PETROGRAPHIC AND MINERALOGICAL STUDY OF ROCKS FROM THE GOLDLUND DEPOSIT IN NORTHERN ONTARIO, CANADA

Prepared For:

TAMAKA GOLD CORPORATION

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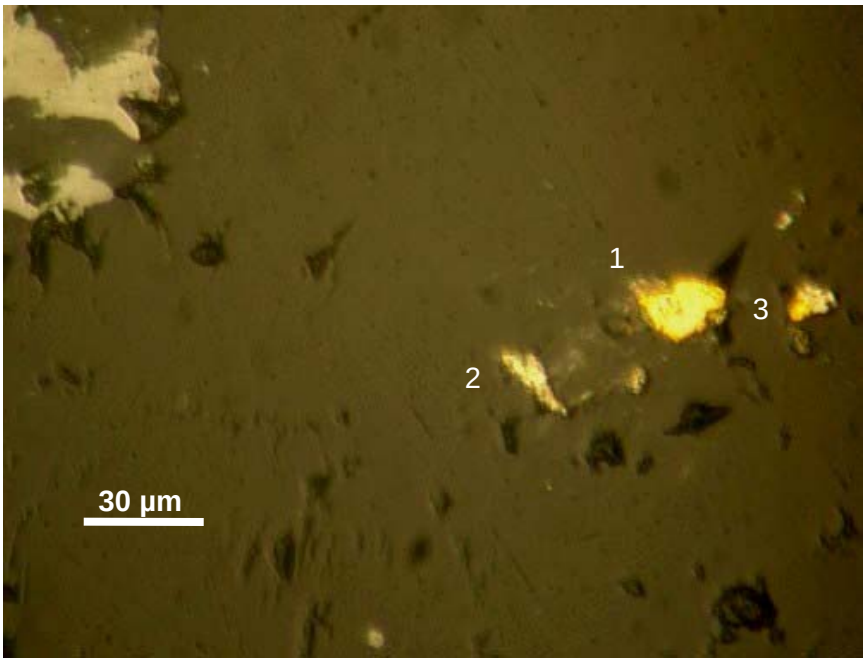
I1589316. Gold (1), Bi-telluride (2), and intergrowth of gold+Bi-telluride (3). Reflected light.



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ABSTRACT

The suite of mineralized rocks from the Goldlund Deposit in Northern Ontario represent a variety of lithologies, consisting predominantly of felsic intrusive rocks, lesser andesite and diorite. Several of the felsic rocks are pervasively albitized and they were converted into 'albitite' - also known as 'albite-quartz rock.'

Gold and Bi-telluride were identified in one of the sheared and recrystallized albitites (sample I589316), where both minerals occur as single grains and as an intergrowth of Au and Bi-Te. The minute grains are included in recrystallized aggregates of fine-grained quartz and albite.

The rocks show evidence of shearing, brecciation, deformation, hydrothermal alteration and recrystallization. Hydrothermal alteration includes silicification, pervasive albitization, carbonate, biotite, minor sericite and chlorite alteration. The secondary quartz, most of the albite and carbonate pre-dated shearing and deformation.

Sulfide mineralogy of the present suite of rocks is relatively simple; pyrite and pyrrhotite are the dominant sulfides, both of which are rimmed and post-dated by chalcopyrite. The texture of pyrite poikiloblasts, which contain inclusions of albite, quartz and carbonate suggests that most of these sulfides post-dated the major hydrothermal events (silicification, albite and carbonate alteration), as well as shearing and deformation.

INTRODUCTION AND OBJECTIVES

A suite of 31 polished and covered thin sections were prepared for petrographic and mineralogical study from samples collected from the Goldlund deposit.

The objectives of the study were:

1. To identify the rock types
2. To describe the mineralogy and texture of individual samples
3. To identify all sulfide minerals and precious metals (if present)
4. To identify the mineral(s) associated with high gold values, and
5. To determine if there is a specific alteration halo or specific sulfides associated with mineralization.

Analytical Techniques

The thin sections were examined under a Nikon petrographic microscope using reflected and transmitted lights in order to identify the silicates, carbonates, oxides, sulfides and gold-bearing minerals. 2-6 photomicrographs were obtained from each thin section using a Leica cooled digital camera attached to the microscope.

Chemical analysis was obtained by an ETEC electron microprobe on selected minerals in order to determine the composition of gold and gold-bearing minerals. Other minerals analyzed included carbonates, ilmenite, magnetite and albite.

Whole rock analysis of the 31 samples (provided by Fladgate Exploration) is shown in Appendix 1..

DISCUSSION

Lithology

The protolith of the altered rocks were identified on the basis of mineralogy and texture, and observations were correlated with chemical data provided by Fladgate Exploration. Immobile trace elements such as Zr, Y, Cr, Sc and some major elements, such as Al2O3 & TiO2 are useful in distinguishing between altered felsic and mafic rocks. Table 1 is a summary of rock types identified within the suite of 31 samples.

Table 1. Summary of rock types

Sample No.	Rock Type
I589313	felsic intrusive
I589314	albitite
I589315	felsic intrusive
I589316	albitite
I589317	felsic intrusive
I589318	andesite + vein
I589319	dacite?
I589320	albitite
589321	albitite
I589322	graphic granite
I589323	andesite
I589324	albitite
I589325	diorite
I589326	hornblende basaltic andesite
I589327	feldspar porphyry
I589328	felsic intrusive
I589329	felsic intrusive
I589330	graphic granite
I589331	quartz diorite?
I589332	?
I589333	quartz diorite?
I589334	albitite
I589335	albitite
I589336	felsic intrusive
I589337	?

Sample No.	Rock Type
I589338	andesite
I589339	quartz diorite?
I589340	felsic intrusive
I589341	albitite
I589342	graphic granite?
I589343	feldspar-quartz porphyry

The term 'albitite' is used where the rock consists of >40 % albite and >70 % albite+quartz. Such 'albite+quartz' rocks are often found at mesothermal gold deposits. The origin of these rocks is uncertain, but textural evidence suggests that the albite is formed by hydrothermal processes and pre-dated shearing, deformation and granulation in the rocks. However, not all albitized rocks were affected by the above.

The term 'graphic granite' is used where the rock contains a large proportion of micro-granophyre. The granophyre may be of igneous origin, but it could have also formed during contact metamorphism.

In this report, the term 'felsic intrusive' is based on texture (grain size) and the relative paucity of mafic minerals. Another factor taken into consideration was geochemistry, notably Zr, Y, and Al2O3 concentrations and the REE patterns.

Rocks named 'andesite' in Table 1 have relatively high chlorite / biotite and carbonate contents and higher TiO2 & Sc concentrations than the felsic intrusives. Sample I589326, a porphyritic hornblende-rich basaltic andesite has slightly different chemistry than the other andesites (high Cr, Ni & Sc), it is more sulfide-rich and less pervasively altered.

Mineralogy and Texture

The mineralogy and texture of individual rocks are described in detail in the "Petrography" section and salient features are demonstrated by photomicrographs. Visual estimation of % minerals in the samples is presented in Table 2 and results of microprobe analyses in Table 3.

Several of the rocks show evidence of shearing, deformation, granulation and recrystallization. In some thin sections the plagioclase are flattened and deformed and in most felsic rocks the relict phenocrysts are fragmented, partly recrystallized and have sutured, embayed grain boundaries.

The albite

Secondary albite is a common replacement in most rocks, particularly in the 'Albitite' where they occur in radiating aggregates, as chessboard albite and as replacement after plagioclase phenocrysts and less commonly, quartz. Most albite show

evidence of shearing and deformation, which suggest that their crystallization pre-dated the major tectonic event in the area.

The quartz

Silicification is apparent in some rocks and secondary quartz occurs as fine-grained aggregates interstitial to the matrix, and as veins. Most quartz are partly granulated, partly recrystallized and some form granoblastic aggregates. 'Blebby' texture of fine-grained quartz is common in the albitized rocks. Where quartz veins are present, the vein quartz have sutured and embayed grain boundaries, suggesting disequilibrium.

The carbonate

Carbonate occurs mostly as replacement and less commonly as veins. Where veins are present, they are often discontinuous and represent two generations. Carbonate alteration ranges from weak to extensive. Extensive carbonate replacement is common in the more mafic rocks (andesite and diorite), although some of the felsic intrusives are variably carbonatized.

The composition of carbonates is mostly ankerite and ferroan dolomite, but some rocks also contain calcite. The few carbonates analyzed by electron microprobe contain up to 1.7 wt% SrO.

The micas

Biotite occurs in fine-grained aggregates and they form sinuous veins in the fractured rocks. This would suggest that much of the biotite alteration post-dated fracturing and deformation in the rocks.

Sericite alteration is limited to where fine-grained sericite forms small veins or occurs as aggregates interstitial to quartz and feldspars.

The chlorite

With a few exceptions, most chlorite alteration is limited to the andesites. The relatively coarse-grained chlorite occurs in veins which often contain carbonate porphyoblasts. The chlorite veins wrap-around the carbonates, suggesting that chlorite post-dated the carbonates

The sulfides

The most abundant sulfide in the suite of 31 rocks is pyrite. Pyrite often occurs as poikiloblasts which contain one or all of the following inclusions; albite, quartz, biotite and carbonate. This would suggest that much of the pyrite post-dated albitization, sericite, biotite and carbonate alteration.

Other sulfides identified in the rocks are pyrrhotite and chalcopyrite. Pyrrhotite was more or less contemporaneous with pyrite, and much of the chalcopyrite post-dated both sulfides.

Magnetite and ilmenite

Both minerals occur as a primary and a secondary phase. In some rocks, the ilmenite was replaced by fine-grained rutile. In the gold-bearing albitite (I589316), large ilmenite grains were completely replaced by fine-grained rutile.

Mineralization

One small grain (ca. 30 µm) of **gold,** a **Bi-telluride (Ruckledgeite)** and one minute grain that consists of an intergrowth of **gold and Bi-telluride**, were identified in a recrystallized quartz-rich domain of sample I589316. The intergrowth of gold with bismuth telluride suggests their contemporaneous crystallization. Recrystallized and granulated quartz intergrown with albite is host to the gold and the Bi-telluride.

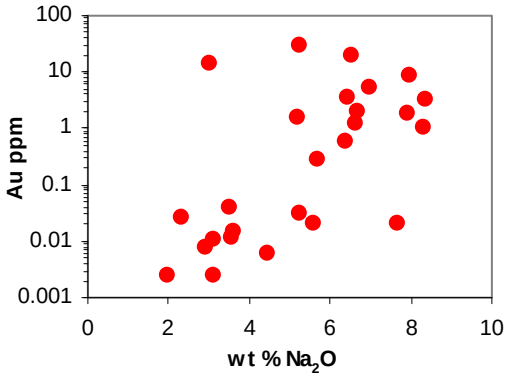
Geochemistry

Geochemistry (Appendix 1), combined with mineralogy and texture suggest that among the suite of 31 altered rocks twenty-one were derived from highly fractionated felsic intrusives and two from a feldspar porphyry. The high Zr, Y concentrations, coupled with high, flat REE pattern and small –ve Eu anomaly in the 21 rocks are consistent with fractionated felsic rocks. Figures 1a-c show a remarkable similarity in REE patterns between rocks described in the text as albitite, quartz diorite, graphic granite and felsic intrusives, suggesting a common protolith. One exception is a less fractionated albitite, I589324 (Fig. 1b). That particular albitite has a REE pattern, (and Zr, Y concentrations) similar to those of the two feldspar porphyries in Figure 2d, and the rock contains 8.4 ppm Au.

The two feldspar porphyries (Fig. 1d) have distinctly different geochemistry from the other felsic intrusive rocks. They are characterized by low Zr, Y and REE concentrations, steep REE patterns and lack of Eu anomaly, all of which suggest that these rocks are less fractionated than the other intrusives shown in Figures 1a, b & c. One of the porphyries is mineralized and it contains 5 ppm Au (Appendix 1).

Figure 2 demonstrates a positive trend between gold and Na2O concentration in the felsic rocks. This would suggest that sodium metasomatism (albitization) was either contemporaneous with gold mineralization, or the highly fractured, albitized rocks served as a channelway to mineralizing solutions.

Figure 2.



The three andesites (Fig. 1e) are distinguished from the felsic intrusive rocks by significantly lower Zr & Y and higher TiO2 concentrations, lower overall REE patterns and a lack of –ve Eu anomaly. Sample !589326 is a porphyritic (hornblende-rich) basaltic andesite, it has low Zr, Y and high TiO2 and Cr concentrations. The anomalously low Tb is most likely the manifestation of an analytical problem as Tb needs a longer 'cooling' time after irradiation than some other REE.

The "Tb problem" is also apparent in Figure 1f where the Tb in the two diorites of different LREE concentrations converge at the same point. And the anomalously low Nd in the highly mineralized sample, I589325 (Au=14 ppm) is due to its low concentration in the rock as the overall geochemistry is significantly diluted by quartz veins (see "Petrography" section).

SUMMARY

1. The suite of 31 samples from the Goldlund Deposit consist of albitized felsic intrusive rocks, andesite and diorite. The felsic intrusives dominate.

2. The rocks are pervasively albitized, partly silicified, biotitized, chloritized, and variably carbonatized.

3. Brecciation, shearing, deformation, granulation and recrystallization of the rocks are characteristic and they post-dated albitization.

4. Gold and accompanying Bi-telluride were identified in an albitite within a recrystallized quartz grain intergrown with albite.

5. Most sulfides in the present suite of rocks post-dated silicification, albitization, carbonate alteration, shearing, deformation and recrystallization.

6. The affinity of gold with increasing Na_2O in the rocks (Fig. 1) suggests a temporal and/or spatial relationship between albitization and gold mineralization.

7. Additional petrography on mineralized rocks would be useful in investigating the relationship between gold, tellurides sufides and gangue minerals.

Table 2. Visual estimation of % minerals in rocks from the Goldlund deposit

Sample Number Rock Type	I589313 felsic int	I589314 albitite	I589315 felsic int.	I589316 albitite.	I589317 felsic int.	I589318 andesite	I589318 vein	I589319 dacite	I589320 albitite
				GOLD					
Quartz	40	30	40	30	45	x	40	50	40
Plagioclase	24	10	24		38	60		20	
Spherulite								20	
Granophyre			12						
Albite	.	45		58					55
K-feldspar									
Muscovite / sericite	3		5					2	
Biotite	6	x	8		x				x
Chlorite	7	1	3	x	2	12	25	5	x
Carbonate	15	5	x	x	6	3	30	x	1
Amphibole						15			
Epidote						x			
Tourmaline	x		x						
Zircon	x	x	x	x	x				
Apatite	x	x	x	x	x			x	x
Rutile		0.5		2					x
Titanite									
Magnetite	1		2	x	2	10		3	1
Ilmenite	0.5	1	1		2				
Pyrite		8	5	10	5		3.5	x	3
Pyrrhotite	3								
Chalcopyrite			x		x		1.5		
All opaques									
Bi-telluride				**x**					

x=trace amount, felsic int.=felsic intrusive, hbl=hornblende, bas=basaltic, qtx=quartz, fldsp=feldspar

Table 2. Visual estimation of % minerals in rocks from the Goldlund deposit

Sample Number Rock Type	I589321 albitite	I589322 graphic granite	I589323 andesite	I589324 albitite	I589325 diorite	I589326 hbl bas andesite	I589327 feldspar porphyry	I589328 felsic int	I589329 felsic int.
Quartz	40	20	22	10	2	20	35	24	34
Plagioclase		22	x	10	48	17	42	7	37
Spherulite									
Granophyre		20							
Albite	55	20		66				25	
K-feldspar							3		
Muscovite / sericite		5	x		x	x	x	2	6
Biotite		0.5	5	8	20		2		
Chlorite		1.5	43	x	x		x	2	10
Carbonate	1	5	22	3	20	4	15	20	6
Amphibole						38			
Epidote		x	3			8			
Tourmaline								x	
Zircon				x				x	
Apatite	x	x	x	x	x	x	x	x	x
Rutile	x	x					x	0.2	
Titanite						x			
Magnetite	1			0.5	3	3		0.3	4
Ilmenite				0.5		2			
Pyrite	3			2	4	x	3	18	3
Pyrrhotite					3	6		x	
Chalcopyrite					x	2			x
All opaques		6	5						
Bi-telluride									

Table 2. Visual estimation of % minerals in rocks from the Goldlund deposit

Sample Number Rock Type	I589330 graphic granite?	I589331 quartz diorite?	I589332 ?	I589333 qz diorite	I589334 albitite	I589335 albitite	I589336 felsic int.
Quartz	12	15	40	40	47	10	45
Plagioclase	43	50	26	40		5	35
Spherulite							
Granophyre	30	2					
Albite		10			40	75	
K-feldspar							
Muscovite / sericite	2		5		x		4
Biotite		2	5	5			
Chlorite	8	10	10	6	x	x	8
Carbonate	3	3	8		8	5	5
Amphibole							
Epidote	x			x			
Tourmaline	x			6			x
Zircon	x					x	
Apatite	x	x	x	x		x	x
Rutile		x	x	x	x		x
Titanite							
Magnetite					x		
Ilmenite						3	
Pyrite					3	0.5	
Pyrrhotite					2	1.5	
Chalcopyrite							
All opaques	2	8	6	3			3
Bi-telluride							

Table 2. Visual estimation of % minerals in rocks from the Goldlund deposit

Sample Number Rock Type	I589337 ?	I589338 andesite	I589339 qtz diorite?	I589340 felsic int.	I589341 albitite	I589342 graphic granite?	I589343 fldsp-qtz porphyry
Quartz	42	25	32	15	20	10	34
Plagioclase	22	20	45	35			45
Spherulite							
Granophyre						30	
Albite					70	55	
K-feldspar							
Muscovite / sericite			x	x	x	x	5
Biotite	25	10	12				10
Chlorite	3	10	3	5	x	3	
Carbonate	8	35	8	38	3	x	6
Amphibole							
Epidote							
Tourmaline	x						
Zircon							
Apatite	x		x	x	x	x	x
Rutile	x	x	x	x		x	x
Titanite							
Magnetite				1	1		
Ilmenite				1	1		
Pyrite				5	5		
Pyrrhotite							
Chalcopyrite							
All opaques	x	x	x			2	x
Bi-telluride							

Table 3. Microprobe analysis of selected minerals

```
I589316 chlorite
ZAF cycles  6    bc drift=1.019
       fac    %el     %ox   stfm
SiO2   .60  14.66   31.36  5.824
Al2O3  .55  12.16   22.97  5.029
MgO    .55  13.79   22.87  6.332
FeO    .85  12.38   15.93  2.475
Total       52.99   93.13 28

I589316 large gold
ZAF cycles 10    bc drift=1.101
       fac    %el    stfm
Au     .99  95.68   .136
Ag     .73   4.63   .012
Total      100.30 28

I589316 small gold
ZAF cycles  5    bc drift=1.147
       fac    %el    stfm
Au     .94  88.58   .126
Ag     .70   3.72   .010
Total       92.29 28

I589316 small Bi Telluride
ZAF cycles  7    bc drift=1.167
       fac    %el     %ox   stfm
Bi2O3  .86  46.67   52.02  5.001
TeO3   .77  38.94   53.59  6.834
Total       85.60  105.61 28

I589316 Bi Telluride with gold
ZAF cycles  6    bc drift=1.195
       fac    %el     %ox   stfm
Bi2O3  .84  39.67   44.23  1.726
TeO3   .78  44.03   60.60  3.137
Total       83.70  104.82 12

I589316 large gold - rim
ZAF cycles  8    bc drift= .936
       fac    %el    stfm
Au     .98  94.29   .057
Ag     .72   5.04   .006
Total       99.33 12

I589316 albite
ZAF cycles  7    bc drift= .998
       fac    %el     %ox   stfm
SiO2   .71  32.12   68.72 12.006
Al2O3  .70  10.29   19.45  4.005
CaO    .83    .00     .00   .000
K2O    .82    .00     .00   .000
Na2O   .50   8.67   11.68  3.957
Total       51.08   99.85 32
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I589316 rutile
ZAF cycles  3    bc drift=1.027
       fac    %el     %ox   stfm
TiO2   .93  59.93   99.96 15.967
FeO    .84    .30     .39   .070
Total       60.23  100.35 32

I589316 apatite
ZAF cycles  4    bc drift=1.127
       fac    %el     %ox   stfm
CaO    .89  39.61   55.43 12.769
P2O5   .87  18.44   42.26  7.693
Total       58.06   97.69 32

I589316 chalcopyrite
ZAF cycles  5    bc drift=1.342
       fac    %el    stfm
Cu     .88  34.06   .994
Fe     .97  29.78   .989
S      .79  34.56  2.000
Total       98.40  2

I589316 rutile
ZAF cycles  3    bc drift=1.337
       fac    %el     %ox   stfm
TiO2   .93  59.53   99.30   .997
FeO    .84    .49     .64   .007
Total       60.03   99.93  2

I589316 ankerite
ZAF cycles  4    bc drift= .729
       fac    %el     %ox   stfm
CaO    .91  18.81   26.33  1.115
SrO    .75    .95    1.12   .026
MgO    .47   4.96    8.22   .484
FeO    .84   8.67   11.15   .368
MnO    .83    .16     .21   .007
Total       33.55   47.03  2

                          ********************
I589320 ankerite
ZAF cycles  4    bc drift= .845
       fac    %el     %ox   stfm
CaO    .91  20.97   29.34  1.141
SrO    .74    .89    1.05   .022
MgO    .48   5.83    9.67   .523
FeO    .84   7.90   10.16   .309
MnO    .82    .11     .14   .004
Total       35.70   50.37  2

 I589320 magnetite
ZAF cycles  3    bc drift= .957
       fac    %el     %ox   stfm
FeO    .94  73.40   94.42  2.000
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```
Total       73.40   94.42  2


I589320 albite
ZAF cycles  7    bc drift=1.049
       fac    %el     %ox   stfm
SiO2   .71  32.21   68.91 12.013
Al2O3  .70  10.29   19.44  3.995
Na2O   .50   8.45   11.39  3.850
K2O    .82    .00     .00   .000
CaO    .83    .20     .28   .053
Total       51.15  100.02 32

I589320 Fe dolomite
ZAF cycles  4    bc drift=1.163
       fac    %el     %ox   stfm
CaO    .91  24.93   34.89 20.970
SrO    .75    .33     .39   .127
MgO    .48   5.31    8.81  7.365
FeO    .83   5.70    7.33  3.441
MnO    .82    .16     .20   .097
Total       36.44   51.63 32

                          ********************

I589321 Ilmenite rim on Pyrite
ZAF cycles  4    bc drift=1.017
       fac    %el     %ox   stfm
FeO    .89  36.95   47.54   .994
TiO2   .97  31.99   53.36  1.003
Total       68.94  100.89  3

I589321 magnetite in pyrite
ZAF cycles  3    bc drift=1.255
       fac    %el     %ox   stfm
FeO    .94  72.37   93.10  3.000
Total       72.37   93.10  3

I589321 Fe dolomite
ZAF cycles  4    bc drift=1.479
       fac    %el     %ox   stfm
CaO    .91  20.05   28.06  1.488
SrO    .73    .67     .79   .023
MgO    .48   8.07   13.38   .987
FeO    .84   9.13   11.75   .486
MnO    .82    .30     .39   .016
Total       38.22   54.37  3

I589321 albite
ZAF cycles  7    bc drift=1.689
       fac    %el     %ox   stfm
SiO2   .70  31.95   68.35 11.958
Al2O3  .70  10.32   19.50  4.022
Na2O   .50   8.66   11.67  3.960
K2O    .82    .00     .00   .000
```

CaO	**.83**	**.26**	**.37**	**.069**
Total		**51.20**	**99.90**	**32**

I589324 albite
ZAF cycles 7 bc drift=1.282

	fac	%el	%ox	stfm
SiO2	.70	31.78	67.98	11.935
Al2O3	.70	10.33	19.51	4.038
Na2O	.50	8.82	11.89	4.048
CaO	.83	.18	.25	.047
K2O	.82	.00	.00	.000
Total		51.10	99.63	32

I589324 ilmenite
ZAF cycles 4 bc drift=1.120

	fac	%el	%ox	stfm
FeO	.89	36.20	46.57	.983
TiO2	.97	31.52	52.58	.998
MnO	.87	.74	.95	.020
Total		68.46	100.11	3

I589324 calcite
ZAF cycles 4 bc drift= .926

	fac	%el	%ox	stfm
CaO	.92	40.73	56.99	2.895
SrO	.80	1.07	1.27	.035
FeO	.82	.93	1.20	.047
MnO	.80	.44	.57	.023
Total		43.17	60.02	3

****

I589341 albite
ZAF cycles 7 bc drift=1.517

	fac	%el	%ox	stfm
SiO2	.71	31.68	67.78	11.807
Al2O3	.71	10.83	20.46	4.202
Na2O	.50	7.14	9.63	3.253
CaO	.83	1.74	2.43	.454
Total		51.40	100.31	32

I589341 calcite
ZAF cycles 4 bc drift= .806

	fac	%el	%ox	stfm
CaO	.92	38.72	54.18	30.349
SrO	.80	1.38	1.63	.493
FeO	.83	1.77	2.28	.998
MnO	.80	.28	.36	.159
Total		42.15	58.45	32

PETROGRAPHY
(with photomicrographs)

Ppl = Plane polarized light
XN = crossed nicols
Refl. light = Reflected light

Sample Number: I589313 **Rock Type: Felsic intrusive**

Petrographic Description:

The protolith of the rock was a felsic intrusive or fragmental derived from a felsic intrusive. Presently silicified, biotite and carbonate altered, deformation, shearing and granulation are also apparent. The rock consists predominantly of relict fragments of coarse-grained feldspars, quartz (as matrix, as clasts and veinlets), carbonate, sericite, biotite, and chlorite. Although the composition of feldspars cannot be determined due to the lack of well-defined twinning, they were originally more sodic than andesine (probably oligoclase). Zoning in plagioclase is absent.

The rock is weakly laminated, the fine-grained matrix is flattened and / or granulated, resulting in micro-mosaic texture of quartz in some domains and flattened, stretched quartz in other domains.

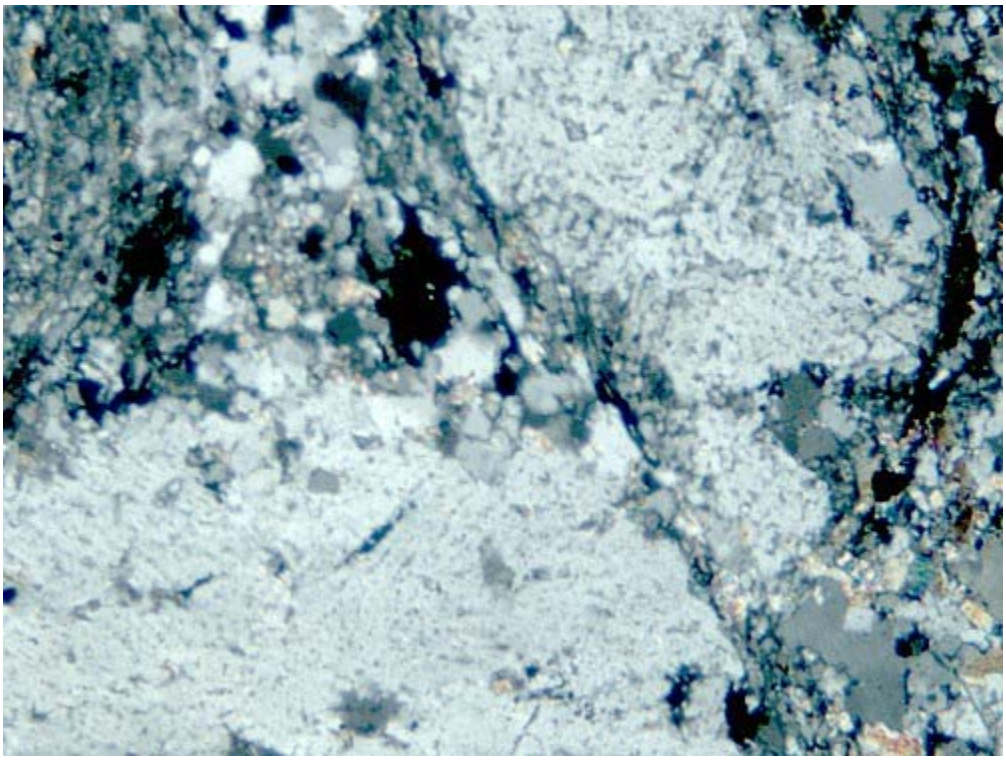
Pyrrhotite and biotite are aligned parallel to the rock fabric.

Detailed mineralogy

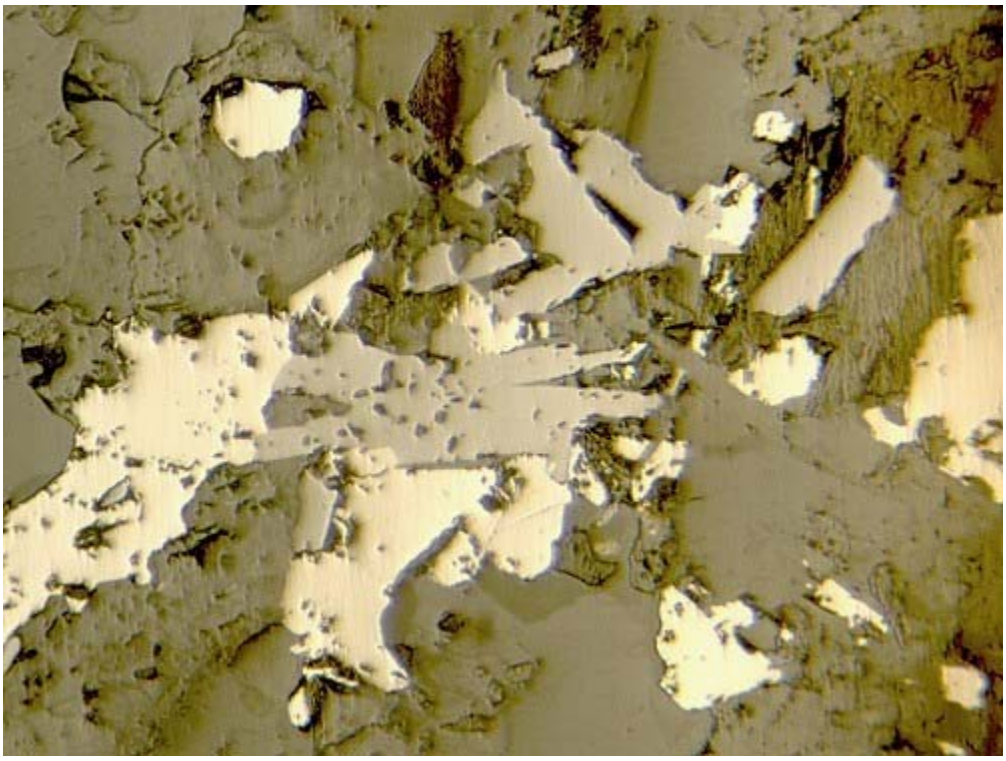
Mineral	%	Grain size(mm)	Comments
Quartz	40	<0.1-2.5	Anhedral, recrystallized, granulated and flattened quartz co-exists on the scale of the thin section. Most quartz show evidence of recrystallization, having sutured and embayed grain boundaries. Granulation produced locally microcrystalline matrix and deformation resulted in flattening of quartz. The feldspars are partly recrystallized to fine-grained quartz, whereas discontinuous quartz veins and aggregates suggest silicification.
Plagioclase	24	0.2-2.8	Large, corroded and partly recrystallized feldspars are randomly distributed and some occur in discontinuous parallel bands. Their composition is not possible to estimate.
Muscovite / sericite	3	av. 0.1	Fine-grained muscovite and sericite partly replaced some of the matrix.
Biotite	6	0.05-1.5	Anhedral, pleochroic brown biotite is interstitial to the quartz and the feldspars. Some occur in parallel bands that define

			the rock fabric. Some contain minute inclusions of zircon and allanite (with dark pleochroic halo). Most biotite are partly replaced by chlorite.
Chlorite	7		Aggregates of chlorite are interstitial to the quartz and feldspars. Replacement of biotite by chlorite along the cleavage traces is common.
Carbonate	15	variable up to 1.8	Anhedral carbonate is disseminated through the rock. The carbonates occur in aggregates that overgrow and partly replace some of the biotite and feldspars
Pyrrhotite	3	0.05-1.8	Aggregates of pyrrhotite are parallel to the rock fabric. Some of the anhedral grains are rimmed by secondary magnetite. Pyrrhotite is most abundant in the carbonate-altered domains.
Magnetite	1	av. 0.3	Fine-grained, anhedral magnetite are disseminated through the matrix. Some occur in aggregates.
Ilmenite	0.5	0.08-1.5	Clusters of elongate grains of ilmenite are disseminated through the matrix. Some are rimmed by pyrrhotite.

Accessory minerals: apatite, zircon, tourmaline



Two large grains of corroded relict plagioclase. X-axis of photo: 1.6mm. XN.



Ilmenite (grey) are rimmed by pyrrhotite. X-axis of photo: 0.64mm. Refl light.

Sample Number: I589314 **Rock Type: Albitite**

Petrographic Description:

An albite-rich rock with relatively simple mineralogy. The texture suggests that the original rock (most likely a felsic intrusive) was extensively albitized and albitization was associated with possible contact metamorphism. Contact metamorphism is suggested by the radiating and plumose texture of the albite and metasomatism by the pervasive replacement of the original mineralogy (quartz and feldspars) by secondary albite. Coarse-grained quartz also occurs as part of a vein. Other, volumetrically less important secondary mineral is carbonate, which over-prints and forms a rim on the albite. A fragmented and slightly deformed carbonate vein that cross-cuts the thin section contains fine-grained biotite and is over-printed by chlorite. Minor deformation in the rock apparently post-dated the carbonates and chlorite. Zircon has an overgrowth of possible hydrothermal origin.

