



8 March 2007 M.S.

Initial Entry - SN 859

Project Identification: 20.06002.01.352

Scientific notebook 895 contains the procedures, results, and data recordings for the petrographic analysis of basalt core samples collected by the Department of Energy (DOE) and tested for magnetic anomalies.

The main objective relevant to this notebook is the characterization of basalt thin sections by textural and compositional observations. The approach for this analysis shall involve viewing the thin sections through a polarizing-light microscope and using the observed phenomena as criteria in the identification of the minerals present. The statistical proportions of these minerals will be calculated through point-counting procedures.

Further information is documented in the following entries of this notebook along with the equipment used, procedures followed and data collected.

Individuals involved:

Saurav Biswas  
Nancy Adams  
John Stamatakos  
Mark Silver

 07/02/2007  
M.S.

Task assigned to: Mark Silver

Objective: Characterize basalt samples by composition and modal percentages of minerals present.

Equipment/Materials used:

- Olympus BX51TF polarizing microscope fitted with a mechanical stage  
sn: 6F11511
- Olympus DP71 digital photographic hardware  
sn: 6M06049
- DP Manager Version 3.1.1.208 imaging software
- Thin sections (identified by sample control documentation)

Measurement parameters/Precision requirements:

The size of grains within thin sections are to be measured to the nearest ten µm in their classification as groundmass or phenocrysts. However, these dimensions need not be recorded. The statistical analysis of mineral phases present in each sample should not exceed a 20% error.

Identified sources of error:

- Mis-identified mineral phases within groundmass
- Inability to account for the presence of trace constituents
- Inability to account for complex alteration products
- Human error induced by the lack of mechanized point-counting hardware

Procedure followed:

1. Mineral identification:

Minerals present within each thin section are identified by criteria selected from the following:

- Color and pleochroism
- Interference color
- Extinction angle
- Type of extinction (parallel, symmetrical, inclined, etc.)
- Style of extinction (undulatory, total, "hourglass" etc.)
- Crystal system
- Optic sign
- Optic angle
- Optic axis dispersion
- Cleavage
- Twinning
- Association

2. Statistics:

The volumetric percentages are estimated by identifying the mineral present directly beneath the cross hairs of the ocular at 450 locations within a grid. Such a grid allows for 30 identifications to be made across the length of a thin section and 15 along the width with each location having a distance of precisely 1mm from any adjacent identified areas. Depending upon the grain size of each mineral appearing beneath the cross-hairs, each will be classified as part of the groundmass or as a phenocryst (these size ranges are specified for each thin section). A tally of each mineral identification is made and any abnormal constituents within the thin sections are recorded and explained. The percentage of each mineral phase may then be calculated along with the ratio of groundmass/phenocrysts.

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Sample Control: Thermal and AF Demagnetization Thin Sections

Sample identification: (Each is a thin section from the base material)	Sample description: Basalt thin sections 30 µm thickness	Date of receipt:	Entry Date:	Entry Made By:	Location:
A1-T1		1/20/2007	2/04/2007	John Stamatakos	Lab 106C, Building 57
A2-T1				Saurav Biswas	
A3-T1				Mark Silver	
A4-T1					
A5-T1					
Q1-T1					
Q2-T1					
Q3-T1					
JF5 1-T1					
JF5 2-T1					
JF5 3-T1					
G1-T1					
G2-T1					
G3-T1					

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Point Counts From Sample

A1-T1

Mineral: Augite  
Counts: 143  
From groundmass: 45

Mineral: ~~Augite~~ <sup>Iddingsite</sup>  
Counts: 81 ~~81~~ M.S. 5 April 2007  
From groundmass: 17

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||||| (1)

From phenocrysts: 48

From phenocrysts: 64

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Mineral: Plagioclase  
Counts: 85  
From groundmass: 84

Mineral: Biotite  
Counts: 11  
From groundmass: 0

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From phenocrysts: 1

From phenocrysts: 11

1

|||||

Other/remarks: Carbonate material from Diagenesis and otherwise cryptocrystalline alteration

~~|||||~~ = 99

Magnetite + opaques 465  
= 46 / 466 Total Counts

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Point Counts From Sample

A2-T1

Mineral: Augite  
Counts: 123  
From groundmass: 124

Mineral: ~~Augite~~ <sup>Iddingsite</sup>  
Counts: 81  
From groundmass: 14

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From phenocrysts: 59

From phenocrysts: 67

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Mineral: Plagioclase  
Counts: 115  
From groundmass: 115

Mineral: Biotite  
Counts: 4  
From groundmass: 0

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From phenocrysts: 0

From phenocrysts: 4

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Other/remarks: Cryptocrystalline, carbonate, complex alteration etc.

