヒラ
Шутэн	Шутэн	Syuten	シュテン
Ухаа-Худаг	Уха-Худук	Uhaa-Hudak	ウハーホダク

Appendix-5. Correlation Table of Terminology (6)

MONGOLIAN	RUSSIAN	ENGLISH	JAPANESE
Өлзийт район	Улзийт	Ulziit area	ウルズィート地区
Өмнөговь	Умнуговь	Umnugovi	ウムヌゴビ（南ゴビ県）
Дундговь	Дундговь	Dundgovi	ドゥンドゴビ（中央ゴビ県）
Даланзадгад	Даланзадгад	Daranzadgad	ダランザドガド（市）
Говь Алтайн Нуруу	Говь Алтай	Govi Altai Mountains	ゴビ・アルタイ山脈
Мандал-Овоо	Мандал-Овоо	Mandal-Ovoo	マンダルオボー
Цогт-Овоо	Цогт-Овоо	Tsogt-Ovoo	ツォグトオボー
Хуртэл Харна	Хуртэл Харна	Hurutel Harna	フルテル・ハルナ
Чойр	Чойр	Choir	チョイル
Улгий	Улгей	Ulgii	ウルギー
Шуруудын Хундий	Шуруудын Хундий	Laky Valley	「湖沼谷」
Мушгиа-Худаг	Мушугай	Mushgia-Hudak	ムシギア・ホダク
Баян-Хушу	Баян-Хушу	Bayan-hoshoo	バヤン・ホショー
Баян-Овоот	Баян-Овоот	Bayan-Ovoot	バヤン・オボート
Олон-Овоот	Олон-Овоот	Olon-Ovoot	オロン・オボート
Дугших	Дугших	Dugshih	ドグシヒ
Онх	Онх	Onh	オンホ
Баян-Боро-Нуруу	Баян-Боро-Нуру	Bayan-Bor-Nuruu	バヤン・ボルノロー

Appendix 6

Microscopic Observations and Photomicrographs (Thin Section)

ABBREVIATION

Aa : Aegirine-augite	Act: Actinolite	Ag : Aegirine
An : Anorthoclase	Au : Augite	Av : Arfvedsonite
Bt : Biotite	Cal: Calcite	Can: Cancrinite
Cb : Carbonate	Ccp: Chalcopyrite	Ce : Cerussite
Cel: Celestite	Cr : Corundum	Cv : Cavity
Ep : Epidote	Fl : Fluorite	Ga : Garnet
Gl : Galena	Go : Goethite	Hb : Hornblende
Fl : Fluorite	Ga : Garnet	Gl : Galena
Hm : Hematite	Hy : Hypersthene	Il : Ilmenite
Kf : K-feldspar	Mf : Mafic mineral	Mo : Molybdenite
Ms : Muscovite	Mt : Magnetite	Ne : Nepheline
Ph : Phlogopite	Pl : Plagioclase	Px : Pyroxene
Qz : Quartz	Rc : Rhodochrosite	Sp : Sphalerite
Sph: Sphene	Sy : Synchysite	Tp : Topaz
Tr : Tremolite		

Nomenclature of the igneous rocks is based upon the following literature:

R.W.Le Maitre ed.(1989) : A classification of igneous rocks and glossary of terms. Blackwell Scientific Publ., Oxford, 193p.

(1)
Sample No. : 3DN2
Locality : Tsav
Rock name : Granodiorite
Observation note :

This specimen is pinkish gray, fine-grained, porphyritic granodiorite. It consists principally of plagioclase(oligoclase), quartz, K-feldspar(orthoclase), biotite and hornblende in a decreasing order. Plagioclase is euhedral, up to 5mm in length, partly replaced by chlorite and epidote. Quartz and K-feldspar occur interstitially between plagioclase crystals. Biotite is mostly altered to chlorite and leucoxene. Hornblende is mostly altered to chlorite, epidote and actinolite.

(2)
Sample No. : 3DN17
Locality : Tsav
Rock name : Monzodiorite
Observation note :

This specimen is dark gray, medium-grained monzodiorite showing an intergranular texture. It consists of plagioclase(andesine), augite, hypersthene, K-feldspar(orthoclase), olivine (pseudomorph), biotite, opaque oxide and apatite in a decreasing order. Plagioclase is long prismatic, up to 5mm. K-feldspar occurs interstitially between plagioclase crystals in a small amount. Olivine is wholly altered to opaque oxide and carbonate. Biotite has a symplektitic rim along the contact with K-feldspar. Small amount of actinolite, chlorite and carbonate occur as alteration products after mafic minerals.

(3)
Sample No. : 3DN18
Locality : Tsav
Rock name : Granite porphyry
Observation note :

This specimen is pale pink granite porphyry with phenocrysts of K-feldspar(orthoclase-microperthite), plagioclase(andesine-oligoclase), quartz and mafic minerals, mostly 1-5mm across. K-feldspar phenocrysts are clouded by dusty materials. Mafic phenocrysts are biotite, augite, brown hornblende and opaque oxide. Groundmass consists of K-feldspar, quartz and a lesser amount of plagioclase, and shows a microgranitic texture.

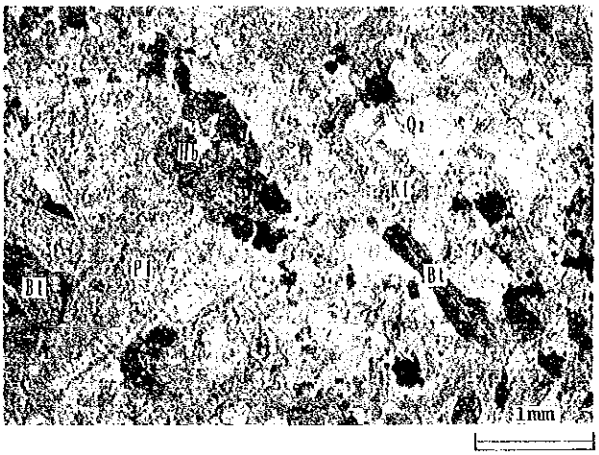
(4)
Sample No. : 3DN19
Locality : Tsav
Rock name : Schistose granite
Observation note :

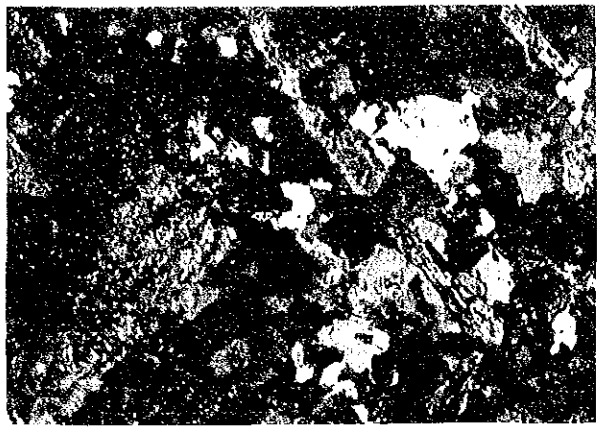
This specimen is pinkish gray, schistose granite which has undergone metamorphic recrystallization. It consists principally of quartz, plagioclase (oligoclase), K-feldspar(orthoclase) and biotite. Plagioclase is subhedral, partly replaced by sericite and carbonate minerals. K-feldspar is subhedral to anhedral, and often includes poikilitically plagioclase crystals. Quartz is anhedral, interstitial between plagioclase crystals, and is recrystallized into a mosaic aggregate of quartz subgrain. Biotite is highly deformed and altered to aggregate of minute opaque oxide and chlorite.

Plane polarized light

Crossed polarized light

(1)





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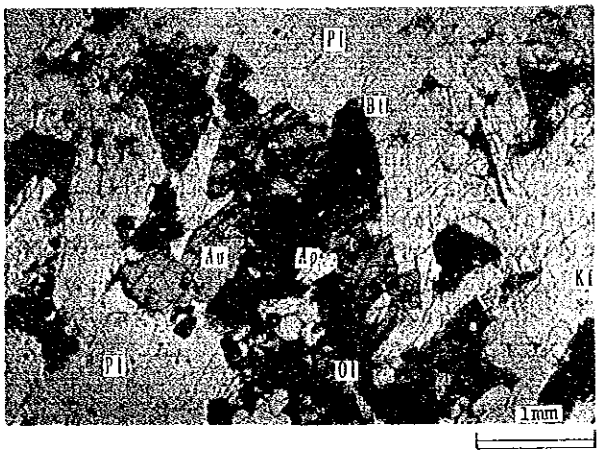

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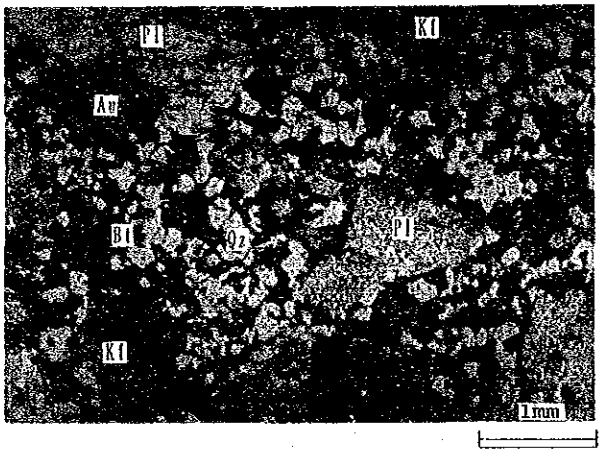

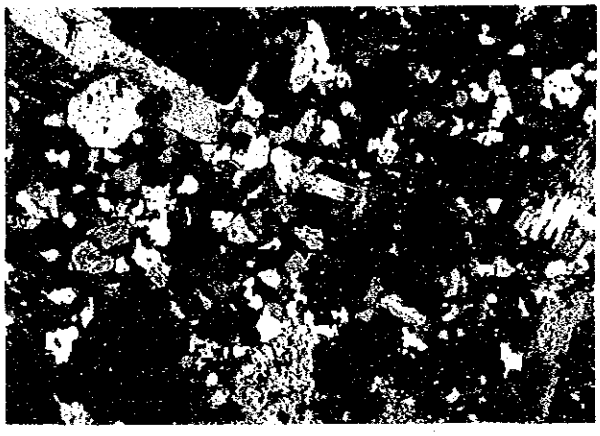

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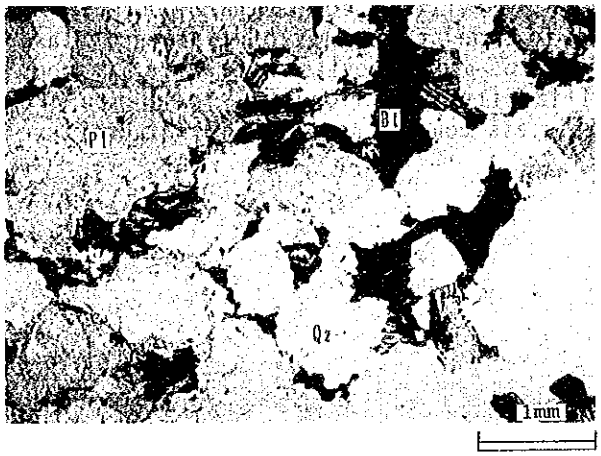
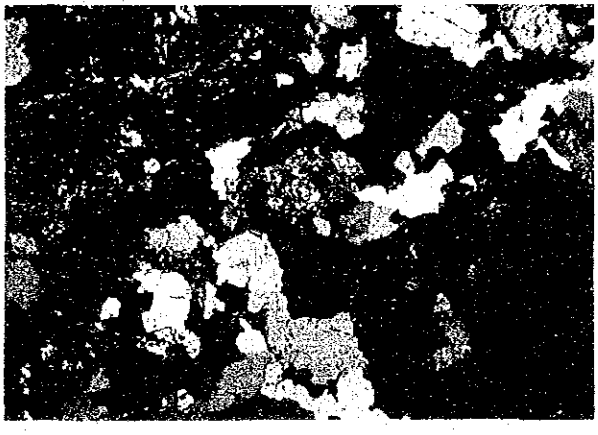