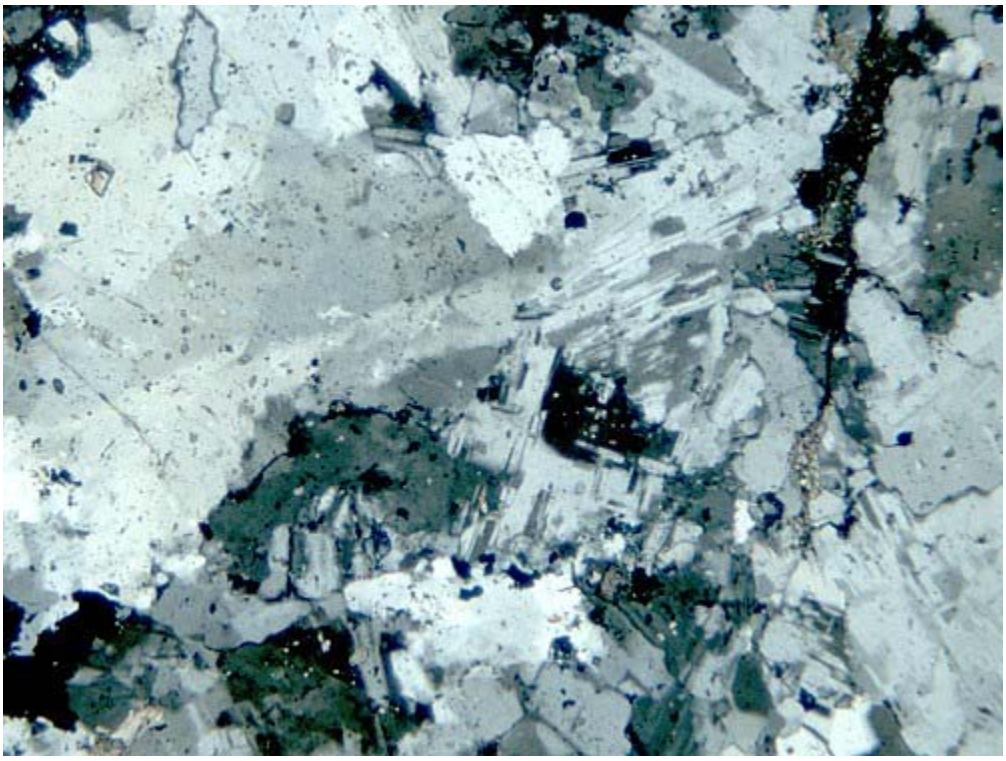
Anhedral pyrite poikiloblasts overgrow the albite and they contain inclusions of albite, whereas some of the carbonates form a rim on the pyrite. Fine-grained magnetite occurs in clusters and lath-shaped ilmenite are disseminated through the thin section. Fine-grained rutile and ilmenite are common in the carbonate vein.

Detailed mineralogy

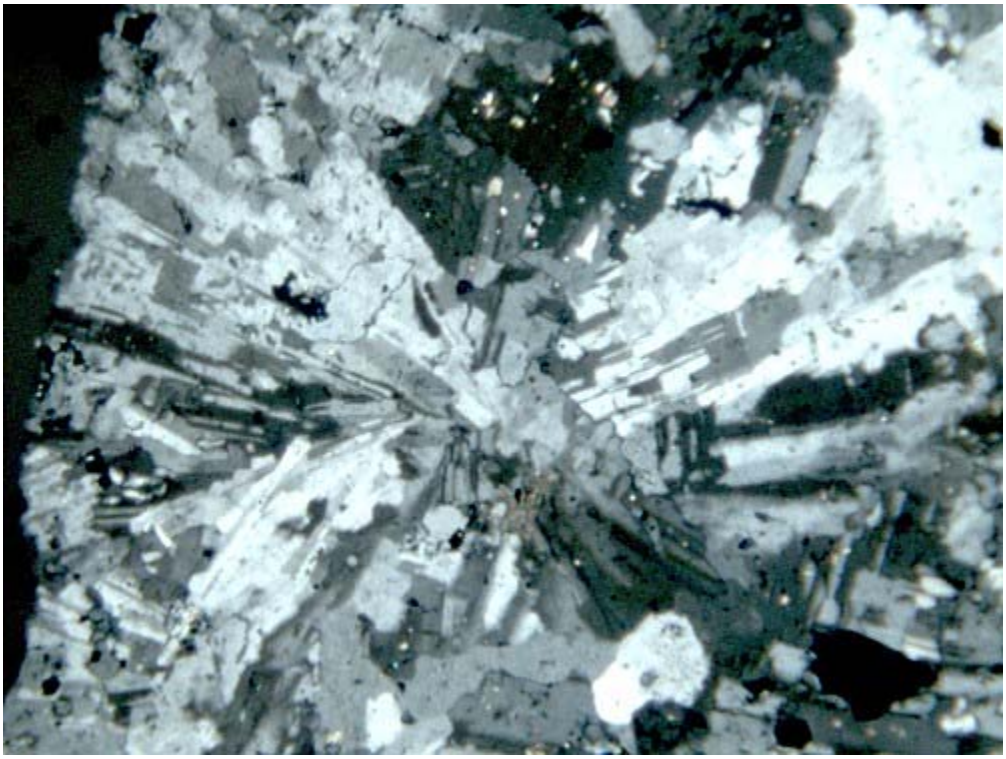
Mineral	%	Grain size(mm)	Comments
Plagioclase / albite	10 45	0.3-2.8	Albite and chessboard albite replaced almost completely the original feldspars in the rock. They occur as blocky aggregates, as radiating slender prisms and as long plumose grains. They are intergrown with quartz. The thin section contains a few coarse-grained, anhedral relict feldspars. They are partly replaced by secondary albite.
Quartz	30	0.2-6.0	Fine to coarse-grained quartz are interstitial to the albite. They occur as minute aggregates – some of which show evidence of granulation, as anhedral aggregates interstitial to the albite and as part of a coarse-grained vein. Some quartz are partly replaced by fine-grained aggregates of albite.
Carbonate	5	0.2-2.5	Anhedral carbonates form a rim on secondary albite and quartz. A fragmented

			and slightly granulated carbonate vein contains inclusions of ilmenite, rutile and biotite. Some biotite are replaced by chlorite, which also form a rim on the carbonates.
Chlorite	1		Chlorite is a local replacement after the biotite and some of the carbonates in the vein.
Pyrite	8	0.1-2.8	Anhedral pyrite occurs as large poikiloblasts that contain inclusions of albite. Other grains are disseminated through the rock.
Ilmenite	1	variable up to 2.2	Lath-shaped prisms of ilmenite occur mostly in clusters and some are included in the carbonate vein. A large, lath-shaped ilmenite is intergrown with pyrite.
Rutile	0.5	<0.1	Fine-grained rutile occur in clusters and as single grains throughout the thin section

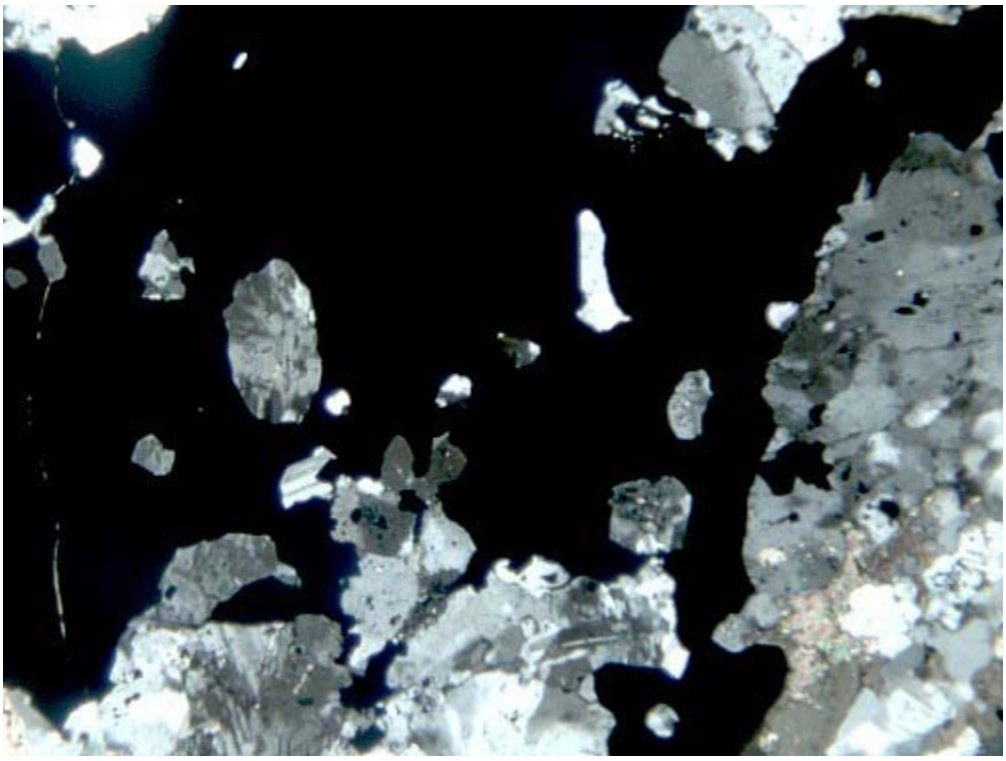
Accessory minerals: biotite, apatite, zircon



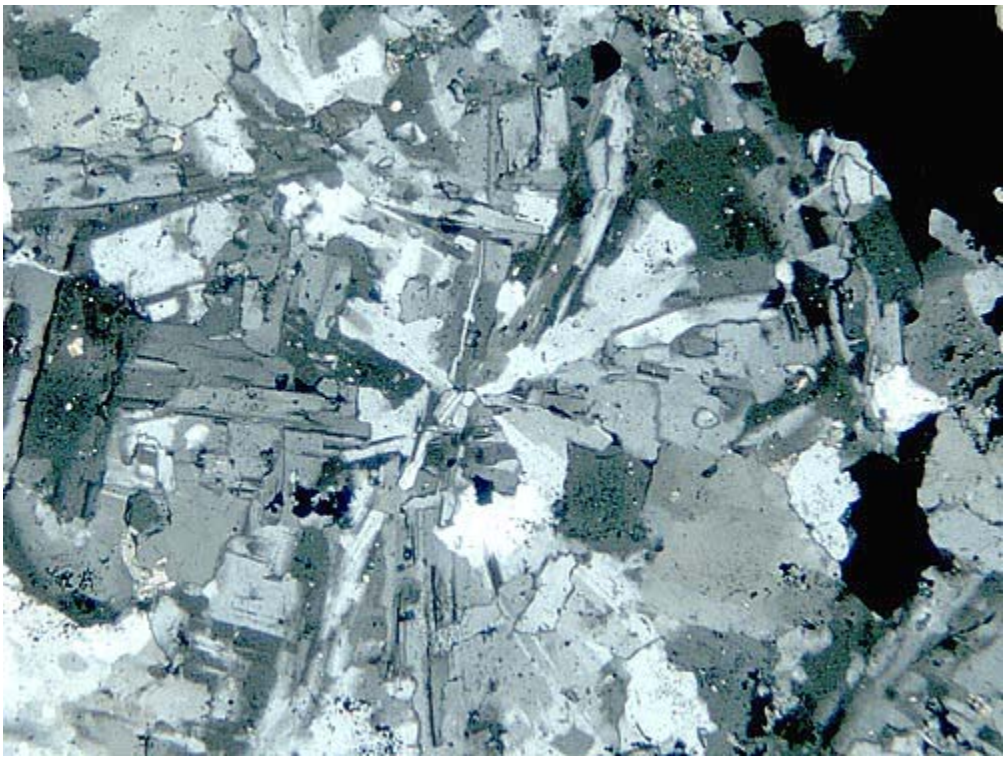
Coarse-grained relic plagioclase is albitized at the grain boundaries (narrow albite twinning. X-axis of photo: 1.6mm. XN.



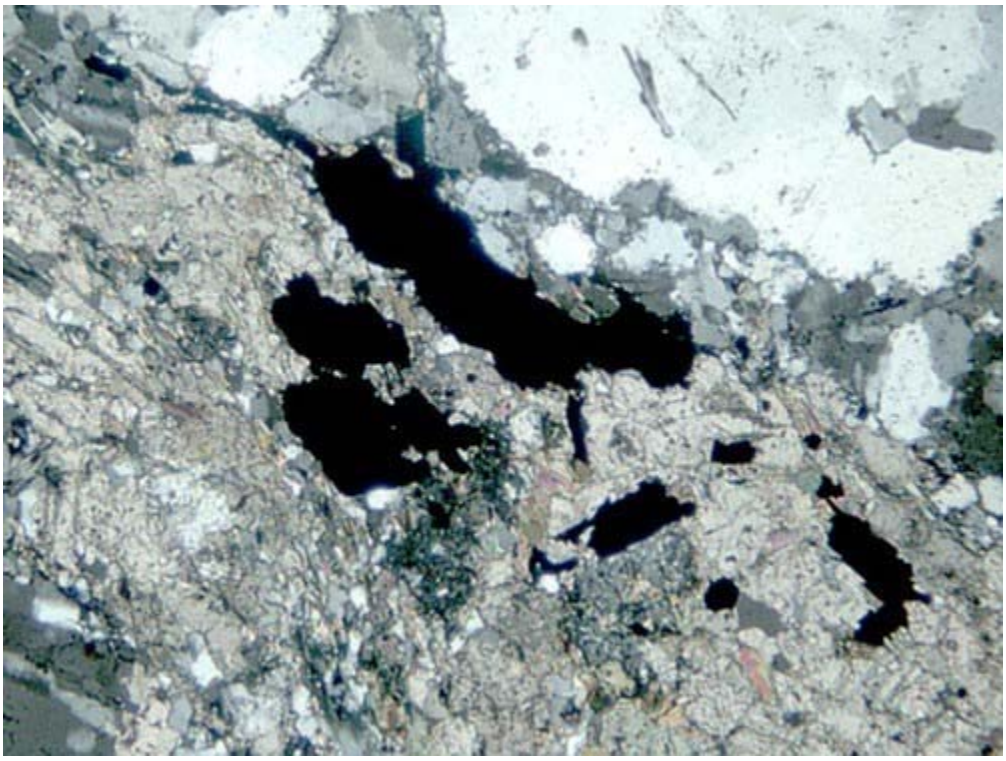
Radiating secondary albite. X-axis of photo: 1.6mm. XN.



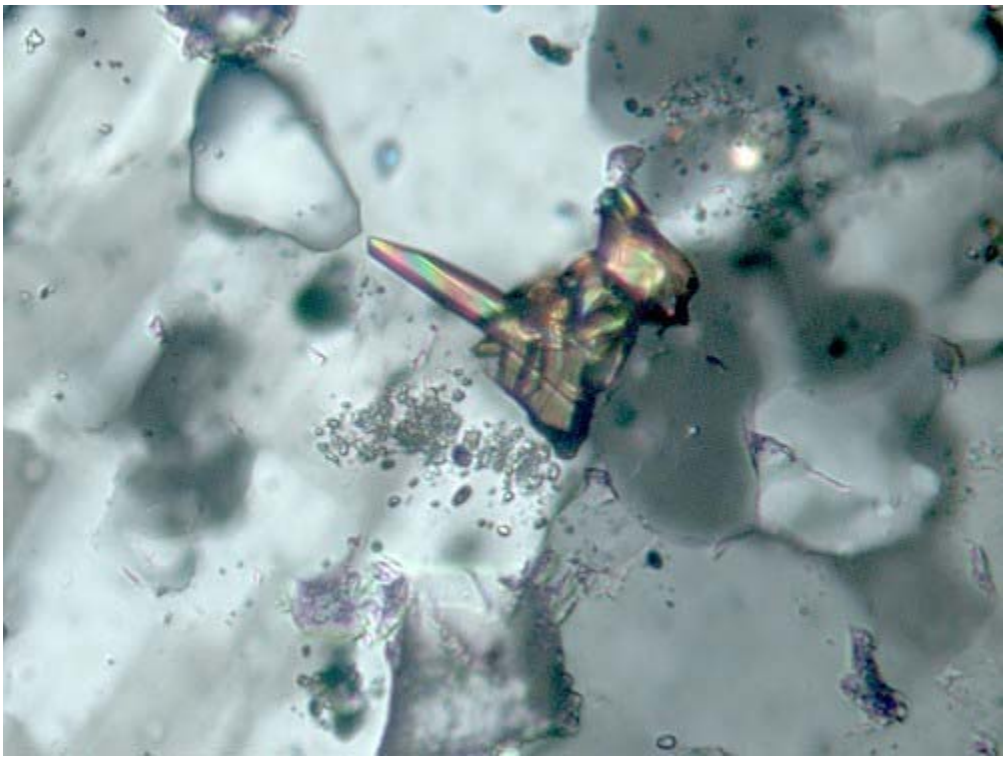
Pyrite poikiloblast (black) with small inclusions of albite. X-axis of photo: 1.6mm. XN.



Albitized rock. X-axis of photo: 1.6mm. XN.



Ilmenite (black) in carbonate vein. X-axis of photo: 1.6mm. XN.



Small aggregate of zircon (multi color, in center). X-axis of photo: 0.16mm. XN.

Sample Number: I589315 **Rock Type: Felsic intrusive**

Petrographic Description:

An extensively recystallized, fragmented and granulated granophyre-rich felsic intrusive rock. It has a chaotic texture. Although albite alteration is suggested by partial replacement of a few relict feldspar phenocrysts by fine-grained albite, on the whole, the rock is more granulated and fragmented than altered. Fine granophyre partly replaced some of the feldspars and some form a rim on the feldspars. This would suggest either a granophyre-rich protolith, or possibly contact metamorphism. The quartz and feldspars are partly recrystallized and partly granulated. Shearing, granulation and weak deformation resulted in development of a fabric which is defined by parallel veins of fine-grained biotite, sericite, and chlorite. A few grains of tourmaline occur in the sericite-rich domain. The biotite-rich veinlets contain an abundance of magnetite and ilmenite aggregates

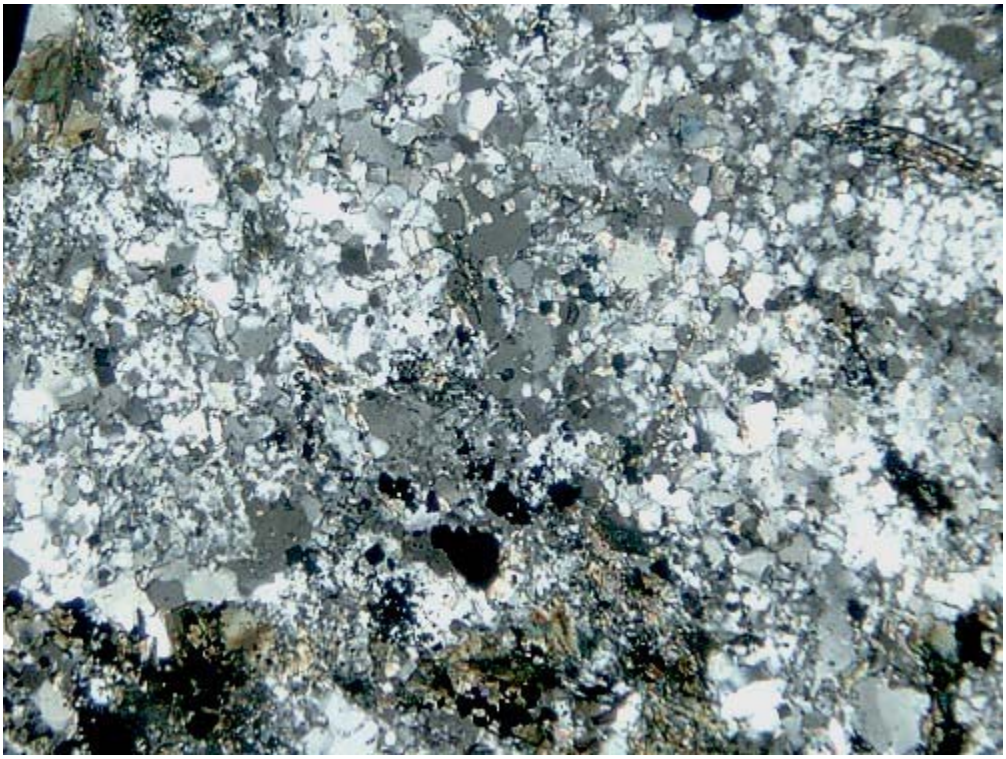
Subhedral / anhedral pyrite occur as blocky grains disseminated through the thin section. They are commonly associated with the fine-grained biotite/magnetite or sericite. Very fine-grained magnetite occurs within the biotite-chlorite veins and less commonly, within the sericite vein. Tourmaline prisms in some veins seem to have crystallized at the expense of muscovite and biotite.

Detailed mineralogy

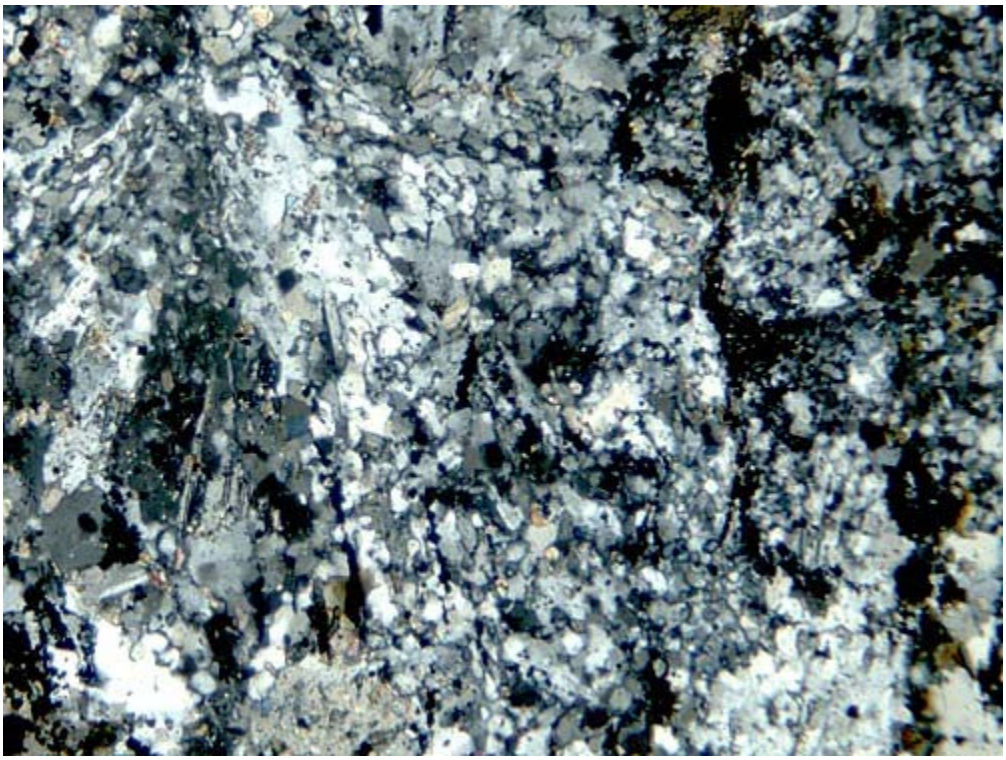
Mineral	%	Grain size(mm)	Comments
Plagioclase + albite	24	0.5-2.5	Large, corroded plagioclase are interstitial to the matrix. The relict grains are granulated and recrystallized along the grain boundaries.
Granophyre	12		Small aggregates of granophyre are interstitial to the feldspars and form a rim on the feldspars. Partial recrystallization resulted in ‘blebby’ texture.
Quartz	40	<0.1-2.0	Fine to medium-grained quartz is partly recrystallized and partly granulated,. Some are weakly stretched and deformed. The average quartz are angular and have sutured, embayed gain boundaries.
Biotite	8	av. 0.3	Fine-grained biotite mostly occurs in veins that contain an abundance of fine-grained magnetite. Some biotite are partly replaced by chlorite and some are

			interstitial to the recrystallized matrix.
Muscovite / sericite	5		A discontinuous sericite vein parallels the biotite+magnetite veinlets. Small stringers of sericite are interstitial to the granulated matrix feldspars and quartz.
Chlorite	3		Fine-grained chlorite partly replace d soma of the biotite. It also forms a rim on stringers of magnetite.
Pyrite	5	0.2-1.	Blocky, subhedral / anhedral pyrite are associated with the biotite, muscovite-rich veins. Some are poikiloblasts that contain minute inclusions of biotite and quartz.
Magnetite Ilmenite	2 1	<0.1-0.5	Fine-grained anhedral magnetite occur in aggregates within the biotite-chlorite and sericite veins. Clusters of magnetite and lesser ilmenite form vein-like segregation.

Accessory minerals: tourmaline, carbonate, apatite, chalcopyrite, zircon

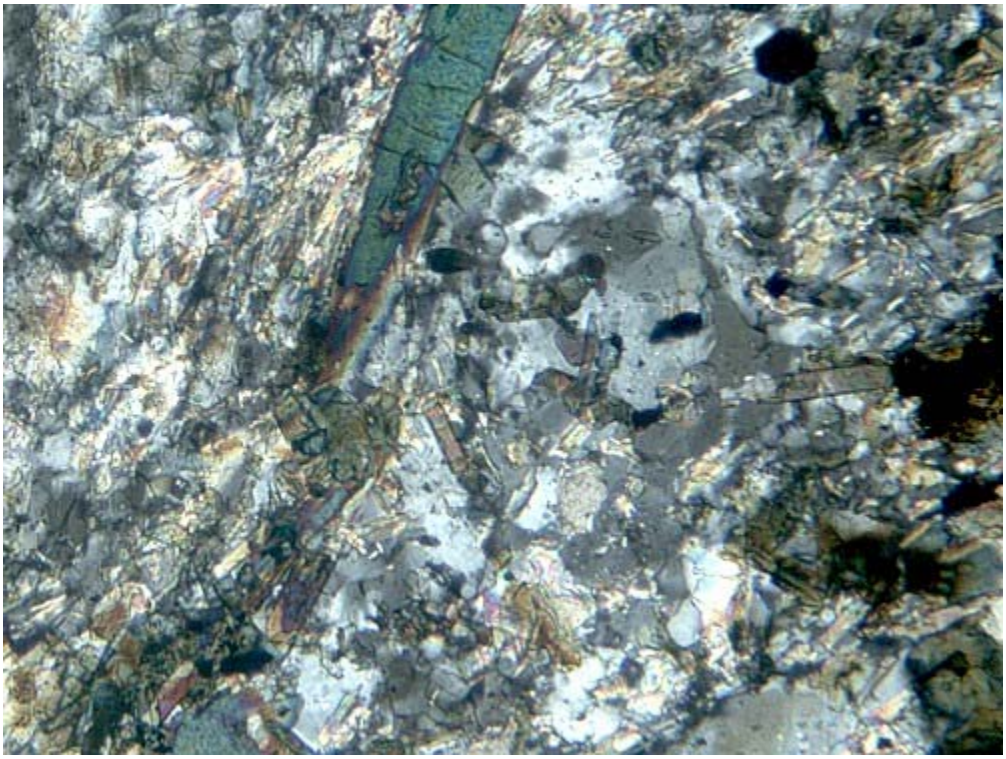


Granulated feldspars. X-axis of photo: 1.6mm. X.



Relict lath-shape of recrystallized feldspars. X-axis of photo: 1.6mm. XN.

Long mottled green tourmaline prisms and small tourmaline grains.
X-axis of photo: 1.6mm. Ppl.



As above, with crossed nicols

Sample Number: I589316 **Rock Type: Albitite (recrystallized)**

Petrographic Description:

An albitized felsic intrusive rock. The mineralogy is relatively simple. It consists predominantly of quartz, albite and pyrite. Just as the previous sample (1589315) its texture suggests granulation and partial recrystallization However, it does not contain appreciable amount of micas and magnetite. Relict fragments of feldspar phenocrysts are albitized and the albite are intercalated with fine-grained quartz. Minute veinlets of almost isotropic chlorite post-dated albitization.

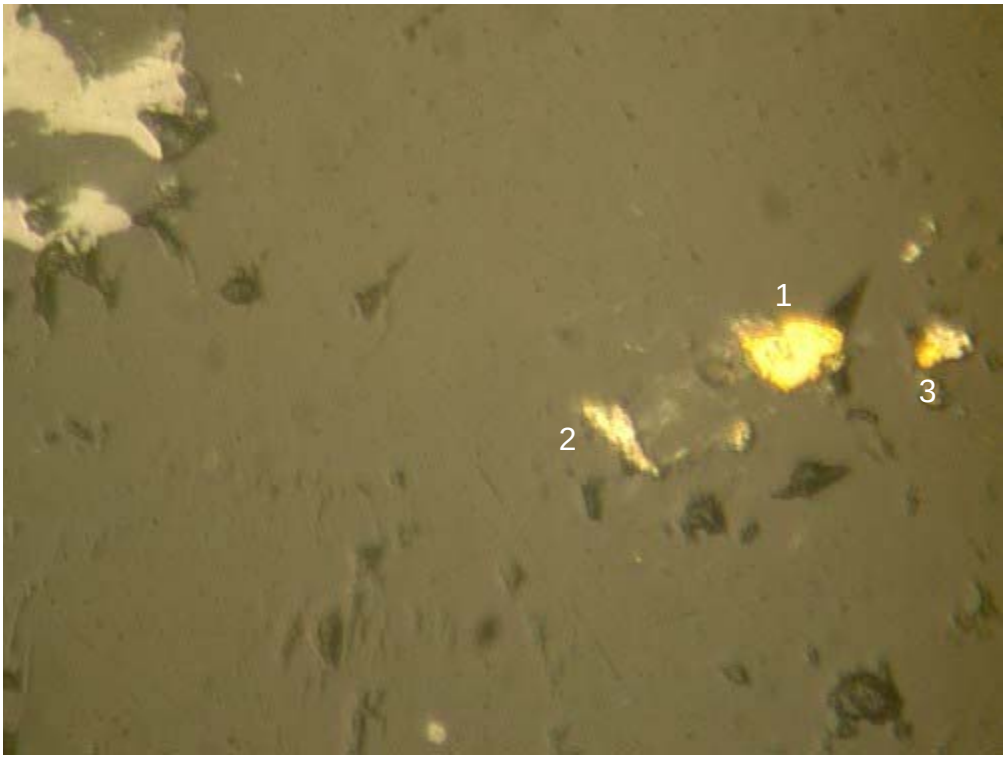
Relatively coarse-grained pyrite poikiloblasts over-grow the albite and quartz, suggesting that they were introduced to the already albitized rock. Fine-grained rutile occur in aggregates within the albite-rich domains.

One small grain (ca. 30 µm) of **gold,** a **Bi-telluride (Ruckledgeite)** and one minute grain that consists of an intergrowth of **gold and Bi-telluride**, were identified in a recrystallized quartz-rich domain. The intergrowth of gold with bismuth telluride suggests their contemporaneous crystallization The recrystallized host quartz is intercalated with recrystallized albite.

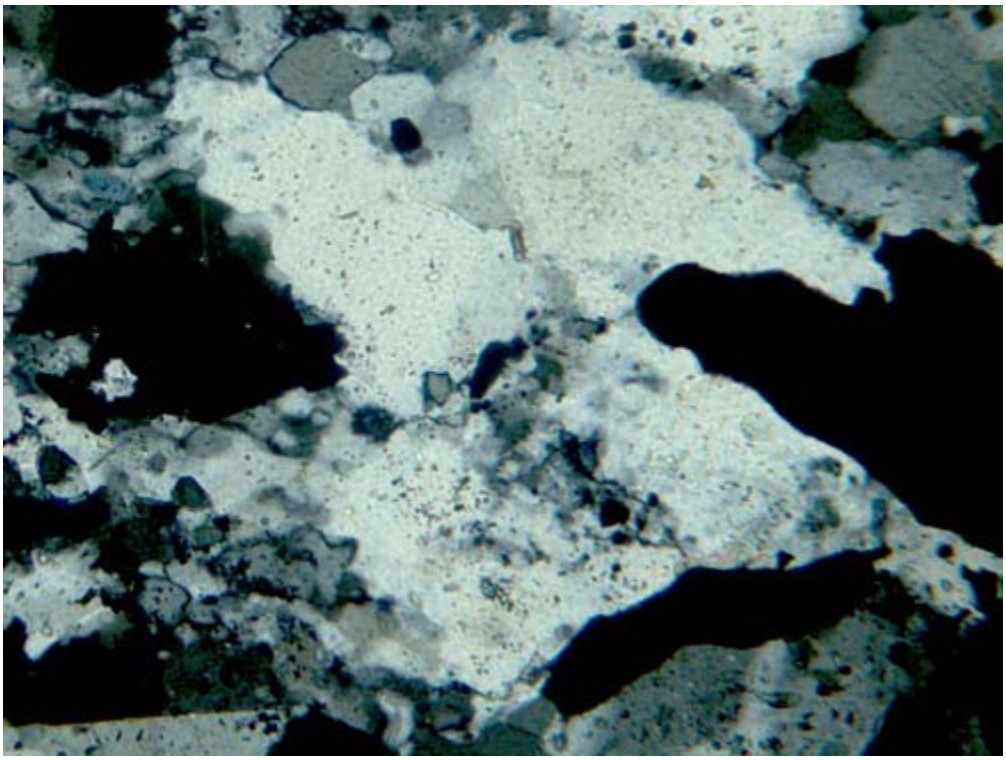
Detailed mineralogy

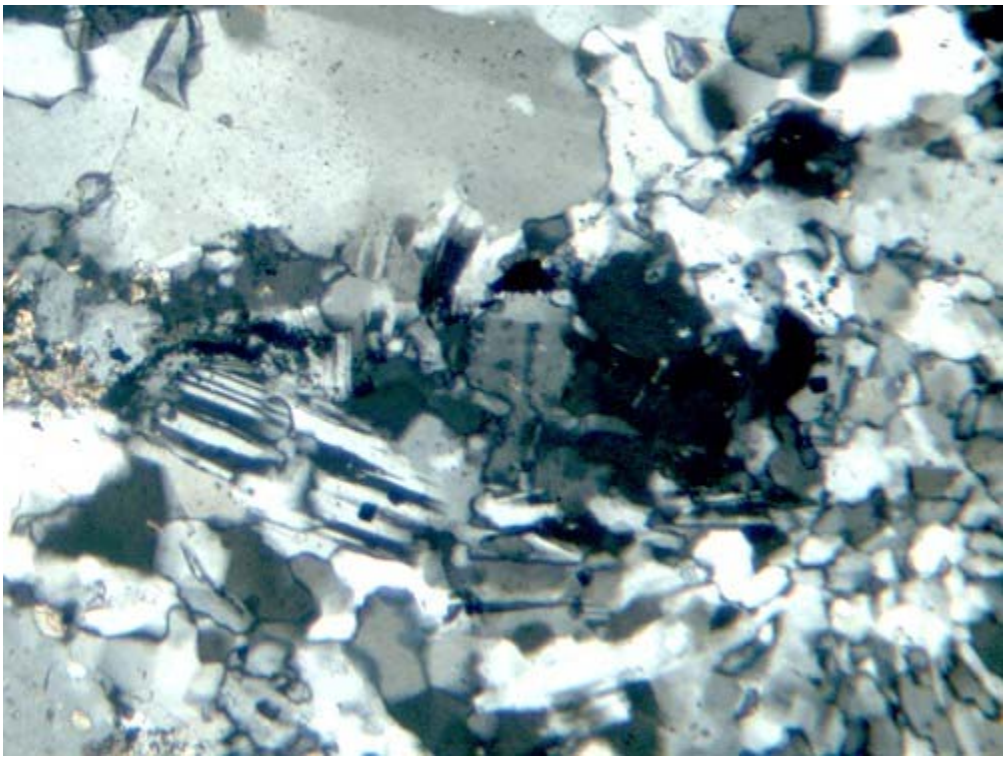
Mineral	%	Grain size(mm)	Comments
Albite	58	0.2-3.0	Fine to medium-grained albite is a secondary mineral. It partly replaced the original feldspars and some quartz The albite has ragged and sutured grain boundaries, suggesting disequilibrium.
Quartz	30	variable up to 2.5	Fine-grained, anhedral quartz is interstitial to the albite and most grains are intergrown with the albite. They have embayed and sutured grain boundaries. The gold and bismuth telluride are included in quartz.
Pyrite	10	0.5-2.8	Pyrite poikiloblasts represent late sulfidation, and the anhedral grains post-dated albitization and silicification.
Rutile	2		Fine-grained rutile occur in aggregates. they crystallized after ilmenite.