~~|||||~~ = 61 <sup>8 March 2007 M.S.</sup> 31

Magnetite + opaques 48  
= 48 / 462 Total Counts





## Textural Description of Anomaly A:

Groundmass crystallinity: Holocrystalline

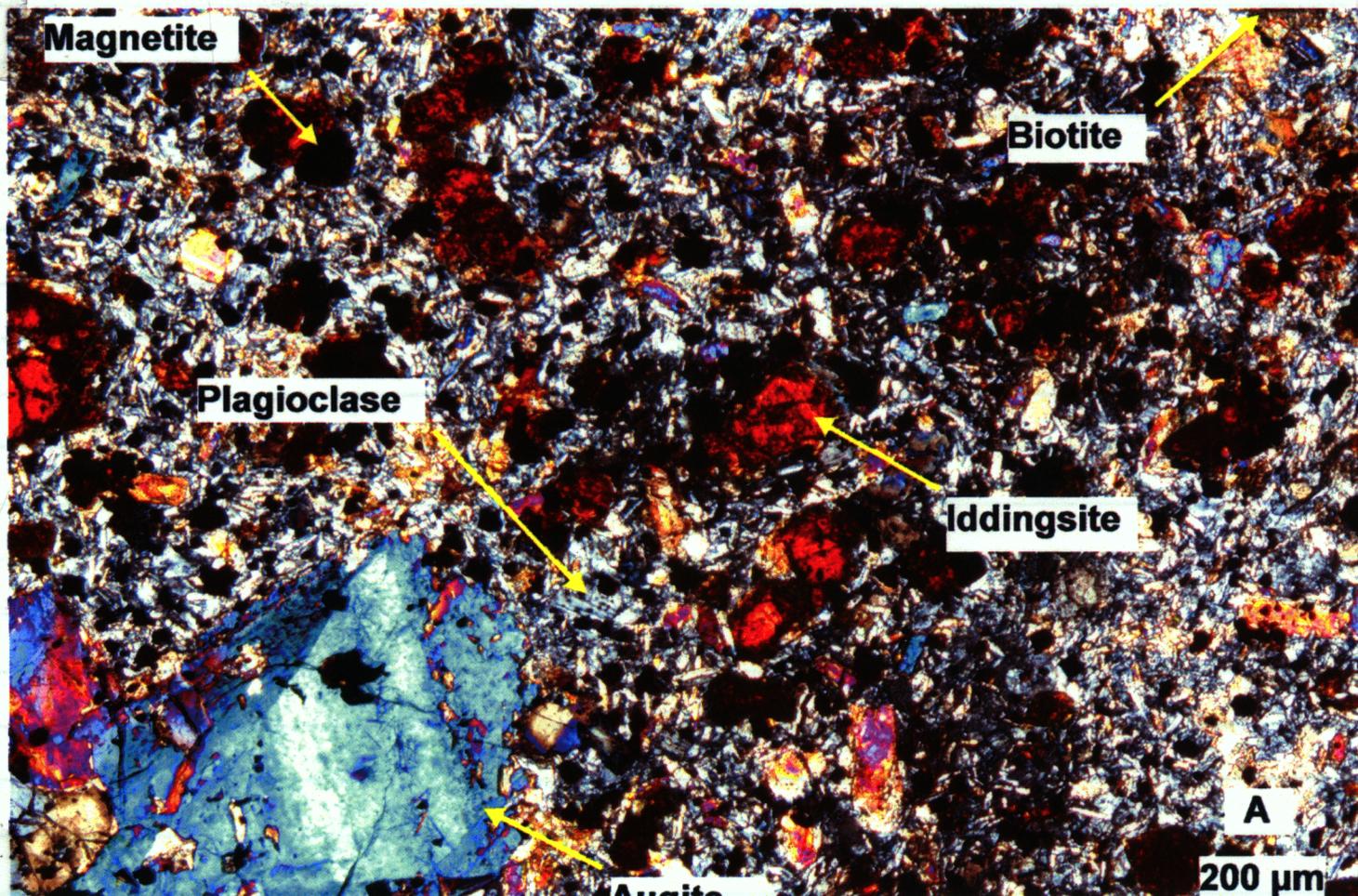
Groundmass crystal size: majority of groundmass grains are microlites  
some microphenocrysts are present.