(5)
Sample No. : 3DN20
Locality : Tsav
Rock name : Alkali basalt
Observation note :

This specimen is dark gray alkali basalt with phenocrysts of plagioclase (andesine), olivine, augite and biotite, mostly 0.5-1mm in length. Plagioclase phenocryst is highly corroded by groundmass and has abundant glass inclusions. Olivine phenocryst shows a pale yellow tint and is rimmed with minute phlogopite. Augite phenocryst is relatively fresh. Biotite phenocryst is mostly opacitized. Groundmass shows an intersertal texture and consists principally of lath-shaped plagioclase, olivine, pyroxene, opaque oxide and glass.

(6)
Sample No. : 3DN21
Locality : Tsav
Rock name : Nepheline basalt
Observation note :

This specimen is dark gray nepheline basalt with phenocrysts of plagioclase(andesine), nepheline, augite and hornblende(or kaersutite). Nepheline phenocryst is up to 2mm in length, usually made of several parts with slightly different orientation and contains abundant minute opaque inclusions. Hornblende(?) phenocryst is mostly opacitized. Groundmass consists principally of nepheline, clinopyroxene, apatite, plagioclase and opaque oxide.

(7)
Sample No. : 3DN22
Locality : Bayan-Uul
Rock name : Schistose granite
Observation note :

This specimen is gray medium-grained schistose granite, consisting principally of plagioclase(oligoclase), quartz, K-feldspar and biotite. It has undergone a marked cataclastic deformation. Plagioclase is 1-3mm in length, tabular to long prismatic but is often bended and broken into subgrains. Quartz is anhedral and changed into subgrains which show sutured or mortar structure. Biotite is changed into lepidoblastic aggregate of secondary biotite.

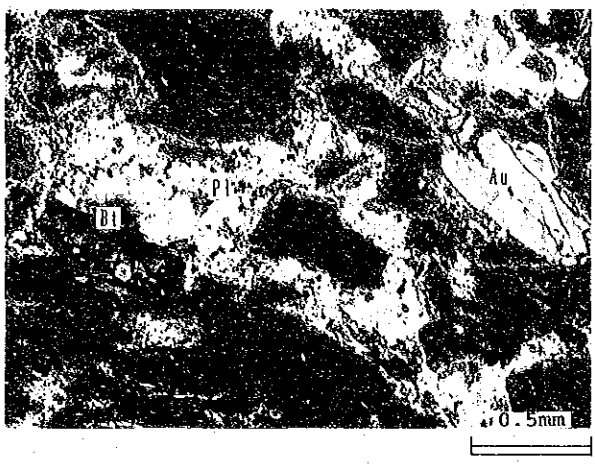
(8)
Sample No. : 3DN29
Locality : Mardai
Rock name : Welded tuff(?) with granite fragment
Observation note :

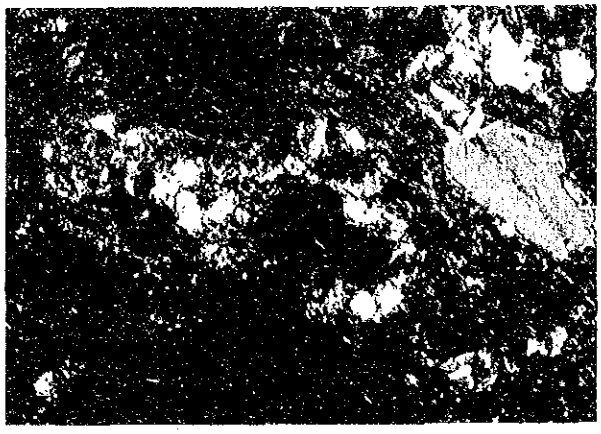
This specimen is black, altered welded tuff(?), containing granite and granite-derived crystal fragments. It is made principally of flattened glass shard which is perfectly altered to sericite and limonite. Granite fragment is of leucocratic granite with myrmekitic structure. Crystal fragments are quartz, plagioclase and K-feldspar. Veinlets consisting of opaque mineral are observed.

Plane polarized light

Crossed polarized light

(5)





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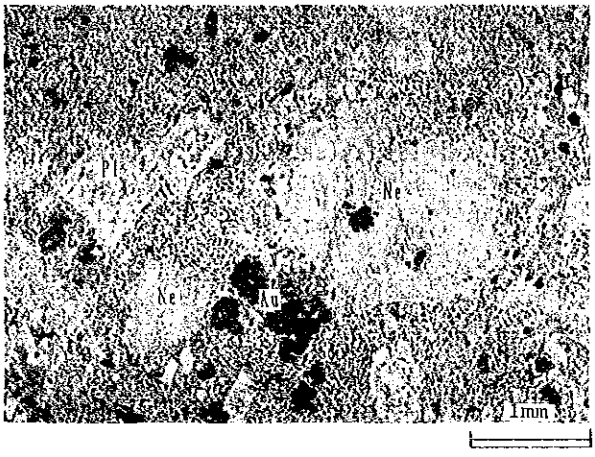
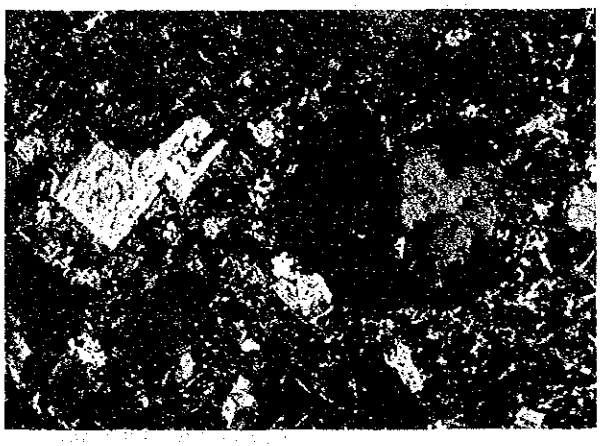
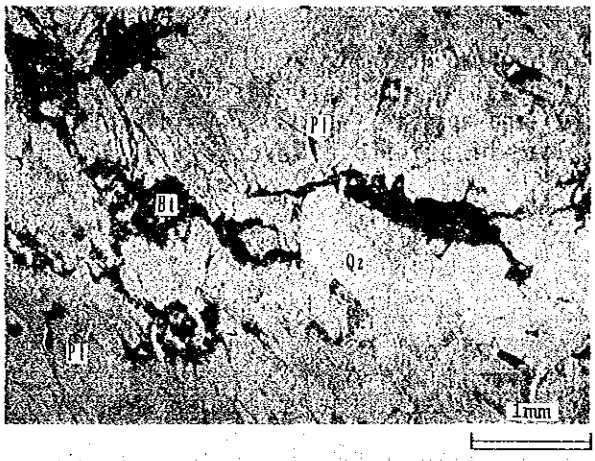
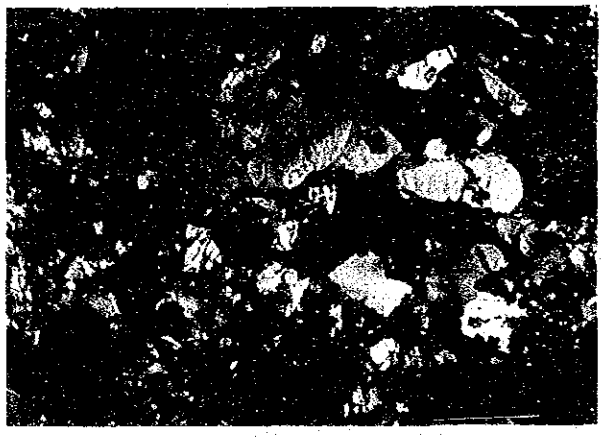




(7)





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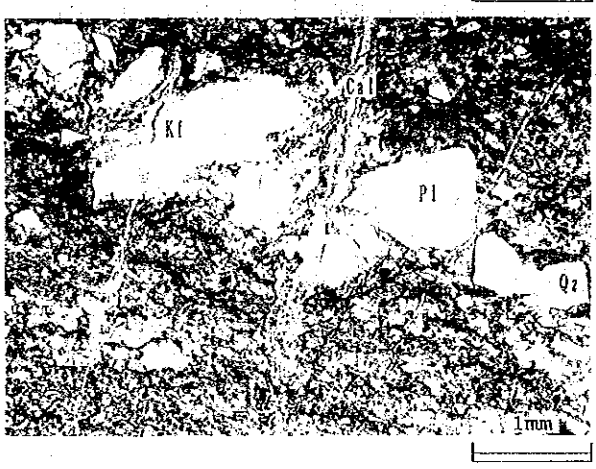


(9)
Sample No. : 3DN31
Locality : Mardai
Rock name : Rhyolite welded tuff ("ignimbrite")
Observation note :

This specimen is purple, aphyric rhyolite welded tuff with a small amount of corroded quartz phenocryst. Matrix shows a micro-eutaxitic foliation, and is made up of flattened glass shards which are perfectly devitrified into minute crystals of quartz, K-feldspar, plagioclase and hematite. Sanidine occurs as small euhedral crystal in drusy part, probably of vapor phase origin.

(10)
Sample No. : 3DN32
Locality : Ulaan area
Rock name : Rhyolite
Observation note :

This specimen is pale purple, aphyric rhyolite with a distinct flow structure. It consists of fine-grained quartz, K-feldspar(sanidine), plagioclase (oligocalse), biotite and glass, and shows a spherulitic texture made of quartzo-feldspathic spherules with 1-2mm diameter. Small garnet crystals are observed.