Accessory minerals: carbonate, chlorite, apatite, zircon, magnetite, **gold, bismuth telluride**

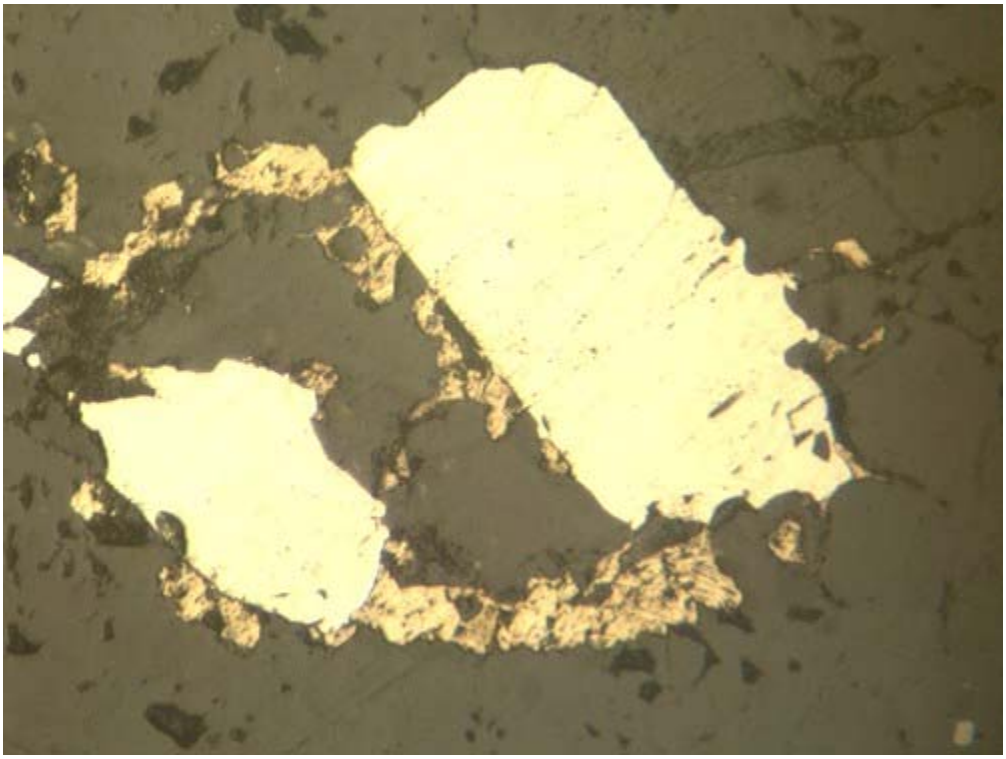


Small gold grain (1), Bi-telluride (2) and intergrowth of gold and Bi-telluride. X-axis of photo: 0.16mm. Refl. Light.


Partly recrystallized quartz that hosts the gold and the Bi-telluride above. X-axis of photo: 0.16mm. Refl. Light.



Albitized quartz. X-axis of photo 0.64mm. XN.



Fine-grained dk. yellow chalcopyrite rims pyrite. X-axis of photo: 0.64mm. Refl. Light.

Sample Number: I589317 **Rock Type: Felsic intrusive**

Petrographic Description:

An extensively altered, granulated and sheared rock. The protolith was a felsic intrusive, as is apparent from the relict fragments of coarse-grained feldspars in the matrix. Although there is some evidence of earlier albitization, the rock is over-printed by carbonate alteration, silicification, granulation, and deformation. Collectively, the original mineralogy, texture and early alteration were destroyed. Fragments of feldspars are granulated, sheared and partly recrystallized to fine-grained aggregates. Silicification is apparent from the presence of quartz aggregates, some of which have granoblastic texture. Carbonate and lesser chlorite veins cross-cut the rock. The chlorite veins weakly define the rock fabric and are intercalated with minor biotite and sericite and the carbonate veins are randomly oriented.

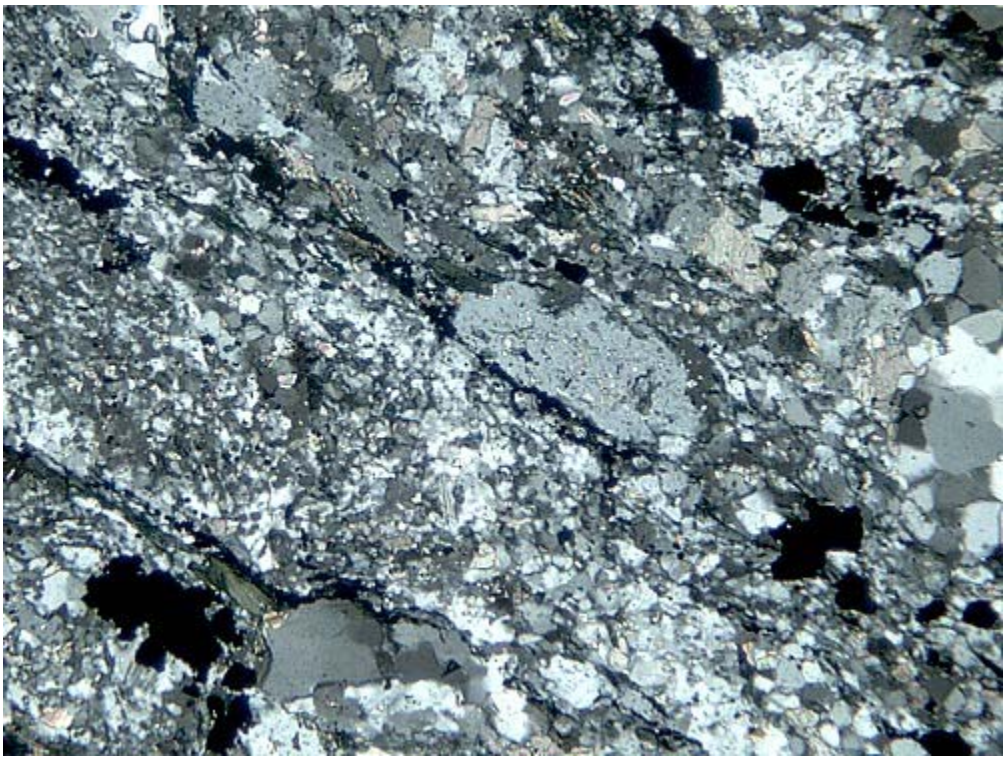
Late pyrite poikiloblasts over-grow the carbonates. Some pyrite contains small inclusions of carbonate and there is a strong spatial relationship between the carbonates and pyrite.

Detailed mineralogy

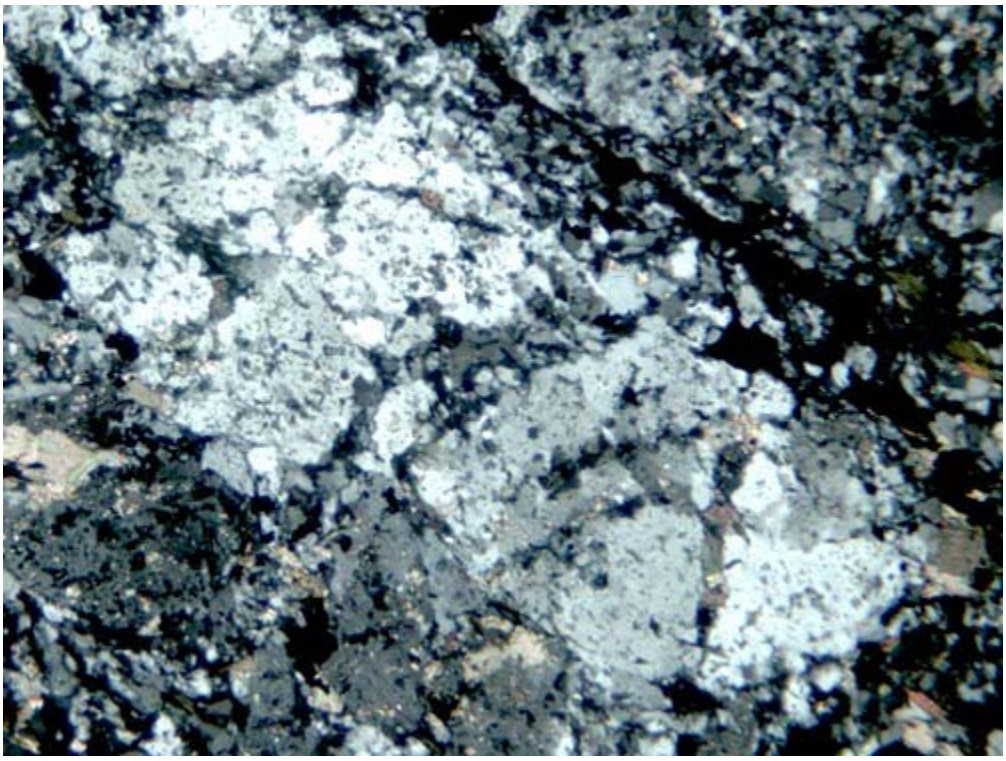
Mineral	%	Grain size(mm)	Comments
Quartz	45	minute-1.2	Granulated and recrystallized quartz makes up a significant part of the rock. Almost microcrystalline, they partly or completely replace some of the relict feldspar phenocrysts. Quartz also occurs as granoblastic aggregates and as veins where the individual grains have sutured and embayed grain boundaries.
Plagioclase / albite	38	0.5-2.5	Most plagioclase are fragmented and granulated and twinning was destroyed during the various metamorphic and metasomatic events, Two relict grains have oligoclase composition. Fine-grained secondary albite represents an early hydrothermal event, as the albite are partly granulated and recrystallized.
Carbonate	6	<0.1-2.0	Fine-grained anhedral carbonate is interstitial to the granulated quartz and feldspars. Late, randomly oriented carbonate veins cross-cut the thin section and contain a large number of subhedral /

			anhedral pyrite. Some are poikiloblasts that contain small inclusions of carbonate.
Chlorite	2		Fine-grained chlorite veinlets are interstitial to the granulated quartz and feldspars. They are intergrown with fine-grained secondary biotite and also contain aggregates of magnetite and ilmenite.
Pyrite	5	variable up to 1.0	Subhedral / anhedral blocky pyrite are relatively abundant and are generally associated with the carbonate-rich domains. They contain inclusions of carbonate, quartz and albite.
Magnetite / ilmenite	2 2	0.05-0.4	Fine-grained magnetite and ilmenite occur in aggregates in a vein-like arrangement. They are mostly associated with the chlorite-rich veins and stringers that weakly define the rock fabric..

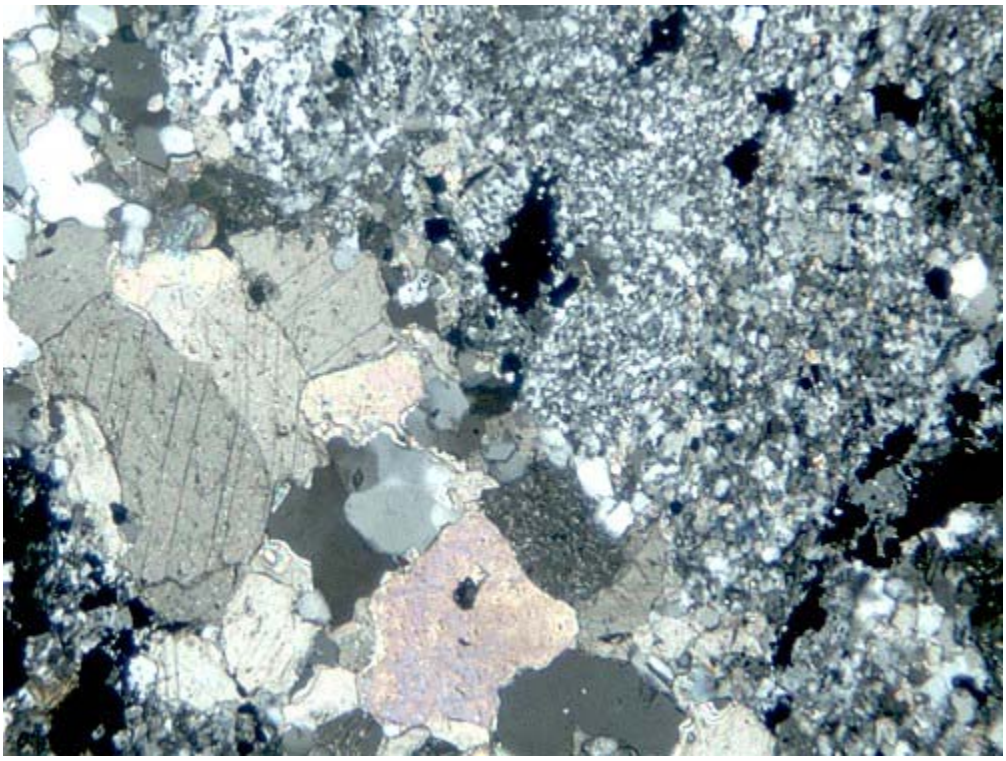
Accessory minerals: chalcopyrite, biotite, zircon, apatite



Silicified rock. X-axis of photo: 1.6mm. XN.



Fragmented large relict plagioclase. X-axis of photo: 1.6mm. XN.



Carbonate vein in siliceous matrix. X-axis of photo: 1.6mm. XN.

Sample Number: I589318 **Rock Type: Andesite + vein**

Petrographic Description:

The thin section consists of a fragment of andesite in contact with or intruded by a coarse-grained sulfide-rich quartz-carbonate-chlorite vein. The rock fragment consists of plagioclase of andesine composition (An_{34}), slender phenocrysts of amphibole and interstitial chlorite. It is slightly porphyritic and contains large phenocrysts and glomerocrysts of plagioclase. Partly chloritized, small chlorite-rich domains are interstitial to the feldspars and amphibole and some amphibole are replaced by chlorite. A few small carbonate veins are interstitial to the matrix. Anhedral, relatively coarse-grained magnetite is abundant in the andesite.

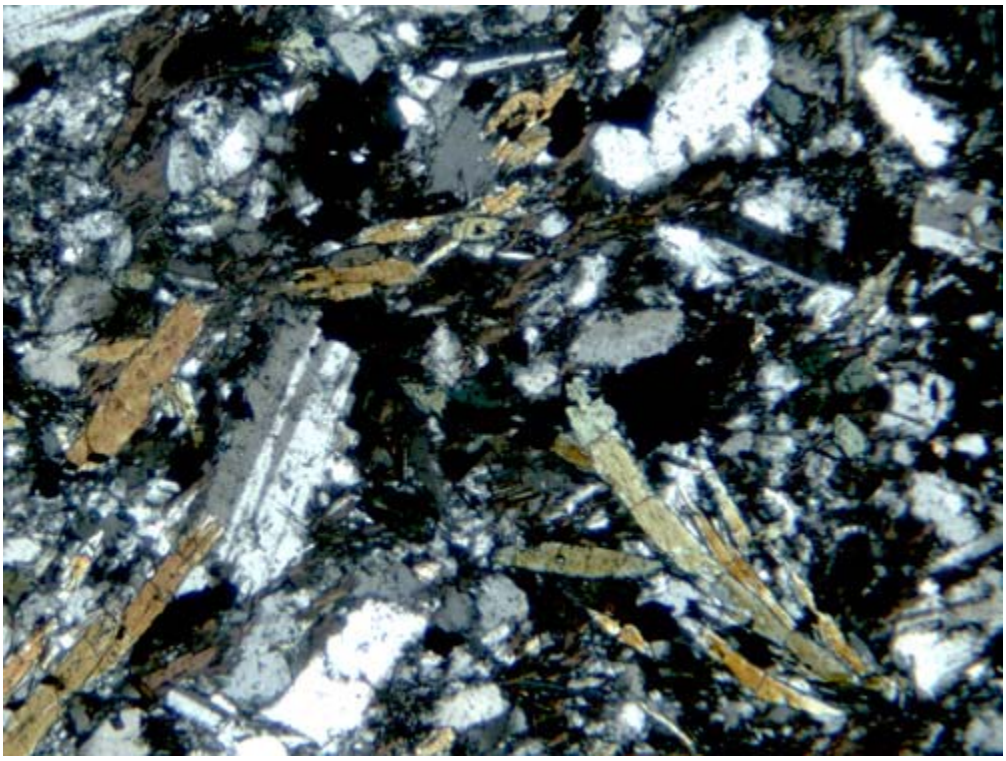
The coarse-grained vein that intrudes or is in-touch with the andesite consists of fine to coarse-grained quartz, coarse-grained carbonate, wide chlorite-rich domains and fine to coarse-grained pyrite and chalcopyrite. The sulfides post-dated the carbonates and contain several carbonate inclusions. The relationship between chlorite and the sulfides is less straightforward, as the sulfides are generally intergrown with the chlorite and they rarely contain inclusions of chlorite.

Andesite fragment

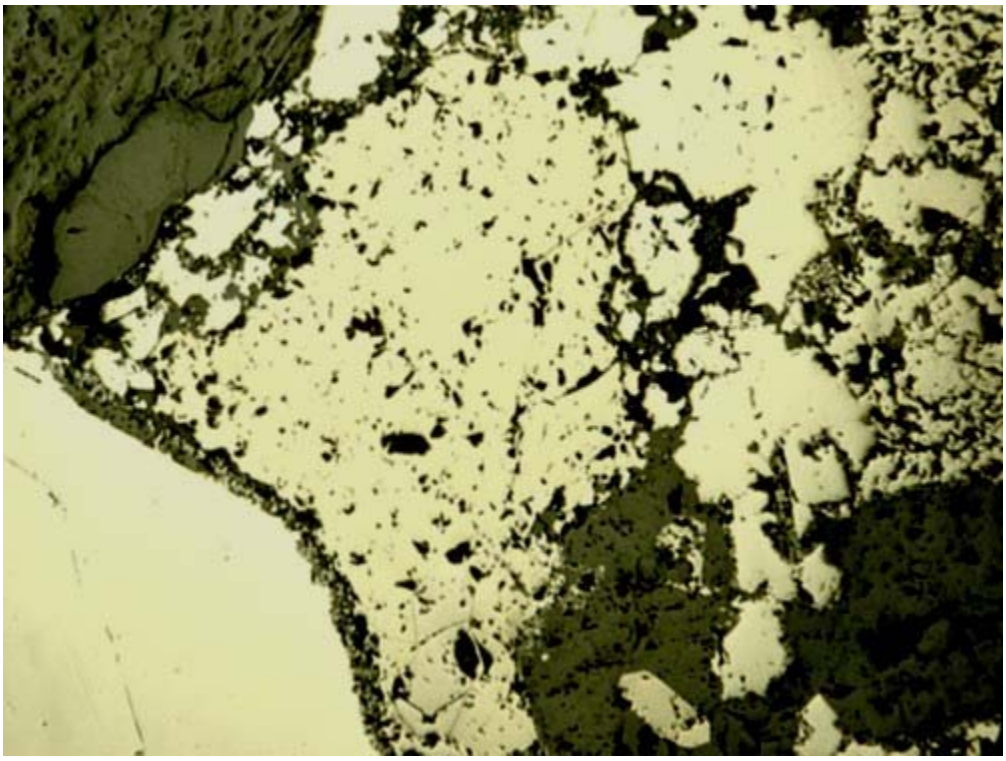
Mineral	**%**
Plagioclase	60
Amphibole	15
Chlorite	12
Carbonate	3
Magnetite	10
Quartz	trace
Epidote	trace

Vein

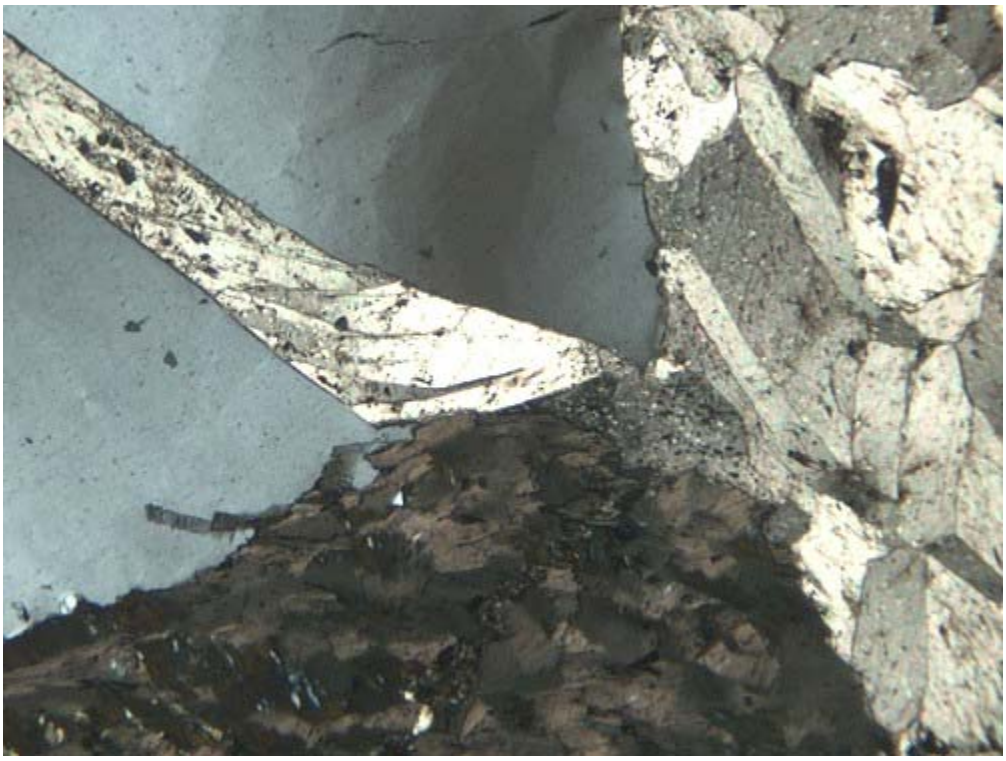
Mineral	**%**
Quartz	40
Carbonate	30
Chlorite	25
Pyrite	3.5
Chalcopyrite	1.5



Andesite. X-axis of photo:1.6mm. XN.



Pyrite+chalcopyrite vein. X-axis of photo: 1.6mm. Refl. Light.



Triple junction of quartz (grey), carbonate (tan) and chlorite (dk. brown). X-axis of photo: 1.6mm. XN.

Sample Number: I589319 **Rock Type: Dacite**

Petrographic Description:

A siliceous rock - either a dacite or a high level felsic intrusion. Although it is slightly more coarse-grained than a volcanic rock, the texture and mineralogy would be consistent with dacite. The rock consists predominantly of fragments of relict feldspar phenocrysts, large spherulites (made up of microcrystalline quartz and alkali feldspars) and fine-grained matrix of quartz, minor sericite, magnetite and fine-grained carbonate. In favor of an intrusive protolith are, the granular appearance of the quartz in the matrix and the highly granulated texture of recrystallized feldspars. Collectively they suggest that the rock is either a dacite or an extensively recrystallized high level felsic intrusion.

Fine-grained magnetite is disseminated through the fine-grained matrix.

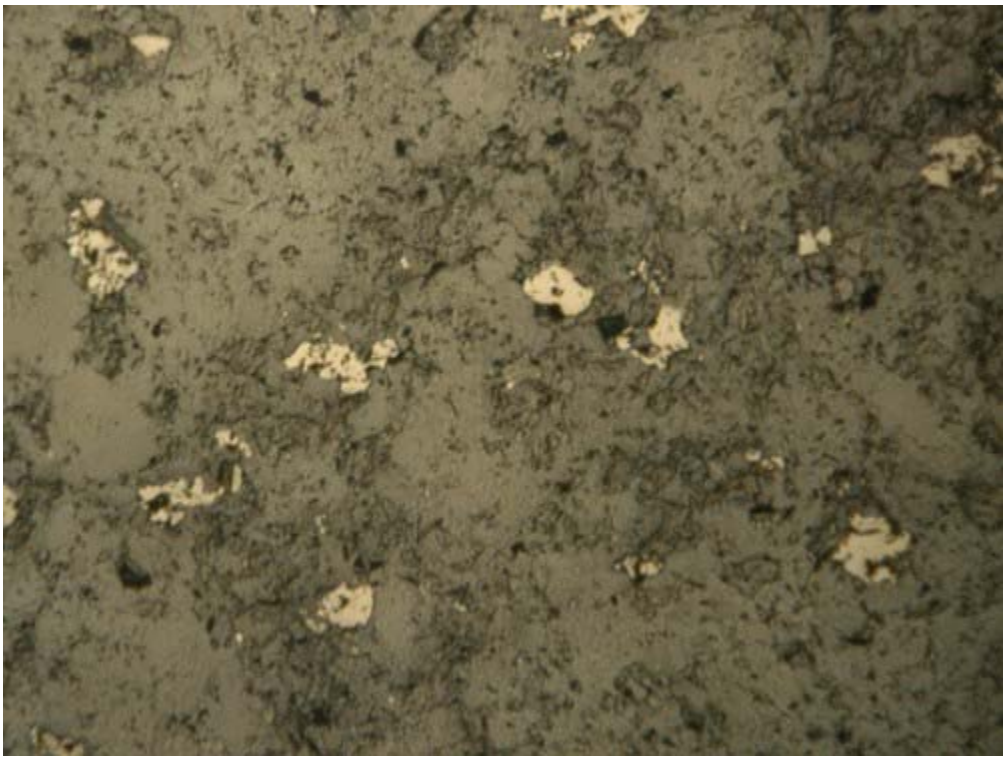
Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Quartz	50	<0.05-0.3	Anhedral, fine-grained quartz makes up a significant part of the matrix. Quartz also occurs as replacement of fragmented and partly recrystallized plagioclase phenocrysts.
Plagioclase	20	<0.1-1.5	Relict fragments of plagioclase phenocrysts are partly recrystallized to aggregates of quartz and feldspars. The texture of the phenocrysts show evidence of granulation and recrystallization.
Spherulite	20	av. 1.5	Spherulites are relatively abundant in the thin section. They are subrounded aggregates of microcrystalline quartz and alkali feldspars, some of which are fragmented and partly replaced by sericite.
Sericite	2		Sericite is disseminated through the rock. The small grains are interstitial to the matrix and are intercalated with chlorite.
Chlorite	5		Fine-grained chlorite occurs as small stringers interstitial to the matrix quartz and feldspars.
Magnetite	3	av. 0.1	Anhedral magnetite are distributed through

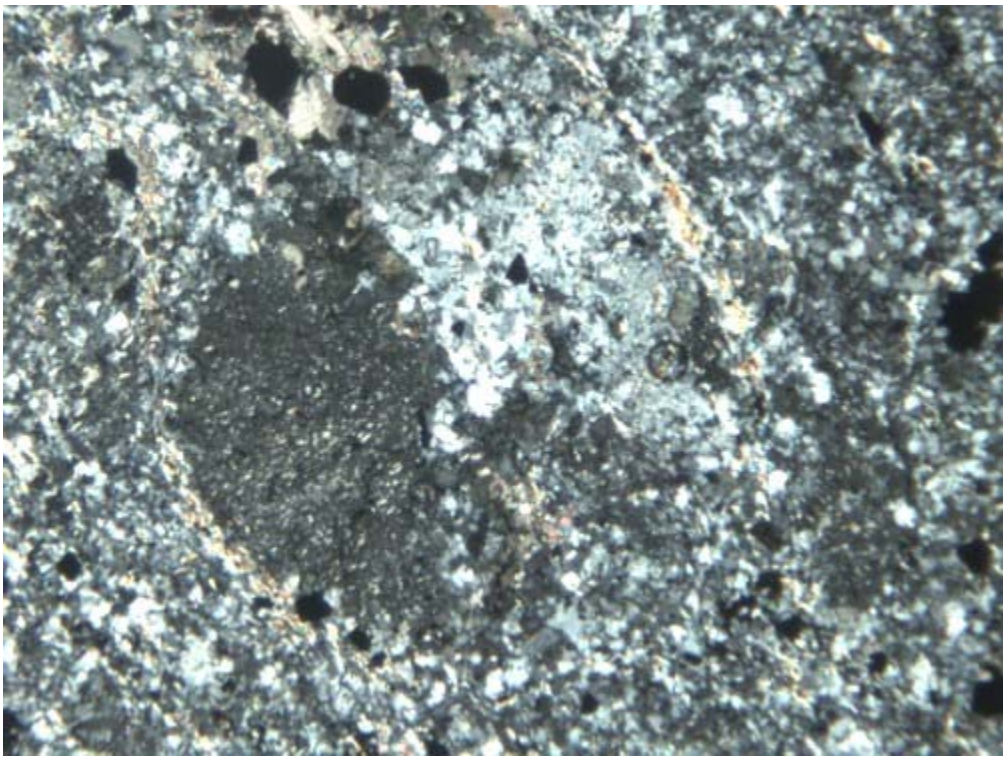
the matrix.

Accessory minerals: carbonate, pyrite, apatite

Relict, corroded plagioclase phenocryst. X-axis of photo: 1.6mm. XN..



Fine-grained magnetite in matrix. X-axis of photo: 1.6mm. Refl. Light.



Spherulite (in partial extinction). X-axis of photo: 1.6mm. XN.

Sample Number: I589320 **Rock Type: Albitite**

Petrographic Description:

The rock is comparable in mineralogy and texture to samples I589314 & I589316. Silicified and albitized, it consists predominantly of albite and quartz. Quartz is interstitial to the albite and partly replace some of the albite. A late quartz vein that intruded the albitite is partly recrystallized at the contact with the rock. The fine-grained anhedral albite are intergrown with quartz. The rock has a semi-granular texture, where the feldspars are partly lath-shaped and partly equant grains. Minor fine-grained carbonates (ankerite and ferroan dolomite) and muscovite are disseminated through the matrix and form a rim on some of the sulfides. The quartz vein is coarse-grained and locally partly recrystallized.

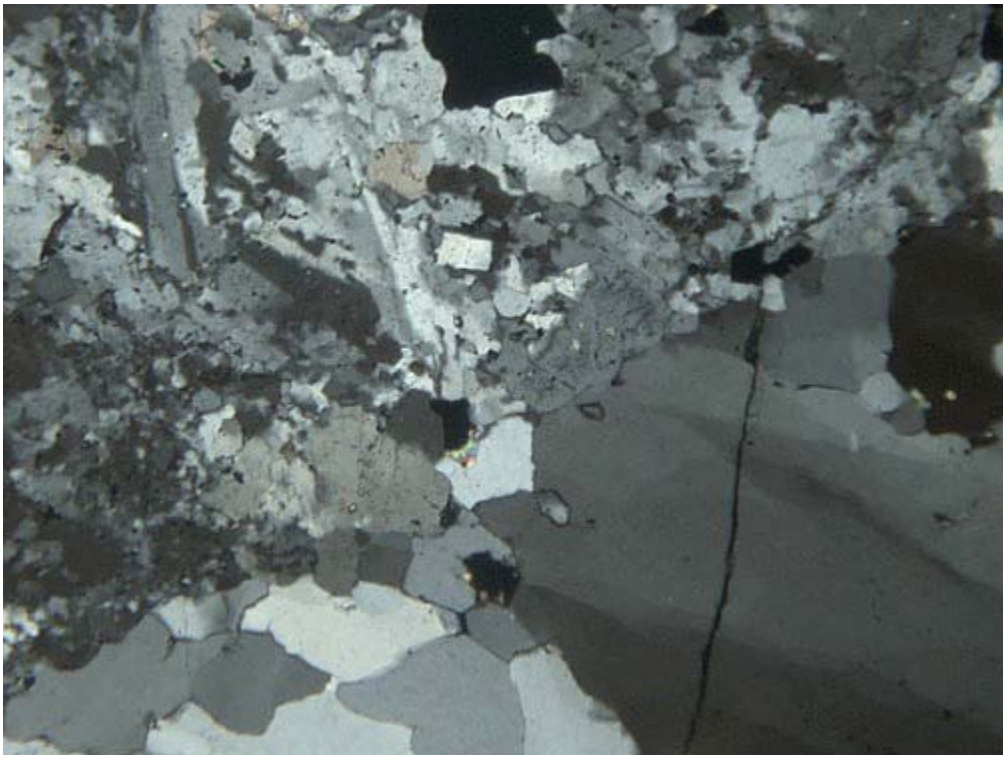
Anhedral and poikiloblastic pyrite over-grows the albitized rock. the poikiloblasts contain inclusions of fine-grained aggregates of albite and minor quartz. Some are rimmed by fine-grained carbonate. Anhedral magnetite and ilmenite are disseminated through the matrix.

Detailed mineralogy

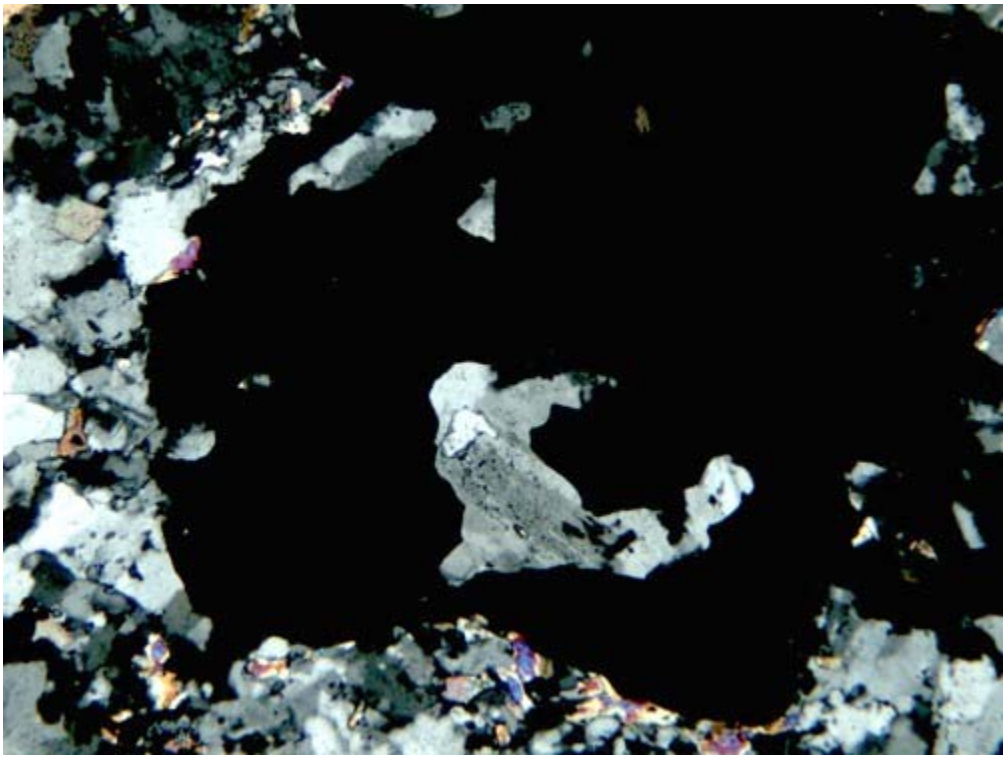
Mineral	%	Grain size(mm)	Comments
Albite	55	0.1-2.5	Lath-shaped and slightly radiating albite aggregates make up a significant part of the rock. Some albite are skeletal and the slender grains are intergrown with quartz. Some are partly recrystallized to fine-grained aggregates.
Quartz	40	variable. Vein: up to 6.0	Anhedral aggregates of quartz are interstitial to the albite. Some also form a corona on the albite and occur as partial replacement. There is textural evidence for the recrystallization of quartz and the partial replacement of albite by quartz. A coarse-grained quartz vein intrudes the albitite. The vein quartz is partly recrystallized and have sutured and embayed grain boundaries, suggesting disequilibrium.
Carbonate	1	0.2-0.5	Fine-grained anhedral carbonate is disseminated through the rock. Some form a rim on the sulfides and some are interstitial to the quartz and albite.