This is a very fine grained rock.

Igneous Textures: very slight display of mineral banding  
augite glomerocrysts are common within anomaly A.

Ratio of groundmass to phenocrysts is nearly 7:3.

Samples from a have been moderately altered by diagenesis and a typical mineralogical components are a result of this.



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Textural description of anomaly 6:

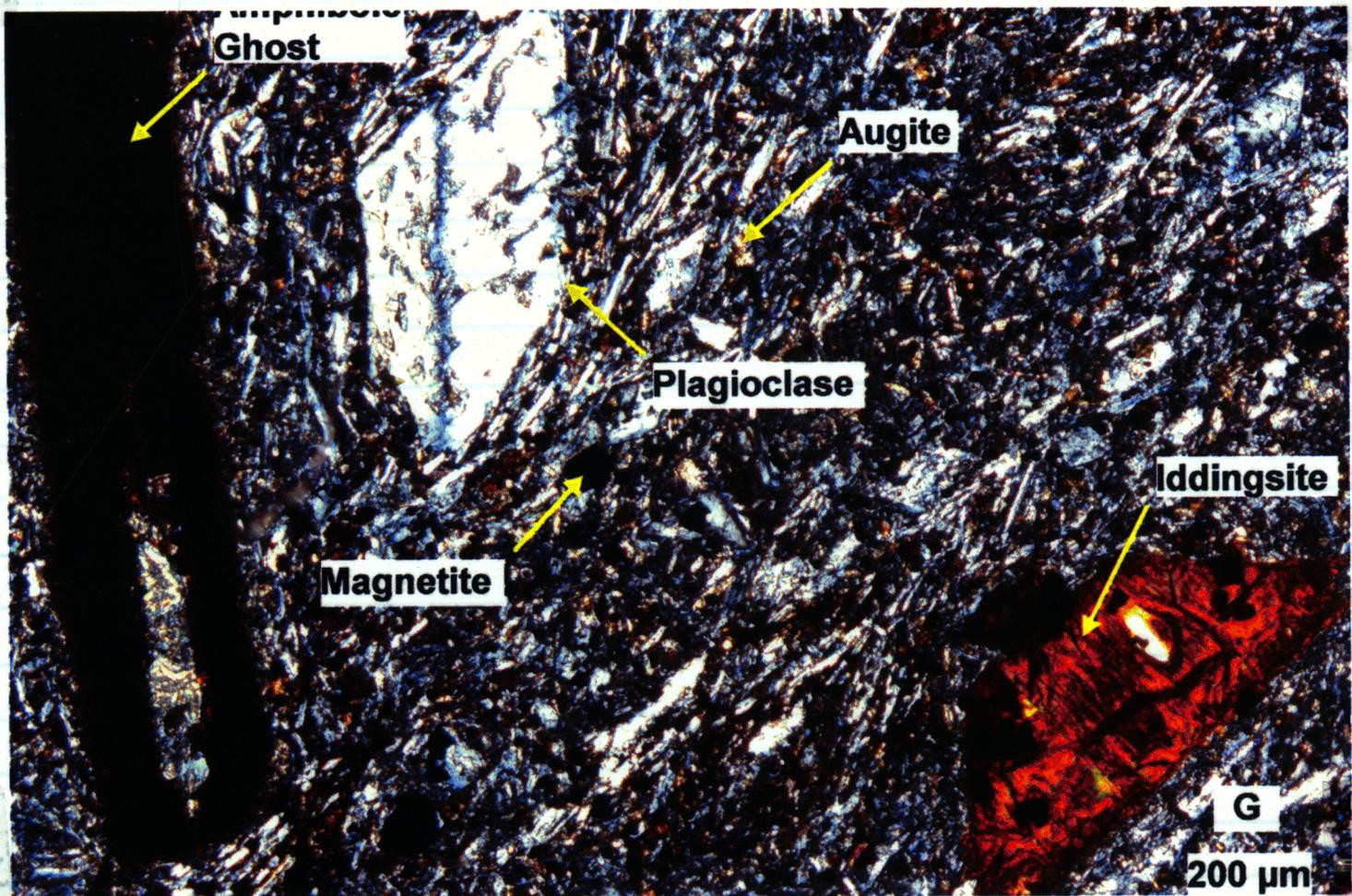
Groundmass crystallinity: Holocrystalline