(11)
Sample No. : 3DN37
Locality : Tsagaan-Chuluut Hud.
Rock name : Granite
Observation note :

This specimen is pale greenish gray, coarse-grained granite. It consists of quartz, K-feldspar(orthoclase-microperthite), plagioclase(oligoclase), biotite and a minor amount of opaque oxide and apatite. It has considerably undergone an alteration, namely chloritization of biotite and sericitization of plagioclase.

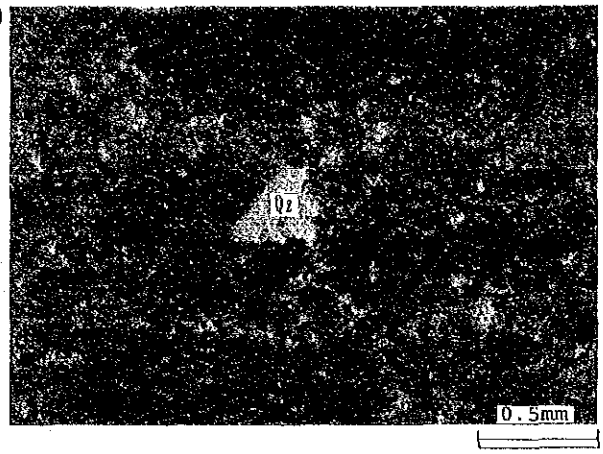
(12)
Sample No. : 3DN38
Locality : Ulaan area
Rock name : Granite
Observation note :

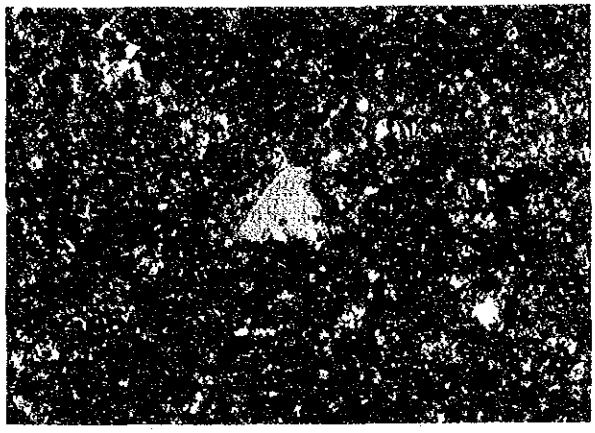
This specimen is pale yellowish gray, coarse-grained granite. It consists of plagioclase(oligoclase), quartz, K-feldspar(microcline-microperthite) and a lesser amount of biotite and muscovite. K-feldspar shows a distinct microcline structure. Biotite is mostly choloritized.

Plane polarized light

Crossed polarized light

(9)





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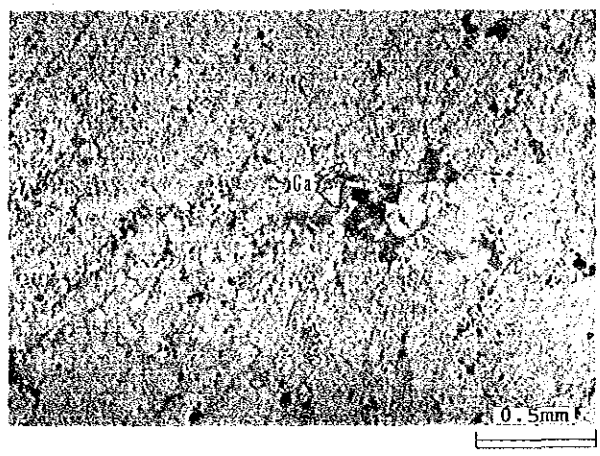

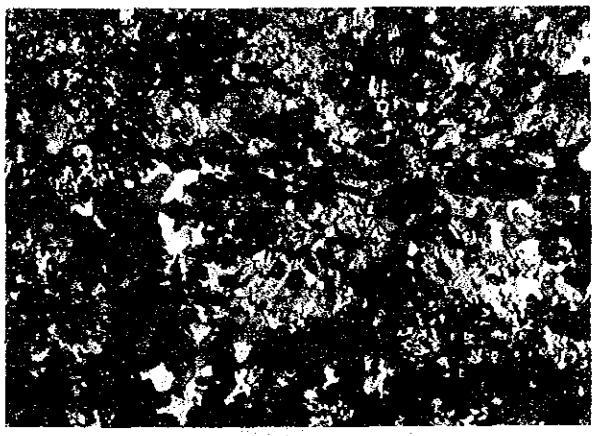

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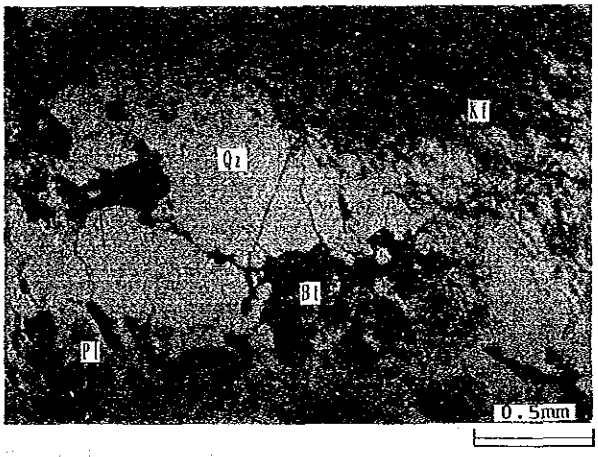

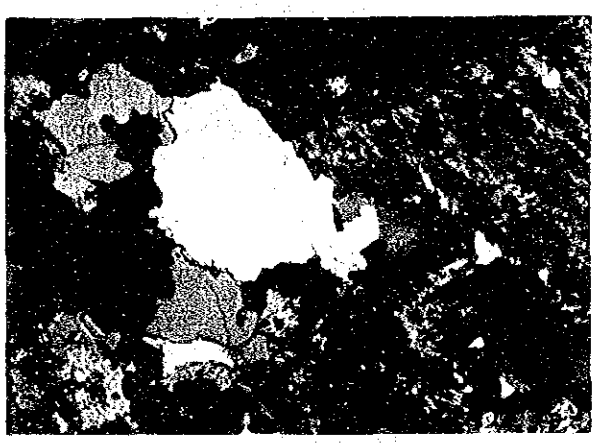

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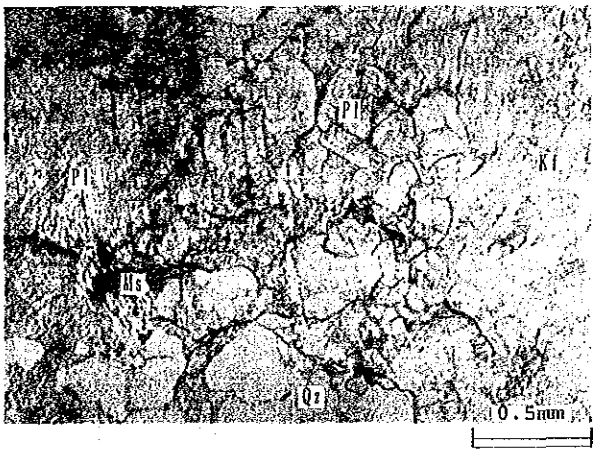


(13)
Sample No. : 3DN39
Locality : Ulaan
Rock name : Rhyolite
Observation note :

This specimen is pale gray, aphyric rhyolite with a small amount of phenocryst. Phenocryst minerals, mostly smaller than 0.5mm, are mainly of K-feldspar(orthoclase) and plagioclase(oligoclase), both considerably replaced by sericite, clay mineral and carbonate mineral. Groundmass consists of fined-grained quartz, K-feldspar and plagioclase. This rock is highly brecciated. The interspace of the breccia are filled with fluorite, quartz and various sulfide minerals.

(14)
Sample No. : 3DN41
Locality : Ulaan
Rock name : Skarn
Observation note :

This specimen is dark green, massive skarn. It consists of epidote, hornblende and garnet(andradite). Garnet occurs as polygonal porphyroblasts, about 1mm across and contains epidote inclusions. Garnet is evidently anisotropic (optic angle 2V=(+)50-60°) and exhibits a distinct twinning and zoning. Epidote is granular crystal, 0.1-0.2mm in length and pleochroic from colorless to pale yellow. Hornblende(or actinolite) occurs as pale-green acicular fibrous crystals.

(15)
Sample No. : 3DN42
Locality : Ulaan
Rock name : Rhyolite
Observation note :

This specimen is pale gray, aphyric rhyolite injected by many quartz veinlets. Rhyolite consists of fine-grained(smaller than 0.1mm) quartz, K-feldspar, plagioclase, carbonate minerals and a minor amount of ore minerals and fluorite. Quartz veinlets contain fluorite, sulfide minerals and carbonate minerals.

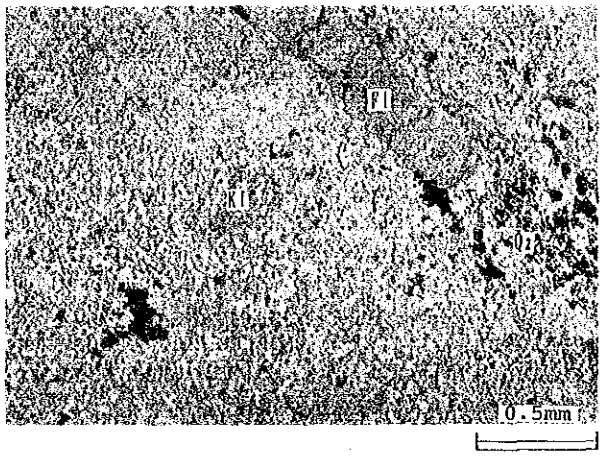
(16)
Sample No. : 3DS10
Locality : Tsav
Rock name : Quartz vein
Observation note :

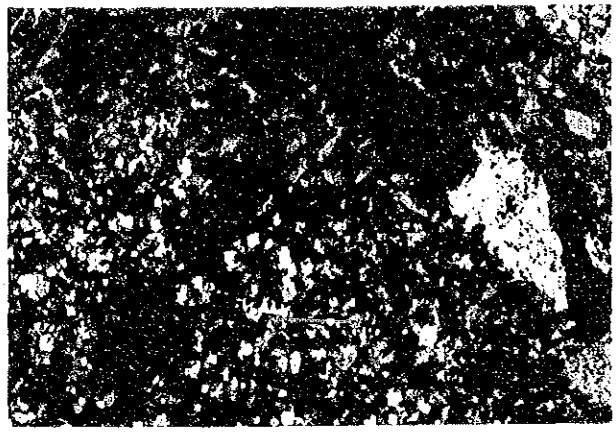
This specimen is pink-gray-black, ore-bearing quartz vein with rhythmically banded structure of about 1mm width. It consists of quartz, sericite, calcite, chlorite, sphalerite, galena, rhodochrosite and other sulfide minerals. Relative abundance of these minerals varies conspicuously from band to band.