Pyrite	3	0.5-2.8	Anhedral pyrite are interstitial to the quartz and albite. Late poikiloblasts contain inclusions of albite aggregates
Magnetite	1	variable <0.5	Anhedral, fine-grained magnetite are randomly distributed in the rock. Some occur in stringers with carbonate or chlorite.

Accessory minerals: biotite, chlorite, rutile, apatite



Albitized rock and quartz vein. X-axis of photo: 1.6mm. XN.



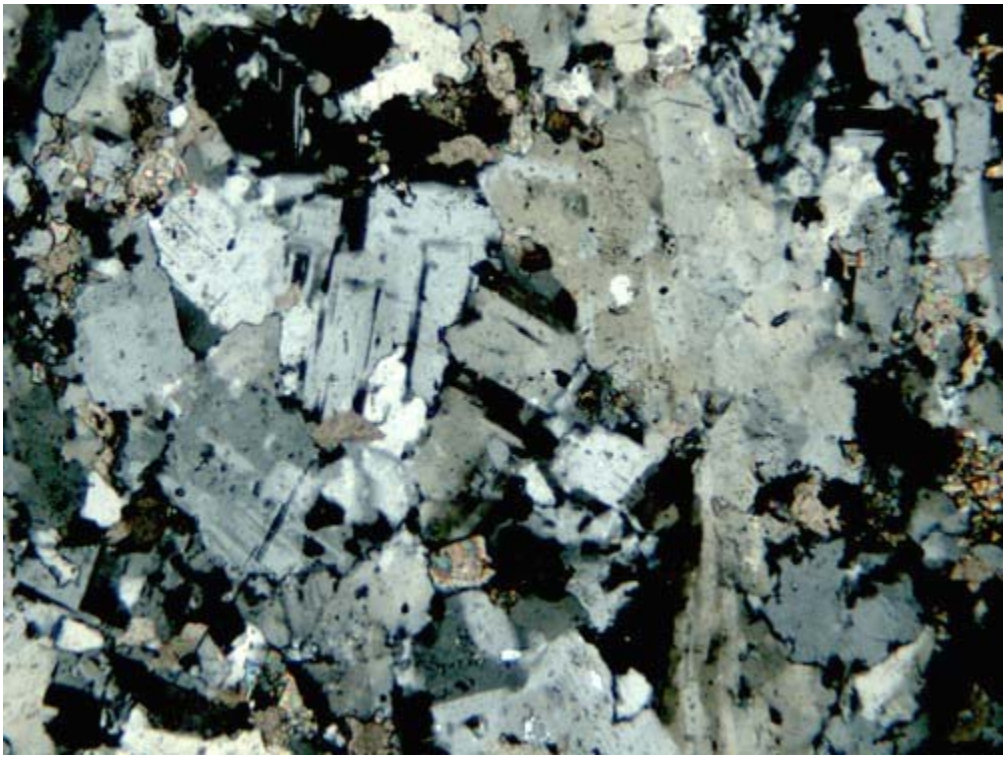
Pyrite poikiloblast (black) with albite inclusions. X-axis of photo: 1.6mm. XN.

Sample Number: I589321 **Rock Type: Albitite**

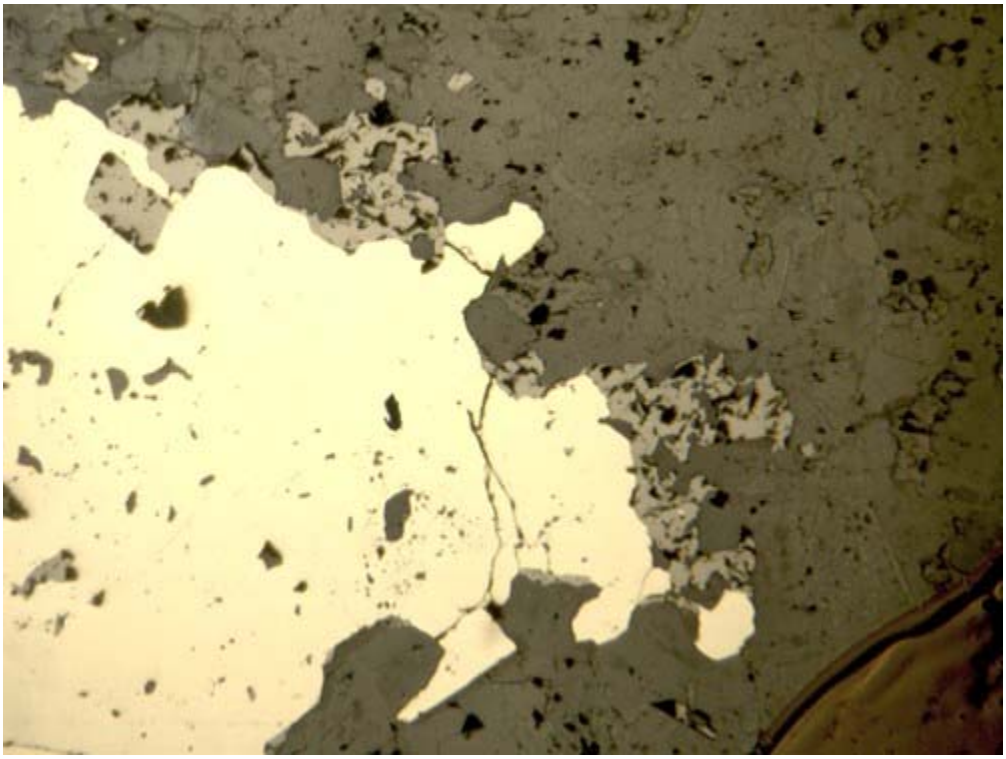
Petrographic Description:

The rock consists predominantly of albite and lesser quartz. The mineralogy and texture are almost identical to the previous albitite samples. The only difference is the absence of relict feldspars and the grain size of pyrite poikiloblasts (up to 3.2mm).

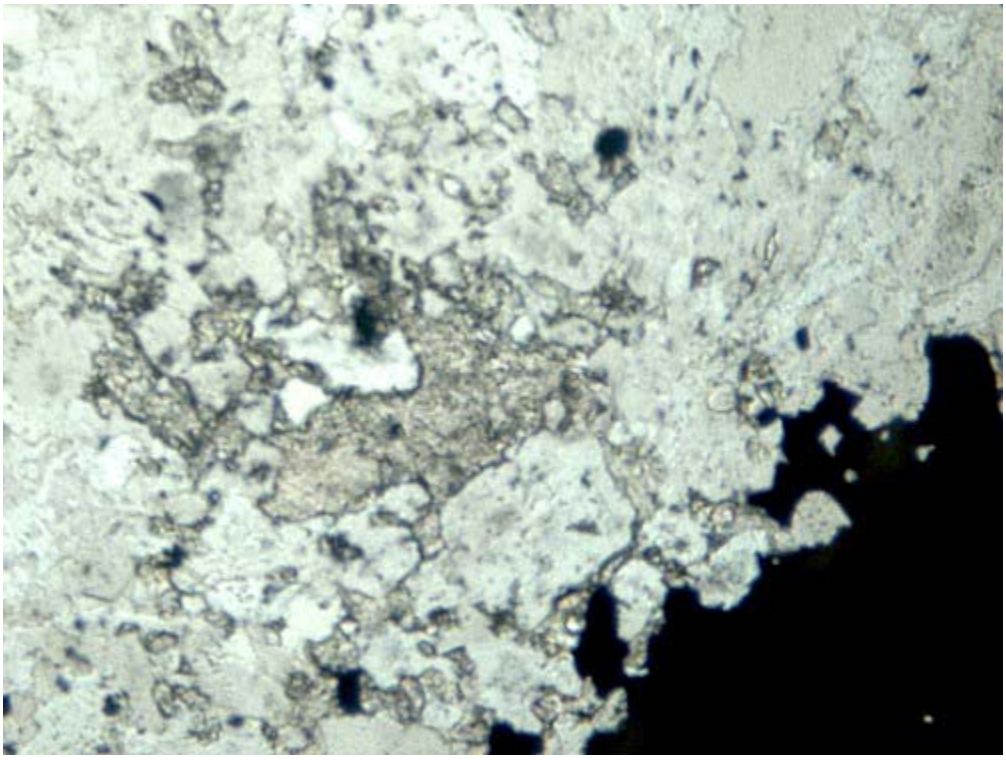
For a full, detailed description of mineralogy and texture, see write-up on sample I589320.



Albitite. X-axis of photo: 1.6mm. XN.



Fine-grained magnetite rims pyrite. X-axis of photo: 1.6mm. Refl. Light.



Mottled carbonate in albitite. X-axis of photo: 1.6mm. Ppl.

Sample Number: I589322 **Rock Type: Graphic granite ?**

Petrographic Description:

A highly granophyric felsic intrusive rock. It consists predominantly of feldspars, quartz, granophyre, sericite, chlorite, secondary biotite and opaque minerals. Relict plagioclase phenocrysts are fragmented and their composition cannot be determined optically. As the thin section is covered, the sulfides are indistinguishable from the oxides.

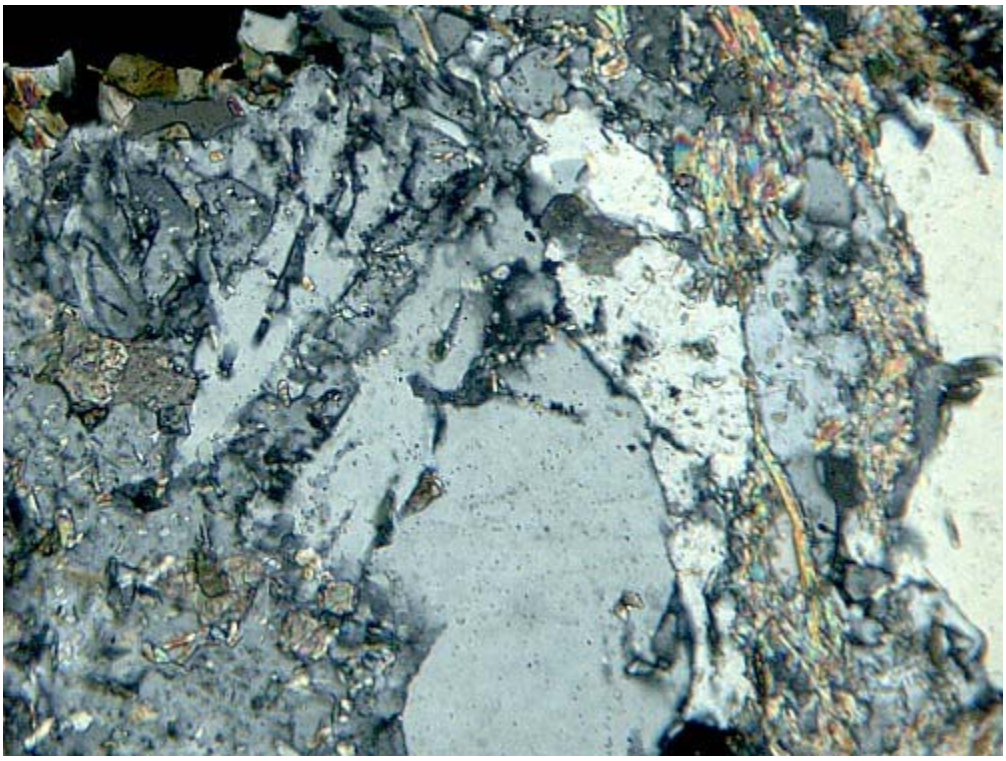
Although the rock is silicified, granulated and partly recrystallized, the texture suggests possible albitization prior to recrystallization. It is uncertain whether the granophyre was inherent in the intrusive or it is the manifestation of contact metamorphism.

Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Plagioclase / albite	22 20	0.5-1.8	Fragments of relict plagioclase are rimmed by granophyre. Some are partly recrystallized to quartz. Fine-grained albite represents a later generation. The lath-shaped, slender grains have comparable texture to albite previously described elsewhere.
Quartz	20	variable up to 1.0	Quartz occur as broken clasts interstitial to the feldspars and carbonate. They have sutured and embayed grain boundaries, suggesting resorption and dissolution.
Granophyre	20	0.1-0.5	Very fine granophyre over-grows a large number of feldspars. They are either relict and were inherent to the igneous host or they developed during contact metamorphism.
Sericite	5		Sericite veins and sericite-rich domains occur throughout the thin section. They form a rim on quartz and boudinage some of the feldspars. They are generally intercalated with minor fine-grained biotite.
Carbonate	5		Carbonate is randomly distributed. The anhedral grains are interstitial to the

			feldspars and quartz
Opaques	6	<0.1-3.0	Sulfides and oxides make up the opaques. They cannot be distinguished in a covered thin section.
Biotite	0.5	av. 0.3	Fine-grained biotite is intercalated with sericite and chlorite. It is also interstitial to some of the sericite and chlorite veinlets.
Chlorite	1.5		Fine-grained chlorite occurs in stringers interstitial to the quartz and feldspars.

Accessory minerals: epidote, rutile, apatite



Albite replace quartz. X-axis of photo: 1.6mm. XN.

Fine radiating granophyre. X-axis of photo: 1.6mm. XN.

Sample Number: I589323 **Rock Type: Andesite**

Petrographic Description:

A fine-grained, pervasively altered andesite. The original mineralogy was almost completely destroyed, only the texture (flow-banded) and a few relict feldspars indicate that the rock is an andesite. The present mineralogy consists of chlorite, coarse-grained carbonate, biotite and fine-grained quartz. Small, subhedral epidote are interstitial to some of the chlorite.

Chlorite occurs in wide, deformed and discontinuous veins that contain coarse-grained, lath-shaped carbonate and minor fine-grained epidote. Some carbonates have the shape of plagioclase as if they are replacing plagioclase phenocrysts. Coarse-grained biotite are included and are also intergrown with the chlorite. The fine-grained matrix consists predominantly of chlorite, quartz, opaque minerals (lath-shaped ilmenite?), and minor, relict plagioclase.

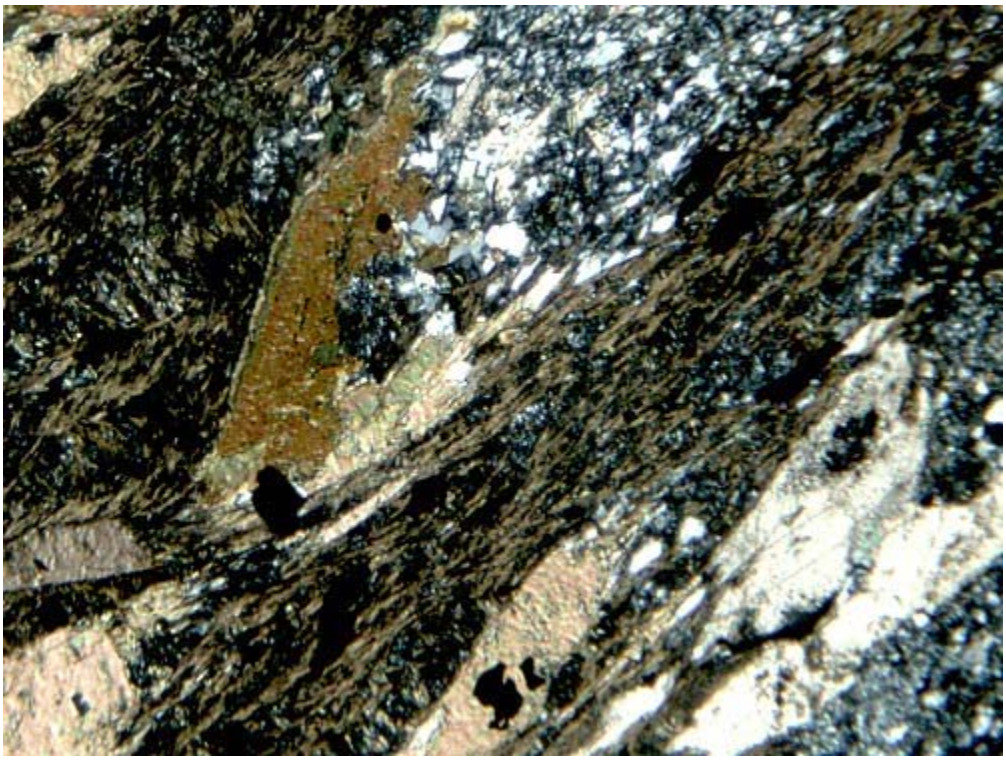
The thin section is covered, and therefore the opaque minerals cannot be identified.

Detailed mineralogy

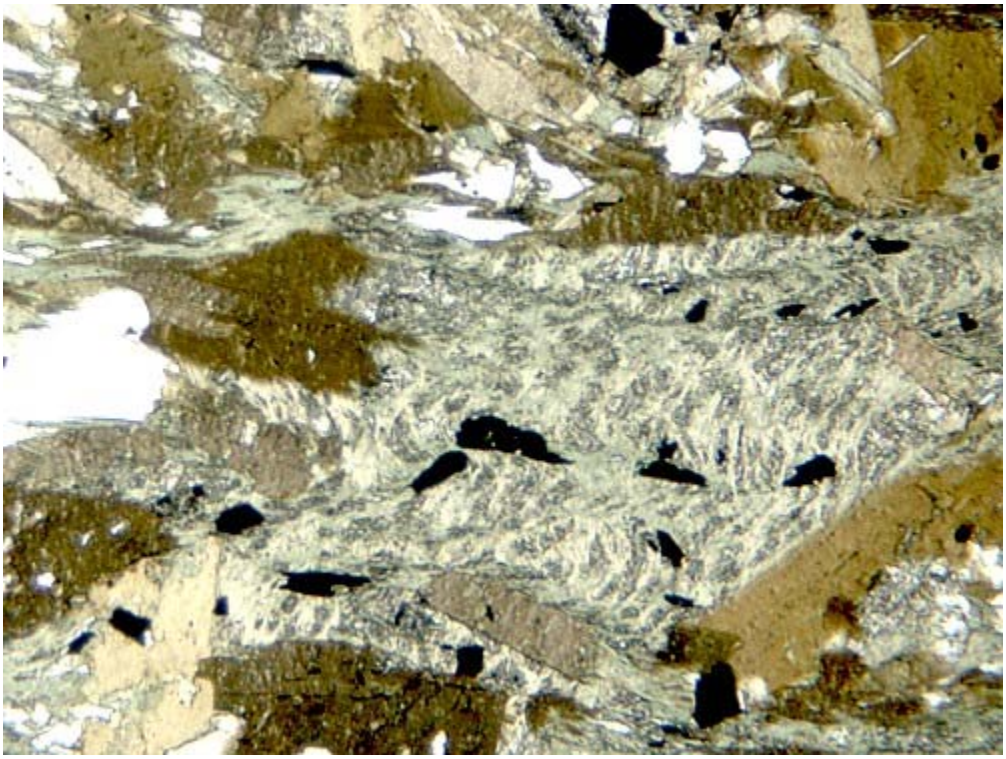
Mineral	%	Grain size(mm)	Comments
Chlorite	43		Chlorite is the most abundant mineral in the thin section. It makes up part of the matrix (fine-grained) and occurs as contorted and deformed vein (medium-grained) that contains inclusions of carbonate, quartz, epidote and biotite. Chlorite veins define the rock fabric.
Carbonate	22	0.5-3.0	Lath-shaped and blocky, anhedral carbonate is interstitial to the chlorite and aligned in the same direction as the chlorite vein. It is a probable replacement after some of the feldspars.
Biotite	5	0.6-2.8	Coarse-grained anhedral biotite are intergrown with the chlorite. Some are partly replaced by chlorite. Fine-grained biotite also occurs as single grains interstitial to the matrix.
Quartz	22	av. 0.3	Fine-grained quartz makes up part of the matrix. It is intergrown with fine-grained chlorite and contain interstitial fine-grained

			epidote.
Epidote	3	av. 0.3	Fine-grained, slightly subrounded epidote rosettes are included in the vein chlorite and in the quartz+chlorite-rich fine-grained matrix.
Opaques	5	variable up to 2.5	Opaque minerals are both blocky, equant and lath-shaped grains. The latter is probably ilmenite, whereas the former is probably pyrite (cannot distinguished them on covered thin section).

Accessory minerals: plagioclase, apatite, sericite



Chlorite (brown) and carbonate altered andesite. X-axis of photo: 1.6mm. XN.



Biotite and chlorite altered andesite. X-axis of photo: 1.6mm. XN.

Sample Number: I589324 **Rock Type: Albitite**

Petrographic Description:

The rock is an albitized intrusive of felsic to intermediate composition. It consists predominantly of albite (and relict oligoclase), biotite and quartz. Except for some relict phenocrysts of oligoclase, the feldspars represent extensive albitization and the fine-grained biotite is secondary in origin. Minor quartz is interstitial to the feldspars and a few small secondary quartz veinlets and aggregates are disseminated through the thin section. Fine-grained biotite occurs in veins and in aggregates interstitial to the albite. Some biotite are partly replaced by minor chlorite. Fine-grained calcite is also interstitial to the feldspars and some contain small inclusions of magnetite and ilmenite.

A few grains of pyrite and pyrite poikiloblasts are disseminated through the thin section.

Detailed mineralogy

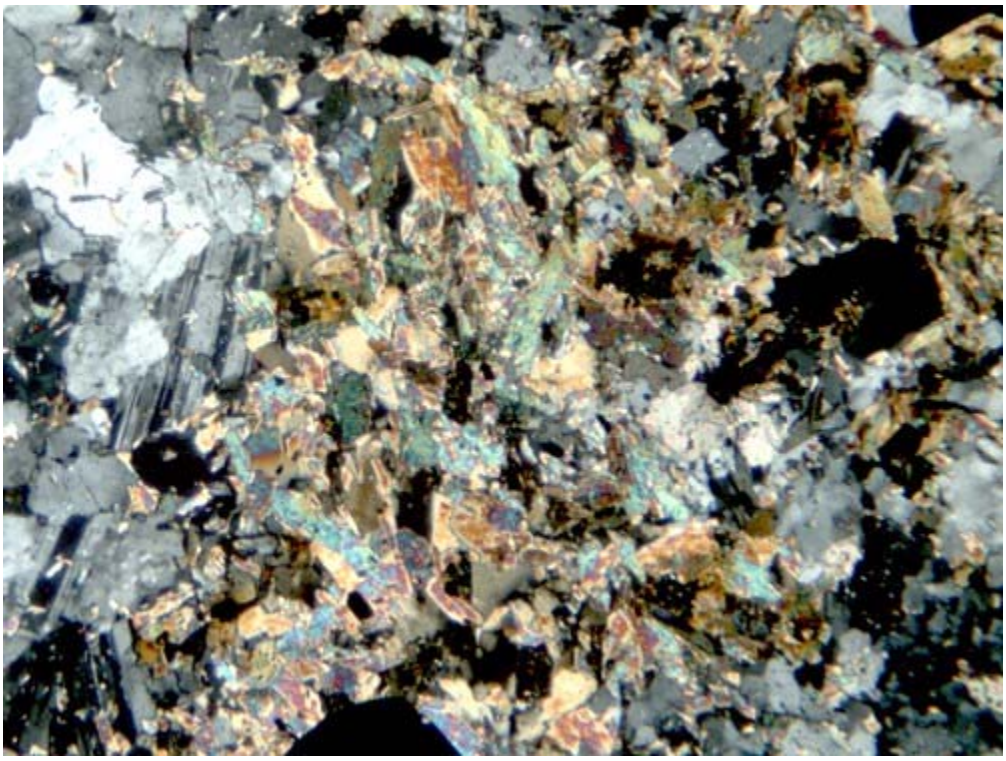
Mineral	%	Grain size(mm)	Comments
Albite / plagioclase	66 10	0.5-2.0	Relict feldspars in the rock are stubby phenocrysts. Their composition (where possible to determine) is in the range of oligoclase. Later albite with well-defined polysynthetic twinning replaced most of the original feldspars. Some are chessboard albite and some show evidence that it is replacing relict grains.
Biotite	6	av. 0.3	Fine-grained secondary biotite is interstitial to the albite. It also occurs as small, poorly defined veins that contain fine-grained magnetite and ilmenite.
Quartz	10	variable up to 0.8	Fine-grained quartz occurs in discontinuous veins and in aggregates interstitial to the feldspars.
Carbonate	3	variable up to 1.0	Anhedral, fine-grained calcite forms a rim on the albite, suggesting that they post-dated albitization in the rock. Some contain inclusions of magnetite / ilmenite.
Pyrite	2	0.2-1.5	Subhedral / anhedral blocky pyrite and poikiloblasts of pyrite post-dated albitization as it contains inclusions of

			secondary albite.
Magnetite / ilmenite	1	<0.1-0.5	Fine-grained magnetite and ilmenite occur as inclusions in the calcite and in some of the chlorite-rich veins.

Accessory minerals: chlorite, apatite, zircon

Relict plagioclase. X-axis of photo: 1.6mm. XN.

Albite-rich domain. X-axis of photo: 1.6mm. XN.



Biotite altered albitite. X-axis of photo: 1.6mm. XN.

Sample Number: I589325 **Rock Type: Diorite**

Petrographic Description:

Biotite and carbonate altered diorite. The rock is extensively altered and it consists of lath-shaped plagioclase of oligoclase composition. Although the feldspars are medium-grained, a large (>3mm) phenocryst suggests that on the scale of the hand specimen, the rock is sparsely phyric. The plagioclase are partly replaced by biotite and carbonate. The matrix between the feldspars also contain subhedral / anhedral magnetite, weakly granophyric feldspars and minor quartz. Some of the biotite are partly replaced by fine-grained chlorite. A few carbonate veins cross-cut the matrix.

A large, coarse-grained quartz vein is in contact with the rock. 50% of the thin section is made up of the vein and sulfides are abundant within the rock at the vein contact.

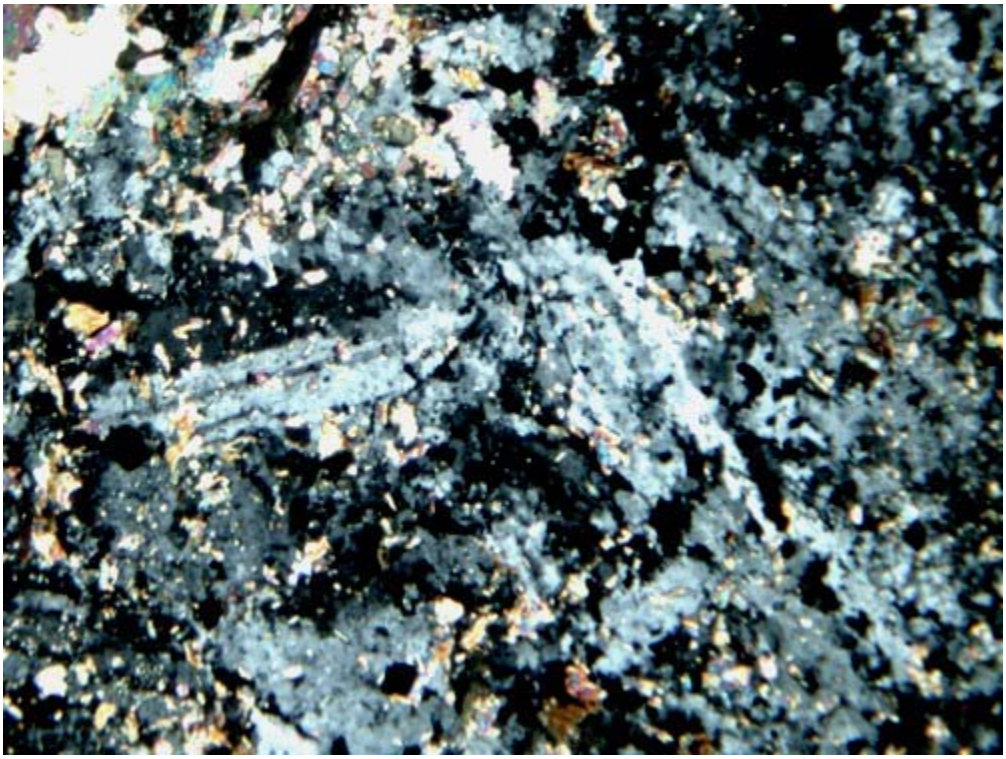
The rock contains a relative abundance of fine-grained magnetite as part of the matrix. Sulfides are relatively abundant and include subhedral pyrite and anhedral, more fine-grained pyrrhotite. A few small grains of chalcopyrite occur within the pyrrhotite aggregates.

Detailed mineralogy (excluding the large quartz vein)

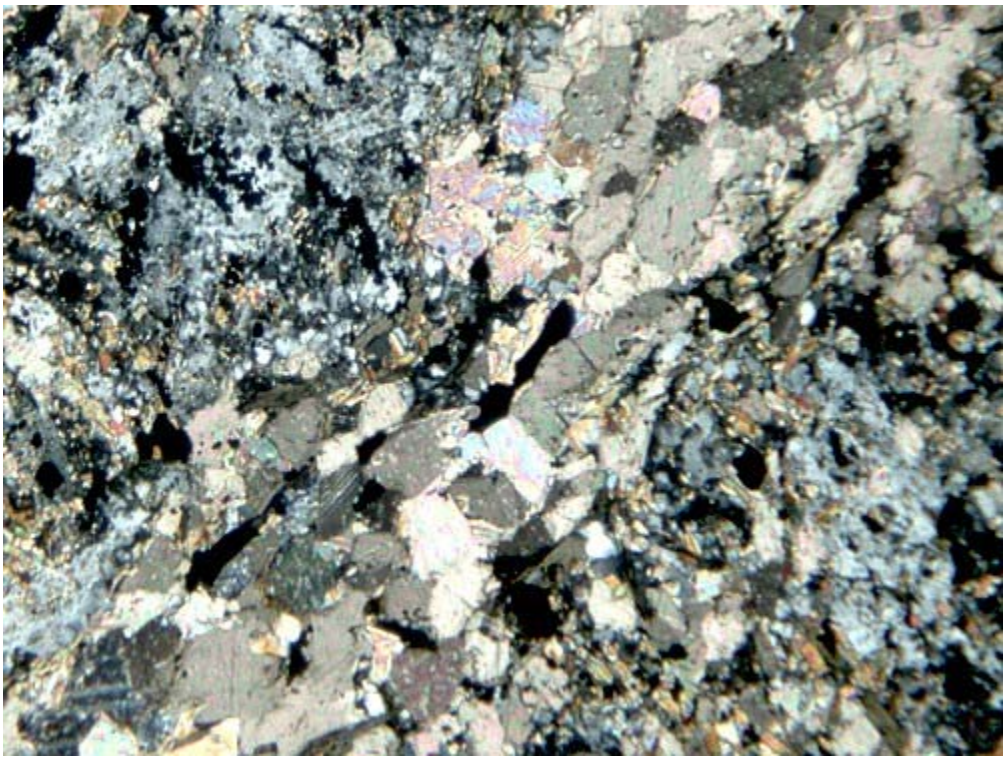
Mineral	%	Grain size(mm)	Comments
Plagioclase	48	0.3-2.5	Slender plagioclase laths make up most of the rock. Some phenocrysts are wide grains, which give the appearance of sparsely phyric texture. Most are partly altered and contain fine-grained inclusions of biotite and rimmed by biotite, whereas some are partly replaced by fine-grained carbonate.
Biotite	20	av. 0.2	Fine-grained biotite is disseminated through the rock. They occur in aggregates interstitial to the feldspars, but also occur as inclusions in the feldspar phenocrysts. Some biotite are partly altered to chlorite.
Carbonate	20	0.1-1.0	Fine-grained carbonate is a replacement after plagioclase, some of which contain inclusions of carbonate aggregates. Carbonate also occurs in veins that cross-cut the rock fabric. The veins are randomly

			oriented and contain minor interstitial chlorite.
Quartz	2	variable	Fine-grained anhedral quartz is interstitial to the plagioclase.
Pyrite	4	0.3-1.5	Subhedral blocky pyrite occurs in the rock at the diorite / quartz vein contact.
Pyrrhotite	3	av. 0.3	Pyrrhotite is also abundant at the contact with the quartz vein.
Magnetite	3	0.05-0.3	Fine-grained magnetite is disseminated through the rock matrix.

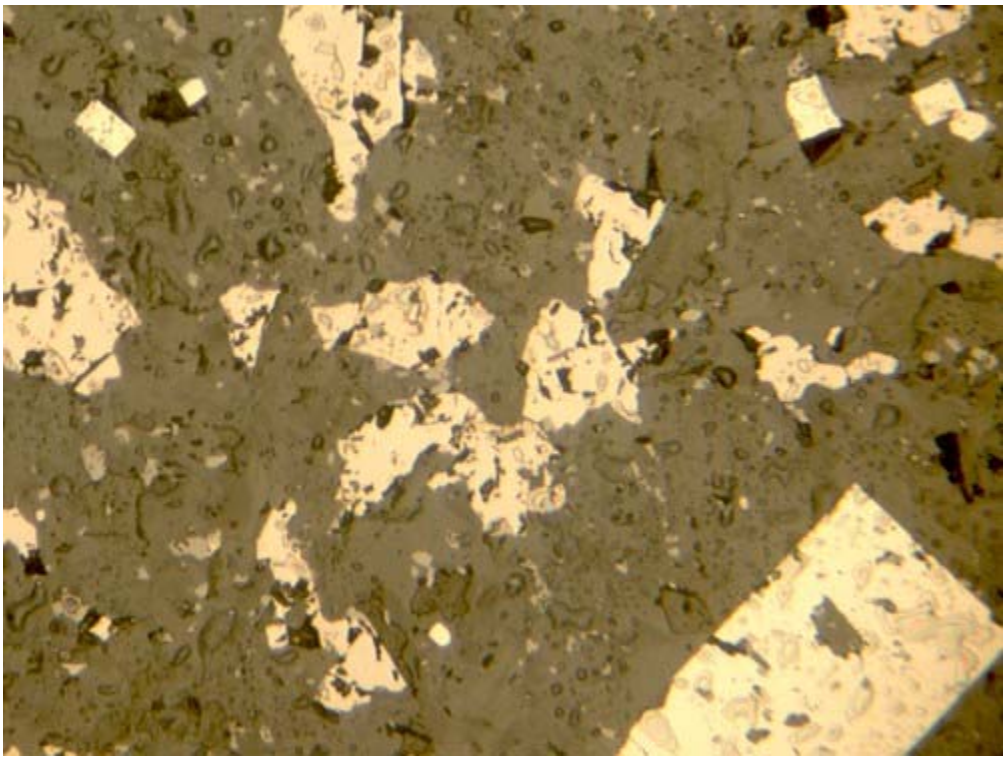
Accessory minerals: chlorite, sericite, chalcopyrite, apatite



Plagioclase phenocrysts in diorite. X-axis of photo: 1.6mm. XN.