Groundmass crystal size: Most grains are microlites, but a large number are microphenocrysts is found.

This is a fine to medium grained aphanite.

Igneous Textures: Obvious flow banding seen by lamination of elongate plagioclase grains which also wrap tightly around phenocrysts.

Ratio of groundmass to phenocrysts is near 17:3





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Point Counts From Sample  
JF5.3-T1

Mineral: Plagioclase  
Counts: 124  
From groundmass: 89

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From phenocrysts: 35

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Mineral: Olivine  
Counts: 0  
From groundmass: -

From phenocrysts: -

Mineral: Albite  
Counts: 35  
From groundmass: 25

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From phenocrysts: 10

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Mineral: Augite  
Counts: 38  
From groundmass: 22

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From phenocrysts: 16

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Other/remarks: Cavities and Nephelins ~~|||||~~ = 7

Magnetite + opaques ~~|||||~~ = 15

alteration + cryptocrystals ~~|||||~~ = 20

239 Total Counts

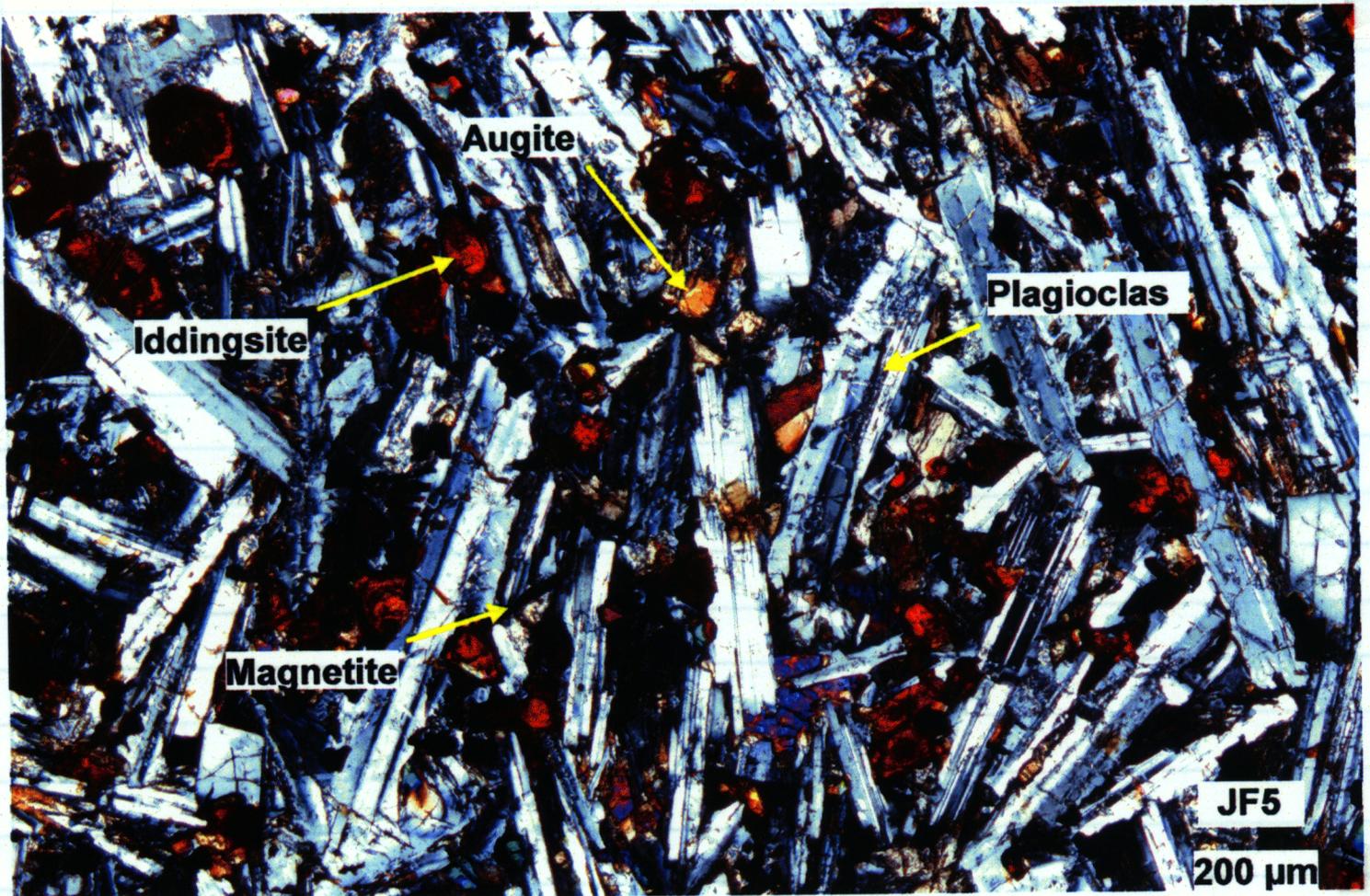
## Textural description of anomaly JF5

Groundmass Crystallinity: Holocrystalline

Groundmass Crystal size: The groundmass of JF5 is coarse in comparison to anomalies A, B and Q with plagioclase grains exceeding typical phenocryst size ranges in the other anomalies.

Igneous Textures: Very well defined flow banding and presence of vesicles in JF5 samples.

Ratio of groundmass to phenocrysts is about 4:1.



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Point Counts From Sample

Q1-T1

Mineral: Plagioclase  
Counts: 146  
From groundmass: 114

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Mineral: Seldingite  
Counts: 42  
From groundmass: 26