Plane polarized light

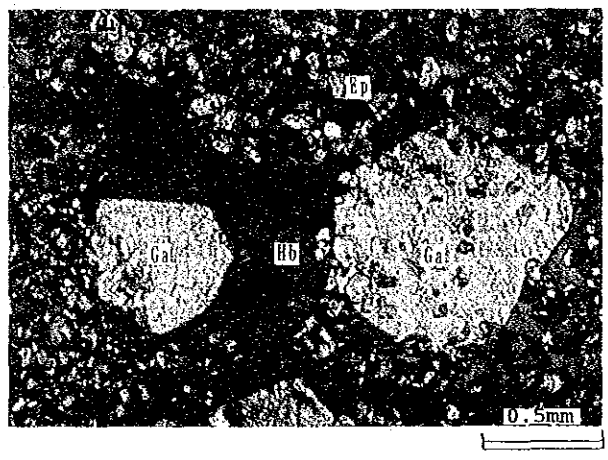
Crossed polarized light

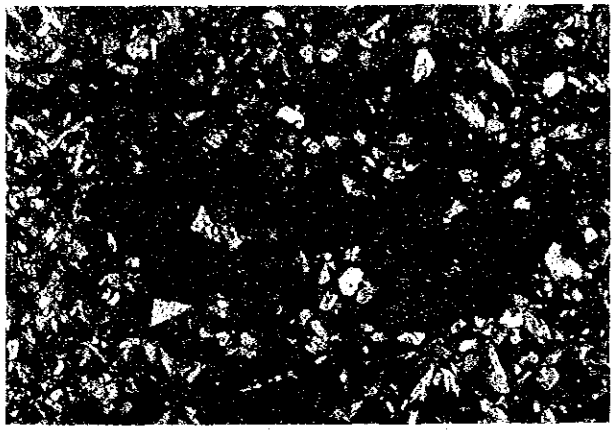
(13)





(14)





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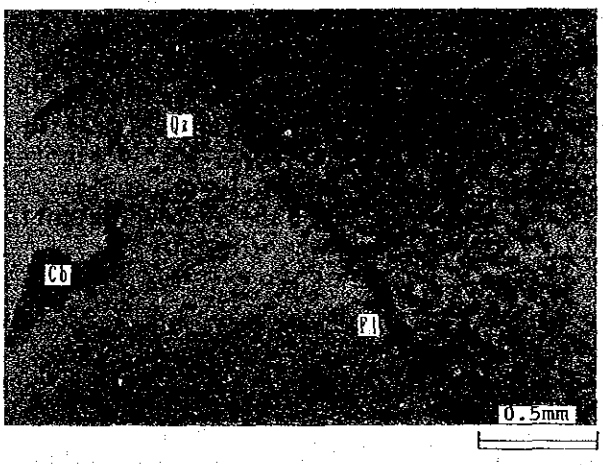

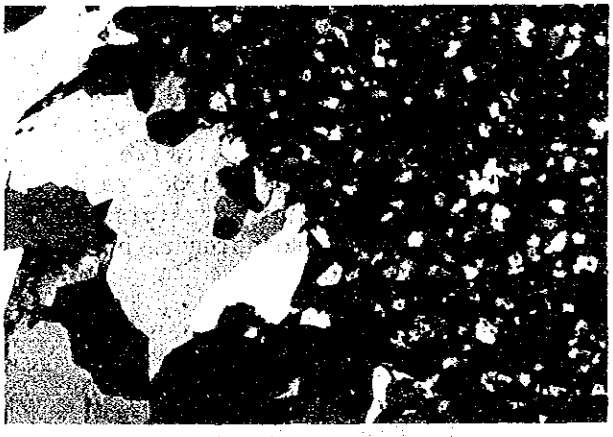

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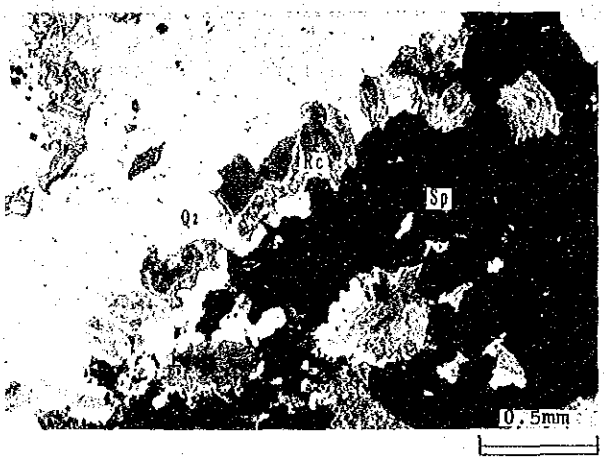
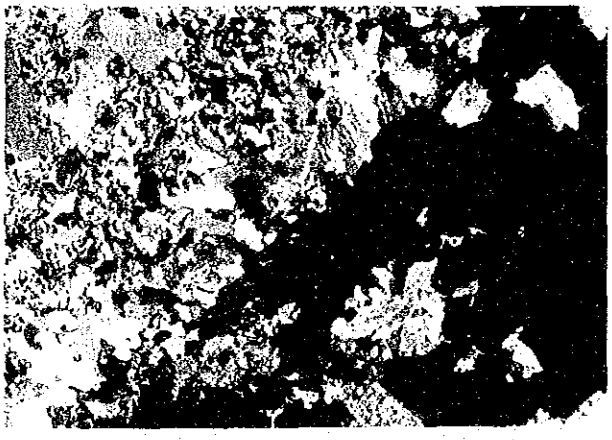




(17)
Sample No. : 3DS12
Locality : Salhiit
Rock name : Meta-tonalite
Observation note :

This specimen is pale greenish-gray, medium-grained tonalite which has undergone an intense deformation and alteration. It consists primarily of plagioclase, quartz and biotite with accessory opaque oxide and apatite. Plagioclase is primarily of subhedral oligoclase with 2-5mm length, but it is considerably distorted, fractured and replaced by epidote and sericite. Biotite is highly distorted and wholly changed into chlorite, actinolite and carbonate mineral. Quartz occurs interstitially between plagioclase and biotite, and it is recrystallized into an aggregate of smaller quartz subgrain.

(18)
Sample No. : 3DS16
Locality : Ulaan
Rock name : Rhyolite
Observation note :

This specimen is purplish gray, aphyric rhyolite. It consists principally of fine-grained (0.05-0.1mm in average diameter) quartz, K-feldspar and plagioclase and subordinately of ilmenite, carbonate mineral and other opaque mineral. K-feldspar phenocryst is rarely observed. Ilmenite is mostly changed into leucoxene.

(19)
Sample No. : 3DS17
Locality : Ulaan
Rock name : Skarn
Observation note :

This specimen is dark yellowish green, fine-grained skarn shown in the photomicrograph, and is accompanied with a subordinate coarse-grained ore-bearing part. The main part of the skarn consists of epidote, hornblende(or actinolite) and biotite. Epidote occurs as ganular crystals, about 0.1mm in length. Hornblende occurs as fibrous crystals, about 0.5mm in length. Biotite occurs as minute crystals, forming a decussate structure. The ore-bearing part consists of hornblende, biotite, garnet, pyrite and carbonate mineral.

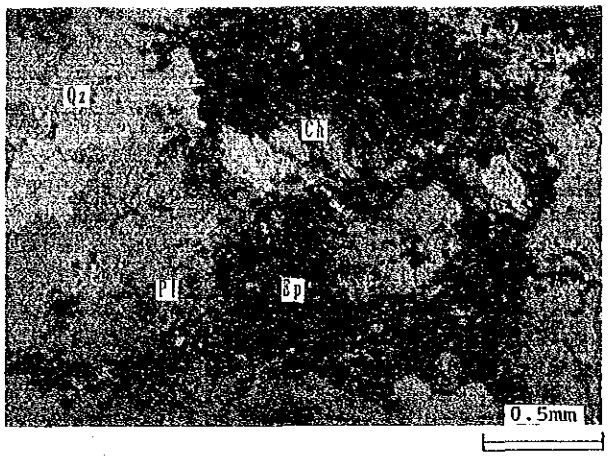
(20)
Sample No. : 3DY1
Locality : Tsav
Rock name : Pb-Zn ore
Obseervation note :

This specimen is a part of Pb-Zn ore. It is gray-yellow-white, ore-bearing drusy quartz vein with banded strucure. It consists of quartz, galena, cerussite and other carbonate minerals and sericite. The alteration of galena to cerussite is observed.

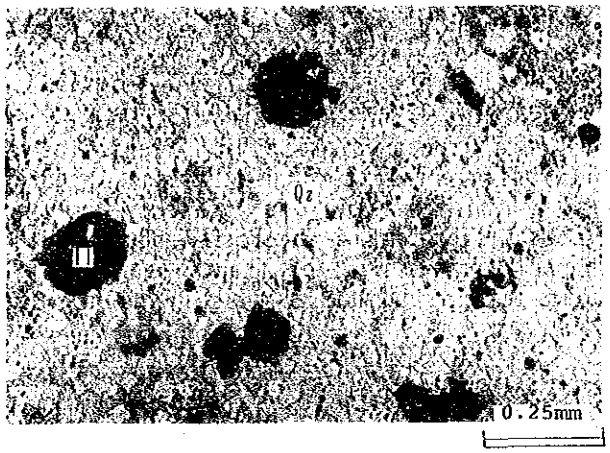
Plane polarized light

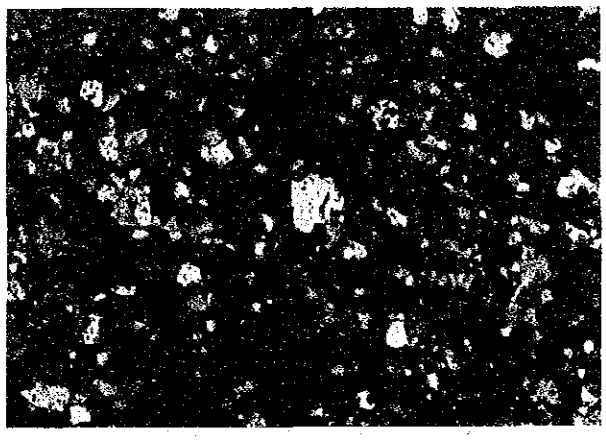
Crossed polarized light

(17)



(18)