Carbonate vein. X-axis of photo: 1.6mm. XN.



Large pyrite and small pyrrhotite. X-axis of photo: 0.64mm. Refl. Light.

Sample Number: I589326 **Rock Type: Hornblendic basaltic andesite?**

Petrographic Description:

An unusual rock. It is a porphyritic hornblendic andesite that consists predominantly of amphibole phenocrysts, fine-grained matrix of quartz, plagioclase and epidote. Aggregates of epidote replaced the original feldspars and destroyed the plagioclase phenocrysts. Blue-green pleochroism suggests an actinolitic composition for the amphibole, some of which contain inclusions of ilmenite and aggregates of fine-grained epidote. Carbonate occurs as discontinuous late veins and partly replace (together with the epidote) the plagioclase in the rock.

A wide (3mm) polymetallic sulfide + magnetite vein cross-cuts the rock. It consists of an intergrowth of pyrite-pyrrhotite-chalcopyrite. Although textural evidence suggests that the pyrite was replaced by pyrrhotite and chalcopyrite, the relationship between the coarse-grained magnetite and the sulfides is contentious. The magnetite contains small inclusions of pyrrhotite, whereas the pyrrhotite forms a rim on aggregates of magnetite.

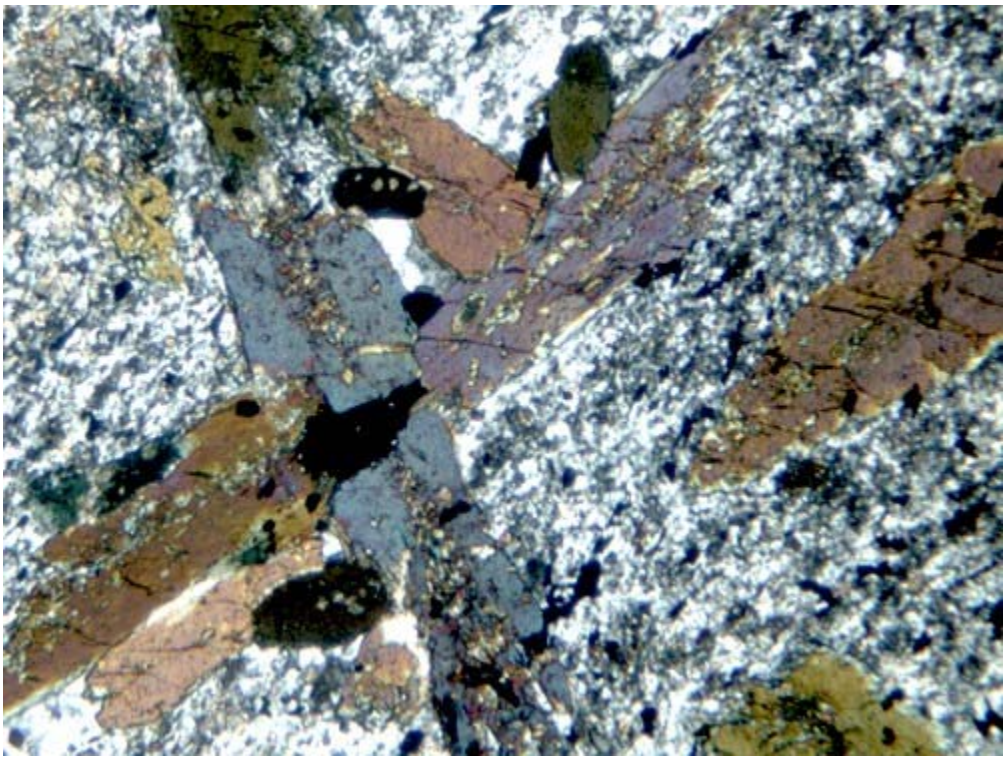
Fine-grained needles of ilmenite are disseminated within the matrix.

Detailed mineralogy

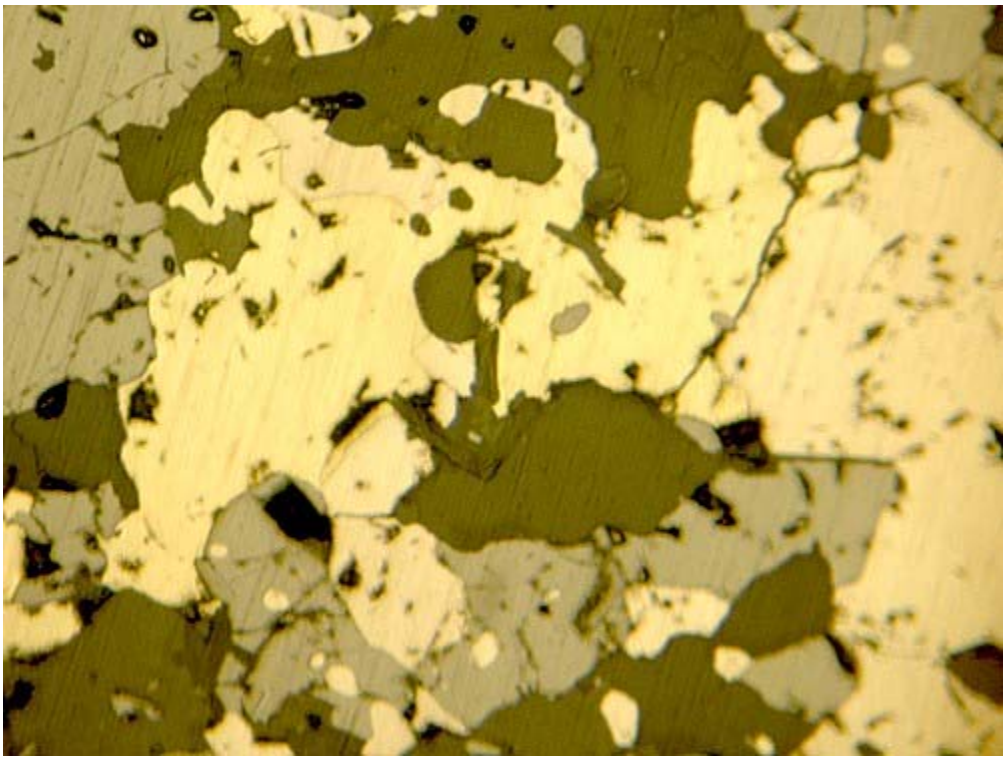
Mineral	%	Grain size(mm)	Comments
Amphibole	38	0.5-4.0	Amphibole porphyroblasts are randomly oriented. In contact with the sulfide+magnetite vein they form coarse-grained aggregates and parallel the orientation of the vein. Some amphibole contain inclusions of ilmenite and magnetite and some contain aggregates of epidote.
Quartz	20	variable up to 0.5	Fine-grained quartz makes up part of the matrix. It is intergrown with untwinned plagioclase. Small domains within the sulfide-rich vein also contain aggregates of recrystallized semi-granoblastic quartz.
Plagioclase	17	0.3-1.5	Only a few relict plagioclase phenocrysts were identified. Most plagioclase were replaced by epidote and clinozoisite. Only the shape of the epidote aggregates suggests that they crystallized at the expense of plagioclase.

Epidote	8	<0.2	Fine-grained epidote and clinozoisite form aggregates as they replaced most of the plagioclase phenocrysts. Some are included in the amphibole phenocrysts.
Carbonate	4	variable up to 0.6	Fine-grained carbonate is interstitial to the recrystallized quartz+feldspar-rich matrix. It partly replaced some of the feldspars and also occur as small, discontinuous veins that cross-cut the rock fabric.
Pyrrhotite	6	0.1-1.2	Coarse-grained pyrrhotite is part of the sulfide vein that intruded the rock. It is intergrown with chalcopyrite and some are included in magnetite. Pyrrhotite is also present in the fine-grained matrix or forms a rim on the amphibole.
Chalcopyrite	2	variable up to 1.0	Chalcopyrite is part of the massive sulfide vein. It also occurs in the matrix with or without pyrrhotite. They form a rim on the amphibole, suggesting that they post-dated (together with pyrrhotite), the amphibole.
Magnetite / ilmenite	3 2	av. 0.5 0.1-0.3	Subhedral magnetite is intergrown with the massive sulfides in the vein and are also disseminated through the rock. Ilmenite occurs as small, needle-shaped grains. Most are part of the matrix, but some occur as inclusions in the amphibole.

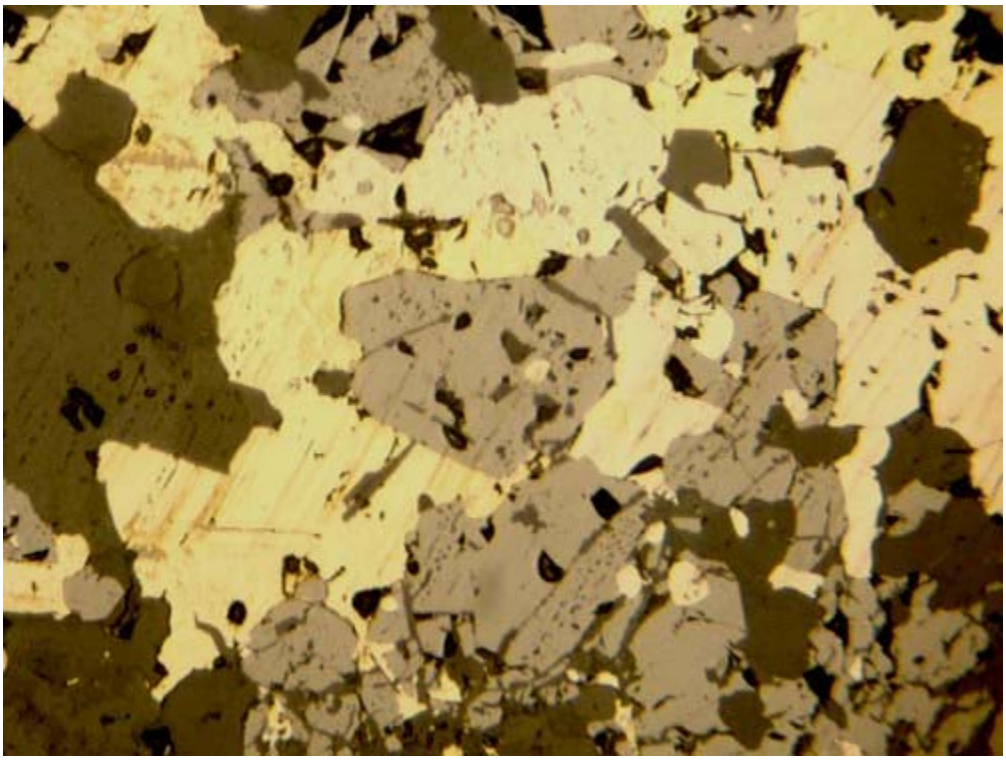
Accessory minerals: sericite, apatite, titanite, pyrite



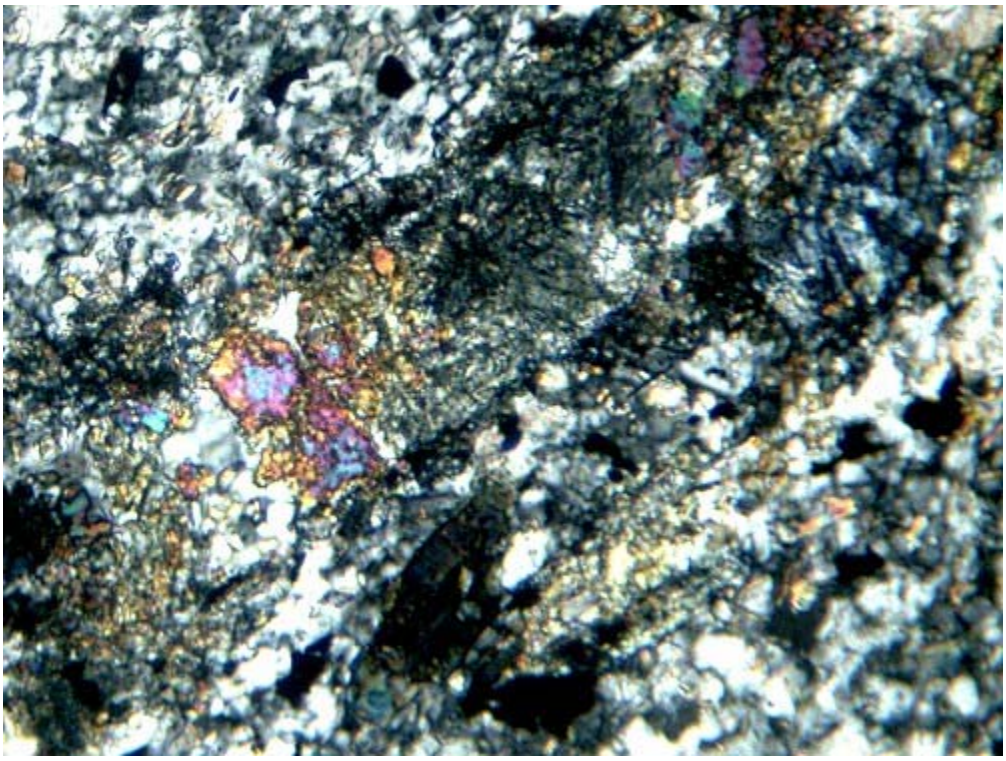
Hornblendic andesite. X-axis of photo: 1.6mm. XN.



Pyrrhotite in polysulfide-magnetite vein is intergrown with magnetite (grey).
X-axis of photo: 1.6mm. Refl. Light.



Magnetite is rimmed by pyrrhotite. X-axis of photo: 0.64mm. Refl. Light.



Epidote (multi color) and clinozoisite aggregates (dark grey) replace 2 large plagioclase laths. X-axis of photo: 1.6mm. XN.

Sample Number: I589327 **Rock Type: Feldspar-quartz porphyry**

Petrographic Description:

A coarse-grained porphyritic intrusive rock of dacite composition. It consists of large plagioclase phenocrysts (oligoclase), a few fragmented quartz phenocrysts, fine-grained matrix of quartz and feldspars and an abundance of carbonate that partly replace the feldspars. Carbonate also occurs as veins and locally, as fine-grained aggregates that form a rim on the feldspars and replace the matrix. There is some textural evidence of minor recrystallization and albitization.

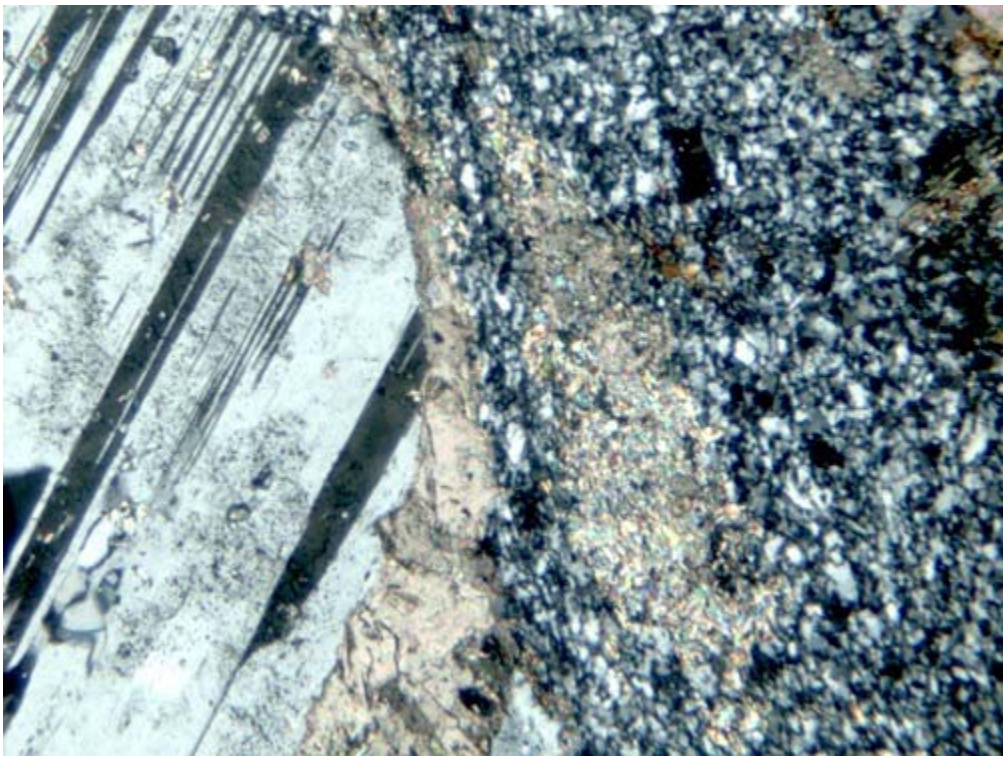
Pyrite is the only sulfide present. As some are poikiloblasts, containing inclusions of quartz, feldspar and carbonate, it evidently post-dated the carbonates.

Detailed mineralogy

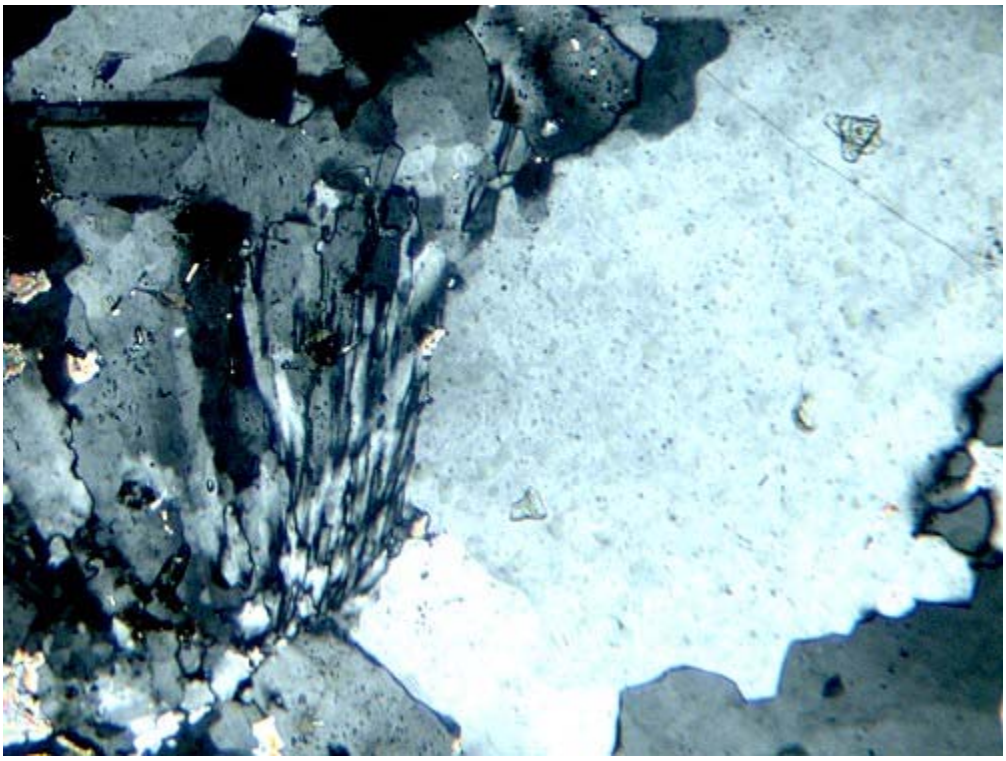
Mineral	%	Grain size(mm)	Comments
Plagioclase	42	0.6-4.0	Plagioclase occurs as very large, up to 4mm diameter phenocrysts. Their composition is in the oligoclase range. Untwinned feldspars are also present in the matrix, where it is intergrown with the matrix quartz. The feldspar phenocrysts are extensively altered and partly replaced by carbonates.
K-feldspar	3	<0.2	Fine-grained orthoclase is interstitial to quartz and untwinned plagioclase in the siliceous matrix.
Quartz	35	0.1-2.5	Fine-grained quartz makes up most of the matrix. Quartz also occurs as fragmented and partly recrystallized phenocrysts. Some are weakly albitized.
Biotite	2	<0.2	Fine-grained biotite is interstitial to the matrix, it also occurs in small veins intercalated with the carbonates.
Carbonate	15	variable up to 1.0	Fine-grained carbonate is disseminated through the matrix. It also occurs as veins intercalated with minor fine-grained biotite, and as replacement after the feldspars.

Pyrite	3	0.3-3.0	Late pyrite poikiloblasts contain inclusions of quartz, feldspar and carbonate.

Accessory minerals: sericite, chlorite, apatite, rutile



Feldspar porphyry. X-axis of photo: 1.6mm. XN.



Albite with polysynthetic twinning replaces quartz. X-axis of photo: 0.64mm. XN.

Sample Number: I589328 **Rock Type: Felsic intrusive**

Petrographic Description:

An extensively altered and recrystallized pyrite-rich felsic intrusive rock. It consists of fine-grained quartz, partly recrystallized feldspars (twinning was destroyed), secondary albite, carbonate, pyrite, and minor sericite. The original plagioclase phenocrysts are recrystallized to fine-grained aggregates of quartz and are partly replaced by secondary albite. Albite represents an early alteration in the rock. Fine-grained carbonate is interstitial to the quartz and feldspars and wide carbonate veins cross-cut the rock fabric. Silicification partly destroyed the primary mineralogy and partly replaced the secondary albite.

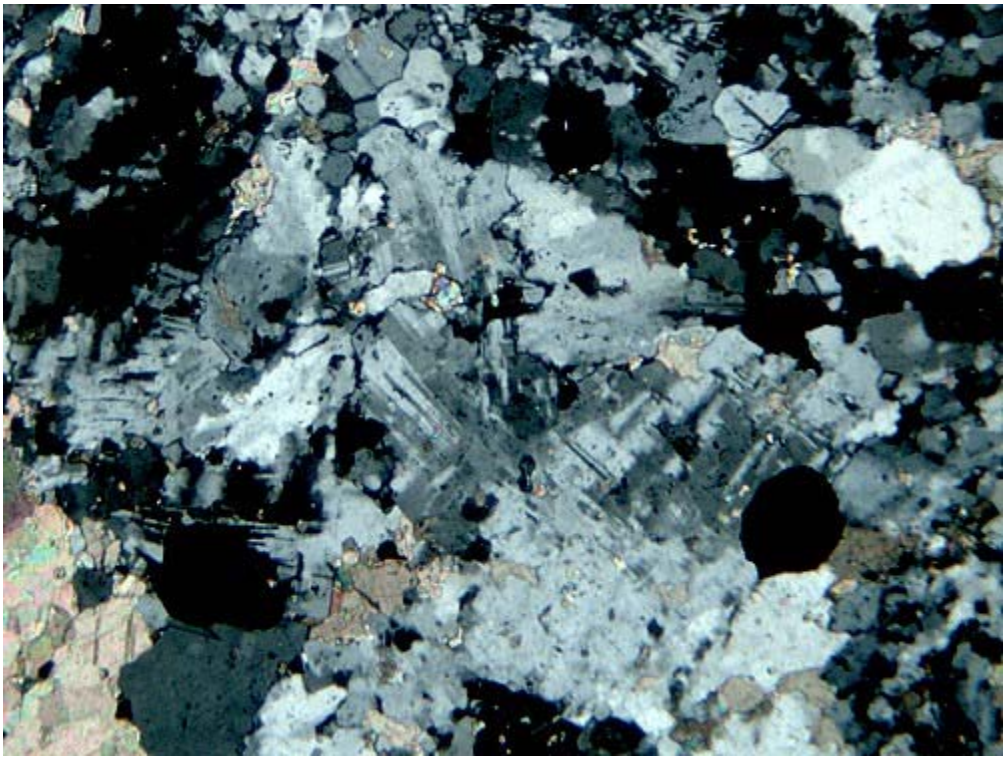
The rock is pyrite-rich and coarse-grained anhedral poikiloblasts of pyrite contain inclusions of fine-grained quartz, carbonate and albite. Evidently, the pyrite post-dated alteration and recrystallization of the feldspars to fine-grained aggregates.

Detailed mineralogy

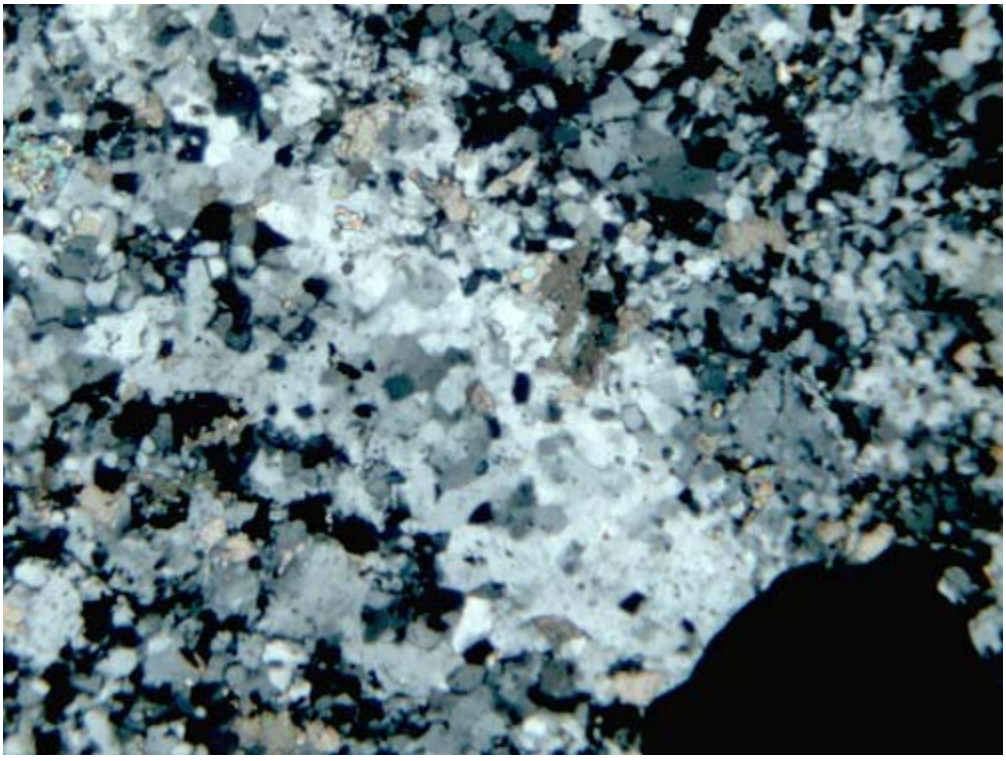
Mineral	%	Grain size(mm)	Comments
Quartz	24	0.05-1.5	Fine-grained quartz occurs as replacement after the feldspars and as fine-grained aggregates interstitial to the feldspars. Granular aggregates of fine-grained quartz are secondary and some of the larger grains are part of the carbonate veins.
Plagioclase / albite	7 25	0.1-1.0	Relict plagioclase phenocrysts are granulated and partly replaced by fine-grained quartz. Most phenocrysts recrystallized to granular aggregates of quartz. Radiating aggregates of secondary albite are relatively abundant, some of which replaced the original feldspar phenocrysts. They also include relict fragments of chessboard albite. Both, primary and secondary feldspars are partly recrystallized to fine-grained aggregates of quartz. All feldspars have sutured and embayed grain boundaries, suggesting disequilibrium crystallization.
Carbonate	20	<0..2-2.2	Fine-grained carbonate is interstitial to the matrix quartz and the feldspars. They form a rim on the grains or partly replace the

			feldspars. Late carbonate veins that cross-cut the rock are coarse-grained and are intergrown with coarse-grained (minor) quartz.
Sericite	2		Sericite is interstitial to the matrix carbonate and feldspars. They also occurs as small stringers in the recrystallized matrix.
Chlorite	2		Chlorite is interstitial to the matrix. Some occur as veins and contain aggregates of tourmaline and sericite.
Pyrite	18	0.3-3.5	Large, anhedral pyrite poikiloblasts are disseminated through the thin section. They contain inclusions of fine-grained quartz, albite and carbonate, suggesting that the pyrite post-dated alteration and partial recrystallization.
Magnetite, rutile	0.3 0.2	av. <0.2 minute	Fine-grained rutile occurs in late stringers and magnetite is randomly distributed in the thin section.

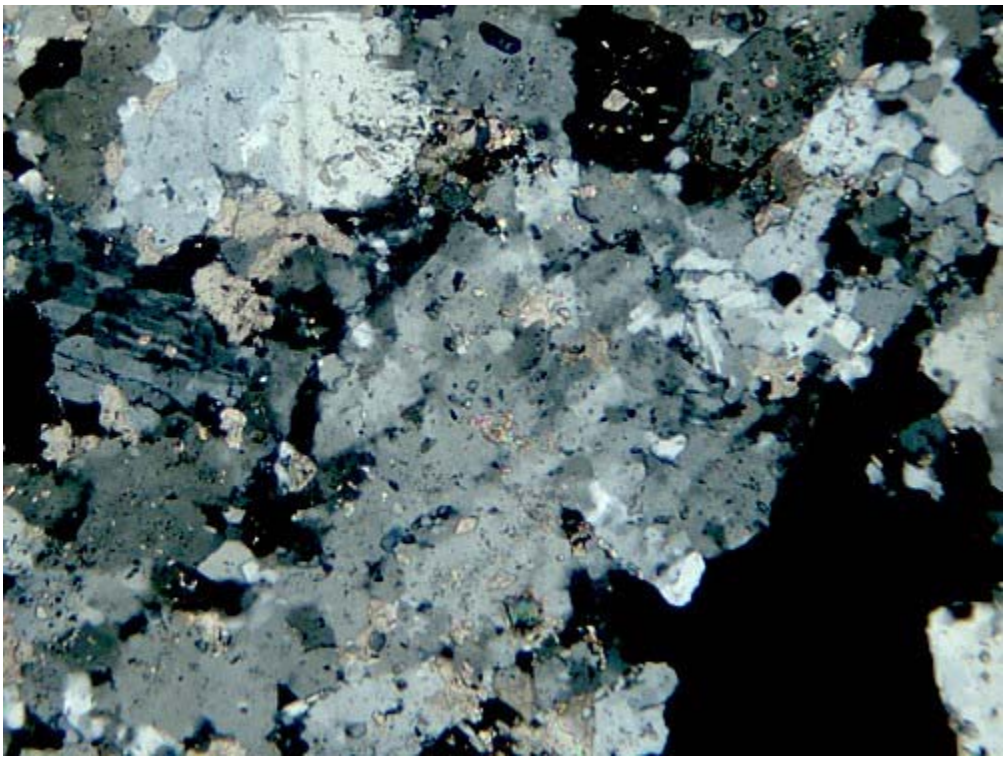
Accessory minerals: tourmaline, pyrrhotite, apatite, zircon



Albitized rock. X-axis of photo: 1.6mm. XN.



Recrystallized feldspar. X-axis of photo: 1.6mm. XN.



Relict, partly recrystallized plagioclase. X-axis of photo: 1.6mm. XN.

Sample Number: I589329 **Rock Type: Felsic intrusive?**

Petrographic Description:

An extensively altered, flattened and partly recrystallized rock. The protolith is difficult to identify due to recrystallization and flattening of the feldspars. The composition of feldspars cannot be determined as the twin lamellae were destroyed. The rock consists of fragmented, granulated and partly recrystallized plagioclase, quartz, chlorite, carbonate and fine-grained magnetite. The chlorite veins define the rock fabric and wrap-around the partly recrystallized plagioclase. They are locally intercalated with carbonates, but a late carbonate vein is at right angle to the chlorite veins and cross-cuts the rock fabric.

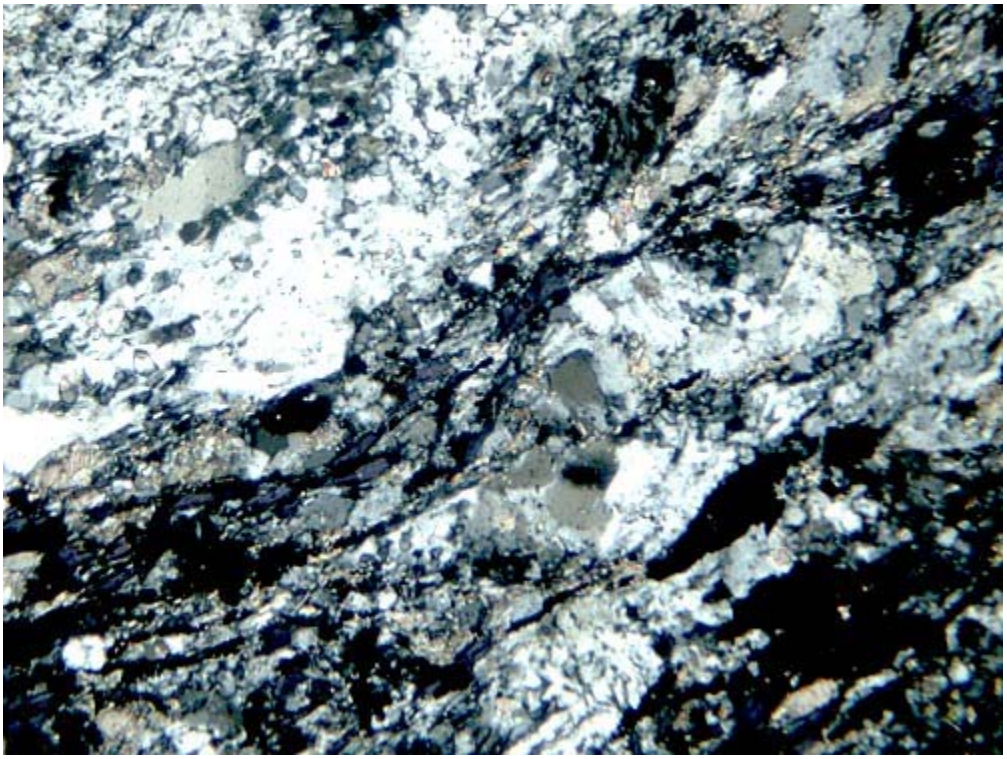
A large, 6 mm long pyrite poikiloblast contains inclusions of quartz, albite and carbonate and have quartz pressure shadows. The large pyrite is rimmed by fine-grained magnetite and a few grains of chalcopyrite. Small, anhedral pyrite are also included in chlorite veins and aggregates. Some are rimmed by fine-grained magnetite and some are intergrown with small grains of chalcopyrite.