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From phenocrysts: 32

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From phenocrysts: 16

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Mineral: Olivine (Unaltered)  
Counts: 0  
From groundmass: -

From phenocrysts: -

Mineral: augite  
Counts: 33  
From groundmass: 32

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From phenocrysts: 1

1

Other/remarks: Cryptocrystalline + complex alteration etc. || = 2

Carbonate ||| = 5

Magnetite + opaques ||| ||| = 11

Silica (from diagenesis) 1 / 240 Total Counts

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Point Counts From Sample

Q2-T1

Mineral: Plagioclase  
Counts: 119  
From groundmass: 88

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From phenocrysts: 31

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Mineral: Seldingite  
Counts: 32  
From groundmass: 17

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From phenocrysts: 15

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Mineral: Olivine (Unaltered)  
Counts: 0  
From groundmass: -

From phenocrysts: -

Mineral: augite  
Counts: 5  
From groundmass: 5

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From phenocrysts: 0

Other/remarks: Carbonate |||| = 4

Cryptocrystalline etc.

Magnetite + opaques ||| ||| ||| ||| ||| ||| = 33

193 Total Counts

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Point Counts From Sample

Q3-T1

Mineral: Plagioclase  
Counts: 100  
From groundmass: 75

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Mineral: Orthopyroxene  
Counts: 26  
From groundmass: 14

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From phenocrysts: 25

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From phenocrysts: 12

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Mineral: Olivine (unaltered)  
Counts: 6  
From groundmass: 0