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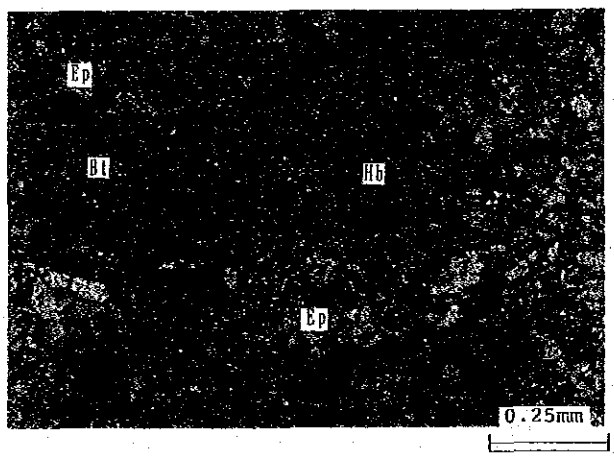

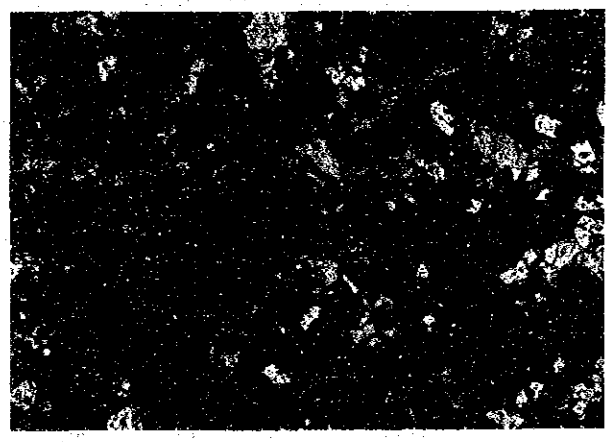

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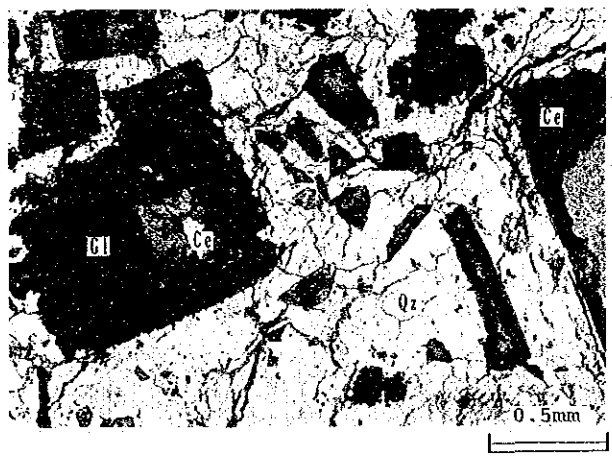
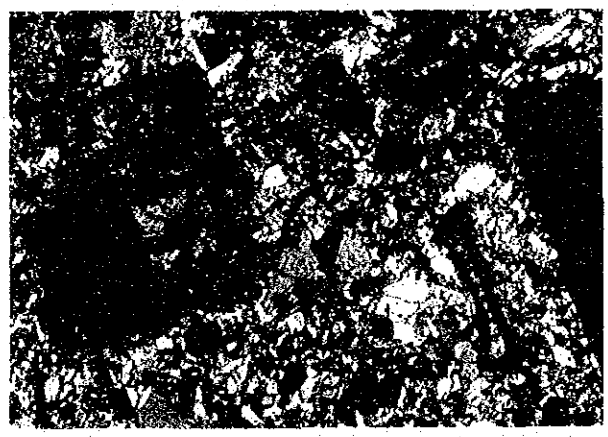




(21)
Sample No. : 3DY4
Locality : Tsav
Rock name : Schistose granite
Observation note :

This specimen is bluish gray, fine-grained, schistose granite. It shows nearly an equigranular texture with an average grain size:0.5mm. It consists of quartz, plagioclase, K-feldspar(orthoclase), biotite, garnet and accessory apatite. Plagioclase occurs as subhedral to anhedral crystals but it is mostly replaced by calcite and sericite. Quartz is anhedral and changed into an aggregate of smaller quartz subgrains. Biotite is aligned with a nearly parallel orientation and often forms a lepidoblastic aggregate. Garnet occurs sporadically and is partly replaced by quartz.

(22)
Sample No. : 3DY13
Locality : Bayan-Uul
Rock name : Meta-dolerite
Observation note :

This specimen is dark gray, fine-grained meta-dolerite with plagioclase phenocryst. It was primarily of dolerite which consists of plagioclase, brown hornblende and opaque oxide and shows an ophitic texture, but it has evidently undergone a thermal metamorphism. Plagioclase(labradorite) occurs as phenocryst up to 3mm in length and also as lath-shaped crystals smaller than 0.5mm. Most of hornblende is changed into fibrous actinolite and a lesser amount of biotite.

(23)
Sample No. : 3DY15
Locality : Tsagaan-Chuluut Hud.
Rock name : Monzodiorite
Observation note :

This specimen is dark gray, fine to medium-grained monzodiorite. It consists principally of plagioclase(andesine), augite, hypersthene, biotite, K-feldspar(orthoclase?) and subordinately of quartz, hornblende(brown to green), opaque oxide and apatite. Plagioclase is nearly euhedral, ranging from 0.2mm to 2mm in length. Augite and hypersthene, 0.1-2mm in length, often show an intergrowth relation to each other and the both are mantled by hornblende and biotite. K-feldspar and quartz occur interstitially between plagioclase and mafic minerals.

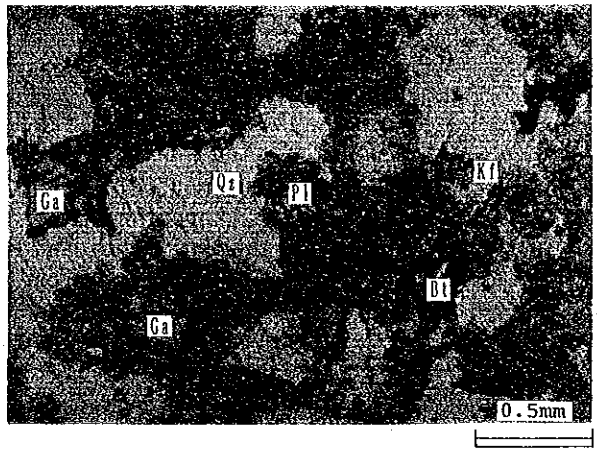
(24)
Sample No. : 3DY16
Locality : Tsagaan-Chuluut Hud.
Rock name : Granite porphyry
Observation note :

This specimen is pale pinkish gray granite porphyry with abundant phenocrysts, 2-5mm in grain size. Phenocryst minerals are quartz, plagioclase (oligoclase), K-feldspar(orthoclase-microperthite) and biotite(choloritized). Groundmass consists principally of fine-grained (smaller than 0.2mm) quartz and K-feldspar.

Plane polarized light

Crossed polarized light

(21)



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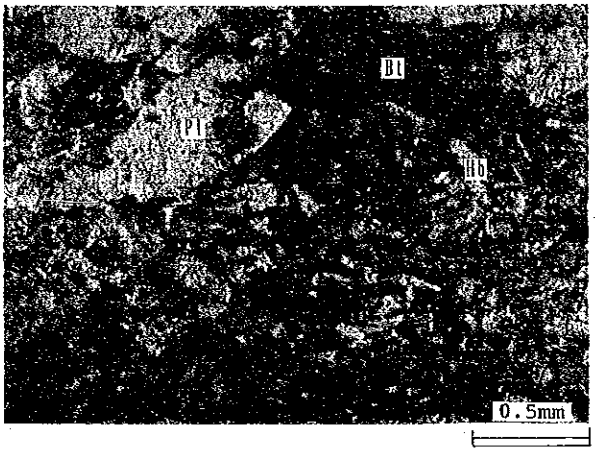

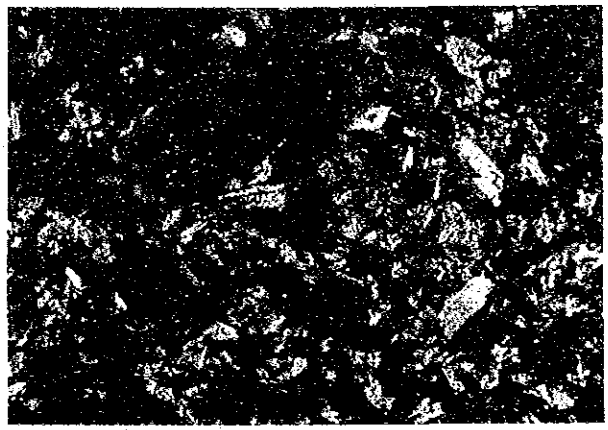

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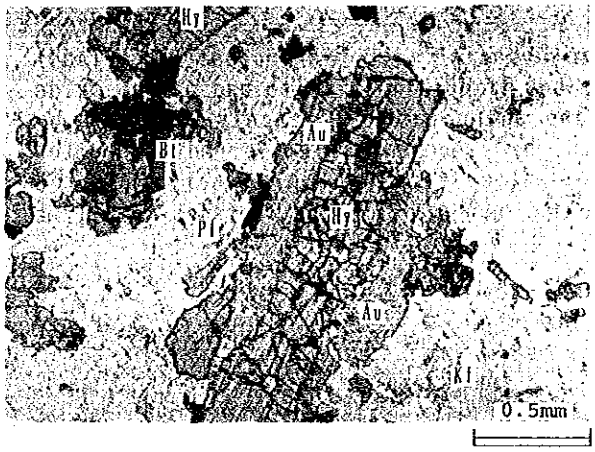

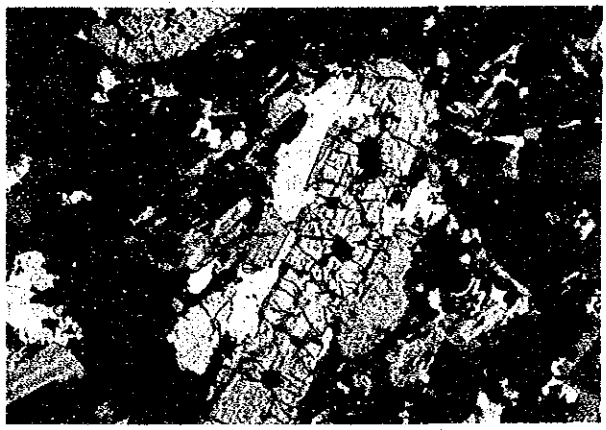

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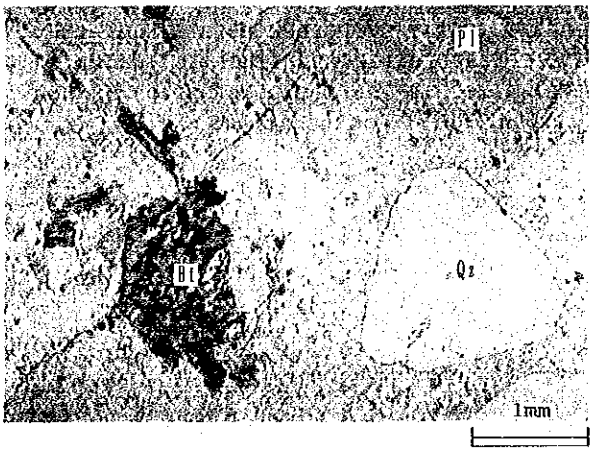
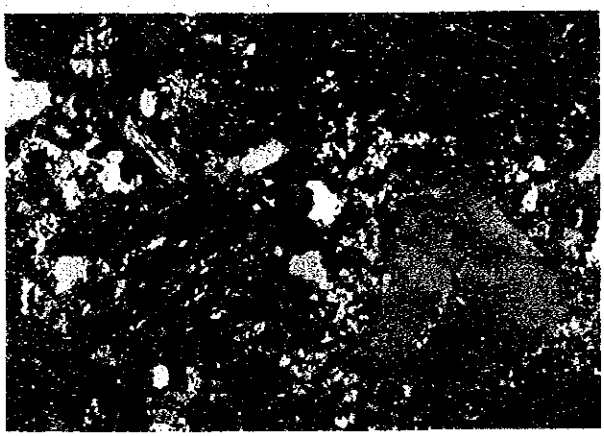