Detailed mineralogy

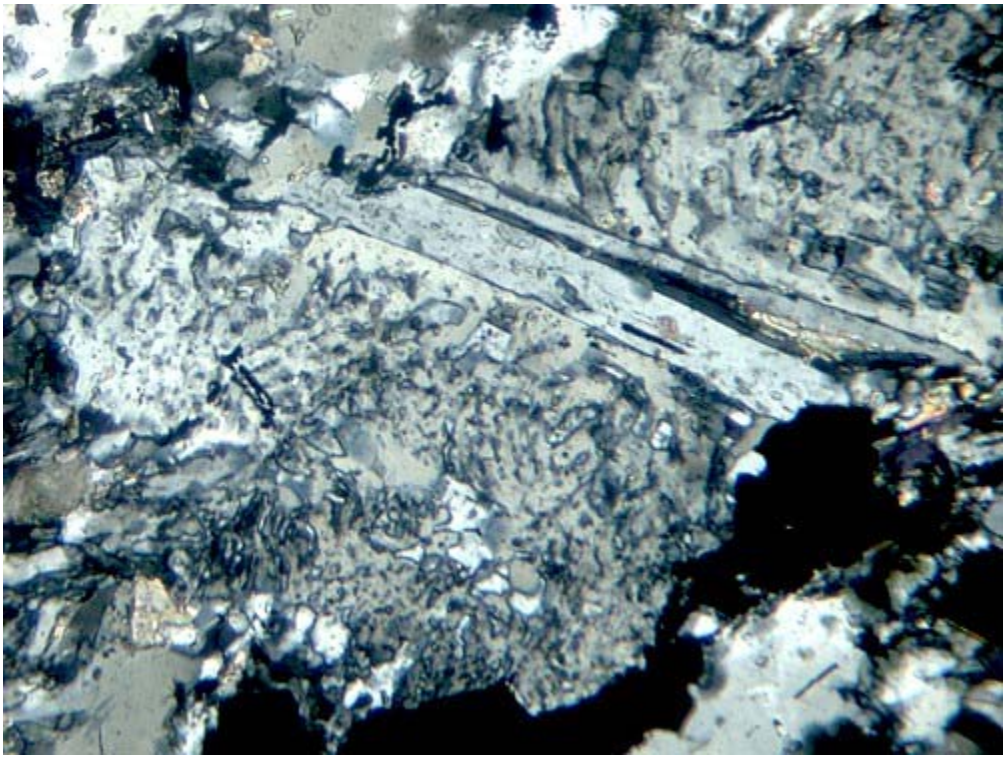
Mineral	%	Grain size(mm)	Comments
Plagioclase	37	0.5-2.0	Plagioclase phenocrysts are granulated, partly recrystallized and some grains are flattened. A number of phenocrysts are rimmed by microcrystalline quartz (recrystallization) and granophyric overgrowth on plagioclase may be primary or secondary. They are wrapped around by narrow chlorite veins, rotated and slightly flattened.
Quartz	34	microcrystalline-1.0	Quartz occurs as fine-grained aggregates that partly replace the plagioclase, as part of the original matrix and as pressure shadows on some pyrite. Their grain size varies and shape of the grains are mostly angular – with the exception of the semi-granoblastic quartz in the pressure shadows.
Chlorite	10		Chlorite stringers define the rock fabric. Chlorite boudinage and wrap-around the feldspars and recrystallized feldspars. They contain aggregates and stringers of

			magnetite.
Sericite	6		Sericite occurs in veins interstitial to the quartz and feldspars. It generally parallels the orientation of chlorite veins.
Carbonate	6	av. 0.3	Fine-grained carbonate is disseminated through the rock. They are interstitial to and partly replace some of the feldspars. They also occur in veinlets that parallel or are perpendicular to the rock fabric.
Magnetite	4	variable up to 0.4	Fine-grained magnetite are included in chlorite veins. Secondary magnetite forms a rim on pyrite, partly replacing pyrite.
Pyrite	3	0.2-5.0	Aggregates of anhedral, fine-grained pyrite are rimmed by magnetite and chlorite. They are often included in chlorite veins. One large euhedral pyrite poikiloblast that contains carbonate and quartz inclusions is rimmed by fine-grained magnetite. This suggests that the pyrite post-dated deformation, the carbonates, but pre-dated the magnetite.

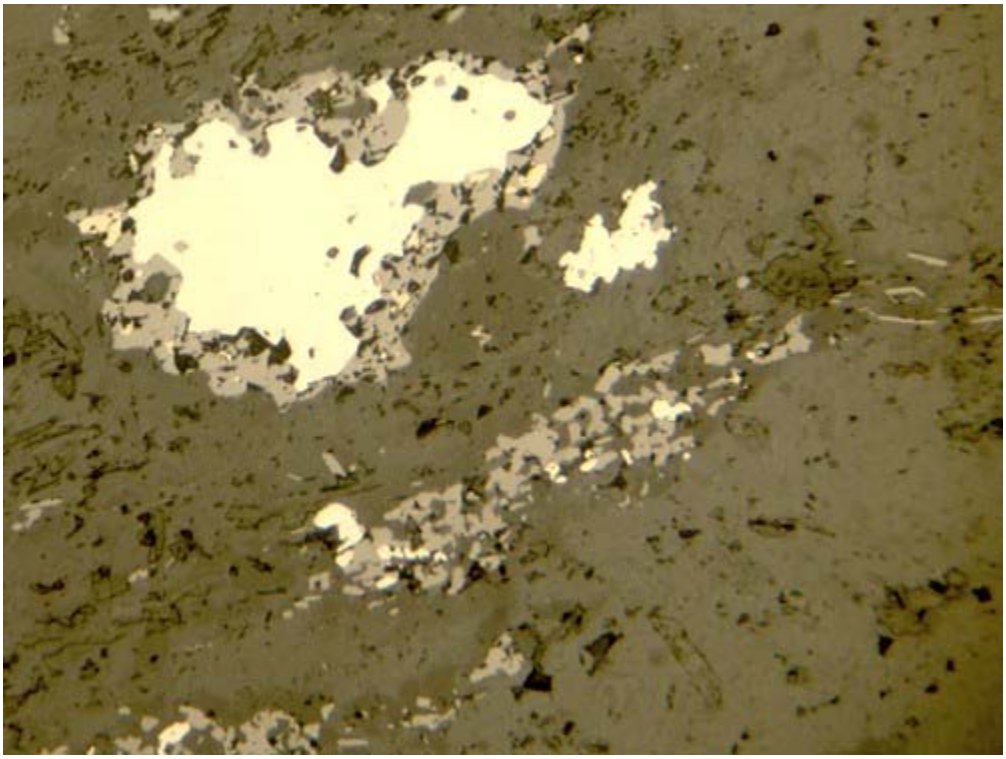
Accessory minerals: chalcopyrite, apatite



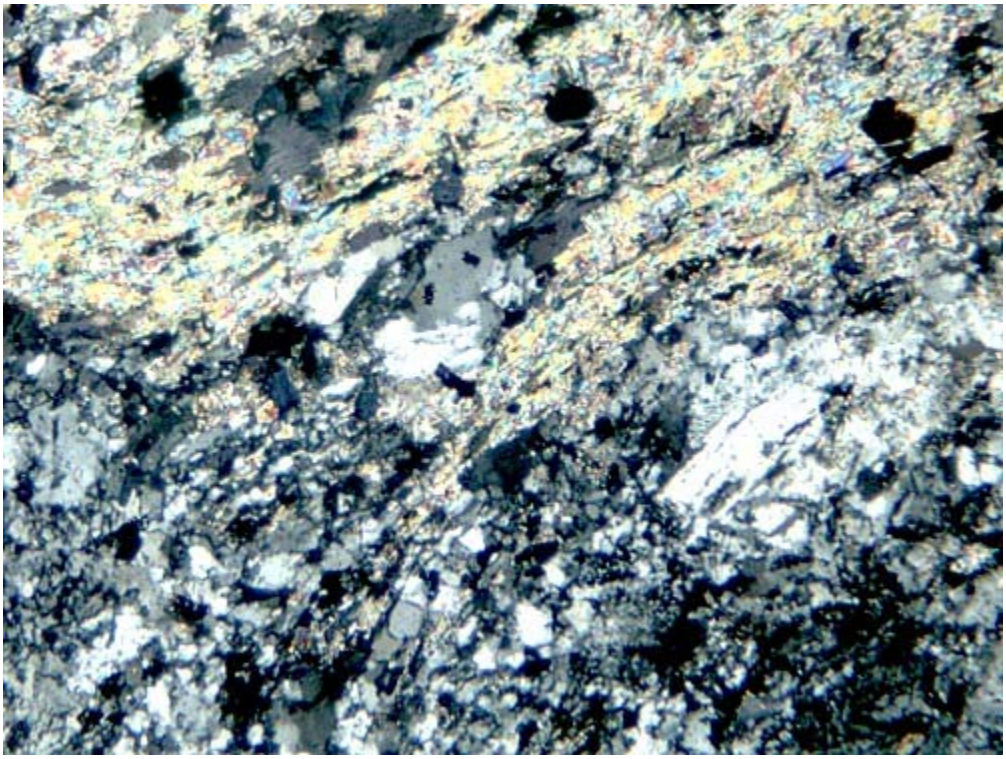
Flattened, sheared and recrystallized plagioclase. X-axis of photo: 1.6mm. XN.



Granophyre on relict plagioclase. X-axis of matrix: 1.6mm. XN.



Pyrite is rimmed by fine-grained magnetite. X-axis of photo: 1.6mm. XN.



Sericite replacement (yellow) of granulated matrix of quartz and feldspars. X-axis of photo: 1.6mm. XN.

Sample Number: I589330 **Rock Type: Graphic granite?**

Petrographic Description:

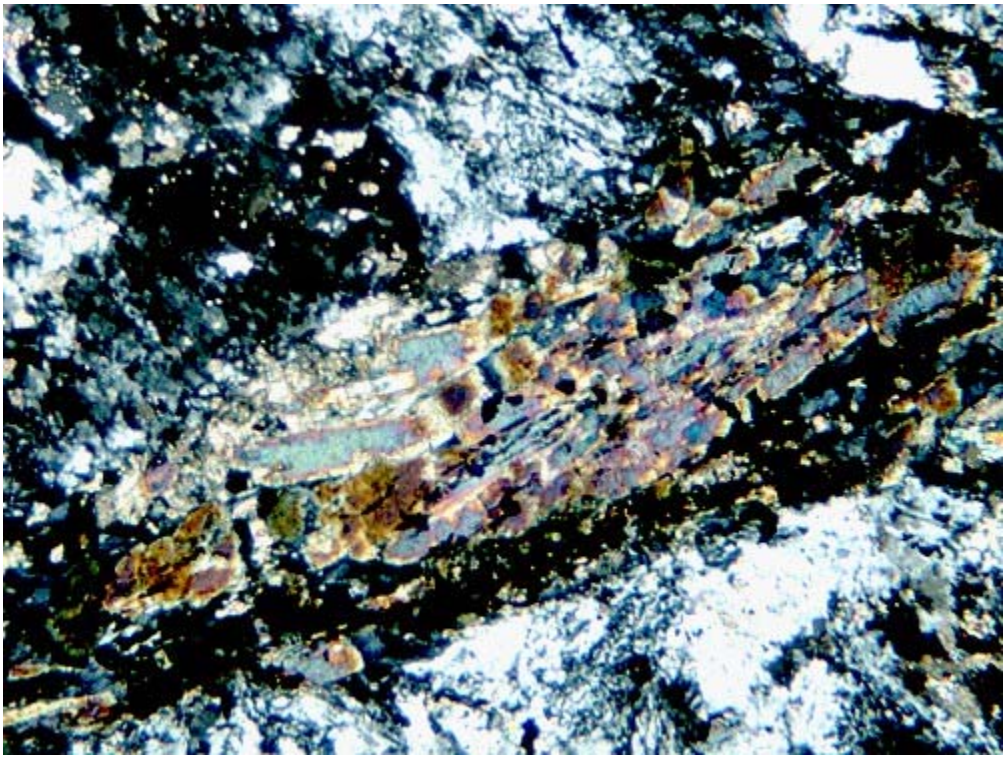
An extensively altered and partly recrystallized rock that consists predominantly of altered, fragmented plagioclase (oligoclase), an abundance of granophyre, chlorite, carbonate, quartz, and opaque minerals (cannot identify in covered thin section). The rock shows evidence of shearing, brecciation and partial recrystallization. The granophyre is believed to be partly secondary and the result of contact metamorphism. Chlorite and minor carbonate and sericite alteration are apparent. The chlorite occurs as cross-cutting veins and interstitial veinlets between the fragmented feldspars. One relatively large vein contains aggregates of lath-shaped tourmaline in the center. Fine-grained carbonate are disseminated through the matrix and sericite is often associated with chlorite.

Detailed mineralogy

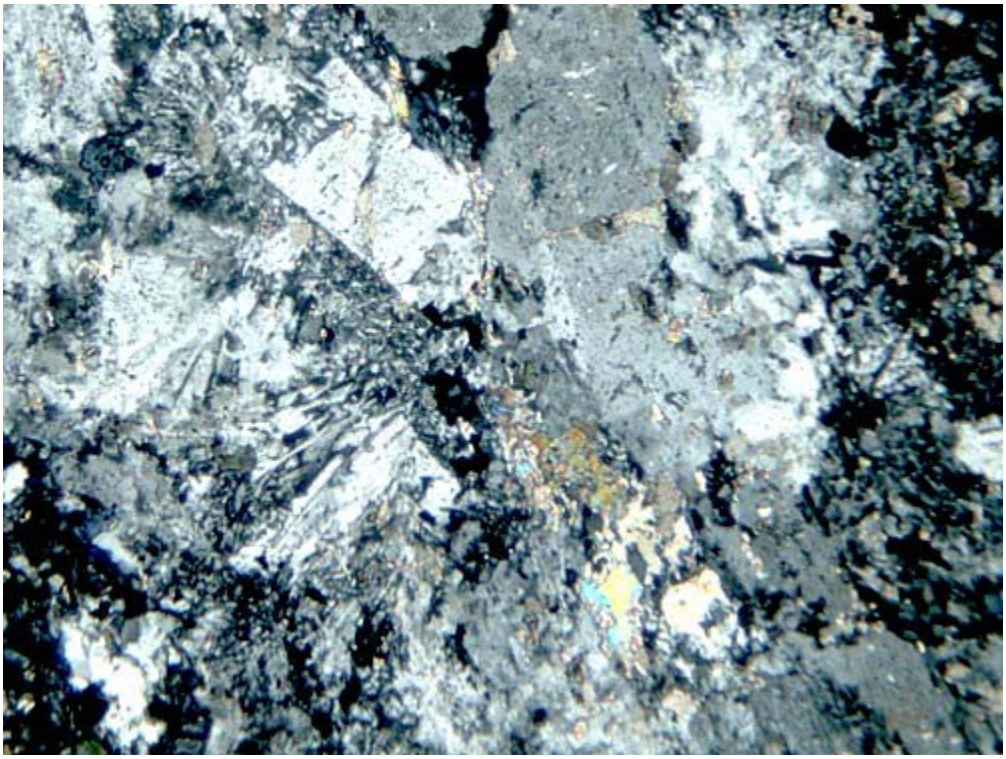
Mineral	%	Grain size(mm)	Comments
Plagioclase	43	0.5-3.0	Fragmented and partly recrystallized plagioclase makes up a significant part of the thin section. The fragmented phenocrysts are overgrown by and partly replaced by fine granophyre. The composition of plagioclase is in the oligoclase range.
Granophyre	30		Fine granophyre appears to be secondary (at least in part). It not only forms a rim on the plagioclase but also on some of the secondary minerals such as carbonate and quartz. It partly replaces the twin lamellae of some plagioclase phenocrysts.
Quartz	12	0.1-1.5	Angular, fine-grained quartz is interstitial to the feldspars. In some domains they are sheared and granulated. Aggregates of secondary quartz occurs as granoblastic aggregates and are associated with chlorite.
Chlorite	8		Chlorite is interstitial to the plagioclase. It occurs as small veinlets and fills fractures. A late chlorite vein contains aggregates of large tourmaline laths.

Sericite	2		Sericite is interstitial to the chlorite-altered domains.
Carbonate	3	av. 0.3	Fine-grained carbonate is disseminated through the thin section. Some occur in aggregates associated with chlorite.
Opaques	2	variable	Opaque minerals cannot be identified in the covered thin section. The anhedral grains are generally rimmed by chlorite.

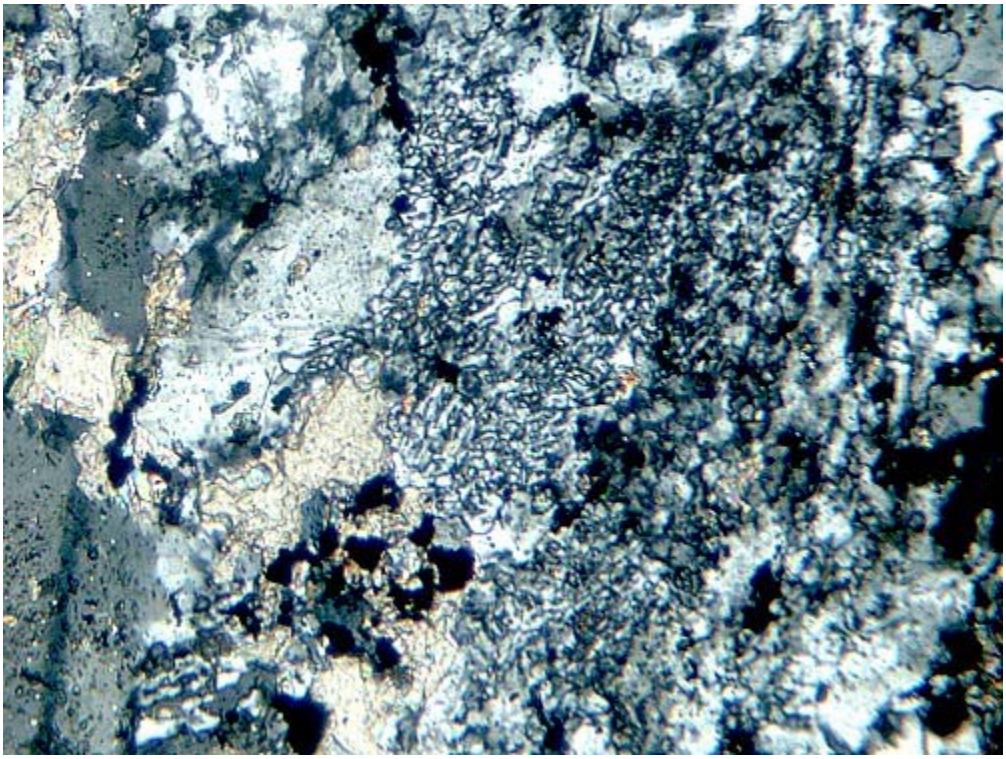
Accessory minerals: tourmaline, zircon, apatite, epidote



Tourmaline vein (multi color) in recrystallized felsic intrusion.
X-axis of photo: 1.6mm. XN.



Fine granophyre is interstitial to the plagioclase. X-axis of photo: 1.6mm. XN.



Recrystallized blebby ‘granophyre’ form a rim on carbonate (tan color) and is interstitial to corroded feldspars. X-axis of photo: 1.6mm. XN.

Sample Number: I589331 **Rock Type Felsic intrusive**

Petrographic Description:

A partly albitized felsic intrusive rock. It consists of medium-grained plagioclase, secondary, fine-grained albite, quartz, carbonate and chlorite. The original plagioclase is partly recrystallized and the twin lamellae were destroyed. Interstitial aggregates of fine-grained albite suggests subsequent albitization. Minor granophyre is also interstitial to the igneous plagioclase. Anhedral aggregates of angular quartz is intergrown with or interstitial to the feldspars. Secondary aggregates of quartz are associated with carbonate and chlorite-rich domains. Chlorite is abundant and is interstitial to the feldspars. A late chlorite vein (appears to be different composition) cross-cuts the rock fabric. Fine-grained biotite is locally associated with chlorite and forms a rim on the opaque minerals.

Opaque minerals cannot be identified from the covered thin section. The anhedral grains are relatively abundant and are randomly distributed..

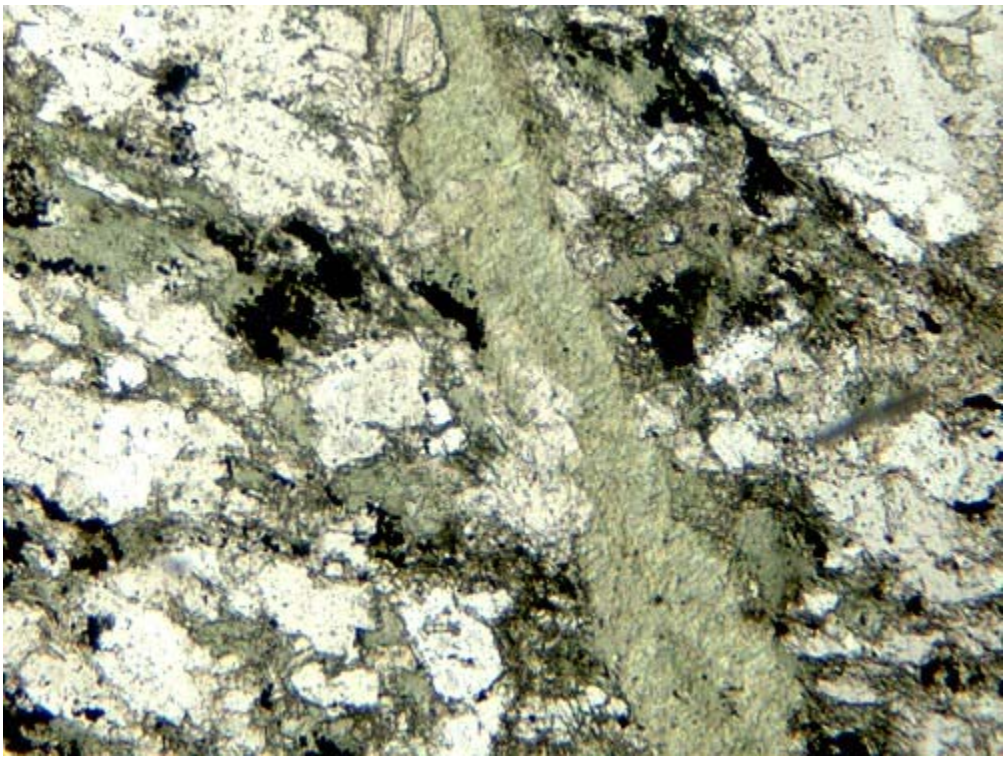
Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Plagioclase / albite	50 10	0.4-3.0	Plagioclase phenocrysts occur as slender, lath-shaped grains and as wide, partly fragmented and recrystallized grains. Some are partly replaced by secondary albite and some by poorly developed granophyre.
Quartz	15	variable up to 1.0	Fine-grained angular quartz are interstitial to the feldspars. Some quartz are fragmented and have sutured grain boundaries. The larger quartz are weakly subrounded and have smooth grain boundaries. The latter occur with chlorite.
Carbonate	3	0.1-0.6	Fine-grained carbonate is disseminated through the thin section. Aggregates of carbonate partly replaced some of the relict plagioclase. Carbonate also occurs in veins with the chlorite.
Granophyre	2		Poorly developed granophyre partly replaced some of the plagioclase.
Chlorite	10		Chlorite occurs in anastomosing and deformed veins interstitial to the feldspars.

			The earlier veinlets weakly define the rock fabric, whereas a late vein cross-cuts the rock fabric. Sericite and carbonate are commonly associated with chlorite.
Biotite	2	av. 0.2	Fine-grained biotite is disseminated through the thin section. It generally occur along the chlorite-rich domains or form a rim on the opaque minerals.
Opaque minerals	8	variable	Cannot be identified from covered thin section

Accessory minerals: apatite, rutile

Secondary albite replaces original plagioclase (untwinned). X-axis of photo: 1.5mm. XN.



Chlorite vein cross-cuts fragmented relict plagioclase. X-axis of photo: 1.6mm. Ppl.

Sample Number: I589332 **Rock Type:?**

Petrographic Description:

An almost completely recrystallized, altered and granulated rock. A few large grains of relict plagioclase suggests that the original mineralogy and texture were probably comparable to the previous sample (I589331). However, the texture of some domains suggests that the rock is a chaotic mixture of sediments and igneous fragments.

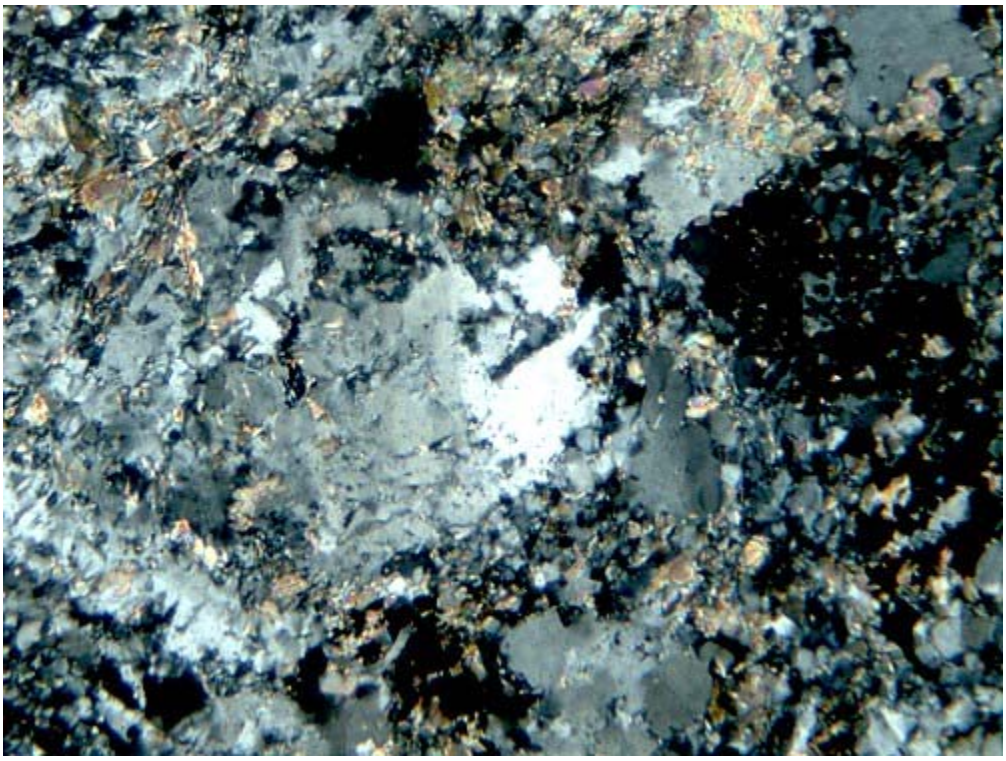
The present mineralogy consists of recrystallized and altered plagioclase, quartz, biotite, chlorite, carbonate and fine-grained opaque minerals. Alteration is pervasive and much of the original mineralogy was destroyed.

Detailed mineralogy

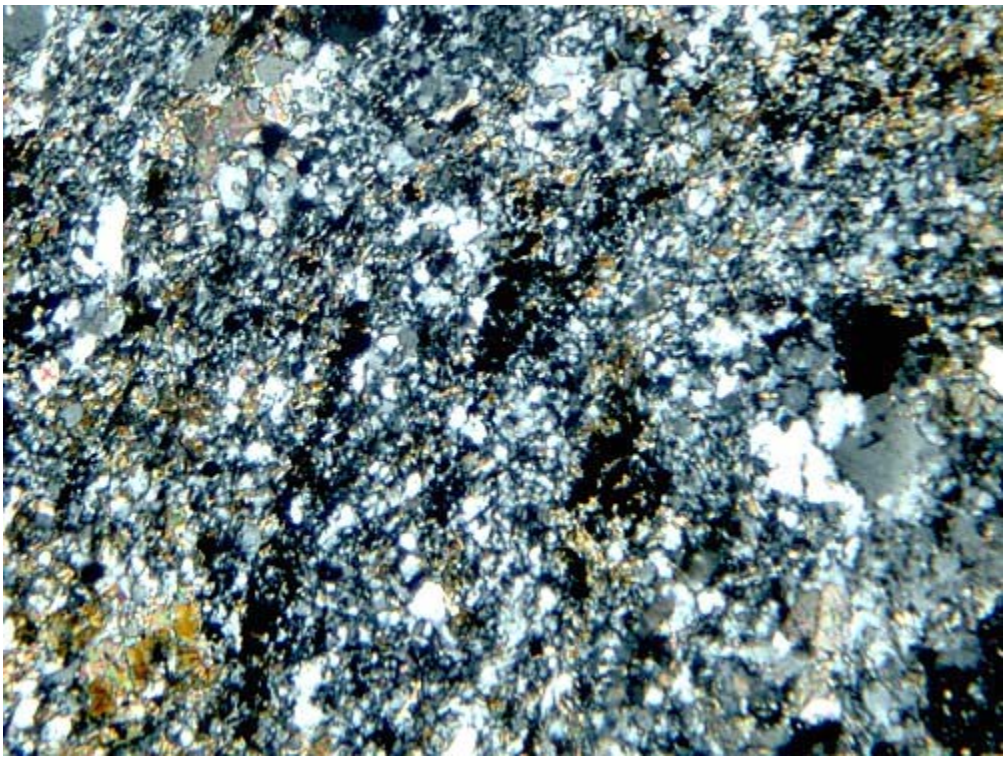
Mineral	%	Grain size(mm)	Comments
Plagioclase	26	fragments only-up to 2.0	Most plagioclase are fragmented and the twin lamellae were destroyed. They are partly recrystallized to fine-grained aggregates and partly occur as angular fragments.
Quartz	40	microcrystalline-2.0	Fine-grained, granulated quartz makes up some domains. Others occur as large, anhedral grains with resorbed grain boundaries.
Carbonate	8	0.2-1.5	Fine-grained carbonate is locally abundant. Some occur in specific domains and some in veins that cross-cuts the rock. They contain inclusions of sericite aggregates, suggesting that sericite pre-dated the carbonates.
Biotite	5	up to 0.4	Fine-grained biotite is randomly distributed through the rock. It occurs in aggregates and also as small veinlets interstitial to the recrystallized quartz and feldspars.
Sericite	5		Sericite is intercalated with chlorite and some of the carbonate. Small sericite veinlets are interstitial to the feldspars and quartz.

Chlorite	10		Chlorite occurs in small stringers interstitial to the quartz. It also forms large domains that are rimmed by a second generation vein.
Opaque minerals:	6	variable	Opaque minerals cannot be identified in covered thin section.

Accessory minerals: apatite, rutile



Relict, fragmented plagioclase. X-axis of photo: 1.6mm. XN.



Recrystallized, fine-grained matrix. X-axis of photo: 1.6mm. XN.

Sample Number: I589333 **Rock Type: Quartz diorite ?**

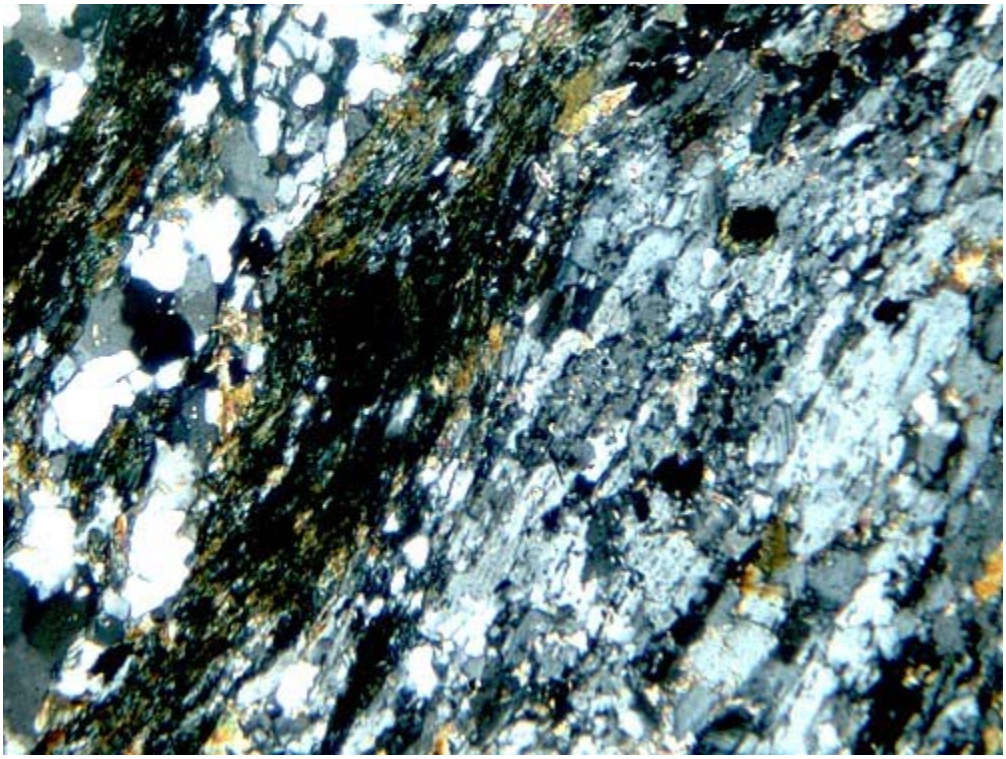
Petrographic Description:

The rock is either a sheared quartz diorite or a metasediment. Compositional banding, flattening of plagioclase and quartz, deformation are characteristic. The various bands include plagioclase, tourmaline+biotite, quartz, chlorite and biotite-rich domains. Fine-grained, fibrous dark green-black tourmaline stringers are deformed and adjacent plagioclase are extensively stretched and flattened, suggesting shearing and deformation. The tourmaline stringers are mixed with some biotite. Fine-grained quartz, mixed with fine-grained granulated feldspars makes up a significant part of the rock.

Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Quartz	40	av. 0.3 up to 1.5	Fine-grained, flattened quartz is mixed with flattened plagioclase and occurs in parallel bands. Their texture suggests shearing.
Plagioclase	40	av. 0.6	Plagioclase is present as small, stretched and flattened grains that make up some of the compositional bands. Their twin lamellae were destroyed and their composition cannot be determined.
Biotite	5	0.1-0.4	Fine-grained biotite seams parallel the rock fabric. Some are intercalated with the tourmaline-rich stringers.
Chlorite	6		Chlorite is relatively abundant in the rock. The chlorite-rich seams (together with tourmaline) define the rock fabric.
Tourmaline	6		Fibrous tourmaline-rich stringers parallel the rock fabric. They are contorted veins adjacent to the stretched and flattened feldspars.
Opaque minerals	3	variable	Small opaque minerals are disseminated through the thin section. They cannot be identified from covered the thin section.

Accessory minerals: epidote, rutile, apatite



Sheared, flattened and granulated plagioclase laths. X-axis of photo: 1.6mm. XN.

Tourmaline veins (multi color) in granulated rock. X-axis of photo: 1.6mm. XN.