From phenocrysts: 6

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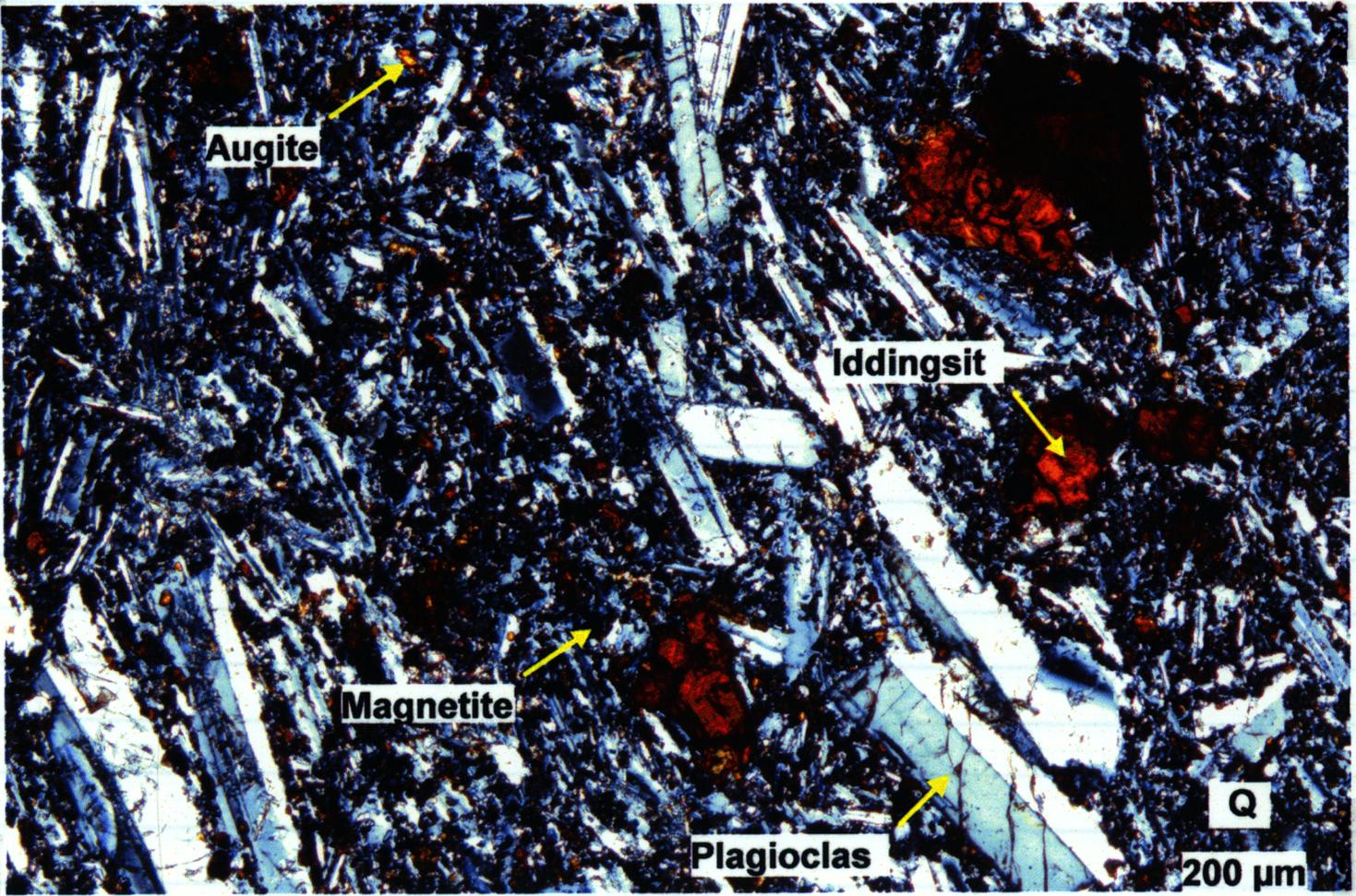
Mineral: Augite  
Counts: 8  
From groundmass: 8

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From phenocrysts: 0

Other/remarks: Carbonate

Cryptocrystalline ||||| = 6  
Magnetite + opaques ||||| ||||| ||||| ||||| = 27  
/ 173 Total Counts



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Table 2-3. Anomaly A

Thin Section	A1-T1			A2-T1			A3-T1			A4-T1			A5-T1		
	Count	Percentage	StdDev.												
Groundmass	242	66.1	2.1	301	69.8	317	68.9	323	69.6	362	71.8	69.2	362	71.8	2.1
Phenocrysts	124	33.9	2.1	130	30.2	143	31.1	141	30.4	142	28.2	30.8	142	28.2	2.1
Augite	143	30.8	8.4	183	39.6	159	31.9	193	36.8	271	51.7	38.2	271	51.7	8.4
Plagioclase	85	18.3	4.1	115	24.9	147	29.5	116	22.1	129	24.6	23.9	129	24.6	4.1
Iddingsite	81	17.4	4.9	81	17.5	90	18.1	94	17.9	36	6.9	15.6	36	6.9	4.9
Olivine	0	0.0	1.1	0	0.0	0	0.0	0	0.0	13	2.5	0.5	13	2.5	1.1
Biotite	11	2.4	0.6	4	0.9	11	2.2	9	1.7	8	1.5	1.7	8	1.5	0.6
Magnetite	46	9.9	0.6	48	10.4	53	10.6	52	9.9	47	9.0	10.0	47	9.0	0.6
Clays	0	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0.0	0	0.0	0.0
Diagenetic	99	21.3	6.8	31	6.7	38	7.6	60	11.5	20	3.8	10.2	20	3.8	6.8
Voids	0	0.0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0.0	0	0.0	0.0
Total	465	100.0		462	100.0	498	100.0	524	100.0	524	100.0		524	100.0	