(25)
Sample No. : 3DY17
Locality : Tsagaan-Chuluut Hud.
Rock name : Monzodiorite
Observation note :

This specimen is dark gray, fine to medium-grained hornblende monzodiorite. It consists principally of plagioclase(andesine-oligoclase), hornblende, K-feldspar(orthoclase) and quartz, and subordinately of sphene, opaque oxide and apatite. Hornblende, about 1mm in length, is mostly of brown to green species but accompanied by colorless amphibole. Plagioclase, 0.5-2mm in length, is compositionally zoned and intensively sericitized. K-feldspar and quartz occur interstitially between plagioclase and hornblende.

(26)
Sample No. : 3DY18
Locality : Tsagaan-Chuluut Hud.
Rock name : Meta-granite porphyry
Observation note :

This specimen is pale pink granite porphyry which has evidently undergone a thermal metamorphism. Phenocryst minerals, mostly 1-5mm in grain size, consist of quartz, plagioclase(oligoclase), K-feldspar(orthoclase-microperthite), biotite and accessory opaque oxide. Quartz phenocryst is recrystallized into smaller quartz subgrains. Biotite phenocryst is recrystallized into an aggregate of scaly biotite. Groundmass consists of recrystallized quartz, plagioclase, K-feldspar and biotite, showing a granoblastic texture.

(27)
Sample No. : 3HN16
Locality : Bor-Undur No.11
Rock name : Meta-dacite
Observation note :

This specimen is purplish gray meta-dacite with plagioclase(oligoclase) phenocryst, 1-2mm in length. A small amount of quartz, biotite and opaque oxide occur also as phenocrysts. Plagioclase phenocryst is largely replaced by sericite. Biotite phenocryst is replaced by secondary biotite and muscovite. Groundmass consists of very fine-grained(smaller than 0.05mm), recrystallized quartz, plagioclase, K-feldspar, biotite and opaque oxide, but retains faintly a flow structure of the original rock.

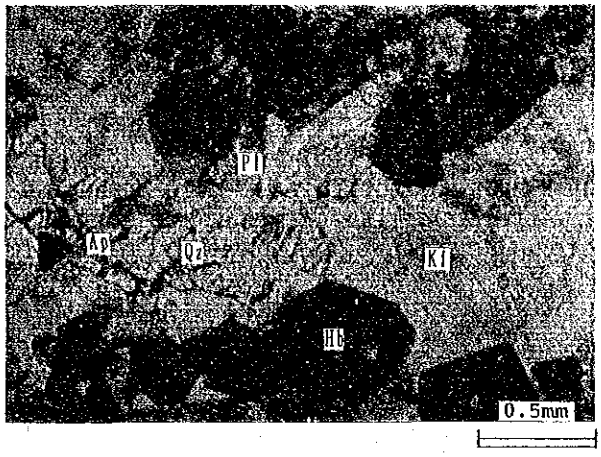
(28)
Sample No. : 3HN21
Locality : Adag No.1
Rock name : Granophyre
Observation note :

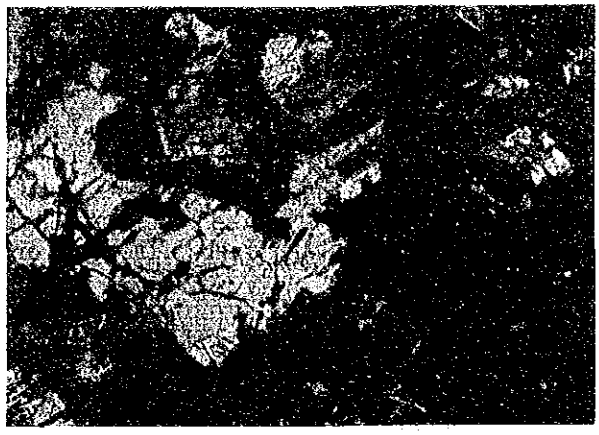
This specimen is pale purple granophyre. It consists almost exclusively of quartz and K-feldspar(orthoclase-microperthite), and both minerals show conspicuously a graphic intergrowth. Biotite, opaque oxide and fluorite occur in a small amount. An unknown mafic mineral given in the photomicrograph is now perfectly replaced by very fine-grained serpentine(?) and hematite.

Plane polarized light

Crossed polarized light

(25)





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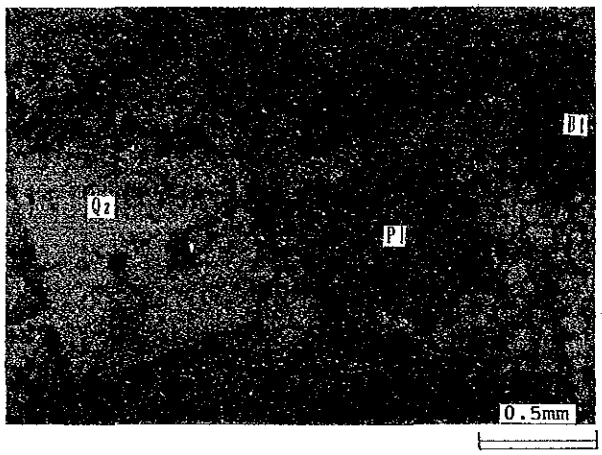
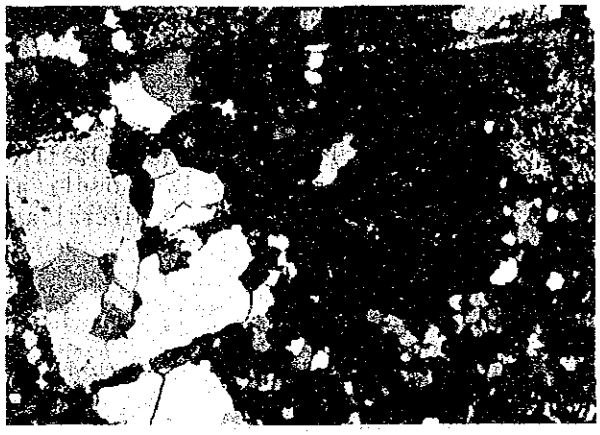
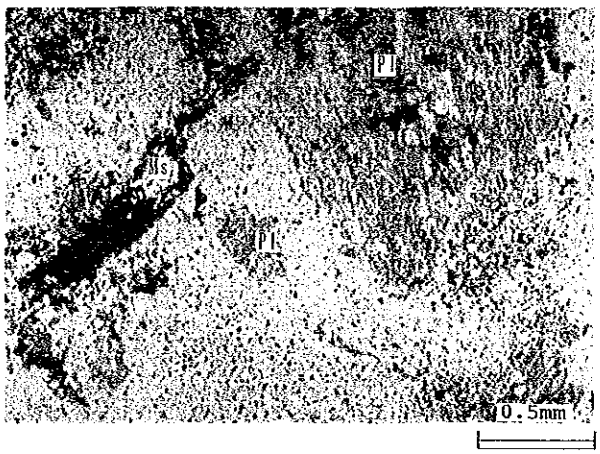
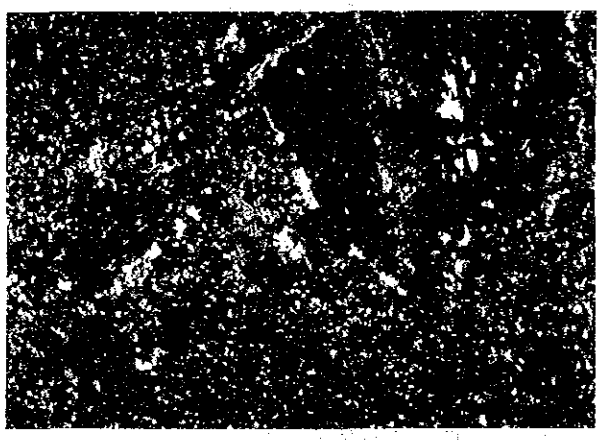


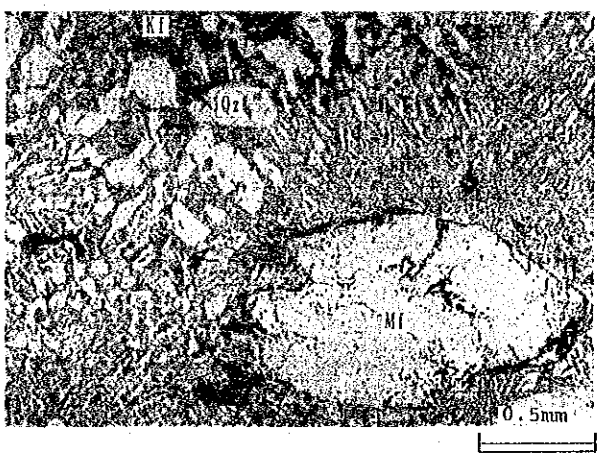


(27)





(28)



(29)
Sample No. : 3HN22
Locality : Bor-Undur No.5
Rock name : Quartz-fluorite vein
Observation note :
This specimen is white to pale purple quartz-fluorite vein. It is made up mostly of fluorite. A small amount of microcrystalline quartz occur interstitially between large fluorite crysals together with small cubic crystals of fluorite.

(30)
Sample No. : 3NS1
Locality : Yuguzer
Rock name : Greisen
Observation note :
This specimen is gray molybdenite-muscovite-quartz greisen with pearly luster. It consists principally of quartz and muscovite, up to 3mm in length. Platy molybdenite is closely associated with muscovite. A small amount of fluorite and carbonate mineral are observed.