Sample Number: I589334 **Rock Type: Albitite?**

Petrographic Description:

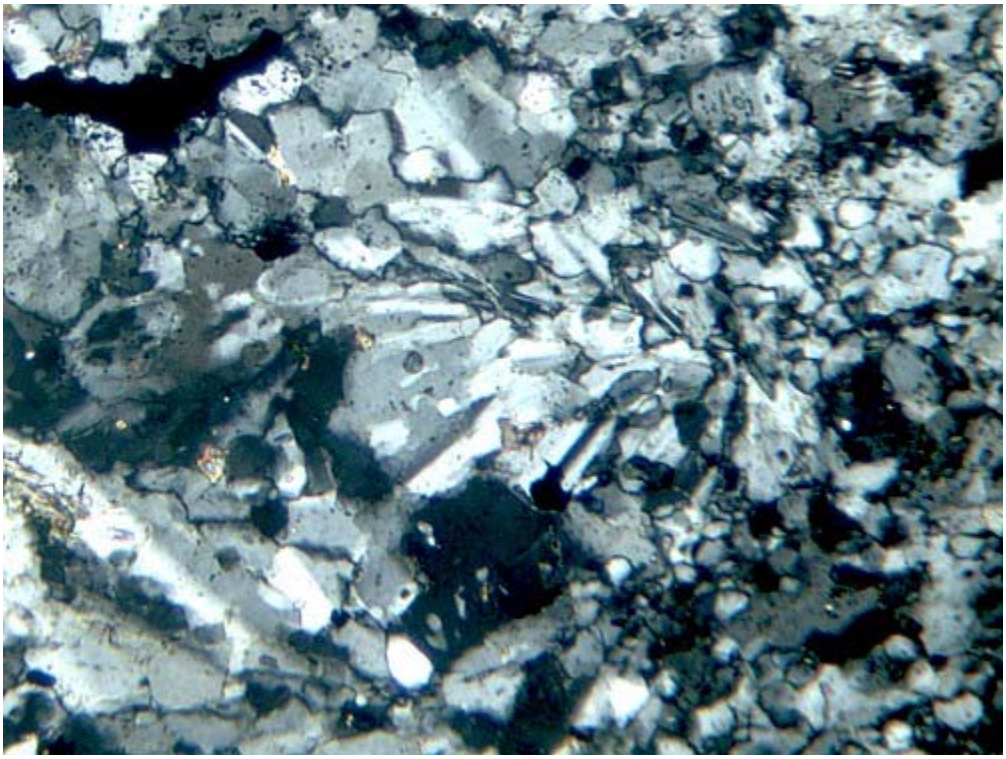
A fine-grained rock that consists predominantly of albite, quartz, carbonate, pyrite and pyrrhotite. Due to extensive recrystallization, the protolith of the rock is uncertain. The present texture indicates a fine-grained felsic intrusive that is albitized and carbonate altered. Radiating aggregates of fine-grained albite make up some domains and they are partly recrystallized. Minerals in the recrystallized domains have 'blebby' texture where the anhedral small grains have sutured and embayed grain boundaries. Carbonate is disseminated through the thin section and fine-grained carbonates occur in some domains where they replaced the feldspars and quartz.

Coarse-grained, anhedral pyrite poikiloblasts contain several inclusions of carbonate and quartz, post-dated carbonate alteration. Fine-grained pyrrhotite are abundant in some domains.

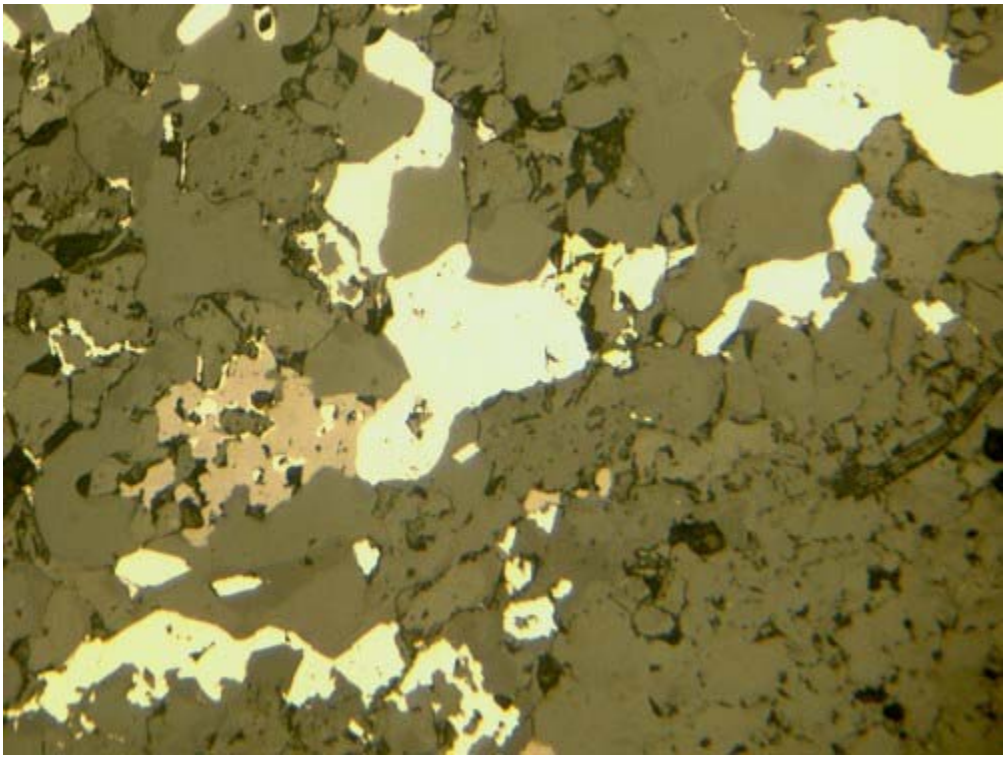
Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Albite	40	0.1-0.5	Fine-grained albite occurs as radiating aggregates within small domains. Most are however, replaced by fine-grained quartz.
Quartz	47	<0.1-0.5	Fine-grained, anhedral quartz makes up a significant part of the rock. The embayed and sutured grain boundaries suggest disequilibrium. They are granulated and partly replaced some of the albite.
Carbonate	8	variable up to 1.0	Carbonate aggregates occur as discontinuous veins and as aggregates intergrown with pyrrhotite. They also form a rim on some of the quartz..
Pyrite	3	minute-3.0	Pyrite poikiloblasts contain inclusions of carbonate, quartz and albite. This suggests that they post-dated the silicates and the carbonate.
Pyrrhotite	2	av. 0.3	Fine-grained pyrrhotite are associated with the carbonate-rich domains. They are interstitial to the carbonate aggregates.

Accessory minerals: chlorite, sericite, rutile, magnetite



Radiating secondary albite. X-axis of photo: 1.6mm. XN.



Pyrite is rimmed by pyrrhotite. (in carbonate). X-axis of photo: 1.6mm. XN.

Sample Number: I589335 **Rock Type: Albitite**

Petrographic Description:

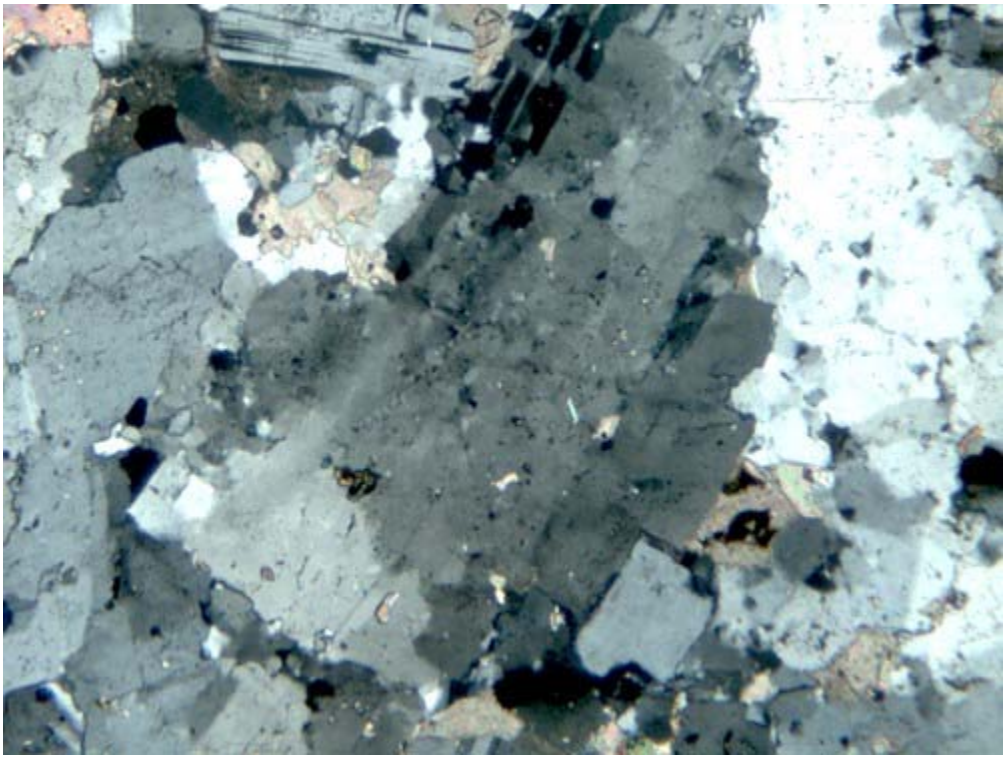
A medium-grained rock that consists almost completely of albite, minor quartz, carbonate and pyrite. The albite are secondary and they crystallized at the expense of earlier feldspars. Radiating aggregates of albite replace the earlier phenocrysts and some form a rim on partly recrystallized plagioclase. Fine-grained carbonate is interstitial to the silicates and is most abundant in the recrystallized (to albite) domains.

Anhedral, amoeba-like pyrrhotite forms a rim on some of the recrystallized feldspars. The smaller grains are interstitial to the albite and carbonates..

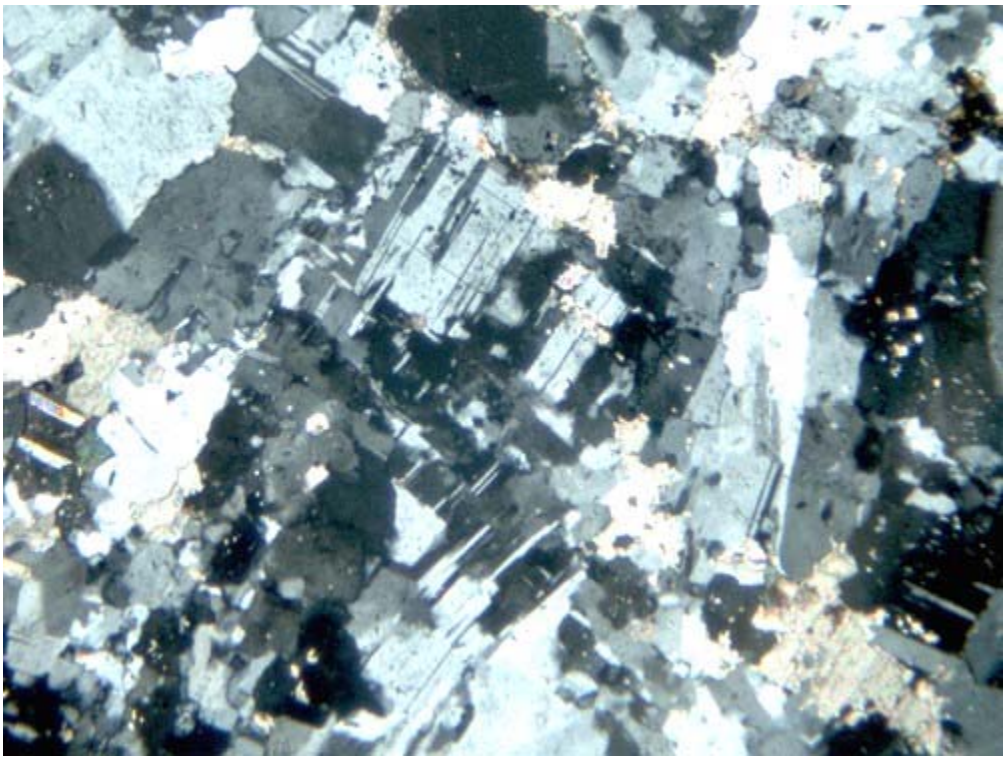
Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Albite / plagioclase	75 5	0.2-2.0	The earlier feldspars were replaced by secondary albite. The latter occurs as radiating aggregates, as blocky grains and as chessboard albite. The twin lamellae were destroyed in the relict plagioclase during partial replacement and recrystallization.
Quartz	10	variable up to 1.5	Quartz is a byproduct of albite replacement. Anhedral quartz is interstitial to the albite.
Carbonate	5	0.2-1.2	Fine-grained carbonate are randomly distributed in the rock. The anhedral grains are most common in the recrystallized domains.
Pyrrhotite	1.5	0.2-2.0	Anhedral pyrrhotite occur as amoeba-like grains intruding recrystallized silicates.
Pyrite	0.5	up to 1.0	Pyrite pre-dated pyrrhotite and some grains are rimmed by pyrrhotite.
Ilmenite	3	up to 2.5	Elongate, coarse-grained ilmenite are relict grains from the original rock.

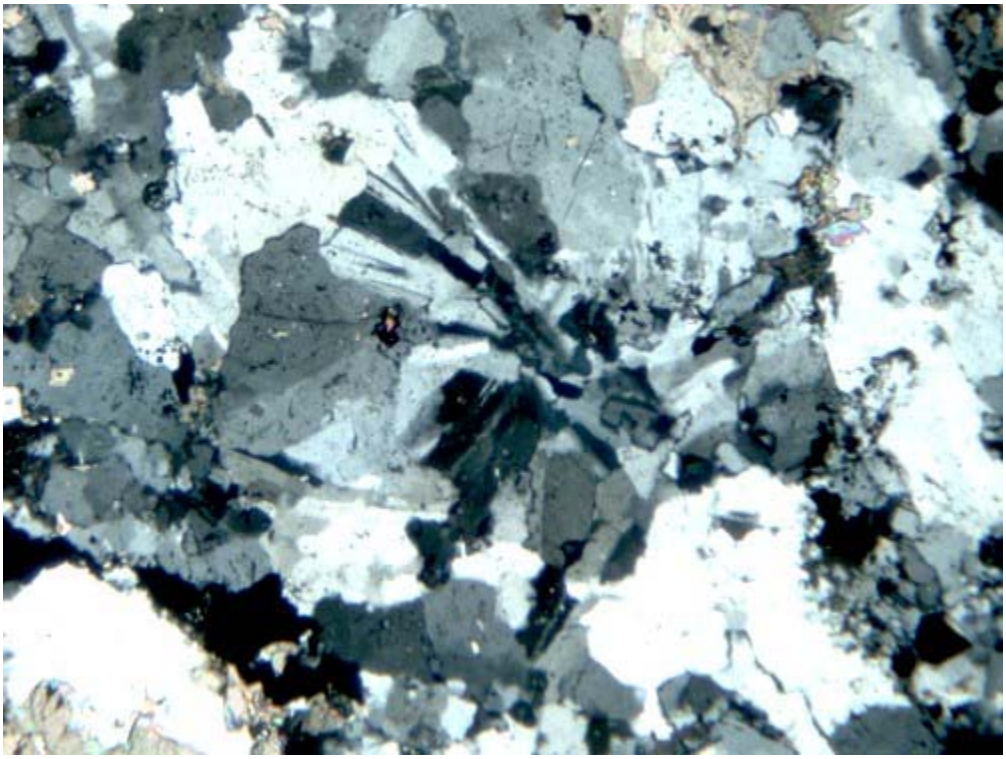
Accessory minerals: zircon, apatite, chlorite



Partly recrystallized relict plagioclase. X-axis of photo: 1.6mm. XN.



Plagioclase replaced by aggregate of twinned albite (in center).
X-axis of photo: 1.6mm. XN.



Radiating albite nucleates (in center) on recrystallized feldspars.
X-axis of photo: 1.6mm. XN.

Sample Number: I589336 **Rock Type: Felsic intrusive?**

Petrographic Description:

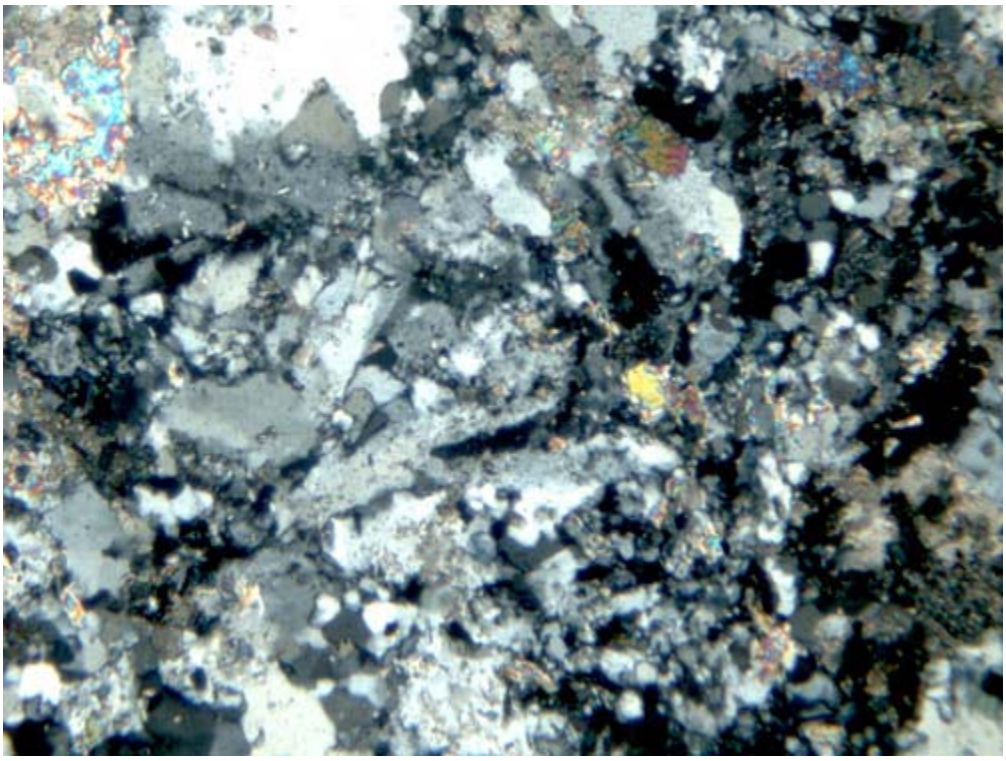
A pervasively altered and recrystallized rock with chaotic texture. Relict texture (rare) and chemistry suggest that the rock may have been a felsic intrusive. It contains a relatively high percent of quartz in comparison with the 'albitites' and recrystallization is extensive. Relict feldspars are rare and the texture of quartz aggregates in some domains suggests a metamorphic origin. Alteration in the rock includes silicification, sericite / muscovite, chlorite and carbonate alteration. A few clusters of fine-grained tourmaline are interstitial to the sericite/muscovite-rich domains.

Opaque minerals cannot be identified from the covered thin sections.

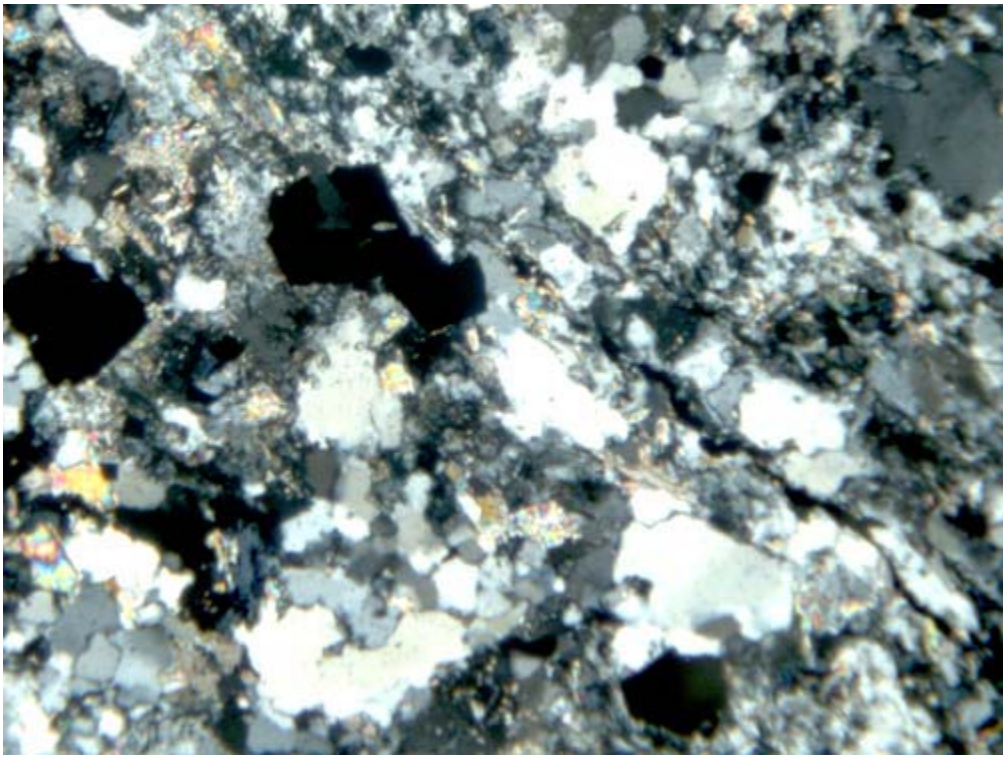
Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Plagioclase	35	0.3-1.2	Relict plagioclase and relict albite are partly recrystallized. The twin lamellae were destroyed and the composition of plagioclase cannot be determined. The grains are partly silicified and recrystallized at the grain boundaries.
Quartz	45	<0.2-1.8	Very fine to medium-grained quartz occur in distinct domains. They all have sutured and resorbed grain boundaries.
Chlorite	8		Chlorite occurs in discontinuous veins interstitial to the quartz and feldspars. They also form distinct domains, several of which contain inclusions of carbonate.
Muscovite / sericite	4	up to 0.5	Muscovite and sericite are randomly distributed in the thin section. Some relict feldspars are partly replaced by the micas.
Carbonate	5	variable up to 0.8	Aggregates of carbonate are commonly associated with the chlorite-rich domains.
Opaque minerals	3	up to 0.8	Anhedral opaque minerals occur as very fine-grained stringers and anhedral blocky grains. They cannot be identified in the covered thin section.

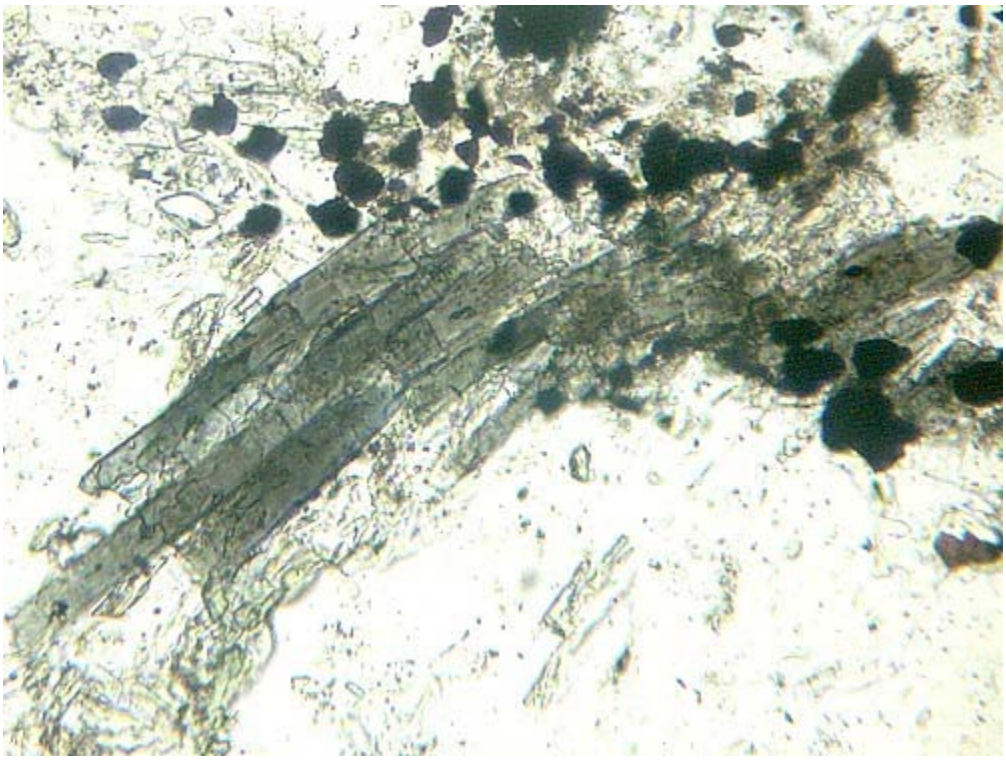
Accessory minerals: coarse apatite, tourmaline, zircon, rutile



Relict lath-shaped plagioclase. X-axis of photo: 1.6mm. XN.



Recrystallized quartz and feldspars. X-axis of photo: 1.6mm. XN.



Tourmaline prisms (green) in recrystallized rock. X-axis of photo: 1.6mm. XN.

Sample Number: I589337 **Rock Type:?**

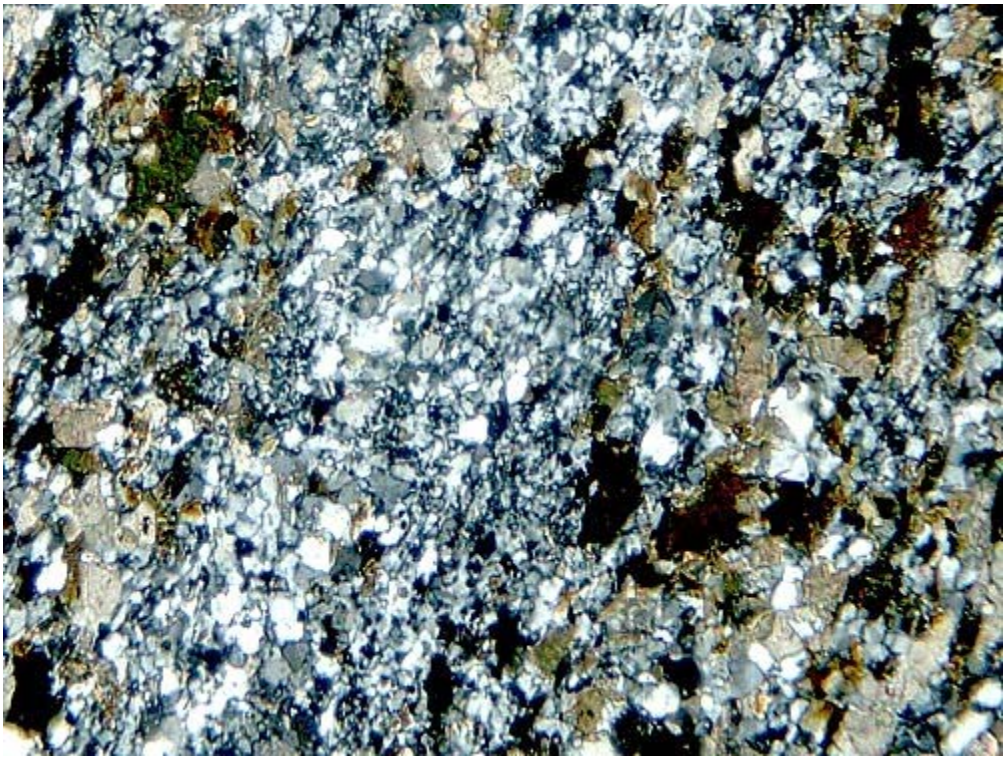
Petrographic Description:

A very fine-grained, weakly laminated rock. It consists of fine-grained quartz intergrown with fine-grained untwinned metamorphic feldspars, interstitial fine-grained biotite, lesser carbonate and chlorite. The protolith is uncertain as all minerals are metamorphic in origin.

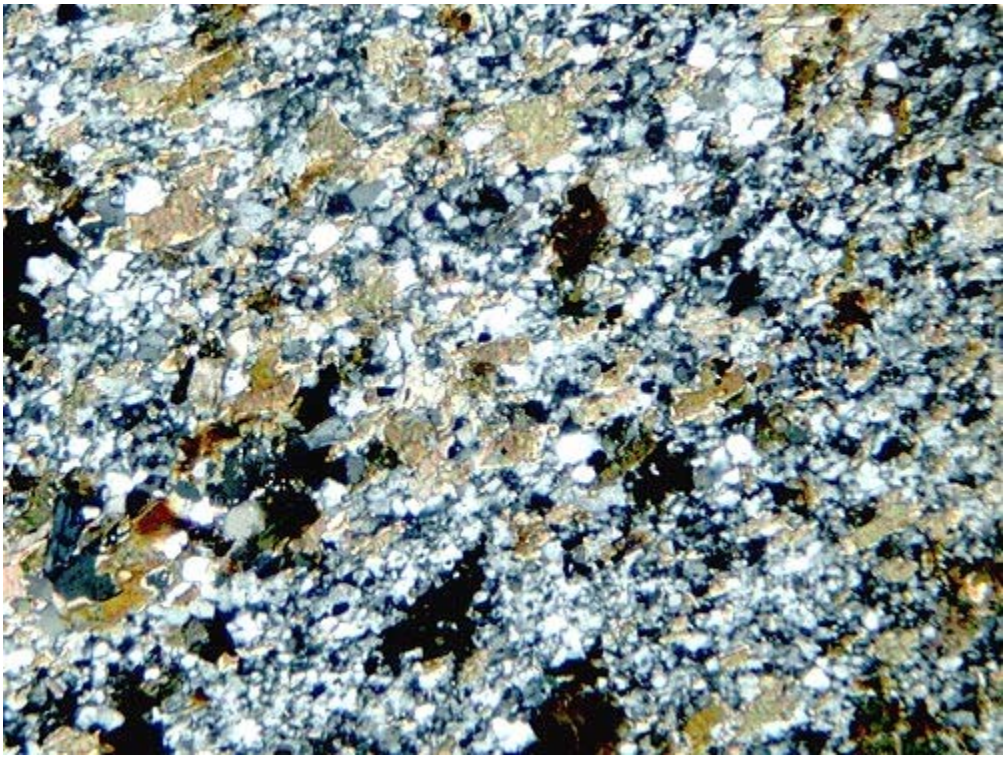
Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Quartz	42	<0.05-0.3	Anhedral, partly granular quartz makes up a significant part of the rock. The grain sizes vary between microcrystalline and very fine-grained. They are intergrown with interstitial feldspars.
Plagioclase	22	<0.3	Untwinned metamorphic plagioclase are interstitial to the quartz.
Biotite	25	0.1-0.3	Fine-grained biotite are weakly aligned in sub-parallel bands. They are intercalated with aggregates of carbonate and chlorite.
Carbonate	8	up to 0.5	Subhedral carbonate aggregates are disseminated through the rock. They are intercalated with biotite and chlorite.
Chlorite	3		Minor chlorite is interstitial to the biotite-rich domains.

Accessory minerals: tourmaline, rutile, opaques, apatite



Fine-grained recrystallized and carbonate-altered rock. X-axis of photo: 1.6mm. XN.



Similar to above. X-axis of photo: 1.6mm. XN.

Sample Number: I589338 **Rock Type: Andesite**

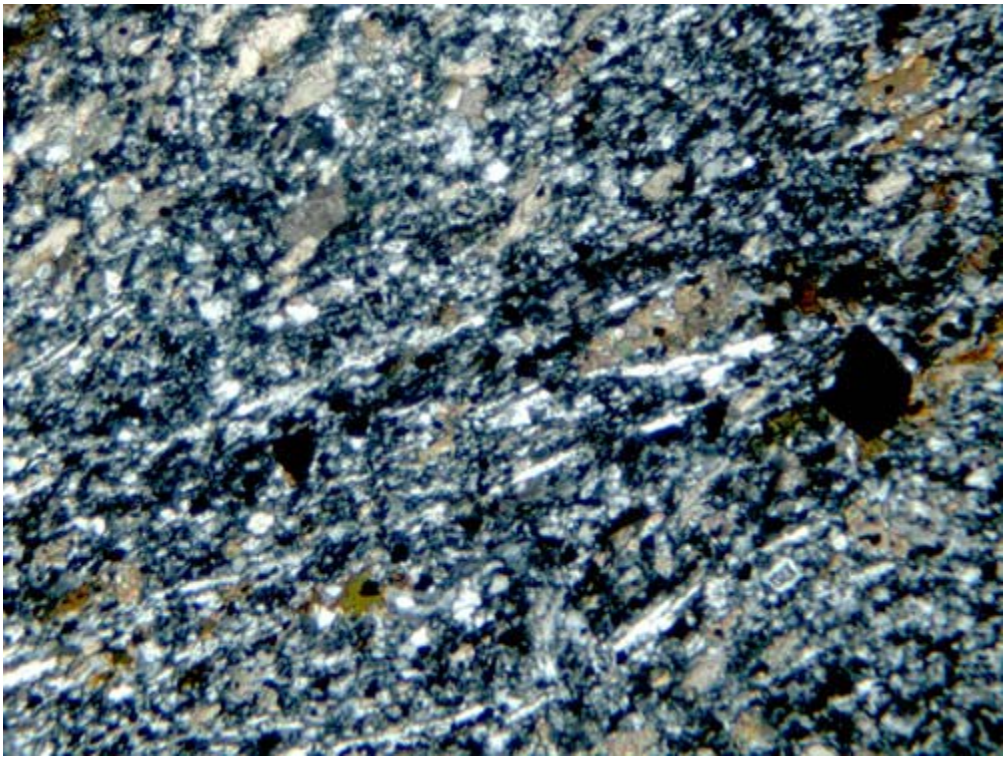
Petrographic Description:

A pervasively altered andesite. Relict, randomly oriented microlite is abundant in the matrix, which makes positive identification of the protolith possible. The rest of the very fine-grained rock had been replaced by carbonate, chlorite and biotite. The mineralogy is very simple as the andesite consists of very fine-grained quartz, biotite, chlorite and carbonate. The biotite is relatively coarse-grained, it occurs in clusters, suggesting that the aggregates replaced original phenocrysts. Fine-grained chlorite is interstitial to the matrix and much of the carbonate are disseminated through the thin section. They also occur in veins that cross-cut the rock and aggregates that may have replaced Ca-rich phenocrysts.

Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Quartz	25	av. <0.2	Fine-grained and microcrystalline quartz makes up part of the matrix. It is intergrown with late biotite.
Plagioclase (microlite)	20	av. 0.2	Small, needle-shaped relict microlite are interstitial to the quartz-chlorite matrix. They are randomly oriented.
Carbonate	35	0.2-1.2	Carbonate over-grows the rock fabric. It occurs as stretched, elongate grains, as aggregates and as a wide vein.
Chlorite	10		Fine-grained, weakly pleochroic chlorite is interstitial to the matrix quartz and microlite.
Biotite	10	0.1-1.0	Biotite forms a rim on some carbonates and it occurs as coarse-grained aggregates replacing earlier phenocrysts.

Accessory minerals: rutile, opaques



Altered andesite. Note plagioclase microlites (needle-shaped) aligned parallel to rock fabric. X-axis of photo: 1.6mm. XN.

Carbonate (light grains) and interstitial green chlorite in andesite.
X-axis of photo: 1.6mm. XN.