N4

Table 2-4. Anomaly G

Thin Section	G1-T1			G2-T1			G3-T1		
	Count	Percentage	StdDev.	Count	Percentage	StdDev.	Count	Percentage	StdDev.
Groundmass	144	88.3	2.5	140	85.4	141	83.4	85.7	2.5
Phenocrysts	19	11.7	2.5	24	14.6	28	16.6	14.3	2.5
Augite	25	14.3	5.4	24	13.6	41	23.3	17.0	5.4
Plagioclase	116	66.3	6.7	112	63.3	94	53.4	61.0	6.7
Iddingsite	3	1.7	4.2	16	9.0	16	9.1	6.6	4.2
Olivine	3	1.7	1.4	0	0.0	5	2.8	1.5	1.4
Biotite	0	0.0	0.0	0	0.0	0	0.0	0.0	0.0
Magnetite	16	9.1	1.2	12	6.8	13	7.4	7.8	1.2
Clays	11	6.3	1.7	13	7.3	7	4.0	5.9	1.7
Diagenetic	1	0.6	0.3	0	0.0	0	0.0	0.2	0.3
Voids	0	0.0	0.0	0	0.0	0	0.0	0.0	0.0
Total	175	100.0		177	100.0	176	100.0		

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Table 2-5. Anomaly JF5

Thin Section	JF5-1-T1		JF5-2-T1		JF5-3-T1		Percentage	StDev.
	Count	Percentage	Count	Percentage	Count	Percentage		
Groundmass	188	84.3	201	83.4	151	71.2	80.0	7.6
Phenocrysts	35	15.7	37	16.6	61	28.8	20.0	7.6
Augite	42	16.5	34	23.3	38	15.9	15.5	1.2
Plagioclase	131	51.6	154	53.4	124	51.9	55.9	7.2
Iddingsite	32	12.6	32	9.1	35	14.6	13.5	1.0
Olivine	1	0.4	4	2.8	0	0.0	0.7	0.9
Biotite	0	0.0	0	0.0	0	0.0	0.0	0.0
Magnetite	17	6.7	14	5.8	15	6.3	6.3	0.4
Clays	0	0.0	0	0.0	0	0.0	0.0	0.0
Diagenetic	0	0.0	0	0.0	20	8.4	2.8	4.8
Voids	31	12.2	2	0.8	7	2.9	5.3	6.1
Total	254	100.0	240	100.0	239	100.0		

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Table 2-6. Anomaly Q

Thin Section	Q1-T1		Q2-T1		Q3-T1		Percentage	StDev.
	Count	Percentage	Count	Percentage	Count	Percentage		
Groundmass	183	78.9	143	75.7	124	74.3	76.3	2.4
Phenocrysts	49	21.1	46	24.3	43	25.8	23.7	2.4
Augite	33	13.8	5	2.6	8	4.6	7.0	5.9
Plagioclase	146	60.8	119	61.7	100	57.8	60.1	2.0
Iddingsite	42	17.5	32	16.6	26	15.0	16.4	1.2
Olivine	0	0.0	0	0.0	6	3.5	1.2	2.0
Biotite	0	0.0	0	0.0	0	0.0	0.0	0.0
Magnetite	11	4.6	33	17.1	27	15.6	12.4	6.8
Clays	0	0.0	0	0.0	0	0.0	0.0	0.0
Diagenetic	8	3.3	4	2.1	6	3.5	3.0	0.8
Voids	0	0.0	0	0.0	0	0.0	0.0	0.0
Total	240	100.0	193	100.0	173	100.0		

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