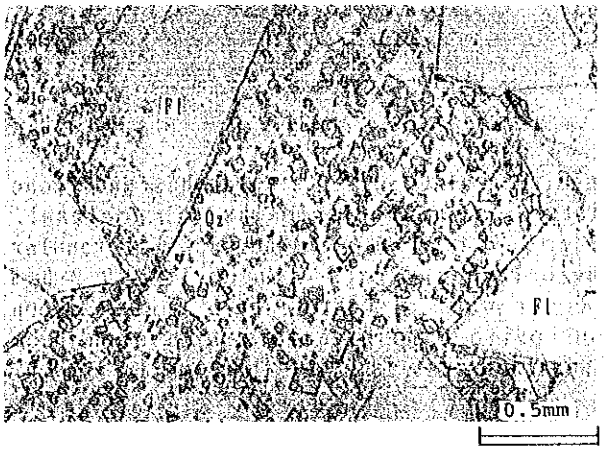
(31)
Sample No. : 3NS3
Locality : Yuguzer
Rock name : Greisen
Observation note :
This specimen is gray molybdenite-muscovite-quartz greisen with pearly luster. It consists principally of quartz and muscovite, up to 4mm in length. Large quartz crystal has often an elongated bipyramidal form. Muscovite gives a pale brownish tint in some parts. Platy molybdenite is closely associated with muscovite. A small amount of carbonate mineral are observed.

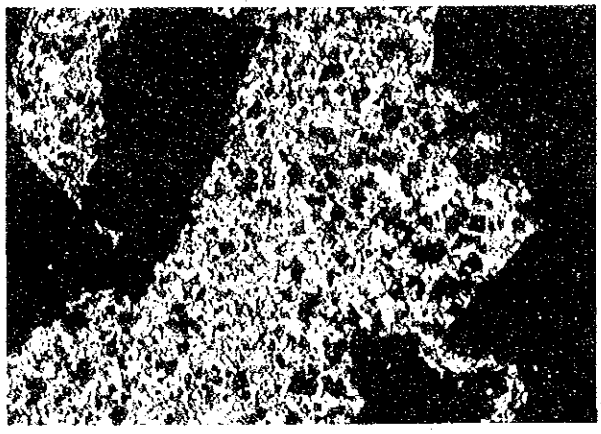
(32)
Sample No. : 3NS4
Locality : Yuguzer
Rock name : Greisen
Observation note :
This specimen is gray molybdenite-muscovite-quartz greisen with pearly luster. It consists principally of quartz and muscovite, up to 4mm in length. Large quartz crystal has often an elongated bipyramidal form emphasized by zonal arrangement of fluid inclusion as shown in the photomicrograph. Molybdenite is closely associated with muscovite. Miarolitic quartz is also observed.

Plane polarized light

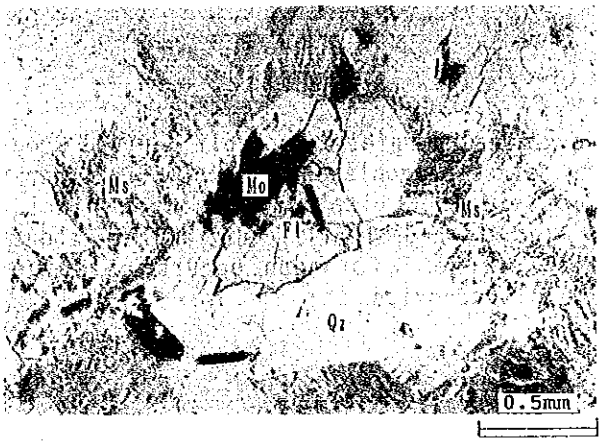
Crossed polarized light

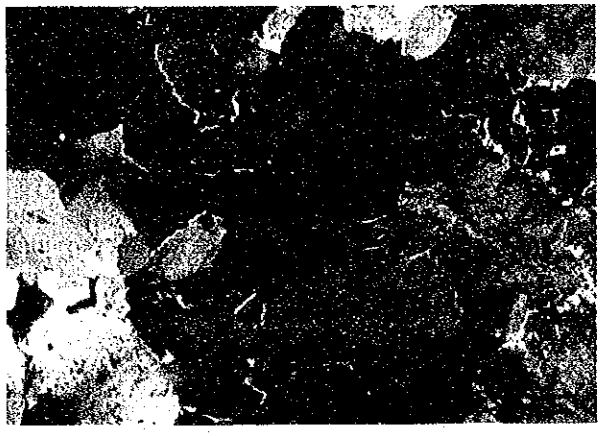
(29)



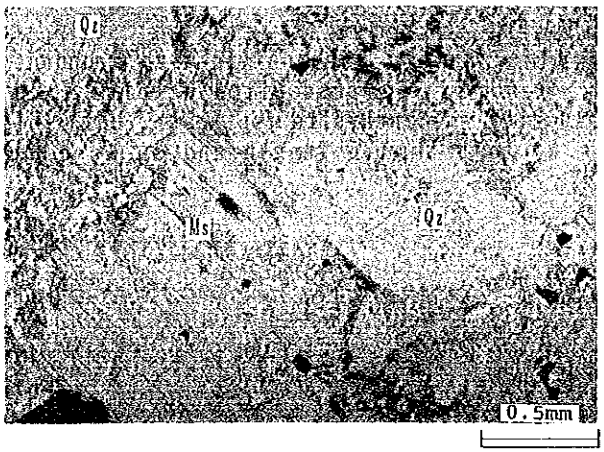


(30)

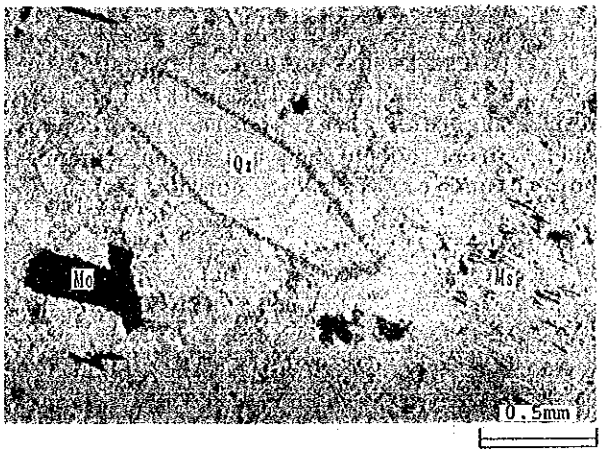


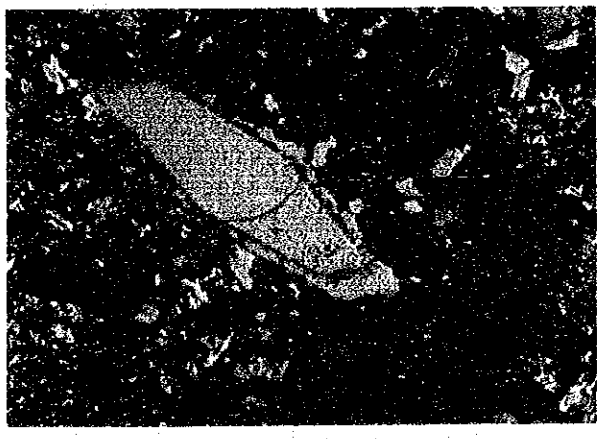


(31)



(32)





(33)
Sample No. : 3NS12
Locality : Tsentr
Rock name : Greisenized granite
Observation note :

This specimen is grayish white, medium-grained granite which has undergone an intensive greisenization. It consists of quartz, plagioclase(oligoclase), muscovite and topaz in a decreasing order. Quartz, 0.5-5mm across, is granular or anhedral, interstitial between plagioclase crystals. Muscovite, 0.2-3mm across, retains often a pale brown color with pleochroic halo around zircon crystals, suggesting that some of muscovite have been formed in situ from biotite by metasomatism. Topaz is anhedral crystal, smaller than 1mm in length, and mostly replaces plagioclase.

(34)
Sample No. : 3RS2
Locality : Lugiingol
Rock name : Hornfels
Observation note :

This is pale yellowish brown, fine-grained hornfels, probably derived from aluminous sediment. It consists of plagioclase(oligoclase), quartz, K-feldspar, corundum, biotite, muscovite and opaque oxide(hematite?) with minor spinel. These minerals excluding corundum are fine-grained, nearly equigranular (about 0.1mm across), forming a granoblastic texture. Corundum occurs as large poikiloblasts, up to 3mm across, rimmed with muscovite.

(35)
Sample No. : 3RS3
Locality : Lugiingol
Rock name : Carbonatite
Observation note :

This specimen is reddish brown, fine-grained carbonatite with abundant small cavities. It consists of quartz, "synchysite", muscovite, calcite and opaque mineral(goethite?) with minor fluorite. "Synchysite"(optically uniaxial positive) occurs as tabular crystals up to 0.5mm in length and shows conspicuously a sector zoning and twinning.

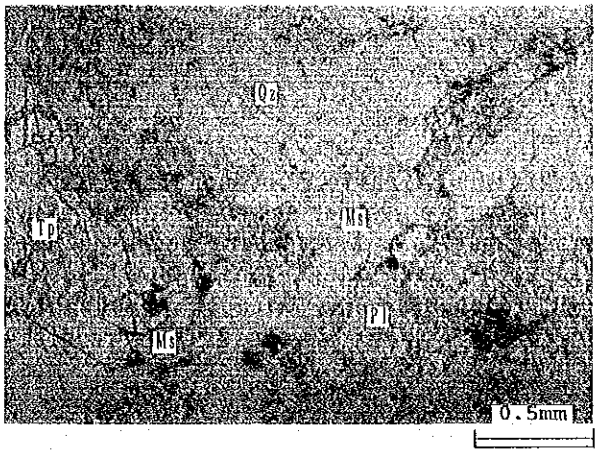
(36)
Sample No. : 3RS4
Locality : Lugiingol
Rock name : Syenite
Observation note :

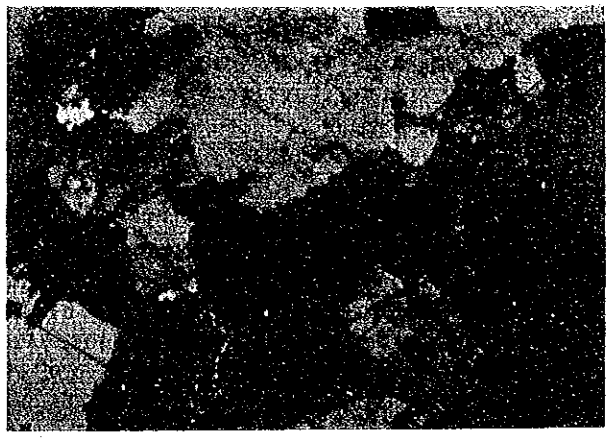
This specimen is gray, medium-grained syenite. It consists of K-feldspar(orthoclase), green hornblende, plagioclase (oligoclase), augite and biotite with a minor amount of sphene, apatite and opaque oxide. K-feldspar occurs as large anhedral crystals up to 5mm and includes poikilitically plagioclase and mafic crystals. Augite(soda augite?) gives a pale green color and is mostly mantled by green hornblende. Green hornblende has often a narrow reaction rim made up of minute clinopyroxene crystals in contact with K-feldspar.