Sample Number: I589339 **Rock Type: Felsic intrusive?**

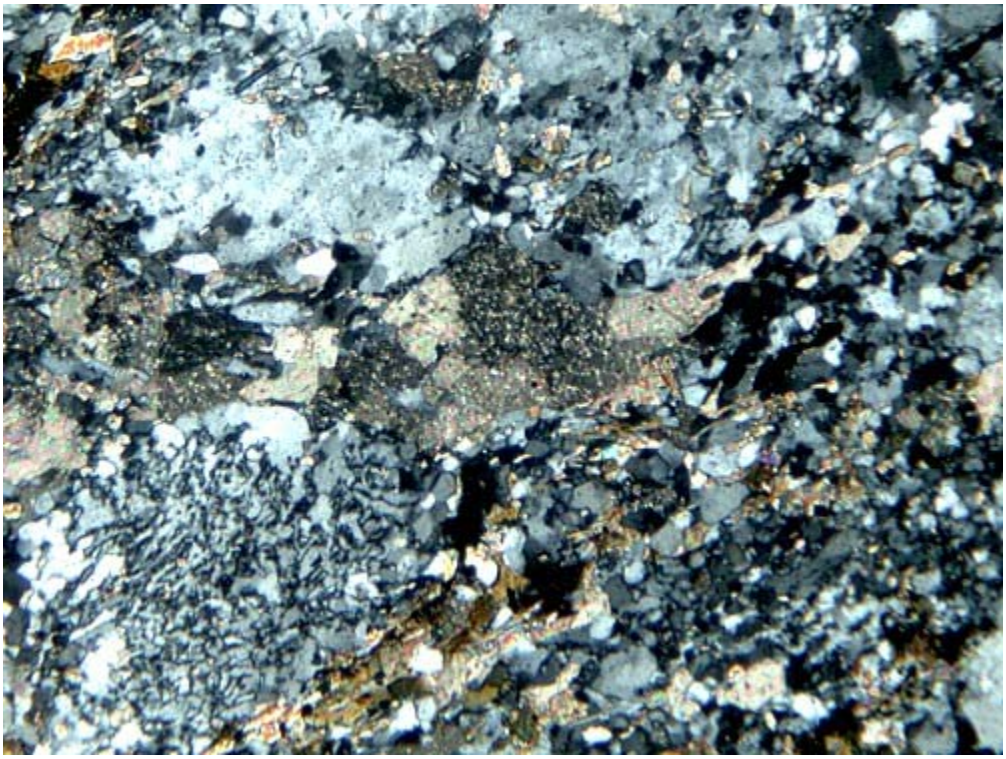
Petrographic Description:

A pervasively altered and partly recrystallized rock. It consists of granulated, partly recrystallized plagioclase, fine granophyre (interstitial to and replace the plagioclase), anhedral quartz, an abundance of biotite, aggregates of carbonate and interstitial chlorite. Extensive recrystallization of the original protolith is apparent from the sutured and embayed grain boundaries of the feldspars and quartz, and from the blebby, recrystallized texture of the granophyre. Biotite-rich veinlets are randomly oriented and appear to fill fractures. Carbonate aggregates are more or less associated with biotite, the latter of which forms a rim on some carbonates.

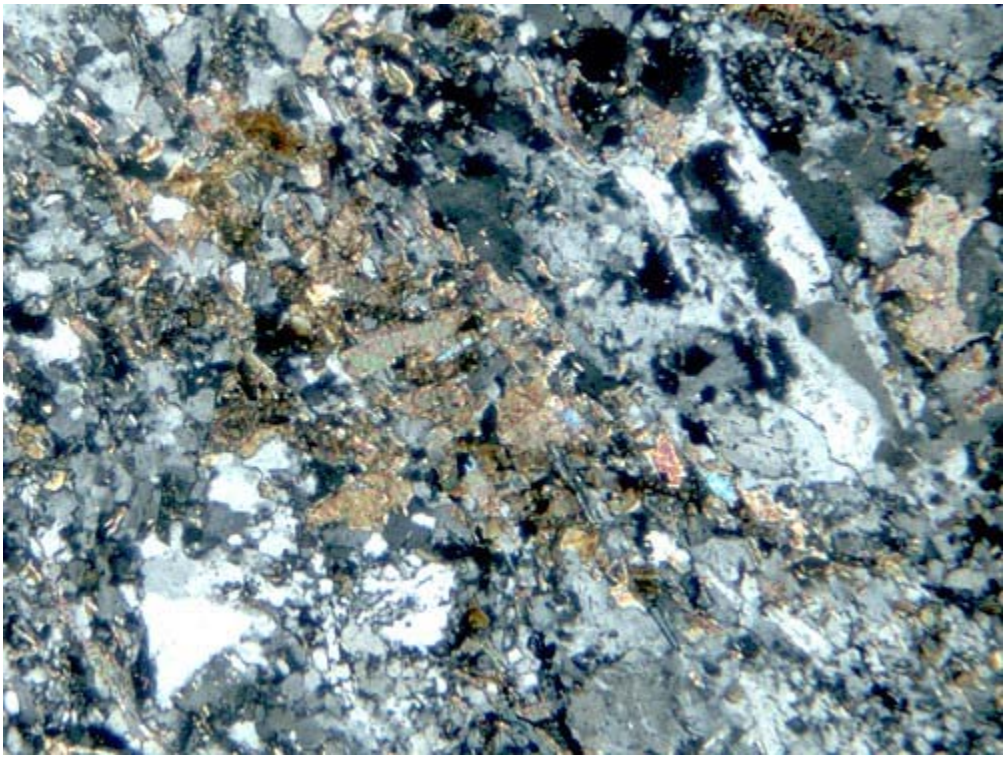
Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Quartz	32	0.2-2.0	Quartz are partly recrystallized and have sutured grain boundaries. The anhedral grains are interstitial to the feldspars.
Plagioclase	45	variable up to 1.2	Plagioclase are partly replaced by blebby recrystallized granophyre and they have sutured and embayed grain boundaries. The composition of the feldspars cannot be determined as the twin lamellae were destroyed.
Biotite	12	<0.1-0.4	Fine-grained biotite occurs in stringers interstitial to the quartz and feldspars. They also form a rim on aggregates of carbonate.
Carbonate	8	0.3-1.5	Anhedral/subhedral carbonate aggregates are interstitial to the recrystallized quartz and feldspars. Some are rimmed by biotite.
Chlorite	3		Minor chlorite partly replace the biotite and it is also interstitial to the recrystallized quartz and feldspars.

Accessory minerals: sericite, apatite, rutile, opaque minerals



Relict granophyre in carbonate-altered felsic intrusion. X-axis of photo: 1.6mm. XN.



Biotite altered and partly recrystallized feldspars. X-axis of photo: 1.6mm. XN.

Sample Number: I589340 **Rock Type: Felsic intrusive**

Petrographic Description:

A highly brecciated and extensively altered felsic intrusive rock – or possibly a granodiorite. Because the primary mafic minerals (if any were present) had been replaced by carbonate, minor sericite and chlorite, the type and percent of the original mafic minerals cannot be estimated.

Brecciation, fracturing and fragmentation are evident in the texture of the feldspars and quartz. Both minerals are fractured and fragmented and some fractures are filled by carbonate. Carbonate veins that intrude the fragmented feldspars also partly replaced some of the feldspars. The composition of plagioclase cannot be estimated due to the absence of well developed and undeformed twinning. There is some evidence of minor albitization as some domains in the thin section contain fine-grained, radiating albite aggregates. But just as the relict plagioclase, they are partly fractured and recrystallized. A large carbonate-rich fragment (or vein?) is part of the thin section. The coarse-grained carbonate is integrand with a few anhedral quartz.

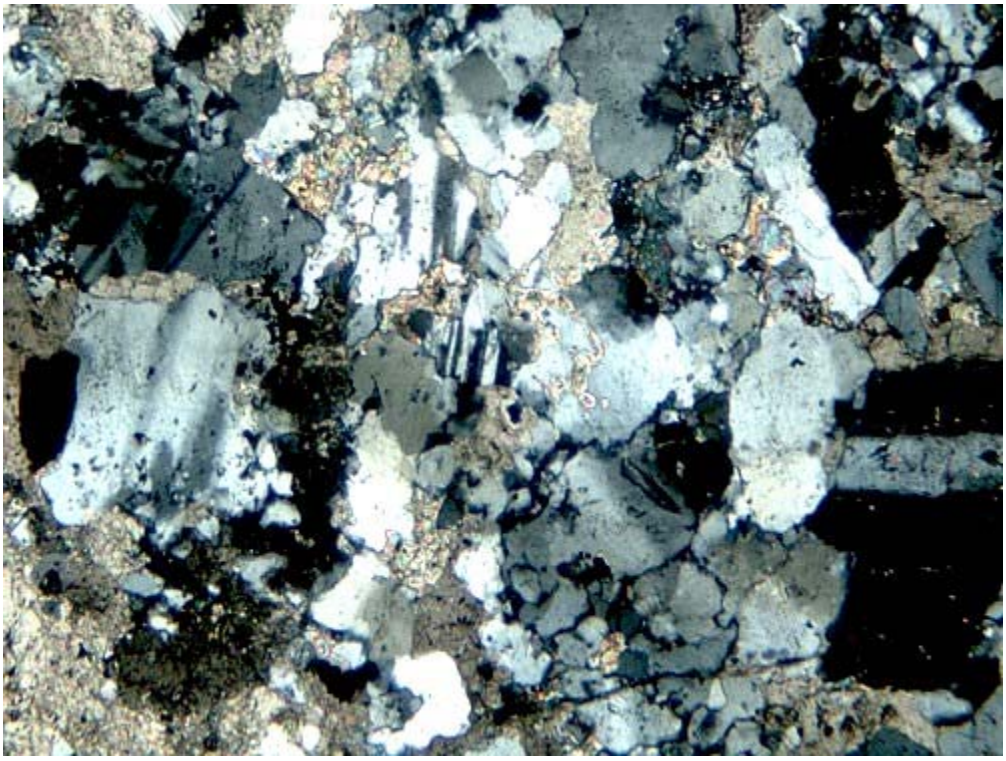
Anhedral pyrite are fractured poikiloblasts that contain inclusions of quartz, albite and carbonate. They are disseminated through the rock. Coarse-grained ilmenite and small magnetite are relatively abundant. The ilmenite are long, lath / needle-shaped grains.

Detailed mineralogy

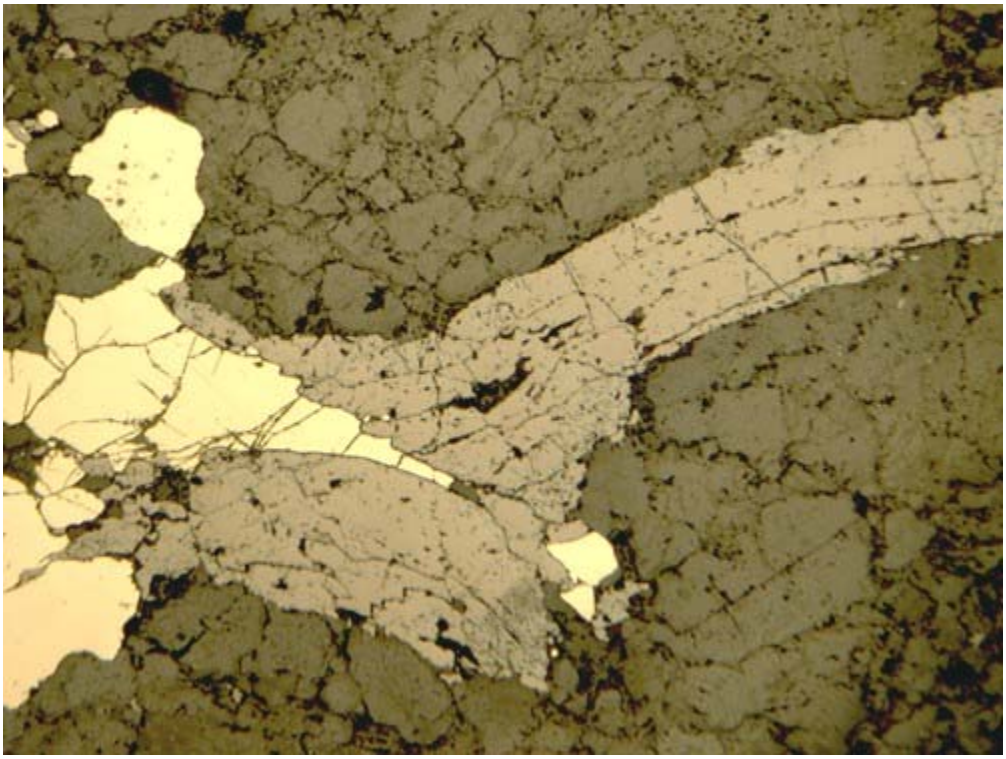
Mineral	%	Grain size(mm)	Comments
Plagioclase	35	0.3-2.0	Fractured, fragmented and partly granulated plagioclase phenocrysts are partly recrystallized and partly replaced by carbonate. Some of the grains are weakly altered to blebby granophyre.
Quartz	15	0.2-1.5	Quartz occurs as part of the original rock and as part of the carbonate aggregate. The relict quartz are strained and they are partly recrystallized.
Carbonate	38	0.3-3.0	Fine-grained carbonate is disseminated through the thin section. Aggregates and stringers / veinlets of carbonate partly replaced some of the plagioclase and the quartz. It also occurs as a large coarse-grained fragment that contains several inclusions of secondary quartz.

Chlorite	5		Stringers of chlorite fill narrow fractures in the feldspars.
Pyrite	5	variable up to 2.5	Large grains of anhedral pyrite poikiloblasts overgrow the altered rock and they contain inclusions of quartz, albite and carbonate. Some are intergrown with coarse-grained ilmenite. Most pyrite are fractured, suggesting that brecciation post-dated alteration and pyrite crystallization.
Ilmenite /	1	0.5-4.0	Coarse-grained, long grains of ilmenite are
magnetite	1	0.2-1.0	intergrown with (or intruded by) pyrite. Fine-grained magnetite is disseminated within the thin section.

Accessory minerals: sericite, apatite, rutile



Relict plagioclase in carbonate-altered intrusive. X-axis of photo: 1.6mm. XN.



Fractured intergrowth of pyrite and ilmenite. X-axis of photo: 1.6mm. Refl. Light.

Sample Number: I589341 **Rock Type: Albitite**

Petrographic Description:

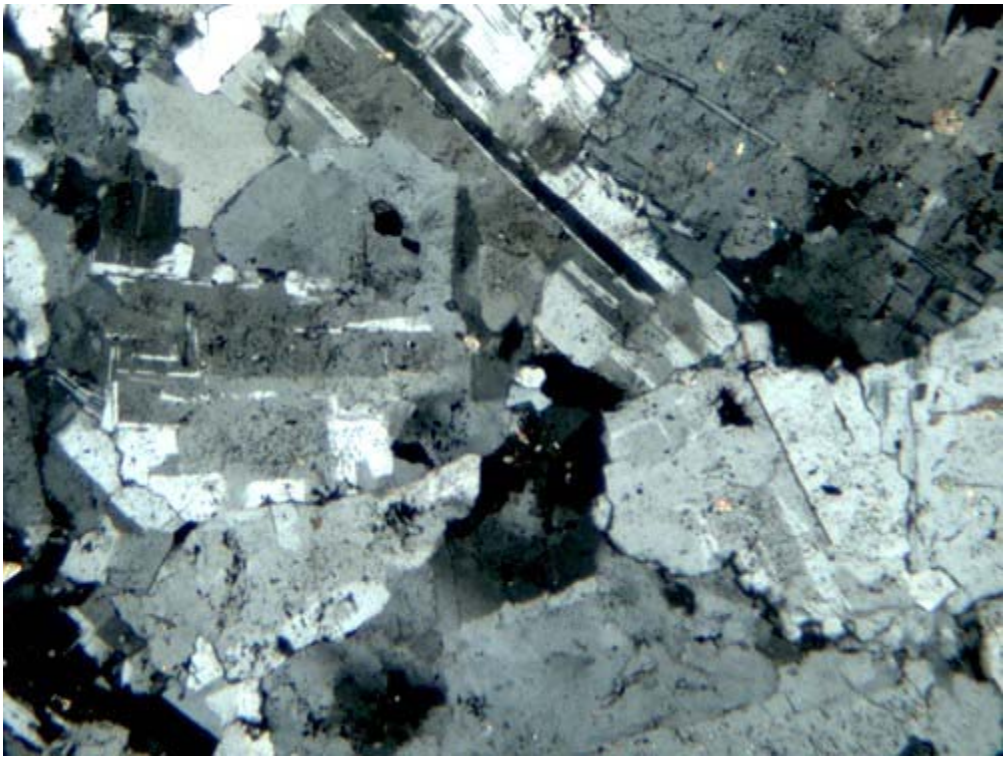
A medium-grained albitite with cross-cutting quartz vein. The rock has a relatively simple mineralogy. It consists predominantly of lath-shaped and equant grains of albite – some with chessboard twinning, and minor interstitial quartz. Fine-grained carbonate is disseminated through the rock and some form a rim on the feldspars and quartz. A ca 6 mm-wide quartz vein cross-cuts the thin section and the strained quartz is partly recrystallized. Fine-grained chlorite occur in aggregates within the large quartz grain.

Anhedral pyrite poikiloblasts are disseminated through the rock and they contain inclusions of quartz and carbonate. Ilmenite and magnetite are relatively common and both minerals co-exist.

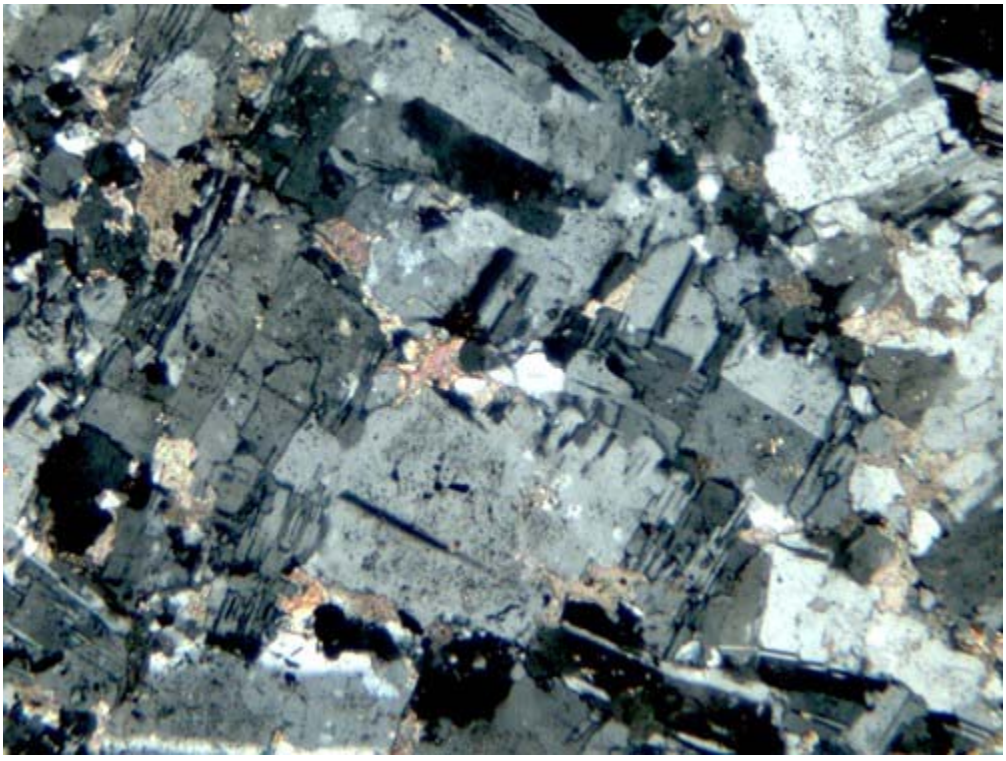
Detailed mineralogy

Mineral	%	Grain size(mm)	Comments
Albite	70	0.5-3.0	Medium-grained weakly altered albite makes up most of the rock. They are relatively fresh and the only secondary mineral interstitial to the feldspars is minor carbonate. Some albite has chessboard twinning, suggesting possible replacement of K-feldspars.
Quartz	20	0.5-6.0 (vein qtz)	Quartz is relatively sparse within the albite-rich rock, but a 6mm quartz vein cross-cuts the thin section. The vein quartz is extensively strained and partly recrystallized to fine-grained aggregates. They contain aggregates of fine-grained albite inclusions.
Carbonate	3	0.1-1.0	Fine-grained euhedral / subhedral carbonate is disseminated through the rock. Their composition is calcite (2 wt% FeO, 1.5 wt% SrO). The carbonates post-dated the albite and the quartz vein.
Pyrite	5	minute to 3.0	Anhedral pyrite poikiloblasts contain inclusions of quartz, albite and carbonate.
Ilmenite	1 1	0.3-1.0	Anhedral ilmenite co-exists with magnetite.

Accessory minerals: chlorite, apatite, sericite



Albitite. X-axis of photo: 1.6mm. XN.



Albitite with interstitial carbonate. X-axis : 1.6mm. XN.

Sample Number: I589342 **Rock Type: Graphic granite?**

Petrographic Description:

A granophyre-rich felsic intrusive rock. It consists predominantly of medium – grained anhedral albite and a large proportion of fine granophyre. Minor quartz is interstitial to the feldspars and granophyre. The entire rock, including the granophyre, is partly recrystallized, resulting in the reduction of grain and granophyre size. In the recrystallized domains the granophyre and albite were replaced by fine-grained aggregates of quartz and untwinned albite. Chlorite veins and small domains of massive chlorite are associated with the recrystallized albite and granophyre. A few grains of fine-grained carbonate are disseminated through the rock. Chlorite is the only significant replacement mineral.

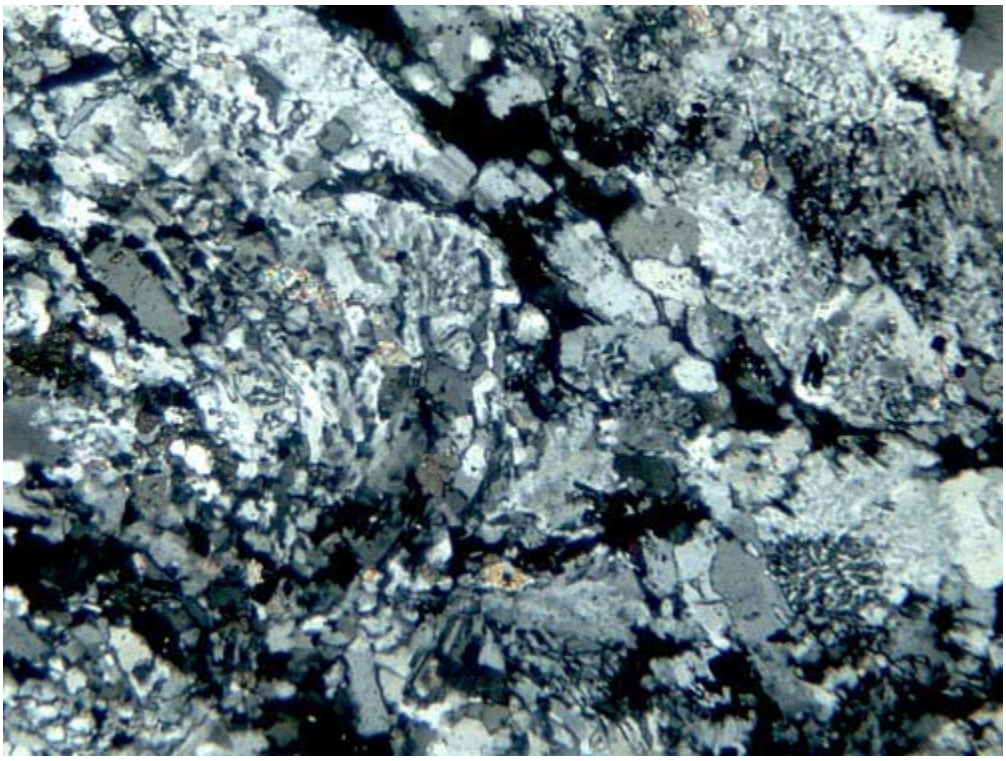
Anhedral opaques are randomly distributed and generally occur in chlorite-rich domains. They cannot be identified in the covered thin section.

Detailed mineralogy

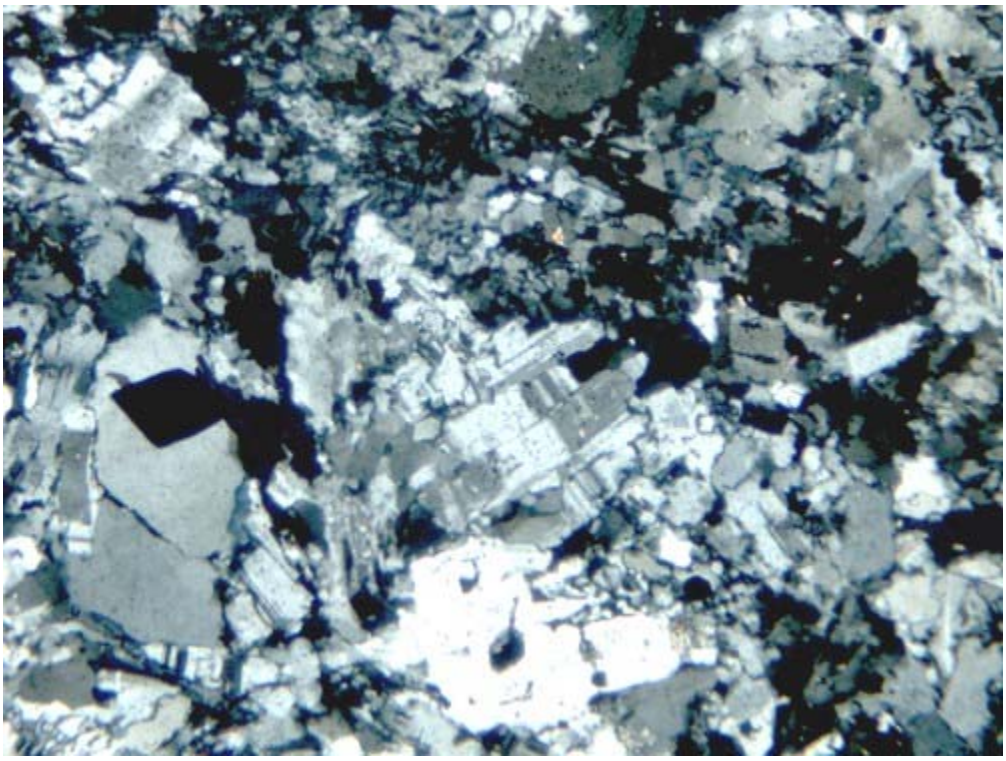
Mineral	%	Grain size(mm)	Comments
Albite	55	0.2-2.3	Albite and less commonly chessboard albite makes up a significant part of the rock. The feldspars are mostly anhedral, some are partly recrystallized and several of the grains are rimmed by or partly replaced by fine granophyre.
Granophyre	30		Fine granophyre is abundant in the rock. It is not possible to determine whether they were inherent in the igneous rock or they represent contact metamorphism (heat). Several of the feldspars are partly replaced by granophyre. In some domains the granophyre is partly recrystallized (where chlorite is abundant) to blebby, granular aggregates.
Quartz	10	0.1-1.5	Fine-grained quartz is interstitial to the recrystallized granophyre. It also occurs as anhedral aggregates interstitial to the aggregates of albite.
Chlorite	3		Chlorite veinlets and small chlorite-rich domains are interstitial to the albite + granophyre. They occur with the

			recrystallized fine-grained aggregates of albite and granophyre.
Opaques	2	variable	Anhedral opaques (mostly in chlorite) cannot be identified in the covered thin section.

Accessory minerals: carbonate, rutile, apatite, sericite



Rosette-like granophyre in albitite. X-axis of photo: 1.6mm. XN.



Fragmented and recrystallized feldspars and quartz in albitite.
X-axis of photo: 1.6mm. XN.

Sample Number: I589343 **Rock Type: Feldspar- quartz porphyry**

Petrographic Description:

A moderately altered feldspar-quartz porphyry. The rock consists of subhedral / euhedral phenocrysts of coarse-grained plagioclase (of oligoclase composition), minor quartz phenocrysts set in a matrix of fine-grained equigranular quartz+feldspars. The rock is moderately altered, the phenocrysts are partly sericitized and contain minor fine-grained carbonate and biotite. Some phenocrysts are fractured and the fractures are filled by fine-grained biotite and carbonate. Biotite and carbonate are the most abundant secondary minerals. They occur in veins that cross-cut the phenocrysts and the matrix. Both, carbonates and biotite also occur in small domains that completely replace the fine-grained matrix. The carbonate aggregates are always rimmed by biotite, suggesting that biotite was the last replacement mineral. Fine-grained rutile are associated with the chlorite.

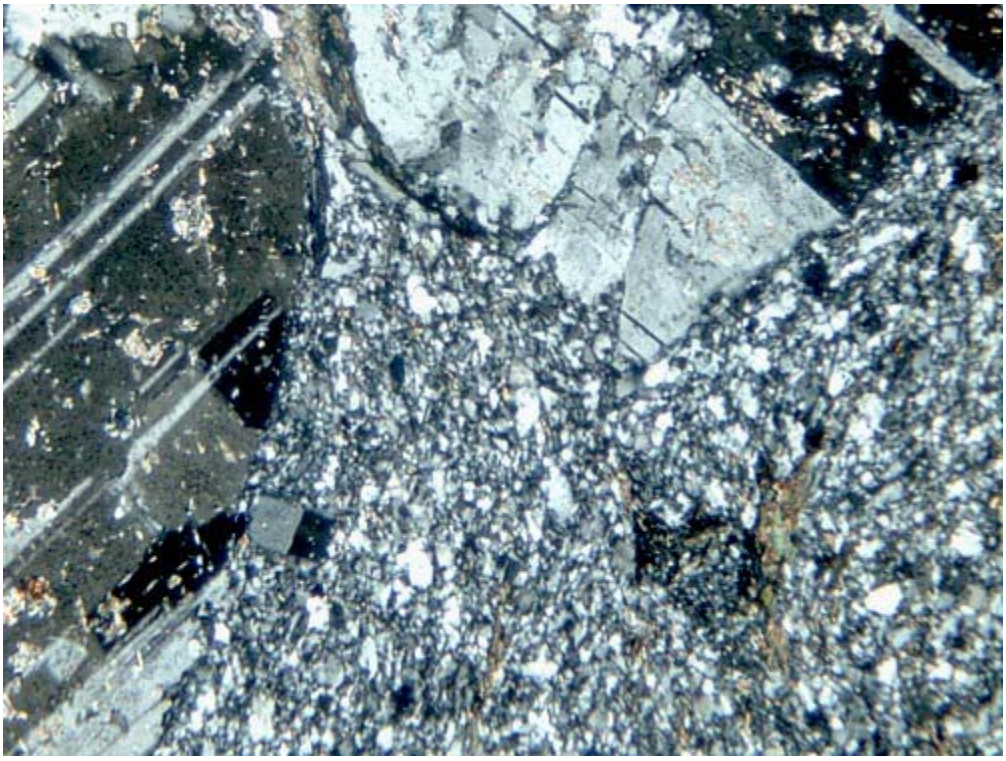
Opaque minerals cannot be identified from the covered thin section.

Detailed mineralogy

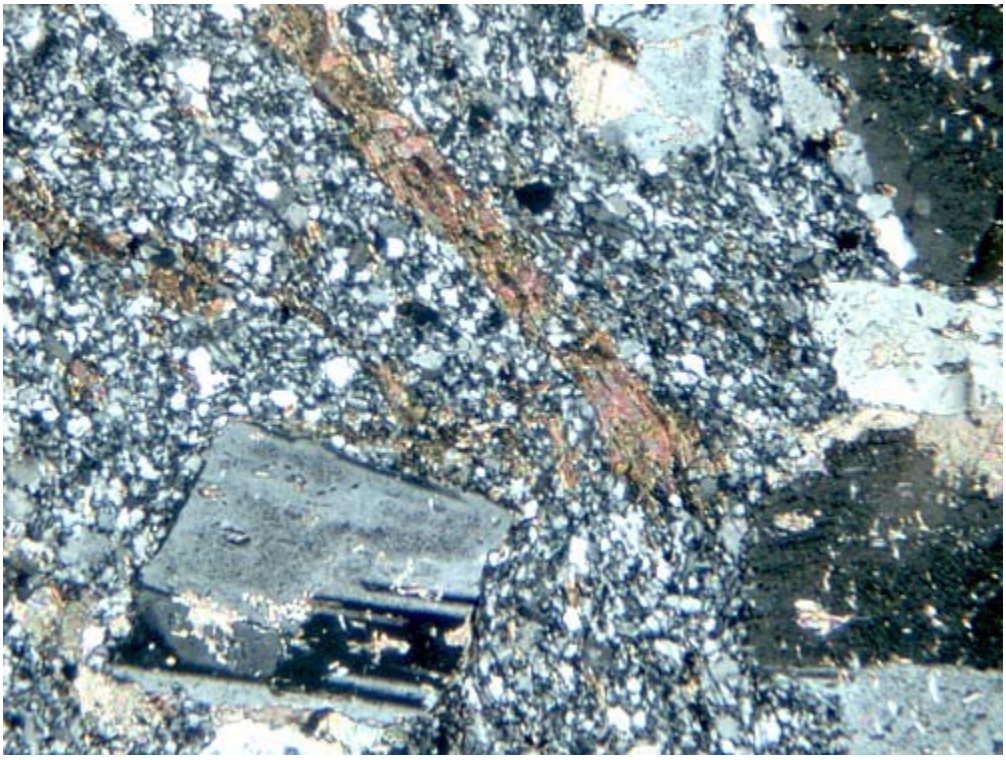
Mineral	%	Grain size(mm)	Comments
Plagioclase	45	phenocrysts 1.0-6.0, matrix (<0.2)	Plagioclase phenocrysts have oligoclase composition. The subhedral / euhedral grains are moderately sericitized and contain inclusions of fine-grained biotite and carbonate. The matrix feldspars are interstitial to the fine-grained matrix quartz.
Quartz	34	<0.2-5.0	A few grains of quartz occur as phenocrysts but most are part of the fine-grained matrix. The phenocrysts are subrounded, fractured and are extensively strained.
Biotite	10	Av. 0.5	Wide and narrow stringers of highly pleochroic contorted biotite veins cross-cut the feldspar phenocrysts. They also occur in aggregates within small domains.
Sericite / muscovite	5		Sericite aggregates are included in the feldspar phenocrysts. They are also disseminated through the matrix. They represent the earliest alteration in the rock

Carbonate	6	minute-2.0	Plagioclase phenocrysts are partly replaced by aggregates and veinlets of carbonate. Carbonate are also disseminated through the fine-grained matrix..

Accessory minerals: rutile, apatite , opaque minerals



Brecciated plagioclase phenocrysts in fine-grained matrix of feldspar porphyry. X-axis of photo: 1.6mm. XN.



Biotite vein (pink) in feldspar porphyry. X-axis of photo: 1.6mm. XN.