Plane polarized light

Crossed polarized light

(33)





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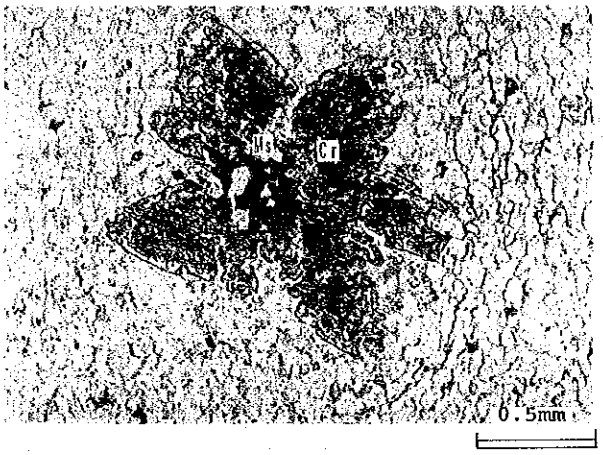

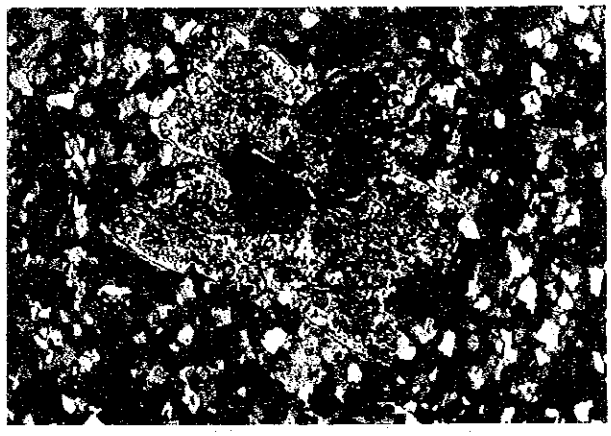

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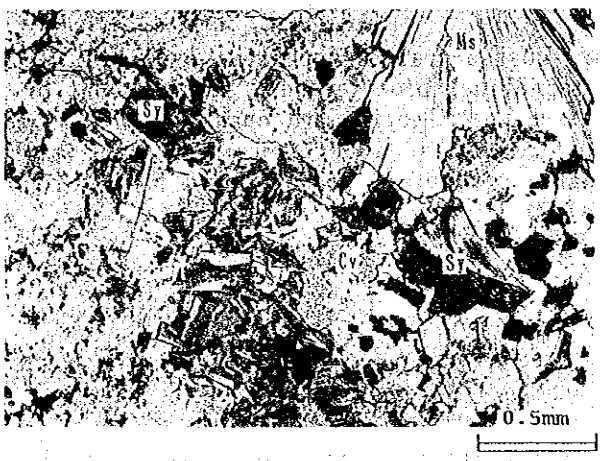

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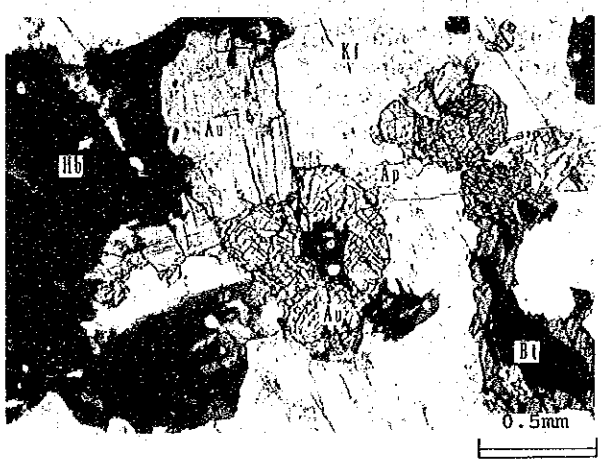


(37)
Sample No. : 3RS6
Locality : Lugiingol
Rock name : Syenite
Observation note :

This specimen is dark gray, fine-grained syenite. It consists of K-feldspar(orthoclase-microperthite), aegirine-augite, garnet and plagioclase with a small amount of sphene, opaque oxide and apatite. K-feldapar occurs as anhedral granular to poikilitic crystals up to 3mm. Aegirine-augite gives a pleochroic color from brownish yellow to deep green. Garnet, presumably melanite(Ti-andradite), occurs as cubic crystals up to 2mm and gives a reddish brown color. Plagioclase is mostly sericitized.

(38)
Sample No. : 3RS7
Locality : Lugiingol
Rock name : Lamprophyre
Observation note :

This specimen is reddish gray, fine-grained lamprophyre. It consists of K-feldspar(sanidine or orthoclase), augite, biotite and a small amount of brown hornblende(or barkevikite), apatite, sphene and opaque oxide. K-feldspar is clouded by minute hematite inclusions. Brown hornblende partly grades into blue-green species, probably alkali amphibole. Small cavities filled with calcite, sericite and K-feldspar are observed.

(39)
Sample No. : 3RS9
Locality : Lugiingol
Rock name : Nepheline syenite
Observation note :

This specimem is light bluish gray, coarse-grained nepheline syenite. It consists of K-feldspar(orthoclase), nepheline, biotite and a minor amount of cancrinite, calcite, garnet(andradite), sphene, fluorite and opaque oxide. K-feldspar occurs as subhedral elongated crystals, about 5mm in length, and poikilitically includes nepheline and mafic crystals. Nepheline is partly replaced by cancrinite and zeolite(natrolite?).

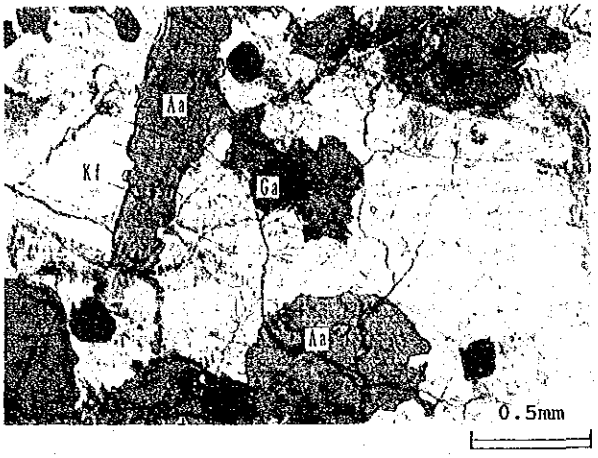
(40)
Sample No. : 3RS14
Locality : Lugiingol
Rock name : Syenite
Observation note :

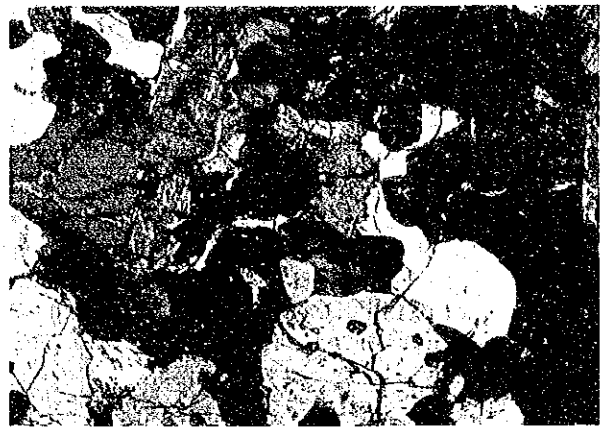
This specimen is light gray, coarse-grained syenite. It consists of K-feldspar(orthoclase-microperthite), green hornblende, biotite, plagioclase (andesine-oligoclase) and a small amount of clinopyroxene, apatite, sphene, fluorite, cancrinite and zircon. K-feldspar occurs as anhedral crystals up to 1cm and includes poikilitically plagioclase and mafic crystals. Fibrous zeolite (natrolite?) crystals are observed as cavity-filling minerals.

Plane polarized light

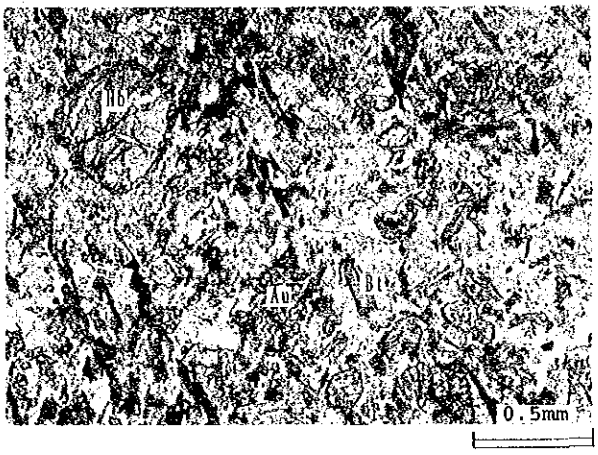
Crossed polarized light

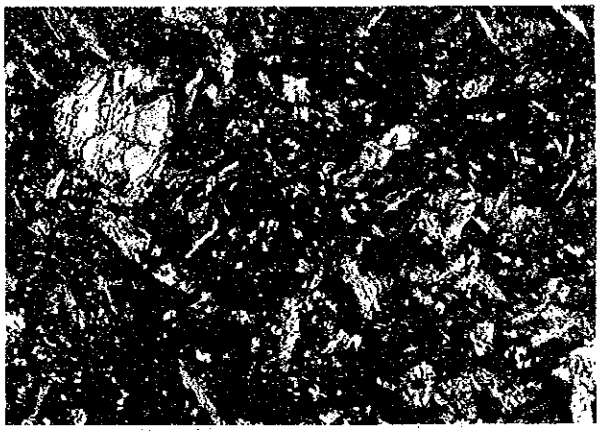
(37)





(38)





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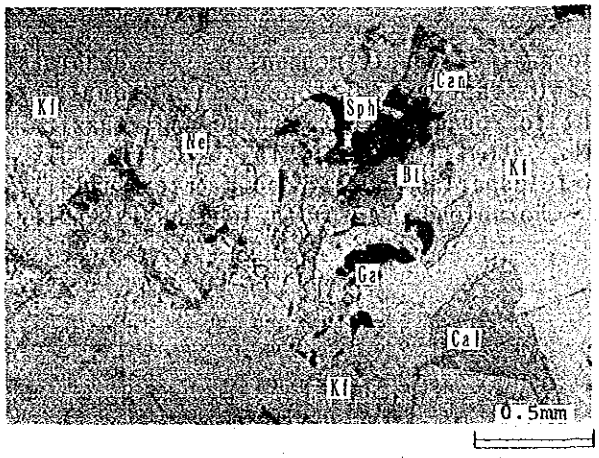

(40)